

Table S1: sgRNA sequences for human and mouse loci

locus	sgRNA	5' sequence	3' sequence
telomeres	1	GTTAGGGTTAGGGTTAGGGTTA	TAACCCTAACCCCTAACCCCTAA C
<i>GAPDH</i>	1	TTAATGCTCTCAATGAGAAA	TTTCTCATTGAGAGCATTAA
	2	CTGCCCTTCTAGCTAAAAGC	GCTTTTAGCTAGAAGGGCAG
	3	GCTGCGCCGGGGGATATTGA	TCAATATCCCCCGGCAGC
<i>FIRRE</i>	1	ACAGCAAAGACACTTCCAGA	TCTGGAAGTGTCTTTGCTGT
	2	CTAGATGGCGAAAGAGACCT	AGGTCTCTTTTCGCCATCTAG
	3	GAAATGTTGAAAACGAGCAA	TTGCTCGTTTTCAACATTTT
<i>CISTR-ACT</i>	1	GGTCGTCAAGACCAACCAAG	CTTGGTTGGTCTTGACGACC
	2	CATATGTAAGGAGACCG	CGGTCTCCTCAGTACATATG
	3	AGAAGTCCCCAACACAAAG	CTTTGTGTTTGGGGACTTCT
	4	GACCTTGAGGGGAGCCCAA	TTGGGCTCCCCTCCAAGGTC
	5	CCAGAAGAGCCCCAATTAGT	ACTAATTGGGGCTCTTCTGG
	6	CCCGCCCCGGATGCCGAGCG	CGCTCGGCATCCGGGGCGG G
<i>XIST</i>	1	CCAGAATCTGATATAAAGGG	CCCTTTATATCAGATTCTGG
	2	GTTTATCAAAAGAGAACACG	CGTGTCTCTTTTGATAAAC
	3	GAAACAACAGAGAACCAGAA	TTCTGGTTCTCTGTTGTTTC
<i>TSIX</i>	1	TATGCTCTCCAGAAACAGAA	TTCTGTTTCTGGAGAGCATA
	2	ATACTCTTGAGTGTAGCCA	TGGCTAACACTCAAGAGTAT
	3	TCATGTTCTAGGCTATAAAG	CTTTATAGCCTAGAACATGA
<i>Firre</i>	1	TTATACTTAATAATAAGGCA	TGCCTTATTATTAAGTATAA
	2	GATCAAATGTAAAGAAAGCA	TGCTTTCTTTACATTTGATC
	3	ATAAATGTCTGTGTTTGCAG	CTGCAAACACAGACATTTAT
<i>Ypel4, 129S1 rs28029584</i>	1	AGAGGCACTGGATTTCGCACC	GGTGCGAATCCAGTGCCTCT
<i>Ypel4, 129S1 rs28029650</i>	2	TCCTGTCCCTGGCGAGCTGC	GCAGCTCGCCAGGGACAGGA
<i>Ypel4, CAST rs28029616</i>	1	CACATCCACCTCAAAGGCCG	CGGCCTTTGAGGTGGATGTG
<i>Ypel4, CAST rs8273639</i>	2	TTATGTTACTAATGTATCTA	TAGATACATTAGTAACATAA
<i>chr18, CAST rs31839508</i>	1	AAATGTGTCTTCCATTACCT	AGGTAATGGAAGACACATTT
<i>chr18, CAST rs31842179</i>	2	GCTTTTTAAATCCAAATTCC	GGAATTTGGATTTAAAAGC
<i>chr18, 129S1 rs31842267</i>	1	ACAAAAGATAAACCAACCTC	GAGGTTGGTTTATCTTTTGT
<i>chr18, 129S1 rs31843018</i>	2	AAAGAAAAAGTGGTAAGAAA	TTTCTTACCACTTTTTCTTT
<i>chr7, CAST rs33265624</i>	1	CAATAAAAATAAAATGAGAT	ATCTCATTATTTTTATTG
<i>chr7, CAST rs33264925</i>	2	CAAGAATAGGGACATCAATA	TATTGATGTCCCTATTCTTG
<i>chr7, 129S1 rs32528342</i>	1	CAATCTGAACTATCTCTCTT	AAGAGAGATAGTTCAGATTG
<i>chr7, 129S1</i>	2	TTCTCAGGGGCAGCTAGGCC	GGCCTAGCTGCCCTGAGAA

rs47741975				
<i>Hdac4</i> , CAST rs33095036	1	GGAGCATGATCGTACCTGCA	TGCAGGTACGATCATGCTCC	
<i>Hdac4</i> , CAST rs33090780	2	AGTAACTTTCAAAGCAAAA	TTTTGCTTTTGAAAGTTACT	
<i>Hdac4</i> , 129S1 rs33095034	1	TTAGCTTTGGAAGATACAAT	ATTGTATCTTCCAAAGCTAA	
<i>Hdac4</i> , 129S1 rs33090216	2	AAACGCACAGTCCCAACCAA	TTGGTTGGGACTGTGCGTTT	
<i>Sox9</i> , CAST rs27032449	1	TGAAAGAAGGCTACAGTGAG	CTCACTGTAGCCTTCTTTCA	
<i>Sox9</i> , CAST rs27032331	2	AGGTGTTGACCTCATCCCAG	CTGGGATGAGGTCAACACCT	
<i>Sox9</i> , 129S1 rs27032530	1	CACCATAGGGTAGGAGCTAC	GTAGCTCCTACCCTATGGTG	
<i>Sox9</i> , 129S1 rs27032349	2	GATTTCAACAACAGATGACA	TGTCATCTGTTGTTGAAATC	
<i>Cistr</i> , CAST rs37349197	1	GCTCCCAGTCACCGGTAATG	CATTACCGGTGACTGGGAGC	
<i>Cistr</i> , CAST rs37589721	2	TCACTGGCTCTCCAAACT	AGTGTTTGGAGAGCCAGTGA	
<i>Cistr</i> , 129S1 rs37810061	1	GAACCTTTCAAACAAAGCAA	TTGCTTTGTTTGAAAGGTTT	
<i>Cistr</i> , 129S1 rs51914516	2	GCTACTGAGCTTGGAGCAGT	ACTGCTCCAAGCTCAGTAGC	
<i>Firre</i> , CAST rs30271762	1	TTGTTTCCTCTTAACTGTGA	TCACAGTTAAGAGGAAACAA	
<i>Firre</i> , CAST rs30266026	2	AAATGTTCTCTAATGACCAC	GTGGTCATTAGAGAACATTT	
<i>Firre</i> , 129S1 rs30249067	1	ACATGTACACATTCTTGTT	AACAAGGAATGTGTACATGT	
<i>Firre</i> , 129S1 rs30267596	2	TCAAAGAAACACCTTCGTA	TACGAAGGTGTTTCTTTTGA	

Table S2: Time properties of 4D-experiments

Combination	Total number of acquired cells [n]	Total number of z-stacks	Mean of time interval [sec]	Total imaging time [h]	Average imaging time per cell [min]
<i>FIRRE</i> - nucleolus	9	108	146	4.4	29.1
<i>GAPDH</i> - nucleolus	7	108	154	4.6	39.4
<i>Firre</i> – nucleolus (short intervals)	8	78	203	4.5	38.2
<i>Firre</i> – nucleolus (sister-chromatids)	3	20	1200	6.7	133.3
<i>Firre</i> – nucleolus (apoptosis)	5	29	1200	9.7	116