wwPDB EM Validation Summary Report

Jul 16, 2025 – 04:16 PM EDT

PDB ID	:	9NAB / pdb_00009nab
EMDB ID	:	EMD-49184
Title	:	Cryo-EM structure of the alpha5beta1 integrin headpiece with OS2966 Fab
Authors	:	Wang, L.; Zhang, C.
Deposited on	:	2025-02-11
Resolution	:	2.54 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:

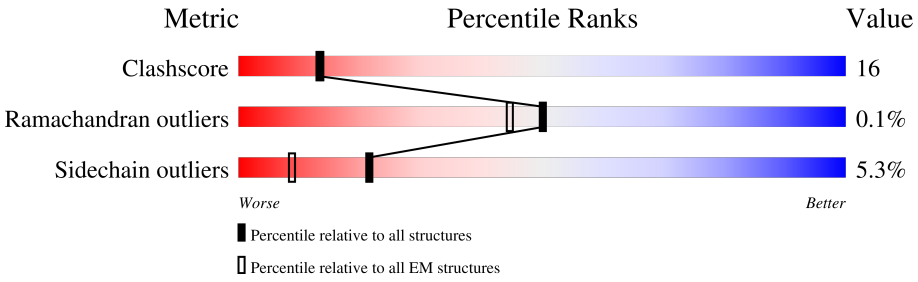
EMDB validation analysis	:	0.0.1.dev118
MolProbity	:	4-5-2 with Phenix2.0rc1
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ	:	1.9.13
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.44

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 2.54 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	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 <=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	498	6% 42% 26% • 28%
2	B	694	10% 40% 20% • 39%
3	D	230	32% 54% 23% • 21%
4	C	214	29% 53% 14% • 33%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 8498 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 Integrin beta-1.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	357	2793	1761	467	551	14	0	0

There are 53 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	466	GLY	-	expression tag	UNP P05556
A	467	GLY	-	expression tag	UNP P05556
A	468	LEU	-	expression tag	UNP P05556
A	469	GLU	-	expression tag	UNP P05556
A	470	ASN	-	expression tag	UNP P05556
A	471	LEU	-	expression tag	UNP P05556
A	472	TYR	-	expression tag	UNP P05556
A	473	PHE	-	expression tag	UNP P05556
A	474	GLN	-	expression tag	UNP P05556
A	475	GLY	-	expression tag	UNP P05556
A	476	GLY	-	expression tag	UNP P05556
A	477	LYS	-	expression tag	UNP P05556
A	478	ASN	-	expression tag	UNP P05556
A	479	ALA	-	expression tag	UNP P05556
A	480	GLN	-	expression tag	UNP P05556
A	481	CYS	-	expression tag	UNP P05556
A	482	LYS	-	expression tag	UNP P05556
A	483	LYS	-	expression tag	UNP P05556
A	484	LYS	-	expression tag	UNP P05556
A	485	LEU	-	expression tag	UNP P05556
A	486	GLN	-	expression tag	UNP P05556
A	487	ALA	-	expression tag	UNP P05556
A	488	LEU	-	expression tag	UNP P05556
A	489	LYS	-	expression tag	UNP P05556
A	490	LYS	-	expression tag	UNP P05556
A	491	LYS	-	expression tag	UNP P05556
A	492	ASN	-	expression tag	UNP P05556
A	493	ALA	-	expression tag	UNP P05556

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Chain	Residue	Modelled	Actual	Comment	Reference
A	494	GLN	-	expression tag	UNP P05556
A	495	LEU	-	expression tag	UNP P05556
A	496	LYS	-	expression tag	UNP P05556
A	497	TRP	-	expression tag	UNP P05556
A	498	LYS	-	expression tag	UNP P05556
A	499	LEU	-	expression tag	UNP P05556
A	500	GLN	-	expression tag	UNP P05556
A	501	ALA	-	expression tag	UNP P05556
A	502	LEU	-	expression tag	UNP P05556
A	503	LYS	-	expression tag	UNP P05556
A	504	LYS	-	expression tag	UNP P05556
A	505	LYS	-	expression tag	UNP P05556
A	506	LEU	-	expression tag	UNP P05556
A	507	ALA	-	expression tag	UNP P05556
A	508	GLN	-	expression tag	UNP P05556
A	509	GLY	-	expression tag	UNP P05556
A	510	GLY	-	expression tag	UNP P05556
A	511	HIS	-	expression tag	UNP P05556
A	512	HIS	-	expression tag	UNP P05556
A	513	HIS	-	expression tag	UNP P05556
A	514	HIS	-	expression tag	UNP P05556
A	515	HIS	-	expression tag	UNP P05556
A	516	HIS	-	expression tag	UNP P05556
A	517	HIS	-	expression tag	UNP P05556
A	518	HIS	-	expression tag	UNP P05556

- Molecule 2 is a protein called Human Integrin alpha 5.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	423	Total	C	N	O	S	0	0
			3196	2037	523	628	8		

- Molecule 3 is a protein called IgG heavy chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	D	182	Total	C	N	O	S	0	0
			1418	911	228	275	4		

- Molecule 4 is a protein called IgG light chain.

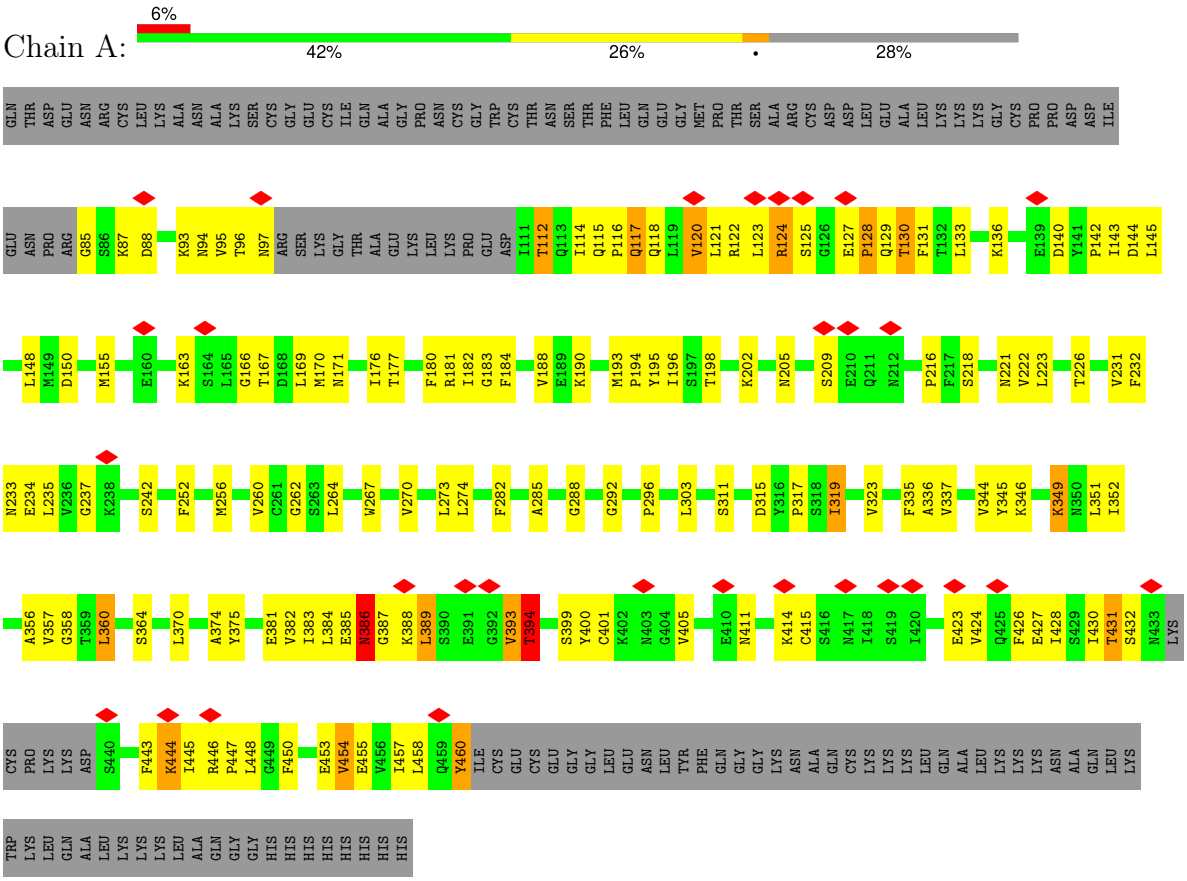
Mol	Chain	Residues	Atoms					AltConf	Trace
4	C	144	Total	C	N	O	S	0	0
			1091	680	183	223	5		

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.

