wwPDB EM Validation Summary Report (i)

Nov 11, 2026 – 03:40 PM EST

PDB ID	:	9Z9N / pdb_00009z9n
EMDB ID	:	EMD-73952
Title	:	Open-state T4825I mouse/rabbit RyR1 with activating ligands (Ca2+/ATP)
Authors	:	Chen, Y.S.; Van Petegem, F.
Deposited on	:	2025-11-18
Resolution	:	2.76 Å(reported)
Based on initial model	:	7TZC

This is a wwPDB EM Validation Summary Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
https://www.wwpdb.org/validation/2017/EMValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

The following versions of software and data (see references (i)) were used in the production of this report:

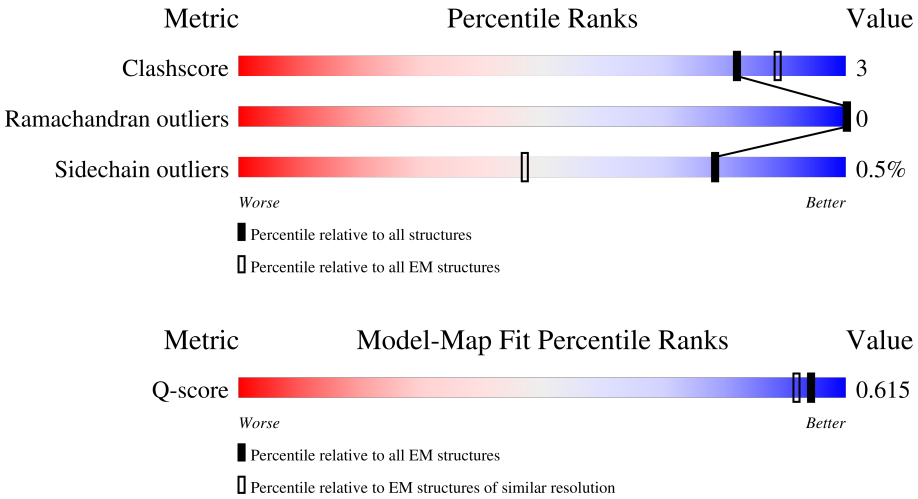
EMDB validation analysis	:	0.0.1.dev133
Mogul	:	2022.3.0, CSD as543be (2022)
MolProbity	:	4-5-2 with Phenix2.2
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics	:	202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ	:	1.9.13
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.51

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
ELECTRON MICROSCOPY

The reported resolution of this entry is 2.76 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



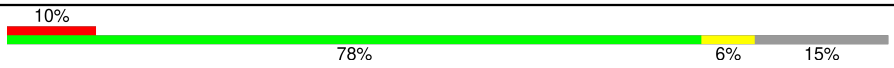
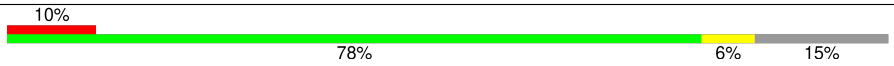
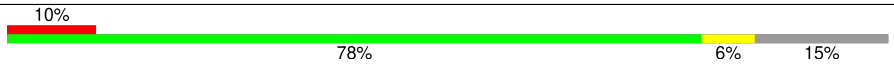
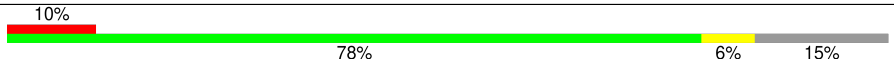
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	10642 (2.26 - 3.26)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=5% The upper red bar (where present) indicates the fraction of residues that have poor fit to the EM map (all-atom inclusion < 40%). The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	110	91% 6% •
1	C	110	89% 8% •
1	E	110	89% 8% •
1	G	110	91% 6% •

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Mol	Chain	Length	Quality of chain
2	B	5037	
2	D	5037	
2	F	5037	
2	H	5037	

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 136040 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Peptidyl-prolyl cis-trans isomerase FKBP1B.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	107	Total	C	N	O	S	0	0
			814	513	143	154	4		
1	C	107	Total	C	N	O	S	0	0
			814	513	143	154	4		
1	E	107	Total	C	N	O	S	0	0
			814	513	143	154	4		
1	G	107	Total	C	N	O	S	0	0
			814	513	143	154	4		

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	SER	-	expression tag	UNP P68106
A	0	ASN	-	expression tag	UNP P68106
A	1	ALA	-	expression tag	UNP P68106
C	-1	SER	-	expression tag	UNP P68106
C	0	ASN	-	expression tag	UNP P68106
C	1	ALA	-	expression tag	UNP P68106
E	-1	SER	-	expression tag	UNP P68106
E	0	ASN	-	expression tag	UNP P68106
E	1	ALA	-	expression tag	UNP P68106
G	-1	SER	-	expression tag	UNP P68106
G	0	ASN	-	expression tag	UNP P68106
G	1	ALA	-	expression tag	UNP P68106

- Molecule 2 is a protein called Ryanodine receptor 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	4257	Total	C	N	O	S	3	0
			33163	21190	5731	6020	222		
2	D	4257	Total	C	N	O	S	3	0
			33163	21190	5731	6020	222		
2	F	4257	Total	C	N	O	S	3	0
			33163	21190	5731	6020	222		

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Mol	Chain	Residues	Atoms					AltConf	Trace
2	H	4257	Total	C	N	O	S	3	0
			33163	21190	5731	6020	222		

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	5	GLY	-	insertion	UNP P11716
B	68	ILE	THR	conflict	UNP P11716
B	208	GLY	CYS	conflict	UNP P11716
B	213	PHE	TYR	conflict	UNP P11716
B	235	PRO	ALA	conflict	UNP P11716
B	236	SER	ALA	conflict	UNP P11716
B	251	PRO	ALA	conflict	UNP P11716
B	4825	ILE	THR	engineered mutation	UNP P11716
D	5	GLY	-	insertion	UNP P11716
D	68	ILE	THR	conflict	UNP P11716
D	208	GLY	CYS	conflict	UNP P11716
D	213	PHE	TYR	conflict	UNP P11716
D	235	PRO	ALA	conflict	UNP P11716
D	236	SER	ALA	conflict	UNP P11716
D	251	PRO	ALA	conflict	UNP P11716
D	4825	ILE	THR	engineered mutation	UNP P11716
F	5	GLY	-	insertion	UNP P11716
F	68	ILE	THR	conflict	UNP P11716
F	208	GLY	CYS	conflict	UNP P11716
F	213	PHE	TYR	conflict	UNP P11716
F	235	PRO	ALA	conflict	UNP P11716
F	236	SER	ALA	conflict	UNP P11716
F	251	PRO	ALA	conflict	UNP P11716
F	4825	ILE	THR	engineered mutation	UNP P11716
H	5	GLY	-	insertion	UNP P11716
H	68	ILE	THR	conflict	UNP P11716
H	208	GLY	CYS	conflict	UNP P11716
H	213	PHE	TYR	conflict	UNP P11716
H	235	PRO	ALA	conflict	UNP P11716
H	236	SER	ALA	conflict	UNP P11716
H	251	PRO	ALA	conflict	UNP P11716
H	4825	ILE	THR	engineered mutation	UNP P11716

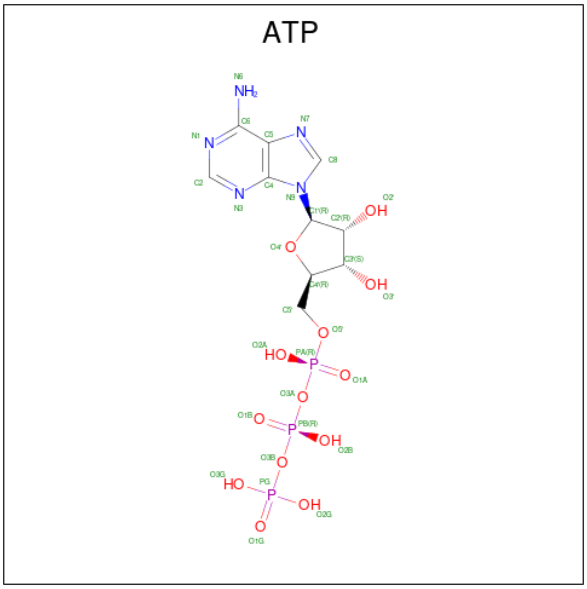
- Molecule 3 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	AltConf
3	B	1	Total Zn 1 1	0
3	D	1	Total Zn 1 1	0
3	F	1	Total Zn 1 1	0
3	H	1	Total Zn 1 1	0

- Molecule 4 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms	AltConf
4	B	1	Total Ca 1 1	0
4	D	1	Total Ca 1 1	0
4	F	1	Total Ca 1 1	0
4	H	1	Total Ca 1 1	0

- Molecule 5 is ADENOSINE-5'-TRIPHOSPHATE (CCD ID: ATP) (formula: $C_{10}H_{16}N_5O_{13}P_3$).



Mol	Chain	Residues	Atoms	AltConf
5	B	1	Total C N O P 31 10 5 13 3	0
5	D	1	Total C N O P 31 10 5 13 3	0

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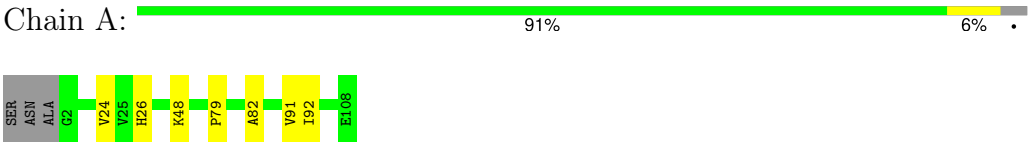
Mol	Chain	Residues	Atoms					AltConf
5	F	1	Total	C	N	O	P	0
			31	10	5	13	3	
5	H	1	Total	C	N	O	P	0
			31	10	5	13	3	

3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion in map density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red diamond above a residue indicates a poor fit to the EM map for this residue (all-atom inclusion < 40%). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

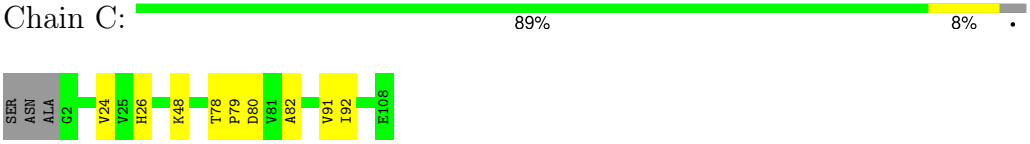
- Molecule 1: Peptidyl-prolyl cis-trans isomerase FKBP1B

Chain A:



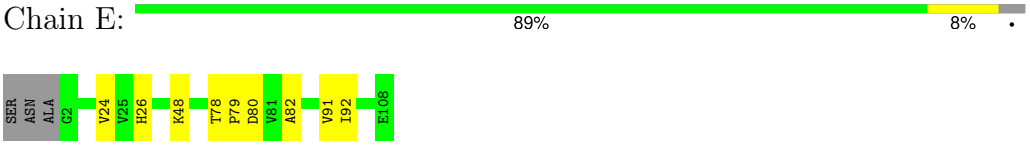
- Molecule 1: Peptidyl-prolyl cis-trans isomerase FKBP1B

Chain C:



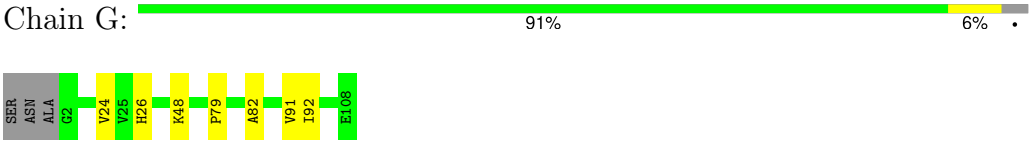
- Molecule 1: Peptidyl-prolyl cis-trans isomerase FKBP1B

Chain E:



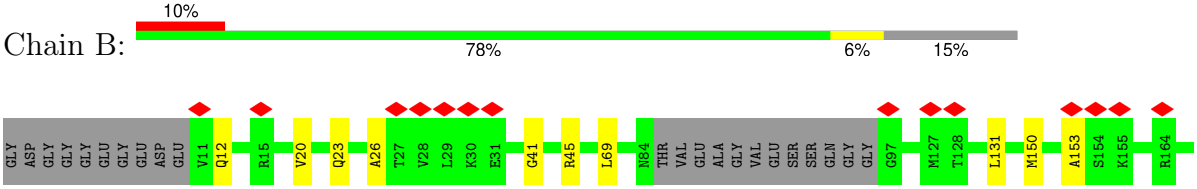
- Molecule 1: Peptidyl-prolyl cis-trans isomerase FKBP1B

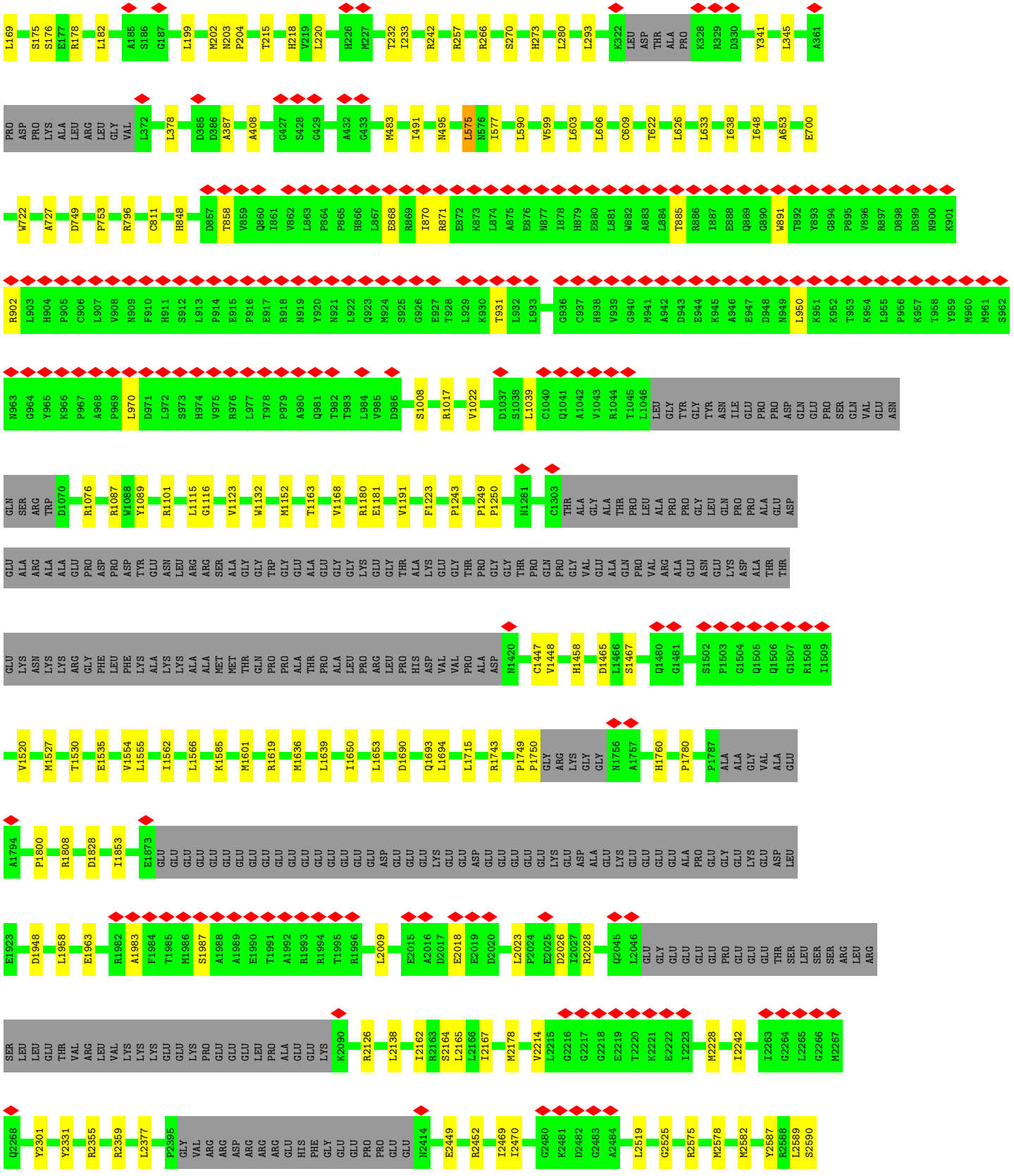
Chain G:

