



wwPDB EM Validation Summary Report ⓘ

Jul 23, 2026 – 07:29 PM JST

PDB ID : 9UKK / pdb_00009ukk
EMDB ID : EMD-64242
Title : CryoEM structure of Brucella melitensis CobS-CobT complex
Authors : Zhou, Y.L.; Chen, X.; Liu, L.
Deposited on : 2025-04-17
Resolution : 4.24 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:

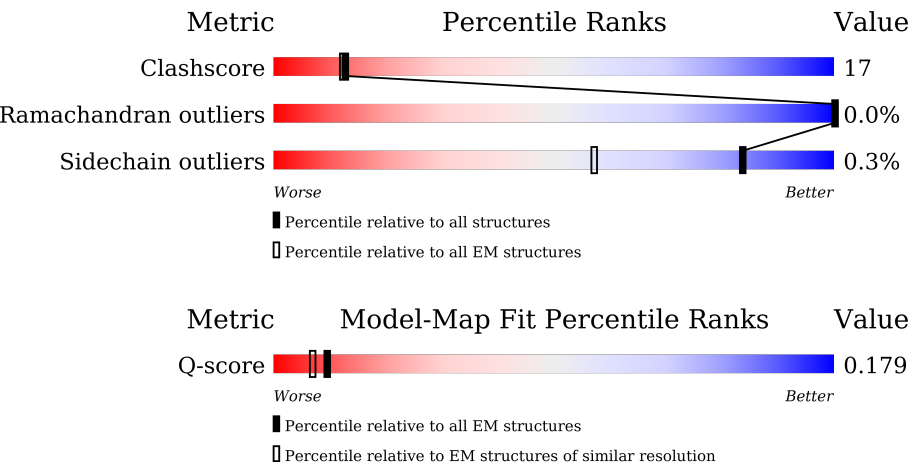
EMDB validation analysis : 0.0.1.dev133
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.50

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 4.24 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.



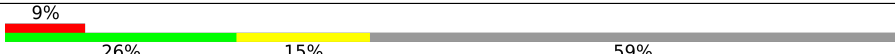
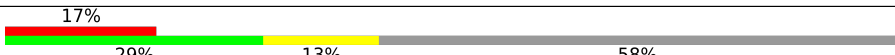
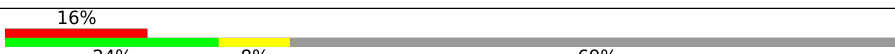
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	4688 (3.74 - 4.74)

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	328	
1	B	328	
1	C	328	
1	D	328	

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Mol	Chain	Length	Quality of chain
1	E	328	
1	F	328	
1	H	328	
2	G	637	
2	I	637	
2	d	637	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 19853 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 Cobaltochelatase subunit CobS.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	199	Total	C	N	O	S	0	0
			1578	999	277	296	6		
1	B	298	Total	C	N	O	S	0	0
			2370	1501	417	442	10		
1	C	298	Total	C	N	O	S	0	0
			2370	1503	416	441	10		
1	D	307	Total	C	N	O	S	0	0
			2433	1543	426	454	10		
1	E	300	Total	C	N	O	S	0	0
			2386	1513	419	444	10		
1	F	280	Total	C	N	O	S	0	0
			2225	1412	392	411	10		
1	H	96	Total	C	N	O	S	0	0
			769	487	137	141	4		

- Molecule 2 is a protein called Cobaltochelatase subunit CobT.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	G	262	Total	C	N	O	S	0	0
			2072	1291	387	385	9		
2	d	200	Total	C	N	O	S	0	0
			1531	941	291	292	7		
2	I	268	Total	C	N	O	S	0	0
			2119	1319	396	394	10		

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.

Chain A:

Chain B:

59% 30% 9%

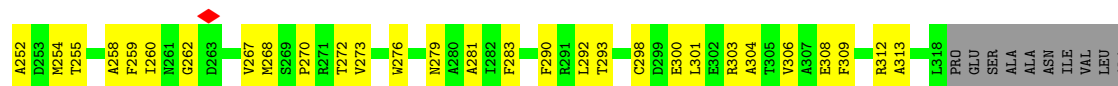
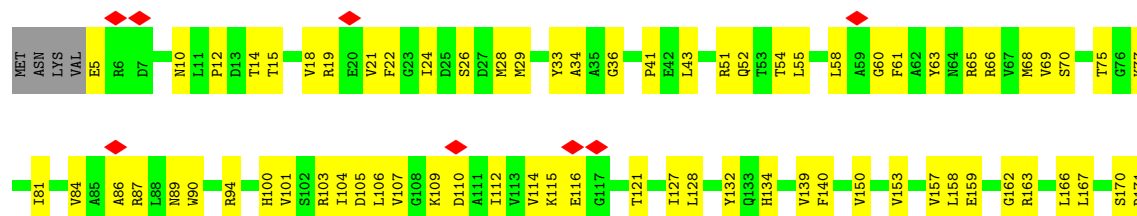
MET ASN LYS VAL E5 R6 D7 I8 A9 R19 F22 G23 I24 D25 S26 Y33 A34 A35 Y39 Y47 R51 Q52 T53 L58 F61 V67 R68 V69 G76 K77 S78 T79 H80 Q83 R87 L88 N89 Y90 P91 H100 R103 I104 A111 T112 V114

V114 K115 E116 G117 V118 Q119 V120 T121 F122 K123 K124 L128 Y132 M135 V136 A137 L138 D141 E142 Y143 R147 P148 V153 R156 V157 L158 E159 G162 R163 L164 T165 L166 L167 D168 Q169 S170 R171 P175 L181 F182 A183 T184 Y188 G189 L190 G191 A192 T193 R194

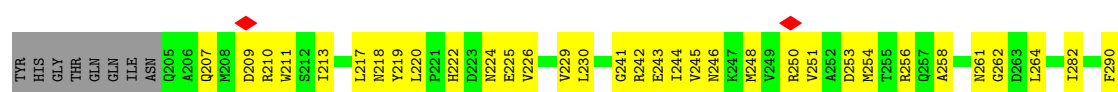
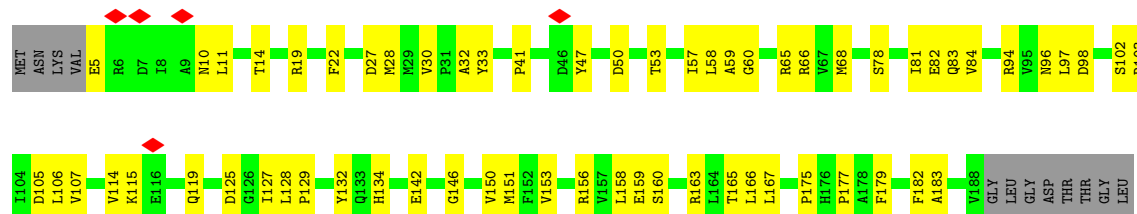
GLY LEU TYR HIS GLY THR GLN GLN N204 Q207 R210 T215 T216 L217 N218 Y219 L220 F221 H222 D223 N224 E225 K232 Q237 N238 A239 R242 E243 N248 V249 R250 V251 N254 T255 R256 I260 N261 G262 D263 L264 S265 T266 V267 N268 S269 T272 V273 L274



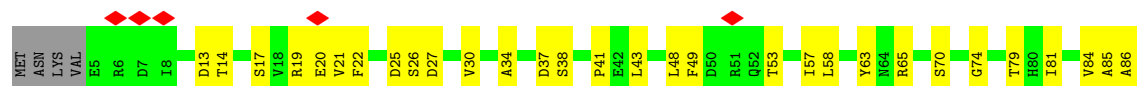
• Molecule 1: Cobaltochelatase subunit CobS

