wwPDB EM Validation Summary Report

Mar 28, 2026 – 01:46 PM EDT

PDB ID	:	9ZF0 / pdb_00009zf0
EMDB ID	:	EMD-74124
Title	:	Human TRPM8 fully-swapped, ligand-free structure in the absence of calcium at 4 degrees Celsius resolved in cell vesicles
Authors	:	Choi, K.Y.; Lin, X.; Cheng, Y.; Julius, D.
Deposited on	:	2025-12-01
Resolution	:	3.71 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:

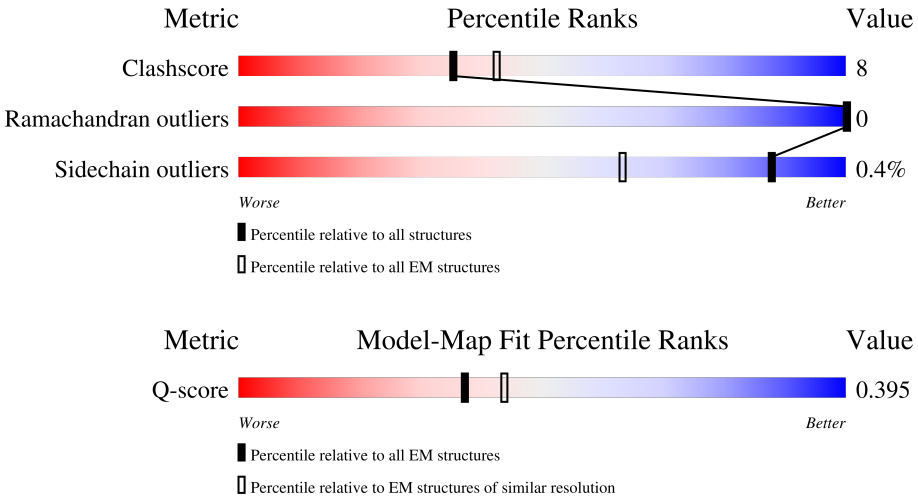
EMDB validation analysis	:	0.0.1.dev132
MolProbity	:	4-5-2 with Phenix2.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
EM percentile statistics	:	202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ	:	1.9.13
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.48.1

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 3.71 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	210492	15764	-
Ramachandran outliers	207382	16835	-
Sidechain outliers	206894	16415	-
Q-score	-	25397	10534 (3.21 - 4.21)

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	1111	17% 73% 13% 14%
1	B	1111	17% 74% 13% 14%
1	C	1111	17% 73% 13% 14%
1	D	1111	17% 74% 13% 14%

2 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 57200 atoms, of which 27832 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 Transient receptor potential cation channel subfamily M member 8.

Mol	Chain	Residues	Atoms						AltConf	Trace
1	A	961	Total	C	H	N	O	S	0	0
			14300	4798	6958	1228	1285	31		
1	B	961	Total	C	H	N	O	S	0	0
			14300	4798	6958	1228	1285	31		
1	C	961	Total	C	H	N	O	S	0	0
			14300	4798	6958	1228	1285	31		
1	D	961	Total	C	H	N	O	S	0	0
			14300	4798	6958	1228	1285	31		

There are 28 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-6	GLY	-	expression tag	UNP Q7Z2W7
A	-5	PRO	-	expression tag	UNP Q7Z2W7
A	-4	GLY	-	expression tag	UNP Q7Z2W7
A	-3	SER	-	expression tag	UNP Q7Z2W7
A	-2	GLY	-	expression tag	UNP Q7Z2W7
A	-1	SER	-	expression tag	UNP Q7Z2W7
A	0	GLY	-	expression tag	UNP Q7Z2W7
B	-6	GLY	-	expression tag	UNP Q7Z2W7
B	-5	PRO	-	expression tag	UNP Q7Z2W7
B	-4	GLY	-	expression tag	UNP Q7Z2W7
B	-3	SER	-	expression tag	UNP Q7Z2W7
B	-2	GLY	-	expression tag	UNP Q7Z2W7
B	-1	SER	-	expression tag	UNP Q7Z2W7
B	0	GLY	-	expression tag	UNP Q7Z2W7
C	-6	GLY	-	expression tag	UNP Q7Z2W7
C	-5	PRO	-	expression tag	UNP Q7Z2W7
C	-4	GLY	-	expression tag	UNP Q7Z2W7
C	-3	SER	-	expression tag	UNP Q7Z2W7
C	-2	GLY	-	expression tag	UNP Q7Z2W7
C	-1	SER	-	expression tag	UNP Q7Z2W7
C	0	GLY	-	expression tag	UNP Q7Z2W7

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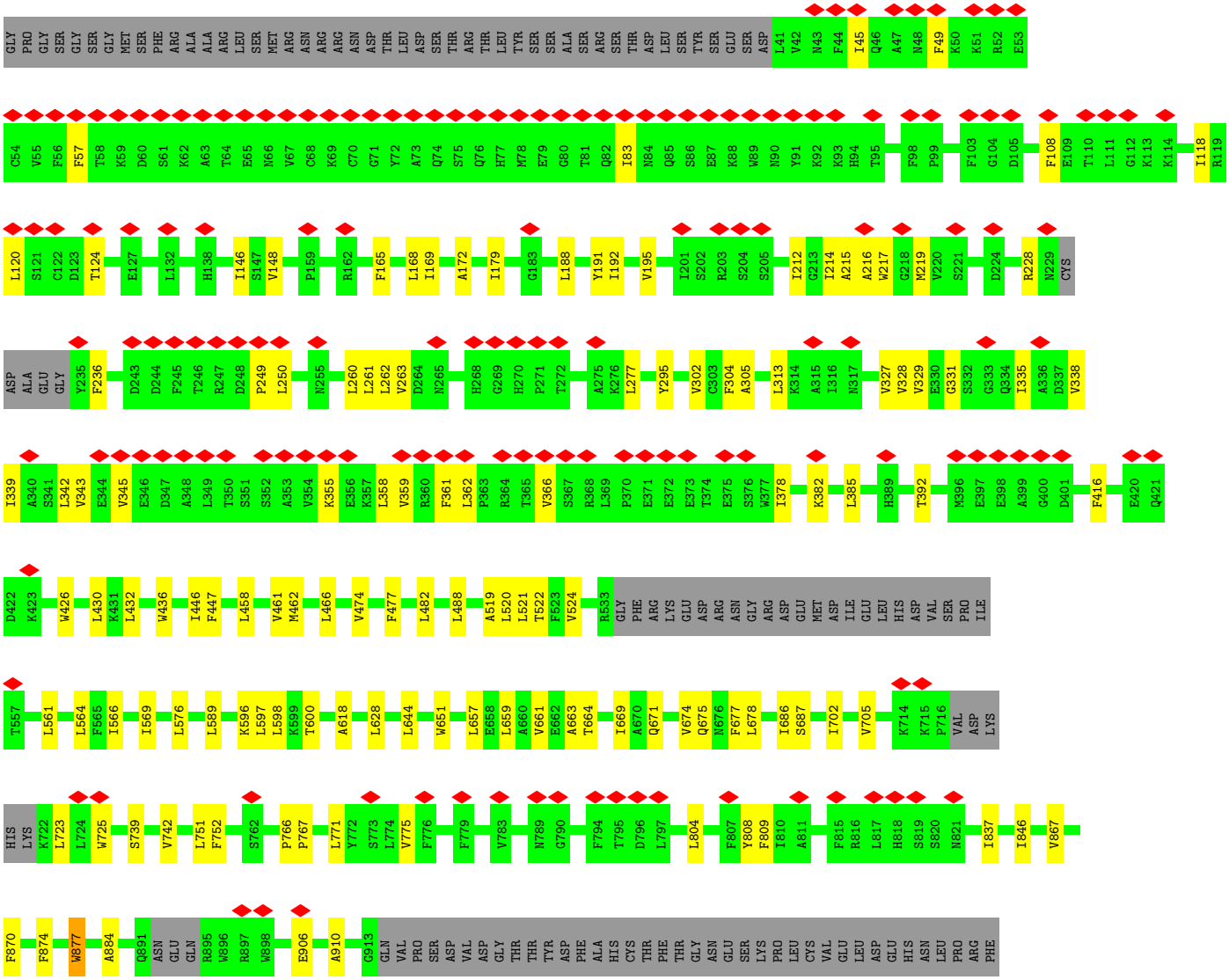
Chain	Residue	Modelled	Actual	Comment	Reference
D	-6	GLY	-	expression tag	UNP Q7Z2W7
D	-5	PRO	-	expression tag	UNP Q7Z2W7
D	-4	GLY	-	expression tag	UNP Q7Z2W7
D	-3	SER	-	expression tag	UNP Q7Z2W7
D	-2	GLY	-	expression tag	UNP Q7Z2W7
D	-1	SER	-	expression tag	UNP Q7Z2W7
D	0	GLY	-	expression tag	UNP Q7Z2W7

