



Full wwPDB EM Validation Report ⓘ

Mar 8, 2026 – 12:35 AM UTC

PDB ID : 8ESA / pdb_00008esa
EMDB ID : EMD-28573
Title : CryoEM structure of HLA-A2 bound to MAGEA4 (230-239) peptide
Authors : Saotome, K.; Franklin, M.C.
Deposited on : 2022-10-13
Resolution : 3.40 Å(reported)

This is a Full wwPDB EM Validation 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

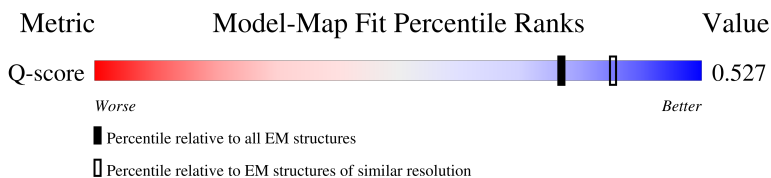
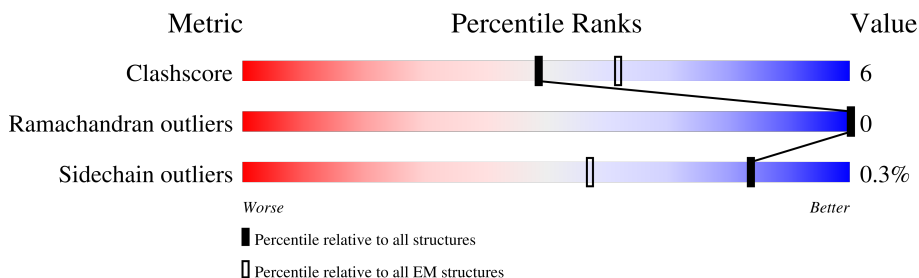
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.40 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	14717 (2.90 - 3.90)

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	448	 6% 53% 8% 39%
1	B	448	 17% 5% 78%
1	C	448	 • 97%

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 3140 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 Beta-2-microglobulin,HLA class I antigen,MAGE-A4 peptide chimera.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	273	Total	C	N	O	S	0	0
			2223	1389	406	418	10		
1	B	99	Total	C	N	O	S	0	0
			828	528	140	157	3		
1	C	12	Total	C	N	O	S	0	0
			89	53	17	18	1		

There are 63 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	GLY	-	linker	PDB ?
A	-18	GLY	-	linker	PDB ?
A	-17	GLY	-	linker	PDB ?
A	-16	GLY	-	linker	PDB ?
A	-15	SER	-	linker	PDB ?
A	-14	GLY	-	linker	PDB ?
A	-13	GLY	-	linker	PDB ?
A	-12	GLY	-	linker	PDB ?
A	-11	GLY	-	linker	PDB ?
A	-10	SER	-	linker	PDB ?
A	-9	GLY	-	linker	PDB ?
A	-8	GLY	-	linker	PDB ?
A	-7	GLY	-	linker	PDB ?
A	-6	GLY	-	linker	PDB ?
A	-5	SER	-	linker	PDB ?
A	-4	GLY	-	linker	PDB ?
A	-3	GLY	-	linker	PDB ?
A	-2	GLY	-	linker	PDB ?
A	-1	GLY	-	linker	PDB ?
A	0	SER	-	linker	PDB ?
A	84	CYS	TYR	conflict	UNP Q53Z42
B	100	GLY	-	linker	PDB ?
B	101	GLY	-	linker	PDB ?

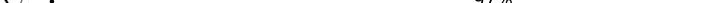
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Chain	Residue	Modelled	Actual	Comment	Reference
B	102	GLY	-	linker	PDB ?
B	103	GLY	-	linker	PDB ?
B	104	SER	-	linker	PDB ?
B	105	GLY	-	linker	PDB ?
B	106	GLY	-	linker	PDB ?
B	107	GLY	-	linker	PDB ?
B	108	GLY	-	linker	PDB ?
B	109	SER	-	linker	PDB ?
B	110	GLY	-	linker	PDB ?
B	111	GLY	-	linker	PDB ?
B	112	GLY	-	linker	PDB ?
B	113	GLY	-	linker	PDB ?
B	114	SER	-	linker	PDB ?
B	115	GLY	-	linker	PDB ?
B	116	GLY	-	linker	PDB ?
B	117	GLY	-	linker	PDB ?
B	118	GLY	-	linker	PDB ?
B	119	SER	-	linker	PDB ?
B	203	CYS	TYR	conflict	UNP Q53Z42
C	125	GLY	-	linker	PDB ?
C	126	GLY	-	linker	PDB ?
C	127	GLY	-	linker	PDB ?
C	128	GLY	-	linker	PDB ?
C	129	SER	-	linker	PDB ?
C	130	GLY	-	linker	PDB ?
C	131	GLY	-	linker	PDB ?
C	132	GLY	-	linker	PDB ?
C	133	GLY	-	linker	PDB ?
C	134	SER	-	linker	PDB ?
C	135	GLY	-	linker	PDB ?
C	136	GLY	-	linker	PDB ?
C	137	GLY	-	linker	PDB ?
C	138	GLY	-	linker	PDB ?
C	139	SER	-	linker	PDB ?
C	140	GLY	-	linker	PDB ?
C	141	GLY	-	linker	PDB ?
C	142	GLY	-	linker	PDB ?
C	143	GLY	-	linker	PDB ?
C	144	SER	-	linker	PDB ?
C	228	CYS	TYR	conflict	UNP Q53Z42

