Supporting material for JCI submission of the manuscript

Multilineage hematopoietic reconstitution without clonal selection in ADA-SCID patients treated with stem cell gene therapy

by A. Aiuti et al.

Index

Supplemental methods for RIS distribution.

There is increasing evidence that integration of retroviruses occurs in a non random fashion. Thus, one important question is to find a suitable statistical method to investigate whether some regions (e.g. promoter) of genes were favored by the integration. In statistical terms we test the following hypotheses:

H_0: the retroviral vector integrates uniformly on the genome

H_A: integrations occurr likely in proximity of TSS

We remark that the null hypothesis is what in the literature is called "random integration" hypothesis. This issue is addressed both by *Hematti et al*. (*5*) as well as in *Wu et al*. (2003) (*4*) but differently. In *Hematti et al.* the authors compare the observed integration distribution to those obtained by 1000 sets of integrations sites randomly generated, each containing a number of random selected genomic coordinate comparable with the observed one. This procedure involves then to identify this position in the concatenated sequence and correlate this position back to its chromosomal origin. Wu et al. does not perform such a simulation. They compute an average integration rate per kb the total number of observed MLV integrations. This is then compared with the expected number of integrations/ kb.

Although the two simulations are performed with different techniques and are not comparable, however they reach the same conclusion: the retrovirus integrate favourable within a distance of 5 upstream/downstream from the TSS of the closest gene.

We propose a different approach which has two main advantage: first it is not computationally demanding second it allows for considering different gene density. Instead of taking the separate distances of the integration from the start site of the closest gene (which might create some misleading idea about uniform distribution due to the different length of the genes), we consider

two distances, *i.e.* the distances between the integration and the startsites upstream and downstream. In this way it is possible to normalize the distance regardless the gene length and accounting for gene orientation. By looking at the observed integration distributions a **Beta distribution** with parameter p and q has been chosen as continuous distribution underlying the observed data. This choice is also consistent with the idea that the null hypothesis of "random" distribution means that integrations follow a uniform distribution between the two start sites (between 0 and 1), uniform distribution being a particular case of beta (with parameter = 1). Beta distributions have two free parameters, which are labeled according to one of two notational conventions. The usual definition calls these α and β. The domain is [0,1] , and the probability function is given by

$$P(x) = \frac{(1-x)^{\alpha-1}x^{\beta-1}}{B(\alpha,\beta)} = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)}(1-x)^{\alpha-1}x^{\beta-1}$$

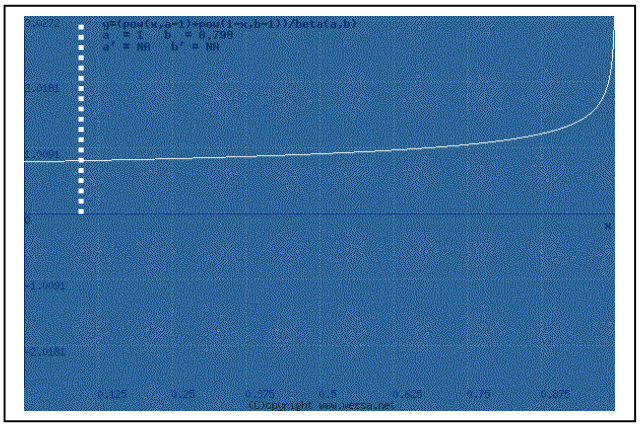
the parameters regulate the mean and variance as it follows:

$$\mu = \frac{\alpha}{\alpha+\beta}$$

$$\sigma^2 = \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$$

The continuous distributions which are equivalent to the following scheme, accounting for gene orientation look like the following figures:

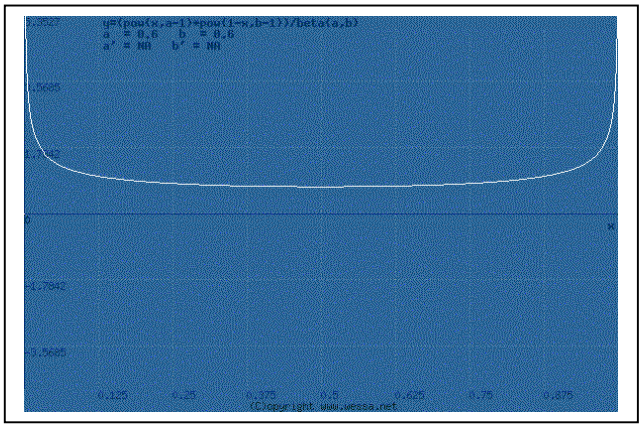
A)



gene orientation

+/+

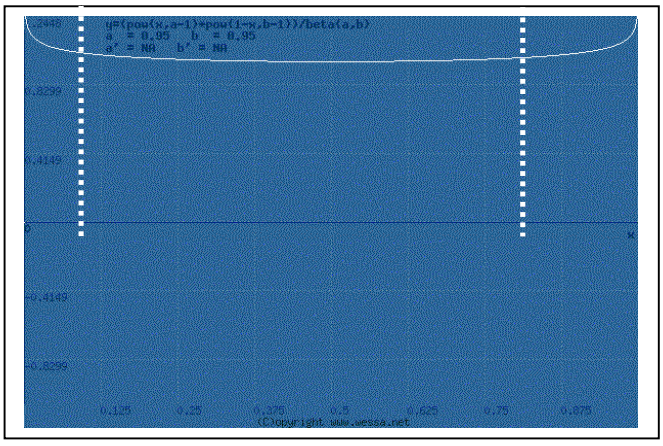
B)



gene orientation

-/+

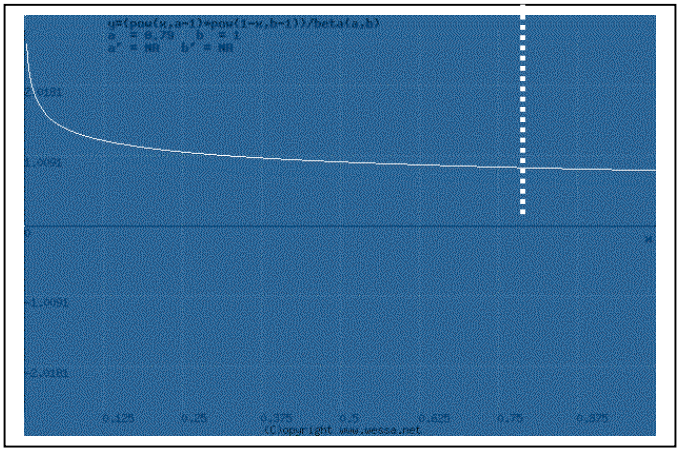
C)



gene orientation

+/-

D)



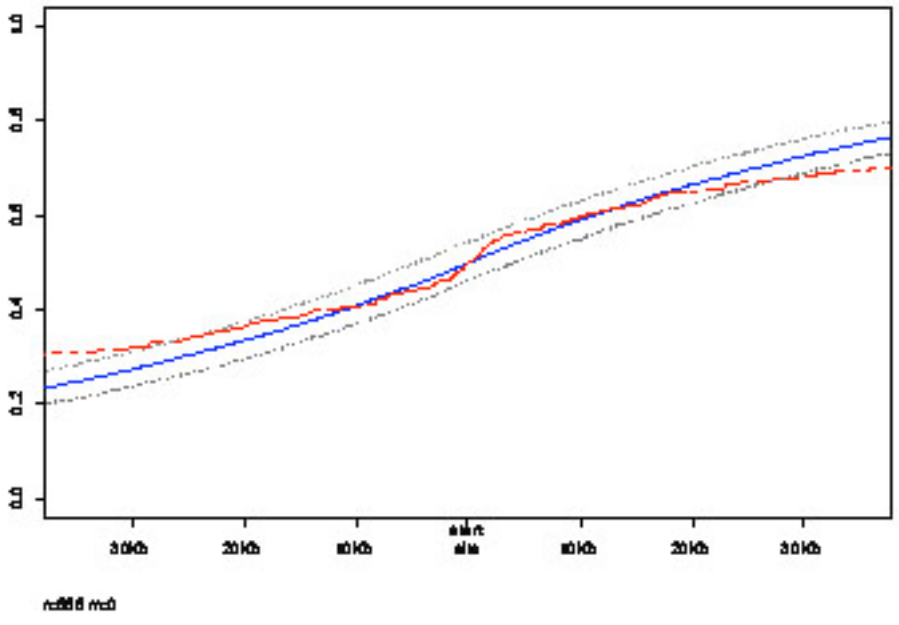
gene orientation

-/-

The observed data are plotted together with the underlying Beta distribution in Fig. 1A and the parameters are estimated and compared with the H_A assumption of uniform distribution. In simple words we investigate how far are the observed parameters α and β from 1 (expected value in case of random integration).

This hypothesis is tested both in the two cases (in vitro-ex vivo) for all orientations. Supplementary Figure 1A shows the result in all cases.

A Kolmogorov-Smirnov (K-S) test for equality of distributions is based on confidence intervals built on 50000 bootstrap replications.



Results: K-S test was not significative (p=0.006) in favor of statistical evidence for no random integration. It easily seen that confidence intervals (95%) do not include value 1.

Confidence Intervals for β (in vitro) = 0.56-0.79

Confidence Intervals for β (in vivo) = 0.53-0.75

References for supplemental material

1. A. Aiuti *et al.*, *Science* **296**, 2410 (2002).

2. A. Aiuti *et al.*, *Nat Med* **8**, 423 (2002).

3. H. J. Kim *et al.*, *Blood* **96**, 1 (2000).

4. X. Wu, Y. Li, B. Crise, S. M. Burgess, *Science* **300**, 1749 (2003).

5. P. Hematti *et al.*, *PLoS Biol* **2**, e423 (2004).

Supplemental Table 1a. Hotspots: list of genes hit independently by two integration sites.

Integration n°	Chr. n°	Relative distance (bp)	Position	RefSeq gene
S3_036 S3_P029	10	4874	Inside	**ADD3**
S5_042 S3_P091	3	20281	Inside	**BBX**
S3_086 S3_P007	19	17343	Inside	**Q8IUV1_HUMAN**
S5_176 S3_P049	5	4000	Inside	**Q8N8D9_HUMAN**
S5_010 S5_P002	22	918	Inside	**TNRC6B**
S3_058 S3_P054	8	140308	Inside	**TRPS1**
S1_062 S3_P024	3	34426	Inside	**NP_002213.1**
S5_049 S5_P020	9	44506	Inside	**CDW92**
S3_135 S3_053	1	17329	Inside	**PDE4B**
S2_031 S5_006	9	1353	Inside	**MLLT3**
S3_054 S5_022	16	12790	Inside	**BANP**
S1_114 S5_151	22	760	Inside	**NP_001008496.1**
S2_022 S4_041	22	4130	Inside	**YVO3_human**
S5_045 S5_173	6	66604	Inside	**Q8TEE4_human**
S3_063 S4_030	8	322230	Inside	**Q96Q05_human**
S4_P004 S5_P039	10	344	Inside	**C10orf107**
S3_P043 S5_P047	9	1811	Inside	**SHB**
S2_P054 S4_P027	10	87528	Inside	**ABLIM1**

The relative distance refers to the distance between the two insertions inside the target gene (see Supplementary Files 2 and 3). All insertions were <30 kb apart, with the exception of ABLIM1, TRPS1, NP_002213.1, Q8TEE4_human, CDW92 and Q96Q05_human. Three of these double hits were present in the pre-transplant sample, 7 in the post-transplant sample, and 8 in both.

Supplemental Table 1b. Hotspots: List of genomic sites frequently hit by retroviral integrations.

Integration n°	Chr. n°	Relative distance (bp)	Position	RefSeq gene
S2_033 **S4_017**	10	25789	Upstream Upstream	**AKR1CL2**
S5_114 **S2_P008** **S5_076** **S2_P015**	18	73653	Downstream Downstream Downstream Inside	**BCL2**
S1_092 **S3_108** **S2_036**	15	41359	Upstream Upstream Upstream	**BLM**
S2_045 **S5_026**	7	27387	Upstream Inside	**CCM2**
S5_138 **S5_034** **S1_021**	12	29994	Upstream Upstream Upstream	**CCND2**
S5_071 **S3_P018**	2	1846	Upstream Upstream	**CYP1B1**
S3_046 **S4_016** **S3_111**	21	14290	Upstream Upstream Inside	**DYRK1A**
S2_004 **S2_019**	X	297	Downstream Downstream	**EIF2S3**
S1_042 **S3_P047**	9	7309	Upstream Upstream	**GADD45G**
S3_P097 **S5_033**	6	1178	Upstream Upstream	**BTN3A2**
S5_056 **S5_086**	21	28407	Upstream Upstream	**HRMT1L1**
S5_P026 **S3_P072**	5	99	Upstream Upstream	**HTR4**
S1_023 **S4_012**	1	1879	Upstream Upstream	**IRF2BP2**
S3_109 **S5_040**	13	243	Upstream Upstream	**LCP1**
S5_163 **S1_049** **S4_048** **S5_144** **S3_042** **S5_P048**	11	58770	Inside Upstream Upstream Upstream Upstream Upstream	**LMO2**
S3_009 **S5_014**	8	642	Upstream Upstream	**MTSS1**
S1_011 **S1_109**	6	975	Upstream Upstream	**MYCT1**

S1_111 **S3_130**	14	6548	Downstream Downstream	**NFKBIA**
S2_007 **S5_145**	1	2445	Inside Upstream	**NP_859071.1**
S2_030 **S2_032**	2	1494	Upstream Upstream	**PTMA**
S5_136 **S5_032**	6	4123	Downstream Downstream	**Q8TEE4_HUMAN**
S3_029 **S3_081**	9	4	Downstream Downstream	**RANBP6**
S5_093 **S4_P033** **S5_P051**	20	28106	Downstream Downstream Downstream	**RNPC1**
S3_047 **S4_047**	3	4502	Downstream Downstream	**RYBP**
S3_P022 **S4_050**	21	52	Upstream Upstream	**SAMSN1**
S3_083 **S5_P058**	7	50	Downstream Downstream	**SYPL**
S2_021 **S2_P033**	17	2560	Upstream Upstream	**UBP32_HUMAN**
S5_174 **S4_P031**	13	10670	Upstream Upstream	**WBP4**
S1_014 **S1_036**	20	15	Upstream Upstream	**ZNF217**
S5_157 **S5_P028**	8	3164	Upstream Inside	**ZNF406**
S2_P035 **S5_092**	1	180	Upstream Upstream	**GMEB1**
S2_P045 **S5_072**	21	685	Downstream Downstream	**MRPL39**

The data report insertions from *in vitro* or *in vivo* samples according to the following categories: 2 RIS within 30 Kb, 3 RIS within 50Kb, ≥4 RIS within 100Kb (Suzuki et al., 2002). In case of three or more integrations the relative distance refers to the external boundaries.

Supplemental Table 2. Number of distinct retroviral integrations retrieved in T cells and granulocytes.

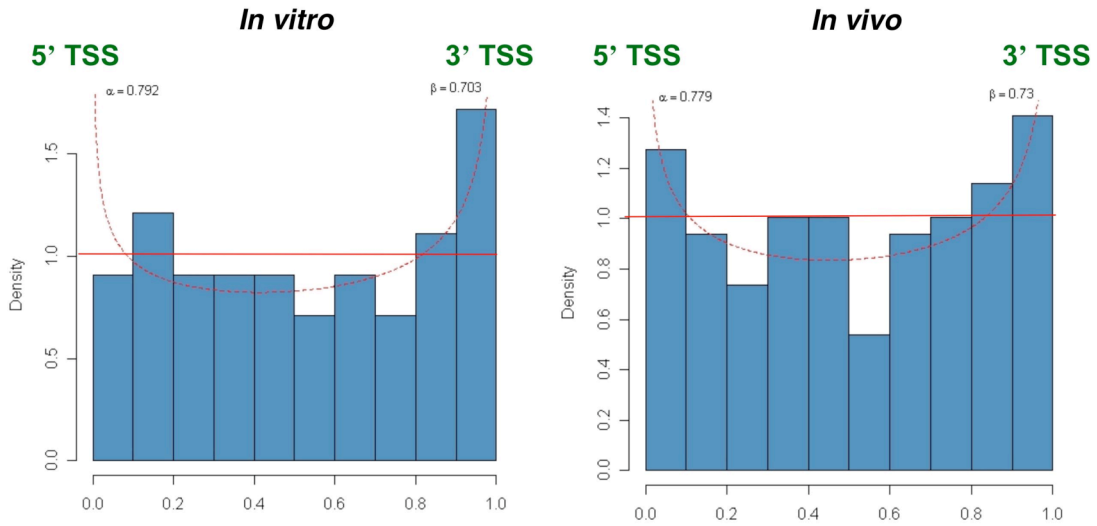
Patient	T cells	Granulocytes
S1	97	21
S2	42	-
S3	121	13
S4	58	6
S5	81	84*
Total	**399**	**124**
* of which 36 detected ≥ 6mo post-GT		

The analysis includes also the common integrations between the two lineages.

Supplemental Table 3. Distribution of retroviral integrations in Pt5.

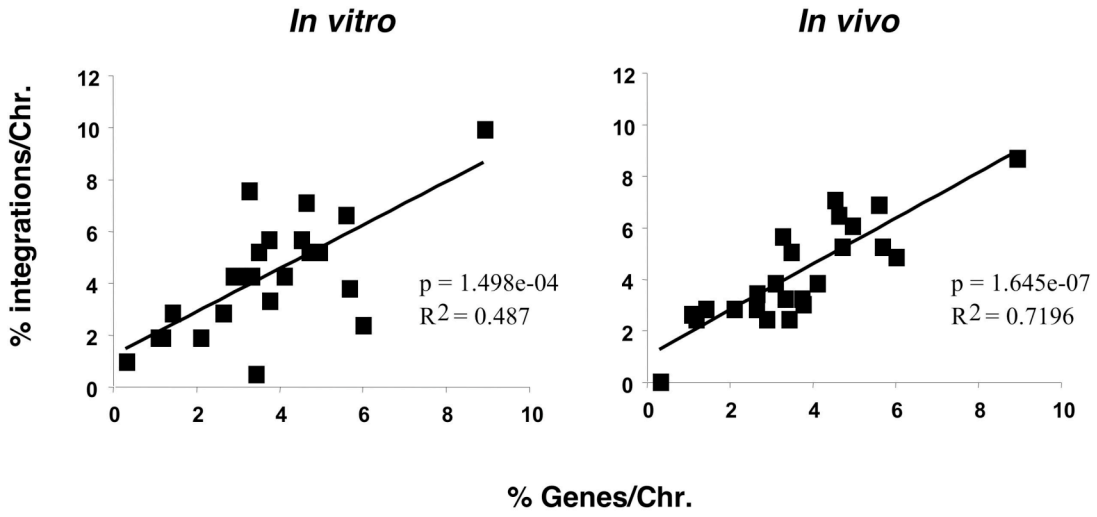
		Total	Inside	<10Kb upstream
***In vitro* CD34$^+$ cells**		62	37 (59.7%)	5 (8.1%)
Granulocytes	**+45d**	48	21 (43.7%)	10 (20.8%)
	≥ 180d	36	13 (36.1%)	9 (25%)
T cells	**≥ 180d**	81	32 (39.5%)	19 (23.5%)

Integrations isolated before transplant (*in vitro*) were compared to those retrieved post-GT from granulocytes and T cells. Numbers indicate the intragenic RIS (inside) and the intergenic RIS mapping <10Kb from the TSS of the nearest gene (<10 Kb upstream).

