S1 Table: Neutralization ID₅₀ titers are shown for IgG purified from sera tested against murine leukemia virus (MLV) for all four cows over the course of immunization. ID₅₀ values are shown as 1/dilution.

MLV											
ID ₅₀ (1/dilution)	Gro	up 1	Group 2								
Day	Cow-485	Cow-16157	Cow-488	Cow-491							
59	<35	<35	<35	<35							
65	<35	<35	<35	<35							
72	<35	<35	<35	<35							
80	<35	37	<35	<35							
85	<35	<35	<35	<35							
150	<35	303	<35	<35							
157	<35	70	<35	<35							
164	<35	49	<35	<35							
171	<35	50	<35	<35							
234	<35	175	<35	<35							
346	<35	<35	<35	<35							
352	<35	<35	<35	<35							
359	<35	<35	<35	<35							

Neutralization ID ₅₀ (1/dilution)							
35	150	300					

S2 Table: Neutralization ID₅₀ titers are shown for IgG purified from sera from Day 359 of all four cows. Geomean ID₅₀ values and percent breadth are shown at the bottom of the graph. ID₅₀ values are shown as 1/dilution.

ID ₅₀ (1/dil	ution)	Gro	oup1	Group2		
Virus	Clade	Cow-485	Cow-16157	Cow-488	Cow-491	
246F3	AC	<35	<35	297	<35	
25710	С	1521	76	15193	<35	
398F1	А	231	<35	234	118	
BJOX2000	BC	<35	<35	718	<35	
CE1176	С	68	72	672	<35	
CE0217	С	45	<35	437	<35	
CH119	BC	<35	<35	143	<35	
CNE55	AE	4258	228	11923	70	
CNE8	AE	581	131	4048	1094	
Tro.11	В	<35	74	59	47	
X1632	G	169	<35	461	46	
X2278	В	<35	<35	65	<35	
Geomear	n ID ₅₀	333 104		612	114	
% Brea	dth	58%	42%	100%	42%	

Neutralization ID ₅₀ (1/dilution)									
35	150	500	1000	5000					

S3 Table: Neutralization IC₅₀ (μ g/ml) and ID₅₀ (1/dilution) titers are shown for ID₅₀ (1/dilution) and IgG purified from sera from Day 359 for cow-485 and cow-488. Geomean IC₅₀ and ID₅₀ values are shown at the bottom of the graph.

Virus Strain	Clade	Bess1	Bess2	Bess4	ElsE1	ElsE2	Cow- 485	Cow- 488
6535.3	В	>50	>50	>50	>50	>50	<35	122
SC422661.8	В	>50	>50	>50	>50	>50	36	<35
PVO.4	В	>50	>50	>50	>50	>50	<35	<35
TRO.11	В	>50	>50	>50	>50	>50	<35	<35
AC10.0.29	В	>50	>50	>50	>50	>50	<35	<35
RHPA4259.7	В	>50	>50	>50	>50	>50	<35	<35
TRJO4551.58	В	>50	>50	>50	>50	>50	<35	<35
WITO4160.33	B	>50	>50	>50	>50	>50	<35	94
CAAN5342.A2	В	>50	>50	>50	>50	>50	<35	<35
WEAU d15 410 5017	B (T/F)	>50	>50	>50	>50	>50	<35	<35
1006 11 C3 1601	B (T/F)	>50	>50	>50	>50	>50	<35	<35
1056 10 TA11 1826	B (T/F)	>50	>50	>50	>50	>50	<35	43
1012 11 TC21 3257	B (T/F)	>50	>50	>50	>50	>50	<35	56
6240 08 TA5 4622	B (T/F)	>50	>50	>50	>50	>50	<35	<35
6244 13 B5 4576	B (T/F)	>50	>50	>50	>50	>50	<35	<35
62357 14 D3 4589	B (T/F)	>50	>50	>50	>50	>50	<35	<35
Du156.12	C	0.016	0.084	0.006	0.004	0.001	120	11126
ZM197M.PB7	С	>50	20	>50	36	0.607	<35	114
ZM214M.PL15	С	>50	>50	>50	>50	>50	318	<35
ZM233M.PB6	С	>50	5	0.508	0.119	0.100	95	264
ZM249M.PL1	С	0.014	0.029	0.015	0.450	0.032	92	318
ZM53M.PB12	С	>50	>50	0.014	10	0.049	98	280
ZM109F.PB4	С	>50	0.496	0.056	0.084	0.020	224	1485
ZM135M.PL10a	С	>50	>50	>50	>50	>50	<35	<35
CAP45.2.00.G3	С	0.001	0.002	0.0006	0.027	0.0006	2126	5804
CAP210.2.00.E8	С	>50	13	0.026	0.289	0.078	<35	154
HIV-0013095-2.11	С	>50	>50	0.023	0.043	0.007	38	6901
HIV-16055-2.3	С	0.001	0.014	0.0006	0.004	0.0006	1017	14435
Ce0393_C3	C (T/F)	>50	0.302	0.008	0.387	0.033	241	25670
Ce1176_A3	C (T/F)	>50	>50	0.049	8	0.004	68	672
Ce2010_F5	C (T/F)	>50	>50	>50	>50	>50	<35	<35
Ce0682_E4	C (T/F)	>50	>50	>50	>50	>50	<35	40
Ce1172_H1	C (T/F)	>50	>50	0.045	0.968	0.033	50	358
Ce2060_G9	C (T/F)	0.190	50	>50	>50	2	412	218
Ce703010054_2A2	C (T/F)	>50	>50	>50	>50	>50	<35	<35
246F C1G	C (T/F)	0.001	0.003	>50	>50	>50	<35	58
249M B10	C (T/F)	0.028	0.118	0.044	1	0.083	69	345
ZM247v1(Rev-)	C (T/F)	11	6	5	>50	>50	<35	39
7030102001E5(Rev-)	C (T/F)	>50	>50	>50	>50	>50	<35	<35
1394C9G1(Rev-)	C (T/F)	0.551	0.168	0.249	2	0.004	2034	1345
Ce704809221_1B3	C (T/F)	>50	>50	>50	>50	>50	<35	<35
CNE19	BC	>50	>50	>50	>50	0.147	72	932
CNE20 (CRF07_BC)	BC	>50	>50	0.319	>50	0.299	<35	135
CNE17	BC	0.517	0.517	0.016	0.085	0.017	140	851

