



wwPDB EM Validation Summary Report ⓘ

Mar 19, 2024 – 01:59 PM JST

PDB ID : 5GO9
EMDB ID : EMD-9528
Title : Cryo-EM structure of RyR2 in closed state
Authors : Peng, W.; Wu, J.P.; Yan, N.
Deposited on : 2016-07-26
Resolution : 4.40 Å(reported)

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 ⓘ 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 ⓘ](#)) were used in the production of this report:

EMDB validation analysis : 0.0.1.dev70
MolProbity : 4.02b-467
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

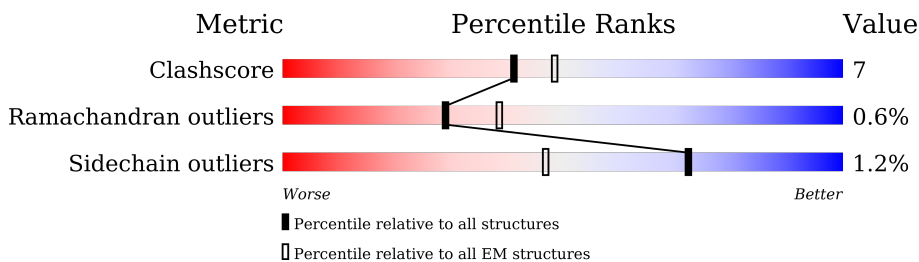
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 4.40 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)
Clashscore	158937	4297
Ramachandran outliers	154571	4023
Sidechain outliers	154315	3826

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 $\leq 5\%$. 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	4968	
1	B	4968	
1	C	4968	
1	D	4968	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 105068 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 RyR2.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	3423	26266	16740	4498	4874	154	0	0
1	B	3423	26266	16740	4498	4874	154	0	0
1	C	3423	26266	16740	4498	4874	154	0	0
1	D	3423	26266	16740	4498	4874	154	0	0

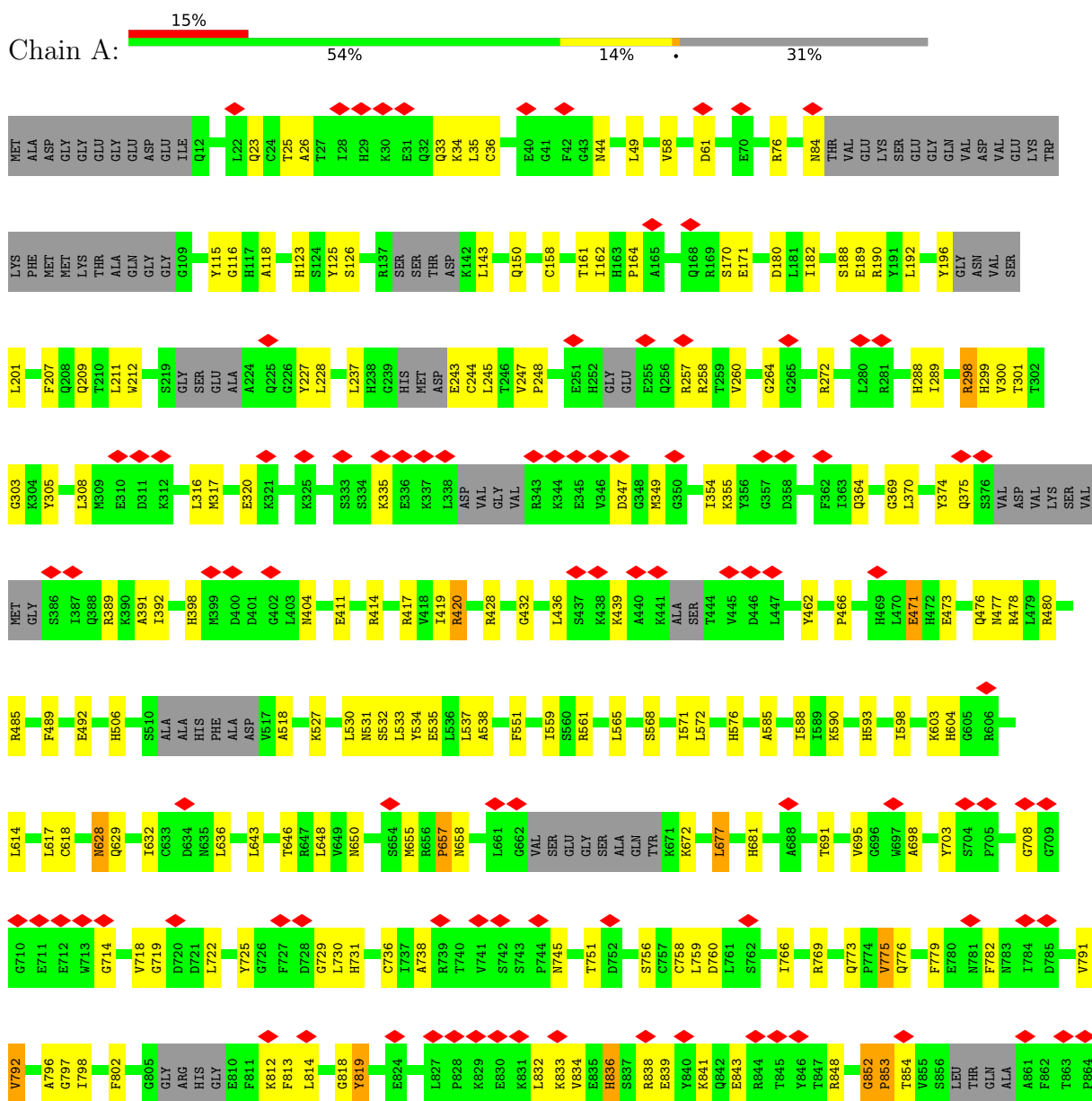
- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

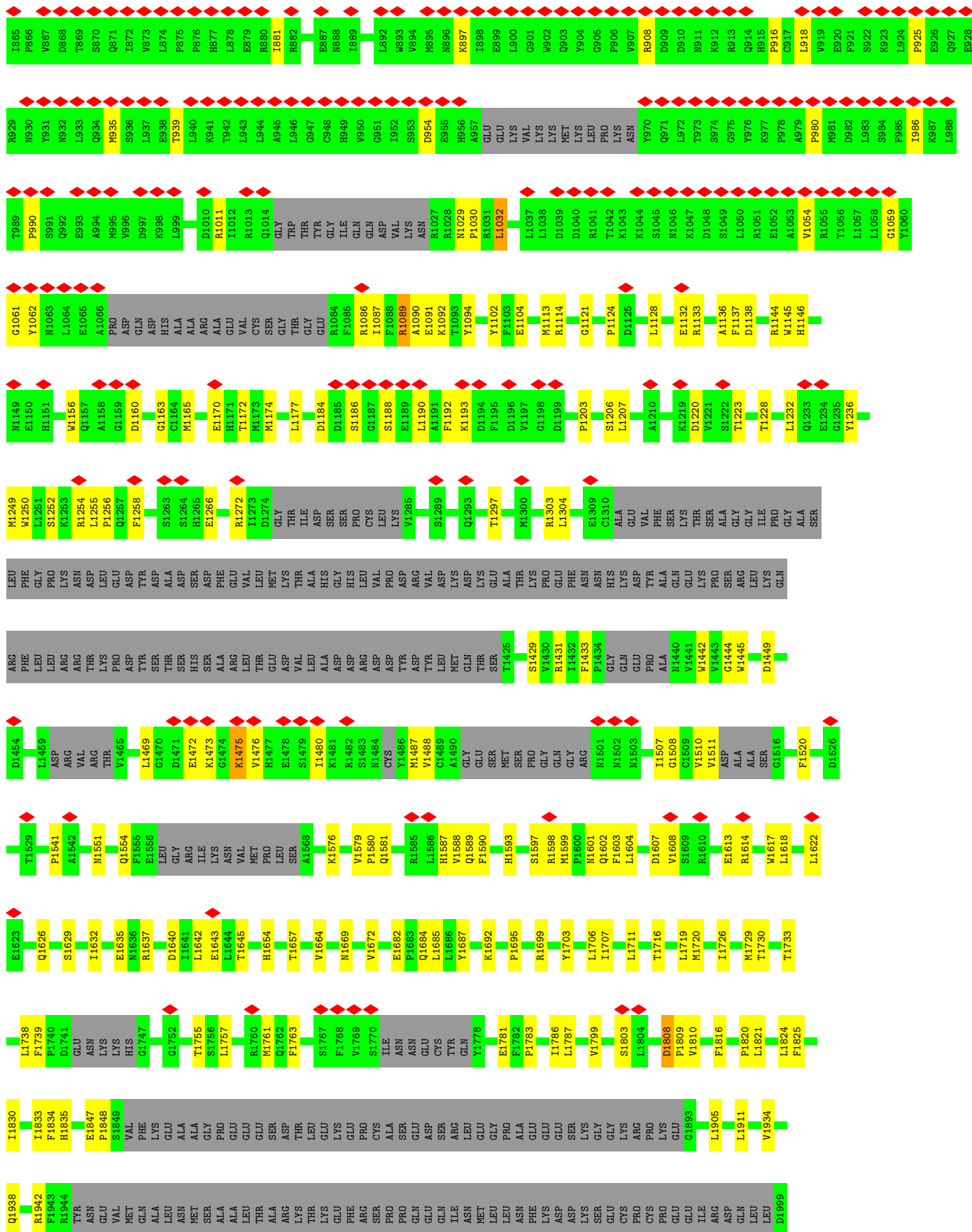
Mol	Chain	Residues	Atoms		AltConf
			Total	Zn	
2	A	1	1	1	0
2	B	1	1	1	0
2	C	1	1	1	0
2	D	1	1	1	0

