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Prolactin Drives a Dynamic STAT5A/HDAC6/HMGN2 Cis-Regulatory Landscape Exploitable in ER+ Breast Cancer

Justin M. Craig
Virginia Commonwealth University

PROLACTIN DRIVES A DYNAMIC STAT5A/HDAC6/HMGN2 *CIS*-REGULATORY LANDSCAPE EXPLOITABLE IN ER$^+$ BREAST CANCER

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

By

JUSTIN M. CRAIG

A.B., Psychology

Harvard University, 2007

Committee Chair: Charles V. Clevenger, M.D., Ph.D.,

Chair, Department of Pathology

Virginia Commonwealth University

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ABBREVIATIONS

AF-2	activation function 2
AP-1	activator protein 1
ATCC	American Type Culture Collection
ATF	activating transcription factor
CASAS1	casein alpha S1
CASAS2	casein alpha S2
CASB	casein beta
CASK	casein kappa
CCND1	cyclin D1
CERM	conditional ERα in mammary epithelium
ChIA-PET	Chromatin Interaction Analysis with Paired-End Tag
ChIP	chromatin immunoprecipitation
CHUD	chromatin regulatory domain
CISH	cytokine inducible SH2 containing protein
co-IP	co-immunoprecipitation
CPM	counts per million
CRE	*cis*-regulatory element
CREB	cAMP responsive element binding protein
CTCF	CCCTC-binding factor
DCIS	ductal carcinoma *in situ*
dELS	distal enhancer-like signature

DMEM	Dulbecco's modified Eagles' medium
DMSO	dimethyl sulfoxide
DNA	deoxyribonucleic acid
DNase	deoxyribonuclease
ECD	extracellular domain
ELF	E74-like ETS transcription factor
ELK	ETS-like transcription factor
ENCODE	Encyclopedia of DNA Elements
ER	estrogen receptor alpha
ERα	estrogen receptor alpha
ESR1	estrogen receptor alpha
ESR2	estrogen receptor beta
ETS	ETS proto-oncogene transcription factor
FBS	fetal bovine serum
FLI	friend leukemia integration 1 transcription factor
FOS	Fos proto-oncogene AP-1 transcription factor subunit
FOXA1	forkhead box A1
GAS	gamma interferon activated sequence
GFP	green fluorescent protein
GH	growth hormone
GR	glucocorticoid receptor
H&E	hematoxylin and eosin

H1	linker histone H1
H3K27ac	acetylated lysine 27 of histone 3
H3K4me3	trimethylated lysine 4 of histone 3
HDAC6	histone deacetylase 6
HER2	human epidermal growth factor receptor 2
Hi-C	chromosome conformation capture (3C) variant
HMGN2	high mobility group nucleosome binding domain 2
Hsp90	heat shock protein 90
IACUC	Institutional Animal Care and Use Committee
ICD	intracellular domain
IP	intraperitoneal
IPA	Ingenuity Pathway Analysis
JAK2	Janus kinase 2
JDP	Jun dimerization protein
JUN	Jun proto-oncogene, AP-1 transcription factor subunit
K	lysine
kDa	kiloDalton
kg	kilogram
KLF	Kruppel-like factor
KO	knockout
LALBA	alpha-lactalbumin
LGB	beta-lactoglobulin

Luc	luciferin
MAPK	mitogen-activated protein kinase
METABRIC	Molecular Taxonomy of Breast Cancer International Consortium
mg	milligram
mL	milliliter
mm	millimeter
MMTV-PyMT	murine mammary tumor virus – polyoma middle T antigen
mRNA	messenger ribonucleic acid
MTT	tetrazolium bromide
NBD	nucleosome binding domain
NES	nuclear export signal
ng	nanogram
NLS	nuclear localization signal
NR	nuclear receptor
NSG	non-obese diabetic severe combined immunodeficient gamma
OR	odds ratio
PBS	phosphate buffered saline
PCA	phenol: chloroform: isoamyl alcohol
PDX	patient-derived xenograft
pELS	proximal enhancer-like signature
PGR	progesterone receptor
PI3K	phosphatidylinositol 3-kinase

PLS	promoter-like signature
PR	progesterone receptor
PRL	prolactin
PRLr	prolactin receptor
pSTAT5A	phosphorylated STAT5A
PVP	polyvinylpyrrolidone
Q	glutamine
R	arginine
RIN	RNA Integrity Number
RNA	ribonucleic acid
SH2	Src homology domain 2
STAT5A	signal transducer and activator of transcription 5A
TCGA	The Cancer Genome Atlas
TFAP2A	transcription factor AP-2 alpha
TMD	transmembrane domain
TSS	transcription start site
TTS	transcription termination site
uM	micromolar
VCU	Virginia Commonwealth University
WAP	whey acidic protein
Y	tyrosine

ABSTRACT

The hormone, prolactin, has been implicated in breast cancer pathogenesis and regulates chromatin engagement by the transcription factor, STAT5A. STAT5A is known to inducibly bind promoters and *cis*-regulatory elements genome wide, though the mechanisms by which it exerts specificity and regulation of target gene expression remain enigmatic. We previously identified HDAC6 and HMGN2 as cofactors that facilitate prolactin induced, STAT5A mediated gene expression. Here, multi-condition STAT5A, HDAC6, and HMGN2 ChIP-seq with parallel condition RNA-seq are utilized to reveal the *cis*-regulatory landscape and cofactor dynamics underlying prolactin stimulated gene expression in breast cancer. We find that prolactin regulated genes are significantly enriched for *cis*-regulatory elements bound by HDAC6 and HMGN2, and that inducible STAT5A binding at enhancers, rather than promoters, conveys specificity for prolactin regulated genes. The selective HDAC6 inhibitor, ACY-241, blocks prolactin induced STAT5A chromatin engagement at *cis*-regulatory elements as well as a significant proportion of prolactin stimulated gene expression. We identify functional pathways known to contribute to the development and/or progression of breast cancer that are activated by prolactin and inhibited by ACY-241. Additionally, we find that the DNA sequences underlying shared STAT5A and HDAC6 binding-sites at enhancers are differentially enriched for estrogen response elements (ESR1 and ESR2 motifs) relative to enhancers bound by STAT5A alone. Gene set enrichment analysis identifies significant overlap of ERα regulated genes with genes regulated by prolactin, particularly prolactin regulated genes with

promoters or enhancers co-occupied by both STAT5A and HDAC6. Lastly, the therapeutic efficacy of ACY-241 is demonstrated in *in vitro* and *in vivo* breast cancer models, where we identify synergistic ACY-241 drug combinations and observe differential sensitivity of ER^+ models relative to ER^- models.

Chapter 1: INTRODUCTION

1.1 Prolactin (PRL) and the Prolactin Receptor (PRLr)

1.1.1 PRL and PRLr Structure, Function, and Regulation

The 23 kDa peptide hormone, prolactin (PRL), is named for its essential role in promoting lactation in mammals and was first isolated and identified in humans from pituitary gland extracts [1, 2]. While PRL is still best known as a neuroendocrine hormone product of the anterior pituitary, it is also produced locally by cells in various tissues, including breast epithelial cells, and acts via autocrine and paracrine routes at these sites[3-5]. As a protein hormone, PRL engages its cognate receptor, the 90 kDa prolactin receptor (PRLr), at the cell surface. The PRLr is a member of the type I cytokine receptor superfamily (membership also shared by erythropoietin, growth hormone, and interleukin receptors) which lack any intrinsic kinase ability. While at least 7 PRLr isoforms have been identified (resulting from alternative splicing or proteolysis), the full length PRLr consists generally of an extracellular domain (ECD), transmembrane domain (TMD), and intracellular domain (ICD). Residues in the ECD and TMD enable pre-dimerization of the PRLr in the absence of ligand[6]. Binding of PRL to subdomains within the PRLr ECD triggers a conformational change in the ICD (requiring the prolyl isomerase, Cyclophilin A)[7-9] and autophosphorylation of ICD associated JAK2 kinases[10]. JAK2 goes on to phosphorylate the PRLr at specific tyrosine residues, including Y509 and Y587, which enable the docking and subsequent phosphorylation of STAT5[11, 12]. Ultimately ligand stimulation of the PRLr initiates a signaling cascade that activates multiple

pathways, including the JAK2/STAT5, MAPK, and PI3K pathways [13], which promote cell proliferation and differentiation in the normal mammary gland. It should be noted that the scope of this text and the work described herein are limited to the study of the STAT5 pathway, a major, but not exclusive, PRL effector pathway. Murine knockout studies of PRL or the PRLr demonstrated that PRL signaling is critical for normal mammary gland development, with loss of signaling leading to impaired lobular budding, ductal branching, and lactation[14-16]. At the level of gene expression, PRLr and STAT5 activation induce pro-proliferative genes (e.g. Cyclin D1[17]) as well as milk protein genes indicative of a differentiated phenotype (e.g. ß-casein).

The neuroendocrine production of PRL in the lactotrophs of the anterior pituitary is primarily regulated by dopamine levels; less is known about the physiological regulation of extrapituitary PRL synthesis, save that production is not responsive to dopamine[18]. At the cellular level, PRL signaling is regulated by complex feedback mechanisms involving the estrogen and progesterone steroid hormone receptors; estrogen, for example, stimulates PRL expression via sequence specific binding at estrogen response elements near the PRL gene promoter [19]. Though not a focus of the studies presented here, post-translational modifications of the PRLr have also been described, including phosphorylation[20-22], glycosylation [23, 24], acetylation[25], and ubiquitination[26].

1.1.2 PRL Signaling in Breast Cancer

A critical mass of evidence implicates PRL in the pathogenesis of breast cancer. Among these findings, overexpression of PRL in the mammary epithelium of transgenic mice induces the spontaneous development of mammary tumors[27]; conversely, in the MMTV-PyMT (murine mammary tumor virus – polyoma middle T antigen) mouse model of breast cancer progression, tumor growth is impaired in PRL deficient mice relative to PRL expressing mice[15]. In human breast cancer biopsies, expression of PRLr mRNA was found to be increased relative to adjacent normal tissues[28]. Furthermore, elevated serum PRL concentrations convey significantly increased risk for breast cancer [29-31] and, among patients with established breast carcinoma, PRL levels correlate with metastatic progression [32]. In breast cancer cell models, *in vitro* studies indicate that PRL promotes the growth and proliferation of breast cancer cells by acting as a mitogen and survival factor [33-38]. PRLr expression also enhances the expression and function of other clinically relevant hormone receptors (e.g. estrogen receptor (ER) and progesterone receptor (PR)) [39-41]. Taken together, the evidence demonstrates a significant role for PRL in breast cancer biology and – given its expression in up to 98% of human breast carcinomas [42] – points to PRLr signaling as a promising target for therapeutic intervention.

1.2 Signal Transducer and Activator of Transcription 5A (STAT5A)

1.2.1 STAT5A Structure, Function, and Regulation

STAT5A is a 91 kDa transcription factor with multiple domains critical for its function and relevant to this study including a DNA binding domain (which mediates DNA sequence specificity for the GAS element [gamma-interferon activated sequence][43, 44]), a transactivation domain (necessary for regulation of target gene transcription[45]), an SH2 domain (which mediates dimerization[46]), and a coiled-coil domain (which mediates cofactor protein-protein interactions[47, 48]).

Two neighboring genes encode the STAT5 transcription factor, STAT5A and STAT5B. While the amino acid composition of these genes is 95% homologous and there are functional redundancies between the two proteins, the slight differences in sequence identity (e.g. a single amino acid in the DNA binding domain[49]) also convey significant differences in function[50]. Knockout studies revealed that STAT5A is critical for normal mammary gland growth and development while STAT5B is comparatively non-essential, and that STAT5A expression levels are significantly higher than STAT5B in the mammary gland [51]. Consequently, STAT5A is more relevant to prolactin signaling in breast cancer and is the exclusive focus of the work presented here.

1.2.2 STAT5A in Breast Cancer

As the major effector transcription factor of prolactin signaling, it is not surprising that the functions of STAT5A and evidence for its role in the pathogenesis

of breast cancer are similar to those of PRL and the PRLr. Just as gain and loss of function studies of PRL in mice demonstrated enhanced and impaired tumor growth, respectively, STAT5A overexpression in the mammary epithelium of transgenic mice led to the incidence of mammary tumors [52], and hemizygous loss of STAT5A impaired tumor progression driven by oncogenic transgene (simian virus 40 T antigen)[53]. In human breast cancer *in vitro* models, STAT5A promoted cell survival and anchorage-independent growth [54]. STAT5A increases expression of CISH and cyclin D1, two well-studied STAT5A target genes that drive cell proliferation and demonstrate elevated expression in breast cancer [55-59]. However, based on evidence that nuclear phosphorylated STAT5A (pSTAT5A) is a positive prognostic indicator for ER^+ breast cancer response to endocrine therapy and that nuclear pSTAT5A is reduced in post-treatment metastases, several studies have suggested that STAT5A is not a driver of breast cancer progression, but rather helps maintain lesions in a more differentiated, less invasive state[60, 61]. Our findings reported here allow reinterpretation of these conclusions, however, and we revisit these studies later in this text (Chapter 4.1.3).

1.3 High Mobility Group Nucleosome Binding Domain 2 (HMGN2)

1.3.1 HMGN2 Structure, Function, and Regulation

The HMGN family of proteins consist of five members (named HMGN1-5), with HMGN1 and HMGN2 ubiquitously expressed in the nuclei of all studied vertebrate species and tissue types [62, 63]. The 9 kDa HMGN2, like all members of the HMGN family, consists of a bipartite nuclear localization signal, a nucleosome binding

domain (NBD), and a C-terminal chromatin regulatory domain (CHUD) [64]. HMGN2 binds to nucleosomes via its NBD and the CHUD makes contact with adjacent nucleosome-free DNA without any sequence specificity[64-66]; HMGN2 nucleosome binding weakens the binding of linker histone H1 at the same site and thus opposes the chromatin condensing activity of H1[65, 67-69]. This opposition of H1 activity is consistent with the observed association of HMGN2 with regions of open/active chromatin and enhancers [70, 71]. Specifically, HMGN2 has been found at cell type specific enhancers and loss of HMGN2 accelerates erasure of cell type specific epigenetic landscapes and reprogramming of cell identity, supporting the conclusion that HMGN2 stabilizes chromatin and cell type specific transcription [71].

1.3.2 HMGN2 in Breast Cancer

While HMGN2 has been relatively well-studied in normal embryogenesis and development, few studies have examined the role of HMGN2 in breast cancer; of five studies published in the English language, our group contributed three. Of the two reports from outside our lab, one found HMGN2 to be increased in several breast cancer cells lines relative to expression in normal cells [72]. The other study, based on a peculiar finding that the HMGN2 peptide has antimicrobial and immunostimulatory antigen effects, administered exogenous recombinant HMGN2 in breast cancer models *in vivo* and *in vitro* and found that it inhibited tumor growth [73]. While interesting, this study has little relevance to the intracellular functions of HMGN2 in breast cancer.

In work spanning more than a decade, our group has investigated multiple aspects of HMGN2 function in breast cancer and prolactin signaling. The body of evidence indicates that HMGN2 plays a significant role in prolactin and STAT5A signaling in breast cancer. Succinctly, overexpression of HMGN2 enhanced prolactin induced, STAT5A target gene expression [20, 74] and anchorage-independent growth of breast cancer cells [74]. Conversely, shRNA mediated knockdown of HMGN2 inhibited prolactin/STAT5A target gene expression [20, 74, 75] and inhibited prolactin induced STAT5A chromatin engagement at the *CISH* promoter [20, 75]. Medler *et al* found that HMGN2 was deacetylated on lysine residue 2 (K2) by histone deacetylase 6 (HDAC6) in a prolactin inducible fashion. Based on studies where HMGN2 acetylation decreased its binding of nucleosome cores [76], deacetylation of HMGN2 likely enhances its affinity for nucleosomes. Overexpression of an acetylated mimic K2Q-HMGN2 failed to enhance anchorage-independent growth, while the deacetylated mimic K2R-HMGN2 enhanced anchorage-independent growth and STAT5A target gene expression beyond both the empty vector control and wild-type HMGN2 transfectants. Pharmacological inhibition of HDAC6 with bufexamac impaired HMGN2 deacetylation, prolactin stimulated gene expression, *in vitro* cell proliferation, and *in vivo* tumor growth. Lastly, deacetylated K2-HMGN2 was found to be significantly increased in histological specimens from breast cancer primary tumors and lymph node metastases relative to patient-matched normal breast tissues.

1.4 Histone Deacetylase 6 (HDAC6)

1.4.1 HDAC6 Structure, Function, and Regulation

The 134 kDa HDAC6 is a class IIb histone deacetylase and is structurally unique among the 18 mammalian histone deacetylases because it contains a functional duplication of its catalytic domain [77]. While both HDAC6 catalytic domains possess Zn^{2+}-dependent deacetylase activity, debate exists over which catalytic domain(s) are active with respect to given substrates and cellular contexts [78-86]. HDAC6 is also distinct among the histone deacetylases because its major known substrates are non-histone proteins[77], including α-tubulin [82, 87], heat shock protein 90 (Hsp90) [88, 89], and cortactin [79]. While initially thought to be predominantly cytoplasmic because of its cytoplasmic retention signal, termed SE14, HDAC6 possesses both a nuclear localization signal (NLS) and nuclear export signal (NES) and has been found in both the cytoplasm and nucleus depending on cell type and signaling context [78, 87, 90]. Additionally, HDAC6 contains a ubiquitin binding domain and a dynein binding domain [91]. A host of HDAC6 post-translational modifications have been described, including serine/threonine/tyrosine phosphorylation (mostly increasing HDAC6 catalytic activity) [92-94], and lysine acetylation, ubiquitination, and sumoylation [95-97]. The growing list of HDAC6 functions is diverse, but most notably includes regulation of cytoskeleton and cell motility [79, 81, 85, 87, 98, 99], as well as being a hub for the cellular stress response, participating in both proteasomal and aggresomal clearance of proteins [78, 98, 100-102]. While these HDAC6 functions are not the focus of the work presented here, pharmacological inhibition of HDAC6 likely

affects these functions as well as those being examined. However, all signaling work reported here was performed with only 2-4 hours of exposure to HDAC6 inhibitor to minimize contributions from HDAC6 effects on motility and protein degradation.

1.4.2 HDAC6 in Breast Cancer

A growing number of studies have investigated the role of HDAC6 in breast cancer. Several studies have reported associations of HDAC6 with the estrogen receptor (ER). Zhang *et al.* reported that HDAC6 mRNA expression was correlated with tumor growth and ER positivity [103]. Saji *et al.* found that HDAC6 expression levels were induced by estrogen and that HDAC6 expression was an independent prognostic indicator significantly associated with improved survival in ER^+ breast cancer patients treated with tamoxifen [104]. While these reports are unanimous regarding the potential importance of HDAC6 as a breast cancer biomarker, varying interpretation of the evidence gave rise to questions over whether HDAC6 was acting as an oncogene or as more of a tumor suppressor in these contexts. Other studies found that in MCF-7 cells, shRNA mediated knockdown of HDAC6 inhibited soft agar anchorage independent growth [105], and pharmacological inhibition of HDAC6 with tubacin inhibited cell proliferation [85]. Finally, our group found that inhibition of HDAC6 with bufexamac in MCF-7 cells resulted in reduced prolactin induced binding of STAT5A at its target gene, *CISH*, reduced MCF-7 tumor growth *in vivo*, and inhibited the expression of a significant proportion of prolactin induced genes [74].

1.5 Summary of Foundational Evidence and Study Rationale

Studies at the genetic, cellular, and epidemiologic levels have implicated the polypeptide hormone, prolactin, in the pathogenesis of human breast cancer [27, 31, 106-115]. Elaborated by both the anterior pituitary [116, 117] and locally by breast epithelium [3, 5], prolactin promotes the growth of breast cancer cells by acting as a mitogen and survival factor [10, 118-122]. Upon prolactin binding to its cognate cell surface receptor, the janus kinase 2 / signal transducer and activator of transcription 5a (JAK2/STAT5A) pathway is rapidly activated leading to STAT5A tyrosine phosphorylation, dimerization, nuclear retrotranslocation, and regulation of target gene expression [50, 123-127]. While substantial progress has been made in understanding prolactin and STAT5A signaling, the precise, chromatin-level mechanisms by which STAT5A elicits specific patterns of gene expression remain incompletely understood.

Our group previously found that high mobility group nucleosome binding domain 2 (HMGN2) is necessary for optimal prolactin induced, STAT5A chromatin engagement at the promoter of its canonical target gene, *CISH*, as well as subsequent *CISH* transcription [20, 75]. HMGN2 is a highly abundant, predominantly nuclear protein without DNA sequence specificity that associates with active chromatin and interferes with chromatin compaction mediated by linker histone H1 [66, 128-133]. We previously identified HMGN2 as a novel substrate of histone deacetylase 6 (HDAC6) [74], with deacetylation thought to enhance HMGN2 affinity for nucleosome cores [76]. Indeed, we found that pharmacological HDAC6 inhibition with bufexamac reduced

HMGN2 and STAT5A binding at the *CISH* promoter, and inhibited a significant subset of prolactin induced gene expression [74]. HDAC6, reported to be predominantly cytoplasmic [134, 135], is best known for its non-histone substrates, including tubulin [82, 87], heat shock protein 90 (Hsp90) [88, 89], and cortactin [79] (among others). HDAC6 has been linked to a variety of cellular processes including cell motility [79, 99, 136], protein degradation [80, 137, 138], and stress response [139], though its role in the nucleus, particularly at the level of chromatin, remains largely unexplored.

Here, we hypothesize that HDAC6 promotes the pathogenesis of breast cancer by facilitating PRL-induced Stat5a-mediated gene expression via enhanced Stat5a/HMGN2 binding at the level of chromatin (Figure 1.5.1). Specifically, we investigate the generalizability of the STAT5A/HDAC6/HMGN2 mechanism identified at the *CISH* promoter (Figure 1.5.1) while elucidating genome-wide patterns of STAT5A and HDAC6 chromatin engagement in human breast cancer. Utilizing recently identified ENCODE *cis*-regulatory elements (CREs) as a framework [140], we integrate multi-condition STAT5A, HDAC6, and HMGN2 ChIP-seq with parallel condition RNA-seq to reveal the chromatin-level cofactor dynamics underlying tumorigenic gene expression driven by prolactin and largely opposed by the clinical trial-ready, small molecule HDAC6 inhibitor, ACY-241 (Citarinostat). Additionally, we demonstrate the functional efficacy of ACY-241 in breast cancer models *in vitro* and *in vivo* and identify potentially translatable drug synergies in patient-derived xenografts.

Figure 1.5.1

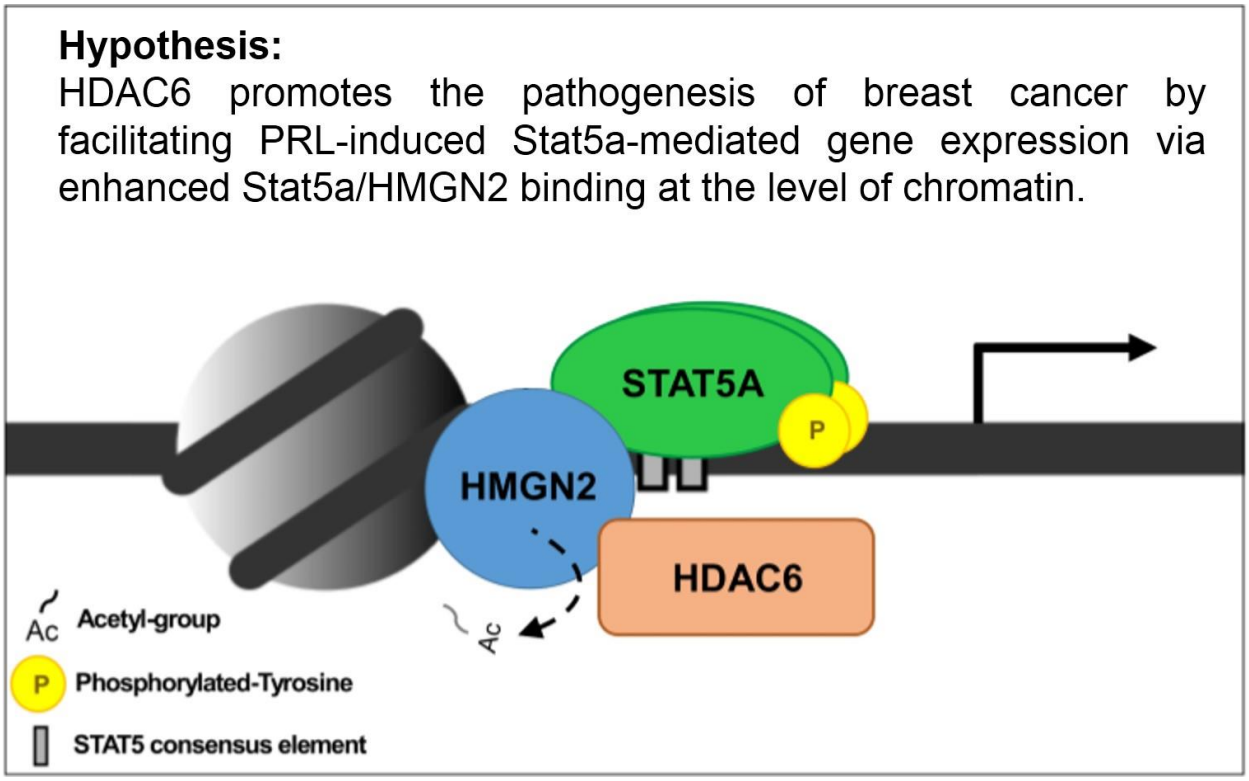


Figure 1.5.1 Working model of prolactin induced, STAT5A/HDAC6/HMGN2 mediated transcription at the *CISH* promoter.

Chapter 2: MATERIALS and METHODS

2.1 Breast cancer PDX models and cell lines

Breast cancer PDX models utilized in this study include the luminal, ER^+ HCI-011 and HCI-013, and triple-negative, basal-like WHIM30 models. HCI-011 and HCI-013 were obtained from the Huntsman Cancer Institute, University of Utah; WHIM30 was obtained from Washington University, St. Louis. PDX cells were transduced with a lentivirus (BLIV101PA-1, Systems Biosciences) encoding green fluorescent protein (GFP) and luciferase (Luc), and GFP-Luc expressing cells were suspended 1:1 in Matrigel (Corning) and injected into the fourth mammary fat pads of female non-obese diabetic severe combined immunodeficient gamma (NSG) mice (500,000 cells per injection). ER^+ MCF-7 and triple-negative MDA-MB-231 cell lines were obtained from the American Type Culture Collection (ATCC) and were cultured in Dulbecco's modified Eagles' medium (DMEM; Life Technologies #11965092) supplemented with 10% fetal bovine serum (FBS; Corning #MT35011CV) and 1% penicillin-streptomycin (ThermoFisher Scientific #15140-122). MCF-7 and MDA-MB-231 cells have been continuously cultured less than four months since they were last authenticated by ATCC via short tandem repeat profiling.

2.2 Cell viability, proliferation, and soft agar assays

All viability, proliferation, and soft agar assays were conducted in at least three biological replicates. For PDX cell viability assays, mammary tumors were harvested once they reached $100mm^2$ by caliper measurement. Tumors were finely

chopped and digested for 1 h at 37 °C in DMEM/F12 containing 5% FBS, 300 U/ml collagenase (Sigma), and 100 U/ml hyaluronidase (Sigma), then resuspended in ammonium chloride and trypsinized to generate single cell suspensions. Cells were plated in 96-well plates at 25,000 cells per well in M87 medium [141] and treated with 0.1% DMSO, or varying concentrations of ACY-241, doxorubicin, and/or CAS285986-31-4 for 72 h, followed by imaging and measurement of luciferase activity (total photon flux per second) two minutes after the addition of D-luciferin (15 mg/ml; GoldBio) to each well (1/10 of total volume per well), using the IVIS Spectrum *In Vivo* Imaging System (Xenogen IVIS-200) and living image software (PerkinElmer), as described in [142].

For MCF-7 and MDA-MB-231 cell viability or proliferation assays, cells were cultured in complete medium as described above and incubated for at least 24 hours before treatment with 0.1% DMSO or varying concentrations of ACY-241. Cell viability or proliferation were assessed 72 hours after ACY-241/vehicle treatment. Viability was assessed by trypan blue exclusion assay. Three minutes after addition of 1:1 ratio of 0.4% trypan blue, cells were imaged and viable cells per high power field were counted using CellProfiler software [143]. MCF-7 cell proliferation was assessed utilizing a fluorescent nucleic acid stain (CyQuant Direct Cell Proliferation Assay; Life Technologies) per the manufacturer's protocol. Anchorage-independent growth was assessed in MCF-7 single cell suspensions plated in soft agar at a density of $2x10^5$ cells/mL. Fresh complete medium with 2 μM ACY-241 or 0.1% DMSO was added every three days. On day 21, cells were imaged before and after treatment

with MTT (tetrazolium bromide). Ten high-power field images were taken per replicate; colony number and diameter were quantified using CellProfiler software [143].

2.3 Animal Studies

All studies involving mice were approved by the Virginia Commonwealth University (VCU) Institutional Animal Care and Use Committee (IACUC) (Protocol#AD10000814; approved May 15, 2019 and Protocol# AD10001247; approved June 29, 2018), and all experiments were performed in accordance with IACUC guidelines and regulations.

Female FVB mice harboring the MMTV-PyMT transgene were monitored daily for palpable tumors from the time of weaning until study end point and tissue harvest. Littermates were assigned to three separate cohorts of treatment and control groups at the time of weening. From weeks 5-7 (Week 7 Cohort; n=13), weeks 9-11 (Week 11 Cohort; n=22), or weeks 11-13 (Week 13 Cohort; n=20), animals were dosed via intraperitoneal (IP) injection six days per week for three weeks (18 doses total) with 50 mg/kg ACY-241 or an equal volume per weight of the formulation vehicle (1% polyvinylpyrrolidone (PVP K-90; Sigma) in 1X PBS (Sigma)) prepared fresh daily. At the study end point for each cohort (end of weeks 7, 11, or 13), mice were humanely euthanized, and all tumors/mammary glands were harvested, weighed, and formalin-fixed, paraffin embedded for histological analysis. Tissue blocks were sectioned and stained with hematoxylin and eosin (H&E). H&E stained sections were examined by

a board-certified pathologist (C.C.) and the histological percent composition of hyperplasia, adenoma, invasive carcinoma, or normal tissue were quantified for each animal.

2.4 Chromatin Immunoprecipitation (ChIP) and sequencing

MCF-7 cells were grown in 150-mm plates to ~60% confluency in complete medium (as described above) before serum starvation (DMEM, 0.1% BSA) for 20 hours. Cells were treated with either 2 μM ACY-241 or 0.1% DMSO for two hours prior to stimulation with prolactin (250 ng/mL) or an equal volume of 1X PBS for 30 minutes, followed by cell harvest. To enable the most informative comparisons across ChIP targets, for each experimental condition (DMSO/PRL$^-$, DMSO/PRL$^+$, ACY-241/PRL$^-$, ACY-241/PRL$^+$), pooled chromatin was aliquoted for incubation with each antibody immediately prior to immunoprecipitation, ensuring sampling from an identical cell population. Of primary importance, the antibodies utilized (rabbit monoclonals targeting STAT5A[144] [abcam #ab32043; 3 μg/IP], HDAC6[145] [Cell Signaling Technology #7558; 3 μg/IP], and HMGN2[146] [Cell Signaling Technology #9437; 10 μg/IP]) were rigorously tested for specificity, confirmed by knockdown of each targeted protein (Figure 2.4.1 [147]) before use. Approximately 1.0 x 10^8 cells were used for each experimental condition and biological replicate (n=2 per condition and ChIP target). At the conclusion of ACY-241 treatment and/or prolactin stimulation, chromatin was cross-linked in 1% formaldehyde for 12 minutes, followed by neutralization with 1/20 volume of 2.5 M glycine. Cells were washed twice with ice-

Figure 2.4.1

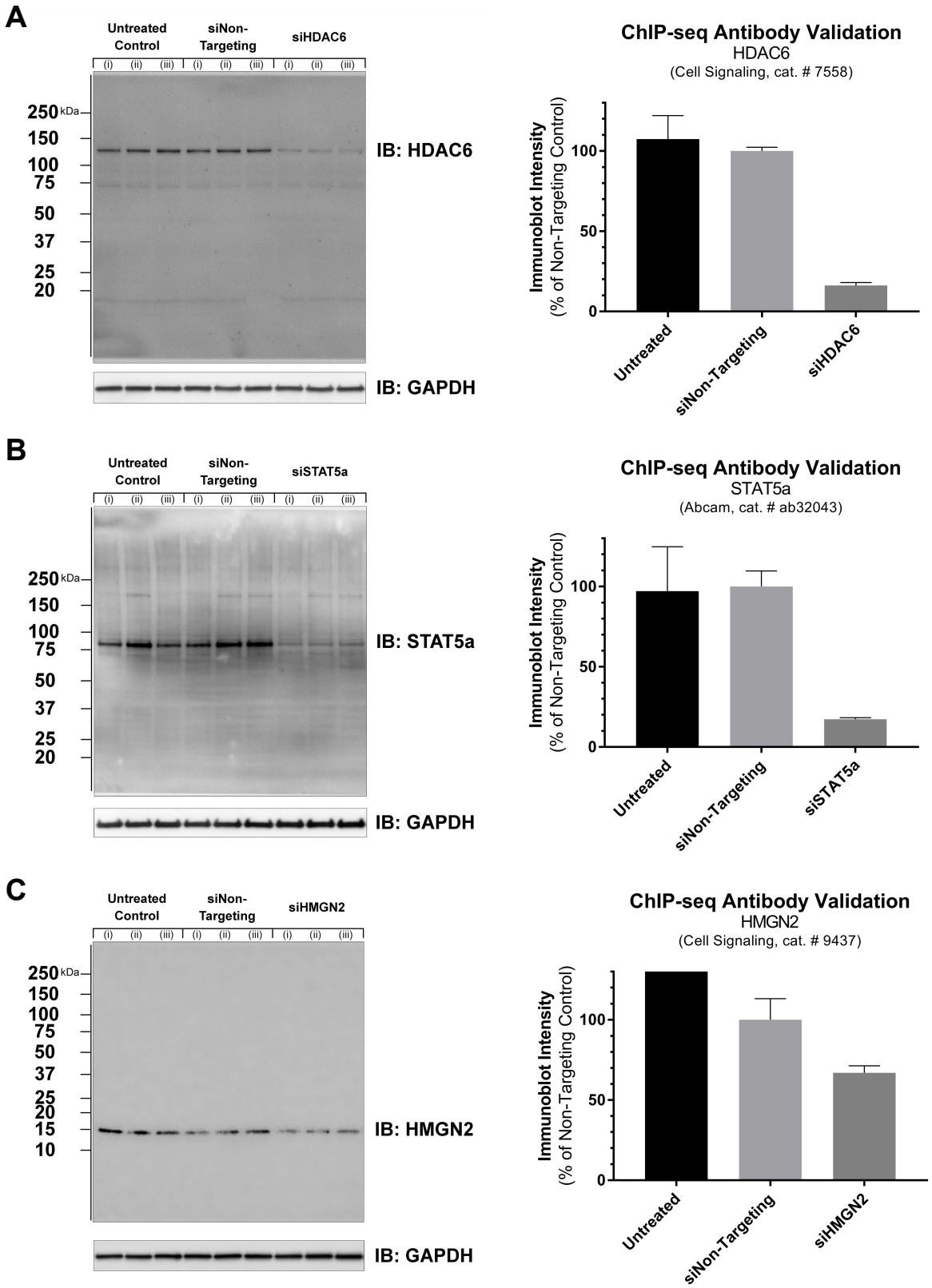


Figure 2.4.1 High exposure immunoblots utilizing ChIP-seq antibodies demonstrate minimal non-specific binding and confirm antibody target protein specificity by siRNA knockdown. (A-C) Full-length, high exposure immunoblots (IBs) of MCF-7 lysates from three independent experiments (i, ii, iii) run on 4-20% gradient gels depict expression of indicated protein in the basal state (untreated control), or 72 hours after siRNA transfection with either a non-targeting control (siNon-Targeting), or siRNA directed against HDAC6 **(A)**, STAT5A **(B)**, or HMGN2 **(C)**. Bar graphs depict mean and SEM of relative immunoblot intensities normalized to GAPDH and non-targeting control expression of the indicated ChIP-seq targets.

cold PBS, scraped and collected in a third volume of PBS, and briefly spun down before pellets were snap-frozen in liquid nitrogen. With the exception of sonication, which was performed using the Covaris M220 Focused-ultrasonicator (Covaris, Inc.), chromatin isolation, immunoprecipitation, and DNA extraction were performed as previously described [148]. DNA purity was assessed by spectrophotometry at 260, 270, and 280 nm, and integrity was assessed by capillary electrophoresis utilizing the Agilent 2100 Bioanalyzer. Library preparation was performed on ≥100 ng DNA using the Ovation Ultralow V2 DNA-Seq Library Preparation Kit (NuGEN) according to the manufacturer's instructions. Sequencing was conducted by the University of Colorado Anschutz Medical Campus Genomics and Microarray Core utilizing the NovaSEQ 6000 (Illumina) platform to generate ≥25 million 150 bp paired-end reads per replicate. Libraries were prepared and sequenced in a single batch/flow cell lane; to ensure sufficient sequencing depth the same libraries were re-sequenced on a separate occasion in a single flow cell lane producing two technical replicates for each biological replicate.

2.5 RNA Isolation and sequencing

MCF-7 cells were grown in 150-mm plates to ~60% confluency in complete medium (as described above) before serum starvation (DMEM, 0.1% BSA) for 20 hours. Cells were treated with either 2 μM ACY-241 or 0.1% DMSO for two hours prior to stimulation with prolactin (250 ng/mL) or an equal volume of 1X PBS for an additional 2 hours, followed by cell harvest. RNA-seq experiments were performed

with three biological replicates per treatment condition (DMSO/PRL$^-$, DMSO/PRL$^+$, ACY-241/PRL$^-$, ACY-241/PRL$^+$). RNA was extracted in phenol: chloroform: isoamyl alcohol (PCA) followed by ethanol precipitation. DNA was enzymatically digested prior to a second round of PCA and ethanol precipitation. RNA purity was assessed by spectrophotometry at 260, 270, and 280 nm, and integrity was assessed by capillary electrophoresis utilizing the Agilent 2100 Bioanalyzer. All samples possessed RIN (RNA Integrity Number) values ≥9. Library preparation was performed on ≥500 ng RNA using the Universal Plus mRNA-Seq Library Preparation Kit (NuGEN) according to the manufacturer's instructions. Sequencing was conducted by the University of Colorado Anschutz Medical Campus Genomics and Microarray Core utilizing the NovaSEQ 6000 (Illumina) platform to generate ≥50 million 150 bp paired-end reads per replicate. All libraries were prepared and sequenced in a single batch/flow cell lane.

2.6 Data Analysis

ChIP-seq and RNA-seq data were analyzed using the R statistical computing environment and the Galaxy web platform via the public server at usegalaxy.org [149]. Raw reads in .FASTQ file format were assessed for sequence quality, GC content, the presence of adaptors, overrepresented k-mers and duplicated reads utilizing FastQC v0.11.2 [150]. Adapters, polyG tails, and 15 bases from 5' and 3' tails were trimmed and any low quality reads (>20% bases with phred quality <Q20) or reads less than 60 bases in length (after trimming) were filtered using fastp v0.20.1 [151].

2.6.1 ChIP-seq

Sequencing depth, read quality, and read duplication rates were all well within ideal specifications for mammalian point-source transcription factors [152] (Table 2.6.1

Table 2.6.1 ChIP-seq sequencing depth and duplication rate per biological replicate.

	Biological Replicate	Prolactin	ACY-241	Paired-End Reads (x1M)	Duplication Rate (%)
STAT5A	1	-	-	56.9	4.9
	2	-	-	55.6	5.0
	1	+	-	54.8	5.3
	2	+	-	50.1	5.0
	1	-	+	79.0	4.0
	2	-	+	45.3	5.0
	1	+	+	49.2	5.0
	2	+	+	28.4	4.1
HDAC6	1	-	-	50.8	5.6
	2	-	-	53.8	12.5
	1	+	-	45.6	7.5
	2	+	-	29.0	5.6
	1	-	+	26.9	4.5
	2	-	+	48.6	6.5
	1	+	+	27.4	5.7
	2	+	+	41.0	6.5
HMGN2	1	-	-	146.4	2.0
	2	-	-	150.0	1.9

[153]). Filtered reads were aligned to the hg38 reference genome (GRCh38; excluding the Y chromosome and alternate scaffolds) using Bowtie2 v2.3.4.3 [154]. The resultant .BAM files from technical replicates were merged and duplicate reads were removed

before biological replicates and corresponding input samples were passed to MACS2 v2.1.1.20160309.6 [155] for peak detection in paired-end mode (-BAMPE) with FDR<0.01. Peaks in ENCODE blacklist regions [156] were removed. Next, the union set of peaks corresponding to the four experimental conditions for a given ChIP target (e.g. STAT5A) was determined and peak summits were recalculated using DiffBind v2.10.0 [157]. The .BAM files of biological replicates were normalized to sequencing depth and combined to create counts per million (CPM) normalized .BIGWIG files using deepTools bamCoverage module v3.3.2.0.0 [158]. CPM values for a 10 bp bin at peak summits were then extracted for each experimental condition using the normalized .BIGWIG files in the deepTools module computeMatrix v3.3.2.0.0. The intersection of peak summits with MCF-7 ENCODE *cis*-regulatory elements (CREs) [140] and, in turn, the intersection of bound CREs with curated RefSeq gene bodies and flanks were determined using bedtools [159] ClosestBed module v2.29.0. STAT5A, HDAC6, and HMGN2 peaks as well as the corresponding signal amplitudes (CPM) for each experimental condition, along with bound CREs, adjacent genes, and later, differential expression data were all integrated and assembled into a large Excel (Microsoft) database that was queried and used to build datasets for quantification and statistical analysis in R or Prism9 (Graphpad). Initial analyses tracked CTCF-bound and CTCF-unbound CREs separately and occupancy trends in gene sets were proportionally similar (data not shown); however, due to reduced statistical power with the relatively low numbers of CTCF-bound sites and the lack of conformational or chromatin looping information to complement the CTCF data, potential

conclusions were limited and the CTCF-bound CREs were ultimately combined with their unbound counterparts in the gene-centric analyses presented here (Figures 3.2.1, 3.2.2).

2.6.2 RNA-seq

Filtered reads were aligned to curated RefSeq transcripts (refMrna.fa downloaded from UCSC Table Browser [160] July 27, 2020) utilizing Kallisto quant v0.46.0.4 [161]. Gene level summaries of transcript counts were obtained using tximport v0.1 [162]. Normalization and differential expression analysis were conducted with limma-voom v3.38.3 [163] using "robust settings" and an FDR<0.05 (Benjamini-Hochberg). This tool makes an internal call to EdgeR [164] for normalization, adjusting for sequencing depth/library size and gross differences in RNA output amongst cells (TMM method), before utilizing a precision weights approach and linear modeling to assess differential expression. Prolactin regulated genes and ACY-241 regulated genes are defined as the differentially expressed genes identified by the contrast of prolactin only versus untreated datasets and prolactin/ACY-241 versus prolactin only datasets, respectively. Differentially expressed genes were integrated with ChIP-seq *cis*-regulation data and also analyzed for gene set enrichment and upstream regulators using Ingenuity Pathway Analysis (Qiagen) software.

2.7 Prolactin and ACY-241

Human recombinant prolactin was a gift from Dr. Anthony Kossiakoff (University of Chicago, Chicago, IL). ACY-241 was purchased from Selleck (#S8464).

Chapter 3: RESULTS

3.1 Introduction to Datasets and Integrative Approach

High quality STAT5A, HDAC6, and HMGN2 ChIP-seq datasets were generated in full accordance with guidelines and quality standards established by the ENCODE consortia [152]. To investigate hormone stimulated binding dynamics and the influence of pharmacological HDAC6 inhibition, the chromatin of MCF-7 human breast cancer cells was harvested for ChIP before and after exposure to prolactin (30 minutes; 250 ng/mL) and/or ACY-241 (120 minutes; 2 μM). Union peaksets of non-overlapping, robust (MACS2 FDR<0.01) peaks were identified for each factor (88,709 STAT5A peaks; 12,815 HDAC6 peaks; 102,661 HMGN2 peaks; Supplemental Tables S2-S4 [153]). In parallel experiments, we generated matching condition RNA-seq expression data identifying differentially expressed genes (FDR<0.05) following prolactin stimulation and/or ACY-241 treatment (Appendix A and B [153]). Finally, we integrated recently identified MCF-7 *cis*-regulatory elements (CREs) from the long awaited, phase III release (July 2020) of the ENCODE project [140] (Figure 3.1.1A). Offering data-rich information beyond simple annotation, these CREs are defined by DNase, CTCF, H3K4me3, and H3K27ac ChIP-seq datasets derived from MCF-7 cells propagated in identical growth medium as the MCF-7 cells utilized here (Figure 3.1.1B-C). DNase, CTCF, H3K4me3, and H3K27ac ChIP-seq peaks are generally associated with accessible chromatin, anchor points in chromatin loops, promoters, and enhancers, respectively. CREs are further defined by their distance from GENCODE transcription start sites (TSS); promoter-like signatures (PLS), for

Figure 3.1.1

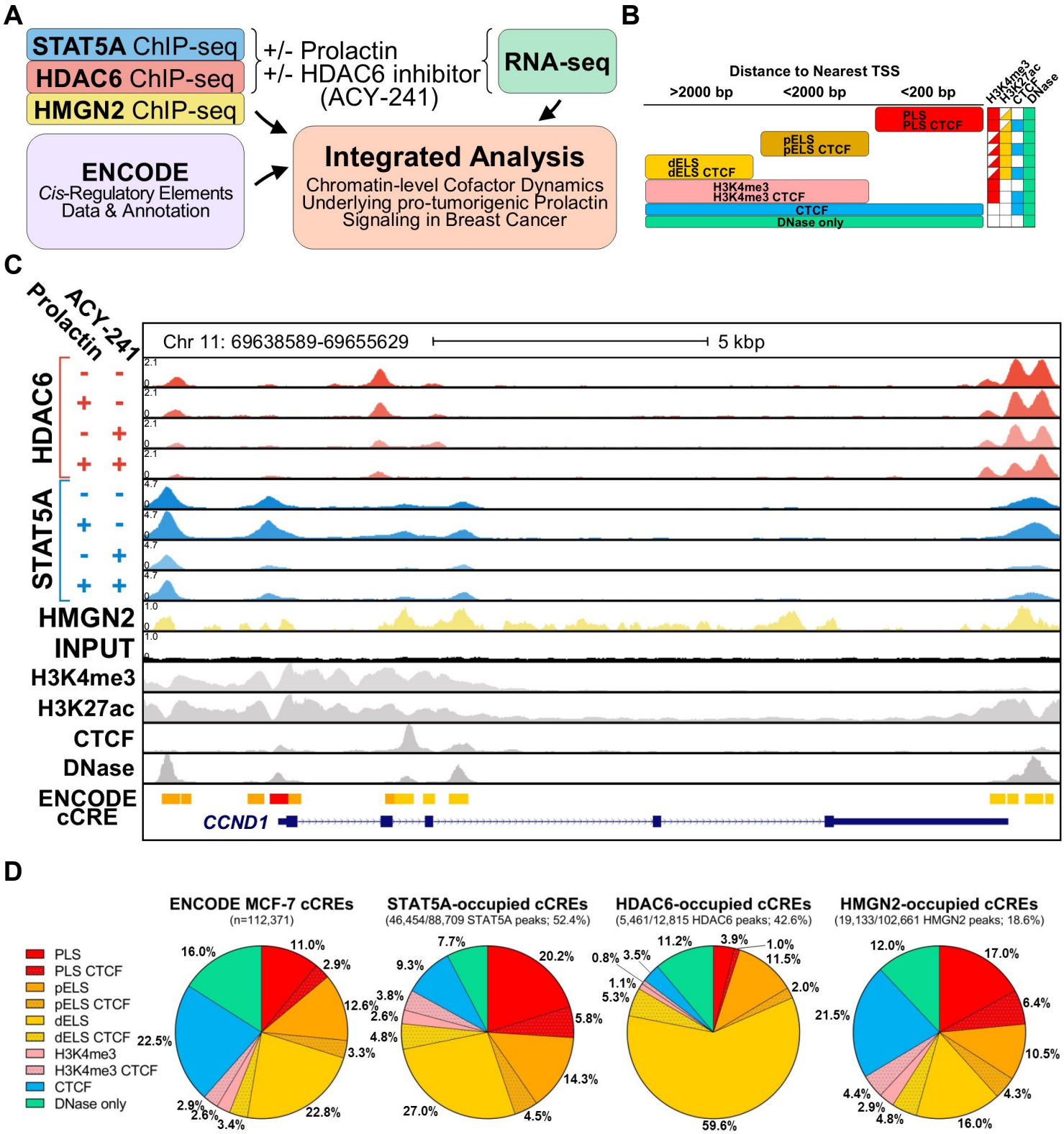

A
STAT5A ChIP-seq
HDAC6 ChIP-seq
HMGN2 ChIP-seq
+/- Prolactin
+/- HDAC6 inhibitor (ACY-241)
RNA-seq
ENCODE
Cis-Regulatory Elements Data & Annotation
Integrated Analysis
Chromatin-level Cofactor Dynamics Underlying pro-tumorigenic Prolactin Signaling in Breast Cancer
B
Distance to Nearest TSS
>2000 bp
<2000 bp
<200 bp
H3K4me3
H3K27ac
CTCF
DNase
PLS
PLS CTCF
pELS
pELS CTCF
dELS
dELS CTCF
H3K4me3
H3K4me3 CTCF
CTCF
DNase only
C
ACY-241
Prolactin
HDAC6
STAT5A
HMGN2
INPUT
H3K4me3
H3K27ac
CTCF
DNase
ENCODE cCRE
Chr 11: 69638589-69655629
5 kbp
CCND1
D
ENCODE MCF-7 cCREs
(n=112,371)
STAT5A-occupied cCREs
(46,454/88,709 STAT5A peaks; 52.4%)
HDAC6-occupied cCREs
(5,461/12,815 HDAC6 peaks; 42.6%)
HMGN2-occupied cCREs
(19,133/102,661 HMGN2 peaks; 18.6%)
PLS
PLS CTCF
pELS
pELS CTCF
dELS
dELS CTCF
H3K4me3
H3K4me3 CTCF
CTCF
DNase only

Figure 3.1.1 An integrated analysis framework enables interrogation of the STAT5A/HDAC6/HMGN2 *cis*-regulatory landscape in human breast cancer cells. (A) Schematic depicts the integrated analysis framework of this study, employing ChIP- and RNA-seq with ENCODE candidate *Cis*-Regulatory Elements (cCREs) in MCF-7 human breast cancer cells. **(B)** ENCODE cCRE definitions. cCRE class (PLS*; promoter-like signatures, pELS*; proximal enhancer-like signatures, dELS*; distal enhancer-like signatures, H3K4me3, CTCF, and DNase only) is defined by its distance from the nearest GENCODE transcription start site (TSS), high DNase signal, and specific combinations of H3K4me3/H3K27ac histone modifications as indicated by the color-shaded table, *right*. Half-shaded squares indicate a histone modification that is present in some, but not all, of the cCREs in the corresponding class. *These cCREs are further subdivided by CTCF binding. **(C)** (hg38) UCSC Genome Browser view of Cyclin D1 (*CCND1*) gene locus displaying ChIP-seq data utilized in this study, including STAT5A and HDAC6 datasets (four experimental conditions each; +/-prolactin x +/-ACY-241), HMGN2 and input datasets, and ENCODE MCF-7 H3K4me3 (ENCFF530LJW), H3K27ac (ENCFF515VXR), CTCF (ENCFF551DQV), and DNase (ENCFF924FJR) datasets that define the MCF-7 ENCODE cCRE track (*bottom row*, rectangles indicate cCRE genomic boundaries with colors corresponding to cCRE class as in **(B**, **D)**). Each STAT5A, HDAC6, HMGN2, and input track represents two biological replicates merged, normalized for sequencing depth, and displayed as counts per million (CPM) as indicated by left y-axis numbering. **(D)** Circle charts depict the relative proportions of each cCRE class in all 112,371 identified ENCODE MCF-7 cCREs (*left*) or the 46,454 STAT5A peaks, 5,461 HDAC6 peaks, and 19,133 HMGN2 peaks with peak center (summit) coordinates mapping to an ENCODE MCF-7 cCRE. cCRE class is indicated by color in the legend.

example, are defined by regions with high DNase and H3K4me3 signals less than 200 bp from a TSS (Figure 3.1.1B). As depicted in Figure 3.1.1C at the locus of the well-established prolactin/STAT5A target gene, Cyclin D1 (*CCND1*), integration of multi-condition STAT5A, HDAC6, and HMGN2 ChIP-seq datasets with underlying regions of accessible chromatin and histone modifications – defining promoter- and enhancer-like CREs – offers a panoramic view of a complex, *cis*-regulatory landscape. MCF-7 *cis*-regulatory elements were occupied by 52%, 43%, and 19% of STAT5A, HDAC6, and HMGN2 peaks, respectively (Figure 3.1.1D). An additional 18%, 24%, and 27%

of STAT5A, HDAC6, and HMGN2 peaks, respectively, occupied "low DNase" elements – CREs that were defined in the 926,535 ENCODE human CREs and represented across other cell types, but lacking strong DNase signal in the MCF-7 cells assayed [140]. The remaining 30%, 33%, and 54% of identified STAT5A, HDAC6, and HMGN2 peaks were located in regions lacking CRE annotation. Comparison of the fractional composition of MCF-7 CREs with STAT5A, HDAC6, and HMGN2 occupied CREs revealed enrichment of STAT5A at promoters (PLS; 20.2% of all STAT5A CREs vs. 11.0% of all MCF-7 CREs), enrichment of HDAC6 at distal enhancers (dELS; 59.6% of all HDAC6 CREs vs. 22.8% of all MCF-7 CREs), and relative depletion of HDAC6 at promoters (PLS; 3.9% of all HDAC6 CREs vs. 11.0% of all MCF-7 CREs) (Figure 3.1.1D); HMGN2, consistent with its lack of DNA sequence specificity and known promiscuity at accessible chromatin, showed slight preference for promoters (PLS; 17.0% of all HMGN2 CREs vs. 11.0% of all MCF-7 CREs) but otherwise occupied CREs at rates approximately proportional to their fractional composition in all MCF-7 CREs (Figure 3.1.1D).

3.2 *Cis*-Regulatory Landscape of Prolactin and ACY-241 Regulated Genes

Having identified significant STAT5A, HDAC6, and HMGN2 ChIP-seq peaks and the *cis*-regulatory elements (CREs) occupied by each factor, we investigated the *cis*-regulatory landscape of differentially expressed genes identified under conditions of prolactin stimulation and/or ACY-241 treatment. To consider only the STAT5A, HDAC6, and HMGN2 binding loci most likely to be involved in direct, *cis*-regulation

of gene expression, we limited our analysis to robust peaks (MACS2 FDR<0.01) and CREs located either within gene bodies or immediately adjacent to gene bodies (up to 12.5 kbp upstream (5') of transcription start sites (TSSs) and up to 2.5 kbp downstream (3') of transcription termination sites (TTSs)). Since actively transcribed genes are known to correlate with open chromatin and enhanced transcription factor binding, while unexpressed genes – genes with very few or no detectable transcripts – correlate with heterochromatin and dramatically decreased transcription factor binding [165], the *cis*-regulatory landscapes of prolactin and ACY-241 regulated genes were compared only to other expressed genes as an important and conservative control. Previous ChIP-seq studies of STAT5 binding sites and growth hormone (GH) induction in the mouse genome concluded that STAT5 promiscuously binds promoter regions and that STAT5-bound promoter regions are poor predictors of GH-/STAT5-inducible gene expression [166, 167]; consistent with these reports, here STAT5A was bound to the promoters (PLS) of 57.0% of expressed genes *not* prolactin regulated and 5.6% of genes lacking detectable expression altogether (Figure 3.2.1A). However, current models of transcriptional regulation suggest that modulation of transcription is likely exerted via a summation of multiple inputs, including multiple transcription factors as well as multiple *cis*- and *trans*- acting regulatory elements [140]. We therefore set out to characterize the *cis*-regulatory landscape of prolactin and ACY-241 differentially expressed genes by measuring independent features of STAT5A-, HDAC6-, and HMGN2-bound CREs as well as the summation of these features. Specifically, we measured the percent of genes with one or more peaks, an indicator

of STAT5A/HDAC6/HMGN2 specificity for a given gene set (Figure 3.2.1A), the peaks per gene, an indicator of differences in the underlying *cis*-regulatory landscape (Figure 3.2.1B), and the ChIP-seq signal per peak (counts per million (CPM) at peak summits), an indicator of average occupancy in the cell population (Figure 3.2.1C), which all contribute to a summation metric – signal per gene, the sum of all ChIP-seq signals at peaks/CREs immediately adjacent to the gene (Figure 3.2.1D). To ensure the independence of each metric, "peaks per gene" and "signal per peak" exclude genes without peaks, which are measured by the "percent of genes with peaks" (i.e. for a given set of genes, average signal/gene = average peaks/gene x average signal/peak x percent of genes with peaks). Consistent with our previous findings that HDAC6 and HMGN2 facilitate prolactin induction of target genes and that the HDAC6 inhibitor, bufexamac, blocks a significant proportion of prolactin stimulated gene expression [74, 75], significant enrichment of STAT5A-, HDAC6-, and HMGN2-bound CREs at both prolactin regulated *and* ACY-241 regulated genes relative to other expressed genes was observed (Figure 3.2.1A). Enrichment of STAT5A peaks among genes regulated by the HDAC6 inhibitor, ACY-241, at levels comparable with prolactin regulated genes (where STAT5A is a canonical effector molecule of prolactin signaling) is striking and further evidence of a significant STAT5A-HDAC6 interaction. Interestingly, and consistent with the previously reported low specificity of STAT5-bound promoters for GH regulated genes [166, 167], STAT5A-bound PLS peaks per gene (Figure 3.2.1B) and signal per peak (Figure 3.2.1C) of prolactin regulated genes showed no difference relative to other expressed

Figure 3.2.1

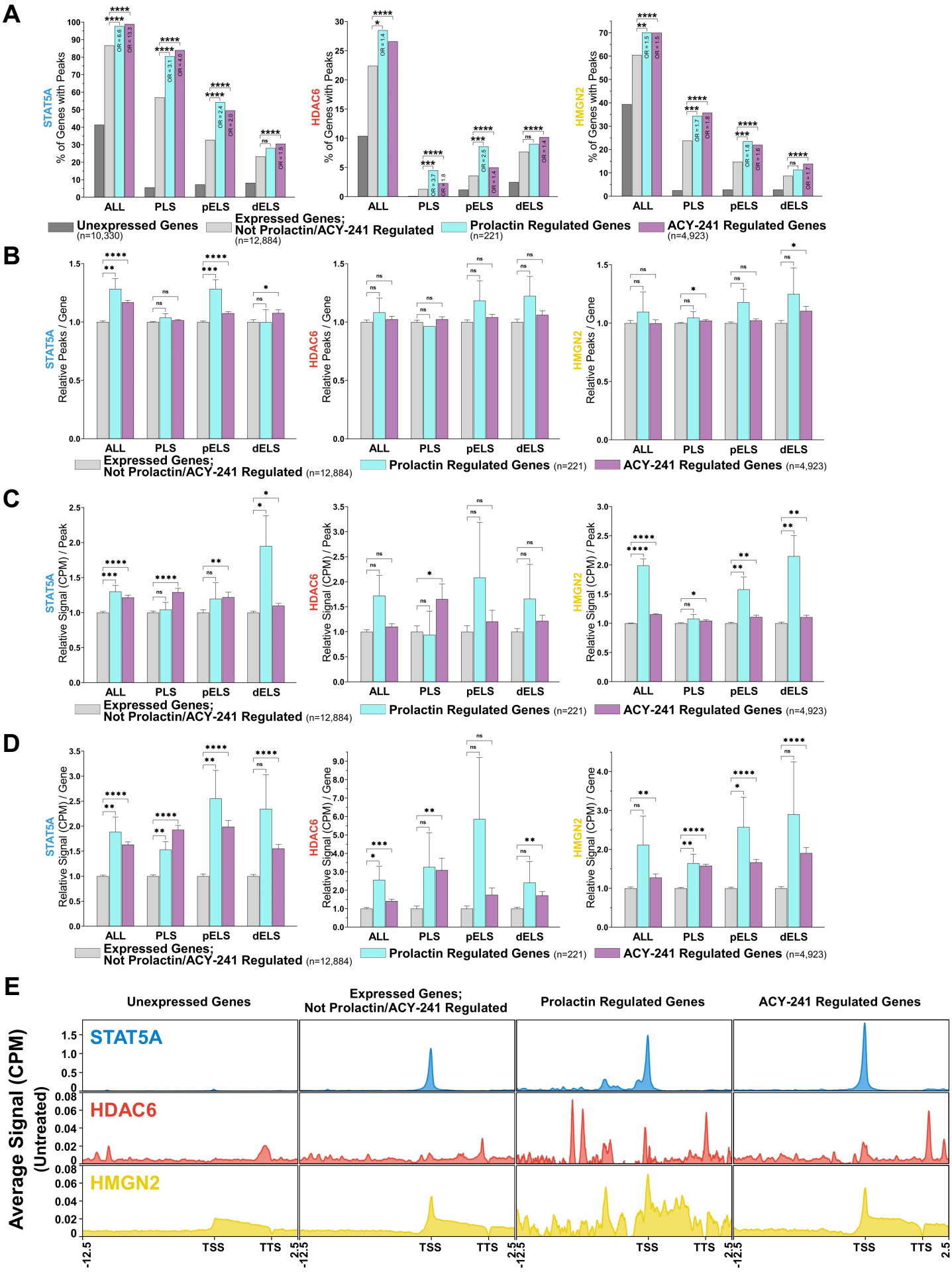

A
STAT5A
% of Genes with Peaks
HDAC6
% of Genes with Peaks
HMGN2
% of Genes with Peaks
ALL
PLS
pELS
dELS
Unexpressed Genes (n=10,330)
Expressed Genes; Not Prolactin/ACY-241 Regulated (n=12,884)
Prolactin Regulated Genes (n=221)
ACY-241 Regulated Genes (n=4,923)
B
STAT5A
Relative Peaks / Gene
HDAC6
Relative Peaks / Gene
HMGN2
Relative Peaks / Gene
Expressed Genes; Not Prolactin/ACY-241 Regulated (n=12,884)
Prolactin Regulated Genes (n=221)
ACY-241 Regulated Genes (n=4,923)
C
STAT5A
Relative Signal (CPM) / Peak
HDAC6
Relative Signal (CPM) / Peak
HMGN2
Relative Signal (CPM) / Peak
Expressed Genes; Not Prolactin/ACY-241 Regulated (n=12,884)
Prolactin Regulated Genes (n=221)
ACY-241 Regulated Genes (n=4,923)
D
STAT5A
Relative Signal (CPM) / Gene
HDAC6
Relative Signal (CPM) / Gene
HMGN2
Relative Signal (CPM) / Gene
Expressed Genes; Not Prolactin/ACY-241 Regulated (n=12,884)
Prolactin Regulated Genes (n=221)
ACY-241 Regulated Genes (n=4,923)
E
Unexpressed Genes
Expressed Genes; Not Prolactin/ACY-241 Regulated
Prolactin Regulated Genes
ACY-241 Regulated Genes
Average Signal (CPM) (Untreated)
STAT5A
HDAC6
HMGN2
-12.5
TSS
TTS
2.5

Figure 3.2.1 Summation of independent features in the STAT5A/HDAC6/HMGN2 *cis*-regulatory landscape reveals specificity for prolactin and ACY-241 targeted genes. (A) Bar graphs depict the percent of genes in the gene set (indicated by color in legend) with one or more CREs of the indicated class bound by STAT5A (*left*), HDAC6 (*middle*), or HMGN2 (*right*). Odds ratio (OR) and statistical significance calculated by Fisher's exact test. **(B-D)** Bar graphs and error bars depict the mean and SEM of gene set (indicated by color in legend) STAT5A (*left*), HDAC6 (*middle*), or HMGN2 (*right*) peaks per gene **(B)**, signal per peak (CPM; counts per million) **(C)**, and signal per gene (sum of CPM) **(D)** relative to other expressed genes (gray bars). Asterisks denote *p* values of Welch's ANOVA posttests comparing the indicated means adjusted for multiple comparisons utilizing the Benjamini-Hochberg method. **(A-D)** ALL category represents bound CREs of all classes as well as any peaks not assigned to a known CRE. (*p<0.05, **p<0.01, ***p<0.001, ****p<0.0001) **(E)** Average (untreated condition with input subtracted) STAT5A, HDAC6, and HMGN2 ChIP-seq signal (CPM) of all genes in the indicated gene set across *cis*-regulatory regions utilized in this study (12.5 kbp upstream of transcription start site (TSS), gene body (scaled here to 5 kbp), and 2.5 kbp downstream of transcription termination site (TTS)).

genes. Prolactin regulated genes were characterized, however, by significantly more STAT5A proximal enhancer (pELS; high DNase and H3K27ac signals <2000 bp from TSS) peaks per gene (Figure 3.2.1B) and a significantly higher (2-fold average difference) STAT5A signal per peak at distal enhancers (dELS; high DNase and H3K27ac signals >2000 bp from TSS) relative to other expressed genes (Figure 3.2.1C). Significant STAT5A specificity for prolactin regulated genes was further demonstrated by the summation metric, signal per gene (Figure 3.2.1D), and the average STAT5A signal of each gene set plotted in Figure 3.2.1E.

While differences in the baseline/untreated *cis*-regulatory landscapes of STAT5A, HDAC6, and HMGN2 at prolactin regulated genes versus other expressed genes can certainly be appreciated visually in Figure 3.2.1E, the multi-condition experimental design employed here enabled us to also examine occupancy dynamics upon perturbation with prolactin and/or ACY-241 (Figure 3.2.2). STAT5A

phosphorylation and nuclear retrotranslocation are among the earliest known events to follow prolactin binding its cognate receptor, and accordingly, as observed at the Cyclin D1 locus in Figure 3.1.1C, increased STAT5A binding was measured 30 minutes after prolactin stimulation at a majority of *cis*-regulatory elements genome-wide. Similar to the PLS signal in the untreated state, the increase in STAT5A signal per peak at promoters of prolactin regulated genes was no different from other expressed genes (Figure 3.2.2A). However, the increase in STAT5A signal per peak at proximal and distal enhancers of prolactin regulated genes was significantly greater than at enhancers of other expressed genes (Figure 3.2.2A), suggesting that prolactin target gene specificity is exerted primarily at the level of enhancer elements rather than gene promoters. Amplification of enhancer-specific binding dynamics was also observed with ACY-241 treatment, in the form of significantly greater *decreases* in STAT5A binding at pELS and dELS of prolactin regulated genes (Figure 3.2.2A). When cells were treated with ACY-241 for two hours prior to prolactin stimulation, no significant changes in STAT5A signal were measured at any *cis*-regulatory elements (Figure 3.2.2A). The differential binding effects observed at promoters and enhancers with prolactin or ACY-241, and the neutralization of these dynamics observed with combined treatment can be visually appreciated in Figure 3.2.2B, where average STAT5A signal for each class of CRE at prolactin regulated genes is plotted and compared with other expressed genes. When the measured changes in signal per peak (Figure 3.2.2A) were aggregated with the proportion of genes with peaks (Figure 3.2.1A) and peaks per gene (Figure 3.2.1B), the product of these

Figure 3.2.2

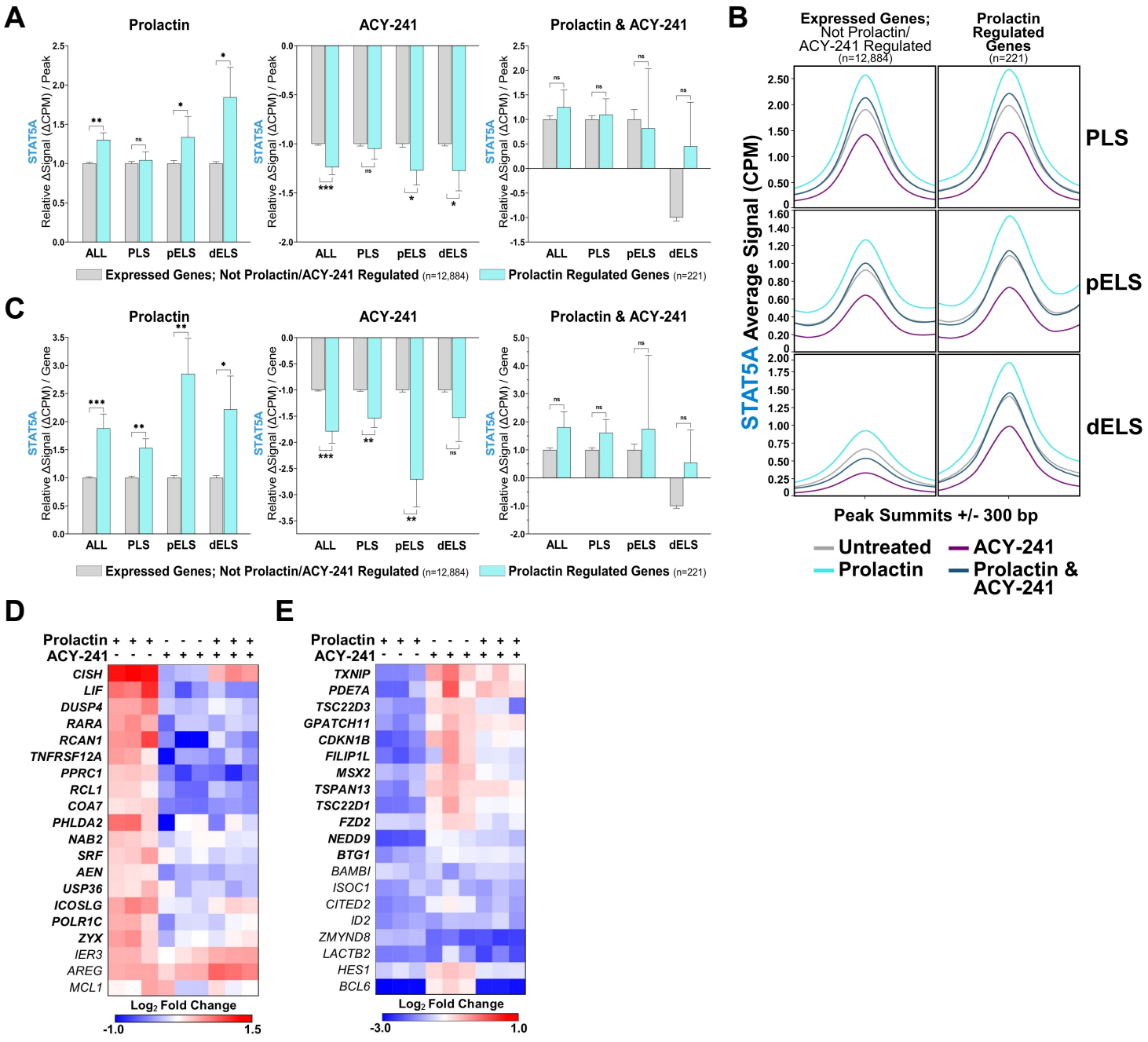


Figure 3.2.2 Prolactin induced STAT5A chromatin engagement and target gene expression are inhibited by ACY-241. (A,C) Bar graphs and error bars depict mean and SEM of STAT5A change (Δ) in signal (CPM; counts per million) per peak **(A)** or the sum of changes in signal per gene **(C)** for indicated CRE classes, with prolactin (*left*), ACY-241 (*middle*), or both prolactin and ACY-241 (*right*) treatment, versus the untreated (0.1% DMSO) state at prolactin regulated genes (blue) relative to other expressed genes (gray). Asterisks denote *p* value of Welch's t-test comparing the indicated means (*p<0.05, **p<0.01, ***p<0.001, ****p<0.0001). ALL category represents bound CREs of all classes as well as any peaks not assigned to a known CRE. **(B)** Lines plot the average STAT5A signal (CPM) of peaks (summit +/- 300 bp) at CREs of the indicated class in the untreated (gray), prolactin (light blue), ACY-241 (purple), or prolactin and ACY-241 (dark blue) treated states for prolactin regulated (*right column*) or other expressed (*left column*) genes. **(D-E)** Heatmaps depict $\log_2$ ratios (fold change) of normalized expression values for RNA-seq biological replicates (n=3 per condition) with indicated treatment versus untreated (0.1% DMSO) at the top 20 (ranked by Benjamini-Hochberg adjusted *p* value) prolactin induced **(D)** or prolactin inhibited **(E)** genes. Gene symbols in bold indicate genes that are significantly (FDR<0.05) inhibited **(D)** or induced **(E)** by ACY-241 in the prolactin + ACY-241 versus prolactin only differential expression analysis.

independent metrics of STAT5A *cis*-regulation – the change in signal per gene (Figure 3.2.2C) – demonstrated further enrichment and enhanced effect size at the CREs of prolactin regulated genes relative to other expressed genes. Consistent with the lack of net change in STAT5A CRE occupancy observed with combined ACY-241 treatment and prolactin stimulation (Figure 3.2.2A-C), ACY-241 significantly inhibited the expression of 85% of the top 20 prolactin induced genes (Figure 3.2.2D) and significantly induced the expression of 60% of the top 20 prolactin inhibited genes (Figure 3.2.2E), with 73% (161/221) of all prolactin regulated genes also differentially expressed with ACY-241 treatment.