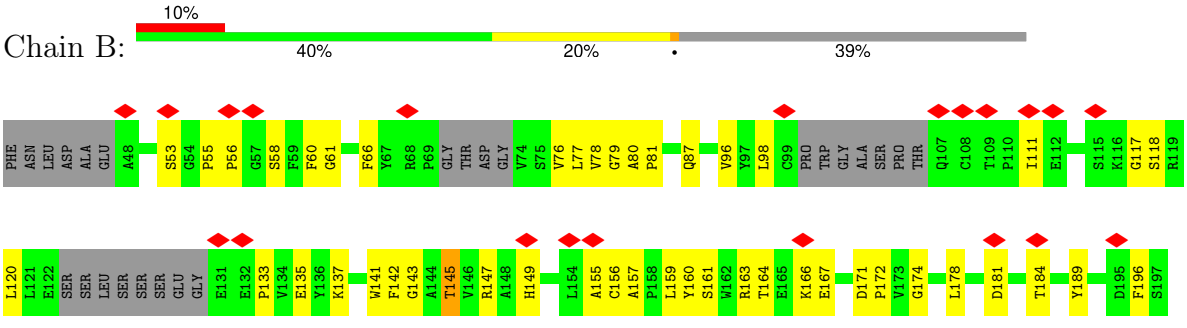
• Molecule 1: Integrin beta-1

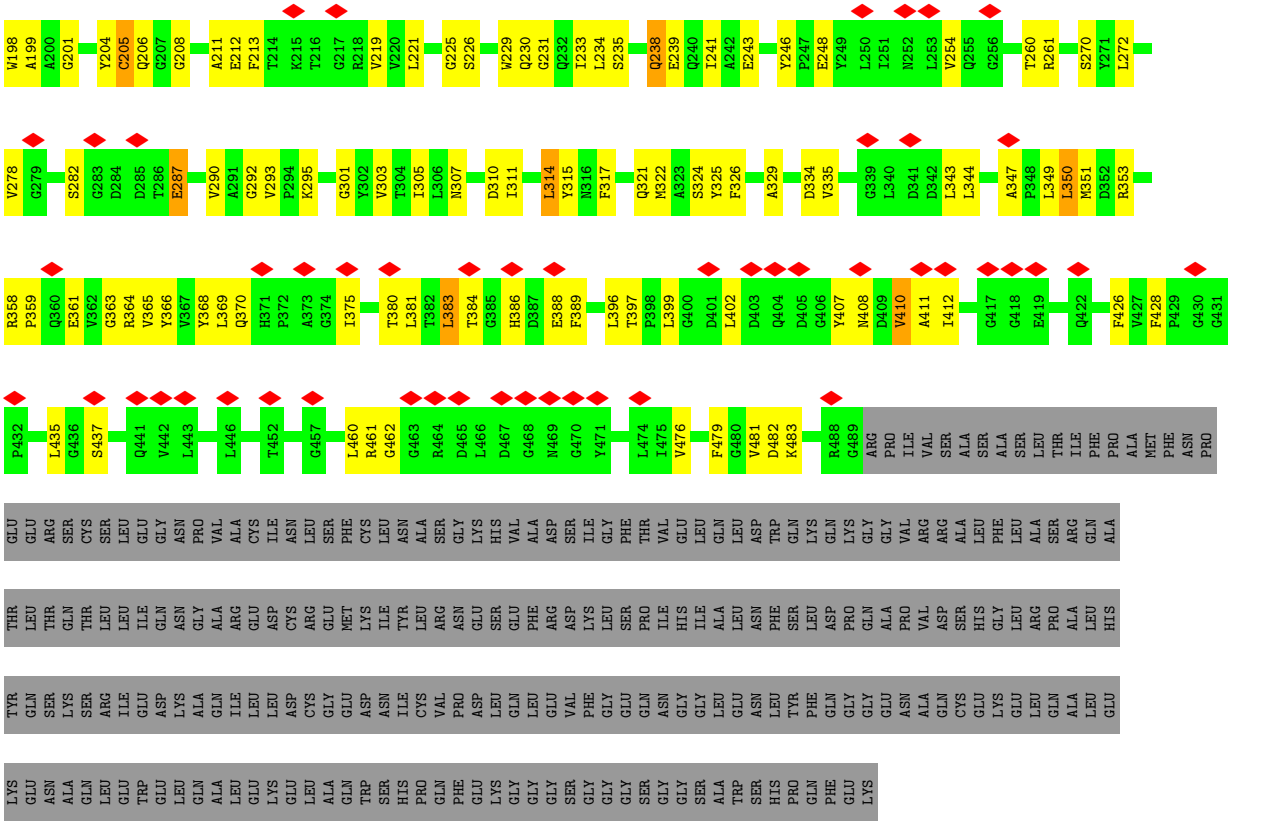
Chain A:



• Molecule 2: Human Integrin alpha 5

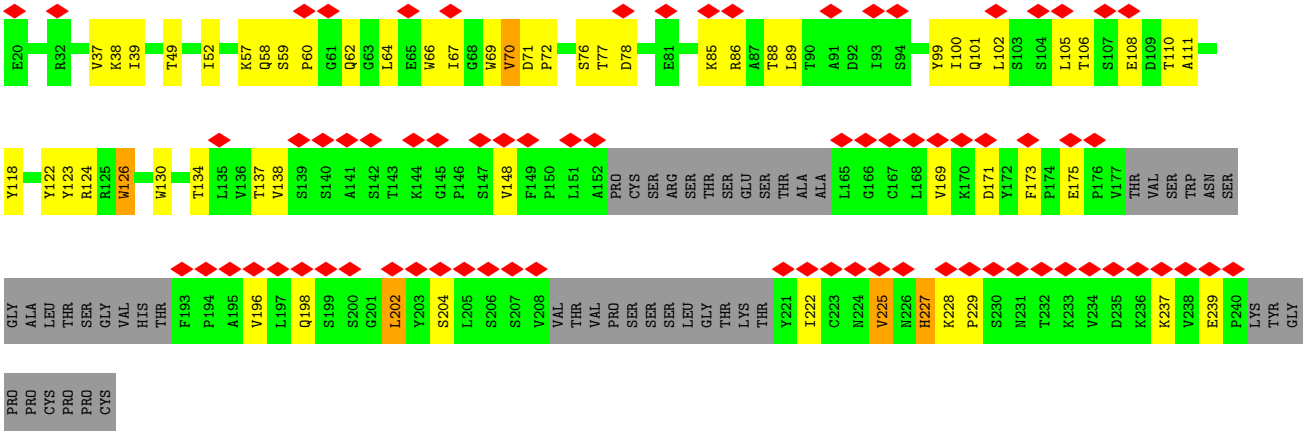
Chain B:





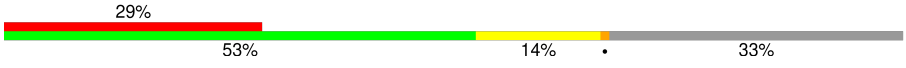
• Molecule 3: IgG heavy chain

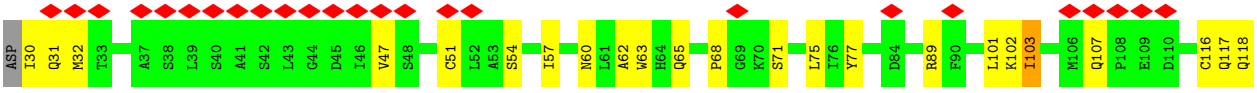
Chain D:

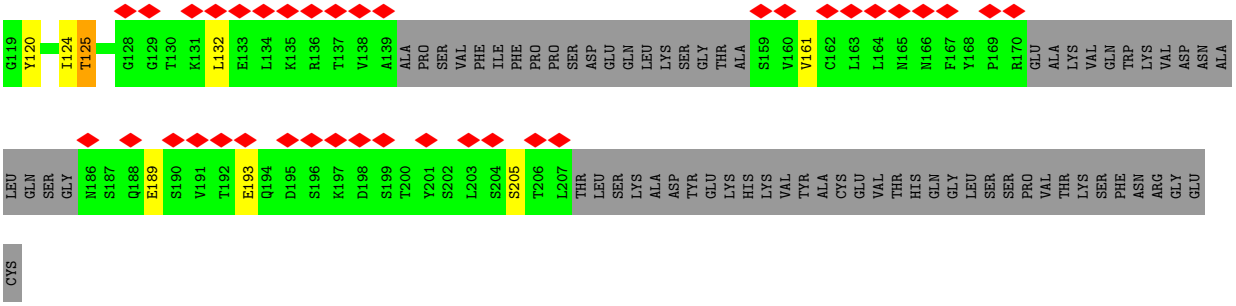


• Molecule 4: IgG light chain

Chain C:






G119 Y120 I124 T125 G128 G129 T130 K131 L132 E133 L134 K135 R136 T137 V138 A139 ALA PRO SER VAL PHE ILE PHE PRO PRO SER ASP GLU GLN LEU LYS SER GLY THR ALA S159 V160 V161 C162 L163 L164 N165 N166 F167 Y168 P169 R170 GLU ALA LYS VAL GLN TRP LYS VAL ASP ASN ALA
LEU GLN SER GLY N186 S187 Q188 E189 S190 V191 T192 E193 Q194 D195 S196 K197 D198 S199 T200 Y201 S202 L203 S204 S205 T206 L207 THR LEU SER LYS ALA ASP TYR GLU LYS HIS LYS VAL TYR ALA CYS GLU VAL THR HIS GLN GLY LEU SER SER PRO VAL THR LYS SER PHE ASN ARG GLY GLU
CYS

4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	1918745	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/Å^2$)	50	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (4k x 4k)	Depositor
Maximum map value	0.586	Depositor
Minimum map value	-0.326	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.008	Depositor
Recommended contour level	0.09	Depositor
Map size (Å)	299.52002, 299.52002, 299.52002	wwPDB
Map dimensions	416, 416, 416	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.72, 0.72, 0.72	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	A	0.39	0/2840	0.71	4/3835 (0.1%)
2	B	0.18	0/3282	0.38	1/4470 (0.0%)
3	D	0.13	0/1456	0.29	0/1979
4	C	0.11	0/1111	0.29	0/1501
All	All	0.26	0/8689	0.50	5/11785 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	2

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	386	ASN	N-CA-C	-7.75	103.93	113.15
1	A	117	GLN	N-CA-C	-6.15	105.53	113.16
2	B	386	HIS	N-CA-C	-5.43	107.20	113.88
1	A	394	THR	CA-C-N	-5.27	116.27	123.12
1	A	394	THR	C-N-CA	-5.27	116.27	123.12

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	122	ARG	Sidechain
1	A	124	ARG	Sidechain

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	2793	0	2763	109	0
2	B	3196	0	3015	109	0
3	D	1418	0	1368	44	0
4	C	1091	0	1054	23	0
All	All	8498	0	8200	265	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.

The worst 5 of 265 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:383:LEU:HB2	2:B:437:SER:HA	1.40	1.03
1:A:85:GLY:HA3	1:A:123:LEU:HD22	1.49	0.91
1:A:120:VAL:HB	1:A:457:ILE:HB	1.55	0.87
1:A:394:THR:HG23	1:A:431:THR:HB	1.61	0.82
1:A:123:LEU:HG	1:A:127:GLU:HG3	1.66	0.78

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	351/498 (70%)	329 (94%)	21 (6%)	1 (0%)	37 46
2	B	415/694 (60%)	393 (95%)	22 (5%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
3	D	174/230 (76%)	164 (94%)	10 (6%)	0	100	100
4	C	138/214 (64%)	132 (96%)	6 (4%)	0	100	100
All	All	1078/1636 (66%)	1018 (94%)	59 (6%)	1 (0%)	50	61

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	128	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	319/437 (73%)	299 (94%)	20 (6%)	15	19
2	B	335/559 (60%)	319 (95%)	16 (5%)	21	31
3	D	157/198 (79%)	146 (93%)	11 (7%)	12	16
4	C	124/184 (67%)	121 (98%)	3 (2%)	44	62
All	All	935/1378 (68%)	885 (95%)	50 (5%)	21	26

5 of 50 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	314	LEU
2	B	410	VAL
4	C	161	VAL
2	B	325	TYR
2	B	383	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
3	D	227	HIS

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Mol	Chain	Res	Type
4	C	59	ASN
4	C	65	GLN
1	A	312	HIS
1	A	406	ASN

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.

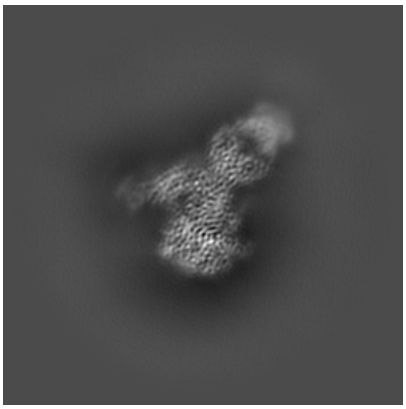
6 Map visualisation

This section contains visualisations of the EMDB entry EMD-49184. These allow visual inspection of the internal detail of the map and identification of artifacts.

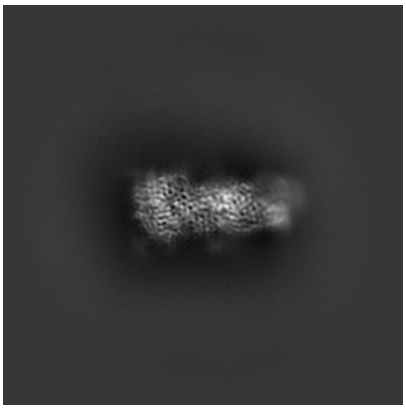
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections

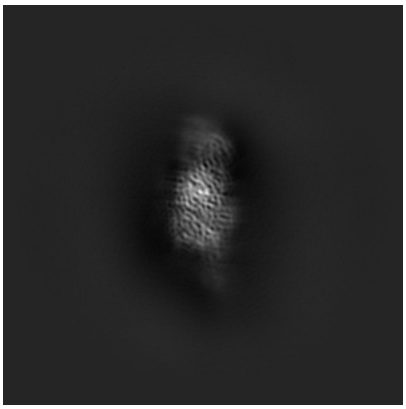
6.1.1 Primary map



X

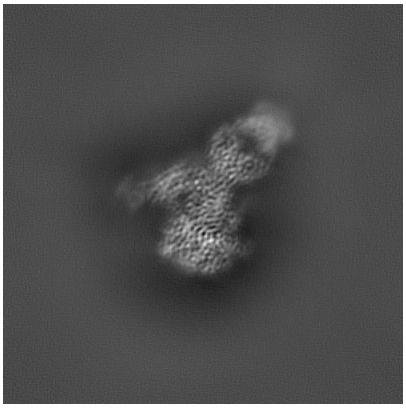


Y

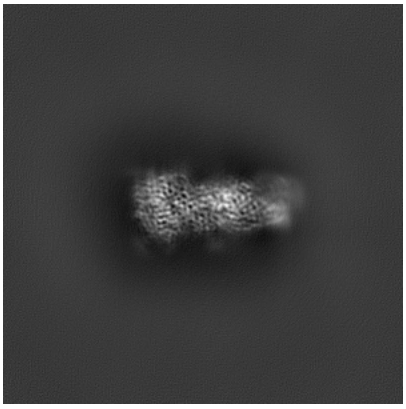


Z

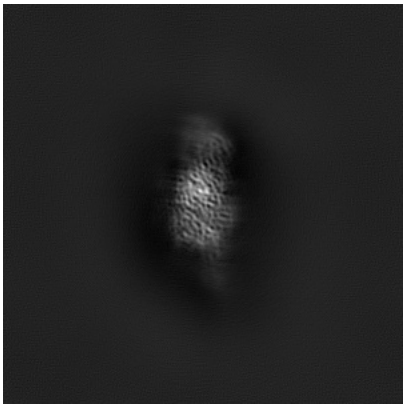
6.1.2 Raw map



X



Y

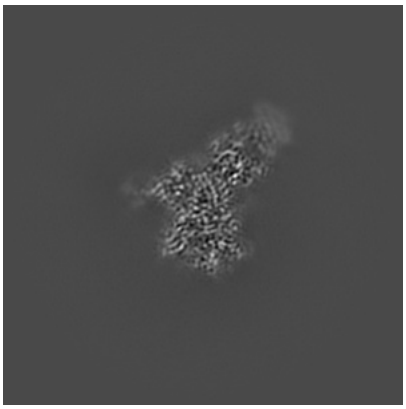


Z

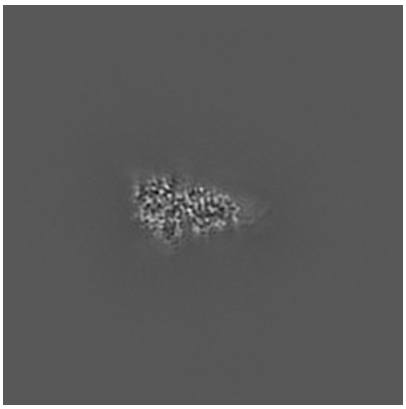
The images above show the map projected in three orthogonal directions.

6.2 Central slices (i)

6.2.1 Primary map



X Index: 208



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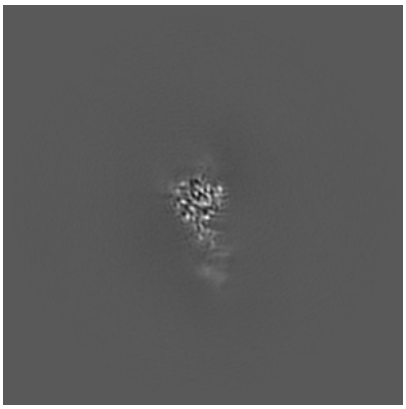
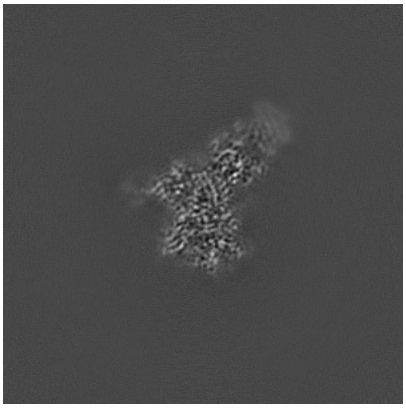


Z Index: 208

6.2.2 Raw map



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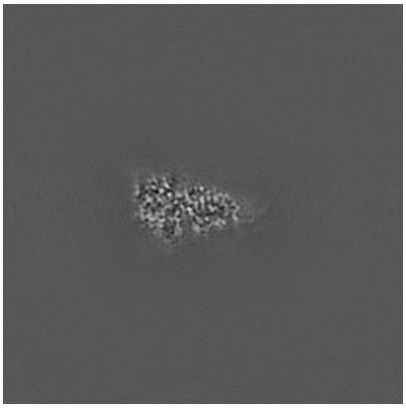
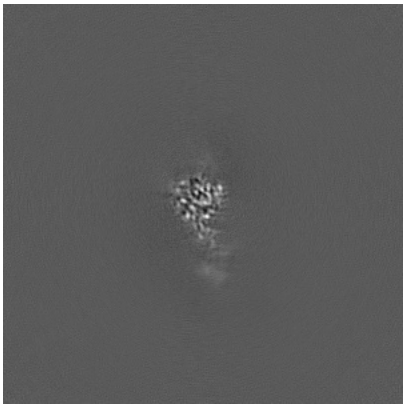


Y Index: 208

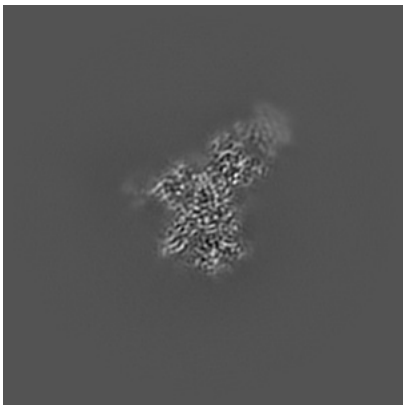


Z Index: 208

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

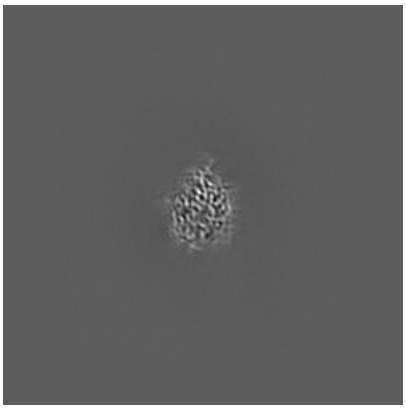
6.3 Largest variance slices (i)

6.3.1 Primary map



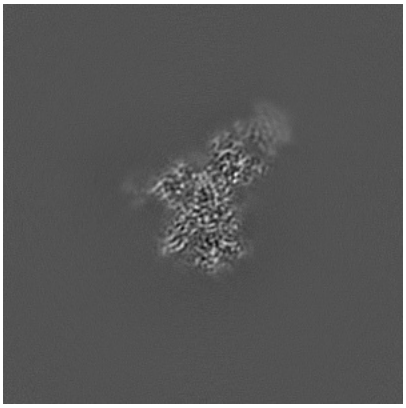
X Index: 207

Y Index: 217

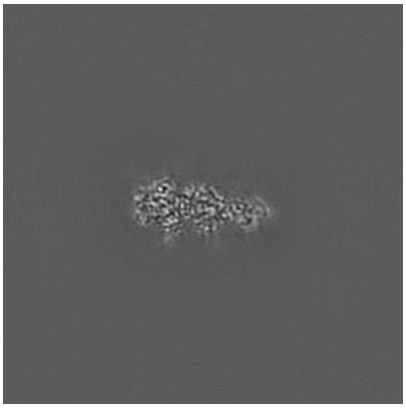


Z Index: 166

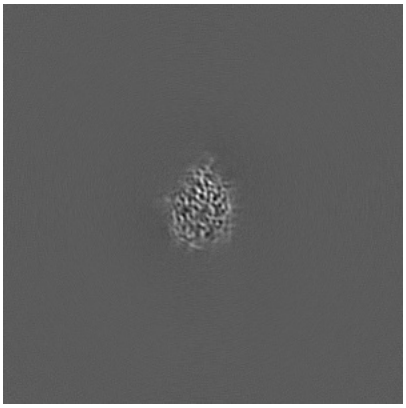
6.3.2 Raw map



X Index: 207



Y Index: 217

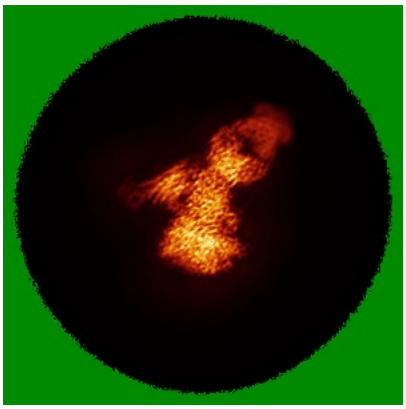


Z Index: 166

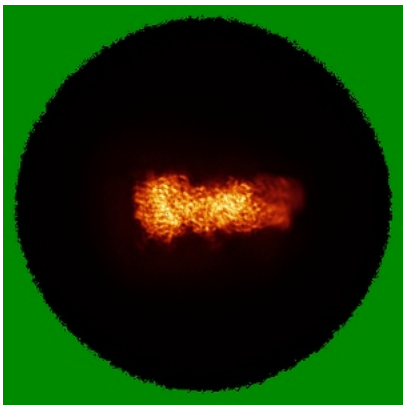
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal standard-deviation projections (False-color) (i)