3 Residue-property plots [i](#)

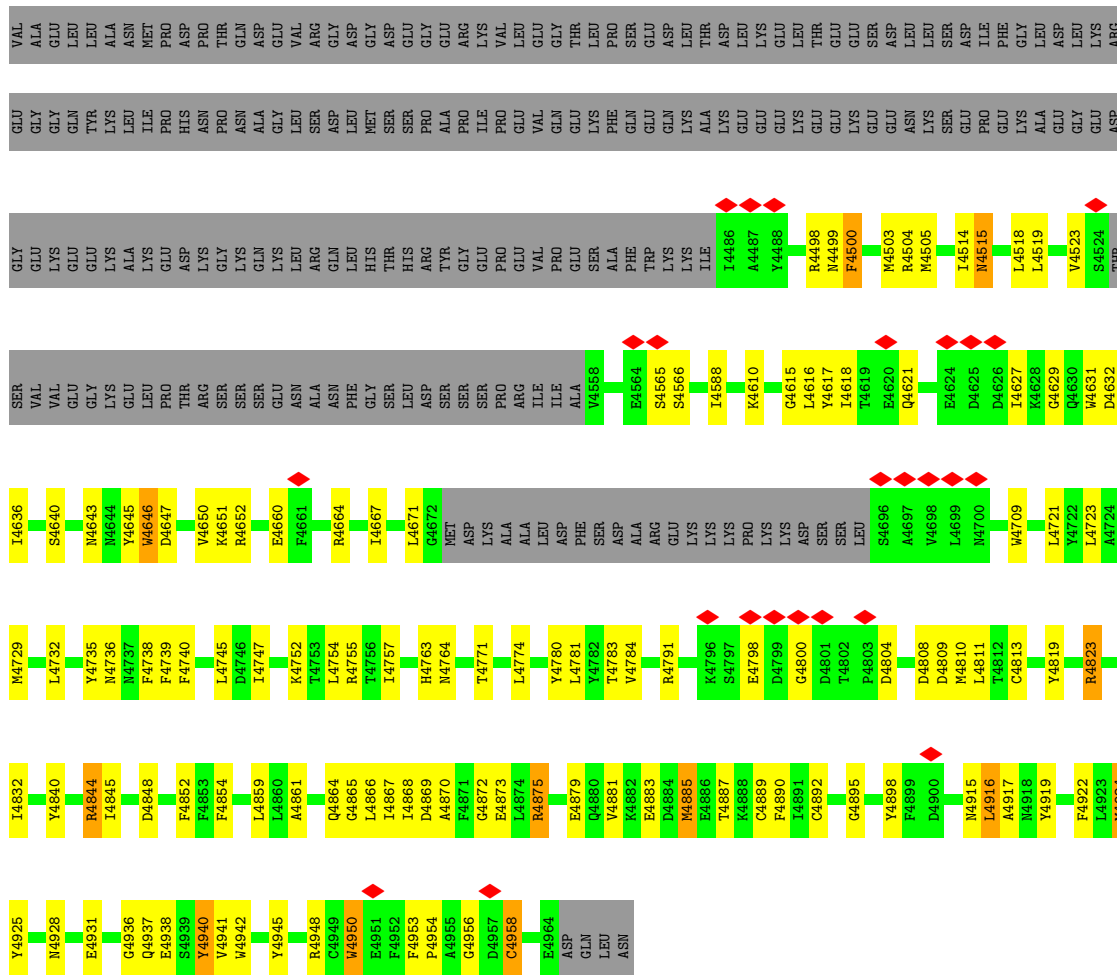
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion 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: RyR2

