



Full wwPDB EM Validation Report ⓘ

Mar 8, 2026 – 07:52 AM UTC

PDB ID : 3A69 / pdb_00003a69
EMDB ID : EMD-1647
Title : Atomic model of the bacterial flagellar hook based on docking an X-ray derived structure and terminal two alpha-helices into an 7.1 angstrom resolution cryoEM map
Authors : Fujii, T.; Kato, T.; Namba, K.
Deposited on : 2009-08-26
Resolution : 7.10 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

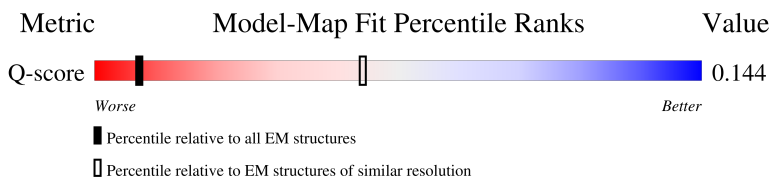
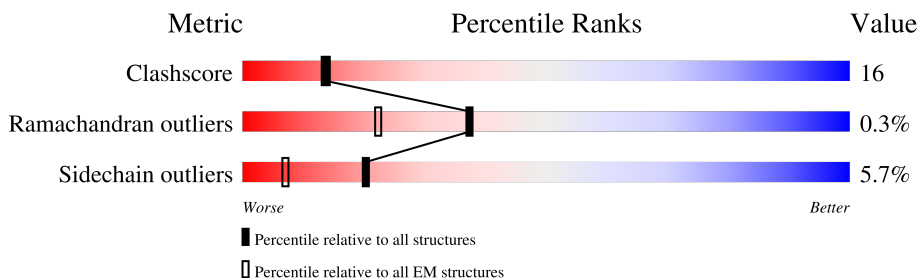
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 7.10 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	464 (6.60 - 7.60)

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	402	

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 2573 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.

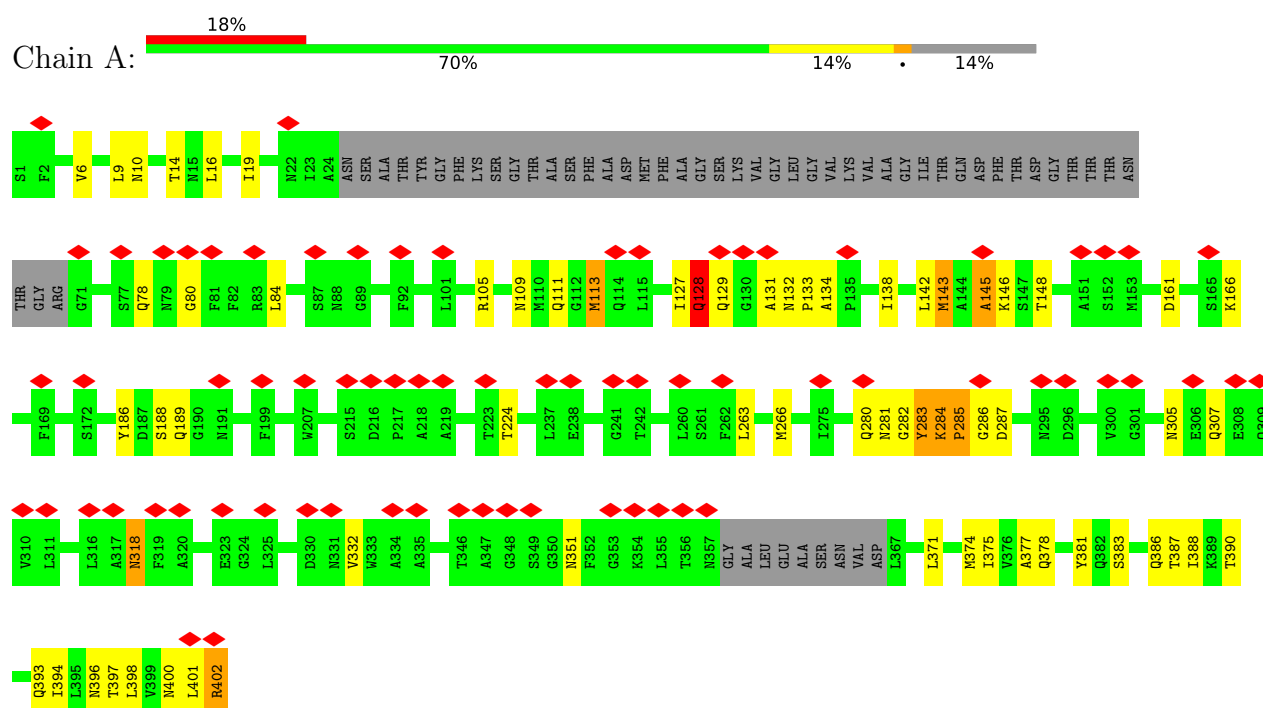
- Molecule 1 is a protein called Flagellar hook protein flgE.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	347	2573	1584	446	536	7	0	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: Flagellar hook protein flgE



