



## wwPDB EM Validation Summary Report ⓘ

Apr 5, 2026 – 08:24 PM UTC

PDB ID : 9H6T / pdb\_00009h6t  
EMDB ID : EMD-51900  
Title : Partial Cas1-Cas2 CRISPR integrase complex bound to a half-integration product, Streptococcus thermophilus DGCC 7710 CRISPR3 system  
Authors : Sasnauskas, G.; Gaizauskaite, U.; Tamulaitiene, G.  
Deposited on : 2024-10-25  
Resolution : 2.93 Å(reported)  
Based on initial model : 9H1V

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:

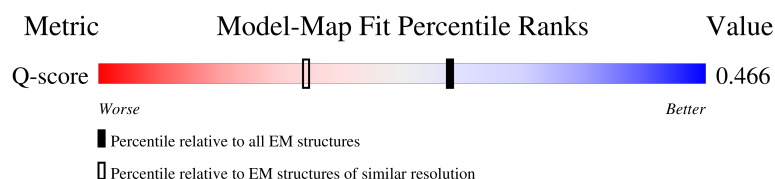
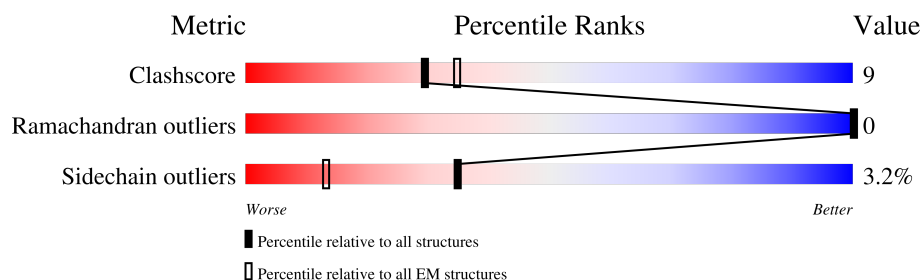
EMDB validation analysis : 0.0.1.dev132  
MolProbity : 4-5-2 with Phenix2.0  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)  
MapQ : 1.9.13  
Ideal geometry (proteins) : 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 2.93 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.





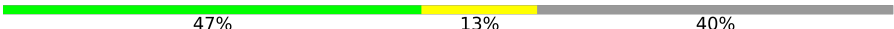
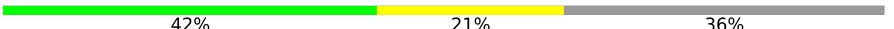
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	13037 ( 2.43 - 3.43 )

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	114	
1	D	114	
2	B	289	
2	C	289	

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Mol	Chain	Length	Quality of chain
3	E	6	 33% 67%
4	F	48	 35% 19% 46%
5	G	75	 47% 13% 40%
6	H	33	 42% 21% 36%

## 2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 7840 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 CRISPR-associated endoribonuclease Cas2.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	106	Total	C	N	O	S	0	0
			839	542	146	144	7		
1	D	95	Total	C	N	O	S	0	0
			735	472	133	123	7		

- Molecule 2 is a protein called CRISPR-associated endonuclease Cas1.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	281	Total	C	N	O	S	0	0
			2073	1355	343	366	9		
2	C	286	Total	C	N	O	S	0	0
			2190	1419	372	389	10		

- Molecule 3 is a DNA chain called Fragment of Leader DNA adjacent to the integration site.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	E	6	Total	C	N	O	P	0	0
			122	59	25	33	5		

- Molecule 4 is a DNA chain called Integration target DNA, the intact strand.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	F	26	Total	C	N	O	P	0	0
			531	254	94	157	26		

- Molecule 5 is a DNA chain called Integration product.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	G	45	Total	C	N	O	P	0	0
			922	438	171	268	45		

- Molecule 6 is a DNA chain called DNA prespacer, the non-integrated strand.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	H	21	Total	C	N	O	P	0	0
			426	203	79	124	20		

