



## Full wwPDB EM Validation Report ⓘ

Oct 14, 2024 – 05:44 AM EDT

PDB ID : 8D8Q  
EMDB ID : EMD-27254  
Title : SARS-CoV-2 Spike RBD in complex with DMAbs 2130 and 2196  
Authors : Du, J.; Cui, J.; Pallesen, J.  
Deposited on : 2022-06-08  
Resolution : 4.20 Å(reported)

This is a Full wwPDB EM Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

EMDB validation analysis : 0.0.1.dev113  
Mogul : 2022.3.0, CSD as543be (2022)  
MolProbity : 4.02b-467  
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) : 2.39

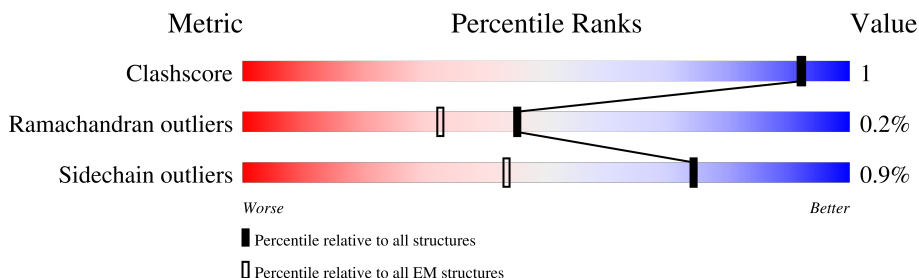
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 4.20 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  $\geq 3$ , 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	H	234	
2	L	219	
3	A	1187	
4	B	216	
5	C	226	

## 2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 5202 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 2130 heavy chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	H	130	Total	C	N	O	S	0	0
			996	633	166	193	4		

- Molecule 2 is a protein called 2130 light chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	L	114	Total	C	N	O	S	0	0
			883	556	146	177	4		

- Molecule 3 is a protein called Spike glycoprotein.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	A	194	Total	C	N	O	S	0	0
			1536	984	256	288	8		

There are 27 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1176	GLY	-	expression tag	UNP P0DTC2
A	1177	TYR	-	expression tag	UNP P0DTC2
A	1178	ILE	-	expression tag	UNP P0DTC2
A	1179	PRO	-	expression tag	UNP P0DTC2
A	1180	GLU	-	expression tag	UNP P0DTC2
A	1181	ALA	-	expression tag	UNP P0DTC2
A	1182	PRO	-	expression tag	UNP P0DTC2
A	1183	ARG	-	expression tag	UNP P0DTC2
A	1184	ASP	-	expression tag	UNP P0DTC2
A	1185	GLY	-	expression tag	UNP P0DTC2
A	1186	GLN	-	expression tag	UNP P0DTC2
A	1187	ALA	-	expression tag	UNP P0DTC2
A	1188	TYR	-	expression tag	UNP P0DTC2
A	1189	VAL	-	expression tag	UNP P0DTC2
A	1190	ARG	-	expression tag	UNP P0DTC2

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Chain	Residue	Modelled	Actual	Comment	Reference
A	1191	LYS	-	expression tag	UNP P0DTC2
A	1192	ASP	-	expression tag	UNP P0DTC2
A	1193	GLY	-	expression tag	UNP P0DTC2
A	1194	GLU	-	expression tag	UNP P0DTC2
A	1195	TRP	-	expression tag	UNP P0DTC2
A	1196	VAL	-	expression tag	UNP P0DTC2
A	1197	LEU	-	expression tag	UNP P0DTC2
A	1198	LEU	-	expression tag	UNP P0DTC2
A	1199	SER	-	expression tag	UNP P0DTC2
A	1200	THR	-	expression tag	UNP P0DTC2
A	1201	PHE	-	expression tag	UNP P0DTC2
A	1202	LEU	-	expression tag	UNP P0DTC2

- Molecule 4 is a protein called 2196 light chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	B	109	Total	C	N	O	S	0	0
			832	522	144	164	2		

- Molecule 5 is a protein called 2196 heavy chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	C	122	Total	C	N	O	S	0	0
			941	588	161	183	9		

- Molecule 6 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula:  $C_8H_{15}NO_6$ ).



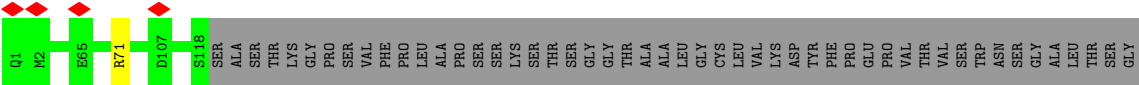
Mol	Chain	Residues	Atoms				AltConf
			Total	C	N	O	
6	A	1	14	8	1	5	0





GLN  
GLY  
LEU  
SER  
SER  
PRO  
VAL  
THR  
LYS  
SER  
PHE  
ASN  
ARG  
GLY  
GLU  
CYS

● Molecule 5: 2196 heavy chain



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



## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	40921	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ( $e^-/\text{\AA}^2$ )	42.969	Depositor
Minimum defocus (nm)	400	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	Not provided	
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	1.013	Depositor
Minimum map value	-0.540	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.044	Depositor
Recommended contour level	0.26	Depositor
Map size (Å)	539.648, 539.648, 539.648	wwPDB
Map dimensions	512, 512, 512	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.054, 1.054, 1.054	Depositor

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 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	H	0.70	0/1020	0.61	0/1383
2	L	0.74	0/902	0.61	0/1223
3	A	0.64	0/1579	0.62	0/2149
4	B	0.69	0/852	0.62	0/1155
5	C	0.69	0/960	0.58	0/1299
All	All	0.68	0/5313	0.61	0/7209

There are no bond length outliers.

There are no bond angle outliers.

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	H	996	0	969	6	0
2	L	883	0	861	6	0
3	A	1536	0	1452	1	0
4	B	832	0	808	1	0
5	C	941	0	913	0	0
6	A	14	0	13	0	0
All	All	5202	0	5016	14	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.