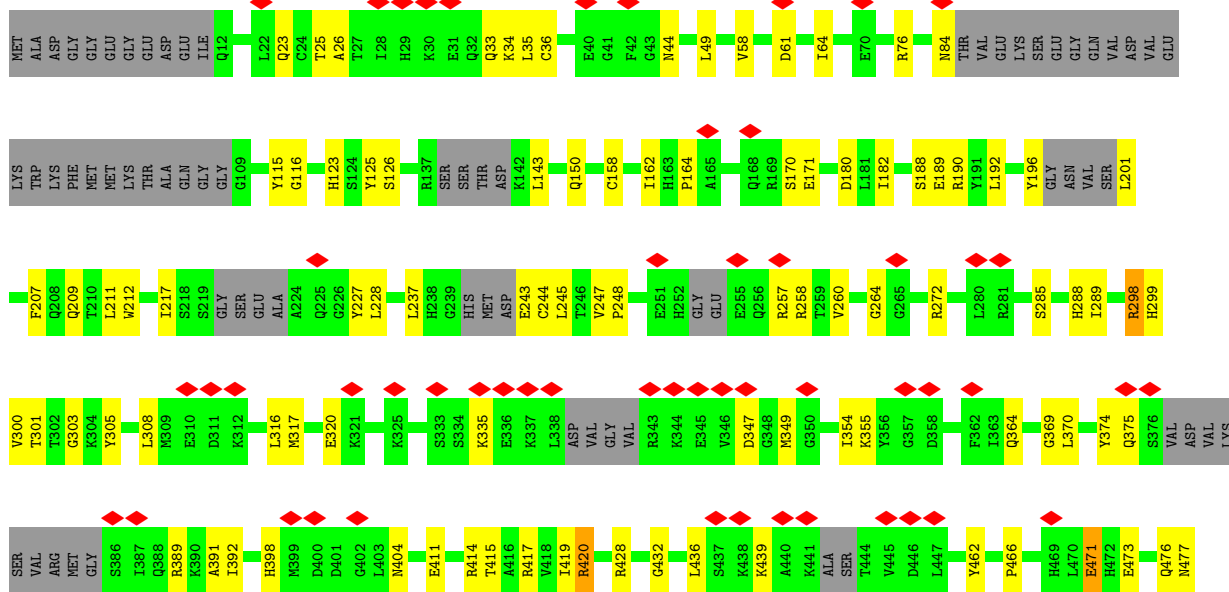


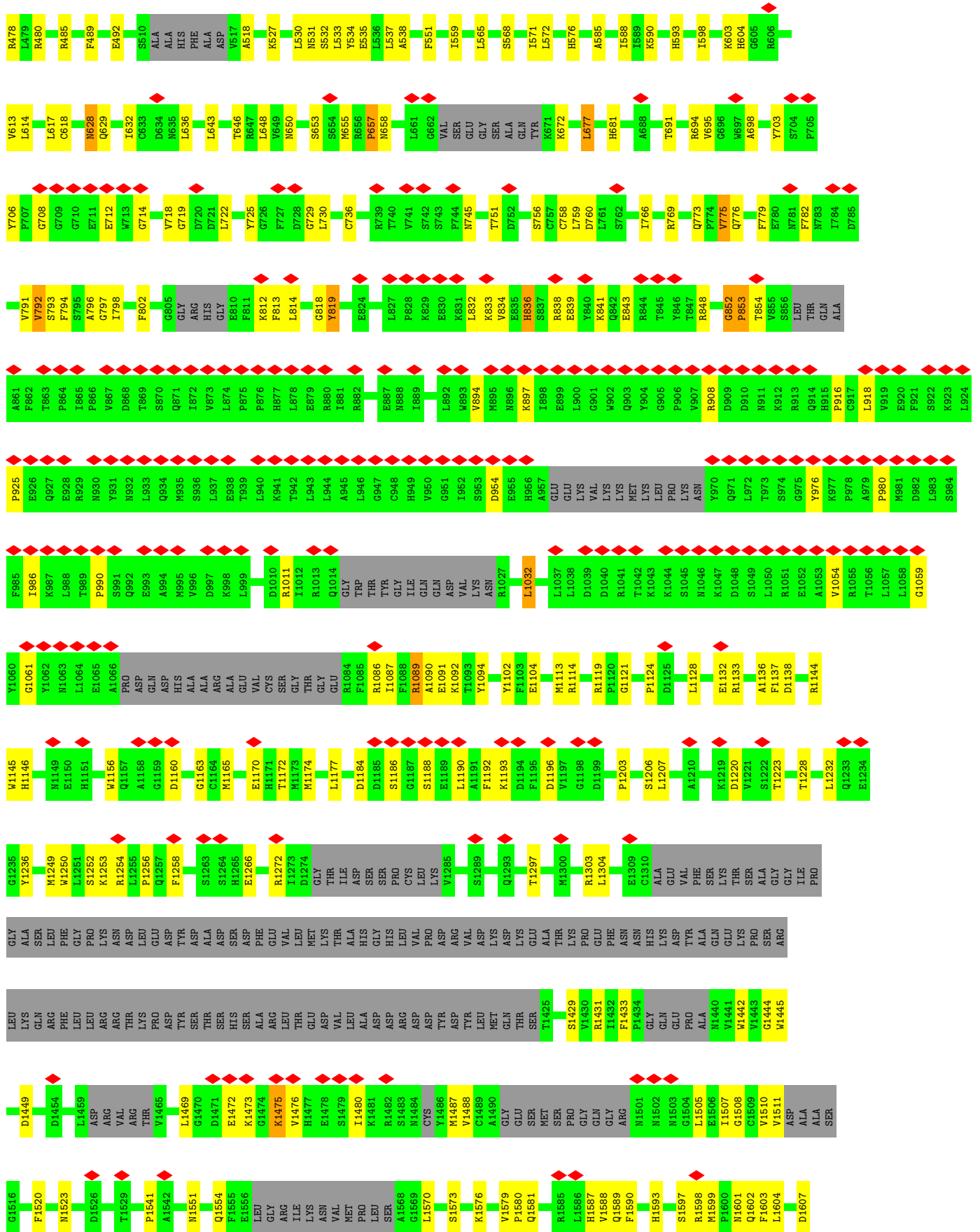


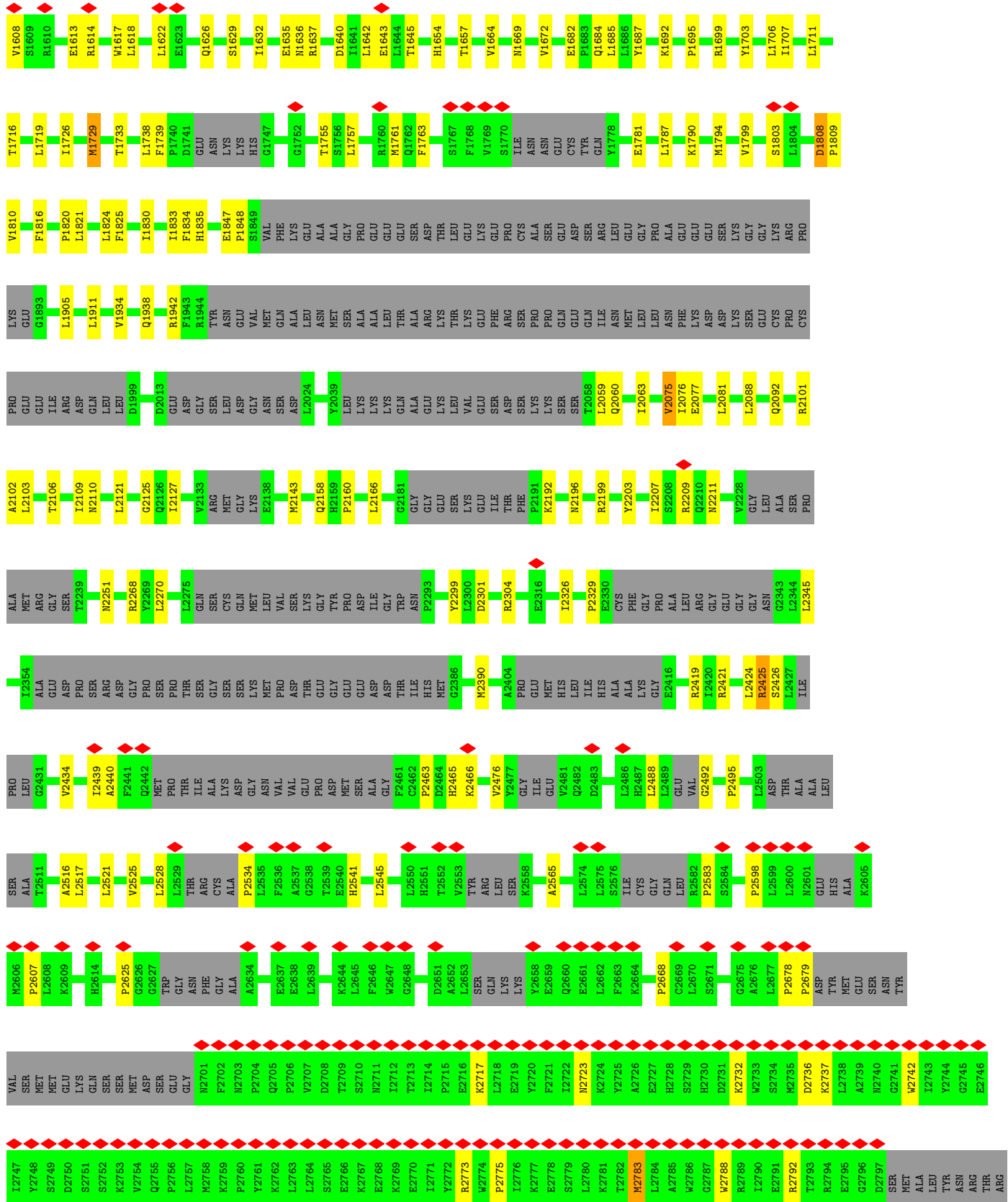
L2951	R2268	L2270	L2275	GLN	GLY	SER	ASN	ASP	L2024	L2039	Y2059	K2154	Q2158	H2159	P2160	L2166	G2181	GLY	GLU	VAL	GLU	SER	L2058	L2059	Q2060	L2063	R2069	V2075	L2076	E2077	L2081	L2088	Q2092	R2101	A2102	L2103	T2106	L2109	L2121																					
G2125	R2128	V2133	ARG	MET	GLY	ASP	ASN	ASP	L2024	L2039	Y2059	K2154	Q2158	H2159	P2160	L2166	G2181	GLY	GLU	VAL	GLU	SER	L2058	L2059	Q2060	L2063	R2069	V2075	L2076	E2077	L2081	L2088	Q2092	R2101	A2102	L2103	T2106	L2109	L2121																					
M2251	R2268	L2270	L2275	GLN	GLY	SER	ASN	ASP	L2024	L2039	Y2059	K2154	Q2158	H2159	P2160	L2166	G2181	GLY	GLU	VAL	GLU	SER	L2058	L2059	Q2060	L2063	R2069	V2075	L2076	E2077	L2081	L2088	Q2092	R2101	A2102	L2103	T2106	L2109	L2121																					
ARG	ASP	GLY	PRO	PRO	THR	SER	SER	SER	GLN	LEU	ASN	VAL	SER	THR	GLY	TYR	PRO	ASP	ILE	TRP	ASN	F2293	Y2299	L2300	D2301	R2304	E2316	I2326	F2329	E2330	CYS	PHE	GLY	PRO	ALA	LEU	GLY	GLY	ASN	G2343	L2344	L2345	T2354	ALA	ASP	PRO	SER													
A2440	F2441	Q2442	MET	THR	ILE	ALA	LYS	ASP	GLY	ASN	ASN	VAL	VAL	GLU	PRO	ASP	GLY	ALA	GLY	F2461	G2462	D2464	H2465	K2466	V2476	Y2477	ILE	GLU	V2481	Q2482	D2483	L2486	H2487	L2488	L2489	GLU	VAL	G2492	P2495	L2503	ASP	THR	ALA	ALA	LEU	SER	ALA	T2511	A2516	L2517										
L2521	V2525	L2528	L2529	THR	ARG	CYS	ALA	P2534	L2535	F2536	A2537	G2538	T2539	L2550	H2551	T2552	V2553	TYR	ARG	LEU	SER	K2558	A2565	L2574	L2575	S2576	ILE	CYS	GLY	GLN	LEU	R2582	P2583	S2584	P2598	L2599	L2600	M2601	GLU	HIS	ALA	K2605	M2606	P2607	L2608	K2609	H2614	P2625	G2626	G2627	TRP									
GLY	ASN	PHE	GLY	ALA	A2634	E2637	E2638	L2639	K2644	L2645	F2646	W2647	G2648	D2651	A2652	L2653	SER	GLN	LYS	LYS	Y2658	E2659	Q2660	E2661	L2662	F2663	K2664	P2668	C2669	L2670	S2671	G2675	A2676	P2678	P2679	ASP	TYR	MET	GLU	ALA	K2605	M2606	P2607	L2608	K2609	H2614	P2625	G2626	G2627	TRP										
SER	GLU	GLY	M2701	F2702	M2703	F2704	Q2705	F2706	V2707	D2708	E2708	K2709	S2710	M2711	L2712	T2713	L2714	P2715	E2716	K2717	L2718	E2719	S2720	F2721	L2722	M2723	K2724	V2725	A2726	E2727	H2728	S2729	H2730	D2731	K2732	M2733	S2734	M2735	D2736	K2737	L2738	A2739	M2740	G2741	M2742	L2743	Y2744	G2745	E2746	L2747	S2748	D2749	D2750	S2751	S2752	K2753	Y2754	Q2755	L2756	L2757
M2758	K2759	P2760	Y2761	L2762	L2763	L2764	S2765	E2766	K2767	E2768	K2769	E2770	I2771	Y2772	R2773	W2774	P2775	I2776	K2777	E2778	S2779	L2780	K2781	T2782	M2783	L2784	A2785	W2786	G2787	W2788	R2789	I2790	R2791	R2792	T2793	R2794	E2795	G2796	D2797	SER	MET	ALA	LEU	TYR	ASN	ARG	THR	ARG	ILE	ARG	GLN	THR	SER	GLN	VAL	SER	V2816	D2817		
A2818	A2819	H2820	G2821	Y2822	S2823	P2824	R2825	A2826	I2827	D2828	M2829	M2830	M2831	V2832	T2833	L2834	S2835	R2836	D2837	L2838	H2839	A2840	M2841	E2842	E2843	M2844	M2845	A2846	E2847	M2848	Y2849	H2850	M2851	I2852	W2853	A2854	K2855	K2856	K2857	K2858	L2859	E2860	L2861	E2862	S2863	K2864	G2865	G2866	G2867	M2868	H2869	P2870	L2871	L2872	V2873	P2874	Y2875	D2876	T2877	
L2878	T2879	A2880	K2881	E2882	K2883	A2884	K2885	D2886	R2887	E2888	K2889	A2890	Q2891	D2892	L2893	L2894	K2895	F2896	L2897	Q2898	L2899	M2900	G2901	Y2902	A2903	V2904	S2905	R2906	PHE	LYS	ASP	GLU	LEU	GLU	ASP	THR	PRO	SER	ILE	GLU	ARG	HIS	ASN	GLN	LEU	Y2982	F2983	L2984	A2987	S2988	R2989	P2990	L2991	C2992	S2993	G2994	L2995	L2996	A2997	S2998
HIS	GLN	TYR	ILE	LEU	PHE	ASP	GLY	SER	ARG	SER	LYS	GLY	GLU	PHE	THR	VAL	VAL	LEU	PRO	ILE	LEU	PRO	PHE	LYS	ASN	HIS	ARG	LEU	Y2982	F2983	L2984	A2987	S2988	R2989	P2990	L2991	C2992	S2993	G2994	L2995	L2996	A2997	S2998																	
M2999	K3000	E3001	K3002	E3003	M3004	V3005	THR	SER	LEU	F3009	C3010	K3011	L3012	G3013	V3014	L3015	V3016	R3017	H3018	R3019	I3020	S3021	L3022	F3023	G3024	N3025	D3026	A3027	T3028	SER	ILE	VAL	ASN	CYS	L3034	H3035	I3036	L3037	G3038	Q3039	T3040	L3041	D3042	A3043	R3044	T3045	V3046	M3047	K3048	T3049	G3050	L3051	E3052	S3053	V3054	K3055	SER	ALA	LEU	

