

Supplementary Information for

Disorder-specific alterations of transient oscillatory dynamics during sleep across cortical and subcortical networks

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Table S1. Sociodemographic and polysomnographic characteristics

Variable	Control		NREMP		NT		RBD		FM		χ^2	p
Gender, % females	48.72		50.00		50.00		11.76		90.91		0.040	.842
Variable	Control		NREMP		NT		RBD		FM		U	p
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Age (years)	45.949	16.540	39.375	6.869	30.875	11.506	60.176	9.639	45.091	6.534	1288.500	.398
TST (min)	420.969	36.058	382.863	39.840	412.525	49.319	361.176	58.091	339.382	89.307	1697.500	1.6E-04*
WASO (min)	60.313	39.087	52.063	42.734	60.675	27.395	90.929	46.740	106.400	67.992	999.000	.222
SOT (min)	21.621	13.170	10.069	7.667	6.275	4.690	21.159	26.371	30.855	38.433	1686.500	2.2E-04*
SE (%)	84.185	8.262	86.494	8.006	85.956	5.877	76.441	12.031	71.227	16.433	1296.500	.367
SL to N1 (min)	21.621	13.170	10.069	7.667	6.275	4.690	21.159	26.371	30.855	38.433	1686.500	2.2E-04*
SL to N2 (min)	26.236	13.689	14.663	8.196	10.869	7.486	26.718	27.673	45.764	49.438	1614.500	.001*
SL to N3 (min)	43.185	18.689	28.944	13.157	20.244	10.547	36.394	28.433	65.627	55.479	1638.000	.001*
SL to REM (min)	81.910	30.172	87.375	23.370	88.406	27.710	109.618	77.669	89.600	43.982	1020.500	.347
AHI	1.846	0.709	1.281	1.928	1.463	1.377	3.571	3.135	1.282	1.550	1411.500	.083
AI	11.685	3.938	15.669	6.699	17.244	5.036	21.106	8.132	20.355	9.002	477.000	7.1E-07*
N1 % of TST	8.972	4.076	8.425	2.841	10.675	5.693	12.265	5.439	13.836	13.664	939.000	.099
N2 % of TST	47.279	7.086	47.863	8.872	42.775	6.552	42.988	8.980	40.736	7.913	1445.000	.049*
N3 % of TST	21.100	6.016	21.469	8.637	26.119	7.154	24.588	6.948	24.327	7.771	872.500	.033*
REM % of TST	22.636	5.066	22.250	3.778	20.438	5.481	20.176	6.321	21.100	7.446	1321.500	.280

Notes. The table depicts results of statistical tests for Control (n=39) versus the combined patient group (NREMP n=16, NT n=16, RBD n=17, FM n=11). The Pearson χ^2 test was utilized for categorical variables, and the Mann-Whitney test was employed for ordinary variables.

Abbreviations: **AHI**, apnea-hypopnea index; **AI**, arousal index; **DF**, degrees of freedom; **FM**, fibromyalgia; **IQR**, interquartile range; **min**, minutes; **n**, number; **N1, N2, N3**, non-rapid eye movement sleep stages 1,2,3; **NREMP**, non-REM parasomnia; **NT**, narcolepsy type 1; **p**, p-value; **RBD**, idiopathic REM behavior disorder; **REM**, rapid eye movement sleep; **SD**, standard deviation; **SE**, sleep efficiency; **SL**, sleep latency; **SOT**, sleep onset time; **Total N**, total number of subjects in 5 groups; **TST**, total sleep time; **U**, Mann-Whitney test statistics; **WASO**, wake after sleep onset; **χ^2** , chi squared statistics; **%**, percent.

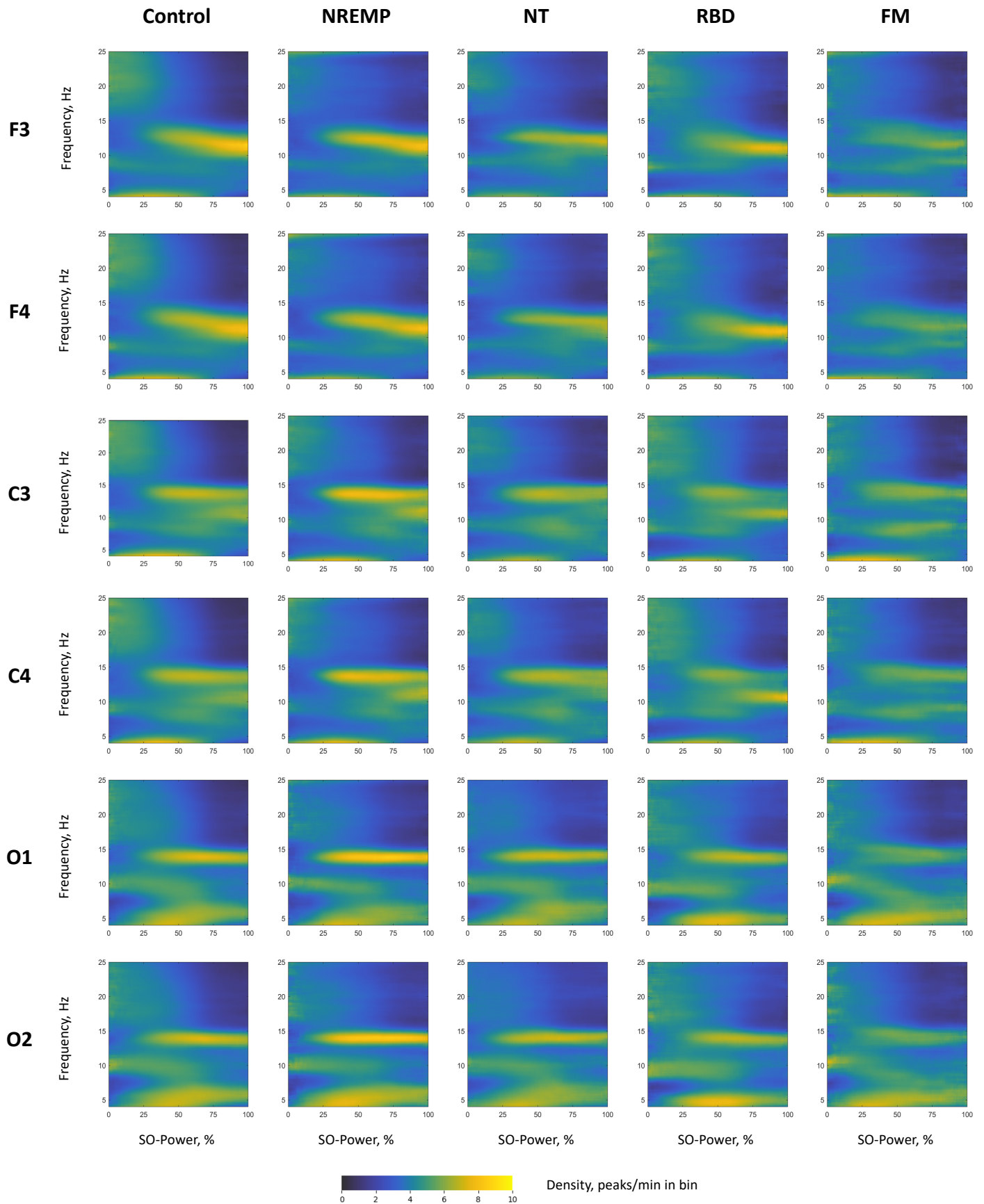
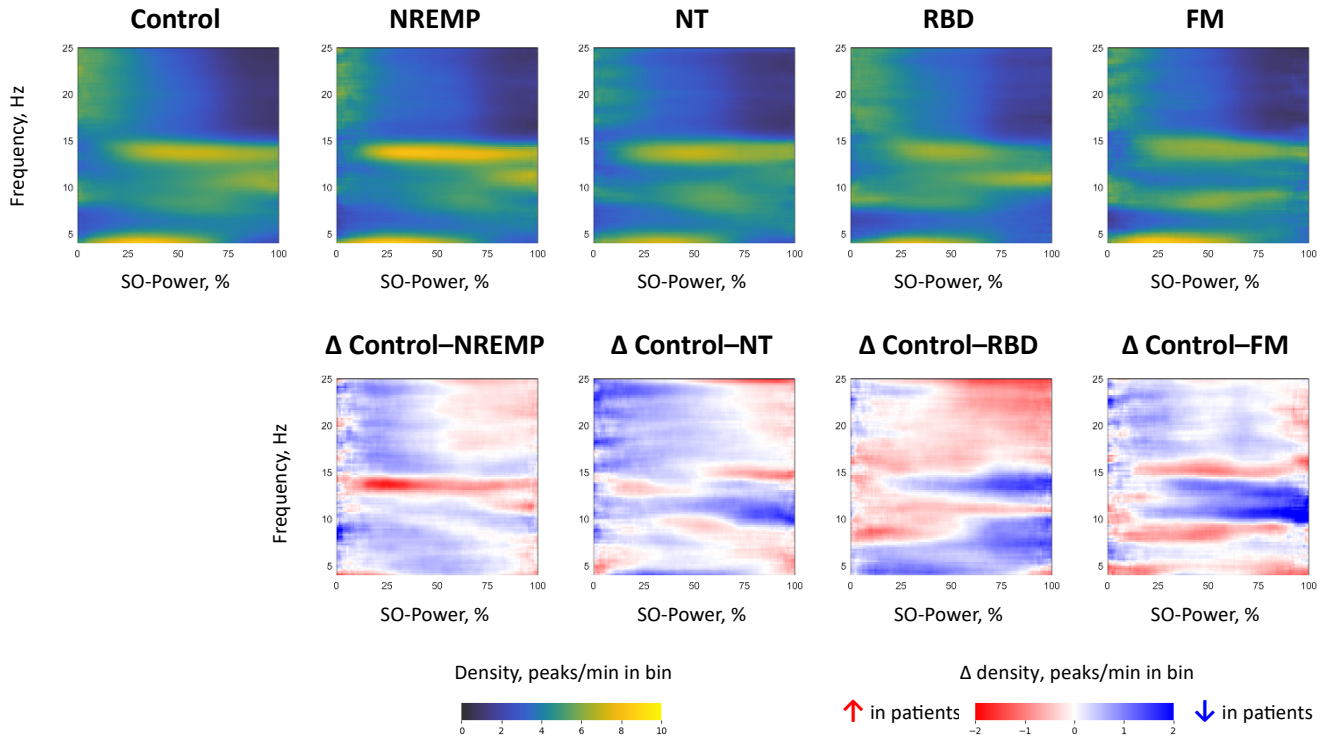


Fig S1. Group average SO-power histograms for NREM + REM stages together. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement stage, **SO**, slow oscillations; **%**, percent.

A NREM stages only, SO-power histograms, channel C3



B REM stage only, SO-power histograms, channel C3

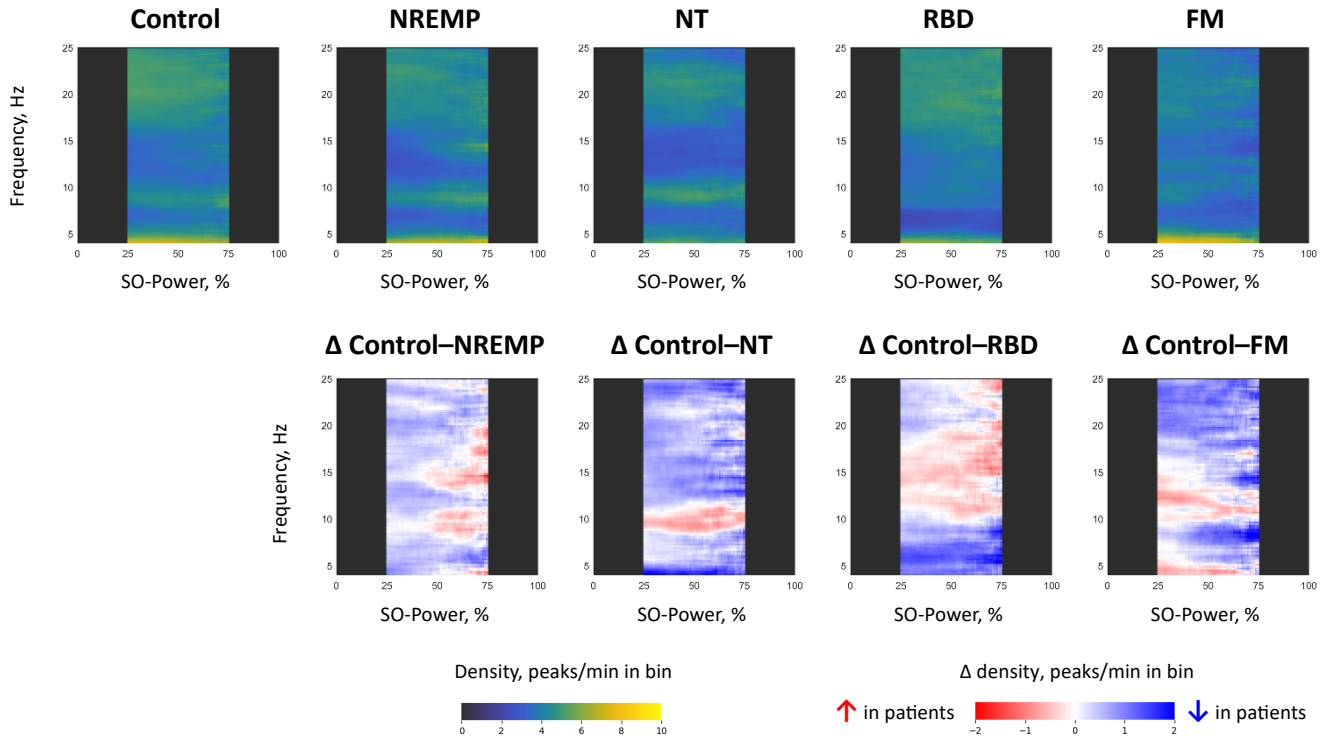


Fig. S2. SO-power histograms for NREM only and REM only stages (A and B, respectively) at channel C3. In each panel, the upper row of histograms illustrate group average, while the lower row shows arithmetical differences between histogram matrices. For REM histograms, only the diapason of 25-75% SO power was considered due to inconsistency in other diapasons (please see **Materials and Methods** section). Please see **Figure 2** for SO-power histograms at NREM+REM stages together and **Table S1** for detailed information about the groups.

Abbreviations: C3, channels' codes in the standard 10-20% electroencephalography montage; FM, fibromyalgia; Hz, hertz; min, minute; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage; SO, slow oscillations; %, percent.

