



wwPDB EM Validation Summary Report ⓘ

Jan 13, 2024 – 12:55 PM EST

PDB ID : 8SR5
EMDB ID : EMD-40720
Title : particulate methane monooxygenase potassium cyanide treated
Authors : Tucci, F.J.; Rosenzweig, A.C.
Deposited on : 2023-05-05
Resolution : 3.22 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 : 1.9.9
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

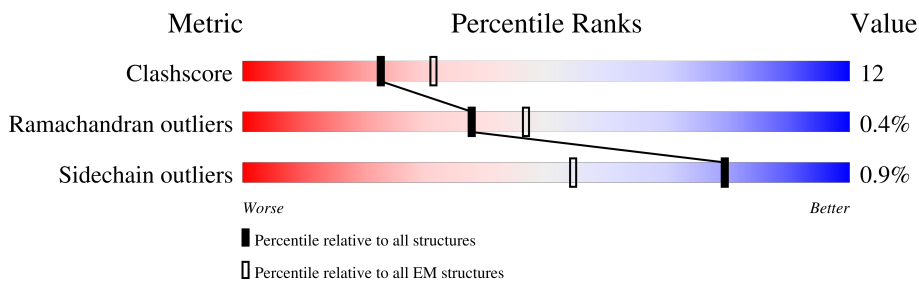
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.22 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.



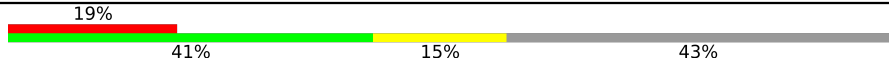
Metric	Whole archive (#Entries)	EM structures (#Entries)
Clashscore	158937	4297
Ramachandran outliers	154571	4023
Sidechain outliers	154315	3826

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	414	
1	E	414	
1	I	414	
2	B	247	
2	F	247	
2	J	247	
3	C	260	
3	G	260	

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Mol	Chain	Length	Quality of chain
3	K	260	 <p>A horizontal bar chart representing the quality of chain. The bar is divided into four segments: a red segment (19%), a green segment (41%), a yellow segment (15%), and a grey segment (43%). The percentages are labeled below the bar.</p>

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 18588 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 Particulate methane monooxygenase alpha subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	382	Total	C	N	O	S	0	0
			3017	1938	513	551	15		
1	E	382	Total	C	N	O	S	0	0
			3017	1938	513	551	15		
1	I	382	Total	C	N	O	S	0	0
			3017	1938	513	551	15		

- Molecule 2 is a protein called Particulate methane monooxygenase beta subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	B	241	Total	C	N	O	S	0	0
			1977	1329	315	322	11		
2	F	241	Total	C	N	O	S	0	0
			1977	1329	315	322	11		
2	J	241	Total	C	N	O	S	0	0
			1977	1329	315	322	11		

- Molecule 3 is a protein called Ammonia monooxygenase/methane monooxygenase, subunit C family protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	C	147	Total	C	N	O	S	0	0
			1200	815	186	196	3		
3	G	147	Total	C	N	O	S	0	0
			1200	815	186	196	3		
3	K	147	Total	C	N	O	S	0	0
			1200	815	186	196	3		

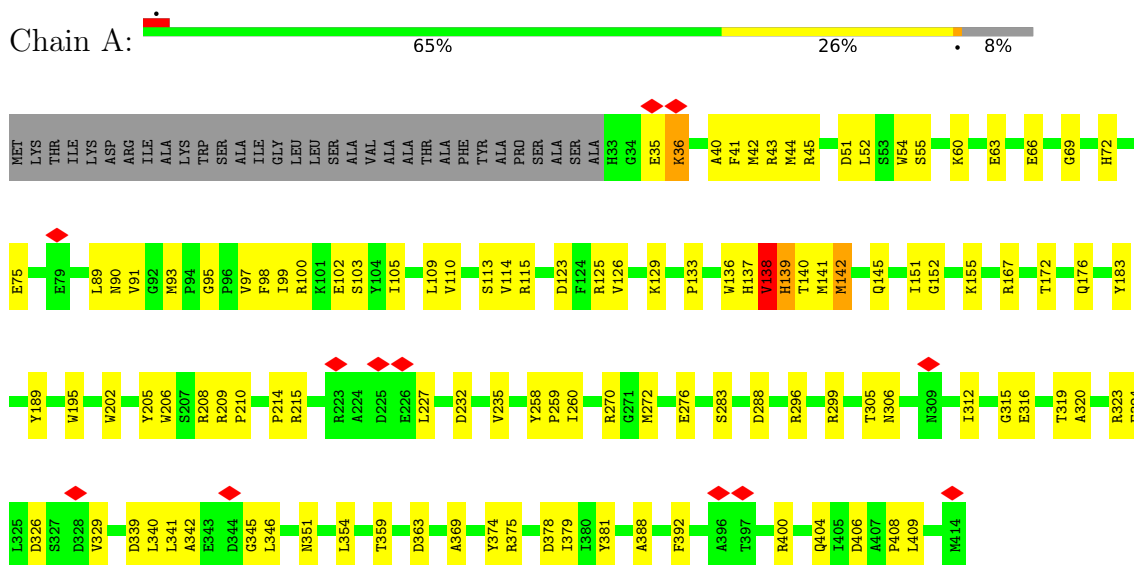
- Molecule 4 is COPPER (II) ION (three-letter code: CU) (formula: Cu) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
4	A	2	Total 2	Cu 2	0
4	E	2	Total 2	Cu 2	0
4	I	2	Total 2	Cu 2	0

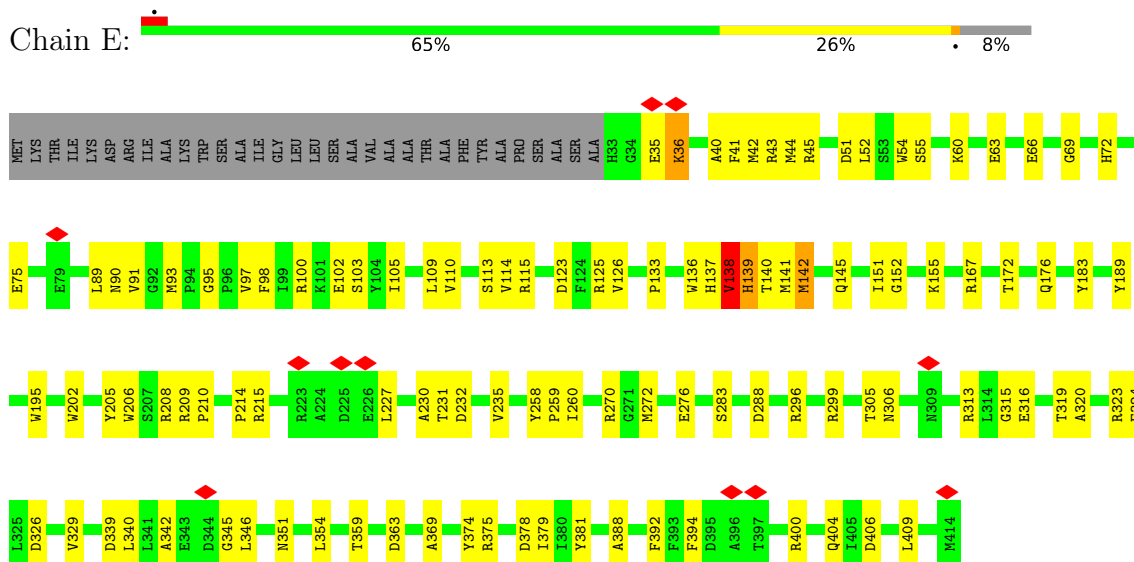
3 Residue-property plots [i](#)

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.

