



wwPDB EM Validation Summary Report ⓘ

Mar 6, 2026 – 07:46 PM UTC

PDB ID : 7JWB / pdb_00007jwb
EMDB ID : EMD-22514
Title : SARS CoV2 Spike ectodomain with engineered trimerized VH binder
Authors : QCRG Structural Biology Consortium
Deposited on : 2020-08-25
Resolution : 6.00 Å(reported)
Based on initial models : 4G80, 6X2B

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:

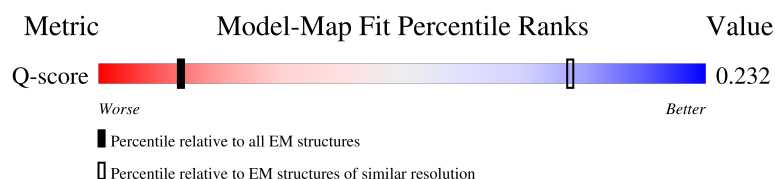
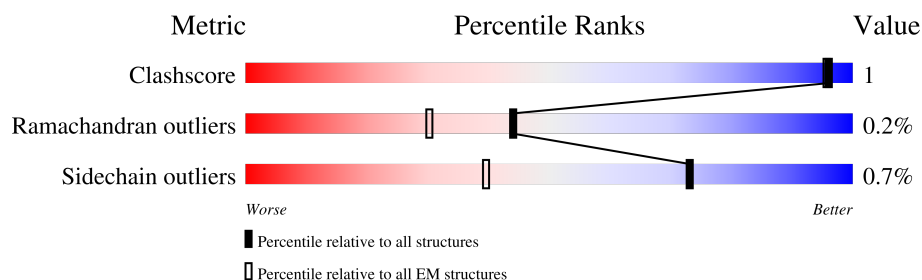
EMDB validation analysis : 0.0.1.dev132
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDb archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & 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 6.00 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	525 (5.50 - 6.50)

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	D	421	30% 84% 13%
2	A	1208	76% 6% 18%
2	B	1208	76% 6% 18%
2	C	1208	73% 5% 22%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 25654 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 autonomous human heavy chain variable domain.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	D	366	Total	C	N	O	S	0	0
			2818	1785	474	550	9		

- Molecule 2 is a protein called Spike glycoprotein.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	A	991	Total	C	N	O	S	0	0
			7738	4946	1283	1474	35		
2	B	986	Total	C	N	O	S	0	0
			7705	4919	1278	1473	35		
2	C	946	Total	C	N	O	S	0	0
			7393	4721	1228	1411	33		

There are 15 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	682	GLY	ARG	conflict	UNP P0DTC2
A	683	SER	ARG	conflict	UNP P0DTC2
A	685	SER	ARG	conflict	UNP P0DTC2
A	986	PRO	LYS	conflict	UNP P0DTC2
A	987	PRO	VAL	conflict	UNP P0DTC2
B	682	GLY	ARG	conflict	UNP P0DTC2
B	683	SER	ARG	conflict	UNP P0DTC2
B	685	SER	ARG	conflict	UNP P0DTC2
B	986	PRO	LYS	conflict	UNP P0DTC2
B	987	PRO	VAL	conflict	UNP P0DTC2
C	682	GLY	ARG	conflict	UNP P0DTC2
C	683	SER	ARG	conflict	UNP P0DTC2
C	685	SER	ARG	conflict	UNP P0DTC2
C	986	PRO	LYS	conflict	UNP P0DTC2
C	987	PRO	VAL	conflict	UNP P0DTC2



- Molecule 2: Spike glycoprotein

[illegible]

ALA	ASP	ALA	GLU
ASP	ALA	ALA	GLU
GLN	GLY	ALA	LEU
LEU	PHE	GLY	ASP
THR	ILE	LYS	TYR
PRO	LYS	PHE	GLN
THR	GLN	LYS	ASP
TRP	TYR	ASN	GLY
ARG	HIS	THR	THR
VAL	ASP	LEU	PRO
TYR	CYS	GLY	ASP
SER	LEU	ASP	VAL
THR	GLY	ALA	LEU
GLY	ASP	GLY	ASP
SER	ASP	ASP	GLY
N641	ALA	ASP	ASP
E661	ALA	ASP	ASP
C671	ARG	ASP	ASP
T676	ASP	ASP	ASP
GLN	GLN	ASP	ASP
THR	GLN	ASP	ASP
ASN	ALA	ASP	ASP
SER	ALA	ASP	ASP
PRO	ALA	ASP	ASP
GLY	ALA	ASP	ASP
SER	ALA	ASP	ASP
ALA	ALA	ASP	ASP
SER	ALA	ASP	ASP
VAL	ALA	ASP	ASP
ALA	ALA	ASP	ASP
S689	ALA	ASP	ASP
F718	ALA	ASP	ASP
V736	ALA	ASP	ASP
L753	ALA	ASP	ASP
N764	ALA	ASP	ASP
K776	ALA	ASP	ASP
T791	ALA	ASP	ASP
P792	ALA	ASP	ASP
D808	ALA	ASP	ASP
K811	ALA	ASP	ASP
PRO	ALA	ASP	ASP
S813	ALA	ASP	ASP
D820	ALA	ASP	ASP
T827	ALA	ASP	ASP
LEU	ALA	ASP	ASP
ALA	ALA	ASP	ASP