All (14) 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:L:49:TYR:HD1	2:L:49:TYR:N	1.38	1.14
2:L:49:TYR:N	2:L:49:TYR:CD1	2.14	0.89
1:H:96:GLY:HA2	1:H:99:TYR:HE1	1.70	0.56
2:L:49:TYR:HD1	2:L:49:TYR:H	0.64	0.49
2:L:49:TYR:OH	2:L:55:GLU:HA	2.14	0.48
1:H:33:TRP:CD1	1:H:33:TRP:N	2.82	0.48
2:L:30(A):TYR:O	2:L:30(C):SER:N	2.49	0.46
1:H:101:ASP:C	1:H:101:ASP:OD1	2.54	0.46
1:H:61:ALA:N	1:H:62:PRO:CD	2.80	0.44
1:H:31:ASP:OD1	1:H:52(B):LYS:NZ	2.51	0.43
3:A:340:GLU:OE1	3:A:356:LYS:NZ	2.50	0.43
2:L:49:TYR:CE1	2:L:53:THR:HG23	2.55	0.41
4:B:58:ILE:HA	4:B:59:PRO:HD3	1.93	0.41
1:H:96:GLY:HA2	1:H:99:TYR:CE1	2.54	0.40

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	H	128/234 (55%)	127 (99%)	1 (1%)	0	100	100
2	L	112/219 (51%)	109 (97%)	2 (2%)	1 (1%)	14	50
3	A	192/1187 (16%)	189 (98%)	3 (2%)	0	100	100
4	B	107/216 (50%)	103 (96%)	4 (4%)	0	100	100
5	C	120/226 (53%)	120 (100%)	0	0	100	100
All	All	659/2082 (32%)	648 (98%)	10 (2%)	1 (0%)	45	77

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	L	30(B)	SER

### 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	H	105/195 (54%)	104 (99%)	1 (1%)	73	81
2	L	98/192 (51%)	96 (98%)	2 (2%)	50	68
3	A	167/1030 (16%)	166 (99%)	1 (1%)	84	88
4	B	90/186 (48%)	90 (100%)	0	100	100
5	C	104/194 (54%)	103 (99%)	1 (1%)	73	81
All	All	564/1797 (31%)	559 (99%)	5 (1%)	74	83

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	99	TYR
2	L	30(D)	ASN
2	L	49	TYR
3	A	377	PHE
5	C	71	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 [i](#)

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

1 ligand is modelled in this entry.

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	$\# Z  > 2$
6	NAG	A	1301	3	14,14,15	0.24	0	17,19,21	0.57	0

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
6	NAG	A	1301	3	-	3/6/23/26	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	A	1301	NAG	C8-C7-N2-C2
6	A	1301	NAG	O7-C7-N2-C2
6	A	1301	NAG	O5-C5-C6-O6

There are no ring outliers.

No monomer is involved in short contacts.

## 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.

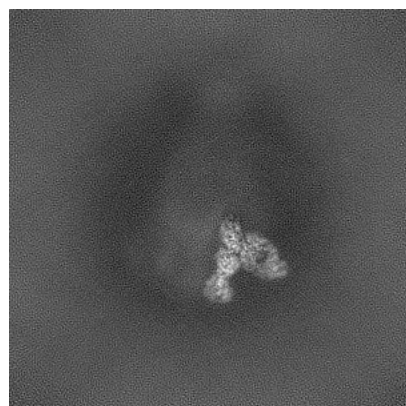
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-27254. These allow visual inspection of the internal detail of the map and identification of artifacts.

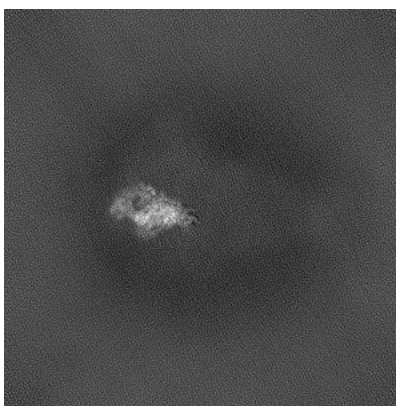
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