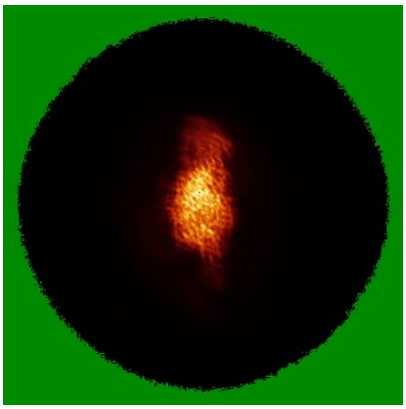
6.4.1 Primary map



X

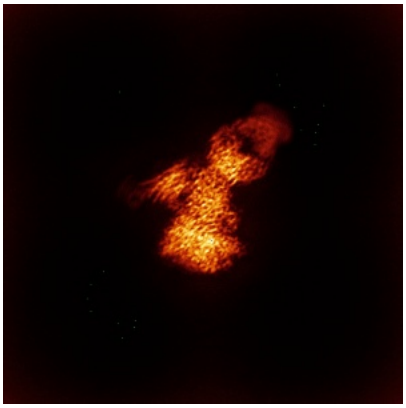


Y

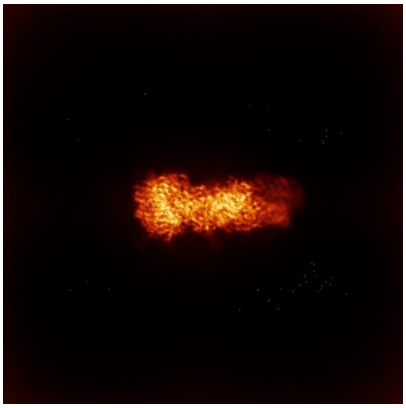


Z

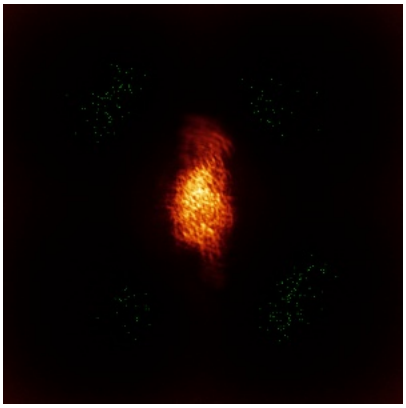
6.4.2 Raw map



X



Y

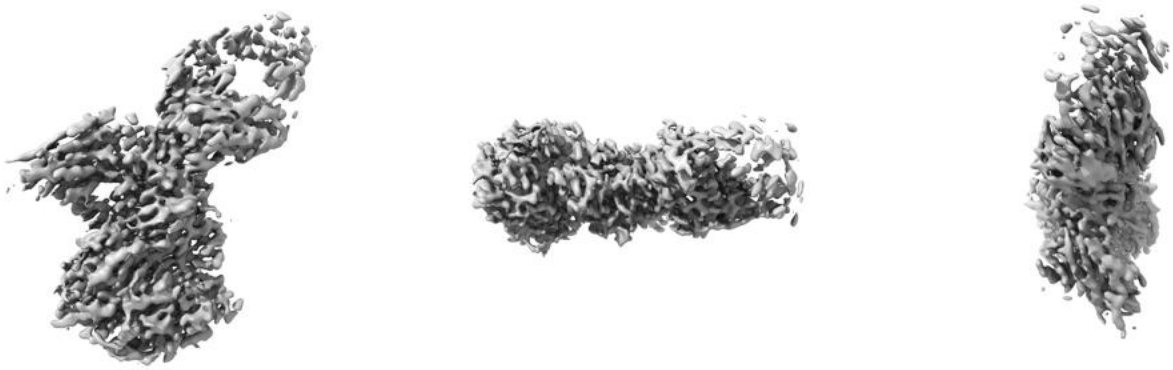


Z

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)

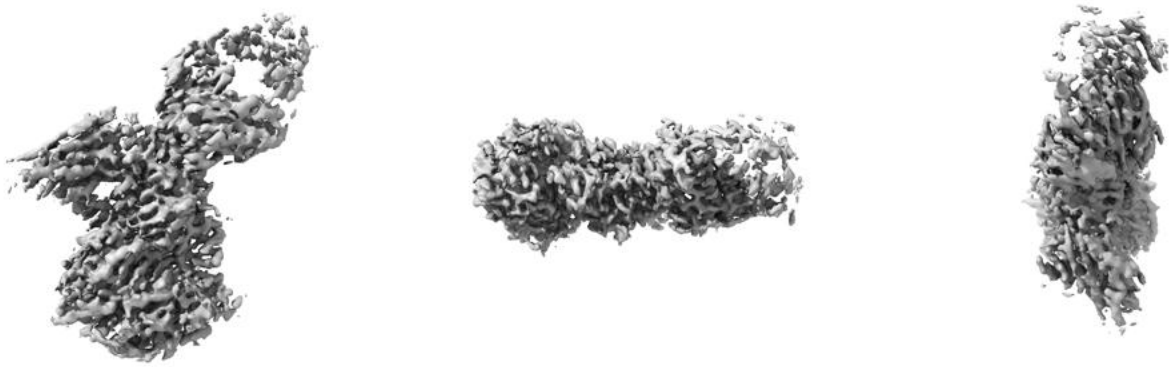
6.5.1 Primary map



X Y Z

The images above show the 3D surface view of the map at the recommended contour level 0.09. 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



X Y Z

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.

