



# wwPDB EM Validation Summary Report ⓘ

Nov 15, 2022 – 10:38 AM EST

PDB ID : 6W6W  
EMDB ID : EMD-21567  
Title : Cryo-EM structure of CST bound to telomeric single-stranded DNA  
Authors : Lim, C.; Barbour, A.T.; Zaug, A.J.; Goodrich, K.J.; McKay, A.E.; Wuttke, D.S.; Cech, T.R.  
Deposited on : 2020-03-17  
Resolution : 3.00 Å (reported)  
Based on initial models : 4JOI, 5W2L, 4JQF

This is a wwPDB EM Validation Summary 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.dev43  
MolProbity : 4.02b-467  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
MapQ : 1.9.9  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.31.2

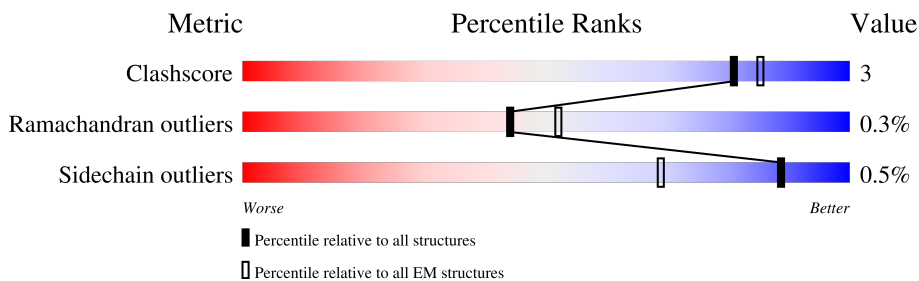
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 3.00 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)
Clashscore	158937	4297
Ramachandran outliers	154571	4023
Sidechain outliers	154315	3826

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	A	1233	 67% 6% 27%
1	B	1233	 97%
2	E	4	 100%
3	C	374	 24% 79% 7% 14%
4	D	152	 72% 5% 23%

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 10981 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 CST complex subunit CTC1.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	905	7121	4577	1257	1247	40	0	0
1	B	43	213	127	43	43		0	0

There are 34 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-15	MET	-	expression tag	UNP Q2NKJ3
A	-14	ASP	-	expression tag	UNP Q2NKJ3
A	-13	TYR	-	expression tag	UNP Q2NKJ3
A	-12	LYS	-	expression tag	UNP Q2NKJ3
A	-11	ASP	-	expression tag	UNP Q2NKJ3
A	-10	ASP	-	expression tag	UNP Q2NKJ3
A	-9	ASP	-	expression tag	UNP Q2NKJ3
A	-8	ASP	-	expression tag	UNP Q2NKJ3
A	-7	LYS	-	expression tag	UNP Q2NKJ3
A	-6	ASP	-	expression tag	UNP Q2NKJ3
A	-5	TYR	-	expression tag	UNP Q2NKJ3
A	-4	LYS	-	expression tag	UNP Q2NKJ3
A	-3	ASP	-	expression tag	UNP Q2NKJ3
A	-2	ASP	-	expression tag	UNP Q2NKJ3
A	-1	ASP	-	expression tag	UNP Q2NKJ3
A	0	ASP	-	expression tag	UNP Q2NKJ3
A	1	LYS	-	expression tag	UNP Q2NKJ3
B	-1081	MET	-	expression tag	UNP Q2NKJ3
B	-1080	ASP	-	expression tag	UNP Q2NKJ3
B	-1079	TYR	-	expression tag	UNP Q2NKJ3
B	-1078	LYS	-	expression tag	UNP Q2NKJ3
B	-1077	ASP	-	expression tag	UNP Q2NKJ3
B	-1076	ASP	-	expression tag	UNP Q2NKJ3
B	-1075	ASP	-	expression tag	UNP Q2NKJ3
B	-1074	ASP	-	expression tag	UNP Q2NKJ3
B	-1073	LYS	-	expression tag	UNP Q2NKJ3

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-1072	ASP	-	expression tag	UNP Q2NKJ3
B	-1071	TYR	-	expression tag	UNP Q2NKJ3
B	-1070	LYS	-	expression tag	UNP Q2NKJ3
B	-1069	ASP	-	expression tag	UNP Q2NKJ3
B	-1068	ASP	-	expression tag	UNP Q2NKJ3
B	-1067	ASP	-	expression tag	UNP Q2NKJ3
B	-1066	ASP	-	expression tag	UNP Q2NKJ3
B	-1065	LYS	-	expression tag	UNP Q2NKJ3

- Molecule 2 is a DNA chain called DNA (5'-D(P\*TP\*AP\*GP\*G)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
2	E	4	85	40	17	24	4	0	0

- Molecule 3 is a protein called CST complex subunit STN1.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	C	323	2631	1680	449	491	11	0	0

There are 7 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	-5	MET	-	expression tag	UNP Q9H668
C	-4	HIS	-	expression tag	UNP Q9H668
C	-3	HIS	-	expression tag	UNP Q9H668
C	-2	HIS	-	expression tag	UNP Q9H668
C	-1	HIS	-	expression tag	UNP Q9H668
C	0	HIS	-	expression tag	UNP Q9H668
C	1	HIS	-	expression tag	UNP Q9H668

- Molecule 4 is a protein called CST complex subunit TEN1.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
4	D	117	930	588	167	169	6	0	0