### 6.1 Orthogonal projections [i](#)

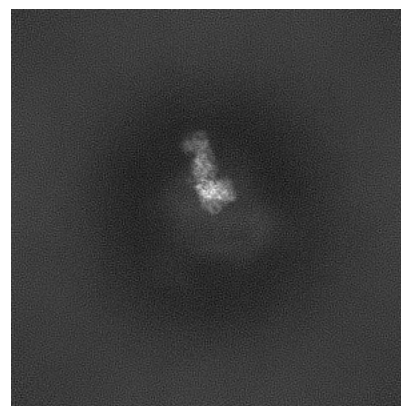
#### 6.1.1 Primary map



X



Y

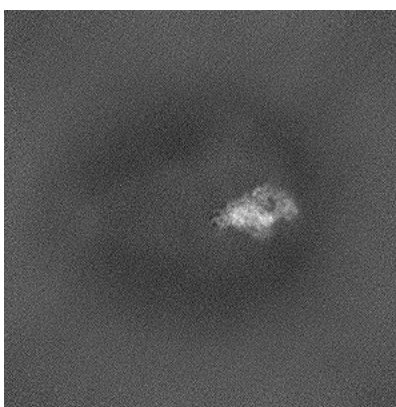


Z

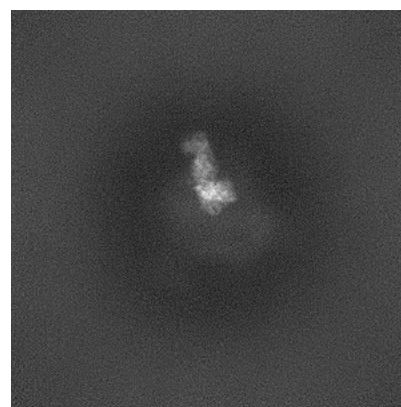
#### 6.1.2 Raw map



X



Y



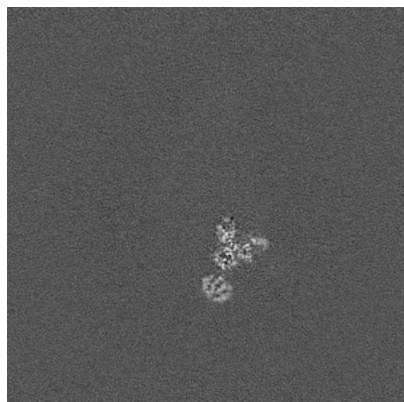
Z

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

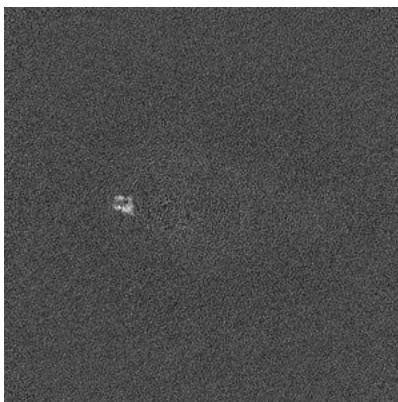


## 6.2 Central slices [i](#)

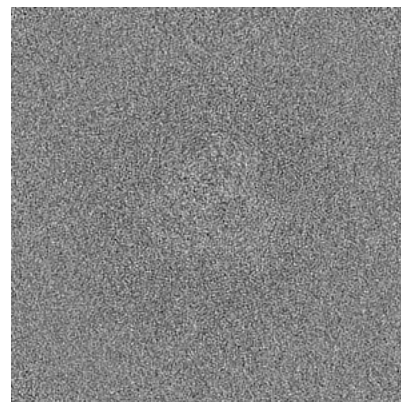
### 6.2.1 Primary map



X Index: 256



Y Index: 256

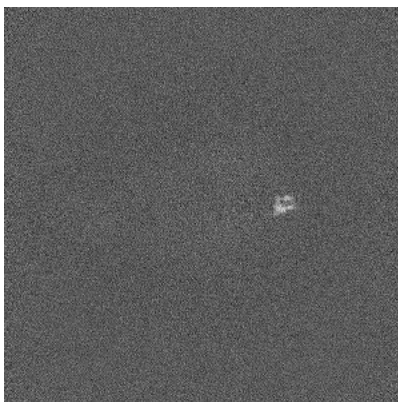


Z Index: 256

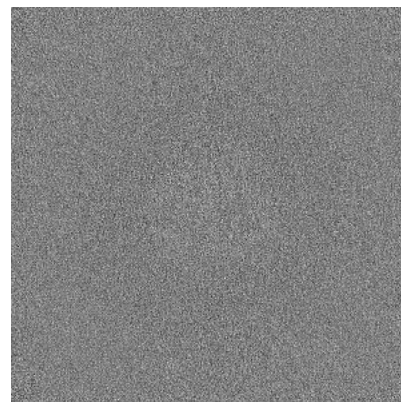
### 6.2.2 Raw map



X Index: 256



Y Index: 256



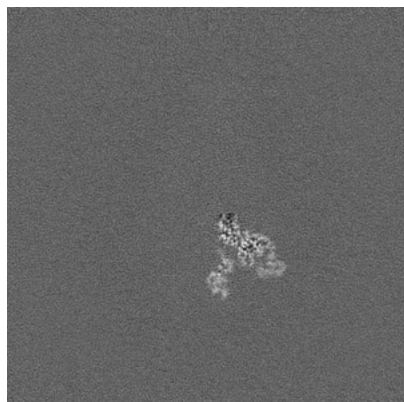
Z Index: 256

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

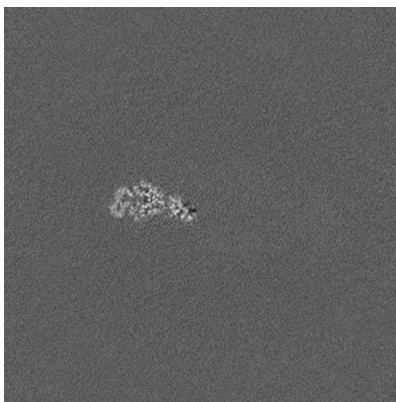


## 6.3 Largest variance slices [i](#)

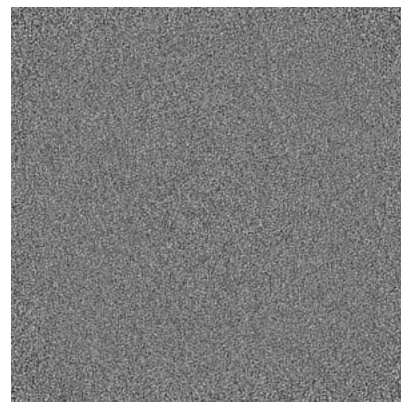