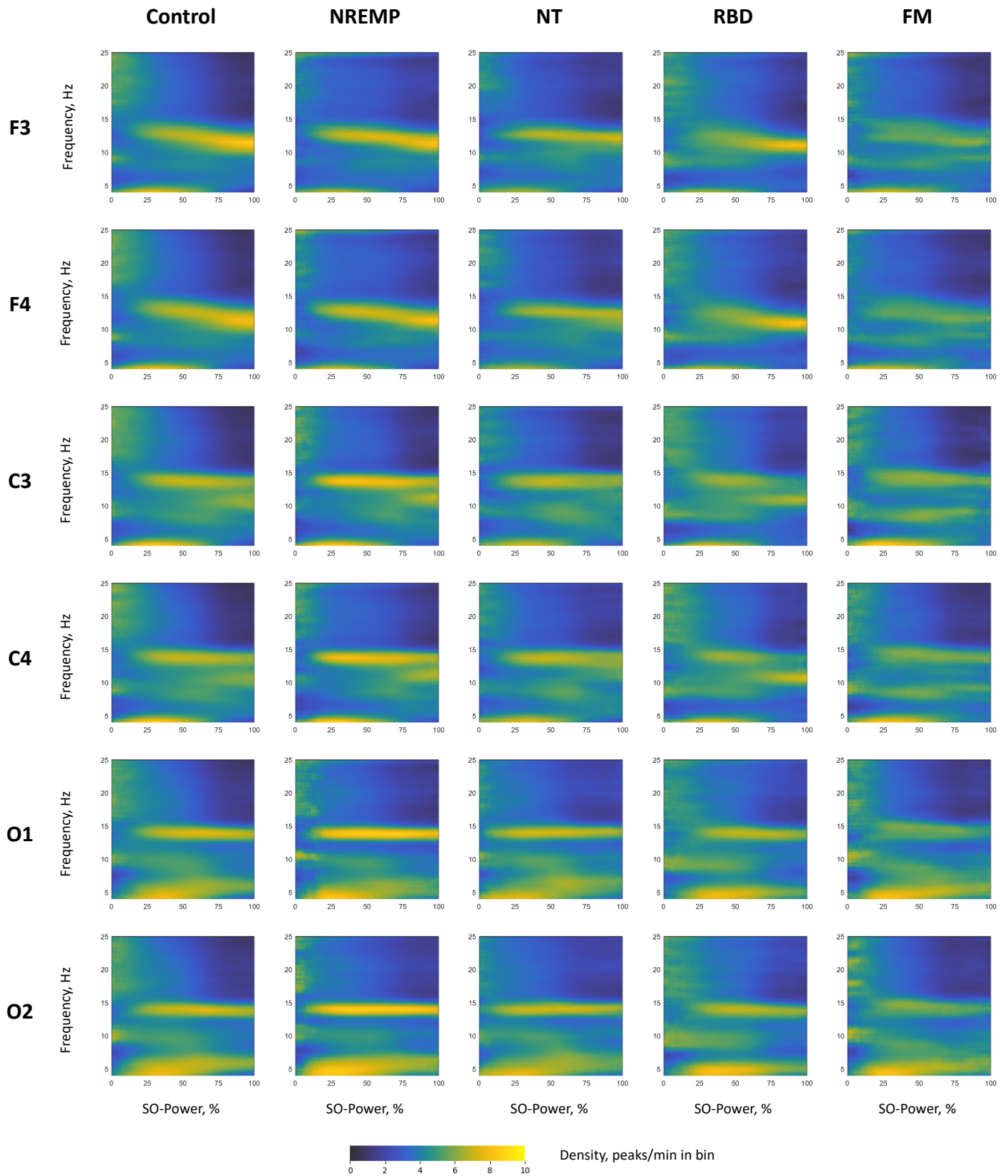


Fig. S3. Group average SO-power histograms for NREM stages only. Please see **Table S1** for detailed information about the groups. **Abbreviations:** [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **RBD**, rapid eye movement sleep behavior disorder; **SO**, slow oscillations; **%**, percent.

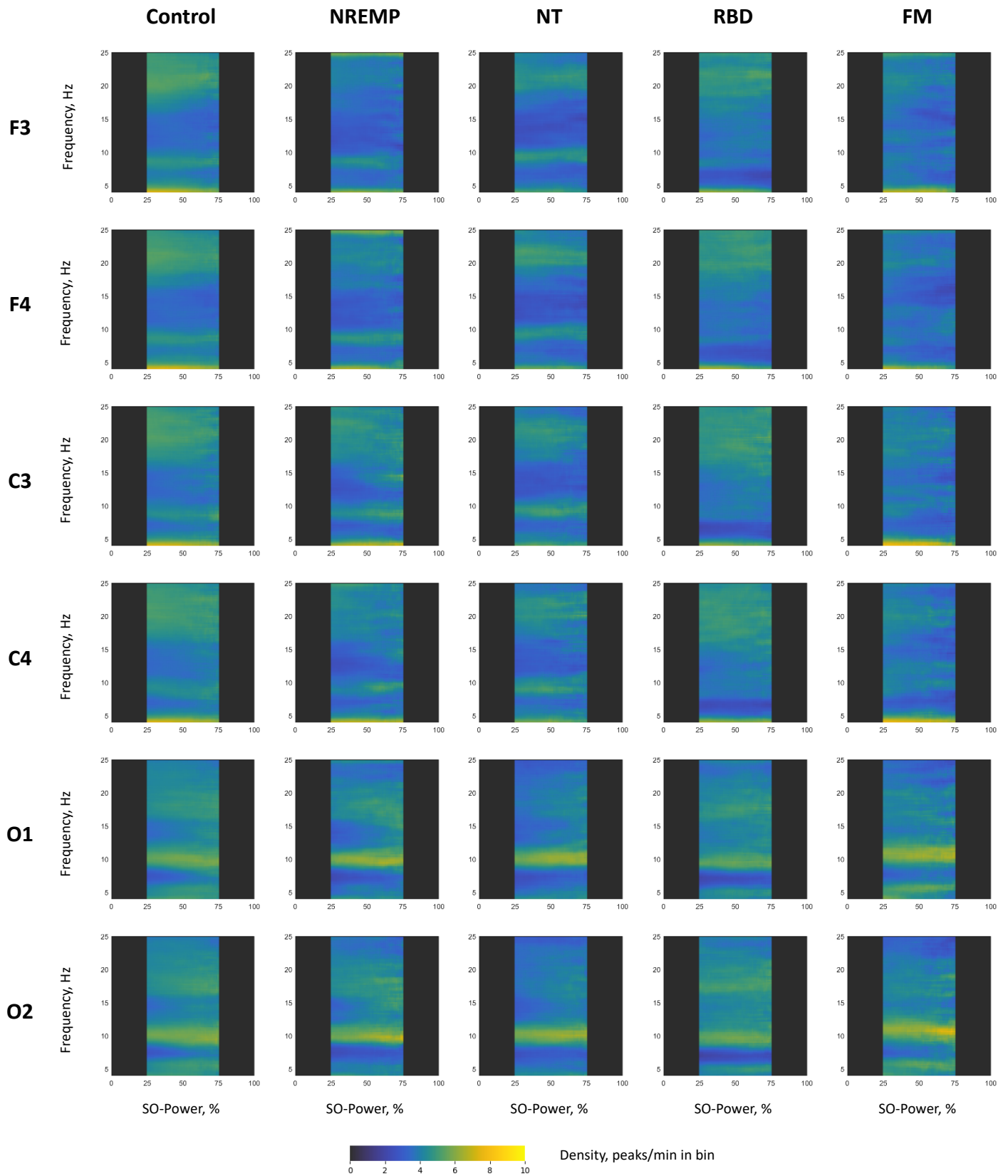


Fig. S4. Group average SO-power histograms for REM stages only. Please see **Table S1** for detailed information about the groups.
Abbreviations: [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement stage; **SO**, slow oscillations; **%**, percent.

Patterns of PCA/ICA components with significant differences between Control and patients, part 1 of 4

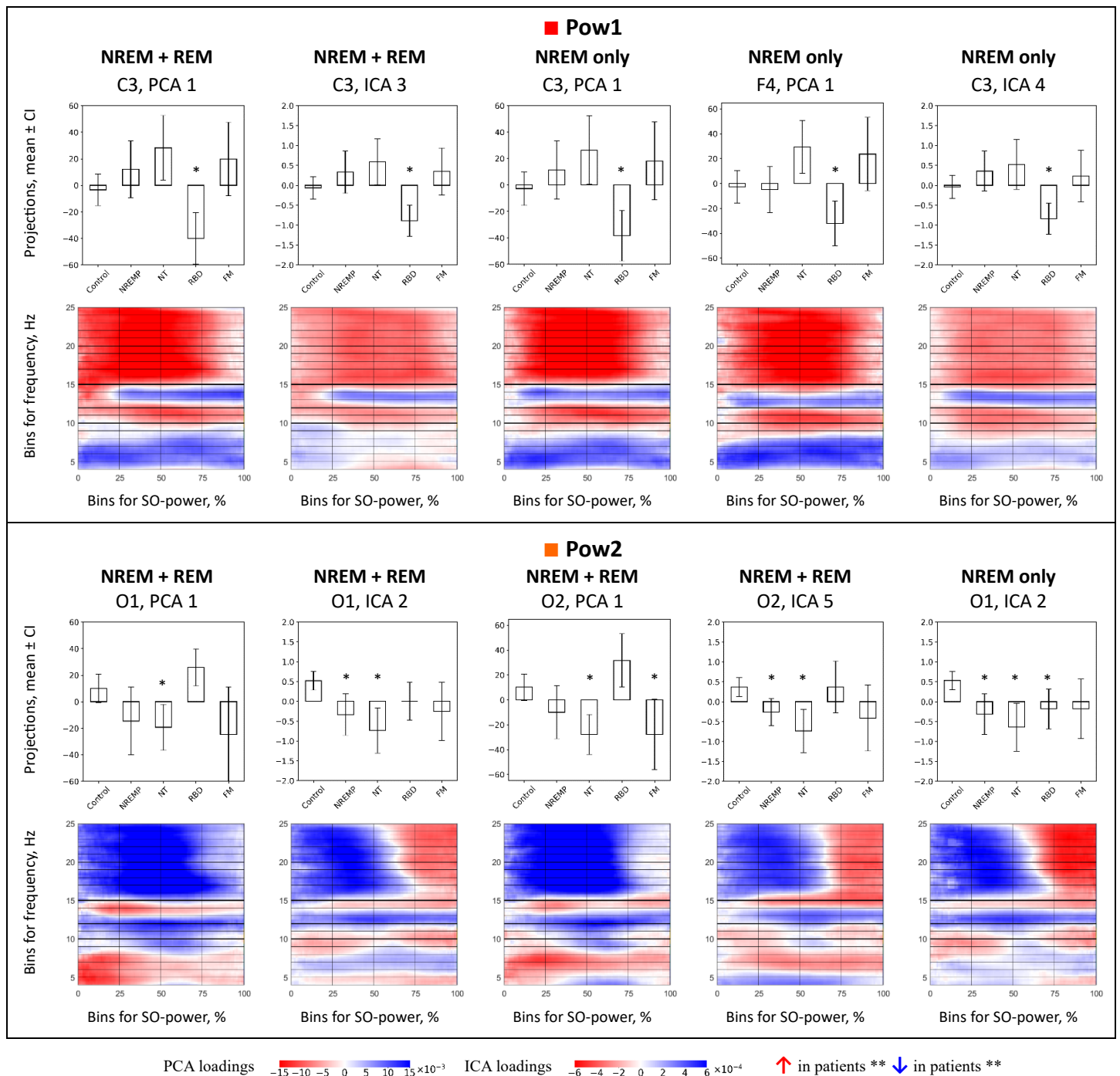


Fig. S5-1. SO-power histograms: PCA and ICA components that were associated with significant differences between groups (pairwise comparisons of Control versus each of the patient groups, $p \leq .05$ Bonferroni adjusted). Grid lines indicate frequency bands (1 Hz resolution) and SO-power quartiles. Thick lines mark bands of slow 10-12 Hz and fast 12-15 Hz sigma. Component histograms were classified into categories Pow1-Pow9 based on the visual similarity of the depicted patterns. Please refer to **Figure 3**, **Tables S2-S16**, and **Table S1** for summary of between-group differences, detailed statistics, and information about the groups, respectively.

* denotes statistically significant Bonferroni-corrected p-values, $p \leq .05$.

** red (increase) and blue (decrease) colors indicate these changes in patient groups with significant differences versus Control; all the patterns are oriented in such a way as to unify the interpretation approaches.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; CI, confidence intervals; Hz, hertz; FM, fibromyalgia; ICA, independent component analysis; ICA x, ICA component x; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; p, p-value; PCA, principal component analysis; PCA x, PCA component x; Pow1-Pow9, SO-power patterns 1-9; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage SO, slow oscillations; %, percent.

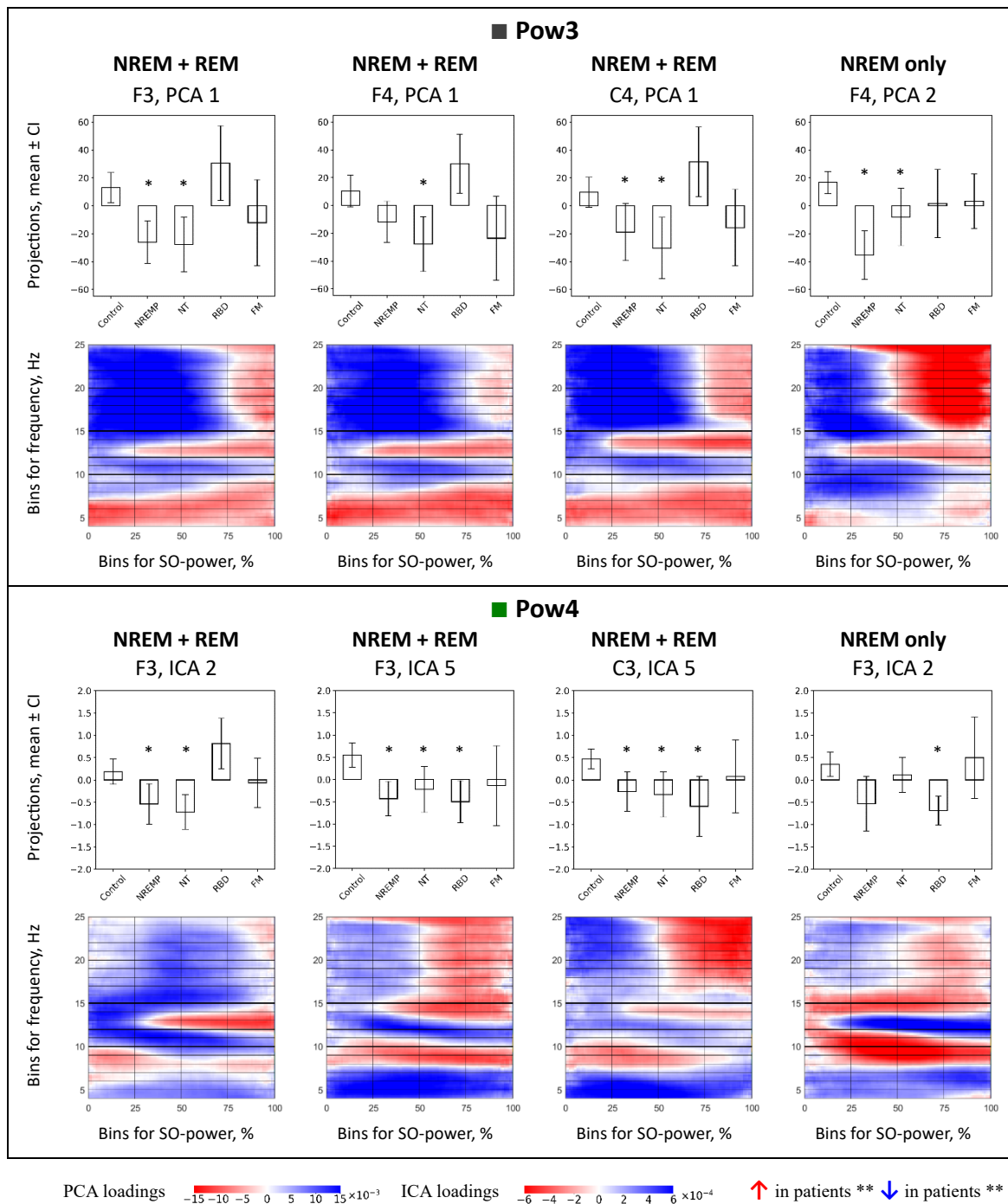


Fig. S5-2. SO-power histograms: PCA and ICA components that were associated with significant differences between groups (pairwise comparisons of Control versus each of the patient groups, $p \leq .05$ Bonferroni adjusted). Grid lines indicate frequency bands (1 Hz resolution) and SO-power quartiles. Thick lines mark bands of slow 10-12 Hz and fast 12-15 Hz sigma.

