



wwPDB EM Validation Summary Report ⓘ

May 19, 2025 – 11:42 AM EDT

PDB ID : 7MR2 / pdb_00007mr2
EMDB ID : EMD-23954
Title : Cryo-EM structure of RecBCD with undocked RecBNuc and flexible RecD
Authors : Hao, L.; Zhang, R.; Lohman, T.M.
Deposited on : 2021-05-07
Resolution : 4.30 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.dev118
MolProbity : 4-5-2 with Phenix2.0rc1
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.43.1

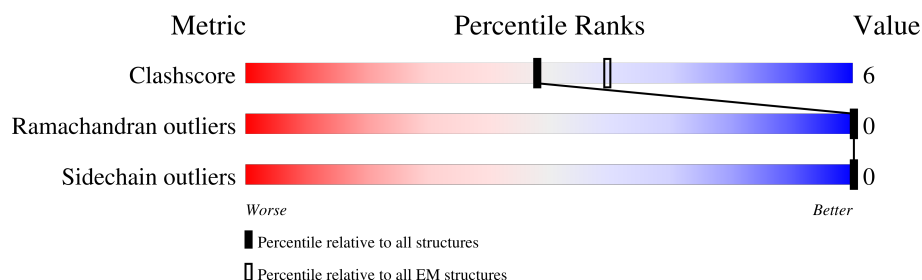
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 4.30 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	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

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	B	1180	9% 62% 11% 28%
2	C	1122	7% 82% 16% •
3	D	608	16% 16% • 80%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 16671 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 RecBCD enzyme subunit RecB.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	B	855	Total	C	N	O	S	0	0
			6827	4290	1224	1283	30		

- Molecule 2 is a protein called RecBCD enzyme subunit RecC.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	C	1097	Total	C	N	O	S	0	0
			8887	5665	1532	1647	43		

- Molecule 3 is a protein called RecBCD enzyme subunit RecD.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	D	123	Total	C	N	O	S	0	0
			957	598	171	181	7		

ALA	MET	ALA	ALA	MET	GLN	ALA	HIS	ARG	TVR	ASP	LEU	GLN	GLN	TVR	THR	LEU	ALA	HIS	ARG	TVR	LEU	ARG	HIS	HIS	PHE	GLY	GLY	VAL	ILE	TVR	LEU	PHE	LEU	ARG	GLY	VAL	ASP	LYS	GLU	PRO	HIS	GLN	GLN	ILE	TVR	
THR	THR	ARG	PRO	ASN	ALA	GLY	LEU	ALA	LEU	MET	ASP	GLU	MET	PHE	GLN	ALA	GLY	TVR	MET	THR	LEU	GLU	GLU	ALA																						

• Molecule 2: RecBCD enzyme subunit RecC



ARG	GLU	ASP	ASN	GLU	TLE	GLY	ASN	ALA	ASN
HIS	LEU	ILE	GLY	ILE	ALA	ASP	GLY	GLN	ALA
ALA	LEU	GLN	ASP	GLN	GLY	VAL	PRO	GLY	LEU
LEU	LEU	ILE	ILE	ALA	ALA	GLY	LEU	SER	ILE
ILE	ILE	GLY	GLY	ALA	ALA	ASP	ARG	ILE	VAL
LEU	GLN	GLN	GLN	ILE	ILE	ILE	LEU	LEU	ASP
PRO	ALA	ALA	ALA	TLE	TLE	CYS	ARG	GLY	GLY
ASP	PHE	ASN	ASN	ASN	ASN	ASN	HIS	HIS	ALA
SER	ASN	GLY	GLY	ARG	ARG	TYR	GLY	GLY	GLU
GLN	ASP	GLY	GLY	GLY	GLY	ALA	ALA	ALA	LEU
ARG	THR	ILE	ILE	ASP	ASP	ASN	GLY	CYS	LEU
PRO	GLY	GLY	GLN	LYS	LYS	ALA	ASN	ILE	GLN
VAL	ILE	ILE	LEU	THR	THR	PHE	GLY	ARG	THR
VAL	VAL	VAL	GLY	GLN	GLN	ARG	LEU	VAL	LEU
THR	THR	THR	THR	GLN	GLN	GLY	VAL	GLY	LEU
ALA	ALA	ARG	ARG	ASP	ASP	SER	ASP	ALA	ASP
VAL	VAL	VAL	VAL	PHE	PHE	ARG	GLY	ALA	GLY
THR	THR	TRP	TRP	THR	THR	THR	ALA	ARG	ILE
ARG	ARG	PHE	PHE	ALA	ASP	THR	ALA	LEU	GLY
ALA	ALA	ALA	ALA	GLY	ILE	THR	ILE	THR	GLN
ARG	ARG	MET	MET	LEU	GLU	GLY	ASP	SER	LYS
ARG	ARG	PRO	PRO	ASN	LYS	THR	ASP	GLY	VAL
ARG	ARG	ASP	ASP	GLU	ARG	HIS	LEU	LEU	ALA
LEU	GLY	GLY	GLY	ARG	LEU	VAL	PRO	GLY	ALA
ASN	ASN	ASN	ASN	ILE	LEU	PRO	ASP	GLY	ALA
ILE	ILE	ILE	ILE	GLU	GLN	THR	ILE	LEU	THR
TYR	TYR	LYS	LYS	GLN	SER	GLY	SER	ARG	ALA
ALA	ALA	SER	SER	PHE	GLY	THR	ARG	ALA	VAL
ASP	GLU	VAL	VAL	MET	GLU	GLY	LEU	GLN	LEU
GLU	GLN	GLN	GLN	ASP	ASP	THR	ILE	LEU	THR
ASP	ARG	ARG	PRO	GLN	TYR	GLU	ASP	PRO	ARG
ILE	ILE	SER	SER	LYS	ILE	ALA	ALA	LEU	ILE
LEU	LEU	LEU	LEU	GLN	ALA	ALA	LEU	THR	GLY
SER	SER	LEU	LEU	ARG	MET	SER	PRO	ASP	PRO
ALA	ALA	PRO	PRO	ILE	LEU	LEU	ASP	GLU	VAL
ALA	ALA	GLU	GLU	HIS	GLU	ARG	HIS	GLY	ILE
ILE	ILE	HIS	HIS	ARG	GLU	ALA	ALA	LYS	SER
THR	THR	THR	THR	HIS	ALA	LEU	VAL	ARG	GLY
ARG	ARG	THR	TRP	SER	GLY	CYS	ILE	ILE	GLY
THR	GLU	ALA	ALA	TRP	TYR	LEU	PHE	PRO	THR
GLU	ARG	MET	ALA	ARG	GLY	LEU	LEU	GLU	GLY
ARG	ARG	THR	MET	TRP	GLY	GLN	GLY	ASP	GLY
SER	SER	VAL	VAL	GLU	TYR	SER	ARG	SER	THR
GLY	GLY	HIS	HIS	GLY	LEU	THR	ASP	THR	THR
LEU	LEU	LYS	LYS	ARG	ASP	ARG	GLN	LEU	THR
ALA	ALA	SER	SER	PRO	LEU	PHE	LEU	HIS	VAL
ALA	ALA	GLN	GLN	VAL	LEU	GLY	ALA	ARG	ALA
LEU	LEU	GLY	GLY	MET	GLN	GLY	SER	LEU	LYS
PHE	PHE	ILE	ILE	ILE	ALA	ASP	VAL	LEU	LEU
SER	SER	GLU	GLU	ARG	ARG	SER	GLU	GLY	ALA