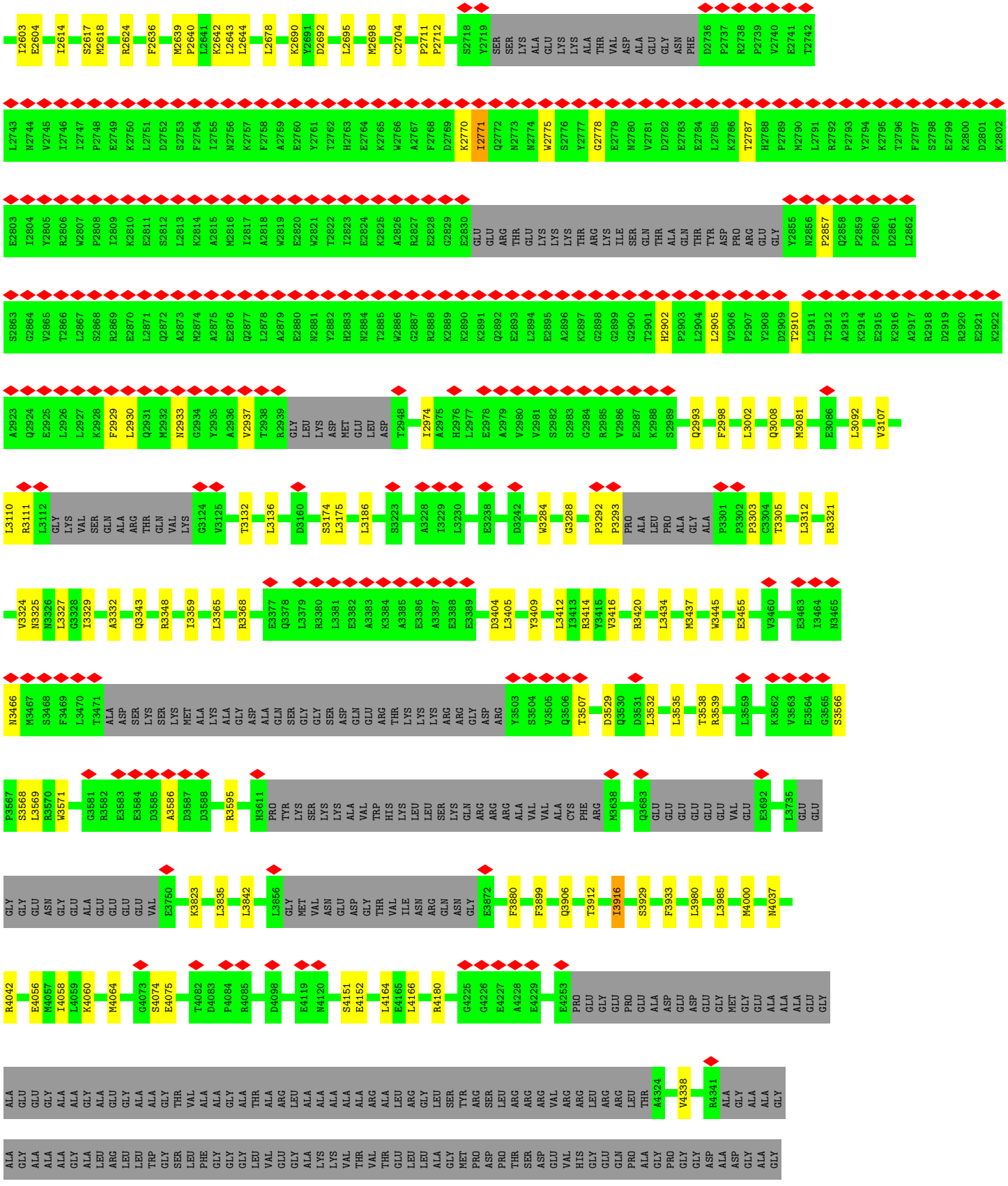


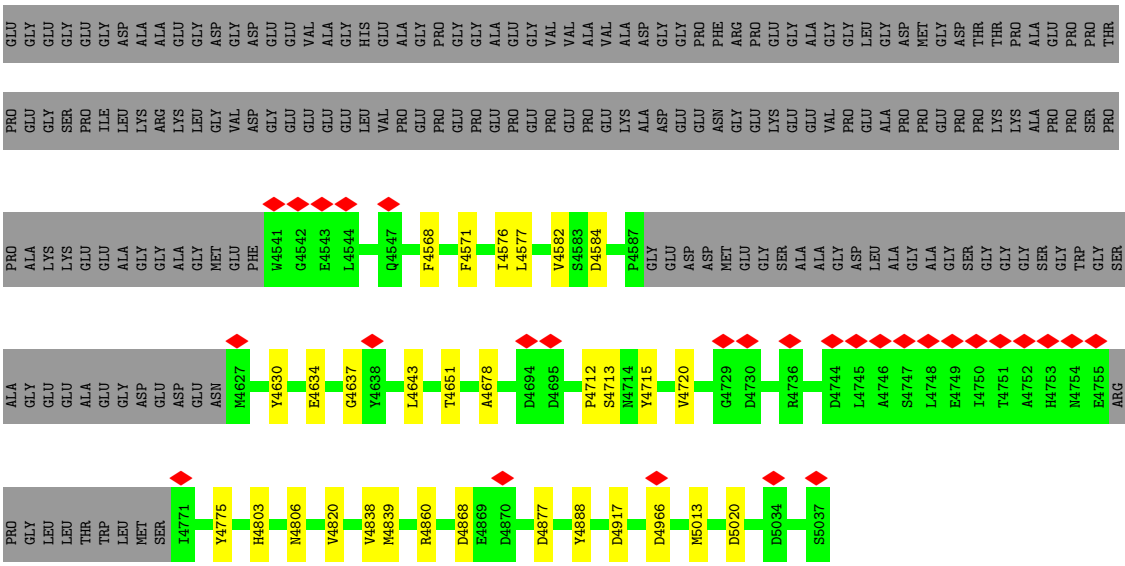
- Molecule 2: Ryanodine receptor 1

Chain B:




L169 S175 S176 E177 R178 L182 A185 S186 G187 L199 M202 N203 P204 T215 H218 V219 L220 H226 M227 T232 I233 R242 R257 R266 S270 H273 L280 L293 K322 LEU ASP THR ALA PRO K328 R329 D330 Y341 L345 A361
PRO ASP PRO LYS ALA LEU ARG LEU GLY VAL L372 L378 D385 D386 A387 A408 G427 S428 G429 A432 G433 M483 I491 N495 L575 N576 I577 L590 V599 L603 L606 C609 T622 L626 L633 I638 I648 A653 E700
W722 A727 D749 P753 R796 C811 H848 D857 T858 V859 Q860 I861 V862 L863 P864 P865 H866 L867 E868 R869 I870 R871 E872 K873 L874 A875 E876 N877 I878 H879 E880 L881 W882 A883 L884 T885 R886 I887 E888 Q889 G890 W891 T892 Y893 G894 P895 V896 R897 D898 D899 N900 K901
R902 L903 H904 P905 C906 L907 V908 N909 F910 H911 S912 L913 P914 E915 P916 E917 R918 N919 Y920 N921 L922 Q923 M924 S925 G926 E927 T928 L929 K930 T931 L932 L933 G936 C937 H938 V939 G940 M941 A942 D943 E944 K945 A946 E947 D948 N949 L950 K951 K952 T953 K954 L955 P956 K957 T958 Y959 M960 M961 S962
N963 G964 Y965 K966 P967 A968 P969 L970 D971 L972 S973 H974 V975 R976 L977 T978 P979 A980 Q981 Y920 T982 T983 L984 V985 D986 S1008 R1017 V1022 D1037 S1038 L1039 C1040 Q1041 A1042 V1043 R1044 T1045 L1046 LEU GLY TYR GLY TYR ASN ILE GLU PRO PRO ASP GLN GLU PRO SER GLN VAL GLU ASN
GLN SER ARG TRP D1070 R1076 R1087 W1088 Y1089 R1101 L1115 G1116 V1123 W1132 M1152 T1163 V1168 R1180 E1181 V1191 F1223 P1243 P1249 P1250 N1281 C1303 THR ALA GLY ALA THR PRO LEU ALA PRO PRO GLY LEU GLN PRO PRO ALA GLU ASP
GLU ALA ARG ALA ALA GLU PRO ASP PRO ASP TYR GLU ASN LEU ARG ARG SER ALA GLY GLY TRP GLY GLU ALA GLU GLY GLY LYS GLU GLY THR ALA LYS GLU GLY THR PRO GLY GLY THR PRO GLN PRO GLY VAL GLU ALA GLN PRO VAL ARG ALA GLU ASN GLU LYS ASP ALA THR THR
GLU LYS ASN LYS LYS ARG GLY PHE LEU PHE LYS ALA LYS LYS ALA ALA MET MET THR GLN PRO PRO ALA THR PRO ALA LEU PRO ARG LEU PRO HIS ASP VAL VAL PRO ALA ASP N1420 C1447 V1448 H1458 D1465 L1466 S1467 Q1480 G1481 S1502 P1503 G1504 Q1505 Q1506 G1507 R1508 I1509
V1520 M1527 T1530 E1535 V1554 L1555 I1562 L1566 K1585 M1601 R1619 M1636 L1639 I1650 L1653 D1690 Q1693 L1694 L1715 R1743 P1749 P1750 GLY ARG LYS GLY GLY N1756 A1757 H1760 P1780 P1787 ALA ALA GLY VAL ALA GLU
A1794 P1800 R1808 D1828 I1853 E1873 GLU GLU GLU

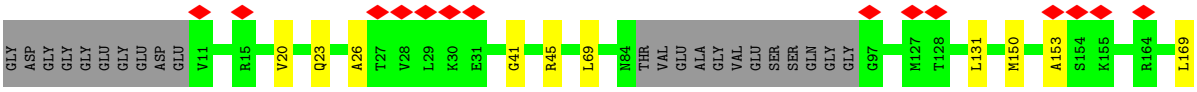

I2603 E2604 I2614 S2617 M2618 R2624 F2636 M2639 P2640 L2641 K2642 L2643 L2644 L2678 K2690 Y2691 D2692 L2695 M2698 C2704 P2711 P2712 S2718 Y2719 SER SER LYS ALA GLU LYS LYS ALA THR VAL ASP ALA GLU GLY ASN PHE D2736 P2737 R2738 P2739 V2740 E2741 T2742
L2743 N2744 V2745 I2746 I2747 P2748 E2749 K2750 L2751 D2752 S2753 F2754 I2755 N2756 K2757 F2758 A2759 E2760 Y2761 T2762 H2763 E2764 K2765 W2766 A2767 F2768 D2769 K2770 I2771 Q2772 N2773 N2774 W2775 S2776 Y2777 G2778 E2779 N2780 V2781 D2782 E2783 E2784 L2785 K2786 T2787 H2788 P2789 M2790 L2791 R2792 P2793 Y2794 K2795 T2796 F2797 S2798 E2799 K2800 D2801 K2802
E2803 I2804 Y2805 R2806 W2807 P2808 I2809 K2810 E2811 S2812 L2813 K2814 A2815 M2816 I2817 A2818 W2819 E2820 W2821 T2822 I2823 E2824 K2825 A2826 R2827 E2828 G2829 E2830 GLU GLU ARG THR GLU LYS LYS LYS THR ARG LYS ILE SER GLN THR ALA GLN THR TYR ASP PRO ARG GLU GLY Y2855 N2856 P2857 Q2858 P2859 P2860 D2861 L2862
S2863 G2864 V2865 T2866 L2867 S2868 R2869 E2870 L2871 Q2872 A2873 M2874 A2875 E2876 Q2877 L2878 A2879 E2880 N2881 Y2882 H2883 N2884 T2885 W2886 G2887 R2888 K2889 K2890 K2891 Q2892 E2893 L2894 E2895 A2896 K2897 G2898 G2899 G2900 T2901 H2902 P2903 L2904 L2905 V2906 P2907 Y2908 D2909 T2910 L2911 T2912 A2913 K2914 E2915 K2916 A2917 R2918 D2919 R2920 E2921 K2922
A2923 Q2924 E2925 L2926 L2927 K2928 F2929 L2930 Q2931 M2932 N2933 G2934 Y2935 A2936 V2937 T2938 R2939 GLY LEU LYS ASP MET GLU LEU ASP T2948 I2974 A2975 H2976 L2977 E2978 A2979 V2980 V2981 S2982 S2983 G2984 R2985 V2986 E2987 K2988 S2989 Q2993 F2998 L3002 Q3008 M3081 E3086 L3092 V3107
L3110 R3111 L3112 GLY LYS VAL SER GLN ALA ARG THR GLN VAL LYS G3124 V3125 T3132 L3136 D3160 S3174 L3175 L3186 S3223 A3228 I3229 L3230 E3238 D3242 W3284 G3288 P3292 P3293 PRO ALA LEU PRO ALA GLY ALA P3301 P3302 P3303 G3304 T3305 L3312 R3321
V3324 N3325 N3326 L3327 G3328 I3329 A3332 Q3343 R3348 I3359 L3365 R3368 E3377 Q3378 L3379 R3380 L3381 E3382 A3383 K3384 A3385 E3386 A3387 E3388 E3389 D3404 L3405 Y3409 L3412 I3413 R3414 Y3415 V3416 R3420 L3434 M3437 W3445 E3455 V3460 E3463 I3464 N3465
N3466 M3467 S3468 F3469 L3470 T3471 ALA ASP SER LYS SER LYS MET ALA LYS ALA GLY ASP ALA GLN SER GLY GLY SER ASP GLN GLU ARG THR LYS LYS LYS ARG ARG GLY ASP ARG Y3503 S3504 V3505 Q3506 T3507 D3529 Q3530 D3531 L3532 L3535 T3538 R3539 L3559 K3562 V3563 E3564 G3565 S3566
P3567 S3568 L3569 R3570 W3571 G3581 R3582 E3583 E3584 D3585 A3586 D3587 D3588 R3595 H3611 PRO TYR LYS SER LYS LYS ALA VAL TRP HIS LYS LEU LEU SER LYS GLN ARG ARG ARG ALA VAL VAL ALA CYS PHE ARG M3638 Q3683 GLU GLU GLU GLU GLU VAL GLU E3692 L3735 GLU GLU
GLY GLY GLU ASN GLY GLU ALA GLU GLU GLU GLU VAL E3750 K3823 L3835 L3842 L3856 GLY MET VAL ASN GLU ASP GLY THR VAL ILE ASN ARG GLN ASN GLY E3872 F3880 F3899 Q3906 T3912 I3916 S3929 F3933 L3980 L3985 M4000 N4037
R4042 E4056 M4057 I4058 L4059 K4060 M4064 G4073 S4074 E4075 T4082 D4083 P4084 R4085 D4098 E4119 N4120 S4151 E4152 L4164 E4165 L4166 R4180 G4225 G4226 E4227 A4228 E4229 E4253 PRO GLU GLY GLU PRO GLU ALA ASP GLU ASP GLU GLY MET GLY GLU ALA ALA ALA GLU GLY
ALA GLU GLU GLY ALA ALA GLY ALA GLU GLY ALA ALA ALA GLY THR VAL ALA ALA GLY ALA THR ALA ARG LEU ALA ALA ALA ALA ALA ARG LEU ALA ALA ALA ARG GLY LEU LEU ARG ARG SER LEU ARG ARG ARG VAL ARG ARG LEU ARG ARG LEU THR A4324 V4338 R4341 ALA GLY ALA ALA
ALA GLY ALA ALA GLY ALA LEU LEU TRP GLY SER LEU PHE GLY GLY GLY LEU VAL GLU GLY ALA LYS LYS VAL THR VAL THR GLU LEU LEU LEU ALA GLY MET PRO ASP PRO THR SER ASP GLU VAL HIS GLY GLU GLN PRO ALA GLY PRO GLY GLY GLY ASP ALA ASP GLY GLY ALA GLY

