

Supplementary data 6. Statistically significant networks derived from differentially abundant proteins found between grade IV of astrocytoma neovascularization vessels and controls. Note: Red is an up-regulated protein molecule, green is a down-regulated protein molecule, and black is a protein molecule with almost no change in expression.

Networks	Molecules in Network	Score	Nodes	Identified DEPs	Top Diseases and Functions
1	60S ribosomal subunit, ACAT1, ALPPL2, ALYREF, ARL8A, BTNL2, BUB3, CAPNS1, CHPF, DDX46, EFHD1, EFHD2, EIF2S2, ERH, EXOSC6, farnesyl transferase, FASTKD2, FNTB, H2AFY2, HDGF, HDGFRP2, HIST1H1C, HNRNPD, HNRNPL, 1TGA4, Lamin b, LARP1, LSM3, LSM8, LSM14B, MRPL16, NOLC1, PABPC4, PAN2, PHLPP1, Pkc(s), POGZ, PUF60, PBM8A, RBMX, RCN2, Ribosomal 40s subunit, Rnr, RPL28, RPL18A, RPL35A, RPLP2, RPS5, RPS10, RPS16, RPS18, RPS27A, SAFB, SERBP1, SF3A2, SLC6A1, SLC6A9, SMG8, snRNP, SNRPA1, SNRPB2, SNRPD2, SNU13, SRRT, SRSF3, SUB1, Tap, U2AF2, U2AF1/U2AF1L5, YBX1	92		62	RNA Post-Transcriptional Modification, RNA Damage and Repair, Cell Cycle
2	ACTC1, Ampa Receptor, ANKS1B, ARAP1, Arp2/3, ARPC3, BSN, Camk, CAMK2B, 68 CaMKII, CRIP1, CSRP1, DBNL, DFNA5, Dynamin, EF-1 alpha, EGFR, Endophilin, F Actin, FABP7, FAH, FAP, FARSA, G-Actin, Gamma tubulin, GOT, GRI, GRIA, GRIA3, GRIA4, GRIN1, HLA-B27, HLA-DQA1, IPO13, ITPKA, LDB3, LMOD1, MAP6, MME, MRPL44, MYH8, MYH11, MYL9, Myosin, NANS, Pp2b, PRPSAP2, PRRT2, RAB3A, Raf, SH3GL3, SH3KBP1, SH3PXD2B, SLC16A1, SLC22A5, SPARCL1, SRCIN1, SSR4, SUGP2, SYDE1, SYN1, SYN2, SYN3, TM9SF1, TPM1, TPM3, TPM4, Tropomyosin, TUBGCP2, WDR33		68	52	Cell-To-Cell Signaling and Interaction, Nervous System Development and Function, Cardiovascular Disease

3	ACSL5, ANGPT2, BGN, C1QA, Casein, CCDC53, CELF1, CNTN1, COL1A2, COL3A1, Collagen Alpha1, Collagen type II, CTSG, CTTN, Cytokeratin, DSG2, DYNC1LI2, EFEMP1, EFEMP2, ELANE, ERK, FBN1, Fc gamma receptor, Fgf, FGF2, FGF12, Hspg, HTRA1, Igfbp, IGFBP7, IGHA2, KRT1, KRT3, KRT5, KRT8, KRT9, KRT16, KRT6A, LGALS1, LPCAT1, Mac1, MCAM, MFAP4, Mmp, MMP8, MMP9*, MMP28, NFASC, NUDCD2, Par, PDGF-AA, plasminogen activator, PPBP, RARRES2, S100P, SEC11C, SERGEF, SERPINE1, signal peptidase, SLC4A7, SPARC, Tenascin, Tgf beta, TGFBI*, Timp, TNC*, TNF, trypsin, VCAN, voltage-gated sodium channel	65	50	Cellular Movement, Dermatological Diseases and Conditions, Developmental Disorder
4	14-3-3, ACTB*, Actin, ADRPK1, Beta Tubulin, CACNA2D1, Calmodulin, CANX, CAPS, CAPZB, Ck2, CNTNAP2, CPSF3, CRYAB, CWC27, CYBB, DLG4, EEF1A1, EPB41L2, EPB41L3, Erm, FBXO21, FLNA*, G protein, GABRG2, GBP1, HSP, Hsp90, HSPA12A, HSPB8, Insulin, LRRTM1, ,MAG, MAP4, METTL7B, MYADM, MYO1B, N-Cadherin, N-type Calcium Channel, NAPB, NEK6, NRXN2, OLFML3 OPCML, P38 MAPK, p70 S6K, PIP5K1A, PLXNC1, PPP3CB, PTBP3, RTN4, SEC61A1, SIRT2, Snare, Spectrin, STXBP1*, STXBP5, SUSP2, Syntaxin, SYT1, TBCA, TUBA1B, TUBA1C, TUBA4A, TUBB2B, tubulin(complex), tubulin(family), tyrosine kinase, VAMP2, XPO5	64	50	Cancer, Organismal Injury and Abnormalities, Gastrointestinal Disease
5	ACADL, Alp, ALPI, ALPL, AMPK, ANAPC4, ATP5L, ATPASE, BOD1L1, C7, C8, C8B, CAT, CBFB, CEP170, Cg, CIRBP, CKAP4, CLDN11, COL1A1*, COX5B, CPEB2, Cyclin B, Cyclin D, CYFIP2, cytochrome-c oxidase, ERCC5, FAM134C, FSH, Growth hormone, Gsk3, GTPASE, HERC2, Histone h3, HLA-B, HMGN1, HPRT1, Hsp70, ICAM1, IL1, LCLAT1, Lh, Mitochondrial complex1, MT-CO1*, NTRK2, OGN, P4HA2, PADI4, PCNA, PHF8, PMM2, PRELP, Pro-inflammatory Cytokine, PTGS1, PTPase, PTPRN2, RIN3, RNA polymerase II, RPAP1, SELP, SLC12A5, Sod, SOD2, TFCP2L1, TMED2, TMEM119, Tnf(family), TP53111, WDR5, ZBTB18	61	48	Cancer, Organismal Injury and Abnormalities, Reproductive System Disease

6	15-LOX, ABCG2 , AKR1C1/AKR1C2 , Alpha Actinin, Alpha catenin, Angiotensin II receptor type 1, AP-3, AP3B2 , APC/APC2, BPI , C4orf27 , Cadherin, CD36 , CDC42EP1 , CDH10 , CHI3L1 , CIDEB , CRIP2 , CTNNBL1 , EHHADH , elastase, estrogen receptor, ETS, FMNL2* , GFAP , GLA , GP9 , histone deacetylase, IDH1 , JUP , LOXL2 , LTF , MARCKSL1 , MT3 , N-cor, NCOR-LXR-Oxysterol-RXR-9 cis RA, NEFL , NFkB(complex), NFKBIE , NNMT , Nr1h, Nuclear factor 1, NUMBL , NUP43 , OAS3 , OSGEP , PADI2 , PARVB , Pdi, PDLIM7 , PKP4 , PLIN2 , PRPH , Rar, RPL7A , Rxr, secreted MMP, SLC16A3 , STK10 , SV2A , SWI-SNF, T3-TR-RXR, TFIIA, TGFB1I1 , thyroid hormone receptor, TIMP1 , TINAGL1 , TPM2 , VIM , VSNL1	57	46	Cardiovascular Disease, Neurological Disease, Cell Death and Survival
7	aldehyde, dehydrogenase(NAD), ALDH, ALDH2 , ALDH1A2 , ALDH1B1 , Alpha 1 antitrypsin, ANK2* , Ap2 alpha, APOC1 , APOC3 , ATP1A2 , ATP1A3 , C4, C4A/C4B , CA1 , CD163 , CEACAM8 , CNP , COL4A3BP , Collagen type ix, creatine kinase, DLG2 , DPEP1 , EGLN2 , ERGIC3 , ERK1/2, FES , Fetal Hemoglobin, FGA* , FGL1 , FSTL1 , FXDY1 , GUCY, GUCY1A2 , HBA1/HBA2* , HBB* , HBD , HBE1 , HBG2 , HBZ , HDL, HDL-cholesterol, hemoglobin, HPSE , HSPG2 , LDL, LIPA , LPL , MARCKS , MPO , Na+, K+-ATPase, Na-k-atpase, NPC2 , NSUN2 , PON2* , PRKAA, PRMT1 , PTPMT1 , Rbp, RBP4 , SAA, SLC1A4 , SLC26A2 , Sphk, STAT5a/b, STRA6 , UBA5 , VLDL, VLDL-cholesterol	56	47	Protein Synthesis, Hematological Disease, Hereditary Discorder
8	20s proteasome, 26s Proteasome, ADH1B , ADHFE1 , alcohol dehydrogenase, ALOX12 , Alpha tubulin, ANGPTL2 , ARID1A , ASXL1 , C/ebp, C1QTNF5 , Calcineurin protein(s), calpain, CASP6 , caspase, CD177 , CRABP1 , Ctbp, CTSB , Cyclin A, Cyclin E, cytochrome C, ECM1 , ERO1A , ERP29 , FAIM2 , Hdac, HDAC1 , HISTONE, Hsp27, Ifn gamma, Importin beta, LDL-cholesterol, LMNB1 , MFRP , MIF , MT1G , Mucin, NACC1 , NCS1 , NDUFA13 , Nos, Notch, NPL , NUP153 , PARP, PDE6D , PKN2 , PLXNA2 , PRSS57 , PSMB10 , PSME3 , PTGDS , PTRH1 , Rb, RCN1 , SCIN , SDCS , Secretase gamma, SERPINA1 , SHBG , SMARCE1 , SMC4 , SNCB , TCF, TRAIP , TSH, TXNIP , Vegf	49	43	Developmental Disorder, Hereditary Disorder, Ophthalmic Disease

