

Supplementary Material for “Catalog of phonon emergent particles and chiral phonons: Symmetry-based classification and materials database investigation”

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b. Results for high-symmetry points	600
c. Results for high-symmetry lines	601
d. Results for high-symmetry planes	603
119. Space group No. 119 ($I\bar{4}m2$)	604
a. Space group operations	604
b. Results for high-symmetry points	604
c. Results for high-symmetry lines	605
d. Results for high-symmetry planes	607

120. Space group No. 120 ($\bar{I}4c2$)	607
a. Space group operations	608
b. Results for high-symmetry points	608
c. Results for high-symmetry lines	609
d. Results for high-symmetry planes	610
121. Space group No. 121 ($\bar{I}42m$)	611
a. Space group operations	611
b. Results for high-symmetry points	611
c. Results for high-symmetry lines	613
d. Results for high-symmetry planes	614
122. Space group No. 122 ($\bar{I}42d$)	615
a. Space group operations	615
b. Results for high-symmetry points	615
c. Results for high-symmetry lines	616
d. Results for high-symmetry planes	617
123. Space group No. 123 ($P4/mmm$)	618
a. Space group operations	618
b. Results for high-symmetry points	618
c. Results for high-symmetry lines	622
d. Results for high-symmetry planes	624
124. Space group No. 124 ($P4/mcc$)	626
a. Space group operations	626
b. Results for high-symmetry points	626
c. Results for high-symmetry lines	628
d. Results for high-symmetry planes	631
125. Space group No. 125 ($P4/nbm$)	632
a. Space group operations	632
b. Results for high-symmetry points	632
c. Results for high-symmetry lines	635
d. Results for high-symmetry planes	637
126. Space group No. 126 ($P4/nnc$)	639
a. Space group operations	639
b. Results for high-symmetry points	639
c. Results for high-symmetry lines	641
d. Results for high-symmetry planes	643
127. Space group No. 127 ($P4/mbm$)	644
a. Space group operations	644
b. Results for high-symmetry points	644
c. Results for high-symmetry lines	647
d. Results for high-symmetry planes	649
128. Space group No. 128 ($P4/mnc$)	650
a. Space group operations	651
b. Results for high-symmetry points	651
c. Results for high-symmetry lines	652
d. Results for high-symmetry planes	654
129. Space group No. 129 ($P4/nmm$)	655
a. Space group operations	655
b. Results for high-symmetry points	655
c. Results for high-symmetry lines	657
d. Results for high-symmetry planes	659
130. Space group No. 130 ($P4/ncc$)	661
a. Space group operations	661
b. Results for high-symmetry points	661
c. Results for high-symmetry lines	662
d. Results for high-symmetry planes	664
131. Space group No. 131 ($P4_2/mmc$)	666
a. Space group operations	666

b. Results for high-symmetry points	666
c. Results for high-symmetry lines	669
d. Results for high-symmetry planes	671
132. Space group No. 132 ($P4_2/mcm$)	673
a. Space group operations	673
b. Results for high-symmetry points	673
c. Results for high-symmetry lines	675
d. Results for high-symmetry planes	678
133. Space group No. 133 ($P4_2/nbc$)	679
a. Space group operations	680
b. Results for high-symmetry points	680
c. Results for high-symmetry lines	681
d. Results for high-symmetry planes	683
134. Space group No. 134 ($P4_2/nmm$)	685
a. Space group operations	685
b. Results for high-symmetry points	685
c. Results for high-symmetry lines	687
d. Results for high-symmetry planes	690
135. Space group No. 135 ($P4_2/mbc$)	691
a. Space group operations	691
b. Results for high-symmetry points	691
c. Results for high-symmetry lines	693
d. Results for high-symmetry planes	695
136. Space group No. 136 ($P4_2/mnm$)	696
a. Space group operations	696
b. Results for high-symmetry points	696
c. Results for high-symmetry lines	698
d. Results for high-symmetry planes	700
137. Space group No. 137 ($P4_2/nmc$)	701
a. Space group operations	701
b. Results for high-symmetry points	702
c. Results for high-symmetry lines	703
d. Results for high-symmetry planes	705
138. Space group No. 138 ($P4_2/ncm$)	706
a. Space group operations	706
b. Results for high-symmetry points	706
c. Results for high-symmetry lines	708
d. Results for high-symmetry planes	710
139. Space group No. 139 ($I4_1/mmm$)	711
a. Space group operations	711
b. Results for high-symmetry points	712
c. Results for high-symmetry lines	714
d. Results for high-symmetry planes	716
140. Space group No. 140 ($I4_1/mcm$)	717
a. Space group operations	717
b. Results for high-symmetry points	717
c. Results for high-symmetry lines	719
d. Results for high-symmetry planes	721
141. Space group No. 141 ($I4_1/amd$)	722
a. Space group operations	722
b. Results for high-symmetry points	722
c. Results for high-symmetry lines	724
d. Results for high-symmetry planes	725
142. Space group No. 142 ($I4_1/acd$)	726
a. Space group operations	726
b. Results for high-symmetry points	726
c. Results for high-symmetry lines	727
d. Results for high-symmetry planes	729

143. Space group No. 143 ($P3$)	729
a. Space group operations	729
b. Results for high-symmetry points	730
c. Results for high-symmetry lines	731
d. Results for high-symmetry planes	732
144. Space group No. 144 ($P3_1$)	733
a. Space group operations	733
b. Results for high-symmetry points	733
c. Results for high-symmetry lines	735
d. Results for high-symmetry planes	736
145. Space group No. 145 ($P3_2$)	737
a. Space group operations	737
b. Results for high-symmetry points	737
c. Results for high-symmetry lines	738
d. Results for high-symmetry planes	740
146. Space group No. 146 ($R3$)	741
a. Space group operations	741
b. Results for high-symmetry points	741
c. Results for high-symmetry lines	742
d. Results for high-symmetry planes	743
147. Space group No. 147 ($\overline{P3}$)	743
a. Space group operations	743
b. Results for high-symmetry points	743
c. Results for high-symmetry lines	745
d. Results for high-symmetry planes	746
148. Space group No. 148 ($\overline{R3}$)	747
a. Space group operations	747
b. Results for high-symmetry points	747
c. Results for high-symmetry lines	748
d. Results for high-symmetry planes	749
149. Space group No. 149 ($P312$)	749
a. Space group operations	749
b. Results for high-symmetry points	749
c. Results for high-symmetry lines	751
d. Results for high-symmetry planes	753
150. Space group No. 150 ($P321$)	754
a. Space group operations	754
b. Results for high-symmetry points	754
c. Results for high-symmetry lines	755
d. Results for high-symmetry planes	757
151. Space group No. 151 ($P3_112$)	758
a. Space group operations	758
b. Results for high-symmetry points	758
c. Results for high-symmetry lines	759
d. Results for high-symmetry planes	761
152. Space group No. 152 ($P3_121$)	762
a. Space group operations	762
b. Results for high-symmetry points	762
c. Results for high-symmetry lines	763
d. Results for high-symmetry planes	765
153. Space group No. 153 ($P3_212$)	766
a. Space group operations	766
b. Results for high-symmetry points	766
c. Results for high-symmetry lines	767
d. Results for high-symmetry planes	769
154. Space group No. 154 ($P3_221$)	770
a. Space group operations	770

b. Results for high-symmetry points	770
c. Results for high-symmetry lines	771
d. Results for high-symmetry planes	773
155. Space group No. 155 ($R\bar{3}2$)	774
a. Space group operations	774
b. Results for high-symmetry points	774
c. Results for high-symmetry lines	775
d. Results for high-symmetry planes	776
156. Space group No. 156 ($P\bar{3}m1$)	776
a. Space group operations	776
b. Results for high-symmetry points	776
c. Results for high-symmetry lines	778
d. Results for high-symmetry planes	779
157. Space group No. 157 ($P\bar{3}1m$)	780
a. Space group operations	780
b. Results for high-symmetry points	780
c. Results for high-symmetry lines	782
d. Results for high-symmetry planes	783
158. Space group No. 158 ($P\bar{3}c1$)	784
a. Space group operations	784
b. Results for high-symmetry points	784
c. Results for high-symmetry lines	786
d. Results for high-symmetry planes	787
159. Space group No. 159 ($P\bar{3}1c$)	788
a. Space group operations	788
b. Results for high-symmetry points	788
c. Results for high-symmetry lines	790
d. Results for high-symmetry planes	791
160. Space group No. 160 ($R\bar{3}m$)	792
a. Space group operations	792
b. Results for high-symmetry points	792
c. Results for high-symmetry lines	793
d. Results for high-symmetry planes	794
161. Space group No. 161 ($R\bar{3}c$)	794
a. Space group operations	794
b. Results for high-symmetry points	795
c. Results for high-symmetry lines	795
d. Results for high-symmetry planes	796
162. Space group No. 162 ($P\bar{3}1m$)	796
a. Space group operations	797
b. Results for high-symmetry points	797
c. Results for high-symmetry lines	799
d. Results for high-symmetry planes	800
163. Space group No. 163 ($P\bar{3}1c$)	801
a. Space group operations	802
b. Results for high-symmetry points	802
c. Results for high-symmetry lines	803
d. Results for high-symmetry planes	805
164. Space group No. 164 ($P\bar{3}m1$)	806
a. Space group operations	806
b. Results for high-symmetry points	806
c. Results for high-symmetry lines	807
d. Results for high-symmetry planes	809
165. Space group No. 165 ($P\bar{3}c1$)	810
a. Space group operations	810
b. Results for high-symmetry points	810

c. Results for high-symmetry lines	812
d. Results for high-symmetry planes	813
166. Space group No. 166 ($R\bar{3}m$)	814
a. Space group operations	814
b. Results for high-symmetry points	814
c. Results for high-symmetry lines	815
d. Results for high-symmetry planes	816
167. Space group No. 167 ($R\bar{3}c$)	817
a. Space group operations	817
b. Results for high-symmetry points	817
c. Results for high-symmetry lines	818
d. Results for high-symmetry planes	819
168. Space group No. 168 ($P6$)	819
a. Space group operations	819
b. Results for high-symmetry points	819
c. Results for high-symmetry lines	821
d. Results for high-symmetry planes	822
169. Space group No. 169 ($P6_1$)	823
a. Space group operations	823
b. Results for high-symmetry points	823
c. Results for high-symmetry lines	825
d. Results for high-symmetry planes	826
170. Space group No. 170 ($P6_5$)	827
a. Space group operations	827
b. Results for high-symmetry points	827
c. Results for high-symmetry lines	829
d. Results for high-symmetry planes	830
171. Space group No. 171 ($P6_2$)	831
a. Space group operations	831
b. Results for high-symmetry points	831
c. Results for high-symmetry lines	833
d. Results for high-symmetry planes	834
172. Space group No. 172 ($P6_4$)	835
a. Space group operations	835
b. Results for high-symmetry points	835
c. Results for high-symmetry lines	837
d. Results for high-symmetry planes	838
173. Space group No. 173 ($P6_3$)	839
a. Space group operations	839
b. Results for high-symmetry points	839
c. Results for high-symmetry lines	841
d. Results for high-symmetry planes	842
174. Space group No. 174 ($P\bar{6}$)	843
a. Space group operations	843
b. Results for high-symmetry points	843
c. Results for high-symmetry lines	845
d. Results for high-symmetry planes	847
175. Space group No. 175 ($P6/m$)	848
a. Space group operations	848
b. Results for high-symmetry points	848
c. Results for high-symmetry lines	850
d. Results for high-symmetry planes	852
176. Space group No. 176 ($P6_3/m$)	853
a. Space group operations	853
b. Results for high-symmetry points	853
c. Results for high-symmetry lines	855
d. Results for high-symmetry planes	856

177. Space group No. 177 ($P6_22$)	857
a. Space group operations	857
b. Results for high-symmetry points	858
c. Results for high-symmetry lines	859
d. Results for high-symmetry planes	861
178. Space group No. 178 ($P6_122$)	862
a. Space group operations	862
b. Results for high-symmetry points	862
c. Results for high-symmetry lines	864
d. Results for high-symmetry planes	866
179. Space group No. 179 ($P6_522$)	866
a. Space group operations	867
b. Results for high-symmetry points	867
c. Results for high-symmetry lines	868
d. Results for high-symmetry planes	870
180. Space group No. 180 ($P6_222$)	871
a. Space group operations	871
b. Results for high-symmetry points	871
c. Results for high-symmetry lines	872
d. Results for high-symmetry planes	874
181. Space group No. 181 ($P6_422$)	875
a. Space group operations	875
b. Results for high-symmetry points	876
c. Results for high-symmetry lines	877
d. Results for high-symmetry planes	879
182. Space group No. 182 ($P6_322$)	880
a. Space group operations	880
b. Results for high-symmetry points	880
c. Results for high-symmetry lines	882
d. Results for high-symmetry planes	883
183. Space group No. 183 ($P6mm$)	884
a. Space group operations	884
b. Results for high-symmetry points	884
c. Results for high-symmetry lines	886
d. Results for high-symmetry planes	888
184. Space group No. 184 ($P6cc$)	889
a. Space group operations	889
b. Results for high-symmetry points	889
c. Results for high-symmetry lines	890
d. Results for high-symmetry planes	892
185. Space group No. 185 ($P6_3cm$)	893
a. Space group operations	893
b. Results for high-symmetry points	893
c. Results for high-symmetry lines	895
d. Results for high-symmetry planes	896
186. Space group No. 186 ($P6_3mc$)	897
a. Space group operations	897
b. Results for high-symmetry points	897
c. Results for high-symmetry lines	899
d. Results for high-symmetry planes	900
187. Space group No. 187 ($P\bar{6}m2$)	901
a. Space group operations	901
b. Results for high-symmetry points	902
c. Results for high-symmetry lines	904
d. Results for high-symmetry planes	906
188. Space group No. 188 ($P\bar{6}c2$)	907
a. Space group operations	907

b. Results for high-symmetry points	907
c. Results for high-symmetry lines	909
d. Results for high-symmetry planes	911
189. Space group No. 189 ($P\bar{6}2m$)	912
a. Space group operations	912
b. Results for high-symmetry points	912
c. Results for high-symmetry lines	914
d. Results for high-symmetry planes	916
190. Space group No. 190 ($P\bar{6}2c$)	917
a. Space group operations	917
b. Results for high-symmetry points	917
c. Results for high-symmetry lines	919
d. Results for high-symmetry planes	921
191. Space group No. 191 ($P6/mmm$)	922
a. Space group operations	922
b. Results for high-symmetry points	922
c. Results for high-symmetry lines	925
d. Results for high-symmetry planes	927
192. Space group No. 192 ($P6/mcc$)	928
a. Space group operations	928
b. Results for high-symmetry points	928
c. Results for high-symmetry lines	931
d. Results for high-symmetry planes	933
193. Space group No. 193 ($P6_3/mcm$)	934
a. Space group operations	934
b. Results for high-symmetry points	934
c. Results for high-symmetry lines	937
d. Results for high-symmetry planes	939
194. Space group No. 194 ($P6_3/mmc$)	940
a. Space group operations	940
b. Results for high-symmetry points	940
c. Results for high-symmetry lines	943
d. Results for high-symmetry planes	945
195. Space group No. 195 ($P23$)	946
a. Space group operations	946
b. Results for high-symmetry points	946
c. Results for high-symmetry lines	947
d. Results for high-symmetry planes	948
196. Space group No. 196 ($F23$)	949
a. Space group operations	949
b. Results for high-symmetry points	949
c. Results for high-symmetry lines	950
d. Results for high-symmetry planes	951
197. Space group No. 197 ($I23$)	952
a. Space group operations	952
b. Results for high-symmetry points	952
c. Results for high-symmetry lines	953
d. Results for high-symmetry planes	954
198. Space group No. 198 ($P2_13$)	955
a. Space group operations	955
b. Results for high-symmetry points	955
c. Results for high-symmetry lines	956
d. Results for high-symmetry planes	958
199. Space group No. 199 ($I2_13$)	958
a. Space group operations	958
b. Results for high-symmetry points	959
c. Results for high-symmetry lines	959

d. Results for high-symmetry planes	961
200. Space group No. 200 ($Pm\bar{3}$)	961
a. Space group operations	961
b. Results for high-symmetry points	961
c. Results for high-symmetry lines	963
d. Results for high-symmetry planes	965
201. Space group No. 201 ($Pn\bar{3}$)	966
a. Space group operations	966
b. Results for high-symmetry points	966
c. Results for high-symmetry lines	968
d. Results for high-symmetry planes	969
202. Space group No. 202 ($Fm\bar{3}$)	970
a. Space group operations	970
b. Results for high-symmetry points	970
c. Results for high-symmetry lines	971
d. Results for high-symmetry planes	973
203. Space group No. 203 ($Fd\bar{3}$)	973
a. Space group operations	973
b. Results for high-symmetry points	974
c. Results for high-symmetry lines	974
d. Results for high-symmetry planes	976
204. Space group No. 204 ($Im\bar{3}$)	976
a. Space group operations	976
b. Results for high-symmetry points	977
c. Results for high-symmetry lines	978
d. Results for high-symmetry planes	979
205. Space group No. 205 ($Pa\bar{3}$)	979
a. Space group operations	979
b. Results for high-symmetry points	979
c. Results for high-symmetry lines	981
d. Results for high-symmetry planes	982
206. Space group No. 206 ($Ia\bar{3}$)	983
a. Space group operations	983
b. Results for high-symmetry points	983
c. Results for high-symmetry lines	984
d. Results for high-symmetry planes	985
207. Space group No. 207 ($P4_2\bar{3}2$)	986
a. Space group operations	986
b. Results for high-symmetry points	986
c. Results for high-symmetry lines	988
d. Results for high-symmetry planes	989
208. Space group No. 208 ($P4_2\bar{3}2$)	990
a. Space group operations	990
b. Results for high-symmetry points	990
c. Results for high-symmetry lines	992
d. Results for high-symmetry planes	994
209. Space group No. 209 ($F4_2\bar{3}2$)	994
a. Space group operations	994
b. Results for high-symmetry points	995
c. Results for high-symmetry lines	996
d. Results for high-symmetry planes	997
210. Space group No. 210 ($F4_1\bar{3}2$)	998
a. Space group operations	998
b. Results for high-symmetry points	998
c. Results for high-symmetry lines	999
d. Results for high-symmetry planes	1000
211. Space group No. 211 ($I4_2\bar{3}2$)	1001
a. Space group operations	1001

b. Results for high-symmetry points	1001
c. Results for high-symmetry lines	1002
d. Results for high-symmetry planes	1004
212. Space group No. 212 ($P4_332$)	1004
a. Space group operations	1004
b. Results for high-symmetry points	1005
c. Results for high-symmetry lines	1005
d. Results for high-symmetry planes	1007
213. Space group No. 213 ($P4_132$)	1007
a. Space group operations	1008
b. Results for high-symmetry points	1008
c. Results for high-symmetry lines	1009
d. Results for high-symmetry planes	1010
214. Space group No. 214 ($I4_132$)	1011
a. Space group operations	1011
b. Results for high-symmetry points	1011
c. Results for high-symmetry lines	1012
d. Results for high-symmetry planes	1013
215. Space group No. 215 ($P\bar{4}3m$)	1014
a. Space group operations	1014
b. Results for high-symmetry points	1014
c. Results for high-symmetry lines	1015
d. Results for high-symmetry planes	1017
216. Space group No. 216 ($F\bar{4}3m$)	1017
a. Space group operations	1018
b. Results for high-symmetry points	1018
c. Results for high-symmetry lines	1019
d. Results for high-symmetry planes	1020
217. Space group No. 217 ($I\bar{4}3m$)	1021
a. Space group operations	1021
b. Results for high-symmetry points	1021
c. Results for high-symmetry lines	1022
d. Results for high-symmetry planes	1023
218. Space group No. 218 ($P\bar{4}3n$)	1024
a. Space group operations	1024
b. Results for high-symmetry points	1024
c. Results for high-symmetry lines	1025
d. Results for high-symmetry planes	1027
219. Space group No. 219 ($F\bar{4}3c$)	1027
a. Space group operations	1027
b. Results for high-symmetry points	1028
c. Results for high-symmetry lines	1029
d. Results for high-symmetry planes	1030
220. Space group No. 220 ($I\bar{4}3d$)	1030
a. Space group operations	1031
b. Results for high-symmetry points	1031
c. Results for high-symmetry lines	1032
d. Results for high-symmetry planes	1033
221. Space group No. 221 ($Pm\bar{3}m$)	1033
a. Space group operations	1033
b. Results for high-symmetry points	1034
c. Results for high-symmetry lines	1036
d. Results for high-symmetry planes	1038
222. Space group No. 222 ($Pn\bar{3}n$)	1039
a. Space group operations	1039

b. Results for high-symmetry points	1039
c. Results for high-symmetry lines	1040
d. Results for high-symmetry planes	1042
223. Space group No. 223 ($Pm\bar{3}n$)	1042
a. Space group operations	1042
b. Results for high-symmetry points	1043
c. Results for high-symmetry lines	1044
d. Results for high-symmetry planes	1046
224. Space group No. 224 ($Pn\bar{3}m$)	1047
a. Space group operations	1047
b. Results for high-symmetry points	1047
c. Results for high-symmetry lines	1049
d. Results for high-symmetry planes	1051
225. Space group No. 225 ($Fm\bar{3}m$)	1052
a. Space group operations	1052
b. Results for high-symmetry points	1052
c. Results for high-symmetry lines	1054
d. Results for high-symmetry planes	1056
226. Space group No. 226 ($Fm\bar{3}c$)	1057
a. Space group operations	1057
b. Results for high-symmetry points	1057
c. Results for high-symmetry lines	1058
d. Results for high-symmetry planes	1060
227. Space group No. 227 ($Fd\bar{3}m$)	1060
a. Space group operations	1061
b. Results for high-symmetry points	1061
c. Results for high-symmetry lines	1062
d. Results for high-symmetry planes	1063
228. Space group No. 228 ($Fd\bar{3}c$)	1064
a. Space group operations	1064
b. Results for high-symmetry points	1064
c. Results for high-symmetry lines	1065
d. Results for high-symmetry planes	1066
229. Space group No. 229 ($Im\bar{3}m$)	1067
a. Space group operations	1067
b. Results for high-symmetry points	1067
c. Results for high-symmetry lines	1069
d. Results for high-symmetry planes	1071
230. Space group No. 230 ($Ia\bar{3}d$)	1072
a. Space group operations	1072
b. Results for high-symmetry points	1072
c. Results for high-symmetry lines	1073
d. Results for high-symmetry planes	1074
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S1. INTRODUCTION TO THE SUPPLEMENTARY MATERIAL

In this work, we have compiled a catalog of phonon emergent particles (EMPs) and chiral phonons. Beyond the main text, the Supplementary Material provides a more detailed account of the materials database and symmetry-based classification results. Sec. S2 provides an overview of our database and its usage, a list of ideal topological materials and two-dimensional (2D) materials, related applications of the database, as well as the calculation methods used in this work. Sec. S3 presents definitely existing EMPs enforced by representations and atomic positions. Sec. S4 provides user-friendly tabulations of phonon angular momentum (AM) resolved by representation and atomic positions, systematically covering the high-symmetry points (HSPs), high-symmetry lines (HSLs), and high-symmetry planes (HSPLs) of all 230 space groups (SGs). Finally, Sec. S5 provides the atomic insulator basis sets for the 230 SGs.

S2. DATABASE OF PHONON EMERGENT PARTICLES AND CHIRAL PHONONS

In this section, we briefly introduce our database in Sec. S2.1 and explain its usage in Sec. S2.2. We list 2,309 ideal candidate materials hosting topological phonons in Sec. S2.3 and 559 ideal 2D materials hosting chiral phonons in Sec. S2.4. In Sec. S2.5, we illustrate how to use the database to (i) search for ideal materials hosting coexisting EMPs, (ii) identify materials with petal-shaped surface states induced by nearly nodal lines, (iii) obtain phonon pseudo-angular momentum (PAM) in chiral materials, and (iv) select ideal materials exhibiting chirality momentum locking in phonon surface states. Sec. S2.6 outlines the calculation methods used for the materials studied in this work.

1. Overview of the database

Our work first establishes an online database (phonon.nju.edu.cn), mapping EMPs and phonon AM to specific phonon band crossings in real materials. In this section, we provide a brief overview of our database.

For building our database, we rely on the following materials database for the high-throughput calculations.

Phonon Database at Kyoto University (PhononDB@kyoto-u) [1]. PhononDB@kyoto-u stores the force constants of 10,034 materials, which are derived from the finite displacement method using the Vienna Ab initio Simulation Package (VASP) [2, 3]. Each material in PhononDB@kyoto-u has a unique Materials Project Identification number (MPID). For the materials obtained from PhononDB@kyoto-u, we verify their SGs and confirm that they are all consistent with those provided in PhononDB@kyoto-u. We also check whether the structures of these materials conform to the conventions of the PHONOPY software [4], and find that 47 materials do not, which are listed in Table S1. We employ the PHONOPY software to standardize the structures of these 47 materials and then recalculate their phonon spectra. The calculation parameters are consistent with the original parameters in the database. For other 9987 materials, we uniformly use the q-grid, supercell size and force constants stored in PhononDB@kyoto-u. We finally collect atomic positions, symmetry, and lattice parameters and the force constants of 10,034 materials.

Inorganic Crystal Structure Database (ICSD) [5]. ICSD is a comprehensive resource for inorganic crystal structures, containing data on the crystallographic properties of a wide range of materials. Each material is assigned a unique ICSD number. We collect atomic positions, symmetry, and lattice parameters of 101,838 materials from ICSD, after discarding duplicate and corrupted structures.

TABLE S1: 47 materials whose structures do not conform to the conventions of the PHONOPY software in PhononDB@kyoto-u.

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
1	3977	4	CsB ₃ O ₅	35799	5	Hf ₂ Bi ₂ O ₇	676020	12	BaCO ₃	978114	14	Sn ₅ O ₆
2	17245	15	Na ₃ TaF ₈	29558	15	Bi ₃ ClO ₄	758054	15	LiAgF ₄	530709	48	TlW ₃ Br ₇
3	531064	48	KMo ₃ Br ₇	569051	60	MgH ₂	7310	67	ZrPbF ₆	8232	67	BaZrF ₆
4	23104	67	Pb ₂ ClOF	556532	67	CaAlB ₃ O ₇	752691	68	Sr ₃ Hf ₂ O ₇	561799	70	Yb(GaS ₂) ₂
5	6578	73	Ba ₃ B(PO ₄) ₃	30129	73	Li ₄ TaN ₃	554445	73	Bi ₅ IO ₇	4103	74	Sr ₂ Sb ₂ O ₇
6	6319	74	Na ₂ MgAlF ₇	8204	74	LiAlB ₁₄	12866	74	SrSnO ₃	13109	74	SrHfO ₃
7	16280	74	Ca ₂ Sb ₂ O ₇	24142	74	MgAlH ₄ O ₂ F ₅	28870	74	PRhO ₄	34022	74	Mg ₂ SnO ₄
8	35647	74	Zn ₂ PtO ₄	38307	74	MgAl ₂ O ₄	38684	74	Li ₂ MgCl ₄	41837	74	RbTiZnOF ₅
9	553965	74	RbLaNb ₂ O ₇	555155	74	KNa ₂ Y(Si ₂ O ₅) ₃	556003	74	CaTiO ₃	557516	74	K ₂ Be ₂ Zn ₂ Si ₃ O ₁₁
10	644506	74	NaAlH ₂ CO ₅	655591	74	LiB ₁₃ C ₂	697168	74	MgH ₆ (NCl) ₂	697263	74	LiAsH ₂ OF ₆
11	699284	74	Li ₂ HN	769128	74	Dy ₂ Sb ₂ O ₇	863066	74	Ta ₆ Pb ₄ O ₁₉	29927	174	Pb ₇ (BrF ₆) ₂

to be continued

TABLE S1

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
12	557375	174	NaLiCO ₃	557667	174	Ge ₃ Pb ₅ O ₁₁	754929	174	Ga ₃ NO ₃			

According to the symmetry and atomic position information of materials collected from PhononDB@Kyoto-u and ICSD, we determine the occurrence of all 19 EMP types at HSPs (shown in Table S2) without explicit phonon calculations. In the ICSD, 91,789 materials are identified as hosting EMPs at HSPs, including 1,865 elementary substances, 27,561 binary compounds, and 37,196 ternary compounds. In PhononDB@Kyoto-u, 9,380 materials are identified as hosting EMPs at HSPs, including 19 elementary substances, 1,139 binary compounds, and 5,399 ternary compounds. Based on the force constants from PhononDB@Kyoto-u, the frequencies of EMPs at HSPs are quantitatively determined, and the phonon AM values for each mode are also calculated. Overall, we have identified over 20 million EMPs at HSPs from PhononDB@Kyoto-u and ICSD. Over 90% of the materials collected from the two databases are found to host EMPs at HSPs.

Furthermore, we map all 15 EMP types along HSLs (shown in Table S3) and their phonon AM values to specific phonon band crossings for each material in PhononDB@Kyoto-u. Over 5 million accidental EMPs (arising from two different representations) along HSLs are identified in the database. The detailed procedure and formulas for identifying EMPs and phonon AM at HSPs and along HSLs based on the force constants are provided in Sec. S2.6.

All computational data for EMPs and phonon AM at HSPs and HSLs are integrated into an online database, phonon.nju.edu.cn. This website provides a convenient and publicly accessible platform to browse and search the materials database and the results presented in our work.

TABLE S2: All 19 types of the EMPs that can appear at HSPs in the phonon system from Ref. [6].

EMP	Full name of EMP
C-1 WP	Charge-1 Weyl point
C-2 WP	Charge-2 Weyl point
C-4 WP	Charge-4 Weyl point
TP	Triple point
C-2 TP	Charge-2 triple point
QCTP	Quadratic contact triple point
DP	Dirac point
C-2 DP	Charge-2 Dirac point
QDP	Quadratic Dirac point
CCDP	Cubic crossing Dirac point
SP	Sextuple point
P-QNL	The nodal point located on the quadratic nodal line
P-WNL	The nodal point located on a Weyl nodal line, or at the joint point of several Weyl nodal lines that can be connected to a specific Weyl nodal line through symmetry operators
P-WNLs	The nodal point located at the joint point of several Weyl nodal lines
P-NS	The nodal point located on a nodal surface
P-NSs	The nodal point located at the intersection of two/three nodal surfaces
P-DNL	The nodal point located on a Dirac nodal line but is not situated along any high-symmetry line
P-DNLs	The nodal point located at the joint point of several Dirac nodal lines
P-WNL/NS	The nodal point located at the intersection of a nodal line and a nodal surface

TABLE S3: All 15 types of the EMPs that can appear in HSLs in the phonon system from Ref. [6].

EMP	Full name of EMP
C-1 WP	Charge-1 Weyl point
C-2 DP	Charge-2 Dirac point

C-2 WP	Charge-2 Weyl point
C-3 WP	Charge-3 Weyl point
DNL	Dirac nodal line
DP	Dirac point
L-NS	A Weyl nodal line residing on a nodal surface (occurring in a high-symmetry plane)
L-NSs	A nodal line residing at the hinge of two nodal surfaces
P-WNL	The nodal point located on a Weyl nodal line, or at the joint point of several Weyl nodal lines that can be connected to a specific Weyl nodal line through symmetry operators
P-WNLs	The nodal point located at the joint point of several Weyl nodal lines
QDP	Quadratic Dirac point
QNL	Quadratic nodal line
QTP	Quadratic triple point
TP	Triple point
WNL	Weyl nodal line

2. Usage of the database

In this section, we provide a detailed guide to phonon.nju.edu.cn. Fig. S1 shows the homepage of phonon.nju.edu.cn, from which the following four modules can be accessed:

- Phonon emergent particles and chiral phonons at high-symmetry points
- Phonon emergent particles and chiral phonons in high-symmetry lines
- Single-valued representations at high-symmetry points
- Single-valued representations in high-symmetry lines

The first two modules store the high-throughput calculation results for all materials at HSPs and along HSLs, while the last two modules provide the irreducible (co-)representation [(co-)irrep]] information at HSPs and along HSLs, as well as the Wyckoff position (WYPO) information for all 230 SGs used in our study. Next, we introduce each module in turn.

The main interface of [Phonon emergent particles and chiral phonons at high-symmetry points](#) includes three engines: “Search”, “Search Results” and “Chart and Info”. The “Search” engine has two modes (Fig. S2(a)). In the default search mode, users can search by materials database (ICSD/MP), specific EMPs, crystal symmetries (Bravais lattice and SGs), and chemical compositions to identify relevant compounds for further study. For example, to find materials containing both C-4 WP and C-2 DP, one can simply select “C-4 WP” and “C-2 DP” in the EMP section of the database website. Additionally, other constraints (e.g., filtering by specific SGs or materials containing certain chemical elements) can be applied to refine the search results. In the second search mode by number, users can directly search for materials database (ICSD/MP) and ICSD number, or the MPID to identify a specific compound to access. The results of the “Search” engine will be displayed in the “Search Results” engine.

Once a compound has been selected in “Search Results”, “Chart and Info” will show several sections of information (Fig. S3). The first section provides crystallographic data, including the ICSD number/MPID, SG, chemical formula, and occupied WYPOs. For materials with an MPID, we also provide detailed WYPO information for each atom. The second section is a table that provides the numbers of (co-)irreps and the corresponding EMP occurrences at each HSP, along with the contribution of each WYPO to each (co-)irrep. Users can view additional HSP information by scrolling within the table. The third section (only for materials with an MPID) shows the phonon spectra together with detailed energy-level information at each HSP, including the EMP type, frequency, degeneracy, band index, and phonon AM. To enhance the readability of dense phonon bands, we provide a zoom function.

The main interface of [Phonon emergent particles and chiral phonons in high-symmetry lines](#) includes three engines: “Search”, “Search Results” and “Chart and Info”. The “Search” engine has two modes (Fig. S2(b)). In the default search mode, users can search by specific EMPs, crystal symmetries (Bravais lattice and SG), and chemical compositions to identify relevant compounds for further study. For example, to find materials containing both C-2 WP and C-3 WP, one can simply select “C-2 WP” and “C-3 WP” in the EMP section of the website. Additionally, another constraint (materials containing certain chemical elements) can be applied to refine the search results. In the second search mode by MPID number, users can directly search for MPID to identify a specific compound to access. The results of the “Search” engine will be displayed in the “Search Results” engine. After selecting a compound, a list of HSL options will appear.

Once a compound and a HSL have been selected in “Search Results”, “Chart and Info” will show several parts of information (Fig. S4). The first part provides the currently viewed material (MPID, SG, chemical formula) and the HSL. The second part provides the (co-)irreps of the bands and their corresponding colors along the HSL. The third part gives phonon spectra with detailed energy bands along the HSL. Accidental band crossings along the HSL are denoted by blue circles. To enhance the readability of dense phonon bands, we provide a zoom function. For each energy level at HSPs, we provide frequency, band index, degeneracy, and phonon AM. For each non-degenerate band along the HSL, we provide (co-)irrep, band index, frequency, degeneracy, and phonon AM. For each degenerate band (including accidental band crossing) along the HSL, we provide (co-)irrep, band index, frequency, degeneracy, EMP type, and phonon AM.

The main interface of [Single-valued representations at high-symmetry points](#) features two search boxes. In the first search box, users can either type the SG number or select it from a drop-down menu. Once the SG number is chosen, the list of coordinates of WYPOs for that SG will be displayed. The coordinates of the WYPOs for all 230 SGs are given in the primitive basis. Users can then click on the second search box to view a table of HSPs for the selected SG. This table lists all inequivalent HSPs, including their coordinates in the primitive basis, along with the equivalent HSPs related by symmetry operations. By clicking on a specific HSP label, users can access character tables, $k \cdot p$ effective models, the types of EMPs, and nearly nodal structures associated with each (co-)irrep.

The main interface of [Single-valued representations in high-symmetry lines](#) features two search boxes. In the first search box, readers can choose the SG number by typing or choose via a drop-down menu. Once the SG number has been chosen, readers can click on the second search box to view the table of the HSLs of the SG. The table of HSLs includes HSL label, components in the primitive basis, and components in the conventional basis. Readers can click on the HSL label to view the information of (co-)irreps. By clicking on a specific HSL label, users can access the character tables, $k \cdot p$ effective models, the types of EMP, topological charges of these EMPs, and nearly nodal structures associated with each (co-)irrep.

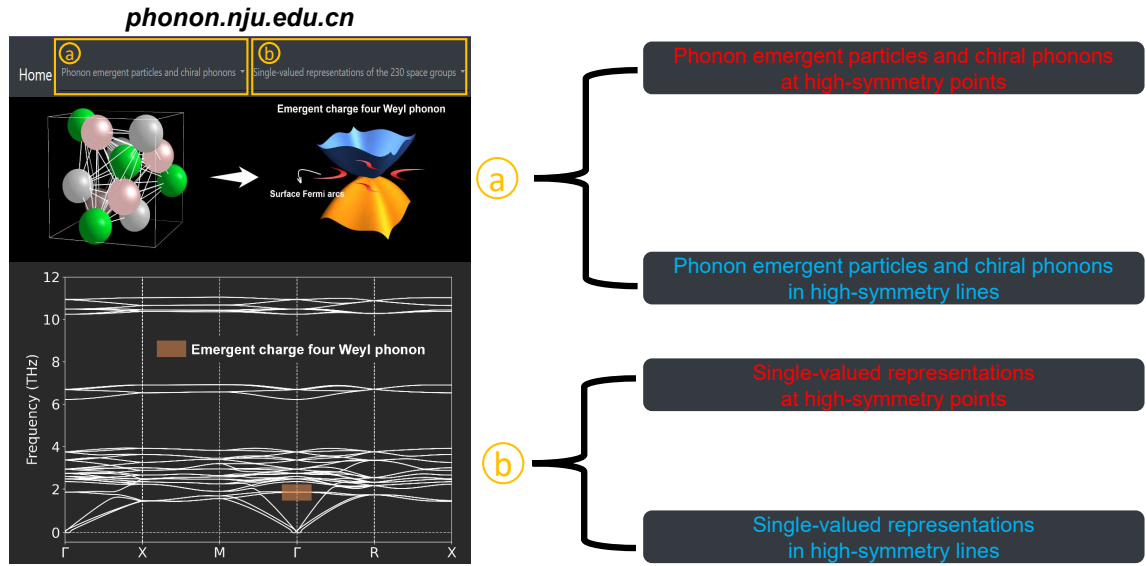


FIG. S1. Homepage of the website phonon.nju.edu.cn and its four modules.

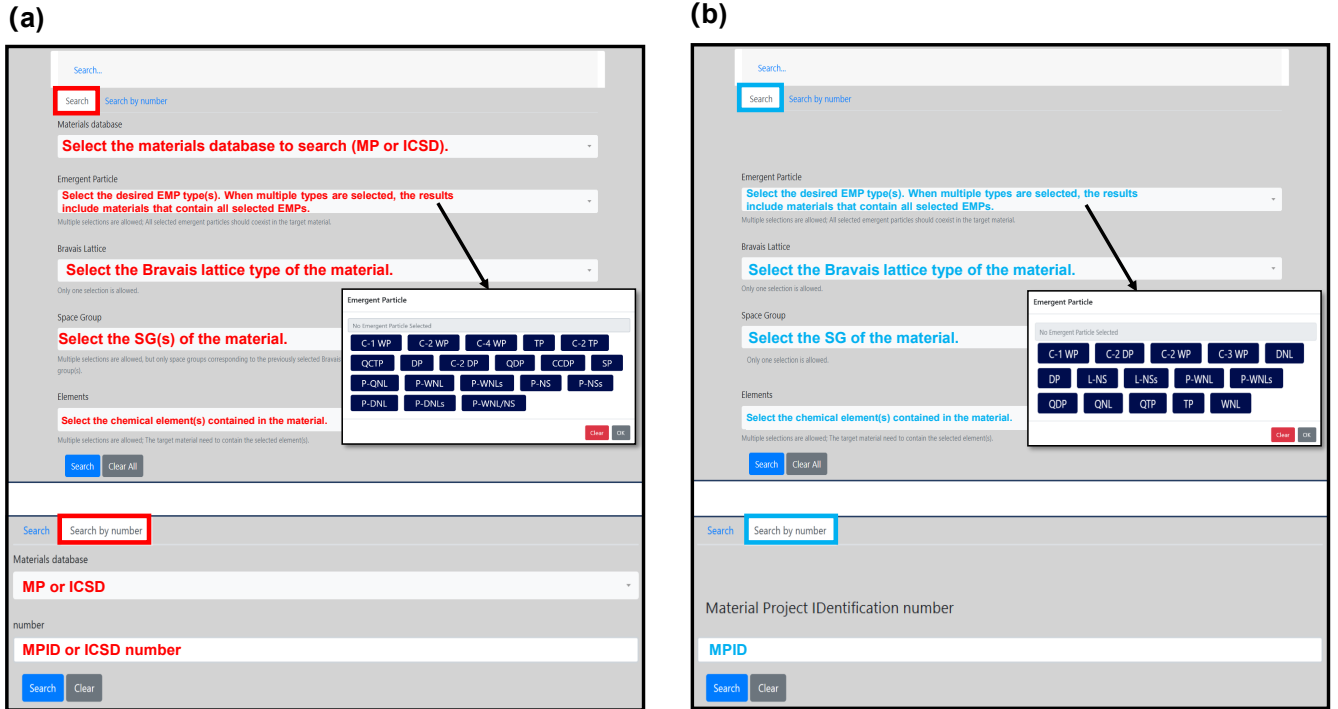


FIG. S2. The “Search” interface of Phonon emergent particles and chiral phonons at high-symmetry points in (a) and Phonon emergent particles and chiral phonons in high-symmetry lines in (b). The “Search” interface provides two modes. In the default mode, users can search the ICSD/MP databases by EMP type, crystal symmetry (Bravais lattice and SG), and chemical composition to identify compounds of interest. In the search mode by number, users can directly query a specific entry using an ICSD number or an MPID.

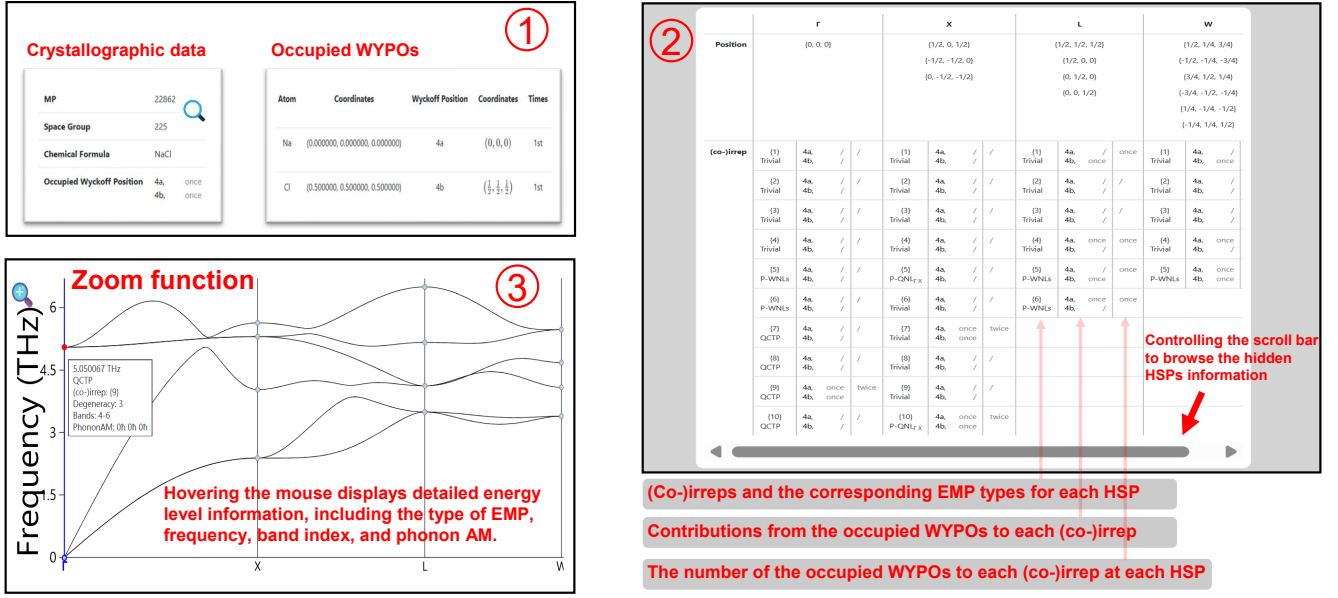


FIG. S3. The “Search Results” engine for a specific material entry stored in **Phonon emergent particles and chiral phonons at high-symmetry points**. Part 1: Crystallographic data and occupied WYPOs. Part 2: The table providing the number of (co-)irreps and corresponding EMP occurrences at each HSP, along with the contribution of the WYPOs to each (co-)irrep. Part 3: Phonon spectra along with detailed energy level information at each HSP, including the type of EMP, frequency, degeneracy, band index, and phonon AM.

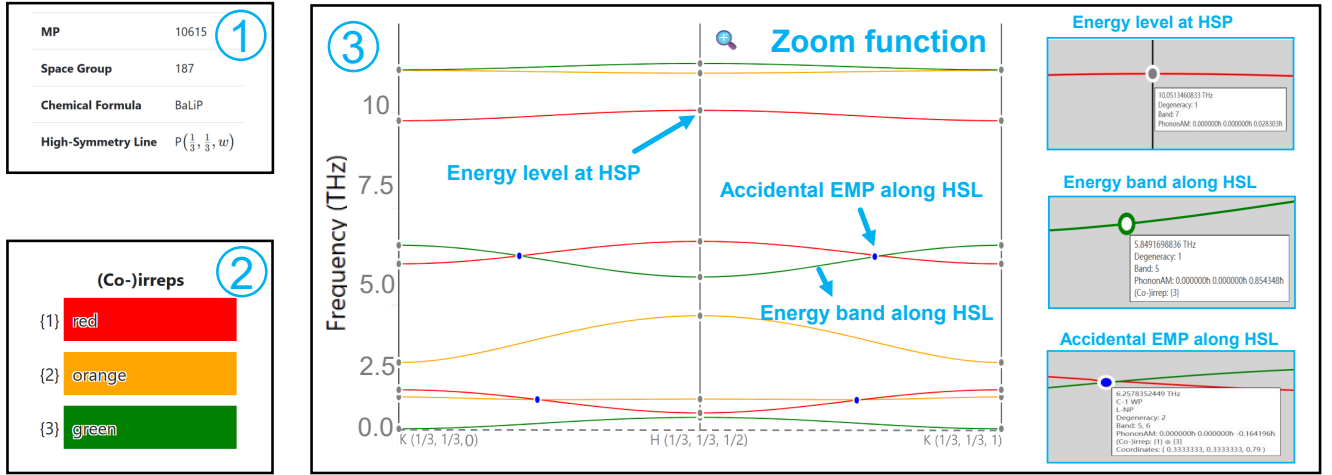


FIG. S4. The “Search Results” engine for a specific material and a HSL entry stored in **Phonon emergent particles and chiral phonons in high-symmetry lines**. Part 1: The currently viewed material (MPID, SG, chemical formula) and HSL. Part 2: The (co-)irreps of the bands and their corresponding colors along the HSL. Part 3: Phonon spectra with detailed energy bands along the HSL. Accidental band crossings along the HSL are denoted by blue circles. For each energy level at HSPs, we provide frequency, band index, degeneracy, and phonon AM. For each non-degenerate band along the HSL, we provide (co-)irrep, band index, frequency, degeneracy, and phonon AM. For each degenerate band (including accidental band crossing) along the HSL, we provide (co-)irrep, band index, frequency, degeneracy, EMP types, and phonon AM.

3. List of ideal topological phonon materials

Our database covers numerous previously reported ideal topological phonon materials, as listed in Table S4. We also provide 2,309 nearly ideal candidate materials selected from our database in Table S5. Their phonon spectra exhibit no negative frequencies, and the bands forming the topological phonons are well separated from other bands. These nearly ideal candidates merit further experimental investigation.

TABLE S4: Information on previously reported ideal topological phonon materials is stored in our database. This information includes the SG, chemical formula, material ID, EMPs, and EMP locations.

SG	Formula	Database	ID	Position	EMP
4	K ₂ ZnBr ₄ [7]	MP	23535	U ($\frac{1}{2}, v, \frac{1}{2}$)	C-1 WP
				W ($\frac{1}{2}, v, 0$)	C-1 WP
33	Li ₃ AsS ₃ [8]	MP	28471	T ($\frac{1}{2}, 0, \frac{1}{2}$)	DP
114	H ₄ BNa [8]	ICSD	159241	A ($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$)	QDP
198	NiSSb [8]	ICSD	038843	R ($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$)	C-2 DP
223	AuTi ₃ [8]	ICSD	058605	R ($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$)	CCDP
223	SnTa ₃ [8]	ICSD	106076	R ($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$)	CCDP
51	RbTeAu [9]	MP	9008	D ($\frac{1}{2}, v, 0$)	L-NS
				P ($\frac{1}{2}, v, \frac{1}{2}$)	L-NS
62	Cs ₂ Te [10]	MP	573763	Q ($\frac{1}{2}, \frac{1}{2}, w$)	DNL
				A ($u, 0, \frac{1}{2}$)	L-NS
				B ($0, v, \frac{1}{2}$)	L-NS
				C ($u, \frac{1}{2}, 0$)	L-NS
				D ($\frac{1}{2}, v, 0$)	L-NS
				E ($u, \frac{1}{2}, \frac{1}{2}$)	L-NSs
				G ($\frac{1}{2}, 0, w$)	L-NS
				H ($0, \frac{1}{2}, w$)	L-NS
				P ($\frac{1}{2}, v, \frac{1}{2}$)	L-NSs
76	TiBO ₂ [11]	MP	28244	Γ (0, 0, 0)	C-2 WP
149	IKNiO ₆ [11]	ICSD	060313	M ($\frac{1}{2}, \frac{1}{2}, 0$)	C-2 WP
				Γ (0, 0, 0)	C-2 WP
92	BaPt ₂ S ₃ [12]	MP	558588	M ($\frac{1}{2}, \frac{1}{2}, 0$)	C-2 WP
				Γ (0, 0, 0)	C-2 DP
96	Na ₂ Zn ₂ O ₃ [13]	MP	554845	A ($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$)	C-1 WP
				LD (0, 0, w)	C-2 DP
137	Li ₆ WN ₄ [14]	MP	3503	S ($u, u, \frac{1}{2}$)	WNL
				T ($u, \frac{1}{2}, \frac{1}{2}$)	L-NS
				W ($0, \frac{1}{2}, w$)	L-NS
				Y ($u, \frac{1}{2}, 0$)	L-NS
				V ($\frac{1}{2}, \frac{1}{2}, w$)	L-NS
138	AuBr [15]	MP	505366	S ($u, u, \frac{1}{2}$)	P-WNL
				SM ($u, u, 0$)	P-WNL
				U ($0, v, \frac{1}{2}$)	WNL
152	BaZnO ₂ [16]	MP	4236	K ($-\frac{1}{3}, \frac{2}{3}, 0$)	C-1 WP
				A ($0, 0, \frac{1}{2}$)	C-2 WP
154	α-SiO ₂ [17]	ICSD	000174	A ($0, 0, \frac{1}{2}$)	C-2 WP
173	LiIO ₃ [18, 19]	MP	22955	K ($-\frac{1}{3}, \frac{2}{3}, 0$)	C-1 WP
				DT (0, 0, w)	C-3 WP
173	NaPH ₃ NO ₃ [20]	MP	632684	K ($-\frac{1}{3}, \frac{2}{3}, 0$)	C-1 WP
				Q ($u, u, \frac{1}{2}$)	L-NS
				R ($u, 0, \frac{1}{2}$)	L-NS
182	OZr ₃ [20]	ICSD	077715	K ($-\frac{1}{3}, \frac{2}{3}, 0$)	C-1 WP

to be continued

TABLE S4

SG	Materials	Database	ID	Position	EMP
180	NbSi ₂ [21]	ICSD	016502	$\Gamma (0, 0, 0)$ $K (-\frac{1}{3}, \frac{2}{3}, 0)$	C-2 WP C-1 WP
194	BaNa ₂ [22]	ICSD	106313	$A (0, 0, \frac{1}{2})$	QDP
198	FeSi [23]	ICSD	005250	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	C-2 TP C-2 DP
198	BaGePt [24]	ICSD	106309	$\Gamma (0, 0, 0)$	C-4 WP
198	BiIrSe [25]	ICSD	616741	$\Gamma (0, 0, 0)$	C-4 WP
198	BaGePt [26]	ICSD	106309	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	C-4 WP, C-2 TP C-2 DP
198	BKMgO ₃ [27]	ICSD	174336	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	C-2 TP C-2 DP
198	HfSO [28]	MP	7787	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	C-2 TP C-2 DP
198	AuBe [29]	ICSD	058396	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	C-2 TP C-2 DP
198	EuPtSi [30]	ICSD	604427	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	C-2 TP C-2 DP
199	K ₂ Sn ₂ O ₃ [31]	MP	8624	$H (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ $P (\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	C-2 TP C-1 WP
205	RuS ₂ [32]	MP	2030	$T (\frac{1}{2}, \frac{1}{2}, w)$	DNL
205	P ₂ Pt [32]	MP	730	$T (\frac{1}{2}, \frac{1}{2}, w)$	DNL
212	Si (<i>cI</i> 16) [33]	ICSD	016569	$H (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ $P (\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	QCTP DP
212	SrSi ₂ [34]	ICSD	002460	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	C-2 TP C-2 DP
213	SrSi ₂ [34]	ICSD	030373	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	C-2 TP C-2 DP
213	CsBe ₂ F ₅ [35]	MP	27192	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ $Z (u, \frac{1}{2}, 0)$ $DT (0, v, 0)$ $SM (u, u, 0)$	C-2 TP C-2 DP L-NS
216	CdTe [36]	MP	406	$V (\frac{1}{2}, \frac{u}{2}, \frac{u+1}{2})$	C-1 WP
218	Li ₇ VN ₄ [37]	MP	4825	$R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	SP
220	C ₃ N ₄ [37]	ICSD	083263	$H (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	SP
220	C ₃ Sc ₄ [37]	ICSD	042760	$H (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	SP
220	Sb ₃ Y ₄ [37]	ICSD	651736	$H (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	SP
223	K ₈ Si ₄₆ [37]	ICSD	015641	$R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	SP
230	Ca ₃ Ge ₃ O ₁₂ Sc ₂ [37]	ICSD	020215	$H (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	SP
220	C ₃ Yb ₂ [38]	ICSD	086293	$\Gamma (0, 0, 0)$ $H (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ $P (\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	QCTP SP DP
220	Zr ₃ Ni ₃ Sb ₄ [39]	MP	17926	$\Gamma (0, 0, 0)$ $H (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ $P (\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	QC DP SP DP
223	SnTa ₃ [40]	ICSD	106076	$\Gamma (0, 0, 0)$ $R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	QCTP CCDP, SP
225	Cs ₂ GeF ₆ [41]	MP	8217	$W (\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$ $LD (u, u, u)$	P-WNLs WNL

TABLE S5: The 2,309 nearly ideal candidate materials, which we have selected from our database.

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
1	6433	4	KNd(PO ₃) ₄	6481	4	Na ₂ ZnSi ₃ O ₈	10517	4	LiScP ₂ O ₇	11634	4	KSmGeSe ₄
2	12012	4	KPrGeSe ₄	13538	4	KPrSiSe ₄	16773	4	TbK(PO ₃) ₄	18572	4	KEr(PO ₃) ₄
3	18661	4	KY(PO ₃) ₄	21097	4	KLaGeSe ₄	23535	4	K ₂ ZnBr ₄	555191	4	La ₃ Si ₂ Cl ₃ O ₇
4	556806	4	BaNa ₂ (SiO ₃) ₂	557728	4	KCu ₄ AsS ₄	559391	4	Pr ₃ Si ₂ Cl ₃ O ₇	634418	4	NaCaSiHO ₄
5	776407	4	LaTa ₂ NO ₅	861606	4	KLaSiSe ₄	861866	4	KNdGeS ₄	861938	4	KLaSiS ₄
6	867328	4	KYSiS ₄	867334	4	KYGeS ₄	3926	7	NbAg ₇ S ₆	6406	7	Na ₂ MgSiO ₄
7	6708	7	RbNb ₂ PS ₁₀	13923	7	SnPS ₃	31243	7	BaAs ₂	560847	7	Nb ₂ TIPS ₁₀
8	570370	7	SnPSe ₃	539	9	Ga ₂ S ₃	1340	9	Ga ₂ Se ₃	2804	9	LaP ₂
9	15895	9	SiCu ₂ S ₃	16839	9	Na ₃ WN ₃	17791	9	Cd ₄ SiSe ₆	28261	9	Na ₄ SnO ₃
10	29246	9	Cd ₂ P ₃ Cl	30126	9	Ba(BS ₂) ₂	32616	9	Ga ₂ S ₃	505607	9	In ₂ Ag ₂ GeSe ₆
11	542199	9	Ag ₄ HgGe ₂ S ₇	542200	9	CdAg ₄ Ge ₂ S ₇	542545	9	K ₃ Nb ₂ AsSe ₁₁	554627	9	Cu ₆ PS ₅ Br
12	558016	9	CaMgAsO ₄ F	570957	9	CsSiTe ₃	640614	9	In ₂ Si(AgSe ₃) ₂	683902	9	Rb ₃ Nb ₂ AsSe ₁₁
13	683905	9	K ₃ Ta ₂ AsSe ₁₁	685991	9	Li ₅ SiP ₃	778194	9	Ge ₂ N ₂ O	866660	9	K ₃ P ₂ AuSe ₈
14	6384	11	RbSO ₂ F	6989	11	BaSeO ₃	9921	11	ZrS ₃	9922	11	HfS ₃
15	10555	11	Ba ₂ LiReN ₄	10556	11	Sr ₂ LiReN ₄	11115	11	RbCuPdSe ₅	11902	11	Ba ₂ GeSe ₄
16	24428	11	KH ₂ N	28490	11	Tl ₃ BSe ₃	28967	11	Ba(PdS ₂) ₂	29337	11	Tl ₃ BS ₃
17	29345	11	LiGaI ₃	29849	11	Ag ₃ SnP ₇	545482	11	PdSeO ₃	558195	11	Ba ₂ HoB ₂ ClO ₆
18	558826	11	KHoBeF ₆	567373	11	LaCN ₂ Cl	569613	11	Ba ₂ P ₇ Cl	569812	11	Ba ₃ N ₃ Cl
19	570803	11	Ba ₂ Ge(TeSe) ₂	579536	11	CsCu ₂ ICl ₂	619510	11	CsHg ₂ Br ₅	634657	11	NaHS
20	634676	11	KHS	697181	11	CsLi ₂ (HO) ₃	766463	11	Na ₃ GaB ₄ O ₉	771774	11	Na ₂ SiSnCO ₇
21	866310	11	Ba ₂ YB ₂ ClO ₆	867219	11	Sr ₂ GaGeN	28606	13	K ₃ AuSe ₁₃	571235	13	ZrI ₄
22	753809	13	BaCaI ₄	771981	13	BaLa ₂ Br ₈	778364	13	Na ₆ Ti ₂ O ₇	200	14	LaP ₇
23	384	14	MgP ₄	524	14	Ba ₃ As ₁₄	909	14	As ₂ Se ₃	927	14	CuP ₂
24	1195	14	Ba ₃ P ₁₄	1247	14	Sb ₂ Ir	1853	14	Sr ₃ P ₁₄	2911	14	Ba ₃ (SnP ₂) ₂
25	2969	14	CsSbSe ₂	3416	14	Na ₃ AlF ₆	3622	14	Na ₂ PdF ₄	3635	14	LiBO ₂
26	3855	14	Na ₂ BeF ₄	3932	14	Ca ₃ Si ₂ O ₇	4172	14	Na ₅ GeP ₃	4421	14	LaTaO ₄
27	4988	14	TlAsS ₂	5001	14	Li ₃ BN ₂	5045	14	SnGeS ₃	5367	14	K ₅ SnSb ₃
28	5409	14	Y ₄ Al ₂ O ₉	5416	14	Na ₂ SeO ₃	5563	14	Ag ₅ GeO ₄	5732	14	La ₂ Si ₂ O ₇
29	5929	14	Na ₅ SiP ₃	6331	14	Na ₂ Y ₂ B ₂ O ₇	6604	14	Na ₂ LiAlF ₆	6899	14	CaBePO ₄ F
30	7198	14	SrPSe ₃	7904	14	CdP ₄	7943	14	LiAs	8194	14	Ba ₂ GeP ₂
31	8195	14	Ba ₂ GeAs ₂	9047	14	RbBS ₃	9635	14	Ag ₂ HgS ₂	9680	14	Na ₃ AlTe ₃
32	9726	14	SrBeF ₄	9788	14	SrPS ₃	9789	14	CaPS ₃	10288	14	LaCuTeS
33	10349	14	Na ₂ SnTeO ₆	10552	14	RbBS ₃	10814	14	SrLiBO ₃	10925	14	Pr ₂ Se ₂ O
34	11006	14	BaPS ₃	11007	14	CaPSe ₃	11008	14	BaPSe ₃	11643	14	K ₂ Mg(PSe ₃) ₂
35	11982	14	Sr ₂ CaTeO ₆	12448	14	LiSm ₂ OsO ₆	12449	14	LiPr ₂ OsO ₆	12450	14	LiNd ₂ OsO ₆
36	12451	14	LiLa ₂ OsO ₆	12878	14	Sr ₂ YSbO ₆	13568	14	NdS ₂	14551	14	Sr ₂ CaUO ₆
37	14552	14	Ba ₂ SrUO ₆	15415	14	K ₂ GaAs ₂	15416	14	Rb ₂ GaAs ₂	15417	14	K ₂ GaP ₂
38	16605	14	Sr ₂ TmTaO ₆	16777	14	NaAlP ₂ O ₇	16993	14	Er ₂ SiO ₅	17065	14	Ho ₂ SiO ₅
39	17291	14	Na ₃ SiTe ₃	17468	14	SrZrSi ₂ O ₇	17470	14	Ba ₃ (SnAs ₂) ₂	17924	14	ZnP ₂ PbO ₇
40	18112	14	Sr ₂ Ge ₂ Se ₅	18139	14	Na ₅ SiAs ₃	18317	14	Na ₅ SnP ₃	18471	14	Sr ₂ UO ₅
41	18483	14	Rb ₆ Si ₂ O ₇	20199	14	PPbS ₃	20222	14	Sr ₂ NbInO ₆	20316	14	PPbSe ₃
42	22355	14	Sr ₂ InSbO ₆	22665	14	AgAsPbS ₃	22999	14	Hg ₃ (ClO) ₂	23093	14	Sr ₂ NdBiO ₆
43	23100	14	Sr ₂ LuBiO ₆	23705	14	Na ₃ AlH ₆	24413	14	Na ₂ LiAlH ₆	27628	14	Te ₃ Cl ₂
44	27688	14	K ₂ TeI ₆	27741	14	TeAuI	27747	14	PdI ₂	27904	14	FeSbS
45	28126	14	K ₂ GeTe ₄	28319	14	PtI ₂	28326	14	LiGaBr ₄	28566	14	NaTiSe ₄
46	28568	14	Rb ₃ CuO ₂	28570	14	NaInI ₄	28630	14	Na ₃ BN ₂	28745	14	Nb ₂ Te ₆ I
47	28805	14	Tl ₂ Pt ₅ S ₆	28809	14	TlBS ₃	28860	14	P ₂ Se ₅	29234	14	InTeI
48	29236	14	InTeBr	29297	14	Cd ₃ (ClO) ₂	29469	14	Pd(Se ₃ Cl) ₂	29566	14	CsNaGe ₂
49	29567	14	CuSe ₂ Br	29808	14	Ca ₄ GeN ₄	29977	14	Rb ₃ BS ₃	29990	14	La ₃ B ₂ N ₅
50	30971	14	CuTe ₂ Cl	30975	14	Na ₃ BO ₃	30990	14	K ₆ Si ₂ O ₇	30996	14	RbAuBr ₄

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
51	31037	14	CuTe ₂ I	31045	14	KAuI ₃	31077	14	Tl ₂ TeI ₆	31487	14	NbI ₅
52	504630	14	InTeCl	510283	14	CsGaSe ₃	540696	14	Ca ₃ (SiAs ₂) ₂	540923	14	Ba ₃ SnP ₃
53	541001	14	LiInI ₄	541041	14	NdAg(PO ₃) ₄	541875	14	K ₃ SnSe ₃	541897	14	Rb ₂ Cd(PSe ₃) ₂
54	554263	14	Ca ₂ BClO ₃	554343	14	K ₂ CuSbS ₃	554351	14	SrHg ₂ (ClO) ₂	554420	14	Y ₂ SiO ₅
55	555022	14	LuSeO ₃ F	555414	14	Ba ₃ Sb ₄ O	556156	14	LiUBO ₅	556169	14	YSeO ₃ F
56	556695	14	NaSrBO ₃	556999	14	ErSeO ₃ F	557012	14	Li ₃ Sc(BO ₃) ₂	557457	14	TmSeO ₃ F
57	557540	14	Rb ₂ AgSbS ₄	558039	14	Sr ₂ HoSbO ₆	558241	14	TaTl ₂ AgS ₄	558415	14	K ₃ CuP ₂ S ₇
58	558538	14	HoSeO ₃ F	558724	14	La ₂ SiS ₅	560623	14	Mg ₃ (PO ₄) ₂	560645	14	Ca ₂ NbInO ₆
59	560921	14	NaAlAs ₂ O ₇	561072	14	Sr ₂ DySbO ₆	561130	14	Na ₃ GaS ₃	561190	14	NaAu(SO ₄) ₂
60	561511	14	FeAsS	561639	14	CsSbS ₂	567967	14	LiGaI ₄	568044	14	KSm ₂ Cl ₅
61	568543	14	Na ₂ SnSe ₃	568855	14	K ₂ Hg(PSe ₃) ₂	568986	14	KAuCl ₄	569129	14	TiCuPSe ₃
62	570186	14	Ga ₂ Te ₂ Br ₇	570505	14	Ca ₃ (AlN ₂) ₂	571293	14	Rb ₂ BaNb ₂ Se ₁₁	572442	14	Cs ₃ Nd(PS ₄) ₂
63	572833	14	Cs ₃ Sm(PS ₄) ₂	573145	14	CsGa ₃ S ₅	574040	14	K ₂ SnBr ₆	574138	14	Cs ₂ Te ₃ As
64	578629	14	BaIn ₂ O ₄	581864	14	CsAsSe ₂	582708	14	Cs ₃ GeAsSe ₅	582813	14	K ₁₀ In ₅ Sb ₉
65	622086	14	La ₂ GeS ₅	624190	14	GePbS ₃	625873	14	Ba(HO ₂) ₂	630528	14	InS
66	636675	14	Ga ₂ I ₃	642817	14	KHO	643392	14	Ca(HO) ₂	643460	14	SnHg ₂ (SBr) ₂
67	653561	14	Tl ₂ GePbS ₄	698205	14	LiB(HO ₂) ₂	752405	14	Dy ₂ SiO ₅	753257	14	LiCuF ₄
68	753662	14	K ₂ Mg ₂ O ₃	753822	14	La ₂ Se ₂ O	755362	14	Sm ₂ Se ₂ O	755530	14	Na ₃ CuO ₂
69	755980	14	SrCaI ₄	756202	14	Ba ₂ SrI ₆	756725	14	Ba ₂ CaI ₆	757407	14	Sr ₂ Tl ₂ O ₅
70	759686	14	BeAlSiHO ₅	766217	14	Sr ₄ Cu ₂ O ₇	768735	14	Ba ₂ SrI ₆	769287	14	Li ₂ TiS ₂ O
71	769481	14	Y ₄ Ga ₂ O ₉	770408	14	Rb ₆ Ti ₂ O ₇	849527	14	Rb ₃ InO ₃	866615	14	CsAg ₂ AsS ₃
72	866651	14	KSiBiS ₄	866688	14	Cs ₄ P ₂ PdSe ₈	972112	14	Sr ₂ MgUO ₆	972216	14	Sr ₂ SmSbO ₆
73	989614	14	LaReN ₃	486	15	NiP ₂	684	15	BaS ₂	1705	15	Sb ₂ O ₅
74	1819	15	SbO ₂	2402	15	NaSi	3054	15	Li ₂ CO ₃	3615	15	Nd(BO ₂) ₃
75	3707	15	CaGe ₂ O ₅	4321	15	MgSiO ₃	4351	15	K ₂ B ₂ S ₇	4426	15	Li ₄ SeO ₅
76	4907	15	Na ₆ Sn ₂ S ₇	5004	15	Na ₂ B ₂ Se ₇	5414	15	NaSbS ₂	5418	15	Li ₆ Zr ₂ O ₇
77	5477	15	Na ₅ NbO ₅	5586	15	NaErO ₂	6240	15	LiIn(SiO ₃) ₂	6333	15	NaIn(SiO ₃) ₂
78	6340	15	LiAl(SiO ₃) ₂	6440	15	CaTiSiO ₅	6526	15	NaGeSbO ₅	6678	15	KHgSbS ₃
79	6693	15	CaZn(SiO ₃) ₂	6766	15	CaMg(SiO ₃) ₂	6822	15	NaGa(SiO ₃) ₂	6873	15	CaAlSiO ₄ F
80	7035	15	CaMgAsO ₄ F	7074	15	NaSc(SiO ₃) ₂	7499	15	Tl ₂ Sn ₂ S ₅	7547	15	BaSe ₂
81	7593	15	RbLiF ₂	7594	15	CsLiF ₂	8230	15	Zn(PO ₃) ₂	8678	15	NaAlPO ₄ F
82	8709	15	KIn(GeO ₃) ₂	8957	15	Na ₅ TaO ₅	8965	15	K ₂ Sn ₂ S ₅	8989	15	Na ₂ P ₂ PdO ₇
83	9322	15	Rb ₂ Sn ₂ Se ₅	9664	15	K ₃ BP ₂	9665	15	K ₃ BAS ₂	9675	15	Cs ₃ BP ₂
84	9718	15	Rb ₃ BA ₂	9720	15	Rb ₃ BP ₂	9750	15	SbPO ₅	9751	15	Al ₂ Ge ₂ O ₇
85	9843	15	Sr ₃ (AlP ₂) ₂	11183	15	Pr(BO ₂) ₃	11677	15	Sr ₃ (SiAs ₂) ₂	11709	15	Sm(BO ₂) ₃
86	14395	15	NaAlAsO ₄ F	16183	15	Tl ₂ B ₂ Se ₇	16184	15	Rb ₂ B ₂ Se ₇	16961	15	Na ₆ Si ₂ Se ₇
87	17012	15	Sr ₂ VN ₃	17024	15	Ba ₂ NbN ₃	17400	15	Ba ₂ TaN ₃	17464	15	SrGeO ₃
88	17911	15	Ba ₂ ZnO ₃	18100	15	Na ₆ Ge ₂ Se ₇	20210	15	Ag ₂ PbO ₂	23018	15	BiSbO ₄
89	23395	15	Hg ₂ ClO	23421	15	Yb ₂ LiCl ₅	23720	15	BeAlH ₅	23966	15	MgH ₂ SeO ₅
90	23969	15	ZnH ₂ SeO ₅	27148	15	BeP ₂	27331	15	K ₃ GeTe ₃	27482	15	Ag ₄ P ₂ S ₇
91	27577	15	Cd ₂ As ₃ I	28158	15	K ₄ Be ₃ O ₅	28266	15	P ₂ Pd	28368	15	TlAuCl ₄
92	28371	15	K ₂ Zn ₃ O ₄	28766	15	K ₂ TiS ₃	28875	15	Hg ₂ P ₃ Cl	28899	15	Hg ₂ As ₃ Br
93	28900	15	Cd ₂ As ₃ Br	29244	15	Cd ₂ P ₃ I	29245	15	Cd ₂ P ₃ Br	29396	15	Cu ₂ PbO ₂
94	29598	15	NaP ₄ N ₇	29711	15	Tl ₂ Te ₃	29880	15	Sm ₂ SCl ₄	29976	15	Na ₃ BS ₃
95	30292	15	Nd ₄ Se ₃ N ₂	30980	15	NaYO ₂	31033	15	HfF ₄	31303	15	Pr ₄ Se ₃ N ₂
96	541638	15	K ₂ (ReS ₂) ₃	541735	15	K ₄ Ti ₃ S ₁₄	542637	15	K ₂ B ₂ Se ₇	553884	15	Ba ₅ Si(Br ₃ O ₂) ₂
97	555082	15	CsLi ₅ (BO ₃) ₂	555087	15	Ba ₅ Si(Cl ₃ O ₂) ₂	555527	15	Sm ₃ Si ₂ S ₈ Br	555852	15	Rb ₂ Ag ₂ GeS ₄
98	556185	15	RbNaTiO ₃	556679	15	Na ₂ Ca ₃ Si ₃ O ₁₀	557104	15	LiAlB ₂ O ₅	557183	15	KNaZnO ₂
99	558455	15	Na ₄ Li ₅ (BO ₃) ₃	558629	15	Ba ₂ ZnSi ₂ O ₇	559710	15	NaInAs ₂ O ₇	559767	15	LiAsO ₃
100	560119	15	TbCl ₂ F	560356	15	Sm ₃ Si ₂ S ₈ I	560490	15	La ₂ C ₂ N ₄ O	560493	15	Ba ₂ V(CuS ₂) ₃

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
101	560767	15	KNaTiO ₃	560853	15	Tb ₃ Si ₂ S ₈ I	561126	15	Nd ₃ Si ₂ S ₈ I	561203	15	F ₂
102	561467	15	YAg ₃ (PS ₄) ₂	561536	15	NaMgBO ₃	561620	15	Ag ₃ AsS ₃	567424	15	K ₈ NbAs ₅ Pb
103	568036	15	La ₂ GaN ₃	568484	15	La ₃ CBr ₅	569059	15	HfI ₄	569442	15	RbAuCl ₄
104	570258	15	Ca ₃ (AlN ₂) ₂	570340	15	AgAuCl ₄	570423	15	Ba ₆ Pr ₃ I ₁₉	570536	15	Rb ₂ AgAu ₃ I ₈
105	571162	15	Ca ₃ (GaN ₂) ₂	571333	15	Ca ₅ (SiN ₃) ₂	571490	15	Pr ₃ CCl ₅	573677	15	Ba ₂ Li ₃ TaN ₄
106	582161	15	K ₃ Ta ₂ Ag ₃ Se ₈	607806	15	Ho ₃ Se ₃ N	616190	15	Tl ₂ (ReSe ₂) ₃	644431	15	Cd ₂ P ₃ Cl
107	675562	15	K ₂ ThF ₆	684690	15	Sc ₂ Se ₃	697977	15	Sr ₂ AlH ₇	698114	15	Ba ₂ AlH ₇
108	752672	15	NaDyO ₂	752675	15	BaYF ₅	753309	15	Bi ₂ OF ₄	753443	15	NaBeO ₂
109	754250	15	NaLuO ₂	754667	15	BaSr ₂ I ₆	754796	15	NaTmO ₂	755043	15	Al ₂ Si ₂ O ₇
110	755617	15	NaHoO ₂	756400	15	NdBIO ₄	768383	15	SmBiO ₄	768388	15	Lu ₂ GeO ₅
111	769971	15	BaGa ₄ O ₇	770799	15	Li ₅ NbO ₅	772055	15	Li ₆ Ti ₂ O ₇	772185	15	Li ₆ Hf ₂ O ₇
112	776074	15	CaGeO ₃	779511	15	Ba ₂ MgO ₃	864766	15	NaMgSO ₄ F	977298	15	LiBeH ₃
113	985608	15	Nd ₂ O ₅	990440	15	Na ₂ ZrO ₃	540877	18	La ₃ InS ₆	648932	18	Nb ₂ PS ₁₀
114	12843	19	YCuS ₂	16911	19	Rb ₂ S ₅	17095	19	CsCuSe ₄	17691	19	Cu ₃ SbS ₃
115	18003	19	CsCuS ₄	18105	19	CsAgSe ₄	18365	19	RbCuSe ₄	23380	19	Tl ₃ PbI ₅
116	24402	19	CaAlSiHO ₅	27931	19	Rb ₂ SnO ₂	28195	19	SiAg ₂ O ₃	29705	19	Rb ₆ Sn ₂ S ₇
117	29820	19	Ca ₃ (AlN ₂) ₂	32684	19	HBr	541281	19	BaNdGaO ₄	554120	19	DyCuS ₂
118	554359	19	Cs ₂ Si ₃ SnO ₉	556771	19	Nd ₂ Si ₂ O ₇	559224	19	Sr ₃ Al ₂ Cl ₂ O ₅	559826	19	ErCuS ₂
119	560611	19	HoCuS ₂	561635	19	CsSmSiS ₄	568450	19	SrAlH ₅	583071	19	CaAlH ₅
120	620372	19	Rb ₂ Se ₅	654956	19	CaAlH ₅	697146	19	Zn(HO) ₂	752526	19	Lu ₂ TeO ₆
121	768313	19	Dy ₂ TeO ₆	768762	19	Ho ₂ TeO ₆	772900	19	Sm ₂ TeO ₆	774557	19	Er ₂ TeO ₆
122	780172	19	Tm ₂ TeO ₆	781712	19	Na ₂ SnO ₂	983589	19	Ag ₂ GeO ₃	985293	19	Al(HO) ₃
123	555203	20	Sr ₅ B ₃ ClO ₉	555318	20	K ₂ Zn(SiO ₃) ₂	560398	20	K ₂ Zn(GeO ₃) ₂	568328	20	FeP ₄
124	756591	20	Sm ₃ NbO ₇	23904	26	BaH ₄ O ₃	28007	26	BaHgS ₂	28420	26	SrH ₄ O ₃
125	983327	26	KH ₄ O ₂ F	989407	26	YWN ₃	4627	29	CoAsS	6955	29	KGeNO
126	9270	29	SbIrS	15148	29	K ₄ Nb ₂ S ₁₁	20817	29	GePtSe	28134	29	Ba ₂ As ₂ S ₅
127	554856	29	Na ₂ Si ₂ O ₅	3934	31	Cu ₃ PS ₄	6356	31	Cd ₂ GaAgS ₄	6449	31	CdSi(CuS ₂) ₂
128	7688	31	Li ₂ CdGeO ₄	8258	31	BaAl ₄ S ₇	9066	31	NaLi ₂ AsO ₄	9197	31	Li ₃ AsO ₄
129	9711	31	Ba ₂ Si ₅ N ₈	12023	31	MnSi(CuS ₂) ₂	13725	31	Li ₃ PO ₄	13872	31	Si(Cu ₄ S ₃) ₂
130	510346	31	In ₅ Se ₅ Br	554105	31	CdAg ₂ GeS ₄	755642	31	Li ₃ VS ₄	756044	31	Na ₃ AsO ₄
131	756316	31	Li ₃ SbS ₄	977414	31	ZnSi(CuS ₂) ₂	555880	32	ZnBi ₂ B ₂ O ₇	230	33	SbO ₂
132	402	33	CdP ₂	2979	33	ZnGeN ₂	3338	33	NaGaO ₂	3647	33	LiGaS ₂
133	3660	33	LiB ₃ O ₅	3677	33	MgSiN ₂	5854	33	LiGaO ₂	7117	33	LiAlSe ₂
134	7798	33	MgGeN ₂	7913	33	BeSiN ₂	8341	33	NaGeSbO ₅	9212	33	NaAlO ₂
135	11582	33	LiGaSe ₂	14383	33	KGePO ₅	15108	33	RbSnAsO ₅	16996	33	Li ₃ GaSiO ₅
136	17885	33	Ba ₂ Ge ₂ Te ₅	17964	33	Na ₂ Ge ₂ Se ₅	20310	33	LiInSe ₂	21459	33	InAgS ₂
137	24473	33	BePH ₄ NO ₄	24603	33	CaAl ₂ Si ₂ (H ₂ O ₅) ₂	28471	33	Li ₃ AsS ₃	541459	33	KSnPO ₅
138	554383	33	Na ₂ Si ₂ O ₅	555076	33	KNaSnF ₆	556892	33	InBiO ₃	557311	33	Sr ₂ GeO ₄
139	557803	33	MgSiO ₃	558085	33	KNaGeO ₃	558807	33	ZnAgPS ₄	559934	33	LiZnPO ₄
140	568759	33	NaNd ₄ I ₇ N ₂	569580	33	NaLa ₄ I ₇ N ₂	570548	33	NaPr ₄ I ₇ N ₂	644097	33	BaAlH ₅
141	753520	33	Li ₃ BiS ₃	771248	33	Na ₂ Ge ₂ O ₅	772788	33	Ba ₂ Cu ₂ O ₅	862754	33	PrBS ₃
142	867286	33	TbBS ₃	972448	33	SmBS ₃	555742	34	Ba ₂ B ₅ ClO ₉	717	36	B ₂ O ₃
143	2798	36	SiP	3281	36	Al ₅ BO ₉	3933	36	Mg ₂ PN ₃	4187	36	Ge ₂ N ₂ O
144	4497	36	Si ₂ N ₂ O	4533	36	Na ₂ SiO ₃	5012	36	Li ₂ SiO ₃	5784	36	Na ₂ GeO ₃
145	5853	36	LiSi ₂ N ₃	7290	36	Er ₃ GaS ₆	8973	36	NaSi ₂ N ₃	9248	36	SiCu ₂ S ₃
146	10223	36	Na ₂ PdS ₂	14433	36	NaGe ₂ N ₃	15349	36	Li ₂ GeO ₃	21489	36	Rb ₂ PbO ₃
147	21521	36	Cs ₂ PbO ₃	28035	36	BaP ₁₀	558907	36	CsCu(BiS ₂) ₂	625054	36	AlHO ₂
148	625056	36	AlHO ₂	625136	36	CsHO	625150	36	ScHO ₂	626620	36	RbHO
149	626785	36	KHO	626902	36	AlHO ₂	632229	36	HBr	643009	36	SrMgH ₄
150	753798	36	Rb ₂ SnO ₃	754401	36	Al ₂ O ₃	754979	36	Y ₃ AlO ₆	756156	36	Rb ₂ ZrO ₃

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
151	768573	36	Lu ₃ AlO ₆	864638	36	Ba ₂ InBiS ₅	865143	36	YbBaCdSb ₂	867203	36	Sr ₂ CdAs ₂
152	756294	37	Li ₂ Ti ₂ O ₅	6013	40	KTa(CuSe ₂) ₂	6376	40	KV(CuS ₂) ₂	6599	40	KNb(CuSe ₂) ₂
153	11925	40	RbTa(CuSe ₂) ₂	16179	40	SrCu ₂ GeSe ₄	20496	40	Ga ₂ PbO ₄	30293	40	Sr ₂ GeSe ₄
154	30294	40	Sr ₂ SnS ₄	555954	40	BaSnHgS ₄	753153	40	Dy ₂ CO ₅	17792	41	K ₂ Hg ₃ (GeS ₄) ₂
155	685150	41	PbF ₂	14288	43	Sr ₃ P ₄	14289	43	Ba ₃ P ₄	15339	43	Sr ₃ As ₄
156	27253	43	Au ₂ O ₃	675531	43	NaBiS ₂	569811	45	Yb ₁₁ GaSb ₉	570504	45	Yb ₁₁ InSb ₉
157	622930	45	Ba ₄ In ₆ O ₁₃	10444	46	Ca ₂ Al ₂ O ₅	20546	46	Ba ₂ In ₂ O ₅	699136	46	NaAlH ₂ CO ₅
158	9008	51	RbTeAu	30107	51	RbNb ₄ Cl ₁₁	573755	51	CsTeAu	582146	51	CsNb ₄ Cl ₁₁
159	4995	52	LiSbO ₃	16945	52	Sr ₃ (Ga ₂ N ₂) ₂	18109	52	RbDy(SO ₄) ₂	18297	52	Ba ₃ (Ga ₂ N ₂) ₂
160	23373	52	BaZnCl ₄	27352	52	Sr(Ag ₃ O ₂) ₂	27522	52	K ₂ Zr ₂ O ₅	28384	52	GaBr ₂
161	29249	52	GeAsSe	29312	52	InI ₂	567398	52	Sr ₃ MgGeN ₄	567524	52	K ₃ Ga ₃ As ₄
162	754658	52	TeO ₃	28741	53	CuSe ₃ Br	569052	53	AgSe ₃ I	570431	53	AgTe ₃ I
163	558536	54	RbCdAuS ₂	4279	55	CaGe ₂ O ₅	4425	55	Ta ₂ Pt ₃ Se ₈	4747	55	Ca ₂ SnO ₄
164	8360	55	RbTe	20944	55	Sr ₂ PbO ₄	23426	55	Al ₄ Bi ₂ O ₉	27295	55	Mg ₁₄ Ge ₅ O ₂₄
165	28663	55	Mg ₁₄ Si ₅ O ₂₄	28823	55	Ba ₄ P ₃	29424	55	Sr ₄ As ₃	29920	55	Rb ₅ Au ₃ O ₂
166	554191	55	Na ₂ UO ₄	556872	55	RbCO ₂	558188	55	AgHg ₂ AsO ₄	558332	55	K ₅ Au(IO) ₂
167	560046	55	Ta ₂ Pt ₃ S ₈	560591	55	NaTi ₂ Al ₅ O ₁₂	560616	55	KCO ₂	570983	55	Sr ₄ Sn ₂ Se ₉
168	752413	55	Ca ₂ HfO ₄	755597	55	Ca ₂ CeO ₄	755950	55	Ba ₂ Sc ₂ O ₅	978553	55	SiAs ₂
169	8056	56	Ca(BO ₂) ₂	669528	56	Na ₂ UO ₄	5611	57	BaUO ₄	6055	57	Sm ₂ SiTeO ₄
170	17633	57	Er ₂ SiSeO ₄	17750	57	Pr ₂ SiTeO ₄	17834	57	La ₂ SiSeO ₄	17913	57	Tb ₂ SiSeO ₄
171	18099	57	BaSbF ₅	18219	57	Dy ₂ SiSeO ₄	18466	57	Nd ₂ SiSeO ₄	18542	57	Nd ₂ SiTeO ₄
172	18584	57	Ho ₂ SiSeO ₄	18610	57	Sm ₂ SiSeO ₄	28853	57	LaAuO ₃	29594	57	La ₅ B ₄ N ₉
173	31304	57	Zr(TeCl) ₆	31305	57	Hf(TeCl) ₆	557384	57	MgUB ₂ O ₇	570817	57	Cu ₂ P ₈ Se ₃ I ₂
174	628647	57	TiHg ₃ As ₂ Cl ₃	768342	57	SrNb ₂ O ₄	766	58	As ₂ Ru	1285	58	PtO ₂
175	1413	58	P ₂ Ru	1522	58	FeS ₂	2319	58	P ₂ Os	2455	58	As ₂ Os
176	3361	58	Ba ₃ Al ₂ F ₁₂	4753	58	Al ₂ SiO ₅	5005	58	Mg ₃ (BO ₃) ₂	5560	58	Cd ₃ (BO ₃) ₂
177	6105	58	Pr ₂ Ta ₃ (SeO ₄) ₂	19795	58	InS	20027	58	FeP ₂	21562	58	Sm ₃ InSe ₆
178	21575	58	Pr ₃ InSe ₆	21604	58	Sm ₃ InS ₆	22882	58	YbBr ₂	22888	58	CaBr ₂
179	23214	58	CaCl ₂	27449	58	GaTeCl	28584	58	Tl ₂ CuI ₃	29924	58	Nb ₃ Cl ₅ O ₂
180	504851	58	Rb ₂ Na ₃ InO ₄	531265	58	Ca ₃ (BN ₂) ₂	540945	58	Na ₂ Li ₃ GaO ₄	541568	58	Sr ₂ Li ₃ NbN ₄
181	541569	58	Sr ₂ Li ₃ TaN ₄	550172	58	SnO ₂	555018	58	RbNa ₂ AuO ₂	555495	58	K ₃ Y(BO ₃) ₂
182	557467	58	Li ₄ Ca(BO ₃) ₂	559067	58	KNa ₂ AuO ₂	695890	58	Mg ₁₀ Si ₃ (H ₂ O ₉) ₂	755072	58	Na ₂ O
183	3838	59	Li ₅ ReN ₄	7535	59	Li ₅ AlO ₄	8263	59	KNa ₂ BO ₃	8840	59	Na ₅ InO ₄
184	8872	59	RbNa ₂ BO ₃	17112	59	K ₃ Ge ₄ Au	17830	59	Rb ₃ Ge ₄ Au	18500	59	K ₃ Sn ₄ Au
185	27702	59	InClO	27703	59	InBrO	27850	59	TiNCl	28458	59	ErSeI
186	28994	59	KLi ₂ As	29898	59	Tl ₂ Au ₄ S ₃	510341	59	Cs ₃ Ge ₄ Au	571020	59	CsMgH ₃
187	754113	59	TmClO	755689	59	ErClO	473	60	Na ₃ P ₁₁	1568	60	K ₃ P ₁₁
188	1666	60	Th ₂ S ₅	1716	60	Rh ₂ O ₃	3123	60	PPdSe	3417	60	Ca(BO ₂) ₂
189	3552	60	Li ₂ Si ₂ O ₅	5026	60	MgSiO ₃	7280	60	PPdS	8898	60	TaAlO ₄
190	8985	60	Ba ₂ YC ₂ (O ₂ F) ₃	11165	60	Na ₂ MgPO ₄ F	12221	60	CaTeO ₄	16771	60	MgSe ₂ O ₅
191	18373	60	ZnSe ₂ O ₅	23711	60	MgH ₂	27537	60	Na ₂ TeO ₄	27742	60	K ₂ CdO ₂
192	28353	60	NaTe	28364	60	Rb ₂ CdO ₂	28856	60	Na ₇ Au ₅ S ₆	28874	60	Hg ₂ P ₃ Br
193	28970	60	Nd ₂ NCl ₃	29001	60	NaLuCl ₄	29107	60	Rb ₂ Hg ₃ Te ₄	29432	60	NaScCl ₄
194	554264	60	Tb ₂ Ba ₃ (PS ₄) ₄	556814	60	LiNdGeO ₄	559171	60	Ba ₃ Ho ₂ (PS ₄) ₄	559434	60	Tb(BO ₂) ₃
195	560534	60	Ba ₃ Er ₂ (PS ₄) ₄	560798	60	Ba ₃ Dy ₂ (PS ₄) ₄	568436	60	Sr ₇ GeN ₆	569051	60	MgH ₂
196	570555	60	Ca ₇ GeN ₆	753737	60	Li ₃ CuS ₂	754885	60	SrCaI ₄	755802	60	K ₂ MgO ₂
197	766467	60	LiCuS	769301	60	Ca ₄ Ta ₂ O ₉	776097	60	HfO ₂	866314	60	Ca ₅ Al ₂ (SiN ₄) ₂
198	4575	61	MgGeO ₃	4657	61	Li ₅ GaO ₄	7214	61	Sr ₃ CrN ₄	7652	61	Na ₅ TiO ₄
199	8863	61	Ba ₃ MoN ₄	10368	61	CoPSe	14493	61	Na ₅ InO ₄	14680	61	Sr ₂ Ga ₂ S ₅
200	14988	61	K ₄ SnO ₃	16167	61	Na ₂ Sn ₂ Se ₅	21801	61	Rb ₄ PbO ₃	21949	61	K ₄ PbO ₃

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
201	22841	61	Ba ₂ In ₂ S ₅	23734	61	MgP(HO) ₇	23883	61	Be ₂ BHO ₄	29102	61	Hg ₃ TeCl ₄
202	29197	61	La ₃ Br ₆ N	29377	61	K ₅ GaSe ₄	29460	61	Tl ₃ PdCl ₅	31287	61	Tl ₃ PdBr ₅
203	31356	61	Sr ₃ MoN ₄	505121	61	Na ₂ Hg ₃ S ₄	510128	61	U(HO ₂) ₂	541431	61	Ca ₂ SiH ₂ O ₅
204	542678	61	AlAs(H ₂ O ₃) ₂	557672	61	Ga ₂ Pb ₂ S ₅	559356	61	Tl ₃ AsS ₃	559384	61	BaNaNdSi ₂ O ₇
205	559711	61	Rb ₂ Na ₂ SiO ₄	567437	61	Pd(Se ₄ Cl) ₂	568545	61	Cd ₄ P ₂ I ₃	570061	61	Nd ₃ NCl ₆
206	570645	61	Ca ₂ Si ₅ N ₈	573635	61	Ba ₂ In ₂ Se ₅	581639	61	Mg ₂ BN ₂ Cl	629430	61	SrLi ₂ CrN ₃
207	654129	61	GaAg(PSe ₃) ₂	667286	61	Re ₆ Te ₇ Se ₈	667369	61	Ca ₂ Zr ₅ Ti ₂ O ₁₆	735022	61	SrPHO ₄
208	769176	61	K ₅ YO ₄	769368	61	Rb ₄ SnO ₃	774753	61	Li ₅ GaO ₄	775757	61	HfO ₂
209	776404	61	ZrO ₂	776890	61	Rb ₂ O	778877	61	Li ₅ InO ₄	780258	61	Na ₅ LaO ₄
210	979340	61	Sr ₂ LiTaN ₃ F	277	62	Zr ₃ N ₄	438	62	Nd ₂ S ₃	691	62	SnSe
211	1146	62	ThS ₂	1244	62	SrGe ₂	1270	62	Dy ₂ S ₃	1403	62	Sm ₂ S ₃
212	1477	62	BaSi ₂	1508	62	LaS ₂	2139	62	BaGe ₂	2231	62	SnS
213	2416	62	YF ₃	2511	62	PbF ₂	2632	62	TlF ₃	2833	62	IrS ₂
214	2878	62	Li ₃ PO ₄	2879	62	SrSnO ₃	2895	62	Mg ₂ SiO ₄	3009	62	Rb ₂ BeF ₄
215	3051	62	Mg ₂ GeO ₄	3075	62	TlGeS ₂	3081	62	BeAl ₂ O ₄	3102	62	TaCuS ₃
216	3164	62	BaSO ₄	3196	62	NdGaO ₃	3317	62	SmRhO ₃	3318	62	Na ₂ BeF ₄
217	3372	62	Rb ₂ SO ₄	3378	62	SrHfO ₃	3792	62	YAlO ₃	3795	62	NaZnF ₃
218	3797	62	K ₃ AsS ₄	3822	62	SrCO ₃	3872	62	Mg(AlS ₂) ₂	3917	62	Cd ₂ GeO ₄
219	4019	62	CaTiO ₃	4160	62	Tl ₃ PSe ₄	4192	62	Ca ₃ AsN	4387	62	SrZrO ₃
220	4434	62	TbAlO ₃	4438	62	CaSnO ₃	4468	62	CuSbS ₂	4473	62	Ba(CuSe) ₂
221	4481	62	Ca ₂ SiO ₄	4582	62	NdRhO ₃	4789	62	PrRhO ₃	4891	62	HoAlO ₃
222	4934	62	Al ₂ SiO ₅	4967	62	MgSO ₄	5013	62	Cs ₂ BeF ₄	5014	62	CuAgS
223	5163	62	LaRhO ₃	5185	62	K ₂ BeF ₄	5587	62	Ba ₂ ZnS ₃	5614	62	Li ₃ BS ₃
224	5637	62	SrZnO ₂	5704	62	Tl ₃ AsS ₄	5838	62	Ba ₂ SiS ₄	5874	62	TlAgTe
225	5926	62	KCaF ₃	5970	62	Ba(CuS) ₂	6224	62	LiScSiO ₄	6456	62	LiNbGeO ₅
226	6493	62	CaMgSiO ₄	6684	62	NaCdPO ₄	6712	62	NaLuGeO ₄	6812	62	KBaPO ₄
227	7205	62	LiInSiO ₄	7238	62	NdBO ₃	7384	62	SmF ₃	7756	62	SrLiSb
228	7781	62	CaZrS ₃	7792	62	YScS ₃	7995	62	Mg ₂ BO ₃ F	8216	62	LaBO ₃
229	8376	62	MgAlBO ₄	8725	62	HfSnS ₃	8754	62	NaLiTe	8755	62	KNaTe
230	8850	62	Dy ₂ S ₃	8870	62	LiMgAsO ₄	8956	62	Ho ₂ S ₃	9167	62	SrCN ₂
231	9186	62	CdSeO ₃	9228	62	HgSeO ₃	9323	62	Tb ₂ S ₃	9371	62	ErF ₃
232	9475	62	KNO ₃	9607	62	Li ₂ UO ₄	9625	62	LiMgPO ₄	9628	62	KCdF ₃
233	10233	62	Ca ₂ BN ₂ F	10234	62	Sr ₂ BN ₂ F	10533	62	YCuS ₂	11347	62	TbF ₃
234	11623	62	LaInO ₃	12271	62	MgSeO ₃	12418	62	SrCaGe	12453	62	HoCuS ₂
235	12454	62	ErCuS ₂	12455	62	TmCuS ₂	12457	62	LuCuS ₂	13374	62	LaTmO ₃
236	16264	62	LiCaSb	16818	62	Rb ₂ Cd ₃ Se ₄	16848	62	Tl ₃ PS ₄	16863	62	Rb ₃ PS ₄
237	16870	62	Ba ₂ CdSe ₃	16905	62	Ba ₂ MnTe ₃	16927	62	TbNaGeO ₄	17043	62	Tm ₂ ZnS ₄
238	17077	62	K ₂ YF ₅	17088	62	KBaPS ₄	17090	62	SrTlPS ₄	17154	62	Rb ₃ SbS ₄
239	17186	62	Ca ₃ AlAs ₃	17283	62	K ₃ NbSe ₄	17361	62	Cs ₂ WS ₄	17394	62	NaYGeO ₄
240	17404	62	Y ₂ Si ₂ O ₇	17441	62	Mg ₂ GeS ₄	17487	62	NaErGeO ₄	17612	62	Ba ₂ SiO ₄
241	17638	62	Rb ₃ SbSe ₄	17697	62	KSmF ₄	17715	62	SrTa ₂ O ₆	17730	62	K ₂ SnO ₃
242	17769	62	YSO ₄ F	17785	62	KNa ₂ GaO ₃	17832	62	RbBaPO ₄	17854	62	LiInGeO ₄
243	17891	62	NaYSiO ₄	17908	62	Ba ₂ TiS ₄	17978	62	Rb ₅ GeP ₃	17980	62	K ₂ MoS ₄
244	17989	62	K ₃ PS ₄	17998	62	Ca(RhO ₂) ₂	18008	62	Ba ₂ HgS ₃	18040	62	KPrF ₄
245	18101	62	K ₂ Cd ₃ S ₄	18132	62	K ₄ SnSe ₄	18138	62	K ₂ WSe ₄	18177	62	Ba ₃ NbAs ₃ O
246	18199	62	Sr ₃ TaAs ₃ O	18305	62	Rb ₃ AsSe ₄	18309	62	Ba ₂ CdS ₃	18332	62	Lu ₂ ZnS ₄
247	18334	62	NaHoGeO ₄	18335	62	Ba ₂ Ge ₂ Se ₅	18445	62	Ba ₂ MnS ₃	18531	62	K ₂ Cd ₃ Te ₄
248	18556	62	Rb ₂ Cd ₃ S ₄	18612	62	Rb ₂ MoS ₄	18629	62	NaTmGeO ₄	18662	62	Ho ₂ Si ₂ O ₇
249	20489	62	SrPbO ₃	21390	62	La ₂ InCuSe ₅	21461	62	Rb ₂ PbO ₃	21872	62	PrLuO ₃
250	22147	62	HfPbS ₃	22569	62	InPO ₄	22996	62	SbSeI	23041	62	SbSI

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
251	23390	62	RbCdCl ₃	23442	62	KCdCl ₃	23481	62	Cs ₃ Cu ₂ I ₅	23497	62	Li ₂ ZnI ₄
252	23632	62	Ca ₂ BN ₂ Cl	23713	62	CaH ₂	23714	62	SrH ₂	23715	62	BaH ₂
253	23730	62	NaMgH ₃	23740	62	Mg ₂ PHO ₅	24266	62	Ca ₂ BHN ₂	24747	62	Na ₃ H ₆ Rh
254	27199	62	AuSeBr	27252	62	TlCdI ₃	27400	62	RbCdBr ₃	27499	62	BaTeS ₃
255	27805	62	Ba ₃ SiS ₅	28049	62	BaBrCl	28127	62	Na ₂ S ₅	28218	62	TlCdCl ₃
256	28219	62	TlCdBr ₃	28270	62	KCuS	28316	62	K ₃ LiSi ₄	28392	62	Sr ₅ (AlSb ₃) ₂
257	28603	62	NaLiSe	28695	62	KSiH ₃	28760	62	KRbS	28829	62	Li ₂ ZnBr ₄
258	28830	62	Na ₂ ZnBr ₄	28877	62	Cs ₂ SnTe ₄	29238	62	TlAgSe	29288	62	TlGeI ₃
259	29344	62	LiGaCl ₃	29371	62	Rb ₂ GaSb ₂	29380	62	K ₂ Te ₂ As	29395	62	NaAlI ₄
260	29411	62	Na ₂ B ₂ S ₅	29454	62	Na ₃ TiO ₂	29483	62	MgInBr ₃	29693	62	Rb ₂ AgCl ₃
261	29883	62	Rb ₃ PbCl ₅	30077	62	K ₂ GaSb ₂	30133	62	Ba(CuTe) ₂	30209	62	LiBH ₄
262	30456	62	SrLiBi	30528	62	MnTiCl ₃	31086	62	NaP ₅	31117	62	NdScO ₃
263	31118	62	SmScO ₃	31119	62	TbScO ₃	31120	62	DyScO ₃	31121	62	HoScO ₃
264	31275	62	Ba(TeP ₂) ₂	31313	62	K ₃ PSe ₄	31468	62	LiCaN	504935	62	K ₂ PbO ₃
265	505001	62	Rb ₃ ZnBr ₅	505089	62	TbLi ₄ F ₈	540703	62	Cs ₂ S	540839	62	CsPbI ₃
266	540881	62	Cs ₂ AgI ₃	541694	62	K ₂ Na ₃ SiP ₃	555273	62	Ca ₃ Ge(ClO ₂) ₂	555585	62	BaF ₂
267	555904	62	NaSmGeO ₄	556125	62	Na ₂ BHO ₃	556347	62	K ₂ ReCl ₅ O	556393	62	RbBe ₄ (BO ₃) ₃
268	556855	62	Ba ₃ Bi(ClO) ₃	557293	62	Li ₂ CdSiO ₄	557798	62	K ₅ Li ₂ NdF ₁₀	557807	62	CsK ₂ AuO ₂
269	558160	62	NaYCO ₃ F ₂	558458	62	Mg ₃ Si(O ₂ F) ₂	558642	62	Sr ₃ Bi(ClO) ₃	558760	62	SrZrS ₃
270	558938	62	Zn ₄ SiTePbO ₁₀	559186	62	BaBiBO ₄	559756	62	PrScO ₃	560670	62	MgSeO ₄
271	560818	62	Sr ₅ B ₃ O ₉ F	561877	62	HoF ₃	567391	62	Dy ₃ Se ₃ N	567714	62	Rb ₂ AgBr ₃
272	568284	62	SrI ₂	569427	62	K ₄ Sn(TeSe) ₂	569531	62	Rb ₂ CuBr ₃	569754	62	Ba ₇ Sn ₃ Se ₁₃
273	569764	62	RbCu ₂ I ₃	569952	62	K ₂ CuCl ₃	569967	62	K ₂ PrCl ₅	570566	62	Rb ₅ Ta(TlAs ₂) ₂
274	570623	62	Pr ₄ Te ₃ N ₂	570646	62	Nd ₄ Te ₃ N ₂	570836	62	K ₅ Ag ₂ (AsSe ₃) ₃	571418	62	YbRbBr ₃
275	571440	62	K ₂ CuBr ₃	571473	62	K ₂ Sm ₂ As ₂ Se ₉	572291	62	K ₃ ClO	583193	62	Cs ₃ PSe ₄
276	605821	62	Nd ₃ SeBrN ₂	608106	62	P ₄ S ₃ I ₂	614491	62	Tl ₃ PSe ₄	616327	62	In ₃ Te ₃ I
277	616461	62	Na ₂ ZnCl ₄	620346	62	Ba ₃ InAs ₃	625404	62	AlHO ₂	625678	62	ScHO ₂
278	640053	62	Rb ₂ CuCl ₃	641010	62	La ₄ Te ₃ N ₂	644236	62	Cs ₂ MgH ₄	653559	62	P ₄ Se ₃ I ₂
279	675601	62	Al ₃ NO ₃	707218	62	Ba ₃ AlHO ₄	707836	62	Na ₃ H ₆ Ir	752418	62	La ₂ Se ₂ O
280	752437	62	SmInO ₃	752579	62	Tm ₂ TiO ₅	753826	62	LiCuS	754140	62	CaSeO ₃
281	754225	62	YbTiO ₃	754853	62	CaHfO ₃	755165	62	YScO ₃	755184	62	Sm ₂ Se ₂ O
282	755416	62	HoGaO ₃	755428	62	Rb ₃ ClO	755574	62	LuAlO ₃	755612	62	DyGaO ₃
283	756205	62	ScBiO ₃	756281	62	TmAlO ₃	756458	62	ErAlO ₃	768605	62	Ho ₂ TiO ₅
284	768865	62	Lu ₂ GeO ₅	770379	62	Tm ₂ GeO ₅	770936	62	Ba ₂ Sc ₂ O ₅	771031	62	Lu ₂ TiO ₅
285	772833	62	Y ₂ HfO ₅	778924	62	ZnSeO ₄	779156	62	CdSeO ₄	861504	62	PrBO ₃
286	864603	62	YbH ₂	866301	62	BaBSbS ₄	974682	62	RbGaH ₂	980666	62	Sr(DyS ₂) ₂
287	3143	63	Na ₂ SO ₄	3247	63	Cs ₂ TiS ₃	4406	63	CaSO ₄	4784	63	CaPtO ₃
288	7077	63	KAuS	7155	63	CsErZnSe ₃	7211	63	CsPrHgSe ₃	7212	63	CsSmHgSe ₃
289	7392	63	Na ₂ AgSb	7467	63	RbCuO ₂	7505	63	K ₂ P ₂ Pd	7566	63	InPO ₄
290	7572	63	MgSO ₄	7639	63	Na ₂ CuP	7642	63	K ₂ AgAs	7643	63	K ₂ AgSb
291	7773	63	Na ₂ AsAu	7774	63	Na ₂ SbAu	8147	63	K ₂ As ₂ Pd	8153	63	NaHgPO ₄
292	8411	63	Na ₂ AgAs	8446	63	K ₂ CuP	8459	63	CdSO ₄	8759	63	Cs ₂ ZrO ₃
293	9010	63	RbAuS	9672	63	K ₂ NiP ₂	9687	63	K ₂ PAu	9778	63	K ₂ AgP
294	11118	63	CsPrCdSe ₃	11121	63	TbCsCdSe ₃	11122	63	CsDyCdSe ₃	11123	63	CsYHgSe ₃
295	12487	63	CsDyCdTe ₃	12488	63	CsErCdTe ₃	12490	63	CsHoCdTe ₃	12491	63	CsLaCdTe ₃
296	12492	63	CsLuCdTe ₃	12495	63	TbCsCdTe ₃	12496	63	CsTmCdTe ₃	12497	63	CsSmCdTe ₃
297	12630	63	MgSeO ₄	13133	63	K ₂ TiO ₃	13326	63	PrLuSe ₃	13327	63	NdLuSe ₃
298	13445	63	Rb ₂ As ₂ Pt	13676	63	TIPO ₄	14969	63	BaErCuS ₃	15684	63	K ₂ CuAs
299	15685	63	Na ₂ CuAs	17344	63	RbEr ₂ Cu ₃ S ₅	17929	63	RbHo ₂ Cu ₃ S ₅	22858	63	TlI
300	22870	63	InBr	23084	63	BiPbClO ₂	23202	63	InI	27549	63	K ₂ AgBi

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
301	29216	63	Cs ₂ PtCl ₄	29410	63	Li ₂ B ₂ S ₅	30314	63	Cs ₂ PdCl ₄	31418	63	La(SbO ₃) ₃
302	551243	63	BaBiIO ₂	552806	63	BaBiClO ₂	553310	63	CsCuO ₂	554376	63	Y ₄ TiSi ₂ (O ₃ F ₂) ₃
303	556046	63	SrGa ₂ B ₂ O ₇	556405	63	LaCN ₂ F	556896	63	Ba ₄ AgAuO ₆	560303	63	BaCa ₂ C ₂ (O ₃ F) ₂
304	560791	63	CsNaTiO ₃	560870	63	BaGa ₂ B ₂ O ₇	571390	63	Cs ₂ LiCl ₃	573710	63	TbCsZnSe ₃
305	638078	63	TbCsZnTe ₃	643023	63	Mg ₂ H ₄ Ru	643718	63	BaMgH ₄	754358	63	ZnSeO ₄
306	755537	63	Y ₂ HfO ₅	761036	63	CdSeO ₄	867335	63	K ₂ SbAu	989609	63	YWN ₃
307	3777	64	BaSiN ₂	5476	64	Cs ₄ Mg ₃ F ₁₀	9703	64	K ₂ LiGaAs ₂	16691	64	SrLi ₂ Ti ₆ O ₁₄
308	17696	64	Ba ₂ VN ₃	17951	64	Cs ₄ Zn ₃ F ₁₀	18439	64	Ba ₃ AlSb ₃	24662	64	Rb ₄ Mg ₃ H ₁₀
309	28463	64	LiNb ₃ Cl ₈	28903	64	Zr ₆ FeCl ₁₄	28913	64	Ti ₆ CCl ₁₄	29357	64	Zr ₆ CCl ₁₄
310	29383	64	KGaSb ₂	29412	64	Ta ₃ Br ₇	29498	64	WBr ₂	29555	64	MoBr ₂
311	29794	64	Ba ₂ PdF ₆	29835	64	K ₂ SnTe ₃	505431	64	K ₂ LiInAs ₂	558083	64	BaLi ₂ Ti ₆ O ₁₄
312	558619	64	Li ₂ Ti ₆ PbO ₁₄	558894	64	Ba ₄ Ti ₂ PtO ₁₀	570192	64	CsZr ₆ MnI ₁₄	570823	64	Ba(BSe ₃) ₂
313	571015	64	CuP ₄ Se ₄ I	643253	64	Ba ₂ H ₆ Pt	753794	64	Hf ₂ P ₂ O ₉	769381	64	Ca ₃ Ta ₂ O ₈
314	770741	64	Mg ₃ (AsO ₄) ₂	772086	64	Ba ₄ Sn ₃ O ₁₀	973391	64	LiSiB ₆	6987	66	Sr(GaTe ₂) ₂
315	7841	66	Ba(GaSe ₂) ₂	8422	66	Sr(AlSe ₂) ₂	20397	66	Sr(InTe ₂) ₂	4971	68	K ₄ Sn ₃ Se ₈
316	676	70	CaN ₆	2131	70	SrN ₆	4770	70	Na ₂ SO ₄	8972	70	K ₂ TaCuSe ₄
317	9003	70	K ₂ NbCuSe ₄	9764	70	Rb ₂ NbAgSe ₄	9910	70	K ₂ Pd ₃ S ₄	11923	70	Rb ₂ TaCuS ₄
318	11924	70	Rb ₂ TaCuSe ₄	14339	70	K ₂ Pd ₃ Se ₄	14340	70	Rb ₂ Pd ₃ Se ₄	14635	70	Rb ₂ VAgSe ₄
319	14636	70	Rb ₂ NbAgS ₄	14637	70	Cs ₂ NbAgSe ₄	15147	70	K ₂ VCuS ₄	15217	70	Rb ₂ TaAgS ₄
320	15218	70	Cs ₂ TaAgS ₄	15221	70	Rb ₂ NbCuS ₄	15222	70	Rb ₂ NbCuSe ₄	17228	70	K ₂ Ni ₃ S ₄
321	28491	70	Cu ₂ SO ₄	31014	70	ZrP ₂ S ₇	555070	70	BaBe ₂ (BO ₃) ₂	560860	70	Na ₂ PtO ₃
322	561641	70	Cs ₂ Sn(AuS ₂) ₂	569857	70	K ₂ P ₃	623028	70	Cs ₂ NbAgS ₄	779704	70	Si(HgO ₂) ₂
323	3257	72	KAuSe ₅	3527	72	Na ₃ AgO ₂	6960	72	Rb ₂ SiAs ₂	6984	72	K ₂ SiAs ₂
324	8187	72	K ₂ ZnO ₂	8235	72	K ₂ SiP ₂	8716	72	K ₂ MnSe ₂	8930	72	K ₂ GeAs ₂
325	18006	72	Rb ₂ Cu ₂ SnS ₄	29882	72	CsPdCl ₃	551203	72	Sr ₂ I ₂ O	551835	72	Ba ₂ I ₂ O
326	570886	72	BeI ₂	754352	72	Na ₃ CuO ₂	541966	73	KAgCO ₃	23768	74	AlZnH ₄ O ₂ F ₅
327	24142	74	MgAlH ₄ O ₂ F ₅	568803	74	Mg(B ₆ C) ₂	570132	74	Mg ₈ B ₅ IN ₁₀	616572	74	Li ₂ P ₂ PdO ₇
328	644506	74	NaAlH ₂ CO ₅	655591	74	LiB ₁₃ C ₂	984766	77	Ca(BH ₄) ₂	556364	79	Ca ₂ SiCl ₂ O ₃
329	505145	80	Ag ₃ BiO ₃	3038	82	Al ₂ HgSe ₄	3167	82	Hg ₂ GeSe ₄	4730	82	Ga ₂ HgSe ₄
330	11175	82	LiZnPS ₄	34034	82	Ba ₈ P ₅ Br	8203	84	Zr(PS ₃) ₂	14249	84	Th(PS ₃) ₂
331	21964	85	TiCu ₇ S ₄	30543	85	RbAg ₇ S ₄	2371	87	Ga ₂ Te ₅	27743	87	BiF ₅
332	28698	87	Na ₄ IrO ₄	556377	87	Ba ₁₇ Dy ₁₆ Zn ₈ Pt ₄ O ₅₇	557304	87	Sr ₂ SiCl ₂ O ₃	560146	87	Ba ₁₇ Y ₁₆ Zn ₈ Pt ₄ O ₅₇
333	561249	87	Ba ₁₇ Er ₁₆ Zn ₈ Pt ₄ O ₅₇	9298	88	Sr(AuO ₂) ₂	9756	88	ThGeO ₄	13530	88	SmAsO ₄
334	28567	88	LiBiF ₄	28789	88	Na ₄ Cu ₂ S ₃	28995	88	Si(CuP ₂) ₄	570229	88	ThBr ₄
335	13843	91	Li ₂ TeO ₄	2782	92	ZnP ₂	3427	92	LiAlO ₂	7623	92	MgAs ₄
336	7812	92	GeO ₂	12112	92	CdP ₂	28320	92	Pt ₃ I ₈	554845	96	Na ₂ Zn ₂ O ₃
337	769025	96	K ₂ Mg ₂ O ₃	771976	96	Rb ₂ Be ₂ O ₃	27809	105	Ba(GeP) ₂	29136	105	Sr ₆ Cu ₃ N ₅
338	35152	107	Sr ₂ H ₅ Rh	27255	109	Ga ₂ TeS ₂	28423	109	Ga ₂ TeSe ₂	756638	109	NbRhO ₄
339	760402	109	TaRhO ₄	973793	109	Li ₈ SeN ₂	8976	111	Cu ₂ WS ₄	239	113	BaS ₃
340	7548	113	BaSe ₃	14415	113	Pr ₂ Be ₂ GeO ₇	14416	113	Sm ₂ Be ₂ GeO ₇	14420	113	Er ₂ Be ₂ GeO ₇
341	19926	113	La ₂ Be ₂ GeO ₇	20778	113	Dy ₂ Be ₂ GeO ₇	541040	113	Y ₂ Be ₂ GeO ₇	752851	113	Ca ₂ SiB ₂ O ₇
342	28768	114	Na ₄ SnSe ₄	29628	114	Na ₄ SnS ₄	569055	115	CsLi ₂ I ₃	30311	118	Zn ₃ (PS ₄) ₂
343	32880	119	CuBr	684580	119	AgI	774907	119	KLiZnS ₂	12532	121	KAg ₂ PS ₄
344	15472	121	Ba ₄ LiCu(CO ₅) ₂	22993	121	AgClO ₄	29091	121	Ti(CuS) ₄	35539	121	Zn ₂ GeSe ₄
345	38103	121	NaClO ₄	568968	121	K ₂ SnHgSe ₄	3078	122	CdSiAs ₂	3524	122	LiPN ₂
346	4666	122	CdSiP ₂	4763	122	ZnSiP ₂	4979	122	AlCuS ₂	5048	122	LiGaTe ₂
347	5238	122	GaCuS ₂	5342	122	GaAgS ₂	5782	122	AlAgS ₂	10074	122	GeSe ₂
348	10572	122	NaPN ₂	12954	122	CuBS ₂	14091	122	AlAgSe ₂	14092	122	AlAgTe ₂
349	15701	122	MgSiN ₂	20187	122	LiInSe ₂	36031	122	Ca(LaTe ₂) ₂	37263	122	Ca(NdTe ₂) ₂
350	37520	122	Ca(PrTe ₂) ₂	673682	122	YbTb ₂ S ₄	675244	122	Yb(NdS ₂) ₂	675620	122	Nd ₂ PbS ₄

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
351	971837	122	ZnCdTe ₂	983565	122	CuBSe ₂	22934	123	K ₂ PtCl ₄	22956	123	K ₂ PdCl ₄
352	27138	123	K ₂ PdBr ₄	27243	123	K ₂ PtBr ₄	29889	123	Tl ₂ PdCl ₄	29170	124	Hg(AuF ₄) ₂
353	557862	125	BaAg ₂ (HgO ₂) ₂	571164	125	Rb ₃ AgSn ₃ Se ₈	571594	125	K ₃ AgSn ₃ Se ₈	628185	125	K ₃ NaSn ₃ Se ₈
354	571085	126	Ga ₂ BiSe ₄	571623	126	Al ₂ BiSe ₄	8959	127	CsK ₂ PdF ₅	29138	127	KAuSe ₂
355	642821	127	K ₃ H ₅ Pt	643022	127	Rb ₃ H ₅ Pd	24822	128	Na ₅ Al ₃ H ₁₄	28517	128	Tl ₆ SeI ₄
356	570339	128	Tl ₄ CdI ₆	616218	128	Cd(In ₂ I ₃) ₂	3104	129	BaZrN ₂	4495	129	KLiTe
357	5339	129	CsNaTe	5962	129	NaMgAs	6138	129	Na ₂ TiSiO ₅	6228	129	Na ₂ TiGeO ₅
358	7060	129	LaZnPO	7061	129	NdZnAsO	7089	129	KMgSb	7090	129	NaMgSb
359	7100	129	LaOF	7950	129	ThSeO	8430	129	KLiS	8452	129	NaLiS
360	8658	129	CsNaSe	8751	129	RbLiS	8756	129	KLiSe	9194	129	SmCuSeO
361	9250	129	RbLiSe	9304	129	DyCuSeO	9562	129	LiBeAs	9845	129	RbCaAs
362	9915	129	LiBeP	10219	129	YOF	10322	129	BaHfN ₂	10932	129	ErSF
363	10942	129	KNaLaNbO ₅	13820	129	Cd ₃ SiO ₅	15844	129	TaPO ₅	16742	129	BaAgTeF
364	21228	129	SrCuSeF	22917	129	CuBr	22939	129	BiClO	22951	129	BaIF
365	23008	129	PbBrF	23023	129	LaBrO	23024	129	SrBrF	23025	129	LaClO
366	23046	129	SrIF	23058	129	NdClO	23068	129	NdBrO	23070	129	BaBrF
367	23364	129	CsLiCl ₂	23859	129	CaHCl	23860	129	SrHCl	23861	129	BaHCl
368	23862	129	BaHI	24204	129	CaHI	24205	129	SrHI	24422	129	CaHBr
369	24423	129	SrHBr	24424	129	BaHBr	27439	129	TmIO	27689	129	PH ₄ Br
370	27823	129	SmClO	27984	129	PrClO	27985	129	YClO	28065	129	ThNCl
371	28066	129	ThBrN	28067	129	ThIN	29254	129	PrIO	29327	129	SmBrO
372	29731	129	HoClO	30993	129	LaIO	546011	129	YZnAsO	549589	129	LaZnAsO
373	552488	129	LaCuSeO	556438	129	KNaSmNbO ₅	557483	129	YbClF	558212	129	KNaNdNbO ₅
374	558317	129	KNaPrNbO ₅	567809	129	AgI	753173	129	HoIO	753712	129	YIO
375	754217	129	SmIO	754969	129	TmBrO	755323	129	DyClO	755336	129	NdIO
376	768906	129	YBrO	773137	129	KCaBi	861607	129	KNaNdTaO ₅	861868	129	KNaLaTaO ₅
377	861944	129	KNaPrTaO ₅	861957	129	KNaSmTaO ₅	973585	129	LuIO	973981	129	LuBrO
378	975666	129	PrBrO	983603	129	ErZnAsO	29359	130	Na ₂ PdCl ₄	7129	132	Rb ₂ Ti(CuS ₂) ₂
379	10488	132	Cs ₂ Ti(AgS ₂) ₂	10489	132	Cs ₂ Ti(CuSe ₂) ₂	470	136	GeO ₂	856	136	SnO ₂
380	2657	136	TiO ₂	13986	136	Li ₂ PtF ₆	14324	136	K ₂ Na ₄ Be ₂ O ₅	23710	136	MgH ₂
381	662530	136	KNiPS ₄	698032	136	Na ₃ H ₇ Ru	755401	136	Na ₃ CuO ₂	776532	136	HfO ₂
382	2574	137	ZrO ₂	3503	137	Li ₆ WN ₄	8804	137	Li ₆ MoN ₄	559639	137	K ₄ U(PO ₅) ₂
383	582259	137	Li ₇ VN ₄	505366	138	AuBr	754761	138	Sr ₂ HfO ₄	341	139	PbF ₄
384	2706	139	SnF ₄	3359	139	Ba ₂ SnO ₄	3808	139	K ₂ UO ₄	4547	139	La ₂ TeO ₂
385	5459	139	Nd ₂ TeO ₂	7232	139	Cs ₂ HgO ₂	7470	139	RbCuO	7523	139	Th ₂ TeN ₂
386	7726	139	Rb ₂ UO ₄	7911	139	KCuO	8603	139	RbAgO	8666	139	CsAgO
387	8789	139	Ca ₄ As ₂ O	9583	139	K ₂ ZnF ₄	9799	139	Yb ₄ As ₂ O	10547	139	RbAuO
388	16032	139	Pr ₂ TeO ₂	16033	139	Sm ₂ TeO ₂	16036	139	Tb ₂ TeO ₂	24517	139	Rb ₂ CaH ₄
389	643260	139	Na ₂ H ₄ Pd	697096	139	Na ₂ H ₄ Pt	753192	139	Yb ₄ Sb ₂ O	754363	139	Ba ₂ HfO ₄
390	760417	139	Rb ₄ I ₂ O	768368	139	K ₄ I ₂ O	743	140	RbN ₃	827	140	KN ₃
391	1950	140	SrS ₂	6468	140	BaNd ₂ ZnO ₅	6770	140	BaLa ₂ MnS ₅	7386	140	NaAgF ₄
392	9579	140	AlTiSe ₂	9580	140	TlGaSe ₂	10163	140	NaAlTe ₂	10165	140	KAlTe ₂
393	10166	140	NaAlSe ₂	10289	140	Ca(BC) ₂	12622	140	SrPdF ₄	12623	140	BaPdF ₄
394	16060	140	AgAuF ₄	16124	140	BaPr ₂ MnS ₅	16454	140	BaPr ₂ ZnS ₅	16455	140	BaNd ₂ ZnS ₅
395	17895	140	K ₃ BeF ₅	19851	140	KInTe ₂	20805	140	PdPbF ₄	22255	140	RbInTe ₂
396	23550	140	KBrF ₄	23571	140	KBa ₄ Bi ₃ O	23846	140	KHF ₂	24668	140	CsHF ₂
397	27801	140	TlAgI ₂	28080	140	K ₂ SnTe ₅	28520	140	Rb ₂ SnTe ₅	29764	140	RbHF ₂
398	559270	140	RbBa ₄ Sb ₃ O	559446	140	NaPPdS ₄	390	141	TiO ₂	2940	141	LuPO ₄
399	3248	141	TbAsO ₄	4006	141	ErPO ₄	4104	141	HoPO ₄	4200	141	ScPO ₄
400	4340	141	TbPO ₄	4609	141	HfSiO ₄	4624	141	TaBO ₄	4790	141	ThGeO ₄

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
401	4820	141	ZrSiO ₄	5132	141	YPO ₄	5488	141	LiInO ₂	5632	141	DyAsO ₄
402	5767	141	DyPO ₄	5836	141	ThSiO ₄	5840	141	LiScO ₂	5884	141	TmPO ₄
403	6964	141	TbNaO ₂	7374	141	Ba(CuO) ₂	7589	141	Mg ₂ NF	7644	141	LuAsO ₄
404	8058	141	YAsO ₄	8128	141	NaNdO ₂	8470	141	NaPrO ₂	8615	141	NbBO ₄
405	10971	141	LiErO ₂	12929	141	SmAsO ₄	12944	141	HoAsO ₄	13900	141	Sr(CuO) ₂
406	15845	141	SrLi ₄ N ₂	29537	141	Cl ₂ O	34081	141	NaYF ₄	35717	141	LiDySe ₂
407	36234	141	NaTiO ₂	36791	141	LiNdS ₂	38695	141	TbLiSe ₂	546125	141	ScAsO ₄
408	674459	141	NaErF ₄	675230	141	NaLaS ₂	675798	141	NaHoF ₄	754027	141	NaSmO ₂
409	754043	141	NaLuO ₂	754334	141	NaTmO ₂	754403	141	ZrO ₂	754605	141	LiLuO ₂
410	755141	141	NaHoO ₂	755357	141	NdAsO ₄	755586	141	NaLaO ₂	755883	141	NaDyO ₂
411	768863	141	PrAsO ₄	771977	141	TmAsO ₄	772156	141	ErAsO ₄	772261	141	LaAsO ₄
412	11054	142	RbSn	21525	142	RbPb	31266	142	YPS ₄	542374	142	KSn
413	768907	146	Sr ₃ TeO ₆	8724	147	K ₂ TeO ₃	27559	147	Na ₁₄ Cd ₂ O ₉	28529	147	KInBr ₃
414	555678	147	Na ₄ Ti ₅ O ₁₂	556741	147	KNaThF ₆	861906	147	BaNa ₂ Mg(PO ₄) ₂	3980	148	LiSbF ₆
415	6026	148	Na ₂ Mg(CO ₃) ₂	6459	148	CaMg(CO ₃) ₂	8000	148	SrSn(BO ₃) ₂	8255	148	CaPtF ₆
416	8256	148	ZnPtF ₆	9144	148	LiAsF ₆	11715	148	MgSn(BO ₃) ₂	13903	148	ZnSnF ₆
417	13907	148	CdSnF ₆	14398	148	CaSn(BO ₃) ₂	23218	148	AsI ₃	27419	148	LiBiF ₆
418	28483	148	WBr ₆	37216	148	CdPbF ₆	571442	148	YI ₃	623024	148	TiCdF ₆
419	675104	148	Na ₃ YCl ₆	676512	148	Na ₃ AlF ₆	634	152	HgS	4236	152	BaZnO ₂
420	7826	152	HgO	561243	152	Sr ₂ CuClO ₂	756018	152	BaMgO ₂	9252	154	HgS
421	11168	154	Ca(PIr) ₂	15074	154	Sr(PIr) ₂	6870	155	KBe ₂ BO ₃ F ₂	7323	155	RbBe ₂ BO ₃ F ₂
422	553342	155	CsBe ₂ BO ₃ F ₂	22965	156	BiTeI	29057	156	Nb ₃ SBr ₇	570485	156	SrAlSiH
423	571093	156	BaAlSiH	9480	159	KAlSiO ₄	1434	160	MoS ₂	4559	160	BaCO ₃
424	7581	160	MoSe ₂	22895	160	CuI	23162	160	ZrCl ₂	38011	160	KHS
425	3666	161	LiTaO ₃	3731	161	LiNbO ₃	4360	161	NaCdF ₃	13334	161	ZnSnO ₃
426	20282	161	CsPbF ₃	23736	161	LiMgH ₃	754009	161	ScBiO ₃	754323	161	TmBiO ₃
427	754943	161	ErBiO ₃	768221	161	YBiO ₃	989524	161	LaWN ₃	31220	162	AlSiTe ₃
428	20902	163	InAg(PSe ₃) ₂	23503	163	Na ₃ InCl ₆	28815	163	ThSnI ₆	29417	163	Na ₃ ScBr ₆
429	505148	163	ThPbI ₆	556301	163	Li ₆ CaCeO ₆	6325	164	Ba ₃ MgTa ₂ O ₉	7233	164	La ₂ SeO ₂
430	7768	164	Th ₂ SeN ₂	7769	164	Th ₂ SN ₂	7786	164	CsCu ₃ S ₂	9006	164	Ho ₂ CF ₂
431	9272	164	TlPt ₂ S ₃	9385	164	RbAu ₃ Se ₂	9566	164	Sr(MgSb) ₂	13974	164	Ho ₂ SeO ₂
432	13975	164	Er ₂ SeO ₂	22880	164	FeBr ₂	23205	164	MgI ₂	30031	164	CaI ₂
433	30034	164	MgBr ₂	570081	164	CuI	643004	164	SrMg ₂ FeH ₈	643264	164	BaMg ₂ FeH ₈
434	753920	164	Tm ₂ SeO ₂	754827	164	Tm ₂ TeO ₂	754834	164	Er ₂ TeO ₂	755340	164	Tb ₂ SeO ₂
435	768908	164	Ho ₂ TeO ₂	769284	164	Dy ₂ SeO ₂	769268	165	Sr ₄ Ta ₂ O ₉	769307	165	Ca ₄ Ta ₂ O ₉
436	7863	166	Rb ₂ Sn ₂ O ₃	9274	166	Rb ₃ Sb ₂ Au ₃	14205	166	K ₃ Cu ₃ As ₂	14206	166	K ₃ Ag ₃ As ₂
437	23033	166	Sr ₂ NCl	23040	166	Ca ₂ PI	23056	166	Sr ₂ BrN	23210	166	MgCl ₂
438	24199	166	LiHF ₂	27837	166	NaHF ₂	27869	166	Ba ₂ PCI	30533	166	KPt ₂ S ₃
439	551456	166	Ba ₂ CuClO ₂	552537	166	Sr ₂ CuBrO ₂	552934	166	Ba ₂ CuBrO ₂	555850	166	LuSF
440	559092	166	ScF ₃	690794	166	Sr ₂ HN	753746	166	Rb ₂ O	588	167	GaF ₃
441	2068	167	RhF ₃	2437	167	IrF ₃	2552	167	TeO ₃	3466	167	PrAlO ₃
442	3889	167	NaBO ₂	3919	167	KBO ₂	3953	167	CaCO ₃	4385	167	CdCO ₃
443	4531	167	NaNO ₃	5348	167	MgCO ₃	5899	167	NdAlO ₃	6361	167	NaSr ₃ NbO ₆
444	6949	167	InF ₃	7027	167	InBO ₃	7560	167	LuBO ₃	8110	167	AlBO ₃
445	8180	167	LiNO ₃	8697	167	ScBO ₃	8960	167	Ba ₃ NaNbO ₆	8961	167	Ba ₃ NaTaO ₆
446	9890	167	TaAgO ₃	10392	167	Sr ₃ CdPtO ₆	10461	167	NaSr ₃ SbO ₆	13042	167	NaSr ₃ TaO ₆
447	14787	167	Tm ₂ S ₃	15567	167	Na ₃ AuS ₂	15571	167	K ₃ AuSe ₂	18705	167	TbSr ₃ RhO ₆
448	22930	167	Rb ₄ CdCl ₆	23125	167	K ₃ NaFeCl ₆	23347	167	YbRb ₄ I ₆	23392	167	K ₄ CdCl ₆
449	23933	167	AlH ₃	28044	167	TmCl ₃	29468	167	Rb ₆ Cl ₄ O	541738	167	Cs ₃ Cr ₂ I ₉
450	542734	167	Rh ₂ O ₃	555812	167	NaSr ₃ BiO ₆	556316	167	Ba ₃ NaBiO ₆	561725	167	CsBO ₂

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
451	570158	167	KRb ₃ CdCl ₆	642996	167	Li ₄ H ₆ Os	643001	167	Na ₄ H ₆ Ru	754409	167	HoBO ₃
452	779545	167	Na ₃ CuO ₂	867700	167	Li ₃ CuS ₂	978093	167	Ho ₂ S ₃	6253	173	KLiBeF ₄
453	6485	173	La ₃ SiAgSe ₇	13335	173	Cd(BO ₂) ₂	17243	173	Pr ₃ CuSnSe ₇	17389	173	Pr ₃ SiAgSe ₇
454	17719	173	La ₃ SiAgS ₇	17827	173	Nd ₃ SiAgSe ₇	504891	173	La ₃ MnGaS ₇	542888	173	La ₃ AgSnS ₇
455	554097	173	Sm ₃ SiCuS ₇	554150	173	Nd ₃ CuGeS ₇	555893	173	Pr ₃ SiCuS ₇	555978	173	Sm ₃ CuGeS ₇
456	556781	173	Y ₃ CuGeS ₇	556962	173	Pr ₃ CuGeS ₇	556975	173	Nd ₃ SiCuS ₇	557517	173	Tb ₃ CuGeS ₇
457	557998	173	Dy ₃ SiCuS ₇	558980	173	Er ₃ SiCuS ₇	560014	173	Pr ₃ CuSnS ₇	560501	173	Tb ₃ SiCuS ₇
458	561173	173	Y ₃ SiCuS ₇	568638	173	Y ₃ SiCuSe ₇	568779	173	Tb ₃ SiCuSe ₇	568801	173	Pr ₃ SiCuSe ₇
459	568954	173	Nd ₃ CuGeSe ₇	569557	173	Dy ₃ SiCuSe ₇	570045	173	Sm ₃ SiCuSe ₇	571347	173	Pr ₃ CuGeSe ₇
460	571468	173	Ho ₃ SiCuSe ₇	617632	173	La ₃ AgGeS ₇	641534	173	Nd ₃ SiCuSe ₇	862792	173	Pr ₃ AgGeS ₇
461	864666	173	Nd ₃ SiAgS ₇	866696	173	La ₃ ScBeS ₇	867322	173	Pr ₃ SiAgS ₇	867929	173	Sm ₃ SiAgS ₇
462	6694	176	Cs ₂ Zr(SiO ₃) ₃	6738	176	Al ₆ B ₅ (O ₅ F) ₃	7191	176	Sr ₃ GaN ₃	10509	176	BaGaBO ₃ F ₂
463	10510	176	BaAlBO ₃ F ₂	11166	176	BaZnCO ₃ F ₂	17037	176	Rb ₂ Ti(SiO ₃) ₃	17382	176	Rb ₂ Si ₃ SnO ₉
464	22896	176	LaCl ₃	23183	176	NdCl ₃	23211	176	PrCl ₃	23221	176	PrBr ₃
465	23263	176	LaBr ₃	29218	176	Ge ₃ Bi ₂ O ₉	540707	176	Cs ₂ Sn(GeO ₃) ₃	554303	176	La ₃ U(ClO ₂) ₃
466	554542	176	Mg ₃ B(OF) ₃	554719	176	Mg ₃ B(HO ₂) ₃	556183	176	Pr ₃ U(ClO ₂) ₃	558533	176	Nd ₃ U(ClO ₂) ₃
467	558672	176	Si ₃ Bi ₂ O ₉	756888	176	La ₂ (SiO ₃) ₃	28549	185	Li ₈ SiO ₆	761931	185	Na ₈ SnO ₆
468	769294	185	Rb ₈ SnO ₆	380	186	ZnSe	661	186	AlN	672	186	CdS
469	804	186	GaN	1039	186	MgTe	1070	186	CdSe	2133	186	ZnO
470	2542	186	BeO	5055	186	Na ₆ MnS ₄	5114	186	K ₆ HgS ₄	7664	186	Na ₆ ZnO ₄
471	8389	186	Na ₆ ZnS ₄	8880	186	AlP	8881	186	AlAs	8882	186	GaP
472	8884	186	ZnTe	9007	186	Na ₆ P ₄ W	9575	186	LiBeSb	10096	186	Na ₃ Sr ₃ GaP ₄
473	12779	186	CdTe	13002	186	K ₂ SiF ₆	13954	186	Rb ₂ GeF ₆	14168	186	K ₂ GeF ₆
474	14780	186	Na ₆ MnSe ₄	14782	186	Na ₆ MnTe ₄	15572	186	Na ₃ Ca ₃ AlAs ₄	18246	186	K ₆ MnTe ₄
475	22894	186	AgI	23794	186	H ₄ NF	29117	186	Ta ₃ TeI ₇	29529	186	NaSnP
476	37657	186	Ca ₃ SiO ₅	560588	186	ZnS	567290	186	LaN	567503	186	PbI ₂
477	567949	186	Hg ₃ AsSe ₄ Br	568916	186	K ₆ InTe ₄ Cl	569346	186	CuI	570084	186	Hg ₃ AsSe ₄ I
478	570935	186	LiI	580941	186	AgI	642725	186	CaHClO	753816	186	Na ₆ MgO ₄
479	755546	186	Na ₆ BeO ₄	966800	186	InP	976280	186	LiBr	978534	186	SiGe
480	6867	187	KCaCO ₃ F	10615	187	BaLiP	10616	187	BaLiAs	24012	187	HoHSe
481	28797	187	YHSe	867261	187	RbSrCO ₃ F	17229	188	RbBe ₃ ZnF ₉	18502	188	BaSi ₃ SnO ₉
482	18509	188	KBe ₃ ZnF ₉	7931	189	SrP	541995	190	LaSiO ₃ F	558491	190	BaAlBO ₃ F ₂
483	569168	193	Ba ₆ NaCu ₃ Te ₁₄	165	194	Si	602	194	Te ₂ Mo	757	194	Li ₃ As
484	841	194	Li ₂ O ₂	2072	194	KTe	2918	194	YCuO ₂	3642	194	ScCuO ₂
485	6112	194	K ₆ Na ₃ GaSb ₄	7437	194	KZnP	7438	194	KZnSb	7738	194	LaSeF
486	7940	194	KNbSe ₂	9037	194	CsPrS ₂	9573	194	NaBeAs	9574	194	NaBeSb
487	9702	194	Sr ₃ BPO ₃	9712	194	Ba ₃ BPO ₃	9793	194	Ba ₃ BAO ₃	10485	194	BaLiSb
488	11019	194	GaCuO ₂	13276	194	SrLiP	13277	194	BaLiP	15668	194	NaSe
489	17120	194	Cs ₆ K ₃ AlSb ₄	20485	194	InSe	23015	194	Cs ₃ Mo ₂ Br ₉	23451	194	Cs ₃ Cr ₂ Br ₉
490	30250	194	YAgO ₂	541707	194	K ₆ Na ₃ AlSb ₄	553308	194	CsNdO ₂	567666	194	Ba ₃ BiN
491	568273	194	LiI	632667	194	YbH ₂	753799	194	CsTmO ₂	754055	194	CsErO ₂
492	754110	194	SmAgO ₂	754138	194	CsDyO ₂	754154	194	CsHoO ₂	754469	194	Er ₂ TeO ₂
493	754535	194	LaAgO ₂	768864	194	KNdO ₂	2488	198	SiOs	7787	198	HfSO
494	8630	198	SbIrS	14889	198	K ₉ Fe ₂ S ₇	15077	198	Ag ₇ AsS ₆	17250	198	K ₃ SbO ₃
495	17538	198	K ₃ SbSe ₃	29168	198	Rb ₃ BiSe ₃	567185	198	SnHg ₆ (As ₂ Br ₃) ₂	568612	198	SnHg ₆ (P ₂ Cl ₃) ₂
496	571478	198	SnHg ₇ (As ₂ I ₃) ₂	621964	198	RbK ₂ BiSe ₃	756361	198	ZrSeO	20694	199	K ₂ Pb ₂ O ₃
497	23653	203	Na ₃ MgC ₂ ClO ₆	29501	203	Rb ₃ AsSe ₁₆	29947	203	K ₃ PSe ₁₆	226	205	FeS ₂
498	730	205	P ₂ Pt	2030	205	RuS ₂	2604	205	MgTe ₂	8484	205	ZnO ₂
499	23287	205	CuCl	567910	205	CdHg ₆ (As ₂ Br ₃) ₂	3887	206	Li ₃ GaN ₂	13944	206	Li ₃ AlN ₂
500	555740	206	SiO ₂	3762	215	VCu ₃ S ₄	4043	215	NbCu ₃ Se ₄	4081	215	TaCu ₃ Se ₄

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TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
501	5621	215	NbCu ₃ S ₄	9295	215	TaCu ₃ Te ₄	10748	215	TaCu ₃ S ₄	21855	215	VCu ₃ Se ₄
502	34337	215	H ₄ NCl	36248	215	H ₄ BrN	755309	215	Li ₃ NbS ₄	760375	215	Li ₃ VS ₄
503	991652	215	VCu ₃ Te ₄	991676	215	NbCu ₃ Te ₄	252	216	BeTe	406	216	CdTe
504	422	216	BeS	830	216	GaN	1190	216	ZnSe	1479	216	BP
505	1541	216	BeSe	1550	216	AlP	1700	216	AlN	1986	216	ZnO
506	2172	216	AlAs	2176	216	ZnTe	2469	216	CdS	2490	216	GaP
507	2624	216	AlSb	2691	216	CdSe	5967	216	TiCoSb	7173	216	ScSbPt
508	7575	216	LiZnN	8062	216	SiC	9124	216	LiZnAs	10182	216	LiZnP
509	10695	216	ZnS	12558	216	LiMgAs	13031	216	MgSe	13032	216	MgS
510	13033	216	MgTe	15988	216	Li ₂ CuSb	16327	216	DySbPt	16329	216	ErSbPt
511	16376	216	HoSbPt	19886	216	ThSnPt	20351	216	InP	22913	216	CuBr
512	22914	216	CuCl	22925	216	AgI	30847	216	TiSnPt	31451	216	ZrCoBi
513	31454	216	TaSbRu	36111	216	LiMgP	37906	216	LiMgN	558992	216	In ₇ GeIrO ₈
514	567636	216	VFeSb	866291	216	AgBr	924129	216	ZrNiSn	924130	216	TiNiSn
515	961682	216	TiSnPd	961684	216	LiCaAs	961685	216	NaCaAs	961687	216	ZrSnPd
516	961693	216	ZrInAu	961706	216	TiSiPt	961711	216	ZrSiPt	961713	216	ZrSnPt
517	976181	216	NaBH ₄	10644	217	TaTi ₃ Se ₄	18062	217	Yb(Na ₅ Sn ₆) ₂	561543	217	BeF ₂
518	23656	218	Na ₄ Ga ₃ Si ₃ ClO ₁₂	23659	218	Na ₄ Ga ₃ Si ₃ BrO ₁₂	27626	218	Ge ₁₉ (AsI) ₄	568847	218	K ₄ GeSe ₄
519	11661	220	Zr ₃ N ₄	13654	220	Y ₃ Sb ₄ Au ₃	17926	220	Zr ₃ Ni ₃ Sb ₄	23331	220	Si ₃ (BiO ₃) ₄
520	23560	220	Ge ₃ (BiO ₃) ₄	861503	220	Pr ₃ Sb ₄ Au ₃	984350	220	Dy ₃ Sb ₄ Au ₃	953	221	NbZn ₃
521	2667	221	CsAu	3614	221	KTaO ₃	5878	221	KZnF ₃	7104	221	CsCaF ₃
522	7604	221	Mg ₃ NF ₃	8399	221	CsCdF ₃	10250	221	BaLiF ₃	22865	221	CsCl
523	22875	221	TlBr	22906	221	CsBr	23167	221	TlCl	23302	221	RbI
524	23737	221	KMgH ₃	23818	221	BaLiH ₃	23949	221	RbCaH ₃	28171	221	K ₃ IO
525	568544	221	CsCdCl ₃	632319	221	CsH	644203	221	CsCaH ₃	862832	221	PaTiO ₃
526	985586	221	Na ₃ BrO	361	224	Cu ₂ O	241	225	CdF ₂	286	225	YbSe
527	315	225	PbF ₂	463	225	KF	648	225	Na ₂ S	682	225	NaF
528	971	225	K ₂ O	981	225	SrF ₂	1000	225	BaTe	1022	225	K ₂ S
529	1087	225	SrS	1138	225	LiF	1216	225	YbO	1253	225	BaSe
530	1265	225	MgO	1315	225	MgS	1342	225	BaO	1394	225	Rb ₂ O
531	1415	225	CaSe	1500	225	BaS	1519	225	CaTe	1672	225	CaS
532	1779	225	YbTe	1784	225	CsF	1820	225	YbS	1958	225	SrTe
533	2074	225	Li ₃ Sb	2286	225	Li ₂ Se	2472	225	SrO	2530	225	Li ₂ Te
534	2605	225	CaO	2758	225	SrSe	2784	225	Na ₂ Te	3042	225	K ₂ SiF ₆
535	4047	225	Cs ₂ SiF ₆	5033	225	Tl ₂ SiF ₆	5077	225	NaLi ₂ Sb	6204	225	Cs ₂ NaScF ₆
536	6231	225	Ba ₂ ErSbO ₆	6270	225	Ba ₂ LiReO ₆	6586	225	K ₂ NaAlF ₆	6687	225	Ba ₂ HoSbO ₆
537	8041	225	Rb ₂ S	8177	225	HgF ₂	8217	225	Cs ₂ GeF ₆	8426	225	K ₂ Se
538	8812	225	Rb ₂ GeF ₆	9262	225	Cs ₂ PtF ₆	9839	225	K ₂ LiAlF ₆	10492	225	Rb ₂ SiF ₆
539	10760	225	MgSe	11327	225	Rb ₂ Se	11718	225	RbF	13800	225	Cs ₂ NaTiF ₆
540	13816	225	Cs ₂ NaErF ₆	13898	225	Cs ₂ NaInF ₆	13925	225	Cs ₂ NaYF ₆	14037	225	NaTi ₂ RhF ₆
541	14038	225	Rb ₂ NaRhF ₆	14088	225	Rb ₂ PdF ₆	15724	225	KNa ₂ Sb	16180	225	Na ₆ S ₂ O ₉
542	17838	225	Tb ₃ KF ₁₀	18451	225	KEr ₃ F ₁₀	19717	225	TePb	20194	225	CeO ₂
543	21879	225	Ba ₂ CePtO ₆	22862	225	NaCl	22867	225	RbBr	22898	225	KI
544	22899	225	LiI	22903	225	RbI	22905	225	LiCl	22916	225	NaBr
545	22922	225	AgCl	23059	225	Rb ₂ SnCl ₆	23060	225	Cs ₂ PtI ₆	23067	225	K ₂ PdCl ₆
546	23155	225	Ar	23193	225	KCl	23209	225	SrCl ₂	23231	225	AgBr
547	23251	225	KBr	23259	225	LiBr	23268	225	NaI	23295	225	RbCl
548	23350	225	Rb ₂ PtCl ₆	23405	225	Cs ₂ TeBr ₆	23406	225	Cs ₂ PtCl ₆	23425	225	Cs ₂ PbCl ₆
549	23465	225	Cs ₂ TeCl ₆	23703	225	LiH	23804	225	Mg ₂ FeH ₆	23870	225	NaH
550	24084	225	KH	24411	225	K ₂ LiAlH ₆	24412	225	K ₂ NaAlH ₆	24721	225	RbH

to be continued

TABLE S5

No.	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula	MPID	SG	Formula
551	27315	225	CaTiF ₆	27827	225	Rb ₂ TiCl ₆	27828	225	Cs ₂ TiCl ₆	27829	225	Rb ₂ SeCl ₆
552	27830	225	Cs ₂ SeCl ₆	27831	225	Rb ₂ ZrCl ₆	27834	225	Tl ₂ PtCl ₆	27882	225	Cs ₂ GeCl ₆
553	28145	225	Rb ₂ PdCl ₆	29398	225	Cs ₂ HfI ₆	30062	225	Cs ₂ PtBr ₆	504729	225	Cs ₂ PdF ₆
554	540957	225	Cs ₂ TeI ₆	541097	225	Zr ₃ Pb(O ₂ F ₃) ₂	550685	225	Ba ₂ CaTeO ₆	560790	225	Cs ₂ NaBiF ₆
555	561561	225	Cs ₂ KRRhF ₆	568560	225	TlBr	568662	225	BaCl ₂	569639	225	TlCl
556	570379	225	Cs ₂ LiLuCl ₆	573697	225	CsCl	580589	225	Cs ₂ NaErCl ₆	608555	225	Cs ₂ SnCl ₆
557	638729	225	Cs ₂ ZrCl ₆	641923	225	Cs ₂ SnBr ₆	862631	225	Ba ₂ SbAu	865101	225	NaLi ₂ Bi
558	865280	225	NbAlFe ₂	865681	225	TiSiRu ₂	865735	225	YbLi ₂ Ge	865965	225	Li ₂ CaSi
559	865986	225	Li ₂ CaGe	866154	225	TiBeIr ₂	975275	225	RbNa ₂ Sb	984352	225	Al ₂ CoOs
560	989400	225	Rb ₂ NaGaF ₆	989405	225	Cs ₂ LiInBr ₆	989531	225	Cs ₂ KGaF ₆	989558	225	Cs ₂ TlGaF ₆
561	989561	225	NaTi ₂ GaF ₆	989571	225	Cs ₂ NaInCl ₆	989577	225	LiTi ₂ GaF ₆	989578	225	Rb ₂ NaInF ₆
562	989610	225	Cs ₂ NaInH ₆	989642	225	Cs ₂ NaAlH ₆	149	227	Si	3443	227	Cd(GaO ₂) ₂
563	3536	227	MgAl ₂ O ₄	3688	227	Er ₂ Sn ₂ O ₇	3807	227	Al ₂ CdSe ₄	3904	227	Mg ₂ GeO ₄
564	3930	227	Sc ₂ MnS ₄	4284	227	Ho ₂ CdSe ₄	4324	227	Tm ₂ CdS ₄	4408	227	Sm ₂ Zr ₂ O ₇
565	4590	227	Mg(GaO ₂) ₂	4974	227	La ₂ Zr ₂ O ₇	5146	227	Zn(RhO ₂) ₂	5548	227	Ta ₂ Cd ₂ O ₇
566	5794	227	Zn(GaO ₂) ₂	5977	227	Nd ₂ Zr ₂ O ₇	6942	227	Ho ₂ CdS ₄	7831	227	MgIn ₂ O ₄
567	8269	227	Lu ₂ CdS ₄	9071	227	Na ₈ TiAs ₄	10191	227	Lu ₂ MgSe ₄	12533	227	La ₂ Hf ₂ O ₇
568	13801	227	Tl ₂ Pt ₂ O ₇	14026	227	Ca ₂ Ta ₂ O ₇	14100	227	Cd(RhO ₂) ₂	14304	227	Lu ₂ MgS ₄
569	14620	227	Tm ₂ CdSe ₄	15802	227	Tm ₂ MgSe ₄	15803	227	Y ₂ MgSe ₄	19803	227	CdIn ₂ O ₄
570	20493	227	Mg(InS ₂) ₂	22052	227	Zn(InS ₂) ₂	22587	227	Cd(InSe ₂) ₂	22766	227	CaIn ₂ O ₄
571	22961	227	Li ₂ ZnCl ₄	35249	227	Sm ₂ Hf ₂ O ₇	35785	227	Y ₂ CdS ₄	36866	227	Al ₂ CdO ₄
572	559200	227	Cd(InS ₂) ₂	559426	227	Pr ₂ Zr ₂ O ₇	570959	227	Dy ₂ CdSe ₄	581857	227	KBiF ₄
573	754114	227	SrSc ₂ O ₄	755450	227	La ₂ Ce ₂ O ₇	973261	227	Mg ₂ SnO ₄	6273	229	Ba ₄ Na(SbO ₄) ₃
574	16137	229	K ₄ CaU ₃ O ₁₂	28167	229	Th ₆ CoBr ₁₅	28734	229	Zr ₆ CoCl ₁₅	6255	230	Ca ₃

4. List of ideal two-dimensional materials

Recently, 2D materials have attracted increasing attention [42–44], particularly chiral phonons in these materials [45–51]. For example, phenomena such as the entanglement of chiral phonons and single photons [49], as well as vibrational dichroism of chiral valley phonons [50], have been discovered in 2D materials. Based on Ref. [42], we have identified 559 layered materials in PhononDB@kyoto-u that can be used to obtain 2D materials through exfoliation, as shown in Table S6. Additionally, these 2D materials can yield another 613 2D materials through chemical substitution. These materials are promising candidates for the study of phonon AM.

TABLE S6: The list of MIPD for layered materials in our database, which can be used to obtain 2D materials through the exfoliation method.

MPID	MPID	MPID	MPID	MPID	MPID	MPID	MPID	MPID	MPID
10009	10402	10476	10796	11131	11641	1186	12263	12307	1243
12509	13383	13384	13385	13682	13829	13923	13995	14333	1443
14791	1581	1582	16755	16819	17008	17708	17945	1821	18625
1863	1880	1943	19885	19921	20078	20331	20459	20815	20878
20902	2097	2125	21365	21405	2160	2173	2231	22323	224
2242	22577	22661	22691	22858	22877	22880	22881	22917	22939
22945	22951	22965	22968	22969	22982	22987	22993	22997	23008
23023	23024	23046	23052	23068	23072	23154	23162	23164	23170
23174	23205	23210	23218	23227	23238	23261	23293	23309	23334
23376	23395	23419	23472	23517	23553	23559	23690	23709	23803
23856	23879	23904	23918	24029	24030	24097	24120	24130	24170
2418	24204	24205	24389	24422	24428	24534	24638	2507	25469
2632	2706	27127	27164	27167	27171	27194	27195	27207	27231
27342	27356	27358	27373	27397	27411	27437	27439	27449	27455
27532	27546	27552	27622	27628	27640	27656	27666	27678	27684
27697	27700	27702	27703	27723	27734	27741	27747	27749	27770
27811	27849	27850	27863	27871	27880	27910	27922	27934	27948
27975	27976	27979	27980	2798	27998	28013	28051	28066	28067
28077	2809	28095	28109	28126	28136	28153	28178	28179	28220
28224	28253	28319	28361	28420	28448	28458	28479	28490	28491
28534	28541	28557	28569	28572	28580	28599	28627	28671	28712
28745	28809	28938	28944	29016	29027	29048	29057	29116	29117
29132	29133	29177	29218	29234	29236	29249	29251	29254	29269
29327	29355	29407	29412	29498	29509	29555	29567	29624	29666
29689	29690	29710	29798	29803	29839	30002	30031	30034	30058
3006	30096	30241	30242	30243	30244	30247	30287	30298	30299
30302	30943	30971	30993	31001	31037	31220	3123	31250	31256
31406	3228	3342	33746	341	34326	3439	3468	3502	3516
3521	36381	3779	3813	38605	3881	4468	4530	4691	4710
484	486	4888	4988	5045	504564	504630	504957	505366	505465
510128	510293	510727	5328	5338	540818	540924	541240	541487	541837
541911	541912	542096	542152	542180	542623	542812	545482	546279	546684
549720	549728	550070	550553	550820	551470	551826	552120	553025	553991
554384	554479	554921	554950	555212	555269	555490	555838	556004	556084
556094	556216	556231	556516	556523	557163	557250	557437	557614	557685
557835	557992	558672	559065	559208	559332	559379	559760	560196	560370
560665	560845	560847	560923	561011	561190	561489	5625	567279	567441
567471	567556	567720	567798	567809	567931	567949	568252	568301	568328
568346	568592	568949	568971	569126	569224	569687	569766	570084	570125
570136	570157	570172	570219	570321	570340	570418	570590	570610	570823
570930	570961	571169	571219	571260	571442	571550	573376	574169	580886
580941	5962	602	6023	604315	620029	6215	623087	624190	625054
625150	625513	625521	625526	625541	625548	625630	626497	626550	626557
6300	630329	630528	632760	634859	642725	642807	643359	643708	643759
643896	644222	644223	665	667	6684	672273	674328	675543	675651
676020	676250	676572	691	696175	696944	696946	696949	698205	700
7008	7090	720	7280	7293	7310	7461	7505	752460	752637

to be continued

TABLE S6

MPID	MPID	MPID	MPID	MPID	MPID	MPID	MPID	MPID	MPID
753173	753309	753425	753445	753575	753670	753712	753720	754031	754113
754152	754217	754246	754300	754329	754494	754526	754815	754969	755336
755350	755463	755565	755689	755703	755705	756437	756578	756702	757145
759405	759883	765493	768906	769028	769077	770718	772282	772295	7784
779704	780260	7868	7991	8140	8147	8285	8299	8300	8612
8616	8946	8976	9006	9010	9018	909	9254	9272	9321
938	9479	9509	9518	9548	9622	9657	972032	972117	973585
973981	975666	976349	976713	977371	978553	9815	983327	985829	985831
9889	989189	989192	989193	989196	9897	9912	9921	9922	

5. Application of the database

In Sec. S2.2, we introduce our database and provide a brief user guide. Here, we demonstrate its usage and applications through the following examples.

a. Ideal materials with coexisting emergent particles

Our database enables researchers to efficiently screen materials with coexisting EMPs and identify promising candidates. For example, to find materials that host coexisting Dirac points, Weyl nodal lines, and a single nodal surface, users can simultaneously select "DP" and "P-NS," and choose one or more from "P-WNL," "P-WNLs," and "P-WNL/NS" in the EMP section of the main interface **Phonon emergent particles and chiral phonons at high-symmetry points**. Additionally, users can specify other constraints (e.g., filtering by specific SGs, materials database (ICSD/MP), materials containing certain chemical elements) to refine the search results.

Here, we present a material from the search results based on these criteria: LiGaSe₂ with SG 33 and MPID 11582. Its phonon spectrum is shown in Fig. S6(a). Detailed information on the type of EMPs and frequencies corresponding to all bands at HSPs is provided in our database: All phonon modes at the T point are DPs, those at the Y, X, and S points are entirely P-WNLs (the plural form of P-WNLs), the phonon modes at the U point are all P-WNL/NSs (the plural form of P-WNL/NS), and the phonon modes at the Z and R points are entirely P-NS[s] (the plural form of P-NS), located on the nodal plane ZURT. According to Ref. [52], it is also known that hourglass nodal line exists. In the following study, we focus on the 21st to 24th bands, which are well-separated from other bands and highlighted with red box in the phonon spectrum shown in Fig. S6(a). Detailed analysis reveals that these bands form 0D nodal points, DP, 1D nodal lines, WNL and hourglass nodal line, and 2D nodal surface. The BZ of SG 33 is shown in Fig. S5(a). Fig. S5(b) shows the various band crossings formed by the 21st to 24th bands, as marked in the red box in Fig. S6(a), for material LiGaSe₂. The blue arrows in Fig. S6(b) indicate the surface states induced by the WNLs formed by the 23rd and 24th bands along paths X–U and Y–T (as indicated by the blue lines along paths X–U and Y–T in Fig. S5(b)). The black arrows in Fig. S6(b) represent the surface states induced by the DP formed by the 21st to 24th bands and the hourglass nodal lines formed by the 22nd and 23rd bands in the TRSY plane (as indicated by the red line in the TRSY plane in Fig. S5(b)). The black arrow in Fig. S6(c) represents the surface states arising from the hourglass nodal lines in the Γ ZTY plane (as indicated by the red line in the Γ ZTY plane in Fig. S5(b)). The local density of states (LDOS) calculations for the (100) and (010) surfaces, shown in Figs. S6(b) and S6(c), clearly demonstrate the rich topological surface states arising from the coexisting EMPs.

Through our database, in addition to LiGaSe₂ (MPID 11582), it is easy and convenient to find that the materials LiInSe₂ (MPID 20310), ZnCl₂ (MPID 22889), NaGaO₂ (MPID 3338), CdP₂ (MPID 402), SiO₂ (MPID 554089), KNaGeO₃ (MPID 558085), and NaAlO₂ (MPID 9212) also exhibit similar properties.

b. Ideal materials with petal-shaped surface states induced by nearly nodal lines

Recently, the expansion order of the $k \cdot p$ effective models around EMPs has received significant attention. When higher-order terms in these models are neglected, nearly nodal structures driven by quasi-symmetry can emerge, which are not captured by strict crystallographic symmetries and can lead to significant physical consequences, such as large Berry curvature and quasi-quantized Berry phases [53–59]. For instance, the $k \cdot p$ effective model around the C-4 WP should be expanded to at least third order. If the third-order $k \cdot p$ term is discarded, four nearly straight nodal lines carrying quasi-quantized Berry phases can emanate from the original charge-4 WP.

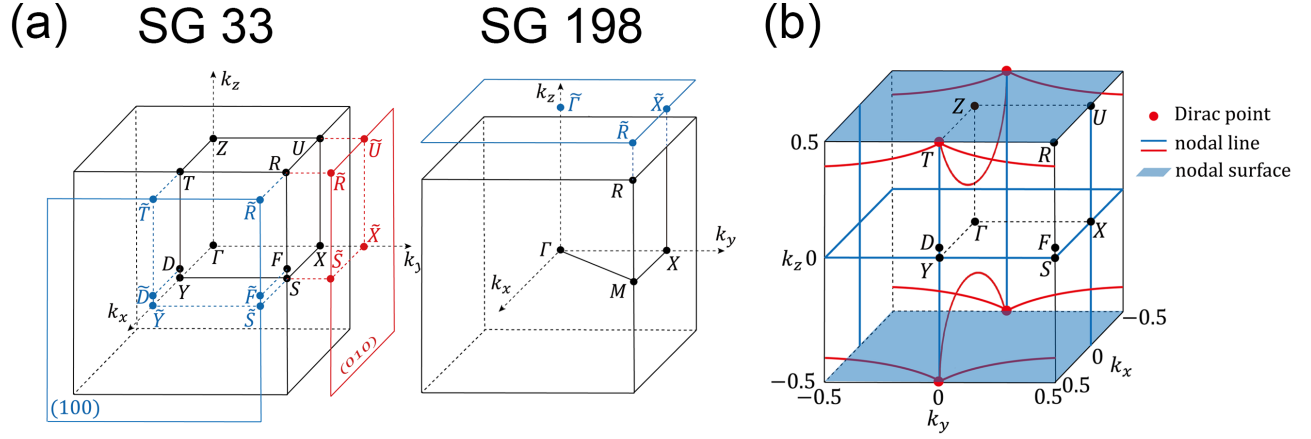


FIG. S5. (a) The bulk BZ and the (100) and (010) surfaces of SG 33, as well as the bulk BZ and the (001) surface of SG 198. The coordinates of F (D) are $(\frac{1}{2}, \frac{1}{2}, 0.03)$ [$(\frac{1}{2}, 0, 0.03)$], and the coordinates of $\bar{F}$ ($\bar{D}$) on the (100) surface are $(\frac{1}{2}, 0.03)$ [$(0, 0.03)$]. (b) Schematic diagram of the band crossings formed by the 21st to 24th bands in the BZ for LiGaSe₂. The red point, located at the T point, represents the DP formed by the 21st to 24th bands. The blue lines, along paths X–U, Y–T, Y–S, and S–X, show the schematic of the WNLs formed by the 23rd and 24th bands (or the 21st and 22nd). The blue plane, located in the ZURT surface, represents the nodal surface formed by the 23rd and 24th bands (or the 21st and 22nd). The red lines in the TRSY and Γ ZTY planes represent the schematic of the nodal lines with hourglass dispersion formed by the 22nd and 23rd bands.

We systematically analyze the $k \cdot p$ effective models for all EMPs at HSPs and along HSLs, and find that nearly nodal structures are widely present. We list eight types of EMPs at HSPs with nearly nodal structures (Tab. S7). All results of nearly nodal structures for HSPs and HSLs are stored in [Single-valued representations at high-symmetry points](#) and [Single-valued representations in high-symmetry lines](#), respectively. Using [Phonon emergent particles and chiral phonons at high-symmetry points](#), we select a material example for demonstration and illustrate the surface states induced by four nearly straight nodal lines emanating from C-4 WP.

TABLE S7. Eight EMP types at HSPs that can exhibit nearly nodal structures. However, not all DP, P-WNLs, P-WNL, and P-NSs in the 230 SGs show nearly nodal structures.

EMP		Nearly nodal structure
C-2 WP	A nearly nodal plane	
C-4 WP	Nearly nodal lines	
CCDP	Nearly nodal lines	
QDP	A nearly nodal plane	
DP	A nearly nodal plane	
P-WNLs	Nearly nodal planes or nodal body	
P-WNL	A nearly nodal plane	
P-NSs	A nearly nodal plane	

This material example is PtSiSr, with SG 198 and ICSD number 604437. Detailed information on all EMPs at HSPs is provided in our database, where C-4 WP, C-2 TP, and C-2 DP coexist. The BZ of SG 198 is shown in Fig. S5(a). In the phonon spectrum shown in Fig. S6(d), a C-4 WP, a C-2 TP, and a C-2 DP, all located in the high-frequency region, are marked with purple, orange, and blue circles, respectively. The isofrequency surface contour at 11.8 THz on the (001) surface, shown in Fig. S6(e), exhibits clear Fermi arcs induced by the C-2 TP and C-2 DP. Interestingly, we find surface states induced by nearly nodal lines emanating from the C-4 WP, resembling a four-petal flower, as shown in Fig. S6(f), which have not been reported before.

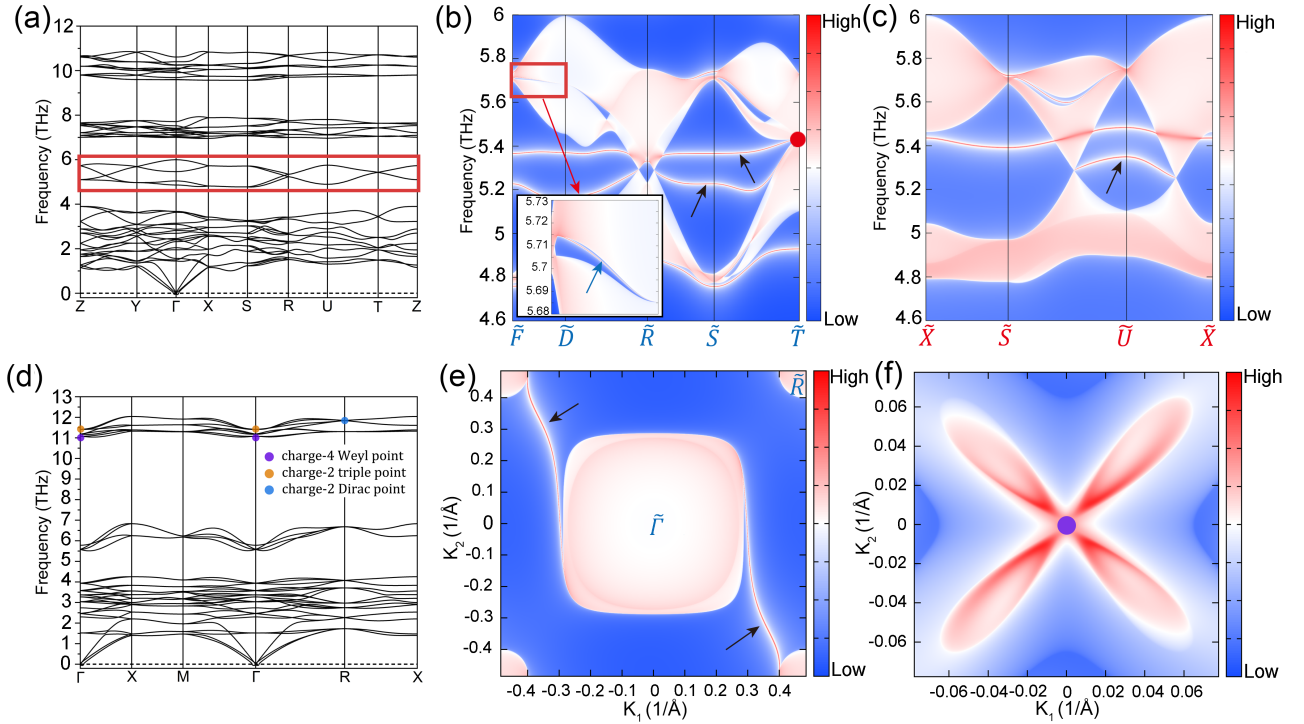


FIG. S6. (a) The phonon dispersion of LiGaSe₂ with MPID 11582 and SG 33. The 21st to the 24th bands, marked within the red box, are the focus of our subsequent study, as they are well-separated from the other bands. (b) The LDOS on the (100) surface from 4.6 to 6.0 THz for LiGaSe₂. The inset in the lower-left corner is an enlarged view of the area within the red box. The blue arrows represent the LDOS induced by the WNL formed by the 23rd and 24th bands. The red points represent the projection of the DP formed by the 21st to 24th bands. The black arrows indicate the LDOS induced by the above DP and the hourglass nodal lines formed by the 22nd and 23rd bands. (c) The LDOS on the (010) surface between 4.6 to 6.0 THz for LiGaSe₂. The black arrow indicates the LDOS induced by the hourglass nodal lines formed by the 22nd and 23rd bands. (d) The phonon dispersion of PtSiSr with ICSD number 604437 and SG 198. The purple circle marks a C-4 WP at the Γ point, the orange circle marks a C-2 TP at the Γ point, and the blue circle marks a C-2 DP at the R point. (e) The isofrequency surface contours on the (001) surface at 11.8 THz for PtSiSr. The black arrows indicate the Fermi arc induced by the C-2 TP and C-2 DP mentioned above. (f) The isofrequency surface contours on the (001) surface at 11.0785 THz for PtSiSr. The purple circle at the center is the projection of the C-4 WP on the (001) surface, and the red region represents the projection of the nearly nodal lines emanating from the C-4 WP.

c. Phonon pseudoangular momentum from representation of phonon band

PAM is defined through the eigenvalues of a rotation (or screw rotation) operation in systems with rotational or screw symmetries [47, 60, 61]:

$$\{C_n|\tau\} e \begin{pmatrix} \mathbf{k} \\ j \end{pmatrix} = e^{-i\mathbf{k}\cdot\tau} e^{-i\frac{2\pi l}{n}} e \begin{pmatrix} \mathbf{k} \\ j \end{pmatrix}.$$

Here, $\{C_n|\tau\}$ denotes the rotation (or screw-rotation) operator, and $e \begin{pmatrix} \mathbf{k} \\ j \end{pmatrix}$ is the j -th phonon eigenvector at wave vector $\mathbf{k}$. The integer l is defined modulo n and labels the C_n eigenvalue. Accordingly, the PAM can be written as

$$m_{\text{PAM}} = l + \frac{\mathbf{k} \cdot \boldsymbol{\tau}}{2\pi/n},$$

where l and $\frac{\mathbf{k} \cdot \boldsymbol{\tau}}{2\pi/n}$ represent spin PAM m_{PAM}^s and orbital PAM m_{PAM}^o , respectively.

Currently, m_{PAM}^s serves as an alternative identifier for chiral phonons in experiments [48, 62–68]. Our database provides users with convenient access to the m_{PAM}^s of chiral phonon materials. Here, we use trigonal α -HgS crystals as an example, which host two enantiomeric cinnabar structures with right- and left-handed helices (R-HgS with MPID 634 and SG 152, and L-HgS with MPID 9254 and SG 154), to demonstrate how to obtain m_{PAM}^s along HSL DT $(0, 0, w)$.

Using **Single-valued representations along high-symmetry lines**, we can obtain the corresponding m_{PAM}^s for each co-irrep on the HSL DT $(0, 0, w)$ in SG 152 and SG 154, as shown in Figs. S7(a) and S7(b): For SG 152, the second operation in the

little group of the HSL DT $(0, 0, w)$ is a threefold screw-rotation about the c axis, $\{C_3|c/3\}$. The valid traces of the co-irreps DT1, DT3, and DT2 are $e^{-i2\pi l/3}$ with $l = -1, 0, 1$. Accordingly, the spin PAM values $m_{\text{PAM}}^s = -1, 0, +1$ correspond to the (co-)irreps DT1, DT3, and DT2, respectively. For SG 154, the second little group operation of HSL DT $(0, 0, w)$ is a threefold screw rotation about the c axis $\{C_3|2c/3\}$. The valid traces for co-irreps DT3, DT2, and DT1 are $e^{-i\frac{2\pi l}{3}}$ with $l = -1, 0, 1$. Accordingly, the spin PAM $m_{\text{PAM}}^s = -1, 0, +1$ correspond to (co-)irreps DT3, DT2, and DT1, respectively.

Using **Phonon emergent particles and chiral phonons in high-symmetry lines**, we can obtain the phonon dispersion curves annotated with the spin PAM m_{PAM}^s , as shown in Figs. S7(c) and S7(d). R-HgS and L-HgS share the same phonon band structure, and m_{PAM}^s remains constant along each band. However, at any k point along the HSL DT $(0, 0, w)$, the corresponding bands in the two enantiomers carry opposite m_{PAM}^s , providing a clear signature of opposite chirality that has also been observed experimentally [62].

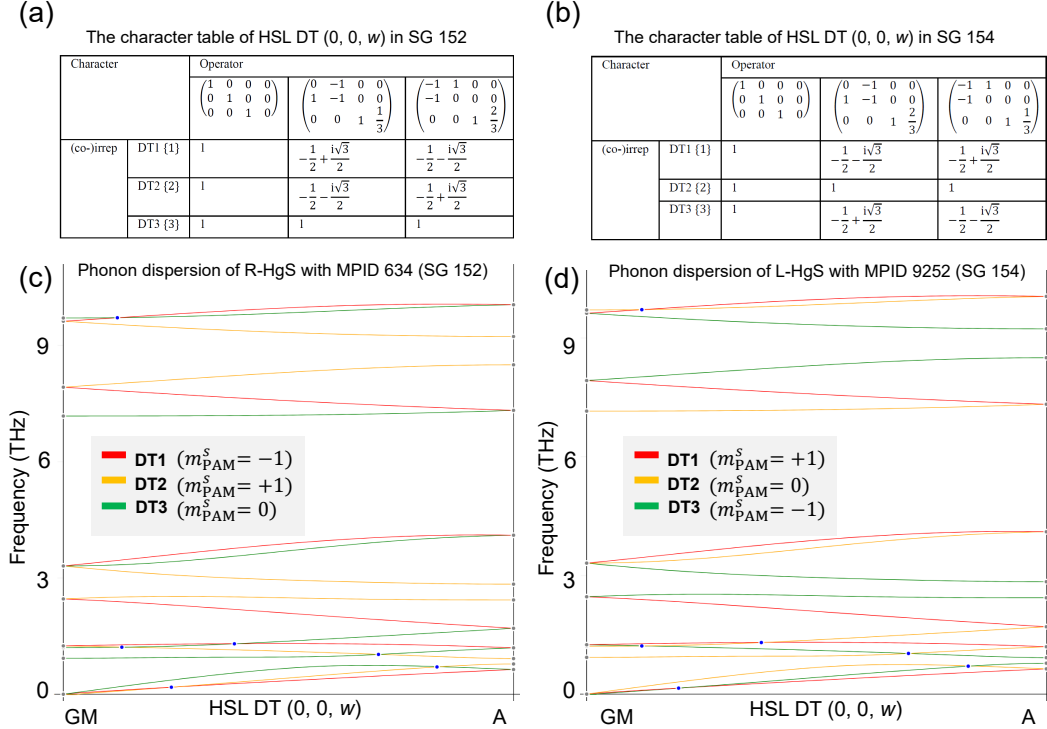


FIG. S7. (a) Representation matrices of the little group along the HSL DT $(0, 0, w)$ in SG 152. (b) Same as (a), but for SG 154. (c) Phonon dispersion of R-HgS (MPID 634, SG 152) along the HSL DT $(0, 0, w)$, i.e., the GM–A path. The line colors indicate the associated (co-)irreps and the corresponding spin PAM. (d) Same as (c), but for L-HgS (MPID 9252, SG 154).

d. Chirality momentum locking of phonon surface state

Momentum space textures of phonon AM for bulk phonon states have been investigated. However, to our knowledge, phonon AM for phonon surface states remains unexplored. WPs located in HSLs provide an ideal platform for investigating phonon AM for surface states: on the one hand, they can induce unidirectional edge states; on the other hand, based on our symmetry-based classification results, they can often carry nonzero phonon AM. Is it possible that the phonon AM for surface states is highly correlated with the momentum direction?

Using **Phonon emergent particles and chiral phonons in high-symmetry lines**, we manually selected two high-quality materials exhibiting phonon AM polarization of the unidirectional edge state: SiGeN₂O (MPID 972831, SG 4) and TeO₂ (MPID 8377, SG 19). Here, we use SiGeN₂O with MPID 972831 and SG 4 as an example (Fig. S8(b)).

The 32nd and 33rd bands form four C-1 WPs in the bulk BZ, all of which appear along HSLs. As shown in the phonon spectra of Fig. S8(a), one C-1 WP with charge -1 and phonon AM $(0.053\hbar, 0, 0)$ appears along the GM–X path, and another with charge $+1$ and phonon AM $(0, 0, -0.03\hbar)$ appears along the Z–GM path. In addition, time-reversal symmetry results in the existence of two additional WPs on the opposite paths. The bulk BZ and (010) surface BZ with the projections of these two pairs of WPs are presented in Fig. S8(b). Fig. S8(c) shows the corresponding clear Fermi arcs from these two pairs of WPs. We select a closed path with vertices located at one of the projected WPs on the (010) surface (shown as a blue rectangle in Fig. S8(b))

to calculate slab energy bands. The corresponding surface states are presented in Fig. S8(d), which exhibit a right-moving edge mode on the top surface and a left-moving chiral edge mode on the bottom surface, emerging inside the band gap. We then calculate the phonon AM of the slab bands using their wavefunctions (Fig. S8(e)). The x and z components dominate, while the y component is negligible. The two unidirectional edge modes have opposite phonon AM components along the z direction (Fig. S8(e)). As a consequence of surface chirality momentum locking, phonon backscattering is suppressed, leading to robust unidirectional phonon surface states with potential applications in thermal diodes, thermal transistors, and other thermal devices.

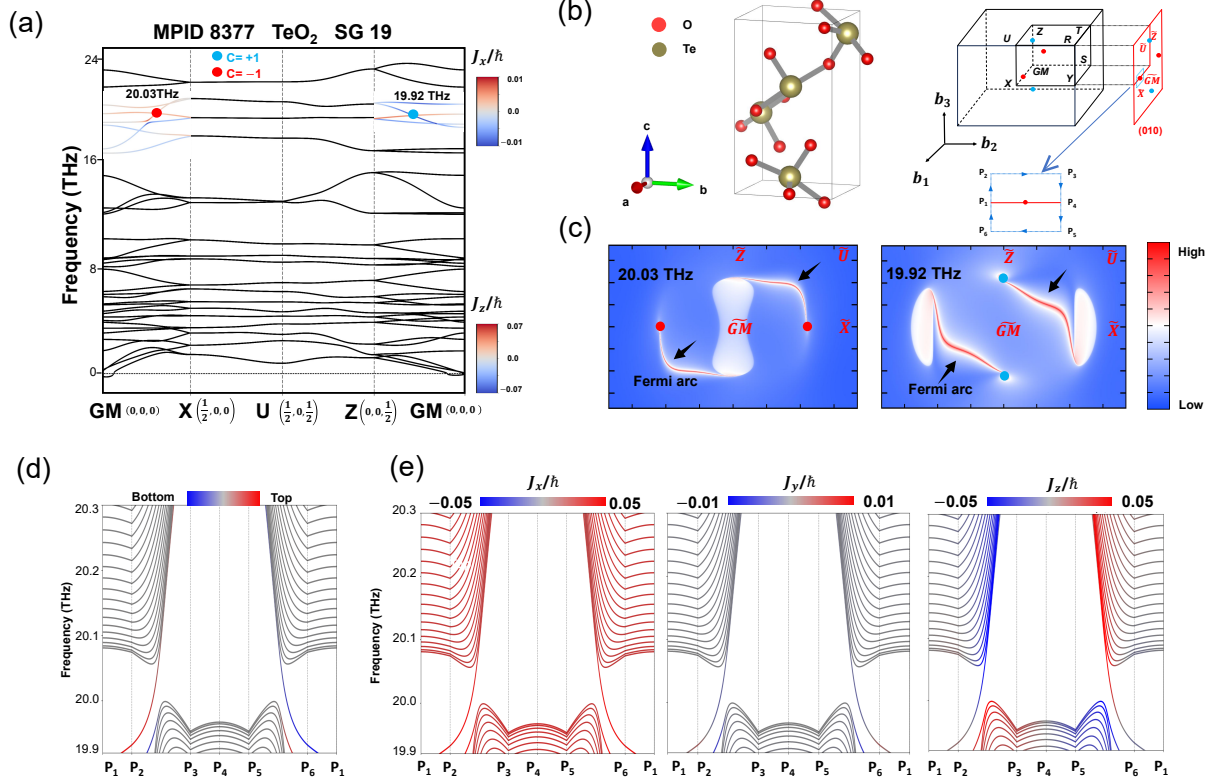


FIG. S8. (a-e) Material example (TeO₂, MPID 8377, SG 19) with surface chirality momentum locking. (a) Phonon spectrum, WPs, and phonon AM. Phonon modes along paths GM–X can carry nonzero phonon AM along the x direction (J_x represents the x component of the phonon AM) and Z–GM can carry nonzero phonon AM along the z direction (J_z represents the z component of the phonon AM) according to the symmetry analysis. Note that there is one WP with charge -1 ($J_x = 0.053\hbar$) at 20.03 THz along GM–X, and one with charge $+1$ ($J_z = -0.03\hbar$) at 19.92 THz along Z–GM, formed by the 32nd and 33rd bands, respectively. (b) Crystal structure, bulk BZ, and (010) surface BZ. The bulk WPs and the four projected WPs formed by the 32nd and 33rd bands are denoted. (c) Isofrequency surface contours on the (010) surface at 20.03 THz and 19.92 THz, respectively. The clear Fermi arcs originating from the WPs in (b) are indicated. (d) Slab bands along a closed blue contour around one of the WPs in (b), revealing two unidirectional surface states. (e) x , y , z components of the phonon AM of slab bands in (d). The y component relative to the x and z components of phonon AM can be neglected. Surface chirality momentum locking: Left-moving and right-moving surface states have opposite phonon AM along the z direction.

6. Calculation methods

a. Representation and phonon angular momentum of phonon band

In this section, we describe our methods to determine EMPs and computing phonon AM at HSPs and along HSLs.

To identify EMPs, we first calculate the (co-)irreps of the bands that host EMPs at HSPs and on HSLs. The detailed procedure and formulas for obtaining (co-)irreps are presented below.

By the mass-reduced discrete Fourier transform of the force constant Φ , we can obtain the dynamical matrix $D(\mathbf{q})$:

$$D_{k\alpha, k'\beta}(\mathbf{q}) = \frac{1}{\sqrt{m_k m_{k'}}} \sum_{l'} \Phi_{0k\alpha, l'k'\beta} e^{i\mathbf{q} \cdot (\mathbf{r}_{l'}^0 - \mathbf{r}_0^0)} \quad (\text{S1})$$

In Eq. (S1), l' denotes the indices of unit cells. k and k' denote the indices of atoms in the 0-th and l' -th unit cells, respectively. $\alpha, \beta \in \{x, y, z\}$, and m_k is the mass of atom k . $\Phi_{0k\alpha, l'k'\beta}$ represents the force constant matrix element. $\mathbf{r}_{l'}^0$ represents the equilibrium position of the l' -th primitive cell.

The phonon eigenvalues and corresponding eigenvectors are obtained by diagonalizing $D(\mathbf{q})$:

$$D(\mathbf{q}) e \left(\begin{matrix} \mathbf{q} \\ j \end{matrix} \right) = \omega^2(\mathbf{q} | j) e \left(\begin{matrix} \mathbf{q} \\ j \end{matrix} \right) \quad (\text{S2})$$

In Eq. (S2), $\omega(\mathbf{q} | j)$ refers to the phonon eigenvalue corresponding to a specific $\mathbf{q}$ point and branch index j ($j = 1, 2, \dots, 3s$, with s denoting the atomic count per primitive cell). Each phonon eigenvector, denoted by the column vector $e \left(\begin{matrix} \mathbf{q} \\ j \end{matrix} \right)$, consists of $3s$ displacement components $e_\alpha \left(k \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right)$ (where $\alpha \in \{x, y, z\}$ and $k = 1, 2, \dots, s$).

When the little group operation $\mathbf{O}$ acts on $e_\alpha \left(k \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right)$, we have:

$$\mathbf{O} e_\alpha \left(k \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right) = e^{i\mathbf{q} \cdot \mathbf{V}_k} \cdot \sum_{\beta} R_{\alpha\beta} e_\beta \left(\tilde{k} \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right) \quad (\text{S3})$$

In Eq. (S3), $\mathbf{V}_k$ may denote any integer translation vector within real space. This vector can be computed via the relation $\mathbf{r}_{0\tilde{k}}^0 = \mathbf{R}^{-1} \mathbf{r}_{0k}^0 - \mathbf{R}^{-1} \boldsymbol{\tau} + \mathbf{V}_k$, where k and $\tilde{k}$ correspond to atoms of identical type. Here, $\mathbf{r}_{0k}^0$ represents the equilibrium position of the k -th atom in the 0-th primitive cell. $\mathbf{R}$ is the rotational part of $\mathbf{O}$ in the Cartesian basis, and $\boldsymbol{\tau}$ is the fractional translational part of $\mathbf{O}$ in the primitive lattice basis.

Using Eq. (S3), we can define and compute the valid traces of $\mathbf{O}$ for an l_m -fold degenerate eigenvalue $\omega(\mathbf{q} | j)$ and its corresponding eigenvectors $e \left(\begin{matrix} \mathbf{q} \\ j_\lambda \end{matrix} \right)$ ($\lambda = 1, \dots, l_m$):

$$\text{Tr}[\mathbf{O}] = e^{i\mathbf{q} \cdot \boldsymbol{\tau}} \cdot \sum_{\lambda=1}^{l_m} \left\langle e \left(\begin{matrix} \mathbf{q} \\ j_\lambda \end{matrix} \right) \left| \mathbf{O} \right| e \left(\begin{matrix} \mathbf{q} \\ j_\lambda \end{matrix} \right) \right\rangle \quad (\text{S4})$$

Based on the above derivation, we calculate the (co-)irreps of all energy levels at HSPs, and calculate the (co-)irreps of bands using 100 sampled $\mathbf{q}$ -points along HSLs for each material in PhononDB@Kyoto-u. By comparing the (co-)irreps of adjacent energy levels between neighboring $\mathbf{q}$ points in HSLs, we identify all degeneracies formed by two different (co-)irreps. Finally, we identify all the EMPs hosted by (co-)irreps at HSPs and HSLs for each material in PhononDB@Kyoto-u.

The formulas along the x, y, z direction of phonon AM are as follows [45]:

$$\begin{cases} l_{\mathbf{q}j}^x = 2\hbar \sum_k \text{Im} \left(e_y^* \left(k \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right) e_z \left(k \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right) \right) \\ l_{\mathbf{q}j}^y = 2\hbar \sum_k \text{Im} \left(e_z^* \left(k \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right) e_x \left(k \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right) \right) \\ l_{\mathbf{q}j}^z = 2\hbar \sum_k \text{Im} \left(e_x^* \left(k \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right) e_y \left(k \left| \begin{matrix} \mathbf{q} \\ j \end{matrix} \right. \right) \right) \end{cases} \quad (\text{S5})$$

For an l_m -fold degeneracy, we calculate the corresponding phonon AM along the α direction by $\sum_{\lambda=1}^{l_m} l_{qj\lambda}^\alpha$, where $\alpha = x, y, z$. Finally, we obtain the phonon AM for all phonon modes at HSPs and along HSLs for each material in PhononDB@Kyoto-u.

The phonon magnetic moment (MM) is obtained by contracting the gyromagnetic ratio tensor with the phonon AM [69]. The x , y , and z components of the phonon MM for mode $(\mathbf{q}, j)$ can be written as

$$[\mu_{\mathbf{q}j}^x, \mu_{\mathbf{q}j}^y, \mu_{\mathbf{q}j}^z]^T = 2\hbar \sum_k \gamma_k \left[\text{Im} \left(e_y^* \left(k \middle| \frac{\mathbf{q}}{j} \right) e_z \left(k \middle| \frac{\mathbf{q}}{j} \right) \right), \text{Im} \left(e_z^* \left(k \middle| \frac{\mathbf{q}}{j} \right) e_x \left(k \middle| \frac{\mathbf{q}}{j} \right) \right), \text{Im} \left(e_x^* \left(k \middle| \frac{\mathbf{q}}{j} \right) e_y \left(k \middle| \frac{\mathbf{q}}{j} \right) \right) \right]^T \quad (\text{S6})$$

In Eq. (S6), γ_k denotes the gyromagnetic-ratio tensor of atom k , defined as $\gamma_k = \frac{e Z_k^*}{2m_k}$, where e is the elementary charge, Z_k^* is the Born effective charge tensor of atom k , and m_k is the mass of atom k . The tensor Z_k^* is obtained from first-principles calculations; computational details and parameter settings are provided in Sec. S2 6 b.

b. Parameter setting for phonon calculation

In this work, our high-throughput calculations are performed using the optimized lattice constants and force constants stored in PhononDB@kyoto-u, which are obtained from the finite-displacement method using VASP [2, 3]. We also find that the structures of 47 materials listed in Table S1 do not conform to the conventions of the PHONOPY software [4]. We use PHONOPY to standardize the structures of these 47 materials and then recalculate their phonon spectra. The calculation parameters are consistent with those used in the original database calculations.

For the material PtSiSr in Sec. S2 5 b, we carry out first-principles calculations based on the density functional theory using VASP [2, 3]. The exchange-correlation functional is selected as the Perdew-Burke-Ernzerhof revised for solids functional (PBEsol) [70] of generalized gradient approximation (GGA) [71]. The projector augmented-wave (PAW) method [72] is adopted to deal with the interactions between ions and valence electrons. Before calculating the phonon spectrum, the lattice constants and atomic positions are both relaxed with the force convergence criterion of $10^{-3} \text{ eV/\AA}$. The electronic self-consistent field cycle is performed with the energy criterion of $10^{-8} \text{ eV/\AA}$ in all calculations. The phonon spectrum is obtained based on the finite-displacement method using PHONOPY package [4]. The plane wave cutoff energy is used as 369 eV. A $10 \times 10 \times 10$ electronic k-mesh is used for structural relaxation, and a $2 \times 2 \times 2$ supercell with $3 \times 3 \times 3$ electronic k-mesh is used for phonon calculation.

The phonon tight-binding Hamiltonian is constructed from force constants using the PHONOPYTB [73]. We then calculate surface states for slab bands and Chern numbers using the WANNIERTOOLS [74]. The phonon AM of the slab bands are evaluated from the corresponding phonon eigenvectors obtained in WANNIERTOOLS.

The Born effective charge tensors are computed within density functional perturbation theory (DFPT) as implemented in VASP [2, 3]. The PBEsol exchange-correlation functional is employed, with a plane-wave cutoff energy of 500 eV and an $8 \times 8 \times 8$ k-mesh.

S3. THE DEFINITELY EXISTING EMERGENT PARTICLES

In this section, we list EMPs that can definitely appear at HSPs, as enforced by representations and WYPOs in Sec. S3 1, and provide specific material examples to illustrate in Sec. S3 2.

1. Symmetry results

The classification in Ref. [6] takes into account the given SG, k point, and the (co-)irrep of the little group of k point, which enables the determination of the SG in which a target EMP can appear. However, it remains unclear whether these EMPs definitely appear in structures that satisfy the SG requirements. A straightforward criterion for ensuring the existence of an EMP is as follows: If this EMP is allowed to occur at a k point and all irreps of this k point correspond to it, then its presence is guaranteed. These EMPs are listed in Table S8, and we refer to them as representation-enforced EMPs.

Below, we introduce two additional rules to enforce the guaranteed existence of an EMP at a k point. These two rules are as follows: (1) Not all (co-)irreps correspond to the same type of EMP, and this EMP will appear when atoms occupy any WYPO in the SG. (2) Not every WYPO contributes to the EMP; however, when atoms occupy only the WYPOs that do not contribute to this EMP, the resulting structure will belong to another SG. We refer to the EMPs enforced by these two rules as the WYPO-enforced EMPs, which are listed in Table S9.

We find that, other than P-WNLs, all EMPs at HSPs are guaranteed to appear through exhaustively examining all WYPOs in the 230 SGs. This clearly shows that nearly all EMPs at HSPs necessarily appear, provided that the structure belongs to the SG that allows the occurrence of this EMP for phonons. Moreover, only for SGs 216, 221, 225, 227, and 229 may P-WNLs be absent. For instance, the co-irreps corresponding to P-WNLs at HSPs in SG 221 are: {5} and {6} at Γ point, and {5} and {6} at R point. At Γ point, when atoms exclusively occupy any of the WYPOs {1a, 1b, 3c, and 3d}, the P-WNLs will not appear. At R point, when atoms exclusively occupy any of the WYPOs {1a, 1b}, the P-WNLs will not appear. When two different types of atoms occupy the 1a and 1b WYPOs, respectively, the structure still belongs to SG 221, and at this time, P-WNLs is absent.

TABLE S8. The EMPs enforced by representations. According to the (co-)irrep, all bands form the same type of EMP at the HSP of the corresponding SG. The number refers to the SG, and the letter following it represents the HSP within that SG. The coordinates of the HSPs are listed in Sec. S4.

Emergent particle	SG and HSP
C-1 WP	24, 210: W; 80, 98, 199, 214: P
DP	29: T, R; 33, 60: T; 52: U; 54: U, R; 56: U, T; 73, 228: W; 110, 142, 206, 230: P; 130, 138: R
C-2 DP	19, 198, 212, 213: R; 92, 96: A
QDP	130, 135: A
P-WNL	39: S, R; 46, 74, 203, 227: W; 64: S; 88, 109, 122, 141: P; 158: L; 206: N
P-WNLs	7, 13: B, D, A, E; 9, 15: A, M; 14: B, A; 27, 49: Z, U, T, R; 28: Y, T, S, R; 29, 31, 53: Y, S; 30: Y, Z, U, T, S, R; 32, 50: Y, X, U, T, S, R; 33, 52: Y, X, S; 34, 48: Y, X, Z, U, T, S; 37, 40, 66: Z, T; 41, 68: Z, T, S, R; 43, 70: Y, X, Z; 45, 72: R, S, W; 46: S; 54: X, S; 56, 58, 60, 114, 135-138: Z; 67: S, R; 73: R, S, T; 74: T; 84, 105, 112, 131: Z, A; 85, 100, 104, 117, 125, 126: M, A, R, X; 86, 102, 106, 118, 133, 134: M, Z, R, X; 88, 109, 122, 141: X, Z; 101, 116, 132: Z, A, R; 103, 124: R; 108, 120, 140: N, P; 110, 142: N, X, Z; 158: H; 159, 161, 163, 165, 167, 184, 192: L; 188, 190: L, H; 201, 224: X, M; 203, 218, 223, 227, 228: X; 219, 226: W; 220, 230: N; 222: M
P-DNL	57, 60, 62: S, R; 61: U, T, S; 205: M, R
P-DNLs	61: R
P-NS	4, 11: Z, C, D, E; 14: Z, C; 17, 26, 51: Z, U, T, R; 18, 55, 57, 59: Y, X, U, T; 19, 61, 62: Y, X, Z; 20, 36, 63: Z, T, R; 29, 31, 53: Z, U; 33, 52: Z, R; 54, 64: Z, T; 56, 58, 60: Y, X; 76, 78, 91, 95: Z, A, R; 90, 94, 113, 114, 127, 129, 135, 137: R, X; 92, 96: Z, X; 128, 130, 136, 138, 198, 205, 212, 213: X; 169, 170, 173, 178, 179, 182: A, L, H; 176, 185, 186, 193, 194: L
P-NSs	18, 55, 56, 58, 59: S, R; 19: U, T, S; 62: U, T; 90, 94, 113, 127, 129, 138: M, A; 92, 96: M, R; 114, 128, 130, 135, 137, 198, 212, 213: M; 136: M, A, R
P-WNL/NS	14: D, E; 31, 53: T, R; 33, 60: U; 52: T; 58: U, T; 64, 128: R

TABLE S9. The EMPs enforced by WYPOs. They can be further divided into two subcases. In subcase I, at the HSP of the corresponding SG, not all bands form the same type of EMP; however, each WYPO contributes to this type of EMP. In subcase II, at the HSP of the corresponding SG, not all bands form the same type of EMP, and not all WYPOs contribute to this type of EMP. However, when atoms occupy only the WYPOs that do not contribute to the EMP, the structure will belong to another SG with higher symmetry.

Case	Emergent particle	SG and HSP
I	C-1 WP	150, 152, 154, 168, 171, 172, 177, 180, 181: K, H; 169, 170, 173, 178, 179, 182: K
	C-2 WP	75, 77, 89, 93: Γ , M, Z, A; 76, 78, 91, 95: Γ , M; 79, 97: Γ , Z, P; 80, 90, 94, 98, 146, 155: Γ , Z; 92, 96, 169, 170, 173, 178, 179, 182: Γ ; 143-145, 149-154, 168, 171, 172, 177, 180, 181: Γ , A; 196: L; 207, 208: X, M; 209: X, L, W; 210: X, L
	C-4 WP	198, 212, 213: Γ ; 199, 214: Γ , H
	TP	204, 217, 229: P
	C-2 TP	195, 207, 208: Γ , R; 196, 198, 209, 210, 212, 213: Γ ; 197, 211: Γ , H, P; 199, 214: Γ , H
	QCTP	200, 201, 215, 221, 224: Γ , R; 202, 203, 205, 216, 218-220, 222, 223, 225-228, 230: Γ ; 204, 206, 217, 229: Γ , H
	DP	103: Z, A; 104, 161, 167: Z; 158, 159, 163: A; 165: A, H; 184, 185, 192, 193: H; 219, 226, 228: L; 220: P
	QDP	106, 114, 133, 137, 176, 184-186, 188, 190, 192-194: A; 124, 128: Z, A; 126, 130: Z; 222: X
	CCDP	220, 230: H
	SP	218, 222, 223: R; 220, 230: H
	P-WNL	147, 157, 175, 183, 189, 191: K, H; 159, 163: Γ , K, H; 160, 166: Γ , Z; 161, 167, 205: Γ ; 162, 164: Γ , A, K, H; 165: Γ , K; 176, 184-186, 190, 192-194: K; 202, 203: L; 206: Γ , H; 216: X
	P-WNLs	87, 107, 121, 139: P; 103, 124: Z, A; 104, 126, 128, 130, 161, 167: Z; 106, 133, 159, 163, 188, 190: A; 147, 156-158: Γ , A; 148: Γ , Z; 165, 184, 192: A, H; 216, 219, 226-228: L; 220: Γ , H, P; 222: X; 225: L, W; 230: Γ , H
	P-QNL	81, 83, 99, 111, 115, 123: Γ , M, Z, A; 82, 85, 87, 100, 107, 108, 113, 117, 119, 120, 121, 125, 127, 129, 139, 140: Γ , Z; 84, 101, 103, 105, 112, 116, 124, 131, 132: Γ , M; 86, 102, 118, 134, 174, 175, 183, 187, 189, 191: Γ , A; 88, 104, 106, 109, 110, 114, 122, 126, 128, 130, 133, 135-138, 141, 142, 176, 184-186, 188, 190, 192-194: Γ ; 215, 221: X, M; 218, 223: M; 219, 225, 226: X
	P-NS	176, 185, 186, 193, 194: A, H
	P-NSs	114, 128, 137: A
	P-WNL/NS	176, 186, 194: H
II	C-4 WP	195, 207, 208: Γ , R; 196, 209, 210: Γ ; 197, 211: Γ , H
	CCDP	218, 222, 223: R
	P-WNL	200, 201: Γ , R; 202, 203: Γ ; 204: Γ , H, P
	P-WNLs	215, 218, 222-224: Γ , R; 217: Γ , H, P; 219, 226, 228: Γ

2. Material examples

We select four ideal topological phonon materials to further illustrate the EMPs enforced by representations and WYPOs. Their phonon spectra are shown in Fig. S9.

Fig. S9(a) shows the phonon spectrum of Na_2PdCl_4 (MPID 29359, SG 130). All branch nodes are DPs at the R point, and all other branch nodes are twofold degenerate at the A, X, and M points, which correspond to QDPs, P-NSs (the plural form of P-NS), and P-NSs (the plural form of P-NS), respectively. This is consistent with the symmetry results of EMPs enforced by representations at the HSPs listed above (Table S8). Table S9 shows that the P-QNL at the Γ point, and P-WNLs along with QDP at the Z point, are all enforced to appear by WYPOs in SG 130. Therefore, P-QNL or QDP will definitely appear at the corresponding HSP and will be accompanied by other types of EMPs or topologically trivial bands. These results are consistent with the phonon spectrum in Fig. S9(a).

Fig. S9(b) shows the phonon spectrum of Zr_3N_4 (MPID 11661, SG 220). Here, we focus on SPs, which have garnered significant interest due to their maximum degeneracy in bosonic systems. Table S9 shows that the CCDP, SP, and P-WNLs

are all enforced to appear at the H point in SG 220 by WYPOs. At the H point of this material, there are five SPs marked by red circles, two CCDPs marked by blue circles, and two P-WNLs (the plural form of P-WNL) marked by green circles, with no topologically trivial bands present. In the high-frequency part of the phonon spectrum, these SPs are well separated, which facilitates their observation in experiments.

Fig. S9(c) and Fig. S9(d) show the projected phonon dispersion of CsCl (MPID 22865, SG 221) and Na₃BrO (MPID 985586, SG 221). In the CsCl material, each of the 1a and 1b WYPOs is occupied once, so P-WNLs do not appear. In contrast, in Na₃BrO, the 1a, 1b, and 3c WYPOs are each occupied once, with the 3c WYPO contributing to P-WNLs at the R point, resulting in one occurrence of P-WNLs at the R point, as indicated by the red circle in Fig. S9(d).

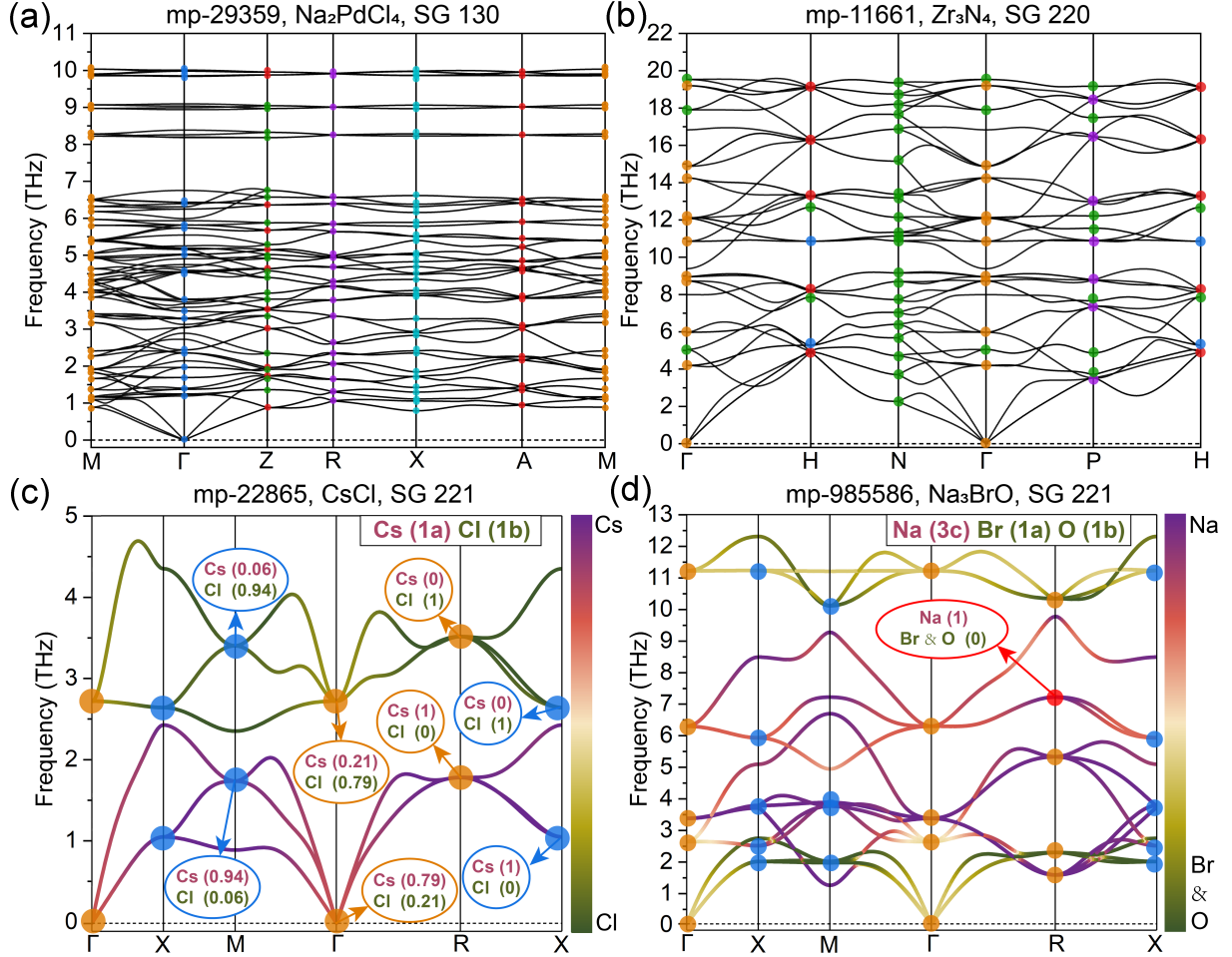


FIG. S9. The phonon spectra of four ideal topological phonon materials. (a) The phonon dispersion of Na₂PdCl₄ with MPID 29359 and SG 130. The DP is marked by purple circle, the QDP is marked by red circle, the P-NS is marked by cyan circle, the P-NSs is marked by orange circle, the P-QNL is marked by blue circle and the P-WMLs is marked by green circle at the HSPs. (b) The phonon dispersion of Zr₃N₄ with MPID 11661 and SG 220. The DP is marked by purple circle, the QCTP is marked by orange circle, the CCDP is marked by blue circle, the SP is marked by red circle and the P-WNLs is marked by green circle at the HSPs. (c) The projected phonon dispersion of CsCl with MPID 22865 and SG 221. The QCTP is marked by orange circle and the P-QNL is marked by blue circle at the HSPs. (d) The projected phonon dispersion of Na₃BrO with MPID 985586 and SG 221. The QCTP is marked by orange circle, the P-QNL is marked by blue circle and the P-WNLs is marked by red circle at the HSPs. The color bars in (c) and (d) represent the atomic contribution to the phonon vibration by the projection of the eigen displacements. In Na₃BrO, our focus lies on the contribution of the atoms occupying the 3c WYPO, namely Na, thus we combine the contributions of the atom at the 1a WYPO, Br, with those at the 1b WYPO, O. The deeper the purple, the greater the contribution of Cs (Na) to the phonon vibration; the deeper the green, the greater the contribution of Cl (Br and O) to the phonon vibration. In (c) and (d), the numbers inside the circles represent the contributions of different atoms to the EMPs, with the maximum value being 1 and the minimum value being 0.

S4. REPRESENTATION AND ATOMIC POSITION-RESOLVED PHONON ANGULAR MOMENTUM

In the previous section, we have obtained all EMPs that can definitely appear at HSPs in terms of (co-)irreps and WYPOs.

In this section, we provide a complete symmetry-based classification: given any SG and the WYPOs occupied by atoms, the number of occurrences of all (co-)irreps can be fully determined. Moreover, the phonon AM for each phonon mode (belonging to one (co-)irrep) and the WYPOs from which phonon AM originates can also be determined. The organization of this section is as follows.

Each subsection is devoted to one SG. At the start of each subsection, we provide the Bravais lattice type; the conventional lattice vectors $(\vec{a}, \vec{b}, \vec{c})$ and their Cartesian components; and the relations between the primitive lattice vectors $(\vec{t}_1, \vec{t}_2, \vec{t}_3)$ and the conventional lattice vectors $(\vec{a}, \vec{b}, \vec{c})$ for the corresponding SG.

Each subsection is divided into four subsubsections, (a), (b), (c), and (d). Subsubsection (a) presents the SG operations $\{R|\tau\}$, where R denotes the rotational part and τ denotes the translational part. The specific meanings of R are listed in Table S10. Subsubsections (b), (c), and (d) present detailed results of phonon AM resolved by (co-)irreps and WYPOs for the HSPs, HSLs, and HSPLs of the corresponding SG, respectively. Below, we demonstrate how to use the symmetry results at HSPs. The analysis for HSLs and HSPLs proceeds analogously.

The results at HSPs consist of two tabulations. The first tabulation lists all inequivalent HSPs and their coordinates in the primitive basis, together with all symmetry-equivalent HSPs generated by the SG operations. The second tabulation provides the phonon AM expressions resolved by (co-)irreps and WYPOs for all HSPs of the corresponding SG. For each HSP, the first column lists the (co-)irreps in order (the corresponding (co-)irrep names are provided in our online database). For each (co-)irrep, the second column gives the symmetry-resolved phonon AM expression. The third column lists, for a single atom placed at a given WYPO, the multiplicity of the (co-)irrep induced by that WYPO (numbers in parentheses). For a specific material, the total multiplicity is obtained by summing the contributions from its occupied WYPOs. WYPOs that allow a nonvanishing phonon AM are printed in bold. For instance, for HSP K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of SG 187, when WYPO 1b is occupied once, co-irreps $\{3\}$, $\{4\}$, and $\{5\}$ will appear once at HSP K $(-\frac{1}{3}, \frac{2}{3}, 0)$, respectively. In addition, a phonon mode corresponding to co-irrep $\{2\}$ can carry a nonvanishing phonon AM $(0, 0, r_1)$, where $r_1 \neq 0$ at HSP K $(-\frac{1}{3}, \frac{2}{3}, 0)$ when the atoms occupy at least one of the WYPOs $\{2g, 2h, 6n, \text{ and } 12o\}$. These tabulations serve as a powerful guide for searching and designing materials that host both EMPs and phonon AM.

TABLE S10. Information on the rotational parts of the symmetry operations of all 230 SGs, including their names, rotation axes, rotation angles, and the determinants (Det) of the rotation matrices. The values Det= 1 and Det= -1 indicate a proper rotation and an improper rotation (roto-inversion), respectively. The notation for the rotational parts follows the convention adopted in Ref. [75].

