



wwPDB EM Validation Summary Report ⓘ

Mar 11, 2024 – 12:14 PM JST

PDB ID : 8WM8
EMDB ID : EMD-37645
Title : Cryo-EM structure of cyanobacterial nitrate/nitrite transporter NrtBCD in complex with nitrate
Authors : Li, B.; Zhou, C.Z.; Chen, Y.X.; Jiang, Y.L.
Deposited on : 2023-10-03
Resolution : 3.54 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
Mogul : 1.8.5 (274361), CSD as541be (2020)
MolProbity : 4.02b-467
buster-report : 1.1.7 (2018)
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

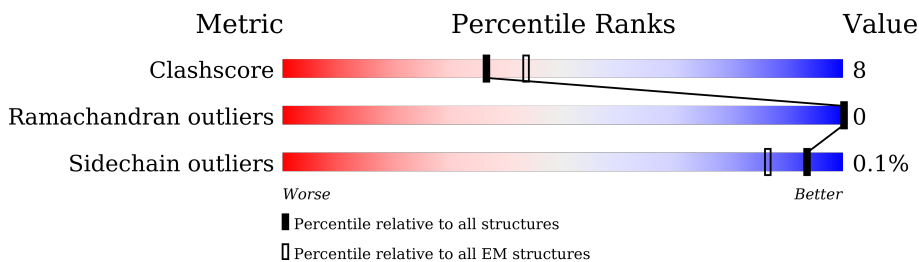
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.54 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	D	277	
2	A	279	
2	B	279	
3	C	682	

2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 16776 atoms, of which 8522 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 Nitrate transport ATP-binding protein.

Mol	Chain	Residues	Atoms						AltConf	Trace
			Total	C	H	N	O	S		
1	D	259	4116	1314	2062	349	379	12	0	0

- Molecule 2 is a protein called Nitrate transport permease protein.

Mol	Chain	Residues	Atoms						AltConf	Trace
			Total	C	H	N	O	S		
2	B	265	4198	1381	2147	321	347	2	0	0
2	A	263	4170	1373	2134	318	343	2	0	0

- Molecule 3 is a protein called Nitrate transport ATP-binding protein.

Mol	Chain	Residues	Atoms						AltConf	Trace
			Total	C	H	N	O	S		
3	C	268	4288	1328	2179	385	387	9	0	0

There are 25 discrepancies between the modelled and reference sequences:

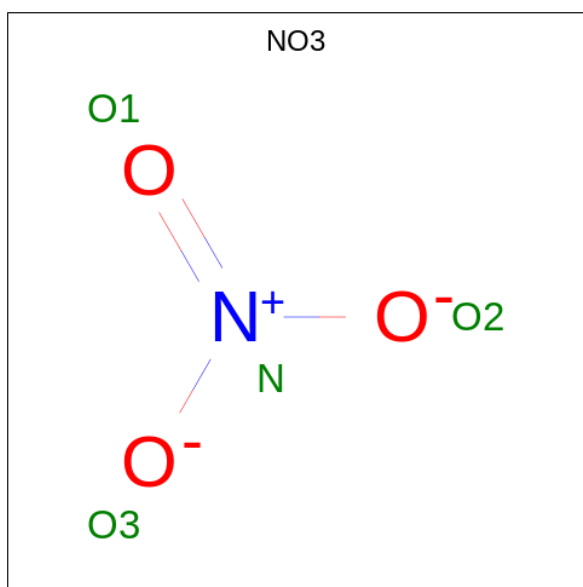
Chain	Residue	Modelled	Actual	Comment	Reference
C	658	SER	-	expression tag	UNP Q8YZ76
C	659	SER	-	expression tag	UNP Q8YZ76
C	660	GLY	-	expression tag	UNP Q8YZ76
C	661	ASP	-	expression tag	UNP Q8YZ76
C	662	TYR	-	expression tag	UNP Q8YZ76
C	663	LYS	-	expression tag	UNP Q8YZ76
C	664	ASP	-	expression tag	UNP Q8YZ76
C	665	HIS	-	expression tag	UNP Q8YZ76
C	666	ASP	-	expression tag	UNP Q8YZ76
C	667	GLY	-	expression tag	UNP Q8YZ76
C	668	ASP	-	expression tag	UNP Q8YZ76
C	669	TYR	-	expression tag	UNP Q8YZ76
C	670	LYS	-	expression tag	UNP Q8YZ76

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Chain	Residue	Modelled	Actual	Comment	Reference
C	671	ASP	-	expression tag	UNP Q8YZ76
C	672	HIS	-	expression tag	UNP Q8YZ76
C	673	ASP	-	expression tag	UNP Q8YZ76
C	674	ILE	-	expression tag	UNP Q8YZ76
C	675	ASP	-	expression tag	UNP Q8YZ76
C	676	TYR	-	expression tag	UNP Q8YZ76
C	677	LYS	-	expression tag	UNP Q8YZ76
C	678	ASP	-	expression tag	UNP Q8YZ76
C	679	ASP	-	expression tag	UNP Q8YZ76
C	680	ASP	-	expression tag	UNP Q8YZ76
C	681	ASP	-	expression tag	UNP Q8YZ76
C	682	LYS	-	expression tag	UNP Q8YZ76

- Molecule 4 is NITRATE ION (three-letter code: NO3) (formula: NO₃) (labeled as "Ligand of Interest" by depositor).

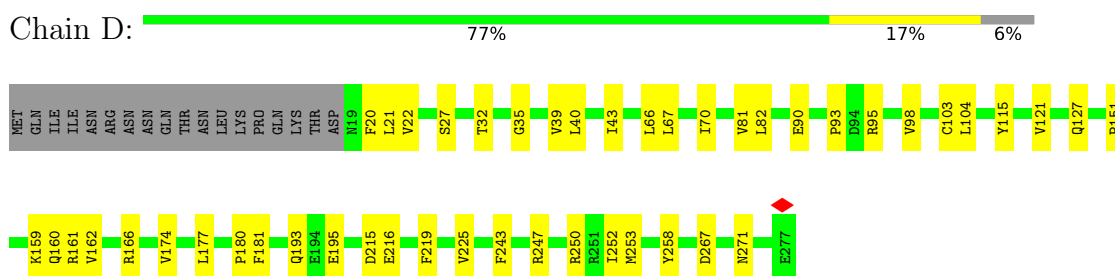


Mol	Chain	Residues	Atoms			AltConf
			Total	N	O	
4	A	1	4	1	3	0

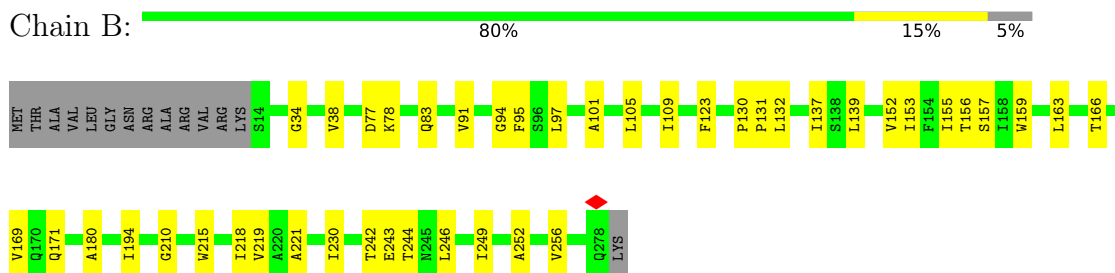
3 Residue-property plots

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.