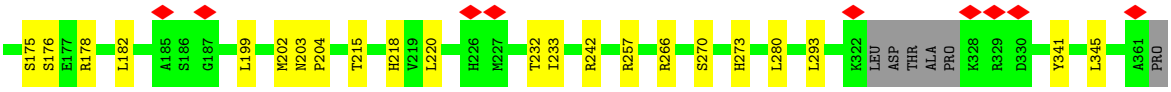


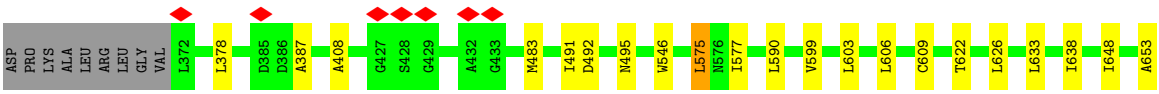
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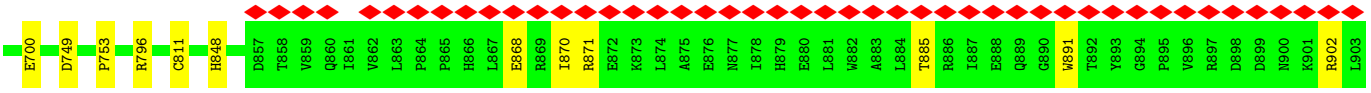
Chain D:

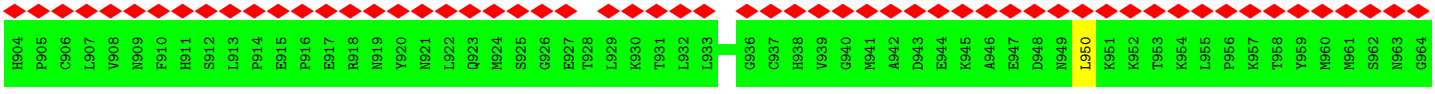


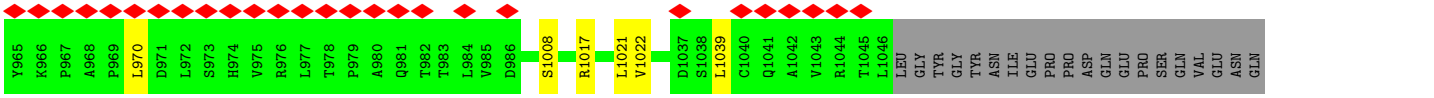




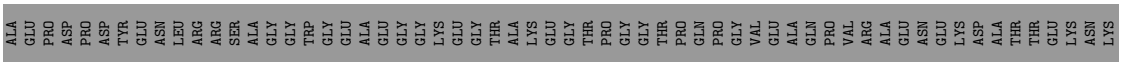


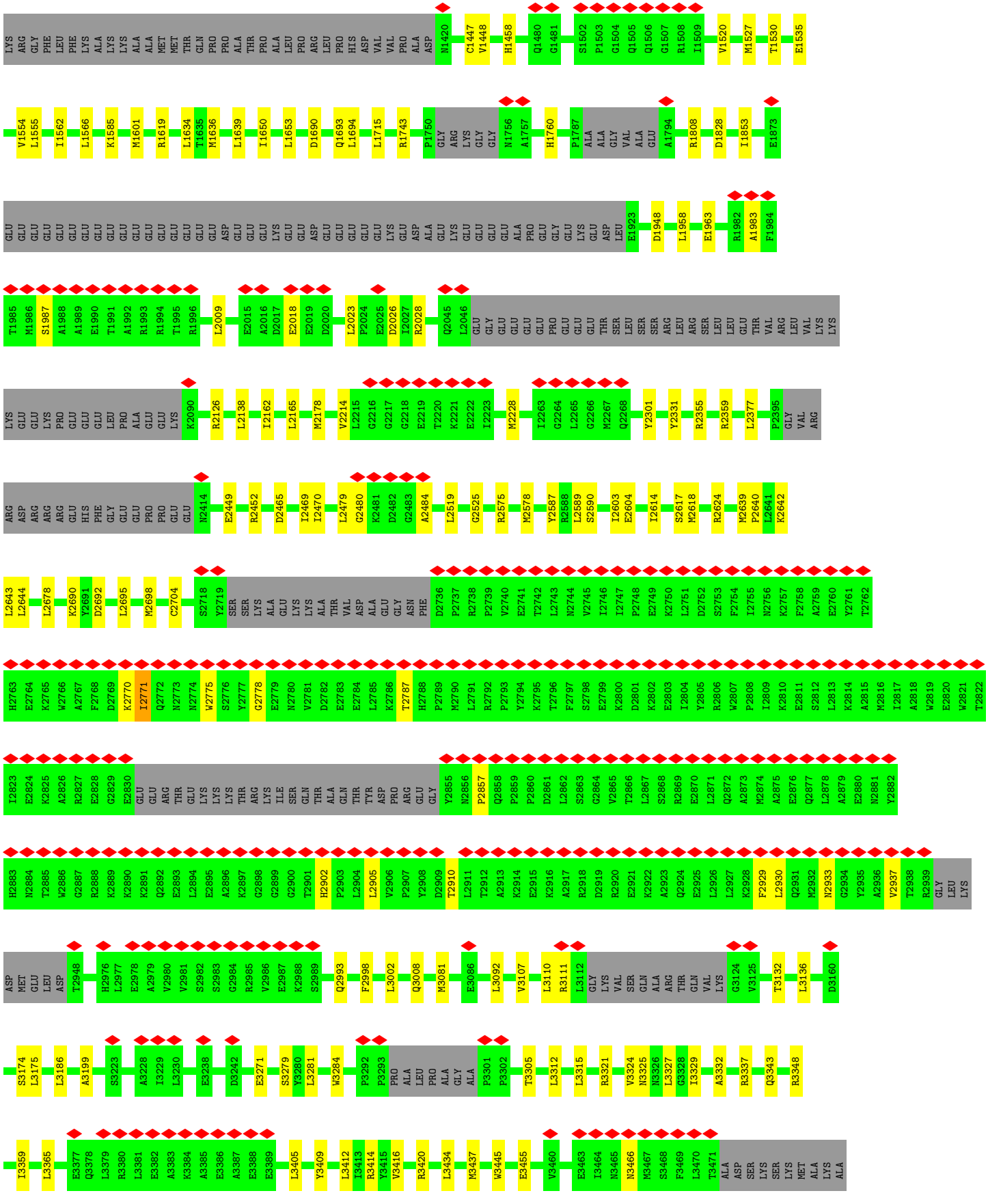


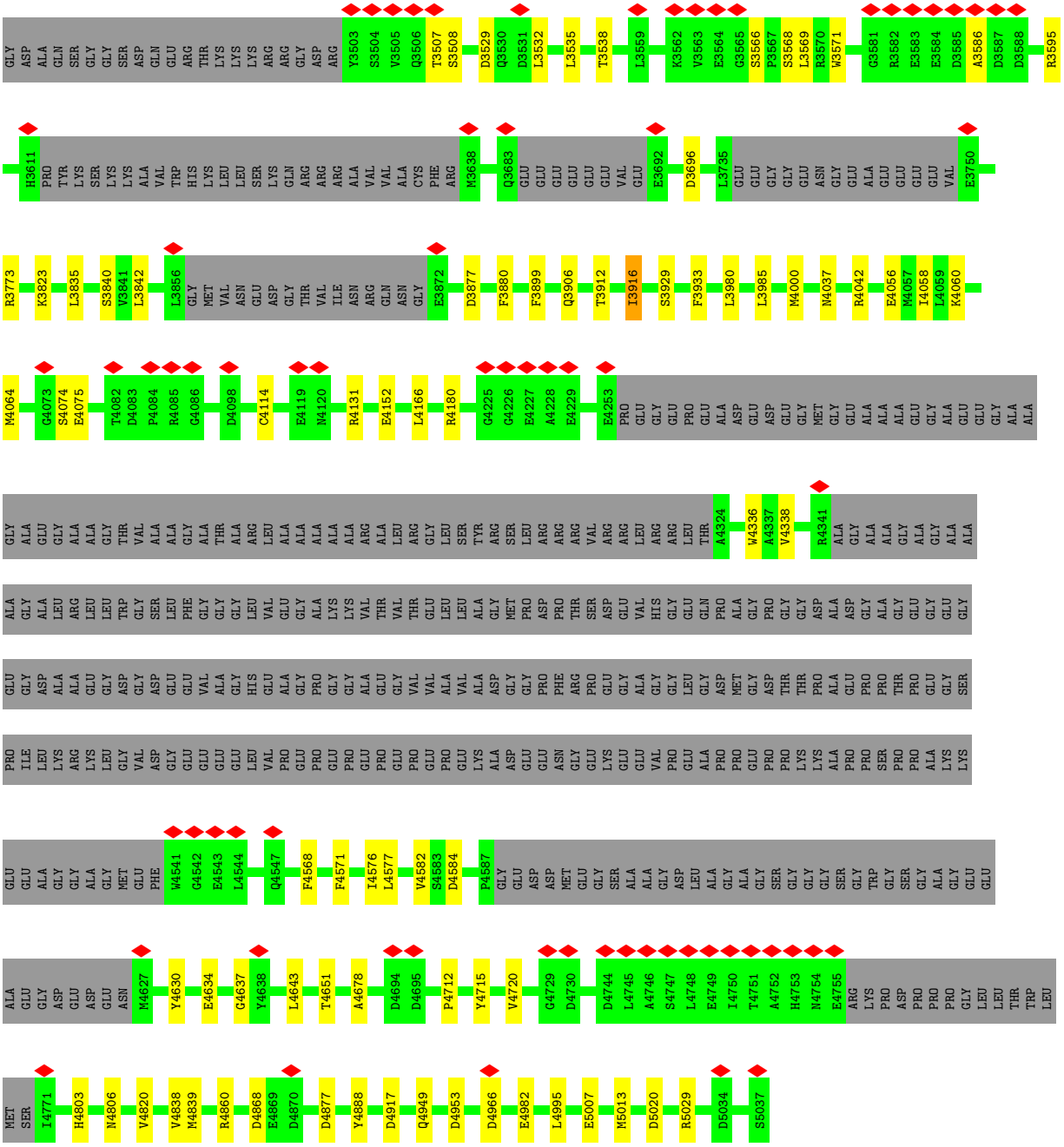








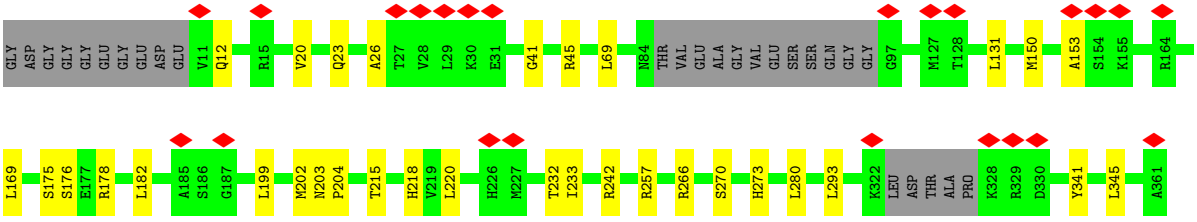

LYS ARG GLY PHE LEU PHE LYS ALA LYS LYS ALA ALA MET MET THR GLN PRO PRO ALA THR PRO ALA LEU PRO ARG LEU PRO HIS ASP VAL VAL PRO ALA ASP N1420 C1447 V1448 H1458 Q1480 G1481 S1502 P1503 G1504 Q1505 Q1506 G1507 R1508 I1509 V1520 M1527 T1530 E1535
V1554 L1555 I1562 L1566 K1585 M1601 R1619 L1634 T1635 M1636 L1639 I1650 L1653 D1690 Q1693 L1694 L1715 R1743 P1750 GLY ARG LYS GLY GLY N1756 A1757 H1760 P1787 ALA ALA GLY VAL ALA GLU A1794 R1808 D1828 I1853 E1873
GLU GLU GLU GLU GLU GLU GLU GLU GLU GLU GLU GLU GLU GLU ASP GLU GLU GLU LYS GLU GLU ASP GLU GLU GLU GLU GLU LYS GLU ASP ALA GLU LYS GLU GLU GLU GLU ALA PRO GLU GLY GLU LYS GLU ASP LEU E1923 D1948 L1958 E1963 R1982 A1983 F1984
T1985 M1986 S1987 A1988 A1989 E1990 T1991 A1992 R1993 R1994 T1995 R1996 L2009 E2015 A2016 D2017 E2018 E2019 D2020 L2023 P2024 E2025 D2026 I2027 R2028 Q2045 L2046 GLU GLY GLU GLU GLU GLU PRO GLU GLU GLU THR SER LEU SER SER ARG LEU ARG SER LEU LEU GLU THR VAL ARG LEU VAL LYS LYS
LYS GLU GLU LYS PRO GLU GLU GLU LEU PRO ALA GLU GLU LYS K2090 R2126 L2138 I2162 L2165 M2178 V2214 L2215 G2216 G2217 G2218 E2219 T2220 K2221 E2222 I2223 M2228 I2263 G2264 L2265 G2266 M2267 Q2268 Y2301 Y2331 R2355 R2359 L2377 P2395 GLY VAL ARG
ARG ASP ARG ARG ARG GLU HIS PHE GLY GLU GLU PRO PRO GLU GLU N2414 E2449 R2452 D2465 I2469 I2470 L2479 G2480 K2481 D2482 G2483 A2484 L2519 G2525 R2575 M2578 Y2587 R2588 L2589 S2590 I2603 E2604 I2614 S2617 M2618 R2624 M2639 P2640 L2641 K2642
L2643 L2644 L2678 K2690 Y2691 D2692 L2695 M2698 C2704 S2718 Y2719 SER SER LYS ALA GLU LYS LYS ALA THR VAL ASP ALA GLU GLY ASN PHE D2736 P2737 R2738 P2739 V2740 E2741 T2742 L2743 N2744 V2745 I2746 I2747 P2748 E2749 K2750 L2751 D2752 S2753 F2754 I2755 N2756 K2757 F2758 A2759 E2760 Y2761 T2762
H2763 E2764 K2765 W2766 A2767 F2768 D2769 K2770 I2771 Q2772 N2773 N2774 W2775 S2776 Y2777 G2778 E2779 N2780 V2781 D2782 E2783 E2784 L2785 K2786 T2787 H2788 P2789 M2790 L2791 R2792 P2793 Y2794 K2795 T2796 F2797 S2798 E2799 K2800 D2801 K2802 E2803 I2804 Y2805 R2806 W2807 P2808 I2809 K2810 E2811 S2812 L2813 K2814 A2815 M2816 I2817 A2818 W2819 E2820 W2821 T2822
I2823 E2824 K2825 A2826 A2827 E2828 G2829 E2830 GLU GLU ARG THR GLU LYS LYS LYS THR ARG LYS ILE SER GLN THR ALA GLN THR TYR ASP PRO ARG GLU GLY Y2855 N2856 P2857 Q2858 P2859 P2860 D2861 L2862 S2863 G2864 V2865 T2866 L2867 S2868 R2869 E2870 L2871 Q2872 A2873 M2874 A2875 E2876 Q2877 L2878 A2879 E2880 N2881 Y2882
H2883 N2884 T2885 W2886 G2887 R2888 K2889 K2890 K2891 Q2892 E2893 L2894 E2895 A2896 K2897 G2898 G2899 G2900 T2901 H2902 P2903 L2904 L2905 V2906 P2907 Y2908 D2909 T2910 L2911 T2912 A2913 K2914 E2915 K2916 A2917 R2918 D2919 R2920 E2921 K2922 A2923 Q2924 E2925 L2926 L2927 K2928 F2929 L2930 Q2931 M2932 N2933 G2934 Y2935 A2936 V2937 T2938 R2939 GLY LEU LYS
ASP MET GLU LEU ASP T2948 H2976 L2977 E2978 A2979 V2980 V2981 S2982 S2983 G2984 R2985 V2986 E2987 K2988 S2989 Q2993 F2998 L3002 Q3008 M3081 E3086 L3092 V3107 L3110 R3111 L3112 GLY LYS VAL SER GLN ALA ARG THR GLN VAL LYS G3124 V3125 T3132 L3136 D3160
S3174 L3175 L3186 A3199 S3223 A3228 I3229 L3230 E3238 D3242 E3271 S3279 Y3280 L3281 W3284 P3292 P3293 PRO ALA LEU PRO ALA GLY ALA P3301 P3302 T3305 L3312 L3315 R3321 V3324 N3325 N3326 L3327 G3328 I3329 A3332 R3337 Q3343 R3348
I3359 L3365 E3377 Q3378 L3379 R3380 L3381 E3382 A3383 K3384 A3385 E3386 A3387 E3388 E3389 L3405 Y3409 L3412 I3413 R3414 Y3415 V3416 R3420 L3434 M3437 W3445 E3455 V3460 E3463 I3464 N3465 N3466 M3467 S3468 F3469 L3470 T3471 ALA ASP SER LYS SER LYS MET ALA LYS ALA