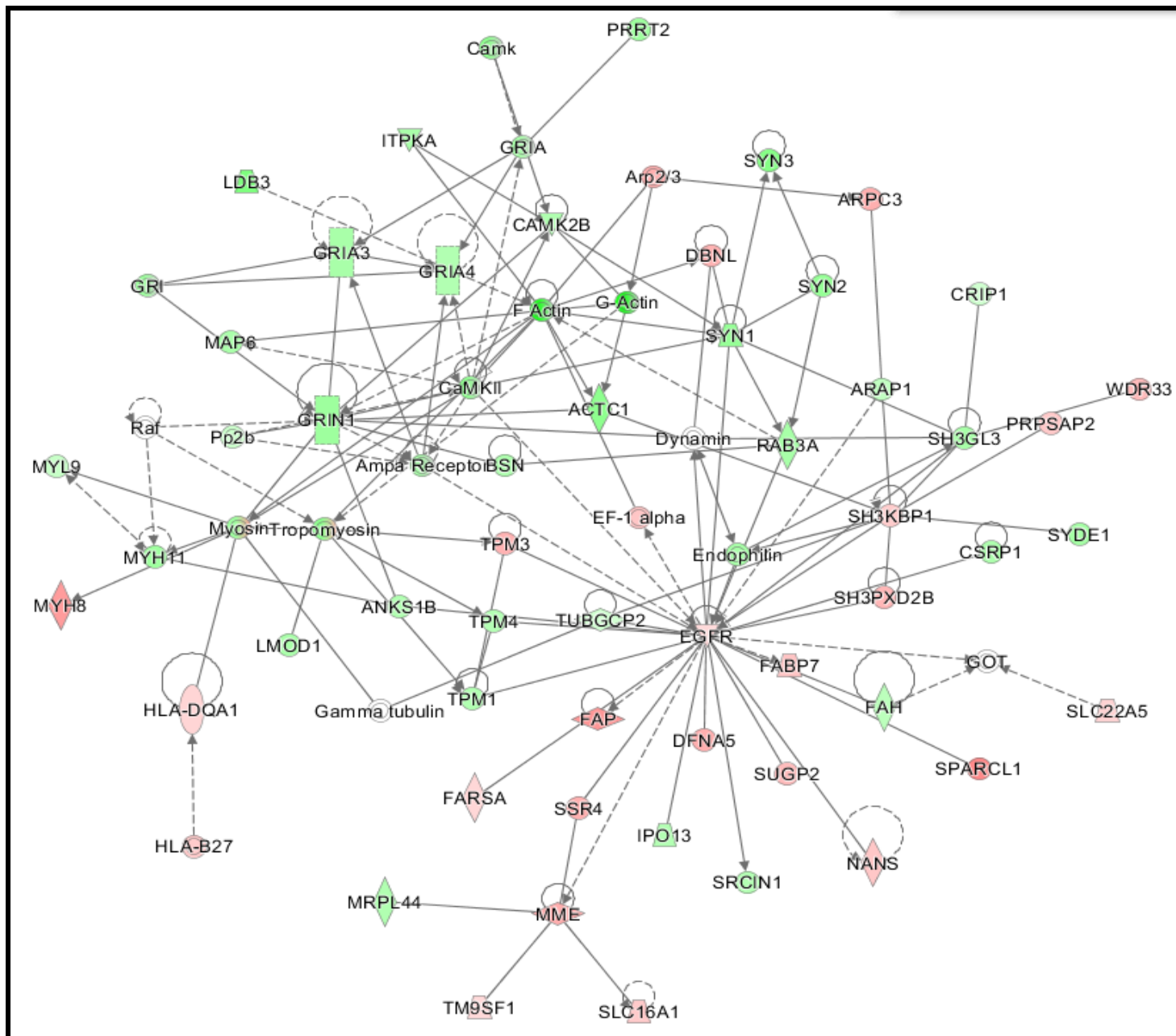
9	ALT, ASAH1 , BCR , BCR(complex), BTK , C1q, CAMP , CD8A , CFH , Cpla2, CTNNA4 , DHCR7 , F8 , Fcer1, FCGR1B , FCN1 , FETUB , FMOD , GBA , GIMAP1-GIMAP5 , Gm-csf, HLA-DPA1 , HLA-DR, HLA-DRA , Hla-Drb, HLA-DRB1* , HLA-DRB3 , HMG CoA synthase, HRNR , IFN Beta, Iga, IgG, IgG1, IgG2b, IgG2b, IGHG1* , Igm, IL12(family), Immunoglobulin, Interferon alpha, Ldh(complex), MAL2 , Mapk, MBP , MHC CLASS I(family), MHC Class II(complex), Mhc2 Alpha, NAMPT , NAT10 , NCF2 , NFAT(complex), NSDHL , PDPN , PEX5L , PKN1 , plc beta, PLC gamma, PLCG2 , PLP1 , POTEE/POTEF , PRG2 , PTX3 , SCAP , Sos, SPTLC2 , SUSD5 , SYK/ZAP, TEC/BTK/ITK/TXK/BMX, THUMPD1 , TPD52L1 , VAV	45	40	Cell-To-Cell signaling and Interaction, Hematological System Development and Function, Lipid Metabolism
10	ACYP2 , ALG11 , ALKBH5, ATP2C1, C19orf70 , C1QL1 , C3orf33, CD33 , CEL2F , CLDN11 , CLUH, COTL1, CRB2 , CREBZF, CTTN , DDX46 , DPP10 , DTX3L , EED, EFHD2 , ELAVL1, EXOG , FAM20B, FGD1, FOS, GLCE, GLIPR2, GSS, HCN3, IL4, KIAA1033, LAAS1L, LGALSL , LRRC37B , LYPLA1, MAN1A2 , MSI1 , MTR , MTRR, MXRA7 , MYADM , NABP1, OMG , OSTC , P3H1 , PBX2, PEX19 , PEX26, PLD6, POLR3D , PRR3, PSMG3 , RAB5B, RPIA , RPS27L , RRP12, SELT, SMAD2, SMG7, SULT2B1, TBCA , TM9SF4 , TMEM56 , TMEM65 , TMTC1 , TMTC4, TMX1 , VHL, VILL , VMA21	39	36	Cancer, Organismal Injury and Abnormalities, Gastrointestinal Disease
11	ALDH1B1 , ANKRD17 , ANKRD13B, APEH, APTIX , ATP2B3 , ATP2C1, ATP6V1A, BARX1 , BCL2L1, BCL2L12, bisphosphoglycerate phosphatase, DCLRE1A, DCUN1D1, EEF1B2 , ERGIC1, EXD2, FBP1 , GDA , H2AFY2 , HARS , Hd-perinuclear inclusions, HPCAL1 , KLF7, LAPT4A, LHX8 , LMNA, Mapre2, MRPL12 , MRPL24, MRPS7, MRPS26, MRPS31 , MRPS35, MRPS18B, MTDH , NADSYN1 , NES , OTUD5, PAFAH1B2 , PGAM2 , PLOD1 , PRPSAP2 , PSEN1, RCCD1 , RPS27L , RRP12, SCN3B, SCPEP1 , SEC61A1 , SEMA3G , SGTB, SLC25A4 , SLC6A1 , SNCB , SPNS1 , SV2B, THUMPD3, TIGAR , TMEM164 , TMEM132A, TP53, TPPP3 , UBC, Ubiquitin, UNC79 , VWA8 , WDR91 , ZNF699 , ZNRF2	39	37	Cell Death and Survival, Nervous System Development and Function, Tissue Morphology