There are 31 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	-28	MET	-	expression tag	UNP Q86WV5
D	-27	SER	-	expression tag	UNP Q86WV5
D	-26	TYR	-	expression tag	UNP Q86WV5
D	-25	TYR	-	expression tag	UNP Q86WV5
D	-24	HIS	-	expression tag	UNP Q86WV5
D	-23	HIS	-	expression tag	UNP Q86WV5
D	-22	HIS	-	expression tag	UNP Q86WV5
D	-21	HIS	-	expression tag	UNP Q86WV5
D	-20	HIS	-	expression tag	UNP Q86WV5
D	-19	HIS	-	expression tag	UNP Q86WV5
D	-18	ASP	-	expression tag	UNP Q86WV5
D	-17	TYR	-	expression tag	UNP Q86WV5
D	-16	ASP	-	expression tag	UNP Q86WV5
D	-15	ILE	-	expression tag	UNP Q86WV5
D	-14	PRO	-	expression tag	UNP Q86WV5
D	-13	THR	-	expression tag	UNP Q86WV5
D	-12	THR	-	expression tag	UNP Q86WV5
D	-11	GLU	-	expression tag	UNP Q86WV5
D	-10	ASN	-	expression tag	UNP Q86WV5
D	-9	LEU	-	expression tag	UNP Q86WV5
D	-8	TYR	-	expression tag	UNP Q86WV5
D	-7	PHE	-	expression tag	UNP Q86WV5
D	-6	GLN	-	expression tag	UNP Q86WV5
D	-5	GLY	-	expression tag	UNP Q86WV5
D	-4	ALA	-	expression tag	UNP Q86WV5
D	-3	MET	-	expression tag	UNP Q86WV5
D	-2	GLY	-	expression tag	UNP Q86WV5
D	-1	SER	-	expression tag	UNP Q86WV5
D	0	GLY	-	expression tag	UNP Q86WV5
D	1	ILE	-	expression tag	UNP Q86WV5
D	2	GLN	-	expression tag	UNP Q86WV5

- Molecule 5 is ZINC ION (three-letter code: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms	AltConf
5	A	1	Total Zn 1 1	0




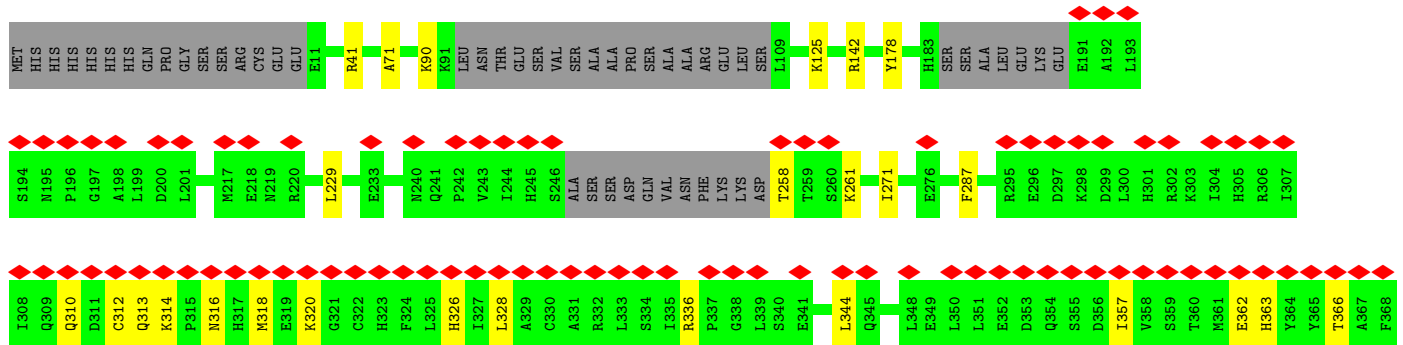


Chain E:  100%

There are no outlier residues recorded for this chain.

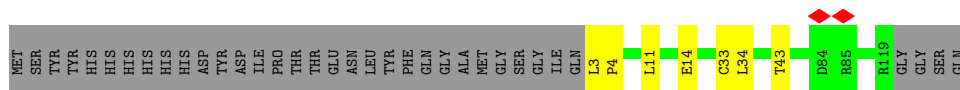
• Molecule 3: CST complex subunit STN1

Chain C:  24% 79% 7% 14%



• Molecule 4: CST complex subunit TEN1

Chain D:  72% 5% 23%





## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	833627	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 ( $e^-/\text{\AA}^2$ )	60	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	4.008	Depositor
Minimum map value	-1.861	Depositor
Average map value	0.006	Depositor
Map value standard deviation	0.074	Depositor
Recommended contour level	0.451	Depositor
Map size (Å)	431.19998, 431.19998, 431.19998	wwPDB
Map dimensions	400, 400, 400	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.078, 1.078, 1.078	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:  
ZN

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	0.32	0/7309	0.59	1/9946 (0.0%)
1	B	0.28	0/212	0.77	1/294 (0.3%)
2	E	0.74	0/95	1.14	0/145
3	C	0.31	0/2682	0.55	0/3623
4	D	0.31	0/948	0.54	0/1284
All	All	0.32	0/11246	0.59	2/15292 (0.0%)

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

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

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	35	PRO	N-CA-CB	8.52	113.53	103.30
1	A	149	LEU	CA-CB-CG	7.70	133.00	115.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	535	CYS	Peptide

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Mol	Chain	Res	Type	Group
1	B	35	PRO	Peptide

## 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	7121	0	7212	42	0
1	B	213	0	113	1	0
2	E	85	0	46	0	0
3	C	2631	0	2637	13	0
4	D	930	0	941	4	0
5	A	1	0	0	0	0
All	All	10981	0	10949	58	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 3.