Name	$\vec{n}$	Angle	Det	Name	$\vec{n}$	Angle	Det	Name	$\vec{n}$	Angle	Det	Name	$\vec{n}$	Angle	Det
E	$(0\ 0\ 1)$	0	1	I	$(0\ 0\ 1)$	0	-1	C_{2y}	$(0\ 1\ 0)$	π	1	σ_y	$(0\ 1\ 0)$	π	-1
C_{2z}	$(0\ 0\ 1)$	π	1	C_{2x}	$(1\ 0\ 0)$	π	1	σ_x	$(1\ 0\ 0)$	π	-1	σ_z	$(0\ 0\ 1)$	π	-1
C_{4z}^+	$(0\ 0\ 1)$	$\frac{\pi}{2}$	1	C_{4z}^-	$(0\ 0\ 1)$	$-\frac{\pi}{2}$	1	S_{4z}^+	$(0\ 0\ 1)$	$-\frac{\pi}{2}$	-1	S_{4z}^-	$(0\ 0\ 1)$	$\frac{\pi}{2}$	-1
C_{2a}	$(\frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}}\ 0)$	π	1	C_{2b}	$(-\frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}}\ 0)$	π	1	σ_{db}	$(-\frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}}\ 0)$	π	-1	σ_{da}	$(\frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}}\ 0)$	π	-1
C_3^+	$(0\ 0\ 1)$	$\frac{2\pi}{3}$	1	C_3^-	$(0\ 0\ 1)$	$-\frac{2\pi}{3}$	1	S_6^+	$(0\ 0\ 1)$	$-\frac{2\pi}{3}$	-1	S_6^-	$(0\ 0\ 1)$	$\frac{2\pi}{3}$	-1
C_{23}''	$(-\frac{\sqrt{3}}{2}\ \frac{1}{2}\ 0)$	π	1	C_{22}''	$(\frac{\sqrt{3}}{2}\ \frac{1}{2}\ 0)$	π	1	C_{23}'	$(\frac{1}{2}\ \frac{\sqrt{3}}{2}\ 0)$	π	1	C_{22}'	$(-\frac{1}{2}\ \frac{\sqrt{3}}{2}\ 0)$	π	1
σ_{d3}	$(\frac{1}{2}\ \frac{\sqrt{3}}{2}\ 0)$	π	-1	σ_{d2}	$(-\frac{1}{2}\ \frac{\sqrt{3}}{2}\ 0)$	π	-1	σ_{v3}	$(-\frac{\sqrt{3}}{2}\ \frac{1}{2}\ 0)$	π	-1	σ_{v2}	$(\frac{\sqrt{3}}{2}\ \frac{1}{2}\ 0)$	π	-1
C_6^+	$(0\ 0\ 1)$	$\frac{\pi}{3}$	1	C_6^-	$(0\ 0\ 1)$	$-\frac{\pi}{3}$	1	S_3^+	$(0\ 0\ 1)$	$-\frac{\pi}{3}$	-1	S_3^-	$(0\ 0\ 1)$	$\frac{\pi}{3}$	-1
C_{31}^+	$(\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}})$	$\frac{2\pi}{3}$	1	C_{34}^+	$(-\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}})$	$\frac{2\pi}{3}$	1	C_{33}^+	$(\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}})$	$\frac{2\pi}{3}$	1	C_{32}^+	$(-\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}})$	$\frac{2\pi}{3}$	1
C_{31}^-	$(\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}})$	$-\frac{2\pi}{3}$	1	C_{33}^-	$(\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}})$	$-\frac{2\pi}{3}$	1	C_{32}^-	$(-\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}})$	$-\frac{2\pi}{3}$	1	C_{34}^-	$(-\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}})$	$-\frac{2\pi}{3}$	1
S_{61}^-	$(\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}})$	$\frac{2\pi}{3}$	-1	S_{64}^-	$(-\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}})$	$\frac{2\pi}{3}$	-1	S_{63}^-	$(\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}})$	$\frac{2\pi}{3}$	-1	S_{62}^-	$(-\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}})$	$\frac{2\pi}{3}$	-1
S_{61}^+	$(\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}})$	$-\frac{2\pi}{3}$	-1	S_{63}^+	$(\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}})$	$-\frac{2\pi}{3}$	-1	S_{62}^+	$(-\frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}})$	$-\frac{2\pi}{3}$	-1	S_{64}^+	$(-\frac{1}{\sqrt{3}}\ \frac{1}{\sqrt{3}}\ -\frac{1}{\sqrt{3}})$	$-\frac{2\pi}{3}$	-1
C_{4x}^+	$(1\ 0\ 0)$	$\frac{\pi}{2}$	1	C_{4y}^-	$(0\ 1\ 0)$	$-\frac{\pi}{2}$	1	C_{4x}^-	$(1\ 0\ 0)$	$-\frac{\pi}{2}$	1	C_{4y}^+	$(0\ 1\ 0)$	$\frac{\pi}{2}$	1
C_{2f}	$(0\ -\frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}})$	π	1	C_{2d}	$(0\ \frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}})$	π	1	C_{2c}	$(\frac{1}{\sqrt{2}}\ 0\ \frac{1}{\sqrt{2}})$	π	1	C_{2e}	$(-\frac{1}{\sqrt{2}}\ 0\ \frac{1}{\sqrt{2}})$	π	1
S_{4x}^-	$(1\ 0\ 0)$	$\frac{\pi}{2}$	-1	S_{4y}^+	$(0\ 1\ 0)$	$-\frac{\pi}{2}$	-1	S_{4x}^+	$(1\ 0\ 0)$	$-\frac{\pi}{2}$	-1	S_{4y}^-	$(0\ 1\ 0)$	$\frac{\pi}{2}$	-1
σ_{df}	$(0\ -\frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}})$	π	-1	σ_{dd}	$(0\ \frac{1}{\sqrt{2}}\ \frac{1}{\sqrt{2}})$	π	-1	σ_{dc}	$(\frac{1}{\sqrt{2}}\ 0\ \frac{1}{\sqrt{2}})$	π	-1	σ_{de}	$(-\frac{1}{\sqrt{2}}\ 0\ \frac{1}{\sqrt{2}})$	π	-1

1. Space group No. 1 ($P1$)

Triclinic primitive lattice

$$\begin{aligned}\vec{a} &= (t_{1x}, t_{1y}, t_{1z}) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (t_{2x}, t_{2y}, t_{2z}) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (t_{3x}, t_{3y}, t_{3z}) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate $(0, 0, 0)$
$B(\frac{1}{2}, 0, 0)$
Operation E
Coordinate $(\frac{1}{2}, 0, 0)$
$F(0, \frac{1}{2}, 0)$
Operation E
Coordinate $(0, \frac{1}{2}, 0)$
$G(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$
$M1(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$M2(0, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$
$M3(\frac{1}{2}, 0, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, 0, \frac{1}{2})$
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E

Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 1		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3)
$B (\frac{1}{2}, 0, 0)$ of space group No. 1		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3)
$F (0, \frac{1}{2}, 0)$ of space group No. 1		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3)
$G (0, 0, \frac{1}{2})$ of space group No. 1		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3)
$M1 (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 1		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3)
$M2 (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 1		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3)
$M3 (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 1		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3)
$L (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 1		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3)

2. Space group No. 2 ($P\bar{1}$)

Triclinic primitive lattice

$$\begin{aligned}\vec{a} &= (t_{1x}, t_{1y}, t_{1z}) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (t_{2x}, t_{2y}, t_{2z}) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (t_{3x}, t_{3y}, t_{3z}) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{I|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$B(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$
$F(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$
$G(0, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, \frac{1}{2})$
$M1(\frac{1}{2}, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
$M2(0, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$
$M3(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 2		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (3)
2	$(0, 0, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 1g: (3); 1h: (3); 2i: (3)

$B(\frac{1}{2}, 0, 0)$ of space group No. 2		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (3); 1e: (3); 1f: (3); 1g: (0); 1h: (3); 2i: (3)
2	(0, 0, 0)	1a: (3); 1b: (3); 1c: (3); 1d: (0); 1e: (0); 1f: (0); 1g: (3); 1h: (0); 2i: (3)
F $(0, \frac{1}{2}, 0)$ of space group No. 2		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (3); 1d: (0); 1e: (3); 1f: (0); 1g: (3); 1h: (3); 2i: (3)
2	(0, 0, 0)	1a: (3); 1b: (3); 1c: (0); 1d: (3); 1e: (0); 1f: (3); 1g: (0); 1h: (0); 2i: (3)
G $(0, 0, \frac{1}{2})$ of space group No. 2		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (3); 1c: (0); 1d: (0); 1e: (0); 1f: (3); 1g: (3); 1h: (3); 2i: (3)
2	(0, 0, 0)	1a: (3); 1b: (0); 1c: (3); 1d: (3); 1e: (3); 1f: (0); 1g: (0); 1h: (0); 2i: (3)
M1 $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 2		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (3); 1d: (3); 1e: (0); 1f: (3); 1g: (3); 1h: (0); 2i: (3)
2	(0, 0, 0)	1a: (3); 1b: (3); 1c: (0); 1d: (0); 1e: (3); 1f: (0); 1g: (0); 1h: (3); 2i: (3)
M2 $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 2		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (3); 1c: (3); 1d: (0); 1e: (3); 1f: (3); 1g: (0); 1h: (0); 2i: (3)
2	(0, 0, 0)	1a: (3); 1b: (0); 1c: (0); 1d: (3); 1e: (0); 1f: (0); 1g: (3); 1h: (3); 2i: (3)
M3 $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 2		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (3); 1c: (0); 1d: (3); 1e: (3); 1f: (0); 1g: (3); 1h: (0); 2i: (3)
2	(0, 0, 0)	1a: (3); 1b: (0); 1c: (3); 1d: (0); 1e: (0); 1f: (3); 1g: (0); 1h: (3); 2i: (3)
L $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 2		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (3); 1c: (3); 1d: (3); 1e: (0); 1f: (0); 1g: (0); 1h: (3); 2i: (3)
2	(0, 0, 0)	1a: (3); 1b: (0); 1c: (0); 1d: (0); 1e: (3); 1f: (3); 1g: (3); 1h: (0); 2i: (3)

3. Space group No. 3 ($P2$)

$$\begin{aligned}
 \vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \vec{a} \\
 \text{Monoclinic primitive lattice} \quad \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \{C_{2y}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$B(0, 0, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, -\frac{1}{2})$
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$
$Z(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$
$C(\frac{1}{2}, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
$D(0, \frac{1}{2}, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$
$A(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$
$E(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 3				
(Co-) irrep	Phonon AM	WYPO information		
1	$(0, 0, 0)$	1a: (1);	1b: (1);	1c: (1); 1d: (1); 2e: (3)
2	$(0, 0, 0)$	1a: (2);	1b: (2);	1c: (2); 1d: (2); 2e: (3)
$B(0, 0, -\frac{1}{2})$ of space group No. 3				
(Co-) irrep	Phonon AM	WYPO information		
1	$(0, 0, 0)$	1a: (1);	1b: (2);	1c: (1); 1d: (2); 2e: (3)
2	$(0, 0, 0)$	1a: (2);	1b: (1);	1c: (2); 1d: (1); 2e: (3)
$Y(\frac{1}{2}, 0, 0)$ of space group No. 3				

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3)
$Z\left(0, \frac{1}{2}, 0\right)$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3)
$C\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3)
$D\left(0, \frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (3)
2	(0, 0, 0)	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (3)
$A\left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (2); 1c: (2); 1d: (1); 2e: (3)
2	(0, 0, 0)	1a: (2); 1b: (1); 1c: (1); 1d: (2); 2e: (3)
$E\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (2); 1c: (2); 1d: (1); 2e: (3)
2	(0, 0, 0)	1a: (2); 1b: (1); 1c: (1); 1d: (2); 2e: (3)

c. Results for high-symmetry lines

LD(0, v , 0)

Operation E
Coordinate (0, v , 0)

U($\frac{1}{2}$, v , $\frac{1}{2}$)

Operation E
Coordinate ($\frac{1}{2}$, v , $\frac{1}{2}$)

V(0, v , $\frac{1}{2}$)

Operation E
Coordinate (0, v , $\frac{1}{2}$)

W($\frac{1}{2}$, v , 0)

Operation E

Coordinate $(\frac{1}{2}, v, 0)$

LD $(0, v, 0)$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3)
2	$(0, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3)
U $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (2); 1d: (1); 2e: (3)
2	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (1); 1d: (2); 2e: (3)
V $(0, v, \frac{1}{2})$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (3)
2	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (3)
W $(\frac{1}{2}, v, 0)$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3)
2	$(0, r_1, 0)$	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3)

d. Results for high-symmetry planes

P1 $(v, \frac{1}{2}, u)$

Operation E
Coordinate $(v, \frac{1}{2}, u)$

P2 $(v, 0, u)$

Operation E
Coordinate $(v, 0, u)$

P1 $(v, \frac{1}{2}, u)$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6)
P2 $(v, 0, u)$ of space group No. 3		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6)

4. Space group No. 4 ($P2_1$)

Monoclinic primitive lattice

$$\begin{aligned}\vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|0, \frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate $(0, 0, 0)$
$B(0, 0, -\frac{1}{2})$
Operation E
Coordinate $(0, 0, -\frac{1}{2})$
$Y(\frac{1}{2}, 0, 0)$
Operation E
Coordinate $(\frac{1}{2}, 0, 0)$
$Z(0, \frac{1}{2}, 0)$
Operation E
Coordinate $(0, \frac{1}{2}, 0)$
$C(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$D(0, \frac{1}{2}, -\frac{1}{2})$
Operation E
Coordinate $(0, \frac{1}{2}, -\frac{1}{2})$
$A(\frac{1}{2}, 0, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, 0, \frac{1}{2})$

$$E\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

Operation	E
Coordinate	$\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$

$\Gamma (0, 0, 0)$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
2	(0, 0, 0)	2a: (3)

$B (0, 0, -\frac{1}{2})$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
2	(0, 0, 0)	2a: (3)

$Y (\frac{1}{2}, 0, 0)$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
2	(0, 0, 0)	2a: (3)

$Z (0, \frac{1}{2}, 0)$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)

$C (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)

$D (0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)

$A (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
2	(0, 0, 0)	2a: (3)

$E (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)

c. Results for high-symmetry lines

 $LD(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

 $U(\frac{1}{2}, v, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

 $V(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

 $W(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

LD $(0, v, 0)$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3)
2	$(0, r_1, 0)$	2a: (3)
U $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3)
2	$(0, r_1, 0)$	2a: (3)
V $(0, v, \frac{1}{2})$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3)
2	$(0, r_1, 0)$	2a: (3)
W $(\frac{1}{2}, v, 0)$ of space group No. 4		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3)
2	$(0, r_1, 0)$	2a: (3)

d. Results for high-symmetry planes

 $P1(v, \frac{1}{2}, u)$

Operation E
Coordinate $(v, \frac{1}{2}, u)$

P2($v, 0, u$)

Operation	E
Coordinate	($v, 0, u$)

P1 ($v, \frac{1}{2}, u$) of space group No. 4

(Co-) irrep	Phonon AM	WYPO information
1	($r_2, 0, r_1$)	2a: (3)

P2 ($v, 0, u$) of space group No. 4

(Co-) irrep	Phonon AM	WYPO information
1	($r_2, 0, r_1$)	2a: (6)

5. Space group No. 5 ($B2$)

Monoclinic base-centered lattice

$\vec{a} = (a \sin \gamma, 0, a \cos \gamma)$	$\vec{t}_1 = \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b}$
$\vec{b} = (0, c, 0)$	$\vec{t}_2 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b}$
$\vec{c} = (0, 0, b)$	$\vec{t}_3 = \vec{c}$

a. Space group operations

$\{E|0, 0, 0\} \{C_{2y}|0, 0, 0\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$

Operation	E
Coordinate	(0, 0, 0)

A($0, 0, -\frac{1}{2}$)

Operation	E
Coordinate	($0, 0, -\frac{1}{2}$)

Z($-\frac{1}{2}, \frac{1}{2}, 0$)

Operation	E
Coordinate	($-\frac{1}{2}, \frac{1}{2}, 0$)

$M(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$	
$L(0, \frac{1}{2}, -\frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$V(0, \frac{1}{2}, 0)$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma (0, 0, 0)$ of space group No. 5			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)	
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)	
$A (0, 0, -\frac{1}{2})$ of space group No. 5			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)	
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)	
$Z (-\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 5			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)	
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)	
$M (-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 5			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)	
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)	
$L (0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 5			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)	
$V (0, \frac{1}{2}, 0)$ of space group No. 5			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)	

c. Results for high-symmetry lines

$\text{LD}\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$	
Operation	E
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$
$\text{U}\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$	
Operation	E
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$

$\text{LD}\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$ of space group No. 5		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 2b: (1); 4c: (3)
2	$(0, r_1, 0)$	2a: (2); 2b: (2); 4c: (3)
$\text{U}\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$ of space group No. 5		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 2b: (2); 4c: (3)
2	$(0, r_1, 0)$	2a: (2); 2b: (1); 4c: (3)

d. Results for high-symmetry planes

$\text{P1}(v, v, u)$	
Operation	E
Coordinate	(v, v, u)

$\text{P1}(v, v, u)$ of space group No. 5		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 4c: (6)

6. Space group No. 6 (Pm)

Monoclinic primitive lattice

$$\begin{aligned} \vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$B(0, 0, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, -\frac{1}{2})$
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$
$Z(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$
$C(\frac{1}{2}, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
$D(0, \frac{1}{2}, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$
$A(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$
$E(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 6			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	1a: (2);	1b: (2); 2c: (3)
2	$(0, 0, 0)$	1a: (1);	1b: (1); 2c: (3)
$B(0, 0, -\frac{1}{2})$ of space group No. 6			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	1a: (2);	1b: (2); 2c: (3)
2	$(0, 0, 0)$	1a: (1);	1b: (1); 2c: (3)
$Y(\frac{1}{2}, 0, 0)$ of space group No. 6			

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (3)
Z $(0, \frac{1}{2}, 0)$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 2c: (3)
2	(0, 0, 0)	1a: (1); 1b: (2); 2c: (3)
C $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 2c: (3)
2	(0, 0, 0)	1a: (1); 1b: (2); 2c: (3)
D $(0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 2c: (3)
2	(0, 0, 0)	1a: (1); 1b: (2); 2c: (3)
A $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (3)
E $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 2c: (3)
2	(0, 0, 0)	1a: (1); 1b: (2); 2c: (3)

c. Results for high-symmetry lines

LD(0, v , 0)

Operation E
Coordinate (0, v , 0)

U($\frac{1}{2}$, v , $\frac{1}{2}$)

Operation E
Coordinate ($\frac{1}{2}$, v , $\frac{1}{2}$)

V(0, v , $\frac{1}{2}$)

Operation E
Coordinate (0, v , $\frac{1}{2}$)

W($\frac{1}{2}$, v , 0)

Operation E

Coordinate $(\frac{1}{2}, v, 0)$

LD $(0, v, 0)$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 2c: (6)
U $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 2c: (6)
V $(0, v, \frac{1}{2})$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 2c: (6)
W $(\frac{1}{2}, v, 0)$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 2c: (6)

d. Results for high-symmetry planes

P1 $(v, \frac{1}{2}, u)$	
Operation	E
Coordinate	$(v, \frac{1}{2}, u)$
P2 $(v, 0, u)$	
Operation	E
Coordinate	$(v, 0, u)$

P1 $(v, \frac{1}{2}, u)$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (1); 2c: (3)
2	$(0, r_1, 0)$	1a: (1); 1b: (2); 2c: (3)
P2 $(v, 0, u)$ of space group No. 6		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (2); 2c: (3)
2	$(0, r_1, 0)$	1a: (1); 1b: (1); 2c: (3)

7. Space group No. 7 (*Pb*)

Monoclinic primitive lattice

$$\begin{aligned}
 \vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{\sigma_y|0, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$B(0, 0, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, -\frac{1}{2})$
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$
$Z(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$
$C(\frac{1}{2}, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
$D(0, \frac{1}{2}, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$
$A(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$
$E(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 7

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (3)
2	(0, 0, 0)	2a: (3)
B $(0, 0, -\frac{1}{2})$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
Y $(\frac{1}{2}, 0, 0)$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
2	(0, 0, 0)	2a: (3)
Z $(0, \frac{1}{2}, 0)$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
2	(0, 0, 0)	2a: (3)
C $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
2	(0, 0, 0)	2a: (3)
D $(0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
A $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)
E $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3)

c. Results for high-symmetry lines

LD(0, v , 0)

Operation E
Coordinate (0, v , 0)

U($\frac{1}{2}$, v , $\frac{1}{2}$)

Operation E
Coordinate ($\frac{1}{2}$, v , $\frac{1}{2}$)

V(0, v , $\frac{1}{2}$)

Operation E
Coordinate $(0, v, \frac{1}{2})$

$W(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

LD $(0, v, 0)$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (6)
U $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3)
V $(0, v, \frac{1}{2})$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3)
W $(\frac{1}{2}, v, 0)$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (6)

d. Results for high-symmetry planes

$P1(v, \frac{1}{2}, u)$

Operation E
Coordinate $(v, \frac{1}{2}, u)$

$P2(v, 0, u)$

Operation E
Coordinate $(v, 0, u)$

P1 $(v, \frac{1}{2}, u)$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3)
2	$(0, r_1, 0)$	2a: (3)
P2 $(v, 0, u)$ of space group No. 7		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_1, 0)$	2a: (3)
2	$(0, r_1, 0)$	2a: (3)

8. Space group No. 8 (Bm)

Monoclinic base-centered lattice

$$\begin{aligned}\vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$A(0, 0, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, -\frac{1}{2})$
$Z(-\frac{1}{2}, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, 0)$
$M(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$	
Operation	E
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$
$L(0, \frac{1}{2}, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$
$V(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$
	σ_y
	$(\frac{1}{2}, 0, -\frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 8		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3)
2	(0, 0, 0)	2a: (1); 4b: (3)
$A (0, 0, -\frac{1}{2})$ of space group No. 8		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3)
2	(0, 0, 0)	2a: (1); 4b: (3)
$Z (-\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 8		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3)
2	(0, 0, 0)	2a: (1); 4b: (3)
$M (-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 8		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3)
2	(0, 0, 0)	2a: (1); 4b: (3)
$L (0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 8		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6)
$V (0, \frac{1}{2}, 0)$ of space group No. 8		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6)

c. Results for high-symmetry lines

$LD(-\frac{v}{2}, \frac{v}{2}, 0)$	
Operation	E
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, 0)$
$U(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$

$LD (-\frac{v}{2}, \frac{v}{2}, 0)$ of space group No. 8		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 4b: (6)

U $(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$ of space group No. 8		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 4b: (6)

d. Results for high-symmetry planes

P1(v, v, u)

Operation E
Coordinate (v, v, u)

P1 (v, v, u) of space group No. 8		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 4b: (3)
2	$(0, r_1, 0)$	2a: (1); 4b: (3)

9. Space group No. 9 (Bb)

Monoclinic base-centered lattice

$$\begin{aligned} \vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{\sigma_y|0, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$

Operation E
Coordinate (0, 0, 0)

$A(0, 0, -\frac{1}{2})$

Operation E
Coordinate $(0, 0, -\frac{1}{2})$

$Z(-\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, 0)$	
$M(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$	
$L(0, \frac{1}{2}, -\frac{1}{2})$		
Operation	E	σ_y
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$V(0, \frac{1}{2}, 0)$		
Operation	E	σ_y
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$

$\Gamma (0, 0, 0)$ of space group No. 9		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
$A (0, 0, -\frac{1}{2})$ of space group No. 9		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
$Z (-\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 9		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
$M (-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 9		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
$L (0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 9		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
$V (0, \frac{1}{2}, 0)$ of space group No. 9		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)

c. Results for high-symmetry lines

$$\text{LD}\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$$

Operation	E
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$

$$\text{U}\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$$

Operation	E
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$

$$\text{LD}\left(-\frac{v}{2}, \frac{v}{2}, 0\right) \text{ of space group No. 9}$$

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6)

$$\text{U}\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right) \text{ of space group No. 9}$$

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (3)

d. Results for high-symmetry planes

$$\text{P1}(v, v, u)$$

Operation	E
Coordinate	(v, v, u)

$$\text{P1}(v, v, u) \text{ of space group No. 9}$$

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3)
2	$(0, r_1, 0)$	4a: (3)

10. Space group No. 10 ($P2/m$)

$$\begin{array}{ll} \vec{a} = (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 = \vec{a} \\ \text{Monoclinic primitive lattice} & \vec{b} = (0, c, 0) \quad \vec{t}_2 = \vec{b} \\ & \vec{c} = (0, 0, b) \quad \vec{t}_3 = \vec{c} \end{array}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$B(0, 0, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, -\frac{1}{2})$
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$
$Z(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$
$C(\frac{1}{2}, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
$D(0, \frac{1}{2}, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$
$A(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$
$E(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 10		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (2); 2n: (2); 4o: (3)
2	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 4o: (3)
3	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (1); 2n: (1); 4o: (3)
4	$(0, 0, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 4o: (3)
$B(0, 0, -\frac{1}{2})$ of space group No. 10		

3	(0, 0, 0)	1a: (0); 1b: (2); 1c: (1); 1d: (0); 1e: (2); 1f: (0); 1g: (1); 1h: (0); 2i: (2); 2j: (2); 2k: (1); 2l: (1); 2m: (1); 2n: (2); 4o: (3)
4	(0, 0, 0)	1a: (2); 1b: (0); 1c: (0); 1d: (2); 1e: (0); 1f: (1); 1g: (0); 1h: (1); 2i: (2); 2j: (2); 2k: (1); 2l: (1); 2m: (2); 2n: (1); 4o: (3)

A $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 10

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (0); 1h: (0); 2i: (1); 2j: (2); 2k: (2); 2l: (1); 2m: (2); 2n: (2); 4o: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (1); 1h: (1); 2i: (1); 2j: (2); 2k: (2); 2l: (1); 2m: (1); 2n: (1); 4o: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (0); 1h: (0); 2i: (2); 2j: (1); 2k: (1); 2l: (2); 2m: (1); 2n: (1); 4o: (3)
4	(0, 0, 0)	1a: (2); 1b: (2); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (2); 1h: (2); 2i: (2); 2j: (1); 2k: (1); 2l: (2); 2m: (2); 2n: (2); 4o: (3)

E $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 10

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (2); 1d: (2); 1e: (0); 1f: (0); 1g: (0); 1h: (1); 2i: (1); 2j: (2); 2k: (2); 2l: (1); 2m: (2); 2n: (1); 4o: (3)
2	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (0); 1e: (2); 1f: (2); 1g: (1); 1h: (0); 2i: (1); 2j: (2); 2k: (2); 2l: (1); 2m: (1); 2n: (2); 4o: (3)
3	(0, 0, 0)	1a: (0); 1b: (2); 1c: (1); 1d: (1); 1e: (0); 1f: (0); 1g: (0); 1h: (2); 2i: (2); 2j: (1); 2k: (1); 2l: (2); 2m: (1); 2n: (2); 4o: (3)
4	(0, 0, 0)	1a: (2); 1b: (0); 1c: (0); 1d: (0); 1e: (1); 1f: (1); 1g: (2); 1h: (0); 2i: (2); 2j: (1); 2k: (1); 2l: (2); 2m: (2); 2n: (1); 4o: (3)

c. Results for high-symmetry lines

LD(0, v , 0)

Operation E
Coordinate (0, v , 0)

U($\frac{1}{2}$, v , $\frac{1}{2}$)

Operation E
Coordinate ($\frac{1}{2}$, v , $\frac{1}{2}$)

V(0, v , $\frac{1}{2}$)

Operation E
Coordinate (0, v , $\frac{1}{2}$)

W($\frac{1}{2}$, v , 0)

Operation E
Coordinate ($\frac{1}{2}$, v , 0)

LD (0, v , 0) of space group No. 10

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (3); 2n: (3); 4o: (6)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (4); 2j: (4); 2k: (4); 2l: (4); 2m: (3); 2n: (3); 4o: (6)
U $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 10		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (1); 1h: (1); 2i: (2); 2j: (4); 2k: (4); 2l: (2); 2m: (3); 2n: (3); 4o: (6)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (2); 1h: (2); 2i: (4); 2j: (2); 2k: (2); 2l: (4); 2m: (3); 2n: (3); 4o: (6)
V $(0, v, \frac{1}{2})$ of space group No. 10		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (2); 1d: (1); 1e: (1); 1f: (2); 1g: (2); 1h: (2); 2i: (2); 2j: (2); 2k: (4); 2l: (4); 2m: (3); 2n: (3); 4o: (6)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (1); 1d: (2); 1e: (2); 1f: (1); 1g: (1); 1h: (1); 2i: (4); 2j: (4); 2k: (2); 2l: (2); 2m: (3); 2n: (3); 4o: (6)
W $(\frac{1}{2}, v, 0)$ of space group No. 10		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (2); 1e: (2); 1f: (1); 1g: (2); 1h: (2); 2i: (2); 2j: (4); 2k: (2); 2l: (4); 2m: (3); 2n: (3); 4o: (6)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (1); 1e: (1); 1f: (2); 1g: (1); 1h: (1); 2i: (4); 2j: (2); 2k: (4); 2l: (2); 2m: (3); 2n: (3); 4o: (6)

d. Results for high-symmetry planes

P1 $(v, \frac{1}{2}, u)$

Operation E
Coordinate $(v, \frac{1}{2}, u)$

P2 $(v, 0, u)$

Operation E
Coordinate $(v, 0, u)$

P1 $(v, \frac{1}{2}, u)$ of space group No. 10		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 1c: (2); 1d: (2); 1e: (1); 1f: (1); 1g: (2); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (4); 2n: (2); 4o: (6)
2	(0, 0, 0)	1a: (1); 1b: (2); 1c: (1); 1d: (1); 1e: (2); 1f: (2); 1g: (1); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (2); 2n: (4); 4o: (6)
P2 $(v, 0, u)$ of space group No. 10		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (4); 2n: (4); 4o: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (2); 2n: (2); 4o: (6)

11. Space group No. 11 ($P2_1/m$)

Monoclinic primitive lattice

$$\begin{aligned} \vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|0, \frac{1}{2}, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_y|0, -\frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate (0, 0, 0)
$B(0, 0, -\frac{1}{2})$
Operation E
Coordinate (0, 0, $-\frac{1}{2}$)
$Y(\frac{1}{2}, 0, 0)$
Operation E
Coordinate ($\frac{1}{2}, 0, 0$)
$Z(0, \frac{1}{2}, 0)$
Operation E
Coordinate (0, $\frac{1}{2}, 0$)
$C(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate ($\frac{1}{2}, \frac{1}{2}, 0$)
$D(0, \frac{1}{2}, -\frac{1}{2})$
Operation E
Coordinate (0, $\frac{1}{2}, -\frac{1}{2}$)

$$A\left(\frac{1}{2}, 0, \frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, 0, \frac{1}{2}\right) \end{array}$$

$$E\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 11			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (2); 4f: (3)	
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (1); 4f: (3)	
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (1); 4f: (3)	
4	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (2); 4f: (3)	
$B (0, 0, -\frac{1}{2})$ of space group No. 11			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (3); 2d: (3); 2e: (2); 4f: (3)	
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (0); 2d: (0); 2e: (1); 4f: (3)	
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (3); 2d: (3); 2e: (1); 4f: (3)	
4	(0, 0, 0)	2a: (3); 2b: (3); 2c: (0); 2d: (0); 2e: (2); 4f: (3)	
$Y (\frac{1}{2}, 0, 0)$ of space group No. 11			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (0); 2b: (3); 2c: (0); 2d: (3); 2e: (2); 4f: (3)	
2	(0, 0, 0)	2a: (3); 2b: (0); 2c: (3); 2d: (0); 2e: (1); 4f: (3)	
3	(0, 0, 0)	2a: (0); 2b: (3); 2c: (0); 2d: (3); 2e: (1); 4f: (3)	
4	(0, 0, 0)	2a: (3); 2b: (0); 2c: (3); 2d: (0); 2e: (2); 4f: (3)	
$Z (0, \frac{1}{2}, 0)$ of space group No. 11			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)	
$C (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 11			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)	
$D (0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 11			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)	
$A (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 11			
(Co-) irrep	Phonon AM	WYPO information	

1	(0, 0, 0)	2a: (0); 2b: (3); 2c: (3); 2d: (0); 2e: (2); 4f: (3)
2	(0, 0, 0)	2a: (3); 2b: (0); 2c: (0); 2d: (3); 2e: (1); 4f: (3)
3	(0, 0, 0)	2a: (0); 2b: (3); 2c: (3); 2d: (0); 2e: (1); 4f: (3)
4	(0, 0, 0)	2a: (3); 2b: (0); 2c: (0); 2d: (3); 2e: (2); 4f: (3)

E $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 11		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)

c. Results for high-symmetry lines

LD(0, v , 0)

Operation E
Coordinate (0, v , 0)

U($\frac{1}{2}$, v , $\frac{1}{2}$)

Operation E
Coordinate ($\frac{1}{2}$, v , $\frac{1}{2}$)

V(0, v , $\frac{1}{2}$)

Operation E
Coordinate (0, v , $\frac{1}{2}$)

W($\frac{1}{2}$, v , 0)

Operation E
Coordinate ($\frac{1}{2}$, v , 0)

LD (0, v , 0) of space group No. 11		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)

U ($\frac{1}{2}$, v , $\frac{1}{2}$) of space group No. 11		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)

V (0, v , $\frac{1}{2}$) of space group No. 11		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)

W ($\frac{1}{2}$, v , 0) of space group No. 11		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)

d. Results for high-symmetry planes

$$\overline{\text{P1}}(v, \frac{1}{2}, u)$$

$$\begin{array}{ll} \text{Operation} & \text{E} \\ \text{Coordinate} & (v, \frac{1}{2}, u) \end{array}$$

$$\text{P2}(v, 0, u)$$

$$\begin{array}{ll} \text{Operation} & \text{E} \\ \text{Coordinate} & (v, 0, u) \end{array}$$

P1 $(v, \frac{1}{2}, u)$ of space group No. 11		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 4f: (6)
P2 $(v, 0, u)$ of space group No. 11		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (4); 4f: (6)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (2); 4f: (6)

12. Space group No. 12 ($B2/m$)

$$\begin{array}{ll} \vec{a} = (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 = \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\ \text{Monoclinic base-centered lattice } \vec{b} = (0, c, 0) & \vec{t}_2 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\ \vec{c} = (0, 0, b) & \vec{t}_3 = \vec{c} \end{array}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$A(0, 0, -\frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, -\frac{1}{2})$	
$Z(-\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, 0)$	
$M(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$	
$L(0, \frac{1}{2}, -\frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$V(0, \frac{1}{2}, 0)$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 12										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (0);	4g: (1);	4h: (1);	4i: (2); 8j: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (1);	4h: (1);	4i: (1); 8j: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (0);	4g: (2);	4h: (2);	4i: (1); 8j: (3)
4	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (2);	4h: (2);	4i: (2); 8j: (3)
$A(0, 0, -\frac{1}{2})$ of space group No. 12										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (2);	2d: (2);	4e: (0);	4f: (3);	4g: (1);	4h: (2);	4i: (2); 8j: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (0);	4e: (3);	4f: (0);	4g: (1);	4h: (2);	4i: (1); 8j: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	2d: (1);	4e: (0);	4f: (3);	4g: (2);	4h: (1);	4i: (1); 8j: (3)
4	(0, 0, 0)	2a: (2);	2b: (2);	2c: (0);	2d: (0);	4e: (3);	4f: (0);	4g: (2);	4h: (1);	4i: (2); 8j: (3)
$Z(-\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 12										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (3);	4f: (3);	4g: (1);	4h: (1);	4i: (2); 8j: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (0);	4f: (0);	4g: (1);	4h: (1);	4i: (1); 8j: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (3);	4f: (3);	4g: (2);	4h: (2);	4i: (1); 8j: (3)
4	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (0);	4f: (0);	4g: (2);	4h: (2);	4i: (2); 8j: (3)

$M \left(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2} \right)$ of space group No. 12									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (2);	2d: (2);	4e: (3);	4f: (0);	4g: (1);	4h: (2); 4i: (2); 8j: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (0);	4e: (0);	4f: (3);	4g: (1);	4h: (2); 4i: (1); 8j: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	2d: (1);	4e: (3);	4f: (0);	4g: (2);	4h: (1); 4i: (1); 8j: (3)
4	(0, 0, 0)	2a: (2);	2b: (2);	2c: (0);	2d: (0);	4e: (0);	4f: (3);	4g: (2);	4h: (1); 4i: (2); 8j: (3)

$L \left(0, \frac{1}{2}, -\frac{1}{2} \right)$ of space group No. 12									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (0);	2b: (3);	2c: (3);	2d: (0);	4e: (3);	4f: (3);	4g: (3);	4h: (3); 4i: (3); 8j: (6)
2	(0, 0, 0)	2a: (3);	2b: (0);	2c: (0);	2d: (3);	4e: (3);	4f: (3);	4g: (3);	4h: (3); 4i: (3); 8j: (6)

$V \left(0, \frac{1}{2}, 0 \right)$ of space group No. 12									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (0);	2b: (3);	2c: (0);	2d: (3);	4e: (3);	4f: (3);	4g: (3);	4h: (3); 4i: (3); 8j: (6)
2	(0, 0, 0)	2a: (3);	2b: (0);	2c: (3);	2d: (0);	4e: (3);	4f: (3);	4g: (3);	4h: (3); 4i: (3); 8j: (6)

c. Results for high-symmetry lines

$LD \left(-\frac{v}{2}, \frac{v}{2}, 0 \right)$	
Operation	E
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, 0 \right)$

$U \left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2} \right)$	
Operation	E
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2} \right)$

$LD \left(-\frac{v}{2}, \frac{v}{2}, 0 \right)$ of space group No. 12									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (2);	4h: (2); 4i: (3); 8j: (6)
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (4);	4h: (4); 4i: (3); 8j: (6)

$U \left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2} \right)$ of space group No. 12									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (2);	4h: (4); 4i: (3); 8j: (6)
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (4);	4h: (2); 4i: (3); 8j: (6)

d. Results for high-symmetry planes

P1(v, v, u)

Operation E
Coordinate (v, v, u)

P1 (v, v, u) of space group No. 12

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 8j: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 8j: (6)

13. Space group No. 13 ($P2/b$)

Monoclinic primitive lattice

$$\begin{aligned} \vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|0, 0, -\frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{\sigma_y|0, 0, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$

Operation E
Coordinate (0, 0, 0)

$B(0, 0, -\frac{1}{2})$

Operation E
Coordinate $(0, 0, -\frac{1}{2})$

$Y(\frac{1}{2}, 0, 0)$

Operation E
Coordinate $(\frac{1}{2}, 0, 0)$

$Z(0, \frac{1}{2}, 0)$

Operation E
Coordinate $(0, \frac{1}{2}, 0)$

$$C\left(\frac{1}{2}, \frac{1}{2}, 0\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, 0\right) \end{array}$$

$$D\left(0, \frac{1}{2}, -\frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(0, \frac{1}{2}, -\frac{1}{2}\right) \end{array}$$

$$A\left(\frac{1}{2}, 0, \frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, 0, \frac{1}{2}\right) \end{array}$$

$$E\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 13				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0); 2d: (0); 2e: (1); 2f: (1); 4g: (3)
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 2e: (1); 2f: (1); 4g: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0); 2d: (0); 2e: (2); 2f: (2); 4g: (3)
4	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 2e: (2); 2f: (2); 4g: (3)
$B \left(0, 0, -\frac{1}{2}\right)$ of space group No. 13				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)
$Y \left(\frac{1}{2}, 0, 0\right)$ of space group No. 13				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (3);	2c: (0); 2d: (3); 2e: (1); 2f: (2); 4g: (3)
2	(0, 0, 0)	2a: (3);	2b: (0);	2c: (3); 2d: (0); 2e: (1); 2f: (2); 4g: (3)
3	(0, 0, 0)	2a: (0);	2b: (3);	2c: (0); 2d: (3); 2e: (2); 2f: (1); 4g: (3)
4	(0, 0, 0)	2a: (3);	2b: (0);	2c: (3); 2d: (0); 2e: (2); 2f: (1); 4g: (3)
$Z \left(0, \frac{1}{2}, 0\right)$ of space group No. 13				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (3);	2c: (3); 2d: (0); 2e: (1); 2f: (1); 4g: (3)
2	(0, 0, 0)	2a: (3);	2b: (0);	2c: (0); 2d: (3); 2e: (1); 2f: (1); 4g: (3)
3	(0, 0, 0)	2a: (0);	2b: (3);	2c: (3); 2d: (0); 2e: (2); 2f: (2); 4g: (3)
4	(0, 0, 0)	2a: (3);	2b: (0);	2c: (0); 2d: (3); 2e: (2); 2f: (2); 4g: (3)
$C \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 13				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (3); 2d: (3); 2e: (1); 2f: (2); 4g: (3)

2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (0); 2d: (0); 2e: (1); 2f: (2); 4g: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (3); 2d: (3); 2e: (2); 2f: (1); 4g: (3)
4	(0, 0, 0)	2a: (3); 2b: (3); 2c: (0); 2d: (0); 2e: (2); 2f: (1); 4g: (3)

$D\left(0, \frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 13

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)

$A\left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 13

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)

$E\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 13

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)

c. Results for high-symmetry lines

$LD(0, v, 0)$

Operation	E
Coordinate	$(0, v, 0)$

$U\left(\frac{1}{2}, v, \frac{1}{2}\right)$

Operation	E
Coordinate	$\left(\frac{1}{2}, v, \frac{1}{2}\right)$

$V\left(0, v, \frac{1}{2}\right)$

Operation	E
Coordinate	$\left(0, v, \frac{1}{2}\right)$

$W\left(\frac{1}{2}, v, 0\right)$

Operation	E
Coordinate	$\left(\frac{1}{2}, v, 0\right)$

$LD(0, v, 0)$ of space group No. 13

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (2); 2f: (2); 4g: (6)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (4); 2f: (4); 4g: (6)

$U\left(\frac{1}{2}, v, \frac{1}{2}\right)$ of space group No. 13

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)

V $(0, v, \frac{1}{2})$ of space group No. 13		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)

W $(\frac{1}{2}, v, 0)$ of space group No. 13		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (2); 2f: (4); 4g: (6)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (4); 2f: (2); 4g: (6)

d. Results for high-symmetry planes

P1 $(v, \frac{1}{2}, u)$

Operation E
Coordinate $(v, \frac{1}{2}, u)$

P2 $(v, 0, u)$

Operation E
Coordinate $(v, 0, u)$

P1 $(v, \frac{1}{2}, u)$ of space group No. 13		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)

P2 $(v, 0, u)$ of space group No. 13		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6)

14. Space group No. 14 ($P2_1/b$)

Monoclinic primitive lattice

$$\begin{aligned} \vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|0, \frac{1}{2}, \frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{\sigma_y|0, -\frac{1}{2}, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate $(0, 0, 0)$
$B(0, 0, -\frac{1}{2})$
Operation E
Coordinate $(0, 0, -\frac{1}{2})$
$Y(\frac{1}{2}, 0, 0)$
Operation E
Coordinate $(\frac{1}{2}, 0, 0)$
$Z(0, \frac{1}{2}, 0)$
Operation E
Coordinate $(0, \frac{1}{2}, 0)$
$C(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$D(0, \frac{1}{2}, -\frac{1}{2})$
Operation E
Coordinate $(0, \frac{1}{2}, -\frac{1}{2})$
$A(\frac{1}{2}, 0, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, 0, \frac{1}{2})$
$E(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 14			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (3)	
2	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (3)	
3	$(0, 0, 0)$	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (3)	
4	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (3)	
$B(0, 0, -\frac{1}{2})$ of space group No. 14			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)	

Y $(\frac{1}{2}, 0, 0)$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (3); 2c: (0); 2d: (3); 4e: (3)
2	(0, 0, 0)	2a: (3); 2b: (0); 2c: (3); 2d: (0); 4e: (3)
3	(0, 0, 0)	2a: (0); 2b: (3); 2c: (0); 2d: (3); 4e: (3)
4	(0, 0, 0)	2a: (3); 2b: (0); 2c: (3); 2d: (0); 4e: (3)
Z $(0, \frac{1}{2}, 0)$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
C $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
D $(0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (0); 2d: (0); 4e: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (3); 2d: (3); 4e: (3)
A $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
E $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (0); 2c: (0); 2d: (3); 4e: (3)
2	(0, 0, 0)	2a: (0); 2b: (3); 2c: (3); 2d: (0); 4e: (3)

c. Results for high-symmetry lines

LD(0, v , 0)

Operation E
Coordinate (0, v , 0)

U($\frac{1}{2}$, v , $\frac{1}{2}$)

Operation E
Coordinate ($\frac{1}{2}$, v , $\frac{1}{2}$)

V(0, v , $\frac{1}{2}$)

Operation E
Coordinate (0, v , $\frac{1}{2}$)

W($\frac{1}{2}$, v , 0)

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, v, 0) \end{array}$$

LD $(0, v, 0)$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
U $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
V $(0, v, \frac{1}{2})$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
W $(\frac{1}{2}, v, 0)$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

d. Results for high-symmetry planes

$$\text{P1}(v, \frac{1}{2}, u)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (v, \frac{1}{2}, u) \end{array}$$

$$\text{P2}(v, 0, u)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (v, 0, u) \end{array}$$

P1 $(v, \frac{1}{2}, u)$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
P2 $(v, 0, u)$ of space group No. 14		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

15. Space group No. 15 ($B2/b$)

Monoclinic base-centered lattice

$$\begin{aligned}\vec{a} &= (a \sin \gamma, 0, a \cos \gamma) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|0, 0, -\frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{\sigma_y|0, 0, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$A(0, 0, -\frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, -\frac{1}{2})$	
$Z(-\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, 0)$	
$M(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$	
$L(0, \frac{1}{2}, -\frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$V(0, \frac{1}{2}, 0)$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma (0, 0, 0)$ of space group No. 15		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 4e: (1); 8f: (3)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (1); 8f: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 4e: (2); 8f: (3)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (2); 8f: (3)
$A (0, 0, -\frac{1}{2})$ of space group No. 15		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
$Z (-\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 15		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (3); 4d: (3); 4e: (1); 8f: (3)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (0); 4d: (0); 4e: (1); 8f: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (3); 4d: (3); 4e: (2); 8f: (3)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (0); 4d: (0); 4e: (2); 8f: (3)
$M (-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 15		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
$L (0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 15		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (6); 4d: (0); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (0); 4d: (6); 4e: (3); 8f: (6)
$V (0, \frac{1}{2}, 0)$ of space group No. 15		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (6); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (6); 4b: (0); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

c. Results for high-symmetry lines

$LD(-\frac{v}{2}, \frac{v}{2}, 0)$

Operation	E
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, 0)$

$U(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$

Operation	E
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$

LD $(-\frac{v}{2}, \frac{v}{2}, 0)$ of space group No. 15		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (2); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (4); 8f: (6)

U $(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$ of space group No. 15		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

d. Results for high-symmetry planes

P1(v, v, u)

Operation	E
Coordinate	(v, v, u)

P1 (v, v, u) of space group No. 15		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

16. Space group No. 16 ($P222$)

Orthorhombic primitive lattice

$\vec{a} = (a, 0, 0)$	$\vec{t}_1 = \vec{a}$
$\vec{b} = (0, b, 0)$	$\vec{t}_2 = \vec{b}$
$\vec{c} = (0, 0, c)$	$\vec{t}_3 = \vec{c}$

a. Space group operations

$\{E|0, 0, 0\} \{C_{2z}|0, 0, 0\} \{C_{2y}|0, 0, 0\} \{C_{2x}|0, 0, 0\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$

Operation	E
Coordinate	(0, 0, 0)

$Y(0, \frac{1}{2}, 0)$
Operation E Coordinate $(0, \frac{1}{2}, 0)$
$X(\frac{1}{2}, 0, 0)$
Operation E Coordinate $(\frac{1}{2}, 0, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E Coordinate $(0, 0, \frac{1}{2})$
$U(\frac{1}{2}, 0, \frac{1}{2})$
Operation E Coordinate $(\frac{1}{2}, 0, \frac{1}{2})$
$T(0, \frac{1}{2}, \frac{1}{2})$
Operation E Coordinate $(0, \frac{1}{2}, \frac{1}{2})$
$S(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 16											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	1e: (0);	1f: (0);	1g: (0);	1h: (0);	2i: (1);	2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (3)
2	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	1g: (1);	1h: (1);	2i: (2);	2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (3)
3	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	1g: (1);	1h: (1);	2i: (2);	2j: (2); 2k: (2); 2l: (2); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	1g: (1);	1h: (1);	2i: (1);	2j: (1); 2k: (1); 2l: (1); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (3)
$Y(0, \frac{1}{2}, 0)$ of space group No. 16											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	1c: (1);	1d: (0);	1e: (1);	1f: (0);	1g: (1);	1h: (1);	2i: (1);	2j: (1); 2k: (2); 2l: (2); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (1); 2s: (2); 2t: (2); 4u: (3)
2	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	1g: (1);	1h: (1);	2i: (2);	2j: (2); 2k: (1); 2l: (1); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (1); 2r: (1); 2s: (2); 2t: (2); 4u: (3)
3	(0, 0, 0)	1a: (1);	1b: (1);	1c: (0);	1d: (1);	1e: (0);	1f: (1);	1g: (0);	1h: (0);	2i: (2);	2j: (2); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (2); 2r: (2); 2s: (1); 2t: (1); 4u: (3)

4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (1); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (1); 2t: (1); 4u: (3)

$X \left(\frac{1}{2}, 0, 0 \right)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (0); 1e: (1); 1f: (1); 1g: (0); 1h: (1); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (2); 2p: (2); 2q: (1); 2r: (2); 2s: (1); 2t: (2); 4u: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (1); 2p: (1); 2q: (1); 2r: (2); 2s: (1); 2t: (2); 4u: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (1); 2n: (1); 2o: (2); 2p: (2); 2q: (2); 2r: (1); 2s: (2); 2t: (1); 4u: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (1); 1e: (0); 1f: (0); 1g: (1); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (2); 2n: (2); 2o: (1); 2p: (1); 2q: (2); 2r: (1); 2s: (2); 2t: (1); 4u: (3)

$Z \left(0, 0, \frac{1}{2} \right)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (1); 1e: (0); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (2); 2k: (1); 2l: (2); 2m: (1); 2n: (2); 2o: (1); 2p: (2); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (0); 1e: (1); 1f: (0); 1g: (0); 1h: (0); 2i: (2); 2j: (1); 2k: (2); 2l: (1); 2m: (2); 2n: (1); 2o: (2); 2p: (1); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (1); 2k: (2); 2l: (1); 2m: (1); 2n: (2); 2o: (1); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (3)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (2); 2k: (1); 2l: (2); 2m: (2); 2n: (1); 2o: (2); 2p: (1); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (3)

$U \left(\frac{1}{2}, 0, \frac{1}{2} \right)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (2); 2k: (1); 2l: (2); 2m: (1); 2n: (2); 2o: (2); 2p: (1); 2q: (1); 2r: (2); 2s: (1); 2t: (2); 4u: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (0); 1e: (1); 1f: (1); 1g: (0); 1h: (1); 2i: (2); 2j: (1); 2k: (2); 2l: (1); 2m: (2); 2n: (1); 2o: (1); 2p: (2); 2q: (1); 2r: (2); 2s: (1); 2t: (2); 4u: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (0); 1g: (1); 1h: (0); 2i: (2); 2j: (1); 2k: (2); 2l: (1); 2m: (1); 2n: (2); 2o: (2); 2p: (1); 2q: (2); 2r: (1); 2s: (2); 2t: (1); 4u: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (1); 1e: (0); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (2); 2k: (1); 2l: (2); 2m: (2); 2n: (1); 2o: (1); 2p: (2); 2q: (2); 2r: (1); 2s: (2); 2t: (1); 4u: (3)

$T \left(0, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (2); 2k: (2); 2l: (1); 2m: (1); 2n: (2); 2o: (1); 2p: (2); 2q: (1); 2r: (1); 2s: (2); 2t: (2); 4u: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (0); 1e: (1); 1f: (0); 1g: (1); 1h: (1); 2i: (2); 2j: (1); 2k: (1); 2l: (2); 2m: (2); 2n: (1); 2o: (2); 2p: (1); 2q: (1); 2r: (1); 2s: (2); 2t: (2); 4u: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (1); 1e: (0); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (1); 2k: (1); 2l: (2); 2m: (1); 2n: (2); 2o: (1); 2p: (2); 2q: (2); 2r: (2); 2s: (1); 2t: (1); 4u: (3)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (0); 1h: (0); 2i: (1); 2j: (2); 2k: (2); 2l: (1); 2m: (2); 2n: (1); 2o: (2); 2p: (1); 2q: (2); 2r: (2); 2s: (1); 2t: (1); 4u: (3)

$S \left(\frac{1}{2}, \frac{1}{2}, 0 \right)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (1); 2k: (2); 2l: (2); 2m: (1); 2n: (1); 2o: (2); 2p: (2); 2q: (1); 2r: (2); 2s: (2); 2t: (1); 4u: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (0); 1f: (1); 1g: (1); 1h: (0); 2i: (2); 2j: (2); 2k: (1); 2l: (1); 2m: (2); 2n: (2); 2o: (1); 2p: (1); 2q: (1); 2r: (2); 2s: (2); 2t: (1); 4u: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (1); 1e: (1); 1f: (1); 1g: (0); 1h: (1); 2i: (2); 2j: (2); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (2); 2p: (2); 2q: (2); 2r: (1); 2s: (1); 2t: (2); 4u: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (1); 1e: (1); 1f: (0); 1g: (1); 1h: (1); 2i: (1); 2j: (1); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (1); 2p: (1); 2q: (2); 2r: (1); 2s: (1); 2t: (2); 4u: (3)

$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (0); 2i: (1); 2j: (2); 2k: (2); 2l: (1); 2m: (1); 2n: (2); 2o: (2); 2p: (1); 2q: (1); 2r: (2); 2s: (2); 2t: (1); 4u: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (0); 1e: (0); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (1); 2k: (1); 2l: (2); 2m: (2); 2n: (1); 2o: (1); 2p: (2); 2q: (1); 2r: (2); 2s: (2); 2t: (1); 4u: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (1); 1e: (1); 1f: (0); 1g: (1); 1h: (1); 2i: (2); 2j: (1); 2k: (1); 2l: (2); 2m: (1); 2n: (2); 2o: (2); 2p: (1); 2q: (2); 2r: (1); 2s: (1); 2t: (2); 4u: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (0); 1h: (1); 2i: (1); 2j: (2); 2k: (2); 2l: (1); 2m: (2); 2n: (1); 2o: (1); 2p: (2); 2q: (2); 2r: (1); 2s: (1); 2t: (2); 4u: (3)

c. Results for high-symmetry lines

$A(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

$B(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

$C(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

$D(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

$DT(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

$E(u, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(u, \frac{1}{2}, \frac{1}{2})$

$G(\frac{1}{2}, 0, w)$

Operation E

Coordinate $(\frac{1}{2}, 0, w)$

H $(0, \frac{1}{2}, w)$

Operation E
Coordinate $(0, \frac{1}{2}, w)$

LD $(0, 0, w)$

Operation E
Coordinate $(0, 0, w)$

P $(\frac{1}{2}, v, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

Q $(\frac{1}{2}, \frac{1}{2}, w)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

SM $(u, 0, 0)$

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (2) ; 1e: (1); 1f: (2) ; 1g: (2) ; 1h: (2) ; 2i: (2); 2j: (4) ; 2k: (2); 2l: (4) ; 2m: (3) ; 2n: (3) ; 2o: (3) ; 2p: (3) ; 2q: (3) ; 2r: (3) ; 2s: (3) ; 2t: (3) ; 4u: (6)
2	$(r_1, 0, 0)$	1a: (2) ; 1b: (2) ; 1c: (2) ; 1d: (1); 1e: (2) ; 1f: (1); 1g: (1); 1h: (1); 2i: (4) ; 2j: (2); 2k: (4) ; 2l: (2); 2m: (3) ; 2n: (3) ; 2o: (3) ; 2p: (3) ; 2q: (3) ; 2r: (3) ; 2s: (3) ; 2t: (3) ; 4u: (6)

B $(0, v, \frac{1}{2})$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (2) ; 1e: (1); 1f: (2) ; 1g: (2) ; 1h: (2) ; 2i: (3) ; 2j: (3) ; 2k: (3) ; 2l: (3) ; 2m: (2); 2n: (4) ; 2o: (2); 2p: (4) ; 2q: (3) ; 2r: (3) ; 2s: (3) ; 2t: (3) ; 4u: (6)
2	$(0, r_1, 0)$	1a: (2) ; 1b: (2) ; 1c: (2) ; 1d: (1); 1e: (2) ; 1f: (1); 1g: (1); 1h: (1); 2i: (3) ; 2j: (3) ; 2k: (3) ; 2l: (3) ; 2m: (4) ; 2n: (2); 2o: (4) ; 2p: (2); 2q: (3) ; 2r: (3) ; 2s: (3) ; 2t: (3) ; 4u: (6)

C $(u, \frac{1}{2}, 0)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (2) ; 1d: (1); 1e: (2) ; 1f: (1); 1g: (2) ; 1h: (2) ; 2i: (2); 2j: (2); 2k: (4) ; 2l: (4) ; 2m: (3) ; 2n: (3) ; 2o: (3) ; 2p: (3) ; 2q: (3) ; 2r: (3) ; 2s: (3) ; 2t: (3) ; 4u: (6)
2	$(r_1, 0, 0)$	1a: (2) ; 1b: (2) ; 1c: (1); 1d: (2) ; 1e: (1); 1f: (2) ; 1g: (1); 1h: (1); 2i: (4) ; 2j: (4) ; 2k: (2); 2l: (2); 2m: (3) ; 2n: (3) ; 2o: (3) ; 2p: (3) ; 2q: (3) ; 2r: (3) ; 2s: (3) ; 2t: (3) ; 4u: (6)

D $(\frac{1}{2}, v, 0)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (2) ; 1c: (1); 1d: (1); 1e: (2) ; 1f: (2) ; 1g: (1); 1h: (2) ; 2i: (3) ; 2j: (3) ; 2k: (3) ; 2l: (3) ; 2m: (2); 2n: (2); 2o: (4) ; 2p: (4) ; 2q: (3) ; 2r: (3) ; 2s: (3) ; 2t: (3) ; 4u: (6)

2	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (2); 1d: (2); 1e: (1); 1f: (1); 1g: (2); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (4); 2n: (4); 2o: (2); 2p: (2); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6)

DT $(0, v, 0)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6)
2	$(0, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (4); 2n: (4); 2o: (4); 2p: (4); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6)

E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (1); 1h: (1); 2i: (2); 2j: (4); 2k: (4); 2l: (2); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6)
2	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (2); 1h: (2); 2i: (4); 2j: (2); 2k: (2); 2l: (4); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6)

G $(\frac{1}{2}, 0, w)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (2); 1c: (1); 1d: (1); 1e: (2); 1f: (2); 1g: (1); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (2); 2r: (4); 2s: (2); 2t: (4); 4u: (6)
2	$(0, 0, r_1)$	1a: (2); 1b: (1); 1c: (2); 1d: (2); 1e: (1); 1f: (1); 1g: (2); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (4); 2r: (2); 2s: (4); 2t: (2); 4u: (6)

H $(0, \frac{1}{2}, w)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (2); 1d: (1); 1e: (2); 1f: (1); 1g: (2); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (2); 2r: (2); 2s: (4); 2t: (4); 4u: (6)
2	$(0, 0, r_1)$	1a: (2); 1b: (2); 1c: (1); 1d: (2); 1e: (1); 1f: (2); 1g: (1); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (4); 2r: (4); 2s: (2); 2t: (2); 4u: (6)

LD $(0, 0, w)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (6)
2	$(0, 0, r_1)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (4); 2r: (4); 2s: (4); 2t: (4); 4u: (6)

P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 1e: (2); 1f: (1); 1g: (2); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (2); 2n: (4); 2o: (4); 2p: (2); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6)
2	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 1e: (1); 1f: (2); 1g: (1); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (4); 2n: (2); 2o: (2); 2p: (4); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6)

Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (2); 1c: (2); 1d: (1); 1e: (1); 1f: (2); 1g: (2); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (2); 2r: (4); 2s: (4); 2t: (2); 4u: (6)

2	$(0, 0, r_1)$	1a: (2); 1b: (1); 1c: (1); 1d: (2); 1e: (2); 1f: (1); 1g: (1); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (4); 2r: (2); 2s: (2); 2t: (4); 4u: (6)

SM $(u, 0, 0)$ of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6)
2	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (4); 2j: (4); 2k: (4); 2l: (4); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6)

d. Results for high-symmetry planes

P1($v, -u, 0$)

Operation	E
Coordinate	$(v, -u, 0)$

P2($0, -u, v$)

Operation	E
Coordinate	$(0, -u, v)$

P3($u, 0, v$)

Operation	E
Coordinate	$(u, 0, v)$

P4($v, -u, \frac{1}{2}$)

Operation	E
Coordinate	$(v, -u, \frac{1}{2})$

P5($\frac{1}{2}, -u, v$)

Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$

P6($u, \frac{1}{2}, v$)

Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

P1 ($v, -u, 0$) of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 1g: (3); 1h: (3); 2i: (6); 2j: (6); 2k: (6); 2l: (6); 2m: (6); 2n: (6); 2o: (6); 2p: (6); 2q: (6); 2r: (6); 2s: (6); 2t: (6); 4u: (12)

P2 ($0, -u, v$) of space group No. 16

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 1g: (3); 1h: (3); 2i: (6); 2j: (6); 2k: (6); 2l: (6); 2m: (6); 2n: (6); 2o: (6); 2p: (6); 2q: (6); 2r: (6); 2s: (6); 2t: (6); 4u: (12)

P3 ($u, 0, v$) of space group No. 16		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 1g: (3); 1h: (3); 2i: (6); 2j: (6); 2k: (6); 2l: (6); 2m: (6); 2n: (6); 2o: (6); 2p: (6); 2q: (6); 2r: (6); 2s: (6); 2t: (6); 4u: (12)
P4 ($v, -u, \frac{1}{2}$) of space group No. 16		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 1g: (3); 1h: (3); 2i: (6); 2j: (6); 2k: (6); 2l: (6); 2m: (6); 2n: (6); 2o: (6); 2p: (6); 2q: (6); 2r: (6); 2s: (6); 2t: (6); 4u: (12)
P5 ($\frac{1}{2}, -u, v$) of space group No. 16		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 1g: (3); 1h: (3); 2i: (6); 2j: (6); 2k: (6); 2l: (6); 2m: (6); 2n: (6); 2o: (6); 2p: (6); 2q: (6); 2r: (6); 2s: (6); 2t: (6); 4u: (12)
P6 ($u, \frac{1}{2}, v$) of space group No. 16		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 1g: (3); 1h: (3); 2i: (6); 2j: (6); 2k: (6); 2l: (6); 2m: (6); 2n: (6); 2o: (6); 2p: (6); 2q: (6); 2r: (6); 2s: (6); 2t: (6); 4u: (12)

17. Space group No. 17 ($P222_1$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (b, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, -\frac{1}{2}\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2y}|0, 0, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$

$X(0, \frac{1}{2}, 0)$
Operation Coordinate
E $(0, \frac{1}{2}, 0)$
$Z(0, 0, -\frac{1}{2})$
Operation Coordinate
E $(0, 0, -\frac{1}{2})$
$U(0, \frac{1}{2}, -\frac{1}{2})$
Operation Coordinate
E $(0, \frac{1}{2}, -\frac{1}{2})$
$T(\frac{1}{2}, 0, -\frac{1}{2})$
Operation Coordinate
E $(\frac{1}{2}, 0, -\frac{1}{2})$
$S(\frac{1}{2}, \frac{1}{2}, 0)$
Operation Coordinate
E $(\frac{1}{2}, \frac{1}{2}, 0)$
$R(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$
Operation Coordinate
E $(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 17			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3)	
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3)	
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3)	
$Y (\frac{1}{2}, 0, 0)$ of space group No. 17			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (2); 4e: (3)	
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (1); 4e: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (1); 4e: (3)	
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (2); 4e: (3)	
$X (0, \frac{1}{2}, 0)$ of space group No. 17			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (1); 4e: (3)	
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (2); 4e: (3)	
3	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (2); 4e: (3)	
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (1); 4e: (3)	

$Z\left(0, 0, -\frac{1}{2}\right)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
$U\left(0, \frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
$T\left(\frac{1}{2}, 0, -\frac{1}{2}\right)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
$S\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3)
3	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3)
$R\left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

c. Results for high-symmetry lines

$A\left(u, 0, \frac{1}{2}\right)$	
Operation	E
Coordinate	$\left(u, 0, \frac{1}{2}\right)$
$B\left(0, v, \frac{1}{2}\right)$	
Operation	E
Coordinate	$\left(0, v, \frac{1}{2}\right)$
$C\left(u, \frac{1}{2}, 0\right)$	
Operation	E
Coordinate	$\left(u, \frac{1}{2}, 0\right)$
$D\left(\frac{1}{2}, v, 0\right)$	
Operation	E
Coordinate	$\left(\frac{1}{2}, v, 0\right)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$

$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
$G(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
$H(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$P(\frac{1}{2}, v, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
$Q(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$SM(u, 0, 0)$	
Operation	E
Coordinate	$(u, 0, 0)$

A $\left(u, 0, \frac{1}{2}\right)$ of space group No. 17			
(Co-) irrep	Phonon AM	WYPO information	
1	$\left(r_1, 0, 0\right)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)	
B $\left(0, v, \frac{1}{2}\right)$ of space group No. 17			
(Co-) irrep	Phonon AM	WYPO information	
1	$\left(0, r_1, 0\right)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)	
C $\left(u, \frac{1}{2}, 0\right)$ of space group No. 17			
(Co-) irrep	Phonon AM	WYPO information	
1	$\left(r_1, 0, 0\right)$	2a: (2); 2b: (4); 2c: (3); 2d: (3); 4e: (6)	
2	$\left(r_1, 0, 0\right)$	2a: (4); 2b: (2); 2c: (3); 2d: (3); 4e: (6)	
D $\left(\frac{1}{2}, v, 0\right)$ of space group No. 17			
(Co-) irrep	Phonon AM	WYPO information	
1	$\left(0, r_1, 0\right)$	2a: (3); 2b: (3); 2c: (2); 2d: (4); 4e: (6)	
2	$\left(0, r_1, 0\right)$	2a: (3); 2b: (3); 2c: (4); 2d: (2); 4e: (6)	

DT $(0, v, 0)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (2); 2d: (2); 4e: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (4); 2d: (4); 4e: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
LD $(0, 0, w)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
SM $(u, 0, 0)$ of space group No. 17		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (2); 2c: (3); 2d: (3); 4e: (6)
2	$(r_1, 0, 0)$	2a: (4); 2b: (4); 2c: (3); 2d: (3); 4e: (6)

d. Results for high-symmetry planes

P1 $(-u, v, 0)$

Operation	E
Coordinate	$(-u, v, 0)$

P2($-u, 0, -v$)

Operation	E
Coordinate	$(-u, 0, -v)$

P3($0, u, -v$)

Operation	E
Coordinate	$(0, u, -v)$

P4($-u, v, -\frac{1}{2}$)

Operation	E
Coordinate	$(-u, v, -\frac{1}{2})$

P5($-u, \frac{1}{2}, -v$)

Operation	E
Coordinate	$(-u, \frac{1}{2}, -v)$

P6($\frac{1}{2}, u, -v$)

Operation	E
Coordinate	$(\frac{1}{2}, u, -v)$

P1 ($-u, v, 0$) of space group No. 17

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12)

P2 ($-u, 0, -v$) of space group No. 17

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12)

P3 ($0, u, -v$) of space group No. 17

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12)

P4 ($-u, v, -\frac{1}{2}$) of space group No. 17

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

P5 ($-u, \frac{1}{2}, -v$) of space group No. 17

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12)

P6 ($\frac{1}{2}, u, -v$) of space group No. 17

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12)

18. Space group No. 18 ($P2_12_12$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2x}|-\frac{1}{2}, \frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$Y(0, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, 0)\end{array}$$

$$X(\frac{1}{2}, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$U(\frac{1}{2}, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, \frac{1}{2})\end{array}$$

$$T(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2})\end{array}$$

$$S(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$\mathbf{R}(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
$\mathbf{Y} (0, \frac{1}{2}, 0)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
$\mathbf{X} (\frac{1}{2}, 0, 0)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
$\mathbf{Z} (0, 0, \frac{1}{2})$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
$\mathbf{U} (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
$\mathbf{T} (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
$\mathbf{S} (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
$\mathbf{R} (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)

c. Results for high-symmetry lines

$A(u, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(u, 0, \frac{1}{2})$
$B(0, v, \frac{1}{2})$	
Operation	E
Coordinate	$(0, v, \frac{1}{2})$
$C(u, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
$D(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
$G(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
$H(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$P(\frac{1}{2}, v, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
$Q(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$SM(u, 0, 0)$	

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
B $(0, v, \frac{1}{2})$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
C $(u, \frac{1}{2}, 0)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
DT $(0, v, 0)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 4c: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 4c: (6)
LD $(0, 0, w)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (2); 2b: (2); 4c: (6)
2	$(0, 0, r_1)$	2a: (4); 2b: (4); 4c: (6)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 18		

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (2); 4c: (3)
2	$(0, 0, r_1)$	2a: (2); 2b: (1); 4c: (3)
SM $(u, 0, 0)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)

d. Results for high-symmetry planes

P1($v, -u, 0$)	
Operation	E
Coordinate	$(v, -u, 0)$
P2($0, -u, v$)	
Operation	E
Coordinate	$(0, -u, v)$
P3($u, 0, v$)	
Operation	E
Coordinate	$(u, 0, v)$
P4($v, -u, \frac{1}{2}$)	
Operation	E
Coordinate	$(v, -u, \frac{1}{2})$
P5($\frac{1}{2}, -u, v$)	
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$
P6($u, \frac{1}{2}, v$)	
Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

P1 ($v, -u, 0$) of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12)

P2 $(0, -u, v)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 4c: (12)
P3 $(u, 0, v)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (6); 2b: (6); 4c: (12)
P4 $(v, -u, \frac{1}{2})$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12)
P5 $(\frac{1}{2}, -u, v)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (3); 2b: (3); 4c: (6)
P6 $(u, \frac{1}{2}, v)$ of space group No. 18		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 4c: (6)

19. Space group No. 19 ($P2_12_12_1$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (b, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{2x}|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2y}|0, \frac{1}{2}, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$

X(0, −1/2, 0)	
Operation	E
Coordinate	(0, −1/2, 0)
Z(0, 0, 1/2)	
Operation	E
Coordinate	(0, 0, 1/2)
U(0, −1/2, 1/2)	
Operation	E
Coordinate	(0, −1/2, 1/2)
T(1/2, 0, 1/2)	
Operation	E
Coordinate	(1/2, 0, 1/2)
S(1/2, −1/2, 0)	
Operation	E
Coordinate	(1/2, −1/2, 0)
R(1/2, −1/2, 1/2)	
Operation	E
Coordinate	(1/2, −1/2, 1/2)

$\Gamma(0, 0, 0)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
3	(0, 0, 0)	4a: (3)
4	(0, 0, 0)	4a: (3)
$Y(\frac{1}{2}, 0, 0)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
$X(0, -\frac{1}{2}, 0)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
$Z(0, 0, \frac{1}{2})$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
$U(0, -\frac{1}{2}, \frac{1}{2})$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
T $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
S $(\frac{1}{2}, -\frac{1}{2}, 0)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
R $(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(u, 0, \frac{1}{2})$
B $(0, v, \frac{1}{2})$	
Operation	E
Coordinate	$(0, v, \frac{1}{2})$
C $(u, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
D $(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
DT $(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
E $(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
G $(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$

$$H(0, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, w) \end{array}$$

$$LD(0, 0, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, w) \end{array}$$

$$P(\frac{1}{2}, v, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, v, \frac{1}{2}) \end{array}$$

$$Q(\frac{1}{2}, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, w) \end{array}$$

$$SM(u, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (u, 0, 0) \end{array}$$

A $(u, 0, \frac{1}{2})$ of space group No. 19

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)

B $(0, v, \frac{1}{2})$ of space group No. 19

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)

C $(u, \frac{1}{2}, 0)$ of space group No. 19

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)

D $(\frac{1}{2}, v, 0)$ of space group No. 19

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)

DT $(0, v, 0)$ of space group No. 19

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)
2	$(0, r_1, 0)$	4a: (6)

E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 19

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3)
2	$(r_1, 0, 0)$	4a: (3)

G $(\frac{1}{2}, 0, w)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (6)
LD $(0, 0, w)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (6)
2	$(0, 0, r_1)$	4a: (6)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3)
2	$(0, r_1, 0)$	4a: (3)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3)
2	$(0, 0, r_1)$	4a: (3)
SM $(u, 0, 0)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)
2	$(r_1, 0, 0)$	4a: (6)

d. Results for high-symmetry planes

P1 $(-u, -v, 0)$

Operation	E
Coordinate	$(-u, -v, 0)$

P2 $(-u, 0, v)$

Operation	E
Coordinate	$(-u, 0, v)$

P3 $(0, -u, v)$

Operation	E
Coordinate	$(0, -u, v)$

P4 $(-u, -v, \frac{1}{2})$

Operation	E

Coordinate	$(-u, -v, \frac{1}{2})$
P5	$(-u, -\frac{1}{2}, v)$
Operation	E
Coordinate	$(-u, -\frac{1}{2}, v)$
P6	$(\frac{1}{2}, -u, v)$
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$

P1 $(-u, -v, 0)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12)
P2 $(-u, 0, v)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (12)
P3 $(0, -u, v)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (12)
P4 $(-u, -v, \frac{1}{2})$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)
P5 $(-u, -\frac{1}{2}, v)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6)
P6 $(\frac{1}{2}, -u, v)$ of space group No. 19		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (6)

20. Space group No. 20 ($C222_1$)

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,\frac{1}{2}\} \quad \{C_{2y}|0,0,\frac{1}{2}\} \quad \{C_{2x}|0,0,0\}$$

b. Results for high-symmetry points

 $\Gamma(0,0,0)$

Operation E
Coordinate (0,0,0)

 $Y(\frac{1}{2}, \frac{1}{2}, 0)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$

 $Z(0,0,\frac{1}{2})$

Operation E
Coordinate $(0,0,\frac{1}{2})$

 $T(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

 $S(0,\frac{1}{2},0)$

Operation E C_{2y}
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

 $R(0,\frac{1}{2},\frac{1}{2})$

Operation E C_{2y}
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,-\frac{1}{2})$

 $\Gamma(0,0,0)$ of space group No. 20

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (1); 4b: (1); 8c: (3)
2	(0,0,0)	4a: (2); 4b: (2); 8c: (3)
3	(0,0,0)	4a: (2); 4b: (1); 8c: (3)
4	(0,0,0)	4a: (1); 4b: (2); 8c: (3)

 $Y(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 20

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (1); 4b: (1); 8c: (3)
2	(0,0,0)	4a: (2); 4b: (2); 8c: (3)
3	(0,0,0)	4a: (2); 4b: (1); 8c: (3)
4	(0,0,0)	4a: (1); 4b: (2); 8c: (3)

 $Z(0,0,\frac{1}{2})$ of space group No. 20

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
T $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
S $(0, \frac{1}{2}, 0)$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)

c. Results for high-symmetry lines

A($\frac{u}{2}, \frac{u}{2}, \frac{1}{2}$)		
Operation	E	
Coordinate	($\frac{u}{2}, \frac{u}{2}, \frac{1}{2}$)	
B($-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}$)		
Operation	E	
Coordinate	($-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}$)	
D($0, \frac{1}{2}, w$)		
Operation	E	C_{2y}
Coordinate	($0, \frac{1}{2}, w$)	($-\frac{1}{2}, 0, -w$)
DT($-\frac{v}{2}, \frac{v}{2}, 0$)		
Operation	E	
Coordinate	($-\frac{v}{2}, \frac{v}{2}, 0$)	
H($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
LD($0, 0, w$)		
Operation	E	
Coordinate	($0, 0, w$)	
SM($\frac{u}{2}, \frac{u}{2}, 0$)		
Operation	E	
Coordinate	($\frac{u}{2}, \frac{u}{2}, 0$)	

A $\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
B $\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)
D $\left(0, \frac{1}{2}, w\right)$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)
DT $\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (2); 8c: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (4); 8c: (6)
H $\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)
LD $(0, 0, w)$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)
SM $\left(\frac{u}{2}, \frac{u}{2}, 0\right)$ of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (2); 4b: (3); 8c: (6)
2	$(r_1, 0, 0)$	4a: (4); 4b: (3); 8c: (6)

d. Results for high-symmetry planes

P1(u, u, v)	
Operation	E
Coordinate	(u, u, v)
P2($u, -u, v$)	
Operation	E
Coordinate	$(u, -u, v)$

$$P3(u, v, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (u, v, 0) \end{array}$$

$$P4\left(u, v, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(u, v, \frac{1}{2}\right) \end{array}$$

P1 (u, u, v) of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6); 4b: (6); 8c: (12)
P2 ($u, -u, v$) of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (6); 4b: (6); 8c: (12)
P3 ($u, v, 0$) of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)
P4 ($u, v, \frac{1}{2}$) of space group No. 20		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)

21. Space group No. 21 ($C222$)

$$\begin{array}{ll} \vec{a} = (a, 0, 0) & \vec{t}_1 = \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\ \text{Orthorhombic base-centered lattice} & \vec{b} = (0, b, 0) \quad \vec{t}_2 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\ & \vec{c} = (0, 0, c) \quad \vec{t}_3 = \vec{c} \end{array}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$Y(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$T(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$S(0, \frac{1}{2}, 0)$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, -\frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 21

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 8l: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (1); 8l: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 8l: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 8l: (3)

$Y(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 21

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (1); 8l: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 8l: (3)

$Z(0, 0, \frac{1}{2})$ of space group No. 21

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 4i: (1); 4j: (1); 4k: (1); 8l: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 8l: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (1); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 8l: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (2); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 8l: (3)
T $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (1); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 8l: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (2); 4h: (1); 4i: (2); 4j: (2); 4k: (1); 8l: (3)
S $(0, \frac{1}{2}, 0)$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 8l: (6)
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 8l: (6)

c. Results for high-symmetry lines

$$A\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$$

Operation	E
Coordinate	$\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$

$$B\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$$

Operation	E
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$

$$D\left(0, \frac{1}{2}, w\right)$$

Operation	E	C_{2y}
Coordinate	$\left(0, \frac{1}{2}, w\right)$	$\left(-\frac{1}{2}, 0, -w\right)$

DT $(-\frac{v}{2}, \frac{v}{2}, 0)$	
Operation	E
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, 0)$
H $(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
LD $(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
SM $(\frac{u}{2}, \frac{u}{2}, 0)$	
Operation	E
Coordinate	$(\frac{u}{2}, \frac{u}{2}, 0)$

A $(\frac{u}{2}, \frac{u}{2}, \frac{1}{2})$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (3); 8l: (6)
2	$(r_1, 0, 0)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (3); 8l: (6)
B $(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 8l: (6)
2	$(0, r_1, 0)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 8l: (6)
D $(0, \frac{1}{2}, w)$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 8l: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 8l: (6)
DT $(-\frac{v}{2}, \frac{v}{2}, 0)$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 8l: (6)
2	$(0, r_1, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 8l: (6)
H $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (4); 8l: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (2); 8l: (6)
LD $(0, 0, w)$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (2); 8l: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (4); 8l: (6)
SM $(\frac{u}{2}, \frac{u}{2}, 0)$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (3); 8l: (6)
2	$(r_1, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (3); 8l: (6)

d. Results for high-symmetry planes

P1(u, u, v)	
Operation	E
Coordinate	(u, u, v)
P2($u, -u, v$)	
Operation	E
Coordinate	$(u, -u, v)$
P3($u, v, 0$)	
Operation	E
Coordinate	$(u, v, 0)$
P4($u, v, \frac{1}{2}$)	
Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 (u, u, v) of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)
P2 ($u, -u, v$) of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_2, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)
P3 $(u, v, 0)$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)
P4 $(u, v, \frac{1}{2})$ of space group No. 21		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)

22. Space group No. 22 ($F222$)

Orthorhombic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, 0) \end{array}$$

$$Y(\frac{1}{2}, 0, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, \frac{1}{2}) \end{array}$$

$$X(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$$Z(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \end{array}$$

Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
Operation	E C_{2x} C_{2y} C_{2z}
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, 0)$ $(0, -\frac{1}{2}, 0)$ $(0, 0, -\frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	8e: (1);	8f: (1);	8g: (1);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (2);	8f: (2);	8g: (1);	8h: (1);	8i: (2);	8j: (2);	16k: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (2);	8f: (1);	8g: (2);	8h: (2);	8i: (1);	8j: (2);	16k: (3)
4	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (1);	8f: (2);	8g: (2);	8h: (2);	8i: (2);	8j: (1);	16k: (3)
$Y (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	8e: (1);	8f: (1);	8g: (1);	8h: (2);	8i: (1);	8j: (2);	16k: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (2);	8f: (2);	8g: (1);	8h: (2);	8i: (2);	8j: (1);	16k: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	8e: (2);	8f: (1);	8g: (2);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
4	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (1);	8f: (2);	8g: (2);	8h: (1);	8i: (2);	8j: (2);	16k: (3)
$X (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	8e: (1);	8f: (1);	8g: (1);	8h: (2);	8i: (2);	8j: (1);	16k: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (2);	8f: (2);	8g: (1);	8h: (2);	8i: (1);	8j: (2);	16k: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (2);	8f: (1);	8g: (2);	8h: (1);	8i: (2);	8j: (2);	16k: (3)
4	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	8e: (1);	8f: (2);	8g: (2);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
$Z (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	8e: (1);	8f: (1);	8g: (1);	8h: (1);	8i: (2);	8j: (2);	16k: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	8e: (2);	8f: (2);	8g: (1);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (2);	8f: (1);	8g: (2);	8h: (2);	8i: (2);	8j: (1);	16k: (3)
4	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (1);	8f: (2);	8g: (2);	8h: (2);	8i: (1);	8j: (2);	16k: (3)
$L (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	4d: (3);	8e: (6);	8f: (6);	8g: (6);	8h: (6);	8i: (6);	8j: (6);	16k: (12)

c. Results for high-symmetry lines

$A(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2})$

$B\left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2}\right)$	
Operation	E
Coordinate	$\left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2}\right)$
$DT\left(\frac{v}{2}, 0, \frac{v}{2}\right)$	
Operation	E
Coordinate	$\left(\frac{v}{2}, 0, \frac{v}{2}\right)$
$H\left(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2}\right)$	
Operation	E
Coordinate	$\left(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2}\right)$
$LD\left(\frac{w}{2}, \frac{w}{2}, 0\right)$	
Operation	E
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, 0\right)$
$SM\left(0, \frac{u}{2}, \frac{u}{2}\right)$	
Operation	E
Coordinate	$\left(0, \frac{u}{2}, \frac{u}{2}\right)$

A $\left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2}\right)$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	$(r_1, 0, 0)$	4a: (1);	4b: (1);	4c: (2);	4d: (2);	8e: (2);	8f: (3);	8g: (3);	8h: (3);	8i: (3);	8j: (4);	16k: (6)
2	$(r_1, 0, 0)$	4a: (2);	4b: (2);	4c: (1);	4d: (1);	8e: (4);	8f: (3);	8g: (3);	8h: (3);	8i: (3);	8j: (2);	16k: (6)
B $\left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2}\right)$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	$(0, r_1, 0)$	4a: (1);	4b: (1);	4c: (2);	4d: (2);	8e: (3);	8f: (2);	8g: (3);	8h: (3);	8i: (4);	8j: (3);	16k: (6)
2	$(0, r_1, 0)$	4a: (2);	4b: (2);	4c: (1);	4d: (1);	8e: (3);	8f: (4);	8g: (3);	8h: (3);	8i: (2);	8j: (3);	16k: (6)
DT $\left(\frac{v}{2}, 0, \frac{v}{2}\right)$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	$(0, r_1, 0)$	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (3);	8f: (2);	8g: (3);	8h: (3);	8i: (2);	8j: (3);	16k: (6)
2	$(0, r_1, 0)$	4a: (2);	4b: (2);	4c: (2);	4d: (2);	8e: (3);	8f: (4);	8g: (3);	8h: (3);	8i: (4);	8j: (3);	16k: (6)
H $\left(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2}\right)$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	$(0, 0, r_1)$	4a: (1);	4b: (1);	4c: (2);	4d: (2);	8e: (3);	8f: (3);	8g: (2);	8h: (4);	8i: (3);	8j: (3);	16k: (6)
2	$(0, 0, r_1)$	4a: (2);	4b: (2);	4c: (1);	4d: (1);	8e: (3);	8f: (3);	8g: (4);	8h: (2);	8i: (3);	8j: (3);	16k: (6)
LD $\left(\frac{w}{2}, \frac{w}{2}, 0\right)$ of space group No. 22												
(Co-) irrep	Phonon AM	WYPO information										
1	$(0, 0, r_1)$	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (3);	8f: (3);	8g: (2);	8h: (2);	8i: (3);	8j: (3);	16k: (6)

2	$(0, 0, r_1)$	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (4); 8h: (4); 8i: (3); 8j: (3); 16k: (6)

SM $(0, \frac{u}{2}, \frac{u}{2})$ of space group No. 22

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (3); 8g: (3); 8h: (3); 8i: (3); 8j: (2); 16k: (6)
2	$(r_1, 0, 0)$	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (4); 8f: (3); 8g: (3); 8h: (3); 8i: (3); 8j: (4); 16k: (6)

d. Results for high-symmetry planes

P1 $(-v, u, u - v)$

Operation	E
Coordinate	$(-v, u, u - v)$

P2 $(u, u + v, v)$

Operation	E
Coordinate	$(u, u + v, v)$

P3 $(u - v, u, -v)$

Operation	E
Coordinate	$(u - v, u, -v)$

P1 $(-v, u, u - v)$ of space group No. 22

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

P2 $(u, u + v, v)$ of space group No. 22

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

P3 $(u - v, u, -v)$ of space group No. 22

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

23. Space group No. 23 ($I222$)

Orthorhombic body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_{2y}|0,0,0\} \quad \{C_{2x}|0,0,0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	
$X(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
$R(0,\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},0,-\frac{1}{2})$
$S(\frac{1}{2},0,0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2},0,0)$	$(0,\frac{1}{2},-\frac{1}{2})$
$T(0,0,\frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0,0,\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},0)$
$W(\frac{1}{4},\frac{1}{4},\frac{1}{4})$		
Operation	E	$E\Theta$
Coordinate	$(\frac{1}{4},\frac{1}{4},\frac{1}{4})$	$(-\frac{1}{4},-\frac{1}{4},-\frac{1}{4})$

$\Gamma(0,0,0)$ of space group No. 23				
(Co-) irrep	Phonon AM	WYPO information		
1	(0,0,0)	2a: (0);	2b: (0); 2c: (0); 2d: (0);	4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 8k: (3)
2	(0,0,0)	2a: (1);	2b: (1); 2c: (1); 2d: (1);	4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 8k: (3)
3	(0,0,0)	2a: (1);	2b: (1); 2c: (1); 2d: (1);	4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 8k: (3)
4	(0,0,0)	2a: (1);	2b: (1); 2c: (1); 2d: (1);	4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (3)

$X(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 23				
(Co-) irrep	Phonon AM	WYPO information		

1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 8k: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 8k: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 8k: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (3)
R $(0, \frac{1}{2}, 0)$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 8k: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 8k: (6)
S $(\frac{1}{2}, 0, 0)$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 8k: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 8k: (6)
T $(0, 0, \frac{1}{2})$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 8k: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 8k: (6)
W $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 8k: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 4i: (1); 4j: (2); 8k: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 4e: (2); 4f: (1); 4g: (1); 4h: (2); 4i: (2); 4j: (1); 8k: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 8k: (3)

c. Results for high-symmetry lines

$$\overline{D\left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right)}$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right) \end{array}$$

$$\overline{DT\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)}$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right) \end{array}$$

$$\overline{LD\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)}$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right) \end{array}$$

$$\overline{P\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)}$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right) \end{array}$$

$Q(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$	
Operation	E
Coordinate	$(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$
$SM(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	
Operation	E
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$

D $(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 8k: (6)
2	$(r_1, 0, 0)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 8k: (6)
DT $(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (3); 4j: (3); 8k: (6)
2	$(0, r_1, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (3); 4j: (3); 8k: (6)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 8k: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 8k: (6)
P $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 8k: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 8k: (6)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 8k: (6)
2	$(0, r_1, 0)$	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 8k: (6)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 8k: (6)
2	$(r_1, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 8k: (6)

d. Results for high-symmetry planes

$PI(-v, v, u)$	
Operation	E

Coordinate	$(-v, v, u)$
P2($v, u, -v$)	
Operation	E
Coordinate	$(v, u, -v)$
P3($u, v, -v$)	
Operation	E
Coordinate	$(u, v, -v)$

P1 ($-v, v, u$) of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)
P2 ($v, u, -v$) of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)
P3 ($u, v, -v$) of space group No. 23		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)

24. Space group No. 24 ($I2_12_12_1$)

Orthorhombic body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{2y}|0, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$X(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, 0)$		
Operation	E	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$S(\frac{1}{2}, 0, 0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$
$T(0, 0, \frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$
$W(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$		
Operation	E	$E\Theta$
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$

$\Gamma(0, 0, 0)$ of space group No. 24			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 8d: (3)	
2	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (1); 8d: (3)	
3	$(0, 0, 0)$	4a: (2); 4b: (1); 4c: (2); 8d: (3)	
4	$(0, 0, 0)$	4a: (1); 4b: (2); 4c: (2); 8d: (3)	
$X(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 24			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	4a: (2); 4b: (1); 4c: (1); 8d: (3)	
2	$(0, 0, 0)$	4a: (1); 4b: (2); 4c: (1); 8d: (3)	
3	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (2); 8d: (3)	
4	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (2); 8d: (3)	
$R(0, \frac{1}{2}, 0)$ of space group No. 24			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)	
2	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)	
$S(\frac{1}{2}, 0, 0)$ of space group No. 24			
(Co-) irrep	Phonon AM	WYPO information	

1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
T $(0, 0, \frac{1}{2})$ of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
W $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

c. Results for high-symmetry lines

D $(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$	
Operation	E
Coordinate	$(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$
DT $(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	
Operation	E
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$	
Operation	E
Coordinate	$(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$
P $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	
Operation	E
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$	
Operation	E
Coordinate	$(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	
Operation	E
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$

D $(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)

DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (2); 4c: (3); 8d: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (4); 4c: (3); 8d: (6)
LD $\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$ of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (2); 8d: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (4); 8d: (6)
P $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
Q $\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$ of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (2); 4b: (3); 4c: (3); 8d: (6)
2	$(r_1, 0, 0)$	4a: (4); 4b: (3); 4c: (3); 8d: (6)

d. Results for high-symmetry planes

P1($-v, v, u$)
Operation E
Coordinate ($-v, v, u$)
P2($v, u, -v$)
Operation E
Coordinate ($v, u, -v$)
P3($u, v, -v$)
Operation E
Coordinate ($u, v, -v$)

P1 ($-v, v, u$) of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)

P2 ($v, u, -v$) of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
P3 ($u, v, -v$) of space group No. 24		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)

25. Space group No. 25 ($Pmm2$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$Y(0, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, 0)\end{array}$$

$$X(\frac{1}{2}, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$U(\frac{1}{2}, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, \frac{1}{2})\end{array}$$

$$T(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$$S(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0) \end{array}$$

$$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$\Gamma(0, 0, 0)$ of space group No. 25									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (2);	2h: (2); 4i: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1); 4i: (3)
3	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (1);	2h: (1); 4i: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (2);	2h: (2); 4i: (3)

$Y(0, \frac{1}{2}, 0)$ of space group No. 25									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (1);	2g: (2);	2h: (2); 4i: (3)
2	(0, 0, 0)	1a: (0);	1b: (1);	1c: (0);	1d: (1);	2e: (1);	2f: (2);	2g: (1);	2h: (1); 4i: (3)
3	(0, 0, 0)	1a: (1);	1b: (0);	1c: (1);	1d: (0);	2e: (2);	2f: (1);	2g: (1);	2h: (1); 4i: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (1);	2f: (2);	2g: (2);	2h: (2); 4i: (3)

$X(\frac{1}{2}, 0, 0)$ of space group No. 25									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (2);	2h: (1); 4i: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (2); 4i: (3)
3	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (1);	2h: (2); 4i: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (2);	2h: (1); 4i: (3)

$Z(0, 0, \frac{1}{2})$ of space group No. 25									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (2);	2h: (2); 4i: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1); 4i: (3)
3	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (1);	2h: (1); 4i: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (2);	2h: (2); 4i: (3)

$U(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 25									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (2);	2h: (1); 4i: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (2); 4i: (3)

3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (2); 4i: (3)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (2); 2h: (1); 4i: (3)

T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 25

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (2); 4i: (3)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 2e: (1); 2f: (2); 2g: (1); 2h: (1); 4i: (3)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (2); 2f: (1); 2g: (1); 2h: (1); 4i: (3)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (2); 2g: (2); 2h: (2); 4i: (3)

S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 25

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (0); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (3)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (1); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3)

R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 25

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (0); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (3)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (1); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

B $(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

C $(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

D $(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

DT $(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
$G(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
$H(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$P(\frac{1}{2}, v, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
$Q(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$SM(u, 0, 0)$	
Operation	E
Coordinate	$(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (3); 2h: (3); 4i: (6)
2	$(0, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (3); 2h: (3); 4i: (6)
B $(0, v, \frac{1}{2})$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (4); 2h: (4); 4i: (6)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (2); 2h: (2); 4i: (6)
C $(u, \frac{1}{2}, 0)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 2h: (3); 4i: (6)
2	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 2h: (3); 4i: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information

1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (4); 2h: (2); 4i: (6)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (2); 2h: (4); 4i: (6)
DT $(0, v, 0)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (4); 2h: (4); 4i: (6)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (2); 2h: (2); 4i: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 2h: (3); 4i: (6)
2	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 2h: (3); 4i: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (1); 4i: (3)
2	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (2); 4i: (3)
3	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (2); 4i: (3)
4	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (2); 2h: (1); 4i: (3)
H $(0, \frac{1}{2}, w)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (2); 4i: (3)
2	$(0, 0, 0)$	1a: (0); 1b: (1); 1c: (0); 1d: (1); 2e: (1); 2f: (2); 2g: (1); 2h: (1); 4i: (3)
3	$(0, 0, 0)$	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (2); 2f: (1); 2g: (1); 2h: (1); 4i: (3)
4	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (2); 2g: (2); 2h: (2); 4i: (3)
LD $(0, 0, w)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (3)
2	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (3)
3	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (1); 4i: (3)
4	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (3)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (4); 2h: (2); 4i: (6)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (2); 2h: (4); 4i: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (0); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3)
2	$(0, 0, 0)$	1a: (0); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3)
3	$(0, 0, 0)$	1a: (1); 1b: (0); 1c: (1); 1d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (3)
4	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (0); 1d: (1); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3)

SM $(u, 0, 0)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (3); 2h: (3); 4i: (6)
2	$(0, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (3); 2h: (3); 4i: (6)

d. Results for high-symmetry planes

P1($v, -u, 0$)	
Operation	E
Coordinate	$(v, -u, 0)$
P2($0, -u, v$)	
Operation	E
Coordinate	$(0, -u, v)$
P3($u, 0, v$)	
Operation	E
Coordinate	$(u, 0, v)$
P4($v, -u, \frac{1}{2}$)	
Operation	E
Coordinate	$(v, -u, \frac{1}{2})$
P5($\frac{1}{2}, -u, v$)	
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$
P6($u, \frac{1}{2}, v$)	
Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

P1 $(v, -u, 0)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12)
P2 $(0, -u, v)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (4); 2h: (4); 4i: (6)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (2); 2h: (2); 4i: (6)
P3 $(u, 0, v)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (3); 2h: (3); 4i: (6)
2	$(0, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (3); 2h: (3); 4i: (6)
P4 $(v, -u, \frac{1}{2})$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12)
P5 $(\frac{1}{2}, -u, v)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (4); 2h: (2); 4i: (6)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (2); 2h: (4); 4i: (6)
P6 $(u, \frac{1}{2}, v)$ of space group No. 25		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 2h: (3); 4i: (6)
2	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 2h: (3); 4i: (6)

26. Space group No. 26 ($Pmc2_1$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{\sigma_y|0, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$Y(0, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, 0)\end{array}$$

$$X(\frac{1}{2}, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2}) \end{array}$$

$$U(\frac{1}{2}, 0, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, \frac{1}{2}) \end{array}$$

$$T(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$$S(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0) \end{array}$$

$$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$$\Gamma (0, 0, 0) \text{ of space group No. 26}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)

$$Y (0, \frac{1}{2}, 0) \text{ of space group No. 26}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)

$$X (\frac{1}{2}, 0, 0) \text{ of space group No. 26}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
3	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
4	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)

$$Z (0, 0, \frac{1}{2}) \text{ of space group No. 26}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)

U $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
3	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
4	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

B $(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

C $(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

D $(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

DT $(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

E $(u, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(u, \frac{1}{2}, \frac{1}{2})$

$G(\frac{1}{2}, 0, w)$

Operation E
Coordinate $(\frac{1}{2}, 0, w)$

$H(0, \frac{1}{2}, w)$

Operation E
Coordinate $(0, \frac{1}{2}, w)$

$LD(0, 0, w)$

Operation E
Coordinate $(0, 0, w)$

$P(\frac{1}{2}, v, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

$Q(\frac{1}{2}, \frac{1}{2}, w)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

$SM(u, 0, 0)$

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 26

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

B $(0, v, \frac{1}{2})$ of space group No. 26

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
2	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (3)

C $(u, \frac{1}{2}, 0)$ of space group No. 26

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

D $(\frac{1}{2}, v, 0)$ of space group No. 26

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (4); 2b: (2); 4c: (6)
2	$(r_1, 0, 0)$	2a: (2); 2b: (4); 4c: (6)

DT $(0, v, 0)$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (4); 2b: (4); 4c: (6)
2	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
H $(0, \frac{1}{2}, w)$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
LD $(0, 0, w)$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
2	$(r_1, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
SM $(u, 0, 0)$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

2 $(0, r_1, 0)$ **2a: (3); 2b: (3); 4c: (6)**

d. Results for high-symmetry planes

P1($v, -u, 0$)	
Operation	E
Coordinate	$(v, -u, 0)$
P2($0, -u, v$)	
Operation	E
Coordinate	$(0, -u, v)$
P3($u, 0, v$)	
Operation	E
Coordinate	$(u, 0, v)$
P4($v, -u, \frac{1}{2}$)	
Operation	E
Coordinate	$(v, -u, \frac{1}{2})$
P5($\frac{1}{2}, -u, v$)	
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$
P6($u, \frac{1}{2}, v$)	
Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

P1 ($v, -u, 0$) of space group No. 26

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12)

P2 ($0, -u, v$) of space group No. 26

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (4); 2b: (4); 4c: (6)
2	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (6)

P3 ($u, 0, v$) of space group No. 26

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

P4 ($v, -u, \frac{1}{2}$) of space group No. 26

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
P5 $(\frac{1}{2}, -u, v)$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (4); 2b: (2); 4c: (6)
2	$(r_1, 0, 0)$	2a: (2); 2b: (4); 4c: (6)
P6 $(u, \frac{1}{2}, v)$ of space group No. 26		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

27. Space group No. 27 ($Pcc2$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_y|0, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$Y(0, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, 0)\end{array}$$

$$X(\frac{1}{2}, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$U\left(\frac{1}{2}, 0, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, 0, \frac{1}{2}\right) \end{array}$$

$$T\left(0, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(0, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$$S\left(\frac{1}{2}, \frac{1}{2}, 0\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, 0\right) \end{array}$$

$$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3)

$Y \left(0, \frac{1}{2}, 0\right)$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3)

$X \left(\frac{1}{2}, 0, 0\right)$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3)

$U \left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3)
T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3)
S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3)

c. Results for high-symmetry lines

$A(u, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(u, 0, \frac{1}{2})$
$B(0, v, \frac{1}{2})$	
Operation	E
Coordinate	$(0, v, \frac{1}{2})$
$C(u, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
$D(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$

$$G(\frac{1}{2}, 0, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, w) \end{array}$$

$$H(0, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, w) \end{array}$$

$$LD(0, 0, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, w) \end{array}$$

$$P(\frac{1}{2}, v, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, v, \frac{1}{2}) \end{array}$$

$$Q(\frac{1}{2}, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, w) \end{array}$$

$$SM(u, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (u, 0, 0) \end{array}$$

A $(u, 0, \frac{1}{2})$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

B $(0, v, \frac{1}{2})$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

C $(u, \frac{1}{2}, 0)$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

D $(\frac{1}{2}, v, 0)$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

DT $(0, v, 0)$ of space group No. 27

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3)
H $(0, \frac{1}{2}, w)$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3)
LD $(0, 0, w)$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3)
SM $(u, 0, 0)$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

d. Results for high-symmetry planes

P1($v, -u, 0$)		
Operation	E	
Coordinate	$(v, -u, 0)$	
P2($0, -u, v$)		
Operation	E	
Coordinate	$(0, -u, v)$	
P3($u, 0, v$)		
Operation	E	
Coordinate	$(u, 0, v)$	
P4($v, -u, \frac{1}{2}$)		
Operation	E	
Coordinate	$(v, -u, \frac{1}{2})$	
P5($\frac{1}{2}, -u, v$)		
Operation	E	
Coordinate	$(\frac{1}{2}, -u, v)$	
P6($u, \frac{1}{2}, v$)		
Operation	E	
Coordinate	$(u, \frac{1}{2}, v)$	

P1 ($v, -u, 0$) of space group No. 27			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12)	
P2 ($0, -u, v$) of space group No. 27			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)	
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)	
P3 ($u, 0, v$) of space group No. 27			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)	
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)	
P4 ($v, -u, \frac{1}{2}$) of space group No. 27			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12)	
P5 ($\frac{1}{2}, -u, v$) of space group No. 27			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)	

2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
P6 $(u, \frac{1}{2}, v)$ of space group No. 27		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6)

28. Space group No. 28 ($Pma2$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (b, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_x|-\frac{1}{2}, 0, 0\} \quad \{\sigma_y|-\frac{1}{2}, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	$(0,0,0)$
$Y(\frac{1}{2},0,0)$	
Operation	E
Coordinate	$(\frac{1}{2},0,0)$
$X(0,-\frac{1}{2},0)$	
Operation	E
Coordinate	$(0,-\frac{1}{2},0)$
$Z(0,0,\frac{1}{2})$	
Operation	E
Coordinate	$(0,0,\frac{1}{2})$
$U(0,-\frac{1}{2},\frac{1}{2})$	
Operation	E
Coordinate	$(0,-\frac{1}{2},\frac{1}{2})$

$$T\left(\frac{1}{2}, 0, \frac{1}{2}\right)$$

Operation	E
Coordinate	$\left(\frac{1}{2}, 0, \frac{1}{2}\right)$

$$S\left(\frac{1}{2}, -\frac{1}{2}, 0\right)$$

Operation	E
Coordinate	$\left(\frac{1}{2}, -\frac{1}{2}, 0\right)$

$$R\left(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\right)$$

Operation	E
Coordinate	$\left(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\right)$

$\Gamma (0, 0, 0)$ of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3)

$Y \left(\frac{1}{2}, 0, 0\right)$ of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)

$X \left(0, -\frac{1}{2}, 0\right)$ of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 4d: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 4d: (3)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 4d: (3)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 4d: (3)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3)

$U \left(0, -\frac{1}{2}, \frac{1}{2}\right)$ of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 4d: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 4d: (3)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 4d: (3)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 4d: (3)

T $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 28		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)
S $(\frac{1}{2}, -\frac{1}{2}, 0)$ of space group No. 28		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)
R $(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 28		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(u, 0, \frac{1}{2})$
B $(0, v, \frac{1}{2})$	
Operation	E
Coordinate	$(0, v, \frac{1}{2})$
C $(u, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
D $(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
DT $(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
E $(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
G $(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
H $(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$

LD(0, 0, w)

Operation E
Coordinate (0, 0, w)

P($\frac{1}{2}$, v , $\frac{1}{2}$)

Operation E
Coordinate ($\frac{1}{2}$, v , $\frac{1}{2}$)

Q($\frac{1}{2}$, $\frac{1}{2}$, w)

Operation E
Coordinate ($\frac{1}{2}$, $\frac{1}{2}$, w)

SM(u , 0, 0)

Operation E
Coordinate (u , 0, 0)

A (u , 0, $\frac{1}{2}$) of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)
2	(0, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)

B (0 , v , $\frac{1}{2}$) of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(r_1 , 0, 0)	2a: (3); 2b: (3); 2c: (4); 4d: (6)
2	(r_1 , 0, 0)	2a: (3); 2b: (3); 2c: (2); 4d: (6)

C (u , $\frac{1}{2}$, 0) of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)
2	(0, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)

D ($\frac{1}{2}$, v , 0) of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(r_1 , 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)

DT (0 , v , 0) of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(r_1 , 0, 0)	2a: (3); 2b: (3); 2c: (4); 4d: (6)
2	(r_1 , 0, 0)	2a: (3); 2b: (3); 2c: (2); 4d: (6)

E (u , $\frac{1}{2}$, $\frac{1}{2}$) of space group No. 28

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)
2	(0, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)

G $(\frac{1}{2}, 0, w)$ of space group No. 28		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 28		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 4d: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 4d: (3)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 4d: (3)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 4d: (3)
LD $(0, 0, w)$ of space group No. 28		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 28		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 28		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6)
SM $(u, 0, 0)$ of space group No. 28		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6)

d. Results for high-symmetry planes

P1 $(-u, -v, 0)$

Operation	E
Coordinate	$(-u, -v, 0)$

P2 $(-u, 0, v)$

Operation	E
Coordinate	$(-u, 0, v)$

P3 $(0, -u, v)$

Operation	E
Coordinate	$(0, -u, v)$

P4($-u, -v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(-u, -v, \frac{1}{2})$	
P5($-u, -\frac{1}{2}, v$)		
Operation	E	
Coordinate	$(-u, -\frac{1}{2}, v)$	
P6($\frac{1}{2}, -u, v$)		
Operation	E	
Coordinate	$(\frac{1}{2}, -u, v)$	

P1 $(-u, -v, 0)$ of space group No. 28			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12)	
P2 $(-u, 0, v)$ of space group No. 28			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6)	
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6)	
P3 $(0, -u, v)$ of space group No. 28			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (4); 4d: (6)	
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (2); 4d: (6)	
P4 $(-u, -v, \frac{1}{2})$ of space group No. 28			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12)	
P5 $(-u, -\frac{1}{2}, v)$ of space group No. 28			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6)	
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6)	
P6 $(\frac{1}{2}, -u, v)$ of space group No. 28			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6)	
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6)	

29. Space group No. 29 ($Pca2_1$)

Orthorhombic primitive lattice

$$\begin{aligned} \vec{a} &= (b, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2}, 0, \frac{1}{2}\} \quad \{\sigma_y|-\frac{1}{2}, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	($\frac{1}{2}$, 0, 0)
$X(0, -\frac{1}{2}, 0)$	
Operation	E
Coordinate	(0, $-\frac{1}{2}$, 0)
$Z(0, 0, \frac{1}{2})$	
Operation	E
Coordinate	(0, 0, $\frac{1}{2}$)
$U(0, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	(0, $-\frac{1}{2}$, $\frac{1}{2}$)
$T(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	($\frac{1}{2}$, 0, $\frac{1}{2}$)
$S(\frac{1}{2}, -\frac{1}{2}, 0)$	
Operation	E
Coordinate	($\frac{1}{2}$, $-\frac{1}{2}$, 0)
$R(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	($\frac{1}{2}$, $-\frac{1}{2}$, $\frac{1}{2}$)

$\Gamma(0, 0, 0)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
3	(0, 0, 0)	4a: (3)
4	(0, 0, 0)	4a: (3)
Y $(\frac{1}{2}, 0, 0)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
X $(0, -\frac{1}{2}, 0)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
3	(0, 0, 0)	4a: (3)
4	(0, 0, 0)	4a: (3)
Z $(0, 0, \frac{1}{2})$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
U $(0, -\frac{1}{2}, \frac{1}{2})$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
T $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
S $(\frac{1}{2}, -\frac{1}{2}, 0)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
R $(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

B $(0, v, \frac{1}{2})$

Operation	E
Coordinate	$(0, v, \frac{1}{2})$
$C(u, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
$D(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
$G(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
$H(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$P(\frac{1}{2}, v, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
$Q(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$SM(u, 0, 0)$	
Operation	E
Coordinate	$(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 29

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3)

2	$(0, r_1, 0)$	4a: (3)
B $(0, v, \frac{1}{2})$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)
C $(u, \frac{1}{2}, 0)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)
2	$(0, r_1, 0)$	4a: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)
DT $(0, v, 0)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)
2	$(r_1, 0, 0)$	4a: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3)
2	$(0, r_1, 0)$	4a: (3)
G $(\frac{1}{2}, 0, w)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3)
2	$(0, 0, 0)$	4a: (3)
3	$(0, 0, 0)$	4a: (3)
4	$(0, 0, 0)$	4a: (3)
LD $(0, 0, w)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3)
2	$(0, 0, 0)$	4a: (3)
3	$(0, 0, 0)$	4a: (3)
4	$(0, 0, 0)$	4a: (3)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3)

2	$(r_1, 0, 0)$	4a: (3)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6)
SM $(u, 0, 0)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)
2	$(0, r_1, 0)$	4a: (6)

d. Results for high-symmetry planes

P1($-u, -v, 0$)	
Operation Coordinate	E ($-u, -v, 0$)
P2($-u, 0, v$)	
Operation Coordinate	E ($-u, 0, v$)
P3($0, -u, v$)	
Operation Coordinate	E ($0, -u, v$)
P4($-u, -v, \frac{1}{2}$)	
Operation Coordinate	E ($-u, -v, \frac{1}{2}$)
P5($-u, -\frac{1}{2}, v$)	
Operation Coordinate	E ($-u, -\frac{1}{2}, v$)
P6($\frac{1}{2}, -u, v$)	
Operation Coordinate	E ($\frac{1}{2}, -u, v$)

P1 $(-u, -v, 0)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12)
P2 $(-u, 0, v)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_1, 0)$	4a: (6)
2	$(0, r_1, 0)$	4a: (6)
P3 $(0, -u, v)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)
2	$(r_1, 0, 0)$	4a: (6)
P4 $(-u, -v, \frac{1}{2})$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)
P5 $(-u, -\frac{1}{2}, v)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)
2	$(0, r_1, 0)$	4a: (6)
P6 $(\frac{1}{2}, -u, v)$ of space group No. 29		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)
2	$(r_1, 0, 0)$	4a: (6)

30. Space group No. 30 ($Pnc2$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_y|0, -\frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_x|0, -\frac{1}{2}, \frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation	E
Coordinate	$(0, 0, 0)$

$$Y(0, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, 0) \end{array}$$

$$X(\frac{1}{2}, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, 0) \end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2}) \end{array}$$

$$U(\frac{1}{2}, 0, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, \frac{1}{2}) \end{array}$$

$$T(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$$S(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0) \end{array}$$

$$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 30

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)

$Y (0, \frac{1}{2}, 0)$ of space group No. 30

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)

$X (\frac{1}{2}, 0, 0)$ of space group No. 30

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
3	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
4	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)

$Z\left(0, 0, \frac{1}{2}\right)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
$U\left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
$T\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
$S\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)

c. Results for high-symmetry lines

$A\left(u, 0, \frac{1}{2}\right)$	
Operation	E
Coordinate	$\left(u, 0, \frac{1}{2}\right)$
$B\left(0, v, \frac{1}{2}\right)$	
Operation	E
Coordinate	$\left(0, v, \frac{1}{2}\right)$
$C\left(u, \frac{1}{2}, 0\right)$	
Operation	E
Coordinate	$\left(u, \frac{1}{2}, 0\right)$
$D\left(\frac{1}{2}, v, 0\right)$	
Operation	E
Coordinate	$\left(\frac{1}{2}, v, 0\right)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
$E\left(u, \frac{1}{2}, \frac{1}{2}\right)$	

Operation E
Coordinate $(u, \frac{1}{2}, \frac{1}{2})$

$G(\frac{1}{2}, 0, w)$

Operation E
Coordinate $(\frac{1}{2}, 0, w)$

$H(0, \frac{1}{2}, w)$

Operation E
Coordinate $(0, \frac{1}{2}, w)$

$LD(0, 0, w)$

Operation E
Coordinate $(0, 0, w)$

$P(\frac{1}{2}, v, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

$Q(\frac{1}{2}, \frac{1}{2}, w)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

$SM(u, 0, 0)$

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
B $(0, v, \frac{1}{2})$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
C $(u, \frac{1}{2}, 0)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
DT $(0, v, 0)$ of space group No. 30		

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
H $(0, \frac{1}{2}, w)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
LD $(0, 0, w)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
SM $(u, 0, 0)$ of space group No. 30		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

d. Results for high-symmetry planes

PI($v, -u, 0$)

Operation E

Coordinate	$(v, -u, 0)$
P2(0, -u, v)	
Operation	E
Coordinate	$(0, -u, v)$
P3(u, 0, v)	
Operation	E
Coordinate	$(u, 0, v)$
P4($v, -u, \frac{1}{2}$)	
Operation	E
Coordinate	$(v, -u, \frac{1}{2})$
P5($\frac{1}{2}, -u, v$)	
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$
P6($u, \frac{1}{2}, v$)	
Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

P1 ($v, -u, 0$) of space group No. 30			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12)	
P2 ($0, -u, v$) of space group No. 30			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)	
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)	
P3 ($u, 0, v$) of space group No. 30			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)	
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)	
P4 ($v, -u, \frac{1}{2}$) of space group No. 30			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12)	
P5 ($\frac{1}{2}, -u, v$) of space group No. 30			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)	
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)	
P6 ($u, \frac{1}{2}, v$) of space group No. 30			

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

31. Space group No. 31 ($Pmn2_1$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (b, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_y|\frac{1}{2}, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$
$X(0, -\frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, -\frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, \frac{1}{2})$
$U(0, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(0, -\frac{1}{2}, \frac{1}{2})$
$T(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$

$$S\left(\frac{1}{2}, -\frac{1}{2}, 0\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, -\frac{1}{2}, 0\right) \end{array}$$

$$R\left(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3)
2	(0, 0, 0)	2a: (1); 4b: (3)
3	(0, 0, 0)	2a: (2); 4b: (3)
4	(0, 0, 0)	2a: (1); 4b: (3)
$Y \left(\frac{1}{2}, 0, 0\right)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6)
$X \left(0, -\frac{1}{2}, 0\right)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3)
2	(0, 0, 0)	2a: (1); 4b: (3)
3	(0, 0, 0)	2a: (2); 4b: (3)
4	(0, 0, 0)	2a: (1); 4b: (3)
$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3)
2	(0, 0, 0)	2a: (1); 4b: (3)
$U \left(0, -\frac{1}{2}, \frac{1}{2}\right)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3)
2	(0, 0, 0)	2a: (1); 4b: (3)
$T \left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6)
$S \left(\frac{1}{2}, -\frac{1}{2}, 0\right)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6)

R $(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6)

c. Results for high-symmetry lines

A($u, 0, \frac{1}{2}$)
Operation E
Coordinate ($u, 0, \frac{1}{2}$)
B($0, v, \frac{1}{2}$)
Operation E
Coordinate ($0, v, \frac{1}{2}$)
C($u, \frac{1}{2}, 0$)
Operation E
Coordinate ($u, \frac{1}{2}, 0$)
D($\frac{1}{2}, v, 0$)
Operation E
Coordinate ($\frac{1}{2}, v, 0$)
DT($0, v, 0$)
Operation E
Coordinate ($0, v, 0$)
E($u, \frac{1}{2}, \frac{1}{2}$)
Operation E
Coordinate ($u, \frac{1}{2}, \frac{1}{2}$)
G($\frac{1}{2}, 0, w$)
Operation E
Coordinate ($\frac{1}{2}, 0, w$)
H($0, \frac{1}{2}, w$)
Operation E
Coordinate ($0, \frac{1}{2}, w$)
LD($0, 0, w$)
Operation E
Coordinate ($0, 0, w$)
P($\frac{1}{2}, v, \frac{1}{2}$)
Operation E
Coordinate ($\frac{1}{2}, v, \frac{1}{2}$)

$$Q(\frac{1}{2}, \frac{1}{2}, w)$$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

$$SM(u, 0, 0)$$

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6)
B $(0, v, \frac{1}{2})$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 4b: (3)
2	$(r_1, 0, 0)$	2a: (1); 4b: (3)
C $(u, \frac{1}{2}, 0)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6)
2	$(0, r_1, 0)$	2a: (3); 4b: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6)
DT $(0, v, 0)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (4); 4b: (6)
2	$(r_1, 0, 0)$	2a: (2); 4b: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 4b: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (2); 4b: (3)
2	$(0, 0, 0)$	2a: (1); 4b: (3)
3	$(0, 0, 0)$	2a: (2); 4b: (3)

4	(0, 0, 0)	2a: (1); 4b: (3)
LD (0, 0, w) of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3)
2	(0, 0, 0)	2a: (1); 4b: (3)
3	(0, 0, 0)	2a: (2); 4b: (3)
4	(0, 0, 0)	2a: (1); 4b: (3)
P ($\frac{1}{2}, v, \frac{1}{2}$) of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	($r_1, 0, 0$)	2a: (3); 4b: (6)
Q ($\frac{1}{2}, \frac{1}{2}, w$) of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6)
SM ($u, 0, 0$) of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	(0, $r_1, 0$)	2a: (3); 4b: (6)
2	(0, $r_1, 0$)	2a: (3); 4b: (6)

d. Results for high-symmetry planes

P1($-u, -v, 0$)

Operation	E
Coordinate	($-u, -v, 0$)

P2($-u, 0, v$)

Operation	E
Coordinate	($-u, 0, v$)

P3($0, -u, v$)

Operation	E
Coordinate	($0, -u, v$)

P4($-u, -v, \frac{1}{2}$)

Operation	E
Coordinate	($-u, -v, \frac{1}{2}$)

P5($-u, -\frac{1}{2}, v$)

Operation	E
Coordinate	($-u, -\frac{1}{2}, v$)

P6($\frac{1}{2}, -u, v$)

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & (\frac{1}{2}, -u, v) \end{array}$$

P1 $(-u, -v, 0)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 4b: (12)
P2 $(-u, 0, v)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6)
2	$(0, r_1, 0)$	2a: (3); 4b: (6)
P3 $(0, -u, v)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (4); 4b: (6)
2	$(r_1, 0, 0)$	2a: (2); 4b: (6)
P4 $(-u, -v, \frac{1}{2})$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 4b: (6)
P5 $(-u, -\frac{1}{2}, v)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6)
2	$(0, r_1, 0)$	2a: (3); 4b: (6)
P6 $(\frac{1}{2}, -u, v)$ of space group No. 31		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6)
2	$(r_1, 0, 0)$	2a: (3); 4b: (6)

32. Space group No. 32 ($Pba2$)

Orthorhombic primitive lattice

$$\begin{array}{ll} \vec{a} = (a, 0, 0) & \vec{t}_1 = \vec{a} \\ \vec{b} = (0, b, 0) & \vec{t}_2 = \vec{b} \\ \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c} \end{array}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{\sigma_y|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_x|-\frac{1}{2}, -\frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	$(0,0,0)$
$Y(0,\frac{1}{2},0)$	
Operation	E
Coordinate	$(0,\frac{1}{2},0)$
$X(\frac{1}{2},0,0)$	
Operation	E
Coordinate	$(\frac{1}{2},0,0)$
$Z(0,0,\frac{1}{2})$	
Operation	E
Coordinate	$(0,0,\frac{1}{2})$
$U(\frac{1}{2},0,\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},0,\frac{1}{2})$
$T(0,\frac{1}{2},\frac{1}{2})$	
Operation	E
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$
$S(\frac{1}{2},\frac{1}{2},0)$	
Operation	E
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$
$R(\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
$Y(0, \frac{1}{2}, 0)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 4c: (6)

X $(\frac{1}{2}, 0, 0)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
Z $(0, 0, \frac{1}{2})$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
U $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

B $(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

C $(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

D $(\frac{1}{2}, v, 0)$

Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
DT(0, v, 0)	
Operation	E
Coordinate	$(0, v, 0)$
E($u, \frac{1}{2}, \frac{1}{2}$)	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
G($\frac{1}{2}, 0, w$)	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
H($0, \frac{1}{2}, w$)	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
LD(0, 0, w)	
Operation	E
Coordinate	$(0, 0, w)$
P($\frac{1}{2}, v, \frac{1}{2}$)	
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
Q($\frac{1}{2}, \frac{1}{2}, w$)	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
SM($u, 0, 0$)	
Operation	E
Coordinate	$(u, 0, 0)$

A $\left(u, 0, \frac{1}{2}\right)$ of space group No. 32			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)	
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)	
B $\left(0, v, \frac{1}{2}\right)$ of space group No. 32			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)	
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)	
C $\left(u, \frac{1}{2}, 0\right)$ of space group No. 32			

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
DT $(0, v, 0)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
LD $(0, 0, w)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
4	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
SM $(u, 0, 0)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

2 $(0, r_1, 0)$ **2a: (3); 2b: (3); 4c: (6)**

d. Results for high-symmetry planes

P1($v, -u, 0$)	
Operation	E
Coordinate	$(v, -u, 0)$
P2($0, -u, v$)	
Operation	E
Coordinate	$(0, -u, v)$
P3($u, 0, v$)	
Operation	E
Coordinate	$(u, 0, v)$
P4($v, -u, \frac{1}{2}$)	
Operation	E
Coordinate	$(v, -u, \frac{1}{2})$
P5($\frac{1}{2}, -u, v$)	
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$
P6($u, \frac{1}{2}, v$)	
Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

P1 ($v, -u, 0$) of space group No. 32

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12)

P2 ($0, -u, v$) of space group No. 32

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)

P3 ($u, 0, v$) of space group No. 32

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

P4 ($v, -u, \frac{1}{2}$) of space group No. 32

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12)
P5 $(\frac{1}{2}, -u, v)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
P6 $(u, \frac{1}{2}, v)$ of space group No. 32		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

33. Space group No. 33 ($Pna2_1$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (b, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_y|-\frac{1}{2}, \frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$
$X(0, -\frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, -\frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, \frac{1}{2})$

$$U(0, -\frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (0, -\frac{1}{2}, \frac{1}{2}) \end{array}$$

$$T(\frac{1}{2}, 0, \frac{1}{2})$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, \frac{1}{2}) \end{array}$$

$$S(\frac{1}{2}, -\frac{1}{2}, 0)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, -\frac{1}{2}, 0) \end{array}$$

$$R(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
3	(0, 0, 0)	4a: (3)
4	(0, 0, 0)	4a: (3)
$Y (\frac{1}{2}, 0, 0)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
$X (0, -\frac{1}{2}, 0)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
$Z (0, 0, \frac{1}{2})$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
$U (0, -\frac{1}{2}, \frac{1}{2})$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
$T (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
$S (\frac{1}{2}, -\frac{1}{2}, 0)$ of space group No. 33		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
R $(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)

c. Results for high-symmetry lines

A($u, 0, \frac{1}{2}$)
Operation E
Coordinate ($u, 0, \frac{1}{2}$)
B($0, v, \frac{1}{2}$)
Operation E
Coordinate ($0, v, \frac{1}{2}$)
C($u, \frac{1}{2}, 0$)
Operation E
Coordinate ($u, \frac{1}{2}, 0$)
D($\frac{1}{2}, v, 0$)
Operation E
Coordinate ($\frac{1}{2}, v, 0$)
DT($0, v, 0$)
Operation E
Coordinate ($0, v, 0$)
E($u, \frac{1}{2}, \frac{1}{2}$)
Operation E
Coordinate ($u, \frac{1}{2}, \frac{1}{2}$)
G($\frac{1}{2}, 0, w$)
Operation E
Coordinate ($\frac{1}{2}, 0, w$)
H($0, \frac{1}{2}, w$)
Operation E
Coordinate ($0, \frac{1}{2}, w$)
LD($0, 0, w$)
Operation E
Coordinate ($0, 0, w$)

$$P\left(\frac{1}{2}, v, \frac{1}{2}\right)$$

Operation	E
Coordinate	$\left(\frac{1}{2}, v, \frac{1}{2}\right)$

$$Q\left(\frac{1}{2}, \frac{1}{2}, w\right)$$

Operation	E
Coordinate	$\left(\frac{1}{2}, \frac{1}{2}, w\right)$

$$SM(u, 0, 0)$$

Operation	E
Coordinate	$(u, 0, 0)$

A $\left(u, 0, \frac{1}{2}\right)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3)
2	$(0, r_1, 0)$	4a: (3)

B $\left(0, v, \frac{1}{2}\right)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)

C $\left(u, \frac{1}{2}, 0\right)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)

D $\left(\frac{1}{2}, v, 0\right)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)

DT $(0, v, 0)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)
2	$(r_1, 0, 0)$	4a: (6)

E $\left(u, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)

G $\left(\frac{1}{2}, 0, w\right)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6)

H $\left(0, \frac{1}{2}, w\right)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (6)
LD (0, 0, w) of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
3	(0, 0, 0)	4a: (3)
4	(0, 0, 0)	4a: (3)
P ($\frac{1}{2}, v, \frac{1}{2}$) of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	($r_1, 0, 0$)	4a: (3)
2	($r_1, 0, 0$)	4a: (3)
Q ($\frac{1}{2}, \frac{1}{2}, w$) of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
3	(0, 0, 0)	4a: (3)
4	(0, 0, 0)	4a: (3)
SM ($u, 0, 0$) of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	(0, $r_1, 0$)	4a: (6)
2	(0, $r_1, 0$)	4a: (6)

d. Results for high-symmetry planes

P1($-u, -v, 0$)

Operation	E
Coordinate	($-u, -v, 0$)

P2($-u, 0, v$)

Operation	E
Coordinate	($-u, 0, v$)

P3($0, -u, v$)

Operation	E
Coordinate	($0, -u, v$)

P4($-u, -v, \frac{1}{2}$)

Operation	E
Coordinate	($-u, -v, \frac{1}{2}$)

P5($-u, -\frac{1}{2}, v$)

Operation	E
Coordinate	$(-u, -\frac{1}{2}, v)$
	$P6(\frac{1}{2}, -u, v)$
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$

P1 $(-u, -v, 0)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12)
P2 $(-u, 0, v)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)
2	$(0, r_1, 0)$	4a: (6)
P3 $(0, -u, v)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)
2	$(r_1, 0, 0)$	4a: (6)
P4 $(-u, -v, \frac{1}{2})$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)
P5 $(-u, -\frac{1}{2}, v)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6)
2	$(0, r_1, 0)$	4a: (6)
P6 $(\frac{1}{2}, -u, v)$ of space group No. 33		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6)
2	$(r_1, 0, 0)$	4a: (6)

34. Space group No. 34 ($Pnn2$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{\sigma_y|\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	$(0,0,0)$
$Y(0,\frac{1}{2},0)$	
Operation	E
Coordinate	$(0,\frac{1}{2},0)$
$X(\frac{1}{2},0,0)$	
Operation	E
Coordinate	$(\frac{1}{2},0,0)$
$Z(0,0,\frac{1}{2})$	
Operation	E
Coordinate	$(0,0,\frac{1}{2})$
$U(\frac{1}{2},0,\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},0,\frac{1}{2})$
$T(0,\frac{1}{2},\frac{1}{2})$	
Operation	E
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$
$S(\frac{1}{2},\frac{1}{2},0)$	
Operation	E
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$
$R(\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 34

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	2a: (1); 2b: (1); 4c: (3)
2	(0,0,0)	2a: (1); 2b: (1); 4c: (3)
3	(0,0,0)	2a: (2); 2b: (2); 4c: (3)
4	(0,0,0)	2a: (2); 2b: (2); 4c: (3)

Y $(0, \frac{1}{2}, 0)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
X $(\frac{1}{2}, 0, 0)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
Z $(0, 0, \frac{1}{2})$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3)
U $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6)
S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3)
3	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)
4	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

B $(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

C $(u, \frac{1}{2}, 0)$

Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
$D(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
$G(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
$H(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$P(\frac{1}{2}, v, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
$Q(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$SM(u, 0, 0)$	
Operation	E
Coordinate	$(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
B $(0, v, \frac{1}{2})$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)

C $(u, \frac{1}{2}, 0)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
DT $(0, v, 0)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
LD $(0, 0, w)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
4	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)
3	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3)
4	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3)

SM $(u, 0, 0)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

d. Results for high-symmetry planes

P1 $(v, -u, 0)$	
Operation	E
Coordinate	$(v, -u, 0)$
P2 $(0, -u, v)$	
Operation	E
Coordinate	$(0, -u, v)$
P3 $(u, 0, v)$	
Operation	E
Coordinate	$(u, 0, v)$
P4 $(v, -u, \frac{1}{2})$	
Operation	E
Coordinate	$(v, -u, \frac{1}{2})$
P5 $(\frac{1}{2}, -u, v)$	
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$
P6 $(u, \frac{1}{2}, v)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

P1 $(v, -u, 0)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12)
P2 $(0, -u, v)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
P3 $(u, 0, v)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
P4 $(v, -u, \frac{1}{2})$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12)
P5 $(\frac{1}{2}, -u, v)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6)
P6 $(u, \frac{1}{2}, v)$ of space group No. 34		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6)

35. Space group No. 35 ($C_{mm}2$)

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (0, 0, 0)
 \end{array}$$

$$Y(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)
 \end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}
 \text{Operation} & E
 \end{array}$$

Coordinate $(0, 0, \frac{1}{2})$

$T(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$S(0, \frac{1}{2}, 0)$

Operation E σ_y
Coordinate $(0, \frac{1}{2}, 0)$ $(\frac{1}{2}, 0, 0)$

$R(0, \frac{1}{2}, \frac{1}{2})$

Operation E σ_y
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(\frac{1}{2}, 0, \frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 35

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (2); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (2); 8f: (3)

$Y (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 35

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (1); 4e: (1); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (1); 8f: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3)

$Z (0, 0, \frac{1}{2})$ of space group No. 35

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (2); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (2); 8f: (3)

$T (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 35

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (1); 4e: (1); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (1); 8f: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3)

$S (0, \frac{1}{2}, 0)$ of space group No. 35

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

2 (0, 0, 0) 2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

c. Results for high-symmetry lines

A($\frac{u}{2}, \frac{u}{2}, \frac{1}{2}$)		
Operation	E	
Coordinate	($\frac{u}{2}, \frac{u}{2}, \frac{1}{2}$)	
B($-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}$)		
Operation	E	
Coordinate	($-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}$)	
D($0, \frac{1}{2}, w$)		
Operation	E	σ_y
Coordinate	($0, \frac{1}{2}, w$)	($\frac{1}{2}, 0, w$)
DT($-\frac{v}{2}, \frac{v}{2}, 0$)		
Operation	E	
Coordinate	($-\frac{v}{2}, \frac{v}{2}, 0$)	
H($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
LD($0, 0, w$)		
Operation	E	
Coordinate	(0, 0, w)	
SM($\frac{u}{2}, \frac{u}{2}, 0$)		
Operation	E	
Coordinate	($\frac{u}{2}, \frac{u}{2}, 0$)	

A $(\frac{u}{2}, \frac{u}{2}, \frac{1}{2})$ of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (4); 4e: (3); 8f: (6)
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (2); 4e: (3); 8f: (6)
B $(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$ of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information

1	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 8f: (6)
2	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 8f: (6)
D $(0, \frac{1}{2}, w)$ of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
DT $(-\frac{v}{2}, \frac{v}{2}, 0)$ of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 8f: (6)
2	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 8f: (6)
H $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3)
2	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (2); 4d: (1); 4e: (1); 8f: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (1); 8f: (3)
4	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3)
LD $(0, 0, w)$ of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (2); 8f: (3)
2	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (3)
4	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (2); 8f: (3)
SM $(\frac{u}{2}, \frac{u}{2}, 0)$ of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (4); 4e: (3); 8f: (6)
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (2); 4e: (3); 8f: (6)

d. Results for high-symmetry planes

P1(u, u, v)

Operation	E
Coordinate	(u, u, v)

P2($u, -u, v$)

Operation	E
Coordinate	$(u, -u, v)$

P3($u, v, 0$)

Operation	E
Coordinate	$(u, v, 0)$

$$P4(u, v, \frac{1}{2})$$

Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 (u, u, v) of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (4); 4e: (3); 8f: (6)
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (2); 4e: (3); 8f: (6)

P2 ($u, -u, v$) of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 8f: (6)
2	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 8f: (6)

P3 ($u, v, 0$) of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

P4 ($u, v, \frac{1}{2}$) of space group No. 35		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

36. Space group No. 36 ($Cmc2_1$)

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (b, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_y|0, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$Y(\frac{1}{2}, -\frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$T(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	
$S(\frac{1}{2}, 0, 0)$		
Operation	E	σ_x
Coordinate	$(\frac{1}{2}, 0, 0)$	$(0, -\frac{1}{2}, 0)$
$R(\frac{1}{2}, 0, \frac{1}{2})$		
Operation	E	σ_x
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$	$(0, -\frac{1}{2}, \frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (2); 8b: (3)
2	$(0, 0, 0)$	4a: (1); 8b: (3)
3	$(0, 0, 0)$	4a: (2); 8b: (3)
4	$(0, 0, 0)$	4a: (1); 8b: (3)
$Y (\frac{1}{2}, -\frac{1}{2}, 0)$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (2); 8b: (3)
2	$(0, 0, 0)$	4a: (1); 8b: (3)
3	$(0, 0, 0)$	4a: (2); 8b: (3)
4	$(0, 0, 0)$	4a: (1); 8b: (3)
$Z (0, 0, \frac{1}{2})$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (2); 8b: (3)
2	$(0, 0, 0)$	4a: (1); 8b: (3)
$T (\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (2); 8b: (3)
2	(0, 0, 0)	4a: (1); 8b: (3)
S $(\frac{1}{2}, 0, 0)$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
2	(0, 0, 0)	4a: (3); 8b: (6)
R $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)

c. Results for high-symmetry lines

A($\frac{u}{2}, \frac{u}{2}, \frac{1}{2}$)		
Operation	E	
Coordinate	($\frac{u}{2}, \frac{u}{2}, \frac{1}{2}$)	
B($-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}$)		
Operation	E	
Coordinate	($-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}$)	
D($0, \frac{1}{2}, w$)		
Operation	E	σ_x
Coordinate	($0, \frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
DT($-\frac{v}{2}, \frac{v}{2}, 0$)		
Operation	E	
Coordinate	($-\frac{v}{2}, \frac{v}{2}, 0$)	
H($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
LD($0, 0, w$)		
Operation	E	
Coordinate	($0, 0, w$)	
SM($\frac{u}{2}, \frac{u}{2}, 0$)		
Operation	E	
Coordinate	($\frac{u}{2}, \frac{u}{2}, 0$)	

A $(\frac{u}{2}, \frac{u}{2}, \frac{1}{2})$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_1, 0)$	4a: (3); 8b: (6)
B $(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (2); 8b: (3)
2	$(r_1, 0, 0)$	4a: (1); 8b: (3)
D $(0, \frac{1}{2}, w)$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, -r_1)$	4a: (3); 8b: (6)
2	$(0, 0, -r_1)$	4a: (3); 8b: (6)
DT $(-\frac{v}{2}, \frac{v}{2}, 0)$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (4); 8b: (6)
2	$(r_1, 0, 0)$	4a: (2); 8b: (6)
H $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (2); 8b: (3)
2	$(0, 0, 0)$	4a: (1); 8b: (3)
3	$(0, 0, 0)$	4a: (2); 8b: (3)
4	$(0, 0, 0)$	4a: (1); 8b: (3)
LD $(0, 0, w)$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (2); 8b: (3)
2	$(0, 0, 0)$	4a: (1); 8b: (3)
3	$(0, 0, 0)$	4a: (2); 8b: (3)
4	$(0, 0, 0)$	4a: (1); 8b: (3)
SM $(\frac{u}{2}, \frac{u}{2}, 0)$ of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 8b: (6)
2	$(0, r_1, 0)$	4a: (3); 8b: (6)

d. Results for high-symmetry planes

P1($u, -u, v$)

Operation	E
Coordinate	$(u, -u, v)$

P2($-u, -u, v$)

Operation	E

Coordinate	$(-u, -u, v)$
P3($v, -u, 0$)	
Operation	E
Coordinate	$(v, -u, 0)$
P4($v, -u, \frac{1}{2}$)	
Operation	E
Coordinate	$(v, -u, \frac{1}{2})$

P1 ($u, -u, v$) of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (4); 8b: (6)
2	$(r_1, 0, 0)$	4a: (2); 8b: (6)
P2 ($-u, -u, v$) of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 8b: (6)
2	$(0, r_1, 0)$	4a: (3); 8b: (6)
P3 ($v, -u, 0$) of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 8b: (12)
P4 ($v, -u, \frac{1}{2}$) of space group No. 36		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (3); 8b: (6)

37. Space group No. 37 (C_{cc2})

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_y|0, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$Y(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$T(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$S(0, \frac{1}{2}, 0)$		
Operation	E	σ_y
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	σ_y
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 37			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 8d: (3)	
2	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 8d: (3)	
3	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (2); 8d: (3)	
4	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (2); 8d: (3)	
$Y(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 37			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (2); 8d: (3)	
2	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (2); 8d: (3)	
3	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (1); 8d: (3)	
4	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (1); 8d: (3)	
$Z(0, 0, \frac{1}{2})$ of space group No. 37			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 8d: (3)	
2	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (2); 8d: (3)	
$T(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 37			

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 8d: (3)
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 8d: (3)
S $(0, \frac{1}{2}, 0)$ of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (4); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (4); 4b: (2); 4c: (3); 8d: (6)
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (4); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (4); 4b: (2); 4c: (3); 8d: (6)

c. Results for high-symmetry lines

A($\frac{u}{2}, \frac{u}{2}, \frac{1}{2}$)		
Operation	E	
Coordinate	($\frac{u}{2}, \frac{u}{2}, \frac{1}{2}$)	
B($-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}$)		
Operation	E	
Coordinate	($-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}$)	
D($0, \frac{1}{2}, w$)		
Operation	E	σ_y
Coordinate	($0, \frac{1}{2}, w$)	($\frac{1}{2}, 0, w$)
DT($-\frac{v}{2}, \frac{v}{2}, 0$)		
Operation	E	
Coordinate	($-\frac{v}{2}, \frac{v}{2}, 0$)	
H($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
LD($0, 0, w$)		
Operation	E	
Coordinate	($0, 0, w$)	
SM($\frac{u}{2}, \frac{u}{2}, 0$)		
Operation	E	
Coordinate	($\frac{u}{2}, \frac{u}{2}, 0$)	

A $\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$ of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
B $\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$ of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
D $\left(0, \frac{1}{2}, w\right)$ of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (2); 4b: (4); 4c: (3); 8d: (6)
2	$(0, 0, r_1)$	4a: (4); 4b: (2); 4c: (3); 8d: (6)
DT $\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$ of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
H $\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (2); 8d: (3)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (2); 8d: (3)
3	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (1); 8d: (3)
4	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (1); 8d: (3)
LD $(0, 0, w)$ of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 8d: (3)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 8d: (3)
3	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (2); 8d: (3)
4	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (2); 8d: (3)
SM $\left(\frac{u}{2}, \frac{u}{2}, 0\right)$ of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)

d. Results for high-symmetry planes

P1(u, u, v)

Operation	E
Coordinate	(u, u, v)

P2($u, -u, v$)

Operation	E
Coordinate	$(u, -u, v)$
P3($u, v, 0$)	
Operation	E
Coordinate	$(u, v, 0)$
P4($u, v, \frac{1}{2}$)	
Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 (u, u, v) of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
P2 ($u, -u, v$) of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
P3 ($u, v, 0$) of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
P4 ($u, v, \frac{1}{2}$) of space group No. 37		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)

38. Space group No. 38 ($Amm2$)

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (c, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, b) & \vec{t}_3 &= -\frac{1}{2}\vec{b} + \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	
$Y(0,\frac{1}{2},-\frac{1}{2})$		
Operation	E	
Coordinate	$(0,\frac{1}{2},-\frac{1}{2})$	
$Z(\frac{1}{2},0,0)$		
Operation	E	
Coordinate	$(\frac{1}{2},0,0)$	
$T(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$	
$S(0,\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(0,0,\frac{1}{2})$
$R(\frac{1}{2},\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$	$(-\frac{1}{2},0,\frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 38			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3)	
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 8f: (3)	
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (2); 8f: (3)	
$Y(0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 38			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3)	
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 8f: (3)	
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (2); 8f: (3)	
$Z(\frac{1}{2}, 0, 0)$ of space group No. 38			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (3)	
2	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (2); 8f: (3)	

4 (0, 0, 0) 2a: (1); 2b: (0); 4c: (1); 4d: (2); 4e: (1); 8f: (3)

T $(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 38

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (2); 8f: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (2); 4e: (1); 8f: (3)

S $(0, \frac{1}{2}, 0)$ of space group No. 38

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (4); 4e: (4); 8f: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (2); 4e: (2); 8f: (6)

R $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 38

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (4); 4e: (2); 8f: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (2); 4e: (4); 8f: (6)

c. Results for high-symmetry lines

A $(\frac{1}{2}, \frac{w}{2}, \frac{w}{2})$

Operation	E
Coordinate	$(\frac{1}{2}, \frac{w}{2}, \frac{w}{2})$

B $(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2})$

Operation	E
Coordinate	$(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2})$

D $(u, 0, -\frac{1}{2})$

Operation	E	C_{2z}
Coordinate	$(u, 0, -\frac{1}{2})$	$(-u, -\frac{1}{2}, 0)$

DT $(0, \frac{v}{2}, -\frac{v}{2})$

Operation	E
Coordinate	$(0, \frac{v}{2}, -\frac{v}{2})$

H $(u, -\frac{1}{2}, -\frac{1}{2})$

Operation	E
Coordinate	$(u, -\frac{1}{2}, -\frac{1}{2})$

LD $(u, 0, 0)$

Operation	E
Coordinate	$(u, 0, 0)$

SM $(0, \frac{w}{2}, \frac{w}{2})$

Operation E
Coordinate $(0, \frac{w}{2}, \frac{w}{2})$

A $(\frac{1}{2}, \frac{w}{2}, \frac{w}{2})$ of space group No. 38		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (2); 8f: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (2); 4e: (1); 8f: (3)
B $(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2})$ of space group No. 38		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (1); 4c: (3); 4d: (4); 4e: (2); 8f: (6)
2	$(r_1, 0, 0)$	2a: (1); 2b: (2); 4c: (3); 4d: (2); 4e: (4); 8f: (6)
D $(u, 0, -\frac{1}{2})$ of space group No. 38		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, -r_2, r_1)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12)
DT $(0, \frac{v}{2}, -\frac{v}{2})$ of space group No. 38		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (4); 4e: (4); 8f: (6)
2	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (2); 4e: (2); 8f: (6)
H $(u, -\frac{1}{2}, -\frac{1}{2})$ of space group No. 38		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6)
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6)
LD $(u, 0, 0)$ of space group No. 38		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6)
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6)
SM $(0, \frac{w}{2}, \frac{w}{2})$ of space group No. 38		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 8f: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (2); 8f: (3)

d. Results for high-symmetry planes

P1($v, u, -u$)	
Operation	E
Coordinate	$(v, u, -u)$
P2($v, -u, -u$)	
Operation	E
Coordinate	$(v, -u, -u)$
P3($0, v, -u$)	
Operation	E
Coordinate	$(0, v, -u)$
P4($\frac{1}{2}, v, -u$)	
Operation	E
Coordinate	$(\frac{1}{2}, v, -u)$

P1 ($v, u, -u$) of space group No. 38			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12)	
P2 ($v, -u, -u$) of space group No. 38			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6)	
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6)	
P3 ($0, v, -u$) of space group No. 38			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (4); 4e: (4); 8f: (6)	
2	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (2); 4e: (2); 8f: (6)	
P4 ($\frac{1}{2}, v, -u$) of space group No. 38			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (2); 2b: (1); 4c: (3); 4d: (4); 4e: (2); 8f: (6)	
2	$(r_1, 0, 0)$	2a: (1); 2b: (2); 4c: (3); 4d: (2); 4e: (4); 8f: (6)	

39. Space group No. 39 ($Abm2$)

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (c, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, b) & \vec{t}_3 &= -\frac{1}{2}\vec{b} + \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{\sigma_y|0,\frac{1}{2},-\frac{1}{2}\} \quad \{\sigma_x|0,-\frac{1}{2},\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	
$Y(0,\frac{1}{2},-\frac{1}{2})$		
Operation	E	
Coordinate	$(0,\frac{1}{2},-\frac{1}{2})$	
$Z(\frac{1}{2},0,0)$		
Operation	E	
Coordinate	$(\frac{1}{2},0,0)$	
$T(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$	
$S(0,\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(0,0,\frac{1}{2})$
$R(\frac{1}{2},\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$	$(-\frac{1}{2},0,\frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 39

(Co-) irrep	Phonon AM	WYPO information
1	$(0,0,0)$	4a: (1); 4b: (1); 4c: (2); 8d: (3)
2	$(0,0,0)$	4a: (1); 4b: (1); 4c: (1); 8d: (3)
3	$(0,0,0)$	4a: (2); 4b: (2); 4c: (2); 8d: (3)
4	$(0,0,0)$	4a: (2); 4b: (2); 4c: (1); 8d: (3)

$Y(0,\frac{1}{2},-\frac{1}{2})$ of space group No. 39

(Co-) irrep	Phonon AM	WYPO information
1	$(0,0,0)$	4a: (1); 4b: (1); 4c: (2); 8d: (3)
2	$(0,0,0)$	4a: (1); 4b: (1); 4c: (1); 8d: (3)
3	$(0,0,0)$	4a: (2); 4b: (2); 4c: (2); 8d: (3)
4	$(0,0,0)$	4a: (2); 4b: (2); 4c: (1); 8d: (3)

$Z(\frac{1}{2},0,0)$ of space group No. 39

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (2); 8d: (3)
2	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 8d: (3)
3	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 8d: (3)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (1); 8d: (3)
T $(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (2); 8d: (3)
2	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 8d: (3)
3	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 8d: (3)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (1); 8d: (3)
S $(0, \frac{1}{2}, 0)$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
R $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

c. Results for high-symmetry lines

A($\frac{1}{2}, \frac{w}{2}, \frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{w}{2}, \frac{w}{2}$)	
B($\frac{1}{2}, \frac{v}{2}, -\frac{v}{2}$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{v}{2}, -\frac{v}{2}$)	
D($u, 0, -\frac{1}{2}$)		
Operation	E	C_{2z}
Coordinate	($u, 0, -\frac{1}{2}$)	($-u, -\frac{1}{2}, 0$)
DT($0, \frac{v}{2}, -\frac{v}{2}$)		
Operation	E	
Coordinate	(0, $\frac{v}{2}, -\frac{v}{2}$)	
H($u, -\frac{1}{2}, -\frac{1}{2}$)		
Operation	E	
Coordinate	(u, $-\frac{1}{2}, -\frac{1}{2}$)	
LD($u, 0, 0$)		
Operation	E	

Coordinate	$(u, 0, 0)$
$\text{SM}\left(0, \frac{w}{2}, \frac{w}{2}\right)$	
Operation	E
Coordinate	$\left(0, \frac{w}{2}, \frac{w}{2}\right)$

A $\left(\frac{1}{2}, \frac{w}{2}, \frac{w}{2}\right)$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (2); 4c: (2); 8d: (3)
2	$(0, 0, 0)$	4a: (1); 4b: (2); 4c: (1); 8d: (3)
3	$(0, 0, 0)$	4a: (2); 4b: (1); 4c: (2); 8d: (3)
4	$(0, 0, 0)$	4a: (2); 4b: (1); 4c: (1); 8d: (3)
B $\left(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2}\right)$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
D $\left(u, 0, -\frac{1}{2}\right)$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, -r_2, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
DT $\left(0, \frac{v}{2}, -\frac{v}{2}\right)$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(r_1, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
H $\left(u, -\frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (2); 8d: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (4); 8d: (6)
LD $(u, 0, 0)$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (4); 8d: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (2); 8d: (6)
SM $\left(0, \frac{w}{2}, \frac{w}{2}\right)$ of space group No. 39		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (2); 8d: (3)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 8d: (3)
3	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (2); 8d: (3)
4	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (1); 8d: (3)

d. Results for high-symmetry planes

P1($v, u, -u$)		
Operation	E	
Coordinate	$(v, u, -u)$	
P2($v, -u, -u$)		
Operation	E	
Coordinate	$(v, -u, -u)$	
P3($0, v, -u$)		
Operation	E	
Coordinate	$(0, v, -u)$	
P4($\frac{1}{2}, v, -u$)		
Operation	E	
Coordinate	$(\frac{1}{2}, v, -u)$	

P1 ($v, u, -u$) of space group No. 39				
(Co-) irrep	Phonon AM	WYPO information		
1	$(r_2, r_1, 0)$	4a: (6);	4b: (6);	4c: (6); 8d: (12)
P2 ($v, -u, -u$) of space group No. 39				
(Co-) irrep	Phonon AM	WYPO information		
1	$(0, r_1, 0)$	4a: (3);	4b: (3);	4c: (4); 8d: (6)
2	$(0, r_1, 0)$	4a: (3);	4b: (3);	4c: (2); 8d: (6)
P3 ($0, v, -u$) of space group No. 39				
(Co-) irrep	Phonon AM	WYPO information		
1	$(r_1, 0, 0)$	4a: (3);	4b: (3);	4c: (3); 8d: (6)
2	$(r_1, 0, 0)$	4a: (3);	4b: (3);	4c: (3); 8d: (6)
P4 ($\frac{1}{2}, v, -u$) of space group No. 39				
(Co-) irrep	Phonon AM	WYPO information		
1	$(r_1, 0, 0)$	4a: (3);	4b: (3);	4c: (3); 8d: (6)
2	$(r_1, 0, 0)$	4a: (3);	4b: (3);	4c: (3); 8d: (6)

40. Space group No. 40 (*Ama*2)

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (c, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, b) & \vec{t}_3 &= -\frac{1}{2}\vec{b} + \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{\sigma_y|\frac{1}{2},0,0\} \quad \{\sigma_x|-\frac{1}{2},0,0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	
$Y(0,\frac{1}{2},-\frac{1}{2})$		
Operation	E	
Coordinate	$(0,\frac{1}{2},-\frac{1}{2})$	
$Z(\frac{1}{2},0,0)$		
Operation	E	
Coordinate	$(\frac{1}{2},0,0)$	
$T(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$	
$S(0,\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(0,0,\frac{1}{2})$
$R(\frac{1}{2},\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$	$(-\frac{1}{2},0,\frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 40		
(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (1); 4b: (2); 8c: (3)
2	(0,0,0)	4a: (1); 4b: (1); 8c: (3)
3	(0,0,0)	4a: (2); 4b: (1); 8c: (3)
4	(0,0,0)	4a: (2); 4b: (2); 8c: (3)

$Y(0,\frac{1}{2},-\frac{1}{2})$ of space group No. 40		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3)
3	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3)
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3)

$$\text{Z } \left(\frac{1}{2}, 0, 0 \right) \text{ of space group No. 40}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)

$$\text{T } \left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2} \right) \text{ of space group No. 40}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)

$$\text{S } \left(0, \frac{1}{2}, 0 \right) \text{ of space group No. 40}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (4); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (2); 8c: (6)

$$\text{R } \left(\frac{1}{2}, \frac{1}{2}, 0 \right) \text{ of space group No. 40}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)

c. Results for high-symmetry lines

$A(\frac{1}{2}, \frac{w}{2}, \frac{w}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{w}{2}, \frac{w}{2})$	
$B(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2})$	
$D(u, 0, -\frac{1}{2})$		
Operation	E	C_{2z}
Coordinate	$(u, 0, -\frac{1}{2})$	$(-u, -\frac{1}{2}, 0)$
$DT(0, \frac{v}{2}, -\frac{v}{2})$		
Operation	E	
Coordinate	$(0, \frac{v}{2}, -\frac{v}{2})$	
$H(u, -\frac{1}{2}, -\frac{1}{2})$		
Operation	E	
Coordinate	$(u, -\frac{1}{2}, -\frac{1}{2})$	
$LD(u, 0, 0)$		

Operation	E
Coordinate	$(u, 0, 0)$
SM $(0, \frac{w}{2}, \frac{w}{2})$	
Operation	E
Coordinate	$(0, \frac{w}{2}, \frac{w}{2})$

A $(\frac{1}{2}, \frac{w}{2}, \frac{w}{2})$ of space group No. 40		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
B $(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2})$ of space group No. 40		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
D $(u, 0, -\frac{1}{2})$ of space group No. 40		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, -r_2, r_1)$	4a: (6); 4b: (6); 8c: (12)
DT $(0, \frac{v}{2}, -\frac{v}{2})$ of space group No. 40		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (4); 8c: (6)
2	$(r_1, 0, 0)$	4a: (3); 4b: (2); 8c: (6)
H $(u, -\frac{1}{2}, -\frac{1}{2})$ of space group No. 40		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)
LD $(u, 0, 0)$ of space group No. 40		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)
SM $(0, \frac{w}{2}, \frac{w}{2})$ of space group No. 40		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (2); 8c: (3)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
3	$(0, 0, 0)$	4a: (2); 4b: (1); 8c: (3)
4	$(0, 0, 0)$	4a: (2); 4b: (2); 8c: (3)

d. Results for high-symmetry planes

P1($v, u, -u$)		
Operation	E	
Coordinate	$(v, u, -u)$	
P2($v, -u, -u$)		
Operation	E	
Coordinate	$(v, -u, -u)$	
P3($0, v, -u$)		
Operation	E	
Coordinate	$(0, v, -u)$	
P4($\frac{1}{2}, v, -u$)		
Operation	E	
Coordinate	$(\frac{1}{2}, v, -u)$	

P1 ($v, u, -u$) of space group No. 40			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	4a: (6);	4b: (6); 8c: (12)
P2 ($v, -u, -u$) of space group No. 40			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	4a: (3);	4b: (3); 8c: (6)
2	$(0, r_1, 0)$	4a: (3);	4b: (3); 8c: (6)
P3 ($0, v, -u$) of space group No. 40			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	4a: (3);	4b: (4); 8c: (6)
2	$(r_1, 0, 0)$	4a: (3);	4b: (2); 8c: (6)
P4 ($\frac{1}{2}, v, -u$) of space group No. 40			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	4a: (3);	4b: (3); 8c: (6)
2	$(r_1, 0, 0)$	4a: (3);	4b: (3); 8c: (6)

41. Space group No. 41 ($Aba2$)

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (c, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, b) & \vec{t}_3 &= -\frac{1}{2}\vec{b} + \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{\sigma_y|\frac{1}{2},\frac{1}{2},-\frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2},-\frac{1}{2},\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	
$Y(0,\frac{1}{2},-\frac{1}{2})$		
Operation	E	
Coordinate	$(0,\frac{1}{2},-\frac{1}{2})$	
$Z(\frac{1}{2},0,0)$		
Operation	E	
Coordinate	$(\frac{1}{2},0,0)$	
$T(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$	
$S(0,\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(0,0,\frac{1}{2})$
$R(\frac{1}{2},\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$	$(-\frac{1}{2},0,\frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 41

(Co-) irrep	Phonon AM	WYPO information
1	$(0,0,0)$	4a: (1); 8b: (3)
2	$(0,0,0)$	4a: (1); 8b: (3)
3	$(0,0,0)$	4a: (2); 8b: (3)
4	$(0,0,0)$	4a: (2); 8b: (3)

$Y(0,\frac{1}{2},-\frac{1}{2})$ of space group No. 41

(Co-) irrep	Phonon AM	WYPO information
1	$(0,0,0)$	4a: (1); 8b: (3)
2	$(0,0,0)$	4a: (1); 8b: (3)
3	$(0,0,0)$	4a: (2); 8b: (3)
4	$(0,0,0)$	4a: (2); 8b: (3)

$Z(\frac{1}{2},0,0)$ of space group No. 41

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
$T\left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
$S\left(0, \frac{1}{2}, 0\right)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
$R\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)

c. Results for high-symmetry lines

$A(\frac{1}{2}, \frac{w}{2}, \frac{w}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{w}{2}, \frac{w}{2})$	
$B(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2})$	
$D(u, 0, -\frac{1}{2})$		
Operation	E	C_{2z}
Coordinate	$(u, 0, -\frac{1}{2})$	$(-u, -\frac{1}{2}, 0)$
$DT(0, \frac{v}{2}, -\frac{v}{2})$		
Operation	E	
Coordinate	$(0, \frac{v}{2}, -\frac{v}{2})$	
$H(u, -\frac{1}{2}, -\frac{1}{2})$		
Operation	E	
Coordinate	$(u, -\frac{1}{2}, -\frac{1}{2})$	
$LD(u, 0, 0)$		
Operation	E	
Coordinate	$(u, 0, 0)$	
$SM(0, \frac{w}{2}, \frac{w}{2})$		
Operation	E	
Coordinate	$(0, \frac{w}{2}, \frac{w}{2})$	

A $\left(\frac{1}{2}, \frac{w}{2}, \frac{w}{2}\right)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
B $\left(\frac{1}{2}, \frac{v}{2}, -\frac{v}{2}\right)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 8b: (6)
D $\left(u, 0, -\frac{1}{2}\right)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, -r_2, r_1)$	4a: (3); 8b: (6)
DT $\left(0, \frac{v}{2}, -\frac{v}{2}\right)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 8b: (6)
2	$(r_1, 0, 0)$	4a: (3); 8b: (6)
H $\left(u, -\frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 8b: (6)
2	$(0, r_1, 0)$	4a: (3); 8b: (6)
LD $(u, 0, 0)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 8b: (6)
2	$(0, r_1, 0)$	4a: (3); 8b: (6)
SM $\left(0, \frac{w}{2}, \frac{w}{2}\right)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 8b: (3)
2	(0, 0, 0)	4a: (1); 8b: (3)
3	(0, 0, 0)	4a: (2); 8b: (3)
4	(0, 0, 0)	4a: (2); 8b: (3)

d. Results for high-symmetry planes

P1($v, u, -u$)

Operation	E
Coordinate	$(v, u, -u)$

P2($v, -u, -u$)

Operation	E
Coordinate	$(v, -u, -u)$

$$P3(0, v, -u)$$

Operation	E
Coordinate	$(0, v, -u)$

$$P4(\frac{1}{2}, v, -u)$$

Operation	E
Coordinate	$(\frac{1}{2}, v, -u)$

P1 $(v, u, -u)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 8b: (12)

P2 $(v, -u, -u)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 8b: (6)
2	$(0, r_1, 0)$	4a: (3); 8b: (6)

P3 $(0, v, -u)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 8b: (6)
2	$(r_1, 0, 0)$	4a: (3); 8b: (6)

P4 $(\frac{1}{2}, v, -u)$ of space group No. 41		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 8b: (6)
2	$(r_1, 0, 0)$	4a: (3); 8b: (6)

42. Space group No. 42 ($Fmm2$)

Orthorhombic face-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate $(0, 0, 0)$
$Y(\frac{1}{2}, 0, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$
$Z(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E σ_x σ_y C_{2z}
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ $(\frac{1}{2}, 0, 0)$ $(0, \frac{1}{2}, 0)$ $(0, 0, -\frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 42			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 8b: (1); 8c: (2); 8d: (2); 16e: (3)	
2	(0, 0, 0)	4a: (0); 8b: (1); 8c: (1); 8d: (1); 16e: (3)	
3	(0, 0, 0)	4a: (1); 8b: (2); 8c: (1); 8d: (2); 16e: (3)	
4	(0, 0, 0)	4a: (1); 8b: (2); 8c: (2); 8d: (1); 16e: (3)	
$Y(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 42			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 8b: (2); 8c: (2); 8d: (2); 16e: (3)	
2	(0, 0, 0)	4a: (0); 8b: (2); 8c: (1); 8d: (1); 16e: (3)	
3	(0, 0, 0)	4a: (1); 8b: (1); 8c: (1); 8d: (2); 16e: (3)	
4	(0, 0, 0)	4a: (1); 8b: (1); 8c: (2); 8d: (1); 16e: (3)	
$X(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 42			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 8b: (2); 8c: (2); 8d: (2); 16e: (3)	
2	(0, 0, 0)	4a: (0); 8b: (2); 8c: (1); 8d: (1); 16e: (3)	
3	(0, 0, 0)	4a: (1); 8b: (1); 8c: (1); 8d: (2); 16e: (3)	
4	(0, 0, 0)	4a: (1); 8b: (1); 8c: (2); 8d: (1); 16e: (3)	
$Z(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 42			

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 8b: (1); 8c: (2); 8d: (2); 16e: (3)
2	(0, 0, 0)	4a: (0); 8b: (1); 8c: (1); 8d: (1); 16e: (3)
3	(0, 0, 0)	4a: (1); 8b: (2); 8c: (1); 8d: (2); 16e: (3)
4	(0, 0, 0)	4a: (1); 8b: (2); 8c: (2); 8d: (1); 16e: (3)

$L \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 42

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6); 8c: (6); 8d: (6); 16e: (12)

c. Results for high-symmetry lines

$A \left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2} \right)$

Operation	E
Coordinate	$\left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2} \right)$

$B \left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2} \right)$

Operation	E
Coordinate	$\left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2} \right)$

$DT \left(\frac{v}{2}, 0, \frac{v}{2} \right)$

Operation	E
Coordinate	$\left(\frac{v}{2}, 0, \frac{v}{2} \right)$

$H \left(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2} \right)$

Operation	E
Coordinate	$\left(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2} \right)$

$LD \left(\frac{w}{2}, \frac{w}{2}, 0 \right)$

Operation	E
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, 0 \right)$

$SM \left(0, \frac{u}{2}, \frac{u}{2} \right)$

Operation	E
Coordinate	$\left(0, \frac{u}{2}, \frac{u}{2} \right)$

$A \left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2} \right)$ of space group No. 42

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	4a: (2); 8b: (3); 8c: (3); 8d: (4); 16e: (6)
2	(0, r_1 , 0)	4a: (1); 8b: (3); 8c: (3); 8d: (2); 16e: (6)

$B \left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2} \right)$ of space group No. 42

(Co-) irrep	Phonon AM	WYPO information

1	$(r_1, 0, 0)$	4a: (2); 8b: (3); 8c: (4); 8d: (3); 16e: (6)
2	$(r_1, 0, 0)$	4a: (1); 8b: (3); 8c: (2); 8d: (3); 16e: (6)
DT $(\frac{v}{2}, 0, \frac{v}{2})$ of space group No. 42		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (2); 8b: (3); 8c: (4); 8d: (3); 16e: (6)
2	$(r_1, 0, 0)$	4a: (1); 8b: (3); 8c: (2); 8d: (3); 16e: (6)
H $(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2})$ of space group No. 42		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 8b: (2); 8c: (2); 8d: (2); 16e: (3)
2	$(0, 0, 0)$	4a: (0); 8b: (2); 8c: (1); 8d: (1); 16e: (3)
3	$(0, 0, 0)$	4a: (1); 8b: (1); 8c: (1); 8d: (2); 16e: (3)
4	$(0, 0, 0)$	4a: (1); 8b: (1); 8c: (2); 8d: (1); 16e: (3)
LD $(\frac{w}{2}, \frac{w}{2}, 0)$ of space group No. 42		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 8b: (1); 8c: (2); 8d: (2); 16e: (3)
2	$(0, 0, 0)$	4a: (0); 8b: (1); 8c: (1); 8d: (1); 16e: (3)
3	$(0, 0, 0)$	4a: (1); 8b: (2); 8c: (1); 8d: (2); 16e: (3)
4	$(0, 0, 0)$	4a: (1); 8b: (2); 8c: (2); 8d: (1); 16e: (3)
SM $(0, \frac{u}{2}, \frac{u}{2})$ of space group No. 42		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (2); 8b: (3); 8c: (3); 8d: (4); 16e: (6)
2	$(0, r_1, 0)$	4a: (1); 8b: (3); 8c: (3); 8d: (2); 16e: (6)

d. Results for high-symmetry planes

P1 $(-v, u, u - v)$

Operation	E
Coordinate	$(-v, u, u - v)$

P2 $(u, u + v, v)$

Operation	E
Coordinate	$(u, u + v, v)$

P3 $(u - v, u, -v)$

Operation	E
Coordinate	$(u - v, u, -v)$

P1 $(-v, u, u - v)$ of space group No. 42

(Co-) irrep	Phonon AM	WYPO information

1	$(r_2, r_1, 0)$	4a: (3); 8b: (6); 8c: (6); 8d: (6); 16e: (12)
P2 ($u, u + v, v$) of space group No. 42		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (2); 8b: (3); 8c: (3); 8d: (4); 16e: (6)
2	$(0, r_1, 0)$	4a: (1); 8b: (3); 8c: (3); 8d: (2); 16e: (6)
P3 ($u - v, u, -v$) of space group No. 42		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (2); 8b: (3); 8c: (4); 8d: (3); 16e: (6)
2	$(r_1, 0, 0)$	4a: (1); 8b: (3); 8c: (2); 8d: (3); 16e: (6)

43. Space group No. 43 ($Fdd2$)

Orthorhombic face-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \left\{\sigma_y \left| \frac{1}{4}, \frac{1}{4}, \frac{1}{4} \right.\right\} \quad \left\{\sigma_x \left| \frac{1}{4}, \frac{1}{4}, -\frac{3}{4} \right.\right\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate $(0, 0, 0)$
$Y(\frac{1}{2}, 0, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$
$Z(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$

$$L\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

Operation	E	σ_x	σ_y	C_{2z}
Coordinate	$\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$	$\left(\frac{1}{2}, 0, 0\right)$	$\left(0, \frac{1}{2}, 0\right)$	$\left(0, 0, -\frac{1}{2}\right)$

$\Gamma (0, 0, 0)$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 16b: (3)
2	(0, 0, 0)	8a: (1); 16b: (3)
3	(0, 0, 0)	8a: (2); 16b: (3)
4	(0, 0, 0)	8a: (2); 16b: (3)

$Y \left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 16b: (6)

$X \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 16b: (6)

$Z \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 16b: (3)
2	(0, 0, 0)	8a: (2); 16b: (3)

$L \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 16b: (12)

c. Results for high-symmetry lines

$$A\left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2}\right)$$

Operation	E
Coordinate	$\left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2}\right)$

$$B\left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2}\right)$$

Operation	E
Coordinate	$\left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2}\right)$

$$DT\left(\frac{v}{2}, 0, \frac{v}{2}\right)$$

Operation	E
Coordinate	$\left(\frac{v}{2}, 0, \frac{v}{2}\right)$

$H(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2})$
$LD(\frac{w}{2}, \frac{w}{2}, 0)$	
Operation	E
Coordinate	$(\frac{w}{2}, \frac{w}{2}, 0)$
$SM(0, \frac{u}{2}, \frac{u}{2})$	
Operation	E
Coordinate	$(0, \frac{u}{2}, \frac{u}{2})$

A $(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2})$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	8a: (3); 16b: (6)
B $(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2})$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	8a: (3); 16b: (6)
DT $(\frac{v}{2}, 0, \frac{v}{2})$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	8a: (3); 16b: (6)
2	$(r_1, 0, 0)$	8a: (3); 16b: (6)
H $(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2})$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (3); 16b: (6)
LD $(\frac{w}{2}, \frac{w}{2}, 0)$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (1); 16b: (3)
2	$(0, 0, 0)$	8a: (1); 16b: (3)
3	$(0, 0, 0)$	8a: (2); 16b: (3)
4	$(0, 0, 0)$	8a: (2); 16b: (3)
SM $(0, \frac{u}{2}, \frac{u}{2})$ of space group No. 43		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	8a: (3); 16b: (6)
2	$(0, r_1, 0)$	8a: (3); 16b: (6)

d. Results for high-symmetry planes

P1($-v, u, u - v$)

Operation	E
Coordinate	($-v, u, u - v$)

P2($u, u + v, v$)

Operation	E
Coordinate	($u, u + v, v$)

P3($u - v, u, -v$)

Operation	E
Coordinate	($u - v, u, -v$)

P1 ($-v, u, u - v$) of space group No. 43

(Co-) irrep	Phonon AM	WYPO information
1	($r_2, r_1, 0$)	8a: (6); 16b: (12)

P2 ($u, u + v, v$) of space group No. 43

(Co-) irrep	Phonon AM	WYPO information
1	($0, r_1, 0$)	8a: (3); 16b: (6)
2	($0, r_1, 0$)	8a: (3); 16b: (6)

P3 ($u - v, u, -v$) of space group No. 43

(Co-) irrep	Phonon AM	WYPO information
1	($r_1, 0, 0$)	8a: (3); 16b: (6)
2	($r_1, 0, 0$)	8a: (3); 16b: (6)

44. Space group No. 44 (*Imm2*)

Orthorhombic body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	
$X(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
$R(0,\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},0,-\frac{1}{2})$
$S(\frac{1}{2},0,0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2},0,0)$	$(0,\frac{1}{2},-\frac{1}{2})$
$T(0,0,\frac{1}{2})$		
Operation	E	σ_y
Coordinate	$(0,0,\frac{1}{2})$	$(-\frac{1}{2},\frac{1}{2},0)$
$W(\frac{1}{4},\frac{1}{4},\frac{1}{4})$		
Operation	E	σ_y
Coordinate	$(\frac{1}{4},\frac{1}{4},\frac{1}{4})$	$(-\frac{1}{4},\frac{3}{4},-\frac{1}{4})$

Γ (0, 0, 0) of space group No. 44						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	8e: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	8e: (3)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (1);	8e: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (2);	8e: (3)
X $(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 44						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	8e: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	8e: (3)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (1);	8e: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (2);	8e: (3)
R $(0, \frac{1}{2}, 0)$ of space group No. 44						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (4);	4d: (3);	8e: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (3);	8e: (6)
S $(\frac{1}{2}, 0, 0)$ of space group No. 44						

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (4); 8e: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (2); 8e: (6)
T $(0, 0, \frac{1}{2})$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 8e: (6)
W $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, r_1)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 8e: (6)

c. Results for high-symmetry lines

$$D(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & (\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}) \end{array}$$

$$DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & (\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}) \end{array}$$

$$LD(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & (\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}) \end{array}$$

$$P(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & (\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}) \end{array}$$

$$Q(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & (\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}) \end{array}$$

$$SM(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & (-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}) \end{array}$$

$$D(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}) \text{ of space group No. 44}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_2 , r_1)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)

DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (4); 8e: (6)
2	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (2); 8e: (6)
LD $\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3)
2	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3)
4	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (2); 8e: (3)
P $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (2); 4c: (3); 4d: (3); 8e: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (1); 4c: (3); 4d: (3); 8e: (6)
Q $\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (3); 8e: (6)
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (3); 8e: (6)

d. Results for high-symmetry planes

P1 $(-v, v, u)$

Operation	E
Coordinate	$(-v, v, u)$

P2 $(v, u, -v)$

Operation	E
Coordinate	$(v, u, -v)$

P3 $(u, v, -v)$

Operation	E
Coordinate	$(u, v, -v)$

P1 $(-v, v, u)$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information

1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
P2 $(v, u, -v)$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (3); 8e: (6)
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (3); 8e: (6)
P3 $(u, v, -v)$ of space group No. 44		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (4); 8e: (6)
2	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (2); 8e: (6)

45. Space group No. 45 (*Iba2*)

Orthorhombic body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{\sigma_y|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_x|\frac{1}{2}, \frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	
$X(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
$R(0,\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},0,-\frac{1}{2})$
$S(\frac{1}{2},0,0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2},0,0)$	$(0,\frac{1}{2},-\frac{1}{2})$

$T(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, 0)$
$W(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$		
Operation	E	
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, \frac{3}{4}, -\frac{1}{4})$

$\Gamma (0, 0, 0)$ of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
3	$(0, 0, 0)$	4a: (2); 4b: (2); 8c: (3)
4	$(0, 0, 0)$	4a: (2); 4b: (2); 8c: (3)
$X(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
3	$(0, 0, 0)$	4a: (2); 4b: (2); 8c: (3)
4	$(0, 0, 0)$	4a: (2); 4b: (2); 8c: (3)
$R(0, \frac{1}{2}, 0)$ of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
$S(\frac{1}{2}, 0, 0)$ of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
$T(0, 0, \frac{1}{2})$ of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (2); 4b: (4); 8c: (6)
2	$(0, 0, 0)$	4a: (4); 4b: (2); 8c: (6)
$W(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (1); 4b: (2); 8c: (3)
2	$(0, 0, r_1)$	4a: (2); 4b: (1); 8c: (3)

c. Results for high-symmetry lines

$D(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$		
Operation	E	
Coordinate	$(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$	
$DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$		
Operation	E	
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	
$LD(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$	
$P(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	
$Q(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$		
Operation	E	
Coordinate	$(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$	
$SM(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$		
Operation	E	
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	

D $\left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 45			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_2, r_1)$	4a: (3); 4b: (3); 8c: (6)	
DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 45			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 8c: (6)	
2	$(r_1, 0, 0)$	4a: (3); 4b: (3); 8c: (6)	
LD $\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$ of space group No. 45			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)	
2	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)	
3	$(0, 0, 0)$	4a: (2); 4b: (2); 8c: (3)	
4	$(0, 0, 0)$	4a: (2); 4b: (2); 8c: (3)	
P $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 45			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	4a: (2); 4b: (4); 8c: (6)	
2	$(0, 0, r_1)$	4a: (4); 4b: (2); 8c: (6)	

Q $\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$ of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)

SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)

d. Results for high-symmetry planes

P1($-v, v, u$)

Operation	E
Coordinate	$(-v, v, u)$

P2($v, u, -v$)

Operation	E
Coordinate	$(v, u, -v)$

P3($u, v, -v$)

Operation	E
Coordinate	$(u, v, -v)$

P1 ($-v, v, u$) of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)

P2 ($v, u, -v$) of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)

P3 ($u, v, -v$) of space group No. 45		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
2	$(r_1, 0, 0)$	4a: (3); 4b: (3); 8c: (6)

46. Space group No. 46 ($Ima2$)

Orthorhombic body-centered lattice

$$\begin{aligned}
 \vec{a} &= (b, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{\sigma_x 0,-\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_y 0,\frac{1}{2},\frac{1}{2}\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	

$X(-\frac{1}{2},\frac{1}{2},-\frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2},\frac{1}{2},-\frac{1}{2})$	

$R(0,\frac{1}{2},-\frac{1}{2})$		
Operation	E	C_{2z}
Coordinate	$(0,\frac{1}{2},-\frac{1}{2})$	$(\frac{1}{2},0,0)$

$S(0,\frac{1}{2},0)$		
Operation	E	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},0,-\frac{1}{2})$

$T(-\frac{1}{2},\frac{1}{2},0)$		
Operation	E	σ_x
Coordinate	$(-\frac{1}{2},\frac{1}{2},0)$	$(0,0,-\frac{1}{2})$

$W(-\frac{1}{4},\frac{3}{4},-\frac{1}{4})$		
Operation	E	σ_x
Coordinate	$(-\frac{1}{4},\frac{3}{4},-\frac{1}{4})$	$(\frac{1}{4},\frac{1}{4},-\frac{3}{4})$

$\Gamma(0,0,0)$ of space group No. 46		
(Co-) irrep	Phonon AM	WYPO information
1	$(0,0,0)$	4a: (1); 4b: (2); 8c: (3)
2	$(0,0,0)$	4a: (1); 4b: (1); 8c: (3)
3	$(0,0,0)$	4a: (2); 4b: (2); 8c: (3)
4	$(0,0,0)$	4a: (2); 4b: (1); 8c: (3)

$X(-\frac{1}{2},\frac{1}{2},-\frac{1}{2})$ of space group No. 46		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3)
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3)
4	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3)

$$\text{R } \left(0, \frac{1}{2}, -\frac{1}{2}\right) \text{ of space group No. 46}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (4); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (2); 8c: (6)

$$\text{S } \left(0, \frac{1}{2}, 0\right) \text{ of space group No. 46}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)

$$\text{T } \left(-\frac{1}{2}, \frac{1}{2}, 0\right) \text{ of space group No. 46}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)

$$\text{W } \left(-\frac{1}{4}, \frac{3}{4}, -\frac{1}{4}\right) \text{ of space group No. 46}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	4a: (3); 4b: (3); 8c: (6)

c. Results for high-symmetry lines

$$\text{D} \left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2} \right)$$

Operation	E
Coordinate	$\left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2} \right)$

$$\text{DT} \left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2} \right)$$

Operation	E
Coordinate	$\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2} \right)$

$$\text{LD} \left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2} \right)$$

Operation	E
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2} \right)$

$$\text{P} \left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2} \right)$$

Operation	E
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2} \right)$

$$\text{Q} \left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2} \right)$$

Operation	E
Coordinate	$\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2} \right)$

$$\text{SM} \left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2} \right)$$

Operation	E
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$

D $(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 46		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (6); 4b: (6); 8c: (12)
DT $(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$ of space group No. 46		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (4); 8c: (6)
2	$(r_1, 0, 0)$	4a: (3); 4b: (2); 8c: (6)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 46		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (2); 8c: (3)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
3	$(0, 0, 0)$	4a: (2); 4b: (2); 8c: (3)
4	$(0, 0, 0)$	4a: (2); 4b: (1); 8c: (3)
P $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 46		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 46		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (3); 4b: (3); 8c: (6)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 46		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)

d. Results for high-symmetry planes

P1 $(-u, u, -v)$	
Operation	E
Coordinate	$(-u, u, -v)$
P2 $(v, u, -u)$	
Operation	E
Coordinate	$(v, u, -u)$

 $P3(v, u, -v)$

Operation	E
Coordinate	$(v, u, -v)$

P1 $(-u, u, -v)$ of space group No. 46

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)

P2 $(v, u, -u)$ of space group No. 46

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (4); 8c: (6)
2	$(r_1, 0, 0)$	4a: (3); 4b: (2); 8c: (6)

P3 $(v, u, -v)$ of space group No. 46

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6)

47. Space group No. 47 ($Pmmm$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

 $\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\}$

b. Results for high-symmetry points

 $\Gamma(0, 0, 0)$

Operation	E
Coordinate	$(0, 0, 0)$

 $Y(0, \frac{1}{2}, 0)$

Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$

$X(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$
$Z(0, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, \frac{1}{2})$
$U(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$
$T(0, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$
$S(\frac{1}{2}, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

Γ (0, 0, 0) of space group No. 47												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (0); 2l: (1); 4w: (2);	1b: (0); 2m: (1); 4x: (2);	1c: (0); 2n: (1); 4y: (2);	1d: (0); 2o: (1); 4z: (2);	1e: (0); 2p: (1); 8 α : (3)	1f: (0); 2q: (1);	1g: (0); 2r: (1);	1h: (0); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (2);	2k: (1); 4v: (2);
2	(0, 0, 0)	1a: (0); 2l: (1); 4w: (2);	1b: (0); 2m: (0); 4x: (2);	1c: (0); 2n: (0); 4y: (1);	1d: (0); 2o: (0); 4z: (1);	1e: (0); 2p: (0); 8 α : (3)	1f: (0); 2q: (1);	1g: (0); 2r: (1);	1h: (0); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (1);	2k: (1); 4v: (1);
3	(0, 0, 0)	1a: (0); 2l: (1); 4w: (1);	1b: (0); 2m: (1); 4x: (1);	1c: (0); 2n: (1); 4y: (2);	1d: (0); 2o: (1); 4z: (2);	1e: (0); 2p: (1); 8 α : (3)	1f: (0); 2q: (0);	1g: (0); 2r: (0);	1h: (0); 2s: (0);	2i: (1); 2t: (0);	2j: (1); 4u: (1);	2k: (1); 4v: (1);
4	(0, 0, 0)	1a: (0); 2l: (0); 4w: (1);	1b: (0); 2m: (1); 4x: (1);	1c: (0); 2n: (1); 4y: (1);	1d: (0); 2o: (1); 4z: (1);	1e: (0); 2p: (1); 8 α : (3)	1f: (0); 2q: (1);	1g: (0); 2r: (1);	1h: (0); 2s: (1);	2i: (0); 2t: (1);	2j: (0); 4u: (2);	2k: (0); 4v: (2);
5	(0, 0, 0)	1a: (0); 2l: (0); 4w: (1);	1b: (0); 2m: (0); 4x: (1);	1c: (0); 2n: (0); 4y: (1);	1d: (0); 2o: (0); 4z: (1);	1e: (0); 2p: (0); 8 α : (3)	1f: (0); 2q: (0);	1g: (0); 2r: (0);	1h: (0); 2s: (0);	2i: (0); 2t: (0);	2j: (0); 4u: (1);	2k: (0); 4v: (1);
6	(0, 0, 0)	1a: (1); 2l: (1); 4w: (1);	1b: (1); 2m: (1); 4x: (1);	1c: (1); 2n: (1); 4y: (2);	1d: (1); 2o: (1); 4z: (2);	1e: (1); 2p: (1); 8 α : (3)	1f: (1); 2q: (1);	1g: (1); 2r: (1);	1h: (1); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (2);	2k: (1); 4v: (2);
7	(0, 0, 0)	1a: (1); 2l: (1); 4w: (2);	1b: (1); 2m: (1); 4x: (2);	1c: (1); 2n: (1); 4y: (1);	1d: (1); 2o: (1); 4z: (1);	1e: (1); 2p: (1); 8 α : (3)	1f: (1); 2q: (1);	1g: (1); 2r: (1);	1h: (1); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (2);	2k: (1); 4v: (2);

(Co-) irrep	Phonon AM	WYPO information											
1	(0, 0, 0)	1a: (0); 2l: (1); 4w: (2);	1b: (0); 2m: (1); 4x: (1);	1c: (0); 2n: (1); 4y: (2);	1d: (0); 2o: (1); 4z: (2);	1e: (1); 2p: (1); 8α: (3)	1f: (1); 2q: (1);	1g: (1); 2r: (1);	1h: (1); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (2);	2k: (1); 4v: (2);	
2	(0, 0, 0)	1a: (0); 2l: (0); 4w: (2);	1b: (0); 2m: (0); 4x: (1);	1c: (0); 2n: (0); 4y: (1);	1d: (0); 2o: (0); 4z: (1);	1e: (0); 2p: (0); 8α: (3)	1f: (0); 2q: (1);	1g: (0); 2r: (0);	1h: (0); 2s: (1);	2i: (1); 2t: (0);	2j: (1); 4u: (1);	2k: (0); 4v: (1);	
3	(0, 0, 0)	1a: (0); 2l: (1); 4w: (1);	1b: (0); 2m: (1); 4x: (2);	1c: (0); 2n: (1); 4y: (2);	1d: (0); 2o: (1); 4z: (2);	1e: (1); 2p: (1); 8α: (3)	1f: (1); 2q: (0);	1g: (1); 2r: (1);	1h: (1); 2s: (0);	2i: (1); 2t: (1);	2j: (1); 4u: (1);	2k: (1); 4v: (1);	
4	(0, 0, 0)	1a: (0); 2l: (1); 4w: (1);	1b: (0); 2m: (1); 4x: (2);	1c: (0); 2n: (1); 4y: (1);	1d: (0); 2o: (1); 4z: (1);	1e: (1); 2p: (1); 8α: (3)	1f: (1); 2q: (1);	1g: (1); 2r: (1);	1h: (1); 2s: (1);	2i: (0); 2t: (1);	2j: (0); 4u: (2);	2k: (1); 4v: (2);	
5	(0, 0, 0)	1a: (0); 2l: (1); 4w: (1);	1b: (0); 2m: (0); 4x: (2);	1c: (0); 2n: (0); 4y: (1);	1d: (0); 2o: (0); 4z: (1);	1e: (0); 2p: (0); 8α: (3)	1f: (0); 2q: (0);	1g: (0); 2r: (1);	1h: (0); 2s: (0);	2i: (0); 2t: (1);	2j: (0); 4u: (1);	2k: (1); 4v: (1);	
6	(0, 0, 0)	1a: (1); 2l: (1); 4w: (1);	1b: (1); 2m: (1); 4x: (2);	1c: (1); 2n: (1); 4y: (2);	1d: (1); 2o: (1); 4z: (2);	1e: (0); 2p: (1); 8α: (3)	1f: (0); 2q: (1);	1g: (0); 2r: (1);	1h: (0); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (2);	2k: (1); 4v: (2);	
7	(0, 0, 0)	1a: (1); 2l: (0); 4w: (2);	1b: (1); 2m: (1); 4x: (1);	1c: (1); 2n: (1); 4y: (1);	1d: (1); 2o: (1); 4z: (1);	1e: (0); 2p: (1); 8α: (3)	1f: (0); 2q: (1);	1g: (0); 2r: (1);	1h: (0); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (2);	2k: (0); 4v: (2);	
8	(0, 0, 0)	1a: (1); 2l: (1); 4w: (2);	1b: (1); 2m: (1); 4x: (1);	1c: (1); 2n: (1); 4y: (2);	1d: (1); 2o: (1); 4z: (2);	1e: (0); 2p: (1); 8α: (3)	1f: (0); 2q: (1);	1g: (0); 2r: (0);	1h: (0); 2s: (1);	2i: (1); 2t: (0);	2j: (1); 4u: (1);	2k: (1); 4v: (1);	

X ($\frac{1}{2}, 0, 0$) of space group No. 47												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (0); 2l: (1); 4w: (2);	1b: (1); 2m: (1); 4x: (2);	1c: (0); 2n: (1); 4y: (2);	1d: (1); 2o: (1); 4z: (2);	1e: (0); 2p: (1); 8 α : (3)	1f: (1); 2q: (1);	1g: (0); 2r: (1);	1h: (1); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (2);	2k: (1); 4v: (1);
2	(0, 0, 0)	1a: (0); 2l: (1); 4w: (2);	1b: (1); 2m: (0); 4x: (2);	1c: (0); 2n: (0); 4y: (1);	1d: (1); 2o: (1); 4z: (1);	1e: (0); 2p: (1); 8 α : (3)	1f: (1); 2q: (1);	1g: (0); 2r: (1);	1h: (1); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (1);	2k: (1); 4v: (2);
3	(0, 0, 0)	1a: (0); 2l: (1); 4w: (1);	1b: (1); 2m: (1); 4x: (1);	1c: (0); 2n: (1); 4y: (2);	1d: (1); 2o: (1); 4z: (2);	1e: (0); 2p: (1); 8 α : (3)	1f: (1); 2q: (0);	1g: (0); 2r: (0);	1h: (1); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (1);	2k: (1); 4v: (2);
4	(0, 0, 0)	1a: (0); 2l: (0); 4w: (1);	1b: (0); 2m: (1); 4x: (1);	1c: (0); 2n: (1); 4y: (1);	1d: (0); 2o: (0); 4z: (1);	1e: (0); 2p: (0); 8 α : (3)	1f: (0); 2q: (1);	1g: (0); 2r: (1);	1h: (0); 2s: (0);	2i: (0); 2t: (0);	2j: (0); 4u: (2);	2k: (0); 4v: (1);
5	(0, 0, 0)	1a: (0); 2l: (0); 4w: (1);	1b: (0); 2m: (0); 4x: (1);	1c: (0); 2n: (0); 4y: (1);	1d: (0); 2o: (1); 4z: (1);	1e: (0); 2p: (1); 8 α : (3)	1f: (0); 2q: (0);	1g: (0); 2r: (0);	1h: (0); 2s: (1);	2i: (0); 2t: (1);	2j: (0); 4u: (1);	2k: (0); 4v: (2);
6	(0, 0, 0)	1a: (1); 2l: (1); 4w: (1);	1b: (0); 2m: (1); 4x: (1);	1c: (1); 2n: (1); 4y: (2);	1d: (0); 2o: (1); 4z: (2);	1e: (1); 2p: (1); 8 α : (3)	1f: (0); 2q: (1);	1g: (1); 2r: (1);	1h: (0); 2s: (0);	2i: (1); 2t: (0);	2j: (1); 4u: (2);	2k: (1); 4v: (1);
7	(0, 0, 0)	1a: (1); 2l: (1); 4w: (2);	1b: (0); 2m: (1); 4x: (2);	1c: (1); 2n: (1); 4y: (1);	1d: (0); 2o: (0); 4z: (1);	1e: (1); 2p: (0); 8 α : (3)	1f: (0); 2q: (1);	1g: (1); 2r: (1);	1h: (0); 2s: (1);	2i: (1); 2t: (1);	2j: (1); 4u: (2);	2k: (1); 4v: (1);

8	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 1e: (1); 1f: (0); 1g: (0); 1h: (1); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (0); 2o: (1); 2p: (1); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (1); 4v: (2); 4w: (2); 4x: (2); 4y: (2); 4z: (1); 8 α : (3)

$T \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (0); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (0); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (2); 4v: (2); 4w: (2); 4x: (1); 4y: (2); 4z: (1); 8 α : (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (1); 2j: (1); 2k: (0); 2l: (1); 2m: (0); 2n: (1); 2o: (0); 2p: (1); 2q: (1); 2r: (0); 2s: (1); 2t: (0); 4u: (1); 4v: (1); 4w: (2); 4x: (1); 4y: (1); 4z: (2); 8 α : (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (1); 1f: (1); 1g: (0); 1h: (0); 2i: (1); 2j: (0); 2k: (1); 2l: (1); 2m: (1); 2n: (0); 2o: (1); 2p: (0); 2q: (0); 2r: (1); 2s: (0); 2t: (1); 4u: (1); 4v: (1); 4w: (1); 4x: (2); 4y: (2); 4z: (1); 8 α : (3)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (0); 1h: (0); 2i: (0); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (2); 4v: (2); 4w: (1); 4x: (2); 4y: (1); 4z: (2); 8 α : (3)
5	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (1); 1h: (1); 2i: (0); 2j: (1); 2k: (1); 2l: (1); 2m: (0); 2n: (1); 2o: (0); 2p: (1); 2q: (0); 2r: (1); 2s: (0); 2t: (1); 4u: (1); 4v: (1); 4w: (1); 4x: (2); 4y: (1); 4z: (2); 8 α : (3)
6	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (1); 1h: (1); 2i: (1); 2j: (0); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (2); 4v: (2); 4w: (1); 4x: (2); 4y: (2); 4z: (1); 8 α : (3)
7	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (1); 1h: (1); 2i: (1); 2j: (1); 2k: (0); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (2); 4v: (2); 4w: (2); 4x: (1); 4y: (1); 4z: (2); 8 α : (3)
8	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (0); 2m: (1); 2n: (0); 2o: (1); 2p: (0); 2q: (1); 2r: (0); 2s: (1); 2t: (0); 4u: (1); 4v: (1); 4w: (2); 4x: (1); 4y: (2); 4z: (1); 8 α : (3)

$S \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 1e: (1); 1f: (0); 1g: (1); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (1); 2s: (1); 2t: (0); 4u: (2); 4v: (1); 4w: (2); 4x: (1); 4y: (2); 4z: (2); 8 α : (3)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (1); 2j: (1); 2k: (0); 2l: (0); 2m: (0); 2n: (0); 2o: (1); 2p: (1); 2q: (1); 2r: (0); 2s: (1); 2t: (1); 4u: (1); 4v: (2); 4w: (2); 4x: (1); 4y: (1); 4z: (1); 8 α : (3)
3	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 1e: (1); 1f: (0); 1g: (1); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (0); 2r: (1); 2s: (1); 2t: (1); 4u: (1); 4v: (2); 4w: (1); 4x: (2); 4y: (2); 4z: (2); 8 α : (3)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (1); 1f: (0); 1g: (1); 1h: (0); 2i: (0); 2j: (0); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (0); 2p: (0); 2q: (1); 2r: (1); 2s: (0); 2t: (1); 4u: (2); 4v: (1); 4w: (1); 4x: (2); 4y: (1); 4z: (1); 8 α : (3)
5	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (1); 1g: (0); 1h: (1); 2i: (0); 2j: (0); 2k: (1); 2l: (1); 2m: (0); 2n: (0); 2o: (1); 2p: (1); 2q: (0); 2r: (1); 2s: (1); 2t: (1); 4u: (1); 4v: (2); 4w: (1); 4x: (2); 4y: (1); 4z: (1); 8 α : (3)
6	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 1e: (0); 1f: (1); 1g: (0); 1h: (1); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (1); 2s: (0); 2t: (1); 4u: (2); 4v: (1); 4w: (1); 4x: (2); 4y: (2); 4z: (2); 8 α : (3)
7	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (1); 2j: (1); 2k: (0); 2l: (0); 2m: (1); 2n: (1); 2o: (0); 2p: (0); 2q: (1); 2r: (1); 2s: (1); 2t: (0); 4u: (2); 4v: (1); 4w: (2); 4x: (1); 4y: (1); 4z: (1); 8 α : (3)

8	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 1e: (0); 1f: (1); 1g: (0); 1h: (1); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (0); 2s: (1); 2t: (1); 4u: (1); 4v: (2); 4w: (2); 4x: (1); 4y: (2); 4z: (2); 8 α : (3)

$R \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 1e: (1); 1f: (0); 1g: (0); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (0); 2m: (1); 2n: (1); 2o: (1); 2p: (0); 2q: (1); 2r: (1); 2s: (1); 2t: (0); 4u: (2); 4v: (1); 4w: (2); 4x: (1); 4y: (2); 4z: (1); 8 α : (3)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 1e: (0); 1f: (0); 1g: (0); 1h: (1); 2i: (1); 2j: (1); 2k: (0); 2l: (1); 2m: (0); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (0); 2s: (1); 2t: (1); 4u: (1); 4v: (2); 4w: (2); 4x: (1); 4y: (1); 4z: (2); 8 α : (3)
3	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (0); 1e: (1); 1f: (0); 1g: (0); 1h: (1); 2i: (1); 2j: (0); 2k: (1); 2l: (1); 2m: (1); 2n: (0); 2o: (1); 2p: (1); 2q: (0); 2r: (1); 2s: (1); 2t: (1); 4u: (1); 4v: (2); 4w: (1); 4x: (2); 4y: (2); 4z: (1); 8 α : (3)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (0); 1e: (1); 1f: (0); 1g: (0); 1h: (1); 2i: (0); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (0); 2p: (1); 2q: (1); 2r: (1); 2s: (0); 2t: (1); 4u: (2); 4v: (1); 4w: (1); 4x: (2); 4y: (1); 4z: (2); 8 α : (3)
5	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (1); 1e: (0); 1f: (1); 1g: (1); 1h: (0); 2i: (0); 2j: (1); 2k: (1); 2l: (1); 2m: (0); 2n: (1); 2o: (1); 2p: (1); 2q: (0); 2r: (1); 2s: (1); 2t: (1); 4u: (1); 4v: (2); 4w: (1); 4x: (2); 4y: (1); 4z: (2); 8 α : (3)
6	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (1); 1g: (1); 1h: (0); 2i: (1); 2j: (0); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (0); 2q: (1); 2r: (1); 2s: (0); 2t: (1); 4u: (2); 4v: (1); 4w: (1); 4x: (2); 4y: (2); 4z: (1); 8 α : (3)
7	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 1e: (0); 1f: (0); 1g: (1); 1h: (0); 2i: (1); 2j: (1); 2k: (0); 2l: (1); 2m: (1); 2n: (1); 2o: (0); 2p: (1); 2q: (1); 2r: (1); 2s: (1); 2t: (0); 4u: (2); 4v: (1); 4w: (2); 4x: (1); 4y: (1); 4z: (2); 8 α : (3)
8	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 1e: (0); 1f: (1); 1g: (0); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (0); 2m: (1); 2n: (0); 2o: (1); 2p: (1); 2q: (1); 2r: (0); 2s: (1); 2t: (1); 4u: (1); 4v: (2); 4w: (2); 4x: (1); 4y: (2); 4z: (1); 8 α : (3)

c. Results for high-symmetry lines

$A(u, 0, \frac{1}{2})$

Operation	E
Coordinate	$(u, 0, \frac{1}{2})$

$B(0, v, \frac{1}{2})$

Operation	E
Coordinate	$(0, v, \frac{1}{2})$

$C(u, \frac{1}{2}, 0)$

Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$

$D(\frac{1}{2}, v, 0)$

Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$

$DT(0, v, 0)$

Operation	E
Coordinate	$(0, v, 0)$
$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
$G(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
$H(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$P(\frac{1}{2}, v, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
$Q(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$SM(u, 0, 0)$	
Operation	E
Coordinate	$(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 47												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (1); 2l: (2); 4w: (4);	1b: (1); 2m: (2); 4x: (4);	1c: (1); 2n: (1); 4y: (4);	1d: (1); 2o: (2); 4z: (2);	1e: (1); 2p: (1); 8 α : (6)	1f: (1); 2q: (2);	1g: (1); 2r: (2);	1h: (1); 2s: (2);	2i: (2); 2t: (2);	2j: (2); 4u: (3);	2k: (2); 4v: (3);
2	(0, 0, 0)	1a: (0); 2l: (2); 4w: (2);	1b: (0); 2m: (1); 4x: (2);	1c: (1); 2n: (2); 4y: (2);	1d: (1); 2o: (1); 4z: (4);	1e: (0); 2p: (2); 8 α : (6)	1f: (0); 2q: (1);	1g: (1); 2r: (1);	1h: (1); 2s: (1);	2i: (0); 2t: (1);	2j: (2); 4u: (3);	2k: (0); 4v: (3);
3	(0, 0, 0)	1a: (1); 2l: (0); 4w: (2);	1b: (1); 2m: (2); 4x: (2);	1c: (0); 2n: (1); 4y: (4);	1d: (0); 2o: (2); 4z: (2);	1e: (1); 2p: (1); 8 α : (6)	1f: (1); 2q: (1);	1g: (0); 2r: (1);	1h: (0); 2s: (1);	2i: (2); 2t: (1);	2j: (0); 4u: (3);	2k: (2); 4v: (3);
4	(0, 0, 0)	1a: (1); 2l: (2); 4w: (4);	1b: (1); 2m: (1); 4x: (4);	1c: (1); 2n: (2); 4y: (2);	1d: (1); 2o: (1); 4z: (4);	1e: (1); 2p: (2); 8 α : (6)	1f: (1); 2q: (2);	1g: (1); 2r: (2);	1h: (1); 2s: (2);	2i: (2); 2t: (2);	2j: (2); 4u: (3);	2k: (2); 4v: (3);
B $(0, v, \frac{1}{2})$ of space group No. 47												
(Co-) irrep	Phonon AM	WYPO information										

1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (1); 2k: (2); 2l: (1); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (4); 4v: (4); 4w: (3); 4x: (3); 4y: (4); 4z: (2); 8 α : (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 1e: (0); 1f: (0); 1g: (1); 1h: (1); 2i: (1); 2j: (2); 2k: (1); 2l: (2); 2m: (0); 2n: (2); 2o: (0); 2p: (2); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (2); 4v: (2); 4w: (3); 4x: (3); 4y: (2); 4z: (4); 8 α : (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (2); 2k: (1); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (4); 4v: (4); 4w: (3); 4x: (3); 4y: (2); 4z: (4); 8 α : (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 1e: (1); 1f: (1); 1g: (0); 1h: (0); 2i: (2); 2j: (1); 2k: (2); 2l: (1); 2m: (2); 2n: (0); 2o: (2); 2p: (0); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (2); 4v: (2); 4w: (3); 4x: (3); 4y: (4); 4z: (2); 8 α : (6)

$C\left(u, \frac{1}{2}, 0\right)$ of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (1); 2s: (2); 2t: (1); 4u: (3); 4v: (3); 4w: (4); 4x: (2); 4y: (4); 4z: (4); 8 α : (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (0); 2j: (0); 2k: (2); 2l: (2); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (1); 2r: (2); 2s: (1); 2t: (2); 4u: (3); 4v: (3); 4w: (2); 4x: (4); 4y: (2); 4z: (2); 8 α : (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (1); 2r: (2); 2s: (1); 2t: (2); 4u: (3); 4v: (3); 4w: (2); 4x: (4); 4y: (4); 4z: (4); 8 α : (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (2); 2j: (2); 2k: (0); 2l: (0); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (2); 2r: (1); 2s: (2); 2t: (1); 4u: (3); 4v: (3); 4w: (4); 4x: (2); 4y: (2); 4z: (2); 8 α : (6)

$D\left(\frac{1}{2}, v, 0\right)$ of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (1); 2t: (1); 4u: (4); 4v: (2); 4w: (3); 4x: (3); 4y: (4); 4z: (4); 8 α : (6)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 1e: (0); 1f: (1); 1g: (0); 1h: (1); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (0); 2n: (0); 2o: (2); 2p: (2); 2q: (1); 2r: (1); 2s: (2); 2t: (2); 4u: (2); 4v: (4); 4w: (3); 4x: (3); 4y: (2); 4z: (2); 8 α : (6)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 1e: (1); 1f: (0); 1g: (1); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (2); 2n: (2); 2o: (0); 2p: (0); 2q: (2); 2r: (2); 2s: (1); 2t: (1); 4u: (4); 4v: (2); 4w: (3); 4x: (3); 4y: (2); 4z: (2); 8 α : (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (1); 2r: (1); 2s: (2); 2t: (2); 4u: (2); 4v: (4); 4w: (3); 4x: (3); 4y: (4); 4z: (4); 8 α : (6)

$DT(0, v, 0)$ of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (4); 4v: (4); 4w: (3); 4x: (3); 4y: (4); 4z: (4); 8 α : (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (0); 2n: (0); 2o: (0); 2p: (0); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (2); 4v: (2); 4w: (3); 4x: (3); 4y: (2); 4z: (2); 8 α : (6)

3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (4); 4v: (4); 4w: (3); 4x: (3); 4y: (2); 4z: (2); 8 α : (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (2); 4v: (2); 4w: (3); 4x: (3); 4y: (4); 4z: (4); 8 α : (6)

$E \left(u, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (0); 1h: (0); 2i: (2); 2j: (2); 2k: (2); 2l: (0); 2m: (2); 2n: (1); 2o: (2); 2p: (1); 2q: (2); 2r: (1); 2s: (2); 2t: (1); 4u: (3); 4v: (3); 4w: (4); 4x: (2); 4y: (4); 4z: (2); 8 α : (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (0); 2j: (2); 2k: (2); 2l: (2); 2m: (1); 2n: (2); 2o: (1); 2p: (2); 2q: (1); 2r: (2); 2s: (1); 2t: (2); 4u: (3); 4v: (3); 4w: (2); 4x: (4); 4y: (2); 4z: (4); 8 α : (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (0); 2k: (2); 2l: (2); 2m: (2); 2n: (1); 2o: (2); 2p: (1); 2q: (1); 2r: (2); 2s: (1); 2t: (2); 4u: (3); 4v: (3); 4w: (2); 4x: (4); 4y: (4); 4z: (2); 8 α : (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (0); 1f: (0); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (0); 2l: (2); 2m: (2); 2n: (2); 2o: (1); 2p: (2); 2q: (2); 2r: (1); 2s: (2); 2t: (1); 4u: (3); 4v: (3); 4w: (4); 4x: (2); 4y: (2); 4z: (4); 8 α : (6)

$G \left(\frac{1}{2}, 0, w \right)$ of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (1); 2p: (1); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (4); 4v: (2); 4w: (4); 4x: (4); 4y: (3); 4z: (3); 8 α : (6)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 1e: (0); 1f: (1); 1g: (0); 1h: (1); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (2); 2p: (2); 2q: (0); 2r: (0); 2s: (2); 2t: (2); 4u: (2); 4v: (4); 4w: (2); 4x: (2); 4y: (3); 4z: (3); 8 α : (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (1); 2n: (1); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (2); 4v: (4); 4w: (4); 4x: (4); 4y: (3); 4z: (3); 8 α : (6)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 1e: (1); 1f: (0); 1g: (1); 1h: (0); 2i: (1); 2j: (1); 2k: (1); 2l: (1); 2m: (2); 2n: (2); 2o: (1); 2p: (1); 2q: (2); 2r: (2); 2s: (0); 2t: (0); 4u: (4); 4v: (2); 4w: (2); 4x: (2); 4y: (3); 4z: (3); 8 α : (6)

$H \left(0, \frac{1}{2}, w \right)$ of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (1); 2l: (1); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (4); 4v: (4); 4w: (4); 4x: (2); 4y: (3); 4z: (3); 8 α : (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (1); 2k: (2); 2l: (2); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (0); 2r: (2); 2s: (0); 2t: (2); 4u: (2); 4v: (2); 4w: (2); 4x: (4); 4y: (3); 4z: (3); 8 α : (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (0); 1f: (0); 1g: (0); 1h: (0); 2i: (2); 2j: (2); 2k: (1); 2l: (1); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (2); 2r: (0); 2s: (2); 2t: (0); 4u: (2); 4v: (2); 4w: (4); 4x: (2); 4y: (3); 4z: (3); 8 α : (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (1); 2j: (1); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (4); 4v: (4); 4w: (2); 4x: (4); 4y: (3); 4z: (3); 8 α : (6)

$LD \left(0, 0, w \right)$ of space group No. 47

3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (1); 2r: (1); 2s: (1); 2t: (1); 4u: (3); 4v: (3); 4w: (2); 4x: (2); 4y: (4); 4z: (4); 8 α : (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (1); 2n: (1); 2o: (1); 2p: (1); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (3); 4v: (3); 4w: (4); 4x: (4); 4y: (2); 4z: (2); 8 α : (6)

d. Results for high-symmetry planes

P1($v, -u, 0$)	
Operation	E
Coordinate	($v, -u, 0$)
P2(0, $-u, v$)	
Operation	E
Coordinate	(0, $-u, v$)
P3($u, 0, v$)	
Operation	E
Coordinate	($u, 0, v$)
P4($v, -u, \frac{1}{2}$)	
Operation	E
Coordinate	($v, -u, \frac{1}{2}$)
P5($\frac{1}{2}, -u, v$)	
Operation	E
Coordinate	($\frac{1}{2}, -u, v$)
P6($u, \frac{1}{2}, v$)	
Operation	E
Coordinate	($u, \frac{1}{2}, v$)

P1 ($v, -u, 0$) of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (4); 2j: (4); 2k: (4); 2l: (4); 2m: (4); 2n: (4); 2o: (4); 2p: (4); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6); 4v: (6); 4w: (6); 4x: (6); 4y: (8); 4z: (8); 8 α : (12)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6); 4v: (6); 4w: (6); 4x: (6); 4y: (4); 4z: (4); 8 α : (12)

P2 (0, $-u, v$) of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (4); 2n: (4); 2o: (4); 2p: (4); 2q: (4); 2r: (4); 2s: (4); 2t: (4); 4u: (8); 4v: (8); 4w: (6); 4x: (6); 4y: (6); 4z: (6); 8 α : (12)

2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (2); 2n: (2); 2o: (2); 2p: (2); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (4); 4v: (4); 4w: (6); 4x: (6); 4y: (6); 4z: (6); 8 α : (12)

P3 ($u, 0, v$) of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (4); 2j: (4); 2k: (4); 2l: (4); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (4); 2r: (4); 2s: (4); 2t: (4); 4u: (6); 4v: (6); 4w: (8); 4x: (8); 4y: (6); 4z: (6); 8 α : (12)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (2); 2j: (2); 2k: (2); 2l: (2); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (2); 2r: (2); 2s: (2); 2t: (2); 4u: (6); 4v: (6); 4w: (4); 4x: (4); 4y: (6); 4z: (6); 8 α : (12)

P4 ($v, -u, \frac{1}{2}$) of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (1); 1d: (1); 1e: (2); 1f: (2); 1g: (1); 1h: (1); 2i: (4); 2j: (2); 2k: (4); 2l: (2); 2m: (4); 2n: (2); 2o: (4); 2p: (2); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6); 4v: (6); 4w: (6); 4x: (6); 4y: (8); 4z: (4); 8 α : (12)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (2); 1d: (2); 1e: (1); 1f: (1); 1g: (2); 1h: (2); 2i: (2); 2j: (4); 2k: (2); 2l: (4); 2m: (2); 2n: (4); 2o: (2); 2p: (4); 2q: (3); 2r: (3); 2s: (3); 2t: (3); 4u: (6); 4v: (6); 4w: (6); 4x: (6); 4y: (4); 4z: (8); 8 α : (12)

P5 ($\frac{1}{2}, -u, v$) of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 1c: (2); 1d: (1); 1e: (2); 1f: (1); 1g: (2); 1h: (1); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (4); 2n: (4); 2o: (2); 2p: (2); 2q: (4); 2r: (4); 2s: (2); 2t: (2); 4u: (8); 4v: (4); 4w: (6); 4x: (6); 4y: (6); 4z: (6); 8 α : (12)
2	(0, 0, 0)	1a: (1); 1b: (2); 1c: (1); 1d: (2); 1e: (1); 1f: (2); 1g: (1); 1h: (2); 2i: (3); 2j: (3); 2k: (3); 2l: (3); 2m: (2); 2n: (2); 2o: (4); 2p: (4); 2q: (2); 2r: (2); 2s: (4); 2t: (4); 4u: (4); 4v: (8); 4w: (6); 4x: (6); 4y: (6); 4z: (6); 8 α : (12)

P6 ($u, \frac{1}{2}, v$) of space group No. 47

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (1); 1f: (1); 1g: (1); 1h: (1); 2i: (4); 2j: (4); 2k: (2); 2l: (2); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (4); 2r: (2); 2s: (4); 2t: (2); 4u: (6); 4v: (6); 4w: (8); 4x: (4); 4y: (6); 4z: (6); 8 α : (12)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (2); 1f: (2); 1g: (2); 1h: (2); 2i: (2); 2j: (2); 2k: (4); 2l: (4); 2m: (3); 2n: (3); 2o: (3); 2p: (3); 2q: (2); 2r: (4); 2s: (2); 2t: (4); 4u: (6); 4v: (6); 4w: (4); 4x: (8); 4y: (6); 4z: (6); 8 α : (12)

48. Space group No. 48 ($Pnnn$)

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

Orthorhombic primitive lattice

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_{2y}|0,0,0\} \quad \{C_{2x}|0,0,0\} \quad \{I|\frac{1}{2},-\frac{1}{2},\frac{1}{2}\} \quad \{\sigma_z|-\frac{1}{2},\frac{1}{2},\frac{1}{2}\} \quad \{\sigma_y|-\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\} \quad \{\sigma_x|\frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$
Operation E
Coordinate (0,0,0)
$Y(0,\frac{1}{2},0)$
Operation E
Coordinate (0, $\frac{1}{2}$,0)
$X(\frac{1}{2},0,0)$
Operation E
Coordinate ($\frac{1}{2}$,0,0)
$Z(0,0,\frac{1}{2})$
Operation E
Coordinate (0,0, $\frac{1}{2}$)
$U(\frac{1}{2},0,\frac{1}{2})$
Operation E
Coordinate ($\frac{1}{2}$,0, $\frac{1}{2}$)
$T(0,\frac{1}{2},\frac{1}{2})$
Operation E
Coordinate (0, $\frac{1}{2}$, $\frac{1}{2}$)
$S(\frac{1}{2},\frac{1}{2},0)$
Operation E
Coordinate ($\frac{1}{2}$, $\frac{1}{2}$,0)
$R(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
Operation E
Coordinate ($\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$)

$\Gamma(0,0,0)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (3)
2	(0,0,0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (0); 4f: (0); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 4l: (2); 8m: (3)
3	(0,0,0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (0); 4f: (0); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (1); 8m: (3)

4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (0); 4f: (0); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (3)
5	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (3); 4f: (3); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 4l: (2); 8m: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (1); 8m: (3)
8	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (3)

$Y \left(0, \frac{1}{2}, 0\right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 4l: (3); 8m: (6)

$X \left(\frac{1}{2}, 0, 0\right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 8m: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (4); 8m: (6)

$U \left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 4l: (3); 8m: (6)

$T \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)

$S \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 8m: (6)

2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (4); 8m: (6)

$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 4e: (3); 4f: (0); 4g: (2); 4h: (1); 4i: (1); 4j: (2); 4k: (2); 4l: (1); 8m: (3)
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (0); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (1); 4l: (2); 8m: (3)
3	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (3); 4f: (0); 4g: (1); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 8m: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 4e: (3); 4f: (0); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 4k: (1); 4l: (2); 8m: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 4e: (0); 4f: (3); 4g: (2); 4h: (1); 4i: (1); 4j: (2); 4k: (2); 4l: (1); 8m: (3)
6	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (0); 4f: (3); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (1); 4l: (2); 8m: (3)
7	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (0); 4f: (3); 4g: (1); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 8m: (3)
8	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 4e: (0); 4f: (3); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 4k: (1); 4l: (2); 8m: (3)

c. Results for high-symmetry lines

$A(u, 0, \frac{1}{2})$

Operation	E
Coordinate	$(u, 0, \frac{1}{2})$

$B(0, v, \frac{1}{2})$

Operation	E
Coordinate	$(0, v, \frac{1}{2})$

$C(u, \frac{1}{2}, 0)$

Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$

$D(\frac{1}{2}, v, 0)$

Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$

$DT(0, v, 0)$

Operation	E
Coordinate	$(0, v, 0)$

$E(u, \frac{1}{2}, \frac{1}{2})$

Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$

$$G(\frac{1}{2}, 0, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, w) \end{array}$$

$$H(0, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, w) \end{array}$$

$$LD(0, 0, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, w) \end{array}$$

$$P(\frac{1}{2}, v, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, v, \frac{1}{2}) \end{array}$$

$$Q(\frac{1}{2}, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, w) \end{array}$$

$$SM(u, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (u, 0, 0) \end{array}$$

$A(u, 0, \frac{1}{2})$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

$B(0, v, \frac{1}{2})$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

$C(u, \frac{1}{2}, 0)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

$D(\frac{1}{2}, v, 0)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

$DT(0, v, 0)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 4l: (3); 8m: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 4l: (3); 8m: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 4l: (3); 8m: (6)

$E \left(u, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)

$G \left(\frac{1}{2}, 0, w \right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

$H \left(0, \frac{1}{2}, w \right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

$LD (0, 0, w)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 8m: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (4); 8m: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (4); 8m: (6)

$P \left(\frac{1}{2}, v, \frac{1}{2} \right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 4l: (3); 8m: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 4l: (3); 8m: (6)

4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 4l: (3); 8m: (6)

$Q\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 8m: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 8m: (6)
3	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (4); 8m: (6)
4	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (4); 8m: (6)

$SM(u, 0, 0)$ of space group No. 48

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)

d. Results for high-symmetry planes

$P1(v, -u, 0)$

Operation	E
Coordinate	$(v, -u, 0)$

$P2(0, -u, v)$

Operation	E
Coordinate	$(0, -u, v)$

$P3(u, 0, v)$

Operation	E
Coordinate	$(u, 0, v)$

$P4(v, -u, \frac{1}{2})$

Operation	E
Coordinate	$(v, -u, \frac{1}{2})$

$P5(\frac{1}{2}, -u, v)$

Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$

$P6(u, \frac{1}{2}, v)$

$$\begin{array}{c} \text{Operation} \\ \text{Coordinate} \end{array} \quad \begin{array}{c} E \\ (u, \frac{1}{2}, v) \end{array}$$

P1 ($v, -u, 0$) of space group No. 48		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
P2 (0, $-u, v$) of space group No. 48		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
P3 ($u, 0, v$) of space group No. 48		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
P4 ($v, -u, \frac{1}{2}$) of space group No. 48		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
P5 ($\frac{1}{2}, -u, v$) of space group No. 48		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
P6 ($u, \frac{1}{2}, v$) of space group No. 48		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

49. Space group No. 49 (*Pccm*)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, -\tfrac{1}{2}\} \quad \{C_{2x}|0, 0, -\tfrac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{\sigma_y|0, 0, -\tfrac{1}{2}\} \quad \{\sigma_x|0, 0, -\tfrac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate (0, 0, 0)
$Y(0, \tfrac{1}{2}, 0)$
Operation E
Coordinate (0, $\tfrac{1}{2}$, 0)
$X(\tfrac{1}{2}, 0, 0)$
Operation E
Coordinate ($\tfrac{1}{2}$, 0, 0)
$Z(0, 0, \tfrac{1}{2})$
Operation E
Coordinate (0, 0, $\tfrac{1}{2}$)
$U(\tfrac{1}{2}, 0, \tfrac{1}{2})$
Operation E
Coordinate ($\tfrac{1}{2}$, 0, $\tfrac{1}{2}$)
$T(0, \tfrac{1}{2}, \tfrac{1}{2})$
Operation E
Coordinate (0, $\tfrac{1}{2}$, $\tfrac{1}{2}$)
$S(\tfrac{1}{2}, \tfrac{1}{2}, 0)$
Operation E
Coordinate ($\tfrac{1}{2}$, $\tfrac{1}{2}$, 0)

$$\mathbf{R}\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & \mathbf{E} \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$\Gamma(0, 0, 0)$ of space group No. 49											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (0);	2f: (0);	2g: (0);	2h: (0);	4i: (1);	4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 4p: (1); 4q: (2); 8r: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (2); 4k: (1); 4l: (1); 4m: (2); 4n: (2); 4o: (2); 4p: (2); 4q: (1); 8r: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (2); 4k: (2); 4l: (2); 4m: (1); 4n: (1); 4o: (1); 4p: (1); 4q: (2); 8r: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (1); 4k: (2); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 4p: (2); 4q: (1); 8r: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (0);	2f: (0);	2g: (0);	2h: (0);	4i: (1);	4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 4p: (1); 4q: (1); 8r: (3)
6	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (2); 4k: (1); 4l: (1); 4m: (2); 4n: (2); 4o: (2); 4p: (2); 4q: (2); 8r: (3)
7	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (2); 4k: (2); 4l: (2); 4m: (1); 4n: (1); 4o: (1); 4p: (1); 4q: (1); 8r: (3)
8	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (1); 4k: (2); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 4p: (2); 4q: (2); 8r: (3)

$\mathbf{Y}\left(0, \frac{1}{2}, 0\right)$ of space group No. 49											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (2);	2c: (2);	2d: (0);	2e: (0);	2f: (0);	2g: (1);	2h: (1);	4i: (1);	4j: (2); 4k: (1); 4l: (1); 4m: (1); 4n: (2); 4o: (2); 4p: (1); 4q: (2); 8r: (3)
2	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (0);	2e: (1);	2f: (1);	2g: (0);	2h: (0);	4i: (2);	4j: (1); 4k: (1); 4l: (1); 4m: (2); 4n: (1); 4o: (1); 4p: (2); 4q: (1); 8r: (3)
3	(0, 0, 0)	2a: (0);	2b: (2);	2c: (2);	2d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (1); 4k: (2); 4l: (2); 4m: (1); 4n: (2); 4o: (2); 4p: (1); 4q: (2); 8r: (3)
4	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (2); 4k: (2); 4l: (2); 4m: (2); 4n: (1); 4o: (1); 4p: (2); 4q: (1); 8r: (3)
5	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0);	2d: (1);	2e: (0);	2f: (0);	2g: (1);	2h: (1);	4i: (1);	4j: (2); 4k: (1); 4l: (1); 4m: (1); 4n: (2); 4o: (2); 4p: (1); 4q: (1); 8r: (3)
6	(0, 0, 0)	2a: (2);	2b: (0);	2c: (0);	2d: (2);	2e: (1);	2f: (1);	2g: (0);	2h: (0);	4i: (2);	4j: (1); 4k: (1); 4l: (1); 4m: (2); 4n: (1); 4o: (1); 4p: (2); 4q: (2); 8r: (3)
7	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0);	2d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (1); 4k: (2); 4l: (2); 4m: (1); 4n: (2); 4o: (2); 4p: (1); 4q: (1); 8r: (3)
8	(0, 0, 0)	2a: (2);	2b: (0);	2c: (0);	2d: (2);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (2); 4k: (2); 4l: (2); 4m: (2); 4n: (1); 4o: (1); 4p: (2); 4q: (2); 8r: (3)

$\mathbf{X}\left(\frac{1}{2}, 0, 0\right)$ of space group No. 49											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (2);	2c: (0);	2d: (2);	2e: (0);	2f: (1);	2g: (0);	2h: (1);	4i: (1);	4j: (1); 4k: (1); 4l: (2); 4m: (1); 4n: (2); 4o: (1); 4p: (2); 4q: (2); 8r: (3)
2	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0);	2d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (2); 4k: (1); 4l: (2); 4m: (2); 4n: (1); 4o: (2); 4p: (1); 4q: (1); 8r: (3)

3	(0, 0, 0)	2a: (0); 2b: (2); 2c: (0); 2d: (2); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (2); 4o: (1); 4p: (2); 4q: (2); 8r: (3)
4	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 2e: (1); 2f: (0); 2g: (1); 2h: (0); 4i: (1); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (1); 4o: (2); 4p: (1); 4q: (1); 8r: (3)
5	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 2e: (0); 2f: (1); 2g: (0); 2h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (2); 4m: (1); 4n: (2); 4o: (1); 4p: (2); 4q: (1); 8r: (3)
6	(0, 0, 0)	2a: (2); 2b: (0); 2c: (2); 2d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 4m: (2); 4n: (1); 4o: (2); 4p: (1); 4q: (2); 8r: (3)
7	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (2); 4o: (1); 4p: (2); 4q: (1); 8r: (3)
8	(0, 0, 0)	2a: (2); 2b: (0); 2c: (2); 2d: (0); 2e: (1); 2f: (0); 2g: (1); 2h: (0); 4i: (1); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (1); 4o: (2); 4p: (1); 4q: (2); 8r: (3)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (2); 4o: (2); 4p: (2); 4q: (3); 8r: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (4); 4o: (4); 4p: (4); 4q: (3); 8r: (6)

$U \left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (4); 4o: (2); 4p: (4); 4q: (3); 8r: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (2); 4o: (4); 4p: (2); 4q: (3); 8r: (6)

$T \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (4); 4o: (4); 4p: (2); 4q: (3); 8r: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 2e: (2); 2f: (2); 2g: (1); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (2); 4o: (2); 4p: (4); 4q: (3); 8r: (6)

$S \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (2); 2d: (2); 2e: (0); 2f: (1); 2g: (1); 2h: (1); 4i: (1); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 4n: (1); 4o: (2); 4p: (2); 4q: (2); 8r: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 2g: (0); 2h: (1); 4i: (2); 4j: (1); 4k: (1); 4l: (2); 4m: (2); 4n: (2); 4o: (1); 4p: (1); 4q: (1); 8r: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 2g: (1); 2h: (0); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 4m: (1); 4n: (1); 4o: (2); 4p: (2); 4q: (2); 8r: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (0); 2g: (1); 2h: (1); 4i: (1); 4j: (2); 4k: (2); 4l: (1); 4m: (2); 4n: (2); 4o: (1); 4p: (1); 4q: (1); 8r: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 2e: (0); 2f: (1); 2g: (1); 2h: (1); 4i: (1); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 4n: (1); 4o: (2); 4p: (2); 4q: (1); 8r: (3)
6	(0, 0, 0)	2a: (2); 2b: (2); 2c: (0); 2d: (0); 2e: (1); 2f: (1); 2g: (0); 2h: (1); 4i: (2); 4j: (1); 4k: (1); 4l: (2); 4m: (2); 4n: (2); 4o: (1); 4p: (1); 4q: (2); 8r: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (0); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 4m: (1); 4n: (1); 4o: (2); 4p: (2); 4q: (1); 8r: (3)

8	(0, 0, 0)	2a: (2); 2b: (2); 2c: (0); 2d: (0); 2e: (1); 2f: (0); 2g: (1); 2h: (1); 4i: (1); 4j: (2); 4k: (2); 4l: (1); 4m: (2); 4n: (2); 4o: (1); 4p: (1); 4q: (2); 8r: (3)

$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (2); 4o: (4); 4p: (4); 4q: (3); 8r: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (4); 4o: (2); 4p: (2); 4q: (3); 8r: (6)

c. Results for high-symmetry lines

$A(u, 0, \frac{1}{2})$

Operation	E
Coordinate	$(u, 0, \frac{1}{2})$

$B(0, v, \frac{1}{2})$

Operation	E
Coordinate	$(0, v, \frac{1}{2})$

$C(u, \frac{1}{2}, 0)$

Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$

$D(\frac{1}{2}, v, 0)$

Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$

$DT(0, v, 0)$

Operation	E
Coordinate	$(0, v, 0)$

$E(u, \frac{1}{2}, \frac{1}{2})$

Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$

$G(\frac{1}{2}, 0, w)$

Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$

$H(0, \frac{1}{2}, w)$

Operation	E
Coordinate	$(0, \frac{1}{2}, w)$

$LD(0, 0, w)$

Operation	E
Coordinate	$(0, 0, w)$

$$P\left(\frac{1}{2}, v, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, v, \frac{1}{2}\right) \end{array}$$

$$Q\left(\frac{1}{2}, \frac{1}{2}, w\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, w\right) \end{array}$$

$$SM(u, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (u, 0, 0) \end{array}$$

A $(u, 0, \frac{1}{2})$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)

B $(0, v, \frac{1}{2})$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)

C $(u, \frac{1}{2}, 0)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (4); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (4); 8r: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (4); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (2); 8r: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 2g: (1); 2h: (1); 4i: (4); 4j: (2); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (4); 8r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (1); 4i: (4); 4j: (2); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (2); 8r: (6)

D $(\frac{1}{2}, v, 0)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (2); 4l: (4); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (4); 8r: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (2); 4l: (4); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (2); 8r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (2); 8r: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (4); 8r: (6)

DT $(0, v, 0)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (4); 8r: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (2); 8r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (4); 4l: (4); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (2); 8r: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (4); 4l: (4); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (4); 8r: (6)

$E \left(u, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)

$G \left(\frac{1}{2}, 0, w \right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (4); 4o: (2); 4p: (4); 4q: (3); 8r: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (4); 4o: (2); 4p: (4); 4q: (3); 8r: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (2); 4o: (4); 4p: (2); 4q: (3); 8r: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (2); 4o: (4); 4p: (2); 4q: (3); 8r: (6)

$H \left(0, \frac{1}{2}, w \right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (4); 4o: (4); 4p: (2); 4q: (3); 8r: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (4); 4o: (4); 4p: (2); 4q: (3); 8r: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 2e: (2); 2f: (2); 2g: (1); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (2); 4o: (2); 4p: (4); 4q: (3); 8r: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 2e: (2); 2f: (2); 2g: (1); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (2); 4o: (2); 4p: (4); 4q: (3); 8r: (6)

$LD \left(0, 0, w \right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (2); 4o: (2); 4p: (2); 4q: (3); 8r: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (2); 4o: (2); 4p: (2); 4q: (3); 8r: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (4); 4o: (4); 4p: (4); 4q: (3); 8r: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (4); 4o: (4); 4p: (4); 4q: (3); 8r: (6)

$P \left(\frac{1}{2}, v, \frac{1}{2} \right)$ of space group No. 49

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)

Q ($\frac{1}{2}, \frac{1}{2}, w$) of space group No. 49		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (2); 4o: (4); 4p: (4); 4q: (3); 8r: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (2); 4o: (4); 4p: (4); 4q: (3); 8r: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (4); 4o: (2); 4p: (2); 4q: (3); 8r: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (4); 4o: (2); 4p: (2); 4q: (3); 8r: (6)

SM ($u, 0, 0$) of space group No. 49		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (4); 8r: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (2); 8r: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (4); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (4); 8r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (4); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 4p: (3); 4q: (2); 8r: (6)

d. Results for high-symmetry planes

P1($v, -u, 0$)

Operation	E
Coordinate	($v, -u, 0$)

P2($0, -u, v$)

Operation	E
Coordinate	($0, -u, v$)

P3($u, 0, v$)

Operation	E
Coordinate	($u, 0, v$)

P4($v, -u, \frac{1}{2}$)

Operation	E
Coordinate	($v, -u, \frac{1}{2}$)

P5($\frac{1}{2}, -u, v$)

