



wwPDB EM Validation Summary Report ⓘ

Jan 13, 2026 – 12:16 PM EST

PDB ID : 9P1M / pdb_00009p1m
EMDB ID : EMD-71128
Title : Cryo-EM structure of CD73 in complex with antibody Sym024
Authors : Bansia, H.; Armbruster, E.; Des Georges, A.
Deposited on : 2025-06-10
Resolution : 2.90 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.dev129
Mogul : 2022.3.0, CSD as543be (2022)
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
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) : 2.47

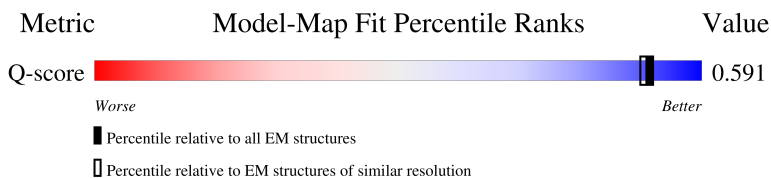
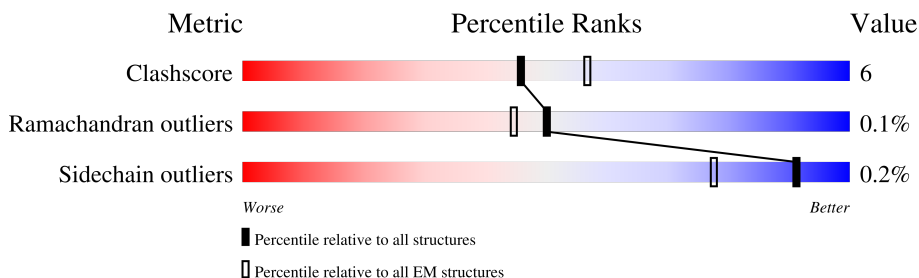
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.90 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	210492	15764	-
Ramachandran outliers	207382	16835	-
Sidechain outliers	206894	16415	-
Q-score	-	25397	13054 (2.40 - 3.40)

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	536	9% 82% 14% .
1	B	536	11% 83% 14% .
2	C	214	21% 84% 15% .
2	E	214	29% 73% 11% 15%

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Mol	Chain	Length	Quality of chain
3	D	453	43%5%52%
3	F	453	15%38%5%57%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 13874 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 5'-nucleotidase.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	517	Total	C	N	O	S	0	0
			3879	2481	649	732	17		
1	B	523	Total	C	N	O	S	0	0
			3988	2545	672	752	19		

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	550	LEU	-	expression tag	UNP P21589
A	551	GLU	-	expression tag	UNP P21589
A	552	GLY	-	expression tag	UNP P21589
A	553	SER	-	expression tag	UNP P21589
A	554	GLY	-	expression tag	UNP P21589
A	555	SER	-	expression tag	UNP P21589
A	556	HIS	-	expression tag	UNP P21589
A	557	HIS	-	expression tag	UNP P21589
A	558	HIS	-	expression tag	UNP P21589
A	559	HIS	-	expression tag	UNP P21589
A	560	HIS	-	expression tag	UNP P21589
A	561	HIS	-	expression tag	UNP P21589
B	550	LEU	-	expression tag	UNP P21589
B	551	GLU	-	expression tag	UNP P21589
B	552	GLY	-	expression tag	UNP P21589
B	553	SER	-	expression tag	UNP P21589
B	554	GLY	-	expression tag	UNP P21589
B	555	SER	-	expression tag	UNP P21589
B	556	HIS	-	expression tag	UNP P21589
B	557	HIS	-	expression tag	UNP P21589
B	558	HIS	-	expression tag	UNP P21589
B	559	HIS	-	expression tag	UNP P21589
B	560	HIS	-	expression tag	UNP P21589
B	561	HIS	-	expression tag	UNP P21589

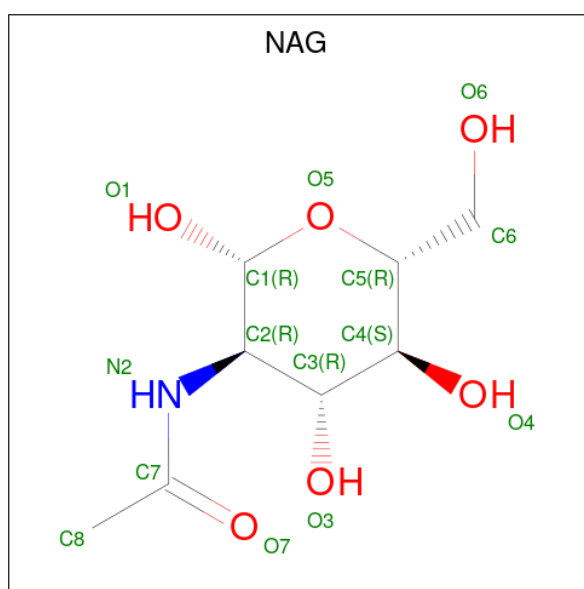
- Molecule 2 is a protein called Antibody Light Chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	C	211	Total	C	N	O	S	0	0
			1561	977	264	315	5		
2	E	181	Total	C	N	O	S	0	0
			1357	853	229	270	5		

- Molecule 3 is a protein called Antibody Heavy Chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	D	218	Total	C	N	O	S	0	0
			1609	1018	270	313	8		
3	F	193	Total	C	N	O	S	0	0
			1448	923	243	274	8		

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: $C_8H_{15}NO_6$).