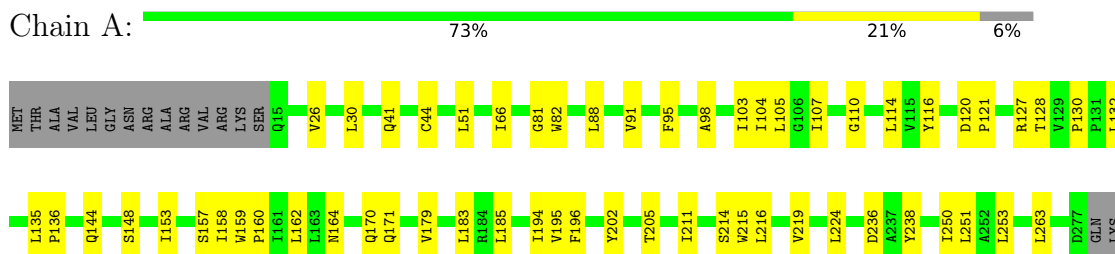
- Molecule 1: Nitrate transport ATP-binding protein



- Molecule 2: Nitrate transport permease protein



- Molecule 2: Nitrate transport permease protein



- Molecule 3: Nitrate transport ATP-binding protein



MET	I3	I7	D8	H9	V10	I13	L16	P17	M18	I23	A24	L25	I28	S39	L40	L51	I55	V66	T67	I73	R74	E75	P76	D79	R80	P81	V82	V83	L89	L90	L93	A102	V106	G109	R115	M125	V126	G127	L128	R129							
ALA	VAL	ILE	GLY	ILE	GLY	PHE	MET	PRO	ALA	THR	ASP	LEU	THR	ALA	PRO	LEU	THR	PRO	ILE	VAL	VAL	ALA	ASN	LYS	GLY	LEU	ASP	ARG	ALA	LYS	VAL	THR	GLY	LYS	ASP	LEU	THR	ALA	GLN	ASP	LEU	THR	ALA	LYS			
GLY	MET	PRO	ILE	GLY	VAL	ASP	LEU	THR	ALA	GLY	VAL	ASP	LEU	THR	ALA	PRO	LEU	THR	PRO	ILE	VAL	VAL	ALA	ASN	LYS	GLY	LEU	ASP	ARG	ALA	LYS	VAL	THR	GLY	LYS	ASP	LEU	THR	ALA	GLN	ASP	LEU	THR	ALA	LYS		
THR	LEU	GLY	VAL	ASP	HIS	SER	ALA	THR	ILE	GLY	VAL	ASP	LEU	THR	ALA	PRO	LEU	THR	PRO	ILE	VAL	VAL	ALA	ASN	LYS	GLY	LEU	ASP	ARG	ALA	LYS	VAL	THR	GLY	LYS	ASP	LEU	THR	ALA	GLN	ASP	LEU	THR	ALA	LYS		
GLN	ALA	VAL	HIS	ASP	ASP	LEU	GLY	PHE	VAL	GLY	VAL	ASP	LEU	THR	ALA	PRO	LEU	THR	PRO	ILE	VAL	VAL	ALA	ASN	LYS	GLY	LEU	ASP	ARG	ALA	LYS	VAL	THR	GLY	LYS	ASP	LEU	THR	ALA	GLN	ASP	LEU	THR	ALA	LYS		
GLU	GLU	ILE	LEU	GLU	ILE	LEU	CYS	ARG	TRP	GLY	VAL	ASP	LEU	THR	ALA	PRO	LEU	THR	PRO	ILE	VAL	VAL	ALA	ASN	LYS	GLY	LEU	ASP	ARG	ALA	LYS	VAL	THR	GLY	LYS	ASP	LEU	THR	ALA	GLN	ASP	LEU	THR	ALA	LYS		
MET	ILE	THR	GLN	MET	ALA	ARG	TRP	ARG	GLY	THR	THR	PRO	PHE	PRO	ASP	VAL	LYS	ASN	ASN	TRP	VAL	GLY	VAL	ASP	LEU	THR	ALA	GLY	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	THR	
PRO	ILE	GLU	TYR	LEU	LYS	SER	LEU	GLU	GLU	ILE	ILE	VAL	PHE	ILE	THR	LYS	ASP	HIS	ASP	ASP	GLY	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA	ALA

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	319161	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 ($e^-/\text{\AA}^2$)	55	Depositor
Minimum defocus (nm)	1500	Depositor
Maximum defocus (nm)	2300	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	3.556	Depositor
Minimum map value	-2.160	Depositor
Average map value	0.001	Depositor
Map value standard deviation	0.073	Depositor
Recommended contour level	0.231	Depositor
Map size (Å)	273.92, 273.92, 273.92	wwPDB
Map dimensions	256, 256, 256	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.07, 1.07, 1.07	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: NO3

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	D	0.24	0/2098	0.48	0/2847
2	A	0.25	0/2092	0.44	0/2868
2	B	0.25	0/2107	0.42	0/2888
3	C	0.24	0/2140	0.50	0/2888
All	All	0.25	0/8437	0.46	0/11491

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	D	2054	2062	2062	34	0
2	A	2036	2134	2134	43	0
2	B	2051	2147	2147	28	0
3	C	2109	2179	2179	41	0
4	A	4	0	0	0	0
All	All	8254	8522	8522	140	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 140 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:153:ILE:HD11	2:B:218:ILE:HD13	1.43	0.98
3:C:106:VAL:HG21	3:C:155:THR:HG23	1.45	0.98
1:D:21:LEU:HD11	1:D:70:ILE:HD11	1.54	0.89
1:D:215:ASP:OD2	1:D:258:TYR:OH	1.96	0.83
3:C:25:LEU:HD12	3:C:28:ILE:HD11	1.64	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	D	257/277 (93%)	238 (93%)	19 (7%)	0	100	100
2	A	261/279 (94%)	236 (90%)	25 (10%)	0	100	100
2	B	263/279 (94%)	250 (95%)	13 (5%)	0	100	100
3	C	266/682 (39%)	247 (93%)	19 (7%)	0	100	100
All	All	1047/1517 (69%)	971 (93%)	76 (7%)	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	D	225/243 (93%)	225 (100%)	0	100	100
2	A	220/233 (94%)	219 (100%)	1 (0%)	88	95
2	B	222/233 (95%)	222 (100%)	0	100	100
3	C	230/579 (40%)	230 (100%)	0	100	100
All	All	897/1288 (70%)	896 (100%)	1 (0%)	93	98

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

Mol	Chain	Res	Type
2	A	127	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	D	203	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](#)

1 ligand is modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the

expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
4	NO3	A	301	-	1,3,3	0.60	0	0,3,3	-	-

There are no bond length outliers.

There are no bond angle outliers.