Operation	E
Coordinate	($\frac{1}{2}, -u, v$)

P6($u, \frac{1}{2}, v$)

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (u, \frac{1}{2}, v) \end{array}$$

P1 ($v, -u, 0$) of space group No. 49											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (4);	2b: (4);	2c: (4);	2d: (4);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (8); 8r: (12)
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (4); 8r: (12)
P2 (0, $-u, v$) of space group No. 49											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)
P3 ($u, 0, v$) of space group No. 49											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)
P4 ($v, -u, \frac{1}{2}$) of space group No. 49											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)
P5 ($\frac{1}{2}, -u, v$) of space group No. 49											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)
P6 ($u, \frac{1}{2}, v$) of space group No. 49											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	2g: (3);	2h: (3);	4i: (6);	4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 4p: (6); 4q: (6); 8r: (12)

50. Space group No. 50 (*Pban*)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{I|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_z|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_y|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_x|\frac{1}{2}, \frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate (0, 0, 0)
$Y(0, \frac{1}{2}, 0)$
Operation E
Coordinate (0, $\frac{1}{2}$, 0)
$X(\frac{1}{2}, 0, 0)$
Operation E
Coordinate ($\frac{1}{2}$, 0, 0)
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate (0, 0, $\frac{1}{2}$)
$U(\frac{1}{2}, 0, \frac{1}{2})$
Operation E
Coordinate ($\frac{1}{2}$, 0, $\frac{1}{2}$)
$T(0, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate (0, $\frac{1}{2}$, $\frac{1}{2}$)
$S(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate ($\frac{1}{2}$, $\frac{1}{2}$, 0)

$$\mathbf{R}(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{c} \text{Operation} \quad \text{E} \\ \text{Coordinate} \quad (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 50											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (1); 4k: (1); 4l: (1); 8m: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (0);	4f: (0);	4g: (2);	4h: (2);	4i: (1);	4j: (1); 4k: (2); 4l: (2); 8m: (3)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (0);	4f: (0);	4g: (2);	4h: (2);	4i: (2);	4j: (2); 4k: (1); 4l: (1); 8m: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (0);	4f: (0);	4g: (1);	4h: (1);	4i: (2);	4j: (2); 4k: (2); 4l: (2); 8m: (3)
5	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (3);	4f: (3);	4g: (1);	4h: (1);	4i: (1);	4j: (1); 4k: (1); 4l: (1); 8m: (3)
6	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (2);	4h: (2);	4i: (1);	4j: (1); 4k: (2); 4l: (2); 8m: (3)
7	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (2);	4h: (2);	4i: (2);	4j: (2); 4k: (1); 4l: (1); 8m: (3)
8	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (1);	4h: (1);	4i: (2);	4j: (2); 4k: (2); 4l: (2); 8m: (3)
$\Upsilon (0, \frac{1}{2}, 0)$ of space group No. 50											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (2);	4j: (2); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (4);	4j: (4); 4k: (3); 4l: (3); 8m: (6)
$\mathbf{X} (\frac{1}{2}, 0, 0)$ of space group No. 50											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (2);	4h: (2);	4i: (3);	4j: (3); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (4);	4h: (4);	4i: (3);	4j: (3); 4k: (3); 4l: (3); 8m: (6)
$\mathbf{Z} (0, 0, \frac{1}{2})$ of space group No. 50											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	2d: (1);	4e: (0);	4f: (3);	4g: (1);	4h: (2);	4i: (1);	4j: (2); 4k: (1); 4l: (1); 8m: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (0);	4f: (3);	4g: (2);	4h: (1);	4i: (1);	4j: (2); 4k: (2); 4l: (2); 8m: (3)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (0);	4e: (0);	4f: (3);	4g: (2);	4h: (1);	4i: (2);	4j: (1); 4k: (1); 4l: (1); 8m: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (0);	4f: (3);	4g: (1);	4h: (2);	4i: (2);	4j: (1); 4k: (2); 4l: (2); 8m: (3)

5	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (3); 4f: (0); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (1); 4l: (1); 8m: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (0); 4g: (2); 4h: (1); 4i: (1); 4j: (2); 4k: (2); 4l: (2); 8m: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (3); 4f: (0); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 4k: (1); 4l: (1); 8m: (3)
8	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (0); 4g: (1); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (2); 8m: (3)
U $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 50		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 50		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 4l: (3); 8m: (6)
S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 50		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (4); 8m: (6)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 50		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (4); 8m: (6)

c. Results for high-symmetry lines

$$A(u, 0, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (u, 0, \frac{1}{2}) \end{array}$$

$$B(0, v, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, v, \frac{1}{2}) \end{array}$$

$$C(u, \frac{1}{2}, 0)$$

Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
$D(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
$G(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
$H(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$P(\frac{1}{2}, v, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
$Q(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$SM(u, 0, 0)$	
Operation	E
Coordinate	$(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)

4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 8m: (6)

B $(0, v, \frac{1}{2})$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 4l: (3); 8m: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 4l: (3); 8m: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 4l: (3); 8m: (6)

C $(u, \frac{1}{2}, 0)$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

D $(\frac{1}{2}, v, 0)$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

DT $(0, v, 0)$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 4l: (3); 8m: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 4l: (3); 8m: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 4l: (3); 8m: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 4l: (3); 8m: (6)

E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

G $(\frac{1}{2}, 0, w)$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

H $(0, \frac{1}{2}, w)$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

LD (0, 0, w) of space group No. 50											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1); 4l: (2);	2b: (1); 8m: (6)	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (3); 4j: (3);	4k: (2);
2	(0, 0, 0)	2a: (1); 4l: (2);	2b: (1); 8m: (6)	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (3); 4j: (3);	4k: (2);
3	(0, 0, 0)	2a: (2); 4l: (4);	2b: (2); 8m: (6)	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (3); 4j: (3);	4k: (4);
4	(0, 0, 0)	2a: (2); 4l: (4);	2b: (2); 8m: (6)	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (3); 4j: (3);	4k: (4);
P ($\frac{1}{2}$, v, $\frac{1}{2}$) of space group No. 50											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3); 4l: (6);	2b: (3); 8m: (12)	2c: (3);	2d: (3);	4e: (6);	4f: (6);	4g: (6);	4h: (6);	4i: (6); 4j: (6);	4k: (6);
Q ($\frac{1}{2}$, $\frac{1}{2}$, w) of space group No. 50											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2); 4l: (2);	2b: (1); 8m: (6)	2c: (1);	2d: (2);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (3); 4j: (3);	4k: (4);
2	(0, 0, 0)	2a: (2); 4l: (2);	2b: (1); 8m: (6)	2c: (1);	2d: (2);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (3); 4j: (3);	4k: (4);
3	(0, 0, 0)	2a: (1); 4l: (4);	2b: (2); 8m: (6)	2c: (2);	2d: (1);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (3); 4j: (3);	4k: (2);
4	(0, 0, 0)	2a: (1); 4l: (4);	2b: (2); 8m: (6)	2c: (2);	2d: (1);	4e: (3);	4f: (3);	4g: (3);	4h: (3);	4i: (3); 4j: (3);	4k: (2);
SM (u, 0, 0) of space group No. 50											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1); 4l: (3);	2b: (1); 8m: (6)	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (2);	4h: (2);	4i: (3); 4j: (3);	4k: (3);
2	(0, 0, 0)	2a: (1); 4l: (3);	2b: (1); 8m: (6)	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (2);	4h: (2);	4i: (3); 4j: (3);	4k: (3);
3	(0, 0, 0)	2a: (2); 4l: (3);	2b: (2); 8m: (6)	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (4);	4h: (4);	4i: (3); 4j: (3);	4k: (3);
4	(0, 0, 0)	2a: (2); 4l: (3);	2b: (2); 8m: (6)	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (4);	4h: (4);	4i: (3); 4j: (3);	4k: (3);

d. Results for high-symmetry planes

P1($v, -u, 0$)

Operation	E
Coordinate	$(v, -u, 0)$

P2($0, -u, v$)

Operation	E
Coordinate	$(0, -u, v)$

 $P3(u, 0, v)$

Operation	E
Coordinate	$(u, 0, v)$

 $P4(v, -u, \frac{1}{2})$

Operation	E
Coordinate	$(v, -u, \frac{1}{2})$

 $P5(\frac{1}{2}, -u, v)$

Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$

 $P6(u, \frac{1}{2}, v)$

Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

 $P1(v, -u, 0)$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

 $P2(0, -u, v)$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

 $P3(u, 0, v)$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

 $P4(v, -u, \frac{1}{2})$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

 $P5(\frac{1}{2}, -u, v)$ of space group No. 50

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
P6 ($u, \frac{1}{2}, v$) of space group No. 50		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 8m: (12)

51. Space group No. 51 ($Pmma$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (c, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2x}|\frac{1}{2}, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_x|\frac{1}{2}, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_z|\frac{1}{2}, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$Y(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	(0, $\frac{1}{2}$, 0)
$X(0, 0, \frac{1}{2})$	
Operation	E
Coordinate	(0, 0, $\frac{1}{2}$)
$Z(-\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	($-\frac{1}{2}$, 0, 0)

$U(-\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(-\frac{1}{2}, 0, \frac{1}{2})$
$T(-\frac{1}{2}, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, 0)$
$S(0, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$
$R(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 51											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (1);	2f: (1);	4g: (1);	4h: (1);	4i: (2);	4j: (2); 4k: (2); 8l: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (1);	2f: (1);	4g: (1);	4h: (1);	4i: (2);	4j: (2); 4k: (1); 8l: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (1);	4j: (1); 4k: (2); 8l: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (0);	2f: (0);	4g: (2);	4h: (2);	4i: (1);	4j: (1); 4k: (1); 8l: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (0);	2f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (1); 4k: (1); 8l: (3)
6	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1); 4k: (2); 8l: (3)
7	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (2);	4j: (2); 4k: (1); 8l: (3)
8	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (2);	4j: (2); 4k: (2); 8l: (3)

$Y (0, \frac{1}{2}, 0)$ of space group No. 51											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0);	2d: (1);	2e: (1);	2f: (1);	4g: (1);	4h: (1);	4i: (2);	4j: (1); 4k: (2); 8l: (3)
2	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0);	2d: (1);	2e: (1);	2f: (0);	4g: (1);	4h: (1);	4i: (2);	4j: (1); 4k: (1); 8l: (3)
3	(0, 0, 0)	2a: (0);	2b: (2);	2c: (0);	2d: (2);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (1);	4j: (2); 4k: (2); 8l: (3)
4	(0, 0, 0)	2a: (0);	2b: (2);	2c: (0);	2d: (2);	2e: (0);	2f: (1);	4g: (2);	4h: (2);	4i: (1);	4j: (2); 4k: (1); 8l: (3)
5	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (0);	2e: (0);	2f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (2); 4k: (1); 8l: (3)

6	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 2e: (1); 2f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (2); 4k: (2); 8l: (3)
7	(0, 0, 0)	2a: (2); 2b: (0); 2c: (2); 2d: (0); 2e: (1); 2f: (0); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 4k: (1); 8l: (3)
8	(0, 0, 0)	2a: (2); 2b: (0); 2c: (2); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 8l: (3)

$X \left(0, 0, \frac{1}{2}\right)$ of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (1); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 8l: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (1); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 8l: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (1); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 2e: (0); 2f: (0); 4g: (2); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 8l: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 2e: (0); 2f: (0); 4g: (1); 4h: (2); 4i: (1); 4j: (1); 4k: (1); 8l: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 2e: (1); 2f: (1); 4g: (1); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
7	(0, 0, 0)	2a: (2); 2b: (2); 2c: (0); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (1); 4i: (2); 4j: (2); 4k: (1); 8l: (3)
8	(0, 0, 0)	2a: (2); 2b: (2); 2c: (0); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 8l: (3)

$Z \left(-\frac{1}{2}, 0, 0\right)$ of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 8l: (6)

$U \left(-\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 8l: (6)

$T \left(-\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (1); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 8l: (6)

$S \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 51

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (2); 2d: (0); 2e: (1); 2f: (1); 4g: (1); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 8l: (3)
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (2); 2d: (0); 2e: (1); 2f: (0); 4g: (1); 4h: (2); 4i: (2); 4j: (1); 4k: (1); 8l: (3)
3	(0, 0, 0)	2a: (0); 2b: (2); 2c: (1); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (1); 4i: (1); 4j: (2); 4k: (2); 8l: (3)
4	(0, 0, 0)	2a: (0); 2b: (2); 2c: (1); 2d: (0); 2e: (0); 2f: (1); 4g: (2); 4h: (1); 4i: (1); 4j: (2); 4k: (1); 8l: (3)
5	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (2); 2e: (0); 2f: (1); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (1); 8l: (3)
6	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (2); 2e: (1); 2f: (1); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (2); 8l: (3)
7	(0, 0, 0)	2a: (2); 2b: (0); 2c: (0); 2d: (1); 2e: (1); 2f: (0); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 4k: (1); 8l: (3)
8	(0, 0, 0)	2a: (2); 2b: (0); 2c: (0); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 4k: (2); 8l: (3)

$R\left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 51		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (1); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 8l: (6)

c. Results for high-symmetry lines

$A(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

$B(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

$C(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

$D(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

$DT(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

$E(u, \frac{1}{2}, \frac{1}{2})$

Operation E

Coordinate $(u, \frac{1}{2}, \frac{1}{2})$

$G(\frac{1}{2}, 0, w)$

Operation E

Coordinate $(\frac{1}{2}, 0, w)$

$H(0, \frac{1}{2}, w)$

Operation E

Coordinate $(0, \frac{1}{2}, w)$

$LD(0, 0, w)$

Operation E

Coordinate $(0, 0, w)$

$P(\frac{1}{2}, v, \frac{1}{2})$

Operation E

Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

$Q(\frac{1}{2}, \frac{1}{2}, w)$

Operation E

Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

$SM(u, 0, 0)$

Operation E

Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 8l: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 8l: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 8l: (6)

B $(0, v, \frac{1}{2})$ of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (4); 8l: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (2); 8l: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (2); 8l: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (4); 8l: (6)

C $(u, \frac{1}{2}, 0)$ of space group No. 51											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2);	2b: (1);	2c: (2);	2d: (1);	2e: (2);	2f: (1);	4g: (3);	4h: (3);	4i: (4);	4j: (2); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1);	2b: (2);	2c: (1);	2d: (2);	2e: (1);	2f: (2);	4g: (3);	4h: (3);	4i: (2);	4j: (4); 4k: (3); 8l: (6)
3	(0, 0, 0)	2a: (2);	2b: (1);	2c: (2);	2d: (1);	2e: (2);	2f: (1);	4g: (3);	4h: (3);	4i: (4);	4j: (2); 4k: (3); 8l: (6)
4	(0, 0, 0)	2a: (1);	2b: (2);	2c: (1);	2d: (2);	2e: (1);	2f: (2);	4g: (3);	4h: (3);	4i: (2);	4j: (4); 4k: (3); 8l: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 51											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	4g: (6);	4h: (6);	4i: (6);	4j: (6); 4k: (6); 8l: (12)
DT $(0, v, 0)$ of space group No. 51											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (2);	2f: (2);	4g: (2);	4h: (2);	4i: (3);	4j: (3); 4k: (4); 8l: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (3);	4j: (3); 4k: (2); 8l: (6)
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (1);	2f: (1);	4g: (4);	4h: (4);	4i: (3);	4j: (3); 4k: (2); 8l: (6)
4	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (2);	2f: (2);	4g: (4);	4h: (4);	4i: (3);	4j: (3); 4k: (4); 8l: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 51											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2);	2b: (1);	2c: (2);	2d: (1);	2e: (2);	2f: (1);	4g: (3);	4h: (3);	4i: (4);	4j: (2); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1);	2b: (2);	2c: (1);	2d: (2);	2e: (1);	2f: (2);	4g: (3);	4h: (3);	4i: (2);	4j: (4); 4k: (3); 8l: (6)
3	(0, 0, 0)	2a: (2);	2b: (1);	2c: (2);	2d: (1);	2e: (2);	2f: (1);	4g: (3);	4h: (3);	4i: (4);	4j: (2); 4k: (3); 8l: (6)
4	(0, 0, 0)	2a: (1);	2b: (2);	2c: (1);	2d: (2);	2e: (1);	2f: (2);	4g: (3);	4h: (3);	4i: (2);	4j: (4); 4k: (3); 8l: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 51											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (2);	2f: (2);	4g: (3);	4h: (3);	4i: (4);	4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	4g: (3);	4h: (3);	4i: (2);	4j: (2); 4k: (3); 8l: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 51											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2);	2b: (1);	2c: (2);	2d: (1);	2e: (2);	2f: (2);	4g: (3);	4h: (3);	4i: (4);	4j: (2); 4k: (4); 8l: (6)

2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (0); 2f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (2); 8l: (6)
3	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (4); 8l: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (0); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (2); 8l: (6)

LD (0, 0, w) of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (4); 8l: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (0); 2f: (0); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (2); 8l: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (4); 8l: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (2); 8l: (6)

P ($\frac{1}{2}, v, \frac{1}{2}$) of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)

Q ($\frac{1}{2}, \frac{1}{2}, w$) of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (1); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 4k: (3); 8l: (6)

SM ($u, 0, 0$) of space group No. 51

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 8l: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 4k: (3); 8l: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 4k: (3); 8l: (6)

d. Results for high-symmetry planes

P1(0, $-u, v$)

Operation	E
Coordinate	(0, $-u, v$)

P2($-v, -u, 0$)

Operation	E
Coordinate	$(-v, -u, 0)$
P3 $(-v, 0, u)$	
Operation	E
Coordinate	$(-v, 0, u)$
P4 $(-\frac{1}{2}, -u, v)$	
Operation	E
Coordinate	$(-\frac{1}{2}, -u, v)$
P5 $(-v, -u, \frac{1}{2})$	
Operation	E
Coordinate	$(-v, -u, \frac{1}{2})$
P6 $(-v, \frac{1}{2}, u)$	
Operation	E
Coordinate	$(-v, \frac{1}{2}, u)$

P1 $(0, -u, v)$ of space group No. 51		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (4); 2f: (4); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (8); 8l: (12)
2	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (2); 2f: (2); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (4); 8l: (12)
P2 $(-v, -u, 0)$ of space group No. 51		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)
2	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)
P3 $(-v, 0, u)$ of space group No. 51		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (4); 2b: (4); 2c: (4); 2d: (4); 2e: (4); 2f: (4); 4g: (6); 4h: (6); 4i: (8); 4j: (8); 4k: (6); 8l: (12)
2	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (6); 4h: (6); 4i: (4); 4j: (4); 4k: (6); 8l: (12)
P4 $(-\frac{1}{2}, -u, v)$ of space group No. 51		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)
P5 $(-v, -u, \frac{1}{2})$ of space group No. 51		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 8l: (12)
P6 $(-v, \frac{1}{2}, u)$ of space group No. 51		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (2); 2c: (4); 2d: (2); 2e: (4); 2f: (2); 4g: (6); 4h: (6); 4i: (8); 4j: (4); 4k: (6); 8l: (12)
2	(0, 0, 0)	2a: (2); 2b: (4); 2c: (2); 2d: (4); 2e: (2); 2f: (4); 4g: (6); 4h: (6); 4i: (4); 4j: (8); 4k: (6); 8l: (12)

52. Space group No. 52 ($Pnna$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{C_{2z}|\frac{1}{2}, 0, 0\} \quad \{C_{2x}|0, \frac{1}{2}, -\frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{\sigma_y|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{\sigma_z|\frac{1}{2}, 0, 0\} \quad \{\sigma_x|0, \frac{1}{2}, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$Y(0, 0, -\frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, -\frac{1}{2})$
$X(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, 0)$
$Z(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$

$$U\left(\frac{1}{2}, \frac{1}{2}, 0\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, 0\right) \end{array}$$

$$T\left(0, \frac{1}{2}, -\frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(0, \frac{1}{2}, -\frac{1}{2}\right) \end{array}$$

$$S\left(\frac{1}{2}, 0, -\frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, 0, -\frac{1}{2}\right) \end{array}$$

$$R\left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\right) \end{array}$$

 $\Gamma (0, 0, 0)$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	8e: (3)
2	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (2);	8e: (3)
3	(0, 0, 0)	4a: (0);	4b: (0);	4c: (2);	4d: (2);	8e: (3)
4	(0, 0, 0)	4a: (0);	4b: (0);	4c: (2);	4d: (1);	8e: (3)
5	(0, 0, 0)	4a: (3);	4b: (3);	4c: (1);	4d: (1);	8e: (3)
6	(0, 0, 0)	4a: (3);	4b: (3);	4c: (1);	4d: (2);	8e: (3)
7	(0, 0, 0)	4a: (3);	4b: (3);	4c: (2);	4d: (2);	8e: (3)
8	(0, 0, 0)	4a: (3);	4b: (3);	4c: (2);	4d: (1);	8e: (3)

 $Y (0, 0, -\frac{1}{2})$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (2);	4d: (3);	8e: (6)
2	(0, 0, 0)	4a: (3);	4b: (3);	4c: (4);	4d: (3);	8e: (6)

 $X (\frac{1}{2}, 0, 0)$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	4d: (2);	8e: (6)
2	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	4d: (4);	8e: (6)

 $Z (0, \frac{1}{2}, 0)$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	4d: (3);	8e: (6)
2	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	4d: (3);	8e: (6)

 $U (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information				

1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
$T\left(0, \frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 52		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (6); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (6); 4b: (0); 4c: (3); 4d: (3); 8e: (6)
$S\left(\frac{1}{2}, 0, -\frac{1}{2}\right)$ of space group No. 52		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
$R\left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 52		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

c. Results for high-symmetry lines

$A\left(u, 0, \frac{1}{2}\right)$	
Operation	E
Coordinate	$\left(u, 0, \frac{1}{2}\right)$
$B\left(0, v, \frac{1}{2}\right)$	
Operation	E
Coordinate	$\left(0, v, \frac{1}{2}\right)$
$C\left(u, \frac{1}{2}, 0\right)$	
Operation	E
Coordinate	$\left(u, \frac{1}{2}, 0\right)$
$D\left(\frac{1}{2}, v, 0\right)$	
Operation	E
Coordinate	$\left(\frac{1}{2}, v, 0\right)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
$E\left(u, \frac{1}{2}, \frac{1}{2}\right)$	
Operation	E
Coordinate	$\left(u, \frac{1}{2}, \frac{1}{2}\right)$
$G\left(\frac{1}{2}, 0, w\right)$	
Operation	E
Coordinate	$\left(\frac{1}{2}, 0, w\right)$

$$H(0, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, w) \end{array}$$

$$LD(0, 0, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, w) \end{array}$$

$$P(\frac{1}{2}, v, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, v, \frac{1}{2}) \end{array}$$

$$Q(\frac{1}{2}, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, w) \end{array}$$

$$SM(u, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (u, 0, 0) \end{array}$$

$A(u, 0, \frac{1}{2})$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

$B(0, v, \frac{1}{2})$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

$C(u, \frac{1}{2}, 0)$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

$D(\frac{1}{2}, v, 0)$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

$DT(0, v, 0)$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

$E(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 52

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)
$G\left(\frac{1}{2}, 0, w\right)$ of space group No. 52		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)
$H\left(0, \frac{1}{2}, w\right)$ of space group No. 52		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)
$LD(0, 0, w)$ of space group No. 52		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (3); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (3); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (3); 8e: (6)
$P\left(\frac{1}{2}, v, \frac{1}{2}\right)$ of space group No. 52		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
$Q\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 52		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
$SM(u, 0, 0)$ of space group No. 52		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 8e: (6)

d. Results for high-symmetry planes

$P1(v, 0, u)$

Operation	E
Coordinate	$(v, 0, u)$

$P2(0, v, u)$

Operation	E
Coordinate	$(0, v, u)$
P3($u, v, 0$)	
Operation	E
Coordinate	$(u, v, 0)$
P4($v, \frac{1}{2}, u$)	
Operation	E
Coordinate	$(v, \frac{1}{2}, u)$
P5($\frac{1}{2}, v, u$)	
Operation	E
Coordinate	$(\frac{1}{2}, v, u)$
P6($u, v, -\frac{1}{2}$)	
Operation	E
Coordinate	$(u, v, -\frac{1}{2})$

P1 ($v, 0, u$) of space group No. 52			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
P2 ($0, v, u$) of space group No. 52			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
P3 ($u, v, 0$) of space group No. 52			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
P4 ($v, \frac{1}{2}, u$) of space group No. 52			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
P5 ($\frac{1}{2}, v, u$) of space group No. 52			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
P6 ($u, v, -\frac{1}{2}$) of space group No. 52			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)	

1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

53. Space group No. 53 ($Pmna$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (b, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2y}|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_y|\frac{1}{2}, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$Y(\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	($\frac{1}{2}, 0, 0$)
$X(0, -\frac{1}{2}, 0)$	
Operation	E
Coordinate	(0, $-\frac{1}{2}, 0$)
$Z(0, 0, \frac{1}{2})$	
Operation	E
Coordinate	(0, 0, $\frac{1}{2}$)
$U(0, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	(0, $-\frac{1}{2}, \frac{1}{2}$)
$T(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	($\frac{1}{2}, 0, \frac{1}{2}$)

$$S\left(\frac{1}{2}, -\frac{1}{2}, 0\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, -\frac{1}{2}, 0\right) \end{array}$$

$$R\left(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\right) \end{array}$$

 $\Gamma (0, 0, 0)$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (2); 8i: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 8i: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (2); 4h: (1); 8i: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 8i: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (1); 8i: (3)
7	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3)
8	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (2); 4f: (2); 4g: (1); 4h: (2); 8i: (3)

 $Y \left(\frac{1}{2}, 0, 0\right)$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6)

 $X \left(0, -\frac{1}{2}, 0\right)$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (2); 2d: (2); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 8i: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (2); 2d: (2); 4e: (1); 4f: (2); 4g: (2); 4h: (2); 8i: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 8i: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (2); 4g: (1); 4h: (1); 8i: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (2); 4g: (2); 4h: (1); 8i: (3)
7	(0, 0, 0)	2a: (2); 2b: (2); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 4h: (2); 8i: (3)
8	(0, 0, 0)	2a: (2); 2b: (2); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (1); 4h: (2); 8i: (3)

 $Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (2); 8i: (6)

 $U \left(0, -\frac{1}{2}, \frac{1}{2}\right)$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (2); 8i: (6)

T $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (0); 2c: (0); 2d: (3); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6)
2	(0, 0, 0)	2a: (0); 2b: (3); 2c: (3); 2d: (0); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6)
S $(\frac{1}{2}, -\frac{1}{2}, 0)$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
R $(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (0); 2c: (3); 2d: (0); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6)
2	(0, 0, 0)	2a: (0); 2b: (3); 2c: (0); 2d: (3); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

B $(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

C $(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

D $(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

DT $(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

E $(u, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(u, \frac{1}{2}, \frac{1}{2})$

G $(\frac{1}{2}, 0, w)$

Operation E
Coordinate $(\frac{1}{2}, 0, w)$

$$H(0, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, w) \end{array}$$

$$LD(0, 0, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, w) \end{array}$$

$$P(\frac{1}{2}, v, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, v, \frac{1}{2}) \end{array}$$

$$Q(\frac{1}{2}, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, w) \end{array}$$

$$SM(u, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (u, 0, 0) \end{array}$$

A $(u, 0, \frac{1}{2})$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

B $(0, v, \frac{1}{2})$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (2); 8i: (6)

C $(u, \frac{1}{2}, 0)$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 8i: (6)

D $(\frac{1}{2}, v, 0)$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

DT $(0, v, 0)$ of space group No. 53

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6)

4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
G $(\frac{1}{2}, 0, w)$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
H $(0, \frac{1}{2}, w)$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (2); 8i: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (4); 8i: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (2); 8i: (6)
LD $(0, 0, w)$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (2); 8i: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (4); 8i: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (2); 8i: (6)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
SM $(u, 0, 0)$ of space group No. 53		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6)

d. Results for high-symmetry planes

P1 $(-u, -v, 0)$

Operation	E
Coordinate	$(-u, -v, 0)$

P2($-u, 0, v$)	
Operation	E
Coordinate	$(-u, 0, v)$
P3($0, -u, v$)	
Operation	E
Coordinate	$(0, -u, v)$
P4($-u, -v, \frac{1}{2}$)	
Operation	E
Coordinate	$(-u, -v, \frac{1}{2})$
P5($-u, -\frac{1}{2}, v$)	
Operation	E
Coordinate	$(-u, -\frac{1}{2}, v)$
P6($\frac{1}{2}, -u, v$)	
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$

$P1(-u, -v, 0)$ of space group No. 53				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
$P2(-u, 0, v)$ of space group No. 53				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
$P3(0, -u, v)$ of space group No. 53				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (4);	2b: (4);	2c: (4); 2d: (4); 4e: (6); 4f: (6); 4g: (6); 4h: (8); 8i: (12)
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2); 2d: (2); 4e: (6); 4f: (6); 4g: (6); 4h: (4); 8i: (12)
$P4(-u, -v, \frac{1}{2})$ of space group No. 53				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
$P5(-u, -\frac{1}{2}, v)$ of space group No. 53				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
$P6(\frac{1}{2}, -u, v)$ of space group No. 53				

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

54. Space group No. 54 ($Pcca$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (c, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2x}|\frac{1}{2}, 0, -\frac{1}{2}\} \quad \{C_{2y}|0, 0, -\frac{1}{2}\} \quad \{C_{2z}|\frac{1}{2}, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_x|\frac{1}{2}, 0, -\frac{1}{2}\} \quad \{\sigma_y|0, 0, -\frac{1}{2}\} \quad \{\sigma_z|\frac{1}{2}, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$Y(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	(0, $\frac{1}{2}$, 0)
$X(0, 0, \frac{1}{2})$	
Operation	E
Coordinate	(0, 0, $\frac{1}{2}$)
$Z(-\frac{1}{2}, 0, 0)$	
Operation	E
Coordinate	($-\frac{1}{2}$, 0, 0)
$U(-\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	($-\frac{1}{2}$, 0, $\frac{1}{2}$)
$T(-\frac{1}{2}, \frac{1}{2}, 0)$	
Operation	E
Coordinate	($-\frac{1}{2}$, $\frac{1}{2}$, 0)

$$S(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$$R(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & (-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (2); 4e: (2); 8f: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 4d: (2); 4e: (2); 8f: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 4d: (1); 4e: (1); 8f: (3)
5	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 4d: (1); 4e: (1); 8f: (3)
6	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 4d: (2); 4e: (2); 8f: (3)
7	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 4e: (2); 8f: (3)
8	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (1); 4e: (1); 8f: (3)

$Y (0, \frac{1}{2}, 0)$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (3); 4c: (1); 4d: (1); 4e: (2); 8f: (3)
2	(0, 0, 0)	4a: (0); 4b: (3); 4c: (1); 4d: (2); 4e: (1); 8f: (3)
3	(0, 0, 0)	4a: (0); 4b: (3); 4c: (2); 4d: (2); 4e: (1); 8f: (3)
4	(0, 0, 0)	4a: (0); 4b: (3); 4c: (2); 4d: (1); 4e: (2); 8f: (3)
5	(0, 0, 0)	4a: (3); 4b: (0); 4c: (1); 4d: (1); 4e: (2); 8f: (3)
6	(0, 0, 0)	4a: (3); 4b: (0); 4c: (1); 4d: (2); 4e: (1); 8f: (3)
7	(0, 0, 0)	4a: (3); 4b: (0); 4c: (2); 4d: (2); 4e: (1); 8f: (3)
8	(0, 0, 0)	4a: (3); 4b: (0); 4c: (2); 4d: (1); 4e: (2); 8f: (3)

$X (0, 0, \frac{1}{2})$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 4e: (2); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 4e: (4); 8f: (6)

$Z (-\frac{1}{2}, 0, 0)$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

$U (-\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

$T \left(-\frac{1}{2}, \frac{1}{2}, 0 \right)$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

$S \left(0, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 4e: (4); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 4e: (2); 8f: (6)

$R \left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

c. Results for high-symmetry lines

$A(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

$B(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

$C(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

$D(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

$DT(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

$E(u, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(u, \frac{1}{2}, \frac{1}{2})$

$G(\frac{1}{2}, 0, w)$

Operation E
Coordinate $(\frac{1}{2}, 0, w)$

$H(0, \frac{1}{2}, w)$

Operation E
Coordinate $(0, \frac{1}{2}, w)$

LD(0, 0, w)

Operation E
Coordinate $(0, 0, w)$

P($\frac{1}{2}, v, \frac{1}{2}$)

Operation E
Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

Q($\frac{1}{2}, \frac{1}{2}, w$)

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

SM(u, 0, 0)

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

B $(0, v, \frac{1}{2})$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

C $(u, \frac{1}{2}, 0)$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

D $(\frac{1}{2}, v, 0)$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

DT $(0, v, 0)$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (3); 4e: (3); 8f: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (3); 4e: (3); 8f: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (3); 4e: (3); 8f: (6)

E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)
$G\left(\frac{1}{2}, 0, w\right)$ of space group No. 54		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
$H\left(0, \frac{1}{2}, w\right)$ of space group No. 54		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 4e: (4); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 4e: (4); 8f: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 4e: (2); 8f: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 4e: (2); 8f: (6)
$LD(0, 0, w)$ of space group No. 54		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 4e: (2); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 4e: (2); 8f: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 4e: (4); 8f: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 4e: (4); 8f: (6)
$P\left(\frac{1}{2}, v, \frac{1}{2}\right)$ of space group No. 54		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
$Q\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 54		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
$SM(u, 0, 0)$ of space group No. 54		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6)

d. Results for high-symmetry planes

$P1(0, -u, v)$

Operation	E
Coordinate	$(0, -u, v)$

P2($-v, -u, 0$)

Operation	E
Coordinate	$(-v, -u, 0)$

P3($-v, 0, u$)

Operation	E
Coordinate	$(-v, 0, u)$

P4($-\frac{1}{2}, -u, v$)

Operation	E
Coordinate	$(-\frac{1}{2}, -u, v)$

P5($-v, -u, \frac{1}{2}$)

Operation	E
Coordinate	$(-v, -u, \frac{1}{2})$

P6($-v, \frac{1}{2}, u$)

Operation	E
Coordinate	$(-v, \frac{1}{2}, u)$

P1 ($0, -u, v$) of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

P2 ($-v, -u, 0$) of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

P3 ($-v, 0, u$) of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

P4 ($-\frac{1}{2}, -u, v$) of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

P5 ($-v, -u, \frac{1}{2}$) of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

P6 ($-v, \frac{1}{2}, u$) of space group No. 54

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12)

55. Space group No. 55 (*Pbam*)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2x}|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{\sigma_y|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_x|-\frac{1}{2}, \frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate (0, 0, 0)
$Y(0, \frac{1}{2}, 0)$
Operation E
Coordinate $(0, \frac{1}{2}, 0)$
$X(\frac{1}{2}, 0, 0)$
Operation E
Coordinate $(\frac{1}{2}, 0, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$
$U(\frac{1}{2}, 0, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, 0, \frac{1}{2})$
$T(0, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$

$$S(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0) \end{array}$$

$$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

 $\Gamma (0, 0, 0)$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 8i: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 8i: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 8i: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 8i: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
6	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
8	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3)

 $Y (0, \frac{1}{2}, 0)$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (6)

 $X (\frac{1}{2}, 0, 0)$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (6)

 $Z (0, 0, \frac{1}{2})$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (1); 8i: (3)
2	(0, 0, 0)	2a: (0); 2b: (2); 2c: (0); 2d: (2); 4e: (2); 4f: (2); 4g: (1); 4h: (2); 8i: (3)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (1); 8i: (3)
4	(0, 0, 0)	2a: (0); 2b: (2); 2c: (0); 2d: (2); 4e: (2); 4f: (2); 4g: (1); 4h: (2); 8i: (3)
5	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (2); 8i: (3)
6	(0, 0, 0)	2a: (2); 2b: (0); 2c: (2); 2d: (0); 4e: (2); 4f: (2); 4g: (2); 4h: (1); 8i: (3)
7	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (2); 8i: (3)
8	(0, 0, 0)	2a: (2); 2b: (0); 2c: (2); 2d: (0); 4e: (2); 4f: (2); 4g: (2); 4h: (1); 8i: (3)

 $U (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6)

T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 55				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (2);	2b: (1);	2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6)
2	(0, 0, 0)	2a: (1);	2b: (2);	2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6)
S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 55				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (2); 2d: (2); 4e: (1); 4f: (2); 4g: (2); 4h: (2); 8i: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0); 2d: (0); 4e: (1); 4f: (2); 4g: (1); 4h: (1); 8i: (3)
4	(0, 0, 0)	2a: (2);	2b: (2);	2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 4h: (2); 8i: (3)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 55				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (1);	2c: (2); 2d: (0); 4e: (1); 4f: (2); 4g: (2); 4h: (1); 8i: (3)
2	(0, 0, 0)	2a: (0);	2b: (2);	2c: (1); 2d: (0); 4e: (2); 4f: (1); 4g: (1); 4h: (2); 8i: (3)
3	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0); 2d: (2); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 8i: (3)
4	(0, 0, 0)	2a: (2);	2b: (0);	2c: (0); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 8i: (3)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(u, 0, \frac{1}{2})$
B $(0, v, \frac{1}{2})$	
Operation	E
Coordinate	$(0, v, \frac{1}{2})$
C $(u, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
D $(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
DT $(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
E $(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$

$$G(\frac{1}{2}, 0, w)$$

Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$

$$H(0, \frac{1}{2}, w)$$

Operation	E
Coordinate	$(0, \frac{1}{2}, w)$

$$LD(0, 0, w)$$

Operation	E
Coordinate	$(0, 0, w)$

$$P(\frac{1}{2}, v, \frac{1}{2})$$

Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$

$$Q(\frac{1}{2}, \frac{1}{2}, w)$$

Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$

$$SM(u, 0, 0)$$

Operation	E
Coordinate	$(u, 0, 0)$

$A(u, 0, \frac{1}{2})$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6)
4	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6)

$B(0, v, \frac{1}{2})$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6)
3	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6)

$C(u, \frac{1}{2}, 0)$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (6)

$D(\frac{1}{2}, v, 0)$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (6)

DT (0, v , 0) of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6)

E ($u, \frac{1}{2}, \frac{1}{2}$) of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6)

G ($\frac{1}{2}, 0, w$) of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

H ($0, \frac{1}{2}, w$) of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

LD (0, 0, w) of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6)

P ($\frac{1}{2}, v, \frac{1}{2}$) of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6)

Q ($\frac{1}{2}, \frac{1}{2}, w$) of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 8i: (6)

SM ($u, 0, 0$) of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (6)

d. Results for high-symmetry planes

$P1(v, -u, 0)$	
Operation	E
Coordinate	$(v, -u, 0)$
$P2(0, -u, v)$	
Operation	E
Coordinate	$(0, -u, v)$
$P3(u, 0, v)$	
Operation	E
Coordinate	$(u, 0, v)$
$P4(v, -u, \frac{1}{2})$	
Operation	E
Coordinate	$(v, -u, \frac{1}{2})$
$P5(\frac{1}{2}, -u, v)$	
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$
$P6(u, \frac{1}{2}, v)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

$P1(v, -u, 0)$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 4e: (6); 4f: (6); 4g: (8); 4h: (8); 8i: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (6); 4f: (6); 4g: (4); 4h: (4); 8i: (12)

$P2(0, -u, v)$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

$P3(u, 0, v)$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

$P4(v, -u, \frac{1}{2})$ of space group No. 55

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (2); 2c: (4); 2d: (2); 4e: (6); 4f: (6); 4g: (8); 4h: (4); 8i: (12)
2	(0, 0, 0)	2a: (2); 2b: (4); 2c: (2); 2d: (4); 4e: (6); 4f: (6); 4g: (4); 4h: (8); 8i: (12)
P5 $(\frac{1}{2}, -u, v)$ of space group No. 55		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
P6 $(u, \frac{1}{2}, v)$ of space group No. 55		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

56. Space group No. 56 ($Pccn$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \{C_{2z}|\frac{1}{2}, -\frac{1}{2}, 0\} \{C_{2y}|0, -\frac{1}{2}, -\frac{1}{2}\} \{C_{2x}|\frac{1}{2}, 0, -\frac{1}{2}\} \{I|0, 0, 0\} \{\sigma_z|\frac{1}{2}, \frac{1}{2}, 0\} \{\sigma_y|0, -\frac{1}{2}, -\frac{1}{2}\} \{\sigma_x|\frac{1}{2}, 0, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$Y(0, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, 0)\end{array}$$

$$X(\frac{1}{2}, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$U\left(\frac{1}{2}, 0, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, 0, \frac{1}{2}\right) \end{array}$$

$$T\left(0, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(0, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$$S\left(\frac{1}{2}, \frac{1}{2}, 0\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, 0\right) \end{array}$$

$$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

 $\Gamma (0, 0, 0)$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 8e: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 4d: (2); 8e: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 8e: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 4d: (2); 8e: (3)
5	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 4d: (1); 8e: (3)
6	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 8e: (3)
7	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 4d: (1); 8e: (3)
8	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 8e: (3)

 $Y \left(0, \frac{1}{2}, 0\right)$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

 $X \left(\frac{1}{2}, 0, 0\right)$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

 $Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (4); 8e: (6)

 $U \left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 56		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 56		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (4); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (2); 8e: (6)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 56		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (0); 4c: (1); 4d: (2); 8e: (3)
2	(0, 0, 0)	4a: (3); 4b: (0); 4c: (2); 4d: (1); 8e: (3)
3	(0, 0, 0)	4a: (0); 4b: (3); 4c: (1); 4d: (2); 8e: (3)
4	(0, 0, 0)	4a: (0); 4b: (3); 4c: (2); 4d: (1); 8e: (3)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

B $(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

C $(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

D $(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

DT $(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

E $(u, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(u, \frac{1}{2}, \frac{1}{2})$

G $(\frac{1}{2}, 0, w)$

Operation E

Coordinate $(\frac{1}{2}, 0, w)$

H $(0, \frac{1}{2}, w)$

Operation E
Coordinate $(0, \frac{1}{2}, w)$

LD $(0, 0, w)$

Operation E
Coordinate $(0, 0, w)$

P $(\frac{1}{2}, v, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

Q $(\frac{1}{2}, \frac{1}{2}, w)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

SM $(u, 0, 0)$

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

B $(0, v, \frac{1}{2})$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

C $(u, \frac{1}{2}, 0)$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

D $(\frac{1}{2}, v, 0)$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

DT $(0, v, 0)$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 56

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
$G \left(\frac{1}{2}, 0, w \right)$ of space group No. 56		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
$H \left(0, \frac{1}{2}, w \right)$ of space group No. 56		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
$LD (0, 0, w)$ of space group No. 56		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (4); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (4); 8e: (6)
$P \left(\frac{1}{2}, v, \frac{1}{2} \right)$ of space group No. 56		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
$Q \left(\frac{1}{2}, \frac{1}{2}, w \right)$ of space group No. 56		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (4); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (2); 8e: (6)
$SM (u, 0, 0)$ of space group No. 56		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

d. Results for high-symmetry planes

$P1(v, -u, 0)$

Operation	E
Coordinate	$(v, -u, 0)$

P2(0, −u, v)		
Operation	E	
Coordinate	(0, −u, v)	
P3(u, 0, v)		
Operation	E	
Coordinate	(u, 0, v)	
P4(v, −u, 1/2)		
Operation	E	
Coordinate	(v, −u, 1/2)	
P5(1/2, −u, v)		
Operation	E	
Coordinate	(1/2, −u, v)	
P6(u, 1/2, v)		
Operation	E	
Coordinate	(u, 1/2, v)	

$P1(v, -u, 0)$ of space group No. 56				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
2	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
$P2(0, -u, v)$ of space group No. 56				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
2	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
$P3(u, 0, v)$ of space group No. 56				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
2	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
$P4(v, -u, \frac{1}{2})$ of space group No. 56				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
2	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
$P5(\frac{1}{2}, -u, v)$ of space group No. 56				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
2	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)
$P6(u, \frac{1}{2}, v)$ of space group No. 56				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 4d: (6); 8e: (12)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

57. Space group No. 57 ($Pbcm$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (c, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2x}|0, -\frac{1}{2}, 0\} \quad \{C_{2z}|0, 0, -\frac{1}{2}\} \quad \{C_{2y}|0, -\frac{1}{2}, \frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{\sigma_x|0, -\frac{1}{2}, 0\} \quad \{\sigma_z|0, 0, -\frac{1}{2}\} \quad \{\sigma_y|0, -\frac{1}{2}, \frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$Y(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$X(0, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, 0)\end{array}$$

$$Z(\frac{1}{2}, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, 0)\end{array}$$

$$U(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$T(\frac{1}{2}, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, \frac{1}{2})\end{array}$$

$$S(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

 $\Gamma (0, 0, 0)$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (2); 8e: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 4d: (2); 8e: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 8e: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 4d: (1); 8e: (3)
5	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 4d: (1); 8e: (3)
6	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (1); 8e: (3)
7	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 4d: (2); 8e: (3)
8	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 8e: (3)

 $Y (0, 0, \frac{1}{2})$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

 $X (0, \frac{1}{2}, 0)$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 8e: (6)

 $Z (\frac{1}{2}, 0, 0)$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (3); 4c: (1); 4d: (2); 8e: (3)
2	(0, 0, 0)	4a: (0); 4b: (3); 4c: (2); 4d: (2); 8e: (3)
3	(0, 0, 0)	4a: (0); 4b: (3); 4c: (1); 4d: (1); 8e: (3)
4	(0, 0, 0)	4a: (0); 4b: (3); 4c: (2); 4d: (1); 8e: (3)
5	(0, 0, 0)	4a: (3); 4b: (0); 4c: (1); 4d: (1); 8e: (3)
6	(0, 0, 0)	4a: (3); 4b: (0); 4c: (2); 4d: (1); 8e: (3)
7	(0, 0, 0)	4a: (3); 4b: (0); 4c: (1); 4d: (2); 8e: (3)
8	(0, 0, 0)	4a: (3); 4b: (0); 4c: (2); 4d: (2); 8e: (3)

 $U (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 8e: (6)

T $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
S $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

B $(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

C $(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

D $(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

DT $(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

E $(u, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(u, \frac{1}{2}, \frac{1}{2})$

G $(\frac{1}{2}, 0, w)$

Operation E
Coordinate $(\frac{1}{2}, 0, w)$

H $(0, \frac{1}{2}, w)$

Operation E

Coordinate $(0, \frac{1}{2}, w)$

LD(0, 0, w)

Operation E
Coordinate $(0, 0, w)$

P($\frac{1}{2}, v, \frac{1}{2}$)

Operation E
Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

Q($\frac{1}{2}, \frac{1}{2}, w$)

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

SM($u, 0, 0$)

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

B $(0, v, \frac{1}{2})$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)

C $(u, \frac{1}{2}, 0)$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 8e: (6)

D $(\frac{1}{2}, v, 0)$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 8e: (6)

DT $(0, v, 0)$ of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (2); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (4); 8e: (6)

E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)
LD $(0, 0, w)$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)
SM $(u, 0, 0)$ of space group No. 57		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (4); 8e: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 8e: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (4); 8e: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (2); 8e: (6)

d. Results for high-symmetry planes

P1(0, v, -u)

Operation	E
Coordinate	(0, v, -u)

P2($v, 0, -u$)

Operation	E
Coordinate	$(v, 0, -u)$

P3($v, u, 0$)

Operation	E
Coordinate	$(v, u, 0)$

P4($\frac{1}{2}, v, -u$)

Operation	E
Coordinate	$(\frac{1}{2}, v, -u)$

P5($v, \frac{1}{2}, -u$)

Operation	E
Coordinate	$(v, \frac{1}{2}, -u)$

P6($v, u, \frac{1}{2}$)

Operation	E
Coordinate	$(v, u, \frac{1}{2})$

P1 ($0, v, -u$) of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

P2 ($v, 0, -u$) of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

P3 ($v, u, 0$) of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (8); 8e: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (4); 8e: (12)

P4 ($\frac{1}{2}, v, -u$) of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

P5 ($v, \frac{1}{2}, -u$) of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

P6 ($v, u, \frac{1}{2}$) of space group No. 57

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12)

58. Space group No. 58 ($Pnnm$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{\sigma_y|\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$Y(0, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, 0)\end{array}$$

$$X(\frac{1}{2}, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$U(\frac{1}{2}, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, 0, \frac{1}{2})\end{array}$$

$$T(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2})\end{array}$$

$$S(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0) \end{array}$$

$$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 58							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1); 4f: (1);	4g: (2); 8h: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (2); 4f: (2);	4g: (1); 8h: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1); 4f: (1);	4g: (2); 8h: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (2); 4f: (2);	4g: (1); 8h: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1); 4f: (1);	4g: (1); 8h: (3)
6	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (2); 4f: (2);	4g: (2); 8h: (3)
7	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1); 4f: (1);	4g: (1); 8h: (3)
8	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (2); 4f: (2);	4g: (2); 8h: (3)
$Y (0, \frac{1}{2}, 0)$ of space group No. 58							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (3); 4f: (3);	4g: (4); 8h: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3); 4f: (3);	4g: (2); 8h: (6)
$X (\frac{1}{2}, 0, 0)$ of space group No. 58							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (3); 4f: (3);	4g: (4); 8h: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3); 4f: (3);	4g: (2); 8h: (6)
$Z (0, 0, \frac{1}{2})$ of space group No. 58							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2); 4f: (2);	4g: (3); 8h: (6)
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4); 4f: (4);	4g: (3); 8h: (6)
$U (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 58							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (3);	2b: (0);	2c: (3);	2d: (0);	4e: (3); 4f: (3);	4g: (3); 8h: (6)
2	(0, 0, 0)	2a: (0);	2b: (3);	2c: (0);	2d: (3);	4e: (3); 4f: (3);	4g: (3); 8h: (6)
$T (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 58							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (3);	2b: (0);	2c: (0);	2d: (3);	4e: (3); 4f: (3);	4g: (3); 8h: (6)
2	(0, 0, 0)	2a: (0);	2b: (3);	2c: (3);	2d: (0);	4e: (3); 4f: (3);	4g: (3); 8h: (6)

S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 58		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (2); 2d: (2); 4e: (1); 4f: (2); 4g: (2); 8h: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (1); 8h: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (2); 4g: (1); 8h: (3)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 8h: (3)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 58		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 8h: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 8h: (6)

c. Results for high-symmetry lines

$A(u, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(u, 0, \frac{1}{2})$
$B(0, v, \frac{1}{2})$	
Operation	E
Coordinate	$(0, v, \frac{1}{2})$
$C(u, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
$D(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
$G(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
$H(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$

LD(0, 0, w)

Operation E
Coordinate (0, 0, w)

 $P(\frac{1}{2}, v, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

 $Q(\frac{1}{2}, \frac{1}{2}, w)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

SM(u , 0, 0)

Operation E
Coordinate (u , 0, 0)

A (u , 0, $\frac{1}{2}$) of space group No. 58

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)

B (0 , v , $\frac{1}{2}$) of space group No. 58

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)

C (u , $\frac{1}{2}$, 0) of space group No. 58

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 8h: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 8h: (6)

D ($\frac{1}{2}$, v , 0) of space group No. 58

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 8h: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 8h: (6)

DT (0, v , 0) of space group No. 58

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 8h: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 8h: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 8h: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 8h: (6)

E (u , $\frac{1}{2}$, $\frac{1}{2}$) of space group No. 58

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)

$G\left(\frac{1}{2}, 0, w\right)$ of space group No. 58		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)
$H\left(0, \frac{1}{2}, w\right)$ of space group No. 58		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)
$LD(0, 0, w)$ of space group No. 58		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 8h: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 8h: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 8h: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 8h: (6)
$P\left(\frac{1}{2}, v, \frac{1}{2}\right)$ of space group No. 58		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)
$Q\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 58		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 8h: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 8h: (6)
$SM(u, 0, 0)$ of space group No. 58		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 8h: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 8h: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 8h: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 8h: (6)

d. Results for high-symmetry planes

$P1(v, -u, 0)$

Operation	E
Coordinate	$(v, -u, 0)$

$P2(0, -u, v)$

Operation	E
Coordinate	$(0, -u, v)$

$P3(u, 0, v)$

Operation	E
Coordinate	$(u, 0, v)$

$P4(v, -u, \frac{1}{2})$	
Operation	E
Coordinate	$(v, -u, \frac{1}{2})$
$P5(\frac{1}{2}, -u, v)$	
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$
$P6(u, \frac{1}{2}, v)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

P1 ($v, -u, 0$) of space group No. 58			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 4e: (6); 4f: (6); 4g: (8); 8h: (12)	
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (6); 4f: (6); 4g: (4); 8h: (12)	
P2 (0, $-u, v$) of space group No. 58			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)	
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)	
P3 ($u, 0, v$) of space group No. 58			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)	
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)	
P4 ($v, -u, \frac{1}{2}$) of space group No. 58			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)	
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)	
P5 ($\frac{1}{2}, -u, v$) of space group No. 58			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)	
P6 ($u, \frac{1}{2}, v$) of space group No. 58			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 8h: (12)	

59. Space group No. 59 ($Pmmn$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_{2y}|\frac{1}{2},-\frac{1}{2},0\} \quad \{C_{2x}|-\frac{1}{2},\frac{1}{2},0\} \quad \{I|\frac{1}{2},-\frac{1}{2},0\} \quad \{\sigma_z|-\frac{1}{2},\frac{1}{2},0\} \quad \{\sigma_y|0,0,0\} \quad \{\sigma_x|0,0,0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	$(0,0,0)$
$Y(0,\frac{1}{2},0)$	
Operation	E
Coordinate	$(0,\frac{1}{2},0)$
$X(\frac{1}{2},0,0)$	
Operation	E
Coordinate	$(\frac{1}{2},0,0)$
$Z(0,0,\frac{1}{2})$	
Operation	E
Coordinate	$(0,0,\frac{1}{2})$
$U(\frac{1}{2},0,\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},0,\frac{1}{2})$
$T(0,\frac{1}{2},\frac{1}{2})$	
Operation	E
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$
$S(\frac{1}{2},\frac{1}{2},0)$	
Operation	E
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$
$R(\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 59

(Co-) irrep

Phonon AM

WYPO information

1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (0); 4e: (2); 4f: (2); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (0); 4e: (1); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (1); 4f: (1); 8g: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (0); 4e: (2); 4f: (1); 8g: (3)
5	(0, 0, 0)	2a: (0); 2b: (0); 4c: (3); 4d: (3); 4e: (1); 4f: (1); 8g: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 4f: (1); 8g: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 4f: (2); 8g: (3)
8	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (1); 4f: (2); 8g: (3)

Y $(0, \frac{1}{2}, 0)$ of space group No. 59

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 4f: (3); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 4f: (3); 8g: (6)

X $(\frac{1}{2}, 0, 0)$ of space group No. 59

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (2); 8g: (6)

Z $(0, 0, \frac{1}{2})$ of space group No. 59

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (3); 4e: (2); 4f: (2); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (3); 4e: (1); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (3); 4e: (1); 4f: (1); 8g: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (3); 4e: (2); 4f: (1); 8g: (3)
5	(0, 0, 0)	2a: (0); 2b: (0); 4c: (3); 4d: (0); 4e: (1); 4f: (1); 8g: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (0); 4e: (2); 4f: (1); 8g: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (0); 4e: (2); 4f: (2); 8g: (3)
8	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (0); 4e: (1); 4f: (2); 8g: (3)

U $(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 59

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (2); 8g: (6)

T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 59

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 4f: (3); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 4f: (3); 8g: (6)

S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 59

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6)

R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 59

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6)

c. Results for high-symmetry lines

A($u, 0, \frac{1}{2}$)

Operation E
Coordinate ($u, 0, \frac{1}{2}$)

B($0, v, \frac{1}{2}$)

Operation E
Coordinate ($0, v, \frac{1}{2}$)

C($u, \frac{1}{2}, 0$)

Operation E
Coordinate ($u, \frac{1}{2}, 0$)

D($\frac{1}{2}, v, 0$)

Operation E
Coordinate ($\frac{1}{2}, v, 0$)

DT($0, v, 0$)

Operation E
Coordinate ($0, v, 0$)

E($u, \frac{1}{2}, \frac{1}{2}$)

Operation E
Coordinate ($u, \frac{1}{2}, \frac{1}{2}$)

G($\frac{1}{2}, 0, w$)

Operation E
Coordinate ($\frac{1}{2}, 0, w$)

H($0, \frac{1}{2}, w$)

Operation E
Coordinate ($0, \frac{1}{2}, w$)

LD($0, 0, w$)

Operation E
Coordinate ($0, 0, w$)

P($\frac{1}{2}, v, \frac{1}{2}$)

Operation E
Coordinate ($\frac{1}{2}, v, \frac{1}{2}$)

Q($\frac{1}{2}, \frac{1}{2}, w$)

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

SM($u, 0, 0$)

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 59							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (3);	4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (3);	4f: (2); 8g: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (3);	4f: (2); 8g: (6)
4	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (3);	4f: (4); 8g: (6)
B $(0, v, \frac{1}{2})$ of space group No. 59							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (4);	4f: (3); 8g: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (2);	4f: (3); 8g: (6)
3	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (4);	4f: (3); 8g: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (2);	4f: (3); 8g: (6)
C $(u, \frac{1}{2}, 0)$ of space group No. 59							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	4f: (6); 8g: (12)
D $(\frac{1}{2}, v, 0)$ of space group No. 59							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	4f: (6); 8g: (12)
DT $(0, v, 0)$ of space group No. 59							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (4);	4f: (3); 8g: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (2);	4f: (3); 8g: (6)
3	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (4);	4f: (3); 8g: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (2);	4f: (3); 8g: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 59							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	4f: (6); 8g: (12)
G $(\frac{1}{2}, 0, w)$ of space group No. 59							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (3);	4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (3);	4f: (2); 8g: (6)

$H(0, \frac{1}{2}, w)$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 4f: (3); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 4f: (3); 8g: (6)
$LD(0, 0, w)$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (3); 4d: (3); 4e: (2); 4f: (2); 8g: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (2); 4f: (4); 8g: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 4f: (2); 8g: (6)
$P(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
$Q(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6)
$SM(u, 0, 0)$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (4); 8g: (6)

d. Results for high-symmetry planes

$P1(v, -u, 0)$

Operation	E
Coordinate	$(v, -u, 0)$

$P2(0, -u, v)$

Operation	E
Coordinate	$(0, -u, v)$

$P3(u, 0, v)$

Operation	E
Coordinate	$(u, 0, v)$

$P4(v, -u, \frac{1}{2})$

Operation	E

Coordinate	$(v, -u, \frac{1}{2})$
P5	$(\frac{1}{2}, -u, v)$
Operation	E
Coordinate	$(\frac{1}{2}, -u, v)$
P6	$(u, \frac{1}{2}, v)$
Operation	E
Coordinate	$(u, \frac{1}{2}, v)$

P1 $(v, -u, 0)$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
P2 $(0, -u, v)$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 4c: (6); 4d: (6); 4e: (8); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (6); 4d: (6); 4e: (4); 4f: (6); 8g: (12)
P3 $(u, 0, v)$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 4c: (6); 4d: (6); 4e: (6); 4f: (8); 8g: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (6); 4d: (6); 4e: (6); 4f: (4); 8g: (12)
P4 $(v, -u, \frac{1}{2})$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
P5 $(\frac{1}{2}, -u, v)$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
P6 $(u, \frac{1}{2}, v)$ of space group No. 59		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

60. Space group No. 60 ($Pbcn$)

Orthorhombic primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2y}|0,0,\frac{1}{2}\} \quad \{C_{2z}|\frac{1}{2},-\frac{1}{2},\frac{1}{2}\} \quad \{C_{2x}|-\frac{1}{2},-\frac{1}{2},0\} \quad \{I|0,0,0\} \quad \{\sigma_y|0,0,-\frac{1}{2}\} \quad \{\sigma_z|\frac{1}{2},-\frac{1}{2},\frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2},-\frac{1}{2},0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	$(0,0,0)$
$Y(0,0,-\frac{1}{2})$	
Operation	E
Coordinate	$(0,0,-\frac{1}{2})$
$X(\frac{1}{2},0,0)$	
Operation	E
Coordinate	$(\frac{1}{2},0,0)$
$Z(0,\frac{1}{2},0)$	
Operation	E
Coordinate	$(0,\frac{1}{2},0)$
$U(\frac{1}{2},\frac{1}{2},0)$	
Operation	E
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$
$T(0,\frac{1}{2},-\frac{1}{2})$	
Operation	E
Coordinate	$(0,\frac{1}{2},-\frac{1}{2})$
$S(\frac{1}{2},0,-\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},0,-\frac{1}{2})$
$R(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 60

(Co-) irrep

Phonon AM

WYPO information

1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 8d: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 8d: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 8d: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 8d: (3)
5	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 8d: (3)
6	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (3)
7	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 8d: (3)
8	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (3)

Y $(0, 0, -\frac{1}{2})$ of space group No. 60

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

X $(\frac{1}{2}, 0, 0)$ of space group No. 60

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

Z $(0, \frac{1}{2}, 0)$ of space group No. 60

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)

U $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 60

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (6); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (6); 4b: (0); 4c: (3); 8d: (6)

T $(0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 60

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

S $(\frac{1}{2}, 0, -\frac{1}{2})$ of space group No. 60

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

R $(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 60

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

c. Results for high-symmetry lines

$$A(u, 0, \frac{1}{2})$$

Operation	E
Coordinate	$(u, 0, \frac{1}{2})$
$B(0, v, \frac{1}{2})$	
Operation	E
Coordinate	$(0, v, \frac{1}{2})$
$C(u, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
$D(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
$DT(0, v, 0)$	
Operation	E
Coordinate	$(0, v, 0)$
$E(u, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
$G(\frac{1}{2}, 0, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
$H(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$P(\frac{1}{2}, v, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
$Q(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$SM(u, 0, 0)$	
Operation	E
Coordinate	$(u, 0, 0)$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
B $(0, v, \frac{1}{2})$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
C $(u, \frac{1}{2}, 0)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
D $(\frac{1}{2}, v, 0)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
DT $(0, v, 0)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
LD $(0, 0, w)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 60		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
SM $(u, 0, 0)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

d. Results for high-symmetry planes

P1($v, 0, u$)		
Operation	E	
Coordinate	$(v, 0, u)$	
P2($0, v, u$)		
Operation	E	
Coordinate	$(0, v, u)$	
P3($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P4($v, \frac{1}{2}, u$)		
Operation	E	
Coordinate	$(v, \frac{1}{2}, u)$	
P5($\frac{1}{2}, v, u$)		
Operation	E	
Coordinate	$(\frac{1}{2}, v, u)$	
P6($u, v, -\frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, -\frac{1}{2})$	

P1 ($v, 0, u$) of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)

P2 $(0, v, u)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
2	$(0, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
P3 $(u, v, 0)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
2	$(0, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
P4 $(v, \frac{1}{2}, u)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
2	$(0, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
P5 $(\frac{1}{2}, v, u)$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
2	$(0, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
P6 $(u, v, -\frac{1}{2})$ of space group No. 60		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)

61. Space group No. 61 ($Pbca$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|0, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{2z}|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{2x}|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_y|0, \frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_z|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2}, \frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$

Y(0, 0, - $\frac{1}{2}$)	
Operation	E
Coordinate	(0, 0, - $\frac{1}{2}$)
X($\frac{1}{2}$, 0, 0)	
Operation	E
Coordinate	($\frac{1}{2}$, 0, 0)
Z(0, $\frac{1}{2}$, 0)	
Operation	E
Coordinate	(0, $\frac{1}{2}$, 0)
U($\frac{1}{2}$, $\frac{1}{2}$, 0)	
Operation	E
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, 0)
T(0, $\frac{1}{2}$, - $\frac{1}{2}$)	
Operation	E
Coordinate	(0, $\frac{1}{2}$, - $\frac{1}{2}$)
S($\frac{1}{2}$, 0, - $\frac{1}{2}$)	
Operation	E
Coordinate	($\frac{1}{2}$, 0, - $\frac{1}{2}$)
R($\frac{1}{2}$, $\frac{1}{2}$, - $\frac{1}{2}$)	
Operation	E
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, - $\frac{1}{2}$)

$\Gamma(0, 0, 0)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3)
5	(0, 0, 0)	4a: (3); 4b: (3); 8c: (3)
6	(0, 0, 0)	4a: (3); 4b: (3); 8c: (3)
7	(0, 0, 0)	4a: (3); 4b: (3); 8c: (3)
8	(0, 0, 0)	4a: (3); 4b: (3); 8c: (3)
$Y(0, 0, -\frac{1}{2})$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
$X(\frac{1}{2}, 0, 0)$ of space group No. 61		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
Z $(0, \frac{1}{2}, 0)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
U $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
T $(0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
S $(\frac{1}{2}, 0, -\frac{1}{2})$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
R $(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (3); 8c: (3)
2	(0, 0, 0)	4a: (3); 4b: (0); 8c: (3)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(u, 0, \frac{1}{2})$
B $(0, v, \frac{1}{2})$	
Operation	E
Coordinate	$(0, v, \frac{1}{2})$
C $(u, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(u, \frac{1}{2}, 0)$
D $(\frac{1}{2}, v, 0)$	
Operation	E
Coordinate	$(\frac{1}{2}, v, 0)$
DT $(0, v, 0)$	

Operation	E
Coordinate	$(0, v, 0)$
	$E(u, \frac{1}{2}, \frac{1}{2})$
Operation	E
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$
	$G(\frac{1}{2}, 0, w)$
Operation	E
Coordinate	$(\frac{1}{2}, 0, w)$
	$H(0, \frac{1}{2}, w)$
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$
	$LD(0, 0, w)$
Operation	E
Coordinate	$(0, 0, w)$
	$P(\frac{1}{2}, v, \frac{1}{2})$
Operation	E
Coordinate	$(\frac{1}{2}, v, \frac{1}{2})$
	$Q(\frac{1}{2}, \frac{1}{2}, w)$
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
	$SM(u, 0, 0)$
Operation	E
Coordinate	$(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6); 4b: (6); 8c: (12)
B $(0, v, \frac{1}{2})$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
C $(u, \frac{1}{2}, 0)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
2	$(0, 0, 0)$	4a: (3); 4b: (3); 8c: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 61		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12)
DT $(0, v, 0)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12)
LD $(0, 0, w)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
SM $(u, 0, 0)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6)

d. Results for high-symmetry planes

P1($v, 0, u$)		
Operation	E	
Coordinate	$(v, 0, u)$	
P2($0, v, u$)		
Operation	E	
Coordinate	$(0, v, u)$	
P3($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P4($v, \frac{1}{2}, u$)		
Operation	E	
Coordinate	$(v, \frac{1}{2}, u)$	
P5($\frac{1}{2}, v, u$)		
Operation	E	
Coordinate	$(\frac{1}{2}, v, u)$	
P6($u, v, -\frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, -\frac{1}{2})$	

P1 ($v, 0, u$) of space group No. 61			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6);	4b: (6); 8c: (12)
2	(0, 0, 0)	4a: (6);	4b: (6); 8c: (12)
P2 (0, v, u) of space group No. 61			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6);	4b: (6); 8c: (12)
2	(0, 0, 0)	4a: (6);	4b: (6); 8c: (12)
P3 ($u, v, 0$) of space group No. 61			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6);	4b: (6); 8c: (12)
2	(0, 0, 0)	4a: (6);	4b: (6); 8c: (12)
P4 ($v, \frac{1}{2}, u$) of space group No. 61			
(Co-) irrep	Phonon AM	WYPO information	

1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12)
P5 $(\frac{1}{2}, v, u)$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12)
P6 $(u, v, -\frac{1}{2})$ of space group No. 61		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12)

62. Space group No. 62 ($Pnma$)

Orthorhombic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|-\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{2y}|0, -\frac{1}{2}, 0\} \quad \{C_{2x}|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|-\frac{1}{2}, 0, \frac{1}{2}\} \quad \{\sigma_y|0, \frac{1}{2}, 0\} \quad \{\sigma_x|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate (0, 0, 0)
$Y(0, \frac{1}{2}, 0)$
Operation E
Coordinate $(0, \frac{1}{2}, 0)$
$X(\frac{1}{2}, 0, 0)$
Operation E
Coordinate $(\frac{1}{2}, 0, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$

$$U\left(\frac{1}{2}, 0, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, 0, \frac{1}{2}\right) \end{array}$$

$$T\left(0, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(0, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$$S\left(\frac{1}{2}, \frac{1}{2}, 0\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, 0\right) \end{array}$$

$$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

 $\Gamma (0, 0, 0)$ of space group No. 62

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 8d: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 4c: (2); 8d: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 8d: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 8d: (3)
5	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 8d: (3)
6	(0, 0, 0)	4a: (3); 4b: (3); 4c: (1); 8d: (3)
7	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (3)
8	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (3)

 $Y \left(0, \frac{1}{2}, 0\right)$ of space group No. 62

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

 $X \left(\frac{1}{2}, 0, 0\right)$ of space group No. 62

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)

 $Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 62

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)

 $U \left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 62

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (0); 4b: (3); 4c: (2); 8d: (3)
2	(0, 0, 0)	4a: (0); 4b: (3); 4c: (1); 8d: (3)
3	(0, 0, 0)	4a: (3); 4b: (0); 4c: (1); 8d: (3)
4	(0, 0, 0)	4a: (3); 4b: (0); 4c: (2); 8d: (3)

T $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

S $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

c. Results for high-symmetry lines

A $(u, 0, \frac{1}{2})$

Operation E
Coordinate $(u, 0, \frac{1}{2})$

B $(0, v, \frac{1}{2})$

Operation E
Coordinate $(0, v, \frac{1}{2})$

C $(u, \frac{1}{2}, 0)$

Operation E
Coordinate $(u, \frac{1}{2}, 0)$

D $(\frac{1}{2}, v, 0)$

Operation E
Coordinate $(\frac{1}{2}, v, 0)$

DT $(0, v, 0)$

Operation E
Coordinate $(0, v, 0)$

E $(u, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(u, \frac{1}{2}, \frac{1}{2})$

G $(\frac{1}{2}, 0, w)$

Operation E

Coordinate $(\frac{1}{2}, 0, w)$

$H(0, \frac{1}{2}, w)$

Operation E
Coordinate $(0, \frac{1}{2}, w)$

$LD(0, 0, w)$

Operation E
Coordinate $(0, 0, w)$

$P(\frac{1}{2}, v, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, v, \frac{1}{2})$

$Q(\frac{1}{2}, \frac{1}{2}, w)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

$SM(u, 0, 0)$

Operation E
Coordinate $(u, 0, 0)$

A $(u, 0, \frac{1}{2})$ of space group No. 62				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (4); 8d: (6)
2	(0, 0, 0)	4a: (3);	4b: (3);	4c: (2); 8d: (6)
B $(0, v, \frac{1}{2})$ of space group No. 62				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 8d: (12)
C $(u, \frac{1}{2}, 0)$ of space group No. 62				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3); 8d: (6)
D $(\frac{1}{2}, v, 0)$ of space group No. 62				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6); 8d: (12)
DT $(0, v, 0)$ of space group No. 62				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3); 8d: (6)
3	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3); 8d: (6)
4	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3); 8d: (6)

E $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
G $(\frac{1}{2}, 0, w)$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)
H $(0, \frac{1}{2}, w)$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
LD $(0, 0, w)$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)
P $(\frac{1}{2}, v, \frac{1}{2})$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
Q $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
SM $(u, 0, 0)$ of space group No. 62		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6)

d. Results for high-symmetry planes

P1($v, -u, 0$)

Operation	E
Coordinate	($v, -u, 0$)

P2($0, -u, v$)

Operation E
Coordinate $(0, -u, v)$

P3($u, 0, v$)

Operation E
Coordinate $(u, 0, v)$

P4($v, -u, \frac{1}{2}$)

Operation E
Coordinate $(v, -u, \frac{1}{2})$

P5($\frac{1}{2}, -u, v$)

Operation E
Coordinate $(\frac{1}{2}, -u, v)$

P6($u, \frac{1}{2}, v$)

Operation E
Coordinate $(u, \frac{1}{2}, v)$

P1 ($v, -u, 0$) of space group No. 62

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)

P2 ($0, -u, v$) of space group No. 62

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)

P3 ($u, 0, v$) of space group No. 62

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (8); 8d: (12)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (4); 8d: (12)

P4 ($v, -u, \frac{1}{2}$) of space group No. 62

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)

P5 ($\frac{1}{2}, -u, v$) of space group No. 62

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)

P6 ($u, \frac{1}{2}, v$) of space group No. 62

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)

63. Space group No. 63 ($Cmcm$)

Orthorhombic base-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{C_{2y}|0, 0, \frac{1}{2}\} \quad \{C_{2x}|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, \frac{1}{2}\} \quad \{\sigma_y|0, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$

Operation E
Coordinate (0, 0, 0)

$Y(\frac{1}{2}, \frac{1}{2}, 0)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$

$Z(0, 0, \frac{1}{2})$

Operation E
Coordinate $(0, 0, \frac{1}{2})$

$T(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$S(0, \frac{1}{2}, 0)$

Operation E C_{2y}
Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

$R(0, \frac{1}{2}, \frac{1}{2})$

Operation E C_{2y}
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, -\frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 63									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	8d: (0);	8e: (1);	8f: (2);	8g: (2);	16h: (3)
2	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	8d: (0);	8e: (2);	8f: (1);	8g: (1);	16h: (3)
3	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	8d: (0);	8e: (2);	8f: (1);	8g: (2);	16h: (3)
4	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	8d: (0);	8e: (1);	8f: (2);	8g: (1);	16h: (3)
5	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	8d: (3);	8e: (1);	8f: (1);	8g: (1);	16h: (3)
6	(0, 0, 0)	4a: (2);	4b: (2);	4c: (1);	8d: (3);	8e: (2);	8f: (2);	8g: (2);	16h: (3)
7	(0, 0, 0)	4a: (2);	4b: (2);	4c: (1);	8d: (3);	8e: (2);	8f: (2);	8g: (1);	16h: (3)
8	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	8d: (3);	8e: (1);	8f: (1);	8g: (2);	16h: (3)
$Y (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 63									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	8d: (3);	8e: (1);	8f: (2);	8g: (2);	16h: (3)
2	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	8d: (3);	8e: (2);	8f: (1);	8g: (1);	16h: (3)
3	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	8d: (3);	8e: (2);	8f: (1);	8g: (2);	16h: (3)
4	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	8d: (3);	8e: (1);	8f: (2);	8g: (1);	16h: (3)
5	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	8d: (0);	8e: (1);	8f: (1);	8g: (1);	16h: (3)
6	(0, 0, 0)	4a: (2);	4b: (2);	4c: (1);	8d: (0);	8e: (2);	8f: (2);	8g: (2);	16h: (3)
7	(0, 0, 0)	4a: (2);	4b: (2);	4c: (1);	8d: (0);	8e: (2);	8f: (2);	8g: (1);	16h: (3)
8	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	8d: (0);	8e: (1);	8f: (1);	8g: (2);	16h: (3)
$Z (0, 0, \frac{1}{2})$ of space group No. 63									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (2);	4b: (2);	4c: (2);	8d: (3);	8e: (3);	8f: (4);	8g: (3);	16h: (6)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	8d: (3);	8e: (3);	8f: (2);	8g: (3);	16h: (6)
$T (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 63									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (2);	4b: (2);	4c: (2);	8d: (3);	8e: (3);	8f: (4);	8g: (3);	16h: (6)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	8d: (3);	8e: (3);	8f: (2);	8g: (3);	16h: (6)
$S (0, \frac{1}{2}, 0)$ of space group No. 63									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (0);	4b: (3);	4c: (2);	8d: (3);	8e: (3);	8f: (3);	8g: (4);	16h: (6)
2	(0, 0, 0)	4a: (3);	4b: (0);	4c: (1);	8d: (3);	8e: (3);	8f: (3);	8g: (2);	16h: (6)
3	(0, 0, 0)	4a: (0);	4b: (3);	4c: (1);	8d: (3);	8e: (3);	8f: (3);	8g: (2);	16h: (6)
4	(0, 0, 0)	4a: (3);	4b: (0);	4c: (2);	8d: (3);	8e: (3);	8f: (3);	8g: (4);	16h: (6)
$R (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 63									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	8d: (6);	8e: (6);	8f: (6);	8g: (6);	16h: (12)

c. Results for high-symmetry lines

$A\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$		
Operation	E	
Coordinate	$\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$	
$B\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$		
Operation	E	
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$	
$D\left(0, \frac{1}{2}, w\right)$		
Operation	E	C_{2y}
Coordinate	$\left(0, \frac{1}{2}, w\right)$	$\left(-\frac{1}{2}, 0, -w\right)$
$DT\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$		
Operation	E	
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$	
$H\left(\frac{1}{2}, \frac{1}{2}, w\right)$		
Operation	E	
Coordinate	$\left(\frac{1}{2}, \frac{1}{2}, w\right)$	
$LD(0, 0, w)$		
Operation	E	
Coordinate	$\left(0, 0, w\right)$	
$SM\left(\frac{u}{2}, \frac{u}{2}, 0\right)$		
Operation	E	
Coordinate	$\left(\frac{u}{2}, \frac{u}{2}, 0\right)$	

A $\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$ of space group No. 63				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 16h: (12)
B $\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$ of space group No. 63				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (2);	4b: (2);	4c: (2); 8d: (3); 8e: (3); 8f: (4); 8g: (3); 16h: (6)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1); 8d: (3); 8e: (3); 8f: (2); 8g: (3); 16h: (6)
D $\left(0, \frac{1}{2}, w\right)$ of space group No. 63				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 16h: (12)
2	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 16h: (12)
DT $\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$ of space group No. 63				
(Co-) irrep	Phonon AM	WYPO information		

1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (3); 8e: (3); 8f: (4); 8g: (4); 16h: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 8d: (3); 8e: (3); 8f: (2); 8g: (2); 16h: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (3); 8e: (3); 8f: (4); 8g: (2); 16h: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 8d: (3); 8e: (3); 8f: (2); 8g: (4); 16h: (6)

H $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 63		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (3); 8e: (3); 8f: (4); 8g: (3); 16h: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 8d: (3); 8e: (3); 8f: (2); 8g: (3); 16h: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 8d: (3); 8e: (3); 8f: (2); 8g: (3); 16h: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (3); 8e: (3); 8f: (4); 8g: (3); 16h: (6)

LD (0, 0, w) of space group No. 63		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (3); 8e: (3); 8f: (4); 8g: (3); 16h: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 8d: (3); 8e: (3); 8f: (2); 8g: (3); 16h: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 8d: (3); 8e: (3); 8f: (2); 8g: (3); 16h: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (3); 8e: (3); 8f: (4); 8g: (3); 16h: (6)

SM $(\frac{u}{2}, \frac{u}{2}, 0)$ of space group No. 63		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 8d: (3); 8e: (2); 8f: (3); 8g: (4); 16h: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 8d: (3); 8e: (2); 8f: (3); 8g: (2); 16h: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (3); 8e: (4); 8f: (3); 8g: (4); 16h: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 8d: (3); 8e: (4); 8f: (3); 8g: (2); 16h: (6)

d. Results for high-symmetry planes

P1(u, u, v)

Operation	E
Coordinate	(u, u, v)

P2($u, -u, v$)

Operation	E
Coordinate	$(u, -u, v)$

P3($u, v, 0$)

Operation	E
Coordinate	$(u, v, 0)$

P4($u, v, \frac{1}{2}$)

Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 (u, u, v) of space group No. 63		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 16h: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 16h: (12)

P2 ($u, -u, v$) of space group No. 63		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (4); 4b: (4); 4c: (4); 8d: (6); 8e: (6); 8f: (8); 8g: (6); 16h: (12)
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (6); 8e: (6); 8f: (4); 8g: (6); 16h: (12)

P3 ($u, v, 0$) of space group No. 63		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 8d: (6); 8e: (6); 8f: (6); 8g: (8); 16h: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 8d: (6); 8e: (6); 8f: (6); 8g: (4); 16h: (12)

P4 ($u, v, \frac{1}{2}$) of space group No. 63		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 16h: (12)

64. Space group No. 64 ($Cmca$)

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{C_{2y}|\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{C_{2x}|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_y|\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation	E
Coordinate	(0, 0, 0)

$$Y(\frac{1}{2}, \frac{1}{2}, 0)$$

Operation	E

Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
Z	$(0, 0, \frac{1}{2})$
Operation	E
Coordinate	$(0, 0, \frac{1}{2})$
T	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
S	$(0, \frac{1}{2}, 0)$
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$
	$(-\frac{1}{2}, 0, 0)$
R	$(0, \frac{1}{2}, \frac{1}{2})$
Operation	E
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$
	$(-\frac{1}{2}, 0, -\frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 64

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (1); 8e: (1); 8f: (2); 16g: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (2); 8e: (1); 8f: (1); 16g: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (2); 8e: (2); 8f: (1); 16g: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (1); 8e: (2); 8f: (2); 16g: (3)
5	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (1); 8e: (1); 8f: (1); 16g: (3)
6	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (2); 8e: (1); 8f: (2); 16g: (3)
7	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (2); 8e: (2); 8f: (2); 16g: (3)
8	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (1); 8e: (2); 8f: (1); 16g: (3)

$Y (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 64

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3); 8d: (1); 8e: (1); 8f: (2); 16g: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3); 8d: (2); 8e: (1); 8f: (1); 16g: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3); 8d: (2); 8e: (2); 8f: (1); 16g: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3); 8d: (1); 8e: (2); 8f: (2); 16g: (3)
5	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (1); 8e: (1); 8f: (1); 16g: (3)
6	(0, 0, 0)	4a: (2); 4b: (2); 8c: (0); 8d: (2); 8e: (1); 8f: (2); 16g: (3)
7	(0, 0, 0)	4a: (2); 4b: (2); 8c: (0); 8d: (2); 8e: (2); 8f: (2); 16g: (3)
8	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (1); 8e: (2); 8f: (1); 16g: (3)

$Z (0, 0, \frac{1}{2})$ of space group No. 64

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (4); 16g: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (2); 16g: (6)

$T (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 64

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (4); 16g: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (2); 16g: (6)
S $(0, \frac{1}{2}, 0)$ of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (3); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 16g: (6)
2	(0, 0, 0)	4a: (3); 4b: (0); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 16g: (6)

c. Results for high-symmetry lines

A $(\frac{u}{2}, \frac{u}{2}, \frac{1}{2})$

Operation E
Coordinate $(\frac{u}{2}, \frac{u}{2}, \frac{1}{2})$

B $(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$

Operation E
Coordinate $(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$

D $(0, \frac{1}{2}, w)$

Operation E C_{2y}
Coordinate $(0, \frac{1}{2}, w)$ $(-\frac{1}{2}, 0, -w)$

DT $(-\frac{v}{2}, \frac{v}{2}, 0)$

Operation E
Coordinate $(-\frac{v}{2}, \frac{v}{2}, 0)$

H $(\frac{1}{2}, \frac{1}{2}, w)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

LD $(0, 0, w)$

Operation E
Coordinate $(0, 0, w)$

SM $(\frac{u}{2}, \frac{u}{2}, 0)$

Operation E
Coordinate $(\frac{u}{2}, \frac{u}{2}, 0)$

A $\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$ of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
B $\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$ of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (4); 16g: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (2); 16g: (6)
D $\left(0, \frac{1}{2}, w\right)$ of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
DT $\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$ of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (2); 8f: (4); 16g: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 8f: (2); 16g: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (4); 8f: (4); 16g: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (4); 8f: (2); 16g: (6)
H $\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (2); 16g: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (4); 16g: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (4); 16g: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (2); 16g: (6)
LD $(0, 0, w)$ of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (4); 16g: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (2); 16g: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (2); 16g: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (4); 16g: (6)
SM $\left(\frac{u}{2}, \frac{u}{2}, 0\right)$ of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (2); 8e: (3); 8f: (3); 16g: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (2); 8e: (3); 8f: (3); 16g: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (4); 8e: (3); 8f: (3); 16g: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (4); 8e: (3); 8f: (3); 16g: (6)

d. Results for high-symmetry planes

$$\text{Pl}(u, u, v)$$

Operation	E
Coordinate	(u, u, v)
P2($u, -u, v$)	
Operation	E
Coordinate	$(u, -u, v)$
P3($u, v, 0$)	
Operation	E
Coordinate	$(u, v, 0)$
P4($u, v, \frac{1}{2}$)	
Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 (u, u, v) of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
P2 ($u, -u, v$) of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (4); 4b: (4); 8c: (6); 8d: (6); 8e: (6); 8f: (8); 16g: (12)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (6); 8d: (6); 8e: (6); 8f: (4); 16g: (12)
P3 ($u, v, 0$) of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
P4 ($u, v, \frac{1}{2}$) of space group No. 64		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)

65. Space group No. 65 ($Cmmm$)

Orthorhombic base-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$Y(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$T(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$S(0, \frac{1}{2}, 0)$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, -\frac{1}{2})$

Γ (0, 0, 0) of space group No. 65												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 8m: (1);	2c: (0); 8n: (2);	2d: (0); 8o: (2);	4e: (0); 8p: (2);	4f: (0); 8q: (2);	4g: (1); 16r: (3)	4h: (1);	4i: (1);	4j: (1);	4k: (1);
2	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 8m: (2);	2c: (0); 8n: (1);	2d: (0); 8o: (2);	4e: (0); 8p: (1);	4f: (0); 8q: (1);	4g: (1); 16r: (3)	4h: (1);	4i: (0);	4j: (0);	4k: (1);
3	(0, 0, 0)	2a: (0); 4l: (0);	2b: (0); 8m: (1);	2c: (0); 8n: (1);	2d: (0); 8o: (1);	4e: (0); 8p: (2);	4f: (0); 8q: (2);	4g: (1); 16r: (3)	4h: (1);	4i: (1);	4j: (1);	4k: (0);
4	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 8m: (2);	2c: (0); 8n: (2);	2d: (0); 8o: (1);	4e: (0); 8p: (1);	4f: (0); 8q: (1);	4g: (0); 16r: (3)	4h: (0);	4i: (1);	4j: (1);	4k: (1);
5	(0, 0, 0)	2a: (0); 4l: (0);	2b: (0); 8m: (1);	2c: (0); 8n: (1);	2d: (0); 8o: (1);	4e: (1); 8p: (1);	4f: (1); 8q: (1);	4g: (0); 16r: (3)	4h: (0);	4i: (0);	4j: (0);	4k: (0);
6	(0, 0, 0)	2a: (1); 4l: (1);	2b: (1); 8m: (2);	2c: (1); 8n: (2);	2d: (1); 8o: (1);	4e: (2); 8p: (2);	4f: (2); 8q: (2);	4g: (1); 16r: (3)	4h: (1);	4i: (1);	4j: (1);	4k: (1);
7	(0, 0, 0)	2a: (1); 4l: (1);	2b: (1); 8m: (1);	2c: (1); 8n: (2);	2d: (1); 8o: (2);	4e: (1); 8p: (1);	4f: (1); 8q: (1);	4g: (1); 16r: (3)	4h: (1);	4i: (1);	4j: (1);	4k: (1);

8	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (2); 8n: (1); 8o: (2); 8p: (2); 8q: (2); 16r: (3)

$Y \left(\frac{1}{2}, \frac{1}{2}, 0 \right)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (2); 8n: (2); 8o: (2); 8p: (2); 8q: (2); 16r: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (0); 4j: (0); 4k: (1); 4l: (1); 8m: (1); 8n: (1); 8o: (2); 8p: (1); 8q: (1); 16r: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (0); 4l: (0); 8m: (2); 8n: (1); 8o: (1); 8p: (2); 8q: (2); 16r: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (0); 4h: (0); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (1); 8n: (2); 8o: (1); 8p: (1); 8q: (1); 16r: (3)
5	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 4g: (0); 4h: (0); 4i: (0); 4j: (0); 4k: (0); 4l: (0); 8m: (2); 8n: (1); 8o: (1); 8p: (1); 8q: (1); 16r: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (0); 4f: (0); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (1); 8n: (2); 8o: (1); 8p: (2); 8q: (2); 16r: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (0); 4f: (0); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (2); 8n: (2); 8o: (2); 8p: (1); 8q: (1); 16r: (3)
8	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (0); 4f: (0); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (1); 8n: (1); 8o: (2); 8p: (2); 8q: (2); 16r: (3)

$Z \left(0, 0, \frac{1}{2} \right)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (0); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (1); 8n: (2); 8o: (2); 8p: (2); 8q: (1); 16r: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (0); 4f: (2); 4g: (1); 4h: (1); 4i: (0); 4j: (1); 4k: (1); 4l: (1); 8m: (2); 8n: (1); 8o: (2); 8p: (1); 8q: (2); 16r: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (1); 4g: (1); 4h: (0); 4i: (1); 4j: (0); 4k: (0); 4l: (0); 8m: (1); 8n: (1); 8o: (1); 8p: (2); 8q: (1); 16r: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (0); 4f: (2); 4g: (0); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (2); 8n: (2); 8o: (1); 8p: (1); 8q: (2); 16r: (3)
5	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (0); 4g: (0); 4h: (1); 4i: (0); 4j: (1); 4k: (0); 4l: (0); 8m: (1); 8n: (1); 8o: (1); 8p: (1); 8q: (2); 16r: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (0); 4g: (1); 4h: (0); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (2); 8n: (2); 8o: (1); 8p: (2); 8q: (1); 16r: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (0); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (1); 8n: (2); 8o: (2); 8p: (1); 8q: (2); 16r: (3)
8	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (0); 4g: (1); 4h: (1); 4i: (1); 4j: (0); 4k: (1); 4l: (1); 8m: (2); 8n: (1); 8o: (2); 8p: (2); 8q: (1); 16r: (3)

$T \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (0); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (2); 8n: (2); 8o: (2); 8p: (2); 8q: (1); 16r: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (0); 4g: (1); 4h: (1); 4i: (0); 4j: (1); 4k: (1); 4l: (1); 8m: (1); 8n: (1); 8o: (2); 8p: (1); 8q: (2); 16r: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (0); 4g: (1); 4h: (0); 4i: (1); 4j: (0); 4k: (0); 4l: (0); 8m: (2); 8n: (1); 8o: (1); 8p: (2); 8q: (1); 16r: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (0); 4g: (0); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (1); 8n: (2); 8o: (1); 8p: (1); 8q: (2); 16r: (3)

5	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (2); 4g: (0); 4h: (1); 4i: (0); 4j: (1); 4k: (0); 4l: (0); 8m: (2); 8n: (1); 8o: (1); 8p: (1); 8q: (2); 16r: (3)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (0); 4f: (1); 4g: (1); 4h: (0); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (1); 8n: (2); 8o: (1); 8p: (2); 8q: (1); 16r: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (0); 4f: (2); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (2); 8n: (2); 8o: (2); 8p: (1); 8q: (2); 16r: (3)
8	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (0); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (0); 4k: (1); 4l: (1); 8m: (1); 8n: (1); 8o: (2); 8p: (2); 8q: (1); 16r: (3)

$S\left(0, \frac{1}{2}, 0\right)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (2); 2c: (2); 2d: (0); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 8m: (3); 8n: (3); 8o: (3); 8p: (4); 8q: (4); 16r: (6)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (2); 8m: (3); 8n: (3); 8o: (3); 8p: (2); 8q: (2); 16r: (6)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (2); 4l: (1); 8m: (3); 8n: (3); 8o: (3); 8p: (2); 8q: (2); 16r: (6)
4	(0, 0, 0)	2a: (2); 2b: (0); 2c: (0); 2d: (2); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (1); 8m: (3); 8n: (3); 8o: (3); 8p: (4); 8q: (4); 16r: (6)

$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (2); 2c: (0); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 4k: (1); 4l: (2); 8m: (3); 8n: (3); 8o: (3); 8p: (4); 8q: (2); 16r: (6)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (2); 2d: (0); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (1); 4l: (2); 8m: (3); 8n: (3); 8o: (3); 8p: (2); 8q: (4); 16r: (6)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (2); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (2); 4l: (1); 8m: (3); 8n: (3); 8o: (3); 8p: (2); 8q: (4); 16r: (6)
4	(0, 0, 0)	2a: (2); 2b: (0); 2c: (1); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 8m: (3); 8n: (3); 8o: (3); 8p: (4); 8q: (2); 16r: (6)

c. Results for high-symmetry lines

$$A\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$$

Operation	E
Coordinate	$\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$

$$B\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$$

Operation	E
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$

$$D\left(0, \frac{1}{2}, w\right)$$

Operation	E	C_{2y}
Coordinate	$\left(0, \frac{1}{2}, w\right)$	$\left(-\frac{1}{2}, 0, -w\right)$

$$DT\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$$

Operation	E
Coordinate	$\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$

$H(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$SM(\frac{u}{2}, \frac{u}{2}, 0)$	
Operation	E
Coordinate	$(\frac{u}{2}, \frac{u}{2}, 0)$

$A(\frac{u}{2}, \frac{u}{2}, \frac{1}{2})$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (2); 8m: (3); 8n: (3); 8o: (4); 8p: (4); 8q: (2); 16r: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (0); 4h: (2); 4i: (1); 4j: (2); 4k: (1); 4l: (1); 8m: (3); 8n: (3); 8o: (2); 8p: (2); 8q: (4); 16r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 4h: (0); 4i: (2); 4j: (1); 4k: (1); 4l: (1); 8m: (3); 8n: (3); 8o: (2); 8p: (4); 8q: (2); 16r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (2); 4k: (2); 4l: (2); 8m: (3); 8n: (3); 8o: (4); 8p: (2); 8q: (4); 16r: (6)

$B(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (3); 8n: (4); 8o: (3); 8p: (4); 8q: (2); 16r: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 4i: (0); 4j: (2); 4k: (1); 4l: (1); 8m: (3); 8n: (2); 8o: (3); 8p: (2); 8q: (4); 16r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (3); 8n: (4); 8o: (3); 8p: (2); 8q: (4); 16r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 4i: (2); 4j: (0); 4k: (1); 4l: (1); 8m: (3); 8n: (2); 8o: (3); 8p: (4); 8q: (2); 16r: (6)

$D(0, \frac{1}{2}, w)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (4); 8m: (6); 8n: (6); 8o: (6); 8p: (6); 8q: (6); 16r: (12)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 8m: (6); 8n: (6); 8o: (6); 8p: (6); 8q: (6); 16r: (12)

$DT(-\frac{v}{2}, \frac{v}{2}, 0)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (3); 8n: (4); 8o: (3); 8p: (4); 8q: (4); 16r: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (0); 4j: (0); 4k: (1); 4l: (1); 8m: (3); 8n: (2); 8o: (3); 8p: (2); 8q: (2); 16r: (6)

3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (3); 8n: (4); 8o: (3); 8p: (2); 8q: (2); 16r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (1); 8m: (3); 8n: (2); 8o: (3); 8p: (4); 8q: (4); 16r: (6)

$H\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (4); 8n: (4); 8o: (4); 8p: (3); 8q: (3); 16r: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (0); 4l: (0); 8m: (4); 8n: (2); 8o: (2); 8p: (3); 8q: (3); 16r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 4l: (2); 8m: (2); 8n: (2); 8o: (4); 8p: (3); 8q: (3); 16r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (2); 8n: (4); 8o: (2); 8p: (3); 8q: (3); 16r: (6)

$LD(0, 0, w)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (2); 8n: (4); 8o: (4); 8p: (3); 8q: (3); 16r: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (0); 4l: (0); 8m: (2); 8n: (2); 8o: (2); 8p: (3); 8q: (3); 16r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 4l: (2); 8m: (4); 8n: (2); 8o: (4); 8p: (3); 8q: (3); 16r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (4); 8n: (4); 8o: (2); 8p: (3); 8q: (3); 16r: (6)

$SM\left(\frac{u}{2}, \frac{u}{2}, 0\right)$ of space group No. 65

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 8m: (3); 8n: (3); 8o: (4); 8p: (4); 8q: (4); 16r: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (0); 4h: (0); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 8m: (3); 8n: (3); 8o: (2); 8p: (2); 8q: (2); 16r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (1); 8m: (3); 8n: (3); 8o: (2); 8p: (4); 8q: (4); 16r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 4l: (2); 8m: (3); 8n: (3); 8o: (4); 8p: (2); 8q: (2); 16r: (6)

d. Results for high-symmetry planes

$P1(u, u, v)$

Operation E
Coordinate (u, u, v)

$P2(u, -u, v)$

Operation E
Coordinate $(u, -u, v)$

$P3(u, v, 0)$

Operation	E
Coordinate	$(u, v, 0)$
	$P4(u, v, \frac{1}{2})$
Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 (u, u, v) of space group No. 65											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2); 4l: (4);	2b: (2); 8m: (6);	2c: (2); 8n: (6);	2d: (2); 8o: (8);	4e: (3); 8p: (6);	4f: (3); 8q: (6);	4g: (4); 16r: (12)	4h: (4);	4i: (3);	4j: (3); 4k: (4);
2	(0, 0, 0)	2a: (1); 4l: (2);	2b: (1); 8m: (6);	2c: (1); 8n: (6);	2d: (1); 8o: (4);	4e: (3); 8p: (6);	4f: (3); 8q: (6);	4g: (2); 16r: (12)	4h: (2);	4i: (3);	4j: (3); 4k: (2);
P2 ($u, -u, v$) of space group No. 65											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2); 4l: (4);	2b: (2); 8m: (6);	2c: (2); 8n: (8);	2d: (2); 8o: (6);	4e: (3); 8p: (6);	4f: (3); 8q: (6);	4g: (3); 16r: (12)	4h: (3);	4i: (4);	4j: (4); 4k: (4);
2	(0, 0, 0)	2a: (1); 4l: (2);	2b: (1); 8m: (6);	2c: (1); 8n: (4);	2d: (1); 8o: (6);	4e: (3); 8p: (6);	4f: (3); 8q: (6);	4g: (3); 16r: (12)	4h: (3);	4i: (2);	4j: (2); 4k: (2);
P3 ($u, v, 0$) of space group No. 65											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2); 4l: (3);	2b: (2); 8m: (6);	2c: (2); 8n: (6);	2d: (2); 8o: (6);	4e: (4); 8p: (8);	4f: (4); 8q: (8);	4g: (4); 16r: (12)	4h: (4);	4i: (4);	4j: (4); 4k: (3);
2	(0, 0, 0)	2a: (1); 4l: (3);	2b: (1); 8m: (6);	2c: (1); 8n: (6);	2d: (1); 8o: (6);	4e: (2); 8p: (4);	4f: (2); 8q: (4);	4g: (2); 16r: (12)	4h: (2);	4i: (2);	4j: (2); 4k: (3);
P4 ($u, v, \frac{1}{2}$) of space group No. 65											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2); 4l: (3);	2b: (2); 8m: (6);	2c: (1); 8n: (6);	2d: (1); 8o: (6);	4e: (4); 8p: (8);	4f: (2); 8q: (4);	4g: (4); 16r: (12)	4h: (2);	4i: (4);	4j: (2); 4k: (3);
2	(0, 0, 0)	2a: (1); 4l: (3);	2b: (1); 8m: (6);	2c: (2); 8n: (6);	2d: (2); 8o: (6);	4e: (2); 8p: (4);	4f: (4); 8q: (8);	4g: (2); 16r: (12)	4h: (4);	4i: (2);	4j: (4); 4k: (3);

66. Space group No. 66 (C_{ccm})

Orthorhombic base-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_{2y}|0,0,-\frac{1}{2}\} \quad \{C_{2x}|0,0,-\frac{1}{2}\} \quad \{I|0,0,0\} \quad \{\sigma_z|0,0,0\} \quad \{\sigma_y|0,0,-\frac{1}{2}\} \quad \{\sigma_x|0,0,-\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$
Operation E
Coordinate (0,0,0)
$Y(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$
$T(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$S(0, \frac{1}{2}, 0)$
Operation E C_{2y}
Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E C_{2y}
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, -\frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 66		
(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 4e: (0); 4f: (0); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 8k: (1); 8l: (2); 16m: (3)
2	(0,0,0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 4e: (0); 4f: (0); 8g: (2); 8h: (1); 8i: (2); 8j: (2); 8k: (2); 8l: (1); 16m: (3)
3	(0,0,0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 4e: (0); 4f: (0); 8g: (2); 8h: (2); 8i: (1); 8j: (1); 8k: (1); 8l: (2); 16m: (3)
4	(0,0,0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 4e: (0); 4f: (0); 8g: (1); 8h: (2); 8i: (2); 8j: (2); 8k: (2); 8l: (1); 16m: (3)
5	(0,0,0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 8k: (1); 8l: (1); 16m: (3)
6	(0,0,0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (2); 8h: (1); 8i: (2); 8j: (2); 8k: (2); 8l: (2); 16m: (3)
7	(0,0,0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (2); 8h: (2); 8i: (1); 8j: (1); 8k: (1); 8l: (1); 16m: (3)

8	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (1); 8h: (2); 8i: (2); 8j: (2); 8k: (2); 8l: (2); 16m: (3)

 $Y \left(\frac{1}{2}, \frac{1}{2}, 0 \right)$ of space group No. 66

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 4e: (2); 4f: (2); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 8k: (2); 8l: (2); 16m: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 4e: (1); 4f: (1); 8g: (2); 8h: (1); 8i: (2); 8j: (2); 8k: (1); 8l: (1); 16m: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 4e: (2); 4f: (2); 8g: (2); 8h: (2); 8i: (1); 8j: (1); 8k: (2); 8l: (2); 16m: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 4e: (1); 4f: (1); 8g: (1); 8h: (2); 8i: (2); 8j: (2); 8k: (1); 8l: (1); 16m: (3)
5	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 4e: (0); 4f: (0); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 8k: (2); 8l: (1); 16m: (3)
6	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (0); 4f: (0); 8g: (2); 8h: (1); 8i: (2); 8j: (2); 8k: (1); 8l: (2); 16m: (3)
7	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (0); 4f: (0); 8g: (2); 8h: (2); 8i: (1); 8j: (1); 8k: (2); 8l: (1); 16m: (3)
8	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (0); 4f: (0); 8g: (1); 8h: (2); 8i: (2); 8j: (2); 8k: (1); 8l: (2); 16m: (3)

 $Z \left(0, 0, \frac{1}{2} \right)$ of space group No. 66

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (3); 8h: (3); 8i: (2); 8j: (2); 8k: (2); 8l: (3); 16m: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (4); 8j: (4); 8k: (4); 8l: (3); 16m: (6)

 $T \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 66

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (2); 8j: (2); 8k: (4); 8l: (3); 16m: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (1); 4f: (1); 8g: (3); 8h: (3); 8i: (4); 8j: (4); 8k: (2); 8l: (3); 16m: (6)

 $S \left(0, \frac{1}{2}, 0 \right)$ of space group No. 66

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (0); 4d: (4); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (2); 8j: (4); 8k: (3); 8l: (4); 16m: (6)
2	(0, 0, 0)	4a: (1); 4b: (2); 4c: (2); 4d: (0); 4e: (1); 4f: (1); 8g: (3); 8h: (3); 8i: (2); 8j: (4); 8k: (3); 8l: (2); 16m: (6)
3	(0, 0, 0)	4a: (2); 4b: (1); 4c: (0); 4d: (2); 4e: (1); 4f: (1); 8g: (3); 8h: (3); 8i: (4); 8j: (2); 8k: (3); 8l: (2); 16m: (6)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (4); 4d: (0); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (4); 8j: (2); 8k: (3); 8l: (4); 16m: (6)

 $R \left(0, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 66

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 4e: (3); 4f: (0); 8g: (3); 8h: (3); 8i: (2); 8j: (4); 8k: (3); 8l: (3); 16m: (6)
2	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 4e: (0); 4f: (3); 8g: (3); 8h: (3); 8i: (2); 8j: (4); 8k: (3); 8l: (3); 16m: (6)
3	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 4e: (3); 4f: (0); 8g: (3); 8h: (3); 8i: (4); 8j: (2); 8k: (3); 8l: (3); 16m: (6)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 4e: (0); 4f: (3); 8g: (3); 8h: (3); 8i: (4); 8j: (2); 8k: (3); 8l: (3); 16m: (6)

c. Results for high-symmetry lines

$A(\frac{u}{2}, \frac{u}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{1}{2})$	
$B(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$	
$D(0, \frac{1}{2}, w)$		
Operation	E	C_{2y}
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, -w)$
$DT(-\frac{v}{2}, \frac{v}{2}, 0)$		
Operation	E	
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, 0)$	
$H(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$LD(0, 0, w)$		
Operation	E	
Coordinate	$(0, 0, w)$	
$SM(\frac{u}{2}, \frac{u}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{u}{2}, \frac{u}{2}, 0)$	

$A\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$ of space group No. 66		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 16m: (12)
$B\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$ of space group No. 66		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 16m: (12)
D $(0, \frac{1}{2}, w)$ of space group No. 66		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (4); 4c: (2); 4d: (4); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (4); 8j: (8); 8k: (6); 8l: (6); 16m: (12)
2	(0, 0, 0)	4a: (4); 4b: (2); 4c: (4); 4d: (2); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (8); 8j: (4); 8k: (6); 8l: (6); 16m: (12)
DT $(-\frac{v}{2}, \frac{v}{2}, 0)$ of space group No. 66		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (3); 8h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (4); 16m: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (3); 8h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (2); 16m: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (3); 8h: (4); 8i: (3); 8j: (3); 8k: (3); 8l: (2); 16m: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (3); 8h: (4); 8i: (3); 8j: (3); 8k: (3); 8l: (4); 16m: (6)
H $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 66		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (2); 8j: (2); 8k: (4); 8l: (3); 16m: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (2); 8j: (2); 8k: (4); 8l: (3); 16m: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (1); 4f: (1); 8g: (3); 8h: (3); 8i: (4); 8j: (4); 8k: (2); 8l: (3); 16m: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (1); 4f: (1); 8g: (3); 8h: (3); 8i: (4); 8j: (4); 8k: (2); 8l: (3); 16m: (6)
LD (0, 0, w) of space group No. 66		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (3); 8h: (3); 8i: (2); 8j: (2); 8k: (2); 8l: (3); 16m: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (3); 8h: (3); 8i: (2); 8j: (2); 8k: (2); 8l: (3); 16m: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (4); 8j: (4); 8k: (4); 8l: (3); 16m: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (4); 8j: (4); 8k: (4); 8l: (3); 16m: (6)
SM $(\frac{u}{2}, \frac{u}{2}, 0)$ of space group No. 66		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (4); 16m: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (2); 16m: (6)

3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (4); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (4); 16m: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (4); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (2); 16m: (6)

d. Results for high-symmetry planes

$P1(u, u, v)$		
Operation	E	
Coordinate	(u, u, v)	
$P2(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	
$P3(u, v, 0)$		
Operation	E	
Coordinate	$(u, v, 0)$	
$P4(u, v, \frac{1}{2})$		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	

$P1(u, u, v)$ of space group No. 66

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 16m: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 16m: (12)

$P2(u, -u, v)$ of space group No. 66

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 16m: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 16m: (12)

$P3(u, v, 0)$ of space group No. 66

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (4); 4e: (4); 4f: (4); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (8); 16m: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (4); 16m: (12)

$P4(u, v, \frac{1}{2})$ of space group No. 66

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 16m: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 16m: (12)

67. Space group No. 67 ($Cmma$)

Orthorhombic base-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2y}|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_y|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$Y(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$T(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})\end{array}$$

$$S(0, \frac{1}{2}, 0)$$

$$\begin{array}{lll}\text{Operation} & E & C_{2y} \\ \text{Coordinate} & (0, \frac{1}{2}, 0) & (-\frac{1}{2}, 0, 0)\end{array}$$

$$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ccc} \text{Operation} & E & C_{2y} \\ \text{Coordinate} & \left(0, \frac{1}{2}, \frac{1}{2}\right) & \left(-\frac{1}{2}, 0, -\frac{1}{2}\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 67											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	4e: (0);	4f: (0);	4g: (1);	8h: (1);	8i: (1);	8j: (1); 8k: (1); 8l: (1); 8m: (2); 8n: (2); 16o: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	4e: (0);	4f: (0);	4g: (1);	8h: (2);	8i: (2);	8j: (1); 8k: (1); 8l: (2); 8m: (1); 8n: (2); 16o: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	4e: (0);	4f: (0);	4g: (0);	8h: (2);	8i: (2);	8j: (2); 8k: (2); 8l: (1); 8m: (1); 8n: (1); 16o: (3)
4	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	4e: (0);	4f: (0);	4g: (1);	8h: (1);	8i: (1);	8j: (2); 8k: (2); 8l: (2); 8m: (2); 8n: (1); 16o: (3)
5	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	4e: (1);	4f: (1);	4g: (0);	8h: (1);	8i: (1);	8j: (1); 8k: (1); 8l: (1); 8m: (1); 8n: (1); 16o: (3)
6	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	4e: (1);	4f: (1);	4g: (1);	8h: (2);	8i: (2);	8j: (1); 8k: (1); 8l: (2); 8m: (2); 8n: (1); 16o: (3)
7	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	4e: (2);	4f: (2);	4g: (1);	8h: (2);	8i: (2);	8j: (2); 8k: (2); 8l: (1); 8m: (2); 8n: (2); 16o: (3)
8	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	4e: (2);	4f: (2);	4g: (1);	8h: (1);	8i: (1);	8j: (2); 8k: (2); 8l: (2); 8m: (1); 8n: (2); 16o: (3)

$Y \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 67											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	4e: (1);	4f: (1);	4g: (1);	8h: (1);	8i: (1);	8j: (1); 8k: (1); 8l: (1); 8m: (2); 8n: (1); 16o: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	4e: (1);	4f: (1);	4g: (0);	8h: (2);	8i: (2);	8j: (1); 8k: (1); 8l: (2); 8m: (1); 8n: (1); 16o: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	4e: (2);	4f: (2);	4g: (1);	8h: (2);	8i: (2);	8j: (2); 8k: (2); 8l: (1); 8m: (1); 8n: (2); 16o: (3)
4	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	4e: (2);	4f: (2);	4g: (1);	8h: (1);	8i: (1);	8j: (2); 8k: (2); 8l: (2); 8m: (2); 8n: (2); 16o: (3)
5	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	4e: (0);	4f: (0);	4g: (1);	8h: (1);	8i: (1);	8j: (1); 8k: (1); 8l: (1); 8m: (1); 8n: (2); 16o: (3)
6	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	4e: (0);	4f: (0);	4g: (1);	8h: (2);	8i: (2);	8j: (1); 8k: (1); 8l: (2); 8m: (2); 8n: (2); 16o: (3)
7	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	4e: (0);	4f: (0);	4g: (1);	8h: (2);	8i: (2);	8j: (2); 8k: (2); 8l: (1); 8m: (2); 8n: (1); 16o: (3)
8	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	4e: (0);	4f: (0);	4g: (0);	8h: (1);	8i: (1);	8j: (2); 8k: (2); 8l: (2); 8m: (1); 8n: (1); 16o: (3)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 67											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (0);	4b: (1);	4c: (0);	4d: (2);	4e: (0);	4f: (2);	4g: (1);	8h: (1);	8i: (2);	8j: (1); 8k: (2); 8l: (1); 8m: (2); 8n: (2); 16o: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (1);	4e: (0);	4f: (2);	4g: (1);	8h: (2);	8i: (1);	8j: (1); 8k: (2); 8l: (2); 8m: (1); 8n: (2); 16o: (3)

3	(0, 0, 0)	4a: (1); 4b: (0); 4c: (0); 4d: (1); 4e: (0); 4f: (1); 4g: (0); 8h: (2); 8i: (1); 8j: (2); 8k: (1); 8l: (1); 8m: (1); 8n: (1); 16o: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (2); 4e: (0); 4f: (1); 4g: (1); 8h: (1); 8i: (2); 8j: (2); 8k: (1); 8l: (2); 8m: (2); 8n: (1); 16o: (3)
5	(0, 0, 0)	4a: (0); 4b: (1); 4c: (1); 4d: (0); 4e: (1); 4f: (0); 4g: (0); 8h: (1); 8i: (2); 8j: (1); 8k: (2); 8l: (1); 8m: (1); 8n: (1); 16o: (3)
6	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (0); 4e: (1); 4f: (0); 4g: (1); 8h: (2); 8i: (1); 8j: (1); 8k: (2); 8l: (2); 8m: (2); 8n: (1); 16o: (3)
7	(0, 0, 0)	4a: (1); 4b: (0); 4c: (2); 4d: (0); 4e: (2); 4f: (0); 4g: (1); 8h: (2); 8i: (1); 8j: (2); 8k: (1); 8l: (1); 8m: (2); 8n: (2); 16o: (3)
8	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (0); 4e: (2); 4f: (0); 4g: (1); 8h: (1); 8i: (2); 8j: (2); 8k: (1); 8l: (2); 8m: (1); 8n: (2); 16o: (3)

$T \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 67

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (1); 4c: (0); 4d: (2); 4e: (1); 4f: (0); 4g: (1); 8h: (1); 8i: (2); 8j: (1); 8k: (2); 8l: (1); 8m: (2); 8n: (1); 16o: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (1); 4e: (1); 4f: (0); 4g: (0); 8h: (2); 8i: (1); 8j: (1); 8k: (2); 8l: (2); 8m: (1); 8n: (1); 16o: (3)
3	(0, 0, 0)	4a: (1); 4b: (0); 4c: (0); 4d: (1); 4e: (2); 4f: (0); 4g: (1); 8h: (2); 8i: (1); 8j: (2); 8k: (1); 8l: (1); 8m: (1); 8n: (2); 16o: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (2); 4e: (2); 4f: (0); 4g: (1); 8h: (1); 8i: (2); 8j: (2); 8k: (1); 8l: (2); 8m: (2); 8n: (2); 16o: (3)
5	(0, 0, 0)	4a: (0); 4b: (1); 4c: (1); 4d: (0); 4e: (0); 4f: (2); 4g: (1); 8h: (1); 8i: (2); 8j: (1); 8k: (2); 8l: (1); 8m: (1); 8n: (2); 16o: (3)
6	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (0); 4e: (0); 4f: (2); 4g: (1); 8h: (2); 8i: (1); 8j: (1); 8k: (2); 8l: (2); 8m: (2); 8n: (2); 16o: (3)
7	(0, 0, 0)	4a: (1); 4b: (0); 4c: (2); 4d: (0); 4e: (0); 4f: (1); 4g: (1); 8h: (2); 8i: (1); 8j: (2); 8k: (1); 8l: (1); 8m: (2); 8n: (1); 16o: (3)
8	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (0); 4e: (0); 4f: (1); 4g: (0); 8h: (1); 8i: (2); 8j: (2); 8k: (1); 8l: (2); 8m: (1); 8n: (1); 16o: (3)

$S \left(0, \frac{1}{2}, 0 \right)$ of space group No. 67

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)

$R \left(0, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 67

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)

c. Results for high-symmetry lines

$$A \left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2} \right)$$

Operation	E
Coordinate	$\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2} \right)$

$$B \left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2} \right)$$

Operation	E
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$
D($0, \frac{1}{2}, w$)	
Operation	E C_{2y}
Coordinate	$(0, \frac{1}{2}, w)$ $(-\frac{1}{2}, 0, -w)$
DT($-\frac{v}{2}, \frac{v}{2}, 0$)	
Operation	E
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, 0)$
H($\frac{1}{2}, \frac{1}{2}, w$)	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
LD($0, 0, w$)	
Operation	E
Coordinate	$(0, 0, w)$
SM($\frac{u}{2}, \frac{u}{2}, 0$)	
Operation	E
Coordinate	$(\frac{u}{2}, \frac{u}{2}, 0)$

A ($\frac{u}{2}, \frac{u}{2}, \frac{1}{2}$) of space group No. 67

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (2); 8i: (4); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 8n: (4); 16o: (6)
2	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 4e: (1); 4f: (1); 4g: (1); 8h: (2); 8i: (4); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 8n: (2); 16o: (6)
3	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 4e: (1); 4f: (1); 4g: (1); 8h: (4); 8i: (2); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 8n: (2); 16o: (6)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 4e: (2); 4f: (2); 4g: (2); 8h: (4); 8i: (2); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 8n: (4); 16o: (6)

B ($-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}$) of space group No. 67

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (2); 4d: (2); 4e: (1); 4f: (2); 4g: (2); 8h: (3); 8i: (3); 8j: (2); 8k: (4); 8l: (3); 8m: (4); 8n: (3); 16o: (6)
2	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (1); 4e: (1); 4f: (2); 4g: (1); 8h: (3); 8i: (3); 8j: (2); 8k: (4); 8l: (3); 8m: (2); 8n: (3); 16o: (6)
3	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (1); 4g: (2); 8h: (3); 8i: (3); 8j: (4); 8k: (2); 8l: (3); 8m: (4); 8n: (3); 16o: (6)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (1); 4g: (1); 8h: (3); 8i: (3); 8j: (4); 8k: (2); 8l: (3); 8m: (2); 8n: (3); 16o: (6)

D ($0, \frac{1}{2}, w$) of space group No. 67

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)

DT $(-\frac{v}{2}, \frac{v}{2}, 0)$ of space group No. 67		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (1); 4f: (1); 4g: (2); 8h: (3); 8i: (3); 8j: (2); 8k: (2); 8l: (3); 8m: (4); 8n: (3); 16o: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 4g: (1); 8h: (3); 8i: (3); 8j: (2); 8k: (2); 8l: (3); 8m: (2); 8n: (3); 16o: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (3); 8i: (3); 8j: (4); 8k: (4); 8l: (3); 8m: (4); 8n: (3); 16o: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 4g: (1); 8h: (3); 8i: (3); 8j: (4); 8k: (4); 8l: (3); 8m: (2); 8n: (3); 16o: (6)

H $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 67		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 4g: (2); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (2); 8m: (2); 8n: (4); 16o: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (1); 4f: (1); 4g: (2); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (2); 8m: (4); 8n: (2); 16o: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (4); 8m: (4); 8n: (4); 16o: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 4g: (0); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (4); 8m: (2); 8n: (2); 16o: (6)

LD (0, 0, w) of space group No. 67		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (2); 8m: (4); 8n: (4); 16o: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 4g: (0); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (2); 8m: (2); 8n: (2); 16o: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 4g: (2); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (4); 8m: (2); 8n: (4); 16o: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (1); 4f: (1); 4g: (2); 8h: (3); 8i: (3); 8j: (3); 8k: (3); 8l: (4); 8m: (4); 8n: (2); 16o: (6)

SM $(\frac{u}{2}, \frac{u}{2}, 0)$ of space group No. 67		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 4g: (2); 8h: (2); 8i: (2); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 8n: (4); 16o: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 4g: (1); 8h: (2); 8i: (2); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 8n: (2); 16o: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (1); 4f: (1); 4g: (1); 8h: (4); 8i: (4); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 8n: (2); 16o: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (4); 8i: (4); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 8n: (4); 16o: (6)

d. Results for high-symmetry planes

$P1(u, u, v)$	
Operation	E
Coordinate	(u, u, v)
$P2(u, -u, v)$	
Operation	E
Coordinate	$(u, -u, v)$
$P3(u, v, 0)$	
Operation	E
Coordinate	$(u, v, 0)$
$P4(u, v, \frac{1}{2})$	
Operation	E
Coordinate	$(u, v, \frac{1}{2})$

$P1(u, u, v)$ of space group No. 67		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (4); 4f: (4); 4g: (4); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 8n: (8); 16o: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (2); 4f: (2); 4g: (2); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 8n: (4); 16o: (12)
$P2(u, -u, v)$ of space group No. 67		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (4); 4e: (3); 4f: (3); 4g: (4); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (8); 8n: (6); 16o: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 4e: (3); 4f: (3); 4g: (2); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (4); 8n: (6); 16o: (12)
$P3(u, v, 0)$ of space group No. 67		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)
$P4(u, v, \frac{1}{2})$ of space group No. 67		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)

68. Space group No. 68 (C_{cca})

Orthorhombic base-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \left\{I\left|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right.\right\} \quad \left\{\sigma_z\left|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\right.\right\} \quad \left\{\sigma_y\left|-\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\right.\right\} \quad \left\{\sigma_x\left|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\right.\right\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$Y\left(\frac{1}{2}, \frac{1}{2}, 0\right)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, 0\right)\end{array}$$

$$Z\left(0, 0, \frac{1}{2}\right)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & \left(0, 0, \frac{1}{2}\right)\end{array}$$

$$T\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)\end{array}$$

$$S\left(0, \frac{1}{2}, 0\right)$$

$$\begin{array}{lll}\text{Operation} & E & C_{2y} \\ \text{Coordinate} & \left(0, \frac{1}{2}, 0\right) & \left(-\frac{1}{2}, 0, 0\right)\end{array}$$

$$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{lll}\text{Operation} & E & C_{2y} \\ \text{Coordinate} & \left(0, \frac{1}{2}, \frac{1}{2}\right) & \left(-\frac{1}{2}, 0, -\frac{1}{2}\right)\end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (1); 8f: (1); 8g: (1); 8h: (1); 16i: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (2); 8f: (1); 8g: (2); 8h: (2); 16i: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (2); 8f: (2); 8g: (1); 8h: (1); 16i: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (1); 8f: (2); 8g: (2); 8h: (2); 16i: (3)
5	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3); 8d: (3); 8e: (1); 8f: (1); 8g: (1); 8h: (1); 16i: (3)
6	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 8f: (1); 8g: (2); 8h: (2); 16i: (3)
7	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 8f: (2); 8g: (1); 8h: (1); 16i: (3)
8	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (1); 8f: (2); 8g: (2); 8h: (2); 16i: (3)

 $Y \left(\frac{1}{2}, \frac{1}{2}, 0 \right)$ of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (3); 8e: (1); 8f: (1); 8g: (1); 8h: (2); 16i: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (3); 8e: (2); 8f: (1); 8g: (2); 8h: (1); 16i: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (3); 8e: (2); 8f: (2); 8g: (1); 8h: (2); 16i: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (3); 8e: (1); 8f: (2); 8g: (2); 8h: (1); 16i: (3)
5	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3); 8d: (0); 8e: (1); 8f: (1); 8g: (1); 8h: (2); 16i: (3)
6	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (0); 8e: (2); 8f: (1); 8g: (2); 8h: (1); 16i: (3)
7	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (0); 8e: (2); 8f: (2); 8g: (1); 8h: (2); 16i: (3)
8	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (0); 8e: (1); 8f: (2); 8g: (2); 8h: (1); 16i: (3)

 $Z \left(0, 0, \frac{1}{2} \right)$ of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (2); 8h: (2); 16i: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (4); 8h: (4); 16i: (6)

 $T \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (2); 8h: (4); 16i: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (4); 8h: (2); 16i: (6)

 $S \left(0, \frac{1}{2}, 0 \right)$ of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

 $R \left(0, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

c. Results for high-symmetry lines

$$A\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$$

Operation	E
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{1}{2})$
$B(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2})$
$D(0, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, w)$ C_{2y} $(-\frac{1}{2}, 0, -w)$
$DT(-\frac{v}{2}, \frac{v}{2}, 0)$	
Operation	E
Coordinate	$(-\frac{v}{2}, \frac{v}{2}, 0)$
$H(\frac{1}{2}, \frac{1}{2}, w)$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$
$LD(0, 0, w)$	
Operation	E
Coordinate	$(0, 0, w)$
$SM(\frac{u}{2}, \frac{u}{2}, 0)$	
Operation	E
Coordinate	$(\frac{u}{2}, \frac{u}{2}, 0)$

A $\left(\frac{u}{2}, \frac{u}{2}, \frac{1}{2}\right)$ of space group No. 68			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)	
B $\left(-\frac{v}{2}, \frac{v}{2}, \frac{1}{2}\right)$ of space group No. 68			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)	
D $\left(0, \frac{1}{2}, w\right)$ of space group No. 68			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)	
DT $\left(-\frac{v}{2}, \frac{v}{2}, 0\right)$ of space group No. 68			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (2); 8g: (3); 8h: (3); 16i: (6)	
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (2); 8g: (3); 8h: (3); 16i: (6)	
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (4); 8g: (3); 8h: (3); 16i: (6)	
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (4); 8g: (3); 8h: (3); 16i: (6)	

H $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (2); 8h: (4); 16i: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (2); 8h: (4); 16i: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (4); 8h: (2); 16i: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (4); 8h: (2); 16i: (6)

LD (0, 0, w) of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (2); 8h: (2); 16i: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (2); 8h: (2); 16i: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (4); 8h: (4); 16i: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (4); 8h: (4); 16i: (6)

SM $(\frac{u}{2}, \frac{u}{2}, 0)$ of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 8f: (3); 8g: (3); 8h: (3); 16i: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 8f: (3); 8g: (3); 8h: (3); 16i: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (4); 8f: (3); 8g: (3); 8h: (3); 16i: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (4); 8f: (3); 8g: (3); 8h: (3); 16i: (6)

d. Results for high-symmetry planes

P1(u, u, v)

Operation	E
Coordinate	(u, u, v)

P2($u, -u, v$)

Operation	E
Coordinate	$(u, -u, v)$

P3($u, v, 0$)

Operation	E
Coordinate	$(u, v, 0)$

P4($u, v, \frac{1}{2}$)

Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 (u, u, v) of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

P2 ($u, -u, v$) of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

P3 ($u, v, 0$) of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

P4 ($u, v, \frac{1}{2}$) of space group No. 68

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

69. Space group No. 69 ($Fmmm$)

Orthorhombic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \{C_{2z}|0, 0, 0\} \{C_{2y}|0, 0, 0\} \{C_{2x}|0, 0, 0\} \{I|0, 0, 0\} \{\sigma_z|0, 0, 0\} \{\sigma_y|0, 0, 0\} \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, 0) \end{array}$$

$$Y\left(\frac{1}{2}, 0, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, 0, \frac{1}{2}\right) \end{array}$$

$$X\left(0, \frac{1}{2}, \frac{1}{2}\right)$$

Operation	E			
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$			
$Z(\frac{1}{2}, \frac{1}{2}, 0)$				
Operation	E			
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$			
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$				
Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, 0)$	$(0, -\frac{1}{2}, 0)$	$(0, 0, -\frac{1}{2})$

Γ (0, 0, 0) of space group No. 69											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (0); 8f: (0); 8g: (1); 8h: (1); 8i: (1); 16j: (1); 16k: (1); 16l: (1); 16m: (2); 16n: (2); 16o: (2); 32p: (3)									
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (0); 8f: (1); 8g: (1); 8h: (0); 8i: (1); 16j: (2); 16k: (1); 16l: (2); 16m: (1); 16n: (2); 16o: (1); 32p: (3)									
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (0); 16j: (1); 16k: (2); 16l: (2); 16m: (1); 16n: (1); 16o: (2); 32p: (3)									
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (0); 8f: (1); 8g: (0); 8h: (1); 8i: (1); 16j: (2); 16k: (2); 16l: (1); 16m: (2); 16n: (1); 16o: (1); 32p: (3)									
5	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (1); 8f: (0); 8g: (0); 8h: (0); 8i: (0); 16j: (1); 16k: (1); 16l: (1); 16m: (1); 16n: (1); 16o: (1); 32p: (3)									
6	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (1); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (2); 16k: (1); 16l: (2); 16m: (2); 16n: (1); 16o: (2); 32p: (3)									
7	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (1); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (1); 16k: (2); 16l: (2); 16m: (2); 16n: (2); 16o: (1); 32p: (3)									
8	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (2); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (2); 16k: (2); 16l: (1); 16m: (1); 16n: (2); 16o: (2); 32p: (3)									
Y ($\frac{1}{2}$, 0, $\frac{1}{2}$) of space group No. 69											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (2); 8d: (0); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (2); 16k: (1); 16l: (2); 16m: (2); 16n: (2); 16o: (2); 32p: (3)									
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (0); 8e: (1); 8f: (0); 8g: (1); 8h: (0); 8i: (1); 16j: (1); 16k: (1); 16l: (1); 16m: (1); 16n: (2); 16o: (1); 32p: (3)									
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (0); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 8i: (0); 16j: (2); 16k: (2); 16l: (1); 16m: (1); 16n: (1); 16o: (2); 32p: (3)									
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (2); 8d: (0); 8e: (1); 8f: (1); 8g: (0); 8h: (1); 8i: (1); 16j: (1); 16k: (2); 16l: (2); 16m: (2); 16n: (1); 16o: (1); 32p: (3)									
5	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (1); 8e: (0); 8f: (1); 8g: (0); 8h: (0); 8i: (0); 16j: (2); 16k: (1); 16l: (2); 16m: (1); 16n: (1); 16o: (1); 32p: (3)									
6	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (1); 8e: (0); 8f: (0); 8g: (1); 8h: (1); 8i: (1); 16j: (1); 16k: (1); 16l: (1); 16m: (2); 16n: (1); 16o: (2); 32p: (3)									
7	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (2); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (2); 16k: (2); 16l: (1); 16m: (2); 16n: (2); 16o: (1); 32p: (3)									
8	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (2); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (1); 16k: (2); 16l: (2); 16m: (1); 16n: (2); 16o: (2); 32p: (3)									

$X \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 69									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (2); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (2); 16k: (2); 16l: (1); 16m: (2); 16n: (2); 16o: (2); 32p: (3)							
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (2); 8e: (1); 8f: (1); 8g: (1); 8h: (0); 8i: (1); 16j: (1); 16k: (2); 16l: (2); 16m: (1); 16n: (2); 16o: (1); 32p: (3)							
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (1); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 8i: (0); 16j: (2); 16k: (1); 16l: (2); 16m: (1); 16n: (1); 16o: (2); 32p: (3)							
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (1); 8e: (1); 8f: (0); 8g: (0); 8h: (1); 8i: (1); 16j: (1); 16k: (1); 16l: (1); 16m: (2); 16n: (1); 16o: (1); 32p: (3)							
5	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (0); 8e: (0); 8f: (1); 8g: (0); 8h: (0); 8i: (0); 16j: (2); 16k: (2); 16l: (1); 16m: (1); 16n: (1); 16o: (1); 32p: (3)							
6	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (0); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (1); 16k: (2); 16l: (2); 16m: (2); 16n: (1); 16o: (2); 32p: (3)							
7	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (0); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (2); 16k: (1); 16l: (2); 16m: (2); 16n: (2); 16o: (1); 32p: (3)							
8	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (0); 8e: (0); 8f: (0); 8g: (1); 8h: (1); 8i: (1); 16j: (1); 16k: (1); 16l: (1); 16m: (1); 16n: (2); 16o: (2); 32p: (3)							

$Z \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 69									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (2); 8d: (2); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (1); 16k: (2); 16l: (2); 16m: (2); 16n: (2); 16o: (2); 32p: (3)							
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (2); 8e: (0); 8f: (1); 8g: (1); 8h: (0); 8i: (1); 16j: (2); 16k: (2); 16l: (1); 16m: (1); 16n: (2); 16o: (1); 32p: (3)							
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (0); 8f: (0); 8g: (1); 8h: (1); 8i: (0); 16j: (1); 16k: (1); 16l: (1); 16m: (1); 16n: (1); 16o: (2); 32p: (3)							
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (2); 8d: (1); 8e: (0); 8f: (1); 8g: (0); 8h: (1); 8i: (1); 16j: (2); 16k: (1); 16l: (2); 16m: (2); 16n: (1); 16o: (1); 32p: (3)							
5	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (1); 8f: (1); 8g: (0); 8h: (0); 8i: (0); 16j: (1); 16k: (2); 16l: (2); 16m: (1); 16n: (1); 16o: (1); 32p: (3)							
6	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (2); 16k: (2); 16l: (1); 16m: (2); 16n: (1); 16o: (2); 32p: (3)							
7	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (1); 8f: (0); 8g: (1); 8h: (1); 8i: (1); 16j: (1); 16k: (1); 16l: (1); 16m: (2); 16n: (2); 16o: (1); 32p: (3)							
8	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (2); 16k: (1); 16l: (2); 16m: (1); 16n: (2); 16o: (2); 32p: (3)							

$L \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 69									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (0); 4b: (3); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (3); 8h: (3); 8i: (3); 16j: (6); 16k: (6); 16l: (6); 16m: (6); 16n: (6); 16o: (6); 32p: (12)							
2	(0, 0, 0)	4a: (3); 4b: (0); 8c: (3); 8d: (3); 8e: (3); 8f: (3); 8g: (3); 8h: (3); 8i: (3); 16j: (6); 16k: (6); 16l: (6); 16m: (6); 16n: (6); 16o: (6); 32p: (12)							

c. Results for high-symmetry lines

$$A\left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2}\right)$$

Operation	E
Coordinate	$(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2})$
$B(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2})$	
Operation	E
Coordinate	$(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2})$
$DT(\frac{v}{2}, 0, \frac{v}{2})$	
Operation	E
Coordinate	$(\frac{v}{2}, 0, \frac{v}{2})$
$H(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2})$
$LD(\frac{w}{2}, \frac{w}{2}, 0)$	
Operation	E
Coordinate	$(\frac{w}{2}, \frac{w}{2}, 0)$
$SM(0, \frac{u}{2}, \frac{u}{2})$	
Operation	E
Coordinate	$(0, \frac{u}{2}, \frac{u}{2})$

A $(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2})$ of space group No. 69

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (2); 8f: (2); 8g: (2); 8h: (2); 8i: (2); 16j: (3); 16k: (3); 16l: (4); 16m: (3); 16n: (4); 16o: (4); 32p: (6)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (2); 8d: (1); 8e: (1); 8f: (2); 8g: (0); 8h: (1); 8i: (1); 16j: (3); 16k: (3); 16l: (4); 16m: (3); 16n: (2); 16o: (2); 32p: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (1); 8e: (2); 8f: (1); 8g: (2); 8h: (2); 8i: (1); 16j: (3); 16k: (3); 16l: (2); 16m: (3); 16n: (2); 16o: (4); 32p: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (2); 8e: (1); 8f: (1); 8g: (2); 8h: (1); 8i: (2); 16j: (3); 16k: (3); 16l: (2); 16m: (3); 16n: (4); 16o: (2); 32p: (6)

B $(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2})$ of space group No. 69

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (2); 8f: (2); 8g: (2); 8h: (2); 8i: (2); 16j: (3); 16k: (4); 16l: (3); 16m: (4); 16n: (3); 16o: (4); 32p: (6)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (2); 8e: (1); 8f: (2); 8g: (1); 8h: (0); 8i: (1); 16j: (3); 16k: (4); 16l: (3); 16m: (2); 16n: (3); 16o: (2); 32p: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (1); 8e: (1); 8f: (1); 8g: (1); 8h: (2); 8i: (2); 16j: (3); 16k: (2); 16l: (3); 16m: (4); 16n: (3); 16o: (2); 32p: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (1); 8e: (2); 8f: (1); 8g: (2); 8h: (2); 8i: (1); 16j: (3); 16k: (2); 16l: (3); 16m: (2); 16n: (3); 16o: (4); 32p: (6)

DT $(\frac{v}{2}, 0, \frac{v}{2})$ of space group No. 69

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (1); 8e: (2); 8f: (1); 8g: (2); 8h: (2); 8i: (2); 16j: (3); 16k: (2); 16l: (3); 16m: (4); 16n: (3); 16o: (4); 32p: (6)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (1); 8f: (1); 8g: (1); 8h: (0); 8i: (1); 16j: (3); 16k: (2); 16l: (3); 16m: (2); 16n: (3); 16o: (2); 32p: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (1); 8f: (2); 8g: (1); 8h: (2); 8i: (2); 16j: (3); 16k: (4); 16l: (3); 16m: (4); 16n: (3); 16o: (2); 32p: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (2); 8e: (2); 8f: (2); 8g: (2); 8h: (2); 8i: (1); 16j: (3); 16k: (4); 16l: (3); 16m: (2); 16n: (3); 16o: (4); 32p: (6)

$H \left(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2} \right)$ of space group No. 69

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (2); 8f: (2); 8g: (2); 8h: (2); 8i: (2); 16j: (4); 16k: (3); 16l: (3); 16m: (4); 16n: (4); 16o: (3); 32p: (6)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (2); 8f: (2); 8g: (1); 8h: (1); 8i: (0); 16j: (4); 16k: (3); 16l: (3); 16m: (2); 16n: (2); 16o: (3); 32p: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (2); 8e: (1); 8f: (1); 8g: (2); 8h: (1); 8i: (2); 16j: (2); 16k: (3); 16l: (3); 16m: (2); 16n: (4); 16o: (3); 32p: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (1); 8e: (1); 8f: (1); 8g: (1); 8h: (2); 8i: (2); 16j: (2); 16k: (3); 16l: (3); 16m: (4); 16n: (2); 16o: (3); 32p: (6)

$LD \left(\frac{w}{2}, \frac{w}{2}, 0 \right)$ of space group No. 69

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (1); 8f: (1); 8g: (2); 8h: (2); 8i: (2); 16j: (2); 16k: (3); 16l: (3); 16m: (4); 16n: (4); 16o: (3); 32p: (6)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (1); 8f: (1); 8g: (1); 8h: (1); 8i: (0); 16j: (2); 16k: (3); 16l: (3); 16m: (2); 16n: (2); 16o: (3); 32p: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (2); 8e: (2); 8f: (2); 8g: (2); 8h: (1); 8i: (2); 16j: (4); 16k: (3); 16l: (3); 16m: (2); 16n: (4); 16o: (3); 32p: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (1); 8e: (2); 8f: (2); 8g: (1); 8h: (2); 8i: (2); 16j: (4); 16k: (3); 16l: (3); 16m: (4); 16n: (2); 16o: (3); 32p: (6)

$SM \left(0, \frac{u}{2}, \frac{u}{2} \right)$ of space group No. 69

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (2); 8e: (2); 8f: (1); 8g: (2); 8h: (2); 8i: (2); 16j: (3); 16k: (3); 16l: (2); 16m: (3); 16n: (4); 16o: (4); 32p: (6)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (1); 8f: (1); 8g: (0); 8h: (1); 8i: (1); 16j: (3); 16k: (3); 16l: (2); 16m: (3); 16n: (2); 16o: (2); 32p: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (1); 8e: (2); 8f: (2); 8g: (2); 8h: (2); 8i: (1); 16j: (3); 16k: (3); 16l: (4); 16m: (3); 16n: (2); 16o: (4); 32p: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (1); 8f: (2); 8g: (2); 8h: (1); 8i: (2); 16j: (3); 16k: (3); 16l: (4); 16m: (3); 16n: (4); 16o: (2); 32p: (6)

d. Results for high-symmetry planes

$P1(-v, u, u - v)$

Operation	E
Coordinate	$(-v, u, u - v)$

$P2(u, u + v, v)$

Operation	E
Coordinate	$(u, u + v, v)$
$P3(u - v, u, -v)$	
Operation	E
Coordinate	$(u - v, u, -v)$

P1 $(-v, u, u - v)$ of space group No. 69		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (4); 8f: (3); 8g: (4); 8h: (4); 8i: (3); 16j: (6); 16k: (6); 16l: (6); 16m: (6); 16n: (6); 16o: (8); 32p: (12)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 8f: (3); 8g: (2); 8h: (2); 8i: (3); 16j: (6); 16k: (6); 16l: (6); 16m: (6); 16n: (6); 16o: (4); 32p: (12)
P2 $(u, u + v, v)$ of space group No. 69		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (4); 8e: (3); 8f: (3); 8g: (4); 8h: (3); 8i: (4); 16j: (6); 16k: (6); 16l: (6); 16m: (6); 16n: (8); 16o: (6); 32p: (12)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (2); 8e: (3); 8f: (3); 8g: (2); 8h: (3); 8i: (2); 16j: (6); 16k: (6); 16l: (6); 16m: (6); 16n: (4); 16o: (6); 32p: (12)
P3 $(u - v, u, -v)$ of space group No. 69		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (4); 8d: (3); 8e: (3); 8f: (3); 8g: (3); 8h: (4); 8i: (4); 16j: (6); 16k: (6); 16l: (6); 16m: (8); 16n: (6); 16o: (6); 32p: (12)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (3); 8e: (3); 8f: (3); 8g: (3); 8h: (2); 8i: (2); 16j: (6); 16k: (6); 16l: (6); 16m: (4); 16n: (6); 16o: (6); 32p: (12)

70. Space group No. 70 (*Fddd*)

Orthorhombic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, c, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, b) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{I|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{\sigma_y|\frac{1}{4}, -\frac{3}{4}, \frac{1}{4}\} \quad \{\sigma_z|\frac{1}{4}, \frac{1}{4}, -\frac{3}{4}\} \quad \{\sigma_x|-\frac{3}{4}, \frac{1}{4}, \frac{1}{4}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$Y(-\frac{1}{2}, -\frac{1}{2}, 0)$	
Operation	E
Coordinate	$(-\frac{1}{2}, -\frac{1}{2}, 0)$
$X(0, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$
$Z(\frac{1}{2}, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$
$L(0, 0, \frac{1}{2})$	
Operation	E
Coordinate	$(0, 0, \frac{1}{2})$
	C_{2x}
	C_{2z}
	C_{2y}
Coordinate	$(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2})$ $(\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 70			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	8a: (0); 8b: (0); 16c: (0); 16d: (0); 16e: (1); 16f: (1); 16g: (1); 32h: (3)	
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (0); 16d: (0); 16e: (2); 16f: (2); 16g: (1); 32h: (3)	
3	(0, 0, 0)	8a: (1); 8b: (1); 16c: (0); 16d: (0); 16e: (2); 16f: (1); 16g: (2); 32h: (3)	
4	(0, 0, 0)	8a: (1); 8b: (1); 16c: (0); 16d: (0); 16e: (1); 16f: (2); 16g: (2); 32h: (3)	
5	(0, 0, 0)	8a: (0); 8b: (0); 16c: (3); 16d: (3); 16e: (1); 16f: (1); 16g: (1); 32h: (3)	
6	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (2); 16f: (2); 16g: (1); 32h: (3)	
7	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (2); 16f: (1); 16g: (2); 32h: (3)	
8	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (1); 16f: (2); 16g: (2); 32h: (3)	
$Y(-\frac{1}{2}, -\frac{1}{2}, 0)$ of space group No. 70			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (3); 16f: (3); 16g: (2); 32h: (6)	
2	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 16e: (3); 16f: (3); 16g: (4); 32h: (6)	
$X(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 70			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (2); 16f: (3); 16g: (3); 32h: (6)	
2	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 16e: (4); 16f: (3); 16g: (3); 32h: (6)	
$Z(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 70			

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (3); 16f: (2); 16g: (3); 32h: (6)
2	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 16e: (3); 16f: (4); 16g: (3); 32h: (6)
L $(0, 0, \frac{1}{2})$ of space group No. 70		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (3); 16d: (9); 16e: (6); 16f: (6); 16g: (6); 32h: (12)
2	(0, 0, 0)	8a: (3); 8b: (3); 16c: (9); 16d: (3); 16e: (6); 16f: (6); 16g: (6); 32h: (12)

c. Results for high-symmetry lines

$$A\left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2}\right) \end{array}$$

$$B\left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2}\right) \end{array}$$

$$DT\left(\frac{v}{2}, 0, \frac{v}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(\frac{v}{2}, 0, \frac{v}{2}\right) \end{array}$$

$$H\left(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2}\right) \end{array}$$

$$LD\left(\frac{w}{2}, \frac{w}{2}, 0\right)$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(\frac{w}{2}, \frac{w}{2}, 0\right) \end{array}$$

$$SM\left(0, \frac{u}{2}, \frac{u}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & \text{E} \\ \text{Coordinate} & \left(0, \frac{u}{2}, \frac{u}{2}\right) \end{array}$$

A $\left(\frac{1}{2}, \frac{1+u}{2}, \frac{u}{2}\right)$ of space group No. 70		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 16g: (6); 32h: (12)
B $\left(\frac{1+v}{2}, \frac{1}{2}, \frac{v}{2}\right)$ of space group No. 70		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 16g: (6); 32h: (12)

DT $\left(\frac{v}{2}, 0, \frac{v}{2}\right)$ of space group No. 70

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (3); 16f: (2); 16g: (3); 32h: (6)
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (3); 16f: (2); 16g: (3); 32h: (6)
3	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 16e: (3); 16f: (4); 16g: (3); 32h: (6)
4	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 16e: (3); 16f: (4); 16g: (3); 32h: (6)

H $\left(\frac{1+w}{2}, \frac{w}{2}, \frac{1}{2}\right)$ of space group No. 70

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 16g: (6); 32h: (12)

LD $\left(\frac{w}{2}, \frac{w}{2}, 0\right)$ of space group No. 70

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (3); 16f: (3); 16g: (2); 32h: (6)
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (3); 16f: (3); 16g: (2); 32h: (6)
3	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 16e: (3); 16f: (3); 16g: (4); 32h: (6)
4	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 16e: (3); 16f: (3); 16g: (4); 32h: (6)

SM $\left(0, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 70

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (2); 16f: (3); 16g: (3); 32h: (6)
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 16e: (2); 16f: (3); 16g: (3); 32h: (6)
3	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 16e: (4); 16f: (3); 16g: (3); 32h: (6)
4	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 16e: (4); 16f: (3); 16g: (3); 32h: (6)

d. Results for high-symmetry planes

P1($v, u + v, u$)

Operation	E
Coordinate	($v, u + v, u$)

P2($u, v, u + v$)

Operation	E
Coordinate	($u, v, u + v$)

P3($u + v, v, u$)

Operation	E
Coordinate	($u + v, v, u$)

P1 ($v, u + v, u$) of space group No. 70

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 16g: (6); 32h: (12)
2	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 16g: (6); 32h: (12)

P2 ($u, v, u + v$) of space group No. 70

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 16g: (6); 32h: (12)
2	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 16g: (6); 32h: (12)

P3 ($u + v, v, u$) of space group No. 70

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 16g: (6); 32h: (12)
2	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 16g: (6); 32h: (12)

71. Space group No. 71 (*Immm*)

Orthorhombic body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$X(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, 0)$		
Operation	E	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, -\frac{1}{2})$

$S(\frac{1}{2}, 0, 0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$
$T(0, 0, \frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$
$W(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$		
Operation	E	I
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$

Γ (0, 0, 0) of space group No. 71												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (2);	2c: (0); 8n: (2);	2d: (0); 16o: (3)	4e: (1);	4f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (0);
2	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (2);	2c: (0); 8n: (1);	2d: (0); 16o: (3)	4e: (1);	4f: (1);	4g: (0);	4h: (0);	4i: (1);	4j: (1);	8k: (0);
3	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (1);	2c: (0); 8n: (2);	2d: (0); 16o: (3)	4e: (1);	4f: (1);	4g: (1);	4h: (1);	4i: (0);	4j: (0);	8k: (0);
4	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (1);	2c: (0); 8n: (1);	2d: (0); 16o: (3)	4e: (0);	4f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (0);
5	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (1);	2c: (0); 8n: (1);	2d: (0); 16o: (3)	4e: (0);	4f: (0);	4g: (0);	4h: (0);	4i: (0);	4j: (0);	8k: (3);
6	(0, 0, 0)	2a: (1); 8l: (2);	2b: (1); 8m: (1);	2c: (1); 8n: (2);	2d: (1); 16o: (3)	4e: (1);	4f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (3);
7	(0, 0, 0)	2a: (1); 8l: (2);	2b: (1); 8m: (2);	2c: (1); 8n: (1);	2d: (1); 16o: (3)	4e: (1);	4f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (3);
8	(0, 0, 0)	2a: (1); 8l: (1);	2b: (1); 8m: (2);	2c: (1); 8n: (2);	2d: (1); 16o: (3)	4e: (1);	4f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (3);

X $\left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 71												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (2);	2c: (0); 8n: (2);	2d: (0); 16o: (3)	4e: (1);	4f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (3);
2	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (2);	2c: (0); 8n: (1);	2d: (0); 16o: (3)	4e: (1);	4f: (1);	4g: (0);	4h: (0);	4i: (1);	4j: (1);	8k: (3);
3	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (1);	2c: (0); 8n: (2);	2d: (0); 16o: (3)	4e: (1);	4f: (1);	4g: (1);	4h: (1);	4i: (0);	4j: (0);	8k: (3);
4	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (1);	2c: (0); 8n: (1);	2d: (0); 16o: (3)	4e: (0);	4f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (3);
5	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (1);	2c: (0); 8n: (1);	2d: (0); 16o: (3)	4e: (0);	4f: (0);	4g: (0);	4h: (0);	4i: (0);	4j: (0);	8k: (0);
6	(0, 0, 0)	2a: (1); 8l: (2);	2b: (1); 8m: (1);	2c: (1); 8n: (2);	2d: (1); 16o: (3)	4e: (1);	4f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (0);
7	(0, 0, 0)	2a: (1); 8l: (2);	2b: (1); 8m: (2);	2c: (1); 8n: (1);	2d: (1); 16o: (3)	4e: (1);	4f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (0);

8	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 8k: (0); 8l: (1); 8m: (2); 8n: (2); 16o: (3)

$R \left(0, \frac{1}{2}, 0\right)$ of space group No. 71

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (2); 2c: (2); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (2); 4i: (2); 4j: (2); 8k: (3); 8l: (3); 8m: (4); 8n: (3); 16o: (6)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (2); 4i: (1); 4j: (1); 8k: (3); 8l: (3); 8m: (2); 8n: (3); 16o: (6)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (1); 4i: (1); 4j: (1); 8k: (3); 8l: (3); 8m: (2); 8n: (3); 16o: (6)
4	(0, 0, 0)	2a: (2); 2b: (0); 2c: (0); 2d: (2); 4e: (2); 4f: (2); 4g: (2); 4h: (1); 4i: (2); 4j: (2); 8k: (3); 8l: (3); 8m: (4); 8n: (3); 16o: (6)

$S \left(\frac{1}{2}, 0, 0\right)$ of space group No. 71

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (2); 2d: (2); 4e: (1); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (3); 8l: (4); 8m: (3); 8n: (3); 16o: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (2); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 8k: (3); 8l: (2); 8m: (3); 8n: (3); 16o: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 8k: (3); 8l: (2); 8m: (3); 8n: (3); 16o: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (3); 8l: (4); 8m: (3); 8n: (3); 16o: (6)

$T \left(0, 0, \frac{1}{2}\right)$ of space group No. 71

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (2); 2c: (0); 2d: (2); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (2); 8k: (3); 8l: (3); 8m: (3); 8n: (4); 16o: (6)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (2); 8k: (3); 8l: (3); 8m: (3); 8n: (2); 16o: (6)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (2); 4j: (1); 8k: (3); 8l: (3); 8m: (3); 8n: (2); 16o: (6)
4	(0, 0, 0)	2a: (2); 2b: (0); 2c: (2); 2d: (0); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 8k: (3); 8l: (3); 8m: (3); 8n: (4); 16o: (6)

$W \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$ of space group No. 71

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 8k: (3); 8l: (3); 8m: (3); 8n: (3); 16o: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 4i: (1); 4j: (2); 8k: (3); 8l: (3); 8m: (3); 8n: (3); 16o: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 4e: (2); 4f: (1); 4g: (1); 4h: (2); 4i: (2); 4j: (1); 8k: (3); 8l: (3); 8m: (3); 8n: (3); 16o: (6)
4	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 8k: (3); 8l: (3); 8m: (3); 8n: (3); 16o: (6)

c. Results for high-symmetry lines

$D\left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right)$	
Operation	E
Coordinate	$\left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right)$
$DT\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$	
Operation	E
Coordinate	$\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$
$LD\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$	
Operation	E
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$
$P\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$	
Operation	E
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$
$Q\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$	
Operation	E
Coordinate	$\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$
$SM\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$	
Operation	E
Coordinate	$\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$

$D\left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 71		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)
$DT\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 71		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (3); 8l: (4); 8m: (3); 8n: (4); 16o: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (0); 4h: (0); 4i: (1); 4j: (1); 8k: (3); 8l: (2); 8m: (3); 8n: (2); 16o: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (3); 8l: (4); 8m: (3); 8n: (2); 16o: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 8k: (3); 8l: (2); 8m: (3); 8n: (4); 16o: (6)
$LD\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$ of space group No. 71		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (3); 8l: (4); 8m: (4); 8n: (3); 16o: (6)

2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (0); 4j: (0); 8k: (3); 8l: (2); 8m: (2); 8n: (3); 16o: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 8k: (3); 8l: (2); 8m: (4); 8n: (3); 16o: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (3); 8l: (4); 8m: (2); 8n: (3); 16o: (6)

$P\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 71

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (2); 4j: (4); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 4i: (4); 4j: (2); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)

$Q\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$ of space group No. 71

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 16o: (12)

$SM\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 71

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (3); 8l: (3); 8m: (4); 8n: (4); 16o: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 8k: (3); 8l: (3); 8m: (2); 8n: (2); 16o: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 8k: (3); 8l: (3); 8m: (2); 8n: (4); 16o: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 8k: (3); 8l: (3); 8m: (4); 8n: (2); 16o: (6)

d. Results for high-symmetry planes

$P1(-v, v, u)$

Operation	E
Coordinate	$(-v, v, u)$

$P2(v, u, -v)$

Operation	E
Coordinate	$(v, u, -v)$

$P3(u, v, -v)$

Operation	E
Coordinate	$(u, v, -v)$

P1 ($-v, v, u$) of space group No. 71		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (4); 4h: (4); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (8); 16o: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (4); 16o: (12)
P2 ($v, u, -v$) of space group No. 71		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 8k: (6); 8l: (6); 8m: (8); 8n: (6); 16o: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 8k: (6); 8l: (6); 8m: (4); 8n: (6); 16o: (12)
P3 ($u, v, -v$) of space group No. 71		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (4); 4j: (4); 8k: (6); 8l: (8); 8m: (6); 8n: (6); 16o: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (6); 8l: (4); 8m: (6); 8n: (6); 16o: (12)

72. Space group No. 72 (*Ibam*)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & \vec{t}_1 = -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \text{Orthorhombic body-centered lattice} & \vec{b} = (0, b, 0) & \vec{t}_2 = \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{array}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2x}|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{\sigma_y|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_x|\frac{1}{2}, -\frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation	E
Coordinate	(0, 0, 0)

$X(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, 0)$		
Operation	E	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$S(\frac{1}{2}, 0, 0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$
$T(0, 0, \frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$
$W(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$		
Operation	E	I
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$

Γ (0, 0, 0) of space group No. 72												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	8e: (0);	8f: (1);	8g: (1);	8h: (1);	8i: (1);	8j: (2);	16k: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	8e: (0);	8f: (2);	8g: (1);	8h: (2);	8i: (2);	8j: (1);	16k: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	8e: (0);	8f: (2);	8g: (2);	8h: (1);	8i: (1);	8j: (2);	16k: (3)
4	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	8e: (0);	8f: (1);	8g: (2);	8h: (2);	8i: (2);	8j: (1);	16k: (3)
5	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	8e: (3);	8f: (1);	8g: (1);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
6	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	8e: (3);	8f: (2);	8g: (1);	8h: (2);	8i: (2);	8j: (2);	16k: (3)
7	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (3);	8f: (2);	8g: (2);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
8	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	8e: (3);	8f: (1);	8g: (2);	8h: (2);	8i: (2);	8j: (2);	16k: (3)

X $(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 72												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	8e: (3);	8f: (1);	8g: (1);	8h: (1);	8i: (1);	8j: (2);	16k: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	8e: (3);	8f: (2);	8g: (1);	8h: (2);	8i: (2);	8j: (1);	16k: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	8e: (3);	8f: (2);	8g: (2);	8h: (1);	8i: (1);	8j: (2);	16k: (3)
4	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	8e: (3);	8f: (1);	8g: (2);	8h: (2);	8i: (2);	8j: (1);	16k: (3)
5	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	8e: (0);	8f: (1);	8g: (1);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
6	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	8e: (0);	8f: (2);	8g: (1);	8h: (2);	8i: (2);	8j: (2);	16k: (3)
7	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (0);	8f: (2);	8g: (2);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
8	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	8e: (0);	8f: (1);	8g: (2);	8h: (2);	8i: (2);	8j: (2);	16k: (3)

R $(0, \frac{1}{2}, 0)$ of space group No. 72		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)
S $(\frac{1}{2}, 0, 0)$ of space group No. 72		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)
T $(0, 0, \frac{1}{2})$ of space group No. 72		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (0); 4d: (4); 8e: (3); 8f: (3); 8g: (3); 8h: (2); 8i: (4); 8j: (4); 16k: (6)
2	(0, 0, 0)	4a: (1); 4b: (2); 4c: (2); 4d: (0); 8e: (3); 8f: (3); 8g: (3); 8h: (2); 8i: (4); 8j: (2); 16k: (6)
3	(0, 0, 0)	4a: (2); 4b: (1); 4c: (0); 4d: (2); 8e: (3); 8f: (3); 8g: (3); 8h: (4); 8i: (2); 8j: (2); 16k: (6)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (4); 4d: (0); 8e: (3); 8f: (3); 8g: (3); 8h: (4); 8i: (2); 8j: (4); 16k: (6)
W $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 72		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 8e: (3); 8f: (3); 8g: (3); 8h: (2); 8i: (4); 8j: (3); 16k: (6)
2	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (3); 8g: (3); 8h: (4); 8i: (2); 8j: (3); 16k: (6)

c. Results for high-symmetry lines

D($\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}$)	
Operation	E
Coordinate	($\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}$)
DT($\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}$)	
Operation	E
Coordinate	($\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Operation	E
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)
P($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Operation	E
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	
Operation	E
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	
Operation	E
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)

D $\left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 72											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	4d: (3);	8e: (6);	8f: (6);	8g: (6);	8h: (6);	8i: (6);	8j: (6); 16k: (12)
DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 72											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	8e: (3);	8f: (3);	8g: (2);	8h: (3);	8i: (3);	8j: (4); 16k: (6)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (3);	8f: (3);	8g: (2);	8h: (3);	8i: (3);	8j: (2); 16k: (6)
3	(0, 0, 0)	4a: (2);	4b: (2);	4c: (1);	4d: (1);	8e: (3);	8f: (3);	8g: (4);	8h: (3);	8i: (3);	8j: (2); 16k: (6)
4	(0, 0, 0)	4a: (2);	4b: (2);	4c: (2);	4d: (2);	8e: (3);	8f: (3);	8g: (4);	8h: (3);	8i: (3);	8j: (4); 16k: (6)
LD $\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$ of space group No. 72											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (3);	8f: (3);	8g: (3);	8h: (2);	8i: (2);	8j: (3); 16k: (6)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (3);	8f: (3);	8g: (3);	8h: (2);	8i: (2);	8j: (3); 16k: (6)
3	(0, 0, 0)	4a: (2);	4b: (2);	4c: (2);	4d: (2);	8e: (3);	8f: (3);	8g: (3);	8h: (4);	8i: (4);	8j: (3); 16k: (6)
4	(0, 0, 0)	4a: (2);	4b: (2);	4c: (2);	4d: (2);	8e: (3);	8f: (3);	8g: (3);	8h: (4);	8i: (4);	8j: (3); 16k: (6)
P $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 72											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (2);	4b: (4);	4c: (2);	4d: (4);	8e: (6);	8f: (6);	8g: (6);	8h: (4);	8i: (8);	8j: (6); 16k: (12)
2	(0, 0, 0)	4a: (4);	4b: (2);	4c: (4);	4d: (2);	8e: (6);	8f: (6);	8g: (6);	8h: (8);	8i: (4);	8j: (6); 16k: (12)
Q $\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$ of space group No. 72											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	4d: (3);	8e: (6);	8f: (6);	8g: (6);	8h: (6);	8i: (6);	8j: (6); 16k: (12)
SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 72											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	8e: (3);	8f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (4); 16k: (6)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (3);	8f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (2); 16k: (6)
3	(0, 0, 0)	4a: (2);	4b: (2);	4c: (2);	4d: (2);	8e: (3);	8f: (4);	8g: (3);	8h: (3);	8i: (3);	8j: (4); 16k: (6)
4	(0, 0, 0)	4a: (2);	4b: (2);	4c: (1);	4d: (1);	8e: (3);	8f: (4);	8g: (3);	8h: (3);	8i: (3);	8j: (2); 16k: (6)

d. Results for high-symmetry planes

P1($-v, v, u$)

Operation E
Coordinate ($-v, v, u$)

P2($v, u, -v$)

Operation E
Coordinate ($v, u, -v$)

P3($u, v, -v$)

Operation	E
Coordinate	($u, v, -v$)

P1 ($-v, v, u$) of space group No. 72

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (8); 16k: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (4); 16k: (12)

P2 ($v, u, -v$) of space group No. 72

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

P3 ($u, v, -v$) of space group No. 72

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

73. Space group No. 73 (*Ibca*)

$$\begin{array}{ll}
 \vec{a} = (a, 0, 0) & \vec{t}_1 = -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \text{Orthorhombic body-centered lattice} & \vec{b} = (0, b, 0) \quad \vec{t}_2 = \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 & \vec{c} = (0, 0, c) \quad \vec{t}_3 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{array}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, 0, -\frac{1}{2}\} \quad \{C_{2y}|0, -\frac{1}{2}, -\frac{1}{2}\} \quad \{C_{2x}|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{\sigma_y|0, \frac{1}{2}, -\frac{1}{2}\} \quad \{\sigma_x|\frac{1}{2}, -\frac{1}{2}, 0\}$$

b. Results for high-symmetry points

 $\Gamma(0, 0, 0)$

Operation	E
Coordinate	(0, 0, 0)

$X(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, 0)$		
Operation	E	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$S(\frac{1}{2}, 0, 0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$
$T(0, 0, \frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$
$W(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$		
Operation	E	I
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$

$\Gamma(0, 0, 0)$ of space group No. 73						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	8a: (0);	8b: (0);	8c: (1);	8d: (1);	8e: (1); 16f: (3)
2	(0, 0, 0)	8a: (0);	8b: (0);	8c: (2);	8d: (1);	8e: (2); 16f: (3)
3	(0, 0, 0)	8a: (0);	8b: (0);	8c: (2);	8d: (2);	8e: (1); 16f: (3)
4	(0, 0, 0)	8a: (0);	8b: (0);	8c: (1);	8d: (2);	8e: (2); 16f: (3)
5	(0, 0, 0)	8a: (3);	8b: (3);	8c: (1);	8d: (1);	8e: (1); 16f: (3)
6	(0, 0, 0)	8a: (3);	8b: (3);	8c: (2);	8d: (1);	8e: (2); 16f: (3)
7	(0, 0, 0)	8a: (3);	8b: (3);	8c: (2);	8d: (2);	8e: (1); 16f: (3)
8	(0, 0, 0)	8a: (3);	8b: (3);	8c: (1);	8d: (2);	8e: (2); 16f: (3)
$X(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 73						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	8a: (3);	8b: (0);	8c: (2);	8d: (1);	8e: (1); 16f: (3)
2	(0, 0, 0)	8a: (3);	8b: (0);	8c: (1);	8d: (1);	8e: (2); 16f: (3)
3	(0, 0, 0)	8a: (3);	8b: (0);	8c: (1);	8d: (2);	8e: (1); 16f: (3)
4	(0, 0, 0)	8a: (3);	8b: (0);	8c: (2);	8d: (2);	8e: (2); 16f: (3)
5	(0, 0, 0)	8a: (0);	8b: (3);	8c: (2);	8d: (1);	8e: (1); 16f: (3)
6	(0, 0, 0)	8a: (0);	8b: (3);	8c: (1);	8d: (1);	8e: (2); 16f: (3)
7	(0, 0, 0)	8a: (0);	8b: (3);	8c: (1);	8d: (2);	8e: (1); 16f: (3)
8	(0, 0, 0)	8a: (0);	8b: (3);	8c: (2);	8d: (2);	8e: (2); 16f: (3)
$R(0, \frac{1}{2}, 0)$ of space group No. 73						
(Co-) irrep	Phonon AM	WYPO information				

1	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
S $(\frac{1}{2}, 0, 0)$ of space group No. 73		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
T $(0, 0, \frac{1}{2})$ of space group No. 73		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
W $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 73		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 8c: (3); 8d: (3); 8e: (3); 16f: (6)

c. Results for high-symmetry lines

$$D(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$$

Operation	E
Coordinate	$(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$

$$DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$$

Operation	E
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$

$$LD(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$$

Operation	E
Coordinate	$(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$

$$P(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$$

Operation	E
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$

$$Q(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$$

Operation	E
Coordinate	$(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$

$$SM(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$$

Operation	E
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$

D $(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 73		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)

DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 73				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	8a: (3);	8b: (3);	8c: (3); 8d: (2); 8e: (3); 16f: (6)
2	(0, 0, 0)	8a: (3);	8b: (3);	8c: (3); 8d: (2); 8e: (3); 16f: (6)
3	(0, 0, 0)	8a: (3);	8b: (3);	8c: (3); 8d: (4); 8e: (3); 16f: (6)
4	(0, 0, 0)	8a: (3);	8b: (3);	8c: (3); 8d: (4); 8e: (3); 16f: (6)
LD $\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$ of space group No. 73				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	8a: (3);	8b: (3);	8c: (3); 8d: (3); 8e: (2); 16f: (6)
2	(0, 0, 0)	8a: (3);	8b: (3);	8c: (3); 8d: (3); 8e: (2); 16f: (6)
3	(0, 0, 0)	8a: (3);	8b: (3);	8c: (3); 8d: (3); 8e: (4); 16f: (6)
4	(0, 0, 0)	8a: (3);	8b: (3);	8c: (3); 8d: (3); 8e: (4); 16f: (6)
P $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 73				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	8a: (6);	8b: (6);	8c: (6); 8d: (6); 8e: (6); 16f: (12)
Q $\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$ of space group No. 73				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	8a: (6);	8b: (6);	8c: (6); 8d: (6); 8e: (6); 16f: (12)
SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 73				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	8a: (3);	8b: (3);	8c: (2); 8d: (3); 8e: (3); 16f: (6)
2	(0, 0, 0)	8a: (3);	8b: (3);	8c: (2); 8d: (3); 8e: (3); 16f: (6)
3	(0, 0, 0)	8a: (3);	8b: (3);	8c: (4); 8d: (3); 8e: (3); 16f: (6)
4	(0, 0, 0)	8a: (3);	8b: (3);	8c: (4); 8d: (3); 8e: (3); 16f: (6)

d. Results for high-symmetry planes

P1($-v, v, u$)

Operation E
Coordinate ($-v, v, u$)

P2($v, u, -v$)

Operation E
Coordinate ($v, u, -v$)

P3($u, v, -v$)

Operation E
Coordinate ($u, v, -v$)

P1 ($-v, v, u$) of space group No. 73		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
2	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)

P2 ($v, u, -v$) of space group No. 73		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
2	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)

P3 ($u, v, -v$) of space group No. 73		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
2	(0, 0, 0)	8a: (6); 8b: (6); 8c: (6); 8d: (6); 8e: (6); 16f: (12)

74. Space group No. 74 (*Imma*)

Orthorhombic body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, b, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, 0, -\frac{1}{2}\} \quad \{C_{2y}|\frac{1}{2}, 0, -\frac{1}{2}\} \quad \{C_{2x}|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|\frac{1}{2}, 0, -\frac{1}{2}\} \quad \{\sigma_y|\frac{1}{2}, 0, -\frac{1}{2}\} \quad \{\sigma_x|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$X(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0, \frac{1}{2}, 0)$	

Operation	E	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$S(\frac{1}{2}, 0, 0)$		
Operation	E	C_{2z}
Coordinate	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$
$T(0, 0, \frac{1}{2})$		
Operation	E	C_{2y}
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$
$W(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$		
Operation	E	I
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$

$\Gamma (0, 0, 0)$ of space group No. 74

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	4e: (1);	8f: (1);	8g: (1);	8h: (2);	8i: (2);	16j: (3)
2	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	4e: (1);	8f: (2);	8g: (1);	8h: (1);	8i: (2);	16j: (3)
3	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	4e: (0);	8f: (2);	8g: (2);	8h: (1);	8i: (1);	16j: (3)
4	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	4e: (1);	8f: (1);	8g: (2);	8h: (2);	8i: (1);	16j: (3)
5	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	4e: (0);	8f: (1);	8g: (1);	8h: (1);	8i: (1);	16j: (3)
6	(0, 0, 0)	4a: (2);	4b: (2);	4c: (1);	4d: (1);	4e: (1);	8f: (2);	8g: (1);	8h: (2);	8i: (1);	16j: (3)
7	(0, 0, 0)	4a: (2);	4b: (2);	4c: (2);	4d: (2);	4e: (1);	8f: (2);	8g: (2);	8h: (2);	8i: (2);	16j: (3)
8	(0, 0, 0)	4a: (1);	4b: (1);	4c: (2);	4d: (2);	4e: (1);	8f: (1);	8g: (2);	8h: (1);	8i: (2);	16j: (3)

$X (-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 74

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (2);	4b: (2);	4c: (0);	4d: (0);	4e: (1);	8f: (2);	8g: (1);	8h: (2);	8i: (2);	16j: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	4e: (1);	8f: (1);	8g: (1);	8h: (1);	8i: (2);	16j: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	4c: (0);	4d: (0);	4e: (0);	8f: (1);	8g: (2);	8h: (1);	8i: (1);	16j: (3)
4	(0, 0, 0)	4a: (2);	4b: (2);	4c: (0);	4d: (0);	4e: (1);	8f: (2);	8g: (2);	8h: (2);	8i: (1);	16j: (3)
5	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	4e: (0);	8f: (2);	8g: (1);	8h: (1);	8i: (1);	16j: (3)
6	(0, 0, 0)	4a: (0);	4b: (0);	4c: (1);	4d: (1);	4e: (1);	8f: (1);	8g: (1);	8h: (2);	8i: (1);	16j: (3)
7	(0, 0, 0)	4a: (0);	4b: (0);	4c: (2);	4d: (2);	4e: (1);	8f: (1);	8g: (2);	8h: (2);	8i: (2);	16j: (3)
8	(0, 0, 0)	4a: (0);	4b: (0);	4c: (2);	4d: (2);	4e: (1);	8f: (2);	8g: (2);	8h: (1);	8i: (2);	16j: (3)

$R (0, \frac{1}{2}, 0)$ of space group No. 74

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (3);	4b: (0);	4c: (2);	4d: (2);	4e: (2);	8f: (3);	8g: (3);	8h: (3);	8i: (4);	16j: (6)
2	(0, 0, 0)	4a: (0);	4b: (3);	4c: (1);	4d: (1);	4e: (1);	8f: (3);	8g: (3);	8h: (3);	8i: (2);	16j: (6)
3	(0, 0, 0)	4a: (3);	4b: (0);	4c: (1);	4d: (1);	4e: (1);	8f: (3);	8g: (3);	8h: (3);	8i: (2);	16j: (6)
4	(0, 0, 0)	4a: (0);	4b: (3);	4c: (2);	4d: (2);	4e: (2);	8f: (3);	8g: (3);	8h: (3);	8i: (4);	16j: (6)

$S (\frac{1}{2}, 0, 0)$ of space group No. 74

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (3); 4e: (1); 8f: (3); 8g: (3); 8h: (2); 8i: (3); 16j: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (3); 4d: (0); 4e: (2); 8f: (3); 8g: (3); 8h: (4); 8i: (3); 16j: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (0); 4d: (3); 4e: (2); 8f: (3); 8g: (3); 8h: (4); 8i: (3); 16j: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (3); 4d: (0); 4e: (1); 8f: (3); 8g: (3); 8h: (2); 8i: (3); 16j: (6)

$T \left(0, 0, \frac{1}{2}\right)$ of space group No. 74

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)

$W \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$ of space group No. 74

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)

c. Results for high-symmetry lines

$D\left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right)$

Operation	E
Coordinate	$\left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right)$

$DT\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$

Operation	E
Coordinate	$\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$

$LD\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$

Operation	E
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$

$P\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$

Operation	E
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$

$Q\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$

Operation	E
Coordinate	$\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$

$SM\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$

Operation	E
Coordinate	$\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$

$D \left(\frac{1-u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 74

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)

DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 74		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (4); 8i: (3); 16j: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 8f: (3); 8g: (2); 8h: (2); 8i: (3); 16j: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (4); 8h: (4); 8i: (3); 16j: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (3); 8g: (4); 8h: (2); 8i: (3); 16j: (6)
LD $\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$ of space group No. 74		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (3); 8h: (4); 8i: (4); 16j: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (0); 8f: (3); 8g: (3); 8h: (2); 8i: (2); 16j: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (3); 8h: (2); 8i: (4); 16j: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (3); 8h: (4); 8i: (2); 16j: (6)
P $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 74		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
Q $\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$ of space group No. 74		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 74		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 8i: (4); 16j: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (1); 8f: (2); 8g: (3); 8h: (3); 8i: (2); 16j: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (1); 8f: (4); 8g: (3); 8h: (3); 8i: (2); 16j: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 8f: (4); 8g: (3); 8h: (3); 8i: (4); 16j: (6)

d. Results for high-symmetry planes

P1($-v, v, u$)	
Operation	E
Coordinate	($-v, v, u$)
P2($v, u, -v$)	
Operation	E
Coordinate	($v, u, -v$)
P3($u, v, -v$)	
Operation	E
Coordinate	($u, v, -v$)

P1 ($-v, v, u$) of space group No. 74		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
P2 ($v, u, -v$) of space group No. 74		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (4); 4e: (4); 8f: (6); 8g: (6); 8h: (6); 8i: (8); 16j: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 4e: (2); 8f: (6); 8g: (6); 8h: (6); 8i: (4); 16j: (12)
P3 ($u, v, -v$) of space group No. 74		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (4); 4b: (4); 4c: (3); 4d: (3); 4e: (4); 8f: (6); 8g: (6); 8h: (8); 8i: (6); 16j: (12)
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (3); 4d: (3); 4e: (2); 8f: (6); 8g: (6); 8h: (4); 8i: (6); 16j: (12)

75. Space group No. 75 ($P4$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$A\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{lll} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & \left(0, \frac{1}{2}, \frac{1}{2}\right) & \left(-\frac{1}{2}, 0, \frac{1}{2}\right) \end{array}$$

$$X\left(0, \frac{1}{2}, 0\right)$$

$$\begin{array}{lll} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & \left(0, \frac{1}{2}, 0\right) & \left(-\frac{1}{2}, 0, 0\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 75

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 4d: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 4d: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 4d: (3)

$M \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 75

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (0); 2c: (2); 4d: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 4d: (3)
3	(0, 0, 0)	1a: (0); 1b: (1); 2c: (2); 4d: (3)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 75

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 4d: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 4d: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 4d: (3)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 75

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (0); 2c: (2); 4d: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 4d: (3)
3	(0, 0, 0)	1a: (0); 1b: (1); 2c: (2); 4d: (3)

$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 75

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (2); 2c: (3); 4d: (6)
2	(0, 0, 0)	1a: (2); 1b: (1); 2c: (3); 4d: (6)

$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 75

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (2); 2c: (3); 4d: (6)

2 (0, 0, 0) 1a: (2); 1b: (1); 2c: (3); 4d: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W(0, $\frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	($-\frac{1}{2}, u, 0$)

DT (0, v, 0) of space group No. 75

(Co-) irrep	Phonon AM	WYPO information
1	($r_2, r_1, 0$)	1a: (3); 1b: (3); 2c: (6); 4d: (12)

LD $(0, 0, w)$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (1); 4d: (3)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 4d: (3)
3	$(0, 0, r_1)$	1a: (0); 1b: (0); 2c: (1); 4d: (3)
4	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 4d: (3)
S $(u, u, \frac{1}{2})$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 2c: (6); 4d: (12)
SM $(u, u, 0)$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 2c: (6); 4d: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 2c: (6); 4d: (12)
U $(0, v, \frac{1}{2})$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 2c: (6); 4d: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (0); 2c: (2); 4d: (3)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (1); 4d: (3)
3	$(0, 0, r_1)$	1a: (0); 1b: (1); 2c: (2); 4d: (3)
4	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (1); 4d: (3)
W $(0, \frac{1}{2}, w)$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (2); 2c: (3); 4d: (6)
2	$(0, 0, r_1)$	1a: (2); 1b: (1); 2c: (3); 4d: (6)
Y $(u, \frac{1}{2}, 0)$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 2c: (6); 4d: (12)

d. Results for high-symmetry planes

Pl($u, v, 0$)

Operation E

Coordinate	$(u, v, 0)$
P2	$(u, v, \frac{1}{2})$
Operation	E
Coordinate	$(u, v, \frac{1}{2})$
P3	$(0, u, v)$
Operation	E C_{4z}^+
Coordinate	$(0, u, v) (-u, 0, v)$
P4	(u, u, v)
Operation	E C_{4z}^+
Coordinate	$(u, u, v) (-u, u, v)$
P5	$(u, \frac{1}{2}, v)$
Operation	E C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v) (-\frac{1}{2}, u, v)$

P1 $(u, v, 0)$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 2c: (6); 4d: (12)
P2 $(u, v, \frac{1}{2})$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 2c: (6); 4d: (12)
P3 $(0, u, v)$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 2c: (6); 4d: (12)
P4 (u, u, v) of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 2c: (6); 4d: (12)
P5 $(u, \frac{1}{2}, v)$ of space group No. 75		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 2c: (6); 4d: (12)

76. Space group No. 76 ($P4_1$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

$$\{E|0,0,0\} \quad \{C_{4z}^+|0,0,\frac{1}{4}\} \quad \{C_{2z}|0,0,\frac{1}{2}\} \quad \{C_{4z}^-|0,0,\frac{3}{4}\}$$

a. Space group operations

b. Results for high-symmetry points

$\Gamma(0,0,0)$

Operation E
Coordinate (0,0,0)

$M(\frac{1}{2}, \frac{1}{2}, 0)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$

$Z(0,0,\frac{1}{2})$

Operation E
Coordinate $(0,0,\frac{1}{2})$

$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$R(0,\frac{1}{2},\frac{1}{2})$

Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,\frac{1}{2})$

$X(0,\frac{1}{2},0)$

Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

$\Gamma(0,0,0)$ of space group No. 76

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (3)
2	(0,0,0)	4a: (3)
3	(0,0,0)	4a: (3)

$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 76

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (3)
2	(0,0,0)	4a: (3)
3	(0,0,0)	4a: (3)

Z $(0, 0, \frac{1}{2})$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
X $(0, \frac{1}{2}, 0)$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
2	(0, 0, 0)	4a: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)

$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12)
LD $(0, 0, w)$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3)
2	$(0, 0, r_1)$	4a: (3)
3	$(0, 0, r_1)$	4a: (3)
4	$(0, 0, r_1)$	4a: (3)
S $(u, u, \frac{1}{2})$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)
SM $(u, u, 0)$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)
U $(0, v, \frac{1}{2})$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3)
2	$(0, 0, r_1)$	4a: (3)
3	$(0, 0, r_1)$	4a: (3)

4	$(0, 0, r_1)$	4a: (3)	
$W \left(0, \frac{1}{2}, w\right)$ of space group No. 76			
(Co-) irrep	Phonon AM		WYPO information
1	$(0, 0, r_1)$	4a: (6)	
2	$(0, 0, r_1)$	4a: (6)	
$Y \left(u, \frac{1}{2}, 0\right)$ of space group No. 76			
(Co-) irrep	Phonon AM		WYPO information
1	$(r_2, r_1, 0)$	4a: (12)	

d. Results for high-symmetry planes

P1($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

$P1(u, v, 0)$ of space group No. 76			
(Co-) irrep	Phonon AM		WYPO information
1	$(r_2, r_1, 0)$	4a: (12)	
$P2(u, v, \frac{1}{2})$ of space group No. 76			
(Co-) irrep	Phonon AM		WYPO information
1	$(r_2, r_1, 0)$	4a: (6)	
$P3(0, u, v)$ of space group No. 76			
(Co-) irrep	Phonon AM		WYPO information

1	(r_3, r_2, r_1)	4a: (12)
P4 (u, u, v) of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	4a: (12)
P5 $(u, \frac{1}{2}, v)$ of space group No. 76		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	4a: (12)

77. Space group No. 77 ($P4_2$)

Tetragonal primitive lattice

$\vec{a} = (a, 0, 0)$
 $\vec{b} = (0, a, 0)$
 $\vec{c} = (0, 0, c)$

$\vec{t}_1 = \vec{a}$
 $\vec{t}_2 = \vec{b}$
 $\vec{t}_3 = \vec{c}$

a. Space group operations

$\{E|0, 0, 0\}$ $\{C_{4z}^+|0, 0, \frac{1}{2}\}$ $\{C_{2z}|0, 0, 0\}$ $\{C_{4z}^-|0, 0, \frac{1}{2}\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate $(0, 0, 0)$
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E C_{4z}^+

Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
X	$(0, \frac{1}{2}, 0)$	
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma (0, 0, 0)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3)	
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3)	
$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3)	
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3)	
$Z (0, 0, \frac{1}{2})$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3)	
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3)	
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3)	
$A (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3)	
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3)	
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3)	
$R (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2); 2b: (4); 2c: (3); 4d: (6)	
2	(0, 0, 0)	2a: (4); 2b: (2); 2c: (3); 4d: (6)	
$X (0, \frac{1}{2}, 0)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2); 2b: (4); 2c: (3); 4d: (6)	
2	(0, 0, 0)	2a: (4); 2b: (2); 2c: (3); 4d: (6)	

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($0, v, \frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	($0, \frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	($-\frac{1}{2}, u, 0$)

DT (0, v, 0) of space group No. 77		
(Co-) irrep	Phonon AM	WYPO information
1	($r_2, r_1, 0$)	2a: (6); 2b: (6); 2c: (6); 4d: (12)
LD (0, 0, w) of space group No. 77		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 4d: (3)
2	(0, 0, r_1)	2a: (2); 2b: (2); 2c: (2); 4d: (3)
3	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 4d: (3)
4	(0, 0, r_1)	2a: (2); 2b: (2); 2c: (2); 4d: (3)

S $\left(u, u, \frac{1}{2}\right)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12)	
SM $(u, u, 0)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12)	
T $\left(u, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12)	
U $\left(0, v, \frac{1}{2}\right)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12)	
V $\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (2); 4d: (3)	
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (1); 4d: (3)	
3	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (2); 4d: (3)	
4	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (1); 4d: (3)	
W $\left(0, \frac{1}{2}, w\right)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	2a: (2); 2b: (4); 2c: (3); 4d: (6)	
2	$(0, 0, r_1)$	2a: (4); 2b: (2); 2c: (3); 4d: (6)	
Y $\left(u, \frac{1}{2}, 0\right)$ of space group No. 77			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12)	

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate $(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 77		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12)
P2 ($u, v, \frac{1}{2}$) of space group No. 77		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12)
P3 ($0, u, v$) of space group No. 77		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 4d: (12)
P4 (u, u, v) of space group No. 77		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 4d: (12)
P5 ($u, \frac{1}{2}, v$) of space group No. 77		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 4d: (12)

78. Space group No. 78 (P_{43})

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{4z}^+|0, 0, \frac{3}{4}\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{C_{4z}^-|0, 0, \frac{1}{4}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$M(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 78			
(Co-) irrep	Phonon AM		WYPO information
1	$(0, 0, 0)$	4a: (3)	
2	$(0, 0, 0)$	4a: (3)	
3	$(0, 0, 0)$	4a: (3)	
$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 78			
(Co-) irrep	Phonon AM		WYPO information
1	$(0, 0, 0)$	4a: (3)	
2	$(0, 0, 0)$	4a: (3)	
3	$(0, 0, 0)$	4a: (3)	
$Z(0, 0, \frac{1}{2})$ of space group No. 78			
(Co-) irrep	Phonon AM		WYPO information
1	$(0, 0, 0)$	4a: (3)	
2	$(0, 0, 0)$	4a: (3)	
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 78			
(Co-) irrep	Phonon AM		WYPO information

1	(0, 0, 0)	4a: (3)
2	(0, 0, 0)	4a: (3)
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 78		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
X $(0, \frac{1}{2}, 0)$ of space group No. 78		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6)
2	(0, 0, 0)	4a: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($0, v, \frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	($0, \frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)

$$Y(u, \frac{1}{2}, 0)$$

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12)

LD $(0, 0, w)$ of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3)
2	$(0, 0, r_1)$	4a: (3)
3	$(0, 0, r_1)$	4a: (3)
4	$(0, 0, r_1)$	4a: (3)

S $(u, u, \frac{1}{2})$ of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)

SM $(u, u, 0)$ of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)

U $(0, v, \frac{1}{2})$ of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3)
2	$(0, 0, r_1)$	4a: (3)
3	$(0, 0, r_1)$	4a: (3)
4	$(0, 0, r_1)$	4a: (3)

W $(0, \frac{1}{2}, w)$ of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (6)
2	$(0, 0, r_1)$	4a: (6)

Y $(u, \frac{1}{2}, 0)$ of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate $(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate $(0, u, v)$ $(-u, 0, v)$

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) $(-u, u, v)$

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, v)$ $(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12)

P2 ($u, v, \frac{1}{2}$) of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6)

P3 ($0, u, v$) of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	4a: (12)

P4 (u, u, v) of space group No. 78

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	4a: (12)

P5 ($u, \frac{1}{2}, v$) of space group No. 78

(Co-) irrep	Phonon AM	WYPO information

1

 (r_3, r_2, r_1) **4a: (12)****79. Space group No. 79 ($I4$)**

Tetragonal body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\}$$

b. Results for high-symmetry points $\Gamma(0, 0, 0)$

Operation E
Coordinate $(0, 0, 0)$

 $N(0, \frac{1}{2}, 0)$

Operation E C_{4z}^+ C_{4z}^- C_{2z}
Coordinate $(0, \frac{1}{2}, 0)$ $(\frac{1}{2}, 0, 0)$ $(0, \frac{1}{2}, -\frac{1}{2})$ $(\frac{1}{2}, 0, -\frac{1}{2})$

 $X(0, 0, \frac{1}{2})$

Operation E C_{4z}^+
Coordinate $(0, 0, \frac{1}{2})$ $(\frac{1}{2}, -\frac{1}{2}, 0)$

 $Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

 $P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$

Operation E C_{4z}^+
Coordinate $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ $(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4})$

 $\Gamma(0, 0, 0)$ of space group No. 79

(Co-) irrep

Phonon AM

WYPO information

1	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)
2	(0, 0, 0)	2a: (1); 4b: (2); 8c: (3)
3	(0, 0, 0)	2a: (0); 4b: (1); 8c: (3)
N $(0, \frac{1}{2}, 0)$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 8c: (12)
X $(0, 0, \frac{1}{2})$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (4); 8c: (6)
2	(0, 0, 0)	2a: (2); 4b: (2); 8c: (6)
Z $(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)
2	(0, 0, 0)	2a: (1); 4b: (2); 8c: (3)
3	(0, 0, 0)	2a: (0); 4b: (1); 8c: (3)
P $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (4); 8c: (6)
2	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	

$Y(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u)$

DT $(0, 0, u)$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 4b: (1); 8c: (3)
2	$(0, 0, r_1)$	2a: (1); 4b: (2); 8c: (3)
3	$(0, 0, r_1)$	2a: (0); 4b: (1); 8c: (3)
4	$(0, 0, r_1)$	2a: (1); 4b: (2); 8c: (3)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (3); 4b: (6); 8c: (12)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 4b: (4); 8c: (6)
2	$(0, 0, r_1)$	2a: (2); 4b: (2); 8c: (6)
Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$ of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)

d. Results for high-symmetry planes

$P1(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$	$(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v)$
$P2(u, v, -u)$		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$

P3($u, -u, v$)	
Operation	E
Coordinate	($u, -u, v$)

P1 ($\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v$) of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (3); 4b: (6); 8c: (12)

P2 ($u, v, -u$) of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (3); 4b: (6); 8c: (12)

P3 ($u, -u, v$) of space group No. 79		
(Co-) irrep	Phonon AM	WYPO information
1	($r_2, r_1, 0$)	2a: (3); 4b: (6); 8c: (12)

80. Space group No. 80 ($I4_1$)

Tetragonal body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{4z}^+|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{C_{2z}|0,0,0\} \quad \{C_{4z}^-|\frac{3}{4}, \frac{1}{4}, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$

$X(0, 0, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4})$

$\Gamma(0, 0, 0)$ of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 8b: (3)
2	(0, 0, 0)	4a: (2); 8b: (3)
3	(0, 0, 0)	4a: (1); 8b: (3)
$N(0, \frac{1}{2}, 0)$ of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 8b: (12)
$X(0, 0, \frac{1}{2})$ of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
2	(0, 0, 0)	4a: (3); 8b: (6)
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 8b: (3)
2	(0, 0, 0)	4a: (1); 8b: (3)
3	(0, 0, 0)	4a: (2); 8b: (3)
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)

c. Results for high-symmetry lines

$DT(0, 0, u)$		
Operation	E	C_{4z}^+
Coordinate	$(0, 0, u)$	$(u, -u, 0)$

LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	
Coordinate	$(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$	$C_{4z}^+ (\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2})$
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$C_{4z}^+ (\frac{u}{2}, -\frac{u}{2}, \frac{u}{2})$
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	
Coordinate	$(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$	$C_{4z}^+ (\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u)$

DT (0, 0, u) of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 8b: (12)
LD ($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$) of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (1); 8b: (3)
2	$(0, 0, r_1)$	4a: (2); 8b: (3)
3	$(0, 0, r_1)$	4a: (1); 8b: (3)
4	$(0, 0, r_1)$	4a: (2); 8b: (3)
Q ($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$) of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	4a: (6); 8b: (12)
SM ($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$) of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 8b: (12)
W ($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$) of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 8b: (6)
2	$(0, 0, r_1)$	4a: (3); 8b: (6)
Y ($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$) of space group No. 80		

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 8b: (12)

d. Results for high-symmetry planes

P1 $(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$	$(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v)$
P2 $(u, v, -u)$		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3 $(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 $(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$ of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	4a: (6); 8b: (12)
P2 $(u, v, -u)$ of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	4a: (6); 8b: (12)
P3 $(u, -u, v)$ of space group No. 80		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 8b: (12)

81. Space group No. 81 ($P4^-$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$M(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	S_{4z}^{+}
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	S_{4z}^{+}
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 81				
(Co-) irrep	Phonon AM	WYPO information		
1	$(0, 0, 0)$	1a: (0);	1b: (0); 1c: (0); 1d: (0);	2e: (1); 2f: (1); 2g: (1); 4h: (3)
2	$(0, 0, 0)$	1a: (1);	1b: (1); 1c: (1); 1d: (1);	2e: (2); 2f: (2); 2g: (2); 4h: (3)
3	$(0, 0, 0)$	1a: (1);	1b: (1); 1c: (1); 1d: (1);	2e: (1); 2f: (1); 2g: (1); 4h: (3)
$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 81				
(Co-) irrep	Phonon AM	WYPO information		
1	$(0, 0, 0)$	1a: (0);	1b: (0); 1c: (1); 1d: (1);	2e: (1); 2f: (1); 2g: (2); 4h: (3)
2	$(0, 0, 0)$	1a: (1);	1b: (1); 1c: (1); 1d: (1);	2e: (2); 2f: (2); 2g: (1); 4h: (3)
3	$(0, 0, 0)$	1a: (1);	1b: (1); 1c: (0); 1d: (0);	2e: (1); 2f: (1); 2g: (2); 4h: (3)
$Z(0, 0, \frac{1}{2})$ of space group No. 81				
(Co-) irrep	Phonon AM	WYPO information		
1	$(0, 0, 0)$	1a: (0);	1b: (1); 1c: (0); 1d: (1);	2e: (1); 2f: (1); 2g: (1); 4h: (3)
2	$(0, 0, 0)$	1a: (1);	1b: (1); 1c: (1); 1d: (1);	2e: (2); 2f: (2); 2g: (2); 4h: (3)
3	$(0, 0, 0)$	1a: (1);	1b: (0); 1c: (1); 1d: (0);	2e: (1); 2f: (1); 2g: (1); 4h: (3)
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 81				

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 2e: (1); 2f: (1); 2g: (2); 4h: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 4h: (3)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 4h: (3)
$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 81		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 4h: (6)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 4h: (6)
$X\left(0, \frac{1}{2}, 0\right)$ of space group No. 81		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 4h: (6)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 4h: (6)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	S_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

S(u , u , $\frac{1}{2}$)

Operation	E	S_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $-\frac{1}{2}$)

SM(u , u , 0)

Operation	E	S_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)

T(u , $\frac{1}{2}$, $\frac{1}{2}$)

Operation	E	S_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $-\frac{1}{2}$)

U(0, v , $\frac{1}{2}$)

Operation	E	S_{4z}^+
Coordinate	(0, v , $\frac{1}{2}$)	($-v$, 0, $-\frac{1}{2}$)

V($\frac{1}{2}$, $\frac{1}{2}$, w)

Operation	E
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)

W(0, $\frac{1}{2}$, w)

Operation	E	S_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, -w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	S_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 81			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)	
LD $(0, 0, w)$ of space group No. 81			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (6)	
2	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (3)	
S $(u, u, \frac{1}{2})$ of space group No. 81			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)	
SM $(u, u, 0)$ of space group No. 81			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)	
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 81			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)	
U $(0, v, \frac{1}{2})$ of space group No. 81			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)	
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 81			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (4); 4h: (6)	
2	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 4h: (3)	
W $(0, \frac{1}{2}, w)$ of space group No. 81			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 4h: (6)	
2	$(0, 0, r_1)$	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 4h: (6)	
Y $(u, \frac{1}{2}, 0)$ of space group No. 81			
(Co-) irrep	Phonon AM	WYPO information	

1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)
Operation E
Coordinate $(u, v, 0)$
P2($u, v, \frac{1}{2}$)
Operation E
Coordinate $(u, v, \frac{1}{2})$
P3($0, u, v$)
Operation E S_{4z}^-
Coordinate $(0, u, v)$ $(u, 0, -v)$
P4(u, u, v)
Operation E S_{4z}^-
Coordinate (u, u, v) $(u, -u, -v)$
P5($u, \frac{1}{2}, v$)
Operation E S_{4z}^+
Coordinate $(u, \frac{1}{2}, v)$ $(-\frac{1}{2}, u, -v)$

P1 ($u, v, 0$) of space group No. 81		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)
P2 ($u, v, \frac{1}{2}$) of space group No. 81		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)
P3 ($0, u, v$) of space group No. 81		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)
P4 (u, u, v) of space group No. 81		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)
P5 ($u, \frac{1}{2}, v$) of space group No. 81		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12)

82. Space group No. 82 ($I\bar{4}$)

Tetragonal body-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	S_{4z}^-	S_{4z}^+	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$	$(0, -\frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	S_{4z}^+		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$				
Operation	E	$E\Theta$		
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$		

 $\Gamma(0, 0, 0)$ of space group No. 82

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 8g: (3)

N $(0, \frac{1}{2}, 0)$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12)
X $(0, 0, \frac{1}{2})$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 8g: (6)
Z $(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 8g: (3)
P $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 8g: (3)
2	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 4e: (2); 4f: (1); 8g: (3)
3	(0, 0, r_1)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 8g: (3)
4	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 4e: (2); 4f: (1); 8g: (3)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	S_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	S_{4z}^-
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1}{2}(-1-v), \frac{v}{2}, \frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		

Operation	E	S_{4z}^+
Coordinate	$(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u)$

DT $(0, 0, u)$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (3)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 8g: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 8g: (6)
Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$ of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12)

d. Results for high-symmetry planes

P1 $(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$		
Operation	E	S_{4z}^+
Coordinate	$(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$	$(\frac{1}{2} - v, -\frac{1}{2} - v, -\frac{1}{2} + u + v)$
P2 $(u, v, -u)$		
Operation	E	S_{4z}^+
Coordinate	$(u, v, -u)$	$(-u, -v, v)$
P3 $(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 ($\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v$) of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12)
P2 ($u, v, -u$) of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12)
P3 ($u, -u, v$) of space group No. 82		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12)

83. Space group No. 83 ($P4/m$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & \vec{t}_1 = \vec{a} \\
 \text{Tetragonal primitive lattice} & \vec{b} = (0, a, 0) & \vec{t}_2 = \vec{b} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

$$\{E|0, 0, 0\} \{C_{4z}^+|0, 0, 0\} \{C_{2z}|0, 0, 0\} \{C_{4z}^-|0, 0, 0\} \{I|0, 0, 0\} \{S_{4z}^-|0, 0, 0\} \{\sigma_z|0, 0, 0\} \{S_{4z}^+|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (0, 0, 0)
 \end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)
 \end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (0, 0, \frac{1}{2})
 \end{array}$$

$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 83											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (0);	2f: (0);	2g: (1);	2h: (1);	4i: (1);	4j: (2); 4k: (2); 8l: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (0);	2f: (0);	2g: (1);	2h: (1);	4i: (2);	4j: (1); 4k: (1); 8l: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (0);	2f: (0);	2g: (0);	2h: (0);	4i: (1);	4j: (2); 4k: (2); 8l: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (1); 4k: (1); 8l: (3)
5	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (1);	2h: (1);	4i: (2);	4j: (2); 4k: (2); 8l: (3)
6	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (0);	2h: (0);	4i: (1);	4j: (1); 4k: (1); 8l: (3)
$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 83											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (2);	2f: (2);	2g: (1);	2h: (0);	4i: (2);	4j: (2); 4k: (2); 8l: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (1); 4k: (1); 8l: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (2);	2f: (2);	2g: (0);	2h: (1);	4i: (2);	4j: (2); 4k: (2); 8l: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (0);	1d: (0);	2e: (0);	2f: (0);	2g: (1);	2h: (0);	4i: (2);	4j: (1); 4k: (1); 8l: (3)
5	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (0);	2f: (0);	2g: (1);	2h: (1);	4i: (1);	4j: (2); 4k: (2); 8l: (3)
6	(0, 0, 0)	1a: (0);	1b: (0);	1c: (1);	1d: (1);	2e: (0);	2f: (0);	2g: (0);	2h: (1);	4i: (2);	4j: (1); 4k: (1); 8l: (3)
$Z(0, 0, \frac{1}{2})$ of space group No. 83											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (1);	1c: (0);	1d: (1);	2e: (0);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (2); 4k: (1); 8l: (3)
2	(0, 0, 0)	1a: (0);	1b: (1);	1c: (0);	1d: (1);	2e: (0);	2f: (2);	2g: (1);	2h: (1);	4i: (2);	4j: (1); 4k: (2); 8l: (3)

3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (1); 2g: (0); 2h: (0); 4i: (1); 4j: (2); 4k: (1); 8l: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (1); 2f: (0); 2g: (1); 2h: (1); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
5	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (2); 2f: (0); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (1); 8l: (3)
6	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (0); 2g: (0); 2h: (0); 4i: (1); 4j: (1); 4k: (2); 8l: (3)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (0); 2e: (2); 2f: (0); 2g: (1); 2h: (0); 4i: (2); 4j: (2); 4k: (1); 8l: (3)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 2e: (1); 2f: (0); 2g: (1); 2h: (1); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (1); 2e: (2); 2f: (0); 2g: (0); 2h: (1); 4i: (2); 4j: (2); 4k: (1); 8l: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (2); 2g: (1); 2h: (0); 4i: (2); 4j: (1); 4k: (2); 8l: (3)
5	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (0); 2f: (1); 2g: (1); 2h: (1); 4i: (1); 4j: (2); 4k: (1); 8l: (3)
6	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (0); 2e: (0); 2f: (2); 2g: (0); 2h: (1); 4i: (2); 4j: (1); 4k: (2); 8l: (3)

$R \left(0, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (2); 1d: (0); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (3); 4j: (4); 4k: (2); 8l: (6)
2	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (2); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (2); 4k: (4); 8l: (6)
3	(0, 0, 0)	1a: (0); 1b: (2); 1c: (1); 1d: (0); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (2); 4k: (4); 8l: (6)
4	(0, 0, 0)	1a: (2); 1b: (0); 1c: (0); 1d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (4); 4k: (2); 8l: (6)

$X \left(0, \frac{1}{2}, 0 \right)$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (2); 1d: (2); 2e: (2); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (4); 4k: (4); 8l: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (2); 4i: (3); 4j: (2); 4k: (2); 8l: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (2); 4k: (2); 8l: (6)
4	(0, 0, 0)	1a: (2); 1b: (2); 1c: (0); 1d: (0); 2e: (2); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (4); 4k: (4); 8l: (6)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	$(0, v, 0)$	$(-v, 0, 0)$

LD(0, 0, w)

Operation	E
Coordinate	$(0, 0, w)$

S($u, u, \frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$

SM($u, u, 0$)

Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$

T($u, \frac{1}{2}, \frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$

U($0, v, \frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$

V($\frac{1}{2}, \frac{1}{2}, w$)

Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$

W($0, \frac{1}{2}, w$)

Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$

Y($u, \frac{1}{2}, 0$)

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT (0, v, 0) of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (8); 4k: (8); 8l: (12)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (4); 4k: (4); 8l: (12)

LD (0, 0, w) of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (3); 4k: (3); 8l: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (3); 4k: (3); 8l: (6)

3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (0); 2h: (0); 4i: (2); 4j: (3); 4k: (3); 8l: (6)

$S(u, u, \frac{1}{2})$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (8); 4k: (4); 8l: (12)
2	(0, 0, 0)	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (4); 4k: (8); 8l: (12)

$SM(u, u, 0)$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (8); 4k: (8); 8l: (12)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (4); 4k: (4); 8l: (12)

$T(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (8); 4k: (4); 8l: (12)
2	(0, 0, 0)	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (4); 4k: (8); 8l: (12)

$U(0, v, \frac{1}{2})$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (8); 4k: (4); 8l: (12)
2	(0, 0, 0)	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (4); 4k: (8); 8l: (12)

$V(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (2); 2f: (2); 2g: (2); 2h: (0); 4i: (4); 4j: (3); 4k: (3); 8l: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (3); 4k: (3); 8l: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (0); 2h: (2); 4i: (4); 4j: (3); 4k: (3); 8l: (6)

$W(0, \frac{1}{2}, w)$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (2); 2h: (4); 4i: (6); 4j: (6); 4k: (6); 8l: (12)
2	(0, 0, 0)	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (4); 2h: (2); 4i: (6); 4j: (6); 4k: (6); 8l: (12)

$Y(u, \frac{1}{2}, 0)$ of space group No. 83

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (8); 4k: (8); 8l: (12)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (4); 4k: (4); 8l: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 83												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (2); 8l: (12)	1b: (2);	1c: (2);	1d: (2);	2e: (4);	2f: (4);	2g: (3);	2h: (3);	4i: (6);	4j: (8);	4k: (8);
2	(0, 0, 0)	1a: (1); 8l: (12)	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (3);	2h: (3);	4i: (6);	4j: (4);	4k: (4);
P2 ($u, v, \frac{1}{2}$) of space group No. 83												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (2); 8l: (12)	1b: (1);	1c: (2);	1d: (1);	2e: (4);	2f: (2);	2g: (3);	2h: (3);	4i: (6);	4j: (8);	4k: (4);
2	(0, 0, 0)	1a: (1); 8l: (12)	1b: (2);	1c: (1);	1d: (2);	2e: (2);	2f: (4);	2g: (3);	2h: (3);	4i: (6);	4j: (4);	4k: (8);
P3 (0, u, v) of space group No. 83												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (3); (12);	1b: (3);	1c: (3);	1d: (3);	2e: (6);	2f: (6);	2g: (6);	2h: (6);	4i: (12);	4j: (12);	4k: (24)

P4 (u, u, v) of space group No. 83		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 8l: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 83		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 8l: (24)

84. Space group No. 84 ($P4_2/m$)

Tetragonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{4z}^+|0, 0, \frac{1}{2}\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^-|0, 0, \frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{S_{4z}^-|0, 0, -\frac{1}{2}\} \quad \{\sigma_z|0, 0, 0\} \quad \{S_{4z}^+|0, 0, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, 0) \end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0) \end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2}) \end{array}$$

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

Γ (0, 0, 0) of space group No. 84											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (0);	2f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (2); 8k: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (2);	4j: (1); 8k: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	2e: (1);	2f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (2); 8k: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1); 8k: (3)
5	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (2);	4j: (2); 8k: (3)
6	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (0);	2f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (1); 8k: (3)
M ($\frac{1}{2}, \frac{1}{2}, 0$) of space group No. 84											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (2);	2d: (2);	2e: (0);	2f: (1);	4g: (1);	4h: (1);	4i: (2);	4j: (2); 8k: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (1);	4j: (1); 8k: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (2);	2d: (2);	2e: (1);	2f: (0);	4g: (1);	4h: (1);	4i: (2);	4j: (2); 8k: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (0);	2e: (1);	2f: (0);	4g: (1);	4h: (1);	4i: (2);	4j: (1); 8k: (3)
5	(0, 0, 0)	2a: (2);	2b: (2);	2c: (0);	2d: (0);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (1);	4j: (2); 8k: (3)
6	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (0);	2e: (0);	2f: (1);	4g: (1);	4h: (1);	4i: (2);	4j: (1); 8k: (3)
Z ($0, 0, \frac{1}{2}$) of space group No. 84											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	2e: (2);	2f: (2);	4g: (4);	4h: (4);	4i: (4);	4j: (3); 8k: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (2);	4j: (3); 8k: (6)
A ($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$) of space group No. 84											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2);	2b: (2);	2c: (1);	2d: (1);	2e: (2);	2f: (2);	4g: (4);	4h: (4);	4i: (2);	4j: (3); 8k: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (2);	2d: (2);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (4);	4j: (3); 8k: (6)
R ($0, \frac{1}{2}, \frac{1}{2}$) of space group No. 84											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (2);	2c: (3);	2d: (0);	2e: (1);	2f: (2);	4g: (2);	4h: (4);	4i: (3);	4j: (3); 8k: (6)
2	(0, 0, 0)	2a: (1);	2b: (2);	2c: (0);	2d: (3);	2e: (1);	2f: (2);	4g: (2);	4h: (4);	4i: (3);	4j: (3); 8k: (6)
3	(0, 0, 0)	2a: (2);	2b: (1);	2c: (3);	2d: (0);	2e: (2);	2f: (1);	4g: (4);	4h: (2);	4i: (3);	4j: (3); 8k: (6)
4	(0, 0, 0)	2a: (2);	2b: (1);	2c: (0);	2d: (3);	2e: (2);	2f: (1);	4g: (4);	4h: (2);	4i: (3);	4j: (3); 8k: (6)
X ($0, \frac{1}{2}, 0$) of space group No. 84											

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (4); 2c: (2); 2d: (2); 2e: (1); 2f: (2); 4g: (2); 4h: (4); 4i: (3); 4j: (4); 8k: (6)
2	(0, 0, 0)	2a: (2); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (2); 4g: (2); 4h: (4); 4i: (3); 4j: (2); 8k: (6)
3	(0, 0, 0)	2a: (0); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (1); 4g: (4); 4h: (2); 4i: (3); 4j: (2); 8k: (6)
4	(0, 0, 0)	2a: (4); 2b: (0); 2c: (2); 2d: (2); 2e: (2); 2f: (1); 4g: (4); 4h: (2); 4i: (3); 4j: (4); 8k: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W(0, $\frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	($-\frac{1}{2}, u, 0$)

DT $(0, v, 0)$ of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (8); 8k: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (4); 8k: (12)

LD $(0, 0, w)$ of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (3); 8k: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (4); 4j: (3); 8k: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (3); 8k: (6)

S $(u, u, \frac{1}{2})$ of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)

SM $(u, u, 0)$ of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (8); 8k: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (4); 8k: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)

U $(0, v, \frac{1}{2})$ of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (4); 4j: (3); 8k: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (2); 4j: (3); 8k: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (4); 4j: (3); 8k: (6)

W $(0, \frac{1}{2}, w)$ of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (4); 2c: (3); 2d: (3); 2e: (2); 2f: (4); 4g: (4); 4h: (8); 4i: (6); 4j: (6); 8k: (12)
2	(0, 0, 0)	2a: (4); 2b: (2); 2c: (3); 2d: (3); 2e: (4); 2f: (2); 4g: (8); 4h: (4); 4i: (6); 4j: (6); 8k: (12)

Y $(u, \frac{1}{2}, 0)$ of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (8); 8k: (12)

2 (0, 0, 0) 2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (4); 8k: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate ($u, v, \frac{1}{2}$)

P3(0, u, v)

Operation E C_{4z}^+
Coordinate (0, u, v) ($-u, 0, v$)

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) ($-u, u, v$)

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate ($u, \frac{1}{2}, v$) ($-\frac{1}{2}, u, v$)

P1 ($u, v, 0$) of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (8); 8k: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (4); 8k: (12)

P2 ($u, v, \frac{1}{2}$) of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12)

P3 (0, u, v) of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 8k: (24)

P4 (u, u, v) of space group No. 84

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 8k: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 84		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 8k: (24)

85. Space group No. 85 ($P4/n$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{4z}^+|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^-|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{I|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{\sigma_z|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{S_{4z}^+|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	
$M(\frac{1}{2},\frac{1}{2},0)$		
Operation	E	
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$	
$Z(0,0,\frac{1}{2})$		
Operation	E	
Coordinate	$(0,0,\frac{1}{2})$	
$A(\frac{1}{2},\frac{1}{2},\frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
$R(0,\frac{1}{2},\frac{1}{2})$		
Operation	E	C_{4z}^{+}
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$
$X(0,\frac{1}{2},0)$		
Operation	E	C_{4z}^{+}

Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

$\Gamma (0, 0, 0)$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 4d: (0); 4e: (0); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (0); 4e: (0); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 4d: (0); 4e: (0); 4f: (1); 8g: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3); 4e: (3); 4f: (1); 8g: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3); 4e: (3); 4f: (2); 8g: (3)
6	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 4d: (3); 4e: (3); 4f: (1); 8g: (3)
$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3); 4e: (3); 4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
$Z (0, 0, \frac{1}{2})$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 4d: (0); 4e: (3); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (0); 4e: (3); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 4d: (0); 4e: (3); 4f: (1); 8g: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 4d: (3); 4e: (0); 4f: (1); 8g: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3); 4e: (0); 4f: (2); 8g: (3)
6	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 4d: (3); 4e: (0); 4f: (1); 8g: (3)
$A (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3); 4e: (3); 4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
$R (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
$X (0, \frac{1}{2}, 0)$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

c. Results for high-symmetry lines

DT(0, v , 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S(u, u, 1/2)		
Operation	E	C _{4z} ⁺
Coordinate	(u, u, 1/2)	(-u, u, 1/2)
SM(u, u, 0)		
Operation	E	C _{4z} ⁺
Coordinate	(u, u, 0)	(-u, u, 0)
T(u, 1/2, 1/2)		
Operation	E	C _{4z} ⁺
Coordinate	(u, 1/2, 1/2)	(-1/2, u, 1/2)
U(0, v, 1/2)		
Operation	E	C _{4z} ⁺
Coordinate	(0, v, 1/2)	(-v, 0, 1/2)
V(1/2, 1/2, w)		
Operation	E	
Coordinate	(1/2, 1/2, w)	
W(0, 1/2, w)		
Operation	E	C _{4z} ⁺
Coordinate	(0, 1/2, w)	(-1/2, 0, w)
Y(u, 1/2, 0)		
Operation	E	C _{4z} ⁺
Coordinate	(u, 1/2, 0)	(-1/2, u, 0)

DT (0, v, 0) of space group No. 85

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

LD (0, 0, w) of space group No. 85

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3); 4e: (3); 4f: (4); 8g: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 4d: (3); 4e: (3); 4f: (2); 8g: (6)

S (u, u, $\frac{1}{2}$) of space group No. 85

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
SM $(u, u, 0)$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
U $(0, v, \frac{1}{2})$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3); 4e: (3); 4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 85		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate ($u, v, \frac{1}{2}$)

P3(0, u, v)

Operation E C_{4z}^+

Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 85

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

P2 ($u, v, \frac{1}{2}$) of space group No. 85

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

P3 ($0, u, v$) of space group No. 85

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

P4 (u, u, v) of space group No. 85

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 85

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

86. Space group No. 86 ($P4_2/n$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & \vec{t}_1 = \vec{a} \\
 \text{Tetragonal primitive lattice} & \vec{b} = (0, a, 0) & \vec{t}_2 = \vec{b} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

$$\{E|0, 0, 0\} \{C_{4z}^+|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \{C_{2z}|0, 0, 0\} \{C_{4z}^-|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \{I|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \{S_{4z}^-|0, 0, 0\} \{\sigma_z|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \{S_{4z}^+|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate $(0, 0, 0)$
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$
Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

Γ (0, 0, 0) of space group No. 86							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (1);	4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (0);	4d: (0);	4e: (2);	4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (0);	4d: (0);	4e: (1);	4f: (1); 8g: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (1);	4f: (1); 8g: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (2);	4f: (2); 8g: (3)
6	(0, 0, 0)	2a: (0);	2b: (0);	4c: (3);	4d: (3);	4e: (1);	4f: (1); 8g: (3)
$M\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 86							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (2);	4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (4);	4f: (2); 8g: (6)
$Z\left(0, 0, \frac{1}{2}\right)$ of space group No. 86							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (4);	4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (2);	4f: (2); 8g: (6)

A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 4c: (0); 4d: (3); 4e: (2); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (3); 4e: (1); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1); 2b: (0); 4c: (0); 4d: (3); 4e: (2); 4f: (1); 8g: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 4c: (3); 4d: (0); 4e: (2); 4f: (1); 8g: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (0); 4e: (1); 4f: (2); 8g: (3)
6	(0, 0, 0)	2a: (0); 2b: (1); 4c: (3); 4d: (0); 4e: (2); 4f: (1); 8g: (3)
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
X $(0, \frac{1}{2}, 0)$ of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($0, v, \frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	

Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

$W(0, \frac{1}{2}, w)$

Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, w)$ $(-\frac{1}{2}, 0, w)$

$Y(u, \frac{1}{2}, 0)$

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, 0)$ $(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 86

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

LD $(0, 0, w)$ of space group No. 86

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 4f: (2); 8g: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 4f: (4); 8g: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 4f: (2); 8g: (6)

S $(u, u, \frac{1}{2})$ of space group No. 86

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

SM $(u, u, 0)$ of space group No. 86

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 86

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

U $(0, v, \frac{1}{2})$ of space group No. 86

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 86

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (2); 4f: (4); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (4); 4f: (2); 8g: (6)

3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (4); 4f: (2); 8g: (6)
$W \left(0, \frac{1}{2}, w\right)$ of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
$Y \left(u, \frac{1}{2}, 0\right)$ of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

d. Results for high-symmetry planes

$P1(u, v, 0)$

Operation E
Coordinate $(u, v, 0)$

$P2(u, v, \frac{1}{2})$

Operation E
Coordinate $(u, v, \frac{1}{2})$

$P3(0, u, v)$

Operation E C_{4z}^+
Coordinate $(0, u, v) (-u, 0, v)$

$P4(u, u, v)$

Operation E C_{4z}^+
Coordinate $(u, u, v) (-u, u, v)$

$P5(u, \frac{1}{2}, v)$

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, v) (-\frac{1}{2}, u, v)$

$P1(u, v, 0)$ of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
$P2(u, v, \frac{1}{2})$ of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

P3 $(0, u, v)$ of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

P4 (u, u, v) of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

P5 $(u, \frac{1}{2}, v)$ of space group No. 86		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

87. Space group No. 87 ($I4/m$)

Tetragonal body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		

$$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$$

$$\begin{array}{ll} \text{Operation} & E \quad C_{4z}^+ \\ \text{Coordinate} & (\frac{1}{4}, \frac{1}{4}, \frac{1}{4}) \quad (\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4}) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (1); 8f: (0); 8g: (1); 8h: (2); 16i: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (1); 8f: (0); 8g: (2); 8h: (1); 16i: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (0); 8f: (0); 8g: (1); 8h: (2); 16i: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (1); 8f: (3); 8g: (1); 8h: (1); 16i: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 8f: (3); 8g: (2); 8h: (2); 16i: (3)
6	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (0); 4e: (0); 8f: (3); 8g: (1); 8h: (1); 16i: (3)

$N (0, \frac{1}{2}, 0)$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	(0, 0, 0)	2a: (3); 2b: (0); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

$X (0, 0, \frac{1}{2})$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (4); 4d: (2); 4e: (1); 8f: (3); 8g: (4); 8h: (4); 16i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (2); 4e: (1); 8f: (3); 8g: (4); 8h: (2); 16i: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (2); 16i: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (0); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (4); 16i: (6)

$Z (-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (1); 8f: (3); 8g: (1); 8h: (2); 16i: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (1); 8f: (3); 8g: (2); 8h: (1); 16i: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (3); 8g: (1); 8h: (2); 16i: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (0); 4e: (1); 8f: (0); 8g: (1); 8h: (1); 16i: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 8f: (0); 8g: (2); 8h: (2); 16i: (3)
6	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (0); 8g: (1); 8h: (1); 16i: (3)

$P (\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (3); 8g: (4); 8h: (3); 16i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 16i: (6)
3	(0, 0, 0)	2a: (1); 2b: (0); 4c: (2); 4d: (2); 4e: (1); 8f: (3); 8g: (4); 8h: (3); 16i: (6)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u$)

DT (0, 0, u) of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (4); 16i: (12)

LD ($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$) of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 16i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (4); 8h: (3); 16i: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (3); 8g: (2); 8h: (3); 16i: (6)

Q ($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$) of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 16i: (24)

SM ($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$) of space group No. 87

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (4); 16i: (12)

$W \left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2} \right)$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (4); 4d: (4); 4e: (2); 8f: (6); 8g: (8); 8h: (6); 16i: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (2); 4d: (2); 4e: (4); 8f: (6); 8g: (4); 8h: (6); 16i: (12)

$Y \left(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2} \right)$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (4); 16i: (12)

d. Results for high-symmetry planes

$P1 \left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$		
Operation	E	C_{4z}^+
Coordinate	$\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$	$\left(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v \right)$
$P2(u, v, -u)$		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
$P3(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

$P1 \left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 16i: (24)

$P2(u, v, -u)$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 16i: (24)

$P3(u, -u, v)$ of space group No. 87

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (4); 16i: (12)

88. Space group No. 88 ($I4_1/a$)

Tetragonal body-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{4z}^+|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^-|\frac{3}{4}, \frac{1}{4}, -\frac{1}{2}\} \quad \{I|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{\sigma_z|\frac{3}{4}, \frac{1}{4}, -\frac{1}{2}\} \quad \{S_{4z}^+|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4})$		

$\Gamma(0, 0, 0)$ of space group No. 88

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (1); 16f: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (2); 16f: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (1); 16f: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (1); 16f: (3)
5	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 16f: (3)
6	(0, 0, 0)	4a: (0); 4b: (0); 8c: (3); 8d: (3); 8e: (1); 16f: (3)

N $(0, \frac{1}{2}, 0)$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (3); 8d: (9); 8e: (6); 16f: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (9); 8d: (3); 8e: (6); 16f: (12)

X $(0, 0, \frac{1}{2})$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)

Z $(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (4); 16f: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 16f: (6)

P $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 16f: (6)
2	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 16f: (6)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		

Operation	E
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$
$Y(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$	
Operation	E C_{4z}^+
Coordinate	$(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}) (\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u)$

DT $(0, 0, u)$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 16f: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (4); 16f: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 16f: (6)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 8d: (12); 8e: (12); 16f: (24)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$ of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)

d. Results for high-symmetry planes

$PI(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$	
Operation	E C_{4z}^+
Coordinate	$(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v) (\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v)$
$P2(u, v, -u)$	

Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3($u, -u, v$)		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 ($\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v$) of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 8d: (12); 8e: (12); 16f: (24)
P2 ($u, v, -u$) of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 8d: (12); 8e: (12); 16f: (24)
P3 ($u, -u, v$) of space group No. 88		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12)