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	48007	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 ($e^-/\text{\AA}^2$)	49.5	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	GATAN K2 QUANTUM (4k x 4k)	Depositor
Maximum map value	0.077	Depositor
Minimum map value	-0.032	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.003	Depositor
Recommended contour level	0.025	Depositor
Map size (Å)	282.5, 282.5, 282.5	wwPDB
Map dimensions	250, 250, 250	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.13, 1.13, 1.13	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	B	0.15	0/6958	0.40	0/9428
2	C	0.15	0/9106	0.40	0/12370
3	D	0.20	0/975	0.54	1/1325 (0.1%)
All	All	0.15	0/17039	0.41	1/23123 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	D	80	ASN	CB-CA-C	5.13	119.87	111.41

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	B	6827	0	6769	79	0
2	C	8887	0	8704	107	0
3	D	957	0	943	15	0
All	All	16671	0	16416	190	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 6.

The worst 5 of 190 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:B:398:ARG:O	1:B:402:HIS:HB2	1.78	0.82
1:B:652:TRP:HA	1:B:660:MET:HE3	1.69	0.74
1:B:59:LEU:HD13	1:B:380:VAL:HG11	1.71	0.72
2:C:379:CYS:SG	2:C:380:HIS:N	2.69	0.66
2:C:841:TRP:HB3	2:C:978:MET:HE1	1.78	0.66

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	B	851/1180 (72%)	805 (95%)	46 (5%)	0	100	100
2	C	1093/1122 (97%)	1045 (96%)	48 (4%)	0	100	100
3	D	121/608 (20%)	110 (91%)	11 (9%)	0	100	100
All	All	2065/2910 (71%)	1960 (95%)	105 (5%)	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	B	722/999 (72%)	722 (100%)	0	100	100
2	C	958/977 (98%)	958 (100%)	0	100	100
3	D	104/492 (21%)	104 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	1784/2468 (72%)	1784 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 22 such sidechains are listed below:

Mol	Chain	Res	Type
2	C	596	ASN
2	C	883	GLN
2	C	822	GLN
2	C	886	ASN
1	B	566	GLN

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.

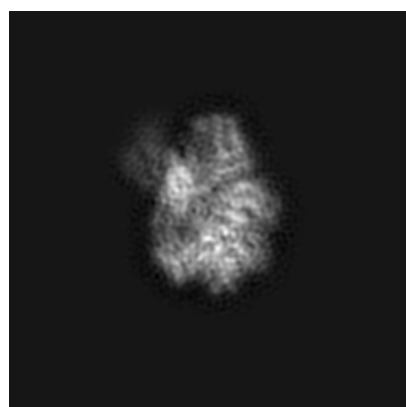
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-23954. These allow visual inspection of the internal detail of the map and identification of artifacts.