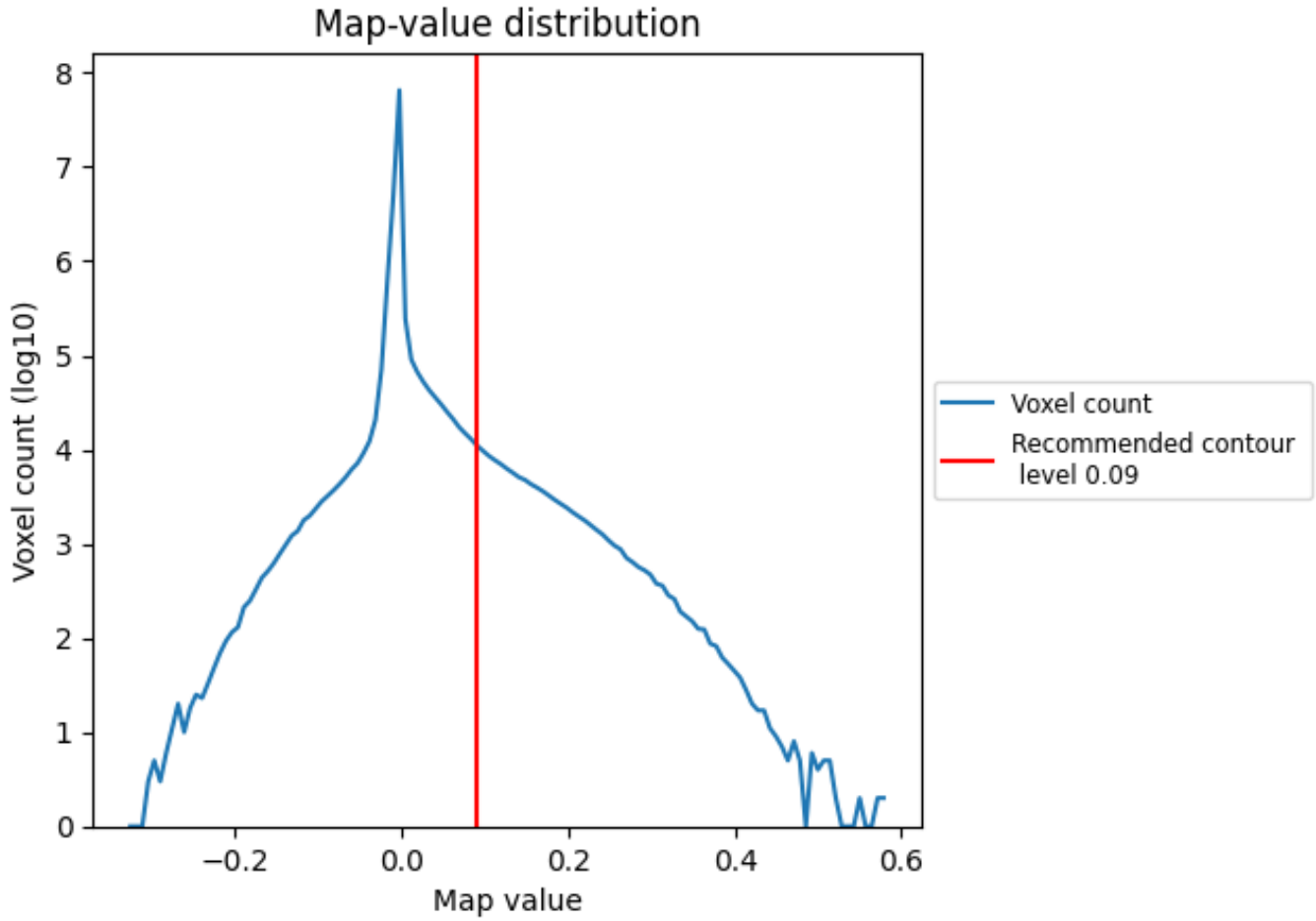
6.6 Mask visualisation (i)

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

7 Map analysis

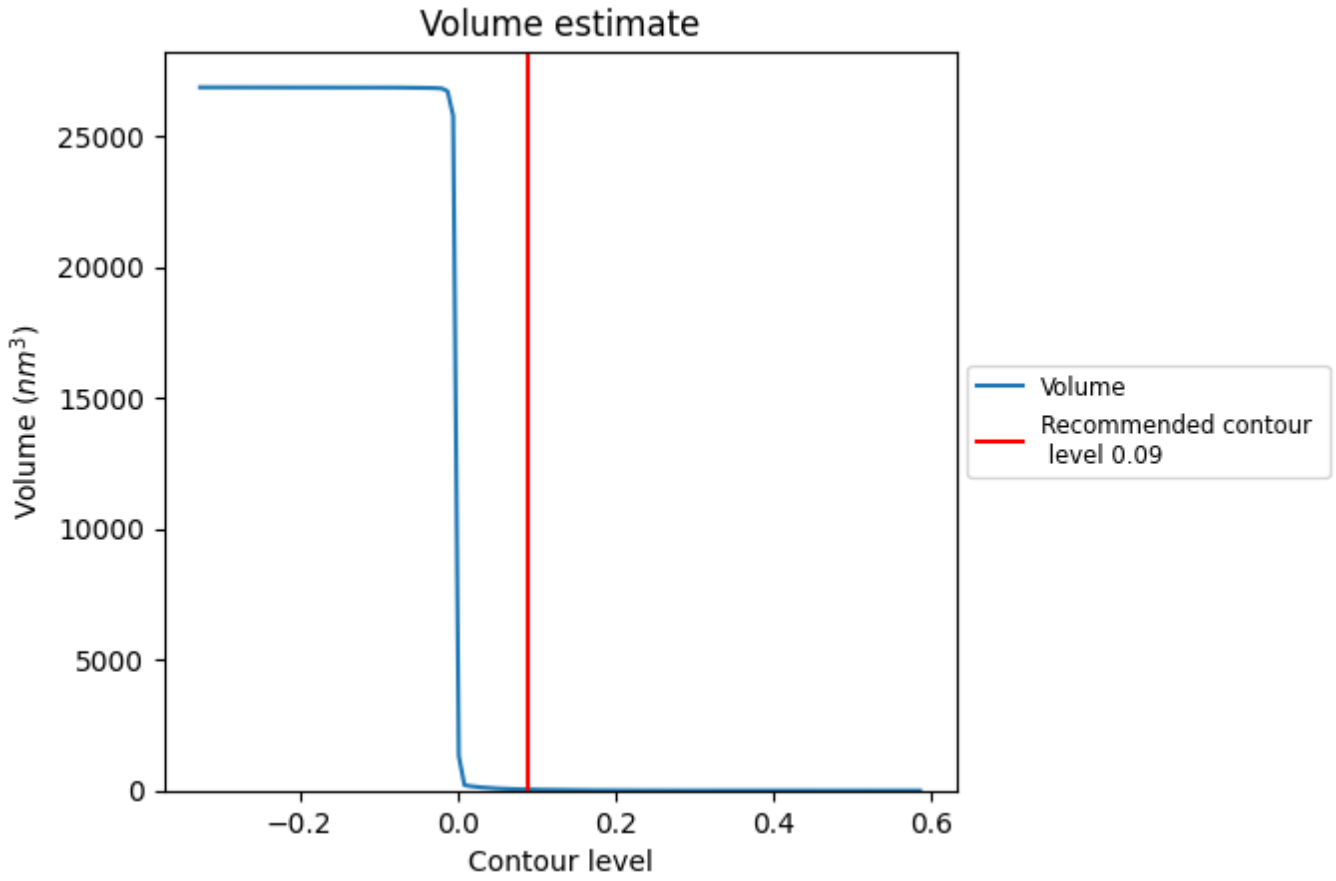
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution



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.