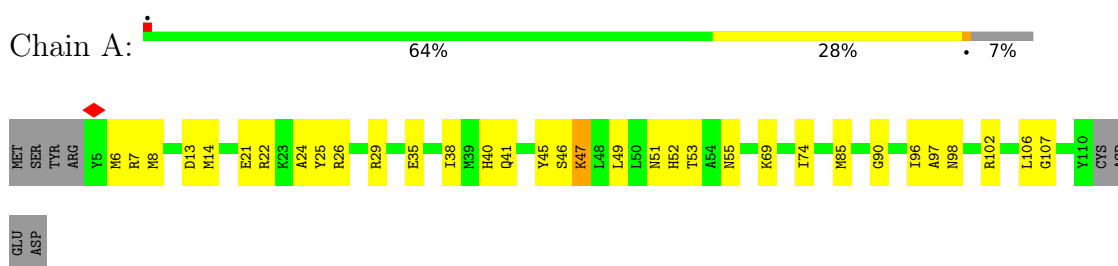
- Molecule 7 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		AltConf
7	A	1	Total	Ca	0
			1	1	
7	D	1	Total	Ca	0
			1	1	

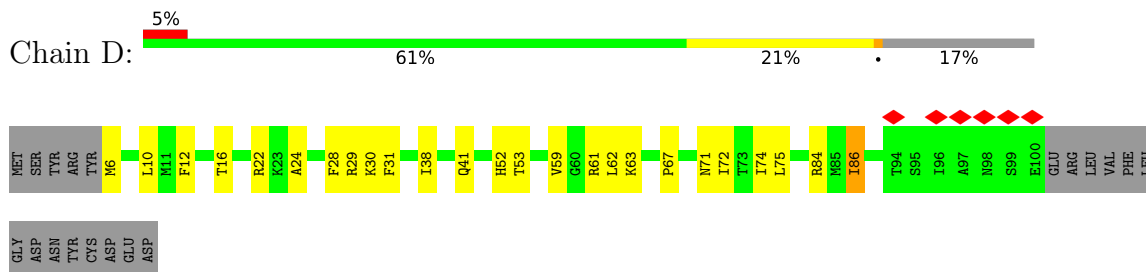
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion in map density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red diamond above a residue indicates a poor fit to the EM map for this residue (all-atom inclusion < 40%). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

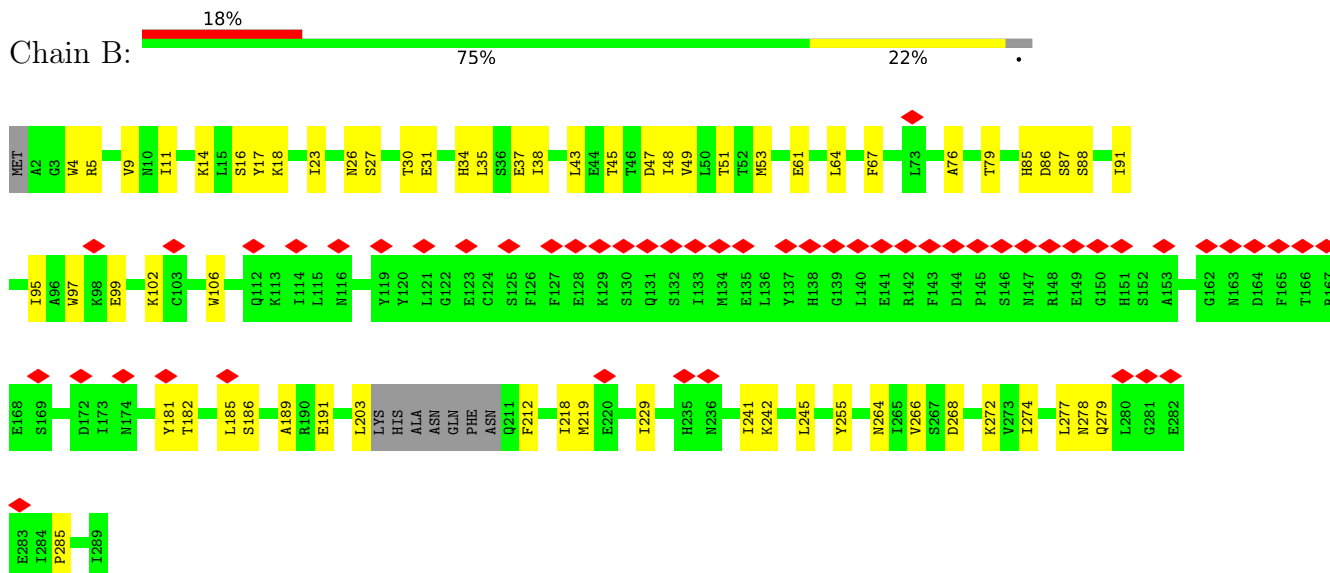
- Molecule 1: CRISPR-associated endoribonuclease Cas2