CNE30	BC	>50	>50	>50	>50	>50	<3	5	<35
CNE52	BC	0.290	0.290	>50	0.937	0.020	<3	5	49
CNE53	BC	>50	>50	>50	>50	>50	<3	5	<3
CNE58	BC	0.458	1	0.087	4	0.044	49	94	90
MS208.A1	А	>50	>50	18	0.566	0.082	<3	5	58
Q23.17	А	1	0.163	0.006	36	2	48	8	<3
Q461.e2	А	0.025	0.172	0.075	1	0.105	<3	5	32
Q769.d22	А	>50	>50	0.001	1	0.078	11	2	27
Q259.d2.17	А	0.009	0.016	0.127	7	0.024	<3	5	60
0330.v4.c3	А	11	0.167	0.105	0.145	0.0006	<3	5	451
0260.v5.c36	А	>50	0.373	0.091	39	18	<3	5	<3
191955_A11	A (T/F)	0.005	0.007	0.374	1	0.001	17	73	78
T257-31	CRF02_AG	0.035	0.057	0.003	0.027	0.001	284	45	84
263-8	CRF02_AG	0.025	0.335	0.040	0.186	0.024	50	6	<3
T250-4	CRF02_AG	0.0006	0.002	0.067	0.005	0.006	675	56	104
T251-18	CRF02_AG	>50	>50	>50	>50	>50	<3	5	<3
T278-50	CRF02_AG	>50	>50	>50	14	1	<3	5	<3
T255-34	CRF02_AG	>50	>50	>50	>50	>50	<3	5	<3
211-9	CRF02_AG	>50	>50	>50	>50	>50	<3	5	<3
235-47	CRF02_AG	>50	>50	>50	24	3	<3	5	<3
620345.c01	CRF01_AE	0.080	0.055	0.001	0.087	0.006	16	0	223
C1080.c03	CRF01_AE	>50	5	0.014	0.0006	0.0006	150	10	1455
R2184.c04	CRF01_AE	0.062	0.654	0.007	0.481	0.024	16	8	54
R1166.c01	CRF01_AE	>50	>50	>50	>50	>50	39	3	15
R3265.c06	CRF01_AE	>50	1	0.014	0.096	0.016	67	'1	61
C3347.c11	CRF01_AE	12	0.545	>50	>50	>50	<3	5	<3
C4118.c09	CRF01_AE	0.005	0.021	0.0006	0.0006	0.0006	140	03	112
C4118.c09 CNE8	CRF01_AE CRF01_AE	0.005 0.386	0.021	0.0006	0.0006	0.0006	140 58	03 31	112 404
C4118.c09 CNE8 CNE5	CRF01_AE CRF01_AE CRF01_AE	0.005 0.386 0.001	0.021 0.057 0.010	0.0006 0.263 0.184	0.0006 0.029 0.027	0.0006 0.005 0.0006	140 58 230	03 1 00	112 404 528
C4118.c09 CNE8 CNE5 BJOX009000.02.4	CRF01_AE CRF01_AE CRF01_AE CRF01_AE	0.005 0.386 0.001 >50	0.021 0.057 0.010 >50	0.0006 0.263 0.184 >50	0.0006 0.029 0.027 >50	0.0006 0.005 0.0006 >50	14(58 23(<3	03 1 00 55	112 404 528 58
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F)	0.005 0.386 0.001 >50 >50	0.021 0.057 0.010 >50 >50	0.0006 0.263 0.184 >50 >50	0.0006 0.029 0.027 >50 >50	0.0006 0.005 0.0006 >50 >50	14(58 23(<3 29	03 1 00 5 3 3	112 404 528 58 63
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F)	0.005 0.386 0.001 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50	0.0006 0.263 0.184 >50 >50 >50	0.0006 0.029 0.027 >50 >50 >50	0.0006 0.005 0.0006 >50 >50 >50	140 58 230 <3 29 <3	03 1 00 5 3 5 5	112 404 528 58 63 <3
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F)	0.005 0.386 0.001 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50	0.0006 0.263 0.184 >50 >50 >50 2	0.0006 0.029 0.027 >50 >50 >50 >50	0.0006 0.005 >50 >50 >50 >50 >50	14(58 23(3 29 <3 26	03 03 00 03 05 03 03 03 04 04	112 404 528 58 63 <3 50
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50	0.0006 0.263 0.184 >50 >50 >50 2 >50 2	0.0006 0.029 0.027 >50 >50 >50 >50 >50	0.0006 0.005 >50 >50 >50 >50 >50 >50	14(58 23(<3 29 <3 29 <3 26 <3	03 1 00 05 03 05 05 05 05 05 05 05 05 05 05	112 404 528 58 63 <3 53 <3
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50	0.0006 0.263 0.184 >50 >50 >50 2 >50 2 >50 16	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 >50	0.0006 0.005 >50 >50 >50 >50 >50 >50 26	140 58 230 <3 29 <3 29 <3 26 <3 <3	03 1 00 35 35 35 35 36 35 36 37	112 404 528 63 <3 53 <3 10
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50	0.0006 0.263 0.184 >50 >50 2 >50 2 >50 16 >50	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 >50	0.0006 0.005 >50 >50 >50 >50 >50 >50 26 >50	144 58 230 <3 29 <3 20 <3 26 <3 <3 <3	03 11 00 35 35 35 35 35 35 35 35 35	112 404 528 63 <3 55 <3 10 <3
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 >50 >5	0.0006 0.263 0.184 >50 >50 2 >50 2 >50 16 >50 0.017	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 >50 >50 >50	0.0006 0.005 >50 >50 >50 >50 >50 26 >50 26 >50	14(58 23) <3 29 <3 26 <3 26 <3 3 3 45	03 1 00 35 35 35 35 35 35 35 35 35 35 36	112 404 528 63 <3 53 <3 10 <3 212
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 >50 >5	0.0006 0.263 0.184 >50 >50 2 >50 2 >50 16 >50 0.017 >50	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 >50 0.087 >50	0.0006 0.005 >50 >50 >50 >50 >50 26 >50 26 >50 0.022 >50	140 58 230 <3 29 <3 26 <3 3 3 3 45 <3	03 1 00 35	112 404 528 58 63 <33 <33 53 <33 10 <33 212 <3