89. Space group No. 89 ($P422$)

Tetragonal primitive lattice

$\vec{a} = (a, 0, 0)$
 $\vec{b} = (0, a, 0)$
 $\vec{c} = (0, 0, c)$

$\vec{t}_1 = \vec{a}$
 $\vec{t}_2 = \vec{b}$
 $\vec{t}_3 = \vec{c}$

a. Space group operations

$\{E|0, 0, 0\}$ $\{C_{2z}|0, 0, 0\}$ $\{C_{4z}^+|0, 0, 0\}$ $\{C_{4z}^-|0, 0, 0\}$ $\{C_{2x}|0, 0, 0\}$ $\{C_{2y}|0, 0, 0\}$ $\{C_{2a}|0, 0, 0\}$ $\{C_{2b}|0, 0, 0\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$

Operation

Coordinate

E

$(0, 0, 0)$

Γ (0, 0, 0) of space group No. 89												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (0);	2f: (0);	2g: (1);	2h: (1);	4i: (1);	4j: (1);	4k: (1);
		4l: (1);	4m: (1);	4n: (1);	4o: (1);	8p: (3)						
2	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (2);	4k: (2);
		4l: (2);	4m: (2);	4n: (2);	4o: (2);	8p: (3)						
3	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (0);	2f: (0);	2g: (0);	2h: (0);	4i: (1);	4j: (2);	4k: (2);
		4l: (1);	4m: (1);	4n: (1);	4o: (1);	8p: (3)						
4	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (0);	2h: (0);	4i: (1);	4j: (1);	4k: (1);
		4l: (2);	4m: (2);	4n: (2);	4o: (2);	8p: (3)						
5	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (2);	2h: (2);	4i: (4);	4j: (3);	4k: (3);
		4l: (3);	4m: (3);	4n: (3);	4o: (3);	8p: (6)						
M ($\frac{1}{2}, \frac{1}{2}, 0$) of space group No. 89												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (0);	4i: (2);	4j: (1);	4k: (1);
		4l: (1);	4m: (2);	4n: (1);	4o: (2);	8p: (3)						
2	(0, 0, 0)	1a: (1);	1b: (1);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (0);	4i: (2);	4j: (2);	4k: (2);
		4l: (2);	4m: (1);	4n: (2);	4o: (1);	8p: (3)						
3	(0, 0, 0)	1a: (0);	1b: (0);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (0);	2h: (1);	4i: (2);	4j: (2);	4k: (2);
		4l: (1);	4m: (2);	4n: (1);	4o: (2);	8p: (3)						
4	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (0);	2h: (1);	4i: (2);	4j: (1);	4k: (1);
		4l: (2);	4m: (1);	4n: (2);	4o: (1);	8p: (3)						
5	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (2);	2h: (2);	4i: (2);	4j: (3);	4k: (3);
		4l: (3);	4m: (3);	4n: (3);	4o: (3);	8p: (6)						
Z ($0, 0, \frac{1}{2}$) of space group No. 89												

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 2e: (0); 2f: (1); 2g: (1); 2h: (1); 4i: (1); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (2); 4o: (1); 8p: (3)
2	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (1); 2f: (0); 2g: (1); 2h: (1); 4i: (1); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 4n: (1); 4o: (2); 8p: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (1); 2g: (0); 2h: (0); 4i: (1); 4j: (2); 4k: (1); 4l: (1); 4m: (2); 4n: (2); 4o: (1); 8p: (3)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (0); 2g: (0); 2h: (0); 4i: (1); 4j: (1); 4k: (2); 4l: (2); 4m: (1); 4n: (1); 4o: (2); 8p: (3)
5	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 89

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (0); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 4m: (1); 4n: (2); 4o: (2); 8p: (3)
2	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (0); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 4m: (2); 4n: (1); 4o: (1); 8p: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (0); 2e: (1); 2f: (1); 2g: (0); 2h: (1); 4i: (2); 4j: (2); 4k: (1); 4l: (1); 4m: (1); 4n: (2); 4o: (2); 8p: (3)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (1); 2e: (1); 2f: (1); 2g: (0); 2h: (1); 4i: (2); 4j: (1); 4k: (2); 4l: (2); 4m: (2); 4n: (1); 4o: (1); 8p: (3)
5	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)

$R \left(0, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 89

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (2); 4m: (3); 4n: (4); 4o: (3); 8p: (6)
2	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (4); 4m: (3); 4n: (2); 4o: (3); 8p: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (1); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (3); 4o: (2); 8p: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (0); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (3); 4o: (4); 8p: (6)

$X \left(0, \frac{1}{2}, 0 \right)$ of space group No. 89

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (2); 4m: (3); 4n: (2); 4o: (3); 8p: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (4); 4m: (3); 4n: (4); 4o: (3); 8p: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (3); 4o: (2); 8p: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (3); 4o: (4); 8p: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($0, v, \frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	($0, \frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	($-\frac{1}{2}, u, 0$)

DT (0, v, 0) of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (5); 4m: (5); 4n: (5); 4o: (5); 8p: (12)
2	(0, r_1 , 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (7); 4m: (7); 4n: (7); 4o: (7); 8p: (12)
LD (0, 0, w) of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)

2	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
3	$(0, 0, r_1)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (0); 2h: (0); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
4	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
S $(u, u, \frac{1}{2})$ of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (5); 4k: (7); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12)
2	$(r_1, r_1, 0)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (7); 4k: (5); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12)
SM $(u, u, 0)$ of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (5); 4k: (5); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12)
2	$(r_1, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (7); 4k: (7); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (2); 1c: (2); 1d: (1); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (5); 4m: (5); 4n: (7); 4o: (7); 8p: (12)
2	$(r_1, 0, 0)$	1a: (2); 1b: (1); 1c: (1); 1d: (2); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (7); 4m: (7); 4n: (5); 4o: (5); 8p: (12)
U $(0, v, \frac{1}{2})$ of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (2); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (5); 4m: (7); 4n: (7); 4o: (5); 8p: (12)
2	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (4); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (7); 4m: (5); 4n: (5); 4o: (7); 8p: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (2); 2f: (2); 2g: (2); 2h: (0); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
3	$(0, 0, r_1)$	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (0); 2h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
4	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (2); 2h: (4); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12)

2	$(0, 0, r_1)$	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (4); 2h: (2); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12)

Y $(u, \frac{1}{2}, 0)$ of space group No. 89

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (5); 4m: (7); 4n: (5); 4o: (7); 8p: (12)
2	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (6); 4j: (6); 4k: (6); 4l: (7); 4m: (5); 4n: (7); 4o: (5); 8p: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate $(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate $(0, u, v)$ $(-u, 0, v)$

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) $(-u, u, v)$

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, v)$ $(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 89

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)

P2 ($u, v, \frac{1}{2}$) of space group No. 89

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)

P3 ($0, u, v$) of space group No. 89

(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_2, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)
P4 (u, u, v) of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)
P5 $(u, \frac{1}{2}, v)$ of space group No. 89		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)

90. Space group No. 90 ($P4_212$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & \vec{t}_1 = \vec{a} \\
 \text{Tetragonal primitive lattice} & \vec{b} = (0, a, 0) & \vec{t}_2 = \vec{b} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{4z}^-|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{2y}|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (0, 0, 0)
 \end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)
 \end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (0, 0, \frac{1}{2})
 \end{array}$$

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})
 \end{array}$$

$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 90				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1); 4d: (1); 4e: (2); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0); 4d: (1); 4e: (2); 4f: (2); 8g: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0); 4d: (1); 4e: (1); 4f: (1); 8g: (3)
5	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2); 4d: (4); 4e: (3); 4f: (3); 8g: (6)
$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 90				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1); 4d: (1); 4e: (2); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (1); 4d: (4); 4e: (3); 4f: (3); 8g: (6)
$Z(0, 0, \frac{1}{2})$ of space group No. 90				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1); 4d: (1); 4e: (1); 4f: (2); 8g: (3)
2	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1); 4d: (1); 4e: (2); 4f: (1); 8g: (3)
3	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0); 4d: (1); 4e: (2); 4f: (1); 8g: (3)
4	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0); 4d: (1); 4e: (1); 4f: (2); 8g: (3)
5	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2); 4d: (4); 4e: (3); 4f: (3); 8g: (6)
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 90				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1); 4d: (1); 4e: (1); 4f: (2); 8g: (3)
2	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1); 4d: (1); 4e: (2); 4f: (1); 8g: (3)
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (1); 4d: (4); 4e: (3); 4f: (3); 8g: (6)
$R(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 90				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
$X(0, \frac{1}{2}, 0)$ of space group No. 90				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

c. Results for high-symmetry lines

DT(0, v , 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S(u , u , $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)
SM(u , u , 0)		
Operation	E	C_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)
T(u , $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $\frac{1}{2}$)
U(0, v , $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v , $\frac{1}{2}$)	($-v$, 0, $\frac{1}{2}$)
V($\frac{1}{2}$, $\frac{1}{2}$, w)		
Operation	E	
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	
W(0, $\frac{1}{2}$, w)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}$, w)	($-\frac{1}{2}$, 0, w)
Y(u , $\frac{1}{2}$, 0)		
Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, 0)	($-\frac{1}{2}$, u , 0)

DT (0, v , 0) of space group No. 90

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	(0, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

LD (0, 0, w) of space group No. 90

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (2); 4d: (2); 4e: (3); 4f: (3); 8g: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (2); 4d: (4); 4e: (3); 4f: (3); 8g: (6)
3	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (0); 4d: (2); 4e: (3); 4f: (3); 8g: (6)
4	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (2); 4d: (4); 4e: (3); 4f: (3); 8g: (6)
S $(u, u, \frac{1}{2})$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (2); 2b: (4); 2c: (3); 4d: (6); 4e: (5); 4f: (7); 8g: (12)
2	$(r_1, r_1, 0)$	2a: (4); 2b: (2); 2c: (3); 4d: (6); 4e: (7); 4f: (5); 8g: (12)
SM $(u, u, 0)$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (2); 2b: (2); 2c: (3); 4d: (6); 4e: (5); 4f: (5); 8g: (12)
2	$(r_1, r_1, 0)$	2a: (4); 2b: (4); 2c: (3); 4d: (6); 4e: (7); 4f: (7); 8g: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
U $(0, v, \frac{1}{2})$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (1); 4d: (4); 4e: (3); 4f: (3); 8g: (6)
2	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (2); 4d: (2); 4e: (3); 4f: (3); 8g: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 $(u, v, 0)$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 4f: (12); 8g: (24)
P2 $(u, v, \frac{1}{2})$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 4f: (12); 8g: (24)
P3 $(0, u, v)$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 4f: (12); 8g: (24)
P4 (u, u, v) of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 4f: (12); 8g: (24)
P5 $(u, \frac{1}{2}, v)$ of space group No. 90		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

91. Space group No. 91 ($P4_122$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,\frac{1}{2}\} \quad \{C_{4z}^+|0,0,\frac{1}{4}\} \quad \{C_{4z}^-|0,0,\frac{3}{4}\} \quad \{C_{2x}|0,0,-\frac{1}{2}\} \quad \{C_{2y}|0,0,0\} \quad \{C_{2a}|0,0,-\frac{1}{4}\} \quad \{C_{2b}|0,0,-\frac{3}{4}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$
Operation E
Coordinate (0,0,0)
$M(\frac{1}{2},\frac{1}{2},0)$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},0)$
$Z(0,0,\frac{1}{2})$
Operation E
Coordinate $(0,0,\frac{1}{2})$
$A(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
$R(0,\frac{1}{2},\frac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,\frac{1}{2})$
$X(0,\frac{1}{2},0)$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

$\Gamma(0,0,0)$ of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (1); 4b: (1); 4c: (1); 8d: (3)
2	(0,0,0)	4a: (2); 4b: (2); 4c: (2); 8d: (3)
3	(0,0,0)	4a: (1); 4b: (1); 4c: (2); 8d: (3)
4	(0,0,0)	4a: (2); 4b: (2); 4c: (1); 8d: (3)
5	(0,0,0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)

$M(\frac{1}{2},\frac{1}{2},0)$ of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (1); 4b: (2); 4c: (1); 8d: (3)
2	(0,0,0)	4a: (2); 4b: (1); 4c: (2); 8d: (3)
3	(0,0,0)	4a: (1); 4b: (2); 4c: (2); 8d: (3)
4	(0,0,0)	4a: (2); 4b: (1); 4c: (1); 8d: (3)

5	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 91		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 91		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)
$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 91		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)
$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 91		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (3); 4c: (3); 8d: (6)
2	(0, 0, 0)	4a: (4); 4b: (3); 4c: (3); 8d: (6)
3	(0, 0, 0)	4a: (3); 4b: (2); 4c: (3); 8d: (6)
4	(0, 0, 0)	4a: (3); 4b: (4); 4c: (3); 8d: (6)

c. Results for high-symmetry lines

$DT(0, v, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, 0)$	$(-v, 0, 0)$
$LD(0, 0, w)$		
Operation	E	
Coordinate	$(0, 0, w)$	
$S(u, u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
$SM(u, u, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
$T(u, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$
$U(0, v, \frac{1}{2})$		

$$\begin{array}{lcl} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, v, \frac{1}{2}) & (-v, 0, \frac{1}{2}) \end{array}$$

$$V(\frac{1}{2}, \frac{1}{2}, w)$$

$$\begin{array}{lcl} \text{Operation} & E & \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, w) & \end{array}$$

$$W(0, \frac{1}{2}, w)$$

$$\begin{array}{lcl} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, w) & (-\frac{1}{2}, 0, w) \end{array}$$

$$Y(u, \frac{1}{2}, 0)$$

$$\begin{array}{lcl} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (u, \frac{1}{2}, 0) & (-\frac{1}{2}, u, 0) \end{array}$$

DT $(0, v, 0)$ of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (5); 4b: (5); 4c: (6); 8d: (12)
2	$(0, r_1, 0)$	4a: (7); 4b: (7); 4c: (6); 8d: (12)

LD $(0, 0, w)$ of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
3	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
4	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)

S $(u, u, \frac{1}{2})$ of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)

SM $(u, u, 0)$ of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (6); 4b: (6); 4c: (5); 8d: (12)
2	$(r_1, r_1, 0)$	4a: (6); 4b: (6); 4c: (7); 8d: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)

U $(0, v, \frac{1}{2})$ of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
3	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
4	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 91		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
2	$(0, 0, r_1)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 91		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (5); 4b: (7); 4c: (6); 8d: (12)
2	$(r_1, 0, 0)$	4a: (7); 4b: (5); 4c: (6); 8d: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate $(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate $(0, u, v)$ $(-u, 0, v)$

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) $(-u, u, v)$

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, v)$ $(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 91

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12); 4b: (12); 4c: (12); 8d: (24)
P2 $(u, v, \frac{1}{2})$ of space group No. 91		

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
P3 $(0, u, v)$ of space group No. 91		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (12); 4b: (12); 4c: (12); 8d: (24)
P4 (u, u, v) of space group No. 91		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	4a: (12); 4b: (12); 4c: (12); 8d: (24)
P5 $(u, \frac{1}{2}, v)$ of space group No. 91		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (12); 4b: (12); 4c: (12); 8d: (24)

92. Space group No. 92 ($P4_12_12$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{C_{4z}^+|-\frac{1}{2}, \frac{1}{2}, \frac{1}{4}\} \quad \{C_{4z}^-|-\frac{1}{2}, -\frac{1}{2}, \frac{3}{4}\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, \frac{3}{4}\} \quad \{C_{2y}|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{4}\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation	E
Coordinate	$(0, 0, 0)$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$

$$Z(0, 0, \frac{1}{2})$$

Operation	E
Coordinate	$(0, 0, \frac{1}{2})$

$$A\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{lcl} \text{Operation} & & E \\ \text{Coordinate} & & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{lcl} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & \left(0, \frac{1}{2}, \frac{1}{2}\right) & \left(-\frac{1}{2}, 0, \frac{1}{2}\right) \end{array}$$

$$X\left(0, \frac{1}{2}, 0\right)$$

$$\begin{array}{lcl} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & \left(0, \frac{1}{2}, 0\right) & \left(-\frac{1}{2}, 0, 0\right) \end{array}$$

$$\Gamma (0, 0, 0) \text{ of space group No. 92}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 8b: (3)
2	(0, 0, 0)	4a: (2); 8b: (3)
3	(0, 0, 0)	4a: (2); 8b: (3)
4	(0, 0, 0)	4a: (1); 8b: (3)
5	(0, 0, 0)	4a: (3); 8b: (6)

$$M\left(\frac{1}{2}, \frac{1}{2}, 0\right) \text{ of space group No. 92}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 8b: (3)
2	(0, 0, 0)	4a: (2); 8b: (3)
3	(0, 0, 0)	4a: (3); 8b: (6)

$$Z\left(0, 0, \frac{1}{2}\right) \text{ of space group No. 92}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
2	(0, 0, 0)	4a: (3); 8b: (6)

$$A\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \text{ of space group No. 92}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)

$$R\left(0, \frac{1}{2}, \frac{1}{2}\right) \text{ of space group No. 92}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
2	(0, 0, 0)	4a: (3); 8b: (6)

$$X\left(0, \frac{1}{2}, 0\right) \text{ of space group No. 92}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 8b: (12)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($0, v, \frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	($0, \frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	($-\frac{1}{2}, u, 0$)

DT (0, v, 0) of space group No. 92

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	4a: (6); 8b: (12)
2	(0, r_1 , 0)	4a: (6); 8b: (12)

LD (0, 0, w) of space group No. 92

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 8b: (6)
2	$(0, 0, r_1)$	4a: (3); 8b: (6)
3	$(0, 0, r_1)$	4a: (3); 8b: (6)
4	$(0, 0, r_1)$	4a: (3); 8b: (6)
S $(u, u, \frac{1}{2})$ of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (6); 8b: (12)
SM $(u, u, 0)$ of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (5); 8b: (12)
2	$(r_1, r_1, 0)$	4a: (7); 8b: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 8b: (6)
2	$(r_1, 0, 0)$	4a: (3); 8b: (6)
U $(0, v, \frac{1}{2})$ of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6); 8b: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 8b: (6)
2	$(0, 0, r_1)$	4a: (3); 8b: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (6); 8b: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6); 8b: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation	E
Coordinate	$(u, v, \frac{1}{2})$
P3(0, u, v)	
Operation	E C_{4z}^+
Coordinate	$(0, u, v)$ $(-u, 0, v)$
P4(u, u, v)	
Operation	E C_{4z}^+
Coordinate	(u, u, v) $(-u, u, v)$
P5($u, \frac{1}{2}, v$)	
Operation	E C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$ $(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12); 8b: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 8b: (12)
P3 (0, u, v) of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (12); 8b: (24)
P4 (u, u, v) of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	4a: (12); 8b: (24)
P5 ($u, \frac{1}{2}, v$) of space group No. 92		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6); 8b: (12)

93. Space group No. 93 ($P4_222$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 2e: (0); 2f: (0); 4g: (1); 4h: (1); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (1); 4o: (1); 8p: (3)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 4n: (2); 4o: (2); 8p: (3)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (1); 4h: (1); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (2); 4o: (2); 8p: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 2e: (0); 2f: (0); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 4n: (1); 4o: (1); 8p: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 93

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (2); 4m: (1); 4n: (1); 4o: (2); 8p: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (1); 4m: (2); 4n: (2); 4o: (1); 8p: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (2); 4m: (1); 4n: (2); 4o: (1); 8p: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (1); 4m: (2); 4n: (1); 4o: (2); 8p: (3)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 93

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (1); 4l: (2); 4m: (2); 4n: (1); 4o: (2); 8p: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (1); 4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (2); 4o: (1); 8p: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (1); 4l: (2); 4m: (2); 4n: (2); 4o: (1); 8p: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (1); 4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (1); 4o: (2); 8p: (3)

$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 93

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 2e: (1); 2f: (2); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (2); 4l: (3); 4m: (4); 4n: (3); 4o: (3); 8p: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (4); 4l: (3); 4m: (2); 4n: (3); 4o: (3); 8p: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 2e: (2); 2f: (1); 4g: (4); 4h: (2); 4i: (3); 4j: (4); 4k: (3); 4l: (2); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (1); 4g: (4); 4h: (2); 4i: (3); 4j: (2); 4k: (3); 4l: (4); 4m: (3); 4n: (3); 4o: (3); 8p: (6)

$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 93

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (0); 2b: (2); 2c: (1); 2d: (1); 2e: (1); 2f: (2); 4g: (2); 4h: (4); 4i: (3); 4j: (2); 4k: (3); 4l: (2); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (1); 2f: (2); 4g: (2); 4h: (4); 4i: (3); 4j: (4); 4k: (3); 4l: (4); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
3	(0, 0, 0)	2a: (2); 2b: (0); 2c: (1); 2d: (1); 2e: (2); 2f: (1); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (2); 4l: (3); 4m: (2); 4n: (3); 4o: (3); 8p: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (1); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (4); 4l: (3); 4m: (4); 4n: (3); 4o: (3); 8p: (6)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

S(u , u , $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)

SM(u , u , 0)

Operation	E	C_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)

T(u , $\frac{1}{2}$, $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $\frac{1}{2}$)

U(0, v , $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(0, v , $\frac{1}{2}$)	($-v$, 0, $\frac{1}{2}$)

V($\frac{1}{2}$, $\frac{1}{2}$, w)

Operation	E
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)

W(0, $\frac{1}{2}$, w)

Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}$, w)	($-\frac{1}{2}$, 0, w)

Y(u , $\frac{1}{2}$, 0)

Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, 0)	($-\frac{1}{2}$, u , 0)

DT $(0, v, 0)$ of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (5); 4k: (5); 4l: (5); 4m: (5); 4n: (6); 4o: (6); 8p: (12)
2	$(0, r_1, 0)$	2a: (4); 2b: (4); 2c: (4); 2d: (4); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (7); 4k: (7); 4l: (7); 4m: (7); 4n: (6); 4o: (6); 8p: (12)
LD $(0, 0, w)$ of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
3	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
4	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
S $(u, u, \frac{1}{2})$ of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (5); 4o: (7); 8p: (12)
2	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (7); 4o: (5); 8p: (12)
SM $(u, u, 0)$ of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (2); 2f: (2); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (5); 4o: (5); 8p: (12)
2	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (4); 2f: (4); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (7); 4o: (7); 8p: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (4); 2d: (2); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (5); 4k: (5); 4l: (7); 4m: (7); 4n: (6); 4o: (6); 8p: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (2); 2d: (4); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (7); 4k: (7); 4l: (5); 4m: (5); 4n: (6); 4o: (6); 8p: (12)
U $(0, v, \frac{1}{2})$ of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (7); 4k: (5); 4l: (5); 4m: (7); 4n: (6); 4o: (6); 8p: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (5); 4k: (7); 4l: (7); 4m: (5); 4n: (6); 4o: (6); 8p: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
3	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
4	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (2); 2b: (4); 2c: (3); 2d: (3); 2e: (2); 2f: (4); 4g: (4); 4h: (8); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12)
2	$(0, 0, r_1)$	2a: (4); 2b: (2); 2c: (3); 2d: (3); 2e: (4); 2f: (2); 4g: (8); 4h: (4); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (4); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (5); 4k: (7); 4l: (5); 4m: (7); 4n: (6); 4o: (6); 8p: (12)
2	$(r_1, 0, 0)$	2a: (4); 2b: (2); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (7); 4k: (5); 4l: (7); 4m: (5); 4n: (6); 4o: (6); 8p: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate $(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate $(0, u, v)$ $(-u, 0, v)$

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) $(-u, u, v)$

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, v)$ $(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)
P3 ($0, u, v$) of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)
P4 (u, u, v) of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)
P5 ($u, \frac{1}{2}, v$) of space group No. 93		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 4o: (12); 8p: (24)

94. Space group No. 94 ($P4_22_12$)

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \text{Tetragonal primitive lattice} \quad \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{4z}^-|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{C_{2y}|-\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation E

Coordinate	(0, 0, 0)
M	$(\frac{1}{2}, \frac{1}{2}, 0)$
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
Z	$(0, 0, \frac{1}{2})$
Operation	E
Coordinate	$(0, 0, \frac{1}{2})$
A	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
R	$(0, \frac{1}{2}, \frac{1}{2})$
Operation	E C_{4z}^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, \frac{1}{2})$
X	$(0, \frac{1}{2}, 0)$
Operation	E C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

Γ (0, 0, 0) of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 8g: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 8g: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (3); 4f: (3); 8g: (6)

M $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (2); 4e: (1); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (2); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (2); 4e: (3); 4f: (3); 8g: (6)

Z $(0, 0, \frac{1}{2})$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (3); 4f: (3); 8g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (1); 8g: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (1); 8g: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 4f: (2); 8g: (3)

A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (2); 4f: (1); 8g: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 4f: (2); 8g: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (4); 4e: (3); 4f: (3); 8g: (6)
$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 94		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 94		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

c. Results for high-symmetry lines

$DT(0, v, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, 0)$	$(-v, 0, 0)$
$LD(0, 0, w)$		
Operation	E	
Coordinate	$(0, 0, w)$	
$S(u, u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
$SM(u, u, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
$T(u, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$
$U(0, v, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$

$$Y(u, \frac{1}{2}, 0)$$

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

LD $(0, 0, w)$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (3); 4f: (3); 8g: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (3); 4f: (3); 8g: (6)
3	$(0, 0, r_1)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (3); 4f: (3); 8g: (6)
4	$(0, 0, r_1)$	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (3); 4f: (3); 8g: (6)

S $(u, u, \frac{1}{2})$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (5); 4f: (7); 8g: (12)
2	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (7); 4f: (5); 8g: (12)

SM $(u, u, 0)$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (2); 2b: (2); 4c: (6); 4d: (6); 4e: (5); 4f: (5); 8g: (12)
2	$(r_1, r_1, 0)$	2a: (4); 2b: (4); 4c: (6); 4d: (6); 4e: (7); 4f: (7); 8g: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

U $(0, v, \frac{1}{2})$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (2); 2b: (2); 4c: (4); 4d: (2); 4e: (3); 4f: (3); 8g: (6)
2	$(0, 0, r_1)$	2a: (1); 2b: (1); 4c: (2); 4d: (4); 4e: (3); 4f: (3); 8g: (6)

W $(0, \frac{1}{2}, w)$ of space group No. 94

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

Y $(u, \frac{1}{2}, 0)$ of space group No. 94		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

d. Results for high-symmetry planes

P1 $(u, v, 0)$

Operation E
Coordinate $(u, v, 0)$

P2 $(u, v, \frac{1}{2})$

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3 $(0, u, v)$

Operation E C_{4z}^+
Coordinate $(0, u, v) (-u, 0, v)$

P4 (u, u, v)

Operation E C_{4z}^+
Coordinate $(u, u, v) (-u, u, v)$

P5 $(u, \frac{1}{2}, v)$

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, v) (-\frac{1}{2}, u, v)$

P1 $(u, v, 0)$ of space group No. 94		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

P2 $(u, v, \frac{1}{2})$ of space group No. 94		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

P3 $(0, u, v)$ of space group No. 94		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

P4 (u, u, v) of space group No. 94		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	2a: (6); 2b: (6); 4c: (12); 4d: (12); 4e: (12); 4f: (12); 8g: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 94		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 8g: (12)

95. Space group No. 95 ($P4_322$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{C_{4z}^+|0, 0, \frac{3}{4}\} \quad \{C_{4z}^-|0, 0, \frac{1}{4}\} \quad \{C_{2x}|0, 0, -\frac{1}{2}\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2a}|0, 0, \frac{1}{4}\} \quad \{C_{2b}|0, 0, -\frac{1}{4}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})\end{array}$$

$$R(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) & (-\frac{1}{2}, 0, \frac{1}{2})\end{array}$$

$$X(0, \frac{1}{2}, 0)$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, 0) & (-\frac{1}{2}, 0, 0)\end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 95			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 8d: (3)	
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (3)	
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 8d: (3)	
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 8d: (3)	
5	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)	
$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 95			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 8d: (3)	
2	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 8d: (3)	
3	(0, 0, 0)	4a: (1); 4b: (2); 4c: (2); 8d: (3)	
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (1); 8d: (3)	
5	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)	
$Z (0, 0, \frac{1}{2})$ of space group No. 95			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)	
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)	
$A (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 95			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)	
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6)	
$R (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 95			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12)	
$X (0, \frac{1}{2}, 0)$ of space group No. 95			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (2); 4b: (3); 4c: (3); 8d: (6)	
2	(0, 0, 0)	4a: (4); 4b: (3); 4c: (3); 8d: (6)	
3	(0, 0, 0)	4a: (3); 4b: (2); 4c: (3); 8d: (6)	
4	(0, 0, 0)	4a: (3); 4b: (4); 4c: (3); 8d: (6)	

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation E
Coordinate (0, 0, w)

 $S(u, u, \frac{1}{2})$

Operation E C_{4z}^+
Coordinate $(u, u, \frac{1}{2})$ $(-u, u, \frac{1}{2})$

SM($u, u, 0$)

Operation E C_{4z}^+
Coordinate $(u, u, 0)$ $(-u, u, 0)$

 $T(u, \frac{1}{2}, \frac{1}{2})$

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, u, \frac{1}{2})$

 $U(0, v, \frac{1}{2})$

Operation E C_{4z}^+
Coordinate $(0, v, \frac{1}{2})$ $(-v, 0, \frac{1}{2})$

 $V(\frac{1}{2}, \frac{1}{2}, w)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

 $W(0, \frac{1}{2}, w)$

Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, w)$ $(-\frac{1}{2}, 0, w)$

 $Y(u, \frac{1}{2}, 0)$

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, 0)$ $(-\frac{1}{2}, u, 0)$

DT (0, $v, 0$) of space group No. 95

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (5); 4b: (5); 4c: (6); 8d: (12)
2	$(0, r_1, 0)$	4a: (7); 4b: (7); 4c: (6); 8d: (12)

LD (0, 0, w) of space group No. 95

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
3	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
4	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)

 $S(u, u, \frac{1}{2})$ of space group No. 95

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
SM $(u, u, 0)$ of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (6); 4b: (6); 4c: (5); 8d: (12)
2	$(r_1, r_1, 0)$	4a: (6); 4b: (6); 4c: (7); 8d: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
U $(0, v, \frac{1}{2})$ of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
3	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
4	$(0, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 8d: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
2	$(0, 0, r_1)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (5); 4b: (7); 4c: (6); 8d: (12)
2	$(r_1, 0, 0)$	4a: (7); 4b: (5); 4c: (6); 8d: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate $(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12); 4b: (12); 4c: (12); 8d: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 8d: (12)
P3 ($0, u, v$) of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (12); 4b: (12); 4c: (12); 8d: (24)
P4 (u, u, v) of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	4a: (12); 4b: (12); 4c: (12); 8d: (24)
P5 ($u, \frac{1}{2}, v$) of space group No. 95		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (12); 4b: (12); 4c: (12); 8d: (24)

96. Space group No. 96 ($P4_32_12$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{C_{4z}^+|-\frac{1}{2}, \frac{1}{2}, \frac{3}{4}\} \quad \{C_{4z}^-|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{4}\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, \frac{1}{4}\} \quad \{C_{2y}|-\frac{1}{2}, -\frac{1}{2}, \frac{3}{4}\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate $(0, 0, 0)$
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$
Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 8b: (3)
2	$(0, 0, 0)$	4a: (2); 8b: (3)
3	$(0, 0, 0)$	4a: (2); 8b: (3)
4	$(0, 0, 0)$	4a: (1); 8b: (3)
5	$(0, 0, 0)$	4a: (3); 8b: (6)
$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 8b: (3)
2	$(0, 0, 0)$	4a: (2); 8b: (3)
3	$(0, 0, 0)$	4a: (3); 8b: (6)
$Z(0, 0, \frac{1}{2})$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3); 8b: (6)
2	$(0, 0, 0)$	4a: (3); 8b: (6)

A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6)
2	(0, 0, 0)	4a: (3); 8b: (6)
X $(0, \frac{1}{2}, 0)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 8b: (12)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W(0, $\frac{1}{2}, w$)		
Operation	E	C_{4z}^+

Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6); 8b: (12)
2	$(0, r_1, 0)$	4a: (6); 8b: (12)
LD $(0, 0, w)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 8b: (6)
2	$(0, 0, r_1)$	4a: (3); 8b: (6)
3	$(0, 0, r_1)$	4a: (3); 8b: (6)
4	$(0, 0, r_1)$	4a: (3); 8b: (6)
S $(u, u, \frac{1}{2})$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (6); 8b: (12)
SM $(u, u, 0)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (5); 8b: (12)
2	$(r_1, r_1, 0)$	4a: (7); 8b: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 8b: (6)
2	$(r_1, 0, 0)$	4a: (3); 8b: (6)
U $(0, v, \frac{1}{2})$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6); 8b: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 8b: (6)
2	$(0, 0, r_1)$	4a: (3); 8b: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (6); 8b: (12)

Y $(u, \frac{1}{2}, 0)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6); 8b: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 $(u, v, 0)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12); 8b: (24)
P2 $(u, v, \frac{1}{2})$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 8b: (12)
P3 $(0, u, v)$ of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (12); 8b: (24)
P4 (u, u, v) of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	4a: (12); 8b: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 96		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6); 8b: (12)

97. Space group No. 97 ($I4_{22}$)

Tetragonal body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4})$		

$\Gamma (0, 0, 0)$ of space group No. 97											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (1);	8f: (1);	8g: (1);	8h: (1);	8i: (1);	8j: (1); 16k: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (1);	8f: (1);	8g: (2);	8h: (2);	8i: (2);	8j: (2); 16k: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (0);	8f: (1);	8g: (2);	8h: (1);	8i: (1);	8j: (2); 16k: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (0);	4e: (0);	8f: (1);	8g: (1);	8h: (2);	8i: (2);	8j: (1); 16k: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (2);	8f: (4);	8g: (3);	8h: (3);	8i: (3);	8j: (3); 16k: (6)
$N (0, \frac{1}{2}, 0)$ of space group No. 97											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (2);	4c: (3);	4d: (3);	4e: (3);	8f: (6);	8g: (6);	8h: (5);	8i: (7);	8j: (6); 16k: (12)
2	(0, 0, 0)	2a: (2);	2b: (1);	4c: (3);	4d: (3);	4e: (3);	8f: (6);	8g: (6);	8h: (7);	8i: (5);	8j: (6); 16k: (12)
$X (0, 0, \frac{1}{2})$ of space group No. 97											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (2);	4d: (2);	4e: (1);	8f: (4);	8g: (2);	8h: (3);	8i: (3);	8j: (3); 16k: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (1);	8f: (4);	8g: (4);	8h: (3);	8i: (3);	8j: (3); 16k: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (2);	4e: (2);	8f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (4); 16k: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (0);	4e: (2);	8f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (2); 16k: (6)
$Z (-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 97											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (1);	8f: (1);	8g: (1);	8h: (1);	8i: (1);	8j: (2); 16k: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (0);	4e: (1);	8f: (1);	8g: (2);	8h: (2);	8i: (2);	8j: (1); 16k: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (0);	8f: (1);	8g: (2);	8h: (1);	8i: (1);	8j: (1); 16k: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	4e: (0);	8f: (1);	8g: (1);	8h: (2);	8i: (2);	8j: (2); 16k: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (2);	8f: (4);	8g: (3);	8h: (3);	8i: (3);	8j: (3); 16k: (6)
$P (\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 97											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (1);	4c: (2);	4d: (2);	4e: (1);	8f: (4);	8g: (3);	8h: (2);	8i: (4);	8j: (3); 16k: (6)
2	(0, 0, 0)	2a: (1);	2b: (0);	4c: (2);	4d: (2);	4e: (1);	8f: (4);	8g: (3);	8h: (4);	8i: (2);	8j: (3); 16k: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	8f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (3); 16k: (6)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	

$Q(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$	$(\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2})$
$SM(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{u}{2}, \frac{u}{2})$
$W(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	
$Y(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u)$

DT $(0, 0, u)$ of space group No. 97		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (1); 2b: (1); 4c: (3) ; 4d: (2); 4e: (3) ; 8f: (6) ; 8g: (5) ; 8h: (6) ; 8i: (6) ; 8j: (5) ; 16k: (12)
2	$(r_1, r_1, 0)$	2a: (2) ; 2b: (2) ; 4c: (3) ; 4d: (4) ; 4e: (3) ; 8f: (6) ; 8g: (7) ; 8h: (6) ; 8i: (6) ; 8j: (7) ; 16k: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 97		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (2); 8g: (3) ; 8h: (3) ; 8i: (3) ; 8j: (3) ; 16k: (6)
2	$(0, 0, r_1)$	2a: (1) ; 2b: (1) ; 4c: (2) ; 4d: (2) ; 4e: (2) ; 8f: (4) ; 8g: (3) ; 8h: (3) ; 8i: (3) ; 8j: (3) ; 16k: (6)
3	$(0, 0, r_1)$	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (2); 8g: (3) ; 8h: (3) ; 8i: (3) ; 8j: (3) ; 16k: (6)
4	$(0, 0, r_1)$	2a: (1) ; 2b: (1) ; 4c: (2) ; 4d: (2) ; 4e: (2) ; 8f: (4) ; 8g: (3) ; 8h: (3) ; 8i: (3) ; 8j: (3) ; 16k: (6)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 97		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 2b: (2) ; 4c: (3) ; 4d: (3) ; 4e: (3) ; 8f: (6) ; 8g: (6) ; 8h: (5) ; 8i: (7) ; 8j: (6) ; 16k: (12)
2	$(0, r_1, 0)$	2a: (2) ; 2b: (1); 4c: (3) ; 4d: (3) ; 4e: (3) ; 8f: (6) ; 8g: (6) ; 8h: (7) ; 8i: (5) ; 8j: (6) ; 16k: (12)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 97		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (3) ; 4e: (3) ; 8f: (6) ; 8g: (6) ; 8h: (5) ; 8i: (5) ; 8j: (6) ; 16k: (12)
2	$(r_1, 0, 0)$	2a: (2) ; 2b: (2) ; 4c: (4) ; 4d: (3) ; 4e: (3) ; 8f: (6) ; 8g: (6) ; 8h: (7) ; 8i: (7) ; 8j: (6) ; 16k: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 97		

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 4c: (4); 4d: (4); 4e: (2); 8f: (8); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 4c: (2); 4d: (2); 4e: (4); 8f: (4); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$ of space group No. 97

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (4); 4e: (3); 8f: (6); 8g: (5); 8h: (6); 8i: (6); 8j: (7); 16k: (12)
2	$(-r_1, r_1, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (2); 4e: (3); 8f: (6); 8g: (7); 8h: (6); 8i: (6); 8j: (5); 16k: (12)

d. Results for high-symmetry planes

P1 $(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$	$(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v)$
P2 $(u, v, -u)$		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3 $(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 $(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$ of space group No. 97

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_2, r_2, r_1)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

P2 $(u, v, -u)$ of space group No. 97

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

P3 $(u, -u, v)$ of space group No. 97

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

98. Space group No. 98 ($I4_122$)

Tetragonal body-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{C_{4z}^-|\frac{3}{4}, \frac{1}{4}, -\frac{1}{2}\} \quad \{C_{2x}|-\frac{1}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{C_{2y}|-\frac{1}{4}, -\frac{3}{4}, -\frac{1}{2}\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4})$		

$\Gamma(0, 0, 0)$ of space group No. 98

(Co-) irrep

Phonon AM

WYPO information

1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (1); 8f: (1); 16g: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (2); 8e: (2); 8f: (2); 16g: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (2); 8e: (2); 8f: (1); 16g: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (1); 8f: (2); 16g: (3)
5	(0, 0, 0)	4a: (2); 4b: (2); 8c: (4); 8d: (3); 8e: (3); 8f: (3); 16g: (6)

$N \left(0, \frac{1}{2}, 0\right)$ of space group No. 98

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)

$X \left(0, 0, \frac{1}{2}\right)$ of space group No. 98

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 8f: (3); 16g: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (4); 8f: (3); 16g: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (4); 8e: (3); 8f: (3); 16g: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (2); 8e: (3); 8f: (3); 16g: (6)

$Z \left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 98

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (1); 8e: (2); 8f: (2); 16g: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (1); 8f: (1); 16g: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (1); 8f: (2); 16g: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (1); 8e: (2); 8f: (1); 16g: (3)
5	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (3); 8e: (3); 8f: (3); 16g: (6)

$P \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$ of space group No. 98

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)

c. Results for high-symmetry lines

$DT(0, 0, u)$		
Operation	E	C_{4z}^+
Coordinate	$(0, 0, u)$	$(u, -u, 0)$
$LD\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$		
Operation	E	
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$	
$Q\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$		
Operation	E	C_{4z}^+
Coordinate	$\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$	$\left(\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}\right)$
$SM\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$		

Operation	E	C_{4z}^+
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{u}{2}, \frac{u}{2})$
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u)$

DT $(0, 0, u)$ of space group No. 98		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (2); 4b: (2); 8c: (6); 8d: (5); 8e: (5); 8f: (6); 16g: (12)
2	$(r_1, r_1, 0)$	4a: (4); 4b: (4); 8c: (6); 8d: (7); 8e: (7); 8f: (6); 16g: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 98		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (1); 4b: (1); 8c: (2); 8d: (3); 8e: (3); 8f: (3); 16g: (6)
2	$(0, 0, r_1)$	4a: (2); 4b: (2); 8c: (4); 8d: (3); 8e: (3); 8f: (3); 16g: (6)
3	$(0, 0, r_1)$	4a: (1); 4b: (1); 8c: (2); 8d: (3); 8e: (3); 8f: (3); 16g: (6)
4	$(0, 0, r_1)$	4a: (2); 4b: (2); 8c: (4); 8d: (3); 8e: (3); 8f: (3); 16g: (6)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 98		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 98		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (5); 16g: (12)
2	$(r_1, 0, 0)$	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (7); 16g: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 98		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$ of space group No. 98		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 8d: (7); 8e: (5); 8f: (6); 16g: (12)
2	$(-r_1, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 8d: (5); 8e: (7); 8f: (6); 16g: (12)

d. Results for high-symmetry planes

P1 ($\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v$)		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$	$(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v)$
P2($u, v, -u$)		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3($u, -u, v$)		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 ($\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v$) of space group No. 98		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_2, r_2, r_1)$	4a: (6); 4b: (6); 8c: (12); 8d: (12); 8e: (12); 8f: (12); 16g: (24)
P2 ($u, v, -u$) of space group No. 98		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6); 4b: (6); 8c: (12); 8d: (12); 8e: (12); 8f: (12); 16g: (24)
P3 ($u, -u, v$) of space group No. 98		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 8c: (12); 8d: (12); 8e: (12); 8f: (12); 16g: (24)

99. Space group No. 99 ($P4mm$)

Tetragonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_{db}|0, 0, 0\} \quad \{\sigma_{da}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E Coordinate (0, 0, 0)
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E Coordinate $(0, 0, \frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E C_{4z}^+ Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$
Operation E C_{4z}^+ Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 99							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	1a: (1);	1b: (1);	2c: (1);	4d: (2);	4e: (2);	4f: (2); 8g: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	2c: (0);	4d: (1);	4e: (1);	4f: (1); 8g: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	2c: (1);	4d: (1);	4e: (2);	4f: (2); 8g: (3)
4	(0, 0, 0)	1a: (0);	1b: (0);	2c: (0);	4d: (2);	4e: (1);	4f: (1); 8g: (3)
5	(0, 0, 0)	1a: (1);	1b: (1);	2c: (2);	4d: (3);	4e: (3);	4f: (3); 8g: (6)
$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 99							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	1a: (1);	1b: (0);	2c: (1);	4d: (2);	4e: (2);	4f: (1); 8g: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	2c: (1);	4d: (1);	4e: (1);	4f: (2); 8g: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	2c: (1);	4d: (1);	4e: (2);	4f: (1); 8g: (3)
4	(0, 0, 0)	1a: (0);	1b: (1);	2c: (1);	4d: (2);	4e: (1);	4f: (2); 8g: (3)
5	(0, 0, 0)	1a: (1);	1b: (1);	2c: (1);	4d: (3);	4e: (3);	4f: (3); 8g: (6)
$Z(0, 0, \frac{1}{2})$ of space group No. 99							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	1a: (1);	1b: (1);	2c: (1);	4d: (2);	4e: (2);	4f: (2); 8g: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	2c: (0);	4d: (1);	4e: (1);	4f: (1); 8g: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	2c: (1);	4d: (1);	4e: (2);	4f: (2); 8g: (3)

4	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 4d: (2); 4e: (1); 4f: (1); 8g: (3)
5	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (3); 8g: (6)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 99

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 4d: (2); 4e: (2); 4f: (1); 8g: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 4d: (1); 4e: (1); 4f: (2); 8g: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 4d: (1); 4e: (2); 4f: (1); 8g: (3)
4	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 4d: (2); 4e: (1); 4f: (2); 8g: (3)
5	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 4d: (3); 4e: (3); 4f: (3); 8g: (6)

$R \left(0, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 99

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 4d: (3); 4e: (4); 4f: (3); 8g: (6)
2	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 4d: (3); 4e: (2); 4f: (3); 8g: (6)
3	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (4); 8g: (6)

$X \left(0, \frac{1}{2}, 0 \right)$ of space group No. 99

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 4d: (3); 4e: (4); 4f: (3); 8g: (6)
2	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 4d: (3); 4e: (2); 4f: (3); 8g: (6)
3	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (4); 8g: (6)

c. Results for high-symmetry lines

$DT(0, v, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, 0)$	$(-v, 0, 0)$
$LD(0, 0, w)$		
Operation	E	
Coordinate	$(0, 0, w)$	
$S(u, u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
$SM(u, u, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
$T(u, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+

Coordinate $(u, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, u, \frac{1}{2})$

$U(0, v, \frac{1}{2})$

Operation E C_{4z}^+
Coordinate $(0, v, \frac{1}{2})$ $(-v, 0, \frac{1}{2})$

$V(\frac{1}{2}, \frac{1}{2}, w)$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, w)$

$W(0, \frac{1}{2}, w)$

Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, w)$ $(-\frac{1}{2}, 0, w)$

$Y(u, \frac{1}{2}, 0)$

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, 0)$ $(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 99

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 2c: (4); 4d: (6); 4e: (7); 4f: (7); 8g: (12)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 2c: (2); 4d: (6); 4e: (5); 4f: (5); 8g: (12)

LD $(0, 0, w)$ of space group No. 99

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 2c: (1); 4d: (2); 4e: (2); 4f: (2); 8g: (3)
2	$(0, 0, 0)$	1a: (0); 1b: (0); 2c: (0); 4d: (1); 4e: (1); 4f: (1); 8g: (3)
3	$(0, 0, 0)$	1a: (0); 1b: (0); 2c: (1); 4d: (1); 4e: (2); 4f: (2); 8g: (3)
4	$(0, 0, 0)$	1a: (0); 1b: (0); 2c: (0); 4d: (2); 4e: (1); 4f: (1); 8g: (3)
5	$(0, 0, 0)$	1a: (1); 1b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (3); 8g: (6)

S $(u, u, \frac{1}{2})$ of space group No. 99

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	1a: (2); 1b: (2); 2c: (3); 4d: (7); 4e: (6); 4f: (6); 8g: (12)
2	$(-r_1, r_1, 0)$	1a: (1); 1b: (1); 2c: (3); 4d: (5); 4e: (6); 4f: (6); 8g: (12)

SM $(u, u, 0)$ of space group No. 99

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	1a: (2); 1b: (2); 2c: (3); 4d: (7); 4e: (6); 4f: (6); 8g: (12)
2	$(-r_1, r_1, 0)$	1a: (1); 1b: (1); 2c: (3); 4d: (5); 4e: (6); 4f: (6); 8g: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 99

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (1); 2c: (3); 4d: (6); 4e: (7); 4f: (5); 8g: (12)
2	$(0, r_1, 0)$	1a: (1); 1b: (2); 2c: (3); 4d: (6); 4e: (5); 4f: (7); 8g: (12)

U $(0, v, \frac{1}{2})$ of space group No. 99		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 2c: (4); 4d: (6); 4e: (7); 4f: (7); 8g: (12)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 2c: (2); 4d: (6); 4e: (5); 4f: (5); 8g: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 99		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (0); 2c: (1); 4d: (2); 4e: (2); 4f: (1); 8g: (3)
2	$(0, 0, 0)$	1a: (0); 1b: (0); 2c: (1); 4d: (1); 4e: (1); 4f: (2); 8g: (3)
3	$(0, 0, 0)$	1a: (0); 1b: (0); 2c: (1); 4d: (1); 4e: (2); 4f: (1); 8g: (3)
4	$(0, 0, 0)$	1a: (0); 1b: (1); 2c: (1); 4d: (2); 4e: (1); 4f: (2); 8g: (3)
5	$(0, 0, 0)$	1a: (1); 1b: (1); 2c: (1); 4d: (3); 4e: (3); 4f: (3); 8g: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 99		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 2c: (2); 4d: (3); 4e: (4); 4f: (3); 8g: (6)
2	$(0, 0, 0)$	1a: (0); 1b: (1); 2c: (1); 4d: (3); 4e: (2); 4f: (3); 8g: (6)
3	$(0, 0, 0)$	1a: (1); 1b: (0); 2c: (1); 4d: (3); 4e: (3); 4f: (2); 8g: (6)
4	$(0, 0, 0)$	1a: (1); 1b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (4); 8g: (6)
Y $(u, \frac{1}{2}, 0)$ of space group No. 99		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (1); 2c: (3); 4d: (6); 4e: (7); 4f: (5); 8g: (12)
2	$(0, r_1, 0)$	1a: (1); 1b: (2); 2c: (3); 4d: (6); 4e: (5); 4f: (7); 8g: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate ($u, v, \frac{1}{2}$)

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate ($0, u, v$) ($-u, 0, v$)

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) ($-u, u, v$)

P5($u, \frac{1}{2}, v$)

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 $(u, v, 0)$ of space group No. 99		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 2c: (6); 4d: (12); 4e: (12); 4f: (12); 8g: (24)
P2 $(u, v, \frac{1}{2})$ of space group No. 99		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 2c: (6); 4d: (12); 4e: (12); 4f: (12); 8g: (24)
P3 $(0, u, v)$ of space group No. 99		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 2c: (4); 4d: (6); 4e: (7); 4f: (7); 8g: (12)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 2c: (2); 4d: (6); 4e: (5); 4f: (5); 8g: (12)
P4 (u, u, v) of space group No. 99		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	1a: (2); 1b: (2); 2c: (3); 4d: (7); 4e: (6); 4f: (6); 8g: (12)
2	$(-r_1, r_1, 0)$	1a: (1); 1b: (1); 2c: (3); 4d: (5); 4e: (6); 4f: (6); 8g: (12)
P5 $(u, \frac{1}{2}, v)$ of space group No. 99		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (1); 2c: (3); 4d: (6); 4e: (7); 4f: (5); 8g: (12)
2	$(0, r_1, 0)$	1a: (1); 1b: (2); 2c: (3); 4d: (6); 4e: (5); 4f: (7); 8g: (12)

100. Space group No. 100 ($P4bm$)

Tetragonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{\sigma_y|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_x|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_{db}|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_{da}|\frac{1}{2}, -\frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$M(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 8d: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (0); 4c: (1); 8d: (3)
3	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 8d: (3)
4	$(0, 0, 0)$	2a: (0); 2b: (1); 4c: (2); 8d: (3)
5	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3); 8d: (6)
$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (0); 4c: (1); 8d: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 8d: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3); 8d: (6)
$Z(0, 0, \frac{1}{2})$ of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 8d: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (0); 4c: (1); 8d: (3)
3	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 8d: (3)
4	$(0, 0, 0)$	2a: (0); 2b: (1); 4c: (2); 8d: (3)
5	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (3); 8d: (6)

A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 8d: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 8d: (3)
3	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 8d: (6)
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 8d: (12)
X $(0, \frac{1}{2}, 0)$ of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 8d: (12)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

S(u , u , $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)

SM(u , u , 0)

Operation	E	C_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)

T(u , $\frac{1}{2}$, $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $\frac{1}{2}$)

U(0, v , $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(0, v , $\frac{1}{2}$)	($-v$, 0, $\frac{1}{2}$)

V($\frac{1}{2}$, $\frac{1}{2}$, w)

Operation	E
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)

W(0, $\frac{1}{2}$, w)

Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$

$$Y(u, \frac{1}{2}, 0)$$

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 100					
(Co-) irrep	Phonon AM	WYPO information			
1	$(r_1, 0, 0)$	2a: (3);	2b: (3);	4c: (6);	8d: (12)
2	$(r_1, 0, 0)$	2a: (3);	2b: (3);	4c: (6);	8d: (12)
LD $(0, 0, w)$ of space group No. 100					
(Co-) irrep	Phonon AM	WYPO information			
1	$(0, 0, 0)$	2a: (1);	2b: (1);	4c: (2);	8d: (3)
2	$(0, 0, 0)$	2a: (1);	2b: (0);	4c: (1);	8d: (3)
3	$(0, 0, 0)$	2a: (0);	2b: (0);	4c: (1);	8d: (3)
4	$(0, 0, 0)$	2a: (0);	2b: (1);	4c: (2);	8d: (3)
5	$(0, 0, 0)$	2a: (2);	2b: (2);	4c: (3);	8d: (6)
S $(u, u, \frac{1}{2})$ of space group No. 100					
(Co-) irrep	Phonon AM	WYPO information			
1	$(-r_1, r_1, 0)$	2a: (3);	2b: (4);	4c: (7);	8d: (12)
2	$(-r_1, r_1, 0)$	2a: (3);	2b: (2);	4c: (5);	8d: (12)
SM $(u, u, 0)$ of space group No. 100					
(Co-) irrep	Phonon AM	WYPO information			
1	$(-r_1, r_1, 0)$	2a: (3);	2b: (4);	4c: (7);	8d: (12)
2	$(-r_1, r_1, 0)$	2a: (3);	2b: (2);	4c: (5);	8d: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 100					
(Co-) irrep	Phonon AM	WYPO information			
1	$(0, r_1, 0)$	2a: (3);	2b: (3);	4c: (6);	8d: (12)
U $(0, v, \frac{1}{2})$ of space group No. 100					
(Co-) irrep	Phonon AM	WYPO information			
1	$(r_1, 0, 0)$	2a: (3);	2b: (3);	4c: (6);	8d: (12)
2	$(r_1, 0, 0)$	2a: (3);	2b: (3);	4c: (6);	8d: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 100					
(Co-) irrep	Phonon AM	WYPO information			
1	$(0, 0, 0)$	2a: (1);	2b: (0);	4c: (1);	8d: (3)
2	$(0, 0, 0)$	2a: (1);	2b: (0);	4c: (1);	8d: (3)
3	$(0, 0, 0)$	2a: (1);	2b: (1);	4c: (2);	8d: (3)
4	$(0, 0, 0)$	2a: (1);	2b: (1);	4c: (2);	8d: (3)

5	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 8d: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 8d: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	2a: (3); 2b: (3); 4c: (6); 8d: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)
Operation E
Coordinate ($u, v, 0$)
P2($u, v, \frac{1}{2}$)
Operation E
Coordinate ($u, v, \frac{1}{2}$)
P3(0, u, v)
Operation E C_{4z}^+
Coordinate (0, u, v) ($-u, 0, v$)
P4(u, u, v)
Operation E C_{4z}^+
Coordinate (u, u, v) ($-u, u, v$)
P5($u, \frac{1}{2}, v$)
Operation E C_{4z}^+
Coordinate ($u, \frac{1}{2}, v$) ($-\frac{1}{2}, u, v$)

P1 ($u, v, 0$) of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	($r_2, r_1, 0$)	2a: (6); 2b: (6); 4c: (12); 8d: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information
1	($r_2, r_1, 0$)	2a: (6); 2b: (6); 4c: (12); 8d: (24)
P3 (0, u, v) of space group No. 100		
(Co-) irrep	Phonon AM	WYPO information

1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)

P4 (u, u, v) of space group No. 100

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (4); 4c: (7); 8d: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (2); 4c: (5); 8d: (12)

P5 ($u, \frac{1}{2}, v$) of space group No. 100

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)

101. Space group No. 101 ($P4_2cm$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & \vec{t}_1 = \vec{a} \\
 \text{Tetragonal primitive lattice} & \vec{b} = (0, a, 0) & \vec{t}_2 = \vec{b} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, \frac{1}{2}\} \quad \{C_{4z}^-|0, 0, \frac{1}{2}\} \quad \{\sigma_y|0, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, \frac{1}{2}\} \quad \{\sigma_{db}|0, 0, 0\} \quad \{\sigma_{da}|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (0, 0, 0)
 \end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)
 \end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}
 \text{Operation} & E \\
 \text{Coordinate} & (0, 0, \frac{1}{2})
 \end{array}$$

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}
 \text{Operation} & E
 \end{array}$$

Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$R(0, \frac{1}{2}, \frac{1}{2})$

Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, \frac{1}{2})$

$X(0, \frac{1}{2}, 0)$

Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 101

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 8e: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 8e: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 8e: (6)

$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 101

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (1); 8e: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (1); 8e: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 4c: (2); 4d: (3); 8e: (6)

$Z(0, 0, \frac{1}{2})$ of space group No. 101

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 8e: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 8e: (6)

$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 101

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (1); 8e: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (2); 4d: (3); 8e: (6)

$R(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 101

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 8e: (6)

$X(0, \frac{1}{2}, 0)$ of space group No. 101

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 8e: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 8e: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 8e: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 8e: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($0, v, \frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	($0, \frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	($-\frac{1}{2}, u, 0$)

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
LD $(0, 0, w)$ of space group No. 101		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (2); 8e: (3)
2	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (3)
3	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (3)
4	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (2); 8e: (3)
5	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (3); 8e: (6)
S $(u, u, \frac{1}{2})$ of space group No. 101		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (4); 2b: (4); 4c: (6); 4d: (7); 8e: (12)
2	$(-r_1, r_1, 0)$	2a: (2); 2b: (2); 4c: (6); 4d: (5); 8e: (12)
SM $(u, u, 0)$ of space group No. 101		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (4); 2b: (4); 4c: (6); 4d: (7); 8e: (12)
2	$(-r_1, r_1, 0)$	2a: (2); 2b: (2); 4c: (6); 4d: (5); 8e: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 101		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
U $(0, v, \frac{1}{2})$ of space group No. 101		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 101		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3)
2	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (2); 4d: (1); 8e: (3)
3	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (2); 4d: (1); 8e: (3)
4	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3)
5	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (2); 4d: (3); 8e: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 101		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3); 4d: (3); 8e: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3); 4d: (3); 8e: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3); 4d: (3); 8e: (6)
4	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3); 4d: (3); 8e: (6)
Y $(u, \frac{1}{2}, 0)$ of space group No. 101		

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)
Operation E
Coordinate $(u, v, 0)$
P2($u, v, \frac{1}{2}$)
Operation E
Coordinate $(u, v, \frac{1}{2})$
P3($0, u, v$)
Operation E C_{4z}^+
Coordinate $(0, u, v) (-u, 0, v)$
P4(u, u, v)
Operation E C_{4z}^+
Coordinate $(u, u, v) (-u, u, v)$
P5($u, \frac{1}{2}, v$)
Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, v) (-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 101

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 8e: (24)

P2 ($u, v, \frac{1}{2}$) of space group No. 101

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 8e: (24)

P3 ($0, u, v$) of space group No. 101

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)

P4 (u, u, v) of space group No. 101

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (4); 2b: (4); 4c: (6); 4d: (7); 8e: (12)
2	$(-r_1, r_1, 0)$	2a: (2); 2b: (2); 4c: (6); 4d: (5); 8e: (12)

P5 ($u, \frac{1}{2}, v$) of space group No. 101		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)

102. Space group No. 102 ($P4_2nm$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{4z}^-|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_y|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_{db}|0, 0, 0\} \quad \{\sigma_{da}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$M(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^{+}
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^{+}

Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

$\Gamma (0, 0, 0)$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 4c: (2); 8d: (3)
2	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 8d: (3)
3	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 8d: (3)
4	(0, 0, 0)	2a: (1); 4b: (1); 4c: (2); 8d: (3)
5	(0, 0, 0)	2a: (2); 4b: (4); 4c: (3); 8d: (6)
$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 4b: (2); 4c: (1); 8d: (3)
2	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 8d: (3)
3	(0, 0, 0)	2a: (2); 4b: (2); 4c: (3); 8d: (6)
$Z (0, 0, \frac{1}{2})$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 4c: (2); 8d: (3)
2	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 8d: (3)
3	(0, 0, 0)	2a: (2); 4b: (4); 4c: (3); 8d: (6)
$A (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 4b: (2); 4c: (1); 8d: (3)
2	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 8d: (3)
3	(0, 0, 0)	2a: (0); 4b: (2); 4c: (1); 8d: (3)
4	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 8d: (3)
5	(0, 0, 0)	2a: (2); 4b: (2); 4c: (3); 8d: (6)
$R (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 8d: (12)
$X (0, \frac{1}{2}, 0)$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 8d: (12)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S(u, u, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, u, 0)		
Operation	E	C_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T(u, $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u, $\frac{1}{2}$, $\frac{1}{2}$)	(- $\frac{1}{2}$, u, $\frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}$, $\frac{1}{2}$, w)		
Operation	E	
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	
W(0, $\frac{1}{2}$, w)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}$, w)	(- $\frac{1}{2}$, 0, w)
Y(u, $\frac{1}{2}$, 0)		
Operation	E	C_{4z}^+
Coordinate	(u, $\frac{1}{2}$, 0)	(- $\frac{1}{2}$, u, 0)

DT (0, v, 0) of space group No. 102

(Co-) irrep	Phonon AM	WYPO information
1	(r_1 , 0, 0)	2a: (3); 4b: (6); 4c: (6); 8d: (12)
2	(r_1 , 0, 0)	2a: (3); 4b: (6); 4c: (6); 8d: (12)

LD (0, 0, w) of space group No. 102

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 4c: (2); 8d: (3)
2	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 8d: (3)
3	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 8d: (3)
4	(0, 0, 0)	2a: (1); 4b: (1); 4c: (2); 8d: (3)
5	(0, 0, 0)	2a: (2); 4b: (4); 4c: (3); 8d: (6)

S (u, u, $\frac{1}{2}$) of space group No. 102

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (4); 4b: (6); 4c: (7); 8d: (12)
2	$(-r_1, r_1, 0)$	2a: (2); 4b: (6); 4c: (5); 8d: (12)
SM $(u, u, 0)$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (4); 4b: (6); 4c: (7); 8d: (12)
2	$(-r_1, r_1, 0)$	2a: (2); 4b: (6); 4c: (5); 8d: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6); 4c: (6); 8d: (12)
2	$(0, r_1, 0)$	2a: (3); 4b: (6); 4c: (6); 8d: (12)
U $(0, v, \frac{1}{2})$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6); 4c: (6); 8d: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (0); 4b: (2); 4c: (1); 8d: (3)
2	$(0, 0, 0)$	2a: (0); 4b: (2); 4c: (1); 8d: (3)
3	$(0, 0, 0)$	2a: (1); 4b: (2); 4c: (2); 8d: (3)
4	$(0, 0, 0)$	2a: (1); 4b: (2); 4c: (2); 8d: (3)
5	$(0, 0, 0)$	2a: (2); 4b: (2); 4c: (3); 8d: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 4b: (6); 4c: (6); 8d: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6); 4c: (6); 8d: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate $(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 4b: (12); 4c: (12); 8d: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 4b: (12); 4c: (12); 8d: (24)
P3 ($0, u, v$) of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6); 4c: (6); 8d: (12)
2	$(r_1, 0, 0)$	2a: (3); 4b: (6); 4c: (6); 8d: (12)
P4 (u, u, v) of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (4); 4b: (6); 4c: (7); 8d: (12)
2	$(-r_1, r_1, 0)$	2a: (2); 4b: (6); 4c: (5); 8d: (12)
P5 ($u, \frac{1}{2}, v$) of space group No. 102		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6); 4c: (6); 8d: (12)
2	$(0, r_1, 0)$	2a: (3); 4b: (6); 4c: (6); 8d: (12)

103. Space group No. 103 ($P4cc$)

Tetragonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_{4z}^+|0,0,0\} \quad \{C_{4z}^-|0,0,0\} \quad \{\sigma_y|0,0,\frac{1}{2}\} \quad \{\sigma_x|0,0,\frac{1}{2}\} \quad \{\sigma_{db}|0,0,\frac{1}{2}\} \quad \{\sigma_{da}|0,0,\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$
Operation E
Coordinate (0,0,0)
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0,0,\frac{1}{2})$
Operation E
Coordinate $(0,0,\frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0,\frac{1}{2},\frac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,\frac{1}{2})$
$X(0,\frac{1}{2},0)$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

$\Gamma(0,0,0)$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	2a: (1); 2b: (1); 4c: (1); 8d: (3)
2	(0,0,0)	2a: (1); 2b: (1); 4c: (1); 8d: (3)
3	(0,0,0)	2a: (0); 2b: (0); 4c: (1); 8d: (3)
4	(0,0,0)	2a: (0); 2b: (0); 4c: (1); 8d: (3)
5	(0,0,0)	2a: (2); 2b: (2); 4c: (4); 8d: (6)

$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	2a: (1); 2b: (0); 4c: (2); 8d: (3)
2	(0,0,0)	2a: (1); 2b: (0); 4c: (2); 8d: (3)
3	(0,0,0)	2a: (0); 2b: (1); 4c: (2); 8d: (3)
4	(0,0,0)	2a: (0); 2b: (1); 4c: (2); 8d: (3)

5 (0, 0, 0) 2a: (2); 2b: (2); 4c: (2); 8d: (6)

Z $(0, 0, \frac{1}{2})$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 8d: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 8d: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 8d: (3)

A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 4c: (2); 8d: (3)
2	(0, 0, 0)	2a: (1); 2b: (0); 4c: (2); 8d: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 8d: (3)

R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 8d: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 8d: (6)

X $(0, \frac{1}{2}, 0)$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 8d: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 8d: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 8d: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 8d: (6)

c. Results for high-symmetry lines

DT(0, v, 0)

Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

S($u, u, \frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)

SM($u, u, 0$)

Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)

T($u, \frac{1}{2}, \frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$
$U(0, v, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)

LD $(0, 0, w)$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 8d: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 8d: (3)
3	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 8d: (3)
4	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 8d: (3)
5	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (4); 8d: (6)

S $(u, u, \frac{1}{2})$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)

SM $(u, u, 0)$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)

U $(0, v, \frac{1}{2})$ of space group No. 103

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
$V\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 103		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (0); 4c: (2); 8d: (3)
2	$(0, 0, 0)$	2a: (1); 2b: (0); 4c: (2); 8d: (3)
3	$(0, 0, 0)$	2a: (0); 2b: (1); 4c: (2); 8d: (3)
4	$(0, 0, 0)$	2a: (0); 2b: (1); 4c: (2); 8d: (3)
5	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (2); 8d: (6)
$W\left(0, \frac{1}{2}, w\right)$ of space group No. 103		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3); 8d: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 4c: (3); 8d: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3); 8d: (6)
4	$(0, 0, 0)$	2a: (2); 2b: (1); 4c: (3); 8d: (6)
$Y\left(u, \frac{1}{2}, 0\right)$ of space group No. 103		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 103		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12); 8d: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 103		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12); 8d: (24)
P3 ($0, u, v$) of space group No. 103		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
P4 (u, u, v) of space group No. 103		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
P5 ($u, \frac{1}{2}, v$) of space group No. 103		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 8d: (12)

104. Space group No. 104 ($P4nc$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_{4z}^+|0,0,0\} \quad \{C_{4z}^-|0,0,0\} \quad \{\sigma_y|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_{db}|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_{da}|\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation	E
Coordinate	(0, 0, 0)

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0) \end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2}) \end{array}$$

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2}) \end{array}$$

$$R(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{lll} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) & (-\frac{1}{2}, 0, \frac{1}{2}) \end{array}$$

$$X(0, \frac{1}{2}, 0)$$

$$\begin{array}{lll} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, 0) & (-\frac{1}{2}, 0, 0) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 104

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)
2	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)
3	(0, 0, 0)	2a: (0); 4b: (1); 8c: (3)
4	(0, 0, 0)	2a: (0); 4b: (1); 8c: (3)
5	(0, 0, 0)	2a: (2); 4b: (4); 8c: (6)

$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 104

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)
2	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)
3	(0, 0, 0)	2a: (1); 4b: (4); 8c: (6)

$Z (0, 0, \frac{1}{2})$ of space group No. 104

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 4b: (1); 8c: (3)
2	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)
3	(0, 0, 0)	2a: (1); 4b: (2); 8c: (3)

$A (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 104

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)
2	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3)
3	(0, 0, 0)	2a: (1); 4b: (4); 8c: (6)

R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 8c: (12)

X $(0, \frac{1}{2}, 0)$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 8c: (12)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W(0, $\frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	($-\frac{1}{2}, u, 0$)

DT $(0, v, 0)$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6); 8c: (12)
2	$(r_1, 0, 0)$	2a: (3); 4b: (6); 8c: (12)
LD $(0, 0, w)$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 4b: (1); 8c: (3)
2	$(0, 0, 0)$	2a: (1); 4b: (1); 8c: (3)
3	$(0, 0, 0)$	2a: (0); 4b: (1); 8c: (3)
4	$(0, 0, 0)$	2a: (0); 4b: (1); 8c: (3)
5	$(0, 0, 0)$	2a: (2); 4b: (4); 8c: (6)
S $(u, u, \frac{1}{2})$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
SM $(u, u, 0)$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
2	$(0, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
U $(0, v, \frac{1}{2})$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6); 8c: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 4b: (1); 8c: (3)
2	$(0, 0, 0)$	2a: (1); 4b: (1); 8c: (3)
3	$(0, 0, 0)$	2a: (1); 4b: (1); 8c: (3)
4	$(0, 0, 0)$	2a: (1); 4b: (1); 8c: (3)
5	$(0, 0, 0)$	2a: (1); 4b: (4); 8c: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 4b: (6); 8c: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate $(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate $(0, u, v) (-u, 0, v)$

P4(u, u, v)

Operation E C_{4z}^+
Coordinate $(u, u, v) (-u, u, v)$

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate $(u, \frac{1}{2}, v) (-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 4b: (12); 8c: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 4b: (12); 8c: (24)
P3 ($0, u, v$) of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6); 8c: (12)
2	$(r_1, 0, 0)$	2a: (3); 4b: (6); 8c: (12)
P4 (u, u, v) of space group No. 104		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
P5 ($u, \frac{1}{2}, v$) of space group No. 104		

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)
2	$(0, r_1, 0)$	2a: (3); 4b: (6); 8c: (12)

105. Space group No. 105 ($P4_2mc$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, \tfrac{1}{2}\} \quad \{C_{4z}^-|0, 0, \tfrac{1}{2}\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_{db}|0, 0, \tfrac{1}{2}\} \quad \{\sigma_{da}|0, 0, \tfrac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$M(\tfrac{1}{2}, \tfrac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\tfrac{1}{2}, \tfrac{1}{2}, 0)\end{array}$$

$$Z(0, 0, \tfrac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \tfrac{1}{2})\end{array}$$

$$A(\tfrac{1}{2}, \tfrac{1}{2}, \tfrac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\tfrac{1}{2}, \tfrac{1}{2}, \tfrac{1}{2})\end{array}$$

$$R(0, \tfrac{1}{2}, \tfrac{1}{2})$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \tfrac{1}{2}, \tfrac{1}{2}) & (-\tfrac{1}{2}, 0, \tfrac{1}{2})\end{array}$$

$$X(0, \tfrac{1}{2}, 0)$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \tfrac{1}{2}, 0) & (-\tfrac{1}{2}, 0, 0)\end{array}$$

Γ (0, 0, 0) of space group No. 105							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (2);	4e: (2);	8f: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	4d: (1);	4e: (1);	8f: (3)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (2);	4e: (2);	8f: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	4d: (1);	4e: (1);	8f: (3)
5	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	4d: (3);	4e: (3);	8f: (6)
M ($\frac{1}{2}$, $\frac{1}{2}$, 0) of space group No. 105							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	4d: (2);	4e: (1);	8f: (3)
2	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	4d: (1);	4e: (2);	8f: (3)
3	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	4d: (2);	4e: (1);	8f: (3)
4	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	4d: (1);	4e: (2);	8f: (3)
5	(0, 0, 0)	2a: (2);	2b: (2);	2c: (1);	4d: (3);	4e: (3);	8f: (6)
Z (0, 0, $\frac{1}{2}$) of space group No. 105							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (2);	4e: (2);	8f: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	4d: (1);	4e: (1);	8f: (3)
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	4d: (3);	4e: (3);	8f: (6)
A ($\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$) of space group No. 105							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	4d: (2);	4e: (1);	8f: (3)
2	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	4d: (1);	4e: (2);	8f: (3)
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (1);	4d: (3);	4e: (3);	8f: (6)
R (0, $\frac{1}{2}$, $\frac{1}{2}$) of space group No. 105							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	4d: (4);	4e: (3);	8f: (6)
2	(0, 0, 0)	2a: (0);	2b: (2);	2c: (1);	4d: (2);	4e: (3);	8f: (6)
3	(0, 0, 0)	2a: (2);	2b: (0);	2c: (1);	4d: (3);	4e: (2);	8f: (6)
4	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	4d: (3);	4e: (4);	8f: (6)
X (0, $\frac{1}{2}$, 0) of space group No. 105							
(Co-) irrep	Phonon AM	WYPO information					
1	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	4d: (4);	4e: (3);	8f: (6)
2	(0, 0, 0)	2a: (0);	2b: (2);	2c: (1);	4d: (2);	4e: (3);	8f: (6)
3	(0, 0, 0)	2a: (2);	2b: (0);	2c: (1);	4d: (3);	4e: (2);	8f: (6)
4	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	4d: (3);	4e: (4);	8f: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S(u, u, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, u, 0)		
Operation	E	C_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T(u, $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u, $\frac{1}{2}$, $\frac{1}{2}$)	(- $\frac{1}{2}$, u, $\frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}$, $\frac{1}{2}$, w)		
Operation	E	
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	
W(0, $\frac{1}{2}$, w)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}$, w)	(- $\frac{1}{2}$, 0, w)
Y(u, $\frac{1}{2}$, 0)		
Operation	E	C_{4z}^+
Coordinate	(u, $\frac{1}{2}$, 0)	(- $\frac{1}{2}$, u, 0)

DT (0, v, 0) of space group No. 105		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₁ , 0, 0)	2a: (4); 2b: (4); 2c: (4); 4d: (7); 4e: (7); 8f: (12)
2	(r ₁ , 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (5); 4e: (5); 8f: (12)
LD (0, 0, w) of space group No. 105		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (2); 4e: (2); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 4d: (1); 4e: (1); 8f: (3)

3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (2); 4e: (2); 8f: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 4d: (1); 4e: (1); 8f: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3); 4e: (3); 8f: (6)
S $(u, u, \frac{1}{2})$ of space group No. 105		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
SM $(u, u, 0)$ of space group No. 105		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 105		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (4); 2b: (2); 2c: (3); 4d: (7); 4e: (5); 8f: (12)
2	$(0, r_1, 0)$	2a: (2); 2b: (4); 2c: (3); 4d: (5); 4e: (7); 8f: (12)
U $(0, v, \frac{1}{2})$ of space group No. 105		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (4); 2b: (4); 2c: (4); 4d: (7); 4e: (7); 8f: (12)
2	$(r_1, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 4d: (5); 4e: (5); 8f: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 105		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 4d: (2); 4e: (1); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 4d: (1); 4e: (2); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 4d: (2); 4e: (1); 8f: (3)
4	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 4d: (1); 4e: (2); 8f: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3); 4e: (3); 8f: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 105		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (4); 4e: (3); 8f: (6)
2	(0, 0, 0)	2a: (0); 2b: (2); 2c: (1); 4d: (2); 4e: (3); 8f: (6)
3	(0, 0, 0)	2a: (2); 2b: (0); 2c: (1); 4d: (3); 4e: (2); 8f: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3); 4e: (4); 8f: (6)
Y $(u, \frac{1}{2}, 0)$ of space group No. 105		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (4); 2b: (2); 2c: (3); 4d: (7); 4e: (5); 8f: (12)
2	$(0, r_1, 0)$	2a: (2); 2b: (4); 2c: (3); 4d: (5); 4e: (7); 8f: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 105			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6);	2b: (6); 2c: (6); 4d: (12); 4e: (12); 8f: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 105			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6);	2b: (6); 2c: (6); 4d: (12); 4e: (12); 8f: (24)
P3 ($0, u, v$) of space group No. 105			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	2a: (4);	2b: (4); 2c: (4); 4d: (7); 4e: (7); 8f: (12)
2	$(r_1, 0, 0)$	2a: (2);	2b: (2); 2c: (2); 4d: (5); 4e: (5); 8f: (12)
P4 (u, u, v) of space group No. 105			
(Co-) irrep	Phonon AM	WYPO information	
1	$(-r_1, r_1, 0)$	2a: (3);	2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
2	$(-r_1, r_1, 0)$	2a: (3);	2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
P5 ($u, \frac{1}{2}, v$) of space group No. 105			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	2a: (4);	2b: (2); 2c: (3); 4d: (7); 4e: (5); 8f: (12)
2	$(0, r_1, 0)$	2a: (2);	2b: (4); 2c: (3); 4d: (5); 4e: (7); 8f: (12)

106. Space group No. 106 ($P4_2bc$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_{4z}^+|0,0,\tfrac{1}{2}\} \quad \{C_{4z}^-|0,0,\tfrac{1}{2}\} \quad \{\sigma_y|\tfrac{1}{2},\tfrac{1}{2},0\} \quad \{\sigma_x|-\tfrac{1}{2},-\tfrac{1}{2},0\} \quad \{\sigma_{db}|-\tfrac{1}{2},\tfrac{1}{2},\tfrac{1}{2}\} \quad \{\sigma_{da}|\tfrac{1}{2},-\tfrac{1}{2},\tfrac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate (0, 0, 0)
$M(\tfrac{1}{2}, \tfrac{1}{2}, 0)$
Operation E
Coordinate $(\tfrac{1}{2}, \tfrac{1}{2}, 0)$
$Z(0, 0, \tfrac{1}{2})$
Operation E
Coordinate $(0, 0, \tfrac{1}{2})$
$A(\tfrac{1}{2}, \tfrac{1}{2}, \tfrac{1}{2})$
Operation E
Coordinate $(\tfrac{1}{2}, \tfrac{1}{2}, \tfrac{1}{2})$
$R(0, \tfrac{1}{2}, \tfrac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0, \tfrac{1}{2}, \tfrac{1}{2})$ $(-\tfrac{1}{2}, 0, \tfrac{1}{2})$
$X(0, \tfrac{1}{2}, 0)$
Operation E C_{4z}^+
Coordinate $(0, \tfrac{1}{2}, 0)$ $(-\tfrac{1}{2}, 0, 0)$

$\Gamma (0, 0, 0)$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3)
5	(0, 0, 0)	4a: (4); 4b: (4); 8c: (6)
$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3)
2	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3)
3	(0, 0, 0)	4a: (2); 4b: (4); 8c: (6)
$Z (0, 0, \frac{1}{2})$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3)
3	(0, 0, 0)	4a: (4); 4b: (4); 8c: (6)
$A (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3)
2	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3)
3	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3)
$R (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12)
$X (0, \frac{1}{2}, 0)$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12)

c. Results for high-symmetry lines

DT(0, v , 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	

$S(u, u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
$SM(u, u, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
$T(u, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$
$U(0, v, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 106

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6); 4b: (6); 8c: (12)
2	$(r_1, 0, 0)$	4a: (6); 4b: (6); 8c: (12)

LD $(0, 0, w)$ of space group No. 106

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
3	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
4	$(0, 0, 0)$	4a: (1); 4b: (1); 8c: (3)
5	$(0, 0, 0)$	4a: (4); 4b: (4); 8c: (6)

S $(u, u, \frac{1}{2})$ of space group No. 106

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)

SM $(u, u, 0)$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)
2	$(-r_1, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)
U $(0, v, \frac{1}{2})$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6); 4b: (6); 8c: (12)
2	$(r_1, 0, 0)$	4a: (6); 4b: (6); 8c: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (2); 4b: (1); 8c: (3)
2	$(0, 0, 0)$	4a: (2); 4b: (1); 8c: (3)
3	$(0, 0, 0)$	4a: (2); 4b: (1); 8c: (3)
4	$(0, 0, 0)$	4a: (2); 4b: (1); 8c: (3)
5	$(0, 0, 0)$	4a: (2); 4b: (4); 8c: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (6); 4b: (6); 8c: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 106		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$

P4(u, u, v)

Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$

P5($u, \frac{1}{2}, v$)

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 106

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12); 4b: (12); 8c: (24)

P2 ($u, v, \frac{1}{2}$) of space group No. 106

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12); 4b: (12); 8c: (24)

P3 ($0, u, v$) of space group No. 106

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6); 4b: (6); 8c: (12)
2	$(r_1, 0, 0)$	4a: (6); 4b: (6); 8c: (12)

P4 (u, u, v) of space group No. 106

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)
2	$(-r_1, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)

P5 ($u, \frac{1}{2}, v$) of space group No. 106

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)
2	$(0, r_1, 0)$	4a: (6); 4b: (6); 8c: (12)

107. Space group No. 107 ($I4mm$)

Tetragonal body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_{4z}^+|0,0,0\} \quad \{C_{4z}^-|0,0,0\} \quad \{\sigma_y|0,0,0\} \quad \{\sigma_x|0,0,0\} \quad \{\sigma_{db}|0,0,0\} \quad \{\sigma_{da}|0,0,0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$				
Operation	E			
Coordinate	$(0,0,0)$			
$N(0,\frac{1}{2},0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},0,0)$	$(0,\frac{1}{2},-\frac{1}{2})$	$(\frac{1}{2},0,-\frac{1}{2})$
$X(0,0,\frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0,0,\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},0)$		
$Z(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$			
$P(\frac{1}{4},\frac{1}{4},\frac{1}{4})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(\frac{1}{4},\frac{1}{4},\frac{1}{4})$	$(\frac{3}{4},-\frac{1}{4},-\frac{1}{4})$		

$\Gamma(0,0,0)$ of space group No. 107

(Co-) irrep	Phonon AM	WYPO information			
1	(0,0,0)	2a: (1);	4b: (1);	8c: (2);	8d: (2); 16e: (3)
2	(0,0,0)	2a: (0);	4b: (0);	8c: (1);	8d: (1); 16e: (3)
3	(0,0,0)	2a: (0);	4b: (1);	8c: (1);	8d: (2); 16e: (3)
4	(0,0,0)	2a: (0);	4b: (0);	8c: (2);	8d: (1); 16e: (3)
5	(0,0,0)	2a: (1);	4b: (2);	8c: (3);	8d: (3); 16e: (6)

$N(0, \frac{1}{2}, 0)$ of space group No. 107

(Co-) irrep	Phonon AM	WYPO information			
1	(0,0,0)	2a: (2);	4b: (4);	8c: (6);	8d: (7); 16e: (12)
2	(0,0,0)	2a: (1);	4b: (2);	8c: (6);	8d: (5); 16e: (12)

$X(0, 0, \frac{1}{2})$ of space group No. 107

(Co-) irrep	Phonon AM	WYPO information			
1	(0,0,0)	2a: (1);	4b: (2);	8c: (4);	8d: (3); 16e: (6)
2	(0,0,0)	2a: (0);	4b: (2);	8c: (2);	8d: (3); 16e: (6)
3	(0,0,0)	2a: (1);	4b: (1);	8c: (3);	8d: (3); 16e: (6)

4 (0, 0, 0) 2a: (1); 4b: (1); 8c: (3); 8d: (3); 16e: (6)

$Z\left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 107

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 8c: (2); 8d: (2); 16e: (3)
2	(0, 0, 0)	2a: (0); 4b: (0); 8c: (1); 8d: (1); 16e: (3)
3	(0, 0, 0)	2a: (0); 4b: (1); 8c: (1); 8d: (2); 16e: (3)
4	(0, 0, 0)	2a: (0); 4b: (0); 8c: (2); 8d: (1); 16e: (3)
5	(0, 0, 0)	2a: (1); 4b: (2); 8c: (3); 8d: (3); 16e: (6)

$P\left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$ of space group No. 107

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (2); 8c: (4); 8d: (3); 16e: (6)
2	(0, 0, 0)	2a: (0); 4b: (2); 8c: (2); 8d: (3); 16e: (6)
3	(0, 0, 0)	2a: (1); 4b: (1); 8c: (3); 8d: (3); 16e: (6)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u$)

DT (0, 0, u) of space group No. 107

(Co-) irrep	Phonon AM	WYPO information

1	$(-r_1, r_1, 0)$	2a: (2); 4b: (3); 8c: (7); 8d: (6); 16e: (12)
2	$(-r_1, r_1, 0)$	2a: (1); 4b: (3); 8c: (5); 8d: (6); 16e: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 107		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 4b: (1); 8c: (2); 8d: (2); 16e: (3)
2	$(0, 0, 0)$	2a: (0); 4b: (0); 8c: (1); 8d: (1); 16e: (3)
3	$(0, 0, 0)$	2a: (0); 4b: (1); 8c: (1); 8d: (2); 16e: (3)
4	$(0, 0, 0)$	2a: (0); 4b: (0); 8c: (2); 8d: (1); 16e: (3)
5	$(0, 0, 0)$	2a: (1); 4b: (2); 8c: (3); 8d: (3); 16e: (6)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 107		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 4b: (6); 8c: (12); 8d: (12); 16e: (24)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 107		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 4b: (4); 8c: (6); 8d: (7); 16e: (12)
2	$(0, r_1, 0)$	2a: (1); 4b: (2); 8c: (6); 8d: (5); 16e: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 107		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 4b: (2); 8c: (4); 8d: (3); 16e: (6)
2	$(0, 0, 0)$	2a: (0); 4b: (2); 8c: (2); 8d: (3); 16e: (6)
3	$(0, 0, 0)$	2a: (1); 4b: (1); 8c: (3); 8d: (3); 16e: (6)
4	$(0, 0, 0)$	2a: (1); 4b: (1); 8c: (3); 8d: (3); 16e: (6)
Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$ of space group No. 107		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (2); 4b: (3); 8c: (7); 8d: (6); 16e: (12)
2	$(r_1, r_1, 0)$	2a: (1); 4b: (3); 8c: (5); 8d: (6); 16e: (12)

d. Results for high-symmetry planes

P1 $(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$	$(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v)$
P2 $(u, v, -u)$		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3 $(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 ($\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v$) of space group No. 107		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (2); 4b: (3); 8c: (7); 8d: (6); 16e: (12)
2	$(r_1, r_1, 0)$	2a: (1); 4b: (3); 8c: (5); 8d: (6); 16e: (12)
P2 ($u, v, -u$) of space group No. 107		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 4b: (4); 8c: (6); 8d: (7); 16e: (12)
2	$(0, r_1, 0)$	2a: (1); 4b: (2); 8c: (6); 8d: (5); 16e: (12)
P3 ($u, -u, v$) of space group No. 107		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 4b: (6); 8c: (12); 8d: (12); 16e: (24)

108. Space group No. 108 ($I4cm$)

Tetragonal body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{\sigma_y|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_x|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_{db}|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_{da}|\frac{1}{2}, \frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$				
Operation	E			
Coordinate	$(0,0,0)$			
$N(0,\frac{1}{2},0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},0,0)$	$(0,\frac{1}{2},-\frac{1}{2})$	$(\frac{1}{2},0,-\frac{1}{2})$

$X(0, 0, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4})$

$\Gamma (0, 0, 0)$ of space group No. 108			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 16d: (3)	
2	(0, 0, 0)	4a: (1); 4b: (0); 8c: (1); 16d: (3)	
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 16d: (3)	
4	(0, 0, 0)	4a: (0); 4b: (1); 8c: (2); 16d: (3)	
5	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 16d: (6)	
$N (0, \frac{1}{2}, 0)$ of space group No. 108			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 16d: (12)	
$X (0, 0, \frac{1}{2})$ of space group No. 108			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3); 16d: (6)	
2	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3); 16d: (6)	
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (4); 16d: (6)	
4	(0, 0, 0)	4a: (2); 4b: (0); 8c: (2); 16d: (6)	
$Z (-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 108			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 4b: (0); 8c: (1); 16d: (3)	
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 16d: (3)	
3	(0, 0, 0)	4a: (0); 4b: (1); 8c: (2); 16d: (3)	
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 16d: (3)	
5	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 16d: (6)	
$P (\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 108			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3); 16d: (6)	
2	(0, 0, 0)	4a: (1); 4b: (0); 8c: (1); 16d: (3)	
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 16d: (3)	

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u$)

DT (0, 0, u) of space group No. 108

(Co-) irrep	Phonon AM	WYPO information
1	($-r_1, r_1, 0$)	4a: (3); 4b: (4); 8c: (7); 16d: (12)
2	($-r_1, r_1, 0$)	4a: (3); 4b: (2); 8c: (5); 16d: (12)

LD ($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$) of space group No. 108

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 16d: (3)
2	(0, 0, 0)	4a: (1); 4b: (0); 8c: (1); 16d: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 16d: (3)
4	(0, 0, 0)	4a: (0); 4b: (1); 8c: (2); 16d: (3)
5	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 16d: (6)

Q ($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$) of space group No. 108

(Co-) irrep	Phonon AM	WYPO information
1	($r_2, 0, r_1$)	4a: (3); 4b: (3); 8c: (6); 16d: (12)

SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 108		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 16d: (12)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 16d: (12)

W $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 108		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (2); 8c: (3); 16d: (6)
2	$(0, 0, 0)$	4a: (1); 4b: (2); 8c: (3); 16d: (6)
3	$(0, 0, 0)$	4a: (2); 4b: (2); 8c: (4); 16d: (6)
4	$(0, 0, 0)$	4a: (2); 4b: (0); 8c: (2); 16d: (6)

Y $\left(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 108		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (3); 4b: (2); 8c: (5); 16d: (12)
2	$(r_1, r_1, 0)$	4a: (3); 4b: (4); 8c: (7); 16d: (12)

d. Results for high-symmetry planes

P1 $\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$		
Operation	E	C_{4z}^+
Coordinate	$\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$	$\left(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v\right)$
P2 $(u, v, -u)$		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3 $(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 $\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$ of space group No. 108		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (3); 4b: (2); 8c: (5); 16d: (12)
2	$(r_1, r_1, 0)$	4a: (3); 4b: (4); 8c: (7); 16d: (12)

P2 $(u, v, -u)$ of space group No. 108		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 16d: (12)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 16d: (12)

P3 $(u, -u, v)$ of space group No. 108		

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 8c: (12); 16d: (24)

109. Space group No. 109 ($I4_1md$)

Tetragonal body-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{C_{4z}^-|\frac{3}{4}, \frac{1}{4}, -\frac{1}{2}\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_{db}|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{\sigma_{da}|\frac{3}{4}, \frac{1}{4}, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	C_{4z}^+	C_{4z}^-	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	C_{4z}^+		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$				
Operation	E	C_{4z}^+		
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4})$		

$\Gamma (0, 0, 0)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 8b: (2); 16c: (3)
2	(0, 0, 0)	4a: (0); 8b: (1); 16c: (3)
3	(0, 0, 0)	4a: (1); 8b: (2); 16c: (3)
4	(0, 0, 0)	4a: (0); 8b: (1); 16c: (3)
5	(0, 0, 0)	4a: (2); 8b: (3); 16c: (6)

$N (0, \frac{1}{2}, 0)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (4); 8b: (7); 16c: (12)
2	(0, 0, 0)	4a: (2); 8b: (5); 16c: (12)

$X (0, 0, \frac{1}{2})$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6); 16c: (12)

$Z (-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 8b: (2); 16c: (3)
2	(0, 0, 0)	4a: (0); 8b: (1); 16c: (3)
3	(0, 0, 0)	4a: (2); 8b: (3); 16c: (6)

$P (\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 8b: (6); 16c: (12)

c. Results for high-symmetry lines

$DT(0, 0, u)$		
Operation	E	C_{4z}^+
Coordinate	$(0, 0, u)$	$(u, -u, 0)$

$LD(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$	

$Q(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$	$(\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2})$

$SM(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{u}{2}, \frac{u}{2})$

$W\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$		
Operation	E	
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$	
$Y\left(\frac{1}{2}-u, -\frac{1}{2}+u, \frac{1}{2}\right)$		
Operation	E	C_{4z}^+
Coordinate	$\left(\frac{1}{2}-u, -\frac{1}{2}+u, \frac{1}{2}\right)$	$\left(\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}+u\right)$

DT $(0, 0, u)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	4a: (3); 8b: (6); 16c: (12)
2	$(-r_1, r_1, 0)$	4a: (3); 8b: (6); 16c: (12)
LD $\left(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}\right)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 8b: (2); 16c: (3)
2	$(0, 0, 0)$	4a: (0); 8b: (1); 16c: (3)
3	$(0, 0, 0)$	4a: (1); 8b: (2); 16c: (3)
4	$(0, 0, 0)$	4a: (0); 8b: (1); 16c: (3)
5	$(0, 0, 0)$	4a: (2); 8b: (3); 16c: (6)
Q $\left(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}\right)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6); 8b: (12); 16c: (24)
SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (4); 8b: (7); 16c: (12)
2	$(0, r_1, 0)$	4a: (2); 8b: (5); 16c: (12)
W $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3); 8b: (6); 16c: (12)
Y $\left(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (3); 8b: (6); 16c: (12)

d. Results for high-symmetry planes

$$PI\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$$

Operation

E

C_{4z}^+

Coordinate	$(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$ $(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v)$	
P2($u, v, -u$)		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3($u, -u, v$)		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 $(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (3); 8b: (6); 16c: (12)
2	$(r_1, r_1, 0)$	4a: (3); 8b: (6); 16c: (12)
P2 $(u, v, -u)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (4); 8b: (7); 16c: (12)
2	$(0, r_1, 0)$	4a: (2); 8b: (5); 16c: (12)
P3 $(u, -u, v)$ of space group No. 109		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 8b: (12); 16c: (24)

110. Space group No. 110 ($I4_1cd$)

Tetragonal body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{C_{4z}^-|\frac{3}{4}, \frac{1}{4}, -\frac{1}{2}\} \quad \{\sigma_y|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_x|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_{db}|\frac{1}{4}, \frac{3}{4}, \frac{1}{2}\} \quad \{\sigma_{da}|\frac{1}{4}, \frac{3}{4}, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4})$		

$\Gamma(0, 0, 0)$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (1); 16b: (3)
2	$(0, 0, 0)$	8a: (1); 16b: (3)
3	$(0, 0, 0)$	8a: (1); 16b: (3)
4	$(0, 0, 0)$	8a: (1); 16b: (3)
5	$(0, 0, 0)$	8a: (4); 16b: (6)
$N(0, \frac{1}{2}, 0)$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (6); 16b: (12)
$X(0, 0, \frac{1}{2})$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (6); 16b: (12)
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (1); 16b: (3)
2	$(0, 0, 0)$	8a: (1); 16b: (3)
3	$(0, 0, 0)$	8a: (4); 16b: (6)
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	8a: (3); 16b: (6)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u$)

DT (0, 0, u) of space group No. 110

(Co-) irrep	Phonon AM	WYPO information
1	($-r_1, r_1, 0$)	8a: (6); 16b: (12)
2	($-r_1, r_1, 0$)	8a: (6); 16b: (12)

LD ($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$) of space group No. 110

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 16b: (3)
2	(0, 0, 0)	8a: (1); 16b: (3)
3	(0, 0, 0)	8a: (1); 16b: (3)
4	(0, 0, 0)	8a: (1); 16b: (3)
5	(0, 0, 0)	8a: (4); 16b: (6)

Q ($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$) of space group No. 110

(Co-) irrep	Phonon AM	WYPO information
1	($r_2, 0, r_1$)	8a: (6); 16b: (12)

SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	8a: (6); 16b: (12)
2	$(0, r_1, 0)$	8a: (6); 16b: (12)

W $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (6); 16b: (12)

Y $\left(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	8a: (6); 16b: (12)

d. Results for high-symmetry planes

P1 $\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$		
Operation	E	C_{4z}^+
Coordinate	$\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$	$\left(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v\right)$
P2 $(u, v, -u)$		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3 $(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 $\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	8a: (6); 16b: (12)
2	$(r_1, r_1, 0)$	8a: (6); 16b: (12)

P2 $(u, v, -u)$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	8a: (6); 16b: (12)
2	$(0, r_1, 0)$	8a: (6); 16b: (12)

P3 $(u, -u, v)$ of space group No. 110		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	8a: (12); 16b: (24)

111. Space group No. 111 ($P\bar{4}2m$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{\sigma_{db}|0, 0, 0\} \quad \{\sigma_{da}|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation	E
Coordinate	(0, 0, 0)

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

Operation	E
Coordinate	($\frac{1}{2}, \frac{1}{2}, 0$)

$$Z(0, 0, \frac{1}{2})$$

Operation	E
Coordinate	(0, 0, $\frac{1}{2}$)

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

Operation	E
Coordinate	($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$)

$$R(0, \frac{1}{2}, \frac{1}{2})$$

Operation	E	S_{4z}^+
Coordinate	(0, $\frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, 0, -\frac{1}{2}$)

$$X(0, \frac{1}{2}, 0)$$

Operation	E	S_{4z}^+
Coordinate	(0, $\frac{1}{2}, 0$)	($-\frac{1}{2}, 0, 0$)

Γ (0, 0, 0) of space group No. 111

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (0);	2f: (0);	2g: (1);	2h: (1);	4i: (1);	4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (2); 8o: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (0);	2h: (0);	4i: (2);	4j: (2); 4k: (2); 4l: (2); 4m: (1); 4n: (1); 8o: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (0);	2f: (0);	2g: (0);	2h: (0);	4i: (1);	4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 8o: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (2); 4k: (2); 4l: (2); 4m: (1); 4n: (2); 8o: (3)
5	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (2);	2h: (2);	4i: (3);	4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (3); 8o: (6)

 M ($\frac{1}{2}, \frac{1}{2}, 0$) of space group No. 111

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (1);	1c: (0);	1d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (2); 4k: (1); 4l: (2); 4m: (2); 4n: (2); 8o: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (0);	2h: (0);	4i: (2);	4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (1); 8o: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (0);	2h: (0);	4i: (1);	4j: (2); 4k: (1); 4l: (2); 4m: (2); 4n: (1); 8o: (3)
4	(0, 0, 0)	1a: (1);	1b: (0);	1c: (1);	1d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (2); 8o: (3)
5	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (2);	2h: (2);	4i: (3);	4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (3); 8o: (6)

 Z ($0, 0, \frac{1}{2}$) of space group No. 111

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (1);	1c: (1);	1d: (0);	2e: (0);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (2); 8o: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (0);	2g: (0);	2h: (0);	4i: (2);	4j: (1); 4k: (1); 4l: (2); 4m: (1); 4n: (1); 8o: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (0);	2f: (1);	2g: (0);	2h: (0);	4i: (1);	4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (1); 8o: (3)
4	(0, 0, 0)	1a: (1);	1b: (0);	1c: (0);	1d: (1);	2e: (1);	2f: (0);	2g: (1);	2h: (1);	4i: (2);	4j: (1); 4k: (1); 4l: (2); 4m: (1); 4n: (2); 8o: (3)
5	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	2e: (2);	2f: (2);	2g: (2);	2h: (2);	4i: (3);	4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (3); 8o: (6)

 A ($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$) of space group No. 111

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	1c: (1);	1d: (1);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (1);	4j: (1); 4k: (2); 4l: (2); 4m: (2); 4n: (2); 8o: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (0);	2h: (0);	4i: (2);	4j: (2); 4k: (1); 4l: (1); 4m: (2); 4n: (1); 8o: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (0);	2h: (0);	4i: (1);	4j: (1); 4k: (2); 4l: (2); 4m: (2); 4n: (1); 8o: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (0);	1d: (0);	2e: (1);	2f: (1);	2g: (1);	2h: (1);	4i: (2);	4j: (2); 4k: (1); 4l: (1); 4m: (2); 4n: (2); 8o: (3)

5	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (3); 8o: (6)

$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 111

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (2); 4j: (3); 4k: (4); 4l: (3); 4m: (3); 4n: (3); 8o: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (4); 4j: (3); 4k: (2); 4l: (3); 4m: (3); 4n: (3); 8o: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (0); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (4); 4k: (3); 4l: (2); 4m: (3); 4n: (3); 8o: (6)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (2); 4k: (3); 4l: (4); 4m: (3); 4n: (3); 8o: (6)

$X\left(0, \frac{1}{2}, 0\right)$ of space group No. 111

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (2); 4i: (2); 4j: (3); 4k: (2); 4l: (3); 4m: (3); 4n: (3); 8o: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (2); 4i: (4); 4j: (3); 4k: (4); 4l: (3); 4m: (3); 4n: (3); 8o: (6)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (1); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (2); 4k: (3); 4l: (2); 4m: (3); 4n: (3); 8o: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (4); 4k: (3); 4l: (4); 4m: (3); 4n: (3); 8o: (6)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	S_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

S(u , u , $\frac{1}{2}$)

Operation	E	S_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $-\frac{1}{2}$)

SM(u , u , 0)

Operation	E	S_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)

T(u , $\frac{1}{2}$, $\frac{1}{2}$)

Operation	E	S_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $-\frac{1}{2}$)

U(0, v , $\frac{1}{2}$)

Operation	E	S_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, -\frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	σ_{db}
Coordinate	$(0, \frac{1}{2}, w)$	$(\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	S_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 111

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (3); 2h: (3); 4i: (5); 4j: (5); 4k: (5); 4l: (5); 4m: (6); 4n: (6); 8o: (12)
2	$(0, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (3); 2h: (3); 4i: (7); 4j: (7); 4k: (7); 4l: (7); 4m: (6); 4n: (6); 8o: (12)

LD $(0, 0, w)$ of space group No. 111

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (4); 8o: (6)
2	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (0); 2h: (0); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (2); 8o: (6)
3	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (3); 8o: (6)

S $(u, u, \frac{1}{2})$ of space group No. 111

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (4); 2h: (4); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (7); 8o: (12)
2	$(-r_1, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (2); 2h: (2); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (5); 8o: (12)

SM $(u, u, 0)$ of space group No. 111

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (4); 2h: (4); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (7); 8o: (12)
2	$(-r_1, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (2); 2h: (2); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (5); 8o: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 111

(Co-) irrep	Phonon AM	WYPO information

1	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (5); 4j: (5); 4k: (7); 4l: (7); 4m: (6); 4n: (6); 8o: (12)
2	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (7); 4j: (7); 4k: (5); 4l: (5); 4m: (6); 4n: (6); 8o: (12)
$U(0, v, \frac{1}{2})$ of space group No. 111		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (2); 1d: (1); 2e: (2); 2f: (4); 2g: (3); 2h: (3); 4i: (5); 4j: (7); 4k: (7); 4l: (5); 4m: (6); 4n: (6); 8o: (12)
2	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (1); 1d: (2); 2e: (4); 2f: (2); 2g: (3); 2h: (3); 4i: (7); 4j: (5); 4k: (5); 4l: (7); 4m: (6); 4n: (6); 8o: (12)
$V(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 111		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (4); 8o: (6)
2	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (2); 2f: (2); 2g: (0); 2h: (0); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (4); 4n: (2); 8o: (6)
3	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (3); 4m: (2); 4n: (3); 8o: (6)
$W(0, \frac{1}{2}, w)$ of space group No. 111		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (3); 2f: (3); 2g: (2); 2h: (4); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 8o: (12)
2	$(0, 0, r_1)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (3); 2f: (3); 2g: (4); 2h: (2); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (6); 8o: (12)
$Y(u, \frac{1}{2}, 0)$ of space group No. 111		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (5); 4j: (7); 4k: (5); 4l: (7); 4m: (6); 4n: (6); 8o: (12)
2	$(r_1, 0, 0)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (3); 2f: (3); 2g: (3); 2h: (3); 4i: (7); 4j: (5); 4k: (7); 4l: (5); 4m: (6); 4n: (6); 8o: (12)

d. Results for high-symmetry planes

$P1(u, v, 0)$

Operation E
Coordinate $(u, v, 0)$

$P2(u, v, \frac{1}{2})$

Operation E
Coordinate $(u, v, \frac{1}{2})$

$P3(0, u, v)$

Operation E σ_{da}
Coordinate $(0, u, v) \quad (-u, 0, v)$

P4(u, u, v)		
Operation	E	S_{4z}^-
Coordinate	(u, u, v)	$(u, -u, -v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	σ_{db}
Coordinate	$(u, \frac{1}{2}, v)$	$(\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 111		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 8o: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 111		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 8o: (24)
P3 ($0, u, v$) of space group No. 111		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 8o: (24)
P4 (u, u, v) of space group No. 111		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (4); 2h: (4); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (7); 8o: (12)
2	$(-r_1, r_1, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (2); 2h: (2); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 4n: (5); 8o: (12)
P5 ($u, \frac{1}{2}, v$) of space group No. 111		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 2h: (6); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 4n: (12); 8o: (24)

112. Space group No. 112 ($P4_2c$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{S_{4z}^+|0,0,0\} \quad \{S_{4z}^-|0,0,0\} \quad \{C_{2x}|0,0,\frac{1}{2}\} \quad \{C_{2y}|0,0,\frac{1}{2}\} \quad \{\sigma_{db}|0,0,-\frac{1}{2}\} \quad \{\sigma_{da}|0,0,-\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$
Operation E
Coordinate (0,0,0)
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0,0,\frac{1}{2})$
Operation E
Coordinate $(0,0,\frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0,\frac{1}{2},\frac{1}{2})$
Operation E S_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,-\frac{1}{2})$
$X(0,\frac{1}{2},0)$
Operation E S_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

$\Gamma(0,0,0)$ of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (0); 2f: (0); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 8n: (3)
2	(0,0,0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (0); 2f: (0); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (1); 4m: (1); 8n: (3)
3	(0,0,0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (1); 2f: (1); 4g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 8n: (3)
4	(0,0,0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (1); 4m: (1); 8n: (3)
5	(0,0,0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (4); 4m: (4); 8n: (6)
$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 2e: (0); 2f: (1); 4g: (1); 4h: (2); 4i: (2); 4j: (1); 4k: (1); 4l: (1); 4m: (2); 8n: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 2e: (0); 2f: (1); 4g: (2); 4h: (1); 4i: (1); 4j: (2); 4k: (1); 4l: (1); 4m: (2); 8n: (3)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (0); 4g: (1); 4h: (2); 4i: (2); 4j: (1); 4k: (1); 4l: (1); 4m: (2); 8n: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 2e: (1); 2f: (0); 4g: (2); 4h: (1); 4i: (1); 4j: (2); 4k: (1); 4l: (1); 4m: (2); 8n: (3)
5	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (4); 4m: (2); 8n: (6)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 112

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (1); 4i: (2); 4j: (1); 4k: (2); 4l: (2); 4m: (2); 8n: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 4m: (2); 8n: (6)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 112

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (1); 8n: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 4l: (2); 4m: (1); 8n: (3)
3	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 4m: (4); 8n: (6)

$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 112

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 2e: (1); 2f: (2); 4g: (3); 4h: (2); 4i: (4); 4j: (3); 4k: (2); 4l: (4); 4m: (3); 8n: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 2e: (1); 2f: (2); 4g: (3); 4h: (4); 4i: (2); 4j: (3); 4k: (2); 4l: (4); 4m: (3); 8n: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 2e: (2); 2f: (1); 4g: (4); 4h: (3); 4i: (3); 4j: (2); 4k: (4); 4l: (2); 4m: (3); 8n: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 2e: (2); 2f: (1); 4g: (2); 4h: (3); 4i: (3); 4j: (4); 4k: (4); 4l: (2); 4m: (3); 8n: (6)

$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 112

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (2); 2d: (1); 2e: (1); 2f: (2); 4g: (2); 4h: (3); 4i: (3); 4j: (2); 4k: (2); 4l: (4); 4m: (3); 8n: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (1); 2f: (2); 4g: (4); 4h: (3); 4i: (3); 4j: (4); 4k: (2); 4l: (4); 4m: (3); 8n: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (0); 2d: (1); 2e: (2); 2f: (1); 4g: (3); 4h: (2); 4i: (2); 4j: (3); 4k: (4); 4l: (2); 4m: (3); 8n: (6)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (1); 4g: (3); 4h: (4); 4i: (4); 4j: (3); 4k: (4); 4l: (2); 4m: (3); 8n: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	S_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, - $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	S_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	(- $\frac{1}{2}, u, -\frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, - $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	σ_{db}
Coordinate	(0, $\frac{1}{2}, w$)	($\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	S_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	(- $\frac{1}{2}, u, 0$)

DT (0, v, 0) of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (3); 2f: (3); 4g: (5); 4h: (5); 4i: (5); 4j: (5); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
2	(0, r_1 , 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 2e: (3); 2f: (3); 4g: (7); 4h: (7); 4i: (7); 4j: (7); 4k: (6); 4l: (6); 4m: (6); 8n: (12)

LD $(0, 0, w)$ of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 4m: (2); 8n: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 4m: (2); 8n: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (4); 4m: (4); 8n: (6)
S $(u, u, \frac{1}{2})$ of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
SM $(u, u, 0)$ of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (2); 2c: (3); 2d: (4); 2e: (3); 2f: (3); 4g: (5); 4h: (5); 4i: (7); 4j: (7); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (4); 2c: (3); 2d: (2); 2e: (3); 2f: (3); 4g: (7); 4h: (7); 4i: (5); 4j: (5); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
U $(0, v, \frac{1}{2})$ of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (7); 4h: (5); 4i: (7); 4j: (5); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (5); 4h: (7); 4i: (5); 4j: (7); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 4m: (4); 8n: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 4l: (2); 4m: (4); 8n: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 4l: (4); 4m: (2); 8n: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (2); 2b: (3); 2c: (4); 2d: (3); 2e: (2); 2f: (4); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (4); 4l: (8); 4m: (6); 8n: (12)

2	$(0, 0, r_1)$	2a: (4); 2b: (3); 2c: (2); 2d: (3); 2e: (4); 2f: (2); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (8); 4l: (4); 4m: (6); 8n: (12)

$Y(u, \frac{1}{2}, 0)$ of space group No. 112

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (2); 2b: (3); 2c: (4); 2d: (3); 2e: (3); 2f: (3); 4g: (5); 4h: (7); 4i: (7); 4j: (5); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
2	$(r_1, 0, 0)$	2a: (4); 2b: (3); 2c: (2); 2d: (3); 2e: (3); 2f: (3); 4g: (7); 4h: (5); 4i: (5); 4j: (7); 4k: (6); 4l: (6); 4m: (6); 8n: (12)

d. Results for high-symmetry planes

$P1(u, v, 0)$

Operation E
Coordinate $(u, v, 0)$

$P2(u, v, \frac{1}{2})$

Operation E
Coordinate $(u, v, \frac{1}{2})$

$P3(0, u, v)$

Operation E σ_{da}
Coordinate $(0, u, v) (-u, 0, v)$

$P4(u, u, v)$

Operation E S_{4z}^-
Coordinate $(u, u, v) (u, -u, -v)$

$P5(u, \frac{1}{2}, v)$

Operation E σ_{db}
Coordinate $(u, \frac{1}{2}, v) (\frac{1}{2}, u, v)$

$P1(u, v, 0)$ of space group No. 112

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 8n: (24)

$P2(u, v, \frac{1}{2})$ of space group No. 112

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 8n: (24)

$P3(0, u, v)$ of space group No. 112

(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 8n: (24)
P4 (u, u, v) of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12)
P5 ($u, \frac{1}{2}, v$) of space group No. 112		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 4l: (12); 4m: (12); 8n: (24)

113. Space group No. 113 ($P\bar{4}2_1m$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{2y}|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_{db}|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_{da}|\frac{1}{2}, -\frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$A\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{lll} \text{Operation} & E & S_{4z}^+ \\ \text{Coordinate} & \left(0, \frac{1}{2}, \frac{1}{2}\right) & \left(-\frac{1}{2}, 0, -\frac{1}{2}\right) \end{array}$$

$$X\left(0, \frac{1}{2}, 0\right)$$

$$\begin{array}{lll} \text{Operation} & E & S_{4z}^+ \\ \text{Coordinate} & \left(0, \frac{1}{2}, 0\right) & \left(-\frac{1}{2}, 0, 0\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 113

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 4d: (1); 4e: (2); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 4d: (1); 4e: (1); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 4d: (1); 4e: (1); 8f: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (1); 4e: (2); 8f: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (4); 4e: (3); 8f: (6)

$M\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 113

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 4d: (2); 4e: (1); 8f: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (2); 4e: (2); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (2); 4e: (3); 8f: (6)

$Z\left(0, 0, \frac{1}{2}\right)$ of space group No. 113

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 4d: (1); 4e: (2); 8f: (3)
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 4d: (1); 4e: (1); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 4d: (1); 4e: (1); 8f: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 4d: (1); 4e: (2); 8f: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (4); 4e: (3); 8f: (6)

$A\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 113

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 4d: (2); 4e: (1); 8f: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (2); 4e: (2); 8f: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (2); 4e: (3); 8f: (6)

$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 113

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)

X $(0, \frac{1}{2}, 0)$ of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)

c. Results for high-symmetry lines

DT(0, v , 0)		
Operation	E	S_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S(u , u , $\frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $-\frac{1}{2}$)
SM(u , u , 0)		
Operation	E	S_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)
T(u , $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $-\frac{1}{2}$)
U(0, v , $\frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	(0, v , $\frac{1}{2}$)	($-v$, 0, $-\frac{1}{2}$)
V($\frac{1}{2}$, $\frac{1}{2}$, w)		
Operation	E	
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	
W(0, $\frac{1}{2}$, w)		
Operation	E	σ_{db}
Coordinate	(0, $\frac{1}{2}$, w)	($\frac{1}{2}$, 0, w)
Y(u , $\frac{1}{2}$, 0)		
Operation	E	S_{4z}^+
Coordinate	(u , $\frac{1}{2}$, 0)	($-\frac{1}{2}$, u , 0)

DT (0, v , 0) of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
LD $(0, 0, w)$ of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (2); 4d: (2); 4e: (4); 8f: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (0); 4d: (2); 4e: (2); 8f: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 4d: (4); 4e: (3); 8f: (6)
S $(u, u, \frac{1}{2})$ of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (4); 4d: (6); 4e: (7); 8f: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (2); 4d: (6); 4e: (5); 8f: (12)
SM $(u, u, 0)$ of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (4); 4d: (6); 4e: (7); 8f: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (2); 4d: (6); 4e: (5); 8f: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
U $(0, v, \frac{1}{2})$ of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (2); 4d: (2); 4e: (3); 8f: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 4d: (2); 4e: (2); 8f: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (0); 4d: (2); 4e: (1); 8f: (3)
W $(0, \frac{1}{2}, w)$ of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 113		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	σ_{da}
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	S_{4z}^-
Coordinate	(u, u, v)	$(u, -u, -v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	σ_{db}
Coordinate	$(u, \frac{1}{2}, v)$	$(\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 113			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 8f: (24)	
P2 ($u, v, \frac{1}{2}$) of space group No. 113			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 8f: (24)	
P3 ($0, u, v$) of space group No. 113			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 2c: (6); 4d: (12); 4e: (12); 8f: (24)	
P4 (u, u, v) of space group No. 113			
(Co-) irrep	Phonon AM	WYPO information	
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (4); 4d: (6); 4e: (7); 8f: (12)	
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (2); 4d: (6); 4e: (5); 8f: (12)	
P5 ($u, \frac{1}{2}, v$) of space group No. 113			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 8f: (12)	

114. Space group No. 114 ($P\bar{4}_2c$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{2y}|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_{db}|-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{\sigma_{da}|\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})\end{array}$$

$$R(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{lll}\text{Operation} & E & S_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) & (-\frac{1}{2}, 0, -\frac{1}{2})\end{array}$$

$$X(0, \frac{1}{2}, 0)$$

$$\begin{array}{lll}\text{Operation} & E & S_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, 0) & (-\frac{1}{2}, 0, 0)\end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 8e: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 8e: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6)
$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (4); 8e: (6)
$Z (0, 0, \frac{1}{2})$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6)
$A (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (2); 8e: (3)
2	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (2); 8e: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3)
$R (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
$X (0, \frac{1}{2}, 0)$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	S_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

$S(u, u, \frac{1}{2})$		
Operation	E	S_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, -\frac{1}{2})$
$SM(u, u, 0)$		
Operation	E	S_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
$T(u, \frac{1}{2}, \frac{1}{2})$		
Operation	E	S_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, -\frac{1}{2})$
$U(0, v, \frac{1}{2})$		
Operation	E	S_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, -\frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	σ_{db}
Coordinate	$(0, \frac{1}{2}, w)$	$(\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	S_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 114			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)	
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)	
LD $(0, 0, w)$ of space group No. 114			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6)	
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6)	
3	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6)	
S $(u, u, \frac{1}{2})$ of space group No. 114			
(Co-) irrep	Phonon AM	WYPO information	
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)	
SM $(u, u, 0)$ of space group No. 114			
(Co-) irrep	Phonon AM	WYPO information	

1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
U $(0, v, \frac{1}{2})$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (4); 8e: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3)
3	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3)
W $(0, \frac{1}{2}, w)$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation	E
Coordinate	$(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation	E	σ_{da}
Coordinate	$(0, u, v)$	$(-u, 0, v)$

P4(u, u, v)

Operation	E	S_{4z}^-
Coordinate	(u, u, v)	$(u, -u, -v)$

P5($u, \frac{1}{2}, v$)

Operation	E	σ_{db}
Coordinate	$(u, \frac{1}{2}, v)$	$(\frac{1}{2}, u, v)$

P1 $(u, v, 0)$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 8e: (24)
P2 $(u, v, \frac{1}{2})$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 8e: (24)
P3 $(0, u, v)$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 4c: (12); 4d: (12); 8e: (24)
P4 (u, u, v) of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
2	$(-r_1, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)
P5 $(u, \frac{1}{2}, v)$ of space group No. 114		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12)

115. Space group No. 115 ($P4\bar{m}2$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E Coordinate (0, 0, 0)
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E Coordinate $(0, 0, \frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E S_{4z}^+ Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, \frac{1}{2}, 0)$
Operation E S_{4z}^+ Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 115

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 4h: (1); 4i: (1); 4j: (2); 4k: (2); 8l: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 4h: (2); 4i: (2); 4j: (1); 4k: (1); 8l: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 4h: (1); 4i: (1); 4j: (1); 4k: (1); 8l: (3)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 8l: (3)
5	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (3); 4i: (3); 4j: (3); 4k: (3); 8l: (6)

$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 115

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (0); 2g: (1); 4h: (1); 4i: (1); 4j: (2); 4k: (1); 8l: (3)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 2e: (0); 2f: (1); 2g: (1); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 8l: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (1); 2g: (1); 4h: (1); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 2e: (1); 2f: (0); 2g: (1); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 8l: (3)

5	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 4h: (3); 4i: (3); 4j: (3); 4k: (3); 8l: (6)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 115

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (2); 8l: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 4h: (2); 4i: (1); 4j: (1); 4k: (1); 8l: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 4h: (1); 4i: (2); 4j: (1); 4k: (1); 8l: (3)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (2); 8l: (3)
5	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (3); 4i: (3); 4j: (3); 4k: (3); 8l: (6)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 115

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (1); 2e: (1); 2f: (0); 2g: (1); 4h: (1); 4i: (2); 4j: (2); 4k: (1); 8l: (3)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (0); 2e: (0); 2f: (1); 2g: (1); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 8l: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (0); 2e: (0); 2f: (1); 2g: (1); 4h: (1); 4i: (2); 4j: (1); 4k: (2); 8l: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (0); 2g: (1); 4h: (2); 4i: (1); 4j: (2); 4k: (1); 8l: (3)
5	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 4h: (3); 4i: (3); 4j: (3); 4k: (3); 8l: (6)

$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 115

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (3); 4i: (3); 4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 2e: (0); 2f: (2); 2g: (1); 4h: (3); 4i: (3); 4j: (2); 4k: (3); 8l: (6)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 2e: (2); 2f: (0); 2g: (1); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 8l: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 8l: (6)

$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 115

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (3); 4i: (3); 4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 2e: (0); 2f: (2); 2g: (1); 4h: (3); 4i: (3); 4j: (2); 4k: (3); 8l: (6)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 2e: (2); 2f: (0); 2g: (1); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 8l: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 8l: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	S_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, - $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	S_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	(- $\frac{1}{2}, u, -\frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, - $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	S_{4z}^+
Coordinate	(0, $\frac{1}{2}, w$)	(- $\frac{1}{2}, 0, -w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	S_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	(- $\frac{1}{2}, u, 0$)

DT (0, v, 0) of space group No. 115		
(Co-) irrep	Phonon AM	WYPO information
1	($r_1, 0, 0$)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (4); 4h: (6); 4i: (6); 4j: (7); 4k: (7); 8l: (12)
2	($r_1, 0, 0$)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (6); 4i: (6); 4j: (5); 4k: (5); 8l: (12)

1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (3); 4i: (3); 4j: (4); 4k: (3); 8l: (6)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 2e: (0); 2f: (2); 2g: (1); 4h: (3); 4i: (3); 4j: (2); 4k: (3); 8l: (6)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 2e: (2); 2f: (0); 2g: (1); 4h: (3); 4i: (3); 4j: (3); 4k: (2); 8l: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (3); 4i: (3); 4j: (3); 4k: (4); 8l: (6)

$Y(u, \frac{1}{2}, 0)$ of space group No. 115

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (1); 1d: (2); 2e: (4); 2f: (2); 2g: (3); 4h: (6); 4i: (6); 4j: (7); 4k: (5); 8l: (12)
2	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (2); 1d: (1); 2e: (2); 2f: (4); 2g: (3); 4h: (6); 4i: (6); 4j: (5); 4k: (7); 8l: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)
Operation E
Coordinate ($u, v, 0$)
P2($u, v, \frac{1}{2}$)
Operation E
Coordinate ($u, v, \frac{1}{2}$)
P3(0, u, v)
Operation E S_{4z}^-
Coordinate (0, u, v) ($u, 0, -v$)
P4(u, u, v)
Operation E σ_x
Coordinate (u, u, v) ($-u, u, v$)
P5($u, \frac{1}{2}, v$)
Operation E S_{4z}^+
Coordinate ($u, \frac{1}{2}, v$) ($-\frac{1}{2}, u, -v$)

P1 ($u, v, 0$) of space group No. 115

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 8l: (24)

P2 ($u, v, \frac{1}{2}$) of space group No. 115

(Co-) irrep	Phonon AM	WYPO information

1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 8l: (24)
P3 $(0, u, v)$ of space group No. 115		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (4); 4h: (6); 4i: (6); 4j: (7); 4k: (7); 8l: (12)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 4h: (6); 4i: (6); 4j: (5); 4k: (5); 8l: (12)
P4 (u, u, v) of space group No. 115		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 2e: (6); 2f: (6); 2g: (6); 4h: (12); 4i: (12); 4j: (12); 4k: (12); 8l: (24)
P5 $(u, \frac{1}{2}, v)$ of space group No. 115		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (2); 1b: (1); 1c: (1); 1d: (2); 2e: (4); 2f: (2); 2g: (3); 4h: (6); 4i: (6); 4j: (7); 4k: (5); 8l: (12)
2	$(0, r_1, 0)$	1a: (1); 1b: (2); 1c: (2); 1d: (1); 2e: (2); 2f: (4); 2g: (3); 4h: (6); 4i: (6); 4j: (5); 4k: (7); 8l: (12)

116. Space group No. 116 ($P4c2$)

Tetragonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{C_{2a}|0, 0, \frac{1}{2}\} \quad \{C_{2b}|0, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, -\frac{1}{2}\} \quad \{\sigma_y|0, 0, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, 0) \end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \end{array}$$

Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$
Z	$(0, 0, \frac{1}{2})$
Operation	E
Coordinate	$(0, 0, \frac{1}{2})$
A	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
R	$(0, \frac{1}{2}, \frac{1}{2})$
Operation	E
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$
	$(-\frac{1}{2}, 0, -\frac{1}{2})$
X	$(0, \frac{1}{2}, 0)$
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$
	$(-\frac{1}{2}, 0, 0)$

$\Gamma (0, 0, 0)$ of space group No. 116

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 8j: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (1); 8j: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (1); 8j: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (1); 8j: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (4); 8j: (6)

$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 116

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (2); 8j: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (2); 8j: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 4i: (2); 8j: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 4i: (2); 8j: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (2); 8j: (6)

$Z (0, 0, \frac{1}{2})$ of space group No. 116

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 8j: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 8j: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (2); 8j: (6)

$A (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 116

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 8j: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (2); 4i: (1); 8j: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (4); 8j: (6)

R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 8j: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 8j: (6)

X $(0, \frac{1}{2}, 0)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 8j: (6)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 8j: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 8j: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 8j: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	S_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, - $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	S_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	(- $\frac{1}{2}, u, -\frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($0, v, \frac{1}{2}$)	(-v, 0, - $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	S_{4z}^+
Coordinate	($0, \frac{1}{2}, w$)	(- $\frac{1}{2}, 0, -w$)

$Y(u, \frac{1}{2}, 0)$		
Operation	E	S_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
LD $(0, 0, w)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (2); 8j: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (2); 8j: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (4); 8j: (6)
S $(u, u, \frac{1}{2})$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (5); 4f: (7); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
2	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (7); 4f: (5); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
SM $(u, u, 0)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (2); 2b: (2); 2c: (3); 2d: (3); 4e: (5); 4f: (5); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
2	$(r_1, r_1, 0)$	2a: (4); 2b: (4); 2c: (3); 2d: (3); 4e: (7); 4f: (7); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
U $(0, v, \frac{1}{2})$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (4); 8j: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (4); 8j: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (2); 8j: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 8j: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 8j: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 8j: (6)

4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 8j: (6)
Y $(u, \frac{1}{2}, 0)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)
Operation E
Coordinate $(u, v, 0)$
P2($u, v, \frac{1}{2}$)
Operation E
Coordinate $(u, v, \frac{1}{2})$
P3($0, u, v$)
Operation E S_{4z}^-
Coordinate $(0, u, v) (u, 0, -v)$
P4(u, u, v)
Operation E σ_x
Coordinate $(u, u, v) (-u, u, v)$
P5($u, \frac{1}{2}, v$)
Operation E S_{4z}^+
Coordinate $(u, \frac{1}{2}, v) (-\frac{1}{2}, u, -v)$

P1 $(u, v, 0)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 4g: (12); 4h: (12); 4i: (12); 8j: (24)
P2 $(u, v, \frac{1}{2})$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 4g: (12); 4h: (12); 4i: (12); 8j: (24)
P3 $(0, u, v)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
P4 (u, u, v) of space group No. 116		

(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 4g: (12); 4h: (12); 4i: (12); 8j: (24)
P5 $(u, \frac{1}{2}, v)$ of space group No. 116		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 8j: (12)

117. Space group No. 117 ($P\bar{4}b2$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{C_{2a}|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{2b}|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_x|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_y|\frac{1}{2}, -\frac{1}{2}, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate $(0, 0, 0)$
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E S_{4z}^+
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, -\frac{1}{2})$

$$X(0, \frac{1}{2}, 0)$$

Operation	E	S_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 117

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 8i: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 8i: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6)

$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 117

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (2); 8i: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6)

$Z(0, 0, \frac{1}{2})$ of space group No. 117

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (2); 8i: (3)
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (1); 8i: (3)
3	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (2); 8i: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (1); 8i: (3)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6)

$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 117

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 4e: (2); 4f: (1); 4g: (2); 4h: (1); 8i: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 4e: (2); 4f: (1); 4g: (1); 4h: (2); 8i: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6)

$R(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 117

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

$X(0, \frac{1}{2}, 0)$ of space group No. 117

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	S_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, - $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	S_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	(- $\frac{1}{2}, u, -\frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, - $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	S_{4z}^+
Coordinate	(0, $\frac{1}{2}, w$)	(- $\frac{1}{2}, 0, -w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	S_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	(- $\frac{1}{2}, u, 0$)

DT (0, v, 0) of space group No. 117

(Co-) irrep	Phonon AM	WYPO information
1	($r_1, 0, 0$)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	($r_1, 0, 0$)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

LD (0, 0, w) of space group No. 117

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6)

S $(u, u, \frac{1}{2})$ of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (2); 2d: (4); 4e: (6); 4f: (6); 4g: (5); 4h: (7); 8i: (12)
2	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (4); 2d: (2); 4e: (6); 4f: (6); 4g: (7); 4h: (5); 8i: (12)
SM $(u, u, 0)$ of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (2); 2d: (2); 4e: (6); 4f: (6); 4g: (5); 4h: (5); 8i: (12)
2	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (4); 2d: (4); 4e: (6); 4f: (6); 4g: (7); 4h: (7); 8i: (12)
T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
U $(0, v, \frac{1}{2})$ of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 8i: (6)
W $(0, \frac{1}{2}, w)$ of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate $(u, v, 0)$

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate $(u, v, \frac{1}{2})$

P3($0, u, v$)

Operation	E	S_{4z}^-
Coordinate	$(0, u, v)$	$(u, 0, -v)$
P4(u, u, v)		
Operation	E	σ_x
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	S_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, -v)$

P1 ($u, v, 0$) of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 4g: (12); 4h: (12); 8i: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 4g: (12); 4h: (12); 8i: (24)
P3 ($0, u, v$) of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
P4 (u, u, v) of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 4g: (12); 4h: (12); 8i: (24)
P5 ($u, \frac{1}{2}, v$) of space group No. 117		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

118. Space group No. 118 ($P4n2$)

Tetragonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{S_{4z}^+|0,0,0\} \quad \{S_{4z}^-|0,0,0\} \quad \{C_{2a}|\frac{1}{2},\frac{1}{2},\frac{1}{2}\} \quad \{C_{2b}|-\frac{1}{2},-\frac{1}{2},\frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2},\frac{1}{2},-\frac{1}{2}\} \quad \{\sigma_y|\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$
Operation E
Coordinate (0,0,0)
$M(\frac{1}{2},\frac{1}{2},0)$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},0)$
$Z(0,0,\frac{1}{2})$
Operation E
Coordinate $(0,0,\frac{1}{2})$
$A(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
$R(0,\frac{1}{2},\frac{1}{2})$
Operation E S_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,-\frac{1}{2})$
$X(0,\frac{1}{2},0)$
Operation E S_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

$\Gamma(0,0,0)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
2	(0,0,0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (2); 4h: (1); 8i: (3)
3	(0,0,0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
4	(0,0,0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (2); 4h: (1); 8i: (3)
5	(0,0,0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (3); 4g: (3); 4h: (4); 8i: (6)

$M(\frac{1}{2},\frac{1}{2},0)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (1); 8i: (3)
2	(0,0,0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 4g: (1); 4h: (1); 8i: (3)
3	(0,0,0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (3); 4g: (3); 4h: (4); 8i: (6)

Z $(0, 0, \frac{1}{2})$ of space group No. 118			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (2); 8i: (3)	
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (2); 4h: (2); 8i: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (3); 4g: (3); 4h: (2); 8i: (6)	
A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 118			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 8i: (3)	
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 8i: (3)	
3	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 8i: (3)	
4	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 8i: (3)	
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (3); 4g: (3); 4h: (2); 8i: (6)	
R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 118			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)	
X $(0, \frac{1}{2}, 0)$ of space group No. 118			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)	

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	S_{4z}^+
Coordinate	(0, v, 0)	$(-v, 0, 0)$
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, -\frac{1}{2})$
SM($u, u, 0$)		
Operation	E	S_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, -\frac{1}{2})$
U($0, v, \frac{1}{2}$)		

Operation	E	S_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, -\frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	S_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, -w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	S_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

LD $(0, 0, w)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (3); 4g: (3); 4h: (2); 8i: (6)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (3); 4g: (3); 4h: (2); 8i: (6)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (3); 4g: (3); 4h: (4); 8i: (6)

S $(u, u, \frac{1}{2})$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (7); 4g: (5); 4h: (6); 8i: (12)
2	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (5); 4g: (7); 4h: (6); 8i: (12)

SM $(u, u, 0)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (2); 2d: (2); 4e: (6); 4f: (5); 4g: (5); 4h: (6); 8i: (12)
2	$(r_1, r_1, 0)$	2a: (3); 2b: (3); 2c: (4); 2d: (4); 4e: (6); 4f: (7); 4g: (7); 4h: (6); 8i: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	$(0, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

U $(0, v, \frac{1}{2})$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

 $V\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (3); 4g: (3); 4h: (4); 8i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (3); 4g: (3); 4h: (4); 8i: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (3); 4g: (3); 4h: (2); 8i: (6)

 $W\left(0, \frac{1}{2}, w\right)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

 $Y\left(u, \frac{1}{2}, 0\right)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

d. Results for high-symmetry planes

 $P1(u, v, 0)$

Operation E
Coordinate $(u, v, 0)$

 $P2\left(u, v, \frac{1}{2}\right)$

Operation E
Coordinate $\left(u, v, \frac{1}{2}\right)$

 $P3(0, u, v)$

Operation E S_{4z}^-
Coordinate $(0, u, v)$ $(u, 0, -v)$

 $P4(u, u, v)$

Operation E σ_x
Coordinate (u, u, v) $(-u, u, v)$

 $P5\left(u, \frac{1}{2}, v\right)$

Operation E S_{4z}^+
Coordinate $\left(u, \frac{1}{2}, v\right)$ $\left(-\frac{1}{2}, u, -v\right)$

 $P1(u, v, 0)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 4g: (12); 4h: (12); 8i: (24)

 $P2\left(u, v, \frac{1}{2}\right)$ of space group No. 118

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 4g: (12); 4h: (12); 8i: (24)

P3 (0, u, v) of space group No. 118		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₁ , 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	(r ₁ , 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

P4 (u, u, v) of space group No. 118		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₂ , r ₂ , r ₁)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 4g: (12); 4h: (12); 8i: (24)

P5 (u, $\frac{1}{2}$, v) of space group No. 118		
(Co-) irrep	Phonon AM	WYPO information
1	(0, r ₁ , 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)
2	(0, r ₁ , 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12)

119. Space group No. 119 ($I\bar{4}m2$)

Tetragonal body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	S_{4z}^-	S_{4z}^+	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$	$(0, -\frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	S_{4z}^+		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		

$$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

Operation E
Coordinate $(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$$

Operation E C_{2a}
Coordinate $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ $(-\frac{1}{4}, -\frac{1}{4}, \frac{3}{4})$

Γ (0, 0, 0) of space group No. 119

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 8g: (1); 8h: (1); 8i: (2); 16j: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 8g: (2); 8h: (2); 8i: (1); 16j: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 8g: (1); 8h: (1); 8i: (1); 16j: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 8g: (2); 8h: (2); 8i: (2); 16j: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (3); 16j: (6)

N (0, $\frac{1}{2}$, 0) of space group No. 119

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 8g: (6); 8h: (6); 8i: (7); 16j: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (6); 8h: (6); 8i: (5); 16j: (12)

X (0, 0, $\frac{1}{2}$) of space group No. 119

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 8g: (2); 8h: (3); 8i: (3); 16j: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 8g: (4); 8h: (3); 8i: (3); 16j: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 8g: (3); 8h: (4); 8i: (3); 16j: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (1); 8g: (3); 8h: (2); 8i: (3); 16j: (6)

Z $(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 119

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 8g: (1); 8h: (2); 8i: (2); 16j: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 8g: (2); 8h: (1); 8i: (1); 16j: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 8g: (1); 8h: (2); 8i: (1); 16j: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 8g: (2); 8h: (1); 8i: (2); 16j: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (3); 16j: (6)

P $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 119

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 8g: (3); 8h: (3); 8i: (3); 16j: (6)
2	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 4e: (2); 4f: (1); 8g: (3); 8h: (3); 8i: (3); 16j: (6)
3	(0, 0, r_1)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 8g: (3); 8h: (3); 8i: (3); 16j: (6)
4	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 4e: (2); 4f: (1); 8g: (3); 8h: (3); 8i: (3); 16j: (6)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	S_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{2b}
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1}{2}(-1+v), -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u$)

DT (0, 0, u) of space group No. 119			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, r_1, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1);	4e: (3); 4f: (3); 8g: (5); 8h: (5); 8i: (6); 16j: (12)
2	$(r_1, r_1, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2);	4e: (3); 4f: (3); 8g: (7); 8h: (7); 8i: (6); 16j: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 119			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (4); 16j: (6)	
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 8g: (3); 8h: (3); 8i: (2); 16j: (6)	
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (3); 16j: (6)	
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 119			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3);	4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 16j: (24)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 119			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2);	4e: (4); 4f: (4); 8g: (6); 8h: (6); 8i: (7); 16j: (12)
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2);	8g: (6); 8h: (6); 8i: (5); 16j: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 119			

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (4); 4f: (2); 8g: (6); 8h: (6); 8i: (6); 16j: (12)

$Y \left(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2} \right)$ of space group No. 119

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 8g: (5); 8h: (7); 8i: (6); 16j: (12)
2	$(-r_1, r_1, 0)$	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 8g: (7); 8h: (5); 8i: (6); 16j: (12)

d. Results for high-symmetry planes

$P1 \left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$		
Operation	E	
Coordinate	$\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$	$\left(-\frac{1}{2} + v, \frac{1}{2} + v, -\frac{1}{2} + u - v \right)$
$P2(u, v, -u)$		
Operation	E	S_{4z}^+
Coordinate	$(u, v, -u)$	$(-u, -v, v)$
$P3(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

$P1 \left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$ of space group No. 119		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_2, r_2, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 16j: (24)

$P2(u, v, -u)$ of space group No. 119

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 8g: (6); 8h: (6); 8i: (7); 16j: (12)
2	$(0, r_1, 0)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 8g: (6); 8h: (6); 8i: (5); 16j: (12)

$P3(u, -u, v)$ of space group No. 119

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 16j: (24)

120. Space group No. 120 ($I\bar{4}c2$)

Tetragonal body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{S_{4z}^+|0,0,0\} \quad \{S_{4z}^-|0,0,0\} \quad \{C_{2a}|\frac{1}{2},\frac{1}{2},0\} \quad \{C_{2b}|\frac{1}{2},\frac{1}{2},0\} \quad \{\sigma_x|-\frac{1}{2},-\frac{1}{2},0\} \quad \{\sigma_y|-\frac{1}{2},-\frac{1}{2},0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$				
Operation	E			
Coordinate	$(0,0,0)$			
$N(0,\frac{1}{2},0)$				
Operation	E	S_{4z}^-	S_{4z}^+	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$	$(0,-\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},0,-\frac{1}{2})$
$X(0,0,\frac{1}{2})$				
Operation	E	S_{4z}^+		
Coordinate	$(0,0,\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},0)$		
$Z(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$			
$P(\frac{1}{4},\frac{1}{4},\frac{1}{4})$				
Operation	E	C_{2a}		
Coordinate	$(\frac{1}{4},\frac{1}{4},\frac{1}{4})$	$(-\frac{1}{4},-\frac{1}{4},\frac{3}{4})$		

$\Gamma(0,0,0)$ of space group No. 120

(Co-) irrep	Phonon AM	WYPO information								
1	(0,0,0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	8e: (1);	8f: (1);	8g: (1);	8h: (1);	16i: (3)
2	(0,0,0)	4a: (1);	4b: (0);	4c: (0);	4d: (1);	8e: (2);	8f: (1);	8g: (1);	8h: (2);	16i: (3)
3	(0,0,0)	4a: (0);	4b: (1);	4c: (1);	4d: (0);	8e: (1);	8f: (1);	8g: (1);	8h: (1);	16i: (3)
4	(0,0,0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (2);	8f: (1);	8g: (1);	8h: (2);	16i: (3)
5	(0,0,0)	4a: (2);	4b: (2);	4c: (2);	4d: (2);	8e: (3);	8f: (4);	8g: (4);	8h: (3);	16i: (6)

$N(0,\frac{1}{2},0)$ of space group No. 120

(Co-) irrep	Phonon AM	WYPO information								
1	(0,0,0)	4a: (3);	4b: (3);	4c: (3);	4d: (3);	8e: (6);	8f: (6);	8g: (6);	8h: (6);	16i: (12)

$X(0,0,\frac{1}{2})$ of space group No. 120

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (1); 4c: (2); 4d: (2); 8e: (2); 8f: (2); 8g: (4); 8h: (3); 16i: (6)
2	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (2); 8e: (4); 8f: (2); 8g: (4); 8h: (3); 16i: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (2); 8e: (3); 8f: (4); 8g: (2); 8h: (4); 16i: (6)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (0); 8e: (3); 8f: (4); 8g: (2); 8h: (2); 16i: (6)

$Z\left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 120

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 8e: (1); 8f: (1); 8g: (1); 8h: (2); 16i: (3)
2	(0, 0, 0)	4a: (1); 4b: (0); 4c: (1); 4d: (0); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 16i: (3)
3	(0, 0, 0)	4a: (0); 4b: (1); 4c: (0); 4d: (1); 8e: (1); 8f: (1); 8g: (1); 8h: (2); 16i: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 16i: (3)
5	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (3); 8f: (4); 8g: (4); 8h: (3); 16i: (6)

$P\left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$ of space group No. 120

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 8e: (3); 8f: (2); 8g: (4); 8h: (3); 16i: (6)
2	(0, 0, r_1)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 8e: (3); 8f: (4); 8g: (2); 8h: (3); 16i: (6)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	S_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{2b}
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1}{2}(-1+v), -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u$)

DT $(0, 0, u)$ of space group No. 120		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (2); 4b: (3); 4c: (3); 4d: (2); 8e: (5); 8f: (6); 8g: (6); 8h: (5); 16i: (12)
2	$(r_1, r_1, 0)$	4a: (4); 4b: (3); 4c: (3); 4d: (4); 8e: (7); 8f: (6); 8g: (6); 8h: (7); 16i: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 120		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (2); 8g: (2); 8h: (3); 16i: (6)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (2); 8g: (2); 8h: (3); 16i: (6)
3	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (3); 8f: (4); 8g: (4); 8h: (3); 16i: (6)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 120		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 120		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 120		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (2); 4b: (2); 4c: (4); 4d: (4); 8e: (6); 8f: (4); 8g: (8); 8h: (6); 16i: (12)
2	$(0, 0, r_1)$	4a: (4); 4b: (4); 4c: (2); 4d: (2); 8e: (6); 8f: (8); 8g: (4); 8h: (6); 16i: (12)
Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$ of space group No. 120		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	4a: (2); 4b: (3); 4c: (3); 4d: (4); 8e: (5); 8f: (6); 8g: (6); 8h: (7); 16i: (12)
2	$(-r_1, r_1, 0)$	4a: (4); 4b: (3); 4c: (3); 4d: (2); 8e: (7); 8f: (6); 8g: (6); 8h: (5); 16i: (12)

d. Results for high-symmetry planes

P1 $(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$		
Operation	E	σ_y
Coordinate	$(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v)$	$(-\frac{1}{2} + v, \frac{1}{2} + v, -\frac{1}{2} + u - v)$
P2 $(u, v, -u)$		
Operation	E	S_{4z}^+
Coordinate	$(u, v, -u)$	$(-u, -v, v)$
P3 $(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 ($\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v$) of space group No. 120		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_2, r_2, r_1)$	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)
P2 ($u, v, -u$) of space group No. 120		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	$(0, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
P3 ($u, -u, v$) of space group No. 120		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)

121. Space group No. 121 ($I\bar{4}2m$)

Tetragonal body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{\sigma_{db}|0, 0, 0\} \quad \{\sigma_{da}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$N(0, \frac{1}{2}, 0)$	
Operation	E
Coordinate	$(0, \frac{1}{2}, 0)$
	S_{4z}^-
	$(-\frac{1}{2}, 0, 0)$
	S_{4z}^+
	$(0, -\frac{1}{2}, \frac{1}{2})$
	C_{2z}
	$(\frac{1}{2}, 0, -\frac{1}{2})$

$X(0, 0, \frac{1}{2})$		
Operation	E	S_{4z}^+
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$		
Operation	E	$E\Theta$
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$

$\Gamma (0, 0, 0)$ of space group No. 121										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (1);	8f: (1);	8g: (1);	8h: (1);	8i: (2); 16j: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (0);	4e: (0);	8f: (2);	8g: (2);	8h: (1);	8i: (1); 16j: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (0);	8f: (1);	8g: (1);	8h: (1);	8i: (1); 16j: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (1);	8f: (2);	8g: (2);	8h: (1);	8i: (2); 16j: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (2);	8f: (3);	8g: (3);	8h: (4);	8i: (3); 16j: (6)
$N (0, \frac{1}{2}, 0)$ of space group No. 121										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (1);	2b: (2);	4c: (3);	4d: (3);	4e: (3);	8f: (5);	8g: (7);	8h: (6);	8i: (6); 16j: (12)
2	(0, 0, 0)	2a: (2);	2b: (1);	4c: (3);	4d: (3);	4e: (3);	8f: (7);	8g: (5);	8h: (6);	8i: (6); 16j: (12)
$X (0, 0, \frac{1}{2})$ of space group No. 121										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (2);	8f: (3);	8g: (3);	8h: (4);	8i: (4); 16j: (6)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (2);	4d: (2);	4e: (0);	8f: (3);	8g: (3);	8h: (4);	8i: (2); 16j: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	8f: (3);	8g: (3);	8h: (2);	8i: (3); 16j: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	8f: (3);	8g: (3);	8h: (2);	8i: (3); 16j: (6)
$Z (-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 121										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (1);	8f: (1);	8g: (1);	8h: (1);	8i: (2); 16j: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	4e: (0);	8f: (2);	8g: (2);	8h: (1);	8i: (1); 16j: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (0);	8f: (1);	8g: (1);	8h: (1);	8i: (1); 16j: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (0);	4e: (1);	8f: (2);	8g: (2);	8h: (1);	8i: (2); 16j: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (2);	8f: (3);	8g: (3);	8h: (4);	8i: (3); 16j: (6)
$P (\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 121										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	2b: (1);	4c: (1);	4d: (1);	4e: (1);	8f: (1);	8g: (2);	8h: (2);	8i: (2); 16j: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	4e: (0);	8f: (2);	8g: (1);	8h: (2);	8i: (1); 16j: (3)

3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (1); 8g: (2); 8h: (2); 8i: (1); 16j: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (2); 8g: (1); 8h: (2); 8i: (2); 16j: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (3); 8h: (2); 8i: (3); 16j: (6)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	S_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	S_{4z}^-
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1}{2}(-1-v), \frac{v}{2}, \frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u$)

DT (0, 0, u) of space group No. 121

(Co-) irrep	Phonon AM	WYPO information
1	($-r_1, r_1, 0$)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 8f: (6); 8g: (6); 8h: (6); 8i: (7); 16j: (12)
2	($-r_1, r_1, 0$)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 8f: (6); 8g: (6); 8h: (6); 8i: (5); 16j: (12)

LD ($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$) of space group No. 121

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (3); 8h: (2); 8i: (4); 16j: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (3); 8g: (3); 8h: (2); 8i: (2); 16j: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (3); 8h: (4); 8i: (3); 16j: (6)

Q ($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$) of space group No. 121

(Co-) irrep	Phonon AM	WYPO information

1	$(0, r_1, 0)$	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 8f: (5); 8g: (7); 8h: (6); 8i: (6); 16j: (12)
2	$(0, r_1, 0)$	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 8f: (7); 8g: (5); 8h: (6); 8i: (6); 16j: (12)
SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 121		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (5); 8g: (5); 8h: (6); 8i: (6); 16j: (12)
2	$(r_1, 0, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (7); 8g: (7); 8h: (6); 8i: (6); 16j: (12)
W $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 121		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (3); 8h: (4); 8i: (4); 16j: (6)
2	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (2); 4d: (2); 4e: (0); 8f: (3); 8g: (3); 8h: (4); 8i: (2); 16j: (6)
3	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (3); 8h: (2); 8i: (3); 16j: (6)
4	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (3); 8h: (2); 8i: (3); 16j: (6)
Y $\left(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 121		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 8f: (6); 8g: (6); 8h: (6); 8i: (7); 16j: (12)
2	$(r_1, r_1, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 8f: (6); 8g: (6); 8h: (6); 8i: (5); 16j: (12)

d. Results for high-symmetry planes

P1 $\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$		
Operation	E	S_{4z}^+
Coordinate	$\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$	$\left(\frac{1}{2} - v, -\frac{1}{2} - v, -\frac{1}{2} + u + v\right)$
P2 $(u, v, -u)$		
Operation	E	σ_{db}
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3 $(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 $\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$ of space group No. 121		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 8f: (6); 8g: (6); 8h: (6); 8i: (7); 16j: (12)
2	$(r_1, r_1, 0)$	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 8f: (6); 8g: (6); 8h: (6); 8i: (5); 16j: (12)
P2 $(u, v, -u)$ of space group No. 121		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)

P3 ($u, -u, v$) of space group No. 121

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)

122. Space group No. 122 ($I\bar{4}2d$)

Tetragonal body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{C_{2y}|-\frac{1}{4}, \frac{1}{4}, -\frac{1}{2}\} \quad \{C_{2x}|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{\sigma_{da}|-\frac{1}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{\sigma_{db}|-\frac{1}{4}, -\frac{3}{4}, -\frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, -\frac{1}{2})$				
Operation	E	S_{4z}^-	S_{4z}^+	C_{2z}
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$	$(0, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$
$X(-\frac{1}{2}, \frac{1}{2}, 0)$				
Operation	E	S_{4z}^+		
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$		
$Z(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$			
$P(-\frac{1}{4}, \frac{3}{4}, -\frac{1}{4})$				
Operation	E	$E\Theta$		
Coordinate	$(-\frac{1}{4}, \frac{3}{4}, -\frac{1}{4})$	$(\frac{1}{4}, -\frac{3}{4}, \frac{1}{4})$		

$\Gamma (0, 0, 0)$ of space group No. 122		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 16e: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (2); 16e: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (1); 16e: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (2); 16e: (3)
5	(0, 0, 0)	4a: (2); 4b: (2); 8c: (4); 8d: (3); 16e: (6)
$N (0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 122		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 16e: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 16e: (12)
$X (-\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 122		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 16e: (12)
$Z (-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 122		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 16e: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (1); 16e: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (3); 16e: (6)
$P (-\frac{1}{4}, \frac{3}{4}, -\frac{1}{4})$ of space group No. 122		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3); 8d: (3); 16e: (6)
2	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3); 8d: (3); 16e: (6)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	S_{4z}^-
Coordinate	(0, 0, u)	($-u$, u , 0)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	S_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{v}{2}, \frac{1}{2}(-1-v), \frac{1-v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	S_{4z}^-

Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{u}{2}, \frac{u}{2}, -\frac{u}{2})$
$W(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	
$Y(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$		
Operation	E	S_{4z}^-
Coordinate	$(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2} - u)$

DT $(0, 0, u)$ of space group No. 122			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, -r_1, 0)$	4a: (3);	4b: (3); 8c: (6); 8d: (6); 16e: (12)
2	$(r_1, -r_1, 0)$	4a: (3);	4b: (3); 8c: (6); 8d: (6); 16e: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 122			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	4a: (1);	4b: (1); 8c: (2); 8d: (3); 16e: (6)
2	$(0, 0, 0)$	4a: (1);	4b: (1); 8c: (2); 8d: (3); 16e: (6)
3	$(0, 0, 0)$	4a: (2);	4b: (2); 8c: (4); 8d: (3); 16e: (6)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 122			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	4a: (3);	4b: (3); 8c: (6); 8d: (6); 16e: (12)
2	$(0, r_1, 0)$	4a: (3);	4b: (3); 8c: (6); 8d: (6); 16e: (12)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 122			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	4a: (3);	4b: (3); 8c: (6); 8d: (5); 16e: (12)
2	$(r_1, 0, 0)$	4a: (3);	4b: (3); 8c: (6); 8d: (7); 16e: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 122			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	4a: (3);	4b: (3); 8c: (6); 8d: (6); 16e: (12)
Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$ of space group No. 122			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, r_1, 0)$	4a: (3);	4b: (3); 8c: (6); 8d: (6); 16e: (12)

d. Results for high-symmetry planes

$$PI(-\frac{1}{2} + v, \frac{1}{2} + v, \frac{1}{2} - u - v)$$

Operation

E

S_{4z}^+

Coordinate	$(-\frac{1}{2} + v, \frac{1}{2} + v, \frac{1}{2} - u - v) \quad (\frac{1}{2} - u - v, -\frac{1}{2} + u - v, \frac{1}{2} + v)$	
P2($u, v, -v$)		
Operation	E	σ_{da}
Coordinate	$(u, v, -v)$	$(u, v, -u)$
P3($-v, v, u$)		
Operation	E	
Coordinate	$(-v, v, u)$	

P1 $(-\frac{1}{2} + v, \frac{1}{2} + v, \frac{1}{2} - u - v)$ of space group No. 122		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 8d: (6); 16e: (12)
2	$(-r_1, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 8d: (6); 16e: (12)
P2 $(u, v, -v)$ of space group No. 122		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	4a: (6); 4b: (6); 8c: (12); 8d: (12); 16e: (24)
P3 $(-v, v, u)$ of space group No. 122		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (6); 4b: (6); 8c: (12); 8d: (12); 16e: (24)

123. Space group No. 123 ($P4/mmm$)

Tetragonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_{2z} 0, 0, 0\}$	$\{C_{4z}^+ 0, 0, 0\}$	$\{C_{4z}^- 0, 0, 0\}$	$\{C_{2x} 0, 0, 0\}$	$\{C_{2y} 0, 0, 0\}$	$\{C_{2a} 0, 0, 0\}$	$\{C_{2b} 0, 0, 0\}$
$\{I 0, 0, 0\}$	$\{\sigma_z 0, 0, 0\}$	$\{S_{4z}^- 0, 0, 0\}$	$\{S_{4z}^+ 0, 0, 0\}$	$\{\sigma_x 0, 0, 0\}$	$\{\sigma_y 0, 0, 0\}$	$\{\sigma_{da} 0, 0, 0\}$	$\{\sigma_{db} 0, 0, 0\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$M(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^{+}
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^{+}
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (1); 2h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (2); 8q: (2); 8r: (2); 8s: (2); 8t: (2); 16u: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 2h: (0); 4i: (0); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (2); 8q: (2); 8r: (1); 8s: (1); 8t: (1); 16u: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 2h: (0); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (2); 8q: (2); 8r: (1); 8s: (2); 8t: (2); 16u: (3)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 2h: (0); 4i: (0); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (2); 8q: (2); 8r: (2); 8s: (1); 8t: (1); 16u: (3)
5	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (1); 2h: (1); 4i: (2); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (2); 8q: (2); 8r: (3); 8s: (3); 8t: (3); 16u: (6)
6	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 2h: (0); 4i: (0); 4j: (0); 4k: (0); 4l: (0); 4m: (0); 4n: (0); 4o: (0); 8p: (1); 8q: (1); 8r: (1); 8s: (1); 8t: (1); 16u: (3)
7	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (1); 8q: (1); 8r: (2); 8s: (2); 8t: (2); 16u: (3)
8	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 2h: (0); 4i: (0); 4j: (1); 4k: (1); 4l: (0); 4m: (0); 4n: (0); 4o: (0); 8p: (1); 8q: (1); 8r: (2); 8s: (1); 8t: (1); 16u: (3)
9	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (0); 2h: (0); 4i: (1); 4j: (0); 4k: (0); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (1); 8q: (1); 8r: (1); 8s: (2); 8t: (2); 16u: (3)
10	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 8p: (4); 8q: (4); 8r: (3); 8s: (3); 8t: (3); 16u: (6)

$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (1);	1c: (0); 4n: (1);	1d: (0); 4o: (1);	2e: (1); 8p: (2);	2f: (1); 8q: (2);	2g: (1); 8r: (2);	2h: (0); 8s: (2);	4i: (1); 8t: (1);	4j: (1); 16u: (3);	4k: (1);
2	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (1);	1c: (0); 4n: (1);	1d: (0); 4o: (1);	2e: (1); 8p: (2);	2f: (1); 8q: (2);	2g: (0); 8r: (1);	2h: (0); 8s: (1);	4i: (1); 8t: (2);	4j: (1); 16u: (3);	4k: (1);
3	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (1);	1c: (0); 4n: (1);	1d: (0); 4o: (1);	2e: (1); 8p: (2);	2f: (1); 8q: (2);	2g: (0); 8r: (1);	2h: (0); 8s: (2);	4i: (1); 8t: (1);	4j: (1); 16u: (3);	4k: (1);
4	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (1);	1c: (0); 4n: (1);	1d: (0); 4o: (1);	2e: (1); 8p: (2);	2f: (1); 8q: (2);	2g: (0); 8r: (2);	2h: (1); 8s: (1);	4i: (1); 8t: (2);	4j: (1); 16u: (3);	4k: (1);
5	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (1);	1c: (0); 4n: (1);	1d: (0); 4o: (1);	2e: (1); 8p: (2);	2f: (1); 8q: (2);	2g: (1); 8r: (3);	2h: (1); 8s: (3);	4i: (1); 8t: (3);	4j: (1); 16u: (6);	4k: (1);
6	(0, 0, 0)	1a: (0); 4l: (0);	1b: (0); 4m: (0);	1c: (0); 4n: (1);	1d: (0); 4o: (1);	2e: (0); 8p: (1);	2f: (0); 8q: (1);	2g: (0); 8r: (1);	2h: (0); 8s: (1);	4i: (1); 8t: (2);	4j: (0); 16u: (3);	4k: (0);
7	(0, 0, 0)	1a: (1); 4l: (1);	1b: (1); 4m: (1);	1c: (0); 4n: (0);	1d: (0); 4o: (0);	2e: (0); 8p: (1);	2f: (0); 8q: (1);	2g: (1); 8r: (2);	2h: (0); 8s: (2);	4i: (1); 8t: (1);	4j: (1); 16u: (3);	4k: (1);
8	(0, 0, 0)	1a: (0); 4l: (0);	1b: (0); 4m: (0);	1c: (1); 4n: (1);	1d: (1); 4o: (1);	2e: (0); 8p: (1);	2f: (0); 8q: (1);	2g: (0); 8r: (2);	2h: (1); 8s: (1);	4i: (1); 8t: (2);	4j: (1); 16u: (3);	4k: (1);
9	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (1);	1c: (0); 4n: (0);	1d: (0); 4o: (0);	2e: (0); 8p: (1);	2f: (0); 8q: (1);	2g: (0); 8r: (1);	2h: (0); 8s: (2);	4i: (1); 8t: (1);	4j: (0); 16u: (3);	4k: (0);
10	(0, 0, 0)	1a: (1); 4l: (2);	1b: (1); 4m: (2);	1c: (1); 4n: (2);	1d: (1); 4o: (2);	2e: (0); 8p: (4);	2f: (0); 8q: (4);	2g: (1); 8r: (3);	2h: (1); 8s: (3);	4i: (1); 8t: (3);	4j: (2); 16u: (6);	4k: (2);

 $\text{Z}(0, 0, \frac{1}{2})$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (0); 4l: (1);	1b: (1); 4m: (1);	1c: (0); 4n: (1);	1d: (1); 4o: (1);	2e: (1); 8p: (2);	2f: (0); 8q: (1);	2g: (1); 8r: (2);	2h: (1); 8s: (2);	4i: (1); 8t: (2);	4j: (1); 16u: (3)	4k: (1);
2	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (0);	1c: (0); 4n: (1);	1d: (0); 4o: (0);	2e: (0); 8p: (2);	2f: (0); 8q: (1);	2g: (0); 8r: (1);	2h: (0); 8s: (1);	4i: (0); 8t: (1);	4j: (1); 16u: (3)	4k: (0);
3	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (1);	1c: (0); 4n: (1);	1d: (0); 4o: (1);	2e: (1); 8p: (2);	2f: (0); 8q: (1);	2g: (0); 8r: (1);	2h: (0); 8s: (2);	4i: (1); 8t: (2);	4j: (1); 16u: (3)	4k: (0);
4	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (0);	1c: (0); 4n: (1);	1d: (0); 4o: (0);	2e: (0); 8p: (2);	2f: (0); 8q: (1);	2g: (0); 8r: (2);	2h: (0); 8s: (1);	4i: (0); 8t: (1);	4j: (1); 16u: (3)	4k: (1);
5	(0, 0, 0)	1a: (0); 4l: (1);	1b: (1); 4m: (2);	1c: (0); 4n: (1);	1d: (1); 4o: (2);	2e: (2); 8p: (2);	2f: (0); 8q: (4);	2g: (1); 8r: (3);	2h: (1); 8s: (3);	4i: (2); 8t: (3);	4j: (1); 16u: (6)	4k: (2);
6	(0, 0, 0)	1a: (0); 4l: (0);	1b: (0); 4m: (1);	1c: (0); 4n: (0);	1d: (0); 4o: (1);	2e: (0); 8p: (1);	2f: (0); 8q: (2);	2g: (0); 8r: (1);	2h: (0); 8s: (1);	4i: (0); 8t: (1);	4j: (0); 16u: (3)	4k: (1);
7	(0, 0, 0)	1a: (1); 4l: (1);	1b: (0); 4m: (1);	1c: (1); 4n: (1);	1d: (0); 4o: (1);	2e: (0); 8p: (1);	2f: (1); 8q: (2);	2g: (1); 8r: (2);	2h: (1); 8s: (2);	4i: (1); 8t: (2);	4j: (1); 16u: (3)	4k: (1);
8	(0, 0, 0)	1a: (0); 4l: (0);	1b: (0); 4m: (1);	1c: (0); 4n: (0);	1d: (0); 4o: (1);	2e: (0); 8p: (1);	2f: (0); 8q: (2);	2g: (0); 8r: (2);	2h: (0); 8s: (1);	4i: (0); 8t: (1);	4j: (1); 16u: (3)	4k: (1);
9	(0, 0, 0)	1a: (0); 4l: (1);	1b: (0); 4m: (1);	1c: (0); 4n: (1);	1d: (0); 4o: (1);	2e: (0); 8p: (1);	2f: (1); 8q: (2);	2g: (0); 8r: (1);	2h: (0); 8s: (2);	4i: (1); 8t: (2);	4j: (0); 16u: (3)	4k: (1);
10	(0, 0, 0)	1a: (1); 4l: (2);	1b: (0); 4m: (1);	1c: (1); 4n: (2);	1d: (0); 4o: (1);	2e: (0); 8p: (4);	2f: (2); 8q: (2);	2g: (1); 8r: (3);	2h: (1); 8s: (3);	4i: (2); 8t: (3);	4j: (2); 16u: (6)	4k: (1);

A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (0);	1b: (1);	1c: (0);	1d: (0);	2e: (0);	2f: (1);	2g: (1);	2h: (0);	4i: (1);	4j: (1);	4k: (1);
		4l: (1);	4m: (1);	4n: (1);	4o: (0);	8p: (2);	8q: (1);	8r: (2);	8s: (2);	8t: (1);	16u: (3)	
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	2e: (0);	2f: (1);	2g: (0);	2h: (0);	4i: (1);	4j: (1);	4k: (0);
		4l: (1);	4m: (0);	4n: (1);	4o: (1);	8p: (2);	8q: (1);	8r: (1);	8s: (1);	8t: (2);	16u: (3)	

3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (1); 2g: (0); 2h: (0); 4i: (1); 4j: (1); 4k: (0); 4l: (1); 4m: (1); 4n: (1); 4o: (0); 8p: (2); 8q: (1); 8r: (1); 8s: (2); 8t: (1); 16u: (3)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (1); 2e: (0); 2f: (1); 2g: (0); 2h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 4m: (0); 4n: (1); 4o: (1); 8p: (2); 8q: (1); 8r: (2); 8s: (1); 8t: (2); 16u: (3)
5	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 2e: (0); 2f: (1); 2g: (1); 2h: (1); 4i: (1); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (1); 4o: (2); 8p: (2); 8q: (4); 8r: (3); 8s: (3); 8t: (3); 16u: (6)
6	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (0); 2g: (0); 2h: (0); 4i: (1); 4j: (0); 4k: (1); 4l: (0); 4m: (1); 4n: (1); 4o: (1); 8p: (1); 8q: (2); 8r: (1); 8s: (1); 8t: (2); 16u: (3)
7	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (0); 2g: (1); 2h: (0); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (0); 4o: (1); 8p: (1); 8q: (2); 8r: (2); 8s: (2); 8t: (1); 16u: (3)
8	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (0); 2e: (1); 2f: (0); 2g: (0); 2h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (0); 4m: (1); 4n: (1); 4o: (1); 8p: (1); 8q: (2); 8r: (2); 8s: (1); 8t: (2); 16u: (3)
9	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (0); 2g: (0); 2h: (0); 4i: (1); 4j: (0); 4k: (1); 4l: (1); 4m: (1); 4n: (0); 4o: (1); 8p: (1); 8q: (2); 8r: (1); 8s: (2); 8t: (1); 16u: (3)
10	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (1); 2f: (0); 2g: (1); 2h: (1); 4i: (1); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 4n: (2); 4o: (1); 8p: (4); 8q: (2); 8r: (3); 8s: (3); 8t: (3); 16u: (6)

$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 4m: (2); 4n: (2); 4o: (1); 8p: (4); 8q: (2); 8r: (3); 8s: (4); 8t: (3); 16u: (6)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (0); 2g: (1); 2h: (0); 4i: (1); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (0); 4o: (2); 8p: (2); 8q: (4); 8r: (3); 8s: (3); 8t: (2); 16u: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (0); 2e: (0); 2f: (1); 2g: (0); 2h: (1); 4i: (1); 4j: (2); 4k: (1); 4l: (2); 4m: (0); 4n: (2); 4o: (1); 8p: (4); 8q: (2); 8r: (3); 8s: (2); 8t: (3); 16u: (6)
4	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 4n: (2); 4o: (2); 8p: (2); 8q: (4); 8r: (3); 8s: (3); 8t: (4); 16u: (6)
5	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (1); 2e: (1); 2f: (0); 2g: (0); 2h: (1); 4i: (1); 4j: (1); 4k: (2); 4l: (0); 4m: (2); 4n: (1); 4o: (2); 8p: (2); 8q: (4); 8r: (3); 8s: (2); 8t: (3); 16u: (6)
6	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 4n: (2); 4o: (2); 8p: (4); 8q: (2); 8r: (3); 8s: (3); 8t: (4); 16u: (6)
7	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (1); 4k: (2); 4l: (2); 4m: (2); 4n: (1); 4o: (2); 8p: (2); 8q: (4); 8r: (3); 8s: (4); 8t: (3); 16u: (6)
8	(0, 0, 0)	1a: (1); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (1); 2g: (1); 2h: (0); 4i: (1); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 4n: (2); 4o: (0); 8p: (4); 8q: (2); 8r: (3); 8s: (3); 8t: (2); 16u: (6)

$X\left(0, \frac{1}{2}, 0\right)$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 8p: (4); 8q: (4); 8r: (3); 8s: (4); 8t: (3); 16u: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (1); 2h: (0); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (0); 4o: (0); 8p: (2); 8q: (2); 8r: (3); 8s: (3); 8t: (2); 16u: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (0); 2h: (1); 4i: (1); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 8p: (4); 8q: (4); 8r: (3); 8s: (2); 8t: (3); 16u: (6)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (2); 4o: (2); 8p: (2); 8q: (2); 8r: (3); 8s: (3); 8t: (4); 16u: (6)
5	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 2h: (1); 4i: (1); 4j: (1); 4k: (1); 4l: (0); 4m: (0); 4n: (1); 4o: (1); 8p: (2); 8q: (2); 8r: (3); 8s: (2); 8t: (3); 16u: (6)
6	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 8p: (4); 8q: (4); 8r: (3); 8s: (3); 8t: (4); 16u: (6)
7	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (2); 4j: (1); 4k: (1); 4l: (2); 4m: (2); 4n: (1); 4o: (1); 8p: (2); 8q: (2); 8r: (3); 8s: (4); 8t: (3); 16u: (6)

8	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (0); 4i: (1); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 8p: (4); 8q: (4); 8r: (3); 8s: (3); 8t: (2); 16u: (6)

c. Results for high-symmetry lines

DT(0, v , 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S(u , u , $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)
SM(u , u , 0)		
Operation	E	C_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)
T(u , $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $\frac{1}{2}$)
U(0, v , $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v , $\frac{1}{2}$)	($-v$, 0, $\frac{1}{2}$)
V($\frac{1}{2}$, $\frac{1}{2}$, w)		
Operation	E	
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	
W(0, $\frac{1}{2}$, w)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}$, w)	($-\frac{1}{2}$, 0, w)
Y(u , $\frac{1}{2}$, 0)		
Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, 0)	($-\frac{1}{2}$, u , 0)

DT (0, v , 0) of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 4n: (4); 4o: (4); 8p: (8); 8q: (8); 8r: (6); 8s: (7); 8t: (7); 16u: (12)

2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (4); 8q: (4); 8r: (6); 8s: (5); 8t: (5); 16u: (12)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (2); 4k: (2); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (4); 8q: (4); 8r: (6); 8s: (7); 8t: (7); 16u: (12)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (1); 4i: (2); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 4n: (4); 4o: (4); 8p: (8); 8q: (8); 8r: (6); 8s: (5); 8t: (5); 16u: (12)

LD (0, 0, w) of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 8p: (3); 8q: (3); 8r: (4); 8s: (4); 8t: (4); 16u: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 2h: (0); 4i: (0); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (3); 8q: (3); 8r: (2); 8s: (2); 8t: (2); 16u: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (0); 2h: (0); 4i: (2); 4j: (1); 4k: (1); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 8p: (3); 8q: (3); 8r: (2); 8s: (4); 8t: (4); 16u: (6)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (0); 2f: (0); 2g: (0); 2h: (0); 4i: (0); 4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (1); 4o: (1); 8p: (3); 8q: (3); 8r: (4); 8s: (2); 8t: (2); 16u: (6)
5	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6); 8q: (6); 8r: (6); 8s: (6); 8t: (6); 16u: (12)

S ($u, u, \frac{1}{2}$) of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (2); 2g: (2); 2h: (2); 4i: (3); 4j: (4); 4k: (3); 4l: (4); 4m: (2); 4n: (4); 4o: (2); 8p: (8); 8q: (4); 8r: (7); 8s: (6); 8t: (6); 16u: (12)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (1); 4i: (3); 4j: (1); 4k: (4); 4l: (2); 4m: (4); 4n: (2); 4o: (4); 8p: (4); 8q: (8); 8r: (5); 8s: (6); 8t: (6); 16u: (12)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (1); 2f: (2); 2g: (1); 2h: (1); 4i: (3); 4j: (4); 4k: (1); 4l: (4); 4m: (2); 4n: (4); 4o: (2); 8p: (8); 8q: (4); 8r: (5); 8s: (6); 8t: (6); 16u: (12)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 4m: (4); 4n: (2); 4o: (4); 8p: (4); 8q: (8); 8r: (7); 8s: (6); 8t: (6); 16u: (12)

SM ($u, u, 0$) of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (3); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 4n: (4); 4o: (4); 8p: (8); 8q: (8); 8r: (7); 8s: (6); 8t: (6); 16u: (12)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (1); 2h: (1); 4i: (3); 4j: (1); 4k: (1); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 8p: (4); 8q: (4); 8r: (5); 8s: (6); 8t: (6); 16u: (12)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (1); 4i: (3); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 4n: (4); 4o: (4); 8p: (8); 8q: (8); 8r: (5); 8s: (6); 8t: (6); 16u: (12)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (3); 4j: (3); 4k: (3); 4l: (2); 4m: (2); 4n: (2); 4o: (2); 8p: (4); 8q: (4); 8r: (7); 8s: (6); 8t: (6); 16u: (12)

T ($u, \frac{1}{2}, \frac{1}{2}$) of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (0); 2e: (1); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (4); 4k: (2); 4l: (4); 4m: (3); 4n: (4); 4o: (1); 8p: (8); 8q: (4); 8r: (6); 8s: (7); 8t: (5); 16u: (12)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (1); 2g: (1); 2h: (2); 4i: (3); 4j: (2); 4k: (4); 4l: (1); 4m: (4); 4n: (3); 4o: (4); 8p: (4); 8q: (8); 8r: (6); 8s: (5); 8t: (7); 16u: (12)
3	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (4); 4k: (2); 4l: (4); 4m: (1); 4n: (4); 4o: (3); 8p: (8); 8q: (4); 8r: (6); 8s: (5); 8t: (7); 16u: (12)

4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (1); 2e: (2); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (2); 4k: (4); 4l: (3); 4m: (4); 4n: (1); 4o: (4); 8p: (4); 8q: (8); 8r: (6); 8s: (7); 8t: (5); 16u: (12)

$U(0, v, \frac{1}{2})$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (4); 4k: (2); 4l: (4); 4m: (3); 4n: (4); 4o: (3); 8p: (8); 8q: (4); 8r: (6); 8s: (7); 8t: (7); 16u: (12)
2	(0, 0, 0)	1a: (0); 1b: (1); 1c: (0); 1d: (1); 2e: (2); 2f: (0); 2g: (1); 2h: (1); 4i: (2); 4j: (2); 4k: (4); 4l: (1); 4m: (4); 4n: (1); 4o: (4); 8p: (4); 8q: (8); 8r: (6); 8s: (5); 8t: (5); 16u: (12)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (2); 4k: (4); 4l: (3); 4m: (4); 4n: (3); 4o: (4); 8p: (4); 8q: (8); 8r: (6); 8s: (7); 8t: (7); 16u: (12)
4	(0, 0, 0)	1a: (1); 1b: (0); 1c: (1); 1d: (0); 2e: (0); 2f: (2); 2g: (1); 2h: (1); 4i: (2); 4j: (4); 4k: (2); 4l: (4); 4m: (1); 4n: (4); 4o: (1); 8p: (8); 8q: (4); 8r: (6); 8s: (5); 8t: (5); 16u: (12)

$V(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (2); 2h: (0); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 4n: (1); 4o: (1); 8p: (3); 8q: (3); 8r: (4); 8s: (4); 8t: (2); 16u: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (0); 2h: (0); 4i: (2); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 4n: (2); 4o: (2); 8p: (3); 8q: (3); 8r: (2); 8s: (2); 8t: (4); 16u: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (0); 2h: (0); 4i: (2); 4j: (1); 4k: (1); 4l: (2); 4m: (2); 4n: (1); 4o: (1); 8p: (3); 8q: (3); 8r: (2); 8s: (4); 8t: (2); 16u: (6)
4	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (0); 2h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (2); 4o: (2); 8p: (3); 8q: (3); 8r: (4); 8s: (2); 8t: (4); 16u: (6)
5	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (2); 2h: (2); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (3); 4o: (3); 8p: (6); 8q: (6); 8r: (6); 8s: (6); 8t: (6); 16u: (12)

$W(0, \frac{1}{2}, w)$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (4); 4m: (4); 4n: (3); 4o: (3); 8p: (6); 8q: (6); 8r: (6); 8s: (8); 8t: (6); 16u: (12)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (0); 2h: (2); 4i: (2); 4j: (3); 4k: (3); 4l: (2); 4m: (2); 4n: (3); 4o: (3); 8p: (6); 8q: (6); 8r: (6); 8s: (4); 8t: (6); 16u: (12)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (2); 2h: (0); 4i: (2); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (2); 4o: (2); 8p: (6); 8q: (6); 8r: (6); 8s: (6); 8t: (4); 16u: (12)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 4n: (4); 4o: (4); 8p: (6); 8q: (6); 8r: (6); 8s: (6); 8t: (8); 16u: (12)

$Y(u, \frac{1}{2}, 0)$ of space group No. 123

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (1); 4i: (3); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 4n: (4); 4o: (4); 8p: (8); 8q: (8); 8r: (6); 8s: (7); 8t: (5); 16u: (12)
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (1); 1d: (1); 2e: (1); 2f: (1); 2g: (1); 2h: (2); 4i: (3); 4j: (2); 4k: (2); 4l: (1); 4m: (1); 4n: (3); 4o: (3); 8p: (4); 8q: (4); 8r: (6); 8s: (5); 8t: (7); 16u: (12)
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (1); 2h: (2); 4i: (3); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 4n: (4); 4o: (4); 8p: (8); 8q: (8); 8r: (6); 8s: (5); 8t: (7); 16u: (12)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (0); 1d: (0); 2e: (1); 2f: (1); 2g: (2); 2h: (1); 4i: (3); 4j: (2); 4k: (2); 4l: (3); 4m: (3); 4n: (1); 4o: (1); 8p: (4); 8q: (4); 8r: (6); 8s: (7); 8t: (5); 16u: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 123						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (8); 4k: (8); 4l: (8); 4m: (8); 4n: (8); 4o: (8); 8p: (16); 8q: (16); 8r: (12); 8s: (12); 8t: (12); 16u: (24)				
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 4n: (4); 4o: (4); 8p: (8); 8q: (8); 8r: (12); 8s: (12); 8t: (12); 16u: (24)				
P2 ($u, v, \frac{1}{2}$) of space group No. 123						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	1a: (2); 1b: (1); 1c: (2); 1d: (1); 2e: (2); 2f: (4); 2g: (3); 2h: (3); 4i: (6); 4j: (8); 4k: (4); 4l: (8); 4m: (4); 4n: (8); 4o: (4); 8p: (16); 8q: (8); 8r: (12); 8s: (12); 8t: (12); 16u: (24)				
2	(0, 0, 0)	1a: (1); 1b: (2); 1c: (1); 1d: (2); 2e: (4); 2f: (2); 2g: (3); 2h: (3); 4i: (6); 4j: (4); 4k: (8); 4l: (4); 4m: (8); 4n: (4); 4o: (8); 8p: (8); 8q: (16); 8r: (12); 8s: (12); 8t: (12); 16u: (24)				
P3 (0, u, v) of space group No. 123						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (4); 2f: (4); 2g: (4); 2h: (4); 4i: (8); 4j: (6); 4k: (6); 4l: (7); 4m: (7); 4n: (7); 4o: (7); 8p: (12); 8q: (12); 8r: (12); 8s: (14); 8t: (14); 16u: (24)				
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (2); 2f: (2); 2g: (2); 2h: (2); 4i: (4); 4j: (6); 4k: (6); 4l: (5); 4m: (5); 4n: (5); 4o: (5); 8p: (12); 8q: (12); 8r: (12); 8s: (10); 8t: (10); 16u: (24)				
P4 (u, u, v) of space group No. 123						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (4); 2h: (4); 4i: (6); 4j: (7); 4k: (7); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12); 8q: (12); 8r: (14); 8s: (12); 8t: (12); 16u: (24)				
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (2); 2h: (2); 4i: (6); 4j: (5); 4k: (5); 4l: (6); 4m: (6); 4n: (6); 4o: (6); 8p: (12); 8q: (12); 8r: (10); 8s: (12); 8t: (12); 16u: (24)				

P5 ($u, \frac{1}{2}, v$) of space group No. 123		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (1); 1d: (1); 2e: (3); 2f: (3); 2g: (4); 2h: (2); 4i: (6); 4j: (6); 4k: (6); 4l: (7); 4m: (7); 4n: (5); 4o: (5); 8p: (12); 8q: (12); 8r: (12); 8s: (14); 8t: (10); 16u: (24)
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (2); 1d: (2); 2e: (3); 2f: (3); 2g: (2); 2h: (4); 4i: (6); 4j: (6); 4k: (6); 4l: (5); 4m: (5); 4n: (7); 4o: (7); 8p: (12); 8q: (12); 8r: (12); 8s: (10); 8t: (14); 16u: (24)

124. Space group No. 124 ($P4/mcc$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{C_{2x}|0, 0, -\tfrac{1}{2}\} \quad \{C_{2y}|0, 0, -\tfrac{1}{2}\} \quad \{C_{2a}|0, 0, -\tfrac{1}{2}\} \quad \{C_{2b}|0, 0, -\tfrac{1}{2}\} \\ \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{\sigma_x|0, 0, -\tfrac{1}{2}\} \quad \{\sigma_y|0, 0, -\tfrac{1}{2}\} \quad \{\sigma_{da}|0, 0, -\tfrac{1}{2}\} \quad \{\sigma_{db}|0, 0, -\tfrac{1}{2}\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate (0, 0, 0)
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate ($\frac{1}{2}, \frac{1}{2}, 0$)
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate ($0, 0, \frac{1}{2}$)
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate ($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$)
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E C_{4z}^+
Coordinate ($0, \frac{1}{2}, \frac{1}{2}$) ($-\frac{1}{2}, 0, \frac{1}{2}$)

$$X(0, \frac{1}{2}, 0)$$

Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

$\Gamma(0, 0, 0)$ of space group No. 124											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (0);	4g: (1);	4h: (1);	8i: (1);	8j: (1); 8k: (1); 8l: (1); 8m: (2); 16n: (3)
2	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (0);	4e: (0);	4f: (1);	4g: (1);	4h: (1);	8i: (1);	8j: (2); 8k: (2); 8l: (2); 8m: (2); 16n: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (0);	4g: (0);	4h: (0);	8i: (1);	8j: (2); 8k: (1); 8l: (1); 8m: (2); 16n: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (1);	4g: (0);	4h: (0);	8i: (1);	8j: (1); 8k: (2); 8l: (2); 8m: (2); 16n: (3)
5	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (0);	4e: (0);	4f: (2);	4g: (2);	4h: (2);	8i: (4);	8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
6	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0);	2d: (1);	4e: (1);	4f: (0);	4g: (1);	4h: (1);	8i: (1);	8j: (1); 8k: (1); 8l: (1); 8m: (1); 16n: (3)
7	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	4g: (1);	4h: (1);	8i: (1);	8j: (2); 8k: (2); 8l: (2); 8m: (1); 16n: (3)
8	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (0);	4g: (0);	4h: (0);	8i: (1);	8j: (2); 8k: (1); 8l: (1); 8m: (1); 16n: (3)
9	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	4g: (0);	4h: (0);	8i: (1);	8j: (1); 8k: (2); 8l: (2); 8m: (1); 16n: (3)
10	(0, 0, 0)	2a: (1);	2b: (2);	2c: (1);	2d: (2);	4e: (4);	4f: (2);	4g: (2);	4h: (2);	8i: (4);	8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)

$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 124											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (2);	4f: (1);	4g: (1);	4h: (0);	8i: (2);	8j: (1); 8k: (1); 8l: (2); 8m: (2); 16n: (3)
2	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0);	2d: (0);	4e: (2);	4f: (1);	4g: (1);	4h: (0);	8i: (2);	8j: (2); 8k: (2); 8l: (1); 8m: (2); 16n: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	2d: (0);	4e: (2);	4f: (1);	4g: (0);	4h: (1);	8i: (2);	8j: (2); 8k: (1); 8l: (2); 8m: (2); 16n: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (2);	4f: (1);	4g: (0);	4h: (1);	8i: (2);	8j: (1); 8k: (2); 8l: (1); 8m: (2); 16n: (3)
5	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (0);	4e: (2);	4f: (1);	4g: (2);	4h: (2);	8i: (2);	8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
6	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0);	2d: (0);	4e: (0);	4f: (1);	4g: (1);	4h: (0);	8i: (2);	8j: (1); 8k: (1); 8l: (2); 8m: (1); 16n: (3)
7	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (0);	4e: (0);	4f: (1);	4g: (1);	4h: (0);	8i: (2);	8j: (2); 8k: (2); 8l: (1); 8m: (1); 16n: (3)
8	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	2d: (1);	4e: (0);	4f: (1);	4g: (0);	4h: (1);	8i: (2);	8j: (2); 8k: (1); 8l: (2); 8m: (1); 16n: (3)
9	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (1);	4e: (0);	4f: (1);	4g: (0);	4h: (1);	8i: (2);	8j: (1); 8k: (2); 8l: (1); 8m: (1); 16n: (3)
10	(0, 0, 0)	2a: (1);	2b: (2);	2c: (1);	2d: (2);	4e: (0);	4f: (1);	4g: (2);	4h: (2);	8i: (2);	8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 124											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	4g: (2);	4h: (2);	8i: (2);	8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	4g: (0);	4h: (0);	8i: (2);	8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	4g: (2);	4h: (2);	8i: (4);	8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 124											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (0);	4e: (2);	4f: (2);	4g: (2);	4h: (0);	8i: (4);	8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	4g: (0);	4h: (2);	8i: (4);	8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	4g: (2);	4h: (2);	8i: (2);	8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 124											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (2);	4h: (4);	8i: (6);	8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (4);	4h: (2);	8i: (6);	8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 124											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	2d: (2);	4e: (2);	4f: (1);	4g: (1);	4h: (2);	8i: (3);	8j: (3); 8k: (2); 8l: (3); 8m: (4); 16n: (6)
2	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0);	2d: (1);	4e: (1);	4f: (1);	4g: (2);	4h: (1);	8i: (3);	8j: (3); 8k: (3); 8l: (2); 8m: (2); 16n: (6)
3	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (2);	4e: (2);	4f: (2);	4g: (1);	4h: (2);	8i: (3);	8j: (3); 8k: (4); 8l: (3); 8m: (4); 16n: (6)
4	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (1);	4e: (1);	4f: (2);	4g: (2);	4h: (1);	8i: (3);	8j: (3); 8k: (3); 8l: (4); 8m: (2); 16n: (6)
5	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (0);	4e: (1);	4f: (1);	4g: (1);	4h: (2);	8i: (3);	8j: (3); 8k: (2); 8l: (3); 8m: (2); 16n: (6)
6	(0, 0, 0)	2a: (1);	2b: (2);	2c: (0);	2d: (0);	4e: (2);	4f: (1);	4g: (2);	4h: (1);	8i: (3);	8j: (3); 8k: (3); 8l: (2); 8m: (4); 16n: (6)
7	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (0);	4e: (1);	4f: (2);	4g: (1);	4h: (2);	8i: (3);	8j: (3); 8k: (4); 8l: (3); 8m: (2); 16n: (6)
8	(0, 0, 0)	2a: (1);	2b: (2);	2c: (1);	2d: (0);	4e: (2);	4f: (2);	4g: (2);	4h: (1);	8i: (3);	8j: (3); 8k: (3); 8l: (4); 8m: (4); 16n: (6)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	$(0, v, 0)$	$(-v, 0, 0)$
LD(0, 0, w)		
Operation	E	
Coordinate	$(0, 0, w)$	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$
U($0, v, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
W($0, \frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT (0, v, 0) of space group No. 124

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (5); 8m: (8); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (5); 8m: (4); 16n: (12)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (7); 8m: (4); 16n: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (7); 8m: (8); 16n: (12)

LD (0, 0, w) of space group No. 124

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 8i: (2); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 8i: (2); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (0); 4h: (0); 8i: (2); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (0); 4h: (0); 8i: (2); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (4); 4h: (4); 8i: (8); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

$S(u, u, \frac{1}{2})$ of space group No. 124

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

$SM(u, u, 0)$ of space group No. 124

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (4); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (5); 8k: (6); 8l: (6); 8m: (8); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (5); 8k: (6); 8l: (6); 8m: (4); 16n: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (7); 8k: (6); 8l: (6); 8m: (8); 16n: (12)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (2); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (7); 8k: (6); 8l: (6); 8m: (4); 16n: (12)

$T(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 124

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

$U(0, v, \frac{1}{2})$ of space group No. 124

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

$V(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 124

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (2); 4h: (0); 8i: (4); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (2); 4h: (0); 8i: (4); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (0); 4h: (2); 8i: (4); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (0); 4h: (2); 8i: (4); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (2); 4f: (2); 4g: (4); 4h: (4); 8i: (4); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

W $(0, \frac{1}{2}, w)$ of space group No. 124		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
Y $(u, \frac{1}{2}, 0)$ of space group No. 124		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (7); 8m: (8); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (1); 4e: (2); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (7); 8m: (4); 16n: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (2); 4e: (4); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (5); 8m: (8); 16n: (12)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (5); 8m: (4); 16n: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate ($u, v, \frac{1}{2}$)

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate ($0, u, v$) ($-u, 0, v$)

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) ($-u, u, v$)

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate ($u, \frac{1}{2}, v$) ($-\frac{1}{2}, u, v$)

P1 ($u, v, 0$) of space group No. 124		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (4); 2c: (3); 2d: (4); 4e: (8); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (16); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (2); 2c: (3); 2d: (2); 4e: (4); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (8); 16n: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 124		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
P3 (0, u, v) of space group No. 124		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
P4 (u, u, v) of space group No. 124		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
P5 ($u, \frac{1}{2}, v$) of space group No. 124		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

125. Space group No. 125 ($P4/nbm$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

b. Results for high-symmetry points

$$\begin{aligned} & \{E|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_{4z}^+|0,0,0\} \quad \{C_{4z}^-|0,0,0\} \quad \{C_{2x}|0,0,0\} \quad \{C_{2y}|0,0,0\} \quad \{C_{2a}|0,0,0\} \quad \{C_{2b}|0,0,0\} \\ & \{I|-\frac{1}{2},\frac{1}{2},0\} \quad \{\sigma_z|-\frac{1}{2},\frac{1}{2},0\} \quad \{S_{4z}^-|-\frac{1}{2},-\frac{1}{2},0\} \quad \{S_{4z}^+|-\frac{1}{2},\frac{1}{2},0\} \quad \{\sigma_x|-\frac{1}{2},-\frac{1}{2},0\} \quad \{\sigma_y|-\frac{1}{2},\frac{1}{2},0\} \quad \{\sigma_{da}|-\frac{1}{2},-\frac{1}{2},0\} \quad \{\sigma_{db}|-\frac{1}{2},\frac{1}{2},0\} \end{aligned}$$

$\Gamma(0,0,0)$
Operation E
Coordinate (0,0,0)
$M(\frac{1}{2},\frac{1}{2},0)$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},0)$
$Z(0,0,\frac{1}{2})$
Operation E
Coordinate $(0,0,\frac{1}{2})$
$A(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
$R(0,\frac{1}{2},\frac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,\frac{1}{2})$
$X(0,\frac{1}{2},0)$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

$\Gamma(0,0,0)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 4g: (1); 4h: (1); 8i: (1); 8j: (1); 8k: (1); 8l: (1); 8m: (2); 16n: (3)
2	(0,0,0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 4g: (1); 4h: (0); 8i: (2); 8j: (2); 8k: (2); 8l: (2); 8m: (1); 16n: (3)
3	(0,0,0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 4g: (0); 4h: (0); 8i: (2); 8j: (2); 8k: (1); 8l: (1); 8m: (1); 16n: (3)
4	(0,0,0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (0); 4f: (0); 4g: (0); 4h: (1); 8i: (1); 8j: (1); 8k: (2); 8l: (2); 8m: (2); 16n: (3)
5	(0,0,0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (0); 4f: (0); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
6	(0,0,0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (0); 8i: (1); 8j: (1); 8k: (1); 8l: (1); 8m: (1); 16n: (3)
7	(0,0,0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (1); 8i: (2); 8j: (2); 8k: (2); 8l: (2); 8m: (2); 16n: (3)

8	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (0); 4h: (1); 8i: (2); 8j: (2); 8k: (1); 8l: (1); 8m: (2); 16n: (3)
9	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (0); 4h: (0); 8i: (1); 8j: (1); 8k: (2); 8l: (2); 8m: (1); 16n: (3)
10	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)

$M \left(\frac{1}{2}, \frac{1}{2}, 0 \right)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (1); 4h: (2); 8i: (4); 8j: (4); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (0); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (2); 8i: (2); 8j: (2); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)

$Z \left(0, 0, \frac{1}{2} \right)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 4e: (0); 4f: (2); 4g: (1); 4h: (1); 8i: (1); 8j: (2); 8k: (1); 8l: (2); 8m: (2); 16n: (3)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (1); 4g: (1); 4h: (0); 8i: (2); 8j: (1); 8k: (2); 8l: (1); 8m: (1); 16n: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (1); 4g: (0); 4h: (0); 8i: (2); 8j: (1); 8k: (1); 8l: (2); 8m: (1); 16n: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (0); 4e: (0); 4f: (2); 4g: (0); 4h: (1); 8i: (1); 8j: (2); 8k: (2); 8l: (1); 8m: (2); 16n: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (0); 4f: (3); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
6	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (0); 4g: (1); 4h: (0); 8i: (1); 8j: (2); 8k: (1); 8l: (2); 8m: (1); 16n: (3)
7	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 4e: (2); 4f: (0); 4g: (1); 4h: (1); 8i: (2); 8j: (1); 8k: (2); 8l: (1); 8m: (2); 16n: (3)
8	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (1); 4e: (2); 4f: (0); 4g: (0); 4h: (1); 8i: (2); 8j: (1); 8k: (1); 8l: (2); 8m: (2); 16n: (3)
9	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (0); 4g: (0); 4h: (0); 8i: (1); 8j: (2); 8k: (2); 8l: (1); 8m: (1); 16n: (3)
10	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (0); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (1); 4g: (1); 4h: (2); 8i: (4); 8j: (2); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (0); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 8i: (2); 8j: (4); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)

R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 125		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (7); 8m: (6); 16n: (12)
2	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (5); 8m: (6); 16n: (12)
X $(0, \frac{1}{2}, 0)$ of space group No. 125		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (5); 8m: (6); 16n: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (7); 8m: (6); 16n: (12)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W(0, $\frac{1}{2}, w$)		
Operation	E	C_{4z}^+

Coordinate $(0, \frac{1}{2}, w) \quad (-\frac{1}{2}, 0, w)$

$Y(u, \frac{1}{2}, 0)$

Operation $E \quad C_{4z}^+$
Coordinate $(u, \frac{1}{2}, 0) \quad (-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (5); 8m: (6); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (5); 8m: (6); 16n: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (7); 8m: (6); 16n: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (7); 8m: (6); 16n: (12)

LD $(0, 0, w)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (0); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (0); 4h: (0); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (0); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

S $(u, u, \frac{1}{2})$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (4); 4g: (3); 4h: (4); 8i: (5); 8j: (7); 8k: (6); 8l: (6); 8m: (7); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (1); 4e: (2); 4f: (3); 4g: (3); 4h: (2); 8i: (5); 8j: (7); 8k: (6); 8l: (6); 8m: (5); 16n: (12)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (2); 4g: (3); 4h: (2); 8i: (7); 8j: (5); 8k: (6); 8l: (6); 8m: (5); 16n: (12)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (2); 4e: (4); 4f: (3); 4g: (3); 4h: (4); 8i: (7); 8j: (5); 8k: (6); 8l: (6); 8m: (7); 16n: (12)

SM $(u, u, 0)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (4); 8i: (5); 8j: (5); 8k: (6); 8l: (6); 8m: (7); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (2); 8i: (5); 8j: (5); 8k: (6); 8l: (6); 8m: (5); 16n: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (2); 8i: (7); 8j: (7); 8k: (6); 8l: (6); 8m: (5); 16n: (12)

4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (4); 8i: (7); 8j: (7); 8k: (6); 8l: (6); 8m: (7); 16n: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 125		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

U $(0, v, \frac{1}{2})$ of space group No. 125		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (7); 8m: (6); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (5); 8l: (7); 8m: (6); 16n: (12)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (5); 8m: (6); 16n: (12)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (7); 8l: (5); 8m: (6); 16n: (12)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 125		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (0); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (2); 4h: (0); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

W $(0, \frac{1}{2}, w)$ of space group No. 125		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

Y $(u, \frac{1}{2}, 0)$ of space group No. 125		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

d. Results for high-symmetry planes

PI($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

 $P2(u, v, \frac{1}{2})$

Operation	E
Coordinate	$(u, v, \frac{1}{2})$

 $P3(0, u, v)$

Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$

 $P4(u, u, v)$

Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$

 $P5(u, \frac{1}{2}, v)$

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

 $P1(u, v, 0)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

 $P2(u, v, \frac{1}{2})$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

 $P3(0, u, v)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

 $P4(u, u, v)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (4); 2d: (4); 4e: (7); 4f: (7); 4g: (6); 4h: (8); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (14); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (2); 2d: (2); 4e: (5); 4f: (5); 4g: (6); 4h: (4); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (10); 16n: (24)

 $P5(u, \frac{1}{2}, v)$ of space group No. 125

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

126. Space group No. 126 ($P4/nnc$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}&\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\} \\&\{I|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_z|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{S_{4z}^-|-\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\} \quad \{S_{4z}^+|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\} \quad \{\sigma_y|-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{\sigma_{da}|-\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\} \quad \{\sigma_{db}|-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}\end{aligned}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})\end{array}$$

$$R(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) & (-\frac{1}{2}, 0, \frac{1}{2})\end{array}$$

$$X(0, \frac{1}{2}, 0)$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+\end{array}$$

Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

$\Gamma (0, 0, 0)$ of space group No. 126												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (1);	8f: (0);	8g: (1);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (0);	4e: (1);	8f: (0);	8g: (1);	8h: (2);	8i: (2);	8j: (2);	16k: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (0);	8f: (0);	8g: (1);	8h: (2);	8i: (1);	8j: (1);	16k: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	4e: (0);	8f: (0);	8g: (1);	8h: (1);	8i: (2);	8j: (2);	16k: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (2);	8f: (0);	8g: (4);	8h: (3);	8i: (3);	8j: (3);	16k: (6)
6	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (1);	8f: (3);	8g: (1);	8h: (1);	8i: (1);	8j: (1);	16k: (3)
7	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (1);	8f: (3);	8g: (1);	8h: (2);	8i: (2);	8j: (2);	16k: (3)
8	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (0);	8f: (3);	8g: (1);	8h: (2);	8i: (1);	8j: (1);	16k: (3)
9	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (0);	4e: (0);	8f: (3);	8g: (1);	8h: (1);	8i: (2);	8j: (2);	16k: (3)
10	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (2);	8f: (6);	8g: (4);	8h: (3);	8i: (3);	8j: (3);	16k: (6)
$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 126												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (1);	8f: (3);	8g: (4);	8h: (4);	8i: (3);	8j: (3);	16k: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	8f: (3);	8g: (2);	8h: (3);	8i: (3);	8j: (3);	16k: (6)
3	(0, 0, 0)	2a: (0);	2b: (0);	4c: (2);	4d: (2);	4e: (1);	8f: (3);	8g: (4);	8h: (2);	8i: (3);	8j: (3);	16k: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	8f: (3);	8g: (2);	8h: (3);	8i: (3);	8j: (3);	16k: (6)
$Z (0, 0, \frac{1}{2})$ of space group No. 126												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	8f: (3);	8g: (2);	8h: (3);	8i: (3);	8j: (3);	16k: (6)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	4e: (0);	8f: (3);	8g: (2);	8h: (3);	8i: (3);	8j: (3);	16k: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (2);	4e: (2);	8f: (3);	8g: (4);	8h: (3);	8i: (3);	8j: (3);	16k: (6)
$A (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 126												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (0);	2b: (1);	4c: (2);	4d: (2);	4e: (1);	8f: (3);	8g: (4);	8h: (3);	8i: (2);	8j: (4);	16k: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	8f: (3);	8g: (2);	8h: (3);	8i: (3);	8j: (3);	16k: (6)
3	(0, 0, 0)	2a: (1);	2b: (0);	4c: (2);	4d: (2);	4e: (1);	8f: (3);	8g: (4);	8h: (3);	8i: (4);	8j: (2);	16k: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	8f: (3);	8g: (2);	8h: (3);	8i: (3);	8j: (3);	16k: (6)
$R (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 126												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (1);	2b: (2);	4c: (3);	4d: (3);	4e: (3);	8f: (6);	8g: (6);	8h: (6);	8i: (5);	8j: (7);	16k: (12)
2	(0, 0, 0)	2a: (2);	2b: (1);	4c: (3);	4d: (3);	4e: (3);	8f: (6);	8g: (6);	8h: (6);	8i: (7);	8j: (5);	16k: (12)
$X (0, \frac{1}{2}, 0)$ of space group No. 126												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (3);	4e: (3);	8f: (6);	8g: (6);	8h: (6);	8i: (5);	8j: (5);	16k: (12)
2	(0, 0, 0)	2a: (2);	2b: (2);	4c: (4);	4d: (3);	4e: (3);	8f: (6);	8g: (6);	8h: (6);	8i: (7);	8j: (7);	16k: (12)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($0, v, \frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	($0, \frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	($-\frac{1}{2}, u, 0$)

DT (0, v, 0) of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (5); 8j: (5); 16k: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (5); 8j: (5); 16k: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (7); 8j: (7); 16k: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (7); 8j: (7); 16k: (12)

LD $(0, 0, w)$ of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (4); 8f: (6); 8g: (8); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

S $(u, u, \frac{1}{2})$ of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

SM $(u, u, 0)$ of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (5); 8i: (6); 8j: (6); 16k: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (5); 8i: (6); 8j: (6); 16k: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (7); 8i: (6); 8j: (6); 16k: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (7); 8i: (6); 8j: (6); 16k: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (5); 8j: (7); 16k: (12)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (5); 8j: (7); 16k: (12)
3	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (7); 8j: (5); 16k: (12)
4	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (7); 8j: (5); 16k: (12)

U $(0, v, \frac{1}{2})$ of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (4); 4d: (4); 4e: (2); 8f: (6); 8g: (8); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

W $(0, \frac{1}{2}, w)$ of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

Y $(u, \frac{1}{2}, 0)$ of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate ($u, v, \frac{1}{2}$)

P3(0, u, v)

Operation E C_{4z}^+
Coordinate (0, u, v) ($-u, 0, v$)

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) ($-u, u, v$)

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate ($u, \frac{1}{2}, v$) ($-\frac{1}{2}, u, v$)

P1 ($u, v, 0$) of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

P2 ($u, v, \frac{1}{2}$) of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

P3 (0, u, v) of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

P4 (u, u, v) of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 126

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

127. Space group No. 127 ($P4/mbm$)

Tetragonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} \{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{2y}|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{2a}|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{2b}|-\frac{1}{2}, -\frac{1}{2}, 0\} \\ \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{\sigma_x|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_y|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_{da}|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_{db}|-\frac{1}{2}, \frac{1}{2}, 0\} \end{aligned}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (0, 0, 0) \end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0) \end{array}$$

$$Z(0, 0, \frac{1}{2})$$

5	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (0); 4g: (0); 4h: (0); 8i: (1); 8j: (1); 8k: (1); 16l: (3)
6	(0, 0, 0)	2a: (0); 2b: (0); 2c: (2); 2d: (2); 4e: (1); 4f: (2); 4g: (2); 4h: (2); 8i: (4); 8j: (4); 8k: (3); 16l: (6)

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (2); 8j: (1); 8k: (2); 16l: (3)
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (0); 4g: (1); 4h: (0); 8i: (2); 8j: (1); 8k: (1); 16l: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 4g: (1); 4h: (0); 8i: (2); 8j: (1); 8k: (1); 16l: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (0); 4e: (0); 4f: (1); 4g: (1); 4h: (1); 8i: (2); 8j: (1); 8k: (2); 16l: (3)
5	(0, 0, 0)	2a: (0); 2b: (2); 2c: (2); 2d: (0); 4e: (2); 4f: (2); 4g: (1); 4h: (2); 8i: (2); 8j: (4); 8k: (3); 16l: (6)
6	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (0); 4g: (0); 4h: (1); 8i: (1); 8j: (2); 8k: (1); 16l: (3)
7	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (1); 8j: (2); 8k: (2); 16l: (3)
8	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (1); 4e: (0); 4f: (1); 4g: (1); 4h: (1); 8i: (1); 8j: (2); 8k: (2); 16l: (3)
9	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 4g: (0); 4h: (1); 8i: (1); 8j: (2); 8k: (1); 16l: (3)
10	(0, 0, 0)	2a: (2); 2b: (0); 2c: (0); 2d: (2); 4e: (2); 4f: (2); 4g: (2); 4h: (1); 8i: (4); 8j: (2); 8k: (3); 16l: (6)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (2); 8j: (1); 8k: (2); 16l: (3)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (0); 4g: (1); 4h: (0); 8i: (2); 8j: (1); 8k: (1); 16l: (3)
3	(0, 0, 0)	2a: (1); 2b: (0); 2c: (2); 2d: (0); 4e: (1); 4f: (2); 4g: (1); 4h: (2); 8i: (2); 8j: (4); 8k: (3); 16l: (6)
4	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 4e: (1); 4f: (1); 4g: (1); 4h: (1); 8i: (1); 8j: (2); 8k: (2); 16l: (3)
5	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (0); 4g: (0); 4h: (1); 8i: (1); 8j: (2); 8k: (1); 16l: (3)
6	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (2); 4e: (1); 4f: (2); 4g: (2); 4h: (1); 8i: (4); 8j: (2); 8k: (3); 16l: (6)

$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (8); 8j: (4); 8k: (6); 16l: (12)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (4); 8j: (8); 8k: (6); 16l: (12)

$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (8); 8j: (8); 8k: (6); 16l: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (4); 8j: (4); 8k: (6); 16l: (12)

c. Results for high-symmetry lines

DT(0, v , 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S(u , u , $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)
SM(u , u , 0)		
Operation	E	C_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)
T(u , $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $\frac{1}{2}$)
U(0, v , $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v , $\frac{1}{2}$)	($-v$, 0, $\frac{1}{2}$)
V($\frac{1}{2}$, $\frac{1}{2}$, w)		
Operation	E	
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	
W(0, $\frac{1}{2}$, w)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}$, w)	($-\frac{1}{2}$, 0, w)
Y(u , $\frac{1}{2}$, 0)		
Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, 0)	($-\frac{1}{2}$, u , 0)

DT (0, v , 0) of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (8); 8j: (8); 8k: (6); 16l: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (4); 8j: (4); 8k: (6); 16l: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (4); 8j: (4); 8k: (6); 16l: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (8); 8j: (8); 8k: (6); 16l: (12)

LD (0, 0, w) of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (4); 16l: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (0); 4g: (1); 4h: (1); 8i: (3); 8j: (3); 8k: (2); 16l: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 4g: (1); 4h: (1); 8i: (3); 8j: (3); 8k: (2); 16l: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (0); 4f: (2); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (4); 16l: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (6); 16l: (12)

S ($u, u, \frac{1}{2}$) of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (4); 4g: (4); 4h: (3); 8i: (8); 8j: (4); 8k: (7); 16l: (12)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (0); 4e: (3); 4f: (2); 4g: (1); 4h: (4); 8i: (4); 8j: (8); 8k: (5); 16l: (12)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (0); 2d: (2); 4e: (3); 4f: (2); 4g: (4); 4h: (1); 8i: (8); 8j: (4); 8k: (5); 16l: (12)
4	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (4); 4g: (3); 4h: (4); 8i: (4); 8j: (8); 8k: (7); 16l: (12)

SM ($u, u, 0$) of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (4); 4g: (4); 4h: (4); 8i: (8); 8j: (8); 8k: (7); 16l: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (3); 4f: (2); 4g: (1); 4h: (1); 8i: (4); 8j: (4); 8k: (5); 16l: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (2); 4g: (4); 4h: (4); 8i: (8); 8j: (8); 8k: (5); 16l: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (4); 4g: (3); 4h: (3); 8i: (4); 8j: (4); 8k: (7); 16l: (12)

T ($u, \frac{1}{2}, \frac{1}{2}$) of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (8); 8j: (4); 8k: (6); 16l: (12)

2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (4); 8j: (8); 8k: (6); 16l: (12)

$U\left(0, v, \frac{1}{2}\right)$ of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (8); 8j: (4); 8k: (6); 16l: (12)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (4); 8j: (8); 8k: (6); 16l: (12)
3	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 8i: (4); 8j: (8); 8k: (6); 16l: (12)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 8i: (8); 8j: (4); 8k: (6); 16l: (12)

$V\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 8i: (3); 8j: (3); 8k: (4); 16l: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (0); 4g: (1); 4h: (1); 8i: (3); 8j: (3); 8k: (2); 16l: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 8i: (6); 8j: (6); 8k: (6); 16l: (12)

$W\left(0, \frac{1}{2}, w\right)$ of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 16l: (24)

$Y\left(u, \frac{1}{2}, 0\right)$ of space group No. 127

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 8i: (8); 8j: (8); 8k: (6); 16l: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 8i: (4); 8j: (4); 8k: (6); 16l: (12)

d. Results for high-symmetry planes

$P1(u, v, 0)$

Operation	E
Coordinate	$(u, v, 0)$

$P2\left(u, v, \frac{1}{2}\right)$

Operation	E
Coordinate	$\left(u, v, \frac{1}{2}\right)$

$P3(0, u, v)$

Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$

$P4(u, u, v)$		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
$P5(u, \frac{1}{2}, v)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 $(u, v, 0)$ of space group No. 127		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 4e: (6); 4f: (6); 4g: (8); 4h: (8); 8i: (16); 8j: (16); 8k: (12); 16l: (24)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (6); 4f: (6); 4g: (4); 4h: (4); 8i: (8); 8j: (8); 8k: (12); 16l: (24)
P2 $(u, v, \frac{1}{2})$ of space group No. 127		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (2); 2c: (2); 2d: (4); 4e: (6); 4f: (6); 4g: (8); 4h: (4); 8i: (16); 8j: (8); 8k: (12); 16l: (24)
2	(0, 0, 0)	2a: (2); 2b: (4); 2c: (4); 2d: (2); 4e: (6); 4f: (6); 4g: (4); 4h: (8); 8i: (8); 8j: (16); 8k: (12); 16l: (24)
P3 $(0, u, v)$ of space group No. 127		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 16l: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 16l: (24)
P4 (u, u, v) of space group No. 127		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (4); 2d: (4); 4e: (6); 4f: (8); 4g: (7); 4h: (7); 8i: (12); 8j: (12); 8k: (14); 16l: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (2); 2d: (2); 4e: (6); 4f: (4); 4g: (5); 4h: (5); 8i: (12); 8j: (12); 8k: (10); 16l: (24)
P5 $(u, \frac{1}{2}, v)$ of space group No. 127		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 8i: (12); 8j: (12); 8k: (12); 16l: (24)

128. Space group No. 128 ($P4/mnc$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{4z}^+ 0,0,0\}$	$\{C_{4z}^- 0,0,0\}$	$\{C_{2x} \frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{C_{2y} -\frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{C_{2a} -\frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{C_{2b} -\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}$
$\{I 0,0,0\}$	$\{\sigma_z 0,0,0\}$	$\{S_{4z}^- 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$	$\{\sigma_x -\frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_y -\frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_{da} -\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_{db} -\frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$		
Operation	E	
Coordinate	$(0,0,0)$	
$M(\frac{1}{2},\frac{1}{2},0)$		
Operation	E	
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$	
$Z(0,0,\frac{1}{2})$		
Operation	E	
Coordinate	$(0,0,\frac{1}{2})$	
$A(\frac{1}{2},\frac{1}{2},\frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
$R(0,\frac{1}{2},\frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$
$X(0,\frac{1}{2},0)$		
Operation	E	C_{4z}^+
Coordinate	$(0,\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$

$\Gamma(0,0,0)$ of space group No. 128

(Co-) irrep	Phonon AM	WYPO information
1	$(0,0,0)$	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (1); 8f: (1); 8g: (1); 8h: (2); 16i: (3)
2	$(0,0,0)$	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (1); 8f: (1); 8g: (2); 8h: (2); 16i: (3)
3	$(0,0,0)$	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (0); 8f: (1); 8g: (2); 8h: (2); 16i: (3)
4	$(0,0,0)$	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (1); 8g: (1); 8h: (2); 16i: (3)
5	$(0,0,0)$	2a: (0); 2b: (0); 4c: (0); 4d: (2); 4e: (2); 8f: (4); 8g: (3); 8h: (2); 16i: (6)
6	$(0,0,0)$	2a: (1); 2b: (1); 4c: (1); 4d: (0); 4e: (1); 8f: (1); 8g: (1); 8h: (1); 16i: (3)

7	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (1); 8f: (1); 8g: (2); 8h: (1); 16i: (3)
8	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (1); 8g: (2); 8h: (1); 16i: (3)
9	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (0); 4e: (0); 8f: (1); 8g: (1); 8h: (1); 16i: (3)
10	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (2); 4e: (2); 8f: (4); 8g: (3); 8h: (4); 16i: (6)

$M\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 128

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (0); 4e: (1); 8f: (1); 8g: (1); 8h: (2); 16i: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (1); 4e: (1); 8f: (1); 8g: (2); 8h: (2); 16i: (3)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (2); 4e: (1); 8f: (4); 8g: (3); 8h: (2); 16i: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (1); 8g: (2); 8h: (1); 16i: (3)
5	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (0); 4e: (1); 8f: (1); 8g: (1); 8h: (1); 16i: (3)
6	(0, 0, 0)	2a: (0); 2b: (0); 4c: (4); 4d: (2); 4e: (1); 8f: (4); 8g: (3); 8h: (4); 16i: (6)

$Z\left(0, 0, \frac{1}{2}\right)$ of space group No. 128

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (4); 8g: (3); 8h: (3); 16i: (6)

$A\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 128

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (0); 4c: (2); 4d: (2); 4e: (1); 8f: (4); 8g: (3); 8h: (3); 16i: (6)
2	(0, 0, 0)	2a: (0); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (4); 8g: (3); 8h: (3); 16i: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)

$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 128

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	(0, 0, 0)	2a: (3); 2b: (0); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

$X\left(0, \frac{1}{2}, 0\right)$ of space group No. 128

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (4); 16i: (12)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

$S(u, u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
$SM(u, u, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
$T(u, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$
$U(0, v, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT (0, v, 0) of space group No. 128

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (4); 16i: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (4); 16i: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (8); 16i: (12)

LD (0, 0, w) of space group No. 128

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (4); 8f: (8); 8g: (6); 8h: (6); 16i: (12)

S ($u, u, \frac{1}{2}$) of space group No. 128

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 16i: (24)
SM ($u, u, 0$) of space group No. 128		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (2); 4e: (3); 8f: (6); 8g: (5); 8h: (8); 16i: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (3); 8f: (6); 8g: (5); 8h: (4); 16i: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (3); 8f: (6); 8g: (7); 8h: (8); 16i: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (4); 4e: (3); 8f: (6); 8g: (7); 8h: (4); 16i: (12)
T ($u, \frac{1}{2}, \frac{1}{2}$) of space group No. 128		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 16i: (24)
U ($0, v, \frac{1}{2}$) of space group No. 128		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 16i: (24)
V ($\frac{1}{2}, \frac{1}{2}, w$) of space group No. 128		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (4); 4d: (4); 4e: (2); 8f: (8); 8g: (6); 8h: (6); 16i: (12)
W ($0, \frac{1}{2}, w$) of space group No. 128		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 16i: (24)
Y ($u, \frac{1}{2}, 0$) of space group No. 128		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (4); 16i: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate ($u, v, \frac{1}{2}$)

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate ($0, u, v$) ($-u, 0, v$)

$P4(u, u, v)$		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
$P5(u, \frac{1}{2}, v)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 128									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (4);	2b: (4);	4c: (8);	4d: (6);	4e: (6);	8f: (12);	8g: (12);	8h: (16); 16i: (24)
2	(0, 0, 0)	2a: (2);	2b: (2);	4c: (4);	4d: (6);	4e: (6);	8f: (12);	8g: (12);	8h: (8); 16i: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 128									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	8f: (12);	8g: (12);	8h: (12); 16i: (24)
2	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	8f: (12);	8g: (12);	8h: (12); 16i: (24)
P3 (0, u, v) of space group No. 128									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	8f: (12);	8g: (12);	8h: (12); 16i: (24)
2	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	8f: (12);	8g: (12);	8h: (12); 16i: (24)
P4 (u, u, v) of space group No. 128									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	8f: (12);	8g: (12);	8h: (12); 16i: (24)
2	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	8f: (12);	8g: (12);	8h: (12); 16i: (24)
P5 ($u, \frac{1}{2}, v$) of space group No. 128									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (3);	2b: (3);	4c: (6);	4d: (6);	4e: (6);	8f: (12);	8g: (12);	8h: (12); 16i: (24)

129. Space group No. 129 ($P4/nmm$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

b. Results for high-symmetry points

$\{E 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{4z}^+ -\frac{1}{2},\frac{1}{2},0\}$	$\{C_{4z}^- -\frac{1}{2},-\frac{1}{2},0\}$	$\{C_{2x} \frac{1}{2},\frac{1}{2},0\}$	$\{C_{2y} -\frac{1}{2},-\frac{1}{2},0\}$	$\{C_{2a} 0,0,0\}$	$\{C_{2b} 0,0,0\}$
$\{I -\frac{1}{2},\frac{1}{2},0\}$	$\{\sigma_z -\frac{1}{2},-\frac{1}{2},0\}$	$\{S_{4z}^- 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$	$\{\sigma_x 0,0,0\}$	$\{\sigma_y 0,0,0\}$	$\{\sigma_{da} -\frac{1}{2},-\frac{1}{2},0\}$	$\{\sigma_{db} -\frac{1}{2},\frac{1}{2},0\}$

 $\Gamma(0,0,0)$

Operation E
Coordinate (0,0,0)

 $M(\frac{1}{2},\frac{1}{2},0)$

Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},0)$

 $Z(0,0,\frac{1}{2})$

Operation E
Coordinate $(0,0,\frac{1}{2})$

 $A(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

 $R(0,\frac{1}{2},\frac{1}{2})$

Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,\frac{1}{2})$

 $X(0,\frac{1}{2},0)$

Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

 $\Gamma(0,0,0)$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information									
1	(0,0,0)	2a: (0);	2b: (0);	2c: (1);	4d: (0);	4e: (0);	4f: (1);	8g: (1);	8h: (1);	8i: (2);	8j: (2); 16k: (3)
2	(0,0,0)	2a: (0);	2b: (0);	2c: (0);	4d: (0);	4e: (0);	4f: (0);	8g: (2);	8h: (2);	8i: (1);	8j: (1); 16k: (3)
3	(0,0,0)	2a: (1);	2b: (1);	2c: (0);	4d: (0);	4e: (0);	4f: (1);	8g: (2);	8h: (2);	8i: (2);	8j: (1); 16k: (3)
4	(0,0,0)	2a: (0);	2b: (0);	2c: (0);	4d: (0);	4e: (0);	4f: (0);	8g: (1);	8h: (1);	8i: (1);	8j: (2); 16k: (3)
5	(0,0,0)	2a: (1);	2b: (1);	2c: (1);	4d: (0);	4e: (0);	4f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (3); 16k: (6)
6	(0,0,0)	2a: (0);	2b: (0);	2c: (0);	4d: (1);	4e: (1);	4f: (0);	8g: (1);	8h: (1);	8i: (1);	8j: (1); 16k: (3)
7	(0,0,0)	2a: (1);	2b: (1);	2c: (1);	4d: (2);	4e: (2);	4f: (1);	8g: (2);	8h: (2);	8i: (2);	8j: (2); 16k: (3)
8	(0,0,0)	2a: (0);	2b: (0);	2c: (0);	4d: (2);	4e: (2);	4f: (0);	8g: (2);	8h: (2);	8i: (1);	8j: (2); 16k: (3)
9	(0,0,0)	2a: (0);	2b: (0);	2c: (0);	4d: (1);	4e: (1);	4f: (1);	8g: (1);	8h: (1);	8i: (2);	8j: (1); 16k: (3)
10	(0,0,0)	2a: (1);	2b: (1);	2c: (1);	4d: (3);	4e: (3);	4f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (3); 16k: (6)