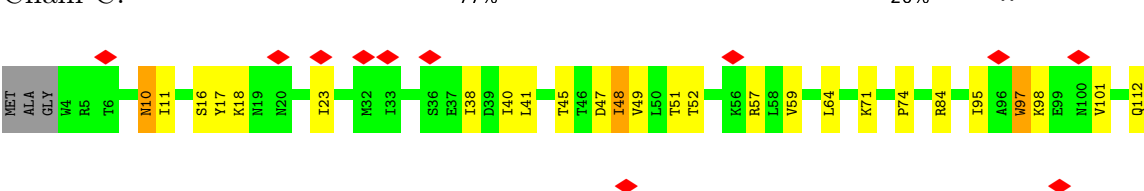


- Molecule 1: CRISPR-associated endoribonuclease Cas2




- Molecule 2: CRISPR-associated endonuclease Cas1




- Chain C: 
- 
- Sequence logo for Chain C showing amino acid frequencies at each position. The sequence is MET ALA GLY W4 R5 T6 M10 I11 S16 Y17 K18 M19 N20 I23 M32 I33 S36 E37 I38 D39 L40 L41 T45 T46 D47 I48 W49 L50 T51 T52 K56 R57 L58 V59 L64 K71 P74 R84 I95 A96 W97 K98 E99 M100 V101 Q112 K113 I114 L115 M116 Y119 K129 I133 L136 L140 S146 R154 R167 M171 A176 L184 M187 R190 E191 V194 C197 M198 T199 N207 N210 Q211 F212 M219 E220 R223 P224 I225 I226 D227 V230 I241 G257 L262 V273 L277 N278 G281 E282 F287 R288 I289.

- Chain E:  33% 67%
- |     |   |
|-----|---|
| T-5 |  |
| A-4 |   |
| C-3 |   |
| G-2 |   |
| A-1 |   |
| G0  |   |

- Chain F: 
- | Category | Percentage |
|----------|------------|
| DT       | 35%        |
| DA       | 19%        |
| DC       | 46%        |
| DG       | 0%         |
| DA       | 0%         |
| DG       | 0%         |
| DG       | 0%         |
| DT       | 0%         |
| DT       | 0%         |
| DT       | 0%         |
| DT       | 0%         |
| DA       | 0%         |
| DG       | 0%         |
| DA       | 0%         |
| DG       | 0%         |
| DG       | 0%         |
| DC       | 0%         |
| DT       | 0%         |
| DG       | 0%         |
| DT       | 0%         |
| DT       | 0%         |
| DT       | 0%         |
| DT       | 0%         |
| G-20     | 0%         |
| C-16     | 0%         |
| G-15     | 0%         |
| T-9      | 0%         |
| T-8      | 0%         |
| C-7      | 0%         |
| C-6      | 0%         |
| A-5      | 0%         |
| C-1      | 0%         |
| O0       | 0%         |
| T1       | 0%         |
| A5       | 0%         |