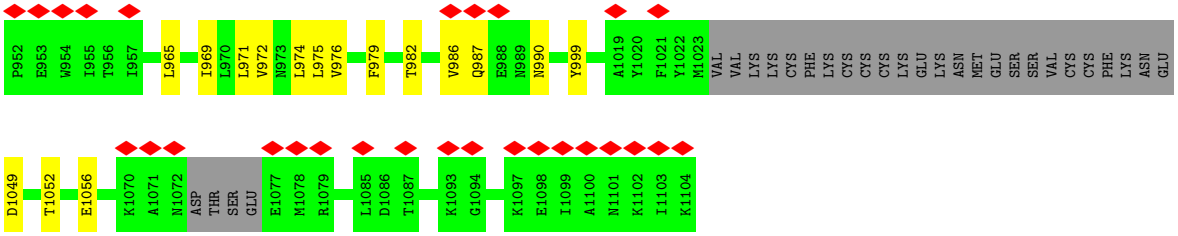
3 Residue-property plots (i)

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: Transient receptor potential cation channel subfamily M member 8

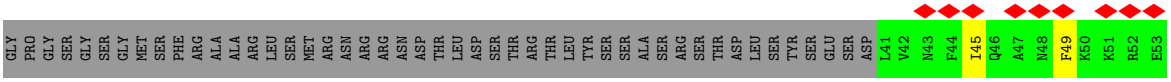
Chain A:

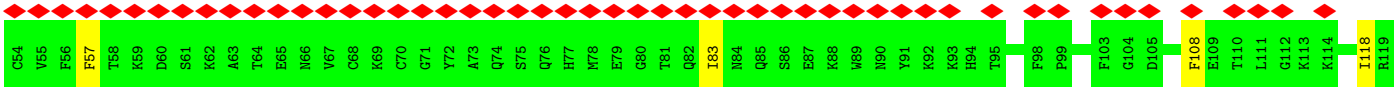


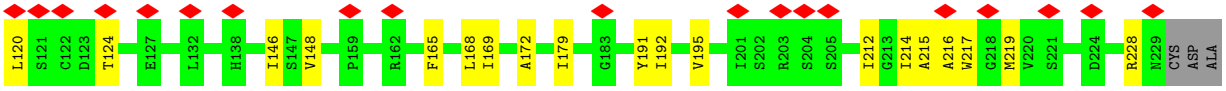


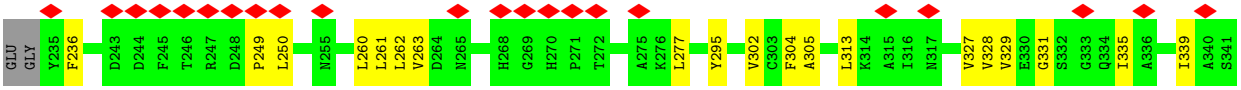
• Molecule 1: Transient receptor potential cation channel subfamily M member 8

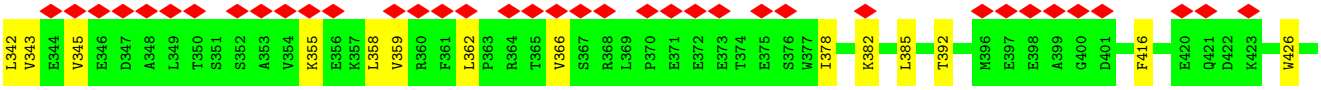
Chain B:

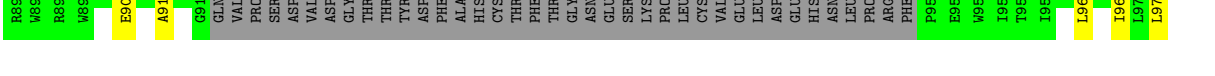


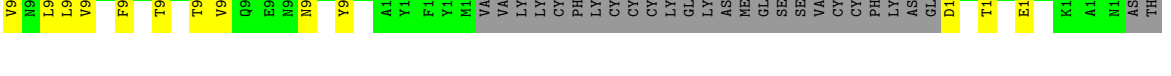


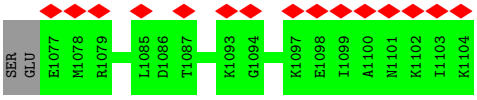






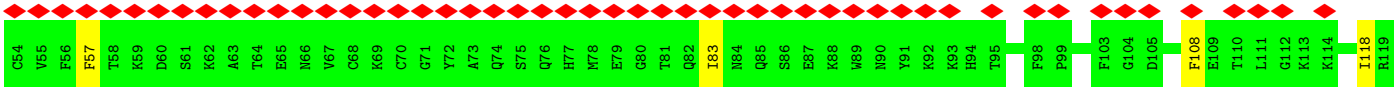


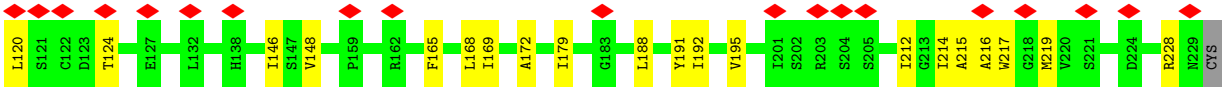


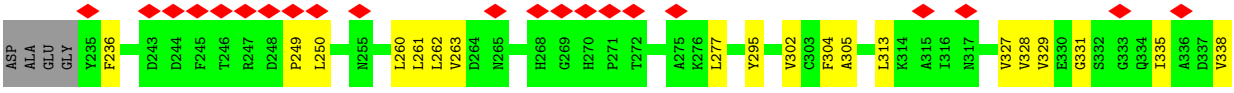


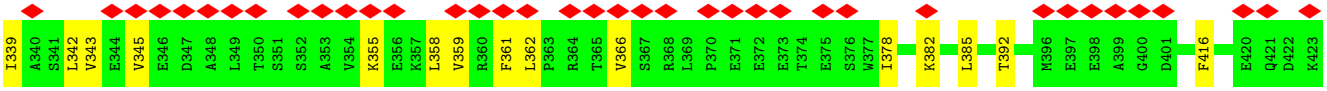
• Molecule 1: Transient receptor potential cation channel subfamily M member 8

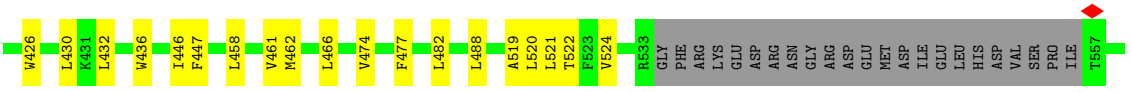
Chain C:

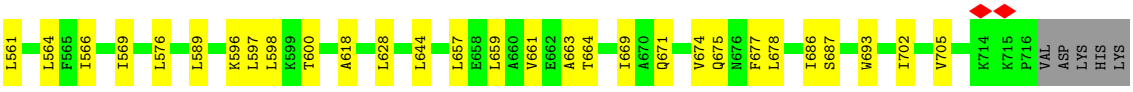


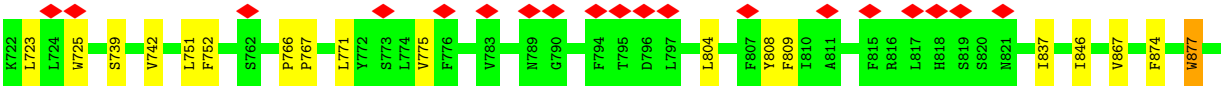


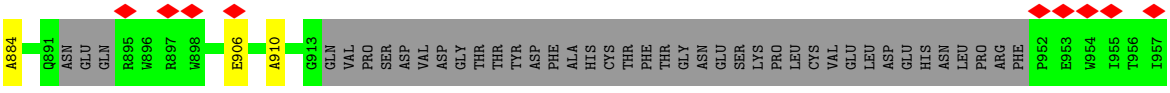


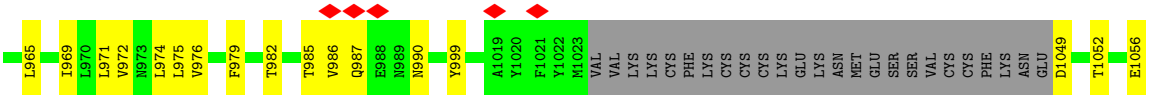


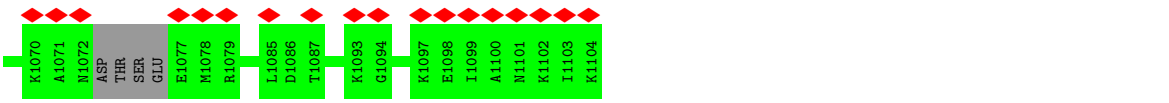


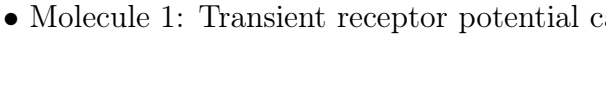








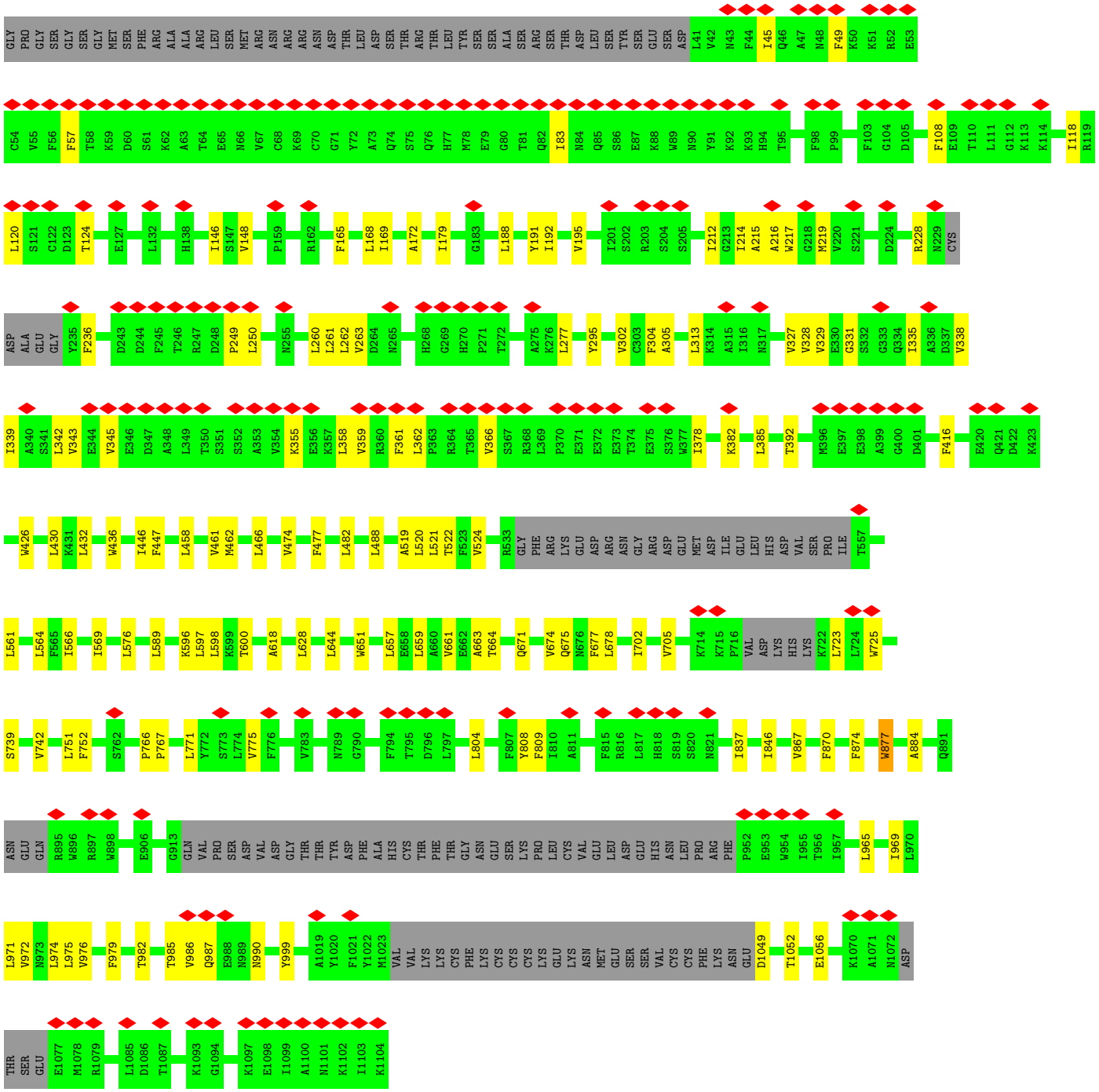




• Molecule 1: Transient receptor potential cation channel subfamily M member 8

Chain D:


17%
74%
13%
14%


GLY PRO GLY SER GLY SER GLY MET SER PHE ARG ALA ALA ARG LEU SER MET ARG ASN ARG ARG ASN ASP THR LEU ASP SER THR ARG THR LEU TYR SER SER ALA SER ARG SER THR ASP LEU SER TYR SER GLU SER ASP L41 V42 N43 F44 I45 Q46 A47 N48 F49 K50 K51 R52 E53
C54 V55 F56 F57 T58 K59 D60 S61 K62 A63 T64 E65 N66 V67 C68 K69 C70 G71 Y72 A73 Q74 S75 Q76 H77 M78 E79 G80 T81 Q82 I83 N84 Q85 S86 E87 K88 W89 N90 Y91 K92 K93 H94 T95 F98 P99 F103 G104 D105 F108 E109 T110 L111 G112 K113 K114 I118 R119
L120 S121 C122 D123 T124 E127 L132 H138 I146 S147 V148 P159 R162 F165 L168 I169 A172 I179 G183 L188 Y191 I192 V195 T201 S202 R203 S204 S205 I212 G213 I214 A215 A216 W217 G218 M219 V220 S221 D224 R228 N229 CYS
ASP ALA GLU GLY Y235 F236 D243 D244 F245 T246 R247 D248 P249 L250 N255 L260 L261 L262 V263 D264 N265 H268 G269 H270 P271 T272 A275 K276 L277 Y295 V302 C303 F304 A305 L313 K314 A315 I316 N317 V327 V328 V329 E330 G331 S332 G333 Q334 I335 A336 D337 V338
I339 A340 S341 L342 V343 E344 V345 E346 D347 A348 L349 T350 S351 S352 A353 V354 K355 E356 K357 L358 V359 R360 F361 L362 P363 R364 T365 V366 S367 R368 L369 P370 E371 E372 E373 T374 E375 S376 W377 I378 K382 L385 T392 M396 E397 E398 A399 G400 D401 F416 E420 Q421 D422 K423
W426 L430 K431 L432 W436 I446 F447 L458 V461 M462 L466 V474 F477 L482 L488 A519 L520 L521 T522 F523 V524 R533 GLY PHE ARG LYS GLU ASP ARG ASN GLY ARG ASP GLU MET ASP ILE GLU LEU HIS ASP VAL SER PRO ILE T557
L561 L564 F565 I566 I569 L576 L589 K596 L597 L598 K599 T600 A618 L628 L644 W651 L657 E658 L659 A660 V661 E662 A663 T664 Q671 V674 Q675 N676 F677 L678 I702 V705 K714 K715 P716 VAL ASP LYS HIS LYS K722 L723 L724 W725
S739 V742 L751 F752 S762 P766 P767 L771 Y772 S773 L774 V775 F776 V783 N789 G790 F794 T795 D796 L797 L804 F807 Y808 F809 I810 A811 F815 R816 L817 H818 S819 S820 N821 I837 I846 V867 F870 F874 W877 A884 Q891
ASN GLU GLN R895 W896 R897 W898 E906 G913 GLN VAL PRO SER ASP VAL ASP GLY THR THR TYR ASP PHE ALA HIS CYS THR PHE THR GLY ASN GLU SER LYS PRO LEU CYS VAL GLU LEU ASP GLU HIS ASN LEU PRO ARG PHE P952 E953 W954 I955 T956 I957 L965 I969 L970
L971 V972 N973 L974 L975 V976 F979 T982 T985 V986 Q987 E988 N989 N990 Y999 A1019 Y1020 F1021 Y1022 M1023 VAL VAL LYS LYS CYS PHE LYS CYS CYS CYS LYS GLU LYS ASN MET GLU SER SER VAL CYS CYS PHE LYS ASN GLU D1049 T1052 E1056 K1070 A1071 N1072 ASP
THR SER GLU E1077 M1078 R1079 L1085 D1086 T1087 K1093 G1094 K1097 E1098 I1099 A1100 N1101 K1102 I1103 K1104

4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C4	Depositor
Number of particles used	438880	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 ($e^-/Å^2$)	47.7	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	105000	Depositor
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	3.598	Depositor
Minimum map value	-1.925	Depositor
Average map value	0.009	Depositor
Map value standard deviation	0.080	Depositor
Recommended contour level	0.25	Depositor
Map size (Å)	262.048, 262.048, 262.048	wwPDB
Map dimensions	320, 320, 320	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.8189, 0.8189, 0.8189	Depositor

5 Model quality

5.1 Standard geometry

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	0.18	0/7517	0.37	0/10240
1	B	0.18	0/7517	0.37	0/10240
1	C	0.18	0/7517	0.37	0/10240
1	D	0.18	0/7517	0.37	0/10240
All	All	0.18	0/30068	0.37	0/40960

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	7342	6958	6949	114	0
1	B	7342	6958	6949	111	0
1	C	7342	6958	6949	116	0
1	D	7342	6958	6949	113	0
All	All	29368	27832	27796	439	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 8.