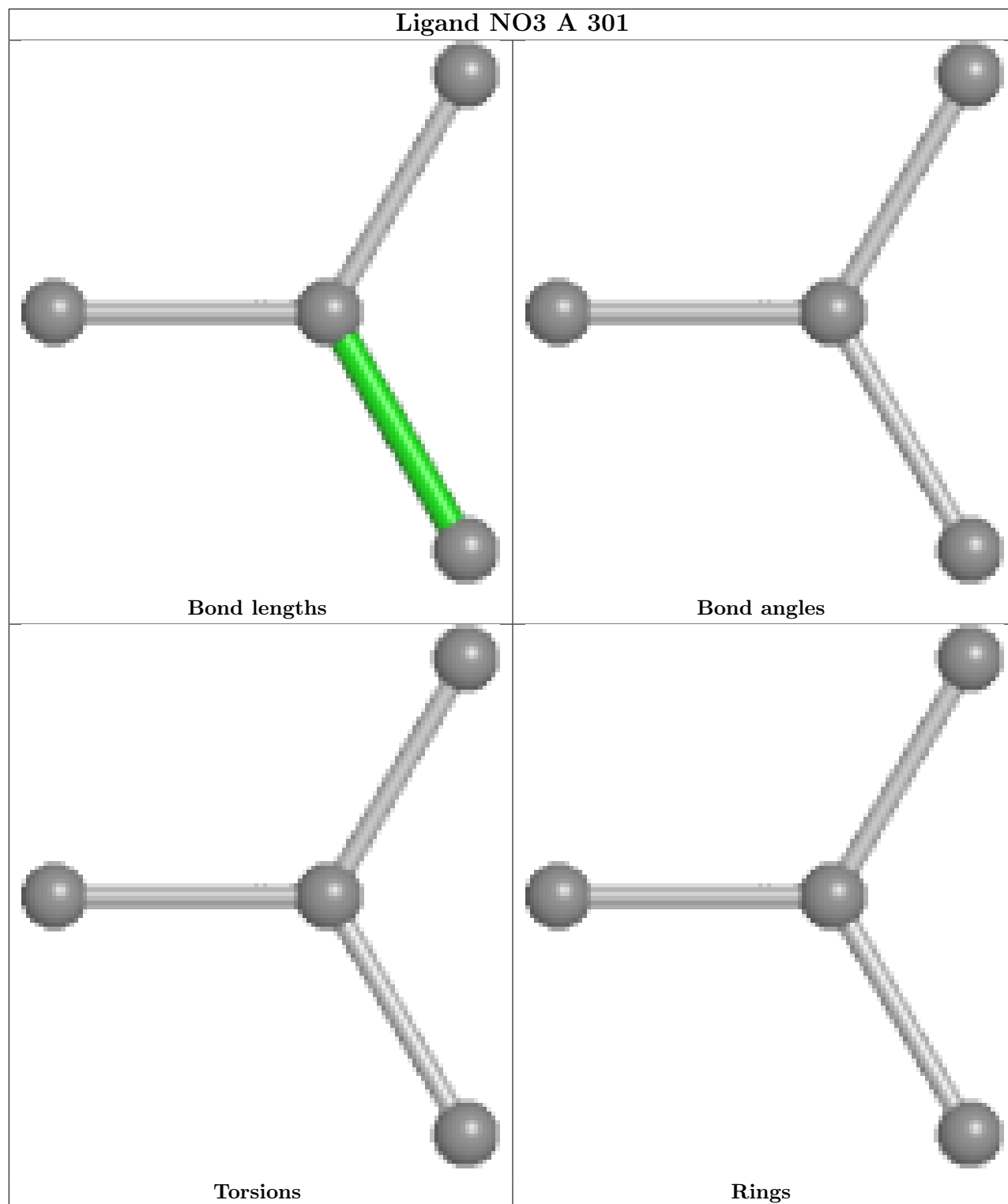
There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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



5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.

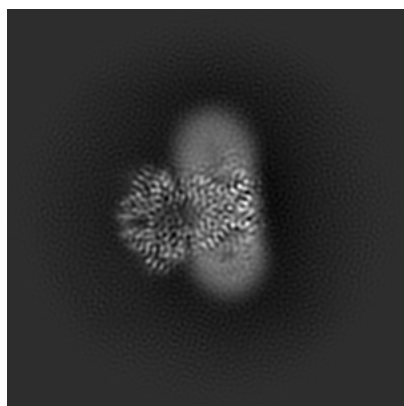
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-37645. These allow visual inspection of the internal detail of the map and identification of artifacts.

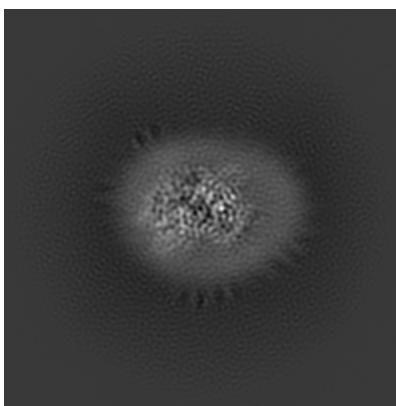
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

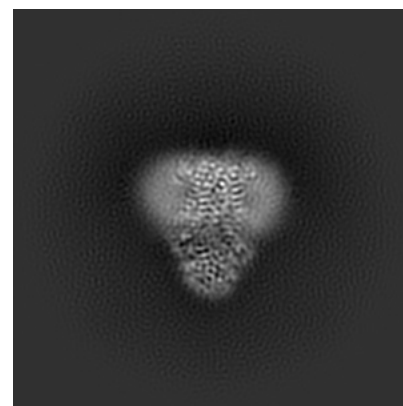
6.1.1 Primary map



X

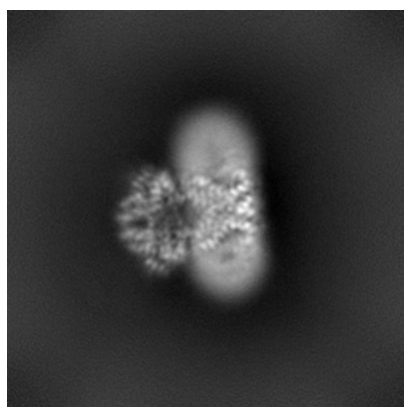


Y

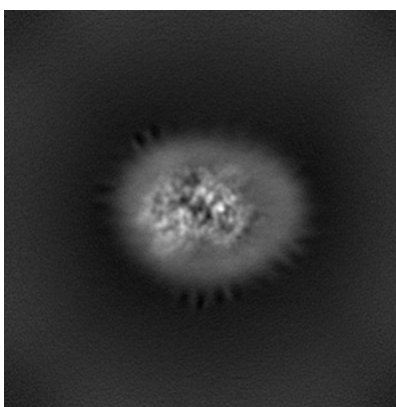


Z

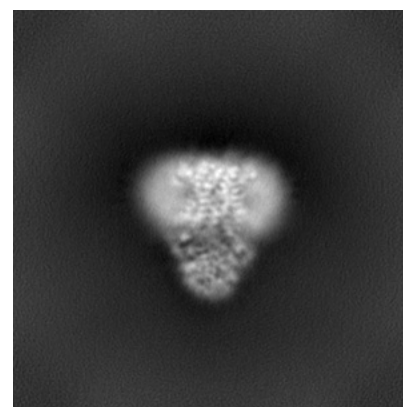
6.1.2 Raw map



X



Y

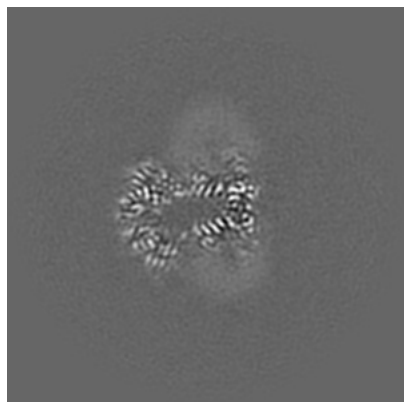


Z

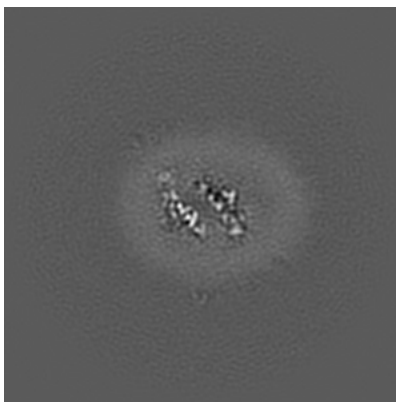
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