Mol	Chain	Residues	Atoms				AltConf
4	A	1	Total	C	N	O	0
			14	8	1	5	
4	B	1	Total	C	N	O	0
			14	8	1	5	

- Molecule 5 is ZINC ION (CCD ID: ZN) (formula: Zn).

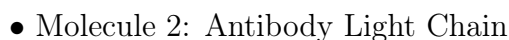
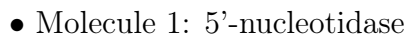
Mol	Chain	Residues	Atoms		AltConf
5	A	2	Total	Zn	0
			2	2	

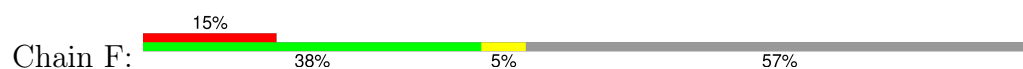
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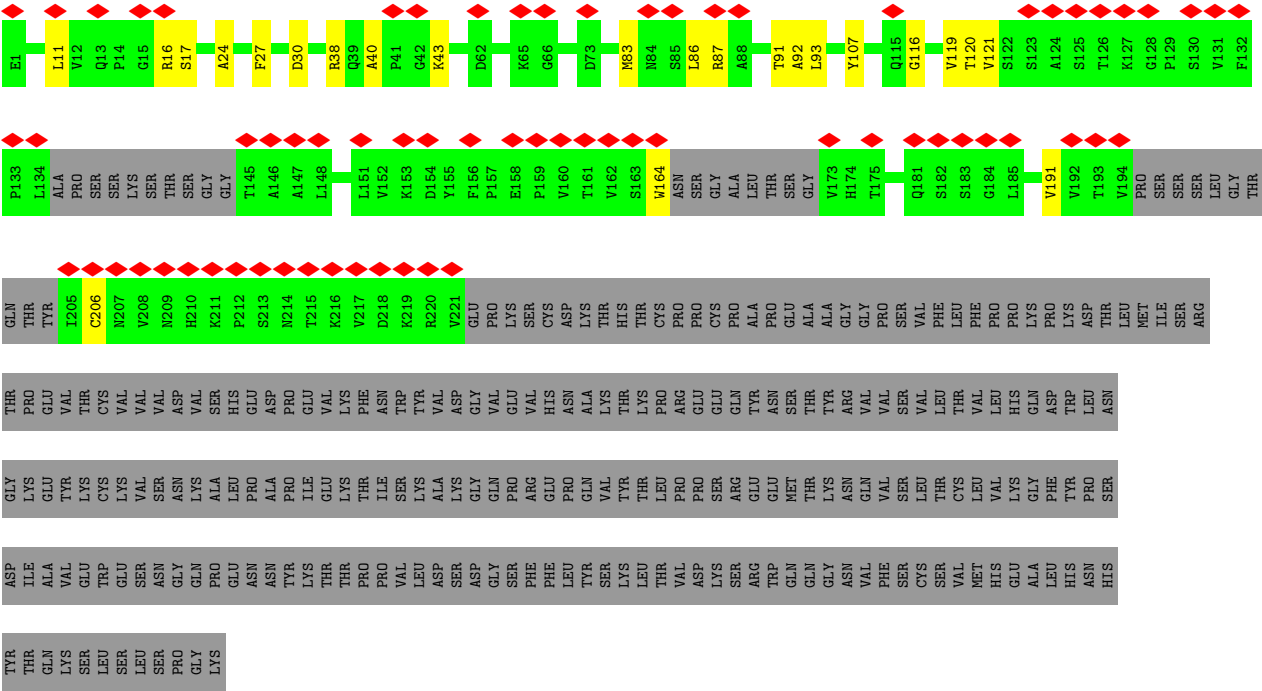
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Mol	Chain	Residues	Atoms		AltConf
			Total	Zn	
5	B	2	2	2	0

- Molecule 1: 5'-nucleotidase







4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	286779	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS TITAN THEMIS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	60	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	3000	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	4.080	Depositor
Minimum map value	-0.142	Depositor
Average map value	0.024	Depositor
Map value standard deviation	0.079	Depositor
Recommended contour level	0.735	Depositor
Map size (Å)	270.88, 270.88, 270.88	wwPDB
Map dimensions	320, 320, 320	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.84650004, 0.84650004, 0.84650004	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, NAG

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	0.26	0/3962	0.51	7/5395 (0.1%)
1	B	0.18	0/4073	0.41	1/5533 (0.0%)
2	C	0.19	0/1594	0.43	0/2175
2	E	0.19	0/1383	0.50	1/1878 (0.1%)
3	D	0.18	0/1649	0.43	1/2248 (0.0%)
3	F	0.15	0/1483	0.40	0/2017
All	All	0.20	0/14144	0.45	10/19246 (0.1%)

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	1
1	B	0	1
2	C	0	1
All	All	0	3

There are no bond length outliers.

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	142	ALA	CA-C-N	-7.63	110.61	122.37
1	A	142	ALA	C-N-CA	-7.63	110.61	122.37
1	A	89	GLY	CA-C-N	-7.23	107.74	121.54
1	A	89	GLY	C-N-CA	-7.23	107.74	121.54
3	D	223	PRO	N-CA-CB	6.20	110.15	103.33

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	328	ARG	Sidechain
1	B	356	ARG	Sidechain
2	C	24	ARG	Sidechain

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3879	0	3729	43	0
1	B	3988	0	3899	52	0
2	C	1561	0	1475	23	0
2	E	1357	0	1313	16	0
3	D	1609	0	1528	14	0
3	F	1448	0	1385	22	0
4	A	14	0	13	1	0
4	B	14	0	13	0	0
5	A	2	0	0	0	0
5	B	2	0	0	0	0
All	All	13874	0	13355	162	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 6.