The worst 5 of 439 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:D:644:LEU:HD21	1:D:674:VAL:HG23	1.61	0.82
1:A:644:LEU:HD21	1:A:674:VAL:HG23	1.61	0.81
1:B:644:LEU:HD21	1:B:674:VAL:HG23	1.61	0.81
1:B:263:VAL:HG22	1:B:277:LEU:HD23	1.64	0.79
1:C:644:LEU:HD21	1:C:674:VAL:HG23	1.61	0.79

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	945/1111 (85%)	907 (96%)	38 (4%)	0	100	100
1	B	945/1111 (85%)	907 (96%)	38 (4%)	0	100	100
1	C	945/1111 (85%)	907 (96%)	38 (4%)	0	100	100
1	D	945/1111 (85%)	907 (96%)	38 (4%)	0	100	100
All	All	3780/4444 (85%)	3628 (96%)	152 (4%)	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	714/992 (72%)	711 (100%)	3 (0%)	89	93
1	B	714/992 (72%)	711 (100%)	3 (0%)	89	93

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	C	714/992 (72%)	711 (100%)	3 (0%)	89 93
1	D	714/992 (72%)	711 (100%)	3 (0%)	89 93
All	All	2856/3968 (72%)	2844 (100%)	12 (0%)	88 93

5 of 12 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	877	TRP
1	C	990	ASN
1	D	990	ASN
1	D	436	TRP
1	B	436	TRP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	480	ASN
1	D	987	GLN
1	C	987	GLN
1	D	1010	ASN
1	D	480	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 oligosaccharides in this entry.

5.6 Ligand geometry (i)

There are no ligands in this entry.

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.

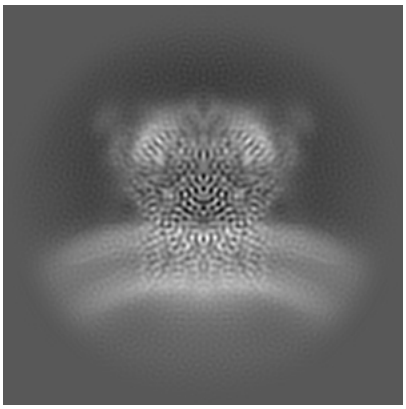
6 Map visualisation

This section contains visualisations of the EMDB entry EMD-74124. These allow visual inspection of the internal detail of the map and identification of artifacts.

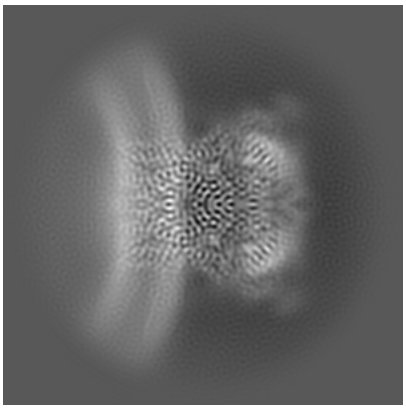
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections

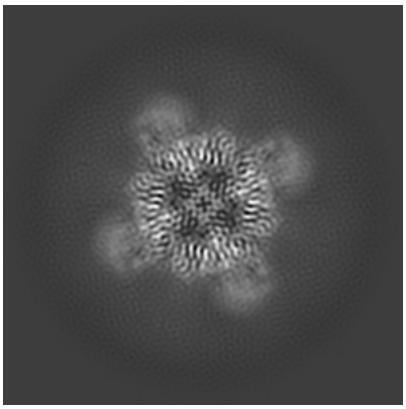
6.1.1 Primary map



X

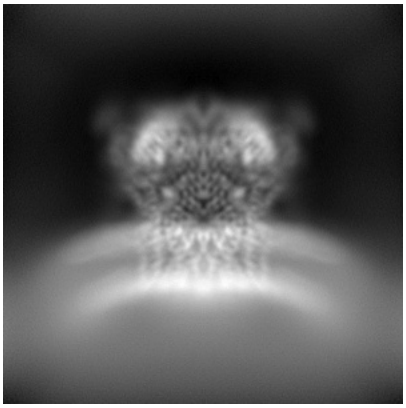


Y

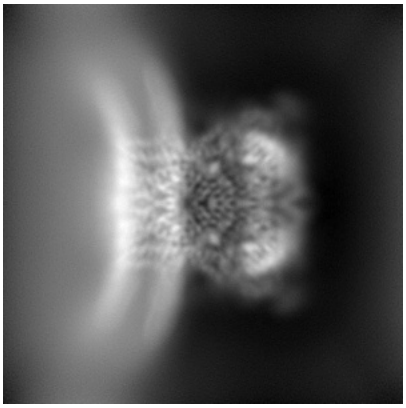


Z

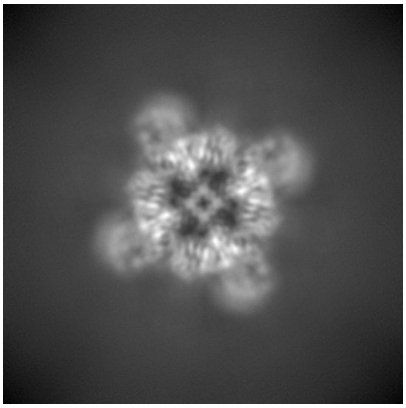
6.1.2 Raw map



X



Y

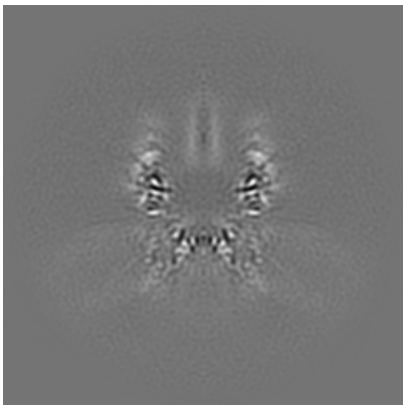


Z

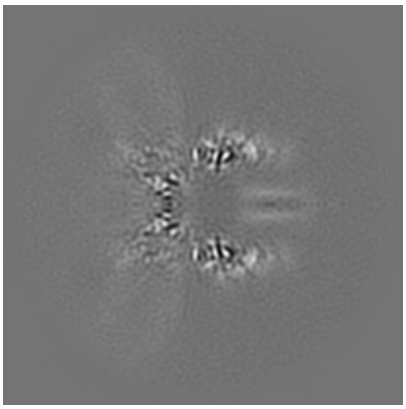
The images above show the map projected in three orthogonal directions.

6.2 Central slices (i)

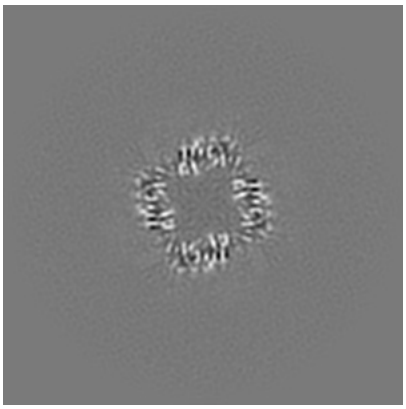
6.2.1 Primary map



X Index: 160

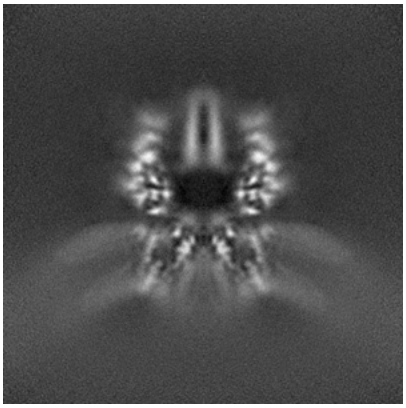


Y Index: 160

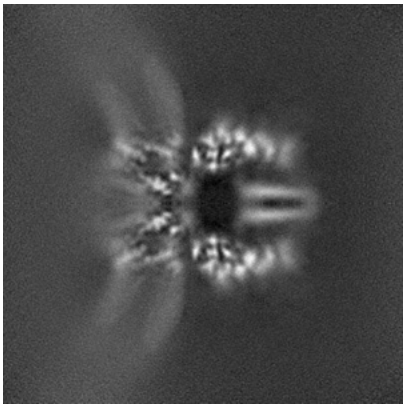


Z Index: 160

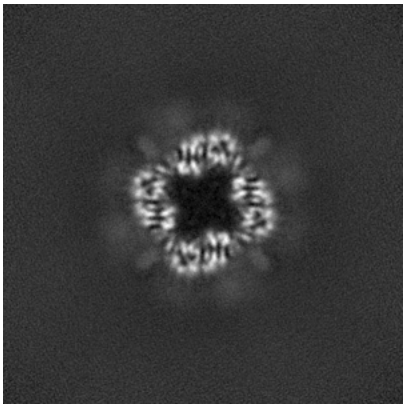
6.2.2 Raw map



X Index: 160



Y Index: 160

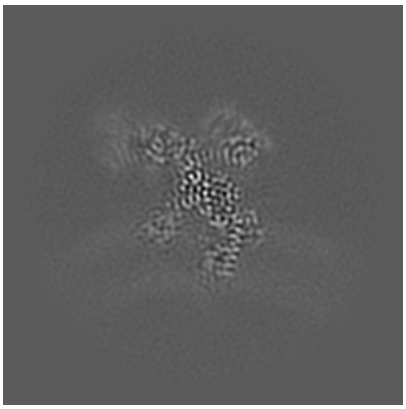


Z Index: 160

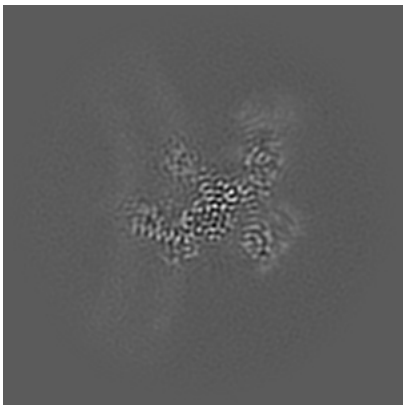
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices (i)

