



wwPDB EM Validation Summary Report ⓘ

Mar 9, 2026 – 10:53 AM UTC

PDB ID : 9GO3 / pdb_00009go3
EMDB ID : EMD-51489
Title : Sub-open structure of the mechanosensitive channel YbiO
Authors : Lane, B.J.; Pliotas, C.
Deposited on : 2024-09-04
Resolution : 3.15 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:

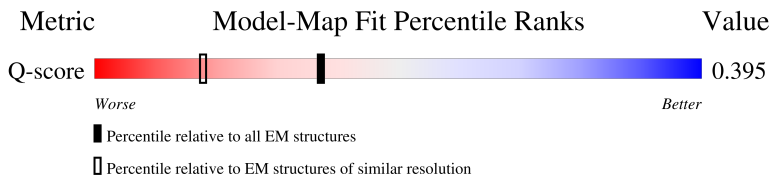
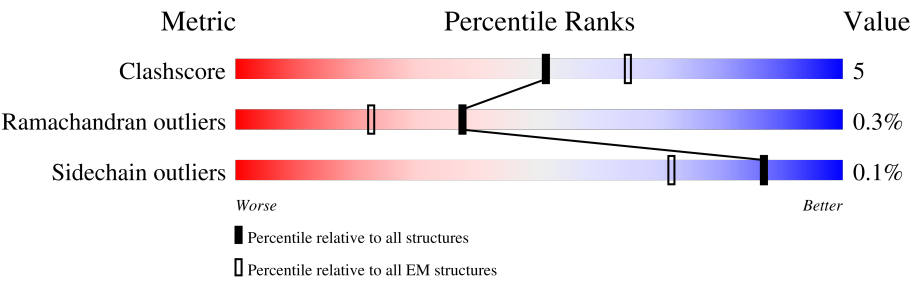
EMDB validation analysis : 0.0.1.dev132
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

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 3.15 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	14486 (2.65 - 3.65)

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	749	29% • 66%
1	B	749	29% 5% 66%
1	C	749	30% • 66%
1	D	749	30% • 66%

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Mol	Chain	Length	Quality of chain
1	E	749	 30%66%
1	F	749	 30%66%
1	G	749	 29%66%

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 12187 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 Mechanosensitive channel protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	253	Total	C	N	O	S	0	0
			1741	1098	307	333	3		
1	B	253	Total	C	N	O	S	0	0
			1741	1098	307	333	3		
1	C	253	Total	C	N	O	S	0	0
			1741	1098	307	333	3		
1	D	253	Total	C	N	O	S	0	0
			1741	1098	307	333	3		
1	E	253	Total	C	N	O	S	0	0
			1741	1098	307	333	3		
1	F	253	Total	C	N	O	S	0	0
			1741	1098	307	333	3		
1	G	253	Total	C	N	O	S	0	0
			1741	1098	307	333	3		

There are 56 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	742	LEU	-	expression tag	UNP W8SQ51
A	743	GLU	-	expression tag	UNP W8SQ51
A	744	HIS	-	expression tag	UNP W8SQ51
A	745	HIS	-	expression tag	UNP W8SQ51
A	746	HIS	-	expression tag	UNP W8SQ51
A	747	HIS	-	expression tag	UNP W8SQ51
A	748	HIS	-	expression tag	UNP W8SQ51
A	749	HIS	-	expression tag	UNP W8SQ51
B	742	LEU	-	expression tag	UNP W8SQ51
B	743	GLU	-	expression tag	UNP W8SQ51
B	744	HIS	-	expression tag	UNP W8SQ51
B	745	HIS	-	expression tag	UNP W8SQ51
B	746	HIS	-	expression tag	UNP W8SQ51
B	747	HIS	-	expression tag	UNP W8SQ51
B	748	HIS	-	expression tag	UNP W8SQ51
B	749	HIS	-	expression tag	UNP W8SQ51

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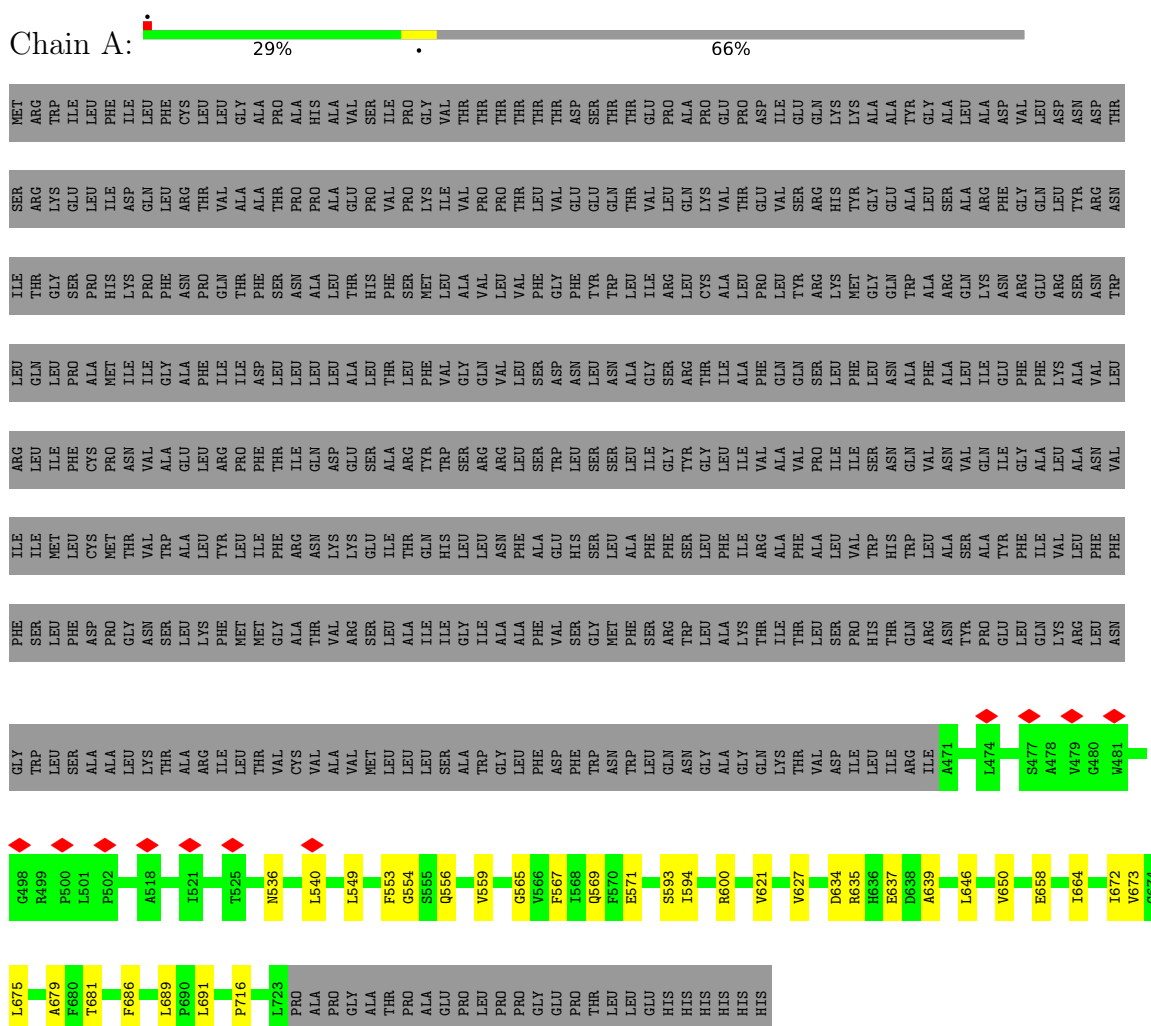
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Chain	Residue	Modelled	Actual	Comment	Reference
C	742	LEU	-	expression tag	UNP W8SQ51
C	743	GLU	-	expression tag	UNP W8SQ51
C	744	HIS	-	expression tag	UNP W8SQ51
C	745	HIS	-	expression tag	UNP W8SQ51
C	746	HIS	-	expression tag	UNP W8SQ51
C	747	HIS	-	expression tag	UNP W8SQ51
C	748	HIS	-	expression tag	UNP W8SQ51
C	749	HIS	-	expression tag	UNP W8SQ51
D	742	LEU	-	expression tag	UNP W8SQ51
D	743	GLU	-	expression tag	UNP W8SQ51
D	744	HIS	-	expression tag	UNP W8SQ51
D	745	HIS	-	expression tag	UNP W8SQ51
D	746	HIS	-	expression tag	UNP W8SQ51
D	747	HIS	-	expression tag	UNP W8SQ51
D	748	HIS	-	expression tag	UNP W8SQ51
D	749	HIS	-	expression tag	UNP W8SQ51
E	742	LEU	-	expression tag	UNP W8SQ51
E	743	GLU	-	expression tag	UNP W8SQ51
E	744	HIS	-	expression tag	UNP W8SQ51
E	745	HIS	-	expression tag	UNP W8SQ51
E	746	HIS	-	expression tag	UNP W8SQ51
E	747	HIS	-	expression tag	UNP W8SQ51
E	748	HIS	-	expression tag	UNP W8SQ51
E	749	HIS	-	expression tag	UNP W8SQ51
F	742	LEU	-	expression tag	UNP W8SQ51
F	743	GLU	-	expression tag	UNP W8SQ51
F	744	HIS	-	expression tag	UNP W8SQ51
F	745	HIS	-	expression tag	UNP W8SQ51
F	746	HIS	-	expression tag	UNP W8SQ51
F	747	HIS	-	expression tag	UNP W8SQ51
F	748	HIS	-	expression tag	UNP W8SQ51
F	749	HIS	-	expression tag	UNP W8SQ51
G	742	LEU	-	expression tag	UNP W8SQ51
G	743	GLU	-	expression tag	UNP W8SQ51
G	744	HIS	-	expression tag	UNP W8SQ51
G	745	HIS	-	expression tag	UNP W8SQ51
G	746	HIS	-	expression tag	UNP W8SQ51
G	747	HIS	-	expression tag	UNP W8SQ51
G	748	HIS	-	expression tag	UNP W8SQ51
G	749	HIS	-	expression tag	UNP W8SQ51