TRP	GLN	ARG	GLY	GLU	ASP	GLN	THR	GLN	ASP	THR	THR	GLU	LEU	VAL	GLU	THR	ARG	PRO	ALA	GLY	ASP	GLY	THR	PHE	GLN	LYS	TRP	ALA	ALA	VAL	VAL	VAL	PRO	SER	GLY	GLN	GLU	GLN	ARG	TYR	THR	CYS	HIS	VAL	GLN	HIS	GLU	GLY	LEU	PRO	LYS	PRO	LEU	THR	LEU	ARG	TRP	TRP	GLU	PRO
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- Molecule 1: Beta-2-microglobulin,HLA class I antigen,MAGE-A4 peptide chimera

Chain C:  97%

[illegible]

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	76433	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 ($e^-/\text{\AA}^2$)	40	Depositor
Minimum defocus (nm)	1400	Depositor
Maximum defocus (nm)	2400	Depositor
Magnification	Not provided	
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	80.705	Depositor
Minimum map value	-58.083	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	1.000	Depositor
Recommended contour level	12	Depositor
Map size ($\text{\AA}$)	306.0, 306.0, 306.0	wwPDB
Map dimensions	360, 360, 360	wwPDB
Map angles ($^\circ$)	90.0, 90.0, 90.0	wwPDB
Pixel spacing ($\text{\AA}$)	0.85, 0.85, 0.85	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	0.15	0/2287	0.27	0/3103
1	B	0.17	0/851	0.28	0/1152
1	C	0.16	0/90	0.21	0/120
All	All	0.16	0/3228	0.28	0/4375

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	2223	0	2078	23	0
1	B	828	0	794	13	0
1	C	89	0	79	1	0
All	All	3140	0	2951	35	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.

All (35) 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:A:160:LEU:O	1:A:164:CYS:HB3	1.97	0.65

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:255:GLN:O	1:A:273:ARG:NH2	2.35	0.58
1:B:7:ILE:HG12	1:B:27:VAL:HG12	1.87	0.56
1:A:28:VAL:HG11	1:A:179:LEU:HD13	1.88	0.56
1:A:266:LEU:HD13	1:A:270:LEU:HD23	1.91	0.53
1:A:261:VAL:HB	1:A:270:LEU:HB2	1.90	0.53
1:B:36:GLU:OE2	1:B:81:ARG:NH1	2.42	0.53
1:A:133:TRP:HB2	1:A:144:LYS:HE3	1.92	0.51
1:A:159:TYR:CZ	1:C:3:TYR:HA	2.47	0.50
1:B:39:LEU:HB2	1:B:49:VAL:HG11	1.93	0.50
1:A:207:SER:HA	1:A:240:THR:HB	1.93	0.49
1:B:49:VAL:HG12	1:B:68:THR:HB	1.93	0.49
1:A:45:MET:SD	1:A:67:VAL:HG21	2.53	0.49
1:B:33:SER:HB2	1:B:54:LEU:HD21	1.95	0.49
1:A:14:ARG:NH2	1:A:19:GLU:O	2.46	0.49
1:A:88:SER:OG	1:A:89:GLU:N	2.46	0.47
1:B:48:LYS:HB3	1:B:48:LYS:HE2	1.68	0.47
1:A:95:VAL:HG22	1:A:118:TYR:HD1	1.80	0.47
1:B:40:LEU:HD11	1:B:81:ARG:HB2	1.97	0.47
1:A:137:ASP:OD1	1:A:137:ASP:N	2.46	0.46
1:A:125:ALA:O	1:A:134:THR:HG22	2.17	0.45
1:A:161:GLU:O	1:A:165:VAL:HG22	2.17	0.44
1:A:59:TYR:O	1:A:63:GLU:HG2	2.17	0.44
1:B:55:SER:OG	1:B:56:PHE:N	2.51	0.43
1:B:21:ASN:OD1	1:B:22:PHE:N	2.46	0.43
1:B:23:LEU:HB2	1:B:70:PHE:CD1	2.55	0.42
1:A:255:GLN:HB2	1:A:273:ARG:HH21	1.84	0.42
1:A:260:HIS:CD2	1:A:271:THR:HG22	2.54	0.41
1:A:14:ARG:HE	1:A:14:ARG:HB2	1.64	0.41
1:A:266:LEU:HD22	1:A:270:LEU:HD21	2.03	0.41
1:B:41:LYS:HB2	1:B:46:ILE:HD11	2.03	0.41
1:A:204:TRP:CE3	1:A:244:TRP:HB3	2.56	0.40
1:A:58:GLU:HG2	1:A:59:TYR:N	2.36	0.40
1:B:24:ASN:HB3	1:B:65:LEU:HD11	2.03	0.40
1:A:122:ASP:OD1	1:B:60:TRP:NE1	2.50	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	269/448 (60%)	259 (96%)	10 (4%)	0	100	100
1	B	97/448 (22%)	93 (96%)	4 (4%)	0	100	100
1	C	10/448 (2%)	9 (90%)	1 (10%)	0	100	100
All	All	376/1344 (28%)	361 (96%)	15 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	229/368 (62%)	228 (100%)	1 (0%)	84	83
1	B	94/368 (26%)	94 (100%)	0	100	100
1	C	9/368 (2%)	9 (100%)	0	100	100
All	All	332/1104 (30%)	331 (100%)	1 (0%)	84	84

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

Mol	Chain	Res	Type
1	A	74	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	74	HIS
1	A	224	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.

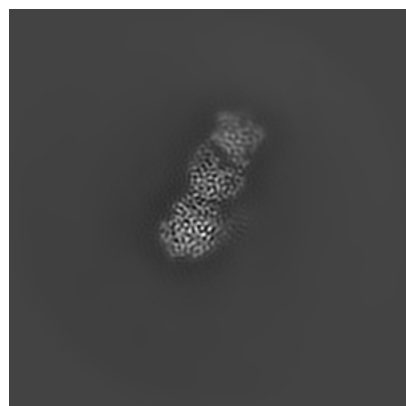
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-28573. These allow visual inspection of the internal detail of the map and identification of artifacts.