Component histograms were classified into categories Pow1-Pow9 based on the visual similarity of the depicted patterns. Please refer **Figure 3**, **Tables S2-S16**, and **Table S1** for summary of between-group differences, detailed statistics, and information about the groups, respectively.

* denotes statistically significant Bonferroni-corrected p-values, $p \leq .05$.

** red (increase) and blue (decrease) colors indicate these changes in patient groups with significant differences versus Control; all the patterns are oriented in such a way as to unify the interpretation approaches.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; CI, confidence intervals; Hz, hertz; FM, fibromyalgia; ICA, independent component analysis; ICA x, ICA component x; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; p, p-value; PCA, principal component analysis; PCA x, PCA component x; Pow1-Pow9, SO-power patterns 1-9; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage SO, slow oscillations; %, percent.

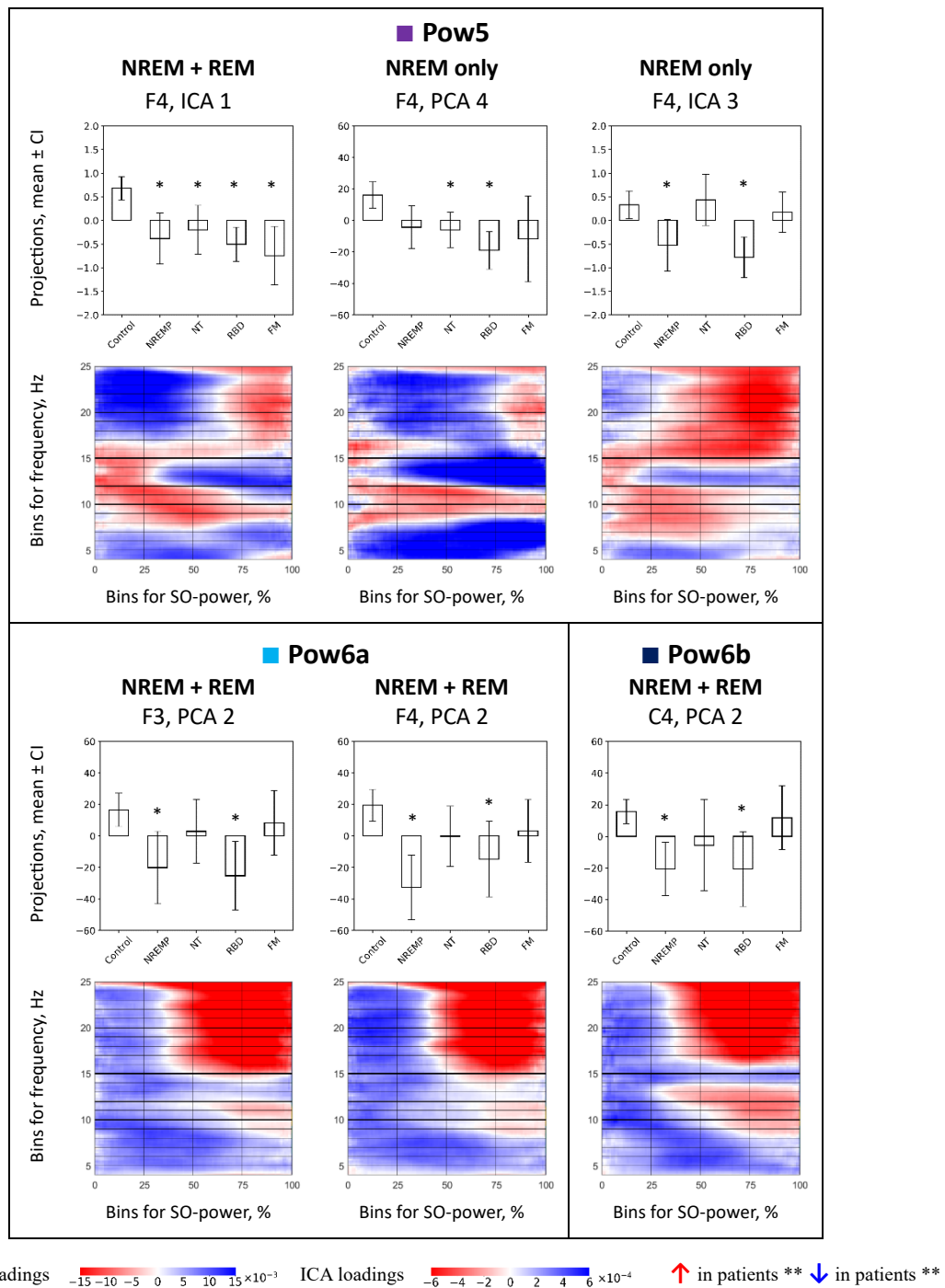


Fig. S5-3. SO-power histograms: PCA and ICA components that were associated with significant differences between groups (pairwise comparisons of Control versus each of the patient groups, $p \leq .05$ Bonferroni adjusted). Grid lines indicate frequency bands (1 Hz resolution) and SO-power quartiles. Thick lines mark bands of slow 10-12 Hz and fast 12-15 Hz sigma. Component histograms were classified into categories Pow1-Pow9 based on the visual similarity of the depicted patterns. Please refer to **Figure 3**, **Tables S2-S16**, and **Table S1** for summary of between-group differences, detailed statistics, and information about the groups, respectively.

* denotes statistically significant Bonferroni-corrected p-values, $p \leq .05$.

** red (increase) and blue (decrease) colors indicate these changes in patient groups with significant differences versus Control; all the patterns are oriented in such a way as to unify the interpretation approaches.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; CI, confidence intervals; Hz, hertz; FM, fibromyalgia; ICA, independent component analysis; ICA x, ICA component x; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; p, p-value; PCA, principal component analysis; PCA x, PCA component x; Pow1-Pow9, SO-power patterns 1-9; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage SO, slow oscillations; %, percent.

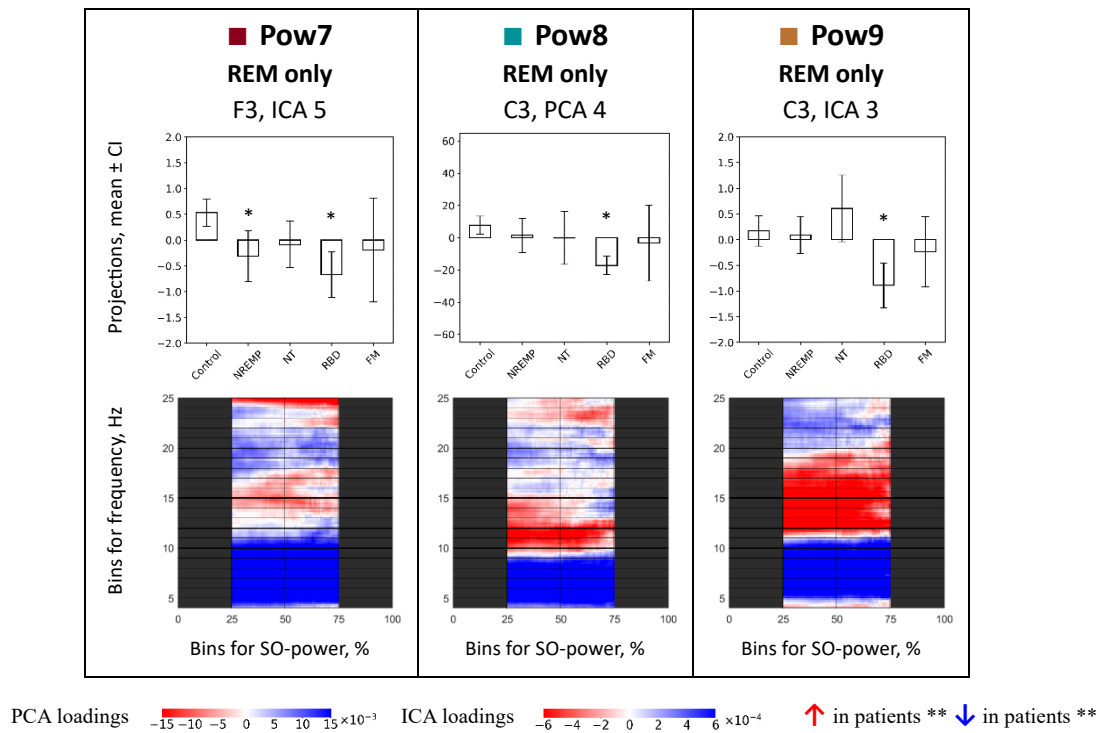


Figure S5-4. SO-power histograms: PCA and ICA components that were associated with significant differences between groups (pairwise comparisons of Control versus each of the patient groups, $p \leq .05$ Bonferroni adjusted). Grid lines indicate frequency bands (1 Hz resolution) and SO-power quartiles. Thick lines mark bands of slow 10-12 Hz and fast 12-15 Hz sigma. Component histograms were classified into categories Pow1-Pow9 based on the visual similarity of the depicted patterns. Please refer to **Figure 3**, **Tables S2-S16**, and **Table S1** for summary of between-group differences, detailed statistics, and information about the groups, respectively.

* denotes statistically significant Bonferroni-corrected p-values, $p \leq .05$.

** red (increase) and blue (decrease) colors indicate these changes in patient groups with significant differences versus Control; all the patterns are oriented in such a way as to unify the interpretation approaches.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; CI, confidence intervals; Hz, hertz; FM, fibromyalgia; ICA, independent component analysis; ICA x, ICA component x; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; p, p-value; PCA, principal component analysis; PCA x, PCA component x; Pow1-Pow9, SO-power patterns 1-9; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage SO, slow oscillations; %, percent.

Table S2. Summary of Kruskal–Wallis test between five groups (PCA and ICA components of SO-power histogram datasets; NREM + REM stages together; components with significant differences only)

Channel	Component	Total N	H	DF	η^2	p	α
F3	PCA 1	97	26.054	4	0.240	3.086E-05	.005 *
F3	PCA 2	97	19.273	4	0.166	6.947E-04	.027 *
F3	ICA 2	97	24.083	4	0.218	7.688E-05	.003 *
F3	ICA 5	97	24.407	4	0.222	6.619E-05	.003 *
F4	PCA 1	98	24.998	4	0.226	5.037E-05	.005 *
F4	PCA 2	98	23.933	4	0.214	8.238E-05	.006 *
F4	ICA 1	98	30.849	4	0.289	3.286E-06	3.938E-04*
F4	ICA 4	98	15.031	4	0.119	.005	.069 *
C3	PCA 1	97	21.079	4	0.186	3.054E-04	.014 *
C3	ICA 3	97	21.478	4	0.190	2.545E-04	.008 *
C3	ICA 5	97	19.423	4	0.168	0.001	.016 *
C4	PCA 1	97	22.004	4	0.196	2.001E-04	.011 *
C4	PCA 2	97	18.596	4	0.159	9.432E-04	.032 *
O1	PCA 1	98	18.319	4	0.154	1.069E-03	.032 *
O1	ICA 2	98	19.002	4	0.161	.001	.016 *
O2	PCA 1	95	25.638	4	0.240	3.744E-05	.005 *
O2	ICA 5	95	17.696	4	0.152	.001	.024 *

Notes: * (in bold) denotes statistically significant differences for adjusted α -values after the Benjamini-Yekutieli procedure, * $\alpha \leq .1$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; **DF**, degree of freedom; **H**, Kruskal-Wallis H test statistics; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **p**, p-value; **PCA**, principal component analysis; **REM**, rapid eye movement sleep stage; **SO**, slow oscillations; **Total N**, number of subjects; α , α -value; η^2 , effect size.

Table S3. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM + REM stages together, channel F3, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	12.934	5.324	2.135	23.732	-26.259	7.148	-41.496	-11.023	488.000	3.720	0.261	2.071E-04	.001*
NT					-27.719	9.162	-47.247	-8.190	472.000	3.410	0.219	.001	.003*
RBD					30.557	12.642	3.757	57.357	259.000	-1.034	0.020	.306	1.000
FM					-12.215	13.886	-43.155	18.725	272.000	1.680	0.059	.095	.381
PCA component 2													
NREMP	16.557	5.204	6.003	27.111	-20.091	10.788	-43.085	2.903	458.000	3.139	0.186	.002	.007*
NT					2.881	9.496	-17.360	23.121	340.000	0.852	0.014	.399	1.000
RBD					-25.176	10.315	-47.044	-3.309	512.000	3.678	0.251	2.435E-04	.001*
FM					8.249	9.191	-12.230	28.728	218.000	0.356	0.003	.731	1.000
ICA component 2													
NREMP	0.186	0.140	-0.099	0.471	-0.539	0.214	-0.994	-0.083	430.000	2.596	0.127	.010	.039*
NT					-0.716	0.183	-1.106	-0.327	463.000	3.236	0.198	.001	.005*
RBD					0.817	0.267	0.252	1.383	214.000	-1.872	0.065	.063	.250
FM					-0.064	0.249	-0.619	0.490	231.000	0.675	0.009	.508	1.000
ICA component 5													
NREMP	0.551	0.134	0.279	0.823	-0.431	0.183	-0.822	-0.041	502.000	3.991	0.301	6.849E-05	2.739E-04*
NT					-0.221	0.242	-0.737	0.295	440.000	2.790	0.147	.005	.022*
RBD					-0.497	0.224	-0.972	-0.023	525.000	3.920	0.285	9.186E-05	3.674E-04*
FM					-0.136	0.403	-1.035	0.762	290.000	2.122	0.094	.035	.140

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S2**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: adj p, Bonferroni-adjusted p-value; F3, channel’s code in the standard 10-20% electroencephalography montage; FM, fibromyalgia; ICA, independent component analysis; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; p, p-value; PCA, principal component analysis; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage; SE, standard error of mean; SO, slow oscillations; U, Mann–Whitney U test statistics; z, z-score; η^2 , effect size; 95% CI lower/upper, 95% confidence interval lower/upper.