3.3 Co-Occupancy Dynamics at Promoters and Enhancers

To further elucidate the chromatin-level interactions between STAT5A and HDAC6, we next analyzed cofactor binding dynamics at *cis*-regulatory elements independent of the gene sets identified by differential expression analysis. While a significant proportion of STAT5A-bound promoters and enhancers were not bound by HDAC6 at detectable levels – indicating chromatin-level HDAC6 interactions are not required for STAT5A DNA binding – HDAC6, on the other hand, demonstrated a remarkable affinity for STAT5A binding sites genome-wide, most significantly at promoters and enhancers; 86% of HDAC6 binding sites directly overlapped (<200 bp summit-to-summit) STAT5A binding sites at promoters (Fisher's exact test odds ratio (OR) = 2.34, p=1.2x10^{-5}), 84% at proximal enhancers (OR=6.97, p<1.0x10^{-15}), and 91% at distal enhancers (OR=14.81, p<1.0x10^{-15}) (Figure 3.3.1A). While direct, chromatin-

Figure 3.3.1

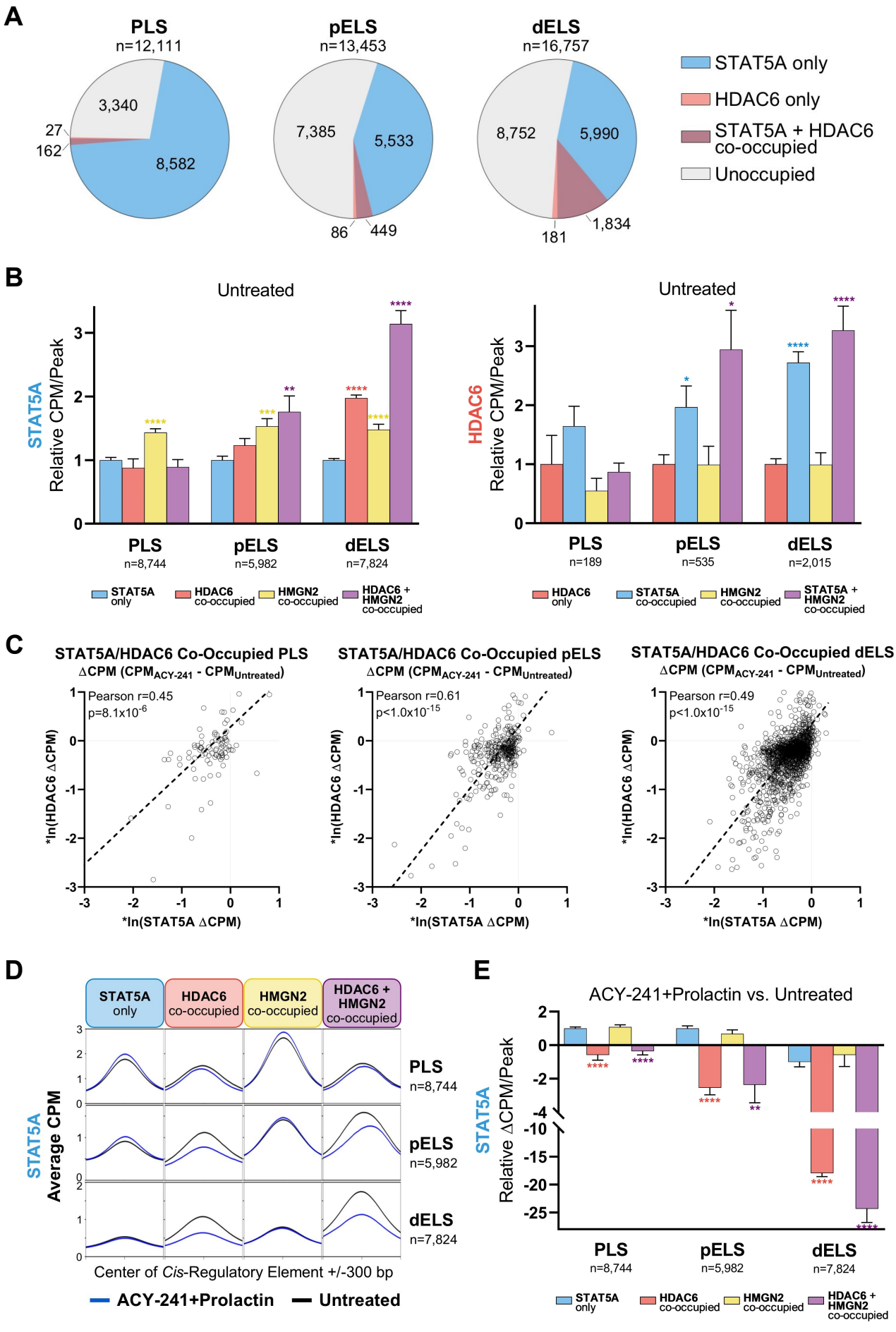

A
PLS
n=12,111
3,340
27
162
8,582
pELS
n=13,453
7,385
5,533
86
449
dELS
n=16,757
8,752
5,990
181
1,834
STAT5A only
HDAC6 only
STAT5A + HDAC6 co-occupied
Unoccupied
B
Untreated
STAT5A
Relative CPM/Peak
PLS
n=8,744
pELS
n=5,982
dELS
n=7,824
STAT5A only
HDAC6 co-occupied
HMGN2 co-occupied
HDAC6 + HMGN2 co-occupied
Untreated
HDAC6
Relative CPM/Peak
PLS
n=189
pELS
n=535
dELS
n=2,015
HDAC6 only
STAT5A co-occupied
HMGN2 co-occupied
STAT5A + HMGN2 co-occupied
C
STAT5A/HDAC6 Co-Occupied PLS
ΔCPM (CPMACY-241 - CPMUntreated)
Pearson r=0.45
p=8.1x10-6
*ln(HDAC6 ΔCPM)
*ln(STAT5A ΔCPM)
STAT5A/HDAC6 Co-Occupied pELS
ΔCPM (CPMACY-241 - CPMUntreated)
Pearson r=0.61
p<1.0x10-15
STAT5A/HDAC6 Co-Occupied dELS
ΔCPM (CPMACY-241 - CPMUntreated)
Pearson r=0.49
p<1.0x10-15
D
STAT5A only
HDAC6 co-occupied
HMGN2 co-occupied
HDAC6 + HMGN2 co-occupied
STAT5A
Average CPM
PLS
n=8,744
pELS
n=5,982
dELS
n=7,824
Center of Cis-Regulatory Element +/-300 bp
ACY-241+Prolactin
Untreated
E
ACY-241+Prolactin vs. Untreated
STAT5A
Relative ΔCPM/Peak
PLS
n=8,744
pELS
n=5,982
dELS
n=7,824
STAT5A only
HDAC6 co-occupied
HMGN2 co-occupied
HDAC6 + HMGN2 co-occupied

Figure 3.3.1 Co-occupancy dynamics demonstrate STAT5A-HDAC6 interactions and cooperative binding effects strongest at proximal and distal enhancers. (A) Circle charts depict the number and proportion of CREs – PLS, pELS, and dELS – bound by STAT5A, HDAC6, or both, as indicated by color in the accompanying legend. **(B)** ChIP-seq signal per peak (CPM; counts per million) in untreated MCF-7 cells at the indicated CRE types (x-axis). **(C)** Scatterplots depict log transformed* change in signal (ΔCPM) upon ACY-241 treatment at STAT5A and HDAC6 co-occupied CREs. Pearson correlation coefficients and linear regression (dashed lines) were calculated using untransformed ΔCPM values. *ΔCPM values were transformed to facilitate visualization as follows: $\ln(|\Delta CPM|+1) \cdot \text{sign}(\Delta CPM)$. **(D)** Lines plot the average STAT5A signal (CPM) of peaks (summit +/- 300 bp) at CREs of the indicated class (rows) and co-occupancy status (columns) in untreated (black) or ACY-241 and prolactin treated (blue) cells. **(E)** Change in STAT5A ChIP-seq signal (ΔCPM) per peak upon treatment with ACY-241 and prolactin at peaks of the indicated CRE type and occupancy status. **(A-E)** All occupancy and CPM measurements represent statistically significant peaks detected by MACS2 with FDR<0.01. Circle and bar colors depict co-occupancy as indicated in the accompanying legends. Bars and error bars indicate mean and SEM. CPM/ΔCPM are relative to the average CPM/ΔCPM of the corresponding CRE type occupied by only STAT5A **(B** *left***, E)** or only HDAC6 **(B** *right***)**. Asterisks indicate *p* value of Welch's ANOVA posttests comparing means of co-occupied CREs to that of the corresponding CRE occupied by only STAT5A **(B** *left***, E)** or only HDAC6 **(B** *right***)** adjusted for multiple comparisons utilizing the Benjamini-Hochberg method. (*p<0.05, **p<0.01, ***p<0.001, ****p<0.0001)

level STAT5A-HDAC6 interactions were not required for STAT5A binding at promoters and enhancers, average signal (CPM) of both HDAC6 and STAT5A were markedly enhanced at *cis*-regulatory elements that were co-occupied (peaks <200 bp summit-to-summit), most significantly at distal enhancers, where STAT5A and HDAC6 signals were 2.0- and 2.7-fold greater, respectively, than at dELS occupied by either cofactor alone (p<0.0001; Figure 3.3.1B). Consistent with our previous studies identifying HMGN2 as an HDAC6 substrate that requires HDAC6 catalytic activity to facilitate STAT5A chromatin engagement [74], STAT5A and HDAC6 signals

(CPM) were further increased relative to singly occupied sites – 3.1- and 3.3-fold, respectively – at sites also bound by HMGN2 (p<0.0001; Figure 3.3.1B).

Here, and in previous work [74], we identify pharmacological HDAC6 inhibition as an important regulator of gene expression mediated by prolactin via STAT5A. Importantly, HDAC6 inhibition had no effect on the elevated nuclear concentration of phosphorylated STAT5A following prolactin stimulation [74], leading us to hypothesize that disrupted STAT5A target gene expression is a product of direct, chromatin-level STAT5A/HDAC6 dynamics and/or DNA-independent, nuclear protein-protein interactions. Indeed, inhibition of HDAC6 catalytic activity with ACY-241 demonstrated a dramatic disruption of STAT5A *and* HDAC6 binding genome-wide and, most significantly, at promoters and enhancers (Figure 3.3.2A-B [168]). Loss of STAT5A binding as a function of treatment with ACY-241, was significantly greater at promoters and enhancers where HDAC6 was present compared with *cis*-regulatory elements bound by STAT5A alone (Figure 3.3.2A-B [168]). This effect was most pronounced at co-occupied proximal and distal enhancers with loss of STAT5A signal (ΔCPM) 1.6- and 2.2-fold greater, respectively, than at pELS and dELS occupied by STAT5A only. Interestingly, while decreased STAT5A binding at HMGN2 co-occupied sites was only modestly different than STAT5A alone, a synergistic effect was observed at STAT5A-bound pELS and dELS co-occupied by HDAC6 *and* HMGN2 with 2.3- and 3.6-fold greater losses than at sites bound by STAT5A only (Figure 3.3.2A-B [168]). Given the significant effect of STAT5A and HDAC6 co-occupancy on binding dynamics observed at the aggregate, group level, we

Figure 3.3.2

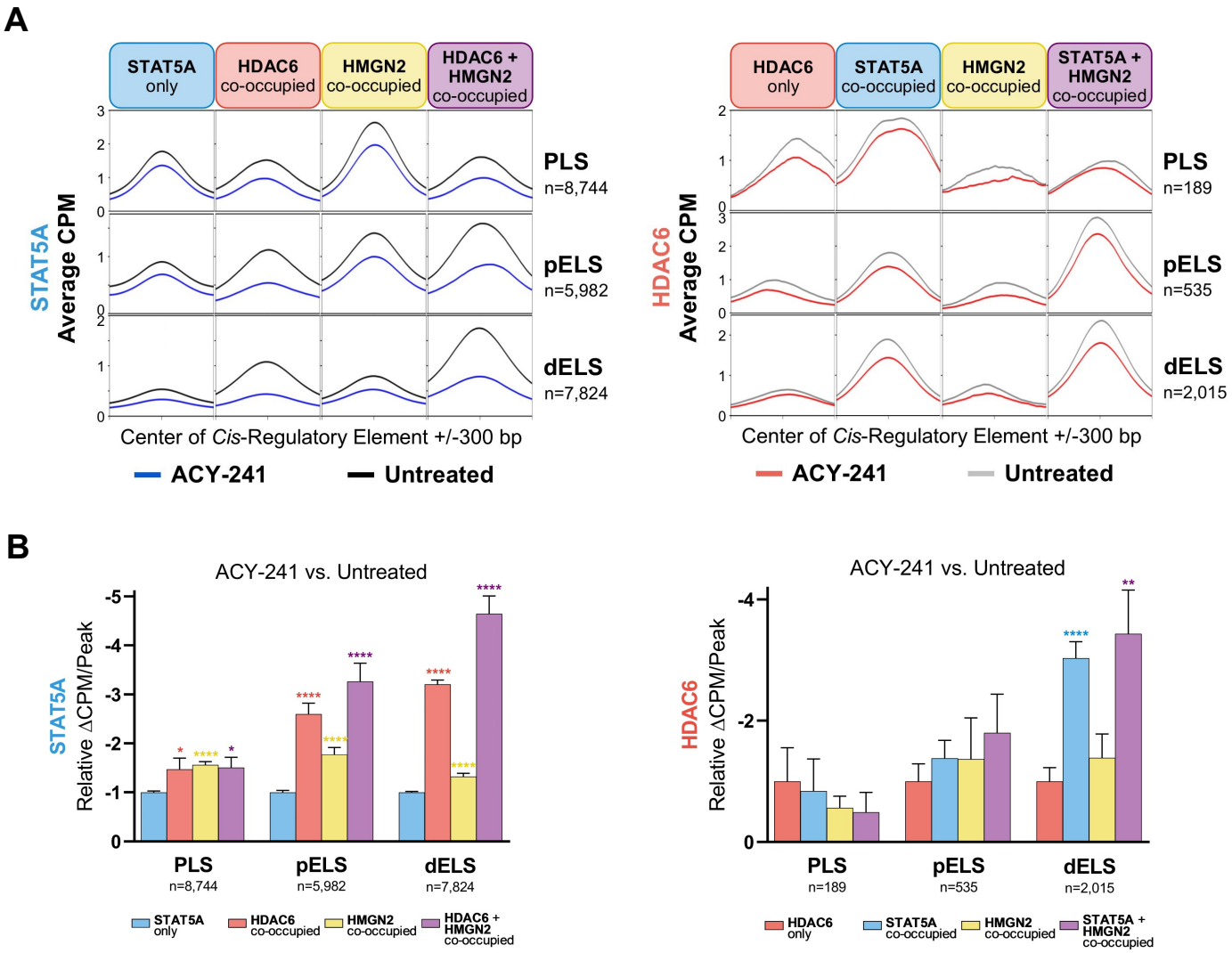


Figure 3.3.2 Inhibition of HDAC6 catalytic activity by ACY-241 disrupts STAT5A and HDAC6 chromatin engagement with greatest effect at co-occupied *cis*-regulatory elements. (A) Plotted lines depict the mean signal (CPM; Counts Per Million) of 10 bp bins surrounding the centers (+/- 300 bp) of the indicated CRE type (rows) and co-occupancy status (columns) in untreated (STAT5A; black, HDAC6; gray) or ACY-241 treated (STAT5A; blue, HDAC6; red) cells. **(B)** Bars and error bars indicate the mean and SEM of the change in STAT5A (*left*) or HDAC6 (*right*) ChIP-seq signal (ΔCPM) per peak upon treatment with ACY-241 at peaks of the indicated CRE type and occupancy status. Bar colors depict co-occupancy (overlapping peaks <200 bp summit-to-summit) as indicated in the accompanying legends. Relative ΔCPM is normalized to the average ΔCPM of the corresponding CRE type occupied by only STAT5A (*left*) or only HDAC6 (*right*). Asterisks indicate *p* value of Welch's ANOVA posttests comparing means of co-occupied CREs to that of the corresponding CRE occupied by only STAT5A (*left*) or only HDAC6 (*right*) adjusted for multiple comparisons utilizing the Benjamini-Hochberg method. (**p*<0.05, ***p*<0.01, ****p*<0.001, *****p*<0.0001) **(A-B)** All occupancy and CPM measurements represent statistically significant peaks detected by MACS2 with FDR<0.01.

next looked at individual loci where these cofactors directly overlapped and asked whether a change in STAT5A binding was correlated with a change in HDAC6 binding at the same site. Indeed, significant ($p<1.0x10^{-5}$), positive, Pearson correlations and a linear relationship were observed between ACY-241 mediated changes in STAT5A and HDAC6 binding at CREs where their binding sites directly overlapped, with the strongest relationship observed at co-occupied proximal enhancers (Pearson r = 0.61, $p<1.0x10^{-15}$; Figure 3.3.1C).

The hormone, prolactin, drives rapidly elevated levels of nuclear phosphorylated STAT5A upon binding its cognate cell surface receptor. Here, we observed this effect 30 minutes following prolactin stimulation manifest as significantly increased STAT5A binding at *cis*-regulatory elements genome-wide (Figure 3.3.3A-B [169]). HDAC6 co-occupancy at STAT5A binding sites also associated with a prolactin stimulated increase in STAT5A binding; at distal enhancers, increased STAT5A binding was significantly amplified ($p<1.0x10^{-6}$) 1.3- or 1.4-fold in the presence of HDAC6 or HMGN2, respectively, and 2.4-fold with HDAC6 and HMGN2 co-occupancy ($p<1.0x10^{-7}$; Figure 3.3.3A-B [169]). Interestingly, average genome-wide HDAC6 binding was decreased by prolactin, and the average decrease was greater at proximal and distal enhancers co-occupied by STAT5A (Figure 3.3.3A-B [169]). However, no statistically significant ($p<0.05$) Pearson correlations were measured between the changes in HDAC6 and STAT5A at individual promoters and enhancers. Upon visual inspection of the data, in contrast to ACY-241 mediated changes in HDAC6/STAT5A binding, prolactin stimulated binding dynamics

Figure 3.3.3

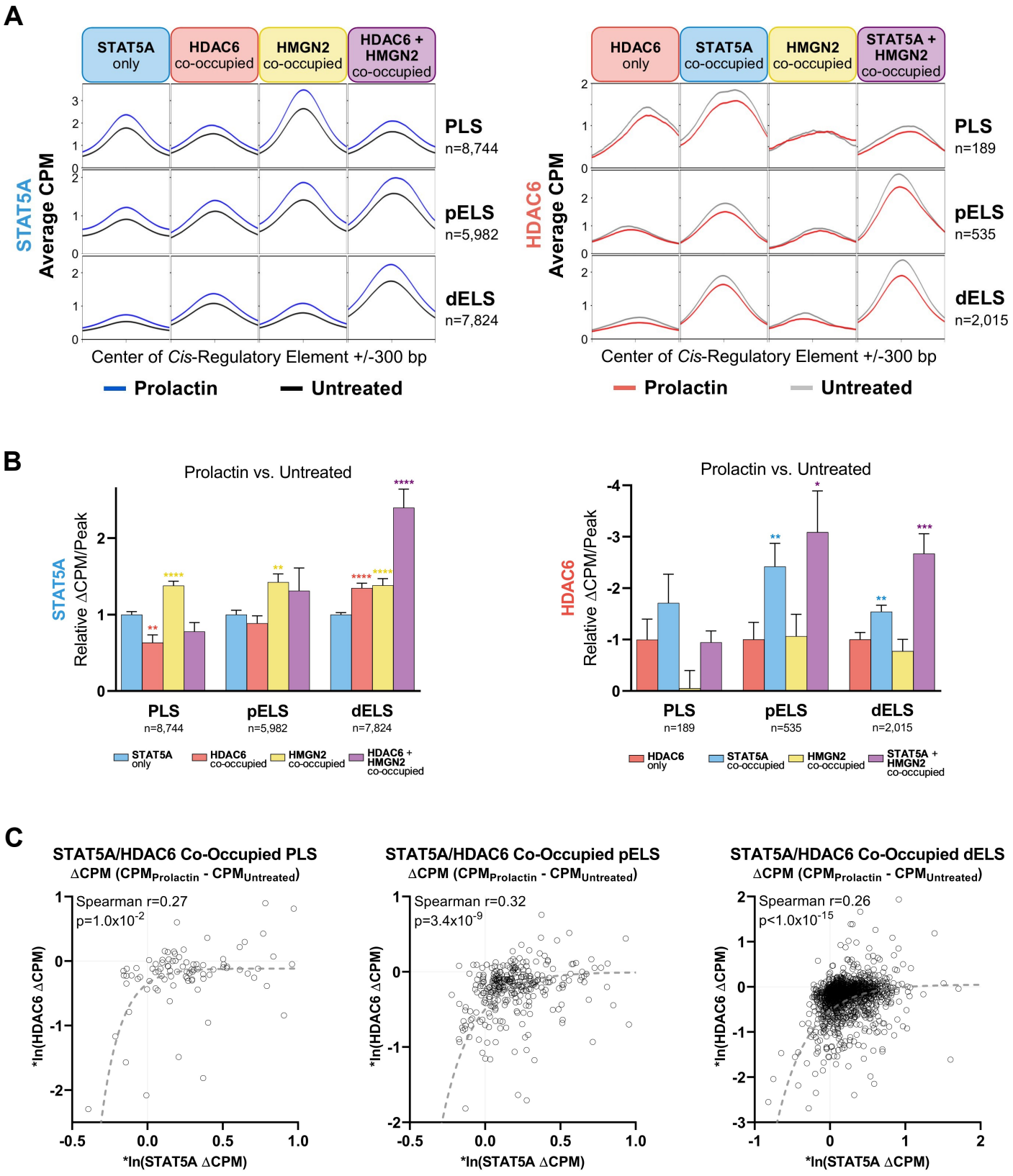

A
STAT5A only
HDAC6 co-occupied
HMGN2 co-occupied
HDAC6 + HMGN2 co-occupied
STAT5A Average CPM
PLS n=8,744
pELS n=5,982
dELS n=7,824
Center of Cis-Regulatory Element +/-300 bp
Prolactin
Untreated
HDAC6 only
STAT5A co-occupied
HMGN2 co-occupied
STAT5A + HMGN2 co-occupied
HDAC6 Average CPM
PLS n=189
pELS n=535
dELS n=2,015
B
Prolactin vs. Untreated
STAT5A Relative ΔCPM/Peak
HDAC6 Relative ΔCPM/Peak
C
STAT5A/HDAC6 Co-Occupied PLS
STAT5A/HDAC6 Co-Occupied pELS
STAT5A/HDAC6 Co-Occupied dELS
ΔCPM (CPMProlactin - CPMUntreated)
Spearman r=0.27
p=1.0x10-2
Spearman r=0.32
p=3.4x10-9
Spearman r=0.26
p<1.0x10-15
*ln(HDAC6 ΔCPM)
*ln(STAT5A ΔCPM)

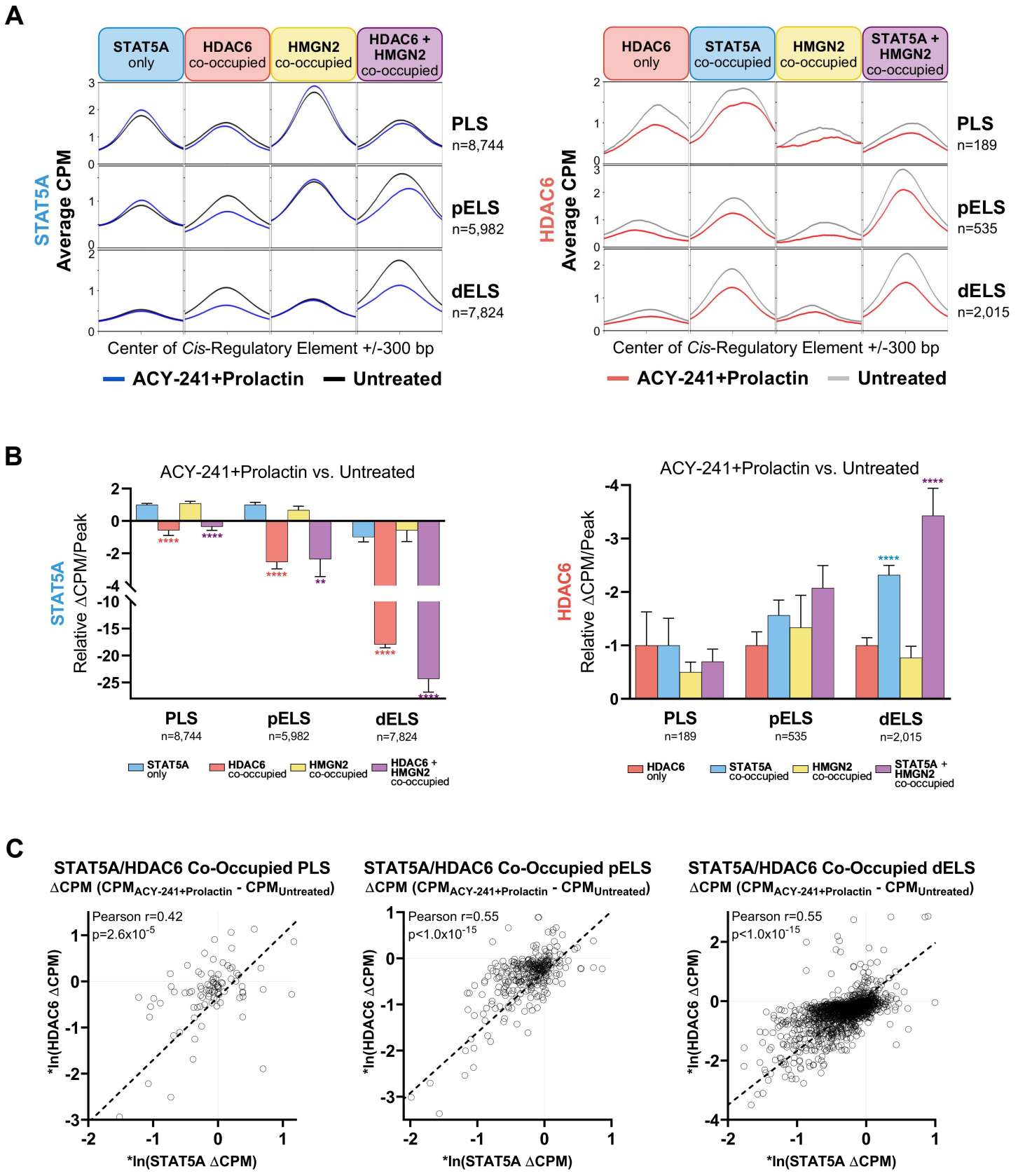
Figure 3.3.3 Prolactin stimulation reveals complex, context and co-occupancy dependent STAT5A-HDAC6 interactions defined by positive Spearman correlations. (A) Plotted lines depict the mean signal (CPM; Counts Per Million) of 10 bp bins surrounding the centers (+/- 300 bp) of the indicated CRE type (rows) and co-occupancy status (columns) in untreated (STAT5A; black, HDAC6; gray) or prolactin treated (STAT5A; blue, HDAC6; red) cells. **(B)** Bars and error bars indicate the mean and SEM of the change in STAT5A (*left*) or HDAC6 (*right*) ChIP-seq signal (ΔCPM) per peak upon treatment with prolactin at peaks of the indicated CRE type and occupancy status. Bar colors depict co-occupancy (overlapping peaks <200 bp summit-to-summit) as indicated in the accompanying legends. Relative ΔCPM is normalized to the average ΔCPM of the corresponding CRE type occupied by only STAT5A (*left*) or only HDAC6 (*right*). Asterisks indicate *p* value of Welch's ANOVA posttests comparing means of co-occupied CREs to that of the corresponding CRE occupied by only STAT5A (*left*) or only HDAC6 (*right*) adjusted for multiple comparisons utilizing the Benjamini-Hochberg method. (*p<0.05, **p<0.01, ***p<0.001, ****p<0.0001) **(C)** Scatterplots depict log transformed* change in signal (ΔCPM) upon prolactin stimulation at STAT5A and HDAC6 co-occupied CREs. Spearman correlation coefficients and non-linear regression (dashed lines) were calculated using untransformed ΔCPM values. *ΔCPM values were transformed to facilitate visualization as follows: $\ln(|\Delta CPM|+1) \cdot \text{sign}(\Delta CPM)$. **(A-C)** All occupancy and CPM measurements represent statistically significant peaks detected by MACS2 with FDR<0.01.

demonstrated a non-linear relationship. Indeed, Spearman correlations of STAT5A/HDAC6 changes at individual loci were positive and statistically significant; the largest prolactin stimulated decreases in HDAC6 binding occurred at sites where prolactin stimulated increases in STAT5A binding were smallest and vice versa (Figure 3.3.3C [169]). This is consistent with the interaction and positive correlation between HDAC6 and STAT5A binding demonstrated with ACY-241 treatment but suggests moderation of this relationship by additional factors. In lieu of unidentified prolactin-specific regulatory mechanism(s), the authors speculate that 30 minutes post prolactin stimulation may have been insufficient time to allow for full STAT5A induction and a corresponding HDAC6 association to equilibrate; lacking a DNA

binding domain, changes in HDAC6 binding may be expected to take longer than STAT5A, and even full STAT5A induction and enhancer remodeling is known to occur over many hours to days or weeks during mammary development [170].

Having established the individual effects of ACY-241 and prolactin on binding dynamics, we next investigated the combined or net effect of ACY-241 and prolactin together, this interaction being the most relevant in the therapeutic context. Consistent with demonstrated inhibition of prolactin stimulated gene expression (Figure 3.2.2D-E), pharmacological HDAC6 inhibition with ACY-241 significantly inhibited prolactin stimulated STAT5A recruitment to *cis*-regulatory elements genome-wide (Figure 3.3.1D-E). This effect was significantly amplified at promoters and enhancers co-occupied by HDAC6 relative to sites occupied by STAT5A alone or with HMGN2 (Figure 3.3.1D-E). HDAC6 co-occupancy effects were statistically significant at both promoters and enhancers, though the greatest effect sizes occurred at enhancers; changes in STAT5A binding at proximal and distal enhancers co-occupied by HDAC6 were 3.5-fold and 17-fold greater, respectively, than at sites occupied by STAT5A alone ($p<1.0x10^{-13}$; Figure 3.3.1D-E). Likewise, HDAC6 was also decreased at promoters and enhancers and demonstrated significantly greater losses at sites co-occupied by STAT5A than at sites occupied by HDAC6 alone (Figure 3.3.4A-B [171]). Importantly, as seen with ACY-241 treatment in isolation, changes in STAT5A and HDAC6 binding at co-occupied *cis*-regulatory elements demonstrated significant, positive correlations and a linear relationship, suggesting that this mechanism is dominant over other prolactin-specific regulation in the context of *both*

Figure 3.3.4


A
STAT5A only
HDAC6 co-occupied
HMGN2 co-occupied
HDAC6 + HMGN2 co-occupied
STAT5A Average CPM
PLS n=8,744
pELS n=5,982
dELS n=7,824
Center of Cis-Regulatory Element +/-300 bp
ACY-241+Prolactin
Untreated
HDAC6 only
STAT5A co-occupied
HMGN2 co-occupied
STAT5A + HMGN2 co-occupied
HDAC6 Average CPM
PLS n=189
pELS n=535
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B
ACY-241+Prolactin vs. Untreated
STAT5A Relative ΔCPM/Peak
HDAC6 Relative ΔCPM/Peak
C
STAT5A/HDAC6 Co-Occupied PLS
STAT5A/HDAC6 Co-Occupied pELS
STAT5A/HDAC6 Co-Occupied dELS
ΔCPM (CPMACY-241+Prolactin - CPMUntreated)
Pearson r=0.42
p=2.6x10-5
Pearson r=0.55
p<1.0x10-15
*ln(HDAC6 ΔCPM)
*ln(STAT5A ΔCPM)

Figure 3.3.4 ACY-241 inhibits prolactin-inducible STAT5A binding with greatest effect at promoters and enhancers co-occupied by HDAC6. (A) Plotted lines depict the mean signal (CPM; Counts Per Million) of 10 bp bins surrounding the centers (+/- 300 bp) of the indicated CRE type (rows) and co-occupancy status (columns) in untreated (STAT5A; black, HDAC6; gray) or ACY-241 and prolactin treated (STAT5A; blue, HDAC6; red) cells. **(B)** Bars and error bars indicate the mean and SEM of the change in STAT5A (*left*) or HDAC6 (*right*) ChIP-seq signal (ΔCPM) per peak upon treatment with ACY-241 and prolactin at peaks of the indicated CRE type and occupancy status. Bar colors depict co-occupancy (overlapping peaks <200 bp summit-to-summit) as indicated in the accompanying legends. Relative ΔCPM is normalized to the average ΔCPM of the corresponding CRE type occupied by only STAT5A (*left*) or only HDAC6 (*right*). Asterisks indicate *p* value of Welch's ANOVA posttests comparing means of co-occupied CREs to that of the corresponding CRE occupied by only STAT5A (*left*) or only HDAC6 (*right*) adjusted for multiple comparisons utilizing the Benjamini-Hochberg method. (*p<0.05, **p<0.01, ***p<0.001, ****p<0.0001) **(C)** Scatterplots depict log transformed* change in signal (ΔCPM) upon treatment with ACY-241 and prolactin at STAT5A and HDAC6 co-occupied CREs. Spearman correlation coefficients and non-linear regression (dashed lines) were calculated using untransformed ΔCPM values. *ΔCPM values were transformed to facilitate visualization as follows: $\ln(|\Delta CPM|+1) \cdot \text{sign}(\Delta CPM)$. **(A-C)** All occupancy and CPM measurements represent statistically significant peaks detected by MACS2 with FDR<0.01.

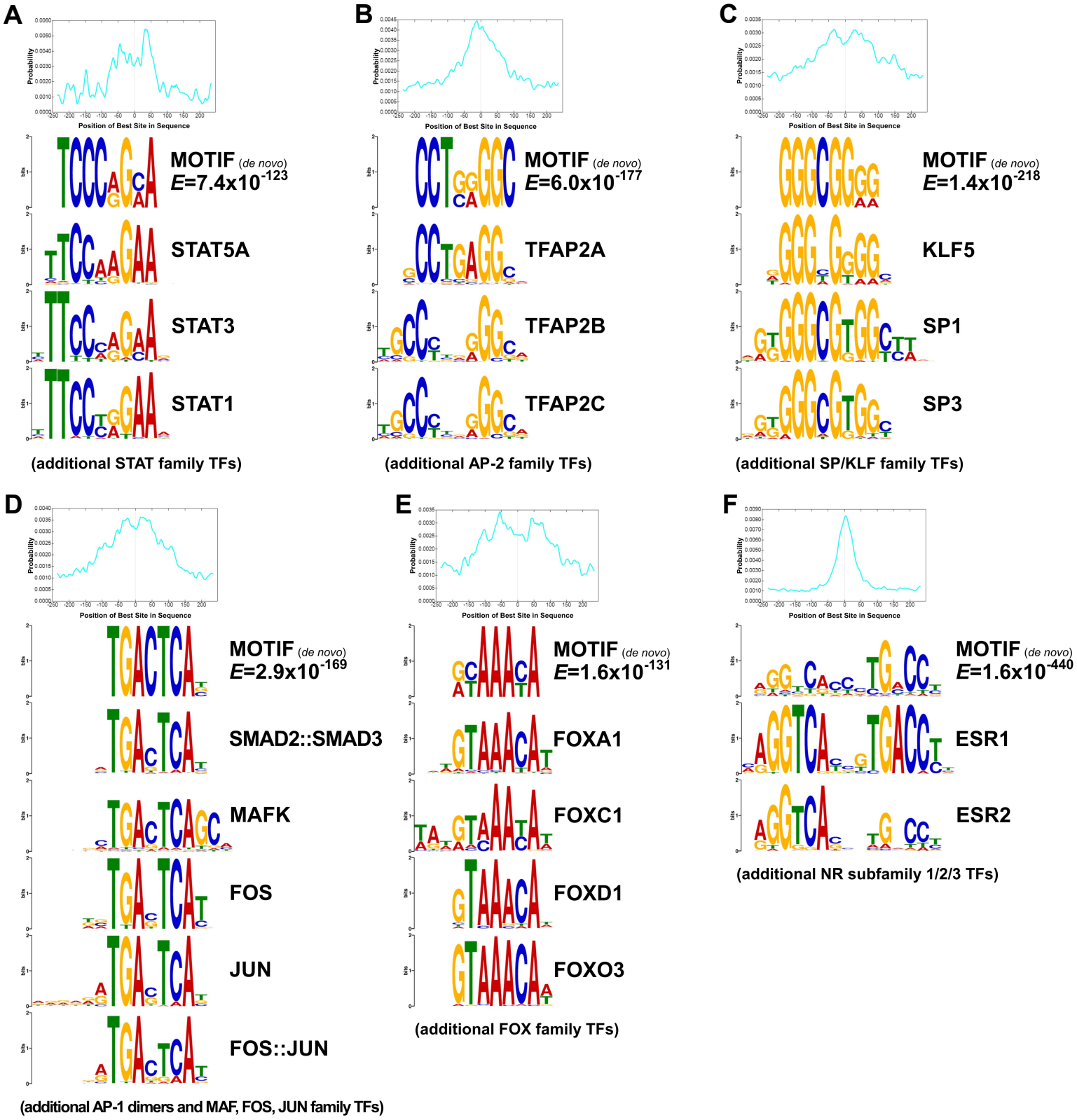
HDAC6 inhibition and prolactin stimulation (Figure 3.3.4C [171]). The binding dynamics observed upon experimental perturbation with ACY-241 and prolactin at co-occupied sites present strong evidence for a direct, chromatin-level, STAT5A/HDAC6 interaction that mediates their DNA binding activity.

3.4 Motif Enrichment Underlying STAT5A and HDAC6 Binding Sites

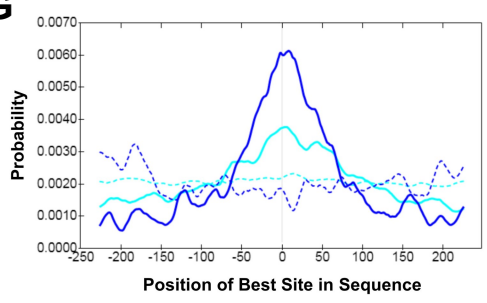
In light of the significant interactions between STAT5A and HDAC6 at shared binding sites, we next investigated the DNA binding motifs underlying shared sites and asked whether these motifs were significantly different from those underlying unshared binding sites. Specifically, MEME-ChIP [172, 173 174 175] *de novo* motif

identification analysis was conducted using the DNA sequences underlying STAT5A and HDAC6 peak summits at promoters and enhancers (PLS, pELS, dELS). The most significant, centrally enriched, *de novo* motifs were analyzed for statistically significant matches (p<0.00001) to known motifs in the 2020 release of the JASPAR CORE database [176] identified by the Tomtom tool [177] (Figure 3.4.1A-F). In the DNA sequences underlying STAT5A peaks, a specific search for canonical interferon gamma activated sequences, or GAS motifs (TCCNNNGAA), revealed occurrences in 67%, 57%, and 45% of STAT5A bound PLS, pELS, and dELS, respectively, and a centrally enriched *de novo* motif matching the JASPAR database STAT5A motif (MA1624.1; a variant of the GAS motif) was identified at STAT5A-bound promoters (PLS) (E=7.4x10^{-123}, Figure 3.4.1A). Not surprisingly, a *de novo* motif matching members of the ubiquitously expressed NFY family of transcription factors (TFs), proteins responsible for maintaining the nucleosome depleted region around promoters [178], was also highly enriched at STAT5A-bound promoters (E=1.4x10^{-474}). Additional, centrally enriched, *de novo* motifs underlying STAT5A binding sites at both promoters and enhancers included motifs matching AP-2 family TFs (e.g. TFAP2A; E=6.0x10^{-177}, Figure 3.4.1B), SP/KLF family TFs (e.g. SP1, SP3, KLF5; E=1.4x10^{-218}, Figure 3.4.1C), AP-1 subunits (e.g. FOS and JUN proteins; E=2.9x10^{-169}, Figure 3.4.1D), ETS family TFs (e.g. ELK, ELF, and FLI proteins; E=2.6x10^{-96}), and the CREB family of TFs (e.g. CREB, CREM, and ATF proteins; E=6.1x10^{-85}). Centrally enriched at enhancers (pELS, dELS) only, *de novo* motifs matching the

Figure 3.4.1



G



- **ESR1;** Enhancers bound by co-localized STAT5A/HDAC6 p=2.0x10^{-53}
- **ESR1;** Enhancers bound by STAT5A only p=1.0
- **ESR2;** Enhancers bound by co-localized STAT5A/HDAC6 p=2.3x10^{-91}
- **ESR2;** Enhancers bound by STAT5A only p=1.4x10^{-3}

H

Co-localized STAT5A/HDAC6 Differential Motif Enrichment

	Fisher's *E*-value
ESR2	1.7x10^{-61}
ESR1	8.2x10^{-41}
FOXP3	2.9x10^{-37}
NR2F2	1.1x10^{-33}
RORA	4.7x10^{-33}
FOXC1	5.7x10^{-26}
FOXA1	2.6x10^{-24}

(additional NR and FOX family TFs)

Figure 3.4.1 Motif analysis at STAT5A and HDAC6 peak centers identifies differential motif enrichment underlying shared STAT5A/HDAC6 binding sites in enhancers. (A-F) *de novo* motif analysis of DNA sequences underlying STAT5A peaks at PLS **(A)**, STAT5A peaks at PLS, pELS, and dELS **(B-D)**, or HDAC6 peaks at PLS, pELS, and dELS **(E-F)**. Motif probability curves (*top*) plot maximum likelihood estimate of the conditional probability that the best match of the *de novo* motifs (indicated below) occur at a relative distance (bp) from peak centers (x-axis). Motif logos plot sequence information content (bits) per position for each motif. *E*-values indicate an estimate of the expected number of motifs with the same width and site count with an equal or greater log likelihood ratio that would be found in a similarly sized set of random sequences. Plotted beneath each *de novo* motif are matching known motifs with statistically significant ($p<1.0x10^{-5}$) similarity. **(G)** Motif probability curves as in **A-F** demonstrate differential enrichment of ESR1 and ESR2 motifs underlying STAT5A peaks at STAT5A/HDAC6 co-occupied (solid lines) or STAT5A only occupied (dashed lines) pELS and dELS. Enrichment *p*-values were calculated by one-tailed binomial test. **(H)** Table lists top scoring motifs (by Fisher's *E*-value; a one-tailed Fisher's exact test *p*-value adjusted for multiple comparisons) that are differentially enriched at STAT5A peaks in co-occupied pELS/dELS relative to pELS/dELS bound by STAT5A only.

FOX TF family (e.g. FOXA1, FOXD1, FOXO3; $E=9.0x10^{-369}$) and Nuclear Receptor (NR) family TFs (e.g. ESR1 (ERα), ESR2 (ERß); $E=3.9x10^{-50}$) were also identified.

Analysis of *de novo* motifs underlying HDAC6 peak summits at promoters and enhancers added further intrigue to the STAT5A/FOXA1/ER association; the most significant, centrally enriched, *de novo* motifs at HDAC6 peaks matched FOXA1 ($E=1.6x10^{-131}$, Figure 3.4.1E) and ERα/ß ($E=1.6x10^{-440}$, Figure 3.4.1F). Given that 90% of HDAC6 binding sites at promoters and enhancers directly overlapped STAT5A binding sites (Figure 3.3.1A), it is not surprising that HDAC6 enriched motifs were a subset of the enriched motifs found at STAT5A binding sites. Comparison of enrichment centrality at HDAC6 binding sites in Figure 3.4.1F with the centrality of

the same enriched motifs at STAT5A binding sites in Figure 3.4.1G provides strong evidence for direct interaction with each other or a shared cofactor (e.g. ER, FOXA1) at these sites, and is consistent with the stringent criteria used here to define peak overlap (<200 bp summit-to-summit). We next asked whether enriched motifs underlying shared STAT5A/HDAC6 binding sites were significantly different from those underlying STAT5A binding sites where HDAC6 is absent. Indeed, while shared STAT5A/HDAC6 binding sites at proximal and distal enhancers were highly enriched for ESR1 and ESR2 motifs, STAT5A binding sites at enhancers lacking HDAC6 were almost entirely devoid of ESR1/2 motifs (Figure 3.4.1G). Differential enrichment analysis confirmed these findings as highly significant (Fisher's *E*-value = $1.7x10^{-61}$ - $8.2x10^{-41}$), and identified other nuclear receptor (NR) family TFs as well as FOX family TFs (including FOXA1) as also being highly differentially enriched at shared STAT5A/HDAC6 enhancer binding sites relative to enhancers bound by STAT5A only (Figure 3.4.1H).

3.5 Functional Pathway Enrichment

Given the observed STAT5A/HDAC6 cofactor dynamics at co-occupied promoters and enhancers (Figure 3.3.1) and differentially enriched motifs underlying shared STAT5A/HDAC6 binding sites at enhancers (Figure 3.4.1), we next investigated the functional pathways enriched by prolactin regulated genes with STAT5A/HDAC6 co-occupied CREs. Attesting to HDAC6 specificity for prolactin and STAT5A signaling, prolactin regulated genes were significantly more likely than

other expressed genes to have cis-regulatory elements co-occupied by STAT5A and HDAC6, particularly promoters (PLS; OR=3.92, Fisher's exact test *p*-value = 8.6×10^{-4}) and proximal enhancers (pELS; OR=2.23, Fisher's exact test *p*-value = 5.3×10^{-3}). Remarkably consistent with the differential enrichment of ESR1/ESR2 motifs at STAT5A-HDAC6 co-occupied enhancers (Figure 3.4.1G-H), Ingenuity Pathway Analysis (IPA) of the 35/221 prolactin regulated genes with STAT5A-HDAC6 co-occupied promoters or enhancers identified ERα target genes among the most significant gene set enrichments (one-tailed Fisher's exact test *p*-value = 2.9×10^{-6}) and ERα as the top scoring predicted upstream regulator (calculated using gene set overlap and direction of change in the prolactin vs. untreated differential expression values, as described in [179]) (Figure 3.5.1A). Since IPA of all 221 prolactin regulated genes also identified ERα targets as being highly enriched (one-tailed Fisher's exact test *p*-value = 9.8×10^{-7}, Figure 3.5.1B), we next asked whether the enrichment of ERα targets among genes with STAT5A/HDAC6 co-occupied promoters or enhancers (8/35 genes) was significantly different from other prolactin regulated genes (12/186 genes). Indeed, genes with STAT5A/HDAC6 co-occupied promoters or enhancers were 4.3 times more likely than other prolactin regulated genes to be ERα targets (Fisher's exact test *p*-value = 5.6×10^{-3}). These results are not only consistent with the enrichment of ERα motifs at enhancers bound by STAT5A and HDAC6, but also highlight the degree of similarity – both in shared targets and direction of regulation – between prolactin and estrogen directed gene expression.

Figure 3.5.1

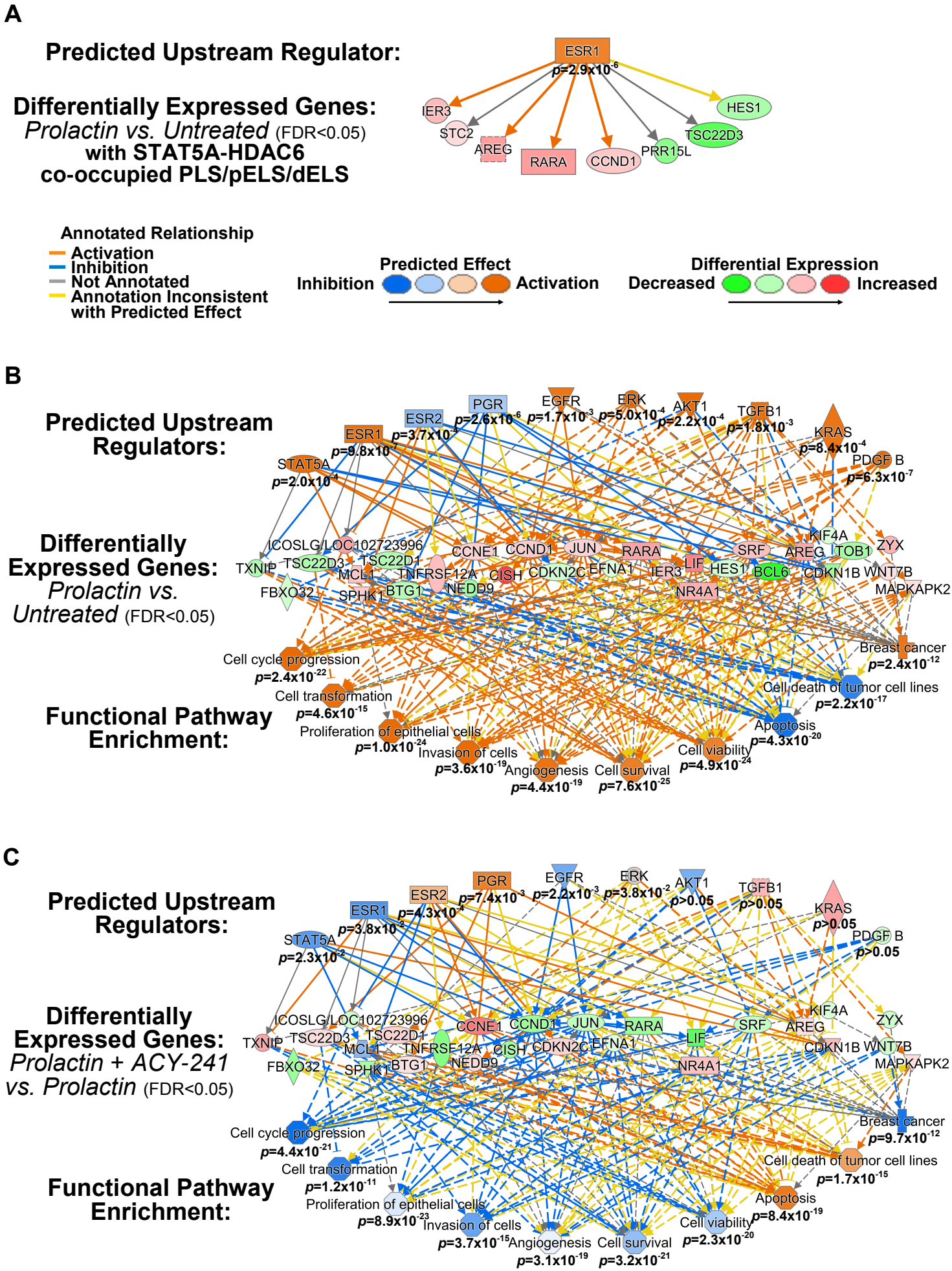

A
Predicted Upstream Regulator:
Differentially Expressed Genes:
Prolactin vs. Untreated (FDR<0.05)
with STAT5A-HDAC6
co-occupied PLS/pELS/dELS
ESR1
p=2.9x10-6
IER3
STC2
AREG
RARA
CCND1
PRR15L
TSC22D3
HES1
Annotated Relationship
Activation
Inhibition
Not Annotated
Annotation Inconsistent with Predicted Effect
Predicted Effect
Inhibition
Activation
Differential Expression
Decreased
Increased
B
Predicted Upstream Regulators:
Differentially Expressed Genes:
Prolactin vs. Untreated (FDR<0.05)
Functional Pathway Enrichment:
PGR p=2.6x10-6
EGFR p=1.7x10-3
ERK p=5.0x10-4
AKT1 p=2.2x10-4
TGFB1 p=1.8x10-3
ESR2 p=3.7x10-4
ESR1 p=9.8x10-7
KRAS p=8.4x10-4
PDGF B p=6.3x10-7
STAT5A p=2.0x10-4
ICOSLG/LOC102723996
CCNE1
CCND1
JUN
RARA
SRF
AREG
TOB1
ZYX
TXNIP
TSC22D3
TSC22D1
MCL1
TNFRSF12A
CISH
CDKN2C
EFNA1
LIF
HES1
BCL6
CDKN1B
WNT7B
FBXO32
SPHK1
BTG1
NEDD9
NR4A1
MAPKAPK2
KIF4A
IER3
Cell cycle progression p=2.4x10-22
Cell transformation p=4.6x10-15
Proliferation of epithelial cells p=1.0x10-24
Invasion of cells p=3.6x10-19
Angiogenesis p=4.4x10-19
Cell survival p=7.6x10-25
Cell viability p=4.9x10-24
Apoptosis p=4.3x10-20
Cell death of tumor cell lines p=2.2x10-17
Breast cancer p=2.4x10-12
C
Predicted Upstream Regulators:
Differentially Expressed Genes:
Prolactin + ACY-241 vs. Prolactin (FDR<0.05)
Functional Pathway Enrichment:
PGR p=7.4x10-3
EGFR p=2.2x10-3
ERK p=3.8x10-2
AKT1 p>0.05
TGFB1 p>0.05
ESR2 p=4.3x10-4
ESR1 p=3.8x10-2
KRAS p>0.05
PDGF B p>0.05
STAT5A p=2.3x10-2
ICOSLG/LOC102723996
CCNE1
CCND1
JUN
RARA
SRF
AREG
KIF4A
ZYX
TXNIP
TSC22D3
TSC22D1
MCL1
TNFRSF12A
CISH
CDKN2C
EFNA1
LIF
CDKN1B
WNT7B
FBXO32
SPHK1
BTG1
NEDD9
NR4A1
MAPKAPK2
Cell cycle progression p=4.4x10-21
Cell transformation p=1.2x10-11
Proliferation of epithelial cells p=8.9x10-23
Invasion of cells p=3.7x10-15
Angiogenesis p=3.1x10-19
Cell survival p=3.2x10-21
Cell viability p=2.3x10-20
Apoptosis p=8.4x10-19
Cell death of tumor cell lines p=1.7x10-15
Breast cancer p=9.7x10-12

Figure 3.5.1 Prolactin regulated genes are significantly enriched in oncogenic pathways activated by prolactin and inhibited by ACY-241. (A-C) Networks depict the results of Ingenuity Pathway Analysis (IPA) analyzing significant (FDR<0.05) gene sets identified by RNA-seq differential expression analysis and the corresponding expression $\log_2$ fold changes - **(A)** prolactin regulated genes with STAT5A/HDAC6 co-occupied PLS, pELS, or dELS, **(B)** all prolactin regulated genes, and **(C)**, ACY-241 regulated genes that intersect (overlap) the enriched prolactin regulated genes depicted in **B**. Predicted upstream regulators are plotted in the top row of each network, followed beneath by differentially expressed genes that overlap with the indicated pathways. Significantly enriched functional pathways are plotted in the bottom row of **B-C**. Fisher's exact test *p*-values are indicated for the differentially expressed gene enrichment in each functional or upstream regulator pathway. Predicted effects are based on concordance/discordance of differential expression values with annotated network relationships in the Ingenuity knowledge base. Gene colors indicate RNA-seq differential expression values (e.g. green indicates decreased expression in the prolactin **(A-B)** or ACY-241 **(C)** treated conditions). The colors of all upstream regulator or functional pathway shapes/lines correspond to a predicted effect or annotated relationship as indicated in the legend beneath **A**. Connecting lines indicate annotated direct (solid) or indirect (dashed) interactions.

IPA of all prolactin regulated genes demonstrated highly significant enrichments in functional pathways underlying the development and progression of cancer (Figure 3.5.1B). Comparison of prolactin regulated differential expression values with literature annotations in the Ingenuity knowledge base enabled predictions of prolactin's net effect on these pathways, demonstrating very consistent, pro-tumorigenic prolactin signaling (Figure 3.5.1B). Additionally, prolactin regulated genes were significantly enriched for the targets of hormone receptors, growth factor receptors and kinases with well-appreciated roles in the pathogenesis of breast cancer; prolactin regulation of these target genes was consistent with net activation of the predicted upstream regulators, with the exceptions of ERß and progesterone receptor (PGR) targets, where the direction of prolactin driven differential expression

was consistent with ERß and PGR inhibition (Figure 3.5.1B). To assess the functional effects of HDAC6 inhibition on prolactin signaling, the differentially expressed genes and differential expression values identified in our prolactin and ACY-241 vs. prolactin only RNA-seq analysis were utilized to recalculate the gene set enrichments and functional predictions identified in Figure 3.5.1B (Figure 3.5.1C). Consistent with the high similarity of differentially expressed gene sets and largely opposite direction of regulation of ACY-241 relative to prolactin, ACY-241 regulated genes were significantly enriched in all of the functional pathways identified with prolactin regulated genes in Figure 3.5.1B, but the predicted net effect of ACY-241 was opposite that of prolactin (Figure 3.5.1C). In contrast to prolactin regulated genes, ACY-241 regulated genes were not significantly enriched for the target genes of AKT1, TGFB1, KRAS, or PDGFB; however, like prolactin, ACY-241 regulated genes were also significantly enriched for the annotated downstream targets of STAT5A, ESR1, ESR2, PGR, and EGFR but with opposite direction of predicted upstream regulator effects (Figure 3.5.1C). The functional enrichments identified here demonstrate the significant oncogenic potential of prolactin signaling – underscored by target genes and regulatory effects shared with established oncogenes – as well as the therapeutic potential of ACY-241 in counteracting these effects.

3.6 ACY-241 Functional Efficacy in Breast Cancer Models

Given the observed and predicted effects of ACY-241 on tumorigenic gene expression (Figure 3.5.1) and its current use in multiple myeloma and non-small cell

lung cancer clinical trials [180, 181], we next assessed the translational potential and functional efficacy of ACY-241 in pre-clinical breast cancer models (Figure 3.6.1). ACY-241 in *in vitro* viability assays utilizing both conventional breast cancer cell lines (MCF-7, MDA-MB-231) and patient derived xenograft (PDX) models (HCI-011, HCI-013, WHIM30) revealed significant dose-dependent decreases in cell viability following treatment (Figure 3.6.1A-E). Consistent with HDAC6 enrichment demonstrated at *cis*-regulatory elements governing ERα target genes (Figure 3.4.1E-H, 3.5.1A) and enrichment of ACY-241 regulated genes in ERα target gene sets (Figure 3.5.1C), pharmacological HDAC6 inhibition showed greater potency and efficacy in reducing the viability of ER^+ breast cancer models (IC_{50} = 1.1-8.2 μM, Figure 3.6.1A-C) in comparison to ER^- breast cancer models (IC_{50} = 36.1-123.6 μM, Figure 3.6.1D-E). Cell proliferation and anchorage independent growth of MCF-7 cells were also inhibited by ACY-241 treatment, with cell proliferation IC_{50} of 2.1 μM (Figure 3.6.1F) and significantly impaired colony seeding and outgrowth in soft agar (Figure 3.6.1G). Given ACY-241 oral bioavailability and a lack of dose-limiting toxicities in early phase I clinical trial reports [182], we next assessed the chemopreventative potential and chemotherapeutic efficacy of ACY-241 *in vivo* utilizing the MMTV-PyMT mouse model of breast cancer progression. MMTV-PyMT mice are immunocompetent and develop spontaneous mammary lesions along a predictable timeline that mimics the progression of human breast cancers. At distinct timepoints corresponding to the animals' development of mammary hyperplasia, adenomas, or invasive carcinomas and metastases, we intervened with daily ACY-

Figure 3.6.1

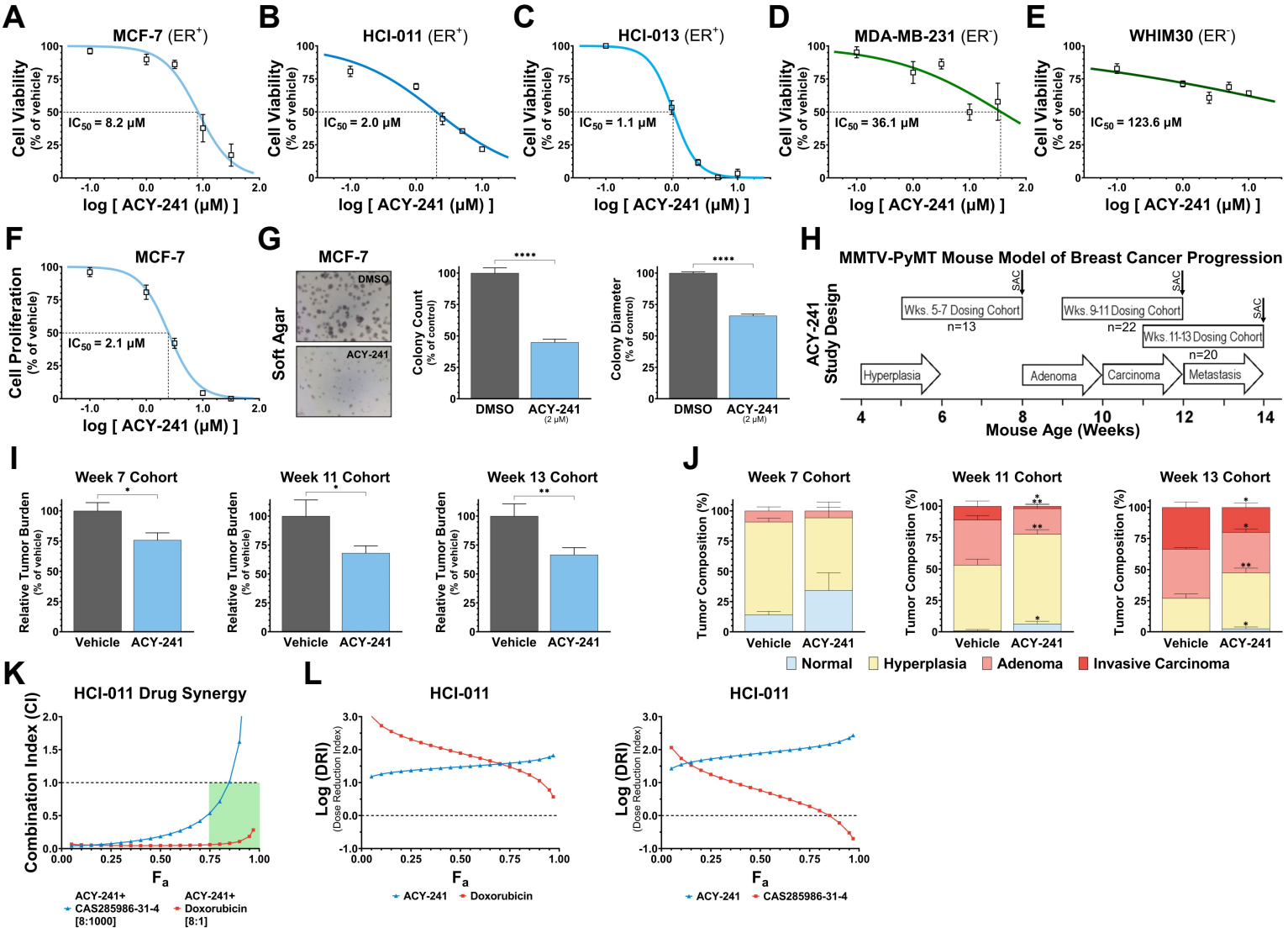


Figure 3.6.1 ACY-241 demonstrates therapeutic efficacy in *in vitro* and *in vivo* breast cancer models. (A-E) Plots indicate cell viability as a function of ACY-241 dose in five *in vitro* breast cancer models (MCF-7, HCI-011, HCI-013, MDA-MB-231, and WHIM30). **(F)** Plot indicates MCF-7 cell proliferation as a function of ACY-241 dose. **(A-F)** Squares and error bars depict the mean and SEM, respectively, of three biological replicates. **(G)** Anchorage-independent growth of MCF-7 single cell suspensions is measured in soft agar 21 days after plating and treatment with either ACY-241 (2 μM) or 0.1% DMSO control. Representative images depict unstained colonies on day 21. Colonies were stained with MTT before quantifying colony numbers and colony diameters in 10 high-power fields per biological replicate (n=3). **(H)** Schematic of *in vivo* ACY-241 study design utilizing the MMTV-PyMT mouse model of breast cancer progression. For the Week 7 Cohort, treatment and control group sample sizes are n=7 and n=6, respectively. Treatment and control groups are equally sized for the Week 11 and Week 13 Cohorts, n=11 and n=10, respectively. **(I)** Tumor burden was quantified as the mass of all grossly visible mammary tumors and adjacent mammary gland tissue and is expressed here as percent of vehicle treated animals for each cohort.**(J)** H&E stained

sections of tumor/adjacent mammary gland were examined by a board-certified pathologist and the histological percent composition of hyperplasia, adenoma, invasive carcinoma, or normal tissue were quantified for each animal. Treatment groups were compared for each histological category by unpaired t-test. **(G-J)** Bars and error bars indicate mean and SEM, respectively. Asterisks denote statistical significance of unpaired t-tests (*p<0.05, **p<0.01, ***p<0.001, ****p<0.0001). **(K-L)** HCI-011 cells were treated with ACY-241, CAS285986-31-4, or doxorubicin alone (6 concentrations of each drug), and with 12 different concentration combinations each of ACY-241 and CAS285986-31-4 or ACY-241 and doxorubicin at constant ratios (ACY-241:CAS285986-31-4 [8:1000]; ACY-241:doxorubicin [8:1]). Cell viability was measured (three biological replicates per concentration combination) and used to calculate the fraction affected (F_a = 1-fraction viable cells). Dose and F_a data were used to calculate Combination Index (CI) versus F_a curves **(K)** and Dose Reduction Index (DRI) curves **(L)**. CI<1 indicates synergism, CI=1 indicates additive effects, CI>1 indicates antagonism, Log (DRI)>0 indicates a favorable dose reduction. All viability and proliferation assays were measured 72 hours after drug treatment and are expressed as percent of vehicle (0.1% DMSO) treated control cells.

