Supplementary Materials and Methods

hiPSC culturing

The hiPSC lines 47-02 control and 47-01 patient were derived from fibroblasts using episomal reprogramming vectors: OCT3/4/shp53 (Addgene #27077), SOX2/KLF4 (Addgene #27078), l-MYC/ LIN28 vector (Addgene #27080) as previously described in (Schlaeger, et al, 2015). Briefly, the fibroblasts were transfected with Amaxa NHDF nucelofector kit (Lonza #VPD-1001) with Amaxa Nucleofector 2b (Lonza #AAB-1001) and using the Amaxa Nucleofection system (program P-022) to deliver episomal vectors into the cells. After transfection the cells were cultured for 10-14 days on adherent cultures on mouse embryonic fibroblasts (MEFs, Global Stem Inc.) in hESC-media: DMEM/F12+glutamax (Life Technologies), knock-out serum replacement (Gibco, Life Technologies), β-mercaptoethanol, MEM-NEAA (Life Technologies), supplemented with bFGF 8ng/ml (Invitrogen). After the hiPSC-colonies started to form on top of MEFs the colonies were picked manually and plated on Geltrex-coated plates (Gibco by Life Technologies) and cultured with mTESR1 medium (Stem Cell Technologies).
78 control, 77-patient and 77-TSC2-null lines were derived from lymphoblasts using the sendai-virus method for delivering OCT3/4, KLF4, L-MYC, SOX2, LIN28, -vectors into the cells. CRA401-patient, female control and male control were derived from fibroblasts using the sendai-virus method, as previously described (Schlaeger, et al, 2015).
After picking of the clones from transfected plates all the hiPSC colonies were cultured in feeder-free culture conditions on top of Geltrex (Gibco by Life Technologies) in mTESR1 medium (Stem Cell Technologies). The hiPSC colonies were passaged every 4-6 days, and media was changed every day. All studied hiPSC-lines had normal karyotype, and cells were tested routinely to be mycoplasma-negative. The cells were analyzed with qRT-PCR and westernblot-method to confirm pluripotency of the hiPSCs, and expression of pluripotency markers OCT4, NANOG, SSEA-4 and TRA1-60 were detected with immunocytochemistry (Supplementary Figure S1).

PC differentiation of hiPSCs

Briefly, to induce the neural differentiation, hiPSC colonies were dissociated into single cells using Versene dissociation reagent for 10 minutes at 37 °C (Life Technologies). Single cells were plated into low-attachment dishes (CLS3471, Corning, Sigma) to form aggregates in neural induction medium: DMEM/F12 (Life Technologies), N2 1x (Life Technologies), B27 1x (Life Technologies), nicotinamide 10 mM (Sigma), noggin 50 ng/ml (Peprotech Inc.), SB-431542 10 μM (Stemgent), Y-27632 10 μM (dihydrochloride) (STEMCELL Technologies), CHIR99021 1.7 μM (Stemgent). At day 2 of differentiation noggin concentration was increased to 100 ng/ml. At day 4 of differentiation FGF8b 100 ng/ml (Peprotech Inc.) was added to the media, together with bFGF 10 ng/ml at day 10-12, and nicotinamide was removed at day 4. Cells were plated into PDL (50 μg/ml) and laminin (10 μg/ml) coated plates at day 8, Y-27632 (dihydrochloride) 10 μM was added to increase cell survival. At day 12 media was changed to Neurobasal (Life Technologies), B27 1x, N2 1x (Life Technologies), BDNF 10 ng/ml (Peprotech Inc.), T3 30 μM (Sigma). Cells were cultured in this media until THY1-selection at day 28-32 of differentiation.
Differentiation was repeated for each cell line 3-5 times. The data from the TALEN-engineered bi-allelic TSC2-mutant (77-TSC2-null) hiPSC-line was analyzed from three biological samples collected from 3 separate differentiation times. Cell lines analyzed; 78 control ($TSC2^{+/+}$), 77-patient ($TSC2^{+/-}$), 77-TSC2-null ($TSC2^{-/-}$), CRISPR-corrected 77-control line ($TSC2^{+/+}$), 47-02 control ($TSC2^{+/+}$), 47-01 patient ($TSC2^{+/-}$), F628 control ($TSC2^{+/+}$), Male control ($TSC2^{+/+}$), CRA401 patient ($TSC2^{+/-}$), (see Supplementary Table 1).

THY1 immunopanning for Purkinje cell precursor selection

The non-tissue culture-treated petri-dishes were coated with goat anti-mouse IgG (Cappel) 20 μg/ml in 50 mM Tris-HCl pH 9.5, overnight +4 °C. Plates were washed with PBS and the anti-human THY1

antibody 2.6 μg/ml (Biolegend) was diluted in 0.2 % BSA-DMEM/F12 and incubated for 30 minutes at 37 °C. The adherently cultured iPSC-derived cerebellar neurons were dissociated with Accutase (Innovative Cell Technologies) for 15 minutes at 37 °C, and single cells were added to THY1-coated dishes in DMEM/F12, glucose 25 mM (Sigma), Y-27632 10 μM and incubated for 30 minutes in 37 °C. Cells were de-attached from immunopanning plates with Accutase treatment for 10 minutes at 37 °C and plated on low-attachment plates to aggregate into spheres in Neurobasal (Life Technologies), B27 1x (Life Technologies), N2 1x (Life Technologies), CHIR 1.7 μM , FGF8b 100 ng/ml, bFGF 10 ng/ml, BDNF 10 ng/ml (Peprotech Inc.), T3 30 μM (Sigma), BSA 1 % media for 2 to 7 days *in vitro*. All hiPSC lines presented in Supplementary Table 1 were differentiated into PCs and underwent Thy1+ immunopanning using this method.

Co-culture of human Purkinje cells with mouse granular cell culture

Mouse granular neurons were isolated from P5-7 pups' cerebellum. Cerebellum was dissociated in MEM-medium with Pen/strep (P/S, Life Technologies) solution supplemented with Glucose 25 mM (Sigma), DNAse 12 U/ml and papain 40 U/ml (Worthington, Biochemical Corporation) solution for 10 minutes at 37 °C. Enzymatic dissociation reaction was inactivated with 10 % FBS-HBSS-Glucose 25 mM-P/S solution, and cells were further dissociated into single cells using mechanical tituration in MEM-base medium with P/S (Life Technologies) solution with Glucose 25 mM (Sigma) and DNAse 12 U/ml. Cells were washed once with 10 % FBS-HBSS-Glucose-P/S solution. Single cells were filtered through cell-strainer 45 μm and plated into Poly-d-lysine 50 μg/ml and laminin 10 μg/ml coated sterile glass-coverslips into co-culture medium: Neurobasal-A (Life Technologies), N2 1x (Life Technologies), B27 1x (Life Technologies), BSA 1 % (Sigma), BDNF 10ng/ml (Peprotech Inc.), T3 30 μM (Sigma), laminin 1 μg/ml (Sigma). AraC 4 μM was added to the cell cultures to inhibit astrocyte proliferation and growth during the first two-weeks of differentiation. Human $THY1^{+}$ spheres were treated with Y-27632 (10 μM) for 30 minutes, prior to mechanical dissociation into smaller clusters and plating on top of mouse granular cells. bFGF 5 ng/ml and Y-27632 were maintained in the medium for two days after plating to inhibit cell death. bFGF was maintained in medium for an additional two weeks to enhance mouse GC survival. All hiPSC lines presented in Supplementary Table 1 were differentiated into PCs and THY1+ immunopanned and co-cultured with mouse GCs.

Protein expression analyzes

Protein samples were collected into RIPA-buffer supplemented with PMSF 2mM, protease inhibitor cocktail and sodium orthovanadate 1 μM (Santa Cruz). Protein concentration was analyzed using the Bradford Assay (Biorad) and 96-well plate reader (A595 nm) and 15 μg/protein was loaded/well. 4–20% Criterion™ TGX™ gel (Biorad) was blotted into Immobilon-Transfer membrane (EMD Millipore) with Turbo-Transfer buffer (Biorad) using the Trans-blot Turbo Transfer System (Biorad). The list of antibodies used is presented in Supplemental Table 3. In the main Figure 2 and FigS1 the protein expression data was analyzed and presented from three differentiation replicates of; 78 control ($TSC2^{+/+}$), 77-patient ($TSC2^{+/-}$) and 77-TSC2-null ($TSC2^{-/-}$). In the Supplementary Figures S5 and S9 the protein expression data was analyzed from three independent control lines: 47-02, 78, F628 ($TSC2^{+/+}$), three patient lines 47-01, 77, CRA401-patient ($TSC2^{+/-}$), and three biological replicates of 77-TSC2-null ($TSC2^{-/-}$). In Figure 5, the protein expression data was analyzed and presented from three differentiation replicates of 78 control ($TSC2^{+/+}$), 77-patient ($TSC2^{+/-}$), 77-TSC2-null ($TSC2^{-/-}$), F628 control ($TSC2^{+/+}$), Male control ($TSC2^{+/+}$), CRA401-patient ($TSC2^{+/-}$), 47-02 control ($TSC2^{+/+}$), and 47-01-patient ($TSC2^{+/-}$) cell lines.

ImageJ analyzes

Cells were analyzed at day 16 and 24 of differentiation for Ki67-positive cell and SKOR2-positive cell calculations. Average number of positive cells was counted from 6-8 randomly selected areas/coverslip. Approximately 7,000 -12,000 cells were counted from each treatment condition. The

Ki67 (day 16 and 24) and SKOR2 (day 24) was analyzed and presented from three differentiation replicates of each cell line; 78 control (*TSC2*$^{+/+}$), 77-patient (*TSC2*$^{+/-}$) and 77-TSC2-null (*TSC2*$^{-/-}$) (Figure 2), 47-02 control (*TSC2*$^{+/+}$), 47-01 patient (*TSC2*$^{+/-}$), F628 control (*TSC2*$^{+/+}$), CRA401 patient (*TSC2*$^{+/-}$), (Supplementary Figure S4), and three technical replicates of CRISPR-corrected isogenic control cell line (Supplementary Figure S2).
For soma size analyses ImageJ software was used for average area measurement of the calbindin positive Purkinje cells at day 125 of differentiation. Co-staining with huNuc was used to identify human cells in co-cultures with mouse granular cells (Figure 3).
Neurite number was analyzed with ImageJ software from calbindin/huNuc positive Purkinje cells. 20 images/condition were analyzed from each differentiation patch (Figure 3).
ImageJ software was used to analyze mean grey intensity value in selected area (integrated density) of pS6 staining at day 125 of Purkinje cell differentiation in co-culture with mouse granular neurons, using maximum intensity projections of z-stacks of confocal images 63x/1.40 Oil DIC M27, Frame size 2048x2048 (Carl Zeiss LSM700, German), human cells were identified with huNuc. 15-20 images/condition were analyzed from each differentiation patch. Cell lines analyzed; 78 control (*TSC2*$^{+/+}$*),* 77-patient (*TSC2*$^{+/-}$), 77-TSC2-null (*TSC2*$^{-/-}$), 47-02 control (*TSC2*$^{+/+}$), 47-01 patient (*TSC2*$^{+/-}$), F628 control (*TSC2*$^{+/+}$), Male control (*TSC2*$^{+/+}$), CRA401 patient (*TSC2*$^{+/-}$), (Figure 3) and isogenic control line CRISPR-corrected 77 (*TSC2*$^{+/+}$), 77-patient (*TSC2*$^{+/-}$), 77-TSC2-null (*TSC2*$^{-/-}$) (Suplemental Figure S2).
For synaptic marker expression analyses of SYP1, PSD95 and GRID2, the hiPSC-PCs were co-stained with calbindin and the synaptic marker expression was analyzed from z-stacks of confocal images 63x/1.40 Oil DIC M27 Frame size 2048x2048 (Carl Zeiss LSM700, German). Synaptic marker expression was analyzed with ImageJ in calbindin positive dendrites. Cell lines analyzed: 78 control (*TSC2*$^{+/+}$*),* 77-patient (*TSC2*$^{+/-}$), 77-TSC2-null (*TSC2*$^{-/-}$), 47-02 control (*TSC2*$^{+/+}$), 47-01 patient (*TSC2*$^{+/-}$) (Figure 3, Supplementary Figure S9). For Torin1 and vehicle treatment (DMSO) cell line 47-01 patient (*TSC2*$^{+/-}$) was analyzed (Supplementary Figure S11).

Immunocytochemistry

Cells were fixed with 4% paraformaldehyde for 20 minutes at room temperature. Prior to addition of primary antibodies the background was blocked with 5 % BSA-PBS-TritonX 0.1 % 1hour at room temperature. Primary antibodies were diluted into 1% BSA-PBS-Triton-X 0.1 % and incubated over night at 4°C (Supplementary Table 2). Secondary antibodies were diluted 1:400 into 1 % BSA-PBS-Triton-X 0.1 %, and incubated for 1-2 hours at room temperature in the dark, (Supplementary Table 2). The nuclear staining was done with Hoechst (Life Technologies) 4 µg/ml for 5 minutes. Coverslips were mounted with Aqua Poly/mount (Polysciences Inc.). Microscopy was done with Nikon Eclipse 80i microscope and iPlab software using Nikon Plan Apo 20x/0.75 magnification. Confocal microscope Imager M2/LSM700 (Carl Zeiss) was used with 63x oil objective and 25x oil objective, and zoom 1 or 0.5, picture capture was done with software ZEN2009 (Zeiss).

Flow cytometry

For live cell staining the cells were dissociated from plates as single cells using Accutase for 20-30 minutes at 37°C. To inactivate the dissociation-reaction the cells were incubated with 2 % BSA-HBSS and centrifuged into a cell-pellet at 1000 rpm 3 min. Primary antibodies were added for the cells and incubated for 20 minutes at room temperature (Supplementary Table 2). After washes with 2 % BSA-HBSS-P/S the secondary antibodies were added to the cells and incubated for 20 min in the dark at room temperature. After the washes, cells were resuspended into 2 % BSA-HBSS and stored on ice until analyses.
For mitochondrial superoxide-analyses, MitoSOX-Red dye (Molecular Probes, Life Technologies, ThermoFisher) was used according to manufacturers' instructions. 24 hours before staining cells were treated with rotenone 500 nM to induce oxidative stress. Cell were washed with dPBS and incubated with MitoSOX for 30 minutes at 37°C. Cells were de-attached with Accutase for 20 minutes at 37°C. After washes with 2 % BSA-HBSS, the cells were incubated for 2 minutes with Sytox-green nucleic

acid stain (dead cell marker, Life Technologies, ThermoFisher) and analyzed with LSRII (BD Biosciences); 20,000 events/sample were recorded.
For intracellular marker staining the cells were washed with 1X dPBS and treated with 0.01 % Formalin for 10 minutes at room temperature, then 0.1 % Triton-X-100 was added to the cells to permeabilize the cell membrane and incubated for an additional 10 minutes at room temperature. Cells were washed with 2% BSA-HBSS-TritonX100-0.1 % and centrifuged for 1500g x 3minutes. Primary antibodies were added to the cells in 2 % BSA-HBSS, incubated for 30min room temperature, washed and secondary antibodies were added to the cells in 2 % BSA-HBSS, and incubated for 30 minutes at room temperature. After washes with 2 % BSA-HBSS, the cells were analyzed with LSRII (BD Biosciences); 20,000 events/sample were recorded. For determination of cell population of interest, gating parameters of SSC/FSC voltages were determined with micro-beads (7.5 μm and 1.3 μm), and cells ≥ 7.5 μm were included inside of the gate. All hiPSC lines presented in Supplemental Table 1 were characterized with flow cytometry. Data presented in Figure 2 was pooled from biological replicates (n=2-3/line) of three control lines ($TSC2^{+/+}$) and three patient lines ($TSC2^{+/-}$), and three biological replicates of the TSC2-null line ($TSC2^{-/-}$). In the Supplementary Figure S6 A-F the representative blots are from 78-control ($TSC2^{+/+}$), 77-patient ($TSC2^{+/-}$), and 77-TSC2-null ($TSC2^{-/-}$). In the Supplementary Figure S6 G-L the PCP2 expression-plots are presented from cell lines; 78 control ($TSC2^{+/+}$), 77-patient ($TSC2^{+/-}$) 77-TSC2-null ($TSC2^{-/-}$), 47-02 control ($TSC2^{+/+}$), 47-01 patient ($TSC2^{+/-}$), CRA401 patient ($TSC2^{+/-}$).

Cell sorting

For the KIRREL2+ sorting the iPSC-derived cerebellar precursors were detached from plates with Accutase treatment for 20 minutes at 37 °C. For the THY1+ sorting the post-mitotic PCs were also detached from plates with Accutase treatment. The enzymatic reaction was inactivated with 2 % BSA-HBSS and primary antibody against KIRREL2 1:50 (Nephrin 3, goat IgG, Santa Cruz) or THY1 1:100 (mouse IgG, Biolegend) was added to the cells in 2 % BSA-HBSS-P/S. Cells were incubated 20 min on ice after which they were washed with 2 % BSA-HBSS-P/S and secondary antibody anti–goat Alexa-488 (Life Tech.) 1:160 or anti-mouse Alexa-488 (Life Tech.) 1:200 was added for the cells and incubated 20 minutes on ice.
Cells were sorted with FACS-Aria II (BD Bioscience) using 100 μm nozzle and low sheath pressure PSI 20. Sorted cells were collected into Neurobasal-medium supplemented with B27, 1% BSA, and P/S. $KIRREL2^{+}$ sphere formation was done in low-attachment plates in Neurobasal-medium with B27, P/S, ROCK-inhibitor 10 μM, FGF8b 100 ng/ml, and CHIR 1.7 μM.
For RNA collection, the sorted THY1+ cells were centrifuged 2500 rpm for 3 min and washed with dPBS and suspended into RLT-Plus buffer (Qiagen), RNA was isolated with RNeasy Mini-Plus kit (Qiagen).

Electrophysiology

Whole-cell current-clamp and voltage-clamp recordings were obtained using a Multiclamp 200 A (Molecular Devices) amplifier at room temperature (25 °C). Data were sampled at 20 kHz, digitized with a Digidata 1440A A/D interface and recorded using pCLAMP 10 software (Molecular Devices). Data was low-pass filtered at 2 kHz. Patch pipettes were pulled from borosilicate glass capillaries on a Sutter Instruments P-97 puller and had resistances of 3–5 MΩ. Series resistance was typically 5–15 MΩ and compensated by ~80 %. Resting membrane potential and spontaneous firing rate were first measured in current clamp mode by recording and averaging for 60 s in gap-free mode, and afterwards a small holding current was used to clamp the resting membrane potential of each cell as close as possible to −70 mV. Action potential threshold was measured by applying 20 ms steps in increments of 5 pA until an action potential was generated. Membrane potentials were corrected for the liquid junction potential. Rheobase was measured by applying 500ms steps in increments of 5 pA until an action potential was generated. Excitability curves (firing rate vs amplitude of current injection) were constructed using data from the rheobase protocol. Only spikes with an amplitude >20 mV were counted. The external solution consisted of (mM): 125 NaCl, 26 $NaHCO_3$, 1.25 NaH_2PO_4,

2.5 KCl, 1 $MgCl_2$, 2 $CaCl_2$, and 25 glucose (pH 7.3, osmolarity 310) equilibrated with 95% O_2 and 5% CO_2. The internal solution contained (in mM): 150 K-gluconate, 3 KCl, 10 HEPES, 0.5 EGTA, 3 MgATP, 0.5 GTP, 5 phosphocreatine-$tris_2$, and 5 phosphocreatine-Na_2. pH was adjusted to 7.2 with NaOH. Current-clamp intrinsic excitability recordings were performed in CNQX (10 μM), AP-5 (10 μM), bicuculline (30 μM) and strychnine (10 μM) to block AMPA receptors, NMDA receptors, $GABA_A$ and glycine receptors respectively. Spontaneous IPSCs were recorded at 0 mV and could be blocked by a 3 minute perfusion of 30 μM bicuculline. Spontaneous EPSCs were recorded at -70 mV and could be blocked by a 3 minute perfusion of 10 μM CNQX. Miniature EPSCs were recorded at -70 mV in the presence of 1 μM TTX and 30 μM bicuculline. Action potentials and miniEPSCs were detected and analyzed using Clampex 10 software (Molecular Devices). All chemicals were purchased from Sigma-Aldrich or Tocris. Purkinje cells were identified by their distinctive morphology – large cells with many neurites (Supplementary Figure S10). Where possible, multiple differentiations of PCs (n=2-4) from the same control and patient lines were recorded at the same age in culture, the data was pooled and analyzed (see the n-values for the cell numbers/line in the supplemental Table 4). Rapamycin treated (20 nM rapamycin for two weeks prior to recording) and vehicle (DMSO) treated control and patient derived PCs from concurrent rounds of differentiation were compared for all cell lines. hiPSC-derived PCs were analyzed from the following lines: 78 control ($TSC2^{+/+}$), 77-patient ($TSC2^{+/-}$) 77-TSC2-null ($TSC2^{-/-}$), 47-02 control ($TSC2^{+/+}$), 47-01 patient ($TSC2^{+/-}$), F628 control ($TSC2^{+/+}$), CRA401 patient ($TSC2^{+/-}$).

Transcriptional gene expression profiling

HiPSC-derived $THY1^+$ selected cells were harvested for RNA extraction after 40 days of differentiation. 500ng of purified total RNA were used for library preparation following the manufacturer's protocol (Illumina TruSeq Stranded mRNA sample preparation kit). The finished dsDNA libraries were quantified by Qubit fluorometer, Agilent TapeStation 2200, and RT-qPCR using the Kapa Biosystems library quantification kit. Sequencing was done on an Illumina NextSeq500 run with single-end 75bp reads at the Dana-Farber Cancer Institute Molecular Biology Core Facilities (Boston). hiPSC-derived $THY1^+$ PCs were analyzed from three independent biological replicates per each cell line: 78 control ($TSC2^{+/+}$), 77-patient ($TSC2^{+/-}$), 77-TSC2-null ($TSC2^{-/-}$), 47-02 control ($TSC2^{+/+}$), 47-01 patient ($TSC2^{+/-}$).

Reads were inspected with fastQC, and no sample was found to be technically poor. Reads were then mapped with Hisat2. We used the pre-built HG38 genome build with transcript annotations from Ensembl. Mapping was performed with default options and with the --dta option. We found that each sample had about 70% reads that uniquely mapped to the genome, 20% that mapped in more than one location, and 10% that did not map. We then used Stringtie to annotate transcripts, and we used the Ensembl transcripts as a reference. All GTF files from each sample were consolidated using Stringtie with the --merge option. Finally, Stringtie was run again on the merged GTF file to estimate transcript abundances. The data was loaded into R using the Ballgown package. Gene expression and transcript expression were obtained from Ballgown. We annotated transcripts by comparing each transcript identified in our dataset to Refseq genes obtained from UCSC Genome Browser. Because some transcripts identified in the RNA sequencing did not map to known Refseq genes, we provided a BED file that contains genomic locations for all transcripts identified. The name position of the BED file contains the "Gene Name" assigned by Stringtie and the unique transcript ID.

We performed differential expression for each patient ($TSC2^{+/-}$) or TSC2-null ($TSC2^{-/-}$) sample by comparing it to a family control ($TSC2^{+/+}$). We extracted count data using the prepDE.py script for each sample. These data were used to perform differential expression analysis using DESeq2. We used a false discovery rate of <0.01 as a threshold for significant differential expression.
Due to the fact that some of our controls were not the same gender as the related patient, we decided to evaluate for and eliminate gene expression differences that could have been caused by comparing across gender alone. First, we obtained microarray data from four different cell lines collected from healthy controls from a separate study of human iPSC derived neurons (Brennand et al., 2011), and

we compared gene expression between the lines obtained from male and female donors using LIMMA. We identified 384 genes that were significantly differentially expressed (FDR < 0.01), and we then compared this group of genes to the patient vs control comparisons that we had performed previously and subtracted out any overlapping genes from our analyses.

We performed Weighted Gene Co-expression Network Analysis using the WGCNA package in R. We obtained transcript level expression data for all transcripts using Ballgown. We then identified transcripts with a median expression in the 70th percentile or greater in the control, patient, or *TSC2*-null cell lines, which lead to the identification of 76,447 transcripts. We then calculated the variance of each of these genes, and we used the top 10,000 genes for construction of the network. We calculated the adjacency matrix for these genes with a beta=6, and this adjacency matrix was used to calculate the topological overlap matrix. Hierarchical clustering of the topological overlap matrix using the "average" algorithm was performed, and modules were identified using dynamic tree cutting. The first principal component was calculated using the moduleEigengenes function.

Gene ontology analyses

We used DAVID (https://david.ncifcrf.gov/) to perform gene ontology analysis. Refseq identifiers corresponding to transcripts in either the M67 or M99 module were used as input into DAVID. The categories of biological process, cellular compartment, and molecular function were analyzed in both the GO_FAT and GO_DIRECT databases. Gene ontology categories were selected based on specificity and non-redundancy. We compared the differential expression analysis and co-expression analysis to other datasets. Genes in the Grabole et al. (2016) dataset were selected if their adjusted p-value was <0.05 in the homozygous mutant (*TSC2*$^{-/-}$) versus control (*TSC2*$^{+/+}$) comparison. The Ascano et al. (2012) dataset was used to identify FMRP targets, and we chose all genes with one or more FMRP binding site. Comparisons were between the differential expression analysis and co-expression modules were performed by calculating the overlap of associated gene symbols in each list, and the p-value was calculated by the hypergeometric probability.