Table S4. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM + REM stages together, channel F4, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	10.190	5.638	-1.233	21.613	-11.858	6.949	-26.669	2.953	417.000	2.141	0.085	.033	.132
NT					-27.898	9.256	-47.626	-8.170	481.000	3.353	0.208	.001	.003*
RBD					29.972	10.034	8.700	51.243	230.000	-1.694	0.052	.092	.368
FM					-23.697	13.552	-53.892	6.499	306.000	2.324	0.110	.021	.083
PCA component 2													
NREMP	19.486	4.944	9.468	29.504	-32.638	9.643	-53.191	-12.084	533.000	4.338	0.348	1.501E-05	6.003E-05*
NT					-0.202	8.939	-19.255	18.852	390.000	1.629	0.049	.105	.421
RBD					-14.712	11.253	-38.567	9.142	502.000	3.260	0.193	.001	.005*
FM					3.189	8.870	-16.574	22.952	274.000	1.558	0.050	.122	.489
ICA component 1													
NREMP	0.684	0.122	0.437	0.931	-0.381	0.254	-0.922	0.160	485.000	3.429	0.218	.001	.003*
NT					-0.198	0.243	-0.715	0.319	459.000	2.936	0.160	.003	.014*
RBD					-0.503	0.170	-0.863	-0.143	566.000	4.426	0.356	1.002E-05	4.010E-05*
FM					-0.744	0.277	-1.362	-0.126	367.000	3.786	0.293	.000	.001*
ICA component 4													
NREMP	-0.040	0.156	-0.356	0.276	0.325	0.236	-0.178	0.828	239.000	-1.231	0.028	.222	.887
NT					-0.515	0.246	-1.039	0.010	392.000	1.667	0.051	.097	.390
RBD					0.604	0.222	0.133	1.075	202.000	-2.204	0.088	.028	.113
FM					-0.520	0.257	-1.092	0.053	280.000	1.701	0.059	.091	.365

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S2**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: adj p, Bonferroni-adjusted p-value; F4, channel’s code in the standard 10-20% electroencephalography montage; FM, fibromyalgia; ICA, independent component analysis; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; p, p-value; PCA, principal component analysis; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage; SE, standard error of mean; SO, slow oscillations; U, Mann–Whitney U test statistics; z, z-score; η^2 , effect size; 95% CI lower/upper, 95% confidence interval lower/upper.

Table S5. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM + REM stages together, channel C3, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	-3.410	5.878	-15.309	8.490	12.034	10.044	-9.374	33.441	245.000	-1.242	0.028	.218	.871
NT					28.216	11.418	3.727	52.705	166.000	-2.443	0.111	.015	.060
RBD					-40.090	9.191	-59.573	-20.606	492.000	2.860	0.146	.004	.017*
FM					19.872	12.234	-7.804	47.548	133.000	-1.538	0.048	.127	.508
ICA component 3													
NREMP	-0.064	0.141	-0.348	0.221	0.331	0.248	-0.199	0.860	230.000	-1.520	0.042	.131	.524
NT					0.590	0.271	0.009	1.172	178.000	-2.211	0.091	.028	.111
RBD					-0.890	0.187	-1.287	-0.494	502.000	3.038	0.165	.002	.010*
FM					0.348	0.261	-0.243	0.938	143.000	-1.290	0.034	.201	.806
ICA component 5													
NREMP	0.471	0.111	0.247	0.696	-0.264	0.208	-0.707	0.179	489.000	3.280	0.196	.001	.004*
NT					-0.324	0.236	-0.830	0.182	449.000	3.022	0.169	.003	.010*
RBD					-0.591	0.319	-1.266	0.084	514.000	3.252	0.189	0.001	.005*
FM					0.075	0.361	-0.741	0.891	265.000	1.736	0.062	.085	.339

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S2**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **C3**, channel’s code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S6. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM + REM stages together, channel C4, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	9.671	5.334	-1.127	20.468	-18.839	9.607	-39.444	1.765	423.000	2.520	0.118	.012	.048*
NT					-30.384	10.236	-52.339	-8.430	464.000	3.312	0.203	.001	.004*
RBD					31.401	11.774	6.440	56.361	242.000	-1.595	0.045	.113	.451
FM					-15.692	12.304	-43.107	11.723	304.000	2.096	0.088	.037	.149
PCA component 2													
NREMP	15.758	3.786	8.093	23.424	-20.644	7.848	-37.477	-3.811	488.000	3.776	0.264	.000	.001*
NT					-5.585	13.432	-34.392	23.223	372.000	1.535	0.044	.127	.508
RBD					-20.648	11.160	-44.307	3.011	513.000	3.234	0.187	.001	.005*
FM					11.807	9.110	-8.491	32.105	223.000	0.199	0.001	.851	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S2**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **C4**, channel’s code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S7. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM + REM stages together, channel O1, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	9.875	5.270	-0.803	20.554	-14.605	11.975	-40.129	10.919	416.000	2.122	0.083	.035	.139
NT					-19.317	8.115	-36.614	-2.020	445.000	2.671	0.132	.008	.031*
RBD					25.814	6.586	11.852	39.775	225.000	-1.785	0.058	.076	.303
FM					-24.667	15.973	-60.258	10.924	289.000	1.917	0.075	.057	.227
ICA component 2													
NREMP	0.523	0.117	0.286	0.760	-0.333	0.247	-0.859	0.193	461.000	2.974	0.164	.003	.012*
NT					-0.735	0.267	-1.304	-0.167	500.000	3.713	0.255	2.127E-04	.001*
RBD					0.002	0.224	-0.473	0.476	428.000	1.912	0.066	.057	.228
FM					-0.256	0.329	-0.988	0.476	293.000	2.013	0.083	.045	.182

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S2**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **O1**, channel’s code in the standard 10-20% electroencephalography montage; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S8. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM + REM stages together, channel O2, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	10.126	5.205	-0.419	20.671	-10.044	9.865	-31.355	11.268	359.000	1.919	0.071	.056	.225
NT					-27.809	7.521	-43.840	-11.779	494.000	3.599	0.240	3.310E-04	.001*
RBD					31.668	10.038	10.273	53.063	225.000	-1.497	0.041	.137	.548
FM					-27.811	12.767	-56.257	0.635	321.000	2.684	0.147	.008	.030*
ICA component 5													
NREMP	0.368	0.115	0.134	0.601	-0.262	0.155	-0.598	0.074	400.000	2.764	0.147	.006	.024*
NT					-0.732	0.255	-1.276	-0.189	489.000	3.505	0.227	4.740E-04	.002*
RBD					0.370	0.306	-0.282	1.023	307.000	0.057	0.000	.962	1.000
FM					-0.411	0.371	-1.237	0.416	294.000	2.037	0.085	.043	.172

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S2**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **O2**, channel’s code in the standard 10-20% electroencephalography montage; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S9. Summary of Kruskal–Wallis test between five groups (PCA and ICA components of SO-power histogram datasets; NREM stages only; components with significant differences only)

Channel	Component	Total N	H	DF	η^2	p	α
F3	PCA 1	97	18.185	4	0.154	.001	.064
F3	ICA 2	97	18.898	4	0.162	.001	.025
F4	PCA 1	98	20.148	4	0.174	4.700E-04	.044
F4	PCA 2	98	24.558	4	0.221	6.000E-05	.017
F4	PCA 4	98	20.749	4	0.180	3.600E-04	.044
F4	ICA 3	98	19.833	4	0.170	.001	.025
C3	PCA 1	97	18.312	4	0.156	.001	.064
C3	ICA 4	97	17.238	4	0.144	.002	.039
O1	ICA 2	98	19.146	4	0.163	.001	.025

Notes: * (in bold) denotes statistically significant differences for adjusted α -values after the Benjamini-Yekutieli procedure, * $\alpha \leq .1$. There were no significant differences for C4 and O2 channels ($\alpha > .1$ in all the cases). Please refer to **Table S1** for detailed information about the groups.

Abbreviations: [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; **DF**, degree of freedom; **H**, Kruskal-Wallis H test statistics; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **p**, p-value; **PCA**, principal component analysis; **REM**, rapid eye movement sleep stage; **SO**, slow oscillations; **Total N**, number of subjects; α , α -value; η^2 , effect size.

Table S10. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (NREM stages only, channel F3, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	5.126	6.344	-7.741	17.992	-13.472	7.675	-29.831	2.887	367.000	1.376	0.036	.172	.688
NT					-28.843	10.219	-50.623	-7.063	415.000	2.306	0.100	.022	.087
RBD					36.993	11.209	13.232	60.755	187.000	-2.375	0.104	.018	.072
FM					-12.863	13.108	-42.069	16.343	241.000	0.920	0.018	.364	1.000
ICA component 2													
NREMP	0.348	0.136	0.073	0.623	-0.533	0.285	-1.141	0.075	407.000	2.151	0.087	.032	.129
NT					0.116	0.185	-0.278	0.509	341.000	0.872	0.014	.389	1.000
RBD					-0.687	0.152	-1.008	-0.365	536.000	4.125	0.315	3.855E-05	1.542E-04*
FM					0.498	0.411	-0.417	1.412	206.000	0.061	0.000	.961	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S9**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **F3**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S11. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (NREM stages only, channel F4, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	-2.769	6.490	-15.918	10.380	-4.870	8.768	-23.559	13.820	321.000	0.322	0.002	.755	1.000
NT					29.327	9.971	8.075	50.579	174.000	-2.463	0.112	.014	.057
RBD					-32.134	8.521	-50.197	-14.071	461.000	2.513	0.115	.012	.049*
FM					23.654	13.224	-5.812	53.119	151.000	-1.390	0.039	.168	.673
PCA component 2													
NREMP	16.678	3.911	8.754	24.602	-35.347	8.131	-52.678	-18.015	556.000	4.774	0.422	1.895E-06	7.582E-06*
NT					-8.074	9.627	-28.593	12.446	444.000	2.652	0.130	.008	.033*
RBD					1.482	11.524	-22.948	25.911	423.000	1.821	0.060	.070	.280
FM					3.252	8.763	-16.273	22.777	259.000	1.198	0.029	.236	.942
PCA component 4													
NREMP	16.183	4.084	7.907	24.459	-4.239	6.325	-17.720	9.242	433.000	2.444	0.111	.015	.060
NT					-5.998	5.229	-17.143	5.147	449.000	2.747	0.140	.006	.025*
RBD					-18.964	5.623	-30.884	-7.043	543.000	4.007	0.292	6.395E-05	2.558E-04*
FM					-11.707	12.248	-38.999	15.584	301.000	2.204	0.099	.028	.113
ICA component 3													
NREMP	0.333	0.144	0.042	0.625	-0.523	0.257	-1.070	0.025	437.000	2.519	0.118	.012	.048*
NT					0.437	0.255	-0.107	0.981	284.000	-0.379	0.003	.712	1.000
RBD					-0.777	0.203	-1.207	-0.348	524.000	3.661	0.244	2.605E-04	.001*
FM					0.175	0.191	-0.249	0.600	228.000	0.455	0.004	.658	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S9**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **F4**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S12. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (NREM stages only, channel C3, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	-2.723	6.292	-15.460	10.014	11.247	10.315	-10.740	33.234	254.000	-1.075	0.021	.287	1.000
NT					26.380	12.074	0.485	52.276	179.000	-2.192	0.089	.029	.116
RBD					-38.305	9.035	-57.459	-19.152	483.000	2.700	0.130	.007	.029*
FM					18.171	13.022	-11.286	47.629	141.000	-1.340	0.037	.184	.738
ICA component 4													
NREMP	-0.042	0.143	-0.331	0.248	0.357	0.236	-0.145	0.859	236.000	-1.408	0.036	.162	.647
NT					0.526	0.293	-0.103	1.155	197.000	-1.844	0.063	.067	.266
RBD					-0.840	0.183	-1.229	-0.452	490.000	2.824	0.142	.005	.019*
FM					0.231	0.287	-0.418	0.880	155.000	-0.992	0.020	.327	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S9**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **C3**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S13. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM stages only, channel O1, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
ICA component 2													
NREMP	0.532	0.113	0.303	0.760	-0.309	0.239	-0.819	0.201	454.000	2.842	0.150	.005	.019*
NT					-0.638	0.282	-1.241	-0.036	506.000	3.827	0.271	1.350E-04	.001*
RBD					-0.179	0.236	-0.680	0.321	462.000	2.532	0.117	.012	.047*
FM					-0.180	0.336	-0.929	0.568	292.000	1.989	0.081	.048	.192

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S9**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **O1**, channel’s code in the standard 10-20% electroencephalography montage; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S14. Summary of Kruskal–Wallis test between five groups (PCA and ICA components of SO-power histogram datasets; REM stage only; components with significant differences only)

Channel	Component	Total N	H	DF	η^2	p	α
F3	ICA 2	97	18.898	4	0.162	.001	.025
C3	PCA 1	97	18.312	4	0.156	.001	.064
C3	ICA 4	97	17.238	4	0.144	.002	.039

Notes: * (in bold) denotes statistically significant differences for adjusted α -values after the Benjamini-Yekutieli procedure, * $\alpha \leq .1$. There were no significant differences for F4, C4, O1, and O2 channels ($\alpha > .1$ in all the cases). Please refer to **Table S1** for detailed information about the groups.

Abbreviations: [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; **DF**, degree of freedom; **H**, Kruskal-Wallis H test statistics; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **p**, p-value; **PCA**, principal component analysis; **REM**, rapid eye movement sleep stage; **SO**, slow oscillations; **Total N**, number of subjects; α , α -value; η^2 , effect size.

Table S15. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (REM stage only, channel F3, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
ICA component 5													
NREMP	0.532	0.132	0.264	0.799	-0.312	0.228	-0.799	0.175	453.000	3.042	0.175	.002	.010*
NT					-0.087	0.211	-0.537	0.363	413.000	2.267	0.097	.024	.096
RBD					-0.671	0.207	-1.110	-0.232	532.000	4.051	0.304	5.311E-05	2.124E-04*
FM					-0.190	0.445	-1.195	0.816	243.000	1.508	0.048	.135	.540

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S14**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **F3**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S16. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (REM stage only, channel C3, PCA and ICA projections of SO-power histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 4													
NREMP	7.765	2.734	2.231	13.299	1.444	4.968	-9.145	12.033	401.000	1.649	0.049	.101	.404
NT					-0.213	7.624	-16.565	16.139	371.000	1.516	0.043	.132	.528
RBD					-17.179	2.699	-22.901	-11.457	591.000	4.624	0.382	3.926E-06	1.570E-05*
FM					-3.411	10.209	-26.953	20.130	234.000	1.545	0.050	.126	.502
ICA component 3													
NREMP	0.170	0.145	-0.124	0.464	0.092	0.170	-0.270	0.454	333.000	0.389	0.003	.704	1.000
NT					0.609	0.303	-0.040	1.259	228.000	1.246	0.029	.216	.866
RBD					-0.889	0.206	-1.324	-0.453	532.000	3.573	0.228	3.654E-04	.001*
FM					-0.236	0.295	-0.916	0.444	220.000	1.175	0.029	.245	.981

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S14**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **C3**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