241 (50 mg/kg) intraperitoneal (IP) injections for 21 days in three separate cohorts of treatment and control animals that we termed the Week 7 Cohort (n=13), Week 11 Cohort (n=22), and Week 13 Cohort (n=20) (Figure 3.6.1H). ACY-241 treatment significantly reduced tumor burden in each cohort of animals (Figure 3.6.1I), and most interestingly, treatment with ACY-241 demonstrated significant efficacy in impairing the histological progression of mammary lesions as scored by a board-certified pathologist (C.C.) (Figure 3.6.1J). While the *in vivo* results of ACY-241 as a monotherapy were significant, the greatest translational potential is likely to be its combined use with other therapeutics; we therefore conducted a small drug screen with several existing and candidate breast cancer therapeutics (n=9) using a luciferase-based cell viability assay in the ER^+ PDX model, HCI-011. Surprisingly,

this small pilot study led to the identification of two drugs, doxorubicin and CAS285986-31-4, that demonstrated significant anti-tumor synergy with ACY-241 (as defined by the Chou-Talalay CI Method [183] [184]; Figure 3.6.1K-L). Identification of ACY-241/doxorubicin synergy is translationally relevant as various formulations of doxorubicin (Adriamycin) are currently employed in the clinical treatment of breast cancer, but dose-limiting toxicities are common; as demonstrated in Figure 3.6.1L, combination of doxorubicin with ACY-241 enables a more than 10-fold doxorubicin dose reduction while still attaining 90% tumor cell death. Lastly, ACY-241 synergy with CAS285986-31-4, an inhibitor of STAT5 tyrosine phosphorylation and subsequent binding of DNA, is of particular note, given the STAT5A/HDAC6 cofactor dynamics demonstrated here, and is consistent with the reported efficacy of vertical pathway inhibition [185-190], in this case targeting the clearly intertwined cellular functions and chromatin interactions of STAT5A and HDAC6 in breast cancer.

Chapter 4: DISCUSSION

4.1 Summary and Discussion of Findings

4.1.1 STAT5A/HDAC6 Chromatin-Level Regulation of Prolactin Induced Gene Expression

This study generated novel STAT5A, HDAC6, and HMGN2 ChIP-seq datasets in human breast cancer cells and utilized a framework of recently identified *cis*-regulatory elements to measure multiple, independent features contributing to the *cis*-regulatory landscape of prolactin responsive genes. The summation of these features provides improved understanding of prolactin inducible STAT5A binding and the manner in which specificity for prolactin responsive genes is achieved. In contrast to previously reported analyses of ChIP-seq datasets, where lack of known CREs made it necessary to define regulatory elements like promoters with arbitrary cutoffs for proximity to the nearest gene (frequently 2500 bp or more), incorporation of the ENCODE CRE framework enabled discrimination of minimal promoter and proximal enhancer elements [140]. This improved resolving power enabled insights gleaned here. Of note, we find that relatively ubiquitous, prolactin induced, STAT5A binding at gene promoters carries exceedingly little information content and that prolactin/STAT5A target gene specificity is instead conveyed by inducible binding at proximal and distal enhancers. Whether this finding extends to other cellular contexts or other hormone-/cytokine-inducible transcription factors is subject to future investigation. It is interesting to note that the importance of STAT5A at several mammary specific enhancers over the course of pregnancy and lactation in

mice has been previously reported [191]. In addition to demonstrating greater sensitivity to prolactin withdrawal than universal cytokine-responsive enhancers, elegant experimentation has revealed evolving contributions of certain STAT5-bound enhancers as a function of time [170]. Complementary, but distinct, our findings demonstrate immediate – developing in minutes rather than days or weeks – prolactin specific STAT5A activity at human enhancers that is also more pervasive and characteristic of prolactin regulated genes than was previously appreciated.

A multi-condition experimental design leveraging prolactin-inducible STAT5A chromatin engagement enabled the demonstration of STAT5A/HDAC6 cofactor interactions at *cis*-regulatory elements genome-wide. Correlated STAT5A/HDAC6 binding dynamics at co-occupied sites following experimental perturbation with ACY-241 and prolactin demonstrate strong evidence for direct chromatin-level interactions governing STAT5A and HDAC6 binding. However, following ACY-241 treatment, significant decreases in STAT5A binding are also observed at many sites not shared by HDAC6; this supports the likely possibility that DNA-independent STAT5A-HDAC6 interactions – either direct or through a shared intermediary – are also present. HDAC6 possesses multiple domains capable of simultaneous protein-protein interactions including two functional deacetylase domains [77], a high affinity ubiquitin-binding domain [95, 192], and a dynein motor binding domain [80]. As a small molecule specifically designed to bind the active site of HDAC6 deacetylase domains, ACY-241 likely disrupts HDAC6 protein-protein interactions asymmetrically dependent upon the specific domain mediating a given interaction. Additional studies

are necessary to determine the structural domains responsible for the STAT5A-HDAC6 interactions reported here as well as the precise mechanism by which ACY-241 disrupts these interactions.

4.1.2 Cofactor Interactions

Our group previously reported the association of immunoprecipitated STAT5A with DNA motifs of the AP-2, SP, ETS, and Estrogen Receptor TF families in 2009 as significant hits in a TF-TF array [193]; subsequent studies employing STAT5 ChIP-seq confirmed these and other STAT5A-associated motifs reported here [194, 195]. AP-1, AP-2, SP/KLF, ETS, CREB, FOX, and Nuclear Receptor transcription factor families represent a particularly interesting group of proteins to associate with STAT5A binding sites; each family contains members with top scoring motifs that also have reported roles in breast cancer. The activator protein 1 (AP-1) transcription factor, consisting of JUN and/or FOS subunits (or ATF/JDP proteins), was previously shown to co-immunoprecipitate (co-IP) with STAT5A and demonstrates prolactin stimulated activity that promotes tumor progression in breast cancer models [196-199]. The AP-2 family of TFs are critical regulators of murine mammary gland development and in the context of human breast cancers, TFAP2C is overexpressed while TFAP2A and TFAP2C correlate with the expression of ERα and HER2 [200, 201]. The SP/KLF family has extensive roles in various cancers and in breast cancer specifically, KLF5 promotes proliferation and invasion of cancer cells while SP1 and SP3 interact with ERα to promote estrogen and VEGF signaling [202, 203]. The forkhead box (FOX) family

is a group of pioneer factors that have been extensively linked to estrogen receptor signaling and ER+ breast cancer pathogenesis [204, 205]; FOXA1, specifically, is frequently amplified and/or overexpressed in human breast cancer primary tumors and metastases where its high expression promotes endocrine resistance via altered ER signaling [206-208]. As such, FOXA1 motif enrichment in conjunction with ESR1/2 motif enrichment at STAT5A-bound enhancers is of particular interest.

The differential enrichment of ESR1 and ESR2 motifs underlying shared STAT5A/HDAC6 binding sites at enhancers is indeed a novel finding, though existing reports in the literature also support the possibility of direct HDAC6-ER and STAT5A-ER physical interactions. The strongest evidence for a direct HDAC6-ER interaction comes from a study where ERα is maintained at the cell surface by fusion with a Src kinase membrane-localizing domain; this "memER" construct co-IPs with HDAC6 via interactions between the activation function 2 (AF-2) domain of ERα and the second deacetylase domain of HDAC6 [209]. However, as whole cell lysates are used for the co-IPs, the interaction could be the result of a shared intermediary such as heat shock protein 90 (Hsp90), with Hsp90-ER and Hsp90-HDAC6 physical interactions well documented [88, 210, 211]. Co-immunoprecipitation of STAT5A and ERα revealed interactions in MCF-7 and T-47D cells [212], and STAT5A interactions with other nuclear hormone receptors like glucocorticoid receptor (GR) and progesterone receptor (PR) have also been reported [213-215]. ChIP re-ChIP experiments previously demonstrated STAT5A/ERα co-occupancy at prolactin receptor promoter chromatin [216]. The collective evidence here and in the literature supports the likelihood of direct

STAT5A/HDAC6/ER interactions. Indirect interactions, on the other hand, are nearly certain as Hsp90-STAT5A binding has been reported [48, 217, 218], establishing Hsp90 as a highly abundant, shared intermediary of STAT5A, HDAC6, and ERα.

4.1.3 Intersection of Prolactin and Estrogen Signaling and Implications in Breast Cancer

This study adds to the already known and complex relationships between the hormone signaling pathways of prolactin and estrogen in breast cancer. Specifically, we demonstrate binding sites that are shared between STAT5A, HDAC6, and ERα at enhancers of shared prolactin and ERα target genes. To determine the overlap of our ChIP-seq peak datasets with similar, experimentally derived ERα binding sites – rather than just ERE sequences – we recently analyzed an ERα ChIP-seq dataset from estrogen stimulated MCF-7 cells published by Guan *et al.* [219]. Of 16,116 detected ERα peaks, 45% (7,203/16,116) overlapped with a STAT5A peak (<300 bp summit-to-summit). In contrast, of ERα peaks occurring in *cis*-regulatory regions of prolactin regulated genes, 85% (123/144) directly overlapped with a STAT5A binding site. 80% of prolactin regulated genes have STAT5A bound promoters, yet only 19% (23/123) of STAT5A/ERα co-occupied sites occurred at promoters. Instead, 63% (77/123) of STAT5A/ERα co-occupied sites occurred at enhancers. This is notable given our findings that prolactin stimulated STAT5A specificity for prolactin regulated genes is conveyed via enhancers and suggests that ERα may interact with STAT5A preferentially at the *cis*-regulatory elements most important for control of hormone

regulated gene expression. In addition to shared chromatin level binding sites, we also demonstrated greater than previously appreciated overlap of gene expression regulated by prolactin and ERα. Pharmacological HDAC6 inhibition with ACY-241 was effective at blocking prolactin induced expression at these shared target genes and ER^+ breast cancer models demonstrated differential sensitivity to ACY-241 relative to ER^- models. These findings provide new perspective for a 2005 study by Saji *et al.* where it was reported that HDAC6 expression levels were induced by estrogen and that HDAC6 expression was an independent prognostic indicator significantly associated with improved survival in ER^+ breast cancer patients treated with tamoxifen (measured by immunohistochemistry of archival tissues; n=139). In ER^- patients or in the absence of stratification by ER status, however, HDAC6 expression was not significantly associated with differences in either relapse-free or overall survival[104]. This study is also interesting with respect to the ACY-241 efficacy we report in the MMTV-PyMT model of breast cancer progression. MMTV-PyMT tumors are known to have heterogeneous hormone receptor expression, tending to be ER/PR positive early on and losing ER expression as invasive carcinoma and metastases develop [220, 221]. While we found that ACY-241 impaired tumor growth and histological progression, the effect size was not overwhelming; mammary tumor growth in these mice was not entirely ablated nor was progression entirely impeded and metastases to the lungs showed only a non-significant trend towards reduction (data not shown). While earlier ACY-241 treatment or increased duration of treatment beyond 3 weeks might improve results, it is also possible that

heterogeneity of these tumors with respect to ER expression contributed to mixed ACY-241 efficacy. Immunohistochemical characterization of ER status in the tumors from our study and correlation analysis with ACY-241 effect could be revealing. Regardless, further investigation of ACY-241 therapeutic efficacy in pre-clinical breast cancer models is certainly warranted, and, given the demonstrated synergy of ACY-241 with the STAT5A inhibitor, CAS285986-31-4, the translational potential of combination treatment utilizing ACY-241 and CAS285986-31-4 with ER-targeting endocrine therapies is particularly intriguing.

Several previous studies from the literature offer additional evidence consistent with the overlap of prolactin/STAT5A and ERα signaling pathways that we report here and are worth noting: 1) STAT5A deletion impaired development of estrogen induced mammary hyperplasia in CERM (conditional ERα in mammary epithelium) mice[222] and completely ablated incidence of estrogen accelerated ductal carcinoma *in situ* (DCIS) and invasive carcinoma in calveolin-1 KO mice [223]. 2) In a large retrospective study, elevated serum prolactin concentration was associated with a 2-fold increased risk for developing ER^+ breast cancers, but showed no association with risk for ER^- tumors [109]. 3) The establishment of luminal ER^+ patient derived xenograft (PDX) models has long been a challenge for the breast cancer field as these tumors rarely grow when transplanted into mice. The Rui laboratory recently generated a human prolactin transgenic mouse (murine prolactin does not stimulate the human prolactin receptor)[224]. Intriguingly, luminal ER^+ patient tumors grew in the human prolactin transgenic mouse at a rate not seen before in the field.

Furthermore, these tumors were more responsive to tamoxifen than the same tumor transplanted into a wildtype mouse, and several PDX lines showed evidence of prolactin dependent metastatic progression. When taken together with shared STAT5A/HDAC6/ERα binding sites, shared prolactin/estrogen target genes, and differential sensitivity of ER+ models to HDAC6 and STAT5A inhibition, this evidence challenges the conception of prolactin/STAT5A signaling and ERα signaling as entirely distinct pathways, and, consequently, may offer resolution to a long-standing controversy regarding the role of STAT5A in breast cancer pathogenesis. Specifically, it has been reported that nuclear phosphorylated STAT5A (pSTAT5A) is a positive prognostic indicator for ER^+ breast cancer response to endocrine therapy and that nuclear pSTAT5A is reduced in post-treatment metastases, indicating that STAT5A is not a driver of breast cancer progression, but rather helps maintain lesions in a more differentiated, less invasive state[60, 61]. Reinterpreted with the perspective that STAT5A and ERα are cooperative branches of a common intertwined pathway rather than separate entities, STAT5A expression and activity may be a prognostic indicator for response to endocrine therapy because STAT5A signaling itself is targeted by anti-estrogen endocrine therapies and pSTAT5A may be reduced post-treatment because of treatment mediated selection, just as ERα expression is a positive prognostic indicator for response to anti-estrogen therapies and is commonly reduced post-treatment [225-227].

4.1.4 Study Limitations

Notably, this study was limited by an absence of chromatin conformation data and analysis was restricted to a conservatively defined group of *cis*-regulatory elements. As such, it ignored topologically associated domains [228] and a significant set of potential cofactor interactions at distal regulatory elements and promoter-enhancer or enhancer-enhancer contacts mediated by CTCF and chromatin loops. Although a study by the Hennighausen group investigating the effect of CTCF binding site deletion on mammary specific super-enhancers at the casein locus concluded that many CTCF mediated chromatin loops may not significantly affect expression of genes under super-enhancer control [229], identification of topologically associated domains in our study would enable the association of genes with more distal (>12.5 kbp) regulatory elements than were considered here and improve utilization of our existing ChIP-seq data; additional analyses integrating our data with chromosome conformation technologies (e.g. Hi-C, ChIA-PET, etc.) would therefore be informative. A substantial fraction of peaks were detected outside annotated CREs; while limiting the conclusions that could be drawn from these binding sites, this finding was not entirely unexpected and can be explained by a host of rationale, including but not limited to the ENCODE authors' explicitly stated incomplete CRE catalogue, the relatively deep sequencing performed here, real binding sites at chromatin lacking high DNase accessibility as well as peak false positives. The reported chromatin interactions and gene expression changes are reflective of the *in vitro* breast cancer model from which they were derived; while

some findings are certainly unique to the specific transformed environment, another subset likely reflect original prolactin functions retained from normal breast epithelium. Though ACY-241 had no effect on the expression of major milk proteins (caseins; *CASAS1, CASAS2, CASB, CASK,* or wheys; *LALBA, LGB, WAP*), studies in additional models are necessary to determine how HDAC6 inhibition affects prolactin signaling in normal epithelium and the generalizability of our findings to other breast cancer models. Finally, even the relatively complex, multi-condition, integrated ChIP-seq and RNA-seq experimental design utilized by this study still captured only limited snapshots – averaged across bulk cell populations – of highly dynamic processes progressing asynchronously amongst individual cells. Future studies incorporating live cell imaging and single cell technologies will likely yield additional mechanistic insights and complement the findings reported here.

4.2 Additional Future Directions

This study examined functional efficacy of ACY-241 in breast cancer models and took a global, genome-wide approach to study STAT5A/HDAC6 chromatin interactions involved in prolactin signaling and breast cancer. Most obviously, similar studies in additional breast cancer models (e.g. ACY-241 antitumor functional assays in additional PDX and *in vivo* models, ChIP-seq in additional *in vitro* models, etc.) would strengthen our findings and enable assessment of generalizability. Given our data presented here and previous reports of STAT5A/ERα associations in patient tumors, analysis of survival/therapeutic response in the most recent, publicly

available, large cohort breast cancer studies (e.g. TCGA, METABRIC) stratifying by STAT5A, ERα, and HDAC6 expression could provide translational insights. Also worth noting, as our group originally discovered the STAT5A/HMGN2 connection when identifying nuclear PRLr and its transactivation domain that bound HMGN2 as well as chromatin at the *CISH* promoter [20], PRLr ChIP-seq would provide a wealth of entirely novel data. As the binding of a cell surface receptor to chromatin is somewhat heretical though, such a study would likely need to be bolstered with thorough validation and confirmation by complementary assays (e.g. ChIP-PCR of detected binding sites, high resolution microscopy confirming nuclear localization, etc.). However, rather than generating additional large genome-wide datasets, perhaps the most important future studies that naturally arise from our work are those that would follow-up on the physical cofactor interactions we propose here. Specifically, the subcellular localization and interacting domains/residues of the STAT5A/HDAC6/ERα associations should be investigated by nuclear/cytoplasmic fractionation and co-immunoprecipitation (co-IP) assays. Initial co-IPs should assess interaction of endogenous, full-length proteins, and if positive, followed by sequential co-IP of truncation mutants, then point-mutants at potential regulatory amino acids. Other studies investigating the regulatory mechanisms governing STAT5A/HDAC6/ERα binding at co-occupied enhancers identified here would also be informative (e.g. examining the effect of individual cofactor knockout/down on the chromatin binding of the remaining cofactors measured by ChIP-PCR, or the effect of binding site mutagenesis on cofactor chromatin engagement and target gene

transcription, etc.). Not only adding to our knowledge of the underlying processes, identification of specific cofactor physical interactions and/or regulatory mechanisms is significant because it can lead to additional opportunities for therapeutic intervention.

Data Availability: All data generated or analyzed during this study are included in this published article or in the data repositories listed in References. All ChIP-seq and RNA-seq datasets are available via the National Center for Biotechnology Information Gene Expression Omnibus under accession GSE165452.

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APPENDICES

Appendix A Differentially Expressed Genes (Prolactin vs. Untreated; FDR<0.05)

GeneID	Log_2 Fold Change	Mean Normalized Expression	*p*-value	adjusted *p*-value
CISH	1.3176	4.4370	0.00000000003	0.00000026866
BCL6	-2.2669	4.2315	0.00000000076	0.00000344198
DUSP4	0.6137	6.7282	0.00000001859	0.00005628085
RARA	0.6385	6.8807	0.00000004765	0.00010691812
LIF	0.8716	3.6912	0.00000005887	0.00010691812
RCAN1	0.7714	4.9732	0.00000032024	0.00044427747
AREG	0.6113	6.5067	0.00000034247	0.00044427747
ICOSLG	0.6616	4.6122	0.00000045012	0.00047804327
NAB2	0.4172	6.6455	0.00000047378	0.00047804327
IER3	0.4443	6.2960	0.00000052715	0.00047870392
TSC22D3	-0.5401	6.8789	0.00000059598	0.00049201243
SRF	0.4387	6.0653	0.00000194382	0.00147098845
PHLDA2	0.6990	5.9495	0.00000322764	0.00225463019
TXNIP	-0.5278	7.4571	0.00000351074	0.00227721702
USP36	0.4414	6.1418	0.00000677824	0.00410354364
AEN	0.3599	5.1018	0.00000944360	0.00535983371
RCL1	0.4072	4.2150	0.00001111395	0.00553251495
TNFRSF12A	0.4429	7.7084	0.00001122822	0.00553251495
BAMBI	-0.3671	6.6170	0.00001217562	0.00553251495
LACTB2	-0.6469	3.6317	0.00001218481	0.00553251495
ISOC1	-0.4892	5.6783	0.00001447146	0.00625787193
ZYX	0.5111	7.6247	0.00001673378	0.00690724691
COA7	0.3548	4.1924	0.00001792841	0.00707860457
PPRC1	0.4620	5.5363	0.00002564414	0.00970310095
POLR1C	0.4672	5.1204	0.00002819083	0.01024003583
ZMYND8	-0.3030	6.2393	0.00003312549	0.01156971466
MCL1	0.3995	7.9787	0.00003534432	0.01173432977
MAP3K14	0.3657	4.8303	0.00003618117	0.01173432977
FER1L4	0.3934	5.6342	0.00003954407	0.01217115648
MAT2A	0.3309	7.0884	0.00004057576	0.01217115648
NOP16	0.4784	6.0102	0.00004154893	0.01217115648
CDKN1B	-0.6612	5.5482	0.00004441871	0.01260519730

SLC10A3	0.3187	6.5905	0.00004934824	0.01303298526
JMJD6	0.4461	5.1088	0.00005072261	0.01303298526
MYBBP1A	0.2779	6.7138	0.00005171588	0.01303298526
NEDD9	-0.6381	4.4329	0.00005476927	0.01303298526
AMPD2	0.2612	6.7727	0.00005536400	0.01303298526
PDE7A	-0.5788	4.4214	0.00005605099	0.01303298526
BYSL	0.4514	4.4993	0.00005611017	0.01303298526
CCDC86	0.4283	4.8780	0.00005740771	0.01303298526
PNP	0.3273	5.3421	0.00006272885	0.01336161655
CAMKK1	0.5261	3.0536	0.00006441273	0.01336161655
RN7SL1	0.8081	5.4183	0.00006555255	0.01336161655
BTG1	-0.4672	6.8631	0.00006599036	0.01336161655
HES1	-0.2825	5.7023	0.00006621217	0.01336161655
CACNB1	0.4350	3.4393	0.00006963951	0.01359874100
TNRC6C-AS1	0.4303	3.4852	0.00007038221	0.01359874100
LOC102724159	0.3289	5.2259	0.00008058293	0.01524528400
GPATCH11	-0.4700	3.5568	0.00008727588	0.01617453605
MBOAT7	0.2562	7.7002	0.00009257881	0.01636071579
CDRT4	1.7366	3.0711	0.00009315627	0.01636071579
CCND1	0.3608	8.7373	0.00009368541	0.01636071579
FILIP1L	-0.7020	3.2801	0.00009985542	0.01710919078
STIMATE	0.4912	3.6169	0.00010194613	0.01714394116
RN7SL2	0.9474	4.7903	0.00010943354	0.01806847294
NR4A1	0.5651	4.0721	0.00011231930	0.01821377741
DGKQ	0.3269	5.3121	0.00011736940	0.01869879872
TWNK	0.3055	4.9531	0.00011976694	0.01875178597
MSX2	-0.3868	5.4106	0.00013069963	0.01954176358
GPR89B	0.3826	5.3399	0.00013117869	0.01954176358
AP5B1	0.3296	5.4611	0.00013126832	0.01954176358
KCNAB2	0.3124	4.6148	0.00013596089	0.01966647848
STK40	0.2523	5.7041	0.00013967757	0.01966647848
FZD2	-0.2796	5.5595	0.00014053833	0.01966647848
CITED2	-0.5749	7.4634	0.00014261125	0.01966647848
FLNA	0.3077	11.2626	0.00014391256	0.01966647848
WDR97	0.4363	3.8869	0.00014725492	0.01966647848
TSC22D1	-0.5164	5.7516	0.00014751691	0.01966647848
ID2	-0.5081	3.7849	0.00014943145	0.01966647848
SLC25A37	0.3283	4.2935	0.00015220105	0.01974482524
TSPAN13	-0.5359	6.1262	0.00015876884	0.01976246307
PRR15L	-0.3825	4.5696	0.00016121684	0.01976246307
HOXC6	-0.4132	3.6778	0.00016289537	0.01976246307

NDUFA5	-0.3679	4.5086	0.00016402491	0.01976246307
PNPLA7	0.2764	5.2169	0.00016630291	0.01976246307
MYADM	0.3525	5.9023	0.00016655740	0.01976246307
LOC100507412	0.4576	5.5993	0.00016875196	0.01976246307
MIDN	0.2392	7.3364	0.00016974696	0.01976246307
DHX37	0.2555	4.9263	0.00017538842	0.02016078758
SLC35F6	0.2694	6.5611	0.00017995740	0.02028339959
TPCN2	0.3035	4.5350	0.00018124013	0.02028339959
SLC52A2	0.3676	6.7334	0.00018526481	0.02028339959
ISCA1	-0.3215	4.3539	0.00018552396	0.02028339959
TYK2	0.2540	6.7588	0.00018762312	0.02028339959
RIMS4	0.3366	4.8776	0.00019150471	0.02045946187
RRP12	0.3157	6.2353	0.00020180939	0.02130966355
ALS2CL	0.4940	3.8521	0.00020805615	0.02151277283
PMEPA1	0.2100	8.2960	0.00020847087	0.02151277283
LYSMD4	0.3777	3.7376	0.00021199070	0.02163019671
FBXO32	-0.2925	4.6865	0.00021569992	0.02176412156
TLE3	0.2339	6.8215	0.00023498896	0.02334601629
MSRB1	0.3951	6.5882	0.00023651949	0.02334601629
ASB6	0.2795	5.9437	0.00024125876	0.02355775013
CBARP	0.4049	4.2321	0.00025219781	0.02414242925
GPBP1L1	-0.3211	5.9711	0.00025534709	0.02414242925
INHBB	-0.3244	6.0055	0.00025602135	0.02414242925
UTP3	0.2600	5.7461	0.00025853444	0.02414242925
CD3EAP	0.3460	4.4858	0.00026240073	0.02414242925
FRAT1	-0.4124	3.8236	0.00026319794	0.02414242925
HBP1	-0.5674	5.7531	0.00026644685	0.02415748386
RRP7A	0.3312	6.0779	0.00026868251	0.02415748386
MICALL1	0.3153	5.1629	0.00027357435	0.02425538578
SNAPC4	0.2700	5.9849	0.00027511339	0.02425538578
NXT1	0.3594	5.0196	0.00028214091	0.02454696961
NOP2	0.2885	6.3346	0.00028635430	0.02454696961
MYO15B	0.3664	6.1002	0.00028652998	0.02454696961
GTPBP4	0.2320	6.3991	0.00029306797	0.02487243247
ZMIZ2	0.2295	7.6173	0.00029748240	0.02501331217
BBOF1	-0.7306	3.3456	0.00030559081	0.02543557974
PDLIM7	0.4276	7.8342	0.00031026982	0.02543557974
HMGB2	-0.2631	7.4844	0.00031135246	0.02543557974
STARD13	-0.5562	4.4130	0.00031370828	0.02543557974
ZNF316	0.2581	7.0704	0.00031818749	0.02557044778
ARHGAP33	0.3618	4.5475	0.00032592207	0.02573444471

ZMYM5	-0.4417	3.4837	0.00032674319	0.02573444471
GEMIN4	0.2617	5.1500	0.00032872983	0.02573444471
MLXIPL	0.3737	4.4762	0.00033318936	0.02586062063
GCA	-0.3534	3.8618	0.00034286087	0.02638575906
LZTR1	0.2830	5.3711	0.00034889321	0.02640520251
SNHG1	0.3008	6.0833	0.00034950109	0.02640520251
PDCD11	0.3369	6.0212	0.00035297739	0.02640520251
VWA5B2	0.6916	2.8633	0.00035474449	0.02640520251
ISG20L2	0.2168	6.3580	0.00037336422	0.02749355248
CBWD3	-0.2843	4.9724	0.00037647906	0.02749355248
WNT7B	0.1967	5.8135	0.00037844886	0.02749355248
CTPS1	0.3186	4.2142	0.00040775841	0.02938773084
CHKA	0.2705	5.6466	0.00041601579	0.02964849484
PUS1	0.3716	5.7996	0.00041826996	0.02964849484
PMM2	0.2523	6.0234	0.00042117122	0.02964849484
PGGHG	0.4571	4.6691	0.00043227624	0.03011037094
WDR1	0.1950	8.0697	0.00043436390	0.03011037094
IRF2	-0.4279	3.9444	0.00045315383	0.03117492360
SLC29A2	0.2657	6.4254	0.00045944603	0.03137014596
MAPK8IP2	0.3458	3.7005	0.00046323870	0.03139306441
OSR2	-0.2841	5.8354	0.00046812599	0.03148927467
CPT1B	0.4238	4.7220	0.00048291058	0.03210977594
IRF9	0.3440	4.5011	0.00048830367	0.03210977594
PDE4DIP	-0.3154	6.4613	0.00048966756	0.03210977594
DDX11	0.2777	5.3489	0.00049149420	0.03210977594
CAV2	-0.3844	3.6647	0.00049565211	0.03215012032
SNAP23	-0.6104	4.2107	0.00052732827	0.03384930683
PLA2G4B	1.5658	2.8828	0.00052930311	0.03384930683
PCLAF	-0.2805	4.9966	0.00054728637	0.03475459824
N4BP1	0.2928	4.8976	0.00056351224	0.03553649051
ZNF276	0.2481	5.6654	0.00057110136	0.03576669936
CCNE1	0.3263	3.9910	0.00057834827	0.03580308641
ACKR3	-0.6058	5.4909	0.00058492040	0.03580308641
SPTSSA	-0.2962	4.6995	0.00058620136	0.03580308641
ZNF526	0.2784	4.0260	0.00058745291	0.03580308641
POMT2	0.2546	6.0738	0.00059650067	0.03611215033
RPL36A-HNRNPH2	-0.3569	5.9975	0.00060456723	0.03635811250
BMP1	0.2403	5.3349	0.00061574427	0.03678666924
TTLL3	0.4301	4.6441	0.00062332239	0.03681046759
MRTO4	0.3272	5.5952	0.00062424975	0.03681046759
STC2	0.2273	6.0141	0.00065313871	0.03825120505

PISD	0.2443	5.3877	0.00065710693	0.03825120505
KLHL5	-0.3272	6.4433	0.00066831968	0.03865612111
RELT	0.4668	3.2005	0.00067352405	0.03871058176
TSC2	0.2317	7.4774	0.00069544037	0.03954425266
CMAS	-0.3072	4.9798	0.00069673829	0.03954425266
RWDD4	-0.4225	3.9095	0.00072906281	0.04112185950
TVP23C-CDRT4	-4.1958	2.9075	0.00073790546	0.04136370037
KIF4A	-0.2374	5.2672	0.00074327883	0.04140929500
KIFBP	-0.4385	4.4198	0.00076159686	0.04210846113
HILPDA	-0.2483	6.6612	0.00076790202	0.04210846113
C1orf52	-0.2846	3.3488	0.00076973952	0.04210846113
PVR	0.2686	4.9203	0.00078663785	0.04277519930
PPAN	0.4398	5.3670	0.00080382312	0.04322147938
PAQR4	0.2381	6.9473	0.00080436406	0.04322147938
ATP13A1	0.2311	6.8474	0.00081339357	0.04344957068
PAQR6	0.3388	4.8756	0.00084115474	0.04466974358
GABBR1	0.3678	4.4002	0.00084845110	0.04466988785
PI4K2A	0.1973	6.0550	0.00085581059	0.04466988785
EFNA1	-0.2185	7.1306	0.00085973198	0.04466988785
CDKN2C	-0.3008	3.9764	0.00086083365	0.04466988785
ZNF121	0.3562	4.2072	0.00086752856	0.04476151598
LPIN3	0.2406	6.8323	0.00088510446	0.04541035939
RRS1	0.2303	5.5938	0.00089362013	0.04543528485
PNO1	0.3003	4.3279	0.00090136173	0.04543528485
ZNF23	-0.4487	3.4509	0.00090227727	0.04543528485
LIMK1	0.1999	5.4424	0.00090560363	0.04543528485
DUSP7	0.3321	3.4209	0.00091619237	0.04571397195
SPATA33	0.3844	5.0047	0.00093326356	0.04592963315
PLXNA3	0.2629	7.2517	0.00093584867	0.04592963315
LOC100128988	0.3077	4.9314	0.00093866629	0.04592963315
NR2F2	-0.4951	5.7498	0.00094952358	0.04592963315
TOB1	-0.5859	6.4901	0.00095488535	0.04592963315
MIER2	0.3288	4.5043	0.00095882480	0.04592963315
C3orf62	0.3327	3.5707	0.00096059792	0.04592963315
CLK4	-0.4094	3.7354	0.00096097680	0.04592963315
RNF103	-0.3846	4.4125	0.00097400967	0.04626576311
PAX9	-0.4573	4.3641	0.00097819915	0.04626576311
ATF1	-0.4868	3.6285	0.00100174734	0.04652612696
ANO10	0.2704	4.6295	0.00100481851	0.04652612696
OAT	-0.4199	5.4302	0.00101846812	0.04652612696
NLE1	0.2516	4.7779	0.00101876963	0.04652612696

JUN	0.3007	5.1839	0.00102270721	0.04652612696
ZNF335	0.2163	5.1824	0.00102619016	0.04652612696
CACNG8	0.4409	3.5023	0.00103937921	0.04652612696
FAM131A	0.3350	4.0291	0.00104629212	0.04652612696
SPATA2L	0.4225	6.0660	0.00104659150	0.04652612696
SETMAR	0.3551	4.0653	0.00104770305	0.04652612696
HSF4	0.3859	5.3081	0.00105291317	0.04652612696
SPHK1	0.3664	6.4295	0.00105523674	0.04652612696
ZNF629	0.2102	6.8605	0.00105859411	0.04652612696
DENND6B	0.3771	4.7178	0.00106370667	0.04652612696
OSGIN1	0.4848	4.6316	0.00106483062	0.04652612696
RILPL1	0.2922	5.1247	0.00106567938	0.04652612696
PIP5K1C	0.2364	5.8427	0.00107259690	0.04660407882
SRSF7	0.1915	6.0477	0.00107792086	0.04661237784
RRBP1	0.2537	7.0915	0.00108444014	0.04667204210
GALNT11	-0.2706	5.0326	0.00111243528	0.04745921511
TUBB2A	0.3522	4.0503	0.00111717210	0.04745921511
SRBD1	-0.4051	4.1735	0.00111917963	0.04745921511
SERTAD1	0.4463	4.4078	0.00112565046	0.04745921511
AP4B1	0.2129	5.9204	0.00112886141	0.04745921511
PLA2G15	0.3401	5.1225	0.00114513162	0.04792138359
CHMP1B	-0.2974	5.8211	0.00116089778	0.04835831547
TMEM198B	0.3432	5.0467	0.00117302168	0.04864022760
MAPKAPK2	0.1743	7.8999	0.00119036978	0.04913521809
YTHDC1	-0.2521	6.0265	0.00119809765	0.04923042898

Appendix B Differentially Expressed Genes (Prolactin + ACY-241 vs. Prolactin; FDR<0.05)

GeneID	Log_2 Fold Change	Mean Normalized Expression	*p*-value	adjusted *p*-value
HES7	5.0043	1.7058	0.00000000000002	0.00000000018935
DACT3	2.7174	3.3352	0.00000000000004	0.00000000018935
TMCC2	2.6478	2.5425	0.00000000000013	0.00000000038055
DUS3L	-1.8476	4.2433	0.00000000000041	0.00000000089594
AGAP2	1.6449	5.0751	0.00000000000049	0.00000000089594
FSCN1	1.3805	5.5567	0.00000000000080	0.00000000120759
KEAP1	-1.2700	6.2141	0.00000000000120	0.00000000155530
MAST1	1.8487	3.9964	0.00000000000157	0.00000000178632
MAB21L4	-1.7767	4.8890	0.00000000000202	0.00000000204167
SAYSD1	-1.4835	4.1551	0.00000000000341	0.00000000289725
ZBTB12	-1.6870	3.0539	0.00000000000364	0.00000000289725
GTF2IRD2B	-1.7476	4.5609	0.00000000000414	0.00000000289725
PDE4A	1.9925	3.0681	0.00000000000479	0.00000000289725
BCORL1	2.0931	4.2725	0.00000000000513	0.00000000289725
FAM214B	1.3429	4.6231	0.00000000000548	0.00000000289725
KAT5	-1.3324	6.2456	0.00000000000565	0.00000000289725
CLSTN3	1.3324	6.0522	0.00000000000591	0.00000000289725
ENO2	1.1745	5.5393	0.00000000000600	0.00000000289725
LANCL2	-1.7012	3.1583	0.00000000000606	0.00000000289725
SFXN3	1.1356	6.2921	0.00000000000767	0.00000000348072
BTN2A2	1.5067	3.4566	0.00000000001179	0.00000000509751
GSDMB	2.0879	2.7948	0.00000000001342	0.00000000554083
CCDC149	-1.5730	4.2303	0.00000000001412	0.00000000557312
NUBP1	-1.5421	4.6985	0.00000000001553	0.00000000587800
LFNG	-1.1598	6.6804	0.00000000001622	0.00000000589351
FGD3	-1.2100	6.4420	0.00000000001981	0.00000000691774
COQ7	-1.3116	4.2013	0.00000000002191	0.00000000720445
FAM83H-AS1	-1.0868	5.6580	0.00000000002221	0.00000000720445
H1-0	0.8911	8.5753	0.00000000002741	0.00000000841326
TTC39A	-1.1254	5.6821	0.00000000002779	0.00000000841326
IGF2BP2	1.3521	3.3895	0.00000000002882	0.00000000844284
ATXN7L2	-1.9270	3.1937	0.00000000003087	0.00000000860565
CRTC1	-1.5695	4.9111	0.00000000003127	0.00000000860565
VTCN1	-1.6731	3.2943	0.00000000003287	0.00000000870269
DMTN	-1.1015	4.8971	0.00000000003403	0.00000000870269

DNAAF3	1.3020	4.7378	0.00000000003450	0.00000000870269
EFNA3	1.1026	6.6931	0.00000000004003	0.00000000982465
LHX4	2.4653	2.4232	0.00000000004320	0.00000001014217
PATZ1	-0.7802	6.3568	0.00000000004356	0.00000001014217
PLCB3	0.7803	7.5474	0.00000000004633	0.00000001045218
MEX3A	1.7362	3.7716	0.00000000004719	0.00000001045218
CCDC92B	1.9463	2.6986	0.00000000004910	0.00000001061717
PPM1J	1.6242	3.7331	0.00000000005922	0.00000001250749
VWA5B2	2.2001	2.8633	0.00000000006568	0.00000001355640
DNAJB12	-0.9120	5.8551	0.00000000007140	0.00000001430051
ZFAT	-1.8489	2.9436	0.00000000007244	0.00000001430051
ATF5	-1.3546	4.8236	0.00000000007926	0.00000001531422
LOC728392	1.5535	3.8041	0.00000000008371	0.00000001583732
ZDHHC11B	1.5590	3.3286	0.00000000009780	0.00000001788227
RFX1	-1.3528	4.2112	0.00000000009846	0.00000001788227
TLCD2	0.8904	5.0708	0.00000000010695	0.00000001904368
PKP1	-1.1190	4.8235	0.00000000011769	0.00000002019338
APLP1	1.0966	5.5472	0.00000000011852	0.00000002019338
CNPY4	1.3075	4.6219	0.00000000012008	0.00000002019338
PGM5	-0.9812	6.0265	0.00000000012774	0.00000002109129
ELL3	1.1444	3.9879	0.00000000013407	0.00000002146683
SEMA4A	-0.8818	5.0997	0.00000000013474	0.00000002146683
PPP2R5B	1.1113	3.9700	0.00000000014314	0.00000002241135
VPS52	-0.7955	6.3444	0.00000000015101	0.00000002324261
NRDE2	-1.2763	4.5184	0.00000000015397	0.00000002330343
GIPR	2.3075	3.0557	0.00000000015947	0.00000002374029
MPP2	1.2056	4.3369	0.00000000016611	0.00000002433017
ZNF837	-1.5910	3.1905	0.00000000017155	0.00000002472705
SARS2	-1.4386	4.7854	0.00000000018230	0.00000002549357
SH2D4A	-0.8626	4.9839	0.00000000018291	0.00000002549357
SYK	-1.3759	3.8014	0.00000000018529	0.00000002549357
RIN3	-1.7689	3.2839	0.00000000018998	0.00000002561287
HABP4	0.9673	5.5458	0.00000000019179	0.00000002561287
CDH24	1.0642	5.0739	0.00000000019746	0.00000002590379
EFNB3	0.8890	6.2099	0.00000000019968	0.00000002590379
NR6A1	1.0999	3.5797	0.00000000021205	0.00000002712157
THADA	-0.9196	6.7303	0.00000000021668	0.00000002732923
SMARCB1	-1.1010	6.2946	0.00000000023292	0.00000002859464
GMPR	1.4225	3.8252	0.00000000023467	0.00000002859464
TMEM63C	0.9712	5.3109	0.00000000023616	0.00000002859464
CARMIL2	2.0220	4.2105	0.00000000024494	0.00000002926769

KATNB1	0.8760	4.9264	0.00000000025948	0.00000003060224
SUSD4	1.2612	3.7191	0.00000000026917	0.00000003133737
RAB29	1.4330	5.5535	0.00000000028218	0.00000003229862
EFHD1	-1.2564	4.6331	0.00000000028565	0.00000003229862
NUDT17	-1.0157	4.0957	0.00000000028809	0.00000003229862
LZTS3	1.5599	3.1717	0.00000000029416	0.00000003241677
TRMO	-1.6625	3.5910	0.00000000029629	0.00000003241677
SREBF1	0.7980	9.4808	0.00000000030584	0.00000003306352
PDZD7	1.3677	3.3460	0.00000000032206	0.00000003433416
KMT5B	-1.0252	5.1458	0.00000000032642	0.00000003433416
WDR6	-0.7975	7.3769	0.00000000033264	0.00000003433416
RASA4	1.3006	6.1641	0.00000000033272	0.00000003433416
KCNH2	0.8808	5.0666	0.00000000034250	0.00000003494653
CHTOP	-0.8191	6.3430	0.00000000035331	0.00000003564914
SECISBP2	-0.9449	5.2273	0.00000000036647	0.00000003657000
ZNF710	-1.0435	5.6607	0.00000000037503	0.00000003701742
DENND2C	1.6060	4.8003	0.00000000038480	0.00000003757395
GMEB2	-0.9979	4.8931	0.00000000039190	0.00000003785998
ARAF	-0.9711	5.6314	0.00000000040046	0.00000003815245
SEMA6B	1.0153	4.6389	0.00000000040615	0.00000003815245
LRRC20	1.0640	4.3492	0.00000000040753	0.00000003815245
OPA3	-1.0341	4.3453	0.00000000041924	0.00000003884774
TMEM184A	-0.8466	6.5949	0.00000000042516	0.00000003899902
BAIAP2-DT	0.7569	5.9172	0.00000000042963	0.00000003901481
MAP7D1	0.7949	6.6821	0.00000000043515	0.00000003902728
MPZL1	0.6514	6.1797	0.00000000043836	0.00000003902728
GDF11	1.1396	4.3496	0.00000000046465	0.00000004058269
DOLPP1	-0.9017	5.0958	0.00000000046477	0.00000004058269
ZNF76	-0.8170	5.4046	0.00000000048134	0.00000004117975
PLEKHG6	1.0770	4.0935	0.00000000048329	0.00000004117975
MEPCE	-0.9665	7.8312	0.00000000048521	0.00000004117975
SCAMP1-AS1	-1.4185	3.5082	0.00000000050183	0.00000004219537
ARMC5	-1.6117	4.4164	0.00000000051612	0.00000004299910
CDKN2D	1.3616	3.4606	0.00000000052902	0.00000004367308
SMG5	-0.6145	7.0335	0.00000000053846	0.00000004401830
AP5S1	-1.1753	4.0480	0.00000000054290	0.00000004401830
NFYC	-1.0147	4.9862	0.00000000056355	0.00000004528874
OGFOD3	-1.0682	5.3438	0.00000000060251	0.00000004799479
ADGRL1	0.6274	7.4815	0.00000000061537	0.00000004859256
CHD4	0.6509	8.5688	0.00000000062997	0.00000004931710
CYB5R1	0.8084	6.8828	0.00000000066087	0.00000005079176

DPP3	-0.6945	6.2968	0.00000000066139	0.00000005079176
SP6	0.9771	3.7063	0.00000000066993	0.00000005079176
C1QTNF6	-0.8655	7.4759	0.00000000067118	0.00000005079176
TMEM185B	-0.7729	5.3261	0.00000000069476	0.00000005214161
FOXO4	0.8268	4.8111	0.00000000070430	0.00000005214480
SRSF7	-0.7017	6.0477	0.00000000070629	0.00000005214480
CBX2	0.7274	6.1734	0.00000000076432	0.00000005597442
ADCK1	-1.3624	4.1611	0.00000000078067	0.00000005671417
SLC25A42	0.8774	4.1135	0.00000000084406	0.00000006067357
RBM23	-0.6319	5.8424	0.00000000084853	0.00000006067357
SZRD1	-0.6698	6.8609	0.00000000086386	0.00000006128702
RASA4B	1.2120	5.3114	0.00000000089141	0.00000006208418
UNC13D	-0.6723	7.3693	0.00000000089753	0.00000006208418
MAP2K7	-1.0056	4.9773	0.00000000090051	0.00000006208418
ABCA7	1.0542	4.8979	0.00000000090863	0.00000006208418
RFX2	1.0886	3.8433	0.00000000091136	0.00000006208418
TMEM79	0.8473	5.4105	0.00000000092605	0.00000006208418
KIF3C	1.5460	4.2875	0.00000000092887	0.00000006208418
TBC1D2	0.6924	5.1353	0.00000000093482	0.00000006208418
CTIF	0.8287	4.7064	0.00000000093672	0.00000006208418
CCDC97	-0.8801	4.8930	0.00000000094876	0.00000006208418
ARSD	-0.6952	5.9652	0.00000000095030	0.00000006208418
RABIF	-0.8548	5.1460	0.00000000096883	0.00000006265304
PPIL2	-0.7773	5.8667	0.00000000097281	0.00000006265304
UBE2D4	-0.9142	3.6594	0.00000000100138	0.00000006403919
SRSF6	-0.7900	6.6285	0.00000000104223	0.00000006589120
PDCL3	-1.1167	4.4849	0.00000000104797	0.00000006589120
SMARCD3	0.9997	4.9825	0.00000000105902	0.00000006589120
MZF1	-1.2712	4.9713	0.00000000106262	0.00000006589120
TUBA4A	1.4533	4.2509	0.00000000106662	0.00000006589120
CDR2L	0.7862	5.4851	0.00000000107691	0.00000006607688
RDH11	0.6443	6.6133	0.00000000108893	0.00000006611225
TMEM25	0.9344	4.2204	0.00000000109204	0.00000006611225
CCNE1	0.9385	3.9910	0.00000000115025	0.00000006917499
JADE2	-0.9163	5.2546	0.00000000117535	0.00000007021961
ADGRB2	1.2932	3.9104	0.00000000123896	0.00000007301815
PMEPA1	-0.5684	8.2960	0.00000000124587	0.00000007301815
PSCA	-1.7553	3.4313	0.00000000124632	0.00000007301815
PRRT1B	-1.5360	3.0067	0.00000000131478	0.00000007653549
LOC100506990	1.0156	3.2614	0.00000000133094	0.00000007698241
FCHSD1	0.7341	5.9534	0.00000000134015	0.00000007702490

ARMC6	-1.1240	4.8802	0.00000000137166	0.00000007833970
SPRYD3	-0.9409	5.6995	0.00000000140475	0.00000007972846
ZBED1	-0.9673	3.8205	0.00000000148823	0.00000008394145
SPEG	1.1924	3.8943	0.00000000152185	0.00000008491387
TEAD2	0.7813	5.0176	0.00000000153259	0.00000008491387
HCN3	0.9433	4.9339	0.00000000154042	0.00000008491387
LMCD1	-0.7782	5.6849	0.00000000154432	0.00000008491387
TMEM38A	0.9316	3.9650	0.00000000155994	0.00000008491387
INO80C	-1.2350	3.5452	0.00000000156157	0.00000008491387
SYT12	-0.8834	8.1633	0.00000000157309	0.00000008503103
ASAP3	0.9924	4.2977	0.00000000162349	0.00000008680830
GPR153	1.1469	4.2307	0.00000000163111	0.00000008680830
POLR3B	-1.4272	3.6250	0.00000000163465	0.00000008680830
RBM4B	-0.9249	3.7215	0.00000000167454	0.00000008796620
ZNF784	-2.2039	3.3597	0.00000000167954	0.00000008796620
LRRC3	1.0837	3.6853	0.00000000168551	0.00000008796620
UNC119	0.8097	6.2161	0.00000000173206	0.00000008987887
HEATR6	-0.7984	7.6697	0.00000000174485	0.00000009002811
RBM22	-0.7034	5.5489	0.00000000182034	0.00000009339269
PISD	-0.7920	5.3877	0.00000000184195	0.00000009348571
TEF	-0.7612	4.7257	0.00000000184274	0.00000009348571
PHF21A	0.8133	5.4642	0.00000000189077	0.00000009538950
CHST14	-0.8853	4.6953	0.00000000191535	0.00000009609564
TTL	0.9600	4.9345	0.00000000202143	0.00000010040929
DLX3	0.7923	4.4437	0.00000000202344	0.00000010040929
PITPNM1	0.8400	6.4332	0.00000000206076	0.00000010170546
TYSND1	-0.7814	5.9863	0.00000000208860	0.00000010252213
OPTN	1.0131	5.6101	0.00000000211344	0.00000010273417
INAFM2	0.8616	3.3442	0.00000000211555	0.00000010273417
PCIF1	-0.7085	5.9047	0.00000000217886	0.00000010524566
NFIX	-0.9550	4.3213	0.00000000221363	0.00000010585000
VAT1	0.6130	7.1258	0.00000000221468	0.00000010585000
MTMR11	1.1553	4.9335	0.00000000227363	0.00000010761125
LIF	-1.0355	3.6912	0.00000000228512	0.00000010761125
RNF224	-1.3850	3.3888	0.00000000228939	0.00000010761125
SLC6A8	0.6327	7.3078	0.00000000229893	0.00000010761125
SHC1	-0.9183	5.7460	0.00000000235372	0.00000010911544
CYB5D2	-0.8489	5.7383	0.00000000236203	0.00000010911544
CALM1	0.5258	8.1980	0.00000000236874	0.00000010911544
U2AF2	-0.6006	7.8698	0.00000000237939	0.00000010911544
NR1H2	-0.8587	5.8442	0.00000000239114	0.00000010911544

ZBTB42	-0.7294	6.4728	0.00000000254598	0.00000011560009
TMBIM4	-0.7574	4.4376	0.00000000261789	0.00000011827412
TMED1	-1.3723	4.8663	0.00000000274514	0.00000012340879
MPDU1	-1.1971	5.2742	0.00000000288396	0.00000012901098
ACOT4	-1.0730	4.4532	0.00000000296892	0.00000013216080
TCF7L1	-0.6949	5.6849	0.00000000301100	0.00000013338011
MTHFS	-1.0911	3.6504	0.00000000304269	0.00000013412924
MAPT	0.9474	5.8319	0.00000000322686	0.00000014156116
LIMK1	0.5746	5.4424	0.00000000332661	0.00000014523526
COMT	-0.7517	7.8469	0.00000000349139	0.00000015170005
TUBB3	0.8428	6.9529	0.00000000357723	0.00000015468976
MYADM	0.8016	5.9023	0.00000000375126	0.00000016144645
ANKHD1	0.7653	5.5139	0.00000000399940	0.00000017131408
FXN	-0.8632	3.5147	0.00000000406212	0.00000017318383
MTURN	0.8439	4.1754	0.00000000413530	0.00000017397925
RCC1L	-0.8258	5.9124	0.00000000413647	0.00000017397925
FAM20B	-0.8114	4.9005	0.00000000415165	0.00000017397925
PIGO	-0.9455	4.5276	0.00000000415742	0.00000017397925
ERMAP	-1.7197	3.3749	0.00000000426065	0.00000017669438
SLC2A6	0.7224	5.6732	0.00000000428807	0.00000017669438
NFKB2	0.7358	6.6106	0.00000000429153	0.00000017669438
SLC43A2	-0.7621	6.2587	0.00000000430013	0.00000017669438
SIDT1	-0.9179	5.2646	0.00000000435055	0.00000017796121
TGFB3	-0.6948	5.2251	0.00000000440415	0.00000017806618
THOC6	-1.2068	6.2355	0.00000000440836	0.00000017806618
SERPINB1	-0.6663	5.2151	0.00000000441195	0.00000017806618
ITFG2	-1.3120	3.9831	0.00000000451812	0.00000018154448
MAPRE3	0.8599	5.0852	0.00000000457868	0.00000018268755
CAVIN1	1.2542	3.7715	0.00000000458680	0.00000018268755
BTBD9	-0.9195	3.8346	0.00000000463759	0.00000018313541
PRDM15	-1.2129	3.7618	0.00000000463838	0.00000018313541
PIM1	0.9637	3.3127	0.00000000469086	0.00000018440560
CCDC103	0.9324	3.9881	0.00000000477738	0.00000018671894
BEX5	1.3751	3.5017	0.00000000479183	0.00000018671894
HOXC6	0.9645	3.6778	0.00000000481139	0.00000018671894
MVP	1.0806	4.7350	0.00000000498518	0.00000019262294
PPFIBP2	-0.7365	4.6204	0.00000000500756	0.00000019262294
PHF1	0.7133	6.1629	0.00000000502716	0.00000019262294
LRFN1	0.9969	4.3414	0.00000000506243	0.00000019315940
LRRC75A	0.8275	3.6145	0.00000000510283	0.00000019388614
PGPEP1	0.8204	6.4405	0.00000000517157	0.00000019567929

DKC1	-0.4999	6.8272	0.00000000520850	0.00000019625893
NUP43	1.0315	4.5562	0.00000000531247	0.00000019934925
TPMT	0.8861	4.1276	0.00000000541311	0.00000020229001
UBIAD1	-0.7713	4.3769	0.00000000549570	0.00000020410826
EARS2	-0.7975	5.1434	0.00000000550672	0.00000020410826
PPP1R18	0.9015	5.0607	0.00000000556942	0.00000020559317
ST6GALNAC6	0.6812	6.1104	0.00000000563434	0.00000020714743
WFS1	0.6381	5.9403	0.00000000581319	0.00000021215101
CRAT	-1.0777	5.1121	0.00000000581716	0.00000021215101
YJU2	-1.2863	5.1440	0.00000000601120	0.00000021835083
RHOF	0.7108	5.8274	0.00000000604128	0.00000021856935
RAPGEFL1	0.9468	4.4957	0.00000000608957	0.00000021944203
CARMIL3	1.0442	3.0397	0.00000000620777	0.00000022271975
PFKM	0.7982	5.9306	0.00000000622958	0.00000022271975
ATP1B3	0.5317	5.7050	0.00000000639325	0.00000022752798
SMG9	-1.0473	5.1197	0.00000000641418	0.00000022752798
ADRA2C	-0.9044	5.1335	0.00000000648229	0.00000022904920
IRGQ	0.7777	5.1459	0.00000000654185	0.00000023025798
RBMS2	1.2200	3.3350	0.00000000671455	0.00000023542418
MED11	-0.9688	4.3634	0.00000000681950	0.00000023818399
DELE1	-0.6834	5.8715	0.00000000706276	0.00000024573528
DUSP4	-0.5900	6.7282	0.00000000710058	0.00000024610821
AIDA	0.8616	4.5220	0.00000000725458	0.00000025000289
DOK4	0.7806	4.3991	0.00000000727186	0.00000025000289
ARHGEF2	0.7540	5.1585	0.00000000729554	0.00000025000289
RXRB	-0.6196	5.5496	0.00000000748206	0.00000025398956
TNFAIP8L1	1.1302	3.6607	0.00000000749467	0.00000025398956
MGAT5B	-0.7429	4.4530	0.00000000749578	0.00000025398956
MED16	-0.9756	5.5269	0.00000000801239	0.00000026977391
BMP4	0.9051	3.3233	0.00000000802103	0.00000026977391
ENOX2	-1.2452	3.2515	0.00000000812202	0.00000027216247
CALCOCO1	0.6518	6.8076	0.00000000820607	0.00000027326999
WDR19	1.2477	4.4153	0.00000000821525	0.00000027326999
CTBP1	-0.5734	7.3927	0.00000000850858	0.00000028199415
CDK2	0.9038	5.7448	0.00000000857844	0.00000028327584
FIZ1	-1.0232	4.4762	0.00000000876286	0.00000028831700
TRIM46	0.8319	4.0316	0.00000000883520	0.00000028964774
RARA	-0.6547	6.8807	0.00000000890110	0.00000029075849
TNFRSF12A	-0.7528	7.7084	0.00000000901745	0.00000029350332
ZNF497	-1.2308	3.4760	0.00000000907399	0.00000029428886
ORAI2	0.6673	6.6896	0.00000000969015	0.00000031263958

NSMAF	-1.1518	4.8464	0.00000000970866	0.00000031263958
SGF29	-1.1617	5.1124	0.00000001014870	0.00000032565482
SLC41A1	1.0320	5.2785	0.00000001034555	0.00000033003487
PLXNA3	0.7086	7.2517	0.00000001039149	0.00000033003487
RAVER1	-0.6441	6.6431	0.00000001039423	0.00000033003487
ZFP64	-1.5549	4.1086	0.00000001045216	0.00000033071799
GRWD1	-0.6625	5.5546	0.00000001050183	0.00000033113598
PRRT2	0.9843	4.5995	0.00000001097509	0.00000034486073
MARVELD1	-0.6550	5.8200	0.00000001107092	0.00000034619984
POLDIP3	-0.5493	6.0177	0.00000001109395	0.00000034619984
ZBTB22	-0.6656	4.8508	0.00000001116999	0.00000034737906
FGF11	0.9230	3.5018	0.00000001120927	0.00000034741073
ELOVL6	0.8661	5.2907	0.00000001151001	0.00000035551845
MCRS1	-0.8055	6.1480	0.00000001177030	0.00000036232577
CRADD	-1.0826	3.5214	0.00000001183904	0.00000036321044
STX2	1.2366	3.3606	0.00000001202711	0.00000036773805
NINJ2-AS1	-0.8484	3.2014	0.00000001229043	0.00000037354699
CHRNA5	0.9284	3.2843	0.00000001229937	0.00000037354699
PBDC1	-1.0469	4.5586	0.00000001238500	0.00000037489393
SLC29A3	-0.6523	4.3435	0.00000001246561	0.00000037608052
AFAP1L2	-0.9911	4.7190	0.00000001271973	0.00000038247652
FBXO6	-1.0397	3.6232	0.00000001277973	0.00000038301223
DENND2D	-0.6357	5.7039	0.00000001288734	0.00000038399717
CHMP4C	-1.1765	4.1158	0.00000001289716	0.00000038399717
BTBD6	-0.8441	6.7991	0.00000001295537	0.00000038446966
TMEM250	-0.6181	5.7786	0.00000001322471	0.00000039118446
TM2D2	0.6315	4.4943	0.00000001337984	0.00000039448806
MYL12A	0.5139	7.8013	0.00000001350155	0.00000039678840
NUDT15	-1.2102	3.0814	0.00000001364524	0.00000039971737
NELFCD	-0.4821	8.3899	0.00000001370012	0.00000040003460
APOBR	-1.4834	4.3793	0.00000001378539	0.00000040123426
ADI1	-0.5870	6.9504	0.00000001399866	0.00000040613996
P2RX4	-0.8509	5.6611	0.00000001405907	0.00000040659356
TMEM254	-0.7227	4.7726	0.00000001442123	0.00000041574348
FAM189A2	-0.9396	4.1531	0.00000001506735	0.00000043136769
ANP32A	0.5717	6.7842	0.00000001510037	0.00000043136769
NUMBL	0.7885	4.1772	0.00000001511921	0.00000043136769
CNN2	0.7836	7.0267	0.00000001515321	0.00000043136769
ZNF414	-1.7497	4.0100	0.00000001537692	0.00000043636805
CISH	-0.6365	4.4370	0.00000001574276	0.00000044475042
MAP3K12	0.7829	4.2069	0.00000001577025	0.00000044475042

ALDH3B2	-0.5313	6.8756	0.00000001596290	0.00000044800806
HSPA1A	0.5062	8.7629	0.00000001606429	0.00000044800806
SLC25A4	-0.8196	4.2556	0.00000001607774	0.00000044800806
RCAN1	-0.9093	4.9732	0.00000001608310	0.00000044800806
ITGB5	-0.4566	8.5023	0.00000001644100	0.00000045657724
UBTF	-0.4792	7.4900	0.00000001685548	0.00000046666033
RABGGTA	-0.8045	5.4266	0.00000001704266	0.00000047040842
FAM136A	-0.6450	6.3855	0.00000001714140	0.00000047082851
HSD3B7	-0.8196	6.1961	0.00000001723434	0.00000047082851
TMOD2	1.4334	3.9644	0.00000001724972	0.00000047082851
DTX3L	-1.1401	3.3153	0.00000001726527	0.00000047082851
PPRC1	-0.8408	5.5363	0.00000001738114	0.00000047256931
ACHE	0.8894	5.5769	0.00000001756597	0.00000047616897
NXF1	0.5269	6.5205	0.00000001766440	0.00000047741203
LYRM9	-0.9034	3.7927	0.00000001818005	0.00000048939188
HDAC7	-0.5437	6.7695	0.00000001821544	0.00000048939188
PPP2R3C	-1.6569	3.1355	0.00000001845960	0.00000049448849
RAB3A	1.0741	3.6034	0.00000001871901	0.00000049996283
DCPS	-0.7375	4.2068	0.00000001885305	0.00000050206606
VASH1	-1.0117	3.1093	0.00000001897053	0.00000050371748
ARHGAP39	0.6062	6.1394	0.00000001924054	0.00000050939744
CBFA2T3	-0.5844	6.9851	0.00000001965094	0.00000051875065
AHNAK2	1.0571	5.2287	0.00000002001813	0.00000052691190
RNF135	-0.6390	4.4961	0.00000002017411	0.00000052806650
RTL10	-0.5511	5.3134	0.00000002018932	0.00000052806650
SAP30	0.9136	3.7259	0.00000002024532	0.00000052806650
ESYT1	0.5126	7.2801	0.00000002029459	0.00000052806650
EHD2	0.6529	5.0305	0.00000002060700	0.00000053394424
SMYD5	-0.7353	4.9737	0.00000002063808	0.00000053394424
SPOP	-0.6109	5.5403	0.00000002093747	0.00000054015091
TMEM39B	-1.3255	3.8623	0.00000002121536	0.00000054518008
JAG2	0.5647	6.1043	0.00000002125248	0.00000054518008
MANBAL	-0.7786	5.8091	0.00000002143943	0.00000054787586
ULK3	-0.7368	5.8687	0.00000002151240	0.00000054787586
CBARP	0.8145	4.2321	0.00000002153856	0.00000054787586
NPRL3	-0.6490	5.8254	0.00000002169873	0.00000055040830
KIAA0930	0.5543	6.1168	0.00000002186121	0.00000055298511
PPCS	-0.6148	5.2308	0.00000002240823	0.00000056524750
DUSP3	-0.6992	5.8947	0.00000002248286	0.00000056555918
COPS7A	-0.5992	6.1322	0.00000002258854	0.00000056664781
KLHL12	-0.8707	5.6715	0.00000002279702	0.00000057030237

VPS37C	-0.8186	5.2100	0.00000002306503	0.00000057542180
ZNF133	0.9060	4.9835	0.00000002331849	0.00000058015133
TIMP2	0.7083	5.6055	0.00000002351520	0.00000058255743
CASKIN1	0.5730	5.7765	0.00000002354351	0.00000058255743
B3GALT6	-1.2660	4.2807	0.00000002382657	0.00000058795956
NLGN2	0.6349	6.6921	0.00000002402951	0.00000059136039
CYP46A1	1.4564	3.0627	0.00000002424769	0.00000059511698
UNK	-0.6149	5.7232	0.00000002454263	0.00000059932197
PFKFB4	0.8388	3.6463	0.00000002455102	0.00000059932197
NCOA5	-0.5714	5.7699	0.00000002502839	0.00000060933730
AKT1S1	-0.8157	6.5728	0.00000002553996	0.00000062012931
CLN3	-0.7752	7.5524	0.00000002606032	0.00000062962495
TRIM45	-0.6292	5.7530	0.00000002610903	0.00000062962495
FMC1-LUC7L2	-1.3191	4.2200	0.00000002613904	0.00000062962495
ASCL2	-1.0945	4.6931	0.00000002629809	0.00000063178033
PCSK6	-0.9227	4.1100	0.00000002675881	0.00000064115240
CHCHD4	-0.6694	4.5954	0.00000002722452	0.00000065059444
WIPI1	0.6984	5.1432	0.00000002731765	0.00000065110639
ZMYND8	-0.5481	6.2393	0.00000002760259	0.00000065338935
DOK7	-0.8265	7.0197	0.00000002770867	0.00000065338935
USP35	1.0835	3.5396	0.00000002780004	0.00000065338935
RNF220	-0.6714	5.8777	0.00000002782182	0.00000065338935
IRF9	-0.8507	4.5011	0.00000002783761	0.00000065338935
PBXIP1	0.5505	6.8327	0.00000002784514	0.00000065338935
CNNM3	-0.7495	5.2577	0.00000002854494	0.00000066808406
HOXC13-AS	-1.0501	3.6933	0.00000002889165	0.00000067446025
SMIM20	-0.8380	4.4447	0.00000002900544	0.00000067482288
MAPK8IP1	0.7083	6.1208	0.00000002905580	0.00000067482288
SMARCD1	-0.4905	5.8110	0.00000002917199	0.00000067579287
CCDC183	0.9014	3.6781	0.00000002933717	0.00000067789017
AAK1	0.6831	4.7211	0.00000003010489	0.00000069236341
TMEM254-AS1	-0.6426	3.9744	0.00000003011602	0.00000069236341
SBK1	0.5719	5.8791	0.00000003032234	0.00000069534635
GAB2	1.2606	3.8289	0.00000003117181	0.00000071302572
LINC02875	-1.1287	3.3752	0.00000003173565	0.00000072250386
TAP1	0.8047	4.9170	0.00000003174530	0.00000072250386
NMT1	-0.4471	6.5955	0.00000003231455	0.00000073317336
GIT1	0.4537	7.0845	0.00000003237557	0.00000073317336
STARD5	0.9632	3.2376	0.00000003270417	0.00000073877247
RAB11FIP5	0.9145	3.7588	0.00000003290993	0.00000074157585
AGPAT1	0.5935	6.4001	0.00000003374770	0.00000075631417

DHX37	-0.5404	4.9263	0.00000003378467	0.00000075631417
PLXNB2	-0.5191	8.6688	0.00000003381430	0.00000075631417
BANP	-0.6345	4.3492	0.00000003389713	0.00000075631417
ECPAS	-0.5324	6.7408	0.00000003398322	0.00000075637652
PDZD4	0.8198	5.4049	0.00000003439637	0.00000076370029
TRAFD1	0.4542	6.3255	0.00000003459996	0.00000076634700
TXLNA	-0.4794	5.6935	0.00000003489378	0.00000077071810
CHRAC1	-0.8677	4.6586	0.00000003496706	0.00000077071810
RBBP8NL	-0.7876	4.8034	0.00000003532238	0.00000077666479
TAF6L	-0.9287	4.7291	0.00000003577248	0.00000078466154
CCND1	-0.6634	8.7373	0.00000003617064	0.00000079148327
IPO13	0.5541	5.4349	0.00000003649507	0.00000079666275
UTP20	-1.2686	4.2845	0.00000003666212	0.00000079678546
ANGPTL4	1.3022	3.3170	0.00000003667617	0.00000079678546
AGFG2	0.6345	5.7101	0.00000003680299	0.00000079763229
IRX3	-0.5638	6.5692	0.00000003696233	0.00000079917834
GTF2H4	0.6048	5.3069	0.00000003780343	0.00000081542262
AGAP2-AS1	-0.8672	4.9768	0.00000003803751	0.00000081747692
TMPO-AS1	-0.7668	3.5652	0.00000003807871	0.00000081747692
TMEM18	-0.6481	6.0932	0.00000003826851	0.00000081961398
STK11IP	-0.7652	5.3394	0.00000003890147	0.00000082692715
KIF1A	0.8063	4.0644	0.00000003890474	0.00000082692715
KCTD15	-0.6821	5.2030	0.00000003901151	0.00000082692715
STAG3L4	-0.7836	3.7136	0.00000003903031	0.00000082692715
NUAK1	-1.0892	4.2710	0.00000003908596	0.00000082692715
SNAP29	0.4424	6.1335	0.00000003917054	0.00000082692715
B3GNT3	0.7212	4.2740	0.00000003930172	0.00000082692715
CASTOR3	0.5472	6.7157	0.00000003933846	0.00000082692715
CTDSP1	-0.6526	7.4845	0.00000004064142	0.00000085234352
NHEJ1	-0.9370	3.2424	0.00000004118892	0.00000086183547
MYORG	0.8051	5.1545	0.00000004155080	0.00000086740886
SH3BP1	0.8241	5.6405	0.00000004185107	0.00000087135814
TTLL5	0.6474	6.2472	0.00000004193189	0.00000087135814
ARSG	-0.5469	5.1836	0.00000004258599	0.00000088287123
RBM5	-0.5195	5.9966	0.00000004274725	0.00000088287123
ARAP1	0.4369	6.5777	0.00000004277760	0.00000088287123
BRD9	-0.6369	5.0471	0.00000004458944	0.00000091683138
BRPF3	-1.3967	4.5343	0.00000004462498	0.00000091683138
PAIP2B	0.7106	4.2185	0.00000004631579	0.00000094802157
ALG12	-0.6572	4.7761	0.00000004639851	0.00000094802157
ELP3	-0.6298	4.5474	0.00000004645629	0.00000094802157