The worst 5 of 162 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)
3:F:91:THR:HG23	3:F:120:THR:HA	1.31	1.10
2:C:155:GLN:HE22	2:C:179:LEU:CD1	1.71	1.03
1:A:175:GLY:HA2	1:A:218:LEU:O	1.65	0.95
1:B:170:VAL:HG23	2:E:31:ARG:HH22	1.35	0.89
1:B:372:ASN:O	1:B:376:THR:HG22	1.74	0.88

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	513/536 (96%)	498 (97%)	14 (3%)	1 (0%)	44	73
1	B	521/536 (97%)	512 (98%)	9 (2%)	0	100	100
2	C	209/214 (98%)	202 (97%)	7 (3%)	0	100	100
2	E	171/214 (80%)	169 (99%)	2 (1%)	0	100	100
3	D	214/453 (47%)	209 (98%)	5 (2%)	0	100	100
3	F	185/453 (41%)	183 (99%)	2 (1%)	0	100	100
All	All	1813/2406 (75%)	1773 (98%)	39 (2%)	1 (0%)	50	77

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	88	GLN

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	404/461 (88%)	402 (100%)	2 (0%)	86	96
1	B	428/461 (93%)	427 (100%)	1 (0%)	92	98
2	C	169/185 (91%)	169 (100%)	0	100	100
2	E	152/185 (82%)	152 (100%)	0	100	100
3	D	172/396 (43%)	172 (100%)	0	100	100
3	F	155/396 (39%)	155 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	1480/2084 (71%)	1477 (100%)	3 (0%)	91 98

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	328	ARG
1	A	446	THR
1	B	356	ARG

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

Mol	Chain	Res	Type
2	E	92	ASN
3	F	39	GLN
3	F	181	GLN
2	C	155	GLN
3	D	202	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](#)

Of 6 ligands modelled in this entry, 4 are monoatomic - leaving 2 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
4	NAG	A	601	1	14,14,15	0.68	0	17,19,21	1.62	1 (5%)
4	NAG	B	601	1	14,14,15	0.71	0	17,19,21	1.04	2 (11%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	NAG	A	601	1	-	1/6/23/26	0/1/1/1
4	NAG	B	601	1	-	1/6/23/26	0/1/1/1

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	601	NAG	C2-N2-C7	5.23	129.91	122.90
4	B	601	NAG	O5-C1-C2	-2.67	107.16	111.29
4	B	601	NAG	C1-O5-C5	2.06	114.95	112.19

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	601	NAG	C3-C2-N2-C7
4	B	601	NAG	C1-C2-N2-C7

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	601	NAG	1	0

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

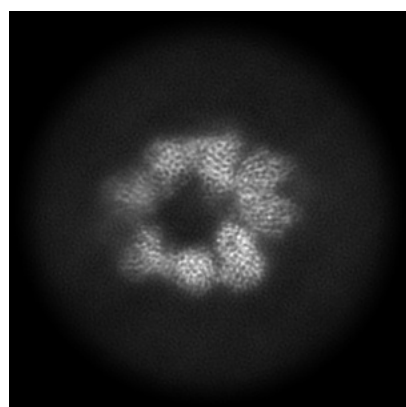
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-71128. These allow visual inspection of the internal detail of the map and identification of artifacts.

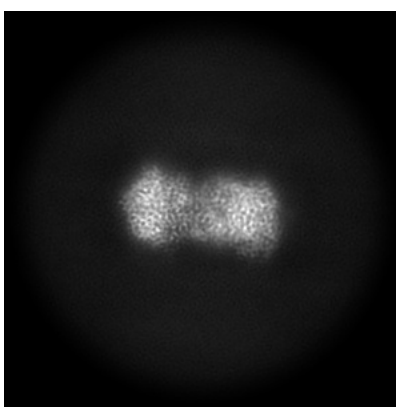
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

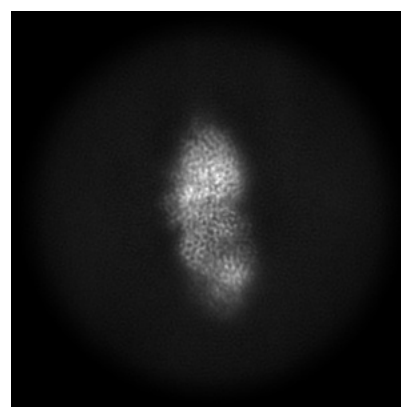
6.1.1 Primary map



X



Y

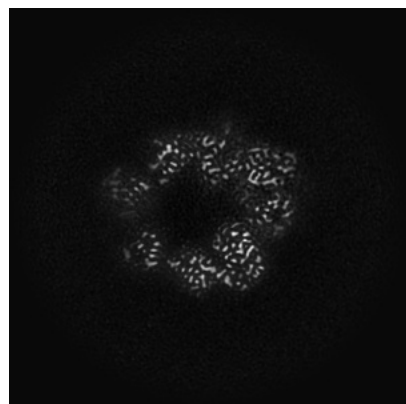


Z

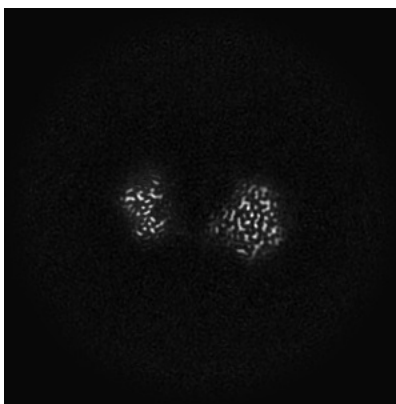
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