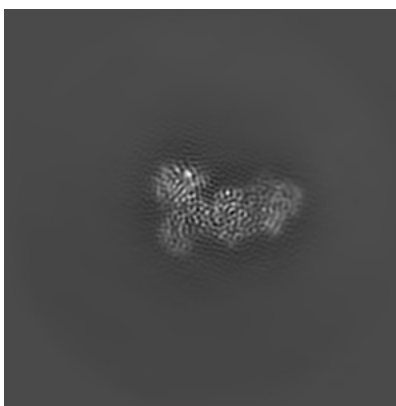
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

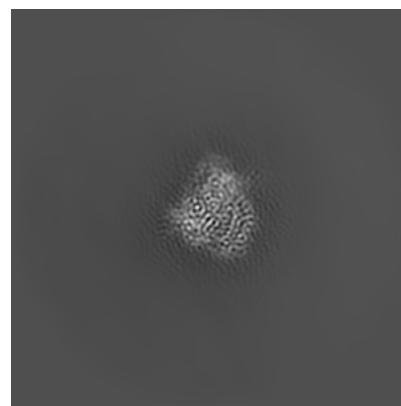
6.1.1 Primary map



X

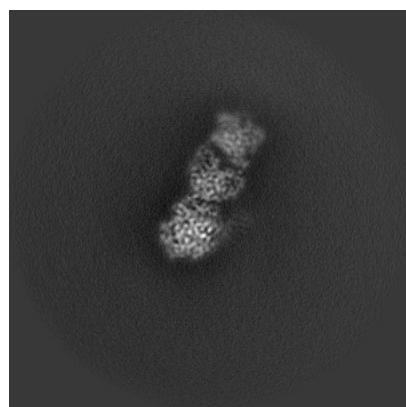


Y

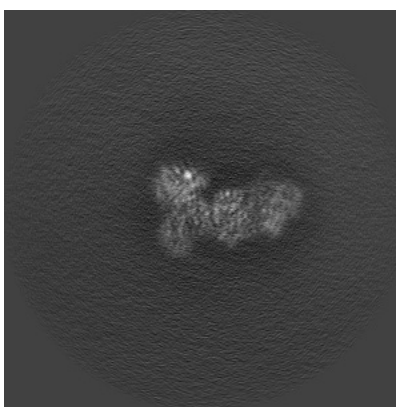


Z

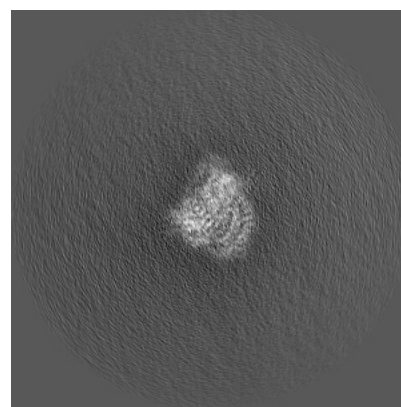
6.1.2 Raw map



X



Y

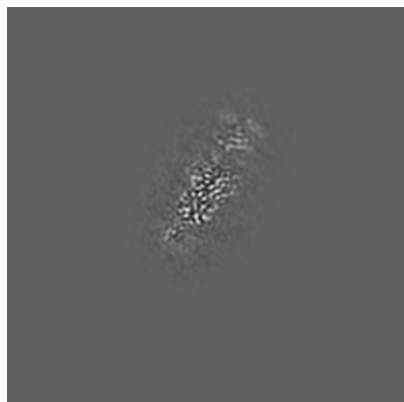


Z

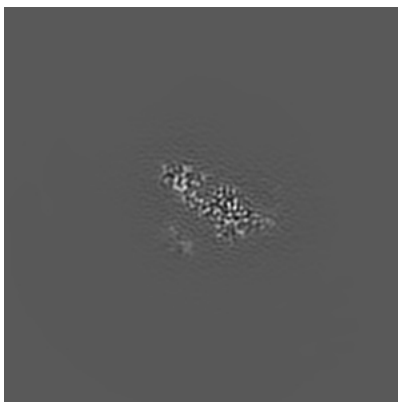
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

