

Enhanced hemato-endothelial specification during human embryonic differentiation through developmental cooperation between *AF4-MLL* and *MLL-AF4* fusions

Clara Bueno,^{1,2} Fernando J Calero-Nieto,³ Xiaonan Wang,³ Rafael Valdés-Mas,⁴ Francisco Gutiérrez-Agüera,¹ Heleia Roca-Ho,¹ Veronica Ayllon,⁵ Pedro J Real,⁵ David Arambilet,⁶ Lluís Espinosa,^{6,2} Raul Torres-Ruiz,¹ Antonio Agraz-Doblas,^{1,7} Ignacio Varela,⁷ Jasper de Boer,⁸ Anna Bigas,^{6,2} Bertie Gottgens,³ Rolf Marschalek⁹ and Pablo Menendez^{1,2,10}

¹Josep Carreras Leukemia Research Institute and Department of Biomedicine, School of Medicine, University of Barcelona, Spain; ²Centro de Investigación Biomédica en Red de Cáncer (CIBER-ONC), ISCIII, Barcelona, Spain; ³Department of Hematology, Cambridge Institute for Medical Research and Wellcome Trust-Medical Research Council Cambridge Stem Cell Institute, University of Cambridge, UK; ⁴Dreamgenics S.L. Oviedo, Spain; ⁵GENyO, Centre for Genomics and Oncological Research, Pfizer/University of Granada/Andalusian Regional Government and University of Granada, Department of Biochemistry and Molecular Biology, Granada, Spain; ⁶Programa de Cáncer, Instituto Hospital del Mar de Investigaciones Médicas, Barcelona, Spain; ⁷Instituto de Biomedicina y Biotecnología de Cantabria (CSIC-UC-Sodercan), Departamento de Biología Molecular, Universidad de Cantabria, Santander, Spain; ⁸Cancer Section, UCL Great Ormond Street Institute of Child Health, London, UK; ⁹Institute of Pharmaceutical Biology, Goethe-University, Frankfurt, Germany and ¹⁰Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain

©2019 Ferrata Storti Foundation. This is an open-access paper. doi:10.3324/haematol.2018.202044

Received: July 18, 2018.

Accepted: January 21, 2019.

Pre-published: January 24, 2019.

Correspondence: CLARA BUENO - cbueno@carrerasresearch.org

PABLO MENENDEZ - pmenendez@carrerasresearch.org

Bueno C *et al.* Figure S1

A

AF4-MLL (8739 bp)

Red: AF4 exon 1-3

Blue: MLL exon 10 to 36

ATG :Start Codon

TAA :Stop Codon

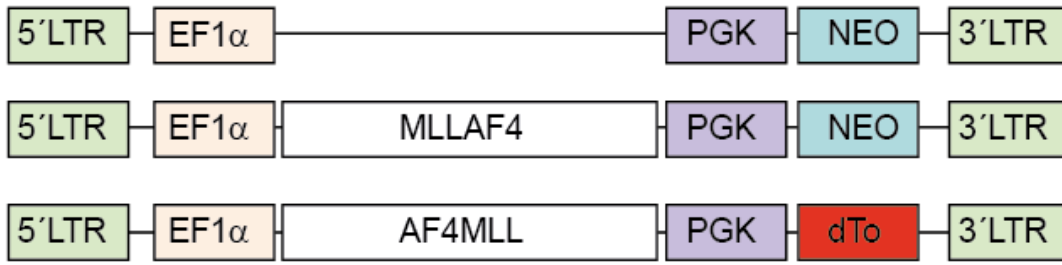
ATGGCAGCCCAGTCAAGTTTGTACAATGACGACAGAAACCTGCTTCGAATTAGAGAGAAGGAA
AGACGCAACCAGGAAGCCCACCAAGAGAAAGAGGCATTTCTGAAAAGATTCCCCTTTTTGGA
GAGCCCTACAAGACAGCAAAAGGTGATGAGCTGTCTAGTCGAATACAGAACATGTTGGGAAAC
TACGAAGAAGTGAAGGAGTTCCTTAGTACTAAGTCTCACACTCATCGCTGGATGCTTCTGAAA
ATAGGTTGGGAAAGCCGAAATATCCTTTAATTCCTGACAAAGGGAGCAGCATTCCATCCAGCT
CCTTCCACACTAGTGTCCACCACCAGTCCATTACACTCCTGCGTCTGGACCACTTTCTGTTGG
CAACATTAGCCACAATCCAAAGATGGCGCAGCCAAGAAGTGAACCAATGCCAAGTCTCCATGC
CAAAGCTGCGGCCACCGGACAGCCAGCACCTGACCCAGGATCGCCTTGGTCAGGAGGGG
TTCGGCTCTAGTCATCACAAGAAAGGTGACCGAAGAGCTGACGGAGACCACTGTGCTTCGGT
GACAGATTTCGGCTCCAGAGAGGGAGCTTTCTCCCTTAATCTCTTTGCCTTCCCCAGTTCCCC
TTTGTACCTATACATTCCAACCAGCAAACCTTTCCCCGGACGCAAGGAAGCAGCAAGGTTCA
TGGCAGCAGCAATAACAGTAAAGGCTATTGCCAGCCAAATCTCCAAGGACCTAGCAGTGAA
AGTCCATGATAAAGAGACCCCTCAAGACAGTTTGGTGGCCCCTGCCAGCCGCCTTCTCAGAC
ATTTCCACCTCCCTCCCTCCCTCAAAAAGTGTGCAATGCAGCAGAAGCCCACGGCTTATGT
CCGGCCCATGGATGGTCAAGATCAGGCCCTAGTGAATCCCCTGAACTGAAACCACTGCCGG
AGGACTATCGACAGCAGACCTTTGAAAAACAGACTTGAAAGTGCCTGCCAAAGCCAAGCTCA
CCAAACTGAAGATGCCTTCTCAGTCAGTTGAGGAGGATTGTGAAGCAGAAAATGTGTGGGAGA
TGGGAGGCTTAGGAATCTTGACTTCTGTTTCTATAACACCCAGGGTGGTTTGTCTTCTGTGC
CAGTAGTGGGCATGTAGAGTTTGTGTATTGCCAAGTCTGTTGTGAGCCCTTCCACAAGTTTTGT
TTAGAGGAGAACGAGCGCCCTCTGGAGGACCAGCTGGAAAATTGGTGTGTCGTCGTTGCAA
ATTCTGTACGTTTTGTGGAAGGCAACATCAGGCTACAAAGCAGCTGCTGGAGTGTAATAAGTG
CCGAAACAGCTATCACCTGAGTGCCTGGGACCAAACCTACCCACCAAACCCACAAAGAAGAA
GAAAGTCTGGATCTGTACCAAGTGTGTTTCGCTGTAAGAGCTGTGGATCCACAACCTCAGGCAA
AGGGTGGGATGCACAGTGGTCTCATGATTTCTCACTGTGTCATGATTGCGCCAAGCTCTTTC
TAAAGGAAACTTCTGCCCTCTCTGTGACAAATGTTATGATGATGATGACTATGAGAGTAAGATG
ATGCAATGTGGAAAGTGTGATCGCTGGGTCCATTCCAAATGTGAGAATCTTTCAGGTACAGAA
GATGAGATGTATGAGATTCTATCTAATCTGCCAGAAAGTGTGGCCTACACTTGTGTGAACTGTA
CTGAGCGGCACCCTGCAGAGTGGCGACTGGCCCTTGAAAAAGAGCTGCAGATTTCTCTGAAG
CAAGTTCTGACAGCTTTGTTGAATTCTCGGACTACCAGCCATTTGCTACGCTACCGGCAGGCT
GCCAAGCCTCCAGACTTAAATCCCGAGACAGAGGAGAGTATACCTTCCCGCAGCTCCCCGA
AGGACCTGATCCACCAGTTCCTACTGAGGTGAGCAAACAGGATGATCAGCAGCCTTTAGATCT
AGAAGGAGTCAAGAGGAAGATGGACCAAGGGAATTACACATCTGTGTTGGAGTTCAGTGATGA
TATTGTGAAGATCATTCAAGCAGCCATTAATTCAGATGGAGGACAGCCAGAAATTAAGGAGCC
AACAGCATGGTCAAGTCCCTTCTTTCATTCCGGCAAATGGAACGTGTTTTTCCATGGTTCAGTGTA
AAAAGTCCAGGTTTTGGGAGCCAAATAAAGTATCAAGCAACAGTGGGATGTTACCAAACGCAG
TGCTTCCACCTTCACTTGACCATAATTATGCTCAGTGGCAGGAGCGAGAGGAAAACAGCCACA
CTGAGCAGCCTCCTTAATGAAGAAAATCATTCCAGCTCCCAAACCCAAAGGTCTGGAGAAC
CAGACTACCAAACCTCTCTGCATCCTCTACACCACCAATTTTGGAGTACTGATAGGAGTCGAGA
AGACAGTCCAGAGCTGAACCCACCCCCAGGCATAGAAGACAATAGACAGTGTGCGTTATGTTT
GACTTATGGTGTGACAGTGCTAATGATGCTGGTTCGTTTACTATATATTGGCCAAAATGAGTGG

ACACATGTA AATTGTGCTTTGTGGTCAGCGGAAGTGTTTGAAGATGATGACGGATCACTAAAGA
ATGTGCATATGGCTGTGATCAGGGGCAAGCAGCTGAGATGTGAATTCTGCCAAAAGCCAGGA
GCCACCGTGGGTTGCTGTCTCACATCCTGCACCAGCAACTATCACTTCATGTGTTCCCGAGCC
AAGAAGTGTGCTTTCTGGATGATAAAAAAGTATATTGCCAACGACATCGGGATTTGATCAAAG
GCGAAGTGGTTCCTGAGAATGGATTTGAAGTTTTGAGAAGAGTGTGGACTTTGAAGGAAT
CAGCTTGAGAAGGAAGTTTCTCAATGGCTTGAACCAGAAAATATCCACATGATGATTGGGTCT
ATGACAATCGACTGCTTAGGAATTCTAATGATCTCTCCGACTGTGAAGATAAGCTCTTTCCTAT
TGGATATCAGTGTTCAGGGTATACTGGAGCACCACAGATGCTCGCAAGCGCTGTGTATATAC
ATGCAAGATAGTGGAGTGCCGTCTCCAGTCGTAGAGCCGGATATCAACAGCACTGTTGAACA
TGATGAAAACAGGACCATTGCCCATAGTCCAACATCTTTTACAGAAAAGTTCATCAAAGAGAGT
CAAACACAGCTGAAATTATAAGTCCTCCATCACCAGACCGACCTCCTCATTACAAAACCTCTG
GCTCCTGTTATTATCATGTCATCTCAAAGGTCCCGAGATTGCAACACCCAGTTATTCTCCAAC
ACAGAGATCCCCTGGCTGTGACCGTTGCCTTCTGCAGGAAGTCCTACCCCAACCACTCATGA
AATAGTCACAGTAGGTGATCCTTTACTCTCCTCTGGACTTCGAAGCATTGGCTCCAGGCGTCA
CAGTACCTCTTCCTTATCACCCCAGCGGTCCAAACTCCGGATAATGTCTCCAATGAGAAGTGG
GAATACTTACTCTAGGAATAATGTTTCTCAGTCTCCACCACCGGGACCGCTACTGATCTTGAA
TCAAGTGCCAAAGTAGTTGATCATGTCTTAGGGCCACTGAATCAAGTACTAGTTTAGGGCAA
ACACTTCCACCTCTTCAAATTTGCAAAGGACAGTGGTTACTGTAGGCAATAAAAACAGTCACTT
GGATGGATCTTCATCTCAGAAATGAAGCAGTCCAGTGCCTCAGACTTGGTGTCCAAGAGCTC
CTCTTTAAAGGGAGAGAAGACCAAAGTGTGAGTTCCAAGAGCTCAGAGGGATCTGCACATAA
TGTGGCTTACCCTGGAATTCCTAAACTGGCCCCACAGGTTCAACACAACATCTAGAGAAGTGA
AATGTTAGTAAAATCGGCTCCTTTGCTGAACCCTCTTCAGTGTGTTTTCTTCTAAAGAGGCC
TCTCCTTCCCACACCTCCATTTGAGAGGGCAAAGGAATGATCGAGACCAACACACAGATTCTA
CCCAATCAGCAAACCTCCTCCTCAGATGAAGATACTGAAGTCAAACCTTGAAGCTATCTGGAAT
GAGCAACAGATCATCCATTATCAACGAACATATGGGATCTAGTTCAGAGATAGGAGACAGAA
AGGGAAAAAATCCTGTAAAGAAAATTTCAAAGAAAAGCATTCCAGTAAATCTTTTTTGAACCTG
GTCAGGTGACAACCTGGTGAGGAAGGAAACTTGAAGCCAGAGTTTATGGATGAGGTTTTGACTC
CTGAGTATATGGGCCAACGACCATGTAACAATGTTTCTTCTGATAAGATTGGTGATAAAGGCC
TTCTATGCCAGGAGTCCCCAAAGCTCCACCATGCAAGTAGAAGGATCTGCCAAGGAATTACA
GGCACCACGGAAACGCACAGTCAAAGTGACACTGACACCTCTAAAAATGGAAAATGAGAGTCA
ATCCAAAAATGCCCTGAAAGAAAAGTAGTCTGCTTCCCCTTTGCAAATAGAGTCAACATCTCCC
ACAGAACCAATTTAGCCTCTGAAAATCCAGGAGATGGTCCAGTGGCCCAACCAAGCCCCAAT
AATACCTCATGCCAGGATTCTCAAAGTAACAACATATCAGAATCTTCCAGTACAGGACAGAAACC
TAATGCTTCCAGATGGCCCCAAACCTCAGGAGGATGGCTCTTTTAAAGGAGGTATCCCCGTC
GCAGTGGCCGTGCACGTTCTAACATGTTTTTTGGGCTTACCCCACTCTATGGAGTAAGATCCTA
TGGTGAAGAAGACATTCCATTCTACAGCAGCTCAACTGGGAAGAAGCGAGGCAAGAGATCAGC
TGAAGGACAGGTGGATGGGGCCGATGACTTAAGCACTTCCAGATGAAGACGACTTATACTATTA
CAACTTCACTAGAACAGTGATTTCTCAGGTGGAGAGGAACGACTGGCATCCATAATTTATTT
CGGGAGGAGGAACAGTGTGATCTTCAAAAAATCTCACAGTTGGATGGTGTGATGATGGGACA
GAGAGTGATACTAGTGTACAGCCACAACAAGGAAAAGCAGCCAGATTCCAAAAAGAAATGGT
AAAGAAAATGGAACAGAGAACTTAAAGATTGATAGACCTGAAGATGCTGGGGAGAAAGAACAT
GTCATAAGAGTTCTGTTGGCCACAAAAATGAGCCAAAGATGGATAACTGCCATTCTGTAAGCA
GAGTTAAAACACAGGGACAAGATTCTTGAAGCTCAGCTCAGCTCATTGGAGTCAAGCCGCA
GAGTCCACACAAGTACCCCTCCGACAAAAATTTACTGGACACCTATAATACTGAGCTCCTGAA
ATCAGATTCAGACAATAACAACAGTGTGACTGTGGGAATATCCTGCCTTCCAGACATTATGGAC
TTTGTACTAAAGAATACTCCATCCATGCAGGCTTTGGGTGAGAGCCCAGAGTCATCTTCATCAG
AACTCCTGAATCTTGGTGAAGGATTGGGTCTTGACAGTAATCGTGA AAAAGACATGGGTCTTTT
TGAAGTATTTTCTCAGCAGCTGCCTACAACAGAACCTGTGGATAGTAGTGTCTCTTCTCTATC
TCAGCAGAGGAACAGTTTGGATTGCCTCTAGAGCTACCATCTGATCTGTCTGTCTTGACCACC
CGGAGTCCCCTGTCCCCAGCCAGAATCCCAGTAGACTAGCTGTTATCTCAGACTCAGGGGA
GAAGAGAGTAACCATCACAGAAAAATCTGTAGCCTCCTCTGAAAGTGACCCAGCACTGCTGAG
CCCAGGAGTAGATCCAACCTCTGAAGGCCACATGACTCCTGATCATTTTATCCAAGGACACAT