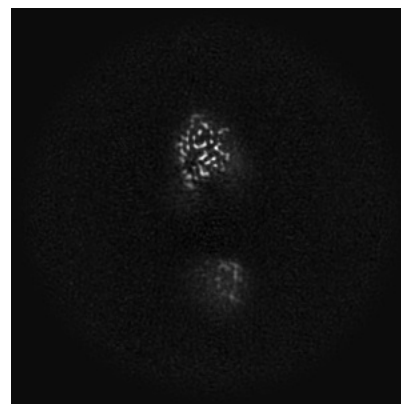
6.2.1 Primary map



X Index: 160



Y Index: 160

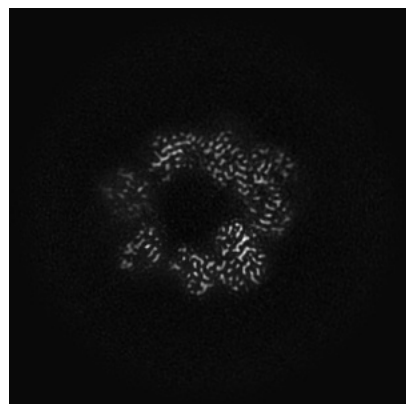


Z Index: 160

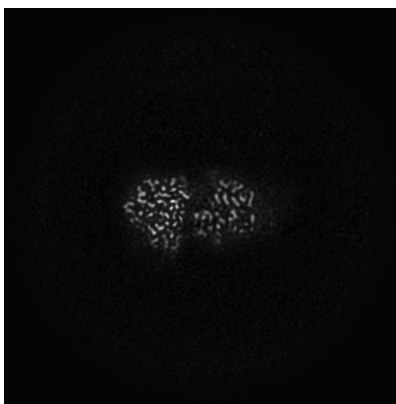
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

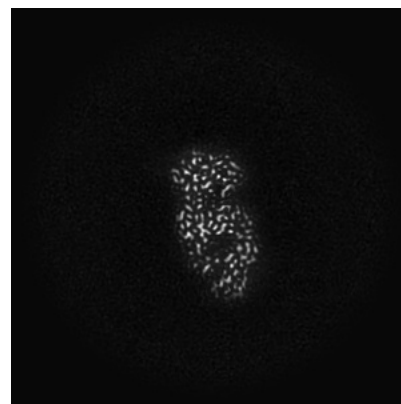
6.3.1 Primary map



X Index: 165



Y Index: 188

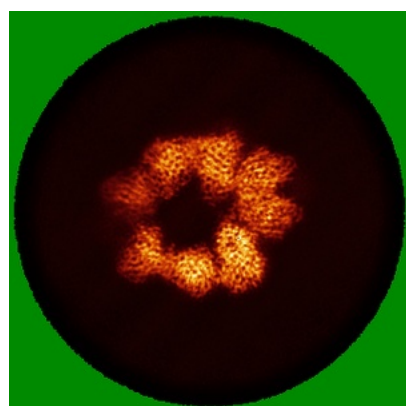


Z Index: 119

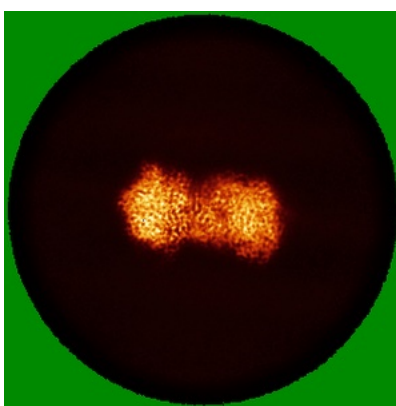
The images above show the largest variance slices of the map in three orthogonal directions.

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

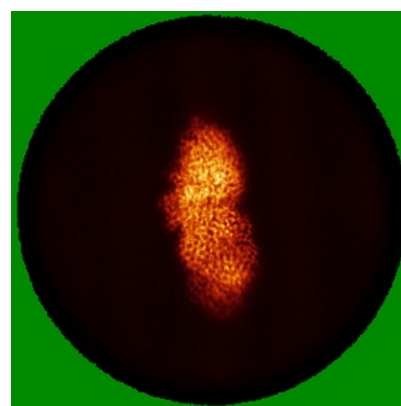
6.4.1 Primary map



X



Y

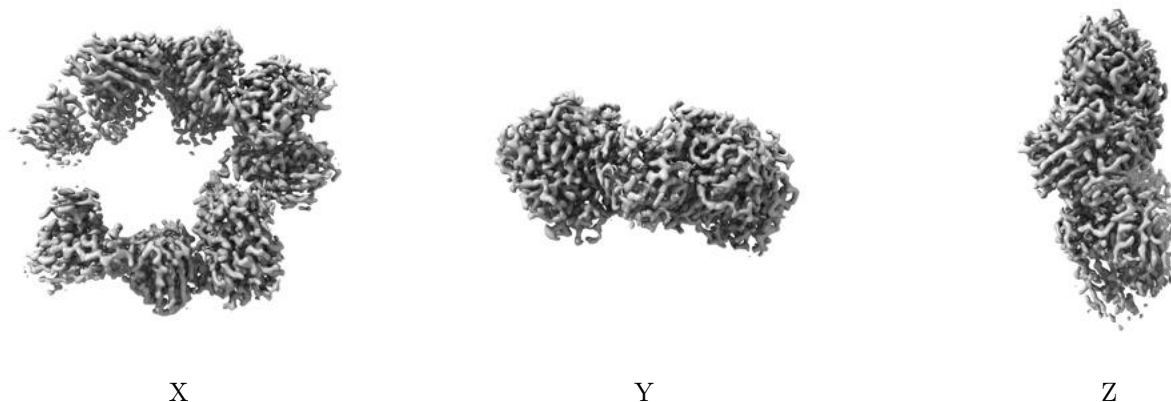


Z

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

6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.735. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