The worst 5 of 58 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)
1:A:235:ALA:HB2	1:A:428:ALA:HA	1.75	0.69
4:D:11:LEU:HB2	4:D:14:GLU:HG3	1.86	0.58
1:A:284:THR:HG23	1:A:285:GLU:HG2	1.87	0.56
1:A:1044:ALA:HB2	1:A:1068:ILE:HG12	1.89	0.55
1:A:895:LEU:HD22	1:A:971:GLN:HB3	1.87	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	A	885/1233 (72%)	765 (86%)	118 (13%)	2 (0%)	47	82
1	B	41/1233 (3%)	31 (76%)	8 (20%)	2 (5%)	2	13
3	C	315/374 (84%)	293 (93%)	22 (7%)	0	100	100
4	D	115/152 (76%)	99 (86%)	16 (14%)	0	100	100
All	All	1356/2992 (45%)	1188 (88%)	164 (12%)	4 (0%)	44	76

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	35	PRO
1	A	376	ASP
1	B	34	CYS
1	A	375	LEU

### 5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	793/1080 (73%)	791 (100%)	2 (0%)	92	97
3	C	294/338 (87%)	290 (99%)	4 (1%)	67	88
4	D	103/132 (78%)	103 (100%)	0	100	100
All	All	1190/1550 (77%)	1184 (100%)	6 (0%)	89	96

5 of 6 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	C	142	ARG
3	C	287	PHE
3	C	336	ARG
1	A	292	ARG
1	A	153	TRP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 11 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1120	GLN
3	C	117	GLN
4	D	53	HIS
3	C	226	GLN
1	A	691	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 monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

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

There are no chain breaks in this entry.

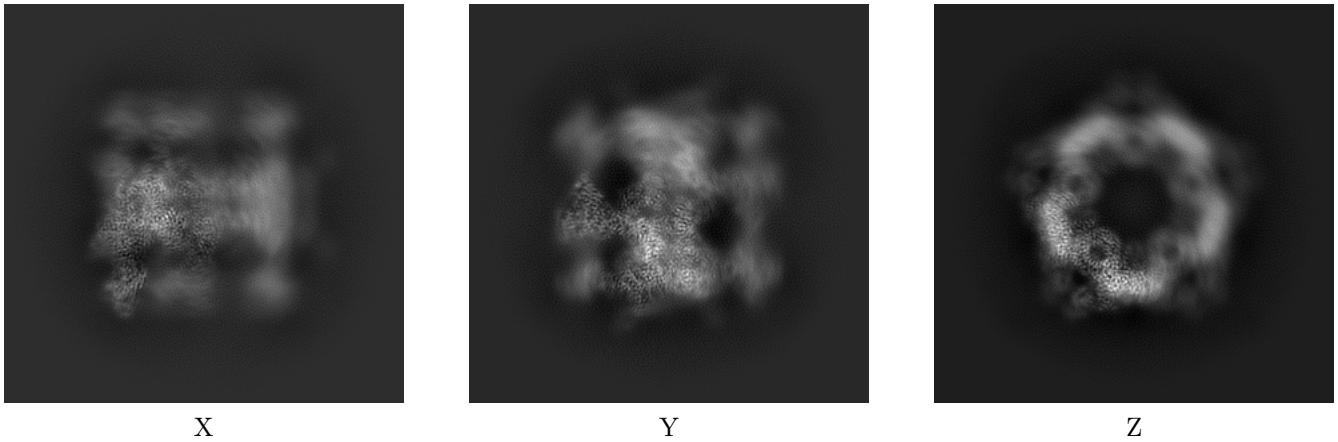
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-21567. 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](#)

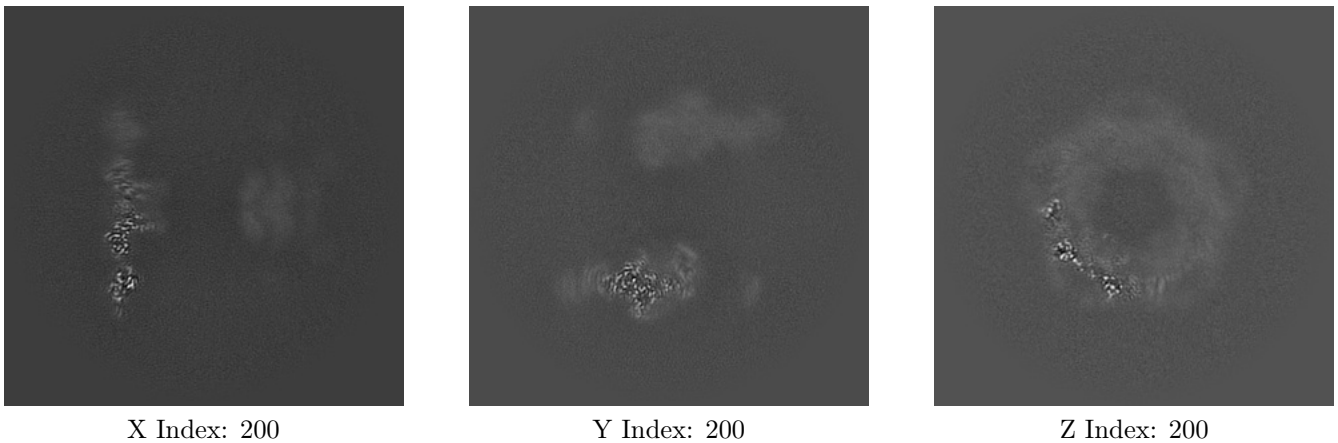
#### 6.1.1 Primary map



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

### 6.2 Central slices [i](#)

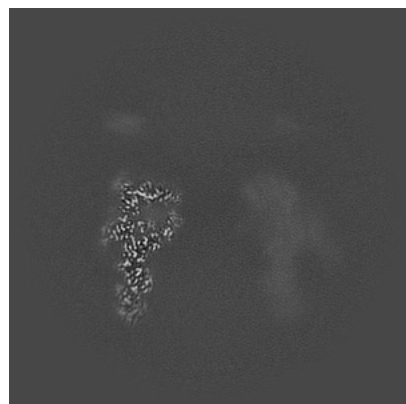
#### 6.2.1 Primary map



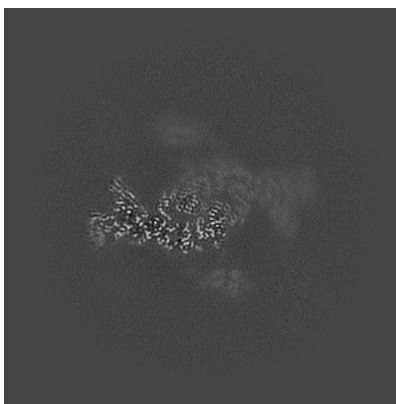
The images above show central slices of the map in three orthogonal directions.