3 Residue-property plots

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: Mechanosensitive channel protein



• Molecule 1: Mechanosensitive channel protein



V673	G674	L675	T681	F686	L689	P690	L691	Q721	V722	L723	PRO	ALA	PRO	GLY	ALA	THR	PRO	PRO	ALA	GLY	PRO	LEU	PRO	PRO	GLY	GLY	PRO	THR	LEU	LEU	HIS	HIS	HIS	HIS
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● Molecule 1: Mechanosensitive channel protein



MET	ARG	TRP	ILE	PHE	LEU	PHE	CYS	LEU	GLY	ALA	PRO	ALA	HIS	VAL	SER	ILE	PRO	GLY	VAL	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR
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SER	ARG	GLY	LEU	ILE	ASP	GLN	THR	VAL	ALA	ALA	PRO	ALA	ALA	GLY	PRO	VAL	VAL	LYS	ILE	VAL	PRO	VAL	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR
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ILE	THR	GLY	SER	PRO	HIS	LYS	PRO	PHE	ASN	THR	GLN	VAL	THR	ALA	LEU	PHE	SER	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR
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LEU	GLN	PRO	ALA	MET	ILE	ILE	GLY	PHE	THR	THR	ILE	ASP	LEU	LEU	ALA	THR	PHE	SER	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR
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ARG	LEU	ILE	PHE	CYS	PRO	ASN	VAL	THR	ALA	GLY	LEU	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR
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ILE	ILE	MET	LEU	CYS	MET	THR	VAL	THR	ALA	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR
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PHE	SER	LEU	PHE	ASP	PRO	GLY	ASN	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR
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GLY	TRP	LEU	SER	ALA	LEU	LYS	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR
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G498	P500	L501	P502	A518	I521	T525	N536	L540	F553	G554	S555	Q556	V559	G565	V566	I568	Q569	F570	E571	S593	I594	R600	V621	V627	D634	R635	R636	E637	L646	V650	E657	E658	I664	V673	G674	L675	T681
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F686	L689	P690	L691	K706	D709	P716	T719	L723	PRO	ALA	PRO	GLY	ALA	THR	PRO	PRO	ALA	GLY	PRO	LEU	PRO	PRO	GLY	PRO	THR	LEU	LEU	GLY	HIS	HIS	HIS	HIS
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4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C7	Depositor
Number of particles used	147935	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 ($e^-/\text{\AA}^2$)	66.3	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (4k x 4k)	Depositor
Maximum map value	0.760	Depositor
Minimum map value	-0.162	Depositor
Average map value	0.002	Depositor
Map value standard deviation	0.033	Depositor
Recommended contour level	0.25	Depositor
Map size (Å)	426.24, 426.24, 426.24	wwPDB
Map dimensions	576, 576, 576	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.74, 0.74, 0.74	Depositor

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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	0.13	0/1766	0.34	0/2413
1	B	0.14	0/1766	0.35	0/2413
1	C	0.13	0/1766	0.34	0/2413
1	D	0.13	0/1766	0.34	0/2413
1	E	0.13	0/1766	0.34	0/2413
1	F	0.14	0/1766	0.35	0/2413
1	G	0.14	0/1766	0.35	0/2413
All	All	0.13	0/12362	0.35	0/16891

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 [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	1741	0	1577	21	0
1	B	1741	0	1577	24	0
1	C	1741	0	1577	17	0
1	D	1741	0	1577	20	0
1	E	1741	0	1577	19	0
1	F	1741	0	1577	21	0
1	G	1741	0	1577	21	0
All	All	12187	0	11039	127	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 5.