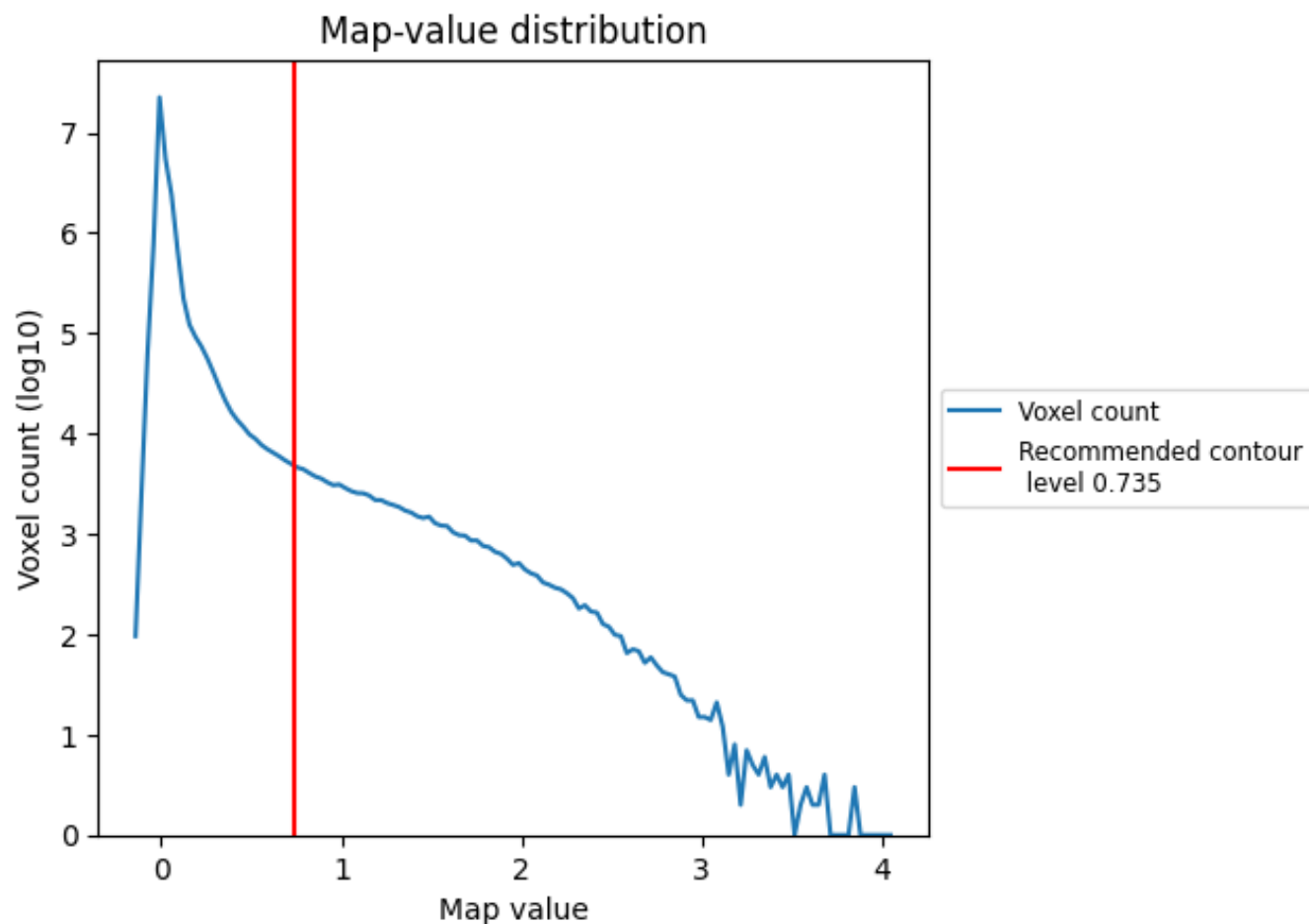
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