Quantitative RT-PCR

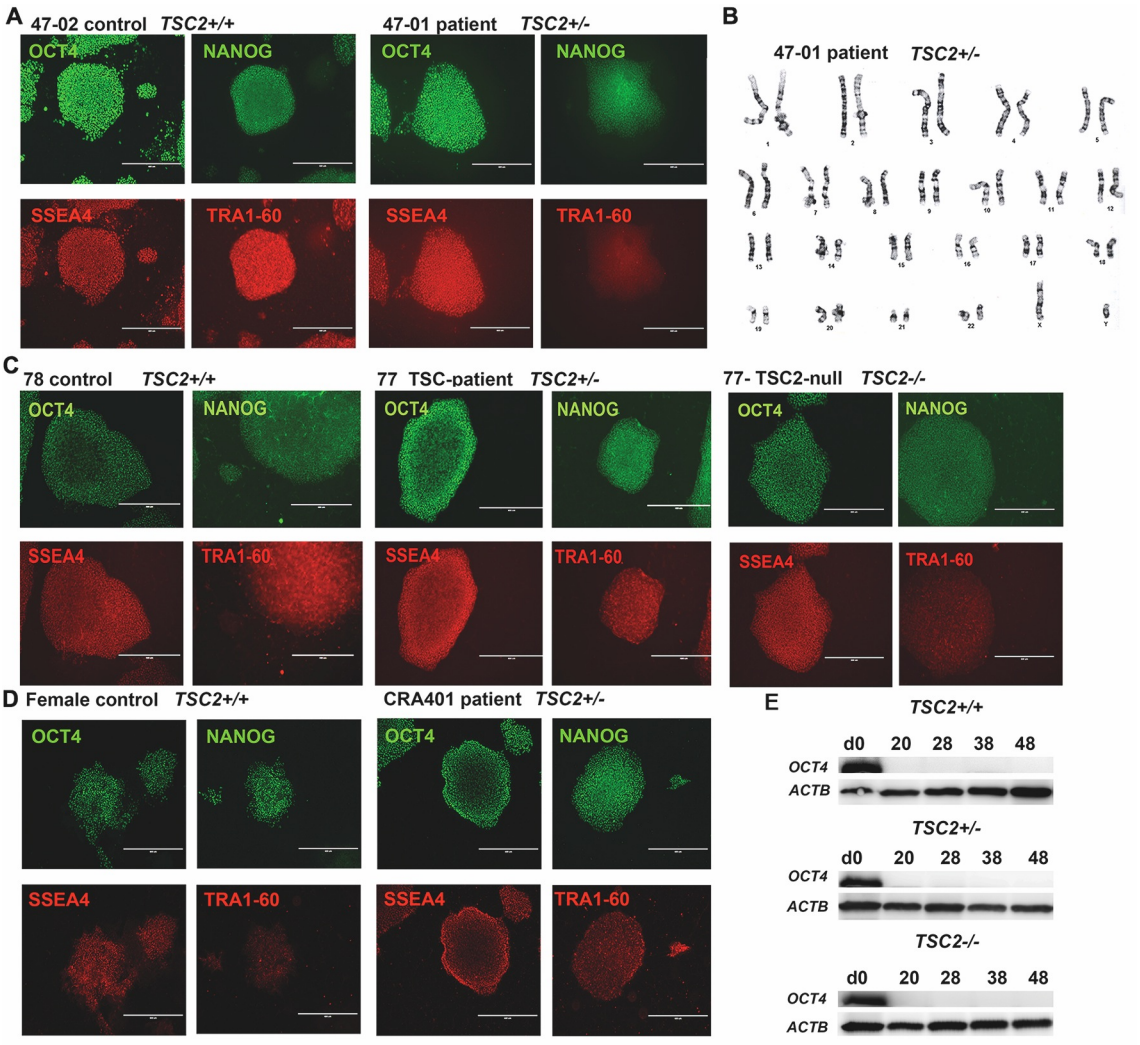
RNA was isolated from undifferentiated hiPSCs at day 0 of differentiation. During differentiation RNA samples were collected at days 10, 16, 24, 32 and 48 and compared to day 0 (Fold change =1, data is presented in Figure 1, Supplementary Figure 5). HiPSC-derived NPC-samples were collected at day 32 of differentiation (Supplemental Figure 3). RNA was also isolated from THY1^{+} selected hiPSC-derived developing Purkinje cells after 40 days of differentiation (data is presented in Figure 5).
RNA purification was done using RNeasy Mini Plus-kit (Qiagen). cDNA was prepared using Superscript RT-kit (Applied Biosystems), 150 ng of RNA was used for each sample. qRT-PCR was performed with SYBR-Green master mix (Life Technologies), supplemented with forward and reverse primers (IDT Primers) and MilliQ-water, cDNA (1:4 dilution in MilliQ-water). The primers were designed with Primer3 software and the size of the product was optimized to be 90-115 bp. Primers were blasted (BLAST) to confirm specificity to desired gene target. Samples for THY1^{+} qRT-PCR were collected from cell lines: 78 control (*TSC2*$^{+/+}$), 77-patient (*TSC2*$^{+/-}$), 77-TSC2-null (*TSC2*$^{-/-}$), 47-02 control (*TSC2*$^{+/+}$), 47-01 patient (*TSC2*$^{+/-}$). HiPSC-derived THY1^{+} PCs were treated with vehicle (DMSO) or rapamycin (20nM) prior to THY1^{+} selection and RNA collection (Figure 5F).

CRISPR-cas-9 method

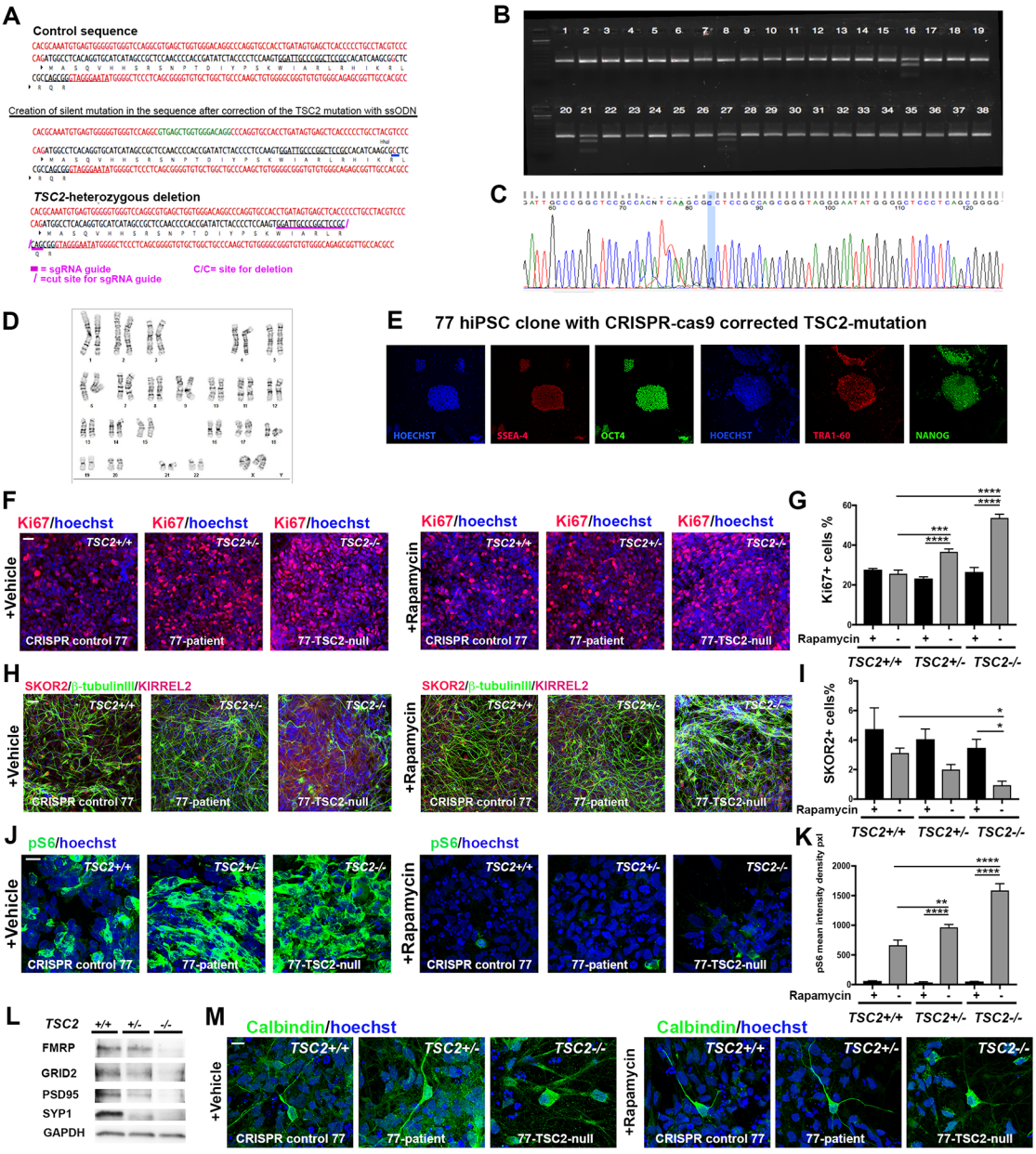
CRISPR-cas9 correction for the TSC2-patient hiPSC-line was done following adapted protocols (Horii et al 2013, Hou et al, 2013), for correction of the microdeletion of the *TSC2*-allele in the hiPSC-line 77-patient (*TSC2*$^{+/-}$). CRISPR sgRNA-guide sequence was designed based on the TSC2-deletion site (Supplementary Figure 2) and cloned into plasmid PX459v2 (Addgene). CIRSPR-

plasmid were prepared using an endo-free midi prep (Qiagen). Prior nucleofection hiPSCs were pre-treated with ROCK-inhibitor for at least 2 hours. Cell were transfected with AMAXA nucleofector 4D primary cell P3 kit. 2 µg of CRISPR-cas9 plasmid and 3 µl of 100 mM ssODN were added to the solution to the cell pellet, nucleofection was done with program CB-150 (Amaxa). Cells were plated on DR4 MEFs in hESC-medium+ROCK-inhibitor on a 10 cm plate. After 24 hours cells were re-fed with hESC-medium+0.5 µg/µl of puromycin. After 48 hours of puromycin-selection the cells were cultured with hESC-media+ROCK-inhibitor (for 3-5 days). About 14 days post nucleofection colonies were isolated manually and transferred into 24 well plates. 3-4 days after colony isolation a few of the newly formed colonies were collected from each well in a PCR tube. The cells were lysed using a HOTSHOT method and PCR performed on each clone. PCR product were digested with restriction enzyme and analyzed by gel-electrophoresis. PCR product were further analyzed by Sanger-sequencing and expanded. Total of 5 hiPSC-clones with corrected *TSC2*-allele were generated.

Supplemental Figures



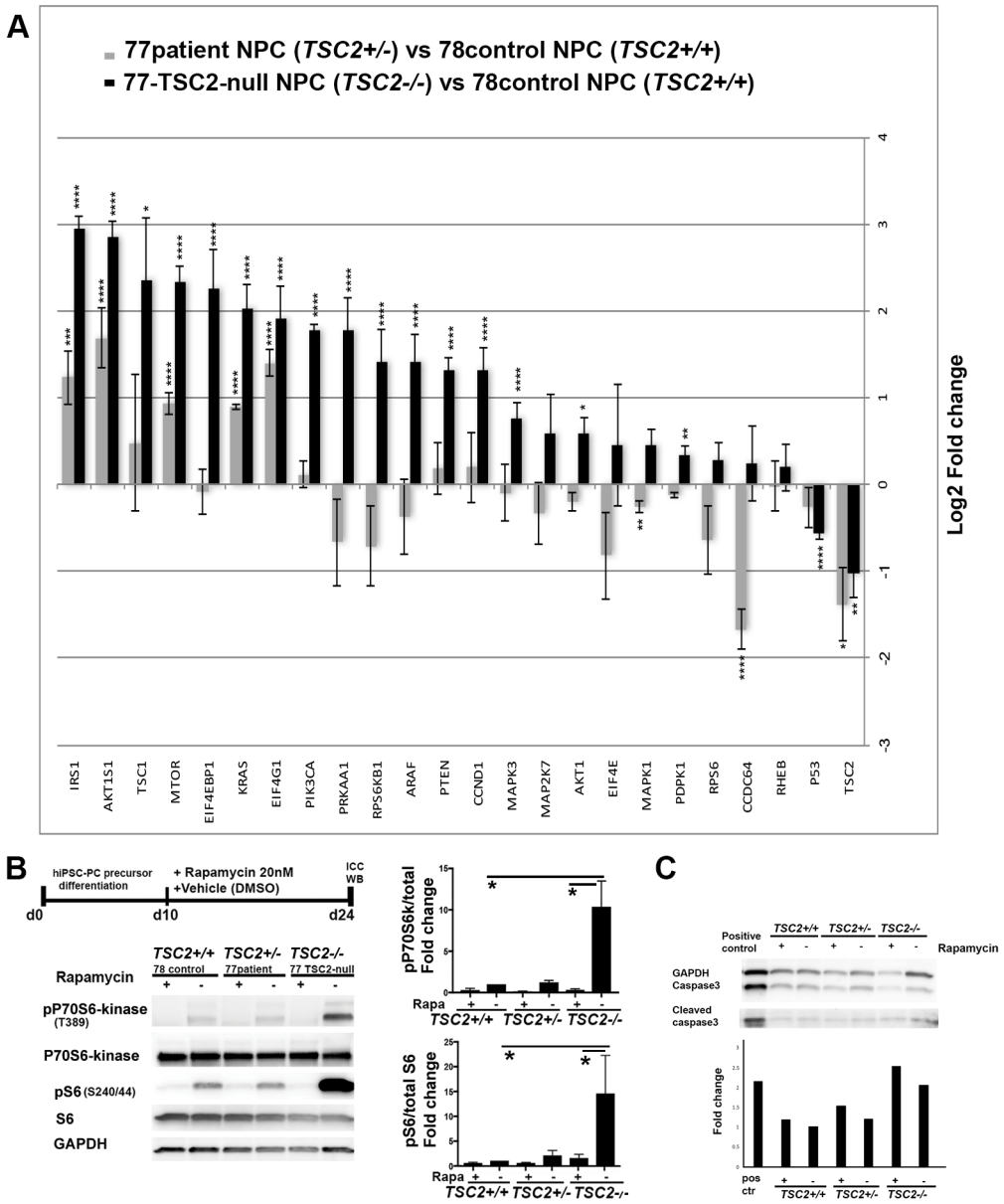
Supplementary Figure 1. Pluripotency marker expression in hiPSCs. A. hiPSC colonies of 47-02 control and 47-01 TSC-patient express OCT4, NANOG, SSEA4, and TRA1-60. Scale bar 400 μm. **B**. Representative image of karyotype characterization of patient cell line 47-01. **C.** Pluripotency marker expression analyses in 78-control, 77 patient, and 77-TSC2-null hiPSCs show that stem cell colonies were positive for OCT4, NANOG, SSEA4, and TRA1-60. **D.** Pluripotency marker expression analyses in gender-matched female hiPSC control (F628), and TSC-patient (CRA401) hiPSCs show that stem cell colonies are positive for OCT4, NANOG, SSEA4, and TRA1-60. Scale bar 400 μm. **E.** Protein expression analyses showed OCT4 expression in hiPSCs at day 0 of differentiation after which its expression became absent in differentiating neural cells at days 20-48. (78 control $TSC2^{+/+}$, 77patient $TSC2^{+/-}$ and 77-TSC2-null $TSC2^{-/-}$).



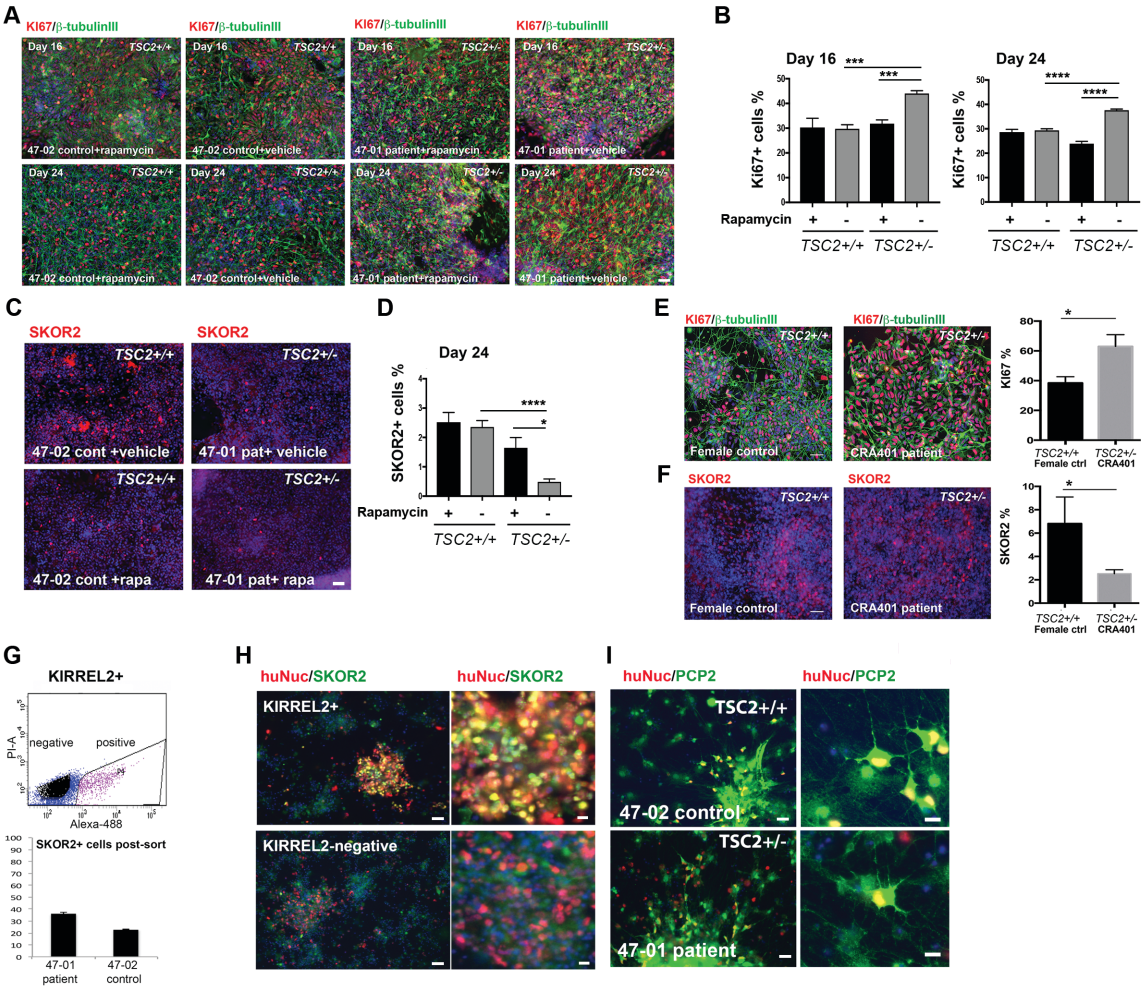
Supplementary Figure 2. CRISPR-mediated gene correction of TSC2-mutation in hiPSC-line and cerebellar cell differentiation capacity of isogenic cells with TSC2-deficiency

A. Sequence of the TSC2-gene and CRISPR-cas9-sgRNA design for TSC2-mutation correction with ssODN. ssODN was used for correction of the microdeletion in the sequence and silent mutation was created into ssODN sequence to include restriction site for DNA-restriction enzyme Hha1. **B.** DNA restriction enzyme Hha1 was used to screen the CRISPR-cas9-sgRNA and ssODN transfected and puromycin selected hiPSC-clones. Clones 16, 21, and 27 were cut with Hha1, which indicates successful incorporation of the ssODN that was used to correct the TSC2-microdeletion. **C.** Sanger-sequencing was used to confirm corrected sequence. **D.** Representative data of normal karyotype of CRISPR-cas9 corrected hiPSC-clone. **E.** Pluripotency marker expression in CRISPR-cas9 corrected 77-hiPSC-clone, SSEA-4, OCT4, TRA1-60, NANOG. **F.** Ki67-positive cells were calculated at day 24 of cerebellar precursor differentiation, scale bar 25 µm. **G.** Quantification of Ki67+ cells from total cell population shows increased Ki67+ cell number in TSC2-deficient cell population (*TSC2*$^{-/-}$) compared to isogenic-control cells (*TSC2*$^{+/+}$). Rapamycin treatment (20nM, for 2 weeks) rescued the hyperproliferation of TSC2-deficient cells. **H.** SKOR2/β–tubulinIII and KIRREL2 expression at day 24 of cerebellar differentiation showed increased SKOR2 expression in isogenic-control cell population compared to TSC2-null cell population. TSC2-null cell population had also increased

expression of KIRREL2-positive cells compared to isogenic control cells, scale bar 25 μm. **I.** Quantification of SKOR2+ cells from total cell population showed decreased SKOR2+ cell number in TSC2-deficient cell populations (*TSC2*$^{+/-}$, *TSC2*$^{-/-}$) compared to isogenic-control cells (*TSC2*$^{+/+}$). Rapamycin treatment (20nM, for 2 weeks) rescued the differentiation deficit of TSC2-deficient cells **J.** Immunocytochemical staining of pS6 expression in isogenic control (*TSC2*$^{+/+}$) and TSC2-mutant THY1+ hiPSC-derived PC precursor cells (*TSC2*$^{+/-}$and *TSC2*$^{-/-}$), scale bar 15 μm. **K.** Quantification of pS6 mean intensity density revealed significantly increased pS6-expression in TSC2-deficient THY1+ selected hiPSC-PC precursors compared to isogenic control cells and rapamycin treatment for two weeks during the differentiation process decreased pS6-expression in the cells. Statistical analyses were performed using two-way ANOVA followed by post-hoc-test of selected pairs. Data are presented as mean ± SEM. **L.** THY1+ hiPSC-PCs at day 49 of differentiation were characterized for the synaptic marker expression with western blot method. Increased expression of FMRP, GRID2, PSD95, and SYP1 were detected in CRISPR-cas9 corrected 77 isogenic control cells (*TSC2*$^{+/+}$) compared to TSC2-deficient 77-patient (*TSC2*$^{+/-}$) and 77-TSC2-null (*TSC2*$^{-/-}$) hiPSC-PCs. **M.** Representative CALB1-positive hiPSC-derived PC-precursors at day 50 of differentiation, isogenic CRISPR-cas9 corrected cell (*TSC2*$^{+/+}$), 77-patient hiPSC derived-cell (*TSC2*$^{+/-}$), 77-TSC2-null hiPSC-derived cell (*TSC2*$^{-/-}$), scale bar 8 μm.

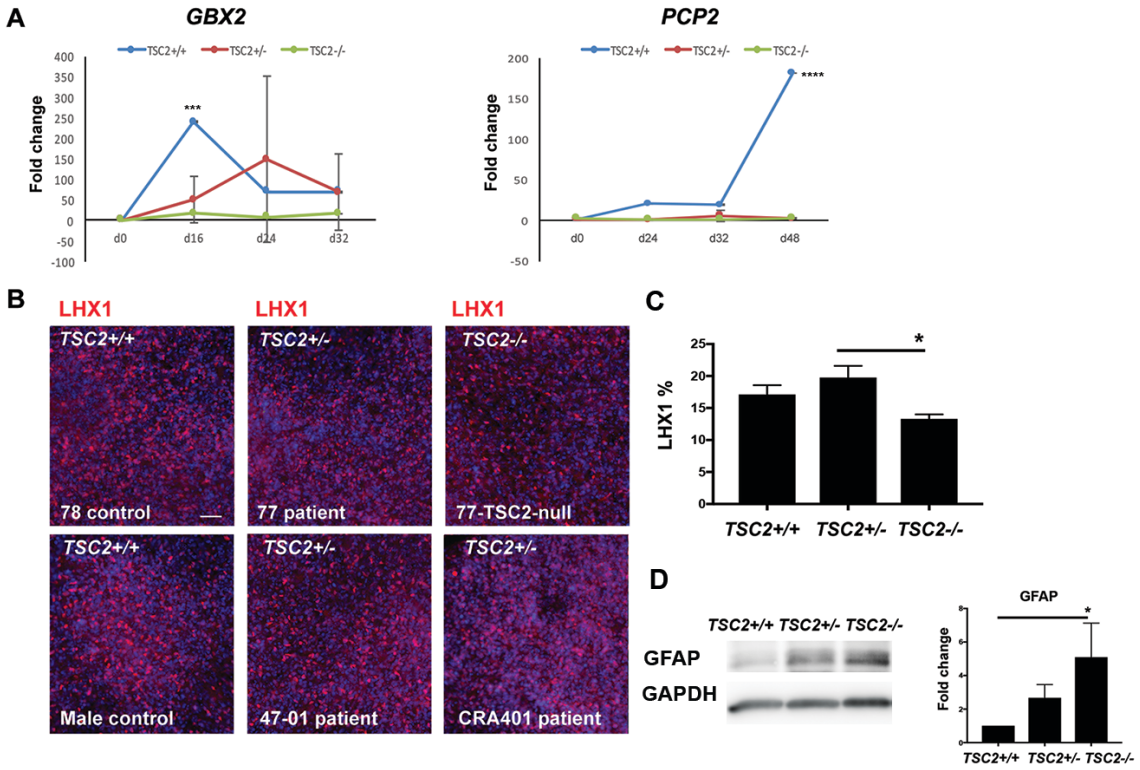


Supplementary Figure 3. Characterization of mTOR-pathway activation in TSC2-deficient hiPSC-derived NPCs. A. Quantitative RT-PCR analyses of mTOR-pathway related genes in hiPSC-NPCs. **B.** Protein expression analyses of mTORC1-pathway related proteins in hiPSC-derived NPCs. NPCs were treated for two weeks with rapamycin (20nM) or vehicle (DMSO). At the early NPC stage mTORC1-pathway overactivation was clearly detected with increased expression of pS6/S6 and pP70S6-kinase/total P70S6-kinase in $TSC2^{-/-}$ NPCs vs control $TSC2^{+/+}$ NPCs. The changes in pS6 levels between $TSC2^{+/-}$and $TSC2^{+/+}$ NPCs were subtle at early stages of differentiation, which is consistent with a previous study of heterozygous loss of TSC2 in hESC-derived NPCs that didn't show significant upregulation of pS6 at the early stages of differentiation (Costa, et al., 2015). **C.** Cleaved caspase-3 expression at day 24 of hiPSC-derived NPC differentiation. No significant increase on cleaved caspase 3 expression was detected on $TSC2^{+/-}$ NPCs compared to $TSC2^{+/+}$ NPCs (1.2 vs 1 fold change), but cleaved caspase 3 expression was increased in $TSC2^{-/-}$ NPCs vs control $TSC2^{+/+}$ NPCs (2 vs 1 fold change).

