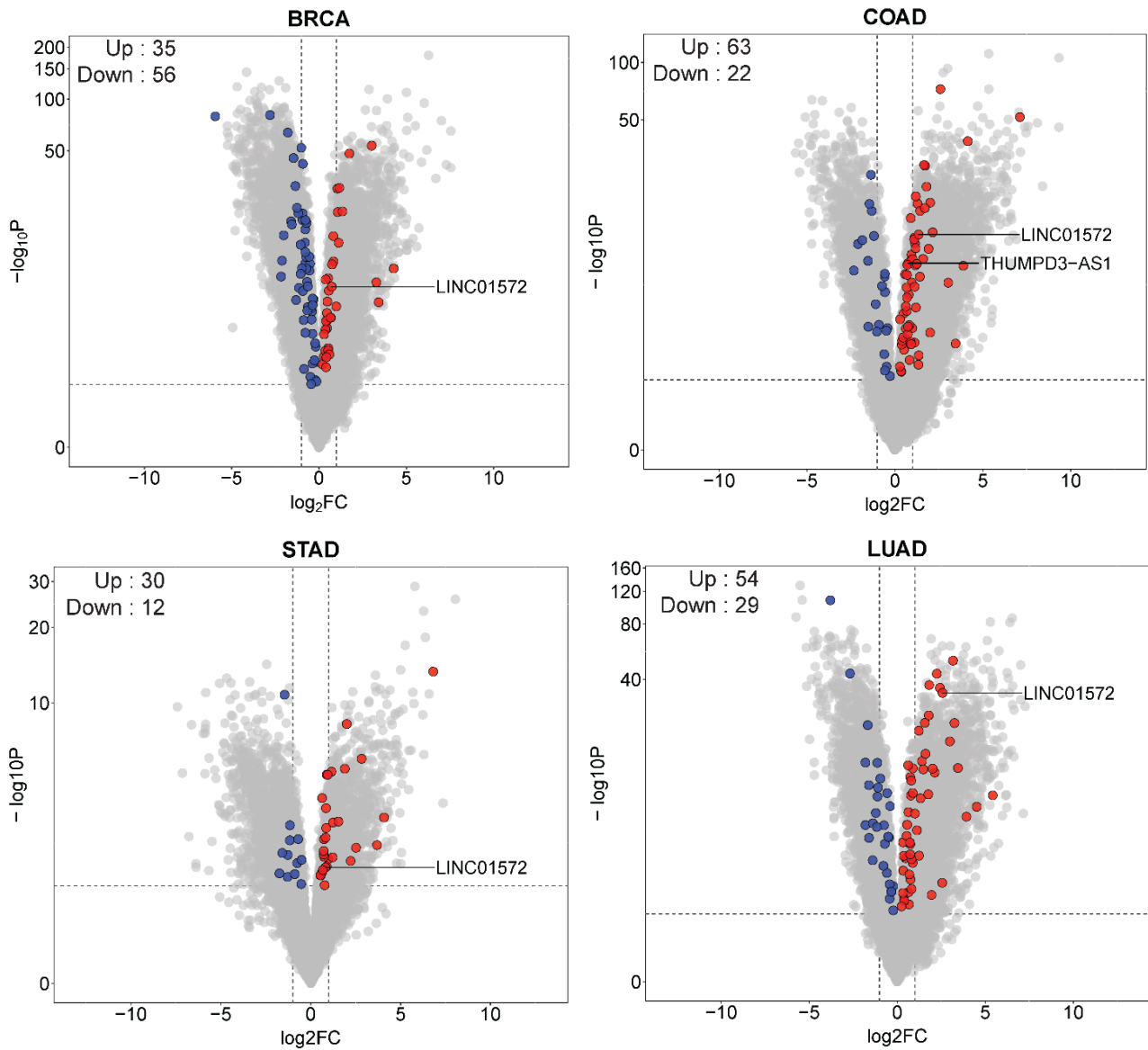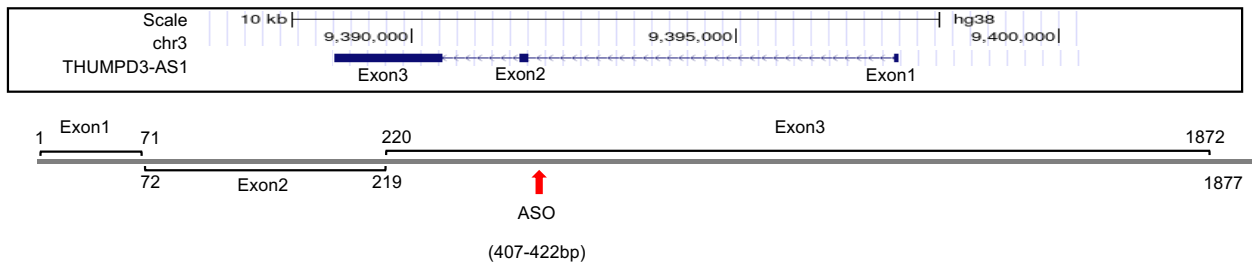**Supplementary Fig. S1. PCA of RNA-seq data derived from seven hepatocellular cell lines.** The four cell lines that were used for identifying eRNAs are shaded with pink ellipses and were differentiated from the other three cell lines by PC1.