4 Experimental information

Property	Value	Source
EM reconstruction method	HELICAL	Depositor
Imposed symmetry	HELICAL, twist=Not provided°, rise=Not provided Å, axial sym=Not provided	Depositor
Number of segments used	Not provided	
Resolution determination method	Not provided	
CTF correction method	each images	Depositor
Microscope	JEOL 3200FSC	Depositor
Voltage (kV)	200	Depositor
Electron dose ($e^-/\text{\AA}^2$)	20	Depositor
Minimum defocus (nm)	500	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	89285	Depositor
Image detector	TVIPS TEMCAM-F415 (4k x 4k)	Depositor
Maximum map value	2.137	Depositor
Minimum map value	-1.557	Depositor
Average map value	0.001	Depositor
Map value standard deviation	0.230	Depositor
Recommended contour level	0.34	Depositor
Map size (Å)	336.0, 336.0, 336.0	wwPDB
Map dimensions	200, 200, 200	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.68, 1.68, 1.68	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	0.78	2/2610 (0.1%)	0.89	7/3557 (0.2%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	113	MET	SD-CE	-7.96	1.59	1.79
1	A	134	ALA	CA-CB	-5.56	1.46	1.53

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	145	ALA	CA-C-N	-7.77	112.03	122.99
1	A	145	ALA	C-N-CA	-7.77	112.03	122.99
1	A	80	GLY	N-CA-C	-5.85	104.05	111.72
1	A	127	ILE	CB-CA-C	-5.64	103.26	110.98
1	A	143	MET	CA-C-N	-5.37	111.28	122.07
1	A	143	MET	C-N-CA	-5.37	111.28	122.07
1	A	128	GLN	N-CA-C	5.05	117.95	110.48

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	2573	0	2487	80	0
All	All	2573	0	2487	80	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 16.

All (80) 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:19:ILE:HG21	1:A:374:MET:SD	1.66	1.34
1:A:19:ILE:CG2	1:A:374:MET:SD	2.21	1.29
1:A:19:ILE:CB	1:A:374:MET:SD	2.34	1.15
1:A:398:LEU:HA	1:A:401:LEU:HD12	1.24	1.13
1:A:6:VAL:O	1:A:9:LEU:HG	1.48	1.11
1:A:16:LEU:HD21	1:A:377:ALA:HB3	1.28	1.08
1:A:19:ILE:HB	1:A:374:MET:SD	1.94	1.05
1:A:401:LEU:O	1:A:402:ARG:HD2	1.61	0.98
1:A:19:ILE:CD1	1:A:374:MET:SD	2.53	0.97
1:A:16:LEU:HD21	1:A:377:ALA:CB	1.98	0.93
1:A:283:TYR:CE2	1:A:307:GLN:HG3	2.10	0.86
1:A:109:ASN:HD21	1:A:113:MET:HE3	1.40	0.85
1:A:142:LEU:HG	1:A:143:MET:H	1.41	0.84
1:A:143:MET:HB2	1:A:285:PRO:HB3	1.62	0.81
1:A:6:VAL:HA	1:A:9:LEU:CD2	2.11	0.80
1:A:16:LEU:CD2	1:A:377:ALA:HB3	2.10	0.80
1:A:397:THR:O	1:A:401:LEU:HG	1.82	0.78
1:A:19:ILE:HD13	1:A:374:MET:SD	2.22	0.78
1:A:283:TYR:CD2	1:A:307:GLN:HG3	2.19	0.78
1:A:9:LEU:HD12	1:A:10:ASN:N	1.99	0.77
1:A:19:ILE:HG21	1:A:374:MET:CG	2.16	0.76
1:A:401:LEU:O	1:A:402:ARG:CD	2.33	0.75
1:A:128:GLN:HE21	1:A:128:GLN:H	1.35	0.75
1:A:16:LEU:O	1:A:374:MET:HE1	1.88	0.74
1:A:283:TYR:HD1	1:A:283:TYR:O	1.68	0.74
1:A:19:ILE:HD12	1:A:374:MET:SD	2.29	0.72
1:A:105:ARG:HD3	1:A:138:ILE:O	1.91	0.70
1:A:401:LEU:O	1:A:402:ARG:CB	2.41	0.69
1:A:9:LEU:CD1	1:A:10:ASN:OD1	2.40	0.69
1:A:386:GLN:O	1:A:390:THR:HG23	1.92	0.69
1:A:401:LEU:O	1:A:402:ARG:HB2	1.95	0.66
1:A:6:VAL:O	1:A:9:LEU:CG	2.37	0.65
1:A:398:LEU:HA	1:A:401:LEU:CD1	2.15	0.65
1:A:318:ASN:OD1	1:A:351:ASN:ND2	2.30	0.64
1:A:143:MET:CE	1:A:305:ASN:HD21	2.11	0.63
1:A:145:ALA:HA	1:A:285:PRO:CD	2.28	0.63
1:A:9:LEU:HD11	1:A:10:ASN:OD1	1.98	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:143:MET:HE1	1:A:305:ASN:HD21	1.65	0.62
1:A:9:LEU:HD23	1:A:388:ILE:HD11	1.82	0.61
1:A:19:ILE:HB	1:A:374:MET:CE	2.31	0.61
1:A:6:VAL:HA	1:A:9:LEU:HD21	1.84	0.59
1:A:19:ILE:CG1	1:A:374:MET:SD	2.90	0.59
1:A:9:LEU:HB2	1:A:381:TYR:CE1	2.39	0.58
1:A:283:TYR:HE2	1:A:307:GLN:HG3	1.65	0.58
1:A:6:VAL:C	1:A:9:LEU:HG	2.26	0.57
1:A:9:LEU:HD23	1:A:388:ILE:CD1	2.34	0.57
1:A:393:GLN:O	1:A:397:THR:HG23	2.04	0.56
1:A:283:TYR:HD1	1:A:283:TYR:C	2.12	0.56
1:A:283:TYR:C	1:A:283:TYR:CD1	2.81	0.56
1:A:9:LEU:HD12	1:A:10:ASN:OD1	2.05	0.55
1:A:6:VAL:HA	1:A:9:LEU:HD23	1.90	0.54
1:A:186:TYR:CE2	1:A:284:LYS:HE3	2.44	0.53
1:A:401:LEU:O	1:A:402:ARG:CG	2.56	0.53
1:A:9:LEU:HD12	1:A:9:LEU:C	2.35	0.51
1:A:132:ASN:HD22	1:A:133:PRO:HD2	1.75	0.51
1:A:128:GLN:CG	1:A:131:ALA:HB2	2.40	0.51
1:A:145:ALA:HA	1:A:285:PRO:HD3	1.92	0.50
1:A:10:ASN:O	1:A:14:THR:HG23	2.12	0.50
1:A:128:GLN:O	1:A:128:GLN:HG2	2.12	0.50
1:A:145:ALA:HA	1:A:285:PRO:HD2	1.94	0.49
1:A:113:MET:HE1	1:A:332:VAL:HG21	1.96	0.48
1:A:383:SER:O	1:A:387:THR:HG23	2.12	0.48
1:A:186:TYR:HE2	1:A:284:LYS:HE3	1.78	0.48
1:A:132:ASN:HD22	1:A:133:PRO:CD	2.26	0.47
1:A:286:GLY:O	1:A:287:ASP:OD2	2.33	0.46
1:A:148:THR:OG1	1:A:282:GLY:HA3	2.16	0.45
1:A:16:LEU:CD2	1:A:377:ALA:CB	2.81	0.45
1:A:396:ASN:O	1:A:400:ASN:ND2	2.49	0.45
1:A:280:GLN:N	1:A:280:GLN:OE1	2.50	0.45
1:A:142:LEU:HG	1:A:143:MET:N	2.17	0.44
1:A:128:GLN:H	1:A:128:GLN:NE2	2.11	0.44
1:A:284:LYS:O	1:A:284:LYS:HG3	2.18	0.44
1:A:283:TYR:O	1:A:283:TYR:CD1	2.58	0.44
1:A:374:MET:O	1:A:378:GLN:HG3	2.18	0.44
1:A:394:ILE:O	1:A:398:LEU:HG	2.18	0.44
1:A:143:MET:O	1:A:285:PRO:HG2	2.20	0.42
1:A:371:LEU:O	1:A:375:ILE:HG13	2.20	0.41
1:A:146:LYS:NZ	1:A:281:ASN:CG	2.79	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:283:TYR:HD2	1:A:307:GLN:HG3	1.82	0.41
1:A:146:LYS:HD3	1:A:281:ASN:O	2.21	0.40