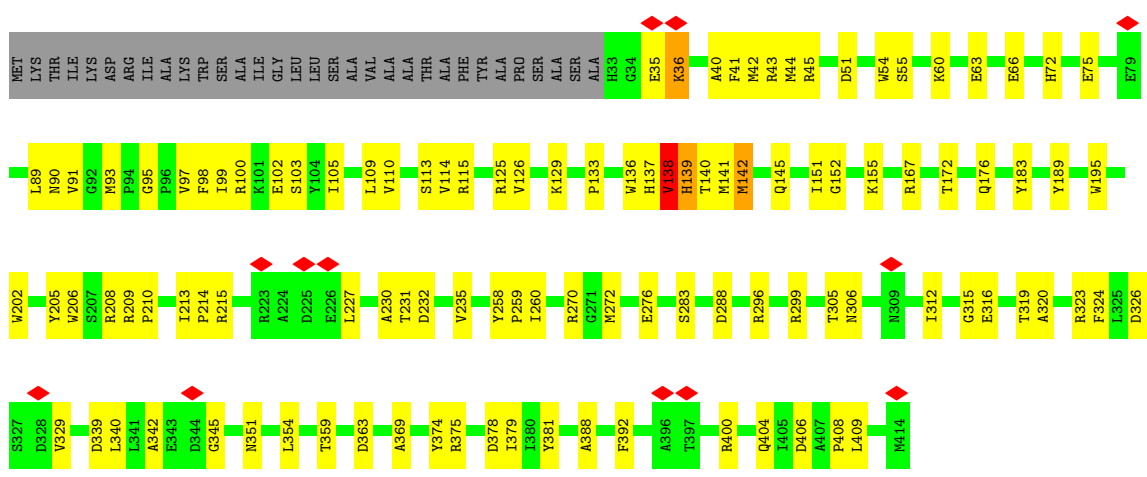
- Molecule 1: Particulate methane monooxygenase alpha subunit



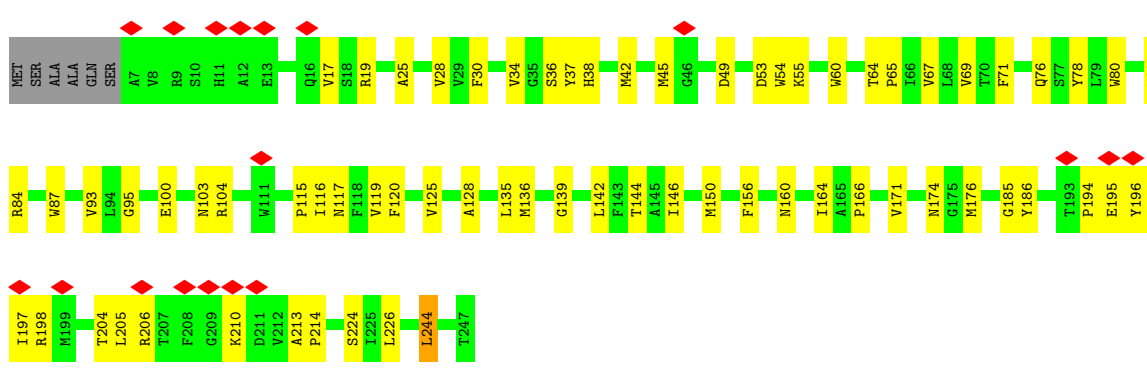
- Molecule 1: Particulate methane monooxygenase alpha subunit



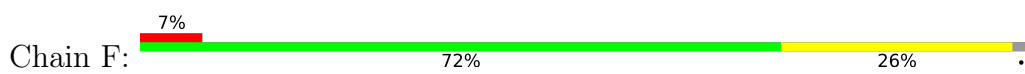
- Molecule 1: Particulate methane monooxygenase alpha subunit



• Molecule 2: Particulate methane monooxygenase beta subunit

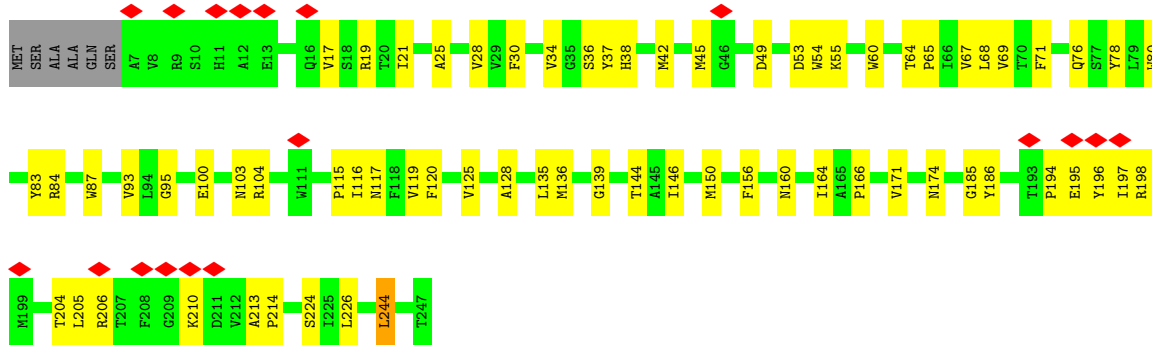


• Molecule 2: Particulate methane monooxygenase beta subunit

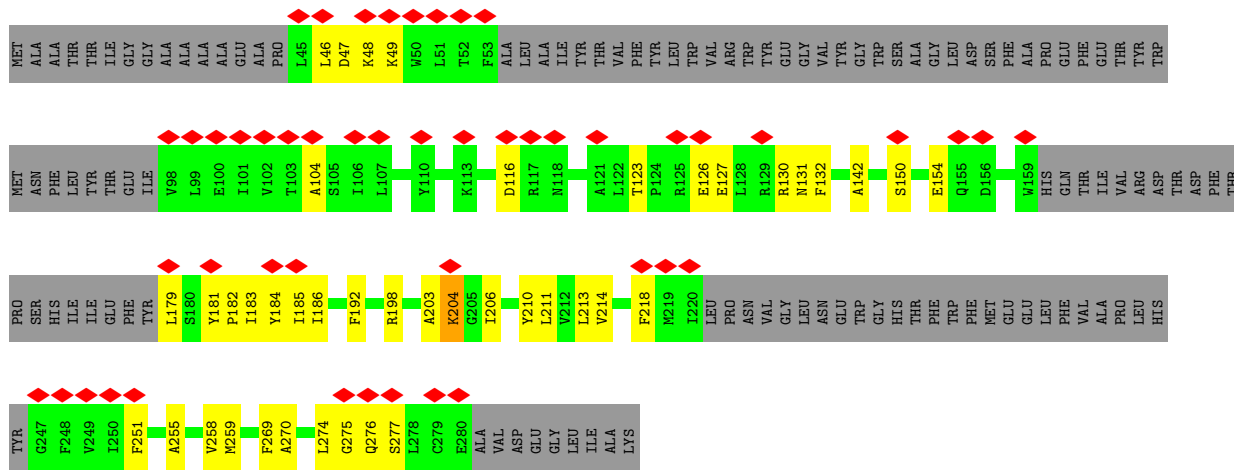


• Molecule 2: Particulate methane monooxygenase beta subunit

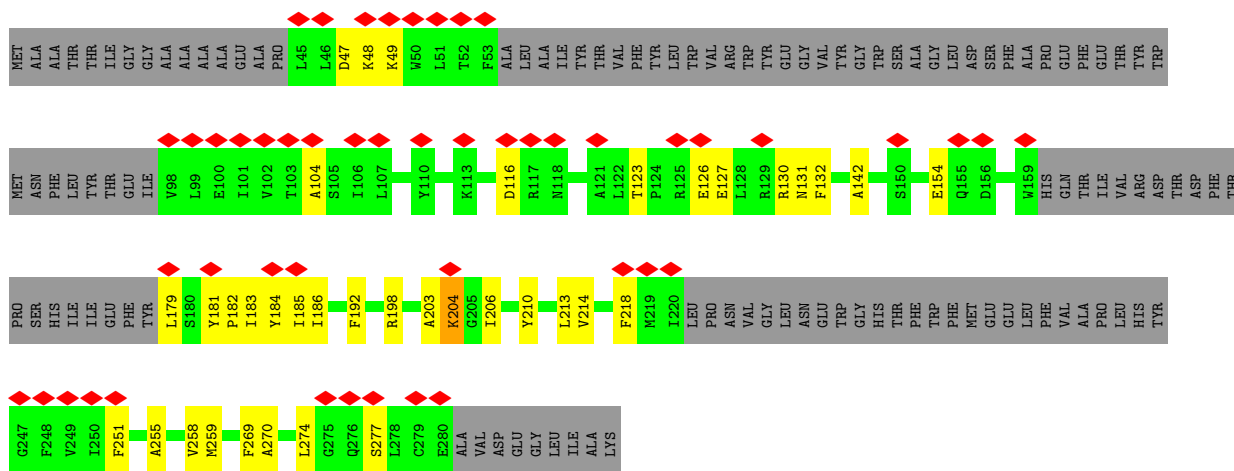
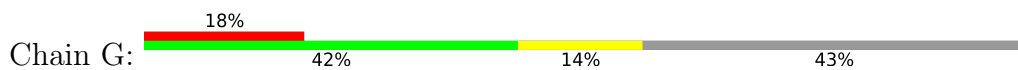