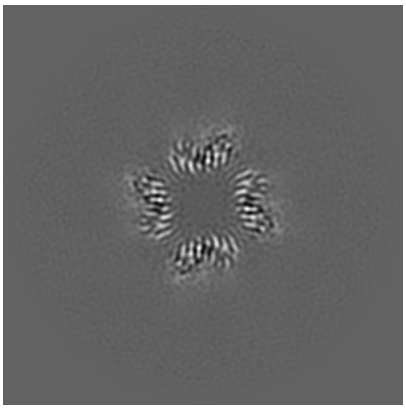
6.3.1 Primary map



X Index: 197

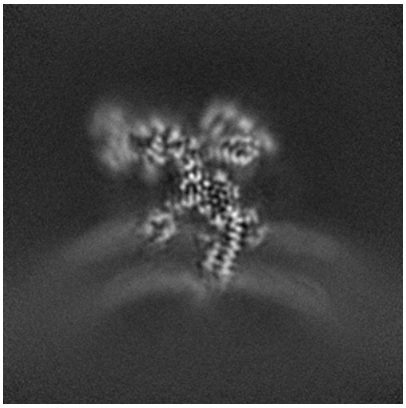


Y Index: 197

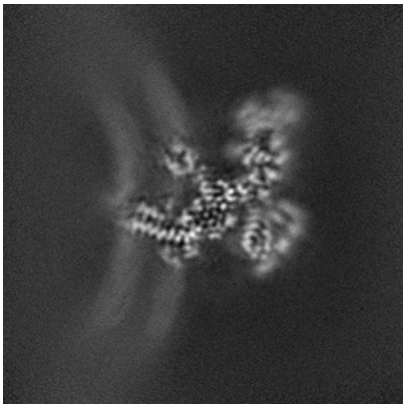


Z Index: 172

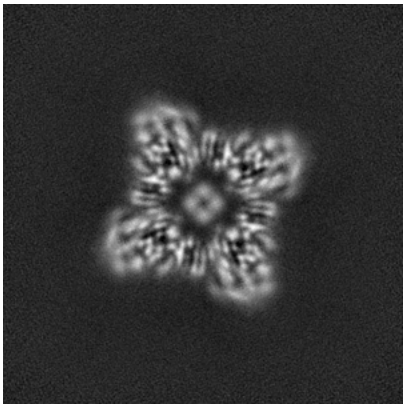
6.3.2 Raw map



X Index: 196



Y Index: 196

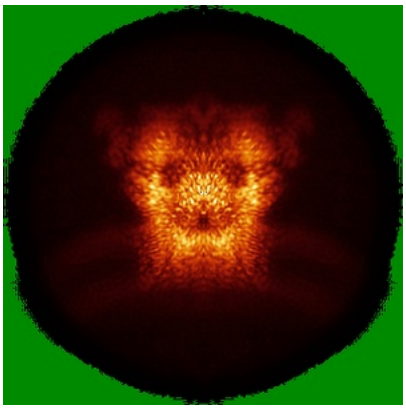


Z Index: 202

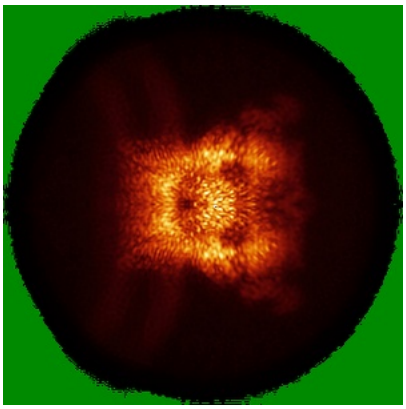
The images above show the largest variance slices of the map in three orthogonal directions.

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

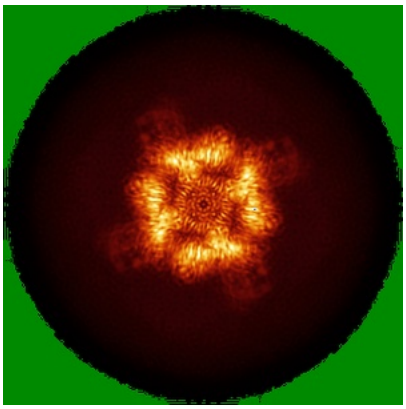
6.4.1 Primary map



X

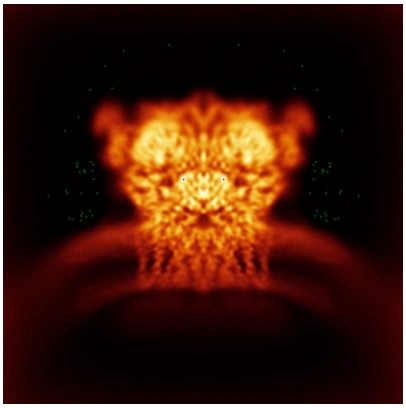


Y

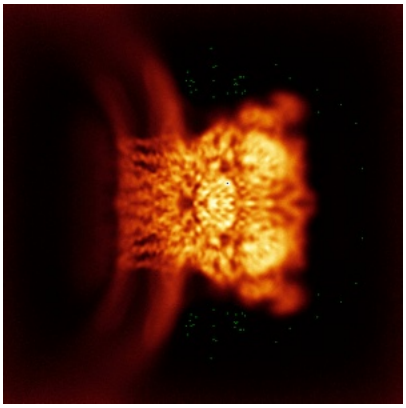


Z

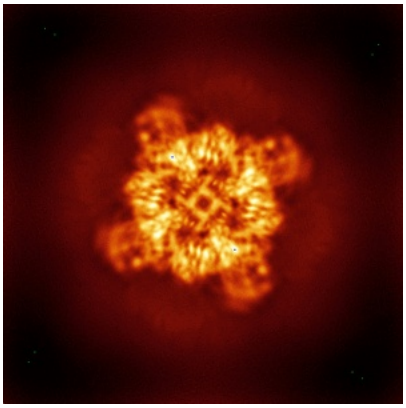
6.4.2 Raw map



X



Y

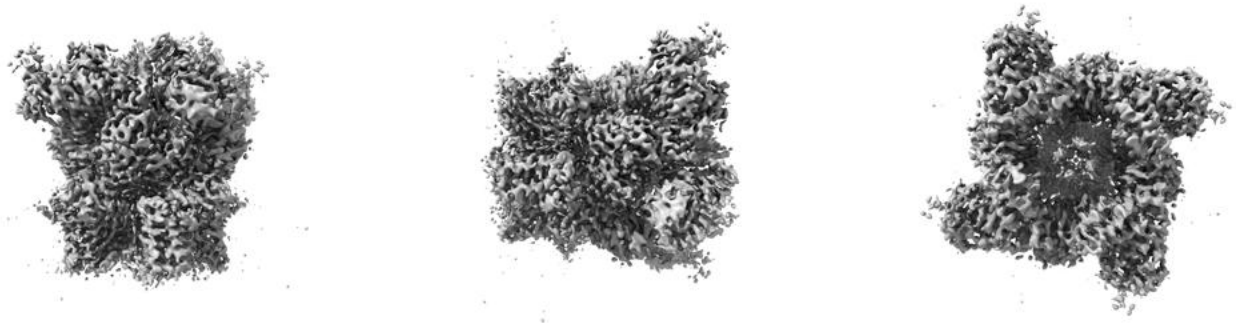


Z

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)

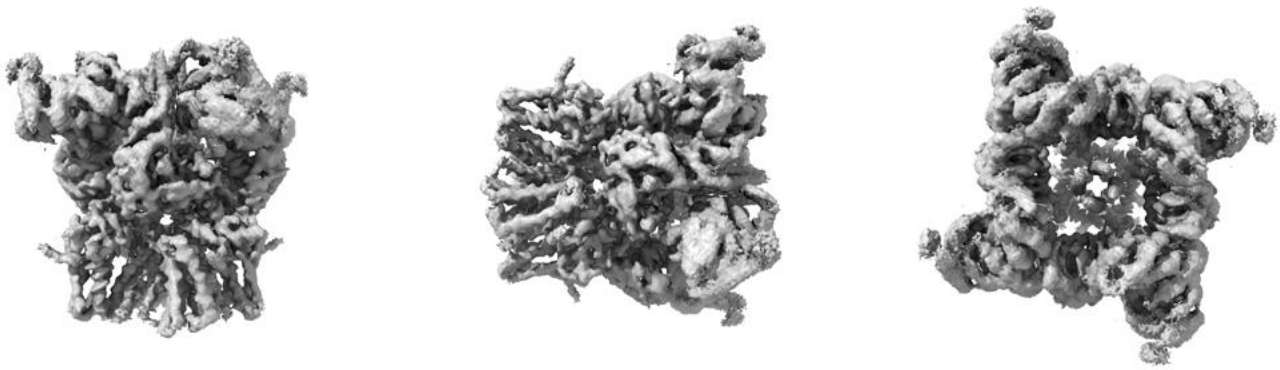
6.5.1 Primary map



X Y Z

The images above show the 3D surface view of the map at the recommended contour level 0.25. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

6.5.2 Raw map



X Y Z

These images show the 3D surface of the raw map. The raw map's contour level was selected so that its surface encloses the same volume as the primary map does at its recommended contour level.