Supplementary Fig. S2. Volcano plots of the DEGs identified from four different TCGA cancer datasets. Four different TCGA RNA-seq datasets were used to identify DEGs by comparing gene expression between normal and tumor samples $P < 0.05$. Only upregulated (red) and downregulated (blue) eRNAs are depicted accordingly in each cancer.

A

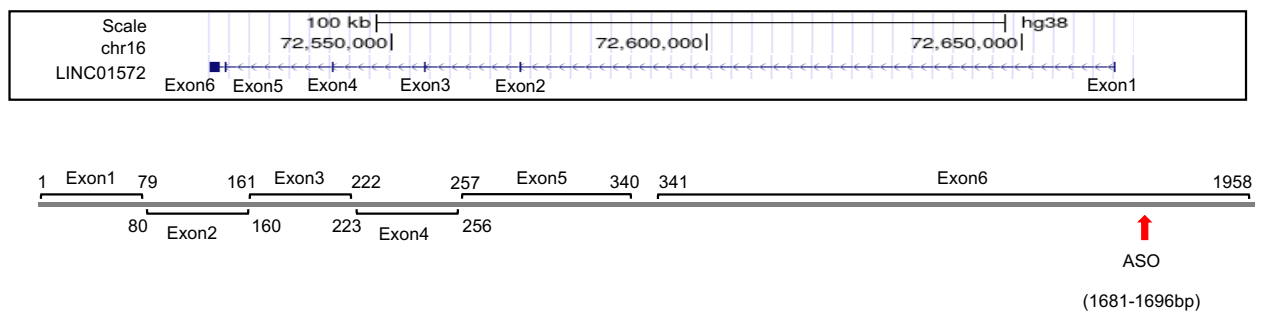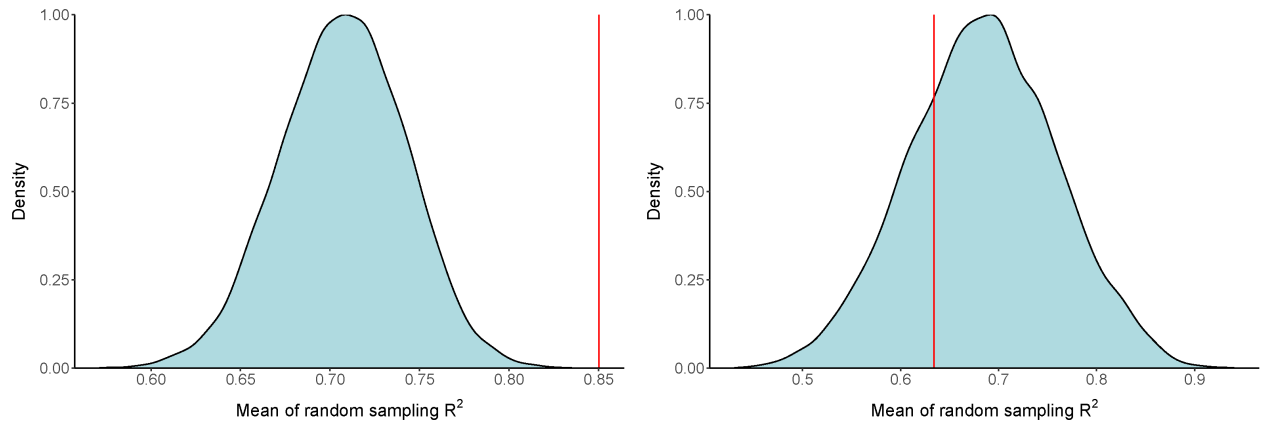**THUMPD3-AS1 (NR_027007.3)**