The worst 5 of 127 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:621:VAL:HG12	1:D:691:LEU:HD11	1.68	0.76
1:E:621:VAL:HG12	1:E:691:LEU:HD11	1.68	0.76
1:C:621:VAL:HG12	1:C:691:LEU:HD11	1.68	0.75
1:F:621:VAL:HG12	1:F:691:LEU:HD11	1.68	0.74
1:G:621:VAL:HG12	1:G:691:LEU:HD11	1.68	0.74

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	251/749 (34%)	246 (98%)	4 (2%)	1 (0%)	30	59
1	B	251/749 (34%)	247 (98%)	3 (1%)	1 (0%)	30	59
1	C	251/749 (34%)	247 (98%)	3 (1%)	1 (0%)	30	59
1	D	251/749 (34%)	246 (98%)	4 (2%)	1 (0%)	30	59
1	E	251/749 (34%)	246 (98%)	5 (2%)	0	100	100
1	F	251/749 (34%)	247 (98%)	3 (1%)	1 (0%)	30	59
1	G	251/749 (34%)	246 (98%)	4 (2%)	1 (0%)	30	59
All	All	1757/5243 (34%)	1725 (98%)	26 (2%)	6 (0%)	37	64

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	536	ASN
1	B	536	ASN

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Mol	Chain	Res	Type
1	C	536	ASN
1	D	536	ASN
1	F	536	ASN

5.3.2 Protein sidechains ⓘ

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	150/628 (24%)	150 (100%)	0	100	100
1	B	150/628 (24%)	150 (100%)	0	100	100
1	C	150/628 (24%)	150 (100%)	0	100	100
1	D	150/628 (24%)	150 (100%)	0	100	100
1	E	150/628 (24%)	150 (100%)	0	100	100
1	F	150/628 (24%)	150 (100%)	0	100	100
1	G	150/628 (24%)	149 (99%)	1 (1%)	76	80
All	All	1050/4396 (24%)	1049 (100%)	1 (0%)	87	89

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	G	709	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 16 such sidechains are listed below:

Mol	Chain	Res	Type
1	G	607	HIS
1	G	575	ASN
1	D	607	HIS
1	F	607	HIS
1	D	575	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.

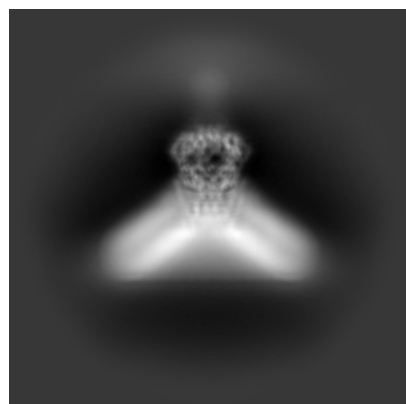
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-51489. These allow visual inspection of the internal detail of the map and identification of artifacts.

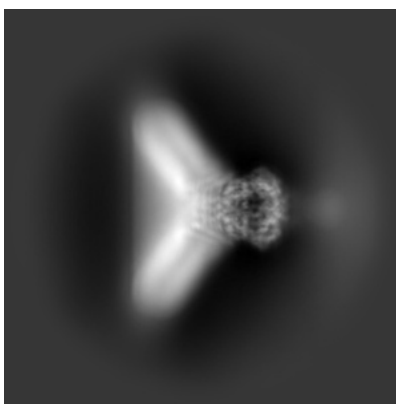
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

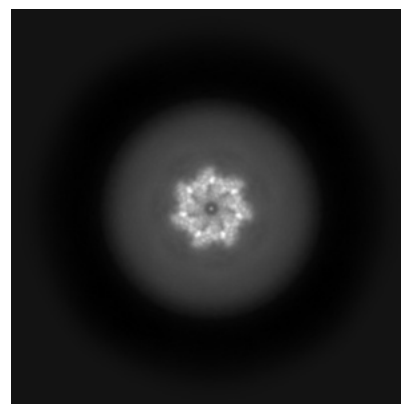
6.1.1 Primary map



X

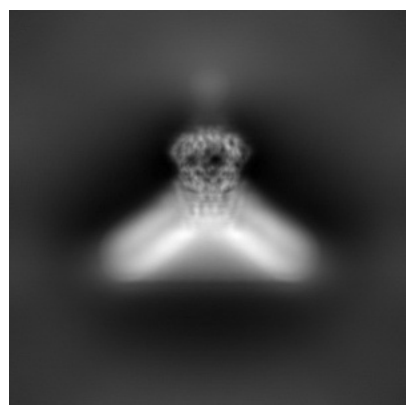


Y

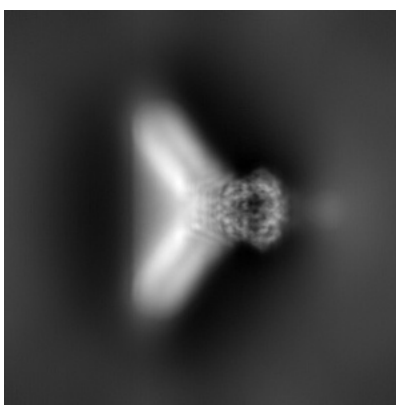


Z

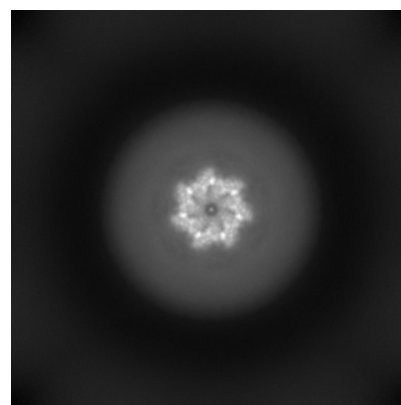
6.1.2 Raw map



X



Y

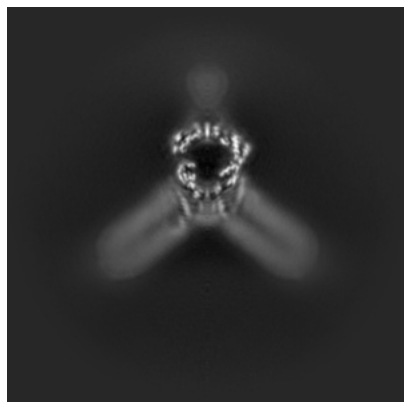


Z

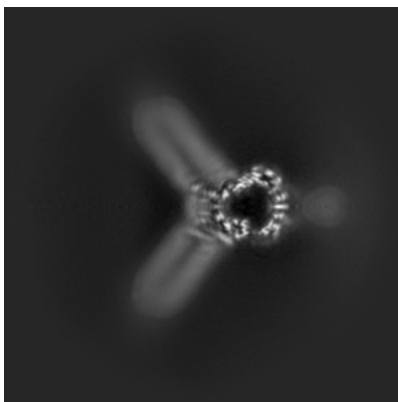
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