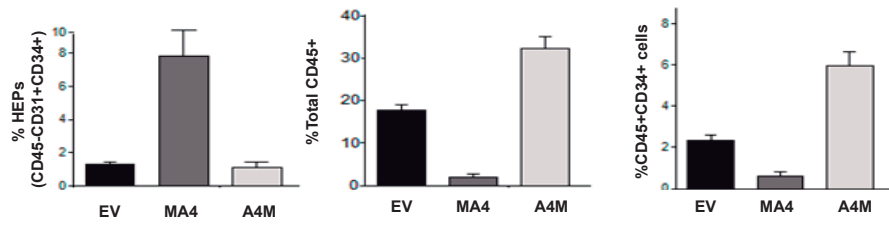
GGATGCAGACCACATCTCTAGCCCTCCTTGTGGTTCAGTAGAGCAAGGTCATGGCAACAATCA
GGATTTAACTAGGAACAGTAGCACCCCTGGCCTTCAGGTACCTGTTTCCCCAACTGTTCCCAT
CCAGAACCAGAAGTATGTGCCCAATTCTACTGATAGTCCTGGCCCGTCTCAGATTTCCAATGCA
GCTGTCCAGACCACTCCACCCACCTGAAGCCAGCCACTGAGAACTCATAGTTGTTAACCAG
AACATGCAGCCACTTTATGTTCTCCAACTCTTCCAAATGGAGTGACCCAAAAAATCCAATTGA
CCTCTTCTGTTAGTTCTACACCCAGTGTGATGGAGACAAATACTTCAGTATTGGGACCCATGGG
AGGTGGTCTCACCCTTACCACAGGACTAAATCCAAGCTTGCCAACCTTCTCAATCTTTGTTCCCT
TCTGCTAGCAAAGGATTGCTACCCATGTCTCATCACCCAGCACTTACATTCCCTCCCTGCAGCTA
CTCAAAGTAGTTTCCCACCAAACATCAGCAATCCTCCTTCAGGCCTGCTTATTGGGGTTCAGCC
TCCTCCGGATCCCCAACTTTTGGTTTTCAGAATCCAGCCAGAGGACAGACCTCAGTACCACAGT
AGCCACTCCATCCTCTGGACTCAAGAAAAGACCCATATCTCGTCTACAGACCCGAAAGAATAAA
AACTTGCTCCCTCTAGTACCCCTTCAAACATTGCCCTTCTGATGTGGTTTCTAATATGACATT
GATTAACCTTCACACCCTCCCAGCTTCCCTAATCATCCAAGTCTGTTAGATTTGGGGTCACTTAATA
CTTCATCTCACCGAACTGTCCCCAACATCATAAAAAGATCTAAATCTAGCATCATGTATTTTGAA
CCGGCACCCCTGTTACCACAGAGTGTGGGAGGAACTGCTGCCACAGCGGCAGGCACATCAAC
AATAAGCCAGGATACTAGCCACCTCACATCAGGGTCTGTGTCTGGCTTGGCATCCAGTTCCTC
TGTCTTGAATGTTGTATCCATGCAAACCTACCACAACCCCTACAAGTAGTGCGTCAGTTCAGGA
CACGTACCTTAACCAACCCAAGGTTGCTTGGTACCCAGATATTGGCTCAATAAGCAATCTTT
TAATCAAAGCTAGCCAGCAGAGCCTGGGGATTACAGGACCAGCCTGTGGCTTTACCGCCAAGTT
CAGGAATGTTTCCACAACCTGGGGACATCACAGACCCCTCTACTGCTGCAATAACAGCGGCAT
CTAGCATCTGTGTGCTCCCTCCACTCAGACTACGGGCATAACAGCCGCTTACCTTCTGGGG
AAGCAGACGAACACTATCAGCTTCAGCATGTGAACCAGCTCCTTGCCAGCAAACTGGGATTC
ATTCTTCCCAGCGTGATCTTGATTCTGCTTCAGGGCCCCAGGTATCCAACCTTACCCAGACGGT
AGACGCTCCTAATAGCATGGGACTGGAGCAGAACAAGGCTTTATCCTCAGCTGTGCAAGCCAG
CCCCACCTCTCCTGGGGTCTCCATCCTCTCCATCTTCTGGACAGCGGTGAGCAAGCCCTTC
AGTGCCGGGTCCCACTAAACCCAAACCAAAAACCAAACGGTTTTAGCTGCCTCTAGACAAAGG
GAATGGCAAGAAGCACAATGTTTCCCATTTGCGGACCAGTTCTTCTGAAGCACACATTCCAGA
CCAAGAAACGACATCCCTGACCTCAGGCACAGGGACTCCAGGAGCAGAGGCTGAGCAGCAG
GATACAGCTAGCGTGGAGCAGTCTCCAGAAAGGAGTGTGGGCAACCTGCAGGGCAAGTCGC
TGTTCTTCCGGAAGTTCAGGTGACCCAAAATCCAGCAAATGAACAAGAAAGTGCAGAACCTAA
AACAGTGAAGAAGAGGAAAGTAATTTACAGCTCCCACTGATGCTTTGGCTTCAGCAAGAACA
AAAGCGGAAGGAAAGCATTACTGAGAAAAAACCAAGAAAGGACTTGTTTTTGAATTTCCAGT
GATGATGGCTTTAGATCTGTGCAGAAAGTATTGAAGATGCCTGGAAGTCATTGACAGATAAAG
TCCAGGAAGCTCGATCAAATGCCCGCCTAAAGCAGCTCTCATTTGCAGGTGTTAACGGTTTGA
GGATGCTGGGGATTCTCCATGATGCAGTTGTGTTCCCTCATTGAGCAGCTGTCTGGTGCCAAGC
ACTGTCGAAATTACAAATTCGTTTTCCACAAGCCAGAGGAGGCAATGAACCCCTTGAACC
CTCACGGCTCAGCCAGGGCTGAAGTCCACCTCAGGAAGTCAGCATTTGACATGTTAACTTCC
TGGCTTCTAAACATCGTCAGCCTCCTGAATACAACCCCAATGATGAAGAAGAGGAGGAGGTAC
AGCTGAAGTCAGCTCGGAGGGCAACTAGCATGGATCTGCCAATGCCATGCGCTTCCGGCAC
TTAAAAAAGACTTCTAAGGAGGCAGTTGGTGTCTACAGGTCTCCCATCCATGGCCGGGGTCTT
TTCTGTAAGAGAAACATTGATGCAGGTGAGATGGTATTGAGTATGCCGGCAACGTCATCCGC
TCCATCCAGACTGACAAGCGGGAAAAGTATTACGACAGCAAGGGCATTGGTTGCTATATGTTCC
CGAATTGATGACTCAGAGGTAGTGGATGCCACCATGCATGGAAATGCTGCACGCTTCATCAAT
CACTCGTGTGAGCCTAACTGCTATTCTCGGGTCATCAATATTGATGGGCAGAAGCACATTGTCA
TCTTTGCCATGCGTAAGATCTACCGAGGAGAGGAACTCACTTACGACTATAAGTTCCCATTGA
GGATGCCAGCAACAAGCTGCCCTGCAACTGTGGCGCTAAGAAATGCCGGAAGTTCCTAAAC