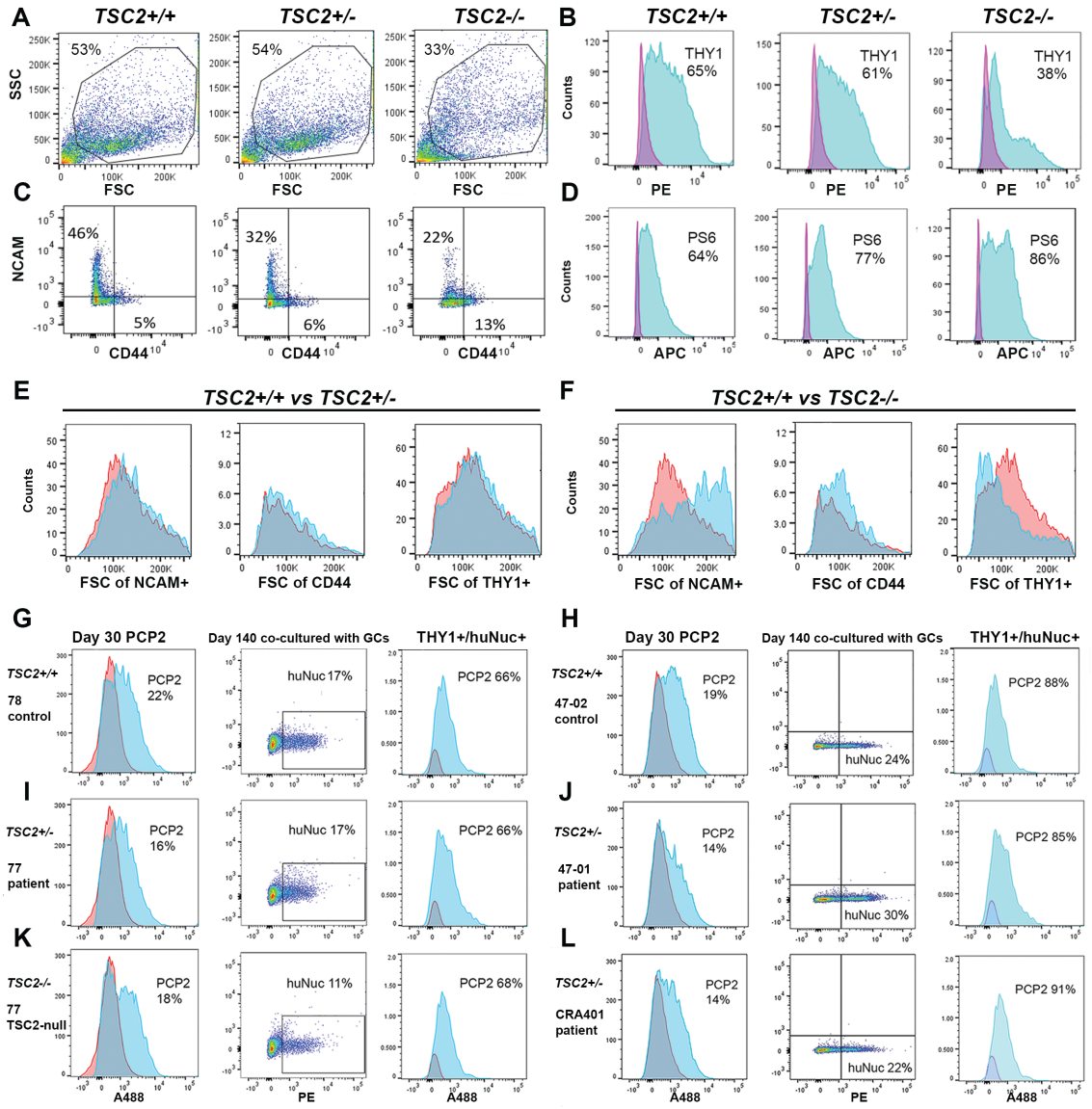


Supplementary Figure 4. Characterization of TSC2-deficient hiPSC-derived NPCs. A. Representative images with Ki67 staining at day 16 and 24 of differentiation of 47-02 control cells (*TSC2*$^{+/+}$) and 47-01 TSC-patient cells (*TSC2*$^{+/-}$). Cells were treated for 1 week (upper lane) or for 2 weeks (second lane) with vehicle (DMSO) or rapamycin (20 nM). Scale bar 32 µm. **B.** Quantification of the Ki67^{+} cells at day 16, and day 24. Proliferation capacity of TSC2-deficient patient cells 47-01 was significantly increased compared to control 47-02 cells, at day 16 and day 24 of differentiation. Rapamycin treatment decreased the proliferation rate of *TSC2*$^{+/-}$ patient cells at day 16 and 24 **C-D.** Quantification of SKOR2^{+} cells at day 24 of differentiation from 47-02 control cell population and 47-01 TSC-patient cell population. SKOR2 PC-precursor marker expression was significantly decreased in TSC2-deficient patient cell population 47-01 compared to control cells 47-02. Rapamycin treatment restored the SKOR2 expression to similar levels to that of control cells. Scale bar 32 µm. Statistical analyses (B and D) were performed using two-way ANOVA followed by post-hoc-test of selected pairs, ****p<0.0001, ***p<0.001, *p<0.05. **E.** Representative images of Ki67 at day 16 and **F)** SKOR2 expression at day 24 in control F628 (*TSC2*$^{+/+}$) and TSC-patient CRA401 (*TSC2*$^{+/-}$) hiPSC-derived NPC cultures. Scale bar 32 µm. CRA401 (*TSC2*$^{+/-}$) patient NPCs expressed significantly increased Ki67^{+} cells, and significantly reduced amounts of a cerebellar precursor marker SKOR2, compared to control cells F628 (*TSC2*$^{+/+}$). Hoechst was used for nuclear staining (blue). Data are presented as mean ± SEM, t-test *p<0.05 (**E-F**). **G.** Gating strategy for KIRREL2 sorting shows selection of KIRREL2^{+} stained cells (purple) and KIRREL2-negative cell population (black). KIRREL2^{+} sorting increased the SKOR2-positive cell number in patient 47-01 and control 47-02 cell populations. After sorting, 35 % of the total cell population were SKOR2^{+} in 47-01 patient cell population and 22 % were SKOR2^{+} in 47-02 control cell population. **H.** Representative images of KIRREL2^{+} sorted cells show differentiation of the cells into SKOR2^{+} cells after 2 weeks of co-culturing with mouse granular neurons. Scale bar 64 µm. Higher magnification shows co-localization

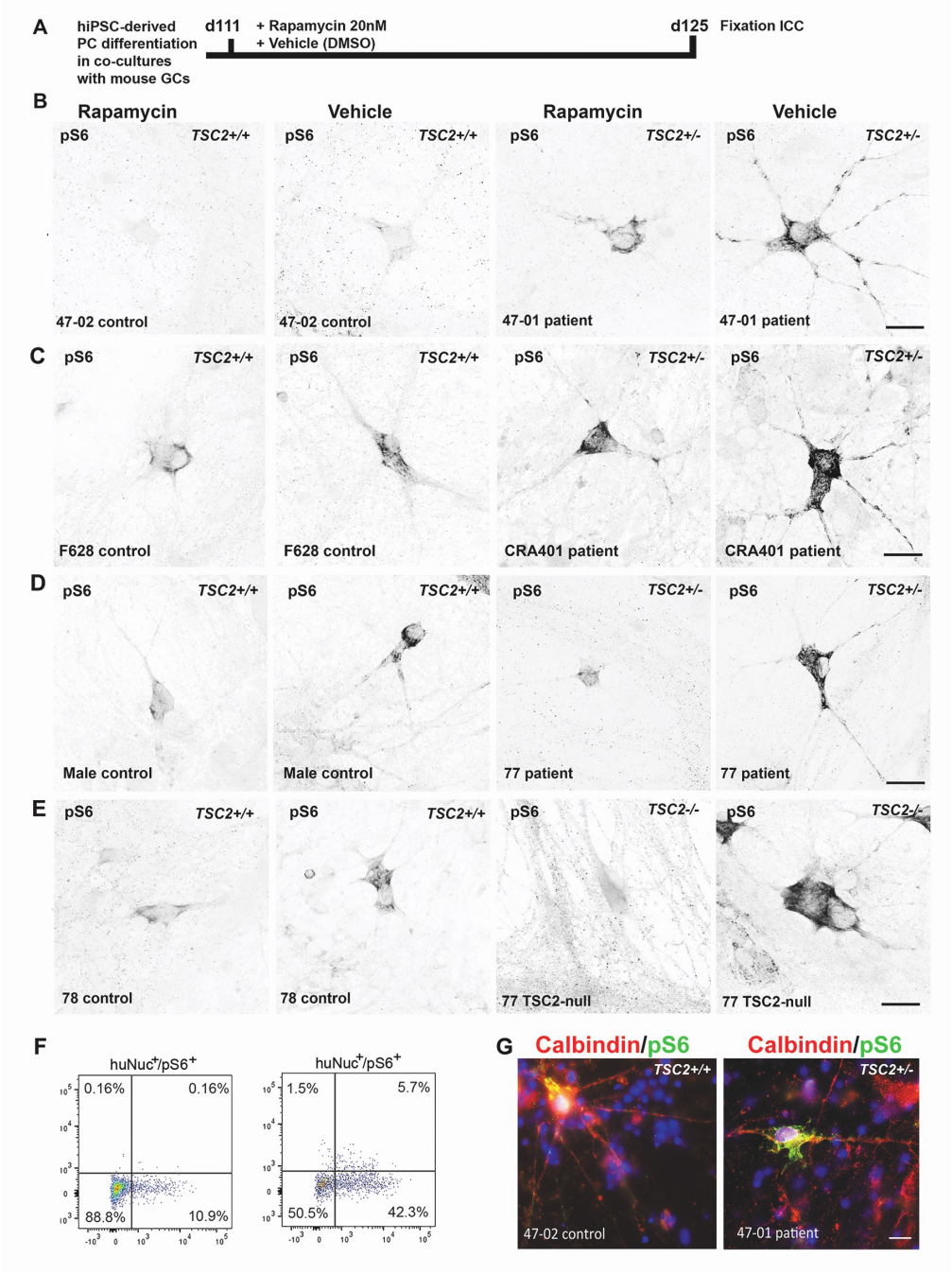
of SKOR2 in huNuc -positive cells. Scale bar 10 µm. KIRREL2-negative sorted cells didn't express SKOR2 in huNuc-positive cells. Scale bar 64 µm. **I.** KIRREL2^{+} sorted cells differentiated into PCP2-positive/huNuc-positive PC precursors after 35 days of sorting in co-cultures with mouse granular neurons. Scale bar 60 µm. Higher magnification shows co-localization of huNuc in PCP2 positive cells, scale bar 20 µm. Hoechst was used for nuclear staining (blue). Data are presented as mean ± SEM.



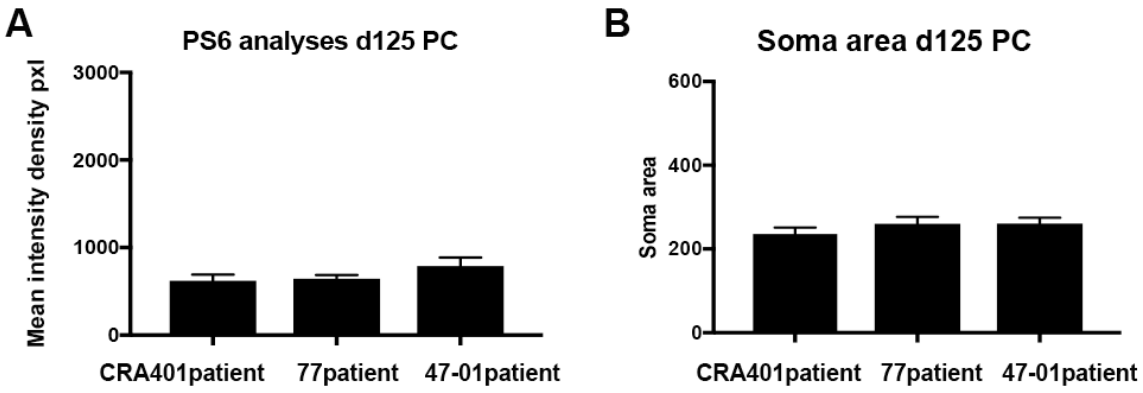
Supplementary Figure 5. Differentiation capacity of TSC2-deficient hiPSC-derived NPCs into PCs. A. Time point mRNA expression analyses of cerebellar lineage marker *GBX2* during days 0-32 of cerebellar cell induction, and Purkinje cell specific marker *PCP2* expression during days 24-48 of differentiation. TSC2 deficient hiPSCs (*TSC2*$^{+/-}$, *TSC2*$^{-/-}$) show delayed and reduced expression of *GBX2* at days 0-16, (*** p< 0.001 at day 16 between *TSC2*$^{+/+}$ and *TSC2*$^{+/-}$, *** p< 0.001 at day 16 between *TSC2*$^{+/+}$ and *TSC2*$^{-/-}$) and downregulated expression of *PCP2* compared to control hiPSC derived cell populations days 24-48 (**** p< 0.0001 at day 48 between *TSC2*$^{+/+}$ and *TSC2*$^{+/-}$, **** p< 0.0001 at day 48 between *TSC2*$^{+/+}$ and *TSC2*$^{-/-}$). **B.** Representative images of LHX1 expression in hiPSC-derived NPCs, control cell lines: 78 and male control (*TSC2*$^{+/+}$), TSC-patients: 77, 47-01 and CRA401 (*TSC2*$^{+/-}$), and 77-TSC2-null (*TSC2*$^{-/-}$) at day 24. Scale bar 32 µm. **C**. Quantification of the LHX1^{+} cells from the total cell population showed >15% LHX1 expression in control cells, >19% in patient cells and >13% in TSC2-null cells (one-way ANOVA, post-hoc-test, *p<0.05). **D.** GFAP expression in hiPSC-derived NPC cultures, representative blots of 78 control (*TSC2*$^{+/+}$), 77patient (*TSC2*$^{+/-}$) and 77-TSC2-null (*TSC2*$^{-/-}$). TSC2-deficient cells had increased GFAP expression compared to control cells, one-way ANOVA, post-hoc-test (*p<0.05). GFAP expression was analyzed between days 30-36 of differentiation, WB-quantification data was pooled from three control lines (47-02, 78, F628), three patient lines (47-01, 77, CRA401), and three biological replicates of 77-TSC2-null line. Data are presented as mean ± SEM.



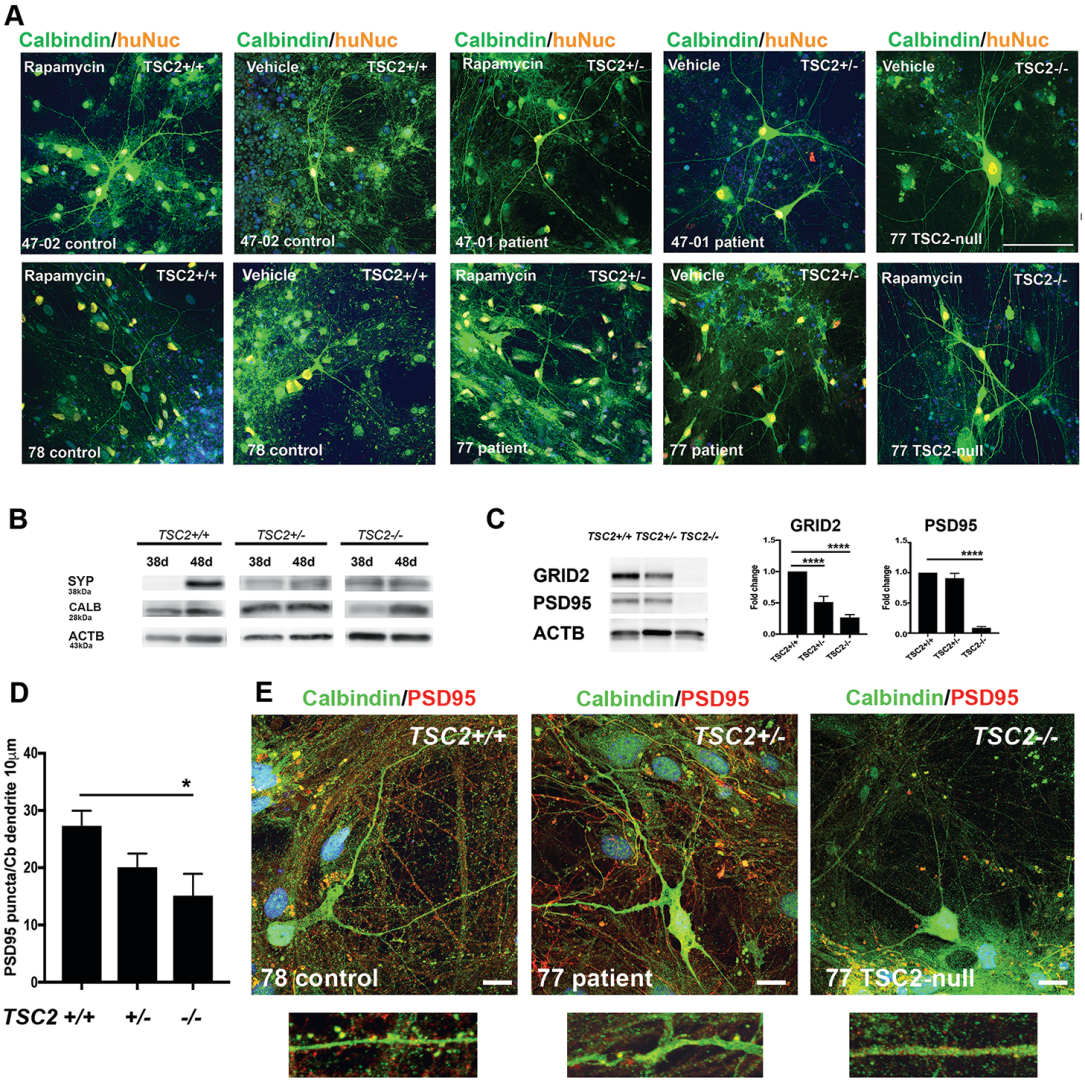
Supplementary Figure 6. Flow cytometric analyses of TSC2-deficient hiPSC-derived cerebellar cell populations. Representative images of flow cytometric analyses at day 30 of PC-differentiation. **A**) Gating strategy (FSC/SSC) for *TSC2*$^{+/+}$, *TSC2*$^{+/-}$, and *TSC2*$^{-/-}$ cell populations; 78 control (*TSC2*$^{+/+}$) 77 patient (*TSC2*$^{+/-}$) and 77-TSC2-null (*TSC2*$^{-/-}$). **B**) Representative plots of THY1^{+} cells, **C)** NCAM/CD44 cell populations, and **(D)** pS6^{+} cells. Mean intensities of FSC of NCAM^{+}, CD44+ and THY1+ cells between *TSC2*$^{+/-}$ vs *TSC2*$^{+/+}$ lines (**E**) and between *TSC2*$^{-/-}$ vs *TSC2*$^{+/+}$ lines (**F**). **G-L**) Representative histograms and dot-plots of PCP2 expression in different cell lines. First panel at left shows PCP2 expression in hiPSC-derived PCs at day 30 of differentiation prior to THY1^{+} selection, huNuc expression in co-cultures with mouse GCs at day 140 (middle panel) and PCP2 expression at day 140 in THY1^{+}/huNuc^{+} PCs (right). 20,000 cells/sample, n=3-4 samples.



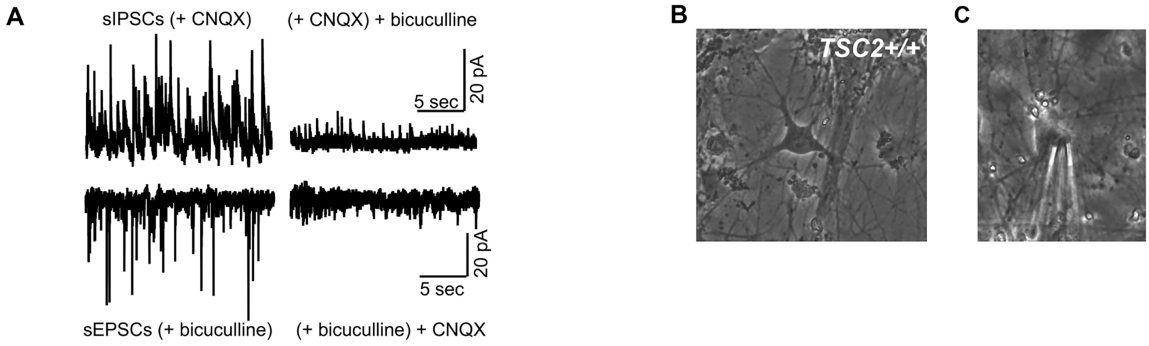
Supplementary Figure 7. mTOR-pathway activation in THY1^{+} hiPSC-PCs. A. Schematic presentation of the rapamycin 20 nM or vehicle treatment prior to pS6 expression analyses, at day 125 of hiPSC-PC differentiation *in vitro*. **B.-E.** Representative images of pS6 in huNuc^{+} hiPSC-PCs (47-02-, F628-, Male-control, 78-control *TSC2*$^{+/+}$) compared to TSC2-deficient hiPSC-PCs (47-01-, CRA401-, 77-patient *TSC2*$^{+/-}$) and TSC2-null 77 (*TSC2*$^{-/-}$). Rapamycin treatment decreased significantly the pS6 in TSC2-deficient patient PCs during the differentiation process. Scale bar 22 µm. **F.** Flow cytometric analyses of pS6 expression in huNuc^{+} PCs show increased pS6^{+} cell number in the TSC2-deficient cell population compared to the control cell population (47-02-control *TSC2*$^{+/+}$ vs 47-01-patient *TSC2*$^{+/-}$). **G.** Immunocytochemical staining of hiPSC-derived PCs in co-cultures with mouse granular neurons show increased pS6 co-localization (green) with calbindin positive PC (red) in TSC2-deficient PC compared to control PC, (47-02-control *TSC2*$^{+/+}$ vs 47-01-patient *TSC2*$^{+/-}$). Mouse granular neurons were negative for pS6 and calbindin (small Hoechst-33342 positive-blue cells in figures). Scale bar 17 µm.



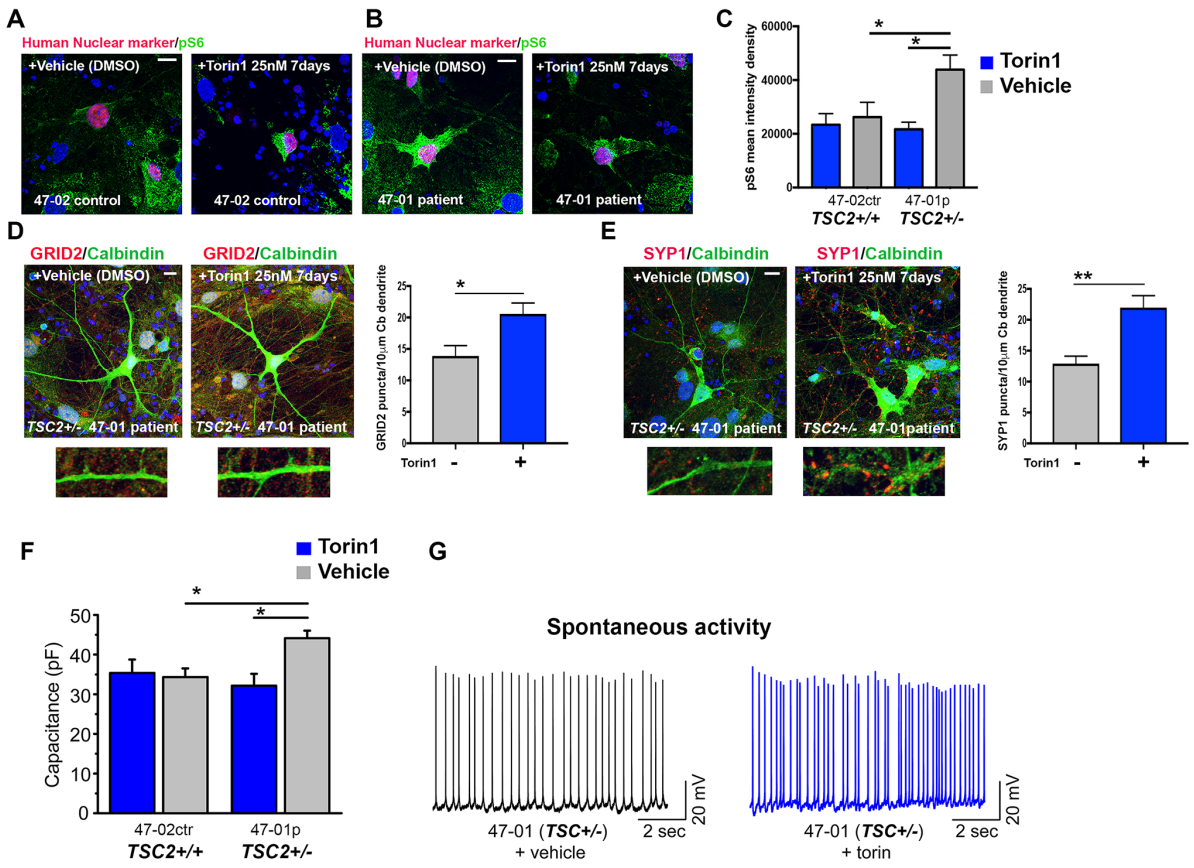
Supplementary Figure 8. Comparison of mTOR-pathway activation and soma size between different TSC-patient hiPSC-derived PCs. A. No significant differences in pS6 expression levels were detected between different patient hiPSC-derived PCs (one-way ANOVA). **B.** No significant differences in soma size were detected between different patient hiPSC-derived PCs (one-way ANOVA). Data are presented as mean ± SEM.