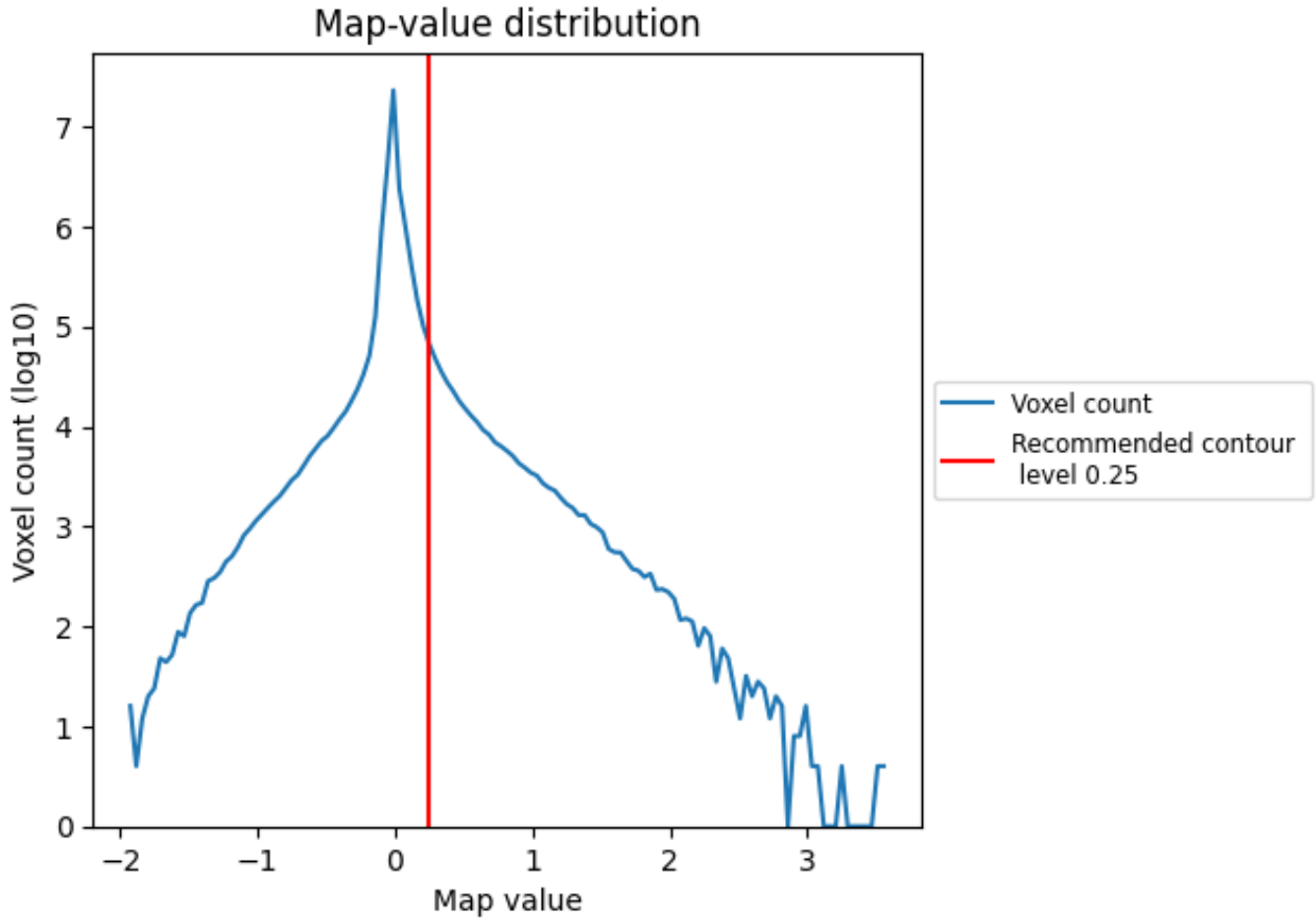
6.6 Mask visualisation (i)

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

7 Map analysis

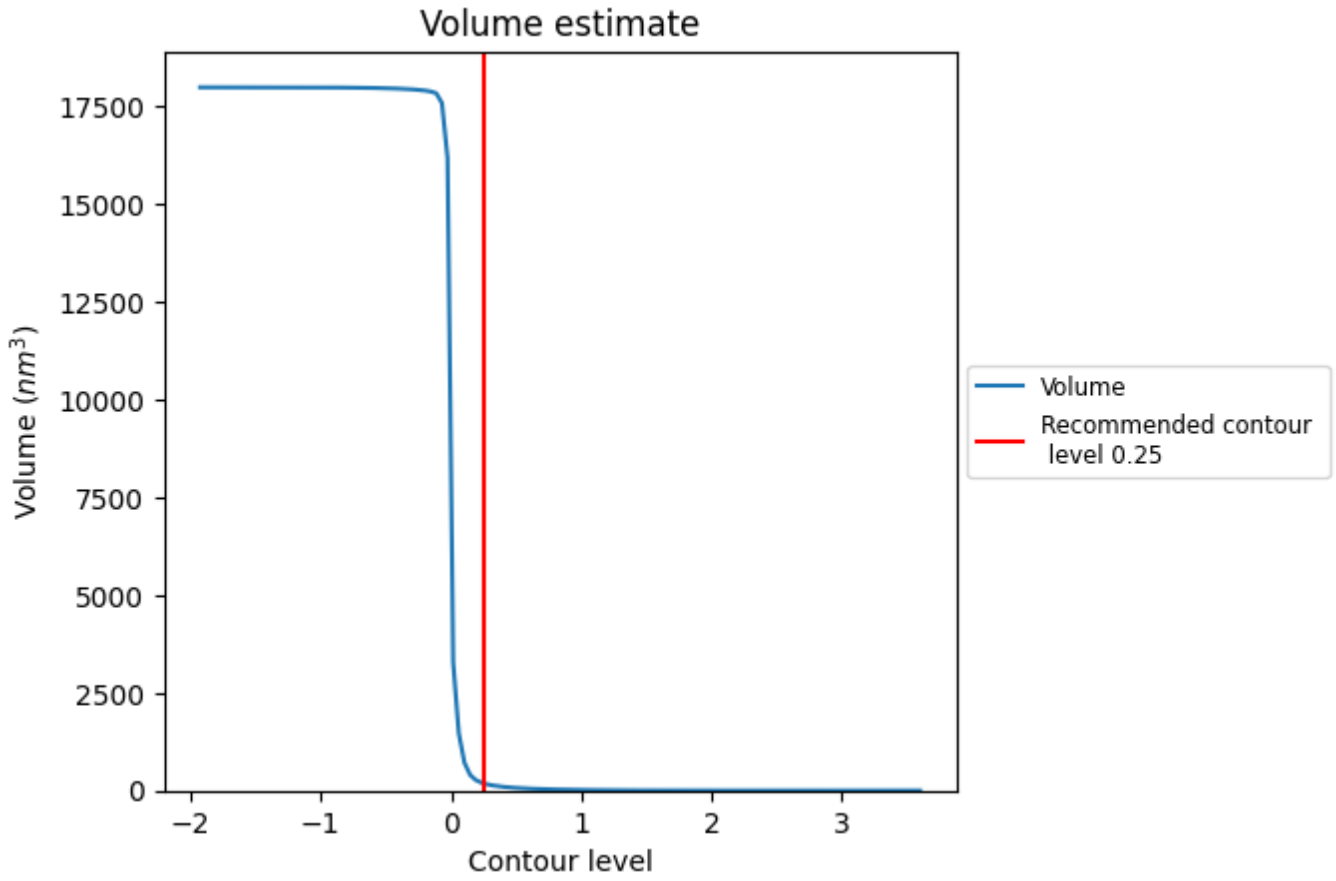
This section contains the results of statistical analysis of the map.