12	ABCB9, ADGRA1, ANKZF1, butyric acid, C3AR1, CARS, CEMIP, CES2, CLCN6, COTL1, DOLPP1, DPP6, ENGASE, ERBB2, EXT2, FAM160A2, Fetal Hemoglobin, FKBP10, GABRB2, Gata, GATA6, GNRH, GPR146, GPRC5A, GRHL1, GTPBP10, HIF1A, histamine, HM13, HNF4A, HNMT, KDELR2, KLK14, LOC344967, LOXL2, Ltbp, MORC2, MUCL1, MYO9A, NANOG, NLN, NNMT, NPTN, PDK2, PRG3, PRL, PRR30, PZP, RAD51C, SEC11C, SELENBP1*, SGSH, SLC35A2, SMTN, SPAG4, SPARCL1, SSR3, TGFB1, TGFB1*, THSD4, TRAM1, tretinoin, TSC22D2, UBE2Q1, USH1C, XBP1, ZNF326, ZNF440	35	35	Cancer, Organismal Injury and Abnormalities, Gastrointestinal Disease
13	ABHD10, ABHD11, AK5, APP, ATCAY, ATXN1, BRWD1, CAMKV, CCNO, CFL2, CLIC6, COPS3, CPNE6, CRIP2, CSNK2A1, CXorf56, DMD, DNAJC4, DNAJC5, DNAJC8, DTD1, E2F1, FAM49A, FBXO38, GALK1, GRAMD4, GSTO1, HIC2, HINT2, HSP90AA1, HSPB1, HSPB7, IARS2, ISOC2, KCMF1, KCNN3, KLHL36, LDB3, LY6H, mir-149, MOBP, MRGPRF, MSI1, MURC, MYH8, MYOZ1, N-acetyl-L-aspartic acid, NARS, NES, NIPSNAP1, NUCKS1, OGN, P2rx7, PDK2, PGM5, PHYHD1, PHYHIPL, PMP2, PTGDR, SLC17A5, SLC6A13, TFB1M, TFDP3, TSPY2(includes others), UBXN7, VAT1L, WNT3A, ZXDC	34	34	Neurological Disease, Skeletal and Muscular Disorders, Cellular Compromise
14	Akt, APBB1IP, ARAP3, ATXN2L, c-Src, CAV2, Caveolin, CD151, chymotrypsin, COL12A1, COL2A1, COL4A3, COL5A1, COL5A3, COL6A3, COL7A1, collagen, Collagen type I, Collagen type III, Collagen type IV, Collagen type V, Collagen type VI, Collagen type XVIII, Collagen(s), Complement component1, DDR1, Ecm, F13A1*, factor XIII, FERMT3, Fgfr, FGG*, Fibrin, Fibrinogen, FSD1, FYB, GPIIB-IIIa, growth factor receptor, IGFBP2, Integrin, Integrin alpha 2 beta1, Integrin alpha 3 beta 1, Integrin alpha 4 beta 1, Integrin alpha 5 beta 1, Integrin alpha V beta 3, Integrinα, ITGA2, ITGA6, ITGA8, ITGA2B*, ITGB3, JINK1/2, Laminin, Lfa-1, PDGF(family), PECAM1, PIP, PLEK, POSTN*, Ptk, RDH10, SERPINH1, SRSF5, SYNM, Talin, TGFB1, THBS1*, TPPP, WASF2, Wnt	34	35	Tissue, Development, Cancer, Connective Tissue Disorders

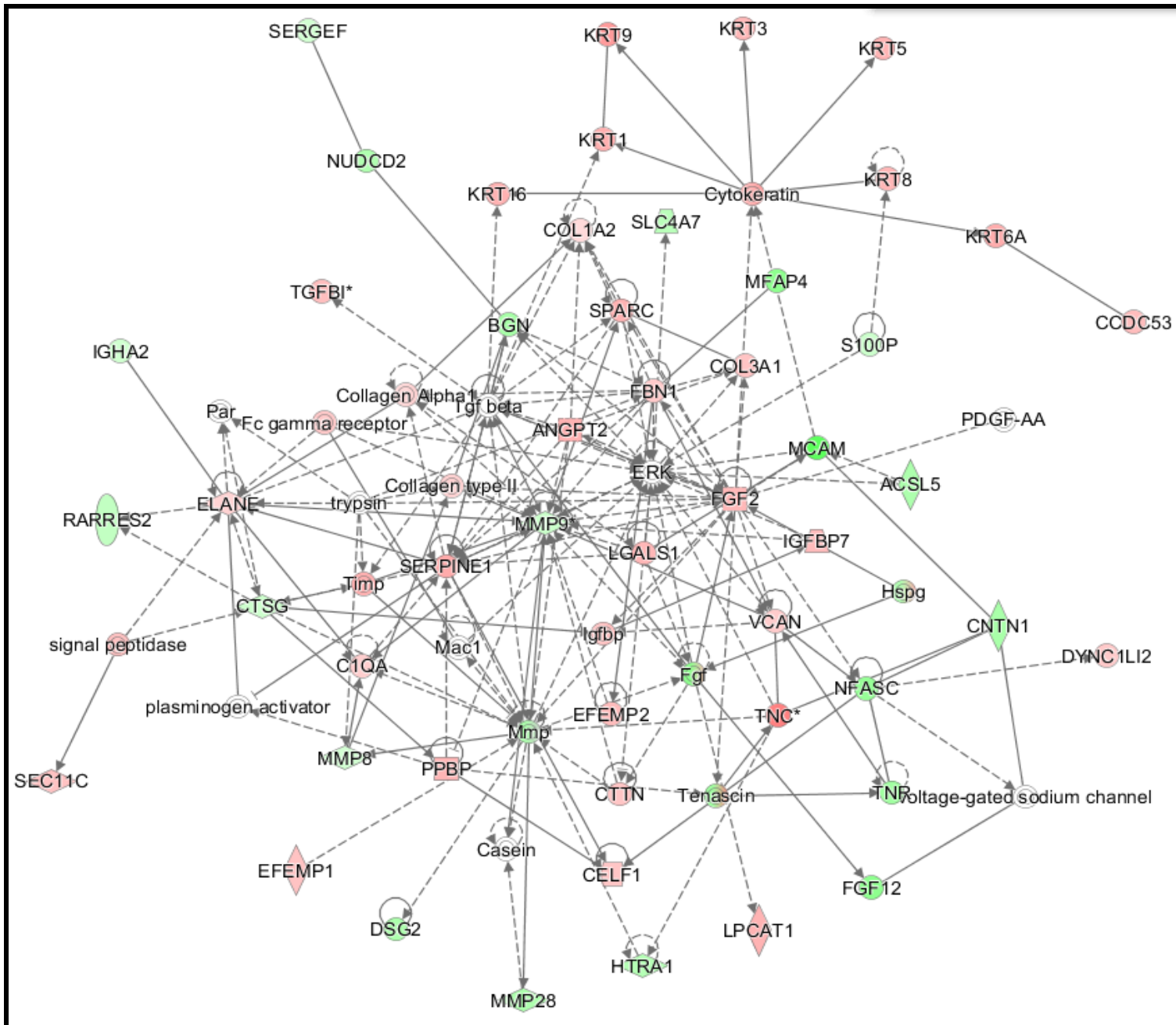
15	Adaptor protein 1, amylase, Calcineurin A, Cd1, CD33 , Cdc2, CELF2 , CLINT1 , DHPS , E2f, EIF2AK2 , EPX , FAM118A , FAM118B , FBXO2 , FKBP9 , FKBP1A , FND3B , GJB2 , HINT1 , Ifn, IFN alpha/beta, IFN type-1, Ifnar, Ige, Igg3, IgG2a, Ikb, IKK(complex), IKK(family), IL12(complex), IL1RAP , I18r, IRAK, IRAK4 , ISG15 , ISG20 , Jnk, MAP1LC3, MAP3K, MAP3K10 , MAVS , MFN1 , MHC, MHC Class I(complex), MHC II, Peptidylprolyl isomerase, PPIC , PURB , RAB27B , RSU1 , SERPINB3 , SGSH , SIAE , Smad, Smad1/5/8, Smad2/3, Smad2/3-Smad4, TGFBR3 , TH2 Cytokine, Tip60, Tlr, TLR8 , TMSB4, TMSB10/TMSB4X , Tnf receptor, transglutaminase, TREX1 , TRIM21	30	33	Cell signaling, Inflammatory Response, Antimicrobial Response
16	ADCY, ADCY3 , ADIPOQ , ADRB, AOC3* , Atrial Natriuretic Peptide, atypical protein kinase C, BCAM , CALR , CAMK1 , CaMK I, CAMK2A , CAV1 , CD200 , CNN1 , Cofilin, Creb CSRP2 , DAB2 , DCK , DGAT1 , FGB , G protein alpha, GDA , GNAO1 , GNAZ , Homer, HOMER1 , ITPR, KALRN , KLK6 , L-type Calcium Channel, Laminin1, Lpa receptor, LRP, Mek, mGluR, mGLUR Group I, MIR124, Mlc, NCAM1 , NCK, NES , NFkB(family), Pak, Pde, Pdgf(complex), PDGF BB, PI3K(complex), Pka catalytic subunit, Pkg, PLA2, Pld, PP1 protein complex group, PP2A, Ppp2c, Rab11, RAB11FIP5 , Rap1, RASA3 , RETSAT , Rock, RPS27L , RYS2 , SLC29A1 , SLC2A3 , SLC39A12 , Stat3-stat3, TRPC6 , Vla-4	30	32	Cancer, Gastrointestinal Disease, Organismal Injury and Abnormalities
17	Adaptor protein 2, Ap1, ATP11B , BCAT1 , CA3 , CALCRL , CAPN2 , CASPASE 3/7, CD3, Clathrin, CPVL , DACT1 , DPYSL3 , ENPP6 , FGF1 , Focal adhesion kinase, G protein alpha, G protein beta gamma, G-protein beta, G-protein gamma, Girk, GNG2 , GPCR, GPR37 , GRM1 , GRM3 , GRM5 , Histone H1, JAK, MAP2K1/2, MTORC1, NADPH OXIDASE, NASP , NEGR1 , Nfat(family), NMDA Receptor , NT5C , NT5C3A , NUDT2 , P110, p85(pik3r), Pdgfr, phosphatase, PI3K(family), PIGS , Pka, PLC, PP1-C, PIIP5K1 , PPM1H , PPP1CC , PPP1R18 , PTPN1 , PTPN7 , Rac, Ras, Ras homolog, RHOV , Rsk, Sapk, Sfk, Shc, SIRPA , SRC(family), ST8SIA3 , STAT, TCR, voltage-gated calcium channel, XPR1 , YAP1	29	32	Post-Translational Modification, Cell-to-Cell Signaling and Interaction, Nervous System Development and Function