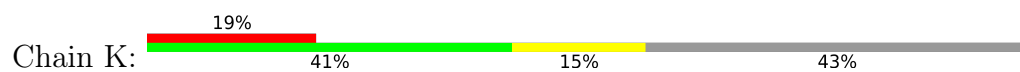
• Molecule 3: Ammonia monooxygenase/methane monooxygenase, subunit C family protein



• Molecule 3: Ammonia monooxygenase/methane monooxygenase, subunit C family protein



• Molecule 3: Ammonia monooxygenase/methane monooxygenase, subunit C family protein



MET	ALA	ALA	THR	THR	ILE	GLY	ALA	ALA	ALA	ALA	PRO	L45	L46	D47	K48	K49	W50	L51	T52	F53	ALA	LEU	ALA	ILE	TYR	THR	VAL	PHE	TYR	LEU	TRP	VAL	ARG	TRP	TYR	GLY	VAL	TYR	GLY	TRP	SER	ALA	GLY	ASP	SER	PHE	ALA	PRO	GLU	PHE	GLU	THR	TYR	TRP
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MET	ASN	PHE	LEU	TYR	THR	GLU	ILE	V98	L99	E100	I101	V102	T103	A104	S105	I106	L107	Y110	K113	D116	R117	N118	A121	L122	T123	P124	R125	E126	E127	L128	R129	N130	N131	F132	A142	S150	E154	Q155	D156	W159	HIS	GLN	THR	ILE	VAL	ARG	ASP	THR	ASP	PHE	THR
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PRO	SER	HIS	ILE	GLU	PHE	TYR	L179	S180	Y181	P182	I183	Y184	I185	I186	F192	R198	A203	K204	G205	I206	Y210	L211	V212	L213	V214	F218	M219	I220	LEU	PRO	ASN	VAL	GLY	LEU	ASN	GLU	TRP	GLY	HIS	THR	PHE	PHE	MET	GLU	GLU	LEU	PHE	VAL	ALA	PRO	LEU	HIS
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TYR	G247	F248	V249	I250	F251	A255	V258	M259	F269	A270	L274	G275	Q276	S277	L278	C279	E280	ALA	VAL	ASP	GLU	GLY	LEU	ILE	ALA	LYS
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4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	920249	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 ($e^-/\text{\AA}^2$)	53.55	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	1.072	Depositor
Minimum map value	-0.666	Depositor
Average map value	0.002	Depositor
Map value standard deviation	0.029	Depositor
Recommended contour level	0.177	Depositor
Map size (Å)	270.8992, 270.8992, 270.8992	wwPDB
Map dimensions	512, 512, 512	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.5291, 0.5291, 0.5291	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: CU

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	0.31	0/3099	0.52	1/4215 (0.0%)
1	E	0.31	0/3099	0.52	1/4215 (0.0%)
1	I	0.31	0/3099	0.52	1/4215 (0.0%)
2	B	0.43	1/2053 (0.0%)	0.61	3/2810 (0.1%)
2	F	0.43	1/2053 (0.0%)	0.61	3/2810 (0.1%)
2	J	0.43	1/2053 (0.0%)	0.61	3/2810 (0.1%)
3	C	0.27	0/1239	0.47	0/1688
3	G	0.27	0/1239	0.47	0/1688
3	K	0.27	0/1239	0.47	0/1688
All	All	0.35	3/19173 (0.0%)	0.54	12/26139 (0.0%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	F	244	LEU	C-N	-12.66	1.04	1.34
2	J	244	LEU	C-N	-12.65	1.04	1.34
2	B	244	LEU	C-N	-12.64	1.04	1.34

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	F	244	LEU	C-N-CA	14.92	158.99	121.70
2	B	244	LEU	C-N-CA	14.90	158.96	121.70
2	J	244	LEU	C-N-CA	14.89	158.93	121.70
2	F	244	LEU	O-C-N	-9.54	107.44	122.70
2	B	244	LEU	O-C-N	-9.52	107.47	122.70

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	3017	0	2980	92	0
1	E	3017	0	2980	92	0
1	I	3017	0	2980	91	0
2	B	1977	0	1935	61	0
2	F	1977	0	1935	56	0
2	J	1977	0	1935	62	0
3	C	1200	0	1201	36	0
3	G	1200	0	1201	32	0
3	K	1200	0	1201	34	0
4	A	2	0	0	0	0
4	E	2	0	0	0	0
4	I	2	0	0	0	0
All	All	18588	0	18348	460	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 12.

The worst 5 of 460 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:E:141:MET:HB3	1:E:151:ILE:HA	1.60	0.83
1:I:141:MET:HB3	1:I:151:ILE:HA	1.60	0.83
1:A:141:MET:HB3	1:A:151:ILE:HA	1.60	0.81
3:G:192:PHE:HA	3:G:210:TYR:HE2	1.47	0.80
3:K:192:PHE:HA	3:K:210:TYR:HE2	1.47	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	380/414 (92%)	357 (94%)	21 (6%)	2 (0%)	29	66
1	E	380/414 (92%)	356 (94%)	22 (6%)	2 (0%)	29	66
1	I	380/414 (92%)	357 (94%)	21 (6%)	2 (0%)	29	66
2	B	239/247 (97%)	222 (93%)	17 (7%)	0	100	100
2	F	239/247 (97%)	222 (93%)	17 (7%)	0	100	100
2	J	239/247 (97%)	222 (93%)	17 (7%)	0	100	100
3	C	139/260 (54%)	132 (95%)	6 (4%)	1 (1%)	22	60
3	G	139/260 (54%)	132 (95%)	6 (4%)	1 (1%)	22	60
3	K	139/260 (54%)	132 (95%)	6 (4%)	1 (1%)	22	60
All	All	2274/2763 (82%)	2132 (94%)	133 (6%)	9 (0%)	38	69

5 of 9 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	C	277	SER
3	G	277	SER
3	K	277	SER
1	A	139	HIS
1	E	139	HIS

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	323/345 (94%)	318 (98%)	5 (2%)	65	84
1	E	323/345 (94%)	318 (98%)	5 (2%)	65	84
1	I	323/345 (94%)	318 (98%)	5 (2%)	65	84
2	B	206/210 (98%)	206 (100%)	0	100	100
2	F	206/210 (98%)	206 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	J	206/210 (98%)	206 (100%)	0	100	100
3	C	121/212 (57%)	120 (99%)	1 (1%)	81	92
3	G	121/212 (57%)	120 (99%)	1 (1%)	81	92
3	K	121/212 (57%)	120 (99%)	1 (1%)	81	92
All	All	1950/2301 (85%)	1932 (99%)	18 (1%)	79	90

5 of 18 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	I	142	MET
3	K	204	LYS
3	G	204	LYS
1	E	138	VAL
1	I	138	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
2	J	38	HIS
2	J	174	ASN
1	E	143	ASN
1	I	143	ASN
2	F	38	HIS

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 6 ligands modelled in this entry, 6 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](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
2	B	1
2	J	1
2	F	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	B	244:LEU	C	245:GLN	N	1.05
1	J	244:LEU	C	245:GLN	N	1.05
1	F	244:LEU	C	245:GLN	N	1.04

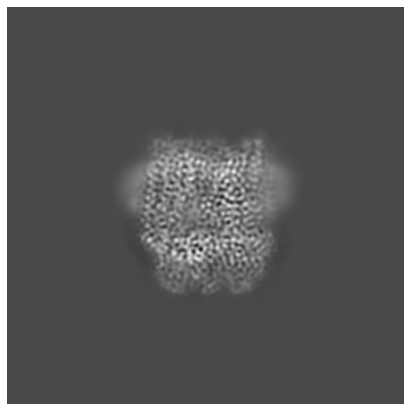
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-40720. These allow visual inspection of the internal detail of the map and identification of artifacts.