B

LINC01572 (NR_159370.1)

Supplementary Fig. S3. Genetic structure of the two eRNAs and the ASO target location. (A) The human THUMPD3-AS1 gene is located on chromosome 3 and consists of 3 exons. The ASO for THUMPD3-AS1 targeted exon 3. (B) The human LINC01572 gene is located on chromosome 16 and consists of 6 exons. The ASO for LINC01572 targeted exon 6.

Supplementary Fig. S4. Permutation analysis of R^2 values for randomly chosen non-TAD genes. Density plot of the R^2 values calculated for randomly chosen non-TAD genes. The R^2 values were estimated during 10,000 iterations for the thirteen randomly chosen genes, i.e., the number of genes among the 343 genes correlated with THUMPD3-AS1 located within the THUMPD3-AS1 TAD (A), and three randomly chosen genes, i.e., the number of genes among the 400 genes correlated with LINC01572 located within the same TAD (B). The red bar in the plot indicates the observed average R^2 value calculated from the thirteen (A) and three (B) TAD genes.

Supplementary Table S1. RNA-seq outputs from seven hepatocellular cell lines

	FT3-7	Huh-7	Huh7.5	PLC-PRF-5	SNU182	SNU387	SNU449
Total reads	116,336,364	109,035,592	125,101,533	122,253,797	105,745,982	132,855,367	132,467,381
Reads after trimming	109,923,572	99,643,491	123,090,118	119,754,251	100,834,914	130,404,876	130,017,094
Overall read mapping rate	95.8%	90.2%	97.2%	96.9%	96.9%	97.2%	97.6%

Supplementary Table S2. ChIP-seq outputs from seven hepatocellular cell lines

	FT3-7	Huh-7	Huh7.5	PLC-PRF-5	SNU182	SNU387	SNU449
Total reads							
H3K27ac	67,930,429	64,361,750	52,085,159	53,971,505	61,707,090	54,072,895	63,531,281
H34me1	80,650,123	50,464,428	52,233,147	65,339,269	72,273,443	54,795,761	60,515,029
H3	66,844,506	57,114,371	50,329,409	51,930,903	51,920,739	49,717,762	54,968,044
Reads after trimming							
H3K27ac	67,704,666	64,237,526	50,802,457	52,606,137	61,495,742	52,704,473	61,956,541
H34me1	80,514,894	50,337,160	51,058,776	63,614,983	72,150,721	53,278,934	58,929,878
H3	65,785,488	56,265,546	48,926,730	50,511,294	51,163,929	47,807,011	53,517,823
Mapping rate							
H3K27ac	76.50%	69.10%	77.00%	77.60%	74.70%	78.20%	78.70%
H34me1	74.40%	62.70%	78.60%	78.40%	74.60%	79.00%	79.40%
H3	70.30%	69.00%	73.00%	74.60%	67.20%	73.00%	75.90%

Supplementary Table S4. The numbers of eRNAs detected in each of the four cell types