 $M(\frac{1}{2},\frac{1}{2},0)$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (2);	4e: (2);	4f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (4); 16k: (6)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	4d: (1);	4e: (1);	4f: (1);	8g: (2);	8h: (2);	8i: (3);	8j: (3); 16k: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	4d: (1);	4e: (1);	4f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (2); 16k: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (2);	4e: (2);	4f: (1);	8g: (4);	8h: (4);	8i: (3);	8j: (3); 16k: (6)
$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 129											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	4d: (0);	4e: (2);	4f: (1);	8g: (1);	8h: (2);	8i: (2);	8j: (2); 16k: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	4d: (0);	4e: (1);	4f: (0);	8g: (2);	8h: (1);	8i: (1);	8j: (1); 16k: (3)
3	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0);	4d: (0);	4e: (1);	4f: (1);	8g: (2);	8h: (1);	8i: (2);	8j: (1); 16k: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	4d: (0);	4e: (2);	4f: (0);	8g: (1);	8h: (2);	8i: (1);	8j: (2); 16k: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (0);	4e: (3);	4f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (3); 16k: (6)
6	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	4d: (1);	4e: (0);	4f: (0);	8g: (1);	8h: (2);	8i: (1);	8j: (1); 16k: (3)
7	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	4d: (2);	4e: (0);	4f: (1);	8g: (2);	8h: (1);	8i: (2);	8j: (2); 16k: (3)
8	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	4d: (2);	4e: (0);	4f: (0);	8g: (2);	8h: (1);	8i: (1);	8j: (2); 16k: (3)
9	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0);	4d: (1);	4e: (0);	4f: (1);	8g: (1);	8h: (2);	8i: (2);	8j: (1); 16k: (3)
10	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (3);	4e: (0);	4f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (3); 16k: (6)
$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 129											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (2);	4e: (2);	4f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (4); 16k: (6)
2	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	4d: (1);	4e: (2);	4f: (1);	8g: (2);	8h: (4);	8i: (3);	8j: (3); 16k: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	4d: (1);	4e: (1);	4f: (2);	8g: (3);	8h: (3);	8i: (3);	8j: (2); 16k: (6)
4	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	4d: (2);	4e: (1);	4f: (1);	8g: (4);	8h: (2);	8i: (3);	8j: (3); 16k: (6)
$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 129											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	4d: (3);	4e: (3);	4f: (4);	8g: (6);	8h: (6);	8i: (7);	8j: (6); 16k: (12)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (3);	4e: (3);	4f: (2);	8g: (6);	8h: (6);	8i: (5);	8j: (6); 16k: (12)
$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 129											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	4d: (3);	4e: (3);	4f: (4);	8g: (6);	8h: (6);	8i: (7);	8j: (6); 16k: (12)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	4d: (3);	4e: (3);	4f: (2);	8g: (6);	8h: (6);	8i: (5);	8j: (6); 16k: (12)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E

Coordinate	(0, 0, w)	
S(u, u, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, u, 0)		
Operation	E	C_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T(u, $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u, $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u, $\frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}$, $\frac{1}{2}$, w)		
Operation	E	
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	
W(0, $\frac{1}{2}$, w)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}$, w)	($-\frac{1}{2}$, 0, w)
Y(u, $\frac{1}{2}$, 0)		
Operation	E	C_{4z}^+
Coordinate	(u, $\frac{1}{2}$, 0)	($-\frac{1}{2}$, u, 0)

DT $(0, v, 0)$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information										
1	$(0, 0, 0)$	2a: (2);	2b: (2);	2c: (2);	4d: (3);	4e: (3);	4f: (4);	8g: (6);	8h: (6);	8i: (7);	8j: (6);	16k: (12)
2	$(0, 0, 0)$	2a: (1);	2b: (1);	2c: (1);	4d: (3);	4e: (3);	4f: (2);	8g: (6);	8h: (6);	8i: (5);	8j: (6);	16k: (12)
3	$(0, 0, 0)$	2a: (2);	2b: (2);	2c: (2);	4d: (3);	4e: (3);	4f: (4);	8g: (6);	8h: (6);	8i: (7);	8j: (6);	16k: (12)
4	$(0, 0, 0)$	2a: (1);	2b: (1);	2c: (1);	4d: (3);	4e: (3);	4f: (2);	8g: (6);	8h: (6);	8i: (5);	8j: (6);	16k: (12)

LD $(0, 0, w)$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information										
1	$(0, 0, 0)$	2a: (1);	2b: (1);	2c: (2);	4d: (2);	4e: (2);	4f: (2);	8g: (3);	8h: (3);	8i: (4);	8j: (4);	16k: (6)
2	$(0, 0, 0)$	2a: (0);	2b: (0);	2c: (0);	4d: (1);	4e: (1);	4f: (0);	8g: (3);	8h: (3);	8i: (2);	8j: (2);	16k: (6)
3	$(0, 0, 0)$	2a: (1);	2b: (1);	2c: (0);	4d: (1);	4e: (1);	4f: (2);	8g: (3);	8h: (3);	8i: (4);	8j: (2);	16k: (6)
4	$(0, 0, 0)$	2a: (0);	2b: (0);	2c: (0);	4d: (2);	4e: (2);	4f: (0);	8g: (3);	8h: (3);	8i: (2);	8j: (4);	16k: (6)
5	$(0, 0, 0)$	2a: (2);	2b: (2);	2c: (2);	4d: (3);	4e: (3);	4f: (4);	8g: (6);	8h: (6);	8i: (6);	8j: (6);	16k: (12)

S $(u, u, \frac{1}{2})$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 4d: (3); 4e: (4); 4f: (3); 8g: (5); 8h: (7); 8i: (6); 8j: (7); 16k: (12)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 4d: (2); 4e: (3); 4f: (3); 8g: (5); 8h: (7); 8i: (6); 8j: (5); 16k: (12)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 4d: (3); 4e: (2); 4f: (3); 8g: (7); 8h: (5); 8i: (6); 8j: (5); 16k: (12)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 4d: (4); 4e: (3); 4f: (3); 8g: (7); 8h: (5); 8i: (6); 8j: (7); 16k: (12)

SM $(u, u, 0)$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (3); 8g: (5); 8h: (5); 8i: (6); 8j: (7); 16k: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (2); 4e: (2); 4f: (3); 8g: (5); 8h: (5); 8i: (6); 8j: (5); 16k: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 4d: (3); 4e: (3); 4f: (3); 8g: (7); 8h: (7); 8i: (6); 8j: (5); 16k: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (4); 4e: (4); 4f: (3); 8g: (7); 8h: (7); 8i: (6); 8j: (7); 16k: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

U $(0, v, \frac{1}{2})$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3); 4e: (3); 4f: (4); 8g: (6); 8h: (6); 8i: (7); 8j: (6); 16k: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3); 4e: (3); 4f: (2); 8g: (6); 8h: (6); 8i: (5); 8j: (6); 16k: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3); 4e: (3); 4f: (4); 8g: (6); 8h: (6); 8i: (7); 8j: (6); 16k: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3); 4e: (3); 4f: (2); 8g: (6); 8h: (6); 8i: (5); 8j: (6); 16k: (12)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (2); 4e: (2); 4f: (2); 8g: (3); 8h: (3); 8i: (3); 8j: (4); 16k: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 4d: (1); 4e: (1); 4f: (2); 8g: (3); 8h: (3); 8i: (3); 8j: (2); 16k: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 4d: (3); 4e: (3); 4f: (2); 8g: (6); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

W $(0, \frac{1}{2}, w)$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (3); 4e: (3); 4f: (4); 8g: (6); 8h: (6); 8i: (7); 8j: (6); 16k: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 4d: (3); 4e: (3); 4f: (2); 8g: (6); 8h: (6); 8i: (5); 8j: (6); 16k: (12)

Y $(u, \frac{1}{2}, 0)$ of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

d. Results for high-symmetry planes

$$\text{Pl}(u, v, 0)$$

Operation	E
Coordinate	$(u, v, 0)$
P2($u, v, \frac{1}{2}$)	
Operation	E
Coordinate	$(u, v, \frac{1}{2})$
P3(0, u, v)	
Operation	E C_{4z}^+
Coordinate	(0, u, v) $(-u, 0, v)$
P4(u, u, v)	
Operation	E C_{4z}^+
Coordinate	(u, u, v) $(-u, u, v)$
P5($u, \frac{1}{2}, v$)	
Operation	E C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$ $(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

P2 ($u, v, \frac{1}{2}$) of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

P3 (0, u, v) of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 4d: (6); 4e: (6); 4f: (8); 8g: (12); 8h: (12); 8i: (14); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 4d: (6); 4e: (6); 4f: (4); 8g: (12); 8h: (12); 8i: (10); 8j: (12); 16k: (24)

P4 (u, u, v) of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (4); 4d: (7); 4e: (7); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 8j: (14); 16k: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (2); 4d: (5); 4e: (5); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 8j: (10); 16k: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 129

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 4d: (6); 4e: (6); 4f: (6); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

130. Space group No. 130 ($P4/ncc$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}\{E|0, 0, 0\} & \quad \{C_{2z}|0, 0, 0\} & \quad \{C_{4z}^+|-\frac{1}{2}, \frac{1}{2}, 0\} & \quad \{C_{4z}^-|-\frac{1}{2}, -\frac{1}{2}, 0\} & \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} & \quad \{C_{2y}|-\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\} & \quad \{C_{2a}|0, 0, -\frac{1}{2}\} & \quad \{C_{2b}|0, 0, -\frac{1}{2}\} \\ \{I|-\frac{1}{2}, \frac{1}{2}, 0\} & \quad \{\sigma_z|-\frac{1}{2}, -\frac{1}{2}, 0\} & \quad \{S_{4z}^-|0, 0, 0\} & \quad \{S_{4z}^+|0, 0, 0\} & \quad \{\sigma_x|0, 0, -\frac{1}{2}\} & \quad \{\sigma_y|0, 0, -\frac{1}{2}\} & \quad \{\sigma_{da}|-\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\} & \quad \{\sigma_{db}|-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}\end{aligned}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})\end{array}$$

$$R(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) & (-\frac{1}{2}, 0, \frac{1}{2})\end{array}$$

$$X(0, \frac{1}{2}, 0)$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, 0) & (-\frac{1}{2}, 0, 0)\end{array}$$

 Γ (0, 0, 0) of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 8d: (0); 8e: (1); 8f: (1); 16g: (3)
2	(0, 0, 0)	4a: (1); 4b: (0); 4c: (1); 8d: (0); 8e: (1); 8f: (2); 16g: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 8d: (0); 8e: (1); 8f: (2); 16g: (3)
4	(0, 0, 0)	4a: (0); 4b: (1); 4c: (0); 8d: (0); 8e: (1); 8f: (1); 16g: (3)
5	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (0); 8e: (4); 8f: (3); 16g: (6)
6	(0, 0, 0)	4a: (0); 4b: (1); 4c: (1); 8d: (3); 8e: (1); 8f: (1); 16g: (3)
7	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 8d: (3); 8e: (1); 8f: (2); 16g: (3)
8	(0, 0, 0)	4a: (1); 4b: (0); 4c: (0); 8d: (3); 8e: (1); 8f: (2); 16g: (3)
9	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 8d: (3); 8e: (1); 8f: (1); 16g: (3)
10	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (6); 8e: (4); 8f: (3); 16g: (6)

 M ($\frac{1}{2}, \frac{1}{2}, 0$) of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 8d: (3); 8e: (4); 8f: (3); 16g: (6)
2	(0, 0, 0)	4a: (0); 4b: (1); 4c: (2); 8d: (3); 8e: (2); 8f: (2); 16g: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 8d: (3); 8e: (4); 8f: (3); 16g: (6)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 8d: (3); 8e: (2); 8f: (4); 16g: (6)

 Z ($0, 0, \frac{1}{2}$) of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 8d: (3); 8e: (2); 8f: (3); 16g: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 8d: (3); 8e: (2); 8f: (3); 16g: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 8d: (3); 8e: (4); 8f: (3); 16g: (6)

 A ($\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$) of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 8d: (3); 8e: (4); 8f: (3); 16g: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 8d: (3); 8e: (2); 8f: (3); 16g: (6)

 R ($0, \frac{1}{2}, \frac{1}{2}$) of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 16g: (12)

 X ($0, \frac{1}{2}, 0$) of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 16g: (12)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S($u, u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, \frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM($u, u, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, u, 0$)	(-u, u, 0)
T($u, \frac{1}{2}, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, \frac{1}{2}$)	($-\frac{1}{2}, u, \frac{1}{2}$)
U($0, v, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($0, v, \frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}, \frac{1}{2}, w$)		
Operation	E	
Coordinate	($\frac{1}{2}, \frac{1}{2}, w$)	
W($0, \frac{1}{2}, w$)		
Operation	E	C_{4z}^+
Coordinate	($0, \frac{1}{2}, w$)	($-\frac{1}{2}, 0, w$)
Y($u, \frac{1}{2}, 0$)		
Operation	E	C_{4z}^+
Coordinate	($u, \frac{1}{2}, 0$)	($-\frac{1}{2}, u, 0$)

DT (0, v, 0) of space group No. 130						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	8d: (6); 8e: (6);	8f: (6); 16g: (12)
2	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	8d: (6); 8e: (6);	8f: (6); 16g: (12)
3	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	8d: (6); 8e: (6);	8f: (6); 16g: (12)
4	(0, 0, 0)	4a: (3);	4b: (3);	4c: (3);	8d: (6); 8e: (6);	8f: (6); 16g: (12)
LD (0, 0, w) of space group No. 130						
(Co-) irrep	Phonon AM	WYPO information				

1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 8d: (3); 8e: (2); 8f: (3); 16g: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 8d: (3); 8e: (2); 8f: (3); 16g: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 8d: (3); 8e: (2); 8f: (3); 16g: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 8d: (3); 8e: (2); 8f: (3); 16g: (6)
5	(0, 0, 0)	4a: (4); 4b: (4); 4c: (4); 8d: (6); 8e: (8); 8f: (6); 16g: (12)

$S(u, u, \frac{1}{2})$ of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12); 8e: (12); 8f: (12); 16g: (24)

$SM(u, u, 0)$ of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (5); 16g: (12)
2	(0, 0, 0)	4a: (2); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (5); 16g: (12)
3	(0, 0, 0)	4a: (4); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (7); 16g: (12)
4	(0, 0, 0)	4a: (4); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (7); 16g: (12)

$T(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 16g: (12)

$U(0, v, \frac{1}{2})$ of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12); 8e: (12); 8f: (12); 16g: (24)

$V(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 8d: (3); 8e: (4); 8f: (3); 16g: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 8d: (3); 8e: (4); 8f: (3); 16g: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (4); 8d: (6); 8e: (4); 8f: (6); 16g: (12)

$W(0, \frac{1}{2}, w)$ of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 16g: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 8d: (6); 8e: (6); 8f: (6); 16g: (12)

$Y(u, \frac{1}{2}, 0)$ of space group No. 130

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 8d: (12); 8e: (12); 8f: (12); 16g: (24)

d. Results for high-symmetry planes

$Pl(u, v, 0)$

Operation	E
Coordinate	$(u, v, 0)$
P2($u, v, \frac{1}{2}$)	
Operation	E
Coordinate	$(u, v, \frac{1}{2})$
P3(0, u, v)	
Operation	E C_{4z}^+
Coordinate	$(0, u, v)$ $(-u, 0, v)$
P4(u, u, v)	
Operation	E C_{4z}^+
Coordinate	(u, u, v) $(-u, u, v)$
P5($u, \frac{1}{2}, v$)	
Operation	E C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$ $(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 130						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6);	8d: (12);	8e: (12); 8f: (12); 16g: (24)
2	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6);	8d: (12);	8e: (12); 8f: (12); 16g: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 130						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6);	8d: (12);	8e: (12); 8f: (12); 16g: (24)
2	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6);	8d: (12);	8e: (12); 8f: (12); 16g: (24)
P3 (0, u, v) of space group No. 130						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6);	8d: (12);	8e: (12); 8f: (12); 16g: (24)
2	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6);	8d: (12);	8e: (12); 8f: (12); 16g: (24)
P4 (u, u, v) of space group No. 130						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6);	8d: (12);	8e: (12); 8f: (12); 16g: (24)
2	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6);	8d: (12);	8e: (12); 8f: (12); 16g: (24)
P5 ($u, \frac{1}{2}, v$) of space group No. 130						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (6);	4b: (6);	4c: (6);	8d: (12);	8e: (12); 8f: (12); 16g: (24)

131. Space group No. 131 ($P4_2/mmc$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, \tfrac{1}{2}\} \quad \{C_{4z}^-|0, 0, \tfrac{1}{2}\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2a}|0, 0, \tfrac{1}{2}\} \quad \{C_{2b}|0, 0, \tfrac{1}{2}\} \\ \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{S_{4z}^-|0, 0, \tfrac{1}{2}\} \quad \{S_{4z}^+|0, 0, \tfrac{1}{2}\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_{da}|0, 0, \tfrac{1}{2}\} \quad \{\sigma_{db}|0, 0, \tfrac{1}{2}\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate (0, 0, 0)
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$
Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$

Γ (0, 0, 0) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (0); 8n: (1);	2d: (0); 8o: (2);	2e: (0); 8p: (2);	2f: (0); 8q: (2);	4g: (1); 16r: (3)	4h: (1);	4i: (1); 4j: (1);	4k: (1);
2	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (0); 8n: (2);	2d: (0); 8o: (1);	2e: (0); 8p: (1);	2f: (0); 8q: (2);	4g: (0); 16r: (3)	4h: (0);	4i: (0); 4j: (1);	4k: (1);
3	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (0); 8n: (2);	2d: (0); 8o: (2);	2e: (1); 8p: (2);	2f: (1); 8q: (2);	4g: (1); 16r: (3)	4h: (1);	4i: (1); 4j: (1);	4k: (1);
4	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (0); 8n: (1);	2d: (0); 8o: (1);	2e: (0); 8p: (1);	2f: (0); 8q: (2);	4g: (0); 16r: (3)	4h: (0);	4i: (0); 4j: (1);	4k: (1);
5	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (0); 8n: (3);	2d: (0); 8o: (3);	2e: (1); 8p: (3);	2f: (1); 8q: (2);	4g: (2); 16r: (6)	4h: (2);	4i: (2); 4j: (1);	4k: (1);
6	(0, 0, 0)	2a: (0); 4l: (0);	2b: (0); 4m: (0);	2c: (0); 8n: (1);	2d: (0); 8o: (1);	2e: (0); 8p: (1);	2f: (0); 8q: (1);	4g: (0); 16r: (3)	4h: (0);	4i: (0); 4j: (0);	4k: (0);
7	(0, 0, 0)	2a: (1); 4l: (1);	2b: (1); 4m: (1);	2c: (1); 8n: (2);	2d: (1); 8o: (2);	2e: (1); 8p: (2);	2f: (1); 8q: (1);	4g: (1); 16r: (3)	4h: (1);	4i: (1); 4j: (1);	4k: (1);
8	(0, 0, 0)	2a: (0); 4l: (0);	2b: (0); 4m: (0);	2c: (0); 8n: (2);	2d: (0); 8o: (1);	2e: (0); 8p: (1);	2f: (0); 8q: (1);	4g: (0); 16r: (3)	4h: (0);	4i: (0); 4j: (0);	4k: (0);
9	(0, 0, 0)	2a: (1); 4l: (1);	2b: (1); 4m: (1);	2c: (1); 8n: (1);	2d: (1); 8o: (2);	2e: (0); 8p: (2);	2f: (0); 8q: (1);	4g: (1); 16r: (3)	4h: (1);	4i: (1); 4j: (1);	4k: (1);
10	(0, 0, 0)	2a: (2); 4l: (2);	2b: (2); 4m: (2);	2c: (2); 8n: (3);	2d: (2); 8o: (3);	2e: (1); 8p: (3);	2f: (1); 8q: (4);	4g: (2); 16r: (6)	4h: (2);	4i: (2); 4j: (2);	4k: (2);

 $M \left(\frac{1}{2}, \frac{1}{2}, 0 \right)$ of space group No. 131

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (1); 8n: (1);	2d: (1); 8o: (2);	2e: (0); 8p: (1);	2f: (0); 8q: (2);	4g: (1); 16r: (3)	4h: (0);	4i: (1); 4j: (1);	4k: (1);
2	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (1); 8n: (2);	2d: (1); 8o: (1);	2e: (0); 8p: (2);	2f: (1); 8q: (2);	4g: (0); 16r: (3)	4h: (1);	4i: (1); 4j: (1);	4k: (1);
3	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (1); 8n: (2);	2d: (1); 8o: (2);	2e: (1); 8p: (1);	2f: (0); 8q: (2);	4g: (1); 16r: (3)	4h: (0);	4i: (1); 4j: (1);	4k: (1);
4	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (1); 8n: (1);	2d: (1); 8o: (1);	2e: (0); 8p: (2);	2f: (0); 8q: (2);	4g: (0); 16r: (3)	4h: (1);	4i: (1); 4j: (1);	4k: (1);
5	(0, 0, 0)	2a: (0); 4l: (1);	2b: (0); 4m: (1);	2c: (1); 8n: (3);	2d: (1); 8o: (3);	2e: (1); 8p: (3);	2f: (1); 8q: (2);	4g: (2); 16r: (6)	4h: (2);	4i: (1); 4j: (1);	4k: (1);
6	(0, 0, 0)	2a: (0); 4l: (0);	2b: (1); 4m: (1);	2c: (0); 8n: (1);	2d: (0); 8o: (1);	2e: (0); 8p: (2);	2f: (0); 8q: (1);	4g: (0); 16r: (3)	4h: (1);	4i: (1); 4j: (0);	4k: (1);
7	(0, 0, 0)	2a: (1); 4l: (1);	2b: (0); 4m: (0);	2c: (0); 8n: (2);	2d: (0); 8o: (2);	2e: (1); 8p: (1);	2f: (0); 8q: (1);	4g: (1); 16r: (3)	4h: (0);	4i: (1); 4j: (1);	4k: (0);
8	(0, 0, 0)	2a: (0); 4l: (0);	2b: (1); 4m: (1);	2c: (0); 8n: (2);	2d: (0); 8o: (1);	2e: (0); 8p: (2);	2f: (1); 8q: (1);	4g: (0); 16r: (3)	4h: (1);	4i: (1); 4j: (0);	4k: (1);
9	(0, 0, 0)	2a: (1); 4l: (1);	2b: (0); 4m: (0);	2c: (0); 8n: (1);	2d: (0); 8o: (2);	2e: (0); 8p: (1);	2f: (0); 8q: (1);	4g: (1); 16r: (3)	4h: (0);	4i: (1); 4j: (1);	4k: (0);
10	(0, 0, 0)	2a: (2); 4l: (2);	2b: (2); 4m: (2);	2c: (0); 8n: (3);	2d: (0); 8o: (3);	2e: (1); 8p: (3);	2f: (1); 8q: (4);	4g: (2); 16r: (6)	4h: (2);	4i: (1); 4j: (2);	4k: (2);

 $Z \left(0, 0, \frac{1}{2} \right)$ of space group No. 131

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1); 4l: (1);	2b: (1); 4m: (2);	2c: (1); 8n: (3);	2d: (1); 8o: (3);	2e: (1); 8p: (3);	2f: (1); 8q: (3);	4g: (2); 16r: (6)	4h: (2);	4i: (2); 4j: (2);	4k: (1);

2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (0); 2f: (0); 4g: (0); 4h: (0); 4i: (0); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 8n: (3); 8o: (2); 8p: (2); 8q: (3); 16r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (2); 4m: (1); 8n: (3); 8o: (3); 8p: (3); 8q: (3); 16r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (3); 8o: (4); 8p: (4); 8q: (3); 16r: (6)

$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (1); 4j: (2); 4k: (2); 4l: (1); 4m: (1); 8n: (3); 8o: (3); 8p: (3); 8q: (3); 16r: (6)
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 2e: (0); 2f: (1); 4g: (0); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 8n: (3); 8o: (2); 8p: (4); 8q: (3); 16r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 4k: (1); 4l: (2); 4m: (2); 8n: (3); 8o: (3); 8p: (3); 8q: (3); 16r: (6)
4	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (0); 4g: (2); 4h: (0); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 8n: (3); 8o: (4); 8p: (2); 8q: (3); 16r: (6)

$R \left(0, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 4m: (2); 8n: (3); 8o: (4); 8p: (3); 8q: (3); 16r: (6)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 2e: (1); 2f: (0); 4g: (2); 4h: (0); 4i: (1); 4j: (2); 4k: (1); 4l: (1); 4m: (1); 8n: (3); 8o: (3); 8p: (2); 8q: (3); 16r: (6)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (0); 2e: (0); 2f: (1); 4g: (0); 4h: (2); 4i: (1); 4j: (1); 4k: (2); 4l: (1); 4m: (1); 8n: (3); 8o: (2); 8p: (3); 8q: (3); 16r: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (2); 4m: (2); 8n: (3); 8o: (3); 8p: (4); 8q: (3); 16r: (6)
5	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 2e: (0); 2f: (1); 4g: (0); 4h: (2); 4i: (1); 4j: (1); 4k: (1); 4l: (1); 4m: (2); 8n: (3); 8o: (2); 8p: (3); 8q: (3); 16r: (6)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (2); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (1); 4m: (2); 8n: (3); 8o: (3); 8p: (4); 8q: (3); 16r: (6)
7	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (2); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (1); 8n: (3); 8o: (4); 8p: (3); 8q: (3); 16r: (6)
8	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (1); 2e: (1); 2f: (0); 4g: (2); 4h: (0); 4i: (1); 4j: (1); 4k: (1); 4l: (2); 4m: (1); 8n: (3); 8o: (3); 8p: (2); 8q: (3); 16r: (6)

$X \left(0, \frac{1}{2}, 0 \right)$ of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (2); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (3); 8o: (4); 8p: (3); 8q: (4); 16r: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (1); 2f: (0); 4g: (2); 4h: (0); 4i: (1); 4j: (1); 4k: (0); 4l: (1); 4m: (0); 8n: (3); 8o: (3); 8p: (2); 8q: (2); 16r: (6)
3	(0, 0, 0)	2a: (0); 2b: (2); 2c: (1); 2d: (1); 2e: (0); 2f: (1); 4g: (0); 4h: (2); 4i: (1); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (3); 8o: (2); 8p: (3); 8q: (4); 16r: (6)
4	(0, 0, 0)	2a: (0); 2b: (2); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 4k: (2); 4l: (1); 4m: (2); 8n: (3); 8o: (3); 8p: (4); 8q: (2); 16r: (6)
5	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (0); 2f: (1); 4g: (0); 4h: (2); 4i: (1); 4j: (0); 4k: (1); 4l: (0); 4m: (1); 8n: (3); 8o: (2); 8p: (3); 8q: (2); 16r: (6)
6	(0, 0, 0)	2a: (2); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (3); 8o: (3); 8p: (4); 8q: (4); 16r: (6)

7	(0, 0, 0)	2a: (2); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (1); 4l: (2); 4m: (1); 8n: (3); 8o: (4); 8p: (3); 8q: (2); 16r: (6)
8	(0, 0, 0)	2a: (2); 2b: (0); 2c: (1); 2d: (1); 2e: (1); 2f: (0); 4g: (2); 4h: (0); 4i: (1); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (3); 8o: (3); 8p: (2); 8q: (4); 16r: (6)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

S(u , u , $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)

SM(u , u , 0)

Operation	E	C_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)

T(u , $\frac{1}{2}$, $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $\frac{1}{2}$)

U(0, v , $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(0, v , $\frac{1}{2}$)	($-v$, 0, $\frac{1}{2}$)

V($\frac{1}{2}$, $\frac{1}{2}$, w)

Operation	E
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)

W(0, $\frac{1}{2}$, w)

Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}$, w)	($-\frac{1}{2}$, 0, w)

Y(u , $\frac{1}{2}$, 0)

Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, 0)	($-\frac{1}{2}$, u , 0)

DT (0, v , 0) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (4); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 8n: (6); 8o: (7); 8p: (7); 8q: (8); 16r: (12)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 8n: (6); 8o: (5); 8p: (5); 8q: (4); 16r: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 8n: (6); 8o: (7); 8p: (7); 8q: (4); 16r: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 8n: (6); 8o: (5); 8p: (5); 8q: (8); 16r: (12)

LD (0, 0, w) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (3); 8o: (4); 8p: (4); 8q: (3); 16r: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (0); 2f: (0); 4g: (0); 4h: (0); 4i: (0); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 8n: (3); 8o: (2); 8p: (2); 8q: (3); 16r: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (3); 8o: (4); 8p: (4); 8q: (3); 16r: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (0); 2f: (0); 4g: (0); 4h: (0); 4i: (0); 4j: (1); 4k: (1); 4l: (1); 4m: (1); 8n: (3); 8o: (2); 8p: (2); 8q: (3); 16r: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (4); 4j: (3); 4k: (3); 4l: (3); 4m: (3); 8n: (6); 8o: (6); 8p: (6); 8q: (6); 16r: (12)

S ($u, u, \frac{1}{2}$) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12); 8o: (12); 8p: (12); 8q: (12); 16r: (24)

SM ($u, u, 0$) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 8n: (5); 8o: (6); 8p: (6); 8q: (8); 16r: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (5); 8o: (6); 8p: (6); 8q: (4); 16r: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 8n: (7); 8o: (6); 8p: (6); 8q: (8); 16r: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (3); 4j: (2); 4k: (2); 4l: (2); 4m: (2); 8n: (7); 8o: (6); 8p: (6); 8q: (4); 16r: (12)

T ($u, \frac{1}{2}, \frac{1}{2}$) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (1); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 4k: (2); 4l: (4); 4m: (3); 8n: (6); 8o: (7); 8p: (5); 8q: (6); 16r: (12)
2	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (1); 2e: (1); 2f: (2); 4g: (2); 4h: (4); 4i: (3); 4j: (2); 4k: (3); 4l: (3); 4m: (4); 8n: (6); 8o: (5); 8p: (7); 8q: (6); 16r: (12)
3	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 4k: (4); 4l: (2); 4m: (3); 8n: (6); 8o: (5); 8p: (7); 8q: (6); 16r: (12)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (2); 2e: (2); 2f: (1); 4g: (4); 4h: (2); 4i: (3); 4j: (4); 4k: (3); 4l: (3); 4m: (2); 8n: (6); 8o: (7); 8p: (5); 8q: (6); 16r: (12)

U ($0, v, \frac{1}{2}$) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information											
1	(0, 0, 0)	2a: (2); 4l: (3);	2b: (2); 4m: (4);	2c: (2); 8n: (6);	2d: (2); 8o: (7);	2e: (2); 8p: (7);	2f: (2); 8q: (6);	4g: (4); 16r: (12)	4h: (4);	4i: (4);	4j: (4);	4k: (3);	
2	(0, 0, 0)	2a: (1); 4l: (2);	2b: (1); 4m: (3);	2c: (1); 8n: (6);	2d: (1); 8o: (5);	2e: (1); 8p: (5);	2f: (1); 8q: (6);	4g: (2); 16r: (12)	4h: (2);	4i: (2);	4j: (3);	4k: (2);	
3	(0, 0, 0)	2a: (2); 4l: (4);	2b: (2); 4m: (3);	2c: (2); 8n: (6);	2d: (2); 8o: (7);	2e: (2); 8p: (7);	2f: (2); 8q: (6);	4g: (4); 16r: (12)	4h: (4);	4i: (4);	4j: (3);	4k: (4);	
4	(0, 0, 0)	2a: (1); 4l: (3);	2b: (1); 4m: (2);	2c: (1); 8n: (6);	2d: (1); 8o: (5);	2e: (1); 8p: (5);	2f: (1); 8q: (6);	4g: (2); 16r: (12)	4h: (2);	4i: (2);	4j: (2);	4k: (3);	
V $\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 131													
(Co-) irrep	Phonon AM	WYPO information											
1	(0, 0, 0)	2a: (1); 4l: (2);	2b: (0); 4m: (1);	2c: (1); 8n: (3);	2d: (1); 8o: (4);	2e: (1); 8p: (2);	2f: (0); 8q: (3);	4g: (2); 16r: (6)	4h: (0);	4i: (2);	4j: (2);	4k: (1);	
2	(0, 0, 0)	2a: (0); 4l: (1);	2b: (1); 4m: (2);	2c: (1); 8n: (3);	2d: (1); 8o: (2);	2e: (0); 8p: (4);	2f: (1); 8q: (3);	4g: (0); 16r: (6)	4h: (2);	4i: (2);	4j: (1);	4k: (2);	
3	(0, 0, 0)	2a: (1); 4l: (2);	2b: (0); 4m: (1);	2c: (1); 8n: (3);	2d: (1); 8o: (4);	2e: (1); 8p: (2);	2f: (0); 8q: (3);	4g: (2); 16r: (6)	4h: (0);	4i: (2);	4j: (2);	4k: (1);	
4	(0, 0, 0)	2a: (0); 4l: (1);	2b: (1); 4m: (2);	2c: (1); 8n: (3);	2d: (1); 8o: (2);	2e: (0); 8p: (4);	2f: (1); 8q: (3);	4g: (0); 16r: (6)	4h: (2);	4i: (2);	4j: (1);	4k: (2);	
5	(0, 0, 0)	2a: (2); 4l: (3);	2b: (2); 4m: (3);	2c: (1); 8n: (6);	2d: (1); 8o: (6);	2e: (2); 8p: (6);	2f: (2); 8q: (6);	4g: (4); 16r: (12)	4h: (4);	4i: (2);	4j: (3);	4k: (3);	
W $\left(0, \frac{1}{2}, w\right)$ of space group No. 131													
(Co-) irrep	Phonon AM	WYPO information											
1	(0, 0, 0)	2a: (2); 4l: (4);	2b: (2); 4m: (3);	2c: (2); 8n: (6);	2d: (2); 8o: (8);	2e: (2); 8p: (6);	2f: (2); 8q: (6);	4g: (4); 16r: (12)	4h: (4);	4i: (4);	4j: (4);	4k: (3);	
2	(0, 0, 0)	2a: (0); 4l: (2);	2b: (2); 4m: (3);	2c: (1); 8n: (6);	2d: (1); 8o: (4);	2e: (0); 8p: (6);	2f: (2); 8q: (6);	4g: (0); 16r: (12)	4h: (4);	4i: (2);	4j: (2);	4k: (3);	
3	(0, 0, 0)	2a: (2); 4l: (3);	2b: (0); 4m: (2);	2c: (1); 8n: (6);	2d: (1); 8o: (6);	2e: (2); 8p: (4);	2f: (0); 8q: (6);	4g: (4); 16r: (12)	4h: (0);	4i: (2);	4j: (3);	4k: (2);	
4	(0, 0, 0)	2a: (2); 4l: (3);	2b: (2); 4m: (4);	2c: (2); 8n: (6);	2d: (2); 8o: (6);	2e: (2); 8p: (8);	2f: (2); 8q: (6);	4g: (4); 16r: (12)	4h: (4);	4i: (4);	4j: (3);	4k: (4);	
Y $\left(u, \frac{1}{2}, 0\right)$ of space group No. 131													
(Co-) irrep	Phonon AM	WYPO information											
1	(0, 0, 0)	2a: (2); 4l: (4);	2b: (2); 4m: (4);	2c: (2); 8n: (6);	2d: (2); 8o: (7);	2e: (2); 8p: (5);	2f: (1); 8q: (8);	4g: (4); 16r: (12)	4h: (2);	4i: (3);	4j: (4);	4k: (4);	
2	(0, 0, 0)	2a: (0); 4l: (1);	2b: (2); 4m: (3);	2c: (1); 8n: (6);	2d: (1); 8o: (5);	2e: (1); 8p: (7);	2f: (2); 8q: (4);	4g: (2); 16r: (12)	4h: (4);	4i: (3);	4j: (1);	4k: (3);	
3	(0, 0, 0)	2a: (2); 4l: (4);	2b: (2); 4m: (4);	2c: (2); 8n: (6);	2d: (2); 8o: (5);	2e: (1); 8p: (7);	2f: (2); 8q: (8);	4g: (2); 16r: (12)	4h: (4);	4i: (3);	4j: (4);	4k: (4);	
4	(0, 0, 0)	2a: (2); 4l: (3);	2b: (0); 4m: (1);	2c: (1); 8n: (6);	2d: (1); 8o: (7);	2e: (2); 8p: (5);	2f: (1); 8q: (4);	4g: (4); 16r: (12)	4h: (2);	4i: (3);	4j: (3);	4k: (1);	

d. Results for high-symmetry planes

$$P1(u, v, 0)$$

Operation	E
Coordinate	$(u, v, 0)$
P2($u, v, \frac{1}{2}$)	
Operation	E
Coordinate	$(u, v, \frac{1}{2})$
P3(0, u, v)	
Operation	E C_{4z}^+
Coordinate	(0, u, v) $(-u, 0, v)$
P4(u, u, v)	
Operation	E C_{4z}^+
Coordinate	(u, u, v) $(-u, u, v)$
P5($u, \frac{1}{2}, v$)	
Operation	E C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$ $(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (8); 4k: (8); 4l: (8); 4m: (8); 8n: (12); 8o: (12); 8p: (12); 8q: (16); 16r: (24)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (4); 4k: (4); 4l: (4); 4m: (4); 8n: (12); 8o: (12); 8p: (12); 8q: (8); 16r: (24)

P2 ($u, v, \frac{1}{2}$) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12); 8o: (12); 8p: (12); 8q: (12); 16r: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12); 8o: (12); 8p: (12); 8q: (12); 16r: (24)

P3 (0, u, v) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 2e: (4); 2f: (4); 4g: (8); 4h: (8); 4i: (8); 4j: (7); 4k: (7); 4l: (7); 4m: (7); 8n: (12); 8o: (14); 8p: (14); 8q: (12); 16r: (24)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (4); 4j: (5); 4k: (5); 4l: (5); 4m: (5); 8n: (12); 8o: (10); 8p: (10); 8q: (12); 16r: (24)

P4 (u, u, v) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12); 8o: (12); 8p: (12); 8q: (12); 16r: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 4k: (6); 4l: (6); 4m: (6); 8n: (12); 8o: (12); 8p: (12); 8q: (12); 16r: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 131

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (2); 2c: (3); 2d: (3); 2e: (4); 2f: (2); 4g: (8); 4h: (4); 4i: (6); 4j: (7); 4k: (5); 4l: (7); 4m: (5); 8n: (12); 8o: (14); 8p: (10); 8q: (12); 16r: (24)
2	(0, 0, 0)	2a: (2); 2b: (4); 2c: (3); 2d: (3); 2e: (2); 2f: (4); 4g: (4); 4h: (8); 4i: (6); 4j: (5); 4k: (7); 4l: (5); 4m: (7); 8n: (12); 8o: (10); 8p: (14); 8q: (12); 16r: (24)

132. Space group No. 132 ($P4_2/mcm$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, \tfrac{1}{2}\} \quad \{C_{4z}^-|0, 0, \tfrac{1}{2}\} \quad \{C_{2x}|0, 0, -\tfrac{1}{2}\} \quad \{C_{2y}|0, 0, -\tfrac{1}{2}\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\} \\ \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{S_{4z}^-|0, 0, -\tfrac{1}{2}\} \quad \{S_{4z}^+|0, 0, -\tfrac{1}{2}\} \quad \{\sigma_x|0, 0, -\tfrac{1}{2}\} \quad \{\sigma_y|0, 0, \tfrac{1}{2}\} \quad \{\sigma_{da}|0, 0, 0\} \quad \{\sigma_{db}|0, 0, 0\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$
Operation E
Coordinate (0, 0, 0)
$M(\frac{1}{2}, \frac{1}{2}, 0)$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$
$Z(0, 0, \frac{1}{2})$
Operation E
Coordinate $(0, 0, \frac{1}{2})$
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$
$R(0, \frac{1}{2}, \frac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0, \frac{1}{2}, \frac{1}{2})$ $(-\frac{1}{2}, 0, \frac{1}{2})$

$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

Γ (0, 0, 0) of space group No. 132												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (1);	2c: (0); 8n: (2);	2d: (0); 8o: (2);	4e: (0); 16p: (3)	4f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (1);
2	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (2);	2c: (0); 8n: (2);	2d: (0); 8o: (1);	4e: (1); 16p: (3)	4f: (0);	4g: (0);	4h: (0);	4i: (1);	4j: (1);	8k: (1);
3	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (1);	2c: (0); 8n: (2);	2d: (0); 8o: (1);	4e: (0); 16p: (3)	4f: (0);	4g: (0);	4h: (0);	4i: (1);	4j: (1);	8k: (1);
4	(0, 0, 0)	2a: (0); 8l: (2);	2b: (1); 8m: (2);	2c: (0); 8n: (2);	2d: (1); 8o: (2);	4e: (1); 16p: (3)	4f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (1);
5	(0, 0, 0)	2a: (0); 8l: (3);	2b: (1); 8m: (3);	2c: (0); 8n: (2);	2d: (1); 8o: (3);	4e: (2); 16p: (6)	4f: (0);	4g: (2);	4h: (2);	4i: (1);	4j: (1);	8k: (4);
6	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (1);	2c: (0); 8n: (1);	2d: (0); 8o: (1);	4e: (0); 16p: (3)	4f: (1);	4g: (0);	4h: (0);	4i: (0);	4j: (0);	8k: (1);
7	(0, 0, 0)	2a: (1); 8l: (2);	2b: (1); 8m: (2);	2c: (1); 8n: (1);	2d: (1); 8o: (2);	4e: (1); 16p: (3)	4f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (1);
8	(0, 0, 0)	2a: (1); 8l: (1);	2b: (0); 8m: (1);	2c: (1); 8n: (1);	2d: (0); 8o: (2);	4e: (0); 16p: (3)	4f: (1);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (1);
9	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (2);	2c: (0); 8n: (1);	2d: (0); 8o: (1);	4e: (1); 16p: (3)	4f: (1);	4g: (0);	4h: (0);	4i: (0);	4j: (0);	8k: (1);
10	(0, 0, 0)	2a: (2); 8l: (3);	2b: (1); 8m: (3);	2c: (2); 8n: (4);	2d: (1); 8o: (3);	4e: (2); 16p: (6)	4f: (4);	4g: (2);	4h: (2);	4i: (2);	4j: (2);	8k: (4);

M ($\frac{1}{2}, \frac{1}{2}, 0$) of space group No. 132												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (2);	2c: (0); 8n: (2);	2d: (1); 8o: (2);	4e: (1); 16p: (3)	4f: (2);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (2);
2	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (1);	2c: (0); 8n: (2);	2d: (0); 8o: (1);	4e: (1); 16p: (3)	4f: (2);	4g: (0);	4h: (0);	4i: (1);	4j: (1);	8k: (2);
3	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (2);	2c: (0); 8n: (2);	2d: (0); 8o: (1);	4e: (1); 16p: (3)	4f: (2);	4g: (0);	4h: (0);	4i: (1);	4j: (1);	8k: (2);
4	(0, 0, 0)	2a: (0); 8l: (2);	2b: (1); 8m: (1);	2c: (0); 8n: (2);	2d: (0); 8o: (2);	4e: (1); 16p: (3)	4f: (2);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (2);
5	(0, 0, 0)	2a: (0); 8l: (3);	2b: (1); 8m: (3);	2c: (0); 8n: (2);	2d: (1); 8o: (3);	4e: (1); 16p: (6)	4f: (2);	4g: (2);	4h: (2);	4i: (1);	4j: (1);	8k: (2);
6	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (2);	2c: (0); 8n: (1);	2d: (0); 8o: (1);	4e: (1); 16p: (3)	4f: (0);	4g: (0);	4h: (0);	4i: (0);	4j: (0);	8k: (2);
7	(0, 0, 0)	2a: (1); 8l: (2);	2b: (1); 8m: (1);	2c: (1); 8n: (1);	2d: (0); 8o: (2);	4e: (1); 16p: (3)	4f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (2);
8	(0, 0, 0)	2a: (1); 8l: (1);	2b: (0); 8m: (2);	2c: (1); 8n: (1);	2d: (1); 8o: (2);	4e: (1); 16p: (3)	4f: (0);	4g: (1);	4h: (1);	4i: (1);	4j: (1);	8k: (2);
9	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (1);	2c: (0); 8n: (1);	2d: (0); 8o: (1);	4e: (1); 16p: (3)	4f: (0);	4g: (0);	4h: (0);	4i: (0);	4j: (0);	8k: (2);
10	(0, 0, 0)	2a: (2); 8l: (3);	2b: (1); 8m: (3);	2c: (2); 8n: (4);	2d: (1); 8o: (3);	4e: (1); 16p: (6)	4f: (0);	4g: (2);	4h: (2);	4i: (2);	4j: (2);	8k: (2);

$Z \left(0, 0, \frac{1}{2}\right)$ of space group No. 132											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	4g: (2);	4h: (2);	4i: (1);	4j: (2); 8k: (4); 8l: (3); 8m: (3); 8n: (3); 8o: (3); 16p: (6)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	4g: (0);	4h: (0);	4i: (1);	4j: (1); 8k: (2); 8l: (3); 8m: (3); 8n: (3); 8o: (2); 16p: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	4g: (2);	4h: (2);	4i: (2);	4j: (1); 8k: (4); 8l: (3); 8m: (3); 8n: (3); 8o: (3); 16p: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	4g: (2);	4h: (2);	4i: (2);	4j: (2); 8k: (2); 8l: (3); 8m: (3); 8n: (3); 8o: (4); 16p: (6)
$A \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 132											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	4g: (2);	4h: (2);	4i: (1);	4j: (2); 8k: (2); 8l: (3); 8m: (3); 8n: (3); 8o: (3); 16p: (6)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (2);	4f: (2);	4g: (0);	4h: (0);	4i: (1);	4j: (1); 8k: (4); 8l: (3); 8m: (3); 8n: (3); 8o: (2); 16p: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	4g: (2);	4h: (2);	4i: (2);	4j: (1); 8k: (2); 8l: (3); 8m: (3); 8n: (3); 8o: (3); 16p: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	4g: (2);	4h: (2);	4i: (2);	4j: (2); 8k: (4); 8l: (3); 8m: (3); 8n: (3); 8o: (4); 16p: (6)
$R \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 132											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	4g: (2);	4h: (4);	4i: (3);	4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (6); 16p: (12)
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	4g: (4);	4h: (2);	4i: (3);	4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (6); 16p: (12)
$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 132											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (2);	2d: (1);	4e: (1);	4f: (2);	4g: (1);	4h: (2);	4i: (2);	4j: (2); 8k: (3); 8l: (2); 8m: (3); 8n: (4); 8o: (3); 16p: (6)
2	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (0);	4e: (1);	4f: (1);	4g: (2);	4h: (1);	4i: (1);	4j: (1); 8k: (3); 8l: (3); 8m: (2); 8n: (2); 8o: (3); 16p: (6)
3	(0, 0, 0)	2a: (0);	2b: (1);	2c: (2);	2d: (1);	4e: (2);	4f: (2);	4g: (1);	4h: (2);	4i: (2);	4j: (2); 8k: (3); 8l: (4); 8m: (3); 8n: (4); 8o: (3); 16p: (6)
4	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (1);	4g: (2);	4h: (1);	4i: (1);	4j: (1); 8k: (3); 8l: (3); 8m: (4); 8n: (2); 8o: (3); 16p: (6)
5	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0);	2d: (1);	4e: (1);	4f: (1);	4g: (1);	4h: (2);	4i: (1);	4j: (1); 8k: (3); 8l: (2); 8m: (3); 8n: (2); 8o: (3); 16p: (6)
6	(0, 0, 0)	2a: (2);	2b: (1);	2c: (0);	2d: (0);	4e: (1);	4f: (2);	4g: (2);	4h: (1);	4i: (2);	4j: (2); 8k: (3); 8l: (3); 8m: (2); 8n: (4); 8o: (3); 16p: (6)
7	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (1);	4e: (2);	4f: (1);	4g: (1);	4h: (2);	4i: (1);	4j: (1); 8k: (3); 8l: (4); 8m: (3); 8n: (2); 8o: (3); 16p: (6)
8	(0, 0, 0)	2a: (2);	2b: (1);	2c: (0);	2d: (1);	4e: (2);	4f: (2);	4g: (2);	4h: (1);	4i: (2);	4j: (2); 8k: (3); 8l: (3); 8m: (4); 8n: (4); 8o: (3); 16p: (6)

c. Results for high-symmetry lines

DT(0, v, 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v, 0)	(-v, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S(u, u, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, u, 0)		
Operation	E	C_{4z}^+
Coordinate	(u, u, 0)	(-u, u, 0)
T(u, $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u, $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u, $\frac{1}{2}$)
U(0, v, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v, $\frac{1}{2}$)	(-v, 0, $\frac{1}{2}$)
V($\frac{1}{2}$, $\frac{1}{2}$, w)		
Operation	E	
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	
W(0, $\frac{1}{2}$, w)		
Operation	E	C_{4z}^+
Coordinate	(0, $\frac{1}{2}$, w)	($-\frac{1}{2}$, 0, w)
Y(u, $\frac{1}{2}$, 0)		
Operation	E	C_{4z}^+
Coordinate	(u, $\frac{1}{2}$, 0)	($-\frac{1}{2}$, u, 0)

DT (0, v, 0) of space group No. 132				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (2); 4f: (4); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 8k: (6); 8l: (5); 8m: (5); 8n: (8); 8o: (6); 16p: (12)		
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 8k: (6); 8l: (5); 8m: (5); 8n: (4); 8o: (6); 16p: (12)		
3	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 4e: (4); 4f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 8k: (6); 8l: (7); 8m: (7); 8n: (4); 8o: (6); 16p: (12)		
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 8k: (6); 8l: (7); 8m: (7); 8n: (8); 8o: (6); 16p: (12)		

LD $(0, 0, w)$ of space group No. 132

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (2); 8l: (3); 8m: (3); 8n: (3); 8o: (4); 16p: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (0); 4h: (0); 4i: (1); 4j: (1); 8k: (2); 8l: (3); 8m: (3); 8n: (3); 8o: (2); 16p: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 4g: (0); 4h: (0); 4i: (1); 4j: (1); 8k: (2); 8l: (3); 8m: (3); 8n: (3); 8o: (2); 16p: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (2); 8l: (3); 8m: (3); 8n: (3); 8o: (4); 16p: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 4g: (4); 4h: (4); 4i: (3); 4j: (3); 8k: (8); 8l: (6); 8m: (6); 8n: (6); 8o: (6); 16p: (12)

S $(u, u, \frac{1}{2})$ of space group No. 132

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (3); 4j: (4); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (7); 16p: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (4); 4h: (4); 4i: (4); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (7); 16p: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (2); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (5); 16p: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (2); 4h: (2); 4i: (3); 4j: (2); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (5); 16p: (12)

SM $(u, u, 0)$ of space group No. 132

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (4); 4g: (4); 4h: (4); 4i: (4); 4j: (4); 8k: (6); 8l: (6); 8m: (6); 8n: (8); 8o: (7); 16p: (12)
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 4e: (3); 4f: (2); 4g: (2); 4h: (2); 4i: (1); 4j: (1); 8k: (6); 8l: (6); 8m: (6); 8n: (4); 8o: (5); 16p: (12)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 4e: (3); 4f: (4); 4g: (2); 4h: (2); 4i: (4); 4j: (4); 8k: (6); 8l: (6); 8m: (6); 8n: (8); 8o: (5); 16p: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (2); 4g: (4); 4h: (4); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (4); 8o: (7); 16p: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 132

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (12); 16p: (24)

U $(0, v, \frac{1}{2})$ of space group No. 132

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (12); 16p: (24)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 132

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (4); 8l: (3); 8m: (3); 8n: (3); 8o: (4); 16p: (6)

2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (0); 4h: (0); 4i: (1); 4j: (1); 8k: (4); 8l: (3); 8m: (3); 8n: (3); 8o: (2); 16p: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 4g: (0); 4h: (0); 4i: (1); 4j: (1); 8k: (4); 8l: (3); 8m: (3); 8n: (3); 8o: (2); 16p: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 4g: (2); 4h: (2); 4i: (2); 4j: (2); 8k: (4); 8l: (3); 8m: (3); 8n: (3); 8o: (4); 16p: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (2); 4f: (2); 4g: (4); 4h: (4); 4i: (3); 4j: (3); 8k: (4); 8l: (6); 8m: (6); 8n: (6); 8o: (6); 16p: (12)

$W(0, \frac{1}{2}, w)$ of space group No. 132

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (6); 16p: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 4g: (2); 4h: (4); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (6); 16p: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (6); 16p: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 4g: (4); 4h: (2); 4i: (3); 4j: (3); 8k: (6); 8l: (6); 8m: (6); 8n: (6); 8o: (6); 16p: (12)

$Y(u, \frac{1}{2}, 0)$ of space group No. 132

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (2); 4e: (3); 4f: (4); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 8k: (6); 8l: (5); 8m: (7); 8n: (8); 8o: (6); 16p: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (2); 4e: (3); 4f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 8k: (6); 8l: (5); 8m: (7); 8n: (4); 8o: (6); 16p: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (1); 4e: (3); 4f: (4); 4g: (3); 4h: (3); 4i: (4); 4j: (4); 8k: (6); 8l: (7); 8m: (5); 8n: (8); 8o: (6); 16p: (12)
4	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (1); 4e: (3); 4f: (2); 4g: (3); 4h: (3); 4i: (2); 4j: (2); 8k: (6); 8l: (7); 8m: (5); 8n: (4); 8o: (6); 16p: (12)

d. Results for high-symmetry planes

$P1(u, v, 0)$

Operation E
Coordinate $(u, v, 0)$

$P2(u, v, \frac{1}{2})$

Operation E
Coordinate $(u, v, \frac{1}{2})$

$P3(0, u, v)$

Operation E C_{4z}^+
Coordinate $(0, u, v)$ $(-u, 0, v)$

$P4(u, u, v)$

Operation E C_{4z}^+
Coordinate (u, u, v) $(-u, u, v)$

$P5(u, \frac{1}{2}, v)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 132		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (3); 2c: (4); 2d: (3); 4e: (6); 4f: (8); 4g: (6); 4h: (6); 4i: (8); 4j: (8); 8k: (12); 8l: (12); 8m: (12); 8n: (16); 8o: (12); 16p: (24)
2	(0, 0, 0)	2a: (2); 2b: (3); 2c: (2); 2d: (3); 4e: (6); 4f: (4); 4g: (6); 4h: (6); 4i: (4); 4j: (4); 8k: (12); 8l: (12); 8m: (12); 8n: (8); 8o: (12); 16p: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 132		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (12); 16p: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (12); 16p: (24)
P3 ($0, u, v$) of space group No. 132		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (12); 16p: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (12); 16p: (24)
P4 (u, u, v) of space group No. 132		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 4e: (6); 4f: (6); 4g: (8); 4h: (8); 4i: (7); 4j: (7); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (14); 16p: (24)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (6); 4f: (6); 4g: (4); 4h: (4); 4i: (5); 4j: (5); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (10); 16p: (24)
P5 ($u, \frac{1}{2}, v$) of space group No. 132		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (12); 16p: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 4g: (6); 4h: (6); 4i: (6); 4j: (6); 8k: (12); 8l: (12); 8m: (12); 8n: (12); 8o: (12); 16p: (24)

133. Space group No. 133 ($P4_2/nbc$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & \vec{t}_1 = \vec{a} \\
 \text{Tetragonal primitive lattice} & \vec{b} = (0, a, 0) & \vec{t}_2 = \vec{b} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

$\{E 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{4z}^+ \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{C_{4z}^- -\frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{C_{2x} 0,0,-\frac{1}{2}\}$	$\{C_{2y} 0,0,-\frac{1}{2}\}$	$\{C_{2a} \frac{1}{2},\frac{1}{2},0\}$	$\{C_{2b} -\frac{1}{2},\frac{1}{2},0\}$
$\{I \frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_z -\frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{S_{4z}^- 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$	$\{\sigma_x \frac{1}{2},-\frac{1}{2},0\}$	$\{\sigma_y -\frac{1}{2},\frac{1}{2},0\}$	$\{\sigma_{da} 0,0,\frac{1}{2}\}$	$\{\sigma_{db} 0,0,\frac{1}{2}\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$
Operation E
Coordinate $(0,0,0)$
$M(\frac{1}{2},\frac{1}{2},0)$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},0)$
$Z(0,0,\frac{1}{2})$
Operation E
Coordinate $(0,0,\frac{1}{2})$
$A(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
$R(0,\frac{1}{2},\frac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,\frac{1}{2})$
$X(0,\frac{1}{2},0)$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

$\Gamma(0,0,0)$ of space group No. 133

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 16k: (3)
2	(0,0,0)	4a: (1); 4b: (1); 4c: (1); 4d: (0); 8e: (0); 8f: (1); 8g: (1); 8h: (2); 8i: (2); 8j: (2); 16k: (3)
3	(0,0,0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 8j: (2); 16k: (3)
4	(0,0,0)	4a: (1); 4b: (1); 4c: (0); 4d: (1); 8e: (0); 8f: (1); 8g: (1); 8h: (2); 8i: (2); 8j: (1); 16k: (3)
5	(0,0,0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (0); 8f: (4); 8g: (4); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
6	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (1); 8e: (3); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 16k: (3)

7	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (1); 8g: (1); 8h: (2); 8i: (2); 8j: (2); 16k: (3)
8	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (0); 8e: (3); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 8j: (2); 16k: (3)
9	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 8e: (3); 8f: (1); 8g: (1); 8h: (2); 8i: (2); 8j: (1); 16k: (3)
10	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (6); 8f: (4); 8g: (4); 8h: (3); 8i: (3); 8j: (3); 16k: (6)

M $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (2); 4d: (2); 8e: (3); 8f: (2); 8g: (4); 8h: (3); 8i: (3); 8j: (4); 16k: (6)
2	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (4); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
3	(0, 0, 0)	4a: (1); 4b: (2); 4c: (0); 4d: (2); 8e: (3); 8f: (2); 8g: (4); 8h: (3); 8i: (3); 8j: (2); 16k: (6)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (4); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)

Z $(0, 0, \frac{1}{2})$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (3); 8f: (4); 8g: (4); 8h: (2); 8i: (4); 8j: (3); 16k: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (2); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (3); 8f: (4); 8g: (4); 8h: (4); 8i: (2); 8j: (3); 16k: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (2); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)

A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (4); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
2	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (4); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
3	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 8e: (3); 8f: (2); 8g: (4); 8h: (3); 8i: (3); 8j: (3); 16k: (6)

R $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (5); 8i: (7); 8j: (6); 16k: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (7); 8i: (5); 8j: (6); 16k: (12)

X $(0, \frac{1}{2}, 0)$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (5); 8i: (5); 8j: (6); 16k: (12)
2	(0, 0, 0)	4a: (4); 4b: (4); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (7); 8i: (7); 8j: (6); 16k: (12)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

$S(u, u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
$SM(u, u, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
$T(u, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$
$U(0, v, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 133

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (5); 8i: (5); 8j: (6); 16k: (12)
2	$(0, 0, 0)$	4a: (2); 4b: (2); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (5); 8i: (5); 8j: (6); 16k: (12)
3	$(0, 0, 0)$	4a: (4); 4b: (4); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (7); 8i: (7); 8j: (6); 16k: (12)
4	$(0, 0, 0)$	4a: (4); 4b: (4); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (7); 8i: (7); 8j: (6); 16k: (12)

LD $(0, 0, w)$ of space group No. 133

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (2); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (2); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
3	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (2); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
4	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (2); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
5	$(0, 0, 0)$	4a: (4); 4b: (4); 4c: (4); 4d: (4); 8e: (6); 8f: (8); 8g: (8); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

 $S(u, u, \frac{1}{2})$ of space group No. 133

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

SM $(u, u, 0)$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (5); 16k: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (5); 16k: (12)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (7); 16k: (12)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 8j: (7); 16k: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

U $(0, v, \frac{1}{2})$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (5); 8i: (7); 8j: (6); 16k: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (5); 8i: (7); 8j: (6); 16k: (12)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (7); 8i: (5); 8j: (6); 16k: (12)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (7); 8i: (5); 8j: (6); 16k: (12)

V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (4); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
2	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (4); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
3	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (4); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (4); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6)
5	(0, 0, 0)	4a: (2); 4b: (4); 4c: (2); 4d: (4); 8e: (6); 8f: (4); 8g: (8); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

W $(0, \frac{1}{2}, w)$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

Y $(u, \frac{1}{2}, 0)$ of space group No. 133		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 ($u, v, 0$) of space group No. 133											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (6); 16k: (24)	4b: (6);	4c: (6);	4d: (6);	8e: (12);	8f: (12);	8g: (12);	8h: (12);	8i: (12);	8j: (12);
2	(0, 0, 0)	4a: (6); 16k: (24)	4b: (6);	4c: (6);	4d: (6);	8e: (12);	8f: (12);	8g: (12);	8h: (12);	8i: (12);	8j: (12);
P2 ($u, v, \frac{1}{2}$) of space group No. 133											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (6); 16k: (24)	4b: (6);	4c: (6);	4d: (6);	8e: (12);	8f: (12);	8g: (12);	8h: (12);	8i: (12);	8j: (12);
2	(0, 0, 0)	4a: (6); 16k: (24)	4b: (6);	4c: (6);	4d: (6);	8e: (12);	8f: (12);	8g: (12);	8h: (12);	8i: (12);	8j: (12);
P3 (0, u, v) of space group No. 133											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (6); 16k: (24)	4b: (6);	4c: (6);	4d: (6);	8e: (12);	8f: (12);	8g: (12);	8h: (12);	8i: (12);	8j: (12);
2	(0, 0, 0)	4a: (6); 16k: (24)	4b: (6);	4c: (6);	4d: (6);	8e: (12);	8f: (12);	8g: (12);	8h: (12);	8i: (12);	8j: (12);
P4 (u, u, v) of space group No. 133											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	4a: (6); 16k: (24)	4b: (6);	4c: (6);	4d: (6);	8e: (12);	8f: (12);	8g: (12);	8h: (12);	8i: (12);	8j: (12);
2	(0, 0, 0)	4a: (6); 16k: (24)	4b: (6);	4c: (6);	4d: (6);	8e: (12);	8f: (12);	8g: (12);	8h: (12);	8i: (12);	8j: (12);
P5 ($u, \frac{1}{2}, v$) of space group No. 133											
(Co-) irrep	Phonon AM	WYPO information									

1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

134. Space group No. 134 ($P4_2/nm$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}\{E|0, 0, 0\} & \quad \{C_{2z}|0, 0, 0\} & \quad \{C_{4z}^+|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} & \quad \{C_{4z}^-|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} & \quad \{C_{2x}|0, 0, 0\} & \quad \{C_{2y}|0, 0, 0\} & \quad \{C_{2a}|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} & \quad \{C_{2b}|-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \\ \{I|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} & \quad \{\sigma_z|-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} & \quad \{S_{4z}^-|0, 0, 0\} & \quad \{S_{4z}^+|0, 0, 0\} & \quad \{\sigma_x|\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\} & \quad \{\sigma_y|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} & \quad \{\sigma_{da}|0, 0, 0\} & \quad \{\sigma_{db}|0, 0, 0\}\end{aligned}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, 0)\end{array}$$

$$M(\frac{1}{2}, \frac{1}{2}, 0)$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, 0)\end{array}$$

$$Z(0, 0, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (0, 0, \frac{1}{2})\end{array}$$

$$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{ll}\text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})\end{array}$$

$$R(0, \frac{1}{2}, \frac{1}{2})$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, \frac{1}{2}) & (-\frac{1}{2}, 0, \frac{1}{2})\end{array}$$

$$X(0, \frac{1}{2}, 0)$$

$$\begin{array}{lll}\text{Operation} & E & C_{4z}^+\end{array}$$

Γ (0, 0, 0) of space group No. 134												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (2);	4c: (0); 16n: (3)	4d: (0);	4e: (0);	4f: (0);	4g: (1);	8h: (1);	8i: (1);	8j: (1);	8k: (1);
2	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (1);	4c: (1); 16n: (3)	4d: (1);	4e: (0);	4f: (0);	4g: (0);	8h: (1);	8i: (2);	8j: (2);	8k: (2);
3	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (1);	4c: (0); 16n: (3)	4d: (1);	4e: (0);	4f: (0);	4g: (0);	8h: (1);	8i: (1);	8j: (1);	8k: (2);
4	(0, 0, 0)	2a: (1); 8l: (1);	2b: (1); 8m: (2);	4c: (1); 16n: (3)	4d: (0);	4e: (0);	4f: (0);	4g: (1);	8h: (1);	8i: (2);	8j: (2);	8k: (1);
5	(0, 0, 0)	2a: (1); 8l: (3);	2b: (1); 8m: (3);	4c: (2); 16n: (6)	4d: (2);	4e: (0);	4f: (0);	4g: (2);	8h: (4);	8i: (3);	8j: (3);	8k: (3);
6	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (1);	4c: (0); 16n: (3)	4d: (0);	4e: (1);	4f: (1);	4g: (0);	8h: (1);	8i: (1);	8j: (1);	8k: (1);
7	(0, 0, 0)	2a: (1); 8l: (2);	2b: (1); 8m: (2);	4c: (1); 16n: (3)	4d: (1);	4e: (2);	4f: (2);	4g: (1);	8h: (1);	8i: (2);	8j: (2);	8k: (2);
8	(0, 0, 0)	2a: (0); 8l: (2);	2b: (0); 8m: (2);	4c: (0); 16n: (3)	4d: (1);	4e: (2);	4f: (2);	4g: (1);	8h: (1);	8i: (1);	8j: (1);	8k: (2);
9	(0, 0, 0)	2a: (0); 8l: (1);	2b: (0); 8m: (1);	4c: (1); 16n: (3)	4d: (0);	4e: (1);	4f: (1);	4g: (0);	8h: (1);	8i: (2);	8j: (2);	8k: (1);
10	(0, 0, 0)	2a: (1); 8l: (3);	2b: (1); 8m: (3);	4c: (2); 16n: (6)	4d: (2);	4e: (3);	4f: (3);	4g: (2);	8h: (4);	8i: (3);	8j: (3);	8k: (3);

M $\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 134												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (1); 8l: (4);	2b: (1); 8m: (3);	4c: (1); 16n: (6)	4d: (2);	4e: (2);	4f: (2);	4g: (2);	8h: (2);	8i: (3);	8j: (3);	8k: (4);
2	(0, 0, 0)	2a: (0); 8l: (3);	2b: (0); 8m: (2);	4c: (2); 16n: (6)	4d: (2);	4e: (1);	4f: (1);	4g: (0);	8h: (4);	8i: (3);	8j: (3);	8k: (3);
3	(0, 0, 0)	2a: (1); 8l: (2);	2b: (1); 8m: (3);	4c: (1); 16n: (6)	4d: (0);	4e: (1);	4f: (1);	4g: (2);	8h: (2);	8i: (3);	8j: (3);	8k: (2);
4	(0, 0, 0)	2a: (1); 8l: (3);	2b: (1); 8m: (4);	4c: (2); 16n: (6)	4d: (2);	4e: (2);	4f: (2);	4g: (2);	8h: (4);	8i: (3);	8j: (3);	8k: (3);

Z $(0, 0, \frac{1}{2})$ of space group No. 134												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (1); 8l: (4);	2b: (1); 8m: (3);	4c: (2); 16n: (6)	4d: (2);	4e: (2);	4f: (1);	4g: (2);	8h: (4);	8i: (3);	8j: (3);	8k: (2);
2	(0, 0, 0)	2a: (0); 8l: (3);	2b: (0); 8m: (2);	4c: (1); 16n: (6)	4d: (1);	4e: (1);	4f: (1);	4g: (0);	8h: (2);	8i: (3);	8j: (3);	8k: (3);
3	(0, 0, 0)	2a: (1); 8l: (2);	2b: (1); 8m: (3);	4c: (2); 16n: (6)	4d: (2);	4e: (1);	4f: (2);	4g: (2);	8h: (4);	8i: (3);	8j: (3);	8k: (4);
4	(0, 0, 0)	2a: (1); 8l: (3);	2b: (1); 8m: (4);	4c: (1); 16n: (6)	4d: (1);	4e: (2);	4f: (2);	4g: (2);	8h: (2);	8i: (3);	8j: (3);	8k: (3);

A $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 134		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 4e: (0); 4f: (2); 4g: (1); 8h: (2); 8i: (1); 8j: (2); 8k: (2); 8l: (1); 8m: (2); 16n: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 4f: (1); 4g: (0); 8h: (2); 8i: (2); 8j: (1); 8k: (1); 8l: (2); 8m: (1); 16n: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 4f: (1); 4g: (0); 8h: (2); 8i: (1); 8j: (2); 8k: (1); 8l: (2); 8m: (1); 16n: (3)
4	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 4f: (2); 4g: (1); 8h: (2); 8i: (2); 8j: (1); 8k: (2); 8l: (1); 8m: (2); 16n: (3)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (0); 4f: (3); 4g: (2); 8h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)
6	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 4f: (0); 4g: (0); 8h: (2); 8i: (1); 8j: (2); 8k: (2); 8l: (1); 8m: (1); 16n: (3)
7	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (1); 4e: (2); 4f: (0); 4g: (1); 8h: (2); 8i: (2); 8j: (1); 8k: (1); 8l: (2); 8m: (2); 16n: (3)
8	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (0); 4g: (1); 8h: (2); 8i: (1); 8j: (2); 8k: (1); 8l: (2); 8m: (2); 16n: (3)
9	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 4f: (0); 4g: (0); 8h: (2); 8i: (2); 8j: (1); 8k: (2); 8l: (1); 8m: (1); 16n: (3)
10	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (3); 4f: (0); 4g: (2); 8h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (3); 16n: (6)

$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (5); 8j: (7); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (7); 8j: (5); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

$X\left(0, \frac{1}{2}, 0\right)$ of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (5); 8j: (5); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (7); 8j: (7); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

c. Results for high-symmetry lines

$DT(0, v, 0)$

Operation	E	C_{4z}^+
Coordinate	$(0, v, 0)$	$(-v, 0, 0)$

$LD(0, 0, w)$

Operation	E
Coordinate	$(0, 0, w)$

$S(u, u, \frac{1}{2})$

Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$

$SM(u, u, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
$T(u, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$
$U(0, v, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (5); 8j: (5); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
2	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (5); 8j: (5); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
3	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (7); 8j: (7); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
4	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (7); 8j: (7); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

LD $(0, 0, w)$ of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 4g: (2); 8h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)
2	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 4g: (0); 8h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
3	$(0, 0, 0)$	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 4f: (1); 4g: (0); 8h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
4	$(0, 0, 0)$	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 4g: (2); 8h: (2); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)
5	$(0, 0, 0)$	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (3); 4f: (3); 4g: (4); 8h: (8); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

$S(u, u, \frac{1}{2})$ of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 4f: (3); 4g: (4); 8h: (6); 8i: (6); 8j: (6); 8k: (5); 8l: (7); 8m: (7); 16n: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (4); 4g: (4); 8h: (6); 8i: (6); 8j: (6); 8k: (7); 8l: (5); 8m: (7); 16n: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (2); 4g: (2); 8h: (6); 8i: (6); 8j: (6); 8k: (5); 8l: (7); 8m: (5); 16n: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 4f: (3); 4g: (2); 8h: (6); 8i: (6); 8j: (6); 8k: (7); 8l: (5); 8m: (5); 16n: (12)

 $SM(u, u, 0)$ of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (2); 4e: (3); 4f: (3); 4g: (4); 8h: (6); 8i: (6); 8j: (6); 8k: (5); 8l: (5); 8m: (7); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (6); 8i: (6); 8j: (6); 8k: (5); 8l: (5); 8m: (5); 16n: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (4); 4e: (3); 4f: (3); 4g: (2); 8h: (6); 8i: (6); 8j: (6); 8k: (7); 8l: (7); 8m: (5); 16n: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (4); 4e: (4); 4f: (4); 4g: (4); 8h: (6); 8i: (6); 8j: (6); 8k: (7); 8l: (7); 8m: (7); 16n: (12)

 $T(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (5); 8j: (7); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
2	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (5); 8j: (7); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
3	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (7); 8j: (5); 8k: (6); 8l: (6); 8m: (6); 16n: (12)
4	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (7); 8j: (5); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

 $U(0, v, \frac{1}{2})$ of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

 $V(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (4); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (4); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (4); 16n: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (2); 4e: (1); 4f: (1); 4g: (0); 8h: (4); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (2); 4e: (1); 4f: (1); 4g: (0); 8h: (4); 8i: (3); 8j: (3); 8k: (3); 8l: (3); 8m: (2); 16n: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 4c: (2); 4d: (2); 4e: (3); 4f: (3); 4g: (4); 8h: (4); 8i: (6); 8j: (6); 8k: (6); 8l: (6); 8m: (6); 16n: (12)

W $(0, \frac{1}{2}, w)$ of space group No. 134		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

Y $(u, \frac{1}{2}, 0)$ of space group No. 134		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

d. Results for high-symmetry planes

P1($u, v, 0$)		
Operation	E	
Coordinate	$(u, v, 0)$	
P2($u, v, \frac{1}{2}$)		
Operation	E	
Coordinate	$(u, v, \frac{1}{2})$	
P3($0, u, v$)		
Operation	E	C_{4z}^+
Coordinate	$(0, u, v)$	$(-u, 0, v)$
P4(u, u, v)		
Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5($u, \frac{1}{2}, v$)		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 $(u, v, 0)$ of space group No. 134		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

P2 $(u, v, \frac{1}{2})$ of space group No. 134		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

P3 (0, u , v) of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

P4 (u , u , v) of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 4c: (6); 4d: (6); 4e: (7); 4f: (7); 4g: (8); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (14); 16n: (24)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (6); 4d: (6); 4e: (5); 4f: (5); 4g: (4); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (10); 16n: (24)

P5 (u , $\frac{1}{2}$, v) of space group No. 134

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 8k: (12); 8l: (12); 8m: (12); 16n: (24)

135. Space group No. 135 ($P4_2/mbc$)

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \text{Tetragonal primitive lattice} \quad \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\begin{aligned}
 \{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, \tfrac{1}{2}\} \quad \{C_{4z}^-|0, 0, \tfrac{1}{2}\} \quad \{C_{2x}|\tfrac{1}{2}, \tfrac{1}{2}, 0\} \quad \{C_{2y}|-\tfrac{1}{2}, \tfrac{1}{2}, 0\} \quad \{C_{2a}|-\tfrac{1}{2}, \tfrac{1}{2}, \tfrac{1}{2}\} \quad \{C_{2b}|-\tfrac{1}{2}, -\tfrac{1}{2}, \tfrac{1}{2}\} \\
 \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{S_{4z}^-|0, 0, \tfrac{1}{2}\} \quad \{S_{4z}^+|0, 0, \tfrac{1}{2}\} \quad \{\sigma_x|-\tfrac{1}{2}, \tfrac{1}{2}, 0\} \quad \{\sigma_y|-\tfrac{1}{2}, \tfrac{1}{2}, 0\} \quad \{\sigma_{da}|-\tfrac{1}{2}, -\tfrac{1}{2}, \tfrac{1}{2}\} \quad \{\sigma_{db}|-\tfrac{1}{2}, \tfrac{1}{2}, \tfrac{1}{2}\}
 \end{aligned}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation	E
Coordinate	(0, 0, 0)

$M(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

Γ (0, 0, 0) of space group No. 135										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (0);	8e: (1);	8f: (1);	8g: (1);	8h: (2);	16i: (3)
2	(0, 0, 0)	4a: (0);	4b: (0);	4c: (0);	4d: (1);	8e: (1);	8f: (1);	8g: (2);	8h: (2);	16i: (3)
3	(0, 0, 0)	4a: (0);	4b: (1);	4c: (0);	4d: (1);	8e: (1);	8f: (1);	8g: (2);	8h: (2);	16i: (3)
4	(0, 0, 0)	4a: (0);	4b: (1);	4c: (0);	4d: (0);	8e: (1);	8f: (1);	8g: (1);	8h: (2);	16i: (3)
5	(0, 0, 0)	4a: (0);	4b: (2);	4c: (0);	4d: (2);	8e: (4);	8f: (4);	8g: (3);	8h: (2);	16i: (6)
6	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (0);	8e: (1);	8f: (1);	8g: (1);	8h: (1);	16i: (3)
7	(0, 0, 0)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	8e: (1);	8f: (1);	8g: (2);	8h: (1);	16i: (3)
8	(0, 0, 0)	4a: (1);	4b: (0);	4c: (1);	4d: (1);	8e: (1);	8f: (1);	8g: (2);	8h: (1);	16i: (3)
9	(0, 0, 0)	4a: (1);	4b: (0);	4c: (1);	4d: (0);	8e: (1);	8f: (1);	8g: (1);	8h: (1);	16i: (3)
10	(0, 0, 0)	4a: (4);	4b: (2);	4c: (4);	4d: (2);	8e: (4);	8f: (4);	8g: (3);	8h: (4);	16i: (6)

M ($\frac{1}{2}, \frac{1}{2}, 0$) of space group No. 135										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	4a: (2);	4b: (1);	4c: (0);	4d: (0);	8e: (2);	8f: (1);	8g: (1);	8h: (2);	16i: (3)
2	(0, 0, 0)	4a: (2);	4b: (1);	4c: (0);	4d: (1);	8e: (2);	8f: (1);	8g: (2);	8h: (2);	16i: (3)
3	(0, 0, 0)	4a: (2);	4b: (1);	4c: (0);	4d: (2);	8e: (2);	8f: (4);	8g: (3);	8h: (2);	16i: (6)
4	(0, 0, 0)	4a: (0);	4b: (1);	4c: (1);	4d: (1);	8e: (2);	8f: (1);	8g: (2);	8h: (1);	16i: (3)
5	(0, 0, 0)	4a: (0);	4b: (1);	4c: (1);	4d: (0);	8e: (2);	8f: (1);	8g: (1);	8h: (1);	16i: (3)
6	(0, 0, 0)	4a: (0);	4b: (1);	4c: (4);	4d: (2);	8e: (2);	8f: (4);	8g: (3);	8h: (4);	16i: (6)

Z $(0, 0, \frac{1}{2})$ of space group No. 135		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (4); 8f: (4); 8g: (3); 8h: (3); 16i: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (4); 8f: (4); 8g: (3); 8h: (3); 16i: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 8e: (4); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 8e: (2); 8f: (4); 8g: (3); 8h: (3); 16i: (6)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (4); 4b: (3); 4c: (4); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	4a: (2); 4b: (3); 4c: (2); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (4); 16i: (12)

c. Results for high-symmetry lines

DT(0, v , 0)		
Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)
LD(0, 0, w)		
Operation	E	
Coordinate	(0, 0, w)	
S(u , u , $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)
SM(u , u , 0)		
Operation	E	C_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)
T(u , $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $\frac{1}{2}$)
U(0, v , $\frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	(0, v , $\frac{1}{2}$)	($-v$, 0, $\frac{1}{2}$)

$$V(\frac{1}{2}, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & (\frac{1}{2}, \frac{1}{2}, w) \end{array}$$

$$W(0, \frac{1}{2}, w)$$

$$\begin{array}{ll} \text{Operation} & E \quad C_{4z}^+ \\ \text{Coordinate} & (0, \frac{1}{2}, w) \quad (-\frac{1}{2}, 0, w) \end{array}$$

$$Y(u, \frac{1}{2}, 0)$$

$$\begin{array}{ll} \text{Operation} & E \quad C_{4z}^+ \\ \text{Coordinate} & (u, \frac{1}{2}, 0) \quad (-\frac{1}{2}, u, 0) \end{array}$$

DT $(0, v, 0)$ of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (4); 4b: (3); 4c: (4); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	4a: (2); 4b: (3); 4c: (2); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (4); 16i: (12)
3	(0, 0, 0)	4a: (2); 4b: (3); 4c: (2); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (4); 16i: (12)
4	(0, 0, 0)	4a: (4); 4b: (3); 4c: (4); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (8); 16i: (12)

LD $(0, 0, w)$ of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
5	(0, 0, 0)	4a: (4); 4b: (4); 4c: (4); 4d: (4); 8e: (8); 8f: (8); 8g: (6); 8h: (6); 16i: (12)

S $(u, u, \frac{1}{2})$ of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)

SM $(u, u, 0)$ of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (4); 4b: (3); 4c: (4); 4d: (2); 8e: (6); 8f: (6); 8g: (5); 8h: (8); 16i: (12)
2	(0, 0, 0)	4a: (2); 4b: (3); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (5); 8h: (4); 16i: (12)
3	(0, 0, 0)	4a: (4); 4b: (3); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (7); 8h: (8); 16i: (12)
4	(0, 0, 0)	4a: (2); 4b: (3); 4c: (2); 4d: (4); 8e: (6); 8f: (6); 8g: (7); 8h: (4); 16i: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)

U $(0, v, \frac{1}{2})$ of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
3	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
4	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12)
$V\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 135		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 8e: (4); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 8e: (4); 8f: (2); 8g: (3); 8h: (3); 16i: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (4); 4d: (4); 8e: (4); 8f: (8); 8g: (6); 8h: (6); 16i: (12)
$W\left(0, \frac{1}{2}, w\right)$ of space group No. 135		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)
$Y\left(u, \frac{1}{2}, 0\right)$ of space group No. 135		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (4); 4b: (3); 4c: (4); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (8); 16i: (12)
2	(0, 0, 0)	4a: (2); 4b: (3); 4c: (2); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (4); 16i: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate ($u, v, \frac{1}{2}$)

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate ($0, u, v$) ($-u, 0, v$)

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) ($-u, u, v$)

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate ($u, \frac{1}{2}, v$) ($-\frac{1}{2}, u, v$)

P1 ($u, v, 0$) of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (8); 4b: (6); 4c: (8); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (16); 16i: (24)
2	(0, 0, 0)	4a: (4); 4b: (6); 4c: (4); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (8); 16i: (24)

P2 ($u, v, \frac{1}{2}$) of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)

P3 ($0, u, v$) of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)

P4 (u, u, v) of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 135

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 8h: (12); 16i: (24)

136. Space group No. 136 ($P4_2/mnm$)

Tetragonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{4z}^-|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{C_{2y}|-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\} \\ \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{S_{4z}^-|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{S_{4z}^+|-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{\sigma_x|\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\} \quad \{\sigma_y|-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_{da}|0, 0, 0\} \quad \{\sigma_{db}|0, 0, 0\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$		
Operation	E	
Coordinate	$(0, 0, 0)$	
$M(\frac{1}{2}, \frac{1}{2}, 0)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	
$Z(0, 0, \frac{1}{2})$		
Operation	E	
Coordinate	$(0, 0, \frac{1}{2})$	
$A(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	
$R(0, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$X(0, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

 $\Gamma(0, 0, 0)$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (1);	4f: (1);	4g: (1);	8h: (1);	8i: (2);	8j: (2); 16k: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (0);	4f: (1);	4g: (1);	8h: (1);	8i: (2);	8j: (1); 16k: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (0);	4f: (1);	4g: (1);	8h: (1);	8i: (2);	8j: (1); 16k: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (1);	4f: (1);	4g: (1);	8h: (1);	8i: (2);	8j: (2); 16k: (3)
5	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (2);	4e: (2);	4f: (1);	4g: (1);	8h: (4);	8i: (2);	8j: (3); 16k: (6)
6	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	4e: (0);	4f: (0);	4g: (0);	8h: (1);	8i: (1);	8j: (1); 16k: (3)
7	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (1);	4f: (1);	4g: (1);	8h: (1);	8i: (1);	8j: (2); 16k: (3)
8	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (0);	4e: (1);	4f: (1);	4g: (1);	8h: (1);	8i: (1);	8j: (2); 16k: (3)
9	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (0);	4e: (0);	4f: (0);	4g: (0);	8h: (1);	8i: (1);	8j: (1); 16k: (3)
10	(0, 0, 0)	2a: (2);	2b: (2);	4c: (4);	4d: (2);	4e: (2);	4f: (2);	4g: (2);	8h: (4);	8i: (4);	8j: (3); 16k: (6)

 $M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (2);	4d: (1);	4e: (1);	4f: (1);	4g: (1);	8h: (2);	8i: (2);	8j: (2); 16k: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (2);	4d: (1);	4e: (0);	4f: (1);	4g: (1);	8h: (2);	8i: (2);	8j: (1); 16k: (3)
3	(0, 0, 0)	2a: (0);	2b: (0);	4c: (2);	4d: (1);	4e: (2);	4f: (1);	4g: (1);	8h: (2);	8i: (2);	8j: (3); 16k: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (0);	4d: (1);	4e: (1);	4f: (1);	4g: (1);	8h: (2);	8i: (1);	8j: (2); 16k: (3)
5	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (0);	4f: (0);	4g: (0);	8h: (2);	8i: (1);	8j: (1); 16k: (3)
6	(0, 0, 0)	2a: (2);	2b: (2);	4c: (0);	4d: (1);	4e: (2);	4f: (2);	4g: (2);	8h: (2);	8i: (4);	8j: (3); 16k: (6)

$Z\left(0, 0, \frac{1}{2}\right)$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (1); 4g: (2); 8h: (4); 8i: (3); 8j: (3); 16k: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 4f: (1); 4g: (1); 8h: (2); 8i: (3); 8j: (2); 16k: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 4g: (1); 8h: (4); 8i: (3); 8j: (3); 16k: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 4g: (2); 8h: (2); 8i: (3); 8j: (4); 16k: (6)

$A\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (4); 8i: (3); 8j: (4); 16k: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (2); 4g: (1); 8h: (2); 8i: (3); 8j: (3); 16k: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (2); 4e: (0); 4f: (1); 4g: (1); 8h: (4); 8i: (3); 8j: (2); 16k: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 4f: (1); 4g: (2); 8h: (2); 8i: (3); 8j: (3); 16k: (6)

$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (3); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (6); 8j: (6); 16k: (12)
2	(0, 0, 0)	2a: (3); 2b: (0); 4c: (3); 4d: (3); 4e: (3); 4f: (3); 4g: (3); 8h: (6); 8i: (6); 8j: (6); 16k: (12)

$X\left(0, \frac{1}{2}, 0\right)$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 4f: (4); 4g: (4); 8h: (6); 8i: (8); 8j: (6); 16k: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 4f: (2); 4g: (2); 8h: (6); 8i: (4); 8j: (6); 16k: (12)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

S(u , u , $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)

SM(u , u , 0)

Operation	E	C_{4z}^+
Coordinate	(u , u , 0)	($-u$, u , 0)

T(u , $\frac{1}{2}$, $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(u , $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, u , $\frac{1}{2}$)

$U(0, v, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (4);	4d: (3);	4e: (3);	4f: (4);	4g: (4);	8h: (6);	8i: (8);	8j: (6);	16k: (12)
2	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (3);	4e: (3);	4f: (2);	4g: (2);	8h: (6);	8i: (4);	8j: (6);	16k: (12)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (2);	4d: (3);	4e: (3);	4f: (2);	4g: (2);	8h: (6);	8i: (4);	8j: (6);	16k: (12)
4	(0, 0, 0)	2a: (2);	2b: (2);	4c: (4);	4d: (3);	4e: (3);	4f: (4);	4g: (4);	8h: (6);	8i: (8);	8j: (6);	16k: (12)

LD $(0, 0, w)$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	4f: (2);	4g: (2);	8h: (2);	8i: (3);	8j: (4);	16k: (6)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	4e: (0);	4f: (1);	4g: (1);	8h: (2);	8i: (3);	8j: (2);	16k: (6)
3	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	4e: (0);	4f: (1);	4g: (1);	8h: (2);	8i: (3);	8j: (2);	16k: (6)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (2);	4f: (2);	4g: (2);	8h: (2);	8i: (3);	8j: (4);	16k: (6)
5	(0, 0, 0)	2a: (2);	2b: (2);	4c: (4);	4d: (4);	4e: (4);	4f: (3);	4g: (3);	8h: (8);	8i: (6);	8j: (6);	16k: (12)

S $(u, u, \frac{1}{2})$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (4);	4f: (3);	4g: (4);	8h: (6);	8i: (6);	8j: (7);	16k: (12)
2	(0, 0, 0)	2a: (2);	2b: (2);	4c: (3);	4d: (3);	4e: (4);	4f: (4);	4g: (3);	8h: (6);	8i: (6);	8j: (7);	16k: (12)
3	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (2);	4f: (2);	4g: (3);	8h: (6);	8i: (6);	8j: (5);	16k: (12)
4	(0, 0, 0)	2a: (1);	2b: (1);	4c: (3);	4d: (3);	4e: (2);	4f: (3);	4g: (2);	8h: (6);	8i: (6);	8j: (5);	16k: (12)

SM $(u, u, 0)$ of space group No. 136

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (2);	2b: (2);	4c: (4);	4d: (3);	4e: (4);	4f: (4);	4g: (4);	8h: (6);	8i: (8);	8j: (7);	16k: (12)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (2);	4d: (3);	4e: (2);	4f: (1);	4g: (1);	8h: (6);	8i: (4);	8j: (5);	16k: (12)
3	(0, 0, 0)	2a: (2);	2b: (2);	4c: (4);	4d: (3);	4e: (2);	4f: (4);	4g: (4);	8h: (6);	8i: (8);	8j: (5);	16k: (12)
4	(0, 0, 0)	2a: (2);	2b: (2);	4c: (2);	4d: (3);	4e: (4);	4f: (3);	4g: (3);	8h: (6);	8i: (4);	8j: (7);	16k: (12)

T $(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
U $(0, v, \frac{1}{2})$ of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
V $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 4f: (2); 4g: (2); 8h: (4); 8i: (3); 8j: (4); 16k: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (2); 4e: (0); 4f: (1); 4g: (1); 8h: (4); 8i: (3); 8j: (2); 16k: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (2); 4d: (2); 4e: (4); 4f: (3); 4g: (3); 8h: (4); 8i: (6); 8j: (6); 16k: (12)
W $(0, \frac{1}{2}, w)$ of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
Y $(u, \frac{1}{2}, 0)$ of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 4f: (4); 4g: (4); 8h: (6); 8i: (8); 8j: (6); 16k: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 4f: (2); 4g: (2); 8h: (6); 8i: (4); 8j: (6); 16k: (12)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation	E
Coordinate	($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation	E
Coordinate	($u, v, \frac{1}{2}$)

P3(0, u, v)

Operation	E	C_{4z}^+
Coordinate	(0, u, v)	($-u, 0, v$)

P4(u, u, v)

Operation	E	C_{4z}^+
Coordinate	(u, u, v)	($-u, u, v$)

P5($u, \frac{1}{2}, v$)

$$\begin{array}{ccc} \text{Operation} & E & C_{4z}^+ \\ \text{Coordinate} & (u, \frac{1}{2}, v) & (-\frac{1}{2}, u, v) \end{array}$$

P1 ($u, v, 0$) of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 4c: (8); 4d: (6); 4e: (6); 4f: (8); 4g: (8); 8h: (12); 8i: (16); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (6); 4e: (6); 4f: (4); 4g: (4); 8h: (12); 8i: (8); 8j: (12); 16k: (24)
P2 ($u, v, \frac{1}{2}$) of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
P3 (0, u, v) of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 16k: (24)
P4 (u, u, v) of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 4c: (6); 4d: (6); 4e: (8); 4f: (7); 4g: (7); 8h: (12); 8i: (12); 8j: (14); 16k: (24)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (6); 4d: (6); 4e: (4); 4f: (5); 4g: (5); 8h: (12); 8i: (12); 8j: (10); 16k: (24)
P5 ($u, \frac{1}{2}, v$) of space group No. 136		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 4f: (6); 4g: (6); 8h: (12); 8i: (12); 8j: (12); 16k: (24)

137. Space group No. 137 ($P4_2/nmc$)

$$\begin{array}{l} \text{Tetragonal primitive lattice} \\ \vec{a} = (a, 0, 0) \quad \vec{t}_1 = \vec{a} \\ \vec{b} = (0, a, 0) \quad \vec{t}_2 = \vec{b} \\ \vec{c} = (0, 0, c) \quad \vec{t}_3 = \vec{c} \end{array}$$

a. Space group operations

$\{E 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{4z}^+ -\frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{C_{4z}^- -\frac{1}{2},-\frac{1}{2},\frac{1}{2}\}$	$\{C_{2x} \frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{C_{2y} -\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}$	$\{C_{2a} 0,0,0\}$	$\{C_{2b} 0,0,0\}$
$\{I -\frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_z -\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}$	$\{S_{4z}^- 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$	$\{\sigma_x 0,0,0\}$	$\{\sigma_y 0,0,0\}$	$\{\sigma_{da} -\frac{1}{2},-\frac{1}{2},\frac{1}{2}\}$	$\{\sigma_{db} -\frac{1}{2},\frac{1}{2},\frac{1}{2}\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$
Operation E
Coordinate (0,0,0)
$M(\frac{1}{2},\frac{1}{2},0)$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},0)$
$Z(0,0,\frac{1}{2})$
Operation E
Coordinate $(0,0,\frac{1}{2})$
$A(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$
$R(0,\frac{1}{2},\frac{1}{2})$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,\frac{1}{2})$
$X(0,\frac{1}{2},0)$
Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

$\Gamma(0,0,0)$ of space group No. 137

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (0); 8f: (1); 8g: (2); 16h: (3)
2	(0,0,0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 8e: (0); 8f: (2); 8g: (1); 16h: (3)
3	(0,0,0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 8e: (0); 8f: (2); 8g: (2); 16h: (3)
4	(0,0,0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 8e: (0); 8f: (1); 8g: (1); 16h: (3)
5	(0,0,0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (0); 8f: (3); 8g: (3); 16h: (6)
6	(0,0,0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 8e: (3); 8f: (1); 8g: (1); 16h: (3)
7	(0,0,0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (2); 8g: (2); 16h: (3)
8	(0,0,0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 8e: (3); 8f: (2); 8g: (1); 16h: (3)
9	(0,0,0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 8e: (3); 8f: (1); 8g: (2); 16h: (3)
10	(0,0,0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6); 8f: (3); 8g: (3); 16h: (6)

$M\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 137			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (3); 8g: (3); 16h: (6)	
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (2); 8e: (3); 8f: (2); 8g: (3); 16h: (6)	
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (3); 8g: (3); 16h: (6)	
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 8e: (3); 8f: (4); 8g: (3); 16h: (6)	
$Z\left(0, 0, \frac{1}{2}\right)$ of space group No. 137			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (3); 16h: (6)	
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 8e: (3); 8f: (3); 8g: (2); 16h: (6)	
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (3); 16h: (6)	
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (4); 16h: (6)	
$A\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 137			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (2); 8e: (3); 8f: (3); 8g: (3); 16h: (6)	
2	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (2); 8e: (3); 8f: (3); 8g: (3); 16h: (6)	
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (3); 8g: (3); 16h: (6)	
$R\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 137			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (7); 16h: (12)	
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (5); 16h: (12)	
$X\left(0, \frac{1}{2}, 0\right)$ of space group No. 137			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (7); 16h: (12)	
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (5); 16h: (12)	

c. Results for high-symmetry lines

$DT(0, v, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, 0)$	$(-v, 0, 0)$
$LD(0, 0, w)$		
Operation	E	
Coordinate	$(0, 0, w)$	
$S(u, u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$

 $SM(u, u, 0)$

Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$

 $T(u, \frac{1}{2}, \frac{1}{2})$

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$

 $U(0, v, \frac{1}{2})$

Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$

 $V(\frac{1}{2}, \frac{1}{2}, w)$

Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$

 $W(0, \frac{1}{2}, w)$

Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$

 $Y(u, \frac{1}{2}, 0)$

Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT (0, v, 0) of space group No. 137

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (7); 16h: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (5); 16h: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (7); 16h: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (5); 16h: (12)

LD (0, 0, w) of space group No. 137

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (4); 16h: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 8e: (3); 8f: (3); 8g: (2); 16h: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (4); 16h: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 8e: (3); 8f: (3); 8g: (2); 16h: (6)
5	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (6); 16h: (12)

S $(u, u, \frac{1}{2})$ of space group No. 137

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)

SM (u, u, 0) of space group No. 137

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 8e: (6); 8f: (5); 8g: (6); 16h: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 8e: (6); 8f: (5); 8g: (6); 16h: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 8e: (6); 8f: (7); 8g: (6); 16h: (12)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 8e: (6); 8f: (7); 8g: (6); 16h: (12)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (7); 16h: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (5); 16h: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (7); 16h: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (5); 16h: (12)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (3); 8g: (3); 16h: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 8e: (3); 8f: (3); 8g: (3); 16h: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (4); 8e: (6); 8f: (6); 8g: (6); 16h: (12)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (7); 16h: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (5); 16h: (12)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate ($u, v, \frac{1}{2}$)

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate ($0, u, v$) ($-u, 0, v$)

P4(u, u, v)

Operation E C_{4z}^+
Coordinate (u, u, v) ($-u, u, v$)

P5($u, \frac{1}{2}, v$)

Operation E C_{4z}^+
Coordinate ($u, \frac{1}{2}, v$) ($-\frac{1}{2}, u, v$)

P1 ($u, v, 0$) of space group No. 137

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)

P2 ($u, v, \frac{1}{2}$) of space group No. 137

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)

P3 ($0, u, v$) of space group No. 137

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 4c: (8); 4d: (8); 8e: (12); 8f: (12); 8g: (14); 16h: (24)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 8e: (12); 8f: (12); 8g: (10); 16h: (24)

P4 (u, u, v) of space group No. 137

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)

P5 ($u, \frac{1}{2}, v$) of space group No. 137

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 8e: (12); 8f: (12); 8g: (12); 16h: (24)

138. Space group No. 138 ($P4_2/nm$)

Tetragonal primitive lattice $\vec{a} = (a, 0, 0)$ $\vec{t}_1 = \vec{a}$
 $\vec{b} = (0, a, 0)$ $\vec{t}_2 = \vec{b}$
 $\vec{c} = (0, 0, c)$ $\vec{t}_3 = \vec{c}$

a. Space group operations

b. Results for high-symmetry points

$\{E 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{4z}^+ -\frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{C_{4z}^- -\frac{1}{2},-\frac{1}{2},\frac{1}{2}\}$	$\{C_{2x} \frac{1}{2},\frac{1}{2},0\}$	$\{C_{2y} -\frac{1}{2},-\frac{1}{2},0\}$	$\{C_{2a} 0,0,-\frac{1}{2}\}$	$\{C_{2b} 0,0,-\frac{1}{2}\}$
$\{I -\frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_z -\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}$	$\{S_{4z}^- 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$	$\{\sigma_x 0,0,-\frac{1}{2}\}$	$\{\sigma_y 0,0,\frac{1}{2}\}$	$\{\sigma_{da} -\frac{1}{2},-\frac{1}{2},0\}$	$\{\sigma_{db} -\frac{1}{2},\frac{1}{2},0\}$

 $\Gamma(0,0,0)$

Operation E
Coordinate (0,0,0)

 $M(\frac{1}{2},\frac{1}{2},0)$

Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},0)$

 $Z(0,0,\frac{1}{2})$

Operation E
Coordinate $(0,0,\frac{1}{2})$

 $A(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

 $R(0,\frac{1}{2},\frac{1}{2})$

Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,\frac{1}{2})$

 $X(0,\frac{1}{2},0)$

Operation E C_{4z}^+
Coordinate $(0,\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$

 $\Gamma(0,0,0)$ of space group No. 138

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 4e: (1); 8f: (1); 8g: (1); 8h: (1); 8i: (2); 16j: (3)
2	(0,0,0)	4a: (1); 4b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (1); 8g: (2); 8h: (2); 8i: (1); 16j: (3)
3	(0,0,0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 4e: (0); 8f: (1); 8g: (2); 8h: (2); 8i: (1); 16j: (3)
4	(0,0,0)	4a: (0); 4b: (1); 4c: (0); 4d: (0); 4e: (1); 8f: (1); 8g: (1); 8h: (1); 8i: (2); 16j: (3)
5	(0,0,0)	4a: (2); 4b: (2); 4c: (0); 4d: (0); 4e: (2); 8f: (4); 8g: (3); 8h: (3); 8i: (3); 16j: (6)
6	(0,0,0)	4a: (0); 4b: (1); 4c: (1); 4d: (1); 4e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (3)
7	(0,0,0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (1); 8g: (2); 8h: (2); 8i: (2); 16j: (3)
8	(0,0,0)	4a: (1); 4b: (0); 4c: (2); 4d: (2); 4e: (1); 8f: (1); 8g: (2); 8h: (2); 8i: (2); 16j: (3)
9	(0,0,0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 16j: (3)
10	(0,0,0)	4a: (2); 4b: (2); 4c: (3); 4d: (3); 4e: (2); 8f: (4); 8g: (3); 8h: (3); 8i: (3); 16j: (6)

 $M(\frac{1}{2},\frac{1}{2},0)$ of space group No. 138

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 8f: (4); 8g: (3); 8h: (3); 8i: (4); 16j: (6)
2	(0, 0, 0)	4a: (0); 4b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (2); 8g: (2); 8h: (2); 8i: (3); 16j: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (0); 8f: (4); 8g: (3); 8h: (3); 8i: (2); 16j: (6)
4	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (2); 8g: (4); 8h: (4); 8i: (3); 16j: (6)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (2); 4e: (2); 8f: (4); 8g: (2); 8h: (4); 8i: (3); 16j: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (0); 8f: (2); 8g: (3); 8h: (3); 8i: (2); 16j: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (1); 4e: (2); 8f: (4); 8g: (4); 8h: (2); 8i: (3); 16j: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 8i: (4); 16j: (6)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (0); 4e: (1); 8f: (2); 8g: (2); 8h: (1); 8i: (2); 16j: (3)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (0); 4e: (0); 8f: (2); 8g: (1); 8h: (2); 8i: (1); 16j: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (3); 4d: (0); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 8i: (3); 16j: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (2); 4e: (1); 8f: (2); 8g: (1); 8h: (2); 8i: (2); 16j: (3)
5	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (1); 4e: (0); 8f: (2); 8g: (2); 8h: (1); 8i: (1); 16j: (3)
6	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (3); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 8i: (3); 16j: (6)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)

c. Results for high-symmetry lines

DT(0, v , 0)

Operation	E	C_{4z}^+
Coordinate	(0, v , 0)	($-v$, 0, 0)

LD(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

S(u , u , $\frac{1}{2}$)

Operation	E	C_{4z}^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)

SM(u , u , 0)

Operation	E	C_{4z}^+
Coordinate	$(u, u, 0)$	$(-u, u, 0)$
$T(u, \frac{1}{2}, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, u, \frac{1}{2})$
$U(0, v, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(0, v, \frac{1}{2})$	$(-v, 0, \frac{1}{2})$
$V(\frac{1}{2}, \frac{1}{2}, w)$		
Operation	E	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	
$W(0, \frac{1}{2}, w)$		
Operation	E	C_{4z}^+
Coordinate	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, 0, w)$
$Y(u, \frac{1}{2}, 0)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(-\frac{1}{2}, u, 0)$

DT $(0, v, 0)$ of space group No. 138

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
2	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
3	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
4	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)

LD $(0, 0, w)$ of space group No. 138

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 8i: (4); 16j: (6)
2	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (0); 8f: (2); 8g: (3); 8h: (3); 8i: (2); 16j: (6)
3	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (1); 4e: (0); 8f: (2); 8g: (3); 8h: (3); 8i: (2); 16j: (6)
4	$(0, 0, 0)$	4a: (1); 4b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (2); 8g: (3); 8h: (3); 8i: (4); 16j: (6)
5	$(0, 0, 0)$	4a: (4); 4b: (4); 4c: (3); 4d: (3); 4e: (4); 8f: (8); 8g: (6); 8h: (6); 8i: (6); 16j: (12)

S $(u, u, \frac{1}{2})$ of space group No. 138

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (4); 4e: (4); 8f: (6); 8g: (5); 8h: (7); 8i: (7); 16j: (12)
2	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (4); 4d: (3); 4e: (4); 8f: (6); 8g: (7); 8h: (5); 8i: (7); 16j: (12)
3	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (2); 4d: (3); 4e: (2); 8f: (6); 8g: (5); 8h: (7); 8i: (5); 16j: (12)
4	$(0, 0, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (2); 4e: (2); 8f: (6); 8g: (7); 8h: (5); 8i: (5); 16j: (12)

SM $(u, u, 0)$ of space group No. 138

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (3); 4c: (3); 4d: (3); 4e: (4); 8f: (6); 8g: (5); 8h: (5); 8i: (7); 16j: (12)
2	(0, 0, 0)	4a: (2); 4b: (3); 4c: (2); 4d: (2); 4e: (2); 8f: (6); 8g: (5); 8h: (5); 8i: (5); 16j: (12)
3	(0, 0, 0)	4a: (4); 4b: (3); 4c: (3); 4d: (3); 4e: (2); 8f: (6); 8g: (7); 8h: (7); 8i: (5); 16j: (12)
4	(0, 0, 0)	4a: (4); 4b: (3); 4c: (4); 4d: (4); 4e: (4); 8f: (6); 8g: (7); 8h: (7); 8i: (7); 16j: (12)
$T(u, \frac{1}{2}, \frac{1}{2})$ of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
$U(0, v, \frac{1}{2})$ of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)
$V(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 4e: (2); 8f: (4); 8g: (3); 8h: (3); 8i: (4); 16j: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 4e: (0); 8f: (4); 8g: (3); 8h: (3); 8i: (2); 16j: (6)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (3); 4d: (3); 4e: (4); 8f: (4); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
$W(0, \frac{1}{2}, w)$ of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (6); 16j: (12)
$Y(u, \frac{1}{2}, 0)$ of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)

d. Results for high-symmetry planes

P1($u, v, 0$)

Operation E
Coordinate ($u, v, 0$)

P2($u, v, \frac{1}{2}$)

Operation E
Coordinate ($u, v, \frac{1}{2}$)

P3($0, u, v$)

Operation E C_{4z}^+
Coordinate ($0, u, v$) ($-u, 0, v$)

P4(u, u, v)

Operation	E	C_{4z}^+
Coordinate	(u, u, v)	$(-u, u, v)$
P5 $(u, \frac{1}{2}, v)$		
Operation	E	C_{4z}^+
Coordinate	$(u, \frac{1}{2}, v)$	$(-\frac{1}{2}, u, v)$

P1 $(u, v, 0)$ of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)
P2 $(u, v, \frac{1}{2})$ of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)
P3 $(0, u, v)$ of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)
P4 (u, u, v) of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (7); 4d: (7); 4e: (8); 8f: (12); 8g: (12); 8h: (12); 8i: (14); 16j: (24)
2	(0, 0, 0)	4a: (6); 4b: (6); 4c: (5); 4d: (5); 4e: (4); 8f: (12); 8g: (12); 8h: (12); 8i: (10); 16j: (24)
P5 $(u, \frac{1}{2}, v)$ of space group No. 138		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 4c: (6); 4d: (6); 4e: (6); 8f: (12); 8g: (12); 8h: (12); 8i: (12); 16j: (24)

139. Space group No. 139 ($I4/mmm$)

Tetragonal body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{4z}^+ 0,0,0\}$	$\{C_{4z}^- 0,0,0\}$	$\{C_{2x} 0,0,0\}$	$\{C_{2y} 0,0,0\}$	$\{C_{2a} 0,0,0\}$	$\{C_{2b} 0,0,0\}$
$\{I 0,0,0\}$	$\{\sigma_z 0,0,0\}$	$\{S_{4z}^- 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$	$\{\sigma_x 0,0,0\}$	$\{\sigma_y 0,0,0\}$	$\{\sigma_{da} 0,0,0\}$	$\{\sigma_{db} 0,0,0\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$				
Operation	E			
Coordinate	$(0,0,0)$			
$N(0,\frac{1}{2},0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},0,0)$	$(0,\frac{1}{2},-\frac{1}{2})$	$(\frac{1}{2},0,-\frac{1}{2})$
$X(0,0,\frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0,0,\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},0)$		
$Z(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$			
$P(\frac{1}{4},\frac{1}{4},\frac{1}{4})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(\frac{1}{4},\frac{1}{4},\frac{1}{4})$	$(\frac{3}{4},-\frac{1}{4},-\frac{1}{4})$		

$\Gamma(0,0,0)$ of space group No. 139											
(Co-) irrep	Phonon AM	WYPO information									
1	(0,0,0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (1);	8f: (0);	8g: (1);	8h: (1);	8i: (1);	8j: (1); 16k: (1); 16l: (2); 16m: (2); 16n: (2); 32o: (3)
2	(0,0,0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (0);	8f: (0);	8g: (0);	8h: (1);	8i: (1);	8j: (1); 16k: (2); 16l: (2); 16m: (1); 16n: (1); 32o: (3)
3	(0,0,0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (0);	8f: (0);	8g: (1);	8h: (1);	8i: (1);	8j: (1); 16k: (2); 16l: (2); 16m: (1); 16n: (2); 32o: (3)
4	(0,0,0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (0);	8f: (0);	8g: (0);	8h: (1);	8i: (1);	8j: (1); 16k: (1); 16l: (2); 16m: (2); 16n: (1); 32o: (3)
5	(0,0,0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (1);	8f: (0);	8g: (2);	8h: (1);	8i: (1);	8j: (1); 16k: (3); 16l: (2); 16m: (3); 16n: (3); 32o: (6)
6	(0,0,0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (0);	8f: (1);	8g: (0);	8h: (0);	8i: (0);	8j: (0); 16k: (1); 16l: (1); 16m: (1); 16n: (1); 32o: (3)
7	(0,0,0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (1);	8f: (2);	8g: (1);	8h: (1);	8i: (1);	8j: (1); 16k: (2); 16l: (1); 16m: (2); 16n: (2); 32o: (3)
8	(0,0,0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (0);	8f: (2);	8g: (0);	8h: (1);	8i: (0);	8j: (0); 16k: (2); 16l: (1); 16m: (2); 16n: (1); 32o: (3)

9	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (0); 4e: (0); 8f: (1); 8g: (1); 8h: (0); 8i: (1); 8j: (1); 16k: (1); 16l: (1); 16m: (1); 16n: (2); 32o: (3)
10	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 8f: (3); 8g: (2); 8h: (2); 8i: (2); 8j: (2); 16k: (3); 16l: (4); 16m: (3); 16n: (3); 32o: (6)

$N \left(0, \frac{1}{2}, 0\right)$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (2); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (4); 8h: (3); 8i: (3); 8j: (4); 16k: (6); 16l: (6); 16m: (6); 16n: (7); 32o: (12)
2	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (3); 8g: (2); 8h: (3); 8i: (2); 8j: (3); 16k: (6); 16l: (6); 16m: (6); 16n: (5); 32o: (12)
3	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 4e: (1); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (2); 16k: (6); 16l: (6); 16m: (6); 16n: (5); 32o: (12)
4	(0, 0, 0)	2a: (2); 2b: (0); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (4); 8h: (3); 8i: (4); 8j: (3); 16k: (6); 16l: (6); 16m: (6); 16n: (7); 32o: (12)

$X \left(0, 0, \frac{1}{2}\right)$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (1); 4e: (1); 8f: (2); 8g: (2); 8h: (2); 8i: (2); 8j: (2); 16k: (3); 16l: (4); 16m: (4); 16n: (3); 32o: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (0); 4e: (1); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 16k: (2); 16l: (2); 16m: (3); 16n: (3); 32o: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (1); 4e: (0); 8f: (1); 8g: (2); 8h: (2); 8i: (2); 8j: (2); 16k: (3); 16l: (4); 16m: (2); 16n: (3); 32o: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (2); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 16k: (4); 16l: (2); 16m: (3); 16n: (3); 32o: (6)
5	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (0); 8f: (1); 8g: (2); 8h: (0); 8i: (1); 8j: (1); 16k: (3); 16l: (2); 16m: (2); 16n: (3); 32o: (6)
6	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (0); 4e: (1); 8f: (1); 8g: (1); 8h: (2); 8i: (2); 8j: (2); 16k: (2); 16l: (4); 16m: (3); 16n: (3); 32o: (6)
7	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (1); 4e: (1); 8f: (2); 8g: (2); 8h: (2); 8i: (1); 8j: (1); 16k: (3); 16l: (2); 16m: (4); 16n: (3); 32o: (6)
8	(0, 0, 0)	2a: (1); 2b: (1); 4c: (0); 4d: (1); 4e: (1); 8f: (2); 8g: (1); 8h: (2); 8i: (2); 8j: (2); 16k: (4); 16l: (4); 16m: (3); 16n: (3); 32o: (6)

$Z \left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (1); 8f: (2); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 16k: (2); 16l: (2); 16m: (2); 16n: (2); 32o: (3)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (1); 8g: (0); 8h: (1); 8i: (1); 8j: (1); 16k: (1); 16l: (2); 16m: (1); 16n: (1); 32o: (3)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (1); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 16k: (1); 16l: (2); 16m: (1); 16n: (2); 32o: (3)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (2); 8g: (0); 8h: (1); 8i: (1); 8j: (1); 16k: (2); 16l: (2); 16m: (2); 16n: (1); 32o: (3)
5	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (1); 8f: (3); 8g: (2); 8h: (1); 8i: (1); 8j: (1); 16k: (3); 16l: (2); 16m: (3); 16n: (3); 32o: (6)
6	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (0); 8g: (0); 8h: (0); 8i: (0); 8j: (0); 16k: (2); 16l: (1); 16m: (1); 16n: (1); 32o: (3)
7	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (0); 4e: (1); 8f: (0); 8g: (1); 8h: (1); 8i: (1); 8j: (1); 16k: (1); 16l: (1); 16m: (2); 16n: (2); 32o: (3)

8	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (0); 8g: (0); 8h: (1); 8i: (0); 8j: (0); 16k: (1); 16l: (1); 16m: (2); 16n: (1); 32o: (3)
9	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (0); 8g: (1); 8h: (0); 8i: (1); 8j: (1); 16k: (2); 16l: (1); 16m: (1); 16n: (2); 32o: (3)
10	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 8f: (0); 8g: (2); 8h: (2); 8i: (2); 8j: (2); 16k: (3); 16l: (4); 16m: (3); 16n: (3); 32o: (6)

P $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 4e: (1); 8f: (2); 8g: (2); 8h: (2); 8i: (1); 8j: (2); 16k: (3); 16l: (3); 16m: (4); 16n: (3); 32o: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (1); 8g: (2); 8h: (1); 8i: (2); 8j: (1); 16k: (3); 16l: (3); 16m: (2); 16n: (3); 32o: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (1); 8g: (2); 8h: (1); 8i: (1); 8j: (2); 16k: (3); 16l: (3); 16m: (2); 16n: (3); 32o: (6)
4	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (2); 8g: (2); 8h: (2); 8i: (2); 8j: (1); 16k: (3); 16l: (3); 16m: (4); 16n: (3); 32o: (6)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6); 16l: (6); 16m: (6); 16n: (6); 32o: (12)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	(u, -u, 0)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u$)

DT $(0, 0, u)$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (2); 8f: (3); 8g: (3); 8h: (4); 8i: (4); 8j: (4); 16k: (5); 16l: (8); 16m: (7); 16n: (6); 32o: (12)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (1); 8f: (2); 8g: (3); 8h: (1); 8i: (2); 8j: (2); 16k: (5); 16l: (4); 16m: (5); 16n: (6); 32o: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (1); 8f: (3); 8g: (3); 8h: (4); 8i: (4); 8j: (4); 16k: (7); 16l: (8); 16m: (5); 16n: (6); 32o: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (2); 4e: (2); 8f: (4); 8g: (3); 8h: (3); 8i: (2); 8j: (2); 16k: (7); 16l: (4); 16m: (7); 16n: (6); 32o: (12)

LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (2); 8g: (2); 8h: (2); 8i: (2); 8j: (2); 16k: (3); 16l: (3); 16m: (4); 16n: (4); 32o: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (1); 8g: (0); 8h: (1); 8i: (1); 8j: (1); 16k: (3); 16l: (3); 16m: (2); 16n: (2); 32o: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 8f: (1); 8g: (2); 8h: (1); 8i: (2); 8j: (2); 16k: (3); 16l: (3); 16m: (2); 16n: (4); 32o: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 8f: (2); 8g: (0); 8h: (2); 8i: (1); 8j: (1); 16k: (3); 16l: (3); 16m: (4); 16n: (2); 32o: (6)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (4); 8h: (3); 8i: (3); 8j: (3); 16k: (6); 16l: (6); 16m: (6); 16n: (6); 32o: (12)

Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (5); 8j: (7); 16k: (12); 16l: (12); 16m: (12); 16n: (12); 32o: (24)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (6); 8i: (7); 8j: (5); 16k: (12); 16l: (12); 16m: (12); 16n: (12); 32o: (24)

SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (4); 8h: (4); 8i: (4); 8j: (4); 16k: (6); 16l: (8); 16m: (6); 16n: (7); 32o: (12)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (1); 8f: (3); 8g: (2); 8h: (2); 8i: (1); 8j: (1); 16k: (6); 16l: (4); 16m: (6); 16n: (5); 32o: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 8f: (3); 8g: (2); 8h: (4); 8i: (4); 8j: (4); 16k: (6); 16l: (8); 16m: (6); 16n: (5); 32o: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (3); 8g: (4); 8h: (2); 8i: (3); 8j: (3); 16k: (6); 16l: (4); 16m: (6); 16n: (7); 32o: (12)

W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (4); 8g: (4); 8h: (4); 8i: (3); 8j: (3); 16k: (6); 16l: (6); 16m: (8); 16n: (6); 32o: (12)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (2); 4e: (0); 8f: (2); 8g: (4); 8h: (2); 8i: (3); 8j: (3); 16k: (6); 16l: (6); 16m: (4); 16n: (6); 32o: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6); 16l: (6); 16m: (6); 16n: (6); 32o: (12)

4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (2); 8h: (3); 8i: (3); 8j: (3); 16k: (6); 16l: (6); 16m: (6); 16n: (6); 32o: (12)

$Y \left(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2} \right)$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (4); 8g: (3); 8h: (4); 8i: (4); 8j: (4); 16k: (7); 16l: (8); 16m: (7); 16n: (6); 32o: (12)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (2); 4e: (1); 8f: (3); 8g: (3); 8h: (1); 8i: (2); 8j: (2); 16k: (7); 16l: (4); 16m: (5); 16n: (6); 32o: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 8f: (3); 8g: (3); 8h: (3); 8i: (2); 8j: (2); 16k: (5); 16l: (4); 16m: (7); 16n: (6); 32o: (12)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 8f: (2); 8g: (3); 8h: (4); 8i: (4); 8j: (4); 16k: (5); 16l: (8); 16m: (5); 16n: (6); 32o: (12)

d. Results for high-symmetry planes

$P1 \left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$

Operation	E	C_{4z}^+
Coordinate	$\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$	$\left(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v \right)$

$P2(u, v, -u)$

Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$

$P3(u, -u, v)$

Operation	E
Coordinate	$(u, -u, v)$

$P1 \left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 8f: (7); 8g: (6); 8h: (7); 8i: (6); 8j: (6); 16k: (12); 16l: (12); 16m: (14); 16n: (12); 32o: (24)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 8f: (5); 8g: (6); 8h: (5); 8i: (6); 8j: (6); 16k: (12); 16l: (12); 16m: (10); 16n: (12); 32o: (24)

$P2(u, v, -u)$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (4); 8f: (6); 8g: (8); 8h: (6); 8i: (7); 8j: (7); 16k: (12); 16l: (12); 16m: (12); 16n: (14); 32o: (24)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 8f: (6); 8g: (4); 8h: (6); 8i: (5); 8j: (5); 16k: (12); 16l: (12); 16m: (12); 16n: (10); 32o: (24)

$P3(u, -u, v)$ of space group No. 139

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (8); 8i: (8); 8j: (8); 16k: (12); 16l: (16); 16m: (12); 16n: (12); 32o: (24)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (3); 4e: (3); 8f: (6); 8g: (6); 8h: (4); 8i: (4); 8j: (4); 16k: (12); 16l: (8); 16m: (12); 16n: (12); 32o: (24)

140. Space group No. 140 ($I4/mcm$)

Tetragonal body-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{C_{2x}|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2y}|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{2a}|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{2b}|-\frac{1}{2}, -\frac{1}{2}, 0\} \\ \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{\sigma_x|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_y|-\frac{1}{2}, \frac{1}{2}, 0\} \quad \{\sigma_{da}|-\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{\sigma_{db}|-\frac{1}{2}, \frac{1}{2}, 0\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		
$Z(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$				
Operation	E			
Coordinate	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4})$		

$\Gamma (0, 0, 0)$ of space group No. 140		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 16i: (1); 16j: (1); 16k: (2); 16l: (2); 32m: (3)
2	(0, 0, 0)	4a: (1); 4b: (0); 4c: (0); 4d: (0); 8e: (0); 8f: (1); 8g: (0); 8h: (1); 16i: (2); 16j: (2); 16k: (2); 16l: (1); 32m: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 8e: (0); 8f: (0); 8g: (0); 8h: (1); 16i: (2); 16j: (1); 16k: (2); 16l: (1); 32m: (3)
4	(0, 0, 0)	4a: (0); 4b: (1); 4c: (0); 4d: (0); 8e: (0); 8f: (0); 8g: (1); 8h: (1); 16i: (1); 16j: (2); 16k: (2); 16l: (2); 32m: (3)
5	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 8e: (0); 8f: (2); 8g: (2); 8h: (1); 16i: (3); 16j: (3); 16k: (2); 16l: (3); 32m: (6)
6	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (0); 8e: (1); 8f: (1); 8g: (0); 8h: (0); 16i: (1); 16j: (1); 16k: (1); 16l: (1); 32m: (3)
7	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 16i: (2); 16j: (2); 16k: (1); 16l: (2); 32m: (3)
8	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (1); 8e: (2); 8f: (0); 8g: (1); 8h: (1); 16i: (2); 16j: (1); 16k: (1); 16l: (2); 32m: (3)
9	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 8e: (1); 8f: (0); 8g: (0); 8h: (0); 16i: (1); 16j: (2); 16k: (1); 16l: (1); 32m: (3)
10	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 8e: (3); 8f: (2); 8g: (2); 8h: (2); 16i: (3); 16j: (3); 16k: (4); 16l: (3); 32m: (6)
$N (0, \frac{1}{2}, 0)$ of space group No. 140		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12); 16j: (12); 16k: (12); 16l: (12); 32m: (24)
$X (0, 0, \frac{1}{2})$ of space group No. 140		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (0); 8e: (2); 8f: (2); 8g: (2); 8h: (2); 16i: (3); 16j: (3); 16k: (4); 16l: (4); 32m: (6)
2	(0, 0, 0)	4a: (0); 4b: (1); 4c: (1); 4d: (0); 8e: (1); 8f: (1); 8g: (2); 8h: (1); 16i: (2); 16j: (3); 16k: (2); 16l: (3); 32m: (6)
3	(0, 0, 0)	4a: (1); 4b: (0); 4c: (2); 4d: (0); 8e: (1); 8f: (2); 8g: (0); 8h: (2); 16i: (3); 16j: (3); 16k: (4); 16l: (2); 32m: (6)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (0); 8e: (2); 8f: (1); 8g: (2); 8h: (1); 16i: (4); 16j: (3); 16k: (2); 16l: (3); 32m: (6)
5	(0, 0, 0)	4a: (1); 4b: (0); 4c: (0); 4d: (0); 8e: (1); 8f: (2); 8g: (0); 8h: (0); 16i: (3); 16j: (3); 16k: (2); 16l: (2); 32m: (6)
6	(0, 0, 0)	4a: (0); 4b: (1); 4c: (0); 4d: (2); 8e: (1); 8f: (1); 8g: (2); 8h: (2); 16i: (2); 16j: (3); 16k: (4); 16l: (3); 32m: (6)
7	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (2); 8e: (2); 8f: (2); 8g: (2); 8h: (2); 16i: (3); 16j: (3); 16k: (2); 16l: (4); 32m: (6)
8	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (2); 8e: (2); 8f: (1); 8g: (2); 8h: (2); 16i: (4); 16j: (3); 16k: (4); 16l: (3); 32m: (6)
$Z (-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 140		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 8e: (2); 8f: (0); 8g: (1); 8h: (1); 16i: (2); 16j: (1); 16k: (2); 16l: (2); 32m: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 8e: (1); 8f: (0); 8g: (0); 8h: (1); 16i: (1); 16j: (2); 16k: (2); 16l: (1); 32m: (3)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 8e: (1); 8f: (1); 8g: (0); 8h: (1); 16i: (1); 16j: (1); 16k: (2); 16l: (1); 32m: (3)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 8e: (2); 8f: (1); 8g: (1); 8h: (1); 16i: (2); 16j: (2); 16k: (2); 16l: (2); 32m: (3)
5	(0, 0, 0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 8e: (3); 8f: (2); 8g: (2); 8h: (1); 16i: (3); 16j: (3); 16k: (2); 16l: (3); 32m: (6)
6	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 8e: (0); 8f: (0); 8g: (0); 8h: (0); 16i: (2); 16j: (1); 16k: (1); 16l: (1); 32m: (3)
7	(0, 0, 0)	4a: (0); 4b: (1); 4c: (0); 4d: (1); 8e: (0); 8f: (0); 8g: (1); 8h: (1); 16i: (1); 16j: (2); 16k: (1); 16l: (2); 32m: (3)
8	(0, 0, 0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 8e: (0); 8f: (1); 8g: (1); 8h: (1); 16i: (1); 16j: (1); 16k: (1); 16l: (2); 32m: (3)
9	(0, 0, 0)	4a: (1); 4b: (0); 4c: (1); 4d: (0); 8e: (0); 8f: (1); 8g: (0); 8h: (0); 16i: (2); 16j: (2); 16k: (1); 16l: (1); 32m: (3)
10	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 8e: (0); 8f: (2); 8g: (2); 8h: (2); 16i: (3); 16j: (3); 16k: (4); 16l: (3); 32m: (6)

P $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 140

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (2); 8g: (2); 8h: (2); 16i: (3); 16j: (3); 16k: (3); 16l: (4); 32m: (6)
2	(0, 0, 0)	4a: (1); 4b: (0); 4c: (1); 4d: (0); 8e: (1); 8f: (2); 8g: (0); 8h: (1); 16i: (3); 16j: (3); 16k: (3); 16l: (2); 32m: (6)
3	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 8e: (3); 8f: (2); 8g: (4); 8h: (3); 16i: (6); 16j: (6); 16k: (6); 16l: (6); 32m: (12)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		

Operation	E
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$
$Y(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$	
Operation	E C_{4z}^+
Coordinate	$(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}) (\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u)$

DT $(0, 0, u)$ of space group No. 140		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (4); 8h: (4); 16i: (5); 16j: (6); 16k: (8); 16l: (7); 32m: (12)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (0); 8e: (2); 8f: (3); 8g: (2); 8h: (1); 16i: (5); 16j: (6); 16k: (4); 16l: (5); 32m: (12)
3	(0, 0, 0)	4a: (2); 4b: (1); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (2); 8h: (4); 16i: (7); 16j: (6); 16k: (8); 16l: (5); 32m: (12)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (2); 8e: (4); 8f: (3); 8g: (4); 8h: (3); 16i: (7); 16j: (6); 16k: (4); 16l: (7); 32m: (12)
LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 140		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (2); 8f: (2); 8g: (2); 8h: (2); 16i: (3); 16j: (3); 16k: (3); 16l: (4); 32m: (6)
2	(0, 0, 0)	4a: (1); 4b: (0); 4c: (1); 4d: (0); 8e: (1); 8f: (2); 8g: (0); 8h: (1); 16i: (3); 16j: (3); 16k: (3); 16l: (2); 32m: (6)
3	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 8e: (1); 8f: (0); 8g: (0); 8h: (1); 16i: (3); 16j: (3); 16k: (3); 16l: (2); 32m: (6)
4	(0, 0, 0)	4a: (0); 4b: (1); 4c: (0); 4d: (1); 8e: (2); 8f: (0); 8g: (2); 8h: (2); 16i: (3); 16j: (3); 16k: (3); 16l: (4); 32m: (6)
5	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (3); 8f: (4); 8g: (4); 8h: (3); 16i: (6); 16j: (6); 16k: (6); 16l: (6); 32m: (12)
Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 140		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12); 16j: (12); 16k: (12); 16l: (12); 32m: (24)
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 140		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (3); 8h: (4); 16i: (6); 16j: (5); 16k: (8); 16l: (6); 32m: (12)
2	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 8e: (3); 8f: (3); 8g: (3); 8h: (2); 16i: (6); 16j: (5); 16k: (4); 16l: (6); 32m: (12)
3	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (3); 8f: (3); 8g: (3); 8h: (4); 16i: (6); 16j: (7); 16k: (8); 16l: (6); 32m: (12)
4	(0, 0, 0)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 8e: (3); 8f: (3); 8g: (3); 8h: (2); 16i: (6); 16j: (7); 16k: (4); 16l: (6); 32m: (12)
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 140		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (4); 8f: (4); 8g: (4); 8h: (4); 16i: (6); 16j: (6); 16k: (6); 16l: (8); 32m: (12)
2	(0, 0, 0)	4a: (2); 4b: (0); 4c: (2); 4d: (0); 8e: (2); 8f: (4); 8g: (0); 8h: (2); 16i: (6); 16j: (6); 16k: (6); 16l: (4); 32m: (12)
3	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 8e: (3); 8f: (2); 8g: (4); 8h: (3); 16i: (6); 16j: (6); 16k: (6); 16l: (6); 32m: (12)
4	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 8e: (3); 8f: (2); 8g: (4); 8h: (3); 16i: (6); 16j: (6); 16k: (6); 16l: (6); 32m: (12)

$Y \left(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2} \right)$ of space group No. 140

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 8e: (4); 8f: (3); 8g: (4); 8h: (4); 16i: (7); 16j: (6); 16k: (8); 16l: (7); 32m: (12)
2	(0, 0, 0)	4a: (2); 4b: (1); 4c: (1); 4d: (0); 8e: (3); 8f: (3); 8g: (2); 8h: (1); 16i: (7); 16j: (6); 16k: (4); 16l: (5); 32m: (12)
3	(0, 0, 0)	4a: (1); 4b: (2); 4c: (1); 4d: (2); 8e: (3); 8f: (3); 8g: (4); 8h: (3); 16i: (5); 16j: (6); 16k: (4); 16l: (7); 32m: (12)
4	(0, 0, 0)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 8e: (2); 8f: (3); 8g: (2); 8h: (4); 16i: (5); 16j: (6); 16k: (8); 16l: (5); 32m: (12)

d. Results for high-symmetry planes

$P1 \left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$		
Operation	E	C_{4z}^+
Coordinate	$\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$	$\left(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v \right)$
$P2(u, v, -u)$		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
$P3(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

$P1 \left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v \right)$ of space group No. 140

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (4); 4c: (3); 4d: (4); 8e: (7); 8f: (6); 8g: (8); 8h: (7); 16i: (12); 16j: (12); 16k: (12); 16l: (14); 32m: (24)
2	(0, 0, 0)	4a: (3); 4b: (2); 4c: (3); 4d: (2); 8e: (5); 8f: (6); 8g: (4); 8h: (5); 16i: (12); 16j: (12); 16k: (12); 16l: (10); 32m: (24)

$P2(u, v, -u)$ of space group No. 140

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12); 16j: (12); 16k: (12); 16l: (12); 32m: (24)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 8e: (6); 8f: (6); 8g: (6); 8h: (6); 16i: (12); 16j: (12); 16k: (12); 16l: (12); 32m: (24)

P3 ($u, -u, v$) of space group No. 140

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 4c: (4); 4d: (4); 8e: (6); 8f: (6); 8g: (6); 8h: (8); 16i: (12); 16j: (12); 16k: (16); 16l: (12); 32m: (24)
2	(0, 0, 0)	4a: (3); 4b: (3); 4c: (2); 4d: (2); 8e: (6); 8f: (6); 8g: (6); 8h: (4); 16i: (12); 16j: (12); 16k: (8); 16l: (12); 32m: (24)

141. Space group No. 141 ($I4_1/amd$)

Tetragonal body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\begin{aligned}
 &\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{4z}^+|-\frac{1}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{C_{4z}^-|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{C_{2x}|-\frac{1}{4}, -\frac{3}{4}, \frac{1}{2}\} \quad \{C_{2y}|-\frac{1}{4}, -\frac{3}{4}, \frac{1}{2}\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\} \\
 &\{I|-\frac{1}{4}, -\frac{3}{4}, \frac{1}{2}\} \quad \{\sigma_z|-\frac{1}{4}, -\frac{3}{4}, \frac{1}{2}\} \quad \{S_{4z}^-|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_{da}|\frac{3}{4}, \frac{1}{4}, \frac{1}{2}\} \quad \{\sigma_{db}|-\frac{1}{4}, \frac{1}{4}, \frac{1}{2}\}
 \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$				
Operation	E			
Coordinate	$(0, 0, 0)$			
$N(0, \frac{1}{2}, 0)$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$
$X(0, 0, \frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$		

$$Z\left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

Operation E
Coordinate $\left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$

$$P\left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$$

Operation E C_{4z}^+
Coordinate $\left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right) \left(\frac{3}{4}, -\frac{1}{4}, -\frac{1}{4}\right)$

$\Gamma (0, 0, 0)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (1); 16f: (1); 16g: (1); 16h: (2); 32i: (3)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (0); 16f: (2); 16g: (2); 16h: (1); 32i: (3)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (1); 16f: (1); 16g: (2); 16h: (2); 32i: (3)
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 8d: (0); 8e: (0); 16f: (2); 16g: (1); 16h: (1); 32i: (3)
5	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 8d: (0); 8e: (2); 16f: (3); 16g: (3); 16h: (3); 32i: (6)
6	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (0); 16f: (1); 16g: (1); 16h: (1); 32i: (3)
7	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (1); 16f: (2); 16g: (2); 16h: (2); 32i: (3)
8	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (0); 16f: (1); 16g: (2); 16h: (1); 32i: (3)
9	(0, 0, 0)	4a: (0); 4b: (0); 8c: (2); 8d: (2); 8e: (1); 16f: (2); 16g: (1); 16h: (2); 32i: (3)
10	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 16f: (3); 16g: (3); 16h: (3); 32i: (6)

$N \left(0, \frac{1}{2}, 0\right)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (2); 8d: (5); 8e: (4); 16f: (6); 16g: (6); 16h: (7); 32i: (12)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (4); 8d: (1); 8e: (2); 16f: (6); 16g: (6); 16h: (5); 32i: (12)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (4); 8e: (2); 16f: (6); 16g: (6); 16h: (5); 32i: (12)
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (5); 8d: (2); 8e: (4); 16f: (6); 16g: (6); 16h: (7); 32i: (12)

$X \left(0, 0, \frac{1}{2}\right)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 16f: (6); 16g: (5); 16h: (6); 32i: (12)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 16f: (6); 16g: (7); 16h: (6); 32i: (12)

$Z \left(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (2); 16f: (4); 16g: (3); 16h: (3); 32i: (6)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (2); 16f: (3); 16g: (3); 16h: (4); 32i: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 8d: (1); 8e: (2); 16f: (2); 16g: (3); 16h: (3); 32i: (6)
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (0); 16f: (3); 16g: (3); 16h: (2); 32i: (6)

$P \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 16f: (6); 16g: (6); 16h: (6); 32i: (12)
2	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 16f: (6); 16g: (6); 16h: (6); 32i: (12)

c. Results for high-symmetry lines

DT(0, 0, u)		
Operation	E	C_{4z}^+
Coordinate	(0, 0, u)	($u, -u, 0$)
LD($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$)	
Q($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$)	($\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2}$)
SM($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, -\frac{u}{2}, \frac{u}{2}$)
W($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)		
Operation	E	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	
Y($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)		
Operation	E	C_{4z}^+
Coordinate	($\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u$)

DT (0, 0, u) of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 16f: (6); 16g: (5); 16h: (6); 32i: (12)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (3); 16f: (6); 16g: (5); 16h: (6); 32i: (12)
3	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 16f: (6); 16g: (7); 16h: (6); 32i: (12)
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (3); 16f: (6); 16g: (7); 16h: (6); 32i: (12)

LD ($\frac{w}{2}, \frac{w}{2}, -\frac{w}{2}$) of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (2); 16f: (3); 16g: (3); 16h: (4); 32i: (6)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (0); 16f: (3); 16g: (3); 16h: (2); 32i: (6)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (2); 16f: (3); 16g: (3); 16h: (4); 32i: (6)
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 8d: (1); 8e: (0); 16f: (3); 16g: (3); 16h: (2); 32i: (6)
5	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (4); 16f: (6); 16g: (6); 16h: (6); 32i: (12)

Q ($\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2}$) of space group No. 141

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12); 16g: (12); 16h: (12); 32i: (24)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12); 16g: (12); 16h: (12); 32i: (24)

SM $\left(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 8d: (3); 8e: (4); 16f: (5); 16g: (6); 16h: (7); 32i: (12)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 8d: (2); 8e: (2); 16f: (5); 16g: (6); 16h: (5); 32i: (12)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 8d: (3); 8e: (2); 16f: (7); 16g: (6); 16h: (5); 32i: (12)
4	(0, 0, 0)	4a: (2); 4b: (2); 8c: (4); 8d: (4); 8e: (4); 16f: (7); 16g: (6); 16h: (7); 32i: (12)

W $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12); 16g: (12); 16h: (12); 32i: (24)

Y $\left(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12); 16g: (12); 16h: (12); 32i: (24)

d. Results for high-symmetry planes

P1 $\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$		
Operation	E	C_{4z}^+
Coordinate	$\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$	$\left(\frac{1}{2} + v, -\frac{1}{2} + v, -\frac{1}{2} + u - v\right)$
P2 $(u, v, -u)$		
Operation	E	C_{4z}^+
Coordinate	$(u, v, -u)$	$(v, u, -u)$
P3 $(u, -u, v)$		
Operation	E	
Coordinate	$(u, -u, v)$	

P1 $\left(\frac{1}{2} - u + v, -\frac{1}{2} + u + v, \frac{1}{2} - v\right)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12); 16g: (12); 16h: (12); 32i: (24)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12); 16g: (12); 16h: (12); 32i: (24)

P2 $(u, v, -u)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (4); 4b: (4); 8c: (7); 8d: (7); 8e: (8); 16f: (12); 16g: (12); 16h: (14); 32i: (24)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (5); 8d: (5); 8e: (4); 16f: (12); 16g: (12); 16h: (10); 32i: (24)

P3 $(u, -u, v)$ of space group No. 141

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12); 16g: (12); 16h: (12); 32i: (24)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 8d: (6); 8e: (6); 16f: (12); 16g: (12); 16h: (12); 32i: (24)

142. Space group No. 142 ($I4_1/acd$)

Tetragonal body-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}\{E|0,0,0\} & \quad \{C_{2z}|0,0,0\} & \{C_{4z}^+|\frac{3}{4},\frac{1}{4},\frac{1}{2}\} & \{C_{4z}^-|\frac{3}{4},\frac{1}{4},-\frac{1}{2}\} & \{C_{2x}|-\frac{3}{4},-\frac{1}{4},\frac{1}{2}\} & \{C_{2y}|-\frac{3}{4},-\frac{1}{4},-\frac{1}{2}\} & \{C_{2a}|-\frac{1}{2},-\frac{1}{2},0\} & \{C_{2b}|-\frac{1}{2},-\frac{1}{2},0\} \\ \{I|-\frac{1}{4},-\frac{3}{4},-\frac{1}{2}\} & \{\sigma_z|-\frac{1}{4},-\frac{3}{4},\frac{1}{2}\} & \{S_{4z}^-|0,0,0\} & \{S_{4z}^+|0,0,0\} & \{\sigma_x|\frac{1}{2},-\frac{1}{2},0\} & \{\sigma_y|\frac{1}{2},\frac{1}{2},0\} & \{\sigma_{da}|\frac{1}{4},-\frac{1}{4},-\frac{1}{2}\} & \{\sigma_{db}|\frac{1}{4},-\frac{1}{4},\frac{1}{2}\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$				
Operation	E			
Coordinate	$(0,0,0)$			
$N(\frac{1}{2},0,-\frac{1}{2})$				
Operation	E	C_{4z}^{+}	C_{4z}^{-}	C_{2z}
Coordinate	$(\frac{1}{2},0,-\frac{1}{2})$	$(0,\frac{1}{2},-\frac{1}{2})$	$(\frac{1}{2},0,0)$	$(0,\frac{1}{2},0)$
$X(0,0,-\frac{1}{2})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(0,0,-\frac{1}{2})$	$(-\frac{1}{2},\frac{1}{2},0)$		
$Z(\frac{1}{2},-\frac{1}{2},-\frac{1}{2})$				
Operation	E			
Coordinate	$(\frac{1}{2},-\frac{1}{2},-\frac{1}{2})$			
$P(\frac{1}{4},\frac{1}{4},-\frac{3}{4})$				
Operation	E	C_{4z}^{+}		
Coordinate	$(\frac{1}{4},\frac{1}{4},-\frac{3}{4})$	$(-\frac{1}{4},\frac{3}{4},-\frac{1}{4})$		

Γ (0, 0, 0) of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (0); 8b: (0); 16c: (0); 16d: (1); 16e: (1); 16f: (1); 32g: (3)
2	(0, 0, 0)	8a: (0); 8b: (1); 16c: (0); 16d: (1); 16e: (2); 16f: (2); 32g: (3)
3	(0, 0, 0)	8a: (1); 8b: (1); 16c: (0); 16d: (1); 16e: (1); 16f: (2); 32g: (3)
4	(0, 0, 0)	8a: (1); 8b: (0); 16c: (0); 16d: (1); 16e: (2); 16f: (1); 32g: (3)
5	(0, 0, 0)	8a: (2); 8b: (2); 16c: (0); 16d: (4); 16e: (3); 16f: (3); 32g: (6)
6	(0, 0, 0)	8a: (1); 8b: (0); 16c: (3); 16d: (1); 16e: (1); 16f: (1); 32g: (3)
7	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (1); 16e: (2); 16f: (2); 32g: (3)
8	(0, 0, 0)	8a: (0); 8b: (1); 16c: (3); 16d: (1); 16e: (1); 16f: (2); 32g: (3)
9	(0, 0, 0)	8a: (0); 8b: (0); 16c: (3); 16d: (1); 16e: (2); 16f: (1); 32g: (3)
10	(0, 0, 0)	8a: (2); 8b: (2); 16c: (6); 16d: (4); 16e: (3); 16f: (3); 32g: (6)

N $(\frac{1}{2}, 0, -\frac{1}{2})$ of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)

X $(0, 0, -\frac{1}{2})$ of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (2); 16c: (6); 16d: (6); 16e: (6); 16f: (5); 32g: (12)
2	(0, 0, 0)	8a: (3); 8b: (4); 16c: (6); 16d: (6); 16e: (6); 16f: (7); 32g: (12)

Z $(\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2})$ of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (4); 16e: (4); 16f: (3); 32g: (6)
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (2); 16e: (3); 16f: (3); 32g: (6)
3	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (4); 16e: (2); 16f: (3); 32g: (6)
4	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (2); 16e: (3); 16f: (3); 32g: (6)

P $(\frac{1}{4}, \frac{1}{4}, -\frac{3}{4})$ of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (6); 16f: (6); 32g: (12)

c. Results for high-symmetry lines

$DT(0, 0, u)$		
Operation	E	C_{4z}^+
Coordinate	$(0, 0, u)$	$(u, -u, 0)$
$LD(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$	
$Q(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$		

Operation	E	C_{4z}^+
Coordinate	$(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$	$(\frac{1+v}{2}, -\frac{v}{2}, -\frac{v}{2})$
SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{u}{2}, \frac{u}{2})$
W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$		
Operation	E	
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	
Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$		
Operation	E	C_{4z}^+
Coordinate	$(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2} + u)$

DT $(0, 0, u)$ of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (2); 16c: (6); 16d: (6); 16e: (6); 16f: (5); 32g: (12)
2	(0, 0, 0)	8a: (3); 8b: (2); 16c: (6); 16d: (6); 16e: (6); 16f: (5); 32g: (12)
3	(0, 0, 0)	8a: (3); 8b: (4); 16c: (6); 16d: (6); 16e: (6); 16f: (7); 32g: (12)
4	(0, 0, 0)	8a: (3); 8b: (4); 16c: (6); 16d: (6); 16e: (6); 16f: (7); 32g: (12)

LD $(\frac{w}{2}, \frac{w}{2}, -\frac{w}{2})$ of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (2); 16e: (3); 16f: (3); 32g: (6)
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (2); 16e: (3); 16f: (3); 32g: (6)
3	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (2); 16e: (3); 16f: (3); 32g: (6)
4	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (2); 16e: (3); 16f: (3); 32g: (6)
5	(0, 0, 0)	8a: (4); 8b: (4); 16c: (6); 16d: (8); 16e: (6); 16f: (6); 32g: (12)

Q $(\frac{v}{2}, \frac{1-v}{2}, \frac{v}{2})$ of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)

SM $(-\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (5); 16f: (6); 32g: (12)
2	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (5); 16f: (6); 32g: (12)
3	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (7); 16f: (6); 32g: (12)
4	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 16e: (7); 16f: (6); 32g: (12)

W $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 142

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)

Y $(\frac{1}{2} - u, -\frac{1}{2} + u, \frac{1}{2})$ of space group No. 142		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)

d. Results for high-symmetry planes

P1 $(-\frac{1}{2} + u + v, \frac{1}{2} - u + v, -\frac{1}{2} - v)$		
Operation	E	C_{4z}^+
Coordinate	$(-\frac{1}{2} + u + v, \frac{1}{2} - u + v, -\frac{1}{2} - v)$	$(-\frac{1}{2} + v, \frac{1}{2} + v, \frac{1}{2} - u - v)$
P2 $(v, u, -v)$		
Operation	E	C_{4z}^+
Coordinate	$(v, u, -v)$	$(u, v, -v)$
P3 $(-u, u, -v)$		
Operation	E	
Coordinate	$(-u, u, -v)$	

P1 $(-\frac{1}{2} + u + v, \frac{1}{2} - u + v, -\frac{1}{2} - v)$ of space group No. 142		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)
2	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)

P2 $(v, u, -v)$ of space group No. 142		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)
2	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)

P3 $(-u, u, -v)$ of space group No. 142		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)
2	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 16e: (12); 16f: (12); 32g: (24)

143. Space group No. 143 (P3)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) \\ \vec{c} &= (0, 0, c) \end{aligned} \quad \begin{aligned} \vec{t}_1 &= \vec{a} \\ \vec{t}_2 &= \vec{b} \\ \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_3^+|0,0,0\} \quad \{C_3^-|0,0,0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},-\frac{1}{2})$	

Γ (0, 0, 0) of space group No. 143				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1); 3d: (3)
2	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1); 3d: (3)
M $(0, \frac{1}{2}, 0)$ of space group No. 143				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	1a: (3);	1b: (3);	1c: (3); 3d: (9)
A $(0, 0, \frac{1}{2})$ of space group No. 143				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1); 3d: (3)
2	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1); 3d: (3)
L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 143				

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 1c: (3); 3d: (9)
$K \left(-\frac{1}{3}, \frac{2}{3}, 0 \right)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	1a: (1); 1b: (1) ; 1c: (1) ; 3d: (3)
2	(0, 0, r_1)	1a: (1) ; 1b: (1); 1c: (1) ; 3d: (3)
3	(0, 0, r_1)	1a: (1) ; 1b: (1) ; 1c: (1); 3d: (3)
$H \left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2} \right)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	1a: (1); 1b: (1) ; 1c: (1) ; 3d: (3)
2	(0, 0, r_1)	1a: (1) ; 1b: (1); 1c: (1) ; 3d: (3)
3	(0, 0, r_1)	1a: (1) ; 1b: (1) ; 1c: (1); 3d: (3)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 0)	(u, -2u, 0)	(-2u, u, 0)
PA(-1/3, -1/3, -w)			
Operation	E	EΘ	
Coordinate	(-1/3, -1/3, -w)	(1/3, 1/3, w)	
Q(u, u, 1/2)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 1/2)	(u, -2u, 1/2)	(-2u, u, 1/2)
R(u, 0, 1/2)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, 1/2)	(0, -u, 1/2)	(-u, u, 1/2)
SM(u, 0, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, 0)	(0, -u, 0)	(-u, u, 0)
U(1/2, 0, w)			
Operation	E	C_3^-	C_3^+
Coordinate	(1/2, 0, w)	(0, -1/2, w)	(-1/2, 1/2, w)

DT $(0, 0, w)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3)
3	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3)
LD $(u, u, 0)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1, r_1\right)$	1a: (3); 1b: (3); 1c: (3); 3d: (9)
PA $\left(-\frac{1}{3}, -\frac{1}{3}, -w\right)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3)
3	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3)
Q $\left(u, u, \frac{1}{2}\right)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1, r_1\right)$	1a: (3); 1b: (3); 1c: (3); 3d: (9)
R $\left(u, 0, \frac{1}{2}\right)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1, r_1\right)$	1a: (3); 1b: (3); 1c: (3); 3d: (9)
SM $(u, 0, 0)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1, r_1\right)$	1a: (3); 1b: (3); 1c: (3); 3d: (9)
U $\left(\frac{1}{2}, 0, w\right)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1, r_1\right)$	1a: (3); 1b: (3); 1c: (3); 3d: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, u, v)$	$(-u, 0, v)$	$(u, -u, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			

Operation	E	C_3^+	C_3^-
Coordinate	$(u, -2u, v)$	(u, u, v)	$(-2u, u, v)$
P4 $(u, v, \frac{1}{2})$			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 $(0, u, v)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 3d: (9)
P2 $(u, v, 0)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 3d: (9)
P3 $(u, -2u, v)$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 3d: (9)
P4 $(u, v, \frac{1}{2})$ of space group No. 143		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 3d: (9)

144. Space group No. 144 ($P3_1$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, \frac{1}{3}\} \quad \{C_3^-|0, 0, \frac{2}{3}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},-\frac{1}{2})$	

$\Gamma(0, 0, 0)$ of space group No. 144			
(Co-) irrep	Phonon AM		WYPO information
1	$(0, 0, 0)$	3a: (3)	
2	$(0, 0, 0)$	3a: (3)	
$M(0, \frac{1}{2}, 0)$ of space group No. 144			
(Co-) irrep	Phonon AM		WYPO information
1	$(0, 0, 0)$	3a: (9)	
$A(0, 0, \frac{1}{2})$ of space group No. 144			
(Co-) irrep	Phonon AM		WYPO information
1	$(0, 0, 0)$	3a: (3)	
2	$(0, 0, 0)$	3a: (3)	
$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 144			
(Co-) irrep	Phonon AM		WYPO information
1	$(0, 0, 0)$	3a: (9)	
$K(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 144			
(Co-) irrep	Phonon AM		WYPO information
1	$(0, 0, r_1)$	3a: (3)	

2	$(0, 0, r_1)$	3a: (3)
3	$(0, 0, r_1)$	3a: (3)

$H \left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2} \right)$ of space group No. 144

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3)
2	$(0, 0, r_1)$	3a: (3)
3	$(0, 0, r_1)$	3a: (3)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 0)	(u, -2u, 0)	(-2u, u, 0)
PA(-1/3, -1/3, -w)			
Operation	E	EΘ	
Coordinate	(-1/3, -1/3, -w)	(1/3, 1/3, w)	
Q(u, u, 1/2)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 1/2)	(u, -2u, 1/2)	(-2u, u, 1/2)
R(u, 0, 1/2)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, 1/2)	(0, -u, 1/2)	(-u, u, 1/2)
SM(u, 0, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, 0)	(0, -u, 0)	(-u, u, 0)
U(1/2, 0, w)			
Operation	E	C_3^-	C_3^+
Coordinate	(1/2, 0, w)	(0, -1/2, w)	(-1/2, 1/2, w)

DT (0, 0, w) of space group No. 144

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3)
2	$(0, 0, r_1)$	3a: (3)
3	$(0, 0, r_1)$	3a: (3)

LD $(u, u, 0)$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1\right)$	3a: (3)
PA $\left(-\frac{1}{3}, -\frac{1}{3}, -w\right)$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3)
2	$(0, 0, r_1)$	3a: (3)
3	$(0, 0, r_1)$	3a: (3)
Q $\left(u, u, \frac{1}{2}\right)$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1\right)$	3a: (3)
R $\left(u, 0, \frac{1}{2}\right)$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1\right)$	3a: (3)
SM $(u, 0, 0)$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1\right)$	3a: (3)
U $\left(\frac{1}{2}, 0, w\right)$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1\right)$	3a: (3)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, u, v)$	$(-u, 0, v)$	$(u, -u, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	$(u, -2u, v)$	(u, u, v)	$(-2u, u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 $(0, u, v)$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9)
P2 $(u, v, 0)$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9)
P3 $(u, -2u, v)$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9)
P4 $(u, v, \frac{1}{2})$ of space group No. 144		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9)

145. Space group No. 145 ($P3_2$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, \frac{2}{3}\} \quad \{C_3^-|0, 0, \frac{1}{3}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		

Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, -\frac{1}{2})$	

Γ (0, 0, 0) of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (3)
2	(0, 0, 0)	3a: (3)
M $(0, \frac{1}{2}, 0)$ of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (9)
A $(0, 0, \frac{1}{2})$ of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (3)
2	(0, 0, 0)	3a: (3)
L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (9)
K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3)
2	$(0, 0, r_1)$	3a: (3)
3	$(0, 0, r_1)$	3a: (3)
H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3)
2	$(0, 0, r_1)$	3a: (3)
3	$(0, 0, r_1)$	3a: (3)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 0)	(u, -2u, 0)	(-2u, u, 0)
PA(-1/3, -1/3, -w)			
Operation	E	EΘ	
Coordinate	(-1/3, -1/3, -w)	(1/3, 1/3, w)	
Q(u, u, 1/2)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 1/2)	(u, -2u, 1/2)	(-2u, u, 1/2)
R(u, 0, 1/2)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, 1/2)	(0, -u, 1/2)	(-u, u, 1/2)
SM(u, 0, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, 0)	(0, -u, 0)	(-u, u, 0)
U(1/2, 0, w)			
Operation	E	C_3^-	C_3^+
Coordinate	(1/2, 0, w)	(0, -1/2, w)	(-1/2, 1/2, w)

DT (0, 0, w) of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	3a: (3)
2	(0, 0, r_1)	3a: (3)
3	(0, 0, r_1)	3a: (3)
LD (u, u, 0) of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	($-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1$)	3a: (9)
PA ($-\frac{1}{3}, -\frac{1}{3}, -w$) of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	3a: (3)
2	(0, 0, r_1)	3a: (3)
3	(0, 0, r_1)	3a: (3)
Q ($u, u, \frac{1}{2}$) of space group No. 145		

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1\right)$	
R $(u, 0, \frac{1}{2})$ of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1\right)$	
SM $(u, 0, 0)$ of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1\right)$	
U $(\frac{1}{2}, 0, w)$ of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2 - \frac{r_3}{2}, -\frac{r_2}{2} + \frac{\sqrt{3}}{2}r_1\right)$	

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, u, v)	(-u, 0, v)	(u, -u, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(u, -2u, v)	(u, u, v)	(-2u, u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9)
P2 (u, v, 0) of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9)
P3 (u, -2u, v) of space group No. 145		

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9)
P4 $(u, v, \frac{1}{2})$ of space group No. 145		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9)

146. Space group No. 146 (*R*3)

Trigonal primitive lattice

$$\vec{a} = \left(\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) \quad \vec{t}_1 = \vec{a}$$
$$\vec{b} = \left(-\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) \quad \vec{t}_2 = \vec{b}$$
$$\vec{c} = (0, -a, c) \quad \vec{t}_3 = \vec{c}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_3^+|0,0,0\} \quad \{C_3^-|0,0,0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$				
Operation	E			
Coordinate	$(0,0,0)$			
$Z(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$				
Operation	E			
Coordinate	$(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$			
$L(0,\frac{1}{2},0)$				
Operation	E	C_3^+	C_3^-	
Coordinate	$(0,\frac{1}{2},0)$	$(0,0,\frac{1}{2})$	$(\frac{1}{2},0,0)$	
$F(0,\frac{1}{2},-\frac{1}{2})$				
Operation	E	C_3^+	C_3^-	
Coordinate	$(0,\frac{1}{2},-\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},0)$	

$\Gamma (0, 0, 0)$ of space group No. 146		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 9b: (3)
2	(0, 0, 0)	3a: (1); 9b: (3)

$Z \left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2} \right)$ of space group No. 146		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 9b: (3)
2	(0, 0, 0)	3a: (1); 9b: (3)

$L \left(0, \frac{1}{2}, 0 \right)$ of space group No. 146		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (3); 9b: (9)

$F \left(0, \frac{1}{2}, -\frac{1}{2} \right)$ of space group No. 146		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (3); 9b: (9)

c. Results for high-symmetry lines

LD($\frac{w}{3}, \frac{w}{3}, \frac{w}{3}$)			
Operation	E		
Coordinate	($\frac{w}{3}, \frac{w}{3}, \frac{w}{3}$)		
SM(0, -u, u)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, -u, u)	(u, 0, -u)	(-u, u, 0)
Y($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)			
Operation	E	C_3^+	C_3^-
Coordinate	($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)	($\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u$)

$LD \left(\frac{w}{3}, \frac{w}{3}, \frac{w}{3} \right)$ of space group No. 146		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (1); 9b: (3)
2	$(0, 0, r_1)$	3a: (1); 9b: (3)
3	$(0, 0, r_1)$	3a: (1); 9b: (3)

$SM (0, -u, u)$ of space group No. 146		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (3); 9b: (9)

Y $(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$ of space group No. 146		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (3); 9b: (9)

d. Results for high-symmetry planes

P1 $(u, \frac{1}{2} + v, -\frac{1}{2} + v)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(u, \frac{1}{2} + v, -\frac{1}{2} + v)$	$(-\frac{1}{2} + v, u, \frac{1}{2} + v)$	$(\frac{1}{2} + v, -\frac{1}{2} + v, u)$

P1 $(u, \frac{1}{2} + v, -\frac{1}{2} + v)$ of space group No. 146		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (3); 9b: (9)

147. Space group No. 147 ($P\bar{3}$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) \\ \vec{c} &= (0, 0, c) \end{aligned} \quad \begin{aligned} \vec{t}_1 &= \vec{a} \\ \vec{t}_2 &= \vec{b} \\ \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{S_6^+|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{S_6^-|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	S_6^+	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(-\frac{1}{2},\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$

A(0, 0, $\frac{1}{2}$)			
Operation	E		
Coordinate	(0, 0, $\frac{1}{2}$)		
L(0, $\frac{1}{2}$, $\frac{1}{2}$)			
Operation	E	S_6^+	C_3^+
Coordinate	(0, $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, $\frac{1}{2}$, $-\frac{1}{2}$)	($-\frac{1}{2}$, 0, $\frac{1}{2}$)
K($-\frac{1}{3}$, $\frac{2}{3}$, 0)			
Operation	E	S_6^+	
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, 0)	($-\frac{2}{3}$, $\frac{1}{3}$, 0)	
H($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)			
Operation	E	S_6^+	
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)	($-\frac{2}{3}$, $\frac{1}{3}$, $-\frac{1}{2}$)	

$\Gamma(0, 0, 0)$ of space group No. 147			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 3e: (0); 3f: (0); 6g: (3)	
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 3e: (3); 3f: (3); 6g: (3)	
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 3e: (0); 3f: (0); 6g: (3)	
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 3e: (3); 3f: (3); 6g: (3)	
$M(0, \frac{1}{2}, 0)$ of space group No. 147			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (3); 2d: (3); 3e: (6); 3f: (6); 6g: (9)	
2	(0, 0, 0)	1a: (3); 1b: (3); 2c: (3); 2d: (3); 3e: (3); 3f: (3); 6g: (9)	
$A(0, 0, \frac{1}{2})$ of space group No. 147			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 3e: (0); 3f: (3); 6g: (3)	
2	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 3e: (3); 3f: (0); 6g: (3)	
3	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 3e: (0); 3f: (3); 6g: (3)	
4	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 3e: (3); 3f: (0); 6g: (3)	
$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 147			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (0); 1b: (3); 2c: (3); 2d: (3); 3e: (6); 3f: (3); 6g: (9)	
2	(0, 0, 0)	1a: (3); 1b: (0); 2c: (3); 2d: (3); 3e: (3); 3f: (6); 6g: (9)	
$K(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 147			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)	
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)	

$H\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	S_6^-	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($\frac{2}{3}, -\frac{1}{3}, -w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $-\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $-\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
LD (u , u , 0) of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)
SM $(u, 0, 0)$ of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, u, v)	(-u, 0, v)	(u, -u, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(u, -2u, v)	(u, u, v)	(-2u, u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

P2 ($u, v, 0$) of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

P3 ($u, -2u, v$) of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

P4 ($u, v, \frac{1}{2}$) of space group No. 147		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

148. Space group No. 148 ($R\bar{3}$)

Trigonal primitive lattice

$$\begin{aligned}\vec{a} &= \left(\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) & \vec{t}_2 &= \vec{b} \\ & & \vec{t}_3 &= \vec{c} \\ \vec{c} &= (0, -a, c)\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{S_6^+|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{S_6^-|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$Z(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$			
Operation	E		
Coordinate	$(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$		
$L(0, \frac{1}{2}, 0)$			
Operation	E	C_3^+	S_6^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$	$(-\frac{1}{2}, 0, 0)$

$$F(0, \frac{1}{2}, -\frac{1}{2})$$

Operation	E	C_3^+	S_6^+
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, 0)$

$\Gamma(0, 0, 0)$ of space group No. 148

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (0); 3b: (0); 6c: (1); 9d: (0); 9e: (0); 18f: (3)
2	(0, 0, 0)	3a: (1); 3b: (1); 6c: (1); 9d: (3); 9e: (3); 18f: (3)
3	(0, 0, 0)	3a: (0); 3b: (0); 6c: (1); 9d: (0); 9e: (0); 18f: (3)
4	(0, 0, 0)	3a: (1); 3b: (1); 6c: (1); 9d: (3); 9e: (3); 18f: (3)

$Z(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 148

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (0); 3b: (1); 6c: (1); 9d: (3); 9e: (0); 18f: (3)
2	(0, 0, 0)	3a: (1); 3b: (0); 6c: (1); 9d: (0); 9e: (3); 18f: (3)
3	(0, 0, 0)	3a: (0); 3b: (1); 6c: (1); 9d: (3); 9e: (0); 18f: (3)
4	(0, 0, 0)	3a: (1); 3b: (0); 6c: (1); 9d: (0); 9e: (3); 18f: (3)

$L(0, \frac{1}{2}, 0)$ of space group No. 148

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (0); 3b: (3); 6c: (3); 9d: (3); 9e: (6); 18f: (9)
2	(0, 0, 0)	3a: (3); 3b: (0); 6c: (3); 9d: (6); 9e: (3); 18f: (9)

$F(0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 148

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (0); 3b: (0); 6c: (3); 9d: (6); 9e: (6); 18f: (9)
2	(0, 0, 0)	3a: (3); 3b: (3); 6c: (3); 9d: (3); 9e: (3); 18f: (9)

c. Results for high-symmetry lines

$$LD(\frac{w}{3}, \frac{w}{3}, \frac{w}{3})$$

Operation	E
Coordinate	$(\frac{w}{3}, \frac{w}{3}, \frac{w}{3})$

$$SM(0, -u, u)$$

Operation	E	C_3^+	C_3^-
Coordinate	$(0, -u, u)$	$(u, 0, -u)$	$(-u, u, 0)$

$$Y(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$$

Operation	E	C_3^+	C_3^-
Coordinate	$(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$	$(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$	$(\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u)$

 LD $\left(\frac{w}{3}, \frac{w}{3}, \frac{w}{3}\right)$ of space group No. 148

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (2); 9d: (3); 9e: (3); 18f: (6)
2	(0, 0, 0)	3a: (1); 3b: (1); 6c: (2); 9d: (3); 9e: (3); 18f: (6)

 SM $(0, -u, u)$ of space group No. 148

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6); 9d: (9); 9e: (9); 18f: (18)

 Y $\left(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u\right)$ of space group No. 148

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6); 9d: (9); 9e: (9); 18f: (18)

d. Results for high-symmetry planes

$$\text{P1}\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$$

Operation	E	C_3^+	C_3^-
Coordinate	$\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$	$\left(-\frac{1}{2} + v, u, \frac{1}{2} + v\right)$	$\left(\frac{1}{2} + v, -\frac{1}{2} + v, u\right)$

 P1 $\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$ of space group No. 148

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6); 9d: (9); 9e: (9); 18f: (18)

149. Space group No. 149 ($P312$)

Hexagonal primitive lattice	$\vec{a} = (a, 0, 0)$	$\vec{t}_1 = \vec{a}$
	$\vec{b} = \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right)$	$\vec{t}_2 = \vec{b}$
	$\vec{c} = (0, 0, c)$	$\vec{t}_3 = \vec{c}$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{23}''|0, 0, 0\} \quad \{C_{22}''|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E		
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	C_{2y} $(\frac{1}{3}, \frac{1}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E		
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	C_{2y} $(\frac{1}{3}, \frac{1}{3}, -\frac{1}{2})$	

$\Gamma(0, 0, 0)$ of space group No. 149		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (1); 6l: (3)
2	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (2); 3k: (2); 6l: (3)
3	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6)
$M(0, \frac{1}{2}, 0)$ of space group No. 149		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (3); 2h: (3); 2i: (3); 3j: (4); 3k: (4); 6l: (9)
2	$(0, 0, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 2g: (3); 2h: (3); 2i: (3); 3j: (5); 3k: (5); 6l: (9)
$A(0, 0, \frac{1}{2})$ of space group No. 149		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (0); 1b: (1); 1c: (0); 1d: (1); 1e: (0); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (2); 6l: (3)
2	$(0, 0, 0)$	1a: (1); 1b: (0); 1c: (1); 1d: (0); 1e: (1); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (2); 3k: (1); 6l: (3)

3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6)

$L\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 149

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (2); 1c: (1); 1d: (2); 1e: (1); 1f: (2); 2g: (3); 2h: (3); 2i: (3); 3j: (4); 3k: (5); 6l: (9)
2	(0, 0, 0)	1a: (2); 1b: (1); 1c: (2); 1d: (1); 1e: (2); 1f: (1); 2g: (3); 2h: (3); 2i: (3); 3j: (5); 3k: (4); 6l: (9)

$K\left(-\frac{1}{3}, \frac{2}{3}, 0\right)$ of space group No. 149

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6)
2	(0, 0, r_1)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6)
3	(0, 0, r_1)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6)

$H\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 149

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6)
2	(0, 0, r_1)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6)
3	(0, 0, r_1)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation E
Coordinate (0, 0, w)

LD(u , u , 0)

Operation E C_{2y} C_3^+
Coordinate (u , u , 0) ($-u$, $2u$, 0) ($-2u$, u , 0)

P($\frac{1}{3}$, $\frac{1}{3}$, w)

Operation E C_{2y}
Coordinate ($\frac{1}{3}$, $\frac{1}{3}$, w) ($-\frac{1}{3}$, $\frac{2}{3}$, $-w$)

Q(u , u , $\frac{1}{2}$)

Operation E C_{2y} C_3^+
Coordinate (u , u , $\frac{1}{2}$) ($-u$, $2u$, $-\frac{1}{2}$) ($-2u$, u , $\frac{1}{2}$)

R(u , 0, $\frac{1}{2}$)

Operation	E	C_3^-	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, -u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
SM($u, 0, 0$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(u, 0, 0)$	$(0, -u, 0)$	$(-u, u, 0)$
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 149											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, r_1)$	1a: (1); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3j: (3); 3k: (3);
2	$(0, 0, r_1)$	1a: (1); 3j: (3); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3k: (3);
3	$(0, 0, r_1)$	1a: (1); 3j: (3); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3k: (3);
LD $(u, u, 0)$ of space group No. 149											
(Co-) irrep	Phonon AM	WYPO information									
1	$\left(\frac{r_2}{\sqrt{3}}, r_2, -r_1\right)$	1a: (3); 9j: (9); 6l: (18)	1b: (3);	1c: (3);	1d: (3);	1e: (3);	1f: (3);	2g: (6);	2h: (6);	2i: (6);	3j: (9); 3k: (9);
P $\left(\frac{1}{3}, \frac{1}{3}, w\right)$ of space group No. 149											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, -r_1)$	1a: (1); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3j: (3); 3k: (3);
2	$(0, 0, -r_1)$	1a: (1); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3j: (3); 3k: (3);
3	$(0, 0, -r_1)$	1a: (1); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3j: (3); 3k: (3);
Q $\left(u, u, \frac{1}{2}\right)$ of space group No. 149											
(Co-) irrep	Phonon AM	WYPO information									
1	$\left(\frac{r_2}{\sqrt{3}}, r_2, -r_1\right)$	1a: (3); 9j: (9); 6l: (18)	1b: (3);	1c: (3);	1d: (3);	1e: (3);	1f: (3);	2g: (6);	2h: (6);	2i: (6);	3j: (9); 3k: (9);
R $\left(u, 0, \frac{1}{2}\right)$ of space group No. 149											
(Co-) irrep	Phonon AM	WYPO information									
1	$\left(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0\right)$	1a: (1); 6l: (9)	1b: (2);	1c: (1);	1d: (2);	1e: (1);	1f: (2);	2g: (3);	2h: (3);	2i: (3);	3j: (4); 3k: (5);
2	$\left(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0\right)$	1a: (2); 6l: (9)	1b: (1);	1c: (2);	1d: (1);	1e: (2);	1f: (1);	2g: (3);	2h: (3);	2i: (3);	3j: (5); 3k: (4);
SM $(u, 0, 0)$ of space group No. 149											

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (3); 2h: (3); 2i: (3); 3j: (4); 3k: (4); 6l: (9)
2	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 2g: (3); 2h: (3); 2i: (3); 3j: (5); 3k: (5); 6l: (9)

U $(\frac{1}{2}, 0, w)$ of space group No. 149

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_2}{2}, \frac{\sqrt{3}r_2}{2}, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 2g: (6); 2h: (6); 2i: (6); 3j: (9); 3k: (9); 6l: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, u, v)	(-u, 0, v)	(u, -u, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(u, -2u, v)	(u, u, v)	(-2u, u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 149

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 2g: (6); 2h: (6); 2i: (6); 3j: (9); 3k: (9); 6l: (18)

P2 (u, v, 0) of space group No. 149

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 2g: (6); 2h: (6); 2i: (6); 3j: (9); 3k: (9); 6l: (18)

P3 (u, -2u, v) of space group No. 149

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_2}{\sqrt{3}}, r_2, r_1)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 2g: (6); 2h: (6); 2i: (6); 3j: (9); 3k: (9); 6l: (18)

P4 ($u, v, \frac{1}{2}$) of space group No. 149		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 2g: (6); 2h: (6); 2i: (6); 3j: (9); 3k: (9); 6l: (18)

150. Space group No. 150 ($P321$)

Hexagonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) \\ \vec{c} &= (0, 0, c)\end{aligned}\quad \begin{aligned}\vec{t}_1 &= \vec{a} \\ \vec{t}_2 &= \vec{b} \\ \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C'_{23}|0, 0, 0\} \quad \{C'_{22}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	$E\Theta$	

$$\text{Coordinate } \left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right) \left(\frac{1}{3}, -\frac{2}{3}, -\frac{1}{2}\right)$$

$\Gamma (0, 0, 0)$ of space group No. 150		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 3e: (1); 3f: (1); 6g: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 3e: (2); 3f: (2); 6g: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
$M (0, \frac{1}{2}, 0)$ of space group No. 150		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (3); 2d: (3); 3e: (4); 3f: (4); 6g: (9)
2	(0, 0, 0)	1a: (2); 1b: (2); 2c: (3); 2d: (3); 3e: (5); 3f: (5); 6g: (9)
$A (0, 0, \frac{1}{2})$ of space group No. 150		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 3e: (1); 3f: (2); 6g: (3)
2	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 3e: (2); 3f: (1); 6g: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 150		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (2); 2c: (3); 2d: (3); 3e: (4); 3f: (5); 6g: (9)
2	(0, 0, 0)	1a: (2); 1b: (1); 2c: (3); 2d: (3); 3e: (5); 3f: (4); 6g: (9)
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 150		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 3e: (1); 3f: (1); 6g: (3)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 3e: (2); 3f: (2); 6g: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 150		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 3e: (1); 3f: (2); 6g: (3)
2	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 3e: (2); 3f: (1); 6g: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)

c. Results for high-symmetry lines

DT(0, 0, w)	
Operation	E
Coordinate	(0, 0, w)

LD($u, u, 0$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(u, u, 0)$	$(u, -2u, 0)$	$(-2u, u, 0)$
PA($-\frac{1}{3}, -\frac{1}{3}, -w$)			
Operation	E	$C_{2x}\Theta$	
Coordinate	$(-\frac{1}{3}, -\frac{1}{3}, -w)$	$(\frac{1}{3}, -\frac{2}{3}, -w)$	
Q($u, u, \frac{1}{2}$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(u, u, \frac{1}{2})$	$(u, -2u, \frac{1}{2})$	$(-2u, u, \frac{1}{2})$
R($u, 0, \frac{1}{2}$)			
Operation	E	C'_{23}	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, u, -\frac{1}{2})$	$(-u, u, \frac{1}{2})$
SM($u, 0, 0$)			
Operation	E	C'_{23}	C_3^+
Coordinate	$(u, 0, 0)$	$(0, u, 0)$	$(-u, u, 0)$
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT ($0, 0, w$) of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
3	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)

LD ($u, u, 0$) of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0\right)$	1a: (1); 1b: (1); 2c: (3); 2d: (3); 3e: (4); 3f: (4); 6g: (9)
2	$\left(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0\right)$	1a: (2); 1b: (2); 2c: (3); 2d: (3); 3e: (5); 3f: (5); 6g: (9)

PA ($-\frac{1}{3}, -\frac{1}{3}, -w$) of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)
3	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (3); 3f: (3); 6g: (6)

Q ($u, u, \frac{1}{2}$) of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0\right)$	1a: (1); 1b: (2); 2c: (3); 2d: (3); 3e: (4); 3f: (5); 6g: (9)

$$2 \quad \left(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0 \right) \quad \mathbf{1a: (2); 1b: (1); 2c: (3); 2d: (3); 3e: (5); 3f: (4); 6g: (9)}$$

R $(u, 0, \frac{1}{2})$ of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_2}{2}, \frac{r_2}{2}, -r_1 \right)$	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

SM $(u, 0, 0)$ of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_2}{2}, \frac{r_2}{2}, -r_1 \right)$	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

U $(\frac{1}{2}, 0, w)$ of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2, -\frac{r_2}{2}, r_1 \right)$	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

d. Results for high-symmetry planes

P1 $(0, u, v)$

Operation	E	C_3^+	C_3^-
Coordinate	$(0, u, v)$	$(-u, 0, v)$	$(u, -u, v)$

P2 $(u, v, 0)$

Operation	E
Coordinate	$(u, v, 0)$

P3 $(u, -2u, v)$

Operation	E	C_3^+	C_3^-
Coordinate	$(u, -2u, v)$	(u, u, v)	$(-2u, u, v)$

P4 $(u, v, \frac{1}{2})$

Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 $(0, u, v)$ of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

P2 $(u, v, 0)$ of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

P3 $(u, -2u, v)$ of space group No. 150

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

P4 ($u, v, \frac{1}{2}$) of space group No. 150		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18)

151. Space group No. 151 ($P3_112$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, \frac{1}{3}\} \quad \{C_3^-|0, 0, \frac{2}{3}\} \quad \{C_{2y}|0, 0, \frac{1}{3}\} \quad \{C_{23}''|0, 0, -\frac{1}{3}\} \quad \{C_{22}''|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, \frac{1}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, \frac{1}{3}, -\frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 151		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$M (0, \frac{1}{2}, 0)$ of space group No. 151		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (4); 3b: (4); 6c: (9)
2	(0, 0, 0)	3a: (5); 3b: (5); 6c: (9)
$A (0, 0, \frac{1}{2})$ of space group No. 151		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (2); 3b: (1); 6c: (3)
2	(0, 0, 0)	3a: (1); 3b: (2); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 151		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (5); 3b: (4); 6c: (9)
2	(0, 0, 0)	3a: (4); 3b: (5); 6c: (9)
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 151		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
2	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
3	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 151		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
2	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
3	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation E
Coordinate (0, 0, w)

LD(u , u , 0)

Operation E C_{2y} C_3^+

Coordinate	$(u, u, 0)$	$(-u, 2u, 0)$	$(-2u, u, 0)$
$P(\frac{1}{3}, \frac{1}{3}, w)$			
Operation	E	C_{2y}	
Coordinate	$(\frac{1}{3}, \frac{1}{3}, w)$	$(-\frac{1}{3}, \frac{2}{3}, -w)$	
$Q(u, u, \frac{1}{2})$			
Operation	E	C_{2y}	C_3^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, 2u, -\frac{1}{2})$	$(-2u, u, \frac{1}{2})$
$R(u, 0, \frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, -u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
$SM(u, 0, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(u, 0, 0)$	$(0, -u, 0)$	$(-u, u, 0)$
$U(\frac{1}{2}, 0, w)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)

LD $(u, u, 0)$ of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_2}{\sqrt{3}}, r_2, -r_1)$	3a: (9); 3b: (9); 6c: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, -r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, -r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, -r_1)$	3a: (3); 3b: (3); 6c: (6)

Q $(u, u, \frac{1}{2})$ of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_2}{\sqrt{3}}, r_2, -r_1)$	3a: (9); 3b: (9); 6c: (18)

R $(u, 0, \frac{1}{2})$ of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	3a: (5); 3b: (4); 6c: (9)

$$2 \quad \left(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0\right) \quad \mathbf{3a: (4); 3b: (5); 6c: (9)}$$

SM $(u, 0, 0)$ of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0\right)$	3a: (4); 3b: (4); 6c: (9)
2	$\left(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0\right)$	3a: (5); 3b: (5); 6c: (9)

U $\left(\frac{1}{2}, 0, w\right)$ of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_2}{2}, \frac{\sqrt{3}r_2}{2}, r_1\right)$	3a: (9); 3b: (9); 6c: (18)

d. Results for high-symmetry planes

P1(0, u, v)

Operation	E	C_3^+	C_3^-
Coordinate	(0, u, v)	($-u, 0, v$)	($u, -u, v$)

P2($u, v, 0$)

Operation	E
Coordinate	($u, v, 0$)

P3($u, -2u, v$)

Operation	E	C_3^+	C_3^-
Coordinate	($u, -2u, v$)	(u, u, v)	($-2u, u, v$)

P4($u, v, \frac{1}{2}$)

Operation	E
Coordinate	($u, v, \frac{1}{2}$)

P1 (0, u, v) of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)

P2 ($u, v, 0$) of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)

P3 ($u, -2u, v$) of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_2}{\sqrt{3}}, r_2, r_1\right)$	3a: (9); 3b: (9); 6c: (18)

P4 ($u, v, \frac{1}{2}$) of space group No. 151

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)

152. Space group No. 152 ($P3_121$)

Hexagonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, \frac{1}{3}\} \quad \{C_3^-|0, 0, \frac{2}{3}\} \quad \{C_{2x}|0, 0, \frac{2}{3}\} \quad \{C'_{23}|0, 0, 0\} \quad \{C'_{22}|0, 0, \frac{1}{3}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},-\frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$M (0, \frac{1}{2}, 0)$ of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (4); 3b: (4); 6c: (9)
2	(0, 0, 0)	3a: (5); 3b: (5); 6c: (9)
$A (0, 0, \frac{1}{2})$ of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (2); 6c: (3)
2	(0, 0, 0)	3a: (2); 3b: (1); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (4); 3b: (5); 6c: (9)
2	(0, 0, 0)	3a: (5); 3b: (4); 6c: (9)
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (2); 6c: (3)
2	(0, 0, 0)	3a: (2); 3b: (1); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 0)	(u, -2u, 0)	(-2u, u, 0)

PA($-\frac{1}{3}, -\frac{1}{3}, -w$)			
Operation	E	C_{2x}	Θ
Coordinate	$(-\frac{1}{3}, -\frac{1}{3}, -w)$	$(\frac{1}{3}, -\frac{2}{3}, -w)$	
Q($u, u, \frac{1}{2}$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(u, u, \frac{1}{2})$	$(u, -2u, \frac{1}{2})$	$(-2u, u, \frac{1}{2})$
R($u, 0, \frac{1}{2}$)			
Operation	E	C'_{23}	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, u, -\frac{1}{2})$	$(-u, u, \frac{1}{2})$
SM($u, 0, 0$)			
Operation	E	C'_{23}	C_3^+
Coordinate	$(u, 0, 0)$	$(0, u, 0)$	$(-u, u, 0)$
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT ($0, 0, w$) of space group No. 152

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)

LD ($u, u, 0$) of space group No. 152

(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0)$	3a: (4); 3b: (4); 6c: (9)
2	$(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0)$	3a: (5); 3b: (5); 6c: (9)

PA ($-\frac{1}{3}, -\frac{1}{3}, -w$) of space group No. 152

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)

Q ($u, u, \frac{1}{2}$) of space group No. 152

(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0)$	3a: (5); 3b: (4); 6c: (9)
2	$(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0)$	3a: (4); 3b: (5); 6c: (9)

R ($u, 0, \frac{1}{2}$) of space group No. 152

(Co-) irrep	Phonon AM	WYPO information

1	$\left(\frac{\sqrt{3}r_2}{2}, \frac{r_2}{2}, -r_1\right)$	3a: (9); 3b: (9); 6c: (18)
SM $(u, 0, 0)$ of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_2}{2}, \frac{r_2}{2}, -r_1\right)$	3a: (9); 3b: (9); 6c: (18)
U $\left(\frac{1}{2}, 0, w\right)$ of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2, -\frac{r_2}{2}, r_1\right)$	3a: (9); 3b: (9); 6c: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, u, v)	(-u, 0, v)	(u, -u, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(u, -2u, v)	(u, u, v)	(-2u, u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(0, r_2 , r_1)	3a: (9); 3b: (9); 6c: (18)
P2 (u, v, 0) of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3 , r_2 , r_1)	3a: (9); 3b: (9); 6c: (18)
P3 (u, -2u, v) of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3 , r_2 , r_1)	3a: (9); 3b: (9); 6c: (18)
P4 (u, v, $\frac{1}{2}$) of space group No. 152		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3 , r_2 , r_1)	3a: (9); 3b: (9); 6c: (18)

153. Space group No. 153 ($P3_212$)

Hexagonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, \frac{2}{3}\} \quad \{C_3^-|0, 0, \frac{1}{3}\} \quad \{C_{2y}|0, 0, \frac{2}{3}\} \quad \{C_{23}''|0, 0, \frac{1}{3}\} \quad \{C_{22}''|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, \frac{1}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, \frac{1}{3}, -\frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$M (0, \frac{1}{2}, 0)$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (4); 3b: (4); 6c: (9)
2	(0, 0, 0)	3a: (5); 3b: (5); 6c: (9)
$A (0, 0, \frac{1}{2})$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (2); 6c: (3)
2	(0, 0, 0)	3a: (2); 3b: (1); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (4); 3b: (5); 6c: (9)
2	(0, 0, 0)	3a: (5); 3b: (4); 6c: (9)
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
2	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
3	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
2	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)
3	(0, 0, r_1)	3a: (3); 3b: (3); 6c: (6)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation E
Coordinate (0, 0, w)

LD(u , u , 0)

Operation E C_{2y} C_3^+
Coordinate (u , u , 0) ($-u$, $2u$, 0) ($-2u$, u , 0)

$P(\frac{1}{3}, \frac{1}{3}, w)$		
Operation	E	C_{2y}
Coordinate	$(\frac{1}{3}, \frac{1}{3}, w)$	$(-\frac{1}{3}, \frac{2}{3}, -w)$
$Q(u, u, \frac{1}{2})$		
Operation	E	C_{2y} C_3^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, 2u, -\frac{1}{2})$ $(-2u, u, \frac{1}{2})$
$R(u, 0, \frac{1}{2})$		
Operation	E	C_3^- C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, -u, \frac{1}{2})$ $(-u, u, \frac{1}{2})$
$SM(u, 0, 0)$		
Operation	E	C_3^- C_3^+
Coordinate	$(u, 0, 0)$	$(0, -u, 0)$ $(-u, u, 0)$
$U(\frac{1}{2}, 0, w)$		
Operation	E	C_3^- C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$ $(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
LD $(u, u, 0)$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_2}{\sqrt{3}}, r_2, -r_1)$	3a: (9); 3b: (9); 6c: (18)
P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, -r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, -r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, -r_1)$	3a: (3); 3b: (3); 6c: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_2}{\sqrt{3}}, r_2, -r_1)$	3a: (9); 3b: (9); 6c: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 153		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	3a: (4); 3b: (5); 6c: (9)
2	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	3a: (5); 3b: (4); 6c: (9)

SM $(u, 0, 0)$ of space group No. 153

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	3a: (4); 3b: (4); 6c: (9)
2	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	3a: (5); 3b: (5); 6c: (9)

U $(\frac{1}{2}, 0, w)$ of space group No. 153

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_2}{2}, \frac{\sqrt{3}r_2}{2}, r_1)$	3a: (9); 3b: (9); 6c: (18)

*d. Results for high-symmetry planes*P1 $(0, u, v)$

Operation	E	C_3^+	C_3^-
Coordinate	$(0, u, v)$	$(-u, 0, v)$	$(u, -u, v)$

P2 $(u, v, 0)$

Operation	E
Coordinate	$(u, v, 0)$

P3 $(u, -2u, v)$

Operation	E	C_3^+	C_3^-
Coordinate	$(u, -2u, v)$	(u, u, v)	$(-2u, u, v)$

P4 $(u, v, \frac{1}{2})$

Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 $(0, u, v)$ of space group No. 153

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)

P2 $(u, v, 0)$ of space group No. 153

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)

P3 $(u, -2u, v)$ of space group No. 153

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_2}{\sqrt{3}}, r_2, r_1)$	3a: (9); 3b: (9); 6c: (18)

P4 $(u, v, \frac{1}{2})$ of space group No. 153

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)

154. Space group No. 154 ($P3_221$)

Hexagonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, \frac{2}{3}\} \quad \{C_3^-|0, 0, \frac{1}{3}\} \quad \{C_{2x}|0, 0, \frac{1}{3}\} \quad \{C_{23}'|0, 0, 0\} \quad \{C_{22}'|0, 0, \frac{2}{3}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},-\frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$M (0, \frac{1}{2}, 0)$ of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (4); 3b: (4); 6c: (9)
2	(0, 0, 0)	3a: (5); 3b: (5); 6c: (9)
$A (0, 0, \frac{1}{2})$ of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (2); 3b: (1); 6c: (3)
2	(0, 0, 0)	3a: (1); 3b: (2); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (5); 3b: (4); 6c: (9)
2	(0, 0, 0)	3a: (4); 3b: (5); 6c: (9)
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)
$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (2); 3b: (1); 6c: (3)
2	(0, 0, 0)	3a: (1); 3b: (2); 6c: (3)
3	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C ₃ [−]	C ₃ ⁺
Coordinate	(u, u, 0)	(u, −2u, 0)	(−2u, u, 0)

PA($-\frac{1}{3}, -\frac{1}{3}, -w$)			
Operation	E	C_{2x}	Θ
Coordinate	$(-\frac{1}{3}, -\frac{1}{3}, -w)$	$(\frac{1}{3}, -\frac{2}{3}, -w)$	
Q($u, u, \frac{1}{2}$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(u, u, \frac{1}{2})$	$(u, -2u, \frac{1}{2})$	$(-2u, u, \frac{1}{2})$
R($u, 0, \frac{1}{2}$)			
Operation	E	C'_{23}	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, u, -\frac{1}{2})$	$(-u, u, \frac{1}{2})$
SM($u, 0, 0$)			
Operation	E	C'_{23}	C_3^+
Coordinate	$(u, 0, 0)$	$(0, u, 0)$	$(-u, u, 0)$
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT ($0, 0, w$) of space group No. 154

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)

LD ($u, u, 0$) of space group No. 154

(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0)$	3a: (4); 3b: (4); 6c: (9)
2	$(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0)$	3a: (5); 3b: (5); 6c: (9)

PA ($-\frac{1}{3}, -\frac{1}{3}, -w$) of space group No. 154

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)

Q ($u, u, \frac{1}{2}$) of space group No. 154

(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0)$	3a: (4); 3b: (5); 6c: (9)
2	$(\frac{r_1}{2\sqrt{3}} - \frac{\sqrt{3}r_1}{2}, -r_1, 0)$	3a: (5); 3b: (4); 6c: (9)

R ($u, 0, \frac{1}{2}$) of space group No. 154

(Co-) irrep	Phonon AM	WYPO information

1	$\left(\frac{\sqrt{3}r_2}{2}, \frac{r_2}{2}, -r_1\right)$	3a: (9); 3b: (9); 6c: (18)
SM $(u, 0, 0)$ of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_2}{2}, \frac{r_2}{2}, -r_1\right)$	3a: (9); 3b: (9); 6c: (18)
U $\left(\frac{1}{2}, 0, w\right)$ of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{1}{2}\sqrt{3}r_2, -\frac{r_2}{2}, r_1\right)$	3a: (9); 3b: (9); 6c: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, u, v)	(-u, 0, v)	(u, -u, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(u, -2u, v)	(u, u, v)	(-2u, u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(0, r_2 , r_1)	3a: (9); 3b: (9); 6c: (18)
P2 (u, v, 0) of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3 , r_2 , r_1)	3a: (9); 3b: (9); 6c: (18)
P3 (u, -2u, v) of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3 , r_2 , r_1)	3a: (9); 3b: (9); 6c: (18)
P4 (u, v, $\frac{1}{2}$) of space group No. 154		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3 , r_2 , r_1)	3a: (9); 3b: (9); 6c: (18)

155. Space group No. 155 ($R\bar{3}2$)

Trigonal primitive lattice

$$\begin{aligned}\vec{a} &= \left(\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) & \vec{t}_2 &= \vec{b} \\ & & \vec{t}_3 &= \vec{c} \\ \vec{c} &= (0, -a, c)\end{aligned}$$

a. Space group operations

$$\{E|0,0,0\} \quad \{C_3^+|0,0,0\} \quad \{C_3^-|0,0,0\} \quad \{C'_{22}|0,0,0\} \quad \{C_{2x}|0,0,0\} \quad \{C'_{23}|0,0,0\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$Z(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$			
Operation	E		
Coordinate	$(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$		
$L(0,\frac{1}{2},0)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0,\frac{1}{2},0)$	$(0,0,\frac{1}{2})$	$(\frac{1}{2},0,0)$
$F(0,\frac{1}{2},-\frac{1}{2})$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0,\frac{1}{2},-\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},0)$

 $\Gamma(0,0,0)$ of space group No. 155

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	3a: (0); 3b: (0); 6c: (1); 9d: (1); 9e: (1); 18f: (3)
2	(0,0,0)	3a: (1); 3b: (1); 6c: (1); 9d: (2); 9e: (2); 18f: (3)
3	(0,0,0)	3a: (1); 3b: (1); 6c: (2); 9d: (3); 9e: (3); 18f: (6)

$Z\left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 155

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (0); 3b: (1); 6c: (1); 9d: (1); 9e: (2); 18f: (3)
2	(0, 0, 0)	3a: (1); 3b: (0); 6c: (1); 9d: (2); 9e: (1); 18f: (3)
3	(0, 0, 0)	3a: (1); 3b: (1); 6c: (2); 9d: (3); 9e: (3); 18f: (6)

 $L\left(0, \frac{1}{2}, 0\right)$ of space group No. 155

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (2); 6c: (3); 9d: (4); 9e: (5); 18f: (9)
2	(0, 0, 0)	3a: (2); 3b: (1); 6c: (3); 9d: (5); 9e: (4); 18f: (9)

 $F\left(0, \frac{1}{2}, -\frac{1}{2}\right)$ of space group No. 155

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3); 9d: (4); 9e: (4); 18f: (9)
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3); 9d: (5); 9e: (5); 18f: (9)

c. Results for high-symmetry lines

LD($\frac{w}{3}, \frac{w}{3}, \frac{w}{3}$)			
Operation	E		
Coordinate	($\frac{w}{3}, \frac{w}{3}, \frac{w}{3}$)		
SM(0, -u, u)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, -u, u)	(u, 0, -u)	(-u, u, 0)
Y($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)			
Operation	E	C_3^+	C_3^-
Coordinate	($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)	($\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u$)

 $LD\left(\frac{w}{3}, \frac{w}{3}, \frac{w}{3}\right)$ of space group No. 155

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (1); 3b: (1); 6c: (2); 9d: (3); 9e: (3); 18f: (6)
2	$(0, 0, r_1)$	3a: (1); 3b: (1); 6c: (2); 9d: (3); 9e: (3); 18f: (6)
3	$(0, 0, r_1)$	3a: (1); 3b: (1); 6c: (2); 9d: (3); 9e: (3); 18f: (6)

 $SM(0, -u, u)$ of space group No. 155

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_1}{\sqrt{3}}, r_1, 0\right)$	3a: (1); 3b: (1); 6c: (3); 9d: (4); 9e: (4); 18f: (9)
2	$\left(-\frac{r_1}{\sqrt{3}}, r_1, 0\right)$	3a: (2); 3b: (2); 6c: (3); 9d: (5); 9e: (5); 18f: (9)

 $Y\left(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u\right)$ of space group No. 155

(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{r_1}{\sqrt{3}}, r_1, 0\right)$	3a: (1); 3b: (2); 6c: (3); 9d: (4); 9e: (5); 18f: (9)
2	$\left(\frac{r_1}{\sqrt{3}}, r_1, 0\right)$	3a: (2); 3b: (1); 6c: (3); 9d: (5); 9e: (4); 18f: (9)

d. Results for high-symmetry planes

$$P1\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$$

Operation	E	C_3^+	C_3^-
Coordinate	$\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$	$\left(-\frac{1}{2} + v, u, \frac{1}{2} + v\right)$	$\left(\frac{1}{2} + v, -\frac{1}{2} + v, u\right)$

P1 $\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$ of space group No. 155

(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_2, r_2, r_1)$	3a: (3); 3b: (3); 6c: (6); 9d: (9); 9e: (9); 18f: (18)

156. Space group No. 156 ($P3m1$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_{d3}|0, 0, 0\} \quad \{\sigma_{d2}|0, 0, 0\}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation	E
Coordinate	$(0, 0, 0)$

$$M\left(0, \frac{1}{2}, 0\right)$$

Operation	E	C_3^-	C_3^+
Coordinate	$\left(0, \frac{1}{2}, 0\right)$	$\left(\frac{1}{2}, -\frac{1}{2}, 0\right)$	$\left(-\frac{1}{2}, 0, 0\right)$

A(0, 0, $\frac{1}{2}$)		
Operation	E	
Coordinate	(0, 0, $\frac{1}{2}$)	
L(0, $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_3^- C_3^+
Coordinate	(0, $\frac{1}{2}$, $\frac{1}{2}$)	($\frac{1}{2}$, $-\frac{1}{2}$, $\frac{1}{2}$) ($-\frac{1}{2}$, 0, $\frac{1}{2}$)
K($-\frac{1}{3}$, $\frac{2}{3}$, 0)		
Operation	E	σ_x
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, 0)	($\frac{1}{3}$, $\frac{1}{3}$, 0)
H($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)		
Operation	E	σ_x
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)	($\frac{1}{3}$, $\frac{1}{3}$, $\frac{1}{2}$)

$\Gamma(0, 0, 0)$ of space group No. 156			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 3d: (2); 6e: (3)	
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 3d: (1); 6e: (3)	
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)	
$M(0, \frac{1}{2}, 0)$ of space group No. 156			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 3d: (5); 6e: (9)	
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 3d: (4); 6e: (9)	
$A(0, 0, \frac{1}{2})$ of space group No. 156			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 3d: (2); 6e: (3)	
2	(0, 0, 0)	1a: (0); 1b: (0); 1c: (0); 3d: (1); 6e: (3)	
3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)	
$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 156			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (2); 1b: (2); 1c: (2); 3d: (5); 6e: (9)	
2	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 3d: (4); 6e: (9)	
$K(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 156			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)	
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)	
3	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 156			

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)
3	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	σ_x	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E		
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, \frac{2}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	σ_x	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, -u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, 0)	(0, -u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 156

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 3d: (2); 6e: (3)
2	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 3d: (1); 6e: (3)
3	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)

LD (u, u, 0) of space group No. 156

(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_2, -r_2, -r_1)$	1a: (3); 1b: (3); 1c: (3); 3d: (9); 6e: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 156		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, -r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)
2	$(0, 0, -r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)
3	$(0, 0, -r_1)$	1a: (1); 1b: (1); 1c: (1); 3d: (3); 6e: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 156		
(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_2, -r_2, -r_1)$	1a: (3); 1b: (3); 1c: (3); 3d: (9); 6e: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 156		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	1a: (2); 1b: (2); 1c: (2); 3d: (5); 6e: (9)
2	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	1a: (1); 1b: (1); 1c: (1); 3d: (4); 6e: (9)
SM $(u, 0, 0)$ of space group No. 156		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	1a: (2); 1b: (2); 1c: (2); 3d: (5); 6e: (9)
2	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	1a: (1); 1b: (1); 1c: (1); 3d: (4); 6e: (9)
U $(\frac{1}{2}, 0, w)$ of space group No. 156		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	1a: (2); 1b: (2); 1c: (2); 3d: (5); 6e: (9)
2	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	1a: (1); 1b: (1); 1c: (1); 3d: (4); 6e: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, u, v)	(-u, 0, v)	(u, -u, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	σ_{d3}	σ_x
Coordinate	(u, -2u, v)	(2u, -u, v)	(-u, -u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 156		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (2); 3d: (5); 6e: (9)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 3d: (4); 6e: (9)
P2 (u, v, 0) of space group No. 156		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 3d: (9); 6e: (18)
P3 (u, -2u, v) of space group No. 156		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 3d: (9); 6e: (18)
P4 (u, v, $\frac{1}{2}$) of space group No. 156		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 3d: (9); 6e: (18)

157. Space group No. 157 ($P31m$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_{v3}|0, 0, 0\} \quad \{\sigma_{v2}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

A(0, 0, $\frac{1}{2}$)			
Operation	E		
Coordinate	(0, 0, $\frac{1}{2}$)		
L(0, $\frac{1}{2}$, $\frac{1}{2}$)			
Operation	E	C_3^-	C_3^+
Coordinate	(0, $\frac{1}{2}$, $\frac{1}{2}$)	($\frac{1}{2}$, $-\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, 0, $\frac{1}{2}$)
K($-\frac{1}{3}$, $\frac{2}{3}$, 0)			
Operation	E	$E\Theta$	
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, 0)	($\frac{1}{3}$, $-\frac{2}{3}$, 0)	
H($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)			
Operation	E	$E\Theta$	
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)	($\frac{1}{3}$, $-\frac{2}{3}$, $-\frac{1}{2}$)	

$\Gamma(0, 0, 0)$ of space group No. 157			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (3)	
2	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (3)	
3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6)	
$M(0, \frac{1}{2}, 0)$ of space group No. 157			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (2); 2b: (3); 3c: (5); 6d: (9)	
2	(0, 0, 0)	1a: (1); 2b: (3); 3c: (4); 6d: (9)	
$A(0, 0, \frac{1}{2})$ of space group No. 157			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (3)	
2	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (3)	
3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6)	
$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 157			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (2); 2b: (3); 3c: (5); 6d: (9)	
2	(0, 0, 0)	1a: (1); 2b: (3); 3c: (4); 6d: (9)	
$K(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 157			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (3)	
2	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (3)	
3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6)	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 157			

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (3)
2	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (3)
3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 0)	(u, -2u, 0)	(-2u, u, 0)
PA(-1/3, -1/3, -w)			
Operation	E	EΘ	
Coordinate	(-1/3, -1/3, -w)	(1/3, 1/3, w)	
Q(u, u, 1/2)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 1/2)	(u, -2u, 1/2)	(-2u, u, 1/2)
R(u, 0, 1/2)			
Operation	E	σ_{v3}	C_3^+
Coordinate	(u, 0, 1/2)	(0, u, 1/2)	(-u, u, 1/2)
SM(u, 0, 0)			
Operation	E	σ_{v3}	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U(1/2, 0, w)			
Operation	E	C_3^-	C_3^+
Coordinate	(1/2, 0, w)	(0, -1/2, w)	(-1/2, 1/2, w)

DT (0, 0, w) of space group No. 157

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (3)
2	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (3)
3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6)

LD (u, u, 0) of space group No. 157

(Co-) irrep	Phonon AM	WYPO information

1	$(-\sqrt{3}r_1, r_1, 0)$	1a: (2); 2b: (3); 3c: (5); 6d: (9)
2	$(-\sqrt{3}r_1, r_1, 0)$	1a: (1); 2b: (3); 3c: (4); 6d: (9)
PA $(-\frac{1}{3}, -\frac{1}{3}, -w)$ of space group No. 157		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 2b: (1); 3c: (2); 6d: (3)
2	$(0, 0, 0)$	1a: (0); 2b: (1); 3c: (1); 6d: (3)
3	$(0, 0, 0)$	1a: (1); 2b: (2); 3c: (3); 6d: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 157		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\sqrt{3}r_1, r_1, 0)$	1a: (2); 2b: (3); 3c: (5); 6d: (9)
2	$(-\sqrt{3}r_1, r_1, 0)$	1a: (1); 2b: (3); 3c: (4); 6d: (9)
R $(u, 0, \frac{1}{2})$ of space group No. 157		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_2}{2}, -\frac{1}{2}\sqrt{3}r_2, -r_1)$	1a: (3); 2b: (6); 3c: (9); 6d: (18)
SM $(u, 0, 0)$ of space group No. 157		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_2}{2}, -\frac{1}{2}\sqrt{3}r_2, -r_1)$	1a: (3); 2b: (6); 3c: (9); 6d: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 157		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	1a: (2); 2b: (3); 3c: (5); 6d: (9)
2	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	1a: (1); 2b: (3); 3c: (4); 6d: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	σ_{v2}	σ_{v3}
Coordinate	(0, u, v)	(-u, u, v)	(u, 0, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(u, -2u, v)	(u, u, v)	(-2u, u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 157		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₃ , r ₂ , r ₁)	1a: (3); 2b: (6); 3c: (9); 6d: (18)
P2 (u, v, 0) of space group No. 157		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₃ , r ₂ , r ₁)	1a: (3); 2b: (6); 3c: (9); 6d: (18)
P3 (u, −2u, v) of space group No. 157		
(Co-) irrep	Phonon AM	WYPO information
1	(√3r ₁ , r ₁ , 0)	1a: (2); 2b: (3); 3c: (5); 6d: (9)
2	(√3r ₁ , r ₁ , 0)	1a: (1); 2b: (3); 3c: (4); 6d: (9)
P4 (u, v, $\frac{1}{2}$) of space group No. 157		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₃ , r ₂ , r ₁)	1a: (3); 2b: (6); 3c: (9); 6d: (18)

158. Space group No. 158 (P3c1)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{\sigma_x|0, 0, \tfrac{1}{2}\} \quad \{\sigma_{d3}|0, 0, \tfrac{1}{2}\} \quad \{\sigma_{d2}|0, 0, \tfrac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$

A(0, 0, $\frac{1}{2}$)		
Operation	E	
Coordinate	(0, 0, $\frac{1}{2}$)	
L(0, $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_3^- C_3^+
Coordinate	(0, $\frac{1}{2}$, $\frac{1}{2}$)	($\frac{1}{2}$, $-\frac{1}{2}$, $\frac{1}{2}$) ($-\frac{1}{2}$, 0, $\frac{1}{2}$)
K($-\frac{1}{3}$, $\frac{2}{3}$, 0)		
Operation	E	σ_x
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, 0)	($\frac{1}{3}$, $\frac{1}{3}$, 0)
H($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)		
Operation	E	σ_x
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)	($\frac{1}{3}$, $\frac{1}{3}$, $\frac{1}{2}$)

$\Gamma(0, 0, 0)$ of space group No. 158			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 6d: (3)	
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 6d: (3)	
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 6d: (6)	
$M(0, \frac{1}{2}, 0)$ of space group No. 158			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 6d: (9)	
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 6d: (9)	
$A(0, 0, \frac{1}{2})$ of space group No. 158			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 6d: (3)	
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 6d: (3)	
$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 158			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 6d: (9)	
$K(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 158			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, r_1)	2a: (2); 2b: (2); 2c: (2); 6d: (6)	
2	(0, 0, r_1)	2a: (2); 2b: (2); 2c: (2); 6d: (6)	
3	(0, 0, r_1)	2a: (2); 2b: (2); 2c: (2); 6d: (6)	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 158			
(Co-) irrep	Phonon AM	WYPO information	

1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 6d: (3)
2	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 6d: (3)
3	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 6d: (3)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	σ_x	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	σ_x	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, \frac{2}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	σ_x	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, -u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, 0, 0)	(0, -u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 158

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 6d: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 6d: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 6d: (6)

LD (u, u, 0) of space group No. 158

(Co-) irrep	Phonon AM	WYPO information
1	($\sqrt{3}r_2, -r_2, -r_1$)	2a: (6); 2b: (6); 2c: (6); 6d: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 158		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, -r_1)$	2a: (2); 2b: (2); 2c: (2); 6d: (6)
2	$(0, 0, -r_1)$	2a: (2); 2b: (2); 2c: (2); 6d: (6)
3	$(0, 0, -r_1)$	2a: (2); 2b: (2); 2c: (2); 6d: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 158		
(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_2, -r_2, -r_1)$	2a: (3); 2b: (3); 2c: (3); 6d: (9)
R $(u, 0, \frac{1}{2})$ of space group No. 158		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	2a: (3); 2b: (3); 2c: (3); 6d: (9)
2	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	2a: (3); 2b: (3); 2c: (3); 6d: (9)
SM $(u, 0, 0)$ of space group No. 158		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	2a: (3); 2b: (3); 2c: (3); 6d: (9)
2	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	2a: (3); 2b: (3); 2c: (3); 6d: (9)
U $(\frac{1}{2}, 0, w)$ of space group No. 158		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	2a: (3); 2b: (3); 2c: (3); 6d: (9)
2	$(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0)$	2a: (3); 2b: (3); 2c: (3); 6d: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, u, v)	(-u, 0, v)	(u, -u, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	σ_{d3}	σ_x
Coordinate	(u, -2u, v)	(2u, -u, v)	(-u, -u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 158		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 6d: (9)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 6d: (9)
P2 (u, v, 0) of space group No. 158		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 6d: (18)
P3 (u, -2u, v) of space group No. 158		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 6d: (18)
P4 (u, v, $\frac{1}{2}$) of space group No. 158		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (6); 2b: (6); 2c: (6); 6d: (18)

159. Space group No. 159 ($P31c$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{\sigma_y|0, 0, \frac{1}{2}\} \quad \{\sigma_{v3}|0, 0, \frac{1}{2}\} \quad \{\sigma_{v2}|0, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

A(0, 0, $\frac{1}{2}$)			
Operation	E		
Coordinate	(0, 0, $\frac{1}{2}$)		
L(0, $\frac{1}{2}$, $\frac{1}{2}$)			
Operation	E	C_3^-	C_3^+
Coordinate	(0, $\frac{1}{2}$, $\frac{1}{2}$)	($\frac{1}{2}$, $-\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, 0, $\frac{1}{2}$)
K($-\frac{1}{3}$, $\frac{2}{3}$, 0)			
Operation	E	E Θ	
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, 0)	($\frac{1}{3}$, $-\frac{2}{3}$, 0)	
H($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)			
Operation	E	E Θ	
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)	($\frac{1}{3}$, $-\frac{2}{3}$, $-\frac{1}{2}$)	

$\Gamma(0, 0, 0)$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6)
$M(0, \frac{1}{2}, 0)$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 6c: (9)
2	(0, 0, 0)	2a: (3); 2b: (3); 6c: (9)
$A(0, 0, \frac{1}{2})$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 6c: (9)
$K(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6)
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 0)	(u, -2u, 0)	(-2u, u, 0)
PA(-1/3, -1/3, -w)			
Operation	E	EΘ	
Coordinate	(-1/3, -1/3, -w)	(1/3, 1/3, w)	
Q(u, u, 1/2)			
Operation	E	C_3^-	C_3^+
Coordinate	(u, u, 1/2)	(u, -2u, 1/2)	(-2u, u, 1/2)
R(u, 0, 1/2)			
Operation	E	σ_{v3}	C_3^+
Coordinate	(u, 0, 1/2)	(0, u, 1/2)	(-u, u, 1/2)
SM(u, 0, 0)			
Operation	E	σ_{v3}	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U(1/2, 0, w)			
Operation	E	C_3^-	C_3^+
Coordinate	(1/2, 0, w)	(0, -1/2, w)	(-1/2, 1/2, w)

DT (0, 0, w) of space group No. 159			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
3	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6)	
LD (u , u , 0) of space group No. 159			
(Co-) irrep	Phonon AM	WYPO information	
1	($-\sqrt{3}r_1$, r_1 , 0)	2a: (3); 2b: (3); 6c: (9)	
2	($-\sqrt{3}r_1$, r_1 , 0)	2a: (3); 2b: (3); 6c: (9)	

PA $(-\frac{1}{3}, -\frac{1}{3}, -w)$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)
3	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6)

Q $(u, u, \frac{1}{2})$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\sqrt{3}r_1, r_1, 0)$	2a: (3); 2b: (3); 6c: (9)
2	$(-\sqrt{3}r_1, r_1, 0)$	2a: (3); 2b: (3); 6c: (9)

R $(u, 0, \frac{1}{2})$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_2}{2}, -\frac{1}{2}\sqrt{3}r_2, -r_1)$	2a: (3); 2b: (3); 6c: (9)

SM $(u, 0, 0)$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_2}{2}, -\frac{1}{2}\sqrt{3}r_2, -r_1)$	2a: (6); 2b: (6); 6c: (18)

U $(\frac{1}{2}, 0, w)$ of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	2a: (3); 2b: (3); 6c: (9)
2	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	2a: (3); 2b: (3); 6c: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	σ_{v2}	σ_{v3}
Coordinate	(0, u, v)	(-u, u, v)	(u, 0, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(u, -2u, v)	(u, u, v)	(-2u, u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₃ , r ₂ , r ₁)	2a: (6); 2b: (6); 6c: (18)
P2 (u, v, 0) of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₃ , r ₂ , r ₁)	2a: (6); 2b: (6); 6c: (18)
P3 (u, -2u, v) of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	($\sqrt{3}r_1$, r ₁ , 0)	2a: (3); 2b: (3); 6c: (9)
2	($\sqrt{3}r_1$, r ₁ , 0)	2a: (3); 2b: (3); 6c: (9)
P4 (u, v, $\frac{1}{2}$) of space group No. 159		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₃ , r ₂ , r ₁)	2a: (6); 2b: (6); 6c: (18)

160. Space group No. 160 (*R3m*)

Trigonal primitive lattice

$$\vec{a} = \left(\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) \quad \vec{t}_1 = \vec{a}$$

$$\vec{b} = \left(-\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) \quad \vec{t}_2 = \vec{b}$$

$$\vec{c} = (0, -a, c) \quad \vec{t}_3 = \vec{c}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{\sigma_{d2}|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_{d3}|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$Z(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$	
Operation	E
Coordinate	($\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}$)

$L(0, \frac{1}{2}, 0)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$

$F(0, \frac{1}{2}, -\frac{1}{2})$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$

$\Gamma(0, 0, 0)$ of space group No. 160		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 9b: (2); 18c: (3)
2	(0, 0, 0)	3a: (0); 9b: (1); 18c: (3)
3	(0, 0, 0)	3a: (1); 9b: (3); 18c: (6)

$Z(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 160		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 9b: (2); 18c: (3)
2	(0, 0, 0)	3a: (0); 9b: (1); 18c: (3)
3	(0, 0, 0)	3a: (1); 9b: (3); 18c: (6)

$L(0, \frac{1}{2}, 0)$ of space group No. 160		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (2); 9b: (5); 18c: (9)
2	(0, 0, 0)	3a: (1); 9b: (4); 18c: (9)

$F(0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 160		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (2); 9b: (5); 18c: (9)
2	(0, 0, 0)	3a: (1); 9b: (4); 18c: (9)

c. Results for high-symmetry lines

$LD(\frac{w}{3}, \frac{w}{3}, \frac{w}{3})$			
Operation	E		
Coordinate	$(\frac{w}{3}, \frac{w}{3}, \frac{w}{3})$		

$SM(0, -u, u)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, -u, u)$	$(u, 0, -u)$	$(-u, u, 0)$

$Y(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$	$(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$	$(\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u)$

LD $\left(\frac{w}{3}, \frac{w}{3}, \frac{w}{3}\right)$ of space group No. 160		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 9b: (2); 18c: (3)
2	(0, 0, 0)	3a: (0); 9b: (1); 18c: (3)
3	(0, 0, 0)	3a: (1); 9b: (3); 18c: (6)

SM $(0, -u, u)$ of space group No. 160		
(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_2, r_2, r_1)$	3a: (3); 9b: (9); 18c: (18)

Y $\left(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u\right)$ of space group No. 160		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\sqrt{3}r_2, r_2, r_1)$	3a: (3); 9b: (9); 18c: (18)

d. Results for high-symmetry planes

$$\text{P1}\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$$

Operation	E	C_3^+	C_3^-
Coordinate	$(u, \frac{1}{2} + v, -\frac{1}{2} + v)$	$(-\frac{1}{2} + v, u, \frac{1}{2} + v)$	$(\frac{1}{2} + v, -\frac{1}{2} + v, u)$

P1 $\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$ of space group No. 160		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_1}{\sqrt{3}}, r_1, 0\right)$	3a: (2); 9b: (5); 18c: (9)
2	$\left(-\frac{r_1}{\sqrt{3}}, r_1, 0\right)$	3a: (1); 9b: (4); 18c: (9)

161. Space group No. 161 ($R3c$)

Trigonal primitive lattice

$$\vec{a} = \left(\frac{\sqrt{3}a}{2}, \frac{a}{2}, c\right) \quad \vec{t}_1 = \vec{a}$$

$$\vec{b} = \left(-\frac{\sqrt{3}a}{2}, \frac{a}{2}, c\right) \quad \vec{t}_2 = \vec{b}$$

$$\vec{c} = (0, -a, c) \quad \vec{t}_3 = \vec{c}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{\sigma_{d2}|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_x|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{\sigma_{d3}|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$Z(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$			
Operation	E		
Coordinate	$(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$		
$L(0, \frac{1}{2}, 0)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$
$F(0, \frac{1}{2}, -\frac{1}{2})$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$

Γ (0, 0, 0) of space group No. 161			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	6a: (1);	18b: (3)
2	(0, 0, 0)	6a: (1);	18b: (3)
3	(0, 0, 0)	6a: (2);	18b: (6)
Z $(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 161			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	6a: (1);	18b: (3)
2	(0, 0, 0)	6a: (1);	18b: (3)
L $(0, \frac{1}{2}, 0)$ of space group No. 161			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	6a: (3);	18b: (9)
F $(0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 161			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	6a: (3);	18b: (9)
2	(0, 0, 0)	6a: (3);	18b: (9)

c. Results for high-symmetry lines

$LD(\frac{w}{3}, \frac{w}{3}, \frac{w}{3})$	
Operation	E
Coordinate	$(\frac{w}{3}, \frac{w}{3}, \frac{w}{3})$

SM(0, -u, u)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, -u, u)	(u, 0, -u)	(-u, u, 0)

Y($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)			
Operation	E	C_3^+	C_3^-
Coordinate	($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)	($\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u$)

LD ($\frac{w}{3}, \frac{w}{3}, \frac{w}{3}$) of space group No. 161		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (1); 18b: (3)
2	(0, 0, 0)	6a: (1); 18b: (3)
3	(0, 0, 0)	6a: (2); 18b: (6)

SM (0, -u, u) of space group No. 161		
(Co-) irrep	Phonon AM	WYPO information
1	($\sqrt{3}r_2, r_2, r_1$)	6a: (6); 18b: (18)

Y ($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$) of space group No. 161		
(Co-) irrep	Phonon AM	WYPO information
1	($-\sqrt{3}r_2, r_2, r_1$)	6a: (3); 18b: (9)

d. Results for high-symmetry planes

P1($u, \frac{1}{2} + v, -\frac{1}{2} + v$)			
Operation	E	C_3^+	C_3^-
Coordinate	($u, \frac{1}{2} + v, -\frac{1}{2} + v$)	($-\frac{1}{2} + v, u, \frac{1}{2} + v$)	($\frac{1}{2} + v, -\frac{1}{2} + v, u$)

P1 ($u, \frac{1}{2} + v, -\frac{1}{2} + v$) of space group No. 161		
(Co-) irrep	Phonon AM	WYPO information
1	($-\frac{r_1}{\sqrt{3}}, r_1, 0$)	6a: (3); 18b: (9)
2	($-\frac{r_1}{\sqrt{3}}, r_1, 0$)	6a: (3); 18b: (9)

162. Space group No. 162 ($P\bar{3}1m$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) \\ \vec{c} &= (0, 0, c) \end{aligned} \quad \begin{aligned} \vec{t}_1 &= \vec{a} \\ \vec{t}_2 &= \vec{b} \\ \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{I 0,0,0\}$	$\{S_6^+ 0,0,0\}$	$\{S_6^- 0,0,0\}$	$\{C_3^+ 0,0,0\}$	$\{C_3^- 0,0,0\}$	$\{C_{2y} 0,0,0\}$	$\{C_{23}'' 0,0,0\}$
$\{C_{22}'' 0,0,0\}$	$\{\sigma_{v2} 0,0,0\}$	$\{\sigma_y 0,0,0\}$	$\{\sigma_{v3} 0,0,0\}$				

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		

$M(0, \frac{1}{2}, 0)$			
Operation	E	S_6^+	S_6^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$

$A(0,0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0,0, \frac{1}{2})$		

$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	S_6^+	S_6^-
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$

$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	I	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	

$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	I	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, -\frac{1}{2})$	

Γ (0, 0, 0) of space group No. 162												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (0);	2d: (0);	2e: (1);	3f: (0);	3g: (0);	4h: (1);	6i: (1);	6j: (1);	6k: (2);
2	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (1);	2d: (1);	2e: (0);	3f: (0);	3g: (0);	4h: (1);	6i: (2);	6j: (2);	6k: (1);
3	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (0);	2d: (0);	2e: (0);	3f: (1);	3g: (1);	4h: (1);	6i: (1);	6j: (1);	6k: (1);
4	(0, 0, 0)	1a: (1); 12l: (3)	1b: (1);	2c: (1);	2d: (1);	2e: (1);	3f: (2);	3g: (2);	4h: (1);	6i: (2);	6j: (2);	6k: (2);

5	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (0); 3g: (0); 4h: (2); 6i: (3); 6j: (3); 6k: (3); 12l: (6)
6	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (3); 3g: (3); 4h: (2); 6i: (3); 6j: (3); 6k: (3); 12l: (6)
M $(0, \frac{1}{2}, 0)$ of space group No. 162		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (2); 3f: (3); 3g: (3); 4h: (3); 6i: (4); 6j: (4); 6k: (5); 12l: (9)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (3); 6i: (4); 6j: (4); 6k: (4); 12l: (9)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (2); 2d: (2); 2e: (1); 3f: (3); 3g: (3); 4h: (3); 6i: (5); 6j: (5); 6k: (4); 12l: (9)
4	(0, 0, 0)	1a: (2); 1b: (2); 2c: (2); 2d: (2); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (5); 6j: (5); 6k: (5); 12l: (9)
A $(0, 0, \frac{1}{2})$ of space group No. 162		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (0); 2d: (1); 2e: (1); 3f: (0); 3g: (2); 4h: (1); 6i: (1); 6j: (2); 6k: (2); 12l: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (0); 2e: (0); 3f: (0); 3g: (1); 4h: (1); 6i: (2); 6j: (1); 6k: (1); 12l: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (1); 2e: (0); 3f: (1); 3g: (0); 4h: (1); 6i: (1); 6j: (2); 6k: (1); 12l: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (0); 2e: (1); 3f: (2); 3g: (0); 4h: (1); 6i: (2); 6j: (1); 6k: (2); 12l: (3)
5	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (0); 3g: (3); 4h: (2); 6i: (3); 6j: (3); 6k: (3); 12l: (6)
6	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (3); 3g: (0); 4h: (2); 6i: (3); 6j: (3); 6k: (3); 12l: (6)
L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 162		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (2); 2c: (1); 2d: (2); 2e: (2); 3f: (3); 3g: (2); 4h: (3); 6i: (4); 6j: (5); 6k: (5); 12l: (9)
2	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (2); 2e: (1); 3f: (1); 3g: (3); 4h: (3); 6i: (4); 6j: (5); 6k: (4); 12l: (9)
3	(0, 0, 0)	1a: (0); 1b: (1); 2c: (2); 2d: (1); 2e: (1); 3f: (3); 3g: (1); 4h: (3); 6i: (5); 6j: (4); 6k: (4); 12l: (9)
4	(0, 0, 0)	1a: (2); 1b: (0); 2c: (2); 2d: (1); 2e: (2); 3f: (2); 3g: (3); 4h: (3); 6i: (5); 6j: (4); 6k: (5); 12l: (9)
K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 162		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (3); 6k: (4); 12l: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (3); 6k: (2); 12l: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 12l: (12)