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

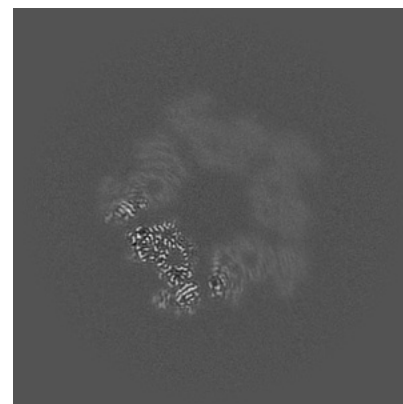
### 6.3.1 Primary map



X Index: 178



Y Index: 124



Z Index: 180

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

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

### 6.4.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.451. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.



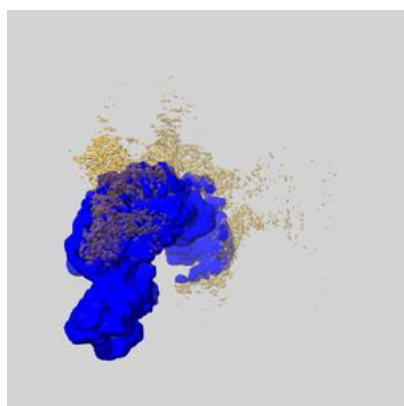
## 6.5 Mask visualisation [i](#)

This section shows the 3D surface view of the primary map at 50% transparency overlaid with the specified mask at 0% transparency

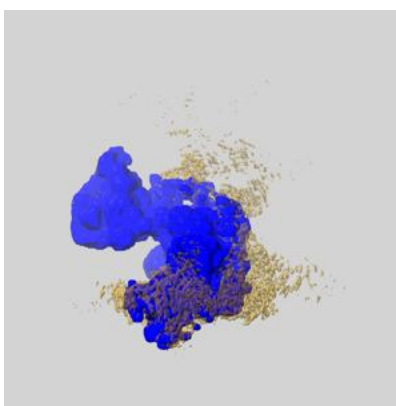
A mask typically either:

- Encompasses the whole structure
- Separates out a domain, a functional unit, a monomer or an area of interest from a larger structure

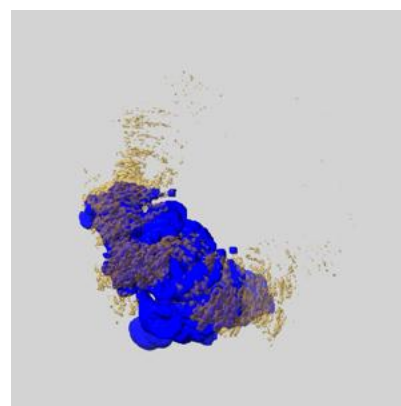
### 6.5.1 emd\_21567\_msk\_1.map [i](#)