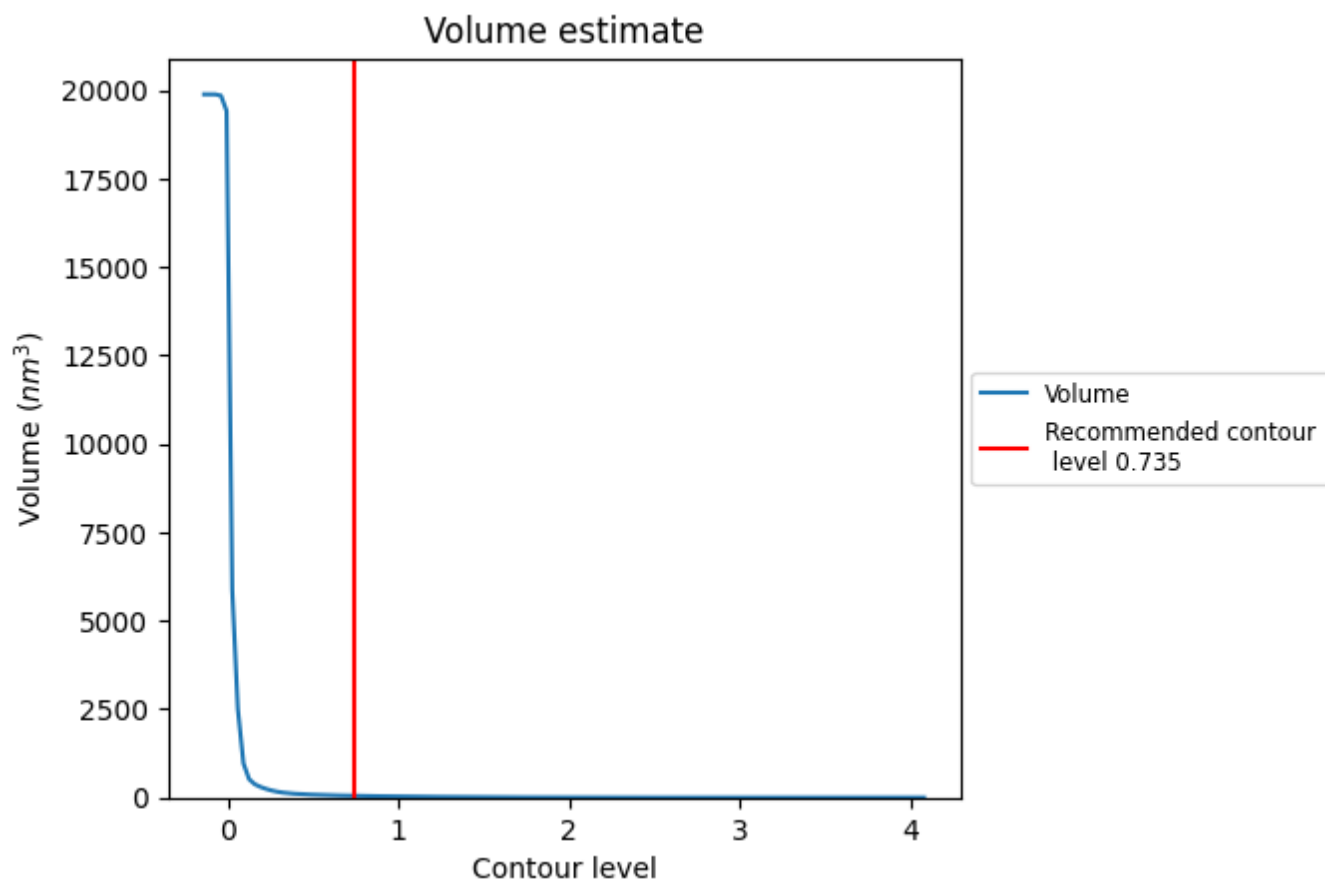
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution [i](#)



The map-value distribution is plotted in 128 intervals along the x-axis. The y-axis is logarithmic. A spike in this graph at zero usually indicates that the volume has been masked.

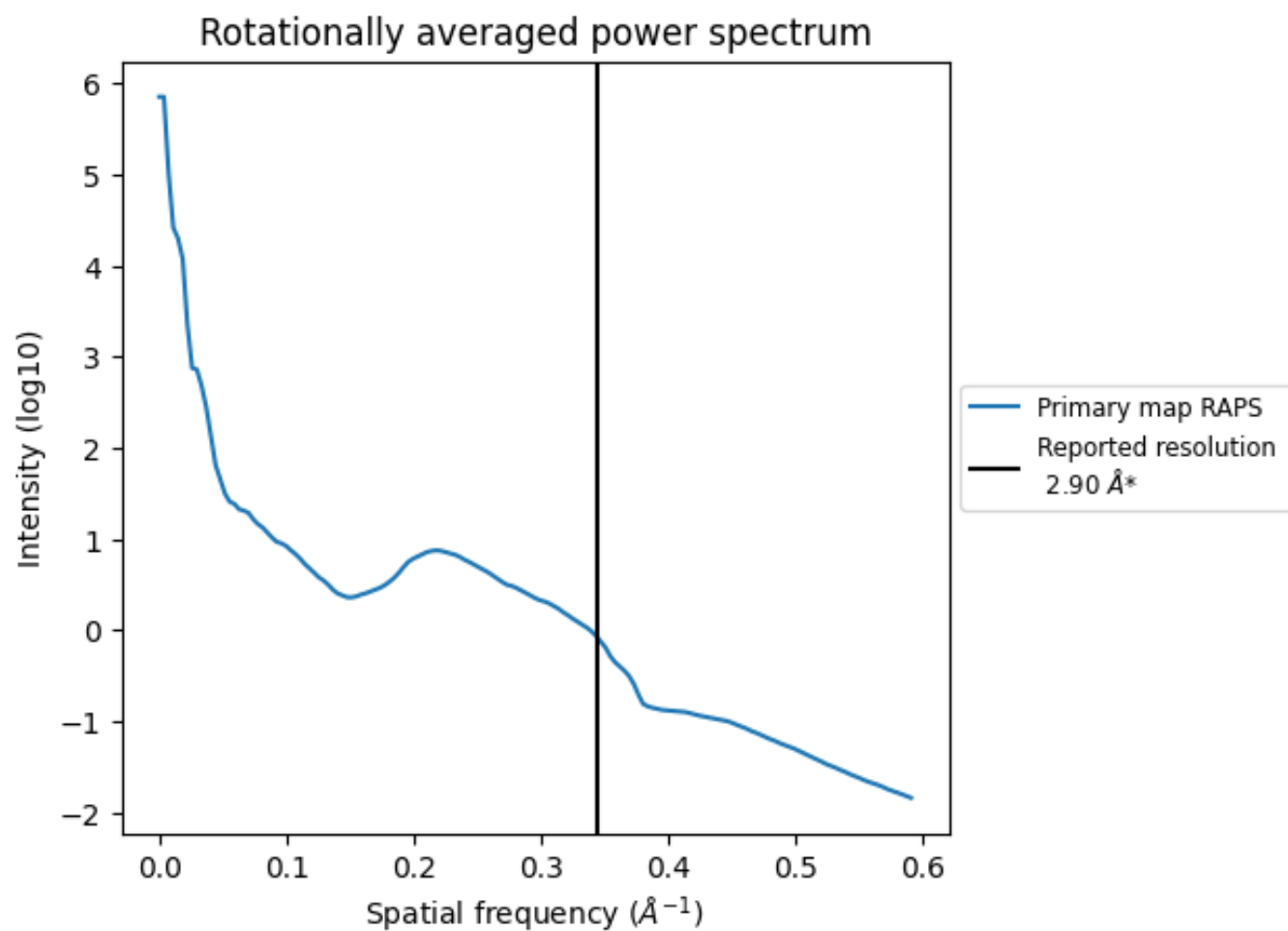
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 49 nm³; this corresponds to an approximate mass of 45 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 0.345 Å⁻¹