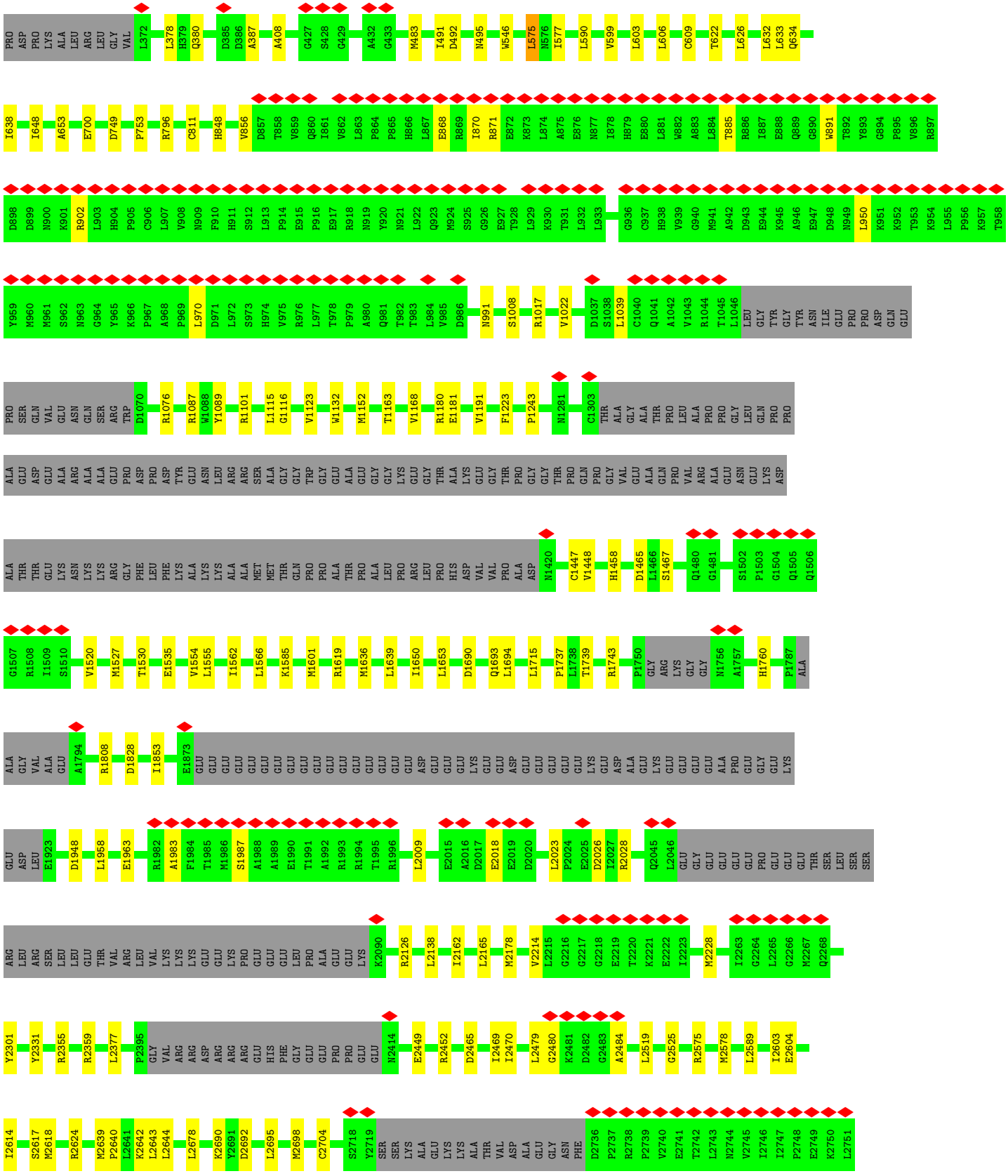


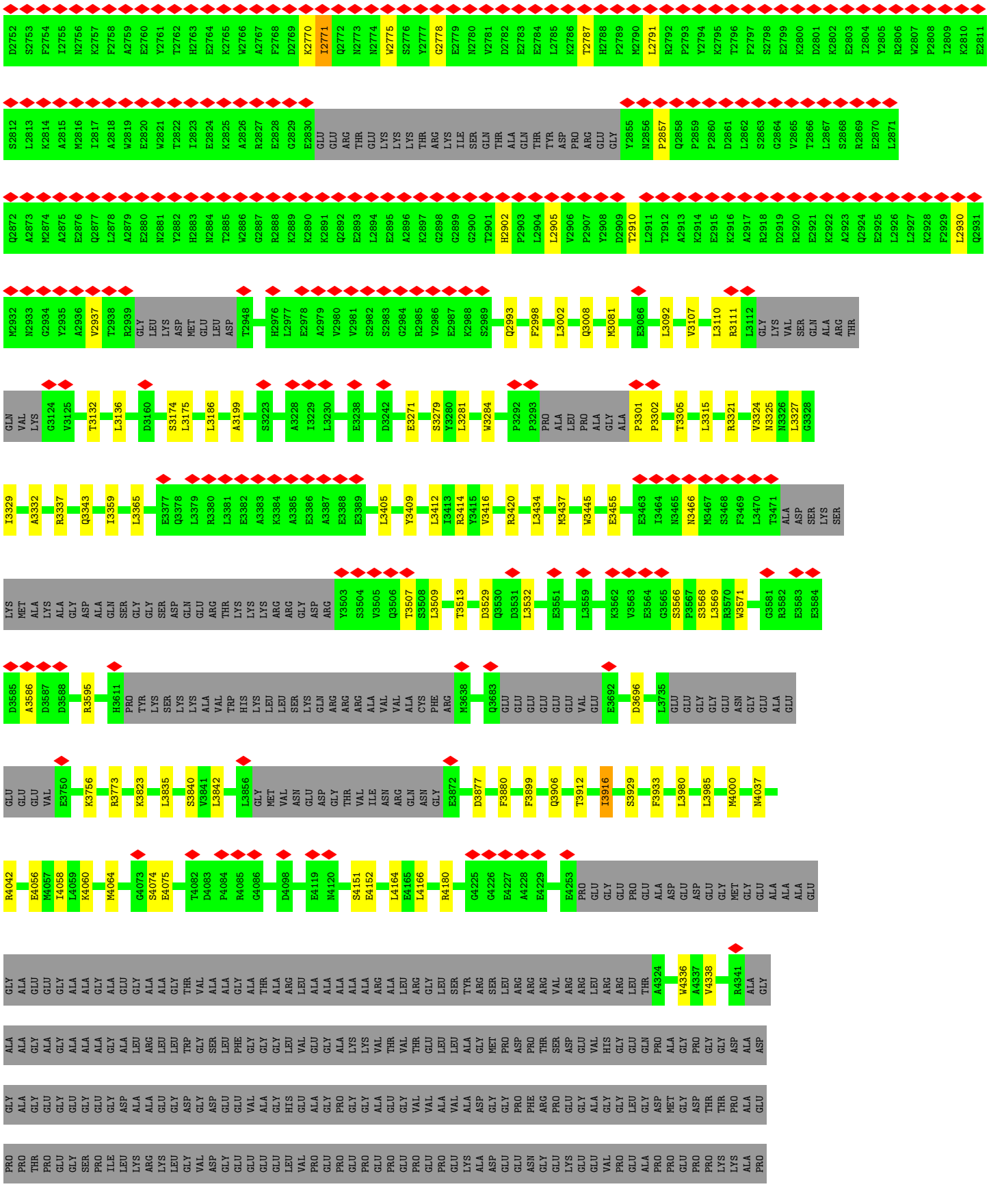
• Molecule 2: Ryanodine receptor 1

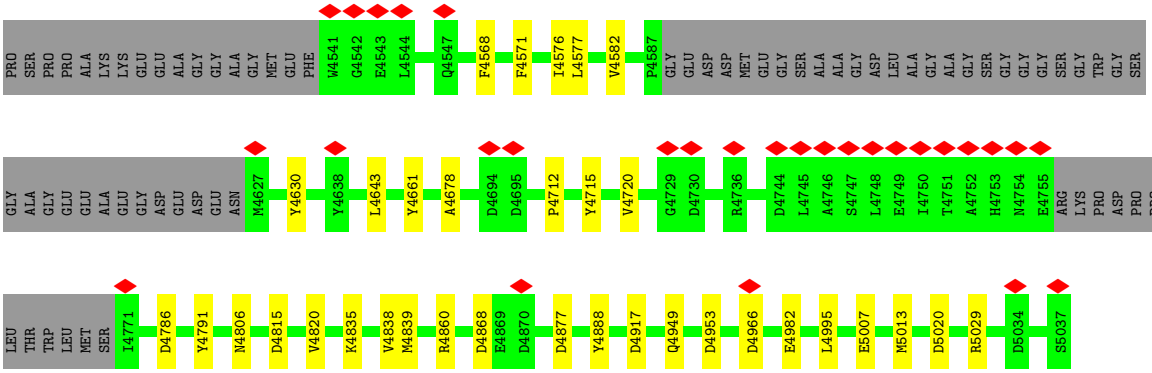
Chain F:






PRO ASP PRO LYS ALA LEU ARG LEU GLY VAL L372 L378 H379 Q380 D385 D386 A387 A408 G427 S428 G429 A432 G433 M483 I491 D492 N495 W546 L575 N576 I577 L590 V599 L603 L606 C609 T622 L626 L632 L633 Q634
I638 I648 A653 E700 D749 P753 R796 C811 H848 V856 D857 T858 V859 Q860 I861 V862 L863 P864 P865 H866 L867 E868 R869 I870 R871 E872 K873 L874 A875 E876 N877 I878 H879 E880 L881 W882 A883 L884 T885 R886 I887 E888 Q889 G890 W891 T892 Y893 G894 P895 V896 R897
D898 D899 N900 K901 R902 L903 H904 P905 C906 L907 V908 N909 P910 H911 S912 L913 P914 E915 P916 E917 R918 N919 Y920 N921 L922 Q923 M924 S925 G926 E927 T928 L929 K930 T931 L932 L933 G936 C937 H938 V939 G940 M941 A942 D943 E944 K945 A946 E947 D948 N949 L950 K951 K952 T953 K954 L955 P956 K957 T958
Y959 M960 H961 S962 N963 G964 Y965 K966 P967 A968 P969 L970 D971 L972 S973 H974 V975 R976 L977 T978 P979 A980 Q981 T982 T983 L984 V985 D986 N991 S1008 R1017 V1022 D1037 S1038 L1039 C1040 Q1041 A1042 V1043 R1044 T1045 L1046 LEU GLY TYR GLY TYR ASN ILE GLU PRO PRO ASP GLN GLU
PRO SER GLN VAL GLU ASN GLN SER ARG TRP D1070 R1076 R1087 W1088 Y1089 R1101 L1115 G1116 V1123 W1132 M1152 T1163 V1168 R1180 E1181 V1191 F1223 P1243 N1281 C1303 THR ALA GLY ALA THR PRO LEU ALA PRO PRO GLY LEU GLN PRO PRO
ALA GLU ASP GLU ALA ALA ALA GLU PRO ASP PRO ASP TYR GLU ASN LEU ARG ARG SER ALA GLY GLY TRP GLY GLU ALA GLU GLY GLY LYS GLU GLY THR ALA LYS GLU GLY THR PRO GLY GLY THR PRO GLN PRO GLY VAL GLU ALA GLN PRO VAL ARG ALA GLU ASN GLU LYS ASP
ALA THR THR GLU LYS ASN LYS LYS ARG GLY PHE LEU PHE LYS ALA LYS LYS ALA ALA MET MET THR GLN PRO PRO ALA THR PRO ALA LEU PRO ARG LEU PRO HIS ASP VAL VAL PRO ALA ASP N1420 C1447 V1448 H1458 D1465 L1466 S1467 Q1480 G1481 S1502 P1503 G1504 Q1505 Q1506
G1507 R1508 I1509 S1510 V1520 M1527 T1530 E1535 V1554 L1555 I1562 L1566 K1585 M1601 R1619 M1636 L1639 I1650 L1653 D1690 Q1693 L1694 L1715 P1737 L1738 T1739 R1743 P1750 GLY ARG LYS GLY GLY N1756 A1757 H1760 P1787 ALA
ALA GLY VAL ALA GLU A1794 R1808 D1828 I1853 E1873 GLU GLU GLU