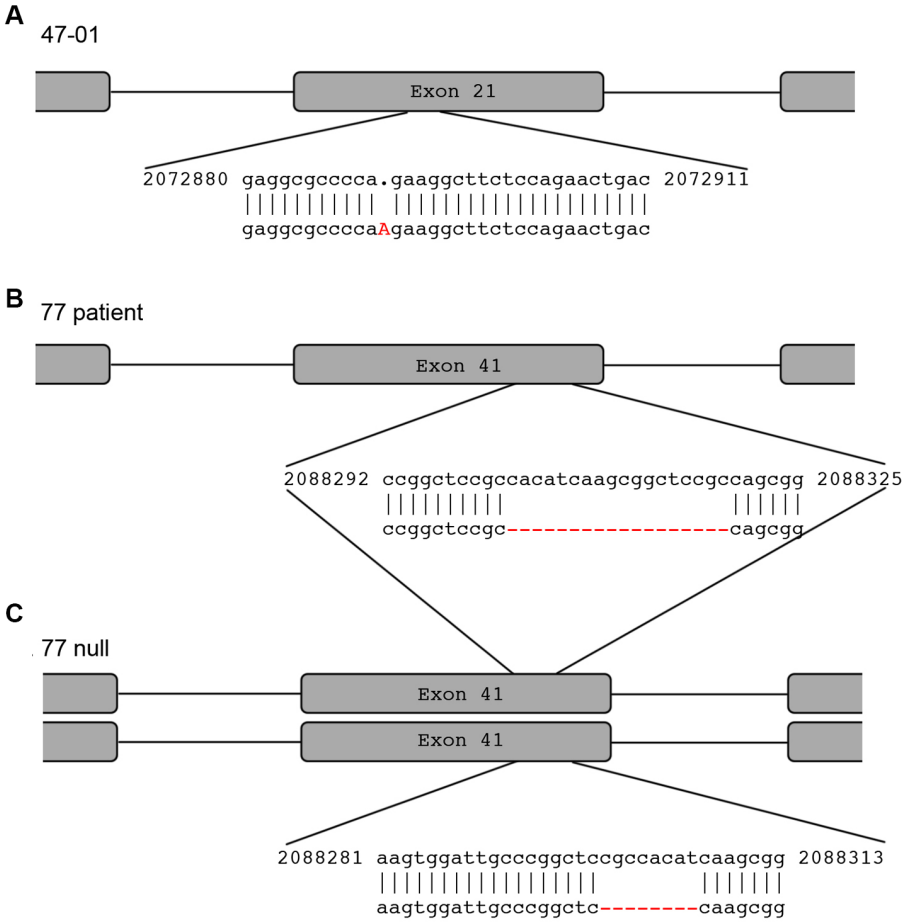
Supplementary Figure 9. TSC2-deficient THY1^{+} hiPSC-PCs have abnormal morphology and synaptic marker expression compared to control cells. A. Representative images of TSC2-deficient PCs with increased soma size and neurite number compared to control cells. *TSC2*$^{+/-}$ (47-01patient) hiPSC-derived PCs have increased soma size and neurite number compared to *TSC2*$^{+/+}$(47-02 control) hiPSC-PCs. Both *TSC2*$^{+/-}$ (77 patient) and *TSC2*$^{-/-}$ (77-TSC2-null) hiPSC-PCs have increased soma size and neurite number compared to *TSC2*$^{+/+}$ (78 control) hiPSC-PCs. Rapamycin treatment 20nM for two weeks rescued the morphological deficits of TSC2-mutant cells *in vitro* (see main Figure 3). Scale bar 100 µm. **B.** WB analyses of synaptophysin (SYP) and calbindin (CALB) expression at days 38-48 show up-regulation of the synaptic marker in *TSC2*$^{+/+}$ cells during differentiation process. **C.** At day 48 of differentiation GLURδ2 (GRID2) expression was significantly down-regulated in TSC2-deficient cells, (one-way ANOVA, post-hoc-test, ****p<0.0001). PSD95 expression was significantly down-regulated in *TSC2*$^{-/-}$ PCs compared to control PCs (one-way ANOVA, post-hoc-test, ****p<0.0001). **D.** Quantification of PSD95 puncta/10µm calbindin-positive dendrite, significant downregulation of PSD95-puncta was detected in *TSC2*$^{-/-}$ PCs compared to control PCs (one-way ANOVA, post-hoc-test, *p<0.05). Data are presented as mean ± SEM. **E.** Representative images of PSD95 expression in calbindin positive hiPSC-PCs (*TSC2*$^{+/+}$, *TSC2*$^{+/-}$ and *TSC2*$^{-/-}$) at day 125 of differentiation, scale bar 10 µm, higher magnification shows PSD95 puncta in calbindin-positive dendrite.



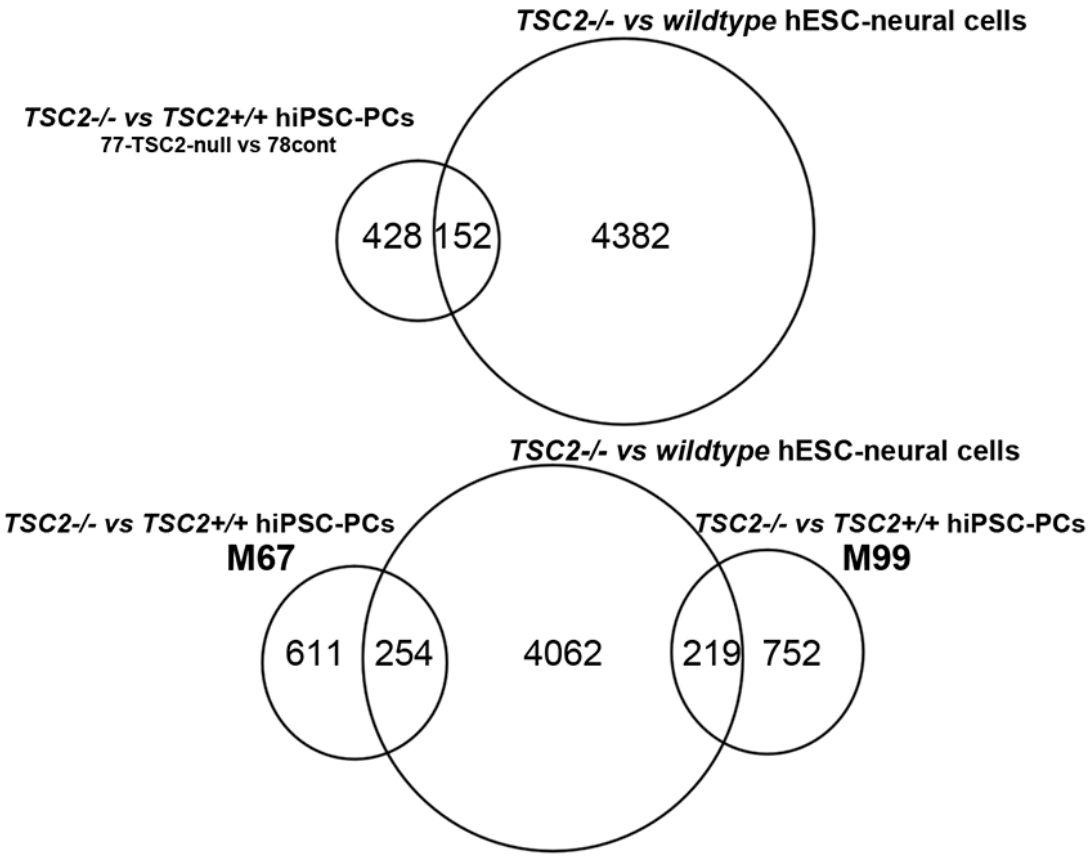
Supplementary Figure 10. Electrophysiological characterization of TSC2-deficient hiPSC-PCs. **A.** hiPSC-derived PCs display synaptic activity as shown by spontaneous IPSCs and EPSCs. Spontaneous IPSCs at 0mV from control (*TSC2*$^{+/+}$) PCs were blocked by perfusion of 30 μM bicuculline. Spontaneous EPSCs at -70mV from (*TSC2*$^{+/+}$) PCs were blocked by perfusion of 10 μM CNQX. **B-C**. Representative bright-field images of patch-clamped hiPSC-PCs, **C**) with patch-clamp pipet.



Supplementary Figure 11. Characterization of Torin1 treated TSC2-deficient hiPSC-derived PCs. A. Control hiPSC-PCs (*TSC2*$^{+/+}$, 47-02ctr) and **B.** TSC2-deficient patient hiPSC-derived PCs (*TSC2*$^{+/-}$, 47-01p) were treated with Torin1 25nM for 1 week *in vitro* and pS6-staining intensities were measured with ImageJ. **C.** Quantification of pS6 mean intensity densities. Torin1-treatment decreased significantly the pS6 expression levels in TSC2-deficient patient hiPSC-derived PCs. Two-way ANOVA and post-hoc-tests, (*p<0.05,). **D**. GRID2 expression in CALB1-positive hiPSC-PCs were analyzed from confocal images with ImageJ-software. Higher magnification shows GRID2 puncta in CALB1-positive dendrite. Torin1 treatment increased significantly the GRID2 expression in CALB1-positive TSC2-deficient PCs (*p<0.05). **E.** SYP1 expression in CALB1-positive PCs were analyzed from confocal images with ImageJ-software. Higher magnification shows SYP1 puncta in CALB1-positive dendrite. Torin1 treatment increased significantly the SYP1 expression in CALB1-positive TSC2-deficient PCs (**p<0.001). All scale bars 10 μm. **F.** TSC2-deficient hiPSC-PCs had increased capacitance compared to control cells, which was significantly decreased after Torin1 treatment in *TSC2*$^{+/-}$ PCs to similar levels with control PCs (*TSC2*$^{+/+}$). Two-way ANOVA and post-hoc-tests, (*p<0.05). Data are presented as mean ± SEM. **G**. Representative traces of spontaneous activity in TSC2-deficient hiPSC-PCs treated with vehicle or Torin1.



Supplementary Figure 12. Identification of *TSC2*-mutations in hiPSC-derived THY1$^+$ PCs. Known *TSC2*-mutations in patient-derived THY1$^+$ hiPSC-PCs were identified in transcripts from RNA sequencing data. **A.** The 47-01 patient cell line has an insertion of an A at position chr16:2072890, which introduces a frameshift in the coding sequence. This insertion was never observed in the control 47-02 line. **B.** The 77-patient cell line has a microdeletion in exon 41 of 18 base pairs at position chr16:2088303-2088320. This introduces a frameshift in the coding sequence but also appears to affect splicing of the transcript by favoring a premature splice site in exon 41. **C.** The 77-null cell line contains two neighboring microdeletions in exon 41. The TALEN engineered microdeletion contains 8 base pairs and is at position chr16:2088299-2088306, and the patient's original microdeletion is also observed. These deletions were never observed in the same read and there were no reads that did not contain either deletion, consistent with the fact that they are in *trans*. Neither microdeletion was observed in the control 78 cell line.



Supplementary Figure 13. Transcriptional profiling of TSC2-deficient THY1^{+} hiPSC-PCs compared to hESC-derived neural cell populations.
A. Differentially expressed genes between TSC2-deficient hiPSC-PCs compared with a prior study of TSC2-deficient hESC-derived neural cells (Grabole et al., 2016). Venn-diagram of differentially expressed genes between *TSC2*$^{-/-}$ and *TSC2*$^{+/+}$ hiPSC derived PCs compared to *TSC2*$^{-/-}$ and *TSC2*$^{+/+}$ hESC-derived neural cells (Grabole et al., 2016). There is a highly significant overlap between these two groups of genes ($p = 2.56e\text{-}07$, hypergeometric probability). **B.** Module 67 contains genes that are upregulated in *TSC2*$^{-/-}$ hiPSC derived PCs and Module 99 contains genes downregulated in *TSC2*$^{-/-}$ hiPSC derived PCs compared to control PCs (*TSC2*$^{+/+}$), and the genes in these modules were compared with differentially expressed genes identified in *TSC2*$^{-/-}$ hESC derived neural cells vs wildtype control cells. There is a significant overlap between both co-expression modules and the prior study (M67 $p = 8.61e\text{-}17$, M99 $p = 1.66e\text{-}4$, hypergeometric probability).

Supplementary Table 1. Clinical information about the patient and control subjects enrolled for the hiPSC-derivation.

Subject	**Age years**	**Sex**	**Genotype**	**Diagnosis**
47-02 SAH0047-02	46	F	*TSC2*$^{+/+}$	Control (mother of the patient 47-01)
47-01 SAH0047-01	5	M	*TSC2*$^{+/-}$ Heterozygous mutation, Chr16:2072890_insA	Tuberous sclerosis complex, cortical tubers, epilepsy and autism.
78 01578.104.10	46	M	*TSC2*$^{+/+}$	Control (father of the patient 77)
77 01577.101.10	11	F	*TSC2*$^{+/-}$ Heterozygous mutation, Chr16:2088303-2088320_del 18bp	Tuberous sclerosis complex, cortical tubers, epilepsy.
77- TSC2 null 01577.101.06201	11	F	*TSC2*$^{-/-}$ Compound heterozygous mutation, Chr16:2088303-2088320_del 18bp Chr16:2088299-2088306_del8bp	TALEN induced *TSC2* knock-out cell line from patient 77 hiPSCs.
CRISPR-cas9-corrected 77	11	F	*TSC2*$^{+/+}$	CRISPR-cas9-sgRNA and ssODN transfected patient 77-hiPSC-clone.
Female control 628		F	*TSC2*$^{+/+}$	Control (fetal control)
CRA401	6	F	*TSC2*$^{+/-}$ Heterozygous mutation. Chr16(GRCh37):g.2135002_2135005del	Tuberous sclerosis complex, cortical tubers, epilepsy and autism.
Male control BJ		M	*TSC2*$^{+/+}$	Control (newborn control)

Supplementary Table 2. A. Primary antibodies and **B**. secondary antibodies used for immunocytochemical staining, and flow cytometry.

A. Primary antibodies

Antibody	**Isotype**	**Dilution**	**Company and catalog number**
β-TUBULIN III	Mouse IgG	1:600	Chemicon/Millipore MAB1637
CALBINDIN	Rabbit IgG	1:400	Chemicon/Millipore AB1778
CD44	Mouse IgG	1:250	Biolegend 338803
GRID2	Goat IgG	1:20	Santa-Cruz sc-26118
huNUC	Mouse IgG	1:200	Chemicon/Millipore MAB1281
KIRREL2 (Neph3)	Goat IgG	1:200	Santa-Cruz sc-70195
KI67	Rabbit IgG	1:500	Abcam Ab15580
LHX1	Rabbit IgG	1:100	Jessell Lab
NANOG	Rabbit IgG	1:250	Abcam Ab109250
NCAM	Mouse IgG	1:250	Novus Biologicals NBP2-34397APC
OCT4	Rabbit IgG	1:250	Abcam Ab181557
PCP2	Rabbit IgG	1:400	Takara M202
Phospho S6	Rabbit IgG	1:300	Biolegend, Cell Signaling 4851
PTF1a	Goat IgG	1:100	R&D Systems AF6119
SKOR2	Rabbit IgG	1:100	Sigma HPA046206
SSEA-4	Mouse IgG	1:250	Invitrogen 414000
THY-1	Mouse IgG	1:100	Biolegend 328102
TRA-1-60	Mouse IgG	1:250	Invitrogen 41-1000

B. Secondary antibodies

Alexa 488-anti-rabbit	Donkey IgG	1:400	Life Technologies A21206
Alexa 594-anti-mouse	Donkey IgG	1:400	Life Technologies A21203
Alexa 647-anti-goat	Donkey IgG	1:400	Life Technologies A21447
Alexa 647-anti-rabbit	Donkey IgG	1:400	Life Technologies A31573
Anti-mouse PE	Goat IgG	1:200	Biolegend 40667

Supplementary Table 3. Antibodies used for western blot analyses.

Antibody	Isotype	Dilution	Company and catalog number
GAPDH	Mouse IgG	1:1000	Ambion, AM 4300
ACTB	Rabbit IgG	1:1000	Cell Signaling Technology #4970
CALBINDIN	Rabbit IgG	1:400	Chemicon/Millipore AB1778
Cleaved Caspase 3	Rabbit IgG	1:1000	Cell Signaling Technology #9664
CYCLIN D1	Rabbit IgG	1:1000	Cell Signaling Technology #2978
FMRP	Rabbit IgG	1:1000	Cell Signaling Technology #4317S
GFAP	Mouse IgG	1:2500	Sigma, GM3893
GlurD2 /GRID2	Goat IgG	1:20	Santa-Cruz sc-26118
HO-1	Mouse IgG	1:1000	Enzo AD1-OSA-110
LC3B	Rabbit IgG	1:1000	Cell Signalling Technology #3868
Phospho 4EBP1	Rabbit IgG	1:1000	Cell Signaling Technology #2855S
Phospho S6	Rabbit IgG	1:1000	Cell Signaling Technology #5364
Phospho p70 S6 kinase	Mouse IgG	1:1000	Cell Signaling Technology #9234
P70 S6 kinase	Rabbit IgG	1:1000	Cell Signaling Technology #2708
PSD95	Mouse IgG	1:1000	UC Davis, 75-028
S6	Mouse IgG	1:1000	Cell Signaling Technology #2317
Synaptophysin	Rabbit IgG	1:1000	Cell Signaling Technology #5461P
4EBP1	Rabbit IgG	1:1000	Cell Signaling Technology #9644S
TSC2	Rabbit IgG	1:1000	Cell Signaling Technology #4308

Supplementary Table 4. Electrophysiological characterization of hiPSC-PCs.

Purkinje cell line	**4702 (*TSC2*$^{+/+}$)**		**4701 (*TSC2*$^{+/-}$)**	
Treatment	**Vehicle**	**Rapamycin**	**Vehicle**	**Rapamycin**
Capacitance (pF)	34±2, n=39	34±3, n=17	44±2, n=65	34±2, n=53
Input Resistance (MΩ)	378±50, n=25	356±37, n=17	287±16, n=54	356±19, n=42
Resting membrane potential (mV)	-59±2, n=25	-58±1, n=17	-61±1, n=39	-54±1, n=36
Action potential threshold (mV)	-54±1, n=25	-57±1, n=17	-52±1, n=54	-52±1, n=40
Spontaneous firing rate (Hz)	4.9±0.7, n=10	7.4±0.8, n=12	1.7±0.5, n=23	2.7±0.4, n=25
Rheobase (pA)	26±2, n=22	23±5, n=17	41±5, n=54	24±2, n=40

Purkinje cell line	**78 (*TSC2*$^{+/+}$)**		**77 (*TSC2*$^{+/-}$)**		**77 (*TSC2*$^{-/-}$)**	
Treatment	**Vehicle**	**Rapamycin**	**Vehicle**	**Rapamycin**	**Vehicle**	**Rapamycin**
Capacitance (pF)	30±1, n=35	28±1, n=30	40±2, n=39	32±2, n=31	61±3, n=25	46±2, n=25
Input Resistance (MΩ)	378±31, n=35	392±31, n=30	293±14, n=39	368±27, n=31	171±22, n=25	251±25, n=25
Resting membrane potential (mV)	-59±1, n=35	-59±1, n=30	-57±1, n=39	-54±1, n=31	-63±1, n=25	-59±1, n=25
Action potential threshold (mV)	-45±1, n=35	-45±1, n=30	-47±1, n=39	-48±1, n=31	-47±1, n=25	-51±1, n=25
Spontaneous firing rate (Hz)	0.48±0.04, n=8	0.6±0.1, n=4	1.1±0.2, n=28	2.0±0.3, n=15	0.3±0.1, n=5	0.7±0.3, n=4
Rheobase (pA)	47±3, n=35	47±4, n=30	54±4, n=39	36±4, n=39	107±9, n=25	63±6, n=25
miniEPSC frequency (Hz)	1.0±0.3, n=8	0.9±0.2, n=8	0.4±0.1, n=7	0.7±0.1, n=7	0.23±0.04, n=9	.6±.2, n=9
miniEPSC amplitude (pA)	19±2, n=8	20±1, n=8	19±2, n=7	21±2, n=7	15±1, n=9	17±2, n=9
miniEPSC decay tau (ms)	4.2±0.2, n=8	3.9±0.1, n=8	4.1±0.3, n=7	4.3±0.4, n=7	3.8±0.1, n=9	4.0±0.2, n=9

Purkinje cell line	**F628 (*TSC2*$^{+/+}$)**		**CRA401 (*TSC2*$^{+/-}$)**	
Treatment	**Vehicle**	**Rapamycin**	**Vehicle**	**Rapamycin**
Capacitance (pF)	26±2, n=15	23±3, n=14	38±4, n=15	28±3, n=11
Input Resistance (MΩ)	403±52, n=15	441±48, n=14	322±32, n=15	402±41, n=11
Resting membrane potential (mV)	-56±3, n=15	-57±3, n=14	-60±2, n=15	-54±2, n=11
Action potential threshold (mV)	-50±1, n=15	-52±3, n=12	-48±2, n=13	-54±0.8, n=11
Spontaneous firing rate (Hz)	3.3±0.6, n=11	3.0±0.6, n=10	0.9±0.1, n=5	3.3±0.6, n=8
Rheobase (pA)	23±5, n=15	25±8, n=14	38±5, n=14	30±7, n=11
All data are mean±SEM				

Supplementary Table 5. Human specific primers for qRT-PCR.