ASP	ASP	ASP	ASP
ALA	ALA	ALA	ALA
PHE	PHE	PHE	PHE
ILE	ILE	ILE	ILE
LYS	LYS	LYS	LYS
GLN	GLN	GLN	GLN
TYR	TYR	TYR	TYR
GLY	GLY	GLY	GLY
ASP	ASP	ASP	ASP
VAL	VAL	VAL	VAL
LEU	LEU	LEU	LEU
ALA	ALA	ALA	ALA
ARG	ARG	ARG	ARG
ASP	ASP	ASP	ASP
LEU	LEU	LEU	LEU
ILE	ILE	ILE	ILE
CYS	CYS	CYS	CYS
ALA	ALA	ALA	ALA
GLN	GLN	GLN	GLN
K854	GLN	GLN	GLN
P862	GLN	GLN	GLN
D867	GLN	GLN	GLN
G908	GLN	GLN	GLN
D985	GLN	GLN	GLN
K1028	GLN	GLN	GLN
K1038	GLN	GLN	GLN
R1039	GLN	GLN	GLN
F1042	GLN	GLN	GLN
T1077	GLN	GLN	GLN
A1078	GLN	GLN	GLN
T1081	GLN	GLN	GLN
D1084	GLN	GLN	GLN
E1111	GLN	GLN	GLN
D1139	GLN	GLN	GLN
Q1142	GLN	GLN	GLN
P1143	GLN	GLN	GLN
E1144	GLN	GLN	GLN
LEU	GLN	GLN	GLN
ASP	GLN	GLN	GLN
SER	GLN	GLN	GLN
PHE	GLN	GLN	GLN
LYS	GLN	GLN	GLN

GLU	GLU	GLU	GLU
GLU	GLU	GLU	GLU
LEU	LEU	LEU	LEU
ASP	ASP	ASP	ASP
LYS	LYS	LYS	LYS
PHE	PHE	PHE	PHE
GLN	GLN	GLN	GLN
TYR	TYR	TYR	TYR
ASN	ASN	ASN	ASN
HIS	HIS	HIS	HIS
ASP	ASP	ASP	ASP
THR	THR	THR	THR
SER	SER	SER	SER
LEU	LEU	LEU	LEU
PRO	PRO	PRO	PRO
ASP	ASP	ASP	ASP
VAL	VAL	VAL	VAL
ASP	ASP	ASP	ASP
LEU	LEU	LEU	LEU
ALA	ALA	ALA	ALA
GLY	GLY	GLY	GLY
ASP	ASP	ASP	ASP
ILE	ILE	ILE	ILE
SER	SER	SER	SER
GLY	GLY	GLY	GLY
ILE	ILE	ILE	ILE
ALA	ALA	ALA	ALA
ASN	ASN	ASN	ASN
ALA	ALA	ALA	ALA
SER	SER	SER	SER
VAL	VAL	VAL	VAL
VAL	VAL	VAL	VAL
ASN	ASN	ASN	ASN
ILE	ILE	ILE	ILE
ILE	ILE	ILE	ILE
LYS	LYS	LYS	LYS
GLU	GLU	GLU	GLU
ILE	ILE	ILE	ILE
ASP	ASP	ASP	ASP
ASP	ASP	ASP	ASP
LEU	LEU	LEU	LEU
GLN	GLN	GLN	GLN
GLU	GLU	GLU	GLU
LEU	LEU	LEU	LEU
GLY	GLY	GLY	GLY
LYS	LYS	LYS	LYS
TYR	TYR	TYR	TYR
GLU	GLU	GLU	GLU
PHE	PHE	PHE	PHE
GLN	GLN	GLN	GLN
LYS	LYS	LYS	LYS

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, POINT	Depositor
Number of particles used	21000, 21000	Depositor
Resolution determination method	OTHER, FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION, PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	78	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	0.641	Depositor
Minimum map value	-0.141	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.022	Depositor
Recommended contour level	0.08	Depositor
Map size ($\text{\AA}$)	427.008, 427.008, 427.008	wwPDB
Map dimensions	512, 512, 512	wwPDB
Map angles ($^\circ$)	90.0, 90.0, 90.0	wwPDB
Pixel spacing ($\text{\AA}$)	0.834, 0.834, 0.834	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	D	0.91	0/2884	1.22	10/3906 (0.3%)
2	A	0.96	1/7910 (0.0%)	1.29	63/10759 (0.6%)
2	B	0.95	4/7875 (0.1%)	1.27	62/10710 (0.6%)
2	C	0.95	3/7552 (0.0%)	1.28	66/10265 (0.6%)
All	All	0.95	8/26221 (0.0%)	1.27	201/35640 (0.6%)

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	363	ALA	CA-C	-7.37	1.45	1.53
2	B	362	VAL	CA-CB	-6.32	1.46	1.53
2	B	242	LEU	CB-CG	5.99	1.65	1.53
2	C	242	LEU	CB-CG	5.93	1.65	1.53
2	C	81	ASN	C-N	5.89	1.40	1.33

The worst 5 of 201 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	213	VAL	N-CA-C	9.36	119.48	111.90
2	B	231	ILE	N-CA-C	9.22	119.74	111.81
2	C	1139	ASP	CA-C-N	8.31	128.03	119.56
2	C	1139	ASP	C-N-CA	8.31	128.03	119.56
2	A	661	GLU	N-CA-C	-7.66	99.12	110.23

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	D	2818	0	2676	2	0
2	A	7738	0	7562	16	0
2	B	7705	0	7514	13	0
2	C	7393	0	7219	15	0
All	All	25654	0	24971	43	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 1.