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 >50 >5	0.0006 0.263 0.184 >50 >50 2 >50 2 >50 16 >50 0.017 >50 0.031	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 >50 0.087 >50 0.112	0.0006 0.005 >50 >50 >50 >50 >50 26 >50 26 >50 0.022 >50 0.007	144 58 230 <3 29 <3 26 <3 26 <3 3 <3 45 <3 74	03 1 00 35 36 37 38 39 39 30 31 32 33 34 35 35 36 37 38 39 39 30 31 32 33 34 35 35 36 36 37 38 39 39 39 39 39 39 39 30 31 32 33 34 35	112 404 528 58 60 <33 50 <33 100 <33 211 <33 211 23 194
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3 X1632_S2_B10	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G G	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 >50 3 3 >50	0.0006 0.263 0.184 >50 >50 2 >50 2 >50 16 >50 0.017 >50 0.031 >50 0.031	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 0.087 >50 0.112 0.231	0.0006 0.005 0.0006 >50 >50 >50 >50 26 >50 0.022 >50 0.007 0.024	144 58 230 <3 29 <3 26 <3 26 <3 3 3 45 <3 74 5 3 74 16	D3 11 00 35 36 37 38 39 39 30 30 31 32 33 34 35 35 36 37 38 39 30 31 32 33 34 35 35 36 37 38 39 39 30 31 32 33 34 35 35 36 <td>112 404 528 633 53 53 53 53 53 53 53 53 53 53 53 212 23 212 53 104 46</td>	112 404 528 633 53 53 53 53 53 53 53 53 53 53 53 212 23 212 53 104 46
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3 X1632_S2_B10 3016.v5.c45	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G G G G G	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 >50 >5	0.0006 0.263 0.184 >50 >50 2 >50 2 >50 16 >50 0.017 >50 0.031 >50 >50 >50	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 0.087 >50 0.112 0.231 37	0.0006 0.005 0.0006 >50 >50 >50 >50 26 >50 0.022 >50 0.007 0.024 0.384	144 58 230 <3 29 <3 26 <3 26 <3 3 3 3 45 <3 74 16 <3	D3 1 00 35 36 37 38 39 35 36 37 38 39 30 30 31 32 33 34 35 35 36 37 38 39 39 30 31 32 35 35 36 37 38 39 39	112 404 528 555 63 <33 53 <33 100 <33 212 <33 194 466 355
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3 X1632_S2_B10 3016.v5.c45 A07412M1.vrc12	CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G G G G G D D D	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 >50 >5	0.0006 0.263 0.184 >50 >50 2 >50 2 >50 16 >50 0.017 >50 0.031 >50 >50 50	0.0006 0.029 >50 >50 >50 >50 >50 >50 >50 >50 >50 0.087 >50 0.112 0.231 37 3	0.0006 0.005 >50 >50 >50 >50 >50 26 >50 0.022 >50 0.007 0.024 0.384 0.237	144 58 230 <3 29 <3 20 <3 20 <3 20 <3 3 45 <3 45 <3 76 16 <3 45	03 11 00 15 15 15 15 15 15 15 15 15 15 15 16 17	112 404 528 58 63 33 55 33 10 32 112 33 104 46 33 26
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3 X1632_S2_B10 3016.v5.c45 A07412M1.vrc12 231965.c01	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G G G G D D D	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 3 >50 3 >50 26 0.993 >50	0.0006 0.263 0.184 >50 >50 2 >50 16 >50 0.017 >50 0.031 >50 50 50 50 0.040	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 >50 0.087 >50 0.112 0.231 37 3 >50	0.0006 0.005 >50 >50 >50 >50 >50 26 >50 0.022 >50 0.022 >50 0.024 0.384 0.237 0.088	144 58 230 <3 29 <3 20 <3 20 <3 20 <3 3 3 3 45 <3 74 16 <3 74 16 <3 74 5	D3 11 00 35	112 404 528 58 60 33 55 33 55 33 100 33 211 46 33 211 23 211 23 211 23 211 23 211 23 211 24 21 24 26 26 26 21 21 21 21 21 21 21 21 21 21 21 21 21
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3 X1632_S2_B10 3016.v5.c45 A07412M1.vrc12 231965.c01 231966.c02	CRF01_AE CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G G G G D D D D	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 >50 3 >50 26 0.993 >50 26	0.0006 0.263 0.184 >50 >50 2 >50 16 >50 0.017 >50 0.031 >50 0.031 >50 50 50 0.040 >50	0.0006 0.029 0.027 >50 >50 >50 >50 >50 0.087 >50 0.112 0.231 37 3 >50 >50 0.50	0.0006 0.005 0.0006 >50 >50 >50 26 >50 0.022 >50 0.007 0.024 0.384 0.237 0.088 >50	144 58 230 <3 29 <3 26 <3 26 <3 3 26 <3 3 45 <3 74 16 <3 74 16 <3 74 5 3 74 5 3 74 5 3 74 5 3 74 5 3 74 5 3 3 74 5 3 3 74 5 3 3 3 4 5 3 3 5 3 5 3 5 3 5 3 5 3 5	D3 11 00 35	112 404 528 556 33 555 33 100 33 211 33 211 33 211 23 266 32 266 322 100