18	ABCB9, ADAM2, ADAM20, ADAM21, ADAM23, ADAM28, ADAMTS6, AHR, AIG1, APOA1, ARSF, ASPN, BORCS5, CC2D1B, CES2, CNN1, Collagen Type XI, DNAH1, DNAH5, DNAH6, DNAH8, DNAH10, DNAH12, DNAL1, DYNLT1, Efna, EGFR ligand, EHD2, EMILIN2, ENPEP, EP300, ERAP2, EWSR1, FAM169A, HMMR, KEL, MACROD1, MANF, MAP7D1, MED14, MED24, MED28, MED12L, mediator, Metalloprotease, MMP2, NEBL, NFATC1, NR1I2, OLFML1, OSTF1, PLSCR1, PPIC, PROCR, PTH1R, PXR ligand-PXR-Retinoic acid-RXRα, REL, SLC27A3, SLC35A2, SLC47A1, sn-glycero-3-phosphocholine, SORBS2*, SPP1, TADA2B, TBC1D9, TFIIR, TMEM165, TRAP/Media, TXLNG	28	29	Cancer, Organismal Injury and Abnormalities, Reproductive System Disease
19	ABCD4, ABI3BP, ADGRG2, ALG1, ARRB2, ATP5G1, AVPR18, BBOX1, beta-estradiol, BSN, C14orf2, C6orf89, CASC4, CCT6A, COL4A6, CPNE1, CPZ, CSTF3, CTHRC1, CTNNB1, CXADR, ER-α-Estradiol, FBXO6, FGD6, FGFRL1, FHOD1, GALR1, GRB2, GRM3, HCRTR2, HDGFRP3, HPCAL4, HRNR, HUNK, IGF1R, IGKV1D-8, JUN, KCTD16, KIAA0922, LY6G6F, MAN2B1, MINK1*, OSBPL7, OSM, P2RY6, POLR1B, PPRC1, Prl3d1(includes others), Proinsulin, PRSS35, PTGER3, PXDN, PYGO2, Relaxin, RGS9, RPUSD2, SDK1, SLC22A8, SLC4A8, SSTR4, TBR1, TESPA1, TMED8, TMEM2, TPD52L1, TXNL4A, UNK, WWC2, YWHAZ, ZBTB18	27	29	Cancer, Cellular Movement, Connective Tissue Disorders
20	ACBD5, ATP5J2-PTCD1, BTAF1, CCNT2, chemokine, CHMP7, CPSF3, DUB, EAF2, ERLIN1, FAAH, FUNDG2, GPD1, GTF2A1, GTF2A2, GTF2F1, GTF2H2, GTF2H3, GTF2H4, GTF3C6, HACD4, HAPLN4, Histone h4, Holo RNA polymerase II, IDO2, L-dopa, MRPL18, MRPL22, MRPL24, MRPL39, MRPL44, NXF1, PLPPR1, POFUT2, PSAT1, PTCD1, PTN, RAB20, RENB, RNA Pol-II Pre-Initiation Complex, RNA Pol-II-TFIIA-TFIIB-TFIID-TFIIF, RNA pol2-transcription factor, S100A9, SCUBE1, SLC22A17, SMYD5, SUPT4H1, TAF4, TAF5, TAF8, TAF11, TAF13, TAF1L, TAF5L, TAGLN, TFIIE, TFIIF, TMEM199, TTC39C, UNC119B, USP6, USP16, USP22, USP29, USP32, USP43, USP45, USP46, USP47, USP48, USP53, WLS	23	26	Post-Translational Modification, Gene Expression, Protein synthesis