The worst 5 of 43 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:332:ILE:HB	2:B:362:VAL:HG21	1.66	0.78
1:D:100:ARG:HB3	1:D:116:TYR:HB2	1.75	0.68
2:B:332:ILE:HG21	2:B:527:PRO:HA	1.77	0.65
2:A:954:GLN:HB3	2:A:1014:ARG:HE	1.69	0.56
2:C:811:LYS:NZ	2:C:820:ASP:OD2	2.39	0.55

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	D	354/421 (84%)	354 (100%)	0	0	100	100
2	A	971/1208 (80%)	948 (98%)	21 (2%)	2 (0%)	43	77
2	B	964/1208 (80%)	946 (98%)	16 (2%)	2 (0%)	43	77
2	C	918/1208 (76%)	897 (98%)	20 (2%)	1 (0%)	48	83
All	All	3207/4045 (79%)	3145 (98%)	57 (2%)	5 (0%)	44	77

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	32	PHE
2	A	333	THR
2	A	1112	PRO
2	B	1036	GLN
2	C	32	PHE

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	D	288/311 (93%)	285 (99%)	3 (1%)	68	78
2	A	866/1053 (82%)	863 (100%)	3 (0%)	86	85
2	B	864/1053 (82%)	855 (99%)	9 (1%)	68	78
2	C	829/1053 (79%)	825 (100%)	4 (0%)	81	83
All	All	2847/3470 (82%)	2828 (99%)	19 (1%)	73	81

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	1107	ARG
2	C	382	VAL
2	C	1039	ARG
2	C	186	PHE
2	B	324	GLU

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	B	919	ASN
2	C	655	HIS
2	C	1058	HIS
2	A	122	ASN
2	A	317	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.

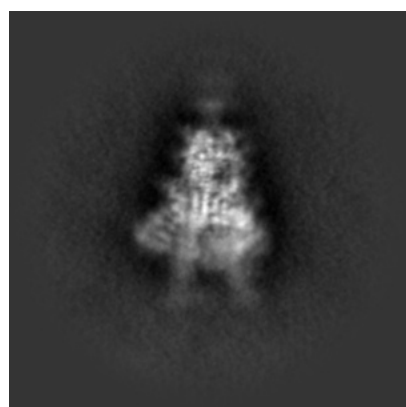
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-22514. These allow visual inspection of the internal detail of the map and identification of artifacts.

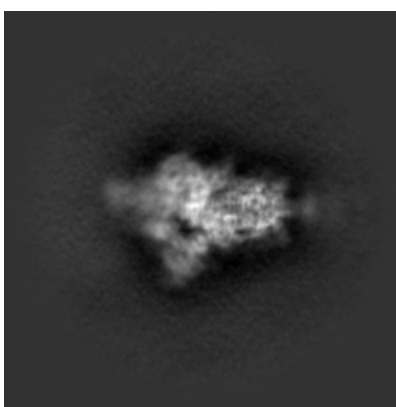
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

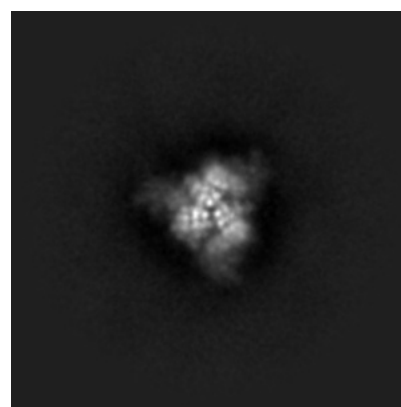
6.1.1 Primary map



X



Y

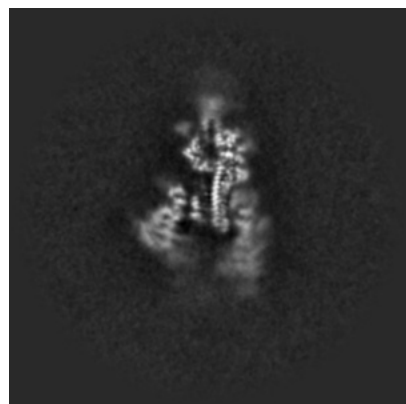


Z

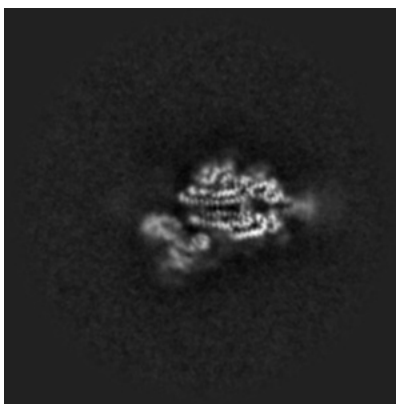
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

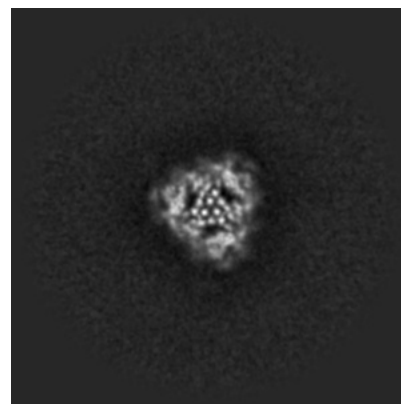
6.2.1 Primary map



X Index: 256



Y Index: 256

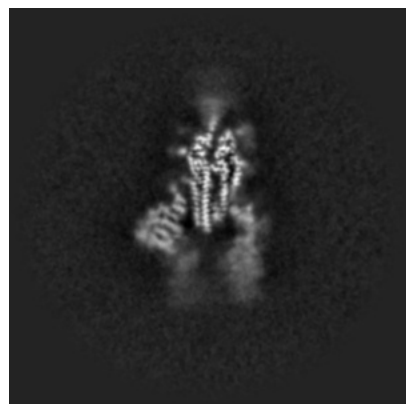


Z Index: 256

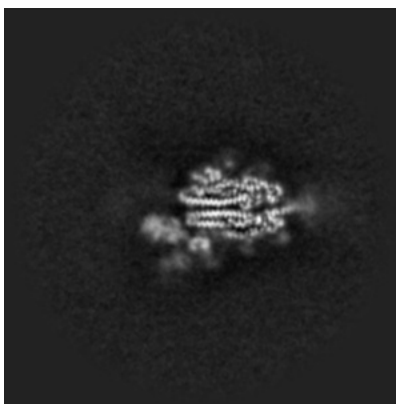
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