### 6.3.1 Primary map



X Index: 247

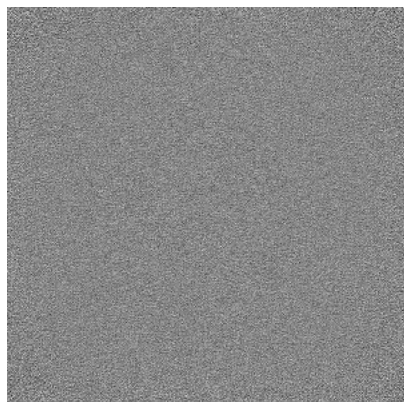


Y Index: 276

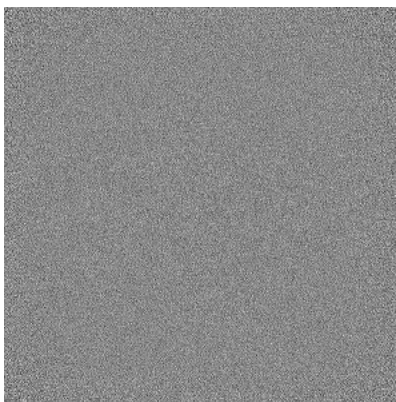


Z Index: 0

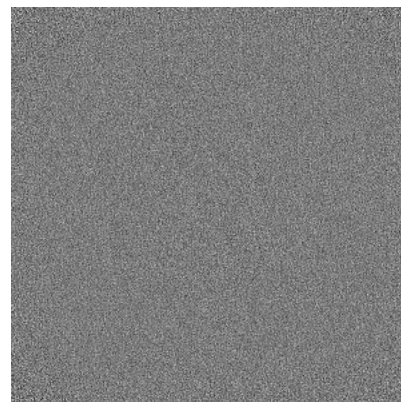
### 6.3.2 Raw map



X Index: 0



Y Index: 0

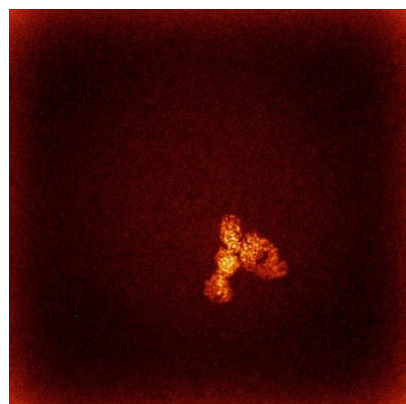


Z Index: 0

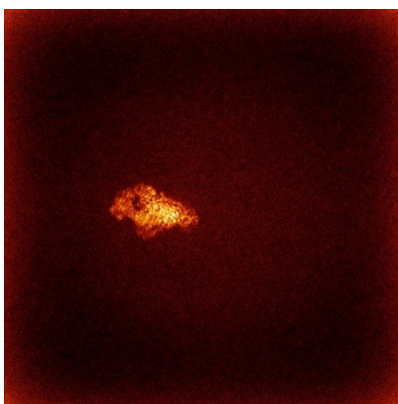
The images above show the largest variance slices of the map in three orthogonal directions.

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

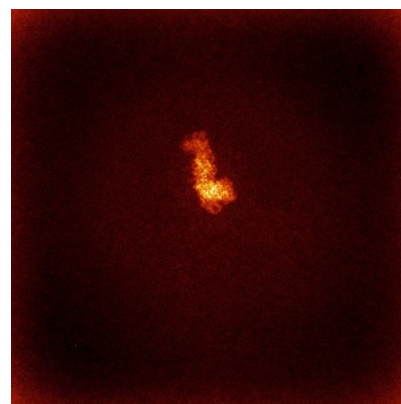
### 6.4.1 Primary map



X

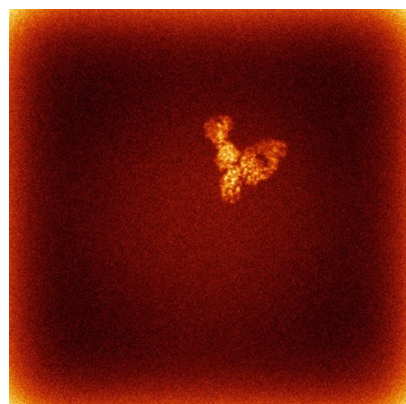


Y

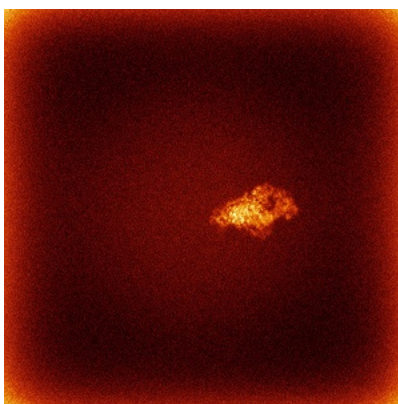


Z

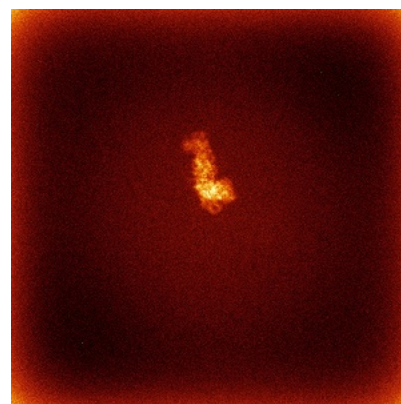
### 6.4.2 Raw map



X



Y

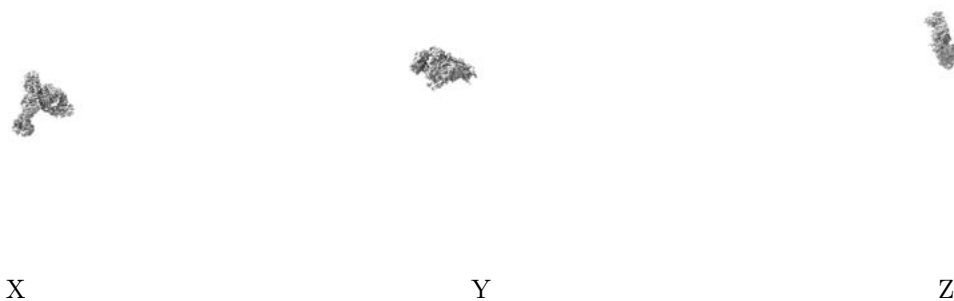


Z

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.

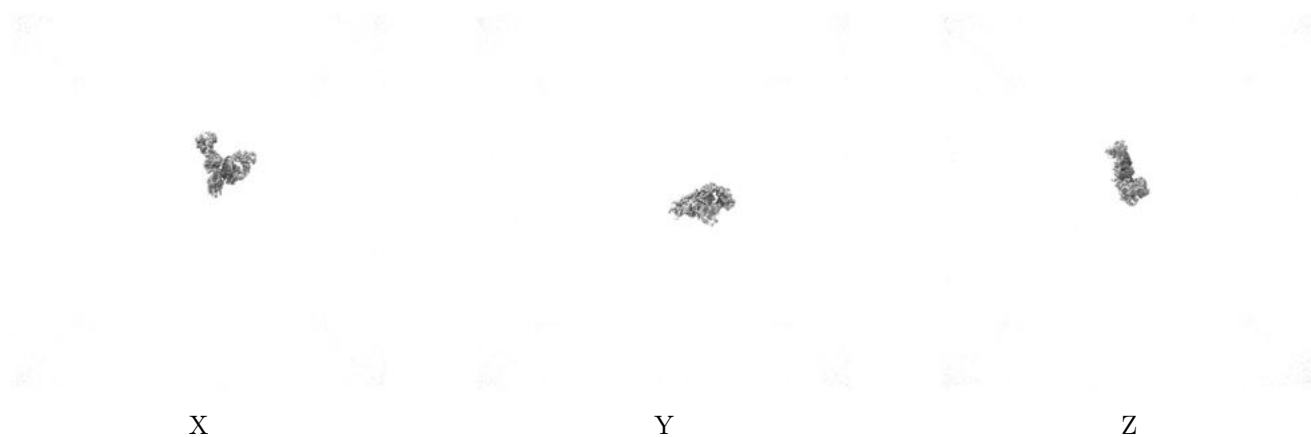
## 6.5 Orthogonal surface views [i](#)