- [illegible]

- Chain H:  42% 21% 36%
- | Category | Value |
|----------|-------|
| DA       | 1     |
| DC       | 1     |
| DA       | 1     |
| DA       | 1     |
| DC       | 1     |
| DC       | 1     |
| DA       | 1     |
| DG       | 1     |
| C4       | 1     |
| G5       | 1     |
| T6       | 1     |
| T10      | 1     |
| G11      | 1     |
| C18      | 1     |
| C21      | 1     |
| T22      | 1     |
| A23      | 1     |
| C24      | 1     |
| DG       | 1     |
| DA       | 1     |
| DA       | 1     |
| DC       | 1     |
| DC       | 1     |

## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	108374	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS GLACIOS	Depositor
Voltage (kV)	200	Depositor
Electron dose ( $e^-/\text{\AA}^2$ )	30	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	92000	Depositor
Image detector	FEI FALCON III (4k x 4k)	Depositor
Maximum map value	58.993	Depositor
Minimum map value	-34.107	Depositor
Average map value	0.000	Depositor
Map value standard deviation	1.000	Depositor
Recommended contour level	5	Depositor
Map size (Å)	281.6, 281.6, 281.6	wwPDB
Map dimensions	256, 256, 256	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.1, 1.1, 1.1	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: CA

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	0.16	0/854	0.37	0/1145
1	D	0.16	0/748	0.40	0/1005
2	B	0.15	0/2115	0.39	0/2886
2	C	0.17	0/2237	0.39	0/3047
3	E	0.19	0/137	0.43	0/210
4	F	0.23	0/594	0.50	0/914
5	G	0.23	0/1034	0.44	0/1593
6	H	0.21	0/477	0.43	0/734
All	All	0.18	0/8196	0.41	0/11534

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	A	839	0	847	25	0
1	D	735	0	733	20	0
2	B	2073	0	1929	45	0
2	C	2190	0	2063	45	0
3	E	122	0	69	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	F	531	0	295	6	0
5	G	922	0	506	9	0
6	H	426	0	237	5	0
7	A	1	0	0	0	0
7	D	1	0	0	0	0
All	All	7840	0	6679	134	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 9.

The worst 5 of 134 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:181:TYR:O	2:B:185:LEU:HG	1.29	1.27
1:D:6:MET:HE1	1:D:52:HIS:CE1	1.90	1.05
2:B:182:THR:HA	2:B:185:LEU:HD12	1.58	0.84
2:C:71:LYS:HD2	5:G:-3:DA:H4'	1.67	0.74
3:E:-3:DC:H2''	3:E:-2:DG:C8	2.28	0.69

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	104/114 (91%)	103 (99%)	1 (1%)	0	100	100
1	D	93/114 (82%)	91 (98%)	2 (2%)	0	100	100
2	B	277/289 (96%)	265 (96%)	12 (4%)	0	100	100
2	C	284/289 (98%)	277 (98%)	7 (2%)	0	100	100
All	All	758/806 (94%)	736 (97%)	22 (3%)	0	100	100

There are no Ramachandran outliers to report.

### 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	86/102 (84%)	83 (96%)	3 (4%)	32	56
1	D	73/102 (72%)	69 (94%)	4 (6%)	19	41
2	B	193/265 (73%)	187 (97%)	6 (3%)	35	60
2	C	216/265 (82%)	211 (98%)	5 (2%)	44	68
All	All	568/734 (77%)	550 (97%)	18 (3%)	35	59

5 of 18 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	38	ILE
1	D	86	ILE
1	D	53	THR
2	B	229	ILE
2	C	225	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	41	GLN
1	D	52	HIS
1	D	55	ASN
2	B	19	ASN
1	A	40	HIS

### 5.3.3 RNA ⓘ

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 2 ligands modelled in this entry, 2 are 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 [i](#)

There are no chain breaks in this entry.