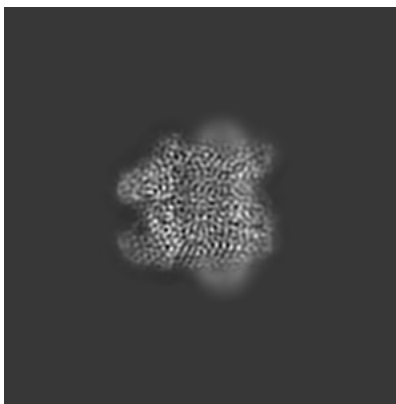
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

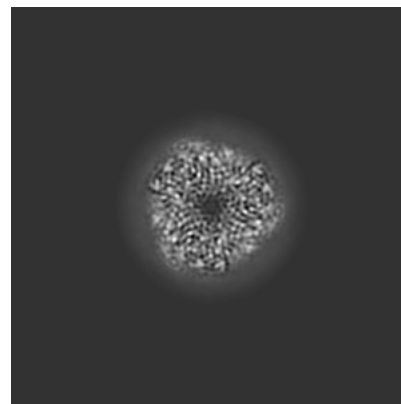
6.1.1 Primary map



X

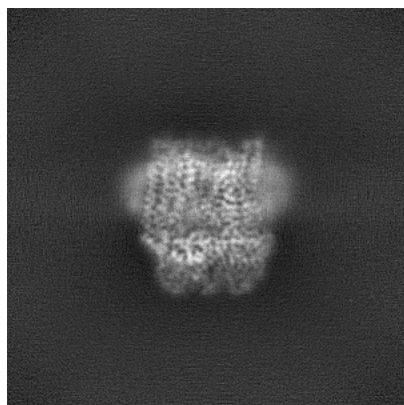


Y

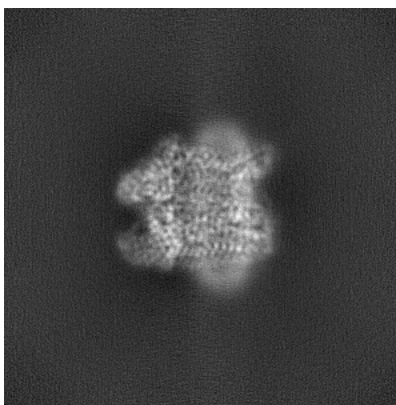


Z

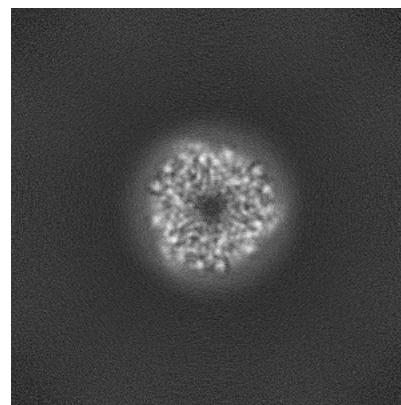
6.1.2 Raw map



X



Y

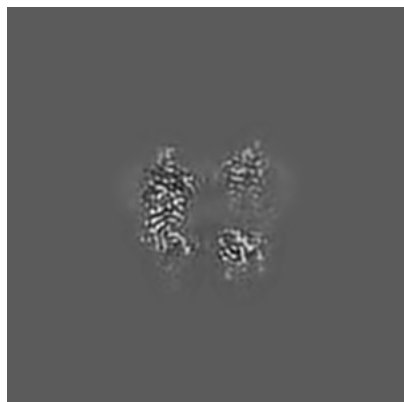


Z

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

6.2 Central slices [i](#)

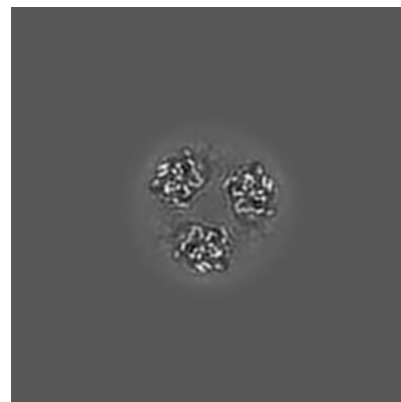
6.2.1 Primary map



X Index: 256

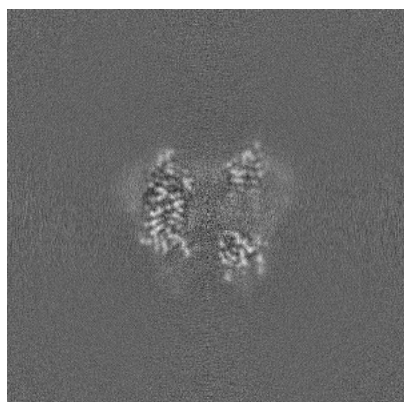


Y Index: 256

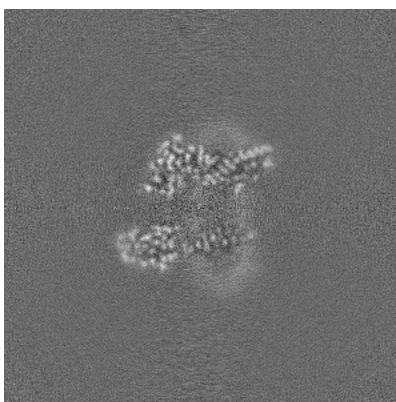


Z Index: 256

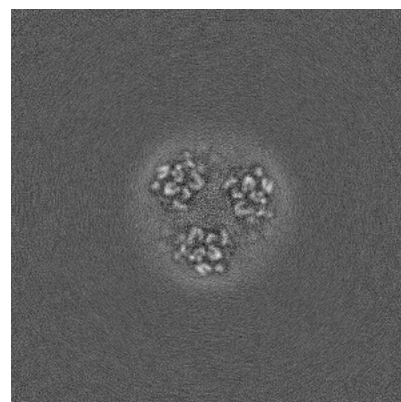
6.2.2 Raw map



X Index: 256



Y Index: 256



Z Index: 256

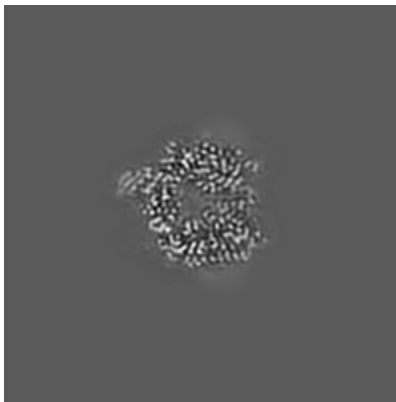
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