### 6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.26. 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.

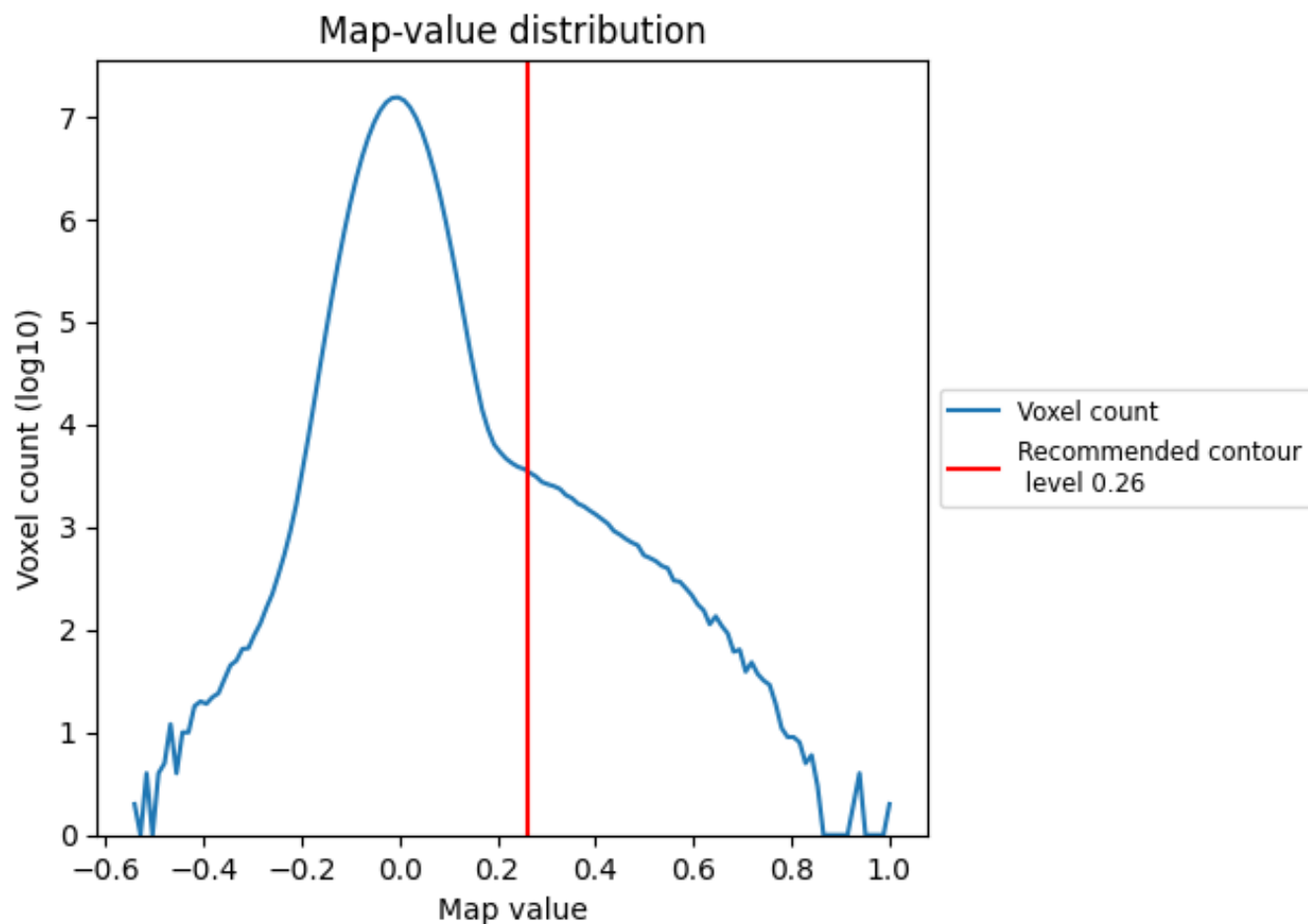
## 6.6 Mask visualisation [i](#)

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

## 7 Map analysis [i](#)

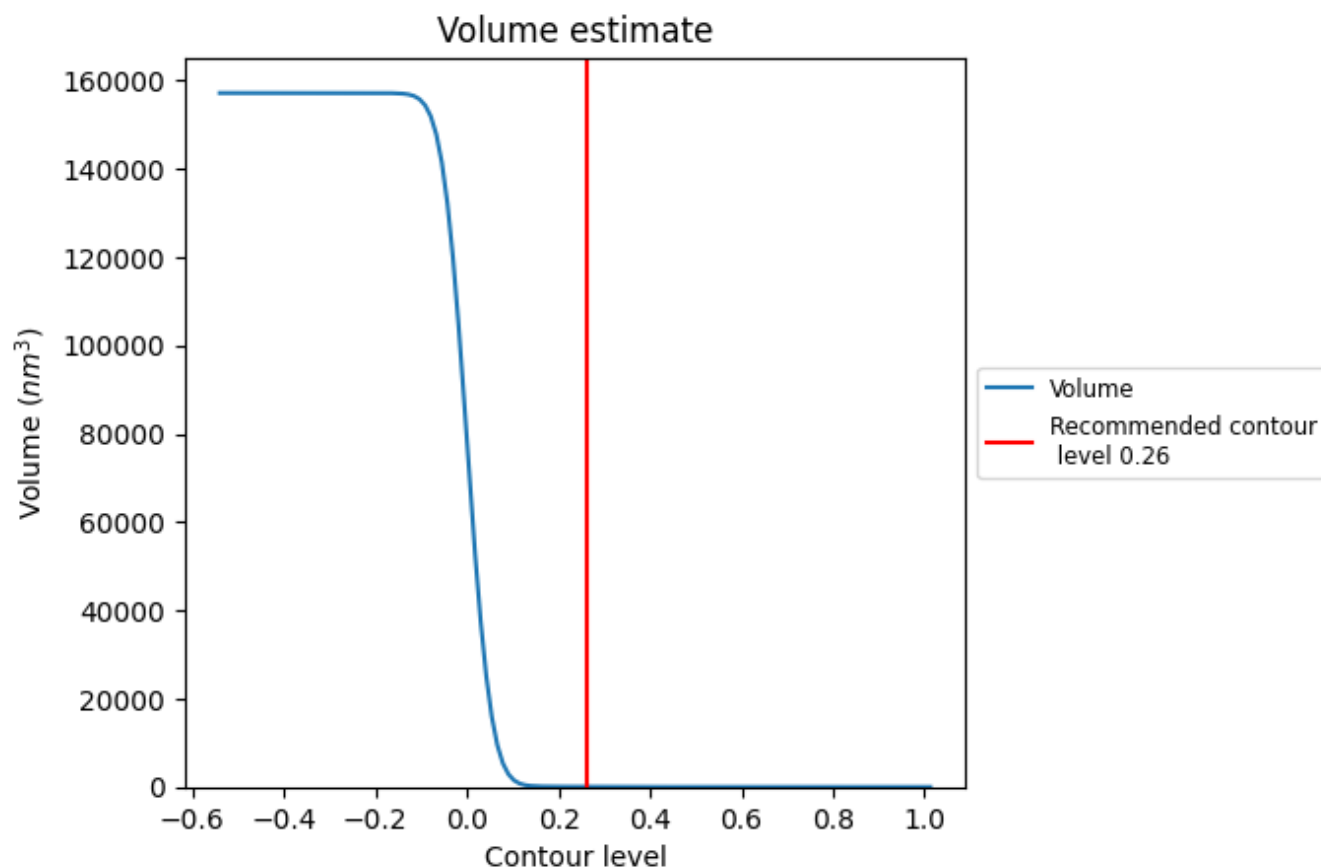
This section contains the results of statistical analysis of the map.