Gene name	**Primer sequence**
GAPDH F	CAGCCTCAAGATCATCAGCA
GAPDH R	TGTGGTCATGAGTCCTTCCA
OTX2 F	ACAAGTGGCCAATTCACTCC
OTX2 R	GAGGTGGACAAGGGATCTGA
EN1 F	GAGCGCAGGGCACCAAATA
EN1 R	CGAGTCAGTTTTGACCACGG
EN2 F	GGCGTGGGTCTACTGTACG
EN2 R	TACCTGTTGGTCTGGAACTCG
HOXA2 F	CGTCGCTCGCTGAGTGCCTG
HOXA2 R	TGTCGAGTGTGAAAGCGTCGAGG
GBX2 F	GACGAGTCAAAGGTGGAAGAC
GBX2 R	GATTGTCATCCGAGCTGTAGTC
GABRA2 F	CAGAGAATCTGTGCCTGCAA
GABRA2 R	CATAAGCCACTTTGGGGAGA
GAD1 F	CAGCCTGCCTATTTCCAAAG
GAD2 R	AAATCCAGCTCACGGTTTTG
PCP2 F	GGGACATGATGGATCAGGAG
PCP2 R	TGGCTCAGCAGATTGAAGAA
XRN1 F	GGGAAGCCCTTCCATCATAC
XRN1 R	GGCTGGCTAGTCTGAACTGG
TIAL1 F	TATACGGGCAACCATGGAAT
TIAL1 R	CATATCCGGCTTGGTTAGGA
TIA1 F	CATGGAACCAGCAAGGATTT
TIA1 R	CACTCCCTGTAGCCTCAAGC
CHRNA7 F	TGTGGATAGCTGCAAACTGC
CHRNA7 R	TATGCCTGGAGGCAGGTACT
FMR1 F	GGCGGCACATAAGGATTTTA
FMR1 R	TATGTGCTCGCTTTGAGGTG
FXR1 F	AGTGTTTCAGGGGGTCGAG
FXR1 R	ACCGCCTACGACGGTTAGTA
EPHA4 F	GGGCTGTGACAATCTGGAAT
EPHA4 R	AATCAACAGGAAGGGCTGTG
GLRB F	TGTCCTTGTCAGCATGAGGT
GLRB R	AACCAAAGCTCTCCAGTTGC
HDAC6 F	CCATGGAAATTCTGGACACC
HDAC6 R	GGCATATCCTCCCCAAACTT
STXBP1 F	GTTCCTCTGCCTCCTTCAGC
STXBP1 R	GCATCTCATTCAGGCTCACA
ROBO1 F	GAAATGCAGGTACTTGGAGGA
ROBO1 R	TCTGGCGTCATGTGTCATCT
VDAC1 F	ACTGCAAAATCCCGAGTGAC
VDAC1 R	AGCGCGTGTTACTGTTTCCT
CAPRIN F	GGCTTGATGAATGGATACCG
CAPRIN R	GAGCCTCGCTTGAAATTCTG
MFF F	CAACCATTGAAGGAACGTCA
MFF R	CGAAACCAGAGCCAGCTATT

Gene name	Primer sequence
IRS-1 F	TACTCAAAAGGGAGCGGAGA
IRS-1 R	CGGACACTGCACAACAGTCT
PIK3CA F	GTCAATCGGTGACTGTGTGG
PIK3CA R	GAACTGCAGTGCACCTTTCA
PTEN F	CATAACGATGGCTGTGGTTG
PTEN R	CCCCCACTTTAGTGCACAGT
AKT1 F	TCTATGGCGCTGAGATTGTG
AKT1 R	CTTAATGTGCCCGTCCTTGT
PDPK1 F	TCAGGGCGTCTGGTTATAGG
PDPK1 R	GAAGAACGCACGGAAGAGTC
TSC2 F	CCCCAAACAAGGCTTGAATA
TSC2 R	CGGACCACATGTTCAGACAC
TSC1 F	AAATGGTCATGGGGATGAAA
TSC1 R	TCTGCTGGCTACATGAAACG
RHEB F	CCAAGGAGCAGCTGTAAAGG
RHEB R	TAGCTGCAAAAGGGAATCGT
MAPK3 F	AGTACATCCACTCCGCCAAC
MAPK3 R	CAGGCCGAAATCACAAATCT
MAPK1 F	CCAGACCATGATCACACAGG
MAPK1 R	GACTTGGTGTAGCCCTTGGA
MAP2K7 F	GGGCTGCCTGGTTTTATTTT
MAP2K7 R	AGGGCTCCCCACTTAACACT
PRKAA1 F	AGCCAAATCAGGGACTGCTA
PRKAA1 R	TTTTCCTTGAGCCTCAGCAT
RPS6KB1 F	ATTTCTGGGGAAGAGGTGCT
RPS6KB1 R	ATGCTTCCCCACTCATTGTC
RPS6 F	CATGAAGCAGGGTGTCTTGA
RPS6 R	ACAATGCAACCACGAACTGA
EIF4E F	TTATCAGTCCCACGCAGACA
EIF4E R	ATTGCTTGACGCAGTCTCCT
EIF4EBP1 F	GATACCTCCTTGTGCCTCCA
EIF4EBP1 R	GAAGGGTTCGTTCTTGTCCA
EIF4G1 F	CATCTTTGTACGGCATGGTG
EIF4G1 R	CAGTAGACAGATGCCCAGCA
AKT1S1 F	CCAGAGAGGACAACGAGGAG
AKT1S1 R	CATCACAAAGAGCCCTCCAT
mTOR F	AGTGGACCAGTGGAAACAGG
mTOR R	CCATTCCAGCCAGTCATCTT
K-RAS F	CACGGTCATCCAGTGTTGTC
K-RAS R	TTGATTTGTCAGCAGGACCA

A-RAF F	AGGTGATCCGTATGCAGGAC
A-RAF R	TGTGGCTGTAAGGCAGTGAG
TP53 F2	AGGCCTTGGAACTCAAGGAT
TP53 R2	TTATGGCGGGAGGTAGACTG
CYCLIND1 F	AACTACCTGGACCGCTTCCT
CYCLIND1 R	GGGGATGGTCTCCTTCATCT

Supplementary Table 6. Transcriptional gene-expression analyses of THY1$^+$ hiPSC-PCs.
A. 47-01 patient vs 47-02 control hiPSC-PCS

Gene Symbol	All refseq transcripts	Sequencing gene ID	Mean Counts	Log2 Fold Change	P-value	BH adjusted p-value
TTTY15	NR_001545	MSTRG.34406	176.7039295	7.265140996	7.78E-46	3.05E-42
XIST	NR_001564	MSTRG.33716	-423.2437578	-7.589148973	1.57E-37	3.85E-34
IRX2	NM_001134222	MSTRG.25453	-621.4508078	-5.569552148	4.73E-36	1.03E-32
TMED7	NM_181836	MSTRG.26307	-49.81697951	-5.892672687	9.30E-29	1.82E-25
IRX1	NM_024337	MSTRG.25445	-459.6079167	-4.776729747	3.30E-22	5.39E-19
ZNF714	NM_182515	MSTRG.16615	268.4437616	2.919112672	1.28E-15	1.56E-12
NA	NA	MSTRG.34412	48.91658127	4.244999219	6.70E-15	7.72E-12
C5orf38	NM_001294337, NM_001306150	MSTRG.25454	-88.96396613	-3.910118326	5.76E-13	6.27E-10
LOC284581	NR_046098	MSTRG.2734	-12.33420032	-4.24181604	6.23E-13	6.43E-10
CUZD1	NM_022034,NM_001204364	MSTRG.4447	-40.484740 9	-3.664638231	2.82E-12	2.77E-09
PCDH7	NM_002589,NM_032456,NM_001173523	MSTRG.24300	210.3670609	3.569175728	1.84E-11	1.64E-08
NA	NA	MSTRG.8589	-36.10260895	-4.307541754	2.14E-11	1.82E-08

ZNF718	NM_001039127	MSTRG.24027	-129.0016664	-2.026251811	2.50E-11	2.04E-08
TCEAL5	NM_001012979	MSTRG.33908	166.2895022	3.192873329	2.64E-11	2.07E-08
LINC01194	NR_033383	MSTRG.25505	-10.74525365	-4.229302567	3.32E-11	2.50E-08
LOC100128885	NR_077227	MSTRG.29356	-25.27453384	-3.957144151	3.83E-11	2.78E-08
AJAP1	NM_001042478, NM_018836	ENSG00000196581	-69.14082386	-3.757115191	9.02E-11	6.31E-08
PKIB	NM_001270394, NM_181795,NM_001270395	MSTRG.28374	-597.0666173	-2.776842893	1.46E-10	9.89E-08
HLA-DRB6	NR_001298,NM_002124	MSTRG.27587	21.88044683	3.914917053	1.57E-10	1.02E-07
FAM46B	NM_052943	MSTRG.584	-103.1291028	-2.902923473	1.77E-10	1.08E-07
NA	NA	MSTRG.16632	-19.8928433	-3.953434517	2.54E-10	1.51E-07
FAM45BP	NR_027141	MSTRG.34130	-49.18536196	-2.900913154	3.00E-10	1.73E-07
NA	NA	MSTRG.30415	-69.9708204	-3.294363599	5.54E-10	3.10E-07
TMSB4Y	NM_004202	MSTRG.34411	16.40699841	3.894246069	5.87E-10	3.19E-07
LINC01060	NR_033869	MSTRG.25388	-6.172681009	-3.936718197	6.60E-10	3.50E-07
NA	NA	MSTRG.18723	-47.62161251	-3.191664539	8.37E-10	4.31E-07
LINC01314	NR_120317	MSTRG.11260	-113.5831377	-3.169812448	1.03E-09	5.18E-07
MIR302A	NR_029835,NR_029860,NR_029857	MSTRG.24909	-19.50653004	-3.576255391	1.31E-09	6.40E-07
DPP6	NM_001039350, NM_001290253,	MSTRG.30380	138.1527151	-3.365712	2.36E-09	1.13E-06

	NM_130797,NM_001290252			829		
NA	NA	ENSG00000283196	9.42287253	-3.509414336	2.59E-09	1.21E-06
SYT6	NM_001270805, NM_205848	MSTRG.1703	191.7736249	-2.90869221	3.69E-09	1.68E-06
KCNC3	NM_004977,NR_110912	MSTRG.17365	57.19451148	-2.755952423	5.00E-09	2.23E-06
ANKRD20A1	NM_032250,NM_001012419	ENSG00000260691	21.18480663	2.633826797	7.87E-09	3.39E-06
EPOP	NM_001130677	MSTRG.14004	242.6466079	-2.012196045	7.96E-09	3.39E-06
ANKRD20A3	NM_001012419, NM_032250	ENSG00000276203	25.71149774	2.606423395	1.15E-08	4.71E-06
NA	NA	MSTRG.16633	27.04814674	-3.380880962	1.75E-08	7.02E-06
HSPB8	NM_014365	MSTRG.7976	187.7233515	2.856178563	3.61E-08	1.41E-05
PAX8	NM_013992	MSTRG.18882	52.26415284	2.961482637	3.88E-08	1.49E-05
POU5F1P3	NR_036440	MSTRG.6574	41.14698062	-3.365080143	5.82E-08	2.19E-05
CTSV	NM_001201575	MSTRG.32458	186.0771409	-1.766551916	6.89E-08	2.55E-05
CLDN6	NM_021195	MSTRG.11794	164.9698683	-2.890659312	9.48E-08	3.44E-05
LINC00371	NR_102432,NR_102431	MSTRG.8587	8.416777442	-3.393040742	1.09E-07	3.88E-05
METTL7A	NM_014033	MSTRG.7115	111.6105952	2.657376752	1.90E-07	6.58E-05
NA	NA	MSTRG.25444	12.85811196	-3.196212385	1.91E-07	6.58E-05
NA	NA	MSTRG.24933	10.40229617	-3.220075539	2.03E-07	6.85E-05
VGLL3	NM_001320494, NM_001320493	MSTRG.22958	2874.524895	-3.146944	2.48E-07	8.22E-05

				858		
HOPX	NM_001145460, NM_001145459	MSTRG.24487	82.28478447	2.993386272	4.99E-07	0.00016277
LINC00632	NR_028345,NR_028344,NR_104228	MSTRG.34243	87.51442658	2.347774005	5.60E-07	0.000179844
CMTM4	NM_178818	MSTRG.12624	220.645899	2.473766532	5.78E-07	0.000182665
CSDC2	NM_014460	MSTRG.21886	167.2185798	1.708906227	6.54E-07	0.000203318
LOC101927286	NR_120324	MSTRG.11519	-11.62382788	-2.891089463	6.85E-07	0.000209586
NA	NA	MSTRG.12027	-8.213842565	-3.052593339	8.56E-07	0.000254165
MYH14	NM_001077186	MSTRG.17362	-24.44330378	-3.021748808	8.52E-07	0.000254165
ERO1B	NM_019891	MSTRG.3079	123.1721871	1.459830896	9.51E-07	0.00027813
ZNF717	NM_001324027,NA,NM_001324026,NM_001128223,NM_001290208	MSTRG.22929	-73.78796138	-2.776674986	1.05E-06	0.000303598
HS3ST4	NM_006040,NR_036146	MSTRG.12185	-27.24629283	-2.912100854	1.14E-06	0.000323384
OBSCN	NM_052843,NM_001098623	MSTRG.2994	282.265166	2.127361521	1.30E-06	0.000363487
TBL1Y	NM_033284	MSTRG.34388	5.111107259	3.056803969	1.33E-06	0.000367572
INPP5D	NM_001017915	MSTRG.19987	264.6912637	2.696302515	1.38E-06	0.000369372
ANKRD20A2	NM_001012421	ENSG00000183148	18.75226618	2.551216182	1.36E-06	0.000369372
NA	NA	MSTRG.385	31.08391995	2.491526856	1.87E-06	0.000494314
CEACAM21	NM_001288773, NM_001098506	MSTRG.17030	53.73084288	3.013404202	2.05E-06	0.000527815
KCNK12	NM_022055	MSTRG.18195	-80.45729292	-2.52419685	2.04E-06	0.000527815
RASGRP3	NM_170672,NM_001139488,NM	ENSG00000152689	18.41968107	2.799638763	2.11E-06	0.000536307

	_015376					
ZBBX	NM_001199201, NM_001199202	MSTRG.23663	79.2564689	1.476058814	2.20E-06	0.000552225
WNT4	NM_030761	MSTRG.477	239.4255575	2.468598893	2.42E-06	0.000600182
A2M-AS1	NR_026971	MSTRG.6584	24.6627216	2.643983179	2.74E-06	0.000663681
NA	NA	MSTRG.6414	-20.29394541	-2.990966759	2.71E-06	0.000663681
LOC441666	NR_024380	MSTRG.3552	-66.25729125	-2.852411799	3.51E-06	0.00082953
NA	NA	MSTRG.24588	-12.2323991	-2.379108921	3.80E-06	0.000886383
CNTN4	NM_175607,NM_001206955,NM_001206956	MSTRG.22056	-90.71400331	-2.711683581	3.85E-06	0.000887637
CDC42EP4	NM_012121	MSTRG.14778	1382.626575	2.210618811	4.11E-06	0.000936722
FAM81B	NM_152548	MSTRG.26149	21.83147942	2.501118528	4.64E-06	0.001032312
MIR3942	NR_037507,NM_080650,NM_001141972	MSTRG.10433	-373.4251873	-1.310630916	4.64E-06	0.001032312
ANKRD20A4	NM_001098805	ENSG00000172014	17.44835092	2.31089617	4.95E-06	0.001090444
TBL1Y	NM_033284	MSTRG.34387	9.355557867	2.648605971	5.30E-06	0.00115371
CYP26A1	NM_057157,NA, NM_000783	MSTRG.4107	-1269.080829	-2.682076722	5.75E-06	0.001224399
GSX2	NM_133267	MSTRG.24454	22.66792268	2.528839376	5.73E-06	0.001224399
MIR153-2	NR_029689,NM_001308267,NM_001308268,NR_030325	MSTRG.30413	-1109.017474	-2.138541789	6.35E-06	0.001336545
DNAJC30	NM_032317	MSTRG.29482	-132.3949996	-2.812087923	6.80E-06	0.001418159
CYP2R1	NM_024514	MSTRG.4871	-193.9692123	-1.645292742	7.49E-06	0.001544377
FST	NM_006350	MSTRG.25739	817.93285	-	8.94E-06	0.001825

			46	1.736497395		063
TRIM61	NM_001012414	MSTRG.25243	19.92535455	2.574409195	9.65E-06	0.001947894
TGM3	NM_003245	ENSG00000125780	-7.776756952	-2.640699355	1.08E-05	0.002153282
SSPO	NM_198455	MSTRG.30318	78.3987196	2.11072649	1.34E-05	0.002657561
SS18L1	NM_198935	MSTRG.20808	452.3102926	1.4365236	1.36E-05	0.002660585
SLC9A3	NM_001284351	MSTRG.25423	17.97655837	2.403983032	1.42E-05	0.002762974
FAR2P2	NR_046258,NR_103761	MSTRG.19026	91.10477493	1.574918046	1.49E-05	0.002861744
LOC403323	NR_122076,NR_122077	MSTRG.32190	14.14345499	1.997224939	1.53E-05	0.002912318
MITF	NM_198159,NM_001184967,NM_006722,NM_198177,NM_000248,NM_001184968	MSTRG.22882	31.83121691	2.245212141	1.63E-05	0.003069158
PTPRG-AS1	NR_038283	MSTRG.22820	-120.1258391	-1.457526567	1.69E-05	0.003160576
MOXD1	NM_015529	MSTRG.28430	1173.666161	2.487952352	1.81E-05	0.003345235
MYOM2	NM_003970	MSTRG.30461	114.8743641	2.121625525	2.00E-05	0.003662689
COMT	NM_000754,NM_001135161,NM_007310,NR_039918	MSTRG.21399	312.0738177	1.668596527	2.18E-05	0.003961611
SBF2	NM_030962	MSTRG.4825	43.85622698	2.057240702	2.24E-05	0.003981144
ANKRD20A3	NM_001012419,NR_026759,NA	ENSG00000240240	11.32771822	2.314515263	2.23E-05	0.003981144
NA	NA	MSTRG.10254	17.55862531	2.274371382	2.31E-05	0.004066807
RPL23AP7	NR_024529	MSTRG.18888	187.2236709	1.872104646	2.33E-05	0.004066807
GRIP2	NM_001080423	MSTRG.22199	77.61230027	2.238810433	2.36E-05	0.004096262
NA	NA	MSTRG.33835	61.51101834	2.368432584	2.62E-05	0.004496639

LINC00839	NR_026827	ENSG00000185904	5.639193799	-2.680302217	2.78E-05	0.004687263
TP53	NM_001276699, NM_000546	MSTRG.13374	1550.054577	1.891705615	2.84E-05	0.004754059
NDUFA4L2	NM_020142	MSTRG.7312	92.79299367	2.133720281	2.88E-05	0.004783152
DAZL	NM_001190811, NM_001351,NA	MSTRG.22224	118.4645605	-2.687520149	2.98E-05	0.004901559
AKIRIN2	NM_018064	MSTRG.28094	1187.042595	0.813280636	3.02E-05	0.004929307
KIAA1644	NM_001099294	MSTRG.21952	350.0459623	1.477769631	3.24E-05	0.005253266
WDR72	NR_102335,NR_102334,NM_182758	ENSG00000166415	24.56451758	-2.330653108	3.30E-05	0.005257417
ZNF467	NM_001329856	MSTRG.30316	163.9557335	1.776291759	3.27E-05	0.005257417
NA	NA	MSTRG.33080	33.53587957	-2.563837506	3.47E-05	0.005483262
CD70	NM_001330332, NM_001252	MSTRG.16074	66.74292136	2.491397429	3.86E-05	0.005901309
ISM1	NM_080826	MSTRG.20256	43.809809	2.591745718	3.83E-05	0.005901309
NA	NA	MSTRG.33151	177.2705922	2.037224827	3.86E-05	0.005901309
SPACA6	NR_024330,NM_001316972,NM_001316994	MSTRG.17410	31.9203185	1.54539805	3.83E-05	0.005901309
HCG23	NR_044996	MSTRG.27593	6.462256723	2.309811688	4.10E-05	0.006227495
CX3CL1	NM_002996	MSTRG.12550	252.5794577	1.120290609	4.19E-05	0.006263684
TSIX	NR_003255	MSTRG.33715	52.25465071	-2.579581322	4.17E-05	0.006263684
GNAS-AS1	NR_002785	MSTRG.20782	17.09223947	-2.368237522	4.22E-05	0.006267226
THNSL2	NM_001244676, NM_018271	ENSG00000144115	39.67897313	2.251926382	4.33E-05	0.006384962
FBXO46	NM_001080469, NM_001329632, NM_001329634	MSTRG.17156	168.7118967	-2.421952617	4.47E-05	0.006536518

OAF	NM_178507	MSTRG.6206	356.9177017	1.857512731	4.81E-05	0.006986243
PTCD2	NM_001284403	MSTRG.25942	183.5588973	1.300201147	4.96E-05	0.007091238
NA	NA	MSTRG.16117	116.1006966	1.501130936	4.94E-05	0.007091238
NA	NA	MSTRG.6821	284.4559096	1.152544098	5.05E-05	0.007167272
OR2AE1	NM_001005276, NM_033017	MSTRG.29745	429.4670991	1.271756321	5.22E-05	0.007353106
NA	NA	MSTRG.20414	13.39279543	2.222701452	5.30E-05	0.0074118
MUC19	NM_173600	ENSG00000205592	5.213194524	2.520130174	5.47E-05	0.007597725
TSPAN11	NM_001080509, NA	MSTRG.6865	341.6467408	2.019516022	5.58E-05	0.007694394
INSC	NM_001031853, NM_001042536, NM_001278313	MSTRG.4875	13.35890318	2.584073319	5.85E-05	0.008009151
MAP3K8	NM_001244134, NM_001320961	MSTRG.3474	125.1395212	1.260285079	5.89E-05	0.008014926
NA	NA	MSTRG.24714	37.57326732	2.369600357	5.98E-05	0.008077345
CFAP100	NM_182628	ENSG00000163885	6.140419338	2.495132595	6.10E-05	0.008183544
PLA2G2A	NM_001161729, NM_000300	MSTRG.438	16.157922 1	-2.564032702	6.23E-05	0.008250658
FAM86C2P	NR_024249	MSTRG.5558	44.88654047	-2.203900031	6.22E-05	0.008250658
ARHGEF4	NM_015320,NM_032995	MSTRG.19032	464.3340902	1.640591808	6.48E-05	0.008517169
DDB2	NM_000107	MSTRG.5173	450.3383224	1.323245827	6.70E-05	0.008744295
CXCL2	NM_002089	MSTRG.24561	18.38659444	2.355756174	6.80E-05	0.008757635
NA	NA,NR_144378, NR_002791	MSTRG.4396	26.1656998	2.562538893	6.88E-05	0.008813392
CDKL5	NM_003159,NM_001037343,NM_001323289	MSTRG.33273	200.7789327	1.603073929	7.09E-05	0.009023086
ARPP19	NM_001306195, NM_001306191, NM_001330309	MSTRG.10777	3224.440003	-2.186526541	7.33E-05	0.009199125
UBIAD1	NM_013319,NM	MSTRG.284	396.08572	-	7.86E-05	0.009803

	_001330349		43	0.830725967		326

B. 77 patient vs 78 control hiPSC-PCS

Gene Symbol	All Refseq Transcripts	Sequencing Gene ID	Mean Counts	Log2 Fold Change	P-value	BH adjusted p-value
NA	NA	MSTRG.19362	1366.930413	-8.976799344	9.07E-90	1.13E-85
ACTG1P20	NR_033926	MSTRG.598	356.2084132	-6.889188017	1.61E-81	1.34E-77
TTTY15	NR_001545	MSTRG.34406	176.7039295	-6.785755891	4.47E-38	1.39E-34
MTRNR2L1	NM_001190452	MSTRG.13690	48.98053654	-6.985600696	4.93E-34	1.23E-30
TMED7	NM_181836	MSTRG.26307	49.81697951	-6.228516322	1.01E-31	2.30E-28
NA	NA	MSTRG.28405	76.74258257	5.639918742	5.70E-26	1.18E-22
XIST	NR_001564	MSTRG.33716	423.2437578	4.916248501	1.28E-16	2.13E-13
NA	NA	MSTRG.1457	241.867752	-4.993924513	4.31E-16	6.72E-13
NA	NA	MSTRG.33036	74.34040311	-4.382356518	2.37E-15	3.28E-12
LOC654342	NR_027238	MSTRG.18656	258.613585	-2.461757218	3.89E-14	5.10E-11
NA	NA	MSTRG.26500	165.5495456	-3.274948261	3.00E-13	3.74E-10
PPM1E	NM_014906	MSTRG.14543	895.6367883	-1.965886178	1.46E-11	1.74E-08
LOC100506797	NR_144530	MSTRG.18904	12.08167974	-3.818368382	3.13E-11	3.55E-08
NA	NA	MSTRG.27417	11.55285797	3.923827848	5.73E-11	6.21E-08
FRG1CP	NR_132315,NA	MSTRG.20413	504.8862869	-2.48187704	1.39E-10	1.44E-07
TMSB4Y	NM_004202	MSTRG.34411	16.40699841	-3.737358144	2.92E-09	2.80E-06
LOC646214	NR_027053	MSTRG.10183	14.99286957	3.194006904	1.12E-08	1.03E-05
TEKT4P2	NR_038327	MSTRG.20913	34.0803212	-3.119195309	6.82E-08	6.08E-05
RNASEL	NM_021133	MSTRG.2491	92.67472665	1.956092584	1.31E-07	0.000112763
CDC42EP4	NM_012121	MSTRG.14778	1382.6265	-	2.28E-07	0.000189

			75	2.485232918		406
LINC00115	NR_024321	MSTRG.56	11.41016125	-3.169519774	3.74E-07	0.000300756
NA	NA	MSTRG.12388	12.52907017	-3.169849748	5.85E-07	0.000455649
NA	NA	ENSG00000283196	9.42287253	-2.931701763	6.76E-07	0.000511259
AK3	NM_001199855, NM_001199853	MSTRG.31803	1336.16357	-1.45848511	7.22E-07	0.000529562
NA	NA	MSTRG.34423	3.513026294	-3.142641981	7.72E-07	0.000550219
ZP3	NM_007155,NM_001110354	MSTRG.29546	39.26766104	-1.867350845	8.72E-07	0.000603782
CRYBB2	NM_000496	MSTRG.21529	18.36368702	-2.22634683	1.92E-06	0.001275375
SYAP1	NM_032796	MSTRG.33254	1533.624296	1.638880929	1.94E-06	0.001275375
ZRSR2	NM_005089	MSTRG.33240	255.9410781	1.216383728	2.77E-06	0.001771022
FAM157C	NR_126161	MSTRG.13117	6.913119802	-2.872817371	3.48E-06	0.002119744
NA	NA	ENSG00000260633	5.025710768	-2.953792614	3.96E-06	0.002352281
ATG4A	NM_001321290	MSTRG.33981	185.4844345	1.911129732	4.55E-06	0.00263633
ZNF587B	NM_001204818	MSTRG.17668	4.938246816	2.909242926	5.03E-06	0.002851531
TBL1Y	NM_033284	MSTRG.34388	5.111107259	-2.881869838	5.46E-06	0.003026567
MIR1270	NR_036053,NR_036455	MSTRG.16576	122.6462755	2.004406303	5.71E-06	0.003097301
TXLNG	NM_001168683	MSTRG.33258	809.1115377	1.172692841	6.16E-06	0.003236793
NA	NA	MSTRG.24565	25.1952085	2.351034375	6.23E-06	0.003236793
EIF3C	NM_001199142, NM_001037808, NR_107058,NM_001317857,NM_001287251	MSTRG.12221	3240.746636	-0.607394366	8.44E-06	0.00429441
ACOT8	NM_005469	MSTRG.20662	215.1572421	1.492911901	1.46E-05	0.007219474
FRG1BP	NR_003579	MSTRG.20423	488.3307525	-1.472464672	1.48E-05	0.007219474
ULBP2	NM_025217	MSTRG.28595	38.87667001	2.505588789	1.72E-05	0.008235006

C. 77 null vs 78 control hiPSC-PCS

Gene Symbol	All Refseq Transcripts	Sequencing Gene ID	Mean Counts	Log2 Fold Change	P-value	BH adjusted p-value
NA	NA	MSTRG.19362	1366.930413	-8.811147521	2.45E-85	2.18E-81
ACTG1P20	NR_033926	MSTRG.598	356.2084132	-7.250431153	7.56E-80	4.48E-76
CHCHD2	NM_001320327	MSTRG.29335	3594.234159	-7.257042517	1.37E-62	4.88E-59
TTTY15	NR_001545	MSTRG.34406	176.7039295	-6.475377482	2.84E-35	5.05E-32
MTRNR2L1	NM_001190452	MSTRG.13690	48.98053654	-6.643157289	2.87E-31	4.26E-28
TMED7	NM_181836	MSTRG.26307	49.81697951	-6.094942915	5.33E-30	7.29E-27
NA	NA	MSTRG.28405	76.74258257	5.695798065	1.97E-26	2.34E-23
ZNF667-AS1	NR_036521,NR_036522	MSTRG.17587	151.4866369	-5.152618833	1.46E-22	1.62E-19
CRYBB1	NM_001887	MSTRG.21555	61.37260294	5.093563394	1.98E-19	2.07E-16
NA	NA	MSTRG.1457	241.867752	-5.402032627	1.93E-18	1.80E-15
PMEL	NM_001200053,NM_006928	MSTRG.7256	2796.803961	4.197686752	7.14E-16	6.04E-13
NA	NA	MSTRG.33036	74.34040311	-4.255839094	2.01E-14	1.56E-11
GANC	NM_001301410,NM_001301409,NM_198141,NM_000070,NM_173088,NM_173090	MSTRG.10569	301.5487597	1.7948269	4.26E-14	3.16E-11
VAX2	NM_012476	MSTRG.18442	64.6142061	3.546306618	6.57E-14	4.67E-11
CREBRF	NM_001168393,NM_153607	MSTRG.26951	465.9857873	-2.18153422	2.03E-12	1.34E-09
NA	NA	MSTRG.27417	11.55285797	4.1299249	5.45E-12	3.46E-09
APOO	NM_024122	MSTRG.33307	756.6270925	2.036945045	9.89E-12	6.06E-09
NA	NA	MSTRG.24565	25.195208 5	3.469211269	1.70E-11	1.01E-08
NUAK2	NM_030952	MSTRG.2714	802.17916	-	2.47E-11	1.42E-08