A

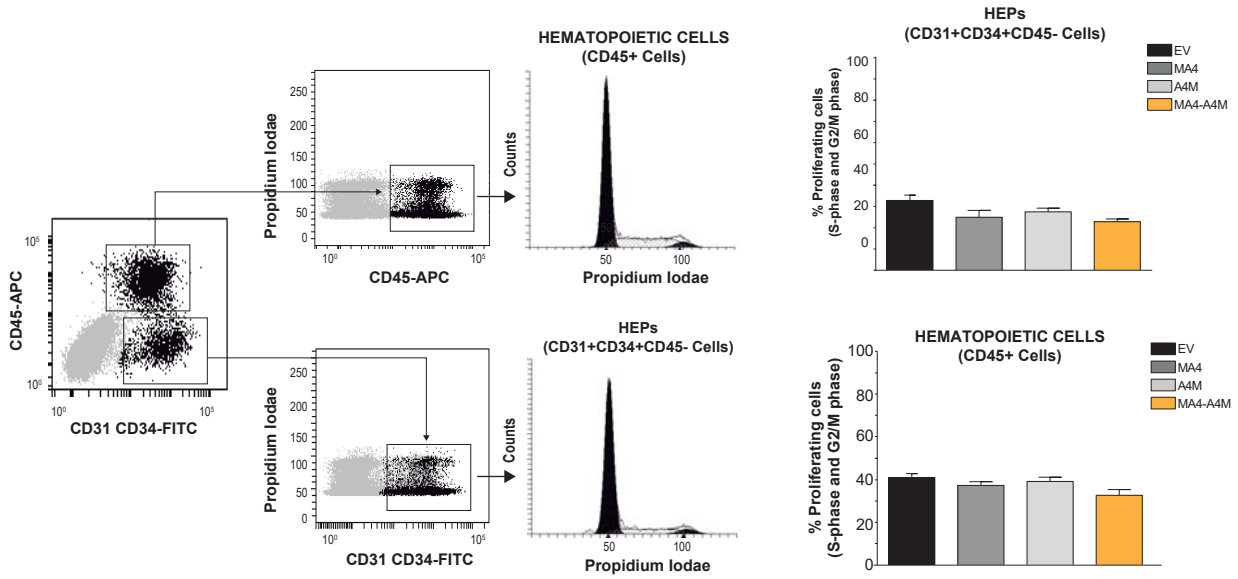
B



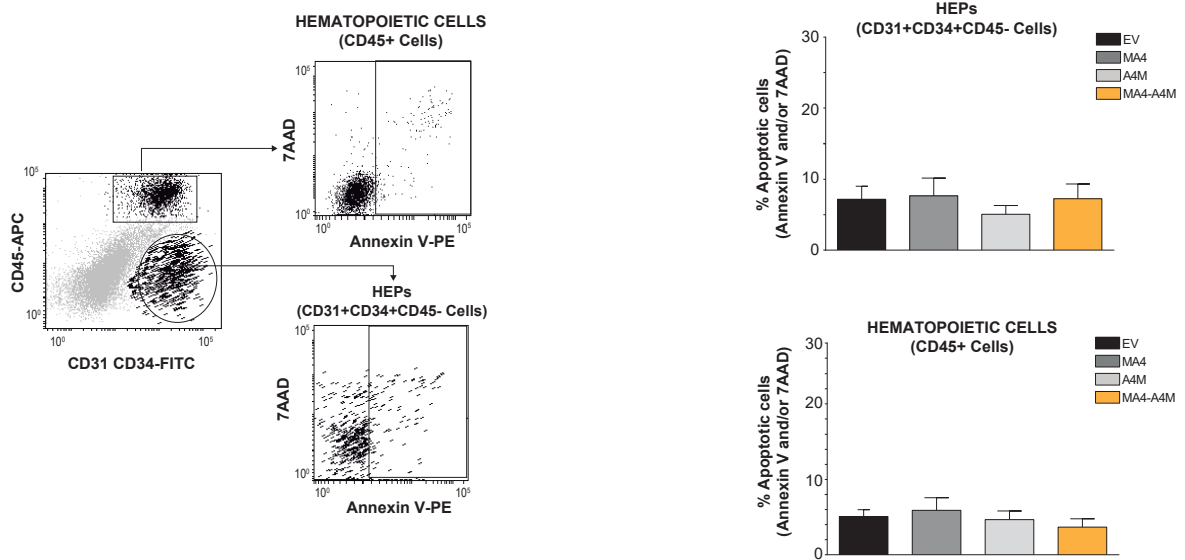
A



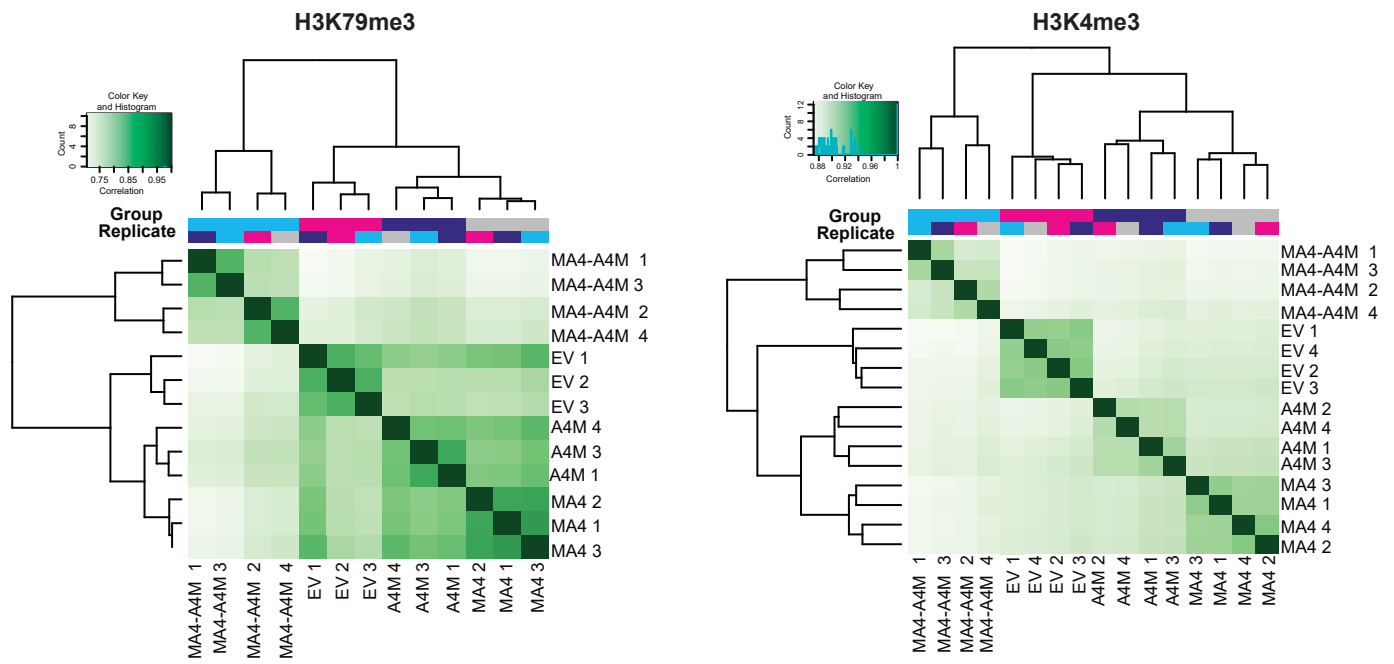
B



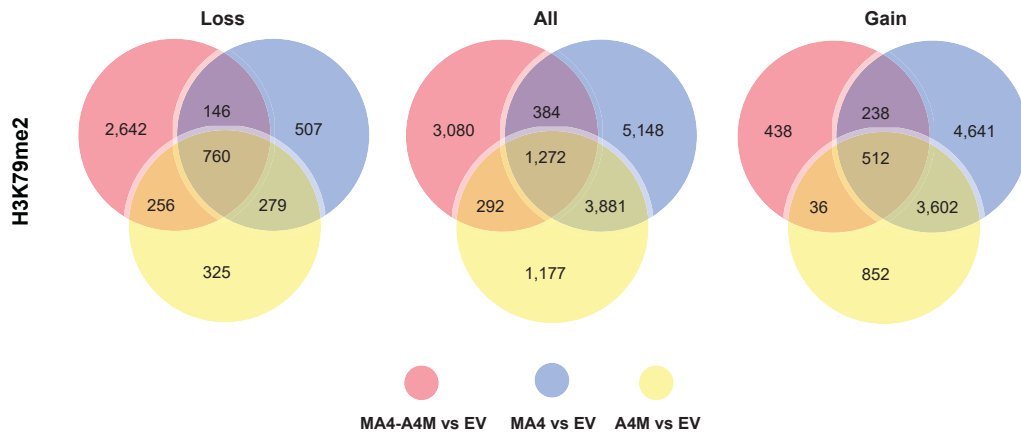
C



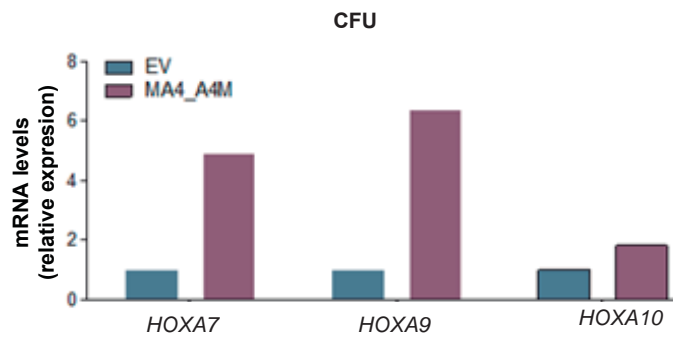
A



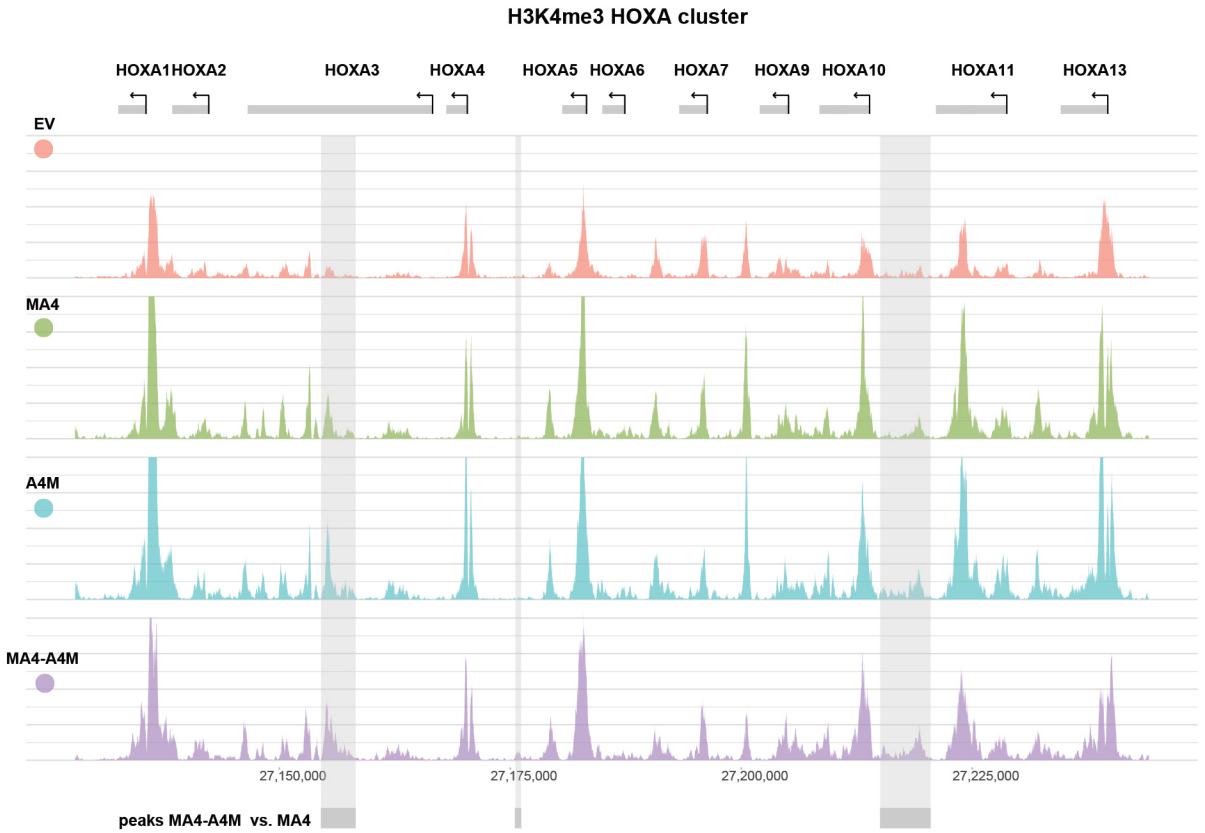
B



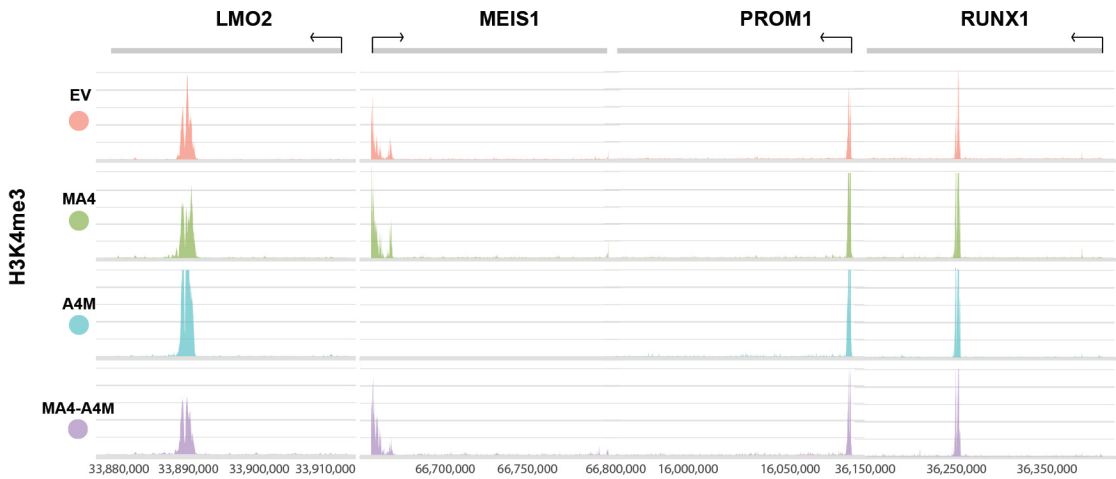
C



A



B



SUPPLEMENTARY LEGENDS AND METHODS

Chromatin immunoprecipitation Sequencing

One million day 15 hematopoietic differentiating hEB-derived cells were subjected to Chromatin Immunoprecipitation (ChIP) as described ¹. Briefly, formaldehyde crosslinked cell extracts were sonicated using a Bioruptor (Diagenode) with a 0.5-min interval protocol to obtain DNA fragments of 200–500 bp. The chromatin fraction was divided into three parts and incubated overnight with 2 µg of anti-H3K4me3, anti-H3K79me3, or anti-H3 antibodies (Abcam) in RIPA buffer, and precipitated with protein A/G-Sepharose (Amersham). Cross-linkage of the co-precipitated DNA-protein complexes was reversed, and the DNA was sequenced at the CRG-CNAG Genomics Facility. Paired-end 50 bp ChIP-seq data reads were generated using a HiSeq 2500 Illumina sequencer. Alignment and peak detection was performed using the ENCODE (phase-3) histone ChIP-seq pipeline specifications. Reads were aligned to the human reference genome (assembly hg19) using BWA², removing all reads with a quality score <30. Peaks were called using MACS2³ and whole cell extract samples as background samples. Differential analysis of histone mark peaks between experimental groups and the EV control group was performed using DiffBind⁴, with a False Discovery Rate (FDR) cut-off of 0.1. Peaks annotation and Gene Ontology (GO) enrichment were analyzed with ChIP-Enrich package in R⁴, using an FDR threshold of 0.1. ChIP-Seq data is deposited and available at Gene Expression Omnibus (GEO, accession number GSE111263).

Low-input RNA-seq and bulk RNA-seq on t(4;11)+B-ALL patients

For low-input RNAseq, 50 HEPs were FACS-purified from day 15 EBs into individual wells of a 96-well PCR plate containing lysis buffer (0.2% Triton-X100 and 2.3 U of SUPERase-In RNase Inhibitor; Ambion). Three independent replicates (50 cells/replicate) per condition were analyzed. RNA/cDNA was obtained and amplified as per the SMARTSEQ2 protocol^{5,6}. Libraries were prepared for

sequencing using the Illumina Nextera XT DNA preparation kit. RNA-seq data was generated using a 50 single-end sequencing protocol. Pooled libraries were sequenced on the Illumina HiSeq 4000 platform. Reads were mapped to the human genome (Ensembl 81) and the ERCC sequences using STAR (version 2.4.2a) with default parameters. HTseq-count⁷ was used to count the number of reads mapped to each gene with -s no (non-strand specific mode). Data were normalized for sequencing depth using the size factor from the DESeq2 package (version 1.12.2)⁸. Low-input RNA-seq data is deposited and available at GEO (GSE118947).

Bulk RNA-seq data on t(4;11)+ B-ALL patients was generated on the Illumina HiSeq 2500 platform using a 76 paired-end sequencing protocol and aligned to the human reference genome (hg19) using Tophat¹⁹. A gene was considered differentially expressed in MA4-A4M+ HEPs when it was >2-fold regulated ($p < 0.01$) compared with the equivalent gene in EV-HEPs. Analysis of functional categories and biofunctions was performed with the genes differentially expressed using Ingenuity Pathway Analysis software (Ingenuity Inc., Redwood City, CA). Potential read pairs supporting the expression of MA4 and A4M fusion transcripts in patient samples were identified manually and with in-house written scripts as pairs in which each read aligned unambiguously to a different gene and which were compatible with the genomic breakpoints that were determined at the DNA level in all the samples. Additionally, RT-PCR with primers corresponding to *AF4* exon3 and *MLL* exon 12 (exons contained in all predicted fusions) was performed in all the samples to confirm the expression of any potential isoform of the reciprocal fusion gene. The identity of the isoform was confirmed by capillary sequencing. Finally, the expression of each fusion gene was determined by qRT-PCR using primer pairs spanning the breakpoint between genes. RNA-seq data is deposited and available at GEO (accession number GSE111263).