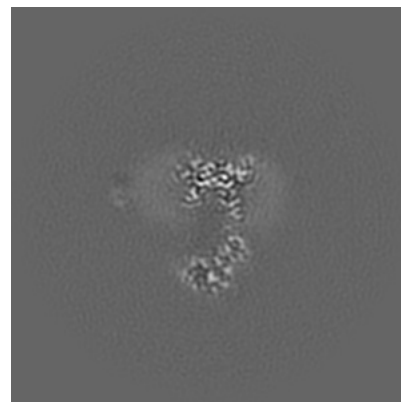
6.2.1 Primary map



X Index: 128

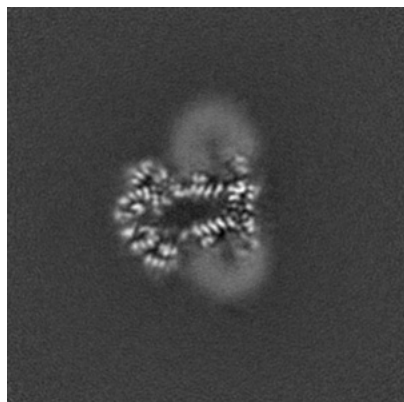


Y Index: 128

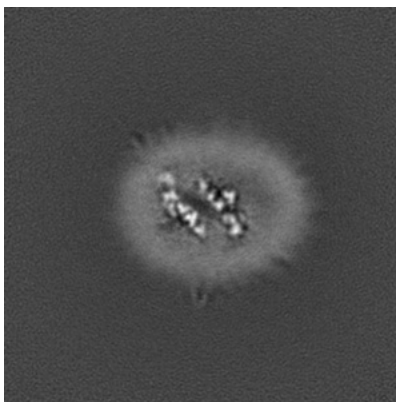


Z Index: 128

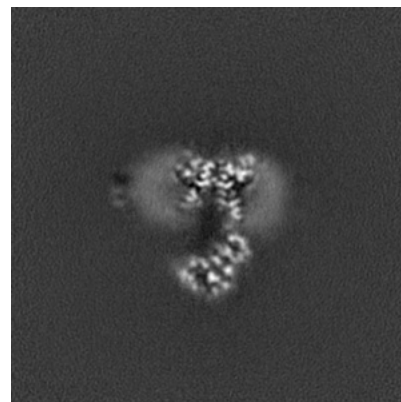
6.2.2 Raw map



X Index: 128



Y Index: 128

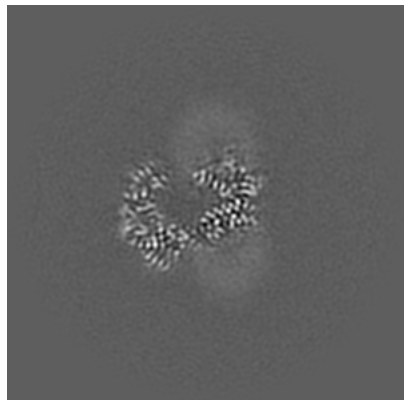


Z Index: 128

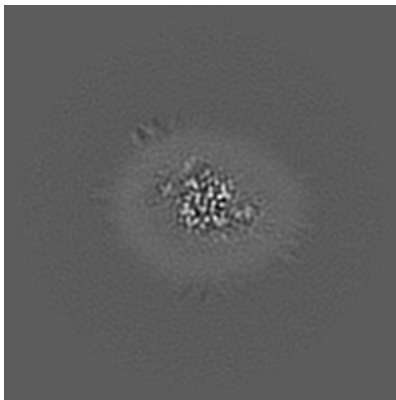
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

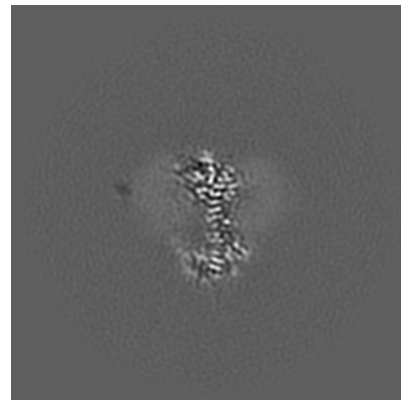
6.3.1 Primary map



X Index: 123

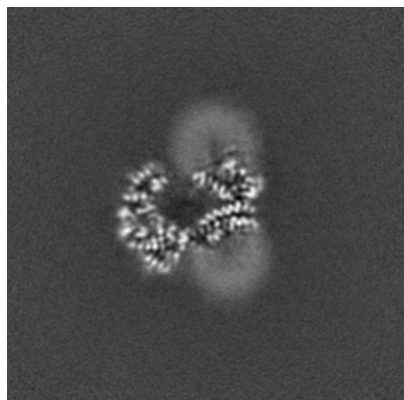


Y Index: 144

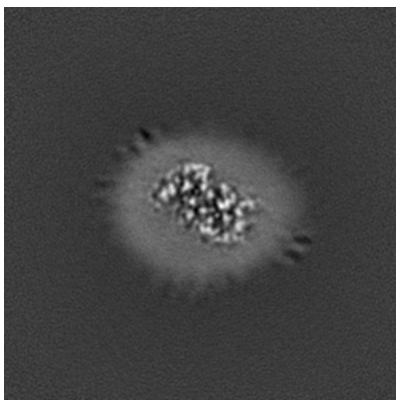


Z Index: 139

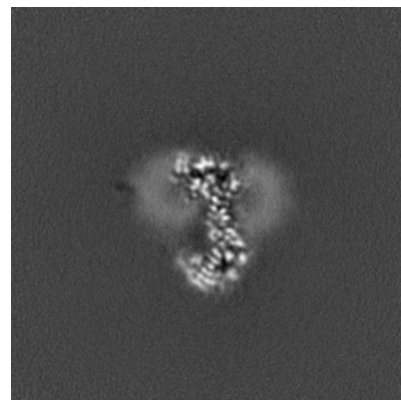
6.3.2 Raw map



X Index: 123



Y Index: 150

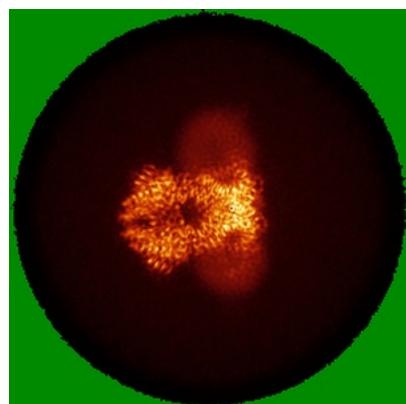


Z Index: 135

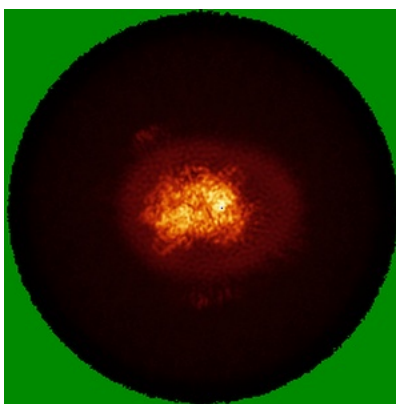
The images above show the largest variance slices of the map in three orthogonal directions.