$H\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 162		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (3); 6k: (4); 12l: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (3); 6k: (2); 12l: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 12l: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	S ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	I	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	(- $\frac{1}{3}, -\frac{1}{3}, -w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	S ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, - $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	S ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, - $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	S ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C ₃ ⁻	C ₃ ⁺
Coordinate	($\frac{1}{2}, 0, w$)	(0, - $\frac{1}{2}, w$)	(- $\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 162		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (3); 6k: (4); 12l: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (3); 6k: (2); 12l: (6)

3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 12l: (12)

LD $(u, u, 0)$ of space group No. 162

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (4); 3f: (5); 3g: (5); 4h: (6); 6i: (9); 6j: (9); 6k: (10); 12l: (18)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (2); 3f: (4); 3g: (4); 4h: (6); 6i: (9); 6j: (9); 6k: (8); 12l: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 162

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (3); 6k: (4); 12l: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (3); 6k: (2); 12l: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 12l: (12)

Q $(u, u, \frac{1}{2})$ of space group No. 162

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (4); 3f: (5); 3g: (5); 4h: (6); 6i: (9); 6j: (9); 6k: (10); 12l: (18)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (2); 3f: (4); 3g: (4); 4h: (6); 6i: (9); 6j: (9); 6k: (8); 12l: (18)

R $(u, 0, \frac{1}{2})$ of space group No. 162

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (2); 2c: (2); 2d: (4); 2e: (3); 3f: (4); 3g: (5); 4h: (6); 6i: (8); 6j: (10); 6k: (9); 12l: (18)
2	(0, 0, 0)	1a: (2); 1b: (1); 2c: (4); 2d: (2); 2e: (3); 3f: (5); 3g: (4); 4h: (6); 6i: (10); 6j: (8); 6k: (9); 12l: (18)

SM $(u, 0, 0)$ of space group No. 162

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (3); 3f: (4); 3g: (4); 4h: (6); 6i: (8); 6j: (8); 6k: (9); 12l: (18)
2	(0, 0, 0)	1a: (2); 1b: (2); 2c: (4); 2d: (4); 2e: (3); 3f: (5); 3g: (5); 4h: (6); 6i: (10); 6j: (10); 6k: (9); 12l: (18)

U $(\frac{1}{2}, 0, w)$ of space group No. 162

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (4); 3f: (5); 3g: (5); 4h: (6); 6i: (9); 6j: (9); 6k: (10); 12l: (18)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (2); 3f: (4); 3g: (4); 4h: (6); 6i: (9); 6j: (9); 6k: (8); 12l: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	σ_{v2}	σ_{v3}
Coordinate	(0, u, v)	(-u, u, v)	(u, 0, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(u, -2u, v)	(u, u, v)	(-2u, u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u , v) of space group No. 162			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 12l: (36)	
P2 (u , v , 0) of space group No. 162			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 12l: (36)	
P3 (u , $-2u$, v) of space group No. 162			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (4); 3f: (5); 3g: (5); 4h: (6); 6i: (9); 6j: (9); 6k: (10); 12l: (18)	
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (2); 3f: (4); 3g: (4); 4h: (6); 6i: (9); 6j: (9); 6k: (8); 12l: (18)	
P4 (u , v , $\frac{1}{2}$) of space group No. 162			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 12l: (36)	

163. Space group No. 163 ($P\bar{3}1c$)

Hexagonal primitive lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) \\
 \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) \\
 \vec{c} &= (0, 0, c)
 \end{aligned}
 \quad
 \begin{aligned}
 \vec{t}_1 &= \vec{a} \\
 \vec{t}_2 &= \vec{b} \\
 \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{I 0,0,0\}$	$\{S_6^+ 0,0,0\}$	$\{S_6^- 0,0,0\}$	$\{C_3^+ 0,0,0\}$	$\{C_3^- 0,0,0\}$	$\{C_{2y} 0,0,\frac{1}{2}\}$	$\{C_{23}'' 0,0,\frac{1}{2}\}$
$\{C_{22}'' 0,0,\frac{1}{2}\}$	$\{\sigma_{v2} 0,0,-\frac{1}{2}\}$	$\{\sigma_y 0,0,-\frac{1}{2}\}$	$\{\sigma_{v3} 0,0,-\frac{1}{2}\}$				

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		

$M(0,\frac{1}{2},0)$			
Operation	E	S_6^+	S_6^-
Coordinate	$(0,\frac{1}{2},0)$	$(-\frac{1}{2},\frac{1}{2},0)$	$(\frac{1}{2},0,0)$

$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		

$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	S_6^+	S_6^-
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},\frac{1}{2},-\frac{1}{2})$	$(\frac{1}{2},0,-\frac{1}{2})$

$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	I	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	

$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	I	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},-\frac{1}{2})$	

$\Gamma(0,0,0)$ of space group No. 163									
(Co-) irrep	Phonon AM	WYPO information							
1	(0,0,0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (0);	6h: (1); 12i: (3)
2	(0,0,0)	2a: (1);	2b: (0);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (0);	6h: (2); 12i: (3)
3	(0,0,0)	2a: (0);	2b: (1);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (3);	6h: (1); 12i: (3)
4	(0,0,0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (3);	6h: (2); 12i: (3)
5	(0,0,0)	2a: (1);	2b: (0);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (0);	6h: (3); 12i: (6)
6	(0,0,0)	2a: (1);	2b: (2);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (6);	6h: (3); 12i: (6)

M $(0, \frac{1}{2}, 0)$ of space group No. 163									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (6);	6h: (4); 12i: (9)
2	(0, 0, 0)	2a: (1);	2b: (3);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (3);	6h: (4); 12i: (9)
3	(0, 0, 0)	2a: (2);	2b: (0);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (6);	6h: (5); 12i: (9)
4	(0, 0, 0)	2a: (2);	2b: (3);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (3);	6h: (5); 12i: (9)
A $(0, 0, \frac{1}{2})$ of space group No. 163									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 163									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9); 12i: (18)
K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 163									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6); 12i: (12)
H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 163									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6); 12i: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
$P(\frac{1}{3}, \frac{1}{3}, w)$			
Operation	E	I	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	(- $\frac{1}{3}, -\frac{1}{3}, -w$)	
$Q(u, u, \frac{1}{2})$			
Operation	E	S_6^+	C_3^+

Coordinate	$(u, u, \frac{1}{2})$	$(-u, 2u, -\frac{1}{2})$	$(-2u, u, \frac{1}{2})$
$R(u, 0, \frac{1}{2})$			
Operation	E	S_6^+	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, u, -\frac{1}{2})$	$(-u, u, \frac{1}{2})$
$SM(u, 0, 0)$			
Operation	E	S_6^+	C_3^+
Coordinate	$(u, 0, 0)$	$(0, u, 0)$	$(-u, u, 0)$
$U(\frac{1}{2}, 0, w)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 163

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)	
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)	
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6);	12i: (12)	

LD $(u, u, 0)$ of space group No. 163

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)	
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)	

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 163

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)	
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)	
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6);	12i: (12)	

Q $(u, u, \frac{1}{2})$ of space group No. 163

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)	
2	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)	

R $(u, 0, \frac{1}{2})$ of space group No. 163

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)	

SM $(u, 0, 0)$ of space group No. 163

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (2);	2b: (3);	2c: (2);	2d: (2);	4e: (6);	4f: (6);	6g: (9);	6h: (8);	12i: (18)	
2	(0, 0, 0)	2a: (4);	2b: (3);	2c: (4);	2d: (4);	4e: (6);	4f: (6);	6g: (9);	6h: (10);	12i: (18)	

U ($\frac{1}{2}, 0, w$) of space group No. 163		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	σ_{v2}	σ_{v3}
Coordinate	(0, u, v)	($-u, u, v$)	($u, 0, v$)
P2($u, v, 0$)			
Operation	E		
Coordinate	($u, v, 0$)		
P3($u, -2u, v$)			
Operation	E	C_3^+	C_3^-
Coordinate	($u, -2u, v$)	(u, u, v)	($-2u, u, v$)
P4($u, v, \frac{1}{2}$)			
Operation	E		
Coordinate	($u, v, \frac{1}{2}$)		

P1 (0, u, v) of space group No. 163		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 6g: (18); 6h: (18); 12i: (36)
P2 ($u, v, 0$) of space group No. 163		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 6g: (18); 6h: (18); 12i: (36)
P3 ($u, -2u, v$) of space group No. 163		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)
2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)
P4 ($u, v, \frac{1}{2}$) of space group No. 163		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 6g: (18); 6h: (18); 12i: (36)

164. Space group No. 164 ($P\bar{3}m1$)

Hexagonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{array}{cccccccc}\{E|0,0,0\} & \{I|0,0,0\} & \{S_6^+|0,0,0\} & \{S_6^-|0,0,0\} & \{C_3^+|0,0,0\} & \{C_3^-|0,0,0\} & \{C_{2x}|0,0,0\} & \{C'_{23}|0,0,0\} \\ \{C'_{22}|0,0,0\} & \{\sigma_{d2}|0,0,0\} & \{\sigma_x|0,0,0\} & \{\sigma_{d3}|0,0,0\} & & & & \end{array}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	S_6^+	S_6^-
Coordinate	$(0,\frac{1}{2},0)$	$(-\frac{1}{2},\frac{1}{2},0)$	$(\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	S_6^+	S_6^-
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},\frac{1}{2},-\frac{1}{2})$	$(\frac{1}{2},0,-\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	I	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	I	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},-\frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 164

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	2c: (1);	2d: (1);	3e: (0);	3f: (0);	6g: (1);	6h: (1);	6i: (2);	12j: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	2c: (0);	2d: (0);	3e: (0);	3f: (0);	6g: (2);	6h: (2);	6i: (1);	12j: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	2c: (0);	2d: (0);	3e: (1);	3f: (1);	6g: (1);	6h: (1);	6i: (1);	12j: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	2c: (1);	2d: (1);	3e: (2);	3f: (2);	6g: (2);	6h: (2);	6i: (2);	12j: (3)
5	(0, 0, 0)	1a: (0);	1b: (0);	2c: (1);	2d: (1);	3e: (0);	3f: (0);	6g: (3);	6h: (3);	6i: (3);	12j: (6)
6	(0, 0, 0)	1a: (1);	1b: (1);	2c: (1);	2d: (1);	3e: (3);	3f: (3);	6g: (3);	6h: (3);	6i: (3);	12j: (6)

 $M (0, \frac{1}{2}, 0)$ of space group No. 164

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	2c: (2);	2d: (2);	3e: (3);	3f: (3);	6g: (4);	6h: (4);	6i: (5);	12j: (9)
2	(0, 0, 0)	1a: (1);	1b: (1);	2c: (1);	2d: (1);	3e: (1);	3f: (1);	6g: (4);	6h: (4);	6i: (4);	12j: (9)
3	(0, 0, 0)	1a: (0);	1b: (0);	2c: (1);	2d: (1);	3e: (3);	3f: (3);	6g: (5);	6h: (5);	6i: (4);	12j: (9)
4	(0, 0, 0)	1a: (2);	1b: (2);	2c: (2);	2d: (2);	3e: (2);	3f: (2);	6g: (5);	6h: (5);	6i: (5);	12j: (9)

 $A (0, 0, \frac{1}{2})$ of space group No. 164

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (1);	2c: (1);	2d: (1);	3e: (0);	3f: (2);	6g: (1);	6h: (2);	6i: (2);	12j: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	2c: (0);	2d: (0);	3e: (0);	3f: (1);	6g: (2);	6h: (1);	6i: (1);	12j: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	2c: (0);	2d: (0);	3e: (1);	3f: (0);	6g: (1);	6h: (2);	6i: (1);	12j: (3)
4	(0, 0, 0)	1a: (1);	1b: (0);	2c: (1);	2d: (1);	3e: (2);	3f: (0);	6g: (2);	6h: (1);	6i: (2);	12j: (3)
5	(0, 0, 0)	1a: (0);	1b: (1);	2c: (1);	2d: (1);	3e: (0);	3f: (3);	6g: (3);	6h: (3);	6i: (3);	12j: (6)
6	(0, 0, 0)	1a: (1);	1b: (0);	2c: (1);	2d: (1);	3e: (3);	3f: (0);	6g: (3);	6h: (3);	6i: (3);	12j: (6)

 $L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 164

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (2);	2c: (2);	2d: (2);	3e: (3);	3f: (2);	6g: (4);	6h: (5);	6i: (5);	12j: (9)
2	(0, 0, 0)	1a: (1);	1b: (0);	2c: (1);	2d: (1);	3e: (1);	3f: (3);	6g: (4);	6h: (5);	6i: (4);	12j: (9)
3	(0, 0, 0)	1a: (0);	1b: (1);	2c: (1);	2d: (1);	3e: (3);	3f: (1);	6g: (5);	6h: (4);	6i: (4);	12j: (9)
4	(0, 0, 0)	1a: (2);	1b: (0);	2c: (2);	2d: (2);	3e: (2);	3f: (3);	6g: (5);	6h: (4);	6i: (5);	12j: (9)

 $K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 164

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	2c: (1);	2d: (1);	3e: (1);	3f: (1);	6g: (2);	6h: (2);	6i: (3);	12j: (6)
2	(0, 0, 0)	1a: (1);	1b: (1);	2c: (1);	2d: (1);	3e: (2);	3f: (2);	6g: (4);	6h: (4);	6i: (3);	12j: (6)
3	(0, 0, 0)	1a: (1);	1b: (1);	2c: (2);	2d: (2);	3e: (3);	3f: (3);	6g: (6);	6h: (6);	6i: (6);	12j: (12)

 $H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 164

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (1);	2c: (1);	2d: (1);	3e: (1);	3f: (2);	6g: (2);	6h: (4);	6i: (3);	12j: (6)
2	(0, 0, 0)	1a: (1);	1b: (0);	2c: (1);	2d: (1);	3e: (2);	3f: (1);	6g: (4);	6h: (2);	6i: (3);	12j: (6)
3	(0, 0, 0)	1a: (1);	1b: (1);	2c: (2);	2d: (2);	3e: (3);	3f: (3);	6g: (6);	6h: (6);	6i: (6);	12j: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	σ_{d2}	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($\frac{2}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $-\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $-\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 164											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (1);	1b: (1);	2c: (2);	2d: (2);	3e: (2);	3f: (2);	6g: (3);	6h: (3);	6i: (4);	12j: (6)
2	(0, 0, 0)	1a: (0);	1b: (0);	2c: (0);	2d: (0);	3e: (1);	3f: (1);	6g: (3);	6h: (3);	6i: (2);	12j: (6)
3	(0, 0, 0)	1a: (1);	1b: (1);	2c: (2);	2d: (2);	3e: (3);	3f: (3);	6g: (6);	6h: (6);	6i: (6);	12j: (12)
LD ($u, u, 0$) of space group No. 164											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (1);	1b: (1);	2c: (3);	2d: (3);	3e: (4);	3f: (4);	6g: (8);	6h: (8);	6i: (9);	12j: (18)
2	(0, 0, 0)	1a: (2);	1b: (2);	2c: (3);	2d: (3);	3e: (5);	3f: (5);	6g: (10);	6h: (10);	6i: (9);	12j: (18)
P ($\frac{1}{3}, \frac{1}{3}, w$) of space group No. 164											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (1);	1b: (1);	2c: (2);	2d: (2);	3e: (3);	3f: (3);	6g: (6);	6h: (6);	6i: (6);	12j: (12)
2	(0, 0, 0)	1a: (1);	1b: (1);	2c: (2);	2d: (2);	3e: (3);	3f: (3);	6g: (6);	6h: (6);	6i: (6);	12j: (12)
Q ($u, u, \frac{1}{2}$) of space group No. 164											

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (2); 2c: (3); 2d: (3); 3e: (4); 3f: (5); 6g: (8); 6h: (10); 6i: (9); 12j: (18)
2	(0, 0, 0)	1a: (2); 1b: (1); 2c: (3); 2d: (3); 3e: (5); 3f: (4); 6g: (10); 6h: (8); 6i: (9); 12j: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 164		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (4); 2d: (4); 3e: (5); 3f: (5); 6g: (9); 6h: (9); 6i: (10); 12j: (18)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (4); 3f: (4); 6g: (9); 6h: (9); 6i: (8); 12j: (18)
SM $(u, 0, 0)$ of space group No. 164		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (4); 2d: (4); 3e: (5); 3f: (5); 6g: (9); 6h: (9); 6i: (10); 12j: (18)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (4); 3f: (4); 6g: (9); 6h: (9); 6i: (8); 12j: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 164		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (4); 2d: (4); 3e: (5); 3f: (5); 6g: (9); 6h: (9); 6i: (10); 12j: (18)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (4); 3f: (4); 6g: (9); 6h: (9); 6i: (8); 12j: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, u, v)	($-u, 0, v$)	($u, -u, v$)
P2($u, v, 0$)			
Operation	E		
Coordinate	($u, v, 0$)		
P3($u, -2u, v$)			
Operation	E	σ_{d3}	σ_x
Coordinate	($u, -2u, v$)	($2u, -u, v$)	($-u, -u, v$)
P4($u, v, \frac{1}{2}$)			
Operation	E		
Coordinate	($u, v, \frac{1}{2}$)		

P1 (0, u, v) of space group No. 164		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (4); 2d: (4); 3e: (5); 3f: (5); 6g: (9); 6h: (9); 6i: (10); 12j: (18)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 3e: (4); 3f: (4); 6g: (9); 6h: (9); 6i: (8); 12j: (18)
P2 ($u, v, 0$) of space group No. 164		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18); 6h: (18); 6i: (18); 12j: (36)
P3 ($u, -2u, v$) of space group No. 164		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18); 6h: (18); 6i: (18); 12j: (36)
P4 ($u, v, \frac{1}{2}$) of space group No. 164		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 3e: (9); 3f: (9); 6g: (18); 6h: (18); 6i: (18); 12j: (36)

165. Space group No. 165 ($P\bar{3}c1$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{I 0, 0, 0\}$	$\{S_6^+ 0, 0, 0\}$	$\{S_6^- 0, 0, 0\}$	$\{C_3^+ 0, 0, 0\}$	$\{C_3^- 0, 0, 0\}$	$\{C_{2x} 0, 0, \frac{1}{2}\}$	$\{C'_{23} 0, 0, \frac{1}{2}\}$
$\{C'_{22} 0, 0, \frac{1}{2}\}$	$\{\sigma_{d2} 0, 0, -\frac{1}{2}\}$	$\{\sigma_x 0, 0, -\frac{1}{2}\}$	$\{\sigma_{d3} 0, 0, -\frac{1}{2}\}$				

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	S_6^+	S_6^-
Coordinate	$(0,\frac{1}{2},0)$	$(-\frac{1}{2},\frac{1}{2},0)$	$(\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	S_6^+	S_6^-
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},\frac{1}{2},-\frac{1}{2})$	$(\frac{1}{2},0,-\frac{1}{2})$

$$K\left(-\frac{1}{3}, \frac{2}{3}, 0\right)$$

$$\begin{array}{ccc} \text{Operation} & E & I \\ \text{Coordinate} & \left(-\frac{1}{3}, \frac{2}{3}, 0\right) & \left(\frac{1}{3}, -\frac{2}{3}, 0\right) \end{array}$$

$$H\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$$

$$\begin{array}{ccc} \text{Operation} & E & I \\ \text{Coordinate} & \left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right) & \left(\frac{1}{3}, -\frac{2}{3}, -\frac{1}{2}\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 165

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 6e: (0); 6f: (1); 12g: (3)
2	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (1); 6e: (0); 6f: (2); 12g: (3)
3	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 6e: (3); 6f: (1); 12g: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 6e: (3); 6f: (2); 12g: (3)
5	(0, 0, 0)	2a: (1); 2b: (0); 4c: (2); 4d: (2); 6e: (0); 6f: (3); 12g: (6)
6	(0, 0, 0)	2a: (1); 2b: (2); 4c: (2); 4d: (2); 6e: (6); 6f: (3); 12g: (6)

$M (0, \frac{1}{2}, 0)$ of space group No. 165

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (0); 4c: (3); 4d: (3); 6e: (6); 6f: (4); 12g: (9)
2	(0, 0, 0)	2a: (1); 2b: (3); 4c: (3); 4d: (3); 6e: (3); 6f: (4); 12g: (9)
3	(0, 0, 0)	2a: (2); 2b: (0); 4c: (3); 4d: (3); 6e: (6); 6f: (5); 12g: (9)
4	(0, 0, 0)	2a: (2); 2b: (3); 4c: (3); 4d: (3); 6e: (3); 6f: (5); 12g: (9)

$A (0, 0, \frac{1}{2})$ of space group No. 165

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 6e: (3); 6f: (3); 12g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 6e: (3); 6f: (3); 12g: (6)

$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 165

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)

$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 165

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 4c: (2); 4d: (2); 6e: (3); 6f: (2); 12g: (6)
2	(0, 0, 0)	2a: (2); 2b: (1); 4c: (2); 4d: (2); 6e: (3); 6f: (4); 12g: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 6e: (6); 6f: (6); 12g: (12)

$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 165

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 6e: (3); 6f: (3); 12g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 6e: (3); 6f: (3); 12g: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	σ_{d2}	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($\frac{2}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $-\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $-\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	S_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 165

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 6e: (3); 6f: (3); 12g: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 6e: (3); 6f: (3); 12g: (6)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 6e: (6); 6f: (6); 12g: (12)

LD (u , u , 0) of space group No. 165

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (8); 12g: (18)
2	(0, 0, 0)	2a: (4); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (10); 12g: (18)

P ($\frac{1}{3}$, $\frac{1}{3}$, w) of space group No. 165

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 6e: (6); 6f: (6); 12g: (12)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 6e: (6); 6f: (6); 12g: (12)
$Q(u, u, \frac{1}{2})$ of space group No. 165		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)
$R(u, 0, \frac{1}{2})$ of space group No. 165		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)
$SM(u, 0, 0)$ of space group No. 165		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)
$U(\frac{1}{2}, 0, w)$ of space group No. 165		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)

d. Results for high-symmetry planes

$P1(0, u, v)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, u, v)$	$(-u, 0, v)$	$(u, -u, v)$
$P2(u, v, 0)$			
Operation	E		
Coordinate	$(u, v, 0)$		
$P3(u, -2u, v)$			
Operation	E	σ_{d3}	σ_x
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
$P4(u, v, \frac{1}{2})$			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

$P1(0, u, v)$ of space group No. 165		
(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 6e: (9); 6f: (9); 12g: (18)
P2 ($u, v, 0$) of space group No. 165		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 2b: (6); 4c: (12); 4d: (12); 6e: (18); 6f: (18); 12g: (36)
P3 ($u, -2u, v$) of space group No. 165		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 2b: (6); 4c: (12); 4d: (12); 6e: (18); 6f: (18); 12g: (36)
P4 ($u, v, \frac{1}{2}$) of space group No. 165		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 2b: (6); 4c: (12); 4d: (12); 6e: (18); 6f: (18); 12g: (36)

166. Space group No. 166 ($R\bar{3}m$)

Trigonal primitive lattice

$$\begin{aligned}\vec{a} &= \left(\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) & \vec{t}_2 &= \vec{b} \\ & & \vec{t}_3 &= \vec{c} \\ \vec{c} &= (0, -a, c)\end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{I 0, 0, 0\}$	$\{S_6^+ 0, 0, 0\}$	$\{S_6^- 0, 0, 0\}$	$\{C_3^+ 0, 0, 0\}$	$\{C_3^- 0, 0, 0\}$	$\{C'_{22} 0, 0, 0\}$	$\{C_{2x} 0, 0, 0\}$
$\{C'_{23} 0, 0, 0\}$	$\{\sigma_{d3} 0, 0, 0\}$	$\{\sigma_{d2} 0, 0, 0\}$	$\{\sigma_x 0, 0, 0\}$				

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$Z(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$

$L(0, \frac{1}{2}, 0)$			
Operation	E	S_6^-	S_6^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, -\frac{1}{2})$	$(-\frac{1}{2}, 0, 0)$

$F(0, \frac{1}{2}, -\frac{1}{2})$			
Operation	E	S_6^-	S_6^+
Coordinate	$(0, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, 0, -\frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, 0)$

$\Gamma (0, 0, 0)$ of space group No. 166									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	3a: (0);	3b: (0);	6c: (1);	9d: (0);	9e: (0);	18f: (1);	18g: (1);	18h: (2); 36i: (3)
2	(0, 0, 0)	3a: (0);	3b: (0);	6c: (0);	9d: (0);	9e: (0);	18f: (2);	18g: (2);	18h: (1); 36i: (3)
3	(0, 0, 0)	3a: (0);	3b: (0);	6c: (0);	9d: (1);	9e: (1);	18f: (1);	18g: (1);	18h: (1); 36i: (3)
4	(0, 0, 0)	3a: (1);	3b: (1);	6c: (1);	9d: (2);	9e: (2);	18f: (2);	18g: (2);	18h: (2); 36i: (3)
5	(0, 0, 0)	3a: (0);	3b: (0);	6c: (1);	9d: (0);	9e: (0);	18f: (3);	18g: (3);	18h: (3); 36i: (6)
6	(0, 0, 0)	3a: (1);	3b: (1);	6c: (1);	9d: (3);	9e: (3);	18f: (3);	18g: (3);	18h: (3); 36i: (6)

$Z (\frac{1}{2}, \frac{1}{2}, -\frac{1}{2})$ of space group No. 166									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	3a: (0);	3b: (1);	6c: (1);	9d: (2);	9e: (0);	18f: (1);	18g: (2);	18h: (2); 36i: (3)
2	(0, 0, 0)	3a: (0);	3b: (0);	6c: (0);	9d: (1);	9e: (0);	18f: (2);	18g: (1);	18h: (1); 36i: (3)
3	(0, 0, 0)	3a: (0);	3b: (0);	6c: (0);	9d: (0);	9e: (1);	18f: (1);	18g: (2);	18h: (1); 36i: (3)
4	(0, 0, 0)	3a: (1);	3b: (0);	6c: (1);	9d: (0);	9e: (2);	18f: (2);	18g: (1);	18h: (2); 36i: (3)
5	(0, 0, 0)	3a: (0);	3b: (1);	6c: (1);	9d: (3);	9e: (0);	18f: (3);	18g: (3);	18h: (3); 36i: (6)
6	(0, 0, 0)	3a: (1);	3b: (0);	6c: (1);	9d: (0);	9e: (3);	18f: (3);	18g: (3);	18h: (3); 36i: (6)

$L (0, \frac{1}{2}, 0)$ of space group No. 166									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	3a: (0);	3b: (2);	6c: (2);	9d: (2);	9e: (3);	18f: (4);	18g: (5);	18h: (5); 36i: (9)
2	(0, 0, 0)	3a: (1);	3b: (0);	6c: (1);	9d: (3);	9e: (1);	18f: (4);	18g: (5);	18h: (4); 36i: (9)
3	(0, 0, 0)	3a: (0);	3b: (1);	6c: (1);	9d: (1);	9e: (3);	18f: (5);	18g: (4);	18h: (4); 36i: (9)
4	(0, 0, 0)	3a: (2);	3b: (0);	6c: (2);	9d: (3);	9e: (2);	18f: (5);	18g: (4);	18h: (5); 36i: (9)

$F (0, \frac{1}{2}, -\frac{1}{2})$ of space group No. 166									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	3a: (0);	3b: (0);	6c: (2);	9d: (3);	9e: (3);	18f: (4);	18g: (4);	18h: (5); 36i: (9)
2	(0, 0, 0)	3a: (1);	3b: (1);	6c: (1);	9d: (1);	9e: (1);	18f: (4);	18g: (4);	18h: (4); 36i: (9)
3	(0, 0, 0)	3a: (0);	3b: (0);	6c: (1);	9d: (3);	9e: (3);	18f: (5);	18g: (5);	18h: (4); 36i: (9)
4	(0, 0, 0)	3a: (2);	3b: (2);	6c: (2);	9d: (2);	9e: (2);	18f: (5);	18g: (5);	18h: (5); 36i: (9)

c. Results for high-symmetry lines

LD($\frac{w}{3}, \frac{w}{3}, \frac{w}{3}$)			
Operation	E		
Coordinate	($\frac{w}{3}, \frac{w}{3}, \frac{w}{3}$)		
SM(0, -u, u)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, -u, u)	(u, 0, -u)	(-u, u, 0)
Y($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)			
Operation	E	C_3^+	C_3^-
Coordinate	($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)	($\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u$)

LD $\left(\frac{w}{3}, \frac{w}{3}, \frac{w}{3}\right)$ of space group No. 166										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	3a: (1);	3b: (1);	6c: (2);	9d: (2);	9e: (2);	18f: (3);	18g: (3);	18h: (4);	36i: (6)
2	(0, 0, 0)	3a: (0);	3b: (0);	6c: (0);	9d: (1);	9e: (1);	18f: (3);	18g: (3);	18h: (2);	36i: (6)
3	(0, 0, 0)	3a: (1);	3b: (1);	6c: (2);	9d: (3);	9e: (3);	18f: (6);	18g: (6);	18h: (6);	36i: (12)
SM $(0, -u, u)$ of space group No. 166										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	3a: (1);	3b: (1);	6c: (3);	9d: (4);	9e: (4);	18f: (8);	18g: (8);	18h: (9);	36i: (18)
2	(0, 0, 0)	3a: (2);	3b: (2);	6c: (3);	9d: (5);	9e: (5);	18f: (10);	18g: (10);	18h: (9);	36i: (18)
Y $\left(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u\right)$ of space group No. 166										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	3a: (1);	3b: (2);	6c: (3);	9d: (5);	9e: (4);	18f: (8);	18g: (10);	18h: (9);	36i: (18)
2	(0, 0, 0)	3a: (2);	3b: (1);	6c: (3);	9d: (4);	9e: (5);	18f: (10);	18g: (8);	18h: (9);	36i: (18)

d. Results for high-symmetry planes

$\text{P1}\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$			
Operation	E	C_3^+	C_3^-
Coordinate	$\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$	$\left(-\frac{1}{2} + v, u, \frac{1}{2} + v\right)$	$\left(\frac{1}{2} + v, -\frac{1}{2} + v, u\right)$

$\text{P1}\left(u, \frac{1}{2} + v, -\frac{1}{2} + v\right)$ of space group No. 166			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (2); 3b: (2); 6c: (4); 9d: (5); 9e: (5); 18f: (9); 18g: (9); 18h: (10); 36i: (18)	
2	(0, 0, 0)	3a: (1); 3b: (1); 6c: (2); 9d: (4); 9e: (4); 18f: (9); 18g: (9); 18h: (8); 36i: (18)	

167. Space group No. 167 ($R\bar{3}c$)

Trigonal primitive lattice

$$\begin{aligned}\vec{a} &= \left(\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{\sqrt{3}a}{2}, \frac{a}{2}, c \right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, -a, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}& \{E|0,0,0\} \quad \{I|0,0,0\} \quad \{S_6^+|0,0,0\} \quad \{S_6^-|0,0,0\} \quad \{C_3^+|0,0,0\} \quad \{C_3^-|0,0,0\} \quad \{C'_{22}|\frac{1}{2},\frac{1}{2},\frac{1}{2}\} \quad \{C_{2x}|\frac{1}{2},\frac{1}{2},\frac{1}{2}\} \\ & \{C'_{23}|\frac{1}{2},\frac{1}{2},\frac{1}{2}\} \quad \{\sigma_{d3}|-\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\} \quad \{\sigma_{d2}|-\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\} \quad \{\sigma_x|-\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$Z(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$			
Operation	E		
Coordinate	$(\frac{1}{2},\frac{1}{2},-\frac{1}{2})$		
$L(0,\frac{1}{2},0)$			
Operation	E	S_6^-	S_6^+
Coordinate	$(0,\frac{1}{2},0)$	$(0,0,-\frac{1}{2})$	$(-\frac{1}{2},0,0)$
$F(0,\frac{1}{2},-\frac{1}{2})$			
Operation	E	S_6^-	S_6^+
Coordinate	$(0,\frac{1}{2},-\frac{1}{2})$	$(\frac{1}{2},0,-\frac{1}{2})$	$(-\frac{1}{2},\frac{1}{2},0)$

 $\Gamma(0,0,0)$ of space group No. 167

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	6a: (0); 6b: (0); 12c: (1); 18d: (0); 18e: (1); 36f: (3)
2	(0,0,0)	6a: (1); 6b: (0); 12c: (1); 18d: (0); 18e: (2); 36f: (3)
3	(0,0,0)	6a: (0); 6b: (1); 12c: (1); 18d: (3); 18e: (1); 36f: (3)
4	(0,0,0)	6a: (1); 6b: (1); 12c: (1); 18d: (3); 18e: (2); 36f: (3)

5	(0, 0, 0)	6a: (1); 6b: (0); 12c: (2); 18d: (0); 18e: (3); 36f: (6)
6	(0, 0, 0)	6a: (1); 6b: (2); 12c: (2); 18d: (6); 18e: (3); 36f: (6)
$Z \left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2} \right)$ of space group No. 167		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (1); 6b: (1); 12c: (2); 18d: (3); 18e: (3); 36f: (6)
2	(0, 0, 0)	6a: (1); 6b: (1); 12c: (2); 18d: (3); 18e: (3); 36f: (6)
$L \left(0, \frac{1}{2}, 0 \right)$ of space group No. 167		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6); 18d: (9); 18e: (9); 36f: (18)
$F \left(0, \frac{1}{2}, -\frac{1}{2} \right)$ of space group No. 167		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (1); 6b: (0); 12c: (3); 18d: (6); 18e: (4); 36f: (9)
2	(0, 0, 0)	6a: (1); 6b: (3); 12c: (3); 18d: (3); 18e: (4); 36f: (9)
3	(0, 0, 0)	6a: (2); 6b: (0); 12c: (3); 18d: (6); 18e: (5); 36f: (9)
4	(0, 0, 0)	6a: (2); 6b: (3); 12c: (3); 18d: (3); 18e: (5); 36f: (9)

c. Results for high-symmetry lines

LD($\frac{w}{3}, \frac{w}{3}, \frac{w}{3}$)			
Operation	E		
Coordinate	($\frac{w}{3}, \frac{w}{3}, \frac{w}{3}$)		
SM(0, -u, u)			
Operation	E	C_3^+	C_3^-
Coordinate	(0, -u, u)	(u, 0, -u)	(-u, u, 0)
Y($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)			
Operation	E	C_3^+	C_3^-
Coordinate	($\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u$)	($\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}$)	($\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u$)

$LD \left(\frac{w}{3}, \frac{w}{3}, \frac{w}{3} \right)$ of space group No. 167		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (1); 6b: (1); 12c: (2); 18d: (3); 18e: (3); 36f: (6)
2	(0, 0, 0)	6a: (1); 6b: (1); 12c: (2); 18d: (3); 18e: (3); 36f: (6)
3	(0, 0, 0)	6a: (2); 6b: (2); 12c: (4); 18d: (6); 18e: (6); 36f: (12)
$SM(0, -u, u)$ of space group No. 167		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (2); 6b: (3); 12c: (6); 18d: (9); 18e: (8); 36f: (18)
2	(0, 0, 0)	6a: (4); 6b: (3); 12c: (6); 18d: (9); 18e: (10); 36f: (18)

Y $(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$ of space group No. 167		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6); 18d: (9); 18e: (9); 36f: (18)

d. Results for high-symmetry planes

P1 $(u, \frac{1}{2} + v, -\frac{1}{2} + v)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(u, \frac{1}{2} + v, -\frac{1}{2} + v)$	$(-\frac{1}{2} + v, u, \frac{1}{2} + v)$	$(\frac{1}{2} + v, -\frac{1}{2} + v, u)$

P1 $(u, \frac{1}{2} + v, -\frac{1}{2} + v)$ of space group No. 167		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6); 18d: (9); 18e: (9); 36f: (18)
2	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6); 18d: (9); 18e: (9); 36f: (18)

168. Space group No. 168 (P6)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_6^+|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{C_6^-|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

A(0, 0, $\frac{1}{2}$)		
Operation	E	
Coordinate	(0, 0, $\frac{1}{2}$)	
L(0, $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_6^+
Coordinate	(0, $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$)
		($-\frac{1}{2}$, 0, $\frac{1}{2}$)
K($-\frac{1}{3}$, $\frac{2}{3}$, 0)		
Operation	E	C_6^+
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, 0)	($-\frac{2}{3}$, $\frac{1}{3}$, 0)
H($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)		
Operation	E	C_6^+
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)	($-\frac{2}{3}$, $\frac{1}{3}$, $\frac{1}{2}$)

$\Gamma(0, 0, 0)$ of space group No. 168			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (1); 6d: (3)	
2	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (3)	
3	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (3)	
4	(0, 0, 0)	1a: (0); 2b: (1); 3c: (2); 6d: (3)	
$M(0, \frac{1}{2}, 0)$ of space group No. 168			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (3); 3c: (5); 6d: (9)	
2	(0, 0, 0)	1a: (2); 2b: (3); 3c: (4); 6d: (9)	
$A(0, 0, \frac{1}{2})$ of space group No. 168			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (1); 6d: (3)	
2	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (3)	
3	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (3)	
4	(0, 0, 0)	1a: (0); 2b: (1); 3c: (2); 6d: (3)	
$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 168			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (3); 3c: (5); 6d: (9)	
2	(0, 0, 0)	1a: (2); 2b: (3); 3c: (4); 6d: (9)	
$K(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 168			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6)	
2	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6)	

$H\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6)
2	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_6^-	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($\frac{2}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_6^-
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($\frac{1}{2}, -\frac{1}{2}, w$)

DT (0, 0, w) of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	1a: (1); 2b: (1); 3c: (1); 6d: (3)
2	(0, 0, r_1)	1a: (1); 2b: (1); 3c: (2); 6d: (3)
3	(0, 0, r_1)	1a: (0); 2b: (1); 3c: (1); 6d: (3)
4	(0, 0, r_1)	1a: (0); 2b: (1); 3c: (2); 6d: (3)
5	(0, 0, r_1)	1a: (0); 2b: (1); 3c: (1); 6d: (3)
6	(0, 0, r_1)	1a: (1); 2b: (1); 3c: (2); 6d: (3)

LD $(u, u, 0)$ of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}\right)$	1a: (3); 2b: (6); 3c: (9); 6d: (18)
P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 2b: (2); 3c: (3); 6d: (6)
2	$(0, 0, r_1)$	1a: (1); 2b: (2); 3c: (3); 6d: (6)
3	$(0, 0, r_1)$	1a: (1); 2b: (2); 3c: (3); 6d: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}\right)$	1a: (3); 2b: (6); 3c: (9); 6d: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}\right)$	1a: (3); 2b: (6); 3c: (9); 6d: (18)
SM $(u, 0, 0)$ of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}\right)$	1a: (3); 2b: (6); 3c: (9); 6d: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 2b: (3); 3c: (5); 6d: (9)
2	$(0, 0, r_1)$	1a: (2); 2b: (3); 3c: (4); 6d: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₃ , r ₂ , r ₁)	1a: (3); 2b: (6); 3c: (9); 6d: (18)
P2 (u, v, 0) of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₂ , r ₁ , 0)	1a: (3); 2b: (6); 3c: (9); 6d: (18)
P3 (u, −2u, v) of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₃ , r ₂ , r ₁)	1a: (3); 2b: (6); 3c: (9); 6d: (18)
P4 (u, v, $\frac{1}{2}$) of space group No. 168		
(Co-) irrep	Phonon AM	WYPO information
1	(r ₂ , r ₁ , 0)	1a: (3); 2b: (6); 3c: (9); 6d: (18)

169. Space group No. 169 (P6₁)

Hexagonal primitive lattice

$\vec{a} = (a, 0, 0)$
 $\vec{b} = \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right)$
 $\vec{c} = (0, 0, c)$

$\vec{t}_1 = \vec{a}$
 $\vec{t}_2 = \vec{b}$
 $\vec{t}_3 = \vec{c}$

a. Space group operations

$\{E|0, 0, 0\}$ $\{C_6^+|0, 0, \frac{1}{6}\}$ $\{C_3^+|0, 0, \frac{1}{3}\}$ $\{C_{2z}|0, 0, \frac{1}{2}\}$ $\{C_3^-|0, 0, \frac{2}{3}\}$ $\{C_6^-|0, 0, \frac{5}{6}\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$

A(0, 0, $\frac{1}{2}$)			
Operation	E		
Coordinate	(0, 0, $\frac{1}{2}$)		
L(0, $\frac{1}{2}$, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(0, $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$)	($-\frac{1}{2}$, 0, $\frac{1}{2}$)
K($-\frac{1}{3}$, $\frac{2}{3}$, 0)			
Operation	E	C_6^+	
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, 0)	($-\frac{2}{3}$, $\frac{1}{3}$, 0)	
H($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)			
Operation	E	C_6^+	
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)	($-\frac{2}{3}$, $\frac{1}{3}$, $\frac{1}{2}$)	

$\Gamma (0, 0, 0)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	6a: (3)
2	$(0, 0, 0)$	6a: (3)
3	$(0, 0, 0)$	6a: (3)
4	$(0, 0, 0)$	6a: (3)
$M (0, \frac{1}{2}, 0)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	6a: (9)
2	$(0, 0, 0)$	6a: (9)
$A (0, 0, \frac{1}{2})$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	6a: (3)
2	$(0, 0, 0)$	6a: (3)
3	$(0, 0, 0)$	6a: (3)
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	6a: (9)
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	6a: (6)
2	$(0, 0, 0)$	6a: (6)
$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 169		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3)
2	(0, 0, 0)	6a: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C ₆ ⁻	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($\frac{2}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C ₃ ⁻	C ₆ ⁻
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($\frac{1}{2}, -\frac{1}{2}, w$)

DT (0, 0, w) of space group No. 169

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	6a: (3)
2	(0, 0, r_1)	6a: (3)
3	(0, 0, r_1)	6a: (3)
4	(0, 0, r_1)	6a: (3)
5	(0, 0, r_1)	6a: (3)
6	(0, 0, r_1)	6a: (3)

LD (u , u , 0) of space group No. 169

(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}\right)$ ~~(6a)~~ (18)	
P $\left(\frac{1}{3}, \frac{1}{3}, w\right)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	6a: (6)
2	$(0, 0, r_1)$	6a: (6)
3	$(0, 0, r_1)$	6a: (6)
Q $\left(u, u, \frac{1}{2}\right)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}\right)$ ~~(6a)~~ (9)	
R $\left(u, 0, \frac{1}{2}\right)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}\right)$ ~~(6a)~~ (9)	
SM $(u, 0, 0)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}\right)$ ~~(6a)~~ (18)	
U $\left(\frac{1}{2}, 0, w\right)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	6a: (9)
2	$(0, 0, r_1)$	6a: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	(0, u, v)	(-u, u, v)	(u, 0, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	(u, -2u, v)	(2u, -u, v)	(-u, -u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 $(0, u, v)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	6a: (18)
P2 $(u, v, 0)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	6a: (18)
P3 $(u, -2u, v)$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	6a: (18)
P4 $(u, v, \frac{1}{2})$ of space group No. 169		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	6a: (9)

170. Space group No. 170 ($P6_3$)

Hexagonal primitive lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_6^+|0, 0, \frac{5}{6}\} \quad \{C_3^+|0, 0, \frac{2}{3}\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{C_3^-|0, 0, \frac{1}{3}\} \quad \{C_6^-|0, 0, \frac{1}{6}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		

Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_6^+	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(-\frac{2}{3}, \frac{1}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_6^+	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(-\frac{2}{3}, \frac{1}{3}, \frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3)
2	(0, 0, 0)	6a: (3)
3	(0, 0, 0)	6a: (3)
4	(0, 0, 0)	6a: (3)
$M (0, \frac{1}{2}, 0)$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (9)
2	(0, 0, 0)	6a: (9)
$A (0, 0, \frac{1}{2})$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3)
2	(0, 0, 0)	6a: (3)
3	(0, 0, 0)	6a: (3)
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (9)
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (6)
2	(0, 0, 0)	6a: (6)
$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3)
2	(0, 0, 0)	6a: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_6^-	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($\frac{2}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_6^-
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($\frac{1}{2}, -\frac{1}{2}, w$)

DT (0, 0, w) of space group No. 170

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	6a: (3)
2	(0, 0, r_1)	6a: (3)
3	(0, 0, r_1)	6a: (3)
4	(0, 0, r_1)	6a: (3)
5	(0, 0, r_1)	6a: (3)
6	(0, 0, r_1)	6a: (3)

LD (u , u , 0) of space group No. 170

(Co-) irrep	Phonon AM	WYPO information
1	($\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}$, $\frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}$, 0)	6a: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	6a: (6)
2	$(0, 0, r_1)$	6a: (6)
3	$(0, 0, r_1)$	6a: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	~~6a: (6)~~ (9)
R $(u, 0, \frac{1}{2})$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	~~6a: (6)~~ (9)
SM $(u, 0, 0)$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	~~6a: (6)~~ (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	6a: (9)
2	$(0, 0, r_1)$	6a: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 170		

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	6a: (18)
P2 $(u, v, 0)$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	6a: (18)
P3 $(u, -2u, v)$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	6a: (18)
P4 $(u, v, \frac{1}{2})$ of space group No. 170		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	6a: (9)

171. Space group No. 171 ($P6_2$)

Hexagonal primitive lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_6^+|0, 0, \frac{1}{3}\} \quad \{C_3^+|0, 0, \frac{2}{3}\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_3^-|0, 0, \frac{1}{3}\} \quad \{C_6^-|0, 0, \frac{2}{3}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		

$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_6^+	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(-\frac{2}{3}, \frac{1}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_6^+	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(-\frac{2}{3}, \frac{1}{3}, \frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 171			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)	
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)	
3	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)	
4	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)	
$M (0, \frac{1}{2}, 0)$ of space group No. 171			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (3); 3b: (5); 6c: (9)	
2	(0, 0, 0)	3a: (6); 3b: (4); 6c: (9)	
$A (0, 0, \frac{1}{2})$ of space group No. 171			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)	
2	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)	
3	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)	
4	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)	
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 171			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (3); 3b: (5); 6c: (9)	
2	(0, 0, 0)	3a: (6); 3b: (4); 6c: (9)	
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 171			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)	
2	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)	
$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 171			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)	

2 (0, 0, 0) 3a: (3); 3b: (3); 6c: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_6^-	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($\frac{2}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_6^-
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($\frac{1}{2}, -\frac{1}{2}, w$)

DT (0, 0, w) of space group No. 171

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	3a: (1); 3b: (1); 6c: (3)
2	(0, 0, r_1)	3a: (2); 3b: (2); 6c: (3)
3	(0, 0, r_1)	3a: (1); 3b: (1); 6c: (3)
4	(0, 0, r_1)	3a: (2); 3b: (2); 6c: (3)
5	(0, 0, r_1)	3a: (1); 3b: (1); 6c: (3)
6	(0, 0, r_1)	3a: (2); 3b: (2); 6c: (3)

LD (u, u, 0) of space group No. 171

(Co-) irrep	Phonon AM	WYPO information
1	($\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}$)	3a: (9); 3b: (9); 6c: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 171		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 171		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	3a: (9); 3b: (9); 6c: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 171		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	3a: (9); 3b: (9); 6c: (18)
SM $(u, 0, 0)$ of space group No. 171		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	3a: (9); 3b: (9); 6c: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 171		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (5); 6c: (9)
2	$(0, 0, r_1)$	3a: (6); 3b: (4); 6c: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 171		

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)
P2 $(u, v, 0)$ of space group No. 171		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	3a: (9); 3b: (9); 6c: (18)
P3 $(u, -2u, v)$ of space group No. 171		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)
P4 $(u, v, \frac{1}{2})$ of space group No. 171		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	3a: (9); 3b: (9); 6c: (18)

172. Space group No. 172 ($P6_4$)

Hexagonal primitive lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_6^+|0, 0, \frac{2}{3}\} \quad \{C_3^+|0, 0, \frac{1}{3}\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_3^-|0, 0, \frac{2}{3}\} \quad \{C_6^-|0, 0, \frac{1}{3}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		

$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_6^+	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(-\frac{2}{3}, \frac{1}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_6^+	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(-\frac{2}{3}, \frac{1}{3}, \frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 172			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)	
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)	
3	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)	
4	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)	
$M (0, \frac{1}{2}, 0)$ of space group No. 172			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (3); 3b: (5); 6c: (9)	
2	(0, 0, 0)	3a: (6); 3b: (4); 6c: (9)	
$A (0, 0, \frac{1}{2})$ of space group No. 172			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)	
2	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)	
3	(0, 0, 0)	3a: (1); 3b: (1); 6c: (3)	
4	(0, 0, 0)	3a: (2); 3b: (2); 6c: (3)	
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 172			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (3); 3b: (5); 6c: (9)	
2	(0, 0, 0)	3a: (6); 3b: (4); 6c: (9)	
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 172			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)	
2	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)	
$H (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 172			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	3a: (3); 3b: (3); 6c: (6)	

2 (0, 0, 0) 3a: (3); 3b: (3); 6c: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_6^-	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($\frac{2}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_6^-
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($\frac{1}{2}, -\frac{1}{2}, w$)

DT (0, 0, w) of space group No. 172

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	3a: (1); 3b: (1); 6c: (3)
2	(0, 0, r_1)	3a: (2); 3b: (2); 6c: (3)
3	(0, 0, r_1)	3a: (1); 3b: (1); 6c: (3)
4	(0, 0, r_1)	3a: (2); 3b: (2); 6c: (3)
5	(0, 0, r_1)	3a: (1); 3b: (1); 6c: (3)
6	(0, 0, r_1)	3a: (2); 3b: (2); 6c: (3)

LD (u, u, 0) of space group No. 172

(Co-) irrep	Phonon AM	WYPO information
1	($\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}$)	3a: (9); 3b: (9); 6c: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 172		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 6c: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 172		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	3a: (9); 3b: (9); 6c: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 172		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	3a: (9); 3b: (9); 6c: (18)
SM $(u, 0, 0)$ of space group No. 172		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	3a: (9); 3b: (9); 6c: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 172		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (5); 6c: (9)
2	$(0, 0, r_1)$	3a: (6); 3b: (4); 6c: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 172		

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)
P2 $(u, v, 0)$ of space group No. 172		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	3a: (9); 3b: (9); 6c: (18)
P3 $(u, -2u, v)$ of space group No. 172		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	3a: (9); 3b: (9); 6c: (18)
P4 $(u, v, \frac{1}{2})$ of space group No. 172		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	3a: (9); 3b: (9); 6c: (18)

173. Space group No. 173 ($P6_3$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{C_6^+|0, 0, \frac{1}{2}\} \quad \{C_3^+|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{C_3^-|0, 0, 0\} \quad \{C_6^-|0, 0, \frac{1}{2}\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		

$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_6^+	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_6^+	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(-\frac{2}{3}, \frac{1}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_6^+	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(-\frac{2}{3}, \frac{1}{3}, \frac{1}{2})$	

$\Gamma(0, 0, 0)$ of space group No. 173			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
4	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
$M(0, \frac{1}{2}, 0)$ of space group No. 173			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 6c: (9)	
2	(0, 0, 0)	2a: (3); 2b: (3); 6c: (9)	
$A(0, 0, \frac{1}{2})$ of space group No. 173			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
3	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 173			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 6c: (9)	
$K(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 173			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6)	
2	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6)	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 173			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3)	
2	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6)	

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_6^-	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($\frac{2}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_6^-
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($\frac{1}{2}, -\frac{1}{2}, w$)

DT (0, 0, w) of space group No. 173

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	2a: (1); 2b: (1); 6c: (3)
2	(0, 0, r_1)	2a: (1); 2b: (1); 6c: (3)
3	(0, 0, r_1)	2a: (1); 2b: (1); 6c: (3)
4	(0, 0, r_1)	2a: (1); 2b: (1); 6c: (3)
5	(0, 0, r_1)	2a: (1); 2b: (1); 6c: (3)
6	(0, 0, r_1)	2a: (1); 2b: (1); 6c: (3)

LD (u , u , 0) of space group No. 173

(Co-) irrep	Phonon AM	WYPO information
1	($\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2}$)	2a: (6); 2b: (6); 6c: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 173		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (2); 2b: (2); 6c: (6)
2	$(0, 0, r_1)$	2a: (2); 2b: (2); 6c: (6)
3	$(0, 0, r_1)$	2a: (2); 2b: (2); 6c: (6)
Q $(u, u, \frac{1}{2})$ of space group No. 173		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	2a: (3); 2b: (3); 6c: (9)
R $(u, 0, \frac{1}{2})$ of space group No. 173		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	2a: (3); 2b: (3); 6c: (9)
SM $(u, 0, 0)$ of space group No. 173		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2} + \frac{r_2}{2}, \frac{r_1}{2} - \frac{\sqrt{3}r_2}{2})$	2a: (6); 2b: (6); 6c: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 173		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 6c: (9)
2	$(0, 0, r_1)$	2a: (3); 2b: (3); 6c: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 173		

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (6); 2b: (6); 6c: (18)
P2 $(u, v, 0)$ of space group No. 173		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 6c: (18)
P3 $(u, -2u, v)$ of space group No. 173		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (6); 2b: (6); 6c: (18)
P4 $(u, v, \frac{1}{2})$ of space group No. 173		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 6c: (9)

174. Space group No. 174 ($P\bar{6}$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\{E|0, 0, 0\} \quad \{S_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{S_3^-|0, 0, 0\}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	S_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		

$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_3^-	S_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, -\frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, -\frac{1}{2})$	

$\Gamma(0, 0, 0)$ of space group No. 174										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	1e: (0);	1f: (0);	2g: (1);	2h: (1);	2i: (1); 3j: (2); 3k: (2); 6l: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	1c: (0);	1d: (0);	1e: (0);	1f: (0);	2g: (1);	2h: (1);	2i: (1); 3j: (1); 3k: (1); 6l: (3)
3	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (1);	2h: (1);	2i: (1); 3j: (2); 3k: (2); 6l: (3)
4	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (1);	2h: (1);	2i: (1); 3j: (1); 3k: (1); 6l: (3)
$M(0, \frac{1}{2}, 0)$ of space group No. 174										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	1a: (2);	1b: (2);	1c: (2);	1d: (2);	1e: (2);	1f: (2);	2g: (3);	2h: (3);	2i: (3); 3j: (6); 3k: (6); 6l: (9)
2	(0, 0, 0)	1a: (1);	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (3);	2h: (3);	2i: (3); 3j: (3); 3k: (3); 6l: (9)
$A(0, 0, \frac{1}{2})$ of space group No. 174										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	1a: (0);	1b: (1);	1c: (0);	1d: (1);	1e: (0);	1f: (1);	2g: (1);	2h: (1);	2i: (1); 3j: (2); 3k: (1); 6l: (3)
2	(0, 0, 0)	1a: (0);	1b: (1);	1c: (0);	1d: (1);	1e: (0);	1f: (1);	2g: (1);	2h: (1);	2i: (1); 3j: (1); 3k: (2); 6l: (3)
3	(0, 0, 0)	1a: (1);	1b: (0);	1c: (1);	1d: (0);	1e: (1);	1f: (0);	2g: (1);	2h: (1);	2i: (1); 3j: (2); 3k: (1); 6l: (3)
4	(0, 0, 0)	1a: (1);	1b: (0);	1c: (1);	1d: (0);	1e: (1);	1f: (0);	2g: (1);	2h: (1);	2i: (1); 3j: (1); 3k: (2); 6l: (3)
$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 174										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	1a: (2);	1b: (1);	1c: (2);	1d: (1);	1e: (2);	1f: (1);	2g: (3);	2h: (3);	2i: (3); 3j: (6); 3k: (3); 6l: (9)
2	(0, 0, 0)	1a: (1);	1b: (2);	1c: (1);	1d: (2);	1e: (1);	1f: (2);	2g: (3);	2h: (3);	2i: (3); 3j: (3); 3k: (6); 6l: (9)

K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 174		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (0); 1b: (0); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (2); 3k: (2); 6l: (3)
2	$(0, 0, r_1)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (1); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (1); 6l: (3)
3	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (0); 1d: (0); 1e: (1); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (2); 3k: (2); 6l: (3)
4	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (1); 6l: (3)
5	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (0); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (2); 3k: (2); 6l: (3)
6	$(0, 0, r_1)$	1a: (0); 1b: (0); 1c: (1); 1d: (1); 1e: (0); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (1); 6l: (3)
H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 174		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (0); 1b: (1); 1c: (1); 1d: (0); 1e: (1); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (2); 3k: (1); 6l: (3)
2	$(0, 0, r_1)$	1a: (0); 1b: (1); 1c: (0); 1d: (1); 1e: (1); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (2); 6l: (3)
3	$(0, 0, r_1)$	1a: (1); 1b: (0); 1c: (0); 1d: (1); 1e: (1); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (2); 3k: (1); 6l: (3)
4	$(0, 0, r_1)$	1a: (1); 1b: (0); 1c: (0); 1d: (1); 1e: (0); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (2); 6l: (3)
5	$(0, 0, r_1)$	1a: (1); 1b: (0); 1c: (1); 1d: (0); 1e: (0); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (2); 3k: (1); 6l: (3)
6	$(0, 0, r_1)$	1a: (0); 1b: (1); 1c: (1); 1d: (0); 1e: (0); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (2); 6l: (3)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	S_3^-	S_3^+
Coordinate	(u, u, 0)	(u, -2u, 0)	(-2u, u, 0)
PA(-\frac{1}{3}, -\frac{1}{3}, -w)			
Operation	E	$S_3^+ \Theta$	
Coordinate	(-\frac{1}{3}, -\frac{1}{3}, -w)	(-\frac{2}{3}, \frac{1}{3}, -w)	
Q(u, u, \frac{1}{2})			
Operation	E	S_3^-	S_3^+
Coordinate	(u, u, \frac{1}{2})	(u, -2u, -\frac{1}{2})	(-2u, u, -\frac{1}{2})

$R(u, 0, \frac{1}{2})$			
Operation	E	S_3^-	S_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, -u, -\frac{1}{2})$	$(-u, u, -\frac{1}{2})$
$SM(u, 0, 0)$			
Operation	E	S_3^-	S_3^+
Coordinate	$(u, 0, 0)$	$(0, -u, 0)$	$(-u, u, 0)$
$U(\frac{1}{2}, 0, w)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 174											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, 0)$	1a: (1); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3j: (3); 3k: (3);
2	$(0, 0, 0)$	1a: (1); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3j: (3); 3k: (3);
LD $(u, u, 0)$ of space group No. 174											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, r_1)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 2g: (3); 2h: (3); 2i: (3); 3j: (6); 3k: (6); 6l: (9)									
2	$(0, 0, r_1)$	1a: (1); 6l: (9)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (3);	2h: (3);	2i: (3);	3j: (3); 3k: (3);
PA $(-\frac{1}{3}, -\frac{1}{3}, -w)$ of space group No. 174											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, r_1)$	1a: (1); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3j: (3); 3k: (3);
2	$(0, 0, r_1)$	1a: (1); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3j: (3); 3k: (3);
3	$(0, 0, r_1)$	1a: (1); 6l: (6)	1b: (1);	1c: (1);	1d: (1);	1e: (1);	1f: (1);	2g: (2);	2h: (2);	2i: (2);	3j: (3); 3k: (3);
Q $(u, u, \frac{1}{2})$ of space group No. 174											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, r_1)$	1a: (2); 6l: (9)	1b: (1);	1c: (2);	1d: (1);	1e: (2);	1f: (1);	2g: (3);	2h: (3);	2i: (3);	3j: (6); 3k: (3);
2	$(0, 0, r_1)$	1a: (1); 6l: (9)	1b: (2);	1c: (1);	1d: (2);	1e: (1);	1f: (2);	2g: (3);	2h: (3);	2i: (3);	3j: (3); 3k: (6);
R $(u, 0, \frac{1}{2})$ of space group No. 174											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, r_1)$	1a: (2); 6l: (9)	1b: (1);	1c: (2);	1d: (1);	1e: (2);	1f: (1);	2g: (3);	2h: (3);	2i: (3);	3j: (6); 3k: (3);

2	$(0, 0, r_1)$	1a: (1); 1b: (2) ; 1c: (1); 1d: (2) ; 1e: (1); 1f: (2) ; 2g: (3) ; 2h: (3) ; 2i: (3) ; 3j: (3); 3k: (6) ; 6l: (9)

SM $(u, 0, 0)$ of space group No. 174

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (2) ; 1b: (2) ; 1c: (2) ; 1d: (2) ; 1e: (2) ; 1f: (2) ; 2g: (3) ; 2h: (3) ; 2i: (3) ; 3j: (6) ; 3k: (6) ; 6l: (9)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (3) ; 2h: (3) ; 2i: (3) ; 3j: (3); 3k: (3); 6l: (9)

U $(\frac{1}{2}, 0, w)$ of space group No. 174

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{1}{2}\sqrt{3}r_1 - \frac{r_2}{2}, -\frac{r_1}{2} + \frac{\sqrt{3}r_2}{2}, 0)$	1a: (3) ; 1b: (3) ; 1c: (3) ; 1d: (3) ; 1e: (3) ; 1f: (3) ; 2g: (6) ; 2h: (6) ; 2i: (6) ; 3j: (9) ; 3k: (9) ; 6l: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, u, v)$	$(-u, 0, v)$	$(u, -u, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	$(u, -2u, v)$	(u, u, v)	$(-2u, u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 $(0, u, v)$ of space group No. 174

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3) ; 1b: (3) ; 1c: (3) ; 1d: (3) ; 1e: (3) ; 1f: (3) ; 2g: (6) ; 2h: (6) ; 2i: (6) ; 3j: (9) ; 3k: (9) ; 6l: (18)

P2 $(u, v, 0)$ of space group No. 174

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (2) ; 1b: (2) ; 1c: (2) ; 1d: (2) ; 1e: (2) ; 1f: (2) ; 2g: (3) ; 2h: (3) ; 2i: (3) ; 3j: (6) ; 3k: (6) ; 6l: (9)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (3) ; 2h: (3) ; 2i: (3) ; 3j: (3); 3k: (3); 6l: (9)

P3 ($u, -2u, v$) of space group No. 174		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 2g: (6); 2h: (6); 2i: (6); 3j: (9); 3k: (9); 6l: (18)
P4 ($u, v, \frac{1}{2}$) of space group No. 174		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 1e: (2); 1f: (1); 2g: (3); 2h: (3); 2i: (3); 3j: (6); 3k: (3); 6l: (9)
2	$(0, 0, r_1)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 1e: (1); 1f: (2); 2g: (3); 2h: (3); 2i: (3); 3j: (3); 3k: (6); 6l: (9)

175. Space group No. 175 ($P6/m$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_3^+ 0, 0, 0\}$	$\{C_3^- 0, 0, 0\}$	$\{C_{2z} 0, 0, 0\}$	$\{C_6^- 0, 0, 0\}$	$\{C_6^+ 0, 0, 0\}$	$\{I 0, 0, 0\}$	$\{S_6^- 0, 0, 0\}$
$\{S_6^+ 0, 0, 0\}$	$\{\sigma_z 0, 0, 0\}$	$\{S_3^+ 0, 0, 0\}$	$\{S_3^- 0, 0, 0\}$				

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	C_3^-	C_3^+

Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, \frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 175											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (0);	2d: (0);	2e: (1);	3f: (0);	3g: (0);	4h: (1);	6i: (1);	6j: (2); 6k: (2);
2	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (1);	2d: (1);	2e: (0);	3f: (0);	3g: (0);	4h: (1);	6i: (1);	6j: (2); 6k: (2);
3	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (1);	2d: (1);	2e: (0);	3f: (0);	3g: (0);	4h: (1);	6i: (2);	6j: (1); 6k: (1);
4	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (0);	2d: (0);	2e: (1);	3f: (0);	3g: (0);	4h: (1);	6i: (2);	6j: (1); 6k: (1);
5	(0, 0, 0)	1a: (1); 12l: (3)	1b: (1);	2c: (1);	2d: (1);	2e: (1);	3f: (1);	3g: (1);	4h: (1);	6i: (1);	6j: (1); 6k: (1);
6	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (0);	2d: (0);	2e: (0);	3f: (1);	3g: (1);	4h: (1);	6i: (1);	6j: (1); 6k: (1);
7	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (0);	2d: (0);	2e: (0);	3f: (2);	3g: (2);	4h: (1);	6i: (2);	6j: (2); 6k: (2);
8	(0, 0, 0)	1a: (1); 12l: (3)	1b: (1);	2c: (1);	2d: (1);	2e: (1);	3f: (2);	3g: (2);	4h: (1);	6i: (2);	6j: (2); 6k: (2);
$M (0, \frac{1}{2}, 0)$ of space group No. 175											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0); 12l: (9)	1b: (0);	2c: (2);	2d: (2);	2e: (1);	3f: (4);	3g: (4);	4h: (3);	6i: (5);	6j: (6); 6k: (6);
2	(0, 0, 0)	1a: (1); 12l: (9)	1b: (1);	2c: (1);	2d: (1);	2e: (1);	3f: (1);	3g: (1);	4h: (3);	6i: (5);	6j: (3); 6k: (3);
3	(0, 0, 0)	1a: (0); 12l: (9)	1b: (0);	2c: (1);	2d: (1);	2e: (2);	3f: (2);	3g: (2);	4h: (3);	6i: (4);	6j: (3); 6k: (3);
4	(0, 0, 0)	1a: (2); 12l: (9)	1b: (2);	2c: (2);	2d: (2);	2e: (2);	3f: (2);	3g: (2);	4h: (3);	6i: (4);	6j: (6); 6k: (6);
$A (0, 0, \frac{1}{2})$ of space group No. 175											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0); 12l: (3)	1b: (1);	2c: (0);	2d: (1);	2e: (1);	3f: (0);	3g: (1);	4h: (1);	6i: (1);	6j: (2); 6k: (1);
2	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (1);	2d: (0);	2e: (0);	3f: (0);	3g: (1);	4h: (1);	6i: (1);	6j: (2); 6k: (1);
3	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (1);	2d: (0);	2e: (0);	3f: (0);	3g: (2);	4h: (1);	6i: (2);	6j: (1); 6k: (2);

4	(0, 0, 0)	1a: (0); 1b: (1); 2c: (0); 2d: (1); 2e: (1); 3f: (0); 3g: (2); 4h: (1); 6i: (2); 6j: (1); 6k: (2); 12l: (3)
5	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (0); 2e: (1); 3f: (1); 3g: (0); 4h: (1); 6i: (1); 6j: (1); 6k: (2); 12l: (3)
6	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (1); 2e: (0); 3f: (1); 3g: (0); 4h: (1); 6i: (1); 6j: (1); 6k: (2); 12l: (3)
7	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (1); 2e: (0); 3f: (2); 3g: (0); 4h: (1); 6i: (2); 6j: (2); 6k: (1); 12l: (3)
8	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (0); 2e: (1); 3f: (2); 3g: (0); 4h: (1); 6i: (2); 6j: (2); 6k: (1); 12l: (3)

$L \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (2); 2d: (1); 2e: (1); 3f: (4); 3g: (1); 4h: (3); 6i: (5); 6j: (6); 6k: (3); 12l: (9)
2	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (2); 2e: (1); 3f: (1); 3g: (4); 4h: (3); 6i: (5); 6j: (3); 6k: (6); 12l: (9)
3	(0, 0, 0)	1a: (0); 1b: (2); 2c: (1); 2d: (2); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (4); 6j: (3); 6k: (6); 12l: (9)
4	(0, 0, 0)	1a: (2); 1b: (0); 2c: (2); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (4); 6j: (6); 6k: (3); 12l: (9)

$K \left(-\frac{1}{3}, \frac{2}{3}, 0\right)$ of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (2); 2d: (2); 2e: (1); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (4); 6k: (4); 12l: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (2); 6k: (2); 12l: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (4); 6k: (4); 12l: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (0); 2d: (0); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (2); 6k: (2); 12l: (6)

$H \left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (2); 2d: (0); 2e: (1); 3f: (2); 3g: (1); 4h: (2); 6i: (3); 6j: (4); 6k: (2); 12l: (6)
2	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (2); 4h: (2); 6i: (3); 6j: (2); 6k: (4); 12l: (6)
3	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (2); 3g: (1); 4h: (2); 6i: (3); 6j: (4); 6k: (2); 12l: (6)
4	(0, 0, 0)	1a: (1); 1b: (0); 2c: (0); 2d: (2); 2e: (1); 3f: (1); 3g: (2); 4h: (2); 6i: (3); 6j: (2); 6k: (4); 12l: (6)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation E
Coordinate (0, 0, w)

LD($u, u, 0$)			
Operation	E	C_6^+	C_3^+
Coordinate	$(u, u, 0)$	$(-u, 2u, 0)$	$(-2u, u, 0)$
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_{2z}	
Coordinate	$(\frac{1}{3}, \frac{1}{3}, w)$	$(-\frac{1}{3}, -\frac{1}{3}, w)$	
Q($u, u, \frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, 2u, \frac{1}{2})$	$(-2u, u, \frac{1}{2})$
R($u, 0, \frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
SM($u, 0, 0$)			
Operation	E	C_6^+	C_3^+
Coordinate	$(u, 0, 0)$	$(0, u, 0)$	$(-u, u, 0)$
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT ($0, 0, w$) of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 12l: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 12l: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 12l: (6)
4	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 12l: (6)

LD ($u, u, 0$) of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (4); 2d: (4); 2e: (3); 3f: (6); 3g: (6); 4h: (6); 6i: (9); 6j: (12); 6k: (12); 12l: (18)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (3); 3f: (3); 3g: (3); 4h: (6); 6i: (9); 6j: (6); 6k: (6); 12l: (18)

P ($\frac{1}{3}, \frac{1}{3}, w$) of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 12l: (12)

2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 12l: (12)

$Q(u, u, \frac{1}{2})$ of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 2c: (4); 2d: (2); 2e: (3); 3f: (6); 3g: (3); 4h: (6); 6i: (9); 6j: (12); 6k: (6); 12l: (18)
2	(0, 0, 0)	1a: (1); 1b: (2); 2c: (2); 2d: (4); 2e: (3); 3f: (3); 3g: (6); 4h: (6); 6i: (9); 6j: (6); 6k: (12); 12l: (18)

$R(u, 0, \frac{1}{2})$ of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 2c: (4); 2d: (2); 2e: (3); 3f: (6); 3g: (3); 4h: (6); 6i: (9); 6j: (12); 6k: (6); 12l: (18)
2	(0, 0, 0)	1a: (1); 1b: (2); 2c: (2); 2d: (4); 2e: (3); 3f: (3); 3g: (6); 4h: (6); 6i: (9); 6j: (6); 6k: (12); 12l: (18)

$SM(u, 0, 0)$ of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 2c: (4); 2d: (4); 2e: (3); 3f: (6); 3g: (6); 4h: (6); 6i: (9); 6j: (12); 6k: (12); 12l: (18)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (3); 3f: (3); 3g: (3); 4h: (6); 6i: (9); 6j: (6); 6k: (6); 12l: (18)

$U(\frac{1}{2}, 0, w)$ of space group No. 175

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (2); 3f: (5); 3g: (5); 4h: (6); 6i: (10); 6j: (9); 6k: (9); 12l: (18)
2	(0, 0, 0)	1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (4); 3f: (4); 3g: (4); 4h: (6); 6i: (8); 6j: (9); 6k: (9); 12l: (18)

d. Results for high-symmetry planes

$P1(0, u, v)$

Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$

$P2(u, v, 0)$

Operation	E
Coordinate	$(u, v, 0)$

$P3(u, -2u, v)$

Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$

$P4(u, v, \frac{1}{2})$

Operation	E

Coordinate $(u, v, \frac{1}{2})$

P1 $(0, u, v)$ of space group No. 175		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 12l: (36)
P2 $(u, v, 0)$ of space group No. 175		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (2); 1b: (2); 2c: (4); 2d: (4); 2e: (3); 3f: (6); 3g: (6); 4h: (6); 6i: (9); 6j: (12); 6k: (12); 12l: (18)
2	$(0, 0, 0)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (3); 3f: (3); 3g: (3); 4h: (6); 6i: (9); 6j: (6); 6k: (6); 12l: (18)
P3 $(u, -2u, v)$ of space group No. 175		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 12l: (36)
P4 $(u, v, \frac{1}{2})$ of space group No. 175		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (2); 1b: (1); 2c: (4); 2d: (2); 2e: (3); 3f: (6); 3g: (3); 4h: (6); 6i: (9); 6j: (12); 6k: (6); 12l: (18)
2	$(0, 0, 0)$	1a: (1); 1b: (2); 2c: (2); 2d: (4); 2e: (3); 3f: (3); 3g: (6); 4h: (6); 6i: (9); 6j: (6); 6k: (12); 12l: (18)

176. Space group No. 176 ($P6_3/m$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{C_6^-|0, 0, \frac{1}{2}\} \quad \{C_6^+|0, 0, \frac{1}{2}\} \quad \{I|0, 0, 0\} \quad \{S_6^-|0, 0, 0\} \\ &\{S_6^+|0, 0, 0\} \quad \{\sigma_z|0, 0, -\frac{1}{2}\} \quad \{S_3^+|0, 0, -\frac{1}{2}\} \quad \{S_3^-|0, 0, -\frac{1}{2}\} \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, \frac{1}{2})$	

$\Gamma(0, 0, 0)$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (0);	6h: (2);	12i: (3)
2	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (0);	6h: (2);	12i: (3)
3	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (0);	6h: (1);	12i: (3)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (0);	6h: (1);	12i: (3)
5	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (3);	6h: (1);	12i: (3)
6	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (3);	6h: (1);	12i: (3)
7	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (3);	6h: (2);	12i: (3)
8	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (3);	6h: (2);	12i: (3)
$M(0, \frac{1}{2}, 0)$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (2);	2b: (0);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (6);	6h: (6);	12i: (9)
2	(0, 0, 0)	2a: (1);	2b: (3);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (3);	6h: (3);	12i: (9)
3	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (6);	6h: (3);	12i: (9)
4	(0, 0, 0)	2a: (2);	2b: (3);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (3);	6h: (6);	12i: (9)
$A(0, 0, \frac{1}{2})$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)

2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)
L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 176		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)
K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 176		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 2c: (2); 2d: (2); 4e: (2); 4f: (2); 6g: (3); 6h: (4); 12i: (6)
2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (2); 12i: (6)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (4); 12i: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 6g: (3); 6h: (2); 12i: (6)
H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 176		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (0); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (2); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_{2z}	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			

Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)
2	$(0, 0, 0)$	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)
3	$(0, 0, 0)$	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)
4	$(0, 0, 0)$	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)
LD $(u, u, 0)$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (4);	2b: (3);	2c: (4);	2d: (4);	4e: (6);	4f: (6);	6g: (9);	6h: (12);	12i: (18)
2	$(0, 0, 0)$	2a: (2);	2b: (3);	2c: (2);	2d: (2);	4e: (6);	4f: (6);	6g: (9);	6h: (6);	12i: (18)
P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6);	12i: (12)
2	$(0, 0, 0)$	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6);	12i: (12)
Q $(u, u, \frac{1}{2})$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)
SM $(u, 0, 0)$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (4);	2b: (3);	2c: (4);	2d: (4);	4e: (6);	4f: (6);	6g: (9);	6h: (12);	12i: (18)
2	$(0, 0, 0)$	2a: (2);	2b: (3);	2c: (2);	2d: (2);	4e: (6);	4f: (6);	6g: (9);	6h: (6);	12i: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 176										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)
2	$(0, 0, 0)$	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)

d. Results for high-symmetry planes

PI(0, u, v)

Operation	E	C_6^+	C_6^-

Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2($u, v, 0$)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3($u, -2u, v$)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4($u, v, \frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 176			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 6g: (18); 6h: (18); 12i: (36)	
P2 (u, v, 0) of space group No. 176			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (4); 2b: (3); 2c: (4); 2d: (4); 4e: (6); 4f: (6); 6g: (9); 6h: (12); 12i: (18)	
2	(0, 0, 0)	2a: (2); 2b: (3); 2c: (2); 2d: (2); 4e: (6); 4f: (6); 6g: (9); 6h: (6); 12i: (18)	
P3 (u, −2u, v) of space group No. 176			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 6g: (18); 6h: (18); 12i: (36)	
P4 (u, v, 1/2) of space group No. 176			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)	

177. Space group No. 177 ($P6_{22}$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & & \vec{t}_1 = \vec{a} \\
 \text{Hexagonal primitive lattice} & \vec{b} = \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0 \right) & \vec{t}_2 = \vec{b} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

$$\begin{array}{cccccccc}
 \{E|0, 0, 0\} & \{C_{2z}|0, 0, 0\} & \{C_6^+|0, 0, 0\} & \{C_6^-|0, 0, 0\} & \{C_3^+|0, 0, 0\} & \{C_3^-|0, 0, 0\} & \{C_{2y}|0, 0, 0\} & \{C_{23}''|0, 0, 0\} \\
 \{C_{22}''|0, 0, 0\} & \{C_{22}'|0, 0, 0\} & \{C_{2x}|0, 0, 0\} & \{C_{23}'|0, 0, 0\} & & & &
 \end{array}$$

3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (4); 6j: (4); 6k: (4); 6l: (5); 6m: (5); 12n: (9)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (4); 6j: (5); 6k: (5); 6l: (4); 6m: (4); 12n: (9)

A $(0, 0, \frac{1}{2})$ of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (0); 2d: (1); 2e: (1); 3f: (0); 3g: (1); 4h: (1); 6i: (1); 6j: (1); 6k: (2); 6l: (1); 6m: (2); 12n: (3)
2	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (0); 2e: (1); 3f: (1); 3g: (0); 4h: (1); 6i: (1); 6j: (2); 6k: (1); 6l: (2); 6m: (1); 12n: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (2); 6k: (1); 6l: (1); 6m: (2); 12n: (3)
4	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (0); 2e: (0); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (1); 6k: (2); 6l: (2); 6m: (1); 12n: (3)
5	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6)
6	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6)

L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (2); 2e: (1); 3f: (2); 3g: (3); 4h: (3); 6i: (5); 6j: (4); 6k: (5); 6l: (4); 6m: (5); 12n: (9)
2	(0, 0, 0)	1a: (1); 1b: (0); 2c: (2); 2d: (1); 2e: (1); 3f: (3); 3g: (2); 4h: (3); 6i: (5); 6j: (5); 6k: (4); 6l: (5); 6m: (4); 12n: (9)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (4); 6j: (4); 6k: (5); 6l: (5); 6m: (4); 12n: (9)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (2); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (4); 6j: (5); 6k: (4); 6l: (4); 6m: (5); 12n: (9)

K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (2); 6k: (2); 6l: (3); 6m: (3); 12n: (6)
2	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (4); 6k: (4); 6l: (3); 6m: (3); 12n: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (12)

H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (2); 4h: (2); 6i: (3); 6j: (2); 6k: (4); 6l: (3); 6m: (3); 12n: (6)
2	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (2); 3g: (1); 4h: (2); 6i: (3); 6j: (4); 6k: (2); 6l: (3); 6m: (3); 12n: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_{2z}	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_6^+	C_3^+
Coordinate	($\frac{1}{2}, 0, w$)	(0, $\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6)
2	(0, 0, r_1)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6)
3	(0, 0, r_1)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6)
4	(0, 0, r_1)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6)
5	(0, 0, r_1)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6)
6	(0, 0, r_1)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6)

LD (u, u, 0) of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	($-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0$)	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (3); 3f: (4); 3g: (4); 4h: (6); 6i: (9); 6j: (8); 6k: (8); 6l: (9); 6m: (9); 12n: (18)

$$2 \quad \left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0 \right) \quad \mathbf{1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (3); 3f: (5); 3g: (5); 4h: (6); 6i: (9); 6j: (10); 6k: (10); 6l: (9); 6m: (9); 12n: (18)}$$

P $\left(\frac{1}{3}, \frac{1}{3}, w\right)$ of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (12)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (12)
3	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (12)

Q $\left(u, u, \frac{1}{2}\right)$ of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	1a: (1); 1b: (2); 2c: (3); 2d: (3); 2e: (3); 3f: (4); 3g: (5); 4h: (6); 6i: (9); 6j: (8); 6k: (10); 6l: (9); 6m: (9); 12n: (18)
2	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	1a: (2); 1b: (1); 2c: (3); 2d: (3); 2e: (3); 3f: (5); 3g: (4); 4h: (6); 6i: (9); 6j: (10); 6k: (8); 6l: (9); 6m: (9); 12n: (18)

R $\left(u, 0, \frac{1}{2}\right)$ of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	1a: (1); 1b: (2); 2c: (2); 2d: (4); 2e: (3); 3f: (4); 3g: (5); 4h: (6); 6i: (9); 6j: (9); 6k: (9); 6l: (8); 6m: (10); 12n: (18)
2	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	1a: (2); 1b: (1); 2c: (4); 2d: (2); 2e: (3); 3f: (5); 3g: (4); 4h: (6); 6i: (9); 6j: (9); 6k: (9); 6l: (10); 6m: (8); 12n: (18)

SM $(u, 0, 0)$ of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (3); 3f: (4); 3g: (4); 4h: (6); 6i: (9); 6j: (9); 6k: (9); 6l: (8); 6m: (8); 12n: (18)
2	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	1a: (2); 1b: (2); 2c: (4); 2d: (4); 2e: (3); 3f: (5); 3g: (5); 4h: (6); 6i: (9); 6j: (9); 6k: (9); 6l: (10); 6m: (10); 12n: (18)

U $\left(\frac{1}{2}, 0, w\right)$ of space group No. 177

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (2); 3f: (5); 3g: (5); 4h: (6); 6i: (10); 6j: (9); 6k: (9); 6l: (9); 6m: (9); 12n: (18)
2	$(0, 0, r_1)$	1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (4); 3f: (4); 3g: (4); 4h: (6); 6i: (8); 6j: (9); 6k: (9); 6l: (9); 6m: (9); 12n: (18)

d. Results for high-symmetry planes

PI(0, u, v)

Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$

P2($u, v, 0$)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3($u, -2u, v$)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4($u, v, \frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 177			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, r ₂ , r ₁)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 6l: (18); 6m: (18); 12n: (36)	
P2 (u, v, 0) of space group No. 177			
(Co-) irrep	Phonon AM	WYPO information	
1	(r ₂ , r ₁ , 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 6l: (18); 6m: (18); 12n: (36)	
P3 (u, −2u, v) of space group No. 177			
(Co-) irrep	Phonon AM	WYPO information	
1	(− $\frac{r_2}{\sqrt{3}}$, r ₂ , r ₁)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 6l: (18); 6m: (18); 12n: (36)	
P4 (u, v, $\frac{1}{2}$) of space group No. 177			
(Co-) irrep	Phonon AM	WYPO information	
1	(r ₂ , r ₁ , 0)	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 6l: (18); 6m: (18); 12n: (36)	

178. Space group No. 178 ($P6_122$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) \\ \vec{c} &= (0, 0, c) \end{aligned} \quad \begin{aligned} \vec{t}_1 &= \vec{a} \\ \vec{t}_2 &= \vec{b} \\ \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

b. Results for high-symmetry points

$$\begin{array}{cccccccc} \{E|0,0,0\} & \{C_{2z}|0,0,\frac{1}{2}\} & \{C_6^+|0,0,\frac{1}{6}\} & \{C_6^-|0,0,\frac{5}{6}\} & \{C_3^+|0,0,\frac{1}{3}\} & \{C_3^-|0,0,\frac{2}{3}\} & \{C_{2y}|0,0,-\frac{1}{2}\} & \{C_{23}''|0,0,-\frac{1}{6}\} \\ \{C_{22}''|0,0,\frac{1}{6}\} & \{C_{22}'|0,0,-\frac{1}{3}\} & \{C_{2x}|0,0,0\} & \{C_{23}'|0,0,\frac{1}{3}\} & & & & \end{array}$$

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0,\frac{1}{2},0)$	$(-\frac{1}{2},\frac{1}{2},0)$	$(\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},0,\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},\frac{1}{2})$	

$\Gamma(0,0,0)$ of space group No. 178

(Co-) irrep	Phonon AM	WYPO information
1	$(0,0,0)$	6a: (1); 6b: (1); 12c: (3)
2	$(0,0,0)$	6a: (2); 6b: (2); 12c: (3)
3	$(0,0,0)$	6a: (2); 6b: (1); 12c: (3)
4	$(0,0,0)$	6a: (1); 6b: (2); 12c: (3)
5	$(0,0,0)$	6a: (3); 6b: (3); 12c: (6)
6	$(0,0,0)$	6a: (3); 6b: (3); 12c: (6)

$M(0,\frac{1}{2},0)$ of space group No. 178

(Co-) irrep	Phonon AM	WYPO information
1	$(0,0,0)$	6a: (4); 6b: (4); 12c: (9)
2	$(0,0,0)$	6a: (5); 6b: (5); 12c: (9)
3	$(0,0,0)$	6a: (4); 6b: (5); 12c: (9)
4	$(0,0,0)$	6a: (5); 6b: (4); 12c: (9)

A $(0, 0, \frac{1}{2})$ of space group No. 178		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6)
2	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6)
3	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6)

L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 178		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (9); 6b: (9); 12c: (18)

K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 178		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (2); 6b: (3); 12c: (6)
2	(0, 0, 0)	6a: (4); 6b: (3); 12c: (6)
3	(0, 0, 0)	6a: (6); 6b: (6); 12c: (12)

H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 178		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6)
2	(0, 0, 0)	6a: (6); 6b: (6); 12c: (12)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation E
Coordinate (0, 0, w)

LD(u , u , 0)

Operation E C_6^+ C_3^+
Coordinate (u , u , 0) ($-u$, $2u$, 0) ($-2u$, u , 0)

P($\frac{1}{3}$, $\frac{1}{3}$, w)

Operation E C_{2z}
Coordinate ($\frac{1}{3}$, $\frac{1}{3}$, w) ($-\frac{1}{3}$, $-\frac{1}{3}$, w)

Q(u , u , $\frac{1}{2}$)

Operation E C_6^+ C_3^+
Coordinate (u , u , $\frac{1}{2}$) ($-u$, $2u$, $\frac{1}{2}$) ($-2u$, u , $\frac{1}{2}$)

R(u , 0, $\frac{1}{2}$)

Operation E C_6^+ C_3^+
Coordinate (u , 0, $\frac{1}{2}$) (0 , u , $\frac{1}{2}$) ($-u$, u , $\frac{1}{2}$)

SM(u , 0, 0)

Operation E C_6^+ C_3^+

Coordinate	$(u, 0, 0)$	$(0, u, 0)$	$(-u, u, 0)$
$U(\frac{1}{2}, 0, w)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 178			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)	
2	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)	
3	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)	
4	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)	
5	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)	
6	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)	
LD $(u, u, 0)$ of space group No. 178			
(Co-) irrep	Phonon AM	WYPO information	
1	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	6a: (8); 6b: (9); 12c: (18)	
2	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	6a: (10); 6b: (9); 12c: (18)	
P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 178			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	6a: (6); 6b: (6); 12c: (12)	
2	$(0, 0, r_1)$	6a: (6); 6b: (6); 12c: (12)	
3	$(0, 0, r_1)$	6a: (6); 6b: (6); 12c: (12)	
Q $(u, u, \frac{1}{2})$ of space group No. 178			
(Co-) irrep	Phonon AM	WYPO information	
1	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	6a: (9); 6b: (9); 12c: (18)	
R $(u, 0, \frac{1}{2})$ of space group No. 178			
(Co-) irrep	Phonon AM	WYPO information	
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	6a: (9); 6b: (9); 12c: (18)	
SM $(u, 0, 0)$ of space group No. 178			
(Co-) irrep	Phonon AM	WYPO information	
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	6a: (9); 6b: (8); 12c: (18)	
2	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	6a: (9); 6b: (10); 12c: (18)	
U $(\frac{1}{2}, 0, w)$ of space group No. 178			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	6a: (9); 6b: (9); 12c: (18)	
2	$(0, 0, r_1)$	6a: (9); 6b: (9); 12c: (18)	

d. Results for high-symmetry planes

P1(0, u , v)			
Operation	E	C_6^+	C_6^-
Coordinate	(0, u , v)	($-u$, u , v)	(u , 0, v)
P2(u , v , 0)			
Operation	E		
Coordinate	(u , v , 0)		
P3(u , $-2u$, v)			
Operation	E	C_6^+	C_6^-
Coordinate	(u , $-2u$, v)	($2u$, $-u$, v)	($-u$, $-u$, v)
P4(u , v , $\frac{1}{2}$)			
Operation	E		
Coordinate	(u , v , $\frac{1}{2}$)		

P1 (0, u , v) of space group No. 178		
(Co-) irrep	Phonon AM	WYPO information
1	(0, r_2 , r_1)	6a: (18); 6b: (18); 12c: (36)
P2 (u , v , 0) of space group No. 178		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2 , r_1 , 0)	6a: (18); 6b: (18); 12c: (36)
P3 (u , $-2u$, v) of space group No. 178		
(Co-) irrep	Phonon AM	WYPO information
1	($-\frac{r_2}{\sqrt{3}}$, r_2 , r_1)	6a: (18); 6b: (18); 12c: (36)
P4 (u , v , $\frac{1}{2}$) of space group No. 178		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2 , r_1 , 0)	6a: (9); 6b: (9); 12c: (18)

179. Space group No. 179 ($P6_522$)

Hexagonal primitive lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) \\
 \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) \\
 \vec{c} &= (0, 0, c)
 \end{aligned}
 \quad
 \begin{aligned}
 \vec{t}_1 &= \vec{a} \\
 \vec{t}_2 &= \vec{b} \\
 \vec{t}_3 &= \vec{c}
 \end{aligned}$$

$$\begin{array}{cccccccc} \{E|0,0,0\} & \{C_{2z}|0,0,\frac{1}{2}\} & \{C_6^+|0,0,\frac{5}{6}\} & \{C_6^-|0,0,\frac{1}{6}\} & \{C_3^+|0,0,\frac{2}{3}\} & \{C_3^-|0,0,\frac{1}{3}\} & \{C_{2y}|0,0,-\frac{1}{2}\} & \{C_{23}''|0,0,\frac{1}{6}\} \\ \{C_{22}''|0,0,-\frac{1}{6}\} & \{C_{22}'|0,0,\frac{1}{3}\} & \{C_{2x}|0,0,0\} & \{C_{23}'|0,0,-\frac{1}{3}\} & & & & \end{array}$$

a. Space group operations

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0,\frac{1}{2},0)$	$(-\frac{1}{2},\frac{1}{2},0)$	$(\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},0,\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},\frac{1}{2})$	

$\Gamma(0,0,0)$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	$(0,0,0)$	6a: (1); 6b: (1); 12c: (3)
2	$(0,0,0)$	6a: (2); 6b: (2); 12c: (3)
3	$(0,0,0)$	6a: (2); 6b: (1); 12c: (3)
4	$(0,0,0)$	6a: (1); 6b: (2); 12c: (3)
5	$(0,0,0)$	6a: (3); 6b: (3); 12c: (6)
6	$(0,0,0)$	6a: (3); 6b: (3); 12c: (6)

$M(0,\frac{1}{2},0)$ of space group No. 179		

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (4); 6b: (4); 12c: (9)
2	(0, 0, 0)	6a: (5); 6b: (5); 12c: (9)
3	(0, 0, 0)	6a: (4); 6b: (5); 12c: (9)
4	(0, 0, 0)	6a: (5); 6b: (4); 12c: (9)
A $(0, 0, \frac{1}{2})$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6)
2	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6)
3	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6)
L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (9); 6b: (9); 12c: (18)
K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (2); 6b: (3); 12c: (6)
2	(0, 0, 0)	6a: (4); 6b: (3); 12c: (6)
3	(0, 0, 0)	6a: (6); 6b: (6); 12c: (12)
H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	6a: (3); 6b: (3); 12c: (6)
2	(0, 0, 0)	6a: (6); 6b: (6); 12c: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_{2z}	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)

$R(u, 0, \frac{1}{2})$			
Operation	E	C_6^+	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
$SM(u, 0, 0)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(u, 0, 0)$	$(0, u, 0)$	$(-u, u, 0)$
$U(\frac{1}{2}, 0, w)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)
2	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)
3	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)
4	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)
5	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)
6	$(0, 0, r_1)$	6a: (3); 6b: (3); 12c: (6)
LD $(u, u, 0)$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	6a: (8); 6b: (9); 12c: (18)
2	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	6a: (10); 6b: (9); 12c: (18)
P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	6a: (6); 6b: (6); 12c: (12)
2	$(0, 0, r_1)$	6a: (6); 6b: (6); 12c: (12)
3	$(0, 0, r_1)$	6a: (6); 6b: (6); 12c: (12)
Q $(u, u, \frac{1}{2})$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	6a: (9); 6b: (9); 12c: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	6a: (9); 6b: (9); 12c: (18)
SM $(u, 0, 0)$ of space group No. 179		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	6a: (9); 6b: (8); 12c: (18)

$$2 \quad \left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0 \right) \quad \mathbf{6a: (9); 6b: (10); 12c: (18)}$$

U $\left(\frac{1}{2}, 0, w \right)$ of space group No. 179

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	6a: (9); 6b: (9); 12c: (18)
2	$(0, 0, r_1)$	6a: (9); 6b: (9); 12c: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 179

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	6a: (18); 6b: (18); 12c: (36)

P2 (u, v, 0) of space group No. 179

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	6a: (18); 6b: (18); 12c: (36)

P3 (u, -2u, v) of space group No. 179

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_2}{\sqrt{3}}, r_2, r_1 \right)$	6a: (18); 6b: (18); 12c: (36)

P4 (u, v, $\frac{1}{2}$) of space group No. 179

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	6a: (9); 6b: (9); 12c: (18)

180. Space group No. 180 ($P6_222$)

Hexagonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{array}{cccccccc}\{E|0, 0, 0\} & \{C_{2z}|0, 0, 0\} & \{C_6^+|0, 0, \frac{1}{3}\} & \{C_6^-|0, 0, \frac{2}{3}\} & \{C_3^+|0, 0, \frac{2}{3}\} & \{C_3^-|0, 0, \frac{1}{3}\} & \{C_{2y}|0, 0, 0\} & \{C_{23}''|0, 0, \frac{2}{3}\} \\ \{C_{22}''|0, 0, \frac{1}{3}\} & \{C_{22}'|0, 0, \frac{1}{3}\} & \{C_{2x}|0, 0, 0\} & \{C_{23}'|0, 0, \frac{2}{3}\} & & & & \end{array}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, \frac{1}{2})$	

Γ (0, 0, 0) of space group No. 180

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	3a: (0);	3b: (0);	3c: (0);	3d: (0);	6e: (1);	6f: (1);	6g: (1);	6h: (1);	6i: (1);	6j: (1);	12k: (3)
2	(0, 0, 0)	3a: (1);	3b: (1);	3c: (1);	3d: (1);	6e: (1);	6f: (1);	6g: (2);	6h: (2);	6i: (2);	6j: (2);	12k: (3)
3	(0, 0, 0)	3a: (1);	3b: (1);	3c: (1);	3d: (1);	6e: (2);	6f: (2);	6g: (2);	6h: (2);	6i: (1);	6j: (1);	12k: (3)
4	(0, 0, 0)	3a: (1);	3b: (1);	3c: (1);	3d: (1);	6e: (2);	6f: (2);	6g: (1);	6h: (1);	6i: (2);	6j: (2);	12k: (3)
5	(0, 0, 0)	3a: (1);	3b: (1);	3c: (1);	3d: (1);	6e: (2);	6f: (2);	6g: (3);	6h: (3);	6i: (3);	6j: (3);	12k: (6)
6	(0, 0, 0)	3a: (2);	3b: (2);	3c: (2);	3d: (2);	6e: (4);	6f: (4);	6g: (3);	6h: (3);	6i: (3);	6j: (3);	12k: (6)

 M (0, $\frac{1}{2}$, 0) of space group No. 180

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	3a: (1);	3b: (1);	3c: (2);	3d: (2);	6e: (3);	6f: (5);	6g: (4);	6h: (4);	6i: (4);	6j: (4);	12k: (9)
2	(0, 0, 0)	3a: (2);	3b: (2);	3c: (3);	3d: (3);	6e: (3);	6f: (5);	6g: (5);	6h: (5);	6i: (5);	6j: (5);	12k: (9)
3	(0, 0, 0)	3a: (3);	3b: (3);	3c: (2);	3d: (2);	6e: (6);	6f: (4);	6g: (4);	6h: (4);	6i: (5);	6j: (5);	12k: (9)
4	(0, 0, 0)	3a: (3);	3b: (3);	3c: (2);	3d: (2);	6e: (6);	6f: (4);	6g: (5);	6h: (5);	6i: (4);	6j: (4);	12k: (9)

 A (0, 0, $\frac{1}{2}$) of space group No. 180

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	3a: (1);	3b: (1);	3c: (1);	3d: (1);	6e: (2);	6f: (2);	6g: (2);	6h: (1);	6i: (1);	6j: (2);	12k: (3)
2	(0, 0, 0)	3a: (1);	3b: (1);	3c: (1);	3d: (1);	6e: (2);	6f: (2);	6g: (1);	6h: (2);	6i: (2);	6j: (1);	12k: (3)
3	(0, 0, 0)	3a: (0);	3b: (1);	3c: (0);	3d: (1);	6e: (1);	6f: (1);	6g: (1);	6h: (2);	6i: (1);	6j: (2);	12k: (3)
4	(0, 0, 0)	3a: (1);	3b: (0);	3c: (1);	3d: (0);	6e: (1);	6f: (1);	6g: (2);	6h: (1);	6i: (2);	6j: (1);	12k: (3)
5	(0, 0, 0)	3a: (2);	3b: (2);	3c: (2);	3d: (2);	6e: (4);	6f: (4);	6g: (3);	6h: (3);	6i: (3);	6j: (3);	12k: (6)
6	(0, 0, 0)	3a: (1);	3b: (1);	3c: (1);	3d: (1);	6e: (2);	6f: (2);	6g: (3);	6h: (3);	6i: (3);	6j: (3);	12k: (6)

 L (0, $\frac{1}{2}$, $\frac{1}{2}$) of space group No. 180

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	3a: (1);	3b: (2);	3c: (2);	3d: (3);	6e: (3);	6f: (5);	6g: (4);	6h: (5);	6i: (4);	6j: (5);	12k: (9)
2	(0, 0, 0)	3a: (2);	3b: (1);	3c: (3);	3d: (2);	6e: (3);	6f: (5);	6g: (5);	6h: (4);	6i: (5);	6j: (4);	12k: (9)
3	(0, 0, 0)	3a: (3);	3b: (3);	3c: (2);	3d: (2);	6e: (6);	6f: (4);	6g: (4);	6h: (5);	6i: (5);	6j: (4);	12k: (9)
4	(0, 0, 0)	3a: (3);	3b: (3);	3c: (2);	3d: (2);	6e: (6);	6f: (4);	6g: (5);	6h: (4);	6i: (4);	6j: (5);	12k: (9)

 K ($-\frac{1}{3}$, $\frac{2}{3}$, 0) of space group No. 180

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	3a: (1);	3b: (1);	3c: (1);	3d: (1);	6e: (3);	6f: (3);	6g: (2);	6h: (2);	6i: (3);	6j: (3);	12k: (6)
2	(0, 0, 0)	3a: (2);	3b: (2);	3c: (2);	3d: (2);	6e: (3);	6f: (3);	6g: (4);	6h: (4);	6i: (3);	6j: (3);	12k: (6)
3	(0, 0, 0)	3a: (3);	3b: (3);	3c: (3);	3d: (3);	6e: (6);	6f: (6);	6g: (6);	6h: (6);	6i: (6);	6j: (6);	12k: (12)

 H ($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$) of space group No. 180

(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	3a: (1);	3b: (2);	3c: (1);	3d: (2);	6e: (3);	6f: (3);	6g: (2);	6h: (4);	6i: (3);	6j: (3);	12k: (6)
2	(0, 0, 0)	3a: (2);	3b: (1);	3c: (2);	3d: (1);	6e: (3);	6f: (3);	6g: (4);	6h: (2);	6i: (3);	6j: (3);	12k: (6)
3	(0, 0, 0)	3a: (3);	3b: (3);	3c: (3);	3d: (3);	6e: (6);	6f: (6);	6g: (6);	6h: (6);	6i: (6);	6j: (6);	12k: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E		
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_6^+	C_3^+
Coordinate	($\frac{1}{2}, 0, w$)	(0, $\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 180			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, r_1)	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)	
2	(0, 0, r_1)	3a: (2); 3b: (2); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)	
3	(0, 0, r_1)	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)	
4	(0, 0, r_1)	3a: (2); 3b: (2); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)	
5	(0, 0, r_1)	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)	
6	(0, 0, r_1)	3a: (2); 3b: (2); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)	

LD (u, u, 0) of space group No. 180			
(Co-) irrep	Phonon AM	WYPO information	
1	($-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0$)	3a: (4); 3b: (4); 3c: (4); 3d: (4); 6e: (9); 6f: (9); 6g: (8); 6h: (8); 6i: (9); 6j: (9); 12k: (18)	
2	($-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0$)	3a: (5); 3b: (5); 3c: (5); 3d: (5); 6e: (9); 6f: (9); 6g: (10); 6h: (10); 6i: (9); 6j: (9); 12k: (18)	

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 180		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 6j: (6); 12k: (12)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 6j: (6); 12k: (12)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 6j: (6); 12k: (12)
Q $(u, u, \frac{1}{2})$ of space group No. 180		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0)$	3a: (5); 3b: (4); 3c: (5); 3d: (4); 6e: (9); 6f: (9); 6g: (10); 6h: (8); 6i: (9); 6j: (9); 12k: (18)
2	$(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0)$	3a: (4); 3b: (5); 3c: (4); 3d: (5); 6e: (9); 6f: (9); 6g: (8); 6h: (10); 6i: (9); 6j: (9); 12k: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 180		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0)$	3a: (4); 3b: (5); 3c: (4); 3d: (5); 6e: (9); 6f: (9); 6g: (9); 6h: (9); 6i: (8); 6j: (10); 12k: (18)
2	$(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0)$	3a: (5); 3b: (4); 3c: (5); 3d: (4); 6e: (9); 6f: (9); 6g: (9); 6h: (9); 6i: (10); 6j: (8); 12k: (18)
SM $(u, 0, 0)$ of space group No. 180		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0)$	3a: (4); 3b: (4); 3c: (4); 3d: (4); 6e: (9); 6f: (9); 6g: (9); 6h: (9); 6i: (8); 6j: (8); 12k: (18)
2	$(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0)$	3a: (5); 3b: (5); 3c: (5); 3d: (5); 6e: (9); 6f: (9); 6g: (9); 6h: (9); 6i: (10); 6j: (10); 12k: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 180		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 3c: (5); 3d: (5); 6e: (6); 6f: (10); 6g: (9); 6h: (9); 6i: (9); 6j: (9); 12k: (18)
2	$(0, 0, r_1)$	3a: (6); 3b: (6); 3c: (4); 3d: (4); 6e: (12); 6f: (8); 6g: (9); 6h: (9); 6i: (9); 6j: (9); 12k: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		

Coordinate	$(u, v, 0)$		
$P3(u, -2u, v)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
$P4(u, v, \frac{1}{2})$			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 $(0, u, v)$ of space group No. 180		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	3a: (9); 3b: (9); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 6j: (18); 12k: (36)
P2 $(u, v, 0)$ of space group No. 180		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	3a: (9); 3b: (9); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 6j: (18); 12k: (36)
P3 $(u, -2u, v)$ of space group No. 180		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_2}{\sqrt{3}}, r_2, r_1)$	3a: (9); 3b: (9); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 6j: (18); 12k: (36)
P4 $(u, v, \frac{1}{2})$ of space group No. 180		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	3a: (9); 3b: (9); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 6j: (18); 12k: (36)

181. Space group No. 181 ($P6_422$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & & \vec{t}_1 = \vec{a} \\
 \text{Hexagonal primitive lattice } \vec{b} = \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & & \vec{t}_2 = \vec{b} \\
 \vec{c} = (0, 0, c) & & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

$$\begin{array}{cccccccc}
 \{E|0, 0, 0\} & \{C_{2z}|0, 0, 0\} & \{C_6^+|0, 0, \frac{2}{3}\} & \{C_6^-|0, 0, \frac{1}{3}\} & \{C_3^+|0, 0, \frac{1}{3}\} & \{C_3^-|0, 0, \frac{2}{3}\} & \{C_{2y}|0, 0, 0\} & \{C_{23}''|0, 0, \frac{1}{3}\} \\
 \{C_{22}''|0, 0, \frac{2}{3}\} & \{C_{22}'|0, 0, \frac{2}{3}\} & \{C_{2x}|0, 0, 0\} & \{C_{23}'|0, 0, \frac{1}{3}\} & & & &
 \end{array}$$

1	(0, 0, 0)	3a: (0); 3b: (1); 3c: (0); 3d: (1); 6e: (1); 6f: (1); 6g: (1); 6h: (2); 6i: (1); 6j: (2); 12k: (3)
2	(0, 0, 0)	3a: (1); 3b: (0); 3c: (1); 3d: (0); 6e: (1); 6f: (1); 6g: (2); 6h: (1); 6i: (2); 6j: (1); 12k: (3)
3	(0, 0, 0)	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (2); 6h: (1); 6i: (1); 6j: (2); 12k: (3)
4	(0, 0, 0)	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (1); 6h: (2); 6i: (2); 6j: (1); 12k: (3)
5	(0, 0, 0)	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)
6	(0, 0, 0)	3a: (2); 3b: (2); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)

$L\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 181

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (2); 3c: (2); 3d: (3); 6e: (3); 6f: (5); 6g: (4); 6h: (5); 6i: (4); 6j: (5); 12k: (9)
2	(0, 0, 0)	3a: (2); 3b: (1); 3c: (3); 3d: (2); 6e: (3); 6f: (5); 6g: (5); 6h: (4); 6i: (5); 6j: (4); 12k: (9)
3	(0, 0, 0)	3a: (3); 3b: (3); 3c: (2); 3d: (2); 6e: (6); 6f: (4); 6g: (4); 6h: (5); 6i: (5); 6j: (4); 12k: (9)
4	(0, 0, 0)	3a: (3); 3b: (3); 3c: (2); 3d: (2); 6e: (6); 6f: (4); 6g: (5); 6h: (4); 6i: (4); 6j: (5); 12k: (9)

$K\left(-\frac{1}{3}, \frac{2}{3}, 0\right)$ of space group No. 181

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (3); 6f: (3); 6g: (2); 6h: (2); 6i: (3); 6j: (3); 12k: (6)
2	(0, 0, 0)	3a: (2); 3b: (2); 3c: (2); 3d: (2); 6e: (3); 6f: (3); 6g: (4); 6h: (4); 6i: (3); 6j: (3); 12k: (6)
3	(0, 0, 0)	3a: (3); 3b: (3); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 6j: (6); 12k: (12)

$H\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 181

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	3a: (1); 3b: (2); 3c: (1); 3d: (2); 6e: (3); 6f: (3); 6g: (2); 6h: (4); 6i: (3); 6j: (3); 12k: (6)
2	(0, 0, 0)	3a: (2); 3b: (1); 3c: (2); 3d: (1); 6e: (3); 6f: (3); 6g: (4); 6h: (2); 6i: (3); 6j: (3); 12k: (6)
3	(0, 0, 0)	3a: (3); 3b: (3); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 6j: (6); 12k: (12)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

LD(u , u , 0)

Operation	E	C_6^+	C_3^+
Coordinate	(u , u , 0)	($-u$, $2u$, 0)	($-2u$, u , 0)

P($\frac{1}{3}$, $\frac{1}{3}$, w)

Operation	E	C_{2z}
Coordinate	($\frac{1}{3}$, $\frac{1}{3}$, w)	($-\frac{1}{3}$, $-\frac{1}{3}$, w)

Q(u , u , $\frac{1}{2}$)

Operation	E	C_6^+	C_3^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, $2u$, $\frac{1}{2}$)	($-2u$, u , $\frac{1}{2}$)

R(u , 0, $\frac{1}{2}$)

Operation	E	C_6^+	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, u, \frac{1}{2})$	$(-u, u, \frac{1}{2})$
SM($u, 0, 0$)			
Operation	E	C_6^+	C_3^+
Coordinate	$(u, 0, 0)$	$(0, u, 0)$	$(-u, u, 0)$
U($\frac{1}{2}, 0, w$)			
Operation	E	C_6^+	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT ($0, 0, w$) of space group No. 181

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)
2	$(0, 0, r_1)$	3a: (2); 3b: (2); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)
3	$(0, 0, r_1)$	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)
4	$(0, 0, r_1)$	3a: (2); 3b: (2); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)
5	$(0, 0, r_1)$	3a: (1); 3b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)
6	$(0, 0, r_1)$	3a: (2); 3b: (2); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 6g: (3); 6h: (3); 6i: (3); 6j: (3); 12k: (6)

LD ($u, u, 0$) of space group No. 181

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0)$	3a: (4); 3b: (4); 3c: (4); 3d: (4); 6e: (9); 6f: (9); 6g: (8); 6h: (8); 6i: (9); 6j: (9); 12k: (18)
2	$(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0)$	3a: (5); 3b: (5); 3c: (5); 3d: (5); 6e: (9); 6f: (9); 6g: (10); 6h: (10); 6i: (9); 6j: (9); 12k: (18)

P ($\frac{1}{3}, \frac{1}{3}, w$) of space group No. 181

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 6j: (6); 12k: (12)
2	$(0, 0, r_1)$	3a: (3); 3b: (3); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 6j: (6); 12k: (12)
3	$(0, 0, r_1)$	3a: (3); 3b: (3); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 6j: (6); 12k: (12)

Q ($u, u, \frac{1}{2}$) of space group No. 181

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0)$	3a: (4); 3b: (5); 3c: (4); 3d: (5); 6e: (9); 6f: (9); 6g: (8); 6h: (10); 6i: (9); 6j: (9); 12k: (18)
2	$(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0)$	3a: (5); 3b: (4); 3c: (5); 3d: (4); 6e: (9); 6f: (9); 6g: (10); 6h: (8); 6i: (9); 6j: (9); 12k: (18)

R ($u, 0, \frac{1}{2}$) of space group No. 181

(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	3a: (4); 3b: (5); 3c: (4); 3d: (5); 6e: (9); 6f: (9); 6g: (9); 6h: (9); 6i: (8); 6j: (10); 12k: (18)
2	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	3a: (5); 3b: (4); 3c: (5); 3d: (4); 6e: (9); 6f: (9); 6g: (9); 6h: (9); 6i: (10); 6j: (8); 12k: (18)
SM $(u, 0, 0)$ of space group No. 181		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	3a: (4); 3b: (4); 3c: (4); 3d: (4); 6e: (9); 6f: (9); 6g: (9); 6h: (9); 6i: (8); 6j: (8); 12k: (18)
2	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	3a: (5); 3b: (5); 3c: (5); 3d: (5); 6e: (9); 6f: (9); 6g: (9); 6h: (9); 6i: (10); 6j: (10); 12k: (18)
U $\left(\frac{1}{2}, 0, w\right)$ of space group No. 181		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	3a: (3); 3b: (3); 3c: (5); 3d: (5); 6e: (6); 6f: (10); 6g: (9); 6h: (9); 6i: (9); 6j: (9); 12k: (18)
2	$(0, 0, r_1)$	3a: (6); 3b: (6); 3c: (4); 3d: (4); 6e: (12); 6f: (8); 6g: (9); 6h: (9); 6i: (9); 6j: (9); 12k: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 181		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	3a: (9); 3b: (9); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 6j: (18); 12k: (36)
P2 (u, v, 0) of space group No. 181		

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	3a: (9); 3b: (9); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 6j: (18); 12k: (36)
P3 $(u, -2u, v)$ of space group No. 181		
(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_2}{\sqrt{3}}, r_2, r_1\right)$	3a: (9); 3b: (9); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 6j: (18); 12k: (36)
P4 $(u, v, \frac{1}{2})$ of space group No. 181		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	3a: (9); 3b: (9); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 6j: (18); 12k: (36)

182. Space group No. 182 ($P6_322$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) \\ \vec{c} &= (0, 0, c) \end{aligned} \quad \begin{aligned} \vec{t}_1 &= \vec{a} \\ \vec{t}_2 &= \vec{b} \\ \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_{2z} 0, 0, \frac{1}{2}\}$	$\{C_6^+ 0, 0, \frac{1}{2}\}$	$\{C_6^- 0, 0, \frac{1}{2}\}$	$\{C_3^+ 0, 0, 0\}$	$\{C_3^- 0, 0, 0\}$	$\{C_{2y} 0, 0, -\frac{1}{2}\}$	$\{C_{23}'' 0, 0, -\frac{1}{2}\}$
$\{C_{22}'' 0, 0, -\frac{1}{2}\}$	$\{C_{22}' 0, 0, 0\}$	$\{C_{2x} 0, 0, 0\}$	$\{C_{23}' 0, 0, 0\}$				

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		

$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, \frac{1}{2})$	

$\Gamma (0, 0, 0)$ of space group No. 182											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (1);	6h: (1);	12i: (3)	
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (2);	6h: (2);	12i: (3)	
3	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (2);	6h: (1);	12i: (3)	
4	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (1);	6h: (2);	12i: (3)	
5	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)	
6	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)	
$M (0, \frac{1}{2}, 0)$ of space group No. 182											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (4);	6h: (4);	12i: (9)	
2	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (5);	6h: (5);	12i: (9)	
3	(0, 0, 0)	2a: (1);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (4);	6h: (5);	12i: (9)	
4	(0, 0, 0)	2a: (2);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (5);	6h: (4);	12i: (9)	
$A (0, 0, \frac{1}{2})$ of space group No. 182											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)	
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)	
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)	
$L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 182											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)	
$K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 182											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (2);	6h: (3);	12i: (6)	
2	(0, 0, 0)	2a: (2);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (4);	6h: (3);	12i: (6)	
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6);	12i: (12)	

H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 182		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 6g: (6); 6h: (6); 12i: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_{2z}	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_6^+	C_3^+
Coordinate	($\frac{1}{2}, 0, w$)	(0, $\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 182		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)
2	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)
3	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)
4	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)
5	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)
6	(0, 0, r_1)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6)

LD $(u, u, 0)$ of space group No. 182									
(Co-) irrep	Phonon AM	WYPO information							
1	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	2a: (2);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (8);	6h: (9); 12i: (18)
2	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	2a: (4);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (10);	6h: (9); 12i: (18)
P $\left(\frac{1}{3}, \frac{1}{3}, w\right)$ of space group No. 182									
(Co-) irrep	Phonon AM	WYPO information							
1	$(0, 0, r_1)$	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6); 12i: (12)
2	$(0, 0, r_1)$	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6); 12i: (12)
3	$(0, 0, r_1)$	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6); 12i: (12)
Q $(u, u, \frac{1}{2})$ of space group No. 182									
(Co-) irrep	Phonon AM	WYPO information							
1	$\left(-\frac{r_1}{2\sqrt{3}} + \frac{\sqrt{3}r_1}{2}, r_1, 0\right)$	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9); 12i: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 182									
(Co-) irrep	Phonon AM	WYPO information							
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9); 12i: (18)
SM $(u, 0, 0)$ of space group No. 182									
(Co-) irrep	Phonon AM	WYPO information							
1	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	2a: (3);	2b: (2);	2c: (2);	2d: (2);	4e: (6);	4f: (6);	6g: (9);	6h: (8); 12i: (18)
2	$\left(\frac{\sqrt{3}r_1}{2}, \frac{r_1}{2}, 0\right)$	2a: (3);	2b: (4);	2c: (4);	2d: (4);	4e: (6);	4f: (6);	6g: (9);	6h: (10); 12i: (18)
U $\left(\frac{1}{2}, 0, w\right)$ of space group No. 182									
(Co-) irrep	Phonon AM	WYPO information							
1	$(0, 0, r_1)$	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9); 12i: (18)
2	$(0, 0, r_1)$	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9); 12i: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$

$$P4(u, v, \frac{1}{2})$$

Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 $(0, u, v)$ of space group No. 182

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 6g: (18); 6h: (18); 12i: (36)

P2 $(u, v, 0)$ of space group No. 182

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 6g: (18); 6h: (18); 12i: (36)

P3 $(u, -2u, v)$ of space group No. 182

(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{r_2}{\sqrt{3}}, r_2, r_1)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 6g: (18); 6h: (18); 12i: (36)

P4 $(u, v, \frac{1}{2})$ of space group No. 182

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)

183. Space group No. 183 ($P6mm$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_6^+|0, 0, 0\} \quad \{C_6^-|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_{d3}|0, 0, 0\} \\ &\{\sigma_{d2}|0, 0, 0\} \quad \{\sigma_{v2}|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_{v3}|0, 0, 0\} \end{aligned}$$

b. Results for high-symmetry points

$$\Gamma(0, 0, 0)$$

Operation	E
Coordinate	$(0, 0, 0)$

$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, \frac{1}{2})$	

$\Gamma(0, 0, 0)$ of space group No. 183			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (1); 6d: (2); 6e: (2); 12f: (3)	
2	(0, 0, 0)	1a: (0); 2b: (0); 3c: (0); 6d: (1); 6e: (1); 12f: (3)	
3	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (1); 6e: (2); 12f: (3)	
4	(0, 0, 0)	1a: (0); 2b: (0); 3c: (1); 6d: (2); 6e: (1); 12f: (3)	
5	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (3); 6e: (3); 12f: (6)	
6	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (3); 6e: (3); 12f: (6)	
$M(0, \frac{1}{2}, 0)$ of space group No. 183			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (5); 6e: (5); 12f: (9)	
2	(0, 0, 0)	1a: (0); 2b: (1); 3c: (2); 6d: (4); 6e: (4); 12f: (9)	
3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (2); 6d: (4); 6e: (5); 12f: (9)	
4	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (5); 6e: (4); 12f: (9)	
$A(0, 0, \frac{1}{2})$ of space group No. 183			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (1); 6d: (2); 6e: (2); 12f: (3)	
2	(0, 0, 0)	1a: (0); 2b: (0); 3c: (0); 6d: (1); 6e: (1); 12f: (3)	
3	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (1); 6e: (2); 12f: (3)	
4	(0, 0, 0)	1a: (0); 2b: (0); 3c: (1); 6d: (2); 6e: (1); 12f: (3)	
5	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (3); 6e: (3); 12f: (6)	
6	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (3); 6e: (3); 12f: (6)	

L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 183		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (5); 6e: (5); 12f: (9)
2	(0, 0, 0)	1a: (0); 2b: (1); 3c: (2); 6d: (4); 6e: (4); 12f: (9)
3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (2); 6d: (4); 6e: (5); 12f: (9)
4	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (5); 6e: (4); 12f: (9)

K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 183		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (4); 6e: (3); 12f: (6)
2	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (2); 6e: (3); 12f: (6)
3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6); 6e: (6); 12f: (12)

H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 183		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (4); 6e: (3); 12f: (6)
2	(0, 0, 0)	1a: (0); 2b: (1); 3c: (1); 6d: (2); 6e: (3); 12f: (6)
3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (3); 6d: (6); 6e: (6); 12f: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, 0)	(−u, 2u, 0)	(−2u, u, 0)
P(1/3, 1/3, w)			
Operation	E	C _{2z}	
Coordinate	(1/3, 1/3, w)	(−1/3, −1/3, w)	
Q(u, u, 1/2)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, 1/2)	(−u, 2u, 1/2)	(−2u, u, 1/2)
R(u, 0, 1/2)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, 1/2)	(0, u, 1/2)	(−u, u, 1/2)
SM(u, 0, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, 0)	(0, u, 0)	(−u, u, 0)

$U(\frac{1}{2}, 0, w)$			
Operation	E	C_6^+	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, \frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 183						
(Co-) irrep	Phonon AM	WYPO information				
1	$(0, 0, 0)$	1a: (1);	2b: (1);	3c: (1);	6d: (2);	6e: (2); 12f: (3)
2	$(0, 0, 0)$	1a: (0);	2b: (0);	3c: (0);	6d: (1);	6e: (1); 12f: (3)
3	$(0, 0, 0)$	1a: (0);	2b: (1);	3c: (1);	6d: (1);	6e: (2); 12f: (3)
4	$(0, 0, 0)$	1a: (0);	2b: (0);	3c: (1);	6d: (2);	6e: (1); 12f: (3)
5	$(0, 0, 0)$	1a: (0);	2b: (1);	3c: (1);	6d: (3);	6e: (3); 12f: (6)
6	$(0, 0, 0)$	1a: (1);	2b: (1);	3c: (2);	6d: (3);	6e: (3); 12f: (6)
LD $(u, u, 0)$ of space group No. 183						
(Co-) irrep	Phonon AM	WYPO information				
1	$(\sqrt{3}r_1, -r_1, 0)$	1a: (2); 2b: (3); 3c: (5); 6d: (10); 6e: (9); 12f: (18)				
2	$(\sqrt{3}r_1, -r_1, 0)$	1a: (1); 2b: (3); 3c: (4); 6d: (8); 6e: (9); 12f: (18)				
P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 183						
(Co-) irrep	Phonon AM	WYPO information				
1	$(0, 0, 0)$	1a: (1);	2b: (1);	3c: (2);	6d: (4);	6e: (3); 12f: (6)
2	$(0, 0, 0)$	1a: (0);	2b: (1);	3c: (1);	6d: (2);	6e: (3); 12f: (6)
3	$(0, 0, 0)$	1a: (1);	2b: (2);	3c: (3);	6d: (6);	6e: (6); 12f: (12)
Q $(u, u, \frac{1}{2})$ of space group No. 183						
(Co-) irrep	Phonon AM	WYPO information				
1	$(\sqrt{3}r_1, -r_1, 0)$	1a: (2); 2b: (3); 3c: (5); 6d: (10); 6e: (9); 12f: (18)				
2	$(\sqrt{3}r_1, -r_1, 0)$	1a: (1); 2b: (3); 3c: (4); 6d: (8); 6e: (9); 12f: (18)				
R $(u, 0, \frac{1}{2})$ of space group No. 183						
(Co-) irrep	Phonon AM	WYPO information				
1	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	1a: (2); 2b: (4); 3c: (5); 6d: (9); 6e: (10); 12f: (18)				
2	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	1a: (1); 2b: (2); 3c: (4); 6d: (9); 6e: (8); 12f: (18)				
SM $(u, 0, 0)$ of space group No. 183						
(Co-) irrep	Phonon AM	WYPO information				
1	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	1a: (2); 2b: (4); 3c: (5); 6d: (9); 6e: (10); 12f: (18)				
2	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	1a: (1); 2b: (2); 3c: (4); 6d: (9); 6e: (8); 12f: (18)				
U $(\frac{1}{2}, 0, w)$ of space group No. 183						
(Co-) irrep	Phonon AM	WYPO information				
1	$(0, 0, 0)$	1a: (1);	2b: (2);	3c: (3);	6d: (5);	6e: (5); 12f: (9)
2	$(0, 0, 0)$	1a: (0);	2b: (1);	3c: (2);	6d: (4);	6e: (4); 12f: (9)

3	(0, 0, 0)	1a: (1); 2b: (2); 3c: (2); 6d: (4); 6e: (5); 12f: (9)
4	(0, 0, 0)	1a: (1); 2b: (1); 3c: (2); 6d: (5); 6e: (4); 12f: (9)

d. Results for high-symmetry planes

P1(0, u , v)			
Operation	E	C_6^+	C_6^-
Coordinate	(0, u , v)	($-u$, u , v)	(u , 0, v)
P2(u , v , 0)			
Operation	E		
Coordinate	(u , v , 0)		
P3(u , $-2u$, v)			
Operation	E	C_6^+	C_6^-
Coordinate	(u , $-2u$, v)	($2u$, $-u$, v)	($-u$, $-u$, v)
P4(u , v , $\frac{1}{2}$)			
Operation	E		
Coordinate	(u , v , $\frac{1}{2}$)		

P1 (0, u , v) of space group No. 183		
(Co-) irrep	Phonon AM	WYPO information
1	(r_1 , 0, 0)	1a: (2); 2b: (4); 3c: (5); 6d: (9); 6e: (10); 12f: (18)
2	(r_1 , 0, 0)	1a: (1); 2b: (2); 3c: (4); 6d: (9); 6e: (8); 12f: (18)
P2 (u , v , 0) of space group No. 183		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2 , r_1 , 0)	1a: (3); 2b: (6); 3c: (9); 6d: (18); 6e: (18); 12f: (36)
P3 (u , $-2u$, v) of space group No. 183		
(Co-) irrep	Phonon AM	WYPO information
1	($\sqrt{3}r_1$, r_1 , 0)	1a: (2); 2b: (3); 3c: (5); 6d: (10); 6e: (9); 12f: (18)
2	($\sqrt{3}r_1$, r_1 , 0)	1a: (1); 2b: (3); 3c: (4); 6d: (8); 6e: (9); 12f: (18)
P4 (u , v , $\frac{1}{2}$) of space group No. 183		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2 , r_1 , 0)	1a: (3); 2b: (6); 3c: (9); 6d: (18); 6e: (18); 12f: (36)

184. Space group No. 184 ($P6cc$)

Hexagonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{array}{cccccccc}\{E|0, 0, 0\} & \{C_{2z}|0, 0, 0\} & \{C_6^+|0, 0, 0\} & \{C_6^-|0, 0, 0\} & \{C_3^+|0, 0, 0\} & \{C_3^-|0, 0, 0\} & \{\sigma_x|0, 0, \frac{1}{2}\} & \{\sigma_{d3}|0, 0, \frac{1}{2}\} \\ \{\sigma_{d2}|0, 0, \frac{1}{2}\} & \{\sigma_{v2}|0, 0, \frac{1}{2}\} & \{\sigma_y|0, 0, \frac{1}{2}\} & \{\sigma_{v3}|0, 0, \frac{1}{2}\} & & & & \end{array}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, \frac{1}{2})$	

Γ (0, 0, 0) of space group No. 184			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 4b: (1); 6c: (1); 12d: (3)	
2	(0, 0, 0)	2a: (1); 4b: (1); 6c: (1); 12d: (3)	
3	(0, 0, 0)	2a: (0); 4b: (1); 6c: (2); 12d: (3)	
4	(0, 0, 0)	2a: (0); 4b: (1); 6c: (2); 12d: (3)	
5	(0, 0, 0)	2a: (0); 4b: (2); 6c: (2); 12d: (6)	
6	(0, 0, 0)	2a: (2); 4b: (2); 6c: (4); 12d: (6)	
M (0, $\frac{1}{2}$, 0) of space group No. 184			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 4b: (3); 6c: (5); 12d: (9)	
2	(0, 0, 0)	2a: (1); 4b: (3); 6c: (5); 12d: (9)	
3	(0, 0, 0)	2a: (2); 4b: (3); 6c: (4); 12d: (9)	
4	(0, 0, 0)	2a: (2); 4b: (3); 6c: (4); 12d: (9)	
A (0, 0, $\frac{1}{2}$) of space group No. 184			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 4b: (1); 6c: (1); 12d: (3)	
2	(0, 0, 0)	2a: (0); 4b: (1); 6c: (1); 12d: (3)	
3	(0, 0, 0)	2a: (0); 4b: (1); 6c: (2); 12d: (3)	
4	(0, 0, 0)	2a: (1); 4b: (1); 6c: (2); 12d: (3)	
L (0, $\frac{1}{2}$, $\frac{1}{2}$) of space group No. 184			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 4b: (3); 6c: (5); 12d: (9)	
2	(0, 0, 0)	2a: (2); 4b: (3); 6c: (4); 12d: (9)	
K ($-\frac{1}{3}$, $\frac{2}{3}$, 0) of space group No. 184			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 4b: (2); 6c: (3); 12d: (6)	
2	(0, 0, 0)	2a: (1); 4b: (2); 6c: (3); 12d: (6)	
3	(0, 0, 0)	2a: (2); 4b: (4); 6c: (6); 12d: (12)	
H ($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$) of space group No. 184			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 4b: (2); 6c: (3); 12d: (6)	
2	(0, 0, 0)	2a: (1); 4b: (2); 6c: (3); 12d: (6)	

c. Results for high-symmetry lines

DT(0, 0, w)

Operation E

Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, 0)	(−u, 2u, 0)	(−2u, u, 0)
P(1/3, 1/3, w)			
Operation	E	C _{2z}	
Coordinate	(1/3, 1/3, w)	(−1/3, −1/3, w)	
Q(u, u, 1/2)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, 1/2)	(−u, 2u, 1/2)	(−2u, u, 1/2)
R(u, 0, 1/2)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, 1/2)	(0, u, 1/2)	(−u, u, 1/2)
SM(u, 0, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, 0)	(0, u, 0)	(−u, u, 0)
U(1/2, 0, w)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(1/2, 0, w)	(0, 1/2, w)	(−1/2, 1/2, w)

DT $(0, 0, w)$ of space group No. 184

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 4b: (1); 6c: (1); 12d: (3)
2	$(0, 0, 0)$	2a: (1); 4b: (1); 6c: (1); 12d: (3)
3	$(0, 0, 0)$	2a: (0); 4b: (1); 6c: (2); 12d: (3)
4	$(0, 0, 0)$	2a: (0); 4b: (1); 6c: (2); 12d: (3)
5	$(0, 0, 0)$	2a: (0); 4b: (2); 6c: (2); 12d: (6)
6	$(0, 0, 0)$	2a: (2); 4b: (2); 6c: (4); 12d: (6)

LD $(u, u, 0)$ of space group No. 184

(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_1, -r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
2	$(\sqrt{3}r_1, -r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 184

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 4b: (2); 6c: (3); 12d: (6)
2	$(0, 0, 0)$	2a: (1); 4b: (2); 6c: (3); 12d: (6)
3	$(0, 0, 0)$	2a: (2); 4b: (4); 6c: (6); 12d: (12)

Q $(u, u, \frac{1}{2})$ of space group No. 184		
(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_1, -r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 184		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
SM $(u, 0, 0)$ of space group No. 184		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
2	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 184		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 4b: (3); 6c: (5); 12d: (9)
2	$(0, 0, 0)$	2a: (1); 4b: (3); 6c: (5); 12d: (9)
3	$(0, 0, 0)$	2a: (2); 4b: (3); 6c: (4); 12d: (9)
4	$(0, 0, 0)$	2a: (2); 4b: (3); 6c: (4); 12d: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
P2(u, v, 0)			
Operation	E		
Coordinate	$(u, v, 0)$		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 (0, u, v) of space group No. 184		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
2	$(r_1, 0, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)

P2 ($u, v, 0$) of space group No. 184		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 4b: (12); 6c: (18); 12d: (36)

P3 ($u, -2u, v$) of space group No. 184		
(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_1, r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
2	$(\sqrt{3}r_1, r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)

P4 ($u, v, \frac{1}{2}$) of space group No. 184		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 4b: (12); 6c: (18); 12d: (36)

185. Space group No. 185 ($P6_3cm$)

Hexagonal primitive lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_{2z} 0, 0, \frac{1}{2}\}$	$\{C_6^+ 0, 0, \frac{1}{2}\}$	$\{C_6^- 0, 0, \frac{1}{2}\}$	$\{C_3^+ 0, 0, 0\}$	$\{C_3^- 0, 0, 0\}$	$\{\sigma_x 0, 0, \frac{1}{2}\}$	$\{\sigma_{d3} 0, 0, \frac{1}{2}\}$
$\{\sigma_{d2} 0, 0, \frac{1}{2}\}$	$\{\sigma_{v2} 0, 0, 0\}$	$\{\sigma_y 0, 0, 0\}$	$\{\sigma_{v3} 0, 0, 0\}$				

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		

$M(0, \frac{1}{2}, 0)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$

$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		

$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, -\frac{2}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, -\frac{2}{3}, \frac{1}{2})$	

Γ (0, 0, 0) of space group No. 185			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1);	4b: (1); 6c: (2); 12d: (3)
2	(0, 0, 0)	2a: (0);	4b: (1); 6c: (1); 12d: (3)
3	(0, 0, 0)	2a: (0);	4b: (1); 6c: (1); 12d: (3)
4	(0, 0, 0)	2a: (1);	4b: (1); 6c: (2); 12d: (3)
5	(0, 0, 0)	2a: (1);	4b: (2); 6c: (3); 12d: (6)
6	(0, 0, 0)	2a: (1);	4b: (2); 6c: (3); 12d: (6)
M $(0, \frac{1}{2}, 0)$ of space group No. 185			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2);	4b: (3); 6c: (5); 12d: (9)
2	(0, 0, 0)	2a: (1);	4b: (3); 6c: (4); 12d: (9)
3	(0, 0, 0)	2a: (1);	4b: (3); 6c: (4); 12d: (9)
4	(0, 0, 0)	2a: (2);	4b: (3); 6c: (5); 12d: (9)
A $(0, 0, \frac{1}{2})$ of space group No. 185			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1);	4b: (1); 6c: (2); 12d: (3)
2	(0, 0, 0)	2a: (0);	4b: (1); 6c: (1); 12d: (3)
3	(0, 0, 0)	2a: (1);	4b: (2); 6c: (3); 12d: (6)
L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 185			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2);	4b: (3); 6c: (5); 12d: (9)
2	(0, 0, 0)	2a: (1);	4b: (3); 6c: (4); 12d: (9)
K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 185			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2);	4b: (2); 6c: (4); 12d: (6)
2	(0, 0, 0)	2a: (0);	4b: (2); 6c: (2); 12d: (6)
3	(0, 0, 0)	2a: (2);	4b: (4); 6c: (6); 12d: (12)

H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 6c: (2); 12d: (3)
2	(0, 0, 0)	2a: (0); 4b: (1); 6c: (1); 12d: (3)
3	(0, 0, 0)	2a: (1); 4b: (2); 6c: (3); 12d: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C _{2z}	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	(- $\frac{1}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	($\frac{1}{2}, 0, w$)	(0, $\frac{1}{2}, w$)	(- $\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (1); 6c: (2); 12d: (3)
2	(0, 0, 0)	2a: (0); 4b: (1); 6c: (1); 12d: (3)
3	(0, 0, 0)	2a: (0); 4b: (1); 6c: (1); 12d: (3)
4	(0, 0, 0)	2a: (1); 4b: (1); 6c: (2); 12d: (3)
5	(0, 0, 0)	2a: (1); 4b: (2); 6c: (3); 12d: (6)

6	(0, 0, 0)	2a: (1); 4b: (2); 6c: (3); 12d: (6)
LD ($u, u, 0$) of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_1, -r_1, 0)$	2a: (4); 4b: (6); 6c: (10); 12d: (18)
2	$(\sqrt{3}r_1, -r_1, 0)$	2a: (2); 4b: (6); 6c: (8); 12d: (18)
P ($\frac{1}{3}, \frac{1}{3}, w$) of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (2); 6c: (4); 12d: (6)
2	(0, 0, 0)	2a: (0); 4b: (2); 6c: (2); 12d: (6)
3	(0, 0, 0)	2a: (2); 4b: (4); 6c: (6); 12d: (12)
Q ($u, u, \frac{1}{2}$) of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_1, -r_1, 0)$	2a: (2); 4b: (3); 6c: (5); 12d: (9)
2	$(\sqrt{3}r_1, -r_1, 0)$	2a: (1); 4b: (3); 6c: (4); 12d: (9)
R ($u, 0, \frac{1}{2}$) of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
SM ($u, 0, 0$) of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
2	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
U ($\frac{1}{2}, 0, w$) of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3); 6c: (5); 12d: (9)
2	(0, 0, 0)	2a: (1); 4b: (3); 6c: (4); 12d: (9)
3	(0, 0, 0)	2a: (1); 4b: (3); 6c: (4); 12d: (9)
4	(0, 0, 0)	2a: (2); 4b: (3); 6c: (5); 12d: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	(0, u, v)	($-u, u, v$)	($u, 0, v$)
P2($u, v, 0$)			
Operation	E		
Coordinate	($u, v, 0$)		
P3($u, -2u, v$)			

Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
P4 $(u, v, \frac{1}{2})$			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 $(0, u, v)$ of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
2	$(r_1, 0, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)
P2 $(u, v, 0)$ of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 4b: (12); 6c: (18); 12d: (36)
P3 $(u, -2u, v)$ of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_1, r_1, 0)$	2a: (4); 4b: (6); 6c: (10); 12d: (18)
2	$(\sqrt{3}r_1, r_1, 0)$	2a: (2); 4b: (6); 6c: (8); 12d: (18)
P4 $(u, v, \frac{1}{2})$ of space group No. 185		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 4b: (6); 6c: (9); 12d: (18)

186. Space group No. 186 ($P6_3mc$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & & \vec{t}_1 = \vec{a} \\
 \text{Hexagonal primitive lattice} & \vec{b} = \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0 \right) & \vec{t}_2 = \vec{b} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_{2z} 0, 0, \frac{1}{2}\}$	$\{C_6^+ 0, 0, \frac{1}{2}\}$	$\{C_6^- 0, 0, \frac{1}{2}\}$	$\{C_3^+ 0, 0, 0\}$	$\{C_3^- 0, 0, 0\}$	$\{\sigma_x 0, 0, 0\}$	$\{\sigma_{d3} 0, 0, 0\}$
$\{\sigma_{d2} 0, 0, 0\}$	$\{\sigma_{v2} 0, 0, \frac{1}{2}\}$	$\{\sigma_y 0, 0, \frac{1}{2}\}$	$\{\sigma_{v3} 0, 0, \frac{1}{2}\}$				

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0,\frac{1}{2},0)$	$(-\frac{1}{2},\frac{1}{2},0)$	$(\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},0,\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	C_{2z}	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},\frac{1}{2})$	

$\Gamma(0, 0, 0)$ of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	2a: (1); 2b: (1); 6c: (2); 12d: (3)	
2	$(0, 0, 0)$	2a: (0); 2b: (0); 6c: (1); 12d: (3)	
3	$(0, 0, 0)$	2a: (1); 2b: (1); 6c: (2); 12d: (3)	
4	$(0, 0, 0)$	2a: (0); 2b: (0); 6c: (1); 12d: (3)	
5	$(0, 0, 0)$	2a: (1); 2b: (1); 6c: (3); 12d: (6)	
6	$(0, 0, 0)$	2a: (1); 2b: (1); 6c: (3); 12d: (6)	
$M(0, \frac{1}{2}, 0)$ of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	2a: (2); 2b: (2); 6c: (5); 12d: (9)	
2	$(0, 0, 0)$	2a: (1); 2b: (1); 6c: (4); 12d: (9)	
3	$(0, 0, 0)$	2a: (2); 2b: (2); 6c: (5); 12d: (9)	
4	$(0, 0, 0)$	2a: (1); 2b: (1); 6c: (4); 12d: (9)	
$A(0, 0, \frac{1}{2})$ of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, 0)$	2a: (1); 2b: (1); 6c: (2); 12d: (3)	
2	$(0, 0, 0)$	2a: (0); 2b: (0); 6c: (1); 12d: (3)	
3	$(0, 0, 0)$	2a: (1); 2b: (1); 6c: (3); 12d: (6)	

L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (2); 2b: (2); 6c: (5); 12d: (9)	
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (4); 12d: (9)	
K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3); 12d: (6)	
2	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3); 12d: (6)	
3	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6); 12d: (12)	
H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	2a: (1); 2b: (1); 6c: (3); 12d: (6)	
2	(0, 0, 0)	2a: (2); 2b: (2); 6c: (6); 12d: (12)	

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C_{2z}	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C_6^+	C_3^+
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C_6^+	C_3^+
Coordinate	($\frac{1}{2}, 0, w$)	(0, $\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT $(0, 0, w)$ of space group No. 186					
(Co-) irrep	Phonon AM	WYPO information			
1	$(0, 0, 0)$	2a: (1);	2b: (1);	6c: (2);	12d: (3)
2	$(0, 0, 0)$	2a: (0);	2b: (0);	6c: (1);	12d: (3)
3	$(0, 0, 0)$	2a: (1);	2b: (1);	6c: (2);	12d: (3)
4	$(0, 0, 0)$	2a: (0);	2b: (0);	6c: (1);	12d: (3)
5	$(0, 0, 0)$	2a: (1);	2b: (1);	6c: (3);	12d: (6)
6	$(0, 0, 0)$	2a: (1);	2b: (1);	6c: (3);	12d: (6)
LD $(u, u, 0)$ of space group No. 186					
(Co-) irrep	Phonon AM	WYPO information			
1	$(\sqrt{3}r_1, -r_1, 0)$	2a: (3);	2b: (3);	6c: (9);	12d: (18)
2	$(\sqrt{3}r_1, -r_1, 0)$	2a: (3);	2b: (3);	6c: (9);	12d: (18)
P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 186					
(Co-) irrep	Phonon AM	WYPO information			
1	$(0, 0, 0)$	2a: (1);	2b: (1);	6c: (3);	12d: (6)
2	$(0, 0, 0)$	2a: (1);	2b: (1);	6c: (3);	12d: (6)
3	$(0, 0, 0)$	2a: (2);	2b: (2);	6c: (6);	12d: (12)
Q $(u, u, \frac{1}{2})$ of space group No. 186					
(Co-) irrep	Phonon AM	WYPO information			
1	$(\sqrt{3}r_1, -r_1, 0)$	2a: (3);	2b: (3);	6c: (9);	12d: (18)
R $(u, 0, \frac{1}{2})$ of space group No. 186					
(Co-) irrep	Phonon AM	WYPO information			
1	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (2);	2b: (2);	6c: (5);	12d: (9)
2	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (1);	2b: (1);	6c: (4);	12d: (9)
SM $(u, 0, 0)$ of space group No. 186					
(Co-) irrep	Phonon AM	WYPO information			
1	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (4);	2b: (4);	6c: (10);	12d: (18)
2	$(\frac{r_1}{2}, -\frac{1}{2}\sqrt{3}r_1, 0)$	2a: (2);	2b: (2);	6c: (8);	12d: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 186					
(Co-) irrep	Phonon AM	WYPO information			
1	$(0, 0, 0)$	2a: (2);	2b: (2);	6c: (5);	12d: (9)
2	$(0, 0, 0)$	2a: (1);	2b: (1);	6c: (4);	12d: (9)
3	$(0, 0, 0)$	2a: (2);	2b: (2);	6c: (5);	12d: (9)
4	$(0, 0, 0)$	2a: (1);	2b: (1);	6c: (4);	12d: (9)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	(0, u, v)	(-u, u, v)	(u, 0, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	(u, -2u, v)	(2u, -u, v)	(-u, -u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u , v) of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	(r_1 , 0, 0)	2a: (4); 2b: (4); 6c: (10); 12d: (18)	
2	(r_1 , 0, 0)	2a: (2); 2b: (2); 6c: (8); 12d: (18)	
P2 (u , v , 0) of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	(r_2 , r_1 , 0)	2a: (6); 2b: (6); 6c: (18); 12d: (36)	
P3 (u , $-2u$, v) of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	($\sqrt{3}r_1$, r_1 , 0)	2a: (3); 2b: (3); 6c: (9); 12d: (18)	
2	($\sqrt{3}r_1$, r_1 , 0)	2a: (3); 2b: (3); 6c: (9); 12d: (18)	
P4 (u , v , $\frac{1}{2}$) of space group No. 186			
(Co-) irrep	Phonon AM	WYPO information	
1	(r_2 , r_1 , 0)	2a: (3); 2b: (3); 6c: (9); 12d: (18)	

187. Space group No. 187 ($P\bar{6}m2$)

Hexagonal primitive lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$H\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (0); 1b: (1); 1c: (1) ; 1d: (0); 1e: (1) ; 1f: (0); 2g: (1); 2h: (1) ; 2i: (1) ; 3j: (2) ; 3k: (1); 6l: (4) ; 6m: (2); 6n: (3) ; 12o: (6)
2	$(0, 0, r_1)$	1a: (0); 1b: (1) ; 1c: (0); 1d: (1) ; 1e: (1); 1f: (0); 2g: (1) ; 2h: (1) ; 2i: (1); 3j: (1); 3k: (2) ; 6l: (2); 6m: (4) ; 6n: (3) ; 12o: (6)
3	$(0, 0, r_1)$	1a: (1) ; 1b: (0); 1c: (0); 1d: (1); 1e: (1) ; 1f: (0); 2g: (1) ; 2h: (1); 2i: (1) ; 3j: (2) ; 3k: (1); 6l: (4) ; 6m: (2); 6n: (3) ; 12o: (6)
4	$(0, 0, r_1)$	1a: (1); 1b: (0); 1c: (0); 1d: (1) ; 1e: (0); 1f: (1) ; 2g: (1); 2h: (1) ; 2i: (1) ; 3j: (1); 3k: (2) ; 6l: (2); 6m: (4) ; 6n: (3) ; 12o: (6)
5	$(0, 0, r_1)$	1a: (1) ; 1b: (0); 1c: (1) ; 1d: (0); 1e: (0); 1f: (1); 2g: (1) ; 2h: (1) ; 2i: (1); 3j: (2) ; 3k: (1); 6l: (4) ; 6m: (2); 6n: (3) ; 12o: (6)
6	$(0, 0, r_1)$	1a: (0); 1b: (1) ; 1c: (1); 1d: (0); 1e: (0); 1f: (1) ; 2g: (1) ; 2h: (1); 2i: (1) ; 3j: (1); 3k: (2) ; 6l: (2); 6m: (4) ; 6n: (3) ; 12o: (6)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

LD(u , u , 0)

Operation	E	C_{2y}	C_3^+
Coordinate	(u , u , 0)	($-u$, $2u$, 0)	($-2u$, u , 0)

P($\frac{1}{3}$, $\frac{1}{3}$, w)

Operation	E	σ_{d3}
Coordinate	($\frac{1}{3}$, $\frac{1}{3}$, w)	($-\frac{1}{3}$, $-\frac{1}{3}$, w)

Q(u , u , $\frac{1}{2}$)

Operation	E	C_{2y}	C_3^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, $2u$, $-\frac{1}{2}$)	($-2u$, u , $\frac{1}{2}$)

R(u , 0, $\frac{1}{2}$)

Operation	E	S_3^-	C_3^+
Coordinate	(u , 0, $\frac{1}{2}$)	(0, $-u$, $-\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)

SM(u , 0, 0)

Operation	E	S_3^-	C_3^+
Coordinate	(u , 0, 0)	(0, $-u$, 0)	($-u$, u , 0)

U($\frac{1}{2}$, 0, w)

Operation	E	C_3^-	C_3^+
Coordinate	($\frac{1}{2}$, 0, w)	(0, $-\frac{1}{2}$, w)	($-\frac{1}{2}$, $\frac{1}{2}$, w)

DT $(0, 0, w)$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (2); 3k: (2); 6l: (3); 6m: (3); 6n: (4); 12o: (6)
2	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 2g: (0); 2h: (0); 2i: (0); 3j: (1); 3k: (1); 6l: (3); 6m: (3); 6n: (2); 12o: (6)
3	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6); 6m: (6); 6n: (6); 12o: (12)

LD $(u, u, 0)$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, -r_1)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 2g: (3); 2h: (3); 2i: (3); 3j: (6); 3k: (6); 6l: (12); 6m: (12); 6n: (9); 12o: (18)
2	$(0, 0, -r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (3); 2h: (3); 2i: (3); 3j: (3); 3k: (3); 6l: (6); 6m: (6); 6n: (9); 12o: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, -r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6); 6m: (6); 6n: (6); 12o: (12)
2	$(0, 0, -r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6); 6m: (6); 6n: (6); 12o: (12)
3	$(0, 0, -r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6); 6m: (6); 6n: (6); 12o: (12)

Q $(u, u, \frac{1}{2})$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, -r_1)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 1e: (2); 1f: (1); 2g: (3); 2h: (3); 2i: (3); 3j: (6); 3k: (3); 6l: (12); 6m: (6); 6n: (9); 12o: (18)
2	$(0, 0, -r_1)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 1e: (1); 1f: (2); 2g: (3); 2h: (3); 2i: (3); 3j: (3); 3k: (6); 6l: (6); 6m: (12); 6n: (9); 12o: (18)

R $(u, 0, \frac{1}{2})$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (2); 6l: (6); 6m: (3); 6n: (5); 12o: (9)
2	$(0, 0, 0)$	1a: (0); 1b: (1); 1c: (0); 1d: (1); 1e: (0); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (3); 6l: (3); 6m: (6); 6n: (4); 12o: (9)
3	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (2); 3k: (3); 6l: (3); 6m: (6); 6n: (5); 12o: (9)
4	$(0, 0, 0)$	1a: (1); 1b: (0); 1c: (1); 1d: (0); 1e: (1); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (3); 3k: (1); 6l: (6); 6m: (3); 6n: (4); 12o: (9)

SM $(u, 0, 0)$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (3); 3k: (3); 6l: (6); 6m: (6); 6n: (5); 12o: (9)
2	$(0, 0, 0)$	1a: (0); 1b: (0); 1c: (0); 1d: (0); 1e: (0); 1f: (0); 2g: (1); 2h: (1); 2i: (1); 3j: (1); 3k: (1); 6l: (3); 6m: (3); 6n: (4); 12o: (9)

3	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (2); 3k: (2); 6l: (3); 6m: (3); 6n: (5); 12o: (9)
4	(0, 0, 0)	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (1); 2h: (1); 2i: (1); 3j: (3); 3k: (3); 6l: (6); 6m: (6); 6n: (4); 12o: (9)

$U\left(\frac{1}{2}, 0, w\right)$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0\right)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 2g: (4); 2h: (4); 2i: (4); 3j: (5); 3k: (5); 6l: (9); 6m: (9); 6n: (10); 12o: (18)
2	$\left(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0\right)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (4); 3k: (4); 6l: (9); 6m: (9); 6n: (8); 12o: (18)

d. Results for high-symmetry planes

$P1(0, u, v)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, u, v)$	$(-u, 0, v)$	$(u, -u, v)$
$P2(u, v, 0)$			
Operation	E		
Coordinate	$(u, v, 0)$		
$P3(u, -2u, v)$			
Operation	E	σ_{d3}	σ_x
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
$P4(u, v, \frac{1}{2})$			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

$P1(0, u, v)$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 2g: (4); 2h: (4); 2i: (4); 3j: (5); 3k: (5); 6l: (9); 6m: (9); 6n: (10); 12o: (18)
2	$(r_1, 0, 0)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (2); 2h: (2); 2i: (2); 3j: (4); 3k: (4); 6l: (9); 6m: (9); 6n: (8); 12o: (18)

$P2(u, v, 0)$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (2); 1b: (2); 1c: (2); 1d: (2); 1e: (2); 1f: (2); 2g: (3); 2h: (3); 2i: (3); 3j: (6); 3k: (6); 6l: (12); 6m: (12); 6n: (9); 12o: (18)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 1c: (1); 1d: (1); 1e: (1); 1f: (1); 2g: (3); 2h: (3); 2i: (3); 3j: (3); 3k: (3); 6l: (6); 6m: (6); 6n: (9); 12o: (18)

$P3(u, -2u, v)$ of space group No. 187

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_2}{\sqrt{3}}, r_2, r_1\right)$	1a: (3); 1b: (3); 1c: (3); 1d: (3); 1e: (3); 1f: (3); 2g: (6); 2h: (6); 2i: (6); 3j: (9); 3k: (9); 6l: (18); 6m: (18); 6n: (18); 12o: (36)
P4 $\left(u, v, \frac{1}{2}\right)$ of space group No. 187		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (2); 1b: (1); 1c: (2); 1d: (1); 1e: (2); 1f: (1); 2g: (3); 2h: (3); 2i: (3); 3j: (6); 3k: (3); 6l: (12); 6m: (6); 6n: (9); 12o: (18)
2	$(0, 0, r_1)$	1a: (1); 1b: (2); 1c: (1); 1d: (2); 1e: (1); 1f: (2); 2g: (3); 2h: (3); 2i: (3); 3j: (3); 3k: (6); 6l: (6); 6m: (12); 6n: (9); 12o: (18)

188. Space group No. 188 ($P\bar{6}c2$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{\sigma_z|0, 0, -\frac{1}{2}\} \quad \{S_3^+|0, 0, -\frac{1}{2}\} \quad \{S_3^-|0, 0, -\frac{1}{2}\} \quad \{C_3^-|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{22}''|0, 0, 0\} \\ &\{C_{23}''|0, 0, 0\} \quad \{\sigma_{d3}|0, 0, -\frac{1}{2}\} \quad \{\sigma_x|0, 0, -\frac{1}{2}\} \quad \{\sigma_{d2}|0, 0, -\frac{1}{2}\} \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	S_3^-	S_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	S_3^-	S_3^+
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},-\frac{1}{2})$	$(-\frac{1}{2},0,-\frac{1}{2})$

$$K(-\frac{1}{3}, \frac{2}{3}, 0)$$

$$\begin{array}{lcl} \text{Operation} & E & C_{2y} \\ \text{Coordinate} & (-\frac{1}{3}, \frac{2}{3}, 0) & (\frac{1}{3}, \frac{1}{3}, 0) \end{array}$$

$$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$$

$$\begin{array}{lcl} \text{Operation} & E & C_{2y} \\ \text{Coordinate} & (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}) & (\frac{1}{3}, \frac{1}{3}, -\frac{1}{2}) \end{array}$$

 $\Gamma (0, 0, 0)$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 2e: (0); 2f: (0); 4g: (1); 4h: (1); 4i: (1); 6j: (1); 6k: (2); 12l: (3)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 2e: (1); 2f: (0); 4g: (1); 4h: (1); 4i: (1); 6j: (2); 6k: (2); 12l: (3)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (1); 2e: (0); 2f: (1); 4g: (1); 4h: (1); 4i: (1); 6j: (1); 6k: (1); 12l: (3)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (1); 4h: (1); 4i: (1); 6j: (2); 6k: (1); 12l: (3)
5	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (4); 12l: (6)
6	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (0); 2e: (1); 2f: (0); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (2); 12l: (6)

 $M (0, \frac{1}{2}, 0)$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 4g: (3); 4h: (3); 4i: (3); 6j: (4); 6k: (6); 12l: (9)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 6j: (4); 6k: (3); 12l: (9)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (2); 2d: (1); 2e: (2); 2f: (1); 4g: (3); 4h: (3); 4i: (3); 6j: (5); 6k: (3); 12l: (9)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (3); 6j: (5); 6k: (6); 12l: (9)

 $A (0, 0, \frac{1}{2})$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (3); 12l: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (3); 12l: (6)

 $L (0, \frac{1}{2}, \frac{1}{2})$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (9); 12l: (18)

 $K (-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (0); 2c: (1); 2d: (2); 2e: (1); 2f: (2); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (4); 12l: (6)
2	$(0, 0, r_1)$	2a: (1); 2b: (0); 2c: (1); 2d: (0); 2e: (1); 2f: (2); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (2); 12l: (6)
3	$(0, 0, r_1)$	2a: (1); 2b: (2); 2c: (1); 2d: (0); 2e: (1); 2f: (2); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (4); 12l: (6)
4	$(0, 0, r_1)$	2a: (1); 2b: (2); 2c: (1); 2d: (0); 2e: (1); 2f: (0); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (2); 12l: (6)
5	$(0, 0, r_1)$	2a: (1); 2b: (2); 2c: (1); 2d: (2); 2e: (1); 2f: (0); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (4); 12l: (6)
6	$(0, 0, r_1)$	2a: (1); 2b: (0); 2c: (1); 2d: (2); 2e: (1); 2f: (0); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (2); 12l: (6)

$H\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (3); 12l: (6)
2	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (3); 12l: (6)
3	$(0, 0, r_1)$	2a: (1); 2b: (1); 2c: (1); 2d: (1); 2e: (1); 2f: (1); 4g: (2); 4h: (2); 4i: (2); 6j: (3); 6k: (3); 12l: (6)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation	E
Coordinate	$(0, 0, w)$

LD($u, u, 0$)

Operation	E	C_{2y}	C_3^+
Coordinate	$(u, u, 0)$	$(-u, 2u, 0)$	$(-2u, u, 0)$

P($\frac{1}{3}, \frac{1}{3}, w$)

Operation	E	σ_{d3}
Coordinate	$(\frac{1}{3}, \frac{1}{3}, w)$	$(-\frac{1}{3}, -\frac{1}{3}, w)$

Q($u, u, \frac{1}{2}$)

Operation	E	C_{2y}	C_3^+
Coordinate	$(u, u, \frac{1}{2})$	$(-u, 2u, -\frac{1}{2})$	$(-2u, u, \frac{1}{2})$

R($u, 0, \frac{1}{2}$)

Operation	E	S_3^-	C_3^+
Coordinate	$(u, 0, \frac{1}{2})$	$(0, -u, -\frac{1}{2})$	$(-u, u, \frac{1}{2})$

SM($u, 0, 0$)

Operation	E	S_3^-	C_3^+
Coordinate	$(u, 0, 0)$	$(0, -u, 0)$	$(-u, u, 0)$

$U(\frac{1}{2}, 0, w)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 188											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, 0)$	2a: (1); 12l: (6)	2b: (1);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (2);	6j: (3); 6k: (3);
2	$(0, 0, 0)$	2a: (1); 12l: (6)	2b: (1);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	4g: (2);	4h: (2);	4i: (2);	6j: (3); 6k: (3);
3	$(0, 0, 0)$	2a: (2); 12l: (12)	2b: (2);	2c: (2);	2d: (2);	2e: (2);	2f: (2);	4g: (4);	4h: (4);	4i: (4);	6j: (6); 6k: (6);
LD $(u, u, 0)$ of space group No. 188											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, -r_1)$	2a: (3); 2b: (4); 2c: (3); 2d: (4); 2e: (3); 2f: (4); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (12); 12l: (18)									
2	$(0, 0, -r_1)$	2a: (3); 12l: (18) 2b: (2); 2c: (3); 2d: (2); 2e: (3); 2f: (2); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (6);									
P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 188											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, -r_1)$	2a: (2); 12l: (12)	2b: (2);	2c: (2);	2d: (2);	2e: (2);	2f: (2);	4g: (4);	4h: (4);	4i: (4);	6j: (6); 6k: (6);
2	$(0, 0, -r_1)$	2a: (2); 2b: (2); 12l: (12) 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (4); 6j: (6); 6k: (6);									
3	$(0, 0, -r_1)$	2a: (2); 2b: (2); 2c: (2); 2d: (2); 12l: (12) 2e: (2); 2f: (2); 4g: (4); 4h: (4); 4i: (4); 6j: (6); 6k: (6);									
Q $(u, u, \frac{1}{2})$ of space group No. 188											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, -r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (9); 12l: (18)									
R $(u, 0, \frac{1}{2})$ of space group No. 188											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, 0)$	2a: (3); 12l: (18)	2b: (3);	2c: (3);	2d: (3);	2e: (3);	2f: (3);	4g: (6);	4h: (6);	4i: (6);	6j: (9); 6k: (9);
SM $(u, 0, 0)$ of space group No. 188											
(Co-) irrep	Phonon AM	WYPO information									
1	$(0, 0, 0)$	2a: (1); 12l: (9)	2b: (2);	2c: (1);	2d: (2);	2e: (1);	2f: (2);	4g: (3);	4h: (3);	4i: (3);	6j: (4); 6k: (6);
2	$(0, 0, 0)$	2a: (1); 12l: (9)	2b: (1);	2c: (1);	2d: (1);	2e: (1);	2f: (1);	4g: (3);	4h: (3);	4i: (3);	6j: (4); 6k: (3);
3	$(0, 0, 0)$	2a: (2); 12l: (9)	2b: (1);	2c: (2);	2d: (1);	2e: (2);	2f: (1);	4g: (3);	4h: (3);	4i: (3);	6j: (5); 6k: (3);

4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 2e: (2); 2f: (2); 4g: (3); 4h: (3); 4i: (3); 6j: (5); 6k: (6); 12l: (9)

$U\left(\frac{1}{2}, 0, w\right)$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information
1	$\left(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0\right)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (9); 12l: (18)
2	$\left(-\frac{r_1}{2}, \frac{\sqrt{3}r_1}{2}, 0\right)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (9); 12l: (18)

d. Results for high-symmetry planes

$P1(0, u, v)$			
Operation	E	C_3^+	C_3^-
Coordinate	$(0, u, v)$	$(-u, 0, v)$	$(u, -u, v)$
$P2(u, v, 0)$			
Operation	E		
Coordinate	$(u, v, 0)$		
$P3(u, -2u, v)$			
Operation	E	σ_{d3}	σ_x
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
$P4(u, v, \frac{1}{2})$			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

$P1(0, u, v)$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (9); 12l: (18)
2	$(r_1, 0, 0)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (9); 12l: (18)

$P2(u, v, 0)$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (4); 2c: (3); 2d: (4); 2e: (3); 2f: (4); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (12); 12l: (18)
2	$(0, 0, r_1)$	2a: (3); 2b: (2); 2c: (3); 2d: (2); 2e: (3); 2f: (2); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (6); 12l: (18)

$P3(u, -2u, v)$ of space group No. 188

(Co-) irrep	Phonon AM	WYPO information

1	$\left(-\frac{r_2}{\sqrt{3}}, r_2, r_1\right)$	2a: (6); 2b: (6); 2c: (6); 2d: (6); 2e: (6); 2f: (6); 4g: (12); 4h: (12); 4i: (12); 6j: (18); 6k: (18); 12l: (36)
P4 $\left(u, v, \frac{1}{2}\right)$ of space group No. 188		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (9); 12l: (18)
2	$(0, 0, r_1)$	2a: (3); 2b: (3); 2c: (3); 2d: (3); 2e: (3); 2f: (3); 4g: (6); 4h: (6); 4i: (6); 6j: (9); 6k: (9); 12l: (18)

189. Space group No. 189 ($P\bar{6}2m$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) \\ \vec{c} &= (0, 0, c) \end{aligned} \quad \begin{aligned} \vec{t}_1 &= \vec{a} \\ \vec{t}_2 &= \vec{b} \\ \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{\sigma_z 0, 0, 0\}$	$\{S_3^+ 0, 0, 0\}$	$\{S_3^- 0, 0, 0\}$	$\{C_3^- 0, 0, 0\}$	$\{C_3^+ 0, 0, 0\}$	$\{C_{2x} 0, 0, 0\}$	$\{C'_{22} 0, 0, 0\}$
$\{C'_{23} 0, 0, 0\}$	$\{\sigma_v 0, 0, 0\}$	$\{\sigma_y 0, 0, 0\}$	$\{\sigma_v 0, 0, 0\}$				

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	S_3^-	S_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	S_3^-	S_3^+
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},-\frac{1}{2})$	$(-\frac{1}{2},0,-\frac{1}{2})$

$$K(-\frac{1}{3}, \frac{2}{3}, 0)$$

$$\begin{array}{ccc} \text{Operation} & E & E\Theta \\ \text{Coordinate} & (-\frac{1}{3}, \frac{2}{3}, 0) & (\frac{1}{3}, -\frac{2}{3}, 0) \end{array}$$

$$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$$

$$\begin{array}{ccc} \text{Operation} & E & E\Theta \\ \text{Coordinate} & (-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}) & (\frac{1}{3}, -\frac{2}{3}, -\frac{1}{2}) \end{array}$$

 $\Gamma (0, 0, 0)$ of space group No. 189

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (2); 6k: (2); 12l: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (1); 3g: (1); 4h: (1); 6i: (1); 6j: (2); 6k: (2); 12l: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (0); 3g: (0); 4h: (1); 6i: (1); 6j: (1); 6k: (1); 12l: (3)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (1); 6k: (1); 12l: (3)
5	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (1); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (4); 6k: (4); 12l: (6)
6	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (2); 6k: (2); 12l: (6)

 $M (0, \frac{1}{2}, 0)$ of space group No. 189

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (3); 6i: (5); 6j: (6); 6k: (6); 12l: (9)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (3); 6i: (4); 6j: (3); 6k: (3); 12l: (9)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (5); 6j: (3); 6k: (3); 12l: (9)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (1); 3f: (3); 3g: (3); 4h: (3); 6i: (4); 6j: (6); 6k: (6); 12l: (9)

 $A (0, 0, \frac{1}{2})$ of space group No. 189

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (0); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (2); 6k: (1); 12l: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (1); 2e: (0); 3f: (1); 3g: (0); 4h: (1); 6i: (1); 6j: (2); 6k: (1); 12l: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (0); 2e: (0); 3f: (0); 3g: (1); 4h: (1); 6i: (1); 6j: (1); 6k: (2); 12l: (3)
4	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (0); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (1); 6k: (2); 12l: (3)
5	(0, 0, 0)	1a: (1); 1b: (0); 2c: (2); 2d: (0); 2e: (1); 3f: (2); 3g: (1); 4h: (2); 6i: (3); 6j: (4); 6k: (2); 12l: (6)
6	(0, 0, 0)	1a: (0); 1b: (1); 2c: (0); 2d: (2); 2e: (1); 3f: (1); 3g: (2); 4h: (2); 6i: (3); 6j: (2); 6k: (4); 12l: (6)

L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 189											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (1); 12l: (9)	1b: (1);	2c: (2);	2d: (1);	2e: (2);	3f: (3);	3g: (2);	4h: (3);	6i: (5);	6j: (6); 6k: (3);
2	(0, 0, 0)	1a: (0); 12l: (9)	1b: (1);	2c: (1);	2d: (2);	2e: (1);	3f: (1);	3g: (3);	4h: (3);	6i: (4);	6j: (3); 6k: (6);
3	(0, 0, 0)	1a: (1); 12l: (9)	1b: (1);	2c: (1);	2d: (2);	2e: (2);	3f: (2);	3g: (3);	4h: (3);	6i: (5);	6j: (3); 6k: (6);
4	(0, 0, 0)	1a: (1); 12l: (9)	1b: (0);	2c: (2);	2d: (1);	2e: (1);	3f: (3);	3g: (1);	4h: (3);	6i: (4);	6j: (6); 6k: (3);
K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 189											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (1);	2d: (1);	2e: (1);	3f: (1);	3g: (1);	4h: (1);	6i: (2);	6j: (2); 6k: (2);
2	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (1);	2d: (1);	2e: (0);	3f: (1);	3g: (1);	4h: (1);	6i: (1);	6j: (2); 6k: (2);
3	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (0);	2d: (0);	2e: (0);	3f: (0);	3g: (0);	4h: (1);	6i: (1);	6j: (1); 6k: (1);
4	(0, 0, 0)	1a: (1); 12l: (3)	1b: (1);	2c: (0);	2d: (0);	2e: (1);	3f: (1);	3g: (1);	4h: (1);	6i: (2);	6j: (1); 6k: (1);
5	(0, 0, 0)	1a: (1); 12l: (6)	1b: (1);	2c: (1);	2d: (1);	2e: (1);	3f: (2);	3g: (2);	4h: (2);	6i: (3);	6j: (4); 6k: (4);
6	(0, 0, 0)	1a: (0); 12l: (6)	1b: (0);	2c: (1);	2d: (1);	2e: (1);	3f: (1);	3g: (1);	4h: (2);	6i: (3);	6j: (2); 6k: (2);
H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 189											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0); 12l: (3)	1b: (1);	2c: (1);	2d: (0);	2e: (1);	3f: (1);	3g: (1);	4h: (1);	6i: (2);	6j: (2); 6k: (1);
2	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (1);	2d: (0);	2e: (0);	3f: (1);	3g: (0);	4h: (1);	6i: (1);	6j: (2); 6k: (1);
3	(0, 0, 0)	1a: (0); 12l: (3)	1b: (0);	2c: (0);	2d: (1);	2e: (0);	3f: (0);	3g: (1);	4h: (1);	6i: (1);	6j: (1); 6k: (2);
4	(0, 0, 0)	1a: (1); 12l: (3)	1b: (0);	2c: (0);	2d: (1);	2e: (1);	3f: (1);	3g: (1);	4h: (1);	6i: (2);	6j: (1); 6k: (2);
5	(0, 0, 0)	1a: (1); 12l: (6)	1b: (0);	2c: (1);	2d: (1);	2e: (1);	3f: (2);	3g: (1);	4h: (2);	6i: (3);	6j: (4); 6k: (2);
6	(0, 0, 0)	1a: (0); 12l: (6)	1b: (1);	2c: (1);	2d: (1);	2e: (1);	3f: (1);	3g: (2);	4h: (2);	6i: (3);	6j: (2); 6k: (4);

c. Results for high-symmetry lines

DT(0, 0, w)	
Operation	E
Coordinate	(0, 0, w)
LD(u , u , 0)	

Operation Coordinate	E ($u, u, 0$)	S_3^- ($u, -2u, 0$)	C_3^+ ($-2u, u, 0$)
PA($-\frac{1}{3}, -\frac{1}{3}, -w$)			
Operation Coordinate	E ($-\frac{1}{3}, -\frac{1}{3}, -w$)	$\sigma_z \Theta$ ($\frac{1}{3}, \frac{1}{3}, -w$)	
Q($u, u, \frac{1}{2}$)			
Operation Coordinate	E ($u, u, \frac{1}{2}$)	S_3^- ($u, -2u, -\frac{1}{2}$)	C_3^+ ($-2u, u, \frac{1}{2}$)
R($u, 0, \frac{1}{2}$)			
Operation Coordinate	E ($u, 0, \frac{1}{2}$)	C'_{23} ($0, u, -\frac{1}{2}$)	C_3^+ ($-u, u, \frac{1}{2}$)
SM($u, 0, 0$)			
Operation Coordinate	E ($u, 0, 0$)	C'_{23} ($0, u, 0$)	C_3^+ ($-u, u, 0$)
U($\frac{1}{2}, 0, w$)			
Operation Coordinate	E ($\frac{1}{2}, 0, w$)	C_3^- ($0, -\frac{1}{2}, w$)	C_3^+ ($-\frac{1}{2}, \frac{1}{2}, w$)

DT ($0, 0, w$) of space group No. 189

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 12l: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 12l: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 12l: (12)

LD ($u, u, 0$) of space group No. 189

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (3); 6i: (5); 6j: (6); 6k: (6); 12l: (9)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (3); 6i: (4); 6j: (3); 6k: (3); 12l: (9)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (5); 6j: (3); 6k: (3); 12l: (9)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (1); 3f: (3); 3g: (3); 4h: (3); 6i: (4); 6j: (6); 6k: (6); 12l: (9)

PA ($-\frac{1}{3}, -\frac{1}{3}, -w$) of space group No. 189

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 12l: (6)

2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 12l: (6)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 12l: (12)
Q $(u, u, \frac{1}{2})$ of space group No. 189		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (1); 2e: (2); 3f: (3); 3g: (2); 4h: (3); 6i: (5); 6j: (6); 6k: (3); 12l: (9)
2	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (2); 2e: (1); 3f: (1); 3g: (3); 4h: (3); 6i: (4); 6j: (3); 6k: (6); 12l: (9)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (2); 2e: (2); 3f: (2); 3g: (3); 4h: (3); 6i: (5); 6j: (3); 6k: (6); 12l: (9)
4	(0, 0, 0)	1a: (1); 1b: (0); 2c: (2); 2d: (1); 2e: (1); 3f: (3); 3g: (1); 4h: (3); 6i: (4); 6j: (6); 6k: (3); 12l: (9)
R $(u, 0, \frac{1}{2})$ of space group No. 189		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, $-r_1$)	1a: (2); 1b: (1); 2c: (4); 2d: (2); 2e: (3); 3f: (6); 3g: (3); 4h: (6); 6i: (9); 6j: (12); 6k: (6); 12l: (18)
2	(0, 0, $-r_1$)	1a: (1); 1b: (2); 2c: (2); 2d: (4); 2e: (3); 3f: (3); 3g: (6); 4h: (6); 6i: (9); 6j: (6); 6k: (12); 12l: (18)
SM $(u, 0, 0)$ of space group No. 189		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, $-r_1$)	1a: (2); 1b: (2); 2c: (4); 2d: (4); 2e: (3); 3f: (6); 3g: (6); 4h: (6); 6i: (9); 6j: (12); 6k: (12); 12l: (18)
2	(0, 0, $-r_1$)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (3); 3f: (3); 3g: (3); 4h: (6); 6i: (9); 6j: (6); 6k: (6); 12l: (18)
U $(\frac{1}{2}, 0, w)$ of space group No. 189		
(Co-) irrep	Phonon AM	WYPO information
1	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (4); 3f: (5); 3g: (5); 4h: (6); 6i: (10); 6j: (9); 6k: (9); 12l: (18)
2	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (2); 3f: (4); 3g: (4); 4h: (6); 6i: (8); 6j: (9); 6k: (9); 12l: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	σ_{v2}	σ_{v3}
Coordinate	(0, u, v)	($-u, u, v$)	($u, 0, v$)
P2($u, v, 0$)			
Operation	E		
Coordinate	($u, v, 0$)		
P3($u, -2u, v$)			

Operation	E	C_3^+	C_3^-
Coordinate	$(u, -2u, v)$	(u, u, v)	$(-2u, u, v)$
P4($u, v, \frac{1}{2}$)			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

P1 ($0, u, v$) of space group No. 189		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_2, r_1)$	1a: (3); 1b: (3); 2c: (6); 2d: (6); 2e: (6); 3f: (9); 3g: (9); 4h: (12); 6i: (18); 6j: (18); 6k: (18); 12l: (36)
P2 ($u, v, 0$) of space group No. 189		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (2); 1b: (2); 2c: (4); 2d: (4); 2e: (3); 3f: (6); 3g: (6); 4h: (6); 6i: (9); 6j: (12); 6k: (12); 12l: (18)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (3); 3f: (3); 3g: (3); 4h: (6); 6i: (9); 6j: (6); 6k: (6); 12l: (18)
P3 ($u, -2u, v$) of space group No. 189		
(Co-) irrep	Phonon AM	WYPO information
1	$(\sqrt{3}r_1, r_1, 0)$	1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (4); 3f: (5); 3g: (5); 4h: (6); 6i: (10); 6j: (9); 6k: (9); 12l: (18)
2	$(\sqrt{3}r_1, r_1, 0)$	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (2); 3f: (4); 3g: (4); 4h: (6); 6i: (8); 6j: (9); 6k: (9); 12l: (18)
P4 ($u, v, \frac{1}{2}$) of space group No. 189		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (2); 1b: (1); 2c: (4); 2d: (2); 2e: (3); 3f: (6); 3g: (3); 4h: (6); 6i: (9); 6j: (12); 6k: (6); 12l: (18)
2	$(0, 0, r_1)$	1a: (1); 1b: (2); 2c: (2); 2d: (4); 2e: (3); 3f: (3); 3g: (6); 4h: (6); 6i: (9); 6j: (6); 6k: (12); 12l: (18)

190. Space group No. 190 ($P\bar{6}2c$)

$$\begin{array}{l}
 \vec{a} = (a, 0, 0) \\
 \vec{b} = \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0 \right) \\
 \vec{c} = (0, 0, c)
 \end{array}
 \quad
 \begin{array}{l}
 \vec{t}_1 = \vec{a} \\
 \vec{t}_2 = \vec{b} \\
 \vec{t}_3 = \vec{c}
 \end{array}$$

Hexagonal primitive lattice

a. Space group operations

b. Results for high-symmetry points

$$\begin{array}{cccccccc} \{E|0,0,0\} & \{\sigma_z|0,0,-\frac{1}{2}\} & \{S_3^+|0,0,-\frac{1}{2}\} & \{S_3^-|0,0,-\frac{1}{2}\} & \{C_3^-|0,0,0\} & \{C_3^+|0,0,0\} & \{C_{2x}|0,0,0\} & \{C_{22}'|0,0,0\} \\ \{C_{23}'|0,0,0\} & \{\sigma_{v3}|0,0,-\frac{1}{2}\} & \{\sigma_y|0,0,-\frac{1}{2}\} & \{\sigma_{v2}|0,0,-\frac{1}{2}\} & & & & \end{array}$$

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	S_3^-	S_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	S_3^-	S_3^+
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},-\frac{1}{2})$	$(-\frac{1}{2},0,-\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},-\frac{2}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	$E\Theta$	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},-\frac{2}{3},-\frac{1}{2})$	

$\Gamma(0,0,0)$ of space group No. 190

(Co-) irrep	Phonon AM	WYPO information									
1	(0,0,0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (1);	6h: (2);	12i: (3)	
2	(0,0,0)	2a: (1);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (2);	6h: (2);	12i: (3)	
3	(0,0,0)	2a: (0);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (1);	6h: (1);	12i: (3)	
4	(0,0,0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (2);	6h: (1);	12i: (3)	
5	(0,0,0)	2a: (1);	2b: (2);	2c: (2);	2d: (2);	4e: (2);	4f: (2);	6g: (3);	6h: (4);	12i: (6)	
6	(0,0,0)	2a: (1);	2b: (0);	2c: (0);	2d: (0);	4e: (2);	4f: (2);	6g: (3);	6h: (2);	12i: (6)	

$M(0,\frac{1}{2},0)$ of space group No. 190

(Co-) irrep	Phonon AM	WYPO information									
1	(0,0,0)	2a: (1);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (4);	6h: (6);	12i: (9)	
2	(0,0,0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (4);	6h: (3);	12i: (9)	
3	(0,0,0)	2a: (2);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (5);	6h: (3);	12i: (9)	
4	(0,0,0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (5);	6h: (6);	12i: (9)	

A $\left(0, 0, \frac{1}{2}\right)$ of space group No. 190										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)
L $\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 190										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9);	12i: (18)
K $\left(-\frac{1}{3}, \frac{2}{3}, 0\right)$ of space group No. 190										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (1);	6h: (2);	12i: (3)
2	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (2);	6h: (2);	12i: (3)
3	(0, 0, 0)	2a: (0);	2b: (1);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (1);	6h: (1);	12i: (3)
4	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (2);	6h: (1);	12i: (3)
5	(0, 0, 0)	2a: (1);	2b: (2);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (4);	12i: (6)
6	(0, 0, 0)	2a: (1);	2b: (0);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (2);	12i: (6)
H $\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 190										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (0);	2d: (2);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (2);	2d: (0);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)
3	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (6)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	S_3^-	C_3^+
Coordinate	(u, u, 0)	(u, -2u, 0)	(-2u, u, 0)
PA(-1/3, -1/3, -w)			
Operation	E	$\sigma_z \Theta$	
Coordinate	(-1/3, -1/3, -w)	(1/3, 1/3, -w)	
Q(u, u, 1/2)			
Operation	E	S_3^-	C_3^+
Coordinate	(u, u, 1/2)	(u, -2u, -1/2)	(-2u, u, 1/2)
R(u, 0, 1/2)			
Operation	E	C'_{23}	C_3^+
Coordinate	(u, 0, 1/2)	(0, u, -1/2)	(-u, u, 1/2)

SM($u, 0, 0$)			
Operation	E	C'_{23}	C_3^+
Coordinate	$(u, 0, 0)$	$(0, u, 0)$	$(-u, u, 0)$
U($\frac{1}{2}, 0, w$)			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT ($0, 0, w$) of space group No. 190									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6); 12i: (12)
LD ($u, u, 0$) of space group No. 190									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (4);	6h: (6); 12i: (9)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (4);	6h: (3); 12i: (9)
3	(0, 0, 0)	2a: (2);	2b: (1);	2c: (1);	2d: (1);	4e: (3);	4f: (3);	6g: (5);	6h: (3); 12i: (9)
4	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (3);	4f: (3);	6g: (5);	6h: (6); 12i: (9)
PA ($-\frac{1}{3}, -\frac{1}{3}, -w$) of space group No. 190									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
2	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3); 12i: (6)
3	(0, 0, 0)	2a: (2);	2b: (2);	2c: (2);	2d: (2);	4e: (4);	4f: (4);	6g: (6);	6h: (6); 12i: (12)
Q ($u, u, \frac{1}{2}$) of space group No. 190									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9); 12i: (18)
R ($u, 0, \frac{1}{2}$) of space group No. 190									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, $-r_1$)	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9); 12i: (18)
SM ($u, 0, 0$) of space group No. 190									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, $-r_1$)	2a: (3);	2b: (4);	2c: (4);	2d: (4);	4e: (6);	4f: (6);	6g: (9);	6h: (12); 12i: (18)
2	(0, 0, $-r_1$)	2a: (3);	2b: (2);	2c: (2);	2d: (2);	4e: (6);	4f: (6);	6g: (9);	6h: (6); 12i: (18)
U ($\frac{1}{2}, 0, w$) of space group No. 190									
(Co-) irrep	Phonon AM	WYPO information							
1	$(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$	2a: (3);	2b: (3);	2c: (3);	2d: (3);	4e: (6);	4f: (6);	6g: (9);	6h: (9); 12i: (18)

2 $(-\frac{1}{2}\sqrt{3}r_1, -\frac{r_1}{2}, 0)$ **2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)**

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	σ_{v2}	σ_{v3}
Coordinate	(0, u, v)	(-u, u, v)	(u, 0, v)
P2(u, v, 0)			
Operation	E		
Coordinate	(u, v, 0)		
P3(u, -2u, v)			
Operation	E	C_3^+	C_3^-
Coordinate	(u, -2u, v)	(u, u, v)	(-2u, u, v)
P4(u, v, $\frac{1}{2}$)			
Operation	E		
Coordinate	(u, v, $\frac{1}{2}$)		

P1 (0, u, v) of space group No. 190

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_2 , r_1)	2a: (6); 2b: (6); 2c: (6); 2d: (6); 4e: (12); 4f: (12); 6g: (18); 6h: (18); 12i: (36)

P2 (u, v, 0) of space group No. 190

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	2a: (3); 2b: (4); 2c: (4); 2d: (4); 4e: (6); 4f: (6); 6g: (9); 6h: (12); 12i: (18)
2	(0, 0, r_1)	2a: (3); 2b: (2); 2c: (2); 2d: (2); 4e: (6); 4f: (6); 6g: (9); 6h: (6); 12i: (18)

P3 (u, -2u, v) of space group No. 190

(Co-) irrep	Phonon AM	WYPO information
1	($\sqrt{3}r_1$, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)
2	($\sqrt{3}r_1$, r_1 , 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)

P4 (u, v, $\frac{1}{2}$) of space group No. 190

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, r_1)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)
2	(0, 0, r_1)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18)

191. Space group No. 191 ($P6/mmm$)

Hexagonal primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}&\{E|0,0,0\} \quad \{C_3^+|0,0,0\} \quad \{C_3^-|0,0,0\} \quad \{C_{2y}|0,0,0\} \quad \{C_{23}''|0,0,0\} \quad \{C_{22}''|0,0,0\} \quad \{C_{2z}|0,0,0\} \quad \{C_6^-|0,0,0\} \\&\{C_6^+|0,0,0\} \quad \{C_{2x}|0,0,0\} \quad \{C_{23}'|0,0,0\} \quad \{C_{22}'|0,0,0\} \quad \{I|0,0,0\} \quad \{S_6^-|0,0,0\} \quad \{S_6^+|0,0,0\} \quad \{\sigma_y|0,0,0\} \\&\{\sigma_{v3}|0,0,0\} \quad \{\sigma_{v2}|0,0,0\} \quad \{\sigma_z|0,0,0\} \quad \{S_3^+|0,0,0\} \quad \{S_3^-|0,0,0\} \quad \{\sigma_x|0,0,0\} \quad \{\sigma_{d3}|0,0,0\} \quad \{\sigma_{d2}|0,0,0\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$
$A(0,0,\frac{1}{2})$			
Operation	E		
Coordinate	$(0,0,\frac{1}{2})$		
$L(0,\frac{1}{2},\frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$
$K(-\frac{1}{3},\frac{2}{3},0)$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3},\frac{2}{3},0)$	$(\frac{1}{3},\frac{1}{3},0)$	
$H(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3},\frac{2}{3},\frac{1}{2})$	$(\frac{1}{3},\frac{1}{3},-\frac{1}{2})$	

 Γ (0, 0, 0) of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (1); 3f: (0); 3g: (0); 4h: (1); 6i: (1); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (2); 12o: (2); 12p: (2); 12q: (2); 24r: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (0); 3g: (0); 4h: (0); 6i: (0); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (1); 12o: (1); 12p: (2); 12q: (2); 24r: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (0); 3g: (0); 4h: (1); 6i: (1); 6j: (2); 6k: (2); 6l: (2); 6m: (2); 12n: (3); 12o: (3); 12p: (4); 12q: (4); 24r: (6)
4	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (0); 3g: (0); 4h: (0); 6i: (1); 6j: (1); 6k: (1); 6l: (0); 6m: (0); 12n: (2); 12o: (1); 12p: (1); 12q: (1); 24r: (3)
5	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (0); 3g: (0); 4h: (1); 6i: (1); 6j: (0); 6k: (0); 6l: (1); 6m: (1); 12n: (1); 12o: (2); 12p: (1); 12q: (1); 24r: (3)
6	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (1); 3f: (0); 3g: (0); 4h: (1); 6i: (2); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (3); 12o: (3); 12p: (2); 12q: (2); 24r: (6)
7	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (0); 3g: (0); 4h: (0); 6i: (0); 6j: (0); 6k: (0); 6l: (0); 6m: (0); 12n: (1); 12o: (1); 12p: (1); 12q: (1); 24r: (3)
8	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (1); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (2); 12o: (2); 12p: (1); 12q: (1); 24r: (3)
9	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (1); 3g: (1); 4h: (1); 6i: (1); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (3); 12o: (3); 12p: (2); 12q: (2); 24r: (6)
10	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (1); 3g: (1); 4h: (1); 6i: (1); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (1); 12o: (2); 12p: (2); 12q: (2); 24r: (3)
11	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (1); 3g: (1); 4h: (0); 6i: (1); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (2); 12o: (1); 12p: (2); 12q: (2); 24r: (3)
12	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (2); 3g: (2); 4h: (1); 6i: (2); 6j: (2); 6k: (2); 6l: (2); 6m: (2); 12n: (3); 12o: (3); 12p: (4); 12q: (4); 24r: (6)

 M ($0, \frac{1}{2}, 0$) of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (5); 12o: (5); 12p: (6); 12q: (6); 24r: (9)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (1); 6k: (1); 6l: (2); 6m: (2); 12n: (4); 12o: (5); 12p: (3); 12q: (3); 24r: (9)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (2); 3g: (2); 4h: (1); 6i: (2); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (4); 12o: (4); 12p: (6); 12q: (6); 24r: (9)
4	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (2); 6k: (2); 6l: (1); 6m: (1); 12n: (5); 12o: (4); 12p: (3); 12q: (3); 24r: (9)
5	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (0); 3g: (0); 4h: (1); 6i: (2); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (4); 12o: (4); 12p: (3); 12q: (3); 24r: (9)
6	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (5); 12o: (4); 12p: (6); 12q: (6); 24r: (9)
7	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (2); 6k: (2); 6l: (2); 6m: (2); 12n: (5); 12o: (5); 12p: (3); 12q: (3); 24r: (9)
8	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (4); 12o: (5); 12p: (6); 12q: (6); 24r: (9)

 A ($0, 0, \frac{1}{2}$) of space group No. 191

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (0); 2d: (1); 2e: (1); 3f: (0); 3g: (1); 4h: (1); 6i: (1); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (2); 12o: (2); 12p: (2); 12q: (1); 24r: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (0); 3g: (0); 4h: (0); 6i: (0); 6j: (1); 6k: (0); 6l: (1); 6m: (0); 12n: (1); 12o: (1); 12p: (2); 12q: (1); 24r: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (0); 2e: (0); 3f: (0); 3g: (1); 4h: (1); 6i: (1); 6j: (2); 6k: (1); 6l: (2); 6m: (1); 12n: (3); 12o: (3); 12p: (4); 12q: (2); 24r: (6)
4	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (0); 3g: (1); 4h: (0); 6i: (1); 6j: (1); 6k: (1); 6l: (0); 6m: (1); 12n: (2); 12o: (1); 12p: (1); 12q: (2); 24r: (3)
5	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (0); 2e: (0); 3f: (0); 3g: (1); 4h: (1); 6i: (1); 6j: (0); 6k: (1); 6l: (1); 6m: (1); 12n: (1); 12o: (2); 12p: (1); 12q: (2); 24r: (3)
6	(0, 0, 0)	1a: (0); 1b: (1); 2c: (0); 2d: (1); 2e: (1); 3f: (0); 3g: (2); 4h: (1); 6i: (2); 6j: (1); 6k: (2); 6l: (1); 6m: (2); 12n: (3); 12o: (3); 12p: (2); 12q: (4); 24r: (6)
7	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (0); 3g: (0); 4h: (0); 6i: (0); 6j: (0); 6k: (1); 6l: (0); 6m: (1); 12n: (1); 12o: (1); 12p: (1); 12q: (2); 24r: (3)
8	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (0); 2e: (1); 3f: (1); 3g: (0); 4h: (1); 6i: (1); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (2); 12o: (2); 12p: (1); 12q: (2); 24r: (3)
9	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (1); 2e: (0); 3f: (1); 3g: (0); 4h: (1); 6i: (1); 6j: (1); 6k: (2); 6l: (1); 6m: (2); 12n: (3); 12o: (3); 12p: (2); 12q: (4); 24r: (6)
10	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (1); 2e: (0); 3f: (1); 3g: (0); 4h: (1); 6i: (1); 6j: (1); 6k: (0); 6l: (1); 6m: (1); 12n: (1); 12o: (2); 12p: (2); 12q: (1); 24r: (3)
11	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (1); 3g: (0); 4h: (0); 6i: (1); 6j: (1); 6k: (1); 6l: (1); 6m: (0); 12n: (2); 12o: (1); 12p: (2); 12q: (1); 24r: (3)
12	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (0); 2e: (1); 3f: (2); 3g: (0); 4h: (1); 6i: (2); 6j: (2); 6k: (1); 6l: (2); 6m: (1); 12n: (3); 12o: (3); 12p: (4); 12q: (2); 24r: (6)

$L\left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (2); 3g: (1); 4h: (2); 6i: (3); 6j: (3); 6k: (2); 6l: (3); 6m: (2); 12n: (5); 12o: (5); 12p: (6); 12q: (3); 24r: (9)
2	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (1); 6k: (3); 6l: (2); 6m: (3); 12n: (4); 12o: (5); 12p: (3); 12q: (6); 24r: (9)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (0); 2e: (0); 3f: (2); 3g: (0); 4h: (1); 6i: (2); 6j: (3); 6k: (1); 6l: (3); 6m: (1); 12n: (4); 12o: (4); 12p: (6); 12q: (3); 24r: (9)
4	(0, 0, 0)	1a: (0); 1b: (1); 2c: (0); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (2); 6k: (3); 6l: (1); 6m: (3); 12n: (5); 12o: (4); 12p: (3); 12q: (6); 24r: (9)
5	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (1); 2e: (0); 3f: (0); 3g: (2); 4h: (1); 6i: (2); 6j: (1); 6k: (3); 6l: (1); 6m: (3); 12n: (4); 12o: (4); 12p: (3); 12q: (6); 24r: (9)
6	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (0); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (3); 6k: (2); 6l: (3); 6m: (1); 12n: (5); 12o: (4); 12p: (6); 12q: (3); 24r: (9)
7	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (2); 4h: (2); 6i: (3); 6j: (2); 6k: (3); 6l: (2); 6m: (3); 12n: (5); 12o: (5); 12p: (3); 12q: (6); 24r: (9)
8	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (1); 6l: (3); 6m: (2); 12n: (4); 12o: (5); 12p: (6); 12q: (3); 24r: (9)

$K\left(-\frac{1}{3}, \frac{2}{3}, 0\right)$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (2); 6k: (2); 6l: (2); 6m: (2); 12n: (4); 12o: (3); 12p: (4); 12q: (4); 24r: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (1); 6i: (1); 6j: (2); 6k: (2); 6l: (2); 6m: (2); 12n: (2); 12o: (3); 12p: (4); 12q: (4); 24r: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (0); 3g: (0); 4h: (1); 6i: (1); 6j: (0); 6k: (0); 6l: (1); 6m: (1); 12n: (2); 12o: (3); 12p: (2); 12q: (2); 24r: (6)

4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (0); 2d: (0); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (2); 6k: (2); 6l: (1); 6m: (1); 12n: (4); 12o: (3); 12p: (2); 12q: (2); 24r: (6)
5	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (2); 3g: (2); 4h: (2); 6i: (3); 6j: (4); 6k: (4); 6l: (4); 6m: (4); 12n: (6); 12o: (6); 12p: (8); 12q: (8); 24r: (12)
6	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (3); 6j: (2); 6k: (2); 6l: (2); 6m: (2); 12n: (6); 12o: (6); 12p: (4); 12q: (4); 24r: (12)

$H\left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2}\right)$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (0); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (2); 6k: (2); 6l: (2); 6m: (1); 12n: (4); 12o: (3); 12p: (4); 12q: (2); 24r: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (0); 2e: (0); 3f: (1); 3g: (0); 4h: (1); 6i: (1); 6j: (2); 6k: (0); 6l: (2); 6m: (1); 12n: (2); 12o: (3); 12p: (4); 12q: (2); 24r: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (1); 2e: (0); 3f: (0); 3g: (1); 4h: (1); 6i: (1); 6j: (0); 6k: (2); 6l: (1); 6m: (2); 12n: (2); 12o: (3); 12p: (2); 12q: (4); 24r: (6)
4	(0, 0, 0)	1a: (1); 1b: (0); 2c: (0); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (1); 6i: (2); 6j: (2); 6k: (2); 6l: (1); 6m: (2); 12n: (4); 12o: (3); 12p: (2); 12q: (4); 24r: (6)
5	(0, 0, 0)	1a: (1); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (2); 3g: (1); 4h: (2); 6i: (3); 6j: (4); 6k: (2); 6l: (4); 6m: (2); 12n: (6); 12o: (6); 12p: (8); 12q: (4); 24r: (12)
6	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (2); 4h: (2); 6i: (3); 6j: (2); 6k: (4); 6l: (2); 6m: (4); 12n: (6); 12o: (6); 12p: (4); 12q: (8); 24r: (12)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

LD(u , u , 0)

Operation	E	C_{2y}	C_3^+
Coordinate	(u , u , 0)	($-u$, $2u$, 0)	($-2u$, u , 0)

P($\frac{1}{3}$, $\frac{1}{3}$, w)

Operation	E	C_{2z}
Coordinate	($\frac{1}{3}$, $\frac{1}{3}$, w)	($-\frac{1}{3}$, $-\frac{1}{3}$, w)

Q(u , u , $\frac{1}{2}$)

Operation	E	C_{2y}	C_3^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, $2u$, $-\frac{1}{2}$)	($-2u$, u , $\frac{1}{2}$)

R(u , 0, $\frac{1}{2}$)

Operation	E	C_6^+	C_3^+
Coordinate	(u , 0, $\frac{1}{2}$)	(0, u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)

SM(u , 0, 0)

Operation	E	C_6^+	C_3^+
Coordinate	(u , 0, 0)	(0, u , 0)	($-u$, u , 0)

$U(\frac{1}{2}, 0, w)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (2); 6k: (2); 6l: (2); 6m: (2); 12n: (4); 12o: (4); 12p: (3); 12q: (3); 24r: (6)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (0); 3g: (0); 4h: (0); 6i: (0); 6j: (1); 6k: (1); 6l: (1); 6m: (1); 12n: (2); 12o: (2); 12p: (3); 12q: (3); 24r: (6)
3	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (1); 6k: (1); 6l: (2); 6m: (2); 12n: (2); 12o: (4); 12p: (3); 12q: (3); 24r: (6)
4	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (0); 3f: (1); 3g: (1); 4h: (0); 6i: (2); 6j: (2); 6k: (2); 6l: (1); 6m: (1); 12n: (4); 12o: (2); 12p: (3); 12q: (3); 24r: (6)
5	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6); 12o: (6); 12p: (6); 12q: (6); 24r: (12)
6	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 6l: (3); 6m: (3); 12n: (6); 12o: (6); 12p: (6); 12q: (6); 24r: (12)

LD $(u, u, 0)$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (3); 6i: (5); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (10); 12o: (9); 12p: (12); 12q: (12); 24r: (18)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (1); 3f: (1); 3g: (1); 4h: (3); 6i: (4); 6j: (2); 6k: (2); 6l: (3); 6m: (3); 12n: (8); 12o: (9); 12p: (6); 12q: (6); 24r: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (3); 6i: (5); 6j: (4); 6k: (4); 6l: (3); 6m: (3); 12n: (10); 12o: (9); 12p: (6); 12q: (6); 24r: (18)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (1); 3f: (3); 3g: (3); 4h: (3); 6i: (4); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (8); 12o: (9); 12p: (12); 12q: (12); 24r: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (4); 6k: (4); 6l: (3); 6m: (3); 12n: (8); 12o: (6); 12p: (6); 12q: (6); 24r: (12)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (1); 3g: (1); 4h: (2); 6i: (2); 6j: (2); 6k: (2); 6l: (3); 6m: (3); 12n: (4); 12o: (6); 12p: (6); 12q: (6); 24r: (12)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (12); 12o: (12); 12p: (12); 12q: (12); 24r: (24)

Q $(u, u, \frac{1}{2})$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (1); 2e: (2); 3f: (3); 3g: (2); 4h: (3); 6i: (5); 6j: (6); 6k: (4); 6l: (6); 6m: (3); 12n: (10); 12o: (9); 12p: (12); 12q: (6); 24r: (18)
2	(0, 0, 0)	1a: (0); 1b: (1); 2c: (1); 2d: (2); 2e: (1); 3f: (1); 3g: (3); 4h: (3); 6i: (4); 6j: (2); 6k: (6); 6l: (3); 6m: (6); 12n: (8); 12o: (9); 12p: (6); 12q: (12); 24r: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (2); 2e: (2); 3f: (2); 3g: (3); 4h: (3); 6i: (5); 6j: (4); 6k: (6); 6l: (3); 6m: (6); 12n: (10); 12o: (9); 12p: (6); 12q: (12); 24r: (18)

4	(0, 0, 0)	1a: (1); 1b: (0); 2c: (2); 2d: (1); 2e: (1); 3f: (3); 3g: (1); 4h: (3); 6i: (4); 6j: (6); 6k: (2); 6l: (6); 6m: (3); 12n: (8); 12o: (9); 12p: (12); 12q: (6); 24r: (18)

$R(u, 0, \frac{1}{2})$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (2); 4h: (4); 6i: (5); 6j: (6); 6k: (3); 6l: (6); 6m: (4); 12n: (9); 12o: (10); 12p: (12); 12q: (6); 24r: (18)
2	(0, 0, 0)	1a: (0); 1b: (1); 2c: (0); 2d: (2); 2e: (1); 3f: (1); 3g: (3); 4h: (2); 6i: (4); 6j: (3); 6k: (6); 6l: (2); 6m: (6); 12n: (9); 12o: (8); 12p: (6); 12q: (12); 24r: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (2); 3g: (3); 4h: (4); 6i: (5); 6j: (3); 6k: (6); 6l: (4); 6m: (6); 12n: (9); 12o: (10); 12p: (6); 12q: (12); 24r: (18)
4	(0, 0, 0)	1a: (1); 1b: (0); 2c: (2); 2d: (0); 2e: (1); 3f: (3); 3g: (1); 4h: (2); 6i: (4); 6j: (6); 6k: (3); 6l: (6); 6m: (2); 12n: (9); 12o: (8); 12p: (12); 12q: (6); 24r: (18)

$SM(u, 0, 0)$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (5); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (9); 12o: (10); 12p: (12); 12q: (12); 24r: (18)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (0); 2d: (0); 2e: (1); 3f: (1); 3g: (1); 4h: (2); 6i: (4); 6j: (3); 6k: (3); 6l: (2); 6m: (2); 12n: (9); 12o: (8); 12p: (6); 12q: (6); 24r: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (2); 3g: (2); 4h: (4); 6i: (5); 6j: (3); 6k: (3); 6l: (4); 6m: (4); 12n: (9); 12o: (10); 12p: (6); 12q: (6); 24r: (18)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (1); 3f: (3); 3g: (3); 4h: (2); 6i: (4); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (9); 12o: (8); 12p: (12); 12q: (12); 24r: (18)

$U(\frac{1}{2}, 0, w)$ of space group No. 191

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (3); 3g: (3); 4h: (4); 6i: (6); 6j: (5); 6k: (5); 6l: (5); 6m: (5); 12n: (10); 12o: (10); 12p: (9); 12q: (9); 24r: (18)
2	(0, 0, 0)	1a: (0); 1b: (0); 2c: (1); 2d: (1); 2e: (0); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (4); 6k: (4); 6l: (4); 6m: (4); 12n: (8); 12o: (8); 12p: (9); 12q: (9); 24r: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (2); 3g: (2); 4h: (4); 6i: (4); 6j: (4); 6k: (4); 6l: (5); 6m: (5); 12n: (8); 12o: (10); 12p: (9); 12q: (9); 24r: (18)
4	(0, 0, 0)	1a: (1); 1b: (1); 2c: (1); 2d: (1); 2e: (2); 3f: (2); 3g: (2); 4h: (2); 6i: (4); 6j: (5); 6k: (5); 6l: (4); 6m: (4); 12n: (10); 12o: (8); 12p: (9); 12q: (9); 24r: (18)

d. Results for high-symmetry planes

$P1(0, u, v)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
$P2(u, v, 0)$			
Operation	E		
Coordinate	$(u, v, 0)$		
$P3(u, -2u, v)$			
Operation	E	C_6^+	C_6^-

Coordinate	$(u, -2u, v)$ $(2u, -u, v)$ $(-u, -u, v)$
$P4(u, v, \frac{1}{2})$	
Operation	E
Coordinate	$(u, v, \frac{1}{2})$

P1 $(0, u, v)$ of space group No. 191		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (2); 1b: (2); 2c: (4); 2d: (4); 2e: (4); 3f: (5); 3g: (5); 4h: (8); 6i: (10); 6j: (9); 6k: (9); 6l: (10); 6m: (10); 12n: (18); 12o: (20); 12p: (18); 12q: (18); 24r: (36)
2	$(0, 0, 0)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (2); 3f: (4); 3g: (4); 4h: (4); 6i: (8); 6j: (9); 6k: (9); 6l: (8); 6m: (8); 12n: (18); 12o: (16); 12p: (18); 12q: (18); 24r: (36)
P2 $(u, v, 0)$ of space group No. 191		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (2); 1b: (2); 2c: (4); 2d: (4); 2e: (3); 3f: (6); 3g: (6); 4h: (6); 6i: (9); 6j: (12); 6k: (12); 6l: (12); 6m: (12); 12n: (18); 12o: (18); 12p: (24); 12q: (24); 24r: (36)
2	$(0, 0, 0)$	1a: (1); 1b: (1); 2c: (2); 2d: (2); 2e: (3); 3f: (3); 3g: (3); 4h: (6); 6i: (9); 6j: (6); 6k: (6); 6l: (6); 6m: (6); 12n: (18); 12o: (18); 12p: (12); 12q: (12); 24r: (36)
P3 $(u, -2u, v)$ of space group No. 191		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (2); 1b: (2); 2c: (3); 2d: (3); 2e: (4); 3f: (5); 3g: (5); 4h: (6); 6i: (10); 6j: (10); 6k: (10); 6l: (9); 6m: (9); 12n: (20); 12o: (18); 12p: (18); 12q: (18); 24r: (36)
2	$(0, 0, 0)$	1a: (1); 1b: (1); 2c: (3); 2d: (3); 2e: (2); 3f: (4); 3g: (4); 4h: (6); 6i: (8); 6j: (8); 6k: (8); 6l: (9); 6m: (9); 12n: (16); 12o: (18); 12p: (18); 12q: (18); 24r: (36)
P4 $(u, v, \frac{1}{2})$ of space group No. 191		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	1a: (2); 1b: (1); 2c: (4); 2d: (2); 2e: (3); 3f: (6); 3g: (3); 4h: (6); 6i: (9); 6j: (12); 6k: (6); 6l: (12); 6m: (6); 12n: (18); 12o: (18); 12p: (24); 12q: (12); 24r: (36)
2	$(0, 0, 0)$	1a: (1); 1b: (2); 2c: (2); 2d: (4); 2e: (3); 3f: (3); 3g: (6); 4h: (6); 6i: (9); 6j: (6); 6k: (12); 6l: (6); 6m: (12); 12n: (18); 12o: (18); 12p: (12); 12q: (24); 24r: (36)

192. Space group No. 192 ($P6/mcc$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & & \vec{t}_1 = \vec{a} \\
 \text{Hexagonal primitive lattice} & \vec{b} = \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0 \right) & \vec{t}_2 = \vec{b} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

b. Results for high-symmetry points

$\{E 0,0,0\}$	$\{C_3^+ 0,0,0\}$	$\{C_3^- 0,0,0\}$	$\{C_{2y} 0,0,\frac{1}{2}\}$	$\{C_{23}'' 0,0,\frac{1}{2}\}$	$\{C_{22}'' 0,0,\frac{1}{2}\}$	$\{C_{2z} 0,0,0\}$	$\{C_6^- 0,0,0\}$
$\{C_6^+ 0,0,0\}$	$\{C_{2x} 0,0,\frac{1}{2}\}$	$\{C_{23}' 0,0,\frac{1}{2}\}$	$\{C_{22}' 0,0,\frac{1}{2}\}$	$\{I 0,0,0\}$	$\{S_6^- 0,0,0\}$	$\{S_6^+ 0,0,0\}$	$\{\sigma_y 0,0,\frac{1}{2}\}$
$\{\sigma_{v3} 0,0,\frac{1}{2}\}$	$\{\sigma_{v2} 0,0,\frac{1}{2}\}$	$\{\sigma_z 0,0,0\}$	$\{S_3^+ 0,0,0\}$	$\{S_3^- 0,0,0\}$	$\{\sigma_x 0,0,\frac{1}{2}\}$	$\{\sigma_{d3} 0,0,\frac{1}{2}\}$	$\{\sigma_{d2} 0,0,\frac{1}{2}\}$

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, \frac{1}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, \frac{1}{3}, -\frac{1}{2})$	

$\Gamma(0,0,0)$ of space group No. 192			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0,0,0)$	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (1); 6f: (0); 6g: (0); 8h: (1); 12i: (1); 12j: (1); 12k: (1); 12l: (2); 24m: (3)	
2	$(0,0,0)$	2a: (1); 2b: (0); 4c: (1); 4d: (0); 4e: (1); 6f: (1); 6g: (0); 8h: (1); 12i: (1); 12j: (2); 12k: (2); 12l: (2); 24m: (3)	
3	$(0,0,0)$	2a: (0); 2b: (0); 4c: (1); 4d: (2); 4e: (0); 6f: (1); 6g: (0); 8h: (2); 12i: (2); 12j: (3); 12k: (3); 12l: (4); 24m: (6)	
4	$(0,0,0)$	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (0); 6f: (1); 6g: (0); 8h: (1); 12i: (2); 12j: (2); 12k: (1); 12l: (1); 24m: (3)	
5	$(0,0,0)$	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 6f: (1); 6g: (0); 8h: (1); 12i: (2); 12j: (1); 12k: (2); 12l: (1); 24m: (3)	
6	$(0,0,0)$	2a: (1); 2b: (0); 4c: (1); 4d: (0); 4e: (2); 6f: (2); 6g: (0); 8h: (2); 12i: (4); 12j: (3); 12k: (3); 12l: (2); 24m: (6)	

7	(0, 0, 0)	2a: (0); 2b: (1); 4c: (0); 4d: (1); 4e: (1); 6f: (0); 6g: (1); 8h: (1); 12i: (1); 12j: (1); 12k: (1); 12l: (1); 24m: (3)
8	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (1); 6f: (1); 6g: (1); 8h: (1); 12i: (1); 12j: (2); 12k: (2); 12l: (1); 24m: (3)
9	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (0); 4e: (0); 6f: (1); 6g: (2); 8h: (2); 12i: (2); 12j: (3); 12k: (3); 12l: (2); 24m: (6)
10	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (0); 4e: (0); 6f: (1); 6g: (2); 8h: (1); 12i: (2); 12j: (2); 12k: (1); 12l: (2); 24m: (3)
11	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (0); 4e: (0); 6f: (1); 6g: (2); 8h: (1); 12i: (2); 12j: (1); 12k: (2); 12l: (2); 24m: (3)
12	(0, 0, 0)	2a: (1); 2b: (2); 4c: (1); 4d: (2); 4e: (2); 6f: (2); 6g: (4); 8h: (2); 12i: (4); 12j: (3); 12k: (3); 12l: (4); 24m: (6)

$M \left(0, \frac{1}{2}, 0\right)$ of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (2); 4e: (1); 6f: (2); 6g: (4); 8h: (3); 12i: (5); 12j: (4); 12k: (4); 12l: (6); 24m: (9)
2	(0, 0, 0)	2a: (1); 2b: (0); 4c: (2); 4d: (1); 4e: (2); 6f: (2); 6g: (2); 8h: (3); 12i: (4); 12j: (4); 12k: (5); 12l: (3); 24m: (9)
3	(0, 0, 0)	2a: (1); 2b: (0); 4c: (2); 4d: (2); 4e: (1); 6f: (3); 6g: (4); 8h: (3); 12i: (5); 12j: (5); 12k: (5); 12l: (6); 24m: (9)
4	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (1); 4e: (2); 6f: (2); 6g: (2); 8h: (3); 12i: (4); 12j: (5); 12k: (4); 12l: (3); 24m: (9)
5	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 4e: (1); 6f: (2); 6g: (1); 8h: (3); 12i: (5); 12j: (4); 12k: (4); 12l: (3); 24m: (9)
6	(0, 0, 0)	2a: (1); 2b: (2); 4c: (2); 4d: (2); 4e: (2); 6f: (2); 6g: (2); 8h: (3); 12i: (4); 12j: (4); 12k: (5); 12l: (6); 24m: (9)
7	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 6f: (3); 6g: (1); 8h: (3); 12i: (5); 12j: (5); 12k: (5); 12l: (3); 24m: (9)
8	(0, 0, 0)	2a: (1); 2b: (2); 4c: (1); 4d: (2); 4e: (2); 6f: (2); 6g: (2); 8h: (3); 12i: (4); 12j: (5); 12k: (4); 12l: (6); 24m: (9)

$A \left(0, 0, \frac{1}{2}\right)$ of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 6f: (1); 6g: (1); 8h: (2); 12i: (2); 12j: (3); 12k: (3); 12l: (3); 24m: (6)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 6f: (1); 6g: (1); 8h: (2); 12i: (2); 12j: (3); 12k: (3); 12l: (3); 24m: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 6f: (2); 6g: (2); 8h: (2); 12i: (4); 12j: (3); 12k: (3); 12l: (3); 24m: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 6f: (2); 6g: (2); 8h: (2); 12i: (4); 12j: (3); 12k: (3); 12l: (3); 24m: (6)

$L \left(0, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 6f: (5); 6g: (5); 8h: (6); 12i: (10); 12j: (9); 12k: (9); 12l: (9); 24m: (18)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 6f: (4); 6g: (4); 8h: (6); 12i: (8); 12j: (9); 12k: (9); 12l: (9); 24m: (18)

$K \left(-\frac{1}{3}, \frac{2}{3}, 0\right)$ of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (2); 4e: (1); 6f: (1); 6g: (2); 8h: (2); 12i: (3); 12j: (2); 12k: (3); 12l: (4); 24m: (6)
2	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (2); 4e: (1); 6f: (2); 6g: (2); 8h: (2); 12i: (3); 12j: (4); 12k: (3); 12l: (4); 24m: (6)
3	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (0); 4e: (1); 6f: (1); 6g: (1); 8h: (2); 12i: (3); 12j: (2); 12k: (3); 12l: (2); 24m: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (0); 4e: (1); 6f: (2); 6g: (1); 8h: (2); 12i: (3); 12j: (4); 12k: (3); 12l: (2); 24m: (6)
5	(0, 0, 0)	2a: (1); 2b: (2); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (4); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 12l: (8); 24m: (12)
6	(0, 0, 0)	2a: (1); 2b: (0); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (2); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 12l: (4); 24m: (12)

$H \left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2} \right)$ of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (3); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 12l: (6); 24m: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (3); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 12l: (6); 24m: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C _{2y}	C ₃ ⁺
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E		
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C _{2y}	C ₃ ⁺
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $-\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			

Operation	E	C_3^-	C_3^+
Coordinate	$(\frac{1}{2}, 0, w)$	$(0, -\frac{1}{2}, w)$	$(-\frac{1}{2}, \frac{1}{2}, w)$

DT $(0, 0, w)$ of space group No. 192											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 6f: (1); 6g: (1); 8h: (2); 12i: (2); 12j: (3); 12k: (3); 12l: (3); 24m: (6)									
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 6f: (1); 6g: (1); 8h: (2); 12i: (2); 12j: (3); 12k: (3); 12l: (3); 24m: (6)									
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 6f: (2); 6g: (2); 8h: (2); 12i: (4); 12j: (3); 12k: (3); 12l: (3); 24m: (6)									
4	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 6f: (2); 6g: (2); 8h: (2); 12i: (4); 12j: (3); 12k: (3); 12l: (3); 24m: (6)									
5	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (2); 4e: (0); 6f: (2); 6g: (2); 8h: (4); 12i: (4); 12j: (6); 12k: (6); 12l: (6); 24m: (12)									
6	(0, 0, 0)	2a: (2); 2b: (2); 4c: (2); 4d: (2); 4e: (4); 6f: (4); 6g: (4); 8h: (4); 12i: (8); 12j: (6); 12k: (6); 12l: (6); 24m: (12)									
LD $(u, u, 0)$ of space group No. 192											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (3); 4d: (4); 4e: (3); 6f: (4); 6g: (6); 8h: (6); 12i: (9); 12j: (8); 12k: (9); 12l: (12); 24m: (18)									
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (2); 4e: (3); 6f: (4); 6g: (3); 8h: (6); 12i: (9); 12j: (8); 12k: (9); 12l: (6); 24m: (18)									
3	(0, 0, 0)	2a: (2); 2b: (1); 4c: (3); 4d: (2); 4e: (3); 6f: (5); 6g: (3); 8h: (6); 12i: (9); 12j: (10); 12k: (9); 12l: (6); 24m: (18)									
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (4); 4e: (3); 6f: (5); 6g: (6); 8h: (6); 12i: (9); 12j: (10); 12k: (9); 12l: (12); 24m: (18)									
P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 192											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (3); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 12l: (6); 24m: (12)									
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (3); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 12l: (6); 24m: (12)									
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (4); 6f: (6); 6g: (6); 8h: (8); 12i: (12); 12j: (12); 12k: (12); 12l: (12); 24m: (24)									
Q $(u, u, \frac{1}{2})$ of space group No. 192											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (18); 24m: (36)									
R $(u, 0, \frac{1}{2})$ of space group No. 192											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (18); 24m: (36)									

SM ($u, 0, 0$) of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 4c: (2); 4d: (4); 4e: (3); 6f: (4); 6g: (6); 8h: (6); 12i: (9); 12j: (9); 12k: (8); 12l: (12); 24m: (18)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (3); 6f: (4); 6g: (3); 8h: (6); 12i: (9); 12j: (9); 12k: (8); 12l: (6); 24m: (18)
3	(0, 0, 0)	2a: (2); 2b: (1); 4c: (4); 4d: (2); 4e: (3); 6f: (5); 6g: (3); 8h: (6); 12i: (9); 12j: (9); 12k: (10); 12l: (6); 24m: (18)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (3); 6f: (5); 6g: (6); 8h: (6); 12i: (9); 12j: (9); 12k: (10); 12l: (12); 24m: (18)

U ($\frac{1}{2}, 0, w$) of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 6f: (5); 6g: (5); 8h: (6); 12i: (10); 12j: (9); 12k: (9); 12l: (9); 24m: (18)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 6f: (5); 6g: (5); 8h: (6); 12i: (10); 12j: (9); 12k: (9); 12l: (9); 24m: (18)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 6f: (4); 6g: (4); 8h: (6); 12i: (8); 12j: (9); 12k: (9); 12l: (9); 24m: (18)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 6f: (4); 6g: (4); 8h: (6); 12i: (8); 12j: (9); 12k: (9); 12l: (9); 24m: (18)

d. Results for high-symmetry planes

P1(0, u, v)			
Operation	E	C_6^+	C_6^-
Coordinate	(0, u, v)	($-u, u, v$)	($u, 0, v$)
P2($u, v, 0$)			
Operation	E		
Coordinate	($u, v, 0$)		
P3($u, -2u, v$)			
Operation	E	C_6^+	C_6^-
Coordinate	($u, -2u, v$)	($2u, -u, v$)	($-u, -u, v$)
P4($u, v, \frac{1}{2}$)			
Operation	E		
Coordinate	($u, v, \frac{1}{2}$)		

P1 (0, u, v) of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (18); 24m: (36)

2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (18); 24m: (36)

P2 ($u, v, 0$) of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (4); 4c: (6); 4d: (8); 4e: (6); 6f: (9); 6g: (12); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (24); 24m: (36)
2	(0, 0, 0)	2a: (3); 2b: (2); 4c: (6); 4d: (4); 4e: (6); 6f: (9); 6g: (6); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (12); 24m: (36)

P3 ($u, -2u, v$) of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (18); 24m: (36)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (18); 24m: (36)

P4 ($u, v, \frac{1}{2}$) of space group No. 192

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (18); 24m: (36)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 12l: (18); 24m: (36)

193. Space group No. 193 ($P6_3/mcm$)

$$\begin{array}{lcl}
 \vec{a} = (a, 0, 0) & & \vec{t}_1 = \vec{a} \\
 \text{Hexagonal primitive lattice} & \vec{b} = \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0 \right) & \vec{t}_2 = \vec{b} \\
 & \vec{c} = (0, 0, c) & \vec{t}_3 = \vec{c}
 \end{array}$$

a. Space group operations

$$\begin{array}{cccccccc}
 \{E|0, 0, 0\} & \{C_3^+|0, 0, 0\} & \{C_3^-|0, 0, 0\} & \{C_{2y}|0, 0, 0\} & \{C_{23}''|0, 0, 0\} & \{C_{22}''|0, 0, 0\} & \{C_{2z}|0, 0, \frac{1}{2}\} & \{C_6^-|0, 0, \frac{1}{2}\} \\
 \{C_6^+|0, 0, \frac{1}{2}\} & \{C_{2x}|0, 0, -\frac{1}{2}\} & \{C_{23}'|0, 0, -\frac{1}{2}\} & \{C_{22}'|0, 0, -\frac{1}{2}\} & \{I|0, 0, 0\} & \{S_6^-|0, 0, 0\} & \{S_6^+|0, 0, 0\} & \{\sigma_y|0, 0, 0\} \\
 \{\sigma_{v3}|0, 0, 0\} & \{\sigma_{v2}|0, 0, 0\} & \{\sigma_z|0, 0, \frac{1}{2}\} & \{S_3^+|0, 0, \frac{1}{2}\} & \{S_3^-|0, 0, \frac{1}{2}\} & \{\sigma_x|0, 0, -\frac{1}{2}\} & \{\sigma_{d3}|0, 0, -\frac{1}{2}\} & \{\sigma_{d2}|0, 0, -\frac{1}{2}\}
 \end{array}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$M(0, \frac{1}{2}, 0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, 0)$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, 0)$
$A(0, 0, \frac{1}{2})$			
Operation	E		
Coordinate	$(0, 0, \frac{1}{2})$		
$L(0, \frac{1}{2}, \frac{1}{2})$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, \frac{1}{2})$
$K(-\frac{1}{3}, \frac{2}{3}, 0)$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, 0)$	$(\frac{1}{3}, \frac{1}{3}, 0)$	
$H(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$			
Operation	E	C_{2y}	
Coordinate	$(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$	$(\frac{1}{3}, \frac{1}{3}, -\frac{1}{2})$	