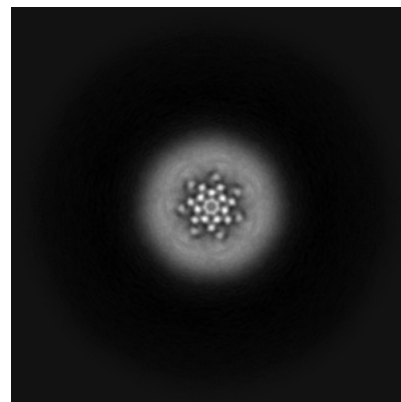
6.2.1 Primary map



X Index: 288

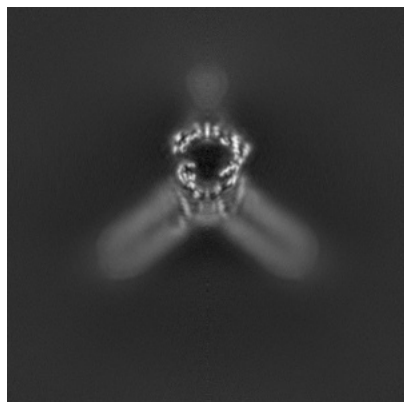


Y Index: 288

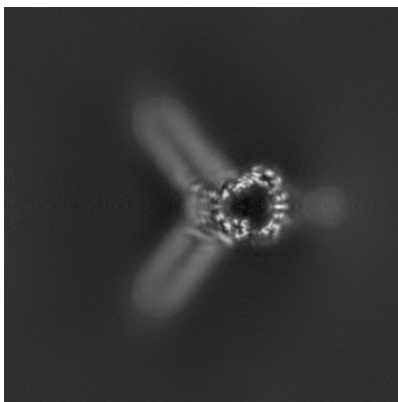


Z Index: 288

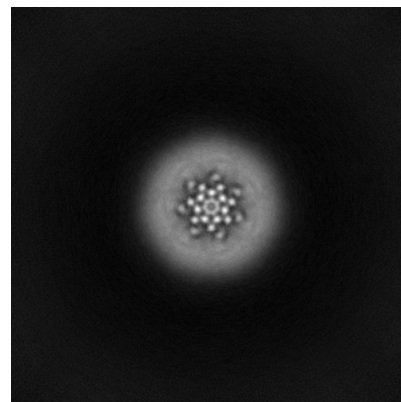
6.2.2 Raw map



X Index: 288



Y Index: 288

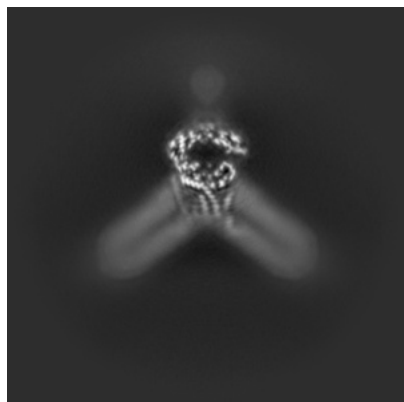


Z Index: 288

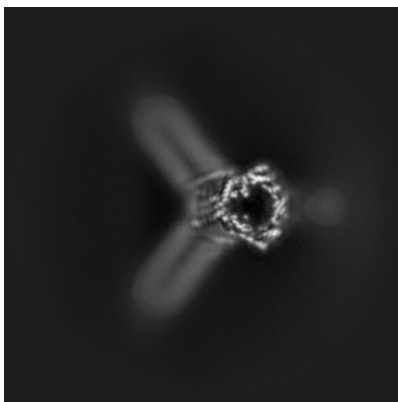
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

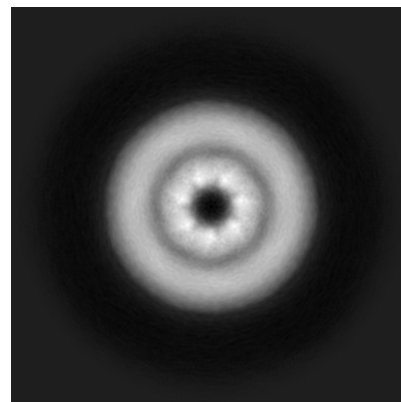
6.3.1 Primary map



X Index: 271

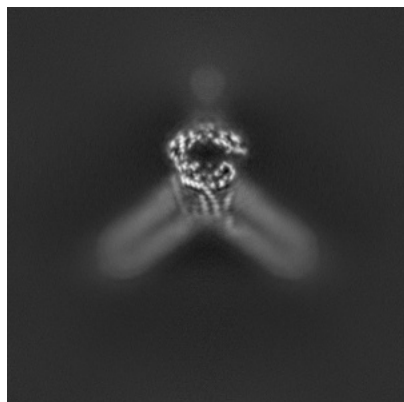


Y Index: 276

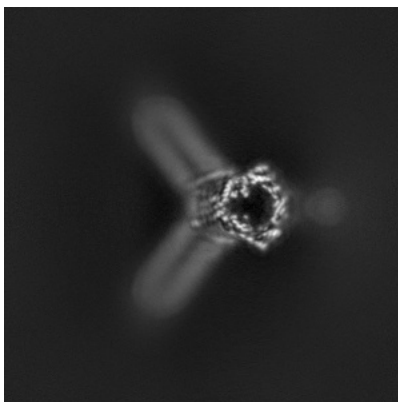


Z Index: 253

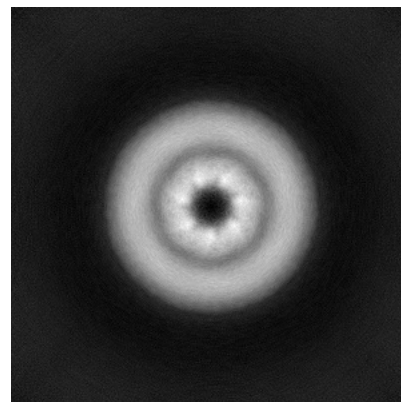
6.3.2 Raw map



X Index: 271



Y Index: 276

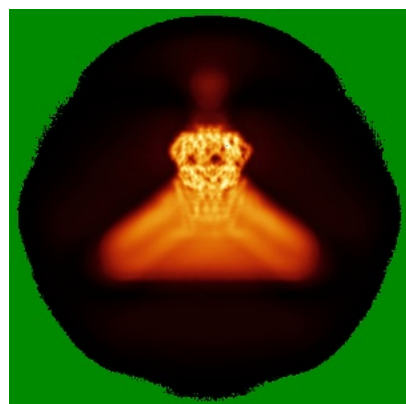


Z Index: 253

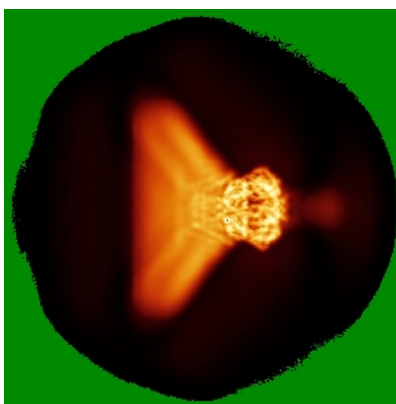
The images above show the largest variance slices of the map in three orthogonal directions.