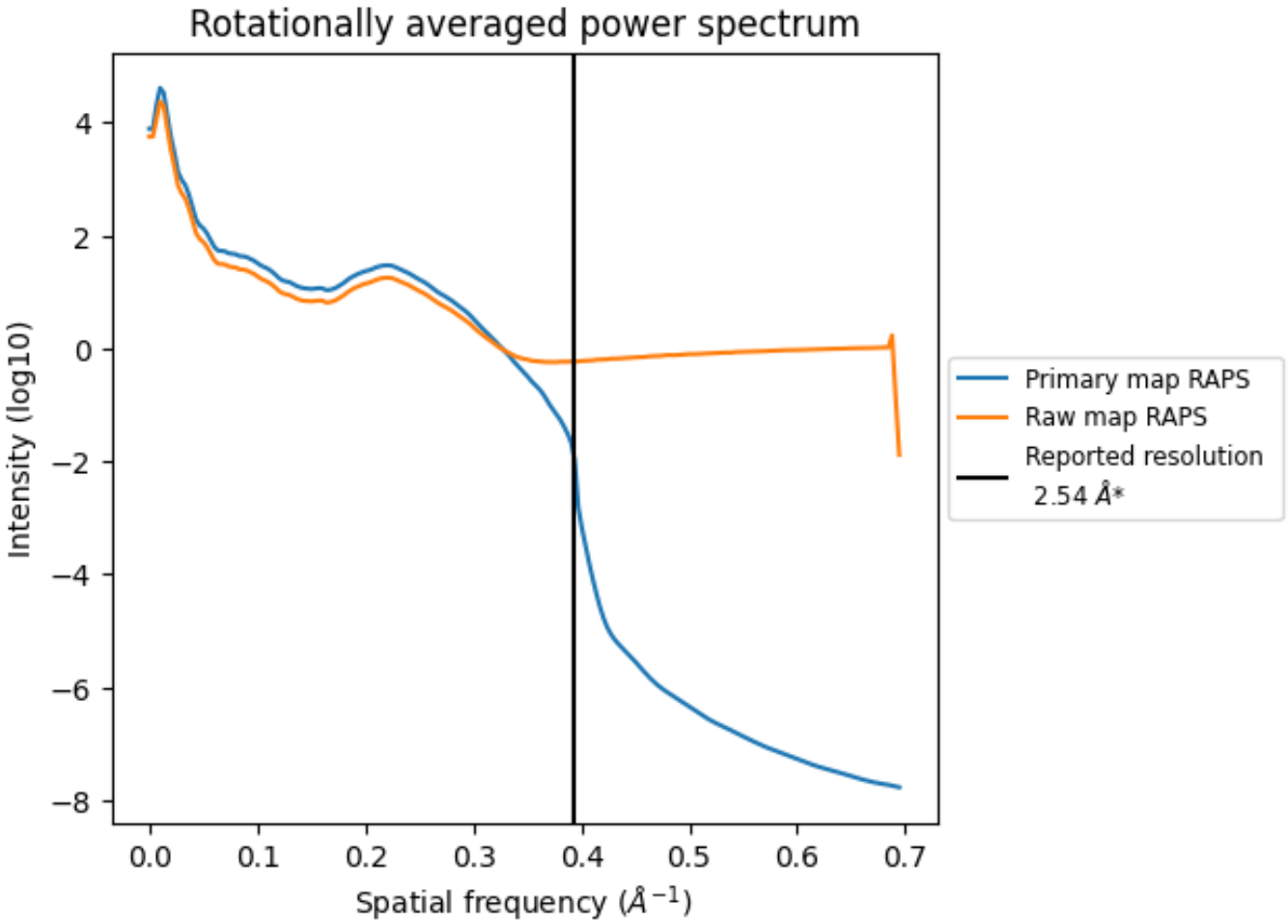
7.2 Volume estimate (i)



The volume at the recommended contour level is 40 nm^3; this corresponds to an approximate mass of 37 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)

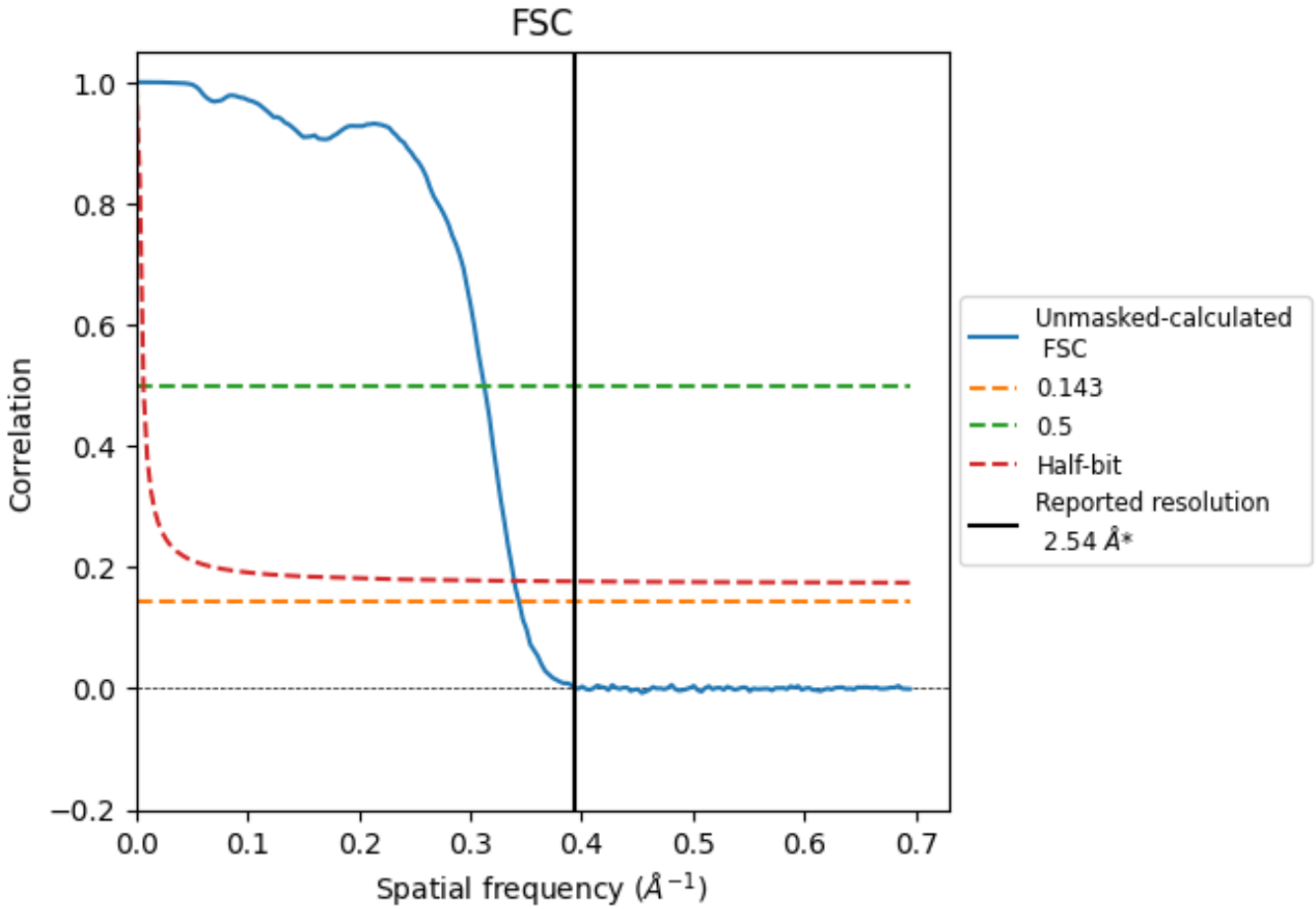


*Reported resolution corresponds to spatial frequency of 0.394 Å^{-1}

8 Fourier-Shell correlation

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



*Reported resolution corresponds to spatial frequency of 0.394 Å^{-1}

8.2 Resolution estimates (i)

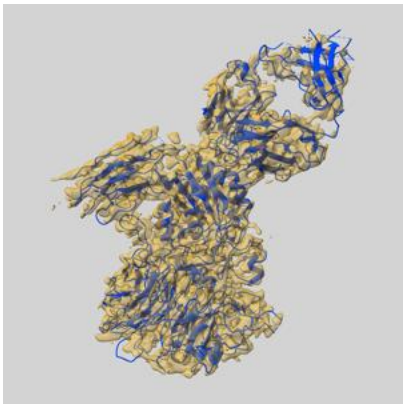
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	2.54	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	2.91	3.20	2.95

*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 2.91 differs from the reported value 2.54 by more than 10 %

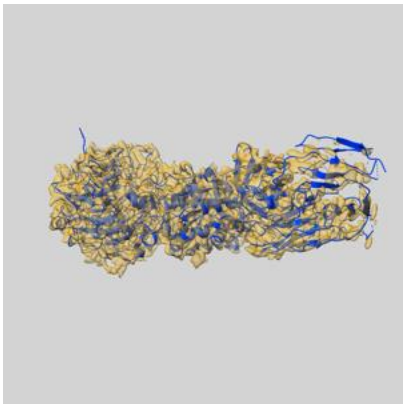
9 Map-model fit

This section contains information regarding the fit between EMDB map EMD-49184 and PDB model 9NAB. Per-residue inclusion information can be found in section 3 on page 6.