GLTP	0.4441	7.1398	0.00000004722195	0.00000095968847
TAX1BP3	-0.7424	7.0308	0.00000004723937	0.00000095968847
ANKRD42	0.9843	4.0268	0.00000004816142	0.00000097623628
LIPH	0.9585	3.5846	0.00000004891130	0.00000098922829
NXPH4	0.8835	5.6610	0.00000004936911	0.00000099553898
DBN1	0.4983	8.2880	0.00000004944258	0.00000099553898
SLC29A2	-0.5929	6.4254	0.00000005006473	0.00000100583586
BSPRY	0.5351	6.7871	0.00000005143851	0.00000103115482
UMPS	-0.5115	5.5999	0.00000005282916	0.00000105669949
CHKA	0.5544	5.6466	0.00000005317847	0.00000106134883
FAM174B	-0.6613	6.3291	0.00000005343578	0.00000106387101
TFIP11	-0.6152	5.3363	0.00000005365126	0.00000106387101
ALG13	-0.8768	3.5862	0.00000005365631	0.00000106387101
PCDH1	0.6071	5.6844	0.00000005389197	0.00000106621569
TRIM8	-0.4777	6.4172	0.00000005470312	0.00000107991089
EPC1	-1.3019	3.6592	0.00000005548003	0.00000109287242
ZNF335	-0.5429	5.1824	0.00000005597376	0.00000110021143
CACFD1	-0.9026	5.7086	0.00000005647593	0.00000110768453
VAV2	-0.5161	7.4387	0.00000005676803	0.00000111101401
LRRC42	0.4747	5.3075	0.00000005727378	0.00000111850140
DYNLL2	0.5573	7.8929	0.00000005777890	0.00000112594461
RNF114	0.4719	7.0688	0.00000005796748	0.00000112693636
C11orf68	-0.9852	5.8346	0.00000005807799	0.00000112693636
AFMID	-0.9421	3.7842	0.00000005848834	0.00000113247898
CNP	0.4531	6.4326	0.00000005884389	0.00000113693905
CTC1	0.6864	4.6752	0.00000006128519	0.00000118159413
SLC31A1	0.6051	5.7121	0.00000006163276	0.00000118572459
CORO1C	0.5661	6.3197	0.00000006176057	0.00000118572459
ZNHIT2	-1.1994	4.4240	0.00000006205122	0.00000118879135
SGCE	0.7221	4.9449	0.00000006240553	0.00000119306235
COA7	-0.5458	4.1924	0.00000006329243	0.00000120652778
B4GALNT1	0.6684	4.3144	0.00000006337559	0.00000120652778
TMEM159	0.5083	5.7777	0.00000006374218	0.00000121096802
CABLES1	-0.5372	5.8310	0.00000006509700	0.00000123412489
FBXO32	-0.6378	4.6865	0.00000006537173	0.00000123675133
SFT2D3	-0.6422	3.8920	0.00000006551059	0.00000123680174
SRSF5	-0.5519	7.7162	0.00000006602147	0.00000124386085
SUMO3	-0.4731	7.7752	0.00000006666126	0.00000125331455
PKNOX1	-0.8281	3.3271	0.00000006680424	0.00000125340773
DCAF8	-0.5212	6.1594	0.00000006702620	0.00000125457906
MARK4	0.6275	5.5541	0.00000006722884	0.00000125457906

IGSF9	0.8268	5.0055	0.00000006728114	0.00000125457906
RCL1	-0.5930	4.2150	0.00000006743763	0.00000125492031
WDR97	-0.8475	3.8869	0.00000006818213	0.00000126617988
SMTN	0.5250	6.4759	0.00000006880355	0.00000127511241
CZIB	-0.8961	4.4146	0.00000006930839	0.00000128185233
MNAT1	0.5494	5.3415	0.00000006954404	0.00000128359641
MAPK13	-0.6408	4.7608	0.00000006977252	0.00000128520126
FAM234B	0.6345	5.0395	0.00000006993321	0.00000128555368
OAZ2	0.5589	6.6925	0.00000007048819	0.00000129313785
MSANTD3	-0.6431	4.2311	0.00000007105678	0.00000130094075
NCL	-0.4422	8.7557	0.00000007183602	0.00000131256107
LPCAT4	0.8292	4.3313	0.00000007285193	0.00000132845058
LINC01521	-0.6295	4.6420	0.00000007311389	0.00000133055566
SLC27A1	0.5799	4.6805	0.00000007338736	0.00000133286132
GRM4	-0.6080	4.9324	0.00000007392155	0.00000133988344
OGDH	-0.5943	6.5840	0.00000007683626	0.00000138994046
PPME1	0.5608	5.8551	0.00000007880692	0.00000142275474
COG1	-0.4380	5.5987	0.00000007919547	0.00000142693266
PGAP3	-0.6576	5.7394	0.00000007963460	0.00000143200361
RPS6KA1	0.4926	6.4985	0.00000008041275	0.00000144313878
PRORP	0.5141	5.8096	0.00000008138218	0.00000145367697
RSAD1	-0.6060	5.7545	0.00000008146261	0.00000145367697
B4GALT1	-0.5127	7.6300	0.00000008148019	0.00000145367697
FAM83H	-0.4705	8.2006	0.00000008192029	0.00000145866306
TAB1	-0.5929	4.9170	0.00000008273307	0.00000147025239
PMF1	-0.9512	6.4324	0.00000008462351	0.00000150091030
FAM155B	-0.6716	3.6812	0.00000008483032	0.00000150164554
SYNGR3	0.6615	4.7011	0.00000008549002	0.00000150744005
ATG13	-0.4125	6.7779	0.00000008565854	0.00000150744005
SUV39H1	-0.7074	3.6107	0.00000008574758	0.00000150744005
SLC35C2	-0.6450	6.4262	0.00000008582166	0.00000150744005
ZNF618	-1.0819	4.4593	0.00000008655375	0.00000151736402
PDE6D	0.5803	4.6768	0.00000008683973	0.00000151944426
TFR2	-0.7739	3.6882	0.00000008775341	0.00000153247834
KIAA0513	0.6912	6.3904	0.00000009026857	0.00000157337590
USB1	0.5363	4.9995	0.00000009192463	0.00000159917164
THG1L	-0.7269	4.6853	0.00000009551923	0.00000165852799
TAF7	-0.4347	7.2120	0.00000009683317	0.00000167813367
MMP15	0.6327	5.9292	0.00000009711037	0.00000167973195
NMRK1	0.7576	3.8573	0.00000009886079	0.00000170675828
CALHM2	-0.5996	5.0880	0.00000009935230	0.00000171198903

LOC100288175	1.1632	3.3449	0.00000010001256	0.00000172010231
TAF11	0.4395	5.9949	0.00000010314197	0.00000177057135
AKAP8	-0.5553	5.3352	0.00000010386364	0.00000177959567
PRMT2	-0.4820	6.7006	0.00000010565368	0.00000180685693
LOC100996842	-0.8515	5.1847	0.00000010728278	0.00000183108397
ALAD	0.5384	6.2949	0.00000010747360	0.00000183108397
NFKB1	-0.8993	4.8409	0.00000010810378	0.00000183722955
SPSB2	0.8102	4.8058	0.00000010823894	0.00000183722955
PRKD2	0.5177	6.5265	0.00000011033620	0.00000186933395
SEMA6A	1.2901	3.5930	0.00000011056370	0.00000186970008
LPCAT3	0.4593	5.8337	0.00000011171536	0.00000188566392
DDX59	-1.1018	4.0254	0.00000011381442	0.00000191753011
PTGR1	0.8015	3.7226	0.00000011411002	0.00000191895018
TXNIP	0.6404	7.4571	0.00000011456661	0.00000192306726
ACOT9	0.5387	4.9485	0.00000011627942	0.00000194821662
CUL7	-0.3568	6.8051	0.00000011682913	0.00000195286207
ELAC2	-0.4246	6.8500	0.00000011719475	0.00000195286207
DAXX	0.4687	6.7516	0.00000011743818	0.00000195286207
HEXIM1	0.6458	6.8596	0.00000011751122	0.00000195286207
ARHGEF40	0.7255	4.4537	0.00000011763193	0.00000195286207
FAM104A	0.5120	5.8928	0.00000011900380	0.00000197099643
CYTH2	-0.4920	6.5081	0.00000011915836	0.00000197099643
IGSF8	0.7773	3.6423	0.00000011950265	0.00000197309733
GEMIN4	-0.5295	5.1500	0.00000011985139	0.00000197526404
ARMCX3	0.9393	4.9296	0.00000012101094	0.00000199076153
MORC4	0.7282	4.4627	0.00000012200761	0.00000200352824
TMEM189	0.5345	6.7453	0.00000012389475	0.00000203084513
MXD4	-0.5754	7.3341	0.00000012445661	0.00000203637919
WDYHV1	0.5817	4.5200	0.00000012562132	0.00000205173951
SETD3	0.5077	6.7629	0.00000012605027	0.00000205504944
IAH1	-0.5329	5.1719	0.00000012792005	0.00000208179563
TMEM86A	0.6811	3.6742	0.00000012842367	0.00000208625289
ETNK2	0.6030	6.6407	0.00000013029426	0.00000211286099
MRPL58	-0.6987	5.5408	0.00000013082956	0.00000211775976
SPATA7	0.7646	3.7704	0.00000013116051	0.00000211933920
LINC01977	-0.9226	4.1011	0.00000013243765	0.00000213617466
DBNDD1	0.6193	7.3157	0.00000013449141	0.00000216545470
ZNF343	0.6930	3.5119	0.00000013590330	0.00000218170471
AIMP2	-0.5714	6.3144	0.00000013598115	0.00000218170471
LOC100294145	0.6716	3.7635	0.00000013699742	0.00000219413328
PCSK7	0.5545	5.3466	0.00000013813586	0.00000220847134

SLC16A13	0.6815	3.8411	0.00000013899747	0.00000221834096
DCDC2	-0.7613	4.1939	0.00000014123026	0.00000225002102
SAT1	0.5137	6.6362	0.00000014244328	0.00000226537198
ADPRHL1	-0.5306	5.4487	0.00000014323762	0.00000227402239
ANKRD13B	0.7974	4.7958	0.00000014379530	0.00000227878441
WWP2	-0.5387	6.1927	0.00000014403945	0.00000227878441
CACNG4	-0.4882	7.9324	0.00000014453609	0.00000228050751
THNSL1	-0.7659	3.5564	0.00000014465063	0.00000228050751
NIF3L1	-0.5209	4.6855	0.00000014530800	0.00000228690109
RRBP1	0.5539	7.0915	0.00000014608620	0.00000229517084
GABBR2	-0.6202	5.3610	0.00000014678007	0.00000230208954
ACOT2	-0.6071	5.5425	0.00000014806021	0.00000231190215
GYG2	0.5667	4.5078	0.00000014808510	0.00000231190215
RIPK1	-0.7385	4.6049	0.00000014816948	0.00000231190215
SUSD3	0.5443	5.2873	0.00000015318240	0.00000238559907
DCUN1D5	0.4552	4.9218	0.00000015341811	0.00000238559907
MZF1-AS1	-0.7521	3.6688	0.00000015454163	0.00000239896163
PPP5C	-0.3932	5.8483	0.00000015676925	0.00000242938840
ZBTB46	0.8751	4.1345	0.00000015831006	0.00000244908623
SLC9A8	-0.6723	4.5995	0.00000015908301	0.00000245685847
CORO7	0.6202	6.0185	0.00000016098625	0.00000248203086
GABBR1	0.7236	4.4002	0.00000016148125	0.00000248256795
TSEN54	0.6768	6.8482	0.00000016168047	0.00000248256795
RAB11B	-0.7195	6.7004	0.00000016184123	0.00000248256795
RCC1	-0.4323	6.2628	0.00000016335466	0.00000250155754
ESRP2	-0.5550	7.1140	0.00000016365577	0.00000250194960
PPFIA3	0.5282	6.3202	0.00000016466155	0.00000251309506
RAF1	-0.5127	6.8966	0.00000016537334	0.00000251972360
MICA	0.5197	4.6621	0.00000016750498	0.00000254792744
LASP1	0.4858	7.8534	0.00000016821347	0.00000255442555
MKS1	-0.5305	4.9403	0.00000017166129	0.00000260243095
RBM14	-0.4803	5.5218	0.00000017543526	0.00000265521271
SKIV2L	-0.4599	6.0685	0.00000017850086	0.00000269711538
LACTB	0.6786	4.1829	0.00000017880940	0.00000269728929
KNDC1	0.7087	3.9816	0.00000017970590	0.00000270287978
MTHFSD	-0.5663	4.8841	0.00000017977529	0.00000270287978
BCL3	-0.6684	5.5169	0.00000018357558	0.00000275545433
GPRIN1	0.5664	4.3625	0.00000018607675	0.00000278557108
LINC00963	-0.6990	5.2751	0.00000018619553	0.00000278557108
PNP	0.4803	5.3421	0.00000018697349	0.00000279260901
PRSS8	0.7826	6.8738	0.00000018756599	0.00000279685835

METTL1	-1.1251	4.1214	0.00000019064084	0.00000283804837
AAR2	-0.4069	5.5093	0.00000019136802	0.00000284421105
CLTCL1	0.8998	3.6637	0.00000019238132	0.00000285139003
MAX	0.4709	5.9659	0.00000019247903	0.00000285139003
TUSC1	-1.2601	3.0950	0.00000019329618	0.00000285883163
MANBA	0.4667	5.4863	0.00000019445444	0.00000287128581
C9orf78	0.3502	6.8425	0.00000019686317	0.00000290213389
SLC25A12	0.7499	3.7967	0.00000019746987	0.00000290635959
VPS53	0.4843	5.7705	0.00000019850053	0.00000291680150
MAP1LC3B	0.4694	6.5937	0.00000019904374	0.00000292005851
MLF1	0.7243	4.3023	0.00000019999495	0.00000292640606
HID1	-0.4971	8.4436	0.00000020012093	0.00000292640606
STXBP1	0.6255	5.4516	0.00000020075148	0.00000293090710
MTSS1	1.4133	3.3778	0.00000020118189	0.00000293247629
MICU1	0.4001	6.0683	0.00000020440158	0.00000297463255
JRK	-0.7255	4.9770	0.00000020481927	0.00000297594202
WDR81	-0.6961	5.3509	0.00000020560135	0.00000297936991
IER3IP1	0.5528	3.9880	0.00000020595354	0.00000297936991
APMAP	0.3734	7.8118	0.00000020624646	0.00000297936991
ST6GALNAC2	-0.4997	6.1926	0.00000020638678	0.00000297936991
RIMS3	0.8642	3.5054	0.00000020698615	0.00000297936991
ARL6IP5	0.6986	5.3713	0.00000020702372	0.00000297936991
ABHD10	-0.6721	3.8839	0.00000020905598	0.00000300051641
TRIP10	0.6473	6.0594	0.00000020921140	0.00000300051641
ZNF385A	0.6690	7.4215	0.00000020948435	0.00000300051641
TSG101	-0.4733	6.0550	0.00000021023502	0.00000300652639
ANAPC13	-0.5412	4.7794	0.00000021219560	0.00000302979281
IGFBP5	-0.8857	8.1841	0.00000021438965	0.00000305383921
PUF60	-0.7375	7.7966	0.00000021455230	0.00000305383921
TMEM268	-0.5021	4.9345	0.00000021619268	0.00000306860020
ALPP	-0.8199	3.7628	0.00000021626518	0.00000306860020
RRNAD1	-0.5701	5.3401	0.00000021673445	0.00000307046103
ZNF362	-0.5934	5.4262	0.00000021757530	0.00000307757214
IL27RA	-0.6922	3.9740	0.00000022147025	0.00000312779369
ALG1	-0.6280	5.4177	0.00000022246783	0.00000313700368
KIF12	0.7252	3.6661	0.00000022716822	0.00000319831721
LOC284581	0.5980	4.7568	0.00000022761455	0.00000319964047
UBQLN4	0.3635	6.9214	0.00000022807608	0.00000320117297
ZNF37BP	0.8376	4.0164	0.00000022885732	0.00000320718104
NOL12	-0.9030	3.9044	0.00000022954076	0.00000321180220
ADCY3	0.6137	5.4312	0.00000023502686	0.00000328350597

VPS33B	0.4775	4.6867	0.00000023733922	0.00000331071807
NAIF1	-0.6114	3.7027	0.00000023814680	0.00000331688815
ACOT1	-0.6633	3.5376	0.00000023964322	0.00000333261888
ODF2	0.3752	7.1029	0.00000024022175	0.00000333555614
TBC1D16	0.5415	6.3447	0.00000024164562	0.00000335020433
CADM4	0.8166	3.7015	0.00000024246355	0.00000335641995
SMAD3	-0.5940	6.9937	0.00000024305033	0.00000335942173
ALDOC	0.6139	5.2311	0.00000025161030	0.00000347026961
EXOSC10	-0.5209	5.8604	0.00000025183434	0.00000347026961
KDM1A	0.3737	6.9423	0.00000025380158	0.00000349207903
ABCB9	0.5237	4.5616	0.00000025476534	0.00000350003641
CGN	0.6687	7.1103	0.00000025729651	0.00000352543615
DEAF1	-0.6663	5.7536	0.00000025739061	0.00000352543615
CCDC142	0.6886	4.3523	0.00000025952597	0.00000354933039
TUBA1A	0.5130	7.1334	0.00000026057830	0.00000355836328
GRB2	0.3483	7.7622	0.00000026103260	0.00000355921480
LINC00174	-0.6948	4.4802	0.00000026149876	0.00000356022521
MAP3K6	-0.6361	4.5388	0.00000026246980	0.00000356809620
PAF1	-0.7177	6.7282	0.00000026422957	0.00000358664978
DMAC2	-0.6254	4.8616	0.00000026485260	0.00000358974102
MBOAT2	0.6832	5.0689	0.00000026691305	0.00000361227636
LTBP4	0.5602	6.5441	0.00000026800222	0.00000362161924
CDK10	-0.8255	6.3710	0.00000026918327	0.00000363217425
MEN1	0.4390	6.8439	0.00000026983806	0.00000363560741
FAM117A	0.5802	5.6617	0.00000027042190	0.00000363807597
NIPAL3	0.5187	4.7524	0.00000027106054	0.00000364127333
DDX11	-0.5455	5.3489	0.00000027551104	0.00000369559193
PPM1K	0.7658	3.3497	0.00000028283879	0.00000378828764
GET1	0.8882	4.3754	0.00000028330738	0.00000378897540
PRXL2A	0.4388	6.5747	0.00000028707490	0.00000383371640
MAST3	0.5364	5.0448	0.00000028915902	0.00000385587821
LAD1	-0.5813	7.2684	0.00000029077605	0.00000387175554
KATNA1	0.4643	5.2066	0.00000029264511	0.00000389093745
EVI5L	0.4890	5.8880	0.00000029383857	0.00000390109368
INO80	-0.6380	5.0258	0.00000029528166	0.00000391452962
NAGLU	-0.5818	6.0101	0.00000029583515	0.00000391615008
ASPSCR1	-0.9266	6.6135	0.00000029701967	0.00000392610723
PMP22	-0.7267	4.0261	0.00000029780825	0.00000393080913
STAT2	0.5234	6.0197	0.00000029898882	0.00000394066398
MYC	-0.8292	6.0182	0.00000030289618	0.00000398637715
PRSS23	-0.5079	7.5659	0.00000030498126	0.00000400487367

USP5	-0.3704	6.7978	0.00000030518363	0.00000400487367
TCEANC2	0.6871	3.4679	0.00000030668284	0.00000401492859
DIO2	-0.5797	5.1641	0.00000030692618	0.00000401492859
FAM110B	-0.8107	3.3584	0.00000030727622	0.00000401492859
UNG	-0.4191	6.5371	0.00000030881726	0.00000402369392
RELL2	0.6047	5.5516	0.00000030883324	0.00000402369392
LDB1	0.3337	7.1940	0.00000031238634	0.00000406415524
CHKB	-0.6479	5.1919	0.00000031607460	0.00000410625672
PSD4	-0.4784	6.5333	0.00000032150207	0.00000417080040
SSH3	-0.4227	7.7647	0.00000032293609	0.00000417816680
TYRO3	0.4932	4.5293	0.00000032299010	0.00000417816680
TM9SF4	-0.4845	6.1005	0.00000032554145	0.00000419439996
PRPS1	0.4506	5.0442	0.00000032596752	0.00000419439996
MICALL1	-0.5694	5.1629	0.00000032600622	0.00000419439996
TESMIN	-0.4777	4.7521	0.00000032661424	0.00000419439996
UBTD1	0.7813	5.2433	0.00000032687142	0.00000419439996
PHLDA2	-0.7723	5.9495	0.00000032701632	0.00000419439996
MLST8	-0.7709	6.8883	0.00000032876314	0.00000421085768
DNPEP	-0.5175	7.2901	0.00000032964649	0.00000421395754
C1orf52	0.5602	3.3488	0.00000032993325	0.00000421395754
FBXL16	0.5321	6.7739	0.00000033387946	0.00000425836988
UBE2L6	0.6410	3.9073	0.00000033961657	0.00000432546716
LRFN4	-0.5592	6.5433	0.00000034268112	0.00000435838549
ANKRD9	0.4829	6.6180	0.00000034320635	0.00000435896061
C7orf26	-0.5797	5.7686	0.00000034735844	0.00000440553347
PCBD2	-0.5769	3.5019	0.00000034963490	0.00000442822106
PELI3	0.5748	4.9051	0.00000035133536	0.00000444356040
CABLES2	0.6636	5.2841	0.00000035523969	0.00000448669213
ASMTL	0.6160	6.9178	0.00000035594837	0.00000448939882
ATP6V1D	0.4350	5.7750	0.00000035689524	0.00000449509804
MISP	-0.6405	7.4045	0.00000035772617	0.00000449876250
SCNN1A	0.4463	5.3719	0.00000035817699	0.00000449876250
PSRC1	0.5357	6.2111	0.00000037374007	0.00000468743250
PWWP2B	-0.6522	6.4952	0.00000037423065	0.00000468743250
PON2	-0.6875	3.8018	0.00000038037397	0.00000475781826
CACNB1	0.6006	3.4393	0.00000038165859	0.00000476731997
COPS5	0.4392	5.7687	0.00000038257942	0.00000477225790
MVB12B	-0.8049	3.7649	0.00000038799726	0.00000483320044
SF1	-0.3755	7.9080	0.00000039429676	0.00000490494372
PP7080	-0.5373	4.2897	0.00000039561930	0.00000491466329
N4BP3	-0.4644	8.6431	0.00000040077809	0.00000497194789

BOLA1	-0.6728	5.9333	0.00000040209239	0.00000498083570
TMEM222	-0.9911	5.0260	0.00000040259150	0.00000498083570
ARHGAP1	-0.4366	6.9226	0.00000040905433	0.00000505226415
RAB31	0.5688	4.9663	0.00000040947764	0.00000505226415
ECI2	0.6314	5.6889	0.00000041133860	0.00000506833893
TOX4	0.3578	6.7663	0.00000041231815	0.00000507352456
CRY1	1.1189	4.3539	0.00000041875938	0.00000514118189
INPP4B	-0.6368	6.7495	0.00000041894886	0.00000514118189
TOR1AIP2	0.5937	6.0760	0.00000042040652	0.00000515210749
FEM1A	-0.4587	5.1064	0.00000042243517	0.00000516999158
HIRIP3	-0.7358	5.6173	0.00000042605548	0.00000520728109
PHF19	-0.5239	5.8489	0.00000042900997	0.00000523634351
ZNF324	0.3848	5.4258	0.00000042990297	0.00000523785660
COQ2	-0.6399	4.3561	0.00000043028753	0.00000523785660
CDK5RAP2	-0.4921	5.5304	0.00000043117072	0.00000524158137
POMT2	-0.4842	6.0738	0.00000043397206	0.00000526858327
NME7	0.6790	4.4198	0.00000043783290	0.00000530835851
FAM217B	-0.8884	4.5504	0.00000043933288	0.00000531944254
GTF2H2B	1.0624	3.5036	0.00000044846550	0.00000542278986
LINC00999	-0.5313	3.9714	0.00000045037761	0.00000543383263
LOC105379152	-0.6953	3.4463	0.00000045057548	0.00000543383263
RUBCN	0.5241	5.7445	0.00000045567784	0.00000548807758
KIF3B	0.4053	6.0919	0.00000045849111	0.00000551464602
FBH1	0.3516	6.8068	0.00000046015819	0.00000552012644
PTPN23	-0.5111	5.7868	0.00000046016251	0.00000552012644
CTSL	-0.3750	6.4636	0.00000046847240	0.00000561239819
UBR7	0.6045	6.4575	0.00000047628616	0.00000569849094
PPARD	0.6693	5.3625	0.00000048461955	0.00000579056602
SYVN1	0.4605	6.3195	0.00000048676260	0.00000580852979
NXN	0.7659	4.0172	0.00000049244026	0.00000586856952
MICAL1	0.5482	4.9165	0.00000049362624	0.00000587499332
NEAT1	0.7322	9.3729	0.00000050315953	0.00000598061736
F8A1	-0.6390	7.0586	0.00000050706428	0.00000601915128
C12orf65	0.5809	4.0579	0.00000050869618	0.00000603063967
MLEC	0.3695	7.4820	0.00000050997086	0.00000603786882
H3-3B	0.3817	9.5225	0.00000051157756	0.00000604080419
USF2	-0.5679	7.4639	0.00000051186269	0.00000604080419
P3H1	0.5499	4.7407	0.00000051221443	0.00000604080419
HEXD	-0.9559	5.1075	0.00000051384937	0.00000605222584
MKNK2	0.3961	6.5451	0.00000051483872	0.00000605602388
DCAF4	-0.3864	6.3520	0.00000051913797	0.00000609869586

LYPD1	-0.6597	4.5443	0.00000052072356	0.00000610941946
MRPL54	-1.1225	4.9514	0.00000053222874	0.00000623634734
COQ6	-0.4706	5.1991	0.00000053407480	0.00000624991396
FAM131A	0.6179	4.0291	0.00000053859552	0.00000628677431
CORO1A	0.8132	4.6375	0.00000053860923	0.00000628677431
GABARAPL2	0.4319	6.5191	0.00000054703752	0.00000637695472
CFAP410	-1.0112	5.5646	0.00000054784868	0.00000637822288
NIT1	0.6762	5.5731	0.00000054955911	0.00000638994397
KHK	0.9204	5.1499	0.00000055226257	0.00000641316676
SNRNP40	-0.5366	4.5251	0.00000055470264	0.00000643327543
PTRHD1	-0.7311	5.3181	0.00000055920343	0.00000646397260
SERPINH1	-0.3754	6.9005	0.00000055961099	0.00000646397260
MRPL15	-0.4725	5.6697	0.00000055996520	0.00000646397260
CATSPERG	0.6591	3.1855	0.00000056038784	0.00000646397260
HCFC1	-0.7609	6.3525	0.00000056141812	0.00000646397260
VPS51	-0.5810	7.5235	0.00000056177253	0.00000646397260
DDX54	-0.4588	7.4574	0.00000056233216	0.00000646397260
RPAP1	-0.5587	3.6799	0.00000057035217	0.00000654787367
DHRSX	-0.7117	3.7112	0.00000057205357	0.00000655911423
SNAPIN	-0.6131	5.8723	0.00000057888792	0.00000662910614
SNN	0.7609	4.1245	0.00000058272550	0.00000666464769
RIOX2	-0.6537	3.9029	0.00000058509377	0.00000668307481
GCA	0.5991	3.8618	0.00000058580856	0.00000668307481
PANK2	0.4698	4.8106	0.00000059653945	0.00000679695702
LMTK3	0.7135	5.8187	0.00000059765157	0.00000680109508
CCND3	0.4946	6.0937	0.00000060242757	0.00000684686456
MRPL42	-0.5664	4.3824	0.00000060602553	0.00000687914729
KAT7	-0.5475	5.8119	0.00000060999599	0.00000690899316
PLEKHG4	-0.5778	4.6193	0.00000061017647	0.00000690899316
NPTXR	-0.5670	4.4446	0.00000061589960	0.00000696511122
RNF145	0.5838	4.4642	0.00000061926914	0.00000699450624
MARCHF9	0.6512	6.4592	0.00000062362294	0.00000703493157
KLHL35	-0.9664	4.9973	0.00000062829563	0.00000707365540
MAN2C1	-0.4404	5.9301	0.00000062861358	0.00000707365540
SH2B2	0.8958	5.2852	0.00000063248984	0.00000710846568
HDAC2	0.4238	6.2125	0.00000063513018	0.00000712623569
MAP3K10	0.6535	4.5301	0.00000063564045	0.00000712623569
NOTCH2NLB	0.5633	4.1573	0.00000063921511	0.00000715747524
SMAGP	-0.6579	4.0139	0.00000064294182	0.00000719033824
PI4K2A	0.3615	6.0550	0.00000065975434	0.00000736928560
PCDHGC3	-0.7250	5.8974	0.00000067141751	0.00000749034698

ANAPC7	-0.4622	5.4684	0.00000067653415	0.00000753816765
SPAG7	-0.6724	6.2869	0.00000067758879	0.00000754066639
SAMHD1	0.8445	3.7400	0.00000068053842	0.00000756422200
SALL2	0.8885	3.8761	0.00000068452699	0.00000759181742
PDHB	-0.5998	5.0087	0.00000068490642	0.00000759181742
ZNF783	-0.4593	4.8411	0.00000068552916	0.00000759181742
RABL3	-0.7312	4.0034	0.00000069036252	0.00000763603177
B2M	0.4099	6.7725	0.00000069318183	0.00000765788829
IRF6	0.5522	4.5939	0.00000070185927	0.00000774433053
PPAN	-0.8511	5.3670	0.00000071003990	0.00000782508777
HSPA14	0.5933	5.4877	0.00000071445030	0.00000786414929
SEC61A2	0.8013	3.4478	0.00000071918645	0.00000790669758
WDR91	0.5641	4.3932	0.00000072183387	0.00000792620723
EHBP1L1	0.5494	6.5471	0.00000072928177	0.00000799831855
GNAI2	0.4210	7.2473	0.00000074450739	0.00000815545425
TARBP2	-0.7840	5.1207	0.00000075816082	0.00000829501008
CDS2	0.3925	5.5255	0.00000076867695	0.00000839994628
SPTSSA	0.5228	4.6995	0.00000077819722	0.00000849376078
C1orf21	0.3789	5.7022	0.00000078810390	0.00000859156240
THRA	0.4614	5.4549	0.00000079068172	0.00000860932936
MACROH2A2	-0.5861	4.8758	0.00000079630679	0.00000866019400
PLIN3	0.3835	6.7813	0.00000080185462	0.00000871009790
ADAM15	0.5047	8.4052	0.00000080308219	0.00000871300997
TJP3	0.4017	6.8995	0.00000080840213	0.00000876026223
RILPL2	0.5329	5.3092	0.00000080953703	0.00000876210462
MAN1B1-DT	-0.6004	4.9378	0.00000082144393	0.00000888039563
PPIL3	0.5426	4.1489	0.00000083267930	0.00000899115424
KLHDC8B	0.6576	3.8907	0.00000083671725	0.00000902402540
ZNF672	-0.4604	4.9500	0.00000083819575	0.00000902924745
COL1A1	0.6205	4.8143	0.00000084066986	0.00000904516943
TENT5C	0.7042	4.8487	0.00000085184609	0.00000915428762
TUBB2A	0.6255	4.0503	0.00000085282759	0.00000915428762
RRP15	-0.5297	4.5381	0.00000085420397	0.00000915823641
HDHD2	-1.0838	3.3428	0.00000085717515	0.00000917925418
CARD10	0.6445	4.4741	0.00000087572559	0.00000936685990
ZNF703	-0.5830	6.8457	0.00000089389182	0.00000954991959
ELK4	-0.8081	4.7429	0.00000089808923	0.00000958348797
NRBP1	-0.3728	8.4663	0.00000090251652	0.00000961778066
MUC5B	-0.9448	5.9287	0.00000090342109	0.00000961778066
CDK3	-1.2504	3.8456	0.00000090686490	0.00000964313835
ADCY1	-0.8565	4.2357	0.00000090908050	0.00000965539179

VDR	0.6774	4.6328	0.00000091063481	0.00000966060128
TBC1D31	0.5403	3.5409	0.00000092831199	0.00000983664083
GTPBP6	-0.5854	6.1138	0.00000094617171	0.00001001420194
CLEC16A	0.5077	5.5040	0.00000095416542	0.00001008705030
PPHLN1	0.4400	6.0200	0.00000095900110	0.00001012638255
MYO9B	0.4658	5.9167	0.00000096146272	0.00001014058411
DIS3L2	-0.6608	4.1060	0.00000096755828	0.00001018472752
POLR2B	0.5210	6.7575	0.00000096789118	0.00001018472752
SLC29A4	0.6683	5.3808	0.00000096959690	0.00001019086737
LRRFIP2	0.5447	5.0550	0.00000097300432	0.00001021485802
NCAPH	-0.5360	4.1514	0.00000097573482	0.00001023169502
PPM1G	0.4113	8.7485	0.00000098132582	0.00001027845414
H2BC5	0.5250	5.8269	0.00000098249890	0.00001027888536
EPB41L1	0.4013	6.0613	0.00000098644490	0.00001030829246
ORMDL3	0.5163	6.3412	0.00000099379227	0.00001037313519
KREMEN2	0.9045	6.2432	0.00000100539694	0.00001048221540
LINC01754	0.6226	3.4871	0.00000100753684	0.00001049247938
ZBTB7B	-0.3547	6.5597	0.00000101961219	0.00001060152386
TUBD1	0.5274	5.7513	0.00000102053943	0.00001060152386
PAQR4	0.4195	6.9473	0.00000102151012	0.00001060152386
FBXW4	-0.6153	6.2121	0.00000102389145	0.00001061410758
CAMK2N2	0.8841	5.5919	0.00000102624664	0.00001062639195
CHURC1-FNTB	-0.4999	5.0365	0.00000102985571	0.00001065161695
EWSR1	-0.3382	8.0693	0.00000103728119	0.00001071621215
WNT7B	-0.3263	5.8135	0.00000103896306	0.00001072139044
WDR33	-0.3654	6.0239	0.00000104351682	0.00001075031427
ZNF628	-1.0492	4.0536	0.00000104485118	0.00001075031427
YWHAE	-0.3529	8.8132	0.00000104531742	0.00001075031427
NLRX1	-0.7849	3.7246	0.00000105007689	0.00001078704552
FAIM	-1.0130	3.4959	0.00000105541950	0.00001082967740
GALE	0.6096	4.6537	0.00000106768531	0.00001094317186
PHF21B	0.7276	3.7685	0.00000108211433	0.00001107855720
SEH1L	-0.6991	4.4777	0.00000108694761	0.00001111550817
ZG16B	-0.8689	5.1509	0.00000109268079	0.00001116156833
KAT2A	-0.5268	5.5955	0.00000109963957	0.00001122003022
URB1-AS1	-0.6950	3.9824	0.00000110485453	0.00001126058804
ZCCHC17	0.4747	4.8386	0.00000110900839	0.00001129025243
ACTR6	0.6226	3.7339	0.00000111455749	0.00001132661344
HENMT1	-0.4405	6.3786	0.00000111598498	0.00001132661344
PMM2	-0.4198	6.0234	0.00000111632188	0.00001132661344
IBA57	-0.6859	3.6690	0.00000112583619	0.00001141040006

SERHL2	-0.5759	4.5109	0.00000113925117	0.00001153348928
SFMBT1	-0.6359	3.7629	0.00000115163062	0.00001164583254
UBE2J1	-0.6122	5.0742	0.00000115513583	0.00001165648100
FBXO44	0.6992	5.4174	0.00000115525084	0.00001165648100
GLA	0.5598	4.2393	0.00000115746382	0.00001166584793
SPDEF	-0.5815	9.0035	0.00000116242101	0.00001169882517
VASP	0.4007	7.3530	0.00000116331231	0.00001169882517
TRIM44	-0.4654	6.3995	0.00000116670168	0.00001171993139
HSPD1	0.4200	7.9789	0.00000118375937	0.00001187546760
GATB	-0.5879	4.5299	0.00000118480053	0.00001187546760
KRBA1	0.4646	5.0497	0.00000118752787	0.00001188968094
SLC30A3	0.6840	4.7748	0.00000119069672	0.00001189616899
DTX3	-0.5159	5.2454	0.00000119079591	0.00001189616899
PIP5K1C	0.4174	5.8427	0.00000120452736	0.00001202012415
YDJC	-0.7250	5.5802	0.00000121402514	0.00001210160512
OBSL1	-0.3918	8.8130	0.00000123507696	0.00001229795386
LIG3	-0.5674	4.6016	0.00000124116745	0.00001234506198
LENG1	-0.8096	4.4823	0.00000124281246	0.00001234789930
CLN6	-0.6281	5.8555	0.00000124608316	0.00001236104561
CERK	0.7168	4.4753	0.00000124685803	0.00001236104561
SELENOK	0.5563	4.6184	0.00000125588186	0.00001242557471
CASTOR2	0.7067	5.7165	0.00000125610369	0.00001242557471
HDHD5	-0.4562	5.7223	0.00000125773246	0.00001242814846
ST7	-0.7860	3.6832	0.00000126543254	0.00001249064447
CHRD	-0.6957	3.7734	0.00000128919883	0.00001268763168
SAR1A	0.3384	6.1347	0.00000128931796	0.00001268763168
INTS10	-0.5039	4.9540	0.00000128958089	0.00001268763168
VPS54	-0.6220	4.2407	0.00000129345790	0.00001271200349
POP1	0.4695	5.3769	0.00000132292603	0.00001298755817
ZNF33A	-0.7084	4.9660	0.00000133411782	0.00001308328713
MEGF8	0.5584	5.1949	0.00000135399876	0.00001326392956
MCM5	-0.4108	6.3891	0.00000136202350	0.00001332816314
FEZ2	-0.7224	4.5455	0.00000137220485	0.00001341333934
C9orf85	0.4645	4.1272	0.00000138010523	0.00001347605977
AMZ2P1	-0.5456	4.2826	0.00000138188987	0.00001347899238
MLH1	-0.4047	5.1720	0.00000140561165	0.00001369566461
SCPEP1	0.6163	5.4607	0.00000142320870	0.00001384466674
WRAP53	0.6044	5.0816	0.00000142395317	0.00001384466674
ACAD10	-0.4622	5.4642	0.00000143278901	0.00001391567591
MRPL27	-0.9598	6.0228	0.00000143442489	0.00001391667996
PCMT1	0.3213	7.0077	0.00000143790834	0.00001393558761

NOP14	-0.3326	6.2032	0.00000146315080	0.00001416510915
USP40	-0.3987	5.6540	0.00000148670323	0.00001436290108
FRMD8	0.6092	5.5765	0.00000148674452	0.00001436290108
ZNF516	0.8137	4.0247	0.00000149489016	0.00001442624611
CTPS1	-0.5185	4.2142	0.00000150609348	0.00001451893302
SLC27A4	0.4284	6.6646	0.00000150965656	0.00001453784860
CAPN5	0.4414	5.1725	0.00000151273896	0.00001455210007
SMAP2	0.4931	5.1652	0.00000151686275	0.00001457109168
CYLD	0.7856	3.5941	0.00000151832105	0.00001457109168
CSTF3	0.5433	4.5699	0.00000151952690	0.00001457109168
TPM3	0.3554	7.6634	0.00000152480793	0.00001460630887
EML2	0.4405	5.4502	0.00000155453165	0.00001487534448
SLC9A5	0.8073	3.0958	0.00000156255707	0.00001493640084
SAPCD2	0.3395	7.8166	0.00000156730873	0.00001496606792
ARRB1	-0.3141	6.9382	0.00000159287916	0.00001517440775
C1orf115	-0.6572	3.2153	0.00000159341006	0.00001517440775
PAICS	0.4279	6.9949	0.00000159413996	0.00001517440775
TNFAIP1	0.5152	6.0413	0.00000159861538	0.00001520107462
PTPA	-0.5425	8.5532	0.00000160105184	0.00001520831777
CSTF2	-0.7012	4.1604	0.00000161591468	0.00001532711634
CENPO	-0.4935	4.6486	0.00000161693398	0.00001532711634
C20orf96	0.7110	3.6968	0.00000162139371	0.00001535336420
HIP1R	0.3455	7.2169	0.00000162921576	0.00001541136286
PCED1A	-0.6478	5.3891	0.00000163223673	0.00001542387279
DFFA	0.3992	5.7199	0.00000163463390	0.00001543046820
ALDH16A1	-0.6609	5.3497	0.00000163722109	0.00001543884188
ZNF789	0.5421	4.6508	0.00000164413125	0.00001548792108
ATG2A	0.4494	6.4271	0.00000165756941	0.00001559832935
ISG20L2	0.3307	6.3580	0.00000166530116	0.00001565486527
NBN	-1.0145	5.0500	0.00000166804928	0.00001566448349
SMIM7	-0.6044	6.0521	0.00000168157685	0.00001577520596
SP2	-0.7312	4.6152	0.00000169170616	0.00001585385311
TFDP2	0.5518	6.0311	0.00000171567674	0.00001606191806
DNAJC5	0.3005	7.2022	0.00000172793270	0.00001615999676
PPP1R9B	0.3196	7.4581	0.00000177399626	0.00001657372435
ZFYVE1	0.4169	5.8983	0.00000177612852	0.00001657659109
ZNF777	-0.3547	5.5795	0.00000180644753	0.00001684224848
DDX24	0.3232	8.1910	0.00000183052543	0.00001704923222
PLK1	-0.5283	6.3690	0.00000184481256	0.00001716469558
GMIP	0.3879	5.8047	0.00000184671393	0.00001716479955
MBD3	-0.8356	6.5302	0.00000185544574	0.00001722832596

HDAC3	0.3987	6.8372	0.00000186184337	0.00001727007117
EVPL	-0.3999	7.1188	0.00000187489688	0.00001737340670
EPOP	0.4114	5.2189	0.00000188885592	0.00001748491397
PVR	-0.4677	4.9203	0.00000189553443	0.00001752886775
ANXA3	-0.6762	4.2947	0.00000190799058	0.00001762610626
HYOU1	0.4257	7.1075	0.00000192248487	0.00001774195639
PCCB	-0.3249	6.6705	0.00000193055452	0.00001779834073
PABPC1L	0.6274	5.3407	0.00000193267091	0.00001779978151
TUBGCP5	-0.7212	3.5012	0.00000193974084	0.00001784679487
MLXIP	0.3760	6.7809	0.00000195822716	0.00001796916734
PTP4A3	-0.7299	4.1367	0.00000195872318	0.00001796916734
VPS37D	0.7475	3.9013	0.00000195897761	0.00001796916734
AHSA1	0.3863	7.7077	0.00000196269285	0.00001798507952
ARHGEF10L	-0.3969	5.0657	0.00000198455499	0.00001816708048
CXXC1	0.5014	6.4673	0.00000200090529	0.00001829830914
M6PR	0.3921	6.8486	0.00000200746253	0.00001833980606
GVQW3	0.8204	3.6883	0.00000202349893	0.00001846773247
ACSF2	0.5942	7.0083	0.00000202744704	0.00001848518733
PCTP	-0.5769	4.0364	0.00000203087398	0.00001849786023
RARS1	0.3042	6.4897	0.00000204192460	0.00001857987705
PCYT2	0.4400	7.3625	0.00000205084555	0.00001862489027
BLOC1S3	-0.4070	4.5902	0.00000205097349	0.00001862489027
CHMP3	-0.3780	6.1653	0.00000206034654	0.00001869131561
ZDHHC3	0.3622	6.1697	0.00000207836270	0.00001883593978
HIP1	0.7992	4.8315	0.00000208788843	0.00001890340458
SF3A3	0.3090	6.2346	0.00000209710412	0.00001896793081
ZNF787	-0.5509	5.9195	0.00000211439011	0.00001910525032
ZXDC	-0.3741	5.4536	0.00000213687591	0.00001928923477
ALAS1	0.4386	5.2429	0.00000215655503	0.00001944754345
ACBD7	0.6041	4.3237	0.00000218714587	0.00001970384094
BYSL	-0.5636	4.4993	0.00000220215421	0.00001981938787
TTC31	-0.4798	4.8660	0.00000223570073	0.00002010138450
AEN	-0.3700	5.1018	0.00000224701411	0.00002018312080
HR	-0.4196	5.8715	0.00000226596445	0.00002029158025
PIP4K2C	0.4891	6.2395	0.00000226648703	0.00002029158025
IFT140	-0.3942	6.3487	0.00000226744901	0.00002029158025
ZNF629	0.3562	6.8605	0.00000226802708	0.00002029158025
TNFRSF1A	0.3356	6.6839	0.00000229402553	0.00002050398209
EIF3D	-0.3655	7.7218	0.00000229948824	0.00002053259856
TRAF3IP1	0.8523	4.2316	0.00000230273479	0.00002054138964
SLC45A4	0.4996	4.2650	0.00000231661646	0.00002064494025

SLC25A44	0.4257	6.1173	0.00000231912025	0.00002064699113
TCFL5	0.5375	4.9795	0.00000232287081	0.00002066012718
ATXN3	-0.5671	4.3496	0.00000232554225	0.00002066364889
RAB1B	-0.5296	9.2870	0.00000233216494	0.00002070223836
ACCS	-0.6802	3.8281	0.00000235709103	0.00002090306992
MRNIP	0.5766	4.7699	0.00000236672996	0.00002095025326
ZNF592	-0.4313	5.9481	0.00000236731237	0.00002095025326
KAT8	-0.4566	5.8750	0.00000236933268	0.00002095025326
NCSTN	-0.5611	5.6187	0.00000238436555	0.00002106266886
HDAC1	0.3004	6.7113	0.00000240108645	0.00002118976295
DNAL1	0.6608	4.3488	0.00000241790360	0.00002131745879
SENP6	-0.7180	5.0333	0.00000243092871	0.00002141150691
BCAS1	-0.5162	6.8462	0.00000244003725	0.00002146603814
TRAPPC4	0.5270	5.7888	0.00000244184753	0.00002146603814
BNIP1	-0.7001	3.9767	0.00000244807115	0.00002149993629
MC1R	-0.6255	4.7872	0.00000245698318	0.00002155735674
GINM1	0.4568	5.7766	0.00000247718997	0.00002171367001
NDUFS2	-0.4859	6.9615	0.00000249709606	0.00002186704856
SEC22C	0.5277	4.4013	0.00000251990963	0.00002204556774
SEMA6C	0.5298	3.7803	0.00000253397019	0.00002214724094
MDH1	0.3694	6.8285	0.00000254711918	0.00002223022055
SRCAP	-0.5799	7.2420	0.00000254836027	0.00002223022055
PRKACA	0.4147	7.4500	0.00000255152246	0.00002223644476
PLA2G6	-0.6052	4.5943	0.00000257843048	0.00002244940290
FGFR4	-0.4125	6.6319	0.00000258212640	0.00002245360634
ELMO3	-0.7111	6.3740	0.00000258385846	0.00002245360634
ZNF791	0.5162	4.9045	0.00000259274299	0.00002250927259
SWSAP1	-0.5924	3.7571	0.00000264775750	0.00002296493398
SCARB1	-0.3670	6.5275	0.00000267356917	0.00002316668093
HDGFL2	0.5923	7.2825	0.00000267860241	0.00002318816824
TCF25	-0.4656	8.1591	0.00000270761956	0.00002341134415
TSC22D4	0.4491	8.2150	0.00000270953889	0.00002341134415
NME6	-0.5991	3.6474	0.00000274330502	0.00002368055212
IRF7	-0.6344	4.4506	0.00000274591140	0.00002368055212
CBWD3	0.4251	4.9724	0.00000275765862	0.00002375929593
HNRNPL	-0.3311	7.7932	0.00000276300745	0.00002378281582
C6orf47	0.4546	5.9917	0.00000280567868	0.00002411893701
MRPL3	-0.4945	5.9913	0.00000280736884	0.00002411893701
BLMH	0.4673	4.9369	0.00000282122476	0.00002421506811
CNIH4	0.4840	5.1141	0.00000286409629	0.00002455982851
PML	0.4939	5.5071	0.00000287693571	0.00002464665395

TMEM107	0.5169	4.3433	0.00000289227795	0.00002475473714
ARHGEF16	-0.3626	5.8833	0.00000289820575	0.00002478211527
ERP44	0.2796	6.1583	0.00000291094798	0.00002486765625
SMIM19	-0.4245	4.4780	0.00000292019799	0.00002492323116
SCD5	0.7391	4.3047	0.00000292629594	0.00002495182484
SRF	-0.3735	6.0653	0.00000293377227	0.00002499210691
KCNK15	-0.6393	5.3240	0.00000293768782	0.00002500200852
RNF8	0.5625	4.2876	0.00000294230099	0.00002501782332
COG7	-0.3609	4.9970	0.00000296958808	0.00002522622018
AP2A1	0.3374	7.4947	0.00000298865456	0.00002536445985
LIMK2	0.4281	5.3373	0.00000303159658	0.00002570488190
CBWD1	0.5441	4.7525	0.00000304656988	0.00002580774357
C1orf43	-0.3293	7.9648	0.00000309002464	0.00002615145733
RARG	-0.3914	6.5827	0.00000310042502	0.00002621504621
HEIH	-0.5037	6.0534	0.00000310506075	0.00002622982018
PFKFB3	-0.7096	5.6017	0.00000311453533	0.00002628540455
RTF1	0.5271	6.5121	0.00000312238953	0.00002632722317
FUCA2	-0.3236	6.4427	0.00000315059566	0.00002654040744
P4HA2	0.4127	4.4409	0.00000317088056	0.00002668653045
USP49	0.6513	3.4779	0.00000317429356	0.00002669051835
RNH1	-0.5406	7.6156	0.00000317831416	0.00002669960306
RAB11FIP4	0.3782	5.5139	0.00000320701261	0.00002691578698
POMGNT2	-0.8311	3.7216	0.00000322064003	0.00002700520051
BACE1	0.3968	6.6636	0.00000323131527	0.00002706971767
MAP4	0.3232	7.4056	0.00000326599435	0.00002733501815
TMEM87A	-0.5064	4.6001	0.00000327238834	0.00002734404492
CCN5	-0.5823	4.7249	0.00000327508222	0.00002734404492
RASGRP1	-1.3588	3.2092	0.00000327610625	0.00002734404492
CEP131	0.6651	6.2736	0.00000328460224	0.00002736601780
ZNF337	0.5021	5.2516	0.00000328476593	0.00002736601780
SPATS2L	-0.5070	4.3257	0.00000330962468	0.00002754784761
SIPA1L1	-0.4616	7.0634	0.00000331484283	0.00002756601441
PLCB4	-0.9093	3.9655	0.00000334998255	0.00002783274616
RXRA	-0.3482	7.2956	0.00000336184053	0.00002790573482
METTL16	-0.4892	4.6203	0.00000342089375	0.00002836998733
RGS12	0.5688	4.7360	0.00000343156368	0.00002843250891
PDE7A	0.6864	4.4214	0.00000348423376	0.00002884259504
PINK1	-0.4305	7.2484	0.00000350643513	0.00002899994300
AIP	-0.6405	6.5397	0.00000352800009	0.00002915174595
SLC9A6	0.8250	3.6580	0.00000354196975	0.00002924057028
ALDH5A1	-0.5344	4.9684	0.00000358155656	0.00002954052235

RBM39	-0.4308	7.1775	0.00000358810690	0.00002956197151
LRRC14	0.3301	5.9230	0.00000359144482	0.00002956197151
ERCC6L2	-1.0477	3.4424	0.00000359392320	0.00002956197151
CSNK1D	-0.2753	7.8665	0.00000360977549	0.00002966549428
MAPK9	0.4041	6.3140	0.00000363412541	0.00002981300753
LRWD1	0.4094	5.9512	0.00000363591383	0.00002981300753
ZBED3	-0.8010	3.2575	0.00000363757431	0.00002981300753
DUSP12	-0.5551	3.9651	0.00000364874695	0.00002987761143
SNX8	-0.3741	6.1228	0.00000367075424	0.00003003073804
SMYD2	-0.3671	4.8459	0.00000367783785	0.00003006160714
SIRT2	0.4541	5.6268	0.00000369622912	0.00003018476318
EPS8L1	-0.5768	6.6928	0.00000370793781	0.00003025317449
ACTR5	-0.5902	3.6719	0.00000374582480	0.00003053486090
DCAF6	0.4174	6.0591	0.00000378086507	0.00003079285709
LMBR1L	0.5303	4.6380	0.00000378847169	0.00003082716076
KCTD10	0.4892	6.3762	0.00000384157542	0.00003123128593
TNIP2	-0.5064	6.0779	0.00000388525243	0.00003155811921
PTPN18	-0.4436	6.0693	0.00000389594004	0.00003161665013
SALL4	0.5868	5.5100	0.00000390460364	0.00003165866577
SVBP	-0.6701	3.3475	0.00000393422891	0.00003187041282
RELT	0.6700	3.2005	0.00000396301565	0.00003207499564
CALML5	-1.0750	6.0391	0.00000399178469	0.00003227907104
GYS1	0.3897	6.3049	0.00000400001526	0.00003228101998
TBC1D24	0.5343	4.7231	0.00000400229785	0.00003228101998
NTAN1	0.4618	5.1565	0.00000400269007	0.00003228101998
SSBP2	0.6263	4.4331	0.00000400992155	0.00003231064557
NIPSNAP1	0.2960	7.1624	0.00000403636530	0.00003247179084
RBM19	-0.3773	5.4118	0.00000403707211	0.00003247179084
TMEM150A	0.4484	4.5408	0.00000406574220	0.00003264521495
PAX8-AS1	-0.3640	5.0400	0.00000406582294	0.00003264521495
RHBDF2	0.4386	4.8243	0.00000407995052	0.00003272970906
OVOL2	0.5281	3.5849	0.00000411135260	0.00003295250927
GABPB1-AS1	-0.5876	4.6694	0.00000416375958	0.00003334312236
SH3BGRL2	0.6374	3.5822	0.00000418265499	0.00003346492508
CAMLG	0.3727	5.7762	0.00000421410255	0.00003368685325
TP53RK	-0.5902	3.8450	0.00000424347498	0.00003389181729
LOC648987	-0.4780	3.9050	0.00000425411818	0.00003394696591
ZMAT3	0.6002	4.5552	0.00000426071867	0.00003396978601
PAN2	-0.6321	5.3548	0.00000426803915	0.00003397635406
C1orf210	0.6188	4.1035	0.00000426902544	0.00003397635406
ARID4A	0.9255	4.7588	0.00000427401373	0.00003398626851

ATG10	-0.4904	3.2446	0.00000429326838	0.00003410951017
ZCWPW1	-0.7713	4.6039	0.00000431188148	0.00003422744382
TMCO4	-0.5517	3.8300	0.00000433838809	0.00003440777487
RNF169	-0.5407	4.1747	0.00000434312798	0.00003441259763
WDR12	0.4730	4.1779	0.00000434659054	0.00003441259763
PCBP3	0.6307	3.2629	0.00000435036473	0.00003441259763
TMEM242	-0.6338	3.2569	0.00000437459270	0.00003457413080
TSPAN31	-0.4619	5.2811	0.00000438793804	0.00003464944816
ARPC5L	0.4394	6.6782	0.00000440246917	0.00003473399002
MRPS27	-0.2842	5.6456	0.00000442625159	0.00003489131135
ANP32E	0.5879	5.3450	0.00000443033803	0.00003489323473
INPP5K	0.4190	6.5368	0.00000446153632	0.00003510850201
IRAK1	-0.2898	8.3853	0.00000455031452	0.00003577265248
KLHDC10	0.5476	4.9260	0.00000455381415	0.00003577265248
WDR13	-0.6347	6.0332	0.00000455869555	0.00003578004690
LRFN3	0.6614	4.4812	0.00000459797119	0.00003605714710
TGFB1	0.5079	6.3935	0.00000460695252	0.00003609640711
PRCC	-0.3600	7.1018	0.00000462061849	0.00003614898588
ATF7	-0.7741	3.5756	0.00000462162456	0.00003614898588
REEP2	0.8486	4.6540	0.00000465161667	0.00003635226419
SEPHS2	0.3209	7.2305	0.00000473768561	0.00003699305504
LINC00910	-0.5411	3.2874	0.00000474721755	0.00003702213972
GLCE	0.6069	4.4216	0.00000474956423	0.00003702213972
RPP25	-0.6309	5.3968	0.00000480118813	0.00003737803867
PSIP1	0.5326	4.9360	0.00000480345459	0.00003737803867
TRNP1	0.4618	3.6860	0.00000480887992	0.00003738233526
CBX6	0.3243	7.0248	0.00000481223983	0.00003738233526
TIMELESS	-0.3115	6.4437	0.00000482137287	0.00003742127099
BRWD3	1.2079	3.4292	0.00000497343015	0.00003856850487
DHRS1	0.5157	5.2646	0.00000498456398	0.00003862186479
FAM20C	-0.4699	5.7399	0.00000502508477	0.00003889952806
CENPN	-0.4938	5.1783	0.00000502896663	0.00003889952806
DMAC2L	-0.5822	4.0276	0.00000503930197	0.00003894629887
ARHGAP27P2	0.7691	3.4748	0.00000504880737	0.00003898658139
NLE1	-0.4107	4.7779	0.00000506418635	0.00003907211239
INO80B	0.6198	6.4126	0.00000506997435	0.00003908356284
TARP	-0.4839	4.6041	0.00000509426104	0.00003923747626
CYB5D1	0.4115	5.1204	0.00000510849714	0.00003931378182
SGPL1	-0.5860	6.0612	0.00000513461594	0.00003948132714
ENTPD2	0.4208	6.3069	0.00000514209489	0.00003949045200
SBNO2	-0.4788	5.6660	0.00000514836677	0.00003949045200

EXOSC6	-0.4197	5.2517	0.00000514884871	0.00003949045200
TAPBPL	-0.4279	4.6853	0.00000518666027	0.00003974688769
CASTOR1	0.7046	3.3793	0.00000520613621	0.00003986249825
VPS45	0.2883	5.9692	0.00000521670831	0.00003990979626
UCKL1	-0.3586	5.4612	0.00000531035728	0.00004059204924
NPIPB9	0.7815	3.7382	0.00000537849857	0.00004107833936
NAB2	-0.2924	6.6455	0.00000539539666	0.00004117277062
ZNF511	-0.5127	5.4554	0.00000548222119	0.00004180021040
SRRM2	-0.5096	8.9652	0.00000550222981	0.00004189893985
RRAS	0.7159	4.8324	0.00000550439767	0.00004189893985
CHMP5	0.5700	5.6320	0.00000557634035	0.00004241101065
MTMR1	-0.7132	5.3565	0.00000559477108	0.00004250317908
MTG1	-0.6309	5.4325	0.00000560193001	0.00004250317908
PASK	0.5707	3.6815	0.00000560250031	0.00004250317908
ATP6V1H	0.2997	6.1138	0.00000561084996	0.00004252988109
SFN	0.6929	6.7897	0.00000561538679	0.00004252988109
LINC00680	-0.4974	3.5554	0.00000569725571	0.00004311398256
RHOQ	0.5926	5.2778	0.00000572075837	0.00004325579245
RAB6A	0.4300	6.7065	0.00000576197463	0.00004353119104
SLC25A29	0.4431	7.3154	0.00000577175120	0.00004356880521
DLG4	0.4862	4.1930	0.00000577995645	0.00004359450544
POLR3H	-0.3644	5.8429	0.00000578555751	0.00004360053756
MEIS3	0.4815	5.6907	0.00000580088244	0.00004363871990
DNHD1	0.7625	3.3385	0.00000580118823	0.00004363871990
CPSF7	-0.4618	5.6740	0.00000580504059	0.00004363871990
PSMG1	0.4301	5.1735	0.00000582570605	0.00004375784668
B4GAT1	0.4174	4.5168	0.00000587643260	0.00004410238381
KCTD17	0.5869	4.7665	0.00000588871043	0.00004415803417
ZBTB40	-0.6092	4.7946	0.00000593390053	0.00004446019038
SRPRA	-0.2768	6.7219	0.00000594360639	0.00004449619921
ZNF174	0.4390	4.9925	0.00000596053165	0.00004458615151
SMPDL3A	-1.0129	3.7132	0.00000598268083	0.00004471499965
COIL	-0.7968	4.0046	0.00000600202510	0.00004480351869
COX10	-0.5174	3.6610	0.00000600439183	0.00004480351869
MYPOP	0.4826	4.4757	0.00000602215760	0.00004486609500
AAGAB	0.3028	6.6418	0.00000602265938	0.00004486609500
GALC	-0.9312	3.4088	0.00000607366401	0.00004520896956
SLC29A1	0.4128	4.8520	0.00000613449437	0.00004562435984
ZBED5-AS1	-0.5185	3.3482	0.00000615827822	0.00004569883829
PMM1	0.5696	5.2447	0.00000616475583	0.00004569883829
SUMO1	0.3546	6.8028	0.00000616530000	0.00004569883829

RRS1	-0.3593	5.5938	0.00000616908808	0.00004569883829
PARP3	-0.4459	4.0214	0.00000616967027	0.00004569883829
LOC105370708	-0.6914	4.6080	0.00000617821812	0.00004572485637
SEC14L1	0.4473	6.1611	0.00000618481334	0.00004573639246
DPYSL2	0.6706	4.3941	0.00000620008231	0.00004581199956
ASPHD1	0.7151	5.0315	0.00000621442939	0.00004588067748
SLC9A1	0.3513	5.7556	0.00000628167686	0.00004633948625
BTBD2	-0.4345	7.1577	0.00000630437295	0.00004646916457
TPCN2	-0.3892	4.5350	0.00000631024887	0.00004647475265
STRIP1	-0.5048	5.6365	0.00000631584779	0.00004647829321
TM9SF1	-0.3285	6.2041	0.00000632385302	0.00004649952167
PTCH1	1.0651	3.7640	0.00000633719914	0.00004653332624
SRD5A3	-0.4661	3.9683	0.00000633869888	0.00004653332624
DCP1B	-0.4294	4.4958	0.00000634632983	0.00004655171340
SLC26A6	0.6150	4.5732	0.00000641919622	0.00004704820086
GTF3C2	-0.4568	6.3850	0.00000643097981	0.00004709655454
CALCOCO2	0.5055	5.9483	0.00000648634295	0.00004746372308
NIPBL-DT	0.5278	3.8471	0.00000650528244	0.00004756398537
NDUFB4	-0.3386	7.1486	0.00000651500649	0.00004759676104
HOOK2	-0.4769	7.1722	0.00000653804834	0.00004769749546
ACTA2	-0.6966	3.5858	0.00000653929984	0.00004769749546
PKN3	-0.4653	5.1995	0.00000656559636	0.00004785086720
MIGA2	0.3452	5.8912	0.00000658495261	0.00004793555358
ZNF707	0.4193	5.3530	0.00000658777347	0.00004793555358
CACNB3	0.4157	6.1813	0.00000659654598	0.00004796095599
CBR1	0.3623	6.6190	0.00000666511546	0.00004840961414
DAB2IP	0.4501	6.3060	0.00000666891612	0.00004840961414
SLC39A7	0.3770	8.0207	0.00000676706417	0.00004908283522
PPP1R26	0.4419	6.2547	0.00000684574608	0.00004957994993
KLHL7	0.5724	3.6341	0.00000684652100	0.00004957994993
TP53	-0.3004	7.1215	0.00000685338264	0.00004959009383
NOP2	-0.3823	6.3346	0.00000687760281	0.00004972572545
SEMA3F	0.3797	5.8188	0.00000699721324	0.00005055027325
ELP2	0.2853	6.1699	0.00000700800983	0.00005058802642
ERMARD	-0.4789	4.2754	0.00000704370777	0.00005080532986
JOSD1	0.3243	5.9325	0.00000706693112	0.00005093238213
CDYL2	-0.6290	6.1981	0.00000710295714	0.00005114704240
TPP2	0.6544	4.0382	0.00000710798012	0.00005114704240
TMEM198	0.4563	4.6806	0.00000715228205	0.00005142507783
NEMF	0.5837	5.6954	0.00000716856474	0.00005145881757
RNF41	0.4539	5.4344	0.00000717335817	0.00005145881757

TRIM14	0.5276	5.1052	0.00000717397457	0.00005145881757
NAA40	0.5719	5.2562	0.00000719456796	0.00005156580243
TOR2A	-0.6560	5.1683	0.00000724375026	0.00005187736290
AGTPBP1	0.6714	3.4432	0.00000726116754	0.00005196112090
PCYOX1L	0.3485	4.4801	0.00000732625820	0.00005238563048
RBM10	-0.4265	6.0372	0.00000734092062	0.00005240160159
SPHK1	-0.5684	6.4295	0.00000734533481	0.00005240160159
LINC02604	-0.7106	4.1447	0.00000734580320	0.00005240160159
CBX7	0.4521	4.7256	0.00000736922386	0.00005252741121
HEXA	-0.3320	7.2987	0.00000739406495	0.00005266314023
RAI2	0.6217	4.7921	0.00000745247328	0.00005303754691
CTNS	0.5074	4.8199	0.00000746014641	0.00005305057914
MMAB	-0.6006	6.8879	0.00000747186008	0.00005306628281
COLQ	0.7931	3.3057	0.00000747404203	0.00005306628281
POMGNT1	-0.3187	5.3743	0.00000749201866	0.00005315236053
RTN2	0.6269	5.9996	0.00000756271271	0.00005361201728
ALKBH3	-0.5392	4.3111	0.00000757673243	0.00005366950639
SETDB1	-0.3024	6.8270	0.00000760450864	0.00005377932491
CCNB1	-0.3108	6.2400	0.00000760487572	0.00005377932491
PSEN2	-0.4133	3.6185	0.00000761000248	0.00005377932491
PTBP1	-0.4043	7.9394	0.00000764767493	0.00005399960641
RBM18	-0.5899	3.9881	0.00000765306612	0.00005399960641
VBP1	-0.5974	4.2594	0.00000770067476	0.00005429334434
TRMT2B	-0.4459	4.2912	0.00000771153658	0.00005432774532
ZNF324B	0.4407	4.1384	0.00000772639577	0.00005439023258
ARL3	0.4259	5.6879	0.00000778838477	0.00005478413798
CDK7	0.3937	5.4083	0.00000779712302	0.00005480315336
RMDN3	0.3702	5.0021	0.00000780345377	0.00005480523100
GEMIN8	-0.4625	4.4386	0.00000782587166	0.00005492020132
LMO4	0.5109	4.1286	0.00000788670139	0.00005530435158
ARID5A	0.8484	3.4996	0.00000790606258	0.00005539734126
CEBPG	-0.4422	4.3099	0.00000791871260	0.00005544319899
HAT1	0.4196	5.4085	0.00000793843589	0.00005553847173
RIPK4	0.4294	5.0644	0.00000795290112	0.00005559683993
SLC27A3	-0.4599	6.1222	0.00000800894333	0.00005594554949
LINC02593	-0.5829	4.8358	0.00000802286772	0.00005599974005
BBX	0.9256	4.5356	0.00000804930020	0.00005614108687
FOXN3	0.5379	5.5865	0.00000807711608	0.00005629185809
DAZAP2	-0.4253	7.4930	0.00000814573376	0.00005669396980
MRPL13	0.3949	5.3947	0.00000814729992	0.00005669396980
UBE2H	0.4279	6.9422	0.00000820631547	0.00005706091176

GOLGA2P5	0.5729	5.3215	0.00000821486201	0.00005707663501
FAM89B	0.5222	6.7028	0.00000830778189	0.00005767810958
RAB11A	0.3454	6.7710	0.00000836012457	0.00005799716671
ACAA2	-0.3717	8.0939	0.00000838372183	0.00005811484107
ARRB2	0.3791	6.2074	0.00000839905599	0.00005811484107
GTF3C6	-0.5212	4.8456	0.00000840470468	0.00005811484107
CBY1	0.4410	4.8452	0.00000840635465	0.00005811484107
TMEM41B	0.5377	4.0228	0.00000840908503	0.00005811484107
FCHO1	0.5287	6.3800	0.00000844038911	0.00005828682397
GPRC5D-AS1	-0.6579	3.3775	0.00000845843049	0.00005836702679
FANK1	0.6233	4.2257	0.00000846527520	0.00005836990439
SLC25A23	0.2780	7.2320	0.00000851512188	0.00005866906055
ADARB1	-0.3741	5.2172	0.00000854154073	0.00005880646803
ALDH3B1	-0.3807	4.2647	0.00000854910630	0.00005881396540
TBC1D25	-0.4855	3.7135	0.00000865120326	0.00005947129208
RAD23A	-0.4270	7.1695	0.00000865784130	0.00005947190383
BAG6	-0.2781	8.3513	0.00000867979917	0.00005957766913
INKA2	0.4173	4.3760	0.00000876591029	0.00006009220277
SF3A1	-0.5259	6.1539	0.00000876799567	0.00006009220277
ZC3HC1	-0.5400	3.6860	0.00000892471583	0.00006112016929
DAP3	0.3287	7.6003	0.00000900036290	0.00006159178262
PCBD1	-0.4837	6.2123	0.00000904714264	0.00006184526932
ZDHHC4	-0.3932	6.4084	0.00000905102554	0.00006184526932
SNW1	-0.2712	7.0542	0.00000917547480	0.00006263640114
CAMKK1	0.5327	3.0536	0.00000918707367	0.00006263640114
RTN3	0.2821	7.5989	0.00000918749987	0.00006263640114
PIGP	-0.5189	3.3174	0.00000928926326	0.00006328267043
TPD52L2	0.2843	7.4466	0.00000934623401	0.00006362305175
STC2	-0.3247	6.0141	0.00000936368312	0.00006369408722
DBP	0.5933	5.5883	0.00000938509583	0.00006379195749
SEC24D	1.3818	3.3476	0.00000947858700	0.00006437924347
DCUN1D4	0.5844	3.8539	0.00000954420587	0.00006477648241
POLR2K	0.4288	6.1466	0.00000956312687	0.00006485642654
CDC25B	0.3109	6.9415	0.00000965318703	0.00006539827722
EPHB2	0.4102	4.4190	0.00000965742647	0.00006539827722
NOP16	-0.4933	6.0102	0.00000969843023	0.00006562700817
CDK18	0.4607	5.4417	0.00000975613421	0.00006596832073
CASC3	-0.4240	5.8270	0.00000980915612	0.00006627749011
GPR37L1	0.4425	4.4046	0.00000982715190	0.00006634971481
AZIN1	0.7387	6.5725	0.00000984737279	0.00006643684420
GTF2IP4	0.5490	6.8756	0.00000986445967	0.00006650271585