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	341/402 (85%)	336 (98%)	4 (1%)	1 (0%)	36 72

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	285	PRO

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	283/322 (88%)	267 (94%)	16 (6%)	18 40

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	78	GLN

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Mol	Chain	Res	Type
1	A	84	LEU
1	A	111	GLN
1	A	128	GLN
1	A	129	GLN
1	A	161	ASP
1	A	166	LYS
1	A	188	SER
1	A	189	GLN
1	A	224	THR
1	A	263	LEU
1	A	266	MET
1	A	283	TYR
1	A	284	LYS
1	A	318	ASN
1	A	402	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	78	GLN
1	A	88	ASN
1	A	98	GLN
1	A	109	ASN
1	A	111	GLN
1	A	128	GLN
1	A	132	ASN
1	A	196	ASN
1	A	292	GLN
1	A	302	ASN
1	A	305	ASN
1	A	309	GLN
1	A	322	ASN
1	A	351	ASN
1	A	400	ASN

5.3.3 RNA ⓘ

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.

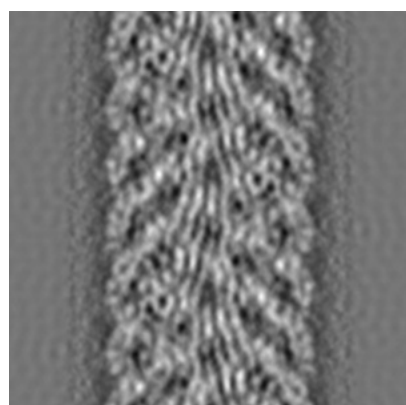
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-1647. These allow visual inspection of the internal detail of the map and identification of artifacts.

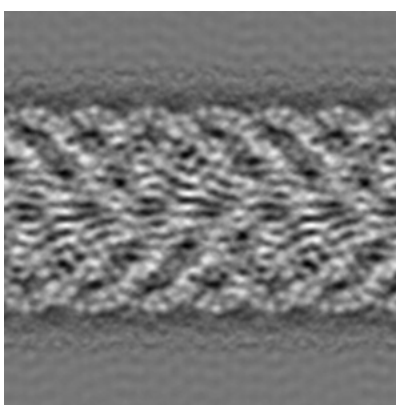
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