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3 X1632_S2_B10 3016.v5.c45 A07412M1.vrc12 231965.c01 231966.c02 3817.v2.c59	CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G G G G D D D D D D D D CD	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 >50 >5	0.0006 0.263 0.184 >50 >50 2 >50 16 >50 0.017 >50 0.031 >50 >50 50 0.031 >50 0.031 >50 0.031 >50 0.031 2 50 0.031 2 50 0.031 2 50 0.031 2 50 0.031 2 50 0.031 2 50 0.031 2 50 0.031 2 50 0.031 2 50 0.031 2 50 0.031 2 50 0.031 0 50 0 0.031 0 50 0 0 0 0 0 0 0 0 0 0 0 0 0	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 0.087 >50 0.112 0.231 37 3 3 >50 >50 >50 0.401	0.0006 0.005 0.0006 >50 >50 >50 26 >50 0.022 >50 0.007 0.024 0.384 0.237 0.088 >50 0.006	144 58 230 <3 29 <3 20 <3 20 <3 20 <3 3 <3 45 <3 76 16 <3 47 47 47 3 3 47 19	D3 11 00 15 13 15 13 15 15 15 15 15 16 17	112 40 52 51 6 3 3 5 3 3 5 3 3 10 4 3 4 6 3 2 11 4 6 3 2 11 2 6 3 2 11 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3 X1632_S2_B10 3016.v5.c45 A07412M1.vrc12 231965.c01 231966.c02 3817.v2.c59 6480.v4.c25	CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G G G G D D D D D D D CD CD	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50 >50 0.119 11 >50 0.582 >50 0.582 >50 >50 0.034 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 3 >50 26 0.993 >50 26 0.993 >50 26 0.993	0.0006 0.263 0.184 >50 >50 2 >50 2 >50 16 >50 0.017 >50 0.031 >50 50 50 0.040 >50 0.040 >50 0.018 >50	0.0006 0.029 0.027 >50 >50 >50 >50 >50 >50 0.087 >50 0.112 0.231 37 3 3 >50 50 >50 0.401 >50	0.0006 0.005 0.0006 >50 >50 >50 26 >50 0.022 >50 0.007 0.024 0.384 0.237 0.088 >50 0.0006 >50	144 58 230 <3 29 <3 26 <3 26 <3 3 45 <3 45 <3 76 16 <3 44 <3 44 <3 19 <3	D3 11 D0 15 15 15 15 15 15 15 16 17 17	112 404 528 55 63 55 33 100 33 211 33 194 46 33 26 32 100 725 33
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3 X1632_S2_B10 3016.v5.c45 A07412M1.vrc12 231965.c01 231966.c02 3817.v2.c59 6480.v4.c25 6952.v1.c20	CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G G G G G D D D D D D D D CD CD CD	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 3 >50 3 >50 26 0.993 >50 26 0.993 >50 26 0.993 >50 250 >50 2 50 2 50	0.0006 0.263 0.184 >50 >50 2 >50 16 >50 0.017 >50 0.017 >50 0.031 >50 0.031 >50 0.031 >50 0.040 >50 0.040 >50 0.018	0.0006 0.029 0.027 >50 >50 >50 >50 >50 0.087 >50 0.112 0.231 37 3 3 >50 >50 0.401 >50 0.401	0.0006 0.005 0.0006 >50 >50 >50 26 >50 0.022 >50 0.007 0.024 0.384 0.237 0.088 >50 0.006 >50	144 58 230 <3 29 <3 20 <3 20 <3 20 <3 3 45 <3 70 10 <3 44 <3 3 41 <3 3 42 3 3 45 3 70 10 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 3 45 3 3 3 45 3 3 3 45 3 3 45 3 3 3 45 3 3 45 3 3 45 3 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 45 45 45 45 45 45 45 45 45 45 45 45	D3 0 11 0 15 1 13 1 13 1 13 1 13 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1	112 404 528 56 6 33 55 33 100 33 211 33 211 33 211 33 211 33 211 33 211 33 211 33 211 33 211 33 33 211 33 33 31 94 466 33 33 31 94 466 33 31 31 31 31 31 31 31 31 31 31 31 31
C4118.c09 CNE8 CNE5 BJOX009000.02.4 BJOX015000.11.5 BJOX010000.06.2 BJOX025000.01.1 X1193_C1 P0402_C2_11 X1254_C3 X2088_C9 X2131_C1_B5 P1981_C5_3 X1632_S2_B10 3016.v5.c45 A07412M1.vrc12 231965.c01 231966.c02 3817.v2.c59 6480.v4.c25 6952.v1.c20 6811.v7.c18	CRF01_AE CRF01_AE CRF01_AE CRF01_AE (T/F) CRF01_AE (T/F) CRF01_AE (T/F) G G G G G G G G G G D D D D D D D D D	0.005 0.386 0.001 >50 >50 >50 >50 >50 >50 >50 >50	0.021 0.057 0.010 >50 >50 >50 >50 >50 >50 >50 >50 >50 3 >50 26 0.993 >50 26 0.993 >50 26 0.993 >50 250 >50 250 250 250 250 250 250 250	0.0006 0.263 0.184 >50 >50 2 >50 2 2 >50 0.017 >50 0.031 >50 0.031 >50 0.031 >50 0.031 >50 0.031 >50 0.031 >50 0.031 >50 0.031 >50 50 0.031 >50 >50 0.031 >50 >50 >50 >50 >50 >50 >50 >50	0.0006 0.029 0.027 >50 >50 >50 >50 >50 0.087 >50 0.112 0.231 37 3 37 3 3 >50 >50 0.401 >50 >50 >50 >50	0.0006 0.005 0.0006 >50 >50 >50 26 >50 0.022 >50 0.007 0.024 0.384 0.237 0.088 >50 0.006 >50 >50 0.0006 >50	144 58 230 <3 29 <3 20 <3 20 <3 3 45 <3 45 <3 76 16 <3 44 <3 3 41 9 3 41 9 3 3 42 5 3 3 45 5 3 3 45 5 3 45 5 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 3 45 45 45 45 45 45 45 45 45 45 45 45 45	D3 0 11 0 15 0 15 0 15 0 15 0 15 0 15 0 15 0 16 0 17 0 15 0 17 0 15 0 15 0 16 0 17 0 15 0 16 0 17 0 15 0 16 0 17 0	112 404 523 53 63 53 53 53 73 73 73 73 73 73 73 73 72 72 73 73 73 73 73 73 73 73 73 73 73 73 73