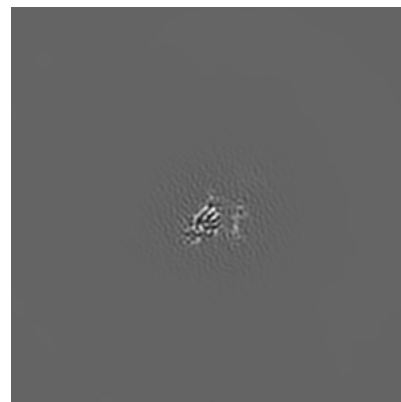
6.2.1 Primary map



X Index: 180

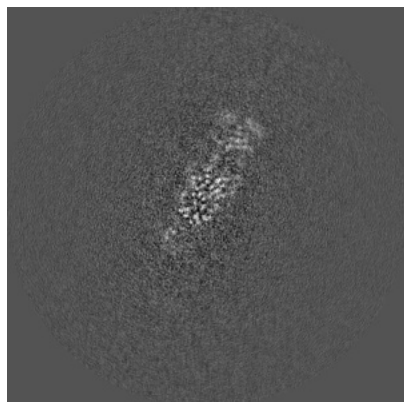


Y Index: 180

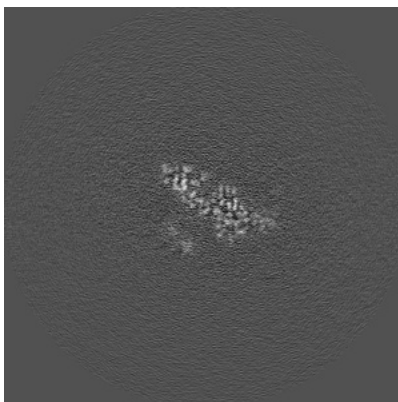


Z Index: 180

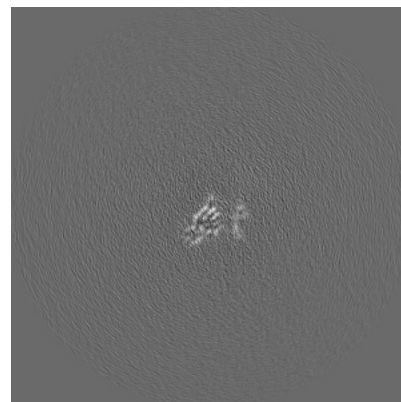
6.2.2 Raw map



X Index: 180



Y Index: 180

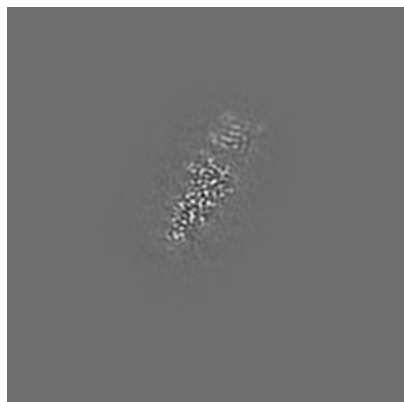


Z Index: 180

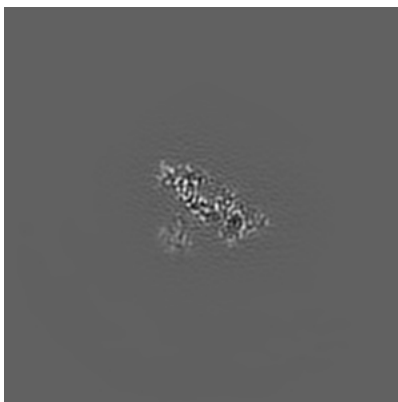
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