ELP6	-0.5444	4.8667	0.00000994022834	0.00006696380831
FHOD1	0.2867	6.6745	0.00000996919869	0.00006710918703
LTBP2	-0.6763	4.0159	0.00000998318657	0.00006711067134
CCDC174	-0.3372	5.0809	0.00000998973776	0.00006711067134
GALNT10	-0.4328	6.7015	0.00000999158987	0.00006711067134
DROSHA	-0.3087	5.8149	0.00001001941780	0.00006724784410
LINC01003	-0.6408	3.7218	0.00001004043325	0.00006730252271
SORT1	0.3009	7.9327	0.00001004238721	0.00006730252271
GALK2	0.4305	4.3325	0.00001005835581	0.00006735982973
ARHGEF19	0.5678	3.6294	0.00001007689582	0.00006743426006
MMADHC	-0.3813	5.4445	0.00001011114539	0.00006757561628
MARCHF8	-0.7237	4.2886	0.00001011290194	0.00006757561628
HSP90B1	0.3887	9.1318	0.00001015102933	0.00006778051278
XRCC3	-0.4308	4.8648	0.00001025556031	0.00006842817280
KHNYN	-0.3531	6.2289	0.00001037977022	0.00006915638495
SLC38A2	0.7110	7.8257	0.00001037993092	0.00006915638495
BAIAP2L1	0.3879	6.0614	0.00001043073404	0.00006944391191
DDX1	-0.2907	6.6977	0.00001048954954	0.00006978432190
CHMP7	-0.3737	4.8719	0.00001060598968	0.00007050731498
FAM104B	-0.5214	3.8070	0.00001074771703	0.00007139723362
CBS	0.2759	7.3661	0.00001078482745	0.00007159138745
AKAP10	-0.6229	4.0433	0.00001084049424	0.00007190834784
METTL3	-0.3663	4.8514	0.00001086166207	0.00007199617025
RND3	-0.5764	4.9118	0.00001088250709	0.00007205102260
H19	-0.4289	7.8651	0.00001088580586	0.00007205102260
DPH1	-0.3319	6.2225	0.00001096226182	0.00007250422404
GNB1L	0.6216	4.5727	0.00001099057129	0.00007263855740
HRAT92	-0.5058	4.1530	0.00001105396807	0.00007300442473
SNX29	0.7349	4.8074	0.00001111009695	0.00007332179535
NMD3	0.9351	6.9018	0.00001120879104	0.00007391941283
PLPPR2	0.3294	6.6421	0.00001121984587	0.00007393862142
CEP164	0.3504	5.3866	0.00001128536356	0.00007431645141
MAP2K3	0.3208	6.3251	0.00001129360564	0.00007431683536
LDHA	0.2606	8.1463	0.00001134301196	0.00007458790125
MRPL46	-0.5649	4.6136	0.00001136814352	0.00007469457983
METTL17	-0.4652	5.5032	0.00001137568593	0.00007469457983
UHRF1	-0.6082	4.1597	0.00001140129215	0.00007480862281
GABPB2	-0.5096	3.9723	0.00001144122189	0.00007498964285
NAT8L	0.4400	4.7892	0.00001144539643	0.00007498964285
SMIM10L1	-0.3206	4.8174	0.00001145391757	0.00007499136659
GAS8	0.3746	6.5035	0.00001148151911	0.00007508660410

ENTR1	-0.3647	6.2264	0.00001149080810	0.00007508660410
CAMK2G	0.3125	6.2855	0.00001149326943	0.00007508660410
PIGU	-0.5856	4.2586	0.00001151966686	0.00007520495670
UBXN7	0.5278	5.2752	0.00001154104051	0.00007529036555
SLCO3A1	-0.5279	3.3437	0.00001159500664	0.00007558812299
PCBP4	0.5004	5.3687	0.00001162918631	0.00007575655734
TRIM39	-0.4389	4.5351	0.00001168904434	0.00007609190802
OSBPL10	-0.6803	4.2318	0.00001172434893	0.00007626705777
CHD3	-0.2604	8.4712	0.00001176417710	0.00007647136168
ANKZF1	0.5297	6.2934	0.00001181049220	0.00007671751049
LINC02210	0.4441	4.2544	0.00001183550526	0.00007679895767
HSPA1B	0.4530	7.6808	0.00001184007000	0.00007679895767
KRT7	-0.8379	4.6859	0.00001184840213	0.00007679895767
PCNT	-0.4421	5.7951	0.00001204614479	0.00007802499345
IKBKB	-0.5853	4.0589	0.00001207780558	0.00007817430684
HIGD2A	-0.5842	7.2920	0.00001214693851	0.00007856577537
ANKRD13A	0.5397	5.5876	0.00001215847474	0.00007858441930
PLD2	0.3111	6.0357	0.00001218388768	0.00007869266286
RMC1	0.4247	4.3224	0.00001221693423	0.00007885002111
NPEPL1	-0.3587	8.6880	0.00001223803069	0.00007893008286
ACTB	-0.3384	11.9655	0.00001226729535	0.00007906267499
RBBP9	0.6146	3.6938	0.00001229514354	0.00007918595635
RCN1	-0.3124	5.5697	0.00001231409163	0.00007925178322
DNLZ	-0.8522	4.9045	0.00001233266818	0.00007931512728
GSTZ1	-0.5765	7.4619	0.00001236163793	0.00007944517628
IRAIN	-0.6448	3.7543	0.00001238585902	0.00007954454436
GTF2H5	-0.5698	4.0307	0.00001240575810	0.00007961603488
PLXND1	0.3296	5.9533	0.00001243748554	0.00007976328123
FBXO17	0.4156	4.7960	0.00001247961255	0.00007997696655
FAM210B	0.2703	8.0306	0.00001249848410	0.00008004142038
MOB1B	0.6953	3.6022	0.00001250780258	0.00008004464777
CCNDBP1	-0.5023	4.9455	0.00001252535296	0.00008010051425
ZNF689	-0.5437	3.9539	0.00001272041762	0.00008126519540
PLPP2	-0.4125	5.5789	0.00001272537252	0.00008126519540
PGRMC2	0.5231	5.2493	0.00001285832590	0.00008202571539
TBC1D7	-0.5270	3.9923	0.00001286252821	0.00008202571539
CRABP2	0.3855	8.0714	0.00001287433328	0.00008202686624
LRRC41	-0.3372	5.9044	0.00001288077428	0.00008202686624
LSM12	-0.2726	5.9172	0.00001292278068	0.00008223670032
GTF2IRD1	-0.2696	6.3366	0.00001296641868	0.00008243195581
DHRS12	-0.5951	3.6292	0.00001297161820	0.00008243195581

TMEM251	-0.3338	4.8638	0.00001298553981	0.00008246271822
HEBP1	0.3771	6.2686	0.00001306805188	0.00008284627433
HERC4	0.6020	5.5102	0.00001306811035	0.00008284627433
HOMEZ	0.4076	4.3231	0.00001307899290	0.00008284627433
C1orf56	-0.3779	4.3541	0.00001308243116	0.00008284627433
CCHCR1	0.4966	5.3593	0.00001314962981	0.00008321378976
DHX30	-0.3321	6.1744	0.00001317512205	0.00008331704968
BORCS6	0.6153	5.7456	0.00001322571995	0.00008357881897
DDX31	-0.3969	4.7096	0.00001333018139	0.00008418037359
ASB16-AS1	0.3777	4.3563	0.00001335292946	0.00008426542905
SUFU	0.4640	5.0695	0.00001344419986	0.00008478248536
AMPD2	0.2631	6.7727	0.00001355124484	0.00008539823342
MUC1	-0.4311	6.4996	0.00001360024193	0.00008559270602
USP36	-0.3644	6.1418	0.00001360095527	0.00008559270602
CARD19	0.3708	6.3650	0.00001363769998	0.00008576451075
THUMPD3-AS1	-0.4971	4.0648	0.00001374493513	0.00008637094815
HSPA4	0.3634	6.8131	0.00001375315395	0.00008637094815
CENPBD1P1	-0.5697	4.8880	0.00001381850637	0.00008672139347
LAPTM4A	0.3610	7.6099	0.00001389401717	0.00008713506210
KCNAB2	0.3341	4.6148	0.00001401886029	0.00008785732941
GDI1	0.3471	7.6571	0.00001422602994	0.00008909419168
PDE4DIP	0.4127	6.4613	0.00001431597580	0.00008959571069
EIF4E2	-0.4657	6.2007	0.00001434045461	0.00008968709938
CNTROB	0.3881	6.3572	0.00001437307875	0.00008982926918
MARS1	0.2507	6.5557	0.00001443162209	0.00009013312256
RABEP2	-0.5568	6.4250	0.00001450242380	0.00009051306569
PCYOX1	0.6345	5.4746	0.00001452862289	0.00009061430252
BID	-0.3187	5.4629	0.00001460866038	0.00009100456740
TADA3	-0.4033	8.5195	0.00001461123877	0.00009100456740
TMEM241	-0.5341	3.9637	0.00001464431409	0.00009114805778
SLC22A15	-0.5977	3.9208	0.00001468032001	0.00009130957945
TRIM41	-0.3015	6.5420	0.00001491557176	0.00009270931359
BCL2L1	-0.2960	7.5844	0.00001493418180	0.00009276149449
LPIN3	-0.3381	6.8323	0.00001498641701	0.00009302231914
METAP1D	-0.5767	3.3495	0.00001502052825	0.00009317036685
LOC100233156	-0.4490	5.0287	0.00001515534831	0.00009388704245
E2F3	0.6800	4.2924	0.00001515674532	0.00009388704245
GGPS1	-0.3945	4.6850	0.00001527372542	0.00009454717146
TEN1	-0.6855	5.4759	0.00001530602871	0.00009468259312
SRR	0.3986	4.1778	0.00001535564034	0.00009492482637
MSRA	-0.5009	4.0881	0.00001538993194	0.00009506665425

STAG1	-0.7172	4.4905	0.00001540713198	0.00009506665425
C2orf68	-0.2922	5.7710	0.00001540998954	0.00009506665425
SYNGAP1	0.5049	5.2896	0.00001546894815	0.00009524541627
CLCN2	0.4770	4.5522	0.00001546995732	0.00009524541627
DYRK1B	-0.5290	4.8438	0.00001548143671	0.00009524541627
MCM7	-0.3680	8.9582	0.00001548451097	0.00009524541627
TXNRD3	-0.4608	4.3091	0.00001549140842	0.00009524541627
TOMM40L	0.3838	4.1385	0.00001552356582	0.00009537855293
VPS72	-0.3826	7.3662	0.00001561206418	0.00009585744072
THBS3	-0.3663	6.0963	0.00001566152332	0.00009609614407
STRAP	0.3418	6.5652	0.00001570407513	0.00009629217168
SMN2	0.4679	5.7095	0.00001579475890	0.00009678286476
PPP2R1A	-0.4161	8.2814	0.00001586704892	0.00009716026385
USP16	-0.7385	3.4431	0.00001588011963	0.00009717477519
SHOC2	0.8621	4.1135	0.00001590638384	0.00009726994725
LYSMD2	-0.5631	3.2867	0.00001592598074	0.00009732424703
NPAS1	0.7490	3.6047	0.00001599076340	0.00009765441992
UBE2K	0.3223	5.8664	0.00001601896474	0.00009772938405
C19orf54	-0.4255	4.6469	0.00001602456259	0.00009772938405
RFC1	0.5352	5.5015	0.00001604334688	0.00009777827720
STK38	0.2810	6.5148	0.00001615893060	0.00009841666586
NKIRAS2	0.2530	5.6227	0.00001617788683	0.00009844781227
ZSCAN2	0.4891	4.1193	0.00001618572665	0.00009844781227
INHBB	-0.4089	6.0055	0.00001622879556	0.00009863318525
TMEM184B	0.3648	6.0295	0.00001623792665	0.00009863318525
CYFIP2	0.4118	6.5762	0.00001628700891	0.00009886519245
PLEKHN1	-0.5040	4.8690	0.00001635380709	0.00009920435685
PWP1	-0.2471	6.5660	0.00001637882564	0.00009928979680
LRRN2	-0.4892	4.3732	0.00001651350796	0.00010003947014
NPHP3	0.7760	3.6892	0.00001655121912	0.00010020108054
TRIM65	-0.3749	5.1467	0.00001657321997	0.00010024676899
TMLHE	-0.3864	3.6374	0.00001658084429	0.00010024676899
SLC35E3	0.4928	4.9452	0.00001667094808	0.00010072447075
NDST1	-0.5304	6.5374	0.00001679447526	0.00010140334429
PCGF1	-0.5183	4.3326	0.00001683152601	0.00010148988712
ZNF33B	-0.4502	4.7219	0.00001683190264	0.00010148988712
ZNF574	-0.4208	5.0181	0.00001684798328	0.00010148988712
ERAL1	-0.4123	5.8118	0.00001685351280	0.00010148988712
TFAP4	-0.3082	5.2666	0.00001692475475	0.00010185135711
ASNS	-0.3559	5.0782	0.00001697962830	0.00010207562632
DHX16	0.4132	6.2760	0.00001698450296	0.00010207562632

VCP	-0.2342	8.2446	0.00001708823301	0.00010260834584
ACTR1B	-0.3691	6.4787	0.00001709574136	0.00010260834584
TTYH3	0.4564	6.5803	0.00001734500018	0.00010403563187
USP39	0.3475	6.2073	0.00001743292050	0.00010449396109
TSPAN15	0.3029	6.9851	0.00001747765945	0.00010469302473
MOGS	0.2547	7.0546	0.00001752272822	0.00010489380025
ZNF514	0.5847	3.7941	0.00001758214654	0.00010518015330
TMEM185A	0.3036	5.6281	0.00001767813252	0.00010568474090
CPT1B	-0.5532	4.7220	0.00001769779834	0.00010573119784
RFT1	-0.3916	4.1317	0.00001770918973	0.00010573119784
TRIQK	-0.7141	4.8281	0.00001779982791	0.00010620252118
LZIC	-0.4047	3.8681	0.00001784668013	0.00010641214854
CCDC92	-0.3619	5.6204	0.00001796767942	0.00010706331814
GRAMD1A	-0.2925	6.2773	0.00001800191056	0.00010719412759
COMMD5	-0.4059	5.4348	0.00001801324069	0.00010719412759
PLXNB3	-0.3384	6.5985	0.00001808398598	0.00010754464744
PCM1	0.5115	5.9958	0.00001811814072	0.00010767724858
ODF2L	0.5528	3.5711	0.00001822001860	0.00010821189596
NIPAL2	-0.4981	4.5456	0.00001827839640	0.00010844690399
DNAJC11	-0.2932	5.7744	0.00001828347209	0.00010844690399
P2RY2	-0.2869	5.6474	0.00001830911290	0.00010852810331
CCDC86	-0.4307	4.8780	0.00001843538894	0.00010920532743
DDA1	-0.5533	5.0093	0.00001852564135	0.00010966841533
PPIL4	0.5174	5.0289	0.00001854526917	0.00010971308749
IDH1	0.4503	5.8444	0.00001859007425	0.00010980786594
TKFC	-0.3385	6.1259	0.00001860349358	0.00010980786594
CHST10	-0.5924	3.6161	0.00001860692991	0.00010980786594
WDR1	-0.2427	8.0697	0.00001860965815	0.00010980786594
HSDL2	0.3331	5.3227	0.00001871505771	0.00011035807731
AARS2	-0.5884	4.4435	0.00001880286021	0.00011080387641
PFKL	-0.3653	8.1909	0.00001889536641	0.00011127679790
GARS1	0.2742	6.9179	0.00001901761013	0.00011192412029
METTL21A	0.5587	3.9036	0.00001904708822	0.00011202500529
BIVM	0.8112	3.4757	0.00001906806854	0.00011207581257
LTBR	-0.3495	6.8645	0.00001912419331	0.00011233298800
TP53INP1	0.5251	4.9265	0.00001919462729	0.00011267382702
SRP54	0.3193	6.8349	0.00001955607411	0.00011472138825
TRIM52	0.6116	3.5015	0.00001965925700	0.00011525223554
CBX1	0.3173	6.8348	0.00001971853799	0.00011552518937
CABIN1	-0.2912	6.0717	0.00001987832625	0.00011638625446
NUMA1	-0.2913	9.0289	0.00001993555252	0.00011664610336

ATF6B	-0.2921	7.1995	0.00001996010139	0.00011669061848
MLH3	-0.3702	4.8113	0.00001997381680	0.00011669061848
PITPNA	0.2761	6.7732	0.00001998171035	0.00011669061848
SLC2A1	-0.3987	6.5859	0.00001999644114	0.00011670159508
KAT6B	-1.0926	3.9181	0.00002001156356	0.00011671484182
CREBBP	-0.7967	6.3816	0.00002027514403	0.00011817624066
EBAG9	-0.4447	5.0591	0.00002028875796	0.00011817973767
ACO2	-0.2578	6.5664	0.00002037068135	0.00011858087007
H6PD	-0.5033	5.3310	0.00002045755343	0.00011901027720
ATIC	-0.2727	7.5223	0.00002048181823	0.00011907515450
BPHL	0.3700	4.8768	0.00002056767145	0.00011949777638
CDC45	-0.4487	4.0862	0.00002059202878	0.00011956279623
SWAP70	0.6984	3.7881	0.00002078260013	0.00012059219924
PDK2	0.3190	6.9079	0.00002095502547	0.00012151506146
GATAD2A	0.3021	6.6536	0.00002102367470	0.00012179361047
ITGA3	0.2358	7.6363	0.00002102988451	0.00012179361047
MYO15B	-0.4348	6.1002	0.00002117837305	0.00012254033558
COPG2	-0.3796	5.7160	0.00002118580849	0.00012254033558
DDRGK1	-0.5531	5.5595	0.00002123905670	0.00012277012981
HOXC13	-0.2937	5.0497	0.00002130894527	0.00012307296931
LOC101927021	-0.3625	5.0339	0.00002131855310	0.00012307296931
KBTBD4	-0.4642	5.1642	0.00002139963466	0.00012346256819
FRAT2	0.3840	5.8877	0.00002148395443	0.00012387034296
PLEKHB2	0.5047	6.2558	0.00002151812789	0.00012398865444
EIF1AD	0.3119	5.6208	0.00002163551890	0.00012458601595
TMPRSS2	0.6229	3.6697	0.00002168341088	0.00012478267059
UCHL5	0.5730	4.3929	0.00002198981109	0.00012643929590
TYMS	-0.3166	5.6565	0.00002199912868	0.00012643929590
SMIM26	-0.4333	5.4661	0.00002213472242	0.00012713814948
EZH1	-0.4553	5.1712	0.00002220887741	0.00012748344863
SRC	-0.5297	4.3902	0.00002248290713	0.00012897490817
SUOX	0.3370	5.8369	0.00002264431057	0.00012981880324
LGALS3BP	-0.4632	5.8431	0.00002276453420	0.00013042570036
PRR13	0.3923	7.4844	0.00002278706506	0.00013047247024
PARP16	-0.4808	3.5446	0.00002297099808	0.00013144274327
NRGN	0.7469	3.8407	0.00002315283752	0.00013239982209
THAP9-AS1	0.5278	4.5558	0.00002321610323	0.00013267805753
USP24	-0.8012	3.8740	0.00002328625631	0.00013299527898
BMP1	-0.3118	5.3349	0.00002335999033	0.00013333254065
COBL	0.6064	4.0080	0.00002344350970	0.00013371835057
CYTH3	0.4496	5.5634	0.00002345703474	0.00013371835057

CREB3L4	-0.3420	7.7779	0.00002349694394	0.00013378472035
ASB13	-0.3355	4.9204	0.00002349814216	0.00013378472035
SUMF1	-0.2671	6.3398	0.00002352519071	0.00013385479752
CAMKK2	-0.3514	5.4868	0.00002356735817	0.00013396667718
FANCG	0.3789	5.3590	0.00002357435857	0.00013396667718
KDSR	0.5321	4.1653	0.00002361571134	0.00013411774527
CCNF	0.2673	5.6721	0.00002364067128	0.00013417558491
ZC3H10	-0.3351	3.8520	0.00002370075089	0.00013432679170
C6orf226	-0.5915	4.6518	0.00002370448938	0.00013432679170
PRLR	-0.7003	4.6526	0.00002371168892	0.00013432679170
KLHL42	-0.6851	3.8774	0.00002384747780	0.00013495303774
CALU	0.4068	6.3951	0.00002385877619	0.00013495303774
TTC9	0.3673	4.7543	0.00002386681848	0.00013495303774
POLH	0.4249	4.3325	0.00002394814265	0.00013532861443
KLHDC3	0.3205	7.4686	0.00002397879786	0.00013541757669
CCDC22	-0.5186	4.5160	0.00002418030090	0.00013647067274
PRKAB2	0.6588	4.9583	0.00002420432884	0.00013652143493
C2orf15	0.5238	3.8936	0.00002433593192	0.00013717852126
WDR60	0.3821	5.2041	0.00002460212723	0.00013856273443
LHPP	-0.4540	4.5344	0.00002461201306	0.00013856273443
HSPB11	0.4205	4.7117	0.00002465912248	0.00013874194008
UBE2E1	0.3765	5.5377	0.00002481617507	0.00013953912436
KCNG1	-0.3894	4.4487	0.00002486839564	0.00013974622576
TOP1MT	-0.4330	6.1954	0.00002492413557	0.00013997283557
EPHB3	0.2826	5.3517	0.00002494376182	0.00013999647778
MAP11	0.3363	6.0109	0.00002496864333	0.00014004956766
PPP1R15A	0.3684	5.0072	0.00002503038647	0.00014030922194
CLDN4	0.3141	7.8749	0.00002510658196	0.00014064951929
PAFAH1B2	0.3481	5.5461	0.00002514262164	0.00014076457896
C1orf216	0.3227	4.9103	0.00002519525434	0.00014097233806
WDR47	0.8208	3.9257	0.00002522878722	0.00014107303985
NDRG3	0.2628	5.8293	0.00002540047189	0.00014194565247
MRTO4	-0.4208	5.5952	0.00002544807012	0.00014212418497
TAOK2	0.2736	6.9979	0.00002555899089	0.00014265592886
SRRD	-0.3791	3.7820	0.00002581081570	0.00014397298366
JUN	-0.4139	5.1839	0.00002599289924	0.00014489964270
TANGO2	0.3251	5.0995	0.00002608773907	0.00014533911565
CCDC58	-0.5059	3.9459	0.00002614636005	0.00014557639215
MRPS18B	-0.3802	6.7637	0.00002616718105	0.00014560304601
MFSD8	0.4717	3.8133	0.00002625964976	0.00014602809520
CRCP	-0.5178	4.9260	0.00002644942264	0.00014699339472

DYNLL1	0.3164	7.5602	0.00002649126363	0.00014713588074
ANAPC16	-0.3359	6.5404	0.00002657681569	0.00014752082106
THEM4	-0.3702	4.9625	0.00002665820747	0.00014784918218
SUSD2	-0.2983	7.2732	0.00002666853435	0.00014784918218
PIGT	-0.2954	7.7508	0.00002685608545	0.00014879811590
MELK	0.6164	3.6274	0.00002688675833	0.00014887722706
DCTD	-0.3627	5.2522	0.00002690438236	0.00014888403183
LOC729737	0.3834	7.2529	0.00002718646441	0.00015030730150
TP53I3	-0.4789	5.2936	0.00002719468080	0.00015030730150
MECP2	-0.3188	6.4958	0.00002724941586	0.00015051821499
IFT80	0.7938	3.4320	0.00002740890000	0.00015130712518
IPO4	-0.2394	7.2956	0.00002744545081	0.00015141685226
BRICD5	0.8845	3.4684	0.00002748667026	0.00015155218740
OLFM1	-0.3595	5.7361	0.00002775950794	0.00015296364782
BTD	-0.4376	3.9341	0.00002779035405	0.00015304075507
WWC1	0.3379	6.1202	0.00002820148150	0.00015521069912
EIF2D	-0.3053	6.3316	0.00002825769879	0.00015542590108
CDKN2AIPNL	0.3716	4.5443	0.00002832486152	0.00015570100934
GMPS	0.2547	6.5815	0.00002839773954	0.00015598751310
BFAR	0.3696	6.0890	0.00002842527594	0.00015598751310
GRK2	-0.3202	7.5021	0.00002842851384	0.00015598751310
ZNF397	0.4448	4.4863	0.00002855972653	0.00015661284820
FAM171A2	0.4917	5.1966	0.00002868497211	0.00015720472642
CSPP1	0.5085	5.1523	0.00002873703499	0.00015739506320
UPF3B	0.5485	5.3697	0.00002876471970	0.00015745172972
CDC42SE2	0.4029	4.6883	0.00002880427958	0.00015757329088
PEMT	-0.5744	5.2682	0.00002885859284	0.00015777536516
LAMTOR1	-0.4269	7.0377	0.00002896410830	0.00015825695999
RET	-0.5198	5.1697	0.00002915077870	0.00015918113132
MGST2	-0.4737	4.6211	0.00002917773429	0.00015923257518
RAD9A	0.4401	6.1652	0.00002921931203	0.00015936370725
ZPR1	-0.4754	5.1935	0.00002937553454	0.00016011958532
SPATC1L	0.5781	5.3687	0.00002958787987	0.00016118028621
BCAR3	-0.5372	4.9963	0.00002965324567	0.00016143952274
PDLIM2	-0.4538	4.7920	0.00002970287485	0.00016158882109
TMEM120B	0.4722	4.5999	0.00002971625715	0.00016158882109
GPT2	0.3794	5.2343	0.00002974259647	0.00016163525947
DCAF1	-0.5865	4.0454	0.00002976597935	0.00016166558521
PEX3	0.5448	4.3792	0.00002990491983	0.00016232311836
COPS4	0.2916	5.3344	0.00002992352654	0.00016232708752
NUDT5	0.2846	6.1834	0.00003002030580	0.00016271399476

INTS12	0.4647	4.7264	0.00003003068552	0.00016271399476
MAPK7	0.3226	4.5571	0.00003028965709	0.00016401930593
ASRGL1	0.3427	4.3833	0.00003031702910	0.00016406969088
FAM241A	0.5418	3.7281	0.00003043040009	0.00016458514783
FANCA	0.3546	5.2287	0.00003056156865	0.00016519619342
AGAP9	-0.6658	3.0834	0.00003060142982	0.00016531325649
MAPKAPK2	0.2350	7.8999	0.00003066121403	0.00016553774350
SAMD12	0.5950	4.2060	0.00003075973831	0.00016592658987
GEMIN2	0.3366	3.8090	0.00003076978057	0.00016592658987
ADGRG1	-0.2434	7.4167	0.00003086736115	0.00016635400983
FAHD1	0.2451	5.6564	0.00003123309143	0.00016808398788
H1-10	0.5497	8.5464	0.00003125518628	0.00016808398788
CEP70	0.4800	4.1140	0.00003125892344	0.00016808398788
YPEL3	-0.4488	7.9298	0.00003126240012	0.00016808398788
RNF157	0.3974	4.3366	0.00003132969050	0.00016834610617
IDUA	-0.3704	5.2608	0.00003150424785	0.00016918395901
CALR	0.2890	8.8619	0.00003155335959	0.00016934755224
EPOR	0.3517	5.4407	0.00003165581778	0.00016979709466
BCL7B	-0.3494	6.1495	0.00003176504314	0.00017017664239
RPS6KL1	0.4101	5.0363	0.00003177418168	0.00017017664239
PIEZO1	-0.3386	9.8163	0.00003178279765	0.00017017664239
DXO	-0.4618	4.7570	0.00003189437427	0.00017067343118
CD3EAP	-0.3906	4.4858	0.00003193769072	0.00017080457562
ZSWIM4	0.5613	4.0077	0.00003216842685	0.00017193730679
ZIC1	-0.5143	3.9696	0.00003222760877	0.00017215230308
TXNDC15	-0.3496	4.4913	0.00003240356017	0.00017299043497
ABCF1	-0.2905	6.8828	0.00003248145294	0.00017330439139
JMJD6	0.3867	5.1088	0.00003251689948	0.00017339164075
PLEKHA8	0.5677	3.4350	0.00003274258003	0.00017439665879
LRTOMT	-0.4765	3.8653	0.00003274378408	0.00017439665879
OXSM	-0.3257	4.0643	0.00003333948905	0.00017746535758
PHF20	0.4411	4.8211	0.00003336144399	0.00017747819147
ENAH	0.7138	4.2608	0.00003355134436	0.00017838393336
DENR	0.3941	5.9179	0.00003368287528	0.00017897846133
ZNF107	-0.5726	4.0060	0.00003370541738	0.00017899350600
NECAB3	0.3445	5.3460	0.00003372820754	0.00017900984961
ZNF446	-0.3909	5.8867	0.00003412658977	0.00018101843557
ZNF37A	0.5419	4.3565	0.00003427035223	0.00018154288087
NXPE3	0.5398	3.9936	0.00003427845672	0.00018154288087
ERG28	0.2667	7.1569	0.00003428543560	0.00018154288087
RCC2	-0.2478	7.9028	0.00003445326739	0.00018232524545

CFLAR	-0.4021	5.2725	0.00003464959894	0.00018325743039
PHF13	0.3945	5.0247	0.00003491192455	0.00018453736137
TNKS1BP1	0.2753	6.4032	0.00003505163988	0.00018516808709
LIG1	-0.3186	6.1773	0.00003516873284	0.00018564473386
TBRG1	-0.4091	4.2217	0.00003518275377	0.00018564473386
LINC01061	-0.6121	3.9487	0.00003551460724	0.00018728696187
DTD1	-0.3345	6.4423	0.00003595205471	0.00018948381245
PTPN2	-0.3478	5.2965	0.00003598666108	0.00018955618866
IFT122	-0.2832	5.7531	0.00003602691544	0.00018965821395
RALGAPA2	0.5941	5.3040	0.00003608178722	0.00018983702766
PEX26	-0.3838	5.0979	0.00003622475755	0.00019047887857
SNTA1	0.5299	4.9828	0.00003640175990	0.00019125514696
RPF1	-0.3262	4.0270	0.00003641450822	0.00019125514696
ARRDC1-AS1	-0.5827	3.6053	0.00003654700410	0.00019173410553
DDHD1	0.6637	4.4440	0.00003654792828	0.00019173410553
SLC35B4	0.5160	3.3897	0.00003679820324	0.00019293561412
DNM1	0.4454	5.3532	0.00003692125978	0.00019346910563
MCUB	0.3885	4.0383	0.00003699310493	0.00019373378653
PSPH	0.5347	3.4652	0.00003712511930	0.00019431308837
RABEPK	-0.3653	4.9553	0.00003715239660	0.00019434384419
PTPN21	-0.7351	4.0649	0.00003724131014	0.00019469679755
FADS2	-0.3414	4.9693	0.00003729690655	0.00019487526372
NT5DC3	-0.6402	3.1910	0.00003741220049	0.00019533695052
SIRT5	-0.4286	4.2616	0.00003742828916	0.00019533695052
MAP3K3	0.3429	6.0519	0.00003766396420	0.00019645402577
OVCA2	-0.6403	6.0942	0.00003769070614	0.00019648065583
TRMT10C	0.3460	4.4002	0.00003783736840	0.00019713203812
MPHOSPH8	0.3392	5.7043	0.00003795240917	0.00019755789122
PLA2G15	0.4219	5.1225	0.00003796261647	0.00019755789122
JMJD8	-0.4493	7.2289	0.00003809368087	0.00019812641234
RAB6B	0.4741	3.6546	0.00003843741920	0.00019979977321
CARM1	-0.2540	7.6559	0.00003847154909	0.00019980334169
B4GALT5	0.7151	4.2213	0.00003848211041	0.00019980334169
HMGN2	-0.3287	9.3107	0.00003896313889	0.00020218529387
RAB5IF	0.3521	6.3020	0.00003903207034	0.00020242731624
PIP5K1A	0.4718	6.6767	0.00003911620737	0.00020274787619
TNIP1	-0.3108	6.8268	0.00003918502529	0.00020297838572
PCK2	0.2758	6.2156	0.00003920538361	0.00020297838572
POU2F1	0.4293	5.1606	0.00003927031512	0.00020319870747
AFG3L1P	-0.5011	5.1134	0.00003938351273	0.00020366838216
MED25	0.3933	6.2090	0.00003949499416	0.00020412865225

GCSH	0.3347	6.1477	0.00003954229981	0.00020425689680
SPR	-0.4876	5.8569	0.00003965640969	0.00020472987855
AOPEP	-0.3102	6.7272	0.00003968600699	0.00020476626672
SLU7	0.3201	6.2907	0.00003974747204	0.00020496694694
EMC1	-0.3443	4.8143	0.00003982205752	0.00020523501949
VPS36	-0.6846	3.6479	0.00003995946100	0.00020582635586
PLEC	-0.3523	9.9358	0.00004000888462	0.00020596410500
ZNF767P	0.4621	4.6970	0.00004008232023	0.00020622524082
HTRA1	-0.5664	3.6303	0.00004018887114	0.00020665636401
LINC01006	-0.3371	4.7430	0.00004071240386	0.00020922996008
LARP6	0.3111	4.6042	0.00004077269497	0.00020942129130
STRN4	-0.2878	6.4410	0.00004085163048	0.00020965680470
LGMN	0.2974	5.7777	0.00004086472242	0.00020965680470
ACSS1	-0.2660	6.4791	0.00004099492728	0.00021020606134
MRPS28	-0.3944	4.6178	0.00004118331693	0.00021105287868
SPRYD4	-0.4031	4.8016	0.00004120732493	0.00021105680638
RHBDD1	-0.3937	3.7977	0.00004155899853	0.00021273803024
ZADH2	-0.3558	4.8376	0.00004163769238	0.00021302078000
UBE2G2	0.3037	6.5571	0.00004193472973	0.00021441964003
RXYLT1	-0.4099	4.4684	0.00004200778837	0.00021467232761
ATP6V1E1	0.3625	6.5636	0.00004208013710	0.00021492110518
DHRS11	0.6707	3.6197	0.00004211302068	0.00021496815108
ZNF821	0.4457	5.3545	0.00004220745621	0.00021532916282
SYT7	0.2971	5.1177	0.00004243106051	0.00021634837757
ANAPC5	-0.2369	7.1508	0.00004249169358	0.00021653595364
DVL3	0.3118	7.5323	0.00004265187095	0.00021722186056
RNF26	-0.2668	5.8870	0.00004267413272	0.00021722186056
PRR15	-0.3088	4.9640	0.00004281473047	0.00021781544392
SCCPDH	-0.3560	3.7612	0.00004293202430	0.00021821014027
GPR108	-0.3358	6.0515	0.00004294037228	0.00021821014027
MEAK7	0.3212	5.1569	0.00004299940291	0.00021828187250
CRTC2	0.2845	7.1024	0.00004300256248	0.00021828187250
ACTR10	0.2879	5.6025	0.00004310599713	0.00021868408489
OSBPL2	0.3388	5.9250	0.00004312996322	0.00021868408489
METTL22	-0.3422	4.8389	0.00004342418130	0.00022005300805
IFI35	-0.5882	4.0281	0.00004348218968	0.00022022407390
SLC25A45	-0.4781	4.0828	0.00004355244140	0.00022037669060
NUDCD1	0.5079	4.5572	0.00004356085889	0.00022037669060
AP1G2	-0.3467	7.3198	0.00004370499542	0.00022098277472
RUSF1	-0.2606	7.3435	0.00004414018774	0.00022302908136
ZBTB7A	-0.2412	6.9634	0.00004415882483	0.00022302908136

MAPK8IP3	0.3011	7.0481	0.00004471555774	0.00022571538623
ZBTB17	-0.4440	4.6825	0.00004477777617	0.00022581415434
PREB	0.3496	6.9228	0.00004478485761	0.00022581415434
RAN	-0.2789	8.5985	0.00004485564521	0.00022604556835
MBD4	0.3068	5.4352	0.00004490099310	0.00022614859586
KPNA2	0.2815	7.7614	0.00004504886386	0.00022676759018
IDI1	0.2685	6.6683	0.00004515995638	0.00022717226294
CWF19L1	0.2929	5.5296	0.00004517928718	0.00022717226294
FLAD1	0.3991	5.9581	0.00004584941534	0.00023041424497
NSFL1C	-0.3487	6.1680	0.00004614351123	0.00023170552717
FKBP15	-0.3215	5.8842	0.00004615739441	0.00023170552717
TAF5L	-0.6060	3.6241	0.00004647081380	0.00023314997798
SMG6	0.2971	6.1045	0.00004661128164	0.00023372559282
KIFC2	0.4905	7.6856	0.00004677468425	0.00023441551195
L3MBTL2	-0.4227	4.2436	0.00004682141990	0.00023452030564
TMEM231	0.4258	4.7335	0.00004699321770	0.00023524678691
ARHGEF25	0.3807	5.2017	0.00004701827092	0.00023524678691
KDF1	-0.3181	4.3636	0.00004705483660	0.00023530009423
KIF5C	0.5400	3.6951	0.00004715620604	0.00023567721906
GHDC	-0.4248	5.2431	0.00004747699635	0.00023714994711
PMVK	-0.6007	6.4217	0.00004758686907	0.00023756809129
MDM4	-0.4866	5.4915	0.00004762535071	0.00023762956583
PKP3	-0.3474	7.6069	0.00004795043002	0.00023912018395
NSD1	-0.4579	6.6829	0.00004817209161	0.00024009372335
PEX11A	0.4658	4.0344	0.00004824500352	0.00024032522048
AHDC1	0.6621	4.4674	0.00004832583963	0.00024046561136
TEX2	0.5714	5.7598	0.00004832614698	0.00024046561136
QSOX1	0.2096	7.3082	0.00004851722679	0.00024128419303
KIN	0.4733	3.9425	0.00004863520133	0.00024173851302
DYNC1LI1	-0.2973	4.7424	0.00004873711555	0.00024211255270
PPARA	0.6232	3.8913	0.00004878101392	0.00024219813419
ATXN10	-0.2675	5.9475	0.00004881985871	0.00024225854476
PIAS4	0.3008	5.2994	0.00004895136949	0.00024277847426
DNAJC19	-0.3563	4.3677	0.00004925082260	0.00024413030569
MAGEH1	0.3090	4.4005	0.00004939077921	0.00024461339305
GPAT4	-0.3631	5.7880	0.00004940215426	0.00024461339305
PEF1	-0.4233	5.8429	0.00004957698409	0.00024534528203
ARNTL	0.7134	3.5409	0.00004969313768	0.00024578615648
RUNX1	-0.3985	3.8480	0.00004983714068	0.00024636422130
SLTM	-0.3389	6.0013	0.00005043435228	0.00024918082320
TSEN2	-0.3527	3.9930	0.00005083113768	0.00025099167026

GSPT1	0.2552	7.4955	0.00005085614726	0.00025099167026
IMPA2	0.3955	4.5154	0.00005109990036	0.00025205768340
MANF	0.4925	5.6557	0.00005162002756	0.00025448505443
ZBTB37	-0.5743	3.9923	0.00005166985602	0.00025459249186
SLC25A15	-0.5344	3.9217	0.00005174817440	0.00025484011481
CMIP	0.3721	5.4806	0.00005181657269	0.00025493393571
SNX5	0.2463	6.3182	0.00005182337246	0.00025493393571
TMED2	0.3821	7.0672	0.00005187250724	0.00025503748687
CCDC71	-0.4567	4.4639	0.00005199303208	0.00025549173392
TMEM63B	0.2675	6.2921	0.00005205798311	0.00025567254985
APH1B	0.3853	3.3160	0.00005242433700	0.00025724780204
LINC01089	-0.6518	4.1619	0.00005243537954	0.00025724780204
SLC26A11	0.3735	5.2767	0.00005276294113	0.00025859325936
PCP4	0.4986	5.2735	0.00005276657963	0.00025859325936
ACD	0.4735	6.2084	0.00005279863133	0.00025861077189
USP2	0.5153	3.0991	0.00005282887455	0.00025861941229
SRPK1	0.4926	4.8778	0.00005296918105	0.00025916655878
CCDC170	-0.3528	6.4695	0.00005303881148	0.00025931713649
ARHGAP19	-0.7045	3.3748	0.00005305706856	0.00025931713649
RRP7A	-0.3529	6.0779	0.00005309627807	0.00025936917762
PLEKHO1	0.6538	3.7764	0.00005317558141	0.00025961691118
CAP1	0.3548	6.6726	0.00005421886092	0.00026456822999
PARD6A	0.4902	4.6550	0.00005442990846	0.00026541977192
SHISA5	-0.3070	7.2544	0.00005445182635	0.00026541977192
FANCE	0.4577	3.6806	0.00005459591341	0.00026597933996
RAB43	0.7721	4.1133	0.00005464117257	0.00026598895829
DDX56	-0.3799	6.8112	0.00005465646913	0.00026598895829
SGSM2	-0.2609	7.6969	0.00005476897760	0.00026633906033
BPTF	-0.6408	6.3793	0.00005478706802	0.00026633906033
C3orf14	-0.3106	6.5450	0.00005481880634	0.00026634750688
DDX5	-0.3251	8.7961	0.00005484746590	0.00026634750688
TWNK	-0.2971	4.9531	0.00005520896795	0.00026795972097
GOLGA2P7	0.3954	5.5627	0.00005566015255	0.00027000525923
ZNF692	-0.4349	4.5752	0.00005571531838	0.00027012856710
PCDHGA8	-1.1065	3.7042	0.00005597363072	0.00027123614757
TTC27	-0.4441	3.9027	0.00005613940187	0.00027189435112
IP6K2	-0.2694	6.5350	0.00005642920419	0.00027315224052
COG4	-0.3205	6.5739	0.00005714237120	0.00027639265178
VTI1B	-0.2750	7.3535	0.00005715949786	0.00027639265178
CDC40	0.5520	4.3145	0.00005753843511	0.00027807691817
GAL	-0.5756	3.2872	0.00005769218331	0.00027867165779

BNIP3L	0.5017	5.0969	0.00005805147422	0.00028012276872
LIN37	0.5284	4.9029	0.00005808207929	0.00028012276872
TRAM2-AS1	-0.3743	3.4601	0.00005808514189	0.00028012276872
TP53I11	-0.3035	7.1029	0.00005823357119	0.00028068952230
C16orf70	0.3562	4.2555	0.00005828077885	0.00028076803857
PFDN6	0.5040	6.3147	0.00005845023614	0.00028134661462
MRPL48	-0.4843	4.3727	0.00005846284129	0.00028134661462
NEU1	0.2421	7.1023	0.00005862708506	0.00028198758445
COX17	-0.6011	5.3636	0.00005891526231	0.00028319837954
ZNF44	0.4478	3.5856	0.00005894118900	0.00028319837954
MRPS30	-0.4023	3.7081	0.00005932868061	0.00028477688593
GON7	0.3626	4.0337	0.00005933243786	0.00028477688593
TINCR	-0.2360	5.6943	0.00005966437884	0.00028621881892
DGCR8	-0.2841	5.1109	0.00006004199760	0.00028787823665
SAMD10	-0.5687	4.4189	0.00006012140153	0.00028810683236
TACC2	-0.3428	5.2441	0.00006016641349	0.00028817046459
DCLRE1B	0.4424	6.3519	0.00006060553895	0.00029002545173
TFF3	-0.8033	4.4625	0.00006061758698	0.00029002545173
KIAA0586	0.5215	4.1534	0.00006080301735	0.00029075945263
ZDHHC6	0.4334	4.8898	0.00006109068519	0.00029189166529
SBF1	0.2850	6.6680	0.00006110406957	0.00029189166529
TMEM131	-0.7003	5.0248	0.00006184677754	0.00029528422023
SVIP	-0.3942	4.2120	0.00006199542365	0.00029574664277
KIAA1324	-0.2849	7.4491	0.00006200876642	0.00029574664277
PTGR2	0.4019	5.4419	0.00006236200483	0.00029727525767
CFAP36	0.4301	5.8786	0.00006270045119	0.00029873179287
KRT10	-0.4220	5.0771	0.00006281758199	0.00029913291140
MTO1	0.4273	4.4627	0.00006292101231	0.00029946840294
FUNDC2	-0.4065	6.8567	0.00006370669455	0.00030299205765
ZNF18	-0.7690	3.1907	0.00006372809494	0.00030299205765
SLC19A1	-0.3624	5.4866	0.00006383579923	0.00030334531283
MRI1	0.4817	5.5617	0.00006409969843	0.00030444004258
MICU2	-0.5442	3.9255	0.00006444702223	0.00030592964397
ILRUN	0.2515	7.2581	0.00006458595368	0.00030642896831
ZNF740	-0.2856	5.0650	0.00006508840518	0.00030865159657
ZNF48	0.2993	6.0277	0.00006533202265	0.00030964514493
ASB7	0.3817	3.9286	0.00006572492312	0.00031134482362
GTF2B	0.3443	4.2061	0.00006602326443	0.00031259502832
NRP1	-0.4075	6.4794	0.00006697775002	0.00031694890462
VARS2	-0.4050	5.8822	0.00006731437411	0.00031831886041
GPATCH11	0.4356	3.5568	0.00006733735611	0.00031831886041

NINJ1	-0.4145	8.4586	0.00006768342864	0.00031973771857
GATA3-AS1	-0.5953	6.5057	0.00006771544724	0.00031973771857
NAA50	0.5161	6.0720	0.00006774386236	0.00031973771857
MRPS22	-0.4636	5.0472	0.00006777834030	0.00031973771857
OXSR1	0.3841	5.3510	0.00006790690466	0.00032017788224
CCDC66	0.5490	3.4034	0.00006795153217	0.00032022203613
ST3GAL1	0.3539	5.0623	0.00006804519947	0.00032049712467
CAD	-0.2674	7.1057	0.00006817560143	0.00032094486084
AP5M1	0.7291	4.4294	0.00006824249982	0.00032096992087
CTPS2	-0.3319	4.6808	0.00006825161515	0.00032096992087
HSD17B12	0.5840	3.4898	0.00006839754431	0.00032148969972
IFNAR1	-0.4057	4.0062	0.00006888788284	0.00032362693435
NUP85	0.2754	6.0156	0.00006892772582	0.00032364667950
PCBP1	-0.2555	7.7503	0.00006903647885	0.00032398980073
PRICKLE3	0.3835	4.1066	0.00006911464121	0.00032418907895
RBMX	-0.2653	7.8057	0.00006935262612	0.00032513742787
ZNF839	-0.2793	5.7884	0.00006993716042	0.00032757397408
EPHX1	-0.4051	4.4824	0.00006994449243	0.00032757397408
LMNA	0.3251	10.0691	0.00006998880990	0.00032761256840
SEPHS1	-0.2995	6.5878	0.00007012031401	0.00032805902707
CMAS	-0.3859	4.9798	0.00007016519357	0.00032809996025
IGHMBP2	0.3413	4.6819	0.00007025615158	0.00032835620817
ABHD4	0.3666	5.3996	0.00007041139409	0.00032891248442
C5orf38	-0.4090	6.6786	0.00007054986087	0.00032938986458
CERS4	0.4459	5.0211	0.00007082776163	0.00033039672550
PSMD6	0.2336	9.8605	0.00007083828043	0.00033039672550
RPTOR	-0.3096	5.5254	0.00007104266046	0.00033117987662
CLDN7	0.2787	7.8962	0.00007130016618	0.00033220975327
AHCY	-0.2457	8.2645	0.00007142995586	0.00033264380984
SNX21	-0.4620	4.9702	0.00007157449199	0.00033314605933
RBM28	-0.3221	5.2219	0.00007202698101	0.00033508043780
MYO1C	-0.2530	8.2781	0.00007226658543	0.00033602297099
MAP2K1	0.5772	4.9683	0.00007240014109	0.00033647168949
DDX46	0.3703	6.5447	0.00007245466372	0.00033655283950
SREK1	-0.5592	4.7071	0.00007254368921	0.00033669347535
C2CD2L	0.2785	5.4248	0.00007255909385	0.00033669347535
TNRC6C	-0.4351	5.2261	0.00007259903073	0.00033670674056
IRF1	0.3074	4.0367	0.00007295381915	0.00033807271054
PSMB10	-0.6328	5.2416	0.00007298608007	0.00033807271054
EPHA2	-0.4459	4.3448	0.00007300524010	0.00033807271054
RSRC2	-0.3559	5.6785	0.00007348975764	0.00034014296081

TDRKH-AS1	0.3933	4.4442	0.00007371437561	0.00034100878499
ADORA1	-0.4486	4.6259	0.00007385845554	0.00034133606802
ECSIT	-0.5096	5.9187	0.00007386029883	0.00034133606802
RTN4	0.5792	6.1079	0.00007389989897	0.00034134536243
NEK3	0.4392	3.5852	0.00007425460412	0.00034280938488
INSR	0.3660	4.7271	0.00007466465252	0.00034436743809
SMIM11B	-0.3801	3.9514	0.00007466793146	0.00034436743809
CARMIL1	0.5748	4.9225	0.00007501312981	0.00034578387403
ADIPOR1	0.3046	7.0493	0.00007569004021	0.00034872717157
EIF2B1	0.2372	6.1406	0.00007592279086	0.00034962214186
HMGN3	0.3224	6.0796	0.00007603400777	0.00034995682949
DENND3	0.4208	3.5129	0.00007650134410	0.00035159487016
EGR1	-0.6697	5.7865	0.00007650468405	0.00035159487016
HGH1	-0.4632	5.6032	0.00007650605257	0.00035159487016
SCD	0.3741	11.3820	0.00007700613984	0.00035358476940
TRAF6	-0.5296	3.5208	0.00007701692257	0.00035358476940
FAM193A	-0.4650	4.8435	0.00007741863207	0.00035524941778
EFR3B	0.7424	3.6815	0.00007750127974	0.00035541710242
TMEM30A	0.4066	5.2811	0.00007753345225	0.00035541710242
COQ9	-0.2845	5.4501	0.00007772667138	0.00035612305895
ARHGEF10	0.6300	4.0611	0.00007781205579	0.00035629479880
LAMB2	-0.2958	8.5101	0.00007784262535	0.00035629479880
SESN2	0.2924	5.1825	0.00007798122089	0.00035674935359
PNO1	-0.3590	4.3279	0.00007808372863	0.00035699561728
FAM50B	-0.4150	4.2415	0.00007813907453	0.00035699561728
GGCX	0.2665	5.4285	0.00007815298834	0.00035699561728
FNBP1L	0.6685	4.1138	0.00007838121004	0.00035785810376
RNASEH2B	-0.5565	3.2713	0.00007899186375	0.00036006755940
ARMC7	-0.3325	5.8894	0.00007899587175	0.00036006755940
TPBG	-0.4802	5.7721	0.00007900566403	0.00036006755940
TRIP6	-0.3548	8.5170	0.00007902374693	0.00036006755940
EMG1	-0.4607	5.5252	0.00007930854992	0.00036118402296
LMF1	-0.3910	4.8532	0.00007952776231	0.00036200080677
RNF166	0.2960	5.3005	0.00007972552193	0.00036271917065
BATF	-0.5575	6.4430	0.00008022855558	0.00036482499411
KIAA1958	0.7006	3.5044	0.00008040251064	0.00036543303261
C1orf174	-0.4043	3.5108	0.00008045717098	0.00036549853410
HIRA	0.4204	5.3480	0.00008095393469	0.00036757134048
PRRT4	-0.4183	3.7054	0.00008099800056	0.00036758762771
AFAP1	0.6111	4.4295	0.00008108730816	0.00036780911358
FBXO22	0.3611	4.7690	0.00008118358470	0.00036806197337

LINC00886	-0.3819	3.5141	0.00008129833064	0.00036830986201
VMP1	0.3233	9.1246	0.00008131937819	0.00036830986201
NECAP2	0.2930	5.2332	0.00008145729978	0.00036875061781
SUGP2	0.2886	6.3777	0.00008152947850	0.00036889346998
NFKBIA	-0.3547	5.8754	0.00008157367367	0.00036890962681
ZNF286A	0.5296	3.8528	0.00008172759480	0.00036942174634
FGFRL1	0.4470	5.7551	0.00008209406689	0.00037089364250
PMS2P5	-0.4159	3.8360	0.00008215685741	0.00037099275094
MED29	0.2450	6.1379	0.00008223850857	0.00037102368983
LRRFIP1	0.3553	6.2131	0.00008224542315	0.00037102368983
RALA	0.3005	5.6549	0.00008255009768	0.00037221322595
CD276	0.2101	6.9600	0.00008262796610	0.00037237943434
KPNA6	0.3125	6.0240	0.00008292098841	0.00037343031954
ASF1B	0.2550	5.5177	0.00008294339330	0.00037343031954
FBXO3	0.5689	4.2834	0.00008368064666	0.00037656290998
CLIP2	0.4921	3.3760	0.00008396098668	0.00037763411240
TXNRD2	-0.4367	6.0245	0.00008409250211	0.00037763411240
MAD2L2	0.5479	6.0018	0.00008409903304	0.00037763411240
AGK	-0.5745	3.8438	0.00008410277092	0.00037763411240
KRAS	0.6240	4.2270	0.00008414941038	0.00037763411240
CTTNBP2NL	0.7933	4.2083	0.00008416820212	0.00037763411240
ARIH2	0.2379	6.3424	0.00008506212328	0.00038145636615
JPT1	0.4785	7.2548	0.00008529286919	0.00038222718191
TUBA1B	-0.2640	9.8250	0.00008531819158	0.00038222718191
DCTN6	-0.4707	3.8642	0.00008577009699	0.00038406225384
ESD	-0.2699	5.7693	0.00008590207321	0.00038446364062
PMS2P1	-0.3362	5.2298	0.00008642988564	0.00038663536526
TARBP1	-0.3950	3.9170	0.00008651893105	0.00038683263783
DPM1	0.4120	5.6238	0.00008655918071	0.00038683263783
TEDC1	-0.6198	6.3449	0.00008661066652	0.00038687233775
IFRD2	-0.2705	5.3783	0.00008666769630	0.00038693675029
MYD88	-0.3969	5.2374	0.00008712372393	0.00038878159066
ADCK2	-0.3721	5.1678	0.00008725232302	0.00038916421675
CCDC12	-0.5666	5.5014	0.00008734253846	0.00038937535185
MCOLN1	0.4047	4.7474	0.00008799341296	0.00039208448629
HNRNPD	0.2626	7.7010	0.00008820293790	0.00039282534528
CCDC47	0.4461	7.2898	0.00008879164574	0.00039525339951
NRM	0.4527	4.9786	0.00008901195224	0.00039603995019
TPR	0.4099	7.5427	0.00008942054159	0.00039734383589
ZFP90	0.3529	5.3532	0.00008944021321	0.00039734383589
MLYCD	-0.2955	4.7150	0.00008946796973	0.00039734383589

HMBS	-0.3697	5.9063	0.00008948002911	0.00039734383589
NAPB	0.3987	3.4433	0.00008960029674	0.00039768342847
TXNDC5	-0.2612	6.8182	0.00008972592893	0.00039804648785
SCAMP4	-0.3979	5.7869	0.00009007360455	0.00039939375143
TRIM16	-0.2802	5.6554	0.00009057016427	0.00040139954209
DTX2	0.3687	4.7819	0.00009071353599	0.00040183883919
LRP10	-0.2208	8.1970	0.00009083181223	0.00040216659524
LINC01002	0.6519	4.9840	0.00009105720309	0.00040285721659
MYO1E	-0.4503	4.2374	0.00009107651863	0.00040285721659
STON1	0.6581	4.0686	0.00009154880188	0.00040474910901
BRD2	-0.3176	8.0206	0.00009170607938	0.00040524715662
GIT2	0.3554	5.7117	0.00009197653727	0.00040624461815
CEBPA	-0.3233	4.9898	0.00009224498925	0.00040723225442
EMC8	0.2879	5.9672	0.00009244254095	0.00040781460754
JUNB	-0.2875	7.8867	0.00009253336232	0.00040781460754
GMCL1	0.5759	3.4816	0.00009254104452	0.00040781460754
SELENBP1	0.3027	7.6304	0.00009255653630	0.00040781460754
GRB7	-0.2844	6.5597	0.00009267389075	0.00040813365755
MTIF3	-0.4203	5.4188	0.00009278037064	0.00040840453021
BZW1	0.4407	7.0283	0.00009287669769	0.00040847980528
NARF	0.3267	6.4697	0.00009288743507	0.00040847980528
MPC2	0.2993	5.5519	0.00009301210656	0.00040883007728
PRPF38A	-0.2409	5.1249	0.00009318837930	0.00040940671138
MLPH	-0.3186	8.7758	0.00009332778989	0.00040982091877
ELL	0.2935	4.8462	0.00009337823496	0.00040984424924
FAM168B	-0.2909	6.5631	0.00009348492518	0.00041011430222
SLC20A2	-0.3678	4.7669	0.00009367952258	0.00041076955314
DNAJC22	-0.2991	5.9050	0.00009373959296	0.00041083457706
SMPD1	0.3194	5.2482	0.00009384510355	0.00041109859398
EIF5	-0.3532	7.4003	0.00009396529540	0.00041125037403
LYPD6B	-0.3825	5.0750	0.00009397032553	0.00041125037403
PSMG3-AS1	-0.3560	6.2585	0.00009412254106	0.00041171810954
PIGM	0.3222	4.7203	0.00009419996991	0.00041185841444
OAT	0.4985	5.4302	0.00009581627943	0.00041872359648
TMEM248	0.2219	6.3827	0.00009630163552	0.00042064220882
HAUS7	-0.5615	4.6734	0.00009674203449	0.00042236269963
LYPD6	0.4644	4.0133	0.00009706409767	0.00042356514703
EXOSC5	-0.4529	4.5760	0.00009738447211	0.00042475907361
SNX27	0.3568	6.1069	0.00009751763568	0.00042503263820
CYTH1	0.2706	5.5736	0.00009754080145	0.00042503263820
LOC100128988	0.3385	4.9314	0.00009768868914	0.00042547289501

PTPN6	0.2896	6.9606	0.00009828233414	0.00042785324846
LOC283028	-0.4349	5.0350	0.00009837156645	0.00042803650930
REPS2	0.4887	4.0038	0.00009892352348	0.00043023204822
THNSL2	-0.4010	5.4096	0.00009906246663	0.00043063009068
PHKA1	-0.4637	3.4822	0.00009919733539	0.00043101004911
PICK1	-0.4528	4.4842	0.00009929090580	0.00043121028959
HOXB7	-0.4348	4.3554	0.00009954124827	0.00043208320368
ZNF384	-0.2828	6.1509	0.00009958706588	0.00043208320368
LMF2	0.3578	6.3519	0.00009980395843	0.00043281745298
SNX24	0.3864	4.0618	0.00009993878585	0.00043312829407
CNOT3	-0.2443	6.9180	0.00009997102790	0.00043312829407
TPCN1	0.3130	5.2750	0.00010018099260	0.00043383099372
KRT86	-0.4807	4.7492	0.00010024864989	0.00043391705894
OSBPL7	0.3260	5.6052	0.00010134762177	0.00043846486580
EPRS1	0.3101	6.6578	0.00010140744554	0.00043851476808
ARHGEF35	-0.4489	3.7002	0.00010171440538	0.00043963280119
TMA16	-0.3324	4.0074	0.00010218502668	0.00044145681604
SOCS2	-0.5626	3.6473	0.00010244354575	0.00044236321394
WDTC1	0.2954	6.2798	0.00010316512009	0.00044526732678
PPIL1	-0.3721	4.6469	0.00010379156952	0.00044775831013
YIPF3	-0.2782	7.1065	0.00010509429333	0.00045314695999
IPO5P1	0.3319	4.4171	0.00010514047403	0.00045314695999
TEP1	-0.4885	4.3249	0.00010532661470	0.00045373386533
PFKP	0.2194	7.2409	0.00010597848222	0.00045632555575
ACOT7	0.3268	5.5589	0.00010650088919	0.00045835761837
STX12	0.4154	3.5624	0.00010675911752	0.00045925132458
NAPG	-0.2885	4.6256	0.00010698197075	0.00045989239681
PGRMC1	0.3049	6.0289	0.00010700943007	0.00045989239681
PWWP3A	0.3362	5.5929	0.00010711861191	0.00046014385751
TMEM121	0.5527	6.0100	0.00010736748991	0.00046099488221
ARVCF	0.3506	5.0131	0.00010777326957	0.00046251845980
CDC42EP1	-0.4074	6.0287	0.00010815581181	0.00046394091973
CFAP44	0.5245	4.0792	0.00010864601124	0.00046582362044
MYH10	0.6065	5.9106	0.00010884851327	0.00046647161349
DHX38	-0.2196	7.3810	0.00010918379884	0.00046752210877
CLPB	-0.6617	3.6179	0.00010919660750	0.00046752210877
MAPK8IP2	0.3464	3.7005	0.00010933096430	0.00046787676099
UBE2F	0.3249	4.2848	0.00011099339544	0.00047476732172
ECHDC2	-0.5235	4.8262	0.00011126567525	0.00047570790819
NUPR1	-0.6746	5.7952	0.00011239716124	0.00048031935115
KCTD21	0.4131	4.1576	0.00011252831501	0.00048065363527

RGS16	-0.4066	3.3568	0.00011283517270	0.00048173775425
CTNNBIP1	0.2537	5.7793	0.00011351922837	0.00048443050413
RPP21	-0.5192	5.8237	0.00011377580044	0.00048529734327
PFDN1	-0.3219	5.2740	0.00011388491352	0.00048553469470
ATP9A	-0.4618	8.2458	0.00011439183243	0.00048746702502
PPM1M	-0.3602	3.5422	0.00011465102200	0.00048834236904
GPRC5A	-0.2162	7.8984	0.00011498703295	0.00048954395041
TMEM243	0.3524	4.0435	0.00011507042678	0.00048966942154
CACUL1	0.3454	5.5568	0.00011565540950	0.00049191336392
BOK	-0.4359	5.5301	0.00011570608362	0.00049191336392
EFNA4	0.3580	5.2516	0.00011593345158	0.00049264935602
REXO2	0.3273	5.0041	0.00011601686509	0.00049277322351
RABGGTB	0.4141	4.4046	0.00011613126214	0.00049302851401
IQGAP3	0.3876	4.7667	0.00011632547423	0.00049362225769
SLC25A26	-0.4232	4.2006	0.00011639039807	0.00049366707374
WBP4	-0.3655	4.4029	0.00011693665881	0.00049560564142
PRKCD	0.2332	7.1698	0.00011695660055	0.00049560564142
SDR39U1	-0.3954	5.8900	0.00011706759111	0.00049584458716
MOCS1	0.3572	4.1767	0.00011836930505	0.00050112431662
CHDH	-0.4385	4.1825	0.00011882318873	0.00050281145241
ZNF141	0.3458	4.3689	0.00011921113162	0.00050421811189
EFHC1	0.3109	5.2105	0.00011928189706	0.00050428254526
PLEKHG4B	-0.3315	3.6357	0.00011939021319	0.00050450559609
SFI1	0.3372	4.8199	0.00011955913884	0.00050498443712
PALM	0.4069	6.0411	0.00011969333938	0.00050531623194
GFM2	0.5262	4.2620	0.00012031383467	0.00050763390845
UGGT2	0.4633	3.4724	0.00012043194144	0.00050763390845
RPN2	-0.1840	8.0095	0.00012044052919	0.00050763390845
MED26	0.3663	4.1159	0.00012050431410	0.00050763390845
BCCIP	0.2033	5.9910	0.00012052182652	0.00050763390845
DCTN5	0.2527	7.1397	0.00012064422677	0.00050788069691
SLC35C1	-0.2660	4.8730	0.00012076174980	0.00050788069691
IPPK	0.3592	4.9773	0.00012077667787	0.00050788069691
FAM219B	0.2739	5.3603	0.00012080413009	0.00050788069691
ZDHHC18	0.2385	5.1107	0.00012108452082	0.00050882393963
SPIRE2	0.3036	5.5533	0.00012137301599	0.00050980035068
NSMCE2	0.2991	6.3252	0.00012160381787	0.00051053364314
LSM1	0.2878	4.9400	0.00012190059556	0.00051154311842
PLPP5	-0.4982	3.6416	0.00012220779538	0.00051234398777
ABCC3	-0.2601	7.6999	0.00012224892616	0.00051234398777
HMCES	0.3162	7.3419	0.00012226070053	0.00051234398777

ZER1	0.2033	7.7478	0.00012263426782	0.00051367241055
TRMT61A	-0.4471	6.0131	0.00012286084788	0.00051438421372
GTPBP1	0.3550	4.8574	0.00012297300982	0.00051461654478
MIEN1	-0.5234	6.6940	0.00012316348076	0.00051517621778
RABGAP1	-0.3653	6.1418	0.00012353583717	0.00051649582750
USP20	0.2540	6.2569	0.00012374218270	0.00051712046070
DLX1	-0.5336	3.4510	0.00012399087578	0.00051792140892
BRD3OS	0.2280	5.9555	0.00012464535848	0.00052041586222
ZBTB45	-0.3985	5.4127	0.00012484223815	0.00052099832933
NMT2	0.3840	4.2060	0.00012494933867	0.00052120576228
GDE1	0.1925	7.2885	0.00012521441790	0.00052207168454
PEX11B	0.2652	6.4073	0.00012546597736	0.00052288046830
UBE2T	0.3399	4.9039	0.00012561734392	0.00052327114685
UBE2B	0.5100	4.6514	0.00012618786922	0.00052540671268
PPOX	0.3962	4.7750	0.00012632760392	0.00052574746619
YARS1	0.2761	5.8804	0.00012642891871	0.00052592808557
AIFM2	-0.3931	5.0320	0.00012818246652	0.00053297846999
TRIB1	-0.4261	4.5837	0.00012906826441	0.00053641597670
ST14	-0.2474	7.1226	0.00012916403897	0.00053656845281
KANK2	0.4468	5.8715	0.00012927344341	0.00053677738434
DDX39B	-0.3465	8.5761	0.00012960656797	0.00053791464521
RAD17	0.4540	4.5051	0.00012968256236	0.00053798417029
GAS2L1	-0.3091	5.2633	0.00013007962565	0.00053936704429
PKIG	0.3473	5.1317	0.00013013469817	0.00053936704429
KLF13	0.5955	4.5185	0.00013039026938	0.00054017976106
RALGPS1	0.4692	4.8127	0.00013058146873	0.00054045419669
COPS7B	0.3002	4.9139	0.00013058462972	0.00054045419669
SYAP1	0.2251	6.7265	0.00013063505800	0.00054045419669
BFSP1	-0.3638	4.1626	0.00013071620898	0.00054054366747
DANCR	-0.3280	6.4642	0.00013116957142	0.00054217154215
ARFGAP2	-0.3134	7.6995	0.00013194946143	0.00054508748394
ZMAT5	-0.5908	4.4755	0.00013199508613	0.00054508748394
PHETA1	0.3504	4.5454	0.00013239675868	0.00054649771164
ARL2BP	-0.3035	4.8789	0.00013273494155	0.00054761539848
SNHG15	-0.4971	4.3665	0.00013278814089	0.00054761539848
MTLN	-0.5129	4.6671	0.00013317898674	0.00054897792946
DNPH1	-0.4924	6.5592	0.00013333305153	0.00054936363020
GPATCH4	-0.3864	5.7407	0.00013356746332	0.00055007987957
INTS5	-0.2490	5.5291	0.00013400399688	0.00055162751389
RSRC1	-0.4458	4.2629	0.00013594378127	0.00055935907463
ZNF219	-0.3390	7.0102	0.00013629536218	0.00056055171376

TULP3	0.2820	5.3762	0.00013704399391	0.00056337551324
DEPDC5	0.4101	3.5435	0.00013924571000	0.00057193770486
C12orf43	-0.4274	4.0538	0.00013925275470	0.00057193770486
CTBP1-DT	-0.4145	4.5359	0.00013946861915	0.00057256533930
SYNGR1	0.2706	6.0427	0.00013977072765	0.00057354630720
ZNF248	0.3053	4.2382	0.00014016008360	0.00057443900722
LINC00467	-0.4010	4.2955	0.00014021874396	0.00057443900722
POLE4	-0.5820	4.7766	0.00014022631948	0.00057443900722
ACAD8	0.4242	4.2679	0.00014024130371	0.00057443900722
CREB3	0.3749	5.9911	0.00014070037808	0.00057605957320
RMND1	0.2578	6.3479	0.00014103583973	0.00057717280783
GAA	-0.2098	8.1638	0.00014311826912	0.00058543108192
COQ8A	-0.2568	5.3055	0.00014337403179	0.00058605099474
NIPSNAP3A	-0.4931	3.5921	0.00014345480996	0.00058605099474
TMEM129	-0.2395	6.2469	0.00014346342488	0.00058605099474
MCM2	-0.2925	6.6441	0.00014537880035	0.00059360831204
PLEK2	-0.4581	3.6895	0.00014550910699	0.00059387334856
RTL8A	-0.2702	7.2690	0.00014740245604	0.00060133050461
RHBDF1	-0.2499	7.1018	0.00014749689806	0.00060144559105
ATN1	-0.2969	7.9751	0.00014784026834	0.00060257516912
SLC39A4	-0.6346	5.7068	0.00014849510023	0.00060497263581
ARID3A	0.3241	4.6370	0.00014857119399	0.00060501121641
TMEM11	-0.4225	5.5421	0.00014952232380	0.00060861148475
CHMP4B	0.2493	7.6171	0.00015026708779	0.00061136891766
ZNF512	0.3239	4.0063	0.00015040463604	0.00061165450061
POLR1C	-0.3437	5.1204	0.00015052490266	0.00061186957971
SAMD11	-0.4218	6.0482	0.00015138650194	0.00061509656559
C8orf58	0.4171	3.7970	0.00015159694059	0.00061567612589
UNC45A	0.2956	7.4397	0.00015173734351	0.00061597086115
SETD4	-0.3870	3.8673	0.00015190271327	0.00061617388932
SYNCRIP	-0.3376	6.8941	0.00015192306334	0.00061617388932
TPM1	0.2163	7.4668	0.00015234091829	0.00061748238737
NAIP	-0.5082	3.9548	0.00015238167934	0.00061748238737
CEP95	0.3178	6.3041	0.00015430445415	0.00062499498131
PODXL2	-0.4102	5.8955	0.00015459299697	0.00062579107597
RCN2	0.4967	5.1538	0.00015470877061	0.00062579107597
ARHGAP27P1	-0.3807	4.3728	0.00015476681223	0.00062579107597
UTP14A	-0.2541	5.1237	0.00015477664978	0.00062579107597
IDH3A	0.2625	5.3327	0.00015542496721	0.00062813267790
ACAD11	0.3802	5.0323	0.00015564462212	0.00062874057537
DDX28	-0.3003	4.5505	0.00015604419317	0.00063007439669