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

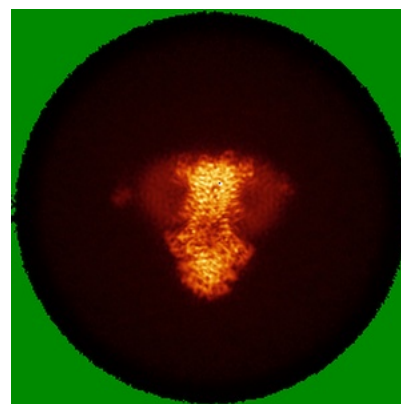
6.4.1 Primary map



X

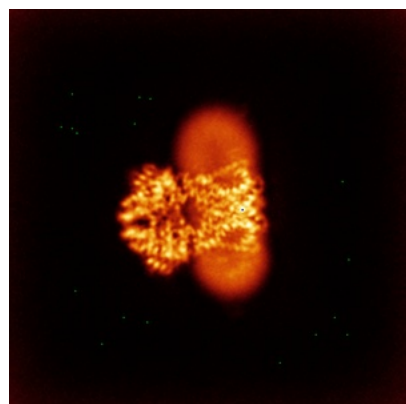


Y

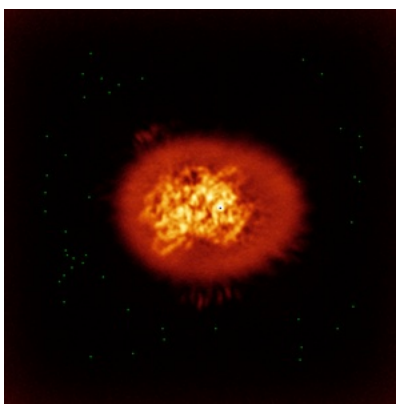


Z

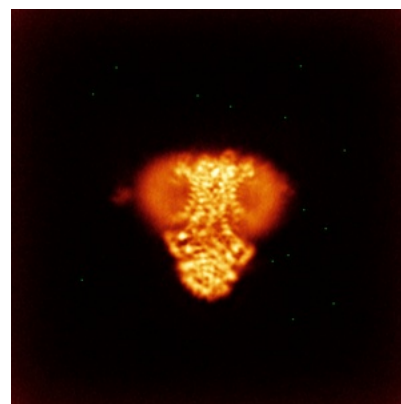
6.4.2 Raw map



X



Y

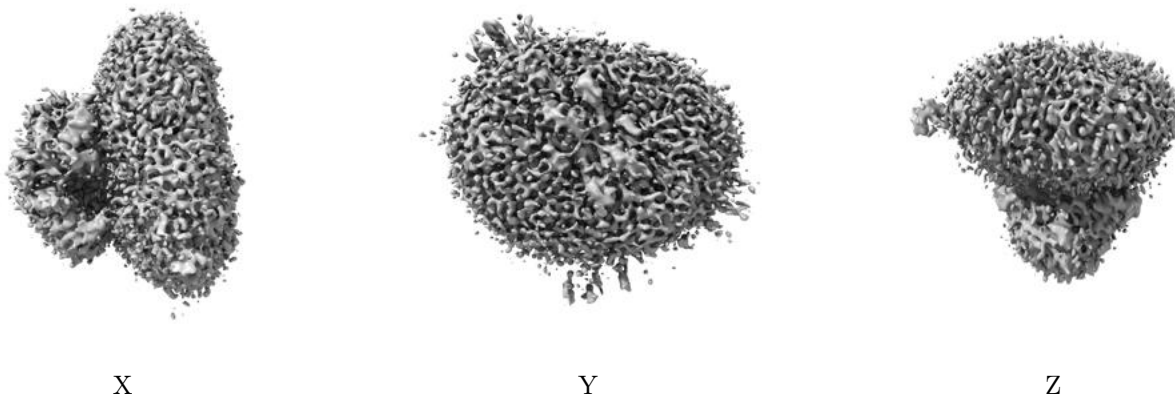


Z

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 0.231. 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.

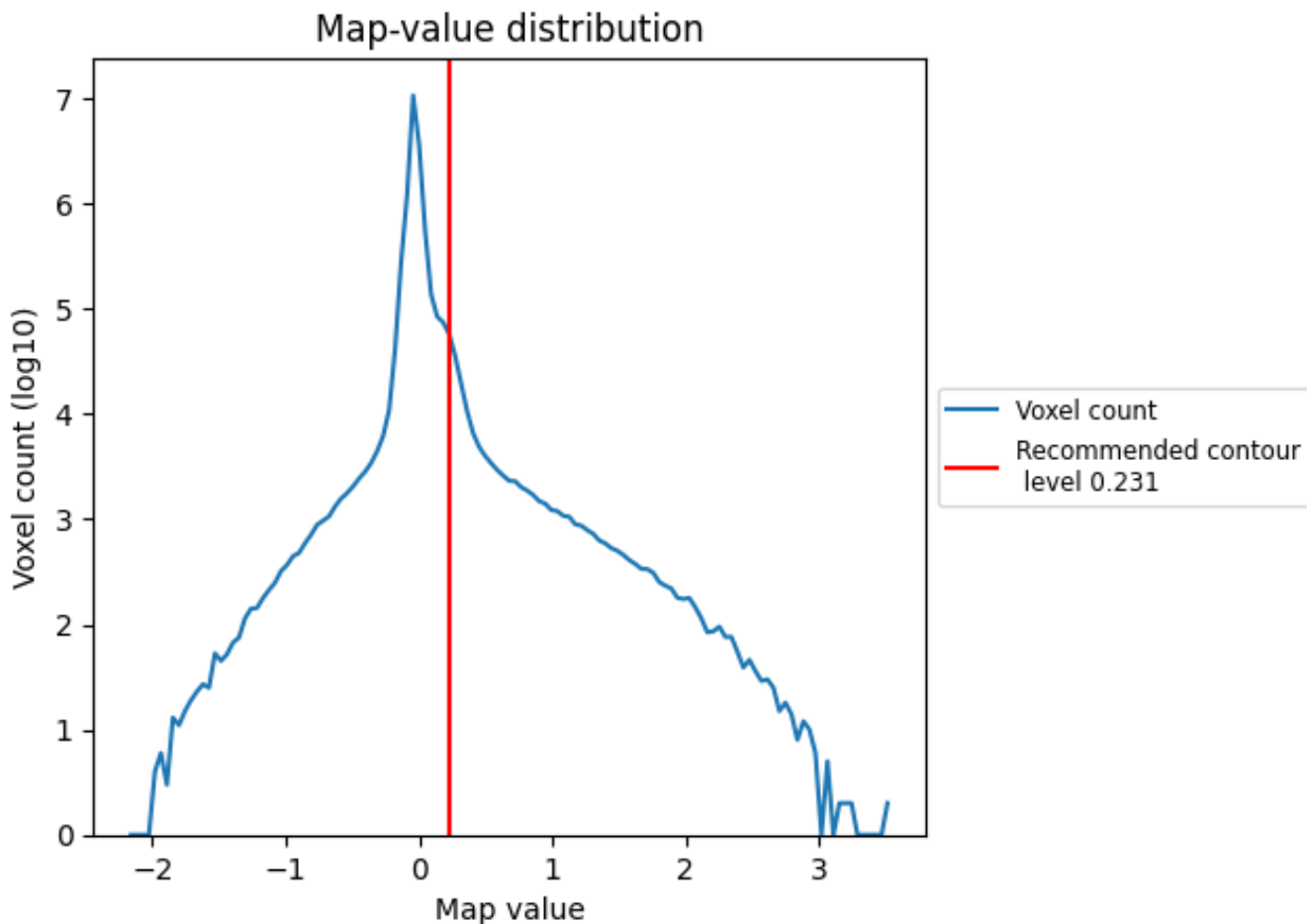
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