### 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.

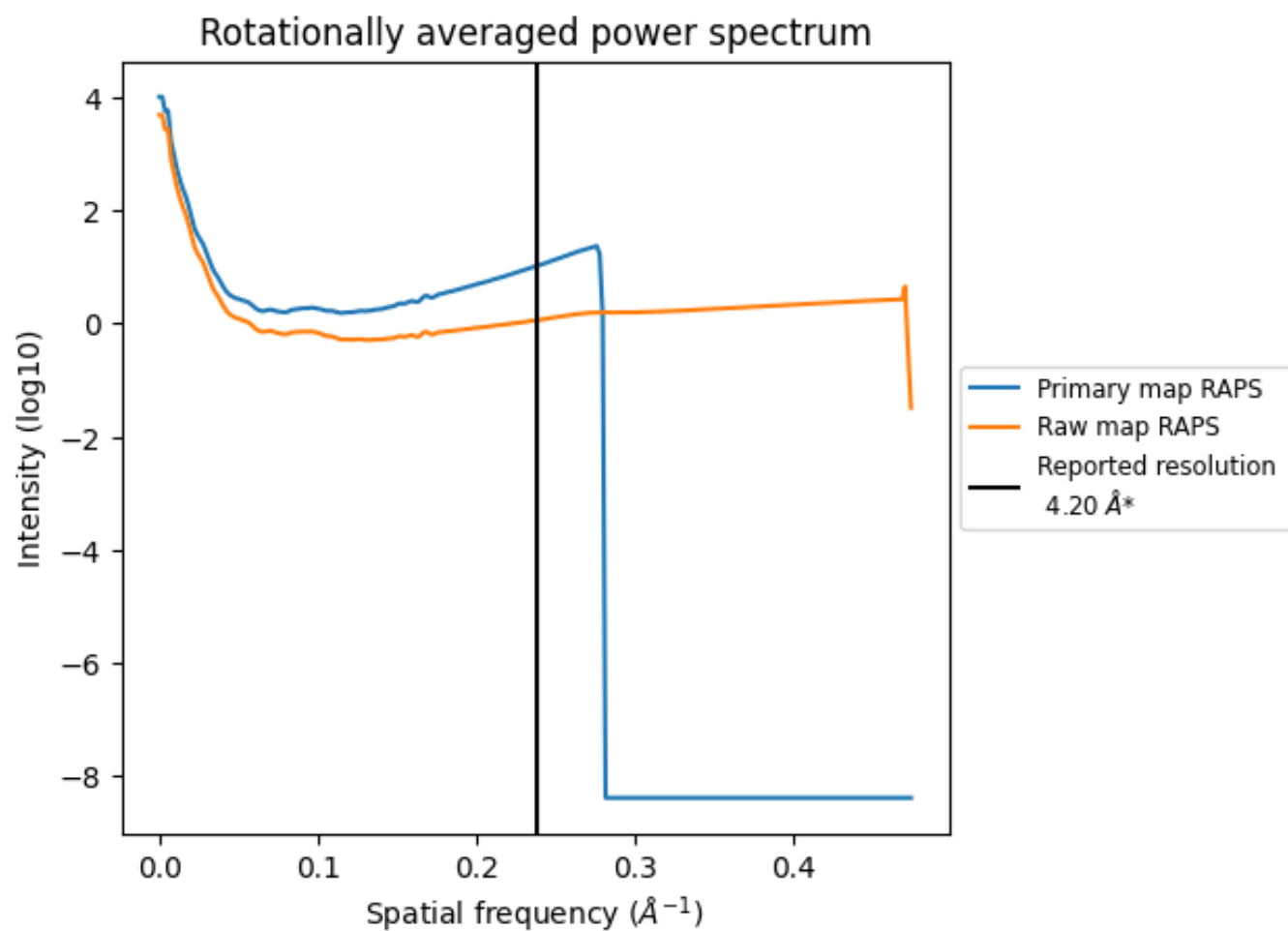
## 7.2 Volume estimate [i](#)



The volume at the recommended contour level is 46  $\text{nm}^3$ ; this corresponds to an approximate mass of 42 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 ⓘ