CDK5	0.4791	6.3545	0.00015660347994	0.00063205164502
KHDRBS1	0.3777	6.9262	0.00015719703887	0.00063416539761
EPB41	0.3856	5.0519	0.00015740622288	0.00063472731349
MCF2L	-0.3803	5.3824	0.00015801520566	0.00063690016980
LUZP1	0.4565	3.9169	0.00015836887625	0.00063804248680
MXI1	0.5008	4.9357	0.00015914848894	0.00064060136868
GTF3C1	0.2150	7.6217	0.00015918457546	0.00064060136868
ZNFX1	0.3388	5.8833	0.00015921564686	0.00064060136868
TCOF1	-0.3155	5.7678	0.00015949193524	0.00064142881484
ZFPL1	-0.4057	6.1958	0.00015980776372	0.00064241447646
ISY1-RAB43	0.4524	6.2351	0.00016000855532	0.00064293703135
STAM2	-0.5965	3.5672	0.00016010468808	0.00064303877595
SFXN1	-0.2328	6.4360	0.00016061547541	0.00064480509821
POGK	-0.4410	5.4632	0.00016084119944	0.00064542595322
DVL2	0.2453	6.6875	0.00016158685293	0.00064795384485
MORF4L2	0.3638	7.5578	0.00016161385955	0.00064795384485
AKT2	-0.2099	6.9559	0.00016179333815	0.00064838715963
KCNK6	0.5233	5.8413	0.00016202554694	0.00064903131531
TINF2	-0.2774	5.9132	0.00016229667867	0.00064983074913
SAMD8	0.5617	3.4911	0.00016238201950	0.00064988590529
XPNPEP3	0.3373	4.4333	0.00016261254694	0.00065052182323
RSL1D1	-0.2922	7.9458	0.00016272252497	0.00065067514278
GFOD2	0.3031	5.4434	0.00016308722346	0.00065184642440
STARD3NL	0.4999	3.7924	0.00016322612125	0.00065195947886
FKBP4	0.2706	7.1090	0.00016325909646	0.00065195947886
ELMOD3	0.3973	4.0517	0.00016365982051	0.00065320430354
FASTKD2	-0.4641	3.9795	0.00016375186276	0.00065320430354
CUX1	-0.1955	7.8923	0.00016378660931	0.00065320430354
NSMF	0.2160	7.3436	0.00016418211628	0.00065442312533
RANBP10	0.3779	5.3395	0.00016423635091	0.00065442312533
MANSC1	-0.4617	4.6801	0.00016755753087	0.00066735800459
SLC35A4	-0.2810	6.6194	0.00016762951310	0.00066735800459
ABCC1	0.4046	5.5417	0.00016811867485	0.00066901213247
CELF1	0.3690	6.4707	0.00016841163926	0.00066988440479
BCAS3	-0.3537	10.1263	0.00016912859278	0.00067244165982
SSNA1	-0.5088	7.1276	0.00016933710760	0.00067297604995
NFKBIE	0.4742	3.8637	0.00016947704354	0.00067323754699
TMEM260	0.3796	4.1239	0.00016970657468	0.00067385457136
ECHDC3	0.3242	4.0414	0.00017012791345	0.00067523233482
STMN3	0.2390	6.9079	0.00017072307504	0.00067729849036
HBP1	0.5392	5.7531	0.00017082651228	0.00067741290744

PEG10	0.6096	4.4463	0.00017090545555	0.00067743013612
COMMD3	-0.2854	5.5102	0.00017177183709	0.00068049494736
SULF2	-0.2785	9.8648	0.00017182853367	0.00068049494736
PPP2R5D	0.2547	6.0373	0.00017191873021	0.00068055535705
OGFOD1	0.3753	4.2895	0.00017257256638	0.00068284595873
TMEM50B	0.4163	3.9827	0.00017273044683	0.00068317299114
C6orf132	0.3196	5.0083	0.00017414642702	0.00068847353232
EHD4	0.3564	4.8445	0.00017459007072	0.00068992708105
RAB4B	-0.5410	3.8188	0.00017562672403	0.00069364644644
ZCCHC3	-0.3267	3.7585	0.00017568404656	0.00069364644644
FBRS	-0.2225	7.5631	0.00017631078843	0.00069550287415
LPIN1	0.4535	5.7254	0.00017637195816	0.00069550287415
SPATA33	0.3909	5.0047	0.00017638400167	0.00069550287415
ZNF410	0.1992	6.5537	0.00017646203375	0.00069550856273
ZNF282	-0.2281	6.7155	0.00017678598545	0.00069648309495
ACACB	-0.3869	3.4246	0.00017732869490	0.00069831824734
ALG1L	-0.7311	3.4339	0.00017752090640	0.00069877215040
MRPL57	-0.3594	6.3834	0.00017822209526	0.00070122826996
ING1	0.4849	3.4652	0.00017837286506	0.00070151753471
DCUN1D3	0.3662	3.5949	0.00017862682326	0.00070211303843
TMUB2	0.2532	5.8184	0.00017867891552	0.00070211303843
PRIM2	0.3931	3.5974	0.00017921182241	0.00070390249104
PHYKPL	-0.3448	5.2312	0.00018031140526	0.00070791520585
PPP1R14B-AS1	-0.5659	3.5614	0.00018165378350	0.00071264628419
GAK	0.2072	7.5373	0.00018167340027	0.00071264628419
PYM1	-0.4079	6.3332	0.00018193703000	0.00071337226658
MAU2	-0.3942	5.8827	0.00018217681547	0.00071400416975
TOB2	0.3878	6.2538	0.00018285231156	0.00071634246820
PROM2	-0.2425	6.5585	0.00018371793689	0.00071935256418
GSN	0.2491	8.4720	0.00018377909359	0.00071935256418
INSIG2	0.4916	4.1705	0.00018385971026	0.00071935804775
CCDC189	0.4951	4.3165	0.00018428176150	0.00072069882694
ARHGEF5	-0.3062	5.0542	0.00018598922665	0.00072706335224
RNF24	0.3409	4.3731	0.00018638783432	0.00072830805655
UAP1L1	0.2126	6.5838	0.00018666352961	0.00072907161824
TGIF2	0.2303	5.9656	0.00018751203228	0.00073207083626
KLHL26	0.3505	3.9501	0.00018824301742	0.00073460887031
NR4A1	0.4388	4.0721	0.00018880106669	0.00073647014030
PDF	-0.3956	4.3000	0.00018927453265	0.00073800001330
HNRNPDL	0.2304	7.0360	0.00019028750052	0.00074163124129
PIGC	-0.2711	4.8285	0.00019077215641	0.00074309943142

ITSN1	0.5159	3.6312	0.00019082786853	0.00074309943142
ATXN1	0.6786	4.5491	0.00019168545086	0.00074581480405
VASN	-0.3217	5.7526	0.00019168943428	0.00074581480405
GS1-124K5.11	0.3118	3.5418	0.00019306343381	0.00075083899034
MYPN	-0.4800	3.9137	0.00019346963058	0.00075209662469
ALPK1	0.4668	3.9496	0.00019480503473	0.00075696385126
URGCP	-0.2606	6.1570	0.00019559842717	0.00075963386732
DENND10	0.5502	4.5177	0.00019565946654	0.00075963386732
KIF1B	0.6758	4.5236	0.00019622971580	0.00076152224324
LMNTD2	-0.4688	4.2780	0.00019691509357	0.00076356661968
RETSAT	0.3105	5.7576	0.00019692468046	0.00076356661968
TAF3	0.2990	4.9461	0.00019707478795	0.00076376330292
CIRBP	-0.3727	8.6729	0.00019714361657	0.00076376330292
VPS29	0.2487	5.4698	0.00019727253370	0.00076393683520
ENOSF1	-0.4668	4.6701	0.00019772896059	0.00076537795869
WDHD1	0.5916	3.7717	0.00019825964606	0.00076657694720
COG8	-0.2538	5.1153	0.00019826660009	0.00076657694720
YARS2	-0.3981	3.7379	0.00019829195562	0.00076657694720
STX16	0.2921	7.8604	0.00019848324372	0.00076698993030
SEPTIN2	0.3065	6.8722	0.00019860679718	0.00076714092949
SLC25A22	-0.3889	4.3493	0.00019897035572	0.00076821845250
GOLGA2P10	0.5208	3.9466	0.00019958918555	0.00077028023542
CCNYL1	0.6224	3.5185	0.00020041547462	0.00077301630344
DNASE1L1	0.2174	6.7977	0.00020046838394	0.00077301630344
SLC41A3	-0.2694	5.8199	0.00020196907484	0.00077847248244
NCBP1	0.3220	5.5779	0.00020443937702	0.00078765972963
FAM219A	0.3951	3.9429	0.00020455186711	0.00078775890807
DEGS2	-0.3716	6.4931	0.00020523685209	0.00079006182867
TRA2A	-0.2838	5.1515	0.00020650368568	0.00079460168204
SLC35A2	0.3818	4.5414	0.00020666215744	0.00079487465131
TNS3	-0.5860	5.5638	0.00020677462097	0.00079497050511
RDH14	-0.3168	4.6552	0.00020717249645	0.00079616311480
DOT1L	-0.3683	5.2066	0.00020749114929	0.00079705039201
HELLS	0.6784	3.3769	0.00020813392464	0.00079918146708
COX19	-0.3480	5.2584	0.00020832955304	0.00079959453558
TAOK3	0.5720	5.0779	0.00020895911519	0.00080167204268
CCDC28A	0.2750	4.6571	0.00020931961275	0.00080271596428
CCNH	0.2466	4.3515	0.00020941343757	0.00080273677779
SH3KBP1	0.3019	4.8902	0.00020988437150	0.00080420252221
PTDSS1	0.2196	7.3261	0.00021024597640	0.00080524829679
RSPH1	0.4530	4.3212	0.00021118905237	0.00080851930210

SLC30A6	0.3414	4.6262	0.00021173979036	0.00081028615096
DERPC	-0.6148	5.6625	0.00021211022102	0.00081136180165
CELSR3	0.5034	4.0686	0.00021363276716	0.00081684175097
ZBED5	-0.4513	3.9938	0.00021385888591	0.00081736218139
FBXO11	0.5781	4.6506	0.00021420558966	0.00081834285223
USP4	-0.3327	4.5223	0.00021482837803	0.00082037699787
HTT	0.2863	6.5281	0.00021553543487	0.00082273109880
MUC20	0.5131	3.4333	0.00021585436337	0.00082360229989
STRADA	-0.2951	5.6354	0.00021608743933	0.00082414533246
ARL4A	-0.2554	5.6822	0.00021669670412	0.00082597242490
AIFM1	0.2270	6.6838	0.00021674840750	0.00082597242490
PPP2R2C	0.3988	5.3886	0.00021725619256	0.00082756018649
INTS14	-0.2837	5.5187	0.00021778715267	0.00082923485676
IFFO2	0.3128	3.6590	0.00021823449842	0.00083058989110
H2AZ1	0.2151	7.5083	0.00021842607765	0.00083097076293
NUDT16L1	-0.3622	5.8793	0.00021902354564	0.00083274063087
COPS2	0.4511	4.5775	0.00021907470181	0.00083274063087
ACSS2	0.2143	6.2664	0.00021921755231	0.00083293497596
MARCHF2	0.3957	5.2086	0.00021960486651	0.00083393221271
CARS1	0.2675	5.3240	0.00021966367722	0.00083393221271
ZFYVE19	0.4430	5.7261	0.00021979494733	0.00083408187075
TBC1D10A	0.2730	4.8845	0.00022019396828	0.00083524704510
PCYT1A	0.2834	6.5430	0.00022122699342	0.00083881516794
RPRD1A	0.4991	4.4652	0.00022174508850	0.00084042869310
TMC4	-0.3315	7.4190	0.00022187690464	0.00084057745976
TAF12	0.3430	4.8056	0.00022210137983	0.00084083142322
TMC6	-0.3396	6.0749	0.00022212912502	0.00084083142322
CTCF	-0.4652	5.8417	0.00022269960650	0.00084263963610
MFN1	0.4869	4.6706	0.00022354734323	0.00084549497038
MAFK	-0.2221	6.1915	0.00022491853867	0.00085032691492
IFT43	0.4153	5.9683	0.00022559490056	0.00085252904370
TIMM17B	-0.5233	5.3567	0.00022578014143	0.00085287415320
ZHX3	0.3273	7.0707	0.00022629493130	0.00085446331440
PRKAG1	-0.2181	6.4430	0.00022708519462	0.00085709087795
ATF7IP	-0.5264	4.3130	0.00022727448720	0.00085744894820
KCTD5	0.2995	5.8202	0.00022747741062	0.00085785812535
ZNF668	-0.3881	4.7158	0.00022837769622	0.00086089574903
MAGT1	0.5242	5.1169	0.00022862654787	0.00086147621626
LARP7	-0.3375	5.3989	0.00022950866107	0.00086444137336
CEBPD	-0.4822	3.6686	0.00023022604860	0.00086640235029
BHLHE40	-0.4168	6.3012	0.00023024996814	0.00086640235029

THSD4	-0.5225	5.1873	0.00023031552402	0.00086640235029
MTX1	-0.4816	5.8489	0.00023217195220	0.00087302422273
ESRRA	0.2458	6.4285	0.00023243720024	0.00087365985736
GRIN3B	0.4511	3.5238	0.00023312285763	0.00087587450150
SRGAP2B	0.7909	3.9824	0.00023383760122	0.00087819654951
EFHD2	0.3976	5.4694	0.00023435267476	0.00087976711015
CDK6	-0.5067	4.9273	0.00023480426384	0.00088109814872
C2orf27A	0.4419	3.4548	0.00023497763699	0.00088138451941
ALS2	0.5926	4.4083	0.00023587929810	0.00088440128244
DUT	-0.2579	5.5449	0.00023673700826	0.00088725083449
SULF1	-0.5179	4.4838	0.00023747533005	0.00088965077235
COPZ1	-0.2544	6.9607	0.00023763196124	0.00088987044951
RSPH3	0.5781	3.9839	0.00023791933713	0.00089057934890
KIF4A	-0.2556	5.2672	0.00023815846188	0.00089110712499
CDKN2C	0.3157	3.9764	0.00023867353876	0.00089234329514
EIF4EBP2	0.2941	6.3873	0.00023868537208	0.00089234329514
TUBB6	-0.2299	5.7707	0.00023928845569	0.00089422982145
PCAT7	0.3683	3.6448	0.00023954927513	0.00089483626798
DOK1	-0.3992	3.7323	0.00024013554708	0.00089665744367
FANCC	-0.3705	3.5524	0.00024096942060	0.00089940127763
PRKD3	0.6061	4.0176	0.00024146897415	0.00090089554406
PRXL2B	0.2447	5.9230	0.00024157896560	0.00090093576451
NUDT14	-0.5464	5.5140	0.00024183527241	0.00090152139113
MALAT1	0.3419	9.5786	0.00024289067960	0.00090508422712
STARD3	0.2419	6.8653	0.00024347610015	0.00090689354614
FBXO7	-0.2134	6.2219	0.00024394565730	0.00090826999343
NHSL1	-0.5241	3.6188	0.00024452658475	0.00091005980167
STX4	0.3897	7.1850	0.00024485079787	0.00091089311570
KDELR2	0.1871	7.6463	0.00024549451063	0.00091291386200
VAC14	-0.2661	5.8296	0.00024592830079	0.00091384305976
CSNK1G2	0.2248	6.9407	0.00024594564894	0.00091384305976
PTPN12	0.6291	4.9514	0.00024605041563	0.00091385841485
EIF2S3	0.2146	7.2757	0.00024675042874	0.00091608366452
OTUB1	-0.3430	7.3730	0.00024718513114	0.00091732250751
SPG11	-0.4732	4.3293	0.00024791283418	0.00091964724151
PSMA2	0.2607	6.8914	0.00024811244816	0.00092001189944
TAF8	-0.4025	4.2247	0.00024880815472	0.00092221504206
SNX30	0.6044	4.5336	0.00024902545362	0.00092264387774
KCNQ1OT1	0.4552	5.8549	0.00025019451781	0.00092659723338
HLTF	0.5274	5.5752	0.00025058459819	0.00092766356958
MXRA7	0.2767	4.6701	0.00025347183602	0.00093760930724

ZMYM5	0.4099	3.4837	0.00025347768410	0.00093760930724
SEMA4B	0.2470	5.5769	0.00025381243549	0.00093846527958
RILP	-0.4659	4.5032	0.00025393153646	0.00093852351753
ABCC10	-0.3380	4.5351	0.00025444486248	0.00094003815955
CPAMD8	0.3866	3.4211	0.00025630285316	0.00094651736868
PPA1	0.2314	7.0073	0.00025659560453	0.00094721328648
NIT2	-0.2771	6.2668	0.00025700846786	0.00094801700588
UBE2C	-0.3868	5.2809	0.00025702211964	0.00094801700588
WDR26	0.5175	5.7252	0.00025725018597	0.00094847297556
USP21	-0.2377	4.6015	0.00025851858966	0.00095276270809
RASA3	-0.3605	5.2601	0.00025879567629	0.00095339697215
GSS	-0.3088	6.7065	0.00025912961873	0.00095424009233
FAR1	0.5585	4.1180	0.00025983476822	0.00095644893807
C22orf39	-0.3332	4.3409	0.00026072755811	0.00095934641621
CLIC1	0.2934	8.7305	0.00026100136926	0.00095996493895
DYNLRB1	-0.4021	7.1457	0.00026121539660	0.00096036316457
MORC2	-0.2475	6.1731	0.00026159649194	0.00096113757155
UFC1	-0.4060	6.2865	0.00026163771356	0.00096113757155
CDH3	0.2136	6.8961	0.00026297415576	0.00096561029437
EMB	-0.4436	4.3036	0.00026331705562	0.00096561029437
PRPF8	-0.3039	8.6022	0.00026333172259	0.00096561029437
KMT2E	0.7259	5.9236	0.00026336931727	0.00096561029437
SCAND2P	0.2891	3.5394	0.00026338692866	0.00096561029437
C14orf28	-0.3879	3.6458	0.00026380650447	0.00096675821917
FUZ	-0.4033	4.0085	0.00026426688471	0.00096765922859
MAPK14	0.3934	5.3542	0.00026431831019	0.00096765922859
QDPR	-0.2647	4.4803	0.00026437204560	0.00096765922859
GLRX5	0.2713	6.9359	0.00026506230816	0.00096979485109
C12orf49	0.4204	5.8377	0.00026601853897	0.00097290147096
RPA1	0.2589	6.8596	0.00026657089482	0.00097440731697
IMP3	-0.3259	6.3271	0.00026664488302	0.00097440731697
NME4	-0.3661	7.5221	0.00026727184570	0.00097630556347
C1orf159	0.4752	4.9759	0.00026793875174	0.00097834813209
MRPS26	-0.4030	6.0105	0.00026904047942	0.00098197612283
ZNF251	0.3426	5.4235	0.00027016145513	0.00098567142386
TTC19	0.2593	5.7305	0.00027065036862	0.00098705863352
LARP4	0.5365	4.5379	0.00027079043427	0.00098717299624
PMPCB	-0.1886	7.2336	0.00027176817820	0.00099033981791
EHD3	-0.5877	4.1659	0.00027243785059	0.00099238191786
POR	0.2262	6.8978	0.00027317223427	0.00099465800298
CUTC	-0.3257	3.4675	0.00027372714162	0.00099618063121

ARMT1	0.4863	4.9449	0.00027380980679	0.00099618063121
SLC44A2	-0.1673	8.3952	0.00027406826522	0.00099672163255
IL10RB	0.2571	4.6094	0.00027596268001	0.00100320940640
INPP5F	0.4147	4.4879	0.00027645374470	0.00100445171372
CPT2	0.2487	5.2239	0.00027652563421	0.00100445171372
ATF6	0.2601	5.1689	0.00027861451266	0.00101163470190
ATG7	-0.3974	5.0836	0.00027982505633	0.00101527178298
UTP6	0.2968	4.7492	0.00027983980540	0.00101527178298
NCS1	0.3209	5.1095	0.00028036374690	0.00101676644790
CRTAP	-0.1840	7.4519	0.00028073160241	0.00101769408442
HNRNPAB	-0.1954	7.9843	0.00028103169707	0.00101837543540
MAF1	-0.3147	7.9305	0.00028162723583	0.00102012641747
APEH	0.2035	7.6653	0.00028261489052	0.00102329578181
FXR1	0.2767	5.9807	0.00028300649765	0.00102430530299
CLTC	0.4003	8.9538	0.00028320495547	0.00102461521939
LINC00294	0.3639	3.5574	0.00028362367217	0.00102537521819
ANKRD39	-0.4725	3.5808	0.00028375156646	0.00102537521819
CNOT8	0.4967	5.2779	0.00028375376317	0.00102537521819
ICOSLG	-0.2946	4.6122	0.00028396960977	0.00102574702719
CXorf56	0.2855	5.0164	0.00028485995008	0.00102847707516
MRE11	0.4434	4.1247	0.00028496306439	0.00102847707516
SLC25A19	0.3286	3.7056	0.00028506516883	0.00102847707516
EIF4G1	-0.2457	9.1008	0.00028791353317	0.00103793362658
ZBTB1	-0.5754	4.2452	0.00028791485578	0.00103793362658
SHPK	-0.3027	4.7691	0.00028858385585	0.00103948478537
CTSK	0.5117	3.4902	0.00028859294198	0.00103948478537
CEBPB	-0.3657	6.0351	0.00028868853967	0.00103948478537
OVOL1	0.2772	4.7179	0.00028929323230	0.00104124924397
INTS3	-0.2762	6.4974	0.00028961117690	0.00104198062499
ZMIZ2	0.2025	7.6173	0.00029021800278	0.00104375036959
FLYWCH1	0.1906	6.4767	0.00029067012684	0.00104496255812
GSKIP	0.6020	3.5879	0.00029084566828	0.00104517986293
SELENOS	0.3295	5.6759	0.00029118926364	0.00104600067371
MTRF1L	0.2597	4.9648	0.00029234365118	0.00104973218521
ZNF75A	-0.4653	4.4863	0.00029322156254	0.00105246838316
ZSWIM9	0.4530	3.6224	0.00029388863665	0.00105444595394
ACTN4	0.2217	9.1130	0.00029442803969	0.00105596407125
STK25	-0.1961	6.1979	0.00029517554833	0.00105822706451
PLA2G12A	0.2737	5.4143	0.00029605425410	0.00106095843785
VAMP2	-0.3116	5.5269	0.00029683823036	0.00106323750197
ATF1	-0.5480	3.6285	0.00029702943117	0.00106323750197

CTDNEP1	-0.2968	7.1357	0.00029704146487	0.00106323750197
TFE3	0.3016	5.5066	0.00029724954827	0.00106356310003
ZNF778	0.2664	5.4074	0.00029835738642	0.00106710650890
MPZL3	-0.4222	3.3220	0.00029903366421	0.00106910421445
SSBP3	0.2314	5.7849	0.00029961290184	0.00107075354648
CUL4A	-0.2535	5.6917	0.00030033084217	0.00107289708017
METTL2A	-0.2644	5.5479	0.00030070910898	0.00107382596092
TOPORS	0.4559	3.6475	0.00030191338688	0.00107770262037
POLG2	0.3836	4.1491	0.00030307191796	0.00108141300079
AAMP	0.2509	8.2512	0.00030355674999	0.00108271753600
PUS1	-0.3427	5.7996	0.00030473804170	0.00108650418401
ING5	-0.2526	5.2014	0.00030494518067	0.00108681600695
MED18	-0.3390	3.6708	0.00030565219212	0.00108889024152
BAHD1	0.3876	5.5324	0.00030576699878	0.00108889024152
FN3K	-0.5630	4.1667	0.00030787476303	0.00109596657118
INTS8	0.2861	5.3899	0.00030873887105	0.00109861194672
FKBPL	0.4988	4.0773	0.00031048309511	0.00110340618627
PPP1R16A	0.3621	7.2593	0.00031064313262	0.00110340618627
H4C14	0.4007	4.5386	0.00031065826718	0.00110340618627
H4C15	0.4007	4.5386	0.00031065826718	0.00110340618627
LTA4H	0.1946	7.2555	0.00031069371416	0.00110340618627
CCDC88C	-0.3778	4.8457	0.00031143353586	0.00110560122720
WDR73	-0.2594	5.6360	0.00031425893325	0.00111519553454
TMEM165	0.5045	5.1022	0.00031517748260	0.00111801824980
UTP3	0.2185	5.7461	0.00031816086653	0.00112816041739
C8orf82	-0.3274	6.7646	0.00031846519092	0.00112879875049
DDB1	0.2074	8.2160	0.00032036249779	0.00113508070327
TBK1	0.3957	4.6796	0.00032050167643	0.00113513093746
GOLGA1	-0.3751	5.4160	0.00032212963710	0.00114045194328
NBL1	-0.4444	4.7909	0.00032228130833	0.00114054425602
PNKD	-0.2819	7.4095	0.00032251920935	0.00114094154271
ALKBH6	0.4456	5.1373	0.00032272405553	0.00114122163095
TRPV1	0.3325	3.8207	0.00032359090778	0.00114384158565
RIC8A	0.1735	6.7994	0.00032750751185	0.00115723568683
SPTLC3	-0.3414	9.6471	0.00032775173035	0.00115764817708
HDHD3	0.4102	5.9981	0.00032906582401	0.00116183777130
SLC22A18	-0.4464	5.7420	0.00032924137820	0.00116200581244
WNT6	-0.5244	4.9171	0.00032945954875	0.00116232407233
DNAJC30	-0.3699	5.5353	0.00032972466123	0.00116280763055
GSTO2	-0.2748	5.5207	0.00033109086592	0.00116684215152
PRMT9	0.5552	3.5462	0.00033112567167	0.00116684215152

ZNF436	0.4925	3.9206	0.00033148208726	0.00116764500947
BANF1	-0.4091	8.1977	0.00033258292116	0.00117106844013
MAP3K9	0.3632	5.3802	0.00033344244729	0.00117363986972
RHOBTB2	-0.2821	5.6699	0.00033543461693	0.00117990440971
SLC37A1	-0.2312	5.8174	0.00033548212596	0.00117990440971
PVT1	-0.3560	6.1410	0.00033623144524	0.00118208197995
GNL1	0.3071	7.6644	0.00033735138599	0.00118556034683
STX6	0.2900	5.8321	0.00033757876360	0.00118590048444
TMEM181	0.4872	3.5213	0.00033946745629	0.00119207423454
CDKN1B	0.4821	5.5482	0.00034036051804	0.00119474830471
MEST	-0.3383	5.4298	0.00034148514568	0.00119809135917
KDM3A	0.4693	5.1654	0.00034157675684	0.00119809135917
PIGZ	-0.3794	4.2441	0.00034181092073	0.00119844979583
FILIP1L	0.5544	3.2801	0.00034227287021	0.00119960630427
DUSP14	-0.2456	4.4787	0.00034264306259	0.00120008370681
PACSIN3	0.3837	7.0886	0.00034267338969	0.00120008370681
LRCH1	0.5397	3.3746	0.00034280985101	0.00120009878836
DNAJB6	0.2395	6.4600	0.00034334789594	0.00120115037271
ATG4A	0.3742	3.5311	0.00034337477894	0.00120115037271
COA6	-0.4256	3.2756	0.00034820348709	0.00121757253224
CLN8	-0.3589	4.3864	0.00034929105932	0.00122090535399
ADPRS	-0.4083	4.9504	0.00034980008525	0.00122215868034
TMEM101	-0.3944	5.5688	0.00034991879406	0.00122215868034
THEM6	-0.2661	7.3439	0.00035257276287	0.00123095473265
APIP	-0.3585	4.0219	0.00035382047862	0.00123483311656
VPS26A	0.3348	5.0538	0.00035395557784	0.00123483311656
LSS	0.1772	8.1276	0.00035419328363	0.00123518786813
GLO1	0.2265	6.3028	0.00035458798420	0.00123608962938
LOC729218	-0.3650	4.0873	0.00035524917427	0.00123750237874
MCM4	-0.3496	6.8787	0.00035526579687	0.00123750237874
ACY1	-0.3221	5.9120	0.00035805049605	0.00124672413903
DENND4A	0.4782	3.7408	0.00035926005974	0.00124975771254
SLC24A1	-0.4951	4.0816	0.00035927661839	0.00124975771254
RWDD2A	0.3129	4.0352	0.00035933458732	0.00124975771254
BICDL2	0.3454	6.3888	0.00035957195552	0.00125010449009
NFIA	0.3823	3.8996	0.00036051125161	0.00125253887638
FOCAD	-0.2862	4.2954	0.00036054802586	0.00125253887638
SGSH	-0.2394	6.0794	0.00036097814067	0.00125355353554
TUBG1	0.2115	7.0336	0.00036248686462	0.00125831162754
RLF	0.5981	3.6281	0.00036298165518	0.00125954773050
ASF1A	0.4282	3.8153	0.00036327386454	0.00125998976900

PIK3C3	0.3755	3.9154	0.00036347396806	0.00125998976900
FAM53C	0.3753	5.1626	0.00036352529400	0.00125998976900
FAM149B1	-0.3432	3.5965	0.00036370841382	0.00126014349710
LDOC1	-0.2612	7.7345	0.00036487776369	0.00126371280400
MBD2	0.2139	5.7684	0.00036550972152	0.00126541890245
EPB41L2	0.6227	3.9903	0.00036566402617	0.00126547066374
SAFB	-0.2444	7.2779	0.00036683355480	0.00126883143586
EIPR1	-0.2621	5.6638	0.00036691458546	0.00126883143586
SRD5A1	0.3530	4.8618	0.00036754963631	0.00127054367998
HECTD3	0.2498	5.9290	0.00036861062553	0.00127372644232
DGKE	0.3855	3.8265	0.00036932208810	0.00127569946065
VPS28	-0.4804	7.2453	0.00037012627947	0.00127799115737
C17orf49	-0.4549	6.5780	0.00037128023844	0.00128148834864
STX5	0.3061	6.2246	0.00037198821475	0.00128344414064
SPTSSB	-0.2674	9.6658	0.00037262464359	0.00128515168569
VAPA	-0.2757	6.2764	0.00037358740347	0.00128798299578
EEF1AKNMT	-0.1902	6.3168	0.00037472919390	0.00129142914984
ST13	0.2014	7.5525	0.00037542387264	0.00129333239279
NOL3	-0.2999	5.6653	0.00037669194270	0.00129720877194
RNPEPL1	-0.4231	5.8943	0.00037780583180	0.00130044851067
TDRD3	-0.4453	3.6337	0.00037791913001	0.00130044851067
S100A16	-0.4033	9.6324	0.00038378708113	0.00132014033477
PPM1L	0.5101	3.9514	0.00038419590162	0.00132104618805
RNFT1	0.5484	4.0618	0.00038779400613	0.00133291346314
STARD7	0.2355	7.1485	0.00039017068644	0.00134057510538
TSC22D3	0.2482	6.8789	0.00039110711502	0.00134328430843
SELENOI	0.3712	5.2199	0.00039194708730	0.00134566030238
ZYX	-0.3188	7.6247	0.00039288946766	0.00134838596215
H2AW	-0.3105	4.5272	0.00039326364483	0.00134916024129
ETV5	0.3171	4.0114	0.00039415137415	0.00135169510147
PHTF1	0.3677	5.1397	0.00039488294502	0.00135369272319
RAB3IP	0.2815	4.5181	0.00039765383772	0.00136267716994
ARHGDIG	-0.6072	5.0186	0.00039845095899	0.00136489368487
SUPT6H	0.1859	7.9260	0.00039962126664	0.00136838639606
LXN	-0.2244	6.2383	0.00040003785287	0.00136929654803
GNPDA1	-0.2342	5.5655	0.00040200753051	0.00137552011477
WASHC3	0.2916	5.9270	0.00040235234928	0.00137618142516
DNMT1	-0.4045	6.6395	0.00040324467454	0.00137871419033
RNF208	-0.5086	6.2001	0.00040362851335	0.00137950716212
ZNF398	0.2577	5.2169	0.00040551323239	0.00138542726237
COTL1	0.3049	5.9407	0.00040685605694	0.00138949223508

TBC1D20	0.2345	5.0667	0.00040926160456	0.00139684834368
NBPF9	0.3820	7.3940	0.00040931763490	0.00139684834368
TYW1	0.3962	4.3439	0.00040954388456	0.00139709542287
HIGD1A	0.3580	3.9934	0.00041147106684	0.00140314260532
FAM199X	0.6639	4.1255	0.00041182392566	0.00140381871956
CREBL2	0.3447	5.1274	0.00041353726815	0.00140895011567
FKBP5	0.4732	4.0702	0.00041363957806	0.00140895011567
CUL1	-0.2042	6.0920	0.00041467113834	0.00141118396604
DAZAP1	-0.2296	7.2547	0.00041470216824	0.00141118396604
MIR600HG	0.4282	3.9084	0.00041476159072	0.00141118396604
NALT1	-0.5304	3.2802	0.00041619383757	0.00141493116112
ADSL	-0.2381	5.7844	0.00041624844127	0.00141493116112
ZW10	0.5210	3.6855	0.00041633036698	0.00141493116112
YPEL5	0.2815	6.1406	0.00041796176461	0.00141994417675
KMT2E-AS1	-0.5207	4.4048	0.00041812827520	0.00141997863393
SLC7A5	-0.2142	10.1138	0.00042005385025	0.00142593224320
ZFP41	0.2477	5.1025	0.00042019542812	0.00142593224320
DNAJC10	0.3877	5.1942	0.00042129491469	0.00142912929410
PPP1R12C	0.3351	7.1511	0.00042189826049	0.00143064156216
H2BC12	-0.2559	6.8058	0.00042232142465	0.00143154193999
PGLS	-0.5107	6.5785	0.00042552083713	0.00144184877685
UNC5A	0.3639	4.0619	0.00042684556375	0.00144579804716
CEP170B	0.2569	8.4313	0.00042751186001	0.00144751498911
ERVK13-1	0.3481	4.5696	0.00042870247519	0.00145100528408
TCP1	0.1982	7.1682	0.00042926470466	0.00145236690872
SAP30L	0.2461	5.5055	0.00042979917466	0.00145363363319
BUD13	-0.3084	4.0994	0.00043357468578	0.00146576154065
CNOT10	0.2350	4.9471	0.00043370788016	0.00146576154065
TWF2	0.3686	6.1146	0.00043451723068	0.00146795051035
UXT	-0.4415	5.1397	0.00043481136646	0.00146839792443
AP4E1	0.3568	4.7646	0.00043498414413	0.00146843532078
MFSD6	-0.4960	3.6786	0.00043593822525	0.00147110926180
VGLL4	0.1895	6.4050	0.00043693796096	0.00147393522416
ITPKB	-0.2505	3.9833	0.00043830001615	0.00147798085653
HLA-B	0.5990	3.4282	0.00044065923299	0.00148538474193
STIP1	0.1983	7.7331	0.00044206585744	0.00148957330295
RAB5B	0.2100	7.2040	0.00044231387819	0.00148985620470
ATP6V1C1	0.2775	6.2677	0.00044248220146	0.00148987054932
TVP23C-CDRT4	4.1598	2.9075	0.00044376655713	0.00149364125474
SLC12A9	0.2183	7.5625	0.00044552437344	0.00149900216199
DHODH	-0.3511	4.5626	0.00044589781423	0.00149970298188

CREG1	-0.2893	5.5365	0.00044670914606	0.00150187551105
APOE	0.4672	5.7297	0.00044957540238	0.00151092957706
GOPC	0.6075	3.7497	0.00044973490219	0.00151092957706
TBC1D14	0.3340	6.4991	0.00045159110821	0.00151660460566
SOCS3	-0.3937	4.1474	0.00045236339587	0.00151863659810
XBP1	-0.2890	9.8201	0.00045429769411	0.00152456665196
CYSTM1	0.2734	5.4029	0.00045648178999	0.00153113957895
PAGR1	-0.2640	6.9735	0.00045659354474	0.00153113957895
ARL6IP1	0.4375	7.0331	0.00045771287238	0.00153432653897
SRSF4	-0.2379	5.5370	0.00045894936548	0.00153769397199
MR1	0.3019	4.2990	0.00045905609052	0.00153769397199
GNA11	0.1986	6.2503	0.00046474352957	0.00155617108851
UCP2	0.3437	7.8979	0.00046779972021	0.00156582722418
THOC1	-0.3847	4.3898	0.00046897805007	0.00156919295235
BAG3	-0.3406	8.4005	0.00047014031895	0.00157250248116
BRIX1	-0.2421	4.4102	0.00047122202269	0.00157550074654
ASH2L	-0.5065	4.3882	0.00047138371637	0.00157550074654
OSER1-DT	0.3642	3.8676	0.00047176202652	0.00157618504886
POLR3A	0.2664	5.0572	0.00047249807722	0.00157806364078
EIF5B	0.5369	8.2809	0.00047291024707	0.00157836242013
TIMM9	0.2766	5.6845	0.00047293515529	0.00157836242013
TMEM14C	0.2225	6.3489	0.00048003827981	0.00160147965429
GGA3	-0.2754	5.5478	0.00048165823192	0.00160629394201
TXN2	-0.3515	7.4896	0.00048220978413	0.00160754296979
POLR2C	-0.1992	5.7825	0.00048293826362	0.00160884966047
CBX5	-0.2165	6.4836	0.00048295608132	0.00160884966047
NUP188	-0.2146	6.4019	0.00048455485676	0.00161315921055
MGST3	0.2469	5.6862	0.00048468515371	0.00161315921055
CAPN2	-0.3166	5.1016	0.00048478267653	0.00161315921055
ZKSCAN1	0.3429	7.2670	0.00048559708877	0.00161470278293
TSSC4	-0.4899	5.5810	0.00048560216938	0.00161470278293
RECQL5	-0.2558	6.2118	0.00048673733155	0.00161788495895
FTSJ1	-0.2598	4.4741	0.00048831147510	0.00162252341947
FBXW5	-0.3412	7.9522	0.00048864566921	0.00162303998614
MYBBP1A	-0.1902	6.7138	0.00048898913184	0.00162358694927
INPP5B	0.2999	3.9344	0.00049019791802	0.00162700558975
TICAM1	0.3728	3.7023	0.00049071136870	0.00162811470191
CYREN	-0.2207	5.2627	0.00049132313606	0.00162954908639
DLG3	0.2047	6.0059	0.00049350530298	0.00163618899466
WBP1	-0.4158	7.2952	0.00049425607275	0.00163808007177
SRP68	-0.1913	6.5647	0.00049537192160	0.00164117928494

TROAP	-0.3219	6.2272	0.00049594453450	0.00164247713997
NIPA2	0.4509	4.3785	0.00049683091470	0.00164481280947
ZNF451	0.4917	3.8314	0.00049720048996	0.00164491524623
D2HGDH	-0.3286	5.0701	0.00049722413290	0.00164491524623
NUP214	-0.2644	6.2998	0.00049754619135	0.00164538126861
ARL8A	0.2538	6.3085	0.00049866883943	0.00164849353145
ANKLE2	0.2588	6.1997	0.00049901785034	0.00164851438992
CRACDL	-0.3063	3.4695	0.00049903821803	0.00164851438992
LINC00205	0.5111	5.2079	0.00050073744983	0.00165352610252
TOP3B	0.2210	5.0076	0.00050297343709	0.00166030599135
CPSF3	0.2167	6.4943	0.00050350760661	0.00166146532546
DECR2	-0.3827	4.9286	0.00050603976960	0.00166921436531
CWC27	-0.2883	4.5132	0.00050628550942	0.00166941855885
TPST2	0.5927	3.2064	0.00050712441888	0.00167157780323
NFIC	-0.2705	6.4101	0.00050880288741	0.00167650182168
TRIB3	-0.2259	6.8963	0.00051406003410	0.00169320970969
FAM3C	-0.5513	3.3638	0.00051558934150	0.00169719631488
LOC284454	0.4006	3.8824	0.00051564416174	0.00169719631488
UQCC3	-0.5454	5.4803	0.00051696861588	0.00170093913073
ANKRD34A	0.2731	4.9509	0.00051911000488	0.00170736615512
TLCD3A	-0.3385	3.9702	0.00051932999018	0.00170747126751
DPH2	-0.2102	4.9364	0.00052026503289	0.00170992644361
MMP24OS	-0.3796	5.4636	0.00052054471387	0.00171022668114
DHPS	-0.3182	5.9587	0.00052243854156	0.00171582799129
CCT5	-0.1528	7.8863	0.00052413586849	0.00172078012357
TMEM214	-0.1820	6.9607	0.00052549624977	0.00172400849733
CHCHD5	-0.5281	5.7912	0.00052549890107	0.00172400849733
ZNF786	-0.3350	4.4647	0.00052613842109	0.00172548320763
TSNARE1	-0.2433	4.4755	0.00053006579825	0.00173773556460
TIMM50	-0.2667	5.9970	0.00053135849826	0.00174134482956
DNAJB11	0.2777	6.3060	0.00053355213323	0.00174790292995
PRPF18	0.2653	4.6503	0.00053478023570	0.00175129438169
DIAPH1	0.2957	7.2886	0.00053564579743	0.00175349657046
GRAMD2B	0.3827	4.5566	0.00053647600628	0.00175558148218
BACE2	0.1800	5.5393	0.00053683258147	0.00175611551597
ZNF768	-0.2928	7.0140	0.00053827058653	0.00176018552261
NPC2	0.2890	6.9957	0.00053951107225	0.00176360692841
HERPUD1	-0.2824	5.4797	0.00054098847178	0.00176780004038
USP32	0.3311	8.3465	0.00054260681942	0.00177209978410
UBAP1	-0.2568	5.2730	0.00054272421893	0.00177209978410
PIGX	0.2985	4.6157	0.00054288972573	0.00177209978410

SLF2	-0.4296	4.0834	0.00054437737094	0.00177631724956
RBM33	-0.2696	5.5178	0.00054534186143	0.00177882523119
STAU1	0.3863	7.1674	0.00054742690100	0.00178403074723
SLC2A4RG	-0.3184	8.0236	0.00054744840787	0.00178403074723
RBM3	-0.1927	7.9313	0.00054752711073	0.00178403074723
ZSWIM8	0.2485	6.7920	0.00054922057845	0.00178890676935
HK1	0.1574	8.1884	0.00055009096253	0.00179109932976
TMPRSS13	-0.2679	4.8620	0.00055535048066	0.00180757624188
IFT57	0.2796	5.8587	0.00055694969394	0.00181213191354
SMYD4	0.3284	3.8400	0.00056350040938	0.00183278911806
CELF5	0.4018	4.2458	0.00056461586483	0.00183575963784
HMGN4	0.3725	4.8739	0.00056661588959	0.00184160303986
TTLL1	-0.3281	3.9299	0.00056918982746	0.00184930691348
UBE3B	-0.2172	6.1975	0.00057134659818	0.00185565037842
ADIPOR2	-0.1982	8.9365	0.00057156639259	0.00185570054027
MED24	-0.2424	5.6345	0.00057484275352	0.00186567085230
UBE2A	0.2438	5.8585	0.00057604815853	0.00186891508668
CTU1	-0.5422	3.6669	0.00057875409685	0.00187646941464
EML4	0.4933	5.5374	0.00057878987230	0.00187646941464
FAXDC2	0.3018	3.5953	0.00058145924509	0.00188434705963
TAFA5	-0.2712	4.6774	0.00058163471073	0.00188434705963
DCAF5	0.3465	6.8178	0.00058243960213	0.00188628174998
CCDC84	0.4368	5.5553	0.00058719706580	0.00190101124939
PACSIN1	0.4224	4.3117	0.00058843317682	0.00190433416917
SLC1A5	0.1727	8.4622	0.00059218072599	0.00191577954139
ZNF524	-0.4588	5.5848	0.00059432064193	0.00192201771700
ABHD12	-0.2786	7.0928	0.00059455707096	0.00192209781466
ABHD14B	-0.3185	6.6376	0.00059546100608	0.00192433501646
LOC105372480	-0.4968	3.3751	0.00059750792210	0.00193026305250
RPL17-C18orf32	0.3316	3.6821	0.00059925508450	0.00193521885574
RWDD4	0.3902	3.9095	0.00060312601769	0.00194702714776
CFAP298	0.2765	6.0684	0.00060519607165	0.00195301546789
RNF216P1	-0.2688	4.1045	0.00060665305414	0.00195702180626
PYCARD	-0.4065	6.7625	0.00060791747529	0.00196040432994
PEX13	0.4018	3.6544	0.00061160836058	0.00197160650422
POLR2J4	0.4950	3.6269	0.00061220125930	0.00197281747188
LOC100505938	-0.5557	3.4833	0.00061293925094	0.00197449497616
ADNP	-0.4160	6.5559	0.00061342901174	0.00197537193461
MAK16	-0.3579	3.4977	0.00061478805009	0.00197873220435
FJX1	-0.3771	4.0392	0.00061490830092	0.00197873220435
MYG1	-0.3646	5.5067	0.00061663693544	0.00198359192729

LOC101930085	0.4017	4.2692	0.00061732571514	0.00198510439773
VPS4A	-0.2757	6.7674	0.00061755453086	0.00198513723709
ZMPSTE24	0.4524	3.6359	0.00061850330553	0.00198748355183
HOXC11	-0.3747	3.2777	0.00062155697083	0.00199658961871
DYRK2	0.4106	3.7738	0.00062235627078	0.00199845024574
TXNDC9	-0.3763	3.6550	0.00062728542719	0.00201334658239
DCLRE1C	0.2747	4.2354	0.00062752074431	0.00201334658239
ENDOV	-0.4125	5.5286	0.00062766040907	0.00201334658239
RMI2	0.2870	5.1745	0.00062889389462	0.00201659090997
ZNF189	0.5692	3.3633	0.00062974174952	0.00201778416176
FLJ20021	-0.6082	4.1682	0.00062992597145	0.00201778416176
SPHK2	-0.2536	4.0752	0.00062993261740	0.00201778416176
ETF1	0.2443	6.9548	0.00063160649871	0.00202243251578
RMDN1	-0.2048	6.7143	0.00063224778606	0.00202365143420
DOHH	-0.4067	4.1463	0.00063243285654	0.00202365143420
VARS1	-0.2064	6.8430	0.00063277079450	0.00202401957901
PTPN13	0.6890	4.7493	0.00063543827262	0.00203183625128
PTK6	-0.2257	5.7822	0.00063603685860	0.00203303439386
PRMT7	-0.3069	5.3183	0.00063638698500	0.00203343779407
BBS2	-0.2632	4.8167	0.00063903996207	0.00204119658654
TBC1D10B	0.2792	7.1172	0.00064031418826	0.00204454751884
NFATC3	0.2066	5.7877	0.00064444262797	0.00205700650424
HPS4	-0.2653	4.6234	0.00064470018703	0.00205710555110
IDH3G	-0.3046	8.3817	0.00064579190169	0.00205986521223
LOC143666	0.3392	3.3111	0.00064761630482	0.00206495915171
ARRDC2	-0.2413	5.3686	0.00064825988766	0.00206576984951
IFT74	0.4440	3.4120	0.00064832552264	0.00206576984951
BICD2	0.4795	5.2037	0.00064999121914	0.00207035084567
STK4	0.4260	4.2381	0.00065125635854	0.00207365322296
NUDT4	0.3160	5.2375	0.00065279160049	0.00207781301230
UACA	0.3449	5.2269	0.00065405259793	0.00208109728163
DNAJC21	0.2204	5.5831	0.00065591344331	0.00208579807955
ARRDC1	-0.2840	8.2915	0.00065598935307	0.00208579807955
RIDA	0.2534	4.6229	0.00065801531454	0.00209150755034
FOXO1	-0.5466	3.9542	0.00065945410397	0.00209534734715
FZD4	0.3215	3.8311	0.00066055333660	0.00209810592853
BOD1	-0.1814	6.2931	0.00066443208854	0.00210968804057
TSTD2	-0.4083	4.4194	0.00066535591043	0.00211188291598
RECQL4	0.3076	6.8236	0.00066741796807	0.00211768782949
LY6E	-0.4303	9.9826	0.00066795149307	0.00211864041516
FHDC1	0.5708	3.5624	0.00066818567307	0.00211864319034

GGT6	-0.3167	4.6020	0.00066846863818	0.00211880059452
NT5C2	0.3387	6.3105	0.00066945444817	0.00212118487222
CA11	0.6094	3.9141	0.00067112505948	0.00212573654173
SDF2	0.2828	5.8454	0.00067245101799	0.00212919375676
LOC646762	-0.3388	3.7362	0.00067329875705	0.00213113489465
TEX264	-0.4027	5.9024	0.00067432265575	0.00213363206860
LINC00339	0.2789	3.3580	0.00067498319279	0.00213441442232
MTIF2	-0.3373	5.3730	0.00067503999790	0.00213441442232
ITGB6	-0.5666	3.6373	0.00067646033248	0.00213816090473
C1orf122	-0.4494	6.2872	0.00067743817735	0.00214050664180
LINC00869	-0.2924	5.6923	0.00067802832929	0.00214162617679
ACTR1A	0.2059	7.0696	0.00067860562435	0.00214270433751
GGA2	0.1788	6.6759	0.00068206134375	0.00215269505926
TMEM229B	-0.2251	5.1680	0.00068224384766	0.00215269505926
FRG1	0.2981	4.7911	0.00068621333882	0.00216446798535
MFSD10	-0.3390	7.0785	0.00068695546564	0.00216541967120
CYHR1	0.3784	6.8181	0.00068699196924	0.00216541967120
IFITM10	-0.4207	5.9756	0.00069291349832	0.00218332667532
FAM98B	-0.4036	3.5379	0.00069352046903	0.00218448122763
HSP90AA1	0.2068	10.0592	0.00069891342388	0.00220070485515
PSMD12	0.2656	5.9089	0.00069967503547	0.00220233934041
TSPAN9	-0.2198	5.7959	0.00070073214603	0.00220490250108
CISD2	-0.3561	4.3255	0.00070166830442	0.00220708343346
TMX4	-0.4722	3.8692	0.00070263347653	0.00220935408600
ST7L	0.3264	3.5646	0.00070408794156	0.00221261877908
OTULINL	0.3452	3.5330	0.00070415904323	0.00221261877908
RBX1	-0.3672	5.0707	0.00070524440845	0.00221526270258
PRIM1	0.3250	3.9052	0.00070575385841	0.00221577899061
ARHGAP27	-0.3036	5.4314	0.00070589677567	0.00221577899061
DBNDD2	-0.2546	5.3622	0.00070738915271	0.00221969623211
ARL16	0.3452	4.8000	0.00070791050859	0.00222056488031
MBTD1	0.5146	4.4593	0.00071038446028	0.00222755569192
ZDHHC9	0.1963	5.6318	0.00071077212999	0.00222800197185
AVPI1	0.2600	5.6831	0.00071306590913	0.00223442081462
MACF1	0.4797	5.0462	0.00071394018620	0.00223638869640
LARS2	-0.3722	3.4060	0.00071499140289	0.00223890928609
TPX2	0.1746	6.9785	0.00071538109924	0.00223935738098
ACTR8	-0.2831	4.2400	0.00071677805447	0.00224295710292
PHPT1	-0.4922	7.2210	0.00071730639874	0.00224383720528
DDX27	-0.2369	7.2316	0.00071959569150	0.00225022330388
NT5C3A	0.4572	4.1204	0.00071984613206	0.00225023157496

CLU	-0.2978	8.4572	0.00072019700888	0.00225055369500
TIMM44	-0.2674	5.2673	0.00072397898212	0.00226158224186
SBDS	0.3374	5.7336	0.00072422433205	0.00226158224186
CRACR2B	-0.3962	7.2036	0.00072764645961	0.00227148762452
B4GALNT4	0.3161	6.4278	0.00072819660975	0.00227242385333
COMMD3-BMI1	-0.6110	3.6496	0.00072865023471	0.00227305832407
CCNB2	-0.2980	5.2377	0.00072978861590	0.00227582775447
PFAS	-0.3910	4.6085	0.00073025142579	0.00227648925423
TOR3A	-0.2079	6.3291	0.00073058157965	0.00227673689937
TBC1D22A	-0.2372	5.3728	0.00073124595629	0.00227802556744
MRPS35	-0.1971	5.2440	0.00073171305690	0.00227869899509
ALG8	-0.2959	4.5677	0.00073714586055	0.00229483083978
SLC35A1	0.1885	5.9581	0.00074170890815	0.00230824489203
PARP9	-0.4027	3.4764	0.00074521476527	0.00231831752611
TAF9B	-0.3295	4.0430	0.00074545613658	0.00231831752611
WDR46	0.3808	7.0562	0.00074749025415	0.00232384765420
MCRIP1	-0.5136	6.9134	0.00074834500689	0.00232570876372
MTCH1	0.2003	7.9424	0.00075009495157	0.00233034972809
AP4M1	-0.2812	5.3698	0.00075553157892	0.00234643716421
LRRC37A3	-0.2705	5.0496	0.00075943483693	0.00235775307835
SNX1	0.2272	6.7852	0.00076259869851	0.00236676650076
GTPBP3	0.3357	4.8042	0.00076375770836	0.00236955372381
GNS	0.3381	6.6739	0.00076423519999	0.00237022535899
ATP13A1	-0.2062	6.8474	0.00076606114801	0.00237507725677
SNRNP35	-0.5057	4.8176	0.00076662486545	0.00237601378949
MATK	-0.3186	4.9575	0.00076696175819	0.00237624692121
PAK4	-0.2128	6.9997	0.00076793519597	0.00237845140336
TPM4	-0.2078	8.5561	0.00077271629485	0.00239244346182
ILF2	0.1952	8.4685	0.00077526840014	0.00239952704214
GPR173	0.4892	3.5082	0.00077648772740	0.00240248213034
ARPC2	0.1712	8.2857	0.00077678989358	0.00240259844127
RIMKLB	0.3366	4.3124	0.00078193845562	0.00241769939239
RAB3GAP1	-0.3212	5.3184	0.00079021346075	0.00244220868537
KRTCAP3	-0.4237	3.9528	0.00079040318536	0.00244220868537
LOC100131257	0.4737	3.4978	0.00079457557905	0.00245426558956
DHCR24	0.1649	7.9826	0.00079665674462	0.00245980451576
DNASE2	0.2227	6.3882	0.00079691056991	0.00245980451576
SAP130	0.3313	5.7200	0.00079719977966	0.00245986109380
PES1	-0.3084	6.5782	0.00079840228263	0.00246207349555
METTL6	-0.2454	4.4350	0.00079845902923	0.00246207349555
ABI2	0.2145	5.8384	0.00080083773673	0.00246857009071

PHF10	0.2177	4.9984	0.00080259913061	0.00247316006281
EPN2	0.2673	4.8620	0.00080309187750	0.00247383898901
SYS1	-0.2984	4.3236	0.00080350068743	0.00247425898358
ARF3	0.1728	8.0965	0.00080632533952	0.00248151665554
EFL1	0.2324	4.8775	0.00080640410202	0.00248151665554
ZWILCH	0.4471	3.7181	0.00081057354344	0.00249350215041
SLC25A25-AS1	0.5004	3.5724	0.00081383185581	0.00250267764397
CALM3	0.2055	7.8347	0.00081443847528	0.00250369525864
KIAA1191	0.2994	6.6485	0.00081719036186	0.00251130479730
SLC7A6	0.3292	5.0554	0.00081763324443	0.00251181579589
KNTC1	0.4257	4.2111	0.00082166113690	0.00252333607851
POLR2A	-0.2293	8.1129	0.00082684501484	0.00253839742384
SYNJ2BP	0.2880	5.0882	0.00082878122411	0.00254312979990
ZNF609	0.4105	5.3921	0.00082894661466	0.00254312979990
CCDC159	-0.4703	3.9697	0.00083635657833	0.00256499631470
MANEAL	-0.1980	5.2651	0.00083680275891	0.00256549826254
LTV1	-0.2199	5.0508	0.00083857238569	0.00257005596844
DMAC1	-0.3269	5.5601	0.00083992225467	0.00257332455959
TCEAL3	0.3003	7.3616	0.00084192501013	0.00257859056221
SF3A2	-0.3268	7.0643	0.00084701168113	0.00259315042395
SUZ12P1	0.4609	3.3844	0.00084725000637	0.00259315042395
LRRC1	0.3404	5.0999	0.00084902750875	0.00259771523146
OSGIN2	0.3569	4.9984	0.00085504098176	0.00261523312744
MPV17L2	0.2856	5.1245	0.00085772154143	0.00262254859184
BAIAP3	0.2911	5.5687	0.00085814484249	0.00262295971548
PRRT3	0.2387	6.6094	0.00085951091553	0.00262625121937
USP14	0.3570	5.6272	0.00086312841340	0.00263641746454
RPS6KA4	-0.2049	6.3743	0.00086490107169	0.00264094372294
SMC6	0.4165	4.4485	0.00086579079741	0.00264277184244
IFT52	0.2413	5.0249	0.00086638330228	0.00264369179033
AATF	-0.2533	5.9266	0.00087108497246	0.00265714566171
ODC1	-0.2077	6.6317	0.00087352497172	0.00266369384426
C8orf33	-0.1603	6.5980	0.00087488030135	0.00266693119053
PPP4R3A	-0.3344	6.1791	0.00087561274918	0.00266826824674
ZBTB5	-0.3080	4.0068	0.00087803174718	0.00267474213223
SEMA4C	-0.1962	5.7208	0.00087965614698	0.00267879190835
UTP11	-0.2870	4.6347	0.00088068344599	0.00268102124474
ARFIP2	0.1755	7.0816	0.00088166698951	0.00268311592887
KIZ	-0.3441	3.8035	0.00088292419095	0.00268604173468
KIF22	-0.2300	7.3655	0.00088460461582	0.00269025268461
HOMER2	-0.2271	4.8159	0.00088650830318	0.00269513957188

AMBRA1	0.2309	5.8491	0.00088864231090	0.00270072316778
PPIF	-0.2933	5.8685	0.00088957691099	0.00270211446006
DNAJC8	0.1903	6.5931	0.00088969521370	0.00270211446006
BCLAF3	0.3536	3.4838	0.00089003537281	0.00270224380490
CRELD2	0.2938	5.7778	0.00089290118779	0.00271003866521
FAM98C	-0.3274	5.0456	0.00089425494201	0.00271324060422
MITD1	0.3223	3.6455	0.00089716579581	0.00272116319030
FAM174C	-0.5724	5.7606	0.00090133801099	0.00273277558158
TRIM66	-0.3165	4.8304	0.00090159626059	0.00273277558158
LINC01963	0.4818	3.7063	0.00090664798541	0.00274717062247
PITHD1	0.2388	5.1999	0.00090717070950	0.00274783762942
CMBL	0.2644	5.1935	0.00090806450734	0.00274962780631
SMIM14	0.2397	7.1927	0.00091853421091	0.00278040305644
CRK	0.2480	6.1360	0.00093245618248	0.00282103856822
APLP2	0.2098	8.1124	0.00093257986806	0.00282103856822
LOC108783654	-0.1663	5.7145	0.00093412250389	0.00282404690639
NUDT7	-0.3856	3.3116	0.00093419633375	0.00282404690639
BRD3	0.3403	5.9726	0.00093881017685	0.00283704998868
SNAPC5	-0.3444	4.6065	0.00094410202626	0.00285209264818
TENM3	-0.4995	4.1059	0.00094468184704	0.00285238251209
PDCL	-0.3366	4.2406	0.00094512789379	0.00285238251209
C15orf39	-0.2789	4.6408	0.00094514029059	0.00285238251209
RPL36A-HNRNPH2	0.3021	5.9975	0.00094642986431	0.00285532544776
ERLIN2	-0.4525	4.3513	0.00094731238181	0.00285703877090
ATXN2L	-0.2313	7.6683	0.00095248446944	0.00287168375398
LOC93622	0.1941	6.2187	0.00095419853230	0.00287589673807
WASF1	0.5933	3.8538	0.00096258572554	0.00290021266544
SQLE	0.4494	7.1681	0.00096374224327	0.00290273409988
MAP3K13	0.2683	4.1559	0.00096519681083	0.00290615127294
UBXN6	-0.3217	7.4667	0.00096576827172	0.00290690807939
CDC42EP4	0.2217	5.8142	0.00097133968354	0.00292270896827
PARP14	-0.3096	4.4825	0.00097169726916	0.00292281646280
NR1H3	-0.3785	4.6333	0.00097745553965	0.00293740334052
NPAS2	-0.2592	3.5739	0.00097747412904	0.00293740334052
PGM3	0.3323	4.5302	0.00097751711211	0.00293740334052
MARF1	-0.4120	5.2442	0.00097834850535	0.00293892913567
CMTR1	-0.2357	6.0647	0.00098345483604	0.00295329145703
ZNF280D	-0.3234	3.5809	0.00098792136735	0.00296565152315
YIPF4	0.2324	5.2514	0.00098822393008	0.00296565152315
MCM3AP	-0.1853	6.7941	0.00098972601691	0.00296917805072
ATP6V1E2	-0.3013	3.4217	0.00099018505778	0.00296957414456

OLMALINC	-0.3223	4.4982	0.00099481239679	0.00298246661446
YPEL2	0.5897	4.7538	0.00099822656094	0.00299171465342
USP54	0.3736	4.7366	0.00099990612893	0.00299514741753
FAM86C1	-0.3389	3.8148	0.00100003160114	0.00299514741753
WDR43	-0.3464	5.5488	0.00100084851354	0.00299660578684
ETV6	0.3005	4.2904	0.00100145173787	0.00299742360963
SON	-0.3252	6.9992	0.00100349077287	0.00300253697147
KSR1	0.5114	3.3702	0.00100608923026	0.00300932025692
PARG	0.5176	3.9054	0.00100873831365	0.00301575991150
VPS33A	-0.1693	5.3010	0.00100890635515	0.00301575991150
TDRKH	0.3100	5.8546	0.00101164263125	0.00302294397316
MED10	-0.2739	4.7839	0.00101279940800	0.00302540507371
PLEKHG3	0.1667	5.6390	0.00101447106394	0.00302930792706
DDX55	0.2684	5.1180	0.00101477312125	0.00302930792706
SLC3A2	-0.2100	8.8932	0.00101576475308	0.00303111804975
BEX3	-0.2928	7.5802	0.00101604705907	0.00303111804975
RIPOR3	-0.2980	5.9050	0.00101712588622	0.00303333995821
ARFGAP1	0.3069	7.3252	0.00102020831779	0.00304153372748
PLXNB1	-0.1931	6.3242	0.00102384805958	0.00305138307484
HUWE1	-0.3052	8.1994	0.00102451279644	0.00305236243586
QPCTL	0.2684	4.7818	0.00102927396733	0.00306421486636
E2F1	-0.2604	4.8516	0.00102982512661	0.00306421486636
NQO2	0.3415	5.5584	0.00102983973117	0.00306421486636
PLEKHH3	0.1739	6.3653	0.00103012943946	0.00306421486636
KMT2A	0.3918	6.3478	0.00103017817278	0.00306421486636
SNAP23	0.5095	4.2107	0.00103122870764	0.00306633526327
HMGCS1	0.3785	5.5087	0.00103299436842	0.00307057998680
ABL2	0.2753	4.8082	0.00103338714198	0.00307074235482
KIDINS220	0.5728	5.7740	0.00103799671201	0.00308343086090
BMP8B	0.3686	3.7174	0.00103839814691	0.00308361464096
APBB2	-0.3031	6.4261	0.00104340736940	0.00309747705835
ARPP19	0.2704	6.9198	0.00104409430886	0.00309850340482
ANAPC15	-0.4284	6.2930	0.00104705484455	0.00310627410759
DLGAP4	0.1873	6.7392	0.00105136366089	0.00311803834243
RCCD1	-0.2476	4.3022	0.00106061953427	0.00314446163589
CEP57	0.4620	4.0913	0.00106214600940	0.00314795950109
LAMB1	-0.2668	7.7069	0.00106691043713	0.00316104850883
C1GALT1C1	-0.2731	4.2028	0.00106755388045	0.00316111151871
RMND5A	0.3878	5.2180	0.00106762790749	0.00316111151871
MRPS2	-0.2850	7.0841	0.00106885390702	0.00316371001618
PXDN	-0.3630	6.0851	0.00107049981721	0.00316754931251

NATD1	0.2770	4.9508	0.00107253221901	0.00317252934230
SMARCA5	0.3258	6.3725	0.00107462121439	0.00317694182901
MET	-0.3778	4.5058	0.00107472363162	0.00317694182901
ATP6V0D1	0.2381	7.3922	0.00107617822074	0.00318020645054
TMEM44	-0.3276	4.2822	0.00107697924999	0.00318153824631
FUS	-0.2312	8.3737	0.00107740043931	0.00318174744371
CSRNP2	0.3615	4.3659	0.00107812286152	0.00318284580802
CKB	-0.4548	5.6031	0.00108312447991	0.00319566294608
HSPG2	0.4543	4.6971	0.00108316821364	0.00319566294608
ATP6V0A1	0.2025	6.5789	0.00108651016022	0.00320448157356
NEIL1	0.2740	3.7597	0.00108845900597	0.00320918708871
IRAK4	-0.2372	4.3004	0.00108981647378	0.00321214651035
TRPM4	-0.2013	5.5318	0.00109641649896	0.00323055101462
QTRT1	-0.3035	6.0964	0.00109695942724	0.00323110235444
SLC25A6	-0.2689	9.9040	0.00109823140949	0.00323380007444
OLA1	0.1794	6.4652	0.00110080676311	0.00324033264693
GTF2I	-0.5956	6.5609	0.00110135988170	0.00324091026757
TSPAN4	-0.3019	6.9299	0.00110353191112	0.00324624984933
NR2C2AP	-0.3589	5.1123	0.00111237017190	0.00327118961496
MARCHF5	0.3326	4.8314	0.00111435555605	0.00327596724004
ZFAND2B	-0.4211	5.7700	0.00111666487630	0.00328169376754
ZNF217	0.6554	7.1475	0.00111728704036	0.00328213039997
CBL	0.5797	4.5604	0.00111767873784	0.00328213039997
TRA2B	-0.2545	6.2779	0.00111789773451	0.00328213039997
NFATC1	0.2586	4.5100	0.00111923316549	0.00328498913244
CMC2	0.2774	5.1427	0.00112450316970	0.00329939039872
ATPAF1	-0.1965	5.2888	0.00112553484249	0.00329957877317
IMPDH1	0.2318	7.4502	0.00112555237540	0.00329957877317
PHF2	-0.5954	5.4250	0.00112565742091	0.00329957877317
IK	0.1928	7.7944	0.00113013497795	0.00331163463528
UBR4	0.2960	6.9493	0.00113375063379	0.00332115790499
KLHL25	0.3009	3.6073	0.00113649818862	0.00332813287677
MBIP	-0.3439	3.9919	0.00113740132984	0.00332970389307
TRAPPC2	0.3218	3.5751	0.00114160867058	0.00334087554698
PPCDC	-0.4414	4.2366	0.00114195327583	0.00334087554698
CCZ1	-0.2497	5.1423	0.00114328036515	0.00334368083605
ABT1	-0.2162	5.3027	0.00114598865524	0.00335039275758
MRPL30	0.2536	5.1561	0.00114631321416	0.00335039275758
MYH14	0.1738	8.2857	0.00114826417296	0.00335501510768
ESRP1	0.3315	7.1453	0.00115091139635	0.00336166818598
CRNKL1	-0.1949	5.7109	0.00115366090035	0.00336861563861

ZNF227	0.3290	3.6307	0.00115625881871	0.00337511614681
SFPQ	-0.1997	7.4713	0.00115674393417	0.00337544719351
NDRG1	0.2356	5.9676	0.00115810953672	0.00337834651556
AREG	0.2225	6.5067	0.00115858089425	0.00337863619162
MAP3K2	-0.4835	4.2602	0.00116098394941	0.00338455706087
SLC38A7	0.1910	4.9813	0.00116187869494	0.00338607844312
PLK2	-0.3315	5.2738	0.00116450234275	0.00339263579548
GNG13	-0.4400	3.3059	0.00116667427124	0.00339787333455
TNS2	-0.2178	4.5051	0.00116733732052	0.00339871439810
CYP51A1	0.3953	5.7750	0.00116864670913	0.00340143614283
HNRNPA2B1	0.2043	9.3373	0.00117011519630	0.00340357894420
ACSS3	0.3432	4.6043	0.00117013252547	0.00340357894420
ZBTB25	0.3541	4.0638	0.00117102557521	0.00340508589448
CYB561D2	-0.4135	3.6000	0.00117261374646	0.00340861249410
DMAP1	-0.3860	5.4051	0.00117446064738	0.00341288868443
GPSM2	0.3199	5.5741	0.00117730130193	0.00342004898364
TRAK2	0.3653	5.8344	0.00118473598805	0.00344054605291
SYNGR2	-0.2406	8.7649	0.00118709156939	0.00344628470000
CCDC6	0.2428	6.7019	0.00118798020750	0.00344776230882
EIF2A	-0.1986	6.5411	0.00118854703742	0.00344830531848
MBOAT7	0.1663	7.7002	0.00119019173483	0.00345197417567
MSX2	0.2688	5.4106	0.00119975286061	0.00347777356584
PRR15L	0.2735	4.5696	0.00119985294371	0.00347777356584
ZNF330	-0.1761	4.9604	0.00120294011461	0.00348560918341
COA4	-0.2588	6.2269	0.00120501367277	0.00349050372007
REEP5	-0.1746	7.1367	0.00120580413126	0.00349167962881
DICER1	-0.4823	5.1781	0.00120642600035	0.00349236675461
TSEN34	0.2027	7.5105	0.00121328710143	0.00351110904019
MED12	-0.3336	5.8587	0.00121446152805	0.00351338806507
DENND1A	-0.1942	5.3273	0.00121693296297	0.00351941663590
FARS2	-0.3353	3.3205	0.00122066669022	0.00352909080354
STRBP	0.2988	5.3490	0.00122784950981	0.00354872737065
FER1L4	0.2237	5.6342	0.00123109283241	0.00355696914130
SPTBN1	0.5136	6.3471	0.00123211052155	0.00355874190597
ACER3	0.3332	3.8608	0.00123249017666	0.00355874190597
DERL1	-0.2163	6.6092	0.00123896012274	0.00357628635555
TMEM132A	0.1994	7.1899	0.00124238030408	0.00358501923779
FBXW11	0.4665	5.1716	0.00124674088916	0.00359645934386
POMT1	0.2477	6.5656	0.00124936298953	0.00360287878944
CYC1	-0.2653	7.8957	0.00125068496619	0.00360554608823
KLHL24	0.4328	3.7864	0.00125223589125	0.00360887151014