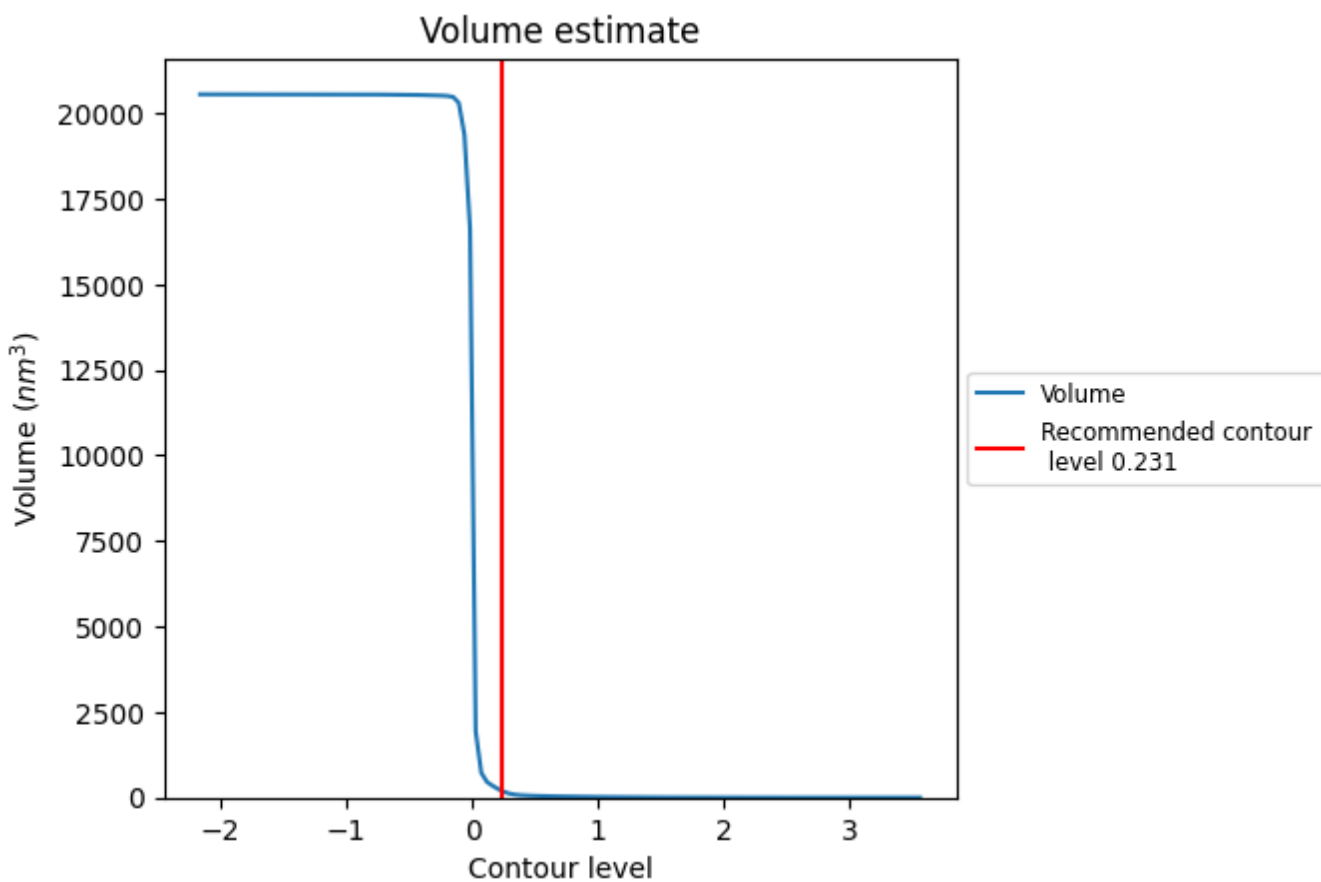
This section contains the results of statistical analysis of the map.

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.

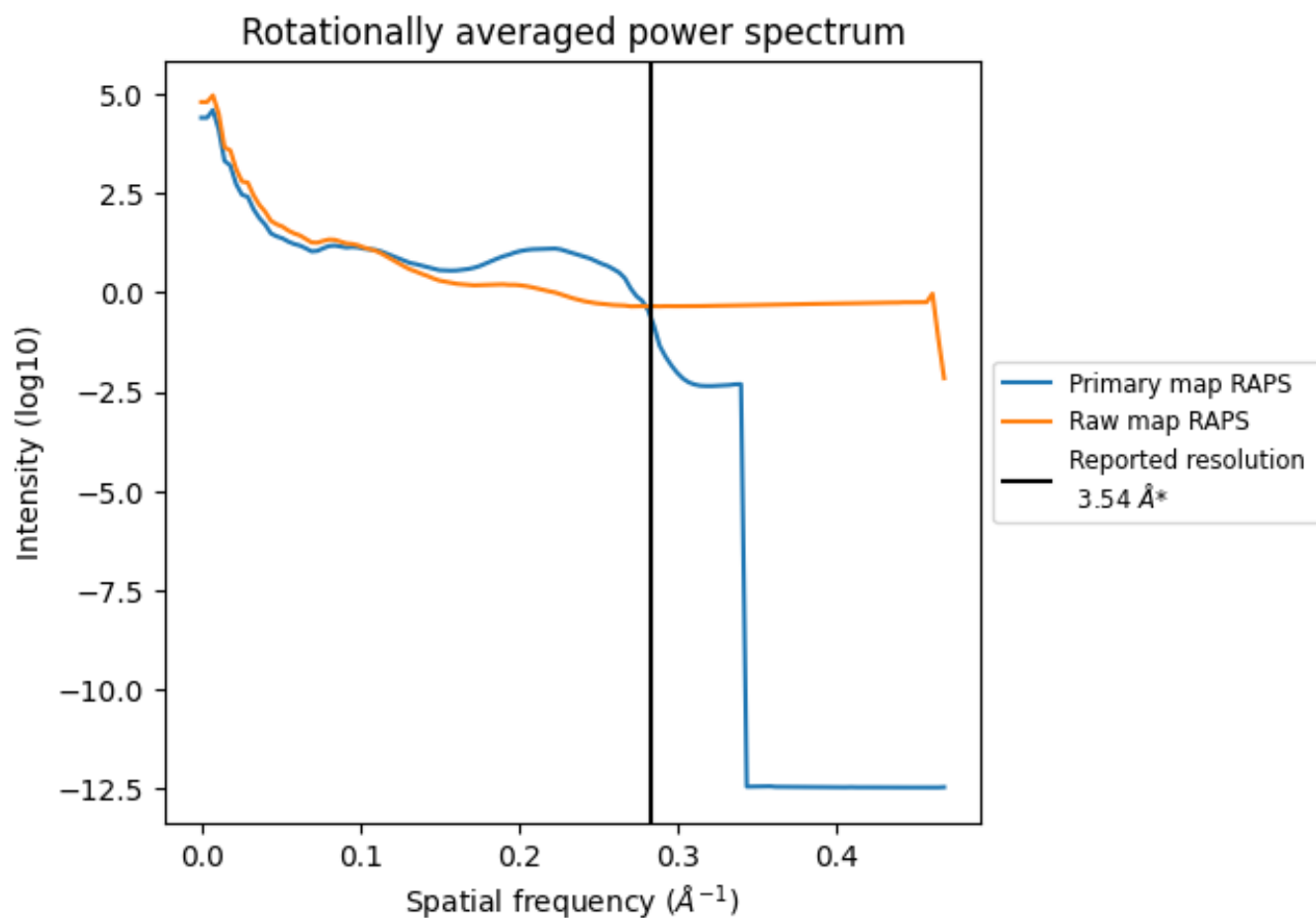
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 207 nm³; this corresponds to an approximate mass of 187 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](#)