SUPPLEMENTARY REFERENCES

1. Guiu J, Bergen DJ, De Pater E, et al. Identification of *Cdca7* as a novel Notch transcriptional target involved in hematopoietic stem cell emergence. *J Exp Med*. 2014;211(12):2411-2423.
2. Li H, Durbin R. Fast and accurate short read alignment with Burrows-Wheeler transform. *Bioinformatics*. 2009;25(14):1754-1760.
3. Zhang Y, Liu T, Meyer CA, et al. Model-based analysis of ChIP-Seq (MACS). *Genome Biol*. 2008;9(9):R137.
4. Welch RP, Lee C, Imbriano PM, et al. ChIP-Enrich: gene set enrichment testing for ChIP-seq data. *Nucleic Acids Res*. 2014;42(13):e105.
5. Picelli S, Bjorklund AK, Faridani OR, Sagasser S, Winberg G, Sandberg R. Smart-seq2 for sensitive full-length transcriptome profiling in single cells. *Nat Methods*. 2013;10(11):1096-1098.
6. Picelli S, Faridani OR, Bjorklund AK, Winberg G, Sagasser S, Sandberg R. Full-length RNA-seq from single cells using Smart-seq2. *Nat Protoc*. 2014;9(1):171-181.
7. Anders S, Pyl PT, Huber W. HTSeq--a Python framework to work with high-throughput sequencing data. *Bioinformatics*. 2015;31(2):166-169.
8. Love MI, Huber W, Anders S. Moderated estimation of fold change and dispersion for RNA-seq data with DESeq2. *Genome Biol*. 2014;15(12):550.

SUPPLEMENTARY LEGENDS

Figure S1. Coding sequence of the A4M fusion used in this study. (A) The full-length cDNA was sequenced-verified. Fusion breakpoint is located in AF4 exon 2 and MLL exon 10. (B) Schematic of lentivectors used in this study.

Figure S2. Co-expression of MA4 and A4M promotes specification rather than survival/proliferation of HEPs. (A) Day 20 MA4-expressing hEBs display a significant higher HEP production coupled to an impaired blood (CD45⁺ and CD45⁺CD34⁺) formation. (B) *Left*, representative FACS analysis of the identification of HEPs and CD45⁺ hematopoietic cells and their cell-cycle distribution. *Right*, frequency of proliferating (S+G₂M phases) CD45⁺ blood cells and HEPs. (C) *Left*, representative FACS analysis of apoptotic CD45⁺ hematopoietic cells and HEPs. *Right*, frequency of apoptotic (Annexin V⁺) HEPs and CD45⁺ hematopoietic cells for the indicated genotypes.

Figure S3. H3K79me3 ChIP-seq profiles for the different genotypes. (A) Correlation heatmap for both H3K79me3 and H3K4me3 using affinity scores based on read counts in consensus peaks distinguishes between the four experimental groups. (B) Venn diagrams depicting the number of differentially enriched genomic regions for H3K79me3 between experimental groups relative to EV. (C) Quantitative expression of the indicated *HOX-A* genes in CFUs from day 15 EV- and double-fusion-expressing HEPs.

Figure S4. H3K4me2 profiles at genomic loci of MLL targets identified by Guenther *et al.* Representative profiles for ChIP-seq using an anti-H3K4me³ antibody at genomic sites of HOX-A (A) and non-HOX (B) MLL targets in the indicated genotypes of human ESC-differentiating derivatives.

Table S1: Primers used in this study for RT-PCR.

<i>GAPDH FW</i>	GCACCGTCAAGGCTGAGAAC
<i>GAPDH RV</i>	AGGGATCTCGCTCCTGGAA
<i>OCT4 FW</i>	GGGTTTTTGGGATTAAGTTCTTCA
<i>OCT4 RV</i>	GCCCCACCCTTTGTGTT
<i>NANOG FW</i>	ACAACGGCCGAAGAATAGCA
<i>NANOG RV</i>	GGTCCCAGTCGGGTTTAC
<i>SOX2 FW</i>	CAAAAATGGCCATGCAGGTT
<i>SOX2 RV</i>	AGTTGGGATCGAACAAAAGCTATT
<i>DNMT3B FW</i>	GCTCACAGGGCCCGATACTT
<i>DNMT3B RV</i>	GCAGTCCTGCAGCTCGAGTTTA
<i>CRIP1 FW</i>	CGGAAGTGTGAGCACGATGT
<i>CRIP1 RV</i>	GGGCAGCCAGGTGTCATG
<i>MLL-AF4 Fw</i>	CAGGTCCAGAGCAGAGCAAAC
<i>MLL-AF4 Rv</i>	GAGCACTTGGAGGTGCAGATG
<i>AF4-MLL Fw</i>	GTTGCAATGCAGCAGAAGCC
<i>AF4-MLL Rv</i>	CAGGGTGATAGCTGTTTCGG

Downregulated

Table S2: Genes differentially expressed in double fusion-expressing as compared to control (EV) I

	geneID	baseMean	log2FoldChange	lfcSE	stat
ENSG00000112319	EYA4	119,7812612	-7,044862129	0,498747	-14,1251
ENSG00000197956	S100A6	74,70274938	-4,207670299	0,362337	-11,6126
ENSG00000159176	CSRP1	189,5093971	-4,448754354	0,433169	-10,2703
ENSG00000171735	CAMTA1	620,0966312	-2,63097972	0,26318	-9,99688
ENSG00000129595	EPB41L4A	143,8337732	-3,620551338	0,367992	-9,83866
ENSG00000121691	CAT	36,73876494	-4,619144396	0,469468	-9,83911
ENSG00000166770	ZNF667-AS1	26,47276123	-4,671600613	0,476384	-9,80638
ENSG00000053438	NNAT	16,76487505	-3,757812712	0,456726	-8,22772
ENSG00000166575	TMEM135	450,180446	-3,324034043	0,415462	-8,00081
ENSG00000257870	RP11-616L12.1	21,50131485	-4,406254358	0,581565	-7,57654
ENSG00000214872	SMTNL1	29,19194545	-4,020118702	0,547389	-7,34417
ENSG00000126947	ARMCX1	19,10444916	-3,661220371	0,518724	-7,05813
ENSG00000251379	RP11-484O2.1	11,01878906	-4,051707545	0,578618	-7,00239
ENSG00000158716	DUSP23	23,54803256	-3,475578813	0,520465	-6,67784
ENSG00000100644	HIF1A	792,004365	-2,324741527	0,349887	-6,64426
ENSG00000122966	CIT	309,5111002	-2,978040214	0,467302	-6,37283
ENSG00000145681	HAPLN1	1168,660196	-2,488794725	0,394148	-6,31436
ENSG00000123307	NEUROD4	14,76503349	-3,711665311	0,603199	-6,1533
ENSG00000151962	RBM46	8,6172188	-3,652100592	0,593965	-6,14868
ENSG00000164619	BMPER	82,57948722	-3,051493964	0,497697	-6,13122
ENSG00000100290	BIK	43,70310088	-3,317822269	0,541896	-6,12261
ENSG00000050555	LAMC3	20,06173885	-3,21721061	0,531609	-6,05184
ENSG00000167555	ZNF528	15,96797568	-3,401966116	0,57936	-5,87194
ENSG00000149179	C11orf49	373,9107859	-2,410856438	0,411459	-5,85929
ENSG00000137871	ZNF280D	37,3536919	-2,381859852	0,415608	-5,73103
ENSG00000165118	C9orf64	8,084483374	-3,283794749	0,596166	-5,50819
ENSG00000162654	GBP4	82,52014498	-2,47923141	0,458077	-5,41226
ENSG00000076716	GPC4	7,134763765	-3,24223284	0,608348	-5,32957
ENSG00000171476	HOPX	162,0285124	-2,521224355	0,474735	-5,3108
ENSG00000245680	ZNF585B	6,288623057	-3,047314734	0,578532	-5,26732
ENSG00000249252	RP11-665G4.1	10,94518525	-2,963291554	0,582687	-5,08556
ENSG00000142748	FCN3	240,9954012	-2,670085804	0,531573	-5,02299
ENSG00000143614	GATAD2B	90,16811689	-2,123176462	0,42897	-4,94947
ENSG00000185507	IRF7	11,90717047	-2,442768243	0,493898	-4,9459
ENSG00000134817	APLNR	237,009581	-2,180931226	0,442427	-4,92947
ENSG00000125170	DOK4	69,15447671	-1,872722463	0,380282	-4,92456
ENSG00000138315	OIT3	123,6956759	-2,82171733	0,579118	-4,87244
ENSG00000125775	SDCBP2	9,950851737	-2,868043853	0,589784	-4,86288
ENSG00000126709	IFI6	157,1396901	-2,135200905	0,44302	-4,81965
ENSG00000137942	FNBP1L	238,2318442	-1,143914856	0,240099	-4,76435
ENSG00000176728	TTY14	7,465857067	-2,871826685	0,606999	-4,73119
ENSG00000118515	SGK1	94,59572992	-2,551626347	0,541541	-4,71178
ENSG00000108798	ABI3	32,92496542	-2,143701535	0,456145	-4,6996
ENSG00000008283	CYB561	12,17136654	-2,271524984	0,486907	-4,66522
ENSG00000188778	ADRB3	8,60506653	-2,566915557	0,554624	-4,62821
ENSG00000266472	MRPS21	256,7992655	-1,032266153	0,224316	-4,60184
ENSG00000253929	CASC21	10,99630532	-2,865101044	0,622643	-4,60151
ENSG00000113790	EHHADH	6,601260431	-2,771625162	0,620618	-4,46591
ENSG00000225792	AC004540.4	33,51932827	-2,490684309	0,564859	-4,40939
ENSG00000253438	PCAT1	26,94528599	-2,547965544	0,579052	-4,40024
ENSG00000095015	MAP3K1	44,49573983	-1,601596875	0,366684	-4,36778
ENSG00000280079	CTC-260E6.4	4,201191271	-2,612039681	0,613045	-4,26077
ENSG00000089050	RBBP9	18,85931665	-2,239301793	0,528577	-4,23647

Downregulated

ENSG00000109501	WFS1	11,45922699	-2,297305349	0,545604	-4,21057
ENSG00000105750	ZNF85	35,18030151	-2,03086483	0,485118	-4,18633
ENSG00000188643	S100A16	658,5606704	-1,602025271	0,386902	-4,14065
ENSG00000050628	PTGER3	22,15704024	-2,396796376	0,57973	-4,13433
ENSG00000113209	PCDHB5	4,603009559	-2,561413963	0,622412	-4,1153
ENSG00000169255	B3GALNT1	6,456259068	-2,420174153	0,5913	-4,09297
ENSG00000138835	RGS3	134,7621143	-1,343148381	0,328301	-4,09121
ENSG00000115461	IGFBP5	43,88760757	-2,456376257	0,607117	-4,04597
ENSG00000167941	SOST	55,5937508	-2,329603289	0,582511	-3,99924
ENSG00000128602	SMO	4,201100881	-2,331501814	0,589037	-3,95816
ENSG00000184220	CMSS1	99,07782163	-1,184435761	0,299615	-3,95319
ENSG00000196814	MVB12B	18,6907974	-2,36958793	0,600272	-3,94753
ENSG00000165259	HDX	3,752930822	-2,416387304	0,615296	-3,92719
ENSG00000137216	TMEM63B	40,97473872	-2,191833358	0,557964	-3,92827
ENSG00000166482	MFAP4	33,74531096	-2,36800861	0,604369	-3,91815
ENSG00000100888	CHD8	120,5148935	-1,370548703	0,35098	-3,90492
ENSG00000198785	GRIN3A	5,057809271	-2,433961659	0,624515	-3,89736
ENSG00000128040	SPINK2	17,31695007	-2,409310609	0,62118	-3,8786
ENSG00000184344	GDF3	47,03429759	-1,608254011	0,414806	-3,87713
ENSG00000172269	DPAGT1	91,17134944	-0,973958418	0,252828	-3,85225
ENSG00000103978	TMEM87A	77,09366437	-0,930827779	0,242655	-3,83602
ENSG00000197859	ADAMTSL2	3,993914273	-2,377353556	0,6191	-3,84001
ENSG00000157152	SYN2	9,446479206	-2,307034408	0,601271	-3,83693
ENSG00000180543	TSPYL5	3,622665339	-2,329868038	0,609108	-3,82505
ENSG00000132622	HSPA12B	7,527287149	-2,359294514	0,618173	-3,81656
ENSG00000154783	FGD5	64,4228883	-1,548935262	0,406995	-3,80578
ENSG00000221923	ZNF880	9,214690052	-2,304807456	0,609095	-3,78399
ENSG00000267383	CTC-260E6.6	3,883965663	-2,232586548	0,592887	-3,76562
ENSG00000120708	TGFBI	91,70684239	-2,076734506	0,551285	-3,76708
ENSG00000278318	ZNF229	6,000326955	-2,312454347	0,614696	-3,76195
ENSG00000182853	VMO1	5,507887137	-2,345260449	0,625084	-3,75191
ENSG00000109099	PMP22	191,524615	-1,714779803	0,458	-3,74406
ENSG00000143621	ILF2	779,2962781	-0,763125525	0,20397	-3,74137
ENSG00000156535	CD109	92,89720586	-1,532077411	0,413633	-3,70395
ENSG00000164053	ATRIP	11,14423421	-1,996586023	0,539181	-3,703
ENSG00000269834	ZNF528-AS1	5,822155471	-2,246975187	0,607714	-3,69742
ENSG00000136869	TLR4	36,50193073	-1,968054924	0,534075	-3,68498
ENSG00000133636	NTS	263,7477271	-1,851710654	0,505231	-3,66508
ENSG00000183072	NKX2-5	7,504153845	-2,287599283	0,624984	-3,66025
ENSG00000171227	TMEM37	64,20801532	-1,828344024	0,501254	-3,64754
ENSG00000118523	CTGF	23,79760678	-2,05484338	0,564356	-3,64104
ENSG00000143878	RHOB	123,0762709	-1,165082318	0,320141	-3,63927
ENSG00000228065	LINC01515	9,063863586	-2,161801995	0,594472	-3,6365
ENSG00000105825	TFPI2	148,9275203	-2,004539393	0,555907	-3,60589
ENSG00000198046	ZNF667	4,673953372	-2,203789836	0,612935	-3,59547
ENSG00000128463	EMC4	243,526124	-1,020257843	0,284652	-3,58422
ENSG00000129219	PLD2	20,75205268	-1,844978284	0,515983	-3,57566
ENSG00000198155	ZNF876P	21,53321141	-1,858631803	0,520801	-3,56879
ENSG00000154864	PIEZO2	10,72154092	-2,04403594	0,574046	-3,56075
ENSG00000188167	TMPPE	8,499811893	-2,171684721	0,610707	-3,55602
ENSG00000167085	PHB	160,4917939	-0,728482562	0,206203	-3,53284
ENSG00000079308	TNS1	15,59828255	-1,907912201	0,542247	-3,51853
ENSG00000173068	BNC2	7,553218219	-2,072085911	0,589584	-3,51449
ENSG00000140937	CDH11	38,05932655	-1,818437228	0,517773	-3,51203
ENSG00000214022	REPIN1	16,34937523	-1,45512511	0,4145	-3,51055