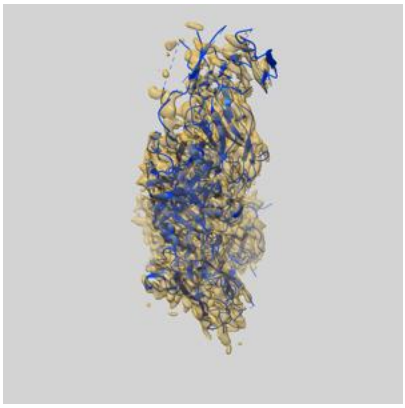
9.1 Map-model overlay



X



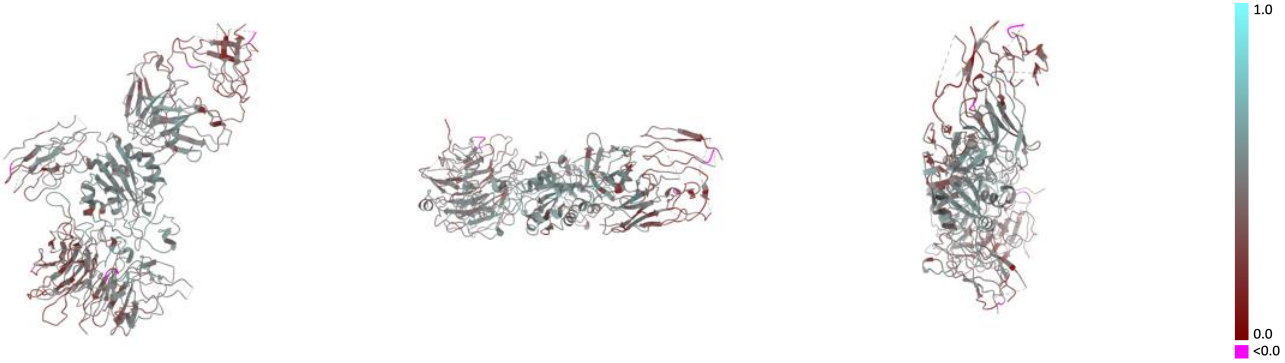
Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.09 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.

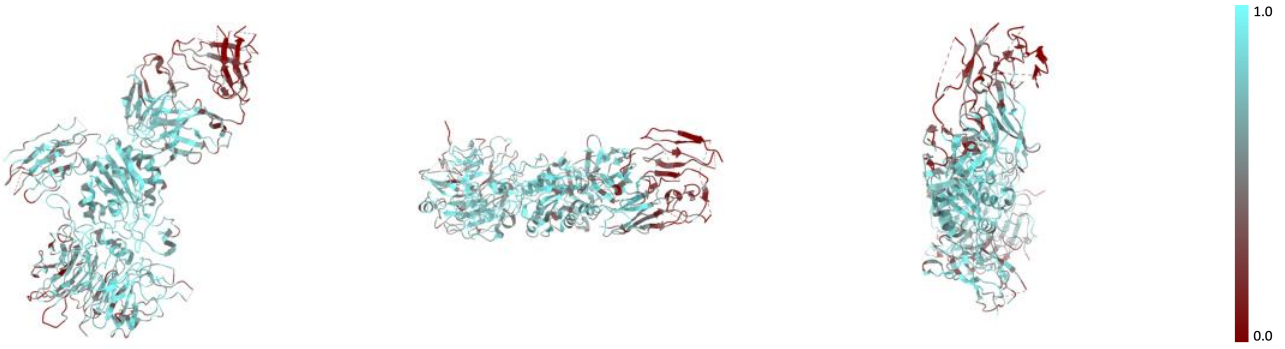
9.2 Q-score mapped to coordinate model (i)



X Y Z

The images above show the model with each residue coloured according 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.

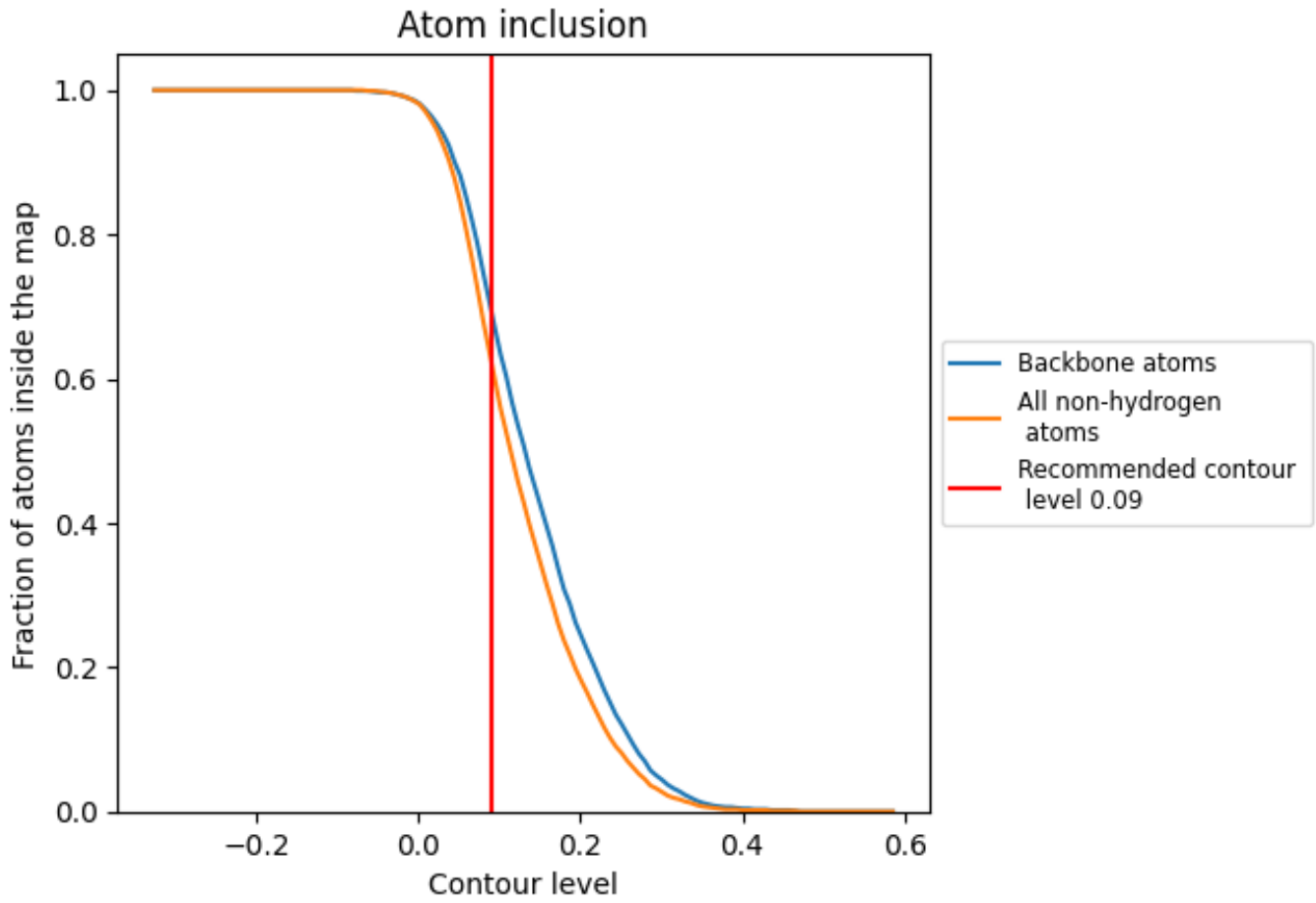
9.3 Atom inclusion mapped to coordinate model (i)



X Y Z

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 (0.09).

9.4 Atom inclusion (i)



At the recommended contour level, 69% of all backbone atoms, 62% 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 (0.09) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.6240	0.4340
A	0.7210	0.4840
B	0.6440	0.4110
C	0.4800	0.3800
D	0.4950	0.4260