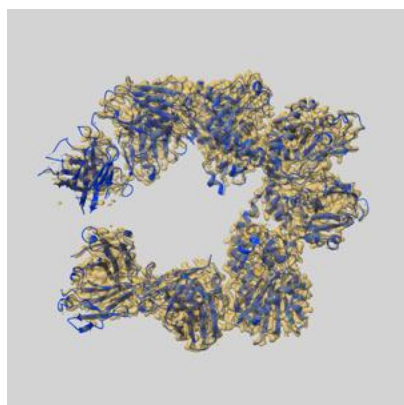
8 Fourier-Shell correlation

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

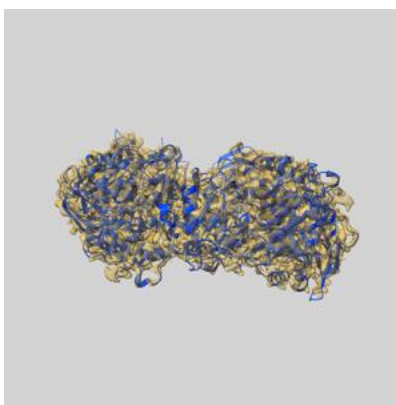
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-71128 and PDB model 9P1M. Per-residue inclusion information can be found in section [3](#) on page [7](#).

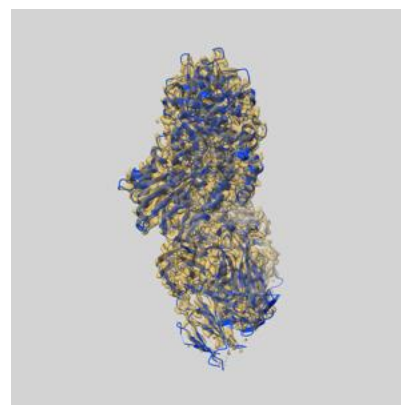
9.1 Map-model overlay [i](#)