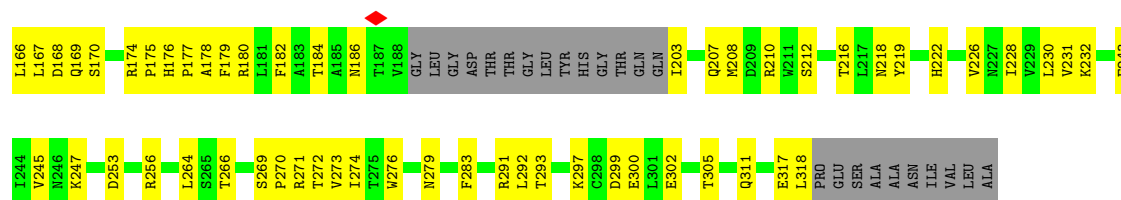


• Molecule 1: Cobaltochelatase subunit CobS

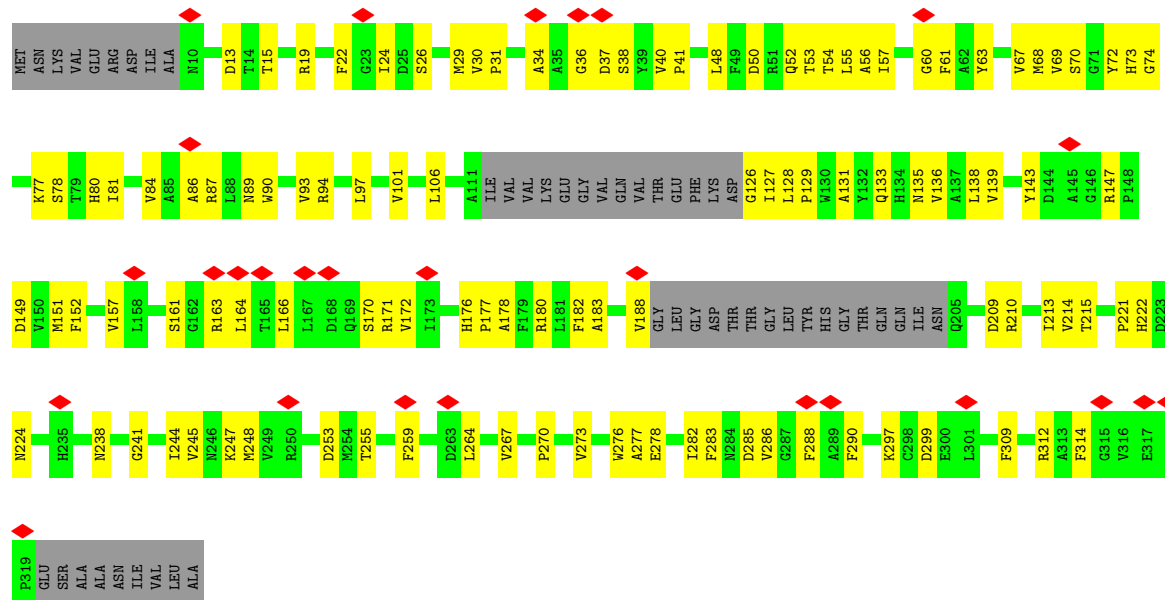


• Molecule 1: Cobaltochelatase subunit CobS

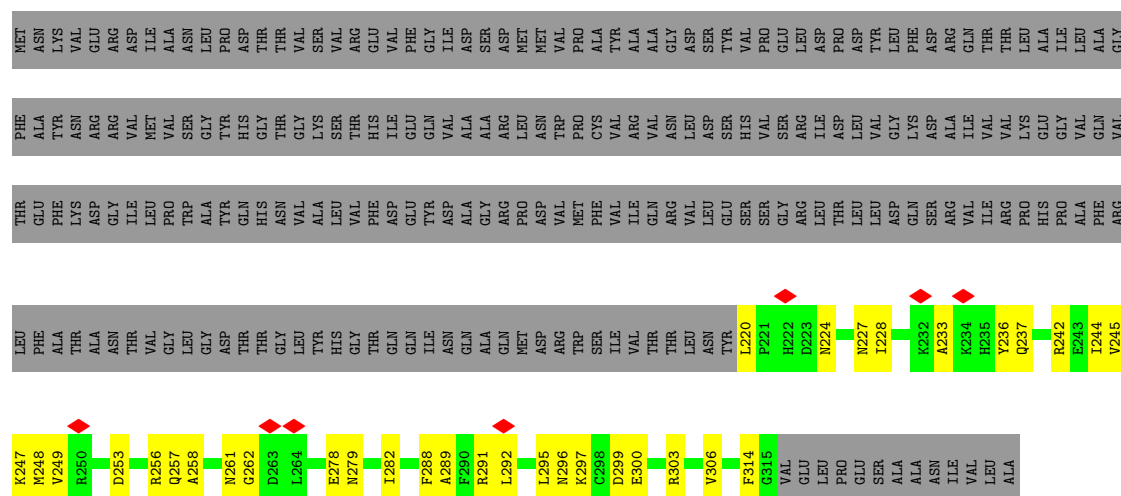




• Molecule 1: Cobaltochelatase subunit CobS

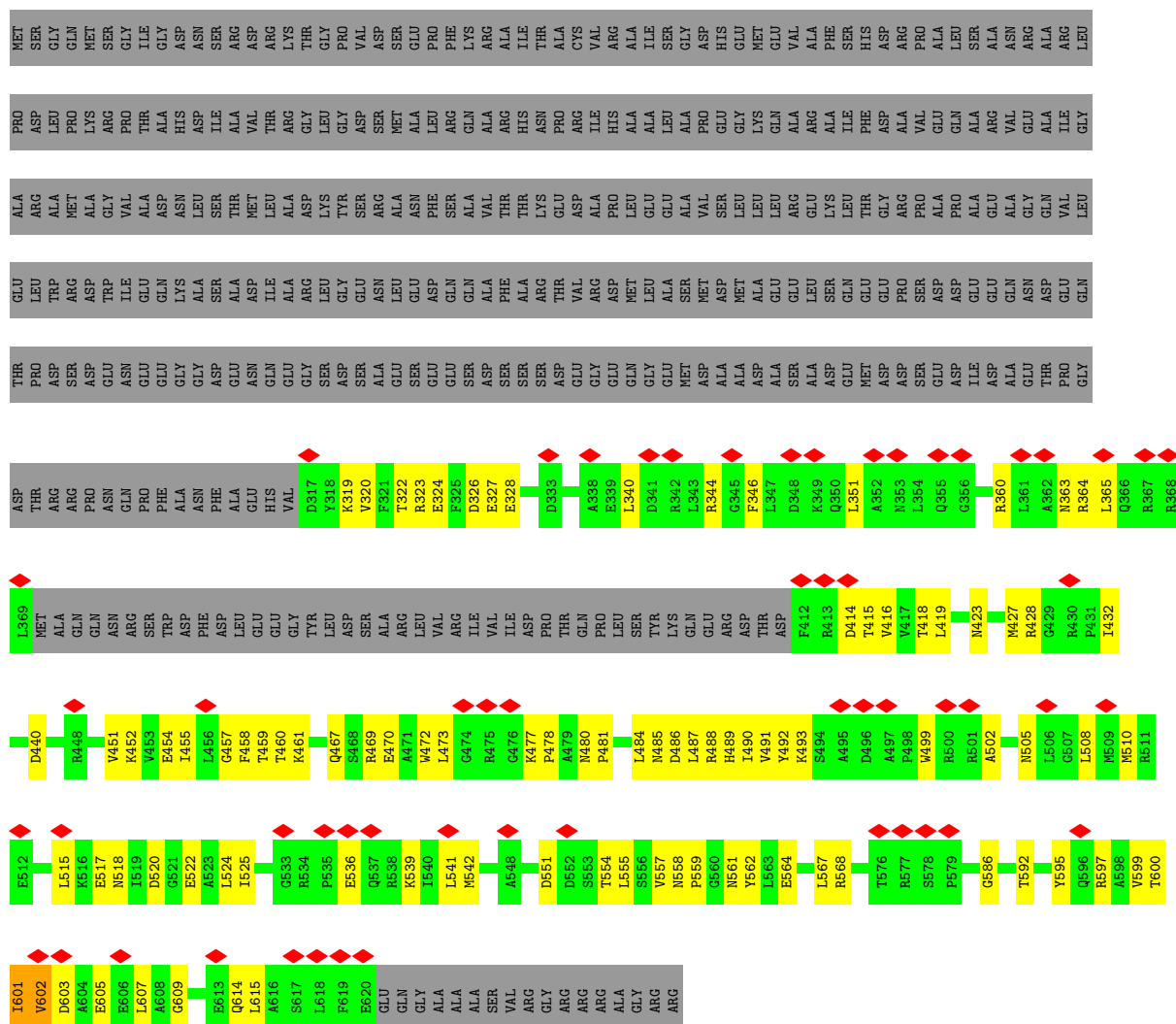


• Molecule 1: Cobaltochelatase subunit CobS

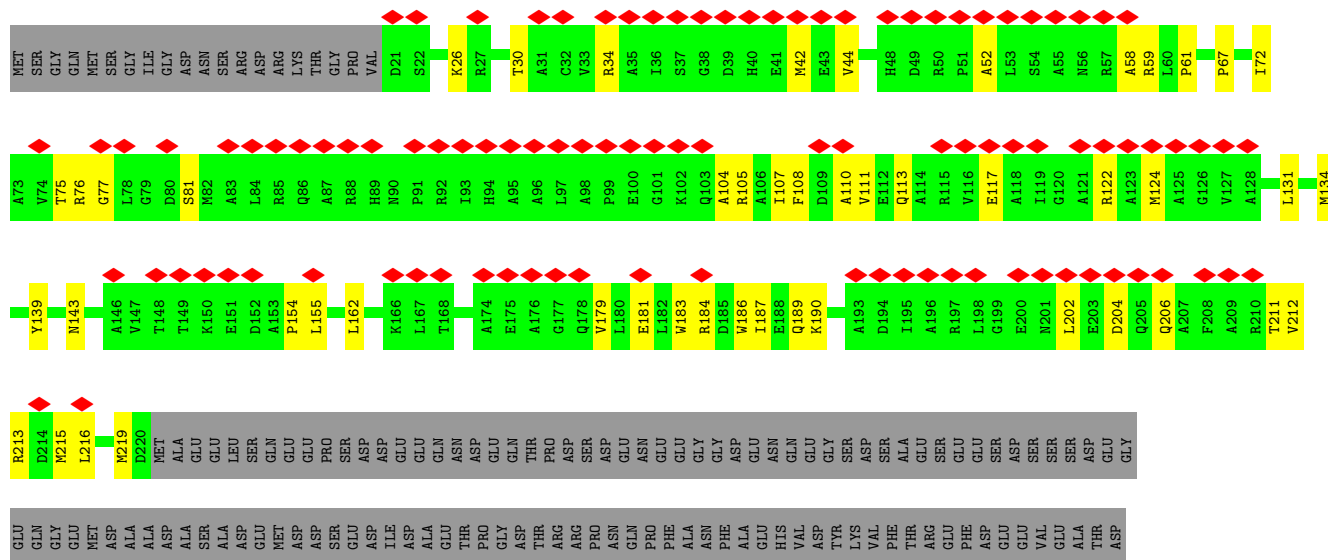


• Molecule 2: Cobaltochelatase subunit CobT





• Molecule 2: Cobaltochelate subunit CobT



- Molecule 2: Cobaltochelatase subunit CobT

[illegible]

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	155925	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	NONE	Depositor
Microscope	TFS GLACIOS	Depositor
Voltage (kV)	200	Depositor
Electron dose ($e^-/\text{\AA}^2$)	50	Depositor
Minimum defocus (nm)	400	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (4k x 4k)	Depositor
Maximum map value	2.327	Depositor
Minimum map value	-0.002	Depositor
Average map value	0.003	Depositor
Map value standard deviation	0.037	Depositor
Recommended contour level	0.02	Depositor
Map size ($\text{\AA}$)	251.28, 251.28, 251.28	wwPDB
Map dimensions	360, 360, 360	wwPDB
Map angles ($^\circ$)	90.0, 90.0, 90.0	wwPDB
Pixel spacing ($\text{\AA}$)	0.698, 0.698, 0.698	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	0.14	0/1612	0.30	0/2195
1	B	0.20	0/2419	0.36	0/3289
1	C	0.19	0/2419	0.36	0/3289
1	D	0.21	0/2483	0.40	0/3378
1	E	0.17	0/2435	0.37	0/3311
1	F	0.15	0/2273	0.39	0/3092
1	H	0.18	0/783	0.40	1/1059 (0.1%)
2	G	0.22	0/2101	0.36	1/2834 (0.0%)
2	I	0.08	0/2149	0.23	0/2899
2	d	0.09	0/1555	0.23	0/2103
All	All	0.17	0/20229	0.35	2/27449 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	G	602	VAL	N-CA-C	-7.17	106.14	113.10
1	H	289	ALA	N-CA-C	-5.53	106.20	113.12

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	1578	0	1545	61	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	2370	0	2327	86	0
1	C	2370	0	2332	97	0
1	D	2433	0	2397	82	0
1	E	2386	0	2349	88	0
1	F	2225	0	2183	93	0
1	H	769	0	757	30	0