3301.v1.c24	AC	0.245	>50	0.269	8	0.454		<35	45
6041.v3.c23	AC	0.018	0.086	>50	>50	>50		<35	<35
6545.v4.c1	AC	0.014	0.065	0.003	0.005	0.001		35	4006
0815.v3.c3	ACD	>50	>50	>50	>50	>50		<35	<35
3103.v3.c10	ACD	>50	>50	>50	>50	>50		<35	<35
	Geomean IC ₅₀	0.061	0.238	0.047	0.352	0.031	Geomean ID ₅₀	276	557

Neutralization IC ₅₀ (µg/ml)									
50	1	0.5	0.05	0.005					

Neutralization ID ₅₀ (1/Dilution)									
35	150	500	1000	5000					

Sort S	Stats and S	Summary of Screening	Sort 1	Sort 2	Sort 3	Sort 4	Short CDRH3 (0-24 AA)	Ultralong CDRH3 (50+ AA)	
		Cells Sorted	108	453	559	438	NA	NA	NA
	All	PCR Wells Positive for Heavy Chains	34	75	169	52	NA	NA	NA
		Heavy Chain Sequences Recovered	13	43	47	49	42	72	38
10		Tested IGHV-1*7 Heavy Chains	10	40	30	NT	0	52	28
186	Universal	Expressed in Screen	9	22	25	NT	0	32	24
N N	Chain	Positive for BG505 Binding	8	13	12	NT	0	14	19
O C		Monoclonals with Cross- Clade Neutralization	1	1	4	2	0	0	8
		Heavy Chain/Light Chain Pairs	12	32	41	49	41	63	30
	Native	Expressed in Screen	9	24	34	45	34	53	25
	Chain	Positive for BG505 Binding	7	12	12	20	13	22	16
		Monoclonals with Cross- Clade Neutralization	1	0	3	2	0	0	6
		Cells Sorted	33	342	636	283	NA	NA	NA
	All	PCR Wells Positive for Heavy Chains	6	13	58	54	NA	NA	NA
		Heavy Chain Sequences Recovered	1	6	17	49	34	4	35
8		IGHV-1*7 Heavy Chains	0	2	1	NT	1	2	0
48	Universal	Expressed in Screen	0	2	0	NT	0	2	0
N N N	Chain	Positive for BG505 Binding	0	2	0	NT	0	2	0
Ŭ		Monoclonals with Cross- Clade Neutralization	0	0	0	11	0	0	0
	Native	Heavy Chain/Light Chain Pairs	1	5	16	49	33	3	35
	Light	Expressed in Screen	1	5	10	44	25	3	32
	Chains	Positive for BG505 Binding	0	3	3	33	8	3	28

S4 Table: Table of recovered heavy chains tested with native and universal light chains.

S5 Table: ElsE and Bess antibodies were tested for their ability to neutralize the 12-virus global panel. IC_{50} (µg/ml), IC_{80} (µg/ml), and MPN (%) are shown for all antibodies whose IC_{50} reach at least 50% neutralization. MPN= Maximum Percent Neutralized.

		А	В	В	С	С	С	G	AC	AE	AE	BC	BC
Bess1	IC ₅₀ (µg/ml)	>50	>50	>50	<.005	>50	>50	11	0.054	<.005	0.386	0.066	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.013	>50	>50	>50	0.215	<.005	2	0.315	>50
	MPN	<50	<50	<50	100%	<50	<50	58%	94%	100%	90%	94%	<50
Bess2	IC ₅₀ (µg/ml)	>50	>50	>50	0.014	0.355	>50	>50	0.03	<.005	0.057	0.232	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.057	1	>50	>50	0.121	0.019	0.229	0.928	>50
	MPN	<50	<50	<50	99%	88%	<50	<50	99%	100%	99%	98%	<50
Bess3	IC ₅₀ (µg/ml)	>50	>50	>50	0.067	>50	>50	6	0.063	0.042	0.603	0.067	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.268	>50	>50	>50	0.250	0.170	2	0.270	>50
	MPN	<50	<50	<50	100%	<50	<50	62%	99%	100%	97%	99%	<50
Bess4	IC ₅₀ (µg/ml)	>50	>50	>50	0.064	0.127	0.049	>50	0.245	0.015	0.263	0.025	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.258	0.509	0.195	>50	0.982	0.061	1	0.098	>50
	MPN	<50	<50	<50	98%	95%	93%	<50	92%	100%	100%	99%	<50
Bess5	IC ₅₀ (µg/ml)	>50	>50	>50	>50	24	13	>50	>50	0.02	0.093	14	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	>50	>50	>50	>50	>50	0.079	1	>50	>50
	MPN	<50	<50	<50	<50	50%	56%	<50	<50	97%	91%	62%	<50
Bess6	IC ₅₀ (µg/ml)	>50	>50	49	41	>50	17	>50	>50	>50	>50	>50	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	>50	>50	34	>50	>50	>50	>50	>50	>50
	MPN	<50	<50	52%	58%	<50	87%	<50	<50	<50	<50	<50	<50
Bess7	IC ₅₀ (µg/ml)	>50	>50	>50	0.477	>50	>50	>50	>50	<.005	>50	31	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	<50	>50	>50	>50	>50	0.02	>50	<50	>50
	MPN	<50	<50	<50	80%	<50	<50	<50	<50	98%	<50	50%	<50
Bess8	IC ₅₀ (µg/ml)	>50	>50	>50	0.009	>50	>50	>50	2	0.007	9	0.21	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.525	>50	>50	>50	7	0.029	>50	0.839	>50
	MPN	<50	<50	<50	97%	<50	<50	<50	72%	97%	59%	84%	<50
ElsE1	IC ₅₀ (µg/ml)	>50	>50	>50	<.005	2	8	0.231	0.058	<.005	0.029	0.033	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.019	>50	>50	0.924	0.233	0.019	0.116	0.133	>50
	MPN	<50	<50	<50	99%	74%	66%	81%	88%	99%	100%	100%	<50
ElsE2	IC₅₀ (µg/ml)	>50	>50	>50	0.006	0.009	<.005	0.024	0.007	<.005	0.005	0.023	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.023	0.037	0.018	0.096	0.027	0.014	0.022	0.091	>50
	MPN	<50	<50	<50	100%	94%	94%	84%	96%	99%	100%	100%	<50
ElsE3	IC ₅₀ (µg/ml)	>50	>50	>50	<.005	0.009	0.062	0.161	0.153	0.007	0.009	0.026	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.015	0.035	0.249	0.643	0.611	0.027	0.034	0.103	>50
	MPN	<50	<50	<50	100%	97%	92%	84%	90%	98%	100%	100%	<50
ElsE4	IC₅₀ (µg/ml)	>50	>50	>50	0.016	23	>50	1	2	<.005	0.011	0.035	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.062	>50	>50	>50	>50	0.012	0.042	0.139	>50
	MPN	<50	<50	<50	98%	54%	<50	74%	78%	98%	100%	100%	<50
ElsE5	IC₅₀ (µg/ml)	>50	>50	>50	800.0	26	>50	3	3	0.008	0.011	0.031	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.032	>50	>50	>50	>50	0.031	0.044	0.123	>50
	MPN	<50	<50	<50	99%	52%	<50	68%	74%	98%	100%	99%	<50
ElsE6	IC ₅₀ (µg/ml)	>50	>50	>50	0.06	>50	>50	5	>50	0.033	0.023	0.013	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.238	>50	>50	>50	>50	0.13	0.093	0.051	>50
	MPN	<50	<50	<50	91%	<50	<50	68%	<50	95%	99%	99	<50
ElsE7	IC ₅₀ (µg/ml)	>50	>50	>50	0.007	0.77	5	0.022	2	<.005	0.007	0.019	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.028	3	>50	0.087	>50	0.019	0.026	0.076	>50
	MPN	<50	<50	<50	99%	80%	68%	91%	78%	99%	99%	100%	<50
ElsE8	IC₅₀ (µg/ml)	>50	>50	>50	0.023	3	10	0.654	0.056	0.024	0.023	0.067	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.094	>50	>50	>50	0.223	0.096	0.092	0.267	>50
	MPN	<50	<50	<50	99%	71%	60%	74%	90%	97%	99%	100%	<50
ElsE9	IC₅₀ (µg/ml)	>50	>50	>50	0.017	0.723	3	0.067	0.047	0.006	0.019	0.043	>50
	IC ₈₀ (µg/ml)	>50	>50	>50	0.067	>50	>50	0.269	0.188	0.022	0.077	0.172	>50
		<0U	<0U	<5U	99%	- 75% >E0	09%	81% 14	92% >E0	99%		0.002	<0U
ElsE10	$ C_{s0}(\mu g/ml) $	>50 >50	>50 >50	~50 >50	0.025	>50 >50	>50	>50	>50 >50	0.12	0.063	0.372	>50 >50
	MPN	<50	<50	<50	93%	<50	60%	62%	<50	96%	98%	93 <u>%</u>	<50
	IC ₅₀ (µq/ml)	>50	>50	>50	0.033	>50	>50	0.772	>50	0.016	0.031	0.027	>50
ElsE11	IC ₈₀ (µg/ml)	>50	>50	>50	0.134	>50	>50	>50	>50	0.064	0.161	0.283	>50
	MPN	<50	<50	<50	93%	<50	<50	72%	<50	96%	98%	99%	<50