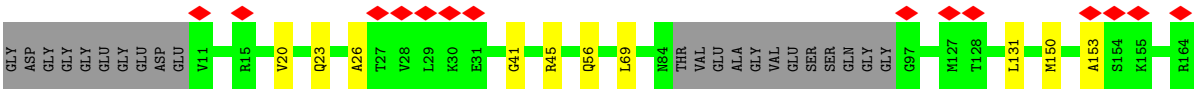


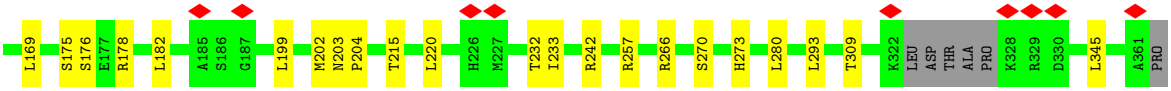


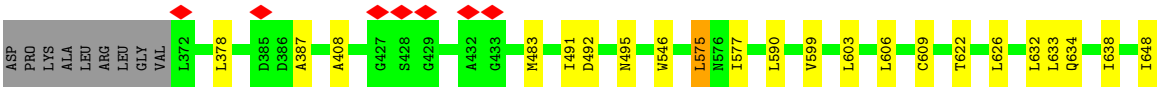
• Molecule 2: Ryanodine receptor 1

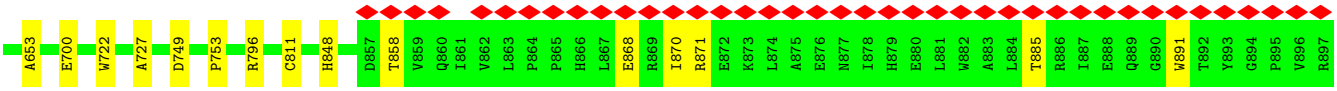
Chain H:

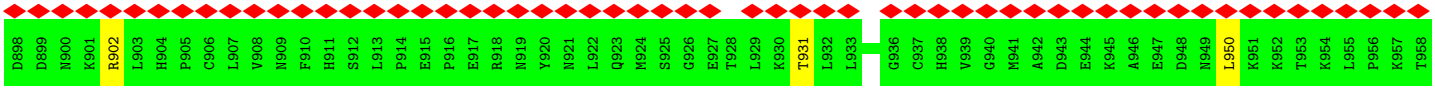


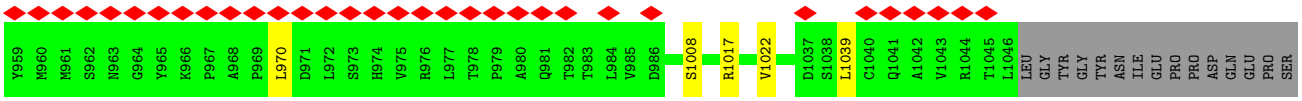


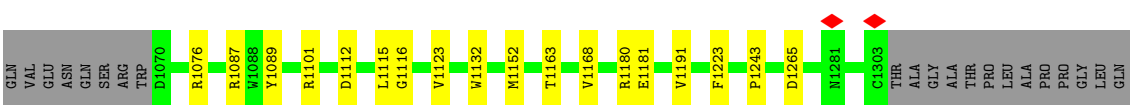


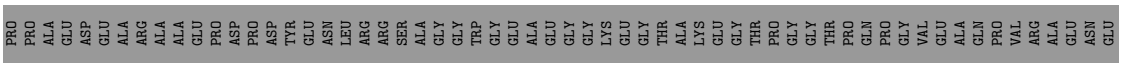


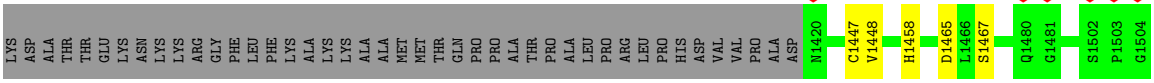


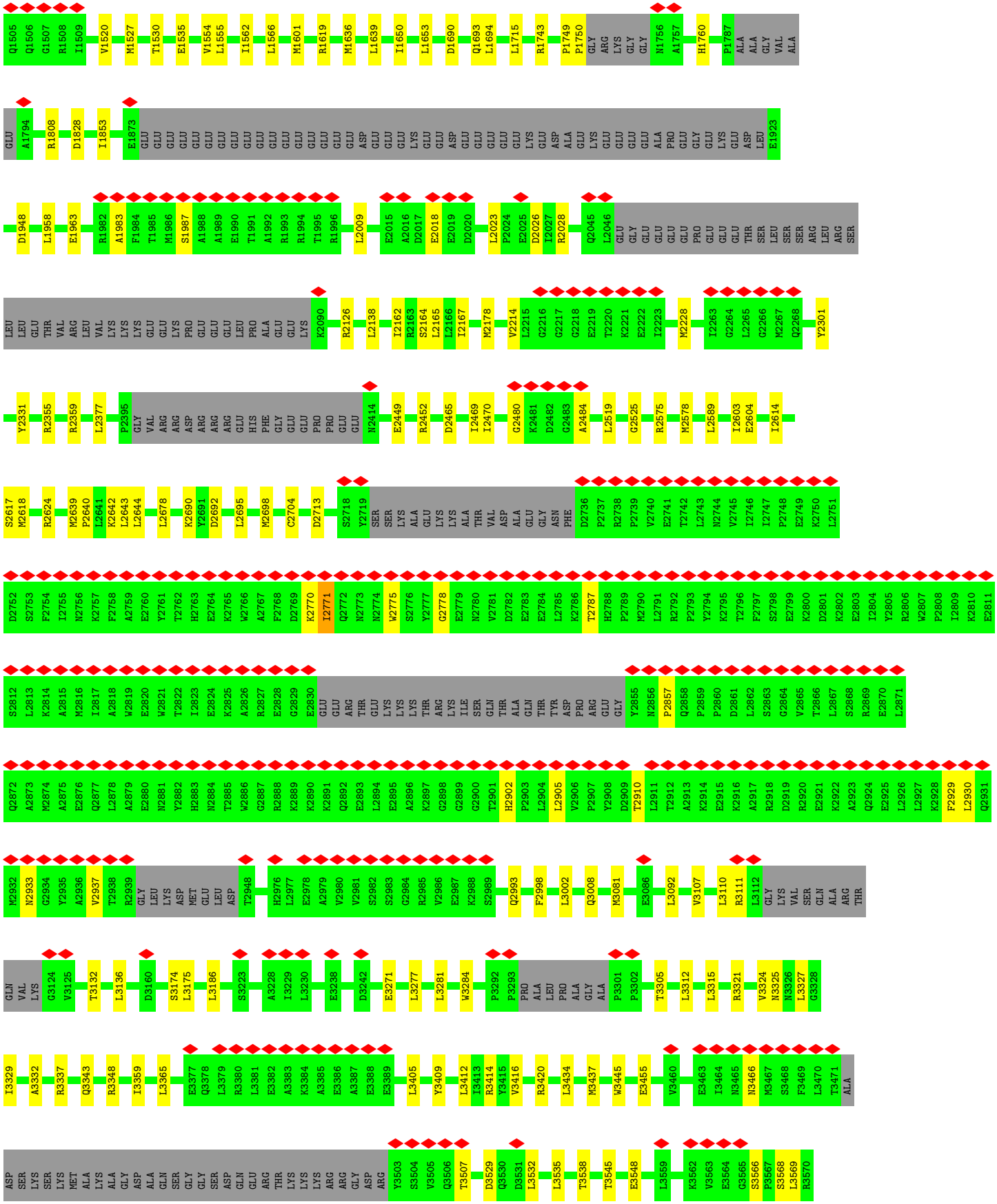


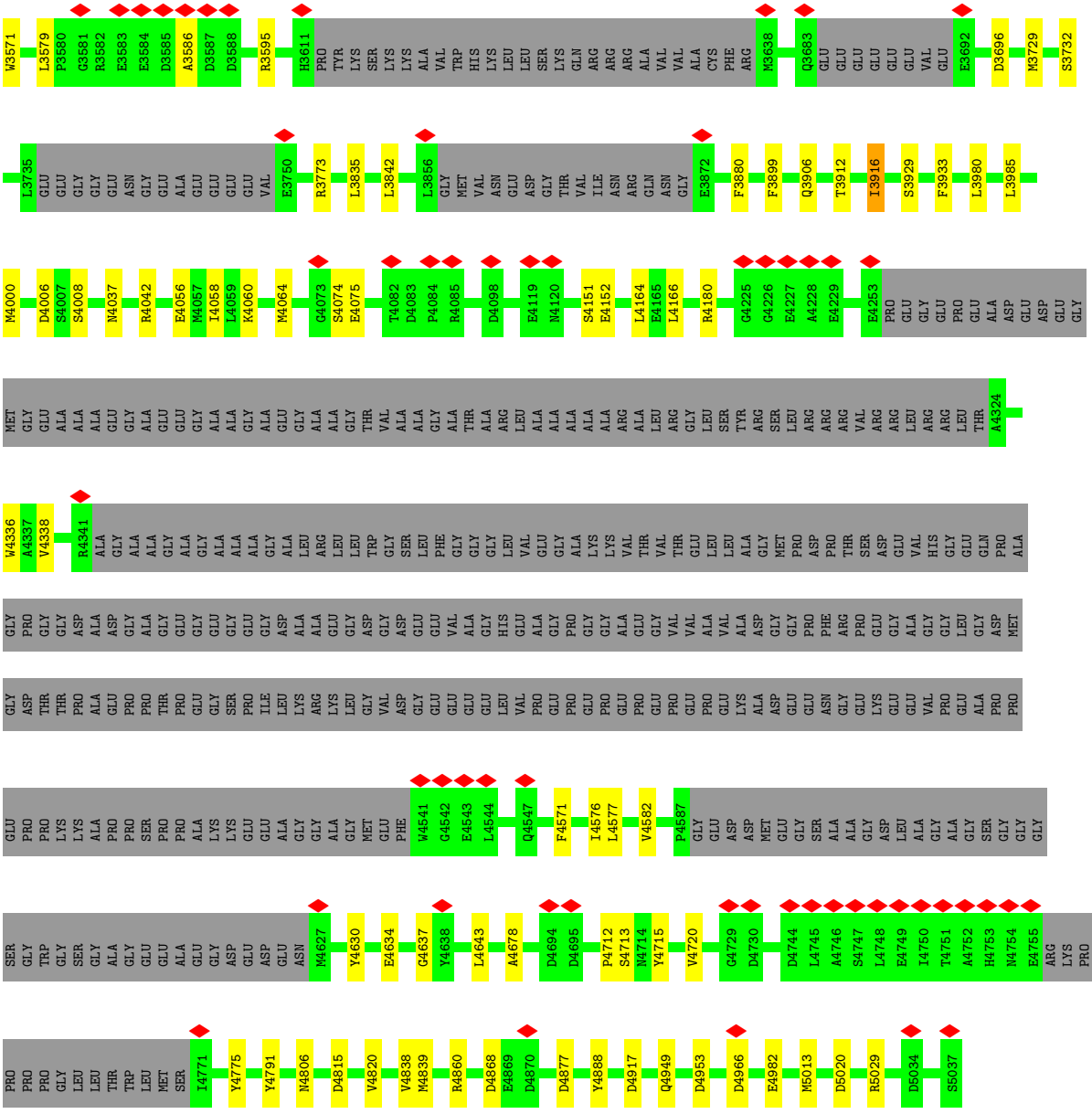









Q1505 Q1506 G1507 R1508 I1509 V1520 M1527 T1530 E1535 V1554 L1555 I1562 L1566 M1601 R1619 M1636 L1639 I1650 L1653 D1690 Q1693 L1694 L1715 R1743 P1749 P1750 GLY ARG LYS GLY GLY N1756 A1767 H1760 P1787 ALA ALA GLY VAL ALA
GLU A1794 R1808 D1828 I1853 E1873 GLU GLU GLU


W3571 L3579 P3580 G3581 R3582 E3583 E3584 D3585 A3586 D3587 D3588 R3595 H3611 M3638 Q3683 E3692 D3696 M3729 S3732
L3735 E3750 R3773 L3835 L3842 L3856 E3872 F3880 F3899 Q3906 T3912 I3916 S3929 F3933 L3980 L3985
M4000 D4006 S4007 S4008 N4037 R4042 E4056 M4057 I4058 L4059 K4060 M4064 G4073 S4074 E4075 T4082 D4083 P4084 R4085 D4098 E4119 N4120 S4151 E4152 L4164 E4165 L4166 R4180 G4225 G4226 E4227 A4228 E4229 E4253
A4324
W4336 A4337 V4338 R4341
GLY PRO GLY GLY ASP ALA ASP GLY ALA GLY GLU GLY GLU GLY GLY GLY ASP ALA ALA GLU GLY ASP GLY GLU GLU VAL ALA GLY HIS GLU ALA GLY PRO GLY GLY ALA GLU GLY VAL ALA ALA ASP GLY GLY PRO PHE ARG PRO GLU GLY GLY ALA GLY LEU GLY ASP MET
GLY ASP THR THR PRO ALA GLU PRO PRO PRO THR PRO GLU GLY SER PRO ILE LEU LEU LYS ARG LYS LEU GLY VAL ASP GLY GLU GLU GLU LEU VAL PRO GLU PRO PRO GLU PRO GLU PRO GLU PRO GLU LYS ALA ASP GLU GLU ASN GLY GLU LYS GLU GLU VAL PRO GLU ALA PRO PRO
GLU PRO PRO LYS LYS ALA PRO PRO PRO SER PRO PRO ALA LYS LYS GLU GLU ALA GLY GLY ALA GLY MET GLU PHE W4541 G4542 E4543 L4544 Q4547 F4571 I4576 L4577 V4582 P4587 GLY GLU ASP ASP MET GLU GLY SER ALA ALA GLY ASP LEU ALA GLY ALA GLY SER GLY GLY GLY
SER GLY TRP GLY SER GLY ALA GLY GLU GLU ALA GLU GLY ASP GLU ASP GLU ASN M4627 Y4630 E4634 G4637 Y4638 L4643 A4678 D4694 D4695 P4712 S4713 N4714 Y4715 V4720 G4729 D4730 D4744 L4745 A4746 S4747 L4748 E4749 I4750 T4751 A4752 H4753 N4754 E4755 ARG LYS PRO ASP
PRO PRO PRO GLY LEU LEU THR TRP LEU MET SER I4771 Y4775 Y4791 N4806 D4815 V4820 V4838 M4839 R4860 D4868 E4869 D4870 D4877 Y4888 D4917 Q4949 D4953 D4966 E4982 M5013 D5020 R5029 D5034 S5037

4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C4	Depositor
Number of particles used	242300	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/Å^2$)	50	Depositor
Minimum defocus (nm)	500	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (4k x 4k)	Depositor
Maximum map value	0.862	Depositor
Minimum map value	0.000	Depositor
Average map value	0.002	Depositor
Map value standard deviation	0.019	Depositor
Recommended contour level	0.086	Depositor
Map size (Å)	477.696, 477.696, 477.696	wwPDB
Map dimensions	512, 512, 512	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.933, 0.933, 0.933	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CA, ZN, ATP

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	#$\|Z\|$ >5	RMSZ	#$\|Z\|$ >5
1	A	0.17	0/830	0.39	0/1119
1	C	0.17	0/830	0.39	0/1119
1	E	0.17	0/830	0.39	0/1119
1	G	0.17	0/830	0.39	0/1119
2	B	0.17	0/33922	0.37	0/46035
2	D	0.17	0/33922	0.37	0/46035
2	F	0.17	0/33922	0.37	0/46035
2	H	0.17	0/33922	0.37	0/46035
All	All	0.17	0/139008	0.37	0/188616

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	814	0	810	3	0
1	C	814	0	810	4	0
1	E	814	0	810	4	0
1	G	814	0	810	3	0
2	B	33163	0	32318	172	0

Continued on next page...

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	D	33163	0	32318	170	0
2	F	33163	0	32318	176	0
2	H	33163	0	32318	173	0
3	B	1	0	0	0	0
3	D	1	0	0	0	0
3	F	1	0	0	0	0
3	H	1	0	0	0	0
4	B	1	0	0	0	0
4	D	1	0	0	0	0
4	F	1	0	0	0	0
4	H	1	0	0	0	0
5	B	31	0	12	0	0
5	D	31	0	12	0	0
5	F	31	0	12	0	0
5	H	31	0	12	0	0
All	All	136040	0	132560	674	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 3.

