

## Supplementary Material

### Normal distribution test

The distributions of the  $a$ -statistic (Equ<sup>n</sup>. 1) generated from each pairing of ortho and foamy virus domains was tested for Normality using the Kolmogorov-Smirnov (KS) test using its implementation in the statistical package "R" (<https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf>). In the following list of results, only two distributions were found to deviate significantly (below the 0.01 level, dashed line) from the null hypothesis that the distributions are Normally distributed.

Virus domains	length	KS D value	p-value
HTLV_C + foamyN	73	D = 0.0426,	p-value = 0.9636
HTLV_N + foamyN	77	D = 0.0261,	p-value = 0.9495
HIV6_N + foamyN	77	D = 0.0301,	p-value = 0.9367
HML2_N + foamyC	79	D = 0.0469,	p-value = 0.8327
BLV_N + foamyN	79	D = 0.0397,	p-value = 0.8287
HIV1_C + foamyC	69	D = 0.0492,	p-value = 0.8254
HML2_C + foamyN	72	D = 0.0545,	p-value = 0.7042
HIV6_C + foamyC	60	D = 0.0599,	p-value = 0.5758
BLV6_N + foamyN	79	D = 0.0462,	p-value = 0.5727
HIV6_N + foamyC	80	D = 0.0576,	p-value = 0.5603
RSV_N + foamyC	79	D = 0.0533,	p-value = 0.5451
RELIK_N + foamyC	87	D = 0.0526,	p-value = 0.5441
BLV_N + foamyC	80	D = 0.0656,	p-value = 0.4732
HIV1_N + foamyN	76	D = 0.0537,	p-value = 0.4342
BLV6_C + foamyC	72	D = 0.0632,	p-value = 0.3804
RELIK_N + foamyN	78	D = 0.0605,	p-value = 0.367
HIV6_C + foamyN	59	D = 0.0695,	p-value = 0.3497
BLV6_C + foamyN	74	D = 0.0865,	p-value = 0.2894
HTLV_C + foamyC	72	D = 0.0841,	p-value = 0.2643
MLV_N + foamyC	80	D = 0.0769,	p-value = 0.2638
JSRV_N + foamyC	81	D = 0.0774,	p-value = 0.2547
HIV1_C + foamyN	71	D = 0.086,	p-value = 0.2479
RSV_N + foamyN	72	D = 0.0815,	p-value = 0.2295
MPMV_N + foamyC	80	D = 0.0826,	p-value = 0.1884
HIV1_N + foamyC	79	D = 0.0794,	p-value = 0.1867
JSRV_N + foamyN	78	D = 0.0737,	p-value = 0.1796
PSIV_N + foamyN	79	D = 0.0685,	p-value = 0.143
BLV6_N + foamyC	79	D = 0.0769,	p-value = 0.1376
MPMV_N + foamyN	78	D = 0.0713,	p-value = 0.1321
BLV_C + foamyC	66	D = 0.0881,	p-value = 0.09677
HML2_C + foamyC	80	D = 0.0956,	p-value = 0.09418
PSIV_N + foamyC	80	D = 0.09,	p-value = 0.06448
BLV_C + foamyN	70	D = 0.1083,	p-value = 0.06359
HML2_N + foamyN	76	D = 0.0886,	p-value = 0.06022

MLV\_N + foamyN 80 D = 0.0751, p-value = 0.05412  
 RSV\_C + foamyN 72 D = 0.1244, p-value = 0.02049  
 ----- 0.01  
 HTLV\_N + foamyC 82 D = 0.1014, p-value = 0.008952  
 RSV\_C + foamyC 69 D = 0.1408, p-value = 0.000203