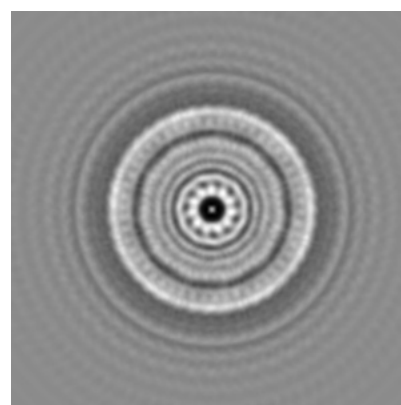
6.1.1 Primary map



X



Y

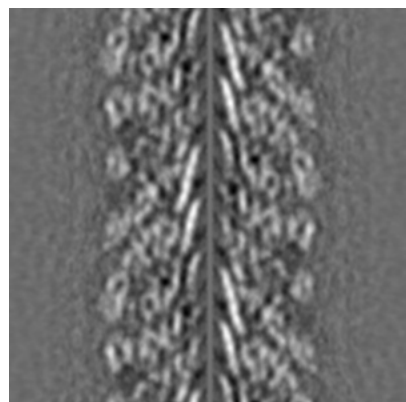


Z

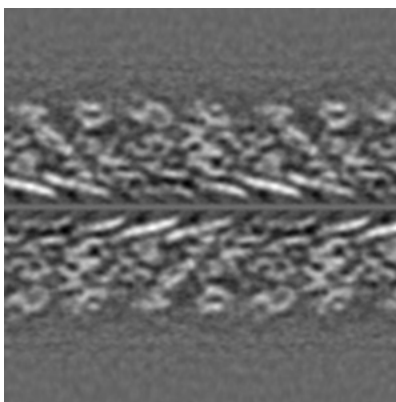
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

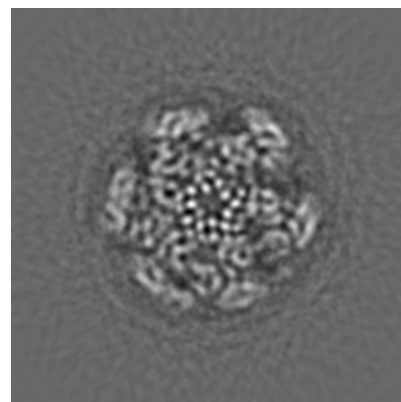
6.2.1 Primary map



X Index: 100



Y Index: 100

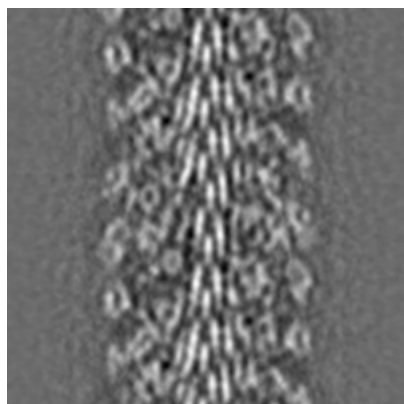


Z Index: 100

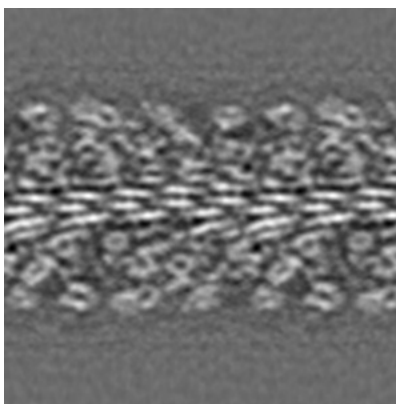
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

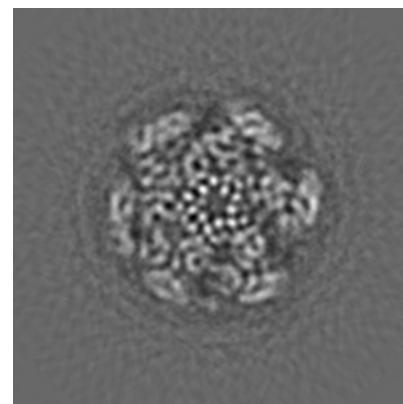
6.3.1 Primary map



X Index: 92



Y Index: 109

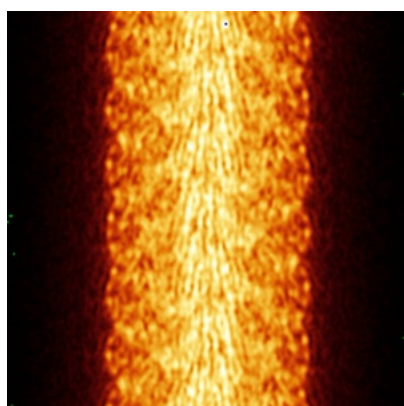


Z Index: 44

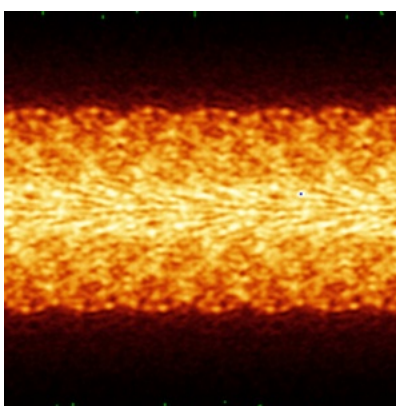
The images above show the largest variance slices of the map in three orthogonal directions.

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

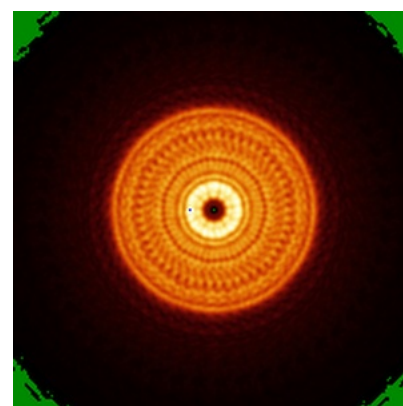
6.4.1 Primary map



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

This section was not generated.