Downregulated

ENSG00000145623	OSMR	22,88032432	-1,714715805	0,48917	-3,50536
ENSG00000134107	BHLHE40	29,32775574	-1,724282256	0,49275	-3,49931
ENSG00000137959	IFI44L	24,12130347	-2,143875186	0,618601	-3,46569
ENSG00000075336	TIMM21	62,0256047	-1,334155081	0,387092	-3,44661
ENSG00000075213	SEMA3A	4,414059558	-2,148672606	0,624614	-3,44
ENSG00000123411	IKZF4	5,955377563	-2,037072187	0,594437	-3,42689
ENSG00000187123	LYPD6	11,07461616	-2,026908881	0,593353	-3,41602
ENSG00000101955	SRPX	28,49768115	-1,900070277	0,559264	-3,39745
ENSG00000132718	SYT11	7,459581183	-2,085624327	0,614559	-3,39369
ENSG00000116871	MAP7D1	63,43010166	-1,164518143	0,344658	-3,37876
ENSG00000221914	PPP2R2A	127,74934	-1,213673571	0,359423	-3,37673
ENSG00000136111	TBC1D4	91,02589998	-1,505884231	0,447621	-3,3642
ENSG00000260589	STAM-AS1	6,353032422	-2,061083344	0,613598	-3,35901
ENSG00000104883	PEX11G	3,473941597	-2,041500351	0,608034	-3,35755
ENSG00000128656	CHN1	22,22951211	-1,754175298	0,524292	-3,3458
ENSG00000100804	PSMB5	1009,211466	-0,468827604	0,140839	-3,32882
ENSG00000143387	CTSK	20,76828404	-1,906330014	0,573337	-3,32497
ENSG00000161298	ZNF382	15,38563794	-1,959869444	0,590249	-3,32041
ENSG00000197879	MYO1C	52,84678543	-1,454858668	0,43873	-3,31607
ENSG00000088756	ARHGAP28	115,6586262	-1,596855186	0,481915	-3,31356
ENSG00000023734	STRAP	462,0612498	-0,747464329	0,22603	-3,30693
ENSG00000165507	C10orf10	220,6959202	-1,658443129	0,50289	-3,29782
ENSG00000075043	KCNQ2	6,601271751	-2,061423654	0,624991	-3,29832
ENSG00000112414	ADGRG6	36,47477989	-1,745878365	0,529655	-3,29626
ENSG00000077616	NAALAD2	56,93366239	-1,520442973	0,462829	-3,28511
ENSG00000075914	EXOSC7	194,602295	-0,783595705	0,239541	-3,27124
ENSG00000171206	TRIM8	63,84318428	-0,865536936	0,264592	-3,27121
ENSG00000118257	NRP2	283,4681789	-1,532317765	0,469263	-3,26537
ENSG00000143127	ITGA10	10,03941541	-1,785434325	0,547072	-3,26362
ENSG00000023697	DERA	150,4101781	-0,681082172	0,208571	-3,26547
ENSG00000118777	ABCG2	3,843971196	-2,022242023	0,623639	-3,24265
ENSG00000187608	ISG15	184,3901201	-1,394462458	0,429952	-3,24329
ENSG00000126458	RRAS	57,58634609	-1,451973482	0,448239	-3,23928
ENSG00000165449	SLC16A9	16,46524127	-1,890504921	0,585565	-3,22851
ENSG00000184602	SNN	32,10538075	-1,634277643	0,507691	-3,21904
ENSG00000127241	MASP1	23,24454565	-1,845003945	0,576404	-3,20089
ENSG00000149948	HMGA2	90,72469841	-1,52121514	0,475166	-3,20144
ENSG00000114021	NIT2	84,62290275	-1,153181957	0,360509	-3,19876
ENSG00000184384	MAML2	14,57290268	-1,826824148	0,572071	-3,19335
ENSG00000242616	GNG10	6,482908148	-1,554933346	0,488834	-3,1809
ENSG00000148677	ANKRD1	4,28010366	-1,970424552	0,622291	-3,1664
ENSG00000196549	MME	3,945823194	-1,974427338	0,625005	-3,15906
ENSG00000253983	RP1-16A9.1	14,33422465	-1,874651488	0,594221	-3,15481
ENSG00000148516	ZEB1	70,75457064	-1,201599666	0,380806	-3,15541
ENSG00000005448	WDR54	242,8808433	-0,998035849	0,316873	-3,14964
ENSG00000154174	TOMM70A	68,10833425	-1,029143057	0,326615	-3,15094
ENSG00000132256	TRIM5	97,54230397	-1,156660563	0,368004	-3,14307
ENSG00000101230	ISM1	3,50609647	-1,959429369	0,624987	-3,13515
ENSG00000237187	NR2F1-AS1	2,905463012	-1,955399501	0,624047	-3,13342
ENSG00000242193	RP11-568K15.1	3,073799555	-1,950988371	0,623719	-3,12799
ENSG00000130299	GTPBP3	13,910181	-1,466872176	0,471831	-3,1089
ENSG00000154451	GBP5	9,678934476	-1,802622749	0,579799	-3,10905
ENSG00000142065	ZFP14	15,70823406	-1,538362857	0,495279	-3,10605
ENSG00000108352	RAPGEFL1	5,309428532	-1,91989045	0,623119	-3,0811
ENSG00000196611	MMP1	14,43198215	-1,892234278	0,614911	-3,07725

Downregulated

ENSG00000136546	SCN7A	7,310132654	-1,9043461	0,619072	-3,07613
ENSG00000182983	ZNF662	5,485208999	-1,918878485	0,624159	-3,07434
ENSG00000155438	NIFK	129,0123703	-0,987586753	0,321598	-3,07088
ENSG00000254615	RP11-395G23.3	15,42007794	-1,887702828	0,614815	-3,07036
ENSG00000233056	ERVH48-1	27,2291599	-1,801462596	0,587193	-3,06792
ENSG00000074219	TEAD2	29,84254346	-1,248631404	0,408137	-3,05934
ENSG00000267152	CTD-2528L19.6	4,012936355	-1,884323661	0,617433	-3,05187
ENSG00000197479	PCDHB11	3,421521002	-1,894232329	0,621873	-3,04601
ENSG00000151746	BICD1	67,26482608	-0,959827076	0,314971	-3,04736
ENSG00000254202	RP11-120I21.2	4,008818691	-1,904714553	0,625006	-3,04751
ENSG00000100379	KCTD17	5,170316551	-1,851441418	0,608966	-3,0403
ENSG00000232282	MTND1P32	5,013687738	-1,787125704	0,588479	-3,03686

Downregulated

human ESC-derived HEPs

pvalue	padj
2,65937E-45	3,67046E-41
3,55721E-31	2,45483E-27
9,59483E-25	4,41426E-21
1,57275E-23	5,42676E-20
7,67258E-23	1,76495E-19
7,63836E-23	1,76495E-19
1,05687E-22	2,08385E-19
1,90803E-16	3,29182E-13
1,23598E-15	1,89545E-12
3,54881E-14	4,89806E-11
2,07039E-13	2,59778E-10
1,68761E-12	1,94103E-09
2,51638E-12	2,67162E-09
2,42493E-11	2,39064E-08
3,04737E-11	2,80399E-08
1,85566E-10	1,42288E-07
2,7128E-10	1,8721E-07
7,58848E-10	4,90169E-07
7,81315E-10	4,90169E-07
8,72064E-10	5,23314E-07
9,2052E-10	5,29376E-07
1,43205E-09	7,90605E-07
4,30731E-09	2,28652E-06
4,64862E-09	2,3763E-06
9,98235E-09	4,92059E-06
3,62548E-08	1,61416E-05
6,22348E-08	2,68426E-05
9,8446E-08	4,11743E-05
1,09144E-07	4,4306E-05
1,38431E-07	5,45892E-05
3,66539E-07	0,000136729
5,08737E-07	0,000184779
7,44147E-07	0,000253558
7,57945E-07	0,000253558
8,24518E-07	0,000264651
8,45503E-07	0,000265219
1,10229E-06	0,000338085
1,15693E-06	0,000347128
1,43812E-06	0,000422318
1,89459E-06	0,000533656
2,2321E-06	0,000616149
2,45557E-06	0,000651765
2,60668E-06	0,00067882
3,08292E-06	0,000787972
3,68849E-06	0,000925609
4,18767E-06	0,000998112
4,19436E-06	0,000998112
7,97286E-06	0,001774861
1,03662E-05	0,002167795
1,08133E-05	0,002227541
1,25515E-05	0,002547587
2,03728E-05	0,004016928
2,27059E-05	0,004352602

Downregulated

2,54723E-05	0,004750937
2,835E-05	0,005217147
3,46317E-05	0,00612804
3,55985E-05	0,006219366
3,8667E-05	0,00658866
4,25878E-05	0,007136073
4,29136E-05	0,007136073
5,21073E-05	0,008362615
6,35458E-05	0,009854603
7,55309E-05	0,011209432
7,71153E-05	0,01132282
7,89632E-05	0,011472109
8,59434E-05	0,012103985
8,55588E-05	0,012103985
8,92307E-05	0,012315615
9,42571E-05	0,012389866
9,72454E-05	0,012543749
0,000105058	0,013262173
0,000105698	0,013262173
0,000117036	0,014294925
0,000125044	0,014625965
0,000123027	0,014625965
0,000124583	0,014625965
0,000130746	0,015115894
0,000135327	0,015436191
0,000141356	0,015861789
0,000154337	0,01704122
0,000166139	0,017683711
0,000165167	0,017683711
0,000168596	0,017763055
0,000175491	0,018135494
0,000181069	0,018399483
0,000183022	0,018438446
0,000212265	0,020856574
0,000213069	0,020856574
0,000217801	0,021021558
0,000228719	0,021922119
0,000247264	0,02337491
0,000251965	0,02365728
0,000264761	0,024361506
0,000271537	0,024819604
0,000273408	0,02482613
0,000276363	0,024930441
0,000311083	0,027174458
0,000323803	0,027668608
0,000338083	0,028592402
0,000349346	0,028604101
0,000358631	0,028946321
0,000369797	0,029332995
0,000376517	0,029695374
0,000411117	0,031699643
0,00043395	0,033090453
0,0004406	0,033413007
0,00044469	0,033538835
0,000447178	0,033543185

Downregulated

0,000455997	0,03383694
0,000466469	0,034428918
0,000528881	0,03821791
0,000567671	0,04017947
0,000581708	0,040962946
0,000610534	0,042344668
0,000635429	0,04341682
0,000680172	0,045956658
0,00068957	0,046201173
0,000728129	0,04831556
0,000733541	0,048441817
0,000767663	0,050214628
0,000782222	0,050717732
0,000786378	0,050717732
0,000820459	0,051944817
0,000872143	0,054467501
0,000884268	0,05472946
0,000898844	0,055383247
0,000912935	0,055794581
0,000921155	0,055999562
0,000943249	0,056648967
0,000974369	0,05771778
0,000972638	0,05771778
0,000979817	0,05779244
0,001019422	0,059618936
0,001070774	0,061583923
0,00107087	0,061583923
0,001093206	0,062221032
0,001099981	0,062221032
0,001092818	0,062221032
0,001184252	0,065642763
0,001181559	0,065642763
0,001198307	0,06615611
0,001244357	0,068420139
0,001286198	0,070166444
0,001370054	0,073577751
0,00136742	0,073577751
0,001380191	0,073834882
0,001406304	0,074653128
0,001468168	0,076466642
0,00154336	0,07948306
0,001582788	0,080909803
0,001606039	0,081494681
0,001602702	0,081494681
0,001634742	0,081844726
0,001627458	0,081844726
0,001671879	0,08319453
0,001717651	0,083770398
0,001727833	0,083970246
0,00176006	0,085236321
0,001877877	0,089475562
0,001876901	0,089475562
0,001896032	0,089619958
0,002062386	0,094255126
0,002089211	0,095165992

Downregulated

0,002097054	0,095208998
0,002109675	0,095310888
0,002134309	0,095498626
0,002138029	0,095498626
0,002155533	0,095661302
0,002218229	0,096297492
0,002274211	0,097783968
0,002318974	0,098178394
0,002308647	0,098178394
0,002307441	0,098178394
0,002363398	0,0985487
0,002390582	0,099354233