398F1 TRO.11 X2278 25710 CE0217 Ce1176 X1632 246F3 CNE55 CNE8 BJOX CH119

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	Fab ElsE1	Fab ElsE2	Fab ElsE5	Fab ElsE6	Fab ElsE7	Fab ElsE8	Fab ElsE9	Fab ElsE11	Fab Bess4	Fab Bess7	
PDB code	8V4I	8VBJ	8VBK	8VBL	8VBM	8VBN	8VBO	8VBR	8VBP	8VBQ	
Crystallization condition	40% ethylene glycol, 0.1M HEPES, pH 7.5, 5% Peg3000, 20°	0.1M Tris, pH 8.5, 1.5M ammonium sulfate, 12% glycerol, 4°	0.1M sodium cacodylate, pH 6.5, 40% MPD, 5% Peg8000, 20°	0.1M Ches, pH 9.5, 50% Peg200, 20°	0.1M Ches, pH 9.5, 20% Peg 8000, 4°	20% Peg3350, 0.2M KCI, 4°	0.1M sodium cacodylate, pH 6.5, 40% MPD, 5% Peg 8000, 20°	0.1M Ches, pH 9.5, 50% Peg200, 4°	70% MPD, 0.1M Hepes, pH 7.5, 20°	0.095M sodium citrate, pH 5.6, 19% 2- propanol, 5% glycerol, 19% Peg4000, 20°	
Wavelength	0.97946	0.97946	1.03317	0.97946	0.97946	0.97741	0.97946	0.97741	0.97946	0.97741	
Beamline	SSRL 12-1	SSRL 12-2	APS 23-ID-B	SSRL 12-2	SSRL 12-2	ALS 5.0.1	SSRL 12-1	ALS 5.0.1	SSRL 12-1	ALS 5.0.1	
Resolution range	37.89 - 1.81 (1.88 - 1.81)	45.48 - 1.90 (1.97 - 1.90)	43.86 - 1.89 (1.96 - 1.89)	46.80 - 2.35 (2.43 - 2.35)	42.23 - 2.54 (2.63 - 2.54)	46.95 - 1.83 (1.90 - 1.83)	36.30 - 2.30 (2.38 - 2.30)	49.58 - 2.65 (2.75 - 2.65)	29.94 - 2.80 (2.90 - 2.80)	48.29 - 2.10 (2.18 - 2.10)	
Space group/twin law	C 2 2 2 ₁	C 2 2 21	P 212121	P 21 21 2	P 21 21 21	P 21 21 21	P 21 21 2	P 2 ₁ 2 ₁ 2 ₁ I,h,-k	P 21 21 21	C 2	
Unit cell (Å,°)	69.79, 84.12, 174.58, 90, 90, 90	69.96, 178.59, 105.71, 90, 90, 90	56.26, 70.02, 109.08, 90, 90, 90	117.59, 69.98, 77.32, 90, 90, 90	58.22, 70.61, 123.97, 90, 90, 90	59.22, 120.27, 150.30, 90, 90, 90	70.11, 150.89, 51.32, 90, 90, 90	70.05, 70.19, 241.83, 90, 90, 90	66.61, 70.28, 111.46, 90, 90, 90	83.00, 69.78, 87.52, 90, 103.52, 90	
Total reflections	460,645 (32,773)	442,490 (44,977)	423,944 (39,845)	168,777 (17,085)	76,645 (6407)	1,219,769 (90,327)	81,165 (7982)	378,268 (10,647)	44,117 (4130)	98,588 (7823)	
Unique reflections	45,028 (3292)	51,939 (5160)	34,653 (3286)	27,185 (2649)	16,971 (1511)	95,768 (9306)	24,379 (2325)	33,457 (1618)	12,710 (1143)	28,113 (2607)	
Multiplicity	10.2 (10.0)	8.5 (8.7)	12.2 (12.1)	6.2 (6.4)	4.5 (4.2)	12.8 (9.8)	3.3 (3.4)	11.3 (6.6)	3.5 (3.3)	3.5 (3.0)	
Completeness (%)	95.6 (70.1)	98.8 (99.2)	98.7 (94.9)	99.7 (98.8)	96.8 (84.6)	99.8 (98.2)	97.8 (95.3)	94.0 (63.9)	93.8 (87.2)	98.8 (92.4)	
Mean I/sigma(I)	10.5 (0.9)	8.4 (1.4)	13.8 (2.4)	9.1 (2.4)	7.5 (1.5)	15.9 (1.3)	9.3 (2.5)	11.3 (6.6)	7.0 (3.0)	8.7 (1.2)	
Wilson B-factor	34	23	27	34	44	26	44	51	38	32	
R-merge (%)	15.5 (251)	22.4 (224)	11.8 (109)	19.8 (140)	16.4 (135)	11.6 (173)	9.2 (77.8)	9.0 (84.8)	19.1 (80.5)	15.2 (107)	
R-meas (%)	16.2 (264)	23.8 (238)	12.3 (114)	21.7 (152)	18.6 (155)	12.0 (183) 10.8 (90.9)		9.4 (91.4)	22.4 (95.9)	17.9 (128)	
R-pim (%)	4.6 (77.2)	7.9 (77.6)	3.5 (32.3)	8.6 (59.4)	8.6 (74.2)	3.3 (57.5)	5.6 (46.2)	2.7 (32.0)	11.5 (51.0)	9.3 (70.3)	
CC1/2 (%)	99.6 (41.0)	99.5 (41.3)	99.8 (86.7)	99.3 (49.7)	99.0 (40.0)	99.9 (50.8)	99.5 (61.1)	99.0 (77.4)	97.3 (49.8)	99.2 (37.6)	
Reflections used in refinement	44,983 (3264)	51,917 (5148)	34,637 (3277)	27,183 (2649)	16,886 (1437)	95,655 (9237)	24,379 (2325)	33,316 (2271)	12,577 (1141)	28,099 (2601)	
Reflections used for R-free	2273 (190)	2580 (266)	1773 (159)	1331 (141)	783 (77)	1970 (191)	1175 (117)	1993 (138)	620 (62)	1348 (114)	
R-work (%)	22.1 (41.1)	19.5 (35.0)	20.4 (33.9)	19.7 (27.7)	23.5 (37.8)	22.4 (37.5)	24.8 (34.1)	24.7 (49.7)	19.6 (26.2)	23.0 (32.5)	
R-free (%)	25.7 (55.6)	22.9 (37.2)	24.5 (39.3)	24.4 (34.5)	29.0 (46.8)	25.8 (39.6)	28.0 (38.9)	26.0 (56.4)	23.2 (30.9)	26.7 (30.7)	
Number of non- hydrogen atoms	3750	3889	3707	3593	3463	7146	3535	7026	3257	3715	
macromolecules	3563	3555	3496	3477	3463	6755	3465	7026	3257	3569	
solvent	191	334	211	116	0	681	70	0	0	142	
Protein residues	479	477	473	475	472	915	469	956	441	486	
RMS(bonds)	0.003	0.013	0.003	0.002	0.002	0.008	0.002	0.003	0.003	0.003	