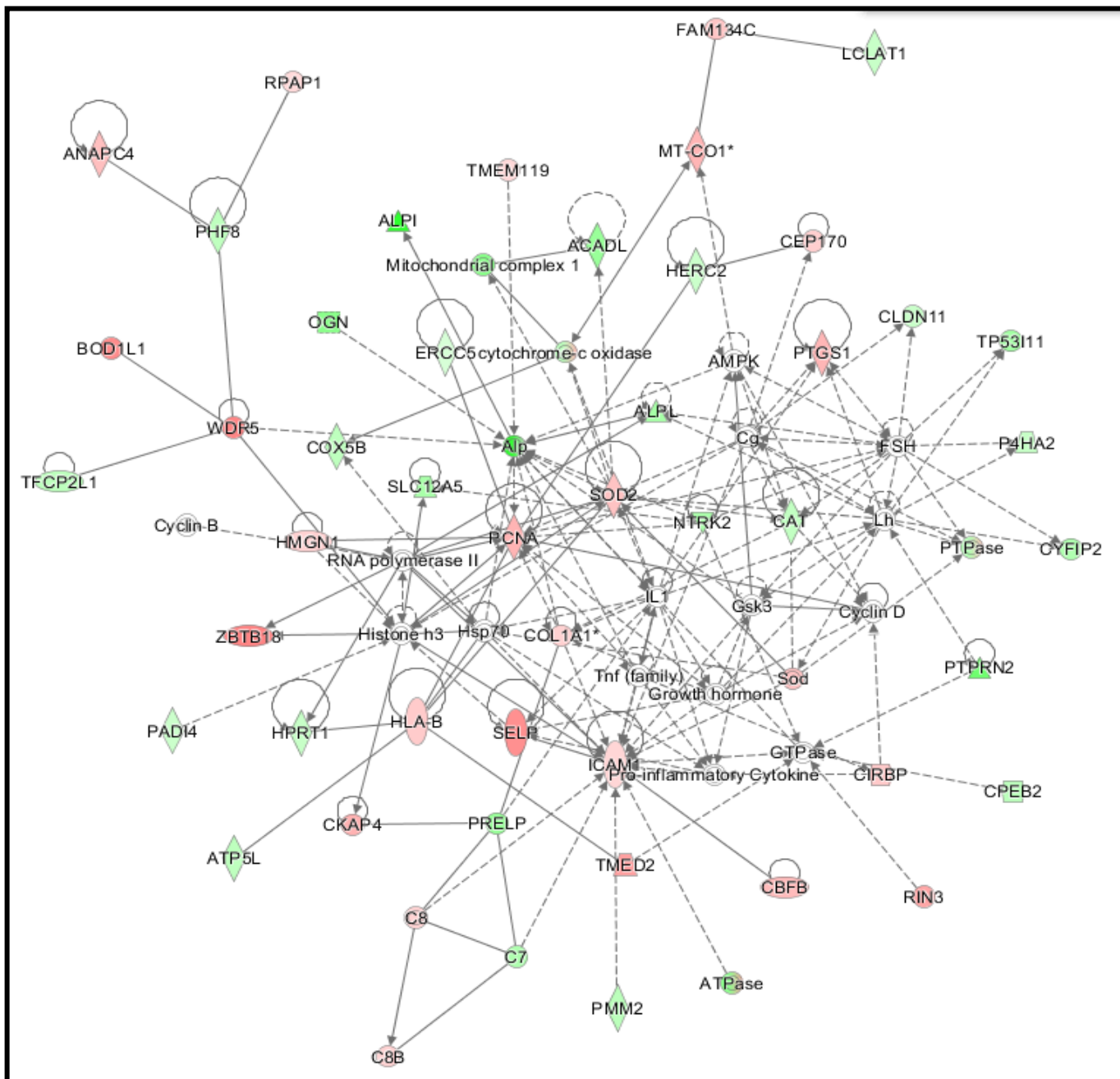
Network2



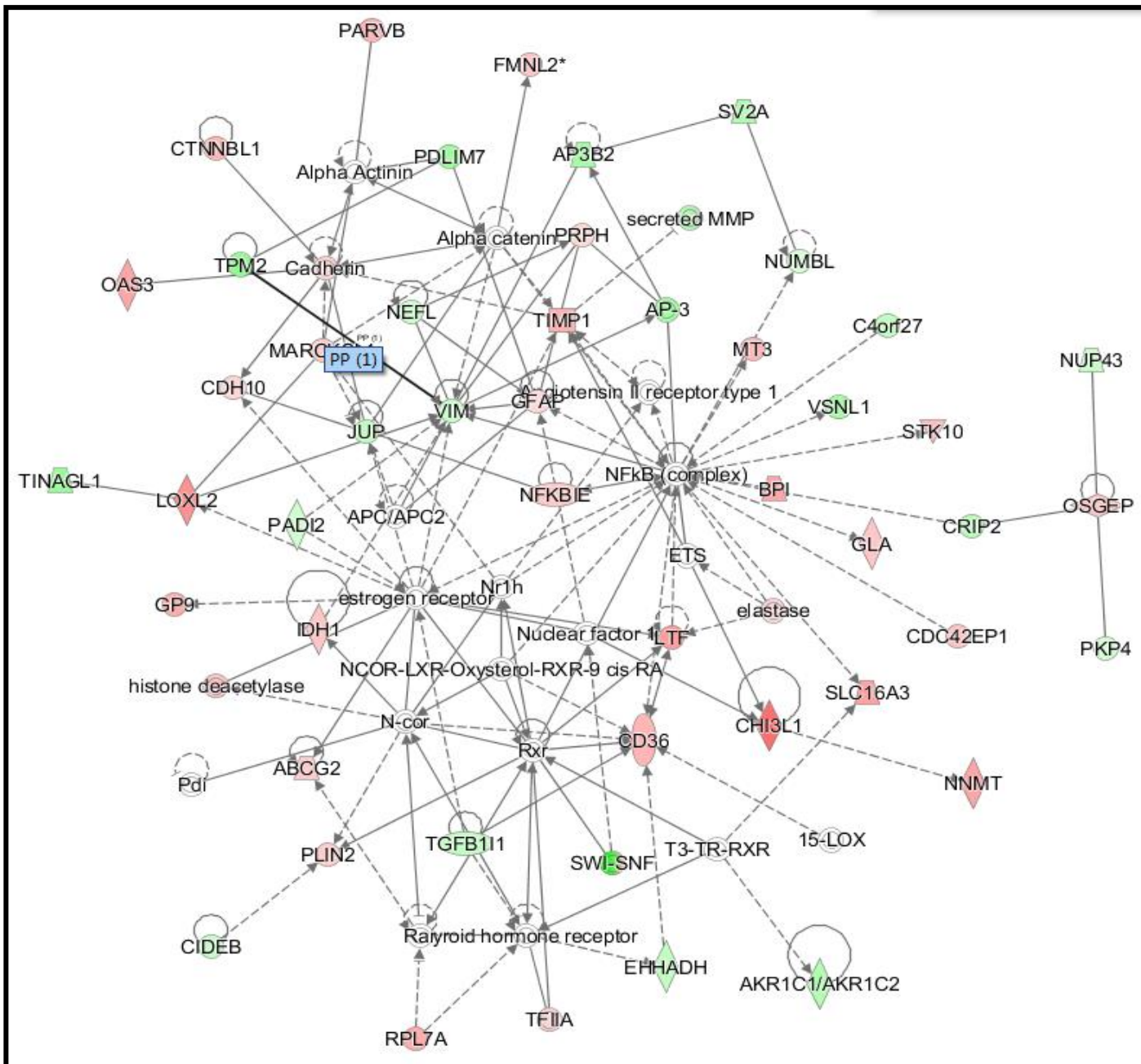
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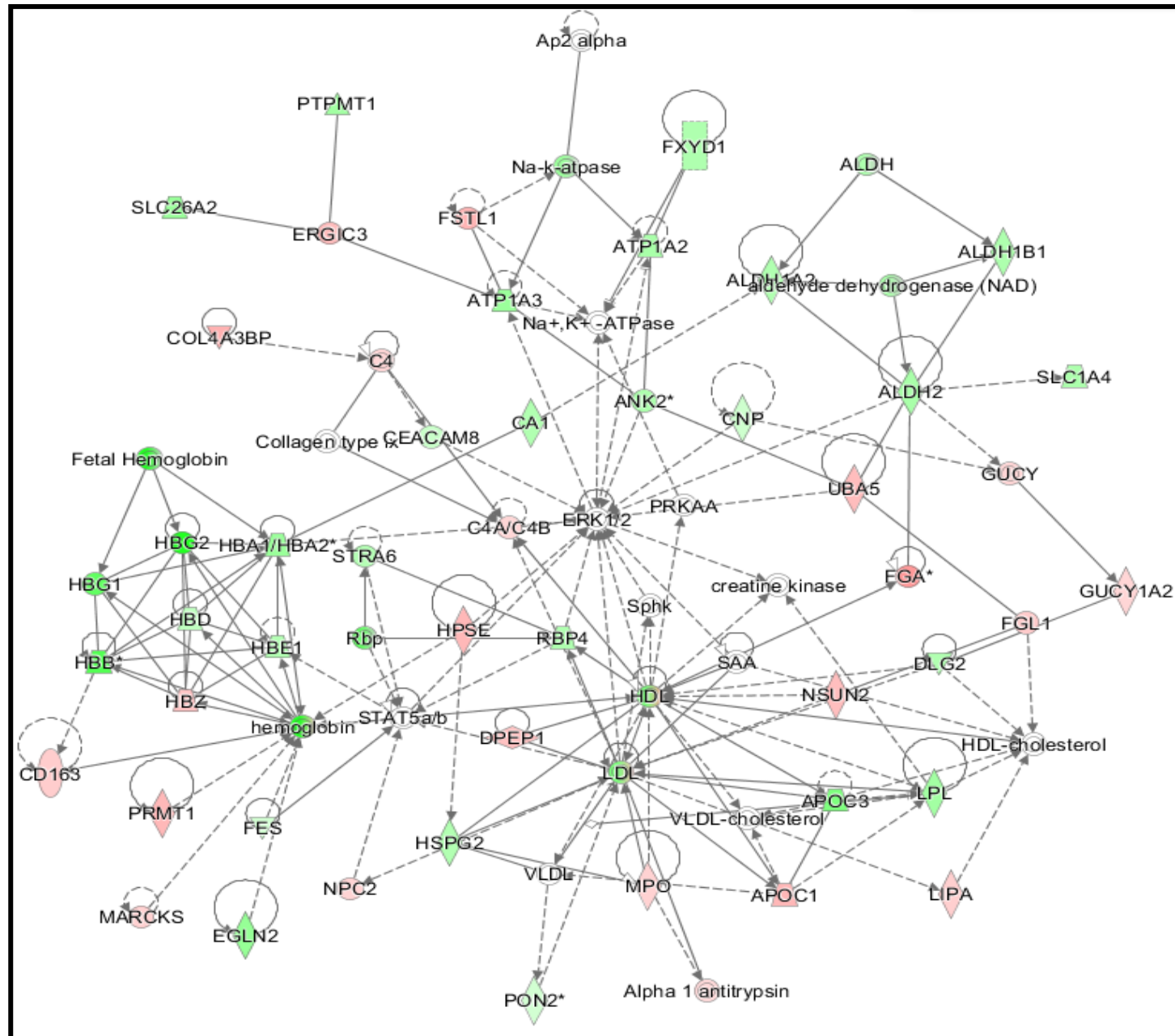
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