The worst 5 of 674 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:2165:LEU:HB2	2:B:2178:MET:HE2	1.72	0.72
2:B:4820:VAL:HG11	2:D:4839:MET:SD	2.30	0.72
2:F:2165:LEU:HB2	2:F:2178:MET:HE2	1.72	0.72
2:D:4820:VAL:HG11	2:F:4839:MET:SD	2.30	0.71
2:B:4839:MET:SD	2:H:4820:VAL:HG11	2.30	0.71

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	105/110 (96%)	103 (98%)	2 (2%)	0	100	100
1	C	105/110 (96%)	103 (98%)	2 (2%)	0	100	100
1	E	105/110 (96%)	103 (98%)	2 (2%)	0	100	100
1	G	105/110 (96%)	103 (98%)	2 (2%)	0	100	100
2	B	4210/5037 (84%)	4158 (99%)	52 (1%)	0	100	100
2	D	4210/5037 (84%)	4158 (99%)	52 (1%)	0	100	100
2	F	4210/5037 (84%)	4158 (99%)	52 (1%)	0	100	100
2	H	4210/5037 (84%)	4158 (99%)	52 (1%)	0	100	100
All	All	17260/20588 (84%)	17044 (99%)	216 (1%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains (i)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	87/90 (97%)	86 (99%)	1 (1%)	65	79
1	C	87/90 (97%)	86 (99%)	1 (1%)	65	79
1	E	87/90 (97%)	86 (99%)	1 (1%)	65	79
1	G	87/90 (97%)	86 (99%)	1 (1%)	65	79
2	B	3486/4277 (82%)	3469 (100%)	17 (0%)	81	89
2	D	3486/4277 (82%)	3469 (100%)	17 (0%)	81	89
2	F	3486/4277 (82%)	3469 (100%)	17 (0%)	81	89
2	H	3486/4277 (82%)	3469 (100%)	17 (0%)	81	89
All	All	14292/17468 (82%)	14220 (100%)	72 (0%)	78	89

5 of 72 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	H	575	LEU
2	H	4571	PHE

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
2	H	885	THR
2	H	2617	SER
2	D	1022	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 234 such sidechains are listed below:

Mol	Chain	Res	Type
2	D	4832	HIS
2	H	3897	ASN
2	F	2032	GLN
2	H	3667	HIS
2	H	1938	GLN

5.3.3 RNA

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 12 ligands modelled in this entry, 8 are monoatomic - leaving 4 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
5	ATP	D	5303	-	32,33,33	0.26	0	48,52,52	0.30	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
5	ATP	H	5303	-	32,33,33	0.26	0	48,52,52	0.30	0
5	ATP	B	5303	-	32,33,33	0.26	0	48,52,52	0.30	0
5	ATP	F	5303	-	32,33,33	0.26	0	48,52,52	0.30	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	ATP	D	5303	-	-	8/22/38/38	0/3/3/3
5	ATP	H	5303	-	-	8/22/38/38	0/3/3/3
5	ATP	B	5303	-	-	8/22/38/38	0/3/3/3
5	ATP	F	5303	-	-	8/22/38/38	0/3/3/3

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 32 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	B	5303	ATP	C5'-O5'-PA-O1A
5	B	5303	ATP	C5'-O5'-PA-O2A
5	B	5303	ATP	C5'-O5'-PA-O3A
5	D	5303	ATP	C5'-O5'-PA-O1A
5	D	5303	ATP	C5'-O5'-PA-O2A

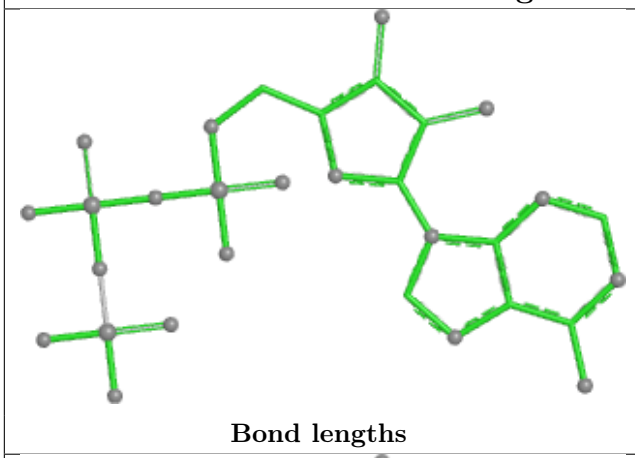
There are no ring outliers.

No monomer is involved in short contacts.

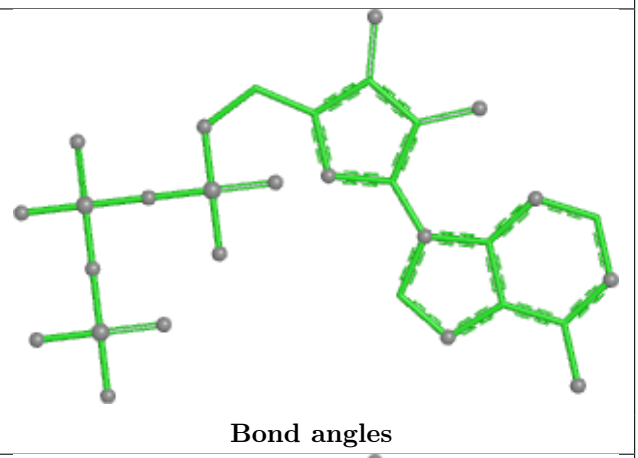
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient

equivalents in the CSD to analyse the geometry.