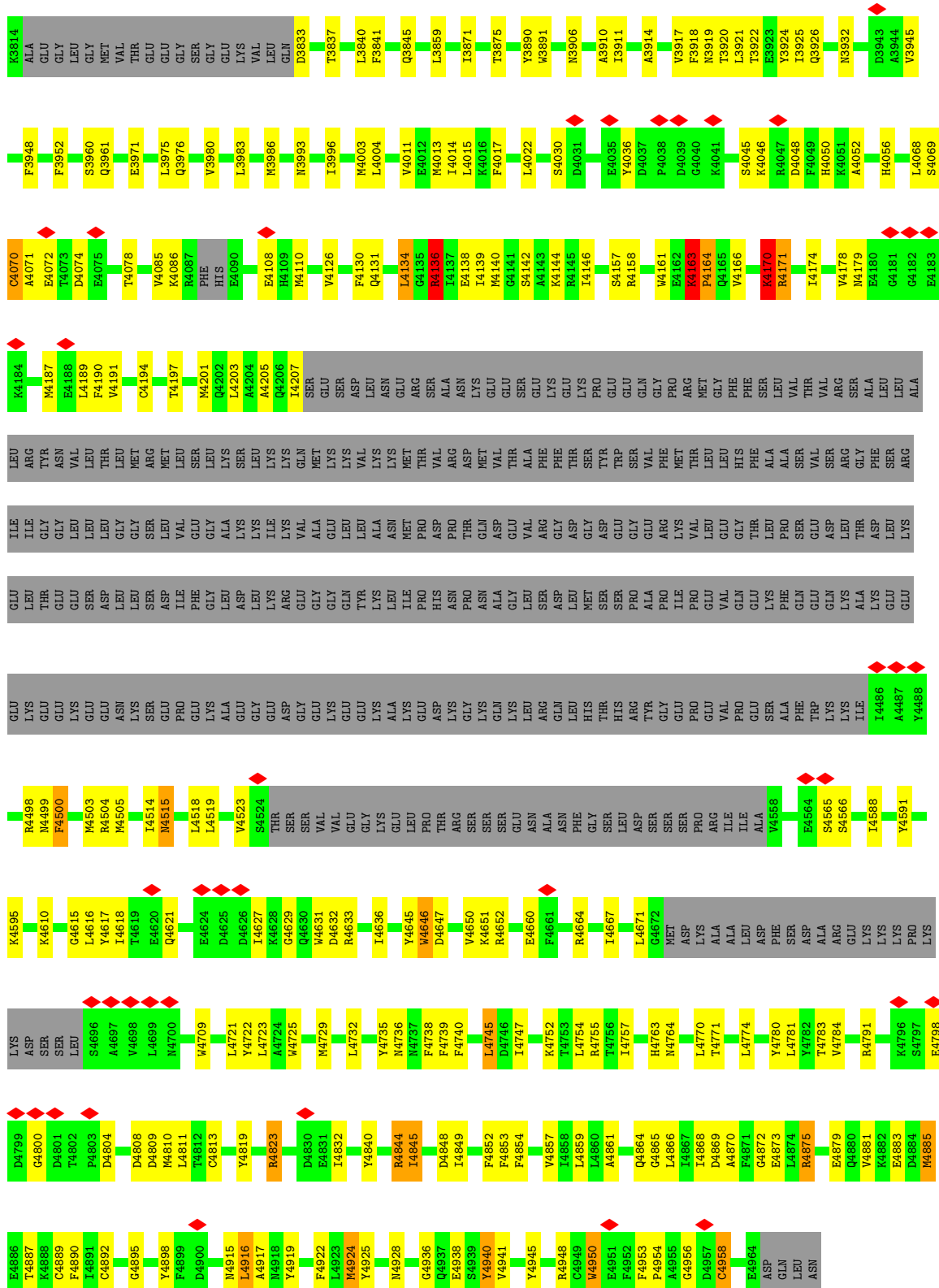


• Molecule 1: RyR2



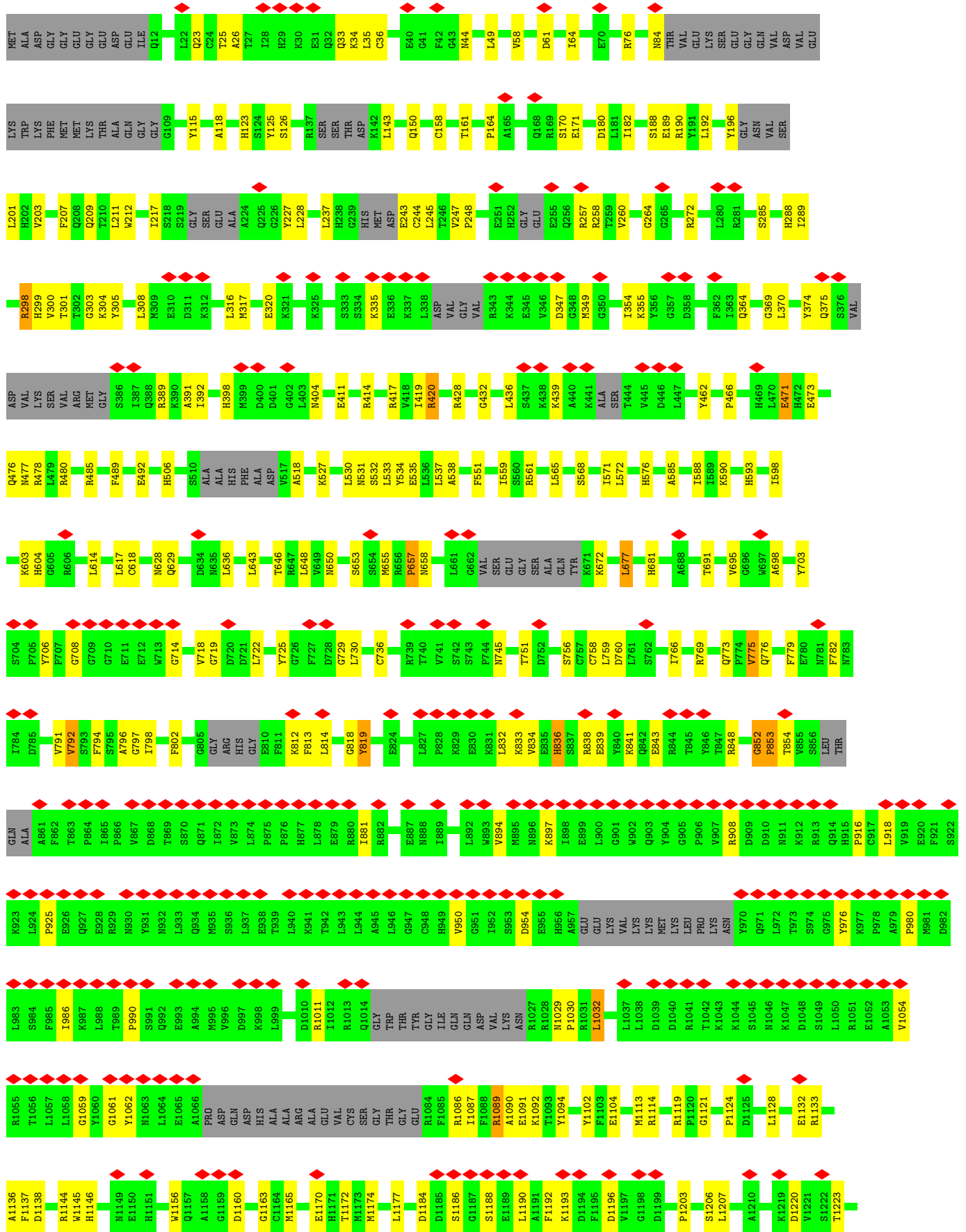


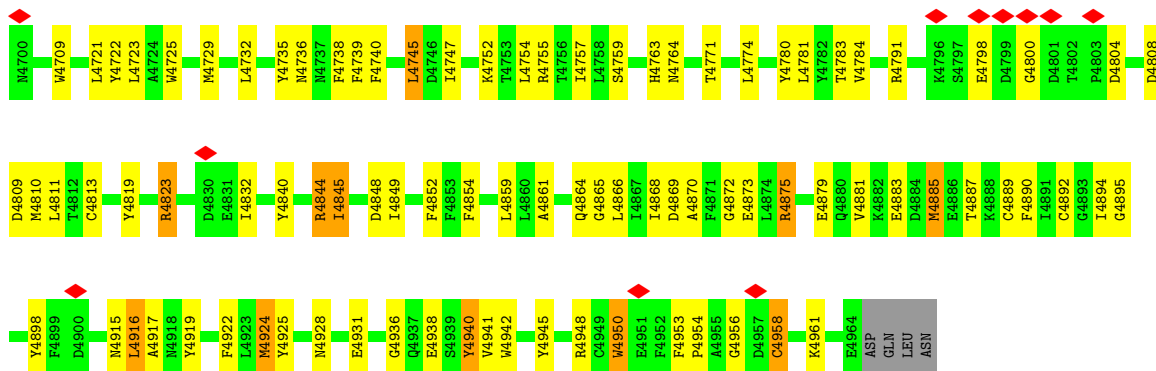




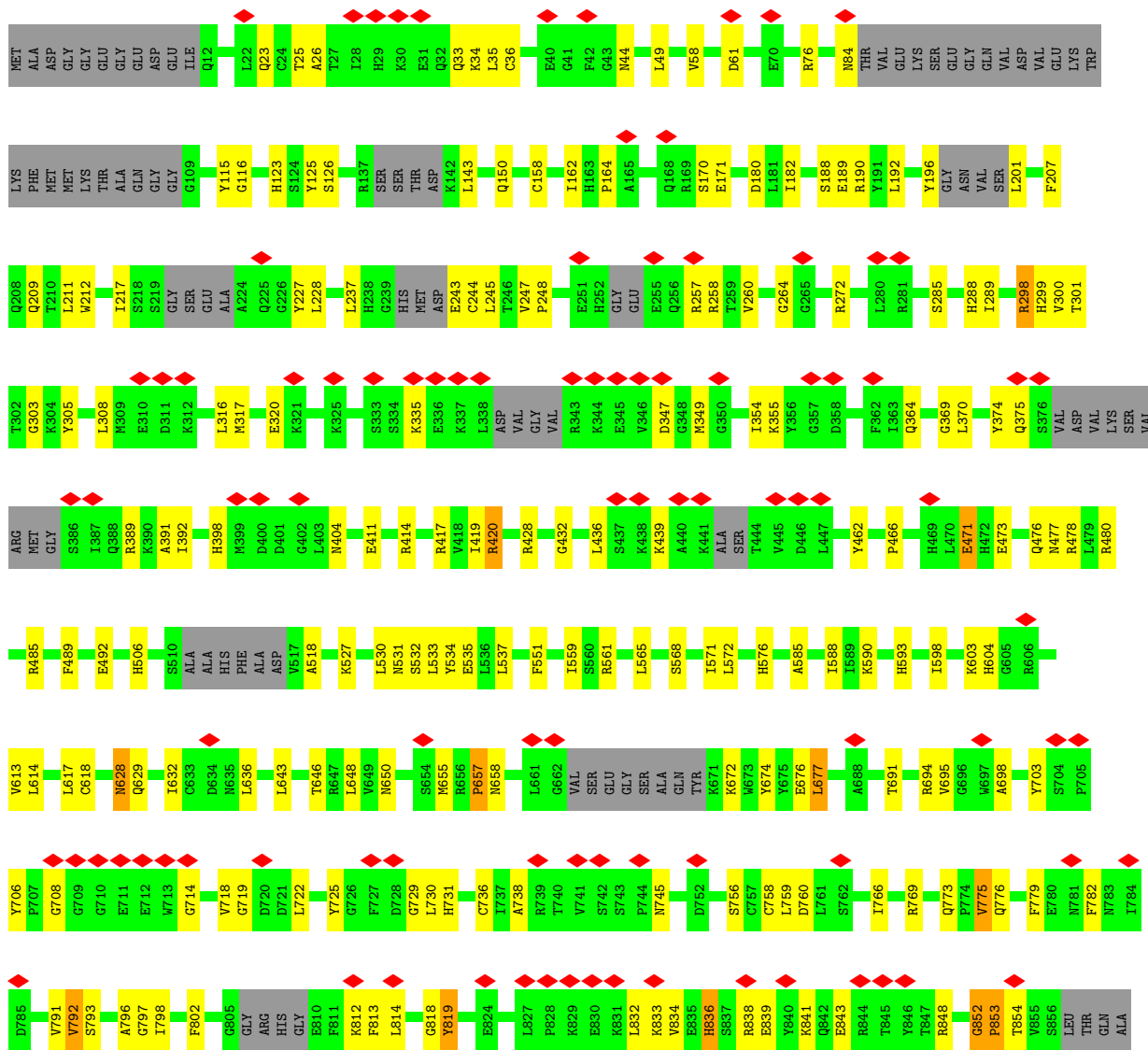
• Molecule 1: RyR2

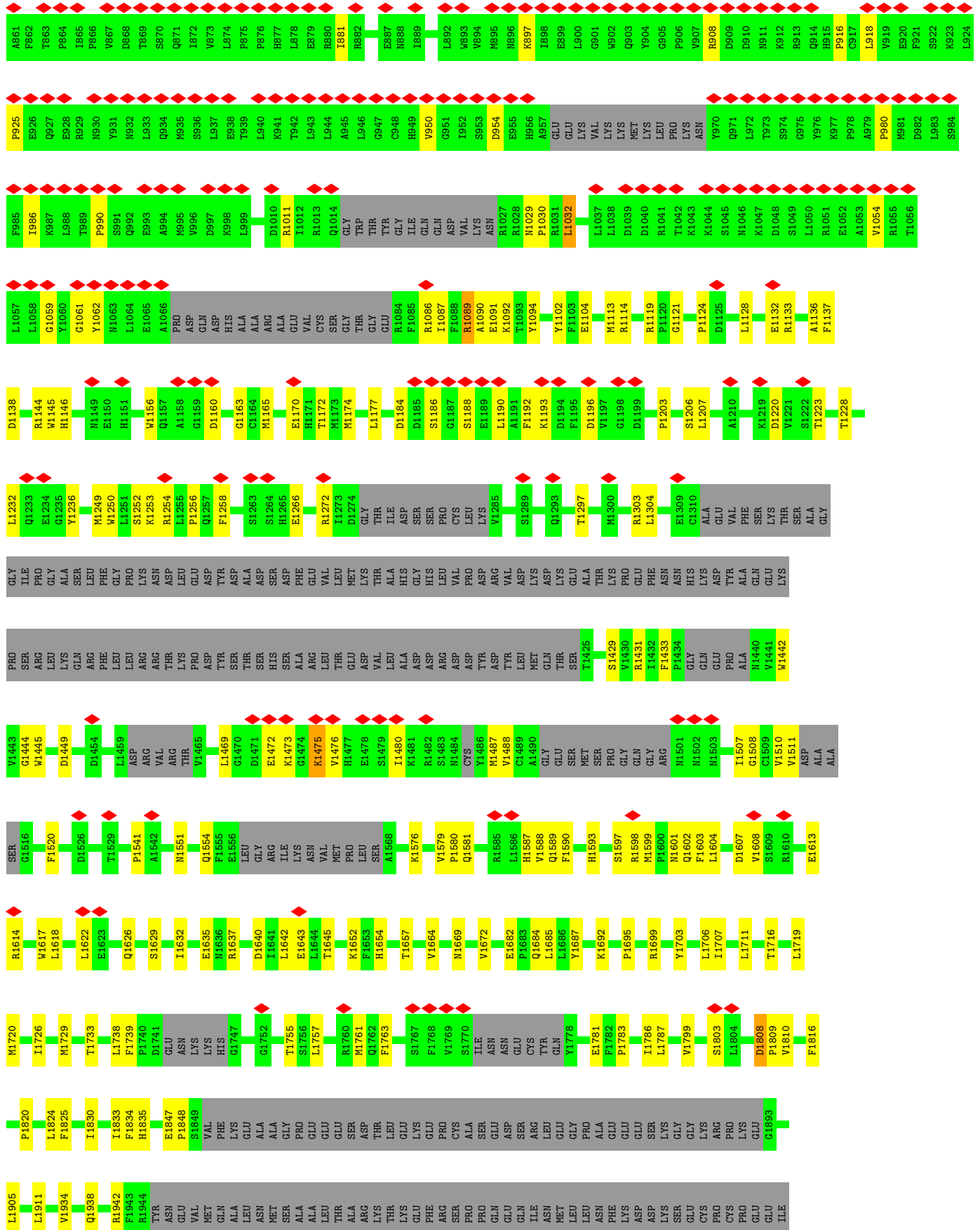






• Molecule 1: RyR2





4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C4	Depositor
Number of particles used	48454	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	44	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	FEI FALCON II (4k x 4k)	Depositor
Maximum map value	0.173	Depositor
Minimum map value	-0.090	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.007	Depositor
Recommended contour level	0.04	Depositor
Map size (Å)	546.0, 546.0, 546.0	wwPDB
Map dimensions	520, 520, 520	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.05, 1.05, 1.05	Depositor

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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

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	0.98	29/26751 (0.1%)	0.94	78/36149 (0.2%)
1	B	0.98	29/26751 (0.1%)	0.94	78/36149 (0.2%)
1	C	0.98	29/26751 (0.1%)	0.94	78/36149 (0.2%)
1	D	0.98	29/26751 (0.1%)	0.94	78/36149 (0.2%)
All	All	0.98	116/107004 (0.1%)	0.94	312/144596 (0.2%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	30
1	B	0	30
1	C	0	30
1	D	0	30
All	All	0	120

The worst 5 of 116 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	4945	TYR	CG-CD1	-10.60	1.25	1.39
1	B	4945	TYR	CG-CD1	-10.60	1.25	1.39
1	C	4945	TYR	CG-CD1	-10.60	1.25	1.39
1	D	4945	TYR	CG-CD1	-10.60	1.25	1.39
1	A	4950	TRP	CE3-CZ3	-9.89	1.21	1.38

The worst 5 of 312 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1089	ARG	NE-CZ-NH2	-9.65	115.48	120.30
1	B	1089	ARG	NE-CZ-NH2	-9.65	115.48	120.30
1	C	1089	ARG	NE-CZ-NH2	-9.65	115.48	120.30
1	D	1089	ARG	NE-CZ-NH2	-9.65	115.48	120.30
1	A	4171	ARG	NE-CZ-NH2	-8.50	116.05	120.30

There are no chirality outliers.