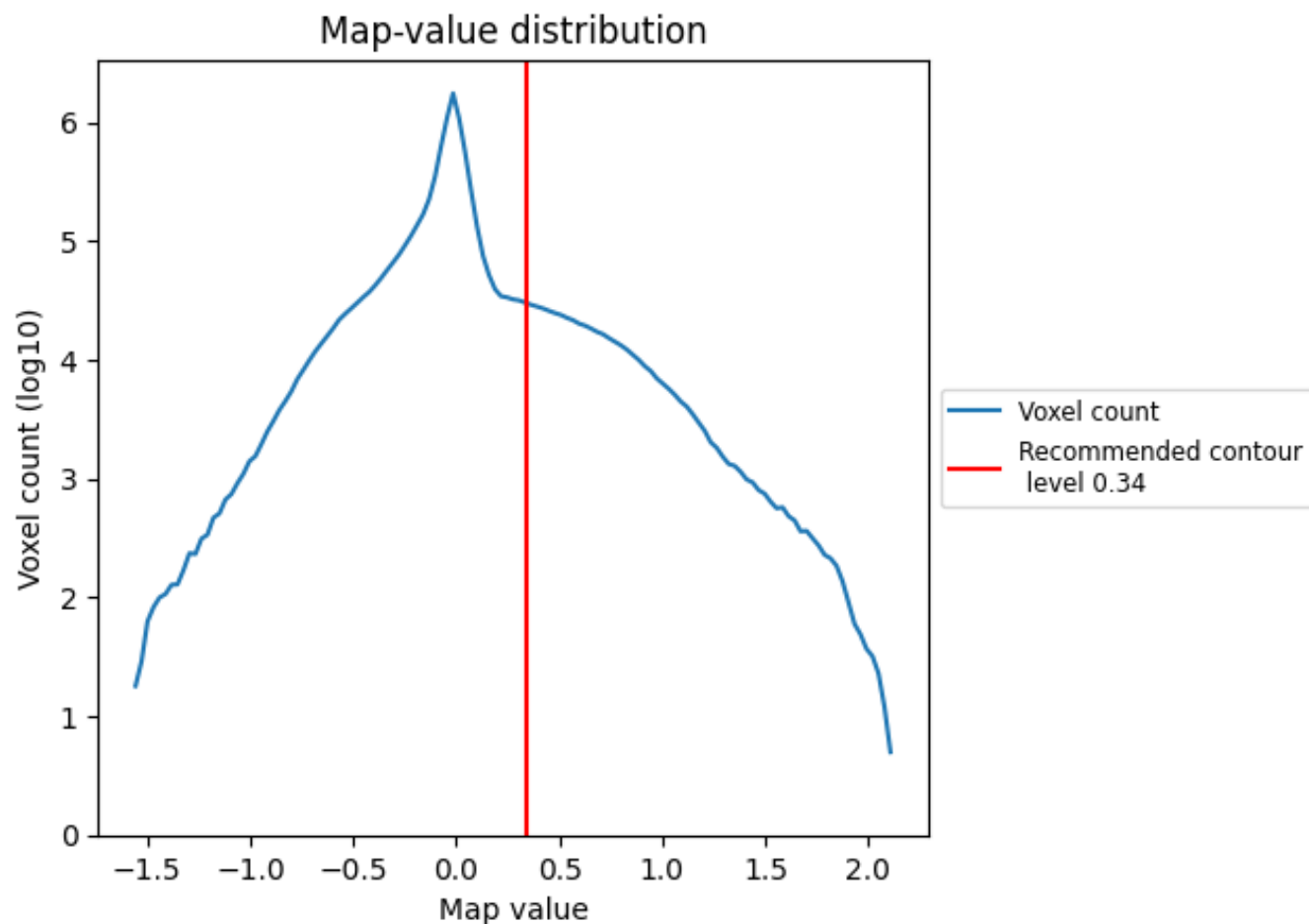
6.6 Mask visualisation

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

7 Map analysis [i](#)

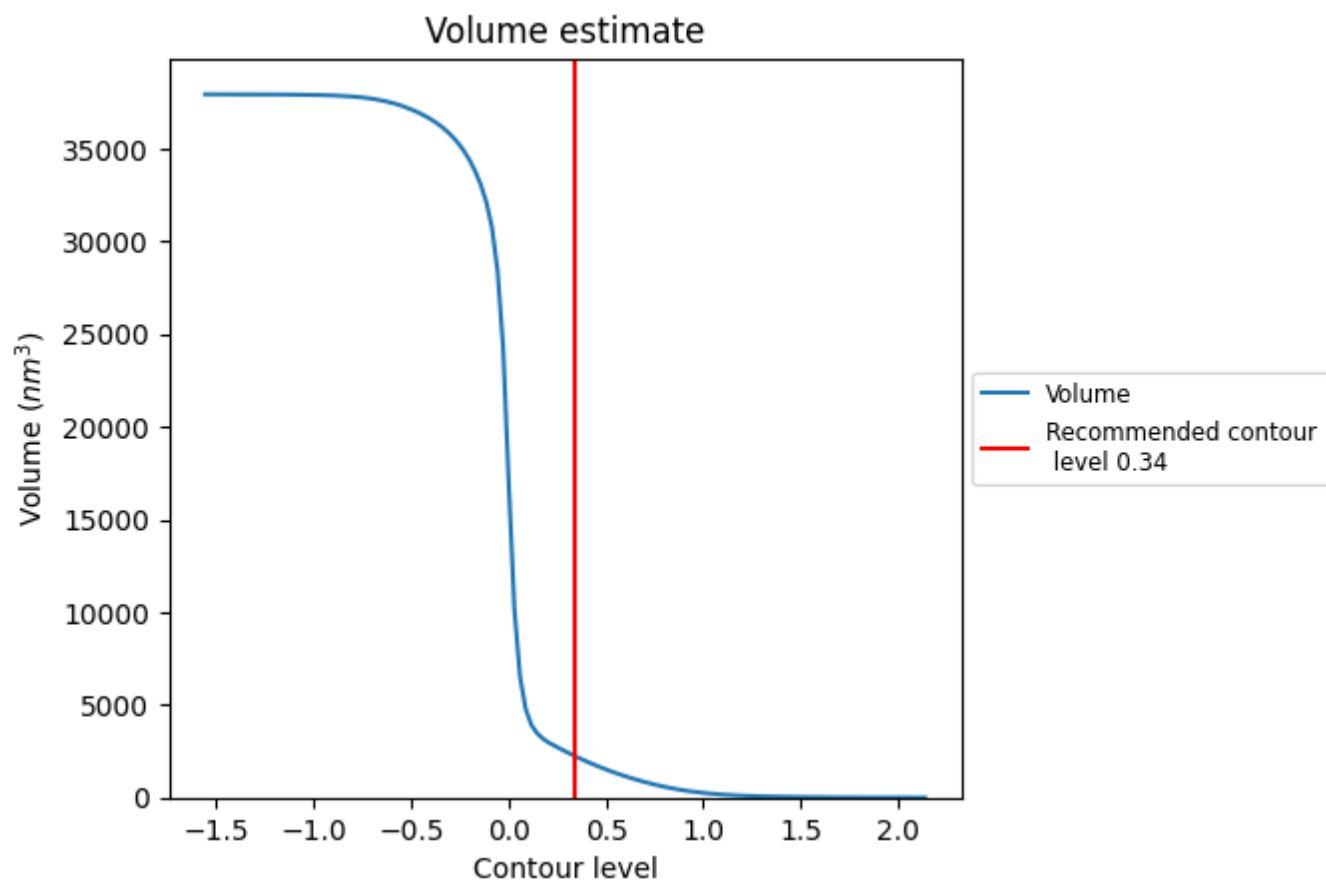
This section contains the results of statistical analysis of the map.