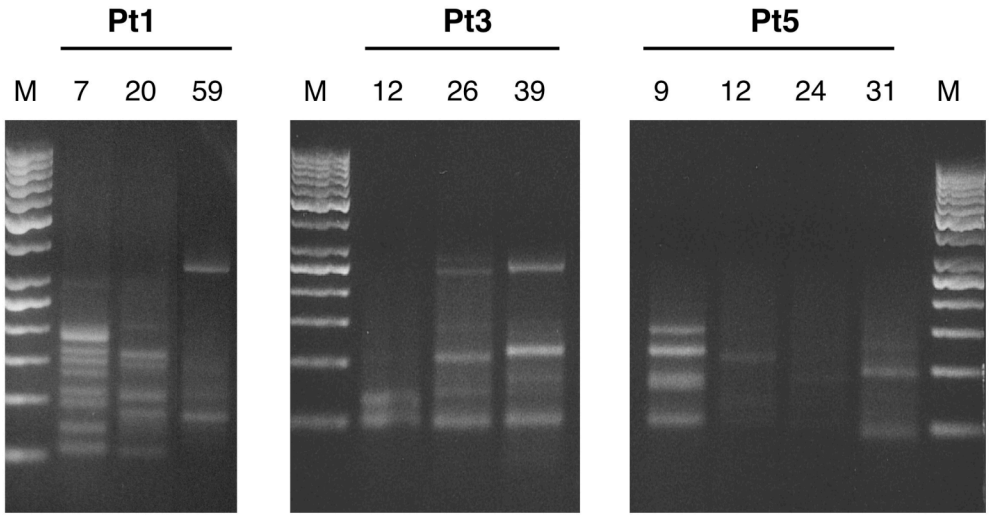


***In vitro*:** $\alpha = 0{,}79$ $\beta = 0{,}70$ ***In vivo*:** $\alpha = 0{,}78$ $\beta = 0{,}73$

Suppl. Fig. 1A. Vector integrations cluster near the start site. The distance between each integration and the start sites of genes immediately upstream (**d_1**) and downstream (**d_2**) were normalized i.e.: $d=d_1/(d_1+d_2)$ according to gene orientation. This allows to consider $0<d<1$ regardless the gene length. A Beta distribution (dotted red line) was chosen to describe the bimodal behaviour of the observed data. The "U" shape, suggesting a higher density of probability for values nearer the start sites, occurs when both the beta parameters (α and β) are less than 1, which represents the case of "uniform" random distribution (continuous red line).
The distribution of both samples is significantly different from the random ($P<0.05$).



Suppl. Figure 1B. Correlation between the percentage of integration events and the percentage of genes on individual chromosomes. Clusters of insertions were observed on chromosome 11p13 (8 sites), 18q21.33, 19p13.3 (7 sites), 1q32.1, 10p15.1, 12p13.32, 17q12, 17q23.2 (6 sites), and 1q21.2, 6q25.3, 11p11.2, 15q26.1, 17p13.1 (5 sites).The number of genes per chromosome refers to NCBI version 35 of human genome. R^2 is the Pearson goodness of fit statistics; p- value was determined using the F statistic.



Suppl. Figure 2. LM-PCR analyses in T lymphocytes over time. Time course of the clonal analysis in purified $CD3^+$ T cells from three ADA SCID patients treated with gene therapy. Nested PCR products were analysed by electrophoresis on Methaphore agarose gels with 50 bps ladder, as marker (M). Numbers refer to months after gene therapy.

Supplemental Data Files

Files S1, S2, S3

Supplemental Data File 1.
List of genomic sequences flanking retroviral vector insertion sites retrieved from pre-transplant CD34+ cells or post-gene therapy samples.
Each sequence is identified by a unique code. The first number following the letter "S" denotes the patient ID (i.e. S1=Pt1). The number following the underscore identifies the specific sequence. All pre-transplant samples are identified by the presence of the letter "P" before the unique sequence number. The sequence is oriented so that the first nucleotide of the sequence corresponds to the genomic-LTR junctions.

seq_id	seq_fasta
S1_001	tggtgtcttgctctgtcgcccaggctgtagtgcagtggcaggatctcggcccactgcaacctctgcctcccaggttcaggcaattctactgcttcagcctcctgagtagctgggattacaggc atgtgccaccacgctcggctaatttttgtatttttagtggagatggggtttcaccatgttgtccaggctggtct
S1_002	ctttctgcaggatggcatcga
S1_003	gttgcaccacgtcatgaggcatataaggtctggttgtctctgttggagtgagctgggctgggccagcaggtaccggtggtaacgctgctcctgatacgtttcga
S1_004	gtgcaatcattgtgtttagccgttttcttgccatttccaaacgcggggtggtgtccttttcga
S1_005	atgctaagcaatgaaagcaaacggaaaaaaggctgctggaatttggagtatttctttgtaatcaagaatgccttgagatatcaggctaggacctaaagaccaacctgaattttgtaattg aacgtctgtgtctgcagcaaaagcacagaacatttttagatgcagatagtatcagatcaccatctggactataaataatttatacatttcagatacctgggaatcacatgggccaggaaca aataaggtactaaatctcagtgagaaaaaatatctccaaacattgtatctgtgaatccaatttaaagtcga
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S5_155	gtagaatttcccgaggttttctttctgagtctggttaataaccgtgagaacacgggcaatggatttgcggacgactcggatctttttttttttttttttttgagacagagtctccctctgtcgccca ggcagaagcgcaatggcgagatctcggctctctgcaagctccgcctcccgggttcaccccatccccctgcctcagcctcccgagtgagtagctgggattacagccgcccgccaccacgcc cggctaatttttttgtatttttagtagagacggggtttcgctgtgttagccaggatggtatcga
S5_156	ggacagtttggtgctgcagtgaattaattacgtaggcaatcga
S5_157	aaataaataactgtcaggctcagtttgtttctgaggctaacggggtgaccaagacagaggtaagggagggagataatgacagataggaatggatgctacgtagaaaatatgaagtgt cttggagggttactttagatgggtttcgggggtgagggttaggggctggaagatatcatttgagccgaggactacggtgttggagctaaacacctta
S5_158	atctgacattcttcaaatgaaaacccctaggaaggttttctccaatagattagtcctgctttcctttacacttcacaatatacttgtttattagattgtaaatttctcaaggccagaaactcacc tta
S5_159	ataggacagttggccggtgaatcttatta
S5_160	ctgttctacattcatacctgcgataaagctta
S5_161	agactatggcatgttctgaggattgtagtgctattttgctta
S5_162	ccaacttctgtagtctttgagaaccttacgaacgcttcaagctta
S5_163	caaacaaacaaataacacccaagcagatgcaaacaggtcatttagtcaccacgataatgaacgtta
S5_164	agatcagacctctctgggtgatcagctctccagggaccctgaaggaagtgggaggggcagggaggaaggtctctggggacaggacgtcctccctttgtta
S5_165	ctctgatccccaggctgggcagatgctgctcccatggcctcccccatcacagctccaaccccccactcaccccgtcacagctgctggtttcccatgtctcccccttatacagagctgggcccaa aaaatacagtcaaggtacactgactaataacagcagctaatatctaccaagtgtttctgtgccgggcactta
S5_166	atttgtgctccaaaacttgtaaaagacaccataaatta
S5_168	ccccatcgtctcacctcctgctacctgccacccactaccctgtgattccagcccacccccagaggaggacaagggactcacattcattgagctgcaactgcatgctagctacttgcatggca cttcaatttactta
S5_169	gttctggttaggagataaaatatgagagggcagcttacatattgccgtgatta
S5_170	ccccagctctctctcctcccttcccgagggtgcgtttcctcttctatgccgggatgggggttctcttcaagcctttcaggtccttcctta

	atatcacacaactctctatgccaatgacaataatgggcttcgtatggagcactgctgtgcacttatctcctgcttgcctagggctttatttacttatatgatctttagtcctcttatcagtcctcta
S5_171	aggtagattttattatcgccaatttacagatgaggaagcaacgctttttttcccttgcatgttaccatgctgcctttcagcacaatctgttcaatgccttgccaaagatacagactgaagtctgct gggtgaaggtcagatcttgactgtgctatatacctgtggaatcttgaggaaatttta
S5_172	aatgaagctaaaggaaaactttta
S5_173	gtaataaatatctgctgatggtttactttacacatttttgattcagtcctta
S5_174	gtccaacaaagcaaaatgatttta
S5_175	gttcccatctcaggcctggtgagtgtctcctgtcctcccctcactcctacctccactgttta
S5_176	gttttagcctccagcatta
S5_P001	ggaaagcagagaggagagatggaaagaaaaggaatcccaggtgataattgtgagttgctagatcaaacctcacctgaagcctttcctctgcaatgttcagctacatgatccagtaaagt atattttta
S5_P002	catataaatcaattggtt
S5_P003	aagcatgccctttgaatta
S5_P004	ttatgtgatgtgatacttgtattgtttgatactaggattcatgattcagtta
S5_P005	acagccaaagatgaaaggaagattctataatcatcccctagctactatacatttttagtatttttatactgtattatagttagcatttagaaaataaaactgtctagcactgttgacccttcaac aatacgagtttgaactgtgcatgtccactta
S5_P006	cttcaagcgaagtgtagaaacccctatgttcatttaggggggaggaaacaaaaaagatgaacgtaaatatcctggaaatgtttttctacacaaattacagaaatatcatcaaaaactacta cactatatccacaaactctcacagatttcctgcactgactccaatacaaggacaagttgtttctaacccatacttttgacatacaaaagaagtagtta
S5_P008	ccttggtccaaagaagtatta
S5_P009	gacccatgcacaacttggtttctaaatcacgtgtactattagtcaccagtaggagccactta
S5_P010	cacataaaggttttgttttgctttgcttgttgtgaatta
S5_P012	ggaaatgaaccttagtaactttgtatgaatttttcattgcagtttggtgctaatttagtgacatta
S5_P013	agagcaagagagagctagagagccagtta
S5_P014	tcagctcctgtctgcatgtcagcgaggtaatgggtggtaaatgctggtgggaaggctggagagcagggaacagctta
S5_P015	cacccatgcagagtgtttggaggaaccctactcccacatgctggcctgtccacagagacccgtgcccctctgtctgtgccccaccacatttctcccccaatta
S5_P016	tagggagacactgccaataggttttctaaagttgtatcaatatacagtcctgctagcagggcaggaatgttctgatggttccacatcctcgtta
S5_P017	agtgtcggatgaaaaatgtgcttgtaaaaaggtctgggttgttatctgtctaatccgtcctaatctgttcagtcatttgctctgggggctctta
S5_P018	ggaagaatcaatgtatattttcccaagtgg
S5_P019	atatatgttatcattattctgtacgtta
S5_P020	acaaccagttagcttgttcccaaacacccacacagaaaacaaaagagcactagttagtcatggaaaaaaaccttaccctaagactctaactagcatta
S5_P021	tgataactttctggaagggctggtgaggttgtta
S5_P022	cagccaaaggattgagatctggggatcccactggtta
S5_P023	ctcctgtgttgaattggtgttgagaaagcagattagacaatgttaactgaactgatgtgacaggagaaactcaatgctagtatagctgtgagtaagaatgctgatctaattcatgtctttatt a
S5_P024	cataacattgacacaaagtatatgtatatagtta
S5_P025	tttgggggctcgtccgggattt
S5_P026	ctaccattagttcataaatta

S5_P028	Ccatatccaaaatgcttgggaccagaagttttagaattccagatgttttggattttggaatatttgcatatacataatgagataacctgaggatgggacccaagtctaaacatgaaatttat ttatgtttgatgtgcaccttatacacacagtctgaaggtaattttacaatatttttta
S5_P030	taagtaagtgaagcactt
S5_P032	atggtttgtgatttttcttctta
S5_P033	caggcgcccaccaccacgcctggctatttttttttgtgtttttagtagagacggggtttcaccgtgttagtcaggatggtctcgatctcctgacctcgtgatccacccgcctcggcctcccaaa gtgctgggattacaggcgtgagccaccgcgcccggccactttcttctcattctt
S5_P035	tgactagtcctaaggcagaaacccaaggaggattactggtaagaaatttcttaaaagtttttcacaagttttcctggcaaagcccagcagtaggtta
S5_P036	ccagtgtcaaagacaaaatgcaaattatggagatgattta
S5_P037	cccttactaagaaagtgtccctgcactctctcactgtcctgttccaagacggaccagagtttcaggggccctgggctgtttttttgtcacccgccatgcctctggtggctgtgactgagccagt ggtggatctattttcggggttgggaggaaagagtctttgaggatggagctgcagaaaaataatggtatgtctggctcatagacataacatcctataggcccctcaggaagaaattcagat ta
S5_P038	ggactcgaccctgtgacagtta
S5_P039	atatcagccatgaaaattatttcactgccttctgtggtgaacaatcgggctatattta
S5_P040	tttgttcccagacaatttactta
S5_P044	ctcctgggtgaaggtaattcccaagaagctggaattacaggcgtgcaccaccacgcccggctaatttttgaaaagagatggggtttctccatgttggccagcctggtctcaaattcctgac ctaaagtgatcaggtcactgatcactcctcccaaggagctggaattacaggcatgagccaccacacccagccctttgctggaaatctta
S5_P045	aaagaaaatatagttcaaagtagaatcagacagtgagtagccagctaataaacacataactgaccacctcccacccctccaagtgagaattgggagggcagtgaccacactggcacat cccataggcttggtgccactagagagttgtaggcaggtagatcaaggcagtgcttctaggtaactgggttcagcattccaagaaggcctttcaagggtttcaacagagaaggctcttggt catcctcatattcctgctggccagcacggtgcctgaaacatggtagccactgatta
S5_P046	actgcatctacacagcttcttgacacagtgttgcatttctttttagaggtaaggtcagctttggggaatagaagggaactggaataggagtagaagaagggaactggaatagaagtaga aaccgctgggtttagtcttgtccctgtccgtgtctctgtctaacagcaataatagtggctataatttacagtgtgcctgcttttctccaggaaccatgccaggttcattgcatgtgtttctgtaat tgtta
S5_P047	actcaagcagagaaggtctgaggacatttgtccttaccgaagtcctcttctccaggctaacaagccacagcttagtttcttctgggcagggatggagg
S5_P048	aagataacccacttggttgaacccctttattggctgatag
S5_P049	agaataaatgtgaagctcaggaaataatgagcataaaagtgttttgaacgccacaaactctttggaatgttttcattcatattatatta
S5_P050	ttatgagccttgtttccctttattattctta
S5_P051	acacctctctcctcctcacctcctccctctttctgcccttacaccctagtctttatttatttatta
S5_P052	attatgttgattgtaggaggctgaattctatcacaaatattgtggtaatta
S5_P053	ccaacataacctcaacggtcttta
S5_P054	gtctcgaatgccactta
S5_P055	atgggtaacttattttcttgtta
S5_P058	gggacaaggatttgtttcataggcaccgtttcagaaaaacatctctaatgtaaagtgaagcccagaagtatattttacctgctcttcactgactatgtaatta
S5_P059	agctagactgagcaaaggctgggtggcagagagctgtcatttggcatagacttccaaaatgccagcaagtgaaaagtcatgtcaaggggctaacctaaggcagaagtttta
S5_P060	agccctctcaacttccgaat
S5_P063	aagagaacaagaatctcaatccagaaagtcgttta

S5_P064 ctagttgaatactactggttttctgatagaagtatgactttctggaagtgtttatacttttta
S5_P065 aaacaaaataaattttagatgtgtatttctcgaatttcaatgtctatgggaatttctgagaaccctgttataaatgcagattttagt
S5_P066 cctcgtccttatgttcatcacatcaccatggacaaaagctatcacaatcaacaagtcaaatgaggcaactgtctta
S5_P067 gttccggtttaccctgccctggaaaagtgcaggggccaaagagtggcttacttta
S5_P068 accatgcctgggtaaataatctagagaaactatagatagatacaaggacacccccataatatactattgtcctta
S5_P069 ctttatatctgcattctctcatta
S5_P070 agaggtttatgcagaaaattactctttagctctgtggggaagtgaatttta
S5_P071 ctaaggttttctaactccattcacatttttagtatacactatggtctgaatgtttttgtcccttctctgcaaaattcatttgtta
S5_P072 ggagagccaaatcctgaaagagcagctcgttggcataggttta
S5_P073 gtagcaataaaataagagacaaaccaatactattcaaagggtgggggggaaaccaggagttttggtta
S5_P074 ggttgtttttttctctaggttggcctcaggaattttggctgtaagatta
S5_P075 Cttcaataaaaataatagccttacaagaacttttgttagttgtagtagtcagaaaggtggtaccagaaagtagaaatacatcaatggtaaaatttttttttttttttaatttctggaaaaattgc
cagtgaaaccgtccatgtcataatttttctta

Supplemental Data File 2. Summary of RIS information isolated from pre-transplant CD34+ cells.
For each RIS the following information are indicated: chromosomal location (chr), first base (chr_start, closest to the genomic-LTR junction), last base (chr_end), for intra-genic RIS: gene hit by the vector, for inter-genic RIS: nearest genes upstream and downstream the integration, distance from transcription start site of each gene, distance from last exon of each gene. All distances were calculated from the first base of the genomic sequence.