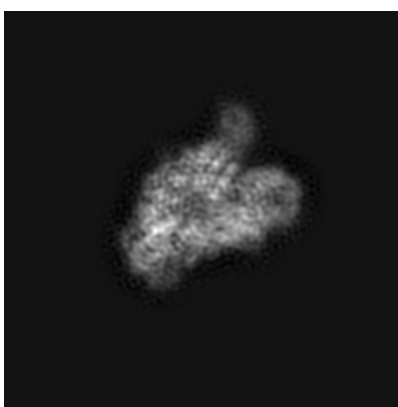
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

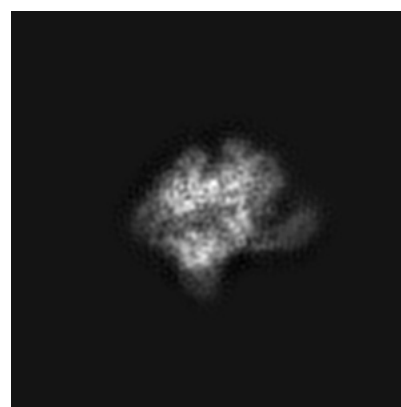
6.1.1 Primary map



X



Y



Z

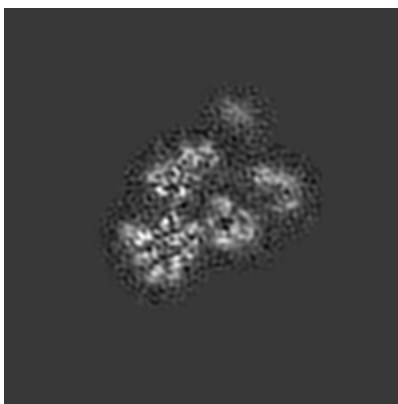
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

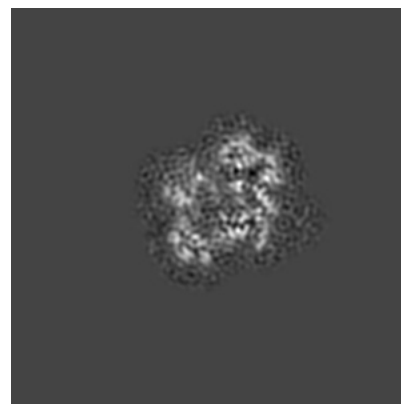
6.2.1 Primary map



X Index: 125



Y Index: 125

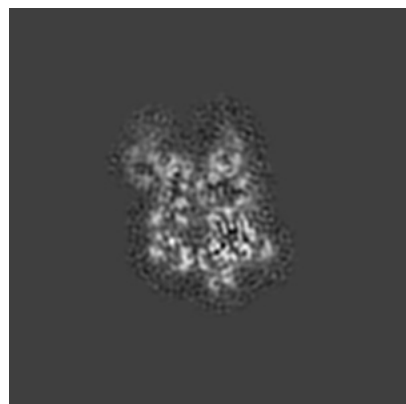


Z Index: 125

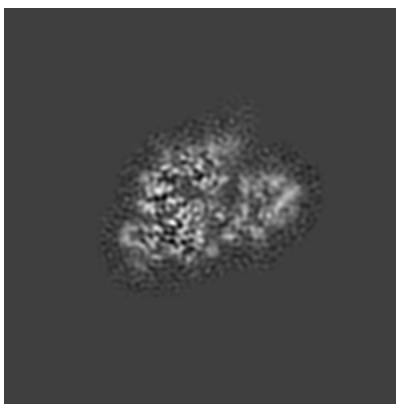
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

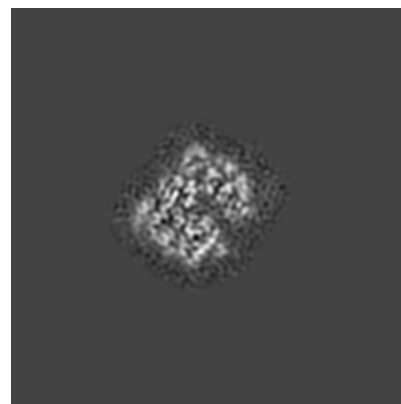
6.3.1 Primary map



X Index: 113



Y Index: 139

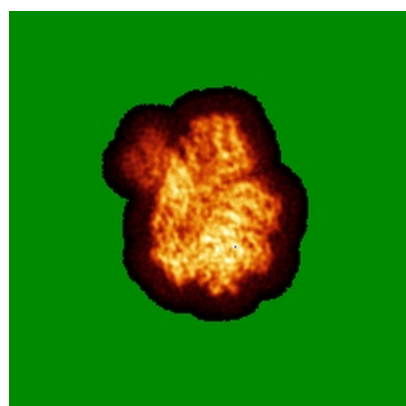


Z Index: 94

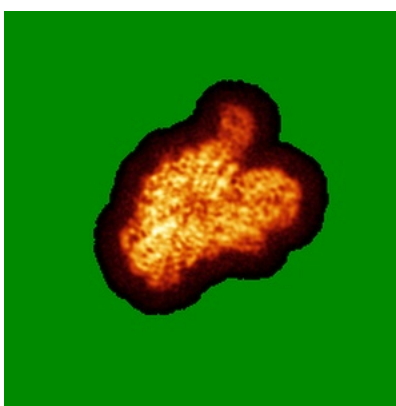
The images above show the largest variance slices of the map in three orthogonal directions.