Table S3:**Regions differentially enriched in H3K79me3 between double fusion- and MA4/EV-hESC blood derivative**

peak_id	peak_start	peak_end	7E+05	locus_start	locus_end	gene_symbol	overlap_start	overlap_end
peak:1	21618836	21619430	594	21554783	21719308	ECE1	21618836	21619430
peak:2	27871020	27871960	940	27767914	27873410	WASF2	27871020	27871960
peak:3	41155277	41157219	1942	41144284	41157806	NFYC	41155277	41157219
peak:4	43767794	43768815	1021	43758928	43795178	TIE1	43767794	43768815
peak:5	47695316	47696362	1046	47672771	47723818	TAL1	47695316	47696362
peak:6	52092228	52092904	676	52013924	52263685	OSBPL9	52092228	52092904
peak:7	62226710	62227754	1044	62199623	62549757	PATJ	62226710	62227754
peak:8	91852668	91853280	612	91650423	91918415	HFM1	91852668	91853280
peak:9	92280907	92281736	829	92153990	92393243	TGFBR3	92280907	92281736
peak:10	94703947	94704550	603	94624102	94812278	ARHGAP29	94703947	94704550
peak:11	108502605	108503363	758	108079204	108621488	VAV3	108502605	108503363
peak:12	114481375	114482734	1359	114459956	114514019	HIPK1	114481375	114482734
peak:13	120176292	120176979	687	120166153	120222404	ZNF697	120176292	120176979
peak:14	154463886	154464492	606	154426098	154474610	SHE	154463886	154464492
peak:15	157250423	157251400	977	157103269	157315346	ETV3	157250423	157251400
peak:16	157986113	157987159	1046	157887349	158103061	KIRREL	157986113	157987159
peak:17	163039109	163041536	2427	162938501	163107329	RGS4	163039109	163041536
peak:18	183783701	183785394	1693	183698362	183845013	RGL1	183783701	183785394
peak:19	201510376	201510995	619	201482710	201553241	RPS10P7	201510376	201510995
peak:20	204647245	204647779	534	204574483	204726189	LRRN2	204647245	204647779
peak:21	208383479	208384731	1252	208143618	209009916	PLXNA2	208383479	208384731
peak:22	220703366	220703980	614	220573706	220782598	MARK1	220703366	220703980
peak:23	232629101	232629915	814	232276214	232795940	SIPA1L2	232629101	232629915
peak:24	17932183	17934084	1901	17824513	17935136	SMC6	17932183	17934084
peak:25	28634051	28635122	1071	28417452	28668758	FOSL2	28634051	28635122
peak:26	46534835	46535854	1019	46214208	46656771	EPAS1	46534835	46535854
peak:27	48759327	48760668	1341	48712609	48801122	STON1	48759327	48760668
peak:28	54168333	54168855	522	54100888	54270193	PSME4	54168333	54168855
peak:29	54690992	54692859	1867	54620763	54720378	SPTBN1	54690992	54692859
peak:30	54702819	54703781	962	54620763	54720378	SPTBN1	54702819	54703781
peak:31	72644998	72645642	644	72099974	72714084	CYP26B1	72644998	72645642
peak:32	109229797	109230389	592	109108195	109303602	LIMS1	109229797	109230389
peak:33	109234180	109234886	706	109108195	109303602	LIMS1	109234180	109234886
peak:34	120125114	120125747	633	120124455	120157348	DBI	120125114	120125747
peak:35	121019287	121019855	568	120989313	121057066	RALB	121019287	121019855
peak:36	121029069	121029803	734	120989313	121057066	RALB	121029069	121029803
peak:37	128113068	128113860	792	128076279	128138400	MAP3K2	128113068	128113860
peak:38	133011780	133012292	512	132967090	133015097	MIR663B	133011780	133012292
peak:39	133038386	133038832	446	133015098	133094844	ANKRD30BL	133038386	133038832
peak:40	145187137	145187678	541	145182640	145351746	ZEB2	145187137	145187678
peak:41	145214821	145215668	847	145182640	145351746	ZEB2	145214821	145215668
peak:42	145235431	145235972	541	145182640	145351746	ZEB2	145235431	145235972
peak:43	149902014	149904254	2240	149875716	150060267	LYPD6B	149902014	149904254
peak:44	165598915	165600426	1511	165516586	165755356	COBLL1	165598915	165600426
peak:45	169333032	169334164	1132	169208433	169376106	CERS6	169333032	169334164
peak:46	169337729	169338323	594	169208433	169376106	CERS6	169337729	169338323
peak:47	175525268	175526385	1117	175407155	175588413	WIPF1	175525268	175526385

peak:48	175695012	175695857	845	175670774	175951272	CHN1	175695012	175695857
peak:49	175707639	175708499	860	175670774	175951272	CHN1	175707639	175708499
peak:50	177146909	177147362	453	177093905	177299951	MTX2	177146909	177147362
peak:51	188300740	188301564	824	188013460	188366120	CALCRL	188300740	188301564
peak:52	188303927	188304492	565	188013460	188366120	CALCRL	188303927	188304492
peak:53	188305395	188306865	1470	188013460	188366120	CALCRL	188305395	188306865
peak:54	188308114	188308817	703	188013460	188366120	CALCRL	188308114	188308817
peak:55	188311462	188312080	618	188013460	188366120	CALCRL	188311462	188312080
peak:56	188408262	188409936	1674	188366121	188787807	TFPI	188408262	188409936
peak:57	189838944	189842924	3980	189746966	189840958	COL3A1	189838944	189840958
peak:57	189838944	189842924	3980	189840959	189842852	MIR1245A	189840959	189842852
peak:57	189838944	189842924	3980	189842853	189849641	MIR1245B	189842853	189842924
peak:58	189844676	189851425	6749	189842853	189849641	MIR1245B	189844676	189849641
peak:58	189844676	189851425	6749	189849642	189858375	COL3A1	189849642	189851425
peak:59	190021826	190023085	1259	190021222	190175382	COL5A2	190021826	190023085
peak:60	204395160	204398532	3372	204329741	204485628	RAPH1	204395160	204398532
peak:61	218706287	218706682	395	218650028	218883687	TNS1	218706287	218706682
peak:62	218715866	218716708	842	218650028	218883687	TNS1	218715866	218716708
peak:63	218716730	218719036	2306	218650028	218883687	TNS1	218716730	218719036
peak:64	225815144	225815631	487	225560167	225843518	DOCK10	225815144	225815631
peak:65	238298545	238299318	773	238123121	238358951	COL6A3	238298545	238299318
peak:66	238300753	238301271	518	238123121	238358951	COL6A3	238300753	238301271
peak:67	238304977	238305456	479	238123121	238358951	COL6A3	238304977	238305456
peak:68	238306153	238309255	3102	238123121	238358951	COL6A3	238306153	238309255
peak:69	238621449	238621986	537	238517997	238692545	LRRFIP1	238621449	238621986
peak:70	240135369	240136093	724	240114464	240168743	MGC16025	240135369	240136093
peak:71	240145501	240146534	1033	240114464	240168743	MGC16025	240145501	240146534
peak:72	240149333	240149905	572	240114464	240168743	MGC16025	240149333	240149905
peak:73	240212422	240213123	701	240168744	240223745	HDAC4	240212422	240213123
peak:74	240228231	240229136	905	240223746	240250328	MIR4269	240228231	240229136
peak:75	8554114	8554720	606	8018481	8578480	LMCD1	8554114	8554720
peak:76	8554930	8556174	1244	8018481	8578480	LMCD1	8554930	8556174
peak:77	8556581	8557182	601	8018481	8578480	LMCD1	8556581	8557182
peak:78	8559899	8560829	930	8018481	8578480	LMCD1	8559899	8560829
peak:79	14763030	14763577	547	14708493	14829669	C3orf20	14763030	14763577
peak:80	14853968	14855571	1603	14829670	14956524	FGD5	14853968	14855571
peak:81	17917820	17918600	780	17162158	18125534	TBC1D5	17917820	17918600
peak:82	52085036	52085872	836	52060210	52094794	DUSP7	52085036	52085872
peak:83	55508987	55510075	1088	55238517	55583304	WNT5A	55508987	55510075
peak:84	56795772	56796406	634	56763366	57022484	ARHGEF3	56795772	56796406
peak:85	63842015	63843350	1335	63827320	63849915	THOC7	63842015	63843350
peak:86	69279329	69280973	1644	69210728	69690159	FRMD4B	69279329	69280973
peak:87	73591060	73591723	663	73296906	74122207	PDZRN3	73591060	73591723
peak:88	73599291	73601321	2030	73296906	74122207	PDZRN3	73599291	73601321
peak:89	73641145	73641964	819	73296906	74122207	PDZRN3	73641145	73641964
peak:90	73658671	73660460	1789	73296906	74122207	PDZRN3	73658671	73660460
peak:91	79061908	79062259	351	78178797	80804919	ROBO1	79061908	79062259
peak:92	93710720	93711323	603	93695959	93723218	ARL13B	93710720	93711323
peak:93	149258030	149258652	622	149143969	149283738	TM4SF4	149258030	149258652
peak:94	149301705	149302474	769	149283739	149445700	WWTR1	149301705	149302474

peak:95	149319672	149320175	503	149283739	149445700	WWTR1	149319672	149320175
peak:96	149322137	149323389	1252	149283739	149445700	WWTR1	149322137	149323389
peak:97	149341930	149343051	1121	149283739	149445700	WWTR1	149341930	149343051
peak:98	150464111	150464934	823	150451503	150570405	SIAH2	150464111	150464934
peak:99	150821094	150821835	741	150747119	150862786	MED12L	150821094	150821835
peak:100	152556204	152556776	572	152342734	152716382	P2RY1	152556204	152556776
peak:101	155618589	155619233	644	155580287	155713331	GMPS	155618589	155619233
peak:102	169878401	169879141	740	169827626	169919878	PHC3	169878401	169879141
peak:103	171518375	171518966	591	171285301	171544821	PLD1	171518375	171518966
peak:104	498352	498925	573	492975	556220	PIGG	498352	498925
peak:105	11411842	11412580	738	11400495	12458263	HS3ST1	11411842	11412580
peak:106	16849393	16850772	1379	16649796	17207140	LDB2	16849393	16850772
peak:107	16870346	16871132	786	16649796	17207140	LDB2	16870346	16871132
peak:108	41201940	41202563	623	40805544	41237766	APBB2	41201940	41202563
peak:109	41433689	41434541	852	41310852	41722979	LIMCH1	41433689	41434541
peak:110	46316153	46316998	845	46258740	46651836	GABRA2	46316153	46316998
peak:111	55968864	55970391	1527	55792673	56102075	KDR	55968864	55970391
peak:112	55976377	55977009	632	55792673	56102075	KDR	55976377	55977009
peak:113	56407226	56411318	4092	56288872	56435727	CLOCK	56407226	56411318
peak:114	70296489	70296866	377	70253922	70448546	UGT2B4	70296489	70296866
peak:115	89078604	89079070	466	89013107	89179228	ABCG2	89078604	89079070
peak:116	98336060	98336772	712	97912816	99123459	STPG2	98336060	98336772
peak:117	99503131	99503880	749	99380664	99715027	TSPAN5	99503131	99503880
peak:118	102236712	102237215	503	101932450	102268781	PPP3CA	102236712	102237215
peak:119	106819006	106819440	434	106724284	106992738	NPNT	106819006	106819440
peak:120	111560606	111561890	1284	111470742	112314916	PITX2	111560606	111561890
peak:121	111561918	111563250	1332	111470742	112314916	PITX2	111561918	111563250
peak:122	121989051	121990325	1274	121918844	122039584	NDNF	121989051	121990325
peak:123	140866867	140867382	515	140831078	141126836	MAML3	140866867	140867382
peak:124	170532926	170533631	705	170356299	170537725	NEK1	170532926	170533631
peak:125	171970641	171971262	621	171872974	173412239	GALNTL6	171970641	171971262
peak:126	174451585	174455688	4103	174389030	174828103	HAND2	174451585	174455688
peak:127	174456733	174457313	580	174389030	174828103	HAND2	174456733	174457313
peak:128	177700357	177701207	850	177477493	177972443	VEGFC	177700357	177701207
peak:129	33815995	33816342	347	33666504	33914307	ADAMTS12	33815995	33816342
peak:130	34682324	34683635	1311	34349903	34763466	RAI14	34682324	34683635
peak:131	71146585	71147075	490	70956662	71209054	CARTPT	71146585	71147075
peak:132	75915631	75916611	980	75912092	75944780	F2RL2	75915631	75916611
peak:133	75916941	75919331	2390	75912092	75944780	F2RL2	75916941	75919331
peak:134	76015283	76017317	2034	76010049	76063350	F2R	76015283	76017317
peak:135	82842228	82843032	804	82634807	82900423	VCAN	82842228	82843032
peak:136	82993967	82995862	1895	82900424	83195771	HAPLN1	82993967	82995862
peak:137	83675308	83675942	634	83195772	84629436	EDIL3	83675308	83675942
peak:138	88678070	88678649	579	88050183	88756229	MEF2C	88678070	88678649
peak:139	119438659	119439276	617	119382637	120570241	PRR16	119438659	119439276
peak:140	134371684	134378062	6378	134369468	134528599	PITX1	134371684	134378062
peak:141	134378989	134379580	591	134369468	134528599	PITX1	134378989	134379580
peak:142	134379602	134380282	680	134369468	134528599	PITX1	134379602	134380282
peak:143	134380973	134381561	588	134369468	134528599	PITX1	134380973	134381561
peak:144	138841628	138842123	495	138780040	138852331	ECSCR	138841628	138842123