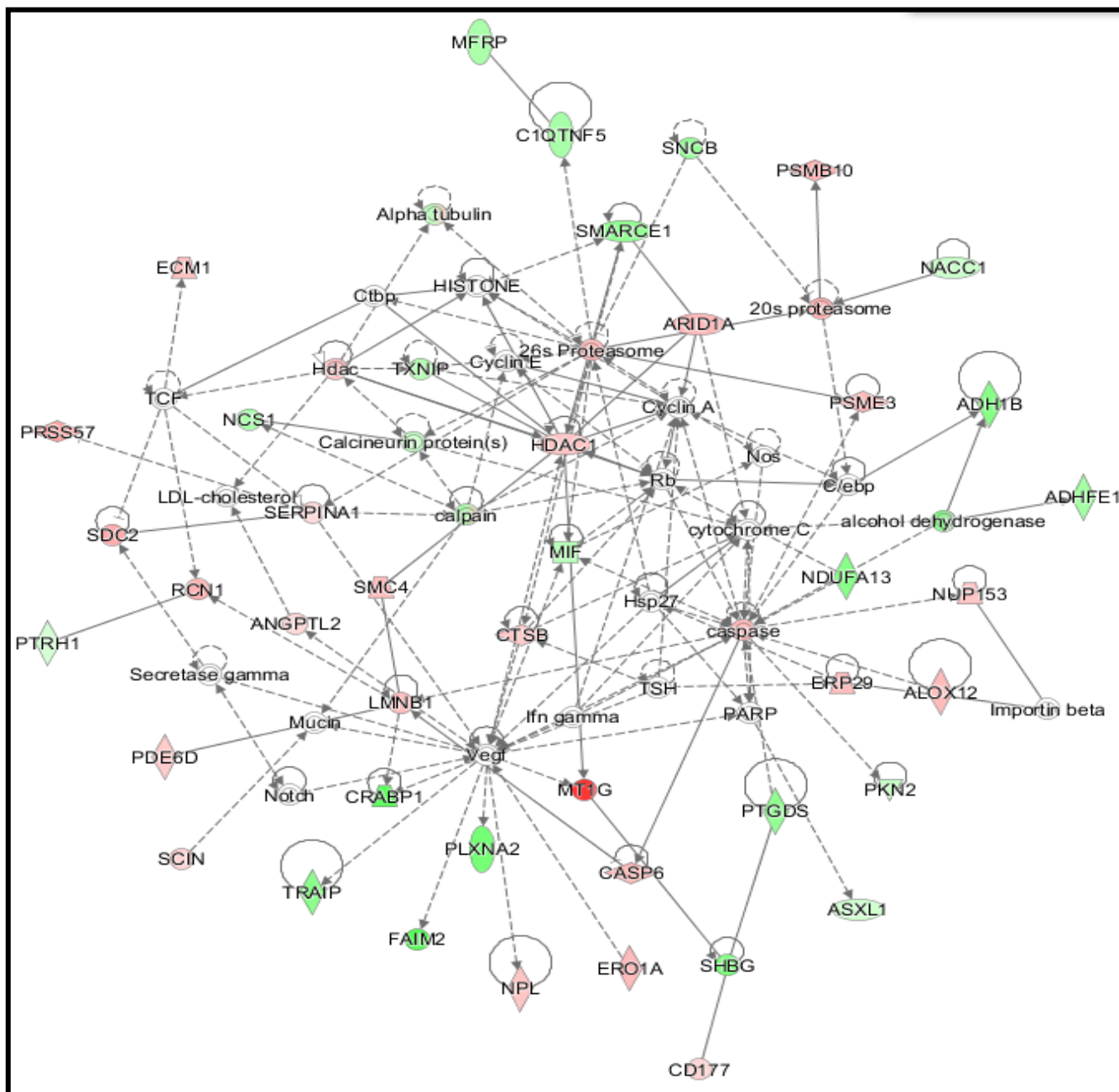
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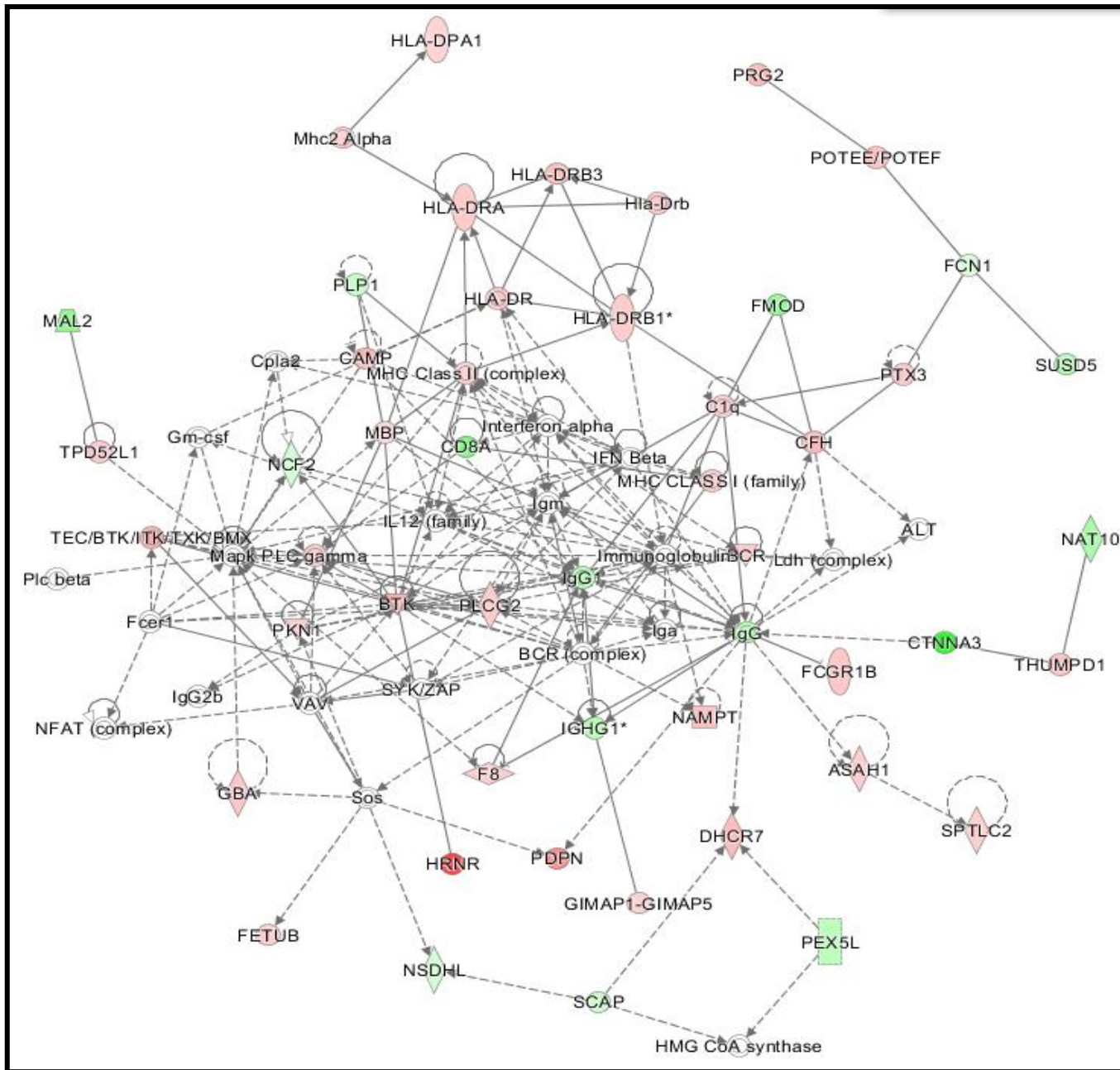
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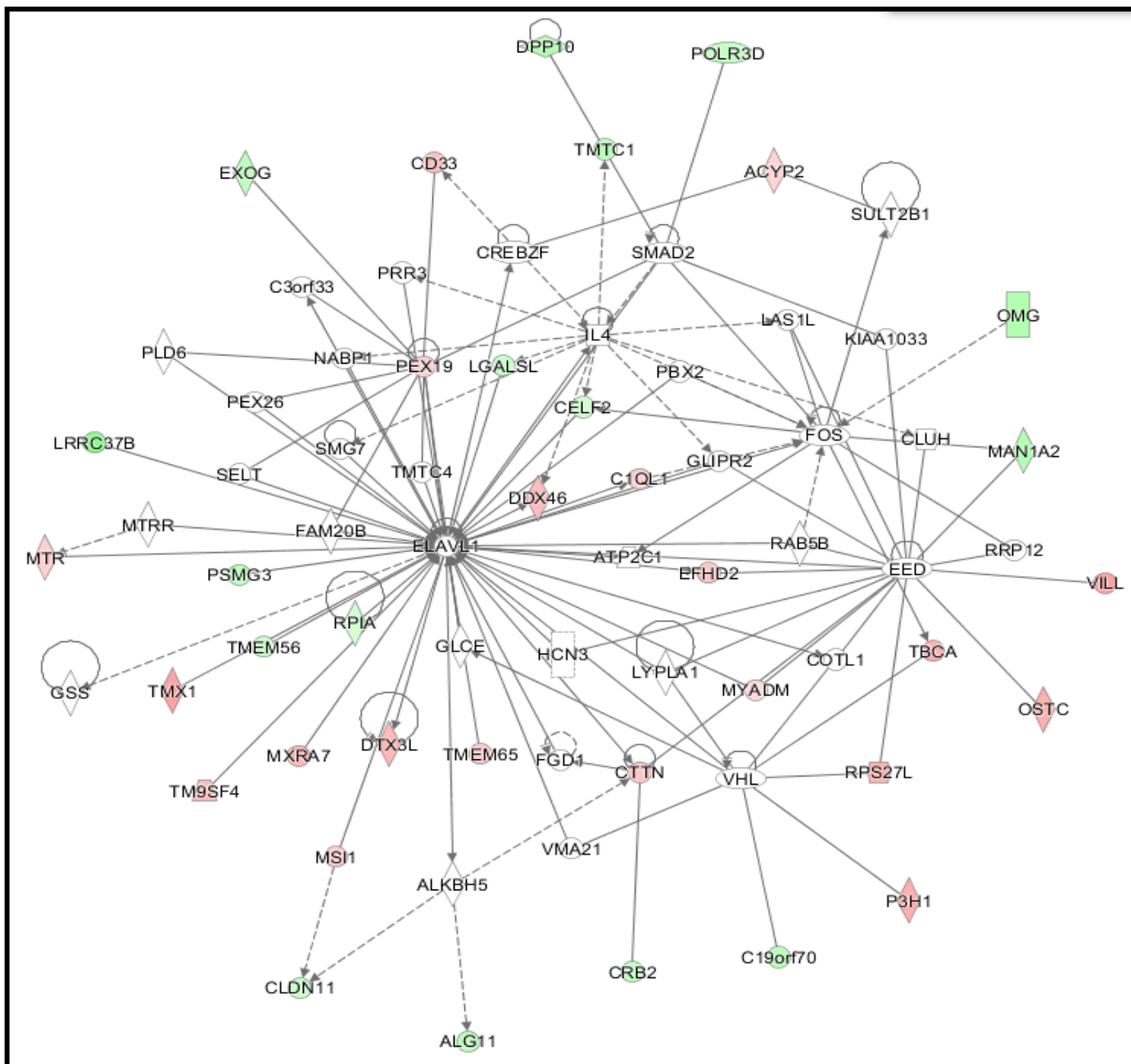
Network8