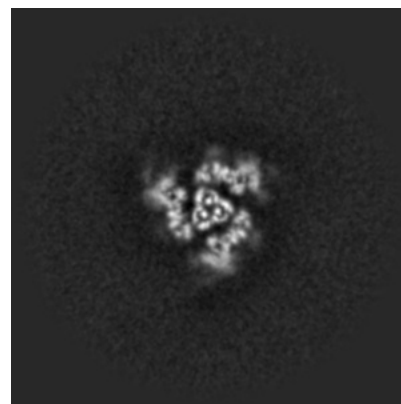
6.3.1 Primary map



X Index: 265



Y Index: 251

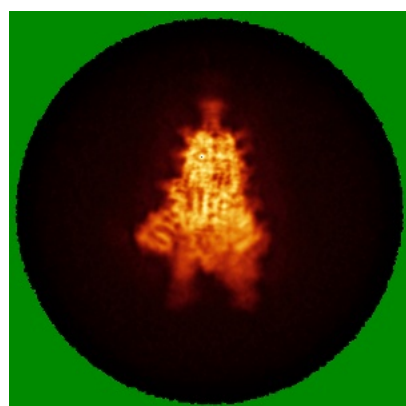


Z Index: 242

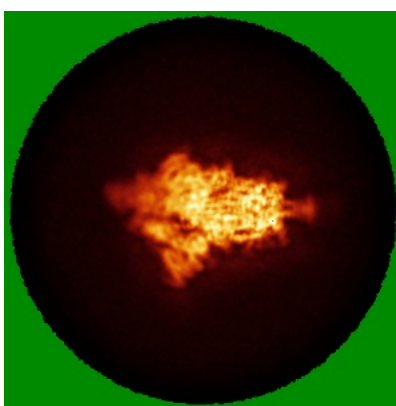
The images above show the largest variance slices of the map in three orthogonal directions.

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

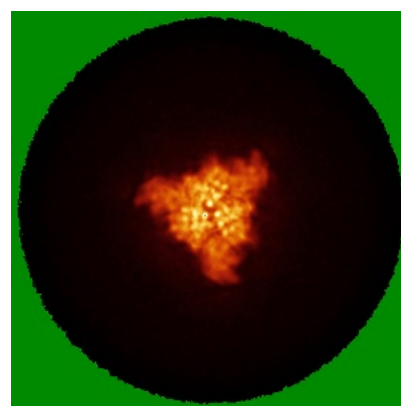
6.4.1 Primary map



X



Y

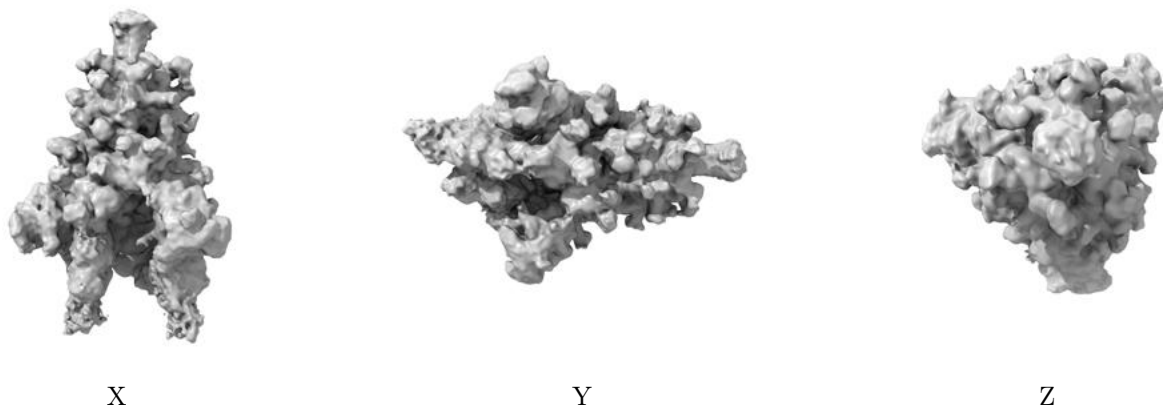


Z

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 0.08. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

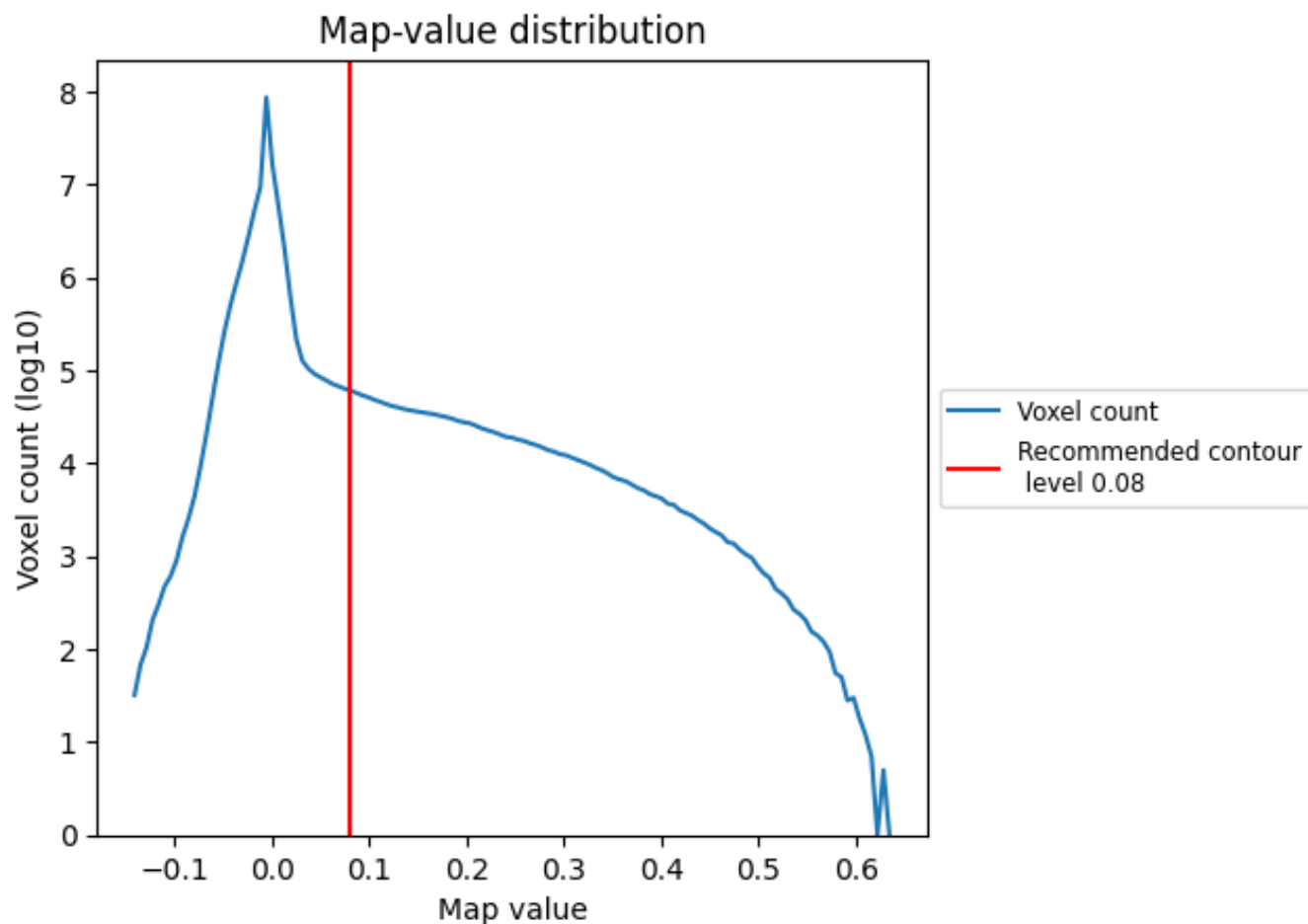
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