X



Y

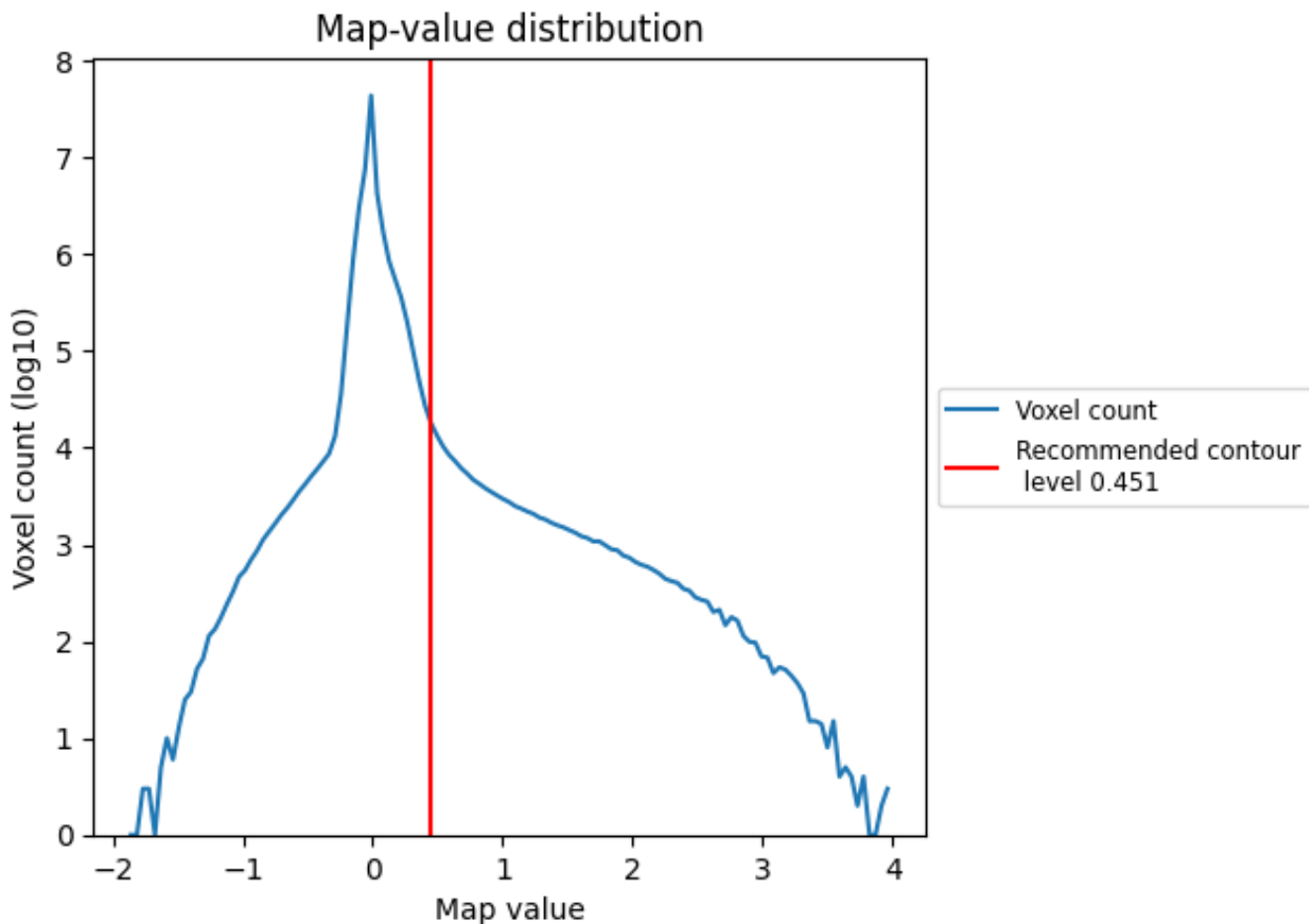


Z

## 7 Map analysis [i](#)

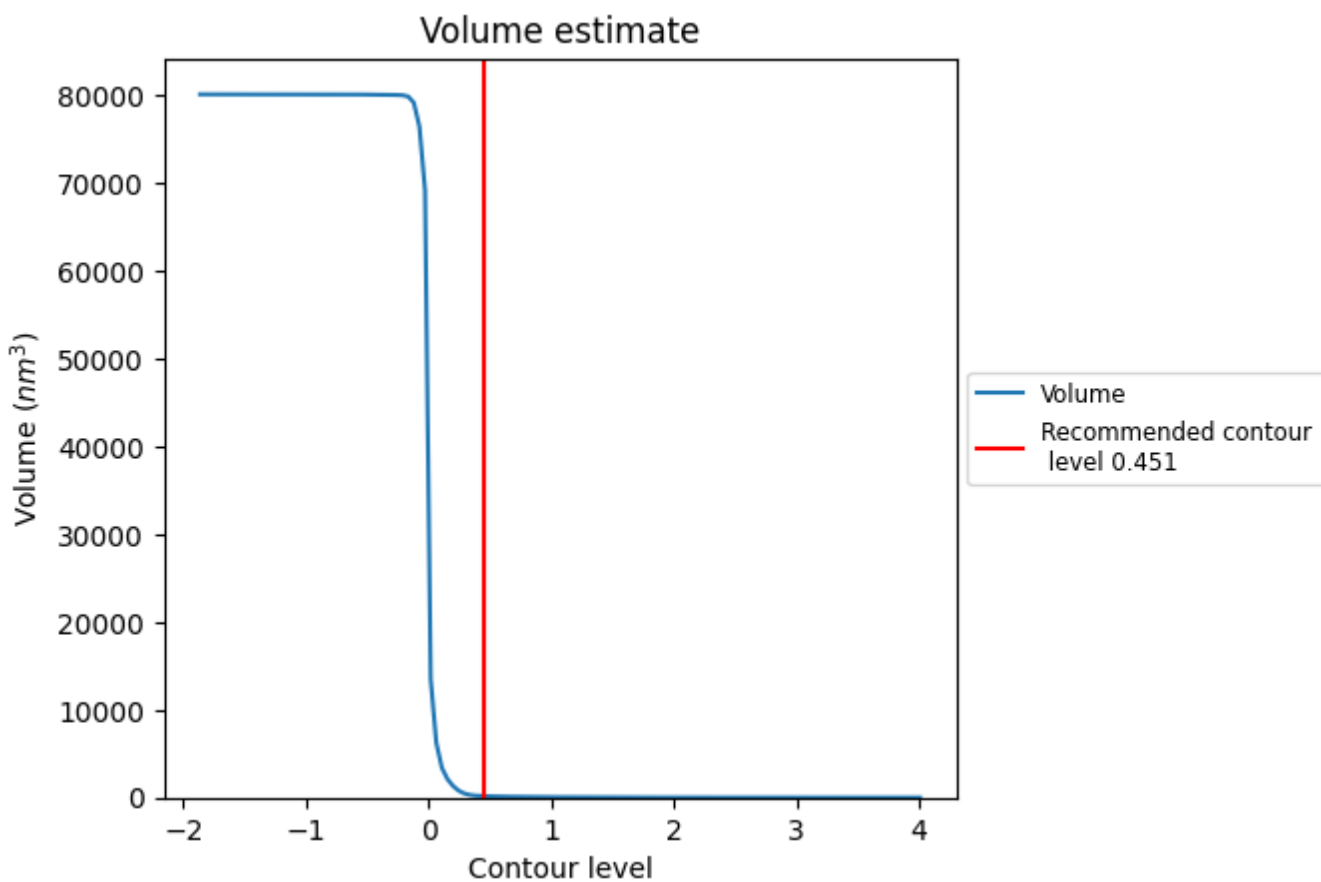
This section contains the results of statistical analysis of the map.