6.3.1 Primary map



X Index: 177

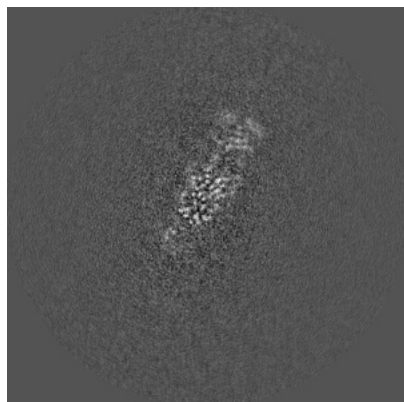


Y Index: 173

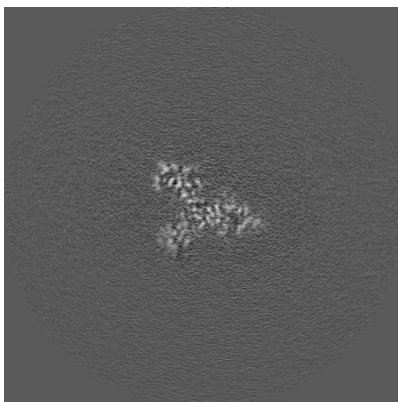


Z Index: 166

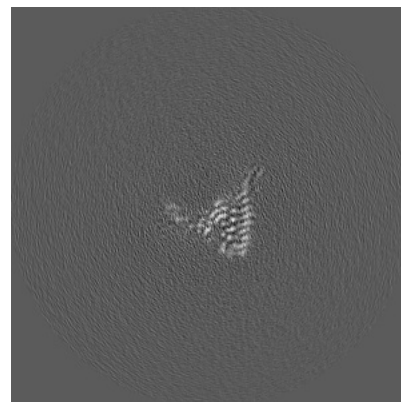
6.3.2 Raw map



X Index: 180



Y Index: 167

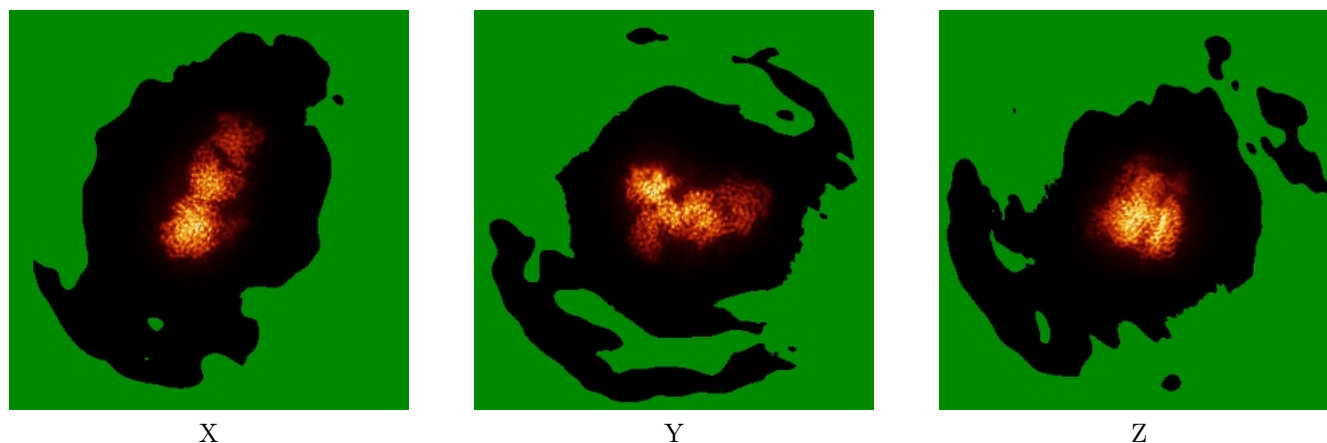


Z Index: 166

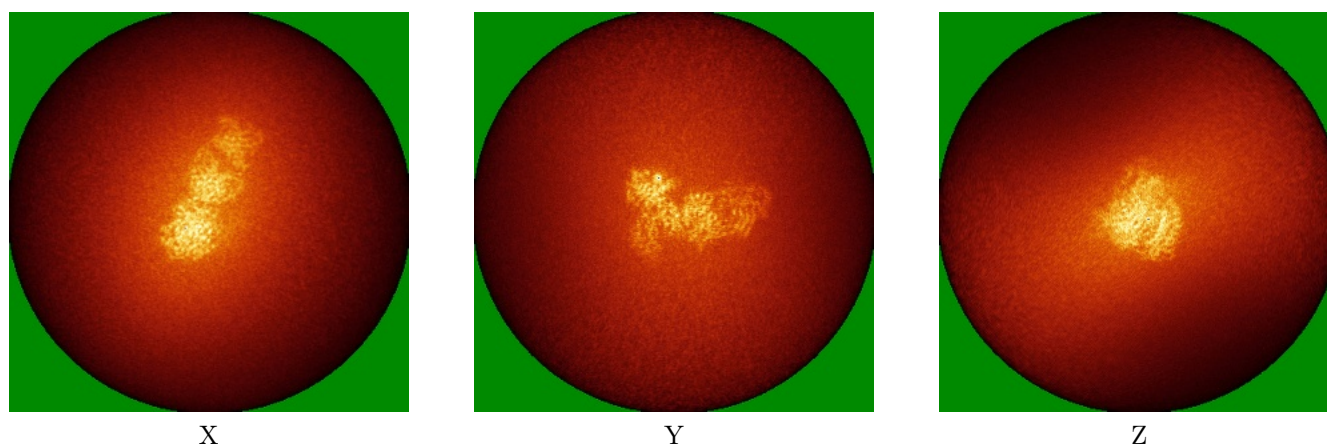
The images above show the largest variance slices of the map in three orthogonal directions.

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

6.4.1 Primary map



6.4.2 Raw map



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](#)

This section was not generated.

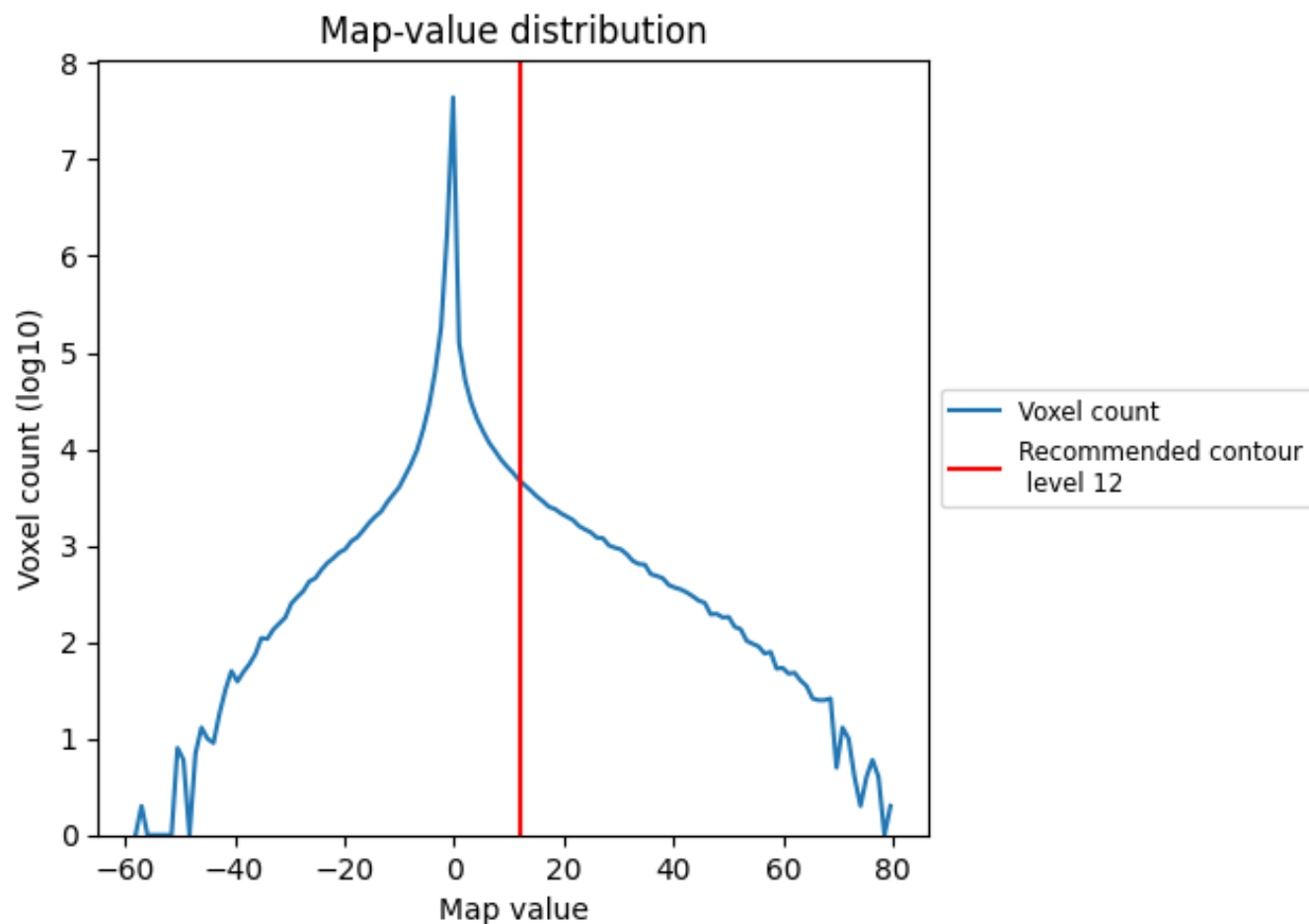
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