			2	1.938539929		
PTGDS	NM_000954,NM_207510	MSTRG.32997	157.3920392	2.653516863	3.84E-11	2.13E-08
RNASEL	NM_021133	MSTRG.2491	92.6747265	2.401957354	8.31E-11	4.48E-08
FAM26E	NM_153711	MSTRG.28319	104.823758	2.716660131	1.66E-10	8.70E-08
NA	NA	MSTRG.30415	69.9708204	-3.155285795	3.29E-10	1.67E-07
NA	NA	MSTRG.33141	31.6189707	-3.138035751	4.25E-10	2.10E-07
MIR1270	NR_036053,NR_036455	MSTRG.16576	122.6462755	2.729568153	5.60E-10	2.69E-07
SLC2A6	NM_017585	MSTRG.32934	166.6775857	1.561026498	8.02E-10	3.66E-07
CA11	NR_136241	MSTRG.17273	529.1189077	1.48661458	7.97E-10	3.66E-07
C18orf8	NM_001276342, NM_001318707	MSTRG.15356	900.427516	2.469601749	8.77E-10	3.90E-07
RENBP	NM_002910	MSTRG.34323	274.6911345	1.683926747	1.29E-09	5.60E-07
NA	NA	MSTRG.12388	12.5290701	-3.819480011	2.07E-09	8.55E-07
LHFPL3	NM_199000	MSTRG.29871	343.2615499	-1.574976474	3.80E-09	1.54E-06
NA	NA	MSTRG.26500	165.5495456	-2.616313615	4.01E-09	1.57E-06
PTRH1	NM_001002913, NA	MSTRG.32778	97.72265981	1.890008189	4.05E-09	1.57E-06
SCRG1	NM_007281	MSTRG.25305	330.4659561	2.394776219	4.27E-09	1.61E-06
ACOT8	NM_005469	MSTRG.20662	215.1572421	2.016152543	4.48E-09	1.66E-06
ACAT1	NM_000019	MSTRG.6044	957.0993937	1.465003319	5.74E-09	2.04E-06
ZNF12	NM_006956	MSTRG.28914	1013.768639	-1.130436488	5.66E-09	2.04E-06
TMSB4Y	NM_004202	MSTRG.34411	16.40699841	-3.656706039	6.59E-09	2.30E-06
KHK	NM_006488	MSTRG.17954	160.2595508	1.965006507	7.36E-09	2.52E-06
FIBP	NM_198897	MSTRG.5467	1350.742531	1.460412658	7.93E-09	2.66E-06
OTOGL	NM_173591	MSTRG.7545	93.24902457	3.400132762	8.62E-09	2.84E-06
CPVL	NM_019029,NM	MSTRG.29100	369.34427	2.353516671	1.16E-08	3.75E-06

	_001348052		53			
CCP110	NM_001199022	MSTRG.12090	978.3884451	-1.335022832	1.28E-08	4.07E-06
UCHL3	NM_001270952, NM_005358,NM_006002,NM_001306080,NM_001330583,NM_015842	MSTRG.8689	535.6081643	1.368845567	1.43E-08	4.47E-06
TSR3	NM_001001410	MSTRG.11668	809.6278843	1.660658388	1.60E-08	4.90E-06
BCYRN1	NR_001568	MSTRG.18181	104.048587	3.374868404	1.95E-08	5.86E-06
REREP3	NR_033735	MSTRG.10187	34.14735214	-2.047331278	2.03E-08	6.02E-06
COMMD4	NM_001284377, NM_001284379, NR_104312	MSTRG.11149	842.0974795	1.432760453	2.60E-08	7.59E-06
LOC646214	NR_027053	MSTRG.10183	14.99286957	3.10974815	2.97E-08	8.51E-06
PTPRZ1	NM_002851	MSTRG.30008	6204.347926	-1.665645799	3.96E-08	1.10E-05
ZBTB44	NM_001301098	MSTRG.6349	499.8895956	-1.276748266	3.95E-08	1.10E-05
SLC25A18	NM_001303484	MSTRG.21339	61.1772056	1.789616272	4.58E-08	1.25E-05
VEZF1	NM_007146,NM_001330393	MSTRG.14503	1045.614935	-1.424576494	5.06E-08	1.36E-05
NA	NA	MSTRG.33143	62.88767472	-2.364654211	5.52E-08	1.46E-05
NA	NA	MSTRG.25417	51.90047546	2.250717195	5.70E-08	1.49E-05
SLC46A3	NM_181785	MSTRG.8382	38.03035031	2.082002634	7.27E-08	1.82E-05
LRRC75A	NM_001113567	MSTRG.13535	164.7406838	-2.07820506	7.17E-08	1.82E-05
SNRNP48	NM_152551	MSTRG.27183	494.4362669	-2.09832283	7.13E-08	1.82E-05
COPRS	NM_018405,NM_001330176	MSTRG.13817	1067.554227	1.713370514	7.70E-08	1.90E-05
EIF5A	NM_001143760, NM_001970,NM_001143761,NM_001143762	MSTRG.13358	3067.001762	1.517409636	9.48E-08	2.25E-05
LRIG2	NM_001312686	MSTRG.1682	542.6093815	-1.521256831	9.70E-08	2.27E-05

SEC14L5	NM_014692,NR_038913,NM_019109,NM_001330504	MSTRG.11894	284.5125922	0.975114808	1.21E-07	2.79E-05
ATP5G1	NM_001002027	MSTRG.14381	1299.217841	1.754701564	1.43E-07	3.26E-05
ZP3	NM_007155,NM_001110354	MSTRG.29546	39.26766104	-2.025996899	1.57E-07	3.54E-05
SNX32	NM_152760	MSTRG.5462	81.97852139	1.336768594	1.61E-07	3.58E-05
MINOS1	NM_001032363, NM_001204088, NR_077246,NM_001278164,NM_001278165,NM_001204084,NM_005380,NM_001204085,NM_001204086,NM_001278166	MSTRG.444	996.2831634	1.457559702	1.64E-07	3.60E-05
STAG2	NM_001042749, NM_006603,NM_001282418	MSTRG.34103	2396.541238	-1.112797584	1.79E-07	3.89E-05
EID2B	NM_152361	MSTRG.16950	94.55494938	3.243322218	1.86E-07	3.98E-05
MRAS	NM_001252091, NM_001252093, NM_001252090	MSTRG.23406	225.1128114	2.41583464	1.97E-07	4.17E-05
TRPC4AP	NM_015638	MSTRG.20515	2160.408781	0.723317696	2.03E-07	4.25E-05
PRPF3	NM_004698	MSTRG.1945	767.5649466	-1.039773101	2.06E-07	4.27E-05
PIM1	NM_001243186	MSTRG.27709	768.3240715	-2.08224294	2.14E-07	4.32E-05
C3orf14	NM_001291941, NM_001291943, NM_020685	MSTRG.22821	339.4845331	1.959560067	2.27E-07	4.52E-05
NA	NA,NR_049748	MSTRG.11350	196.1453574	-1.604150956	2.28E-07	4.52E-05
TEKT4P2	NR_038327	MSTRG.20913	34.0803212	-2.999901345	2.41E-07	4.68E-05
BEND3P3	NR_027512	MSTRG.3980	34.66154992	-2.175757326	2.42E-07	4.68E-05
PMP2	NM_002677	MSTRG.31207	39.38086889	2.973873484	2.53E-07	4.82E-05
BBS9	NM_001348036,	MSTRG.29163	522.92673	1.143323301	2.55E-07	4.82E-05

	NM_198428,NM_001348041		68			
PIBF1	NM_006346	MSTRG.8682	396.6518535	-1.63250592	2.66E-07	4.98E-05
ACP5	NM_001111035,NM_001611,NM_001322023,NM_001111034	MSTRG.16243	26.46602396	3.053751884	2.75E-07	5.10E-05
ANKRD20A3	NM_001012419,NM_032250	ENSG00000276203	25.71149774	-2.334695467	3.20E-07	5.88E-05
USP11	NM_004651	MSTRG.33464	5662.175246	0.818768447	3.29E-07	5.97E-05
PSPH	NM_004577	MSTRG.29345	649.2636419	1.541689444	3.42E-07	6.09E-05
MYO3A	NM_017433	MSTRG.3436	68.09046217	-2.027148364	3.39E-07	6.09E-05
MIR5692C2	NR_049868,NR_002822	MSTRG.29710	97.56457726	1.699105025	3.57E-07	6.28E-05
ANKRD20A1	NM_032250,NM_001012419	ENSG00000260691	21.18480663	-2.288936487	3.63E-07	6.34E-05
SNTA1	NM_003098	MSTRG.20467	259.4889842	1.124418162	4.22E-07	7.29E-05
GOLGA2P7	NR_027001	MSTRG.11327	891.3328442	-1.658435391	4.46E-07	7.58E-05
NAXE	NM_144772	MSTRG.2168	1062.725007	1.638502501	4.48E-07	7.58E-05
AP1S2	NM_001272071	MSTRG.33247	2221.680074	1.731292427	4.82E-07	8.09E-05
PDK2	NM_001199898,NM_001199900,NM_001199899	MSTRG.14423	626.8755376	1.006666199	4.93E-07	8.11E-05
TRIM61	NM_001012414	MSTRG.25243	19.92535455	-3.007608444	4.92E-07	8.11E-05
CRYBA4	NM_001886	MSTRG.21556	28.31697593	3.127260765	5.33E-07	8.70E-05
CUZD1	NM_022034,NM_001204364	MSTRG.4447	40.4847409	2.635445145	5.72E-07	9.16E-05
PUDP	NM_001178136,NM_001178135	MSTRG.33184	930.4168676	1.630334164	6.00E-07	9.54E-05
NA	NA	MSTRG.16150	113.8377512	-3.074522041	6.18E-07	9.66E-05
RESP18	NM_001007089	MSTRG.19853	14.24514737	3.022229641	6.19E-07	9.66E-05
ARID4A	NM_002892	MSTRG.9510	416.0148087	-1.570970806	7.14E-07	0.00011041

ASPHD1	NM_181718	MSTRG.12266	102.6887048	2.39555047	7.32E-07	0.000110779
RANGRF	NM_001330127, NM_001177801	MSTRG.13412	356.6160547	1.394968522	7.35E-07	0.000110779
NA	NA	MSTRG.21323	66.49202004	1.735405529	7.32E-07	0.000110779
ASNS	NM_001178076, NM_133436,NA	MSTRG.29716	4898.003215	1.724692151	7.48E-07	0.000111868
PAPPA2	NM_021936,NM_020318	MSTRG.2425	173.0680096	3.010922139	7.88E-07	0.000116833
EIF4B	NM_001300821	MSTRG.7161	11126.02071	-1.417929277	9.19E-07	0.000135017
HPS1	NM_001322477, NM_001322490, NR_039833	MSTRG.4177	462.0594692	1.301835898	9.78E-07	0.000142519
SLC31A2	NM_001860	MSTRG.32622	13.80658658	2.702531624	1.02E-06	0.0001466 8
SYNGR2	NM_001320523	MSTRG.14909	386.5174806	1.493421043	1.02E-06	0.0001466 8
UCHL1	NM_004181	MSTRG.24362	3994.001108	1.92196782	1.12E-06	0.000158809
MTCH2	NM_001317231	MSTRG.5186	3370.905569	1.171083302	1.15E-06	0.000162629
PEPD	NM_000285	MSTRG.16746	1087.023167	1.470206024	1.33E-06	0.000182728
FAM45BP	NR_027141	MSTRG.34130	49.18536196	1.815526238	1.32E-06	0.000182728
TMEM255B	NM_182614,NR_044995	MSTRG.8919	20.70953877	2.451151451	1.32E-06	0.000182728
ACAD10	NM_001136538, NM_001204889, NR_106819,NA	MSTRG.7891	1741.106084	0.985254017	1.35E-06	0.000184071
TMEM150A	NM_001031738	MSTRG.18605	187.8492405	1.166546328	1.37E-06	0.0001856 1
RIT2	NM_001272077	MSTRG.15494	33.04855374	3.069628166	1.40E-06	0.000188191
TSTA3	NM_001317783, NM_003313	MSTRG.31673	504.5529322	1.196839971	1.41E-06	0.000188883
AKR1C1	NM_001353	MSTRG.3238	524.1529015	2.348341812	1.49E-06	0.000198386
NA	NA	MSTRG.24503	9.504429034	3.004464724	1.56E-06	0.000205616
HSD17B10	NM_004493	MSTRG.33570	1285.401621	1.321326548	1.73E-06	0.000225595
MRPL41	NM_032477	MSTRG.33026	1145.56945	1.633731883	1.74E-06	0.000226495

KRIT1	NM_194455,NM_004912,NR_031616	MSTRG.29656	571.096714	-1.255657188	1.84E-06	0.000237389
GSTP1	NM_000852	MSTRG.5550	7277.376867	1.284741773	1.96E-06	0.000251403
ANKRD20A3	NM_001012419,NR_026759,NA	ENSG00000240240	11.32771822	-2.680417151	2.00E-06	0.000254451
PRMT7	NM_001184824,NM_001290018	MSTRG.12722	621.828615	1.2256663	2.06E-06	0.000259944
LCA5	NM_181714	MSTRG.28035	311.245274	-1.386073686	2.12E-06	0.000265402
TET1	NM_030625	MSTRG.3783	1118.654698	-2.355577563	2.22E-06	0.000276713
GATAD2B	NM_020699	MSTRG.2041	903.798091	-1.52702141	2.35E-06	0.000290677
SSFA2	NM_001287505,NM_001130445	MSTRG.19431	1657.688137	-1.642602312	2.69E-06	0.000329488
GPAA1	NM_003801	MSTRG.31705	1714.319347	1.014065959	2.74E-06	0.000332403
COX6C	NM_004374	MSTRG.31393	3002.102306	1.554290049	2.75E-06	0.000332403
NDUFA3	NM_004542,NA	MSTRG.17502	1304.301934	1.358393407	2.78E-06	0.000334174
PHF24	NM_001347982,NM_001347983	ENSG00000122733	34.23824255	2.186872224	2.82E-06	0.000334174
ZNF677	NM_001317998,NM_182609	MSTRG.17474	321.171206	-1.921751669	2.82E-06	0.000334174
AKR1B1	NM_001628,NM_001346142	MSTRG.30147	2345.033368	1.406691192	2.92E-06	0.000340348
ZNF277	NM_021994	MSTRG.29947	659.2583014	-1.41297739	2.93E-06	0.000340348
GDPD5	NM_030792	MSTRG.5737	209.008773	1.189398949	2.91E-06	0.000340348
NDUFS5	NM_001184979	MSTRG.837	3715.207524	1.489943704	2.98E-06	0.000343907
MRPL23	NM_021134	MSTRG.4633	601.1286565	1.557311676	3.05E-06	0.000349688
AKR1C2	NM_001354,NM_001321027,NM_001135241,NA	MSTRG.3243	379.4425603	2.33180042	3.08E-06	0.000351186
LINC00339	NR_023918,NR_023919	MSTRG.476	154.4260006	1.344764133	3.28E-06	0.000371146
RLF	NM_012421	MSTRG.866	1442.974377	-1.289851119	3.35E-06	0.000376993
HDAC5	NM_005474	MSTRG.14202	1446.981608	-1.048147486	3.44E-06	0.000384 93

ADI1	NM_018269,NM_001306077	MSTRG.17750	506.8866829	1.40257942	3.53E-06	0.000392774
F11R	NM_016946,NM_001348091,NM_001113206	MSTRG.2236	1102.093334	-1.630820461	3.64E-06	0.000399545
GUCA1B	NM_002098,NM_018141	MSTRG.27755	504.1855796	1.850981092	3.66E-06	0.000399545
UGP2	NM_001001521,NM_006759	MSTRG.18354	1527.186294	1.172061963	3.66E-06	0.000399545
HORMAD2-AS1	NR_110541	MSTRG.21627	89.29200279	-2.647256075	3.87E-06	0.00041976
PPP1R14B	NM_138689	MSTRG.5379	924.5358254	1.152047332	3.91E-06	0.0004213
PRDX5	NM_181652	MSTRG.5393	3857.212099	1.395165271	4.41E-06	0.000458852
FAM221A	NM_001127364	MSTRG.29039	114.6438541	1.80652441	4.40E-06	0.000458852
APOE	NM_001302690,NM_001321066,NM_001302691,NM_001302689,NM_001645	MSTRG.17130	873.1091987	2.143276829	4.40E-06	0.000458852
AKR1C3	NM_001253908,NM_001253909,NM_003739	MSTRG.3246	59.07437896	2.41748662	4.39E-06	0.000458852
NDUFA4L2	NM_020142	MSTRG.7312	92.79299367	2.297987224	4.29E-06	0.000458852
MIA	NM_001202553,NM_006533,NR_037775,NM_016154,NR_037791,NM_080732,NM_053046,NR_040249	MSTRG.16997	1171.619146	0.830178165	4.32E-06	0.000458852
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SP8	NM_198956	MSTRG.28999	459.8373982	-1.842944171	4.75E-06	0.000485293
KMO	NM_003679	MSTRG.3122	47.65809509	2.942118195	4.88E-06	0.000495748
TMSB15B	NM_194324,NA	MSTRG.33941	288.4157164	1.863653597	5.02E-06	0.000507769
NA	NA,NR_130152,NM_003902	MSTRG.1357	3707.314189	-0.984068542	5.16E-06	0.000518278
RAB9B	NM_016370	MSTRG.33933	213.4089553	2.039792742	5.34E-06	0.000533234

LOC100101478	NR_130172,NM_194324	MSTRG.33944	450.9705121	1.722222008	5.45E-06	0.000541082
PRDX4	NM_006406	MSTRG.33302	3755.096847	1.657705278	5.66E-06	0.00055956
GPD1L	NM_015141	MSTRG.22330	308.2727613	1.656612999	5.75E-06	0.000564585
NBR1	NM_031862,NM_001291571,NM_001291572	MSTRG.14187	1701.18376	-1.099612858	5.92E-06	0.000578543
ACBD7	NM_001039844	MSTRG.3330	93.38545434	-2.406592007	6.02E-06	0.000584913
OAT	NM_001171814	MSTRG.4461	1932.661991	1.357614361	6.37E-06	0.000615592
NA	NA,NM_001304759,NR_130897	MSTRG.1128	331.8788461	0.780779523	6.52E-06	0.000626425
C7orf73	NM_001130929	MSTRG.30164	1413.128361	-2.420113894	6.75E-06	0.000645601
LAMTOR2	NM_001145264	MSTRG.2145	646.4901737	1.243674919	7.19E-06	0.000683688
C5AR1	NM_001736,NA	MSTRG.17225	44.17291586	-2.600414602	7.57E-06	0.000716192
GTF3A	NM_002097	MSTRG.8368	1404.560949	1.375677228	7.73E-06	0.000727469
FAH	NM_000137	MSTRG.11261	348.8689145	1.043427154	7.88E-06	0.000737297
LOC102724219	NM_001322044,NM_001322975	MSTRG.20899	69.30433852	1.990687925	8.01E-06	0.000745774
MRPS18C	NM_016067	MSTRG.24659	542.5237415	1.707292168	8.20E-06	0.000759577
CDK4	NM_000075,NR_106817	MSTRG.7338	3746.754079	1.258418767	8.27E-06	0.000762098
ZBBX	NM_001199201,NM_001199202	MSTRG.23663	79.2564689	-1.413561973	8.41E-06	0.00077132
NA	NA	MSTRG.19159	37.19677492	1.663143462	8.62E-06	0.000781931
RFX3	NM_001282116,NM_001282117,NM_002919	MSTRG.31794	1809.573325	-1.70106674	8.63E-06	0.000781931
UROS	NR_136677,NM_001324037,NM_001324039	MSTRG.4477	1115.61712	1.37337375	8.66E-06	0.000781931
PPP1R7	NM_001282410,NM_001282414,NM_001282412,NM_001282409	MSTRG.20076	929.7653078	1.068372845	8.71E-06	0.000782219
MLLT10	NM_001324296,	MSTRG.3403	1188.6214	-1.09834631	9.49E-06	0.000848

	NM_001324297, NR_136736,NM_001195630,NM_001195626		73			506
ZNF471	NM_001321768	MSTRG.17585	74.2182606	-2.804179236	9.93E-06	0.000882054
RSRC2	NM_023012	MSTRG.8082	1722.818475	-1.219700516	9.97E-06	0.000882054
SCG5	NM_003020	MSTRG.10391	353.8272905	2.165410376	1.01E-05	0.000887342
NA	NA	MSTRG.33144	20.38686084	-2.200980042	1.04E-05	0.000903496
SDF2L1	NM_022044	MSTRG.21452	210.8991793	1.255439121	1.05E-05	0.000913128
ZMYM2	NM_197968,NM_001190964,NM_001190965	MSTRG.8262	2414.09588	-0.904341512	1.08E-05	0.000933304
GPNMB	NM_002510	MSTRG.29022	124.7119472	2.663846403	1.09E-05	0.000933304
GNPDA1	NM_005471	MSTRG.26668	2093.270893	1.406961535	1.11E-05	0.000947479
LOC554223	NR_132323,NR_001434,NM_001242758,NA	MSTRG.27456	2144.390059	1.50501082	1.17E-05	0.000992125
GUSBP4	NR_132999	MSTRG.27914	124.9531538	-1.671952649	1.17E-05	0.000992125
SMIM4	NM_001124767	MSTRG.22717	169.1266344	1.495606667	1.28E-05	0.001065184
NA	NA	MSTRG.32160	34.41661492	-1.45428358	1.27E-05	0.001065184
NA	NA	MSTRG.6176	13.92062361	2.80613848	1.27E-05	0.001065184
SLC27A4	NM_005094	MSTRG.32809	1223.039692	1.371863359	1.29E-05	0.001074296
NA	NA	MSTRG.3392	67.15657817	-1.442458146	1.31E-05	0.001080994
AK3	NM_001199855, NM_001199853	MSTRG.31803	1336.16357	-1.282267078	1.32E-05	0.001090264
NA	NA	MSTRG.13524	45.69043015	-2.335936858	1.34E-05	0.001094731
TIMM22	NM_013337	MSTRG.13159	592.6069813	1.22330101	1.37E-05	0.001112633
PSMB6	NM_001270481	MSTRG.13277	2495.978732	1.332356707	1.36E-05	0.001112633
C1QTNF2	NM_031908	MSTRG.26845	17.96597898	2.191617615	1.39E-05	0.001120309

HNRNPUL1	NM_144732,NM_007040,NM_001321208,NM_001321211	MSTRG.17018	4856.759568	-1.081364062	1.46E-05	0.001178984
CORIN	NM_001278585, NM_001278586	MSTRG.24404	58.72575522	-2.719647792	1.47E-05	0.001180074
RRP36	NM_001329704, NA	MSTRG.27784	563.0857079	0.915527649	1.51E-05	0.001204966
ABCB8	NM_001282293	MSTRG.30342	383.5538753	0.979763849	1.65E-05	0.001308444
ARNTL	NM_001297719	MSTRG.4859	122.7594501	1.092721892	1.69E-05	0.001338044
TFAP4	NM_003223	MSTRG.11837	357.4007468	-1.582548999	1.70E-05	0.00133962
LOC101927752	NR_134303	MSTRG.30465	87.928186 8	1.479863091	1.73E-05	0.001340293
BCL2L1	NM_001322242, NM_001191,NM_138578,NM_001317920	MSTRG.20430	957.697881	1.258217312	1.73E-05	0.001340293
RAI14	NM_015577,NM_001145520,NM_001145521,NM_001145523	MSTRG.25623	1900.640409	-1.763533339	1.73E-05	0.001340293
PSMG1	NR_049728,NM_001320795	MSTRG.21169	838.5591342	1.155344302	1.74E-05	0.001340293
ARPC4	NM_001024959, NM_001198780, NM_001198793, NM_005718,NM_001025930	MSTRG.22122	2082.342481	1.027420241	1.75E-05	0.001340293
TMEM147	NM_001242598	MSTRG.16794	1726.731657	1.504564129	1.74E-05	0.001340293
ZNF644	NM_016620,NM_201269	MSTRG.1438	1156.598484	-1.053669961	1.78E-05	0.001360068
HIKESHI	NM_016401,NM_001322404	MSTRG.5868	1124.639485	1.413481823	1.80E-05	0.001367909
RLN2	NM_005059	MSTRG.31810	22.224076 8	2.574468331	1.82E-05	0.00137377
FAM184A	NM_024581,NM_001100411	MSTRG.28361	281.43234	-1.792356565	1.84E-05	0.001389404
SERTAD4-AS1	NR_024337	MSTRG.2768	11.08066615	2.459760996	1.95E-05	0.001423905
LOC100506797	NR_144530	MSTRG.18904	12.08167974	-2.326983718	1.91E-05	0.001423905
CHD9	NM_025134,NM	MSTRG.12480	1298.2258	-1.5385758	1.93E-05	0.001423