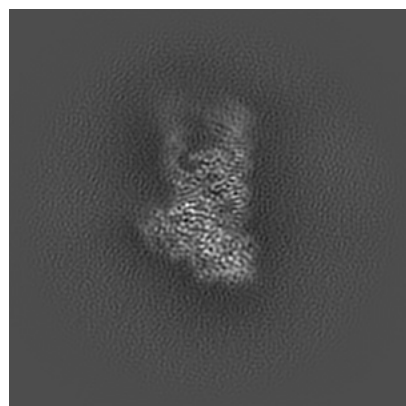
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-51900. These allow visual inspection of the internal detail of the map and identification of artifacts.

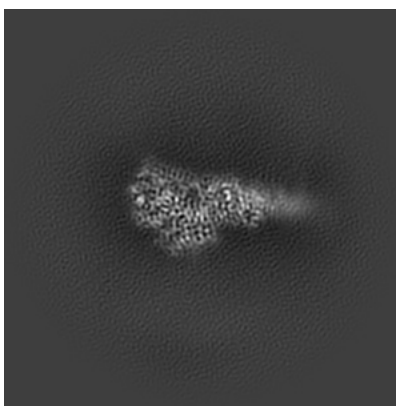
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

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

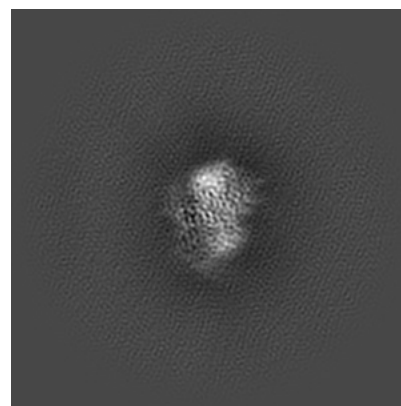
#### 6.1.1 Primary map



X

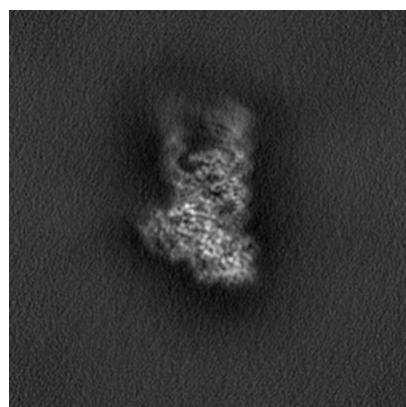


Y

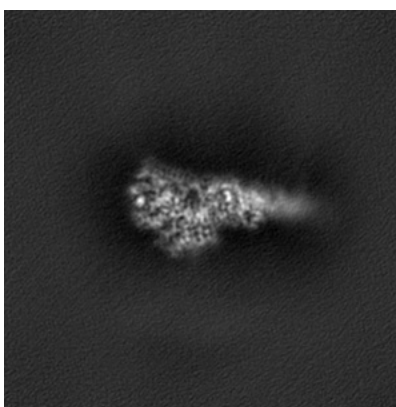


Z

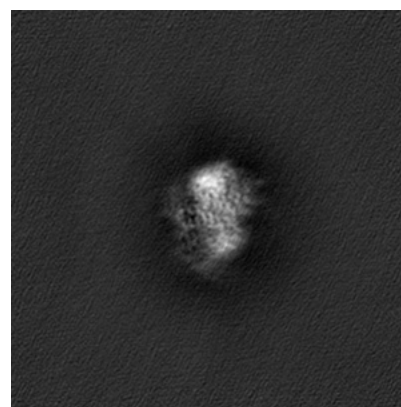