X



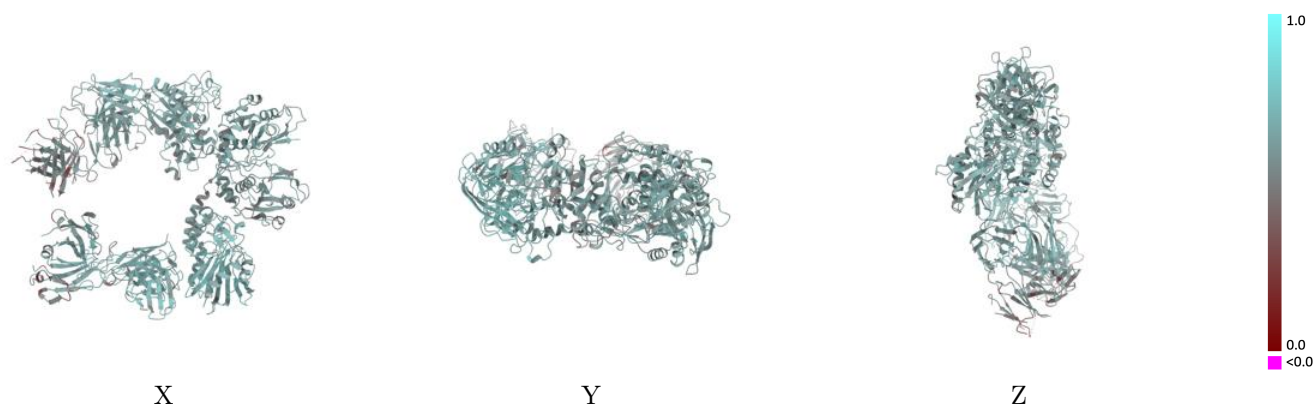
Y



Z

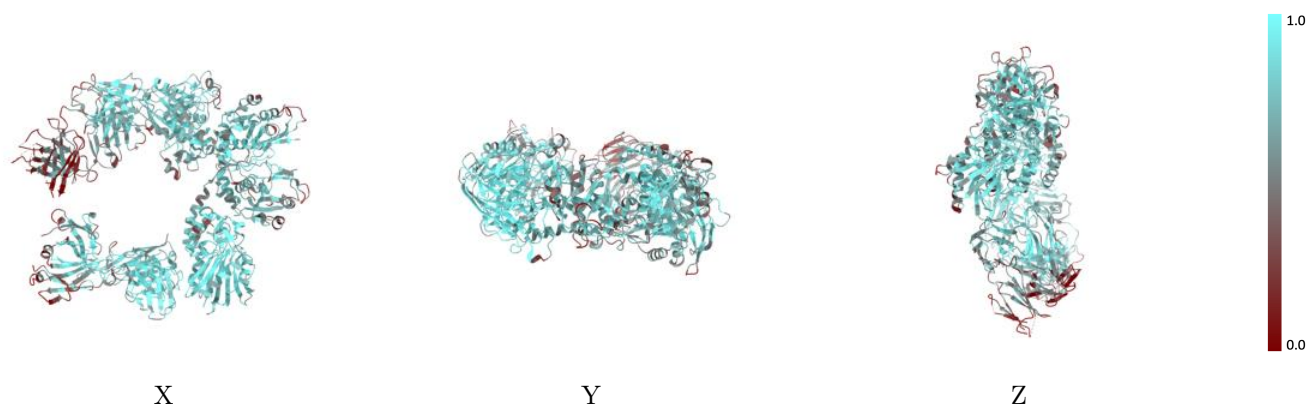
The images above show the 3D surface view of the map at the recommended contour level 0.735 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



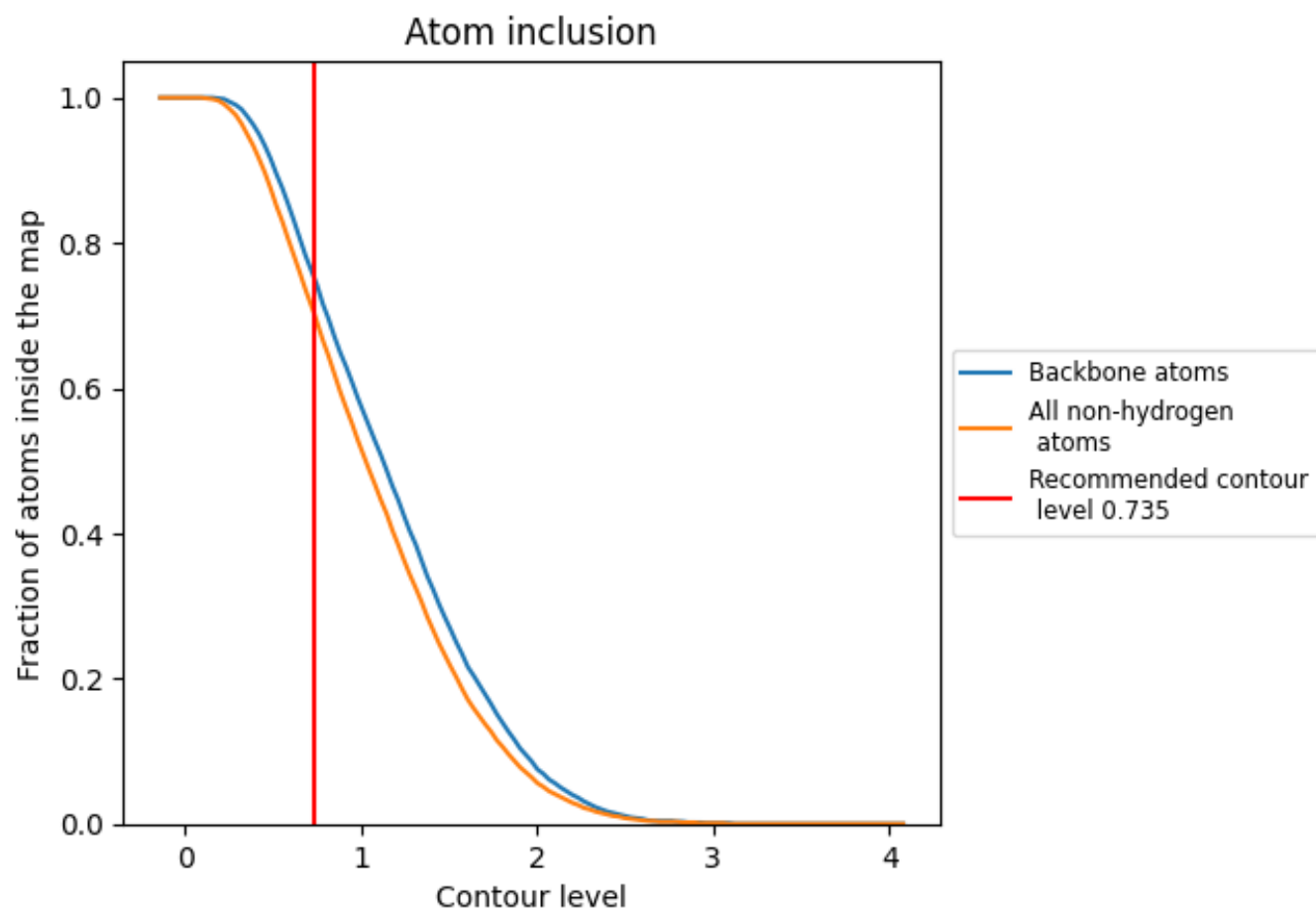
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.735).

9.4 Atom inclusion [i](#)



At the recommended contour level, 75% of all backbone atoms, 70% 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 (0.735) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.7010	0.5910
A	0.7750	0.6070
B	0.7260	0.5970
C	0.6730	0.5880
D	0.7800	0.6180
E	0.5170	0.5400
F	0.5450	0.5570