### 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.

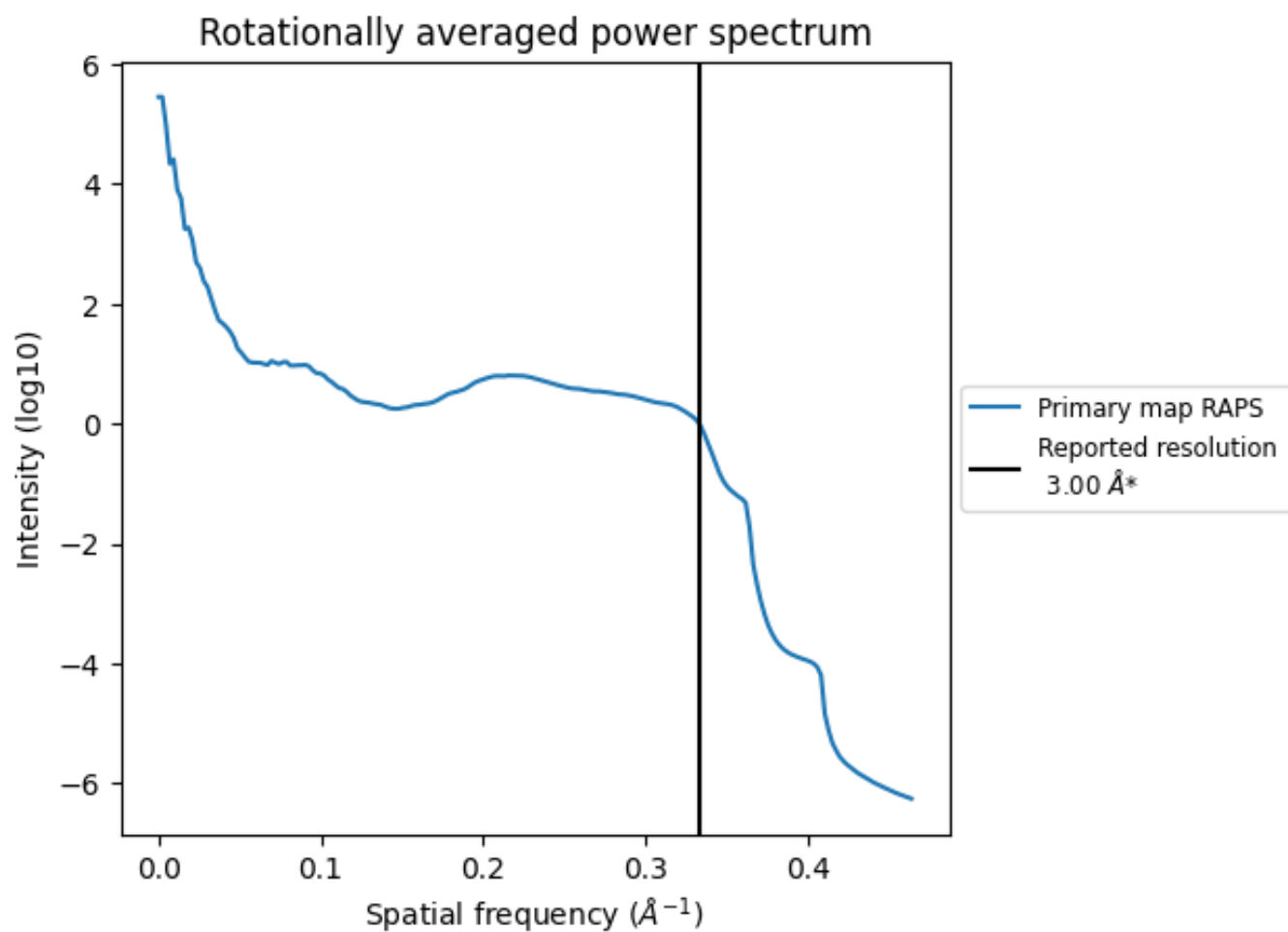
## 7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is 164 nm<sup>3</sup>; this corresponds to an approximate mass of 148 kDa.

The volume estimate graph shows how the enclosed volume varies with the contour level. The recommended contour level is shown as a vertical line and the intersection between the line and the curve gives the volume of the enclosed surface at the given level.