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.

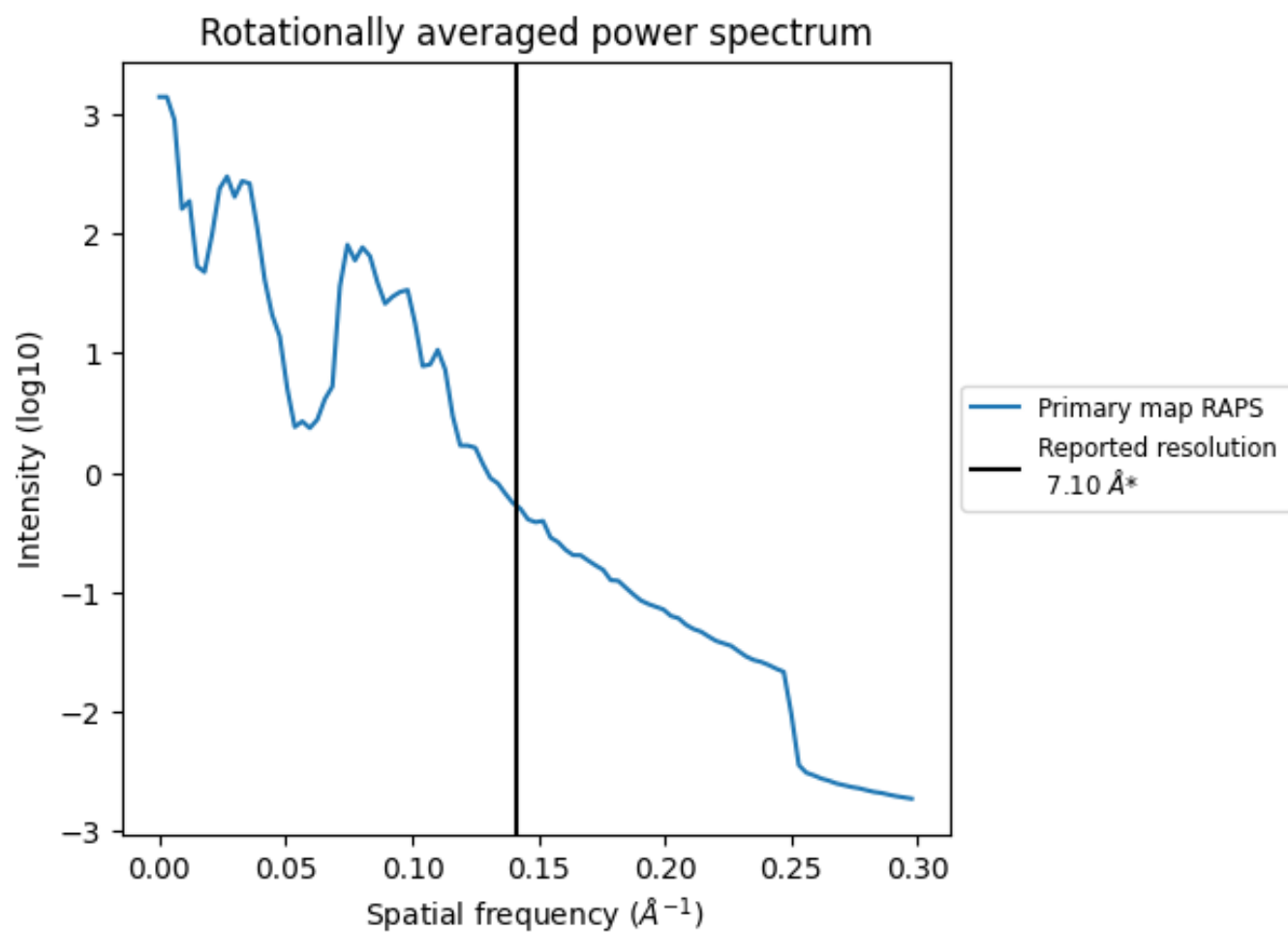
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 2241 nm³; this corresponds to an approximate mass of 2024 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 0.141 Å⁻¹