$\Gamma(0, 0, 0)$ of space group No. 193											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (1);	6f: (0);	6g: (1);	8h: (1);	12i: (1);	12j: (2); 12k: (2); 24l: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (0);	6f: (0);	6g: (1);	8h: (1);	12i: (2);	12j: (2); 12k: (1); 24l: (3)
3	(0, 0, 0)	2a: (1);	2b: (0);	4c: (2);	4d: (1);	4e: (1);	6f: (0);	6g: (2);	8h: (2);	12i: (3);	12j: (4); 12k: (3); 24l: (6)
4	(0, 0, 0)	2a: (1);	2b: (0);	4c: (1);	4d: (0);	4e: (1);	6f: (0);	6g: (1);	8h: (1);	12i: (1);	12j: (1); 12k: (2); 24l: (3)
5	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (1);	4e: (0);	6f: (0);	6g: (0);	8h: (1);	12i: (2);	12j: (1); 12k: (1); 24l: (3)
6	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (1);	4e: (1);	6f: (0);	6g: (1);	8h: (2);	12i: (3);	12j: (2); 12k: (3); 24l: (6)
7	(0, 0, 0)	2a: (0);	2b: (0);	4c: (1);	4d: (0);	4e: (0);	6f: (1);	6g: (0);	8h: (1);	12i: (1);	12j: (1); 12k: (1); 24l: (3)
8	(0, 0, 0)	2a: (1);	2b: (1);	4c: (1);	4d: (1);	4e: (1);	6f: (2);	6g: (1);	8h: (1);	12i: (2);	12j: (1); 12k: (2); 24l: (3)
9	(0, 0, 0)	2a: (0);	2b: (1);	4c: (0);	4d: (1);	4e: (1);	6f: (3);	6g: (1);	8h: (2);	12i: (3);	12j: (2); 12k: (3); 24l: (6)
10	(0, 0, 0)	2a: (0);	2b: (0);	4c: (0);	4d: (0);	4e: (0);	6f: (1);	6g: (1);	8h: (1);	12i: (1);	12j: (2); 12k: (1); 24l: (3)
11	(0, 0, 0)	2a: (0);	2b: (1);	4c: (0);	4d: (1);	4e: (1);	6f: (2);	6g: (1);	8h: (1);	12i: (2);	12j: (2); 12k: (2); 24l: (3)

12 (0, 0, 0) 2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 6f: (3); 6g: (2); 8h: (2); 12i: (3); 12j: (4); 12k: (3); 24l: (6)

$M(0, \frac{1}{2}, 0)$ of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (0); 4c: (2); 4d: (1); 4e: (2); 6f: (3); 6g: (3); 8h: (3); 12i: (4); 12j: (6); 12k: (5); 24l: (9)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (2); 4e: (1); 6f: (3); 6g: (1); 8h: (3); 12i: (5); 12j: (3); 12k: (4); 24l: (9)
3	(0, 0, 0)	2a: (1); 2b: (0); 4c: (2); 4d: (2); 4e: (1); 6f: (3); 6g: (3); 8h: (3); 12i: (5); 12j: (6); 12k: (4); 24l: (9)
4	(0, 0, 0)	2a: (1); 2b: (0); 4c: (1); 4d: (1); 4e: (2); 6f: (3); 6g: (2); 8h: (3); 12i: (4); 12j: (3); 12k: (5); 24l: (9)
5	(0, 0, 0)	2a: (0); 2b: (1); 4c: (1); 4d: (1); 4e: (1); 6f: (1); 6g: (1); 8h: (3); 12i: (4); 12j: (3); 12k: (4); 24l: (9)
6	(0, 0, 0)	2a: (1); 2b: (2); 4c: (2); 4d: (2); 4e: (2); 6f: (2); 6g: (3); 8h: (3); 12i: (5); 12j: (6); 12k: (5); 24l: (9)
7	(0, 0, 0)	2a: (1); 2b: (2); 4c: (1); 4d: (2); 4e: (2); 6f: (2); 6g: (2); 8h: (3); 12i: (5); 12j: (3); 12k: (5); 24l: (9)
8	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (1); 4e: (1); 6f: (1); 6g: (3); 8h: (3); 12i: (4); 12j: (6); 12k: (4); 24l: (9)

$A(0, 0, \frac{1}{2})$ of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 6f: (2); 6g: (2); 8h: (2); 12i: (3); 12j: (3); 12k: (4); 24l: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 6f: (1); 6g: (1); 8h: (2); 12i: (3); 12j: (3); 12k: (2); 24l: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (3); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 24l: (12)

$L(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 6f: (5); 6g: (5); 8h: (6); 12i: (9); 12j: (9); 12k: (10); 24l: (18)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 6f: (4); 6g: (4); 8h: (6); 12i: (9); 12j: (9); 12k: (8); 24l: (18)

$K(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (1); 4c: (2); 4d: (1); 4e: (2); 6f: (2); 6g: (2); 8h: (2); 12i: (3); 12j: (4); 12k: (4); 24l: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (1); 4e: (0); 6f: (1); 6g: (2); 8h: (2); 12i: (3); 12j: (4); 12k: (2); 24l: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (0); 4d: (1); 4e: (0); 6f: (1); 6g: (0); 8h: (2); 12i: (3); 12j: (2); 12k: (2); 24l: (6)
4	(0, 0, 0)	2a: (2); 2b: (1); 4c: (0); 4d: (1); 4e: (2); 6f: (2); 6g: (2); 8h: (2); 12i: (3); 12j: (2); 12k: (4); 24l: (6)
5	(0, 0, 0)	2a: (2); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (4); 8h: (4); 12i: (6); 12j: (8); 12k: (6); 24l: (12)

6	(0, 0, 0)	2a: (0); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (2); 8h: (4); 12i: (6); 12j: (4); 12k: (6); 24l: (12)

$H \left(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2} \right)$ of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 6f: (2); 6g: (2); 8h: (2); 12i: (3); 12j: (3); 12k: (4); 24l: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 6f: (1); 6g: (1); 8h: (2); 12i: (3); 12j: (3); 12k: (2); 24l: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (3); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 24l: (12)

c. Results for high-symmetry lines

DT(0, 0, w)

Operation	E
Coordinate	(0, 0, w)

LD(u , u , 0)

Operation	E	C_{2y}	C_3^+
Coordinate	(u , u , 0)	($-u$, $2u$, 0)	($-2u$, u , 0)

P($\frac{1}{3}$, $\frac{1}{3}$, w)

Operation	E	C_{2z}
Coordinate	($\frac{1}{3}$, $\frac{1}{3}$, w)	($-\frac{1}{3}$, $-\frac{1}{3}$, w)

Q(u , u , $\frac{1}{2}$)

Operation	E	C_{2y}	C_3^+
Coordinate	(u , u , $\frac{1}{2}$)	($-u$, $2u$, $-\frac{1}{2}$)	($-2u$, u , $\frac{1}{2}$)

R(u , 0, $\frac{1}{2}$)

Operation	E	C_6^+	C_3^+
Coordinate	(u , 0, $\frac{1}{2}$)	(0, u , $\frac{1}{2}$)	($-u$, u , $\frac{1}{2}$)

SM(u , 0, 0)

Operation	E	C_6^+	C_3^+
Coordinate	(u , 0, 0)	(0, u , 0)	($-u$, u , 0)

U($\frac{1}{2}$, 0, w)

Operation	E	C_3^-	C_3^+
Coordinate	($\frac{1}{2}$, 0, w)	(0, $-\frac{1}{2}$, w)	($-\frac{1}{2}$, $\frac{1}{2}$, w)

DT (0, 0, w) of space group No. 193

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 6f: (2); 6g: (2); 8h: (2); 12i: (3); 12j: (3); 12k: (4); 24l: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 6f: (1); 6g: (1); 8h: (2); 12i: (3); 12j: (3); 12k: (2); 24l: (6)
3	(0, 0, 0)	2a: (0); 2b: (0); 4c: (1); 4d: (1); 4e: (0); 6f: (1); 6g: (1); 8h: (2); 12i: (3); 12j: (3); 12k: (2); 24l: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 4c: (1); 4d: (1); 4e: (2); 6f: (2); 6g: (2); 8h: (2); 12i: (3); 12j: (3); 12k: (4); 24l: (6)
5	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (3); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 24l: (12)
6	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (2); 6f: (3); 6g: (3); 8h: (4); 12i: (6); 12j: (6); 12k: (6); 24l: (12)

LD ($u, u, 0$) of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (3); 4e: (4); 6f: (5); 6g: (6); 8h: (6); 12i: (9); 12j: (12); 12k: (10); 24l: (18)
2	(0, 0, 0)	2a: (0); 2b: (1); 4c: (2); 4d: (3); 4e: (2); 6f: (4); 6g: (2); 8h: (6); 12i: (9); 12j: (6); 12k: (8); 24l: (18)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (2); 4d: (3); 4e: (4); 6f: (5); 6g: (4); 8h: (6); 12i: (9); 12j: (6); 12k: (10); 24l: (18)
4	(0, 0, 0)	2a: (2); 2b: (1); 4c: (4); 4d: (3); 4e: (2); 6f: (4); 6g: (6); 8h: (6); 12i: (9); 12j: (12); 12k: (8); 24l: (18)

P ($\frac{1}{3}, \frac{1}{3}, w$) of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (2); 4d: (2); 4e: (4); 6f: (4); 6g: (4); 8h: (4); 12i: (6); 12j: (6); 12k: (8); 24l: (12)
2	(0, 0, 0)	2a: (0); 2b: (0); 4c: (2); 4d: (2); 4e: (0); 6f: (2); 6g: (2); 8h: (4); 12i: (6); 12j: (6); 12k: (4); 24l: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (4); 6f: (6); 6g: (6); 8h: (8); 12i: (12); 12j: (12); 12k: (12); 24l: (24)

Q ($u, u, \frac{1}{2}$) of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 6f: (5); 6g: (5); 8h: (6); 12i: (9); 12j: (9); 12k: (10); 24l: (18)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 6f: (4); 6g: (4); 8h: (6); 12i: (9); 12j: (9); 12k: (8); 24l: (18)

R ($u, 0, \frac{1}{2}$) of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 24l: (36)

SM ($u, 0, 0$) of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (1); 4c: (4); 4d: (2); 4e: (3); 6f: (4); 6g: (6); 8h: (6); 12i: (8); 12j: (12); 12k: (9); 24l: (18)

2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (2); 4d: (2); 4e: (3); 6f: (4); 6g: (3); 8h: (6); 12i: (8); 12j: (6); 12k: (9); 24l: (18)
3	(0, 0, 0)	2a: (1); 2b: (2); 4c: (2); 4d: (4); 4e: (3); 6f: (5); 6g: (3); 8h: (6); 12i: (10); 12j: (6); 12k: (9); 24l: (18)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (4); 4d: (4); 4e: (3); 6f: (5); 6g: (6); 8h: (6); 12i: (10); 12j: (12); 12k: (9); 24l: (18)

$U\left(\frac{1}{2}, 0, w\right)$ of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 6f: (5); 6g: (5); 8h: (6); 12i: (9); 12j: (9); 12k: (10); 24l: (18)
2	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 6f: (4); 6g: (4); 8h: (6); 12i: (9); 12j: (9); 12k: (8); 24l: (18)
3	(0, 0, 0)	2a: (1); 2b: (1); 4c: (3); 4d: (3); 4e: (2); 6f: (4); 6g: (4); 8h: (6); 12i: (9); 12j: (9); 12k: (8); 24l: (18)
4	(0, 0, 0)	2a: (2); 2b: (2); 4c: (3); 4d: (3); 4e: (4); 6f: (5); 6g: (5); 8h: (6); 12i: (9); 12j: (9); 12k: (10); 24l: (18)

d. Results for high-symmetry planes

$P1(0, u, v)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(0, u, v)$	$(-u, u, v)$	$(u, 0, v)$
$P2(u, v, 0)$			
Operation	E		
Coordinate	$(u, v, 0)$		
$P3(u, -2u, v)$			
Operation	E	C_6^+	C_6^-
Coordinate	$(u, -2u, v)$	$(2u, -u, v)$	$(-u, -u, v)$
$P4(u, v, \frac{1}{2})$			
Operation	E		
Coordinate	$(u, v, \frac{1}{2})$		

$P1(0, u, v)$ of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 24l: (36)
2	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 24l: (36)

$P2(u, v, 0)$ of space group No. 193

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (4); 2b: (3); 4c: (8); 4d: (6); 4e: (6); 6f: (9); 6g: (12); 8h: (12); 12i: (18); 12j: (24); 12k: (18); 24l: (36)
2	(0, 0, 0)	2a: (2); 2b: (3); 4c: (4); 4d: (6); 4e: (6); 6f: (9); 6g: (6); 8h: (12); 12i: (18); 12j: (12); 12k: (18); 24l: (36)

P3 ($u, -2u, v$) of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 4c: (6); 4d: (6); 4e: (8); 6f: (10); 6g: (10); 8h: (12); 12i: (18); 12j: (18); 12k: (20); 24l: (36)
2	(0, 0, 0)	2a: (2); 2b: (2); 4c: (6); 4d: (6); 4e: (4); 6f: (8); 6g: (8); 8h: (12); 12i: (18); 12j: (18); 12k: (16); 24l: (36)

P4 ($u, v, \frac{1}{2}$) of space group No. 193

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 4c: (6); 4d: (6); 4e: (6); 6f: (9); 6g: (9); 8h: (12); 12i: (18); 12j: (18); 12k: (18); 24l: (36)

194. Space group No. 194 ($P6_3/mmc$)

Hexagonal primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= \left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}, 0\right) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, c) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_3^+|0, 0, 0\} \quad \{C_3^-|0, 0, 0\} \quad \{C_{2y}|0, 0, \frac{1}{2}\} \quad \{C_{23}''|0, 0, \frac{1}{2}\} \quad \{C_{22}''|0, 0, \frac{1}{2}\} \quad \{C_{2z}|0, 0, \frac{1}{2}\} \quad \{C_6^-|0, 0, \frac{1}{2}\} \\ &\{C_6^+|0, 0, \frac{1}{2}\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{23}'|0, 0, 0\} \quad \{C_{22}'|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{S_6^-|0, 0, 0\} \quad \{S_6^+|0, 0, 0\} \quad \{\sigma_y|0, 0, \frac{1}{2}\} \\ &\{\sigma_{v3}|0, 0, \frac{1}{2}\} \quad \{\sigma_{v2}|0, 0, \frac{1}{2}\} \quad \{\sigma_z|0, 0, \frac{1}{2}\} \quad \{S_3^+|0, 0, \frac{1}{2}\} \quad \{S_3^-|0, 0, \frac{1}{2}\} \quad \{\sigma_x|0, 0, 0\} \quad \{\sigma_{d3}|0, 0, 0\} \quad \{\sigma_{d2}|0, 0, 0\} \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$M(0,\frac{1}{2},0)$			
Operation	E	C_3^-	C_3^+
Coordinate	$(0,\frac{1}{2},0)$	$(\frac{1}{2},-\frac{1}{2},0)$	$(-\frac{1}{2},0,0)$

A(0, 0, $\frac{1}{2}$)		
Operation	E	
Coordinate	(0, 0, $\frac{1}{2}$)	
L(0, $\frac{1}{2}$, $\frac{1}{2}$)		
Operation	E	C_3^- C_3^+
Coordinate	(0, $\frac{1}{2}$, $\frac{1}{2}$)	($\frac{1}{2}$, $-\frac{1}{2}$, $\frac{1}{2}$) ($-\frac{1}{2}$, 0, $\frac{1}{2}$)
K($-\frac{1}{3}$, $\frac{2}{3}$, 0)		
Operation	E	C_{2y}
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, 0)	($\frac{1}{3}$, $\frac{1}{3}$, 0)
H($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)		
Operation	E	C_{2y}
Coordinate	($-\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$)	($\frac{1}{3}$, $\frac{1}{3}$, $-\frac{1}{2}$)

$\Gamma(0, 0, 0)$ of space group No. 194											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (0);	6h: (1);	12i: (1);	12j: (2); 12k: (2); 24l: (3)
2	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (0);	6g: (0);	6h: (1);	12i: (2);	12j: (2); 12k: (1); 24l: (3)
3	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (0);	6h: (2);	12i: (3);	12j: (4); 12k: (3); 24l: (6)
4	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (0);	6g: (0);	6h: (0);	12i: (2);	12j: (1); 12k: (1); 24l: (3)
5	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (0);	6h: (1);	12i: (1);	12j: (1); 12k: (2); 24l: (3)
6	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (0);	6h: (1);	12i: (3);	12j: (2); 12k: (3); 24l: (6)
7	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (0);	6g: (1);	6h: (0);	12i: (1);	12j: (1); 12k: (1); 24l: (3)
8	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (2);	6h: (1);	12i: (2);	12j: (1); 12k: (2); 24l: (3)
9	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (3);	6h: (1);	12i: (3);	12j: (2); 12k: (3); 24l: (6)
10	(0, 0, 0)	2a: (1);	2b: (0);	2c: (0);	2d: (0);	4e: (1);	4f: (1);	6g: (2);	6h: (1);	12i: (2);	12j: (2); 12k: (2); 24l: (3)
11	(0, 0, 0)	2a: (0);	2b: (0);	2c: (0);	2d: (0);	4e: (0);	4f: (0);	6g: (1);	6h: (1);	12i: (1);	12j: (2); 12k: (1); 24l: (3)
12	(0, 0, 0)	2a: (1);	2b: (1);	2c: (1);	2d: (1);	4e: (1);	4f: (1);	6g: (3);	6h: (2);	12i: (3);	12j: (4); 12k: (3); 24l: (6)
$M(0, \frac{1}{2}, 0)$ of space group No. 194											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	2b: (1);	2c: (1);	2d: (1);	4e: (2);	4f: (2);	6g: (3);	6h: (3);	12i: (4);	12j: (6); 12k: (5); 24l: (9)

2	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (2); 12i: (4); 12j: (3); 12k: (5); 24l: (9)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 6g: (3); 6h: (3); 12i: (5); 12j: (6); 12k: (4); 24l: (9)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 6g: (3); 6h: (1); 12i: (5); 12j: (3); 12k: (4); 24l: (9)
5	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 6g: (1); 6h: (1); 12i: (4); 12j: (3); 12k: (4); 24l: (9)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 6g: (1); 6h: (3); 12i: (4); 12j: (6); 12k: (4); 24l: (9)
7	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (2); 6h: (2); 12i: (5); 12j: (3); 12k: (5); 24l: (9)
8	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (2); 6h: (3); 12i: (5); 12j: (6); 12k: (5); 24l: (9)

A $(0, 0, \frac{1}{2})$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (2); 6h: (2); 12i: (3); 12j: (3); 12k: (4); 24l: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 6g: (1); 6h: (1); 12i: (3); 12j: (3); 12k: (2); 24l: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6); 12j: (6); 12k: (6); 24l: (12)

L $(0, \frac{1}{2}, \frac{1}{2})$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 6g: (5); 6h: (5); 12i: (9); 12j: (9); 12k: (10); 24l: (18)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (4); 6h: (4); 12i: (9); 12j: (9); 12k: (8); 24l: (18)

K $(-\frac{1}{3}, \frac{2}{3}, 0)$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 6g: (1); 6h: (2); 12i: (2); 12j: (4); 12k: (3); 24l: (6)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (1); 4f: (1); 6g: (2); 6h: (2); 12i: (4); 12j: (4); 12k: (3); 24l: (6)
3	(0, 0, 0)	2a: (0); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 6g: (1); 6h: (1); 12i: (2); 12j: (2); 12k: (3); 24l: (6)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (0); 4e: (1); 4f: (1); 6g: (2); 6h: (1); 12i: (4); 12j: (2); 12k: (3); 24l: (6)
5	(0, 0, 0)	2a: (1); 2b: (2); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (4); 12i: (6); 12j: (8); 12k: (6); 24l: (12)
6	(0, 0, 0)	2a: (1); 2b: (0); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (2); 12i: (6); 12j: (4); 12k: (6); 24l: (12)

H $(-\frac{1}{3}, \frac{2}{3}, \frac{1}{2})$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (2); 2d: (0); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6); 12j: (6); 12k: (6); 24l: (12)

2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (0); 2d: (2); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6); 12j: (6); 12k: (6); 24l: (12)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6); 12j: (6); 12k: (6); 24l: (12)

c. Results for high-symmetry lines

DT(0, 0, w)			
Operation	E		
Coordinate	(0, 0, w)		
LD(u, u, 0)			
Operation	E	C _{2y}	C ₃ ⁺
Coordinate	(u, u, 0)	(-u, 2u, 0)	(-2u, u, 0)
P($\frac{1}{3}, \frac{1}{3}, w$)			
Operation	E	C _{2z}	
Coordinate	($\frac{1}{3}, \frac{1}{3}, w$)	($-\frac{1}{3}, -\frac{1}{3}, w$)	
Q(u, u, $\frac{1}{2}$)			
Operation	E	C _{2y}	C ₃ ⁺
Coordinate	(u, u, $\frac{1}{2}$)	(-u, 2u, $-\frac{1}{2}$)	(-2u, u, $\frac{1}{2}$)
R(u, 0, $\frac{1}{2}$)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, $\frac{1}{2}$)	(0, u, $\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)
SM(u, 0, 0)			
Operation	E	C ₆ ⁺	C ₃ ⁺
Coordinate	(u, 0, 0)	(0, u, 0)	(-u, u, 0)
U($\frac{1}{2}, 0, w$)			
Operation	E	C ₃ ⁻	C ₃ ⁺
Coordinate	($\frac{1}{2}, 0, w$)	(0, $-\frac{1}{2}, w$)	($-\frac{1}{2}, \frac{1}{2}, w$)

DT (0, 0, w) of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (2); 6h: (2); 12i: (3); 12j: (3); 12k: (4); 24l: (6)
2	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 6g: (1); 6h: (1); 12i: (3); 12j: (3); 12k: (2); 24l: (6)
3	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (2); 6h: (2); 12i: (3); 12j: (3); 12k: (4); 24l: (6)
4	(0, 0, 0)	2a: (0); 2b: (0); 2c: (0); 2d: (0); 4e: (0); 4f: (0); 6g: (1); 6h: (1); 12i: (3); 12j: (3); 12k: (2); 24l: (6)

5	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6); 12j: (6); 12k: (6); 24l: (12)
6	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6); 12j: (6); 12k: (6); 24l: (12)

LD $(u, u, 0)$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 6g: (4); 6h: (6); 12i: (8); 12j: (12); 12k: (9); 24l: (18)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 6g: (4); 6h: (3); 12i: (8); 12j: (6); 12k: (9); 24l: (18)
3	(0, 0, 0)	2a: (2); 2b: (1); 2c: (1); 2d: (1); 4e: (3); 4f: (3); 6g: (5); 6h: (3); 12i: (10); 12j: (6); 12k: (9); 24l: (18)
4	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (3); 4f: (3); 6g: (5); 6h: (6); 12i: (10); 12j: (12); 12k: (9); 24l: (18)

P $(\frac{1}{3}, \frac{1}{3}, w)$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6); 12j: (6); 12k: (6); 24l: (12)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (3); 6h: (3); 12i: (6); 12j: (6); 12k: (6); 24l: (12)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 6g: (6); 6h: (6); 12i: (12); 12j: (12); 12k: (12); 24l: (24)

Q $(u, u, \frac{1}{2})$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18); 12j: (18); 12k: (18); 24l: (36)

R $(u, 0, \frac{1}{2})$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 6g: (5); 6h: (5); 12i: (9); 12j: (9); 12k: (10); 24l: (18)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (4); 6h: (4); 12i: (9); 12j: (9); 12k: (8); 24l: (18)

SM $(u, 0, 0)$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 6g: (5); 6h: (6); 12i: (9); 12j: (12); 12k: (10); 24l: (18)
2	(0, 0, 0)	2a: (1); 2b: (0); 2c: (0); 2d: (0); 4e: (2); 4f: (2); 6g: (4); 6h: (2); 12i: (9); 12j: (6); 12k: (8); 24l: (18)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 6g: (5); 6h: (4); 12i: (9); 12j: (6); 12k: (10); 24l: (18)
4	(0, 0, 0)	2a: (1); 2b: (2); 2c: (2); 2d: (2); 4e: (2); 4f: (2); 6g: (4); 6h: (6); 12i: (9); 12j: (12); 12k: (8); 24l: (18)

U $(\frac{1}{2}, 0, w)$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 6g: (5); 6h: (5); 12i: (9); 12j: (9); 12k: (10); 24l: (18)
2	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (4); 6h: (4); 12i: (9); 12j: (9); 12k: (8); 24l: (18)
3	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 6g: (5); 6h: (5); 12i: (9); 12j: (9); 12k: (10); 24l: (18)
4	(0, 0, 0)	2a: (1); 2b: (1); 2c: (1); 2d: (1); 4e: (2); 4f: (2); 6g: (4); 6h: (4); 12i: (9); 12j: (9); 12k: (8); 24l: (18)

d. Results for high-symmetry planes

P1(0, u , v)			
Operation	E	C_6^+	C_6^-
Coordinate	(0, u , v)	($-u$, u , v)	(u , 0, v)
P2(u , v , 0)			
Operation	E		
Coordinate	(u , v , 0)		
P3(u , $-2u$, v)			
Operation	E	C_6^+	C_6^-
Coordinate	(u , $-2u$, v)	($2u$, $-u$, v)	($-u$, $-u$, v)
P4(u , v , $\frac{1}{2}$)			
Operation	E		
Coordinate	(u , v , $\frac{1}{2}$)		

P1 (0, u , v) of space group No. 194		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 2b: (4); 2c: (4); 2d: (4); 4e: (8); 4f: (8); 6g: (10); 6h: (10); 12i: (18); 12j: (18); 12k: (20); 24l: (36)
2	(0, 0, 0)	2a: (2); 2b: (2); 2c: (2); 2d: (2); 4e: (4); 4f: (4); 6g: (8); 6h: (8); 12i: (18); 12j: (18); 12k: (16); 24l: (36)
P2 (u , v , 0) of space group No. 194		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (4); 2c: (4); 2d: (4); 4e: (6); 4f: (6); 6g: (9); 6h: (12); 12i: (18); 12j: (24); 12k: (18); 24l: (36)
2	(0, 0, 0)	2a: (3); 2b: (2); 2c: (2); 2d: (2); 4e: (6); 4f: (6); 6g: (9); 6h: (6); 12i: (18); 12j: (12); 12k: (18); 24l: (36)
P3 (u , $-2u$, v) of space group No. 194		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18); 12j: (18); 12k: (18); 24l: (36)

2	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18); 12j: (18); 12k: (18); 24l: (36)

P4 $(u, v, \frac{1}{2})$ of space group No. 194

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 2b: (3); 2c: (3); 2d: (3); 4e: (6); 4f: (6); 6g: (9); 6h: (9); 12i: (18); 12j: (18); 12k: (18); 24l: (36)

195. Space group No. 195 ($P23$)

Cubic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}&\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \\&\{C_{31}^-|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$

Operation E
Coordinate (0, 0, 0)

$X(0, \frac{1}{2}, 0)$

Operation E C_{31}^+ C_{31}^-
Coordinate $(0, \frac{1}{2}, 0)$ $(0, 0, \frac{1}{2})$ $(\frac{1}{2}, 0, 0)$

$M(\frac{1}{2}, \frac{1}{2}, 0)$

Operation E C_{31}^+ C_{31}^-
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$ $(0, \frac{1}{2}, \frac{1}{2})$ $(\frac{1}{2}, 0, \frac{1}{2})$

$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 4e: (1); 6f: (1); 6g: (1); 6h: (1); 6i: (1); 12j: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 4e: (1); 6f: (1); 6g: (1); 6h: (1); 6i: (1); 12j: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 4e: (3); 6f: (5); 6g: (5); 6h: (5); 6i: (5); 12j: (9)

X $(0, \frac{1}{2}, 0)$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 3c: (2); 3d: (1); 4e: (3); 6f: (3); 6g: (4); 6h: (4); 6i: (5); 12j: (9)
2	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 4e: (3); 6f: (5); 6g: (6); 6h: (4); 6i: (5); 12j: (9)
3	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (2); 4e: (3); 6f: (5); 6g: (4); 6h: (4); 6i: (3); 12j: (9)
4	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 4e: (3); 6f: (5); 6g: (4); 6h: (6); 6i: (5); 12j: (9)

M $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 3c: (3); 3d: (2); 4e: (3); 6f: (3); 6g: (5); 6h: (5); 6i: (5); 12j: (9)
2	(0, 0, 0)	1a: (1); 1b: (0); 3c: (2); 3d: (3); 4e: (3); 6f: (5); 6g: (5); 6h: (5); 6i: (3); 12j: (9)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 4e: (3); 6f: (5); 6g: (5); 6h: (3); 6i: (5); 12j: (9)
4	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 4e: (3); 6f: (5); 6g: (3); 6h: (5); 6i: (5); 12j: (9)

R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 4e: (1); 6f: (1); 6g: (2); 6h: (2); 6i: (1); 12j: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 4e: (1); 6f: (1); 6g: (2); 6h: (2); 6i: (1); 12j: (3)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 4e: (3); 6f: (5); 6g: (4); 6h: (4); 6i: (5); 12j: (9)

c. Results for high-symmetry lines

DT _(0, v, 0)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)			
LD _(u, u, u)						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)		
S _(u, $\frac{1}{2}$, u)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{33}^{-}
Coordinate	(u, $\frac{1}{2}$, u)	(u, $-\frac{1}{2}$, -u)	(u, u, $\frac{1}{2}$)	(-u, u, $-\frac{1}{2}$)	($\frac{1}{2}$, u, u)	($-\frac{1}{2}$, u, -u)
SM _(u, u, 0)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, 0)	(u, -u, 0)	(0, u, u)	(0, u, -u)	(u, 0, u)	(u, 0, -u)
T _($\frac{1}{2}$, $\frac{1}{2}$, w)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	(w, $\frac{1}{2}$, $\frac{1}{2}$)	($\frac{1}{2}$, w, $\frac{1}{2}$)			

 $ZA(\frac{1}{2}, u, 0)$

Operation	E	C_{31}^+	C_{33}^-
Coordinate	$(\frac{1}{2}, u, 0)$	$(0, \frac{1}{2}, u)$	$(-u, 0, -\frac{1}{2})$

 $Z(u, \frac{1}{2}, 0)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, \frac{1}{2}, 0)$	$(0, u, \frac{1}{2})$	$(\frac{1}{2}, 0, u)$

DT $(0, v, 0)$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (1); 3c: (3); 3d: (3); 4e: (6); 6f: (8); 6g: (8); 6h: (8); 6i: (8); 12j: (18)
2	$(0, r_1, 0)$	1a: (2); 1b: (2); 3c: (6); 3d: (6); 4e: (6); 6f: (10); 6g: (10); 6h: (10); 6i: (10); 12j: (18)

LD (u, u, u) of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	(r_1, r_1, r_1)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 4e: (4); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 12j: (12)
2	(r_1, r_1, r_1)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 4e: (4); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 12j: (12)
3	(r_1, r_1, r_1)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 4e: (4); 6f: (6); 6g: (6); 6h: (6); 6i: (6); 12j: (12)

S $(u, \frac{1}{2}, u)$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 3c: (9); 3d: (9); 4e: (12); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 12j: (36)

SM $(u, u, 0)$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 3c: (9); 3d: (9); 4e: (12); 6f: (18); 6g: (18); 6h: (18); 6i: (18); 12j: (36)

T $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (1); 3c: (5); 3d: (5); 4e: (6); 6f: (8); 6g: (10); 6h: (10); 6i: (8); 12j: (18)
2	$(0, 0, r_1)$	1a: (2); 1b: (2); 3c: (4); 3d: (4); 4e: (6); 6f: (10); 6g: (8); 6h: (8); 6i: (10); 12j: (18)

ZA $(\frac{1}{2}, u, 0)$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	1a: (1); 1b: (2); 3c: (5); 3d: (4); 4e: (6); 6f: (8); 6g: (10); 6h: (8); 6i: (10); 12j: (18)
2	$(0, r_1, 0)$	1a: (2); 1b: (1); 3c: (4); 3d: (5); 4e: (6); 6f: (10); 6g: (8); 6h: (10); 6i: (8); 12j: (18)

Z $(u, \frac{1}{2}, 0)$ of space group No. 195

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (2); 3c: (5); 3d: (4); 4e: (6); 6f: (8); 6g: (8); 6h: (10); 6i: (10); 12j: (18)
2	$(r_1, 0, 0)$	1a: (2); 1b: (1); 3c: (4); 3d: (5); 4e: (6); 6f: (10); 6g: (10); 6h: (8); 6i: (8); 12j: (18)

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^+	C_{31}^-			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^+	C_{31}^-			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

P1 (u, u, v) of space group No. 195											
(Co-) irrep	Phonon AM	WYPO information									
1	(r_3, r_2, r_1)	1a: (3);	1b: (3);	3c: (9);	3d: (9);	4e: (12);	6f: (18);	6g: (18);	6h: (18);	6i: (18);	12j: (36)
P2 ($u, v, 0$) of space group No. 195											
(Co-) irrep	Phonon AM	WYPO information									
1	$(r_2, r_1, 0)$	1a: (3);	1b: (3);	3c: (9);	3d: (9);	4e: (12);	6f: (18);	6g: (18);	6h: (18);	6i: (18);	12j: (36)
P4 ($u, \frac{1}{2}, v$) of space group No. 195											
(Co-) irrep	Phonon AM	WYPO information									
1	$(r_2, 0, r_1)$	1a: (3);	1b: (3);	3c: (9);	3d: (9);	4e: (12);	6f: (18);	6g: (18);	6h: (18);	6i: (18);	12j: (36)

196. Space group No. 196 ($F23$)

$$\begin{array}{ll}
 \vec{a} = (a, 0, 0) & \vec{t}_1 = \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \text{Cubic face-centered lattice} & \vec{b} = (0, a, 0) \quad \vec{t}_2 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\
 & \vec{c} = (0, 0, a) \quad \vec{t}_3 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b}
 \end{array}$$

a. Space group operations

$$\begin{array}{cccccccc}
 \{E|0,0,0\} & \{C_{2z}|0,0,0\} & \{C_{2y}|0,0,0\} & \{C_{2x}|0,0,0\} & \{C_{31}^+|0,0,0\} & \{C_{34}^+|0,0,0\} & \{C_{33}^+|0,0,0\} & \{C_{32}^+|0,0,0\} \\
 \{C_{31}^-|0,0,0\} & \{C_{33}^-|0,0,0\} & \{C_{32}^-|0,0,0\} & \{C_{34}^-|0,0,0\} & & & &
 \end{array}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$						
Operation	E					
Coordinate	$(0, 0, 0)$					
$X(\frac{1}{2}, 0, \frac{1}{2})$						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$	$(\frac{1}{2}, \frac{1}{2}, 0)$	$(0, \frac{1}{2}, \frac{1}{2})$			
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, 0)$	$(0, -\frac{1}{2}, 0)$	$(0, 0, -\frac{1}{2})$		
$W(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$						
Operation	E	C_{2z}	C_{31}^{+}	C_{34}^{+}	C_{31}^{-}	C_{33}^{-}
Coordinate	$(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$	$(-\frac{1}{2}, -\frac{1}{4}, -\frac{3}{4})$	$(\frac{3}{4}, \frac{1}{2}, \frac{1}{4})$	$(-\frac{3}{4}, -\frac{1}{2}, -\frac{1}{4})$	$(\frac{1}{4}, \frac{3}{4}, \frac{1}{2})$	$(-\frac{1}{4}, -\frac{3}{4}, -\frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 196								
(Co-) irrep	Phonon AM	WYPO information						
1	$(0, 0, 0)$	4a: (0);	4b: (0);	4c: (0);	4d: (0);	16e: (1);	24f: (1);	24g: (1); 48h: (3)
2	$(0, 0, 0)$	4a: (0);	4b: (0);	4c: (0);	4d: (0);	16e: (1);	24f: (1);	24g: (1); 48h: (3)
3	$(0, 0, 0)$	4a: (1);	4b: (1);	4c: (1);	4d: (1);	16e: (3);	24f: (5);	24g: (5); 48h: (9)
$X(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 196								
(Co-) irrep	Phonon AM	WYPO information						
1	$(0, 0, 0)$	4a: (0);	4b: (0);	4c: (1);	4d: (1);	16e: (3);	24f: (3);	24g: (5); 48h: (9)
2	$(0, 0, 0)$	4a: (1);	4b: (1);	4c: (1);	4d: (1);	16e: (3);	24f: (5);	24g: (5); 48h: (9)
3	$(0, 0, 0)$	4a: (1);	4b: (1);	4c: (0);	4d: (0);	16e: (3);	24f: (5);	24g: (3); 48h: (9)
4	$(0, 0, 0)$	4a: (1);	4b: (1);	4c: (1);	4d: (1);	16e: (3);	24f: (5);	24g: (5); 48h: (9)
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 196								
(Co-) irrep	Phonon AM	WYPO information						
1	$(0, 0, 0)$	4a: (1);	4b: (1);	4c: (1);	4d: (1);	16e: (4);	24f: (6);	24g: (6); 48h: (12)
2	$(0, 0, 0)$	4a: (1);	4b: (1);	4c: (1);	4d: (1);	16e: (4);	24f: (6);	24g: (6); 48h: (12)
$W(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$ of space group No. 196								
(Co-) irrep	Phonon AM	WYPO information						
1	$(r_1, 0, 0)$	4a: (1);	4b: (1);	4c: (2);	4d: (2);	16e: (6);	24f: (8);	24g: (10); 48h: (18)
2	$(r_1, 0, 0)$	4a: (2);	4b: (2);	4c: (1);	4d: (1);	16e: (6);	24f: (10);	24g: (8); 48h: (18)

c. Results for high-symmetry lines

$$DT(\frac{y}{2}, 0, \frac{y}{2})$$

Operation Coordinate	E $(\frac{u}{2}, 0, \frac{u}{2})$	C_{31}^{+} $(\frac{u}{2}, \frac{u}{2}, 0)$	C_{31}^{-} $(0, \frac{u}{2}, \frac{u}{2})$	
LD(u, u, u)				
Operation Coordinate	E (u, u, u)	C_{2x} $(-u, 0, 0)$	C_{2y} $(0, -u, 0)$	C_{2z} $(0, 0, -u)$
Q($\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v)$)				
Operation Coordinate	E $(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$	C_{2y} $(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$	C_{31}^{+} $(\frac{1}{4}(1+2v), \frac{1}{2}, \frac{1}{4}(3-2v))$	C_{33}^{+} $(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(-3+2v))$
	C_{31}^{-} $(\frac{1}{4}(3-2v), \frac{1}{4}(1+2v), \frac{1}{2})$	C_{32}^{-} $(\frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$		
SM($\frac{u}{2}, \frac{u}{2}, u$)				
Operation Coordinate	E $(\frac{u}{2}, \frac{u}{2}, u)$	C_{2x} $(-\frac{u}{2}, \frac{u}{2}, 0)$	C_{31}^{+} $(u, \frac{u}{2}, \frac{u}{2})$	C_{32}^{+} $(0, -\frac{u}{2}, \frac{u}{2})$
			C_{31}^{-} $(\frac{u}{2}, u, \frac{u}{2})$	C_{32}^{-} $(-\frac{u}{2}, 0, \frac{u}{2})$
V($\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}$)				
Operation Coordinate	E $(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$	C_{31}^{+} $(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2})$	C_{31}^{-} $(\frac{u}{2}, \frac{1+u}{2}, \frac{1}{2})$	

DT $\left(\frac{v}{2}, 0, \frac{v}{2}\right)$ of space group No. 196						
(Co-) irrep	Phonon AM	WYPO information				
1	$(0, r_1, 0)$	4a: (1);	4b: (1);	4c: (1);	4d: (1);	16e: (6); 24f: (8); 24g: (8); 48h: (18)
2	$(0, r_1, 0)$	4a: (2);	4b: (2);	4c: (2);	4d: (2);	16e: (6); 24f: (10); 24g: (10); 48h: (18)
LD (u, u, u) of space group No. 196						
(Co-) irrep	Phonon AM	WYPO information				
1	(r_1, r_1, r_1)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	16e: (4); 24f: (6); 24g: (6); 48h: (12)
2	(r_1, r_1, r_1)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	16e: (4); 24f: (6); 24g: (6); 48h: (12)
3	(r_1, r_1, r_1)	4a: (1);	4b: (1);	4c: (1);	4d: (1);	16e: (4); 24f: (6); 24g: (6); 48h: (12)
Q $\left(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v)\right)$ of space group No. 196						
(Co-) irrep	Phonon AM	WYPO information				
1	(r_3, r_2, r_1)	4a: (3);	4b: (3);	4c: (3);	4d: (3);	16e: (12); 24f: (18); 24g: (18); 48h: (36)
SM $\left(\frac{u}{2}, \frac{u}{2}, u\right)$ of space group No. 196						
(Co-) irrep	Phonon AM	WYPO information				
1	$(r_2, r_1, 0)$	4a: (3);	4b: (3);	4c: (3);	4d: (3);	16e: (12); 24f: (18); 24g: (18); 48h: (36)
V $\left(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}\right)$ of space group No. 196						
(Co-) irrep	Phonon AM	WYPO information				
1	$(r_1, 0, 0)$	4a: (1);	4b: (1);	4c: (2);	4d: (2);	16e: (6); 24f: (8); 24g: (10); 48h: (18)
2	$(r_1, 0, 0)$	4a: (2);	4b: (2);	4c: (1);	4d: (1);	16e: (6); 24f: (10); 24g: (8); 48h: (18)

d. Results for high-symmetry planes

P1($u, v, u + v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, u + v)$	$(u + v, u, v)$	$(v, u + v, u)$

P2(u, u, v)

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-u, -u + v, 0)$	(v, u, u)	$(0, -u, -u + v)$	(u, v, u)	$(-u, 0, -u + v)$

P1 ($u, v, u + v$) of space group No. 196

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (3); 4b: (3); 4c: (3); 4d: (3); 16e: (12); 24f: (18); 24g: (18); 48h: (36)

P2 (u, u, v) of space group No. 196		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 16e: (12); 24f: (18); 24g: (18); 48h: (36)

197. Space group No. 197 ($I23$)

Cubic body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \\ &\{C_{31}^-|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \end{aligned}$$

b. Results for high-symmetry points

 $\Gamma(0, 0, 0)$

Operation	E
Coordinate	$(0, 0, 0)$

H($\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}$)

Operation	E
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$

$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$						
Operation	E	$E\Theta$				
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$				
$N(0, 0, \frac{1}{2})$						
Operation	E	C_{2y}	C_{31}^{+}	C_{33}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, \frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 197						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (1);	12e: (1); 24f: (3)
2	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (1);	12e: (1); 24f: (3)
3	(0, 0, 0)	2a: (1);	6b: (3);	8c: (3);	12d: (5);	12e: (5); 24f: (9)
$H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 197						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (1);	12e: (1); 24f: (3)
2	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (1);	12e: (1); 24f: (3)
3	(0, 0, 0)	2a: (1);	6b: (3);	8c: (3);	12d: (5);	12e: (5); 24f: (9)
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 197						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	2a: (0);	6b: (1);	8c: (1);	12d: (1);	12e: (2); 24f: (3)
2	(0, 0, 0)	2a: (0);	6b: (1);	8c: (1);	12d: (1);	12e: (2); 24f: (3)
3	(0, 0, 0)	2a: (0);	6b: (1);	8c: (1);	12d: (1);	12e: (2); 24f: (3)
4	(0, 0, 0)	2a: (1);	6b: (2);	8c: (3);	12d: (5);	12e: (4); 24f: (9)
$N(0, 0, \frac{1}{2})$ of space group No. 197						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	2a: (1);	6b: (5);	8c: (6);	12d: (8);	12e: (10); 24f: (18)
2	(0, 0, 0)	2a: (2);	6b: (4);	8c: (6);	12d: (10);	12e: (8); 24f: (18)

c. Results for high-symmetry lines

D($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)				
Operation	E	C_{31}^+	C_{31}^-	
Coordinate	($\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}$)	($\frac{1-w}{2}, \frac{w}{2}, \frac{w}{2}$)	($\frac{w}{2}, \frac{1-w}{2}, \frac{w}{2}$)	
DT($\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}$)				
Operation	E	C_{31}^+	C_{31}^-	
Coordinate	($\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}$)	($\frac{v}{2}, \frac{v}{2}, -\frac{v}{2}$)	($-\frac{v}{2}, \frac{v}{2}, \frac{v}{2}$)	

$G(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	$(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$	$(-\frac{3}{2}, \frac{1}{2}, \frac{1}{2} + u)$	$(\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u)$	$(\frac{1}{2} + u, -\frac{3}{2}, \frac{1}{2})$	$(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$	$(-\frac{3}{2}, \frac{1}{2} - u, \frac{1}{2})$

 $LD(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$

Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$

 $SM_{(0,0,u)}$

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	$(0, 0, u)$	$(-u, u, 0)$	$(u, 0, 0)$	$(0, -u, u)$	$(0, u, 0)$	$(-u, 0, u)$

 $D(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 197

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 6b: (5); 8c: (6); 12d: (8); 12e: (10); 24f: (18)
2	$(0, 0, r_1)$	2a: (2); 6b: (4); 8c: (6); 12d: (10); 12e: (8); 24f: (18)

 $DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$ of space group No. 197

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 6b: (3); 8c: (6); 12d: (8); 12e: (8); 24f: (18)
2	$(0, r_1, 0)$	2a: (2); 6b: (6); 8c: (6); 12d: (10); 12e: (10); 24f: (18)

 $G(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$ of space group No. 197

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 24f: (36)

 $LD(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 197

(Co-) irrep	Phonon AM	WYPO information
1	(r_1, r_1, r_1)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 24f: (12)
2	(r_1, r_1, r_1)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 24f: (12)
3	(r_1, r_1, r_1)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 24f: (12)

 $SM(0, 0, u)$ of space group No. 197

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 24f: (36)

d. Results for high-symmetry planes

 $PI(u, u, v)$

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-2u - v, v, u)$	(v, u, u)	$(u, -2u - v, v)$	(u, v, u)	$(-2u - v, u, v)$

P2($u, -u, v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, -u, v)$	$(v, u, -u)$	$(-u, v, u)$

P1 (u, u, v) of space group No. 197

(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 24f: (36)

P2 ($u, -u, v$) of space group No. 197

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 24f: (36)

198. Space group No. 198 ($P2_13$)

Cubic primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_{2z}|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{2y}|0, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{2x}|\frac{1}{2}, -\frac{1}{2}, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{34}^+|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{33}^+|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{32}^+|0, \frac{1}{2}, -\frac{1}{2}\} \\ &\{C_{31}^-|0, 0, 0\} \quad \{C_{33}^-|0, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{32}^-|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{34}^-|-\frac{1}{2}, 0, \frac{1}{2}\} \end{aligned}$$

b. Results for high-symmetry points

 $\Gamma(0, 0, 0)$

Operation	E
Coordinate	$(0, 0, 0)$

 $X(0, \frac{1}{2}, 0)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$

 $M(\frac{1}{2}, \frac{1}{2}, 0)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$

$$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{ll} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 198		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 12b: (3)
2	(0, 0, 0)	4a: (1); 12b: (3)
3	(0, 0, 0)	4a: (3); 12b: (9)
$X (0, \frac{1}{2}, 0)$ of space group No. 198		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 12b: (18)
$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 198		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 12b: (9)
2	(0, 0, 0)	4a: (3); 12b: (9)
$R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 198		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 12b: (3)
2	(0, 0, 0)	4a: (2); 12b: (6)

c. Results for high-symmetry lines

$DT_{(0, v, 0)}$						
Operation	E	C_{31}^+	C_{31}^-			
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)			
$LD_{(u, u, u)}$						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)		
$S_{(u, \frac{1}{2}, u)}$						
Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{33}^-
Coordinate	(u, $\frac{1}{2}$, u)	(u, $-\frac{1}{2}$, -u)	(u, u, $\frac{1}{2}$)	(-u, u, $-\frac{1}{2}$)	($\frac{1}{2}$, u, u)	($-\frac{1}{2}$, u, -u)
$SM_{(u, u, 0)}$						
Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, 0)	(u, -u, 0)	(0, u, u)	(0, u, -u)	(u, 0, u)	(u, 0, -u)

$T(\frac{1}{2}, \frac{1}{2}, w)$			
Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	$(w, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, w, \frac{1}{2})$
$ZA(\frac{1}{2}, u, 0)$			
Operation	E	C_{31}^+	C_{33}^-
Coordinate	$(\frac{1}{2}, u, 0)$	$(0, \frac{1}{2}, u)$	$(-u, 0, -\frac{1}{2})$
$Z(u, \frac{1}{2}, 0)$			
Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, \frac{1}{2}, 0)$	$(0, u, \frac{1}{2})$	$(\frac{1}{2}, 0, u)$

DT $(0, v, 0)$ of space group No. 198			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	4a: (6); 12b: (18)	
2	$(0, r_1, 0)$	4a: (6); 12b: (18)	
LD (u, u, u) of space group No. 198			
(Co-) irrep	Phonon AM	WYPO information	
1	(r_1, r_1, r_1)	4a: (4); 12b: (12)	
2	(r_1, r_1, r_1)	4a: (4); 12b: (12)	
3	(r_1, r_1, r_1)	4a: (4); 12b: (12)	
S $(u, \frac{1}{2}, u)$ of space group No. 198			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, 0, r_1)$	4a: (6); 12b: (18)	
SM $(u, u, 0)$ of space group No. 198			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	4a: (12); 12b: (36)	
T $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 198			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	4a: (3); 12b: (9)	
2	$(0, 0, r_1)$	4a: (3); 12b: (9)	
ZA $(\frac{1}{2}, u, 0)$ of space group No. 198			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	4a: (6); 12b: (18)	
Z $(u, \frac{1}{2}, 0)$ of space group No. 198			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_1, 0, 0)$	4a: (6); 12b: (18)	

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

P1 (u, u, v) of space group No. 198		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	4a: (12); 12b: (36)
P2 ($u, v, 0$) of space group No. 198		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12); 12b: (36)
P4 ($u, \frac{1}{2}, v$) of space group No. 198		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6); 12b: (18)

199. Space group No. 199 ($I2_13$)

Cubic body-centered lattice

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\
 \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}
 \end{aligned}$$

a. Space group operations

$$\begin{aligned}
 &\{E|0,0,0\} \quad \{C_{2z}|\frac{1}{2},0,\frac{1}{2}\} \quad \{C_{2y}|0,\frac{1}{2},\frac{1}{2}\} \quad \{C_{2x}|\frac{1}{2},-\frac{1}{2},0\} \quad \{C_{31}^+|0,0,0\} \quad \{C_{34}^+|\frac{1}{2},\frac{1}{2},0\} \quad \{C_{33}^+|\frac{1}{2},0,\frac{1}{2}\} \quad \{C_{32}^+|0,\frac{1}{2},-\frac{1}{2}\} \\
 &\{C_{31}^-|0,0,0\} \quad \{C_{33}^-|0,\frac{1}{2},\frac{1}{2}\} \quad \{C_{32}^-|\frac{1}{2},\frac{1}{2},0\} \quad \{C_{34}^-|-\frac{1}{2},0,\frac{1}{2}\}
 \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$						
Operation	E					
Coordinate	$(0, 0, 0)$					
$H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$						
Operation	E					
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$					
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$						
Operation	E	$E\Theta$				
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	$(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$				
$N(0, 0, \frac{1}{2})$						
Operation	E	C_{2y}	C_{31}^{+}	C_{33}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, \frac{1}{2})$

Γ (0, 0, 0) of space group No. 199			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	8a: (1);	12b: (1); 24c: (3)
2	(0, 0, 0)	8a: (1);	12b: (1); 24c: (3)
3	(0, 0, 0)	8a: (3);	12b: (5); 24c: (9)
H ($\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}$) of space group No. 199			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	8a: (1);	12b: (2); 24c: (3)
2	(0, 0, 0)	8a: (1);	12b: (2); 24c: (3)
3	(0, 0, 0)	8a: (3);	12b: (4); 24c: (9)
P ($\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$) of space group No. 199			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	8a: (2);	12b: (3); 24c: (6)
2	(0, 0, 0)	8a: (2);	12b: (3); 24c: (6)
3	(0, 0, 0)	8a: (2);	12b: (3); 24c: (6)
N (0, 0, $\frac{1}{2}$) of space group No. 199			
(Co-) irrep	Phonon AM	WYPO information	
1	(0, 0, 0)	8a: (6);	12b: (9); 24c: (18)
2	(0, 0, 0)	8a: (6);	12b: (9); 24c: (18)

c. Results for high-symmetry lines

$D(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	$(\frac{1-w}{2}, \frac{w}{2}, \frac{w}{2})$	$(\frac{w}{2}, \frac{1-w}{2}, \frac{w}{2})$			
$DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, -\frac{v}{2})$	$(-\frac{v}{2}, \frac{v}{2}, \frac{v}{2})$			
$G(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$	$(-\frac{3}{2}, \frac{1}{2}, \frac{1}{2} + u)$	$(\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u)$	$(\frac{1}{2} + u, -\frac{3}{2}, \frac{1}{2})$	$(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$	$(-\frac{3}{2}, \frac{1}{2} - u, \frac{1}{2})$
$LD(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$		
$SM_{(0, 0, u)}$						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(0, 0, u)$	$(-u, u, 0)$	$(u, 0, 0)$	$(0, -u, u)$	$(0, u, 0)$	$(-u, 0, u)$

D $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 199			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, 0, r_1)$	8a: (6); 12b: (9); 24c: (18)	
2	$(0, 0, r_1)$	8a: (6); 12b: (9); 24c: (18)	
DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 199			
(Co-) irrep	Phonon AM	WYPO information	
1	$(0, r_1, 0)$	8a: (6); 12b: (8); 24c: (18)	
2	$(0, r_1, 0)$	8a: (6); 12b: (10); 24c: (18)	
G $\left(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 199			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	8a: (12); 12b: (18); 24c: (36)	
LD $\left(\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 199			
(Co-) irrep	Phonon AM	WYPO information	
1	(r_1, r_1, r_1)	8a: (4); 12b: (6); 24c: (12)	
2	(r_1, r_1, r_1)	8a: (4); 12b: (6); 24c: (12)	
3	(r_1, r_1, r_1)	8a: (4); 12b: (6); 24c: (12)	
SM $(0, 0, u)$ of space group No. 199			
(Co-) irrep	Phonon AM	WYPO information	
1	$(r_2, r_1, 0)$	8a: (12); 12b: (18); 24c: (36)	

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(-2u - v, v, u)$	(v, u, u)	$(u, -2u - v, v)$	(u, v, u)	$(-2u - v, u, v)$
P2($u, -u, v$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, -u, v)$	$(v, u, -u)$	$(-u, v, u)$			

P1 (u, u, v) of space group No. 199		
(Co-) irrep	Phonon AM	WYPO information
1	(r_3, r_2, r_1)	8a: (12); 12b: (18); 24c: (36)
P2 ($u, -u, v$) of space group No. 199		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	8a: (12); 12b: (18); 24c: (36)

200. Space group No. 200 ($Pm\bar{3}$)

Cubic primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \\ &\{C_{31}^-|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \\ &\{S_{61}^-|0, 0, 0\} \quad \{S_{64}^-|0, 0, 0\} \quad \{S_{63}^-|0, 0, 0\} \quad \{S_{62}^-|0, 0, 0\} \quad \{S_{61}^+|0, 0, 0\} \quad \{S_{63}^+|0, 0, 0\} \quad \{S_{62}^+|0, 0, 0\} \quad \{S_{64}^+|0, 0, 0\} \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$X(0, \frac{1}{2}, 0)$			
Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$
$M(\frac{1}{2}, \frac{1}{2}, 0)$			
Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$
$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
Operation	E		
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		

$\Gamma(0, 0, 0)$ of space group No. 200											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	6e: (1);	6f: (1);	6g: (1);	6h: (1);	8i: (1);	12j: (2); 12k: (2); 24l: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	6e: (1);	6f: (1);	6g: (1);	6h: (1);	8i: (1);	12j: (2); 12k: (2); 24l: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	6e: (2);	6f: (2);	6g: (2);	6h: (2);	8i: (3);	12j: (4); 12k: (4); 24l: (9)
4	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	6e: (0);	6f: (0);	6g: (0);	6h: (0);	8i: (1);	12j: (1); 12k: (1); 24l: (3)
5	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	6e: (0);	6f: (0);	6g: (0);	6h: (0);	8i: (1);	12j: (1); 12k: (1); 24l: (3)
6	(0, 0, 0)	1a: (1);	1b: (1);	3c: (3);	3d: (3);	6e: (3);	6f: (3);	6g: (3);	6h: (3);	8i: (3);	12j: (5); 12k: (5); 24l: (9)
$X(0, \frac{1}{2}, 0)$ of space group No. 200											
(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (1);	3c: (2);	3d: (1);	6e: (3);	6f: (3);	6g: (3);	6h: (3);	8i: (3);	12j: (6); 12k: (5); 24l: (9)
2	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	6e: (2);	6f: (1);	6g: (1);	6h: (0);	8i: (3);	12j: (4); 12k: (3); 24l: (9)
3	(0, 0, 0)	1a: (0);	1b: (1);	3c: (2);	3d: (1);	6e: (2);	6f: (3);	6g: (2);	6h: (3);	8i: (3);	12j: (4); 12k: (5); 24l: (9)
4	(0, 0, 0)	1a: (0);	1b: (1);	3c: (2);	3d: (1);	6e: (2);	6f: (2);	6g: (3);	6h: (3);	8i: (3);	12j: (4); 12k: (5); 24l: (9)
5	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	6e: (0);	6f: (1);	6g: (1);	6h: (2);	8i: (3);	12j: (3); 12k: (4); 24l: (9)
6	(0, 0, 0)	1a: (1);	1b: (0);	3c: (1);	3d: (2);	6e: (3);	6f: (3);	6g: (3);	6h: (3);	8i: (3);	12j: (5); 12k: (6); 24l: (9)
7	(0, 0, 0)	1a: (1);	1b: (0);	3c: (1);	3d: (2);	6e: (3);	6f: (3);	6g: (2);	6h: (2);	8i: (3);	12j: (5); 12k: (4); 24l: (9)

8	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (2); 6e: (3); 6f: (2); 6g: (3); 6h: (2); 8i: (3); 12j: (5); 12k: (4); 24l: (9)

$M\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 200

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 3c: (2); 3d: (2); 6e: (3); 6f: (3); 6g: (3); 6h: (2); 8i: (3); 12j: (6); 12k: (4); 24l: (9)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 6g: (1); 6h: (2); 8i: (3); 12j: (4); 12k: (4); 24l: (9)
3	(0, 0, 0)	1a: (0); 1b: (0); 3c: (2); 3d: (2); 6e: (2); 6f: (3); 6g: (3); 6h: (3); 8i: (3); 12j: (4); 12k: (6); 24l: (9)
4	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (1); 6g: (2); 6h: (2); 8i: (3); 12j: (4); 12k: (4); 24l: (9)
5	(0, 0, 0)	1a: (0); 1b: (1); 3c: (1); 3d: (0); 6e: (0); 6f: (2); 6g: (2); 6h: (3); 8i: (3); 12j: (3); 12k: (5); 24l: (9)
6	(0, 0, 0)	1a: (1); 1b: (1); 3c: (1); 3d: (1); 6e: (3); 6f: (3); 6g: (2); 6h: (3); 8i: (3); 12j: (5); 12k: (5); 24l: (9)
7	(0, 0, 0)	1a: (1); 1b: (0); 3c: (0); 3d: (1); 6e: (3); 6f: (2); 6g: (2); 6h: (0); 8i: (3); 12j: (5); 12k: (3); 24l: (9)
8	(0, 0, 0)	1a: (1); 1b: (1); 3c: (1); 3d: (1); 6e: (3); 6f: (2); 6g: (3); 6h: (3); 8i: (3); 12j: (5); 12k: (5); 24l: (9)

$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 200

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (1); 6e: (1); 6f: (1); 6g: (1); 6h: (0); 8i: (1); 12j: (2); 12k: (1); 24l: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (1); 6e: (1); 6f: (1); 6g: (1); 6h: (0); 8i: (1); 12j: (2); 12k: (1); 24l: (3)
3	(0, 0, 0)	1a: (0); 1b: (1); 3c: (0); 3d: (2); 6e: (2); 6f: (2); 6g: (2); 6h: (3); 8i: (3); 12j: (4); 12k: (5); 24l: (9)
4	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (0); 6e: (0); 6f: (1); 6g: (1); 6h: (1); 8i: (1); 12j: (1); 12k: (2); 24l: (3)
5	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (0); 6e: (0); 6f: (1); 6g: (1); 6h: (1); 8i: (1); 12j: (1); 12k: (2); 24l: (3)
6	(0, 0, 0)	1a: (1); 1b: (0); 3c: (2); 3d: (0); 6e: (3); 6f: (2); 6g: (2); 6h: (2); 8i: (3); 12j: (5); 12k: (4); 24l: (9)

c. Results for high-symmetry lines

$DT_{(0, v, 0)}$

Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)

$LD_{(u, u, u)}$

Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)

$S_{(u, \frac{1}{2}, u)}$

Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{33}^{-}

Coordinate	$(u, \frac{1}{2}, u)$	$(u, -\frac{1}{2}, -u)$	$(u, u, \frac{1}{2})$	$(-u, u, -\frac{1}{2})$	$(\frac{1}{2}, u, u)$	$(-\frac{1}{2}, u, -u)$
SM($u, u, 0$)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(u, u, 0)$	$(u, -u, 0)$	$(0, u, u)$	$(0, u, -u)$	$(u, 0, u)$	$(u, 0, -u)$
T($\frac{1}{2}, \frac{1}{2}, w$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	$(w, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, w, \frac{1}{2})$			
ZA($\frac{1}{2}, u, 0$)						
Operation	E	C_{31}^{+}	C_{33}^{-}			
Coordinate	$(\frac{1}{2}, u, 0)$	$(0, \frac{1}{2}, u)$	$(-u, 0, -\frac{1}{2})$			
Z($u, \frac{1}{2}, 0$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, \frac{1}{2}, 0)$	$(0, u, \frac{1}{2})$	$(\frac{1}{2}, 0, u)$			

DT $(0, v, 0)$ of space group No. 200

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 8i: (6); 12j: (11); 12k: (11); 24l: (18)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (2); 6f: (2); 6g: (2); 6h: (2); 8i: (6); 12j: (7); 12k: (7); 24l: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (5); 6g: (5); 6h: (5); 8i: (6); 12j: (9); 12k: (9); 24l: (18)
4	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (5); 6g: (5); 6h: (5); 8i: (6); 12j: (9); 12k: (9); 24l: (18)

LD (u, u, u) of space group No. 200

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 8i: (8); 12j: (12); 12k: (12); 24l: (24)
2	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (6); 6h: (6); 8i: (8); 12j: (12); 12k: (12); 24l: (24)

S $(u, \frac{1}{2}, u)$ of space group No. 200

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 3c: (4); 3d: (5); 6e: (11); 6f: (9); 6g: (9); 6h: (7); 8i: (12); 12j: (20); 12k: (16); 24l: (36)
2	(0, 0, 0)	1a: (1); 1b: (2); 3c: (5); 3d: (4); 6e: (7); 6f: (9); 6g: (9); 6h: (11); 8i: (12); 12j: (16); 12k: (20); 24l: (36)

SM $(u, u, 0)$ of space group No. 200

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 3c: (6); 3d: (6); 6e: (11); 6f: (11); 6g: (11); 6h: (11); 8i: (12); 12j: (20); 12k: (20); 24l: (36)

2	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (7); 6f: (7); 6g: (7); 6h: (7); 8i: (12); 12j: (16); 12k: (16); 24l: (36)

$T\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 200

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (0); 3c: (2); 3d: (3); 6e: (6); 6f: (5); 6g: (5); 6h: (2); 8i: (6); 12j: (11); 12k: (7); 24l: (18)
2	(0, 0, 0)	1a: (0); 1b: (1); 3c: (3); 3d: (2); 6e: (2); 6f: (5); 6g: (5); 6h: (6); 8i: (6); 12j: (7); 12k: (11); 24l: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (5); 6f: (4); 6g: (4); 6h: (5); 8i: (6); 12j: (9); 12k: (9); 24l: (18)
4	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (5); 6f: (4); 6g: (4); 6h: (5); 8i: (6); 12j: (9); 12k: (9); 24l: (18)

$ZA\left(\frac{1}{2}, u, 0\right)$ of space group No. 200

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 6g: (5); 6h: (5); 8i: (6); 12j: (11); 12k: (9); 24l: (18)
2	(0, 0, 0)	1a: (0); 1b: (1); 3c: (2); 3d: (1); 6e: (2); 6f: (4); 6g: (3); 6h: (5); 8i: (6); 12j: (7); 12k: (9); 24l: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (5); 6g: (6); 6h: (6); 8i: (6); 12j: (9); 12k: (11); 24l: (18)
4	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (2); 6e: (5); 6f: (3); 6g: (4); 6h: (2); 8i: (6); 12j: (9); 12k: (7); 24l: (18)

$Z\left(u, \frac{1}{2}, 0\right)$ of space group No. 200

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (5); 6g: (6); 6h: (5); 8i: (6); 12j: (11); 12k: (9); 24l: (18)
2	(0, 0, 0)	1a: (0); 1b: (1); 3c: (2); 3d: (1); 6e: (2); 6f: (3); 6g: (4); 6h: (5); 8i: (6); 12j: (7); 12k: (9); 24l: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (6); 6g: (5); 6h: (6); 8i: (6); 12j: (9); 12k: (11); 24l: (18)
4	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (2); 6e: (5); 6f: (4); 6g: (3); 6h: (2); 8i: (6); 12j: (9); 12k: (7); 24l: (18)

d. Results for high-symmetry planes

$P1(u, u, v)$

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$

$P2(u, v, 0)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$

$P4\left(u, \frac{1}{2}, v\right)$

Operation	E	C_{31}^+	C_{31}^-

Coordinate $(u, \frac{1}{2}, v)$ $(v, u, \frac{1}{2})$ $(\frac{1}{2}, v, u)$

P1 (u, u, v) of space group No. 200		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (3); 1b: (3); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 6g: (18); 6h: (18); 8i: (24); 12j: (36); 12k: (36); 24l: (72)
P2 $(u, v, 0)$ of space group No. 200		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 3c: (6); 3d: (6); 6e: (11); 6f: (11); 6g: (11); 6h: (11); 8i: (12); 12j: (20); 12k: (20); 24l: (36)
2	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (7); 6f: (7); 6g: (7); 6h: (7); 8i: (12); 12j: (16); 12k: (16); 24l: (36)
P4 $(u, \frac{1}{2}, v)$ of space group No. 200		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 3c: (4); 3d: (5); 6e: (11); 6f: (9); 6g: (9); 6h: (7); 8i: (12); 12j: (20); 12k: (16); 24l: (36)
2	(0, 0, 0)	1a: (1); 1b: (2); 3c: (5); 3d: (4); 6e: (7); 6f: (9); 6g: (9); 6h: (11); 8i: (12); 12j: (16); 12k: (20); 24l: (36)

201. Space group No. 201 ($Pn3$)

$$\begin{aligned}
 \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\
 \text{Cubic primitive lattice} \quad \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\
 \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}
 \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_{2z} 0, 0, 0\}$	$\{C_{2y} 0, 0, 0\}$	$\{C_{2x} 0, 0, 0\}$	$\{C_{31}^+ 0, 0, 0\}$	$\{C_{34}^+ 0, 0, 0\}$	$\{C_{33}^+ 0, 0, 0\}$	$\{C_{32}^+ 0, 0, 0\}$
$\{C_{31}^- 0, 0, 0\}$	$\{C_{33}^- 0, 0, 0\}$	$\{C_{32}^- 0, 0, 0\}$	$\{C_{34}^- 0, 0, 0\}$	$\{I \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_z \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_y \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_x \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$
$\{S_{61}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{64}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{63}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{62}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{61}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{63}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{62}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{64}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		

$X(0, \frac{1}{2}, 0)$			
Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$

$M(\frac{1}{2}, \frac{1}{2}, 0)$			
Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$

$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
Operation	E		
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		

$\Gamma(0, 0, 0)$ of space group No. 201									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (0);	4b: (0);	4c: (0);	6d: (0);	8e: (1);	12f: (1);	12g: (1);	24h: (3)
2	(0, 0, 0)	2a: (0);	4b: (0);	4c: (0);	6d: (0);	8e: (1);	12f: (1);	12g: (1);	24h: (3)
3	(0, 0, 0)	2a: (1);	4b: (0);	4c: (0);	6d: (3);	8e: (3);	12f: (5);	12g: (5);	24h: (9)
4	(0, 0, 0)	2a: (0);	4b: (1);	4c: (1);	6d: (0);	8e: (1);	12f: (1);	12g: (1);	24h: (3)
5	(0, 0, 0)	2a: (0);	4b: (1);	4c: (1);	6d: (0);	8e: (1);	12f: (1);	12g: (1);	24h: (3)
6	(0, 0, 0)	2a: (1);	4b: (3);	4c: (3);	6d: (3);	8e: (3);	12f: (5);	12g: (5);	24h: (9)
$X(0, \frac{1}{2}, 0)$ of space group No. 201									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	4b: (3);	4c: (3);	6d: (3);	8e: (6);	12f: (8);	12g: (8);	24h: (18)
2	(0, 0, 0)	2a: (2);	4b: (3);	4c: (3);	6d: (6);	8e: (6);	12f: (10);	12g: (10);	24h: (18)
$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 201									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (1);	4b: (3);	4c: (3);	6d: (5);	8e: (6);	12f: (8);	12g: (10);	24h: (18)
2	(0, 0, 0)	2a: (2);	4b: (3);	4c: (3);	6d: (4);	8e: (6);	12f: (10);	12g: (8);	24h: (18)
$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 201									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	2a: (0);	4b: (0);	4c: (1);	6d: (1);	8e: (1);	12f: (1);	12g: (2);	24h: (3)
2	(0, 0, 0)	2a: (0);	4b: (0);	4c: (1);	6d: (1);	8e: (1);	12f: (1);	12g: (2);	24h: (3)
3	(0, 0, 0)	2a: (1);	4b: (0);	4c: (3);	6d: (2);	8e: (3);	12f: (5);	12g: (4);	24h: (9)
4	(0, 0, 0)	2a: (0);	4b: (1);	4c: (0);	6d: (1);	8e: (1);	12f: (1);	12g: (2);	24h: (3)
5	(0, 0, 0)	2a: (0);	4b: (1);	4c: (0);	6d: (1);	8e: (1);	12f: (1);	12g: (2);	24h: (3)
6	(0, 0, 0)	2a: (1);	4b: (3);	4c: (0);	6d: (2);	8e: (3);	12f: (5);	12g: (4);	24h: (9)

c. Results for high-symmetry lines

DT _(0, v, 0)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)			
LD _(u, u, u)						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)		
S _(u, ½, u)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{33}^{-}
Coordinate	(u, ½, u)	(u, -½, -u)	(u, u, ½)	(-u, u, -½)	(½, u, u)	(-½, u, -u)
SM _(u, u, 0)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, 0)	(u, -u, 0)	(0, u, u)	(0, u, -u)	(u, 0, u)	(u, 0, -u)
T _(½, ½, w)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	(½, ½, w)	(w, ½, ½)	(½, w, ½)			
ZA _(½, u, 0)						
Operation	E	C_{31}^{+}	C_{33}^{-}			
Coordinate	(½, u, 0)	(0, ½, u)	(-u, 0, -½)			
Z _(u, ½, 0)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	(u, ½, 0)	(0, u, ½)	(½, 0, u)			

DT $(0, v, 0)$ of space group No. 201

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (1); 4b: (3); 4c: (3); 6d: (3); 8e: (6); 12f: (8); 12g: (8); 24h: (18)
2	$(0, 0, 0)$	2a: (1); 4b: (3); 4c: (3); 6d: (3); 8e: (6); 12f: (8); 12g: (8); 24h: (18)
3	$(0, 0, 0)$	2a: (2); 4b: (3); 4c: (3); 6d: (6); 8e: (6); 12f: (10); 12g: (10); 24h: (18)
4	$(0, 0, 0)$	2a: (2); 4b: (3); 4c: (3); 6d: (6); 8e: (6); 12f: (10); 12g: (10); 24h: (18)

LD (u, u, u) of space group No. 201

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	2a: (2); 4b: (4); 4c: (4); 6d: (6); 8e: (8); 12f: (12); 12g: (12); 24h: (24)
2	$(0, 0, 0)$	2a: (2); 4b: (4); 4c: (4); 6d: (6); 8e: (8); 12f: (12); 12g: (12); 24h: (24)

S $(u, \frac{1}{2}, u)$ of space group No. 201

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)
2	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)
SM ($u, u, 0$) of space group No. 201		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)
2	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)
T ($\frac{1}{2}, \frac{1}{2}, w$) of space group No. 201		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (3); 4c: (3); 6d: (5); 8e: (6); 12f: (8); 12g: (10); 24h: (18)
2	(0, 0, 0)	2a: (1); 4b: (3); 4c: (3); 6d: (5); 8e: (6); 12f: (8); 12g: (10); 24h: (18)
3	(0, 0, 0)	2a: (2); 4b: (3); 4c: (3); 6d: (4); 8e: (6); 12f: (10); 12g: (8); 24h: (18)
4	(0, 0, 0)	2a: (2); 4b: (3); 4c: (3); 6d: (4); 8e: (6); 12f: (10); 12g: (8); 24h: (18)
ZA ($\frac{1}{2}, u, 0$) of space group No. 201		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)
Z ($u, \frac{1}{2}, 0$) of space group No. 201		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

P1 (u, u, v) of space group No. 201		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (6); 4b: (12); 4c: (12); 6d: (18); 8e: (24); 12f: (36); 12g: (36); 24h: (72)

P2 ($u, v, 0$) of space group No. 201

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)
2	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)

P4 ($u, \frac{1}{2}, v$) of space group No. 201

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)
2	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36)

202. Space group No. 202 ($Fm\bar{3}$)

Cubic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \\ &\{C_{31}^-|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \\ &\{S_{61}^-|0, 0, 0\} \quad \{S_{64}^-|0, 0, 0\} \quad \{S_{63}^-|0, 0, 0\} \quad \{S_{62}^-|0, 0, 0\} \quad \{S_{61}^+|0, 0, 0\} \quad \{S_{63}^+|0, 0, 0\} \quad \{S_{62}^+|0, 0, 0\} \quad \{S_{64}^+|0, 0, 0\} \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$				
Operation	E			
Coordinate	$(0,0,0)$			
$X(\frac{1}{2},0,\frac{1}{2})$				
Operation	E	C_{31}^{+}	C_{31}^{-}	
Coordinate	$(\frac{1}{2},0,\frac{1}{2})$	$(\frac{1}{2},\frac{1}{2},0)$	$(0,\frac{1}{2},\frac{1}{2})$	
$L(\frac{1}{2},\frac{1}{2},\frac{1}{2})$				
Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$	$(-\frac{1}{2},0,0)$	$(0,-\frac{1}{2},0)$	$(0,0,-\frac{1}{2})$

$$W\left(\frac{1}{2}, \frac{1}{4}, \frac{3}{4}\right)$$

Operation	E	C_{2z}	C_{31}^+	C_{34}^+	C_{31}^-	C_{33}^-
Coordinate	$\left(\frac{1}{2}, \frac{1}{4}, \frac{3}{4}\right)$	$\left(-\frac{1}{2}, -\frac{1}{4}, -\frac{3}{4}\right)$	$\left(\frac{3}{4}, \frac{1}{2}, \frac{1}{4}\right)$	$\left(-\frac{3}{4}, -\frac{1}{2}, -\frac{1}{4}\right)$	$\left(\frac{1}{4}, \frac{3}{4}, \frac{1}{2}\right)$	$\left(-\frac{1}{4}, -\frac{3}{4}, -\frac{1}{2}\right)$

$\Gamma (0, 0, 0)$ of space group No. 202									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (0);	4b: (0);	8c: (0);	24d: (0);	24e: (1);	32f: (1);	48g: (1);	48h: (2); 96i: (3)
2	(0, 0, 0)	4a: (0);	4b: (0);	8c: (0);	24d: (0);	24e: (1);	32f: (1);	48g: (1);	48h: (2); 96i: (3)
3	(0, 0, 0)	4a: (0);	4b: (0);	8c: (1);	24d: (0);	24e: (2);	32f: (3);	48g: (5);	48h: (4); 96i: (9)
4	(0, 0, 0)	4a: (0);	4b: (0);	8c: (0);	24d: (1);	24e: (0);	32f: (1);	48g: (1);	48h: (1); 96i: (3)
5	(0, 0, 0)	4a: (0);	4b: (0);	8c: (0);	24d: (1);	24e: (0);	32f: (1);	48g: (1);	48h: (1); 96i: (3)
6	(0, 0, 0)	4a: (1);	4b: (1);	8c: (1);	24d: (5);	24e: (3);	32f: (3);	48g: (5);	48h: (5); 96i: (9)
$X \left(\frac{1}{2}, 0, \frac{1}{2}\right)$ of space group No. 202									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (0);	4b: (0);	8c: (1);	24d: (4);	24e: (3);	32f: (3);	48g: (5);	48h: (6); 96i: (9)
2	(0, 0, 0)	4a: (0);	4b: (0);	8c: (0);	24d: (2);	24e: (2);	32f: (3);	48g: (3);	48h: (4); 96i: (9)
3	(0, 0, 0)	4a: (0);	4b: (0);	8c: (1);	24d: (3);	24e: (2);	32f: (3);	48g: (5);	48h: (4); 96i: (9)
4	(0, 0, 0)	4a: (0);	4b: (0);	8c: (1);	24d: (3);	24e: (2);	32f: (3);	48g: (5);	48h: (4); 96i: (9)
5	(0, 0, 0)	4a: (0);	4b: (0);	8c: (1);	24d: (1);	24e: (0);	32f: (3);	48g: (5);	48h: (3); 96i: (9)
6	(0, 0, 0)	4a: (1);	4b: (1);	8c: (0);	24d: (1);	24e: (3);	32f: (3);	48g: (3);	48h: (5); 96i: (9)
7	(0, 0, 0)	4a: (1);	4b: (1);	8c: (1);	24d: (2);	24e: (3);	32f: (3);	48g: (5);	48h: (5); 96i: (9)
8	(0, 0, 0)	4a: (1);	4b: (1);	8c: (1);	24d: (2);	24e: (3);	32f: (3);	48g: (5);	48h: (5); 96i: (9)
$L \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 202									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (0);	4b: (1);	8c: (1);	24d: (3);	24e: (3);	32f: (4);	48g: (6);	48h: (6); 96i: (12)
2	(0, 0, 0)	4a: (1);	4b: (0);	8c: (1);	24d: (3);	24e: (3);	32f: (4);	48g: (6);	48h: (6); 96i: (12)
3	(0, 0, 0)	4a: (0);	4b: (1);	8c: (1);	24d: (3);	24e: (3);	32f: (4);	48g: (6);	48h: (6); 96i: (12)
4	(0, 0, 0)	4a: (1);	4b: (0);	8c: (1);	24d: (3);	24e: (3);	32f: (4);	48g: (6);	48h: (6); 96i: (12)
$W \left(\frac{1}{2}, \frac{1}{4}, \frac{3}{4}\right)$ of space group No. 202									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	4a: (1);	4b: (1);	8c: (2);	24d: (6);	24e: (6);	32f: (6);	48g: (10);	48h: (11); 96i: (18)
2	(0, 0, 0)	4a: (0);	4b: (0);	8c: (2);	24d: (4);	24e: (2);	32f: (6);	48g: (10);	48h: (7); 96i: (18)
3	(0, 0, 0)	4a: (1);	4b: (1);	8c: (1);	24d: (4);	24e: (5);	32f: (6);	48g: (8);	48h: (9); 96i: (18)
4	(0, 0, 0)	4a: (1);	4b: (1);	8c: (1);	24d: (4);	24e: (5);	32f: (6);	48g: (8);	48h: (9); 96i: (18)

c. Results for high-symmetry lines

$$DT\left(\frac{y}{2}, 0, \frac{y}{2}\right)$$

Operation	E	C_{31}^+	C_{31}^-

Coordinate	$(\frac{v}{2}, 0, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, 0)$	$(0, \frac{v}{2}, \frac{v}{2})$	
$LD(u, u, u)$				
Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	(u, u, u)	$(-u, 0, 0)$	$(0, -u, 0)$	$(0, 0, -u)$
$Q(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$				
Operation	E	C_{2y}	C_{31}^+	C_{33}^+
Coordinate	$(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$	$(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$	$(\frac{1}{4}(1+2v), \frac{1}{2}, \frac{1}{4}(3-2v))$	$(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(-3+2v))$
	C_{31}^-	C_{32}^-		
	$(\frac{1}{4}(3-2v), \frac{1}{4}(1+2v), \frac{1}{2})$	$(\frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$		
$SM(\frac{u}{2}, \frac{u}{2}, u)$				
Operation	E	C_{2x}	C_{31}^+	C_{32}^+
Coordinate	$(\frac{u}{2}, \frac{u}{2}, u)$	$(-\frac{u}{2}, \frac{u}{2}, 0)$	$(u, \frac{u}{2}, \frac{u}{2})$	$(0, -\frac{u}{2}, \frac{u}{2})$
				C_{31}^- C_{32}^-
				$(\frac{u}{2}, u, \frac{u}{2})$ $(-\frac{u}{2}, 0, \frac{u}{2})$
$V(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$				
Operation	E	C_{31}^+	C_{31}^-	
Coordinate	$(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$	$(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{1+u}{2}, \frac{1}{2})$	

DT $(\frac{v}{2}, 0, \frac{v}{2})$ of space group No. 202				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 24d: (5); 24e: (6); 32f: (6); 48g: (8); 48h: (11); 96i: (18)		
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 24d: (3); 24e: (2); 32f: (6); 48g: (8); 48h: (7); 96i: (18)		
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (5); 24e: (5); 32f: (6); 48g: (10); 48h: (9); 96i: (18)		
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (5); 24e: (5); 32f: (6); 48g: (10); 48h: (9); 96i: (18)		
LD (u, u, u) of space group No. 202				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (6); 24e: (6); 32f: (8); 48g: (12); 48h: (12); 96i: (24)		
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (6); 24e: (6); 32f: (8); 48g: (12); 48h: (12); 96i: (24)		
Q $(\frac{1}{2}, \frac{1}{4}(3 - 2v), \frac{1}{4}(1 + 2v))$ of space group No. 202				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 24d: (18); 24e: (18); 32f: (24); 48g: (36); 48h: (36); 96i: (72)		
SM $(\frac{u}{2}, \frac{u}{2}, u)$ of space group No. 202				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 24d: (10); 24e: (11); 32f: (12); 48g: (18); 48h: (20); 96i: (36)		
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 24d: (8); 24e: (7); 32f: (12); 48g: (18); 48h: (16); 96i: (36)		
V $(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$ of space group No. 202				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (6); 24e: (6); 32f: (6); 48g: (10); 48h: (11); 96i: (18)		
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (2); 24d: (4); 24e: (2); 32f: (6); 48g: (10); 48h: (7); 96i: (18)		
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 24d: (4); 24e: (5); 32f: (6); 48g: (8); 48h: (9); 96i: (18)		

4 (0, 0, 0) 4a: (1); 4b: (1); 8c: (1); 24d: (4); 24e: (5); 32f: (6); 48g: (8); 48h: (9); 96i: (18)

d. Results for high-symmetry planes

P1($u, v, u + v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, u + v)$	$(u + v, u, v)$	$(v, u + v, u)$

P2(u, u, v)

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-u, -u + v, 0)$	(v, u, u)	$(0, -u, -u + v)$	(u, v, u)	$(-u, 0, -u + v)$

P1 ($u, v, u + v$) of space group No. 202

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 24d: (10); 24e: (11); 32f: (12); 48g: (18); 48h: (20); 96i: (36)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 24d: (8); 24e: (7); 32f: (12); 48g: (18); 48h: (16); 96i: (36)

P2 (u, u, v) of space group No. 202

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 24d: (18); 24e: (18); 32f: (24); 48g: (36); 48h: (36); 96i: (72)

203. Space group No. 203 ($Fd\bar{3}$)

Cubic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \\ &\{C_{31}^-|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \quad \{I|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{\sigma_z|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{\sigma_y|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{\sigma_x|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \\ &\{S_{61}^-|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{S_{64}^-|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{S_{63}^-|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{S_{62}^-|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{S_{61}^+|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{S_{63}^+|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{S_{62}^+|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{S_{64}^+|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$						
Operation	E					
Coordinate	$(0, 0, 0)$					
$X(\frac{1}{2}, 0, \frac{1}{2})$						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$	$(\frac{1}{2}, \frac{1}{2}, 0)$	$(0, \frac{1}{2}, \frac{1}{2})$			
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, 0)$	$(0, -\frac{1}{2}, 0)$	$(0, 0, -\frac{1}{2})$		
$W(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$						
Operation	E	C_{2z}	C_{31}^{+}	C_{34}^{+}	C_{31}^{-}	C_{33}^{-}
Coordinate	$(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$	$(-\frac{1}{2}, -\frac{1}{4}, -\frac{3}{4})$	$(\frac{3}{4}, \frac{1}{2}, \frac{1}{4})$	$(-\frac{3}{4}, -\frac{1}{2}, -\frac{1}{4})$	$(\frac{1}{4}, \frac{3}{4}, \frac{1}{2})$	$(-\frac{1}{4}, -\frac{3}{4}, -\frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 203

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (0); 8b: (0); 16c: (0); 16d: (0); 32e: (1); 48f: (1); 96g: (3)
2	$(0, 0, 0)$	8a: (0); 8b: (0); 16c: (0); 16d: (0); 32e: (1); 48f: (1); 96g: (3)
3	$(0, 0, 0)$	8a: (1); 8b: (1); 16c: (0); 16d: (0); 32e: (3); 48f: (5); 96g: (9)
4	$(0, 0, 0)$	8a: (0); 8b: (0); 16c: (1); 16d: (1); 32e: (1); 48f: (1); 96g: (3)
5	$(0, 0, 0)$	8a: (0); 8b: (0); 16c: (1); 16d: (1); 32e: (1); 48f: (1); 96g: (3)
6	$(0, 0, 0)$	8a: (1); 8b: (1); 16c: (3); 16d: (3); 32e: (3); 48f: (5); 96g: (9)

$X(\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 203

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (1); 8b: (1); 16c: (3); 16d: (3); 32e: (6); 48f: (8); 96g: (18)
2	$(0, 0, 0)$	8a: (2); 8b: (2); 16c: (3); 16d: (3); 32e: (6); 48f: (10); 96g: (18)

$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 203

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (1); 8b: (1); 16c: (3); 16d: (1); 32e: (4); 48f: (6); 96g: (12)
2	$(0, 0, 0)$	8a: (1); 8b: (1); 16c: (1); 16d: (3); 32e: (4); 48f: (6); 96g: (12)
3	$(0, 0, 0)$	8a: (1); 8b: (1); 16c: (3); 16d: (1); 32e: (4); 48f: (6); 96g: (12)
4	$(0, 0, 0)$	8a: (1); 8b: (1); 16c: (1); 16d: (3); 32e: (4); 48f: (6); 96g: (12)

$W(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$ of space group No. 203

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 96g: (36)

c. Results for high-symmetry lines

$DT(\frac{v}{2}, 0, \frac{v}{2})$				
Operation	E	C_{31}^{+}	C_{31}^{-}	
Coordinate	$(\frac{v}{2}, 0, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, 0)$	$(0, \frac{v}{2}, \frac{v}{2})$	
$LD(u, u, u)$				
Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	(u, u, u)	$(-u, 0, 0)$	$(0, -u, 0)$	$(0, 0, -u)$
$Q(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$				
Operation	E	C_{2y}	C_{31}^{+}	C_{33}^{+}
Coordinate	$(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$	$(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$	$(\frac{1}{4}(1+2v), \frac{1}{2}, \frac{1}{4}(3-2v))$	$(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(-3+2v))$
	C_{31}^{-}	C_{32}^{-}		
	$(\frac{1}{4}(3-2v), \frac{1}{4}(1+2v), \frac{1}{2})$	$(\frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$		
$SM(\frac{u}{2}, \frac{u}{2}, u)$				
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}
Coordinate	$(\frac{u}{2}, \frac{u}{2}, u)$	$(-\frac{u}{2}, \frac{u}{2}, 0)$	$(u, \frac{u}{2}, \frac{u}{2})$	$(0, -\frac{u}{2}, \frac{u}{2})$
				C_{31}^{-} C_{32}^{-}
				$(\frac{u}{2}, u, \frac{u}{2})$ $(-\frac{u}{2}, 0, \frac{u}{2})$
$V(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$				
Operation	E	C_{31}^{+}	C_{31}^{-}	
Coordinate	$(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$	$(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{1+u}{2}, \frac{1}{2})$	

DT $(\frac{v}{2}, 0, \frac{v}{2})$ of space group No. 203								
(Co-) irrep	Phonon AM	WYPO information						
1	(0, 0, 0)	8a: (1);	8b: (1);	16c: (3);	16d: (3);	32e: (6);	48f: (8);	96g: (18)
2	(0, 0, 0)	8a: (1);	8b: (1);	16c: (3);	16d: (3);	32e: (6);	48f: (8);	96g: (18)
3	(0, 0, 0)	8a: (2);	8b: (2);	16c: (3);	16d: (3);	32e: (6);	48f: (10);	96g: (18)
4	(0, 0, 0)	8a: (2);	8b: (2);	16c: (3);	16d: (3);	32e: (6);	48f: (10);	96g: (18)
LD (u, u, u) of space group No. 203								
(Co-) irrep	Phonon AM	WYPO information						
1	(0, 0, 0)	8a: (2);	8b: (2);	16c: (4);	16d: (4);	32e: (8);	48f: (12);	96g: (24)
2	(0, 0, 0)	8a: (2);	8b: (2);	16c: (4);	16d: (4);	32e: (8);	48f: (12);	96g: (24)
Q $(\frac{1}{2}, \frac{1}{4}(3 - 2v), \frac{1}{4}(1 + 2v))$ of space group No. 203								
(Co-) irrep	Phonon AM	WYPO information						
1	(0, 0, 0)	8a: (6);	8b: (6);	16c: (12);	16d: (12);	32e: (24);	48f: (36);	96g: (72)
SM $(\frac{u}{2}, \frac{u}{2}, u)$ of space group No. 203								
(Co-) irrep	Phonon AM	WYPO information						
1	(0, 0, 0)	8a: (3);	8b: (3);	16c: (6);	16d: (6);	32e: (12);	48f: (18);	96g: (36)
2	(0, 0, 0)	8a: (3);	8b: (3);	16c: (6);	16d: (6);	32e: (12);	48f: (18);	96g: (36)
V $(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$ of space group No. 203								
(Co-) irrep	Phonon AM	WYPO information						

1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 96g: (36)

d. Results for high-symmetry planes

P1($u, v, u + v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, u + v)$	$(u + v, u, v)$	$(v, u + v, u)$

P2(u, u, v)

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-u, -u + v, 0)$	(v, u, u)	$(0, -u, -u + v)$	(u, v, u)	$(-u, 0, -u + v)$

P1 ($u, v, u + v$) of space group No. 203				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	8a: (3);	8b: (3);	16c: (6); 16d: (6); 32e: (12); 48f: (18); 96g: (36)
2	(0, 0, 0)	8a: (3);	8b: (3);	16c: (6); 16d: (6); 32e: (12); 48f: (18); 96g: (36)
P2 (u, u, v) of space group No. 203				
(Co-) irrep	Phonon AM	WYPO information		
1	(0, 0, 0)	8a: (6);	8b: (6);	16c: (12); 16d: (12); 32e: (24); 48f: (36); 96g: (72)

204. Space group No. 204 ($Im\bar{3}$)

Cubic body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \\ &\{C_{31}^-|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \quad \{I|0, 0, 0\} \quad \{\sigma_z|0, 0, 0\} \quad \{\sigma_y|0, 0, 0\} \quad \{\sigma_x|0, 0, 0\} \\ &\{S_{61}^-|0, 0, 0\} \quad \{S_{64}^-|0, 0, 0\} \quad \{S_{63}^-|0, 0, 0\} \quad \{S_{62}^-|0, 0, 0\} \quad \{S_{61}^+|0, 0, 0\} \quad \{S_{63}^+|0, 0, 0\} \quad \{S_{62}^+|0, 0, 0\} \quad \{S_{64}^+|0, 0, 0\} \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	
Operation	E I
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ $(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$
$N(0, 0, \frac{1}{2})$	
Operation	E C_{2y} C_{31}^{+} C_{33}^{+} C_{31}^{-} C_{32}^{-}
Coordinate	$(0, 0, \frac{1}{2})$ $(\frac{1}{2}, -\frac{1}{2}, 0)$ $(\frac{1}{2}, 0, 0)$ $(0, \frac{1}{2}, -\frac{1}{2})$ $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, \frac{1}{2})$

 $\Gamma(0, 0, 0)$ of space group No. 204

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (1); 12e: (1); 16f: (1); 24g: (2); 48h: (3)
2	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (1); 12e: (1); 16f: (1); 24g: (2); 48h: (3)
3	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (2); 12e: (2); 16f: (3); 24g: (4); 48h: (9)
4	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (0); 12e: (0); 16f: (1); 24g: (1); 48h: (3)
5	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (0); 12e: (0); 16f: (1); 24g: (1); 48h: (3)
6	(0, 0, 0)	2a: (1); 6b: (3); 8c: (3); 12d: (3); 12e: (3); 16f: (3); 24g: (5); 48h: (9)

 $H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 204

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (1); 12e: (1); 16f: (1); 24g: (2); 48h: (3)
2	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (1); 12e: (1); 16f: (1); 24g: (2); 48h: (3)
3	(0, 0, 0)	2a: (0); 6b: (0); 8c: (3); 12d: (2); 12e: (2); 16f: (3); 24g: (4); 48h: (9)
4	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (0); 12e: (0); 16f: (1); 24g: (1); 48h: (3)
5	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (0); 12e: (0); 16f: (1); 24g: (1); 48h: (3)
6	(0, 0, 0)	2a: (1); 6b: (3); 8c: (0); 12d: (3); 12e: (3); 16f: (3); 24g: (5); 48h: (9)

 $P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 204

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (1); 12e: (2); 16f: (2); 24g: (3); 48h: (6)
2	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (1); 12e: (2); 16f: (2); 24g: (3); 48h: (6)
3	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (5); 12e: (4); 16f: (6); 24g: (9); 48h: (18)

 $N(0, 0, \frac{1}{2})$ of space group No. 204

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (0); 6b: (4); 8c: (3); 12d: (5); 12e: (6); 16f: (6); 24g: (10); 48h: (18)
2	(0, 0, 0)	2a: (1); 6b: (1); 8c: (3); 12d: (3); 12e: (4); 16f: (6); 24g: (8); 48h: (18)
3	(0, 0, 0)	2a: (0); 6b: (2); 8c: (3); 12d: (4); 12e: (3); 16f: (6); 24g: (8); 48h: (18)
4	(0, 0, 0)	2a: (2); 6b: (2); 8c: (3); 12d: (6); 12e: (5); 16f: (6); 24g: (10); 48h: (18)

c. Results for high-symmetry lines

$D(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	$(\frac{1-w}{2}, \frac{w}{2}, \frac{w}{2})$	$(\frac{w}{2}, \frac{1-w}{2}, \frac{w}{2})$			
$DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, -\frac{v}{2})$	$(-\frac{v}{2}, \frac{v}{2}, \frac{v}{2})$			
$G(\frac{1}{2}-u, \frac{1}{2}+u, \frac{1}{2})$						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(\frac{1}{2}-u, \frac{1}{2}+u, \frac{1}{2})$	$(-\frac{3}{2}, \frac{1}{2}, \frac{1}{2}+u)$	$(\frac{1}{2}, \frac{1}{2}-u, \frac{1}{2}+u)$	$(\frac{1}{2}+u, -\frac{3}{2}, \frac{1}{2})$	$(\frac{1}{2}+u, \frac{1}{2}, \frac{1}{2}-u)$	$(-\frac{3}{2}, \frac{1}{2}-u, \frac{1}{2})$
$LD(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$		
$SM(0, 0, u)$						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(0, 0, u)$	$(-u, u, 0)$	$(u, 0, 0)$	$(0, -u, u)$	$(0, u, 0)$	$(-u, 0, u)$

D $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 204								
(Co-) irrep	Phonon AM	WYPO information						
1	(0, 0, 0)	2a: (1);	6b: (5);	8c: (6);	12d: (8);	12e: (10);	16f: (12);	24g: (18); 48h: (36)
2	(0, 0, 0)	2a: (2);	6b: (4);	8c: (6);	12d: (10);	12e: (8);	16f: (12);	24g: (18); 48h: (36)
DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 204								
(Co-) irrep	Phonon AM	WYPO information						
1	(0, 0, 0)	2a: (1);	6b: (3);	8c: (3);	12d: (6);	12e: (6);	16f: (6);	24g: (11); 48h: (18)
2	(0, 0, 0)	2a: (0);	6b: (0);	8c: (3);	12d: (2);	12e: (2);	16f: (6);	24g: (7); 48h: (18)
3	(0, 0, 0)	2a: (1);	6b: (3);	8c: (3);	12d: (5);	12e: (5);	16f: (6);	24g: (9); 48h: (18)
4	(0, 0, 0)	2a: (1);	6b: (3);	8c: (3);	12d: (5);	12e: (5);	16f: (6);	24g: (9); 48h: (18)
G $\left(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 204								
(Co-) irrep	Phonon AM	WYPO information						
1	(0, 0, 0)	2a: (2);	6b: (6);	8c: (6);	12d: (11);	12e: (11);	16f: (12);	24g: (20); 48h: (36)
2	(0, 0, 0)	2a: (1);	6b: (3);	8c: (6);	12d: (7);	12e: (7);	16f: (12);	24g: (16); 48h: (36)

LD $\left(\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 204

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 16f: (8); 24g: (12); 48h: (24)
2	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 16f: (8); 24g: (12); 48h: (24)

SM (0, 0, u) of space group No. 204

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 6b: (6); 8c: (6); 12d: (11); 12e: (11); 16f: (12); 24g: (20); 48h: (36)
2	(0, 0, 0)	2a: (1); 6b: (3); 8c: (6); 12d: (7); 12e: (7); 16f: (12); 24g: (16); 48h: (36)

d. Results for high-symmetry planes

P1(u, u, v)

Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(-2u - v, v, u)$	(v, u, u)	$(u, -2u - v, v)$	(u, v, u)	$(-2u - v, u, v)$

P2($u, -u, v$)

Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	$(u, -u, v)$	$(v, u, -u)$	$(-u, v, u)$

P1 (u, u, v) of space group No. 204

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 48h: (72)

P2 ($u, -u, v$) of space group No. 204

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 6b: (6); 8c: (6); 12d: (11); 12e: (11); 16f: (12); 24g: (20); 48h: (36)
2	(0, 0, 0)	2a: (1); 6b: (3); 8c: (6); 12d: (7); 12e: (7); 16f: (12); 24g: (16); 48h: (36)

205. Space group No. 205 ($Pa\bar{3}$)

Cubic primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c} \end{aligned}$$
*a. Space group operations**b. Results for high-symmetry points*

$\{E 0,0,0\}$	$\{C_{2z} \frac{1}{2},0,\frac{1}{2}\}$	$\{C_{2y} 0,\frac{1}{2},\frac{1}{2}\}$	$\{C_{2x} \frac{1}{2},-\frac{1}{2},0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{34}^+ \frac{1}{2},\frac{1}{2},0\}$	$\{C_{33}^+ \frac{1}{2},0,\frac{1}{2}\}$	$\{C_{32}^+ 0,\frac{1}{2},-\frac{1}{2}\}$
$\{C_{31}^- 0,0,0\}$	$\{C_{33}^- 0,\frac{1}{2},\frac{1}{2}\}$	$\{C_{32}^- \frac{1}{2},\frac{1}{2},0\}$	$\{C_{34}^- -\frac{1}{2},0,\frac{1}{2}\}$	$\{I 0,0,0\}$	$\{\sigma_z -\frac{1}{2},0,-\frac{1}{2}\}$	$\{\sigma_y 0,-\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_x -\frac{1}{2},\frac{1}{2},0\}$
$\{S_{61}^- 0,0,0\}$	$\{S_{64}^- -\frac{1}{2},-\frac{1}{2},0\}$	$\{S_{63}^- -\frac{1}{2},0,-\frac{1}{2}\}$	$\{S_{62}^- 0,-\frac{1}{2},\frac{1}{2}\}$	$\{S_{61}^+ 0,0,0\}$	$\{S_{63}^+ 0,-\frac{1}{2},-\frac{1}{2}\}$	$\{S_{62}^+ -\frac{1}{2},-\frac{1}{2},0\}$	$\{S_{64}^+ \frac{1}{2},0,-\frac{1}{2}\}$

 $\Gamma(0,0,0)$

Operation E
Coordinate (0,0,0)

 $X(0,\frac{1}{2},0)$

Operation E C_{31}^+ C_{31}^-
Coordinate $(0,\frac{1}{2},0)$ $(0,0,\frac{1}{2})$ $(\frac{1}{2},0,0)$

 $M(\frac{1}{2},\frac{1}{2},0)$

Operation E C_{31}^+ C_{31}^-
Coordinate $(\frac{1}{2},\frac{1}{2},0)$ $(0,\frac{1}{2},\frac{1}{2})$ $(\frac{1}{2},0,\frac{1}{2})$

 $R(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

 $\Gamma(0,0,0)$ of space group No. 205

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (0); 4b: (0); 8c: (1); 24d: (3)
2	(0,0,0)	4a: (0); 4b: (0); 8c: (1); 24d: (3)
3	(0,0,0)	4a: (0); 4b: (0); 8c: (3); 24d: (9)
4	(0,0,0)	4a: (1); 4b: (1); 8c: (1); 24d: (3)
5	(0,0,0)	4a: (1); 4b: (1); 8c: (1); 24d: (3)
6	(0,0,0)	4a: (3); 4b: (3); 8c: (3); 24d: (9)

 $X(0,\frac{1}{2},0)$ of space group No. 205

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)
2	(0,0,0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)

 $M(\frac{1}{2},\frac{1}{2},0)$ of space group No. 205

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)

 $R(\frac{1}{2},\frac{1}{2},\frac{1}{2})$ of space group No. 205

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (0); 4b: (1); 8c: (1); 24d: (3)

2	(0, 0, 0)	4a: (0); 4b: (2); 8c: (2); 24d: (6)
3	(0, 0, 0)	4a: (1); 4b: (0); 8c: (1); 24d: (3)
4	(0, 0, 0)	4a: (2); 4b: (0); 8c: (2); 24d: (6)

c. Results for high-symmetry lines

DT _(0, v, 0)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)			
LD _(u, u, u)						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)		
S _(u, $\frac{1}{2}$, u)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{33}^{-}
Coordinate	(u, $\frac{1}{2}$, u)	(u, $-\frac{1}{2}$, -u)	(u, u, $\frac{1}{2}$)	(-u, u, $-\frac{1}{2}$)	($\frac{1}{2}$, u, u)	($-\frac{1}{2}$, u, -u)
SM _(u, u, 0)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, 0)	(u, -u, 0)	(0, u, u)	(0, u, -u)	(u, 0, u)	(u, 0, -u)
T _($\frac{1}{2}$, $\frac{1}{2}$, w)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	(w, $\frac{1}{2}$, $\frac{1}{2}$)	($\frac{1}{2}$, w, $\frac{1}{2}$)			
ZA _($\frac{1}{2}$, u, 0)						
Operation	E	C_{31}^{+}	C_{33}^{-}			
Coordinate	($\frac{1}{2}$, u, 0)	(0, $\frac{1}{2}$, u)	(-u, 0, $-\frac{1}{2}$)			
Z _(u, $\frac{1}{2}$, 0)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	(u, $\frac{1}{2}$, 0)	(0, u, $\frac{1}{2}$)	($\frac{1}{2}$, 0, u)			

$DT (0, v, 0)$ of space group No. 205

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)
3	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)
4	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)

$LD (u, u, u)$ of space group No. 205

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	4a: (4); 4b: (4); 8c: (8); 24d: (24)
2	(0, 0, 0)	4a: (4); 4b: (4); 8c: (8); 24d: (24)
S $(u, \frac{1}{2}, u)$ of space group No. 205		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 24d: (36)
SM $(u, u, 0)$ of space group No. 205		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 24d: (36)
2	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 24d: (36)
T $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 205		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)
ZA $(\frac{1}{2}, u, 0)$ of space group No. 205		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 24d: (36)
Z $(u, \frac{1}{2}, 0)$ of space group No. 205		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)
2	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 24d: (18)

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^+	C_{31}^-			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^+	C_{31}^-			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

P1 (u, u, v) of space group No. 205		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (12); 4b: (12); 8c: (24); 24d: (72)

P2 ($u, v, 0$) of space group No. 205		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 24d: (36)
2	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 24d: (36)

P4 ($u, \frac{1}{2}, v$) of space group No. 205		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (6); 4b: (6); 8c: (12); 24d: (36)

206. Space group No. 206 ($Ia\bar{3}$)

Cubic body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_{2z} \frac{1}{2}, 0, \frac{1}{2}\}$	$\{C_{2y} 0, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{2x} \frac{1}{2}, -\frac{1}{2}, 0\}$	$\{C_{31}^+ 0, 0, 0\}$	$\{C_{34}^+ \frac{1}{2}, \frac{1}{2}, 0\}$	$\{C_{33}^+ \frac{1}{2}, 0, \frac{1}{2}\}$	$\{C_{32}^+ 0, \frac{1}{2}, -\frac{1}{2}\}$
$\{C_{31}^- 0, 0, 0\}$	$\{C_{33}^- 0, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{32}^- \frac{1}{2}, \frac{1}{2}, 0\}$	$\{C_{34}^- -\frac{1}{2}, 0, \frac{1}{2}\}$	$\{I 0, 0, 0\}$	$\{\sigma_z -\frac{1}{2}, 0, -\frac{1}{2}\}$	$\{\sigma_y 0, -\frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_x -\frac{1}{2}, \frac{1}{2}, 0\}$
$\{S_{61}^- 0, 0, 0\}$	$\{S_{64}^- -\frac{1}{2}, -\frac{1}{2}, 0\}$	$\{S_{63}^- -\frac{1}{2}, 0, -\frac{1}{2}\}$	$\{S_{62}^- 0, -\frac{1}{2}, \frac{1}{2}\}$	$\{S_{61}^+ 0, 0, 0\}$	$\{S_{63}^+ 0, -\frac{1}{2}, -\frac{1}{2}\}$	$\{S_{62}^+ -\frac{1}{2}, -\frac{1}{2}, 0\}$	$\{S_{64}^+ \frac{1}{2}, 0, -\frac{1}{2}\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)

$H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$

$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	
Operation	E I
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ $(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$

$N(0, 0, \frac{1}{2})$

Operation	E	C_{2y}	C_{31}^+	C_{33}^+	C_{31}^-	C_{32}^-
Coordinate	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, -\frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, -\frac{1}{2})$	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, \frac{1}{2})$

 $\Gamma(0, 0, 0)$ of space group No. 206

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (0); 8b: (0); 16c: (1); 24d: (1); 48e: (3)
2	(0, 0, 0)	8a: (0); 8b: (0); 16c: (1); 24d: (1); 48e: (3)
3	(0, 0, 0)	8a: (0); 8b: (0); 16c: (3); 24d: (5); 48e: (9)
4	(0, 0, 0)	8a: (1); 8b: (1); 16c: (1); 24d: (1); 48e: (3)
5	(0, 0, 0)	8a: (1); 8b: (1); 16c: (1); 24d: (1); 48e: (3)
6	(0, 0, 0)	8a: (3); 8b: (3); 16c: (3); 24d: (5); 48e: (9)

 $H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 206

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (0); 8b: (1); 16c: (1); 24d: (2); 48e: (3)
2	(0, 0, 0)	8a: (0); 8b: (1); 16c: (1); 24d: (2); 48e: (3)
3	(0, 0, 0)	8a: (0); 8b: (3); 16c: (3); 24d: (4); 48e: (9)
4	(0, 0, 0)	8a: (1); 8b: (0); 16c: (1); 24d: (2); 48e: (3)
5	(0, 0, 0)	8a: (1); 8b: (0); 16c: (1); 24d: (2); 48e: (3)
6	(0, 0, 0)	8a: (3); 8b: (0); 16c: (3); 24d: (4); 48e: (9)

 $P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 206

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 24d: (3); 48e: (6)
2	(0, 0, 0)	8a: (2); 8b: (2); 16c: (4); 24d: (6); 48e: (12)

 $N(0, 0, \frac{1}{2})$ of space group No. 206

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 24d: (18); 48e: (36)

c. Results for high-symmetry lines

 $D(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	$(\frac{1-w}{2}, \frac{w}{2}, \frac{w}{2})$	$(\frac{w}{2}, \frac{1-w}{2}, \frac{w}{2})$

 $DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, -\frac{v}{2})$	$(-\frac{v}{2}, \frac{v}{2}, \frac{v}{2})$

 $G(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	$(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$	$(-\frac{3}{2}, \frac{1}{2}, \frac{1}{2} + u)$	$(\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u)$	$(\frac{1}{2} + u, -\frac{3}{2}, \frac{1}{2})$	$(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$	$(-\frac{3}{2}, \frac{1}{2} - u, \frac{1}{2})$
LD($\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$		
SM _(0, 0, u)						
Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	$(0, 0, u)$	$(-u, u, 0)$	$(u, 0, 0)$	$(0, -u, u)$	$(0, u, 0)$	$(-u, 0, u)$

D $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 206						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 24d: (18); 48e: (36)				
DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 206						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 24d: (8); 48e: (18)				
2	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 24d: (8); 48e: (18)				
3	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 24d: (10); 48e: (18)				
4	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 24d: (10); 48e: (18)				
G $\left(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 206						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 24d: (18); 48e: (36)				
2	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 24d: (18); 48e: (36)				
LD $\left(\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 206						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	8a: (4); 8b: (4); 16c: (8); 24d: (12); 48e: (24)				
2	(0, 0, 0)	8a: (4); 8b: (4); 16c: (8); 24d: (12); 48e: (24)				
SM (0, 0, u) of space group No. 206						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 24d: (18); 48e: (36)				
2	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 24d: (18); 48e: (36)				

d. Results for high-symmetry planes

$PI(u, u, v)$						
Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-2u - v, v, u)$	(v, u, u)	$(u, -2u - v, v)$	(u, v, u)	$(-2u - v, u, v)$

P2($u, -u, v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, -u, v)$	$(v, u, -u)$	$(-u, v, u)$

P1 (u, u, v) of space group No. 206

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (12); 8b: (12); 16c: (24); 24d: (36); 48e: (72)

P2 ($u, -u, v$) of space group No. 206

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 24d: (18); 48e: (36)
2	(0, 0, 0)	8a: (6); 8b: (6); 16c: (12); 24d: (18); 48e: (36)

207. Space group No. 207 ($P432$)

Cubic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}&\{E|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{4x}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{C_{4y}^-|0, 0, 0\} \quad \{C_{4x}^-|0, 0, 0\} \\&\{C_{4z}^+|0, 0, 0\} \quad \{C_{4y}^+|0, 0, 0\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\} \quad \{C_{2f}|0, 0, 0\} \quad \{C_{2d}|0, 0, 0\} \quad \{C_{2c}|0, 0, 0\} \quad \{C_{2e}|0, 0, 0\} \\&\{C_{31}^-|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\}\end{aligned}$$

b. Results for high-symmetry points

 $\Gamma(0, 0, 0)$

Operation	E
Coordinate	(0, 0, 0)

 $X(0, \frac{1}{2}, 0)$

Operation	E	C_{4x}^+	C_{4z}^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$

$$M\left(\frac{1}{2}, \frac{1}{2}, 0\right)$$

$$\begin{array}{lcl} \text{Operation} & E & C_{4y}^- \quad C_{4x}^+ \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, 0\right) & \left(0, \frac{1}{2}, \frac{1}{2}\right) \quad \left(\frac{1}{2}, 0, \frac{1}{2}\right) \end{array}$$

$$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{lcl} \text{Operation} & E & \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) & \end{array}$$

 $\Gamma (0, 0, 0)$ of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (1); 8g: (1); 12h: (1); 12i: (1); 12j: (1); 24k: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (0); 8g: (1); 12h: (1); 12i: (2); 12j: (2); 24k: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (1); 8g: (2); 12h: (2); 12i: (3); 12j: (3); 24k: (6)
4	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (3); 6f: (3); 8g: (3); 12h: (5); 12i: (5); 12j: (5); 24k: (9)
5	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 8g: (3); 12h: (5); 12i: (4); 12j: (4); 24k: (9)

 $X \left(0, \frac{1}{2}, 0\right)$ of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (3); 8g: (3); 12h: (4); 12i: (4); 12j: (5); 24k: (9)
2	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (1); 6e: (3); 6f: (2); 8g: (3); 12h: (4); 12i: (5); 12j: (4); 24k: (9)
3	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (0); 6e: (1); 6f: (2); 8g: (3); 12h: (4); 12i: (5); 12j: (4); 24k: (9)
4	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (1); 6e: (2); 6f: (1); 8g: (3); 12h: (4); 12i: (4); 12j: (5); 24k: (9)
5	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (5); 8g: (6); 12h: (10); 12i: (9); 12j: (9); 24k: (18)

 $M \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 8g: (3); 12h: (5); 12i: (4); 12j: (4); 24k: (9)
2	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (2); 6e: (3); 6f: (1); 8g: (3); 12h: (5); 12i: (5); 12j: (5); 24k: (9)
3	(0, 0, 0)	1a: (0); 1b: (1); 3c: (2); 3d: (1); 6e: (1); 6f: (3); 8g: (3); 12h: (5); 12i: (5); 12j: (5); 24k: (9)
4	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 8g: (3); 12h: (5); 12i: (4); 12j: (4); 24k: (9)
5	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (5); 6f: (5); 8g: (6); 12h: (8); 12i: (9); 12j: (9); 24k: (18)

 $R \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (1); 6e: (1); 6f: (0); 8g: (1); 12h: (2); 12i: (1); 12j: (2); 24k: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (0); 6e: (0); 6f: (1); 8g: (1); 12h: (2); 12i: (2); 12j: (1); 24k: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (1); 6f: (1); 8g: (2); 12h: (4); 12i: (3); 12j: (3); 24k: (6)
4	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (1); 6e: (3); 6f: (2); 8g: (3); 12h: (4); 12i: (5); 12j: (4); 24k: (9)
5	(0, 0, 0)	1a: (0); 1b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (3); 8g: (3); 12h: (4); 12i: (4); 12j: (5); 24k: (9)

c. Results for high-symmetry lines

DT _(0, v, 0)						
Operation	E	C_{4x}^+	C_{4z}^-			
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)			
LD _(u, u, u)						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)		
S _(u, $\frac{1}{2}$, u)						
Operation	E	C_{2x}	C_{4x}^-	C_{2d}	C_{4z}^+	C_{2a}
Coordinate	(u, $\frac{1}{2}$, u)	(u, $-\frac{1}{2}$, -u)	(u, u, $-\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)	($-\frac{1}{2}$, u, u)	($\frac{1}{2}$, u, -u)
SM _(u, u, 0)						
Operation	E	C_{2x}	C_{4y}^-	C_{4y}^+	C_{4x}^+	C_{4x}^-
Coordinate	(u, u, 0)	(u, -u, 0)	(0, u, u)	(0, u, -u)	(u, 0, u)	(u, 0, -u)
T _($\frac{1}{2}$, $\frac{1}{2}$, w)						
Operation	E	C_{4y}^+	C_{4x}^-			
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	(w, $\frac{1}{2}$, $-\frac{1}{2}$)	($\frac{1}{2}$, w, $-\frac{1}{2}$)			
Z _(u, $\frac{1}{2}$, 0)						
Operation	E	C_{31}^+	C_{31}^-	C_{4z}^+	C_{4y}^-	C_{2f}
Coordinate	(u, $\frac{1}{2}$, 0)	(0, u, $\frac{1}{2}$)	($\frac{1}{2}$, 0, u)	($-\frac{1}{2}$, u, 0)	(0, $\frac{1}{2}$, u)	(-u, 0, $-\frac{1}{2}$)

DT (0, v, 0) of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (5); 6f: (5); 8g: (6); 12h: (8); 12i: (9); 12j: (9); 24k: (18)
2	(0, r_1 , 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (5); 8g: (6); 12h: (10); 12i: (9); 12j: (9); 24k: (18)
3	(0, r_1 , 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (3); 6f: (3); 8g: (6); 12h: (8); 12i: (9); 12j: (9); 24k: (18)

4 $(0, r_1, 0)$ **1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (5); 8g: (6); 12h: (10); 12i: (9); 12j: (9); 24k: (18)**

LD (u, u, u) of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	(r_1, r_1, r_1)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 8g: (8); 12h: (12); 12i: (12); 12j: (12); 24k: (24)
2	(r_1, r_1, r_1)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 8g: (8); 12h: (12); 12i: (12); 12j: (12); 24k: (24)
3	(r_1, r_1, r_1)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 8g: (8); 12h: (12); 12i: (12); 12j: (12); 24k: (24)

S $(u, \frac{1}{2}, u)$ of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, r_1)$	1a: (1); 1b: (2); 3c: (4); 3d: (5); 6e: (9); 6f: (9); 8g: (12); 12h: (18); 12i: (17); 12j: (19); 24k: (36)
2	$(r_1, 0, r_1)$	1a: (2); 1b: (1); 3c: (5); 3d: (4); 6e: (9); 6f: (9); 8g: (12); 12h: (18); 12i: (19); 12j: (17); 24k: (36)

SM $(u, u, 0)$ of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	1a: (1); 1b: (1); 3c: (4); 3d: (4); 6e: (9); 6f: (9); 8g: (12); 12h: (18); 12i: (17); 12j: (17); 24k: (36)
2	$(r_1, r_1, 0)$	1a: (2); 1b: (2); 3c: (5); 3d: (5); 6e: (9); 6f: (9); 8g: (12); 12h: (18); 12i: (19); 12j: (19); 24k: (36)

T $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	1a: (1); 1b: (0); 3c: (2); 3d: (3); 6e: (5); 6f: (3); 8g: (6); 12h: (10); 12i: (9); 12j: (9); 24k: (18)
2	$(0, 0, r_1)$	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (5); 6f: (5); 8g: (6); 12h: (8); 12i: (9); 12j: (9); 24k: (18)
3	$(0, 0, r_1)$	1a: (0); 1b: (1); 3c: (3); 3d: (2); 6e: (3); 6f: (5); 8g: (6); 12h: (10); 12i: (9); 12j: (9); 24k: (18)
4	$(0, 0, r_1)$	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (5); 6f: (5); 8g: (6); 12h: (8); 12i: (9); 12j: (9); 24k: (18)

Z $(u, \frac{1}{2}, 0)$ of space group No. 207

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (2); 3c: (5); 3d: (4); 6e: (8); 6f: (10); 8g: (12); 12h: (18); 12i: (18); 12j: (18); 24k: (36)
2	$(r_1, 0, 0)$	1a: (2); 1b: (1); 3c: (4); 3d: (5); 6e: (10); 6f: (8); 8g: (12); 12h: (18); 12i: (18); 12j: (18); 24k: (36)

d. Results for high-symmetry planes

PI(u, u, v)

Operation E C_{2x} C_{31}^+ C_{32}^+ C_{31}^- C_{32}^-

Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

P1 (u, u, v) of space group No. 207		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	1a: (3); 1b: (3); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 8g: (24); 12h: (36); 12i: (36); 12j: (36); 24k: (72)
P2 ($u, v, 0$) of space group No. 207		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 8g: (24); 12h: (36); 12i: (36); 12j: (36); 24k: (72)
P4 ($u, \frac{1}{2}, v$) of space group No. 207		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 3c: (9); 3d: (9); 6e: (18); 6f: (18); 8g: (24); 12h: (36); 12i: (36); 12j: (36); 24k: (72)

208. Space group No. 208 ($P4_232$)

Cubic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_{2x} 0, 0, 0\}$	$\{C_{2z} 0, 0, 0\}$	$\{C_{2y} 0, 0, 0\}$	$\{C_{4x}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{4z}^- \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{C_{4y}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{4x}^- \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$
$\{C_{4z}^+ -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{C_{4y}^+ -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{C_{2a} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{2b} -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{2f} -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{C_{2d} -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{2c} -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{2e} \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$
$\{C_{31}^- 0, 0, 0\}$	$\{C_{31}^+ 0, 0, 0\}$	$\{C_{33}^- 0, 0, 0\}$	$\{C_{34}^- 0, 0, 0\}$	$\{C_{32}^- 0, 0, 0\}$	$\{C_{33}^+ 0, 0, 0\}$	$\{C_{32}^+ 0, 0, 0\}$	$\{C_{34}^+ 0, 0, 0\}$

b. Results for high-symmetry points

Γ (0, 0, 0) of space group No. 208												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (0); 4b: (0); 4c: (0); 6d: (0); 6e: (0); 6f: (0); 8g: (1); 12h: (1); 12i: (1); 12j: (1); 12k: (1); 12l: (1); 24m: (3)										
2	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 6d: (0); 6e: (1); 6f: (1); 8g: (1); 12h: (1); 12i: (1); 12j: (1); 12k: (2); 12l: (2); 24m: (3)										
3	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 6d: (0); 6e: (1); 6f: (1); 8g: (2); 12h: (2); 12i: (2); 12j: (2); 12k: (3); 12l: (3); 24m: (6)										
4	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 6d: (3); 6e: (3); 6f: (3); 8g: (3); 12h: (5); 12i: (5); 12j: (5); 12k: (5); 12l: (5); 24m: (9)										
5	(0, 0, 0)	2a: (1); 4b: (1); 4c: (1); 6d: (3); 6e: (2); 6f: (2); 8g: (3); 12h: (5); 12i: (5); 12j: (5); 12k: (4); 12l: (4); 24m: (9)										

X $(0, \frac{1}{2}, 0)$ of space group No. 208												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (1); (5);	4b: (2); (12l: (4);	4c: (1); (24m: (9)	6d: (3);	6e: (3);	6f: (2);	8g: (3);	12h: (5);	12i: (6);	12j: (4);	12k:
2	(0, 0, 0)	2a: (1); (4);	4b: (1); (12l: (5);	4c: (2); (24m: (9)	6d: (3);	6e: (2);	6f: (3);	8g: (3);	12h: (5);	12i: (4);	12j: (6);	12k:
3	(0, 0, 0)	2a: (1); (4);	4b: (1); (12l: (5);	4c: (2); (24m: (9)	6d: (3);	6e: (3);	6f: (2);	8g: (3);	12h: (5);	12i: (6);	12j: (4);	12k:
4	(0, 0, 0)	2a: (1); (5);	4b: (2); (12l: (4);	4c: (1); (24m: (9)	6d: (3);	6e: (2);	6f: (3);	8g: (3);	12h: (5);	12i: (4);	12j: (6);	12k:
5	(0, 0, 0)	2a: (1); (9);	4b: (3); (12l: (9);	4c: (3); (24m: (18)	6d: (3);	6e: (4);	6f: (4);	8g: (6);	12h: (8);	12i: (8);	12j: (8);	12k:

M ($\frac{1}{2}, \frac{1}{2}, 0$) of space group No. 208												
(Co-) irrep	Phonon AM	WYPO information										
1	(0, 0, 0)	2a: (1); (5);	4b: (2); 12l: (5);	4c: (2); 24m: (9)	6d: (2);	6e: (2);	6f: (3);	8g: (3);	12h: (5);	12i: (3);	12j: (5);	12k:
2	(0, 0, 0)	2a: (1); (4);	4b: (1); 12l: (4);	4c: (1); 24m: (9)	6d: (2);	6e: (2);	6f: (1);	8g: (3);	12h: (5);	12i: (5);	12j: (3);	12k:

3	(0, 0, 0)	2a: (1); 4b: (1); 4c: (1); 6d: (2); 6e: (1); 6f: (2); 8g: (3); 12h: (5); 12i: (3); 12j: (5); 12k: (4); 12l: (4); 24m: (9)
4	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 6d: (2); 6e: (3); 6f: (2); 8g: (3); 12h: (5); 12i: (5); 12j: (3); 12k: (5); 12l: (5); 24m: (9)
5	(0, 0, 0)	2a: (1); 4b: (3); 4c: (3); 6d: (5); 6e: (5); 6f: (5); 8g: (6); 12h: (8); 12i: (10); 12j: (10); 12k: (9); 12l: (9); 24m: (18)

$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 4b: (0); 4c: (1); 6d: (1); 6e: (1); 6f: (1); 8g: (1); 12h: (1); 12i: (2); 12j: (2); 12k: (1); 12l: (2); 24m: (3)
2	(0, 0, 0)	2a: (0); 4b: (1); 4c: (0); 6d: (1); 6e: (1); 6f: (1); 8g: (1); 12h: (1); 12i: (2); 12j: (2); 12k: (2); 12l: (1); 24m: (3)
3	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 6d: (2); 6e: (2); 6f: (2); 8g: (2); 12h: (2); 12i: (4); 12j: (4); 12k: (3); 12l: (3); 24m: (6)
4	(0, 0, 0)	2a: (1); 4b: (2); 4c: (1); 6d: (2); 6e: (2); 6f: (2); 8g: (3); 12h: (5); 12i: (4); 12j: (4); 12k: (5); 12l: (4); 24m: (9)
5	(0, 0, 0)	2a: (1); 4b: (1); 4c: (2); 6d: (2); 6e: (2); 6f: (2); 8g: (3); 12h: (5); 12i: (4); 12j: (4); 12k: (4); 12l: (5); 24m: (9)

c. Results for high-symmetry lines

$DT_{(0, v, 0)}$

Operation	E	C_{4x}^+	C_{4z}^-
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)

$LD_{(u, u, u)}$

Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)

$S_{(u, \frac{1}{2}, u)}$

Operation	E	C_{2x}	C_{4x}^-	C_{2d}	C_{4z}^+	C_{2a}
Coordinate	(u, $\frac{1}{2}$, u)	(u, $-\frac{1}{2}$, -u)	(u, u, $-\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)	($-\frac{1}{2}$, u, u)	($\frac{1}{2}$, u, -u)

$SM_{(u, u, 0)}$

Operation	E	C_{2x}	C_{4y}^-	C_{4y}^+	C_{4x}^+	C_{4x}^-
Coordinate	(u, u, 0)	(u, -u, 0)	(0, u, u)	(0, u, -u)	(u, 0, u)	(u, 0, -u)

$T_{(\frac{1}{2}, \frac{1}{2}, w)}$

Operation	E	C_{4y}^+	C_{4x}^-
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	(w, $\frac{1}{2}$, $-\frac{1}{2}$)	($\frac{1}{2}$, w, $-\frac{1}{2}$)

$Z_{(u, \frac{1}{2}, 0)}$

Operation	E	C_{31}^+	C_{31}^-	C_{4z}^+	C_{4y}^-	C_{2f}
Coordinate	(u, $\frac{1}{2}$, 0)	(0, u, $\frac{1}{2}$)	($\frac{1}{2}$, 0, u)	($-\frac{1}{2}$, u, 0)	(0, $\frac{1}{2}$, u)	(-u, 0, $-\frac{1}{2}$)

DT $(0, v, 0)$ of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 4b: (3); 4c: (3); 6d: (3); 6e: (4); 6f: (4); 8g: (6); 12h: (8); 12i: (8); 12j: (8); 12k: (9); 12l: (9); 24m: (18)
2	$(0, r_1, 0)$	2a: (2); 4b: (3); 4c: (3); 6d: (6); 6e: (5); 6f: (5); 8g: (6); 12h: (10); 12i: (10); 12j: (10); 12k: (9); 12l: (9); 24m: (18)
3	$(0, r_1, 0)$	2a: (1); 4b: (3); 4c: (3); 6d: (3); 6e: (4); 6f: (4); 8g: (6); 12h: (8); 12i: (8); 12j: (8); 12k: (9); 12l: (9); 24m: (18)
4	$(0, r_1, 0)$	2a: (2); 4b: (3); 4c: (3); 6d: (6); 6e: (5); 6f: (5); 8g: (6); 12h: (10); 12i: (10); 12j: (10); 12k: (9); 12l: (9); 24m: (18)

LD (u, u, u) of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	(r_1, r_1, r_1)	2a: (2); 4b: (4); 4c: (4); 6d: (6); 6e: (6); 6f: (6); 8g: (8); 12h: (12); 12i: (12); 12j: (12); 12k: (12); 12l: (12); 24m: (24)
2	(r_1, r_1, r_1)	2a: (2); 4b: (4); 4c: (4); 6d: (6); 6e: (6); 6f: (6); 8g: (8); 12h: (12); 12i: (12); 12j: (12); 12k: (12); 12l: (12); 24m: (24)
3	(r_1, r_1, r_1)	2a: (2); 4b: (4); 4c: (4); 6d: (6); 6e: (6); 6f: (6); 8g: (8); 12h: (12); 12i: (12); 12j: (12); 12k: (12); 12l: (12); 24m: (24)

S $(u, \frac{1}{2}, u)$ of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, r_1)$	2a: (3); 4b: (7); 4c: (5); 6d: (9); 6e: (9); 6f: (9); 8g: (12); 12h: (18); 12i: (18); 12j: (18); 12k: (19); 12l: (17); 24m: (36)
2	$(r_1, 0, r_1)$	2a: (3); 4b: (5); 4c: (7); 6d: (9); 6e: (9); 6f: (9); 8g: (12); 12h: (18); 12i: (18); 12j: (18); 12k: (17); 12l: (19); 24m: (36)

SM $(u, u, 0)$ of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (3); 4b: (5); 4c: (5); 6d: (9); 6e: (8); 6f: (8); 8g: (12); 12h: (18); 12i: (18); 12j: (18); 12k: (17); 12l: (17); 24m: (36)
2	$(r_1, r_1, 0)$	2a: (3); 4b: (7); 4c: (7); 6d: (9); 6e: (10); 6f: (10); 8g: (12); 12h: (18); 12i: (18); 12j: (18); 12k: (19); 12l: (19); 24m: (36)

T $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (2); 4b: (3); 4c: (3); 6d: (4); 6e: (4); 6f: (4); 8g: (6); 12h: (10); 12i: (8); 12j: (8); 12k: (9); 12l: (9); 24m: (18)
2	$(0, 0, r_1)$	2a: (1); 4b: (3); 4c: (3); 6d: (5); 6e: (5); 6f: (5); 8g: (6); 12h: (8); 12i: (10); 12j: (10); 12k: (9); 12l: (9); 24m: (18)
3	$(0, 0, r_1)$	2a: (2); 4b: (3); 4c: (3); 6d: (4); 6e: (4); 6f: (4); 8g: (6); 12h: (10); 12i: (8); 12j: (8); 12k: (9); 12l: (9); 24m: (18)
4	$(0, 0, r_1)$	2a: (1); 4b: (3); 4c: (3); 6d: (5); 6e: (5); 6f: (5); 8g: (6); 12h: (8); 12i: (10); 12j: (10); 12k: (9); 12l: (9); 24m: (18)

Z $(u, \frac{1}{2}, 0)$ of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 4b: (6); 4c: (6); 6d: (9); 6e: (8); 6f: (10); 8g: (12); 12h: (18); 12i: (16); 12j: (20); 12k: (18); 12l: (18); 24m: (36)

2	$(r_1, 0, 0)$	2a: (3); 4b: (6); 4c: (6); 6d: (9); 6e: (10); 6f: (8); 8g: (12); 12h: (18); 12i: (20); 12j: (16); 12k: (18); 12l: (18); 24m: (36)

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

P1 (u, u, v) of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	2a: (6); 4b: (12); 4c: (12); 6d: (18); 6e: (18); 6f: (18); 8g: (24); 12h: (36); 12i: (36); 12j: (36); 12k: (36); 12l: (36); 24m: (72)

P2 $(u, v, 0)$ of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 4b: (12); 4c: (12); 6d: (18); 6e: (18); 6f: (18); 8g: (24); 12h: (36); 12i: (36); 12j: (36); 12k: (36); 12l: (36); 24m: (72)

P4 $(u, \frac{1}{2}, v)$ of space group No. 208

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (6); 4b: (12); 4c: (12); 6d: (18); 6e: (18); 6f: (18); 8g: (24); 12h: (36); 12i: (36); 12j: (36); 12k: (36); 12l: (36); 24m: (72)

209. Space group No. 209 ($F432$)

Cubic face-centered lattice	$\vec{a} = (a, 0, 0)$	$\vec{t}_1 = \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c}$
	$\vec{b} = (0, a, 0)$	$\vec{t}_2 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c}$
	$\vec{c} = (0, 0, a)$	$\vec{t}_3 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b}$

a. Space group operations

1	(0, 0, 0)	4a: (0); 4b: (1); 8c: (1); 24d: (3); 24e: (3); 32f: (4); 48g: (5); 48h: (7); 48i: (6); 96j: (12)
2	(0, 0, 0)	4a: (1); 4b: (0); 8c: (1); 24d: (3); 24e: (3); 32f: (4); 48g: (7); 48h: (5); 48i: (6); 96j: (12)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (6); 24e: (6); 32f: (8); 48g: (12); 48h: (12); 48i: (12); 96j: (24)

W $(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$ of space group No. 209

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (1); 8c: (2); 24d: (5); 24e: (4); 32f: (6); 48g: (8); 48h: (10); 48i: (10); 96j: (18)
2	(0, 0, 0)	4a: (1); 4b: (0); 8c: (2); 24d: (5); 24e: (4); 32f: (6); 48g: (10); 48h: (8); 48i: (10); 96j: (18)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 24d: (4); 24e: (5); 32f: (6); 48g: (9); 48h: (9); 48i: (8); 96j: (18)

c. Results for high-symmetry lines

DT($\frac{v}{2}, 0, \frac{v}{2}$)					
Operation	E	C_{4x}^+	C_{4z}^-		
Coordinate	$(\frac{v}{2}, 0, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, 0)$	$(0, \frac{v}{2}, \frac{v}{2})$		
LD(u, u, u)					
Operation	E	C_{2x}	C_{2y}	C_{2z}	
Coordinate	(u, u, u)	$(-u, 0, 0)$	$(0, -u, 0)$	$(0, 0, -u)$	
Q($\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v)$)					
Operation	E	C_{2y}	C_{2b}	C_{2a}	
Coordinate	$(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$	$(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$	$(\frac{1}{4}(-3+2v), -\frac{1}{2}, \frac{1}{4}(-1-2v))$	$(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(1+2v))$	
	C_{2e}	C_{4y}^-			
	$(\frac{1}{4}(-1-2v), \frac{1}{4}(-3+2v), -\frac{1}{2})$	$(\frac{1}{4}(1+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$			
SM($\frac{u}{2}, \frac{u}{2}, u$)					
Operation	E	C_{2x}	C_{4y}^-	C_{4y}^+	$C_{4x}^+ \quad C_{4x}^-$
Coordinate	$(\frac{u}{2}, \frac{u}{2}, u)$	$(-\frac{u}{2}, \frac{u}{2}, 0)$	$(u, \frac{u}{2}, \frac{u}{2})$	$(0, -\frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, u, \frac{u}{2}) \quad (-\frac{u}{2}, 0, u)$
V($\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}$)					
Operation	E	C_{31}^+	C_{31}^-		
Coordinate	$(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$	$(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{1+u}{2}, \frac{1}{2})$		

DT $(\frac{v}{2}, 0, \frac{v}{2})$ of space group No. 209

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	4a: (1); 4b: (1); 8c: (1); 24d: (4); 24e: (5); 32f: (6); 48g: (9); 48h: (9); 48i: (8); 96j: (18)
2	$(0, r_1, 0)$	4a: (1); 4b: (1); 8c: (2); 24d: (5); 24e: (5); 32f: (6); 48g: (9); 48h: (9); 48i: (10); 96j: (18)
3	$(0, r_1, 0)$	4a: (0); 4b: (0); 8c: (1); 24d: (4); 24e: (3); 32f: (6); 48g: (9); 48h: (9); 48i: (8); 96j: (18)
4	$(0, r_1, 0)$	4a: (1); 4b: (1); 8c: (2); 24d: (5); 24e: (5); 32f: (6); 48g: (9); 48h: (9); 48i: (10); 96j: (18)

LD (u, u, u) of space group No. 209

(Co-) irrep	Phonon AM	WYPO information
1	(r_1, r_1, r_1)	4a: (1); 4b: (1); 8c: (2); 24d: (6); 24e: (6); 32f: (8); 48g: (12); 48h: (12); 48i: (12); 96j: (24)
2	(r_1, r_1, r_1)	4a: (1); 4b: (1); 8c: (2); 24d: (6); 24e: (6); 32f: (8); 48g: (12); 48h: (12); 48i: (12); 96j: (24)
3	(r_1, r_1, r_1)	4a: (1); 4b: (1); 8c: (2); 24d: (6); 24e: (6); 32f: (8); 48g: (12); 48h: (12); 48i: (12); 96j: (24)

Q $(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$ of space group No. 209

(Co-) irrep	Phonon AM	WYPO information
1	$(0, -r_1, r_1)$	4a: (1); 4b: (2); 8c: (3); 24d: (9); 24e: (9); 32f: (12); 48g: (17); 48h: (19); 48i: (18); 96j: (36)
2	$(0, -r_1, r_1)$	4a: (2); 4b: (1); 8c: (3); 24d: (9); 24e: (9); 32f: (12); 48g: (19); 48h: (17); 48i: (18); 96j: (36)

SM $(\frac{u}{2}, \frac{u}{2}, u)$ of space group No. 209

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (1); 4b: (1); 8c: (3); 24d: (8); 24e: (9); 32f: (12); 48g: (17); 48h: (17); 48i: (18); 96j: (36)
2	$(r_1, r_1, 0)$	4a: (2); 4b: (2); 8c: (3); 24d: (10); 24e: (9); 32f: (12); 48g: (19); 48h: (19); 48i: (18); 96j: (36)

V $(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$ of space group No. 209

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (1); 4b: (1); 8c: (4); 24d: (10); 24e: (8); 32f: (12); 48g: (18); 48h: (18); 48i: (20); 96j: (36)
2	$(r_1, 0, 0)$	4a: (2); 4b: (2); 8c: (2); 24d: (8); 24e: (10); 32f: (12); 48g: (18); 48h: (18); 48i: (16); 96j: (36)

*d. Results for high-symmetry planes*P1($u, v, u+v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, u+v)$	$(u+v, u, v)$	$(v, u+v, u)$

P2(u, u, v)

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-u, -u+v, 0)$	(v, u, u)	$(0, -u, -u+v)$	(u, v, u)	$(-u, 0, -u+v)$

P1 $(u, v, u+v)$ of space group No. 209

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (3); 4b: (3); 8c: (6); 24d: (18); 24e: (18); 32f: (24); 48g: (36); 48h: (36); 48i: (36); 96j: (72)

P2 (u, u, v) of space group No. 209

(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	4a: (3); 4b: (3); 8c: (6); 24d: (18); 24e: (18); 32f: (24); 48g: (36); 48h: (36); 48i: (36); 96j: (72)

210. Space group No. 210 ($F_{41}32$)

Cubic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{4x}^+|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{C_{4z}^-|-\frac{3}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{C_{4y}^-|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{C_{4x}^-|-\frac{3}{4}, \frac{1}{4}, \frac{1}{4}\} \\ &\{C_{4z}^+|\frac{1}{4}, -\frac{3}{4}, \frac{1}{4}\} \quad \{C_{4y}^+|\frac{1}{4}, -\frac{3}{4}, \frac{1}{4}\} \quad \{C_{2a}|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \quad \{C_{2b}|\frac{1}{4}, \frac{1}{4}, -\frac{3}{4}\} \quad \{C_{2f}|\frac{1}{4}, -\frac{3}{4}, \frac{1}{4}\} \quad \{C_{2d}|\frac{1}{4}, \frac{1}{4}, -\frac{3}{4}\} \quad \{C_{2c}|\frac{1}{4}, \frac{1}{4}, -\frac{3}{4}\} \quad \{C_{2e}|\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\} \\ &\{C_{31}^-|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\} \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$					
Operation	E				
Coordinate	$(0, 0, 0)$				
$X(\frac{1}{2}, 0, \frac{1}{2})$					
Operation	E	C_{4x}^{+}	C_{4z}^{-}		
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$	$(\frac{1}{2}, \frac{1}{2}, 0)$	$(0, \frac{1}{2}, \frac{1}{2})$		
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$					
Operation	E	C_{2x}	C_{2y}	C_{2z}	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(-\frac{1}{2}, 0, 0)$	$(0, -\frac{1}{2}, 0)$	$(0, 0, -\frac{1}{2})$	
$W(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$					
Operation	E	C_{2z}	C_{4z}^{-}	C_{4z}^{+}	C_{4y}^{+}
Coordinate	$(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$	$(-\frac{1}{2}, -\frac{1}{4}, -\frac{3}{4})$	$(-\frac{1}{4}, \frac{1}{2}, \frac{1}{4})$	$(\frac{1}{4}, -\frac{1}{2}, -\frac{1}{4})$	$(\frac{1}{4}, -\frac{1}{4}, \frac{1}{2})$
					$(\frac{3}{4}, \frac{1}{4}, \frac{1}{2})$

$\Gamma (0, 0, 0)$ of space group No. 210

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (0); 8b: (0); 16c: (0); 16d: (0); 32e: (1); 48f: (1); 48g: (1); 96h: (3)
2	(0, 0, 0)	8a: (0); 8b: (0); 16c: (1); 16d: (1); 32e: (1); 48f: (1); 48g: (2); 96h: (3)
3	(0, 0, 0)	8a: (0); 8b: (0); 16c: (1); 16d: (1); 32e: (2); 48f: (2); 48g: (3); 96h: (6)
4	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (3); 48f: (5); 48g: (5); 96h: (9)
5	(0, 0, 0)	8a: (1); 8b: (1); 16c: (1); 16d: (1); 32e: (3); 48f: (5); 48g: (4); 96h: (9)

 $X (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 210

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (1); 16d: (1); 32e: (3); 48f: (5); 48g: (4); 96h: (9)
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (3); 48f: (5); 48g: (5); 96h: (9)
3	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (3); 48f: (5); 48g: (5); 96h: (9)
4	(0, 0, 0)	8a: (1); 8b: (1); 16c: (1); 16d: (1); 32e: (3); 48f: (5); 48g: (4); 96h: (9)
5	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 32e: (6); 48f: (8); 48g: (9); 96h: (18)

 $L (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 210

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (4); 48f: (6); 48g: (6); 96h: (12)
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (4); 48f: (6); 48g: (6); 96h: (12)
3	(0, 0, 0)	8a: (2); 8b: (2); 16c: (4); 16d: (4); 32e: (8); 48f: (12); 48g: (12); 96h: (24)

 $W (\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$ of space group No. 210

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 48g: (18); 96h: (36)

c. Results for high-symmetry lines

$DT(\frac{y}{2}, 0, \frac{y}{2})$					
Operation	E	C_{4x}^+	C_{4z}^-		
Coordinate	$(\frac{y}{2}, 0, \frac{y}{2})$	$(\frac{y}{2}, \frac{y}{2}, 0)$	$(0, \frac{y}{2}, \frac{y}{2})$		
$LD(u, u, u)$					
Operation	E	C_{2x}	C_{2y}	C_{2z}	
Coordinate	(u, u, u)	$(-u, 0, 0)$	$(0, -u, 0)$	$(0, 0, -u)$	
$Q(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$					
Operation	E	C_{2y}	C_{2b}	C_{2a}	
Coordinate	$(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$	$(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$	$(\frac{1}{4}(-3+2v), -\frac{1}{2}, \frac{1}{4}(-1-2v))$	$(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(1+2v))$	
	C_{2e}	C_{4y}^-			
	$(\frac{1}{4}(-1-2v), \frac{1}{4}(-3+2v), -\frac{1}{2})$	$(\frac{1}{4}(1+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$			
$SM(\frac{y}{2}, \frac{y}{2}, u)$					
Operation	E	C_{2x}	C_{4y}^-	C_{4y}^+	$C_{4x}^+ \quad C_{4x}^-$
Coordinate	$(\frac{y}{2}, \frac{y}{2}, u)$	$(-\frac{y}{2}, \frac{y}{2}, 0)$	$(u, \frac{y}{2}, \frac{y}{2})$	$(0, -\frac{y}{2}, \frac{y}{2})$	$(\frac{y}{2}, u, \frac{y}{2}) \quad (-\frac{y}{2}, 0, u)$

$$V\left(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}\right)$$

Operation
Coordinate

$$E$$

$$\left(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}\right)$$

$$C_{31}^{+}$$

$$\left(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2}\right)$$

$$C_{31}^{-}$$

$$\left(\frac{u}{2}, \frac{1+u}{2}, \frac{1}{2}\right)$$

DT $\left(\frac{v}{2}, 0, \frac{v}{2}\right)$ of space group No. 210

(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	8a: (1); 8b: (1); 16c: (3); 16d: (3); 32e: (6); 48f: (8); 48g: (9); 96h: (18)
2	$(0, r_1, 0)$	8a: (2); 8b: (2); 16c: (3); 16d: (3); 32e: (6); 48f: (10); 48g: (9); 96h: (18)
3	$(0, r_1, 0)$	8a: (1); 8b: (1); 16c: (3); 16d: (3); 32e: (6); 48f: (8); 48g: (9); 96h: (18)
4	$(0, r_1, 0)$	8a: (2); 8b: (2); 16c: (3); 16d: (3); 32e: (6); 48f: (10); 48g: (9); 96h: (18)

LD (u, u, u) of space group No. 210

(Co-) irrep	Phonon AM	WYPO information
1	(r_1, r_1, r_1)	8a: (2); 8b: (2); 16c: (4); 16d: (4); 32e: (8); 48f: (12); 48g: (12); 96h: (24)
2	(r_1, r_1, r_1)	8a: (2); 8b: (2); 16c: (4); 16d: (4); 32e: (8); 48f: (12); 48g: (12); 96h: (24)
3	(r_1, r_1, r_1)	8a: (2); 8b: (2); 16c: (4); 16d: (4); 32e: (8); 48f: (12); 48g: (12); 96h: (24)

Q $\left(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v)\right)$ of space group No. 210

(Co-) irrep	Phonon AM	WYPO information
1	$(0, -r_1, r_1)$	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 48g: (18); 96h: (36)
2	$(0, -r_1, r_1)$	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 48g: (18); 96h: (36)

SM $\left(\frac{u}{2}, \frac{u}{2}, u\right)$ of space group No. 210

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	8a: (3); 8b: (3); 16c: (5); 16d: (5); 32e: (12); 48f: (18); 48g: (17); 96h: (36)
2	$(r_1, r_1, 0)$	8a: (3); 8b: (3); 16c: (7); 16d: (7); 32e: (12); 48f: (18); 48g: (19); 96h: (36)

V $\left(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}\right)$ of space group No. 210

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 48g: (18); 96h: (36)
2	$(r_1, 0, 0)$	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 48g: (18); 96h: (36)

d. Results for high-symmetry planes

P1($u, v, u+v$)

Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	$(u, v, u+v)$	$(u+v, u, v)$	$(v, u+v, u)$

P2(u, u, v)

Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(-u, -u+v, 0)$	(v, u, u)	$(0, -u, -u+v)$	(u, v, u)	$(-u, 0, -u+v)$

P1 ($u, v, u + v$) of space group No. 210		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	8a: (6); 8b: (6); 16c: (12); 16d: (12); 32e: (24); 48f: (36); 48g: (36); 96h: (72)
P2 (u, u, v) of space group No. 210		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	8a: (6); 8b: (6); 16c: (12); 16d: (12); 32e: (24); 48f: (36); 48g: (36); 96h: (72)

211. Space group No. 211 ($I432$)

Cubic body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$$\begin{aligned} &\{E|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{C_{4x}^+|0, 0, 0\} \quad \{C_{4z}^-|0, 0, 0\} \quad \{C_{4y}^-|0, 0, 0\} \quad \{C_{4x}^-|0, 0, 0\} \\ &\{C_{4z}^+|0, 0, 0\} \quad \{C_{4y}^+|0, 0, 0\} \quad \{C_{2a}|0, 0, 0\} \quad \{C_{2b}|0, 0, 0\} \quad \{C_{2f}|0, 0, 0\} \quad \{C_{2d}|0, 0, 0\} \quad \{C_{2c}|0, 0, 0\} \quad \{C_{2e}|0, 0, 0\} \\ &\{C_{31}^-|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\} \end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	$(0, 0, 0)$
$H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	
Operation	E C_{4x}^+
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ $(-\frac{1}{4}, \frac{3}{4}, -\frac{1}{4})$

$N(0, 0, \frac{1}{2})$

Operation	E	C_{2x}	C_{4y}^-	C_{4y}^+	C_{4x}^+	C_{4x}^-
Coordinate	$(0, 0, \frac{1}{2})$	$(-\frac{1}{2}, \frac{1}{2}, 0)$	$(\frac{1}{2}, 0, 0)$	$(0, -\frac{1}{2}, \frac{1}{2})$	$(0, \frac{1}{2}, 0)$	$(-\frac{1}{2}, 0, \frac{1}{2})$

 $\Gamma(0, 0, 0)$ of space group No. 211

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	6b: (0);	8c: (0);	12d: (0);	12e: (1);	16f: (1);	24g: (1);	24h: (1);	24i: (1);	48j: (3)
2	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (1);	12e: (0);	16f: (1);	24g: (1);	24h: (2);	24i: (2);	48j: (3)
3	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (1);	12e: (1);	16f: (2);	24g: (2);	24h: (3);	24i: (3);	48j: (6)
4	(0, 0, 0)	2a: (1);	6b: (2);	8c: (2);	12d: (3);	12e: (3);	16f: (3);	24g: (5);	24h: (5);	24i: (5);	48j: (9)
5	(0, 0, 0)	2a: (0);	6b: (1);	8c: (1);	12d: (2);	12e: (2);	16f: (3);	24g: (5);	24h: (4);	24i: (4);	48j: (9)

 $H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 211

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (1);	12e: (1);	16f: (1);	24g: (1);	24h: (1);	24i: (2);	48j: (3)
2	(0, 0, 0)	2a: (0);	6b: (0);	8c: (0);	12d: (0);	12e: (0);	16f: (1);	24g: (1);	24h: (2);	24i: (1);	48j: (3)
3	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (1);	12e: (1);	16f: (2);	24g: (2);	24h: (3);	24i: (3);	48j: (6)
4	(0, 0, 0)	2a: (1);	6b: (2);	8c: (1);	12d: (2);	12e: (3);	16f: (3);	24g: (5);	24h: (5);	24i: (4);	48j: (9)
5	(0, 0, 0)	2a: (0);	6b: (1);	8c: (2);	12d: (3);	12e: (2);	16f: (3);	24g: (5);	24h: (4);	24i: (5);	48j: (9)

 $P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 211

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	6b: (1);	8c: (1);	12d: (2);	12e: (1);	16f: (2);	24g: (4);	24h: (3);	24i: (3);	48j: (6)
2	(0, 0, 0)	2a: (0);	6b: (1);	8c: (1);	12d: (2);	12e: (1);	16f: (2);	24g: (4);	24h: (3);	24i: (3);	48j: (6)
3	(0, 0, 0)	2a: (0);	6b: (1);	8c: (1);	12d: (2);	12e: (1);	16f: (2);	24g: (4);	24h: (3);	24i: (3);	48j: (6)
4	(0, 0, 0)	2a: (1);	6b: (2);	8c: (3);	12d: (4);	12e: (5);	16f: (6);	24g: (8);	24h: (9);	24i: (9);	48j: (18)

 $N(0, 0, \frac{1}{2})$ of space group No. 211

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	2a: (0);	6b: (2);	8c: (3);	12d: (5);	12e: (4);	16f: (6);	24g: (10);	24h: (8);	24i: (9);	48j: (18)
2	(0, 0, 0)	2a: (1);	6b: (3);	8c: (3);	12d: (5);	12e: (4);	16f: (6);	24g: (10);	24h: (10);	24i: (9);	48j: (18)
3	(0, 0, 0)	2a: (1);	6b: (2);	8c: (4);	12d: (5);	12e: (5);	16f: (6);	24g: (8);	24h: (9);	24i: (10);	48j: (18)
4	(0, 0, 0)	2a: (1);	6b: (2);	8c: (2);	12d: (3);	12e: (5);	16f: (6);	24g: (8);	24h: (9);	24i: (8);	48j: (18)

c. Results for high-symmetry lines

 $D(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	$(\frac{1-w}{2}, \frac{w}{2}, \frac{w}{2})$	$(\frac{w}{2}, \frac{1-w}{2}, \frac{w}{2})$

 $DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$

Operation	E	C_{4x}^+	C_{4x}^-

Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, -\frac{v}{2})$	$(-\frac{v}{2}, \frac{v}{2}, \frac{v}{2})$			
$G(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$						
Operation	E	C_{2x}	C_{2e}	C_{2c}	C_{2f}	C_{2d}
Coordinate	$(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$	$(-\frac{3}{2}, \frac{1}{2}, \frac{1}{2} + u)$	$(-\frac{1}{2}, -\frac{1}{2} - u, -\frac{1}{2} + u)$	$(-\frac{1}{2} + u, \frac{3}{2}, -\frac{1}{2})$	$(-\frac{1}{2} + u, -\frac{1}{2}, -\frac{1}{2} - u)$	$(\frac{3}{2}, -\frac{1}{2} - u, -\frac{1}{2})$
$LD(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$		
$SM(0, 0, u)$						
Operation	E	C_{2x}	C_{4y}^{-}	C_{4y}^{+}	C_{4x}^{+}	C_{4x}^{-}
Coordinate	$(0, 0, u)$	$(-u, u, 0)$	$(u, 0, 0)$	$(0, -u, u)$	$(0, u, 0)$	$(-u, 0, u)$

$D(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 211		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	2a: (1); 6b: (5); 8c: (6); 12d: (10); 12e: (8); 16f: (12); 24g: (20); 24h: (18); 24i: (18); 48j: (36)
2	$(0, 0, r_1)$	2a: (2); 6b: (4); 8c: (6); 12d: (8); 12e: (10); 16f: (12); 24g: (16); 24h: (18); 24i: (18); 48j: (36)
$DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$ of space group No. 211		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, r_1, 0)$	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 16f: (6); 24g: (8); 24h: (9); 24i: (9); 48j: (18)
2	$(0, r_1, 0)$	2a: (1); 6b: (3); 8c: (3); 12d: (5); 12e: (5); 16f: (6); 24g: (10); 24h: (9); 24i: (9); 48j: (18)
3	$(0, r_1, 0)$	2a: (0); 6b: (1); 8c: (3); 12d: (4); 12e: (3); 16f: (6); 24g: (8); 24h: (9); 24i: (9); 48j: (18)
4	$(0, r_1, 0)$	2a: (1); 6b: (3); 8c: (3); 12d: (5); 12e: (5); 16f: (6); 24g: (10); 24h: (9); 24i: (9); 48j: (18)
$G(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$ of space group No. 211		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (1); 6b: (4); 8c: (7); 12d: (10); 12e: (9); 16f: (12); 24g: (18); 24h: (17); 24i: (19); 48j: (36)
2	$(-r_1, r_1, 0)$	2a: (2); 6b: (5); 8c: (5); 12d: (8); 12e: (9); 16f: (12); 24g: (18); 24h: (19); 24i: (17); 48j: (36)
$LD(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$ of space group No. 211		
(Co-) irrep	Phonon AM	WYPO information
1	(r_1, r_1, r_1)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 16f: (8); 24g: (12); 24h: (12); 24i: (12); 48j: (24)
2	(r_1, r_1, r_1)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 16f: (8); 24g: (12); 24h: (12); 24i: (12); 48j: (24)
3	(r_1, r_1, r_1)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 16f: (8); 24g: (12); 24h: (12); 24i: (12); 48j: (24)
$SM(0, 0, u)$ of space group No. 211		

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (1); 6b: (4); 8c: (5); 12d: (8); 12e: (9); 16f: (12); 24g: (18); 24h: (17); 24i: (17); 48j: (36)
2	$(r_1, r_1, 0)$	2a: (2); 6b: (5); 8c: (7); 12d: (10); 12e: (9); 16f: (12); 24g: (18); 24h: (19); 24i: (19); 48j: (36)

d. Results for high-symmetry planes

$P1(u, u, v)$						
Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-2u - v, v, u)$	(v, u, u)	$(u, -2u - v, v)$	(u, v, u)	$(-2u - v, u, v)$
$P2(u, -u, v)$						
Operation	E	C_{31}^+	C_{31}^-			
Coordinate	$(u, -u, v)$	$(v, u, -u)$	$(-u, v, u)$			

P1 (u, u, v) of space group No. 211		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 24i: (36); 48j: (72)
P2 $(u, -u, v)$ of space group No. 211		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 24i: (36); 48j: (72)

212. Space group No. 212 ($P4_332$)

Cubic primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_{2x} \frac{1}{2}, \frac{1}{2}, 0\}$	$\{C_{2z} \frac{1}{2}, 0, \frac{1}{2}\}$	$\{C_{2y} 0, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{4x}^+ \frac{3}{4}, \frac{3}{4}, \frac{1}{4}\}$	$\{C_{4z}^- \frac{3}{4}, -\frac{1}{4}, -\frac{3}{4}\}$	$\{C_{4y}^- \frac{3}{4}, \frac{1}{4}, \frac{3}{4}\}$	$\{C_{4x}^- \frac{1}{4}, -\frac{1}{4}, -\frac{1}{4}\}$
$\{C_{4z}^+ -\frac{1}{4}, \frac{1}{4}, -\frac{1}{4}\}$	$\{C_{4y}^+ -\frac{3}{4}, \frac{3}{4}, -\frac{1}{4}\}$	$\{C_{2a} \frac{1}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{C_{2b} \frac{1}{4}, -\frac{3}{4}, \frac{1}{4}\}$	$\{C_{2f} -\frac{3}{4}, \frac{1}{4}, \frac{1}{4}\}$	$\{C_{2d} -\frac{1}{4}, -\frac{3}{4}, \frac{3}{4}\}$	$\{C_{2c} -\frac{1}{4}, -\frac{1}{4}, \frac{1}{4}\}$	$\{C_{2e} \frac{1}{4}, \frac{1}{4}, -\frac{3}{4}\}$
$\{C_{31}^- 0, 0, 0\}$	$\{C_{31}^+ 0, 0, 0\}$	$\{C_{33}^- 0, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{34}^- \frac{1}{2}, 0, \frac{1}{2}\}$	$\{C_{32}^- -\frac{1}{2}, \frac{1}{2}, 0\}$	$\{C_{33}^+ \frac{1}{2}, 0, -\frac{1}{2}\}$	$\{C_{32}^+ 0, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{34}^+ \frac{1}{2}, \frac{1}{2}, 0\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$X(0, \frac{1}{2}, 0)$			
Operation	E	C_{4x}^+	C_{4z}^-
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$
$M(\frac{1}{2}, \frac{1}{2}, 0)$			
Operation	E	C_{4y}^-	C_{4x}^+
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$
$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			
Operation	E		
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$		

Γ (0, 0, 0) of space group No. 212						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (0);	4b: (0);	8c: (1);	12d: (1);	24e: (3)
2	(0, 0, 0)	4a: (1);	4b: (1);	8c: (1);	12d: (2);	24e: (3)
3	(0, 0, 0)	4a: (1);	4b: (1);	8c: (2);	12d: (3);	24e: (6)
4	(0, 0, 0)	4a: (2);	4b: (2);	8c: (3);	12d: (5);	24e: (9)
5	(0, 0, 0)	4a: (1);	4b: (1);	8c: (3);	12d: (4);	24e: (9)
X $(0, \frac{1}{2}, 0)$ of space group No. 212						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (3);	4b: (3);	8c: (6);	12d: (9);	24e: (18)
2	(0, 0, 0)	4a: (3);	4b: (3);	8c: (6);	12d: (9);	24e: (18)
M $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 212						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (2);	4b: (2);	8c: (3);	12d: (5);	24e: (9)
2	(0, 0, 0)	4a: (1);	4b: (1);	8c: (3);	12d: (4);	24e: (9)
3	(0, 0, 0)	4a: (3);	4b: (3);	8c: (6);	12d: (9);	24e: (18)
R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 212						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, 0, 0)	4a: (1);	4b: (1);	8c: (2);	12d: (3);	24e: (6)
2	(0, 0, 0)	4a: (2);	4b: (2);	8c: (4);	12d: (6);	24e: (12)

c. Results for high-symmetry lines

DT _(0, v, 0)						
Operation	E	C_{4x}^+	C_{4z}^-			
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)			
LD _(u, u, u)						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)		
S _(u, $\frac{1}{2}$, u)						
Operation	E	C_{2x}	C_{4x}^-	C_{2d}	C_{4z}^+	C_{2a}
Coordinate	(u, $\frac{1}{2}$, u)	(u, $-\frac{1}{2}$, -u)	(u, u, $-\frac{1}{2}$)	(-u, u, $\frac{1}{2}$)	($-\frac{1}{2}$, u, u)	($\frac{1}{2}$, u, -u)
SM _(u, u, 0)						
Operation	E	C_{2x}	C_{4y}^-	C_{4y}^+	C_{4x}^+	C_{4x}^-
Coordinate	(u, u, 0)	(u, -u, 0)	(0, u, u)	(0, u, -u)	(u, 0, u)	(u, 0, -u)
T _($\frac{1}{2}$, $\frac{1}{2}$, w)						
Operation	E	C_{4y}^+	C_{4x}^-			
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	(w, $\frac{1}{2}$, $-\frac{1}{2}$)	($\frac{1}{2}$, w, $-\frac{1}{2}$)			
Z _(u, $\frac{1}{2}$, 0)						
Operation	E	C_{31}^+	C_{31}^-	C_{4z}^+	C_{4y}^-	C_{2f}
Coordinate	(u, $\frac{1}{2}$, 0)	(0, u, $\frac{1}{2}$)	($\frac{1}{2}$, 0, u)	($-\frac{1}{2}$, u, 0)	(0, $\frac{1}{2}$, u)	(-u, 0, $-\frac{1}{2}$)

DT (0, v, 0) of space group No. 212						
(Co-) irrep	Phonon AM	WYPO information				
1	(0, r_1 , 0)	4a: (3);	4b: (3);	8c: (6);	12d: (9);	24e: (18)
2	(0, r_1 , 0)	4a: (3);	4b: (3);	8c: (6);	12d: (9);	24e: (18)
3	(0, r_1 , 0)	4a: (3);	4b: (3);	8c: (6);	12d: (9);	24e: (18)
4	(0, r_1 , 0)	4a: (3);	4b: (3);	8c: (6);	12d: (9);	24e: (18)
LD (u, u, u) of space group No. 212						
(Co-) irrep	Phonon AM	WYPO information				
1	(r_1 , r_1 , r_1)	4a: (4);	4b: (4);	8c: (8);	12d: (12);	24e: (24)
2	(r_1 , r_1 , r_1)	4a: (4);	4b: (4);	8c: (8);	12d: (12);	24e: (24)
3	(r_1 , r_1 , r_1)	4a: (4);	4b: (4);	8c: (8);	12d: (12);	24e: (24)
S (u, $\frac{1}{2}$, u) of space group No. 212						
(Co-) irrep	Phonon AM	WYPO information				
1	(r_1 , 0, r_1)	4a: (6);	4b: (6);	8c: (12);	12d: (18);	24e: (36)
SM (u, u, 0) of space group No. 212						
(Co-) irrep	Phonon AM	WYPO information				
1	(r_1 , r_1 , 0)	4a: (5);	4b: (5);	8c: (12);	12d: (17);	24e: (36)
2	(r_1 , r_1 , 0)	4a: (7);	4b: (7);	8c: (12);	12d: (19);	24e: (36)

T $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 212		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)
Z $(u, \frac{1}{2}, 0)$ of space group No. 212		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6); 4b: (6); 8c: (12); 12d: (18); 24e: (36)

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

P1 (u, u, v) of space group No. 212		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	4a: (12); 4b: (12); 8c: (24); 12d: (36); 24e: (72)
P2 $(u, v, 0)$ of space group No. 212		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12); 4b: (12); 8c: (24); 12d: (36); 24e: (72)
P4 $(u, \frac{1}{2}, v)$ of space group No. 212		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6); 4b: (6); 8c: (12); 12d: (18); 24e: (36)

213. Space group No. 213 ($P4_132$)

Cubic primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c} \end{aligned}$$

$\{E 0,0,0\}$	$\{C_{2x} \frac{1}{2}, \frac{1}{2}, 0\}$	$\{C_{2z} \frac{1}{2}, 0, \frac{1}{2}\}$	$\{C_{2y} 0, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{4x}^+ \frac{1}{4}, \frac{1}{4}, \frac{3}{4}\}$	$\{C_{4z}^- \frac{1}{4}, \frac{1}{4}, -\frac{1}{4}\}$	$\{C_{4y}^- \frac{1}{4}, \frac{3}{4}, \frac{1}{4}\}$	$\{C_{4x}^- -\frac{1}{4}, \frac{1}{4}, -\frac{3}{4}\}$
$\{C_{4z}^+ -\frac{3}{4}, -\frac{1}{4}, \frac{1}{4}\}$	$\{C_{4y}^+ -\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\}$	$\{C_{2a} \frac{3}{4}, \frac{1}{4}, \frac{1}{4}\}$	$\{C_{2b} -\frac{1}{4}, -\frac{1}{4}, \frac{3}{4}\}$	$\{C_{2f} -\frac{1}{4}, \frac{3}{4}, -\frac{1}{4}\}$	$\{C_{2d} \frac{1}{4}, -\frac{1}{4}, \frac{1}{4}\}$	$\{C_{2c} \frac{1}{4}, -\frac{3}{4}, -\frac{1}{4}\}$	$\{C_{2e} \frac{3}{4}, -\frac{1}{4}, -\frac{1}{4}\}$
$\{C_{31}^- 0,0,0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{33}^- 0, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{34}^- \frac{1}{2}, 0, \frac{1}{2}\}$	$\{C_{32}^- -\frac{1}{2}, \frac{1}{2}, 0\}$	$\{C_{33}^+ \frac{1}{2}, 0, -\frac{1}{2}\}$	$\{C_{32}^+ 0, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{34}^+ \frac{1}{2}, \frac{1}{2}, 0\}$

a. Space group operations

b. Results for high-symmetry points

$\Gamma(0,0,0)$				
Operation	E			
Coordinate	$(0,0,0)$			

$X(0, \frac{1}{2}, 0)$				
Operation	E	C_{4x}^+	C_{4z}^-	
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$	

$M(\frac{1}{2}, \frac{1}{2}, 0)$				
Operation	E	C_{4y}^-	C_{4x}^+	
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	$(0, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, \frac{1}{2})$	

$R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$				
Operation	E			
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$			

$\Gamma(0,0,0)$ of space group No. 213				
(Co-) irrep	Phonon AM	WYPO information		
1	$(0,0,0)$	4a: (0); 4b: (0); 8c: (1); 12d: (1); 24e: (3)		
2	$(0,0,0)$	4a: (1); 4b: (1); 8c: (1); 12d: (2); 24e: (3)		
3	$(0,0,0)$	4a: (1); 4b: (1); 8c: (2); 12d: (3); 24e: (6)		
4	$(0,0,0)$	4a: (2); 4b: (2); 8c: (3); 12d: (5); 24e: (9)		
5	$(0,0,0)$	4a: (1); 4b: (1); 8c: (3); 12d: (4); 24e: (9)		

$X(0, \frac{1}{2}, 0)$ of space group No. 213				
(Co-) irrep	Phonon AM	WYPO information		
1	$(0,0,0)$	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)		
2	$(0,0,0)$	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)		

$M(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 213				
(Co-) irrep	Phonon AM	WYPO information		

1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 12d: (4); 24e: (9)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 12d: (5); 24e: (9)
3	(0, 0, 0)	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)

$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 213

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 12d: (3); 24e: (6)
2	(0, 0, 0)	4a: (2); 4b: (2); 8c: (4); 12d: (6); 24e: (12)

c. Results for high-symmetry lines

$DT_{(0, v, 0)}$						
Operation	E	C_{4x}^+	C_{4z}^-			
Coordinate	$(0, v, 0)$	$(0, 0, v)$	$(v, 0, 0)$			
$LD_{(u, u, u)}$						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	(u, u, u)	$(u, -u, -u)$	$(-u, u, -u)$	$(-u, -u, u)$		
$S_{(u, \frac{1}{2}, u)}$						
Operation	E	C_{2x}	C_{4x}^-	C_{2d}	C_{4z}^+	C_{2a}
Coordinate	$(u, \frac{1}{2}, u)$	$(u, -\frac{1}{2}, -u)$	$(u, u, -\frac{1}{2})$	$(-u, u, \frac{1}{2})$	$(-\frac{1}{2}, u, u)$	$(\frac{1}{2}, u, -u)$
$SM_{(u, u, 0)}$						
Operation	E	C_{2x}	C_{4y}^-	C_{4y}^+	C_{4x}^+	C_{4x}^-
Coordinate	$(u, u, 0)$	$(u, -u, 0)$	$(0, u, u)$	$(0, u, -u)$	$(u, 0, u)$	$(u, 0, -u)$
$T_{(\frac{1}{2}, \frac{1}{2}, w)}$						
Operation	E	C_{4y}^+	C_{4x}^-			
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	$(w, \frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, w, -\frac{1}{2})$			
$Z_{(u, \frac{1}{2}, 0)}$						
Operation	E	C_{31}^+	C_{31}^-	C_{4z}^+	C_{4y}^-	C_{2f}
Coordinate	$(u, \frac{1}{2}, 0)$	$(0, u, \frac{1}{2})$	$(\frac{1}{2}, 0, u)$	$(-\frac{1}{2}, u, 0)$	$(0, \frac{1}{2}, u)$	$(-u, 0, -\frac{1}{2})$

$DT(0, v, 0)$ of space group No. 213

(Co-) irrep	Phonon AM	WYPO information
1	(0, r_1 , 0)	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)
2	(0, r_1 , 0)	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)
3	(0, r_1 , 0)	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)
4	(0, r_1 , 0)	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)

$LD(u, u, u)$ of space group No. 213

(Co-) irrep	Phonon AM	WYPO information

1	(r_1, r_1, r_1)	4a: (4); 4b: (4); 8c: (8); 12d: (12); 24e: (24)
2	(r_1, r_1, r_1)	4a: (4); 4b: (4); 8c: (8); 12d: (12); 24e: (24)
3	(r_1, r_1, r_1)	4a: (4); 4b: (4); 8c: (8); 12d: (12); 24e: (24)
S $(u, \frac{1}{2}, u)$ of space group No. 213		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, r_1)$	4a: (6); 4b: (6); 8c: (12); 12d: (18); 24e: (36)
SM $(u, u, 0)$ of space group No. 213		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	4a: (5); 4b: (5); 8c: (12); 12d: (17); 24e: (36)
2	$(r_1, r_1, 0)$	4a: (7); 4b: (7); 8c: (12); 12d: (19); 24e: (36)
T $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 213		
(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)
2	$(0, 0, r_1)$	4a: (3); 4b: (3); 8c: (6); 12d: (9); 24e: (18)
Z $(u, \frac{1}{2}, 0)$ of space group No. 213		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (6); 4b: (6); 8c: (12); 12d: (18); 24e: (36)

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

P1 (u, u, v) of space group No. 213		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	4a: (12); 4b: (12); 8c: (24); 12d: (36); 24e: (72)
P2 $(u, v, 0)$ of space group No. 213		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	4a: (12); 4b: (12); 8c: (24); 12d: (36); 24e: (72)

P4 ($u, \frac{1}{2}, v$) of space group No. 213

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	4a: (6); 4b: (6); 8c: (12); 12d: (18); 24e: (36)

214. Space group No. 214 ($I4_132$)

Cubic body-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}& \{E|0,0,0\} \quad \{C_{2x}|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{2z}|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{2y}|0, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{4x}^+|0, 0, \frac{1}{2}\} \quad \{C_{4z}^-|0, 0, -\frac{1}{2}\} \quad \{C_{4y}^-|0, \frac{1}{2}, 0\} \quad \{C_{4x}^-|\frac{1}{2}, 0, 0\} \\& \{C_{4z}^+|0, \frac{1}{2}, 0\} \quad \{C_{4y}^+|-\frac{1}{2}, 0, 0\} \quad \{C_{2a}|\frac{1}{2}, 0, 0\} \quad \{C_{2b}|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{2f}|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{2d}|0, -\frac{1}{2}, 0\} \quad \{C_{2c}|0, 0, \frac{1}{2}\} \quad \{C_{2e}|\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\} \\& \{C_{31}^-|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{33}^-|0, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{34}^-|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{32}^-|\frac{1}{2}, \frac{1}{2}, 0\} \quad \{C_{33}^+|\frac{1}{2}, 0, \frac{1}{2}\} \quad \{C_{32}^+|0, \frac{1}{2}, \frac{1}{2}\} \quad \{C_{34}^+|\frac{1}{2}, \frac{1}{2}, 0\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	$(0,0,0)$
$H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	
Operation	E C_{4x}^+
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ $(-\frac{1}{4}, \frac{3}{4}, -\frac{1}{4})$
$N(0,0,\frac{1}{2})$	
Operation	E C_{2x} C_{4y}^- C_{4y}^+ C_{4x}^+ C_{4x}^-
Coordinate	$(0,0,\frac{1}{2})$ $(-\frac{1}{2}, \frac{1}{2}, 0)$ $(\frac{1}{2}, 0, 0)$ $(0, -\frac{1}{2}, \frac{1}{2})$ $(0, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, \frac{1}{2})$

Operation Coordinate	E $(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	C_{2x} $(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	C_{2y} $(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	C_{2z} $(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$		
$SM_{(0,0,u)}$						
Operation Coordinate	E $(0,0,u)$	C_{2x} $(-u,u,0)$	C_{4y}^- $(u,0,0)$	C_{4y}^+ $(0,-u,u)$	C_{4x}^+ $(0,u,0)$	C_{4x}^- $(-u,0,u)$

D $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 214									
(Co-) irrep	Phonon AM	WYPO information							
1	$(0, 0, r_1)$	8a: (6);	8b: (6);	12c: (9);	12d: (9);	16e: (12);	24f: (18);	24g: (18);	24h: (18); 48i: (36)
2	$(0, 0, r_1)$	8a: (6);	8b: (6);	12c: (9);	12d: (9);	16e: (12);	24f: (18);	24g: (18);	24h: (18); 48i: (36)
DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 214									
(Co-) irrep	Phonon AM	WYPO information							
1	$(0, r_1, 0)$	8a: (3);	8b: (3);	12c: (4);	12d: (4);	16e: (6);	24f: (8);	24g: (9);	24h: (9); 48i: (18)
2	$(0, r_1, 0)$	8a: (3);	8b: (3);	12c: (5);	12d: (5);	16e: (6);	24f: (10);	24g: (9);	24h: (9); 48i: (18)
3	$(0, r_1, 0)$	8a: (3);	8b: (3);	12c: (4);	12d: (4);	16e: (6);	24f: (8);	24g: (9);	24h: (9); 48i: (18)
4	$(0, r_1, 0)$	8a: (3);	8b: (3);	12c: (5);	12d: (5);	16e: (6);	24f: (10);	24g: (9);	24h: (9); 48i: (18)
G $\left(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 214									
(Co-) irrep	Phonon AM	WYPO information							
1	$(-r_1, r_1, 0)$	8a: (5);	8b: (7);	12c: (9);	12d: (9);	16e: (12);	24f: (18);	24g: (19);	24h: (17); 48i: (36)
2	$(-r_1, r_1, 0)$	8a: (7);	8b: (5);	12c: (9);	12d: (9);	16e: (12);	24f: (18);	24g: (17);	24h: (19); 48i: (36)
LD $\left(\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 214									
(Co-) irrep	Phonon AM	WYPO information							
1	(r_1, r_1, r_1)	8a: (4);	8b: (4);	12c: (6);	12d: (6);	16e: (8);	24f: (12);	24g: (12);	24h: (12); 48i: (24)
2	(r_1, r_1, r_1)	8a: (4);	8b: (4);	12c: (6);	12d: (6);	16e: (8);	24f: (12);	24g: (12);	24h: (12); 48i: (24)
3	(r_1, r_1, r_1)	8a: (4);	8b: (4);	12c: (6);	12d: (6);	16e: (8);	24f: (12);	24g: (12);	24h: (12); 48i: (24)
SM $(0, 0, u)$ of space group No. 214									
(Co-) irrep	Phonon AM	WYPO information							
1	$(r_1, r_1, 0)$	8a: (5);	8b: (5);	12c: (8);	12d: (8);	16e: (12);	24f: (18);	24g: (17);	24h: (17); 48i: (36)
2	$(r_1, r_1, 0)$	8a: (7);	8b: (7);	12c: (10);	12d: (10);	16e: (12);	24f: (18);	24g: (19);	24h: (19); 48i: (36)

d. Results for high-symmetry planes

$P1(u, u, v)$						
Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-2u - v, v, u)$	(v, u, u)	$(u, -2u - v, v)$	(u, v, u)	$(-2u - v, u, v)$
$P2(u, -u, v)$						
Operation	E	C_{31}^+	C_{31}^-			

Coordinate $(u, -u, v)$ $(v, u, -u)$ $(-u, v, u)$

P1 (u, u, v) of space group No. 214		
(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_2, r_1)	8a: (12); 8b: (12); 12c: (18); 12d: (18); 16e: (24); 24f: (36); 24g: (36); 24h: (36); 48i: (72)
P2 $(u, -u, v)$ of space group No. 214		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	8a: (12); 8b: (12); 12c: (18); 12d: (18); 16e: (24); 24f: (36); 24g: (36); 24h: (36); 48i: (72)

215. Space group No. 215 ($P\bar{4}3m$)

Cubic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}&\{E|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{S_{4x}^-|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4y}^+|0, 0, 0\} \quad \{S_{4x}^+|0, 0, 0\} \\&\{S_{4z}^-|0, 0, 0\} \quad \{S_{4y}^-|0, 0, 0\} \quad \{\sigma_{da}|0, 0, 0\} \quad \{\sigma_{db}|0, 0, 0\} \quad \{\sigma_{df}|0, 0, 0\} \quad \{\sigma_{dd}|0, 0, 0\} \quad \{\sigma_{dc}|0, 0, 0\} \quad \{\sigma_{de}|0, 0, 0\} \\&\{C_{31}^-|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$X(0,\frac{1}{2},0)$			
Operation	E	S_{4x}^{-}	S_{4z}^{+}
Coordinate	$(0,\frac{1}{2},0)$	$(0,0,-\frac{1}{2})$	$(-\frac{1}{2},0,0)$
$M(\frac{1}{2},\frac{1}{2},0)$			
Operation	E	S_{4y}^{+}	S_{4x}^{-}
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$	$(0,-\frac{1}{2},-\frac{1}{2})$	$(-\frac{1}{2},0,-\frac{1}{2})$

$$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 215

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	4e: (1);	6f: (1);	6g: (1);	12h: (1);	12i: (2);	24j: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	4e: (0);	6f: (0);	6g: (0);	12h: (1);	12i: (1);	24j: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	4e: (1);	6f: (1);	6g: (1);	12h: (2);	12i: (3);	24j: (6)
4	(0, 0, 0)	1a: (0);	1b: (0);	3c: (1);	3d: (1);	4e: (1);	6f: (2);	6g: (2);	12h: (5);	12i: (4);	24j: (9)
5	(0, 0, 0)	1a: (1);	1b: (1);	3c: (2);	3d: (2);	4e: (2);	6f: (3);	6g: (3);	12h: (5);	12i: (5);	24j: (9)

$X (0, \frac{1}{2}, 0)$ of space group No. 215

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (1);	3c: (1);	3d: (1);	4e: (2);	6f: (2);	6g: (3);	12h: (4);	12i: (5);	24j: (9)
2	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (1);	4e: (1);	6f: (2);	6g: (1);	12h: (4);	12i: (4);	24j: (9)
3	(0, 0, 0)	1a: (0);	1b: (0);	3c: (1);	3d: (0);	4e: (1);	6f: (1);	6g: (2);	12h: (4);	12i: (4);	24j: (9)
4	(0, 0, 0)	1a: (1);	1b: (0);	3c: (1);	3d: (1);	4e: (2);	6f: (3);	6g: (2);	12h: (4);	12i: (5);	24j: (9)
5	(0, 0, 0)	1a: (1);	1b: (1);	3c: (3);	3d: (3);	4e: (3);	6f: (5);	6g: (5);	12h: (10);	12i: (9);	24j: (18)

$M (\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 215

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (1);	3c: (2);	3d: (1);	4e: (2);	6f: (2);	6g: (3);	12h: (5);	12i: (5);	24j: (9)
2	(0, 0, 0)	1a: (0);	1b: (0);	3c: (1);	3d: (1);	4e: (1);	6f: (2);	6g: (1);	12h: (5);	12i: (4);	24j: (9)
3	(0, 0, 0)	1a: (0);	1b: (0);	3c: (1);	3d: (1);	4e: (1);	6f: (1);	6g: (2);	12h: (5);	12i: (4);	24j: (9)
4	(0, 0, 0)	1a: (1);	1b: (0);	3c: (1);	3d: (2);	4e: (2);	6f: (3);	6g: (2);	12h: (5);	12i: (5);	24j: (9)
5	(0, 0, 0)	1a: (1);	1b: (1);	3c: (2);	3d: (2);	4e: (3);	6f: (5);	6g: (5);	12h: (8);	12i: (9);	24j: (18)

$R (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 215

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	1a: (0);	1b: (0);	3c: (1);	3d: (1);	4e: (1);	6f: (1);	6g: (1);	12h: (2);	12i: (2);	24j: (3)
2	(0, 0, 0)	1a: (0);	1b: (0);	3c: (0);	3d: (0);	4e: (0);	6f: (0);	6g: (0);	12h: (2);	12i: (1);	24j: (3)
3	(0, 0, 0)	1a: (0);	1b: (0);	3c: (1);	3d: (1);	4e: (1);	6f: (1);	6g: (1);	12h: (4);	12i: (3);	24j: (6)
4	(0, 0, 0)	1a: (0);	1b: (0);	3c: (1);	3d: (1);	4e: (1);	6f: (2);	6g: (2);	12h: (4);	12i: (4);	24j: (9)
5	(0, 0, 0)	1a: (1);	1b: (1);	3c: (1);	3d: (1);	4e: (2);	6f: (3);	6g: (3);	12h: (4);	12i: (5);	24j: (9)

c. Results for high-symmetry lines

$$DT_{(0, v, 0)}$$

$$\begin{array}{cccc} \text{Operation} & E & S_{4x}^{+} & S_{4z}^{-} \\ \text{Coordinate} & (0, v, 0) & (0, 0, v) & (v, 0, 0) \end{array}$$

1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 4e: (4); 6f: (5); 6g: (5); 12h: (10); 12i: (10); 24j: (18)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (2); 3d: (2); 4e: (2); 6f: (3); 6g: (3); 12h: (10); 12i: (8); 24j: (18)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 4e: (3); 6f: (5); 6g: (5); 12h: (8); 12i: (9); 24j: (18)

$Z(u, \frac{1}{2}, 0)$ of space group No. 215

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	1a: (1); 1b: (2); 3c: (5); 3d: (4); 4e: (6); 6f: (8); 6g: (10); 12h: (18); 12i: (18); 24j: (36)
2	$(r_1, 0, 0)$	1a: (2); 1b: (1); 3c: (4); 3d: (5); 4e: (6); 6f: (10); 6g: (8); 12h: (18); 12i: (18); 24j: (36)

d. Results for high-symmetry planes

$P1(u, u, v)$

Operation	E	C_{2x}	σ_{de}	σ_{dc}	σ_{df}	σ_{dd}
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$

$P2(u, v, 0)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$

$P4(u, \frac{1}{2}, v)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$

$P1(u, u, v)$ of space group No. 215

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	1a: (2); 1b: (2); 3c: (5); 3d: (5); 4e: (7); 6f: (10); 6g: (10); 12h: (18); 12i: (19); 24j: (36)
2	$(-r_1, r_1, 0)$	1a: (1); 1b: (1); 3c: (4); 3d: (4); 4e: (5); 6f: (8); 6g: (8); 12h: (18); 12i: (17); 24j: (36)

$P2(u, v, 0)$ of space group No. 215

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	1a: (3); 1b: (3); 3c: (9); 3d: (9); 4e: (12); 6f: (18); 6g: (18); 12h: (36); 12i: (36); 24j: (72)

$P4(u, \frac{1}{2}, v)$ of space group No. 215

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	1a: (3); 1b: (3); 3c: (9); 3d: (9); 4e: (12); 6f: (18); 6g: (18); 12h: (36); 12i: (36); 24j: (72)

216. Space group No. 216 ($F\bar{4}3m$)

Cubic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{C_{2x} 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{2y} 0,0,0\}$	$\{S_{4x}^- 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$	$\{S_{4y}^+ 0,0,0\}$	$\{S_{4x}^+ 0,0,0\}$
$\{S_{4z}^- 0,0,0\}$	$\{S_{4y}^- 0,0,0\}$	$\{\sigma_{da} 0,0,0\}$	$\{\sigma_{db} 0,0,0\}$	$\{\sigma_{df} 0,0,0\}$	$\{\sigma_{dd} 0,0,0\}$	$\{\sigma_{dc} 0,0,0\}$	$\{\sigma_{de} 0,0,0\}$
$\{C_{31}^- 0,0,0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{33}^- 0,0,0\}$	$\{C_{34}^- 0,0,0\}$	$\{C_{32}^- 0,0,0\}$	$\{C_{33}^+ 0,0,0\}$	$\{C_{32}^+ 0,0,0\}$	$\{C_{34}^+ 0,0,0\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	(0,0,0)

$X(\frac{1}{2},0,\frac{1}{2})$	
Operation	E S_{4x}^- S_{4z}^+
Coordinate	$(\frac{1}{2},0,\frac{1}{2})$ $(-\frac{1}{2},-\frac{1}{2},0)$ $(0,-\frac{1}{2},-\frac{1}{2})$

$L(\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
Operation	E C_{2x} C_{2y} C_{2z}
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,0)$ $(0,-\frac{1}{2},0)$ $(0,0,-\frac{1}{2})$

$W(\frac{1}{2},\frac{1}{4},\frac{3}{4})$	
Operation	E C_{2z} S_{4z}^- S_{4z}^+ S_{4y}^+ S_{4y}^-
Coordinate	$(\frac{1}{2},\frac{1}{4},\frac{3}{4})$ $(-\frac{1}{2},-\frac{1}{4},-\frac{3}{4})$ $(-\frac{1}{4},\frac{1}{2},\frac{1}{4})$ $(\frac{1}{4},-\frac{1}{2},-\frac{1}{4})$ $(-\frac{3}{4},-\frac{1}{4},-\frac{1}{2})$ $(-\frac{1}{4},\frac{1}{4},-\frac{1}{2})$

 $\Gamma(0,0,0)$ of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 16e: (1); 24f: (1); 24g: (1); 48h: (2); 96i: (3)
2	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 16e: (0); 24f: (0); 24g: (0); 48h: (1); 96i: (3)
3	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 16e: (1); 24f: (1); 24g: (1); 48h: (3); 96i: (6)
4	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 16e: (1); 24f: (2); 24g: (2); 48h: (4); 96i: (9)
5	(0,0,0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (2); 24f: (3); 24g: (3); 48h: (5); 96i: (9)

 $X(\frac{1}{2},0,\frac{1}{2})$ of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	4a: (0); 4b: (0); 4c: (1); 4d: (1); 16e: (2); 24f: (2); 24g: (3); 48h: (5); 96i: (9)
2	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 16e: (1); 24f: (2); 24g: (1); 48h: (4); 96i: (9)
3	(0,0,0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 16e: (1); 24f: (1); 24g: (2); 48h: (4); 96i: (9)
4	(0,0,0)	4a: (1); 4b: (1); 4c: (0); 4d: (0); 16e: (2); 24f: (3); 24g: (2); 48h: (5); 96i: (9)

5 (0, 0, 0) 4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (3); 24f: (5); 24g: (5); 48h: (9); 96i: (18)

L $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (3); 24f: (4); 24g: (4); 48h: (7); 96i: (12)
2	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 16e: (1); 24f: (2); 24g: (2); 48h: (5); 96i: (12)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (4); 24f: (6); 24g: (6); 48h: (12); 96i: (24)

W $(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$ of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	4a: (0); 4b: (1); 4c: (1); 4d: (1); 16e: (3); 24f: (4); 24g: (5); 48h: (9); 96i: (18)
2	$(r_1, 0, 0)$	4a: (1); 4b: (1); 4c: (1); 4d: (0); 16e: (3); 24f: (5); 24g: (4); 48h: (9); 96i: (18)
3	$(r_1, 0, 0)$	4a: (1); 4b: (0); 4c: (1); 4d: (1); 16e: (3); 24f: (4); 24g: (5); 48h: (9); 96i: (18)
4	$(r_1, 0, 0)$	4a: (1); 4b: (1); 4c: (0); 4d: (1); 16e: (3); 24f: (5); 24g: (4); 48h: (9); 96i: (18)

c. Results for high-symmetry lines

DT($\frac{v}{2}, 0, \frac{v}{2}$)					
Operation	E	S_{4x}^+	S_{4z}^-		
Coordinate	$(\frac{v}{2}, 0, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, 0)$	$(0, \frac{v}{2}, \frac{v}{2})$		
LD(u, u, u)					
Operation	E	C_{2x}	C_{2y}	C_{2z}	
Coordinate	(u, u, u)	$(-u, 0, 0)$	$(0, -u, 0)$	$(0, 0, -u)$	
Q($\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v)$)					
Operation	E	C_{2y}	C_{31}^+	C_{33}^+	
Coordinate	$(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$	$(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$	$(\frac{1}{4}(1+2v), \frac{1}{2}, \frac{1}{4}(3-2v))$	$(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(-3+2v))$	
	C_{31}^-	C_{32}^-			
	$(\frac{1}{4}(3-2v), \frac{1}{4}(1+2v), \frac{1}{2})$	$(\frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$			
SM($\frac{u}{2}, \frac{u}{2}, u$)					
Operation	E	C_{2x}	σ_{dc}	σ_{dc}	$\sigma_{df} \quad \sigma_{dd}$
Coordinate	$(\frac{u}{2}, \frac{u}{2}, u)$	$(-\frac{u}{2}, \frac{u}{2}, 0)$	$(u, \frac{u}{2}, \frac{u}{2})$	$(0, -\frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, u, \frac{u}{2}) \quad (-\frac{u}{2}, 0, \frac{u}{2})$
V($\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}$)					
Operation	E	C_{31}^+	C_{31}^-		
Coordinate	$(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$	$(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{1+u}{2}, \frac{1}{2})$		

DT $(\frac{v}{2}, 0, \frac{v}{2})$ of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (4); 24f: (5); 24g: (5); 48h: (10); 96i: (18)
2	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 16e: (2); 24f: (3); 24g: (3); 48h: (8); 96i: (18)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (3); 24f: (5); 24g: (5); 48h: (9); 96i: (18)

LD (u, u, u) of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (3); 24f: (4); 24g: (4); 48h: (7); 96i: (12)
2	(0, 0, 0)	4a: (0); 4b: (0); 4c: (0); 4d: (0); 16e: (1); 24f: (2); 24g: (2); 48h: (5); 96i: (12)
3	(0, 0, 0)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (4); 24f: (6); 24g: (6); 48h: (12); 96i: (24)

Q ($\frac{1}{2}, \frac{1}{4}(3 - 2v), \frac{1}{4}(1 + 2v)$) of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_1, r_1)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 16e: (12); 24f: (18); 24g: (18); 48h: (36); 96i: (72)

SM ($\frac{u}{2}, \frac{u}{2}, u$) of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	($-r_1, r_1, 0$)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 16e: (7); 24f: (10); 24g: (10); 48h: (19); 96i: (36)
2	($-r_1, r_1, 0$)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (5); 24f: (8); 24g: (8); 48h: (17); 96i: (36)

V ($\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}$) of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	($r_1, 0, 0$)	4a: (1); 4b: (1); 4c: (2); 4d: (2); 16e: (6); 24f: (8); 24g: (10); 48h: (18); 96i: (36)
2	($r_1, 0, 0$)	4a: (2); 4b: (2); 4c: (1); 4d: (1); 16e: (6); 24f: (10); 24g: (8); 48h: (18); 96i: (36)

*d. Results for high-symmetry planes*P1($u, v, u + v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	($u, v, u + v$)	($u + v, u, v$)	($v, u + v, u$)

P2(u, u, v)

Operation	E	C_{2x}	σ_{de}	σ_{dc}	σ_{df}	σ_{dd}
Coordinate	(u, u, v)	($-u, -u + v, 0$)	(v, u, u)	($0, -u, -u + v$)	(u, v, u)	($-u, 0, -u + v$)

P1 ($u, v, u + v$) of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	($r_2, r_1, 0$)	4a: (3); 4b: (3); 4c: (3); 4d: (3); 16e: (12); 24f: (18); 24g: (18); 48h: (36); 96i: (72)

P2 (u, u, v) of space group No. 216

(Co-) irrep	Phonon AM	WYPO information
1	($-r_1, r_1, 0$)	4a: (2); 4b: (2); 4c: (2); 4d: (2); 16e: (7); 24f: (10); 24g: (10); 48h: (19); 96i: (36)
2	($-r_1, r_1, 0$)	4a: (1); 4b: (1); 4c: (1); 4d: (1); 16e: (5); 24f: (8); 24g: (8); 48h: (17); 96i: (36)

217. Space group No. 217 ($I\bar{4}3m$)

Cubic body-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}\end{aligned}$$

a. Space group operations

$$\begin{aligned}&\{E|0, 0, 0\} \quad \{C_{2x}|0, 0, 0\} \quad \{C_{2z}|0, 0, 0\} \quad \{C_{2y}|0, 0, 0\} \quad \{S_{4x}^-|0, 0, 0\} \quad \{S_{4z}^+|0, 0, 0\} \quad \{S_{4y}^+|0, 0, 0\} \quad \{S_{4x}^+|0, 0, 0\} \\&\{S_{4z}^-|0, 0, 0\} \quad \{S_{4y}^-|0, 0, 0\} \quad \{\sigma_{da}|0, 0, 0\} \quad \{\sigma_{db}|0, 0, 0\} \quad \{\sigma_{df}|0, 0, 0\} \quad \{\sigma_{dd}|0, 0, 0\} \quad \{\sigma_{dc}|0, 0, 0\} \quad \{\sigma_{de}|0, 0, 0\} \\&\{C_{31}^-|0, 0, 0\} \quad \{C_{31}^+|0, 0, 0\} \quad \{C_{33}^-|0, 0, 0\} \quad \{C_{34}^-|0, 0, 0\} \quad \{C_{32}^-|0, 0, 0\} \quad \{C_{33}^+|0, 0, 0\} \quad \{C_{32}^+|0, 0, 0\} \quad \{C_{34}^+|0, 0, 0\}\end{aligned}$$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)
$H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	
Operation	E E Θ
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ $(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$
$N(0, 0, \frac{1}{2})$	
Operation	E C_{2x} S_{4y}^+ S_{4y}^- S_{4x}^- S_{4x}^+
Coordinate	$(0, 0, \frac{1}{2})$ $(-\frac{1}{2}, \frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$ $(0, \frac{1}{2}, -\frac{1}{2})$ $(0, -\frac{1}{2}, 0)$ $(\frac{1}{2}, 0, -\frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 217

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (0); 12e: (1); 24f: (1); 24g: (2); 48h: (3)
2	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (1); 12e: (0); 24f: (1); 24g: (1); 48h: (3)
3	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (1); 12e: (1); 24f: (2); 24g: (3); 48h: (6)
4	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (2); 12e: (2); 24f: (5); 24g: (4); 48h: (9)
5	(0, 0, 0)	2a: (1); 6b: (2); 8c: (2); 12d: (3); 12e: (3); 24f: (5); 24g: (5); 48h: (9)

$H \left(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2} \right)$ of space group No. 217

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (1); 12e: (1); 24f: (1); 24g: (2); 48h: (3)
2	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (0); 12e: (0); 24f: (1); 24g: (1); 48h: (3)
3	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (1); 12e: (1); 24f: (2); 24g: (3); 48h: (6)
4	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (3); 12e: (2); 24f: (5); 24g: (4); 48h: (9)
5	(0, 0, 0)	2a: (1); 6b: (2); 8c: (2); 12d: (2); 12e: (3); 24f: (5); 24g: (5); 48h: (9)

$P \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4} \right)$ of space group No. 217

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (1); 12e: (1); 24f: (2); 24g: (2); 48h: (3)
2	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (1); 12e: (0); 24f: (2); 24g: (1); 48h: (3)
3	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (2); 12e: (1); 24f: (4); 24g: (3); 48h: (6)
4	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (2); 12e: (2); 24f: (4); 24g: (4); 48h: (9)
5	(0, 0, 0)	2a: (1); 6b: (1); 8c: (2); 12d: (2); 12e: (3); 24f: (4); 24g: (5); 48h: (9)

$N \left(0, 0, \frac{1}{2} \right)$ of space group No. 217

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (5); 12e: (5); 24f: (10); 24g: (10); 48h: (18)
2	(0, 0, 0)	2a: (0); 6b: (2); 8c: (2); 12d: (5); 12e: (3); 24f: (10); 24g: (8); 48h: (18)
3	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 24f: (8); 24g: (9); 48h: (18)
4	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 24f: (8); 24g: (9); 48h: (18)

c. Results for high-symmetry lines

$D(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$						
Operation	E	S_{4y}^+	S_{4x}^-			
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	$(\frac{1}{2}(-1-w), \frac{w}{2}, \frac{w}{2})$	$(\frac{w}{2}, \frac{1}{2}(-1-w), \frac{w}{2})$			
$DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$						
Operation	E	S_{4x}^+	S_{4z}^-			
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, -\frac{v}{2})$	$(-\frac{v}{2}, \frac{v}{2}, \frac{v}{2})$			
$G(\frac{1}{2}-u, \frac{1}{2}+u, \frac{1}{2})$						
Operation	E	C_{2x}	S_{4y}^+	S_{4y}^-	S_{4x}^-	S_{4x}^+
Coordinate	$(\frac{1}{2}-u, \frac{1}{2}+u, \frac{1}{2})$	$(-\frac{3}{2}, \frac{1}{2}, \frac{1}{2}+u)$	$(-\frac{3}{2}, \frac{1}{2}-u, \frac{1}{2}+u)$	$(\frac{1}{2}+u, \frac{1}{2}, -\frac{3}{2})$	$(\frac{1}{2}+u, -\frac{3}{2}, \frac{1}{2}-u)$	$(\frac{1}{2}, \frac{1}{2}-u, -\frac{3}{2})$
$LD(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$						
Operation	E	C_{2x}	C_{2y}	C_{2z}		

Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$		
$SM_{(0,0,u)}$						
Operation	E	C_{2x}	σ_{de}	σ_{dc}	σ_{df}	σ_{dd}
Coordinate	$(0, 0, u)$	$(-u, u, 0)$	$(u, 0, 0)$	$(0, -u, u)$	$(0, u, 0)$	$(-u, 0, u)$

$D\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 217

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (5); 12e: (5); 24f: (10); 24g: (10); 48h: (18)
2	(0, 0, 0)	2a: (0); 6b: (2); 8c: (2); 12d: (5); 12e: (3); 24f: (10); 24g: (8); 48h: (18)
3	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 24f: (8); 24g: (9); 48h: (18)
4	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 24f: (8); 24g: (9); 48h: (18)

$DT\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 217

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (2); 8c: (4); 12d: (4); 12e: (5); 24f: (8); 24g: (10); 48h: (18)
2	(0, 0, 0)	2a: (0); 6b: (1); 8c: (2); 12d: (4); 12e: (3); 24f: (8); 24g: (8); 48h: (18)
3	(0, 0, 0)	2a: (1); 6b: (3); 8c: (3); 12d: (5); 12e: (5); 24f: (10); 24g: (9); 48h: (18)

$G\left(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 217

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	2a: (2); 6b: (5); 8c: (7); 12d: (9); 12e: (10); 24f: (18); 24g: (19); 48h: (36)
2	$(r_1, r_1, 0)$	2a: (1); 6b: (4); 8c: (5); 12d: (9); 12e: (8); 24f: (18); 24g: (17); 48h: (36)

$LD\left(\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 217

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (3); 12e: (4); 24f: (6); 24g: (7); 48h: (12)
2	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (3); 12e: (2); 24f: (6); 24g: (5); 48h: (12)
3	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 24f: (12); 24g: (12); 48h: (24)

$SM(0, 0, u)$ of space group No. 217

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (2); 6b: (5); 8c: (7); 12d: (9); 12e: (10); 24f: (18); 24g: (19); 48h: (36)
2	$(-r_1, r_1, 0)$	2a: (1); 6b: (4); 8c: (5); 12d: (9); 12e: (8); 24f: (18); 24g: (17); 48h: (36)

d. Results for high-symmetry planes

$P1(u, u, v)$

Operation	E	C_{2x}	σ_{de}	σ_{dc}	σ_{df}	σ_{dd}
Coordinate	(u, u, v)	$(-2u - v, v, u)$	(v, u, u)	$(u, -2u - v, v)$	(u, v, u)	$(-2u - v, u, v)$

$P2(u, -u, v)$

Operation	E	C_{31}^+	C_{31}^-

Coordinate $(u, -u, v)$ $(v, u, -u)$ $(-u, v, u)$

P1 (u, u, v) of space group No. 217		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (2); 6b: (5); 8c: (7); 12d: (9); 12e: (10); 24f: (18); 24g: (19); 48h: (36)
2	$(-r_1, r_1, 0)$	2a: (1); 6b: (4); 8c: (5); 12d: (9); 12e: (8); 24f: (18); 24g: (17); 48h: (36)
P2 $(u, -u, v)$ of space group No. 217		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 24f: (36); 24g: (36); 48h: (72)

218. Space group No. 218 ($P\bar{4}3n$)

Cubic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{C_{2x} 0, 0, 0\}$	$\{C_{2z} 0, 0, 0\}$	$\{C_{2y} 0, 0, 0\}$	$\{S_{4x}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4z}^+ \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{S_{4y}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4x}^+ \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$
$\{S_{4z}^- -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{S_{4y}^- -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_{da} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{db} -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{df} -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_{dd} -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{dc} -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{dc} \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$
$\{C_{31}^- 0, 0, 0\}$	$\{C_{31}^+ 0, 0, 0\}$	$\{C_{33}^- 0, 0, 0\}$	$\{C_{34}^- 0, 0, 0\}$	$\{C_{32}^- 0, 0, 0\}$	$\{C_{33}^+ 0, 0, 0\}$	$\{C_{32}^+ 0, 0, 0\}$	$\{C_{34}^+ 0, 0, 0\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$			
Operation	E		
Coordinate	$(0, 0, 0)$		
$X(0, \frac{1}{2}, 0)$			
Operation	E	S_{4x}^{-}	S_{4z}^{+}
Coordinate	$(0, \frac{1}{2}, 0)$	$(0, 0, -\frac{1}{2})$	$(-\frac{1}{2}, 0, 0)$
$M(\frac{1}{2}, \frac{1}{2}, 0)$			
Operation	E	S_{4y}^{+}	S_{4x}^{-}
Coordinate	$(\frac{1}{2}, \frac{1}{2}, 0)$	$(0, -\frac{1}{2}, -\frac{1}{2})$	$(-\frac{1}{2}, 0, -\frac{1}{2})$

$$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$$

$$\begin{array}{cc} \text{Operation} & E \\ \text{Coordinate} & \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right) \end{array}$$

$\Gamma (0, 0, 0)$ of space group No. 218

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (0); 6c: (0); 6d: (0); 8e: (1); 12f: (1); 12g: (1); 12h: (1); 24i: (3)
2	(0, 0, 0)	2a: (0); 6b: (0); 6c: (1); 6d: (1); 8e: (1); 12f: (1); 12g: (1); 12h: (1); 24i: (3)
3	(0, 0, 0)	2a: (0); 6b: (0); 6c: (1); 6d: (1); 8e: (2); 12f: (2); 12g: (2); 12h: (2); 24i: (6)
4	(0, 0, 0)	2a: (1); 6b: (3); 6c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (5); 12h: (5); 24i: (9)
5	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (3); 8e: (3); 12f: (5); 12g: (5); 12h: (5); 24i: (9)

$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 218

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (3); 6c: (2); 6d: (3); 8e: (3); 12f: (5); 12g: (4); 12h: (6); 24i: (9)
2	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (2); 8e: (3); 12f: (5); 12g: (6); 12h: (4); 24i: (9)
3	(0, 0, 0)	2a: (1); 6b: (3); 6c: (4); 6d: (4); 8e: (6); 12f: (8); 12g: (8); 12h: (8); 24i: (18)

$M \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 218

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (2); 6c: (3); 6d: (1); 8e: (3); 12f: (5); 12g: (5); 12h: (3); 24i: (9)
2	(0, 0, 0)	2a: (1); 6b: (2); 6c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (3); 12h: (5); 24i: (9)
3	(0, 0, 0)	2a: (1); 6b: (2); 6c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (5); 12h: (3); 24i: (9)
4	(0, 0, 0)	2a: (1); 6b: (2); 6c: (1); 6d: (3); 8e: (3); 12f: (5); 12g: (3); 12h: (5); 24i: (9)
5	(0, 0, 0)	2a: (1); 6b: (5); 6c: (5); 6d: (5); 8e: (6); 12f: (8); 12g: (10); 12h: (10); 24i: (18)

$R \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 218

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (1); 6c: (1); 6d: (1); 8e: (1); 12f: (1); 12g: (2); 12h: (2); 24i: (3)
2	(0, 0, 0)	2a: (0); 6b: (1); 6c: (1); 6d: (1); 8e: (1); 12f: (1); 12g: (2); 12h: (2); 24i: (3)
3	(0, 0, 0)	2a: (1); 6b: (2); 6c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (4); 12h: (4); 24i: (9)

c. Results for high-symmetry lines

$DT_{(0, v, 0)}$

$$\begin{array}{cccc} \text{Operation} & E & S_{4x}^+ & S_{4z}^- \\ \text{Coordinate} & (0, v, 0) & (0, 0, v) & (v, 0, 0) \end{array}$$

$LD_{(u, u, u)}$

$$\begin{array}{cccccc} \text{Operation} & E & C_{2x} & C_{2y} & C_{2z} \\ \text{Coordinate} & (u, u, u) & (u, -u, -u) & (-u, u, -u) & (-u, -u, u) \end{array}$$

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	2a: (3); 6b: (9); 6c: (10); 6d: (8); 8e: (12); 12f: (18); 12g: (20); 12h: (16); 24i: (36)
2	$(r_1, 0, 0)$	2a: (3); 6b: (9); 6c: (8); 6d: (10); 8e: (12); 12f: (18); 12g: (16); 12h: (20); 24i: (36)

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	σ_{de}	σ_{dc}	σ_{df}	σ_{dd}
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^+	C_{31}^-			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^+	C_{31}^-			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

P1 (u, u, v) of space group No. 218		
(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	2a: (3); 6b: (9); 6c: (9); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 12h: (18); 24i: (36)
2	$(-r_1, r_1, 0)$	2a: (3); 6b: (9); 6c: (9); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 12h: (18); 24i: (36)
P2 ($u, v, 0$) of space group No. 218		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	2a: (6); 6b: (18); 6c: (18); 6d: (18); 8e: (24); 12f: (36); 12g: (36); 12h: (36); 24i: (72)
P4 ($u, \frac{1}{2}, v$) of space group No. 218		
(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, 0, r_1)$	2a: (6); 6b: (18); 6c: (18); 6d: (18); 8e: (24); 12f: (36); 12g: (36); 12h: (36); 24i: (72)

219. Space group No. 219 ($F\bar{4}3c$)

Cubic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{C_{2x} 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{2y} 0,0,0\}$	$\{S_{4x}^- \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{S_{4z}^+ -\frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{S_{4y}^+ \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{S_{4x}^+ -\frac{1}{2},\frac{1}{2},\frac{1}{2}\}$
$\{S_{4z}^- \frac{1}{2},-\frac{1}{2},\frac{1}{2}\}$	$\{S_{4y}^- \frac{1}{2},-\frac{1}{2},\frac{1}{2}\}$	$\{\sigma_{da} \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{\sigma_{db} \frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_{df} \frac{1}{2},-\frac{1}{2},\frac{1}{2}\}$	$\{\sigma_{dd} \frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_{dc} \frac{1}{2},\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_{de} \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$
$\{C_{31}^- 0,0,0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{33}^- 0,0,0\}$	$\{C_{34}^- 0,0,0\}$	$\{C_{32}^- 0,0,0\}$	$\{C_{33}^+ 0,0,0\}$	$\{C_{32}^+ 0,0,0\}$	$\{C_{34}^+ 0,0,0\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	(0,0,0)

$X(\frac{1}{2},0,\frac{1}{2})$	
Operation	E S_{4x}^- S_{4z}^+
Coordinate	$(\frac{1}{2},0,\frac{1}{2})$ $(-\frac{1}{2},-\frac{1}{2},0)$ $(0,-\frac{1}{2},-\frac{1}{2})$

$L(\frac{1}{2},\frac{1}{2},\frac{1}{2})$	
Operation	E C_{2x} C_{2y} C_{2z}
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$ $(-\frac{1}{2},0,0)$ $(0,-\frac{1}{2},0)$ $(0,0,-\frac{1}{2})$

$W(\frac{1}{2},\frac{1}{4},\frac{3}{4})$	
Operation	E C_{2z} S_{4z}^- S_{4z}^+ S_{4y}^+ S_{4y}^-
Coordinate	$(\frac{1}{2},\frac{1}{4},\frac{3}{4})$ $(-\frac{1}{2},-\frac{1}{4},-\frac{3}{4})$ $(-\frac{1}{4},\frac{1}{2},\frac{1}{4})$ $(\frac{1}{4},-\frac{1}{2},-\frac{1}{4})$ $(-\frac{3}{4},-\frac{1}{4},-\frac{1}{2})$ $(-\frac{1}{4},\frac{1}{4},-\frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 219

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	8a: (0); 8b: (0); 24c: (0); 24d: (0); 32e: (1); 48f: (1); 48g: (1); 96h: (3)
2	(0,0,0)	8a: (0); 8b: (0); 24c: (1); 24d: (1); 32e: (1); 48f: (1); 48g: (1); 96h: (3)
3	(0,0,0)	8a: (0); 8b: (0); 24c: (1); 24d: (1); 32e: (2); 48f: (2); 48g: (2); 96h: (6)
4	(0,0,0)	8a: (1); 8b: (1); 24c: (2); 24d: (2); 32e: (3); 48f: (5); 48g: (5); 96h: (9)
5	(0,0,0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 32e: (3); 48f: (5); 48g: (5); 96h: (9)

$X(\frac{1}{2},0,\frac{1}{2})$ of space group No. 219

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	8a: (0); 8b: (1); 24c: (3); 24d: (1); 32e: (3); 48f: (3); 48g: (5); 96h: (9)
2	(0,0,0)	8a: (1); 8b: (0); 24c: (2); 24d: (2); 32e: (3); 48f: (5); 48g: (3); 96h: (9)
3	(0,0,0)	8a: (0); 8b: (1); 24c: (2); 24d: (2); 32e: (3); 48f: (3); 48g: (5); 96h: (9)
4	(0,0,0)	8a: (1); 8b: (0); 24c: (1); 24d: (3); 32e: (3); 48f: (5); 48g: (3); 96h: (9)
5	(0,0,0)	8a: (2); 8b: (2); 24c: (5); 24d: (5); 32e: (6); 48f: (10); 48g: (10); 96h: (18)

$L(\frac{1}{2},\frac{1}{2},\frac{1}{2})$ of space group No. 219

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 32e: (4); 48f: (6); 48g: (6); 96h: (12)
2	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 32e: (4); 48f: (6); 48g: (6); 96h: (12)

$$\text{W} \left(\frac{1}{2}, \frac{1}{4}, \frac{3}{4} \right) \text{ of space group No. 219}$$

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	8a: (1); 8b: (2); 24c: (5); 24d: (4); 32e: (6); 48f: (8); 48g: (10); 96h: (18)
2	$(r_1, 0, 0)$	8a: (2); 8b: (1); 24c: (4); 24d: (5); 32e: (6); 48f: (10); 48g: (8); 96h: (18)

c. Results for high-symmetry lines

$\text{DT}(\frac{v}{2}, 0, \frac{v}{2})$					
Operation	E	S_{4x}^+	S_{4z}^-		
Coordinate	$(\frac{v}{2}, 0, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, 0)$	$(0, \frac{v}{2}, \frac{v}{2})$		

$\text{LD}(u, u, u)$					
Operation	E	C_{2x}	C_{2y}	C_{2z}	
Coordinate	(u, u, u)	$(-u, 0, 0)$	$(0, -u, 0)$	$(0, 0, -u)$	

$\text{Q}(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$					
Operation	E	C_{2y}	C_{31}^+	C_{33}^+	
Coordinate	$(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$	$(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$	$(\frac{1}{4}(1+2v), \frac{1}{2}, \frac{1}{4}(3-2v))$	$(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(-3+2v))$	
	C_{31}^-	C_{32}^-			
	$(\frac{1}{4}(3-2v), \frac{1}{4}(1+2v), \frac{1}{2})$	$(\frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$			

$\text{SM}(\frac{u}{2}, \frac{u}{2}, u)$					
Operation	E	C_{2x}	σ_{dc}	σ_{dc}	$\sigma_{df} \quad \sigma_{dd}$
Coordinate	$(\frac{u}{2}, \frac{u}{2}, u)$	$(-\frac{u}{2}, \frac{u}{2}, 0)$	$(u, \frac{u}{2}, \frac{u}{2})$	$(0, -\frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, u, \frac{u}{2}) \quad (-\frac{u}{2}, 0, \frac{u}{2})$

$\text{V}(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$					
Operation	E	C_{31}^+	C_{31}^-		
Coordinate	$(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$	$(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{1+u}{2}, \frac{1}{2})$		

$$\text{DT} \left(\frac{v}{2}, 0, \frac{v}{2} \right) \text{ of space group No. 219}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 24c: (4); 24d: (4); 32e: (6); 48f: (8); 48g: (8); 96h: (18)
2	(0, 0, 0)	8a: (1); 8b: (1); 24c: (4); 24d: (4); 32e: (6); 48f: (8); 48g: (8); 96h: (18)
3	(0, 0, 0)	8a: (2); 8b: (2); 24c: (5); 24d: (5); 32e: (6); 48f: (10); 48g: (10); 96h: (18)

$$\text{LD} (u, u, u) \text{ of space group No. 219}$$

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 32e: (4); 48f: (6); 48g: (6); 96h: (12)
2	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 32e: (4); 48f: (6); 48g: (6); 96h: (12)
3	(0, 0, 0)	8a: (2); 8b: (2); 24c: (6); 24d: (6); 32e: (8); 48f: (12); 48g: (12); 96h: (24)

Q $(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$ of space group No. 219

(Co-) irrep	Phonon AM	WYPO information
1	(r_2, r_1, r_1)	8a: (3); 8b: (3); 24c: (9); 24d: (9); 32e: (12); 48f: (18); 48g: (18); 96h: (36)

SM $(\frac{u}{2}, \frac{u}{2}, u)$ of space group No. 219

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	8a: (3); 8b: (3); 24c: (9); 24d: (9); 32e: (12); 48f: (18); 48g: (18); 96h: (36)
2	$(-r_1, r_1, 0)$	8a: (3); 8b: (3); 24c: (9); 24d: (9); 32e: (12); 48f: (18); 48g: (18); 96h: (36)

V $(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$ of space group No. 219

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, 0, 0)$	8a: (2); 8b: (4); 24c: (10); 24d: (8); 32e: (12); 48f: (16); 48g: (20); 96h: (36)
2	$(r_1, 0, 0)$	8a: (4); 8b: (2); 24c: (8); 24d: (10); 32e: (12); 48f: (20); 48g: (16); 96h: (36)

d. Results for high-symmetry planes

P1($u, v, u+v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, u+v)$	$(u+v, u, v)$	$(v, u+v, u)$

P2(u, u, v)

Operation	E	C_{2x}	σ_{dc}	σ_{dc}	σ_{df}	σ_{dd}
Coordinate	(u, u, v)	$(-u, -u+v, 0)$	(v, u, u)	$(0, -u, -u+v)$	(u, v, u)	$(-u, 0, -u+v)$

P1 ($u, v, u+v$) of space group No. 219

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	8a: (6); 8b: (6); 24c: (18); 24d: (18); 32e: (24); 48f: (36); 48g: (36); 96h: (72)

P2 (u, u, v) of space group No. 219

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	8a: (3); 8b: (3); 24c: (9); 24d: (9); 32e: (12); 48f: (18); 48g: (18); 96h: (36)
2	$(-r_1, r_1, 0)$	8a: (3); 8b: (3); 24c: (9); 24d: (9); 32e: (12); 48f: (18); 48g: (18); 96h: (36)

220. Space group No. 220 ($I\bar{4}3d$)

Cubic body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

$\{E 0,0,0\}$	$\{C_{2x} \frac{1}{2},\frac{1}{2},0\}$	$\{C_{2z} \frac{1}{2},0,\frac{1}{2}\}$	$\{C_{2y} 0,\frac{1}{2},\frac{1}{2}\}$	$\{S_{4x}^- 0,0,\frac{1}{2}\}$	$\{S_{4z}^+ 0,0,-\frac{1}{2}\}$	$\{S_{4y}^+ 0,\frac{1}{2},0\}$	$\{S_{4x}^+ \frac{1}{2},0,0\}$
$\{S_{4z}^- 0,\frac{1}{2},0\}$	$\{S_{4y}^- -\frac{1}{2},0,0\}$	$\{\sigma_{da} \frac{1}{2},0,0\}$	$\{\sigma_{db} \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{\sigma_{df} \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{\sigma_{dd} 0,-\frac{1}{2},0\}$	$\{\sigma_{dc} 0,0,\frac{1}{2}\}$	$\{\sigma_{de} \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$
$\{C_{31}^- 0,0,0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{33}^- 0,\frac{1}{2},\frac{1}{2}\}$	$\{C_{34}^- \frac{1}{2},0,\frac{1}{2}\}$	$\{C_{32}^- \frac{1}{2},\frac{1}{2},0\}$	$\{C_{33}^+ \frac{1}{2},0,\frac{1}{2}\}$	$\{C_{32}^+ 0,\frac{1}{2},\frac{1}{2}\}$	$\{C_{34}^+ \frac{1}{2},\frac{1}{2},0\}$

a. Space group operations

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	(0,0,0)
$H(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$
$P(\frac{1}{4},\frac{1}{4},\frac{1}{4})$	
Operation	E E Θ
Coordinate	$(\frac{1}{4},\frac{1}{4},\frac{1}{4})$ $(-\frac{1}{4},-\frac{1}{4},-\frac{1}{4})$
$N(0,0,\frac{1}{2})$	
Operation	E C_{2x} S_{4y}^+ S_{4y}^- S_{4x}^- S_{4x}^+
Coordinate	$(0,0,\frac{1}{2})$ $(-\frac{1}{2},\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$ $(0,\frac{1}{2},-\frac{1}{2})$ $(0,-\frac{1}{2},0)$ $(\frac{1}{2},0,-\frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 220