### 7.3 Rotationally averaged power spectrum [i](#)

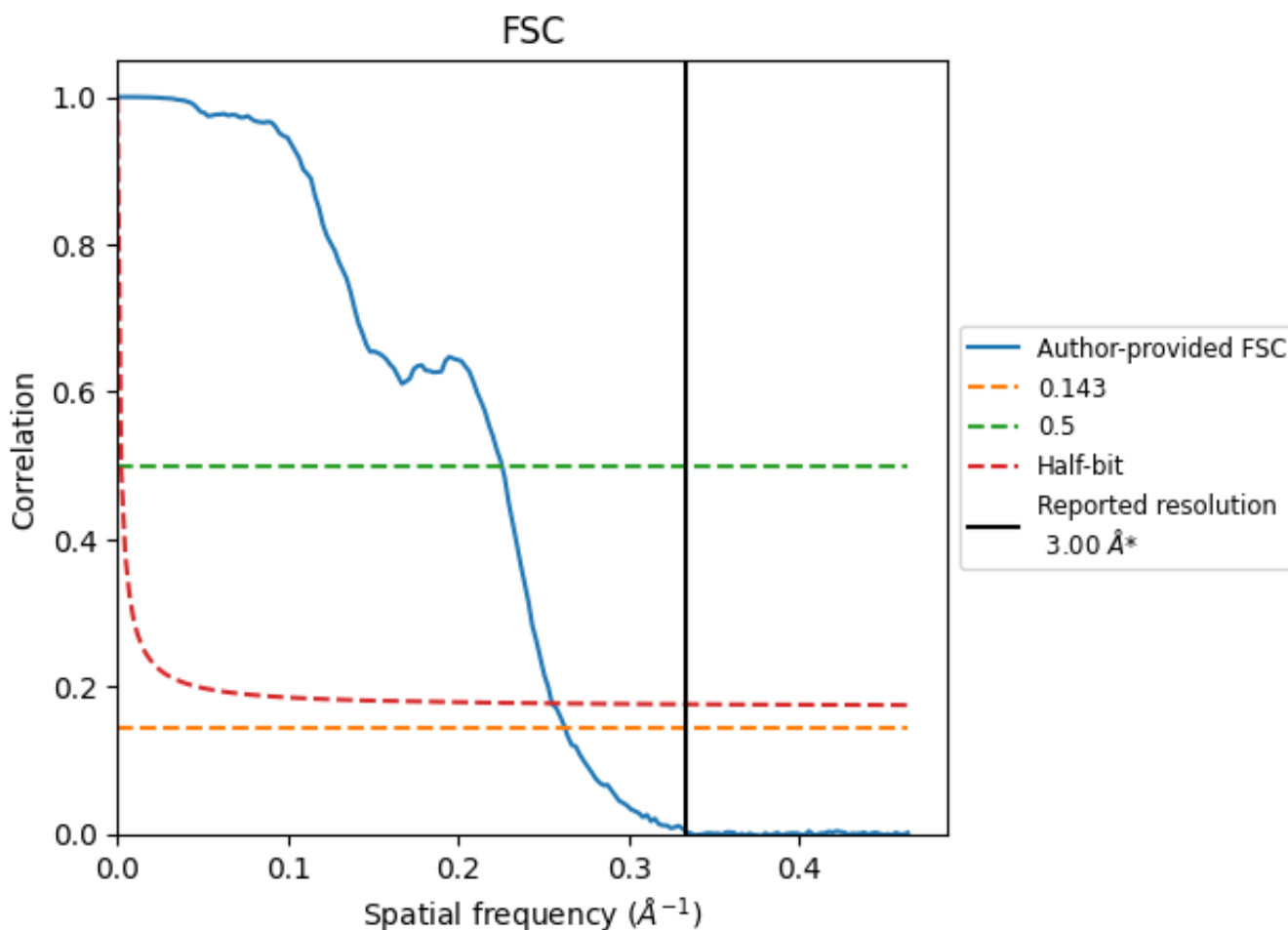


\*Reported resolution corresponds to spatial frequency of 0.333 Å<sup>-1</sup>

## 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 0.333 Å<sup>-1</sup>

## 8.2 Resolution estimates [i](#)

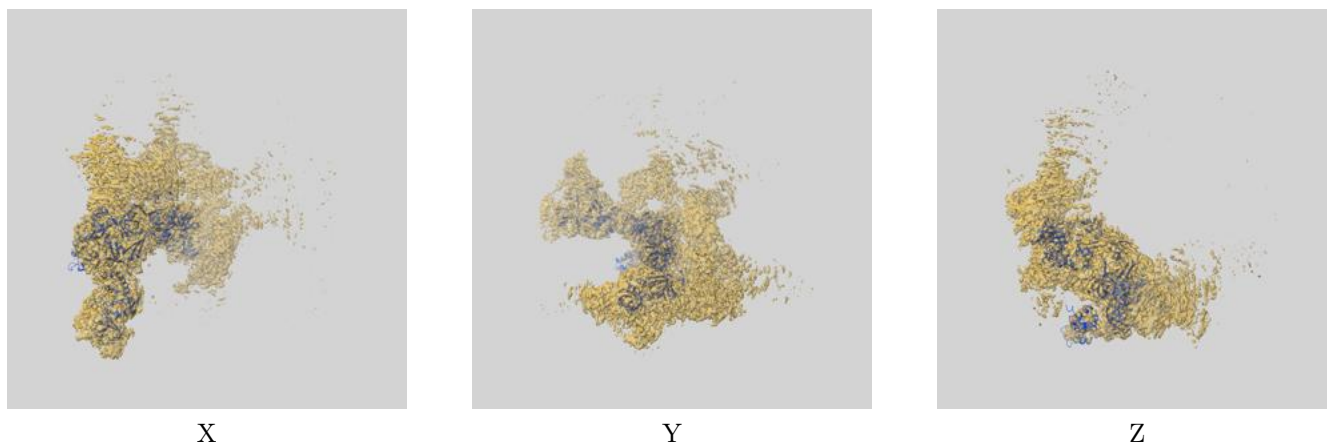
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.00	-	-
Author-provided FSC curve	3.81	4.43	3.92
Unmasked-calculated*	-	-	-

\*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps. The value from author-provided FSC intersecting FSC 0.143 CUT-OFF 3.81 differs from the reported value 3.0 by more than 10 %

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

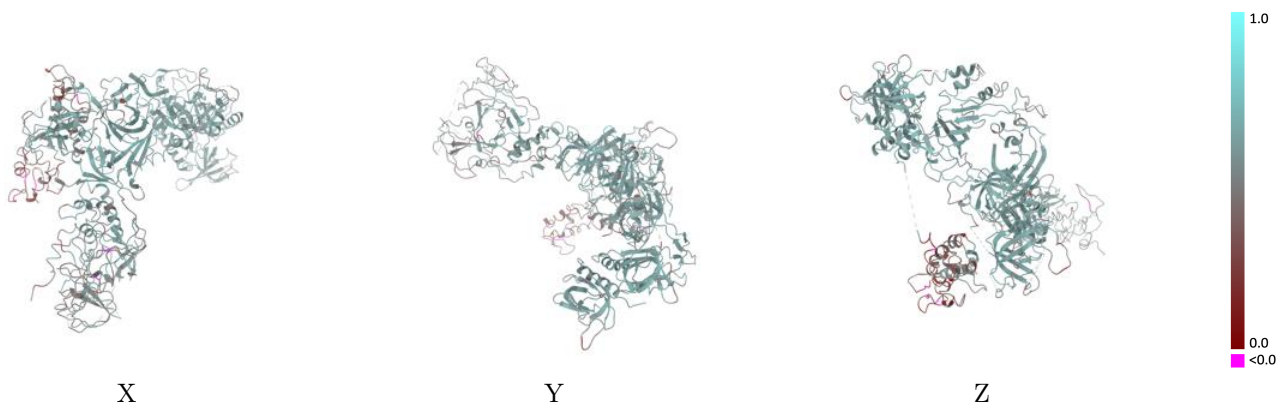
This section contains information regarding the fit between EMDB map EMD-21567 and PDB model 6W6W. Per-residue inclusion information can be found in section 3 on page 6.