5 of 120 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	471	GLU	Peptide
1	A	657	PRO	Peptide
1	A	729	GLY	Peptide
1	A	775	VAL	Peptide
1	A	791	VAL	Peptide

5.2 Too-close contacts [i](#)

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	26266	0	24898	409	0
1	B	26266	0	24898	421	0
1	C	26266	0	24898	414	0
1	D	26266	0	24898	401	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
All	All	105068	0	99592	1515	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 7.

The worst 5 of 1515 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)
1:A:4873:GLU:HA	1:B:4875:ARG:NH1	1.62	1.15

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:4875:ARG:NH1	1:D:4873:GLU:HA	1.62	1.14
1:B:4873:GLU:HA	1:C:4875:ARG:NH1	1.62	1.13
1:C:4873:GLU:OE1	1:D:4875:ARG:HD3	1.49	1.12
1:C:4873:GLU:HA	1:D:4875:ARG:NH1	1.62	1.12

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	3289/4968 (66%)	2983 (91%)	285 (9%)	21 (1%)	25	65
1	B	3289/4968 (66%)	2983 (91%)	285 (9%)	21 (1%)	25	65
1	C	3289/4968 (66%)	2983 (91%)	285 (9%)	21 (1%)	25	65
1	D	3289/4968 (66%)	2983 (91%)	285 (9%)	21 (1%)	25	65
All	All	13156/19872 (66%)	11932 (91%)	1140 (9%)	84 (1%)	29	65

5 of 84 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	4071	ALA
1	B	4071	ALA
1	C	4071	ALA
1	D	4071	ALA
1	A	730	LEU

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	2659/4355 (61%)	2628 (99%)	31 (1%)	71	84
1	B	2658/4355 (61%)	2627 (99%)	31 (1%)	71	84
1	C	2659/4355 (61%)	2627 (99%)	32 (1%)	71	84
1	D	2660/4355 (61%)	2628 (99%)	32 (1%)	71	84
All	All	10636/17420 (61%)	10510 (99%)	126 (1%)	72	84

5 of 126 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	4515	ASN
1	D	1761	MET
1	C	841	LYS
1	D	1089	ARG
1	D	4171	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 156 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	4515	ASN
1	D	3906	ASN
1	D	44	ASN
1	D	1267	HIS
1	D	4179	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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.