2	G	2072	0	2096	71	0
2	I	2119	0	2138	61	0
2	d	1531	0	1523	29	0
All	All	19853	0	19647	655	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 17.

The worst 5 of 655 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:G:601:ILE:HG21	2:G:607:LEU:HB2	1.41	1.01
1:B:210:ARG:O	1:B:210:ARG:NH1	2.06	0.89
1:D:300:GLU:HA	1:D:303:ARG:HH12	1.48	0.78
2:G:419:LEU:HA	2:G:542:MET:HB3	1.68	0.75
2:I:423:ASN:HB2	2:I:515:LEU:HA	1.68	0.75

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	195/328 (60%)	182 (93%)	13 (7%)	0	100	100
1	B	294/328 (90%)	265 (90%)	28 (10%)	1 (0%)	36	71

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	294/328 (90%)	273 (93%)	21 (7%)	0	100	100
1	D	303/328 (92%)	275 (91%)	28 (9%)	0	100	100
1	E	296/328 (90%)	273 (92%)	23 (8%)	0	100	100
1	F	274/328 (84%)	252 (92%)	22 (8%)	0	100	100
1	H	94/328 (29%)	90 (96%)	4 (4%)	0	100	100
2	G	258/637 (40%)	242 (94%)	16 (6%)	0	100	100
2	I	264/637 (41%)	259 (98%)	5 (2%)	0	100	100
2	d	198/637 (31%)	195 (98%)	3 (2%)	0	100	100
All	All	2470/4207 (59%)	2306 (93%)	163 (7%)	1 (0%)	100	100

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	218	ASN

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	171/278 (62%)	171 (100%)	0	100	100
1	B	255/278 (92%)	252 (99%)	3 (1%)	63	73
1	C	255/278 (92%)	254 (100%)	1 (0%)	84	82
1	D	262/278 (94%)	261 (100%)	1 (0%)	84	82
1	E	257/278 (92%)	257 (100%)	0	100	100
1	F	239/278 (86%)	239 (100%)	0	100	100
1	H	81/278 (29%)	81 (100%)	0	100	100
2	G	217/517 (42%)	215 (99%)	2 (1%)	70	76
2	I	222/517 (43%)	222 (100%)	0	100	100
2	d	154/517 (30%)	154 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	2113/3497 (60%)	2106 (100%)	7 (0%)	84 84

5 of 7 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	218	ASN
1	D	102	SER
2	G	605	GLU
2	G	601	ILE
1	B	220	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 26 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	96	ASN
1	F	224	ASN
2	d	205	GLN
1	F	83	GLN
1	F	235	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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.