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

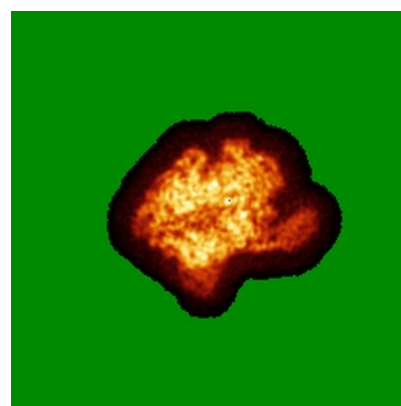
6.4.1 Primary map



X



Y

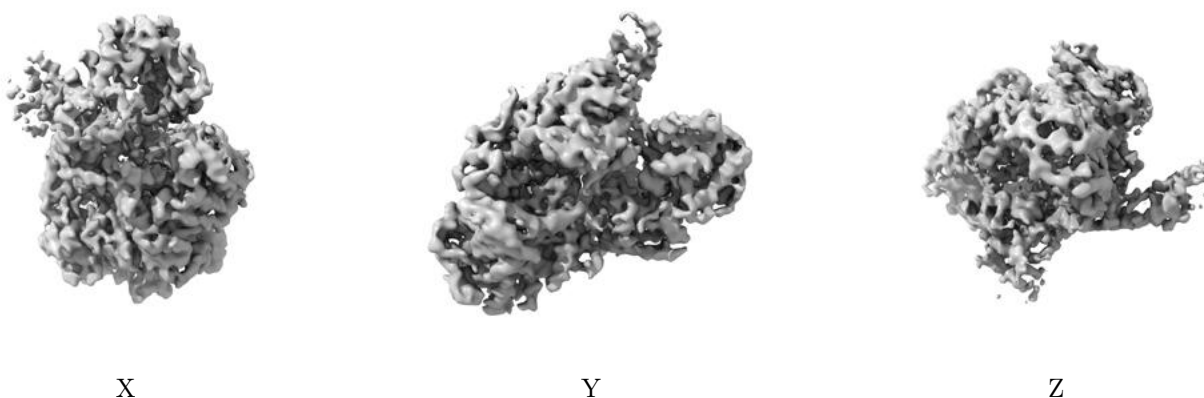


Z

The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.025. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

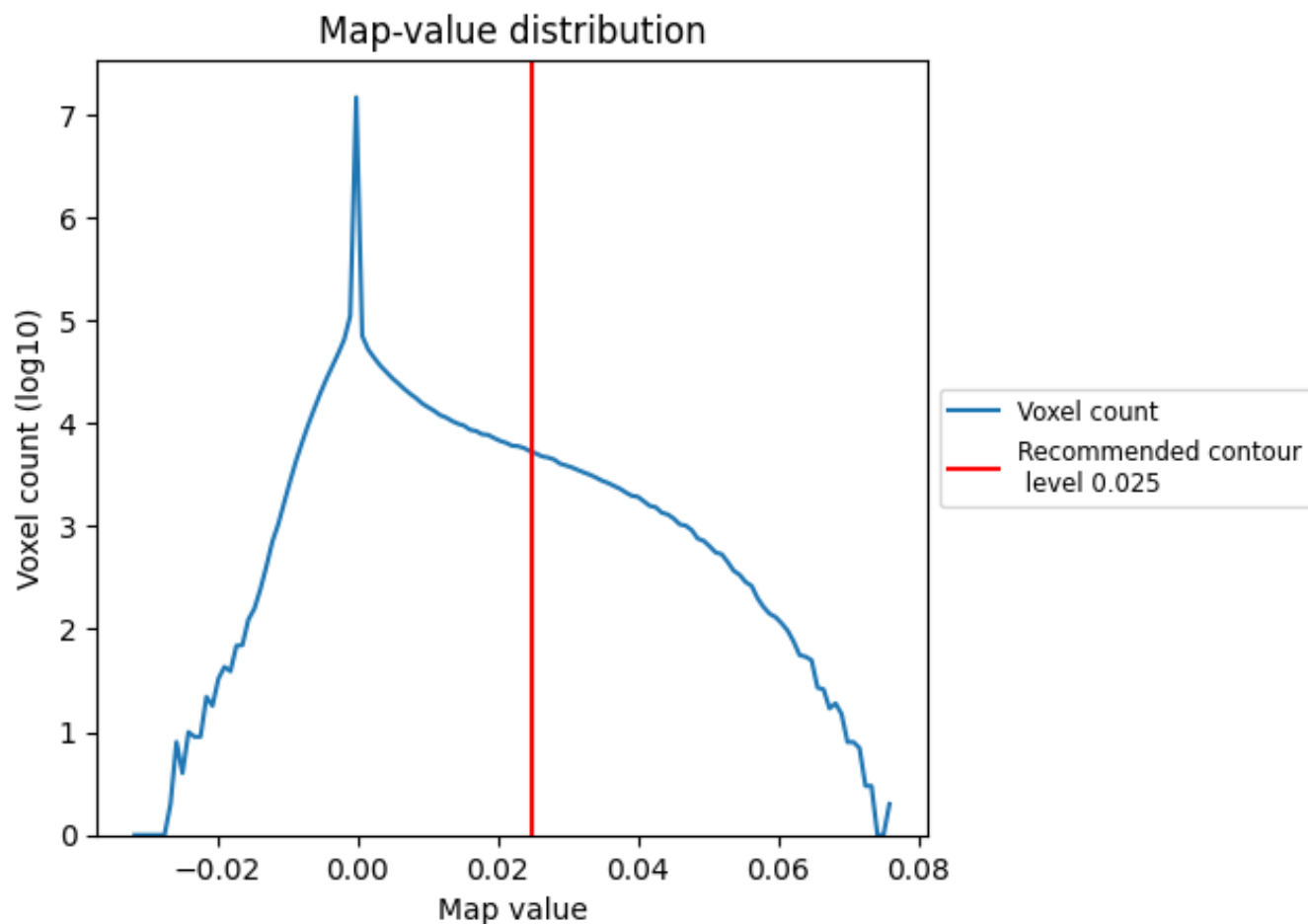
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