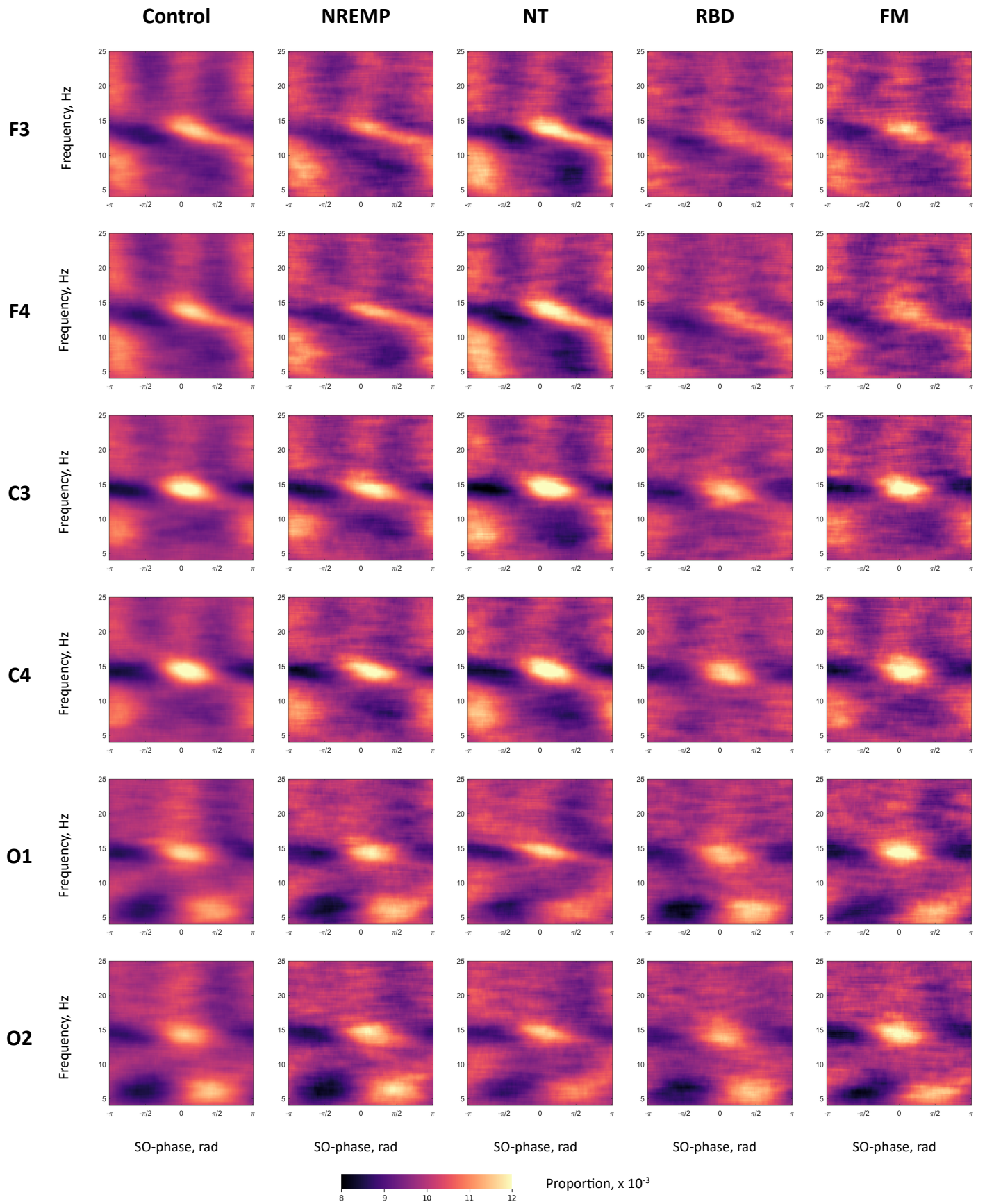
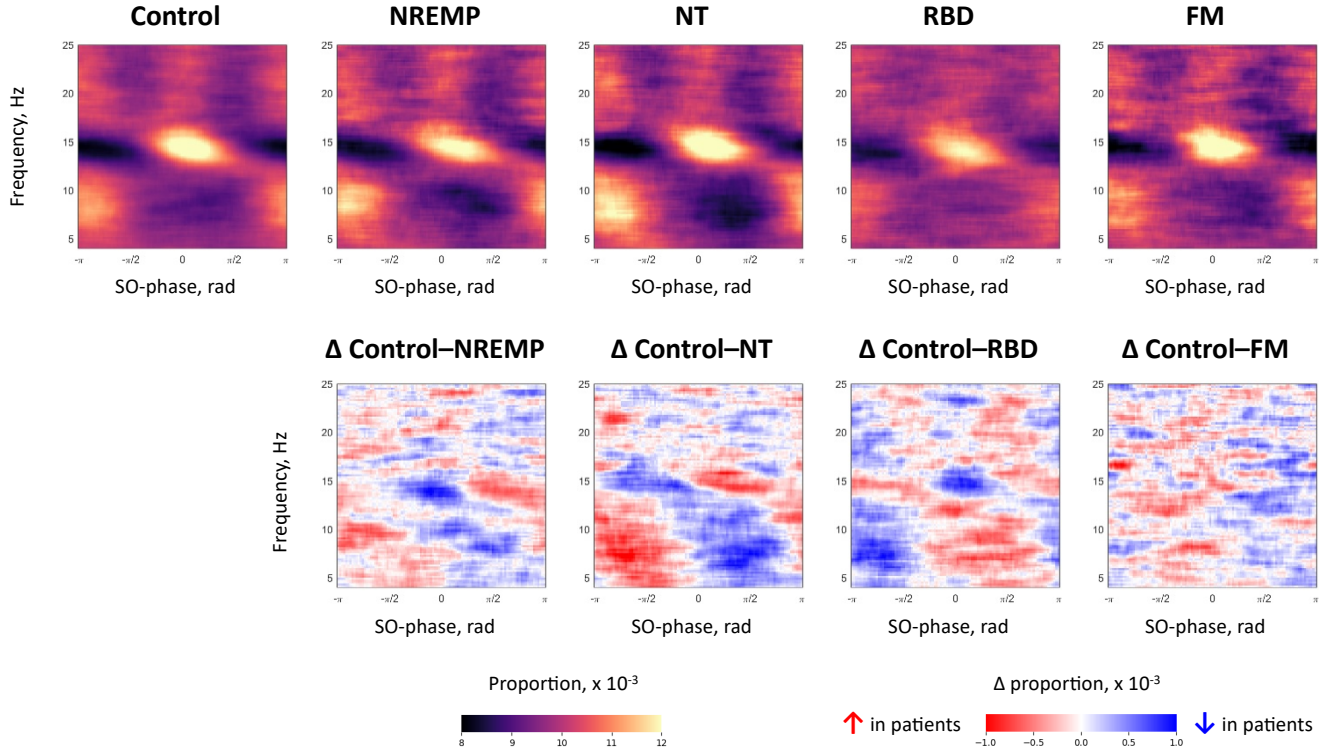


Fig. S6. Group average SO-phase histograms for NREM + REM stages together. Please see **Table S1** for detailed information about the groups.

Abbreviations: [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; FM, fibromyalgia; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; rad, radian; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement stage, SO, slow oscillations.

A NREM stages only, SO-phase histograms, channel C3



B REM stages only, SO-phase histograms, channel C3

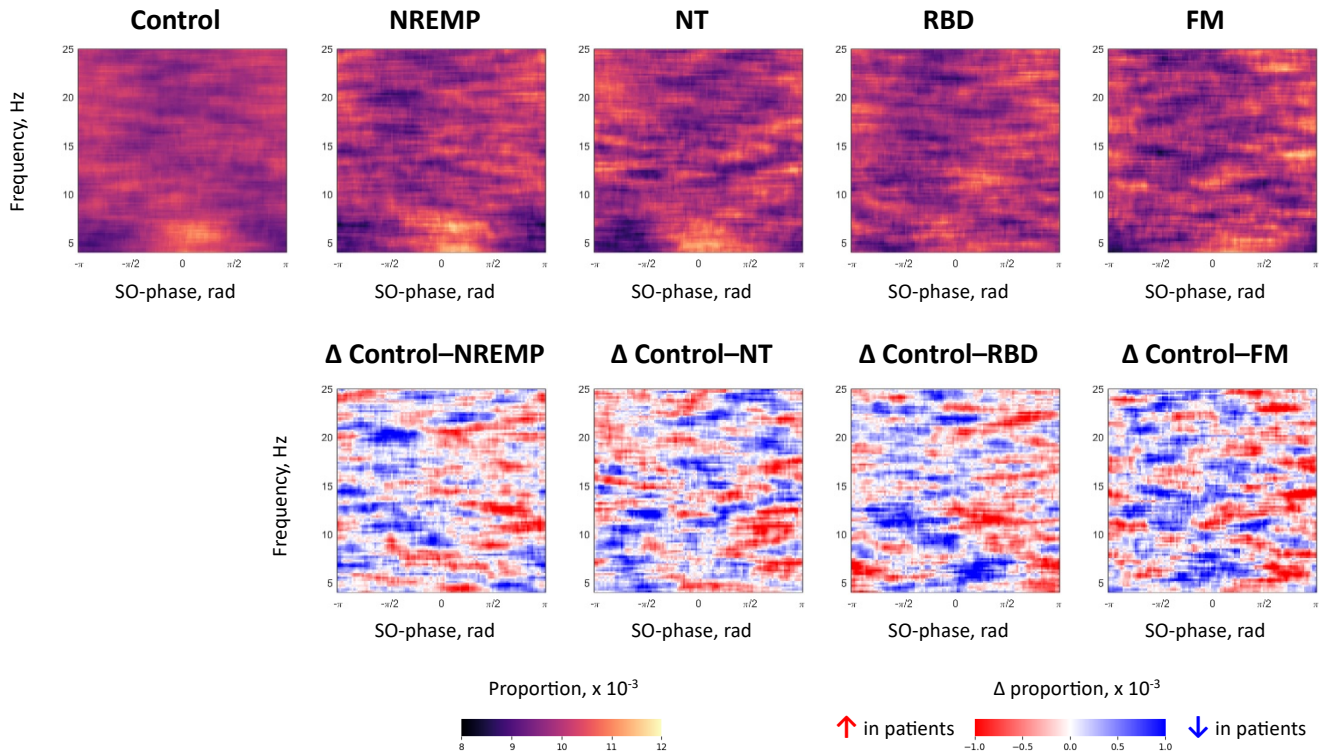


Fig. S7. SO-phase histograms for NREM only and REM only stages (A and B, respectively) at channel C3. In each panel, the upper row of histograms illustrate group average, while the lower row shows arithmetical differences between histogram matrices. Please see **Figure 2** for SO-phase histograms at NREM+REM stages together and **Table S1** for detailed information about the groups.

Abbreviations: C3, channels' codes in the standard 10-20% electroencephalography montage; FM, fibromyalgia; Hz, hertz; min, minute; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; rad, radian; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage; SO, slow oscillations.

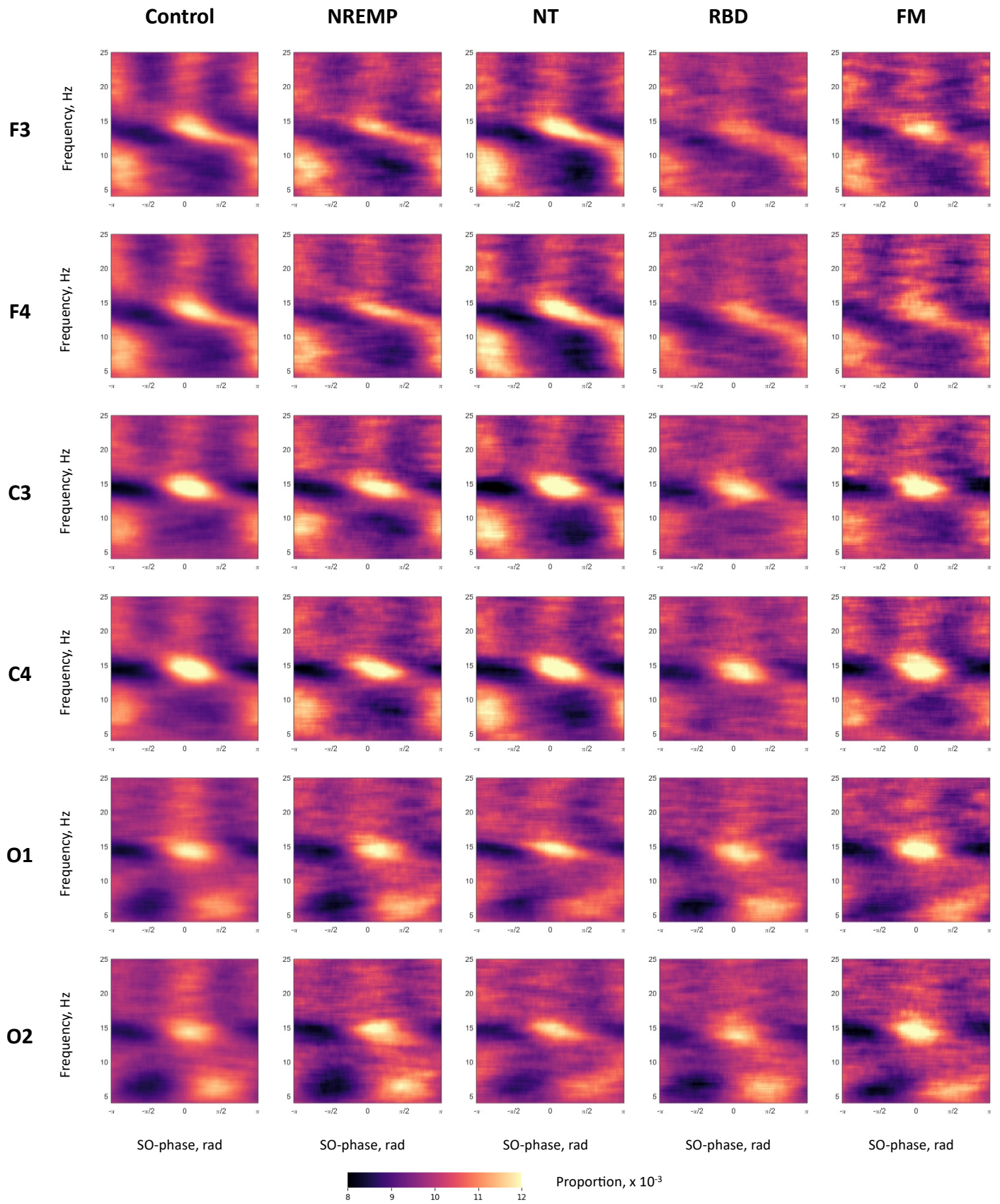


Fig. S8. Group average SO-phase histograms for NREM stages only. Please see **Table S1** for detailed information about the groups. *Abbreviations:* [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; FM, fibromyalgia; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; rad, radian; RBD, rapid eye movement sleep behavior disorder; SO, slow oscillations.

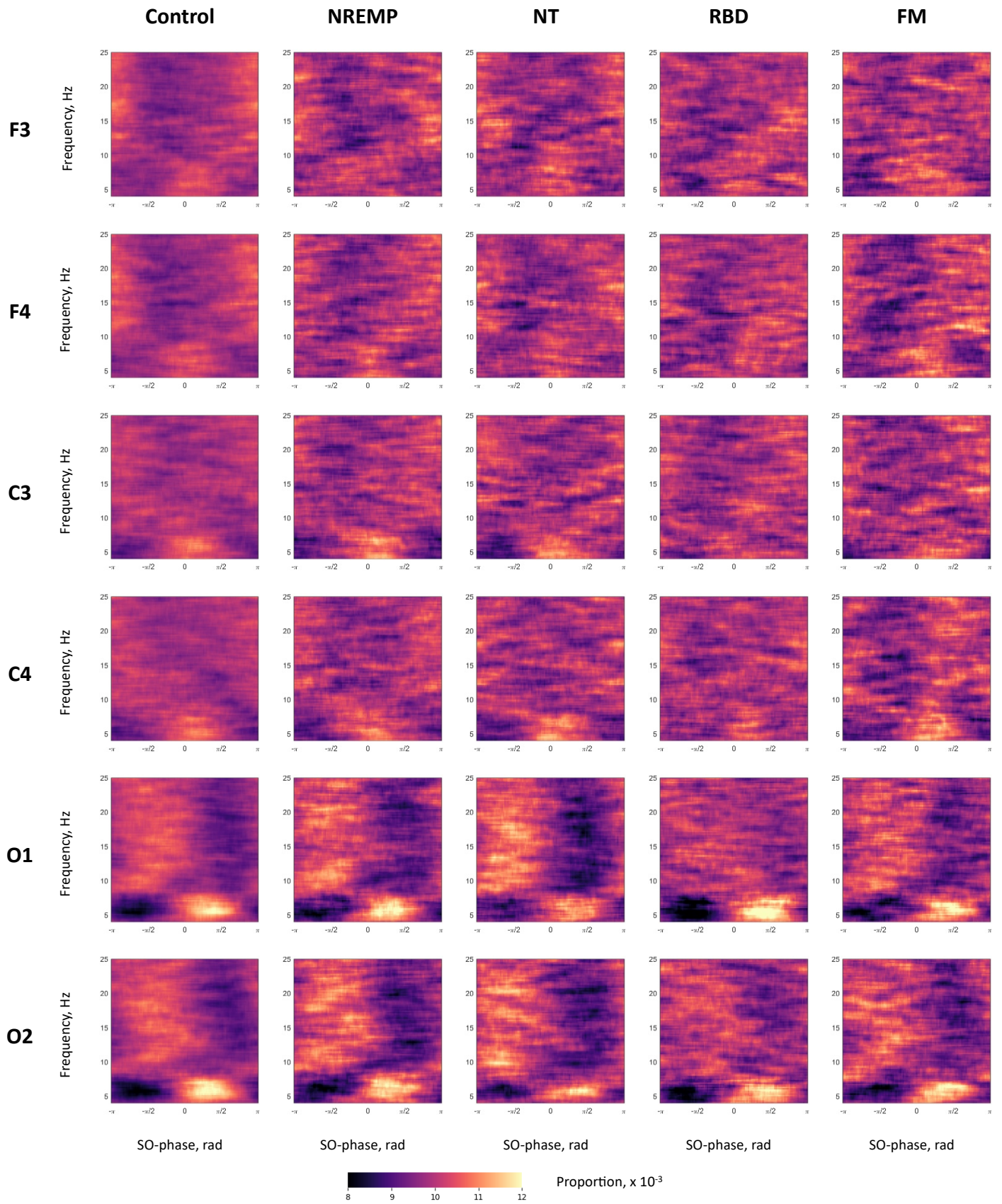


Fig. S9. Group average SO-phase histograms for REM stage only. Please see Table S1 for detailed information about the groups.
Abbreviations: [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; FM, fibromyalgia; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; **rad**, radian; RBD, rapid eye movement behavior disorder; REM, rapid eye movement stage, SO, slow oscillations.