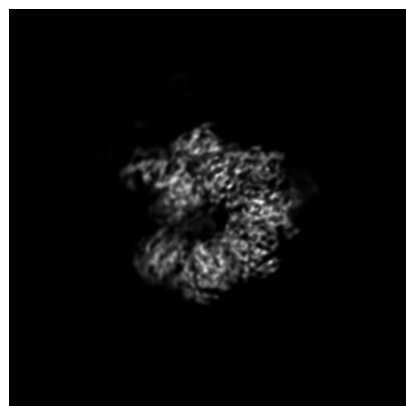
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-64242. These allow visual inspection of the internal detail of the map and identification of artifacts.

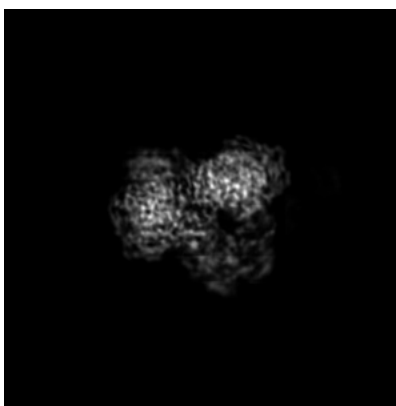
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

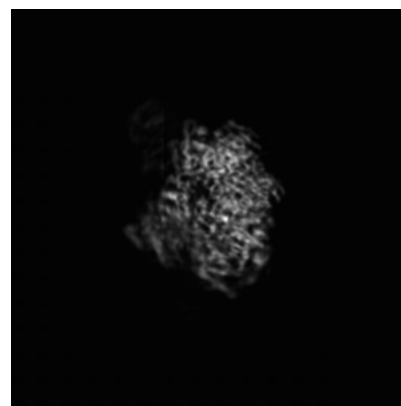
6.1.1 Primary map



X

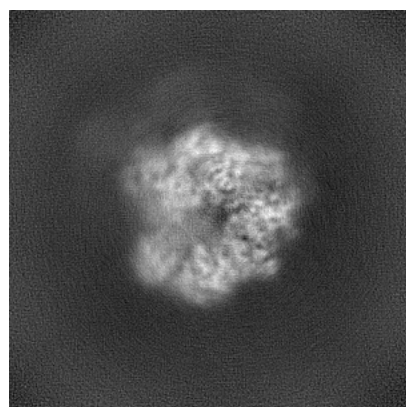


Y

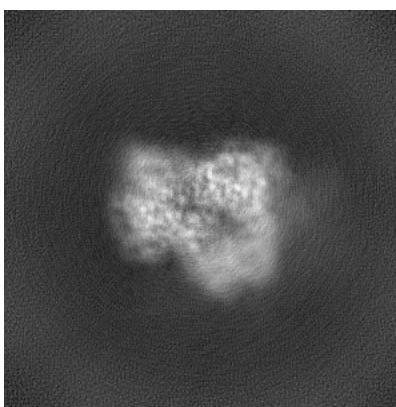


Z

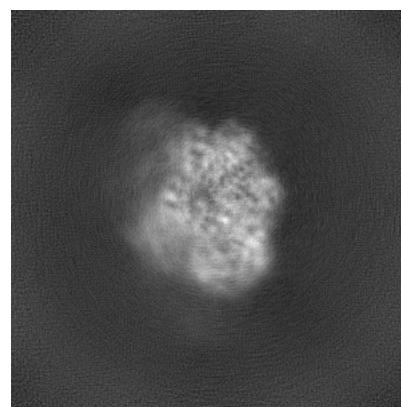
6.1.2 Raw map



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

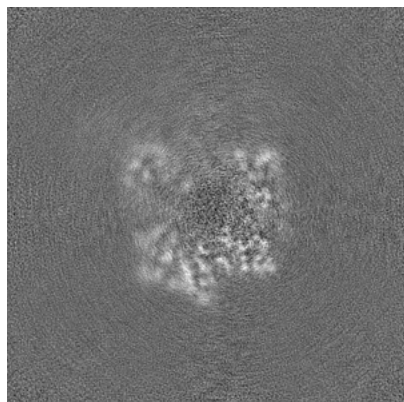


Y Index: 180

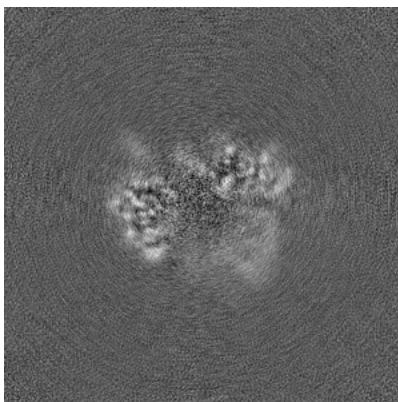


Z Index: 180

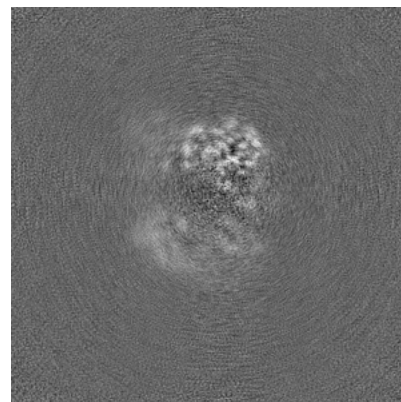
6.2.2 Raw map



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: 200

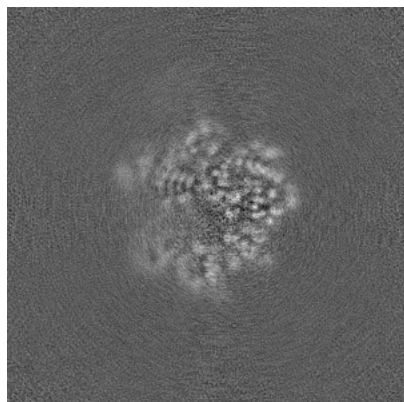


Y Index: 226

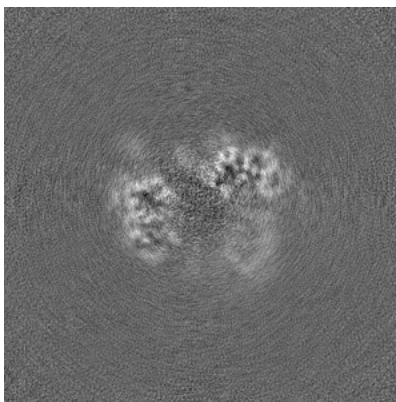


Z Index: 132

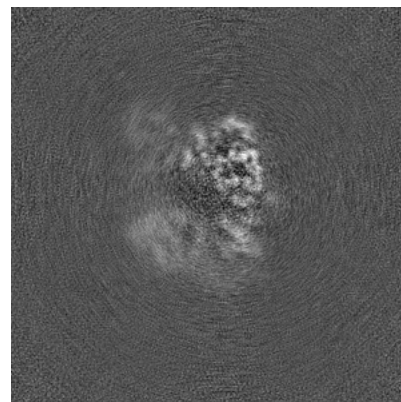
6.3.2 Raw map



X Index: 200



Y Index: 184

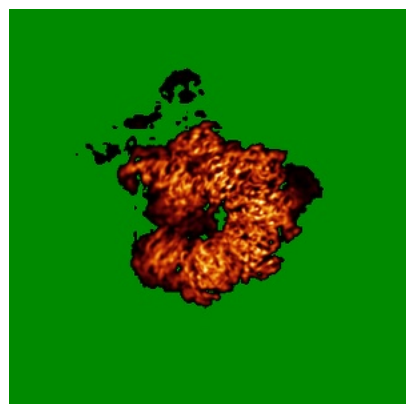


Z Index: 185

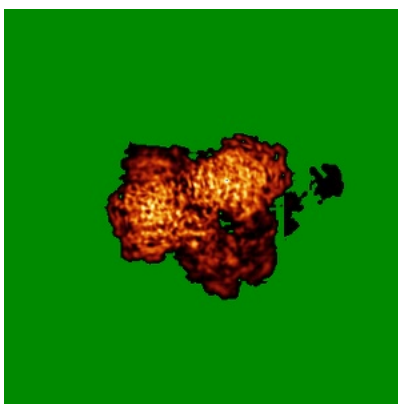
The images above show the largest variance slices of the map in three orthogonal directions.