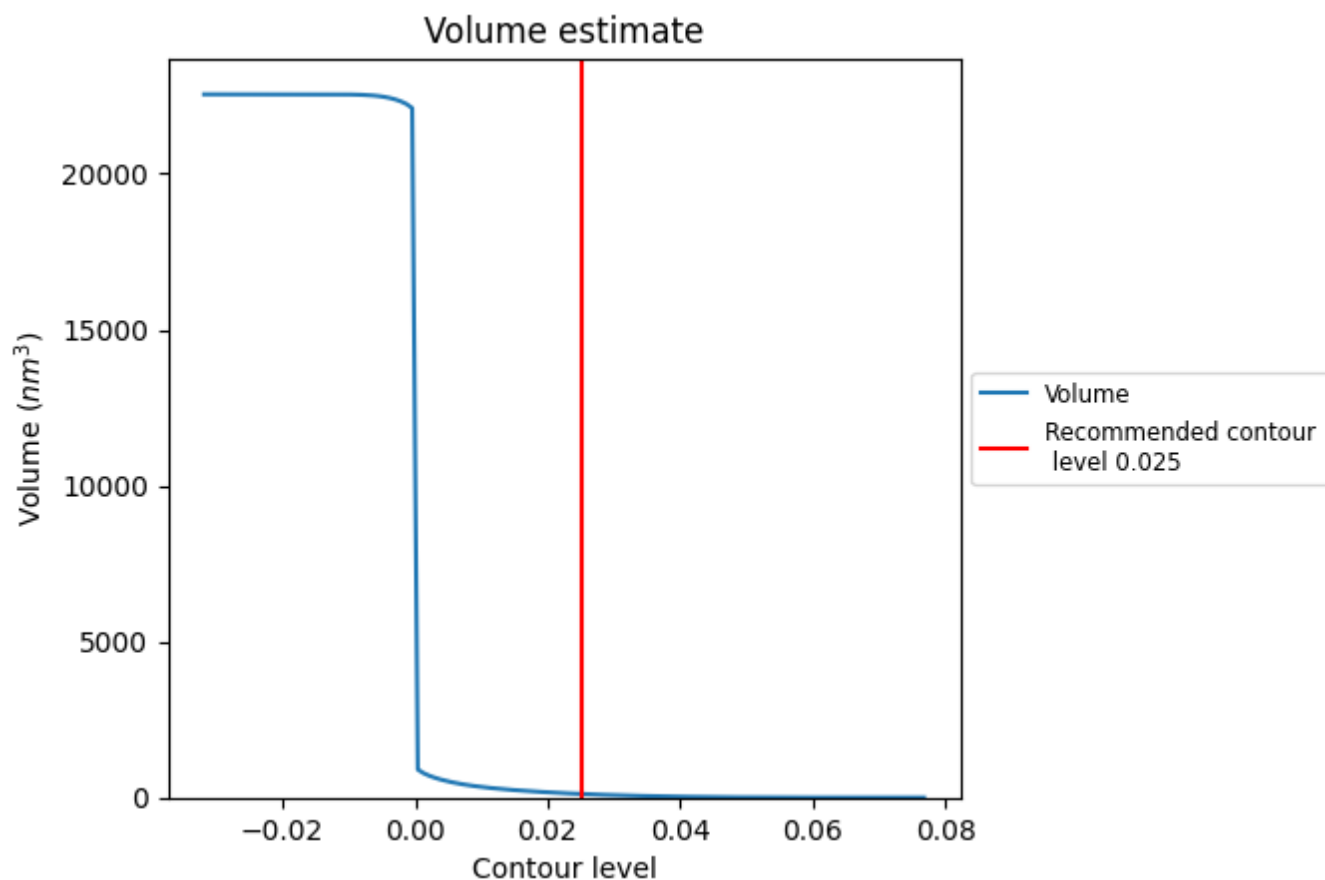
This section contains the results of statistical analysis of the map.

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.