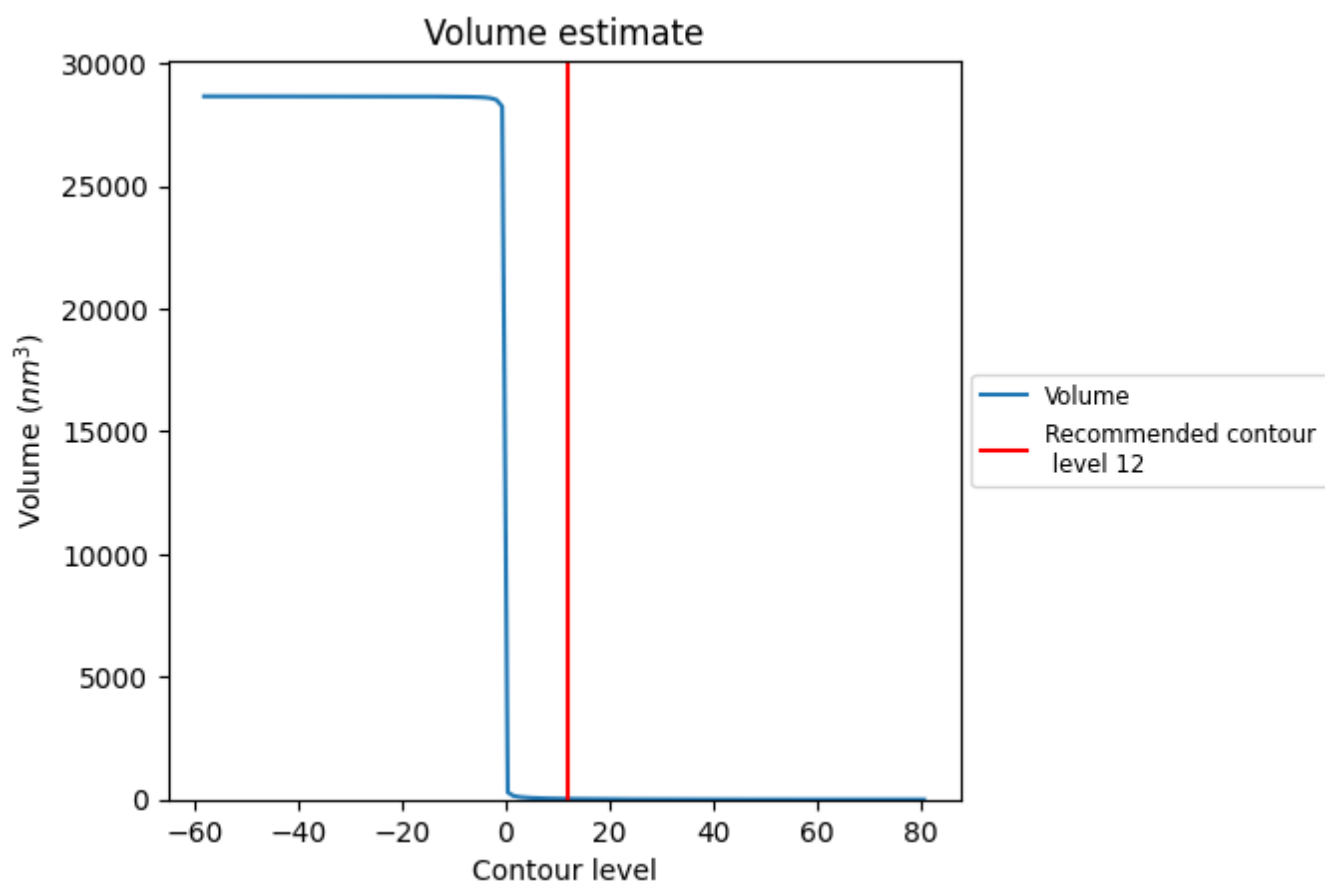
This section contains the results of statistical analysis of the map.

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.