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.

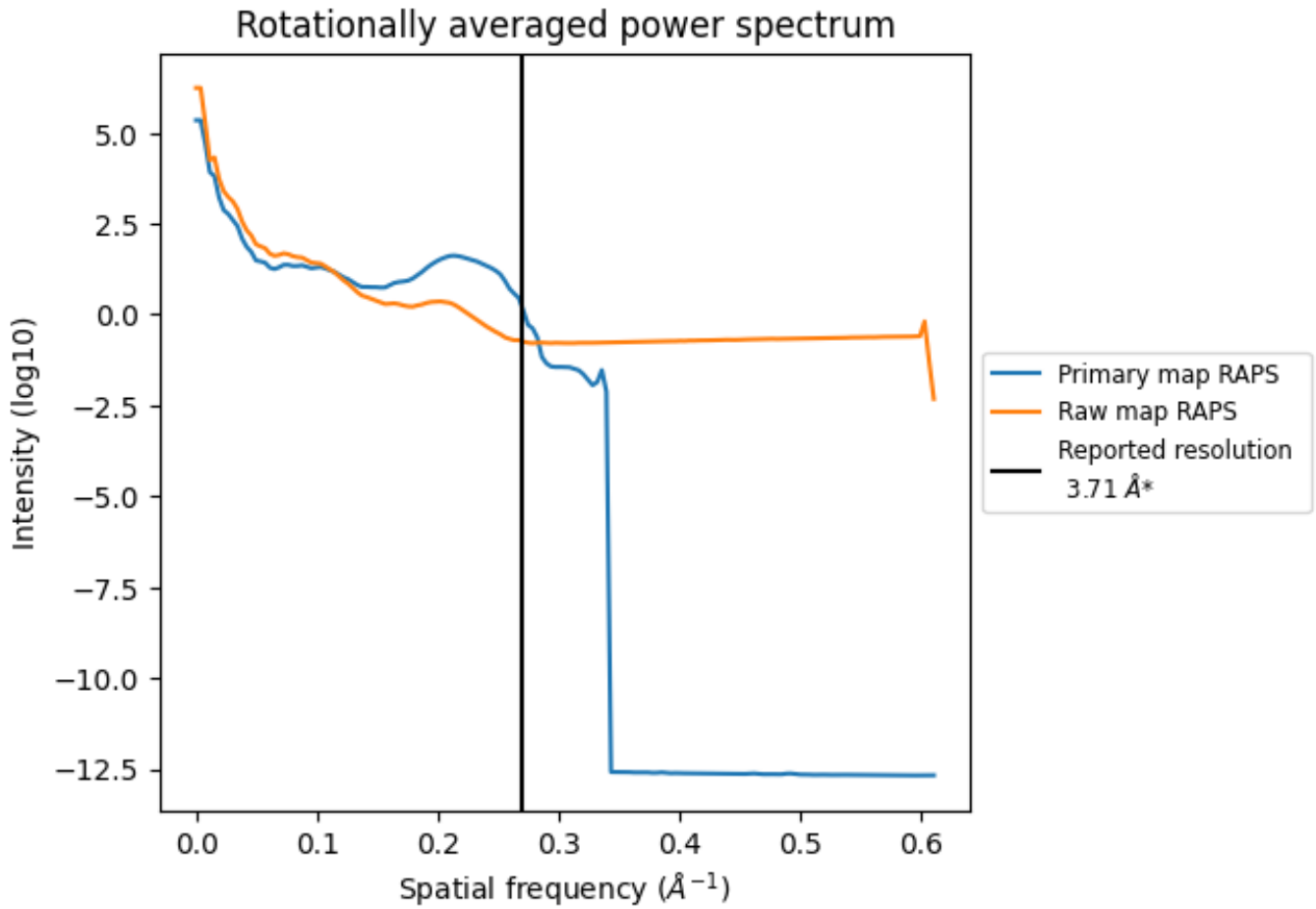
7.2 Volume estimate (i)



The volume at the recommended contour level is 186 nm^3; this corresponds to an approximate mass of 168 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)

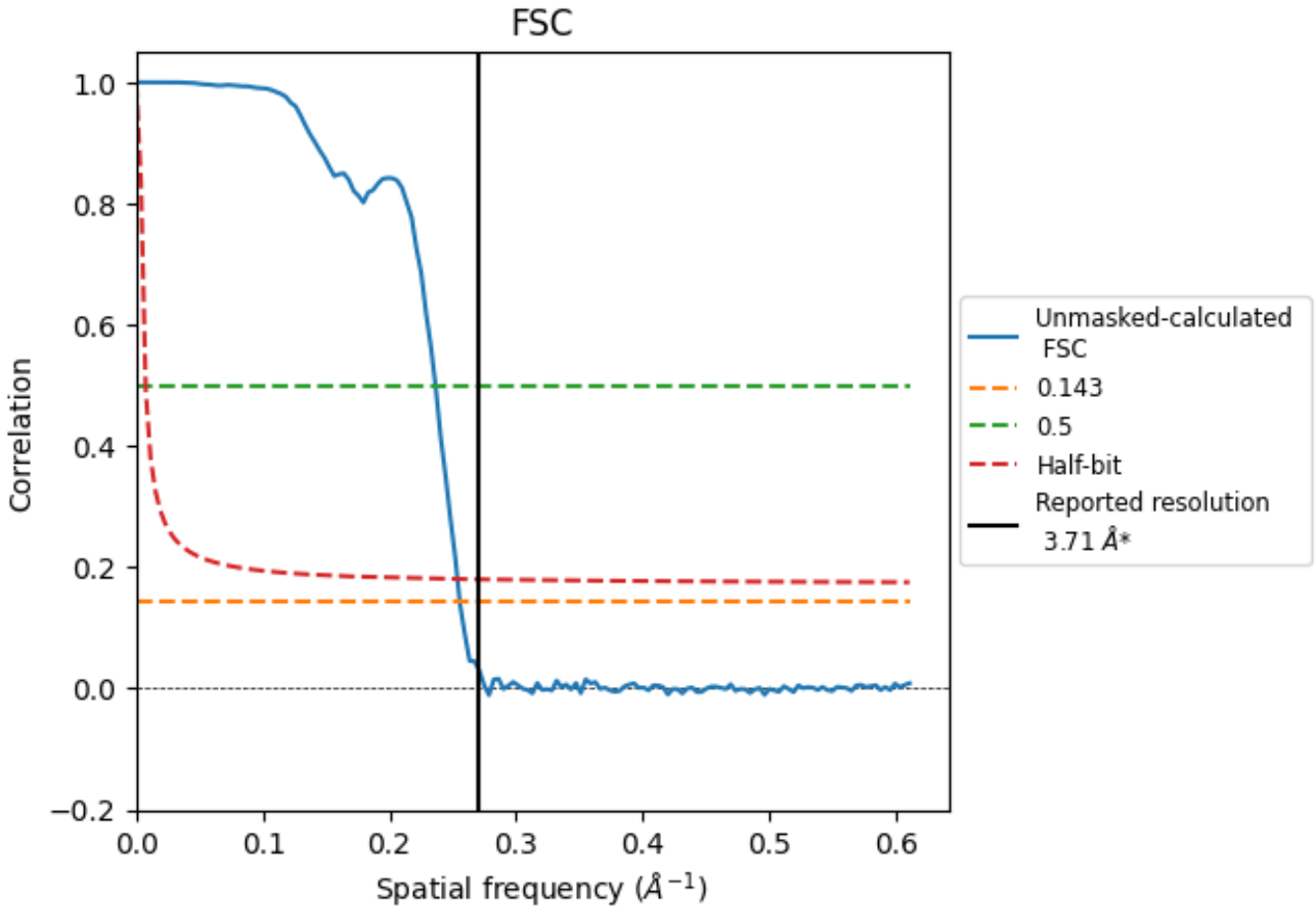


*Reported resolution corresponds to spatial frequency of 0.270 Å^{-1}

8 Fourier-Shell correlation

Fourier-Shell Correlation (FSC) is the most commonly used method to estimate the resolution of single-particle and subtomogram-averaged maps. The shape of the curve depends on the imposed symmetry, mask and whether or not the two 3D reconstructions used were processed from a common reference. The reported resolution is shown as a black line. A curve is displayed for the half-bit criterion in addition to lines showing the 0.143 gold standard cut-off and 0.5 cut-off.

8.1 FSC



*Reported resolution corresponds to spatial frequency of 0.270 Å^{-1}

8.2 Resolution estimates (i)

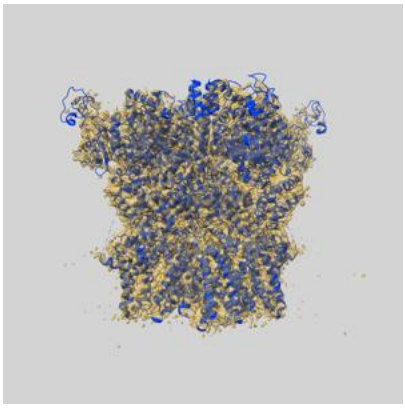
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.71	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	3.91	4.23	3.94

*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps.