peak:145	149531548	149532482	934	149504776	149540883	PDGFRB	149531548	149532482
peak:146	153628730	153629524	794	153494408	153751441	GALNT10	153628730	153629524
peak:147	168710264	168710743	479	168709416	168869385	SLIT3	168710264	168710743
peak:148	168720216	168724104	3888	168709416	168869385	SLIT3	168720216	168724104
peak:149	171607930	171608476	546	171524612	171618261	STK10	171607930	171608476
peak:150	173321859	173322378	519	173179499	173386363	CPEB4	173321859	173322378
peak:151	178013980	178014644	664	177678584	178035805	COL23A1	178013980	178014644
peak:152	179767625	179769376	1751	179749694	179850866	GFPT2	179767625	179769376
peak:153	24904932	24905894	962	24826613	25090224	FAM65B	24904932	24905894
peak:154	33789984	33790510	526	33764350	33816160	MLN	33789984	33790510
peak:155	41906137	41906900	763	41899055	42017430	CCND3	41906137	41906900
peak:156	43069195	43070889	1694	43036095	43119539	PTK7	43069195	43070889
peak:157	44670589	44671034	445	44379315	44738564	MIR4642	44670589	44671034
peak:158	44671581	44672269	688	44379315	44738564	MIR4642	44671581	44672269
peak:159	86163397	86164057	660	85816629	86218751	NT5E	86163397	86164057
peak:160	91226084	91226619	535	91134700	91764199	MAP3K7	91226084	91226619
peak:161	98343495	98344020	525	98167346	98877493	MIR2113	98343495	98344020
peak:162	138809524	138810570	1046	138788506	138953236	NHSL1	138809524	138810570
peak:163	147531349	147531922	573	147526429	147737961	STXBP5	147531349	147531922
peak:164	157262218	157262772	554	157178733	157500926	ARID1B	157262218	157262772
peak:165	6052643	6053433	790	6048810	6059944	AIMP2	6052643	6053433
peak:166	22258202	22258490	288	22093851	22468217	RAPGEF5	22258202	22258490
peak:167	26074531	26075475	944	25935119	26090726	MIR148A	26074531	26075475
peak:168	27202934	27209614	6680	27200723	27207165	HOXA9	27202934	27207165
peak:168	27202934	27209614	6680	27207166	27211568	MIR196B	27207166	27209614
peak:169	27210826	27219500	8674	27207166	27211568	MIR196B	27210826	27211568
peak:169	27210826	27219500	8674	27211569	27222357	HOXA10	27211569	27219500
peak:170	27232641	27233483	842	27232284	27239882	HOXA13	27232641	27233483
peak:171	27234692	27235912	1220	27232284	27239882	HOXA13	27234692	27235912
peak:172	27281139	27284013	2874	27261103	27485780	EVX1	27281139	27284013
peak:173	27811436	27811765	329	27740807	27905694	TAX1BP1	27811436	27811765
peak:174	29700851	29701893	1042	29661936	29722607	MIR550A3	29700851	29701893
peak:175	29702454	29703401	947	29661936	29722607	MIR550A3	29702454	29703401
peak:176	29716072	29717020	948	29661936	29722607	MIR550A3	29716072	29717020
peak:177	29717084	29718133	1049	29661936	29722607	MIR550A3	29717084	29718133
peak:178	30960869	30961483	614	30924392	30982377	AQP1	30960869	30961483
peak:179	32328879	32329394	515	31918549	32434203	PDE1C	32328879	32329394
peak:180	33958414	33958857	443	33667270	34321210	BMPER	33958414	33958857
peak:181	35284954	35285617	663	35259743	35514228	TBX20	35284954	35285617
peak:182	43695681	43696256	575	43406594	43695916	STK17A	43695681	43695916
peak:182	43695681	43696256	575	43695917	43783706	COA1	43695917	43696256
peak:183	79765871	79770957	5086	79582357	79881981	GNAI1	79765871	79770957
peak:184	94029143	94029692	549	93828782	94093103	COL1A2	94029143	94029692
peak:185	97950456	97951212	756	97896272	97970703	BRI3	97950456	97951212
peak:186	1780828	1781459	631	1768774	1876422	ARHGEF10	1780828	1781459
peak:187	10582724	10583330	606	10559085	10635487	SOX7	10582724	10583330
peak:188	20038777	20039619	842	19918650	20047710	SLC18A1	20038777	20039619
peak:189	37669114	37669986	872	37637252	37680916	ADGRA2	37669114	37669986
peak:190	37670156	37670966	810	37637252	37680916	ADGRA2	37670156	37670966
peak:191	37897298	37898459	1161	37856103	37925515	EIF4EBP1	37897298	37898459

peak:192	48864485	48865178	693	48761735	48872753	PRKDC	48864485	48865178
peak:193	49295108	49296034	926	49284433	49740934	EFCAB1	49295108	49296034
peak:194	49828980	49834100	5120	49740935	49900447	SNAI2	49828980	49834100
peak:195	58969532	58970281	749	58549608	59115468	FAM110B	58969532	58970281
peak:196	79428973	79429516	543	78670809	79540874	PKIA	79428973	79429516
peak:197	93033549	93034137	588	92632817	93456871	RUNX1T1	93033549	93034137
peak:198	95445551	95448329	2778	95361864	95513467	RAD54B	95445551	95448329
peak:199	102524986	102525522	536	102442895	102654053	GRHL2	102524986	102525522
peak:200	102546839	102547518	679	102442895	102654053	GRHL2	102546839	102547518
peak:201	106337054	106338228	1174	105966200	106992762	ZFPM2	106337054	106338228
peak:202	106338309	106340334	2025	105966200	106992762	ZFPM2	106338309	106340334
peak:203	106340804	106341562	758	105966200	106992762	ZFPM2	106340804	106341562
peak:204	106374855	106375487	632	105966200	106992762	ZFPM2	106374855	106375487
peak:205	106380509	106381181	672	105966200	106992762	ZFPM2	106380509	106381181
peak:206	106381391	106382004	613	105966200	106992762	ZFPM2	106381391	106382004
peak:207	106413579	106414280	701	105966200	106992762	ZFPM2	106413579	106414280
peak:208	124169312	124169710	398	124164792	124211184	FAM83A	124169312	124169710
peak:209	144771302	144772218	916	144749289	144772953	ZNF707	144771302	144772218
peak:210	16484326	16485027	701	16356917	17002912	BNC2	16484326	16485027
peak:211	16789404	16790188	784	16356917	17002912	BNC2	16789404	16790188
peak:212	16828950	16832075	3125	16356917	17002912	BNC2	16828950	16832075
peak:213	16832166	16832985	819	16356917	17002912	BNC2	16832166	16832985
peak:214	16833064	16835139	2075	16356917	17002912	BNC2	16833064	16835139
peak:215	16835678	16838916	3238	16356917	17002912	BNC2	16835678	16838916
peak:216	16841587	16845686	4099	16356917	17002912	BNC2	16841587	16845686
peak:217	16850699	16852788	2089	16356917	17002912	BNC2	16850699	16852788
peak:218	16853303	16855571	2268	16356917	17002912	BNC2	16853303	16855571
peak:219	16855770	16857548	1778	16356917	17002912	BNC2	16855770	16857548
peak:220	16864908	16866306	1398	16356917	17002912	BNC2	16864908	16866306
peak:221	18549881	18550727	846	18523692	18699720	MIR3152	18549881	18550727
peak:222	20693805	20694368	563	20687207	20768198	MIR491	20693805	20694368
peak:223	27126520	27127273	753	27057420	27220305	TEK	27126520	27127273
peak:224	27142964	27143524	560	27057420	27220305	TEK	27142964	27143524
peak:225	34116427	34117310	883	34087860	34152887	DCAF12	34116427	34117310
peak:226	37992368	37992931	563	37986781	38230935	SHB	37992368	37992931
peak:227	108027552	108028747	1195	107848729	108164036	SLC44A1	108027552	108028747
peak:228	108031856	108032804	948	107848729	108164036	SLC44A1	108031856	108032804
peak:229	111650827	111651505	678	111639663	111696640	IKBKAP	111650827	111651505
peak:230	112547947	112548821	874	112331831	112676727	PALM2	112547947	112548821
peak:231	124128773	124129673	900	124103166	124197444	STOM	124128773	124129673
peak:232	125796359	125797211	852	125749611	125836839	GPR21	125796359	125797211
peak:233	125800184	125800852	668	125749611	125836839	GPR21	125800184	125800852
peak:234	126129800	126131502	1702	126074652	126141665	CRB2	126129800	126131502
peak:235	130317788	130318293	505	130294416	130357877	FAM129B	130317788	130318293
peak:236	134147587	134148770	1183	134106696	134158493	FAM78A	134147587	134148770
peak:237	134149070	134152060	2990	134106696	134158493	FAM78A	134149070	134152060
peak:238	137616525	137617372	847	137421328	137637433	COL5A1	137616525	137617372
peak:239	138973618	138974226	608	138920179	138998704	NACC2	138973618	138974226
peak:240	139423069	139424634	1565	139411041	139427158	MIR4673	139423069	139424634
peak:241	1093416	1094782	1366	1081438	1095269	IDI1	1093416	1094782

peak:242	6144391	6145180	789	6117642	6171484	RBM17	6144391	6145180
peak:243	24633820	24634513	693	24554436	24651604	MIR603	24633820	24634513
peak:244	29946523	29947035	512	29907589	30187176	SVIL	29946523	29947035
peak:245	30329105	30330584	1479	30187177	30521343	KIAA1462	30329105	30330584
peak:246	33602986	33604361	1375	33435531	33842807	NRP1	33602986	33604361
peak:247	33612310	33623591	11281	33435531	33842807	NRP1	33612310	33623591
peak:248	69524126	69524508	382	69055605	69526943	CTNNA3	69524126	69524508
peak:249	71563416	71564435	1019	71475824	71687000	COL13A1	71563416	71564435
peak:250	72972242	72977264	5022	72810417	73025651	UNC5B	72972242	72977264
peak:251	80947229	80947935	706	80828665	81086538	ZMIZ1	80947229	80947935
peak:252	88716692	88717151	459	88616911	88717856	MMRN2	88716692	88717151
peak:253	91155250	91155882	632	91145059	91163314	IFIT1	91155250	91155882
peak:254	104552485	104553797	1312	104489013	104566589	WBP1L	104552485	104553797
peak:255	104559723	104560312	589	104489013	104566589	WBP1L	104559723	104560312
peak:256	112837909	112838721	812	112780337	113390129	ADRA2A	112837909	112838721
peak:257	116158426	116160362	1936	116034844	116208076	AFAP1L2	116158426	116160362
peak:258	123244575	123245599	1024	122927677	123522759	FGFR2	123244575	123245599
peak:259	130381649	130382040	391	129885908	130594961	MKI67	130381649	130382040
peak:260	2017705	2019003	1298	1993282	2018563	MIR675	2017705	2018563
peak:260	2017705	2019003	1298	2018564	2087252	H19	2018564	2019003
peak:261	2160943	2164498	3555	2156971	2176525	IGF2	2160943	2164498
peak:262	11268043	11268592	549	11127263	11509232	CSNK2A3	11268043	11268592
peak:263	12402647	12403252	605	12353737	12557878	PARVA	12402647	12403252
peak:264	12404587	12407120	2533	12353737	12557878	PARVA	12404587	12407120
peak:265	12410514	12411161	647	12353737	12557878	PARVA	12410514	12411161
peak:266	12414622	12416345	1723	12353737	12557878	PARVA	12414622	12416345
peak:267	12834669	12835287	618	12557879	12956175	TEAD1	12834669	12835287
peak:268	16566539	16567254	715	15797531	16694225	SOX6	16566539	16567254
peak:269	16592793	16593551	758	15797531	16694225	SOX6	16592793	16593551
peak:270	16609429	16610177	748	15797531	16694225	SOX6	16609429	16610177
peak:271	16615703	16616149	446	15797531	16694225	SOX6	16615703	16616149
peak:272	16623340	16624503	1163	15797531	16694225	SOX6	16623340	16624503
peak:273	27433611	27434180	569	27230870	27439564	CCDC34	27433611	27434180
peak:274	44798075	44798691	616	44686559	44949858	TSPAN18	44798075	44798691
peak:275	46377734	46378238	504	46345834	46390548	DGKZ	46377734	46378238
peak:276	48050352	48050895	543	47936084	48197802	PTPRJ	48050352	48050895
peak:277	61534047	61535299	1252	61523999	61535107	DKFZP434K1	61534047	61535107
peak:277	61534047	61535299	1252	61535108	61552555	MYRF	61535108	61535299
peak:278	66486509	66487328	819	66450413	66500538	SPTBN2	66486509	66487328
peak:279	66493674	66495379	1705	66450413	66500538	SPTBN2	66493674	66495379
peak:280	82581850	82582560	710	82528232	82612147	PRCP	82581850	82582560
peak:281	82583067	82583651	584	82528232	82612147	PRCP	82583067	82583651
peak:282	85194858	85195323	465	83195442	85338965	DLG2	85194858	85195323
peak:283	114316541	114317397	856	114290747	114355869	REXO2	114316541	114317397
peak:284	121332485	121333650	1165	121243245	121715840	SORL1	121332485	121333650
peak:285	128361238	128362192	954	127632781	128506941	ETS1	128361238	128362192
peak:286	128600867	128601738	871	128596965	128670219	FLI1	128600867	128601738
peak:287	129984417	129985076	659	129906224	130019573	APLP2	129984417	129985076
peak:288	133953655	133955119	1464	133882735	134016623	JAM3	133953655	133955119
peak:289	133956162	133956636	474	133882735	134016623	JAM3	133956162	133956636

peak:290	11830639	11831672	1033	11751877	12123118	ETV6	11830639	11831672
peak:291	20704229	20704633	404	20057848	20786543	PDE3A	20704229	20704633
peak:292	33592073	33592479	406	33321268	33883985	SYT10	33592073	33592479
peak:293	34372437	34372829	392	33883986	36442886	ALG10	34372437	34372829
peak:294	47468861	47473585	4724	47346584	47473560	PCED1B	47468861	47473560
peak:294	47468861	47473585	4724	47473561	47527664	AMIGO2	47473561	47473585
peak:295	48578048	48580774	2726	48564372	48587220	CCDC184	48578048	48580774
peak:296	48581132	48581632	500	48564372	48587220	CCDC184	48581132	48581632
peak:297	48740759	48744225	3466	48733719	48805738	ZNF641	48740759	48744225
peak:298	50095140	50096362	1222	50035177	50118245	FMNL3	50095140	50096362
peak:299	51319023	51320625	1602	51277618	51333292	METTL7A	51319023	51320625
peak:300	54411997	54412633	636	54406767	54424513	HOXC6	54411997	54412633
peak:301	54422385	54422911	526	54406767	54424513	HOXC6	54422385	54422911
peak:302	54520010	54522014	2004	54517390	54604019	SMUG1	54520010	54522014
peak:303	54526117	54526871	754	54517390	54604019	SMUG1	54526117	54526871
peak:304	62661805	62662398	593	62654024	62757359	USP15	62661805	62662398
peak:305	76945776	76946352	576	76779548	77055721	OSBPL8	76945776	76946352
peak:306	91497059	91498160	1101	91478837	91538952	LUM	91497059	91498160
peak:307	91566883	91567833	950	91538953	92056147	DCN	91566883	91567833
peak:308	91572618	91573569	951	91538953	92056147	DCN	91572618	91573569
peak:309	95535046	95536009	963	95499430	95611381	FGD6	95535046	95536009
peak:310	95539092	95539807	715	95499430	95611381	FGD6	95539092	95539807
peak:311	96423196	96423846	650	96399548	96512752	LTA4H	96423196	96423846
peak:312	96601230	96602388	1158	96512753	96691286	ELK3	96601230	96602388
peak:313	109227249	109229598	2349	109162144	109252033	SSH1	109227249	109229598
peak:314	111855696	111856834	1138	111825339	111890655	SH2B3	111855696	111856834
peak:315	111860717	111861162	445	111825339	111890655	SH2B3	111860717	111861162
peak:316	116460997	116461510	513	115854215	116650725	MIR620	116460997	116461510
peak:317	116462513	116463600	1087	115854215	116650725	MIR620	116462513	116463600
peak:318	116465234	116466269	1035	115854215	116650725	MIR620	116465234	116466269
peak:319	116466391	116469400	3009	115854215	116650725	MIR620	116466391	116469400
peak:320	116476688	116479586	2898	115854215	116650725	MIR620	116476688	116479586
peak:321	29052854	29053736	882	28815491	29151203	FLT1	29052854	29053736
peak:322	70834842	70835388	546	70681986	71135949	KLHL1	70834842	70835388
peak:323	97886176	97888570	2394	97720348	98042885	MBNL2	97886176	97888570
peak:324	97888978	97890385	1407	97720348	98042885	MBNL2	97888978	97890385
peak:325	113424650	113425196	546	113323001	113559702	ATP11A	113424650	113425196
peak:326	114844483	114845177	694	114716817	114949228	RASA3	114844483	114845177
peak:327	114862352	114862769	417	114716817	114949228	RASA3	114862352	114862769
peak:328	114874693	114876466	1773	114716817	114949228	RASA3	114874693	114876466
peak:329	114878447	114879160	713	114716817	114949228	RASA3	114878447	114879160
peak:330	27858359	27859154	795	27729822	28659036	LINC00645	27858359	27859154
peak:331	52513146	52521420	8274	52496088	52635188	NID2	52513146	52521420
peak:332	64966283	64967079	796	64951386	64970628	ZBTB25	64966283	64967079
peak:333	65194298	65196221	1923	65112010	65227024	PLEKHG3	65194298	65196221
peak:334	75745948	75747572	1624	75694416	75753726	FOS	75745948	75747572
peak:335	75911206	75912346	1140	75827809	75943810	JDP2	75911206	75912346
peak:336	41225335	41225921	586	41204080	41233583	DLL4	41225335	41225921
peak:337	50400402	50401262	860	50040977	50442906	ATP8B4	50400402	50401262
peak:338	53827799	53828339	540	53457630	54180088	WDR72	53827799	53828339