seq_id	chr	chr_start	chr_end	ensembl_id	ext_name	D_firstexon	D_lastexon	position
S2_P001	1	148396904	148396880	ENSG00000143376	SNX27	831	87720	5_prime
S2_P001	1	148396904	148396880	ENSG00000143367	TUFT1	71050	27773	3_prime
S2_P002	11	85455576	85455616	ENSG00000073921	PICALM	2173	109442	IN_GENE
S2_P003	15	36152217	36152249	ENSG00000166069	NP_689666.2	138098	113725	5_prime
S2_P003	15	36152217	36152249	ENSG00000166068	SPRE1_HUMAN	179591	281316	3_prime
S2_P005	3	123038151	123038080	ENSG00000145088	EAF2	1427	49911	IN_GENE
S2_P006	17	32925990	32925956	ENSG00000161326	DUSP14	1872	21717	IN_GENE
S2_P008	18	58915548	58915518	ENSG00000171791	BCL2	221941	26011	5_prime
S2_P008	18	58915548	58915518	ENSG00000081913	PLEKHE1	380609	116903	3_prime
S2_P009	14	63177774	63177793	ENSG00000140006	C14orf150	41361	42524	5_prime
S2_P009	14	63177774	63177793	ENSG00000126821	SGPP1	86752	42916	3_prime
S2_P010	4	158232182	158232279	ENSG00000145431	PDGFC	17969	191813	IN_GENE
S2_P011	2	60270734	60270866	ENSG00000119866	BCL11A	421550	320211	3_prime
S2_P011	2	60270734	60270866	ENSG00000115392	FANCL	1890569	1972703	5_prime
S2_P012	16	52023245	52023281	ENSG00000103479	RBL2	2617	59808	3_prime
S2_P012	16	52023245	52023281	ENSG00000185853	XP_375357.2	60862	64893	5_prime
S2_P013	3	99963694	99963583	ENSG00000064225	SIA10_HUMAN	29665	33090	IN_GENE
S2_P014	10	31190209	31190178	ENSG00000183621	NP_877432.1	170651	16636	IN_GENE
S2_P015	18	58960526	58960340	ENSG00000171791	BCL2	176963	18967	IN_GENE
S2_P016	5	59777180	59777258	ENSG00000152931	PART1_HUMAN	42336	45668	3_prime
S2_P016	5	59777180	59777258	ENSG00000197007	Q9BXE3_HUMAN	14858	14484	5_prime
S2_P017	5	10595752	10595775	ENSG00000112977	DAP	218592	136591	3_prime
S2_P017	5	10595752	10595775	ENSG00000145491	ROPN1L	100739	77617	5_prime
S2_P018	1	94933802	94933835	ENSG00000117525	F3	214421	226998	5_prime
S2_P018	1	94933802	94933835	ENSG00000143036	NP_689582.1	64154	139016	3_prime
S2_P020	3	17987279	17987212	ENSG00000182568	SATB1	467929	377160	5_prime
S2_P020	3	17987279	17987212	ENSG00000131374	TBC1D5	229876	812376	3_prime
S2_P021	21	34807116	34807191	ENSG00000159200	DSCR1	102187	3542	3_prime
S2_P021	21	34807116	34807191	ENSG00000180509	KCNE1	673	63891	5_prime
S2_P022	6	144714190	144714272	ENSG00000152818	UTRN	59532	-495472	IN_GENE
S2_P023	15	62485846	62485871	ENSG00000103671	TRIP4	18773	-48707	IN_GENE
S2_P024	10	90773792	90773765	ENSG00000138135	CH25H	183237	182419	5_prime
S2_P024	10	90773792	90773765	ENSG00000026103	Q8IUB6_HUMAN	33524	8271	3_prime
S2_P025	16	11116122	11116221	ENSG00000038532	NP_056041.1	170179	-67417	IN_GENE
S2_P028	8	32549595	32549686	ENSG00000157168	NRG1	932552	-191966	IN_GENE
S2_P029	12	115534910	115534875	ENSG00000111412	NP_079014.1	103653	81406	5_prime
S2_P029	12	115534910	115534875	ENSG00000196668	NP_997319.1	100963	98864	3_prime
S2_P030	2	122659211	122659191	ENSG00000155052	CNTNAP5	1839883	2729931	5_prime
S2_P030	2	122659211	122659191	ENSG00000163084	TSN	429860	417552	3_prime
S2_P031	1	168854693	168854660	ENSG00000197959	DNM3	312365	-258853	IN_GENE
S2_P032	7	19190087	19190044	ENSG00000146618	FERD3L	231862	232362	3_prime
S2_P032	7	19190087	19190044	ENSG00000105849	NP_001002926.1	331813	318238	5_prime
S2_P033	17	55828605	55828646	ENSG00000141371	NP_859058.1	26047	34958	3_prime
S2_P033	17	55828605	55828646	ENSG00000170832	UBP32_HUMAN	4237	219132	5_prime
S2_P035	1	28790678	28790744	ENSG00000162419	GMEB1	25182	71323	3_prime
S2_P035	1	28790678	28790744	ENSG00000120656	TAF12	477	40446	5_prime
S2_P036	21	33108267	33108149	ENSG00000159100	CU062_HUMAN	453	20520	5_prime
S2_P036	21	33108267	33108149	ENSG00000185569	OLIG2	211846	215104	3_prime
S2_P038	12	31119167	31119227	ENSG00000013573	DDX11	1090	-29832	IN_GENE
S2_P039	1	176862934	176862984	ENSG00000116260	NP_002817.2	7309	-35890	IN_GENE
S2_P040	4	141900548	141900510	ENSG00000109436	NP_055945.1	134331	1004	IN_GENE

S2_P042	17	71293107	71293066	ENSG00000132478	ZC3H5_HUMAN	575	-40367	IN_GENE
S2_P044	9	109909308	109909252	ENSG00000157654	PALM2	287176	-105036	IN_GENE
S2_P045	21	25781800	25781766	ENSG00000185433	CU042_HUMAN	56302	57715	5_prime
S2_P045	21	25781800	25781766	ENSG00000154719	MRPL39	119872	98041	3_prime
S2_P046	23	16496871	16496977	ENSG00000047230	CTPS2	6155	129541	5_prime
S2_P046	23	16496871	16496977	ENSG00000169895	SYAP1	541	42119	3_prime
S2_P047	19	1855372	1855407	ENSG00000129968	NP_112490.2	18872	27396	5_prime
S2_P047	19	1855372	1855407	ENSG00000167475	NP_612431.1	1001	21639	3_prime
S2_P048	11	129325834	129325783	ENSG00000170325	PRDM10	52106	51019	IN_GENE
S2_P050	12	111838349	111838298	ENSG00000089127	OAS1	30877	18271	5_prime
S2_P050	12	111838349	111838298	ENSG00000111331	OAS3	528	35421	3_prime
S2_P052	13	35889269	35889237	ENSG00000133101	CCNA1	15364	25737	3_prime
S2_P052	13	35889269	35889237	ENSG00000120664	Q9H1T1_HUMAN	56454	48908	5_prime
S2_P053	13	76817446	76817312	ENSG00000005810	MYCBP2	18266	300652	5_prime
S2_P053	13	76817446	76817312	ENSG00000136155	SCEL	36662	299945	3_prime
S2_P054	10	116266975	116266944	ENSG00000099204	ABLIM1	167231	86113	IN_GENE
S2_P056	5	134100284	134100404	ENSG00000164615	CAMLG	1821	15456	3_prime
S2_P056	5	134100284	134100404	ENSG00000113615	SEC24A	87871	8886	5_prime
S2_P057	8	130054592	130054611	ENSG00000173301	NP_659487.1	379824	379495	3_prime
S2_P057	8	130054592	130054611	ENSG00000197244	Q9BZ64_HUMAN	855153	854779	5_prime
S2_P058	12	13210351	13210333	ENSG00000134531	EMP1	30566	50623	3_prime
S2_P058	12	13210351	13210333	ENSG00000111305	GSG1	62505	82590	5_prime
S2_P059	3	39068103	39068181	ENSG00000168356	SCN11A	101047	205841	5_prime
S2_P059	3	39068103	39068181	ENSG00000114742	WDR48	407	45060	3_prime
S3_P001	9	35719656	35719609	ENSG00000196186		130368	504219	IN_GENE
S3_P002	10	32036481	32036563	ENSG00000165322	Q9NV28_HUMAN	221295	97891	3_prime
S3_P002	10	32036481	32036563	ENSG00000148516	TCF8	389051	178348	5_prime
S3_P004	16	85483638	85483490	ENSG00000176678	FOXL1	313807	312770	3_prime
S3_P004	16	85483638	85483490	ENSG00000131152	Q9H693_HUMAN	424711	410286	5_prime
S3_P005	17	9100333	9100458	ENSG00000170310	STX8	319667	5819	IN_GENE
S3_P006	17	2665398	2665420	ENSG00000132359	GARNL4	38298	-222385	IN_GENE
S3_P007	19	43168201	43168087	ENSG00000179573	Q8IUV1_HUMAN	78358	-97019	IN_GENE
S3_P009	1	188861554	188861532	ENSG00000150681	RGS18	2275	-25067	IN_GENE
S3_P010	10	17495013	17494980	ENSG00000148488	SIA8F_HUMAN	41280	92134	IN_GENE
S3_P012	12	92662579	92662643	ENSG00000169372	CRADD	88957	-84413	IN_GENE
S3_P013	15	46672426	46672507	ENSG00000166147	FBN1	51965	182947	IN_GENE
S3_P014	6	135798134	135798210	ENSG00000135541	AHI1	62442	151316	IN_GENE
S3_P015	17	53054956	53054994	ENSG00000153944	MSI2H_HUMAN	366026	-57342	IN_GENE
S3_P016	15	50312273	50312243	ENSG00000128833	MYO5C	62901	40429	IN_GENE
S3_P017	1	39341745	39341711	ENSG00000127603	MACF1	122779	-280171	IN_GENE
S3_P018	2	38234637	38234567	ENSG00000138061	CYP1B1	19694	28240	3_prime
S3_P018	2	38234637	38234567	ENSG00000177744	NP_775923.1	35261	86002	5_prime
S3_P019	2	179104854	179104786	ENSG00000079156	OSBPL6	220120	18474	3_prime
S3_P019	2	179104854	179104786	ENSG00000180228	PRKRA	36410	16803	5_prime
S3_P020	18	55725978	55725945	ENSG00000141682	PMAIP1	7761	3461	3_prime
S3_P020	18	55725978	55725945	ENSG00000189078	XP_371118.1	103377	102235	5_prime
S3_P022	21	14970863	14970786	ENSG00000180530	NRIP1	291521	288045	5_prime
S3_P022	21	14970863	14970786	ENSG00000155307	SAMSN1	93269	191443	3_prime
S3_P023	16	71333825	71333849	ENSG00000140836	ATBF1	305950	44643	3_prime
S3_P023	16	71333825	71333849	ENSG00000118557	PMFBP1	570264	623325	5_prime
S3_P024	3	4755925	4756100	ENSG00000150995	NP_002213.1	245964	107981	IN_GENE
S3_P025	y	2792802	2792928	ENSG00000129824	RPS4Y1	39787	14449	5_prime
S3_P025	y	2792802	2792928	ENSG00000067646	ZFY	54105	100450	3_prime
S3_P026	8	120759187	120759228	ENSG00000136960	ENPP2	38927	120678	5_prime
S3_P026	8	120759187	120759228	ENSG00000064313	TAF2	154798	53009	3_prime
S3_P028	22	28882936	28883044	ENSG00000176635	HORMAD2	81929	-14661	IN_GENE
S3_P029	10	111823809	111823852	ENSG00000148700	ADD3	68015	-61504	IN_GENE
S3_P031	22	27521637	27521670	ENSG00000100219	XBP1	523	6534	5_prime

S3_P031	22	27521637	27521670	ENSG00000183579	ZNRF3	82807	256392	3_prime
S3_P032	17	36228423	36228440	ENSG00000186395	KRT10	3933	544	IN_GENE
S3_P033	4	1167829	1167899	ENSG00000181877	Q8NAZ9_HUMAN	17205	11608	3_prime
S3_P033	4	1167829	1167899	ENSG00000159674	SPON2	11397	17274	5_prime
S3_P039	10	365856	365786	ENSG00000151240	KIAA0934	359732	54354	IN_GENE
S3_P040	8	103793837	103793812	ENSG00000155090	KLF10_HUMAN	56709	63640	3_prime
S3_P040	8	103793837	103793812	ENSG00000197942	NP_997388.1	94389	97538	5_prime
S3_P041	11	33715172	33715085	ENSG00000085063	CD59	572	34038	3_prime
S3_P041	11	33715172	33715085	ENSG00000110429	FBXO3	37475	3894	5_prime
S3_P042	2	32769697	32769874	ENSG00000018699	NP_060205.3	4917	-188070	IN_GENE
S3_P043	9	38029205	38029263	ENSG00000107338	SHB	29696	119591	IN_GENE
S3_P044	3	22467306	22467433	ENSG00000132967	Q9NYD7_HUMAN	68992	-105424	IN_GENE
S3_P045	12	117259375	117259413	ENSG00000135090	TAOK3	14006	207875	IN_GENE
S3_P046	7	114158535	114158563	ENSG00000135272	NP_951038.1	2375	-94672	IN_GENE
S3_P047	9	89381238	89381103	ENSG00000130222	GADD45G	68244	69779	5_prime
S3_P047	9	89381238	89381103	ENSG00000187764	SEMA4D	38796	159532	3_prime
S3_P048	13	110616758	110616820	ENSG00000102606	ARHGEF7	51037	139259	IN_GENE
S3_P049	5	131787171	131787034	ENSG00000197536	Q8N8D9_HUMAN	12462	-38924	IN_GENE
S3_P050	12	26985503	26985456	ENSG00000111790	FGFR1OP2	2873	-39438	IN_GENE
S3_P053	Y	21074990	21074962	ENSG00000198692	EIF1AY	746	18174	5_prime
S3_P053	Y	21074990	21074962	ENSG00000196941	TTTY10	106770	108497	3_prime
S3_P054	8	116600560	116600536	ENSG00000104447	TRPS1	149893	110636	IN_GENE
S3_P055	19	14915006	14914937	ENSG00000127529	OR7C2	1705	746	3_prime
S3_P055	19	14915006	14914937	ENSG00000105143	SLC1A6	36499	6985	5_prime
S3_P056	3	20040791	20040730	ENSG00000183977	NP_653315.1	12038	23320	3_prime
S3_P056	3	20040791	20040730	ENSG00000114166	PCAF	15737	130107	5_prime
S3_P057	8	99125712	99125650	ENSG00000156482	RL30_HUMAN	1299	2531	IN_GENE
S3_P058	3	50611909	50611859	ENSG00000114737	CISH	12298	7016	5_prime
S3_P058	3	50611909	50611859	ENSG00000114735	HEMK1	29917	14539	3_prime
S3_P059	10	102018095	102018031	ENSG00000196072	BLOC1S2	18334	5608	5_prime
S3_P059	10	102018095	102018031	ENSG00000095485	CWF19L1	668	36050	3_prime
S3_P061	5	35922775	35922855	ENSG00000168685	IL7R	30027	10097	5_prime
S3_P061	5	35922775	35922855	ENSG00000152611	NP_653248.2	51865	17453	3_prime
S3_P062	11	125767568	125767500	ENSG00000110080	Q9HAA9_HUMAN	36194	-48462	IN_GENE
S3_P063	6	2697534	2697508	ENSG00000145949	NM_001012418.1	72834	88659	3_prime
S3_P063	6	2697534	2697508	ENSG00000124535	WRNIP1	13131	33443	5_prime
S3_P064	7	20030575	20030551	ENSG00000105855	ITGB8	113411	193084	5_prime
S3_P064	7	20030575	20030551	ENSG00000183742	NP_877439.2	322	77084	3_prime
S3_P066	10	94441268	94441231	ENSG00000152804	HHEX	1578	4115	IN_GENE
S3_P067	4	22162524	22162563	ENSG00000152990	GPR125	31430	96927	IN_GENE
S3_P068	10	5494084	5494059	ENSG00000178372	CALML5	37317	36877	5_prime
S3_P068	10	5494084	5494059	ENSG00000173848	NET1	49522	3683	3_prime
S3_P069	17	27681820	27681871	ENSG00000108666	NJMU_HUMAN	11482	685	3_prime
S3_P069	17	27681820	27681871	ENSG00000141314	RHBDL4	64512	9269	5_prime
S3_P070	14	49899835	49899875	ENSG00000100490	CDKL1	53094	33365	IN_GENE
S3_P072	5	148164920	148164891	ENSG00000164270	HTR4	150982	354019	5_prime
S3_P072	5	148164920	148164891	ENSG00000169256	Q13715_HUMAN	20710	21465	3_prime
S3_P073	1	231992763	231992640	ENSG00000162885	Q96AL7_HUMAN	1059	53475	IN_GENE
S3_P076	3	151649019	151649041	ENSG00000196428	Q9H2Z7_HUMAN	40199	-11292	IN_GENE
S3_P077	5	58986296	58986350	ENSG00000113448	PDE4D	238910	683828	IN_GENE
S3_P079	20	48430590	48430642	ENSG00000172216	CEBPB	189807	187971	5_prime
S3_P079	20	48430590	48430642	ENSG00000196396	PTPN1	129708	203899	3_prime
S3_P082	10	105513192	105513259	ENSG00000107957	SH3MD1	37853	163925	IN_GENE
S3_P083	1	196560127	196560097	ENSG00000116833	NR5A2	168300	318078	5_prime
S3_P083	1	196560127	196560097	ENSG00000081237	PTPRC	1220245	1102140	3_prime
S3_P084	17	41628452	41628470	ENSG00000120071	NP_056258.1	2509	165271	5_prime
S3_P084	17	41628452	41628470	ENSG00000185829	Q9BVU5_HUMAN	166413	91188	3_prime
S3_P087	17	37863134	37863225	ENSG00000033627	ATP6V0A1	1254	64988	3_prime