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



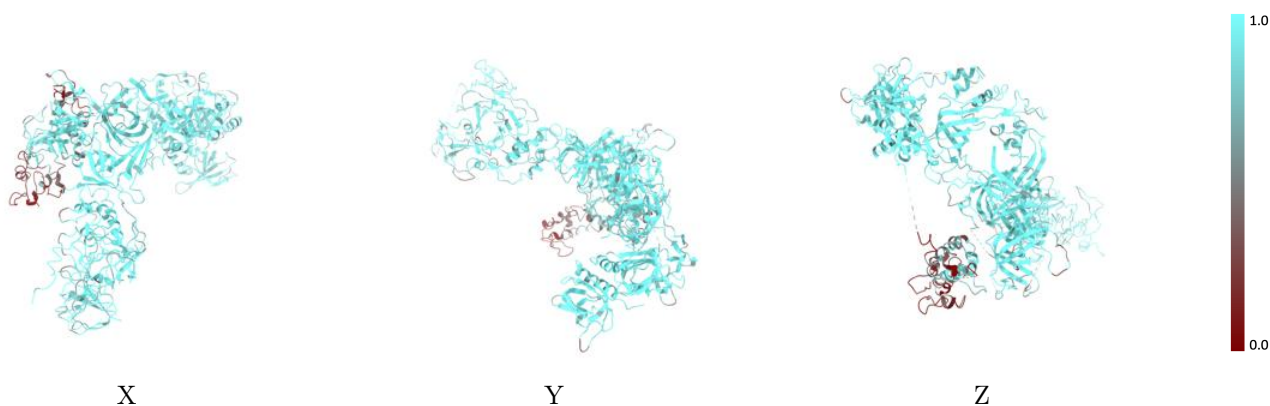
The images above show the 3D surface view of the map at the recommended contour level 0.451 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

## 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.

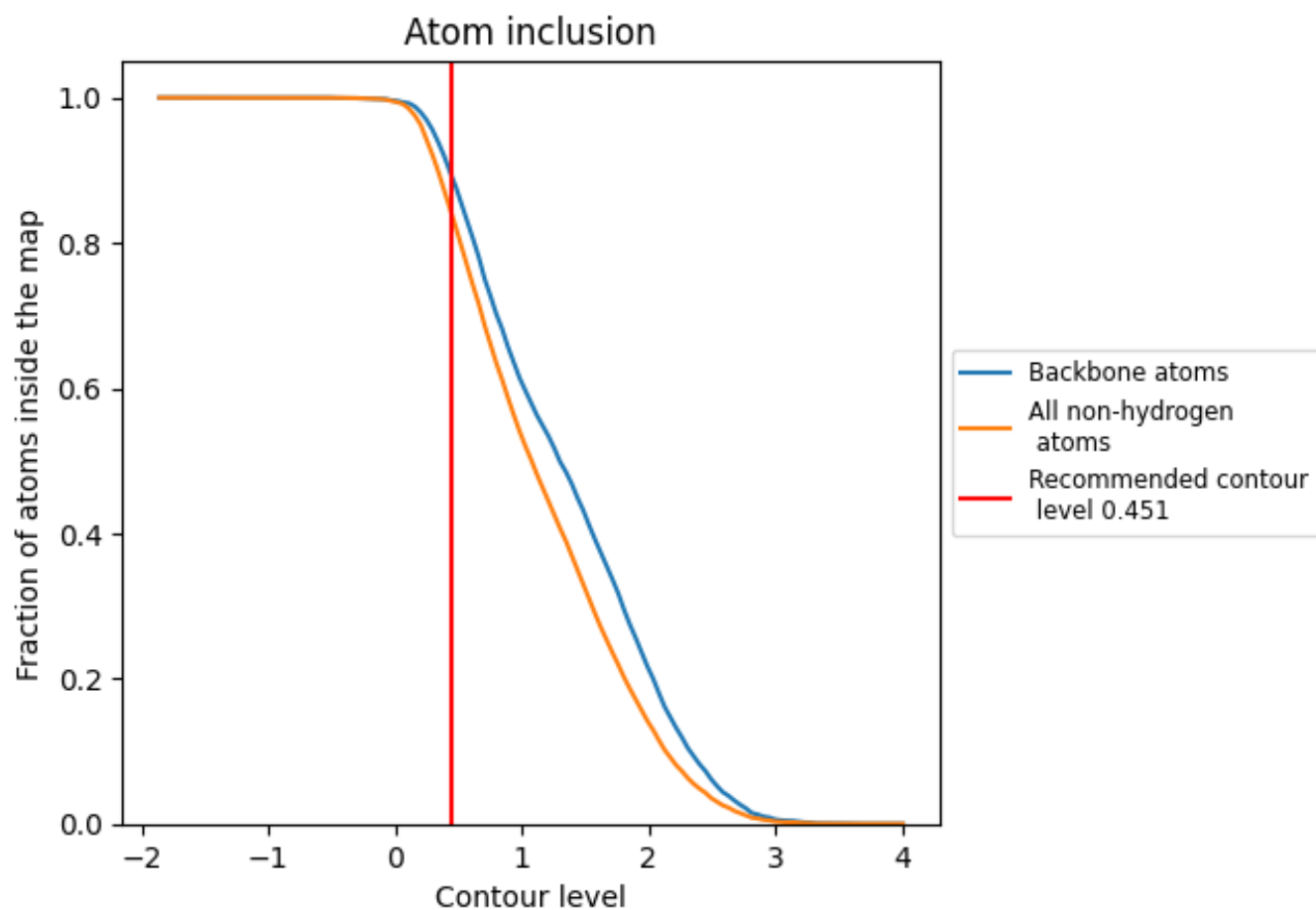
## 9.3 Atom inclusion mapped to coordinate model [i](#)



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 (0.451).















## 9.4 Atom inclusion [i](#)



At the recommended contour level, 89% of all backbone atoms, 84% 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 (0.451) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8367	 0.5360
A	 0.8896	 0.5590
B	 0.9014	 0.4750
C	 0.6640	 0.4700
D	 0.8954	 0.5560
E	 0.9529	 0.5940