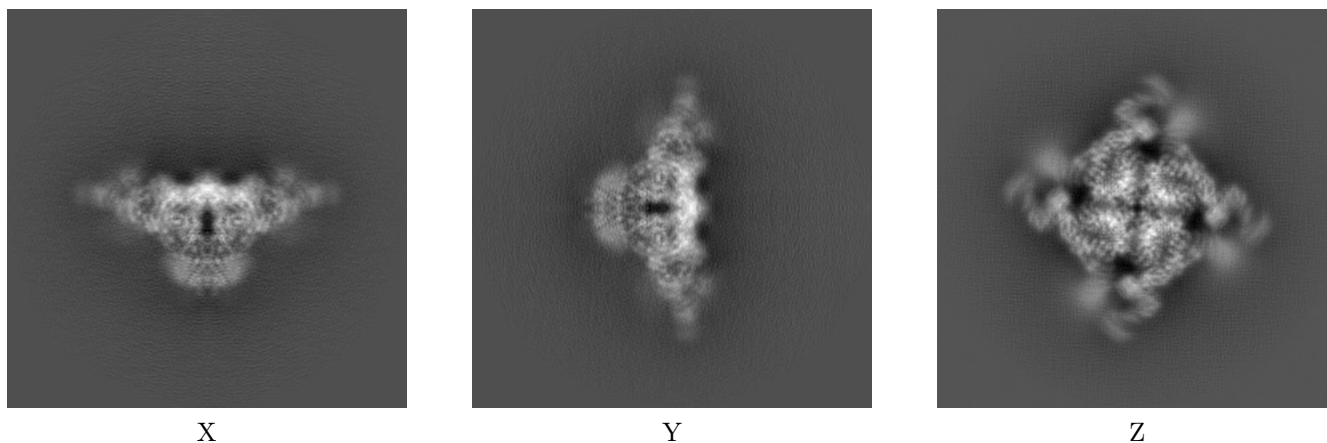
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-9528. 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 [i](#)

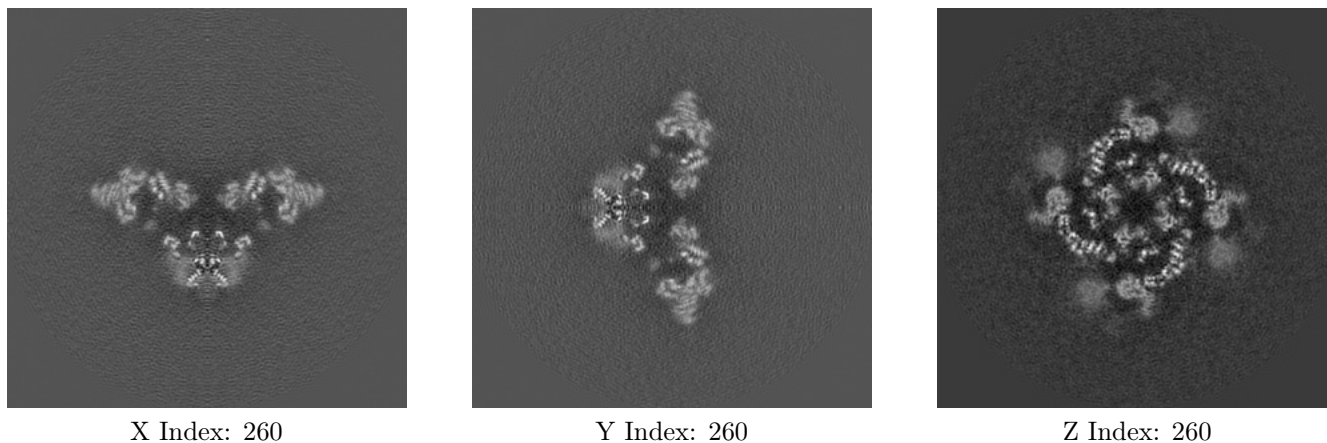
6.1.1 Primary map



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

6.2 Central slices [i](#)

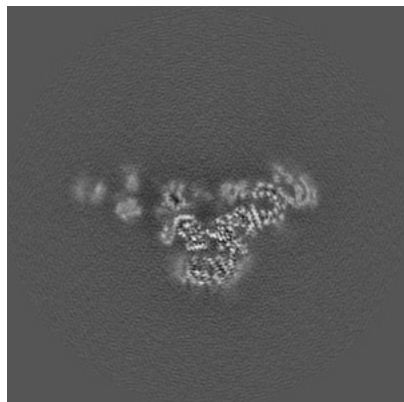
6.2.1 Primary map



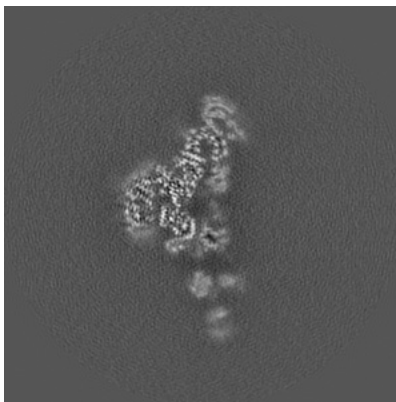
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [\(i\)](#)

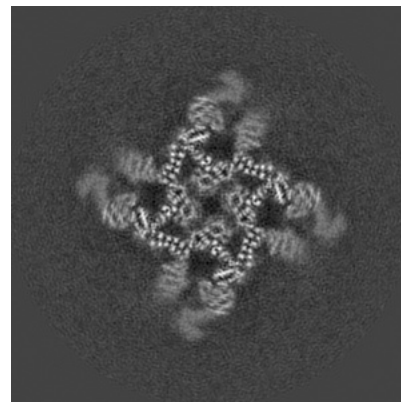
6.3.1 Primary map



X Index: 243



Y Index: 277

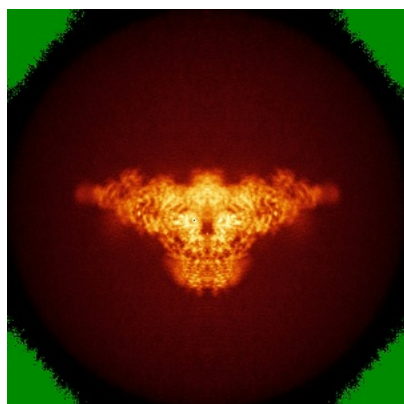


Z Index: 271

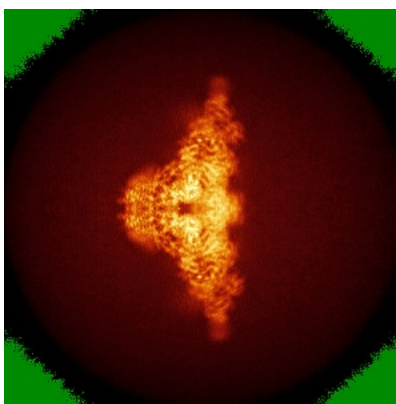
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal standard-deviation projections (False-color) [\(i\)](#)

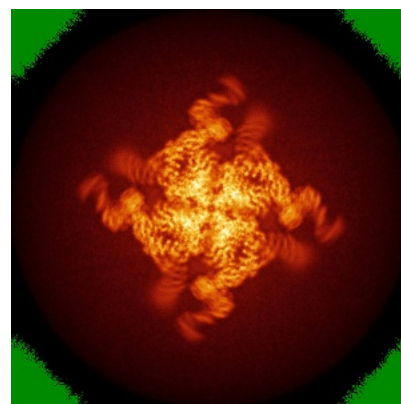
6.4.1 Primary map



X



Y

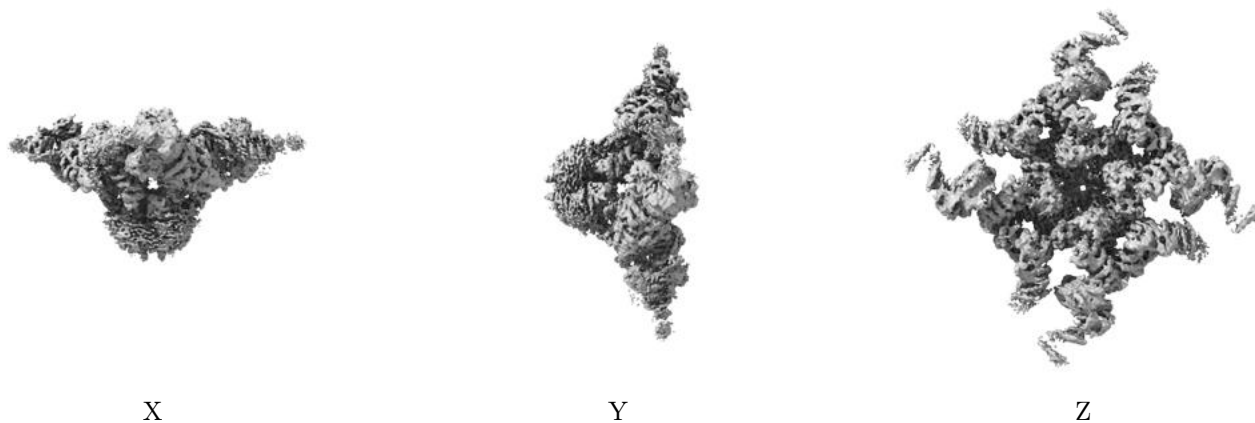


Z

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



The images above show the 3D surface view of the map at the recommended contour level 0.04. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

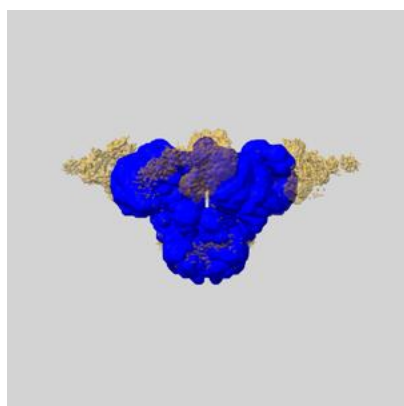
6.6 Mask visualisation [i](#)

This section shows the 3D surface view of the primary map at 50% transparency overlaid with the specified mask at 0% transparency

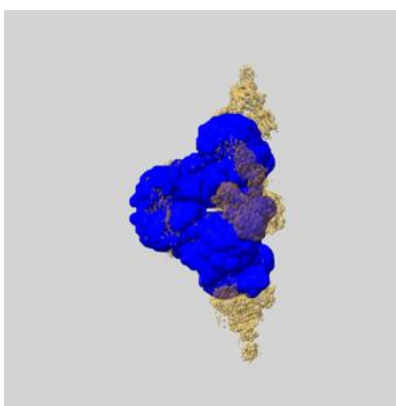
A mask typically either:

- Encompasses the whole structure
- Separates out a domain, a functional unit, a monomer or an area of interest from a larger structure

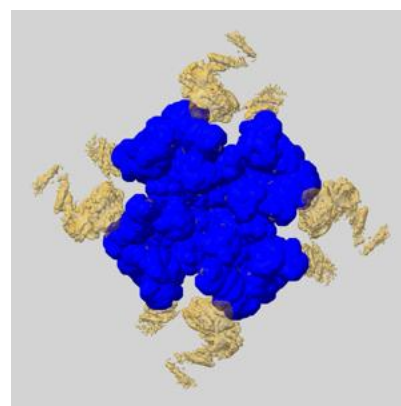
6.6.1 emd_9528_msk_1.map [i](#)