peak:339	55255684	55256393	709	55195386	55525856	RSL24D1	55255684	55256393
peak:340	57680561	57685031	4470	57630634	57776402	CGNL1	57680561	57685031
peak:341	60661001	60661414	413	60493304	60718084	ANXA2	60661001	60661414
peak:342	68132224	68132783	559	68022467	68229307	SKOR1	68132224	68132783
peak:343	78361246	78361773	527	78149052	78372934	TBC1D2B	78361246	78361773
peak:344	83939486	83940588	1102	83914419	84034779	BNC1	83939486	83940588
peak:345	23137116	23137663	547	22954865	23177315	USP31	23137116	23137663
peak:346	33962904	33963356	452	33612312	34183632	LINC00273	33962904	33963356
peak:347	65122252	65122769	517	63554842	65276815	CDH11	65122252	65122769
peak:348	65275625	65276174	549	63554842	65276815	CDH11	65275625	65276174
peak:349	65280051	65280935	884	65276816	66005364	LINC00922	65280051	65280935
peak:350	67499011	67499644	633	67479083	67516402	ATP6VOD1	67499011	67499644
peak:351	68706305	68706780	475	68625907	68724673	CDH3	68706305	68706780
peak:352	75489293	75490494	1201	75482851	75513755	TMEM170A	75489293	75490494
peak:353	77465736	77467040	1304	77321978	77612700	ADAMTS18	77465736	77467040
peak:354	84865362	84867141	1779	84793572	84949364	CRISPLD2	84865362	84867141
peak:355	84867188	84868387	1199	84793572	84949364	CRISPLD2	84867188	84868387
peak:356	86537415	86539157	1742	86460876	86543299	FENDRR	86537415	86539157
peak:357	86539384	86541739	2355	86460876	86543299	FENDRR	86539384	86541739
peak:358	86544002	86551528	7526	86543300	86566243	FOXF1	86544002	86551528
peak:359	4411509	4412371	862	4369675	4442887	SPNS2	4411509	4412371
peak:360	4412486	4413888	1402	4369675	4442887	SPNS2	4412486	4413888
peak:361	7611015	7611676	661	7606290	7614799	EFNB3	7611015	7611676
peak:362	15146073	15146631	558	15044653	15159553	MIR4731	15146073	15146631
peak:363	15152152	15152660	508	15044653	15159553	MIR4731	15152152	15152660
peak:364	15154738	15155824	1086	15044653	15159553	MIR4731	15154738	15155824
peak:365	15156973	15157873	900	15044653	15159553	MIR4731	15156973	15157873
peak:366	15161580	15163773	2193	15159554	15206801	PMP22	15161580	15163773
peak:367	20783982	20784869	887	20641246	20872902	CCDC144NL	20783982	20784869
peak:368	25850578	25851670	1092	25772034	25947557	KSR1	25850578	25851670
peak:369	28457021	28457549	528	28444138	28463722	MIR3184	28457021	28457549
peak:370	29907826	29908340	514	29902360	30044378	MIR365B	29907826	29908340
peak:371	36610107	36610693	586	36546364	36669058	ARHGAP23	36610107	36610693
peak:372	36613351	36614272	921	36546364	36669058	ARHGAP23	36613351	36614272
peak:373	40513617	40514505	888	40499324	40557893	STAT3	40513617	40514505
peak:374	46641880	46654040	12160	46626315	46654090	HOXB3	46641880	46654040
peak:375	46655944	46662212	6268	46654091	46656526	HOXB4	46655944	46656526
peak:375	46655944	46662212	6268	46656527	46658562	MIR10A	46656527	46658562
peak:375	46655944	46662212	6268	46658563	46669367	HOXB3	46658563	46662212
peak:376	46662319	46671164	8845	46658563	46669367	HOXB3	46662319	46669367
peak:376	46662319	46671164	8845	46669368	46676718	HOXB5	46669368	46671164
peak:377	46671218	46685602	14384	46669368	46676718	HOXB5	46671218	46676718
peak:377	46671218	46685602	14384	46676719	46685368	HOXB6	46676719	46685368
peak:377	46671218	46685602	14384	46685369	46690342	HOXB7	46685369	46685602
peak:378	46698382	46701475	3093	46698069	46706878	HOXB9	46698382	46701475
peak:379	46701835	46703183	1348	46698069	46706878	HOXB9	46701835	46703183
peak:380	48134857	48135604	747	48102965	48152720	ITGA3	48134857	48135604
peak:381	60727017	60728343	1326	60631619	60821415	MRC2	60727017	60728343
peak:382	62610344	62610838	494	62593672	62738303	SMURF2	62610344	62610838
peak:383	72425330	72425990	660	72395657	72450873	GPRC5C	72425330	72425990

peak:384	73677273	73677974	701	73663335	73690457	SAP30BP	73677273	73677974
peak:385	78526234	78527056	822	78484515	78944438	RPTOR	78526234	78527056
peak:386	81042045	81046708	4663	81023627	81108307	METRNL	81042045	81046708
peak:387	6730641	6740773	10132	6649955	6889670	ARHGAP28	6730641	6740773
peak:388	6773975	6775515	1540	6649955	6889670	ARHGAP28	6773975	6775515
peak:389	43771278	43772276	998	43719144	43830380	C18orf25	43771278	43772276
peak:390	53058240	53058853	613	52798296	53138910	TCF4	53058240	53058853
peak:391	11207061	11208924	1863	11165648	11252584	LDLR	11207061	11208924
peak:392	17483803	17484462	659	17468232	17502260	PLVAP	17483803	17484462
peak:393	17486542	17487410	868	17468232	17502260	PLVAP	17486542	17487410
peak:394	24183657	24183873	216	24156966	24308112	ZNF254	24183657	24183873
peak:395	31775147	31775723	576	31740487	31959642	TSHZ3	31775147	31775723
peak:396	31808196	31809598	1402	31740487	31959642	TSHZ3	31808196	31809598
peak:397	31841439	31843763	2324	31740487	31959642	TSHZ3	31841439	31843763
peak:398	31845066	31845687	621	31740487	31959642	TSHZ3	31845066	31845687
peak:399	36066328	36066921	593	36042626	36079103	ATP4A	36066328	36066921
peak:400	54376620	54378204	1584	54348635	54379124	MYADM	54376620	54378204
peak:401	55542916	55543440	524	55513672	55557464	GP6	55542916	55543440
peak:402	587634	588435	801	557697	612462	TCF15	587634	588435
peak:403	17614207	17615256	1049	17588903	17668624	RRBP1	17614207	17615256
peak:404	19969145	19969984	839	19956839	20015798	NAA20	19969145	19969984
peak:405	23026698	23028411	1713	23023180	23048639	THBD	23026698	23028411
peak:406	48599528	48604817	5289	48576214	48628839	SNAI1	48599528	48604817
peak:407	49275133	49275912	779	49227875	49327998	FAM65C	49275133	49275912
peak:408	49304551	49305860	1309	49227875	49327998	FAM65C	49304551	49305860
peak:409	50155602	50155980	378	50114387	50246706	NFATC2	50155602	50155980
peak:410	57464269	57466116	1847	57404082	57517149	GNAS	57464269	57466116
peak:411	9826877	9827690	813	9826018	9897398	MIR3687-1	9826877	9827690
peak:412	15910563	15911212	649	15837096	16196424	SAMSN1	15910563	15911212
peak:413	28211847	28217731	5884	28081655	28272004	ADAMTS1	28211847	28217731
peak:414	29466657	29467408	751	29240191	29648661	LINC00314	29466657	29467408
peak:415	33739292	33739898	606	33718237	33775032	URB1	33739292	33739898
peak:416	38626544	38627209	665	38610319	38689846	DSCR3	38626544	38627209
peak:417	39868629	39869645	1016	39709987	40078942	ERG	39868629	39869645
peak:418	44400848	44402672	1824	44354011	44456475	PKNOX1	44400848	44402672
peak:419	46203226	46203991	765	46176624	46229897	UBE2G2	46203226	46203991
peak:420	46700079	46700967	888	46634925	46766454	POFUT2	46700079	46700967
peak:421	47401672	47407366	5694	47358893	47469572	COL6A1	47401672	47407366
peak:422	47516950	47517447	497	47469573	47540344	COL6A2	47516950	47517447
peak:423	47518597	47531485	12888	47469573	47540344	COL6A2	47518597	47531485
peak:424	47531878	47535394	3516	47469573	47540344	COL6A2	47531878	47535394
peak:425	20788478	20789449	971	20770276	20821158	SCARF2	20788478	20789449
peak:426	26952565	26953742	1177	26929864	26956329	MIR548J	26952565	26953742
peak:427	26975135	26975847	712	26956330	27000040	TPST2	26975135	26975847
peak:428	31647411	31648425	1014	31582195	31665530	LIMK2	31647411	31648425
peak:429	31650134	31650700	566	31582195	31665530	LIMK2	31650134	31650700
peak:430	39873686	39874512	826	39824543	39889667	MGAT3	39873686	39874512
peak:431	41208671	41209275	604	41142620	41212677	MIR4766	41208671	41209275
peak:432	50952415	50953010	595	50946391	50955339	NCAPH2	50952415	50953010
peak:433	45656406	45657062	656	45606113	45956577	MIR222	45656406	45657062

peak:434	64927214	64928223	1009	64829907	65068474	MSN	64927214	64928223
peak:435	131169422	131170423	1001	131060959	131192913	STK26	131169422	131170423

.
peak_overlap

595
941
1943
1022
1047
677
1045
613
830
604
759
1360
688
607
978
1047
2428
1694
620
535
1253
615
815
1902
1072
1020
1342
523
1868
963
645
593
707
634
569
735
793
513
447
542
848
542
2241
1512
1133
595
1118

846
861
454
825
566
1471
704
619
1675
2015
1894
72
4966
1784
1260
3373
396
843
2307
488
774
519
480
3103
538
725
1034
573
702
906
607
1245
602
931
548
1604
781
837
1089
635
1336
1645
664
2031
820
1790
352
604
623
770

504
1253
1122
824
742
573
645
741
592
574
739
1380
787
624
853
846
1528
633
4093
378
467
713
750
504
435
1285
1333
1275
516
706
622
4104
581
851
348
1312
491
981
2391
2035
805
1896
635
580
618
6379
592
681
589
496

935
795
480
3889
547
520
665
1752
963
527
764
1695
446
689
661
536
526
1047
574
555
791
289
945
4232
2449
743
7932
843
1221
2875
330
1043
948
949
1050
615
516
444
664
236
340
5087
550
757
632
607
843
873
811
1162

694
927
5121
750
544
589
2779
537
680
1175
2026
759
633
673
614
702
399
917
702
785
3126
820
2076
3239
4100
2090
2269
1779
1399
847
564
754
561
884
564
1196
949
679
875
901
853
669
1703
506
1184
2991
848
609
1566
1367

790
694
513
1480
1376
11282
383
1020
5023
707
460
633
1313
590
813
1937
1025
392
859
440
3556
550
606
2534
648
1724
619
716
759
749
447
1164
570
617
505
544
1061
192
820
1706
711
585
466
857
1166
955
872
660
1465
475

1034
405
407
393
4700
25
2727
501
3467
1223
1603
637
527
2005
755
594
577
1102
951
952
964
716
651
1159
2350
1139
446
514
1088
1036
3010
2899
883
547
2395
1408
547
695
418
1774
714
796
8275
797
1924
1625
1141
587
861
541

710
4471
414
560
528
1103
548
453
518
550
885
634
476
1202
1305
1780
1200
1743
2356
7527
863
1403
662
559
509
1087
901
2194
888
1093
529
515
587
922
889
12161
583
2036
3650
7049
1797
5501
8650
234
3094
1349
748
1327
495
661

702
823
4664
10133
1541
999
614
1864
660
869
217
577
1403
2325
622
594
1585
525
802
1050
840
1714
5290
780
1310
379
1848
814
650
5885
752
607
666
1017
1825
766
889
5695
498
12889
3517
972
1178
713
1015
567
827
605
596
657

1010

1002