CLK2	-0.2376	6.0898	0.00125741513500	0.00362196612609
MSRB1	0.2779	6.5882	0.00125757727074	0.00362196612609
DCUN1D2	0.3031	4.1912	0.00125876620981	0.00362382621137
THYN1	0.3515	5.0324	0.00125902121978	0.00362382621137
FADS3	0.2819	5.0618	0.00126053541584	0.00362703488950
ADAT3	-0.5596	4.2197	0.00126655070526	0.00364318877241
USP8	0.4222	6.6184	0.00126744164621	0.00364459708336
ATRAID	-0.2095	7.5924	0.00126894298569	0.00364775918110
URM1	-0.3277	6.8623	0.00127147444377	0.00365387956452
STX1A	0.3142	4.5096	0.00127915191491	0.00367477967076
SCAMP5	0.2420	5.6493	0.00128010189329	0.00367634575995
KDM4A	-0.2154	5.7943	0.00128529926433	0.00369010515947
CDC16	-0.2338	5.4042	0.00128857629289	0.00369834428437
EAPP	-0.2138	5.4964	0.00128936808901	0.00369944758809
KDM5B	0.3383	7.6200	0.00129000340707	0.00369962332767
FAM222B	0.2626	4.6069	0.00129024414478	0.00369962332767
TSPAN13	0.3745	6.1262	0.00129752182689	0.00371931682764
CMC1	-0.2571	4.3061	0.00130107252760	0.00372831796250
KTN1	0.3432	7.3621	0.00130669209005	0.00374324002201
ATG2B	0.5062	5.5661	0.00130737239631	0.00374400779907
CEP250	0.3021	5.5319	0.00130856432956	0.00374623980981
GINS2	0.2989	5.6701	0.00131112445061	0.00375238611282
PHGDH	0.2911	6.5311	0.00131780973124	0.00377033086622
UBE2Z	-0.2120	7.1744	0.00132034622485	0.00377629041738
PARVB	-0.3075	4.3370	0.00132072440982	0.00377629041738
TFF1	-0.4076	10.0009	0.00132141986605	0.00377708964545
NUCKS1	-0.3197	9.1523	0.00132234064141	0.00377853221041
FBP1	-0.2257	9.3178	0.00132490307004	0.00378466334667
SLC39A11	-0.2010	5.3254	0.00132575285854	0.00378589990830
CCDC25	0.2877	5.5452	0.00132668204606	0.00378736235782
SPICE1	0.5222	4.0477	0.00132738619319	0.00378818165317
RAB7A	0.1830	8.4866	0.00132876890974	0.00379093637116
GDF15	-0.2953	6.0234	0.00133318559934	0.00380234247098
RSL24D1	0.1679	6.3149	0.00133531588260	0.00380722245836
RAB40B	0.2647	4.6108	0.00133625389932	0.00380870108592
SQOR	-0.4385	3.6442	0.00135019133005	0.00384721916164
IFT46	0.1907	5.6298	0.00135773048031	0.00386633101373
MED6	-0.1728	4.9298	0.00135775020403	0.00386633101373
TIGD1	0.3408	4.2354	0.00136198712413	0.00387718027405
GBAP1	0.2953	3.7305	0.00136261835934	0.00387776161741
TRIP12	-0.3284	6.1408	0.00136746246524	0.00388911127155

AFTPH	0.3538	4.9257	0.00136746308667	0.00388911127155
CSNK2A2	0.2329	4.6240	0.00137863645356	0.00391966112549
SRPK2	0.5653	5.6753	0.00138054182947	0.00392384987588
TMEM9	0.2422	7.4385	0.00138253374911	0.00392828190729
KSR2	-0.3793	3.6310	0.00138536157552	0.00393508553872
PEX1	0.4245	4.3626	0.00138736496031	0.00393954384134
AHSA2P	-0.2678	5.3212	0.00138839286134	0.00394123025129
BRCC3	0.3943	5.0420	0.00138998670089	0.00394452163461
ZNF277	0.3241	4.4832	0.00139543497656	0.00395874571138
ARIH1	0.3344	5.5894	0.00140436284248	0.00398282916071
CDK4	0.2216	7.9264	0.00140486409991	0.00398300683461
GM2A	0.2014	5.1911	0.00141045764713	0.00399761732009
WDR62	-0.2593	4.7789	0.00141176387471	0.00400007105968
WDR61	0.1764	6.0110	0.00141864588826	0.00401672351006
ABLIM3	0.2437	5.0489	0.00141867217493	0.00401672351006
EXOSC3	-0.2472	4.0536	0.00141896806742	0.00401672351006
CCNC	0.3651	4.7867	0.00142069830843	0.00402036813301
RAB13	0.2922	8.6767	0.00142364484334	0.00402745134654
DERL2	-0.2580	4.7777	0.00143023945344	0.00404484723658
EFNB1	0.3279	4.0403	0.00143525637640	0.00405777184125
GGNBP2	0.2035	5.5090	0.00143578860368	0.00405801316839
TMEM41A	0.2517	4.3594	0.00143830473509	0.00406385976956
ZNF598	0.1708	6.9828	0.00144167598526	0.00407211807842
KIAA0232	0.3658	5.0155	0.00144264436653	0.00407358628498
ERCC3	-0.1718	6.1499	0.00144356975676	0.00407493222293
ELOVL5	0.4996	5.1163	0.00144460676526	0.00407659230432
WDR83OS	-0.3820	7.1527	0.00144624028831	0.00407993415909
PDZD11	-0.2166	5.7736	0.00144904244859	0.00408656971292
TRIP11	-0.3238	5.0547	0.00145353758939	0.00409797418480
NR3C1	-0.4234	5.3135	0.00145833817695	0.00411023245961
ZDHHC24	-0.3112	6.2710	0.00146764298591	0.00413517404749
SLC4A11	-0.3065	3.9932	0.00147299213435	0.00414865350824
CPNE2	-0.2859	3.9533	0.00147334077349	0.00414865350824
COPA	0.3236	7.1052	0.00147404918825	0.00414936164864
MRPS36	-0.3301	4.1727	0.00147799641323	0.00415918358492
WDR18	-0.4008	5.8934	0.00148006252831	0.00416370750297
GRK6	0.1926	6.5921	0.00148147802925	0.00416639888002
NACC2	-0.3137	5.6363	0.00148390146532	0.00417192235498
YWHAB	0.1407	7.9287	0.00148446586998	0.00417221744515
BMERB1	0.2461	4.3525	0.00148785282758	0.00418044292303
NBPF8	0.3611	6.3240	0.00148885870326	0.00418197521938

KIF13B	0.3147	5.1785	0.00149113108882	0.00418706289969
RPP25L	-0.3638	4.9426	0.00150224247708	0.00421695948513
TP53INP2	0.3764	4.3920	0.00150444671787	0.00422184197929
CTNNAL1	0.2625	4.5028	0.00150547050975	0.00422340985450
LOC100134868	0.3060	3.7051	0.00150653302786	0.00422508536937
CBX3	0.2013	6.9593	0.00150913042164	0.00423106309320
TOPBP1	0.4186	5.5840	0.00151558793157	0.00424785617487
PARD3	-0.1803	6.0428	0.00152387482513	0.00426928205383
UBA6	0.4637	3.8621	0.00152433007642	0.00426928205383
NBPF15	0.4103	6.9772	0.00152464284777	0.00426928205383
RNF31	0.1632	6.6515	0.00152539367465	0.00427006780501
WARS1	0.1376	7.0514	0.00152660682566	0.00427046410895
SAMD1	-0.3264	6.8837	0.00152707134926	0.00427046410895
CHPF	0.2548	7.8871	0.00152726826199	0.00427046410895
CACNA1H	0.1878	7.4818	0.00152741630061	0.00427046410895
SLX1A-SULT1A3	0.5090	4.7498	0.00154014453173	0.00430472529782
EIF1	-0.2629	9.2047	0.00154279391401	0.00431080354865
PIGQ	0.2718	7.1437	0.00154349361134	0.00431143201618
ACADSB	0.4093	4.5460	0.00154461823914	0.00431324668809
USP30	0.2744	5.0268	0.00154908114712	0.00432437931049
PLOD3	0.2309	7.2757	0.00155376051277	0.00433560986222
PHKG2	0.3154	7.1945	0.00155405903552	0.00433560986222
CEP89	0.3177	4.0221	0.00155822554172	0.00434589869297
MKNK1	0.2536	5.0554	0.00155942656486	0.00434791299830
BCKDHA	-0.2622	6.7371	0.00156048548302	0.00434858150145
BLVRB	0.3377	7.1328	0.00156102569512	0.00434858150145
HSDL1	0.2266	5.5256	0.00156110292861	0.00434858150145
ACADS	-0.4066	4.9791	0.00156543746884	0.00435926091202
MASTL	0.3086	3.7075	0.00156589682799	0.00435926091202
ZMYND11	-0.4473	5.6716	0.00156845818323	0.00436330095286
ALKBH2	-0.2567	5.9005	0.00156852812464	0.00436330095286
GTF2F2	0.2630	4.3265	0.00156878951779	0.00436330095286
CHD7	0.3420	5.2141	0.00156992244323	0.00436511503581
ARHGEF26	0.3695	4.4216	0.00157094804803	0.00436662969823
BOLA2	-0.5229	4.3724	0.00157223952894	0.00436888224062
TMEM60	0.3422	3.6974	0.00157863887734	0.00438532262011
ZNF83	0.4498	3.9537	0.00158543109815	0.00440276815561
PTTG1IP	0.2002	7.6839	0.00158588862868	0.00440276815561
EMC7	0.1897	4.7371	0.00158677007316	0.00440386889804
ALKBH4	-0.2800	5.5580	0.00158930510714	0.00440955688295
ZNF263	0.2180	6.0017	0.00158994666668	0.00440998951745

TDRD7	0.3390	3.9403	0.00160194343767	0.00444190789541
ARHGAP8	-0.2584	6.7175	0.00160278357414	0.00444288084151
ELP4	-0.3035	3.7639	0.00160639770504	0.00445154029889
DPAGT1	0.1613	5.9449	0.00161033119326	0.00446107918426
N4BP2L2	0.2303	4.9067	0.00161742164417	0.00447935527621
DCAF11	0.1701	7.7323	0.00162466049450	0.00449803108250
RAP2B	0.1932	5.8400	0.00162711228966	0.00450210565847
MAFG	0.2911	5.0891	0.00162761721597	0.00450210565847
SRXN1	0.2255	5.2920	0.00162761952172	0.00450210565847
ILF3	-0.1610	8.1205	0.00163456836651	0.00451994985880
NAE1	-0.2450	4.3515	0.00163574060183	0.00452181443080
FSD1	0.3161	3.6708	0.00164933059010	0.00455799485352
NOL11	-0.2369	5.5728	0.00165130598587	0.00456206560929
AGPAT3	-0.1919	6.3117	0.00165745792369	0.00457766891881
KDM5A	0.3018	5.3192	0.00166566837971	0.00459657008982
VPS13D	0.3665	5.4285	0.00166578779571	0.00459657008982
WRAP73	0.2079	4.7851	0.00166582008211	0.00459657008982
LYPLA2	0.3447	6.5309	0.00166672612122	0.00459767311872
CHP1	0.2492	5.8284	0.00166798431463	0.00459974660224
CDC42EP2	0.4011	4.1019	0.00166933646647	0.00460207785427
L3HYPDH	-0.2570	3.7491	0.00167664182284	0.00462081468687
ATP6V0E1	0.2847	7.4564	0.00169155309302	0.00466049564252
CHST12	0.2236	5.8200	0.00169301373456	0.00466310516335
BAK1	0.1669	6.0286	0.00169539878346	0.00466825844529
TNFRSF21	-0.3533	3.5913	0.00169996008699	0.00467939907546
SIRT3	0.2083	5.1164	0.00170048639881	0.00467942939018
CCZ1P-OR7E38P	-0.4499	3.4990	0.00170194426484	0.00468202237777
WWC3	-0.2710	7.4607	0.00170673853076	0.00469378939971
MAT2B	-0.4211	4.1916	0.00170812263121	0.00469617366454
CSNK1G1	0.3931	4.3591	0.00170915178334	0.00469758091540
TBX2	-0.1661	8.3625	0.00171452019517	0.00471091010359
OAS3	-0.6499	3.6240	0.00172026360371	0.00472526127806
ACTL6A	-0.3102	5.0275	0.00172247260973	0.00472989832748
CCDC107	-0.4058	3.3330	0.00172993896631	0.00474896485885
C11orf52	-0.3898	4.5379	0.00173180953359	0.00475266315338
CERS6	0.3658	5.0715	0.00173390088060	0.00475696492348
RAB9A	0.2367	4.4061	0.00173898762578	0.00476947950157
PAM16	-0.3990	5.0139	0.00174065631772	0.00477261474071
VDAC1	0.1498	7.8261	0.00174359532841	0.00477923005653
NDUFS4	-0.3027	4.9803	0.00174459042880	0.00478051469039
BMF	0.1837	6.3795	0.00174888997194	0.00479085062902

VKORC1L1	0.2266	5.0961	0.00175205159439	0.00479806409188
KAZALD1	-0.2616	5.5803	0.00175952618329	0.00481708087743
ISCA1	-0.2297	4.3539	0.00176468839634	0.00482975748257
ATP5MC2	-0.3114	8.2779	0.00176622264428	0.00483173013844
PGD	-0.1716	7.9234	0.00176647330246	0.00483173013844
PDGFB	-0.3050	5.1247	0.00176784936089	0.00483374055301
NOTCH2NLA	0.2665	4.8737	0.00176827289033	0.00483374055301
SIAE	0.2209	5.0000	0.00176916977542	0.00483473690357
TRAK1	0.2981	5.3913	0.00177268950075	0.00484253028666
NBPF14	0.3451	6.7092	0.00177352121497	0.00484253028666
SNX12	-0.1977	5.8938	0.00177409973735	0.00484253028666
PLEKHM2	-0.1534	6.2733	0.00177415463757	0.00484253028666
ABHD17A	0.3433	6.6741	0.00177958314107	0.00485588777165
NOLC1	-0.2118	6.8428	0.00178099069607	0.00485826870263
MYLK-AS1	0.4120	3.4535	0.00178230627362	0.00486039737861
ACBD4	0.2603	5.3181	0.00178846320157	0.00487572330634
ECH1	-0.2683	8.2227	0.00179370370513	0.00488854242085
CCT7	-0.1969	8.3767	0.00179859801116	0.00490041060287
CHPF2	0.1857	6.6792	0.00180141575639	0.00490560935836
PRKX	0.3488	4.2002	0.00180158652243	0.00490560935836
LEPROT	0.3211	5.0582	0.00180538275074	0.00491360246889
SUGT1	0.2720	4.4414	0.00180560416680	0.00491360246889
RNF130	0.1507	6.9673	0.00180673466518	0.00491515041030
CCDC71L	0.3074	3.4861	0.00180725550270	0.00491515041030
PRR3	-0.2145	4.9928	0.00180913474982	0.00491878822250
MDN1	0.4827	5.0852	0.00181169925039	0.00492428640911
MTHFD1L	-0.1568	5.4848	0.00181540934256	0.00493289414714
SPATA20	-0.1893	8.0871	0.00183201338493	0.00497652215033
CNOT2	-0.2416	5.7227	0.00183390779655	0.00498017843914
ANKS6	-0.1751	6.3050	0.00184043175423	0.00499640082517
GADD45G	-0.4474	4.2667	0.00184284621278	0.00500146038801
DIS3L	-0.2892	4.1734	0.00184702543910	0.00501130505301
UQCC2	-0.4368	5.2203	0.00185000220746	0.00501718646930
HYKK	0.3701	3.5367	0.00185029814841	0.00501718646930
RANBP3	-0.1800	5.8062	0.00185124869299	0.00501826548688
HELZ	0.4325	5.5851	0.00185886935307	0.00503741945545
GFRA1	-0.2442	6.1203	0.00186043851739	0.00504016771374
FEZ1	-0.5174	3.2604	0.00187286085785	0.00507230821657
VAMP1	0.3826	3.9594	0.00187658594035	0.00508088161132
ILK	0.2378	6.6130	0.00189231941438	0.00512195308554
FAM131C	0.4340	3.4086	0.00189860772880	0.00513744242707

SMAD2	-0.2728	5.1376	0.00189937435092	0.00513798584473
KLHDC2	0.1827	6.6897	0.00190243336489	0.00514472822708
ZNF500	0.1924	4.9890	0.00190570036772	0.00515202888932
IQCB1	0.4037	4.5749	0.00190727081724	0.00515473996767
NOP56	-0.2515	6.7868	0.00190896017558	0.00515777070943
LEPROTL1	0.2331	4.2229	0.00191422929882	0.00517046884670
SETMAR	-0.2901	4.0653	0.00191557403689	0.00517107849471
PEX10	-0.1768	5.5975	0.00191559388351	0.00517107849471
EPHA1	0.2166	5.3307	0.00192535922639	0.00519589513667
NCDN	-0.1870	5.4882	0.00192687011700	0.00519842766860
WDR74	-0.3460	6.2883	0.00192905213265	0.00520276876049
MGME1	-0.1979	5.3324	0.00193366442954	0.00521365994201
MRPL50	-0.2473	4.1370	0.00193696865529	0.00522101880639
SPSB3	0.3226	7.0442	0.00193986505597	0.00522727435408
CENPC	0.3954	3.6629	0.00194206108979	0.00523163950055
SIN3A	0.2645	6.4306	0.00194490418797	0.00523774464145
PPP6C	0.1901	5.8272	0.00196155123573	0.00528101001235
DUSP22	-0.2386	4.6537	0.00196326146340	0.00528404782133
SMIM29	0.3044	5.2621	0.00197375288574	0.00531071109790
ZNF121	-0.2825	4.2072	0.00197923258787	0.00532387770451
SLC4A3	-0.2449	3.9620	0.00198068349567	0.00532620279070
SLC16A3	-0.4707	3.3638	0.00198172411386	0.00532734409106
HECA	0.3113	4.2659	0.00198228121173	0.00532734409106
OXR1	0.6464	3.7517	0.00198677950457	0.00533785345591
COMMD7	-0.2453	6.1264	0.00199150428846	0.00534896493448
NIBAN2	0.1387	8.4912	0.00200019851557	0.00537072818448
HTRA2	0.2339	6.1043	0.00200808867057	0.00539032019435
NEK8	-0.2651	5.5586	0.00200930295393	0.00539198585244
BRSK1	0.2639	3.9362	0.00201071942842	0.00539419294814
AKR7A2	-0.2499	6.4053	0.00201476547196	0.00540345104870
TMEM127	0.1637	6.5790	0.00202162729304	0.00542025315858
GART	0.2352	6.1654	0.00202344387362	0.00542352237790
CKMT1B	-0.2668	6.4583	0.00202829725974	0.00543492694474
INHA	-0.3137	5.3271	0.00203927391854	0.00546122369670
TOP3A	0.2451	5.2155	0.00203931390326	0.00546122369670
ACO1	0.3341	4.4476	0.00204419719337	0.00547268712058
SDC3	0.1764	5.2390	0.00204756457400	0.00548008661848
SDHA	0.1437	8.0467	0.00204846961264	0.00548089350393
VPS9D1	-0.2420	5.6886	0.00205206968894	0.00548879824039
HCCS	0.1938	4.8489	0.00205263284048	0.00548879824039
MRPL4	-0.2962	7.4608	0.00205392540027	0.00549063778624

PLAA	0.3345	3.9515	0.00205651064958	0.00549593090312
DHDDS	0.2252	4.7306	0.00205745751812	0.00549684369582
BNIP3	0.1732	5.3931	0.00206851529111	0.00552466114888
C19orf47	0.2626	4.2864	0.00206947794019	0.00552466114888
PPP2R5E	0.2795	5.7633	0.00206996420718	0.00552466114888
ISCU	0.1661	7.1365	0.00207030303817	0.00552466114888
SMAD6	0.2523	4.2998	0.00207516325845	0.00553600398061
RTN4IP1	0.2901	3.6922	0.00208369850508	0.00555714129945
UNKL	-0.2137	5.2564	0.00208768022960	0.00556612570904
RIOK3	0.4005	4.8297	0.00209112802410	0.00557368171025
C12orf75	0.3708	4.1138	0.00209300679792	0.00557572140214
NFU1	-0.3669	4.2482	0.00209312127077	0.00557572140214
ZNF394	0.2331	5.6882	0.00209387727629	0.00557609957360
TMCO6	-0.2381	4.0099	0.00209727908595	0.00558352136602
PTK7	0.1762	5.9035	0.00210708364782	0.00560797966174
MGAT2	0.4516	4.7522	0.00210808823637	0.00560900945633
ORMDL2	0.2575	5.1826	0.00211137459930	0.00561610800709
DNAJB1	0.1372	7.3627	0.00211373849246	0.00561953287213
PRKAR1B	-0.3034	5.9379	0.00211437783604	0.00561953287213
TSC22D1	0.3375	5.7516	0.00211451864597	0.00561953287213
RIPOR1	-0.1966	6.4596	0.00211734557766	0.00562497321810
DUSP23	-0.4410	5.4816	0.00211780458459	0.00562497321810
RUFY1	-0.1587	5.9000	0.00212474376451	0.00564175383786
ANKMY1	-0.2144	4.3214	0.00212737480798	0.00564708875511
CAV1	-0.4139	4.9302	0.00213007907474	0.00565261486782
MRM2	-0.1900	6.2902	0.00213550710937	0.00566536373362
ZNF428	-0.3886	5.3775	0.00214360202242	0.00568517814415
LRP5	-0.2324	6.4696	0.00214481139737	0.00568672475899
AGR2	-0.1979	8.1231	0.00214571644335	0.00568746381263
PRPF40A	0.3044	6.2075	0.00214909265875	0.00569475063734
PRR36	-0.2639	6.2844	0.00215341390345	0.00570453665613
PEX6	0.3487	3.5920	0.00215975258320	0.00571965972822
S100A14	0.3240	8.3924	0.00216294878692	0.00572645420818
STIMATE	0.2833	3.6169	0.00216924443777	0.00574144818985
EID2	0.2653	4.0658	0.00217954180441	0.00576702188981
USP22	-0.2437	7.5062	0.00218058573702	0.00576810343079
CENPM	-0.3824	3.7925	0.00218338522558	0.00577382680067
B3GALNT2	0.3672	4.2453	0.00219447776062	0.00580087303820
DCP1A	0.2981	3.7446	0.00219489040406	0.00580087303820
EPHX2	-0.3213	3.6523	0.00220095191045	0.00581520055246
ABCB8	-0.2090	5.4462	0.00220162645131	0.00581529080987

AK7	0.2236	4.6561	0.00220866879270	0.00583219578554
NFATC2IP	0.2172	6.1636	0.00221212495114	0.00583962403527
MROH6	-0.3683	4.1652	0.00222113569898	0.00586170685337
KAT14	-0.1677	5.3563	0.00222269264473	0.00586411153597
PAM	0.3996	3.6329	0.00222408530329	0.00586608151008
SBDSP1	0.2703	4.2966	0.00222584642134	0.00586902187926
ATP11B	0.4099	4.0064	0.00223285849964	0.00588580204216
SENP1	0.3812	4.1943	0.00223969767193	0.00590211681916
FBXO9	0.2734	5.9352	0.00224310777209	0.00590938836042
CACYBP	0.1782	6.4767	0.00224594898594	0.00591473987139
HPS5	0.4874	4.1799	0.00224693103135	0.00591473987139
RAD18	-0.2102	4.1023	0.00224772960917	0.00591473987139
ALKBH7	-0.4074	6.0094	0.00224774444402	0.00591473987139
HIPK1	0.5164	7.7264	0.00225920097029	0.00594316454554
PAPSS2	-0.4360	4.2267	0.00226332557324	0.00595229062571
FBXO46	0.3094	4.7109	0.00226959211285	0.00596704284215
BAG5	0.2200	5.7057	0.00227157757129	0.00597053427637
ZNF467	0.1876	5.8284	0.00227481371769	0.00597512645933
TOLLIP	-0.2245	5.4885	0.00227534525530	0.00597512645933
RNF139	0.2656	5.5435	0.00227566343355	0.00597512645933
PEX2	-0.3393	4.3843	0.00227595665927	0.00597512645933
BRD7	0.1946	5.8851	0.00228498165019	0.00599708623277
NAA20	0.2285	6.1522	0.00228593318886	0.00599785012657
IRS2	-0.3119	5.8022	0.00229665967836	0.00602362961701
ZNF584	0.2670	4.4440	0.00229771036510	0.00602362961701
RPP30	-0.2963	4.2081	0.00229774837499	0.00602362961701
FAH	0.3083	4.7401	0.00230776673781	0.00604814711287
CCNT1	0.3816	4.6556	0.00231033591267	0.00605313341688
TRMT112	-0.2868	7.6160	0.00232025742215	0.00607737457473
OARD1	-0.2659	5.7866	0.00232842776412	0.00609701629929
TBC1D2B	0.2531	5.9411	0.00233411067633	0.00611013521238
AGRN	-0.1774	9.6373	0.00233500065858	0.00611070345261
WASL	0.4382	4.7334	0.00234023793297	0.00612264496379
MED19	-0.2942	3.3967	0.00234399470000	0.00613070733603
RPAIN	0.2181	5.4824	0.00234537423342	0.00613254921212
CHST11	0.2001	4.9856	0.00234802000776	0.00613769996848
FADS1	0.2531	4.7242	0.00235332971950	0.00614980926122
NAT9	-0.2350	5.3309	0.00235629676936	0.00615579141616
MYO6	0.3582	5.9905	0.00236275941813	0.00617089970551
DNAJC25	0.3467	3.4848	0.00236863877229	0.00618447633443
ANKHD1-EIF4EBP3	0.2461	7.0927	0.00237646831343	0.00620313560054

PRKCI	0.3792	4.7781	0.00237896253850	0.00620786172761
NCOA7	0.5043	3.7448	0.00238088863006	0.00621110303062
ZNF770	0.3437	3.4487	0.00238710403583	0.00622552893434
APRT	-0.3674	8.5800	0.00239501537407	0.00624436824919
DGKZ	0.1909	8.3734	0.00239780174382	0.00624983858657
MAT2A	-0.1784	7.0884	0.00240708919123	0.00627224589542
KLC1	0.1464	6.6877	0.00242045016552	0.00630397059265
RTL8B	-0.2471	5.6067	0.00242065251146	0.00630397059265
ELMO2	0.2410	4.9761	0.00242436770875	0.00631183576926
ELAVL1	0.1642	5.9750	0.00242544806295	0.00631283859548
DSTN	0.1608	8.7543	0.00242663413882	0.00631411593542
MTA3	-0.1474	6.3489	0.00243821028031	0.00634241980965
FGD1	0.1701	4.9903	0.00243975851667	0.00634462975083
SPIRE1	0.3782	5.1778	0.00245938820698	0.00639384606572
LAMTOR3	0.2842	4.4372	0.00246244228848	0.00639995375549
MORN2	0.2633	4.4915	0.00247551777086	0.00643209638833
DCUN1D1	0.2895	4.0428	0.00247690182569	0.00643385168167
TAMM41	0.1895	4.7758	0.00248025128540	0.00644070972911
CDK2AP1	-0.1526	5.9518	0.00249064766315	0.00646585804147
S100P	-0.4105	4.3730	0.00249529151744	0.00647506997677
CKS1B	-0.2947	5.7805	0.00249562216922	0.00647506997677
CHUK	0.4878	3.3700	0.00251927773605	0.00653457901202
PGAP6	0.1710	6.7819	0.00252279383504	0.00654183061566
TMED4	-0.1548	6.1549	0.00252880180489	0.00655553787903
EDEM1	0.3879	5.1322	0.00252990402805	0.00655652353844
HIVEP3	-0.3725	3.9415	0.00253410925753	0.00656554812201
AFG3L2	-0.1596	6.8426	0.00253712107183	0.00657147645559
MAPRE1	-0.2041	5.7918	0.00253905564556	0.00657461200949
SUCO	0.4179	4.3972	0.00253989455626	0.00657490948273
PNPLA2	0.2962	8.1209	0.00254232612853	0.00657932846200
SOWAHB	-0.4027	3.7381	0.00255205005613	0.00660261155547
FARP1	-0.1603	5.6722	0.00256021644508	0.00662185290166
CBWD5	0.1514	6.9465	0.00256287177784	0.00662683331850
TEX261	-0.1694	6.7154	0.00256992179027	0.00664317101550
MAVS	0.1651	7.2537	0.00257873508967	0.00666405616086
NUP62	-0.2444	6.0558	0.00258230049264	0.00666999361837
FLJ46906	-0.4640	3.4974	0.00258250165865	0.00666999361837
RAP1GAP2	0.2735	5.3467	0.00259005279229	0.00668759437214
XPNPEP1	0.1540	5.5204	0.00259761020814	0.00670520133601
HROB	0.2368	3.7341	0.00259953269943	0.00670825701720
GSTK1	-0.2686	6.8271	0.00260059620289	0.00670909492002

RNF14	-0.3145	4.4198	0.00260189839993	0.00671054796073
RAP1GDS1	0.2740	4.4033	0.00261321114779	0.00673781102586
AHCYL2	0.4189	3.8388	0.00262113061480	0.00675631198211
NOC2L	0.2084	7.8903	0.00262815040432	0.00677248405836
UEVLD	0.4259	3.7002	0.00264291525282	0.00680859954917
BBOF1	0.5044	3.3456	0.00265263196394	0.00683128045875
PPDPF	-0.3811	9.8257	0.00265322389362	0.00683128045875
SAR1B	0.2503	4.6254	0.00267088595827	0.00687429659822
NPIPB11	0.3323	4.6426	0.00267144507159	0.00687429659822
PYGO2	0.1309	6.2978	0.00268205923240	0.00689965435961
HMGXB4	-0.5339	3.5845	0.00268380122332	0.00690111768496
PLEKHF1	0.3417	4.0839	0.00268414796424	0.00690111768496
KANSL3	-0.2626	5.5369	0.00268705622899	0.00690663957415
ALMS1	-0.4157	4.2266	0.00269765693807	0.00693192491643
NFAT5	0.4559	4.4265	0.00270426843681	0.00694694813992
UGGT1	0.2601	5.2709	0.00270532637020	0.00694770044339
ADAMTS19	-0.4362	3.6280	0.00270980028041	0.00695722260288
FAT1	-0.5843	5.8284	0.00271718106188	0.00697420045870
SLC33A1	0.3283	4.0163	0.00272122550530	0.00698260774614
SLC11A2	0.2677	5.0214	0.00272794054120	0.00699786103239
ANXA5	0.2224	6.8995	0.00273332303814	0.00700968836751
IP6K1	-0.1515	5.4179	0.00273786366394	0.00701935063021
ZNF554	0.2894	3.4176	0.00274082447921	0.00702495825449
MIS18BP1	0.4541	4.3900	0.00274631769038	0.00703705162142
MTERF4	-0.1927	4.5920	0.00274865321523	0.00704104932228
ZDHHC8	0.2224	5.4265	0.00276516531444	0.00708134975194
DHX32	0.2434	5.9286	0.00276798720696	0.00708657790426
ATP6V0A2	0.3009	4.3912	0.00277177135188	0.00709426596573
DUSP16	-0.2568	5.5387	0.00278664985082	0.00713033736130
ANKRD17	0.3828	5.9540	0.00278790252212	0.00713153318404
IMP4	-0.2328	6.8239	0.00278927328285	0.00713303032429
MRPS7	-0.1975	6.8669	0.00279238108763	0.00713896752725
ZFC3H1	0.4093	4.5826	0.00279371137079	0.00714035827699
GIPC1	0.2579	8.7151	0.00279837561296	0.00715026700654
NRBP2	0.3644	5.1299	0.00280296468655	0.00715997814867
SEMA4D	0.2418	4.9405	0.00281669248380	0.00719302149758
EFTUD2	-0.1313	6.9520	0.00282421904682	0.00720702888539
KIFC3	-0.1817	5.5329	0.00282424565689	0.00720702888539
ZC3H18	-0.1549	6.4707	0.00282455850711	0.00720702888539
U2AF1L4	-0.5476	3.5445	0.00283823372707	0.00723988777402
CLIC4	0.6229	4.0238	0.00284841405432	0.00726381578974

MB	-0.2803	5.3564	0.00285349868498	0.00727473934822
ARHGAP4	-0.3491	6.4294	0.00285531788612	0.00727733419137
LPP	0.3777	5.0284	0.00286225562364	0.00729296950568
CAPG	-0.3057	5.2193	0.00288359841163	0.00734528953044
UPF2	0.2031	6.0744	0.00289394912102	0.00736958832528
UBAP2	0.2292	5.5112	0.00289496182919	0.00737010046842
DARS1	-0.3335	5.1499	0.00290002524808	0.00738092188280
NFYA	-0.3366	4.4937	0.00290827406968	0.00739984220420
LYRM2	-0.1990	5.3103	0.00291914220807	0.00742406211733
MT1X	0.3382	5.9091	0.00291942801685	0.00742406211733
NFRKB	0.2064	5.6729	0.00292150442333	0.00742726250511
DLC1	-0.2918	4.7558	0.00293472908648	0.00745879508377
SERTAD1	-0.3450	4.4078	0.00293859969733	0.00746654276760
DDX19B	-0.2210	5.7443	0.00295052767598	0.00749341862908
ASB6	0.1749	5.9437	0.00295082755397	0.00749341862908
ACSF3	-0.1999	5.7415	0.00295507126452	0.00750209733103
COG2	-0.1958	4.4573	0.00295835910057	0.00750834516274
KLC4	-0.1711	5.7687	0.00295959681148	0.00750938771864
NAAA	-0.1697	5.0143	0.00296550314888	0.00752227209357
BCKDK	0.2283	7.2235	0.00296895206906	0.00752891754793
TUBGCP6	0.2268	5.3486	0.00300180741560	0.00761010975461
ATP6V0B	0.2719	6.5185	0.00300953460629	0.00762757012553
INTS9	-0.2357	3.8141	0.00301256011800	0.00763112777542
HDAC11	0.2238	5.9075	0.00301261899294	0.00763112777542
GOSR2	-0.1472	5.5666	0.00302544136628	0.00766147045376
KIF2A	0.3871	4.1107	0.00303552678782	0.00768486723172
NDUFB2	-0.3777	5.9708	0.00306368278991	0.00775229823709
AK3	0.2611	5.1132	0.00306386943871	0.00775229823709
MORN4	-0.2334	3.4460	0.00306775171730	0.00775995914897
IRF5	0.2742	3.4764	0.00307780289222	0.00778321583521
SRCIN1	0.3593	3.8733	0.00308145637426	0.00779028544952
UBE2R2	-0.1609	5.7613	0.00308350836126	0.00779330348694
RNF10	0.1657	7.2036	0.00308468380734	0.00779410507914
SRA1	-0.3268	5.4090	0.00309123936447	0.00780649348275
LUC7L	-0.2908	6.1989	0.00309170021927	0.00780649348275
UBE2V2	-0.1956	5.0675	0.00309216573697	0.00780649348275
ZSCAN21	0.2232	4.7187	0.00310164311290	0.00782824377661
ELK3	0.4337	3.6524	0.00310638712339	0.00783657195408
PCCA-DT	-0.3575	3.4608	0.00310666876277	0.00783657195408
DEXI	0.2564	5.6620	0.00310820768172	0.00783827657810
LOC114841035	0.3812	3.6257	0.00311085568731	0.00784277637324

WDR24	-0.2600	5.3716	0.00311279518442	0.00784548794607
GLRX3	0.1677	5.5013	0.00311691947442	0.00785370303752
SERF1B	-0.3533	3.9737	0.00313619612280	0.00790008238312
FAM157A	0.5433	4.3435	0.00313715636367	0.00790030974445
MLF2	0.2223	8.9814	0.00313853740250	0.00790159638262
PIK3C2B	-0.3333	5.7759	0.00314815047756	0.00792360157615
YKT6	0.1906	7.5199	0.00315416142537	0.00793653086833
BICDL1	0.2405	5.4472	0.00316366011521	0.00795822645603
CDK5RAP1	0.2280	5.5108	0.00316537151408	0.00796032642464
SH3GL1	-0.1952	7.0131	0.00316968784602	0.00796897434377
TECPR1	-0.2207	4.7966	0.00317743723841	0.00798624621146
MSI2	-0.1967	7.1014	0.00318317485192	0.00799845346714
MYDGF	-0.2366	5.7551	0.00318901638233	0.00800941003582
DCAF15	-0.2002	5.6975	0.00318929927206	0.00800941003582
ARMH3	-0.2781	4.7069	0.00322436500321	0.00809523323035
ENKD1	0.3373	4.9906	0.00323137032349	0.00811057874727
PAFAH2	0.3050	3.4059	0.00324854678095	0.00815143777779
TMEM38B	0.3889	3.7058	0.00325378725170	0.00816233205323
ESCO1	0.3605	4.1229	0.00325491917135	0.00816291659626
STPG3-AS1	0.4729	3.3940	0.00326264340589	0.00818002892571
CAMK2N1	-0.1944	5.9210	0.00326493634343	0.00818351833692
VAV1	-0.2930	3.4189	0.00326715504575	0.00818681980421
SENP3	0.1475	6.5076	0.00326944385737	0.00818808142879
MINK1	0.1961	7.2110	0.00326946187213	0.00818808142879
YME1L1	0.2692	6.5106	0.00327161106365	0.00819120487153
TSNAX	0.4816	3.6144	0.00327333509307	0.00819326239807
SNHG9	-0.4182	4.5262	0.00328757633111	0.00822664113057
TASOR	-0.3627	4.4224	0.00329151873035	0.00823423735270
AAAS	-0.2404	5.3663	0.00329256355859	0.00823458267022
NUDCD3	-0.1390	6.4095	0.00330849314648	0.00827214379494
PITPNC1	-0.1896	5.6388	0.00331301020474	0.00828115762985
SH3PXD2B	0.3380	4.0660	0.00333549679806	0.00833507056223
AXIN1	-0.1732	6.7938	0.00334255663313	0.00834819738093
CFAP20	0.2490	4.6875	0.00334258844588	0.00834819738093
EXD2	-0.3020	5.0945	0.00334386759348	0.00834909585273
RAB15	0.1492	7.5422	0.00334807195356	0.00835729560482
BOLA3	-0.2919	4.1181	0.00335018218686	0.00835833599192
IRF2BP1	-0.2271	5.9843	0.00335032959042	0.00835833599192
SGSM3	-0.1927	6.6033	0.00336695083546	0.00839565665674
UQCRC1	-0.2744	7.7763	0.00336713815041	0.00839565665674
LTO1	0.2542	4.9310	0.00337252379496	0.00840677699206

AGO1	0.2126	5.5487	0.00337849449555	0.00841934920803
TMEM106C	0.1483	7.7887	0.00338222017629	0.00842632137748
ULK2	-0.5137	3.5077	0.00338608670512	0.00843364052913
NKRF	0.3340	4.1654	0.00339595958757	0.00845591143810
RPP38	-0.2046	4.7589	0.00339944923156	0.00846120444259
MTFR1	0.3662	5.0613	0.00339994879540	0.00846120444259
SMC3	0.3320	5.5929	0.00340282642231	0.00846604568248
TIPRL	-0.2426	4.5795	0.00341079045077	0.00848353549260
SNX15	-0.2958	4.0028	0.00341889573737	0.00850136697455
PSMD2	0.1474	8.1904	0.00342117282991	0.00850470037460
ABHD17C	-0.2687	5.5832	0.00342868580061	0.00852104426801
TK1	-0.2694	6.9171	0.00344605077733	0.00856185693815
MRPL9	-0.1976	7.2351	0.00346897771286	0.00861646242081
ROGDI	-0.2877	6.4596	0.00348111924710	0.00864425591549
PIK3R3	0.2348	6.3137	0.00348337633726	0.00864749604117
SAP25	-0.4474	4.1567	0.00350904875183	0.00870884714823
SPOUT1	-0.2200	6.6682	0.00351557889481	0.00872266993000
TSPYL4	0.5310	4.7821	0.00352475708071	0.00874305355092
NPTN	0.4797	5.0768	0.00353253935373	0.00875996446512
EPS15L1	-0.1435	6.4668	0.00354209408973	0.00877985023075
EEFSEC	-0.2400	6.0096	0.00354249215345	0.00877985023075
CD2BP2	0.2466	7.7266	0.00354618319115	0.00878660015248
TBC1D17	-0.2736	6.1774	0.00355606044827	0.00880561235340
KIF1C	0.1461	8.7910	0.00355629311537	0.00880561235340
STIM2	-0.2476	5.2167	0.00355676534658	0.00880561235340
FGFR1OP2	0.2777	3.8364	0.00356510256119	0.00882384746748
DBF4B	0.2284	4.0328	0.00356761560198	0.00882766138462
WDR70	-0.1880	4.7752	0.00357204634335	0.00883621706454
SRGAP3	-0.2739	4.2312	0.00357519930464	0.00884160808428
HPS1	-0.2070	5.8609	0.00359283295018	0.00888061728253
PIK3C2A	0.6423	3.8412	0.00359292896113	0.00888061728253
TRIM26	-0.1267	6.5903	0.00359415601172	0.00888123285509
TF	0.3931	5.4336	0.00359527270326	0.00888157546743
NET1	0.2662	5.3153	0.00359859872082	0.00888737421371
NT5C	-0.3959	6.6582	0.00360244008544	0.00889444220116
NOTCH2NLC	0.3364	5.5278	0.00361472630377	0.00892235106403
ZNF444	-0.3244	6.9556	0.00361903895399	0.00893056867966
ERH	0.2068	7.1931	0.00362098765664	0.00893169946296
RABGEF1	0.2452	5.0808	0.00362146431259	0.00893169946296
TMEM179B	-0.2560	5.9904	0.00362564284410	0.00893957715648
LBHD1	0.2507	3.8694	0.00363085599340	0.00895000088928

C6orf62	0.2025	5.5750	0.00363788614825	0.00896463739101
EVL	-0.1853	7.7971	0.00363876813382	0.00896463739101
SIN3B	0.1892	6.0631	0.00364502164717	0.00897760823921
ACKR3	-0.4641	5.4909	0.00365261847865	0.00899371670416
STX3	0.2493	4.8129	0.00365354266289	0.00899371670416
CANX	0.2708	8.5070	0.00366178892113	0.00901157322297
LMBR1	0.2912	5.6459	0.00366376277949	0.00901398802507
TMEM125	-0.3151	4.6005	0.00366669028491	0.00901874714986
TMEM8B	0.3048	3.9058	0.00366909539454	0.00902221913831
C15orf40	0.2298	5.8219	0.00369798366493	0.00909079308641
ANAPC1	-0.2497	5.5595	0.00370550038066	0.00910599898407
JPT2	-0.1644	7.2118	0.00370617467736	0.00910599898407
PALB2	0.2801	4.3432	0.00370902241923	0.00911053085991
SLC8B1	0.2418	3.8947	0.00371277586173	0.00911728437004
CLNS1A	0.1458	6.9462	0.00372338340772	0.00914086096932
TSPAN14	0.1480	6.6929	0.00372448427885	0.00914109236116
DYNC1LI2	0.2633	5.1970	0.00373962263595	0.00917576686222
ZNF395	0.2573	5.6951	0.00377303688112	0.00925525335426
SERINC2	-0.2642	5.1855	0.00377540881226	0.00925857073296
TIMM17A	0.2129	4.7736	0.00377994727683	0.00926475841094
TM9SF3	0.2909	6.3265	0.00378003165205	0.00926475841094
SLC4A2	0.1327	8.3525	0.00378099269584	0.00926475841094
TMEM177	0.2304	4.2786	0.00379510811324	0.00929683754421
ERGIC2	-0.2649	4.2817	0.00380429674404	0.00931683353092
ELK1	0.2851	4.9963	0.00380682070367	0.00932050116205
NEIL2	0.2509	4.2434	0.00381611926805	0.00934074907633
DSG2	0.5399	4.2846	0.00381718216278	0.00934083298847
KLHL17	0.2663	4.9888	0.00382104280615	0.00934776123994
IMMT	-0.2062	6.4987	0.00382548265816	0.00935610234817
PRAG1	-0.2076	4.8020	0.00383212304024	0.00936981942069
DHRS4	-0.2777	5.4497	0.00383855388988	0.00938301692437
ATP2A3	-0.1455	8.6667	0.00384989523113	0.00940820737188
SCAF8	-0.5072	5.3074	0.00385193823545	0.00941066750502
TMED8	0.5064	4.1807	0.00386321104947	0.00943566959125
PNISR	-0.1910	6.2643	0.00386792236636	0.00944463646381
ERC1	0.2862	5.1528	0.00386918812583	0.00944518746524
CCDC115	-0.1816	5.4183	0.00387347993880	0.00945312317233
REX1BD	-0.4208	6.3047	0.00388240964063	0.00947237021670
FAM53B	-0.2110	5.7175	0.00388598041864	0.00947853563837
SDC4	-0.1611	7.1151	0.00388726215117	0.00947911589547
CCP110	0.5791	3.7242	0.00388954755834	0.00948061694634

FAM133B	-0.2162	4.9544	0.00388996572427	0.00948061694634
SCMH1	-0.2630	4.0686	0.00389221426540	0.00948355184978
MRFAP1	0.1502	9.0422	0.00390045694505	0.00949856188966
ANKRD27	0.2942	5.6822	0.00390046661013	0.00949856188966
CPTP	0.2883	5.4235	0.00390282928359	0.00950176748639
CERS2	-0.1827	8.3680	0.00390687815284	0.00950907545053
S100PBP	0.2308	3.6134	0.00391097209598	0.00951648917567
TIMP1	-0.3742	6.6219	0.00392255618282	0.00954211966145
PRMT1	-0.1789	7.5143	0.00392707668695	0.00954978741169
ETFDH	-0.2549	4.5456	0.00392927083648	0.00954978741169
HADH	0.1607	5.3390	0.00392988726030	0.00954978741169
PUS7	-0.3429	4.6466	0.00392991471837	0.00954978741169
SPDL1	0.3069	3.8653	0.00394740556411	0.00958972443223
AUP1	-0.2269	7.3501	0.00396071128680	0.00961716361062
EFEMP1	-0.3112	4.0666	0.00396081840147	0.00961716361062
REXO1	-0.2820	5.2253	0.00397524024229	0.00964960081268
YES1	0.4616	4.6036	0.00397790580959	0.00965349082225
LOC102724135	0.4972	3.5457	0.00399416213605	0.00969035168513
TCEAL1	-0.2373	4.8511	0.00399804432600	0.00969717962726
NISCH	0.1391	5.9579	0.00400801287841	0.00971876233614
UBC	0.1977	10.6453	0.00401980494634	0.00974475406238
CXCL16	-0.2049	4.9601	0.00402378440150	0.00975179774487
IL17RA	0.1793	5.1775	0.00402951671419	0.00976072763659
CBX4	0.2600	6.2553	0.00402961875450	0.00976072763659
NSUN4	-0.2266	4.2767	0.00403563032324	0.00977268239076
MTX2	-0.1962	4.1452	0.00404228176836	0.00978617988230
EXOSC9	-0.2425	4.2930	0.00404966105676	0.00980143178477
RSPRY1	0.3381	3.9864	0.00405746203926	0.00981769591753
TBRG4	-0.1848	6.7729	0.00405942262016	0.00981982333874
DNMT3B	0.4386	4.5012	0.00406290195915	0.00982562255419
HEG1	-0.4776	4.0113	0.00407660087601	0.00985612687833
OCIAD1	-0.1870	5.9625	0.00407953952435	0.00986060644680
MUS81	-0.1759	5.8910	0.00408433144507	0.00986844339844
TNRC6B	0.2948	4.7749	0.00408495526206	0.00986844339844
FXR2	0.1761	6.0432	0.00408708073926	0.00987095217904
TSPAN5	0.1742	4.4609	0.00409370102973	0.00988431243047
SURF4	0.1213	8.1244	0.00409573928355	0.00988660511268
TMEM104	0.2029	4.7014	0.00411567466537	0.00993208653633
TTPAL	-0.2889	4.1826	0.00411837100111	0.00993595299178
PHF14	-0.2670	6.4220	0.00414687773187	0.01000207083218
TIGD5	-0.2407	5.2775	0.00416240370382	0.01003430912110

TNPO3	-0.2020	5.8131	0.00416245374509	0.01003430912110
TMEM123	0.4634	4.7590	0.00417461627856	0.01006095818089
TRNAU1AP	0.2769	4.0088	0.00417994817904	0.01006950681590
TMEM40	0.4500	3.4273	0.00418038109194	0.01006950681590
MUTYH	-0.2609	4.3259	0.00419047444727	0.01009114252339
THUMPD3	-0.2197	5.5152	0.00419516780502	0.01009976639380
TRIAP1	-0.1779	5.1495	0.00423675433065	0.01019718157345
MMP17	0.3724	4.6913	0.00426064977679	0.01025197684765
MYO10	0.4332	3.7519	0.00426227038653	0.01025315957089
GPATCH1	0.2486	4.3381	0.00427447546459	0.01027979652912
ARFIP1	0.3319	4.1676	0.00427819674305	0.01028602187547
GPBP1L1	0.1992	5.9711	0.00430456444579	0.01034667806570
TMEM265	0.3933	3.7023	0.00430584329805	0.01034701322825
SLC22A17	-0.2306	3.7733	0.00431729370214	0.01037165608270
FGFR2	-0.3835	4.6035	0.00431838251830	0.01037165608270
CD82	-0.2171	4.8024	0.00433635991079	0.01041207941562
PSMD1	0.1378	6.7935	0.00434222744986	0.01042341196727
MMGT1	0.2382	4.9253	0.00434892126618	0.01043672146358
HSBP1L1	-0.2715	4.8160	0.00435214292104	0.01044169349168
MRPL47	0.2657	4.7601	0.00435362572646	0.01044249213470
EAF1	0.3637	5.4663	0.00435502176228	0.01044308228763
YTHDF2	0.2509	5.4975	0.00436261390167	0.01045852609321
PAAF1	-0.2496	4.9464	0.00437470752364	0.01048475033575
CDAN1	-0.2478	4.1061	0.00438495636502	0.01050654056747
MCFD2	0.3053	5.9982	0.00441799830314	0.01058291811944
RBM8A	-0.1894	8.5259	0.00442082365070	0.01058689334705
MAZ	-0.1909	8.9828	0.00442914411385	0.01060402259369
GPC4	0.3426	4.3632	0.00443351589234	0.01061169157047
ZNF721	-0.3230	3.8756	0.00444771634417	0.01064287539432
STXBP2	-0.2574	6.7791	0.00444920485229	0.01064363257736
TMEM69	0.2020	4.2660	0.00445660223467	0.01065852117277
GINS1	0.3081	3.9557	0.00446904277944	0.01068546010533
MT2A	-0.3449	8.4597	0.00447024920235	0.01068553119414
TUFT1	0.1681	6.6411	0.00448953892976	0.01072881658452
DPP7	-0.3039	8.2241	0.00449149518065	0.01073066764943
RPAP2	0.2735	4.6640	0.00449978614621	0.01074764807830
PREPL	0.3991	4.9924	0.00450698522432	0.01076201231188
SPIDR	-0.2104	5.5788	0.00452448194481	0.01080095177204
FCHSD2	0.3353	4.1002	0.00453211152158	0.01081632187319
C16orf74	-0.3040	5.2551	0.00454161144564	0.01083614648920
NUP210	-0.1897	7.3602	0.00454363978294	0.01083797485790

CACNA1D	-0.3342	4.9783	0.00454476470200	0.01083797485790
TPRG1L	0.1863	5.4912	0.00454850215113	0.01084403991452
PTPRJ	-0.2451	5.6100	0.00455327625037	0.01085257260620
TTLL12	-0.1488	6.0295	0.00458298479137	0.01092015970758
DDAH2	0.2853	6.9911	0.00458403796997	0.01092015970758
SAT2	0.3017	5.4012	0.00458609468799	0.01092172971301
TMEM198B	0.2389	5.0467	0.00458710242544	0.01092172971301
FAF2	-0.2170	6.6468	0.00459057336919	0.01092712890318
DDX19A	-0.1647	5.5861	0.00459317631927	0.01093045968430
PSME4	0.1894	5.8340	0.00459501338685	0.01093196661408
NDRG2	-0.2057	3.5008	0.00463148330674	0.01101584596871
CYP1B1	-0.5189	5.0832	0.00464087075901	0.01103528341517
WDR34	-0.2878	8.5785	0.00465237178578	0.01105973512739
NEDD4L	-0.2010	5.5143	0.00466082787954	0.01107693744416
TYK2	-0.1471	6.7588	0.00466374689563	0.01108097476694
FA2H	0.2068	4.2718	0.00466607311001	0.01108146730223
RIMS4	-0.1950	4.8776	0.00466639477632	0.01108146730223
CROT	0.2596	4.8095	0.00468367447708	0.01111959422910
MED22	0.1550	6.3629	0.00468978106252	0.01113118186846
GATD3B	-0.2364	7.6353	0.00469434472834	0.01113910229371
PIK3IP1	0.1950	4.0018	0.00469865951481	0.01114642817501
LETM1	0.1635	6.1970	0.00471572008268	0.01118397860299
SPTAN1	0.1356	8.3401	0.00472015037566	0.01119156280975
GNG5	-0.1666	5.5409	0.00472983565645	0.01121159947697
NSMCE3	0.2095	4.4414	0.00474545421041	0.01124568624341
CCN1	0.2316	3.9758	0.00474807295660	0.01124895656636
SMARCE1	-0.1393	7.0995	0.00477383729024	0.01130698900651
CHD5	0.2100	4.4464	0.00477505812575	0.01130698900651
RACGAP1	0.3553	5.0699	0.00478545557579	0.01132865539202
RAB17	0.2659	6.4261	0.00480550024016	0.01137314247612
OTUD7B	0.2022	5.6701	0.00480867507835	0.01137769108559
SLC39A3	-0.2936	4.5054	0.00482255549946	0.01140600752092
MICAL3	-0.2445	5.6782	0.00482423855954	0.01140600752092
HACD3	0.2093	6.5661	0.00482441084548	0.01140600752092
IRF3	0.2881	6.7488	0.00482646944484	0.01140790448428
COQ10A	0.2323	3.4335	0.00483273825314	0.01141974917427
SNRNP27	0.2866	3.7381	0.00483485783953	0.01142178565057
RNF149	0.2044	4.7756	0.00484057184784	0.01143177084090
PSMA3-AS1	-0.2549	5.1204	0.00484160231848	0.01143177084090
ARHGDIA	-0.2672	8.9339	0.00485438562597	0.01145897475161
SPTLC2	0.1763	6.3368	0.00487130101243	0.01149591592876

SSB	0.2561	6.7992	0.00487694531355	0.01150624588005
UPK3B	-0.2938	5.0865	0.00489987358747	0.01155408957597
CPD	0.5410	3.7353	0.00490005891259	0.01155408957597
PPP1R11	-0.1817	5.9132	0.00490104096979	0.01155408957597
SBNO1	0.3779	5.5910	0.00490348912631	0.01155686082430
KRT80	0.1622	8.6338	0.00490656151688	0.01156043856811
MICALL2	0.1837	6.4398	0.00490755320781	0.01156043856811
PPP3CB	-0.2734	4.2647	0.00493162537457	0.01161413123094
GLIDR	-0.3423	4.3543	0.00493522071455	0.01161958499062
ADGRA3	-0.3624	4.0013	0.00493730546932	0.01162148029210
GRHL3	-0.3924	4.3803	0.00494090409890	0.01162693706197
NOL4L	0.2930	4.8637	0.00494635618729	0.01163675143439
FBXO42	0.1836	4.4053	0.00495898674287	0.01166344434396
LINC01297-DUXAP10-NBEAP6	0.2429	4.6466	0.00496663619292	0.01167841099636
TECPR2	0.2094	5.6599	0.00497269723057	0.01168963591788
ZNF696	-0.2130	4.2606	0.00499480658318	0.01173857106157
DPF2	-0.1741	6.0314	0.00501762789367	0.01178915366168
TMCO3	0.3557	5.1637	0.00502038169068	0.01179257271937
BMP7	-0.1471	9.2053	0.00502470819595	0.01179968324992
ELFN1	0.3592	3.6086	0.00502616224605	0.01180004636928
FOXM1	-0.1688	6.7672	0.00503172874477	0.01180777202753
RBM15B	-0.1307	6.2348	0.00503205349042	0.01180777202753
SUV39H2	0.2461	3.5654	0.00504300648008	0.01183041638998
ABRACL	0.1564	5.2064	0.00506420484094	0.01187707752080
TEAD4	-0.2186	5.1836	0.00507727029802	0.01190464538506
PKD1	0.2010	6.6531	0.00510382022002	0.01196380780021
RPUSD3	-0.2514	6.9769	0.00511042435624	0.01197619705264
GSTM4	-0.1833	7.3614	0.00511225301928	0.01197739155524
MACROH2A1	0.1173	7.8685	0.00511621779012	0.01198358879341
SNX4	0.4250	4.4716	0.00515007680332	0.01205978531483
LINC01004	-0.3752	4.0290	0.00516841801885	0.01209961434111
RBCK1	0.2030	6.9903	0.00517403321956	0.01210863289603
CCDC93	0.2523	5.0335	0.00517493715114	0.01210863289603
CCDC117	0.3061	4.9605	0.00518371763944	0.01212605355069
RRM2B	0.4629	4.3448	0.00518902021188	0.01213347222244
B9D1	-0.2088	5.4053	0.00518956129413	0.01213347222244
ALG3	-0.2876	6.1840	0.00521215631113	0.01218316382532
MFSD14B	0.3067	5.1809	0.00522439223349	0.01220862220079
ETV4	0.2417	4.5827	0.00523212884778	0.01222355597290
PDK3	0.1794	5.2976	0.00526528395827	0.01229648982761
EIF2AK4	0.3318	4.7268	0.00526668435002	0.01229648982761

ZNF200	0.2637	3.4518	0.00526740947356	0.01229648982761
ERO1A	0.2156	4.4121	0.00527340893374	0.01230733141282
LTC4S	-0.4374	3.6478	0.00529430695209	0.01235292945321
TBCD	-0.1682	7.2106	0.00531132275562	0.01238554302754
RNF207	-0.3189	3.5991	0.00531184428903	0.01238554302754
EIF2B2	0.1674	6.7482	0.00531237640043	0.01238554302754
HILPDA	-0.1700	6.6612	0.00531450952753	0.01238733599062
SUN1	0.4078	6.8192	0.00534494056511	0.01245506935381
USP37	0.3178	3.6614	0.00535817939988	0.01248271604164
SPNS1	-0.2309	7.3519	0.00536202217133	0.01248846456473
GALNT6	-0.1162	6.8394	0.00537249135669	0.01250963948978
VPS11	-0.1656	6.3268	0.00539987279997	0.01257017300602
ABITRAM	-0.2022	4.6867	0.00541569054441	0.01260376366832
CCDC32	0.2039	3.7924	0.00544014953990	0.01265744247292
PRX	0.2956	3.6917	0.00544207876184	0.01265868781668
SIRT7	0.2095	6.2655	0.00544869637989	0.01267083529468
PPP2R3B	-0.2838	4.3296	0.00545118380387	0.01267337432744
RNF4	0.2513	6.0018	0.00545394438987	0.01267654696811
GLUL	-0.2495	7.2763	0.00546884968170	0.01270793857715
SIMC1	0.3666	4.0443	0.00547399653756	0.01271379436193
LTB4R	0.2113	5.3065	0.00547416980015	0.01271379436193
CROCC	-0.1855	5.1072	0.00549758877129	0.01276492038662
NUTM2B	0.2976	3.4008	0.00550349492932	0.01277536744714
CREBZF	0.3428	5.3710	0.00554724936482	0.01287364464143
FNDC10	-0.3277	6.1384	0.00555235876803	0.01288221000830
MFSD11	0.1768	4.8845	0.00556347152926	0.01290469602994
PLBD2	-0.1584	6.3682	0.00556700177857	0.01290958711726
XPO7	0.2506	5.6758	0.00557611541328	0.01292741998161
LINC01551	0.7903	3.0500	0.00558705995484	0.01294948735321
LOC374443	-0.3314	3.8927	0.00559509941949	0.01296481189804
CHERP	-0.1743	6.5005	0.00559743226412	0.01296690877309
EXT1	-0.1914	4.7240	0.00560219259165	0.01297462660667
METTL7B	-0.3179	3.3187	0.00561040883727	0.01299034233842
CETN2	0.1903	6.6845	0.00561447612999	0.01299644602000
ZCCHC9	-0.2259	3.9619	0.00561995494503	0.01300581316408
ATP5F1C	0.1485	7.6544	0.00562812744019	0.01302140771576
IER5	0.1423	6.3240	0.00563556504431	0.01303206751280
TTC12	-0.2649	3.6693	0.00563577161872	0.01303206751280
HPDL	-0.1752	3.8629	0.00563704010464	0.01303206751280
CTSD	-0.2477	10.0963	0.00568195718633	0.01313256635507
KHDC4	0.3386	4.6292	0.00569554605744	0.01316062436326

GTF2A1	-0.3932	4.0414	0.00570413609386	0.01317712029212
CENPA	-0.2831	3.9909	0.00570766757851	0.01318192504590
PCGF5	-0.2336	4.0424	0.00572262819244	0.01321213878521
BRPF1	0.2269	5.9883	0.00572365972702	0.01321213878521
SRGAP2	0.2256	6.2588	0.00573179861353	0.01322756371270
NR1D1	-0.3303	3.6885	0.00575672773852	0.01328171864673
TCHP	-0.2385	5.0318	0.00577645857254	0.01332385580321
PEPD	-0.1936	5.4884	0.00581904807373	0.01341868348337
NBPF25P	0.4488	3.7807	0.00582795785760	0.01343581754376
TTC17	-0.2299	5.4363	0.00583170132648	0.01344103546847
WDFY2	0.2075	3.7601	0.00584558679911	0.01346962033056
CANT1	-0.1547	6.9232	0.00586543720327	0.01351193182215
ACLY	0.2951	7.8198	0.00587958121552	0.01354107963940
ARL8B	0.1967	5.7109	0.00590134971367	0.01358776793859
LRP8	0.3723	4.1030	0.00592629720624	0.01364175029908
CERS5	0.2509	5.5162	0.00592999886348	0.01364681188020
SEC23IP	0.3138	5.2530	0.00594297717062	0.01367321400719
SPATA2	0.1528	4.9087	0.00594968402654	0.01368517746834
POLM	-0.1702	5.4986	0.00595242984113	0.01368802618062
C19orf12	-0.2617	3.8724	0.00596523477398	0.01371399923608
ATP6V1A	0.3752	5.4826	0.00597133446969	0.01372454779025
ELF4	-0.2648	5.6323	0.00597635819531	0.01373261861629
GAPVD1	0.3041	6.4730	0.00599925442661	0.01378174284039
TSFM	0.1923	6.2553	0.00600292930682	0.01378669727751
IKBKG	-0.1848	6.3455	0.00603466697760	0.01385608364692
CIZ1	-0.1328	8.6144	0.00606385054001	0.01391957198023
AP3S2	0.1726	6.2810	0.00606623972720	0.01392153726629
STAT3	0.2573	6.4241	0.00610878403755	0.01401563108767
MTHFR	0.2003	4.7223	0.00612263109124	0.01404385272532
MAP6D1	0.2865	3.8872	0.00614063594483	0.01408159470077
HINFP	0.1785	4.8459	0.00615129507574	0.01410247679444
PIGV	-0.2147	4.2626	0.00616025919114	0.01411946333032
PGM2	0.3916	4.2591	0.00618393574538	0.01417015405092
UBA1	-0.1317	8.3644	0.00619398180867	0.01418959354302
HSPE1	0.1865	6.5909	0.00620004254384	0.01419989567229
ATP1A1-AS1	-0.2237	4.3533	0.00621080976514	0.01422096910671
MRS2	0.2183	4.4012	0.00623007674861	0.01426148902298
RIPK2	0.2241	5.2212	0.00623351736141	0.01426576894126
RGP1	0.2167	5.2289	0.00625452320423	0.01431023563054
SART1	-0.2433	7.9008	0.00626655467629	0.01433415189304
ADAR	-0.2506	7.7280	0.00628482902595	0.01437233250684

CREM	-0.2236	3.5875	0.00629511679718	0.01439159307082
ATF4	-0.2273	8.2698	0.00629642101865	0.01439159307082
MYO19	-0.1853	5.2419	0.00632451697252	0.01445217378648
C4orf19	-0.1578	6.3458	0.00636897528817	0.01455010429985
B4GALT7	-0.2349	5.6496	0.00638827251075	0.01458560558660
LRPPRC	0.2243	7.0784	0.00638838307889	0.01458560558660
PAOX	0.2295	3.6124	0.00638933366628	0.01458560558660
MID2	-0.2960	4.0959	0.00639381302374	0.01459216287222
TACO1	-0.2173	6.3281	0.00640846228804	0.01462192111500
CCDC90B	0.2021	4.9838	0.00642788775084	0.01466255932312
SLC39A1	0.1272	8.9503	0.00643116871518	0.01466635939291
CD46	0.4176	4.9814	0.00649022956751	0.01479733233807
RAD51D	-0.2209	3.7491	0.00649249588910	0.01479878392795
SC5D	0.2926	4.5225	0.00650191183344	0.01481204384804
ANKMY2	0.2511	4.3993	0.00650212322516	0.01481204384804
DSN1	0.2528	4.7489	0.00650320656559	0.01481204384804
R3HDM1	0.3623	5.0692	0.00650824713877	0.01481980748926
STOML1	0.2487	3.8232	0.00651294438508	0.01482678565076
ADAP1	-0.2207	5.3713	0.00652910590163	0.01485985230393
TADA2B	-0.2439	4.3302	0.00653950488177	0.01487979048642
EEF2KMT	0.1902	4.9234	0.00654658922060	0.01489217853514
SLC25A37	-0.1753	4.2935	0.00655079966069	0.01489802447252
SFXN4	-0.3439	4.5639	0.00662642374793	0.01506623787054
TSEN15	-0.2302	4.3406	0.00664718286834	0.01510965397431
IGFBP4	-0.1990	6.6310	0.00665697994333	0.01512813685320
MIR4435-2HG	-0.3460	5.4877	0.00671271204523	0.01525097275024
UBE2D2	0.1790	6.1797	0.00673345901238	0.01529428246408
NUDT8	-0.3734	4.7207	0.00676478036916	0.01536158302884
TIMM13	-0.3624	5.4035	0.00677784637490	0.01538568087102
CIR1	0.2396	6.0144	0.00677878087930	0.01538568087102
TOM1L2	0.1812	6.8438	0.00678148328634	0.01538796844658
SUPT4H1	-0.1651	6.9250	0.00678392078872	0.01538965393013
ARHGEF7	-0.2530	4.8641	0.00679445452153	0.01540970067683
ZNF140	-0.2301	4.0733	0.00680500851484	0.01542978335163
TRIM16L	-0.2088	4.6805	0.00680935032725	0.01543577391956
LOC107985911	-0.3194	4.5262	0.00683664364533	0.01549377612759
PDXP	0.2647	4.4595	0.00684000902382	0.01549753541549
CTTN	0.1263	8.3473	0.00684605120716	0.01550735620160
GALNT16	0.2359	3.8076	0.00687006830302	0.01555787787025
LMAN2L	0.1714	4.0634	0.00688859969607	0.01559595458489
GATC	0.1574	5.3862	0.00690096158935	0.01562004790451

BCDIN3D	0.1861	4.0101	0.00690672777179	0.01562920381153
SCX	0.3548	4.1800	0.00691150230495	0.01563611171681
MYO5A	-0.3479	5.4323	0.00691866195889	0.01564841077178
TAF9	-0.1799	5.0725	0.00692324154018	0.01565486962807
MON1B	-0.1722	6.0329	0.00692532776005	0.01565568867042
TMEM216	-0.2016	3.3767	0.00694081298946	0.01568679013372
FAM83B	-0.4835	3.8941	0.00696717555349	0.01574245364549
OCLN	0.2534	4.6887	0.00697963529079	0.01576668360090
SLC37A3	0.3695	4.2301	0.00699335488677	0.01579374676119
POLL	-0.1849	5.7372	0.00703428718677	0.01588223817581
BABAM2	-0.1715	6.0394	0.00704422175249	0.01590071532050
DCAF13	0.1444	6.1202	0.00705156397731	0.01591333312077
UBALD1	-0.2664	6.5417	0.00708497258410	0.01598475429470
SNX2	0.1603	5.8718	0.00708950566007	0.01599100866844
EPB41L5	0.2968	5.2492	0.00709253806118	0.01599387587127
AP3D1	0.1252	7.1974	0.00712252396222	0.01605750747292
ALDH4A1	-0.1334	5.9332	0.00714345617939	0.01610070130678
C14orf93	-0.2047	5.1305	0.00718346195358	0.01618685310185
ADH5	0.1212	6.4165	0.00719079960690	0.01619936770782
KIAA0040	0.2192	4.5427	0.00720683252926	0.01623145987059
SLC25A38	-0.1382	6.2558	0.00721035991904	0.01623345395085
MON1A	0.2787	3.4927	0.00721258551071	0.01623345395085
RNF19A	0.4168	4.8933	0.00721308079415	0.01623345395085
ZNF646	-0.2844	5.0091	0.00722734458689	0.01626152532050
NKTR	0.3424	5.1237	0.00723178856744	0.01626749367870
ZNF641	-0.2528	4.8441	0.00724108660991	0.01628437531070
CDC34	0.2794	6.6058	0.00724428562942	0.01628753597443
PRKAB1	-0.1386	5.4223	0.00725340446636	0.01630072403895
BCLAF1	-0.3476	5.8714	0.00725374142070	0.01630072403895
PSMF1	-0.1334	6.8570	0.00727250215752	0.01633884020100
DDIT3	0.3326	4.2726	0.00727449132001	0.01633926680115
KNSTRN	0.3166	4.0539	0.00728053725174	0.01634660341304
ADSS2	0.3736	4.1041	0.00728135786871	0.01634660341304
DTYMK	-0.2858	5.0853	0.00728516395262	0.01634921126257
SWI5	0.3153	6.6396	0.00728612024883	0.01634921126257
PRRC2A	-0.1835	8.3018	0.00731078286479	0.01640049881304
THOC2	0.2783	6.5506	0.00731543731413	0.01640688719427
SRM	-0.2992	6.6289	0.00733580874522	0.01644851338650
LRCH4	-0.1760	7.4059	0.00733865003488	0.01645082225791
TCAIM	-0.2632	3.9215	0.00734335944200	0.01645731665666
ISOC2	-0.3124	6.8234	0.00734893496835	0.01646574844501