## DALI hits

## Matches to PDB90

No:	Chain	Z	rmsd	lali	nres	%id	PDB	Description
1:	4x3x-A	5.0	3.1	66	82	11	PDB	MOLECULE: ACTIVITY-REGULATED CYTOSKELETON-ASS
2	3g29-A	3.7	2.7	60	77	8	PDB	MOLECULE: GAG POLYPROTEIN;
3	3g0v-A	3.7	2.9	62	76	8	PDB	MOLECULE: GAG POLYPROTEIN;
4:	2v50-D	3.6	2.2	41	998	7	PDB	MOLECULE: MULTIDRUG RESISTANCE PROTEIN MEXB;
5:	3j39-i	3.6	2.5	40	113	3	PDB	MOLECULE: 60S RIBOSOMAL PROTEIN L10A-2;
6	4ph2-A	3.6	3.2	69	127	7	PDB	MOLECULE: BLV CAPSID - N-TERMINAL DOMAIN;
7:	1iqp-E	3.6	3.8	69	326	7	PDB	MOLECULE: RFCS;
8:	4gco-A	3.6	3.7	55	120	11	PDB	MOLECULE: PROTEIN STI-1;
9	3g29-B	3.6	2.8	62	77	8	PDB	MOLECULE: GAG POLYPROTEIN;
10	3gli-B	3.6	2.9	62	75	8	PDB	MOLECULE: GAG POLYPROTEIN;
11	3g21-A	3.6	2.8	60	77	8	PDB	MOLECULE: GAG POLYPROTEIN;
12:	2a0u-A	3.5	3.1	68	374	4	PDB	MOLECULE: INITIATION FACTOR 2B;
13:	1j7q-A	3.5	2.9	60	86	5	PDB	MOLECULE: CALCIUM VECTOR PROTEIN;
14:	2a0u-B	3.5	8.1	80	367	4	PDB	MOLECULE: INITIATION FACTOR 2B;
15:	1iqp-A	3.5	3.7	70	326	7	PDB	MOLECULE: RFCS;
16	4ph0-C	3.5	4.6	101	199	8	PDB	MOLECULE: BLV CAPSID;
17	4ph0-D	3.5	4.2	101	198	8	PDB	MOLECULE: BLV CAPSID;
18	4ph2-B	3.5	3.3	69	127	7	PDB	MOLECULE: BLV CAPSID - N-TERMINAL DOMAIN;
19:	1sxj-B	3.4	3.5	65	316	3	PDB	MOLECULE: ACTIVATOR 1 95 KDA SUBUNIT;
20:	2afd-A	3.4	2.7	59	88	14	PDB	MOLECULE: PROTEIN ASL1650;
21:	2yhe-A	3.4	2.8	40	639	8	PDB	MOLECULE: SEC-ALKYL SULFATASE;
22:	4u8y-B	3.4	4.4	64	1033	3	PDB	MOLECULE: MULTIDRUG EFFLUX PUMP SUBUNIT ACRB;
23:	2yhe-C	3.4	7.1	70	634	6	PDB	MOLECULE: SEC-ALKYL SULFATASE;
24:	2yhe-E	3.4	6.6	72	634	7	PDB	MOLECULE: SEC-ALKYL SULFATASE;
25	4coc-B	3.4	3.1	64	79	9	PDB	MOLECULE: CAPSID PROTEIN P24;
26:	4av7-D	3.4	8.1	70	634	7	PDB	MOLECULE: SEC-ALKYLSULFATASE;
27:	4mbq-F	3.4	3.2	42	50	5	PDB	MOLECULE: MOTILITY PROTEIN FIMV;
28	3g1g-B	3.4	2.9	61	75	8	PDB	MOLECULE: GAG POLYPROTEIN;
29:	2w8a-A	3.3	2.0	43	531	7	PDB	MOLECULE: GLYCINE BETAINE TRANSPORTER BETP;
30	3ce7-A	3.3	2.7	59	90	5	PDB	MOLECULE: SPECIFIC MITOCHODRIAL ACYL CARRIER I
31:	1eia-A	3.3	2.8	62	207	11	PDB	MOLECULE: EIAV CAPSID PROTEIN P26;
32:	1k6y-B	3.3	2.4	40	194	3	PDB	MOLECULE: INTEGRASE;
33:	2lo0-A	3.3	2.5	33	45	6	PDB	MOLECULE: UNCHARACTERIZED PROTEIN;
34:	3w9j-B	3.3	4.3	64	1030	5	PDB	MOLECULE: MULTIDRUG RESISTANCE PROTEIN MEXB;
35:	4dx6-B	3.3	4.6	67	1033	4	PDB	MOLECULE: ACRIFLAVINE RESISTANCE PROTEIN B;
36:	1iqp-D	3.3	3.9	70	326	7	PDB	MOLECULE: RFCS;