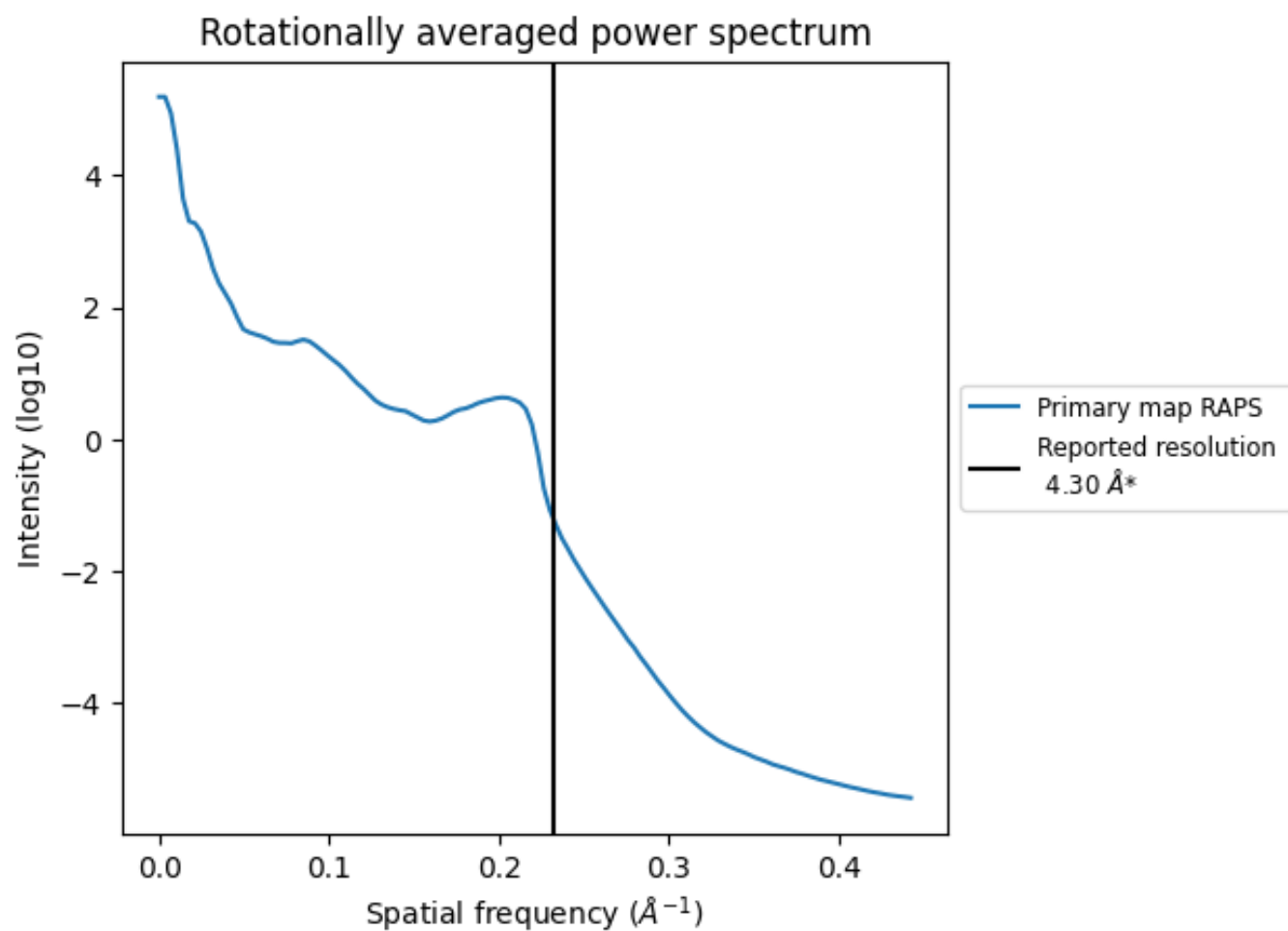
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 116 nm³; this corresponds to an approximate mass of 105 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 ⓘ