Patterns of PCA/ICA components with significant differences between Control and patients

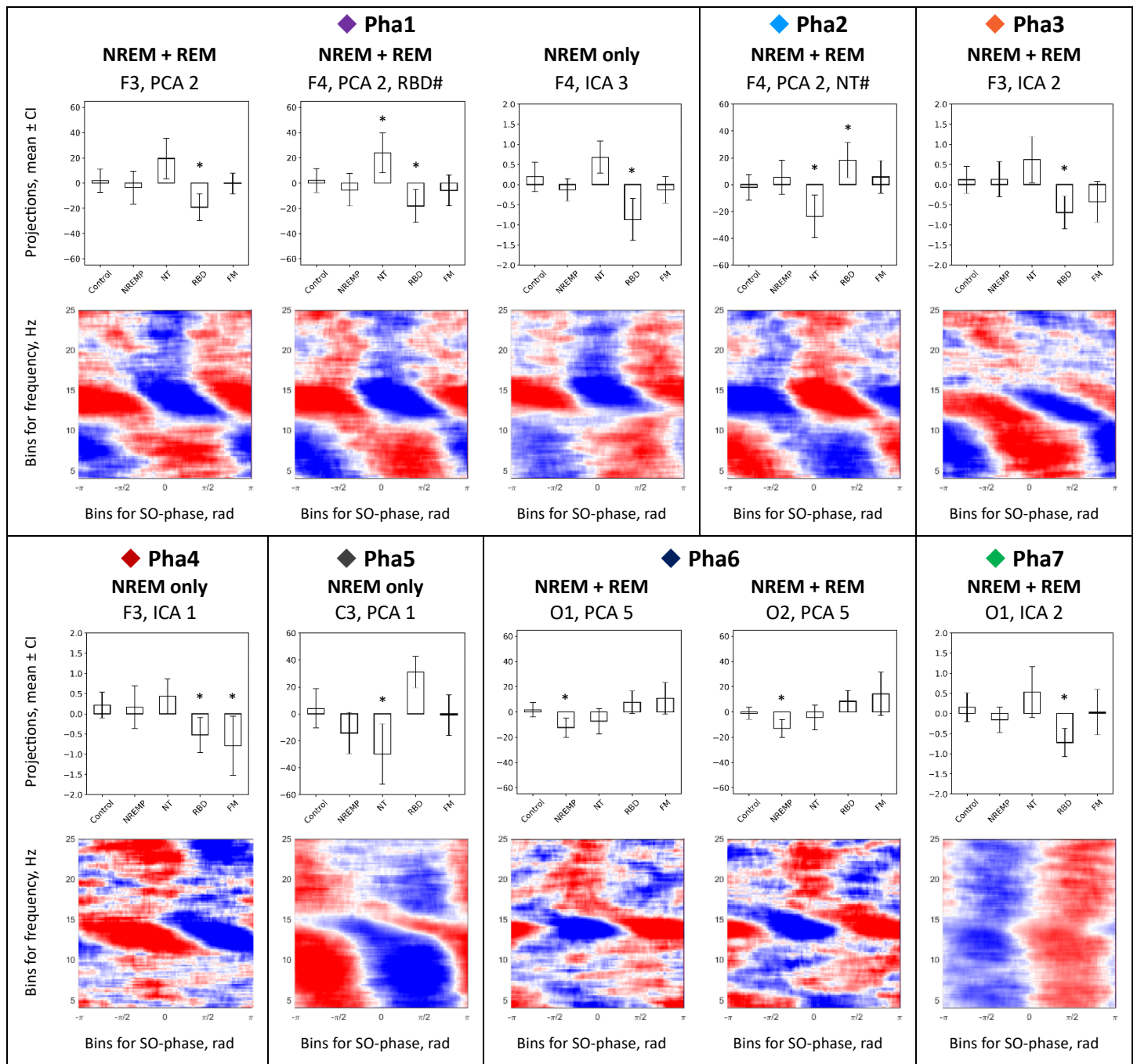


Fig. S10. SO-phase histograms: PCA and ICA components that were associated with significant differences between groups (pairwise comparisons of Control versus each of the patient groups, $p \leq .05$ Bonferroni adjusted). There were no significant differences for SO-phase histograms during REM in any case. Component histograms were classified into categories Pha1-Pha7 based on the visual similarity of the depicted patterns. Please refer to **Fig. S11**, **Tables S17-S28**, and **Table S1** for summary of between-group differences, detailed statistics, and information about the groups, respectively.

* denotes statistically significant Bonferroni-corrected p-values, $p \leq .05$.

** red (increase) and blue (decrease) colors indicate these changes in patient groups with significant differences versus Control; all the patterns are oriented in such a way as to unify the interpretation approaches.

Pattern Pha2 F4, PCA 2, NT is an inverted version of Pha1 F4, PCA 2, RBD.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; CI, confidence intervals; Hz, hertz; FM, fibromyalgia; ICA, independent component analysis; ICA x, ICA component x; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; p, p-value; PCA, principal component analysis; PCA x, PCA component x; Pha1-Pha7, SO-phase patterns 1-7; rad, radian; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage SO, slow oscillations.

Summary of significant differences between Control and patient groups, SO phase histograms

NREM + REM	NREMP		NT		RBD		FM	
	Left	Right	Left	Right	Left	Right	Left	Right
F3-F4				◆	◆◆	◆		
C3-C4								
O1-O2	◆	◆			◆			

NREM only	NREMP		NT		RBD		FM	
	Left	Right	Left	Right	Left	Right	Left	Right
F3-F4					◆	◆	◆	
C3-C4			◆					
O1-O2								

Pattern codes ◆ Pha1 ◆ Pha2 ◆ Pha3 ◆ Pha4 ◆ Pha5 ◆ Pha6 ◆ Pha7

Fig. S11. Summary of significant differences between Control and patient groups, SO phase histograms. Colored rhombs indicate significant differences in the pairwise comparison between Control and this patient group ($p \leq 0.05$ Bonferroni adjusted), and these differences are illustrated by the PCA/ICA patterns (**Fig. S10**). Empty cells mean an absence of significant differences in this channel. There were no significant differences for SO-phase histograms during REM in any case. Please refer to **Tables S17-S28** and **Table S1** for detailed statistics and information about the groups, respectively.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **Pha1-Pha7**, SO-phase patterns 1-7; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage **SO**, slow oscillations.

Table S17. Summary of Kruskal–Wallis test between five groups (PCA and ICA components of SO-phase histogram datasets; NREM + REM stages together; components with significant differences only)

Channel	Component	Total N	H	DF	η^2	p	α
F3	PCA 2	97	18.717	4	0.160	.001	.096 *
F3	ICA 2	97	18.612	4	0.159	.001	.043 *
F4	PCA 2	98	19.191	4	0.163	.001	.096 *
C3	PCA 1	97	17.969	4	0.152	.001	.096 *
C4	PCA 1	97	17.713	4	0.149	.001	.096 *
O1	PCA 5	98	16.873	4	0.138	.002	.096 *
O1	ICA 2	98	18.459	4	0.155	.001	.043 *
O2	PCA 5	95	17.239	4	0.147	.002	.096 *

Notes: * (in bold) denotes statistically significant differences for adjusted α -values after the Benjamini-Yekutieli procedure, * $\alpha \leq .1$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; **DF**, degree of freedom; **H**, Kruskal-Wallis H test statistics; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **p**, p-value; **PCA**, principal component analysis; **REM**, rapid eye movement sleep stage; **SO**, slow oscillations; **Total N**, number of subjects; **α** , α -value; **η^2** , effect size.

Table S18. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (NREM + REM stages together, channel F3, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 2													
NREMP	1.929	4.610	-7.421	11.278	-3.478	6.069	-16.413	9.457	329.000	0.639	0.008	.529	1.000
NT					19.485	7.547	3.399	35.571	189.000	-2.073	0.081	.039	.156
RBD					-19.108	5.015	-29.740	-8.476	468.000	2.859	0.151	.004	.018*
FM					-0.239	3.657	-8.387	7.909	197.000	-0.159	0.001	.883	1.000
ICA component 2													
NREMP	0.120	0.167	-0.219	0.458	0.136	0.202	-0.293	0.566	291.000	-0.097	0.000	.931	1.000
NT					0.618	0.270	0.043	1.192	217.000	-1.531	0.044	.128	.513
RBD					-0.693	0.191	-1.099	-0.287	476.000	3.008	0.168	.003	.011*
FM					-0.429	0.226	-0.933	0.074	269.000	1.607	0.054	.111	.443

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S17**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **F3**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S19. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM + REM stages together, channel F4, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 2													
NREMP	2.033	4.651	-7.392	11.457	-5.347	6.016	-18.170	7.476	350.000	0.871	0.014	.389	1.000
NT					23.798	7.416	7.991	39.606	157.000	-2.785	0.144	.006	.022*
RBD					-18.191	6.153	-31.234	-5.147	462.000	2.532	0.117	.012	.047*
FM					-5.748	5.480	-17.958	6.463	252.000	1.030	0.022	.309	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S17**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **F4**, channel’s code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S20. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (NREM + REM stages together, channel C3, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	3.456	7.271	-11.263	18.176	-11.555	8.817	-30.347	7.237	386.000	1.371	0.034	.173	.693
NT					-27.044	9.886	-48.247	-5.842	417.000	2.404	0.107	.017	.067
RBD					27.351	5.632	15.411	39.291	226.000	-1.880	0.063	.061	.245
FM					-0.921	7.270	-17.368	15.526	221.000	0.645	0.008	.527	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S17**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **C3**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S21. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM + REM stages together, channel C4, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	-2.917	7.517	-18.135	12.300	14.969	6.980	-0.003	29.940	213.000	-1.535	0.044	.127	.508
NT					26.445	9.987	5.025	47.865	175.000	-2.269	0.095	.024	.095
RBD					-27.487	5.994	-40.193	-14.780	420.000	1.577	0.044	.117	.467
FM					-3.650	4.425	-13.509	6.208	188.000	-0.621	0.008	.543	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S17**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **C4**, channel’s code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S22. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (NREM + REM stages together, channel O1, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 5													
NREMP	1.723	2.811	-3.973	7.419	-12.370	3.580	-20.000	-4.740	456.000	2.879	0.154	.004	.016*
NT					-7.334	4.701	-17.353	2.685	371.000	1.269	0.030	.208	.831
RBD					7.762	4.196	-1.134	16.658	248.000	-1.366	0.034	.175	.699
FM					10.713	5.614	-1.796	23.221	152.000	-1.366	0.038	.176	.703
ICA component 2													
NREMP	0.156	0.175	-0.198	0.510	-0.156	0.146	-0.468	0.155	388.000	1.591	0.047	.114	.455
NT					0.533	0.296	-0.099	1.164	236.000	-1.288	0.031	.201	.804
RBD					-0.721	0.163	-1.066	-0.376	519.000	3.570	0.232	3.700E-04	.001*
FM					0.030	0.253	-0.533	0.593	226.000	0.407	0.003	.693	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S17**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: adj p, Bonferroni-adjusted p-value; FM, fibromyalgia; ICA, independent component analysis; NREM, non-rapid eye movement stages; NREMP, non-REM parasomnia; NT, narcolepsy; O1, channel's code in the standard 10-20% electroencephalography montage; p, p-value; PCA, principal component analysis; RBD, rapid eye movement sleep behavior disorder; REM, rapid eye movement sleep stage; SE, standard error of mean; SO, slow oscillations; U, Mann–Whitney U test statistics; z, z-score; η^2 , effect size; 95% CI lower/upper, 95% confidence interval lower/upper.

Table S23. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM + REM stages together, channel O2, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 5													
NREMP	-1.046	2.324	-5.755	3.664	-12.974	3.303	-20.110	-5.838	395.000	2.661	0.136	.008	.032*
NT					-4.470	4.605	-14.286	5.345	334.000	0.568	0.006	.576	1.000
RBD					8.472	4.037	-0.133	17.078	190.000	-2.160	0.086	.032	.126
FM					14.303	7.674	-2.796	31.403	127.000	-1.965	0.079	.051	.203

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S17**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **O2**, channel’s code in the standard 10-20% electroencephalography montage; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S24. Summary of Kruskal–Wallis test between five groups (PCA and ICA components of SO-phase histogram datasets; NREM stages only; components with significant differences only)

Channel	Component	Total N	H	DF	η^2	p	α
F3	ICA 1	97	15.769	4	0.128	.003	.057*
F3	ICA 4	97	16.867	4	0.140	.002	.047*
F4	ICA 3	98	25.069	4	0.227	4.873E-05	.004*
C3	PCA 1	97	22.160	4	0.197	1.862E-04	.032*
C3	ICA 3	97	18.442	4	0.157	.001	.043*
C4	PCA 1	97	21.729	4	0.193	2.269E-04	.032*
C4	ICA 3	97	16.719	4	0.138	.002	.047*

Notes: * (in bold) denotes statistically significant differences for adjusted α -values after the Benjamini-Yekutieli procedure, * $\alpha \leq .1$. There were no significant differences for O1 and O2 channels ($\alpha > .1$ in all the cases). Please refer to **Table S1** for detailed information about the groups.

Abbreviations: [C3, C4, F3, F4, O1, O2], channels' codes in the standard 10-20% electroencephalography montage; **DF**, degree of freedom; **H**, Kruskal-Wallis H test statistics; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **p**, p-value; **PCA**, principal component analysis; **REM**, rapid eye movement sleep stage; **SO**, slow oscillations; **Total N**, number of subjects; **α** , α -value; **η^2** , effect size.