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

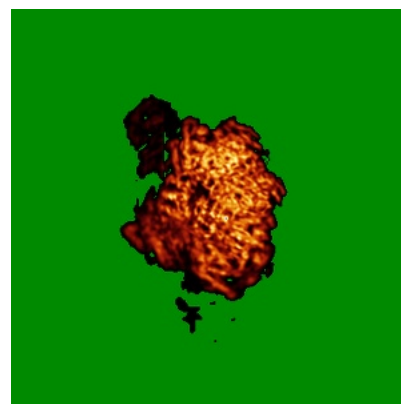
6.4.1 Primary map



X

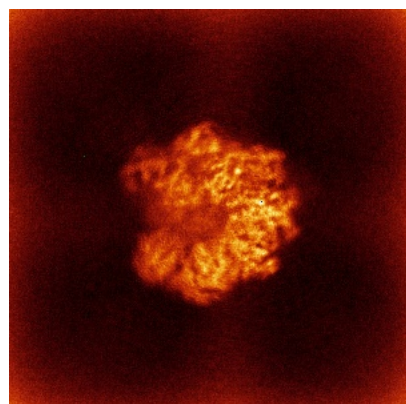


Y

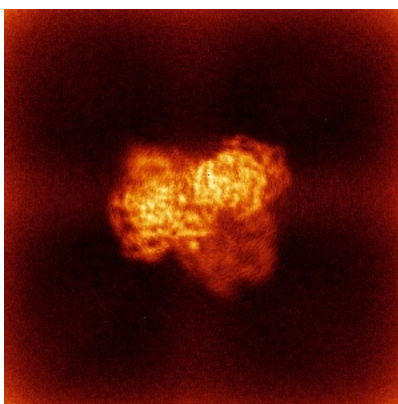


Z

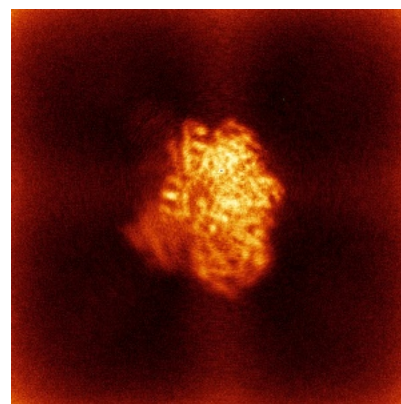
6.4.2 Raw map



X



Y

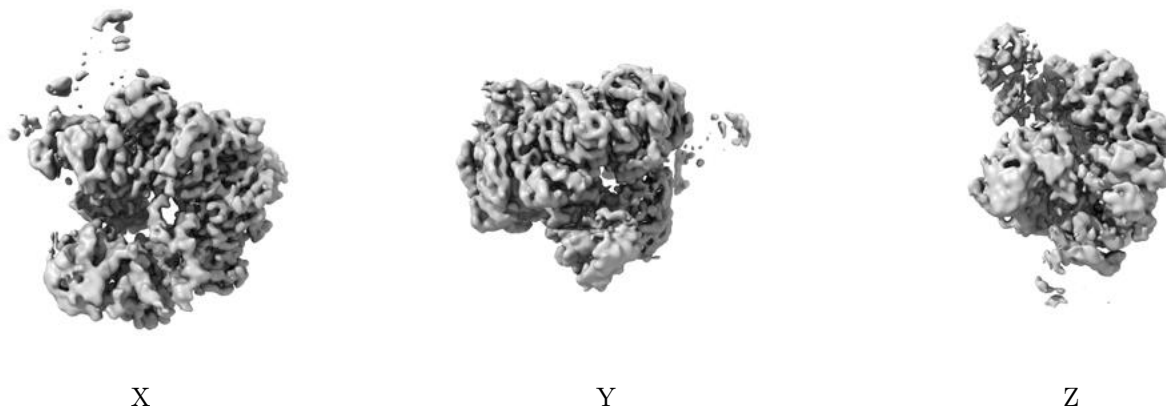


Z

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.

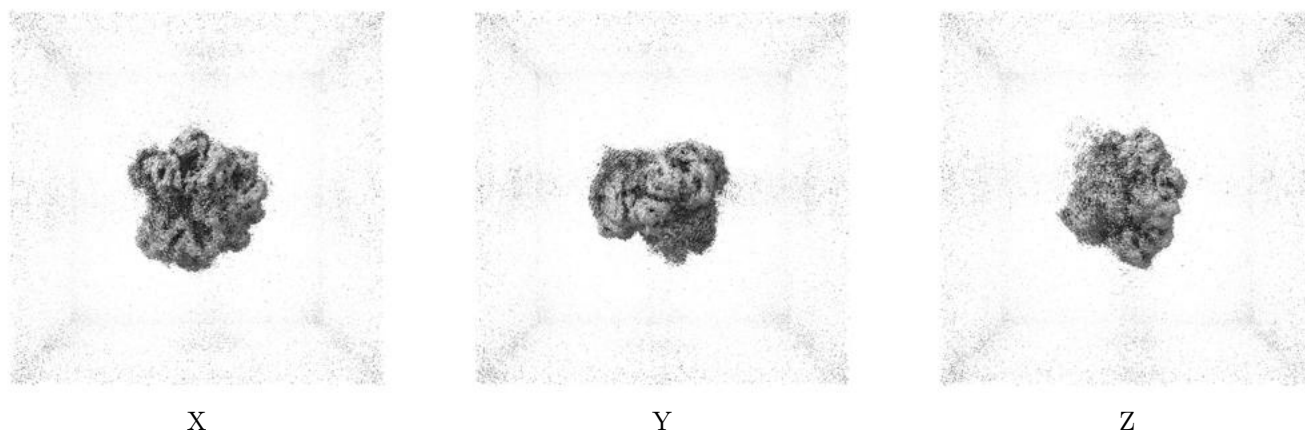
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.02. 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.

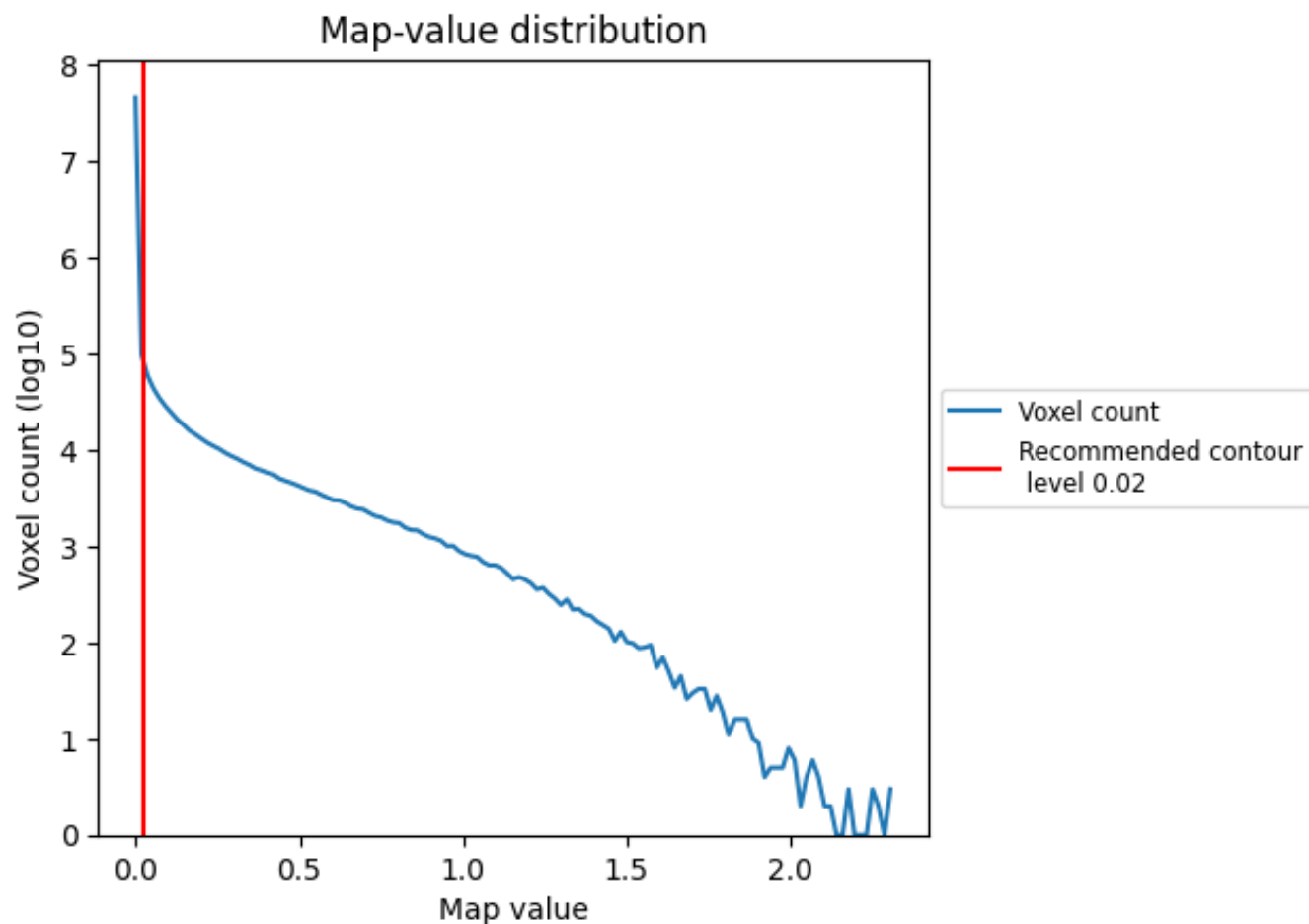
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