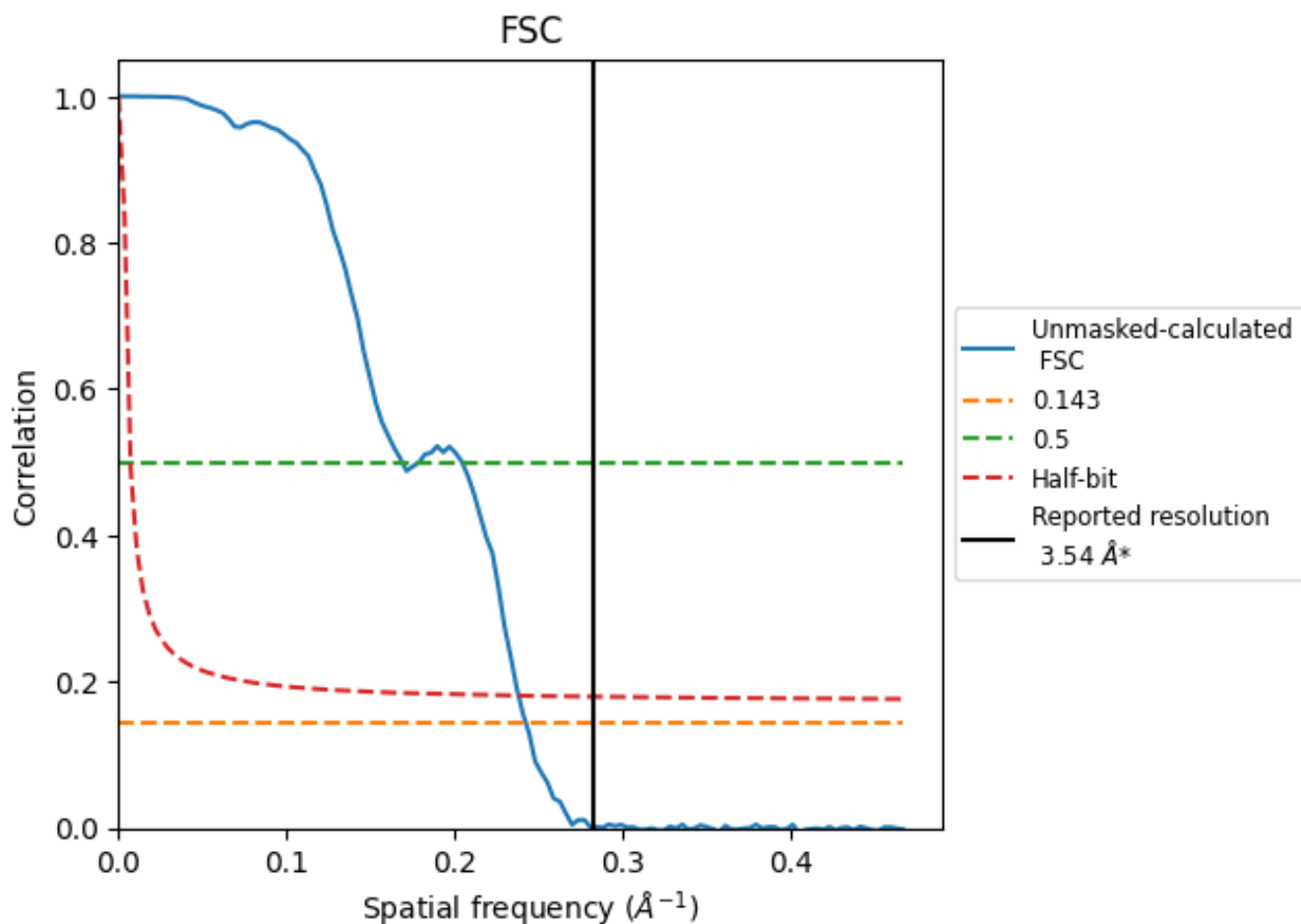


*Reported resolution corresponds to spatial frequency of 0.282 Å⁻¹

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 0.282 Å⁻¹

8.2 Resolution estimates [i](#)

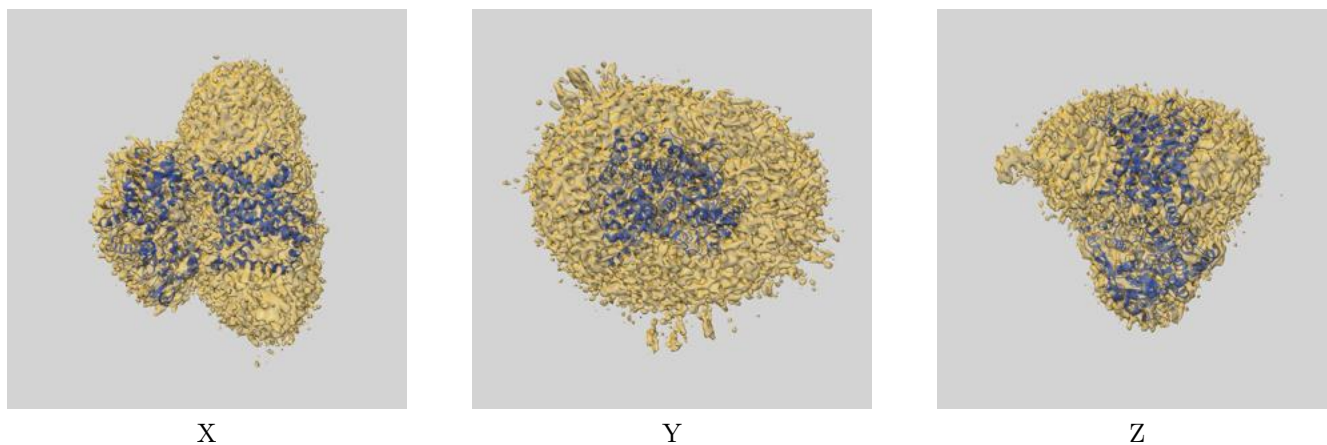
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.54	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	4.12	5.92	4.20

*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 4.12 differs from the reported value 3.54 by more than 10 %