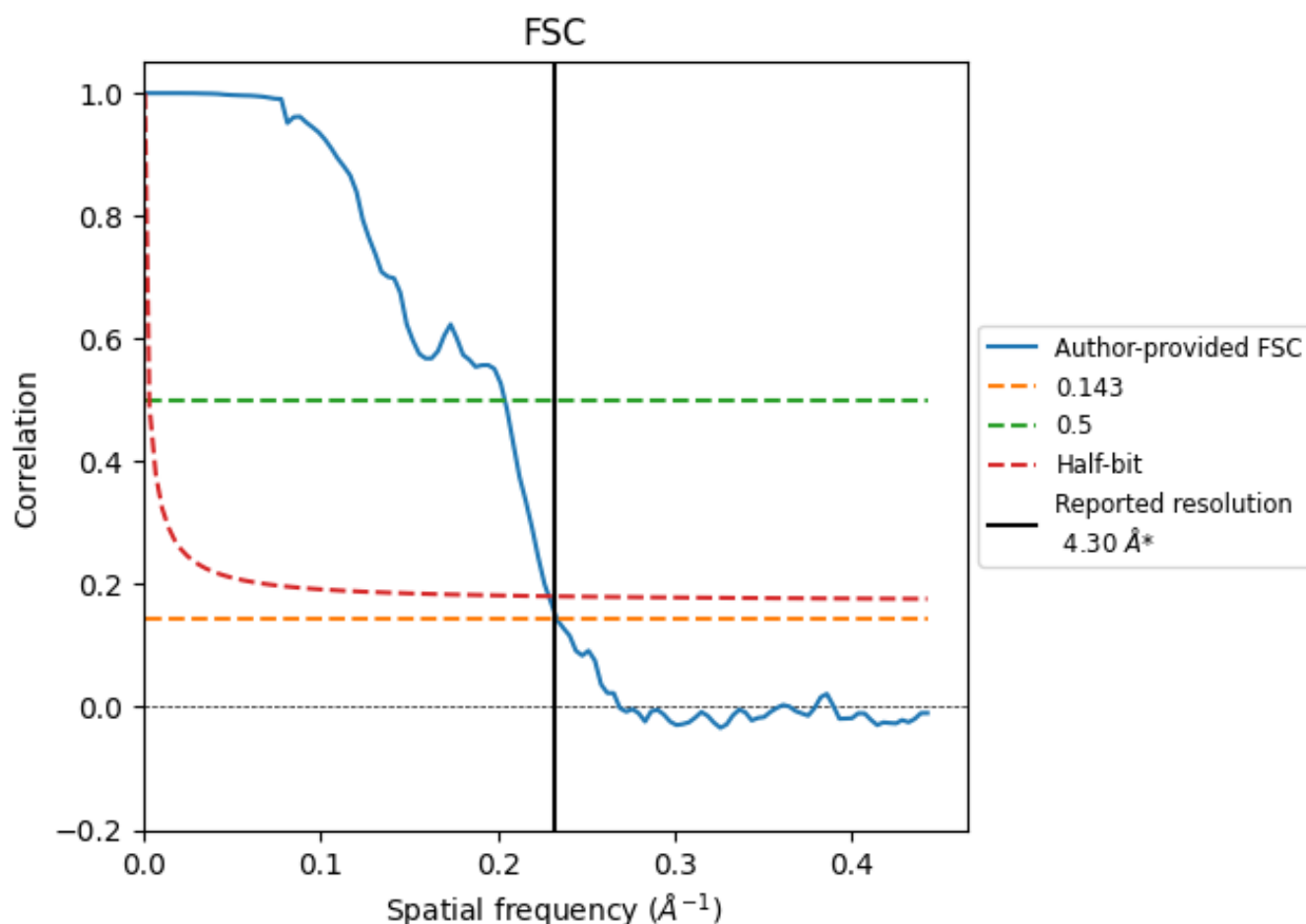


*Reported resolution corresponds to spatial frequency of 0.233 Å⁻¹

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 0.233 Å⁻¹

8.2 Resolution estimates [i](#)

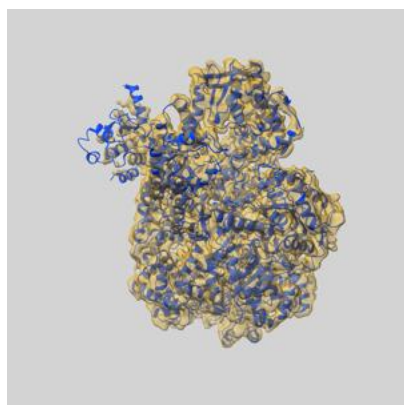
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	4.30	-	-
Author-provided FSC curve	4.28	4.90	4.37
Unmasked-calculated*	-	-	-

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

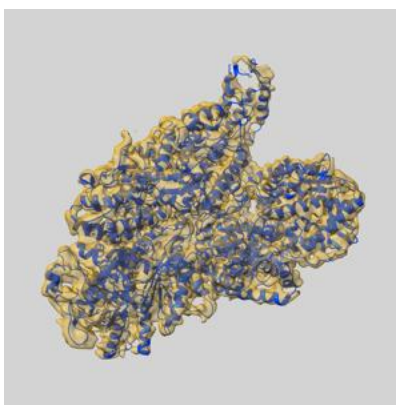
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-23954 and PDB model 7MR2. Per-residue inclusion information can be found in [section 3](#) on [page 4](#).

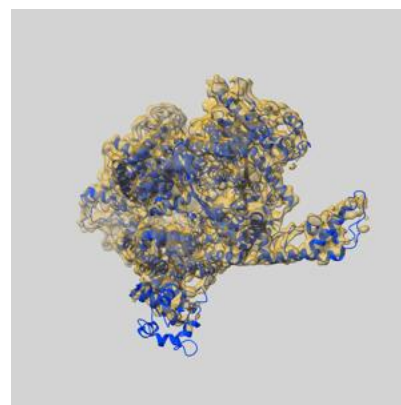
9.1 Map-model overlay [i](#)