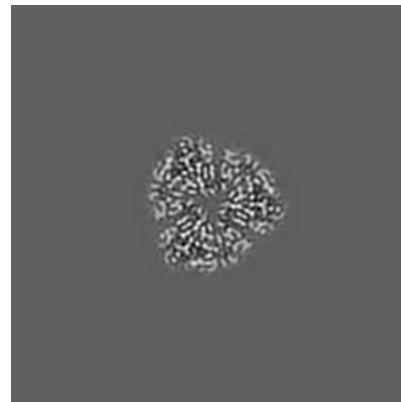
6.3.1 Primary map



X Index: 229

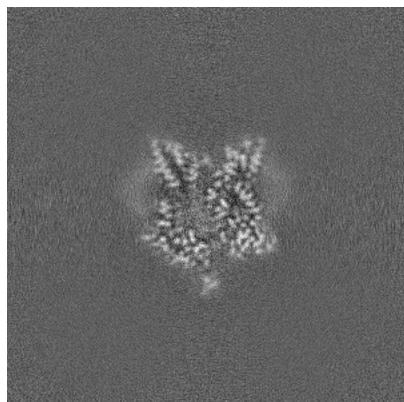


Y Index: 288

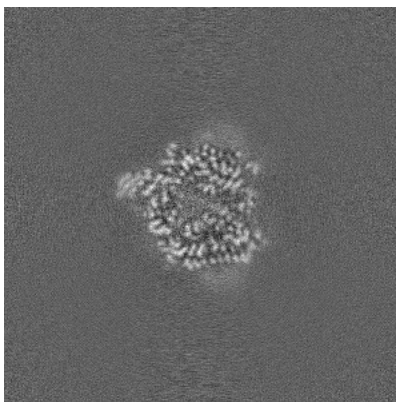


Z Index: 213

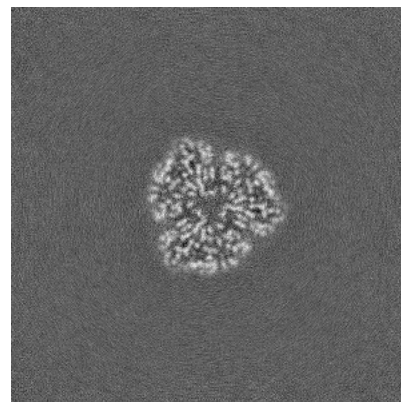
6.3.2 Raw map



X Index: 222



Y Index: 288

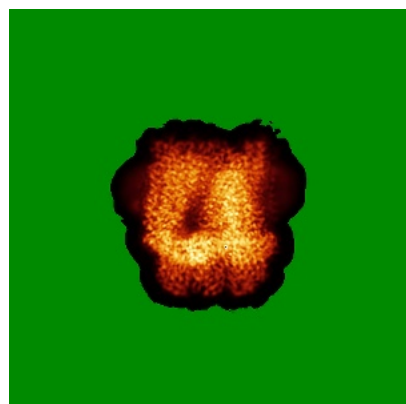


Z Index: 213

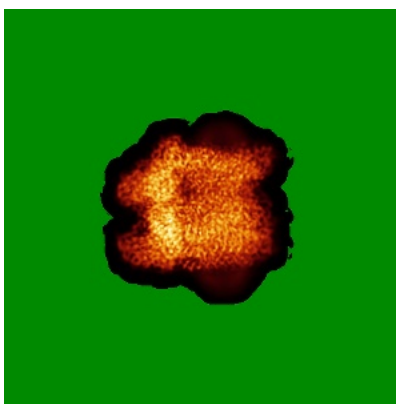
The images above show the largest variance slices of the map in three orthogonal directions.

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

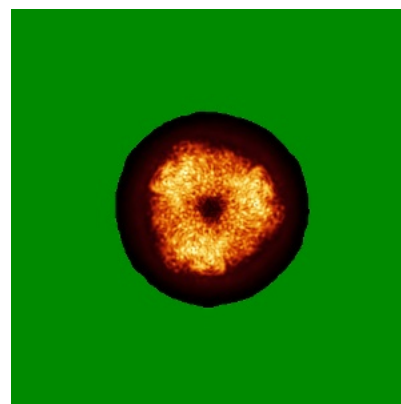
6.4.1 Primary map



X

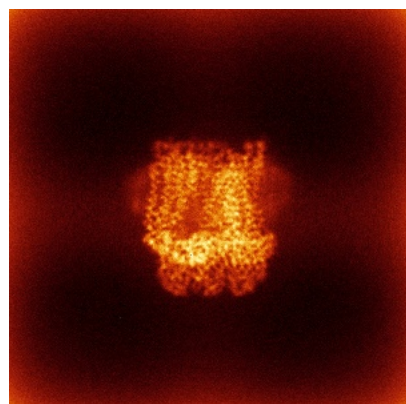


Y

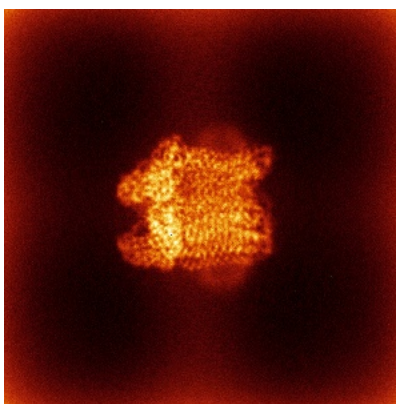


Z

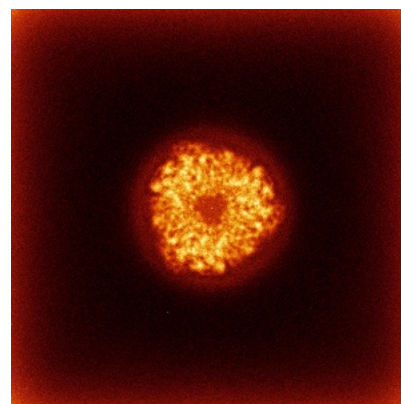
6.4.2 Raw map



X



Y

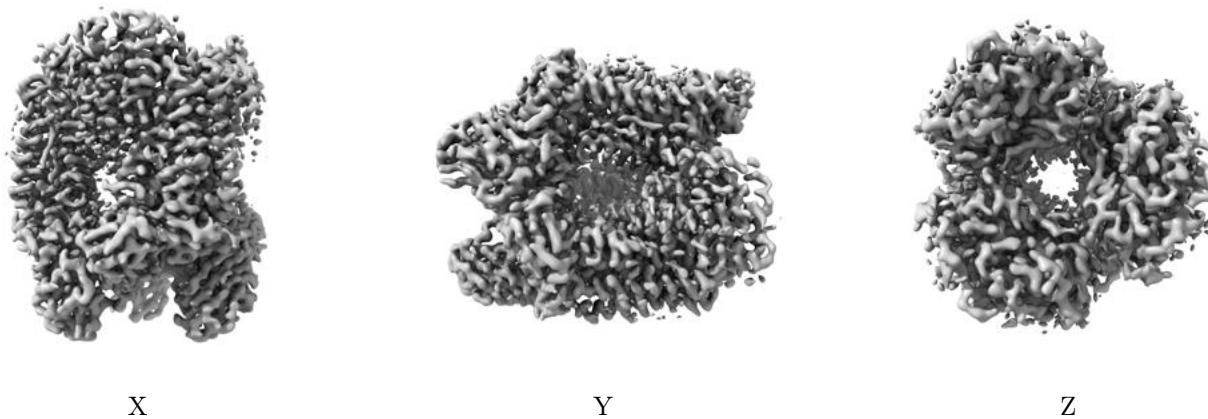


Z

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.

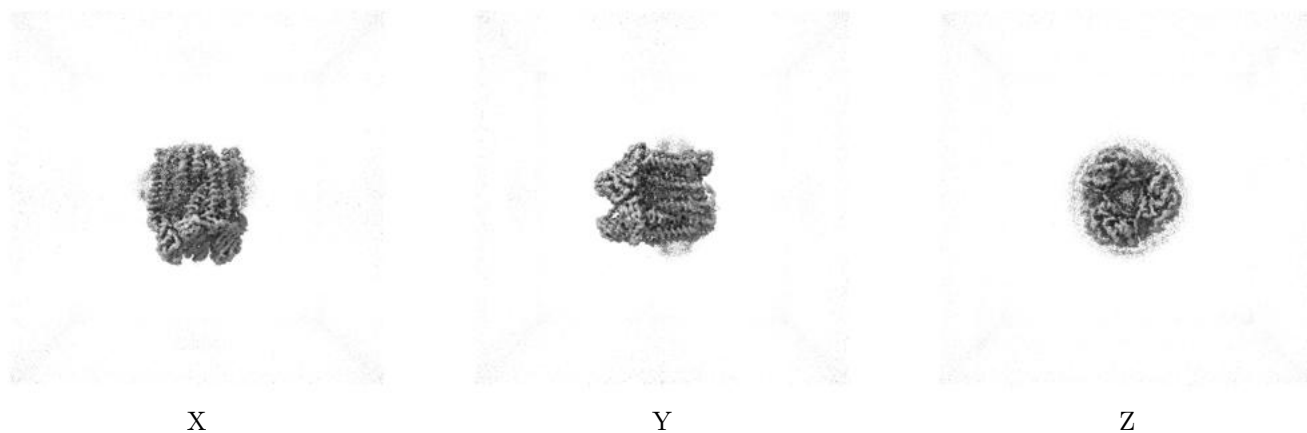
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.177. 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.