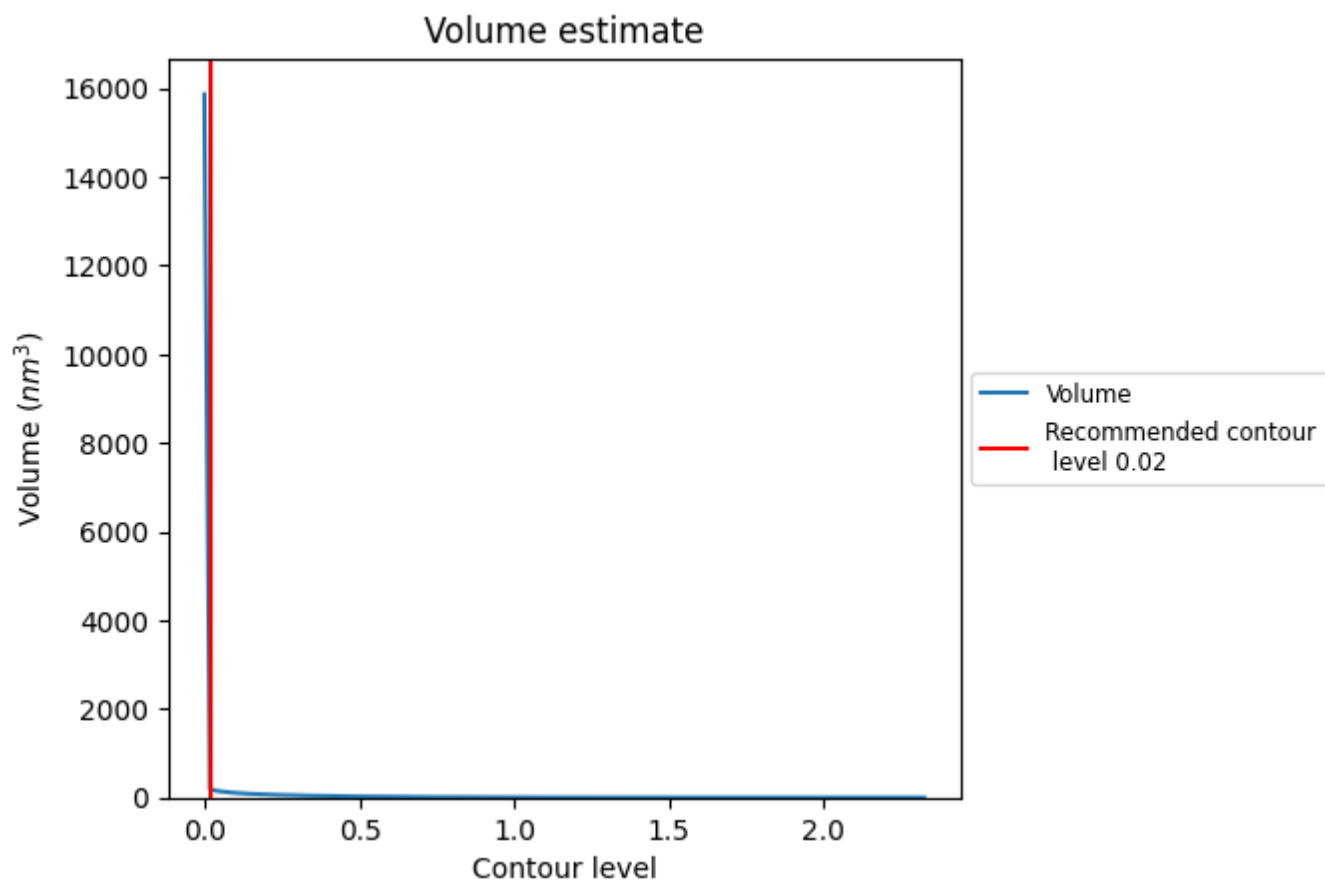
This section contains the results of statistical analysis of the map.

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.

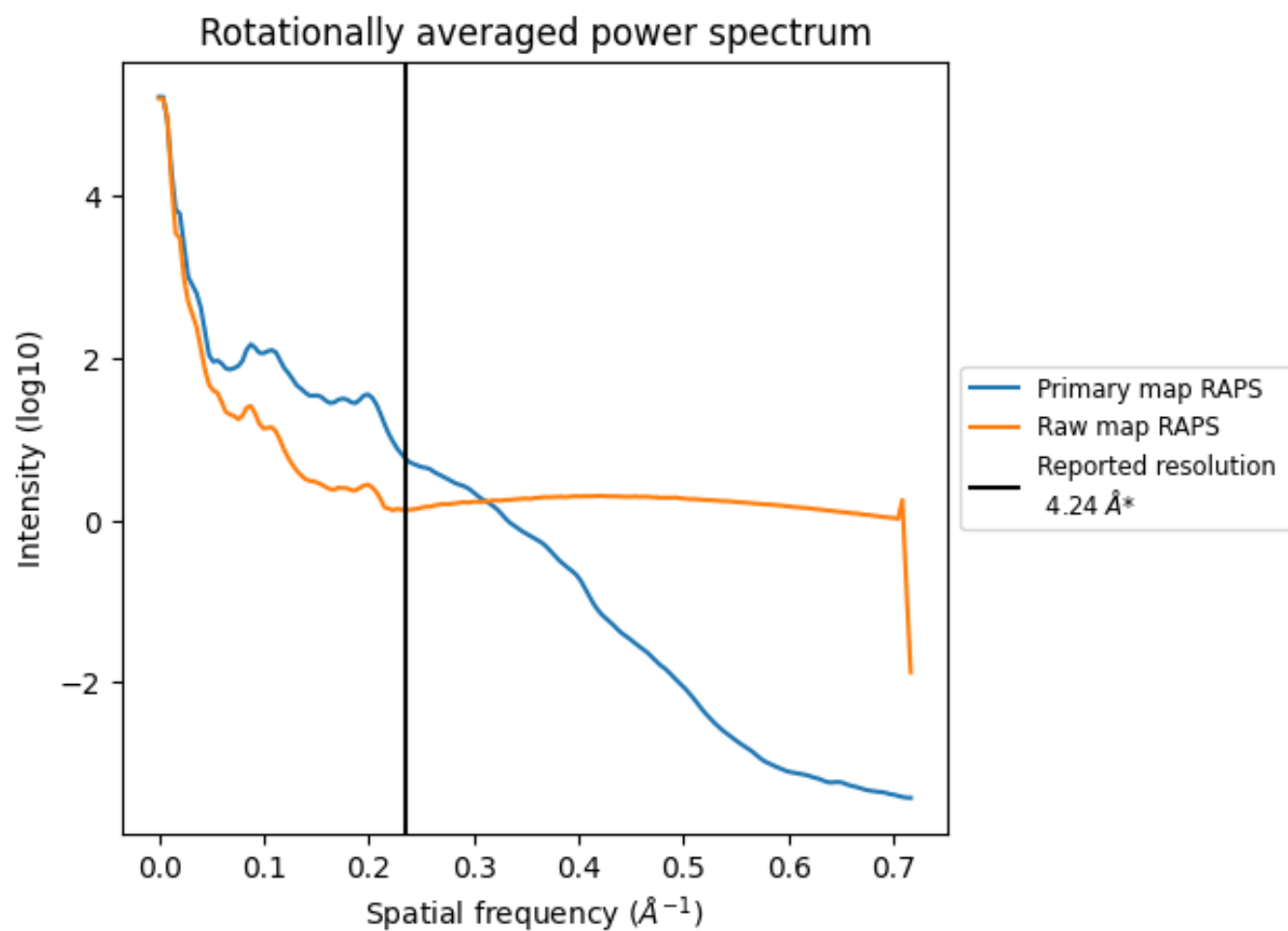
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 183 nm^3 ; this corresponds to an approximate mass of 165 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 ⓘ