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

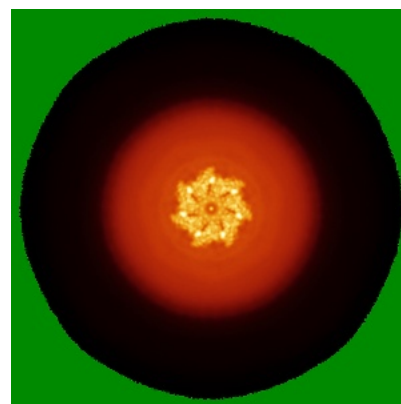
6.4.1 Primary map



X

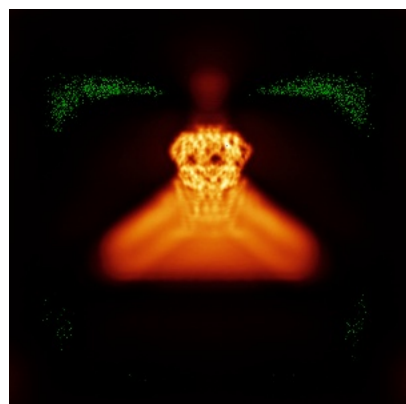


Y

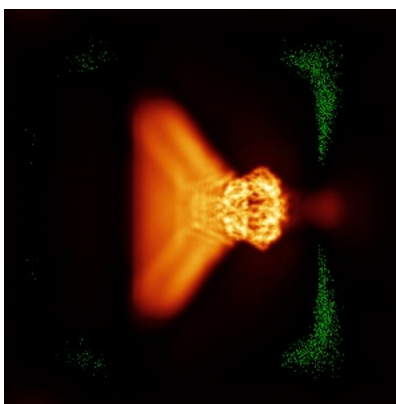


Z

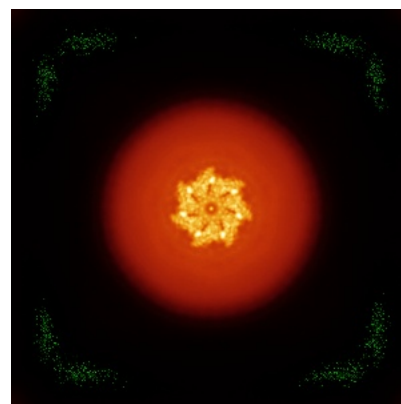
6.4.2 Raw map



X



Y

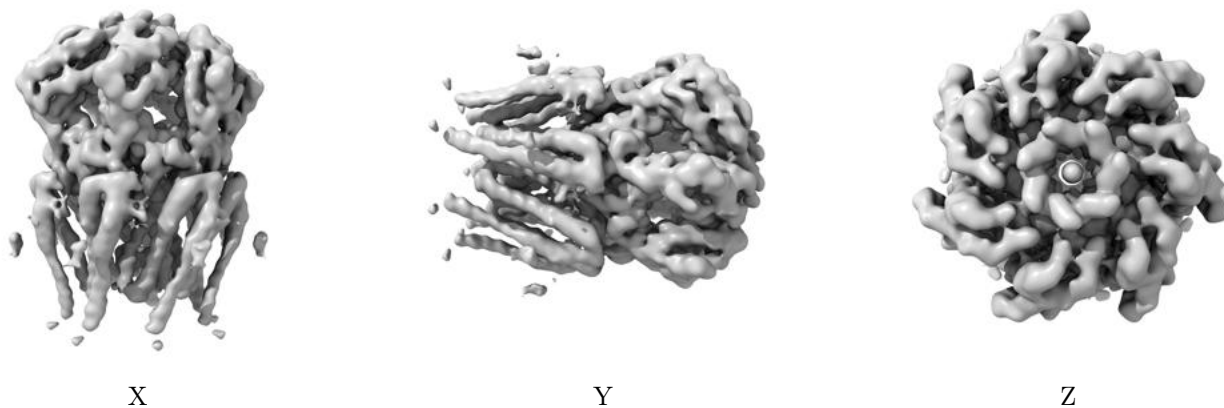


Z

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.

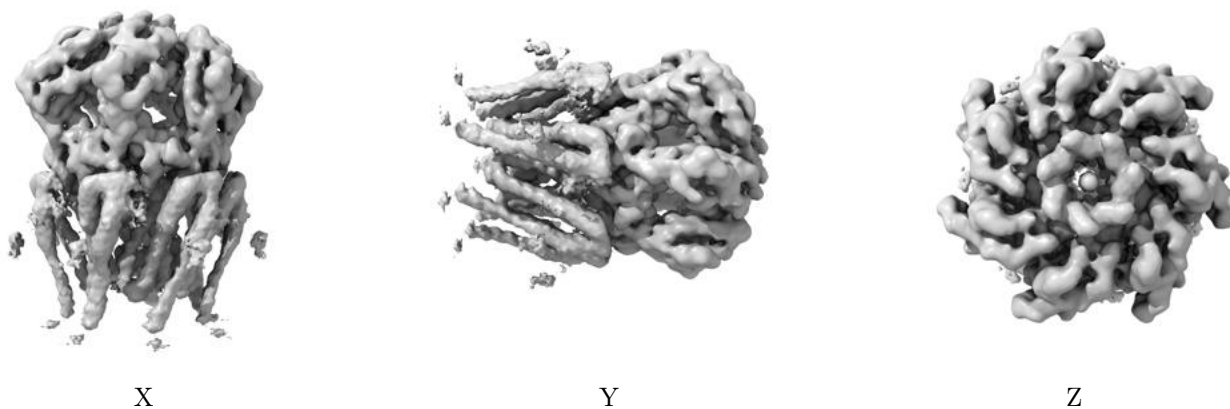
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



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



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.

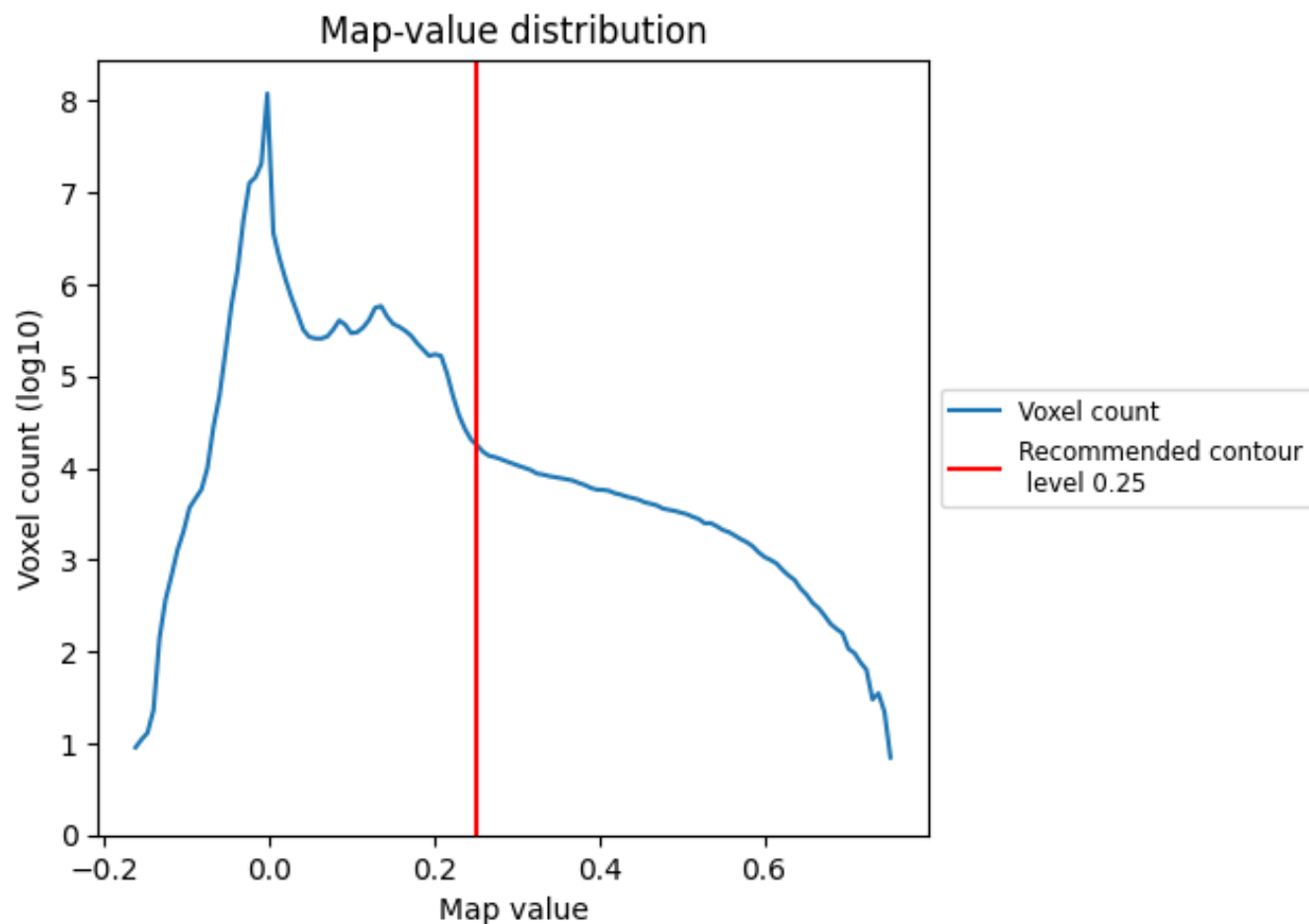
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