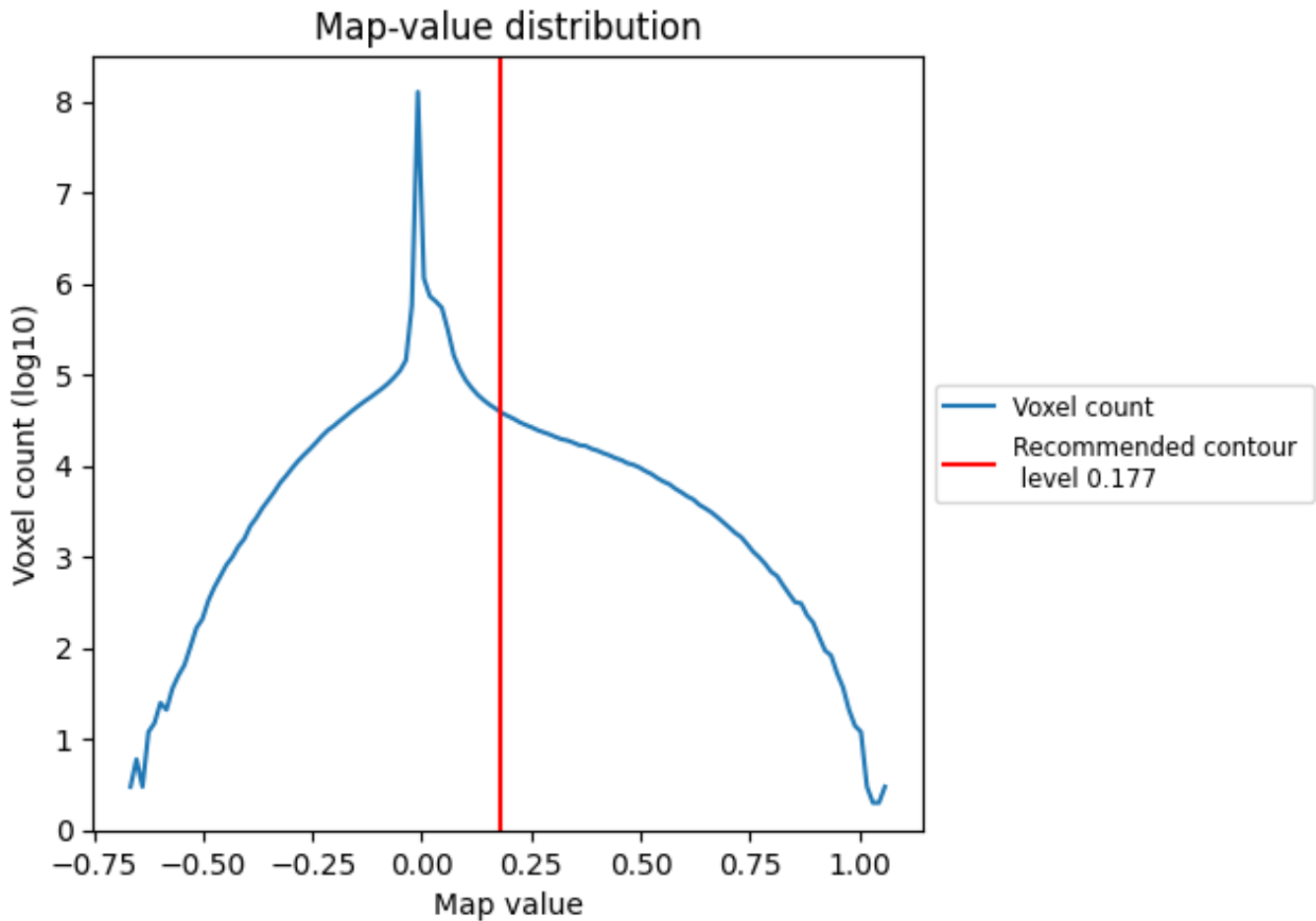
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

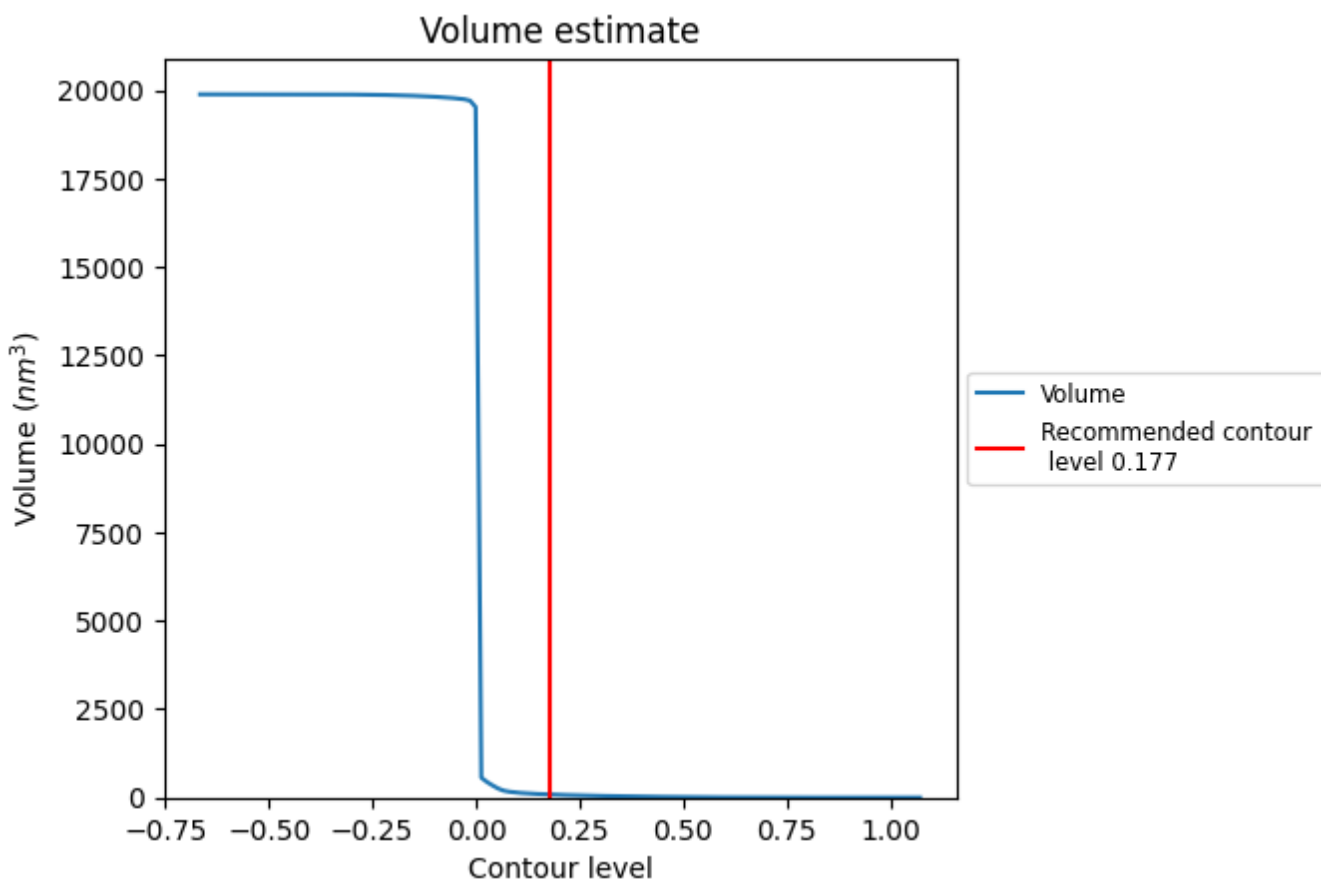
This section contains the results of statistical analysis of the map.

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.