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ROGDI	NM_024589	MSTRG.11868	425.870888	1.125798548	1.95E-05	0.001423905
CDK5	NM_004935	MSTRG.30345	563.6537656	1.751075144	1.94E-05	0.001423905
ULBP2	NM_025217	MSTRG.28595	38.8766701	2.493792712	1.90E-05	0.001423905
LOC441155	NM_001271675	MSTRG.27942	71.6266373	-2.678612838	1.95E-05	0.001423905
TIMM17B	NM_001167947	MSTRG.33499	1100.542259	1.206663163	1.97E-05	0.001430899
ZFP1	NM_153688	MSTRG.12863	236.1437485	-1.466982304	1.99E-05	0.001430899
SECISBP2	NM_001282688, NM_001282690	MSTRG.32347	1182.400377	-1.146100907	1.99E-05	0.001430899
SLC25A4	NM_001151	MSTRG.25366	1114.137448	1.644460671	2.00E-05	0.001430899
EIF2A	NM_001319043	MSTRG.23549	1786.365915	-0.950380632	2.03E-05	0.001448083
TMEM53	NM_001300746	MSTRG.972	156.9138722	1.32097108	2.04E-05	0.001448083
SPICE1	NM_144718,NM_001331079	MSTRG.23096	422.487624	-1.217418364	2.14E-05	0.001515408
DIXDC1	NM_001278542, NM_001037954, NM_033425	MSTRG.6076	951.8903323	-1.49991046	2.15E-05	0.001518697
NDUFAF4	NM_014165	MSTRG.28139	575.1636537	1.44098462	2.22E-05	0.001557953
HMOX2	NM_001127206, NM_001127204, NM_001286270, NM_001127205	MSTRG.11846	428.4436825	1.289125484	2.26E-05	0.001582089
SLC1A5	NM_005628,NM_001145145,NM_001145144	MSTRG.17215	2211.349956	1.229481488	2.31E-05	0.001608013
TRAPPC2L	NR_134671,NM_001318525	MSTRG.13076	954.9832477	1.503405452	2.32E-05	0.001608055
NKX6-2	NM_177400,NA	MSTRG.4528	406.2107771	-2.484304575	2.32E-05	0.001608055
LHFPL3	NM_199000	MSTRG.29870	1000.305628	-1.450660633	2.34E-05	0.001614686
FDX1	NM_004109	MSTRG.6054	363.8578454	1.089151664	2.35E-05	0.001616447
ANKRD20A8P	NR_003366	ENSG00000229089	9.523435124	-2.266596146	2.36E-05	0.001617749
CSNK2A2	NM_001896	MSTRG.12571	1476.5203	-	2.40E-05	0.001632

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GMPPA	NM_013335,NM_205847	MSTRG.19879	328.3208839	0.898943274	2.43E-05	0.001648157
FABP6	NM_001130958, NM_001040442, NM_001445	MSTRG.26843	36.35338887	2.342160695	2.45E-05	0.001654393
BRWD3	NM_153252	MSTRG.33789	659.8947261	-1.480201862	2.46E-05	0.001658301
MPP1	NM_001166462	MSTRG.34344	128.718179	1.631403228	2.50E-05	0.001678561
EPHA4	NM_001304537, NM_001304536	MSTRG.19873	1409.489404	-1.123694539	2.51E-05	0.001680377
NA	NA	MSTRG.33835	61.51101834	2.317538313	2.56E-05	0.001703198
ITGB1BP1	NM_001319068, NM_001319070	MSTRG.17785	1009.758761	1.328867282	2.57E-05	0.001703198
NDUFB10	NM_004548	MSTRG.11703	1480.69644	1.116393904	2.58E-05	0.001708365
DBNL	NM_001014436, NR_106896,NA	MSTRG.29258	1070.119394	1.191630569	2.60E-05	0.001708838
ZNF714	NM_182515	MSTRG.16615	268.4437616	-1.503733006	2.60E-05	0.001708838
EEF1AKMT1	NM_174928	MSTRG.8270	123.0645738	1.490860474	2.71E-05	0.001770906
TUBB4A	NM_001289130, NM_001289123	MSTRG.16072	1374.636454	2.017509476	2.76E-05	0.001776495
KCNS2	NM_020697	MSTRG.31359	11.77713583	2.647036779	2.75E-05	0.001776495
AHI1	NM_001134830, NM_001134832	MSTRG.28462	316.2844819	-1.6870829	2.75E-05	0.001776495
PPIG	NM_004792	MSTRG.19280	1447.973859	-1.672326241	2.75E-05	0.001776495
SPATA13	NM_001286792, NR_104595,NM_001166271,NR_031753,NM_001286793,NM_001303138,NM_001303137	MSTRG.8321	882.309325	-1.606273446	2.78E-05	0.001783666
NA	NA	MSTRG.22456	13.58247683	2.518317968	2.81E-05	0.001797496
DECR1	NM_001359,NM_001330575	MSTRG.31268	942.0414935	1.091781138	2.84E-05	0.001806232
FAM118B	NM_024556,NM_001330446	MSTRG.6301	563.8267781	1.126916743	2.85E-05	0.001806232
VPS29	NM_016226	MSTRG.7864	718.45073	1.291396048	2.85E-05	0.001806

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KIF21A	NM_001173463	MSTRG.6933	2615.111347	-1.856080278	2.91E-05	0.001825774
NA	NA	ENSG00000236816	8.060240317	-2.459880299	2.90E-05	0.001825774
MALAT1	NR_002819,NR_144569	MSTRG.5438	882.3286804	-2.050597672	3.00E-05	0.001878438
UQCRQ	NM_014402,NM_052971	MSTRG.26448	1850.219687	1.822358797	3.11E-05	0.001933421
RAB27B	NM_004163	MSTRG.15586	77.26912754	2.151356972	3.10E-05	0.001933421
IDH3B	NM_006899,NM_001258384	MSTRG.20149	960.0190173	1.218904241	3.17E-05	0.001965986
KIAA1143	NM_001320334	MSTRG.22500	1169.178069	-1.12107278	3.26E-05	0.002004182
MFSD1	NM_001167903, NA	MSTRG.23626	291.81205	1.227320821	3.25E-05	0.002004182
ALG14	NM_001305242	MSTRG.1504	216.3553986	1.459578418	3.28E-05	0.002010444
CABLES1	NM_001256438, NM_001100619, NM_138375	MSTRG.15347	166.7431234	1.770485857	3.29E-05	0.002011588
ZCCHC11	NM_001009881	MSTRG.1114	1531.26975	-1.779243104	3.41E-05	0.002064778
HSPB11	NR_133632,NM_001316935	MSTRG.1142	563.2383368	1.145893294	3.41E-05	0.002064778
LRP6	NM_002336	MSTRG.6656	1265.515698	-1.365678822	3.42E-05	0.002064778
CCDC102B	NM_001093729, NM_024781	MSTRG.15694	151.7411051	-1.384131138	3.41E-05	0.002064778
BEX2	NM_032621,NM_001168400	MSTRG.33916	761.0520328	1.546830391	3.45E-05	0.002068452
CENPX	NM_001330536, NM_001271006	MSTRG.15053	569.1362902	1.400947006	3.45E-05	0.002068452
SLIRP	NM_001267863, NM_001173978	MSTRG.9810	1330.76208	1.563195941	3.47E-05	0.002071244
LOC100506124	NR_045375,NM_024753	MSTRG.19255	594.1520386	-0.973459128	3.49E-05	0.002077396
MAEA	NR_123716,NM_001297432,NM_001297433	MSTRG.24081	1203.989581	0.827141567	3.52E-05	0.002085067
ANKRD20A4	NM_001098805	ENSG00000172014	17.44835092	-2.086603404	3.72E-05	0.002198436
SEMA3E	NM_012431,NM_001178129	MSTRG.29607	114.6077206	1.999726032	3.82E-05	0.002242484
SP4	NM_001326542,	MSTRG.29002	383.81719	-	3.84E-05	0.002247

	NR_031594,NR_137166		75	0.994548319		528
RPE65	NM_000329	MSTRG.1274	43.36339254	-2.174128982	3.85E-05	0.002247644
DOLK	NM_014908	MSTRG.32842	448.6887255	1.465923117	3.95E-05	0.002286094
PTCD1	NM_015545,NM_001198879,NM_001003713	MSTRG.29742	2495.298774	0.995937447	3.94E-05	0.002286094
PWP2	NM_005049	MSTRG.21234	245.7145026	0.984666865	3.96E-05	0.002286094
SNX17	NM_001267059	MSTRG.17973	1730.12825	1.206492026	4.03E-05	0.002319669
CD83	NM_001251901, NM_001040280	MSTRG.27234	156.1516369	1.39122417	4.06E-05	0.002325884
FAM173A	NM_001271285	MSTRG.11641	241.8709639	1.230174354	4.07E-05	0.002325884
NA	NA	MSTRG.33051	565.0967006	-0.9786739	4.10E-05	0.002335704
PPP2R2C	NM_181876,NM_001206994,NM_001206996,NM_020416,NM_001206995	MSTRG.24150	58.59548077	1.436948216	4.17E-05	0.002364995
SNF8	NM_001317192	MSTRG.14384	1043.613276	1.443038714	4.18E-05	0.002364995
DDHD1	NM_001160148	MSTRG.9446	23.58184772	-2.066852659	4.20E-05	0.002372855
BMP6	NM_001718	MSTRG.27186	38.78875697	-1.938654481	4.27E-05	0.002404845
DGCR6L	NM_033257	MSTRG.21409	683.0529431	1.294981664	4.36E-05	0.002436464
NKX2-5	NM_001166176	MSTRG.26953	17.33974752	2.533971766	4.35E-05	0.002436464
TCEAL5	NM_001012979	MSTRG.33908	166.2895022	1.828968724	4.40E-05	0.002442924
NA	NA	MSTRG.12613	10.39371309	2.505963224	4.51E-05	0.002497818
NDUFS6	NM_004553	MSTRG.25443	1445.212405	1.410421708	4.53E-05	0.002504827
NT5C2	NM_001134373	MSTRG.4280	1094.887063	1.110314346	4.58E-05	0.002513635
PGP	NM_001042371, NM_182563	MSTRG.11733	501.2281279	1.620464064	4.58E-05	0.002513635
SMPD2	NM_003080	MSTRG.28253	116.0293121	0.871351681	4.70E-05	0.002531208

ZNF337	NM_001290261, NM_015655	MSTRG.20393	160.602312	-2.01979059	4.71E-05	0.002531208
EGF	NM_001178130	MSTRG.24885	149.8738646	-2.012031482	4.78E-05	0.002531208
POMZP3	NM_152992	MSTRG.29557	151.4476743	-0.888527822	4.75E-05	0.002531208
PDZD11	NM_016484	MSTRG.33659	675.7971483	1.39864942	4.77E-05	0.002531208
PIN1	NR_038422	MSTRG.16164	1520.558875	1.170807837	4.73E-05	0.002531208
FAIM2	NM_012306	MSTRG.7082	346.5047001	2.06497783	4.70E-05	0.002531208
LOC101928509	NR_125896	MSTRG.25309	9.01259999	2.466158858	4.68E-05	0.002531208
SEC31B	NM_015490,NM_001284367	MSTRG.4206	2481.639663	1.350645446	4.69E-05	0.002531208
GPBP1	NM_001203246, NM_001127235, NM_001127236	MSTRG.25794	2071.889199	-0.870772843	4.71E-05	0.002531208
ZHX2	NM_014943	MSTRG.31506	442.1561507	-1.474685189	4.76E-05	0.002531208
ABRACL	NM_021243	MSTRG.28499	674.4086659	1.185512391	4.73E-05	0.002531208
SMC2	NM_001042551, NM_001042550	MSTRG.32531	794.4877805	-1.367098437	4.84E-05	0.002536982
MAGI3	NM_001142782	MSTRG.1685	403.6046165	-1.43627908	4.82E-05	0.002536982
MDFIC	NM_199072,NM_001166346	MSTRG.29961	246.9125853	-1.096408196	4.81E-05	0.002536982
ATP6AP2	NM_005765	MSTRG.33392	3118.883406	1.289415684	4.97E-05	0.002590721
ADCK2	NM_052853,NM_004546	MSTRG.30233	1397.238419	1.428477348	5.01E-05	0.0026065
ETV1	NM_001163147, NM_001163152, NM_001163148, NR_120445	MSTRG.28961	351.7465784	-1.104512818	5.03E-05	0.002608618
PRCD	NM_001077620, NR_033357,NA	MSTRG.14888	23.72391324	2.000924282	5.12E-05	0.002621791
PUM1	NM_001020658, NR_003066,NR_004054	MSTRG.668	2259.502123	-0.945720871	5.11E-05	0.002621791
HMGB2	NM_002129,NM_001130689	MSTRG.25300	7189.584116	-1.175945658	5.10E-05	0.002621791
EPN3	NM_017957,NM_001258372	MSTRG.14442	372.0663515	-0.929649277	5.10E-05	0.002621791

GOT1	NM_002079	MSTRG.4176	1207.535648	1.305996158	5.16E-05	0.002627509
RAB32	NM_006834	MSTRG.28547	248.2841311	2.13305063	5.15E-05	0.002627509
JAG1	NM_000214,NR_106930	MSTRG.20246	4995.453907	-1.302734308	5.26E-05	0.002664596
CCDC191	NM_020817	MSTRG.23115	134.0779266	-1.803180632	5.27E-05	0.002664596
NA	NA	MSTRG.11352	116.3353547	-1.418211947	5.27E-05	0.002664596
PINK1	NM_032409,NR_106732	MSTRG.446	567.7865166	1.137353783	5.39E-05	0.002715841
NOC3L	NM_022451	MSTRG.4118	452.9607493	-0.927235571	5.52E-05	0.002751866
PCDHA1	NM_031410,NM_018900,NM_031495,NM_018905,NM_031496,NM_031497,NM_031500,NM_018906,NM_018907,NM_031501,NM_018908,NM_031848,NM_031849,NM_031852,NM_018910,NM_031856,NM_018911,NM_031857,NM_014005,NM_031859,NM_031860,NM_031861,NM_018902,NM_031864,NM_018903,NM_018904,NM_031865,NM_031882,NM_018898,NM_018899,NM_031883	MSTRG.26606	1288.001831	1.013753458	5.50E-05	0.002751866
RBBP7	NM_001198719,NM_002893	MSTRG.33260	3878.346813	1.070619318	5.52E-05	0.002751866
ZNF92	NM_001287532	MSTRG.29378	647.8562489	-0.817913057	5.60E-05	0.002770573
GCH1	NM_000161	MSTRG.9453	81.66522784	2.074290414	5.61E-05	0.002770573
NDUFS2	NM_004550,NM_001166159	MSTRG.2250	1955.035965	0.795969222	5.61E-05	0.002770573

GALE	NM_000403,NM_001008216,NM_001127621	MSTRG.520	465.3666422	1.282971477	5.75E-05	0.002826035
TBL1Y	NM_033284	MSTRG.34387	9.355557867	-2.387540296	5.80E-05	0.002842993
NA	NA	MSTRG.20417	9.344356926	2.314764887	5.88E-05	0.00287172
NAA16	NM_024561,NM_001110798	MSTRG.8486	461.5753403	-1.584179048	5.94E-05	0.002896259
KIF20B	NM_001284259	MSTRG.4071	615.4048095	-1.881654132	5.97E-05	0.002899821
NTAN1	NM_001270766	MSTRG.12016	745.2724191	0.966909172	6.02E-05	0.002919562
IGF2BP2	NM_001007225, NM_001291872, NR_049838	MSTRG.23853	2037.151881	-1.669250811	6.06E-05	0.002922705
LOC101929411	NR_135549,NM_175056	MSTRG.23035	27.51522675	2.508366115	6.06E-05	0.002922705
LRRIQ1	NM_001079910	MSTRG.7563	78.73430907	-1.923740413	6.10E-05	0.002931498
INTS9	NM_001172562, NM_018250	MSTRG.30746	457.6277077	0.740621008	6.13E-05	0.002931498
COPS6	NM_006833	MSTRG.29759	1870.016149	1.158894327	6.13E-05	0.002931498
TMEM14A	NM_014051	MSTRG.27882	514.271499	1.495375616	6.20E-05	0.002957235
TANC2	NM_025185	MSTRG.14638	535.9567335	-1.208088314	6.32E-05	0.003003579
QPCT	NM_012413	MSTRG.18075	60.42720868	2.271636118	6.53E-05	0.003095359
LZTFL1	NR_075080,NM_001276379	MSTRG.22520	674.1017314	-0.849230712	6.55E-05	0.003100429
AFTPH	NM_001002243	MSTRG.18361	705.8996113	-0.90999671	6.61E-05	0.003104301
NA	NA	MSTRG.7066	7574.183771	1.578757097	6.60E-05	0.003104301
UAP1L1	NM_207309	MSTRG.33002	268.6515368	2.097693343	6.61E-05	0.003104301
NA	NA	MSTRG.33065	427.0057311	1.191366263	6.67E-05	0.003122857
C7orf76	NM_001201450, NR_038948,NM_006304	MSTRG.29706	1741.662777	1.23407372	6.71E-05	0.003122857
MPC1	NM_001270879	MSTRG.28754	515.7266321	1.30419767	6.69E-05	0.003122857
MSL2	NM_018133	MSTRG.23385	891.04682	-	6.90E-05	0.003204

			98	0.657547046		524
POP4	NM_006627	MSTRG.16703	325.6007018	1.292175401	6.95E-05	0.003221196
ZNF800	NM_176814	MSTRG.30033	11.9800994	-1.994888449	6.98E-05	0.003225757
BCAS3	NM_001330413, NM_001320470	MSTRG.14593	586.6582614	0.79386621	7.12E-05	0.003280831
HLA-DMB	NM_002118,NM_006120	MSTRG.27605	44.56059251	2.078433105	7.14E-05	0.003280831
DFNA5	NM_001127454, NM_001127453	MSTRG.29045	393.2454166	1.014062434	7.18E-05	0.003289127
SPRY1	NM_001258038, NM_001258039, NM_005841	MSTRG.24995	259.9576387	-1.941229058	7.19E-05	0.003289127
ZNF710	NM_198526	MSTRG.11420	490.5403813	-1.438108396	7.25E-05	0.003305103
RASA4CP	NR_024116	MSTRG.29249	208.5557983	-1.260668331	7.41E-05	0.003359921
ACSS2	NM_001242393, NM_001076552	MSTRG.20511	613.3974515	0.880791965	7.52E-05	0.003402787
ATP13A2	NM_022089	MSTRG.408	1016.642578	0.991895233	7.54E-05	0.003404763
NUP43	NM_198887	MSTRG.28604	583.436658	-1.116291345	7.57E-05	0.003408314
KIAA1958	NM_001287036	MSTRG.32610	872.7454014	-1.41584739	7.63E-05	0.003416226
NAE1	NM_003905	MSTRG.12640	2068.829182	0.878252474	7.62E-05	0.003416226
PNISR	NM_001322413, NM_001322418	MSTRG.28158	1763.006892	-1.513050645	7.67E-05	0.003426149
RCAN1	NM_001285393, NM_001285392, NM_203417,NM_203418,NM_001331016,NM_001285389,NM_004414	MSTRG.21113	643.5613833	1.772642745	7.77E-05	0.003462187
MIEN1	NM_032339	MSTRG.14049	475.8597186	2.015867047	7.83E-05	0.003480039
YWHAH	NM_003405	MSTRG.21683	3895.282747	0.935637595	7.96E-05	0.003511445
BAZ2A	NM_001300905, NM_013449	MSTRG.7295	2116.060418	-1.369089914	7.95E-05	0.003511445
C21orf33	NM_004649,NM_001320384	MSTRG.21237	892.4666058	1.093473987	7.96E-05	0.003511445
DNAJC25	NM_001015882,	MSTRG.32589	1383.7844	1.31474908	8.13E-05	0.003569

	NM_004125,NM_001017998		38			265
NGLY1	NM_001145293, NM_001145294	MSTRG.22297	659.2291767	0.635071687	8.16E-05	0.003573924
NA	NA,NM_001303114,NM_032704	MSTRG.7068	19222.40917	1.342828581	8.37E-05	0.003650097
DAD1	NM_001344	MSTRG.8993	3032.875608	1.534281276	8.36E-05	0.003650097
NTMT1	NM_001286796, NM_001286797, NM_001286803, NM_001286799	MSTRG.32855	406.7750083	1.162431092	8.45E-05	0.003672825
NA	NA	MSTRG.32287	133.2880495	-2.470270244	8.57E-05	0.003718385
CDK5R2	NM_003936	MSTRG.19844	133.4077179	2.131103157	8.73E-05	0.0037491
ZC3H6	NM_198581	MSTRG.18868	248.5477178	-1.682885738	8.67E-05	0.0037491
MBD3	NM_001281453, NM_006830	MSTRG.15877	3511.435219	1.406296247	8.75E-05	0.0037491
CEP295	NM_033395,NR_002569	MSTRG.5948	337.5212547	-2.169460205	8.71E-05	0.0037491
PPM1H	NM_020700	MSTRG.7374	275.3933701	1.344320632	8.69E-05	0.0037491
DRAP1	NM_006442	MSTRG.5469	1329.334339	0.679100256	8.94E-05	0.003816892
ZNF626	NM_001076675	MSTRG.16608	13.28222903	2.430712384	8.95E-05	0.003816892
BCL7C	NM_001286526, NR_039744,NM_004765	MSTRG.12336	824.6685937	1.256838423	8.97E-05	0.003818446
MRPL52	NM_178336	MSTRG.9088	761.6731592	1.324268007	9.03E-05	0.003834144
STEAP1	NM_012449	MSTRG.29644	40.20815671	1.655351731	9.17E-05	0.003882582
JPX	NR_024582	MSTRG.33723	594.3723421	1.232338148	9.19E-05	0.003883477
NA	NA	MSTRG.15692	11.28194219	-2.046822048	9.22E-05	0.003886391
CTNS	NM_004937	MSTRG.13236	293.6543239	1.055283243	9.38E-05	0.003942624
ZNF610	NM_001161425, NM_173530	MSTRG.17438	104.08717	-1.651283698	9.43E-05	0.003954938
FUCA1	NM_000147	MSTRG.518	384.624451	1.598241945	9.46E-05	0.003954938
GADD45GI	NM_052850	MSTRG.16326	1535.2275	1.255654123	9.47E-05	0.003954

P1			95			938
MDH1	NM_001316374, NM_001199111	MSTRG.18341	4710.141799	1.200511992	9.58E-05	0.003990946
ZMPSTE24	NM_005857	MSTRG.869	967.526249	1.430332328	9.90E-05	0.004112371
MPDU1	NM_004870	MSTRG.13380	868.9602701	1.214160036	9.92E-05	0.004112371
MED27	NM_001253881, NM_001253882	MSTRG.32897	738.9799169	1.189451029	0.000100519	0.004139717
ABHD8	NM_024527	MSTRG.16454	363.735397	0.898375405	0.000100549	0.004139717
CLEC2L	NM_001080511	MSTRG.30209	15.70234476	2.399541917	0.000100337	0.004139717
NA	NA	MSTRG.1892	32.4760978	2.179680262	0.000101499	0.004169192
STS	NM_001320752, NR_039924,NM_000351	MSTRG.33186	170.9185572	1.659698318	0.000102792	0.004212593
PET100	NM_001171155, NM_001127396	MSTRG.16098	977.9930623	1.492997216	0.000103115	0.004216088
MYBL1	NM_001080416	MSTRG.31077	160.4976807	-1.867991765	0.000103515	0.004222727
NA	NA	MSTRG.29269	56.78280164	-2.111065666	0.000104411	0.004230194
SOS1	NM_005633	MSTRG.18115	47.60781888	-2.205008965	0.000104328	0.004230194
INIP	NM_021218	MSTRG.32614	544.1872849	-1.219382113	0.000104131	0.004230194
PARK7	NM_001123377	MSTRG.208	3013.583385	1.126352289	0.000104821	0.004237149
TSC22D3	NM_001015881, NM_004089,NM_001318470,NM_198057	MSTRG.33972	1443.696913	1.421964739	0.000105136	0.004240261
ZFR	NM_016107,NR_030305	MSTRG.25594	4149.959208	-0.879197707	0.000106229	0.004264995
NCDN	NM_001014839	MSTRG.764	757.1656092	0.880703387	0.000108086	0.004329786
DDX25	NM_013264,NM_001330438,NA	MSTRG.6289	169.996553	1.520776622	0.000108748	0.004346512
TTBK2	NM_173500	MSTRG.10581	696.6236279	-1.127720549	0.000110815	0.004419172
LAMTOR1	NM_017907	MSTRG.5642	1645.12331	1.575145874	0.000112478	0.004475466
S100A16	NM_001317007, NM_080388	MSTRG.2032	234.4255162	1.906957668	0.000113259	0.004496478