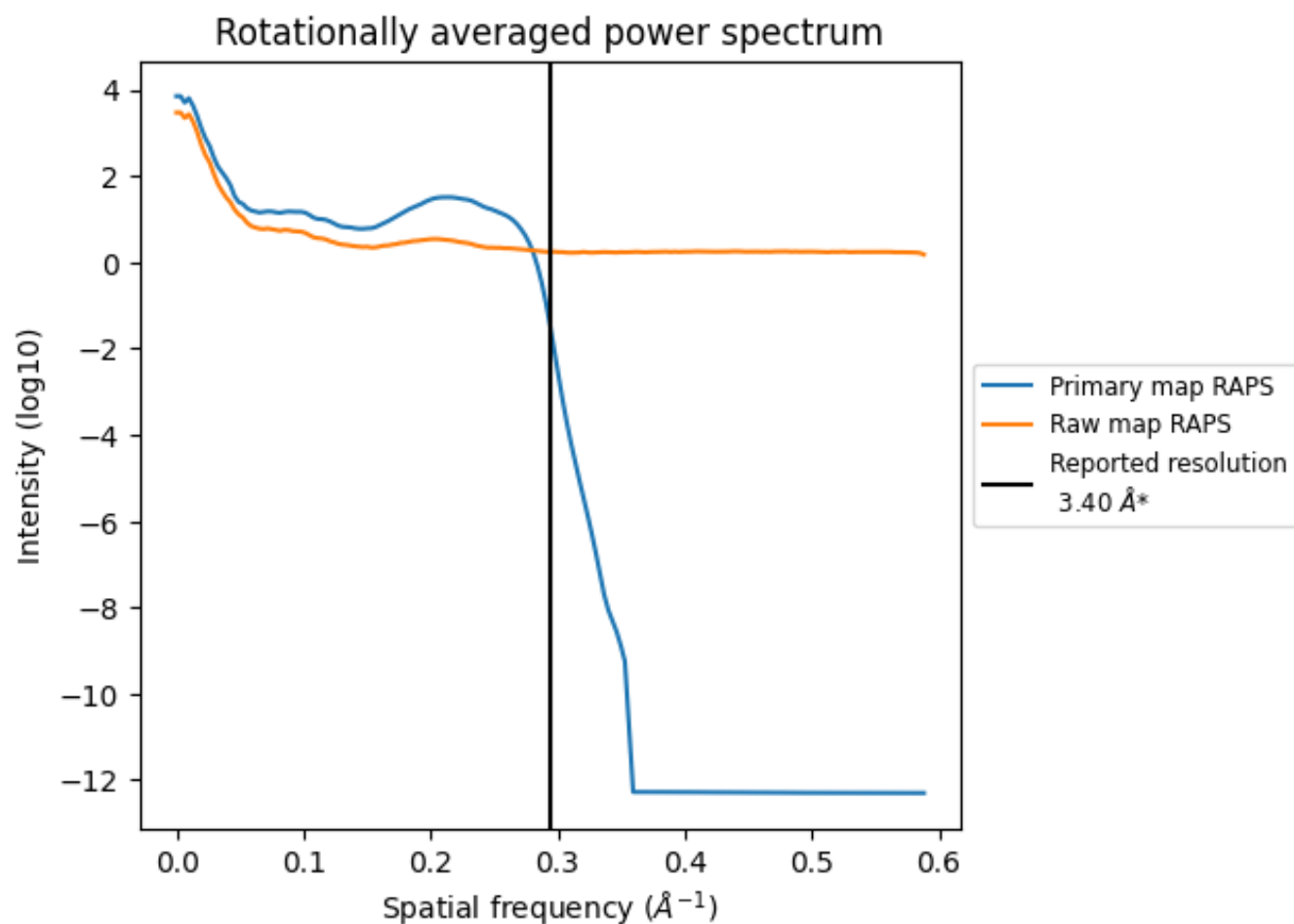
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 29 nm³; this corresponds to an approximate mass of 26 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 ⓘ