RMS(angles)	0.66	1.05	0.64	0.56	0.51	0.98	0.53	0.56	0.58	0.56
Ramachandran favored, allowed, outliers (%)	ndran Ilowed, 94.3, 5.3, 0.4 97.5, 2.5, 0.0 96.8, 3.2, 0.0 96.2, 3.4, 0.4 94.6, 4 (%)		94.6, 4.7, 0.6	96.56, 3.33, 0.11	94.58, 4.34, 1.08	95.25, 4.11, 0.63	95.17, 4.37, 0.46	95.23, 4.77, 0.00		
Rotamer outliers (%)	1.94	2.18	0.99	1.23	1.75	1.79	1.76	1.84	1.58	0.73
Clashscore	3.3	1.9	1.3	3.2	4.6	2.4	3.7	2.9	2.2	1.7
Average B-factor	45	31	35	43	65	35	63	59	36	47
macromolecules	45	31	35	43	65	35	63	59	36	48
solvent	44	35	36	41	NA	37	72	NA	NA	37

Statistics for the highest-resolution shell are shown in parentheses.

S7 Table: Secondary structural elements in stalk/knob regions. #=residue number, AA=residue type, and SS=secondary structure type. DSSP was used to assign the secondary structure type for residues in stalk/knob regions from the crystal structures [86]. SS are designated as: α -helix: H, 3₁₀ helix :G, extended strand: E, bend: S, hydrogen bonded turn: T. Blank fields have 'coil' secondary structure. Blank AA fields indicate unmodeled residues. Residues at the tips of the two knob 'loops' (114-118 and 127 -133 in the EIsE Fabs and 114-120 and 132-137 in Bess7) are highlighted in bold; these might be expected to interact with Env.