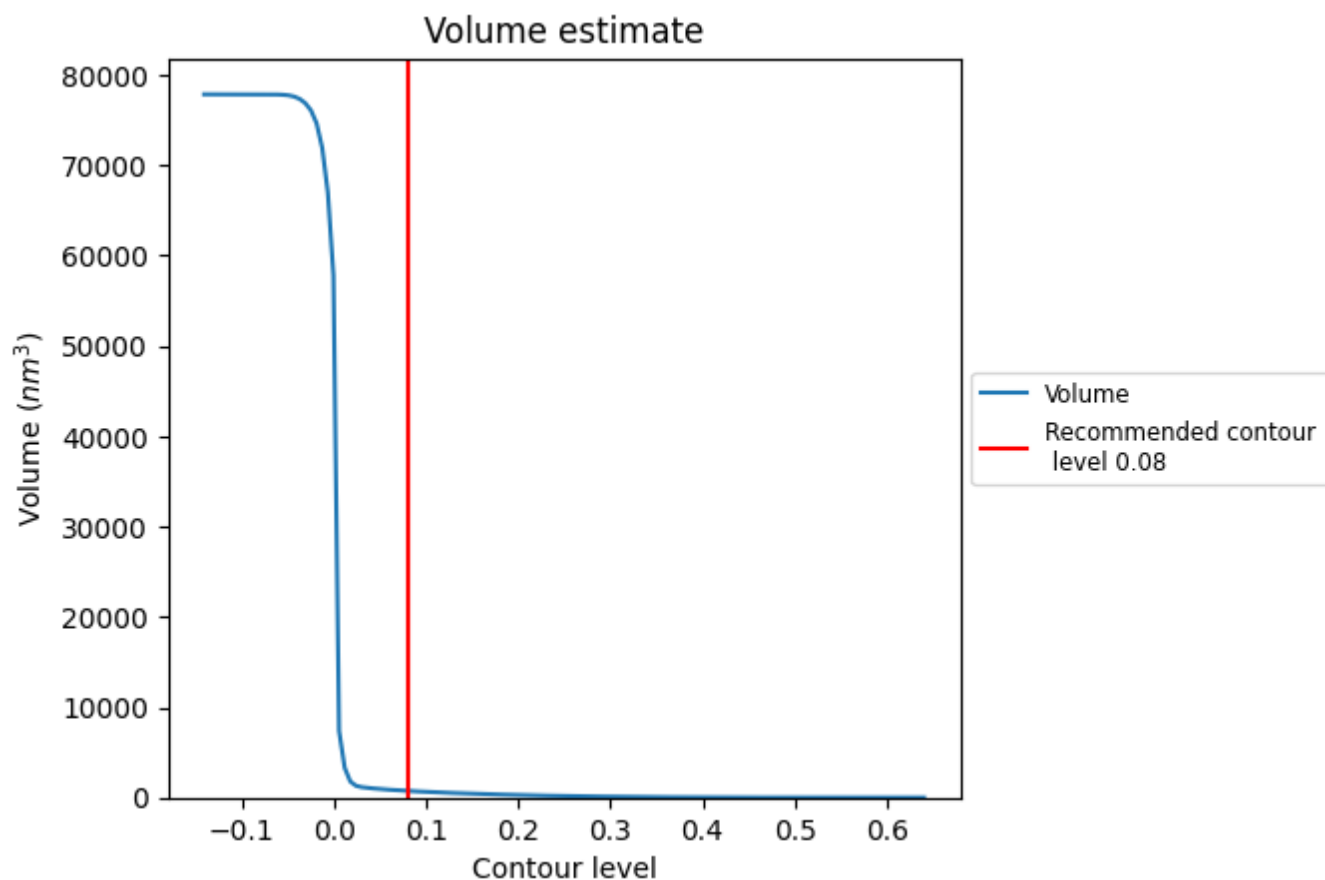
This section contains the results of statistical analysis of the map.

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.