S3_P087	17	37863134	37863225	ENSG00000177469	PTRF_HUMAN	34334	55133	5_prime
S3_P088	6	134735138	134735190	ENSG00000118514	ALDH8A1	577808	545084	3_prime
S3_P088	6	134735138	134735190	ENSG00000187613	Q7Z3I4_HUMAN	54249	110551	5_prime
S3_P091	3	108835862	108835941	ENSG00000114439	BBX	111382	-171536	IN_GENE
S3_P093	19	16089570	16089524	ENSG00000167461	RAB8A_HUMAN	6057	-16513	IN_GENE
S3_P094	9	104834418	104834522	ENSG00000165029	ABCA1	64427	211580	5_prime
S3_P094	9	104834418	104834522	ENSG00000070214	CDW92	252248	445713	3_prime
S3_P095	16	16120372	16120341	ENSG00000103222	ABCC1	111167	-24069	IN_GENE
S3_P097	6	26471833	26471743	ENSG00000186470	BTN3A2	1541	12586	5_prime
S3_P097	6	26471833	26471743	ENSG00000158406	H4_HUMAN	78092	82571	3_prime
S3_P098	1	194970336	194970425	ENSG00000151414	NEK7	37000	-50090	IN_GENE
S3_P099	12	126778859	126778940	ENSG00000189238	Q7Z587_HUMAN	1024607	1024102	5_prime
S3_P099	12	126778859	126778940	ENSG00000196891	Q8NED3_HUMAN	115671	115387	3_prime
S3_P100	6	5351185	5351144	ENSG00000145982	FARS1_HUMAN	144386	-365664	IN_GENE
S3_P101	12	11691875	11691839	ENSG00000139083	ETV6	2180	247713	3_prime
S3_P101	12	11691875	11691839	ENSG00000173342	Q7M4Q5_HUMAN	252122	254847	5_prime
S3_P102	6	16869526	16869434	ENSG00000124788	ATXN1	177	462203	IN_GENE
S3_P103	7	79377576	79377556	ENSG00000127955	GNAI1_HUMAN	31215	115794	3_prime
S3_P103	7	79377576	79377556	ENSG00000198617	XP_498432.1	556995	556924	5_prime
S3_P104	3	52118421	52118390	ENSG00000164087	NP_056241.2	45039	34111	IN_GENE
S4_P002	6	2764400	2764376	ENSG00000021355	SERPINB1	22704	14359	3_prime
S4_P002	6	2764400	2764376	ENSG00000124535	WRNIP1	53711	33399	5_prime
S4_P003	12	8365781	8365641	ENSG00000179177	Q8NC93_HUMAN	68953	54448	5_prime
S4_P003	12	8365781	8365641	ENSG00000171847	XP_372013.2	97086	100648	3_prime
S4_P004	10	63179101	63179058	ENSG00000183346	C10orf107	86376	16994	IN_GENE
S4_P006	18	44609062	44608989	ENSG00000134030	KIAA0427	289637	34514	IN_GENE
S4_P008	2	45284082	45284540	ENSG00000068784	NP_060549.3	465972	243389	3_prime
S4_P008	2	45284082	45284540	ENSG00000170577	SIX2	135889	140083	5_prime
S4_P009	14	105433783	105433846	ENSG00000130076	IGHG3	751536	189281	IN_GENE
S4_P010	1	120347522	120347470	ENSG00000134250	NOTCH2	23204	246643	3_prime
S4_P010	1	120347522	120347470	ENSG00000198186	Q8NE92_HUMAN	183471	183268	5_prime
S4_P011	1	147407532	147407601	ENSG00000143420	ENSA	7639	145	3_prime
S4_P011	1	147407532	147407601	ENSG00000143384	MCL1	42323	47422	5_prime
S4_P013	4	2438174	2437973	ENSG00000063978	RNF4	136	46634	5_prime
S4_P013	4	2438174	2437973	ENSG00000159733	ZFYVE28	50574	199618	3_prime
S4_P014	2	148563712	148563564	ENSG00000115947	ORC4L	49304	38100	IN_GENE
S4_P015	4	39878854	39878800	ENSG00000078177	N4BP2_HUMAN	18866	100729	5_prime
S4_P015	4	39878854	39878800	ENSG00000121892	NP_056015.1	76796	231804	3_prime
S4_P018	7	65590603	65590554	ENSG00000146684	KCTD7	52508	40636	3_prime
S4_P018	7	65590603	65590554	ENSG00000154710	NP_055319.1	59267	129993	5_prime
S4_P020	10	63299337	63299449	ENSG00000150347	ARI5B_HUMAN	32128	223458	3_prime
S4_P020	10	63299337	63299449	ENSG00000183346	C10orf107	206612	103242	5_prime
S4_P021	14	57782098	57782057	ENSG00000100567	PSMA3	711	-26420	IN_GENE
S4_P022	3	113946908	113946950	ENSG00000163606	CD200R1	229742	175838	3_prime
S4_P022	3	113946908	113946950	ENSG00000091986	NP_955805.1	104241	140807	5_prime
S4_P023	3	47528622	47528647	ENSG00000163832	Q9BW57_HUMAN	1566	16064	IN_GENE
S4_P024	14	21986879	21986918	ENSG00000166056	Q6PJ56_HUMAN	25585	-104051	IN_GENE
S4_P025	1	110046933	110046734	ENSG00000184371	CSF1	118566	137470	5_prime
S4_P025	1	110046933	110046734	ENSG00000198758	EPS8L3	28327	42189	3_prime
S4_P026	6	113280521	113280492	ENSG00000182805	XP_498131.1	505296	501330	3_prime
S4_P026	6	113280521	113280492	ENSG00000173180	XP_498135.1	986638	986979	5_prime
S4_P027	10	116354503	116354374	ENSG00000099204	ABLIM1	79832	173512	IN_GENE
S4_P029	20	57266300	57266206	ENSG00000124203	C20orf174	65697	1822	3_prime
S4_P029	20	57266300	57266206	ENSG00000124205	EDN3	42577	68141	5_prime
S4_P030	11	117283504	117283401	ENSG00000137747	Q9BYE2_HUMAN	21905	6831	IN_GENE
S4_P031	13	40481410	40481510	ENSG00000120690	ELF1	26992	77245	5_prime
S4_P031	13	40481410	40481510	ENSG00000120688	WBP4	52252	74727	3_prime
S4_P032	16	49883899	49883919	ENSG00000197029	NP_001011725.1	353303	354629	3_prime

S4_P032	16	49883899	49883919	ENSG00000103449	SALL1	141246	156069	5_prime
S4_P033	20	55489515	55489561	ENSG00000124097	NP_001008735.1	7974	7339	3_prime
S4_P033	20	55489515	55489561	ENSG00000132819	RNPC1	89645	71729	5_prime
S4_P034	1	13804736	13804767	ENSG00000116731	PRDM2	28080	-92145	IN_GENE
S5_P001	16	17474981	17474854	ENSG00000187529	XP_018432.4	459114	459650	5_prime
S5_P001	16	17474981	17474854	ENSG00000103489	XYLT1	2742	366141	3_prime
S5_P002	22	38898688	38898671	ENSG00000100354	TNRC6B	22055	-145182	IN_GENE
S5_P003	6	14842215	14842197	ENSG00000112149	CD83	616372	597133	3_prime
S5_P003	6	14842215	14842197	ENSG00000008083	JARID2	512291	788017	5_prime
S5_P004	3	183912777	183912726	ENSG00000058063	ATP11B	107973	209340	5_prime
S5_P004	3	183912777	183912726	ENSG00000181449	SOX2	1000353	997854	3_prime
S5_P005	14	70954346	70954191	ENSG00000192062	NR_001276.1	19539	19469	3_prime
S5_P005	14	70954346	70954191	ENSG00000198527	Q8NF05_HUMAN	46280	53145	5_prime
S5_P006	6	122014841	122015058	ENSG00000152661	GJA1	216354	202270	5_prime
S5_P006	6	122014841	122015058	ENSG00000025156	HSF2	747653	780969	3_prime
S5_P008	12	103499079	103499059	ENSG00000171310	CHST11	145816	-155291	IN_GENE
S5_P009	14	95944905	95944844	ENSG00000140057	AK7	16643	-80022	IN_GENE
S5_P010	4	159490119	159490157	ENSG00000164124	NP_060812.2	838	-43913	IN_GENE
S5_P012	10	11614085	11614020	ENSG00000148429	USP6NL	79623	71390	IN_GENE
S5_P013	1	163190683	163190711	ENSG00000188859	XP_097622.4	382835	419547	IN_GENE
S5_P014	20	61953394	61953318	ENSG00000183260	C20orf135	9619	12696	5_prime
S5_P014	20	61953394	61953318	ENSG00000171738	C20orf181	7677	8171	3_prime
S5_P015	19	12758585	12758687	ENSG00000095066	HOOK2_HUMAN	11228	23767	5_prime
S5_P015	19	12758585	12758687	ENSG00000171223	JUNB	4725	6539	3_prime
S5_P016	8	130661921	130661828	ENSG00000147697	MLZE	197094	168008	5_prime
S5_P016	8	130661921	130661828	ENSG00000173301	NP_659487.1	227505	227834	3_prime
S5_P017	11	128038248	128038155	ENSG00000134954	ETS1	140877	204376	3_prime
S5_P017	11	128038248	128038155	ENSG00000151702	FLI1	30991	147845	5_prime
S5_P018	14	38386052	38386023	ENSG00000176435	CN027_HUMAN	591074	592546	3_prime
S5_P018	14	38386052	38386023	ENSG00000100934	SEC23A	256138	184822	5_prime
S5_P019	1	111382550	111382577	ENSG00000156171	NP_848549.1	12154	10207	IN_GENE
S5_P020	9	105139008	105138911	ENSG00000070214	CDW92	52245	-141220	IN_GENE
S5_P021	20	5878127	5878094	ENSG00000089195	Q9ULR7_HUMAN	1079	11608	IN_GENE
S5_P022	9	127411885	127411849	ENSG00000136830	C9orf88	8973	64670	IN_GENE
S5_P023	3	33296676	33296757	ENSG00000153558	FBXL2_HUMAN	2738	-106445	IN_GENE
S5_P024	1	64632302	64632335	ENSG00000158966	NP_065976.1	51317	238460	3_prime
S5_P024	1	64632302	64632335	ENSG00000177414	NP_689702.1	250791	210254	5_prime
S5_P025	22	44897216	44897236	ENSG00000186951	PPARA	30208	61093	IN_GENE
S5_P026	5	148164821	148164841	ENSG00000164270	HTR4	150912	353949	5_prime
S5_P026	5	148164821	148164841	ENSG00000169256	Q13715_HUMAN	20780	21535	3_prime
S5_P028	8	135791994	135792172	ENSG00000066827	ZNF406	2480	232777	IN_GENE
S5_P030	1	202801803	202801820	ENSG00000196188	CTSE	58723	73368	3_prime
S5_P030	1	202801803	202801820	ENSG00000196533	NP_001007545.1	15487	19357	5_prime
S5_P032	9	85786349	85786371	ENSG00000135040	MAK10	734	-80406	IN_GENE
S5_P033	13	106317242	106317066	ENSG00000174405	LIG4	1351475	1340553	5_prime
S5_P033	13	106317242	106317066	ENSG00000174408	XM_063084.4	2607	3048	3_prime
S5_P035	3	105724784	105724837	ENSG00000170017	ALCAM	843619	1053649	3_prime
S5_P035	3	105724784	105724837	ENSG00000170044	ZPLD1	2088235	2043409	5_prime
S5_P036	2	130815436	130815397	ENSG00000136710	NP_115733.2	755	3351	IN_GENE
S5_P037	5	2584005	2583829	ENSG00000170561	IRX2	220532	215279	5_prime
S5_P037	5	2584005	2583829	ENSG00000113430	IRX4	648125	653456	3_prime
S5_P038	15	42742531	42742552	ENSG00000104133	NP_079413.2	607	100339	IN_GENE
S5_P039	10	63178757	63178814	ENSG00000183346	C10orf107	86032	-17338	IN_GENE
S5_P040	5	95074527	95074549	ENSG00000164292	RHOBTB3	18272	82033	3_prime
S5_P040	5	95074527	95074549	ENSG00000145757	SPATA9	30057	60886	5_prime
S5_P044	15	90286906	90287115	ENSG00000176463	SLCO3A1	88956	-220869	IN_GENE
S5_P045	17	40741374	40741667	ENSG00000006062	MAP3K14	8774	45096	IN_GENE
S5_P046	13	23320304	23320553	ENSG00000027001	MIPEP	41006	118224	IN_GENE

S5_P047	9	38031016	38031113	ENSG00000107338	SHB	27885	121402	IN_GENE
S5_P048	11	33909660	33909621	ENSG00000135363	LMO2	39248	72959	3_prime
S5_P048	11	33909660	33909621	ENSG00000135387	M11S1	120088	169017	5_prime
S5_P049	4	75062620	75062708	ENSG00000124875	CXCL6	4828	6891	3_prime
S5_P049	4	75062620	75062708	ENSG00000169429	IL8	91310	88154	5_prime
S5_P050	1	99049870	99049898	ENSG00000162627	SNX7	210636	111795	5_prime
S5_P050	1	99049870	99049898	ENSG00000117598	XP_375754.2	132332	17961	3_prime
S5_P051	20	55461409	55461344	ENSG00000124097	NP_001008735.1	36080	35445	5_prime
S5_P051	20	55461409	55461344	ENSG00000132819	RNPC1	61539	43623	3_prime
S5_P052	2	28072768	28072718	ENSG00000158019	BRE	47635	400648	IN_GENE
S5_P053	11	113511383	113511406	ENSG00000109906	ZBTB16	75858	-115193	IN_GENE
S5_P054	1	26549170	26549186	ENSG00000117676	RPS6KA1	8770	-36486	IN_GENE
S5_P055	7	91800839	91800861	ENSG00000127980	PEX1	1621	39848	IN_GENE
S5_P058	7	105307108	105307210	ENSG00000128536	Q8TCI7_HUMAN	109472	39272	5_prime
S5_P058	7	105307108	105307210	ENSG00000008282	SYPL	39900	17801	3_prime
S5_P059	2	207834417	207834527	ENSG00000118263	KLF7	22660	63833	IN_GENE
S5_P060	2	227216803	227216818	ENSG00000197218		488915	-1644033	IN_GENE
S5_P063	9	34115402	34115436	ENSG00000165006	UBAP1	89274	-127118	IN_GENE
S5_P064	2	241985225	241985287	ENSG00000168385	SEPT2_HUMAN	10450	-28207	IN_GENE
S5_P065	7	16080144	16080228	ENSG00000186065	XP_499266.1	153866	51213	IN_GENE
S5_P066	2	196932474	196932549	ENSG00000138411	HECW2	350367	42991	IN_GENE
S5_P067	7	156694982	156694928	ENSG00000105993	DNAJB6	44185	-13340	IN_GENE
S5_P068	2	45998136	45998062	ENSG00000171132	PRKCE	207368	-328717	IN_GENE
S5_P069	8	99315772	99315795	ENSG00000104361	NP_079035.1	60025	42209	IN_GENE
S5_P070	9	77950295	77950345	ENSG00000148019	C9orf81	130270	160815	3_prime
S5_P070	9	77950295	77950345	ENSG00000156052	GNAQ	74549	385541	5_prime
S5_P071	4	25554728	25554764	ENSG00000091490	NP_056002.1	14015	129409	5_prime
S5_P071	4	25554728	25554764	ENSG00000180408	XP_371691.1	37360	52974	3_prime
S5_P072	5	27207336	27207294	ENSG00000113100	CDH9	132905	290870	5_prime
S5_P072	5	27207336	27207294	ENSG00000197298	REC17_HUMAN	3318194	3316178	3_prime
S5_P073	14	99617498	99617564	ENSG00000196405	EVL	15994	-62827	IN_GENE
S5_P074	12	122739135	122739182	ENSG00000185344	ATP6V0A2	17390	-30186	IN_GENE
S5_P075	1	110254277	110254363	ENSG00000168710	AHCYL1	14927	-22761	IN_GENE

Supplemental Data File 3.
Summary of RIS information isolated from post-gene therapy samples. For each RIS the information are reported as described in Suppl. Data File 2.

seq_id	chr	chr_start	chr_end	ensembl_id	ext_name	D_firstexon	D_lastexon	position
S1_001	20	29668510	29668706	ENSG00000125968	ID1	11757	10536	5_prime
S1_001	20	29668510	29668706	ENSG00000131055	COX4I2	20842	27951	3_prime
S1_002	12	4809736	4809716	ENSG00000151079	KCNA6	20364	18604	3_prime
S1_002	12	4809736	4809716	ENSG00000111262	KCNA1	81070	82557	5_prime
S1_003	8	144344859	144344756	ENSG00000176956	LY6H	31739	34150	3_prime
S1_003	8	144344859	144344756	ENSG00000182851	NP_835466.1	21584	25559	5_prime
S1_004	9	121340759	121340821	ENSG00000136848	DAB2IP	200444	286602	3_prime
S1_004	9	121340759	121340821	ENSG00000148175	STOM	128660	159848	5_prime
S1_005	X	40612935	40613246	ENSG00000124486	USP9X	126142	235498	3_prime
S1_005	X	40612935	40613246	ENSG00000197639	MKRN	163285	159940	5_prime
S1_006	12	74072627	74072844	ENSG00000180481	NP_689649.1	1471	-31460	IN_GENE
S1_007	13	49164688	49164361	ENSG00000123179	EBPL	1076	31820	3_prime
S1_007	13	49164688	49164361	ENSG00000102753	KPNA3	100370	6775	5_prime
S1_008	20	33213329	33213024	ENSG00000088298	C20orf31	14525	46498	3_prime
S1_008	20	33213329	33213024	ENSG00000101000	PROCR	10106	15496	5_prime
S1_009	6	6603226	6603338	ENSG00000124782	RREB1	481251	592968	3_prime
S1_009	6	6603226	6603338	ENSG00000112799	LY86	69292	3013	5_prime
S1_010	3	27377115	27377495	ENSG00000163491	Q96MB3_HUMA	8801	249707	IN_GENE
S1_011	6	153109201	153109414	ENSG00000120279	MYCT1	1951	26671	3_prime
S1_011	6	153109201	153109414	ENSG00000131018	SYNE1	58553	574264	5_prime
S1_012	17	43921458	43921282	ENSG00000141293	SCAP1	58907	355654	3_prime
S1_012	17	43921458	43921282	ENSG00000120094	HOXB1	41813	40355	5_prime
S1_013	17	26182860	26182729	ENSG00000176390	CRLF3	7034	49030	3_prime
S1_013	17	26182860	26182729	ENSG00000176208	NP_079133.3	286	63561	5_prime
S1_014	20	51802285	51802158	ENSG00000171940	ZNF217	169242	185266	3_prime
S1_014	20	51802285	51802158	ENSG00000149617	Q6P094_HUMA	123218	122913	5_prime
S1_015	19	44519283	44519598	ENSG00000179134	NP_060498.2	20091	47375	3_prime
S1_015	19	44519283	44519598	ENSG00000130755	GMFG	797	8443	5_prime
S1_016	1	25095300	25095133	ENSG00000020633	RUNX3	58382	123936	3_prime
S1_016	1	25095300	25095133	ENSG00000117614	NP_056299.1	209009	199178	5_prime
S1_017	17	53767250	53767038	ENSG00000005379	BZRAP1	6130	33655	3_prime
S1_017	17	53767250	53767038	ENSG00000108372	SPT41_HUMAN	17312	10288	5_prime
S1_018	10	61338119	61337766	ENSG00000108091	CCDC6	1805	119591	3_prime
S1_018	10	61338119	61337766	ENSG00000151150	ANK3	481375	120046	5_prime
S1_019	15	29562584	29562752	ENSG00000169918	C15orf16	172250	37	3_prime
S1_019	15	29562584	29562752	ENSG00000189263	Q6ZSZ2_HUMA	81909	78417	5_prime
S1_020	5	20572231	20572114	ENSG00000145526	CDH18	697121	1063317	3_prime
S1_020	5	20572231	20572114	ENSG00000154162	CDH12	1969002	1214501	5_prime
S1_021	12	4225250	4224710	ENSG00000111224	NP_065100.1	372449	433854	3_prime
S1_021	12	4225250	4224710	ENSG00000118971	CCND2	27949	59527	5_prime
S1_022	19	54647224	54647489	ENSG00000161618	ALDH16A1	1101	18433	3_prime
S1_022	19	54647224	54647489	ENSG00000104872	NP_060386.1	345	5856	5_prime
S1_023	1	231054083	231054277	ENSG00000177107	Q8WYG7_HUM	148251	147703	3_prime
S1_023	1	231054083	231054277	ENSG00000168264	IRF2BP2	2077	4570	5_prime
S1_024	1	144625592	144625479	ENSG00000188092	GPR89	141	-65094	IN_GENE
S1_025	19	14352246	14352076	ENSG00000072071	LPHN1	174264	230496	3_prime
S1_025	19	14352246	14352076	ENSG00000123146	CD97	1020	28290	5_prime
S1_026	22	15680472	15680141	ENSG00000172967	NM_175878.2	3336	41546	3_prime
S1_026	22	15680472	15680141	ENSG00000172963	XP_496488.1	97145	89251	5_prime
S1_027	19	46743517	46743279	ENSG00000105341	Q96D43_HUMA	105862	114453	3_prime
S1_027	19	46743517	46743279	ENSG00000007129	NP_291021.2	30854	34312	5_prime
S1_030	12	108974411	108974466	ENSG00000122970	CDV1	50529	144340	3_prime
S1_030	12	108974411	108974466	ENSG00000174456	NP_997318.1	8012	32707	5_prime
S1_031	3	52198893	52199001	ENSG00000187839	XP_497922.1	3333	3791	3_prime
S1_031	3	52198893	52199001	ENSG00000164087	NP_056241.2	35433	114583	5_prime
S1_032	17	37937248	37937010	ENSG00000033627	ATP6V0A1	72860	9126	3_prime
S1_032	17	37937248	37937010	ENSG00000108784	NAGLU	4229	12742	5_prime
S1_033	2	85038466	85038510	ENSG00000034510	TYB10_HUMAN	5967	6987	3_prime