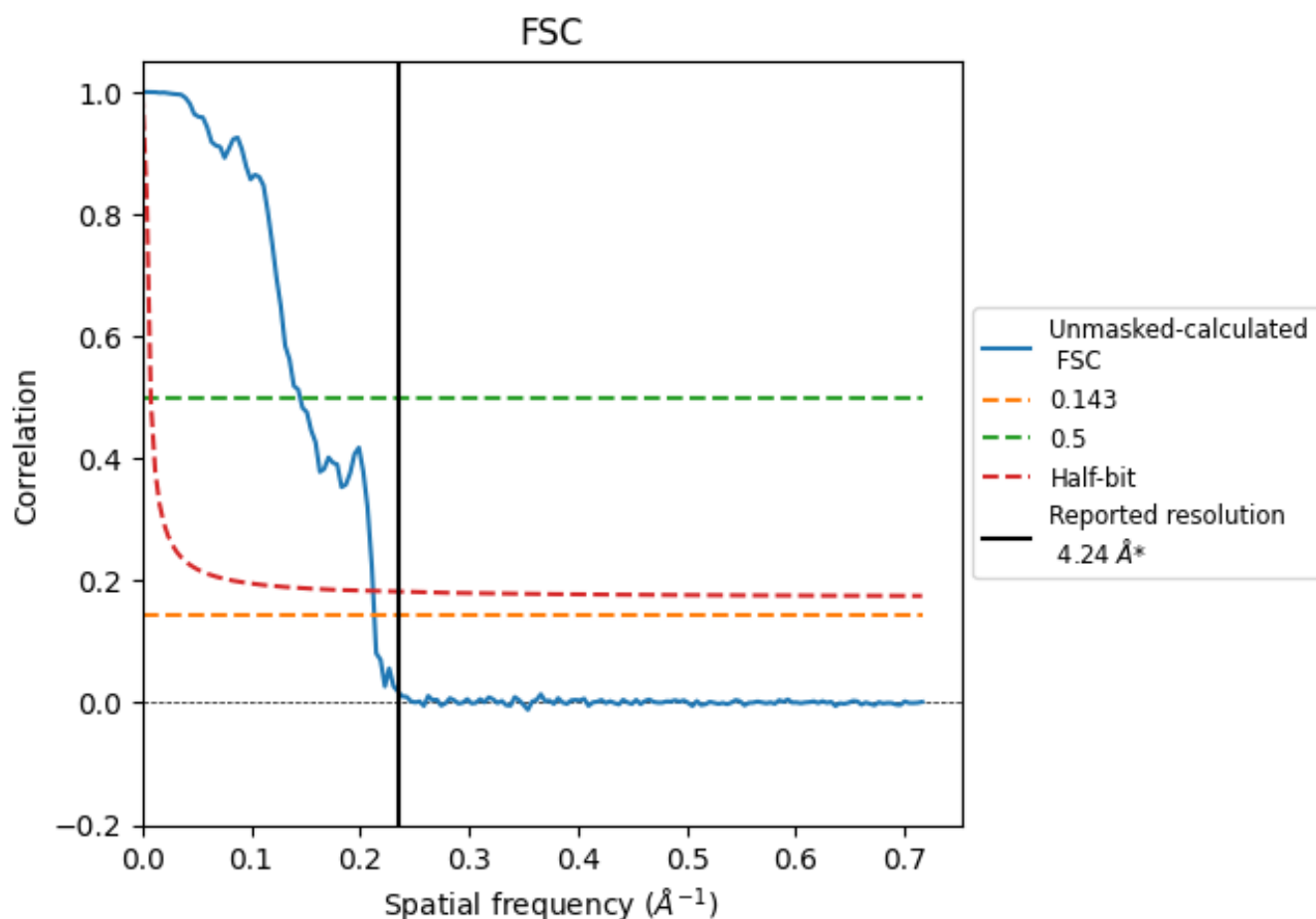


*Reported resolution corresponds to spatial frequency of 0.236 Å⁻¹

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 0.236 Å⁻¹

8.2 Resolution estimates [i](#)

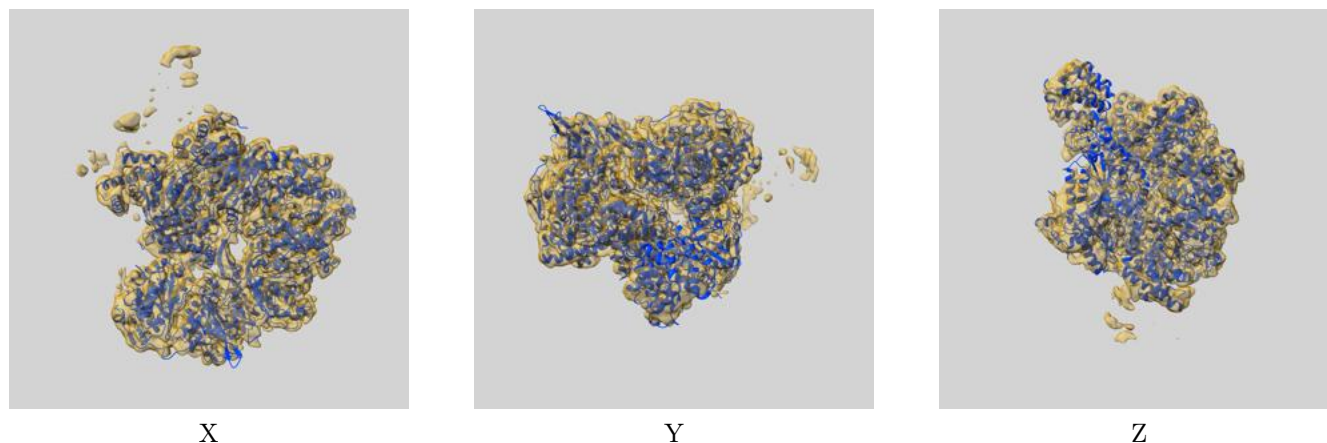
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	4.24	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	4.69	6.90	4.71

*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 4.69 differs from the reported value 4.24 by more than 10 %