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	12a: (0); 12b: (0); 16c: (1); 24d: (1); 48e: (3)
2	(0,0,0)	12a: (1); 12b: (1); 16c: (1); 24d: (1); 48e: (3)
3	(0,0,0)	12a: (1); 12b: (1); 16c: (2); 24d: (2); 48e: (6)
4	(0,0,0)	12a: (2); 12b: (2); 16c: (3); 24d: (5); 48e: (9)
5	(0,0,0)	12a: (3); 12b: (3); 16c: (3); 24d: (5); 48e: (9)

$H(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$ of space group No. 220

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	12a: (1); 12b: (1); 16c: (1); 24d: (2); 48e: (3)
2	(0,0,0)	12a: (1); 12b: (1); 16c: (1); 24d: (2); 48e: (3)
3	(0,0,0)	12a: (2); 12b: (2); 16c: (3); 24d: (4); 48e: (9)

P $(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ of space group No. 220		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	12a: (1); 12b: (2); 16c: (2); 24d: (3); 48e: (6)
2	(0, 0, 0)	12a: (2); 12b: (1); 16c: (2); 24d: (3); 48e: (6)
3	(0, 0, 0)	12a: (3); 12b: (3); 16c: (4); 24d: (6); 48e: (12)

N $(0, 0, \frac{1}{2})$ of space group No. 220		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	12a: (9); 12b: (9); 16c: (12); 24d: (18); 48e: (36)

c. Results for high-symmetry lines

D $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$						
Operation	E	S_{4y}^+	S_{4x}^-			
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	$(\frac{1}{2}(-1-w), \frac{w}{2}, \frac{w}{2})$	$(\frac{w}{2}, \frac{1}{2}(-1-w), \frac{w}{2})$			

DT $(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$			
Operation	E	S_{4x}^+	S_{4z}^-
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, -\frac{v}{2})$	$(-\frac{v}{2}, \frac{v}{2}, \frac{v}{2})$

G $(\frac{1}{2}-u, \frac{1}{2}+u, \frac{1}{2})$						
Operation	E	C_{2x}	S_{4y}^+	S_{4y}^-	S_{4x}^-	S_{4x}^+
Coordinate	$(\frac{1}{2}-u, \frac{1}{2}+u, \frac{1}{2})$	$(-\frac{3}{2}, \frac{1}{2}, \frac{1}{2}+u)$	$(-\frac{3}{2}, \frac{1}{2}-u, \frac{1}{2}+u)$	$(\frac{1}{2}+u, \frac{1}{2}, -\frac{3}{2})$	$(\frac{1}{2}+u, -\frac{3}{2}, \frac{1}{2}-u)$	$(\frac{1}{2}, \frac{1}{2}-u, -\frac{3}{2})$

LD $(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$				
Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$

SM $(0, 0, u)$						
Operation	E	C_{2x}	σ_{de}	σ_{dc}	σ_{df}	σ_{dd}
Coordinate	$(0, 0, u)$	$(-u, u, 0)$	$(u, 0, 0)$	$(0, -u, u)$	$(0, u, 0)$	$(-u, 0, u)$

D $(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 220		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	12a: (9); 12b: (9); 16c: (12); 24d: (18); 48e: (36)

DT $(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$ of space group No. 220		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	12a: (4); 12b: (4); 16c: (6); 24d: (8); 48e: (18)
2	(0, 0, 0)	12a: (4); 12b: (4); 16c: (6); 24d: (8); 48e: (18)
3	(0, 0, 0)	12a: (5); 12b: (5); 16c: (6); 24d: (10); 48e: (18)

$G \left(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2} \right)$ of space group No. 220

(Co-) irrep	Phonon AM	WYPO information
1	$(r_1, r_1, 0)$	12a: (9); 12b: (9); 16c: (12); 24d: (18); 48e: (36)

$LD \left(\frac{u}{2}, \frac{u}{2}, \frac{u}{2} \right)$ of space group No. 220

(Co-) irrep	Phonon AM	WYPO information
1	$(0, 0, 0)$	12a: (3); 12b: (3); 16c: (4); 24d: (6); 48e: (12)
2	$(0, 0, 0)$	12a: (3); 12b: (3); 16c: (4); 24d: (6); 48e: (12)
3	$(0, 0, 0)$	12a: (6); 12b: (6); 16c: (8); 24d: (12); 48e: (24)

$SM (0, 0, u)$ of space group No. 220

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	12a: (9); 12b: (9); 16c: (12); 24d: (18); 48e: (36)
2	$(-r_1, r_1, 0)$	12a: (9); 12b: (9); 16c: (12); 24d: (18); 48e: (36)

d. Results for high-symmetry planes

$P1(u, u, v)$

Operation	E	C_{2x}	σ_{de}	σ_{dc}	σ_{df}	σ_{dd}
Coordinate	(u, u, v)	$(-2u - v, v, u)$	(v, u, u)	$(u, -2u - v, v)$	(u, v, u)	$(-2u - v, u, v)$

$P2(u, -u, v)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, -u, v)$	$(v, u, -u)$	$(-u, v, u)$

$P1 (u, u, v)$ of space group No. 220

(Co-) irrep	Phonon AM	WYPO information
1	$(-r_1, r_1, 0)$	12a: (9); 12b: (9); 16c: (12); 24d: (18); 48e: (36)
2	$(-r_1, r_1, 0)$	12a: (9); 12b: (9); 16c: (12); 24d: (18); 48e: (36)

$P2 (u, -u, v)$ of space group No. 220

(Co-) irrep	Phonon AM	WYPO information
1	$(r_2, r_1, 0)$	12a: (18); 12b: (18); 16c: (24); 24d: (36); 48e: (72)

221. Space group No. 221 ($Pm3m$)

Cubic primitive lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c} \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{I 0,0,0\}$	$\{\sigma_x 0,0,0\}$	$\{\sigma_z 0,0,0\}$	$\{\sigma_y 0,0,0\}$	$\{C_{2x} 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{2y} 0,0,0\}$
$\{C_{34}^+ 0,0,0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{32}^+ 0,0,0\}$	$\{C_{33}^+ 0,0,0\}$	$\{C_{34}^- 0,0,0\}$	$\{C_{31}^- 0,0,0\}$	$\{C_{32}^- 0,0,0\}$	$\{C_{33}^- 0,0,0\}$
$\{S_{64}^- 0,0,0\}$	$\{S_{61}^- 0,0,0\}$	$\{S_{62}^- 0,0,0\}$	$\{S_{63}^- 0,0,0\}$	$\{S_{64}^+ 0,0,0\}$	$\{S_{61}^+ 0,0,0\}$	$\{S_{62}^+ 0,0,0\}$	$\{S_{63}^+ 0,0,0\}$
$\{C_{4x}^- 0,0,0\}$	$\{C_{4z}^- 0,0,0\}$	$\{C_{4y}^+ 0,0,0\}$	$\{C_{4x}^+ 0,0,0\}$	$\{C_{4z}^+ 0,0,0\}$	$\{C_{4y}^- 0,0,0\}$	$\{S_{4x}^+ 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$
$\{S_{4y}^- 0,0,0\}$	$\{S_{4x}^- 0,0,0\}$	$\{S_{4z}^- 0,0,0\}$	$\{S_{4y}^+ 0,0,0\}$	$\{C_{2c} 0,0,0\}$	$\{C_{2e} 0,0,0\}$	$\{C_{2b} 0,0,0\}$	$\{C_{2f} 0,0,0\}$
$\{C_{2a} 0,0,0\}$	$\{C_{2d} 0,0,0\}$	$\{\sigma_{dc} 0,0,0\}$	$\{\sigma_{de} 0,0,0\}$	$\{\sigma_{db} 0,0,0\}$	$\{\sigma_{df} 0,0,0\}$	$\{\sigma_{da} 0,0,0\}$	$\{\sigma_{dd} 0,0,0\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$			
Operation	E		
Coordinate	$(0,0,0)$		
$X(0,\frac{1}{2},0)$			
Operation	E	C_{34}^{+}	C_{34}^{-}
Coordinate	$(0,\frac{1}{2},0)$	$(0,0,-\frac{1}{2})$	$(-\frac{1}{2},0,0)$
$M(\frac{1}{2},\frac{1}{2},0)$			
Operation	E	C_{34}^{+}	C_{34}^{-}
Coordinate	$(\frac{1}{2},\frac{1}{2},0)$	$(0,-\frac{1}{2},-\frac{1}{2})$	$(-\frac{1}{2},0,\frac{1}{2})$
$R(\frac{1}{2},\frac{1}{2},\frac{1}{2})$			
Operation	E		
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$		

$\Gamma(0,0,0)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (1); 8g: (1); 12h: (1); 12i: (1); 12j: (1); 24k: (2); 24l: (2); 24m: (2); 48n: (3)
2	(0,0,0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (0); 8g: (0); 12h: (1); 12i: (1); 12j: (1); 24k: (2); 24l: (2); 24m: (1); 48n: (3)
3	(0,0,0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (0); 8g: (1); 12h: (0); 12i: (1); 12j: (1); 24k: (1); 24l: (1); 24m: (2); 48n: (3)
4	(0,0,0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (0); 8g: (0); 12h: (0); 12i: (0); 12j: (0); 24k: (1); 24l: (1); 24m: (1); 48n: (3)
5	(0,0,0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (1); 8g: (1); 12h: (2); 12i: (2); 12j: (2); 24k: (4); 24l: (4); 24m: (3); 48n: (6)
6	(0,0,0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (0); 8g: (1); 12h: (0); 12i: (1); 12j: (1); 24k: (2); 24l: (2); 24m: (3); 48n: (6)
7	(0,0,0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (1); 8g: (1); 12h: (2); 12i: (2); 12j: (2); 24k: (4); 24l: (4); 24m: (4); 48n: (9)
8	(0,0,0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (1); 8g: (2); 12h: (2); 12i: (2); 12j: (2); 24k: (4); 24l: (4); 24m: (5); 48n: (9)
9	(0,0,0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (2); 6f: (2); 8g: (2); 12h: (3); 12i: (3); 12j: (3); 24k: (5); 24l: (5); 24m: (5); 48n: (9)

10 (0, 0, 0) 1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (1); 6f: (1); 8g: (1); 12h: (3); 12i: (2); 12j: (2); 24k: (5); 24l: (5); 24m: (4); 48n: (9)

X $(0, \frac{1}{2}, 0)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (1); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 8g: (2); 12h: (3); 12i: (3); 12j: (3); 24k: (6); 24l: (5); 24m: (5); 48n: (9)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (0); 8g: (1); 12h: (1); 12i: (2); 12j: (1); 24k: (4); 24l: (3); 24m: (4); 48n: (9)
3	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (0); 6e: (1); 6f: (1); 8g: (1); 12h: (3); 12i: (3); 12j: (2); 24k: (6); 24l: (5); 24m: (4); 48n: (9)
4	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (0); 8g: (2); 12h: (1); 12i: (2); 12j: (2); 24k: (4); 24l: (3); 24m: (5); 48n: (9)
5	(0, 0, 0)	1a: (0); 1b: (1); 3c: (2); 3d: (1); 6e: (2); 6f: (3); 8g: (3); 12h: (5); 12i: (4); 12j: (5); 24k: (8); 24l: (10); 24m: (9); 48n: (18)
6	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (1); 8g: (1); 12h: (1); 12i: (1); 12j: (2); 24k: (3); 24l: (4); 24m: (4); 48n: (9)
7	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 8g: (2); 12h: (3); 12i: (3); 12j: (3); 24k: (5); 24l: (6); 24m: (5); 48n: (9)
8	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (1); 8g: (2); 12h: (1); 12i: (2); 12j: (2); 24k: (3); 24l: (4); 24m: (5); 48n: (9)
9	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (1); 6e: (1); 6f: (1); 8g: (1); 12h: (3); 12i: (2); 12j: (3); 24k: (5); 24l: (6); 24m: (4); 48n: (9)
10	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (2); 6e: (3); 6f: (2); 8g: (3); 12h: (5); 12i: (5); 12j: (4); 24k: (10); 24l: (8); 24m: (9); 48n: (18)

M $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (1); 8g: (2); 12h: (3); 12i: (3); 12j: (2); 24k: (6); 24l: (4); 24m: (5); 48n: (9)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (1); 6f: (1); 8g: (1); 12h: (3); 12i: (2); 12j: (3); 24k: (4); 24l: (6); 24m: (4); 48n: (9)
3	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (1); 6f: (1); 8g: (1); 12h: (3); 12i: (3); 12j: (2); 24k: (6); 24l: (4); 24m: (4); 48n: (9)
4	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (1); 6f: (2); 8g: (2); 12h: (3); 12i: (2); 12j: (3); 24k: (4); 24l: (6); 24m: (5); 48n: (9)
5	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 8g: (3); 12h: (3); 12i: (4); 12j: (4); 24k: (8); 24l: (8); 24m: (9); 48n: (18)
6	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (1); 8g: (1); 12h: (2); 12i: (1); 12j: (2); 24k: (3); 24l: (5); 24m: (4); 48n: (9)
7	(0, 0, 0)	1a: (1); 1b: (0); 3c: (0); 3d: (1); 6e: (2); 6f: (0); 8g: (2); 12h: (2); 12i: (3); 12j: (2); 24k: (5); 24l: (3); 24m: (5); 48n: (9)
8	(0, 0, 0)	1a: (0); 1b: (1); 3c: (1); 3d: (0); 6e: (0); 6f: (2); 8g: (2); 12h: (2); 12i: (2); 12j: (3); 24k: (3); 24l: (5); 24m: (5); 48n: (9)
9	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (0); 8g: (1); 12h: (2); 12i: (2); 12j: (1); 24k: (5); 24l: (3); 24m: (4); 48n: (9)
10	(0, 0, 0)	1a: (1); 1b: (1); 3c: (1); 3d: (1); 6e: (3); 6f: (3); 8g: (3); 12h: (5); 12i: (5); 12j: (5); 24k: (10); 24l: (10); 24m: (9); 48n: (18)

R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (1); 6e: (1); 6f: (0); 8g: (1); 12h: (1); 12i: (1); 12j: (1); 24k: (2); 24l: (1); 24m: (2); 48n: (3)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (0); 8g: (0); 12h: (1); 12i: (1); 12j: (0); 24k: (2); 24l: (1); 24m: (1); 48n: (3)
3	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (0); 6e: (0); 6f: (1); 8g: (1); 12h: (1); 12i: (1); 12j: (1); 24k: (1); 24l: (2); 24m: (2); 48n: (3)
4	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (0); 6f: (0); 8g: (0); 12h: (1); 12i: (0); 12j: (1); 24k: (1); 24l: (2); 24m: (1); 48n: (3)
5	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (1); 6e: (1); 6f: (0); 8g: (1); 12h: (2); 12i: (2); 12j: (1); 24k: (4); 24l: (2); 24m: (3); 48n: (6)
6	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (0); 6e: (0); 6f: (1); 8g: (1); 12h: (2); 12i: (1); 12j: (2); 24k: (2); 24l: (4); 24m: (3); 48n: (6)
7	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (1); 6e: (1); 6f: (1); 8g: (1); 12h: (2); 12i: (2); 12j: (2); 24k: (4); 24l: (5); 24m: (4); 48n: (9)
8	(0, 0, 0)	1a: (0); 1b: (1); 3c: (0); 3d: (1); 6e: (1); 6f: (2); 8g: (2); 12h: (2); 12i: (2); 12j: (3); 24k: (4); 24l: (5); 24m: (5); 48n: (9)
9	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (0); 6e: (2); 6f: (1); 8g: (2); 12h: (2); 12i: (3); 12j: (2); 24k: (5); 24l: (4); 24m: (5); 48n: (9)
10	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (0); 6e: (1); 6f: (1); 8g: (1); 12h: (2); 12i: (2); 12j: (2); 24k: (5); 24l: (4); 24m: (4); 48n: (9)

c. Results for high-symmetry lines

DT _(0, v, 0)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)			
LD _(u, u, u)						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)		
S _(u, $\frac{1}{2}$, u)						
Operation	E	σ_z	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{33}^{-}
Coordinate	(u, $\frac{1}{2}$, u)	(u, $\frac{1}{2}$, -u)	(u, u, $\frac{1}{2}$)	(-u, u, - $\frac{1}{2}$)	($\frac{1}{2}$, u, u)	(- $\frac{1}{2}$, u, -u)
SM _(u, u, 0)						
Operation	E	σ_y	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, 0)	(u, -u, 0)	(0, u, u)	(0, u, -u)	(u, 0, u)	(u, 0, -u)
T _($\frac{1}{2}$, $\frac{1}{2}$, w)						
Operation	E	C_{34}^{+}	C_{31}^{-}			
Coordinate	($\frac{1}{2}$, $\frac{1}{2}$, w)	(w, - $\frac{1}{2}$, - $\frac{1}{2}$)	($\frac{1}{2}$, w, $\frac{1}{2}$)			
Z _(u, $\frac{1}{2}$, 0)						
Operation	E	C_{31}^{+}	C_{34}^{-}	C_{4z}^{+}	C_{4y}^{-}	S_{4x}^{+}
Coordinate	(u, $\frac{1}{2}$, 0)	(0, u, $\frac{1}{2}$)	(- $\frac{1}{2}$, 0, u)	(- $\frac{1}{2}$, u, 0)	(0, $\frac{1}{2}$, u)	(-u, 0, $\frac{1}{2}$)

DT $(0, v, 0)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 8g: (4); 12h: (6); 12i: (6); 12j: (6); 24k: (11); 24l: (11); 24m: (10); 48n: (18)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (1); 8g: (2); 12h: (2); 12i: (3); 12j: (3); 24k: (7); 24l: (7); 24m: (8); 48n: (18)
3	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 8g: (2); 12h: (6); 12i: (5); 12j: (5); 24k: (11); 24l: (11); 24m: (8); 48n: (18)
4	(0, 0, 0)	1a: (0); 1b: (0); 3c: (0); 3d: (0); 6e: (1); 6f: (1); 8g: (4); 12h: (2); 12i: (4); 12j: (4); 24k: (7); 24l: (7); 24m: (10); 48n: (18)
5	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (5); 8g: (6); 12h: (10); 12i: (9); 12j: (9); 24k: (18); 24l: (18); 24m: (18); 48n: (36)

LD (u, u, u) of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 8g: (6); 12h: (6); 12i: (7); 12j: (7); 24k: (12); 24l: (12); 24m: (14); 48n: (24)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (2); 8g: (2); 12h: (6); 12i: (5); 12j: (5); 24k: (12); 24l: (12); 24m: (10); 48n: (24)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 8g: (8); 12h: (12); 12i: (12); 12j: (12); 24k: (24); 24l: (24); 24m: (24); 48n: (48)

S $(u, \frac{1}{2}, u)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (3); 6e: (6); 6f: (4); 8g: (7); 12h: (9); 12i: (10); 12j: (9); 24k: (20); 24l: (16); 24m: (19); 48n: (36)
2	(0, 0, 0)	1a: (0); 1b: (1); 3c: (2); 3d: (2); 6e: (3); 6f: (5); 8g: (5); 12h: (9); 12i: (7); 12j: (10); 24k: (16); 24l: (20); 24m: (17); 48n: (36)
3	(0, 0, 0)	1a: (1); 1b: (0); 3c: (2); 3d: (2); 6e: (5); 6f: (3); 8g: (5); 12h: (9); 12i: (10); 12j: (7); 24k: (20); 24l: (16); 24m: (17); 48n: (36)
4	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (2); 6e: (4); 6f: (6); 8g: (7); 12h: (9); 12i: (9); 12j: (10); 24k: (16); 24l: (20); 24m: (19); 48n: (36)

SM $(u, u, 0)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (6); 8g: (7); 12h: (11); 12i: (10); 12j: (10); 24k: (20); 24l: (20); 24m: (19); 48n: (36)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (3); 6f: (3); 8g: (5); 12h: (7); 12i: (7); 12j: (7); 24k: (16); 24l: (16); 24m: (17); 48n: (36)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (5); 8g: (5); 12h: (11); 12i: (10); 12j: (10); 24k: (20); 24l: (20); 24m: (17); 48n: (36)
4	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (4); 6f: (4); 8g: (7); 12h: (7); 12i: (9); 12j: (9); 24k: (16); 24l: (16); 24m: (19); 48n: (36)

T $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (2); 6e: (4); 6f: (1); 8g: (4); 12h: (5); 12i: (6); 12j: (4); 24k: (11); 24l: (7); 24m: (10); 48n: (18)
2	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (1); 6f: (2); 8g: (2); 12h: (5); 12i: (3); 12j: (5); 24k: (7); 24l: (11); 24m: (8); 48n: (18)

3	(0, 0, 0)	1a: (0); 1b: (0); 3c: (1); 3d: (1); 6e: (2); 6f: (1); 8g: (2); 12h: (5); 12i: (5); 12j: (3); 24k: (11); 24l: (7); 24m: (8); 48n: (18)
4	(0, 0, 0)	1a: (0); 1b: (1); 3c: (2); 3d: (1); 6e: (1); 6f: (4); 8g: (4); 12h: (5); 12i: (4); 12j: (6); 24k: (7); 24l: (11); 24m: (10); 48n: (18)
5	(0, 0, 0)	1a: (1); 1b: (1); 3c: (2); 3d: (2); 6e: (5); 6f: (5); 8g: (6); 12h: (8); 12i: (9); 12j: (9); 24k: (18); 24l: (18); 24m: (18); 48n: (36)

$Z(u, \frac{1}{2}, 0)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (6); 6f: (5); 8g: (6); 12h: (11); 12i: (11); 12j: (9); 24k: (22); 24l: (18); 24m: (18); 48n: (36)
2	(0, 0, 0)	1a: (0); 1b: (1); 3c: (2); 3d: (1); 6e: (2); 6f: (5); 8g: (6); 12h: (7); 12i: (7); 12j: (9); 24k: (14); 24l: (18); 24m: (18); 48n: (36)
3	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (5); 6f: (6); 8g: (6); 12h: (11); 12i: (9); 12j: (11); 24k: (18); 24l: (22); 24m: (18); 48n: (36)
4	(0, 0, 0)	1a: (1); 1b: (0); 3c: (1); 3d: (2); 6e: (5); 6f: (2); 8g: (6); 12h: (7); 12i: (9); 12j: (7); 24k: (18); 24l: (14); 24m: (18); 48n: (36)

d. Results for high-symmetry planes

$P1(u, u, v)$

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$

$P2(u, v, 0)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$

$P4(u, \frac{1}{2}, v)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$

$P1(u, u, v)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 3c: (5); 3d: (5); 6e: (10); 6f: (10); 8g: (14); 12h: (18); 12i: (19); 12j: (19); 24k: (36); 24l: (36); 24m: (38); 48n: (72)
2	(0, 0, 0)	1a: (1); 1b: (1); 3c: (4); 3d: (4); 6e: (8); 6f: (8); 8g: (10); 12h: (18); 12i: (17); 12j: (17); 24k: (36); 24l: (36); 24m: (34); 48n: (72)

$P2(u, v, 0)$ of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (2); 3c: (6); 3d: (6); 6e: (11); 6f: (11); 8g: (12); 12h: (22); 12i: (20); 12j: (20); 24k: (40); 24l: (40); 24m: (36); 48n: (72)
2	(0, 0, 0)	1a: (1); 1b: (1); 3c: (3); 3d: (3); 6e: (7); 6f: (7); 8g: (12); 12h: (14); 12i: (16); 12j: (16); 24k: (32); 24l: (32); 24m: (36); 48n: (72)

P4 ($u, \frac{1}{2}, v$) of space group No. 221

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	1a: (2); 1b: (1); 3c: (4); 3d: (5); 6e: (11); 6f: (7); 8g: (12); 12h: (18); 12i: (20); 12j: (16); 24k: (40); 24l: (32); 24m: (36); 48n: (72)
2	(0, 0, 0)	1a: (1); 1b: (2); 3c: (5); 3d: (4); 6e: (7); 6f: (11); 8g: (12); 12h: (18); 12i: (16); 12j: (20); 24k: (32); 24l: (40); 24m: (36); 48n: (72)

222. Space group No. 222 ($Pn3n$)

Cubic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{I \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_x \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_z \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_y \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{C_{2x} 0, 0, 0\}$	$\{C_{2z} 0, 0, 0\}$	$\{C_{2y} 0, 0, 0\}$
$\{C_{34}^+ 0, 0, 0\}$	$\{C_{31}^+ 0, 0, 0\}$	$\{C_{32}^+ 0, 0, 0\}$	$\{C_{33}^+ 0, 0, 0\}$	$\{C_{34}^- 0, 0, 0\}$	$\{C_{31}^- 0, 0, 0\}$	$\{C_{32}^- 0, 0, 0\}$	$\{C_{33}^- 0, 0, 0\}$
$\{S_{64}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{61}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{62}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{63}^- -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{S_{64}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{61}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{62}^+ -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{S_{63}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$
$\{C_{4x}^- 0, 0, 0\}$	$\{C_{4z}^- 0, 0, 0\}$	$\{C_{4y}^+ 0, 0, 0\}$	$\{C_{4x}^+ 0, 0, 0\}$	$\{C_{4z}^+ 0, 0, 0\}$	$\{C_{4y}^- 0, 0, 0\}$	$\{S_{4x}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4z}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$
$\{S_{4y}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4x}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4z}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4y}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{2c} 0, 0, 0\}$	$\{C_{2e} 0, 0, 0\}$	$\{C_{2b} 0, 0, 0\}$	$\{C_{2f} 0, 0, 0\}$
$\{C_{2a} 0, 0, 0\}$	$\{C_{2d} 0, 0, 0\}$	$\{\sigma_{dc} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{de} \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_{db} -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{df} -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_{da} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{dd} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$

b. Results for high-symmetry points $\Gamma(0, 0, 0)$

Operation E
Coordinate (0, 0, 0)

 $X(0, \frac{1}{2}, 0)$

Operation E C_{34}^+ C_{34}^-
Coordinate $(0, \frac{1}{2}, 0)$ $(0, 0, -\frac{1}{2})$ $(-\frac{1}{2}, 0, 0)$

 $M(\frac{1}{2}, \frac{1}{2}, 0)$

Operation E C_{34}^+ C_{34}^-
Coordinate $(\frac{1}{2}, \frac{1}{2}, 0)$ $(0, -\frac{1}{2}, -\frac{1}{2})$ $(-\frac{1}{2}, 0, \frac{1}{2})$

 $R(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

Operation E
Coordinate $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$

Γ (0, 0, 0) of space group No. 222

(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	6b: (0);	8c: (0);	12d: (0);	12e: (1);	16f: (1);	24g: (1);	24h: (1);	48i: (3)
2	(0, 0, 0)	2a: (0);	6b: (0);	8c: (0);	12d: (1);	12e: (0);	16f: (1);	24g: (1);	24h: (2);	48i: (3)
3	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (0);	12e: (0);	16f: (1);	24g: (1);	24h: (2);	48i: (3)
4	(0, 0, 0)	2a: (0);	6b: (0);	8c: (1);	12d: (1);	12e: (1);	16f: (1);	24g: (1);	24h: (1);	48i: (3)
5	(0, 0, 0)	2a: (0);	6b: (0);	8c: (0);	12d: (1);	12e: (1);	16f: (2);	24g: (2);	24h: (3);	48i: (6)
6	(0, 0, 0)	2a: (0);	6b: (0);	8c: (2);	12d: (1);	12e: (1);	16f: (2);	24g: (2);	24h: (3);	48i: (6)
7	(0, 0, 0)	2a: (1);	6b: (2);	8c: (0);	12d: (2);	12e: (3);	16f: (3);	24g: (5);	24h: (5);	48i: (9)
8	(0, 0, 0)	2a: (0);	6b: (1);	8c: (0);	12d: (3);	12e: (2);	16f: (3);	24g: (5);	24h: (4);	48i: (9)
9	(0, 0, 0)	2a: (1);	6b: (2);	8c: (3);	12d: (3);	12e: (3);	16f: (3);	24g: (5);	24h: (5);	48i: (9)
10	(0, 0, 0)	2a: (0);	6b: (1);	8c: (3);	12d: (2);	12e: (2);	16f: (3);	24g: (5);	24h: (4);	48i: (9)

 X $(0, \frac{1}{2}, 0)$ of space group No. 222

(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (1);	6b: (2);	8c: (3);	12d: (4);	12e: (5);	16f: (6);	24g: (8);	24h: (9);	48i: (18)
2	(0, 0, 0)	2a: (0);	6b: (1);	8c: (3);	12d: (4);	12e: (3);	16f: (6);	24g: (8);	24h: (9);	48i: (18)
3	(0, 0, 0)	2a: (1);	6b: (3);	8c: (3);	12d: (5);	12e: (5);	16f: (6);	24g: (10);	24h: (9);	48i: (18)

 M $(\frac{1}{2}, \frac{1}{2}, 0)$ of space group No. 222

(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	6b: (2);	8c: (3);	12d: (5);	12e: (4);	16f: (6);	24g: (10);	24h: (8);	48i: (18)
2	(0, 0, 0)	2a: (1);	6b: (2);	8c: (3);	12d: (4);	12e: (5);	16f: (6);	24g: (8);	24h: (9);	48i: (18)
3	(0, 0, 0)	2a: (1);	6b: (3);	8c: (3);	12d: (5);	12e: (4);	16f: (6);	24g: (10);	24h: (10);	48i: (18)
4	(0, 0, 0)	2a: (1);	6b: (2);	8c: (3);	12d: (4);	12e: (5);	16f: (6);	24g: (8);	24h: (9);	48i: (18)

 R $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 222

(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (0);	6b: (1);	8c: (1);	12d: (2);	12e: (1);	16f: (2);	24g: (4);	24h: (3);	48i: (6)
2	(0, 0, 0)	2a: (0);	6b: (1);	8c: (1);	12d: (2);	12e: (1);	16f: (2);	24g: (4);	24h: (3);	48i: (6)
3	(0, 0, 0)	2a: (1);	6b: (2);	8c: (3);	12d: (4);	12e: (5);	16f: (6);	24g: (8);	24h: (9);	48i: (18)

*c. Results for high-symmetry lines*DT_(0, v, 0)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)

LD_(u, u, u)

Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)

S_(u, $\frac{1}{2}$, u)

Operation	E	σ_z	C_{31}^+	C_{32}^+	C_{31}^-	C_{33}^-

Coordinate	$(u, \frac{1}{2}, u)$	$(u, \frac{1}{2}, -u)$	$(u, u, \frac{1}{2})$	$(-u, u, -\frac{1}{2})$	$(\frac{1}{2}, u, u)$	$(-\frac{1}{2}, u, -u)$
SM _(u, u, 0)						
Operation	E	σ_y	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	$(u, u, 0)$	$(u, -u, 0)$	$(0, u, u)$	$(0, u, -u)$	$(u, 0, u)$	$(u, 0, -u)$
T _($\frac{1}{2}, \frac{1}{2}, w$)						
Operation	E	C_{34}^+	C_{31}^-			
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	$(w, -\frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, w, \frac{1}{2})$			
Z _(u, $\frac{1}{2}, 0$)						
Operation	E	C_{31}^+	C_{34}^-	C_{4z}^+	C_{4y}^-	S_{4x}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(0, u, \frac{1}{2})$	$(-\frac{1}{2}, 0, u)$	$(-\frac{1}{2}, u, 0)$	$(0, \frac{1}{2}, u)$	$(-u, 0, \frac{1}{2})$

DT $(0, v, 0)$ of space group No. 222

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 16f: (6); 24g: (8); 24h: (9); 48i: (18)
2	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 16f: (6); 24g: (8); 24h: (9); 48i: (18)
3	(0, 0, 0)	2a: (0); 6b: (1); 8c: (3); 12d: (4); 12e: (3); 16f: (6); 24g: (8); 24h: (9); 48i: (18)
4	(0, 0, 0)	2a: (0); 6b: (1); 8c: (3); 12d: (4); 12e: (3); 16f: (6); 24g: (8); 24h: (9); 48i: (18)
5	(0, 0, 0)	2a: (2); 6b: (6); 8c: (6); 12d: (10); 12e: (10); 16f: (12); 24g: (20); 24h: (18); 48i: (36)

LD (u, u, u) of space group No. 222

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 16f: (8); 24g: (12); 24h: (12); 48i: (24)
2	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 16f: (8); 24g: (12); 24h: (12); 48i: (24)
3	(0, 0, 0)	2a: (2); 6b: (6); 8c: (8); 12d: (12); 12e: (12); 16f: (16); 24g: (24); 24h: (24); 48i: (48)

S $(u, \frac{1}{2}, u)$ of space group No. 222

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 48i: (72)

SM $(u, u, 0)$ of space group No. 222

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (4); 8c: (6); 12d: (9); 12e: (9); 16f: (12); 24g: (18); 24h: (17); 48i: (36)
2	(0, 0, 0)	2a: (1); 6b: (4); 8c: (6); 12d: (9); 12e: (9); 16f: (12); 24g: (18); 24h: (17); 48i: (36)
3	(0, 0, 0)	2a: (2); 6b: (5); 8c: (6); 12d: (9); 12e: (9); 16f: (12); 24g: (18); 24h: (19); 48i: (36)
4	(0, 0, 0)	2a: (2); 6b: (5); 8c: (6); 12d: (9); 12e: (9); 16f: (12); 24g: (18); 24h: (19); 48i: (36)

T $(\frac{1}{2}, \frac{1}{2}, w)$ of space group No. 222

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 16f: (6); 24g: (8); 24h: (9); 48i: (18)
2	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 16f: (6); 24g: (8); 24h: (9); 48i: (18)
3	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 16f: (6); 24g: (8); 24h: (9); 48i: (18)
4	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 16f: (6); 24g: (8); 24h: (9); 48i: (18)

5	(0, 0, 0)	2a: (1); 6b: (5); 8c: (6); 12d: (10); 12e: (8); 16f: (12); 24g: (20); 24h: (18); 48i: (36)
$Z(u, \frac{1}{2}, 0)$ of space group No. 222		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 48i: (72)

d. Results for high-symmetry planes

P1(u, u, v)						
Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$
P2($u, v, 0$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$			
P4($u, \frac{1}{2}, v$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(u, \frac{1}{2}, v)$	$(v, u, \frac{1}{2})$	$(\frac{1}{2}, v, u)$			

$P1(u, u, v)$ of space group No. 222		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 48i: (72)
2	(0, 0, 0)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 48i: (72)
$P2(u, v, 0)$ of space group No. 222		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 48i: (72)
2	(0, 0, 0)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 48i: (72)
$P4(u, \frac{1}{2}, v)$ of space group No. 222		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 48i: (72)
2	(0, 0, 0)	2a: (3); 6b: (9); 8c: (12); 12d: (18); 12e: (18); 16f: (24); 24g: (36); 24h: (36); 48i: (72)

223. Space group No. 223 ($Pm\bar{3}n$)

Cubic primitive lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= \vec{a} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \vec{b} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \vec{c}\end{aligned}$$

a. Space group operations

$X \left(0, \frac{1}{2}, 0\right)$ of space group No. 223

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (3); 8e: (3); 12f: (6); 12g: (6); 12h: (6); 16i: (6); 24j: (9); 24k: (11); 48l: (18)
2	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (2); 8e: (3); 12f: (5); 12g: (6); 12h: (4); 16i: (6); 24j: (9); 24k: (9); 48l: (18)
3	(0, 0, 0)	2a: (0); 6b: (0); 6c: (1); 6d: (1); 8e: (3); 12f: (2); 12g: (2); 12h: (2); 16i: (6); 24j: (9); 24k: (7); 48l: (18)
4	(0, 0, 0)	2a: (1); 6b: (3); 6c: (2); 6d: (3); 8e: (3); 12f: (5); 12g: (4); 12h: (6); 16i: (6); 24j: (9); 24k: (9); 48l: (18)

$M \left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 223

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (1); 6c: (0); 6d: (1); 8e: (1); 12f: (2); 12g: (1); 12h: (2); 16i: (3); 24j: (4); 24k: (4); 48l: (9)
2	(0, 0, 0)	2a: (0); 6b: (1); 6c: (1); 6d: (1); 8e: (2); 12f: (2); 12g: (2); 12h: (1); 16i: (3); 24j: (5); 24k: (4); 48l: (9)
3	(0, 0, 0)	2a: (0); 6b: (1); 6c: (1); 6d: (1); 8e: (2); 12f: (2); 12g: (1); 12h: (2); 16i: (3); 24j: (5); 24k: (4); 48l: (9)
4	(0, 0, 0)	2a: (0); 6b: (1); 6c: (1); 6d: (0); 8e: (1); 12f: (2); 12g: (2); 12h: (1); 16i: (3); 24j: (4); 24k: (4); 48l: (9)
5	(0, 0, 0)	2a: (0); 6b: (4); 6c: (3); 6d: (3); 8e: (3); 12f: (5); 12g: (6); 12h: (6); 16i: (6); 24j: (9); 24k: (10); 48l: (18)
6	(0, 0, 0)	2a: (1); 6b: (1); 6c: (1); 6d: (1); 8e: (1); 12f: (3); 12g: (2); 12h: (3); 16i: (3); 24j: (4); 24k: (5); 48l: (9)
7	(0, 0, 0)	2a: (1); 6b: (1); 6c: (2); 6d: (1); 8e: (2); 12f: (3); 12g: (3); 12h: (2); 16i: (3); 24j: (5); 24k: (5); 48l: (9)
8	(0, 0, 0)	2a: (1); 6b: (1); 6c: (1); 6d: (2); 8e: (2); 12f: (3); 12g: (2); 12h: (3); 16i: (3); 24j: (5); 24k: (5); 48l: (9)
9	(0, 0, 0)	2a: (1); 6b: (1); 6c: (1); 6d: (1); 8e: (1); 12f: (3); 12g: (3); 12h: (2); 16i: (3); 24j: (4); 24k: (5); 48l: (9)
10	(0, 0, 0)	2a: (1); 6b: (1); 6c: (2); 6d: (2); 8e: (3); 12f: (3); 12g: (4); 12h: (4); 16i: (6); 24j: (9); 24k: (8); 48l: (18)

$R \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 223

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (1); 6c: (1); 6d: (1); 8e: (1); 12f: (1); 12g: (2); 12h: (2); 16i: (2); 24j: (3); 24k: (3); 48l: (6)
2	(0, 0, 0)	2a: (0); 6b: (1); 6c: (1); 6d: (1); 8e: (1); 12f: (1); 12g: (2); 12h: (2); 16i: (2); 24j: (3); 24k: (3); 48l: (6)
3	(0, 0, 0)	2a: (1); 6b: (2); 6c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (4); 12h: (4); 16i: (6); 24j: (9); 24k: (9); 48l: (18)

c. Results for high-symmetry lines

$DT_{(0, v, 0)}$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)

LD(u, u, u)						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	(u, u, u)	$(u, -u, -u)$	$(-u, u, -u)$	$(-u, -u, u)$		
S($u, \frac{1}{2}, u$)						
Operation	E	σ_z	C_{31}^+	C_{32}^+	C_{31}^-	C_{33}^-
Coordinate	$(u, \frac{1}{2}, u)$	$(u, \frac{1}{2}, -u)$	$(u, u, \frac{1}{2})$	$(-u, u, -\frac{1}{2})$	$(\frac{1}{2}, u, u)$	$(-\frac{1}{2}, u, -u)$
SM($u, u, 0$)						
Operation	E	σ_y	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	$(u, u, 0)$	$(u, -u, 0)$	$(0, u, u)$	$(0, u, -u)$	$(u, 0, u)$	$(u, 0, -u)$
T($\frac{1}{2}, \frac{1}{2}, w$)						
Operation	E	C_{34}^+	C_{31}^-			
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	$(w, -\frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, w, \frac{1}{2})$			
Z($u, \frac{1}{2}, 0$)						
Operation	E	C_{31}^+	C_{34}^-	C_{4z}^+	C_{4y}^-	S_{4x}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(0, u, \frac{1}{2})$	$(-\frac{1}{2}, 0, u)$	$(-\frac{1}{2}, u, 0)$	$(0, \frac{1}{2}, u)$	$(-u, 0, \frac{1}{2})$

DT (0, v, 0) of space group No. 223										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (3); 8e: (3); 12f: (6); 12g: (6); 12h: (6); 16i: (6); 24j: (9); 24k: (11); 48l: (18)								
2	(0, 0, 0)	2a: (0); 6b: (0); 6c: (1); 6d: (1); 8e: (3); 12f: (2); 12g: (2); 12h: (2); 16i: (6); 24j: (9); 24k: (7); 48l: (18)								
3	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (3); 8e: (3); 12f: (6); 12g: (6); 12h: (6); 16i: (6); 24j: (9); 24k: (11); 48l: (18)								
4	(0, 0, 0)	2a: (0); 6b: (0); 6c: (1); 6d: (1); 8e: (3); 12f: (2); 12g: (2); 12h: (2); 16i: (6); 24j: (9); 24k: (7); 48l: (18)								
5	(0, 0, 0)	2a: (2); 6b: (6); 6c: (5); 6d: (5); 8e: (6); 12f: (10); 12g: (10); 12h: (10); 16i: (12); 24j: (18); 24k: (18); 48l: (36)								
LD (u, u, u) of space group No. 223										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (3); 8e: (4); 12f: (6); 12g: (6); 12h: (6); 16i: (8); 24j: (12); 24k: (12); 48l: (24)								
2	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (3); 8e: (4); 12f: (6); 12g: (6); 12h: (6); 16i: (8); 24j: (12); 24k: (12); 48l: (24)								
3	(0, 0, 0)	2a: (2); 6b: (6); 6c: (6); 6d: (6); 8e: (8); 12f: (12); 12g: (12); 12h: (12); 16i: (16); 24j: (24); 24k: (24); 48l: (48)								
S (u, 1/2, u) of space group No. 223										
(Co-) irrep	Phonon AM	WYPO information								
1	(0, 0, 0)	2a: (3); 6b: (9); 6c: (9); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 12h: (18); 16i: (24); 24j: (36); 24k: (36); 48l: (72)								

SM ($u, u, 0$) of space group No. 223

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 6b: (6); 6c: (5); 6d: (5); 8e: (5); 12f: (11); 12g: (11); 12h: (11); 16i: (12); 24j: (17); 24k: (20); 48l: (36)
2	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (3); 8e: (5); 12f: (7); 12g: (7); 12h: (7); 16i: (12); 24j: (17); 24k: (16); 48l: (36)
3	(0, 0, 0)	2a: (2); 6b: (6); 6c: (6); 6d: (6); 8e: (7); 12f: (11); 12g: (11); 12h: (11); 16i: (12); 24j: (19); 24k: (20); 48l: (36)
4	(0, 0, 0)	2a: (1); 6b: (3); 6c: (4); 6d: (4); 8e: (7); 12f: (7); 12g: (7); 12h: (7); 16i: (12); 24j: (19); 24k: (16); 48l: (36)

T ($\frac{1}{2}, \frac{1}{2}, w$) of space group No. 223

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (2); 6c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (4); 12h: (4); 16i: (6); 24j: (9); 24k: (9); 48l: (18)
2	(0, 0, 0)	2a: (1); 6b: (2); 6c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (4); 12h: (4); 16i: (6); 24j: (9); 24k: (9); 48l: (18)
3	(0, 0, 0)	2a: (1); 6b: (2); 6c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (4); 12h: (4); 16i: (6); 24j: (9); 24k: (9); 48l: (18)
4	(0, 0, 0)	2a: (1); 6b: (2); 6c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (4); 12h: (4); 16i: (6); 24j: (9); 24k: (9); 48l: (18)
5	(0, 0, 0)	2a: (1); 6b: (5); 6c: (5); 6d: (5); 8e: (6); 12f: (8); 12g: (10); 12h: (10); 16i: (12); 24j: (18); 24k: (18); 48l: (36)

Z ($u, \frac{1}{2}, 0$) of space group No. 223

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 6b: (6); 6c: (5); 6d: (6); 8e: (6); 12f: (11); 12g: (10); 12h: (12); 16i: (12); 24j: (18); 24k: (20); 48l: (36)
2	(0, 0, 0)	2a: (1); 6b: (3); 6c: (3); 6d: (4); 8e: (6); 12f: (7); 12g: (6); 12h: (8); 16i: (12); 24j: (18); 24k: (16); 48l: (36)
3	(0, 0, 0)	2a: (2); 6b: (6); 6c: (6); 6d: (5); 8e: (6); 12f: (11); 12g: (12); 12h: (10); 16i: (12); 24j: (18); 24k: (20); 48l: (36)
4	(0, 0, 0)	2a: (1); 6b: (3); 6c: (4); 6d: (3); 8e: (6); 12f: (7); 12g: (8); 12h: (6); 16i: (12); 24j: (18); 24k: (16); 48l: (36)

*d. Results for high-symmetry planes*P1(u, u, v)

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	($u, -u, -v$)	(v, u, u)	($-v, u, -u$)	(u, v, u)	($u, -v, -u$)

P2($u, v, 0$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	($u, v, 0$)	($0, u, v$)	($v, 0, u$)

P4($u, \frac{1}{2}, v$)

Operation	E	C_{31}^+	C_{31}^-

Coordinate $(u, \frac{1}{2}, v)$ $(v, u, \frac{1}{2})$ $(\frac{1}{2}, v, u)$

P1 (u, u, v) of space group No. 223		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 6b: (9); 6c: (9); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 12h: (18); 16i: (24); 24j: (36); 24k: (36); 48l: (72)
2	(0, 0, 0)	2a: (3); 6b: (9); 6c: (9); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 12h: (18); 16i: (24); 24j: (36); 24k: (36); 48l: (72)
P2 $(u, v, 0)$ of space group No. 223		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (4); 6b: (12); 6c: (11); 6d: (11); 8e: (12); 12f: (22); 12g: (22); 12h: (22); 16i: (24); 24j: (36); 24k: (40); 48l: (72)
2	(0, 0, 0)	2a: (2); 6b: (6); 6c: (7); 6d: (7); 8e: (12); 12f: (14); 12g: (14); 12h: (14); 16i: (24); 24j: (36); 24k: (32); 48l: (72)
P4 $(u, \frac{1}{2}, v)$ of space group No. 223		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 6b: (9); 6c: (9); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 12h: (18); 16i: (24); 24j: (36); 24k: (36); 48l: (72)
2	(0, 0, 0)	2a: (3); 6b: (9); 6c: (9); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 12h: (18); 16i: (24); 24j: (36); 24k: (36); 48l: (72)

224. Space group No. 224 ($Pn3m$)

Cubic primitive lattice

$$\vec{a} = (a, 0, 0) \quad \vec{t}_1 = \vec{a}$$

$$\vec{b} = (0, a, 0) \quad \vec{t}_2 = \vec{b}$$

$$\vec{c} = (0, 0, a) \quad \vec{t}_3 = \vec{c}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{I \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_x \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_z \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_y \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{C_{2x} 0, 0, 0\}$	$\{C_{2z} 0, 0, 0\}$	$\{C_{2y} 0, 0, 0\}$
$\{C_{34}^+ 0, 0, 0\}$	$\{C_{31}^+ 0, 0, 0\}$	$\{C_{32}^+ 0, 0, 0\}$	$\{C_{33}^+ 0, 0, 0\}$	$\{C_{34}^- 0, 0, 0\}$	$\{C_{31}^- 0, 0, 0\}$	$\{C_{32}^- 0, 0, 0\}$	$\{C_{33}^- 0, 0, 0\}$
$\{S_{64}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{61}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{62}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{63}^- -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{S_{64}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{61}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{62}^+ -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{S_{63}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$
$\{C_{4x}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{4z}^- -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{4y}^+ \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{C_{4x}^+ \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{C_{4z}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{4y}^- -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{4x}^+ 0, 0, 0\}$	$\{S_{4z}^+ 0, 0, 0\}$
$\{S_{4y}^- 0, 0, 0\}$	$\{S_{4x}^- 0, 0, 0\}$	$\{S_{4z}^- 0, 0, 0\}$	$\{S_{4y}^+ 0, 0, 0\}$	$\{C_{2c} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{2e}^- -\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{2b} \frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{C_{2f} \frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$
$\{C_{2a}^- -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{C_{2d}^- -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_{dc} 0, 0, 0\}$	$\{\sigma_{de} 0, 0, 0\}$	$\{\sigma_{db} 0, 0, 0\}$	$\{\sigma_{df} 0, 0, 0\}$	$\{\sigma_{da} 0, 0, 0\}$	$\{\sigma_{dd} 0, 0, 0\}$

b. Results for high-symmetry points

4	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 6d: (2); 8e: (4); 12f: (4); 12g: (5); 24h: (8); 24i: (9); 24j: (9); 24k: (10); 48l: (18)

$M\left(\frac{1}{2}, \frac{1}{2}, 0\right)$ of space group No. 224

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 6d: (2); 8e: (3); 12f: (5); 12g: (5); 24h: (8); 24i: (10); 24j: (10); 24k: (9); 48l: (18)
2	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 6d: (2); 8e: (2); 12f: (5); 12g: (3); 24h: (10); 24i: (9); 24j: (9); 24k: (8); 48l: (18)
3	(0, 0, 0)	2a: (1); 4b: (1); 4c: (1); 6d: (2); 8e: (3); 12f: (3); 12g: (5); 24h: (8); 24i: (8); 24j: (8); 24k: (9); 48l: (18)
4	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 6d: (3); 8e: (4); 12f: (5); 12g: (5); 24h: (10); 24i: (9); 24j: (9); 24k: (10); 48l: (18)

$R\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 224

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 4b: (0); 4c: (1); 6d: (1); 8e: (1); 12f: (1); 12g: (1); 24h: (2); 24i: (1); 24j: (2); 24k: (2); 48l: (3)
2	(0, 0, 0)	2a: (0); 4b: (0); 4c: (0); 6d: (0); 8e: (0); 12f: (1); 12g: (0); 24h: (2); 24i: (2); 24j: (1); 24k: (1); 48l: (3)
3	(0, 0, 0)	2a: (0); 4b: (1); 4c: (0); 6d: (1); 8e: (1); 12f: (1); 12g: (1); 24h: (2); 24i: (2); 24j: (1); 24k: (2); 48l: (3)
4	(0, 0, 0)	2a: (0); 4b: (0); 4c: (0); 6d: (0); 8e: (0); 12f: (1); 12g: (0); 24h: (2); 24i: (1); 24j: (2); 24k: (1); 48l: (3)
5	(0, 0, 0)	2a: (0); 4b: (0); 4c: (1); 6d: (1); 8e: (1); 12f: (2); 12g: (1); 24h: (4); 24i: (3); 24j: (3); 24k: (3); 48l: (6)
6	(0, 0, 0)	2a: (0); 4b: (1); 4c: (0); 6d: (1); 8e: (1); 12f: (2); 12g: (1); 24h: (4); 24i: (3); 24j: (3); 24k: (3); 48l: (6)
7	(0, 0, 0)	2a: (0); 4b: (0); 4c: (1); 6d: (1); 8e: (1); 12f: (2); 12g: (2); 24h: (4); 24i: (5); 24j: (4); 24k: (4); 48l: (9)
8	(0, 0, 0)	2a: (1); 4b: (0); 4c: (2); 6d: (1); 8e: (2); 12f: (2); 12g: (3); 24h: (4); 24i: (4); 24j: (5); 24k: (5); 48l: (9)
9	(0, 0, 0)	2a: (1); 4b: (2); 4c: (0); 6d: (1); 8e: (2); 12f: (2); 12g: (3); 24h: (4); 24i: (5); 24j: (4); 24k: (5); 48l: (9)
10	(0, 0, 0)	2a: (0); 4b: (1); 4c: (0); 6d: (1); 8e: (1); 12f: (2); 12g: (2); 24h: (4); 24i: (4); 24j: (5); 24k: (4); 48l: (9)

c. Results for high-symmetry lines

$DT_{(0, v, 0)}$

Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	(0, v, 0)	(0, 0, v)	(v, 0, 0)

$LD_{(u, u, u)}$

Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	(u, u, u)	(u, -u, -u)	(-u, u, -u)	(-u, -u, u)

$S_{(u, \frac{1}{2}, u)}$

Operation	E	σ_z	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{33}^{-}

Coordinate	$(u, \frac{1}{2}, u)$	$(u, \frac{1}{2}, -u)$	$(u, u, \frac{1}{2})$	$(-u, u, -\frac{1}{2})$	$(\frac{1}{2}, u, u)$	$(-\frac{1}{2}, u, -u)$
$SM_{(u, u, 0)}$						
Operation	E	σ_y	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	$(u, u, 0)$	$(u, -u, 0)$	$(0, u, u)$	$(0, u, -u)$	$(u, 0, u)$	$(u, 0, -u)$
$T(\frac{1}{2}, \frac{1}{2}, w)$						
Operation	E	C_{34}^+	C_{31}^-			
Coordinate	$(\frac{1}{2}, \frac{1}{2}, w)$	$(w, -\frac{1}{2}, -\frac{1}{2})$	$(\frac{1}{2}, w, \frac{1}{2})$			
$Z_{(u, \frac{1}{2}, 0)}$						
Operation	E	C_{31}^+	C_{34}^-	C_{4z}^+	C_{4y}^-	S_{4x}^+
Coordinate	$(u, \frac{1}{2}, 0)$	$(0, u, \frac{1}{2})$	$(-\frac{1}{2}, 0, u)$	$(-\frac{1}{2}, u, 0)$	$(0, \frac{1}{2}, u)$	$(-u, 0, \frac{1}{2})$

DT $(0, v, 0)$ of space group No. 224										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (1); 4b: (2); 4c: (2); 6d: (2); 8e: (4); 12f: (4); 12g: (5); 24h: (8); 24i: (9); 24j: (9); 24k: (10); 48l: (18)								
2	$(0, 0, 0)$	2a: (0); 4b: (1); 4c: (1); 6d: (1); 8e: (2); 12f: (4); 12g: (3); 24h: (8); 24i: (9); 24j: (9); 24k: (8); 48l: (18)								
3	$(0, 0, 0)$	2a: (0); 4b: (1); 4c: (1); 6d: (1); 8e: (2); 12f: (4); 12g: (3); 24h: (8); 24i: (9); 24j: (9); 24k: (8); 48l: (18)								
4	$(0, 0, 0)$	2a: (1); 4b: (2); 4c: (2); 6d: (2); 8e: (4); 12f: (4); 12g: (5); 24h: (8); 24i: (9); 24j: (9); 24k: (10); 48l: (18)								
5	$(0, 0, 0)$	2a: (2); 4b: (3); 4c: (3); 6d: (6); 8e: (6); 12f: (10); 12g: (10); 24h: (20); 24i: (18); 24j: (18); 24k: (18); 48l: (36)								
LD (u, u, u) of space group No. 224										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (2); 4b: (3); 4c: (3); 6d: (4); 8e: (6); 12f: (6); 12g: (8); 24h: (12); 24i: (12); 24j: (12); 24k: (14); 48l: (24)								
2	$(0, 0, 0)$	2a: (0); 4b: (1); 4c: (1); 6d: (2); 8e: (2); 12f: (6); 12g: (4); 24h: (12); 24i: (12); 24j: (12); 24k: (10); 48l: (24)								
3	$(0, 0, 0)$	2a: (2); 4b: (4); 4c: (4); 6d: (6); 8e: (8); 12f: (12); 12g: (12); 24h: (24); 24i: (24); 24j: (24); 24k: (24); 48l: (48)								
S $(u, \frac{1}{2}, u)$ of space group No. 224										
(Co-) irrep	Phonon AM	WYPO information								
1	$(0, 0, 0)$	2a: (2); 4b: (4); 4c: (3); 6d: (5); 8e: (7); 12f: (9); 12g: (10); 24h: (18); 24i: (19); 24j: (17); 24k: (19); 48l: (36)								
2	$(0, 0, 0)$	2a: (2); 4b: (3); 4c: (4); 6d: (5); 8e: (7); 12f: (9); 12g: (10); 24h: (18); 24i: (17); 24j: (19); 24k: (19); 48l: (36)								
3	$(0, 0, 0)$	2a: (1); 4b: (3); 4c: (2); 6d: (4); 8e: (5); 12f: (9); 12g: (8); 24h: (18); 24i: (19); 24j: (17); 24k: (17); 48l: (36)								
4	$(0, 0, 0)$	2a: (1); 4b: (2); 4c: (3); 6d: (4); 8e: (5); 12f: (9); 12g: (8); 24h: (18); 24i: (17); 24j: (19); 24k: (17); 48l: (36)								
SM $(u, u, 0)$ of space group No. 224										

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 4b: (3); 4c: (3); 6d: (5); 8e: (7); 12f: (8); 12g: (10); 24h: (18); 24i: (17); 24j: (17); 24k: (19); 48l: (36)
2	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 6d: (4); 8e: (5); 12f: (8); 12g: (8); 24h: (18); 24i: (17); 24j: (17); 24k: (17); 48l: (36)
3	(0, 0, 0)	2a: (1); 4b: (3); 4c: (3); 6d: (4); 8e: (5); 12f: (10); 12g: (8); 24h: (18); 24i: (19); 24j: (19); 24k: (17); 48l: (36)
4	(0, 0, 0)	2a: (2); 4b: (4); 4c: (4); 6d: (5); 8e: (7); 12f: (10); 12g: (10); 24h: (18); 24i: (19); 24j: (19); 24k: (19); 48l: (36)

$T\left(\frac{1}{2}, \frac{1}{2}, w\right)$ of space group No. 224

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 6d: (3); 8e: (4); 12f: (5); 12g: (5); 24h: (10); 24i: (9); 24j: (9); 24k: (10); 48l: (18)
2	(0, 0, 0)	2a: (1); 4b: (2); 4c: (2); 6d: (3); 8e: (4); 12f: (5); 12g: (5); 24h: (10); 24i: (9); 24j: (9); 24k: (10); 48l: (18)
3	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 6d: (2); 8e: (2); 12f: (5); 12g: (3); 24h: (10); 24i: (9); 24j: (9); 24k: (8); 48l: (18)
4	(0, 0, 0)	2a: (0); 4b: (1); 4c: (1); 6d: (2); 8e: (2); 12f: (5); 12g: (3); 24h: (10); 24i: (9); 24j: (9); 24k: (8); 48l: (18)
5	(0, 0, 0)	2a: (2); 4b: (3); 4c: (3); 6d: (4); 8e: (6); 12f: (8); 12g: (10); 24h: (16); 24i: (18); 24j: (18); 24k: (18); 48l: (36)

$Z\left(u, \frac{1}{2}, 0\right)$ of space group No. 224

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36); 24i: (36); 24j: (36); 24k: (36); 48l: (72)

d. Results for high-symmetry planes

$P1(u, u, v)$

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(u, -u, -v)$	(v, u, u)	$(-v, u, -u)$	(u, v, u)	$(u, -v, -u)$

$P2(u, v, 0)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, 0)$	$(0, u, v)$	$(v, 0, u)$

$P4\left(u, \frac{1}{2}, v\right)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$\left(u, \frac{1}{2}, v\right)$	$\left(v, u, \frac{1}{2}\right)$	$\left(\frac{1}{2}, v, u\right)$

$P1(u, u, v)$ of space group No. 224

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	2a: (4); 4b: (7); 4c: (7); 6d: (10); 8e: (14); 12f: (18); 12g: (20); 24h: (36); 24i: (36); 24j: (36); 24k: (38); 48l: (72)
2	(0, 0, 0)	2a: (2); 4b: (5); 4c: (5); 6d: (8); 8e: (10); 12f: (18); 12g: (16); 24h: (36); 24i: (36); 24j: (36); 24k: (34); 48l: (72)

P2 ($u, v, 0$) of space group No. 224

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36); 24i: (36); 24j: (36); 24k: (36); 48l: (72)
2	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36); 24i: (36); 24j: (36); 24k: (36); 48l: (72)

P4 ($u, \frac{1}{2}, v$) of space group No. 224

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36); 24i: (36); 24j: (36); 24k: (36); 48l: (72)
2	(0, 0, 0)	2a: (3); 4b: (6); 4c: (6); 6d: (9); 8e: (12); 12f: (18); 12g: (18); 24h: (36); 24i: (36); 24j: (36); 24k: (36); 48l: (72)

225. Space group No. 225 ($Fm\bar{3}m$)

Cubic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$\{E 0, 0, 0\}$	$\{I 0, 0, 0\}$	$\{\sigma_x 0, 0, 0\}$	$\{\sigma_z 0, 0, 0\}$	$\{\sigma_y 0, 0, 0\}$	$\{C_{2x} 0, 0, 0\}$	$\{C_{2z} 0, 0, 0\}$	$\{C_{2y} 0, 0, 0\}$
$\{C_{34}^+ 0, 0, 0\}$	$\{C_{31}^+ 0, 0, 0\}$	$\{C_{32}^+ 0, 0, 0\}$	$\{C_{33}^+ 0, 0, 0\}$	$\{C_{34}^- 0, 0, 0\}$	$\{C_{31}^- 0, 0, 0\}$	$\{C_{32}^- 0, 0, 0\}$	$\{C_{33}^- 0, 0, 0\}$
$\{S_{64}^- 0, 0, 0\}$	$\{S_{61}^- 0, 0, 0\}$	$\{S_{62}^- 0, 0, 0\}$	$\{S_{63}^- 0, 0, 0\}$	$\{S_{64}^+ 0, 0, 0\}$	$\{S_{61}^+ 0, 0, 0\}$	$\{S_{62}^+ 0, 0, 0\}$	$\{S_{63}^+ 0, 0, 0\}$
$\{C_{4x}^- 0, 0, 0\}$	$\{C_{4z}^- 0, 0, 0\}$	$\{C_{4y}^+ 0, 0, 0\}$	$\{C_{4x}^+ 0, 0, 0\}$	$\{C_{4z}^+ 0, 0, 0\}$	$\{C_{4y}^- 0, 0, 0\}$	$\{S_{4x}^+ 0, 0, 0\}$	$\{S_{4z}^+ 0, 0, 0\}$
$\{S_{4y}^- 0, 0, 0\}$	$\{S_{4x}^- 0, 0, 0\}$	$\{S_{4z}^- 0, 0, 0\}$	$\{S_{4y}^+ 0, 0, 0\}$	$\{C_{2c} 0, 0, 0\}$	$\{C_{2e} 0, 0, 0\}$	$\{C_{2b} 0, 0, 0\}$	$\{C_{2f} 0, 0, 0\}$
$\{C_{2a} 0, 0, 0\}$	$\{C_{2d} 0, 0, 0\}$	$\{\sigma_{dc} 0, 0, 0\}$	$\{\sigma_{de} 0, 0, 0\}$	$\{\sigma_{db} 0, 0, 0\}$	$\{\sigma_{df} 0, 0, 0\}$	$\{\sigma_{da} 0, 0, 0\}$	$\{\sigma_{dd} 0, 0, 0\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$

Operation	E
Coordinate	(0, 0, 0)

6	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 24d: (0); 24e: (0); 32f: (1); 48g: (2); 48h: (1); 48i: (1); 96j: (3); 96k: (4); 192l: (9)
7	(0, 0, 0)	4a: (1); 4b: (1); 8c: (0); 24d: (1); 24e: (2); 32f: (2); 48g: (2); 48h: (3); 48i: (3); 96j: (5); 96k: (5); 192l: (9)
8	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 24d: (1); 24e: (0); 32f: (2); 48g: (3); 48h: (2); 48i: (2); 96j: (3); 96k: (5); 192l: (9)
9	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 24d: (0); 24e: (1); 32f: (1); 48g: (1); 48h: (2); 48i: (2); 96j: (5); 96k: (4); 192l: (9)
10	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 24d: (2); 24e: (3); 32f: (3); 48g: (5); 48h: (5); 48i: (5); 96j: (10); 96k: (9); 192l: (18)

$L\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$ of space group No. 225

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (1); 8c: (1); 24d: (2); 24e: (2); 32f: (3); 48g: (4); 48h: (3); 48i: (4); 96j: (6); 96k: (7); 192l: (12)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 24d: (1); 24e: (1); 32f: (1); 48g: (2); 48h: (3); 48i: (2); 96j: (6); 96k: (5); 192l: (12)
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 24d: (1); 24e: (1); 32f: (1); 48g: (2); 48h: (2); 48i: (3); 96j: (6); 96k: (5); 192l: (12)
4	(0, 0, 0)	4a: (1); 4b: (0); 8c: (1); 24d: (2); 24e: (2); 32f: (3); 48g: (4); 48h: (4); 48i: (3); 96j: (6); 96k: (7); 192l: (12)
5	(0, 0, 0)	4a: (0); 4b: (1); 8c: (1); 24d: (3); 24e: (3); 32f: (4); 48g: (6); 48h: (6); 48i: (6); 96j: (12); 96k: (12); 192l: (24)
6	(0, 0, 0)	4a: (1); 4b: (0); 8c: (1); 24d: (3); 24e: (3); 32f: (4); 48g: (6); 48h: (6); 48i: (6); 96j: (12); 96k: (12); 192l: (24)

$W\left(\frac{1}{2}, \frac{1}{4}, \frac{3}{4}\right)$ of space group No. 225

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (0); 4b: (1); 8c: (1); 24d: (3); 24e: (3); 32f: (3); 48g: (5); 48h: (5); 48i: (6); 96j: (11); 96k: (9); 192l: (18)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 24d: (2); 24e: (1); 32f: (3); 48g: (5); 48h: (4); 48i: (3); 96j: (7); 96k: (9); 192l: (18)
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 24d: (2); 24e: (1); 32f: (3); 48g: (5); 48h: (3); 48i: (4); 96j: (7); 96k: (9); 192l: (18)
4	(0, 0, 0)	4a: (1); 4b: (0); 8c: (1); 24d: (3); 24e: (3); 32f: (3); 48g: (5); 48h: (6); 48i: (5); 96j: (11); 96k: (9); 192l: (18)
5	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 24d: (4); 24e: (5); 32f: (6); 48g: (8); 48h: (9); 48i: (9); 96j: (18); 96k: (18); 192l: (36)

c. Results for high-symmetry lines

$DT\left(\frac{u}{2}, 0, \frac{v}{2}\right)$				
Operation	E	C_{31}^+	C_{31}^-	
Coordinate	$\left(\frac{v}{2}, 0, \frac{v}{2}\right)$	$\left(\frac{v}{2}, \frac{v}{2}, 0\right)$	$\left(0, \frac{v}{2}, \frac{v}{2}\right)$	
$LD(u, u, u)$				
Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	(u, u, u)	$(-u, 0, 0)$	$(0, -u, 0)$	$(0, 0, -u)$

$$Q(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$$

Operation	E	C_{2y}	C_{31}^{+}	C_{33}^{+}
Coordinate	$(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$	$(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$	$(\frac{1}{4}(1+2v), \frac{1}{2}, \frac{1}{4}(3-2v))$	$(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(-3+2v))$
	C_{31}^{-}	C_{32}^{-}		
	$(\frac{1}{4}(3-2v), \frac{1}{4}(1+2v), \frac{1}{2})$	$(\frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$		

SM($\frac{u}{2}, \frac{u}{2}, u$)

Operation	E	σ_y	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(\frac{u}{2}, \frac{u}{2}, u)$	$(-\frac{u}{2}, \frac{u}{2}, 0)$	$(u, \frac{u}{2}, \frac{u}{2})$	$(0, -\frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, u, \frac{u}{2})$	$(-\frac{u}{2}, 0, \frac{u}{2})$

V($\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}$)

Operation	E	C_{31}^{+}	C_{34}^{-}
Coordinate	$(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$	$(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{1}{2}(-1+u), -\frac{1}{2})$

DT ($\frac{v}{2}, 0, \frac{v}{2}$) of space group No. 225		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 24d: (3); 24e: (4); 32f: (4); 48g: (5); 48h: (6); 48i: (6); 96j: (11); 96k: (10); 192l: (18)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 24d: (1); 24e: (1); 32f: (2); 48g: (3); 48h: (3); 48i: (3); 96j: (7); 96k: (8); 192l: (18)
3	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 24d: (2); 24e: (2); 32f: (2); 48g: (3); 48h: (5); 48i: (5); 96j: (11); 96k: (8); 192l: (18)
4	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 24d: (2); 24e: (1); 32f: (4); 48g: (5); 48h: (4); 48i: (4); 96j: (7); 96k: (10); 192l: (18)
5	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (5); 24e: (5); 32f: (6); 48g: (10); 48h: (9); 48i: (9); 96j: (18); 96k: (18); 192l: (36)

LD (u, u, u) of space group No. 225		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (4); 24e: (4); 32f: (6); 48g: (8); 48h: (7); 48i: (7); 96j: (12); 96k: (14); 192l: (24)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (0); 24d: (2); 24e: (2); 32f: (2); 48g: (4); 48h: (5); 48i: (5); 96j: (12); 96k: (10); 192l: (24)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (6); 24e: (6); 32f: (8); 48g: (12); 48h: (12); 48i: (12); 96j: (24); 96k: (24); 192l: (48)

Q ($\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v)$) of space group No. 225		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (2); 8c: (3); 24d: (9); 24e: (9); 32f: (12); 48g: (18); 48h: (17); 48i: (19); 96j: (36); 96k: (36); 192l: (72)
2	(0, 0, 0)	4a: (2); 4b: (1); 8c: (3); 24d: (9); 24e: (9); 32f: (12); 48g: (18); 48h: (19); 48i: (17); 96j: (36); 96k: (36); 192l: (72)

SM ($\frac{u}{2}, \frac{u}{2}, u$) of space group No. 225		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (5); 24e: (6); 32f: (7); 48g: (10); 48h: (10); 48i: (10); 96j: (20); 96k: (19); 192l: (36)

2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (1); 24d: (3); 24e: (3); 32f: (5); 48g: (8); 48h: (7); 48i: (7); 96j: (16); 96k: (17); 192l: (36)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 24d: (5); 24e: (5); 32f: (5); 48g: (8); 48h: (10); 48i: (10); 96j: (20); 96k: (17); 192l: (36)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (5); 24e: (4); 32f: (7); 48g: (10); 48h: (9); 48i: (9); 96j: (16); 96k: (19); 192l: (36)

$V\left(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}\right)$ of space group No. 225

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (6); 24e: (6); 32f: (6); 48g: (10); 48h: (11); 48i: (11); 96j: (22); 96k: (18); 192l: (36)
2	(0, 0, 0)	4a: (0); 4b: (0); 8c: (2); 24d: (4); 24e: (2); 32f: (6); 48g: (10); 48h: (7); 48i: (7); 96j: (14); 96k: (18); 192l: (36)
3	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 24d: (4); 24e: (5); 32f: (6); 48g: (8); 48h: (9); 48i: (9); 96j: (18); 96k: (18); 192l: (36)
4	(0, 0, 0)	4a: (1); 4b: (1); 8c: (1); 24d: (4); 24e: (5); 32f: (6); 48g: (8); 48h: (9); 48i: (9); 96j: (18); 96k: (18); 192l: (36)

d. Results for high-symmetry planes

$P1(u, v, u + v)$

Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	$(u, v, u + v)$	$(u + v, u, v)$	$(v, u + v, u)$

$P2(u, u, v)$

Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(-u, -u + v, 0)$	(v, u, u)	$(0, -u, -u + v)$	(u, v, u)	$(-u, 0, -u + v)$

$P1(u, v, u + v)$ of space group No. 225

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (3); 24d: (10); 24e: (11); 32f: (12); 48g: (18); 48h: (20); 48i: (20); 96j: (40); 96k: (36); 192l: (72)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (3); 24d: (8); 24e: (7); 32f: (12); 48g: (18); 48h: (16); 48i: (16); 96j: (32); 96k: (36); 192l: (72)

$P2(u, u, v)$ of space group No. 225

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	4a: (2); 4b: (2); 8c: (4); 24d: (10); 24e: (10); 32f: (14); 48g: (20); 48h: (19); 48i: (19); 96j: (36); 96k: (38); 192l: (72)
2	(0, 0, 0)	4a: (1); 4b: (1); 8c: (2); 24d: (8); 24e: (8); 32f: (10); 48g: (16); 48h: (17); 48i: (17); 96j: (36); 96k: (34); 192l: (72)

226. Space group No. 226 ($Fm\bar{3}c$)

$$\begin{array}{lcl} \vec{a} = (a, 0, 0) & \vec{t}_1 = \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \text{Cubic face-centered lattice} & \vec{b} = (0, a, 0) & \vec{t}_2 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ & \vec{c} = (0, 0, a) & \vec{t}_3 = \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{array}$$

a. Space group operations

$\{E 0,0,0\}$	$\{I 0,0,0\}$	$\{\sigma_x 0,0,0\}$	$\{\sigma_z 0,0,0\}$	$\{\sigma_y 0,0,0\}$	$\{C_{2x} 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{2y} 0,0,0\}$
$\{C_{34}^+ 0,0,0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{32}^+ 0,0,0\}$	$\{C_{33}^+ 0,0,0\}$	$\{C_{34}^- 0,0,0\}$	$\{C_{31}^- 0,0,0\}$	$\{C_{32}^- 0,0,0\}$	$\{C_{33}^- 0,0,0\}$
$\{S_{64}^- 0,0,0\}$	$\{S_{61}^- 0,0,0\}$	$\{S_{62}^- 0,0,0\}$	$\{S_{63}^- 0,0,0\}$	$\{S_{64}^+ 0,0,0\}$	$\{S_{61}^+ 0,0,0\}$	$\{S_{62}^+ 0,0,0\}$	$\{S_{63}^+ 0,0,0\}$
$\{C_{4x}^- -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{4z}^- -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{C_{4y}^+ -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{4x}^+ -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{C_{4z}^+ \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{C_{4y}^- \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{S_{4x}^+ \frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{S_{4z}^+ \frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$
$\{S_{4y}^- \frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{S_{4x}^- \frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{S_{4z}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4y}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{2c}^- -\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{C_{2e}^- -\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{C_{2b}^- -\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{C_{2f}^- -\frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$
$\{C_{2a}^- -\frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{C_{2d}^- \frac{1}{2}, -\frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_{dc} \frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{de}^- \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{db} \frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_{df} \frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{da} \frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_{dd}^- -\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$						
Operation	E					
Coordinate	$(0, 0, 0)$					
$X(\frac{1}{2}, 0, \frac{1}{2})$						
Operation	E	C_{34}^{+}	C_{34}^{-}			
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$	$(-\frac{1}{2}, -\frac{1}{2}, 0)$	$(0, -\frac{1}{2}, -\frac{1}{2})$			
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$						
Operation	E	σ_x	σ_y	σ_z		
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$		
$W(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$						
Operation	E	I	C_{31}^{+}	C_{34}^{+}	C_{34}^{-}	C_{32}^{-}
Coordinate	$(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$	$(-\frac{1}{2}, -\frac{1}{4}, -\frac{3}{4})$	$(\frac{3}{4}, \frac{1}{2}, \frac{1}{4})$	$(-\frac{3}{4}, -\frac{1}{2}, -\frac{1}{4})$	$(\frac{1}{4}, -\frac{1}{4}, -\frac{1}{2})$	$(-\frac{1}{4}, \frac{1}{4}, \frac{1}{2})$

$\Gamma(0,0,0)$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information									
1	(0, 0, 0)	8a: (0);	8b: (0);	24c: (0);	24d: (0);	48e: (1);	48f: (1);	64g: (1);	96h: (1);	96i: (2);	192j: (3)
2	(0, 0, 0)	8a: (0);	8b: (0);	24c: (1);	24d: (0);	48e: (1);	48f: (0);	64g: (1);	96h: (2);	96i: (2);	192j: (3)
3	(0, 0, 0)	8a: (0);	8b: (0);	24c: (0);	24d: (0);	48e: (0);	48f: (0);	64g: (1);	96h: (2);	96i: (1);	192j: (3)

4	(0, 0, 0)	8a: (0); 8b: (0); 24c: (0); 24d: (1); 48e: (0); 48f: (1); 64g: (1); 96h: (1); 96i: (1); 192j: (3)
5	(0, 0, 0)	8a: (0); 8b: (0); 24c: (1); 24d: (0); 48e: (2); 48f: (1); 64g: (2); 96h: (3); 96i: (4); 192j: (6)
6	(0, 0, 0)	8a: (0); 8b: (0); 24c: (0); 24d: (1); 48e: (0); 48f: (1); 64g: (2); 96h: (3); 96i: (2); 192j: (6)
7	(0, 0, 0)	8a: (1); 8b: (0); 24c: (1); 24d: (0); 48e: (2); 48f: (3); 64g: (3); 96h: (5); 96i: (4); 192j: (9)
8	(0, 0, 0)	8a: (0); 8b: (0); 24c: (1); 24d: (0); 48e: (2); 48f: (2); 64g: (3); 96h: (4); 96i: (4); 192j: (9)
9	(0, 0, 0)	8a: (1); 8b: (1); 24c: (2); 24d: (3); 48e: (3); 48f: (3); 64g: (3); 96h: (5); 96i: (5); 192j: (9)
10	(0, 0, 0)	8a: (0); 8b: (1); 24c: (1); 24d: (2); 48e: (3); 48f: (2); 64g: (3); 96h: (4); 96i: (5); 192j: (9)

$X \left(\frac{1}{2}, 0, \frac{1}{2} \right)$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (0); 8b: (0); 24c: (1); 24d: (1); 48e: (2); 48f: (2); 64g: (3); 96h: (4); 96i: (4); 192j: (9)
2	(0, 0, 0)	8a: (1); 8b: (0); 24c: (2); 24d: (2); 48e: (3); 48f: (3); 64g: (3); 96h: (5); 96i: (6); 192j: (9)
3	(0, 0, 0)	8a: (0); 8b: (0); 24c: (1); 24d: (1); 48e: (2); 48f: (1); 64g: (3); 96h: (5); 96i: (4); 192j: (9)
4	(0, 0, 0)	8a: (0); 8b: (0); 24c: (1); 24d: (2); 48e: (3); 48f: (2); 64g: (3); 96h: (4); 96i: (6); 192j: (9)
5	(0, 0, 0)	8a: (1); 8b: (0); 24c: (2); 24d: (3); 48e: (4); 48f: (5); 64g: (6); 96h: (9); 96i: (8); 192j: (18)
6	(0, 0, 0)	8a: (0); 8b: (1); 24c: (1); 24d: (1); 48e: (3); 48f: (2); 64g: (3); 96h: (4); 96i: (5); 192j: (9)
7	(0, 0, 0)	8a: (1); 8b: (0); 24c: (0); 24d: (1); 48e: (0); 48f: (3); 64g: (3); 96h: (5); 96i: (3); 192j: (9)
8	(0, 0, 0)	8a: (0); 8b: (1); 24c: (2); 24d: (0); 48e: (3); 48f: (1); 64g: (3); 96h: (5); 96i: (5); 192j: (9)
9	(0, 0, 0)	8a: (0); 8b: (0); 24c: (0); 24d: (0); 48e: (0); 48f: (2); 64g: (3); 96h: (4); 96i: (3); 192j: (9)
10	(0, 0, 0)	8a: (1); 8b: (2); 24c: (3); 24d: (2); 48e: (6); 48f: (5); 64g: (6); 96h: (9); 96i: (10); 192j: (18)

$L \left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2} \right)$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 48e: (6); 48f: (6); 64g: (8); 96h: (12); 96i: (12); 192j: (24)
2	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 48e: (6); 48f: (6); 64g: (8); 96h: (12); 96i: (12); 192j: (24)

$W \left(\frac{1}{2}, \frac{1}{4}, \frac{3}{4} \right)$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (0); 24c: (1); 24d: (2); 48e: (2); 48f: (5); 64g: (6); 96h: (9); 96i: (7); 192j: (18)
2	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 48e: (6); 48f: (5); 64g: (6); 96h: (9); 96i: (11); 192j: (18)
3	(0, 0, 0)	8a: (1); 8b: (2); 24c: (5); 24d: (4); 48e: (10); 48f: (8); 64g: (12); 96h: (18); 96i: (18); 192j: (36)

c. Results for high-symmetry lines

$DT\left(\frac{v}{2}, 0, \frac{v}{2}\right)$				
Operation	E	C_{31}^+	C_{31}^-	
Coordinate	$\left(\frac{v}{2}, 0, \frac{v}{2}\right)$	$\left(\frac{v}{2}, \frac{v}{2}, 0\right)$	$\left(0, \frac{v}{2}, \frac{v}{2}\right)$	
$LD(u, u, u)$				
Operation	E	C_{2x}	C_{2y}	C_{2z}
Coordinate	(u, u, u)	$(-u, 0, 0)$	$(0, -u, 0)$	$(0, 0, -u)$

$Q(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$

Operation	E	C_{2y}	C_{31}^{+}	C_{33}^{+}
Coordinate	$(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$	$(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$	$(\frac{1}{4}(1+2v), \frac{1}{2}, \frac{1}{4}(3-2v))$	$(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(-3+2v))$
	C_{31}^{-}	C_{32}^{-}		
	$(\frac{1}{4}(3-2v), \frac{1}{4}(1+2v), \frac{1}{2})$	$(\frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$		

Operation	E	σ_y	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(\frac{u}{2}, \frac{u}{2}, u)$	$(-\frac{u}{2}, \frac{u}{2}, 0)$	$(u, \frac{u}{2}, \frac{u}{2})$	$(0, -\frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, u, \frac{u}{2})$	$(-\frac{u}{2}, 0, \frac{u}{2})$

Operation	E	C_{31}^{+}	C_{34}^{-}
Coordinate	$(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$	$(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{1}{2}(-1+u), -\frac{1}{2})$

 $DT(\frac{v}{2}, 0, \frac{v}{2})$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 48e: (6); 48f: (5); 64g: (6); 96h: (9); 96i: (11); 192j: (18)
2	(0, 0, 0)	8a: (1); 8b: (0); 24c: (1); 24d: (2); 48e: (2); 48f: (5); 64g: (6); 96h: (9); 96i: (7); 192j: (18)
3	(0, 0, 0)	8a: (0); 8b: (1); 24c: (3); 24d: (2); 48e: (6); 48f: (3); 64g: (6); 96h: (9); 96i: (11); 192j: (18)
4	(0, 0, 0)	8a: (0); 8b: (0); 24c: (1); 24d: (1); 48e: (2); 48f: (3); 64g: (6); 96h: (9); 96i: (7); 192j: (18)
5	(0, 0, 0)	8a: (2); 8b: (2); 24c: (5); 24d: (5); 48e: (10); 48f: (10); 64g: (12); 96h: (18); 96i: (18); 192j: (36)

 $LD(u, u, u)$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 48e: (6); 48f: (6); 64g: (8); 96h: (12); 96i: (12); 192j: (24)
2	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (3); 48e: (6); 48f: (6); 64g: (8); 96h: (12); 96i: (12); 192j: (24)
3	(0, 0, 0)	8a: (2); 8b: (2); 24c: (6); 24d: (6); 48e: (12); 48f: (12); 64g: (16); 96h: (24); 96i: (24); 192j: (48)

 $Q(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 24c: (9); 24d: (9); 48e: (18); 48f: (18); 64g: (24); 96h: (36); 96i: (36); 192j: (72)

 $SM(\frac{u}{2}, \frac{u}{2}, u)$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (2); 24c: (5); 24d: (5); 48e: (11); 48f: (9); 64g: (12); 96h: (17); 96i: (20); 192j: (36)
2	(0, 0, 0)	8a: (1); 8b: (1); 24c: (3); 24d: (4); 48e: (7); 48f: (9); 64g: (12); 96h: (17); 96i: (16); 192j: (36)
3	(0, 0, 0)	8a: (2); 8b: (2); 24c: (6); 24d: (5); 48e: (11); 48f: (9); 64g: (12); 96h: (19); 96i: (20); 192j: (36)

4	(0, 0, 0)	8a: (2); 8b: (1); 24c: (4); 24d: (4); 48e: (7); 48f: (9); 64g: (12); 96h: (19); 96i: (16); 192j: (36)

$V\left(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}\right)$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (2); 24c: (5); 24d: (4); 48e: (10); 48f: (8); 64g: (12); 96h: (18); 96i: (18); 192j: (36)
2	(0, 0, 0)	8a: (1); 8b: (2); 24c: (5); 24d: (4); 48e: (10); 48f: (8); 64g: (12); 96h: (18); 96i: (18); 192j: (36)
3	(0, 0, 0)	8a: (2); 8b: (2); 24c: (6); 24d: (6); 48e: (12); 48f: (10); 64g: (12); 96h: (18); 96i: (22); 192j: (36)
4	(0, 0, 0)	8a: (2); 8b: (0); 24c: (2); 24d: (4); 48e: (4); 48f: (10); 64g: (12); 96h: (18); 96i: (14); 192j: (36)

d. Results for high-symmetry planes

$P1(u, v, u + v)$

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, u + v)$	$(u + v, u, v)$	$(v, u + v, u)$

$P2(u, u, v)$

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-u, -u + v, 0)$	(v, u, u)	$(0, -u, -u + v)$	(u, v, u)	$(-u, 0, -u + v)$

$P1(u, v, u + v)$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (4); 24c: (11); 24d: (10); 48e: (22); 48f: (18); 64g: (24); 96h: (36); 96i: (40); 192j: (72)
2	(0, 0, 0)	8a: (3); 8b: (2); 24c: (7); 24d: (8); 48e: (14); 48f: (18); 64g: (24); 96h: (36); 96i: (32); 192j: (72)

$P2(u, u, v)$ of space group No. 226

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 24c: (9); 24d: (9); 48e: (18); 48f: (18); 64g: (24); 96h: (36); 96i: (36); 192j: (72)
2	(0, 0, 0)	8a: (3); 8b: (3); 24c: (9); 24d: (9); 48e: (18); 48f: (18); 64g: (24); 96h: (36); 96i: (36); 192j: (72)

227. Space group No. 227 ($Fd3m$)

Cubic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{I \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{\sigma_x \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{\sigma_z \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{\sigma_y -\frac{3}{4},\frac{1}{4},\frac{1}{4}\}$	$\{C_{2x} 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{2y} 0,0,0\}$
$\{C_{34}^+ 0,0,0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{32}^+ 0,0,0\}$	$\{C_{33}^+ 0,0,0\}$	$\{C_{34}^- 0,0,0\}$	$\{C_{31}^- 0,0,0\}$	$\{C_{32}^- 0,0,0\}$	$\{C_{33}^- 0,0,0\}$
$\{S_{64}^- \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{S_{61}^- \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{S_{62}^- \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{S_{63}^- \frac{1}{4},-\frac{3}{4},\frac{1}{4}\}$	$\{S_{64}^+ \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{S_{61}^+ \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{S_{62}^+ \frac{1}{4},\frac{1}{4},-\frac{3}{4}\}$	$\{S_{63}^+ \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$
$\{C_{4x}^- \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{C_{4z}^- \frac{1}{4},\frac{1}{4},-\frac{3}{4}\}$	$\{C_{4y}^+ -\frac{3}{4},\frac{1}{4},\frac{1}{4}\}$	$\{C_{4x}^+ -\frac{3}{4},\frac{1}{4},\frac{1}{4}\}$	$\{C_{4z}^+ \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{C_{4y}^- \frac{1}{4},\frac{1}{4},-\frac{3}{4}\}$	$\{S_{4x}^+ 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$
$\{S_{4y}^- 0,0,0\}$	$\{S_{4x}^- 0,0,0\}$	$\{S_{4z}^- 0,0,0\}$	$\{S_{4y}^+ 0,0,0\}$	$\{C_{2c} \frac{1}{4},\frac{1}{4},\frac{1}{4}\}$	$\{C_{2e} \frac{1}{4},-\frac{3}{4},\frac{1}{4}\}$	$\{C_{2b} - \frac{3}{4},\frac{1}{4},\frac{1}{4}\}$	$\{C_{2f} \frac{1}{4},\frac{1}{4},-\frac{3}{4}\}$
$\{C_{2a} \frac{1}{4},-\frac{3}{4},\frac{1}{4}\}$	$\{C_{2d} \frac{1}{4},-\frac{3}{4},\frac{1}{4}\}$	$\{\sigma_{dc} 0,0,0\}$	$\{\sigma_{de} 0,0,0\}$	$\{\sigma_{db} 0,0,0\}$	$\{\sigma_{df} 0,0,0\}$	$\{\sigma_{da} 0,0,0\}$	$\{\sigma_{dd} 0,0,0\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$						
Operation	E					
Coordinate	$(0,0,0)$					
$X(\frac{1}{2},0,\frac{1}{2})$						
Operation	E	C_{34}^{+}	C_{34}^{-}			
Coordinate	$(\frac{1}{2},0,\frac{1}{2})$	$(-\frac{1}{2},-\frac{1}{2},0)$	$(0,-\frac{1}{2},-\frac{1}{2})$			
$L(\frac{1}{2},\frac{1}{2},\frac{1}{2})$						
Operation	E	σ_x	σ_y	σ_z		
Coordinate	$(\frac{1}{2},\frac{1}{2},\frac{1}{2})$	$(\frac{1}{2},0,0)$	$(0,\frac{1}{2},0)$	$(0,0,\frac{1}{2})$		
$W(\frac{1}{2},\frac{1}{4},\frac{3}{4})$						
Operation	E	I	C_{31}^{+}	C_{34}^{+}	C_{34}^{-}	C_{32}^{-}
Coordinate	$(\frac{1}{2},\frac{1}{4},\frac{3}{4})$	$(-\frac{1}{2},-\frac{1}{4},-\frac{3}{4})$	$(\frac{3}{4},\frac{1}{2},\frac{1}{4})$	$(-\frac{3}{4},-\frac{1}{2},-\frac{1}{4})$	$(\frac{1}{4},-\frac{1}{4},-\frac{1}{2})$	$(-\frac{1}{4},\frac{1}{4},\frac{1}{2})$

 $\Gamma(0,0,0)$ of space group No. 227

(Co-) irrep	Phonon AM	WYPO information									
1	(0,0,0)	8a: (0);	8b: (0);	16c: (0);	16d: (0);	32e: (1);	48f: (1);	96g: (2);	96h: (1);	192i: (3)	
2	(0,0,0)	8a: (0);	8b: (0);	16c: (0);	16d: (0);	32e: (0);	48f: (0);	96g: (1);	96h: (2);	192i: (3)	
3	(0,0,0)	8a: (0);	8b: (0);	16c: (1);	16d: (1);	32e: (1);	48f: (1);	96g: (2);	96h: (2);	192i: (3)	
4	(0,0,0)	8a: (0);	8b: (0);	16c: (0);	16d: (0);	32e: (0);	48f: (0);	96g: (1);	96h: (1);	192i: (3)	
5	(0,0,0)	8a: (0);	8b: (0);	16c: (0);	16d: (0);	32e: (1);	48f: (1);	96g: (3);	96h: (3);	192i: (6)	
6	(0,0,0)	8a: (0);	8b: (0);	16c: (1);	16d: (1);	32e: (1);	48f: (1);	96g: (3);	96h: (3);	192i: (6)	
7	(0,0,0)	8a: (0);	8b: (0);	16c: (0);	16d: (0);	32e: (1);	48f: (2);	96g: (4);	96h: (5);	192i: (9)	
8	(0,0,0)	8a: (1);	8b: (1);	16c: (0);	16d: (0);	32e: (2);	48f: (3);	96g: (5);	96h: (4);	192i: (9)	
9	(0,0,0)	8a: (1);	8b: (1);	16c: (2);	16d: (2);	32e: (2);	48f: (3);	96g: (5);	96h: (5);	192i: (9)	
10	(0,0,0)	8a: (0);	8b: (0);	16c: (1);	16d: (1);	32e: (1);	48f: (2);	96g: (4);	96h: (4);	192i: (9)	

 $X(\frac{1}{2},0,\frac{1}{2})$ of space group No. 227

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (4); 48f: (5); 96g: (10); 96h: (9); 192i: (18)
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (1); 16d: (1); 32e: (3); 48f: (5); 96g: (9); 96h: (8); 192i: (18)
3	(0, 0, 0)	8a: (0); 8b: (0); 16c: (1); 16d: (1); 32e: (2); 48f: (3); 96g: (8); 96h: (9); 192i: (18)
4	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (3); 48f: (5); 96g: (9); 96h: (10); 192i: (18)

L $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 227

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (1); 32e: (3); 48f: (4); 96g: (7); 96h: (6); 192i: (12)
2	(0, 0, 0)	8a: (0); 8b: (0); 16c: (1); 16d: (0); 32e: (1); 48f: (2); 96g: (5); 96h: (6); 192i: (12)
3	(0, 0, 0)	8a: (0); 8b: (0); 16c: (0); 16d: (1); 32e: (1); 48f: (2); 96g: (5); 96h: (6); 192i: (12)
4	(0, 0, 0)	8a: (1); 8b: (1); 16c: (1); 16d: (2); 32e: (3); 48f: (4); 96g: (7); 96h: (6); 192i: (12)
5	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (1); 32e: (4); 48f: (6); 96g: (12); 96h: (12); 192i: (24)
6	(0, 0, 0)	8a: (1); 8b: (1); 16c: (1); 16d: (3); 32e: (4); 48f: (6); 96g: (12); 96h: (12); 192i: (24)

W $(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$ of space group No. 227

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (2); 16c: (3); 16d: (3); 32e: (6); 48f: (9); 96g: (18); 96h: (18); 192i: (36)
2	(0, 0, 0)	8a: (2); 8b: (1); 16c: (3); 16d: (3); 32e: (6); 48f: (9); 96g: (18); 96h: (18); 192i: (36)

c. Results for high-symmetry lines

DT($\frac{v}{2}, 0, \frac{v}{2}$)					
Operation	E	C_{31}^{+}	C_{31}^{-}		
Coordinate	($\frac{v}{2}, 0, \frac{v}{2}$)	($\frac{v}{2}, \frac{v}{2}, 0$)	($0, \frac{v}{2}, \frac{v}{2}$)		
LD(u, u, u)					
Operation	E	C_{2x}	C_{2y}	C_{2z}	
Coordinate	(u, u, u)	($-u, 0, 0$)	($0, -u, 0$)	($0, 0, -u$)	
Q($\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v)$)					
Operation	E	C_{2y}	C_{31}^{+}	C_{33}^{+}	
Coordinate	($\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v)$)	($-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v)$)	($\frac{1}{4}(1+2v), \frac{1}{2}, \frac{1}{4}(3-2v)$)	($\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(-3+2v)$)	
	C_{31}^{-}	C_{32}^{-}			
	($\frac{1}{4}(3-2v), \frac{1}{4}(1+2v), \frac{1}{2}$)	($\frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v$)			
SM($\frac{u}{2}, \frac{u}{2}, u$)					
Operation	E	σ_y	C_{31}^{+}	C_{32}^{+}	C_{31}^{-} C_{32}^{-}
Coordinate	($\frac{u}{2}, \frac{u}{2}, u$)	($-\frac{u}{2}, \frac{u}{2}, 0$)	($u, \frac{u}{2}, \frac{u}{2}$)	($0, -\frac{u}{2}, \frac{u}{2}$)	($\frac{u}{2}, u, \frac{u}{2}$) ($-\frac{u}{2}, 0, \frac{u}{2}$)
V($\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}$)					
Operation	E	C_{31}^{+}	C_{34}^{-}		
Coordinate	($\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}$)	($\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2}$)	($\frac{u}{2}, \frac{1}{2}(-1+u), -\frac{1}{2}$)		

DT $\left(\frac{v}{2}, 0, \frac{v}{2}\right)$ of space group No. 227

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (4); 48f: (5); 96g: (10); 96h: (9); 192i: (18)
2	(0, 0, 0)	8a: (0); 8b: (0); 16c: (1); 16d: (1); 32e: (2); 48f: (3); 96g: (8); 96h: (9); 192i: (18)
3	(0, 0, 0)	8a: (0); 8b: (0); 16c: (1); 16d: (1); 32e: (2); 48f: (3); 96g: (8); 96h: (9); 192i: (18)
4	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (4); 48f: (5); 96g: (10); 96h: (9); 192i: (18)
5	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 32e: (6); 48f: (10); 96g: (18); 96h: (18); 192i: (36)

LD (u, u, u) of space group No. 227

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 32e: (6); 48f: (8); 96g: (14); 96h: (12); 192i: (24)
2	(0, 0, 0)	8a: (0); 8b: (0); 16c: (1); 16d: (1); 32e: (2); 48f: (4); 96g: (10); 96h: (12); 192i: (24)
3	(0, 0, 0)	8a: (2); 8b: (2); 16c: (4); 16d: (4); 32e: (8); 48f: (12); 96g: (24); 96h: (24); 192i: (48)

Q $\left(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v)\right)$ of space group No. 227

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 96g: (36); 96h: (36); 192i: (72)
2	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 96g: (36); 96h: (36); 192i: (72)

SM $\left(\frac{u}{2}, \frac{u}{2}, u\right)$ of space group No. 227

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (2); 8b: (2); 16c: (3); 16d: (3); 32e: (7); 48f: (10); 96g: (19); 96h: (17); 192i: (36)
2	(0, 0, 0)	8a: (1); 8b: (1); 16c: (2); 16d: (2); 32e: (5); 48f: (8); 96g: (17); 96h: (17); 192i: (36)
3	(0, 0, 0)	8a: (1); 8b: (1); 16c: (3); 16d: (3); 32e: (5); 48f: (8); 96g: (17); 96h: (19); 192i: (36)
4	(0, 0, 0)	8a: (2); 8b: (2); 16c: (4); 16d: (4); 32e: (7); 48f: (10); 96g: (19); 96h: (19); 192i: (36)

V $\left(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2}\right)$ of space group No. 227

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 96g: (36); 96h: (36); 192i: (72)

*d. Results for high-symmetry planes*P1($u, v, u+v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, u+v)$	$(u+v, u, v)$	$(v, u+v, u)$

P2(u, u, v)

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-u, -u+v, 0)$	(v, u, u)	$(0, -u, -u+v)$	(u, v, u)	$(-u, 0, -u+v)$

P1 $(u, v, u+v)$ of space group No. 227

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 96g: (36); 96h: (36); 192i: (72)
2	(0, 0, 0)	8a: (3); 8b: (3); 16c: (6); 16d: (6); 32e: (12); 48f: (18); 96g: (36); 96h: (36); 192i: (72)

P2 (u, u, v) of space group No. 227

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	8a: (4); 8b: (4); 16c: (7); 16d: (7); 32e: (14); 48f: (20); 96g: (38); 96h: (36); 192i: (72)
2	(0, 0, 0)	8a: (2); 8b: (2); 16c: (5); 16d: (5); 32e: (10); 48f: (16); 96g: (34); 96h: (36); 192i: (72)

228. Space group No. 228 ($Fd3c$)

Cubic face-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{I \frac{3}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{\sigma_x \frac{3}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{\sigma_z \frac{3}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{\sigma_y -\frac{1}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{C_{2x} 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{2y} 0,0,0\}$
$\{C_{34}^+ 0,0,0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{32}^+ 0,0,0\}$	$\{C_{33}^+ 0,0,0\}$	$\{C_{34}^- 0,0,0\}$	$\{C_{31}^- 0,0,0\}$	$\{C_{32}^- 0,0,0\}$	$\{C_{33}^- 0,0,0\}$
$\{S_{64}^+ \frac{3}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{S_{61}^+ \frac{3}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{S_{62}^+ \frac{3}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{S_{63}^+ \frac{3}{4}, -\frac{1}{4}, \frac{3}{4}\}$	$\{S_{64}^+ \frac{3}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{S_{61}^+ \frac{3}{4}, \frac{3}{4}, \frac{3}{4}\}$	$\{S_{62}^+ \frac{3}{4}, \frac{3}{4}, -\frac{1}{4}\}$	$\{S_{63}^+ \frac{3}{4}, \frac{3}{4}, \frac{3}{4}\}$
$\{C_{4x}^+ \frac{1}{4}, \frac{1}{4}, \frac{1}{4}\}$	$\{C_{4z}^+ \frac{1}{4}, \frac{1}{4}, -\frac{3}{4}\}$	$\{C_{4y}^+ -\frac{3}{4}, \frac{1}{4}, \frac{1}{4}\}$	$\{C_{4x}^+ -\frac{3}{4}, \frac{1}{4}, \frac{1}{4}\}$	$\{C_{4z}^+ \frac{1}{4}, \frac{1}{4}, \frac{1}{4}\}$	$\{C_{4y}^+ \frac{1}{4}, \frac{1}{4}, -\frac{3}{4}\}$	$\{S_{4x}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4z}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$
$\{S_{4y}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4x}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4z}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{S_{4y}^+ \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{C_{2c} \frac{1}{4}, \frac{1}{4}, \frac{1}{4}\}$	$\{C_{2e} \frac{1}{4}, -\frac{3}{4}, \frac{1}{4}\}$	$\{C_{2b} \frac{1}{4}, \frac{1}{4}, \frac{1}{4}\}$	$\{C_{2f} \frac{1}{4}, \frac{1}{4}, -\frac{3}{4}\}$
$\{C_{2a} \frac{1}{4}, -\frac{3}{4}, \frac{1}{4}\}$	$\{C_{2d} \frac{1}{4}, -\frac{3}{4}, \frac{1}{4}\}$	$\{\sigma_{dc} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{dc} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{db} \frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\}$	$\{\sigma_{df} \frac{1}{2}, -\frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{da} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$	$\{\sigma_{dd} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$						
Operation	E					
Coordinate	$(0, 0, 0)$					
$X(\frac{1}{2}, 0, \frac{1}{2})$						
Operation	E	C_{34}^{+}	C_{34}^{-}			
Coordinate	$(\frac{1}{2}, 0, \frac{1}{2})$	$(-\frac{1}{2}, -\frac{1}{2}, 0)$	$(0, -\frac{1}{2}, -\frac{1}{2})$			
$L(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$						
Operation	E	σ_x	σ_y	σ_z		
Coordinate	$(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$	$(\frac{1}{2}, 0, 0)$	$(0, \frac{1}{2}, 0)$	$(0, 0, \frac{1}{2})$		
$W(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$						
Operation	E	I	C_{31}^{+}	C_{34}^{+}	C_{34}^{-}	C_{32}^{-}
Coordinate	$(\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$	$(-\frac{1}{2}, -\frac{1}{4}, -\frac{3}{4})$	$(\frac{3}{4}, \frac{1}{2}, \frac{1}{4})$	$(-\frac{3}{4}, -\frac{1}{2}, -\frac{1}{4})$	$(\frac{1}{4}, -\frac{1}{4}, -\frac{1}{2})$	$(-\frac{1}{4}, \frac{1}{4}, \frac{1}{2})$

 $\Gamma (0, 0, 0)$ of space group No. 228

(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	16a: (0);	32b: (0);	32c: (0);	48d: (0);	64e: (1);	96f: (1);	96g: (1);	192h: (3)
2	(0, 0, 0)	16a: (0);	32b: (1);	32c: (0);	48d: (1);	64e: (1);	96f: (1);	96g: (2);	192h: (3)
3	(0, 0, 0)	16a: (0);	32b: (1);	32c: (1);	48d: (0);	64e: (1);	96f: (1);	96g: (2);	192h: (3)
4	(0, 0, 0)	16a: (0);	32b: (0);	32c: (1);	48d: (1);	64e: (1);	96f: (1);	96g: (1);	192h: (3)
5	(0, 0, 0)	16a: (0);	32b: (1);	32c: (0);	48d: (1);	64e: (2);	96f: (2);	96g: (3);	192h: (6)
6	(0, 0, 0)	16a: (0);	32b: (1);	32c: (2);	48d: (1);	64e: (2);	96f: (2);	96g: (3);	192h: (6)
7	(0, 0, 0)	16a: (1);	32b: (2);	32c: (0);	48d: (2);	64e: (3);	96f: (5);	96g: (5);	192h: (9)
8	(0, 0, 0)	16a: (1);	32b: (1);	32c: (0);	48d: (3);	64e: (3);	96f: (5);	96g: (4);	192h: (9)
9	(0, 0, 0)	16a: (1);	32b: (2);	32c: (3);	48d: (3);	64e: (3);	96f: (5);	96g: (5);	192h: (9)
10	(0, 0, 0)	16a: (1);	32b: (1);	32c: (3);	48d: (2);	64e: (3);	96f: (5);	96g: (4);	192h: (9)

 $X (\frac{1}{2}, 0, \frac{1}{2})$ of space group No. 228

(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	16a: (2);	32b: (4);	32c: (3);	48d: (5);	64e: (6);	96f: (10);	96g: (10);	192h: (18)
2	(0, 0, 0)	16a: (1);	32b: (3);	32c: (3);	48d: (4);	64e: (6);	96f: (8);	96g: (9);	192h: (18)
3	(0, 0, 0)	16a: (2);	32b: (2);	32c: (3);	48d: (5);	64e: (6);	96f: (10);	96g: (8);	192h: (18)
4	(0, 0, 0)	16a: (1);	32b: (3);	32c: (3);	48d: (4);	64e: (6);	96f: (8);	96g: (9);	192h: (18)

 $L (\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ of space group No. 228

(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	16a: (2);	32b: (4);	32c: (4);	48d: (6);	64e: (8);	96f: (12);	96g: (12);	192h: (24)
2	(0, 0, 0)	16a: (2);	32b: (4);	32c: (4);	48d: (6);	64e: (8);	96f: (12);	96g: (12);	192h: (24)

 $W (\frac{1}{2}, \frac{1}{4}, \frac{3}{4})$ of space group No. 228

(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	16a: (3);	32b: (6);	32c: (6);	48d: (9);	64e: (12);	96f: (18);	96g: (18);	192h: (36)

c. Results for high-symmetry lines

 $DT(\frac{v}{2}, 0, \frac{v}{2})$

Operation
Coordinate

 E
 $(\frac{v}{2}, 0, \frac{v}{2})$
 C_{31}^{+}
 $(\frac{v}{2}, \frac{v}{2}, 0)$
 C_{31}^{-}
 $(0, \frac{v}{2}, \frac{v}{2})$

 $LD(u, u, u)$

Operation
Coordinate

 E
 (u, u, u)
 C_{2x}
 $(-u, 0, 0)$
 C_{2y}
 $(0, -u, 0)$
 C_{2z}
 $(0, 0, -u)$

 $Q(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$

Operation
Coordinate

 E
 $(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$
 C_{2y}
 $(-\frac{1}{2}+v, \frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v))$
 C_{31}^{+}
 $(\frac{1}{4}(1+2v), \frac{1}{2}, \frac{1}{4}(3-2v))$
 C_{33}^{+}
 $(\frac{1}{4}(-1+2v), -\frac{1}{2}+v, \frac{1}{4}(-3+2v))$

	C_{31}^- $(\frac{1}{4}(3-2v), \frac{1}{4}(1+2v), \frac{1}{2})$	C_{32}^- $(\frac{1}{4}(-3+2v), \frac{1}{4}(-1+2v), -\frac{1}{2}+v)$			
$SM(\frac{u}{2}, \frac{u}{2}, u)$					
Operation	E	σ_y	C_{31}^+	C_{32}^+	C_{31}^- C_{32}^-
Coordinate	$(\frac{u}{2}, \frac{u}{2}, u)$	$(-\frac{u}{2}, \frac{u}{2}, 0)$	$(u, \frac{u}{2}, \frac{u}{2})$	$(0, -\frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, u, \frac{u}{2})$ $(-\frac{u}{2}, 0, \frac{u}{2})$
$V(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$					
Operation	E	C_{31}^+	C_{34}^-		
Coordinate	$(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$	$(\frac{1+u}{2}, \frac{1}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{1}{2}(-1+u), -\frac{1}{2})$		

DT $(\frac{v}{2}, 0, \frac{v}{2})$ of space group No. 228		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (1); 32b: (3); 32c: (3); 48d: (4); 64e: (6); 96f: (8); 96g: (9); 192h: (18)
2	(0, 0, 0)	16a: (1); 32b: (3); 32c: (3); 48d: (4); 64e: (6); 96f: (8); 96g: (9); 192h: (18)
3	(0, 0, 0)	16a: (1); 32b: (3); 32c: (3); 48d: (4); 64e: (6); 96f: (8); 96g: (9); 192h: (18)
4	(0, 0, 0)	16a: (1); 32b: (3); 32c: (3); 48d: (4); 64e: (6); 96f: (8); 96g: (9); 192h: (18)
5	(0, 0, 0)	16a: (4); 32b: (6); 32c: (6); 48d: (10); 64e: (12); 96f: (20); 96g: (18); 192h: (36)
LD (u, u, u) of space group No. 228		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (2); 32b: (4); 32c: (4); 48d: (6); 64e: (8); 96f: (12); 96g: (12); 192h: (24)
2	(0, 0, 0)	16a: (2); 32b: (4); 32c: (4); 48d: (6); 64e: (8); 96f: (12); 96g: (12); 192h: (24)
3	(0, 0, 0)	16a: (4); 32b: (8); 32c: (8); 48d: (12); 64e: (16); 96f: (24); 96g: (24); 192h: (48)
Q $(\frac{1}{2}, \frac{1}{4}(3-2v), \frac{1}{4}(1+2v))$ of space group No. 228		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (6); 32b: (12); 32c: (12); 48d: (18); 64e: (24); 96f: (36); 96g: (36); 192h: (72)
SM $(\frac{u}{2}, \frac{u}{2}, u)$ of space group No. 228		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (3); 32b: (5); 32c: (6); 48d: (9); 64e: (12); 96f: (18); 96g: (17); 192h: (36)
2	(0, 0, 0)	16a: (3); 32b: (5); 32c: (6); 48d: (9); 64e: (12); 96f: (18); 96g: (17); 192h: (36)
3	(0, 0, 0)	16a: (3); 32b: (7); 32c: (6); 48d: (9); 64e: (12); 96f: (18); 96g: (19); 192h: (36)
4	(0, 0, 0)	16a: (3); 32b: (7); 32c: (6); 48d: (9); 64e: (12); 96f: (18); 96g: (19); 192h: (36)
V $(\frac{1}{2}, \frac{u}{2}, \frac{1+u}{2})$ of space group No. 228		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (6); 32b: (12); 32c: (12); 48d: (18); 64e: (24); 96f: (36); 96g: (36); 192h: (72)

d. Results for high-symmetry planes

P1($u, v, u+v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	$(u, v, u+v)$	$(u+v, u, v)$	$(v, u+v, u)$

P2(u, u, v)

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	$(-u, -u+v, 0)$	(v, u, u)	$(0, -u, -u+v)$	(u, v, u)	$(-u, 0, -u+v)$

P1 ($u, v, u+v$) of space group No. 228									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	16a: (6);	32b: (12);	32c: (12);	48d: (18);	64e: (24);	96f: (36);	96g: (36);	192h: (72)
2	(0, 0, 0)	16a: (6);	32b: (12);	32c: (12);	48d: (18);	64e: (24);	96f: (36);	96g: (36);	192h: (72)

P2 (u, u, v) of space group No. 228									
(Co-) irrep	Phonon AM	WYPO information							
1	(0, 0, 0)	16a: (6);	32b: (12);	32c: (12);	48d: (18);	64e: (24);	96f: (36);	96g: (36);	192h: (72)
2	(0, 0, 0)	16a: (6);	32b: (12);	32c: (12);	48d: (18);	64e: (24);	96f: (36);	96g: (36);	192h: (72)

229. Space group No. 229 ($Im\bar{3}m$)

Cubic body-centered lattice

$$\begin{aligned} \vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c} \end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{I 0,0,0\}$	$\{\sigma_x 0,0,0\}$	$\{\sigma_z 0,0,0\}$	$\{\sigma_y 0,0,0\}$	$\{C_{2x} 0,0,0\}$	$\{C_{2z} 0,0,0\}$	$\{C_{2y} 0,0,0\}$
$\{C_{34}^+ 0,0,0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{32}^+ 0,0,0\}$	$\{C_{33}^+ 0,0,0\}$	$\{C_{34}^- 0,0,0\}$	$\{C_{31}^- 0,0,0\}$	$\{C_{32}^- 0,0,0\}$	$\{C_{33}^- 0,0,0\}$
$\{S_{64}^- 0,0,0\}$	$\{S_{61}^- 0,0,0\}$	$\{S_{62}^- 0,0,0\}$	$\{S_{63}^- 0,0,0\}$	$\{S_{64}^+ 0,0,0\}$	$\{S_{61}^+ 0,0,0\}$	$\{S_{62}^+ 0,0,0\}$	$\{S_{63}^+ 0,0,0\}$
$\{C_{4x}^- 0,0,0\}$	$\{C_{4z}^- 0,0,0\}$	$\{C_{4y}^+ 0,0,0\}$	$\{C_{4x}^+ 0,0,0\}$	$\{C_{4z}^+ 0,0,0\}$	$\{C_{4y}^- 0,0,0\}$	$\{S_{4x}^+ 0,0,0\}$	$\{S_{4z}^+ 0,0,0\}$
$\{S_{4y}^- 0,0,0\}$	$\{S_{4x}^- 0,0,0\}$	$\{S_{4z}^- 0,0,0\}$	$\{S_{4y}^+ 0,0,0\}$	$\{C_{2c} 0,0,0\}$	$\{C_{2e} 0,0,0\}$	$\{C_{2b} 0,0,0\}$	$\{C_{2f} 0,0,0\}$
$\{C_{2a} 0,0,0\}$	$\{C_{2d} 0,0,0\}$	$\{\sigma_{dc} 0,0,0\}$	$\{\sigma_{de} 0,0,0\}$	$\{\sigma_{db} 0,0,0\}$	$\{\sigma_{df} 0,0,0\}$	$\{\sigma_{da} 0,0,0\}$	$\{\sigma_{dd} 0,0,0\}$

b. Results for high-symmetry points

$\Gamma(0, 0, 0)$	
Operation	E
Coordinate	(0, 0, 0)

$H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$
$P(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$	
Operation	E I
Coordinate	$(\frac{1}{4}, \frac{1}{4}, \frac{1}{4})$ $(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4})$
$N(0, 0, \frac{1}{2})$	
Operation	E σ_x C_{34}^+ C_{32}^+ C_{31}^- C_{34}^-
Coordinate	$(0, 0, \frac{1}{2})$ $(\frac{1}{2}, -\frac{1}{2}, 0)$ $(-\frac{1}{2}, 0, 0)$ $(0, -\frac{1}{2}, \frac{1}{2})$ $(0, \frac{1}{2}, 0)$ $(\frac{1}{2}, 0, -\frac{1}{2})$

$\Gamma(0, 0, 0)$ of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (0); 12e: (1); 16f: (1); 24g: (1); 24h: (1); 48i: (1); 48j: (2); 48k: (2); 96l: (3)
2	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (1); 12e: (0); 16f: (0); 24g: (1); 24h: (1); 48i: (2); 48j: (2); 48k: (1); 96l: (3)
3	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (0); 12e: (0); 16f: (1); 24g: (0); 24h: (1); 48i: (2); 48j: (1); 48k: (2); 96l: (3)
4	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (0); 12e: (0); 16f: (0); 24g: (0); 24h: (0); 48i: (1); 48j: (1); 48k: (1); 96l: (3)
5	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (1); 12e: (1); 16f: (1); 24g: (2); 24h: (2); 48i: (3); 48j: (4); 48k: (3); 96l: (6)
6	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (0); 12e: (0); 16f: (1); 24g: (0); 24h: (1); 48i: (3); 48j: (2); 48k: (3); 96l: (6)
7	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (1); 12e: (1); 16f: (1); 24g: (2); 24h: (2); 48i: (5); 48j: (4); 48k: (4); 96l: (9)
8	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (1); 12e: (1); 16f: (2); 24g: (2); 24h: (2); 48i: (4); 48j: (4); 48k: (5); 96l: (9)
9	(0, 0, 0)	2a: (1); 6b: (2); 8c: (2); 12d: (2); 12e: (2); 16f: (2); 24g: (3); 24h: (3); 48i: (5); 48j: (5); 48k: (5); 96l: (9)
10	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (1); 12e: (1); 16f: (1); 24g: (3); 24h: (2); 48i: (4); 48j: (5); 48k: (4); 96l: (9)

$H(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (1); 12e: (1); 16f: (1); 24g: (1); 24h: (1); 48i: (2); 48j: (2); 48k: (2); 96l: (3)
2	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (0); 12e: (0); 16f: (0); 24g: (1); 24h: (1); 48i: (1); 48j: (2); 48k: (1); 96l: (3)
3	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (0); 12e: (0); 16f: (1); 24g: (0); 24h: (1); 48i: (1); 48j: (1); 48k: (2); 96l: (3)
4	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (0); 12e: (0); 16f: (0); 24g: (0); 24h: (0); 48i: (2); 48j: (1); 48k: (1); 96l: (3)
5	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (1); 12e: (1); 16f: (1); 24g: (2); 24h: (2); 48i: (3); 48j: (4); 48k: (3); 96l: (6)

6	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (0); 12e: (0); 16f: (1); 24g: (0); 24h: (1); 48i: (3); 48j: (2); 48k: (3); 96l: (6)
7	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (1); 12e: (1); 16f: (1); 24g: (2); 24h: (2); 48i: (4); 48j: (4); 48k: (4); 96l: (9)
8	(0, 0, 0)	2a: (0); 6b: (0); 8c: (2); 12d: (1); 12e: (1); 16f: (2); 24g: (2); 24h: (2); 48i: (5); 48j: (4); 48k: (5); 96l: (9)
9	(0, 0, 0)	2a: (1); 6b: (2); 8c: (0); 12d: (1); 12e: (2); 16f: (2); 24g: (3); 24h: (3); 48i: (4); 48j: (5); 48k: (5); 96l: (9)
10	(0, 0, 0)	2a: (0); 6b: (1); 8c: (0); 12d: (2); 12e: (1); 16f: (1); 24g: (3); 24h: (2); 48i: (5); 48j: (5); 48k: (4); 96l: (9)

$P\left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$ of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (1); 12e: (1); 16f: (2); 24g: (2); 24h: (2); 48i: (3); 48j: (3); 48k: (4); 96l: (6)
2	(0, 0, 0)	2a: (0); 6b: (0); 8c: (0); 12d: (1); 12e: (0); 16f: (0); 24g: (2); 24h: (1); 48i: (3); 48j: (3); 48k: (2); 96l: (6)
3	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (2); 12e: (1); 16f: (2); 24g: (4); 24h: (3); 48i: (6); 48j: (6); 48k: (6); 96l: (12)
4	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (2); 12e: (2); 16f: (2); 24g: (4); 24h: (4); 48i: (9); 48j: (9); 48k: (8); 96l: (18)
5	(0, 0, 0)	2a: (1); 6b: (1); 8c: (2); 12d: (2); 12e: (3); 16f: (4); 24g: (4); 24h: (5); 48i: (9); 48j: (9); 48k: (10); 96l: (18)

$N\left(0, 0, \frac{1}{2}\right)$ of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (0); 6b: (2); 8c: (2); 12d: (3); 12e: (3); 16f: (4); 24g: (6); 24h: (5); 48i: (9); 48j: (10); 48k: (10); 96l: (18)
2	(0, 0, 0)	2a: (0); 6b: (1); 8c: (2); 12d: (2); 12e: (2); 16f: (3); 24g: (3); 24h: (4); 48i: (10); 48j: (8); 48k: (9); 96l: (18)
3	(0, 0, 0)	2a: (0); 6b: (2); 8c: (1); 12d: (3); 12e: (2); 16f: (2); 24g: (6); 24h: (5); 48i: (9); 48j: (10); 48k: (8); 96l: (18)
4	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (1); 12e: (2); 16f: (3); 24g: (3); 24h: (4); 48i: (8); 48j: (8); 48k: (9); 96l: (18)
5	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (2); 12e: (1); 16f: (2); 24g: (4); 24h: (3); 48i: (9); 48j: (8); 48k: (8); 96l: (18)
6	(0, 0, 0)	2a: (1); 6b: (1); 8c: (2); 12d: (3); 12e: (3); 16f: (3); 24g: (5); 24h: (5); 48i: (10); 48j: (10); 48k: (9); 96l: (18)
7	(0, 0, 0)	2a: (1); 6b: (1); 8c: (2); 12d: (2); 12e: (2); 16f: (4); 24g: (4); 24h: (5); 48i: (9); 48j: (8); 48k: (10); 96l: (18)
8	(0, 0, 0)	2a: (1); 6b: (1); 8c: (1); 12d: (2); 12e: (3); 16f: (3); 24g: (5); 24h: (5); 48i: (8); 48j: (10); 48k: (9); 96l: (18)

c. Results for high-symmetry lines

$D\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$				
Operation	E	C_{34}^+	C_{31}^-	
Coordinate	$\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$	$\left(\frac{1}{2}(-1-w), \frac{w}{2}, \frac{w}{2}\right)$	$\left(\frac{w}{2}, \frac{1-w}{2}, \frac{w}{2}\right)$	

DT($\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}$)						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, -\frac{v}{2})$	$(-\frac{v}{2}, \frac{v}{2}, \frac{v}{2})$			
G($\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}$)						
Operation	E	σ_y	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$	$(-\frac{1}{2}, \frac{3}{2}, -\frac{1}{2} + u)$	$(\frac{1}{2}, \frac{1}{2} - u, \frac{1}{2} + u)$	$(\frac{1}{2} + u, -\frac{3}{2}, \frac{1}{2})$	$(\frac{1}{2} + u, \frac{1}{2}, \frac{1}{2} - u)$	$(-\frac{3}{2}, \frac{1}{2} - u, \frac{1}{2})$
LD($\frac{u}{2}, \frac{u}{2}, \frac{u}{2}$)						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$		
SM($0, 0, u$)						
Operation	E	σ_y	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(0, 0, u)$	$(-u, u, 0)$	$(u, 0, 0)$	$(0, -u, u)$	$(0, u, 0)$	$(-u, 0, u)$

$D(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$ of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (5); 12e: (5); 16f: (8); 24g: (10); 24h: (10); 48i: (18); 48j: (18); 48k: (20); 96l: (36)
2	(0, 0, 0)	2a: (0); 6b: (2); 8c: (2); 12d: (5); 12e: (3); 16f: (4); 24g: (10); 24h: (8); 48i: (18); 48j: (18); 48k: (16); 96l: (36)
3	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 16f: (6); 24g: (8); 24h: (9); 48i: (18); 48j: (18); 48k: (18); 96l: (36)
4	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (4); 12e: (5); 16f: (6); 24g: (8); 24h: (9); 48i: (18); 48j: (18); 48k: (18); 96l: (36)

$DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$ of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (2); 8c: (2); 12d: (3); 12e: (4); 16f: (4); 24g: (6); 24h: (6); 48i: (9); 48j: (11); 48k: (10); 96l: (18)
2	(0, 0, 0)	2a: (0); 6b: (0); 8c: (1); 12d: (1); 12e: (1); 16f: (2); 24g: (2); 24h: (3); 48i: (9); 48j: (7); 48k: (8); 96l: (18)
3	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (3); 12e: (2); 16f: (2); 24g: (6); 24h: (5); 48i: (9); 48j: (11); 48k: (8); 96l: (18)
4	(0, 0, 0)	2a: (0); 6b: (0); 8c: (2); 12d: (1); 12e: (1); 16f: (4); 24g: (2); 24h: (4); 48i: (9); 48j: (7); 48k: (10); 96l: (18)
5	(0, 0, 0)	2a: (1); 6b: (3); 8c: (3); 12d: (5); 12e: (5); 16f: (6); 24g: (10); 24h: (9); 48i: (18); 48j: (18); 48k: (18); 96l: (36)

$G(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2})$ of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 16f: (7); 24g: (11); 24h: (10); 48i: (19); 48j: (20); 48k: (19); 96l: (36)
2	(0, 0, 0)	2a: (0); 6b: (1); 8c: (3); 12d: (4); 12e: (3); 16f: (5); 24g: (7); 24h: (7); 48i: (19); 48j: (16); 48k: (17); 96l: (36)
3	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (3); 12e: (4); 16f: (7); 24g: (7); 24h: (9); 48i: (17); 48j: (16); 48k: (19); 96l: (36)

4	(0, 0, 0)	2a: (1); 6b: (3); 8c: (2); 12d: (5); 12e: (5); 16f: (5); 24g: (11); 24h: (10); 48i: (17); 48j: (20); 48k: (17); 96l: (36)

LD $\left(\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (2); 8c: (3); 12d: (3); 12e: (4); 16f: (6); 24g: (6); 24h: (7); 48i: (12); 48j: (12); 48k: (14); 96l: (24)
2	(0, 0, 0)	2a: (0); 6b: (1); 8c: (1); 12d: (3); 12e: (2); 16f: (2); 24g: (6); 24h: (5); 48i: (12); 48j: (12); 48k: (10); 96l: (24)
3	(0, 0, 0)	2a: (1); 6b: (3); 8c: (4); 12d: (6); 12e: (6); 16f: (8); 24g: (12); 24h: (12); 48i: (24); 48j: (24); 48k: (24); 96l: (48)

SM (0, 0, u) of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (1); 6b: (3); 8c: (3); 12d: (5); 12e: (6); 16f: (7); 24g: (11); 24h: (10); 48i: (17); 48j: (20); 48k: (19); 96l: (36)
2	(0, 0, 0)	2a: (0); 6b: (1); 8c: (2); 12d: (3); 12e: (3); 16f: (5); 24g: (7); 24h: (7); 48i: (17); 48j: (16); 48k: (17); 96l: (36)
3	(0, 0, 0)	2a: (1); 6b: (3); 8c: (3); 12d: (6); 12e: (5); 16f: (5); 24g: (11); 24h: (10); 48i: (19); 48j: (20); 48k: (17); 96l: (36)
4	(0, 0, 0)	2a: (1); 6b: (2); 8c: (4); 12d: (4); 12e: (4); 16f: (7); 24g: (7); 24h: (9); 48i: (19); 48j: (16); 48k: (19); 96l: (36)

d. Results for high-symmetry planes

P1(u, u, v)

Operation	E	C_{2x}	C_{31}^+	C_{32}^+	C_{31}^-	C_{32}^-
Coordinate	(u, u, v)	($-2u - v, v, u$)	(v, u, u)	($u, -2u - v, v$)	(u, v, u)	($-2u - v, u, v$)

P2($u, -u, v$)

Operation	E	C_{31}^+	C_{31}^-
Coordinate	($u, -u, v$)	($v, u, -u$)	($-u, v, u$)

P1 (u, u, v) of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 6b: (5); 8c: (7); 12d: (9); 12e: (10); 16f: (14); 24g: (18); 24h: (19); 48i: (36); 48j: (36); 48k: (38); 96l: (72)
2	(0, 0, 0)	2a: (1); 6b: (4); 8c: (5); 12d: (9); 12e: (8); 16f: (10); 24g: (18); 24h: (17); 48i: (36); 48j: (36); 48k: (34); 96l: (72)

P2 ($u, -u, v$) of space group No. 229

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	2a: (2); 6b: (6); 8c: (6); 12d: (11); 12e: (11); 16f: (12); 24g: (22); 24h: (20); 48i: (36); 48j: (40); 48k: (36); 96l: (72)
2	(0, 0, 0)	2a: (1); 6b: (3); 8c: (6); 12d: (7); 12e: (7); 16f: (12); 24g: (14); 24h: (16); 48i: (36); 48j: (32); 48k: (36); 96l: (72)

230. Space group No. 230 ($Ia\bar{3}d$)

Cubic body-centered lattice

$$\begin{aligned}\vec{a} &= (a, 0, 0) & \vec{t}_1 &= -\frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{b} &= (0, a, 0) & \vec{t}_2 &= \frac{1}{2}\vec{a} - \frac{1}{2}\vec{b} + \frac{1}{2}\vec{c} \\ \vec{c} &= (0, 0, a) & \vec{t}_3 &= \frac{1}{2}\vec{a} + \frac{1}{2}\vec{b} - \frac{1}{2}\vec{c}\end{aligned}$$

a. Space group operations

$\{E 0,0,0\}$	$\{I 0,0,0\}$	$\{\sigma_x \frac{1}{2},\frac{1}{2},0\}$	$\{\sigma_z \frac{1}{2},0,\frac{1}{2}\}$	$\{\sigma_y 0,-\frac{1}{2},-\frac{1}{2}\}$	$\{C_{2x} -\frac{1}{2},-\frac{1}{2},0\}$	$\{C_{2z} -\frac{1}{2},0,-\frac{1}{2}\}$	$\{C_{2y} 0,\frac{1}{2},\frac{1}{2}\}$
$\{C_{34}^+ -\frac{1}{2},-\frac{1}{2},0\}$	$\{C_{31}^+ 0,0,0\}$	$\{C_{32}^+ 0,-\frac{1}{2},-\frac{1}{2}\}$	$\{C_{33}^+ \frac{1}{2},0,\frac{1}{2}\}$	$\{C_{34}^- -\frac{1}{2},0,-\frac{1}{2}\}$	$\{C_{31}^- 0,0,0\}$	$\{C_{32}^- -\frac{1}{2},\frac{1}{2},0\}$	$\{C_{33}^- 0,-\frac{1}{2},-\frac{1}{2}\}$
$\{S_{64}^- \frac{1}{2},\frac{1}{2},0\}$	$\{S_{61}^- 0,0,0\}$	$\{S_{62}^- 0,\frac{1}{2},\frac{1}{2}\}$	$\{S_{63}^- -\frac{1}{2},0,-\frac{1}{2}\}$	$\{S_{64}^+ \frac{1}{2},0,\frac{1}{2}\}$	$\{S_{61}^+ 0,0,0\}$	$\{S_{62}^+ -\frac{1}{2},-\frac{1}{2},0\}$	$\{S_{63}^+ 0,\frac{1}{2},\frac{1}{2}\}$
$\{C_{4x}^- \frac{1}{2},0,0\}$	$\{C_{4z}^- 0,0,-\frac{1}{2}\}$	$\{C_{4y}^+ -\frac{1}{2},0,0\}$	$\{C_{4x}^+ 0,0,-\frac{1}{2}\}$	$\{C_{4z}^+ 0,\frac{1}{2},0\}$	$\{C_{4y}^- 0,-\frac{1}{2},0\}$	$\{S_{4x}^+ -\frac{1}{2},0,0\}$	$\{S_{4z}^+ 0,0,\frac{1}{2}\}$
$\{S_{4y}^- \frac{1}{2},0,0\}$	$\{S_{4x}^- 0,0,\frac{1}{2}\}$	$\{S_{4z}^- 0,-\frac{1}{2},0\}$	$\{S_{4y}^+ 0,\frac{1}{2},0\}$	$\{C_{2c} 0,0,\frac{1}{2}\}$	$\{C_{2e} \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{C_{2b} \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$	$\{C_{2f} \frac{1}{2},\frac{1}{2},\frac{1}{2}\}$
$\{C_{2a} -\frac{1}{2},0,0\}$	$\{C_{2d} 0,-\frac{1}{2},0\}$	$\{\sigma_{dc} 0,0,-\frac{1}{2}\}$	$\{\sigma_{dc} -\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_{db} -\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_{df} -\frac{1}{2},-\frac{1}{2},-\frac{1}{2}\}$	$\{\sigma_{da} \frac{1}{2},0,0\}$	$\{\sigma_{dd} 0,\frac{1}{2},0\}$

b. Results for high-symmetry points

$\Gamma(0,0,0)$	
Operation	E
Coordinate	(0,0,0)
$H(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$	
Operation	E
Coordinate	$(\frac{1}{2},-\frac{1}{2},\frac{1}{2})$
$P(\frac{1}{4},\frac{1}{4},\frac{1}{4})$	
Operation	E I
Coordinate	$(\frac{1}{4},\frac{1}{4},\frac{1}{4})$ $(-\frac{1}{4},-\frac{1}{4},-\frac{1}{4})$
$N(0,0,\frac{1}{2})$	
Operation	E σ_x C_{34}^+ C_{32}^+ C_{31}^- C_{34}^-
Coordinate	$(0,0,\frac{1}{2})$ $(\frac{1}{2},-\frac{1}{2},0)$ $(-\frac{1}{2},0,0)$ $(0,-\frac{1}{2},\frac{1}{2})$ $(0,\frac{1}{2},0)$ $(\frac{1}{2},0,-\frac{1}{2})$

 $\Gamma(0,0,0)$ of space group No. 230

(Co-) irrep	Phonon AM	WYPO information
1	(0,0,0)	16a: (0); 16b: (0); 24c: (0); 24d: (0); 32e: (1); 48f: (1); 48g: (1); 96h: (3)
2	(0,0,0)	16a: (0); 16b: (1); 24c: (1); 24d: (1); 32e: (1); 48f: (1); 48g: (2); 96h: (3)
3	(0,0,0)	16a: (1); 16b: (1); 24c: (1); 24d: (0); 32e: (1); 48f: (1); 48g: (2); 96h: (3)

4	(0, 0, 0)	16a: (1); 16b: (0); 24c: (0); 24d: (1); 32e: (1); 48f: (1); 48g: (1); 96h: (3)
5	(0, 0, 0)	16a: (0); 16b: (1); 24c: (1); 24d: (1); 32e: (2); 48f: (2); 48g: (3); 96h: (6)
6	(0, 0, 0)	16a: (2); 16b: (1); 24c: (1); 24d: (1); 32e: (2); 48f: (2); 48g: (3); 96h: (6)
7	(0, 0, 0)	16a: (0); 16b: (2); 24c: (3); 24d: (2); 32e: (3); 48f: (5); 48g: (5); 96h: (9)
8	(0, 0, 0)	16a: (0); 16b: (1); 24c: (2); 24d: (3); 32e: (3); 48f: (5); 48g: (4); 96h: (9)
9	(0, 0, 0)	16a: (3); 16b: (2); 24c: (3); 24d: (3); 32e: (3); 48f: (5); 48g: (5); 96h: (9)
10	(0, 0, 0)	16a: (3); 16b: (1); 24c: (2); 24d: (2); 32e: (3); 48f: (5); 48g: (4); 96h: (9)

$H \left(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2} \right)$ of space group No. 230

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (1); 16b: (1); 24c: (2); 24d: (2); 32e: (2); 48f: (4); 48g: (3); 96h: (6)
2	(0, 0, 0)	16a: (1); 16b: (1); 24c: (2); 24d: (2); 32e: (2); 48f: (4); 48g: (3); 96h: (6)
3	(0, 0, 0)	16a: (3); 16b: (3); 24c: (4); 24d: (4); 32e: (6); 48f: (8); 48g: (9); 96h: (18)

$P \left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4} \right)$ of space group No. 230

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (2); 16b: (2); 24c: (3); 24d: (3); 32e: (4); 48f: (6); 48g: (6); 96h: (12)
2	(0, 0, 0)	16a: (4); 16b: (4); 24c: (6); 24d: (6); 32e: (8); 48f: (12); 48g: (12); 96h: (24)

$N \left(0, 0, \frac{1}{2} \right)$ of space group No. 230

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (6); 16b: (5); 24c: (8); 24d: (9); 32e: (12); 48f: (18); 48g: (17); 96h: (36)
2	(0, 0, 0)	16a: (6); 16b: (7); 24c: (10); 24d: (9); 32e: (12); 48f: (18); 48g: (19); 96h: (36)

c. Results for high-symmetry lines

$D(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$						
Operation	E	C_{34}^{+}	C_{31}^{-}			
Coordinate	$(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2})$	$(\frac{1}{2}(-1-w), \frac{w}{2}, \frac{w}{2})$	$(\frac{w}{2}, \frac{1-w}{2}, \frac{w}{2})$			
$DT(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$						
Operation	E	C_{31}^{+}	C_{31}^{-}			
Coordinate	$(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2})$	$(\frac{v}{2}, \frac{v}{2}, -\frac{v}{2})$	$(-\frac{v}{2}, \frac{v}{2}, \frac{v}{2})$			
$G(\frac{1}{2}-u, \frac{1}{2}+u, \frac{1}{2})$						
Operation	E	σ_y	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(\frac{1}{2}-u, \frac{1}{2}+u, \frac{1}{2})$	$(-\frac{1}{2}, \frac{3}{2}, -\frac{1}{2}+u)$	$(\frac{1}{2}, \frac{1}{2}-u, \frac{1}{2}+u)$	$(\frac{1}{2}+u, -\frac{3}{2}, \frac{1}{2})$	$(\frac{1}{2}+u, \frac{1}{2}, \frac{1}{2}-u)$	$(-\frac{3}{2}, \frac{1}{2}-u, \frac{1}{2})$
$LD(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$						
Operation	E	C_{2x}	C_{2y}	C_{2z}		
Coordinate	$(\frac{u}{2}, \frac{u}{2}, \frac{u}{2})$	$(-\frac{3u}{2}, \frac{u}{2}, \frac{u}{2})$	$(\frac{u}{2}, -\frac{3u}{2}, \frac{u}{2})$	$(\frac{u}{2}, \frac{u}{2}, -\frac{3u}{2})$		
$SM(0, 0, u)$						
Operation	E	σ_y	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	$(0, 0, u)$	$(-u, u, 0)$	$(u, 0, 0)$	$(0, -u, u)$	$(0, u, 0)$	$(-u, 0, u)$

D $\left(\frac{w}{2}, \frac{w}{2}, \frac{1-w}{2}\right)$ of space group No. 230

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (12); 16b: (12); 24c: (18); 24d: (18); 32e: (24); 48f: (36); 48g: (36); 96h: (72)

DT $\left(\frac{v}{2}, -\frac{v}{2}, \frac{v}{2}\right)$ of space group No. 230

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (3); 16b: (3); 24c: (4); 24d: (4); 32e: (6); 48f: (8); 48g: (9); 96h: (18)
2	(0, 0, 0)	16a: (3); 16b: (3); 24c: (4); 24d: (4); 32e: (6); 48f: (8); 48g: (9); 96h: (18)
3	(0, 0, 0)	16a: (3); 16b: (3); 24c: (4); 24d: (4); 32e: (6); 48f: (8); 48g: (9); 96h: (18)
4	(0, 0, 0)	16a: (3); 16b: (3); 24c: (4); 24d: (4); 32e: (6); 48f: (8); 48g: (9); 96h: (18)
5	(0, 0, 0)	16a: (6); 16b: (6); 24c: (10); 24d: (10); 32e: (12); 48f: (20); 48g: (18); 96h: (36)

G $\left(\frac{1}{2} - u, \frac{1}{2} + u, \frac{1}{2}\right)$ of space group No. 230

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (12); 16b: (12); 24c: (18); 24d: (18); 32e: (24); 48f: (36); 48g: (36); 96h: (72)

LD $\left(\frac{u}{2}, \frac{u}{2}, \frac{u}{2}\right)$ of space group No. 230

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (4); 16b: (4); 24c: (6); 24d: (6); 32e: (8); 48f: (12); 48g: (12); 96h: (24)
2	(0, 0, 0)	16a: (4); 16b: (4); 24c: (6); 24d: (6); 32e: (8); 48f: (12); 48g: (12); 96h: (24)
3	(0, 0, 0)	16a: (8); 16b: (8); 24c: (12); 24d: (12); 32e: (16); 48f: (24); 48g: (24); 96h: (48)

SM (0, 0, u) of space group No. 230

(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (6); 16b: (5); 24c: (8); 24d: (9); 32e: (12); 48f: (18); 48g: (17); 96h: (36)
2	(0, 0, 0)	16a: (6); 16b: (5); 24c: (8); 24d: (9); 32e: (12); 48f: (18); 48g: (17); 96h: (36)
3	(0, 0, 0)	16a: (6); 16b: (7); 24c: (10); 24d: (9); 32e: (12); 48f: (18); 48g: (19); 96h: (36)
4	(0, 0, 0)	16a: (6); 16b: (7); 24c: (10); 24d: (9); 32e: (12); 48f: (18); 48g: (19); 96h: (36)

d. Results for high-symmetry planes

P1(u, u, v)

Operation	E	C_{2x}	C_{31}^{+}	C_{32}^{+}	C_{31}^{-}	C_{32}^{-}
Coordinate	(u, u, v)	$(-2u - v, v, u)$	(v, u, u)	$(u, -2u - v, v)$	(u, v, u)	$(-2u - v, u, v)$

P2($u, -u, v$)

Operation	E	C_{31}^{+}	C_{31}^{-}
Coordinate	$(u, -u, v)$	$(v, u, -u)$	$(-u, v, u)$

P1 (u, u, v) of space group No. 230

(Co-) irrep	Phonon AM	WYPO information

1	(0, 0, 0)	16a: (12); 16b: (12); 24c: (18); 24d: (18); 32e: (24); 48f: (36); 48g: (36); 96h: (72)
2	(0, 0, 0)	16a: (12); 16b: (12); 24c: (18); 24d: (18); 32e: (24); 48f: (36); 48g: (36); 96h: (72)
P2 ($u, -u, v$) of space group No. 230		
(Co-) irrep	Phonon AM	WYPO information
1	(0, 0, 0)	16a: (12); 16b: (12); 24c: (18); 24d: (18); 32e: (24); 48f: (36); 48g: (36); 96h: (72)
2	(0, 0, 0)	16a: (12); 16b: (12); 24c: (18); 24d: (18); 32e: (24); 48f: (36); 48g: (36); 96h: (72)

S5. THE ATOMIC INSULATOR BASIS SETS FOR 230 SPACE GROUPS

In this section, we provide the atomic insulator basis sets for all 230 SGs. The ordering of the HSPs and their (co-)irreps in each basis set below matches that on the webpage [Single-valued representations at high-symmetry points](#).

Specifically, the (co-)irreps are listed HSP by HSP in the order specified on that webpage; within each HSP, the (co-)irreps follow the same ordering. Using the (co-)irreps at HSPs together with the atomic insulator basis sets, the corresponding symmetry indicator diagnoses can be obtained [76, 77], and band crossing and nodal line information at generic momenta can also be inferred [78].

SG 1

$$\{1, 1, 1, 1, 1, 1, 1, 1\}$$

SG 2

$$\begin{aligned} &\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\} \\ &\{1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1\} \\ &\{1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0\} \\ &\{1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0\} \\ &\{1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0\} \\ &\{-2, 0, 0, -2, 0, -2, 0, -2, -2, 0, 0, -2, -2, 0, -2, 0\} \\ &\{-2, 0, 0, -2, 0, -2, 0, -2, -2, 0, -2, 0, 0, -2, -2, 0\} \\ &\{-2, 0, 0, -2, 0, -2, 0, -2, 0, -2, -2, 0, -2, 0, -2, 0\} \\ &\{4, 0, 0, 4, 0, 4, 0, 4, 4, 0, 4, 4, 0, 4, 0, 4, 0\} \end{aligned}$$

SG 3

$$\begin{aligned} &\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\} \\ &\{1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0\} \\ &\{1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1\} \\ &\{1, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1\} \\ &\{-2, 0, 0, -2, 0, -2, -2, 0, 0, -2, 0, -2, 0, -2, 0, -2\} \end{aligned}$$

SG 4

$$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$$

SG 5

$$\begin{aligned} &\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2\} \\ &\{1, 0, 0, 1, 1, 0, 0, 1, 1, 1\} \\ &\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1\} \end{aligned}$$

SG 6

$$\begin{aligned} &\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\} \\ &\{1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 1\} \\ &\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0\} \end{aligned}$$

SG 7

$$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$$

SG 8

$$\begin{aligned} &\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2\} \\ &\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1\} \end{aligned}$$

SG 9

$$\{1, 1, 1, 1, 1, 1, 2, 2\}$$

SG 10

$$\begin{aligned} &\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\} \\ &\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0\} \end{aligned}$$

$\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1\}$
 $\{0, -2, 0, 0, 2, 0, -2, -2, 2, 0, -2, -2, -1, -1, 0, 0, 1, 1, -2, -2, 1, 1, -2, -2, 2, 0, -2, -2, 1, 1, -2, -2\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1\}$
 $\{-4, 2, 0, 0, -4, 0, 2, 0, -2, 0, 2, -2, 0, 0, -2, 0, 0, -2, -2, 0, 2, -4, 0, 2, 0, -2, -2, 0, 2\}$
 $\{-2, 0, 0, 0, 0, 0, 0, -2, 0, 0, 0, -2, 0, -2, 0, 0, 0, 0, -2, 0, 0, 0, -2, 0, 0, 0, 0, -2, 0, 0, -2, 0\}$
 $\{-2, 0, 0, 0, 0, 0, 0, -2, 0, 0, 0, -2, -2, 0, 0, 0, 0, 0, 0, -2, 0, 0, 0, -2, 0, 0, 0, -2, 0, 0, 0, -2\}$

SG 11

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 1, 1, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1\}$
 $\{1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 0, 1\}$
 $\{1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 1, 0, 1, 1\}$
 $\{-2, 0, -2, 0, 0, -2, 0, -2, 0, -2, 0, -2, -2, -2, -2, 0, -2, 0, -2, -2\}$

SG 12

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1\}$
 $\{-1, -2, 0, 0, 1, -2, 0, -2, -1, -2, 0, 0, -1, 0, -2, 0, -1, -2, -1, -2\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0\}$
 $\{0, 2, 0, 0, 0, 2, 0, 0, 0, 2, 0, 0, 2, 0, 2, -2, 0, 2, 0, 2\}$
 $\{-2, 0, 0, 0, 0, 0, 0, -2, -2, 0, 0, 0, 0, 0, 0, -2, 0, -2, 0, -2\}$

SG 13

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2\}$
 $\{1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1\}$
 $\{-2, -2, 0, 0, -2, -2, 0, -2, 0, -2, -2, 0, 0, 0, -2, 0, -2, -2, -2, -2\}$
 $\{-2, -2, 0, 0, -2, 0, -2, 0, -2, -2, -2, 0, 0, 0, -2, 0, -2, -2, -2, -2\}$

SG 14

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 1, 1, 2, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 0, 1\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 0\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0\}$
 $\{-2, 0, -2, 0, -2, 0, -2, 0, -2, -2, -2, -2, 0, -2, -2, 0\}$

SG 15

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 2, 0, 1, 1\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, -1, 3, 2, 0\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, -2, -2, 2\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, -2\}$

$\{1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 2, 0, 1, 1, 0, 0\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 0, 2, 1, 1, 1, 0, 1, 0, 1\}$
 $\{-1, -1, 0, 0, -1, -1, 0, 0, 0, -2, -1, -1, -1, -1, 0, -1, 0, -1\}$
 $\{-1, -1, -1, 0, -1, -1, -1, 0, -1, -2, -2, -1, -2, -1, -1, -1, 0, -1\}$
 $\{-1, -1, -1, 0, -1, -1, -1, 0, -1, -2, -1, -2, -1, -2, 0, -1, -1, -1\}$

SG 24

$\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1\}$

SG 25

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1\}$
 $\{1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0\}$

SG 26

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0\}$

SG 27

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1\}$
 $\{-2, -2, 0, 0, 0, 0, -2, -2, 0, 0, -2, -2, -2, 0, 0, -2, 0, -2, 0, 0, -2, -2, 0, -2\}$

SG 28

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1\}$
 $\{1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1\}$

SG 29

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1\}$

SG 30

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2\}$
 $\{1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1\}$

SG 31

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1\}$

SG 32

$\{1, 1, 1, 1, 2, 2, 1, 1, 1, 1, 2, 2, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 0\}$
 $\{1, 1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1\}$

SG 33

 $\{1, 1, 1, 1, 2, 2, 1, 1, 2, 1, 1, 1, 1, 1\}$

SG 34

 $\{1, 1, 1, 1, 2, 2, 1, 1, 2, 2, 1, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 0\}$
 $\{1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 0, 0, 1, 1\}$

SG 35

 $\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0\}$

SG 36

 $\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1\}$

SG 37

 $\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 2, 0, 2\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, -2, 2, -2\}$

SG 38

 $\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 2, 0, 0, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 2, 0, 2, 0\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0\}$

SG 39

 $\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1\}$

SG 40

 $\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 2, 0, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1\}$

SG 41

 $\{1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1\}$

SG 42

 $\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 4\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 2\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 0, 0, 2\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1\}$

SG 43

SG 57

$\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 2, 0, 1, 1, 0, 0, 0, 0, 1, 1, 2, 0, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1\}$

SG 58

$\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1, 1, 1, 2, 2\}$
 $\{1, 0, 1, 0, 0, 1, 0, 1, 2, 0, 2, 0, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 2, 0, 1, 1, 1, 1, 0, 1, 0, 1, 0, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 2, 0, 1, 1, 1, 1, 0, 1, 0, 2, 0\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0\}$
 $\{-2, 0, -2, 0, 0, 0, 0, 0, -2, 0, -2, 0, -2, 0, -2, 0, -2, 0, 0, 0, 0, -2, 0, -2\}$

SG 59

$\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 2, 0, 1, 1, 0, 0, 0, 0, 1, 1, 2, 0, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 0, 1, 1, 0, 2, 0, 1, 1, 1, 0, 0, 1, 0, 1, 1, 0, 1, 1, 2, 0, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0\}$

SG 60

$\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 2, 0, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 2, 1, 1, 1\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, -2, 0, 0, 0\}$

SG 61

$\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0\}$

SG 62

$\{1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 2, 0, 2, 0, 1, 0, 0, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1\}$

SG 63

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 4\}$
 $\{1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 2, 0, 0, 2, 2\}$
 $\{1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 2, 0, 2, 0, 1, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1\}$

SG 64

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 4, 2, 2\}$
 $\{1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 2, 0, 2, 0, 2, 1, 1\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 2, 1, 1\}$

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 4, 4, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 2, 2, 2, 1\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 2, 2, 2, 1\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 2, 2, 2, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 2, 2, 2, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 2, 2, 2, 1\}$

SG 74

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 4, 4\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 2, 0, 0, 2, 1, 1, 1, 1, 2, 2\}$
 $\{1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 2, 2, 0, 2, 2\}$
 $\{1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 2, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 2, 2\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0, 1, 1\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 1\}$

SG 75

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1\}$
 $\{1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1\}$
 $\{0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 2, 0, 2, 0\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -2, 2, -2, 2\}$

SG 76

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2\}$

SG 77

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 2, 0, 2\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, -2, 2, -2\}$

SG 78

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2\}$

SG 79

$\{1, 1, 1, 4, 2, 2, 1, 1, 1, 2, 1\}$
 $\{1, 0, 1, 2, 0, 2, 1, 0, 1, 0, 1\}$
 $\{1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0\}$
 $\{0, 1, 0, 2, 0, 2, 0, 1, 0, 0, 1\}$

SG 80

$\{1, 1, 1, 4, 2, 2, 1, 1, 1, 2\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1, 0, 1\}$

SG 81

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1\}$
 $\{1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 2, 0, 2\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 3, -2, 3, -2\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1\}$
 $\{1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1\}$
 $\{-2, 0, 0, 0, 0, -2, -2, 0, 0, -2, 0, 0, -2, 0, -2, 0\}$
 $\{-2, 0, 0, 0, 0, -2, 0, 0, -2, 0, 0, -2, 0, -2, 0, -2\}$

SG 82

$\{1, 1, 1, 4, 2, 2, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 2, 0, 2, 1, 0, 1, 0, 1, 0, 1\}$
 $\{1, 0, 1, 2, 2, 0, 1, 0, 1, 1, 0, 1, 0\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1\}$
 $\{1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0\}$
 $\{-4, 0, -2, -6, -2, -4, -2, 0, -4, 0, -2, -2, -2\}$

SG 83

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 2, 2, 0, 2, 0, 0, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 2, 0, 0, 2, 2, 0, 0, 2\}$
 $\{1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1\}$
 $\{0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 2, 2, 0, 0, 2, 2, 0, 0\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0\}$
 $\{6, 2, 2, 0, 0, 0, 2, 2, 2, 0, 2, 0, 3, 1, 1, 3, 1, 1, 1, 2, 1, 1, 2, 1, 0, 0, 6, 6, 2, -2, 6, 6\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1\}$
 $\{0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 2, 0, 0, 0, 0, 2, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1\}$
 $\{0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 2, 0, 0, 0, 2, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -2, 0, 0, 2, 0, -2, 2, 0\}$
 $\{-10, -4, -4, 0, 0, 0, -2, -4, -4, 0, -4, 0, -4, -2, -2, -6, -2, -2, 0, -4, -2, -2, -4, -2, -2, -4, -8, -8, -4, -2, -6, -10\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -2, 2, 0, 0, -2, 2, 0\}$

SG 84

$\{1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 2, 0, 0, 2\}$
 $\{1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 2, 2, 0, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 2, 0, 2, 0, 0, 2, 2, 0, 0, 2, 2\}$
 $\{3, 0, 1, 0, 0, 2, 2, 0, 2, 1, 0, 1, 0, 3, 0, 3, 4, 4, -1, -1, 5, 3, -1, -1\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1\}$
 $\{1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1\}$
 $\{-6, 0, -2, 0, 0, -4, -2, 0, -2, -2, -2, -2, 0, -6, -2, -4, -6, -6, 0, 0, -8, -4, 0, 0\}$
 $\{-2, 0, -2, 0, 0, 0, 0, 0, 0, 0, -2, 0, 0, -2, -2, 0, 0, 0, -2, -2, 0, 0, 0, -4\}$

SG 85

$\{1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 1, 1, 1, 2, 2, 4, 4\}$
 $\{1, 0, 1, 1, 0, 1, 0, 2, 1, 0, 1, 1, 0, 1, 0, 2, 2, 2\}$
 $\{1, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 2, 2\}$
 $\{1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 2, 2\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1\}$
 $\{0, 0, -2, -2, 0, 0, -2, 0, -1, 0, -1, -1, 0, -1, -2, 0, -2, -2\}$
 $\{1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1\}$
 $\{0, 0, 2, 2, 0, 0, 2, 0, 2, 0, 0, 0, 0, 2, 2, 0, 2, 2\}$

SG 86

$\{1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 4, 4\}$
 $\{1, 0, 1, 1, 0, 1, 0, 2, 0, 2, 1, 0, 1, 1, 0, 1, 2, 2\}$
 $\{1, 0, 1, 1, 0, 1, 2, 0, 0, 2, 0, 1, 0, 0, 1, 0, 2, 2\}$
 $\{1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 1, 1, 1, 2, 2\}$

$\{0, 0, -2, -2, 0, 0, -2, 0, 0, -2, 1, 0, 1, -1, -2, -1, -2, -2\}$
 $\{1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1\}$
 $\{0, 0, 2, 2, 0, 0, 2, 0, 0, 2, 0, 0, -2, 0, 2, 2, 2, 2\}$

SG 87

$\{1, 1, 1, 1, 1, 1, 4, 4, 2, 2, 2, 2, 1, 1, 1, 1, 1, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 2, 2, 2, 0, 0, 2, 1, 0, 1, 0, 1, 0, 1, 1, 1\}$
 $\{1, 0, 1, 1, 0, 1, 2, 2, 0, 0, 2, 2, 1, 0, 1, 1, 0, 1, 0, 2, 0\}$
 $\{1, 1, 1, 0, 0, 0, 2, 2, 1, 1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1\}$
 $\{2, 1, -1, -2, 0, -1, 1, -1, 0, -2, 1, 1, 1, 1, 0, -1, 0, -2, -1, 1, -1\}$
 $\{1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0\}$
 $\{1, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 2, 1, 0, 1, 0, 0, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1\}$
 $\{0, 1, 0, 0, 0, 0, 0, 2, 0, 0, 2, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0\}$
 $\{-4, -2, 0, 2, 0, 0, -2, -4, 0, 2, -4, -4, -2, -2, -2, 0, 0, 2, 2, -4, 0\}$
 $\{0, 0, 0, 0, 0, 0, 2, -2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0\}$

SG 88

$\{1, 1, 1, 1, 1, 1, 4, 4, 4, 2, 2, 2, 2\}$
 $\{1, 0, 1, 1, 0, 1, 2, 2, 2, 0, 2, 1, 1\}$
 $\{1, 1, 1, 0, 0, 0, 1, 3, 2, 1, 1, 1, 1\}$
 $\{2, 0, 0, 0, 0, 2, 4, 0, 2, 0, 2, 1, 1\}$
 $\{1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 0, 1\}$
 $\{-2, 0, 0, 0, 0, -2, -4, 0, -2, 0, -2, 0, -2\}$

SG 89

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 2, 0, 1, 1, 2, 0\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 2, 0, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 2, 0\}$
 $\{-1, 0, -1, 0, -1, 0, -1, 0, -1, -1, 0, -1, 0, -1, -1, 0, -1, 0, -1, -1, -1, -2, 0\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{-1, 0, -1, 0, -1, 0, -1, 0, -1, -1, 0, -1, -1, 0, -1, 0, -1, -1, -1, -1, -1, -2, 0\}$
 $\{-1, 0, -1, 0, -2, -1, -1, -1, -1, -1, 0, -1, 0, -1, -2, -1, -1, -1, -1, -2, -1, -2, -2, -1, -2, -1\}$
 $\{-1, 0, -1, -1, -2, -1, -1, 0, -1, -2, 0, -1, -1, -1, -2, -1, -1, 0, -2, -2, -2, -1, -2, -2, -2, -1\}$
 $\{0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0\}$
 $\{-1, 0, -1, -1, -2, -1, 0, -1, -1, -2, 0, -1, -1, -1, -2, 0, -1, -1, -1, -2, -1, -2, -2, -2, -1, -2, -2\}$
 $\{0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1\}$

SG 90

$\{1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 4, 4\}$
 $\{1, 0, 0, 1, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 2, 2\}$
 $\{0, 0, 0, 0, -1, 0, 0, -1, 0, 0, 0, 0, -1, 0, 0, -1, -1, -1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1\}$
 $\{0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 0, 2, 2\}$

SG 91

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 4, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 2, 1, 1, 2, 0\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 2, 2, 0, 1, 1\}$

SG 92

$\{1, 1, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 2, 4\}$
 $\{1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 2\}$

SG 93

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 2, 1, 1, 1, 1, 2, 0\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 2, 0, 2, 0, 1, 1\}$
 $\{-1, 0, 0, -1, -1, -1, 0, 0, -1, -1, -1, -1, 0, -1, 0, -1, 0, -1, 0, -2, -1, -1, -1, -1, -1\}$
 $\{-1, 0, 0, -1, -1, -1, 0, 0, -1, -1, -1, 0, -1, 0, -1, -1, 0, -1, -1, -1, -2, 0, -1, -1, -1, -1\}$
 $\{-1, 0, -1, 0, -2, -1, -1, -1, -1, -1, -1, -1, -1, -1, -2, 0, -1, 0, -1, -1, -2, -2, -1, -2, -1, -2, -1\}$
 $\{-1, 0, 0, -1, -2, -1, 0, 0, -1, -2, -1, -1, -1, -1, -1, -1, -1, -1, -2, -2, -1, -1, -2, -2, -1, -1\}$
 $\{-1, 0, 0, -1, -2, -1, 0, 0, -1, -2, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -2, -2, -1, -1, -2, -2\}$

SG 94

$\{1, 1, 1, 1, 2, 1, 1, 2, 2, 1, 1, 1, 1, 1, 1, 2, 4, 4\}$
 $\{1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 1, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 1, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 2, 2, 0, 0, 0, 0, 1, 1, 0, 2, 2\}$
 $\{-1, 0, 0, -1, -2, -1, 0, -2, -1, -1, -1, -1, -1, -1, -1, -1, -3, -3\}$

SG 95

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 4, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 2, 1, 1, 2, 0\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 2, 2, 0, 1, 1\}$

SG 96

$\{1, 1, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 2, 4\}$
 $\{1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 2\}$

SG 97

$\{1, 1, 1, 1, 2, 4, 4, 2, 2, 2, 2, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 2, 2, 1, 1, 0, 2, 0, 1, 1, 0, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 1, 3, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 2, 1\}$
 $\{0, 0, 0, 0, 0, 1, -1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, -1, 0\}$
 $\{1, 0, 0, 1, 1, 2, 2, 2, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, 0, 0, 0, 0, 0, 0, -1, -1, -1, 0\}$
 $\{-1, 0, -1, -1, -2, -3, -4, -2, -1, -2, -2, -1, 0, -1, -1, -2, -1, -2, -2\}$
 $\{0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1\}$

SG 98

$\{1, 1, 1, 1, 2, 4, 4, 2, 2, 2, 2, 1, 1, 1, 1, 2, 4\}$
 $\{1, 0, 1, 0, 1, 2, 2, 1, 1, 1, 1, 0, 1, 0, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 2, 2, 2, 0, 1, 1, 0, 1, 1, 0, 1, 2\}$
 $\{1, 0, 0, 1, 1, 2, 2, 1, 1, 0, 2, 1, 0, 0, 1, 1, 2\}$
 $\{-1, 0, 0, -1, -2, -3, -3, -2, -1, -1, -2, -1, -1, -1, -1, -1, -3\}$

SG 99

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 2, 1, 1, 0, 2\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 2, 0, 1, 1, 2, 0, 1, 1\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1\}$
 $\{0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0\}$
 $\{0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0\}$

SG 100

$\{1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 4, 4\}$
 $\{1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 2, 2\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1\}$
 $\{0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 0, 2, 2\}$

SG 101

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 2, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0\}$

SG 102

$\{1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 2, 4, 4\}$
 $\{1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 2, 1, 1, 0, 0, 0, 0, 0, 2, 2, 2\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1\}$

SG 103

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1\}$
 $\{0, 0, 0, 0, 2, 0, 0, 0, 0, 2, 0, 0, 1, 0, 0, 1, 2, 0, 2, 2, 0, 0\}$
 $\{1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -2, 2, -2, -2, 2, 2\}$

SG 104

$\{1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 1, 1, 2, 4, 4\}$
 $\{1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 2, 2\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 1\}$
 $\{0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 1, 1, 1, 0, 2, 2\}$

SG 105

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 2, 1, 1, 0, 2\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 1, 2, 0, 1, 1, 2, 0, 1, 1\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 2, 0, 0, 0, 2\}$
 $\{1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 2, 0, 0, 0, 2, 0, 0, 0\}$

SG 106

$\{1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 1, 1, 1, 4, 4\}$
 $\{1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 2, 1, 1, 0, 0, 0, 1, 2, 2\}$

SG 107

$\{1, 1, 1, 1, 2, 4, 4, 2, 2, 2, 2, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 3, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 1, 2, 2, 2, 0, 1, 1, 1, 0, 0, 1, 1, 2, 0, 1\}$
 $\{1, 0, 1, 0, 0, 2, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0\}$
 $\{0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0\}$

SG 108

$\{1, 1, 1, 1, 2, 4, 2, 2, 2, 2, 1, 1, 1, 1, 2, 2, 1, 1\}$

$\{1, 0, 0, 1, 1, 2, 1, 1, 2, 0, 0, 1, 1, 0, 1, 1, 0, 1\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 2, 0, 0, 1, 1, 0, 0, 0, 0, 1\}$
 $\{1, 1, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0\}$
 $\{0, 0, 0, 0, 2, 2, 0, 0, 2, 2, 0, 0, 0, 0, 2, 0, 1, 1\}$

SG 109

$\{1, 1, 1, 1, 2, 4, 4, 4, 1, 1, 2, 4\}$
 $\{1, 0, 1, 0, 1, 3, 1, 2, 1, 0, 1, 2\}$
 $\{1, 0, 1, 0, 0, 2, 0, 1, 1, 0, 0, 1\}$

SG 110

$\{1, 1, 1, 1, 2, 4, 4, 1, 1, 2, 2\}$
 $\{1, 1, 1, 1, 0, 2, 2, 1, 1, 0, 1\}$

SG 111

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 2, 0, 1, 1, 2, 0\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 2, 1, 1, 2, 0, 1, 1\}$
 $\{-1, -1, -1, -1, -1, -1, 0, -1, 0, -2, -1, -1, -1, -1, -1, 0, -1, 0, -1, -2, -1, -2, -2, -1, -2, -1, -1, -2\}$
 $\{-1, -1, -1, -1, -1, 0, -1, 0, -1, -2, -1, -1, -1, -1, -1, 0, -1, 0, -1, -2, -1, -2, -2, -1, -1, -2, -2, -1\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 0, 1, 1\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0\}$

SG 112

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 0, 0, 2, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 0, 2, 0, 0, 2, 0, 0, 2, 2, 0, 0, 2, 2\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, -1, -1, 1, 1, -1, -1\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 2, 0, 2, 0, 1, 1\}$
 $\{-1, -1, -1, -1, -1, -1, 0, -1, 0, -2, 0, -1, -2, -1, -1, -1, -2, -1, -2, -1, -2, -1, -1, -2\}$
 $\{-1, -1, -1, -1, 0, -1, 0, -1, 0, -1, 0, 0, -2, 0, -1, -1, 0, -1, -2, -1, -1, 0, -1, -2\}$
 $\{-1, -1, -1, -1, -1, -1, -1, -1, -1, -1, 0, -1, -2, 0, -1, -2, -1, -1, -3, -1, -1, -1, -2, -2\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1\}$
 $\{1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0\}$

SG 113

$\{1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 4, 4\}$
 $\{1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 2, 1, 1, 1, 1, 0, 0, 0, 2, 2, 2\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1\}$

SG 114

$\{1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 1, 1, 4, 4\}$
 $\{1, 1, 1, 1, 0, 1, 1, 0, 0, 0, 2, 0, 0, 1, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 2, 0, 0, 2, 1, 1, 0, 2, 2\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1\}$

SG 115

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2\}$

$\{1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 2, 1, 1, 0, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 2, 0, 1, 1, 2, 0, 1, 1\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1\}$
 $\{1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 2, 0, 0, 0, 2\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 2, 0, 0, 0, 2, 0, 0, 0\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0\}$

SG 116

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 0, 0, 2, 1, 1, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 0, 2, 0, 0, 2, 0, 2, 0, 0, 2, 2\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, -1, 1, 1, -1, -1\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{-1, -1, -1, -1, -1, -1, -1, -1, -1, -1, 0, -1, -2, 0, -1, -2, -1, -2, -1, -1, -2, -2\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1\}$
 $\{1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0\}$

SG 117

$\{1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 4, 4\}$
 $\{1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 2, 2\}$
 $\{0, 0, 0, 0, -1, 0, 0, -1, 0, 0, 0, 0, -1, 0, 0, -1, -1, -1\}$
 $\{1, 1, 1, 1, 0, 0, 0, 2, 1, 1, 1, 1, 0, 0, 0, 2, 2, 2\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1\}$

SG 118

$\{1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 2, 4, 4\}$
 $\{1, 1, 1, 1, 0, 1, 1, 0, 0, 0, 2, 0, 0, 0, 0, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 2, 2\}$
 $\{-1, -1, -1, -1, -1, -1, -1, -1, -1, 0, -2, 0, -1, 0, -1, -2, -3, -3\}$
 $\{1, 1, 1, 1, 0, 0, 0, 2, 0, 0, 2, 1, 1, 1, 1, 0, 2, 2\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1\}$

SG 119

$\{1, 1, 1, 1, 2, 4, 4, 2, 2, 2, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 3, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 2, 2, 1, 1, 0, 2, 0, 1, 0, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 2, 2, 2, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 0, 2, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1\}$
 $\{1, 0, 0, 1, 0, 2, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0\}$

SG 120

$\{1, 1, 1, 1, 2, 4, 2, 2, 2, 2, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 2, 1, 1, 0, 2, 0, 1, 0, 1, 1, 1, 1\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, 0, 0, 0, 0, 0, 0, -1, -1, 0\}$
 $\{0, 0, 0, 0, -1, -1, 0, 0, -1, -1, 0, 0, 0, 0, -1, 0, -1\}$
 $\{1, 0, 1, 0, 1, 2, 2, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1\}$

$\{-1, 0, -1, -1, -2, -1, 0, -1, -1, -2, -1, -2, -2, -2, -1, -2, -2, -1, -2, -2, -2, -3, -4, -4, -3\}$
 $\{0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1\}$

SG 127

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 4, 4, 4\}$
 $\{1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 2, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 2, 0, 0, 0, 2, 1, 1, 1, 0, 0, 0, 2, 1, 1, 0, 0, 4, 4, 0\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 2, 1, 1, 1, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 2, 4, 0, 4, 0\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 2, 2, 0\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 2, 0, 2, 0\}$
 $\{1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1\}$
 $\{0, 0, 0, 0, 2, 0, 0, 0, 0, 2, 1, 1, 0, 1, 1, 0, 0, 0, 0, 2, 0, 0, 0, 0, 2, 1, 1, 0, 1, 1, 0, 2, 2, 2\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0\}$
 $\{1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0\}$
 $\{0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 0, 2, 0, 0, 2\}$
 $\{1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0\}$
 $\{0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 2, 0, 2\}$

SG 128

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 2, 2, 4, 4, 4\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 2, 1, 1, 1, 1, 1, 2, 2, 4, 0\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2\}$
 $\{0, 0, 0, 0, -1, 0, 0, 0, 0, -1, 0, 0, -1, 0, 0, -1, 0, 0, -1, -1, -1, 0, -1, -1, -1, -1\}$
 $\{1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 2, 0, 0, 1, 1, 0, 1, 1, 1, 1\}$
 $\{0, 0, 0, 0, 2, 0, 0, 0, 0, 2, 1, 1, 0, 1, 1, 0, 0, 0, 2, 0, 0, 2, 2, 2, 2, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1, 2, 0\}$
 $\{1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 1, 1, 0\}$
 $\{0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 2, 0, 2\}$
 $\{1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, -2, 0, 0\}$

SG 129

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 4, 4, 4\}$
 $\{1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 2, 1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 2, 1, 0, 1, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 3, 1, 3, 1\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 2, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 1, 2, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 2, 1, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 2, 1, 0, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 2, 0, 2, 0\}$
 $\{1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0\}$
 $\{0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0\}$

SG 130

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 4, 4, 4\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 2, 1, 0, 1, 1, 1, 1, 2, 2, 2\}$
 $\{0, 0, 0, 0, -1, 0, 0, 0, 0, -1, -1, 0, -1, 0, 0, 0, -1, -1, 0, -1, -1, -1\}$
 $\{1, 1, 1, 1, 2, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2\}$
 $\{1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 2, 0, 0, 1, 0, 1, 1, 1\}$
 $\{1, 1, 0, 0, 2, 0, 0, 1, 1, 2, 0, 3, 0, 3, 1, 1, 2, 0, 3, 3, 3\}$
 $\{0, 0, 0, 0, -2, 0, 0, 0, 0, -2, 0, -2, 0, -2, 0, 0, -2, 0, -2, -2, -2, -2\}$

SG 131

{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0}

SG 135

{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 2, 4, 4, 4, 4}
 {1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 2, 1, 1, 1, 1, 1, 2, 2, 4, 0}
 {1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2}
 {0, 0, 0, 0, -1, 0, 0, 0, 0, -1, 0, 0, -1, 0, 0, -1, -1, 0, -1, 0, 0, -1, -1, -1, -1, -1}
 {1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 0, 2, 0, 0, 2, 0, 2, 0, 2, 0, 2, 2, 2, 2, 2}
 {1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 2, 0}
 {1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1}
 {1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, 0, 1, 0, 1, 0, 1, 1, 1, 2, 0}

SG 136

{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 2, 2, 4, 4, 4, 4}
 {1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 2, 2, 1, 0, 1, 2, 2, 2, 2}
 {1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 2, 1, 1, 1, 1, 1, 1, 2, 2, 4, 0}
 {1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 0, 2, 0, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2, 2, 2, 2, 2}
 {1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 2, 0}
 {1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 2, 0}
 {1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 2, 2, 0, 0, 0, 1, 1, 1, 1}
 {1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1}
 {1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, 0, 1, 0, 1, 0, 1, 0, 1, 1, 2, 0}
 {1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0}
 {1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0}

SG 137

{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 4, 4, 4, 4}
 {1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 2, 1, 1, 1, 3, 1, 3, 1}
 {1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 2, 1, 0, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2}
 {1, 1, 1, 1, 2, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2}
 {1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 2, 0, 0, 1, 2, 0, 2, 0}
 {1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 2, 1, 1, 0, 2, 0, 2, 0}
 {1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0}
 {1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0}

SG 138

{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1, 2, 1, 1, 2, 4, 4, 4}
 {1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 2, 1, 0, 1, 1, 0, 1, 2, 1, 0, 1, 1, 0, 1, 2, 2, 2}
 {1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 2, 1, 0, 0, 1, 2, 1, 1, 0, 1, 0, 1, 1, 2, 2, 2}
 {1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 2, 1, 0, 2, 1, 0, 1, 0, 1, 1, 1, 0, 1, 2, 2, 2}
 {-1, 0, 0, -1, -2, -1, 0, 0, -1, -2, -2, -2, -2, 0, -2, -1, -2, -1, -1, -1, -1, -1, -1, -1, -1, -1, -3, -3, -3}
 {1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 2, 0, 0, 0, 0, 0, 2, 1, 0, 0, 1, 0, 0, 1, 1, 1}
 {1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0, 1, 1, 1}
 {1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 1, 1}
 {1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1}

SG 139

{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 4}
 {1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 3, 1, 1, 3, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 2}
 {1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 2, 2, 2, 2, 2, 1, 0, 1, 0, 1, 2, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 2, 0, 0, 2, 2}
 {1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 2, 2, 2, 2, 2, 0, 2, 0, 0, 2, 0, 2, 1, 1, 1, 1, 0, 0, 0, 0, 2, 1, 1, 1, 1, 2}
 {1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 2, 2, 2, 2, 1, 2, 1, 0, 1, 2, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 2}
 {1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 2, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1}
 {1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 2, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 1}
 {1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 2, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1}
 {1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 2, 0, 0, 2, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 2}
 {1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1}
 {1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0}

$\{0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0\}$
 $\{0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0\}$
 $\{0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0\}$

SG 140

$\{1, 1, 1, 1, 2, 1, 1, 1, 2, 8, 2, 2, 2, 2, 2, 2, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 2, 2, 4\}$
 $\{1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 4, 2, 1, 0, 1, 0, 1, 2, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 2, 0, 2\}$
 $\{1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 4, 2, 0, 2, 0, 0, 2, 0, 2, 1, 1, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 2\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 4, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 4, 1, 2, 1, 0, 1, 2, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 2\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 2, 2, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 1\}$
 $\{1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 2, 2, 0, 0, 0, 0, 0, 2, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 2, 0, 0\}$
 $\{-1, 0, -1, -1, -2, -1, 0, -1, -1, -2, -7, -2, -2, -2, -1, -2, -2, -2, -1, -1, -1, -1, 0, -2, -1, -1, -1, 0, -2, -2, -2, -3\}$
 $\{0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 2, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0\}$
 $\{1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0, 1\}$
 $\{1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 2, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0\}$
 $\{1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1\}$
 $\{0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 2, 0, 2, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 1, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0\}$

SG 141

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 4, 4, 4, 4, 4, 2, 2, 2, 2, 4, 4\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 3, 1, 1, 3, 2, 2, 1, 2, 1, 0, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 2, 2, 2, 2, 3, 1, 1, 1, 1, 1, 2, 2\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 2, 2, 2, 2, 2, 2, 0, 1, 2, 1, 2, 2\}$
 $\{1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 2, 0, 0, 2, 1, 1, 0, 2, 0, 0, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 2, 1, 1, 0, 1, 1, 0, 1, 1\}$
 $\{1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 2, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0\}$

SG 142

$\{1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 8, 4, 4, 2, 2, 2, 2, 4\}$
 $\{1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 4, 3, 1, 1, 1, 1, 1, 2\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 4, 2, 2, 0, 1, 2, 1, 2\}$
 $\{0, 0, 0, 0, -1, 0, 0, 0, 0, -1, -2, -1, -1, -1, 0, -1, 0, -1\}$
 $\{1, 1, 1, 1, 2, 0, 0, 0, 0, 0, 4, 2, 2, 1, 1, 1, 1, 2\}$
 $\{1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 2, 1, 1, 0, 1, 0, 1, 1\}$

SG 143

$\{1, 1, 3, 1, 1, 3, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 0, 1\}$
 $\{1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 1, 1, 0, 1, 1, 0, 0, 1, 0, 0\}$

SG 144

$\{1, 1, 3, 1, 1, 3, 1, 1, 1, 1, 1, 1\}$

SG 145

$\{1, 1, 3, 1, 1, 3, 1, 1, 1, 1, 1, 1\}$

SG 146

$\{1, 1, 1, 1, 3, 3\}$
 $\{1, 0, 1, 0, 1, 1\}$

SG 147

$\{1, 1, 1, 1, 3, 3, 1, 1, 1, 1, 3, 3, 2, 2, 2, 2\}$
 $\{1, 0, 1, 0, 1, 2, 0, 1, 0, 1, 2, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 2, 1, 0, 1, 0, 1, 2, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 0, 1\}$
 $\{1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 2, 0, 2, 0\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0\}$
 $\{-7, 0, -6, -2, -9, -12, -5, -2, -4, -4, -11, -10, -9, -6, -9, -6\}$
 $\{8, 0, 6, 2, 10, 12, 6, 2, 4, 4, 12, 10, 10, 6, 10, 6\}$
 $\{-4, 0, -4, 0, -4, -8, -4, 0, -4, 0, -8, -4, -4, -4, -4, -4\}$

SG 148

$\{1, 1, 1, 1, 1, 1, 1, 1, 3, 3, 3, 3\}$
 $\{1, 0, 1, 0, 1, 0, 1, 0, 1, 2, 1, 2\}$
 $\{1, 0, 1, 0, 0, 1, 0, 1, 2, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0\}$
 $\{-7, 0, -6, -2, -5, -2, -4, -4, -11, -10, -9, -12\}$
 $\{8, 0, 6, 2, 6, 2, 4, 4, 12, 10, 10, 12\}$
 $\{-4, 0, -4, 0, -4, 0, -4, 0, -8, -4, -4, -8\}$

SG 149

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 2, 1, 0, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1, 2, 1, 1, 1, 1, 1, 1, 1\}$
 $\{0, 0, -1, -1, -1, 0, 0, -1, -1, -1, -1, -1, 0, -1, -1, 0\}$
 $\{0, 0, -1, -1, -1, 0, 0, -1, -1, -1, -1, 0, -1, -1, 0, -1\}$
 $\{0, 0, -1, -1, -1, 0, 0, -1, -1, -1, 0, -1, -1, 0, -1, -1\}$

SG 150

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 1, 2, 1, 0, 1, 1, 1, 2, 1, 0, 1, 0, 1, 1\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1, 2, 1, 1, 0, 1, 1, 0, 1\}$
 $\{1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 0, 0, 1\}$
 $\{0, 0, -1, -1, -1, 0, 0, -1, -1, -1, 0, 0, -1, 0, 0, -1\}$

SG 151

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1, 2, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 2, 1, 0, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1\}$

SG 152

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 1, 2, 1, 0, 1, 1, 1, 2, 1, 0, 1, 0, 1, 1\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1, 2, 1, 1, 0, 1, 1, 0, 1\}$

SG 153

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 2, 1, 0, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1, 2, 1, 1, 1, 1, 1, 1, 1\}$

SG 154

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1, 2, 1, 1, 0, 1, 1, 0, 1\}$
 $\{1, 0, 1, 2, 1, 0, 1, 1, 1, 2, 1, 0, 1, 0, 1, 1\}$

SG 155

$\{1, 1, 2, 1, 1, 2, 3, 3, 3, 3\}$
 $\{1, 0, 1, 0, 1, 1, 1, 2, 2, 1\}$
 $\{1, 0, 1, 1, 0, 1, 2, 1, 2, 1\}$
 $\{0, 0, -1, 0, 0, -1, -1, -1, -1, -1\}$

SG 156

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 2, 2, 2, 2, 2\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1, 2, 1, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0\}$

SG 157

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1, 2, 1, 1, 0, 1, 1, 0, 1\}$
 $\{1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 0, 0, 1\}$
 $\{1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0\}$

SG 158

$\{1, 1, 2, 3, 3, 1, 1, 3, 2, 2, 2, 1, 1, 1\}$
 $\{1, 1, 0, 1, 1, 1, 0, 1, 0, 0, 2, 0, 0, 1\}$
 $\{1, 1, 0, 1, 1, 1, 0, 1, 0, 2, 0, 0, 1, 0\}$
 $\{1, 1, 0, 1, 1, 1, 0, 1, 2, 0, 0, 1, 0, 0\}$

SG 159

$\{1, 1, 2, 3, 3, 1, 1, 3, 1, 1, 2, 1, 1, 2\}$
 $\{1, 1, 0, 1, 1, 1, 0, 1, 0, 0, 1, 0, 0, 1\}$
 $\{1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0\}$

SG 160

$\{1, 1, 2, 1, 1, 2, 3, 3, 3, 3\}$
 $\{1, 0, 1, 1, 0, 1, 2, 1, 2, 1\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 1, 0\}$

SG 161

$\{1, 1, 2, 1, 1, 3, 3, 3\}$
 $\{1, 1, 0, 1, 0, 1, 1, 1\}$

SG 162

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 3, 3, 3, 2, 2, 4, 2, 2, 4\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 1, 2, 1, 0, 0, 1, 1, 1, 2, 1, 1, 2, 2, 0, 2, 2, 0, 2\}$
 $\{1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 2, 2, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 1, 2, 1, 1, 2\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, 0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1\}$
 $\{1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 1\}$
 $\{1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 2, 0, 0, 2, 0, 0\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0\}$
 $\{0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0\}$
 $\{-4, 0, 0, 0, -2, 0, -4, -2, 0, -2, -2, 0, 0, -2, 0, -2, -2, -2, 0, -4, -4, 0, -2, -4, 0, -2\}$

SG 163

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 6, 2, 2, 4, 2, 2, 4\}$
 $\{1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 1, 1, 3, 1, 1, 2, 1, 1, 2\}$
 $\{1, 1, 0, 0, 2, 0, 1, 2, 1, 2, 1, 1, 3, 1, 1, 2, 1, 1, 2\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, 0, -2, -1, -1, -1, -1, -1\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, 0, -2, 0, 0, -2, 0, 0, -2\}$

{1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 0}
 {-2, -2, 0, 0, -2, 2, -2, 0, -2, 0, 0, -2, -2, -2, -2, 0, -2, -2, 0}

SG 164

{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 4, 2, 2, 4}
 {1, 0, 0, 1, 1, 1, 2, 1, 1, 2, 1, 0, 0, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 1, 1, 2}
 {1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 0, 1, 0, 1, 1, 1, 1, 2, 2, 2, 0, 2, 0, 2, 2}
 {1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 2, 0, 2, 2, 0, 2}
 {1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1}
 {1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1}
 {1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1}
 {1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0}
 {1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0}
 {0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1}
 {1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0}
 {-4, 0, 0, 0, -2, 0, -4, -2, 0, -2, -2, 0, 0, -2, 0, -2, -2, -2, 0, -4, -4, 0, -2, -2, -2, -2}

SG 165

{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 6, 2, 2, 4, 2, 2}
 {1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 1, 1, 3, 2, 0, 2, 1, 1}
 {1, 1, 0, 0, 2, 0, 1, 2, 1, 2, 1, 1, 3, 1, 1, 2, 1, 1}
 {1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 2, 2, 0, 0, 2, 0, 1}
 {0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, 0, -2, 0, 0, -2, 0, -1}
 {1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0}
 {-2, -2, 0, 0, -2, 2, -2, 0, -2, 0, 0, -2, -2, -2, -2, 0, -2, 0}

SG 166

{1, 1, 1, 1, 2, 2, 1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3}
 {1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 2, 1, 1, 2, 2, 1, 1, 2}
 {1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 2, 2, 2, 2, 1, 1}
 {1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 2, 2, 1, 1}
 {1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1}
 {1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 1}
 {1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1}
 {1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0}
 {0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0}
 {1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0}
 {-4, 0, 0, 0, -2, 0, -2, 0, 0, -2, 0, -2, -2, -2, 0, -4, -4, -2, 0, -2}

SG 167

{1, 1, 1, 1, 2, 2, 2, 2, 6, 3, 3, 3, 3}
 {1, 0, 1, 0, 1, 1, 1, 1, 3, 2, 2, 1, 1}
 {1, 1, 0, 0, 2, 0, 1, 1, 3, 1, 2, 1, 2}
 {0, 0, 0, 0, -1, -1, -1, 0, -2, -1, -1, -1, -1}
 {1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 1, 0}
 {-2, -2, 0, 0, -2, 2, 0, -2, -2, -2, 0, -2, 0}

SG 168

{1, 1, 1, 1, 3, 3, 1, 1, 1, 1, 3, 3, 2, 2, 2, 2}
 {1, 0, 1, 0, 1, 2, 1, 0, 1, 0, 1, 2, 1, 1, 1, 1}
 {1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 0, 1}
 {1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0}
 {0, 1, 0, 0, 0, 2, 0, 1, 0, 0, 0, 2, 0, 1, 0, 1}
 {-2, 0, 0, 0, 0, -2, -2, 0, 0, 0, 0, -2, -2, 0, -2, 0}

SG 169

{1, 1, 1, 1, 3, 3, 1, 1, 1, 1, 3, 2, 2, 1, 2}

$\{1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 2, 2, 2, 0, 0, 2, 2, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 0, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0\}$
 $\{-3, -2, -4, -2, -2, 0, -1, 0, -5, -4, -6, -3, -2, -5, -9, -4, -2, -2, -6, -5, -2, -2\}$
 $\{4, 2, 4, 2, 2, 0, 2, 0, 6, 4, 6, 4, 2, 6, 10, 6, 2, 2, 6, 6, 2, 2\}$

SG 177

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 3, 3, 3, 2, 2, 4, 2, 2, 4\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 0, 1, 0, 1, 1, 1, 1, 2, 2, 1, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 2, 1, 0, 1, 1, 0, 1, 1, 1, 2, 1, 2, 2, 0, 2, 0, 2, 2\}$
 $\{-1, 0, -1, 0, -1, -1, -2, -1, -1, -2, 0, -1, -1, 0, -1, -1, -1, -2, -1, -2, -1, -1, -2, 0, -2, -2\}$
 $\{-1, 0, -1, -1, -1, -2, -3, -2, -2, -2, 0, -1, -1, -1, -1, -2, -2, -3, -2, -2, -2, -1, -3, -1, -2, -3\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, 0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1\}$
 $\{-1, 0, -1, -1, -2, -2, -3, -2, -3, -3, 0, -1, -1, -1, -2, -2, -2, -3, -3, -3, -2, -1, -4, -1, -2, -4\}$
 $\{0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1\}$
 $\{0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1\}$

SG 178

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 2, 6, 2, 2, 4, 2, 4\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 1, 1, 3, 1, 1, 2, 1, 2\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 2, 1, 1, 1, 1, 3, 2, 0, 2, 1, 2\}$

SG 179

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 2, 6, 2, 2, 4, 2, 4\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 1, 1, 3, 1, 1, 2, 1, 2\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 2, 1, 1, 1, 1, 3, 2, 0, 2, 1, 2\}$

SG 180

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 3, 3, 3, 2, 2, 4, 2, 2, 4\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 0, 1, 0, 1, 1, 1, 1, 2, 2, 1, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 2, 1, 1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 2, 0, 2, 0, 2, 2\}$
 $\{-1, 0, -1, 0, -1, -1, -2, -1, -1, -2, -1, 0, 0, -1, -1, -1, -1, -2, -1, -2, -1, -1, -2, 0, -2, -2\}$
 $\{-1, 0, -1, -1, -1, -2, -3, -2, -2, -2, -1, -1, 0, -1, -2, -1, -2, -3, -2, -2, -2, -1, -3, -1, -2, -3\}$
 $\{-1, 0, -1, -1, -1, -2, -2, -1, -3, -3, -1, -1, 0, -1, -2, -1, -1, -2, -3, -3, -2, -1, -3, -1, -2, -3\}$

SG 181

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 3, 3, 3, 2, 2, 4, 2, 2, 4\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 0, 1, 0, 1, 1, 1, 1, 2, 2, 1, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 2, 1, 0, 1, 1, 0, 1, 1, 1, 2, 1, 2, 2, 0, 2, 0, 2, 2\}$
 $\{-1, 0, -1, 0, -1, -1, -2, -1, -1, -2, 0, -1, -1, 0, -1, -1, -1, -2, -1, -2, -1, -1, -2, 0, -2, -2\}$
 $\{-1, 0, -1, -1, -1, -2, -3, -2, -2, -2, 0, -1, -1, -1, -1, -2, -2, -3, -2, -2, -2, -1, -3, -1, -2, -3\}$
 $\{-1, 0, -1, -1, -1, -2, -2, -1, -3, -3, 0, -1, -1, -1, -1, -2, -1, -2, -3, -3, -2, -1, -3, -1, -2, -3\}$

SG 182

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 2, 6, 2, 2, 4, 2, 4\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 1, 1, 3, 1, 1, 2, 1, 2\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 2, 1, 1, 1, 1, 3, 2, 0, 2, 1, 2\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, -1, 0, -2, -1, -1, -1, -1, -1\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, -1, 0, -2, 0, 0, -2, 0, -2\}$

SG 183

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 3, 3, 3, 2, 2, 4, 2, 2, 4\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 2, 1, 1, 0, 1, 0, 1, 1, 2, 1, 2, 1, 1, 1, 2, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 1, 2, 1, 0, 0, 1, 1, 1, 2, 1, 1, 2, 2, 0, 2, 2, 0, 2\}$

$\{1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0\}$
 $\{0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0\}$
 $\{0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1\}$

SG 184

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 3, 3, 2, 2, 4, 2, 2\}$
 $\{1, 1, 0, 0, 2, 0, 1, 1, 2, 2, 1, 1, 0, 0, 1, 2, 1, 1, 2, 1, 1\}$
 $\{1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 0, 0, 2, 0, 1\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0\}$
 $\{0, 0, 0, 0, 0, 2, 0, 0, 2, 2, 0, 0, 0, 1, 0, 2, 0, 0, 2, 0, 1\}$
 $\{-2, -2, 0, 0, 0, 0, 0, 0, -2, -2, -2, 0, 0, 0, 0, -2, -2, -2, 0, -2, 0\}$

SG 185

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 2, 3, 3, 2, 2, 4, 1, 1, 2\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 1, 2, 1, 0, 1, 2, 1, 2, 0, 2, 1, 0, 1\}$
 $\{1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 0, 2, 0, 0, 1\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 2, 0, 0, 1, 0, 0\}$

SG 186

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 2, 3, 3, 2, 2, 4, 2, 4\}$
 $\{1, 0, 1, 0, 1, 1, 2, 1, 2, 1, 1, 0, 1, 2, 1, 1, 1, 2, 1, 2\}$
 $\{1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0\}$

SG 187

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 0, 0, 1, 1, 1, 2, 1, 2, 1, 1, 0, 0, 1, 1, 1, 2, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 2, 0, 3, 0, 0, 3, 0, 0, 1, 1, 0, 2, 0, 3, 3, 0, 2, 0, 2, 0, 2, 0, 2, 0, 2\}$
 $\{1, 1, 0, 0, 2, 0, 3, 0, 0, 3, 1, 1, 0, 0, 2, 0, 3, 0, 0, 3, 2, 0, 2, 0, 2, 0, 2, 0, 2\}$
 $\{1, 0, 0, 0, 1, 0, 2, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 2, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1\}$
 $\{1, 0, 0, 0, 1, 0, 2, 0, 0, 1, 1, 0, 0, 0, 1, 0, 2, 0, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1\}$

SG 188

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 6, 2, 2, 2, 2, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 2, 0, 3, 0, 0, 3, 1, 1, 3, 2, 0, 2, 0, 2, 0, 1, 1, 1\}$
 $\{1, 0, 1, 0, 1, 1, 2, 2, 1, 1, 1, 1, 3, 1, 1, 1, 1, 1, 1, 1, 1\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, 0, -2, -1, 0, -1, -1, 0, -1, -1, 0, -1\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, 0, -2, -1, -1, 0, -1, -1, 0, -1, -1, 0\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, 0, -2, 0, -1, -1, 0, -1, -1, 0, -1, -1\}$
 $\{1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 2, 0, 0, 1, 0\}$
 $\{1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 2, 0, 0, 0, 0, 0, 1\}$
 $\{1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 2, 0, 0, 0, 0, 0, 1, 0, 0\}$

SG 189

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 1, 1, 1, 2, 2\}$
 $\{1, 1, 0, 0, 2, 0, 3, 0, 0, 3, 0, 0, 1, 1, 0, 2, 0, 3, 3, 0, 1, 1, 0, 0, 2, 0, 0, 0, 1, 1, 0, 2\}$
 $\{1, 1, 0, 0, 2, 0, 3, 0, 0, 3, 1, 1, 0, 0, 2, 0, 3, 0, 0, 3, 1, 1, 0, 0, 2, 0, 1, 1, 0, 0, 2, 0\}$

SG 195

$\{1, 1, 3, 3, 3, 3, 3, 3, 3, 3, 1, 1, 3\}$
 $\{0, 0, -1, -1, -1, 0, -1, -1, 0, -1, -1, 0, 0, -1\}$
 $\{1, 1, 1, 2, 2, 2, 0, 1, 1, 3, 1, 0, 0, 2\}$
 $\{0, 0, 0, 0, -1, 0, 1, 0, 0, -1, 1, 0, 0, 0\}$
 $\{0, 0, -1, 0, -1, -1, -1, 0, -1, -1, -1, 0, 0, -1\}$
 $\{1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1\}$

SG 196

$\{1, 1, 3, 3, 3, 3, 3, 4, 4, 6, 6\}$
 $\{0, 0, -1, -1, -1, 0, -1, -1, -1, -2, -1\}$
 $\{0, 0, -1, 0, -1, -1, -1, -1, -1, -1, -2\}$
 $\{1, 0, 1, 1, 1, 1, 1, 2, 1, 2, 2\}$

SG 197

$\{1, 1, 3, 1, 1, 3, 1, 1, 1, 3, 6, 6\}$
 $\{1, 1, 1, 1, 1, 1, 0, 0, 0, 2, 2, 4\}$
 $\{0, 0, -1, 0, 0, -1, 0, 0, 0, -1, -1, -2\}$
 $\{1, 0, 1, 1, 0, 1, 1, 0, 0, 1, 2, 2\}$

SG 198

$\{1, 1, 3, 6, 3, 3, 1, 2\}$
 $\{1, 0, 1, 2, 1, 1, 0, 1\}$

SG 199

$\{1, 1, 3, 1, 1, 3, 2, 2, 2, 6, 6\}$
 $\{1, 1, 1, 0, 0, 2, 1, 1, 1, 3, 3\}$
 $\{1, 0, 1, 1, 0, 1, 0, 1, 1, 2, 2\}$

SG 200

$\{1, 1, 3, 1, 1, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 1, 1, 3, 1, 1, 3\}$
 $\{1, 1, 1, 0, 0, 2, 2, 0, 2, 2, 1, 3, 1, 1, 1, 1, 3, 1, 2, 2, 0, 2, 0, 0, 2, 1, 1, 1\}$
 $\{1, 1, 1, 0, 0, 2, 3, 1, 1, 1, 0, 2, 2, 2, 3, 1, 1, 1, 0, 2, 2, 2, 1, 1, 1, 0, 0, 2\}$
 $\{1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1\}$
 $\{1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 0, 3, 0, 0, 0, 0, 3, 0, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0\}$
 $\{1, 1, 0, 0, 0, 1, 2, 0, 1, 0, 0, 2, 1, 0, 1, 1, 1, 0, 0, 2, 0, 1, 0, 0, 1, 0, 0, 1\}$
 $\{1, 1, 0, 0, 0, 1, 2, 0, 0, 1, 0, 2, 0, 1, 1, 0, 1, 1, 0, 2, 0, 0, 1, 0, 0, 1\}$
 $\{1, 1, 0, 0, 0, 1, 3, 0, 0, 0, 0, 1, 1, 1, 3, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1\}$
 $\{1, 1, 0, 0, 0, 0, 2, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1\}$
 $\{1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 2, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0\}$
 $\{0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0\}$
 $\{0, 1, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0\}$

SG 201

$\{1, 1, 3, 1, 1, 3, 6, 6, 6, 6, 1, 1, 3, 1, 1, 3\}$
 $\{1, 1, 1, 1, 1, 1, 4, 2, 2, 4, 0, 0, 2, 0, 0, 2\}$
 $\{0, 0, -1, 0, 0, -1, -1, -2, -1, -2, 0, 0, -1, 0, 0, -1\}$
 $\{1, 0, 1, 1, 0, 1, 2, 2, 2, 2, 1, 0, 1, 1, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1\}$
 $\{0, 0, 0, 0, 1, 2, 2, 2, 2, 2, 0, 1, 2, 0, 0, 0\}$
 $\{1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 0, 0, 0\}$
 $\{-4, -2, -6, -2, -2, -4, -12, -10, -10, -12, -2, -2, -8, -2, 0, -4\}$

SG 202

$\{1, 1, 3, 1, 1, 3, 3, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 6, 6, 6, 6\}$

$\{1, 1, 1, 0, 0, 2, 3, 1, 1, 1, 0, 2, 2, 2, 2, 2, 5, 1, 3, 3\}$
 $\{0, 0, -1, 0, 0, -1, -1, 0, -1, -1, -1, 0, -1, -1, -1, -1, -1, -2, -2, -1, -1\}$
 $\{1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 0, 1, 3, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 4, 0, 1, 1\}$
 $\{1, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 2, 1, 1, 1, 1, 1, 2, 0, 2, 2\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0\}$
 $\{0, 1, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 2, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0\}$
 $\{0, 1, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 2, 0, 0, 0\}$

SG 203

$\{1, 1, 3, 1, 1, 3, 6, 6, 4, 4, 4, 4, 12\}$
 $\{0, 0, -1, 0, 0, -1, -1, -2, -1, -1, -1, -1, -3\}$
 $\{1, 0, 1, 1, 0, 1, 2, 2, 2, 1, 1, 2, 4\}$
 $\{1, 0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 1, 2\}$
 $\{0, 0, 0, 0, 1, 2, 2, 2, 0, 2, 1, 2, 4\}$
 $\{1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 0, 1, 2\}$
 $\{-2, 0, -2, 0, 0, 0, -2, -2, 0, -2, 0, -4, -4\}$

SG 204

$\{1, 1, 3, 1, 1, 3, 1, 1, 3, 1, 1, 3, 2, 2, 6, 6, 6, 6\}$
 $\{1, 1, 1, 0, 0, 2, 1, 1, 1, 0, 0, 2, 1, 1, 3, 4, 2, 2, 4\}$
 $\{1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 2, 0, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 2, 2, 0, 1, 3\}$
 $\{1, 1, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 1, 3, 1, 0, 2\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1\}$
 $\{0, 0, 0, 0, 1, 2, 0, 1, 2, 0, 0, 0, 0, 1, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 2\}$
 $\{1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0\}$
 $\{0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 2, 0, 0, 0\}$

SG 205

$\{1, 1, 3, 1, 1, 3, 6, 6, 6, 1, 2, 1, 2\}$
 $\{1, 0, 1, 1, 0, 1, 2, 2, 2, 0, 1, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1\}$
 $\{0, 0, 0, 0, 1, 2, 2, 2, 2, 1, 1, 0, 0\}$
 $\{1, 0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0\}$
 $\{0, 0, 0, 0, 1, 2, 2, 2, 2, 0, 0, 1, 1\}$

SG 206

$\{1, 1, 3, 1, 1, 3, 1, 1, 3, 1, 1, 3, 2, 4, 12\}$
 $\{1, 1, 1, 1, 1, 1, 0, 0, 2, 0, 0, 2, 1, 2, 6\}$
 $\{1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 2, 4\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 2\}$
 $\{0, 0, 0, 0, 1, 2, 0, 1, 2, 0, 0, 0, 1, 1, 4\}$
 $\{1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 2\}$
 $\{0, 0, 0, 0, 1, 2, 0, 0, 0, 0, 1, 2, 1, 1, 4\}$

SG 207

$\{1, 1, 2, 3, 3, 3, 3, 3, 6, 3, 3, 3, 3, 6, 1, 1, 2, 3, 3\}$
 $\{1, 0, 1, 1, 2, 1, 2, 2, 1, 3, 2, 1, 1, 2, 3, 0, 1, 1, 2, 1\}$
 $\{1, 0, 1, 1, 2, 2, 1, 1, 2, 3, 2, 1, 1, 2, 3, 1, 0, 1, 1, 2\}$
 $\{-1, 0, -1, -2, -3, -2, -2, -2, -2, -5, -3, -2, -2, -3, -4, -1, -1, -2, -2, -2\}$
 $\{0, 0, -1, -1, -1, -1, -1, -1, -1, -2, -1, -1, -1, -1, -2, 0, 0, -1, -1, -1\}$
 $\{0, 0, 0, 0, -1, 0, 0, -1, 0, -1, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0\}$
 $\{0, 0, 0, 1, 1, 1, 0, 1, 0, 2, 1, 0, 1, 0, 2, 0, 0, 0, 1, 1\}$
 $\{0, 0, 0, 0, -1, 0, 0, 0, -1, -1, 0, 0, 0, -1, -1, 0, 0, 0, 0, -1\}$
 $\{0, 0, 0, 1, 1, 0, 1, 0, 1, 2, 0, 1, 0, 1, 2, 0, 0, 0, 1, 1\}$

SG 208

$\{1, 1, 2, 3, 3, 3, 3, 3, 6, 3, 3, 3, 3, 6, 1, 1, 2, 3, 3\}$
 $\{1, 0, 1, 1, 2, 2, 1, 1, 2, 3, 1, 2, 2, 1, 3, 0, 1, 1, 2, 1\}$
 $\{1, 0, 1, 1, 2, 1, 2, 2, 1, 3, 1, 2, 2, 1, 3, 1, 0, 1, 1, 2\}$
 $\{-1, 0, -1, -2, -3, -2, -3, -2, -3, -4, -2, -2, -3, -1, -5, -1, -1, -2, -2, -2\}$
 $\{-1, 0, -1, -2, -3, -3, -2, -3, -2, -4, -1, -3, -2, -2, -5, -1, -1, -2, -2, -2\}$
 $\{0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, 0, 0, 0, -1, -1\}$
 $\{0, 0, -1, -1, -1, -1, -1, -1, -2, -1, -1, -1, -1, -2, 0, 0, -1, -1, -1\}$

SG 209

$\{1, 1, 2, 3, 3, 3, 3, 3, 6, 4, 4, 8, 6, 6, 6\}$
 $\{0, 0, 0, -1, -1, -1, 0, -1, 0, -2, -1, -1, -2, -2, -2, -1\}$
 $\{1, 0, 1, 1, 2, 2, 1, 1, 2, 3, 1, 3, 4, 2, 4, 3\}$
 $\{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, -1, 0, 1, -1, 0\}$
 $\{0, 0, -1, -1, -1, -1, -1, -1, -1, -2, -1, -1, -3, -2, -2, -2\}$
 $\{0, 0, 0, 0, -1, 0, 0, 0, -1, -1, 0, -1, -1, 0, -1, -1\}$
 $\{0, 0, 0, 1, 1, 0, 1, 0, 1, 2, 1, 1, 2, 1, 1, 2\}$

SG 210

$\{1, 1, 2, 3, 3, 3, 3, 3, 6, 4, 4, 8, 12\}$
 $\{1, 0, 1, 1, 2, 2, 1, 1, 2, 3, 2, 2, 4, 6\}$
 $\{0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, -1, -2, -3\}$
 $\{0, 0, -1, -1, -1, -1, -1, -1, -1, -2, -1, -1, -3, -4\}$

SG 211

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 2, 2, 2, 6, 6, 6, 6, 6\}$
 $\{1, 0, 1, 1, 2, 0, 1, 1, 2, 1, 1, 1, 1, 3, 3, 3, 2, 4\}$
 $\{1, 0, 1, 1, 2, 1, 0, 1, 1, 2, 1, 1, 1, 3, 4, 2, 3, 3\}$
 $\{0, 0, 0, -1, -1, 0, 0, 0, -1, -1, -1, -1, -1, -1, -2, -2, -1, -1\}$
 $\{0, 0, -1, -1, -1, 0, 0, -1, -1, -1, 0, -1, -1, -2, -2, -2, -2, -2\}$
 $\{0, 0, 0, 0, -1, 0, 0, 0, 0, -1, 0, 0, 0, -1, -1, 0, -1, -1\}$
 $\{0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 2, 1, 1, 2, 2\}$

SG 212

$\{1, 1, 2, 3, 3, 6, 6, 3, 3, 6, 2, 4\}$
 $\{1, 0, 1, 1, 2, 3, 3, 1, 2, 3, 1, 2\}$
 $\{0, 0, -1, -1, -1, -2, -2, -1, -1, -2, -1, -1\}$

SG 213

$\{1, 1, 2, 3, 3, 6, 6, 3, 3, 6, 2, 4\}$
 $\{1, 0, 1, 1, 2, 3, 3, 2, 1, 3, 1, 2\}$
 $\{0, 0, -1, -1, -1, -2, -2, -1, -1, -2, -1, -1\}$

SG 214

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 4, 4, 4, 6, 6, 6, 6\}$
 $\{1, 0, 1, 1, 2, 1, 0, 1, 2, 1, 2, 2, 2, 4, 3, 3, 2\}$
 $\{1, 0, 1, 1, 2, 0, 1, 1, 1, 2, 2, 2, 2, 3, 4, 2, 3\}$
 $\{-1, 0, -1, -2, -3, -1, -1, -2, -2, -2, -3, -3, -3, -5, -5, -4, -4\}$
 $\{0, 0, -1, -1, -1, 0, 0, -1, -1, -1, -2, -1, -1, -2, -2, -2, -2\}$

SG 215

$\{1, 1, 2, 3, 3, 3, 3, 3, 6, 3, 3, 3, 3, 6, 1, 1, 2, 3, 3\}$
 $\{1, 0, 1, 1, 2, 2, 1, 1, 2, 3, 2, 1, 1, 2, 3, 1, 0, 1, 1, 2\}$
 $\{1, 1, 2, 1, 1, 2, 2, 2, 2, 2, 1, 1, 1, 1, 4, 0, 0, 0, 2, 2\}$
 $\{1, 0, 1, 0, 1, 1, 1, 0, 2, 1, 1, 1, 0, 2, 1, 1, 0, 1, 0, 1\}$
 $\{1, 0, 1, 0, 1, 2, 0, 1, 1, 1, 2, 0, 1, 1, 1, 1, 0, 1, 0, 1\}$
 $\{1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1\}$

$\{1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1\}$
 $\{1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0\}$

SG 216

$\{1, 1, 2, 3, 3, 3, 3, 3, 6, 4, 4, 8, 6, 6, 6, 6\}$
 $\{1, 0, 1, 1, 2, 2, 1, 1, 2, 3, 3, 1, 4, 3, 3, 3, 3\}$
 $\{1, 0, 1, 0, 1, 1, 1, 0, 2, 1, 2, 0, 2, 1, 2, 1, 2\}$
 $\{1, 0, 1, 0, 1, 2, 0, 1, 1, 1, 2, 0, 2, 2, 1, 2, 1\}$
 $\{1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 2, 0, 1, 1, 1, 1, 1\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0\}$

SG 217

$\{1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 1, 1, 2, 3, 3, 6, 6, 6, 6\}$
 $\{1, 0, 1, 1, 2, 1, 0, 1, 1, 2, 1, 0, 1, 1, 2, 4, 2, 3, 3\}$
 $\{1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 0, 0, 0, 2, 2, 2, 2, 4, 4\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 3, 1, 1, 1\}$
 $\{1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 2, 2\}$
 $\{1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 2, 0, 1, 1\}$
 $\{1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1\}$
 $\{1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0\}$

SG 218

$\{1, 1, 2, 3, 3, 3, 3, 6, 3, 3, 3, 3, 6, 1, 1, 3\}$
 $\{1, 1, 2, 1, 1, 0, 2, 4, 3, 1, 3, 1, 2, 0, 0, 2\}$
 $\{0, 0, 0, 0, 0, 1, -1, 0, -1, 1, -1, 1, 0, 0, 0, 0\}$
 $\{0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, 0, 0, -1\}$
 $\{1, 1, 0, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 0, 1\}$
 $\{1, 0, 1, 1, 0, 0, 1, 2, 2, 1, 1, 0, 1, 0, 0, 1\}$
 $\{1, 0, 1, 1, 0, 1, 0, 2, 0, 1, 1, 2, 1, 0, 0, 1\}$

SG 219

$\{1, 1, 2, 3, 3, 3, 3, 3, 6, 4, 4, 6, 6\}$
 $\{0, 0, 0, -1, -1, -1, 0, -1, 0, -2, -1, -1, -2, -1\}$
 $\{0, 0, 0, -1, -1, 0, -1, 0, -1, -2, -1, -1, -1, -2\}$
 $\{1, 1, 0, 1, 1, 1, 1, 1, 2, 2, 1, 2, 2\}$
 $\{1, 0, 1, 1, 0, 2, 1, 1, 0, 1, 1, 1, 2, 1\}$
 $\{1, 0, 1, 1, 0, 0, 1, 1, 2, 1, 1, 1, 1, 2\}$

SG 220

$\{1, 1, 2, 3, 3, 1, 1, 3, 2, 2, 4, 12\}$
 $\{1, 1, 2, 1, 1, 0, 0, 2, 1, 1, 2, 6\}$
 $\{1, 1, 0, 1, 1, 1, 0, 1, 0, 0, 2, 4\}$
 $\{1, 0, 1, 1, 0, 0, 0, 1, 0, 1, 1, 3\}$
 $\{1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 3\}$

SG 221

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 3, 3, 6, 3, 3, 3, 3, 6, 3, 3, 3, 3, 6, 3, 3, 3, 6, 1, 1, 1, 1, 2, 2, 3, 3, 3, 3\}$
 $\{1, 0, 1, 0, 1, 1, 1, 2, 2, 1, 2, 1, 1, 2, 3, 1, 2, 2, 1, 3, 2, 1, 1, 2, 3, 1, 2, 2, 1, 3, 1, 0, 1, 0, 1, 1, 1, 2, 2, 1\}$
 $\{1, 1, 0, 0, 2, 0, 1, 1, 2, 2, 2, 0, 2, 0, 4, 1, 3, 1, 3, 2, 1, 3, 1, 3, 2, 2, 0, 2, 0, 4, 0, 0, 1, 1, 0, 2, 2, 2, 1, 1\}$
 $\{1, 1, 0, 0, 2, 0, 1, 1, 2, 2, 3, 1, 3, 1, 2, 0, 2, 0, 2, 4, 3, 1, 3, 1, 2, 0, 2, 0, 2, 4, 1, 1, 0, 0, 2, 0, 1, 1, 2, 2\}$
 $\{1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0, 2, 0, 2, 1, 1, 1, 1, 0, 2, 1, 1, 0, 1, 0, 1, 0, 2, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0\}$
 $\{1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 2, 0, 1, 1, 1, 0, 1, 0, 1, 2, 2, 0, 1, 1, 1, 0, 1, 0, 1, 2, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1\}$
 $\{1, 1, 0, 0, 2, 0, 0, 0, 1, 1, 2, 0, 2, 0, 1, 0, 2, 0, 2, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 3, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1\}$

{1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0}
 {1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 2, 0, 1, 0, 0, 1, 0, 2, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0}
 {0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 2, 0, 0, 2, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0}
 {1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 2, 0, 1, 0, 0, 0, 1, 0, 0, 1, 2, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0}
 {0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 2, 0, 0, 0, 0, 0, 1, 1, 1, 0, 2, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1}
 {1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0}
 {0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1}
 {1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0}
 {0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0}
 {1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}
 {0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}
 {0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}
 {1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}
 {0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}
 {0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0}

SG 222

{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 6, 6, 6, 6, 6, 6, 2, 2, 6}
 {1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 3, 3, 3, 4, 3, 2, 3, 1, 1, 3}
 {0, 0, 0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -2, -2, -1, -2, -1, -1, -1, -1}
 {0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -2, -2, -2, -2, -2, -2, -2, 0, -1, -2}
 {0, 0, 0, 0, 0, 0, -1, 0, -1, 0, -1, -1, -1, -1, 0, -1, 0, 0, -1}
 {0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 2, 1, 2, 1, 2, 0, 0, 2}
 {1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 2, 2, 1, 1, 2, 1, 2, 0, 0, 2}
 {1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1}
 {0, 0, 0, 0, 0, 2, 0, 0, 2, 2, 2, 2, 2, 2, 2, 2, 0, 1, 2}

SG 223

{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 6, 6, 6, 6, 3, 3, 3, 3, 6, 3, 3, 3, 3, 6, 2, 2, 6}
 {1, 1, 0, 0, 2, 0, 1, 1, 1, 2, 2, 5, 3, 1, 3, 1, 1, 1, 1, 4, 2, 2, 2, 2, 2, 1, 1, 3}
 {1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 3, 3, 3, 3, 2, 1, 1, 2, 3, 2, 1, 1, 2, 3, 1, 1, 3}
 {0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -2, -2, -2, -2, -1, -1, -1, -1, -2, -1, -1, -1, -1, -2, 0, -1, -2}
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 {1, 1, 0, 0, 2, 0, 0, 0, 1, 1, 4, 0, 0, 2, 1, 0, 1, 0, 2, 2, 1, 2, 1, 0, 0, 0, 2}
 {1, 1, 0, 0, 2, 0, 0, 0, 1, 1, 4, 1, 0, 1, 0, 0, 0, 0, 3, 1, 1, 1, 1, 1, 1, 1, 1}
 {1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 2, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0, 1}
 {1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 2, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1}
 {1, 1, 0, 0, 2, 0, 0, 0, 0, 0, 3, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 1}
 {1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0}
 {0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 1, 0}

SG 224

{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 6, 6, 6, 6, 6, 6, 6, 1, 1, 1, 1, 2, 2, 3, 3, 3, 3}
 {1, 0, 1, 0, 1, 1, 1, 2, 2, 1, 3, 2, 3, 4, 3, 2, 3, 4, 1, 0, 1, 0, 1, 1, 1, 2, 2, 1}
 {1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 4, 3, 2, 3, 2, 3, 4, 3, 0, 1, 1, 0, 1, 1, 2, 1, 2, 1}
 {1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 2, 3, 4, 3, 2, 3, 4, 3, 1, 0, 0, 1, 1, 1, 1, 2, 1, 2}
 {-1, 0, 0, -1, -1, -1, -2, -3, -2, -3, -5, -4, -5, -4, -3, -5, -5, -5, -1, -1, -1, -1, -2, -2, -2, -2, -2, -2}
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 {1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 1, 2, 1, 0, 1, 2, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0}
 {1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 2, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0}
 {1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0}
 {0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1}
 {1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0}
 {0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0}
 {1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0}

SG 225

{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 6, 3, 3, 3, 3, 6, 4, 4, 4, 4, 8, 8, 6, 6, 6, 6, 12}

$\{1, 0, 1, 0, 1, 1, 1, 2, 2, 1, 2, 1, 1, 2, 3, 1, 2, 2, 1, 3, 3, 1, 1, 3, 4, 4, 3, 3, 3, 6\}$
 $\{1, 1, 0, 0, 2, 0, 1, 1, 2, 2, 3, 1, 3, 1, 2, 0, 2, 0, 2, 4, 2, 2, 2, 2, 4, 4, 5, 1, 1, 5, 6\}$
 $\{1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 2, 0, 1, 1, 1, 0, 1, 0, 1, 2, 1, 1, 0, 2, 2, 2, 2, 1, 0, 3, 3\}$
 $\{1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 2, 0, 1, 1, 1, 0, 1, 0, 1, 2, 2, 0, 1, 1, 2, 2, 3, 0, 1, 2, 3\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 2, 1, 0, 2, 1, 1, 1, 2, 0, 0, 2, 2, 2, 1, 1, 1, 1, 4\}$
 $\{1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 2, 0, 0, 2, 1, 1, 1, 1, 1, 2\}$
 $\{1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 2, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 2, 0, 0, 2, 1\}$
 $\{0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 2, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 2, 0, 0, 2, 1\}$
 $\{1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 2\}$
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 $\{0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0\}$
 $\{0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0\}$
 $\{1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0\}$
 $\{0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0\}$
 $\{0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0\}$

SG 226

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 3, 3, 3, 6, 3, 3, 3, 3, 6, 8, 8, 6, 6, 12\}$
 $\{1, 1, 0, 0, 2, 0, 1, 1, 2, 2, 1, 3, 1, 3, 2, 2, 0, 2, 0, 4, 4, 4, 1, 5, 6\}$
 $\{1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 2, 1, 1, 2, 3, 2, 1, 1, 2, 3, 4, 4, 3, 3, 6\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, -1, -1, -2, -1, -1, -1, -1, -2, -3, -2, -2, -2, -4\}$
 $\{0, 0, 0, 0, 0, 0, 0, -1, 0, -1, 0, 0, 0, -1, -1, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1\}$
 $\{0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 0, 1, 2, 0, 1, 0, 1, 2, 2, 2, 2, 2, 2\}$
 $\{1, 1, 0, 0, 2, 0, 0, 0, 1, 1, 0, 3, 0, 3, 0, 1, 0, 1, 0, 2, 2, 2, 0, 4, 2\}$
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 $\{0, 0, 0, 0, 2, 0, 0, 0, 0, 0, 0, 2, 0, 2, 0, 0, 0, 0, 0, 0, 1, 0, 0, 2, 0\}$

SG 227

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 6, 6, 6, 6, 4, 4, 4, 4, 8, 8, 12, 12\}$
 $\{1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 3, 4, 3, 2, 2, 2, 2, 2, 4, 4, 6, 6\}$
 $\{1, 0, 1, 0, 1, 1, 1, 2, 2, 1, 4, 3, 2, 3, 3, 1, 1, 3, 4, 4, 6, 6\}$
 $\{1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 3, 1, 1, 1, 2, 0, 0, 2, 2, 2, 3, 3\}$
 $\{1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 2, 1, 0, 1, 2, 0, 0, 2, 1, 1, 2, 2\}$
 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1\}$
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 $\{1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1, 1\}$
 $\{0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 2, 2, 2\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1\}$
 $\{1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0\}$

SG 228

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 6, 6, 6, 6, 8, 8, 12\}$
 $\{1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 2, 3, 4, 3, 4, 4, 6\}$
 $\{0, 0, 0, 0, 0, 0, -1, -1, -1, -1, -2, -1, -2, -1, -2, -2, -3\}$
 $\{0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -2, -2, -2, -2, -3, -2, -4\}$
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 $\{1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 2, 2\}$
 $\{0, 0, 0, 0, 0, 2, 0, 0, 2, 2, 2, 2, 2, 2, 3, 2, 4\}$

SG 229

$\{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 4, 6, 6, 6, 6, 6, 6, 6, 6, 6\}$
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 $\{1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 0, 1, 1, 0, 1, 1, 2, 1, 2, 1, 1, 1, 2, 3, 3, 3, 2, 3, 4, 3, 2, 3, 4\}$

{1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 2, 3, 1, 1, 1, 1, 2, 1, 2}
 {1, 1, 0, 0, 2, 0, 0, 0, 1, 1, 1, 1, 0, 0, 2, 0, 0, 0, 1, 1, 0, 0, 0, 2, 2, 2, 1, 2, 1, 0, 3, 0, 3}
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 {0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 1, 1, 0, 1, 0, 2, 0, 1, 1, 0, 1}
 {1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 0, 2}
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 {1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1}
 {0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1}
 {1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0}
 {0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0}
 {0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0}

SG 230

{1, 1, 1, 1, 2, 2, 3, 3, 3, 3, 2, 2, 6, 4, 8, 12, 12}
 {1, 0, 0, 1, 1, 1, 1, 2, 1, 2, 1, 1, 3, 2, 4, 7, 5}
 {0, 0, 0, 0, 0, 0, -1, -1, -1, -1, -1, -1, -1, -1, -2, -3, -3}
 {0, 0, 0, 0, -1, -1, -1, -1, -1, -1, 0, -1, -2, -2, -2, -4, -4}
 {1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 0, 2, 1, 2, 3, 3}
 {1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 2, 2, 2}
 {0, 0, 0, 0, 0, 2, 0, 0, 2, 2, 0, 1, 2, 2, 2, 4, 4}

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