	FT3-7	Huh7.5	PLC-PRF-5	SNU182
Histone marks ChIP-seq				
H3K4me1	308,558	234,525	294,164	233,037
H3K27ac	64,868	255,525	212,855	74,913
Active enhancer regions				
Total	26,889	55,306	50,553	27,284
(Remove) TTS, TSS, exon of protein coding	2,746	11,557	10,070	3,325
Intergenic	8,650	15,641	14,618	6,576
non-coding RNA	15,493	28,108	25,865	17,383
Map RNA seq				
Total	505	1,162	1,383	597
Antisense	158	397	464	209
lincRNA	149	302	299	125
Others	181	427	560	249
(Remove) non eRNAs :snoRNA,rRNA,tRNA, etc.	17	36	60	14

Supplementary Table S5. eRNAs commonly detected in four cell lines

Symbol	Position	FANTOM	Symbol	Position	FANTOM
antisense			AC114763.1	chr2:138418284-138501698	2
AL513327.1	chr1:33307348-33349245	3	LINC01876	chr2:156011530-156254950	2
AL050341.2	chr1:40256427-40257967	.	AC116049.2	chr4:65998846-66150012	2
AC105942.1	chr1:94927566-94963270	.	LINC02163	chr5:104079911-104105403	.
SLC16A1-AS1	chr1:112956415-113047055	3	LINC01843	chr5:134506552-134509229	.
AC242426.2	chr1:147172771-147211568	.	SNHG4	chr5:139274102-139283477	.
AL606537.1	chr1:214028891-214030901	.	LINC01006	chr7:156472196-156640654	7
AL445524.1	chr1:231522388-231528556	.	LINC00174	chr7:66376044-66493566	1
CCDC18-AS1	chr1:93262186-93346025	2	LINC-PINT	chr7:130938963-131110176	23
ATP1A1-AS1	chr1:116392247-116418622	.	AC006001.3	chr7:66526088-66592397	3
ADAMTSL4-AS1	chr1:150560202-150574552	1	AF117829.1	chr8:89609409-89757727	3
PROX1-AS1	chr1:213817751-213988508	2	PVT1	chr8:127794533-128101253	35
AC074117.1	chr2:27356246-27367622	.	CASC19	chr8:127072694-127227541	23
AC007388.1	chr2:39436637-39665343	10	LINC01515	chr10:65570338-65768835	.
AC093110.1	chr2:54661011-54680045	1	OLMALINC	chr10:100373513-100454043	1
AC009303.2	chr2:117995397-118055033	1	RAB30-AS1	chr11:83072066-83106719	1
AC010976.1	chr2:127455394-127514623	2	AC025031.4	chr12:46388856-46392126	.
AC007364.1	chr2:149587196-149848233	3	LINC02381	chr12:54126098-54142493	.
AC007319.1	chr2:187003220-187554663	12	AC073569.2	chr12:79690144-79778451	4
PCBP1-AS1	chr2:69962263-70103220	15	AL139089.1	chr13:52651305-52652279	.
THUMPD3-AS1	chr3:9349689-9398579	1	LINC00355	chr13:63986371-64076011	4
AC099329.1	chr3:42785087-42852428	2	LINC02331	chr14:53768942-53850882	.
AC068631.1	chr3:186579476-186772986	1	AL132989.2	chr14:58288033-58289158	.
SGO1-AS1	chr3:20174244-21145967	3	AL355916.1	chr14:61570540-61658696	17
THRB-AS1	chr3:24494087-24681711	2	AC023906.3	chr15:52116574-52122131	.
GLYCTK-AS1	chr3:52288580-52299067	.	AC090825.1	chr15:99807023-99877148	.
UBA6-AS1	chr4:67701280-68080952	3	LINC01578	chr15:92882707-92899701	.
THAP9-AS1	chr4:82893009-82900960	.	LINC01572	chr16:72283301-72665009	3
AL022068.1	chr6:19324988-19839080	8	AC005224.4	chr17:14303854-14305505	1
TRAF3IP2-AS1	chr6:111483511-111598302	6	LINC00511	chr17:72323123-72640472	33