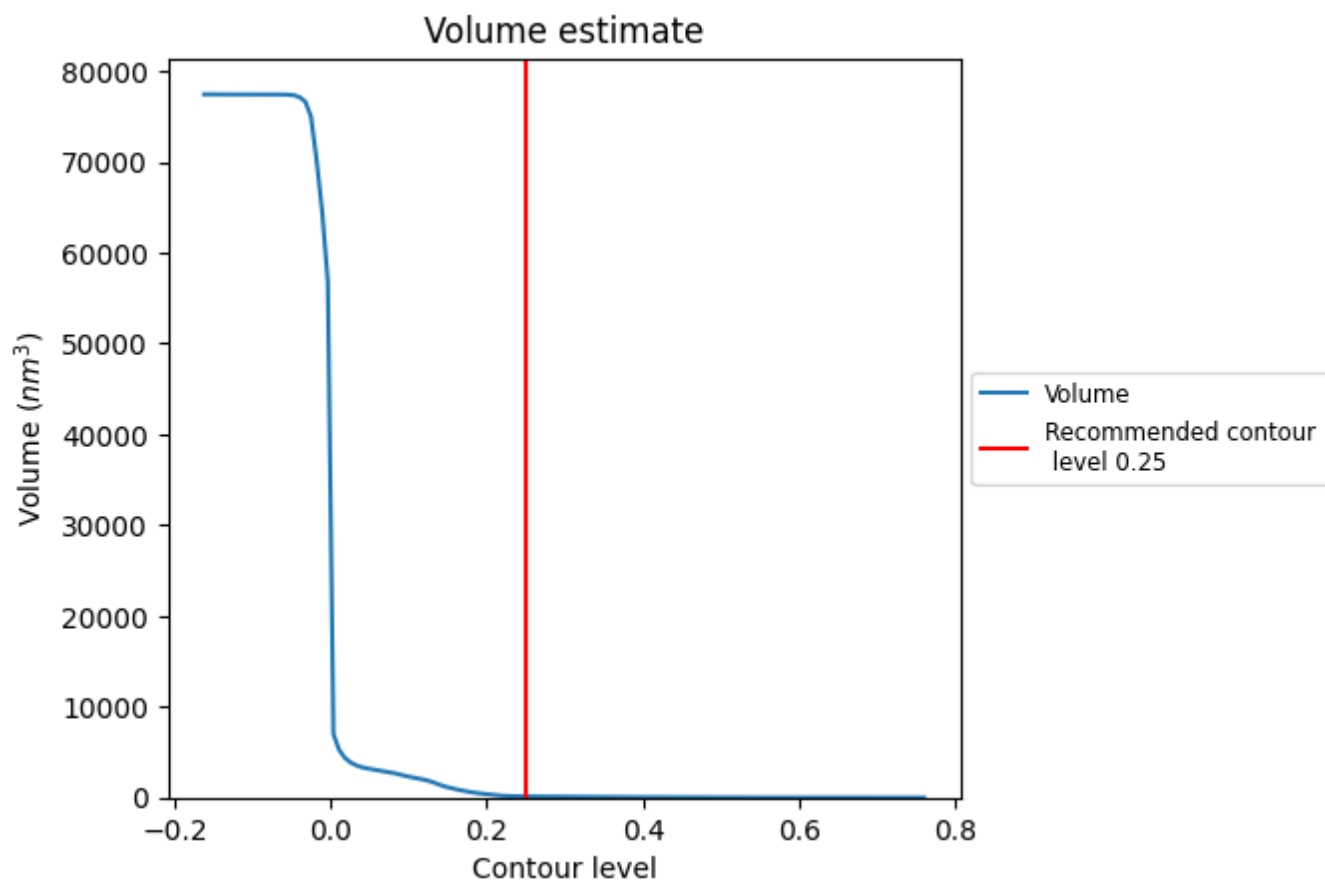
This section contains the results of statistical analysis of the map.

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.

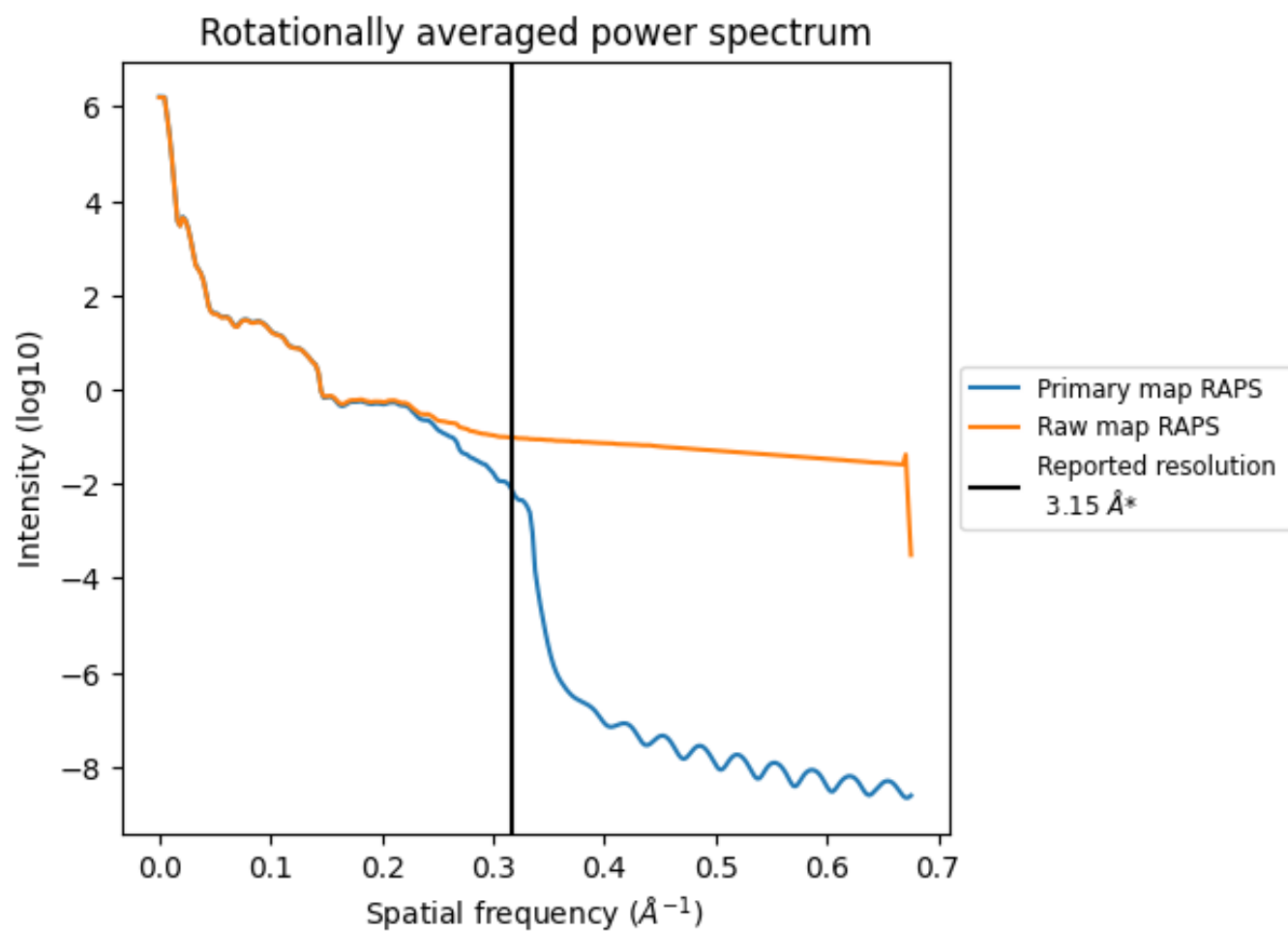
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 125 nm³; this corresponds to an approximate mass of 113 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 ⓘ