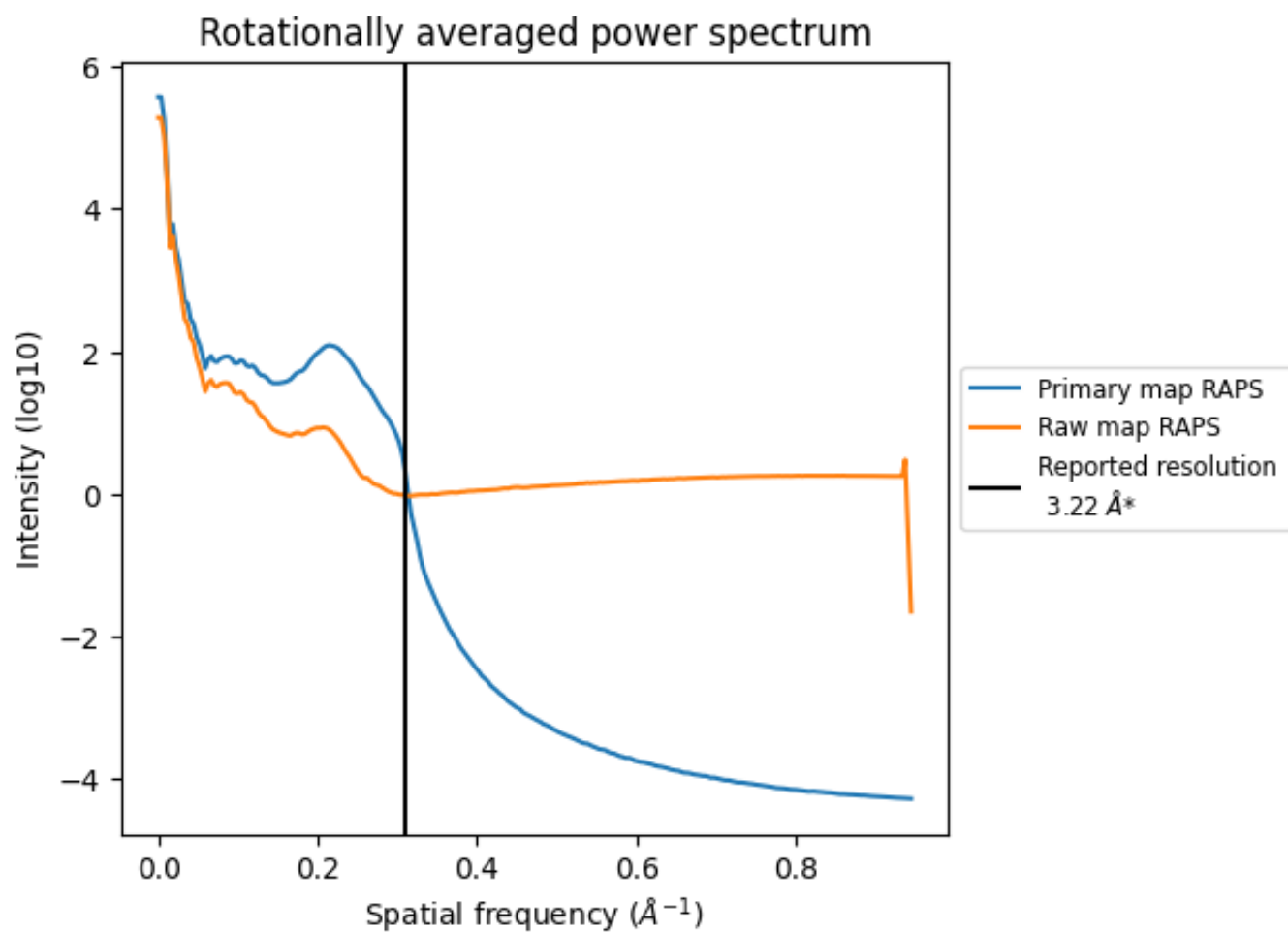
7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is 87 nm³; this corresponds to an approximate mass of 79 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](#)

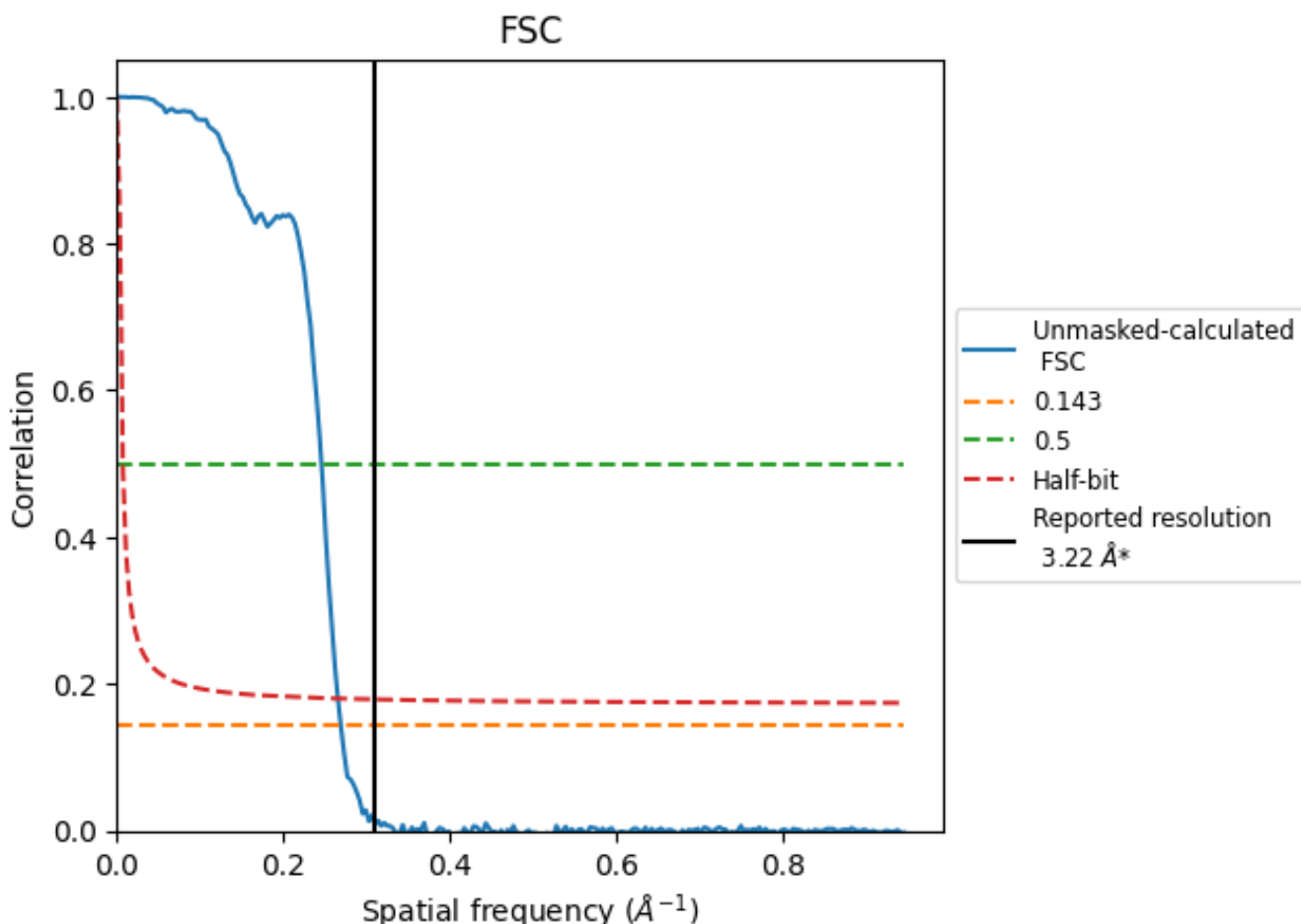


*Reported resolution corresponds to spatial frequency of 0.311 Å⁻¹

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 0.311 Å⁻¹

8.2 Resolution estimates [i](#)

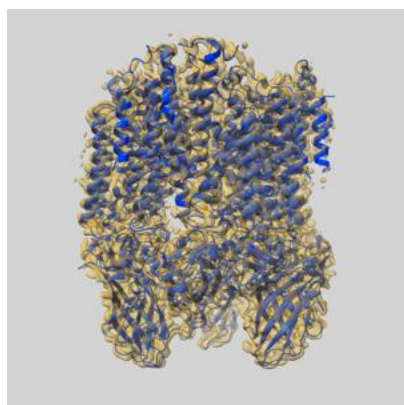
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.22	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	3.72	4.07	3.77

*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 3.72 differs from the reported value 3.22 by more than 10 %

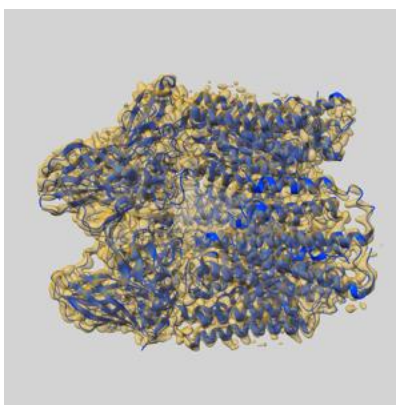
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-40720 and PDB model 8SR5. Per-residue inclusion information can be found in section 3 on page 6.