9 Map-model fit [i](#)

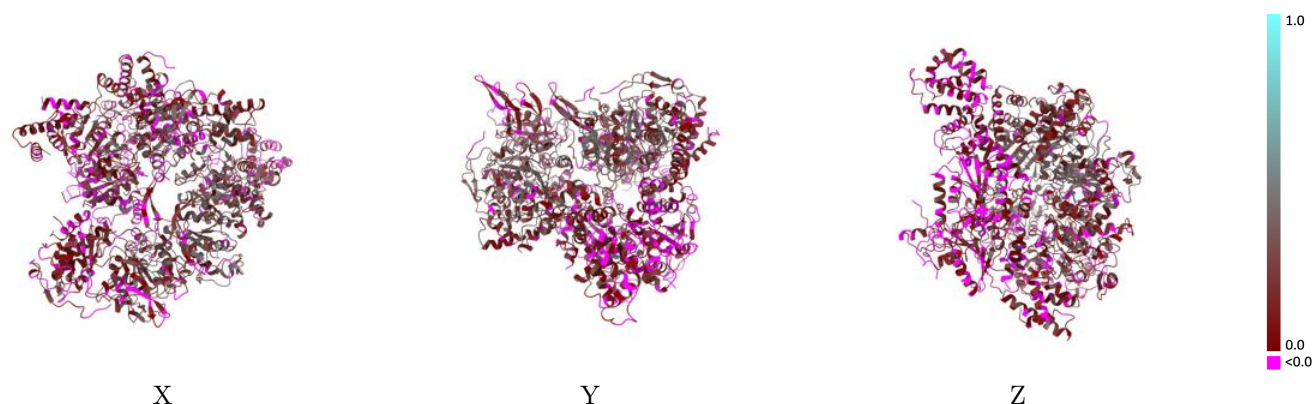
This section contains information regarding the fit between EMDB map EMD-64242 and PDB model 9UKK. Per-residue inclusion information can be found in [section 3](#) on [page 5](#).

9.1 Map-model overlay [i](#)



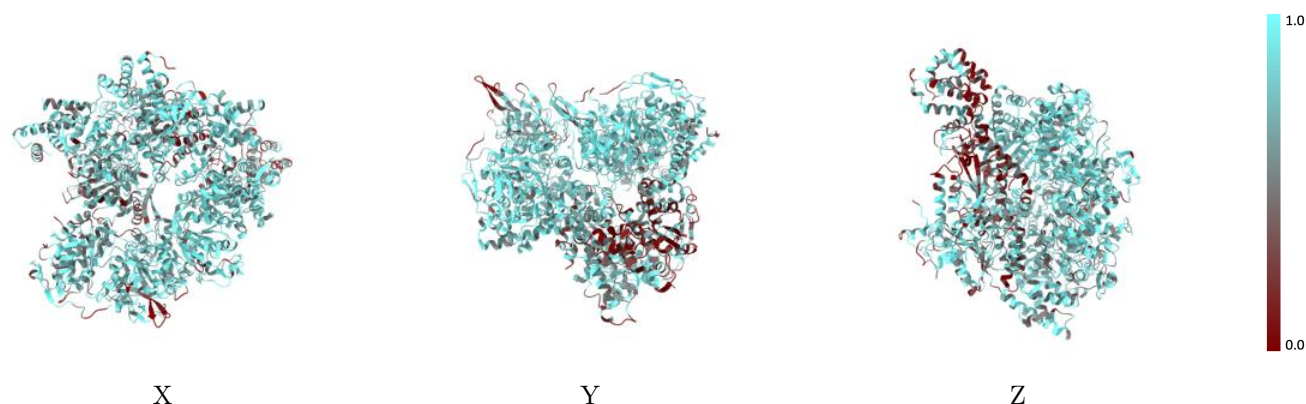
The images above show the 3D surface view of the map at the recommended contour level 0.02 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



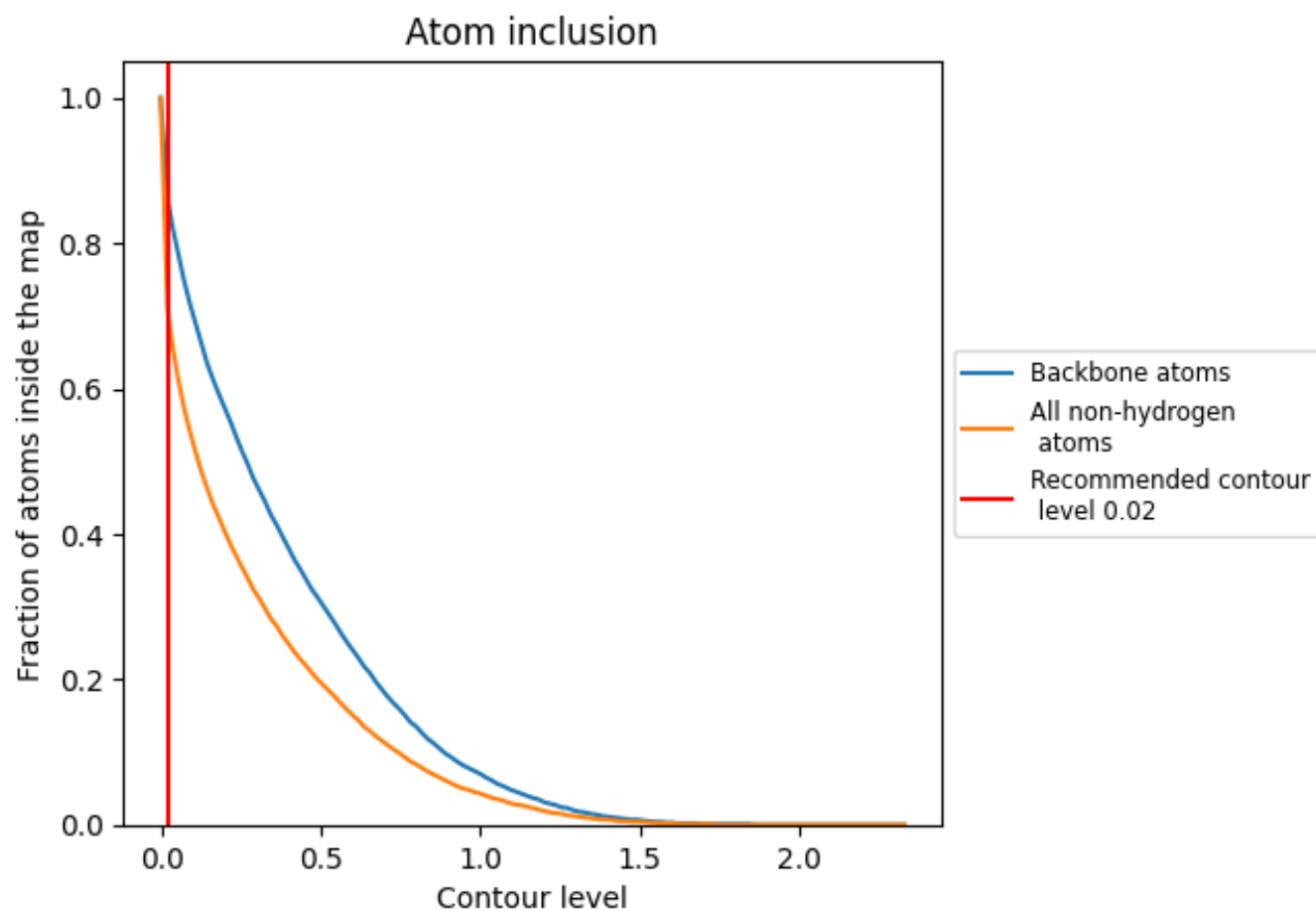
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.02).

9.4 Atom inclusion [i](#)



At the recommended contour level, 86% of all backbone atoms, 71% 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 (0.02) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.7090	0.1790
A	0.6280	0.1060
B	0.7970	0.2260
C	0.8330	0.2810
D	0.8120	0.2730
E	0.8050	0.2580
F	0.7440	0.1840
G	0.6590	0.0900
H	0.6900	0.1160
I	0.5180	0.0540
d	0.4340	0.0640

1.0

0.0

<0.0