SLC35E4	NM_001001479, NM_001318370, NM_001318371	MSTRG.21647	94.8539608	1.057555703	0.000116456	0.004613092
TCN2	NM_000355	MSTRG.21655	525.1520493	1.411769857	0.000118105	0.004668023
GPBP1L1	NM_021639,NR_026768	MSTRG.1006	1342.540926	-1.062794794	0.000118661	0.004669263
GBAT2	NR_131972	MSTRG.2000	110.3951639	1.722074985	0.000118583	0.004669263
IPO7	NM_006391	MSTRG.4805	7049.823975	-0.820515607	0.000119225	0.004674104
CKMT1A	NM_001321927, NM_001321928	MSTRG.10602	107.2103751	1.895145612	0.00011931	0.004674104
LOC100130357	NR_134859,NM_001318809,NR_134872,NM_001242698,NM_001318805,NM_001318806	MSTRG.27225	610.0374413	1.016883682	0.000119663	0.004677622
NDUFA8	NM_014222	MSTRG.32685	889.6794708	1.306854535	0.000120079	0.0046836
POLDIP3	NM_001278657	MSTRG.21926	2901.687825	-0.604485858	0.000121373	0.004716907
NIT2	NM_020202	MSTRG.23011	474.5564861	1.212274536	0.000121463	0.004716907
NA	NA	MSTRG.5554	267.9423437	1.703808917	0.000122012	0.004727907
NA	NA	MSTRG.3670	8.297259234	-2.28025758	0.00012391	0.004770256
RFX3-AS1	NR_121586	MSTRG.31784	10.03255264	-2.012179012	0.000123786	0.004770256
NDUFB1	NM_004545	MSTRG.9906	790.2388464	1.266990405	0.00012343	0.004770256
ATP5G3	NM_001190329, NM_001002258	MSTRG.19356	4445.098513	1.179372285	0.000126291	0.004851426
SLC25A14	NM_001282197	MSTRG.34126	280.464659	1.39776585	0.000126573	0.004851766
ZDHHC16	NM_001287803	MSTRG.4167	517.1071189	1.439256599	0.000127412	0.00487345
RSRP1	NR_135143,NM_001321772,NR_135777,NR_135790	MSTRG.536	289.1174581	-1.705357983	0.000129016	0.004924212
SMDT1	NM_033318	MSTRG.21904	766.6445412	1.631804966	0.000130515	0.004970 74
DLD	NM_000108	MSTRG.29929	1797.9984	0.80135373	0.00013	0.005015

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CKMT1B	NR_135750,NR_135748	MSTRG.10599	120.3325522	1.889445603	0.000133667	0.005047544
NDUFS7	NM_024407	MSTRG.15859	1302.400185	0.999808539	0.000133594	0.005047544
SNORD136	NR_132757,NM_014366,NR_003687	MSTRG.22721	1233.075858	-0.946681011	0.000133207	0.005047544
LRRCC1	NM_033402	MSTRG.31229	437.8210546	-1.338999206	0.000135547	0.005107708
YARS	NM_003680	MSTRG.718	3088.553134	1.162530972	0.000136729	0.005120956
FAM49A	NM_030797	MSTRG.17842	802.6626649	1.71102396	0.000136458	0.005120956
ALKBH3	NM_139178,NR_026952	MSTRG.5115	352.5795664	1.288786998	0.000136762	0.005120956
NA	NA,NM_022782	MSTRG.8102	524.6482546	-1.623685669	0.000137344	0.005131922
NA	NA	MSTRG.20489	20.95540089	-2.04952715	0.000137869	0.005140735
SP3	NM_003111,NM_001017371	MSTRG.19334	1383.585785	-0.770995708	0.000140087	0.005212518
LARP6	NM_001286679,NM_018357,NM_197958	MSTRG.11052	425.3040511	0.851581462	0.000141521	0.005243949
HAGH	NM_001040427	MSTRG.11689	666.2723896	1.109187278	0.000141445	0.005243949
NA	NA	MSTRG.17470	426.4751111	1.130078096	0.000142638	0.005274346
NAGK	NM_017567	MSTRG.18457	441.6925138	1.262522999	0.000144096	0.005296302
PQLC2	NM_001040125,NR_109848	MSTRG.428	274.2578713	0.995019596	0.000144055	0.005296302
BLOC1S4	NM_018366	MSTRG.24156	418.8714863	0.870592685	0.000144125	0.005296302
DAAM1	NM_001270520,NM_014992	MSTRG.9520	1913.927708	-1.347209669	0.000144473	0.005298122
RAB32	NM_006834	MSTRG.28548	28.86062849	1.633643194	0.000147934	0.005403984
NA	NA	MSTRG.2387	10.87800533	-2.228926395	0.000147967	0.005403984
UBA3	NM_003968	MSTRG.22881	1167.159334	0.859560629	0.000149437	0.005446471
FAM229A	NM_001167676,NM_001143888	MSTRG.710	1307.868339	-1.151678034	0.000150102	0.005448625
SSBP1	NM_001256511,	MSTRG.30245	2010.2482	1.202865091	0.00015	0.005448

	NM_016943,NM_001256510,NA		4		0108	625
RB1CC1	NM_014781	MSTRG.30957	1289.075314	-1.342353627	0.000150646	0.005457012
ZSWIM6	NM_020928	MSTRG.25823	1327.670562	-0.929702512	0.000152797	0.005512459
TST	NM_003312,NM_001270483	MSTRG.21743	258.9312193	1.200525629	0.00015271	0.005512459
SYT3	NM_032298,NM_001160328	MSTRG.17380	112.1763539	1.989799463	0.000153233	0.005516999
RASA3	NM_001320821,NM_001320822	MSTRG.8923	875.3427081	-1.032558856	0.000154239	0.005533731
PAICS	NM_006452,NM_001079524	MSTRG.24481	6129.712822	-0.68216828	0.00015432	0.005533731
SCART1	NR_002934	MSTRG.4545	18.2820369	-2.212390241	0.000158249	0.005659234
GPALPP1	NM_018559,NM_001316952,NM_001316951	MSTRG.8528	518.3298578	-1.021720507	0.000158728	0.005659234
MCAM	NM_006500,NR_106814	MSTRG.6205	357.8120551	-1.579996198	0.000158774	0.005659234
PTGES	NM_004878	MSTRG.32854	192.1121796	1.871971377	0.000159185	0.005662525
ZNF737	NM_001159293,NM_001076675,NM_145297	MSTRG.16603	215.8737843	1.31245105	0.000159692	0.005669217
PIP5KL1	NM_001135219,NM_173492	MSTRG.32788	44.46506777	1.505150579	0.000163113	0.005779134
DGAT2	NM_001253891	MSTRG.5748	56.63949991	1.938405942	0.000165404	0.005848662
PHB	NM_001281496,NM_001281497	MSTRG.14397	2444.265688	1.045341348	0.000166872	0.005865585
NSD3	NM_023034,NM_017778	MSTRG.30851	1906.203945	-1.303091429	0.00016627	0.005865585
MON1A	NM_032355	MSTRG.22633	269.5920876	1.028820741	0.000166813	0.005865585
LIN54	NM_001115008,NM_001115007	MSTRG.24668	300.2442879	-1.025360691	0.00016819	0.005900259
KCNN3	NM_001204087,NM_170782	MSTRG.2081	261.5940849	-1.869483534	0.000168927	0.005902817
JADE1	NM_001287437,NM_024900,NM_001287439,NM_001287442,NM_001287441,NM_001287443	MSTRG.25029	600.3788142	-1.453075876	0.000168767	0.005902817

DNAJC15	NM_013238	MSTRG.8500	205.3872698	1.986977247	0.000170724	0.005942258
NA	NA	MSTRG.9223	14.4729805	1.833919303	0.000170528	0.005942258
DYRK4	NR_104115,NA,NM_003845,NM_001282285,NM_005002,NM_017417,NM_002235	MSTRG.6474	1767.741248	1.195098179	0.00017284	0.006004149
DDHD1	NM_001160148	MSTRG.9445	15.37537352	-2.077369974	0.000173329	0.006009398
EPHX4	NM_173567	MSTRG.1451	49.87279396	1.629615826	0.00017573	0.006080814
CIR1	NM_004882	MSTRG.19344	595.3057355	-1.202245572	0.000177378	0.006114034
SLC8A2	NM_015063	MSTRG.17229	162.3549605	1.893664037	0.000177778	0.006115974
TNNI1	NM_003281	MSTRG.2616	76.35800534	1.771340912	0.000181683	0.006178614
ETFA	NM_001127716,NR_028510	MSTRG.11186	1859.538594	0.917208793	0.000181304	0.006178614
RASGRF1	NM_001145648,NM_153815	ENSG00000058335	27.1026919	2.33325939	0.000180522	0.006178614
CYP4X1	NM_178033	MSTRG.1032	15.69197823	2.219789562	0.000181602	0.006178614
DHRS4	NM_001282987,NM_001193636,NM_001193635,NM_198083	MSTRG.9125	237.1449351	1.202780566	0.000180605	0.006178614
NA	NA	MSTRG.17572	9.513799585	-2.283439274	0.000180954	0.006178614
LOC102724532	NR_135480	MSTRG.14338	116.8773449	1.62098724	0.000182648	0.006199571
IPO5	NM_002271	MSTRG.8771	8965.57352	-1.017333121	0.000184703	0.006249414
TMEM117	NM_001286211	MSTRG.6963	244.664254	1.431744382	0.000184819	0.006249414
CLOCK	NM_001267843,NM_004898	MSTRG.24463	355.756884	-1.31009144	0.000186398	0.006279101
PTK2	NM_001199649,NR_029892	MSTRG.31645	3271.154998	-0.793941336	0.000186403	0.006279101
NA	NA	MSTRG.11295	91.87973434	-1.777693396	0.000187011	0.006287675
PSMB3	NM_002795	MSTRG.14021	2189.135395	1.205362871	0.000188115	0.006291867

C4orf48	NM_001168243, NM_001141936	MSTRG.24096	1185.851119	1.762455646	0.000188526	0.006291867
NDUFA12	NM_001258338, NA	MSTRG.7639	1583.377886	1.427949945	0.000188866	0.006291867
BLOC1S1	NM_001487,NR_037658,NR_037657,NM_001199771	MSTRG.7240	1078.484235	1.46368057	0.000188905	0.006291867
MIPEP	NM_005932	MSTRG.8317	319.0154992	0.908472889	0.000188163	0.006291867
MFSD12	NM_001287529, NA	MSTRG.15961	479.673594	0.77402448	0.000190698	0.006336733
LOC389765	NR_029410	MSTRG.32317	131.9500718	-1.485293394	0.000190964	0.006336733
NA	NA	MSTRG.8818	14.45665689	2.065609481	0.000192374	0.006371641
COPS9	NM_138336,NM_001163424	MSTRG.20058	1027.841744	1.69536433	0.000193113	0.00638422
FAAH	NM_001441	MSTRG.1026	63.26421635	1.728065685	0.000195195	0.006441078
S100B	NM_006272	MSTRG.21304	185.8776832	2.178340608	0.000196224	0.006463035
CACFD1	NM_001242370	MSTRG.32933	813.3966982	1.127906001	0.000200746	0.006599747
LOC101927045	NR_110032	MSTRG.9143	29.8788759	-1.517275701	0.000202907	0.006658493
DNPEP	NM_001319121, NM_001319117, NM_001319118	MSTRG.19867	641.8300698	0.968268657	0.000203707	0.006672421
VPS26B	NM_052875	MSTRG.6380	1197.109171	0.885677603	0.000204819	0.006696539
BTBD8	NM_183242,NM_015237	MSTRG.1452	186.7116439	-1.396362997	0.000205604	0.006709845
NA	NA	MSTRG.33833	60.62046169	-1.145397542	0.000207109	0.006746596
WASF3	NM_006646	MSTRG.8352	2576.157268	-1.185367609	0.000207987	0.006762799
SMAD2	NM_005901	MSTRG.15535	31.07176973	1.51954411	0.000208898	0.00677566
NTS	NM_006183	MSTRG.7577	47.15213959	2.012168717	0.000209144	0.00677566
TXNDC17	NM_032731	MSTRG.13326	701.9824531	1.430353338	0.000210292	0.006800469
WDSUB1	NM_001128212, NM_152528,NM_001128213	MSTRG.19194	178.4168905	0.699449904	0.000212114	0.006822173

MIR7113	NR_106963,NM_002496,NR_039840	MSTRG.5569	1897.085621	0.947615665	0.000211765	0.006822173
H2AFZ	NM_002106	MSTRG.24782	6048.725526	1.384855048	0.000214401	0.006870869
MRPS25	NR_135246,NM_022497	MSTRG.22204	617.5170086	1.170308204	0.000214351	0.006870869
NA	NA	MSTRG.27923	404.3346267	0.773698066	0.000215848	0.006904807
WAC	NM_100264,NM_016628	MSTRG.3466	2129.881686	-1.035905847	0.000217426	0.006932036
SLC17A8	NM_001145288	MSTRG.7706	44.95622914	-2.345543795	0.000217479	0.006932036
NA	NA	MSTRG.8264	157.1012251	1.072359772	0.000220378	0.007011884
SLC35B1	NM_001278784	MSTRG.14413	993.0380941	1.219711661	0.000220885	0.00701545
YAE1D1	NM_020192,NM_001282446	MSTRG.29206	242.9003557	1.806629662	0.000221416	0.007019793
TMEM266	NM_152335	MSTRG.11184	22.28439137	1.564449047	0.000222602	0.007044837
TRMT61B	NM_017910	MSTRG.18005	354.6133421	1.227536117	0.000223193	0.007046775
HIGD1A	NM_001099668	MSTRG.22464	103.0606724	0.929859077	0.000223456	0.007046775
CENPC	NM_001812	MSTRG.24520	415.7235584	-1.844912875	0.000224494	0.007068511
CEP44	NM_001040157,NM_001145314	MSTRG.25313	355.4062997	-1.067705874	0.000224778	0.007068511
THUMPD1	NM_001304550	MSTRG.12109	1158.263827	-0.888039916	0.000227693	0.007142424
SCO2	NM_005138,NM_001169110,NM_001169109,NM_001113755,NM_001014440	MSTRG.22034	83.04273648	1.648226463	0.000228624	0.007159001
NA	NA,NM_013280	MSTRG.5373	116.3413025	-1.484309347	0.00022939	0.007170355
CWF19L2	NM_152434	MSTRG.6029	389.398959	-1.212290838	0.000234029	0.007276799
PTPN12	NM_002835,NM_001131008	MSTRG.29576	1594.376531	-1.085629864	0.000234432	0.007276799
ZC3HC1	NM_001282190	MSTRG.30100	590.7574456	0.857241062	0.000233896	0.007276799
CRABP1	NM_004378	MSTRG.11221	17795.16817	1.51829565	0.000233464	0.007276799

MIR6769B	NR_106919,NM_001193321	MSTRG.2738	50.88707946	1.758588523	0.000237232	0.007350884
PPP1CA	NM_206873	MSTRG.5538	2216.942773	1.112557976	0.00023843	0.007375155
NPY	NM_000905	MSTRG.29041	12.79320971	-2.168960787	0.000239116	0.007383541
PKIB	NM_001270394,NM_181795,NM_001270395	MSTRG.28374	597.0666173	1.576176321	0.00024 0039	0.007399181
SYNPR	NM_001130003,NM_144642	MSTRG.22825	69.58209581	2.049662265	0.00024 0736	0.007407853
KANSL1	NM_001193466,NM_015443,NM_001193465	MSTRG.14294	1210.10463	-1.184613161	0.00024 1163	0.007408148
ACTR10	NM_018477	MSTRG.9504	1438.865908	1.0053955	0.00024 2266	0.007425006
SEC24B	NM_001042734	MSTRG.24874	1085.748873	-1.082816822	0.00024 2546	0.007425006
MPHOSPH10	NM_005791	MSTRG.18444	750.8130792	-1.26237018	0.00024 3593	0.007444239
ANAPC11	NM_001289414,NM_001002249,NM_001002244,NM_148896	MSTRG.15043	1337.587051	1.299175573	0.00024 4229	0.007450857
ZSCAN23	NM_001012455,NA	MSTRG.27412	553.1657643	-1.255108613	0.00024 5214	0.007468097
UFD1L	NM_005659	MSTRG.21389	1091.100319	1.254655544	0.00024 6438	0.007479761
LY6H	NM_002347,NM_001135655,NM_001130478	MSTRG.31641	477.3269086	1.992676648	0.00024 6259	0.007479761
RNASEH2A	NM_006397	MSTRG.16312	1122.049527	1.087042689	0.00024 6873	0.00748022
RNF44	NM_014901	MSTRG.26984	1291.771087	-1.230497043	0.00024 9331	0.007541843
RBM39	NM_001242599,NR_136587	MSTRG.20546	3589.997838	-0.802818208	0.00025 1942	0.007601976
NETO1	NM_001201465,NM_138966,NM_138999,NA	MSTRG.15712	73.51701402	-1.629297908	0.00025 2174	0.007601976
NA	NA	MSTRG.16201	108.4523892	1.422016224	0.00025 4982	0.007666861
ARFGEF1	NM_006421	MSTRG.31100	1053.102389	-0.937117231	0.00025 5188	0.007666861
SETD6	NM_001160305	MSTRG.12600	123.5462288	-1.933217943	0.00025 6312	0.007687626

ZNF71	NM_021216	MSTRG.17612	193.0360443	2.204033657	0.000258229	0.007732089
TIAM1	NM_003253	MSTRG.21058	804.1263681	-1.467944737	0.000262082	0.007834263
MOSPD3	NM_001040097, NM_001040098, NM_023948	MSTRG.29789	410.7320286	0.820816761	0.000264114	0.007881775
GLRX2	NM_197962,NM_016066	MSTRG.2557	83.00747243	1.644021808	0.000265067	0.007896957
LRP3	NM_002333	MSTRG.16740	1340.885244	0.976005666	0.000268741	0.007968376
LOC102723360	NM_001322975	MSTRG.20908	88.35815616	2.175321906	0.000268808	0.007968376
NA	NA	MSTRG.16697	79.32325995	-1.683561632	0.000268334	0.007968376
CREBZF	NR_028024	MSTRG.5862	601.9579944	-1.583606648	0.000269872	0.007986601
CLK1	NM_004071,NM_001162407	MSTRG.19601	1037.865539	-1.482429074	0.000271895	0.008033102
ARMT1	NM_001286562	MSTRG.28638	770.9662134	0.70563897	0.000272663	0.008042416
ELOB	NM_007108	MSTRG.11781	2931.705675	1.335527962	0.000273554	0.00805535
UBL7	NM_001286739	MSTRG.11118	1051.418918	0.891291992	0.000275528	0.008100067
ZNF626	NM_001076675	MSTRG.16609	48.73461532	1.626091918	0.000278312	0.008168397
AGAP12P	NR_029396	ENSG00000265018	24.02104381	-1.85955519	0.000280124	0.008199649
ITPA	NR_052000,NM_001267623,NM_001324240	MSTRG.20164	594.4616341	0.93793675	0.000280298	0.008199649
SLC22A5	NM_001308122	MSTRG.26438	58.11284532	1.391692481	0.000281317	0.008215948
SOD1	NM_000454	MSTRG.21061	3576.434217	1.396224408	0.00028241	0.008231264
PTCH2	NM_001166292, NM_003738	MSTRG.979	56.53905171	-2.106173813	0.000282767	0.008231264
IL17D	NM_138284	MSTRG.8265	136.1066826	1.088850646	0.00028349	0.008238824
INF2	NM_022489,NM_032714	MSTRG.10127	586.3299887	-1.433791095	0.000284182	0.00824546
CAPN1	NM_001198868, NM_001198869, NR_040008	MSTRG.5432	1351.410208	0.992379714	0.00028588	0.00826775

RPS18P9	NR_077247	MSTRG.28580	17.68369345	-1.938848196	0.000285443	0.00826775
CDC14A	NM_001319211,NM_033313,NM_001319212,NM_001319210	MSTRG.1547	219.2459424	-1.341731653	0.000289838	0.008368616
DNAJC21	NM_001012339	MSTRG.25628	601.7939312	-1.230354624	0.000291425	0.008400782
NANS	NM_018946	MSTRG.32487	423.4887152	1.433049992	0.000293304	0.008441263
RSBN1L	NM_198467	MSTRG.29578	476.991226	-0.796417599	0.000295275	0.008463386
PHF3	NM_001290259,NM_001290260,NM_015153,NA	MSTRG.27934	1213.982041	-1.640277874	0.00029455	0.008463386
CYB5R4	NM_016230	MSTRG.28068	388.4481848	1.078196642	0.000294998	0.008463386
NEU3	NM_006656	MSTRG.5716	214.5045456	-2.019579508	0.000296609	0.008481485
EIF5AL1	NM_001099692	MSTRG.3967	701.1104891	1.070120715	0.000298331	0.008503396
DIRC2	NM_032839	MSTRG.23206	435.308677	1.088227007	0.000298158	0.008503396
CMKLR1	NM_001142345,NM_004072	ENSG00000174600	16.54100211	-2.311537742	0.000302643	0.008612507
ZNF184	NM_001318893,NM_001318892	MSTRG.27374	188.7716719	-1.834356508	0.000303552	0.008624548
NPL	NM_001200051	MSTRG.2498	49.33982008	1.417897732	0.000308981	0.008764801
BEX1	NM_018476	MSTRG.33891	2537.033101	1.390053421	0.000309864	0.008775856
POMP	NM_015932	MSTRG.8381	2766.266445	1.405593114	0.000310598	0.008782651
JAG2	NM_145159,NR_106823,NM_177533,NM_001318380	MSTRG.10154	595.8503908	1.281928505	0.000311137	0.008783937
ATP6V0D1	NM_004691	MSTRG.12663	2241.655429	1.50085125	0.000317339	0.00887442
PTPN5	NM_001039970,NM_001278236	MSTRG.4928	199.8310169	1.6849094	0.000317026	0.00887442
SSNA1	NM_003731	MSTRG.33015	833.5326049	1.171788732	0.000315788	0.00887442
SLC6A17	NM_001010898	MSTRG.1619	68.80716567	2.219805541	0.000317835	0.00887442
DYRK3	NM_001004023	MSTRG.2749	130.58920	2.20843419	0.00031	0.008874

			48		6497	42
USMG5	NM_001206426, NR_031707	MSTRG.4290	2395.628837	1.365881939	0.000317035	0.00887442
CYB5R1	NM_016243	MSTRG.2665	568.5355131	1.716375415	0.000315098	0.00887442
TOGARAM1	NR_131765	MSTRG.9344	384.7938346	-1.310479313	0.000319872	0.008917308
NA	NA	MSTRG.16516	47.52175478	-1.683401357	0.0003211	0.008923417
VCP	NM_007126	MSTRG.32037	7722.335807	0.69615945	0.000320811	0.008923417
LARP7	NM_001267039, NM_015454	MSTRG.24908	868.1355243	-1.109909784	0.000321596	0.008923417
ANKMY1	NM_001282771, NM_001308375	MSTRG.20064	70.88468648	-1.307002299	0.00032365	0.008966417
GSTZ1	NM_001312660	MSTRG.9801	461.5454515	1.236446266	0.000327754	0.009066
TBCB	NM_001281,NM_001300971	MSTRG.16827	2521.099555	1.117283436	0.000328911	0.009083873
ADCYAP1	NM_001099733, NM_001117	MSTRG.15129	19.01836507	1.652030152	0.000330777	0.009121235
XPO1	NM_003400	MSTRG.18328	6485.372134	-1.139190714	0.000334544	0.009210843
NA	NA,NM_018713	MSTRG.2862	69.401865	1.853286677	0.000339217	0.009302402
TCFL5	NM_006602,NM_001301726	MSTRG.20826	416.3947275	-0.955642434	0.000339439	0.009302402
B2M	NM_004048	MSTRG.10624	2762.880959	1.695881195	0.000345272	0.009447707
PCF11	NM_001346415	MSTRG.5834	851.911947	-1.099222955	0.000346941	0.009478793
BAZ2B	NM_001289975, NM_001329858, NR_110586	MSTRG.19206	1017.705089	-1.530864707	0.000349485	0.009533652
FIG4	NM_014845	MSTRG.28257	914.6761107	0.854772899	0.000352102	0.009546472
CCDC186	NM_018017,NM_153249,NR_031747	MSTRG.4365	283.6615455	-1.371456069	0.000350527	0.009546472
RITA1	NM_001286215	MSTRG.7919	352.9425079	1.170867689	0.000351348	0.009546472
UQCC2	NM_032340	MSTRG.27637	1108.793465	1.123557033	0.000352091	0.009546472
LINC00698	NR_027104,NA	MSTRG.22822	20.0169085	2.198700053	0.000353327	0.009565098
COQ8A	NM_020247,NA	MSTRG.2949	432.80607	-1.34230984	0.00035	0.009625

			34		6104	632
ASAH1	NM_177924,NM_001127505	MSTRG.30626	2545.529107	1.483146167	0.000356854	0.009631254
MTF1	NM_005955	MSTRG.816	312.0390104	-1.323180005	0.00035908	0.009676663
ZNF254	NM_001278661, NM_001278662, NM_001278665	MSTRG.16678	842.8822231	-0.802094432	0.000360454	0.009688017
SYNE4	NM_001039876, NM_001297701, NM_198867	MSTRG.16818	214.650589	0.929827232	0.000360591	0.009688017
ECHS1	NM_004092	MSTRG.4535	2510.838928	1.135032821	0.000361257	0.009691275
METRN	NM_024042	MSTRG.11636	1124.281262	1.228378487	0.000362748	0.009716624
MFSD13A	NM_024789	MSTRG.4252	128.4662251	0.959614167	0.000364996	0.009762129
NA	NA,NM_003348	MSTRG.7625	3110.638729	1.068250825	0.000365591	0.009763366
POLR2L	NM_021128	MSTRG.4611	1321.539287	1.244998179	0.000367581	0.009771787
TTC3P1	NR_030737	MSTRG.33758	328.0164701	-1.412586405	0.000368653	0.009771787
NA	NA	MSTRG.34398	30.07158652	1.643586129	0.000368108	0.009771787
PMS2CL	NR_002217,NA	MSTRG.28915	418.6632889	-1.271689827	0.00036844	0.009771787
NOTCH1	NM_017617	MSTRG.32974	3110.073577	-1.616506607	0.000366921	0.009771787
GLRX3	NM_001321980, NM_001199868	MSTRG.4512	2249.569495	0.960348962	0.000369229	0.009772476
NA	NA	MSTRG.14161	8.364530674	-2.036294414	0.00037279	0.009850364
WEE1	NM_003390,NM_001143976	MSTRG.4808	694.9843542	-1.141986927	0.000373279	0.009850364
MTERF2	NM_025198	MSTRG.7799	251.375979	1.31580186	0.000376072	0.009909354