37:	2afe-A	3.3	2.8	59	88	12 PDB	MOLECULE: PROTEIN ASL1650;
38:	4av7-B	3.3	7.6	72	637	8 PDB	MOLECULE: SEC-ALKYLSULFATASE;
39:	1iqp-B	3.3	4.1	70	326	7 PDB	MOLECULE: RFCS;
40:	1k6y-D	3.3	3.7	52	189	2 PDB	MOLECULE: INTEGRASE;
41:	1k6y-C	3.3	3.3	49	191	4 PDB	MOLECULE: INTEGRASE;
42:	1k6y-A	3.3	4.2	54	192	2 PDB	MOLECULE: INTEGRASE;
43:	2lo0-B	3.3	2.9	36	45	6 PDB	MOLECULE: UNCHARACTERIZED PROTEIN;
44	1afv-B	3.3	3.6	86	151	15 PDB	MOLECULE: HUMAN IMMUNODEFICIENCY VIRUS TYPE 1
45:	2o98-A	3.3	12.4	74	234	11 PDB	MOLECULE: 14-3-3-LIKE PROTEIN C;
46	4ph0-A	3.2	4.1	100	201	9 PDB	MOLECULE: BLV CAPSID;
47	1l6n-A	3.2	9.7	88	288	13 PDB	MOLECULE: GAG POLYPROTEIN;
48:	3d5l-A	3.2	9.1	68	203	7 PDB	MOLECULE: REGULATORY PROTEIN RECX;
49:	1mw7-A	3.2	2.3	41	220	10 PDB	MOLECULE: HYPOTHETICAL PROTEIN HP0162;
50:	2lni-A	3.2	3.5	43	133	2 PDB	MOLECULE: STRESS-INDUCED-PHOSPHOPROTEIN 1;
51:	2kc7-A	3.2	3.1	40	99	10 PDB	MOLECULE: BFR218_PROTEIN;
52:	4dx5-B	3.2	4.6	65	1033	3 PDB	MOLECULE: ACRIFLAVINE RESISTANCE PROTEIN B;
53	4coc-C	3.2	2.7	59	73	5 PDB	MOLECULE: CAPSID PROTEIN P24;
54	4coc-A	3.2	2.7	61	75	5 PDB	MOLECULE: CAPSID PROTEIN P24;
55	4cop-B	3.2	2.7	57	68	5 PDB	MOLECULE: CAPSID PROTEIN P24;
56	3lry-A	3.2	2.9	62	71	8 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
57	3lry-B	3.2	2.8	61	71	8 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
58	4ph0-B	3.2	4.2	88	188	9 PDB	MOLECULE: BLV CAPSID;
59	1afv-A	3.2	3.6	86	151	15 PDB	MOLECULE: HUMAN IMMUNODEFICIENCY VIRUS TYPE 1
60	2gon-C	3.2	4.3	85	138	14 PDB	MOLECULE: CAPSID PROTEIN P24 (CA);
61	4ph3-B	3.2	3.1	64	115	8 PDB	MOLECULE: BLV CAPSID;
62:	3ual-A	3.2	12.1	69	230	7 PDB	MOLECULE: 14-3-3 PROTEIN EPSILON;
63:	1o9e-A	3.2	12.2	70	231	11 PDB	MOLECULE: 14-3-3-LIKE PROTEIN C;
64:	1o9c-A	3.2	12.3	69	231	10 PDB	MOLECULE: 14-3-3-LIKE PROTEIN C;
65:	3cu8-A	3.2	11.3	68	229	9 PDB	MOLECULE: 14-3-3 PROTEIN ZETA/DELTA;
66:	3ubw-A	3.2	12.1	69	230	7 PDB	MOLECULE: 14-3-3 PROTEIN EPSILON;
67:	1o9f-A	3.2	12.2	71	231	8 PDB	MOLECULE: 14-3-3-LIKE PROTEIN C;
68:	4fj3-A	3.2	12.2	70	220	9 PDB	MOLECULE: 14-3-3 PROTEIN ZETA/DELTA;
69	3dph-B	3.2	2.9	63	80	10 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
70	3ds3-B	3.2	2.6	59	73	10 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
71	4ph1-A	3.2	3.2	63	73	6 PDB	MOLECULE: BLV CAPSID;
72	2y4z-A	3.1	3.8	68	135	10 PDB	MOLECULE: CAPSID PROTEIN P30;
73	5a9e-A	3.1	3.1	61	254	3 PDB	MOLECULE: DELTAMD GAG PROTEIN;
74:	2liu-A	3.1	2.9	58	99	7 PDB	MOLECULE: CURA;
75:	2o98-B	3.1	2.8	42	237	12 PDB	MOLECULE: 14-3-3-LIKE PROTEIN C;
76:	3ph0-C	3.1	3.3	42	53	14 PDB	MOLECULE: ASCE;
77:	1s7e-A	3.1	2.0	40	147	10 PDB	MOLECULE: HEPATOCYTE NUCLEAR FACTOR 6;
78:	4dx7-B	3.1	4.5	65	1033	5 PDB	MOLECULE: ACRIFLAVINE RESISTANCE PROTEIN B;
79	3ds2-B	3.1	3.2	70	84	11 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
80	2eia-B	3.1	2.9	61	204	11 PDB	MOLECULE: EIAV CAPSID PROTEIN P26;
81	4m0i-A	3.1	2.9	61	71	8 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
82	4u0d-L	3.1	3.9	83	191	14 PDB	MOLECULE: GAG POLYPROTEIN;