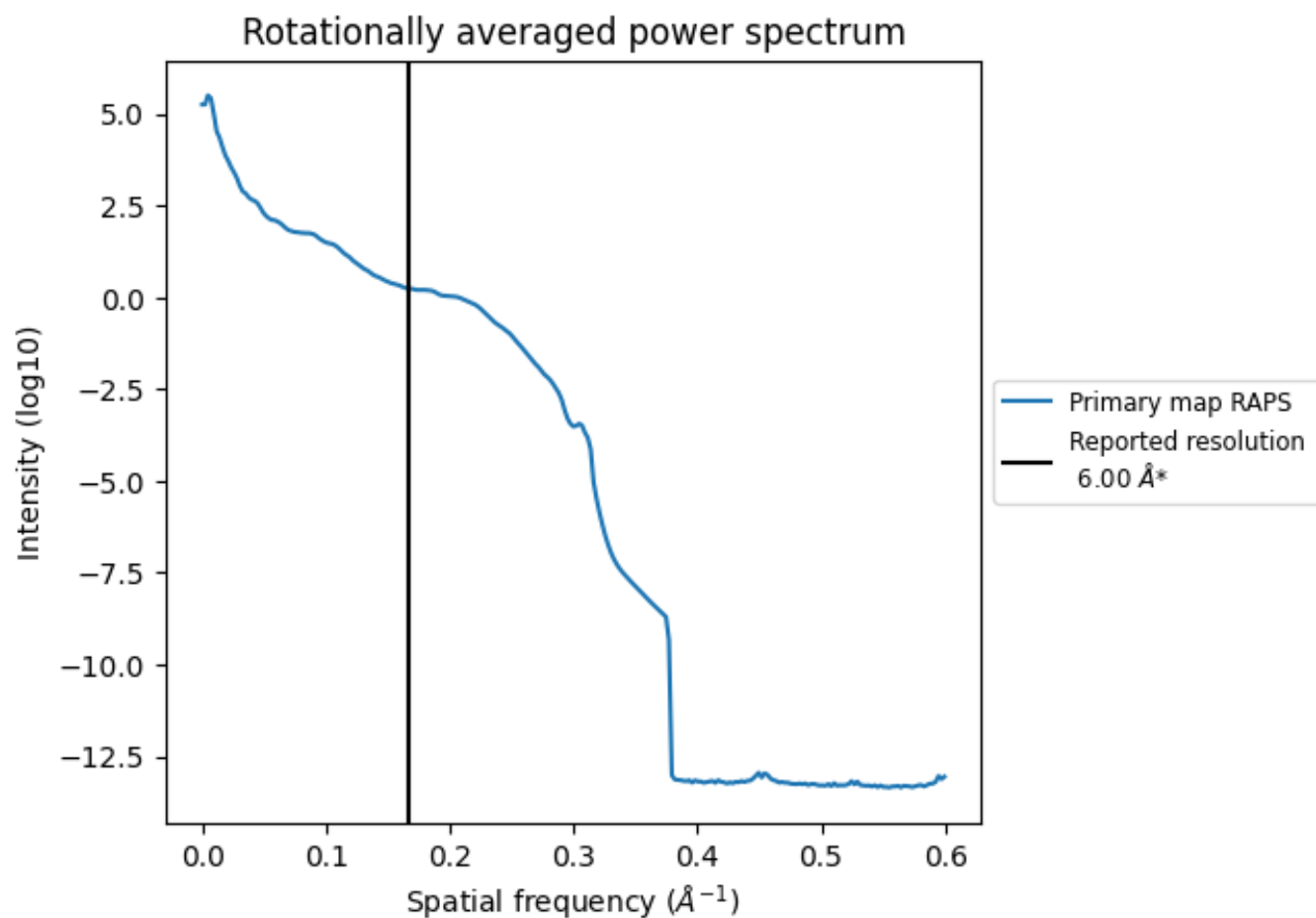
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 739 nm³; this corresponds to an approximate mass of 668 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 ⓘ