Bess7		ss7	ElsE1		ElsE2		ElsE5		ElsE6		ElsE7		ElsE8		ElsE9		ElsE11_1		ElsE11_2	
#	AA	SS	AA	SS	AA	SS	AA	SS	AA	SS	AA	SS	AA	SS	AA	SS	AA	SS	AA	SS
92	С		С		С		С		С		С		С		С		С		С	
93	Т		Т		Т		Т		Т		Т		Т		Т		Т		Т	
94	Т	Е	Т	Е	Т	Е	Т	Е	Т	Е	Т	Е	Α	Е	Т		Т	E	Т	
95	V	Е	V	Е	V	Е	V	Е	V	Е	V	Е	V	Е	V	Е	V	E	V	E
96	Н	Е	Н	Е	Н	Е	Н	Е	н	Е	Н	Е	V	Е	R	Е	R	E	R	E
97	Q	Е	Q	Е	Q	Е	Q	Е	Q	Е	Q	Е	Q	Е	Q	Е	Q	E	Q	E
98	Т	Е	Q	Е	Q	Е	Q	Е	Q	Е	Q	Е	Е	Е	Q	Е	Q	E	Q	E
99	Т	Е	Т	Е	Т	Е	Т	Е	Т	Е	Т	Е	Т	Е	V	Е	Т	E	Т	E
100	К	Е	R	Е	R	Е	R	Е	R	Е	R	Е	R	Е	Н	Е	R	E	R	Е
101	Т		K	Е	К	Е	K	Е	К	Е	K	Е	К	Е	K	Е	К	E	К	E
102	Т		G	Е	S	Е	G	Е	S	Е	S	Е	S	Е	Т	Е	S	E	S	E
103	К	Е	С		С		С		С		С		С		С		С		С	
104	Е	Е	Р		Р		Р		Р		Р		Р		Р		Р		Р	
105	С		D	Т	G	Т	D	S	Α	S	D	S	D	Т	Q	S	D	Т	D	Т
106	Ρ		G	Т	G	Т	G	S	G	S	G	S	G	Т	G	S	G	Т	G	Т
107	Е	Т	W		Y		W		Y		W		W		W		W		W	
108	G	Т	R	E	Т	E	S	E	Т	E	М	Е	R	E	R	E	Т	E	Т	E
109	Y		F	Е	F	Е	F	Е	L	Е	F	Е	F	Е	F	E	L	E	L	E
110	Ν	E	G	Н	G	G	G	Т	Α	Т	G	S	G	Т	G	Н	A	Н	A	Н
111	W	E	W	Н	Y	G	W	Т	К	Т	F	Т	W	Т	W	Н	К	Н	К	Н
112	D		D	Н	D	G	D	Т	D	Т	D	Т	D	Т	D	Н	D	Н	D	Н
113	D	S	С	Н	С	G	С	Т	С	Т	С		С	Т	С	Н	С	Н	С	Н
114	G		G	Т	G	т	G	Т	G				G	Т	G	Т	G	Т	G	Т
115	С		F		F		F						F		F		F		F	
116	G		Н		н								Н		Н		Y		Y	
117	S	G	G	S	G	S							G	S	G	S	G	S	G	S
118	Е	G	Y	Т	w	т							Y	Т	Y	Т	Y	Т	Y	Т
119	L	G	G	Т	G	Т			G		G		G	Т	G	Т	G	Т	G	Т
120	G		Q	Т	S	Т	!		S	Т	S		Т	Т	S	Т	S	Т	S	Т
121	С		Е	Т	D	Т	Е		Е	Т	Е	S	Е	Т	D	Т	Е	Т	E	Т
122	G	S	D	S	D	S	D		D	S	D	S	D	S	D	S	D		D	S
123	G	S	С	Е	С	Е	С	Е	С	Е	С	Е	С	Е	С	Е	С	Е	С	E
124	А	S	Y	E	Y	Е	Y	E	Y	Е	V	Е	Y	Е	Y	Е	Y	Е	Y	E
125	D	S	Е	S	Р	S	D	S	D	S	D	S	Е	S	Е	S	D	S	D	S
126	С	S	D		D	S	D		D		D		D		D	S	D		D	

127	С		С	S	С	S	С	S	С	Т	С	Т	С	S	С		С	т	С	Т
128	С	Е	I	S	S	S	Т	S	S	Т	S	Т	۷	S	I	S	т	т	т	Т
129	W	Е	D	S	D		D		D	Т	D	Т	D		D	Т	D		D	
130	G	Е	I	G	I	Т	I	Т	I	S	I	S	I	Т	I	Т	I	т	l.	S
131	G	Е	L	G	L	Т	L	Т	L	S	L	S	L	Т	L	S	L	т	L	Т
132	V	Е	S	G	N		S	S	S	S	S	S	S	Т	S	S	S	т	S	Т
133	D	Е	S	S	S	Т	S		S		Α	S	S		S	S	S	S	S	
134	Е	Т	Q		D	Т	Q		Н		Q		E		Q		N		N	
135	Y	Т	Т	E	V		F		Т	E	Т	ш	Т	ш	F	ш	Т	E	Т	ш
136	Α	Т	L	Е	V	В	L	В	L	E	L	ш	V	Е	L	Ш	L	Е	L	Е
137	G	E	S		G		S		S		S		S		S		S		S	
138	D	E	Ρ		Ρ		Ρ		Ρ		Ρ		S		А		Р		Р	
139	L	E	Т	Е	I	E	Т	Е	Т	E	-	ш	Т	Е	ш	Ш	Т	Е	Т	Е
140	Y	E	D	E	D	E	D	ш	Т	E	Y	ш	D	ш	D	ш	Т	E	Т	ш
141	S	Е	A	Е	Т	Е	Т	E	Т	Е	Т	E	R	Е	Т	Е	Т	E	Т	Е
142	С		Y	E	Н	Е	Y	ш	Y	E	Ν	ш	Y	Е	Y	Ш	Н	Е	H	ш
143	С		Е	E	Е	Е	ш	ш	Е	Е	A	ш	Е	ш	ш	ш	ш	ш	ш	ш
144	S	Е	F	E	F	Е	F	E	L	Е	Y	E	L	Е	L	E	F	Е	F	Е
145	V	Е	Н	E	Н	Е	Н	E	Н	Е	H	E	Н	Е	Н	E	Ν	E	Ν	E
146	А		V	E	V	E	V	E	V	E	V	E	V	E	V	E	V	E	V	E
147	Н		D	E	D	E	D	E	D	E	D	E	D	E	D		D	E	D	
148	Т	E	A	E	A	E	А	E	A	E	А	E	A	E	А		A	E	A	
149	Y	E	W		W		W		W		W		W		W		W		W	
150	Е	E																		
151	W	E																		
152	Y	Е																		
153	V	E																		
154	D	E																		
155	A	Е																		
156	W																			

	BG505 SOSIP + Bess4 Fab + RM20A3 Fab
	(EMD-41498)
	(PDB: 8TQ1)
Data collection and processing	
Microscope	TFS Krios
Magnification	130,000x
Voltage (kV)	300
Electron exposure (e–/Å ²)	55.5
Defocus range (µm)	-0.7 to -1.7
Detector	Gatan K2 Summit
Recording mode	Counting
Pixel size (Å)	1.045
Symmetry imposed	C1
Micrographs (no.)	3,871
Initial particle images (no.)	494,075
Final particle images (no.)	82.374
Map resolution (Å)	3.3
FSC threshold	0.143
Map sharpening <i>B</i> factor ($Å^2$)	-83.5
Map pixel size (Å)	1.045
Map resolution range (Å)	2.4-5.0
Refinement	
Initial model used (PDB code)	6x9r
Model resolution (Å)	3.3
FSC threshold	0.5
Model resolution range (Å)	2.4-4.0
EMRinger score	3.95
Model composition	
Non-hydrogen atoms	19,788
Protein residues	2,400
Ligands	79
Mean <i>B</i> factors (A ²)	
Protein	71
Ligand	96
R.m.s. deviations	0.000
Bond lengths (A)	0.006
Bond angles (*)	1.125
	1 44
MolProbily Score	1.11
Door rotamors (%)	0.49
Pamachandran plot	0.18
	06 54
Allowed (%)	3 / 6
Disallowed (%)	0.40

S8 Table: Cryo-EM data collection, refinement and validation statistics.