Table S25. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (NREM stages only, channel F3, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
ICA component 1													
NREMP	0.216	0.157	-0.102	0.535	0.162	0.246	-0.362	0.686	322.000	0.504	0.005	.621	1.000
NT					0.434	0.203	0.002	0.866	260.000	-0.697	0.009	.492	1.000
RBD					-0.523	0.204	-0.956	-0.090	453.000	2.579	0.123	.010	.041*
FM					-0.786	0.329	-1.519	-0.053	309.000	2.588	0.140	.010	.040*
ICA component 4													
NREMP	0.032	0.189	-0.351	0.416	0.093	0.217	-0.370	0.556	259.000	-0.717	0.010	.479	1.000
NT					0.574	0.230	0.083	1.065	200.000	-1.860	0.065	.064	.257
RBD					-0.736	0.147	-1.048	-0.425	441.000	2.356	0.103	.019	.076
FM					0.059	0.207	-0.403	0.522	177.000	-0.650	0.009	.524	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S24**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **F3**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S26. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients’ groups (NREM stages only, channel F4, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
ICA component 3													
NREMP	0.193	0.178	-0.168	0.554	-0.128	0.131	-0.407	0.150	344.000	0.758	0.011	.454	1.000
NT					0.680	0.188	0.279	1.080	184.000	-2.273	0.096	.024	.094
RBD					-0.868	0.244	-1.386	-0.351	520.000	3.588	0.234	3.451E-04	.001*
FM					-0.127	0.148	-0.457	0.203	230.000	0.503	0.005	.623	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S24**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **F4**, channel’s code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S27. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (NREM stages only, channel C3, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	4.035	7.158	-10.456	18.526	-14.232	7.204	-29.588	1.124	402.000	1.668	0.051	.097	.389
NT					-29.890	10.418	-52.235	-7.544	423.000	2.520	0.118	.012	.048*
RBD					31.033	5.470	19.438	42.629	223.000	-1.933	0.067	.054	.217
FM					-0.887	6.673	-15.982	14.208	228.000	0.819	0.014	.420	1.000
ICA component 3													
NREMP	0.044	0.155	-0.270	0.358	-0.396	0.200	-0.821	0.029	396.000	1.557	0.044	.122	.487
NT					-0.687	0.263	-1.250	-0.123	408.000	2.231	0.092	.026	.105
RBD					0.692	0.175	0.321	1.063	197.000	-2.397	0.103	.017	.068
FM					0.316	0.335	-0.441	1.074	166.000	-0.719	0.011	.480	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S24**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **C3**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Table S28. Summary of the two-tailed Mann–Whitney pairwise tests between Control group and each of patients' groups (NREM stages only, channel C4, PCA and ICA projections of SO-phase histogram datasets)

Patient group	Control				Patient group				Mann-Whitney statistics				
	Mean	SE	95% CI lower	95% CI upper	Mean	SE	95% CI lower	95% CI upper	U	z	η^2	p	adj p
PCA component 1													
NREMP	3.010	7.356	-11.883	17.902	-15.504	6.722	-29.921	-1.087	375.000	1.593	0.047	.113	.453
NT					-28.712	9.886	-49.915	-7.509	418.000	2.424	0.109	.016	.063
RBD					31.409	5.789	19.136	43.681	220.000	-1.987	0.070	.048	.192
FM					1.084	4.965	-9.980	12.147	242.000	0.644	0.008	.527	1.000
ICA component 3													
NREMP	-0.076	0.166	-0.413	0.260	0.425	0.233	-0.076	0.925	206.000	-1.671	0.052	.097	.387
NT					0.619	0.262	0.058	1.181	184.000	-2.095	0.081	.037	.148
RBD					-0.680	0.154	-1.006	-0.354	452.000	2.147	0.082	.032	.130
FM					-0.103	0.255	-0.671	0.464	217.000	0.059	0.000	.963	1.000

Notes: pairwise comparisons were performed only for PCA/ICA components for those with significant differences adjusted in the Kruskal–Wallis test between all 5 groups together (**Table S24**).

* (in bold) denotes statistically significant differences for adjusted p-values after the Bonferroni correction, $p \leq .05$. Please refer to **Table S1** for detailed information about the groups.

Abbreviations: **adj p**, Bonferroni-adjusted p-value; **C4**, channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **p**, p-value; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage; **SE**, standard error of mean; **SO**, slow oscillations; **U**, Mann–Whitney U test statistics; **z**, z-score; **η^2** , effect size; **95% CI lower/upper**, 95% confidence interval lower/upper.

Split-half reliability correlation matrices (SO-power histogram datasets, NREM + REM stages together)

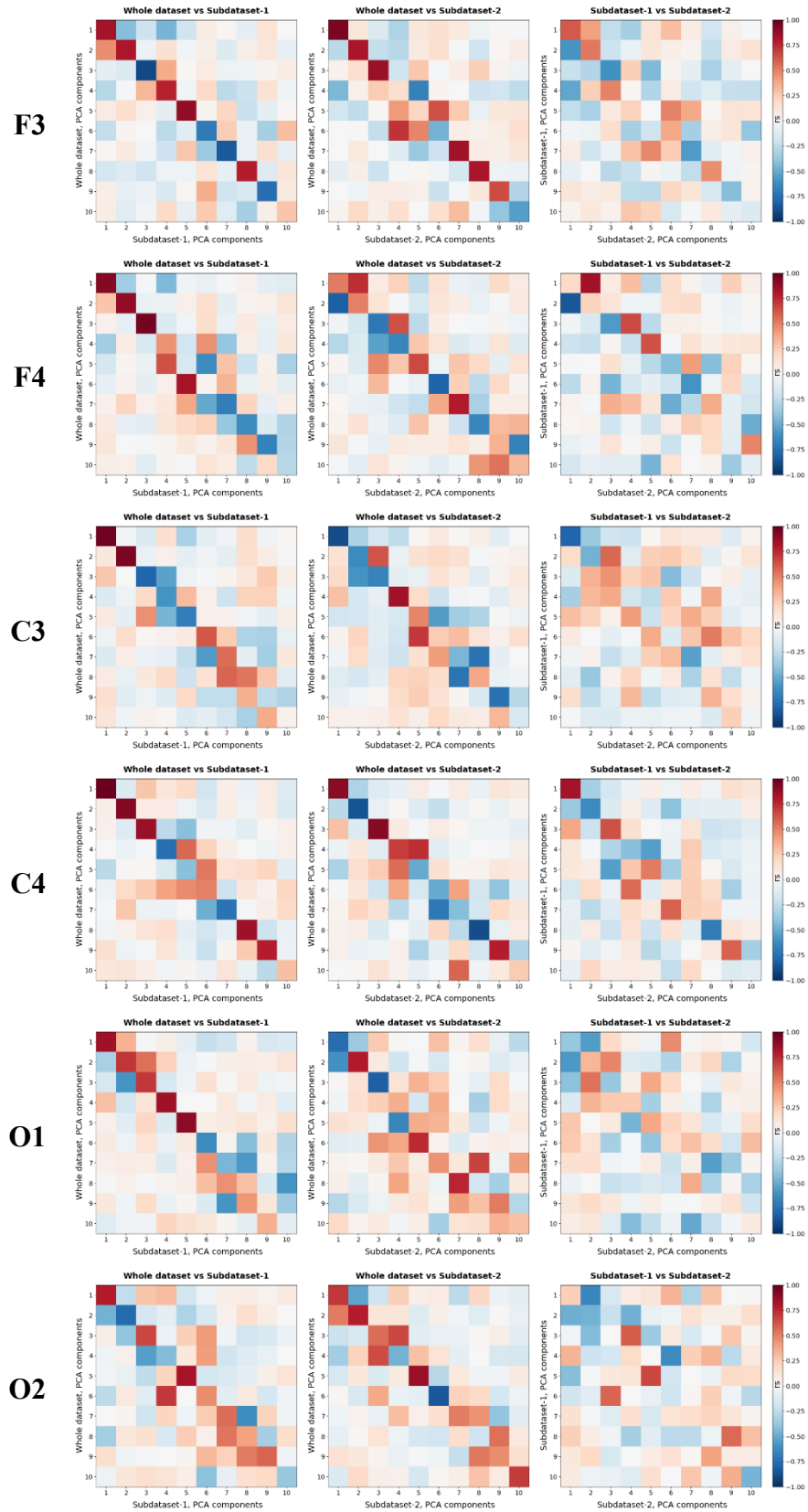


Fig. S12. Correlations between PCA component eigenvectors of the whole dataset and 2 subdatasets. Please see Table S1 for detailed information about each group.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; PCA, principal component analysis; rs, Spearman's correlation coefficient; SO, slow oscillations.

Split-half reliability correlation matrices (SO-phase histogram datasets, NREM + REM stages together)

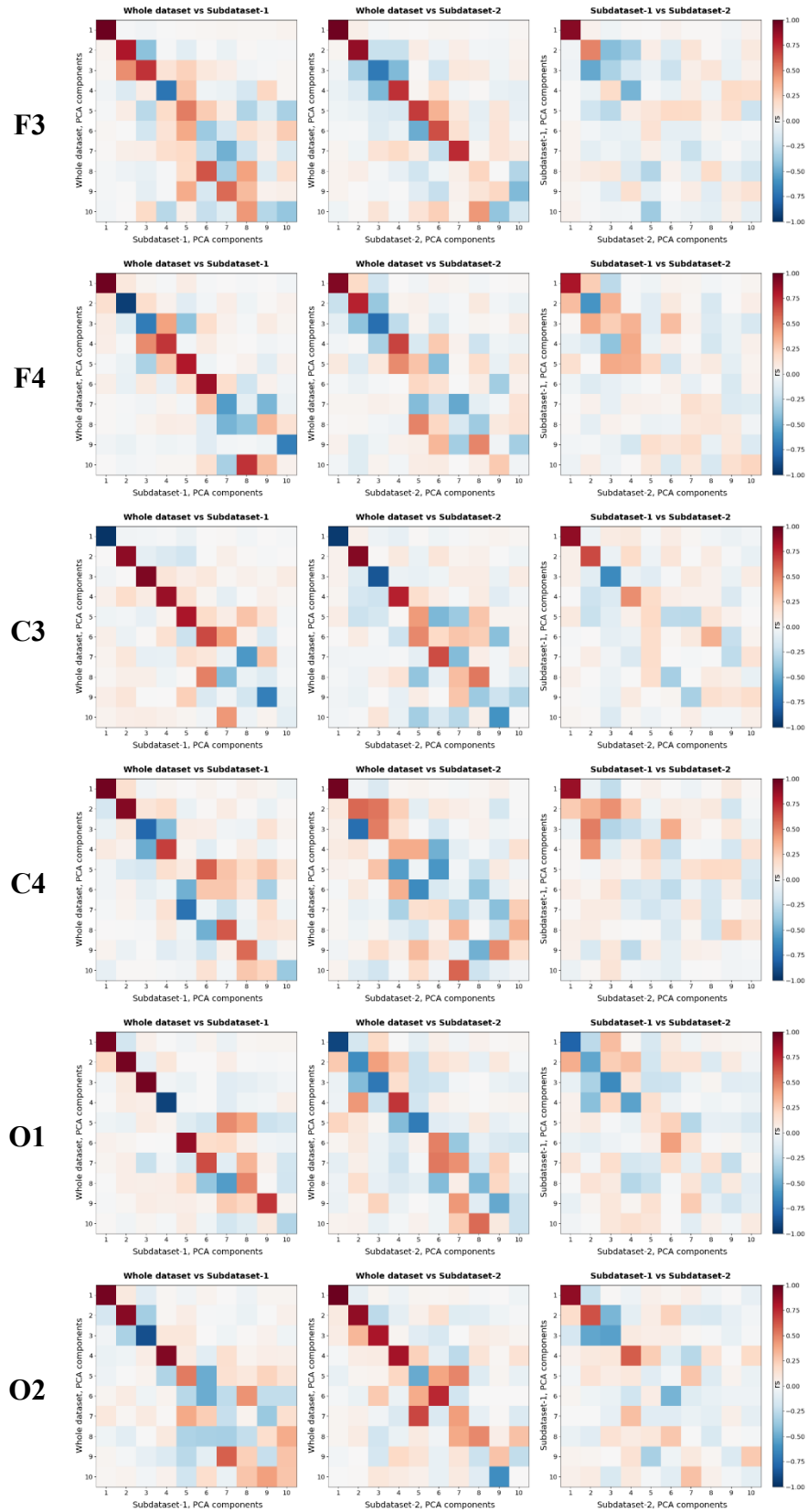


Fig. S13. Correlations between PCA component eigenvectors of the whole dataset and 2 subdatasets. Please see Table S1 for detailed information about each group.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; PCA, principal component analysis; rs, Spearman's correlation coefficient; SO, slow oscillations.

ROC curves of the SO-power histogram datasets separability (NREM+REM stages together)

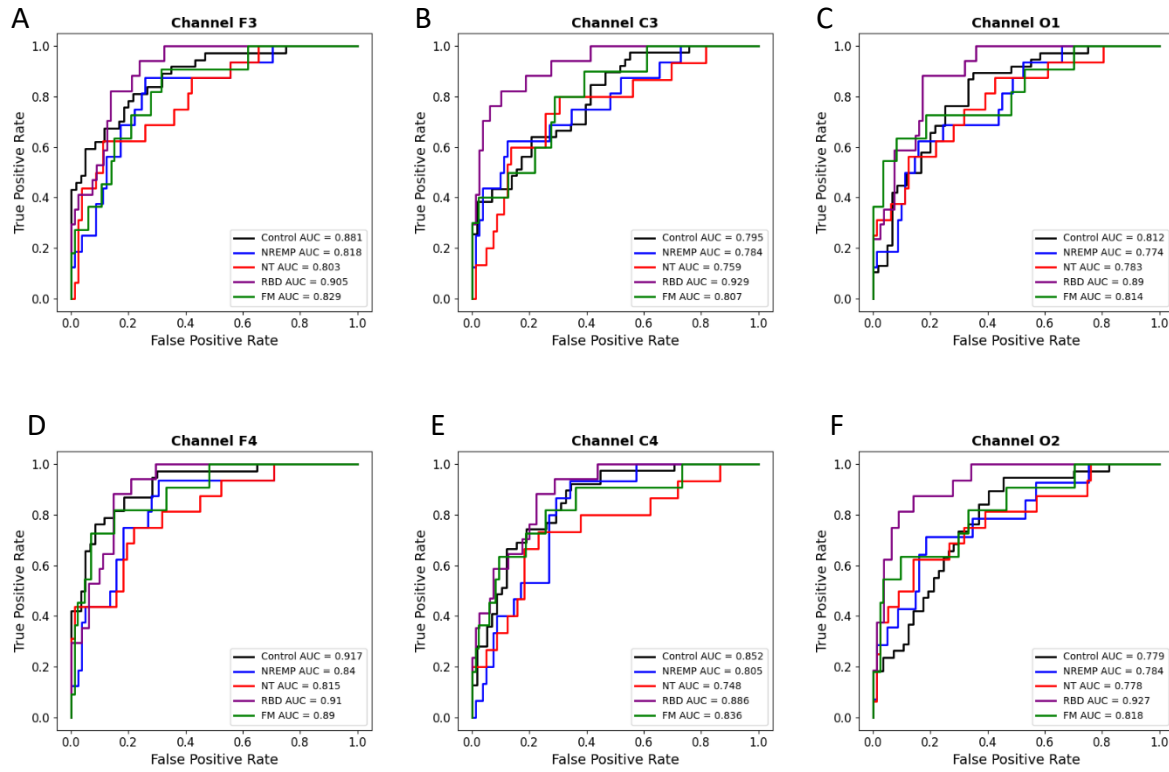


Figure S14. ROC curves illustrating group-level discrimination based on PCA projections of SO-power histograms (NREM+REM stages combined).