83	4ph3-A	3.1	3.1	65	115	8 PDB	MOLECULE: BLV CAPSID;
84:	4wrq-A	3.1	12.3	71	220	8 PDB	MOLECULE: 14-3-3 PROTEIN ZETA/DELTA;
85:	1o9d-A	3.1	11.4	68	230	9 PDB	MOLECULE: 14-3-3-LIKE PROTEIN C;
86:	4n84-B	3.1	12.5	68	226	9 PDB	MOLECULE: 14-3-3 PROTEIN ZETA/DELTA;
87:	4f15-B	3.1	12.2	69	229	9 PDB	MOLECULE: 14-3-3 PROTEIN SIGMA;
88	1a43-A	3.1	2.9	61	72	8 PDB	MOLECULE: HIV-1 CAPSID;
89:	2c63-D	3.1	10.9	63	233	10 PDB	MOLECULE: 14-3-3 PROTEIN ETA;
90:	4n7g-A	3.1	12.4	69	229	7 PDB	MOLECULE: 14-3-3 PROTEIN ZETA/DELTA;
91	1baj-A	3.1	2.8	60	71	8 PDB	MOLECULE: GAG POLYPROTEIN;
92:	3ph0-D	3.1	3.8	48	53	15 PDB	MOLECULE: ASCE;
93:	3uzd-A	3.1	12.2	69	229	13 PDB	MOLECULE: 14-3-3 PROTEIN GAMMA;
94	4ph1-C	3.1	3.1	64	79	6 PDB	MOLECULE: BLV CAPSID;
95:	4n84-A	3.1	12.4	71	227	8 PDB	MOLECULE: 14-3-3 PROTEIN ZETA/DELTA;
96:	3rmr-A	3.0	4.9	99	236	11 PDB	MOLECULE: AVIRULENCE PROTEIN;
97:	2l0q-A	3.0	3.1	53	80	6 PDB	MOLECULE: ACYL CARRIER PROTEIN;
98:	2br9-A	3.0	2.8	42	230	12 PDB	MOLECULE: 14-3-3 PROTEIN EPSILON;
99:	2btp-A	3.0	2.8	42	248	14 PDB	MOLECULE: 14-3-3 PROTEIN TAU;
100:	3axy-C	3.0	2.8	42	235	12 PDB	MOLECULE: PROTEIN HEADING DATE 3A;
:							
101	1qrx-A	3.0	3.1	64	214	9 PDB	MOLECULE: HTLV-I CAPSID PROTEIN;
:							
104	4xfx-A	3.0	4.0	82	216	15 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
105	4u0d-F	3.0	3.9	83	211	14 PDB	MOLECULE: GAG POLYPROTEIN;
106	2jpr-A	3.0	4.4	83	145	14 PDB	MOLECULE: GAG-POL POLYPROTEIN;
107	4xfz-A	3.0	3.1	79	213	15 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
108	2l6e-A	3.0	3.9	62	94	8 PDB	MOLECULE: CAPSID PROTEIN P24;
109	4xfy-A	3.0	3.9	83	216	14 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
110	4u0d-G	3.0	3.9	82	212	15 PDB	MOLECULE: GAG POLYPROTEIN;
111	4u0d-B	3.0	4.0	83	207	14 PDB	MOLECULE: GAG POLYPROTEIN;
:							
141	4cop-A	2.9	2.9	64	83	8 PDB	MOLECULE: CAPSID PROTEIN P24;
142	2xv6-C	2.9	2.8	55	68	5 PDB	MOLECULE: CAPSID PROTEIN P24;
143	4u0c-A	2.9	4.0	83	210	14 PDB	MOLECULE: CAPSID PROTEIN P24;
144	4u0d-H	2.9	4.2	83	204	14 PDB	MOLECULE: GAG POLYPROTEIN;
145	2pwo-B	2.9	5.4	83	143	14 PDB	MOLECULE: GAG-POL POLYPROTEIN (PR160GAG-POL);
146	2pwm-E	2.9	5.7	83	145	14 PDB	MOLECULE: GAG-POL POLYPROTEIN;
147:	3upv-A	2.9	7.1	59	125	7 PDB	MOLECULE: HEAT SHOCK PROTEIN STI1;
148	4u0d-I	2.9	3.9	83	196	14 PDB	MOLECULE: GAG POLYPROTEIN;
149	4u0d-A	2.9	4.2	83	216	14 PDB	MOLECULE: GAG POLYPROTEIN;
150	3p05-E	2.9	3.2	78	199	14 PDB	MOLECULE: HIV-1 CA;
:							
165	3ds4-B	2.9	3.0	63	75	10 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