X



Y

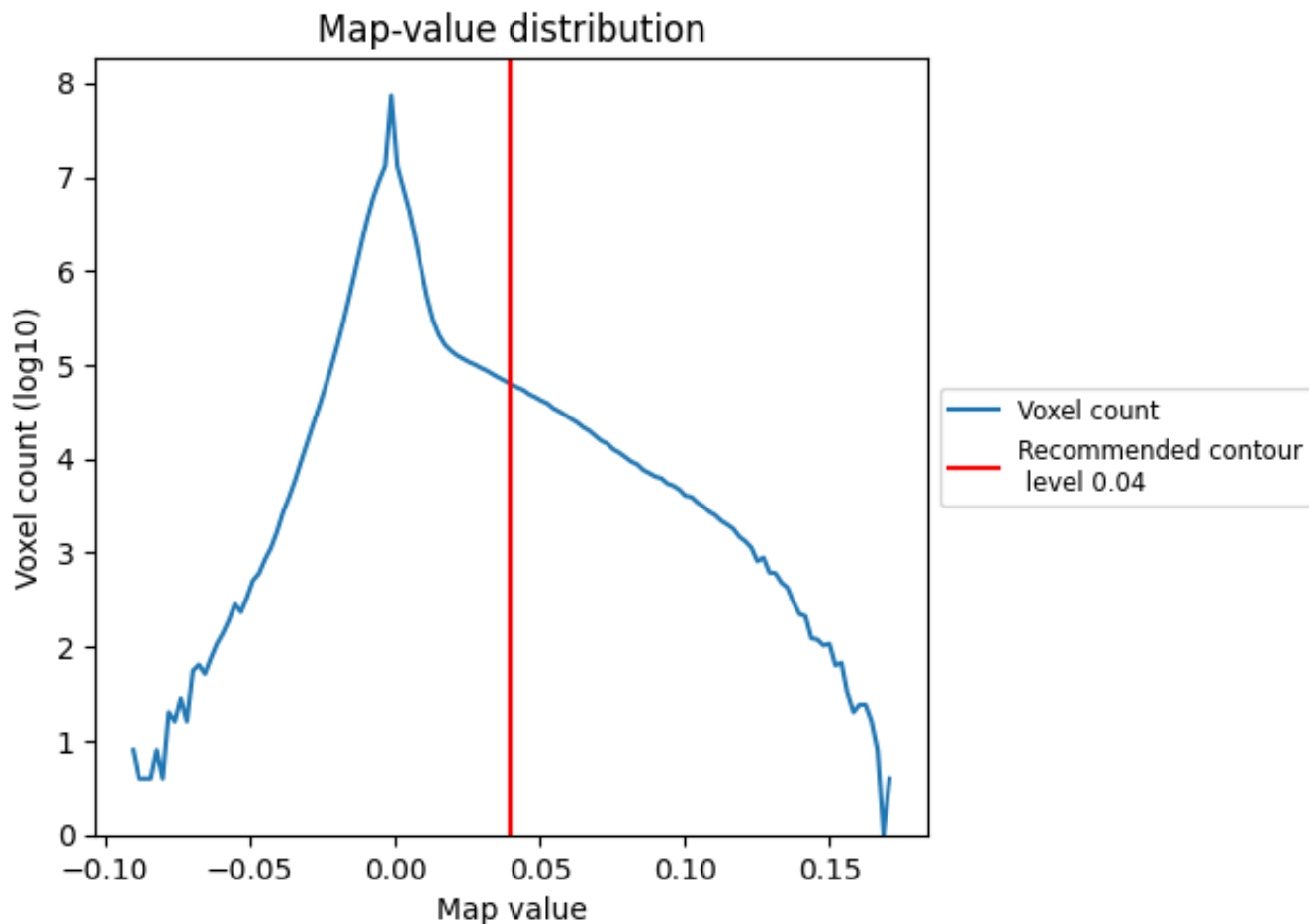


Z

7 Map analysis [i](#)

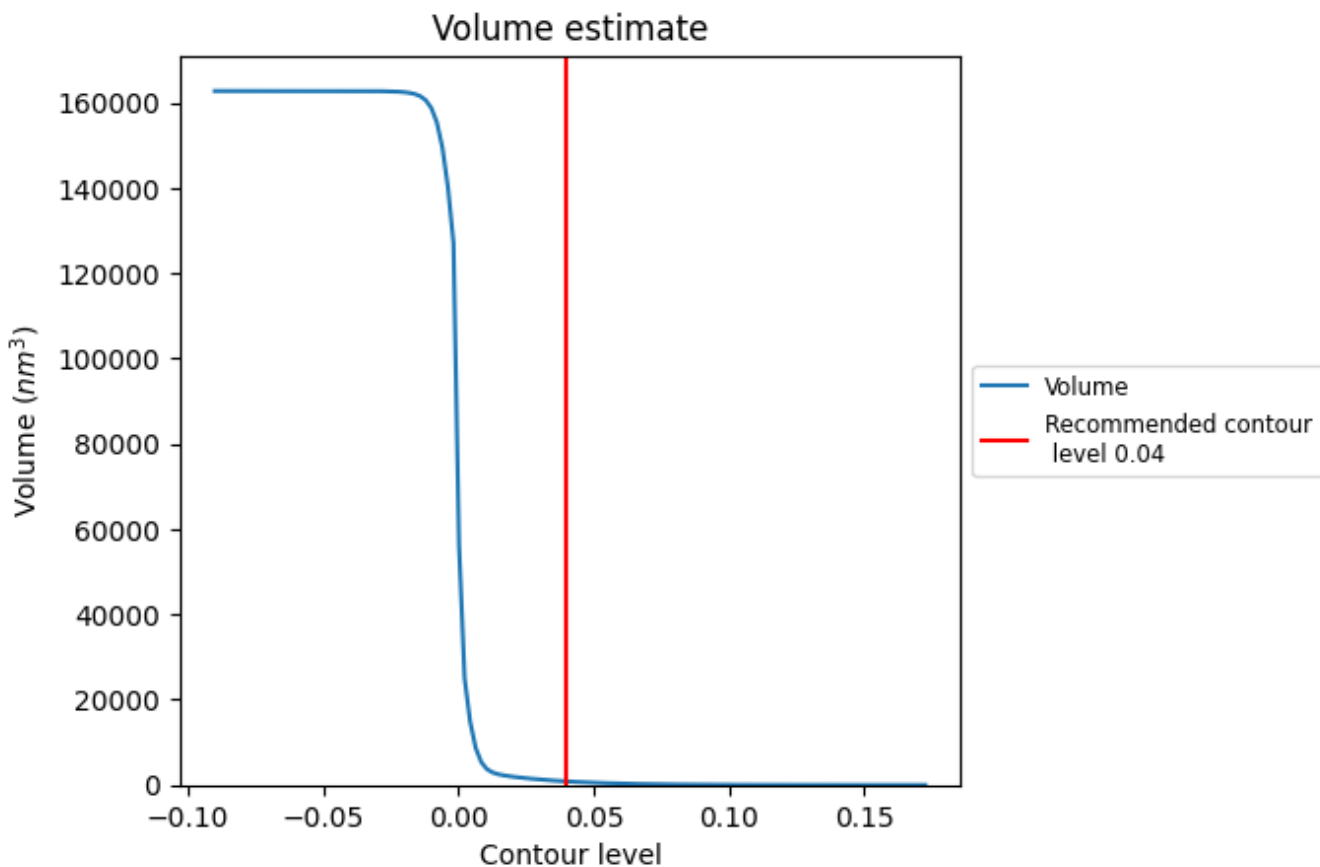
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution [i](#)



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.

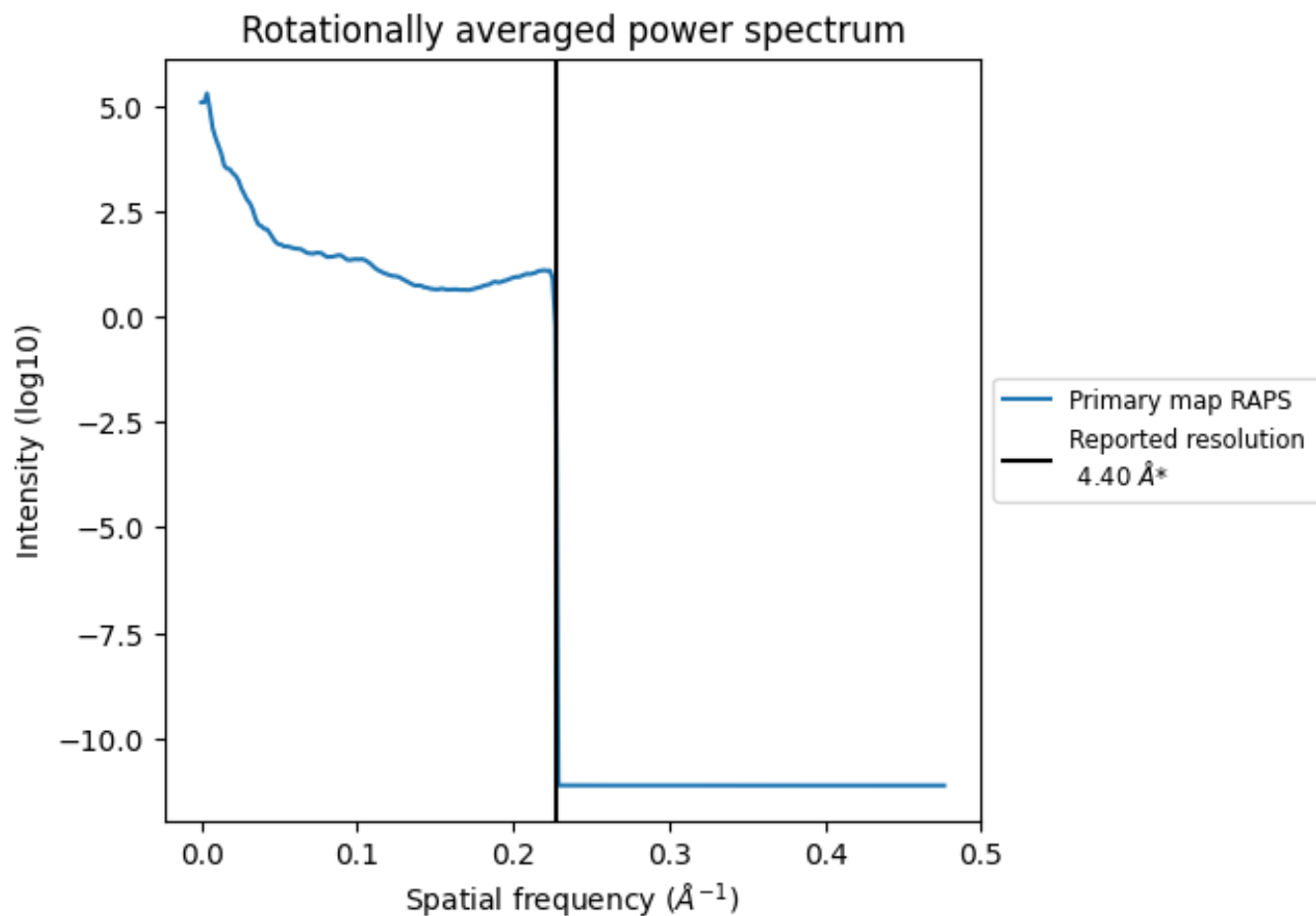
7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is 837 nm^3 ; this corresponds to an approximate mass of 756 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 0.227 Å⁻¹