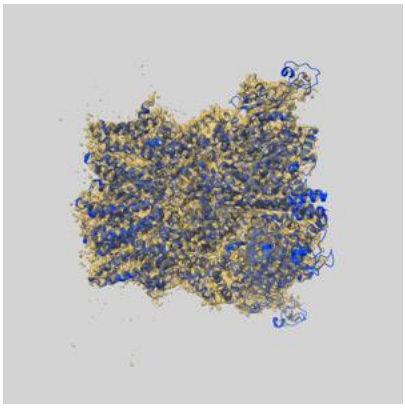
9 Map-model fit

This section contains information regarding the fit between EMDB map EMD-74124 and PDB model 9ZF0. Per-residue inclusion information can be found in section 3 on page 5.

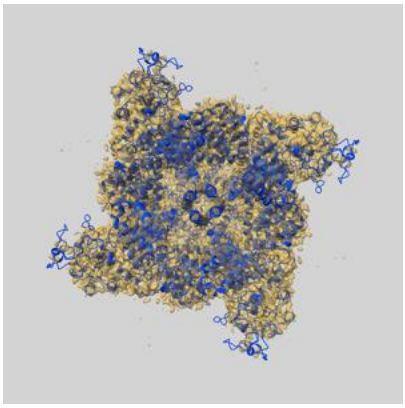
9.1 Map-model overlay



X



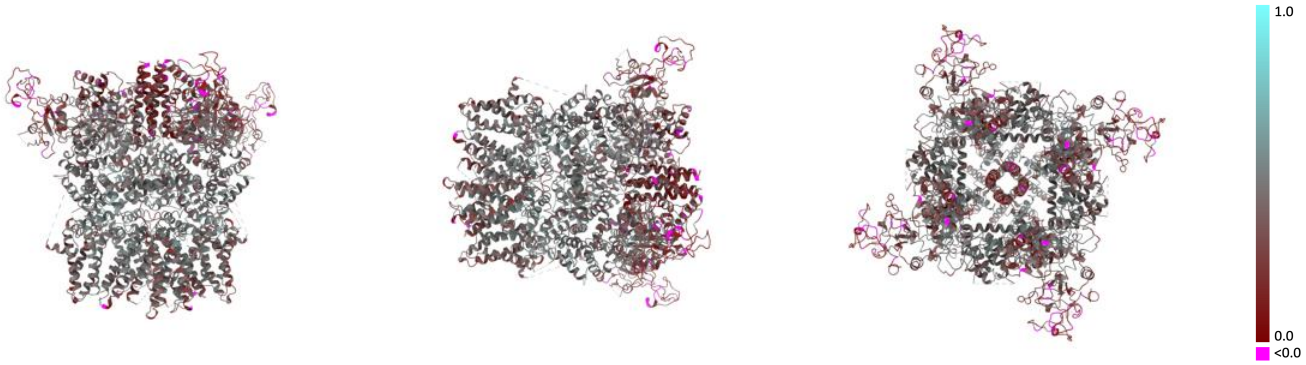
Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.25 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.

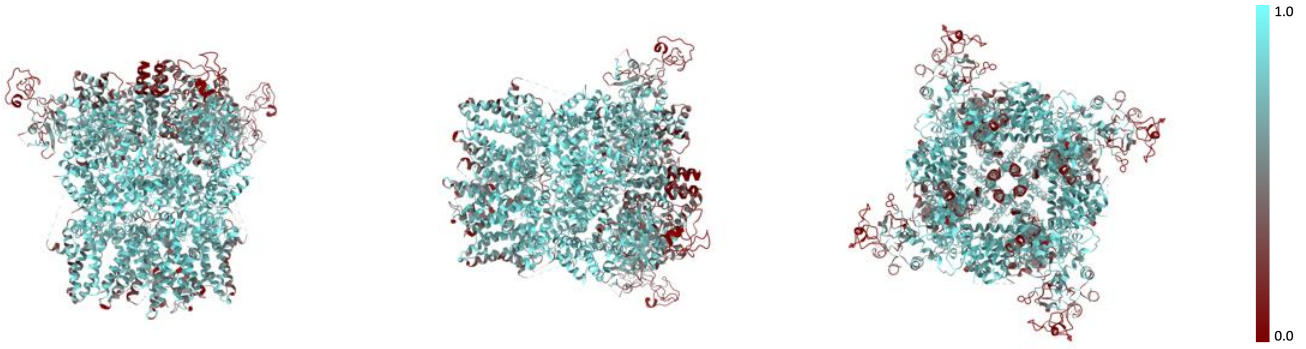
9.2 Q-score mapped to coordinate model



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.

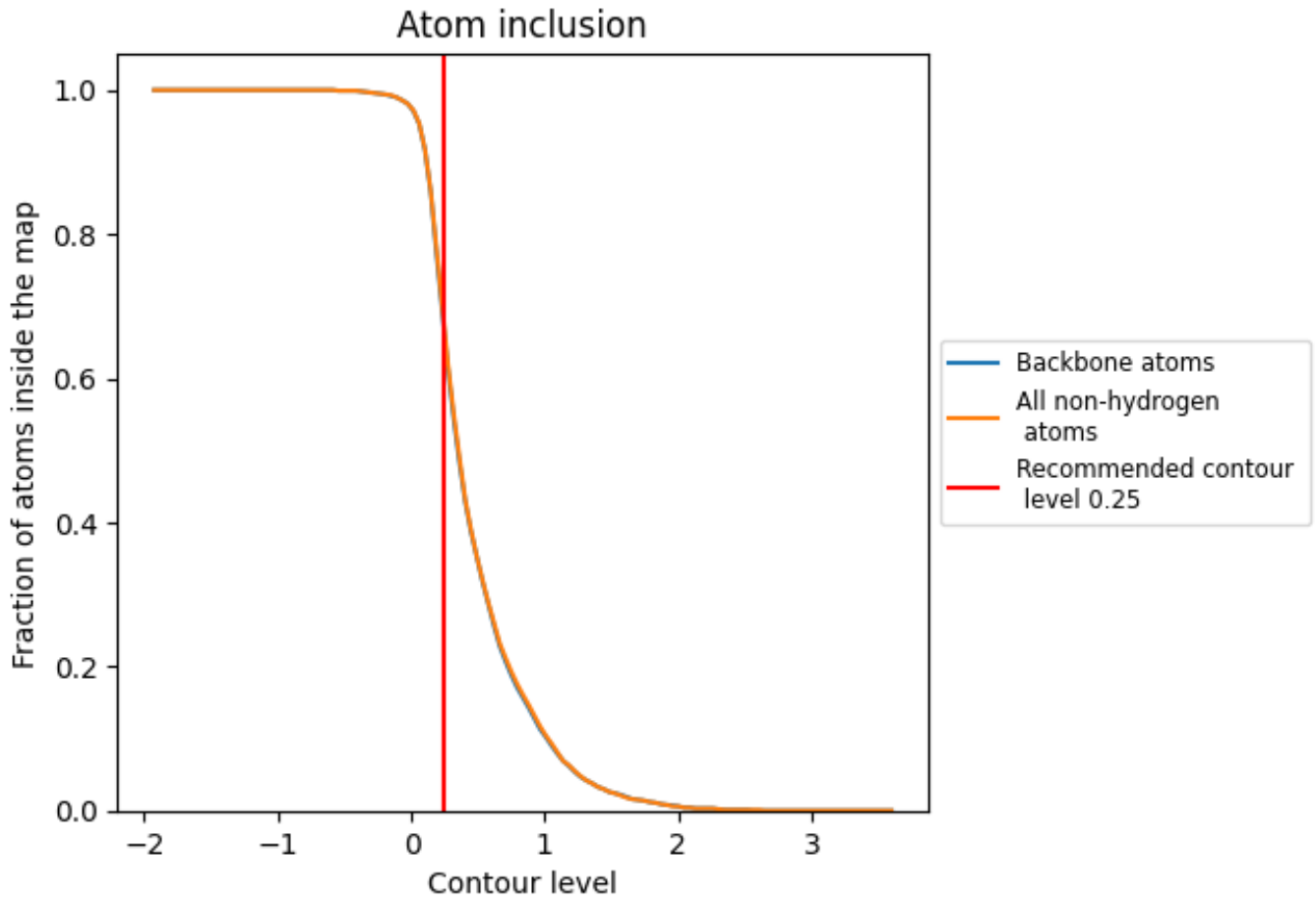
9.3 Atom inclusion mapped to coordinate model



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 (0.25).

9.4 Atom inclusion (i)



At the recommended contour level, 66% of all backbone atoms, 67% 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 (0.25) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.6670	0.3950
A	0.6720	0.3950
B	0.6730	0.3960
C	0.6740	0.3950
D	0.6740	0.3940