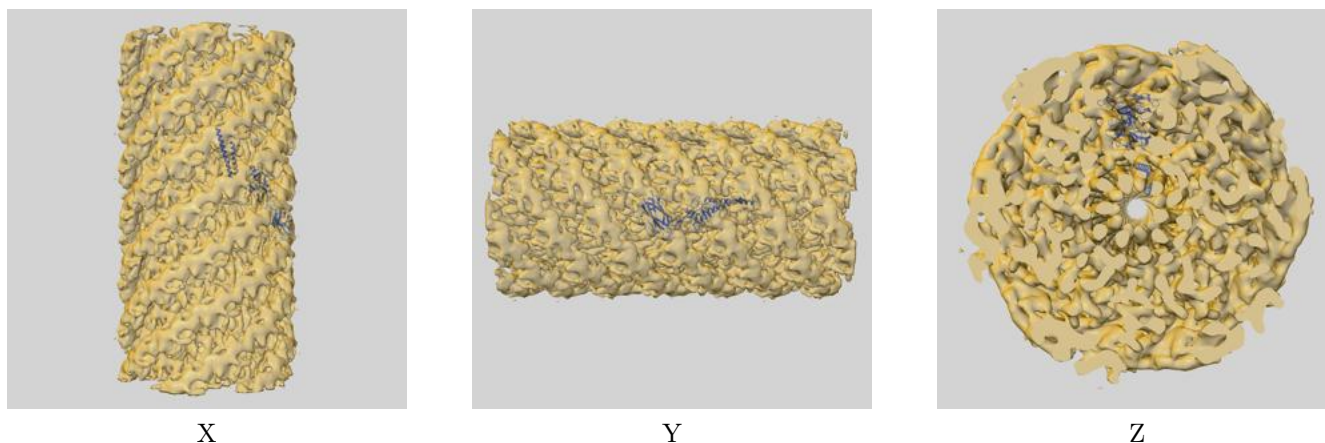
8 Fourier-Shell correlation ⓘ

This section was not generated. No FSC curve or half-maps provided.

9 Map-model fit [i](#)

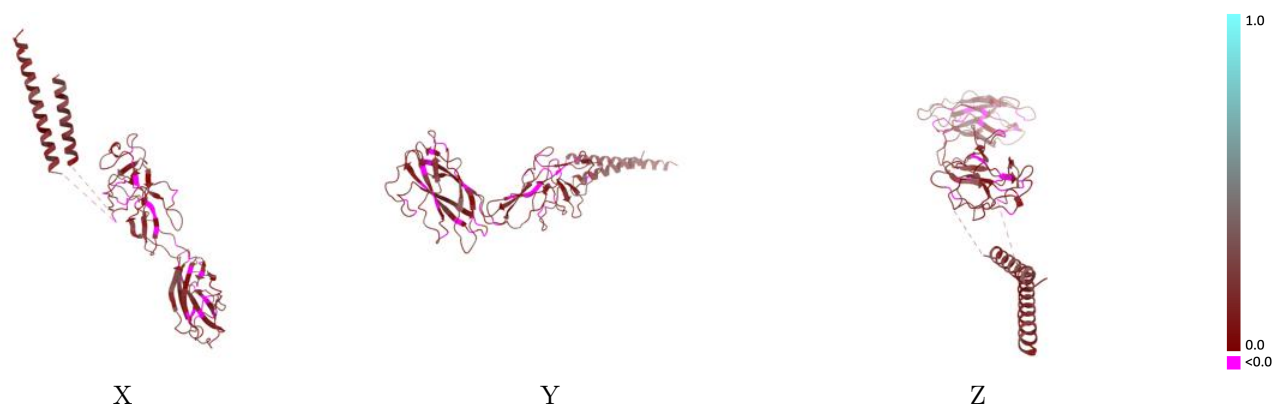
This section contains information regarding the fit between EMDB map EMD-1647 and PDB model 3A69. Per-residue inclusion information can be found in section [3](#) on page [4](#).