9 Map-model fit [i](#)

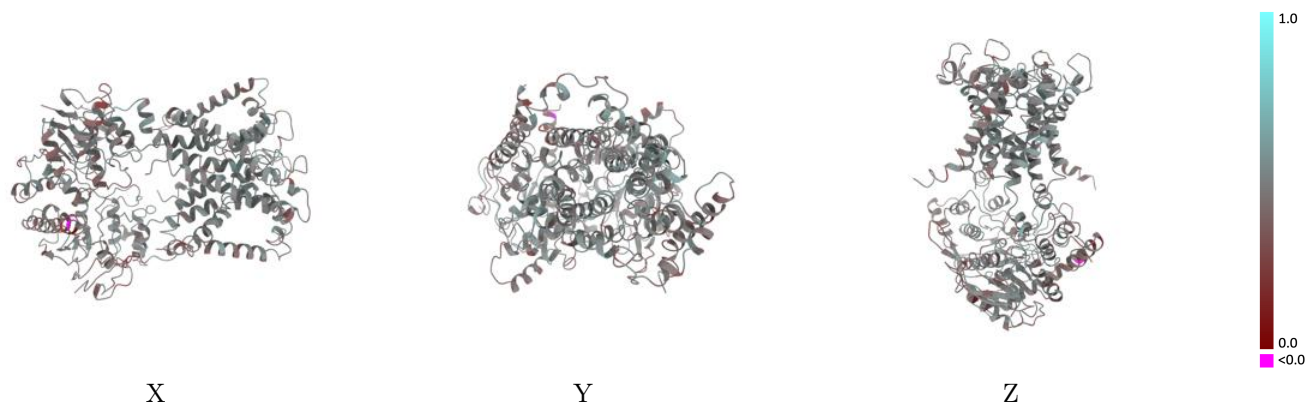
This section contains information regarding the fit between EMDB map EMD-37645 and PDB model 8WM8. Per-residue inclusion information can be found in section [3](#) on page [5](#).

9.1 Map-model overlay [i](#)



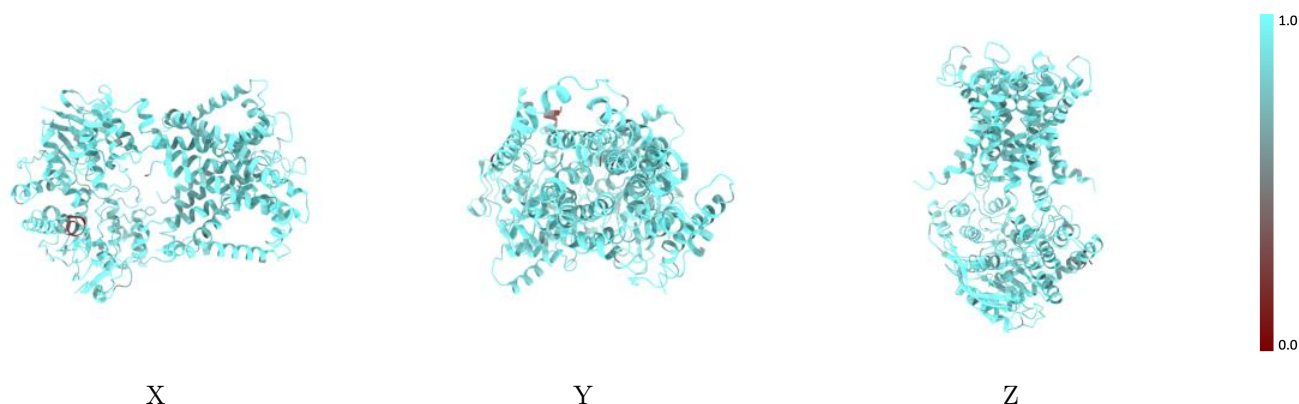
The images above show the 3D surface view of the map at the recommended contour level 0.231 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



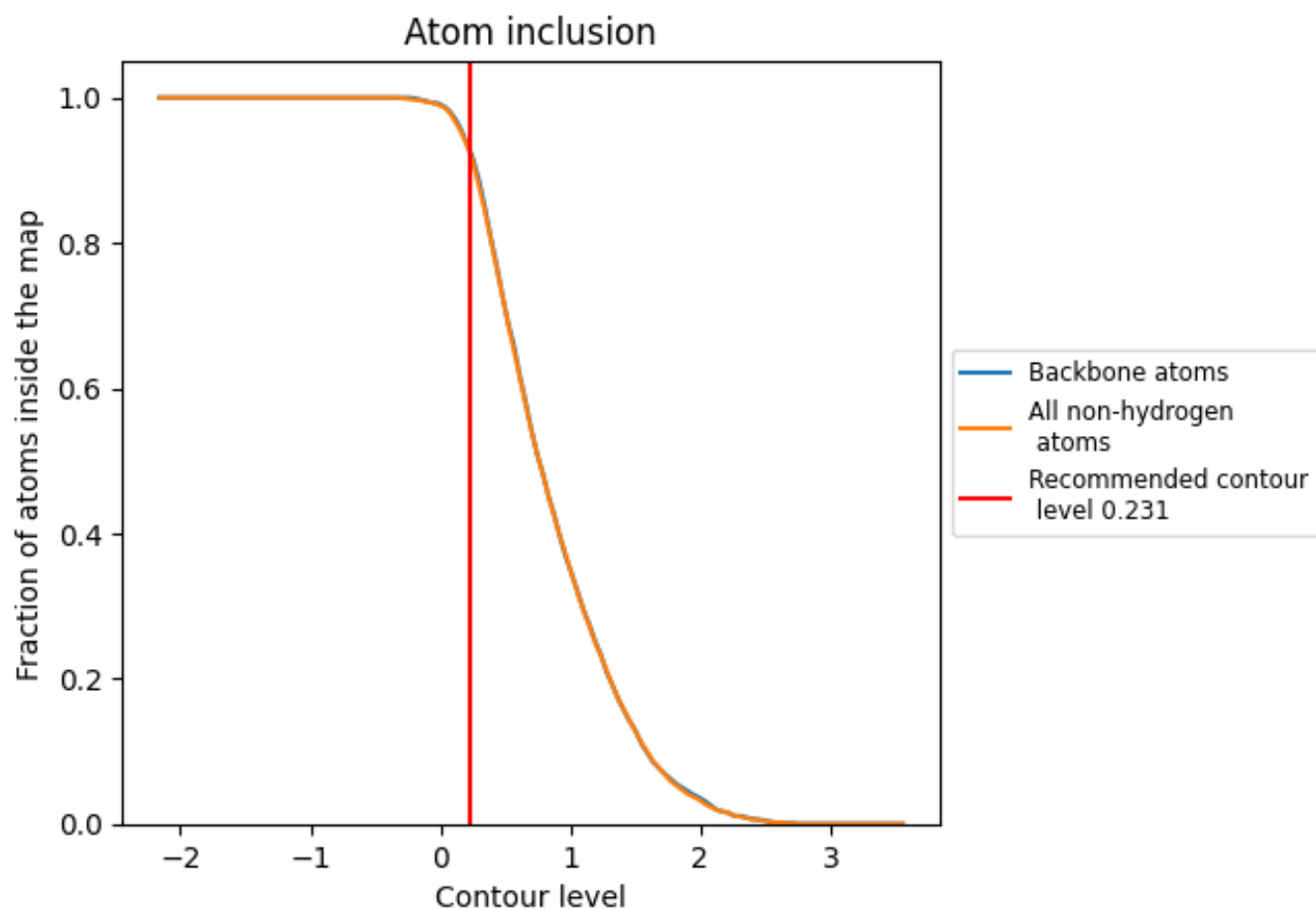
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.231).









9.4 Atom inclusion [i](#)



At the recommended contour level, 92% of all backbone atoms, 92% of all non-hydrogen atoms, are inside the map.

9.5 Map-model fit summary [i](#)

The table lists the average atom inclusion at the recommended contour level (0.231) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.9230	 0.4630
A	 0.9190	 0.4760
B	 0.9250	 0.4790
C	 0.9150	 0.4460
D	 0.9150	 0.4510