166	3ds4-A	2.9	2.8	59	77	10 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
:							
179	3ds2-A	2.9	3.4	68	84	12 PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
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183	3ds3-A	2.9	2.7	58	73	10	PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
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186	2x82-A	2.8	3.3	67	145	9	PDB	MOLECULE: CAPSID PROTEIN P24;
:								
200	3ds0-A	2.8	3.5	63	82	10	PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
201	2xv6-A	2.8	2.9	60	75	10	PDB	MOLECULE: CAPSID PROTEIN P24;
:								
204	3mge-A	2.8	4.0	81	204	15	PDB	MOLECULE: CAPSID PROTEIN P24;
205	1ak4-C	2.8	4.7	82	145	15	PDB	MOLECULE: CYCLOPHILIN A;
206	2pwm-H	2.8	5.4	81	145	15	PDB	MOLECULE: GAG-POL POLYPROTEIN;
207	4u0d-J	2.8	4.2	83	204	14	PDB	MOLECULE: GAG POLYPROTEIN;
:								
208	1m9x-G	2.8	4.7	83	146	14	PDB	MOLECULE: CYCLOPHILIN A;
209	1e6j-P	2.8	3.1	78	209	15	PDB	MOLECULE: IMMUNOGLOBULIN;
210	4ph0-E	2.8	4.3	98	193	8	PDB	MOLECULE: BLV CAPSID;
:								
211	4hkc-A	2.8	12.1	69	229	9	PDB	MOLECULE: 14-3-3 PROTEIN ZETA/DELTA;
212	3axy-J	2.8	12.1	71	234	8	PDB	MOLECULE: PROTEIN HEADING DATE 3A;
213	2c74-B	2.8	12.3	70	234	10	PDB	MOLECULE: 14-3-3 PROTEIN ETA;
214	4o46-C	2.8	12.2	69	235	12	PDB	MOLECULE: 14-3-3 PROTEIN GAMMA;
215	3axy-D	2.8	12.1	71	235	8	PDB	MOLECULE: PROTEIN HEADING DATE 3A;
216	3ds1-A	2.8	2.7	57	81	5	PDB	MOLECULE: HIV-1 CAPSID PROTEIN;
:								
241	2pwm-D	2.7	5.4	82	145	13	PDB	MOLECULE: GAG-POL POLYPROTEIN;
242	4u0d-K	2.7	4.0	83	204	14	PDB	MOLECULE: GAG POLYPROTEIN;
:								
244	2kod-A	2.7	3.6	65	88	5	PDB	MOLECULE: HIV-1 CA C-TERMINAL DOMAIN;
:								
249	2v4x-A	2.6	3.4	68	131	9	PDB	MOLECULE: CAPSID PROTEIN P27;
:								
272	3j34-H	2.6	3.6	82	231	15	PDB	MOLECULE: CAPSID PROTEIN;
:								
274	2jy1-A	2.6	6.8	64	84	9	PDB	MOLECULE: CAPSID PROTEIN P24 (CA);
:								
363	3j34-d	2.4	3.9	83	231	13	PDB	MOLECULE: CAPSID PROTEIN;
:								
409	3j34-6	2.3	4.4	84	231	14	PDB	MOLECULE: CAPSID PROTEIN;
410	3j34-Z	2.3	4.3	84	231	13	PDB	MOLECULE: CAPSID PROTEIN;
:								
471	4e91-A	2.2	3.0	75	131	15	PDB	MOLECULE: GAG PROTEIN;
472	3j34-c	2.2	4.4	82	231	16	PDB	MOLECULE: CAPSID PROTEIN;
473	3j34-E	2.2	4.9	84	231	15	PDB	MOLECULE: CAPSID PROTEIN;
474	3j34-A	2.2	3.6	83	231	16	PDB	MOLECULE: CAPSID PROTEIN;
:								
548	1u7k-A	2.1	4.9	79	131	8	PDB	MOLECULE: GAG POLYPROTEIN;
549	4ph0-F	2.1	4.5	97	199	8	PDB	MOLECULE: BLV CAPSID;
550	3j34-i	2.1	4.9	81	231	16	PDB	MOLECULE: CAPSID PROTEIN;