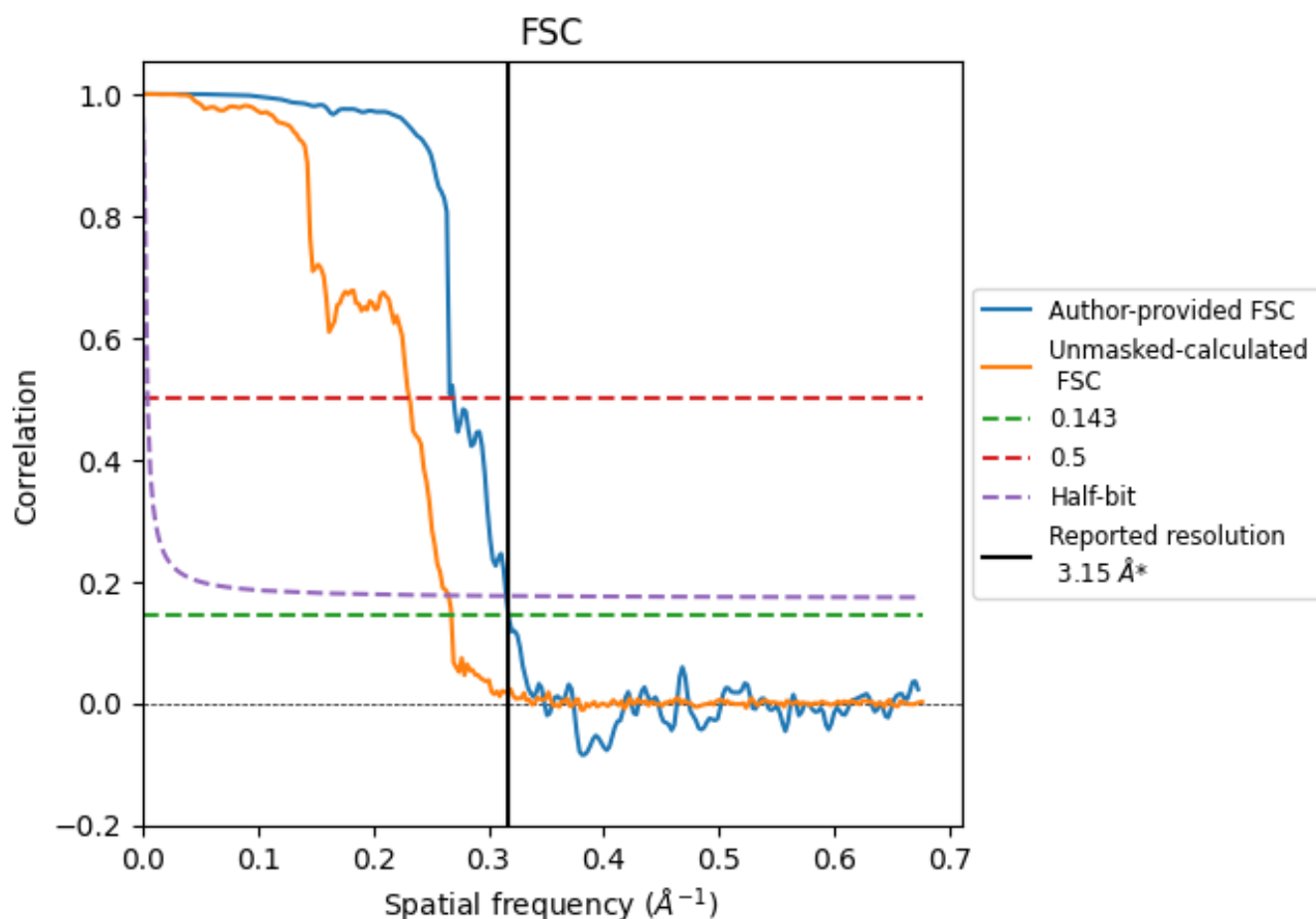


*Reported resolution corresponds to spatial frequency of $0.317 \text{ \AA}^{-1}$

8 Fourier-Shell correlation [i](#)

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 [i](#)



*Reported resolution corresponds to spatial frequency of 0.317 Å⁻¹

8.2 Resolution estimates [i](#)

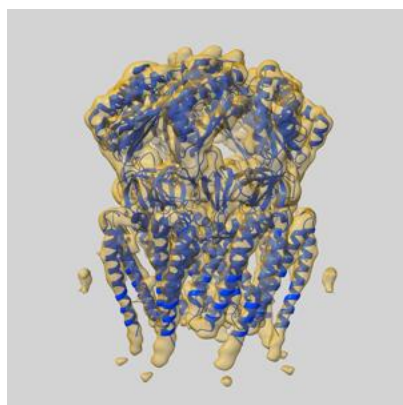
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.15	-	-
Author-provided FSC curve	3.15	3.71	3.17
Unmasked-calculated*	3.73	4.32	3.77

*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps. The value from deposited half-maps intersecting FSC 0.143 CUT-OFF 3.73 differs from the reported value 3.15 by more than 10 %

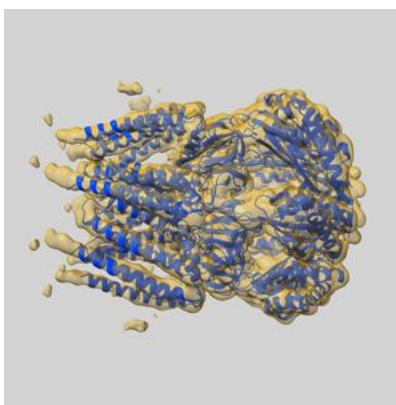
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-51489 and PDB model 9GO3. Per-residue inclusion information can be found in section [3](#) on page [6](#).