Network9

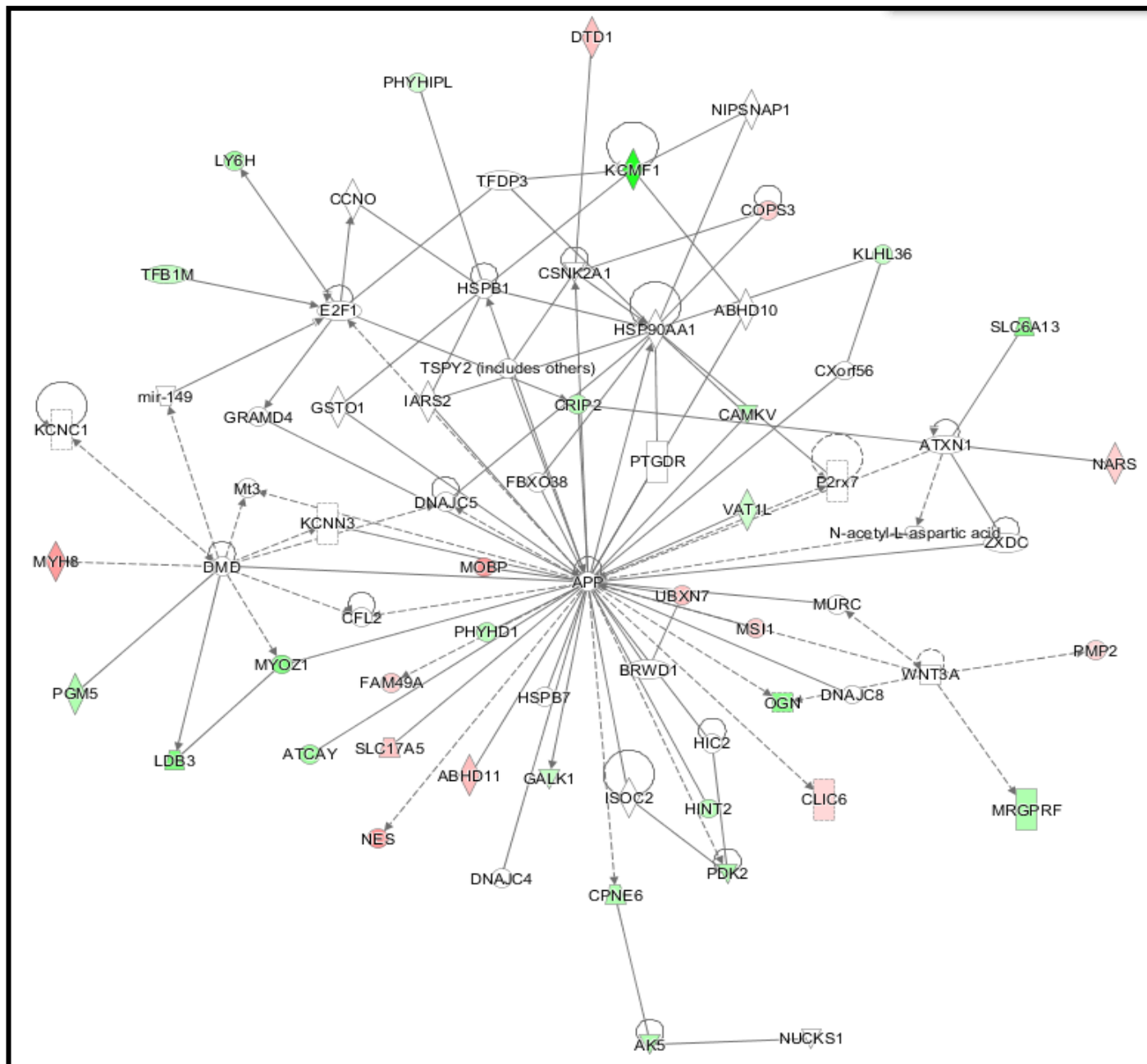


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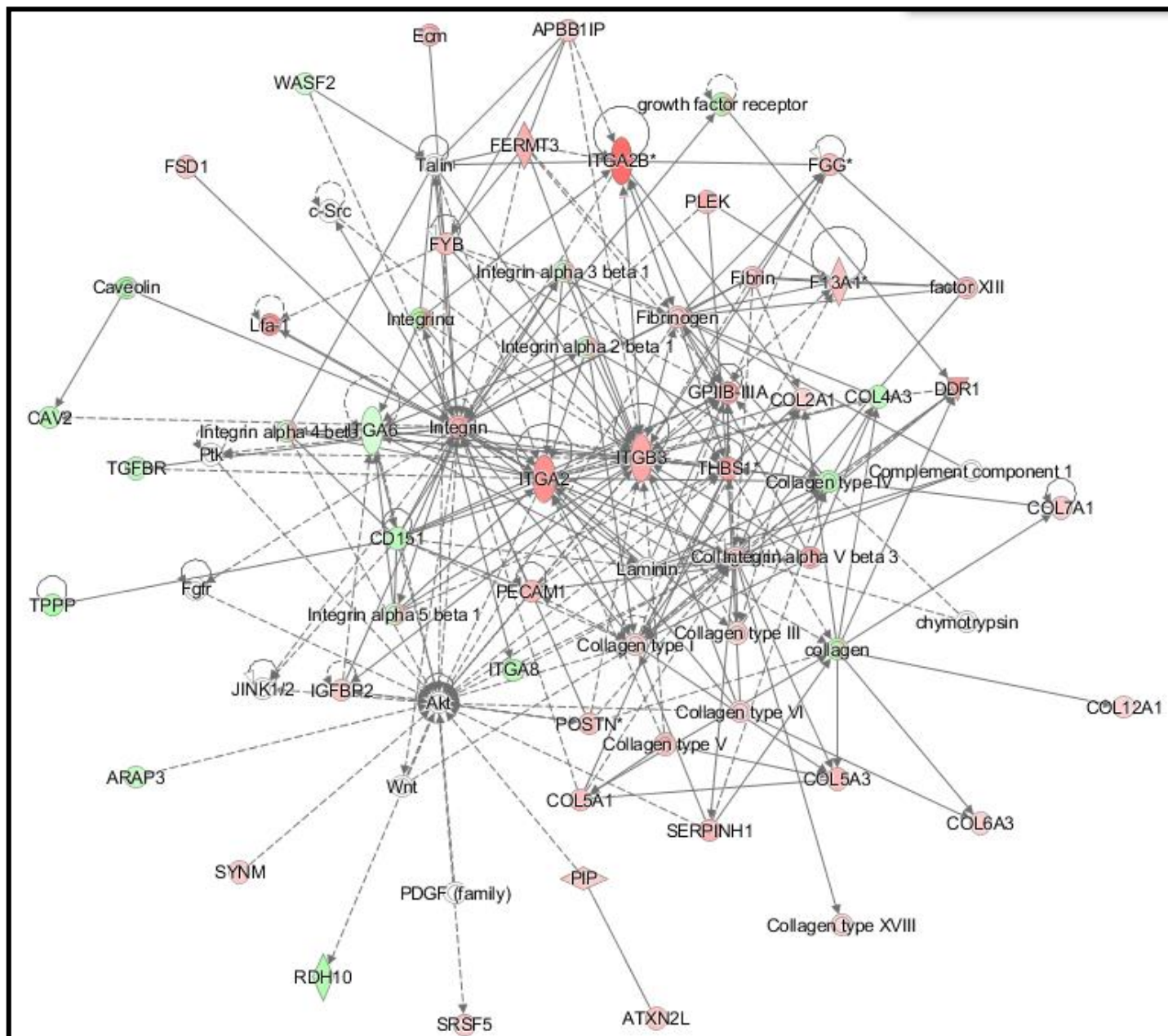


The diagram illustrates a dense network of protein-protein interactions. Central nodes like TP53 and UBC are highly connected. The network includes various functional clusters, such as metabolic pathways (e.g., bisphosphoglycerate phosphatase, PGAM2, GDA) and structural components (e.g., HD-perinuclear inclusions). Nodes are color-coded: red for one group, green for another, and grey for a third. Shapes also vary, with circles, diamonds, and squares used to distinguish different types of proteins or complexes. Dashed lines and boxes highlight specific sub-networks or clusters of interest.