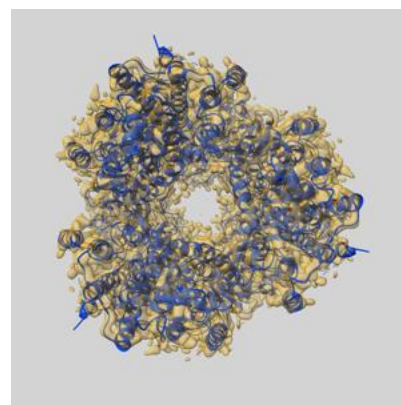
9.1 Map-model overlay [i](#)



X



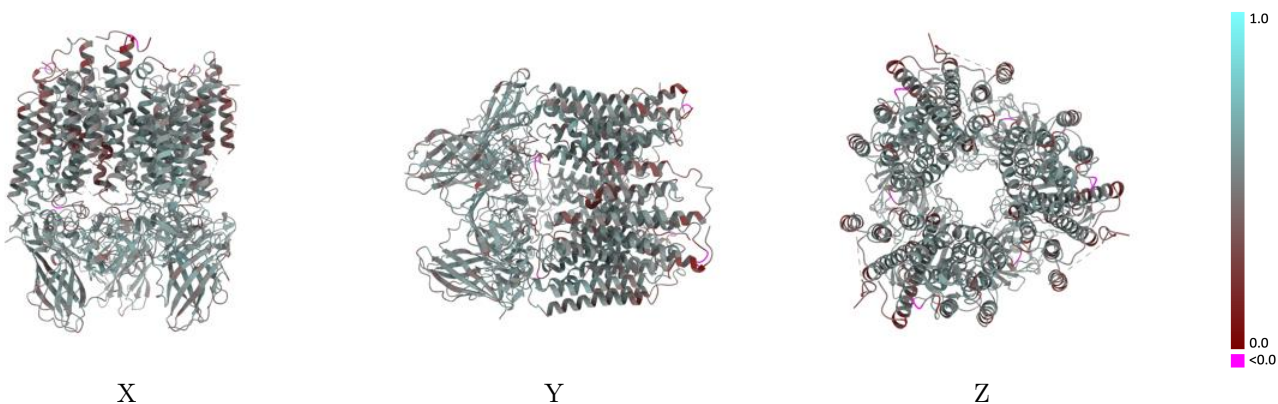
Y



Z

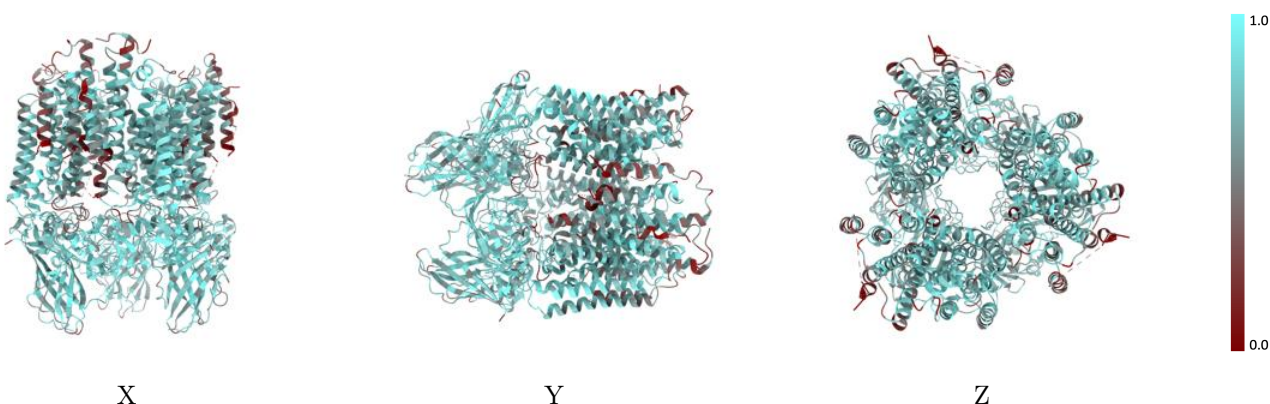
The images above show the 3D surface view of the map at the recommended contour level 0.177 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



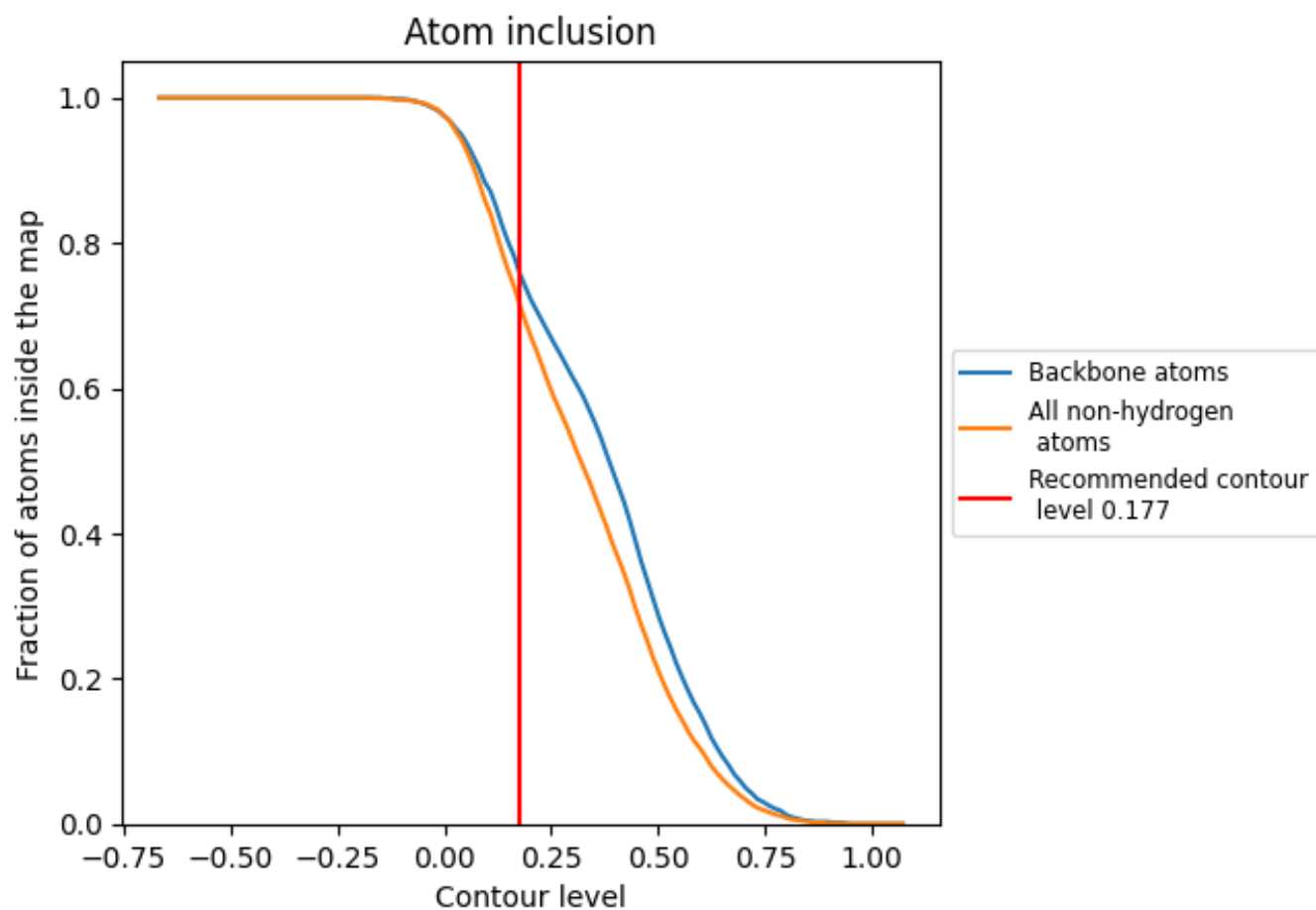
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.177).




















9.4 Atom inclusion [i](#)



At the recommended contour level, 76% of all backbone atoms, 71% 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 (0.177) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.7140	 0.5010
A	 0.7660	 0.5200
B	 0.7480	 0.5180
C	 0.5290	 0.4220
E	 0.7680	 0.5190
F	 0.7480	 0.5170
G	 0.5290	 0.4240
I	 0.7650	 0.5200
J	 0.7460	 0.5190
K	 0.5280	 0.4240