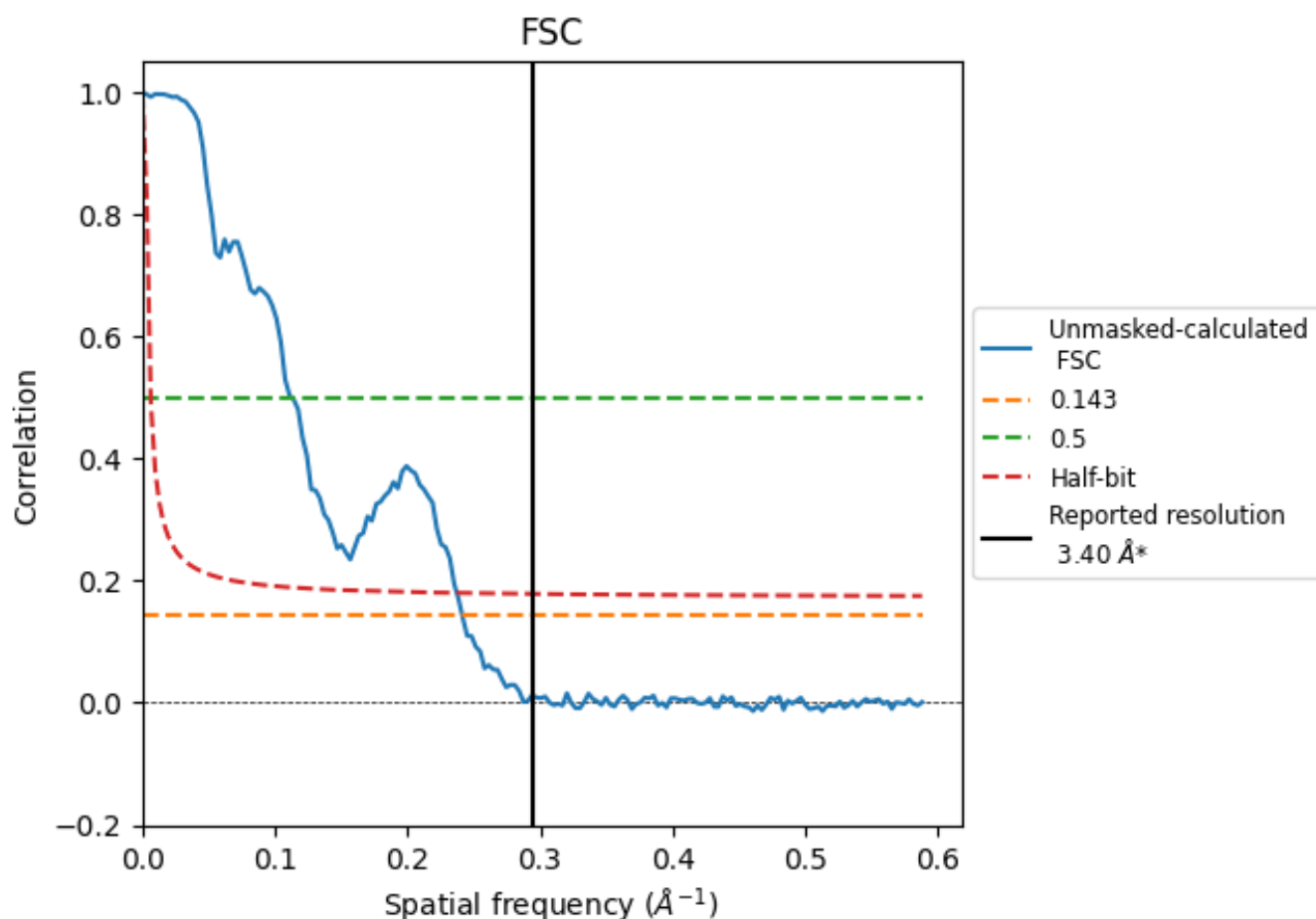


*Reported resolution corresponds to spatial frequency of 0.294 Å⁻¹

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 $0.294 \text{ \AA}^{-1}$

8.2 Resolution estimates [i](#)

Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.40	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	4.14	8.88	4.22

*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 4.14 differs from the reported value 3.4 by more than 10 %

9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-28573 and PDB model 8ESA. Per-residue inclusion information can be found in section 3 on page 5.

9.1 Map-model overlay [i](#)

This section was not generated.

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

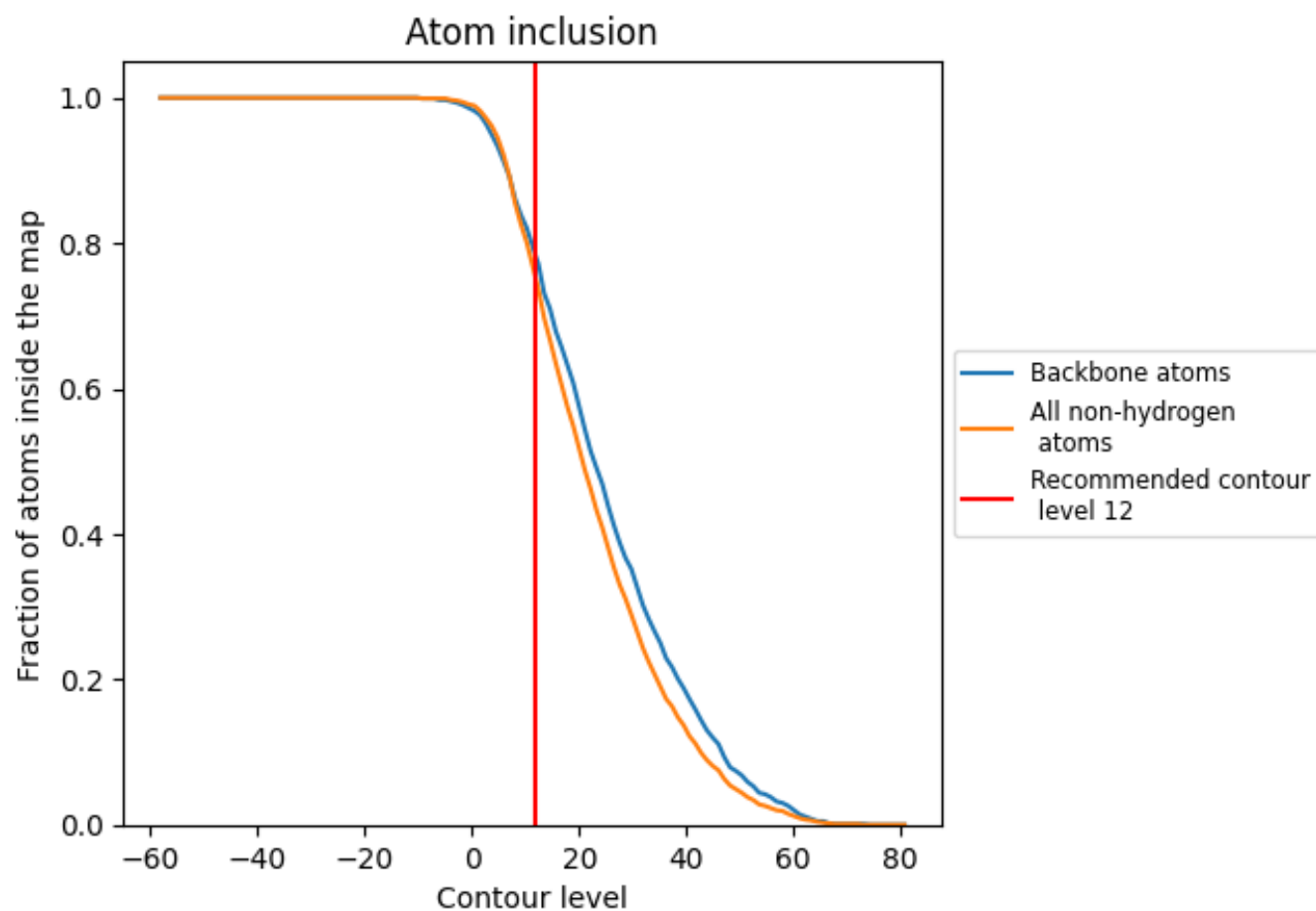


The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions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

This section was not generated.

9.4 Atom inclusion [i](#)



At the recommended contour level, 78% of all backbone atoms, 75% 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 (12) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.7480	0.5270
A	0.7170	0.5160
B	0.8270	0.5590
C	0.7790	0.5130