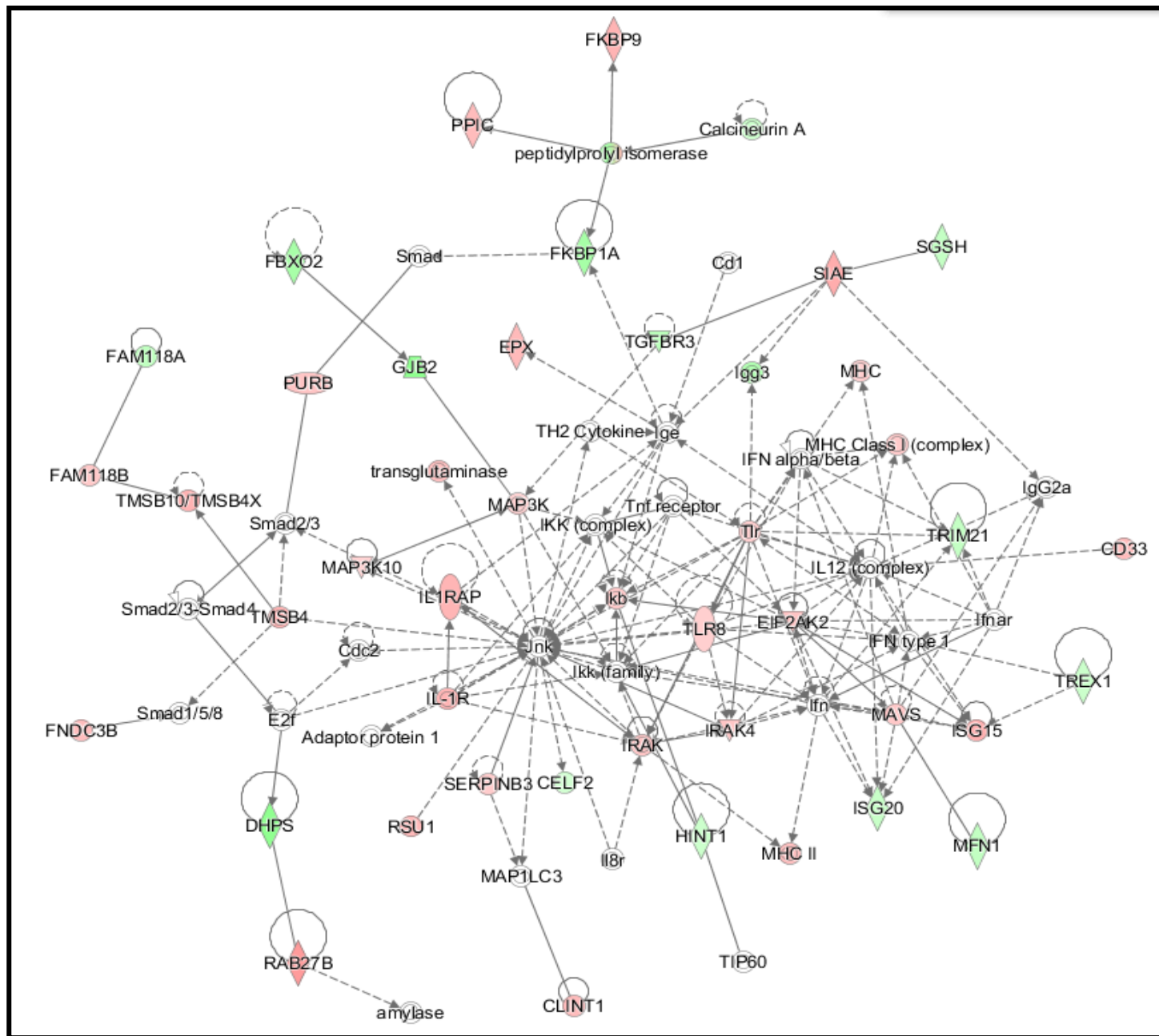
Network13



Network14

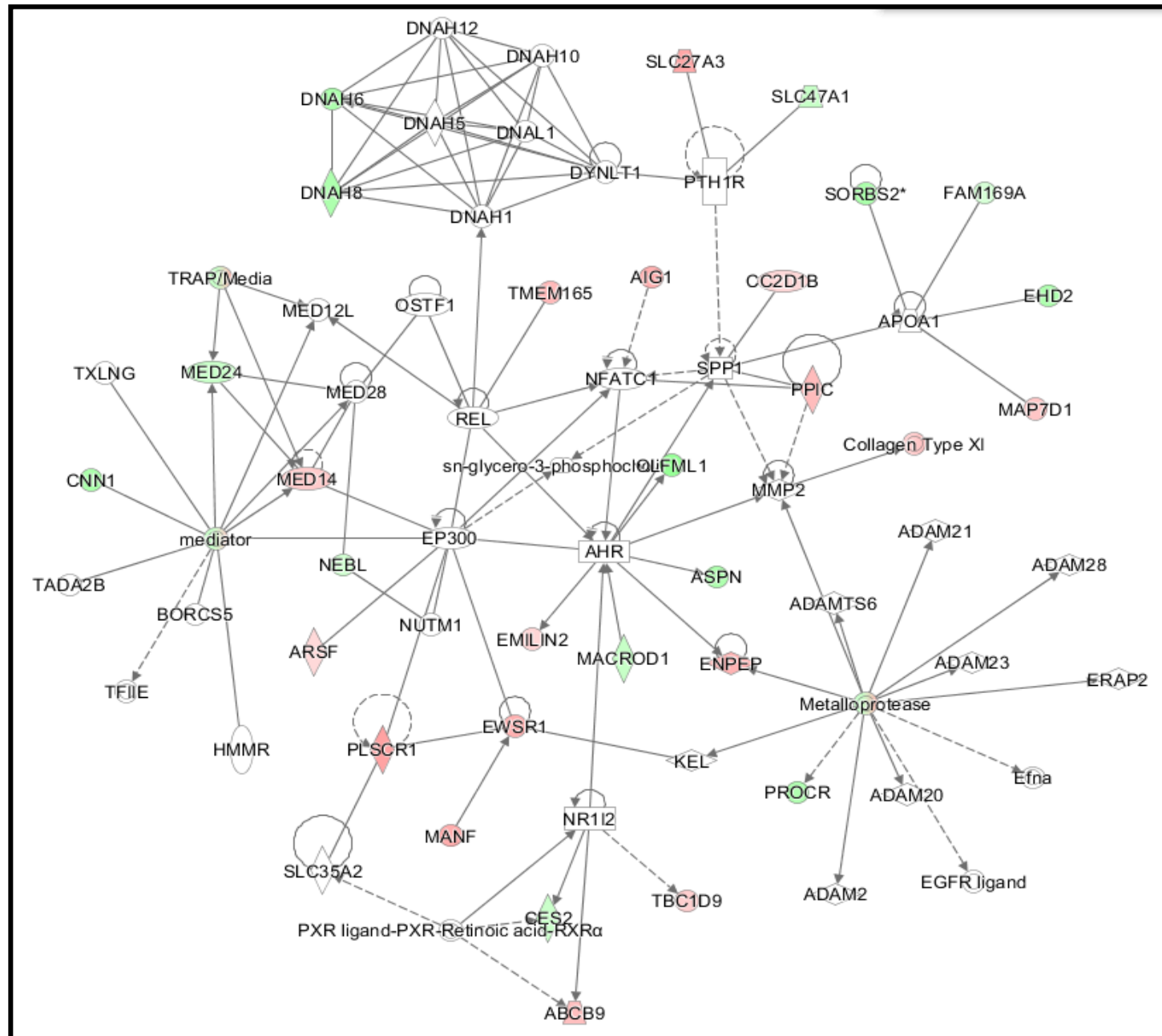


Network15

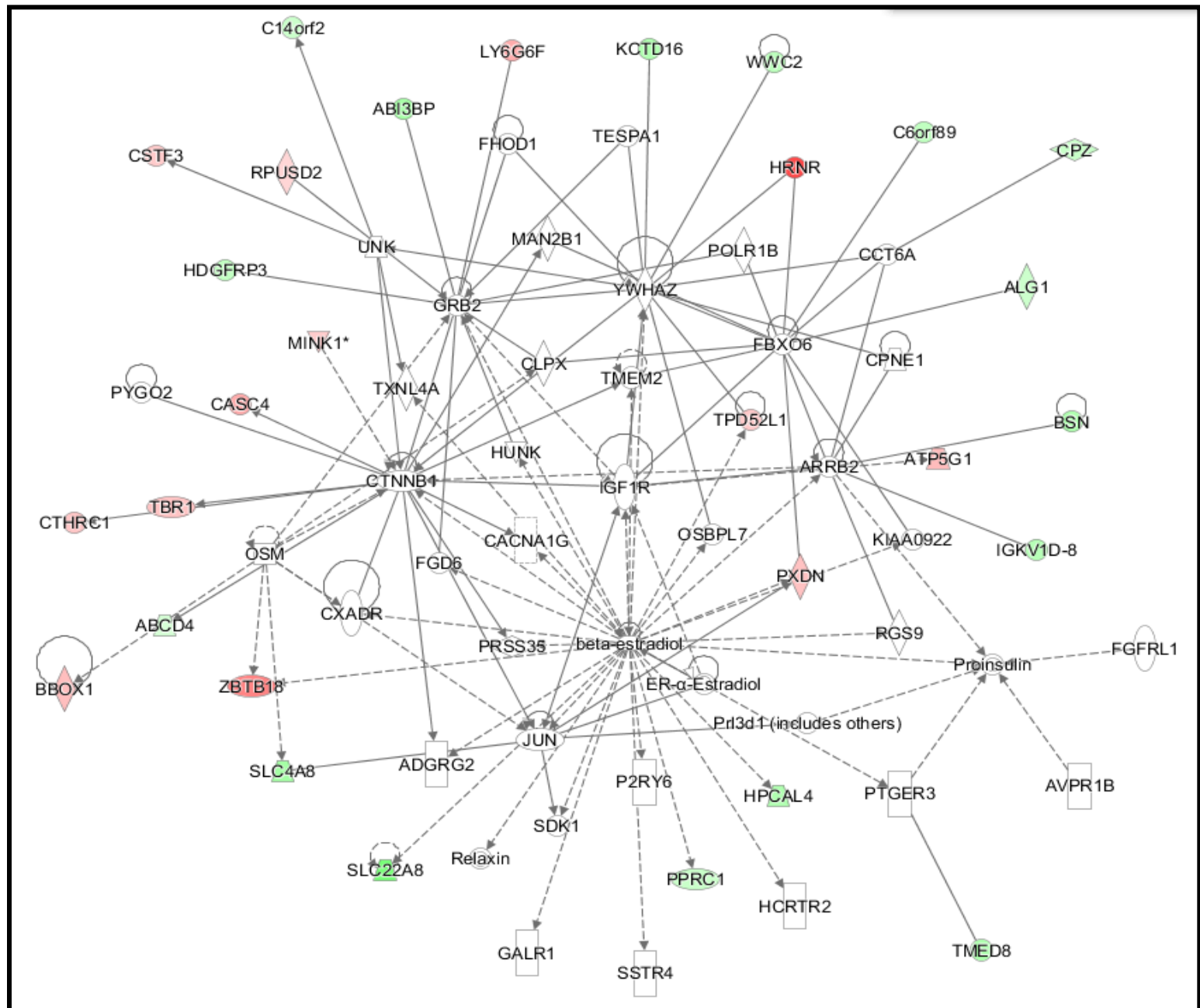


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Network18



Network19



Network20