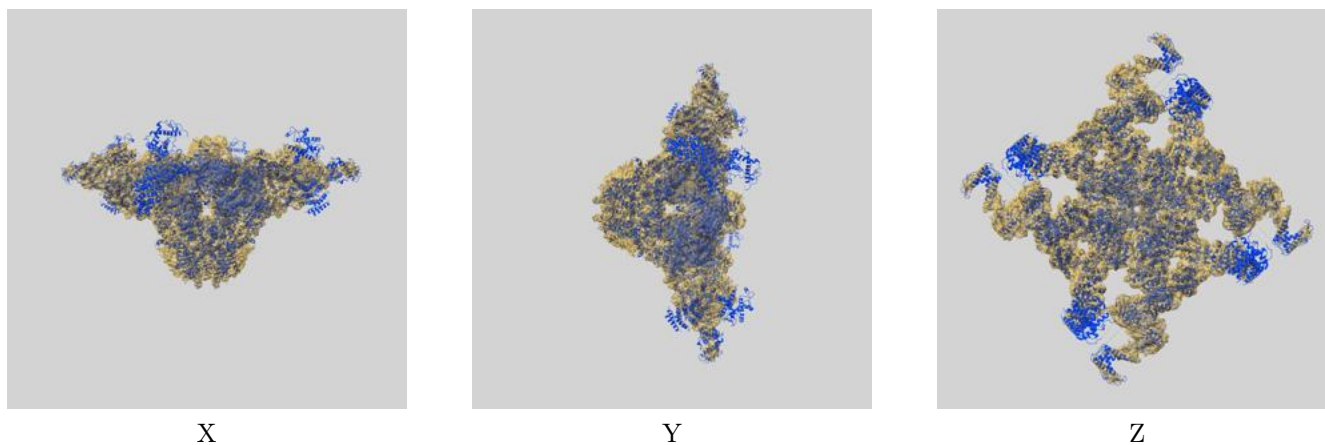
8 Fourier-Shell correlation

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

9 Map-model fit [i](#)

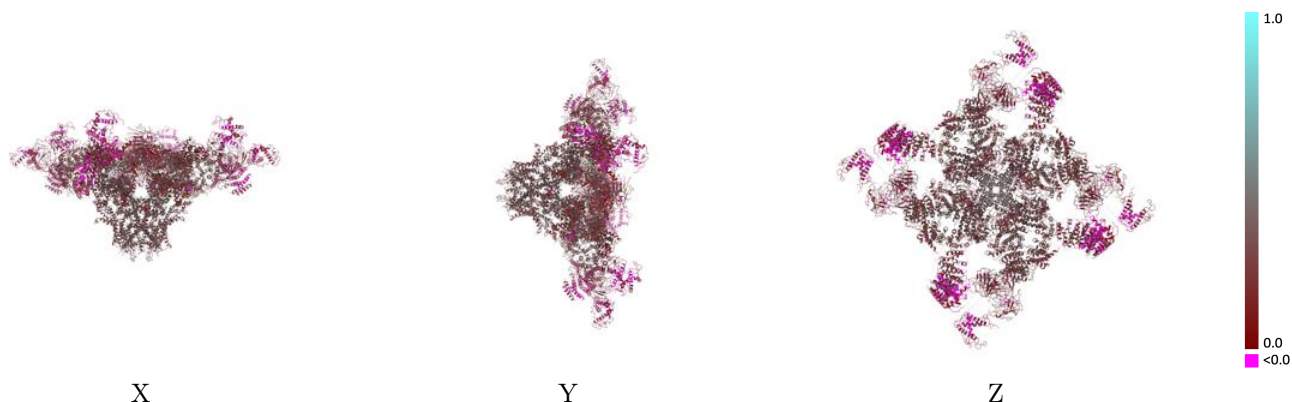
This section contains information regarding the fit between EMDB map EMD-9528 and PDB model 5GO9. Per-residue inclusion information can be found in section 3 on page 4.

9.1 Map-model overlay [i](#)



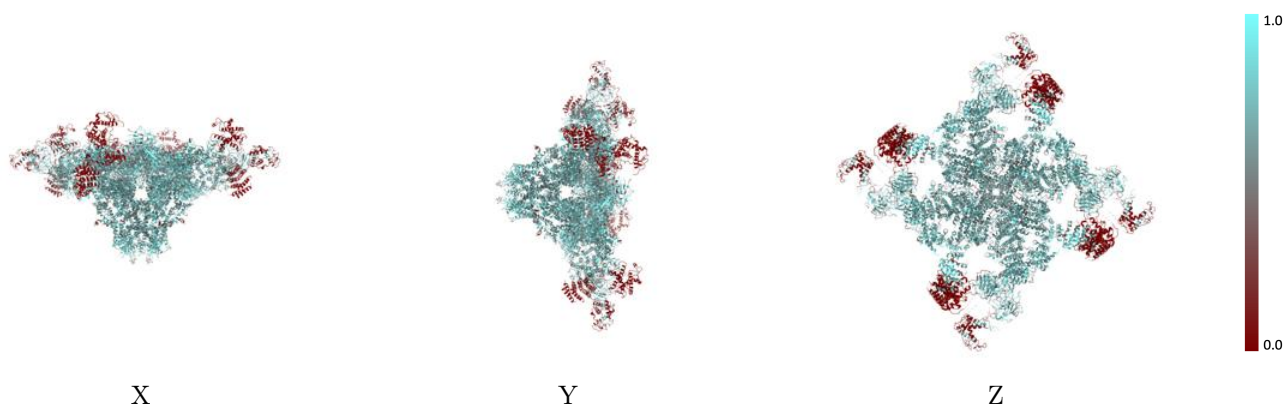
The images above show the 3D surface view of the map at the recommended contour level 0.04 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

9.2 Q-score mapped to coordinate model [i](#)



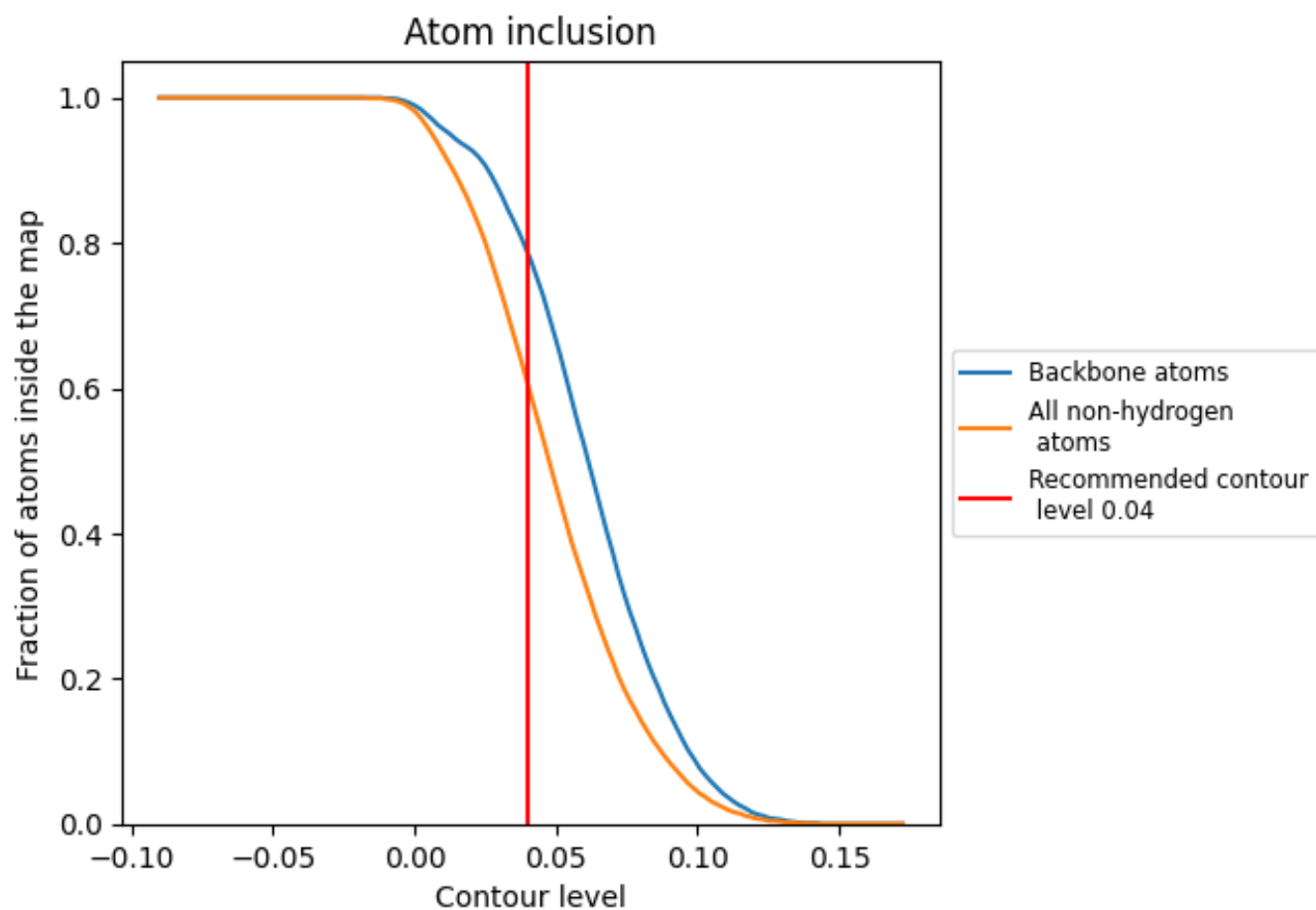
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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](#)



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 (0.04).











9.4 Atom inclusion [i](#)



At the recommended contour level, 79% of all backbone atoms, 61% of all non-hydrogen atoms, are inside the map.

9.5 Map-model fit summary

The table lists the average atom inclusion at the recommended contour level (0.04) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.6060	 0.2520
A	 0.6060	 0.2520
B	 0.6060	 0.2530
C	 0.6060	 0.2520
D	 0.6060	 0.2520