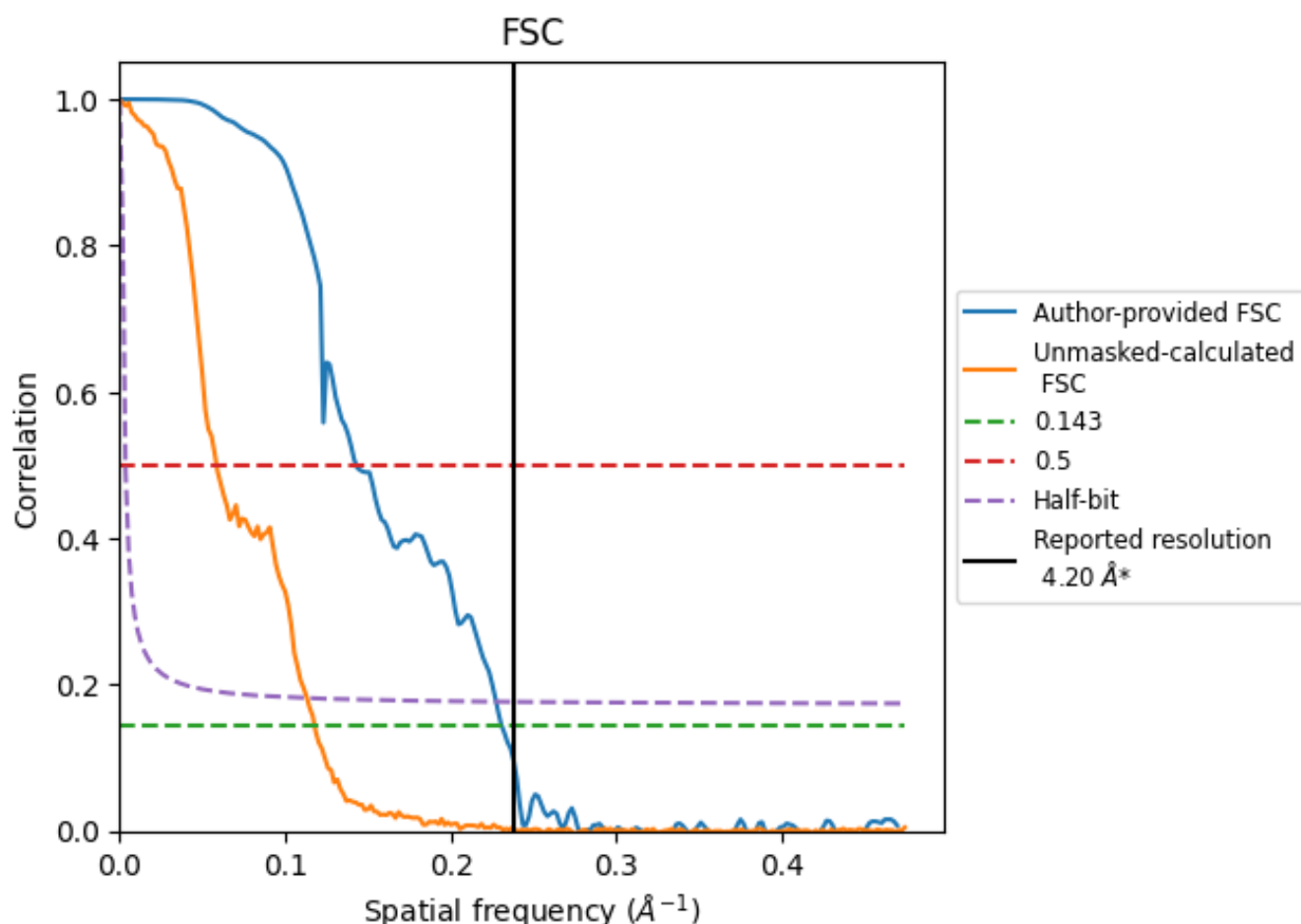
\*Reported resolution corresponds to spatial frequency of 0.238  $\text{\AA}^{-1}$



## 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 0.238 Å<sup>-1</sup>

## 8.2 Resolution estimates [i](#)

Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	4.20	-	-
Author-provided FSC curve	4.33	6.99	4.40
Unmasked-calculated*	8.48	17.04	8.83

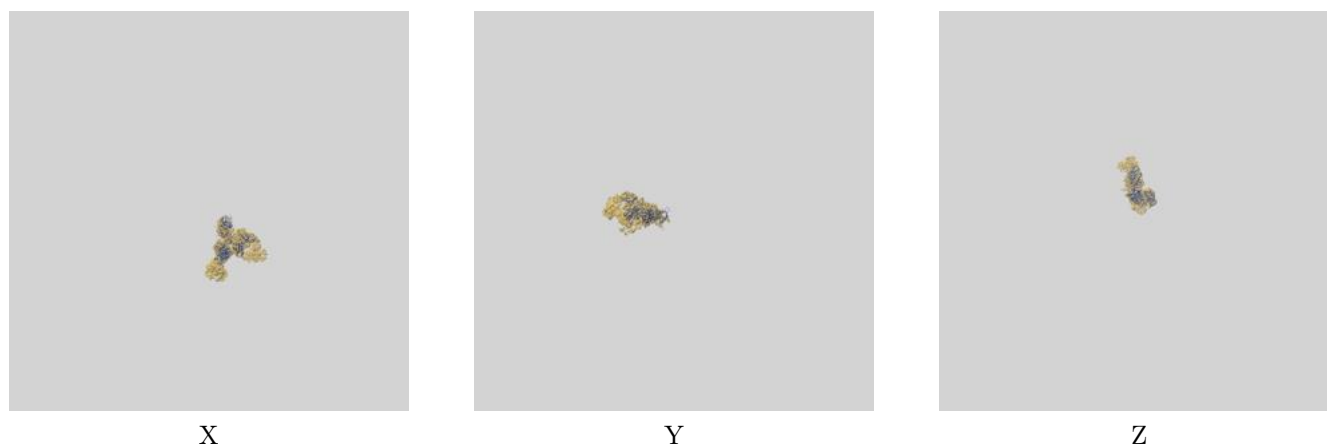
\*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps. The value from deposited half-maps intersecting FSC 0.143 CUT-OFF 8.48 differs from the reported value 4.2 by more than 10 %