Each curve reflects a binary logistic regression model trained to distinguish one group versus all others, using internal cross-validation. PCA was performed on the full dataset to preserve interpretability of the components. Detailed group information is provided in **Table S1**.

A, B, C, D, E, F: ROC curves for channels F3, C3, O1, F4, C4, O2, respectively.

Abbreviations: AUC, area under the ROC curve; [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; FM, fibromyalgia; NREMP, non-REM parasomnia; NT, narcolepsy; PCA, principal component analysis; RBD, REM behavior disorder; REM, rapid eye movement sleep stage; ROC, receiver operating characteristic curve; SO, slow oscillations.

ROC curves of the SO-phase histogram datasets separability (NREM + REM stages together)

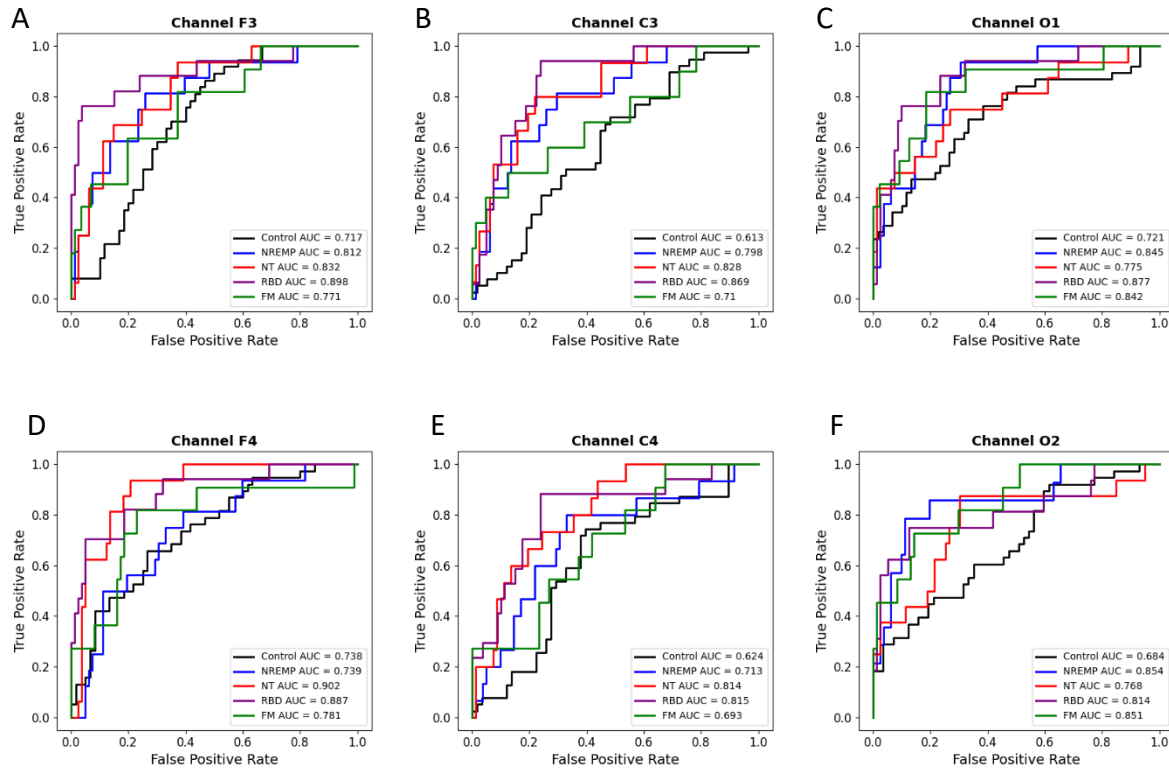


Figure S15. ROC curves illustrating group-level discrimination based on PCA projections of SO-power histograms (NREM+REM stages combined).

Each curve reflects a binary logistic regression model trained to distinguish one group versus all others, using internal cross-validation. PCA was applied to the full dataset to preserve component interpretability. Detailed group information is provided in **Table S1**.

A, B, C, D, E, F: ROC curves for channels F3, C3, O1, F4, C4, O2, respectively.

Abbreviations: AUC, area under the ROC curve; [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; FM, fibromyalgia; NREMP, non-REM parasomnia; NT, narcolepsy; PCA, principal component analysis; RBD, REM behavior disorder; REM, rapid eye movement sleep stage; ROC, receiver operating characteristic curve; SO, slow oscillations.

Permutations tests for SO-power histogram datasets separability (NREM + REM stages together)

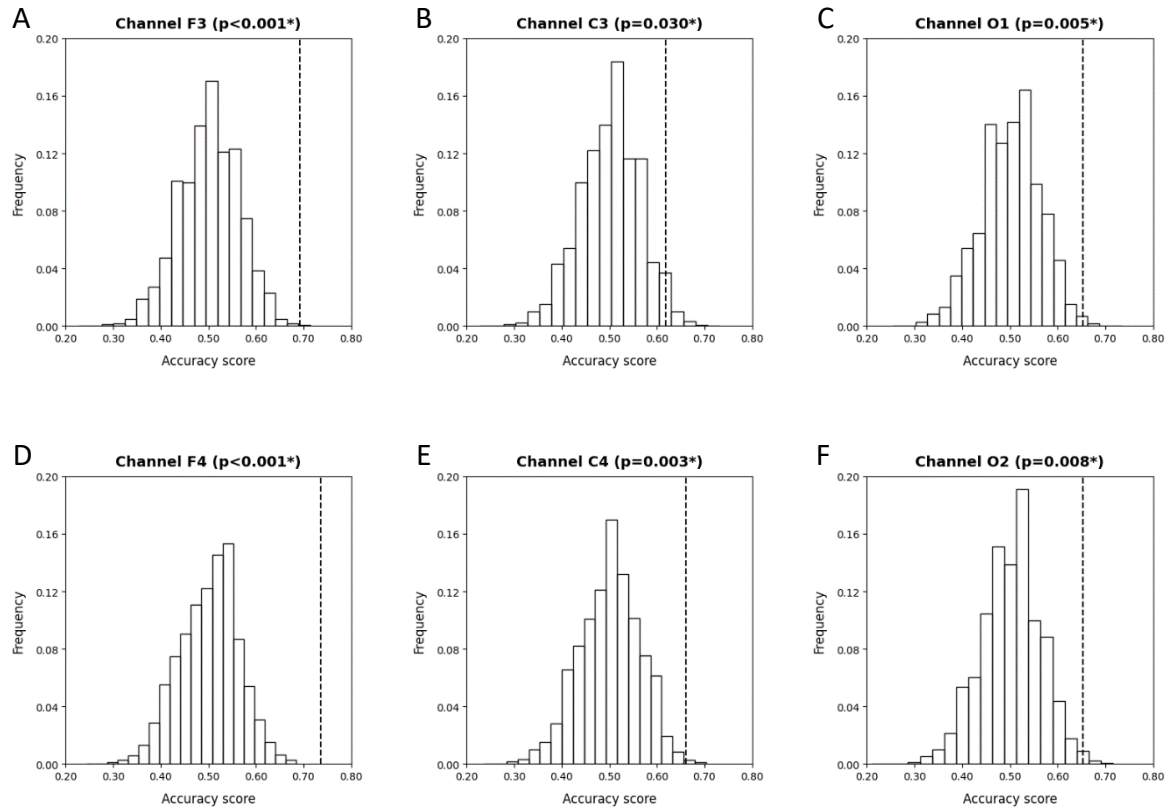


Figure S16. Permutation tests for logistic regression models trained in a fixed PCA feature space derived from SO-power histograms (NREM+REM stages combined).

Dashed lines indicate classifier performance using true labels; histograms show the distribution of scores from 1,000 label shuffles. Detailed group information is provided in **Table S1**.

A, B, C, D, E, F: results of the permutations tests for channels F3, C3, O1, F4, C4, O2, respectively.

* $p \leq .05$. P-values for the channels F3 and F4 were $7.0E-4$ and $1.0E-4$, respectively.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; **p**, p-value; **PCA**, principal component analysis; **SO**, slow oscillations.

Permutations tests for SO-phase histogram datasets separability (NREM + REM stages together)

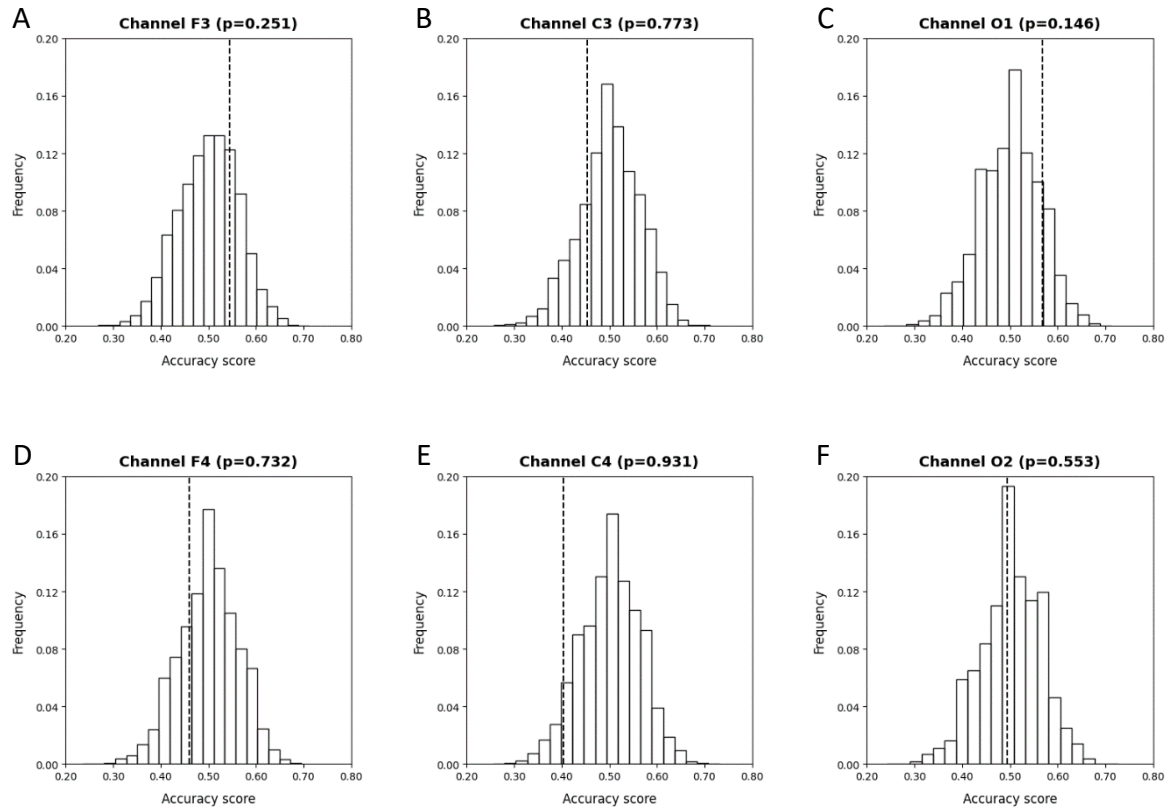


Figure S17. Permutation tests for logistic regression models trained in a fixed PCA feature space derived from SO-power histograms. Dashed lines show scores on original labels. Detailed information about the groups is presented in Table S1.

A, B, C, D, E, F: results of the permutations tests for channels F3, C3, O1, F4, C4, O2, respectively.

Abbreviations: [C3, C4, F3, F4, O1, O2], channel's code in the standard 10-20% electroencephalography montage; **p**, p-value; **PCA**, principal component analysis; **SO**, slow oscillations.

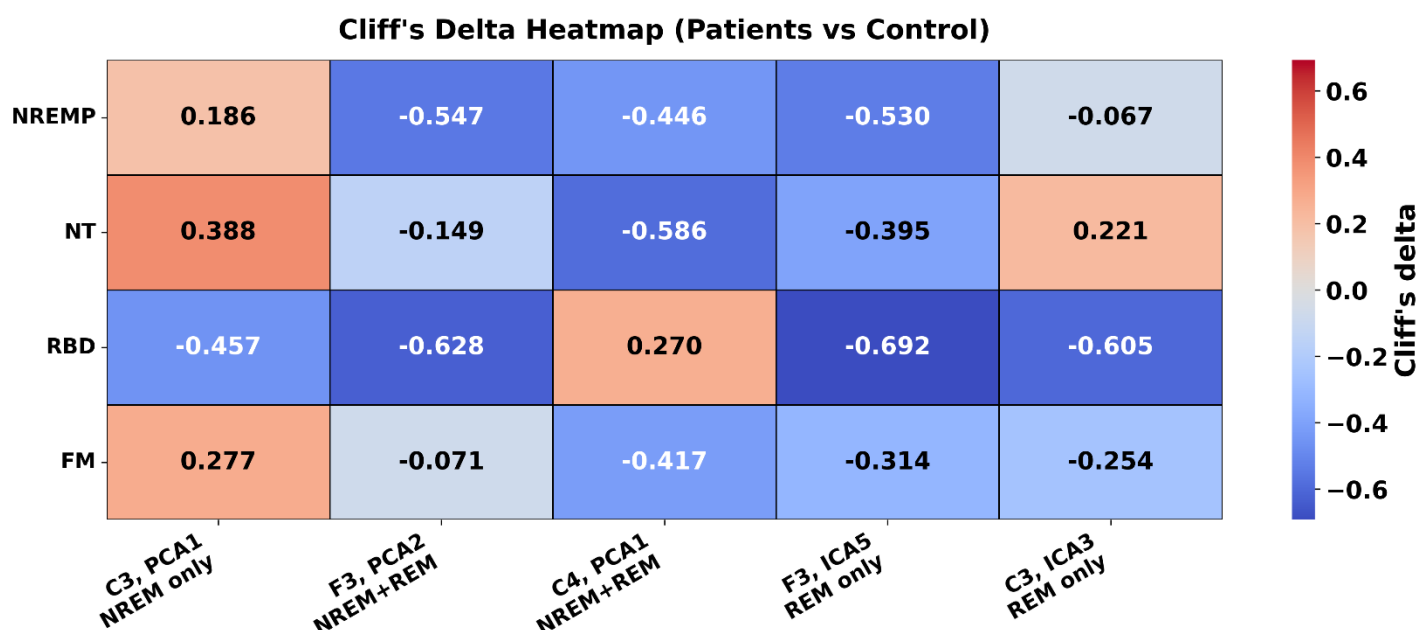


Fig. S18. Cliff's Delta heatmap for PCA and ICA components. This heatmap summarizes Cliff's Delta effect size estimates for representative PCA and ICA patterns shown in **Figure 4** in the main manuscript. Red shades indicate that the patient group tends to have higher values than controls; blue indicates lower values. Effect size magnitude reflects the degree of separation. Detailed information about the groups is presented in **Table S1**.

Abbreviations: [C3, C4, F3], channel's code in the standard 10-20% electroencephalography montage; **FM**, fibromyalgia; **ICA**, independent component analysis; **NREM**, non-rapid eye movement stages; **NREMP**, non-REM parasomnia; **NT**, narcolepsy; **PCA**, principal component analysis; **RBD**, rapid eye movement sleep behavior disorder; **REM**, rapid eye movement sleep stage.