S1_033	2	85038466	85038510	ENSG00000186854	Q86V40_HUMA	18439	78010	5_prime
S1_034	4	55527084	55527314	ENSG00000128052	KDR	305606	258493	3_prime
S1_034	4	55527084	55527314	ENSG00000157404	KIT	161995	79572	5_prime
S1_035	11	60365551	60365832	ENSG00000110104	NP_077003.1	569	9578	3_prime
S1_035	11	60365551	60365832	ENSG00000172689	M4A10_HUMAN	56154	40197	5_prime
S1_036	20	51802300	51802336	ENSG00000149617	Q6P094_HUMA	123203	122898	3_prime
S1_036	20	51802300	51802336	ENSG00000171940	ZNF217	169257	185281	5_prime
S1_037	11	128282951	128283013	ENSG00000120457	KCNJ5	16428	-10208	IN_GENE
S1_038	17	8476448	8476466	ENSG00000161973	Q8N6Q0_HUMA	112431	97529	3_prime
S1_038	17	8476448	8476466	ENSG00000133026	MYH10	1687	158193	5_prime
S1_040	18	71050870	71050852	ENSG00000180011	ZADH2	765	11393	3_prime
S1_040	18	71050870	71050852	ENSG00000179981	SDCCAG33	1260	79795	5_prime
S1_041	12	27504463	27504540	ENSG00000110841	LIPB1_HUMAN	63849	235300	3_prime
S1_041	12	27504463	27504540	ENSG00000029153	ARNTL2	127208	39730	5_prime
S1_042	9	89373929	89374011	ENSG00000130222	GADD45G	75553	77088	3_prime
S1_042	9	89373929	89374011	ENSG00000187764	SEMA4D	31487	152223	5_prime
S1_043	20	5008344	5008363	ENSG00000089063	C20orf30	33378	20157	3_prime
S1_043	20	5008344	5008363	ENSG00000089057	SLC23A2	78199	227342	5_prime
S1_044	13	43910996	43911029	ENSG00000102804	TB1I4_HUMAN	137705	5335	IN_GENE
S1_045	3	187716413	187716460	ENSG00000113838	CRYGS	51418	22678	3_prime
S1_045	3	187716413	187716460	ENSG00000058866	DGKG	153708	366699	5_prime
S1_046	3	16501071	16500980	ENSG00000131378	Q8N5I0_HUMAI	29246	168623	IN_GENE
S1_047	3	131153155	131153471	ENSG00000170893	TRH	23106	26323	3_prime
S1_047	3	131153155	131153471	ENSG00000172765	TMCC1	71148	302913	5_prime
S1_048	1	27874670	27874751	ENSG00000130775	Q9NS90_HUMA	8558	22657	3_prime
S1_048	1	27874670	27874751	ENSG00000117751	PPP1R8	33235	12345	5_prime
S1_049	11	33871750	33871800	ENSG00000135387	M11S1	157998	206927	3_prime
S1_049	11	33871750	33871800	ENSG00000135363	LMO2	1338	35049	5_prime
S1_050	1	62615859	62615667	ENSG00000162607	USP1	967	-13763	IN_GENE
S1_051	17	34564235	34564185	ENSG00000161381	PLXDC1	2937	91152	3_prime
S1_051	17	34564235	34564185	ENSG00000141748	XP_372668.2	11304	2438	5_prime
S1_052	19	4918455	4918589	ENSG00000127663	JMJD2B	1677	186151	3_prime
S1_052	19	4918455	4918589	ENSG00000034063	UHRF1	57942	5295	5_prime
S1_053	17	70039478	70039402	ENSG00000178789	NP_777552.1	278	10569	3_prime
S1_053	17	70039478	70039402	ENSG00000167850	CM35A_HUMAN	14399	9364	5_prime
S1_054	2	37991551	37991335	ENSG00000198769	XP_293026.4	35842	34796	3_prime
S1_054	2	37991551	37991335	ENSG00000115841	Q8NHM0_HUMA	72562	214380	5_prime
S1_055	12	29361569	29361653	ENSG00000064763	MLSTD1	168169	-16703	IN_GENE
S1_056	4	79096171	79096275	ENSG00000169288	MRPL1	44909	134945	3_prime
S1_056	4	79096171	79096275	ENSG00000138767	CNOT6L	41440	100820	5_prime
S1_057	2	118565471	118564745	ENSG00000125629	INSIG2	2465	-19081	IN_GENE
S1_058	7	149766417	149766071	ENSG00000133561	Q8TES8_HUMA	984	5957	IN_GENE
S1_059	3	134862380	134862590	ENSG00000163781	TOPBP1	1008	60195	IN_GENE
S1_060	4	13306100	13306219	ENSG00000137449	CPEB2	1375691	1441943	3_prime
S1_060	4	13306100	13306219	ENSG00000145133	FAM44A	503	23770	5_prime
S1_061	7	157143412	157143183	ENSG00000155093	PTPRN2	736654	311956	IN_GENE
S1_062	3	4790351	4790194	ENSG00000150995	NP_002213.1	280058	-73887	IN_GENE
S1_063	1	157044189	157043839	ENSG00000132716	WDR42A	1460	45261	IN_GENE
S1_064	1	148068943	148069046	ENSG00000143373	NP_065883.1	1082	-8510	IN_GENE
S1_065	14	20847277	20847310	ENSG00000092200	RPGRIP1	21301	-42021	IN_GENE
S1_066	2	216693414	216693611	ENSG00000118242	NP_060470.1	10407	60380	IN_GENE
S1_067	7	5271457	5271366	ENSG00000155034	FBXL18	55257	27159	IN_GENE
S1_069	17	76351736	76351760	ENSG00000141564	Q96C97_HUMA	218073	-203030	IN_GENE
S1_070	11	87710100	87710050	ENSG00000109861	CTSC	536	43642	IN_GENE
S1_071	2	202144091	202144057	ENSG00000082146	ALS2CR2	2159	-26899	IN_GENE
S1_072	19	2646367	2646394	ENSG00000176533	GNG7	7296	184149	IN_GENE
S1_073	18	13502704	13502737	ENSG00000168675	C18orf1	293909	-140049	IN_GENE
S1_074	1	17047368	17047330	ENSG00000117122	MFAP2	5149	1023	IN_GENE
S1_075	3	10891998	10891980	ENSG00000132164	NP_055044.1	59063	-63166	IN_GENE
S1_076	21	16517569	16517537	ENSG00000174496	C21orf34	152145	148423	3_prime
S1_076	21	16517569	16517537	ENSG00000154639	CXADR	1289632	1343566	5_prime
S1_077	1	33233065	33232976	ENSG00000142920	DCOP_HUMAN	17169	-22247	IN_GENE

S1_078	7	138236813	138236992	ENSG00000105939	ZC3HAV1	14907	51290	IN_GENE
S1_080	12	24992869	24993079	ENSG00000060982	BCAT1	630	137307	IN_GENE
S1_081	2	28540269	28540801	ENSG00000075426	FOSL2	12949	-10827	IN_GENE
S1_082	15	78048366	78048244	ENSG00000140379	BCL2A1	2454	7954	IN_GENE
S1_083	21	42214328	42214452	ENSG00000188675		227291	-667301	IN_GENE
S1_084	6	143583675	143583565	ENSG00000146416	AIG1	159849	-119569	IN_GENE
S1_085	17	1926296	1926352	ENSG00000070366	EST1A_HUMAN	293864	16408	IN_GENE
S1_086	1	142753611	142753468	ENSG00000163386	NOTCH2NL	55310	-26063	IN_GENE
S1_088	5	134763884	134763904	ENSG00000185555	NP_570900.1	52003	43932	3_prime
S1_088	5	134763884	134763904	ENSG00000113648	H2AFY	408	65914	5_prime
S1_089	4	56646953	56646977	ENSG00000174799	CE135_HUMAN	9012	93501	3_prime
S1_089	4	56646953	56646977	ENSG00000090989	NP_839955.1	86195	34842	5_prime
S1_090	15	32935895	32935936	ENSG00000021776	AQR	113466	853	IN_GENE
S1_091	3	25234357	25234341	ENSG00000077092	RARB	43448	-380083	IN_GENE
S1_092	15	89046946	89046979	ENSG00000197299	BLM	14693	112742	3_prime
S1_092	15	89046946	89046979	ENSG00000140577	Q8NF38_HUMA	172785	57379	5_prime
S1_093	6	32549531	32549571	ENSG00000198502	NP_002116.2	56491	43645	3_prime
S1_093	6	32549531	32549571	ENSG00000196301	HLA-DRB9	13689	13955	5_prime
S1_094	3	85387325	85387309	ENSG00000175161	IGSF4D	295860	-811314	IN_GENE
S1_095	17	17569926	17569965	ENSG00000108557	RAI1	44414	-87474	IN_GENE
S1_097	3	87926444	87926485	ENSG00000179097	HTR1F	196146	197246	3_prime
S1_097	3	87926444	87926485	ENSG00000064835	POU1F1	518017	534971	5_prime
S1_098	2	33633129	33633176	ENSG00000152689	RASGRP3	60062	-68180	IN_GENE
S1_099	20	25319950	25319925	ENSG00000100997	CT022_HUMAN	496	96570	3_prime
S1_099	20	25319950	25319925	ENSG00000101003	K0186_HUMAN	16413	57241	5_prime
S1_100	10	121521197	121521136	ENSG00000198825	INPP5F	45537	-57512	IN_GENE
S1_101	12	40475169	40474821	ENSG00000165966	PDRN4_HUMAN	357361	220518	3_prime
S1_101	12	40475169	40474821	ENSG00000151233	Q8IXV1_HUMAI	349779	292144	5_prime
S1_102	2	231568377	231568273	ENSG00000135916	ITM2C	13142	-1194	IN_GENE
S1_103	13	23081265	23081055	ENSG00000127863	TNFRSF19	38332	-67176	IN_GENE
S1_105	2	63999797	63999895	ENSG00000169764	UGP2	20048	-30546	IN_GENE
S1_106	6	161577692	161577667	ENSG00000026652	AGPAT4	87837	50149	IN_GENE
S1_107	3	58046088	58046040	ENSG00000136068	FLNB	76873	-86975	IN_GENE
S1_109	6	153110176	153110233	ENSG00000120279	MYCT1	976	25696	3_prime
S1_109	6	153110176	153110233	ENSG00000131018	SYNE1	59528	575239	5_prime
S1_110	12	3941968	3942014	ENSG00000118971	CCND2	311231	342809	3_prime
S1_110	12	3941968	3942014	ENSG00000111224	NP_065100.1	89167	150572	5_prime
S1_111	14	34872785	34872811	ENSG00000100906	NFKBIA	70918	67688	3_prime
S1_111	14	34872785	34872811	ENSG00000100902	PSA6_HUMAN	41460	16361	5_prime
S1_112	22	36004773	36004728	ENSG00000100055	PSCD4	1804	-31152	IN_GENE
S1_113	4	95804247	95804165	ENSG00000163110	ENH_HUMAN	73918	-139645	IN_GENE
S1_114	22	23449296	23449350	ENSG00000184571	NP_001008496	33724	9303	IN_GENE
S1_115	3	87402570	87402774	ENSG00000064835	POU1F1	5857	11097	IN_GENE
S1_116	8	22455916	22455886	ENSG00000120910	PPP3CC	101375	1319	3_prime
S1_116	8	22455916	22455886	ENSG00000120896	VINEX_HUMAN	12049	33036	5_prime
S1_117	5	172048091	172048246	ENSG00000176966		952	-3045	IN_GENE
S2_001	1	16976430	16976032	ENSG00000186715	MSTP9	145757	149719	3_prime
S2_001	1	16976430	16976032	ENSG00000058453	CROCC	19792	68329	5_prime
S2_002	16	19036259	19035530	ENSG00000167186	COQ7	49831	37408	3_prime
S2_002	16	19036259	19035530	ENSG00000103528	NP_057608.2	50880	149796	5_prime
S2_003	X	108783215	108782824	ENSG00000068366	ACSL4	449	92504	3_prime
S2_003	X	108783215	108782824	ENSG00000157600	NP_115603.1	269273	443830	5_prime
S2_004	X	23926791	23926993	ENSG00000130741	EIF2S3	93769	71348	5_prime
S2_004	X	23926791	23926993	ENSG00000005889	ZFX	2969	62383	3_prime
S2_005	3	142999521	142999872	ENSG00000114124	GRK7	19780	-20500	IN_GENE
S2_006	19	53947418	53947243	ENSG00000174951	FUT1	416	4163	IN_GENE
S2_007	1	157851071	157850229	ENSG00000186517	NP_859071.1	2579	19651	IN_GENE
S2_010	11	47193931	47193864	ENSG00000134574	DDB2	775	-23475	IN_GENE
S2_011	11	108282571	108282611	ENSG00000178105	DDX10	241545	-34285	IN_GENE
S2_012	18	21063652	21063701	ENSG00000198795	ZNF521	122462	167763	IN_GENE
S2_013	6	154670100	154670204	ENSG00000074706	NP_056368.1	99913	102241	IN_GENE
S2_014	21	35320352	35320474	ENSG00000159216	RUNX1	23159	238381	IN_GENE

S2_015	11	10721645	10721606	ENSG00000072952	MRVI1	49534	167762	3_prime
S2_015	11	10721645	10721606	ENSG00000198730	SH2BP1	7734	36218	5_prime
S2_016	X	12861445	12861647	ENSG00000123594	ATXN3L	236238	235198	3_prime
S2_016	X	12861445	12861647	ENSG00000187268	FAM9C	38987	48051	5_prime
S2_017	19	50478076	50477939	ENSG00000007047	MARK4	31549	-22442	IN_GENE
S2_018	17	73767039	73767170	ENSG00000184557	SOCS3	100714	97424	3_prime
S2_018	17	73767039	73767170	ENSG00000089685	BIRC5	45095	34667	5_prime
S2_019	X	23926494	23927055	ENSG00000130741	EIF2S3	94072	71051	3_prime
S2_019	X	23926494	23927055	ENSG00000005889	ZFX	2666	62680	5_prime
S2_020	1	243273738	243273703	ENSG00000143653	NP_057086.2	59972	16258	3_prime
S2_020	1	243273738	243273703	ENSG00000198294	NP_997209.1	4699	7994	5_prime
S2_021	17	55826045	55826159	ENSG00000141371	NP_859058.1	28607	37518	3_prime
S2_021	17	55826045	55826159	ENSG00000170832	UBP32_HUMAN	1677	216572	5_prime
S2_022	22	48928655	48928508	ENSG00000170638	YV03_HUMAN	1691	-11976	IN_GENE
S2_023	5	66334794	66334880	ENSG00000069020	MAST4	44340	-165895	IN_GENE
S2_025	3	57670993	57670793	ENSG00000174839	NP_689891.1	17150	84771	3_prime
S2_025	3	57670993	57670793	ENSG00000163681	SLMAP	131090	218941	5_prime
S2_026	11	47243882	47243795	ENSG00000025434	NR1H3	7689	-3177	IN_GENE
S2_027	9	136883917	136883981	ENSG00000165716	NP_689634.1	1050	-10407	IN_GENE
S2_028	13	102250506	102250554	ENSG00000134897	NP_060163.2	1106	-41376	IN_GENE
S2_029	10	30560375	30560245	ENSG00000165757	KIAA1462	115947	214181	3_prime
S2_029	10	30560375	30560245	ENSG00000107951	PAPD1	117879	81390	5_prime
S2_030	2	232307336	232307431	ENSG00000187514	PTMA	91405	96418	3_prime
S2_030	2	232307336	232307431	ENSG00000177673	NP_689827.1	24219	22839	5_prime
S2_031	9	20368570	20368550	ENSG00000171843	MLLT3	243955	33582	IN_GENE
S2_032	2	232305842	232305887	ENSG00000187514	PTMA	92899	97912	3_prime
S2_032	2	232305842	232305887	ENSG00000177673	NP_689827.1	22725	21345	5_prime
S2_033	10	3818454	3818504	ENSG00000165568	AKR1CL2	1039972	1061795	3_prime
S2_033	10	3818454	3818504	ENSG00000067082	O43838_HUMA	999	7213	5_prime
S2_034	14	49581516	49581360	ENSG00000175860	Q8NF59_HUMA	38529	52283	3_prime
S2_034	14	49581516	49581360	ENSG00000168260	NP_001014830	47595	38603	5_prime
S2_036	15	89005590	89005438	ENSG00000140577	Q8NF38_HUMA	131429	16023	3_prime
S2_036	15	89005590	89005438	ENSG00000197299	BLM	56049	154098	5_prime
S2_037	1	231451014	231451284	ENSG00000188739	K0117_HUMAN	66827	37252	3_prime
S2_037	1	231451014	231451284	ENSG00000177107	Q8WYG7_HUMA	248680	249228	5_prime
S2_038	8	29730614	29730673	ENSG00000133872	NP_057211.4	329587	309560	3_prime
S2_038	8	29730614	29730673	ENSG00000120875	DUSP4	466510	481075	5_prime
S2_039	3	162277055	162277087	ENSG00000169255	B3GALT3	28807	7318	3_prime
S2_039	3	162277055	162277087	ENSG00000163590	PPM1L	11352	5537	5_prime
S2_041	16	85483558	85483490	ENSG00000131152	Q9H693_HUMA	424791	410366	3_prime
S2_041	16	85483558	85483490	ENSG00000176678	FOXL1	313727	312690	5_prime
S2_042	15	72803398	72803443	ENSG00000140465	CYP1A1	1532	4455	IN_GENE
S2_043	6	31901697	31902033	ENSG00000096682	C6orf48	8927	13817	3_prime
S2_043	6	31901697	31902033	ENSG00000111987	LSM2	18966	28542	5_prime
S2_044	2	28501993	28502017	ENSG00000075426	FOSL2	25327	49103	3_prime
S2_044	2	28501993	28502017	ENSG00000158019	BRE	476860	28577	5_prime
S2_045	7	44811644	44811512	ENSG00000136286	MYO1G	19726	36143	3_prime
S2_045	7	44811644	44811512	ENSG00000136280	CCM2	1383	77637	5_prime
S2_046	6	26342863	26342952	ENSG00000124575	HIST1H1D	277	388	IN_GENE
S2_047	6	45452901	45452656	ENSG00000186284	RUNX2	1013	11740	IN_GENE
S2_048	11	74728918	74728859	ENSG00000137486	ARRB1	36790	74676	3_prime
S2_048	11	74728918	74728859	ENSG00000149273	RPS3	59292	65462	5_prime
S3_001	15	92330699	92330894	ENSG00000140563	Q8TAX2_HUMA	245256	493937	3_prime
S3_001	15	92330699	92330894	ENSG00000185578	Q8NCT9_HUMA	12978	12844	5_prime
S3_002	9	741469	741619	ENSG00000137090	DMRT1	90221	217619	3_prime
S3_002	9	741469	741619	ENSG00000107104	Q86TE2_HUMA	246766	5367	5_prime
S3_003	12	87936069	87936047	ENSG00000049130	KITLG	459356	543004	3_prime
S3_003	12	87936069	87936047	ENSG00000139318	DUSP6	312695	308238	5_prime
S3_004	20	5049130	5049187	ENSG00000132646	PCNA	6138	5531	IN_GENE
S3_005	10	29137696	29137572	ENSG00000095739	BAMBI	131237	125994	3_prime
S3_005	10	29137696	29137572	ENSG00000175925	XP_498446.1	38360	38464	5_prime
S3_006	12	4100652	4100463	ENSG00000111224	NP_065100.1	247851	309256	3_prime