X



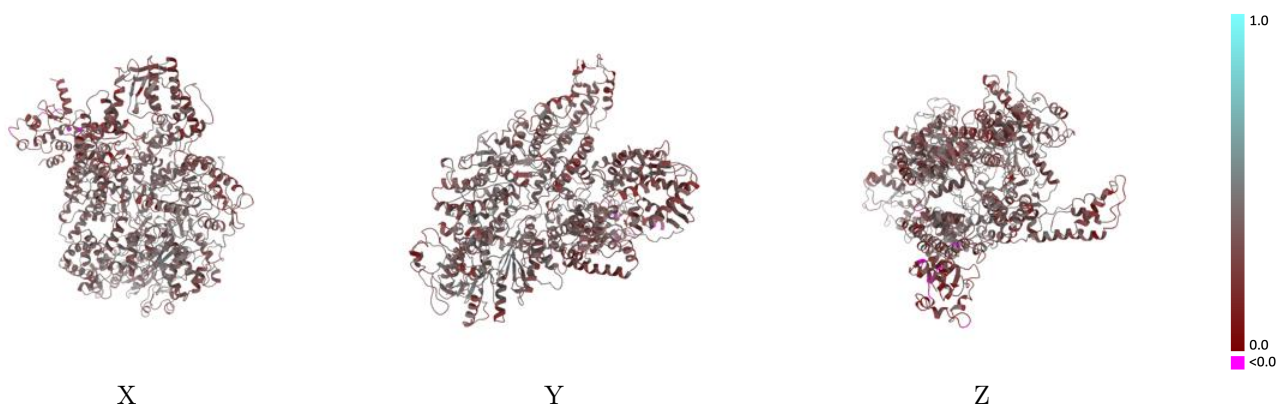
Y



Z

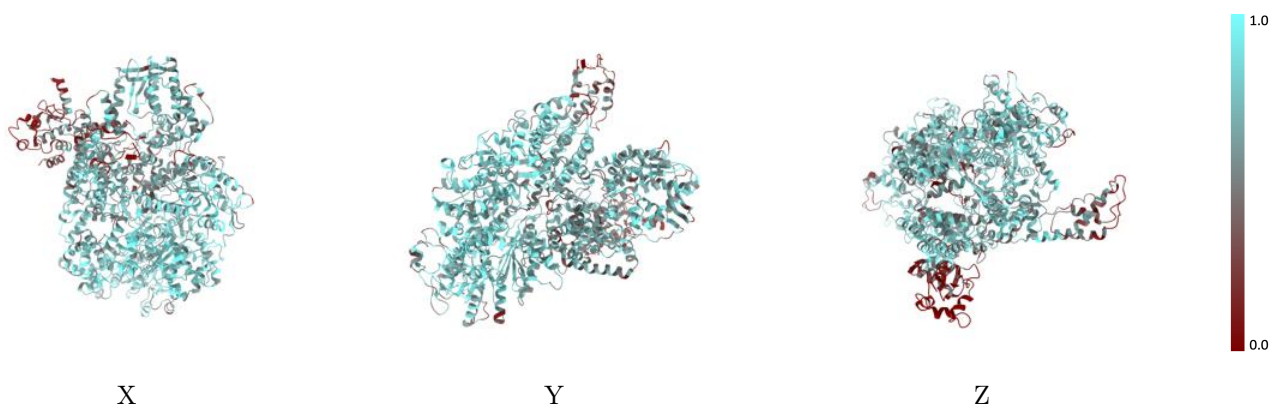
The images above show the 3D surface view of the map at the recommended contour level 0.025 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



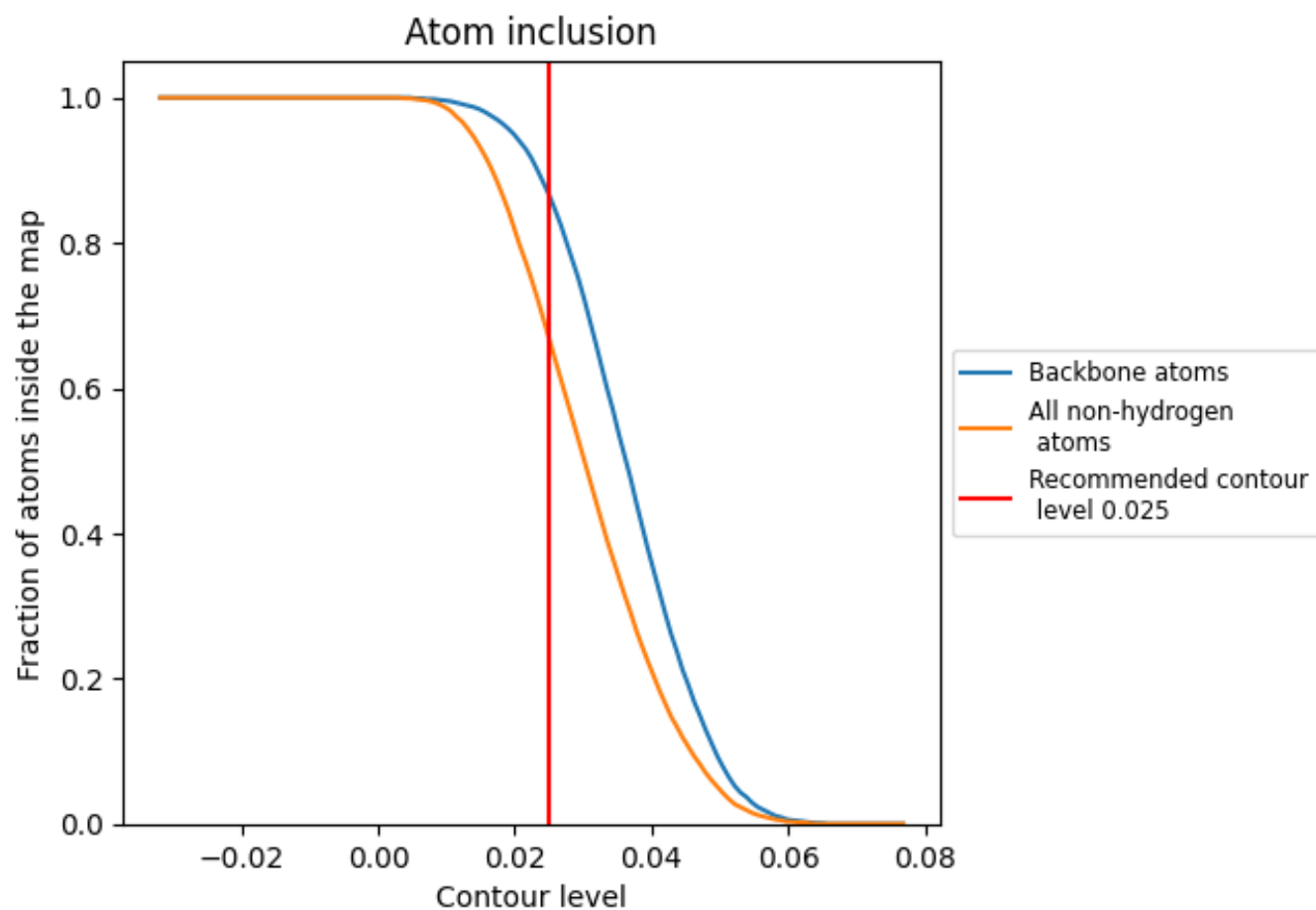
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.025).

9.4 Atom inclusion [i](#)



At the recommended contour level, 87% 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 (0.025) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.6690	0.3560
B	0.6770	0.3640
C	0.7140	0.3620
D	0.1950	0.2380