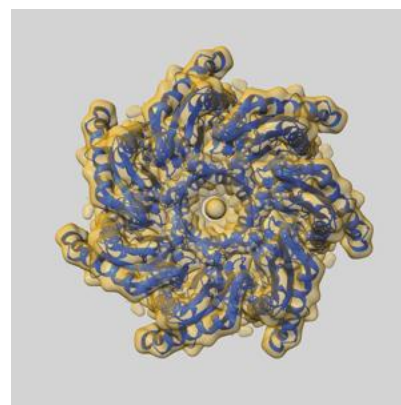
9.1 Map-model overlay [i](#)



X



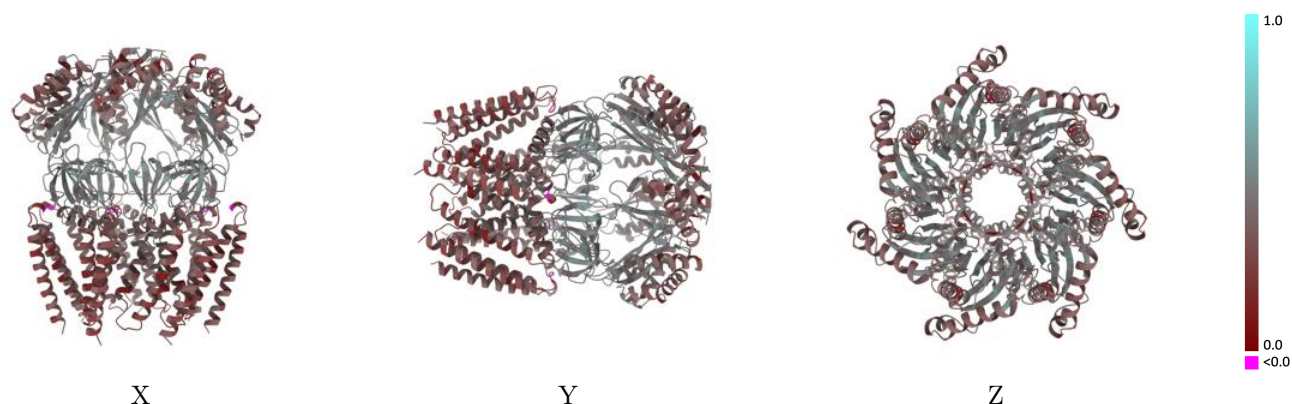
Y



Z

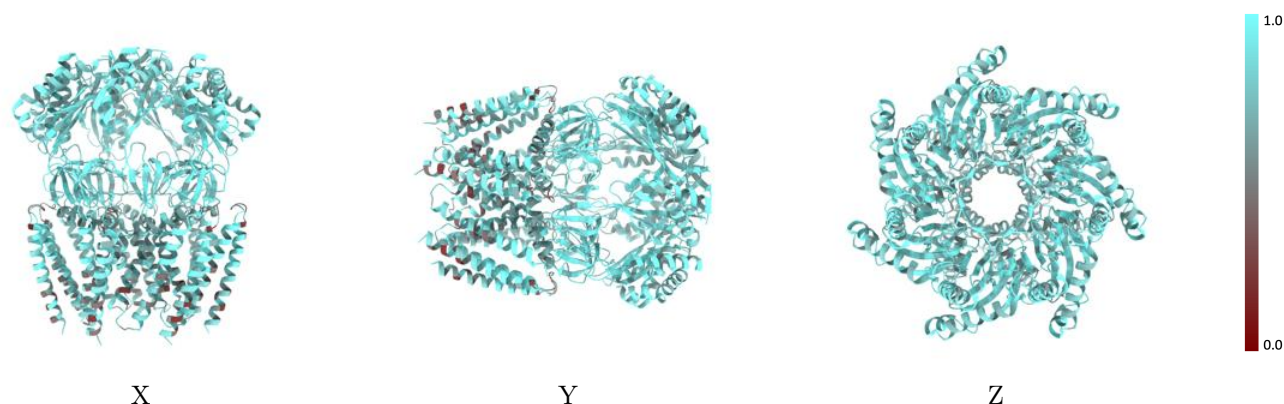
The images above show the 3D surface view of the map at the recommended contour level 0.25 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



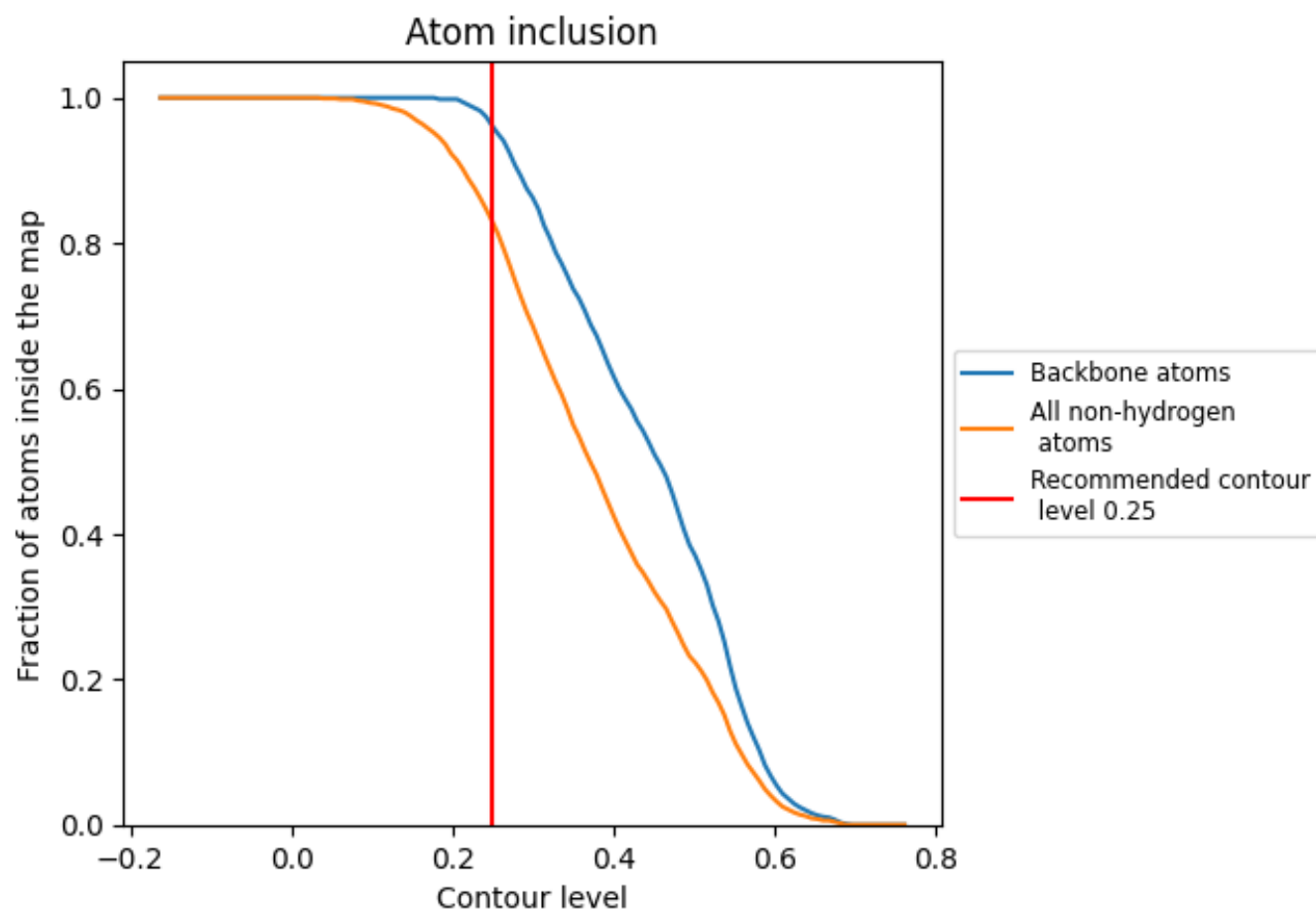
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.25).

9.4 Atom inclusion [i](#)



At the recommended contour level, 96% of all backbone atoms, 83% 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	0.8280	0.3950
A	0.8280	0.3950
B	0.8300	0.3950
C	0.8260	0.3940
D	0.8280	0.3940
E	0.8270	0.3950
F	0.8280	0.3960
G	0.8270	0.3950

1.0

0.0

<0.0