S3_006	12	4100652	4100463	ENSG00000118971	CCND2	152547	184125	5_prime
S3_007	12	95342680	95342818	ENSG00000165990	Q96N23_HUMA	43173	94533	3_prime
S3_007	12	95342680	95342818	ENSG00000059758	PCTK2	45989	168172	5_prime
S3_008	2	172972136	172971832	ENSG00000115844	DLX2	179363	182462	3_prime
S3_008	2	172972136	172971832	ENSG00000091409	ITGA6	145688	224373	5_prime
S3_009	8	125871525	125871603	ENSG00000180938	ZNF572	183196	189280	3_prime
S3_009	8	125871525	125871603	ENSG00000170873	MTSS1	61685	239313	5_prime
S3_010	X	78097724	78097948	ENSG00000147138	GPR174	134890	136147	3_prime
S3_010	X	78097724	78097948	ENSG00000078589	P2RY10	90750	74142	5_prime
S3_011	1	48066446	48066310	ENSG00000180029	Q8NF14_HUMA	127136	127447	3_prime
S3_011	1	48066446	48066310	ENSG00000198709	Q9UI23_HUMAI	214880	215452	5_prime
S3_012	8	82214971	82215060	ENSG00000164687	FABP5	140355	144590	3_prime
S3_012	8	82214971	82215060	ENSG00000076641	NP_060910.2	110162	166001	5_prime
S3_013	13	90663052	90663175	ENSG00000198051	NP_998889.1	135023	141818	3_prime
S3_013	13	90663052	90663175	ENSG00000165300	SLITRK5	3540181	3533183	5_prime
S3_014	X	13446978	13446909	ENSG00000176896	XP_372198.1	6707	3796	3_prime
S3_014	X	13446978	13446909	ENSG00000123595	RAB9A	39545	40150	5_prime
S3_015	10	73281986	73282585	ENSG00000122863	CHST3	112140	161332	3_prime
S3_015	10	73281986	73282585	ENSG00000197746	PSAP	971	35922	5_prime
S3_016	5	147072749	147072778	ENSG00000176049	Y0555_HUMAN	69667	124595	IN_GENE
S3_017	15	74229872	74229712	ENSG00000169758	C15orf27	90358	-54646	IN_GENE
S3_018	7	31624747	31624949	ENSG00000154678	PDE1C	486840	58875	IN_GENE
S3_019	2	235135992	235135777	ENSG00000072080	SPP2	394646	368216	3_prime
S3_019	2	235135992	235135777	ENSG00000188042	ARL7	51238	50660	5_prime
S3_020	12	130240793	130240638	ENSG00000111452	Q9NSM3_HUM/	277076	89907	3_prime
S3_020	12	130240793	130240638	ENSG00000061936	SFRS8	621072	709719	5_prime
S3_021	20	38568497	38568733	ENSG00000179050	MAFB	182415	180524	3_prime
S3_021	20	38568497	38568733	ENSG00000101452	DHX35	1544088	1466720	5_prime
S3_022	10	29695830	29695810	ENSG00000196412	Q8NAN8_HUMA	87768	88142	5_prime
S3_022	10	29695830	29695810	ENSG00000120563	LYZL1	77800	55670	3_prime
S3_023	6	37262362	37262547	ENSG00000172738	C6orf128	71028	25573	3_prime
S3_023	6	37262362	37262547	ENSG00000137193	PIM1	16398	11182	5_prime
S3_024	17	38238328	38238299	ENSG00000126581	BECN1	8512	22650	3_prime
S3_024	17	38238328	38238299	ENSG00000131467	PSME3_HUMAN	621	10973	5_prime
S3_025	12	115447825	115448007	ENSG00000111412	NP_079014.1	190738	168491	3_prime
S3_025	12	115447825	115448007	ENSG00000196668	NP_997319.1	13878	11779	5_prime
S3_026	7	18235048	18235307	ENSG00000048052	HDAC9	73561	575176	3_prime
S3_026	7	18235048	18235307	ENSG00000153287	PRPS1L1	394406	395359	5_prime
S3_027	12	7720092	7720363	ENSG00000184344	GDF3	19564	13557	3_prime
S3_027	12	7720092	7720363	ENSG00000111701	APOBEC1	10323	26828	5_prime
S3_028	7	40945383	40945253	ENSG00000175600	C7orf10	997544	271786	3_prime
S3_028	7	40945383	40945253	ENSG00000122641	INHBA	570532	556647	5_prime
S3_029	9	5998737	5998621	ENSG00000183354	KIAA2026	54641	89714	3_prime
S3_029	9	5998737	5998621	ENSG00000137040	RANBP6	6879	3553	5_prime
S3_030	18	259702	259612	ENSG00000079134	THOC1_HUMAN	1653	55175	3_prime
S3_030	18	259702	259612	ENSG00000158270	COLEC12	230983	49654	5_prime
S3_031	3	72607158	72606964	ENSG00000163602	RYBP	28694	100710	3_prime
S3_031	3	72607158	72606964	ENSG00000144736	NP_060600.2	373131	273962	5_prime
S3_032	X	77016004	77016206	ENSG00000165240	ATP7A	43837	92150	IN_GENE
S3_033	17	27465242	27465026	ENSG00000185158	NP_443120.2	92963	60612	3_prime
S3_033	17	27465242	27465026	ENSG00000126858	RHOT1	28344	111657	5_prime
S3_034	10	6167051	6166969	ENSG00000134460	IL2RA	22773	73539	3_prime
S3_034	10	6167051	6166969	ENSG00000134453	RBM17	3962	31794	5_prime
S3_035	5	79470099	79469974	ENSG00000113296	THBS4	103240	55238	3_prime
S3_035	5	79470099	79469974	ENSG00000164300	C5orf12	64529	7572	5_prime
S3_036	10	111818935	111818910	ENSG00000148700	ADD3	63116	-66403	IN_GENE
S3_038	2	29146965	29147012	ENSG00000189350	NP_954974.1	20983	35099	3_prime
S3_038	2	29146965	29147012	ENSG00000163811	WDR43	117778	64230	5_prime
S3_039	16	10220524	10220581	ENSG00000166669	ATF7IP2	211433	264471	3_prime
S3_039	16	10220524	10220581	ENSG00000183454	GRIN2A	38755	456017	5_prime
S3_040	4	99725048	99725105	ENSG00000168785	T4S9_HUMAN	211857	25542	3_prime
S3_040	4	99725048	99725105	ENSG00000138698	RAP1GDS1	185250	4055	5_prime

S3_041	22	22249630	22249753	ENSG00000189269	Q9NU31_HUMA	49134	48748	3_prime
S3_041	22	22249630	22249753	ENSG00000128322	IGLL1	2581	9764	5_prime
S3_042	11	33909635	33909815	ENSG00000135387	M11S1	120113	169042	3_prime
S3_042	11	33909635	33909815	ENSG00000135363	LMO2	39223	72934	5_prime
S3_043	21	15775324	15775346	ENSG00000155313	USP25	248891	398924	3_prime
S3_043	21	15775324	15775346	ENSG00000197510	C21orf116	430943	428761	5_prime
S3_044	2	60532415	60532668	ENSG00000119866	BCL11A	159869	58530	3_prime
S3_044	2	60532415	60532668	ENSG00000115392	FANCL	2152250	2234384	5_prime
S3_045	2	238633473	238633606	ENSG00000184182	NP_542409.1	24227	99192	3_prime
S3_045	2	238633473	238633606	ENSG00000132329	RAMP1	83186	30727	5_prime
S3_046	21	37651408	37651318	ENSG00000157538	DSCR3	89318	133812	3_prime
S3_046	21	37651408	37651318	ENSG00000157540	DYRK1A	9698	157939	5_prime
S3_047	3	72483565	72483462	ENSG00000163421	PROK2	566663	580068	3_prime
S3_047	3	72483565	72483462	ENSG00000163602	RYBP	94899	22883	5_prime
S3_048	4	13662901	13662816	ENSG00000145133	FAM44A	357304	380571	3_prime
S3_048	4	13662901	13662816	ENSG00000137449	CPEB2	1018890	1085142	5_prime
S3_049	11	58216804	58217039	ENSG00000149124	GLYAT	39219	16003	3_prime
S3_049	11	58216804	58217039	ENSG00000186660	CNTF	113583	67026	5_prime
S3_050	17	30892567	30892689	ENSG00000196883	XP_496207.1	16621	19160	IN_GENE
S3_051	9	114789579	114789455	ENSG00000106952	TNFSF8	17255	44901	3_prime
S3_051	9	114789579	114789455	ENSG00000041982	TNC	170414	72788	5_prime
S3_053	1	66527650	66527772	ENSG00000184588	PDE4B	436631	-24630	IN_GENE
S3_054	16	86545112	86544824	ENSG00000172530	BANP	2285	-164677	IN_GENE
S3_055	10	27188140	27188081	ENSG00000136754	Q5W070_HUMA	1792	112251	IN_GENE
S3_056	20	30736853	30737192	ENSG00000198179	BCL2L7P1	5425	4790	3_prime
S3_056	20	30736853	30737192	ENSG00000198547	NP_872390.1	34238	34958	5_prime
S3_057	12	89663	89861	ENSG00000120645	Q9UPP2_HUMA	28453	68218	3_prime
S3_057	12	89663	89861	ENSG00000181164	XP_495902.1	43471	40738	5_prime
S3_058	8	116740868	116740891	ENSG00000104447	TRPS1	9561	250968	IN_GENE
S3_059	19	45545860	45545744	ENSG00000160392	NP_849152.1	518	26931	IN_GENE
S3_060	17	7531170	7531045	ENSG00000141510	TP53	597	18581	IN_GENE
S3_061	16	65169982	65170168	ENSG00000089505	CKLF	26011	-555	IN_GENE
S3_062	14	92190037	92190211	ENSG00000100599	RIN3	140159	-35048	IN_GENE
S3_063	8	141118246	141118022	ENSG00000167632	Q96Q05_HUMA	419838	306252	IN_GENE
S3_064	10	104535240	104535154	ENSG00000166272	C10orf26	9158	-30156	IN_GENE
S3_065	1	203114519	203114724	ENSG00000136653	RASSF5	45245	-36482	IN_GENE
S3_066	8	97362789	97362579	ENSG00000156471	PTDSS1	19239	-53371	IN_GENE
S3_067	3	170352099	170352991	ENSG00000184531	NM_003002.1	557686	558161	3_prime
S3_067	3	170352099	170352991	ENSG00000085276	EVI1	3875	68101	5_prime
S3_068	7	37222102	37222129	ENSG00000155849	ELMO1	39594	554895	IN_GENE
S3_070	16	75782827	75782857	ENSG00000103111	Q9H8Q7_HUMA	490	-8215	IN_GENE
S3_071	18	19062842	19062995	ENSG00000134508	CABLES1	92517	-29772	IN_GENE
S3_072	3	113596292	113596381	ENSG00000186265	BTLA	104603	71353	3_prime
S3_072	3	113596292	113596381	ENSG00000091972	CD200	61598	31946	5_prime
S3_073	9	90032318	90032551	ENSG00000165023	DIRAS2	452344	419350	3_prime
S3_073	9	90032318	90032551	ENSG00000130222	GADD45G	582836	581301	5_prime
S3_074	21	36724888	36725031	ENSG00000159261	CLDN14	145849	29901	3_prime
S3_074	21	36724888	36725031	ENSG00000159259	CHAF1B	45329	13894	5_prime
S3_075	16	25372446	25372511	ENSG00000182601	HS3ST4	238794	682624	3_prime
S3_075	16	25372446	25372511	ENSG00000155592	XP_292504.3	196090	213748	5_prime
S3_076	1	201213752	201213818	ENSG00000198625	MDM4	3471	37264	3_prime
S3_076	1	201213752	201213818	ENSG00000133056	PIK3C2B	22621	90325	5_prime
S3_077	4	88215980	88216083	ENSG00000172493	MLLT2	2638	-203382	IN_GENE
S3_078	9	131562589	131562672	ENSG00000107263	RAPGEF1	79890	80877	IN_GENE
S3_079	2	238380622	238380229	ENSG00000124839	RAB17	98884	115657	3_prime
S3_079	2	238380622	238380229	ENSG00000124831	LRRFIP1	2166	90335	5_prime
S3_080	1	203491830	203492230	ENSG00000162896	PIGR	16372	155957	IN_GENE
S3_081	9	5998734	5998771	ENSG00000137040	RANBP6	6882	3556	3_prime
S3_081	9	5998734	5998771	ENSG00000183354	KIAA2026	54638	89711	5_prime
S3_082	12	50004656	50004889	ENSG00000139610	ELA1	22074	3838	3_prime
S3_082	12	50004656	50004889	ENSG00000110934	BIN2	441	43566	5_prime
S3_083	7	105307158	105307210	ENSG00000008282	SYPL	39850	17751	3_prime

S3_083	7	105307158	105307210	ENSG00000128536	Q8TCI7_HUMAI	109522	39322	5_prime
S3_084	3	142602084	142602196	ENSG00000177311	XM_172341.5	41915	44169	3_prime
S3_084	3	142602084	142602196	ENSG00000155893	ACPL2	168687	105641	5_prime
S3_085	3	197846894	197846999	ENSG00000174004	NP_940967.1	8065	30283	3_prime
S3_085	3	197846894	197846999	ENSG00000174013	XP_117294.3	62614	44428	5_prime
S3_086	19	43185544	43185420	ENSG00000179573	Q8IUV1_HUMAI	95691	-79686	IN_GENE
S3_088	10	50067007	50067080	ENSG00000177354	C10orf71	110237	138531	3_prime
S3_088	10	50067007	50067080	ENSG00000172538	C10orf73	54936	57790	5_prime
S3_089	1	26297238	26297553	ENSG00000158062	NP_663321.1	20040	4300	IN_GENE
S3_090	6	162230647	162230970	ENSG00000185345	PARK2	888464	489105	IN_GENE
S3_091	12	102862643	102862682	ENSG00000139372	NP_003202.3	536	-22366	IN_GENE
S3_093	1	101435786	101435403	ENSG00000170989	EDG1	21190	16692	3_prime
S3_093	1	101435786	101435403	ENSG00000183298	XP_371273.1	528975	528127	5_prime
S3_094	1	218371458	218371375	ENSG00000143507	DUSP10	67602	108297	3_prime
S3_094	1	218371458	218371375	ENSG00000143512	NP_079022.1	738367	712539	5_prime
S3_095	13	27612800	27612701	ENSG00000122025	FLT3	40071	137043	3_prime
S3_095	13	27612800	27612701	ENSG00000152520	NP_787050.3	33617	154665	5_prime
S3_096	5	65258394	65258199	ENSG00000112851	ERBB2IP	59	-153894	IN_GENE
S3_097	2	143743344	143743545	ENSG00000075884	ARHGAP15	22649	-616303	IN_GENE
S3_098	4	141333436	141333458	ENSG00000196951	Q8N984_HUMA	250449	230499	3_prime
S3_098	4	141333436	141333458	ENSG00000196782	MAML3	334416	335348	5_prime
S3_099	2	87732452	87731975	ENSG00000184943	NP_443103.1	138237	72166	3_prime
S3_099	2	87732452	87731975	ENSG00000125551	PLGL	154414	173705	5_prime
S3_100	9	88168204	88168072	ENSG00000177910	Q9Y4N5_HUMA	193171	194103	3_prime
S3_100	9	88168204	88168072	ENSG00000106723	SPIN	64684	154957	5_prime
S3_102	16	24649161	24649319	ENSG00000090905	NP_055309.1	90	-94536	IN_GENE
S3_103	6	35122665	35122492	ENSG00000064999	ANKS1	157473	-44674	IN_GENE
S3_104	11	47372183	47372108	ENSG00000165915	SLC39A13	21278	-22510	IN_GENE
S3_105	20	10224494	10224443	ENSG00000132639	SNP25_HUMAN	76966	-11622	IN_GENE
S3_106	9	68825059	68824882	ENSG00000107242	PIP5K1B	274712	-28763	IN_GENE
S3_107	17	10540704	10540821	ENSG00000133028	SCO1	866	16324	IN_GENE
S3_108	15	89005587	89005730	ENSG00000197299	BLM	56052	154101	3_prime
S3_108	15	89005587	89005730	ENSG00000140577	Q8NF38_HUMA	131426	16020	5_prime
S3_109	13	45669378	45669278	ENSG00000136167	LCP1	14992	71318	3_prime
S3_109	13	45669378	45669278	ENSG00000177376	XM_497373.1	72823	73374	5_prime
S3_110	10	17826318	17825897	ENSG00000136738	STAM	100188	28405	3_prime
S3_110	10	17826318	17825897	ENSG00000148483	XP_291726.3	7983	31863	5_prime
S3_111	21	37665698	37666184	ENSG00000157540	DYRK1A	4592	-143649	IN_GENE
S3_112	1	147764311	147764681	ENSG00000143412	ANXA9	3316	16869	3_prime
S3_112	1	147764311	147764681	ENSG00000143418	LASS2	3919	13576	5_prime
S3_113	10	5148161	5148512	ENSG00000196326	NP_001007537	68906	45658	3_prime
S3_113	10	5148161	5148512	ENSG00000196139	AKR1C3	21593	8289	5_prime
S3_114	10	1966427	1966627	ENSG00000067057	PFKP	1133285	1202557	3_prime
S3_114	10	1966427	1966627	ENSG00000185736	ADARB2	197083	747444	5_prime
S3_115	X	9788799	9788998	ENSG00000047644	NP_056506.2	4549	133450	3_prime
S3_115	X	9788799	9788998	ENSG00000146950	APXL	224567	61582	5_prime
S3_116	22	44786261	44785821	ENSG00000182257	NP_060750.1	15718	19403	3_prime
S3_116	22	44786261	44785821	ENSG00000188437	Q6ZWA3_HUMA	1156	773	5_prime
S3_117	3	197402570	197401979	ENSG00000072274	TFRC	105314	138104	3_prime
S3_117	3	197402570	197401979	ENSG00000163958	ZDHHC19	24040	10064	5_prime
S3_119	1	200328099	200328212	ENSG00000058668	ATP2B4	753	-116765	IN_GENE
S3_120	3	143780215	143779917	ENSG00000175054	ATR	432	129136	IN_GENE
S3_121	16	56138484	56138564	ENSG00000159618	GPR114	4416	-44610	IN_GENE
S3_122	20	15969326	15969146	ENSG00000187768	Q5W0V6_HUMA	53436	-9375	IN_GENE
S3_123	9	92901296	92901275	ENSG00000157303	SUSD3	731	-25692	IN_GENE
S3_124	14	81283811	81283739	ENSG00000071537	SEL1L	213877	276165	3_prime
S3_124	14	81283811	81283739	ENSG00000185070	FLRT2	3782430	3876016	5_prime
S3_125	14	106326069	106326114	ENSG00000182778	NP_787066.1	4768	3689	3_prime
S3_125	14	106326069	106326114	ENSG00000130076	IGHG3	140750	1081567	5_prime
S3_126	16	15645665	15645601	ENSG00000166783	Q9Y4J9_HUMAI	5012	49919	3_prime
S3_126	16	15645665	15645601	ENSG00000072864	NDE1	20420	80827	5_prime
S3_127	4	152311843	152311950	ENSG00000145425	RS3A_HUMAN	66525	71564	3_prime