9.1 Map-model overlay [i](#)



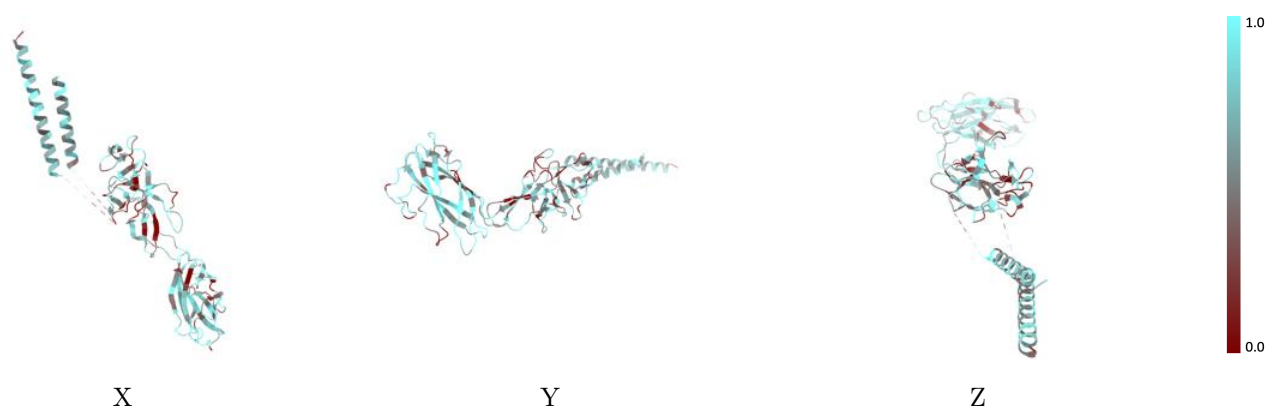
The images above show the 3D surface view of the map at the recommended contour level 0.34 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



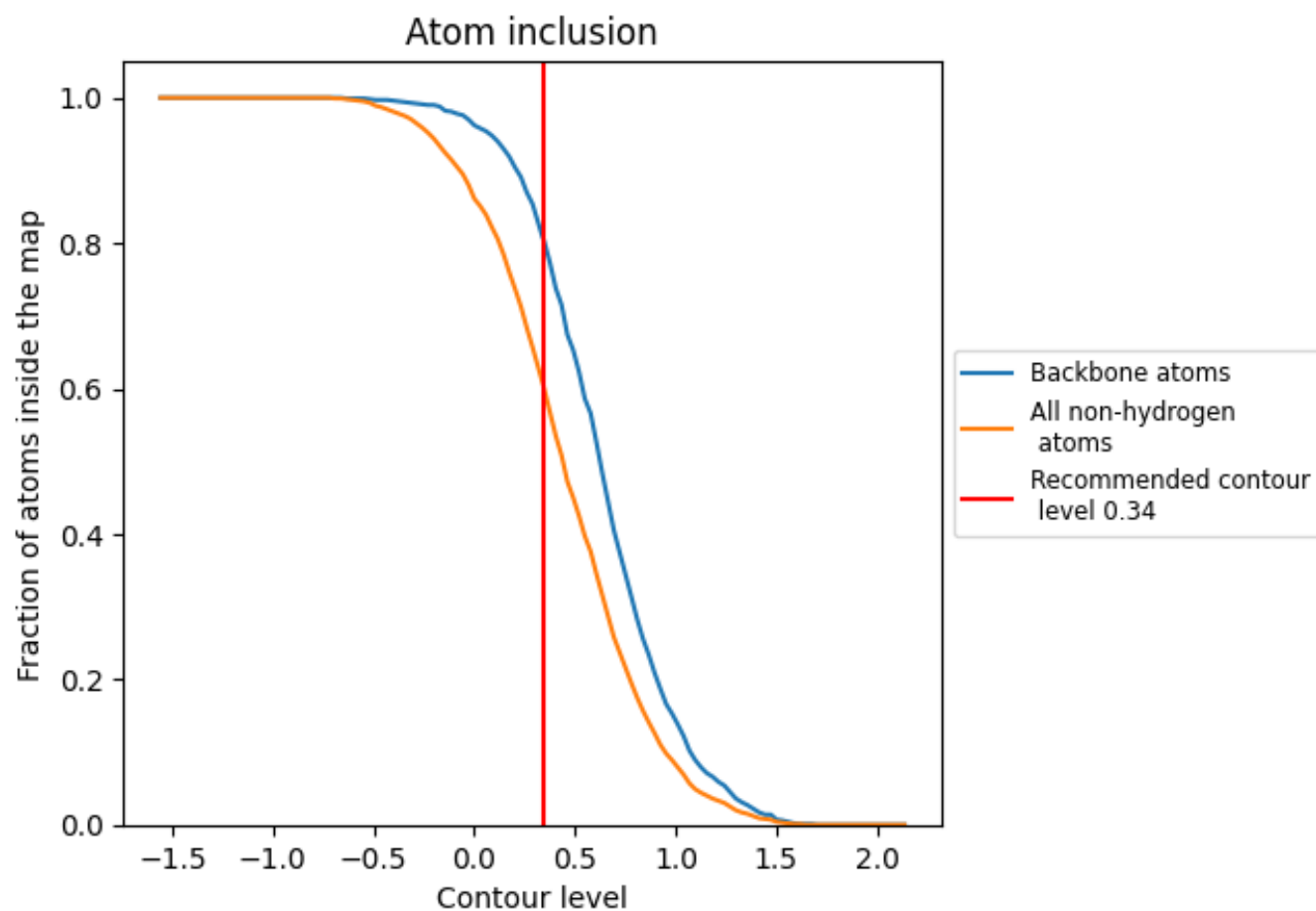
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.34).

9.4 Atom inclusion [i](#)



At the recommended contour level, 81% of all backbone atoms, 61% 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 (0.34) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.6070	0.1440
A	0.6070	0.1440