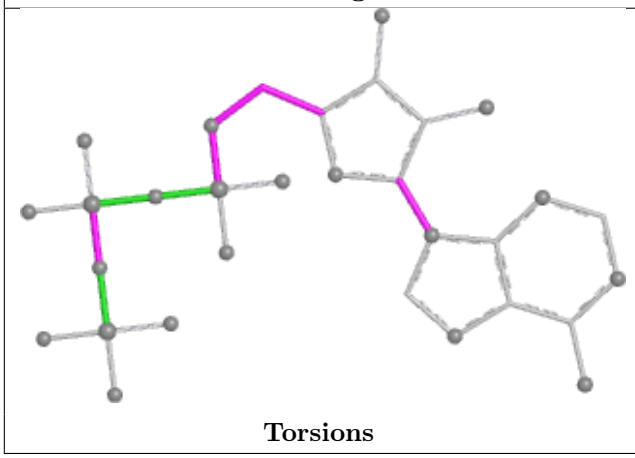
Ligand ATP D 5303



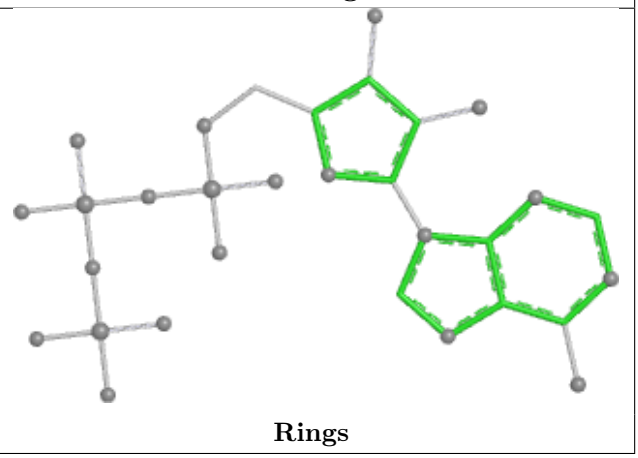
Bond lengths



Bond angles

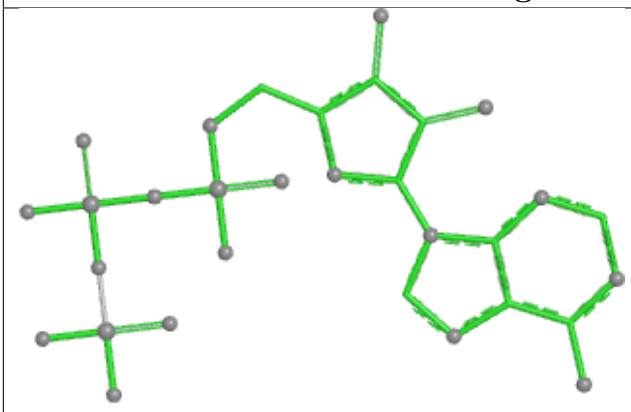


Torsions

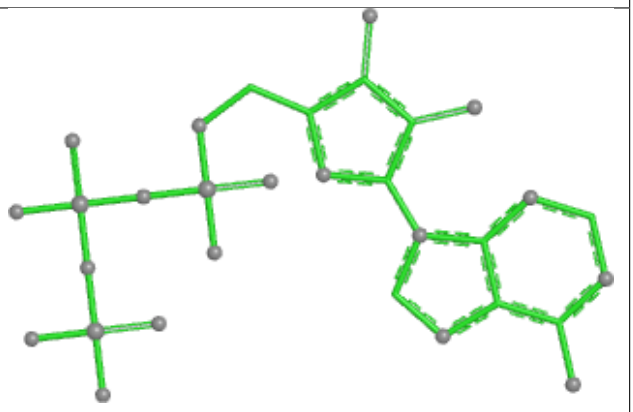


Rings

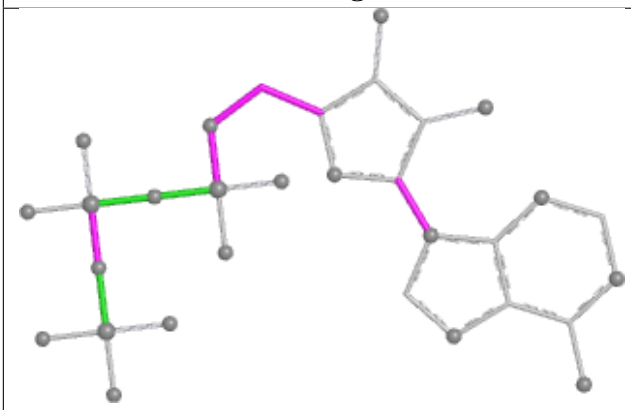
Ligand ATP H 5303



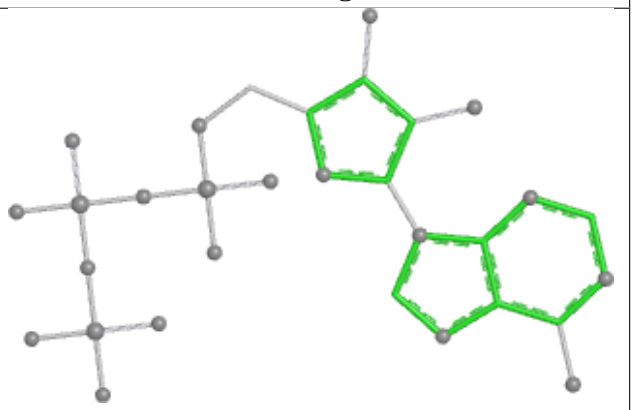
Bond lengths



Bond angles

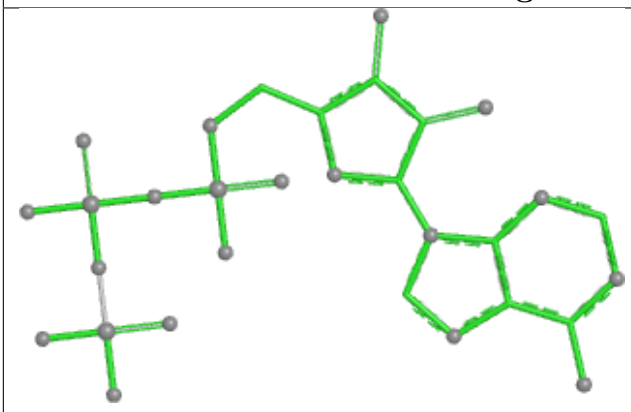


Torsions

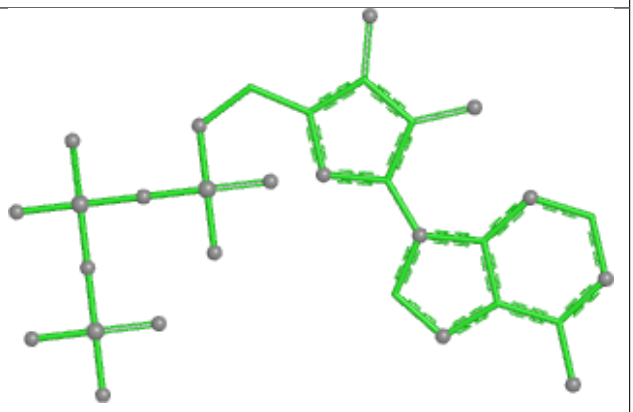


Rings

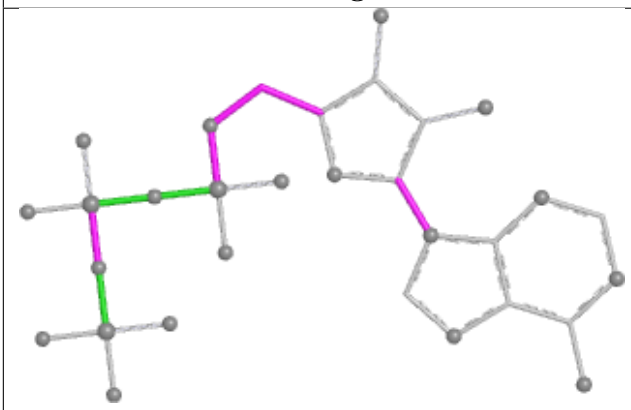
Ligand ATP B 5303



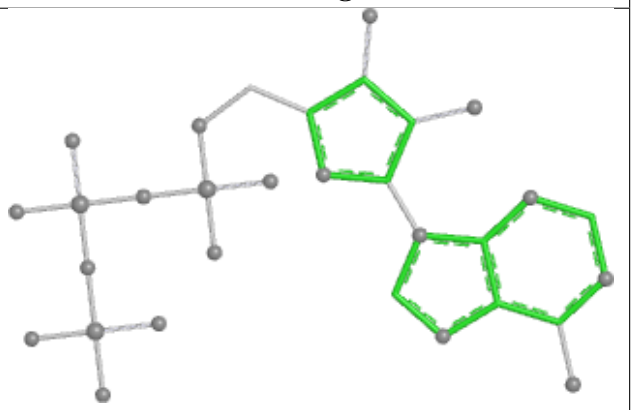
Bond lengths



Bond angles

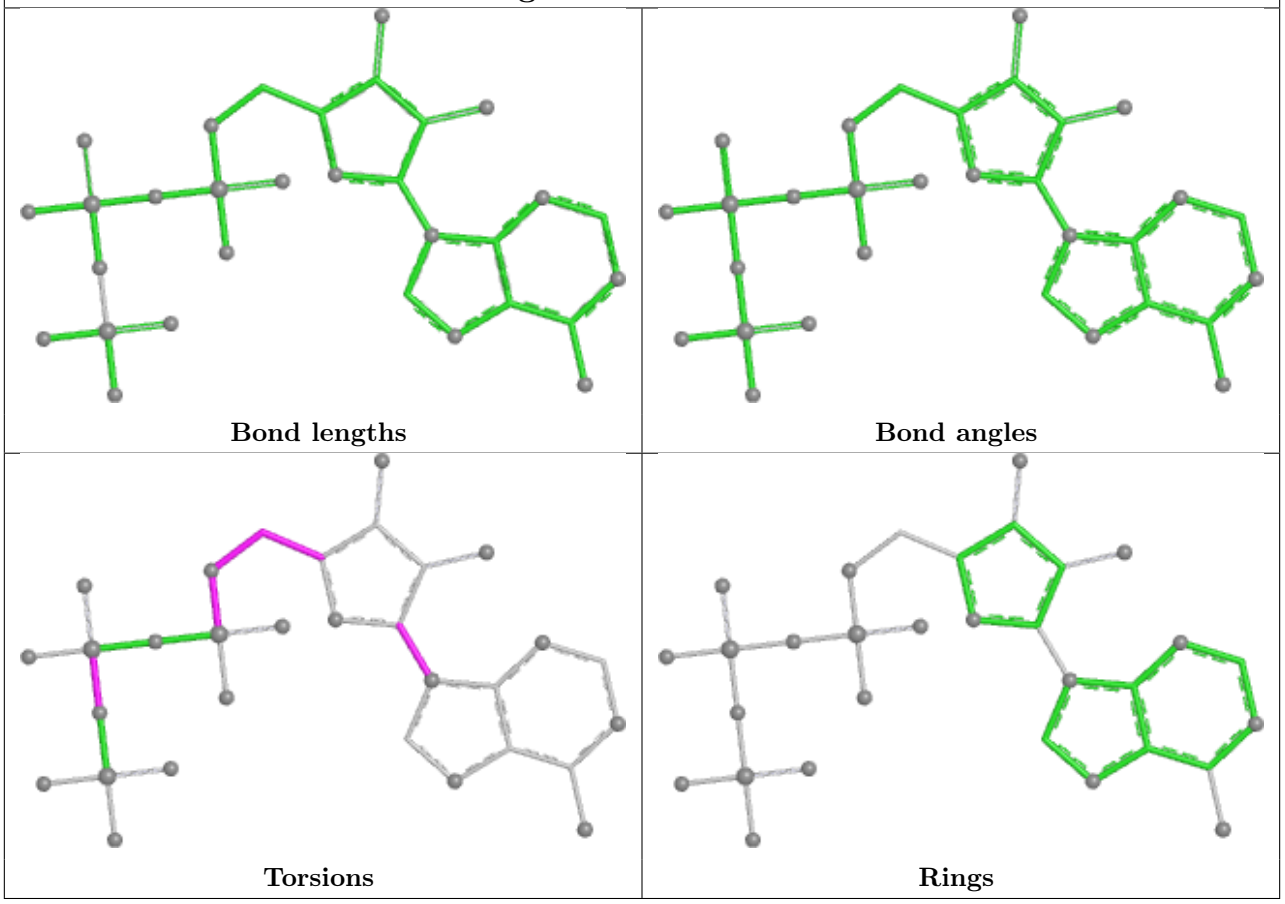


Torsions



Rings

Ligand ATP F 5303



5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

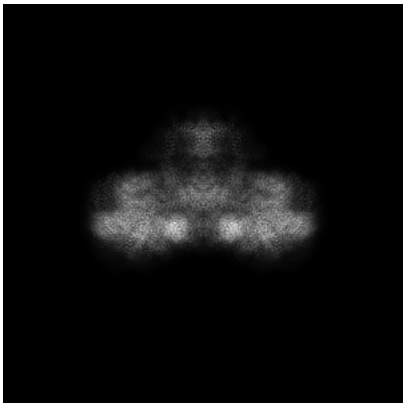
6 Map visualisation

This section contains visualisations of the EMDB entry EMD-73952. These allow visual inspection of the internal detail of the map and identification of artifacts.

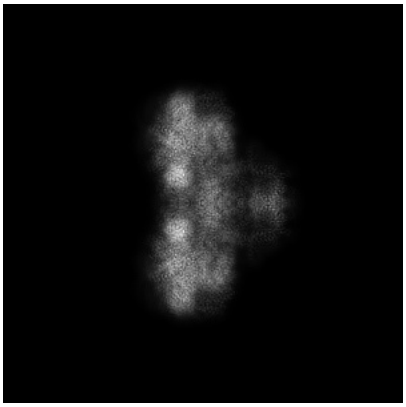
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections

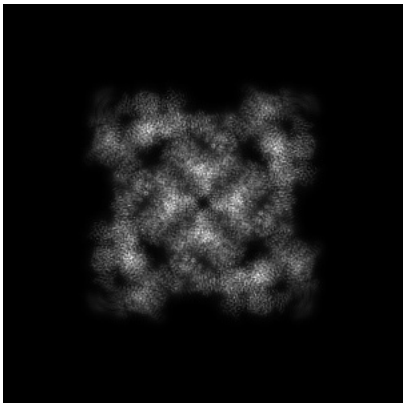
6.1.1 Primary map



X



Y

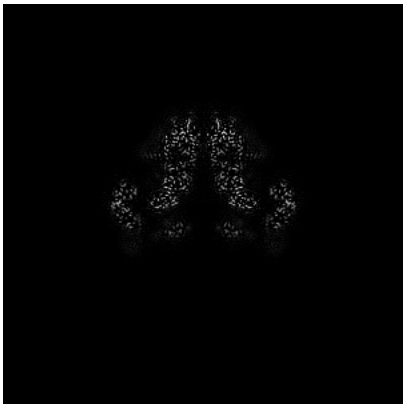


Z

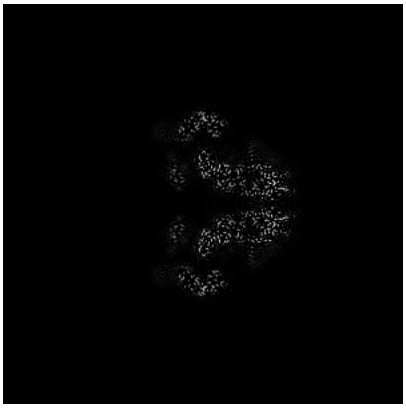
The images above show the map projected in three orthogonal directions.

6.2 Central slices

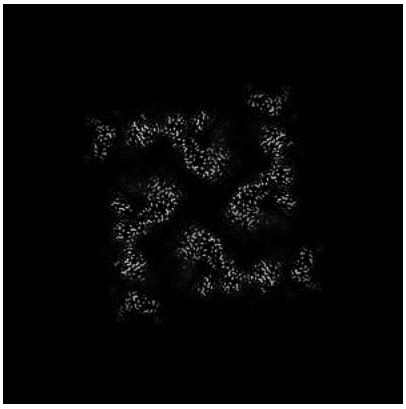
6.2.1 Primary map



X Index: 256



Y Index: 256

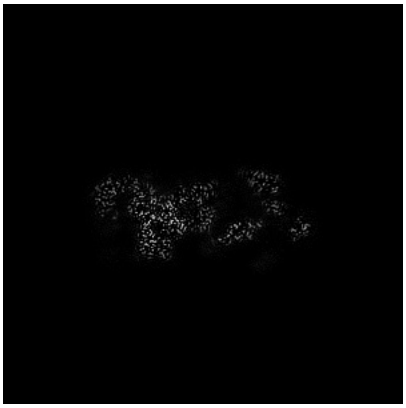


Z Index: 256

The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices (i)

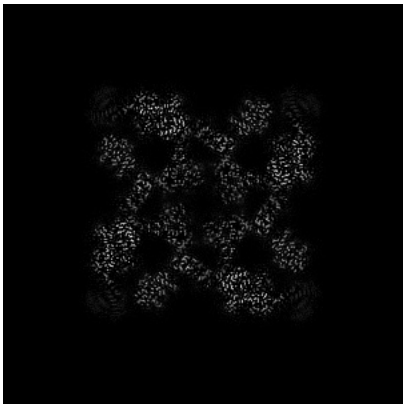
6.3.1 Primary map



X Index: 161



Y Index: 351

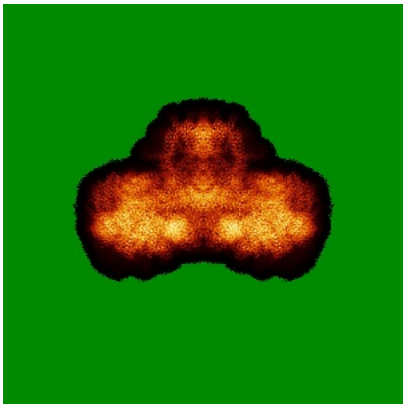


Z Index: 231

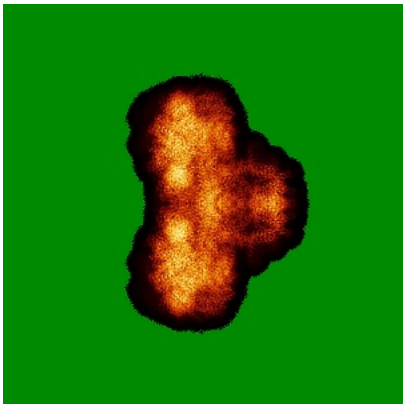
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal standard-deviation projections (False-color) (i)

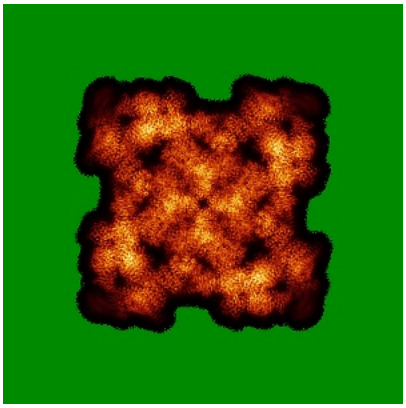
6.4.1 Primary map



X



Y



Z

The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

6.5 Orthogonal surface views (i)

6.5.1 Primary map



X Y Z

The images above show the 3D surface view of the map at the recommended contour level 0.086. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

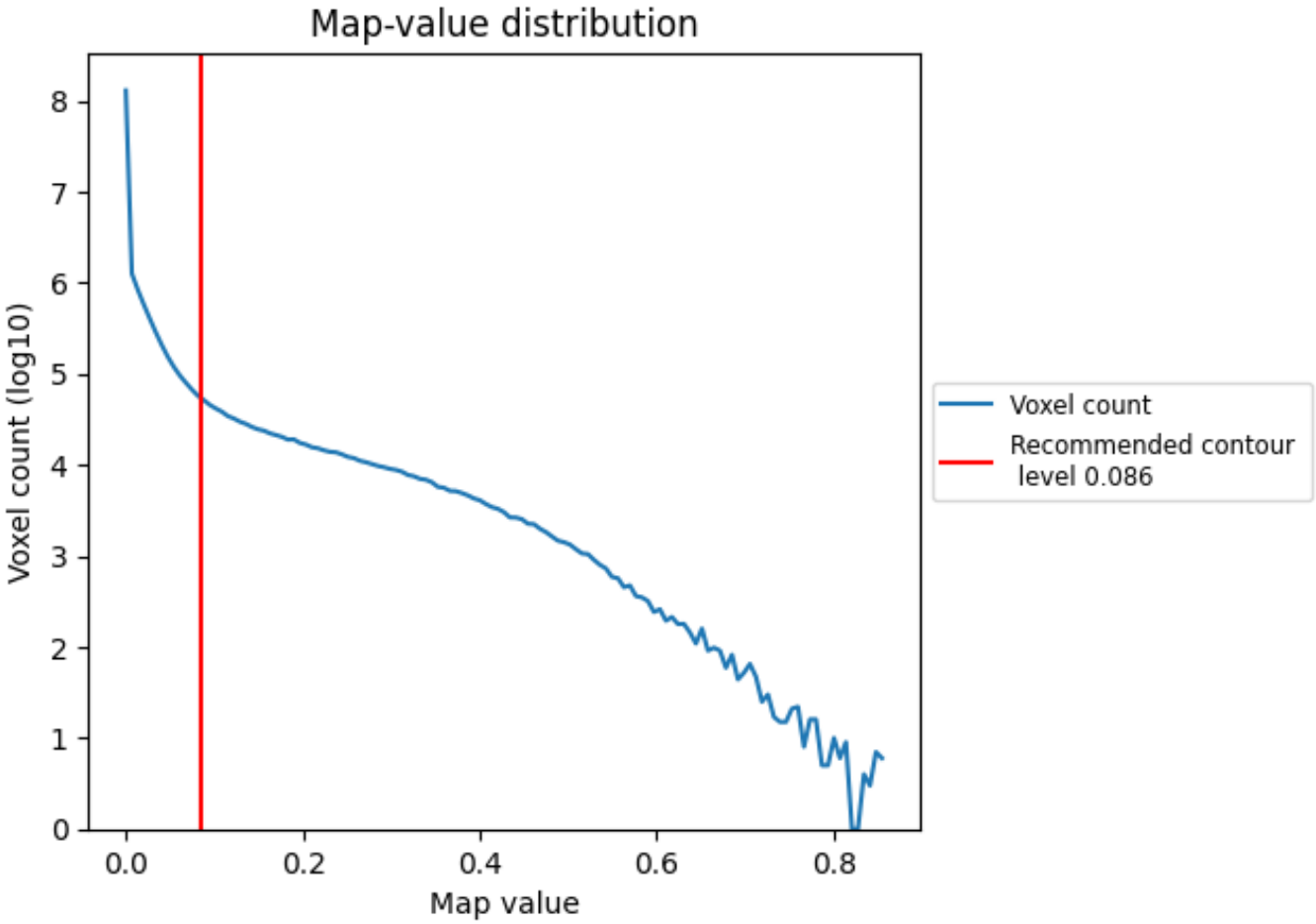
6.6 Mask visualisation (i)

This section was not generated. No masks/segmentation were deposited.

7 Map analysis

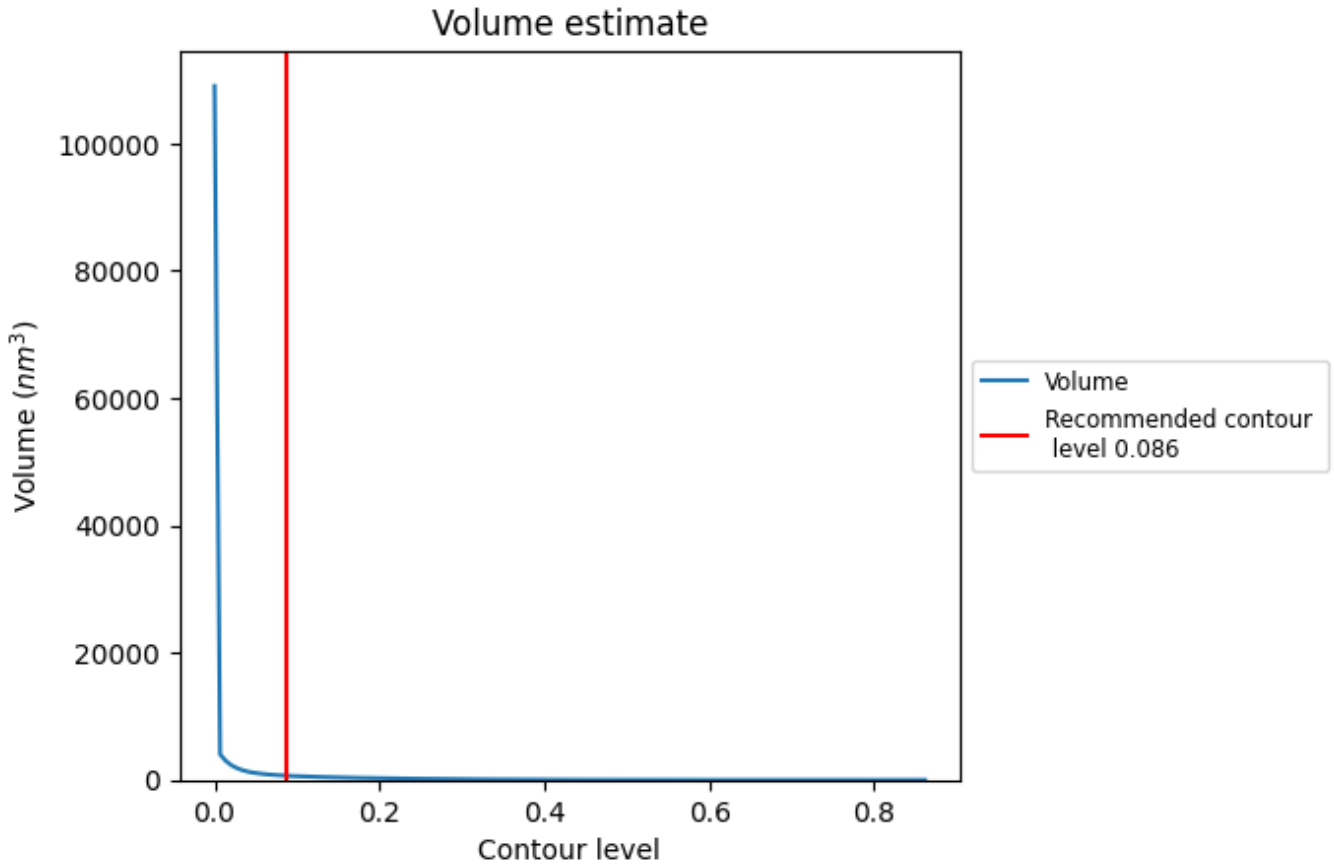
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution



The map-value distribution is plotted in 128 intervals along the x-axis. The y-axis is logarithmic. A spike in this graph at zero usually indicates that the volume has been masked.