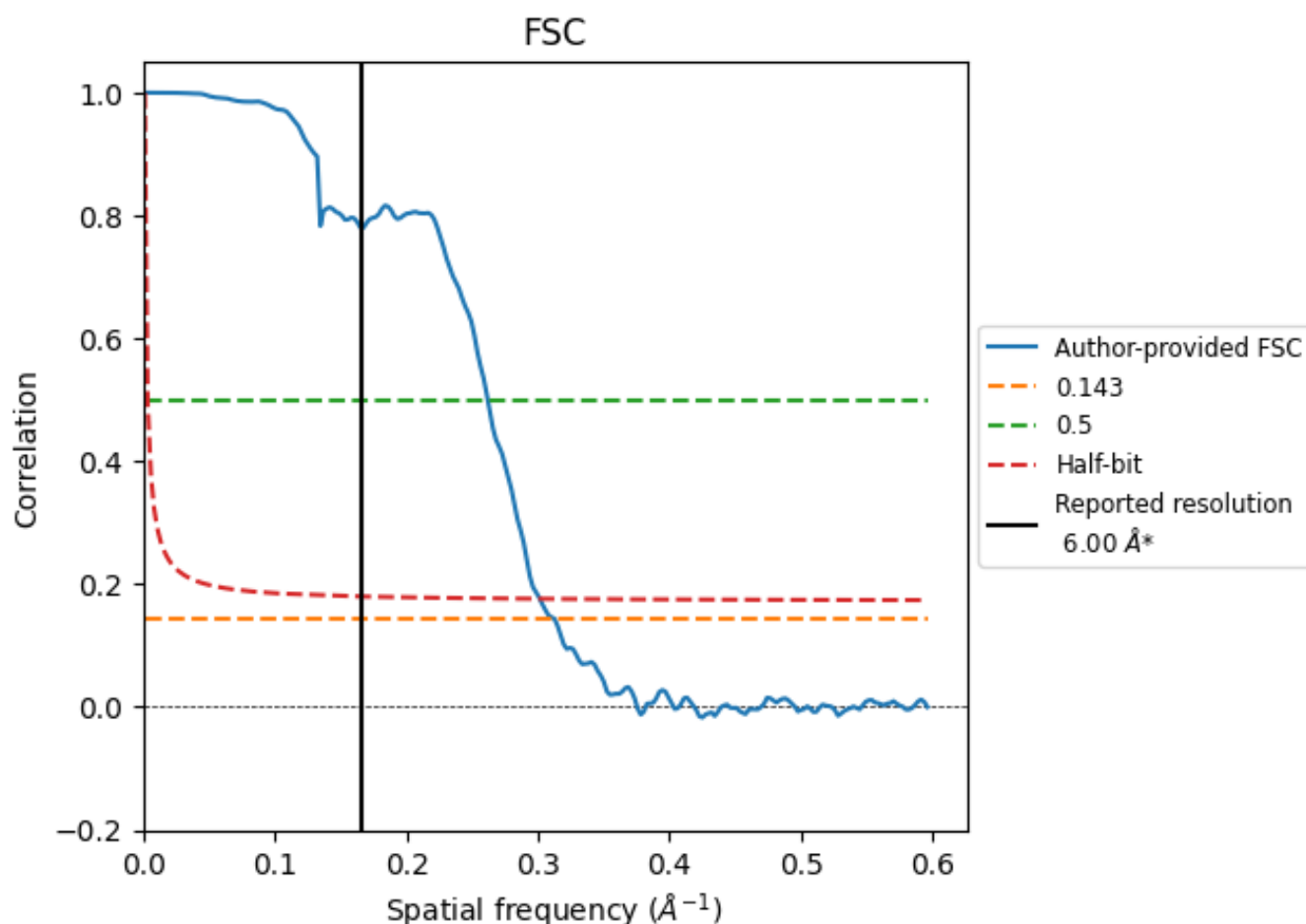


*Reported resolution corresponds to spatial frequency of 0.167 Å⁻¹

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 0.167 Å⁻¹

8.2 Resolution estimates [i](#)

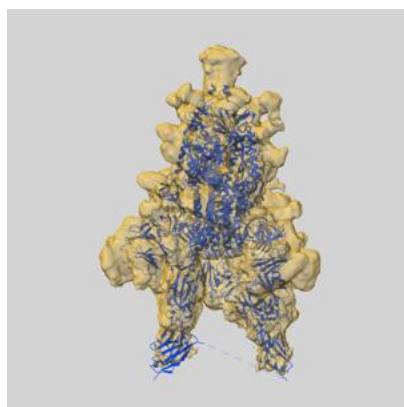
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	-	-	-
Author-provided FSC curve	3.20	3.82	3.32
Unmasked-calculated*	-	-	-

*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps.

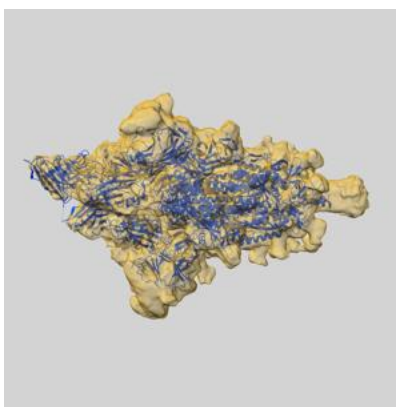
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-22514 and PDB model 7JWB. Per-residue inclusion information can be found in [section 3](#) on [page 4](#).

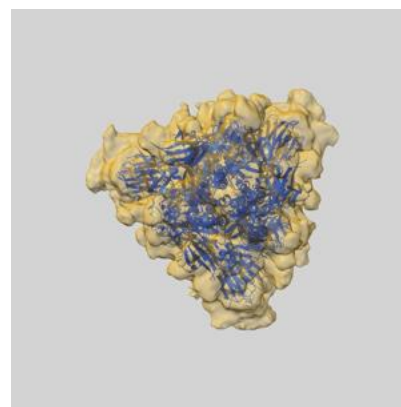
9.1 Map-model overlay [i](#)