S3_127	4	152311843	152311950	ENSG00000198589	LRBA	17589	768555	5_prime
S3_128	9	11097267	11097188	ENSG00000196089	XP_497007.1	2016369	2015956	3_prime
S3_128	9	11097267	11097188	ENSG00000107165	TYRP1	1586168	1602982	5_prime
S3_129	9	108484730	108485290	ENSG00000148156	ACTL7B	213035	211788	3_prime
S3_129	9	108484730	108485290	ENSG00000186502	XP_294581.1	16062	15745	5_prime
S3_130	14	34879333	34878775	ENSG00000100902	PSA6_HUMAN	48008	22909	3_prime
S3_130	14	34879333	34878775	ENSG00000100906	NFKBIA	64370	61140	5_prime
S3_131	14	90649481	90649433	ENSG00000100784	KS6A5_HUMAN	52735	242556	3_prime
S3_131	14	90649481	90649433	ENSG00000133943	C14orf159	678	111975	5_prime
S3_133	12	50507987	50507929	ENSG00000196876	SCN8A	143777	19423	3_prime
S3_133	12	50507987	50507929	ENSG00000167612	ANKRD33	60024	63719	5_prime
S3_135	1	66510321	66510185	ENSG00000184588	PDE4B	419166	-42095	IN_GENE
S3_136	16	12012560	12012510	ENSG00000140660	NP_115543.1	34407	-42132	IN_GENE
S3_137	13	113652638	113652913	ENSG00000179951		384844	-383198	IN_GENE
S4_001	1	208146883	208146950	ENSG00000117650	NEK2	90472	77627	3_prime
S4_001	1	208146883	208146950	ENSG00000170385	SLC30A1	6534	9758	5_prime
S4_002	10	37855618	37855695	ENSG00000198105	ZNF248	330874	302287	3_prime
S4_002	10	37855618	37855695	ENSG00000148513	ANKRD30A	400827	294117	5_prime
S4_003	19	13812183	13812323	ENSG00000187556	NANO3_HUMAN	36880	40134	3_prime
S4_003	19	13812183	13812323	ENSG00000132003	ZSWIM4	44909	8139	5_prime
S4_004	5	178892967	178892948	ENSG00000087116	ADAMTS2	188032	419493	3_prime
S4_004	5	178892967	178892948	ENSG00000176783	RUFY1	17210	76651	5_prime
S4_005	8	122723571	122723381	ENSG00000170961	HAS2	760	28852	3_prime
S4_005	8	122723571	122723381	ENSG00000178764	ZHX2	1139599	1332356	5_prime
S4_006	2	201578818	201578976	ENSG00000115934	PPIL3	687	17632	IN_GENE
S4_007	3	30623793	30623743	ENSG00000163513	TGFBR2	745	-86885	IN_GENE
S4_008	12	120703056	120703074	ENSG00000139718	XP_037523.9	17041	30225	3_prime
S4_008	12	120703056	120703074	ENSG00000139725	RHOF	8742	24674	5_prime
S4_009	17	74263213	74263394	ENSG00000108669	PSCD1	26758	81486	IN_GENE
S4_010	7	29798549	29798717	ENSG00000136193	SCRN1	4068	65581	IN_GENE
S4_011	1	203877743	203877764	ENSG00000196352	DAF	5517	44498	3_prime
S4_011	1	203877743	203877764	ENSG00000123838	C4BPA	211741	171042	5_prime
S4_012	1	231055962	231055904	ENSG00000168264	IRF2BP2	3956	6449	3_prime
S4_012	1	231055962	231055904	ENSG00000177107	Q8WYG7_HUMA	146372	145824	5_prime
S4_013	12	6752208	6752319	ENSG00000089692	LAG3	277	-5672	IN_GENE
S4_014	18	59139272	59139355	ENSG00000119537	FVT1	46193	9541	3_prime
S4_014	18	59139272	59139355	ENSG00000171791	BCL2	1783	197713	5_prime
S4_015	16	2945991	2945855	ENSG00000059122	Q9BQG6_HUMA	44010	4790	3_prime
S4_015	16	2945991	2945855	ENSG00000131650	KREMEN2	8227	12390	5_prime
S4_016	21	37654922	37654795	ENSG00000157538	DSCR3	92832	137326	3_prime
S4_016	21	37654922	37654795	ENSG00000157540	DYRK1A	6184	154425	5_prime
S4_017	10	3844243	3844013	ENSG00000067082	O43838_HUMA	26788	33002	3_prime
S4_017	10	3844243	3844013	ENSG00000165568	AKR1CL2	1014183	1036006	5_prime
S4_018	1	100527027	100527540	ENSG00000079335	CC14A_HUMAN	3041	170826	3_prime
S4_018	1	100527027	100527540	ENSG00000137996	RTCD1	83243	57679	5_prime
S4_019	4	8391186	8391288	ENSG00000170801	HTRA3	1623	-35723	IN_GENE
S4_020	18	5456912	5456553	ENSG00000082397	EPB41L3	77727	74165	IN_GENE
S4_021	19	2039962	2039834	ENSG00000172081	MOBKL2A	7470	17797	IN_GENE
S4_022	11	47026663	47026643	ENSG00000149179	NP_077018.1	111773	-113729	IN_GENE
S4_023	6	82589413	82589455	ENSG00000005700	IBTK	417743	347262	3_prime
S4_023	6	82589413	82589455	ENSG00000112773	FAM46A	70287	77246	5_prime
S4_024	11	66962129	66962211	ENSG00000172725	CORO1B	5413	27	IN_GENE
S4_025	5	453809	453735	ENSG00000063438	AHRR	128996	-34490	IN_GENE
S4_026	2	161926129	161926242	ENSG00000115233	PSMD14	63927	167604	3_prime
S4_026	2	161926129	161926242	ENSG00000136560	TANK	107156	7940	5_prime
S4_027	3	47491770	47491824	ENSG00000163832	Q9BW57_HUMA	38418	20788	3_prime
S4_027	3	47491770	47491824	ENSG00000114650	SCAP_HUMAN	32246	61563	5_prime
S4_028	1	147149914	147149840	ENSG00000163125	Q86XD2_HUMA	180	-109417	IN_GENE
S4_029	10	22586803	22586865	ENSG00000148444	COMMD3	58521	62435	3_prime
S4_029	10	22586803	22586865	ENSG00000165296	XP_291767.2	47939	48535	5_prime
S4_030	8	141440476	141440491	ENSG00000167632	Q96Q05_HUMA	97384	628706	IN_GENE
S4_031	X	43930484	43930362	ENSG00000183690	EFHC2	28810	166195	IN_GENE

S4_032	1	86152627	86152549	ENSG00000171502	NP_690850.1	181593	245606	IN_GENE
S4_033	1	151007798	151007686	ENSG00000143569	UBAP2L	799	-49372	IN_GENE
S4_034	11	103866279	103866299	ENSG00000196954	CASP4	479094	452531	3_prime
S4_034	11	103866279	103866299	ENSG00000170962	PDGFD	325962	583148	5_prime
S4_035	20	42714220	42714179	ENSG00000196839	ADA	430	32642	3_prime
S4_035	20	42714220	42714179	ENSG00000132832	Q9BVX4_HUMA	11286	6931	5_prime
S4_036	19	2992476	2992695	ENSG00000104964	AES	21534	11432	3_prime
S4_036	19	2992476	2992695	ENSG00000065717	TLE2	12454	43839	5_prime
S4_037	12	22593553	22593295	ENSG00000111731	NP_055617.1	4834	100760	3_prime
S4_037	12	22593553	22593295	ENSG00000139163	ETNK1	75723	136357	5_prime
S4_038	8	102191436	102191584	ENSG00000120963	NP_057180.1	95584	87028	3_prime
S4_038	8	102191436	102191584	ENSG00000164924	1433Z_HUMAN	156691	191346	5_prime
S4_039	20	62212975	62212854	ENSG00000125510	OPRL1	30922	-8793	IN_GENE
S4_040	17	26664218	26663715	ENSG00000196712	NF1	217472	-61875	IN_GENE
S4_041	22	48932785	48932870	ENSG00000170638	YV03_HUMAN	5968	-7699	IN_GENE
S4_042	9	127703166	127703231	ENSG00000106992	AK1	13284	6507	3_prime
S4_042	9	127703166	127703231	ENSG00000106991	ENG	6628	46318	5_prime
S4_043	1	158467328	158467540	ENSG00000118217	ATF6	418	193202	3_prime
S4_043	1	158467328	158467540	ENSG00000081721	DUSP12	16110	8721	5_prime
S4_044	18	9059602	9059637	ENSG00000178127	NDUFV2	33116	64734	3_prime
S4_044	18	9059602	9059637	ENSG00000168502	KIAA0802	352233	236827	5_prime
S4_045	15	73111267	73111743	ENSG00000138621	NP_068595.2	8280	-18852	IN_GENE
S4_046	1	16039054	16038640	ENSG00000116809	ZBTB17	9180	24968	IN_GENE
S4_047	3	72479063	72479260	ENSG00000163602	RYBP	99401	27385	3_prime
S4_047	3	72479063	72479260	ENSG00000163421	PROK2	562161	575566	5_prime
S4_048	11	33885599	33885578	ENSG00000135363	LMO2	15187	48898	3_prime
S4_048	11	33885599	33885578	ENSG00000135387	M11S1	144149	193078	5_prime
S4_049	19	49938252	49938183	ENSG00000178679	XP_371177.2	39806	37263	3_prime
S4_049	19	49938252	49938183	ENSG00000069399	BCL3	5568	16888	5_prime
S4_050	21	14970811	14970883	ENSG00000180530	NRIP1	291573	288097	3_prime
S4_050	21	14970811	14970883	ENSG00000155307	SAMSN1	93217	191391	5_prime
S4_051	11	116305132	116305188	ENSG00000160584	NP_079440.2	169071	85802	IN_GENE
S4_052	9	615401	615487	ENSG00000107104	Q86TE2_HUMA	120698	-120701	IN_GENE
S5_001	5	122787689	122787668	ENSG00000168944	Q8IWB5_HUMA	752	77692	3_prime
S5_001	5	122787689	122787668	ENSG00000151292	CSNK1G3	121538	191358	5_prime
S5_002	8	20920279	20920234	ENSG00000061337	LZTS1	763196	768766	3_prime
S5_002	8	20920279	20920234	ENSG00000168546	GFRA2	782013	673533	5_prime
S5_003	19	52711139	52711077	ENSG00000105402	NAPA	830	28436	3_prime
S5_003	19	52711139	52711077	ENSG00000118156	ZNF541	29229	4621	5_prime
S5_004	10	14625205	14625090	ENSG00000065809	C10orf45	231812	24525	IN_GENE
S5_005	4	15730840	15730890	ENSG00000007062	PROM1	22995	84714	IN_GENE
S5_006	9	20369923	20369886	ENSG00000171843	MLLT3	242619	34918	IN_GENE
S5_007	17	53307698	53307631	ENSG00000180891	CUEDC1	80052	12295	IN_GENE
S5_008	10	126825505	126825473	ENSG00000175029	CTBP2	14112	158579	IN_GENE
S5_009	7	94808633	94808649	ENSG00000005981	ASB4	48698	-3089	IN_GENE
S5_010	22	38899606	38899666	ENSG00000100354	TNRC6B	22990	-144247	IN_GENE
S5_011	10	103870757	103870738	ENSG00000198728	LDB1	6065	13440	3_prime
S5_011	10	103870757	103870738	ENSG00000148840	PPRC1	12020	29321	5_prime
S5_012	16	3272234	3272267	ENSG00000006194	ZNF263	1254	9218	3_prime
S5_012	16	3272234	3272267	ENSG00000178554	XP_370932.1	18431	14862	5_prime
S5_013	8	53038817	53038778	ENSG00000168300	YH01_HUMAN	64668	146119	3_prime
S5_013	8	53038817	53038778	ENSG00000147488	ST18	446033	147135	5_prime
S5_014	8	125872167	125872186	ENSG00000180938	ZNF572	182554	188638	3_prime
S5_014	8	125872167	125872186	ENSG00000170873	MTSS1	62327	239955	5_prime
S5_015	7	81160869	81160759	ENSG00000019991	HGF	116866	184773	3_prime
S5_015	7	81160869	81160759	ENSG00000153956	CACNA2D1	556587	63200	5_prime
S5_016	12	18189289	18189261	ENSG00000111404	NP_079006.1	54908	64216	3_prime
S5_016	12	18189289	18189261	ENSG00000139144	PIK3C2G	116452	503326	5_prime
S5_017	7	104191278	104191323	ENSG00000005483	MLL5	57310	157481	3_prime
S5_017	7	104191278	104191323	ENSG00000187416	NP_945351.1	628099	201360	5_prime
S5_018	19	56742535	56742591	ENSG00000105497	ZNF175	23808	42270	3_prime
S5_018	19	56742535	56742591	ENSG00000105492	SIGLEC6	15613	29772	5_prime

S5_019	4	110250965	110251039	ENSG00000188517	COL25A1	329814	154808	IN_GENE
S5_020	6	63139688	63139644	ENSG00000112232	KHDRBS2	85597	691864	3_prime
S5_020	6	63139688	63139644	ENSG00000198225	NP_001011510	839733	840059	5_prime
S5_021	13	79340607	79340653	ENSG00000136158	SPRY2	472480	467508	3_prime
S5_021	13	79340607	79340653	ENSG00000102471	NDFIP2	387319	314385	5_prime
S5_022	16	86557902	86557847	ENSG00000172530	BANP	15308	-151654	IN_GENE
S5_023	2	15414145	15414164	ENSG00000151779	NP_056993.2	237907	156515	IN_GENE
S5_024	6	111995812	111995792	ENSG00000056972	C6orf4	38165	11442	IN_GENE
S5_025	7	47806038	47806100	ENSG00000164744	SUNC1	35906	6044	IN_GENE
S5_026	7	44839031	44839097	ENSG00000136280	CCM2	26004	-50250	IN_GENE
S5_027	12	55766143	55766108	ENSG00000166881	K0286_HUMAN	7324	30445	3_prime
S5_027	12	55766143	55766108	ENSG00000166886	NAB2	3014	9382	5_prime
S5_028	9	21072257	21072239	ENSG00000171855	IFNB1	4389	4952	3_prime
S5_028	9	21072257	21072239	ENSG00000177047	IFNW1	59312	58725	5_prime
S5_029	17	33278676	33278770	ENSG00000174115	TBC1D3	273506	262616	3_prime
S5_029	17	33278676	33278770	ENSG00000108753	TCF2	99494	158128	5_prime
S5_030	15	91155325	91155362	ENSG00000173575	CHD2	89098	211071	3_prime
S5_030	15	91155325	91155362	ENSG00000185442	NP_997329.1	155290	193640	5_prime
S5_031	6	25148240	25148255	ENSG00000168405	NR_002174.1	98060	41537	3_prime
S5_031	6	25148240	25148255	ENSG00000111913	C6orf32	164212	235748	5_prime
S5_032	6	156573617	156573578	ENSG00000074771	NOX3	704467	765002	3_prime
S5_032	6	156573617	156573578	ENSG00000049618	Q8TEE4_HUMA	617582	1048897	5_prime
S5_033	6	26473011	26472964	ENSG00000158406	H4_HUMAN	79270	83749	3_prime
S5_033	6	26473011	26472964	ENSG00000186470	BTN3A2	363	11408	5_prime
S5_034	12	4195373	4195396	ENSG00000118971	CCND2	57826	89404	3_prime
S5_034	12	4195373	4195396	ENSG00000111224	NP_065100.1	342572	403977	5_prime
S5_035	12	46387484	46387546	ENSG00000111405	PP11_HUMAN	18133	2311	3_prime
S5_035	12	46387484	46387546	ENSG00000005175	NP_078880.1	1443	44140	5_prime
S5_036	20	301178	301218	ENSG00000101255	TRIB3	8095	25027	3_prime
S5_036	20	301178	301218	ENSG00000125841	C20orf98	22901	17667	5_prime
S5_037	10	75214479	75214458	ENSG00000172586	CHCHD1	2652	1351	3_prime
S5_037	10	75214479	75214458	ENSG00000176961	NP_001010864	1164	1541	5_prime
S5_039	19	13127283	13127373	ENSG00000141837	CACNA1A	350755	51025	3_prime
S5_039	19	13127283	13127373	ENSG00000160888	IER2	5001	567	5_prime
S5_040	13	45669135	45669160	ENSG00000177376	XM_497373.1	73066	73617	3_prime
S5_040	13	45669135	45669160	ENSG00000136167	LCP1	14749	71075	5_prime
S5_041	X	39231293	39231257	ENSG00000165175	MID1IP1	814368	809379	3_prime
S5_041	X	39231293	39231257	ENSG00000183337	NP_060215.4	481589	435548	5_prime
S5_042	3	108856143	108856161	ENSG00000114439	BBX	131663	-151255	IN_GENE
S5_043	17	18765873	18765851	ENSG00000188522	Q6ZW60_HUM/	82228	126769	IN_GENE
S5_044	6	10831671	10831721	ENSG00000111843	TMEM14C	347	-7669	IN_GENE
S5_045	6	157407393	157407375	ENSG00000049618	Q8TEE4_HUMA	216176	-215139	IN_GENE
S5_047	10	25251313	25251286	ENSG00000099256	PRTFDC1	30253	73726	IN_GENE
S5_048	14	50202550	50202466	ENSG00000151748	SAV1	2307	32356	IN_GENE
S5_049	9	105183514	105183559	ENSG00000070214	CDW92	96848	-96617	IN_GENE
S5_050	21	26860645	26860669	ENSG00000166265	CYYR1	6807	100243	IN_GENE
S5_051	6	157100323	157100416	ENSG00000049618	Q8TEE4_HUMA	90876	522191	3_prime
S5_051	6	157100323	157100416	ENSG00000074771	NOX3	1231173	1291708	5_prime
S5_052	19	10381475	10381586	ENSG00000065989	PDE4A	10966	59831	3_prime
S5_052	19	10381475	10381586	ENSG00000105401	CDC37	6204	18666	5_prime
S5_053	1	146572109	146572034	ENSG00000150337	FCGR1A	4673	-5112	IN_GENE
S5_054	11	18300499	18300558	ENSG00000110768	GTF2H1	220	44653	3_prime
S5_054	11	18300499	18300558	ENSG00000110756	HPS5	202	43706	5_prime
S5_055	17	41017183	41017119	ENSG00000141342	PLEKHM1	93290	148133	3_prime
S5_055	17	41017183	41017119	ENSG00000167159	NP_689679.1	56548	57822	5_prime
S5_056	21	46850497	46850221	ENSG00000160307	S100B	1073	7529	3_prime
S5_056	21	46850497	46850221	ENSG00000160310	HRMT1L1	29010	58793	5_prime
S5_057	10	112608984	112608926	ENSG00000108055	CSPG6	291510	254604	3_prime
S5_057	10	112608984	112608926	ENSG00000150593	PDCD4	9123	40769	5_prime
S5_058	17	51933456	51933177	ENSG00000153930	NP_694960.1	8631	-10452	IN_GENE
S5_059	19	17996364	17996294	ENSG00000105643	ARRDC2	16387	10459	3_prime
S5_059	19	17996364	17996294	ENSG00000096996	IL12RB1	108157	34442	5_prime