AL034349.1	chr6:128500527-128501176	.	LINC00261	chr20:22547671-22578642	2
AL356599.1	chr6:145799409-145886585	.	AC073529.1	chrX:10847877-11111141	1
AC073332.1	chr7:16970320-17299357	21	**pseudogene**		
HOXA-AS2	chr7:27107777-27134302	3	MST1L	chr1:16754910-16770237	.
AC005021.1	chr7:95416108-95416462	.	EMBP1	chr1:121519112-121571892	1
LINC01004	chr7:104950315-105013044	10	AC096921.1	chr3:30626423-30626797	.
AC009403.1	chr7:155611231-155645205	.	AC108693.1	chr3:113740823-113741254	.
AC090739.1	chr8:42537529-42538304	.	EMC3-AS1	chr3:9986893-10006990	.
MIR181A2HG	chr9:124658467-124698631	4	LINC00888	chr3:183447608-183456013	.
ENTPD1-AS1	chr10:95753206-96090238	13	AC132008.2	chr3:197578213-197627906	1
AP001107.9	chr11:66347950-66364804	1	CCT6P3	chr7:65038354-65074713	.
KCTD21-AS1	chr11:78139771-78175323	.	STAG3L4	chr7:67302621-67321526	1
C1RL-AS1	chr12:7108052-7122501	.	AC004980.1	chr7:76549360-76627982	.
AC034102.6	chr12:56120033-56129619	.	RPL13P5	chr12:6873389-6884741	.
AC090673.1	chr12:65851340-65882167	.	PLEKHA8P1	chr12:45173064-45216041	1
DLEU2	chr13:49982552-50125720	8	AC009533.1	chr12:9277235-9313241	.
STARD13-AS	chr13:33180401-33281584	9	MRPS31P5	chr13:52167709-52194465	.
PSMA3-AS1	chr14:58265365-58298134	1	AC104046.1	chr15:85415228-85415633	.
USP3-AS1	chr15:63544247-63601589	1	UBE2Q2P2	chr15:82355142-82420075	.
AC087482.1	chr15:66984108-67065268	5	UBE2Q2P1	chr15:84526781-84571216	.
UBL7-AS1	chr15:74461265-74481302	.	PDXDC2P	chr16:70010751-70065945	1
AC005921.2	chr17:50693448-50695449	.	**[a]SIN**		
COX10-AS1	chr17:13756478-14069495	2	AC096947.1	chr1:61124733-61125202	.
AP005899.1	chr18:9112404-9115877	.	THRB-IT1	chr3:24455136-24459434	.
SNHG22	chr18:49814023-49851059	1	ST7-OT4	chr7:116953899-117098806	4
AC243964.2	chr19:44632199-44718759	4	AC090181.2	chr15:77067654-77068325	.
SDCBP2-AS1	chr20:1325405-1378734	6	AC004832.4	chr22:30421206-30421536	.
Z93930.2	chr22:28800683-28848559	5	**[b]SON**		
TTC28-AS1	chr22:27919376-28008581	1	AC019080.1	chr2:177283508-177392691	1
AC231533.1	chrX:48698963-48737163	2	AC007066.2	chr9:122937623-122940333	.
lincRNA			**Not assigned**		
AL445686.2	chr1:24538802-24556024	1	DANCR	chr4:52712404-52720351	.
AL023755.1	chr1:168400829-168495685	4	Z94721.2	chr6:166999405-167139141	11
LINC01138	chr1:148290889-148519604	4	BMS1P4	chr10:73699151-73730487	.
CROCCP2	chr1:16618253-16657232	.	AL137782.1	chr13:75549773-75807120	9
AC245100.4	chr1:148402516-148432545	.	AC090022.1	chr16:69976297-70065948	1
AC009414.2	chr2:36354749-36355114	.	AC068152.1	chr17:46984045-47100323	.
CYTOR	chr2:87454781-87636740	3	AC090181.3	chr15:77063397-77064910	.
MIR4435-2HG	chr2:111036776-111523376	11	AL031009.1	chr16:1688355-1690536	.

[a]SIN: sense intronic ncRNA, [b]SON : sense overlapping ncRNA