X



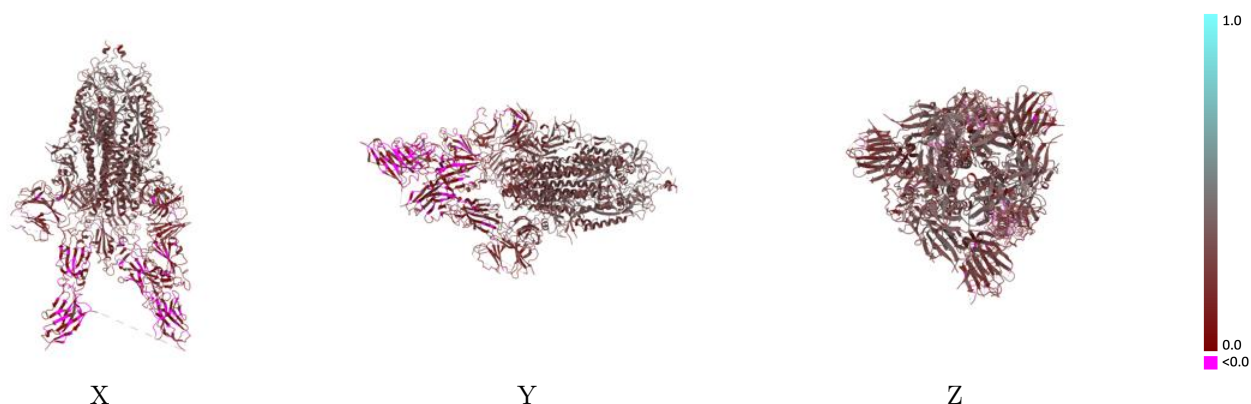
Y



Z

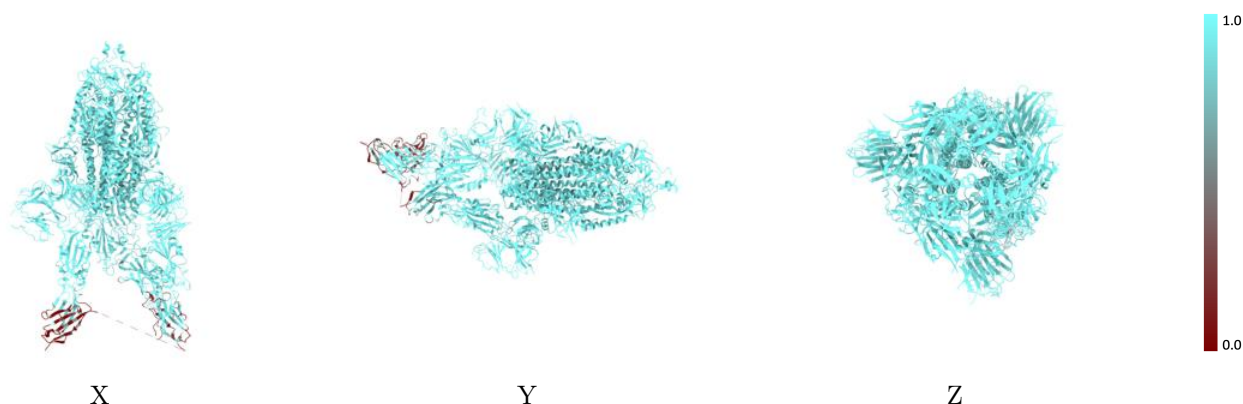
The images above show the 3D surface view of the map at the recommended contour level 0.08 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



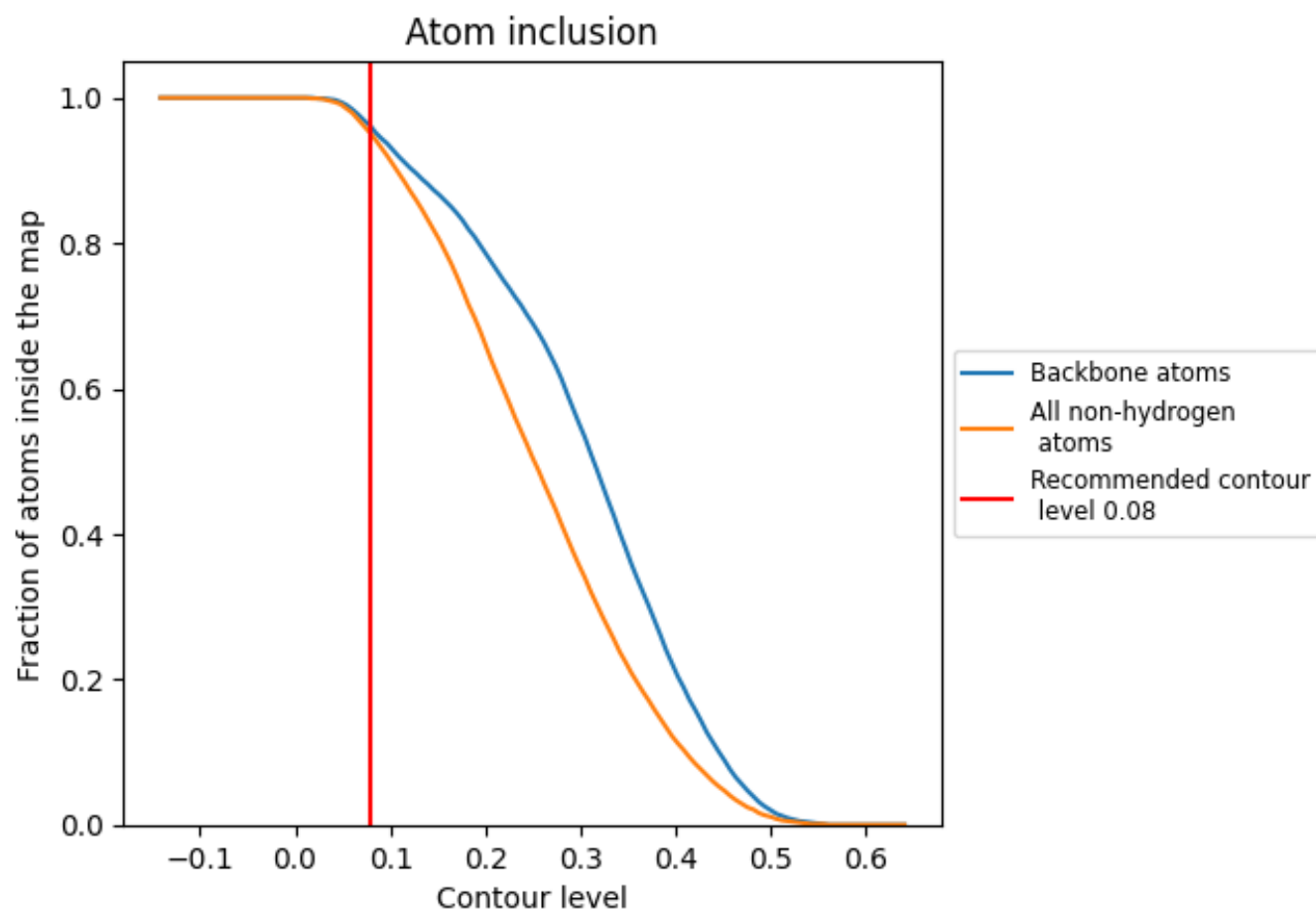
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.08).

9.4 Atom inclusion [i](#)



At the recommended contour level, 96% of all backbone atoms, 95% 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 (0.08) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.9500	0.2320
A	0.9900	0.2560
B	0.9830	0.2520
C	0.9900	0.2500
D	0.6410	0.0650