S5_060	9	3517228	3516923	ENSG00000080298	RFX3	1245	302579	3_prime
S5_060	9	3517228	3516923	ENSG00000107249	GLIS3	624955	298027	5_prime
S5_061	4	89598767	89598450	ENSG00000163644	PPM1K	35841	58543	3_prime
S5_061	4	89598767	89598450	ENSG00000138642	HERC6	58427	122659	5_prime
S5_062	8	145006072	145006199	ENSG00000178209	PLEC1	115459	55237	3_prime
S5_062	8	145006072	145006199	ENSG00000185189	NRBP2	9884	18313	5_prime
S5_063	19	53444545	53444681	ENSG00000105483	CARD8	6410	38988	IN_GENE
S5_064	1	145111807	145112029	ENSG00000122497	Q8IX76_HUMAI	28953	6747	3_prime
S5_064	1	145111807	145112029	ENSG00000198161	NP_997283	65084	145690	5_prime
S5_065	15	32116150	32116215	ENSG00000169857	AVEN	2445	170429	IN_GENE
S5_066	9	35720513	35720462	ENSG00000107175	CREB3	1804	6491	3_prime
S5_066	9	35720513	35720462	ENSG00000198467	NP_998839	40460	48523	5_prime
S5_067	10	104488326	104488532	ENSG00000156398	SFXN2	24038	-606	IN_GENE
S5_068	13	47918149	47917969	ENSG00000139687	RB1	142057	-36154	IN_GENE
S5_069	X	153528334	153528419	ENSG00000160219	GAB3	14702	61095	IN_GENE
S5_070	11	88956869	88957061	ENSG00000134612	NP_710163.1	75244	114662	3_prime
S5_070	11	88956869	88957061	ENSG00000086991	NOX4	92568	257706	5_prime
S5_071	2	38232791	38232928	ENSG00000177744	NP_775923.1	37107	87848	3_prime
S5_071	2	38232791	38232928	ENSG00000138061	CYP1B1	17848	26394	5_prime
S5_072	21	25782485	25782594	ENSG00000154719	MRPL39	119187	97356	3_prime
S5_072	21	25782485	25782594	ENSG00000185433	C21orf42	56987	58400	5_prime
S5_073	15	88379973	88380077	ENSG00000140548	NP_940928.1	34217	-45056	IN_GENE
S5_074	16	30795243	30795315	ENSG00000099385	BCL7C	17657	11376	3_prime
S5_074	16	30795243	30795315	ENSG00000102870	ZNF629	89253	94703	5_prime
S5_075	22	46815611	46815870	ENSG00000198291	NP_997361.1	1447579	1455371	3_prime
S5_075	22	46815611	46815870	ENSG00000054611	TB22A_HUMAN	1336563	925363	5_prime
S5_076	18	58920437	58920462	ENSG00000171791	BCL2	217052	21122	3_prime
S5_076	18	58920437	58920462	ENSG00000081913	PLEKHE1	385498	121792	5_prime
S5_078	4	83038690	83038550	ENSG00000138670	RASGEF1B	288450	333292	3_prime
S5_078	4	83038690	83038550	ENSG00000138668	HNRPD	613608	592983	5_prime
S5_079	1	88049336	88049475	ENSG00000065243	PKN2	812941	962107	3_prime
S5_079	1	88049336	88049475	ENSG00000143013	LMO4_HUMAN	543164	526065	5_prime
S5_080	9	132785359	132785292	ENSG00000165698	C9orf9	1988	-9683	IN_GENE
S5_081	8	17374560	17374535	ENSG00000003987	MTMR7	123623	171025	3_prime
S5_081	8	17374560	17374535	ENSG00000003989	SLC7A2	66112	92385	5_prime
S5_082	8	92521318	92521243	ENSG00000147606	SLC26A7	190626	41764	3_prime
S5_082	8	92521318	92521243	ENSG00000079102	MTG8_HUMAN	655301	519010	5_prime
S5_083	17	62685070	62685013	ENSG00000198265	HELZ	13331	180541	3_prime
S5_083	17	62685070	62685013	ENSG00000197170	PSMD12	108113	79425	5_prime
S5_084	7	39403211	39403182	ENSG00000106540	C7orf36	23962	17491	3_prime
S5_084	7	39403211	39403182	ENSG00000197412	Q8N8G3_HUMA	19115	21716	5_prime
S5_085	1	52057069	52057110	ENSG00000169213	RAB3B	111300	39789	3_prime
S5_085	1	52057069	52057110	ENSG00000078618	NRD1	626	90164	5_prime
S5_086	21	46878904	46878843	ENSG00000160307	S100B	29480	35936	3_prime
S5_086	21	46878904	46878843	ENSG00000160310	HRMT1L1	603	30386	5_prime
S5_088	22	31349785	31349910	ENSG00000185666	SYN3	377416	115552	IN_GENE
S5_089	14	64637077	64636944	ENSG00000125952	MAX_HUMAN	2036	94299	IN_GENE
S5_090	1	46896239	46896187	ENSG00000159658	K0494_HUMAN	569	43334	IN_GENE
S5_091	11	5796577	5796614	ENSG00000180988	OR52N2	1565	2530	3_prime
S5_091	11	5796577	5796614	ENSG00000181001	OR52N1	29955	30917	5_prime
S5_092	1	28790858	28790771	ENSG00000120656	TAF12	657	40626	3_prime
S5_092	1	28790858	28790771	ENSG00000162419	GMEB1	25002	71143	5_prime
S5_093	20	55482140	55482156	ENSG00000124097	NP_001008735	15349	14714	3_prime
S5_093	20	55482140	55482156	ENSG00000132819	RNPC1	82270	64354	5_prime
S5_094	8	52949324	52949364	ENSG00000168300	YH01_HUMAN	24825	56626	IN_GENE
S5_095	9	97361210	97361275	ENSG00000136842	TMOD1	17734	-81875	IN_GENE
S5_096	3	13437772	13437978	ENSG00000163517	HDAC11	59052	84062	3_prime
S5_096	3	13437772	13437978	ENSG00000132182	NUP210	963	105035	5_prime
S5_097	5	172166658	172166477	ENSG00000120129	DUSP1	35849	38951	3_prime
S5_097	5	172166658	172166477	ENSG00000113719	EG32_HUMAN	27226	145631	5_prime
S5_098	12	107203729	107203569	ENSG00000174600	CMKLR1	14526	15644	3_prime
S5_098	12	107203729	107203569	ENSG00000198855	NP_009007.2	207789	212118	5_prime

S5_099	20	3002608	3002843	ENSG00000101200	AVP	10762	8595	3_prime
S5_099	20	3002608	3002843	ENSG00000101405	OXT	2342	1446	5_prime
S5_100	2	217244960	217244877	ENSG00000197756	RL37A_HUMAN	55887	51185	3_prime
S5_100	2	217244960	217244877	ENSG00000115457	IGFBP2	78699	109702	5_prime
S5_101	3	5027856	5027638	ENSG00000134107	BHLHB2	31648	25995	3_prime
S5_101	3	5027856	5027638	ENSG00000134108	ARL10C	111074	169741	5_prime
S5_102	17	34870497	34870408	ENSG00000125686	PPARBP	9467	54117	3_prime
S5_102	17	34870497	34870408	ENSG00000167258	CD2L7_HUMAN	1321	71547	5_prime
S5_103	5	76278256	76278431	ENSG00000145708	CRHBP	6180	22798	3_prime
S5_103	5	76278256	76278431	ENSG00000171643	S100Z	71374	25649	5_prime
S5_104	2	171943468	171943322	ENSG00000198586	TLK1	30137	269391	3_prime
S5_104	2	171943468	171943322	ENSG00000123600	NP_079046.1	99055	62337	5_prime
S5_105	12	25820791	25820700	ENSG00000152936	NP_689803.1	223346	300508	3_prime
S5_105	12	25820791	25820700	ENSG00000123094	C12orf2	182467	302482	5_prime
S5_106	12	94998723	94998833	ENSG00000111145	ELK3	91952	165353	3_prime
S5_106	12	94998723	94998833	ENSG00000111144	LTA4H	66890	101644	5_prime
S5_107	5	138750884	138750995	ENSG00000170476	Q8WU39_HUM/	2785	199	3_prime
S5_107	5	138750884	138750995	ENSG00000170482	SLC23A1	3984	20091	5_prime
S5_108	3	188111279	188111867	ENSG00000073849	SIAT1_HUMAN	19939	167764	3_prime
S5_108	3	188111279	188111867	ENSG00000127266	XP_496668.1	10590	10231	5_prime
S5_109	12	52981410	52981326	ENSG00000123405	NFE2	352	9245	3_prime
S5_109	12	52981410	52981326	ENSG00000111481	COPZ1_HUMAN	23768	50490	5_prime
S5_110	17	71537752	71538052	ENSG00000167881	SRP68	42450	9034	3_prime
S5_110	17	71537752	71538052	ENSG00000167880	EVPL	2780	23230	5_prime
S5_111	14	76573739	76573535	ENSG00000119669	C14orf4	9851	12241	3_prime
S5_111	14	76573739	76573535	ENSG00000198894	KIAA1737	60592	79643	5_prime
S5_112	22	46855012	46855561	ENSG00000198291	NP_997361.1	1408178	1415970	3_prime
S5_112	22	46855012	46855561	ENSG00000054611	TB22A_HUMAN	1375964	964764	5_prime
S5_113	1	244038173	244038358	ENSG00000169224	NP_660321.1	317	27714	3_prime
S5_113	1	244038173	244038358	ENSG00000196242	OR2C3_HUMAN	16322	17281	5_prime
S5_114	18	58886873	58886757	ENSG00000081913	PLEKHE1	351934	88228	3_prime
S5_114	18	58886873	58886757	ENSG00000171791	BCL2	250616	54686	5_prime
S5_115	10	19967131	19966832	ENSG00000165997	ARL8	978791	960185	3_prime
S5_115	10	19967131	19966832	ENSG00000120594	PLXDC2	178247	641994	5_prime
S5_116	2	7020458	7020629	ENSG00000151692	RNF144	12337	-114447	IN_GENE
S5_117	11	63795960	63796014	ENSG00000002330	BAD	12780	2082	IN_GENE
S5_119	17	7180713	7180800	ENSG00000072818	CENTB1	123	-14808	IN_GENE
S5_121	10	27570469	27570554	ENSG00000107897	ACBD5	596	44716	IN_GENE
S5_122	12	15004668	15004106	ENSG00000111348	ARHGDIB	1764	17874	IN_GENE
S5_123	19	1046106	1046194	ENSG00000099817	POLR2E	250	6951	IN_GENE
S5_124	13	101845357	101845523	ENSG00000102466	FGF14	6672	672321	IN_GENE
S5_125	3	32330620	32330251	ENSG00000170293	CKLFSF8	75076	-56564	IN_GENE
S5_126	20	11629543	11629563	ENSG00000196740	C20orf61	148715	109337	3_prime
S5_126	20	11629543	11629563	ENSG00000125899	C20orf187	672732	672607	5_prime
S5_127	2	101300097	101300152	ENSG00000158435	C2orf29	27799	45197	3_prime
S5_127	2	101300097	101300152	ENSG00000071082	RL31_HUMAN	222828	218699	5_prime
S5_129	18	51165682	51165571	ENSG00000196628	TCF4	241287	119478	IN_GENE
S5_130	22	41652627	41652419	ENSG00000100266	PACSIN2	83230	62144	IN_GENE
S5_131	12	122040328	122040439	ENSG00000090975	PITPNM2	119837	47420	IN_GENE
S5_132	1	142435448	142435547	ENSG00000178104	PDE4DIP	129784	246069	IN_GENE
S5_133	5	150141518	150141248	ENSG00000181368	NM_032947.3	3547	-15241	IN_GENE
S5_134	2	74724883	74725043	ENSG00000159374	Q96L07_HUMA	62206	27385	IN_GENE
S5_135	4	73605804	73605825	ENSG00000156140	ADAMTS3	193747	94082	IN_GENE
S5_136	6	156569494	156569755	ENSG00000049618	Q8TEE4_HUMA	621705	1053020	3_prime
S5_136	6	156569494	156569755	ENSG00000074771	NOX3	700344	760879	5_prime
S5_137	22	33505463	33505636	ENSG00000175329	NP_001008494	281221	302469	3_prime
S5_137	22	33505463	33505636	ENSG00000133424	LARGE	864499	1512062	5_prime
S5_138	12	4195256	4195199	ENSG00000111224	NP_065100.1	342455	403860	3_prime
S5_138	12	4195256	4195199	ENSG00000118971	CCND2	57943	89521	5_prime
S5_140	9	96261597	96261624	ENSG00000130956	HABP4	30441	70745	3_prime
S5_140	9	96261597	96261624	ENSG00000165244	ZNF367	1373	31806	5_prime
S5_141	12	121910310	121910280	ENSG00000139722	NP_078943.1	4718	35548	3_prime

S5_141	12	121910310	121910280	ENSG00000150967	ABCB9	74322	28111	5_prime
S5_143	2	25408719	25408917	ENSG00000119772	DNMT3A	68391	41222	IN_GENE
S5_144	11	33909621	33909695	ENSG00000135387	M11S1	120127	169056	3_prime
S5_144	11	33909621	33909695	ENSG00000135363	LMO2	39209	72920	5_prime
S5_145	1	157853516	157853656	ENSG00000143217	PVRL4	18899	1053	3_prime
S5_145	1	157853516	157853656	ENSG00000186517	NP_859071.1	708	22938	5_prime
S5_146	14	51848061	51848003	ENSG00000168229	PTGDR	43880	34870	3_prime
S5_146	14	51848061	51848003	ENSG00000125384	PTGER2	2802	17009	5_prime
S5_147	5	175901041	175900989	ENSG00000146083	RNF44	4014	14735	3_prime
S5_147	5	175901041	175900989	ENSG00000074276	NP_060145.2	7957	54238	5_prime
S5_149	13	102229043	102229297	ENSG00000134901	KDELC1	20315	5595	3_prime
S5_149	13	102229043	102229297	ENSG00000151287	NP_620134.2	4900	12575	5_prime
S5_150	19	10673476	10673964	ENSG00000129348	QTRT1	833	11076	IN_GENE
S5_151	22	23450056	23450433	ENSG00000184571	NP_001008496	32587	10440	IN_GENE
S5_152	2	170415635	170415703	ENSG00000144362	PHOSPHO2	39127	-16186	IN_GENE
S5_153	15	92631198	92631292	ENSG00000140563	Q8TAX2_HUMA	55337	193344	IN_GENE
S5_154	17	58870798	58870973	ENSG00000008283	CYB561	6600	7400	IN_GENE
S5_155	19	3081925	3082247	ENSG00000181694	XP_372704.2	212	-472	IN_GENE
S5_156	18	58681134	58681176	ENSG00000081913	PLEKHE1	146195	-117511	IN_GENE
S5_157	8	135795158	135795373	ENSG00000131773	KHDRBS3	743726	933870	3_prime
S5_157	8	135795158	135795373	ENSG00000066827	ZNF406	684	235941	5_prime
S5_158	6	149596440	149596568	ENSG00000055208	MAP3K7IP2	109202	178000	3_prime
S5_158	6	149596440	149596568	ENSG00000111962	NP_005706.1	486275	156622	5_prime
S5_159	2	70224614	70224586	ENSG00000179818	NP_690005.1	124143	125174	3_prime
S5_159	2	70224614	70224586	ENSG00000169564	PCBP1	1736	3369	5_prime
S5_160	17	74494208	74494177	ENSG00000108679	LGALS3BP	6552	15276	3_prime
S5_160	17	74494208	74494177	ENSG00000171302	CANT1	23225	5186	5_prime
S5_161	12	8003937	8003896	ENSG00000059804	SLC2A3	23903	40258	3_prime
S5_161	12	8003937	8003896	ENSG00000065970	FOXJ2	72689	95447	5_prime
S5_162	6	26393000	26393044	ENSG00000158406	H4_HUMAN	741	3738	IN_GENE
S5_163	11	33850890	33850825	ENSG00000135363	LMO2	19587	14124	IN_GENE
S5_164	11	65164372	65164471	ENSG00000173101	SIPA1	204	-10593	IN_GENE
S5_165	11	65112170	65111976	ENSG00000173442	EHBP1L1	11782	-4348	IN_GENE
S5_166	7	46576186	46576149	ENSG00000146674	IGFBP3	842207	850988	3_prime
S5_166	7	46576186	46576149	ENSG00000176657	EPS15L2	18025	20071	5_prime
S5_168	11	45072402	45072267	ENSG00000175274	Q99785_HUMA	142986	190502	3_prime
S5_168	11	45072402	45072267	ENSG00000019485	PRDM11	1531	130812	5_prime
S5_169	10	130723062	130723010	ENSG00000127610	XP_370585.1	121927	119638	3_prime
S5_169	10	130723062	130723010	ENSG00000170430	MGMT	432448	732294	5_prime
S5_170	19	48776258	48776169	ENSG00000073050	XRCC1	4703	36954	3_prime
S5_170	19	48776258	48776169	ENSG00000167378	NP_001007562	15258	11608	5_prime
S5_171	2	197838459	197838151	ENSG00000065413	Q8IZ72_HUMAI	162850	180900	IN_GENE
S5_172	2	64790862	64790885	ENSG00000119844	NM_203437.2	127746	-45684	IN_GENE
S5_173	6	157473979	157474030	ENSG00000049618	Q8TEE4_HUMA	282780	-148535	IN_GENE
S5_174	13	40492080	40492103	ENSG00000120688	WBP4	41582	64057	3_prime
S5_174	13	40492080	40492103	ENSG00000120690	ELF1	37662	87915	5_prime
S5_175	7	75567426	75567487	ENSG00000106211	HSPB1	9148	10837	3_prime
S5_175	7	75567426	75567487	ENSG00000177679	NP_694588.1	10811	6172	5_prime
S5_176	5	131791171	131791189	ENSG00000197536	Q8N8D9_HUMA	16599	-34787	IN_GENE