SEC16A	-0.2317	7.8823	0.00736020891158	0.01648694058363
GPS2	0.2553	7.0153	0.00737426300640	0.01651434830114
SKP1	0.1502	7.9763	0.00743078310545	0.01663681986701
IMPACT	-0.3572	4.0320	0.00743382113929	0.01663951929157
MRPL39	-0.1871	3.9966	0.00743607931179	0.01664047221053
REEP6	0.2923	6.3124	0.00745630427772	0.01668162087854
UBQLN1	0.2856	5.8812	0.00747382808112	0.01671670758735
PDCD4-AS1	-0.2362	4.1752	0.00747938382677	0.01672501465916
MFAP3	0.3205	3.7491	0.00749726117697	0.01676086379815
PSMG4	-0.2409	4.1929	0.00752403348689	0.01681657595237
KCTD9	0.3437	3.5933	0.00752774443158	0.01682073011397
VIPR1	0.2269	4.1340	0.00755621170599	0.01687979576923
RBM41	0.3758	3.4745	0.00755789556191	0.01687979576923
MKI67	-0.2070	7.2000	0.00757467040044	0.01691114518774
GEN1	-0.3156	3.3611	0.00757565671443	0.01691114518774
TGFBRAP1	-0.3204	4.6953	0.00758532229330	0.01692856027169
ITSN2	-0.3427	4.4757	0.00760627814921	0.01697115770834
CNOT9	-0.1314	5.7926	0.00760963061045	0.01697221897771
ATG9A	0.1495	6.7193	0.00761049176051	0.01697221897771
TSR1	-0.1517	6.1565	0.00761595511820	0.01698023285745
YIPF6	0.2575	3.6074	0.00763683763762	0.01701907534675
GRHL1	0.4722	4.9912	0.00763712499042	0.01701907534675
PRC1	-0.2202	5.8113	0.00765459621561	0.01705382439499
BAZ2A	0.3231	6.3394	0.00767943212095	0.01710496028706
OFD1	-0.2035	5.1240	0.00769081579065	0.01712254288579
TCTA	-0.1844	4.7491	0.00769109706322	0.01712254288579
UBE2N	0.1734	5.9437	0.00770038401114	0.01713901647186
SPINT1-AS1	-0.3373	4.6532	0.00770611433543	0.01714756782163
H2BC20P	0.2490	3.9544	0.00772845910688	0.01719307622478
PICALM	0.3322	5.7013	0.00773044791426	0.01719328863812
VOPP1	0.1241	5.3710	0.00774703239260	0.01722595522949
F11R	0.1480	6.8852	0.00775000652921	0.01722834988781
NOSIP	0.3606	6.3593	0.00777048512566	0.01726964645769
DYNC1H1	0.1995	8.4752	0.00777392183548	0.01727305705604
SLBP	0.2468	5.3028	0.00777866856009	0.01727937602598
FAM122A	-0.3366	3.5862	0.00778119449548	0.01728075989569
HNRNPK	-0.1653	8.7763	0.00783624647825	0.01739795767077
LYAR	-0.2157	4.4295	0.00783779813139	0.01739795767077
SETD2	0.2761	5.7701	0.00785554927381	0.01743309945149
GID4	0.3262	3.5528	0.00789444734331	0.01751514202897
NOP9	0.1433	6.1613	0.00790817437087	0.01754131203269

GOLGA7B	-0.2711	4.3045	0.00792599609676	0.01757654958600
YTHDF1	0.1446	6.4006	0.00793167120510	0.01758484038415
GLI3	-0.3055	4.8853	0.00795271038947	0.01762718160771
SDF2L1	0.3565	5.4719	0.00795471830354	0.01762732965214
TBC1D9B	-0.1584	7.9400	0.00801574629863	0.01775823179748
TMEM94	-0.1157	7.5071	0.00801840051569	0.01775977928853
CRTC3	-0.2987	4.8802	0.00802557832424	0.01777134278528
HADHA	0.1329	8.6307	0.00803513967034	0.01778817731505
PNPLA7	-0.1446	5.2169	0.00803940362574	0.01779327914339
FIS1	-0.3345	8.3869	0.00805560008872	0.01781755397375
RAPGEF1	-0.2384	6.7203	0.00805604428116	0.01781755397375
CYB561	-0.1050	8.1238	0.00805625774873	0.01781755397375
NRBF2	0.2989	3.7866	0.00806767024583	0.01783844984232
LNX1	0.3307	3.7813	0.00807539661425	0.01785118711150
TPRKB	0.2179	3.4520	0.00808735722346	0.01787327596647
LINC00685	0.3522	4.9594	0.00809797204810	0.01788873868994
PYGL	0.1731	4.4136	0.00809962487395	0.01788873868994
AAMDC	0.3758	4.9292	0.00810026357153	0.01788873868994
ARID1A	-0.2646	5.9879	0.00810666733250	0.01789852809299
MARCKS	-0.2723	6.7792	0.00811599456954	0.01791476584492
FDX1	0.1841	4.2530	0.00813331703260	0.01794623341144
ITPR3	0.2674	6.6452	0.00813420292055	0.01794623341144
BTBD10	-0.2551	4.5255	0.00815360983293	0.01798468080953
GTF2E1	0.3879	4.2676	0.00815688389498	0.01798753342650
DHX36	-0.3371	4.8680	0.00817695701095	0.01802742088284
USP48	0.2187	5.0383	0.00818854952148	0.01804859665159
STEAP3	-0.1330	5.4886	0.00819124818097	0.01805016373001
FAM83G	-0.1598	5.4100	0.00819491863558	0.01805387096791
EEF2	-0.1509	12.3036	0.00820276958117	0.01806678403265
SLC39A6	0.3669	6.7526	0.00820822718354	0.01807442072108
RPN1	0.1156	7.9720	0.00821236283131	0.01807524152400
KCTD1	-0.2429	4.2367	0.00821258083119	0.01807524152400
LOC101927391	-0.3178	3.4925	0.00823688888124	0.01812434890491
EMC2	0.1919	4.9240	0.00824658697344	0.01814002536611
NDUFA5	0.1987	4.5086	0.00824800845024	0.01814002536611
COA3	-0.3166	5.6359	0.00825491220762	0.01815081301632
RAB24	0.2565	7.1499	0.00827367491136	0.01818236746602
MIS18A	-0.2450	3.6852	0.00827375934885	0.01818236746602
SOAT1	0.3429	3.4701	0.00827554773601	0.01818236746602
BLVRA	0.2540	6.9422	0.00827727200799	0.01818236746602
DRAM2	0.1912	4.9290	0.00828063791312	0.01818536224645

DCTN2	0.1472	7.5546	0.00828334417543	0.01818689782322
TTC9C	0.2978	4.0482	0.00828534261586	0.01818689782322
PEAK1	0.3577	3.6175	0.00829615293255	0.01820622638485
RNPEP	-0.1325	6.6448	0.00830314901481	0.01821717714509
UST	0.2517	4.0479	0.00831776996742	0.01824484760246
PLPBP	0.2106	4.2572	0.00832859035935	0.01826417026160
SIX5	-0.2104	4.6423	0.00833063130075	0.01826423535541
ZNF3	0.1152	6.5375	0.00833535207579	0.01826610771116
DPY30	-0.1448	5.7364	0.00833550824304	0.01826610771116
SETD1A	-0.1584	6.4642	0.00835342363145	0.01830095054215
TPRN	0.2377	7.4031	0.00835835779847	0.01830734374527
DHCR7	-0.1543	8.6581	0.00836515966031	0.01831782369791
NR2C2	-0.4293	4.5440	0.00838116791383	0.01834845367055
COX8A	-0.2548	8.1581	0.00840120790594	0.01838789322580
PBX2	-0.1187	6.6203	0.00840590784099	0.01839374677205
MGAT5	0.1996	5.1254	0.00841463049239	0.01840839785627
MRPL11	-0.2574	6.8409	0.00843492476166	0.01844835061671
RTL6	-0.3398	4.9151	0.00846102098858	0.01850097076748
NCK2	0.2098	5.2331	0.00846431789459	0.01850372431411
HERC2P9	0.3513	4.1446	0.00847337695483	0.01851151669709
RSBN1L	0.2865	3.8973	0.00847508539798	0.01851151669709
BCAS4	0.1671	6.1906	0.00847580035647	0.01851151669709
CDK1	-0.3390	3.6548	0.00847603638658	0.01851151669709
SH3YL1	0.2532	6.0894	0.00847877838342	0.01851305277708
MSMO1	0.1507	5.2240	0.00848458348923	0.01852127467926
HMGCL	-0.2148	5.1830	0.00848852828169	0.01852543266668
CYP20A1	-0.3702	3.5591	0.00849467995083	0.01853440380429
CEPT1	0.2449	3.9273	0.00849851647389	0.01853832046586
HLA-E	0.1757	8.1107	0.00851179600983	0.01856282890616
FRG1HP	-0.1840	3.5951	0.00851441041567	0.01856407226523
DCTN4	-0.4204	4.3485	0.00852649647591	0.01858596123326
MRPL10	-0.1440	6.8056	0.00854113504905	0.01861340229912
TRMT2A	-0.2045	5.6970	0.00855126588141	0.01862916780088
ATP5MC3	0.1542	7.1311	0.00855247225657	0.01862916780088
POC1A	0.2284	4.3748	0.00855584262164	0.01863204001131
COPE	-0.2770	8.1159	0.00860614596259	0.01873709218085
PHLDA3	-0.2498	7.6438	0.00862588956711	0.01877557602084
PHTF2	0.3890	4.0559	0.00864340252207	0.01880918722811
TMEM102	0.2517	5.0552	0.00864606559756	0.01881047477035
NAA60	-0.1492	6.7504	0.00865209159502	0.01881907635314
KMT2B	-0.1975	5.9869	0.00867378322243	0.01886173980911

MSL3	0.1878	4.5943	0.00871228544560	0.01894092988544
RNASEK	0.3299	7.7607	0.00871993077655	0.01895301373429
LPAR2	-0.2546	5.4463	0.00874909010550	0.01901184188755
PLD3	0.1813	7.3206	0.00875179728367	0.01901317491220
QTRT2	-0.3199	4.2897	0.00876953745187	0.01904715847893
NOMO3	0.2969	6.1154	0.00880760101736	0.01912525701546
AMDHD2	0.2614	6.7939	0.00884067252631	0.01919219044844
REEP3	-0.2018	4.1180	0.00884265222291	0.01919219044844
SDC1	-0.1194	8.5062	0.00884633139241	0.01919558790311
PIGS	0.1356	6.5373	0.00884959794140	0.01919808860628
ROCK2	0.3455	5.0443	0.00885926322987	0.01921446605934
TBX2-AS1	-0.3165	6.7483	0.00886367125029	0.01921943615660
SPECC1L	-0.1919	5.2556	0.00887742721177	0.01924466853904
MAP4K2	0.1717	5.2069	0.00890360111088	0.01929680231215
EFNA5	-0.1971	3.8432	0.00896126730982	0.01941714827976
MMUT	0.2501	4.6135	0.00897507942417	0.01944243708275
STAP2	-0.2471	6.9182	0.00898985642980	0.01946980353900
RNF167	0.1929	7.5489	0.00899773944547	0.01948222982935
ASB1	-0.2158	4.3607	0.00903978502304	0.01956860257312
RELA	-0.1103	7.0944	0.00905900289430	0.01960553033440
MST1	-0.2800	4.6236	0.00906371671406	0.01961105825123
NEK11	-0.1952	3.6479	0.00907083218632	0.01962177872416
NSMCE1	-0.2899	5.8561	0.00911219599227	0.01970563301289
TAF1D	0.1962	5.4673	0.00911393664290	0.01970563301289
TSTD1	-0.2717	7.2182	0.00912674989159	0.01972863979184
MRPL20-AS1	-0.2334	4.9726	0.00913723332615	0.01974660062704
ZNF213	-0.1471	5.6601	0.00915366093304	0.01977739589173
TRIOBP	-0.1356	6.2131	0.00915644842680	0.01977871269357
HELZ2	0.2556	5.2598	0.00917254634939	0.01980877369770
BLOC1S4	-0.2148	4.7044	0.00917916090219	0.01981834525744
UBE2G1	0.2175	5.4579	0.00918177590733	0.01981927906215
GPR143	0.2477	4.0545	0.00918926080797	0.01983067907102
PPIE	-0.2307	5.2614	0.00919142475607	0.01983067907102
PPP4R1L	-0.1972	3.6979	0.00920614719831	0.01985772510876
HDAC8	0.2738	4.1127	0.00922469936795	0.01989301708866
ARHGAP12	0.4332	4.4121	0.00925374927044	0.01995092524332
FZD2	0.1438	5.5595	0.00926513717407	0.01997073597857
OSER1	0.1666	5.5431	0.00928265422762	0.02000374538230
SDCBP	0.4334	3.8808	0.00928873070508	0.02001209099238
E4F1	-0.1888	6.4573	0.00929192478615	0.02001422414209
BCAS2	-0.1203	8.2597	0.00930964744012	0.02004764249554

FAM185A	-0.1925	3.5053	0.00932888944294	0.02008431603399
ADAM10	0.3523	4.6405	0.00933520098162	0.02009314058168
COPS3	-0.1861	5.7140	0.00934267840967	0.02010446981949
MRPL35	-0.1409	4.9156	0.00934905444881	0.02011342417664
SCO2	-0.3107	4.5566	0.00937740928630	0.02016964796990
CAP2	-0.5318	3.6469	0.00938190557606	0.02017454050111
TATDN1	-0.1433	5.9607	0.00939709166140	0.02020241225785
KCNN4	0.2327	4.4726	0.00945873357074	0.02032652421977
BBC3	0.2371	5.5080	0.00945929868437	0.02032652421977
NSRP1	0.2135	4.5676	0.00946804849873	0.02034051299196
CCDC186	0.3841	3.9074	0.00947341018769	0.02034721804976
EBF4	-0.3092	4.1993	0.00952394908790	0.02045092969194
EIF4A3	0.1212	7.4216	0.00953333591673	0.02046624668080
ABCG2	-0.2433	4.8421	0.00953766100807	0.02047069241652
GDAP1	-0.2563	3.9947	0.00957067232389	0.02053669077817
OSTC	0.1867	5.5598	0.00958479547938	0.02055541665640
SYT17	-0.1570	5.2523	0.00958485599327	0.02055541665640
ZNF75D	0.2582	5.1111	0.00958618979626	0.02055541665640
P4HTM	-0.1610	5.9062	0.00960493358866	0.02059074643971
NEB	-0.3950	3.7370	0.00961459988981	0.02060660410653
NPIPB3	0.2397	8.9654	0.00964685480352	0.02067085617526
NETO2	-0.2241	3.8544	0.00964995627869	0.02067262396009
POP5	-0.2296	5.2933	0.00965556842189	0.02067976812244
ZSCAN16	0.1893	4.0437	0.00967024900136	0.02070632661668
TENT2	0.3437	3.9657	0.00972578754192	0.02082033867708
DMWD	-0.1433	4.6880	0.00974593503344	0.02085508071086
PDIA4	0.1460	7.4693	0.00974660968362	0.02085508071086
MAP1S	-0.2344	5.4138	0.00975735208712	0.02087314824573
CHD2	0.2227	6.4678	0.00977680858101	0.02090984425910
CC2D1B	0.1484	5.2352	0.00989842986761	0.02116497330534
FURIN	-0.1145	6.6637	0.00990644036246	0.02117497249732
MIR1915HG	0.2715	3.9165	0.00990776986467	0.02117497249732
HTATIP2	-0.1325	5.6310	0.00991559676429	0.02118671393330
POLD1	-0.2245	5.7961	0.00999292675482	0.02134692257363
MRPS24	-0.2636	7.2582	0.01000006892931	0.02135715567899
PHF5A	-0.1944	4.6498	0.01000399001047	0.02136050629792
HARS2	0.1580	5.8894	0.01002448806738	0.02139924215793
PLOD1	-0.1426	5.7645	0.01007959149188	0.02151181441546
TUBA1C	-0.1482	8.5505	0.01011655703804	0.02158563309737
KCNC3	0.2698	5.4260	0.01014777194298	0.02164714987413
CASP7	0.2309	4.6185	0.01016443948674	0.02167761272407

RNF7	-0.1683	6.5024	0.01016920763265	0.02168227942967
SAMD4A	0.3676	3.6274	0.01017140296998	0.02168227942967
RTF2	-0.1369	8.5568	0.01017902757482	0.02168561389393
HAX1	-0.2096	6.9274	0.01017957216234	0.02168561389393
CENPBD1	-0.1762	4.6994	0.01018013126636	0.02168561389393
DHRS4L2	-0.3714	5.3095	0.01018425579995	0.02168931212930
GPR89A	0.1996	5.9415	0.01019177576099	0.02170023814432
IGDCC3	-0.2667	4.3715	0.01020357849776	0.02172027574734
ZRANB2	-0.2535	4.1374	0.01023450006847	0.02177876318073
CUEDC1	-0.1582	6.1820	0.01023585081548	0.02177876318073
IPO7	0.3399	5.9825	0.01026566007587	0.02183707171446
C20orf27	0.3211	7.0419	0.01028394954210	0.02186854040615
GOLGA7	0.2690	4.7955	0.01028526991242	0.02186854040615
PDXDC1	0.2027	7.5608	0.01029628025150	0.02188682606832
MBD6	-0.1765	6.8170	0.01029974561661	0.02188906855708
SNAPC4	-0.1433	5.9849	0.01032325660690	0.02193390108734
HIKESHI	-0.2001	5.0222	0.01033758500640	0.02195742300040
ENDOG	-0.3559	5.9330	0.01033916317032	0.02195742300040
RBM38	0.1545	6.9839	0.01038282182151	0.02204498596238
NELFB	-0.1673	7.3851	0.01047327970864	0.02222945774756
USP3	0.1813	5.2290	0.01047460078205	0.02222945774756
PBRM1	-0.3737	3.7065	0.01048152413310	0.02223895342353
ST3GAL4	-0.1704	6.1913	0.01048434647895	0.02223974547427
C5orf24	-0.3330	3.6877	0.01048764828200	0.02224155395816
AMZ2	-0.1093	6.9262	0.01052428214269	0.02231403365347
MRPL18	-0.1808	5.0274	0.01053772462760	0.02233696409883
ADAM9	0.5343	4.5381	0.01054001664613	0.02233696409883
NAGPA	-0.1874	4.8687	0.01054626552950	0.02234363020798
KLHDC9	0.2110	4.2345	0.01054808310776	0.02234363020798
SIL1	-0.2799	7.0244	0.01056969562981	0.02238418983542
ZNF146	-0.3188	5.0056	0.01057859368711	0.02239781050889
ACAP3	0.2094	6.1444	0.01063775829275	0.02251782821828
HS6ST1	-0.1271	6.0973	0.01064982392677	0.02253811491005
RABEP1	0.2428	5.8755	0.01065569399384	0.02254528358761
ENOPH1	0.2562	4.6014	0.01068309642123	0.02259799641304
HMGB1	-0.1244	9.0514	0.01068707049862	0.02260113814578
PANX2	-0.1634	4.4513	0.01069626210178	0.02261530992929
CDCA7L	0.1518	4.9649	0.01073154955708	0.02268463722714
SARNP	0.2497	6.2687	0.01075346615269	0.02272567515303
SDF4	-0.1663	7.3136	0.01077695308789	0.02277001186391
MPHOSPH10	-0.1777	5.2295	0.01080551396537	0.02282504589895

PC	-0.1265	6.3775	0.01084109657798	0.02289488326154
GPC1	0.1657	5.5969	0.01087621704826	0.02296371239601
MKKS	0.1749	5.7959	0.01098504896182	0.02318810544451
MLX	0.1195	5.9143	0.01100229775878	0.02321911827735
TIGAR	0.2547	4.6597	0.01100660474656	0.02322039472979
RRAGB	0.2333	3.7487	0.01100801666246	0.02322039472979
MFN2	0.1726	6.2598	0.01102250938006	0.02324290831565
ASL	-0.2300	6.3048	0.01102380862411	0.02324290831565
ZNRD2	0.3277	6.1223	0.01106013243165	0.02331408138621
BRF2	0.2181	3.6601	0.01106899344697	0.02332734497377
BTBD1	0.3169	4.9062	0.01107576836169	0.02333620707483
PRR5	-0.3019	4.6602	0.01122212553748	0.02363909116350
EXOC2	-0.2427	4.1154	0.01123893163337	0.02366900235682
ANKS1A	0.3020	4.6327	0.01126104162424	0.02371006700434
RPL15	-0.1448	11.2219	0.01127748671708	0.02373918796427
FDFT1	0.1188	7.3990	0.01128343806006	0.02374621112940
SENP5	0.1643	5.3897	0.01131848913661	0.02381445779646
RPF2	-0.1590	4.5155	0.01133911680460	0.02385233256950
MYL12B	0.1347	9.4755	0.01134222219833	0.02385333945878
CSTF2T	-0.2552	4.0689	0.01134796549066	0.02385989224837
ING4	-0.1833	5.2540	0.01136846419972	0.02389745911982
TRIM33	0.2170	8.8275	0.01142171743623	0.02400384541505
FUBP1	-0.1862	6.1629	0.01144575679403	0.02404880089000
ATG4D	-0.1990	5.6733	0.01146038326178	0.02407396261860
FASTK	-0.2724	7.1345	0.01150425653302	0.02416053505466
PRADC1	0.2510	5.5593	0.01153251909575	0.02421429038348
HOXC9	0.2858	3.9048	0.01154894740111	0.02424317876780
SPTY2D1	0.2931	4.2104	0.01159783611840	0.02433564466833
TMEM87B	-0.3189	4.2094	0.01159835592165	0.02433564466833
ZNF32	-0.2152	5.0423	0.01160256002460	0.02433884213060
GCC1	0.1938	4.8401	0.01161411863887	0.02435746220776
GBA2	0.1863	5.1981	0.01162497127064	0.02437459342153
WDR83	0.2493	5.1917	0.01163320992036	0.02438623713914
KLHL5	0.1919	6.4433	0.01166743562292	0.02445233853953
INPP4A	0.2106	4.8241	0.01168449040802	0.02448243133254
SPINDOC	0.1503	5.3403	0.01170831015639	0.02452668155252
MORF4L1	-0.1528	7.3273	0.01173190130615	0.02457043260175
ANO10	0.1598	4.6295	0.01177014433903	0.02464484222797
TRIM27	-0.1149	6.5069	0.01181569295984	0.02473451078107
WBP1L	0.1239	6.5834	0.01186374648525	0.02482938046383
GGT7	0.1541	4.9676	0.01190246914733	0.02490468256381

ARID1B	-0.3558	4.0924	0.01190972469913	0.02491412347219
DPH3	0.1561	4.0904	0.01191954237942	0.02492692544469
HDGF	-0.1331	9.7915	0.01192133434713	0.02492692544469
CDC37	0.1911	8.8827	0.01195793403533	0.02499769773821
IGF2R	0.3672	6.2434	0.01197767957943	0.02503321248811
SLC35F2	-0.2520	3.7214	0.01199263285543	0.02505448745492
LRRC26	-0.4194	4.4251	0.01199374215789	0.02505448745492
MRPL43	-0.2091	6.7242	0.01199702719185	0.02505448745492
PSME3IP1	-0.1348	6.2943	0.01199889504916	0.02505448745492
TAX1BP1	0.1978	6.6191	0.01202288100676	0.02509880055688
ITPRIPL2	-0.2048	5.3013	0.01204264825264	0.02513428838938
POLD2	-0.2322	7.3163	0.01206219792395	0.02516930591622
XPO5	0.1663	6.1725	0.01207793627365	0.02519635637514
HIBCH	0.2443	3.7599	0.01208494557041	0.02520475032149
USP11	-0.1352	6.6191	0.01208751102853	0.02520475032149
RAB4A	-0.1290	5.3080	0.01209874102441	0.02522237540006
FRA10AC1	0.1848	3.6498	0.01212263460952	0.02526638624950
ZNF830	-0.2063	3.6371	0.01213243820407	0.02528101682679
ARHGAP10	-0.1661	4.9812	0.01217316035358	0.02536005257418
PHKA2	-0.1606	5.3695	0.01219239495530	0.02539429784153
BDH1	-0.1357	6.0526	0.01219695487716	0.02539797001594
ALG9	-0.2955	3.6069	0.01222364806604	0.02544771849788
NDUFA12	-0.1793	6.1452	0.01225111235695	0.02549904912066
PDZD8	0.4218	3.8628	0.01226154382858	0.02551370604917
SLK	0.3162	4.9988	0.01226377347259	0.02551370604917
UBL7	-0.2478	5.9544	0.01227427740391	0.02552970982706
POLR3E	-0.1456	5.6424	0.01228178663076	0.02553530050072
CACNG8	0.2561	3.5023	0.01228258920682	0.02553530050072
STYX	0.2867	3.8946	0.01230817019226	0.02557848504113
CHMP1B	0.1871	5.8211	0.01230899456335	0.02557848504113
SEC13	-0.1472	7.5156	0.01231188805498	0.02557864457270
TMEM178B	0.2708	3.7500	0.01237620035955	0.02570637590693
TAP2	-0.2239	3.9795	0.01238918153507	0.02572068434954
C9orf64	-0.2651	3.9230	0.01238942067053	0.02572068434954
NOP53	-0.2693	9.1660	0.01239446661839	0.02572068434954
WIPI2	0.1107	7.7956	0.01239701827092	0.02572068434954
ZNF304	0.3456	3.7584	0.01239725089725	0.02572068434954
GGCT	0.2059	7.0422	0.01243487315867	0.02579284676881
C1orf131	-0.1887	3.5308	0.01243880450396	0.02579325485477
LRR1	0.1513	3.9839	0.01244075060719	0.02579325485477
RBSN	-0.2113	5.2784	0.01245156296581	0.02580906348889

ITCH	0.3234	4.5350	0.01245405970800	0.02580906348889
SLC31A2	0.2353	4.0615	0.01245825066771	0.02581185815958
SRP19	0.1609	5.0205	0.01249972569571	0.02589188162472
XPOT	0.2570	6.1049	0.01253731075821	0.02596381276975
FAM32A	-0.1376	6.9400	0.01255675974350	0.02599633062447
NOA1	0.1299	6.5379	0.01255873829419	0.02599633062447
LINC00265	-0.2104	4.7359	0.01260994391511	0.02609637663928
ATP1A1	0.1440	10.2089	0.01265734074368	0.02618849653528
PPP4R1	-0.2062	5.6204	0.01266915690637	0.02620697354596
CRELD1	-0.1681	4.4842	0.01269631519341	0.02625717109345
EIF4E3	-0.3059	3.8136	0.01270245026918	0.02626387770821
NHLRC3	0.2849	3.7273	0.01271214430733	0.02627793818686
ARPC3	-0.1597	8.1568	0.01273414199678	0.02631741999834
EPAS1	-0.3011	6.6189	0.01274212337470	0.02632792317763
ICMT	0.1506	5.7693	0.01276463733726	0.02636844214278
PRR14	0.1443	6.5685	0.01281779677676	0.02647223391625
TFAP2A	0.2794	3.9480	0.01282577497990	0.02648268817473
TRPT1	0.2154	6.1508	0.01283705364278	0.02649995092750
CHMP4A	-0.3321	5.7213	0.01284418391290	0.02650368784332
DOP1A	0.3337	3.9970	0.01284609179607	0.02650368784332
TBC1D5	-0.2740	5.9944	0.01284761963289	0.02650368784332
EZH2	0.1710	5.4169	0.01288078856146	0.02656607788477
TMED3	-0.2170	6.9496	0.01289891164312	0.02659741522053
RNF103	0.2368	4.4125	0.01292115433417	0.02663723098946
JKAMP	0.2445	4.8998	0.01296159487910	0.02671047308385
MAP3K14	-0.1474	4.8303	0.01296256523296	0.02671047308385
MOB3A	-0.2598	4.4245	0.01297345306033	0.02672684374792
PPM1B	0.2689	4.9849	0.01297730074982	0.02672870676097
NPY1R	0.3453	3.9903	0.01303811029950	0.02684786386161
PRR12	-0.3292	5.0531	0.01305102271185	0.02686836029162
AP5Z1	0.1190	6.9382	0.01307022409996	0.02690175923335
TONSL	-0.1500	6.0099	0.01307317074075	0.02690175923335
KIAA0319L	0.1194	6.1894	0.01311130734149	0.02697412369009
PDIA3	0.1057	7.8734	0.01317176604549	0.02709236862041
EIF4ENIF1	0.1702	4.7017	0.01319910711075	0.02713276636862
R3HDM2	-0.2359	6.0300	0.01320012367717	0.02713276636862
ZFAND1	0.2432	4.6832	0.01320037020334	0.02713276636862
FAM160A2	-0.1672	4.1250	0.01325559538398	0.02724011352838
KXD1	-0.1858	6.8382	0.01326235941621	0.02724784747932
ASCC1	0.1488	5.3047	0.01332497814783	0.02736694242473
LRRC73	0.2839	4.4997	0.01332635385995	0.02736694242473

CETN3	0.2784	3.5754	0.01333790078981	0.02738177643307
DCAKD	-0.1432	5.5738	0.01333960785595	0.02738177643307
MAP2K4	-0.2266	4.2387	0.01335151343992	0.02740002114077
FIG4	0.1662	4.5161	0.01336797800556	0.02742761144791
TNS1	-0.2670	4.3091	0.01337564293770	0.02743555091688
ZNF326	0.2558	4.3443	0.01337789004074	0.02743555091688
NCOA6	-0.2803	5.5705	0.01339099896486	0.02745498860756
TMEM50A	-0.1429	5.5846	0.01339341477057	0.02745498860756
ERGIC3	-0.2133	8.3529	0.01339764421329	0.02745746041545
PDXK	-0.1685	8.6241	0.01343497426199	0.02752775299485
PRPF6	-0.1790	8.5194	0.01353258877306	0.02772150657527
LOXL2	-0.2735	3.6255	0.01354422719396	0.02773909047098
BTBD7	-0.3489	4.8199	0.01357369564846	0.02779317478774
FOXRED2	0.1203	6.6292	0.01360687716001	0.02785483577322
ZFYVE26	0.2396	5.1912	0.01361421067251	0.02786356707618
PHB2	-0.1467	8.6907	0.01365046543052	0.02793147286493
GORASP1	0.1295	6.1541	0.01366742359125	0.02795987241094
MPST	0.2514	6.6384	0.01368650321313	0.02799259812578
DKK1	-0.2966	6.4047	0.01370339048165	0.02802082615713
TSIX	0.3239	3.5950	0.01373270040999	0.02807443773597
PXN	0.1093	8.6398	0.01373816497985	0.02807928790953
IER5L	0.2276	8.3319	0.01377094701181	0.02813549207947
CLDN9	-0.3046	4.4537	0.01377186017985	0.02813549207947
ZFPM1	-0.2467	5.7536	0.01379709062085	0.02817876806940
FHL3	0.2271	4.3133	0.01379924915809	0.02817876806940
ENY2	-0.1762	6.4496	0.01380686111494	0.02818797342284
VPS39	-0.1204	5.7848	0.01384444313836	0.02825834752517
TBC1D13	0.1262	5.9439	0.01384822910712	0.02825972326332
STXBP3	-0.3336	4.4646	0.01385167491689	0.02826040438559
WIZ	-0.1408	7.0391	0.01386539174315	0.02828179791125
KDM4C	0.2987	3.9289	0.01386838961555	0.02828179791125
PHLDB3	0.2069	5.7155	0.01387541381862	0.02828976939536
SLC5A6	-0.1144	6.9069	0.01396014937255	0.02845614286243
MSL1	-0.2012	5.2695	0.01404608266987	0.02862488256847
GTF2E2	0.2093	4.7063	0.01407223931264	0.02867175346603
AFF1	0.3487	4.3640	0.01407647801138	0.02867395621833
ATAD1	0.2655	4.2540	0.01410404308237	0.02871972260136
MRM3	-0.2074	5.1920	0.01410527065324	0.02871972260136
HMGN1	0.1234	9.3429	0.01415633266011	0.02881722862283
CASP3	0.1924	3.7636	0.01417883630517	0.02885656936065
PRUNE1	0.1759	5.8117	0.01418651210886	0.02886572181504

SHISA4	-0.3216	3.3842	0.01420546312608	0.02889780704478
NFKBIL1	-0.2659	5.9623	0.01420913707131	0.02889880710965
LRRC56	-0.2573	4.1172	0.01422520618875	0.02892501061353
ANXA7	0.1939	6.5298	0.01423140553311	0.02893113804482
TAPBP	-0.2273	7.6951	0.01425579522953	0.02897145725155
PIN1	0.2780	5.8003	0.01425761947552	0.02897145725155
PSME2	0.2480	7.3471	0.01427852593553	0.02900744832674
NDUFAF8	-0.3305	5.5340	0.01434428605958	0.02913452509662
NGRN	-0.1235	7.0687	0.01440089954194	0.02923630402048
ATG12	0.1607	4.5543	0.01440158698056	0.02923630402048
KRI1	-0.1762	5.9154	0.01440405508068	0.02923630402048
TMEM126B	0.2339	4.0959	0.01444844883954	0.02931985785740
CIAO1	0.1112	6.8706	0.01446054123970	0.02933784070548
PANK4	-0.1749	3.9772	0.01449113951628	0.02938699728550
TTLL3	-0.2349	4.6441	0.01449124257730	0.02938699728550
QARS1	-0.1198	7.9612	0.01455583288730	0.02950854042549
LINC00997	-0.2355	3.5048	0.01455767658916	0.02950854042549
UXS1	0.2113	4.3871	0.01458620954991	0.02955977882676
TPGS1	-0.3746	4.8045	0.01460995035625	0.02960128495874
PSD	-0.3319	3.7638	0.01462910329413	0.02963347914655
ERCC1	-0.1985	6.0529	0.01464087812894	0.02965071683517
FOXK1	0.2291	5.7437	0.01464829260047	0.02965911819506
ELOC	0.1790	5.7281	0.01466106787593	0.02967836767305
FN3KRP	0.1635	5.3690	0.01466714749889	0.02968405759693
TXNDC12	0.1590	5.4675	0.01473398167459	0.02981267548728
LOC102724159	-0.1417	5.2259	0.01473727246151	0.02981269129494
TRAPPC3	-0.1789	5.5699	0.01478248116489	0.02989748584820
EFNA1	-0.1259	7.1306	0.01481394850643	0.02994802371981
ARHGEF1	-0.1227	6.0994	0.01481406481108	0.02994802371981
MRTFA	-0.1440	6.0360	0.01483855076593	0.02999084787568
SLC44A1	-0.2024	6.0611	0.01484727372303	0.03000180077411
ACAP2	0.4235	3.7797	0.01486818771644	0.03003672151796
NUDCD2	0.1943	4.7932	0.01487117056984	0.03003672151796
LEO1	-0.1892	6.4627	0.01488337240035	0.03005468195854
SPIN3	-0.2174	4.0722	0.01489670479812	0.03007491691235
ANAPC4	0.1849	4.6015	0.01491260744724	0.03010033079093
SLC46A1	-0.1515	4.2813	0.01492598423695	0.03012063619017
AGPAT2	-0.2460	7.7779	0.01497595140035	0.03021475553578
CCDC167	-0.3276	3.7729	0.01498996049841	0.03023630192938
LSR	0.1382	7.6321	0.01500400774346	0.03024959101468
IRF2BPL	-0.3303	6.9961	0.01500635943112	0.03024959101468

CPSF1	-0.1197	7.7754	0.01500654195806	0.03024959101468
RAB12	0.2666	4.8302	0.01501949275629	0.03026897774519
NBDY	-0.1685	5.7224	0.01505126552078	0.03032627960821
RPS27L	-0.1645	5.7998	0.01506389617780	0.03034499582755
MAGED1	0.1047	6.8923	0.01508739729743	0.03038559655310
NMB	-0.3451	4.0695	0.01512895982035	0.03046254636998
SAP18	-0.1318	7.0566	0.01513817202869	0.03047433832688
CEP68	0.2779	3.9055	0.01516127148151	0.03051401324669
SKA2	-0.1144	6.8091	0.01516460101116	0.03051401324669
GEMIN7	0.2670	4.6098	0.01521127411245	0.03060114758864
ATAD3A	0.1872	5.8194	0.01522056077389	0.03061304814789
MOB3C	0.1627	4.3556	0.01522861608011	0.03062246736569
CCAR2	-0.1141	7.2389	0.01524748152271	0.03065361516665
MRPL24	-0.2569	7.0673	0.01527560182531	0.03069929102199
SLC25A32	-0.3403	3.8789	0.01527696246320	0.03069929102199
VPS13C	0.5205	3.7075	0.01532801615196	0.03079506961857
MYCBP	0.1556	4.9283	0.01536210560723	0.03085673103722
TBCA	0.1976	6.8634	0.01538663977069	0.03089917641699
PRSS27	-0.3136	3.4169	0.01546411617621	0.03104789719128
TBC1D1	0.1026	6.2339	0.01548344649995	0.03107983591203
TMEM131L	-0.1087	5.9597	0.01552010275477	0.03114653107537
TDP1	0.1462	5.3637	0.01552746989019	0.03115443086010
TTF2	0.2962	6.1140	0.01553290203089	0.03115844562458
KIF18B	-0.2123	3.9489	0.01554629925762	0.03117843276467
LIMCH1	-0.2794	4.2125	0.01555160935867	0.03118219575757
HLA-F	0.2249	3.9650	0.01555902833225	0.03119018461041
DRG2	-0.1684	5.7948	0.01556562380203	0.03119651947610
UBAC1	0.1467	6.8556	0.01558422501305	0.03122690806343
DCTPP1	0.1994	6.9303	0.01559535796503	0.03124232201201
EMC3	0.1727	7.4947	0.01560418046804	0.03125310163879
RPARP-AS1	-0.3068	4.5860	0.01566228421523	0.03136255853550
AURKB	-0.2024	5.6686	0.01566884776371	0.03136878451109
GTPBP10	-0.2003	3.9793	0.01569577325417	0.03140902257104
CTDP1	0.1380	5.1659	0.01569878254770	0.03140902257104
DYNC1I2	0.1612	5.7298	0.01569932314172	0.03140902257104
SMCR8	-0.3324	4.8986	0.01573837829457	0.03148022319229
RETREG2	0.1098	7.7227	0.01577285725094	0.03154224106932
RILPL1	-0.1698	5.1247	0.01579420000477	0.03157796790914
MBTPS1	-0.1985	7.8269	0.01582319632411	0.03162897772820
MFSD1	0.1933	5.6421	0.01583938096486	0.03165436147489
CIAPIN1	0.1371	5.5886	0.01587599053718	0.03172054346934

HIBADH	0.2278	5.2917	0.01592729656269	0.03181605369244
CEP55	0.2138	4.3787	0.01598513077791	0.03192455962045
TM7SF2	0.2135	7.8769	0.01598922892980	0.03192572293569
BRF1	-0.1433	7.4228	0.01601239317644	0.03196494667735
CDC20	-0.1650	6.2537	0.01602951946152	0.03199210246814
MTA2	-0.1012	7.4466	0.01604941661246	0.03202477527088
PPP2R5C	0.1156	6.9681	0.01607912490433	0.03207700642711
ARHGAP32	-0.3279	4.8548	0.01612118500318	0.03215385043133
LAMP1	0.1130	7.7505	0.01621202552654	0.03232793232467
PRDX1	0.1965	8.5998	0.01621661073457	0.03232997630749
APTX	0.1567	4.7008	0.01622185703758	0.03233333708478
TDRD1	0.2789	3.4174	0.01626447211597	0.03240835323963
PODXL	-0.2334	6.6872	0.01626863666239	0.03240835323963
LOC112694756	0.3980	4.2138	0.01627019958369	0.03240835323963
TOMM70	0.2121	5.7598	0.01632941769134	0.03251917588927
MRPL45	-0.1616	5.4600	0.01640689737444	0.03266630893605
PRRC2C	0.2393	7.7105	0.01641732120288	0.03267989781749
GPALPP1	0.2623	3.8453	0.01642294936867	0.03268224833018
UBR5	0.3158	7.3267	0.01642569996465	0.03268224833018
SCAF1	-0.1443	6.6990	0.01645978612769	0.03274289547111
NSUN5	-0.2255	5.8047	0.01647278153899	0.03276157011729
POLE3	0.1393	6.8490	0.01650959324924	0.03282759279535
NBPF19	0.2527	5.5362	0.01657658832309	0.03294686413657
USP15	0.2094	4.8171	0.01657683319458	0.03294686413657
EMSY	0.4500	4.0611	0.01661295814846	0.03301143828143
MMACHC	0.2053	3.4102	0.01662131769997	0.03302082389706
KAZN	0.1857	3.4517	0.01664245740551	0.03305558961055
VPS35	0.1678	5.9838	0.01668519913092	0.03313323711085
TSPAN3	0.1123	6.2501	0.01672580111109	0.03320660251198
CLMN	0.1789	5.5574	0.01679536264059	0.03333510581751
LRIG1	0.3237	4.2448	0.01679884709674	0.03333510581751
CPT1A	0.2323	7.5521	0.01680329027353	0.03333510581751
SCYL2	0.4565	4.8595	0.01680817741704	0.03333510581751
SRRM3	0.2424	4.9316	0.01680888112965	0.03333510581751
ATXN7L3	-0.1458	6.2111	0.01686784253006	0.03344473319115
NDUFAF7	0.1790	4.8441	0.01693135496862	0.03356333430911
LRRC47	-0.1206	5.5262	0.01697775248277	0.03364725417887
PDHA1	0.1557	7.3470	0.01698109964781	0.03364725417887
PDLIM1	-0.1639	5.9513	0.01704042457645	0.03375743795348
METTL23	0.1225	5.7906	0.01710675910715	0.03388145680525
SMNDC1	0.2994	3.6578	0.01712846160459	0.03391704313809

DDX52	0.2091	3.7362	0.01716447583984	0.03398094726435
JMJD4	-0.2643	5.1316	0.01719118179370	0.03402639970980
PEX5	0.1811	5.8669	0.01721611711476	0.03406832850711
TRIM28	-0.1858	10.3620	0.01726120287702	0.03414779673902
ITGB1	0.2883	6.7276	0.01726379636922	0.03414779673902
FBXL20	0.1580	4.0405	0.01728189205771	0.03417614585715
CD99L2	0.1526	5.3303	0.01729844964180	0.03420144158440
ZMAT2	0.1733	7.0893	0.01730850349300	0.03421387031344
MCM6	-0.1746	5.8155	0.01737157863121	0.03433107846573
ITGB1BP1	-0.1088	6.0536	0.01738259739660	0.03434224332239
ALOX15	-0.2790	4.7306	0.01738479160368	0.03434224332239
MOB2	0.2851	4.9345	0.01740171409480	0.03436819610589
RRAGD	0.1493	4.3472	0.01743276864330	0.03442204219391
MSH5	0.1810	4.4929	0.01748881422028	0.03452520042052
GNL3L	-0.2531	4.8033	0.01756647870973	0.03467098308259
C6orf120	-0.3042	3.5751	0.01758654482103	0.03470304509340
CHPT1	0.2671	4.0649	0.01764147711580	0.03480219449029
MTHFD2	0.2415	5.4372	0.01764445583452	0.03480219449029
GRSF1	0.1435	6.6918	0.01765166348215	0.03480885039770
ZSCAN32	0.2109	4.5912	0.01766539567721	0.03482179975403
YY1	0.2100	7.2942	0.01766589929158	0.03482179975403
C21orf58	0.1928	4.4292	0.01767678497975	0.03483569539955
CYB5R4	-0.2008	3.8770	0.01769485040935	0.03486373108425
VPS26C	0.2392	4.3374	0.01773040236497	0.03492620040701
CST3	-0.2829	8.8267	0.01778376292682	0.03502371527619
MYB	-0.2303	4.5627	0.01783017423890	0.03510750482730
MALSU1	-0.2161	4.1632	0.01783887500999	0.03511702232077
CCNY	-0.1594	6.0457	0.01789882312014	0.03522739764933
KRT81	-0.2504	10.2710	0.01791680671678	0.03525515098484
ZKSCAN8	0.3507	4.0575	0.01797807750410	0.03536386514516
SNHG11	-0.2523	4.9198	0.01797984422147	0.03536386514516
FYTTD1	0.3543	5.2512	0.01799198358352	0.03538007858856
ZSCAN25	-0.3076	4.3253	0.01801610255905	0.03541983705103
ANGEL1	-0.2258	5.5172	0.01802873885306	0.03543700812222
USP43	0.1757	4.3369	0.01811069818211	0.03558281388573
STMN1	0.1384	6.6975	0.01811437182154	0.03558281388573
DDX17	-0.1901	7.5300	0.01811467333925	0.03558281388573
DCAF7	0.1899	7.1633	0.01814893950782	0.03564241342356
MGP	-0.2515	4.9266	0.01815542188522	0.03564743484101
AKIRIN2	0.1675	4.9613	0.01817207273100	0.03567241514705
STARD10	-0.2960	9.3014	0.01820440470173	0.03572816060005

ATP8B2	0.2972	6.0659	0.01822345271199	0.03575037977873
ZNF16	-0.2123	4.1905	0.01822359960310	0.03575037977873
LRP1	0.2195	4.9784	0.01823567271828	0.03576633778719
TES	0.2983	3.9163	0.01824920342703	0.03576979167025
OCRL	0.2402	4.9753	0.01825022708826	0.03576979167025
CBFA2T2	0.1818	4.8713	0.01825419685117	0.03576979167025
CNOT4	-0.2853	3.9674	0.01825618055345	0.03576979167025
NUDT6	-0.2095	3.6386	0.01825932389690	0.03576979167025
PSMA6	0.1691	8.0278	0.01826106752376	0.03576979167025
ANLN	-0.4422	4.5237	0.01827632566016	0.03579195887856
ARL1	0.1252	5.9661	0.01830167567399	0.03583057170310
CWC22	-0.2706	3.8143	0.01830393372213	0.03583057170310
KIFBP	0.2460	4.4198	0.01831423499344	0.03584301033953
FIP1L1	-0.1169	5.7804	0.01832873053451	0.03586365050288
CLK4	-0.2431	3.7354	0.01834930421472	0.03589617224772
AFDN	0.3278	4.4548	0.01839295539877	0.03597098648918
PPP1R15B	0.2930	5.3683	0.01839546980022	0.03597098648918
TMEM191A	-0.3277	4.3634	0.01840574069457	0.03598332212000
HGSNAT	-0.1986	4.3326	0.01841463205309	0.03599295602111
MRPL38	-0.2479	7.2972	0.01843808426894	0.03603042037699
ADCY9	0.2325	4.7300	0.01844173482130	0.03603042037699
WDR25	0.2002	4.8998	0.01845327624213	0.03604521435896
TACC1	-0.2501	7.0804	0.01847961562163	0.03608450046799
OSGIN1	-0.2698	4.6316	0.01848133594060	0.03608450046799
RWDD1	0.1931	5.6138	0.01849583275588	0.03610504240244
FOXP4	0.1158	6.8927	0.01852619877381	0.03615654654308
OGDHL	-0.1483	3.8899	0.01853762590003	0.03617107451616
CNPPD1	-0.1403	7.1074	0.01861383873229	0.03631198056454
ANKRD52	0.1851	6.6441	0.01861867906786	0.03631362212527
P4HA1	0.2606	3.4555	0.01863254343180	0.03632908478529
RSU1	0.1689	5.9230	0.01863460818521	0.03632908478529
SHLD2	-0.2357	4.2763	0.01865124480621	0.03635257090247
PAK1IP1	-0.2074	4.0401	0.01865466142556	0.03635257090247
IVNS1ABP	-0.1432	6.7788	0.01867964884511	0.03639345444378
RNF213	-0.2280	6.8211	0.01869967096600	0.03642464865770
USP33	0.3685	3.6925	0.01874836811287	0.03651167292151
SULT2B1	-0.2529	5.0486	0.01877435918050	0.03655445019685
RPE	0.2071	4.2313	0.01882910495003	0.03665318371945
HLCS	-0.1966	4.3723	0.01884746554656	0.03668106185776
PRR14L	0.3153	4.4472	0.01887888482954	0.03673433750527
HMG20B	-0.1888	8.8170	0.01888649692630	0.03674127647553

ANO8	0.2534	4.3613	0.01895897583862	0.03687437558161
HSBP1	0.1363	7.3322	0.01899494514249	0.03693642330599
TOMM22	-0.1848	6.4398	0.01901131395802	0.03696033869680
ARHGAP17	0.1464	5.6547	0.01902956090351	0.03698789438458
SLC50A1	0.1604	7.3349	0.01906056542118	0.03704022995715
KDM2B	-0.2897	4.6381	0.01908596707536	0.03708165746927
GRTP1	0.1733	4.6593	0.01909924600700	0.03709951935606
CHAF1B	0.1516	4.3465	0.01911291952586	0.03711813990897
DHX57	0.1646	4.8108	0.01916493319134	0.03720881104483
DDB2	-0.1462	7.1673	0.01916780289260	0.03720881104483
CALB2	-0.2048	4.7347	0.01921560388857	0.03729363088526
SKIL	-0.3887	4.1059	0.01922247306612	0.03729899100714
TEKT4P2	-0.2621	3.8301	0.01924645465711	0.03733754640915
SFXN5	-0.1550	4.2555	0.01926147741511	0.03735870918552
RAB22A	-0.1605	6.7548	0.01936184295686	0.03754535466393
RNF214	-0.1839	4.0110	0.01941895360846	0.03763110497951
HINT2	-0.3253	5.5454	0.01941929099161	0.03763110497951
PPT1	-0.1190	8.1935	0.01942419203232	0.03763110497951
TENT4A	0.1811	5.0281	0.01942483377761	0.03763110497951
EIF4E	0.2286	4.9515	0.01942678340975	0.03763110497951
CCM2	0.2166	6.1454	0.01948350989150	0.03773293950196
NEDD9	0.2651	4.4329	0.01952160649899	0.03779865855380
NDUFB9	-0.2399	8.9015	0.01958664470705	0.03791650406838
MGST1	0.1358	5.8681	0.01960990481989	0.03794624680830
SUCLG2	-0.3122	5.0096	0.01961063738940	0.03794624680830
CTR9	0.2642	5.1057	0.01961454493097	0.03794624680830
GREB1	-0.3294	6.0811	0.01962994714631	0.03796795527915
CCNB1IP1	0.1307	5.7827	0.01963725554063	0.03797400288851
PLAGL2	0.2424	4.8203	0.01971166813277	0.03810978461010
ADCY6	0.1952	6.0375	0.01971668223505	0.03811113147258
ZNF576	-0.2020	3.5766	0.01972452210858	0.03811113147258
LOC100133331	-0.2451	4.7032	0.01972496841717	0.03811113147258
ABCE1	-0.2800	4.2903	0.01973006090219	0.03811113147258
PPM1F	-0.1672	4.7350	0.01973334877041	0.03811113147258
SLC37A4	-0.1284	6.1924	0.01977703280543	0.03818737718607
FAM204A	-0.1678	5.2654	0.01980405017445	0.03822933927874
B4GALNT3	0.1107	5.5610	0.01980718437468	0.03822933927874
RSF1	0.2823	4.9548	0.01985526345202	0.03830837122290
UBA2	0.2833	5.4304	0.01985656902832	0.03830837122290
ARID5B	0.4151	4.7362	0.01988168069397	0.03834867085428
XXYLT1	-0.1355	4.8830	0.01989846105361	0.03837288698828

EOLA1	0.1227	6.3235	0.01990465243788	0.03837667702514
DBNL	0.1194	7.5741	0.01994568420782	0.03844762434541
DAGLB	0.1641	5.6442	0.01995117506278	0.03845004684744
PKP4	0.1558	6.7100	0.01999643331659	0.03852909207467
MUCL1	-0.3052	3.3918	0.02000425785165	0.03853599184361
ICAM3	0.2769	5.2744	0.02002282378665	0.03856357641710
SHISA2	-0.4394	3.7378	0.02010616948216	0.03871384645977
PIGG	-0.1318	5.1927	0.02010937272886	0.03871384645977
TMF1	0.3470	4.3128	0.02015144261071	0.03878070006586
SASH1	-0.4117	3.7667	0.02015263997476	0.03878070006586
SMDT1	-0.2448	5.6474	0.02016858196691	0.03879578993885
PRPF4B	0.3048	4.9243	0.02016902591139	0.03879578993885
SUDS3	0.1524	5.3794	0.02018224077858	0.03881056158788
ATP11A	-0.4387	4.2115	0.02018525298751	0.03881056158788
COA1	0.1318	5.8388	0.02024999531038	0.03892680089196
FRMD4A	-0.1661	4.9309	0.02028003964848	0.03897630477203
ALDH7A1	0.1397	6.9113	0.02028687619298	0.03898119397132
MRPS33	-0.1820	5.5234	0.02030502632089	0.03900781553204
TTC21A	0.2407	3.6043	0.02030981548868	0.03900876363214
NUP133	0.2274	4.7567	0.02032307679337	0.03902598019890
IGFBP2	-0.1931	7.5923	0.02037700948376	0.03912127338733
LINC01588	-0.2006	3.3621	0.02044300529421	0.03923968105617
COA5	-0.1510	5.0317	0.02049671300849	0.03932616083315
OSBPL9	0.1769	6.6111	0.02049672053995	0.03932616083315
LUC7L3	0.2249	7.8037	0.02060342890827	0.03952254708831
ENTPD4	-0.2502	3.8833	0.02061233936885	0.03953128908311
GORASP2	0.1584	6.9539	0.02065428471903	0.03960336983393
LSM7	-0.2910	6.4406	0.02073543973485	0.03975058649613
RUNDC3A-AS1	0.2023	4.9927	0.02074139405599	0.03975360899588
SLC15A4	-0.2617	4.0799	0.02082859595656	0.03991231902965
MAPK11	0.2045	5.3367	0.02087341688994	0.03998976767459
ZNF580	-0.2695	6.7662	0.02091652475142	0.04006390239773
CIPC	0.2089	5.4172	0.02092432204613	0.04007038559698
KIAA1217	0.2799	4.9824	0.02096428491308	0.04013845062105
CCDC34	0.2906	4.6420	0.02102228212626	0.04024100842929
NUDT18	-0.2844	4.9312	0.02103950668148	0.04026160971367
ZNF350	0.1521	3.5341	0.02104191165082	0.04026160971367
ACAA1	0.1645	7.2259	0.02106550612218	0.04029826439762
HES6	0.2362	4.0803	0.02107099302043	0.04030027119176
SERP1	0.1305	7.0101	0.02109797255288	0.04034337518482
POLR3GL	-0.1379	6.0709	0.02111544014955	0.04036827621012

LINC01137	0.3095	3.2919	0.02113841899821	0.04040370088881
MRPL34	0.1706	5.8717	0.02118155704354	0.04047763457753
PARP2	-0.1741	5.0599	0.02123767316757	0.04056813584556
CKMT1A	-0.1294	6.6119	0.02123785021581	0.04056813584556
SORBS3	-0.1797	6.5562	0.02127940222620	0.04063895933042
TLCD1	0.1939	5.1596	0.02130307987269	0.04067562412193
ZBTB10	0.3235	4.0320	0.02135534959703	0.04076288917773
GBA	0.1189	7.2256	0.02135776089722	0.04076288917773
SP1	-0.1660	6.2016	0.02138028026491	0.04079729461770
MSH2	0.2674	4.9214	0.02140912373457	0.04084375055329
DYNLT1	0.1563	5.4715	0.02143310134044	0.04088090595937
SLX4	-0.2021	4.4226	0.02145738488042	0.04091862916822
MIF	-0.2817	9.4707	0.02149649429017	0.04098460311757
SMARCA2	0.3361	5.2630	0.02151954956846	0.04101994744567
C11orf49	0.1593	4.9981	0.02157216034667	0.04111160296078
PSMC5	-0.2140	8.6570	0.02157777570041	0.04111367627685
LINC01184	0.1559	4.7631	0.02161641832751	0.04117866474347
NDUFA9	-0.1431	5.7296	0.02165328503643	0.04124024358553
SS18L2	0.2231	3.5368	0.02175183408819	0.04141925044137
SCAMP1	0.3538	3.7930	0.02188851424755	0.04167077523732
GOLGA8A	0.3687	4.5521	0.02190490624615	0.04169324116983
STAT6	-0.1222	5.0283	0.02192219734147	0.04171740864583
SUPT20H	0.1859	5.2576	0.02193893557737	0.04174051413745
RNF223	-0.1714	4.8231	0.02197928570022	0.04180852397228
SLC35E1	0.1712	6.4085	0.02203992113684	0.04191508352747
PHKB	0.1837	4.8231	0.02209420865865	0.04200213415546
AP5B1	-0.1383	5.4611	0.02209494492464	0.04200213415546
CCDC130	-0.2128	5.2678	0.02226158660142	0.04231006026109
ECD	0.1189	5.4139	0.02228247795509	0.04234090443821
NUCB2	0.1492	6.0974	0.02231632900621	0.04239635642372
TUSC3	0.2042	4.5494	0.02232255881260	0.04239932160159
HSPBP1	-0.2493	6.5776	0.02234004413768	0.04242365972695
NASP	0.1576	6.7734	0.02236513647379	0.04246243034047
BCL9	0.2288	5.8552	0.02238864561296	0.04249817951741
LOC100288798	-0.2199	4.7117	0.02242159615314	0.04255183169626
OSR2	-0.1445	5.8354	0.02247845721647	0.04264419555524
ACP6	-0.1376	5.9152	0.02247965687952	0.04264419555524
SPCS1	0.1247	6.3323	0.02248524159558	0.04264588114650
NFIB	-0.1515	5.0729	0.02249746182769	0.04266014843543
PER3	-0.4138	3.9291	0.02252003814415	0.04269404308706
CMTM6	0.2412	4.9434	0.02254057191249	0.04272405208460

HGS	-0.1115	7.6960	0.02254601454238	0.04272545034628
GPSM1	0.2044	4.9357	0.02258404444973	0.04278858911913
KPNA4	0.2335	5.7533	0.02259203361072	0.04279479708364
SCARF2	0.2452	4.0191	0.02265277901704	0.04290091475574
ITPA	-0.2239	5.4669	0.02267632081562	0.04293187015898
EXT2	0.1785	5.3979	0.02268192190048	0.04293187015898
MAN2A2	-0.1891	5.8807	0.02268330723739	0.04293187015898
C6orf136	-0.2089	4.6790	0.02270404696865	0.04296216931076
MZT2A	-0.2856	7.1254	0.02271546907467	0.04297482805564
ZNF8	0.3395	3.4815	0.02272492928527	0.04298377063935
PURB	0.1666	5.6644	0.02278462478854	0.04308770880981
ATP5IF1	0.1912	7.2160	0.02284010799394	0.04318363953632
NT5C3B	0.1660	5.9319	0.02299136622106	0.04346057382461
SCNM1	0.2442	6.6938	0.02304294754741	0.04354901283623
NIN	0.2592	4.8032	0.02311979350435	0.04368515289492
SNAP47	0.1526	5.4068	0.02313777836025	0.04371004062605
GCDH	0.1812	5.0781	0.02317896808691	0.04377874567329
EIF3M	0.1190	6.8691	0.02324670351426	0.04389754930610
TMEM14A	0.1417	3.8846	0.02327765620567	0.04394685987602
INVS	0.2431	3.7046	0.02329002429775	0.04396107059818
TNC	-0.2950	6.9264	0.02336325745473	0.04409013735378
USP6NL	0.3278	4.2480	0.02339214785799	0.04413315484292
SLC25A16	0.2321	4.0389	0.02339577220722	0.04413315484292
YIPF5	0.2420	4.4991	0.02340535356281	0.04414205933622
PDPR	-0.2036	5.7338	0.02343490616704	0.04418861771240
PRMT6	-0.3276	6.4651	0.02345704916818	0.04422118818689
BTAF1	0.3744	4.4304	0.02347961488053	0.04424696429732
TMEM164	-0.1689	5.1362	0.02348046701341	0.04424696429732
ECE1	0.1078	6.4549	0.02349702563209	0.04426476287346
ACBD6	-0.1464	6.7210	0.02349966102995	0.04426476287346
PARN	0.1129	6.1232	0.02350465503944	0.04426498805748
ALS2CL	-0.2137	3.8521	0.02351381085250	0.04427304921243
PPP1R12A	0.3310	4.9629	0.02357283706744	0.04437498619598
ATRN	0.2059	5.6392	0.02359588274392	0.04440328714450
NIPA1	0.2134	3.6395	0.02359765045252	0.04440328714450
TENT5A	-0.1386	5.2286	0.02361505828752	0.04442683743712
NDUFS3	-0.2287	6.6579	0.02367132979559	0.04452347677584
FPGS	-0.1732	7.2646	0.02367779667922	0.04452641781819
HNRNPUL2	0.1652	7.3705	0.02370548252417	0.04456925192589
MOSPD3	0.1732	7.0796	0.02371726243087	0.04457509632835
NADSYN1	0.1418	7.0210	0.02371840826545	0.04457509632835

GID8	-0.0849	7.3445	0.02372834447868	0.04458454297762
BTG2	0.1706	5.3272	0.02381892311639	0.04474547803474
NARS1	0.2239	5.7574	0.02384947797317	0.04479361105985
ZNF766	-0.1508	4.5744	0.02387847633655	0.04483880140864
TMEM9B	-0.1955	4.5273	0.02389829983010	0.04486674814081
EIF6	-0.2257	7.3664	0.02407657103342	0.04519209209476
CDH1	0.2357	8.2322	0.02409989639738	0.04522652597325
HIF1AN	-0.1000	6.4415	0.02411907024207	0.04525315637774
PSENEN	0.2514	6.3906	0.02416164874258	0.04532367945287
RRM1	0.1213	5.8606	0.02418935511103	0.04536310183690
DNAJC14	-0.1891	5.2429	0.02419265523578	0.04536310183690
GFPT1	0.2997	4.6333	0.02425988998362	0.04547978136689
ANP32B	-0.1674	9.0890	0.02427339438319	0.04549570575722
BRSK2	-0.2615	3.4403	0.02429687282008	0.04553031408980
UCHL3	0.2093	4.1138	0.02430496108145	0.04553607418623
KIAA1109	0.3944	4.8168	0.02431399833758	0.04554360950982
ZNF473	0.1721	3.6432	0.02447346162625	0.04583285317137
DDX51	-0.1715	5.7292	0.02448705035624	0.04584884624434
PER1	0.1707	5.4696	0.02452212194884	0.04590504832352
SLMAP	0.3634	3.6474	0.02454608341675	0.04593098280487
NBPF12	-0.2689	5.5967	0.02454609179078	0.04593098280487
CNOT6L	0.3394	3.9973	0.02456453273575	0.04595602014284
TCEA1	0.2128	5.7202	0.02458383488980	0.04598265800912
MAFIP	-0.1425	6.3455	0.02464220286471	0.04607328398272
FBXO41	0.1821	5.3032	0.02464243368617	0.04607328398272
SLC38A1	0.2923	8.0017	0.02472327230421	0.04621491062054
PIH1D1	0.2090	5.9106	0.02473643147979	0.04622999264622
ENSA	-0.1332	9.1113	0.02489838054568	0.04652308513073
CLASRP	-0.1587	6.0354	0.02494573682193	0.04659730046785
PTK2	0.2354	6.2245	0.02494836195074	0.04659730046785
SIGIRR	-0.2451	6.6299	0.02503226015541	0.04674438710081
POLDIP2	-0.1229	7.4708	0.02505660690800	0.04678023177047
PYCR1	0.1318	7.4266	0.02514372375591	0.04692486546805
HEXB	-0.1082	6.2789	0.02514899028113	0.04692486546805
LARP1B	0.2140	3.6148	0.02514957826594	0.04692486546805
NELFA	-0.0995	6.1801	0.02524322546435	0.04708991997572
MIEF2	0.1411	4.8985	0.02530324918146	0.04719219671736
AP2B1	0.1365	6.6984	0.02538419962491	0.04732513412041
ZDHHC16	-0.1251	6.4773	0.02538494970824	0.04732513412041
UBTD2	0.2588	3.8423	0.02544257485678	0.04742282887407
CLUH	0.0945	7.7854	0.02557338378838	0.04765686398159

DRAP1	0.2343	8.1321	0.02559704180974	0.04769116468492
GPR89B	-0.1550	5.3399	0.02560468851580	0.04769562593066
CHCHD7	0.1525	4.7195	0.02561674085406	0.04770829033956
FUCA1	0.1503	4.9556	0.02562300051371	0.04771016355649
ANXA2	-0.1265	8.7991	0.02564223360816	0.04773618765800
SDAD1	0.1727	5.1280	0.02566253515111	0.04776418973298
BTG1	0.1797	6.8631	0.02568050805714	0.04778784706288
STN1	-0.1175	5.5773	0.02569731851397	0.04780933198634
STOML2	-0.1482	7.2259	0.02571911507405	0.04784008275039
RBBP5	0.1844	4.6667	0.02582954445310	0.04803565291391
GBF1	-0.1375	6.6277	0.02584579495066	0.04805603274916
DICER1-AS1	-0.2696	4.7192	0.02586547929073	0.04808112575716
G3BP2	0.3317	4.9886	0.02586988001867	0.04808112575716
PPIA	-0.1807	10.6798	0.02589101513040	0.04811056034361
MSH3	-0.2160	3.8289	0.02594246551061	0.04819630304866
NABP2	-0.1539	6.2095	0.02597292424121	0.04824302005205
RAB35	-0.1436	5.9711	0.02600355551698	0.04828310180518
ZNF706	0.0971	6.4554	0.02600513720176	0.04828310180518
MGLL	0.1559	4.1650	0.02603439172505	0.04832753705134
C18orf21	-0.1783	4.1926	0.02609266618355	0.04842581271467
SYNPO	0.1193	5.4243	0.02611619638431	0.04845957894686
RARS2	0.1012	5.6821	0.02612414902921	0.04846443255041
PHF3	0.2316	5.6168	0.02615123464671	0.04850477161494
RHOT1	0.2569	3.6564	0.02617952743879	0.04854733278981
LOC100129434	-0.1995	4.1810	0.02623049161856	0.04862420469347
MRPL53	-0.2475	6.3812	0.02623169020959	0.04862420469347
ABAT	0.2739	6.7832	0.02623874347511	0.04862735295868
AUTS2	-0.2828	4.6116	0.02624891240654	0.04863627291651
ANXA4	0.1727	5.2254	0.02629430778005	0.04871044654236
DEF8	0.1299	6.3329	0.02630089637022	0.04871271465183
AP3B1	0.2373	5.3008	0.02633650414074	0.04876871821004
LOC727751	0.3261	3.5061	0.02636647061445	0.04881425477060
OXNAD1	0.1414	4.4020	0.02637278825335	0.04881599880323
NPIPB4	0.3312	3.6104	0.02645656856511	0.04896109621759
BORCS5	0.1702	3.7179	0.02647659618466	0.04898817643701
FNBP1	0.1649	6.0487	0.02650316496717	0.04902734590891
EIF3C	-0.1341	10.3853	0.02656581042975	0.04913322291498
MYCBP2	0.3529	4.5726	0.02659358850944	0.04917458302875
ALDH18A1	0.1682	6.5867	0.02662138949656	0.04921596865193
GGH	0.1910	4.2097	0.02664789020251	0.04924632938873
PIGF	0.2067	4.0977	0.02664865792492	0.04924632938873

FBXO34	0.2429	4.3336	0.02665684150876	0.04925142985576
ENTPD5	-0.2222	4.4972	0.02674713367392	0.04940820197169
TBX6	-0.2383	4.2050	0.02676062457711	0.04942306930744
KDM2A	0.1643	7.2191	0.02677288829789	0.04943072082994
TTC1	-0.1190	5.6555	0.02677565419695	0.04943072082994
DDX23	-0.0917	7.2692	0.02682703858033	0.04951551572114
ABCF3	0.1152	6.5380	0.02690178815733	0.04964339326492
LOC283335	0.2039	3.7155	0.02693190226441	0.04968609783563
MARK2	0.0974	6.7687	0.02693587266213	0.04968609783563

VITA

Justin Michael Craig was born in 1985 and raised in Northville, Michigan. He attended University of Detroit Jesuit High School where he captained two varsity sports and graduated valedictorian in 2003. Of note, Justin was recognized at the state and national levels in both academics and athletics as a National Merit Scholar, All-State Scholar Athlete in football, and Academic All-American in lacrosse. Justin then attended Harvard University where he was a member of the NCAA Division I Harvard Men's Varsity Lacrosse team and earned an A.B. in Psychology in 2007. After graduation, Justin decided to pursue a career in medicine and completed remaining pre-medical course pre-requisites at the Harvard University Extension School while teaching for Kaplan as an instructor and tutor for medical, dental, and optometry school admissions tests. In 2009, he began work at the Dana Farber Cancer Institute (DFCI) in Boston, MA where he studied adult and pediatric gliomas under Dr. Keith Ligon. While at DFCI, Justin developed and patented a novel method to enable clinical whole-genome copy number profiling of formalin-fixed paraffin embedded brain tumor specimens. Justin published this method in a manuscript entitled, *DNA Fragmentation Simulation Method (FSM) and Fragment Size Matching Improve aCGH Performance of FFPE Tissues*, and shared the findings in a series of invited conferences and webinars for Agilent Technologies, while working with his mentors, Dr. Azra Ligon and Dr. Keith Ligon, to validate the method as a clinical diagnostic. Since its adoption in 2012, Justin's method has been the basis of the OncoCopy clinical diagnostic assay at DFCI and Brigham and Women's Hospital and has been utilized to provide diagnostic and prognostic tumor whole-genome copy number information for thousands of patients. In the summer of 2012, Justin matriculated at the Virginia Commonwealth University M.D.-Ph.D. program. Upon completion of the pre-clinical medical curriculum, Justin joined the laboratory of Dr. Charles Clevenger where he has studied various aspects of prolactin signaling as they contribute to breast cancer pathogenesis. During his graduate studies, Justin has presented his work at local and national conferences and received numerous awards, including a FASEB travel award, an ENDO2016 Presidential Poster Competition Outstanding Abstract Award, and the Cold Spring Harbor Laboratories Helmsley Scholarship. The work presented in this dissertation has been accepted for publication by *Endocrinology* and selected by the editorial staff as the journal's feature article in the latest issue.