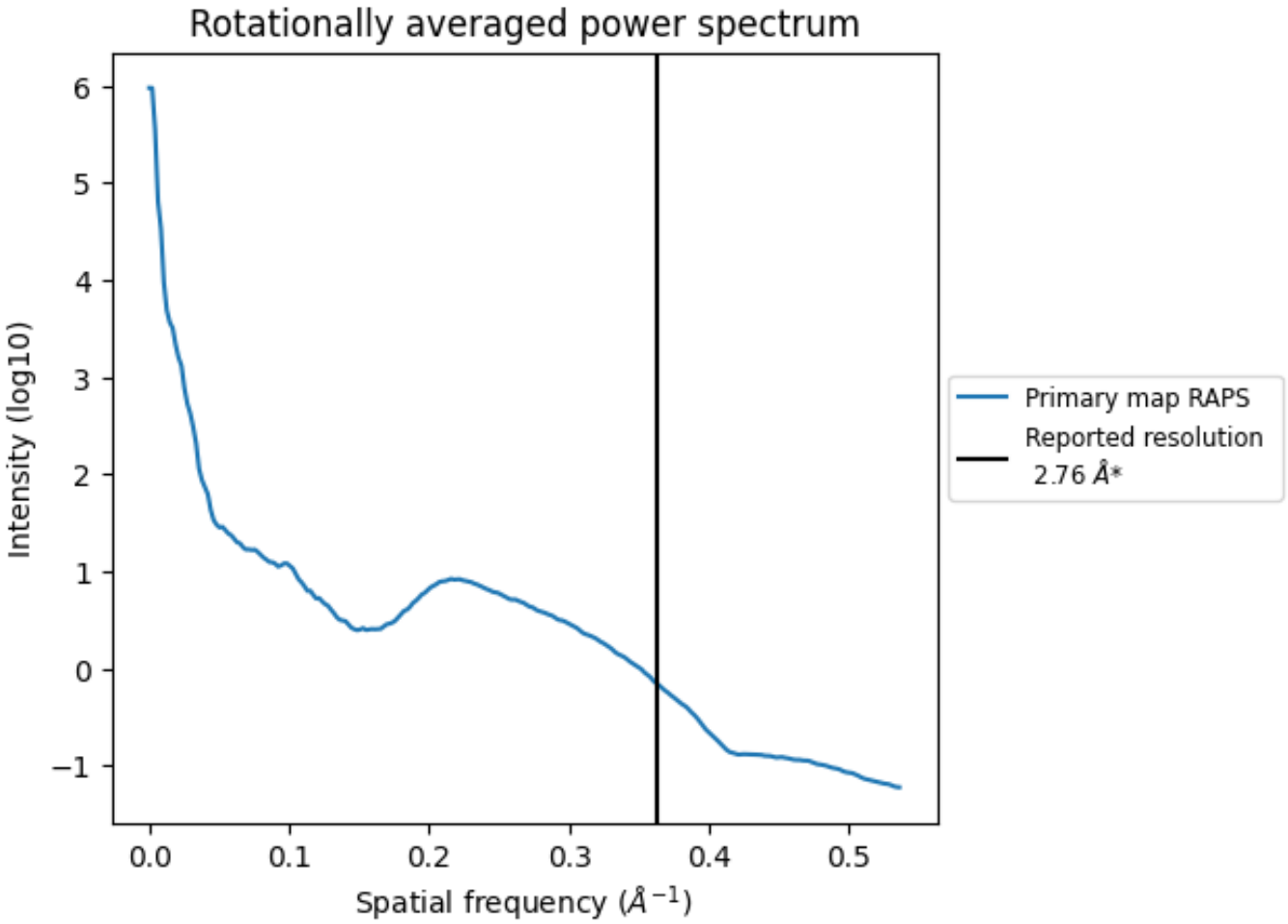
7.2 Volume estimate (i)



The volume at the recommended contour level is 681 nm^3; this corresponds to an approximate mass of 615 kDa.

The volume estimate graph shows how the enclosed volume varies with the contour level. The recommended contour level is shown as a vertical line and the intersection between the line and the curve gives the volume of the enclosed surface at the given level.

7.3 Rotationally averaged power spectrum (i)



*Reported resolution corresponds to spatial frequency of 0.362 Å^{-1}

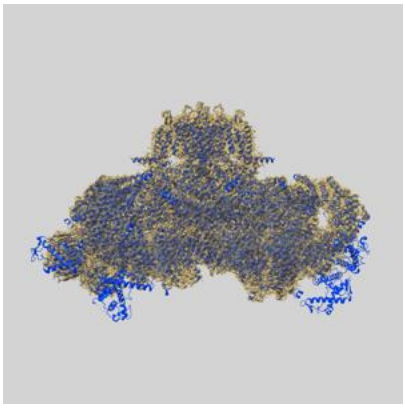
8 Fourier-Shell correlation

This section was not generated. No FSC curve or half-maps provided.

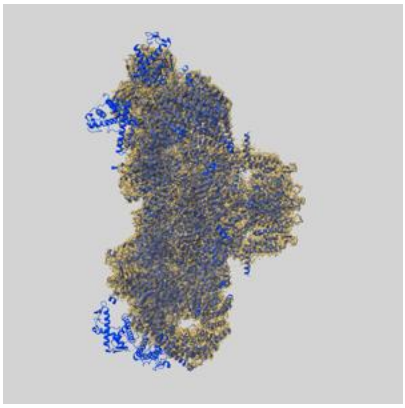
9 Map-model fit

This section contains information regarding the fit between EMDB map EMD-73952 and PDB model 9Z9N. Per-residue inclusion information can be found in section 3 on page 8.

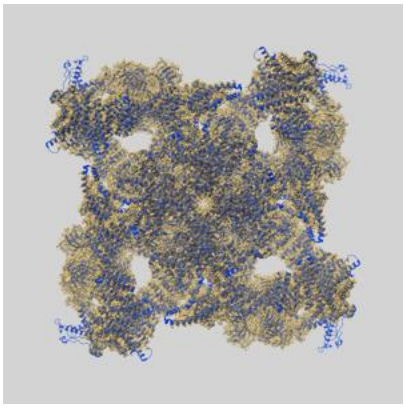
9.1 Map-model overlay



X



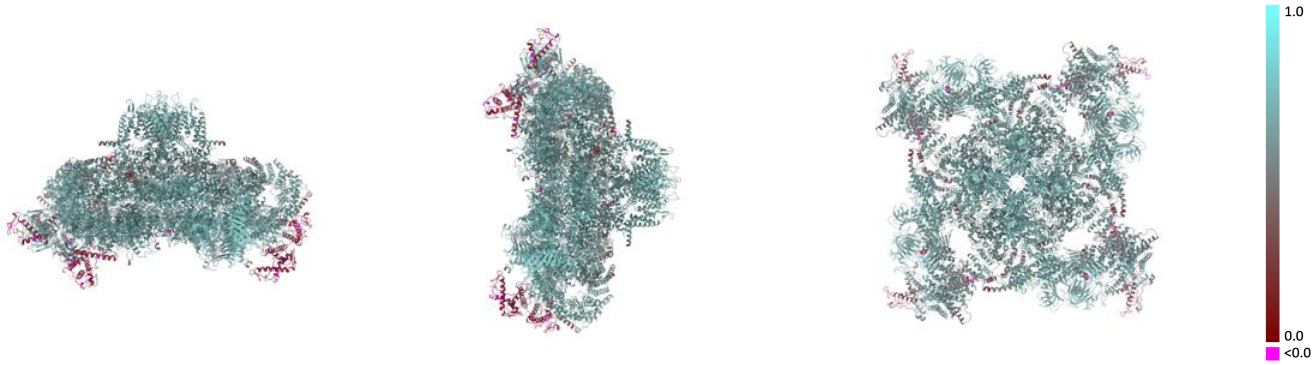
Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.086 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

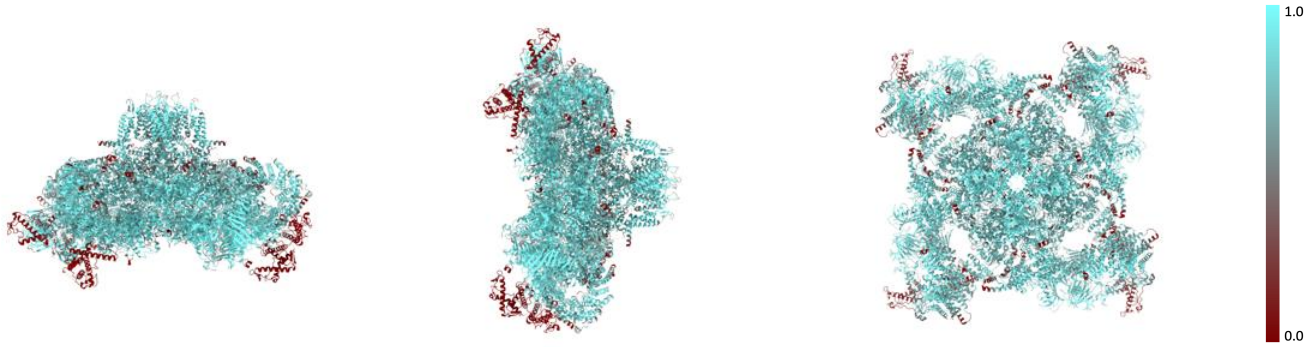
9.2 Q-score mapped to coordinate model (i)



X Y Z

The images above show the model with each residue coloured according its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions at which atoms can be resolved. Low Q-score values may therefore be expected for many entries.

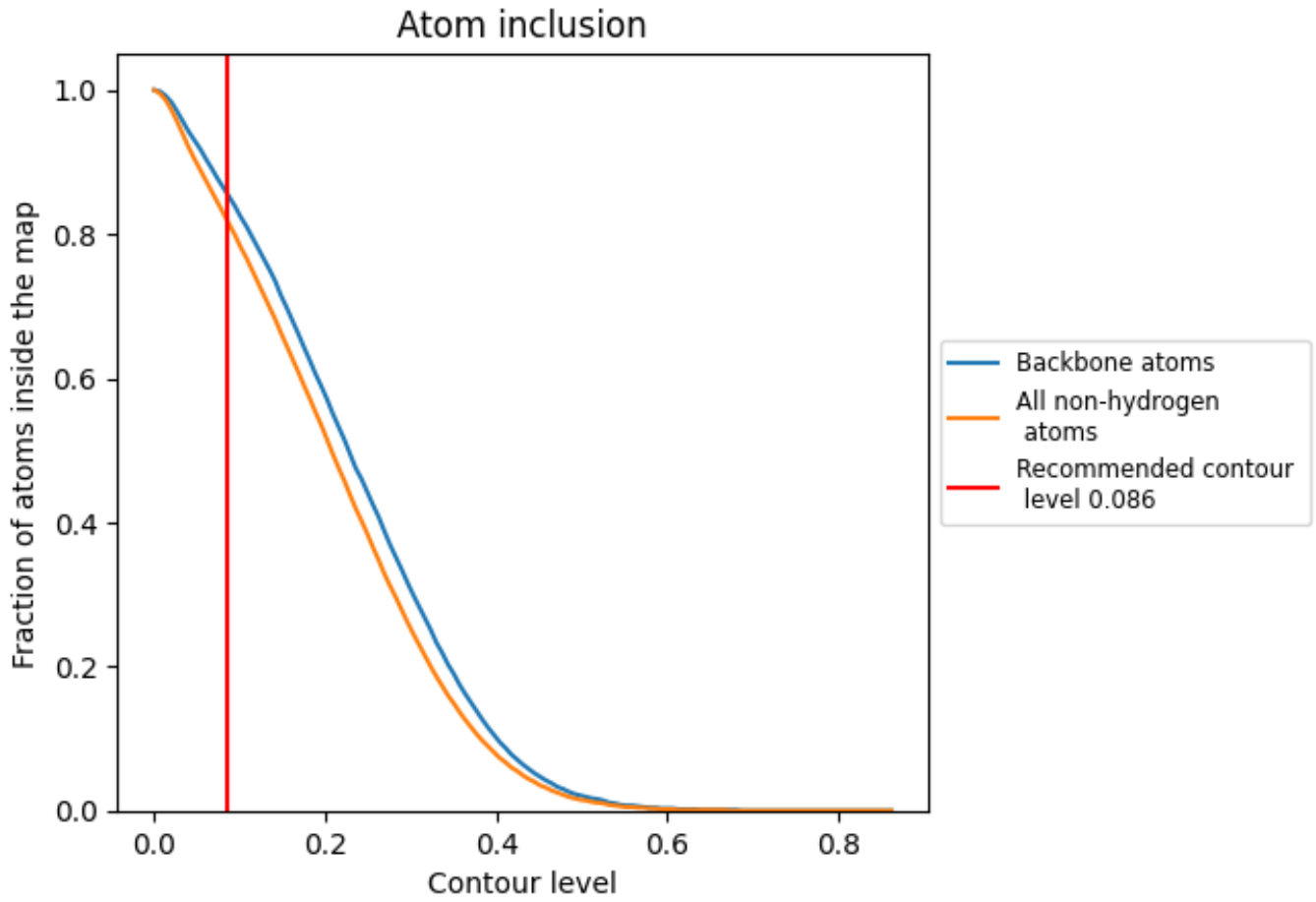
9.3 Atom inclusion mapped to coordinate model (i)



X Y Z

The images above show the model with each residue coloured according to its atom inclusion. This shows to what extent they are inside the map at the recommended contour level (0.086).

9.4 Atom inclusion (i)



At the recommended contour level, 86% of all backbone atoms, 82% of all non-hydrogen atoms, are inside the map.

9.5 Map-model fit summary (i)

The table lists the average atom inclusion at the recommended contour level (0.086) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.8170	0.6150
A	0.9410	0.6850
B	0.8150	0.6140
C	0.9390	0.6860
D	0.8140	0.6140
E	0.9410	0.6840
F	0.8140	0.6130
G	0.9400	0.6850
H	0.8140	0.6140