## 9 Map-model fit [i](#)

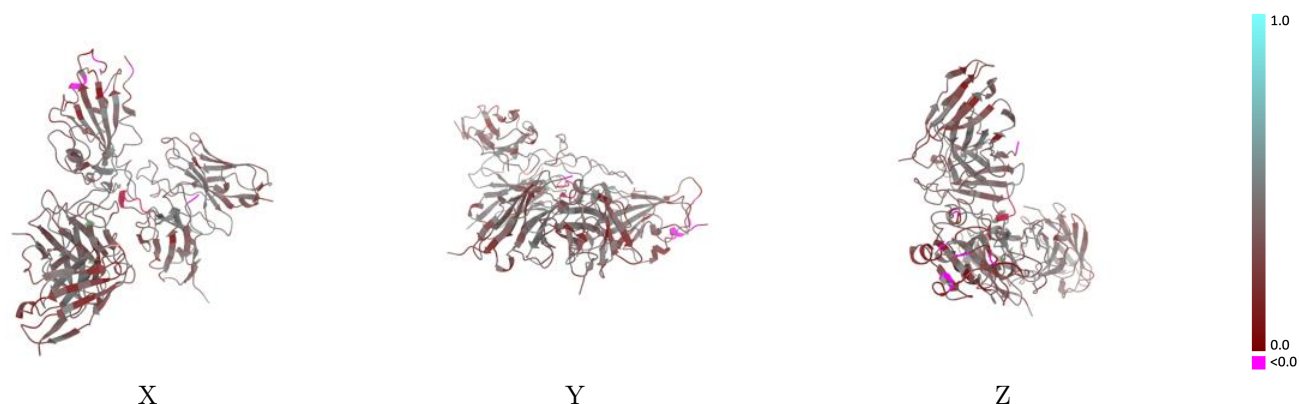
This section contains information regarding the fit between EMDB map EMD-27254 and PDB model 8D8Q. Per-residue inclusion information can be found in [section 3](#) on [page 6](#).

### 9.1 Map-model overlay [i](#)



The images above show the 3D surface view of the map at the recommended contour level 0.26 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](#)



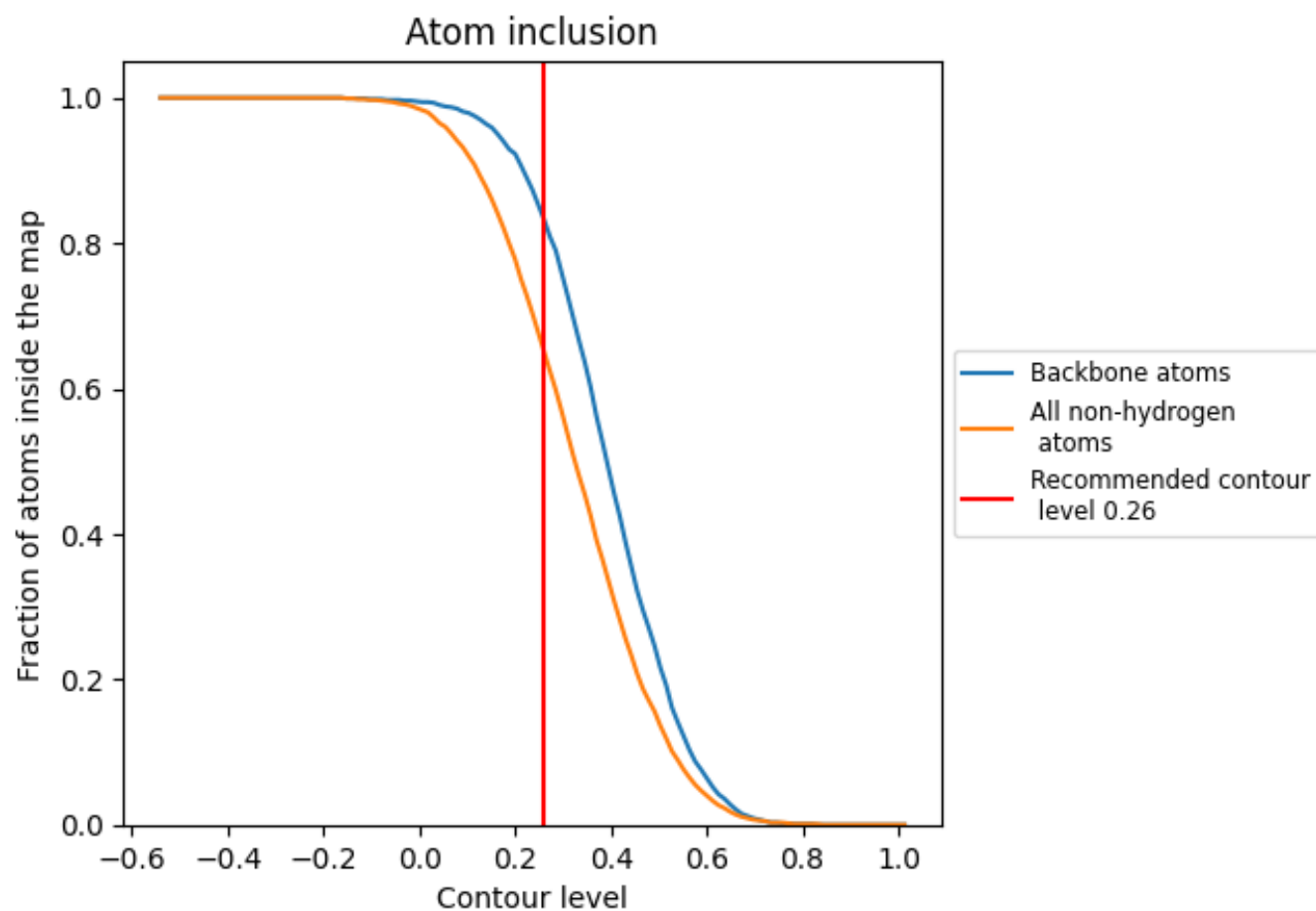
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.26).

## 9.4 Atom inclusion [i](#)



At the recommended contour level, 83% of all backbone atoms, 65% 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 (0.26) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div></div> 0.6510	<div></div> 0.3580
A	<div></div> 0.6190	<div></div> 0.3410
B	<div></div> 0.6190	<div></div> 0.3430
C	<div></div> 0.6860	<div></div> 0.3900
H	<div></div> 0.6800	<div></div> 0.3660
L	<div></div> 0.6700	<div></div> 0.3610