#### 6.1.2 Raw map



X



Y

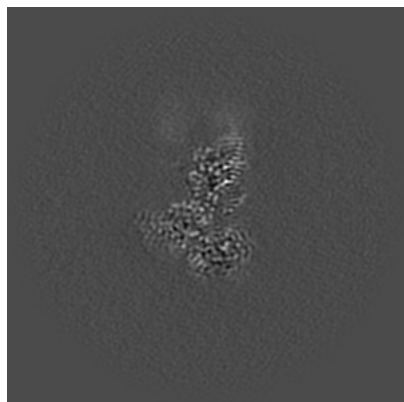


Z

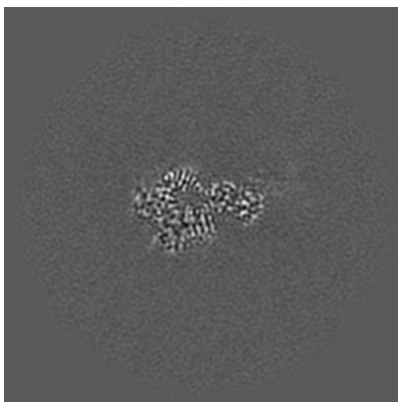
The images above show the map projected in three orthogonal directions.

## 6.2 Central slices [i](#)

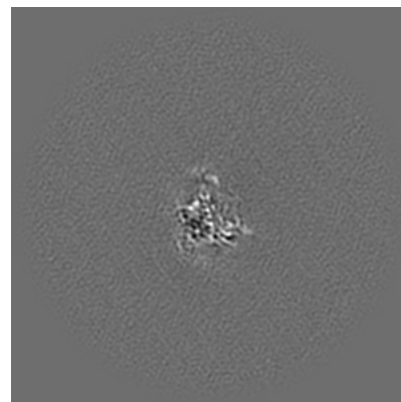
### 6.2.1 Primary map



X Index: 128

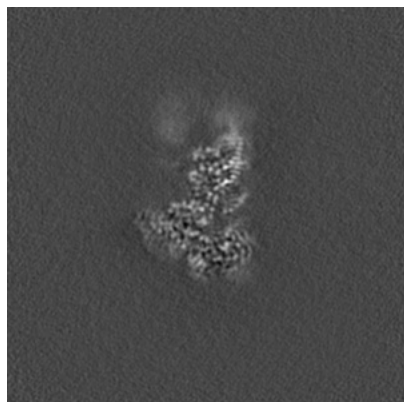


Y Index: 128

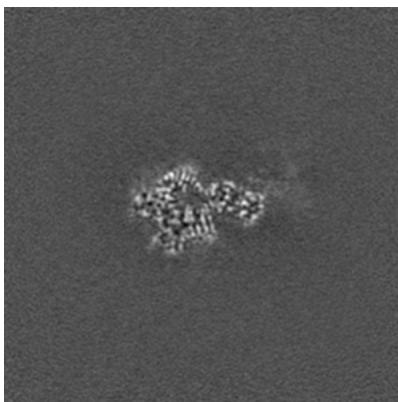


Z Index: 128

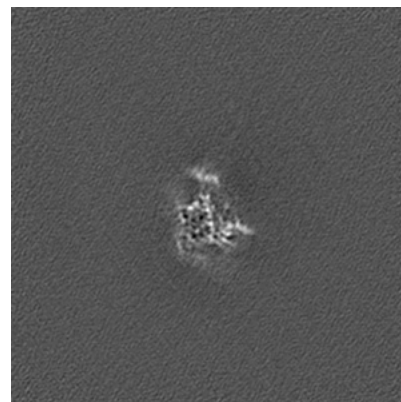
### 6.2.2 Raw map



X Index: 128



Y Index: 128

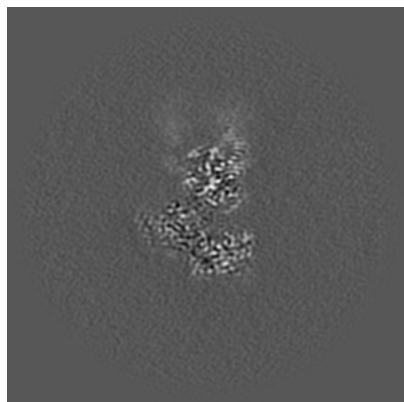


Z Index: 128

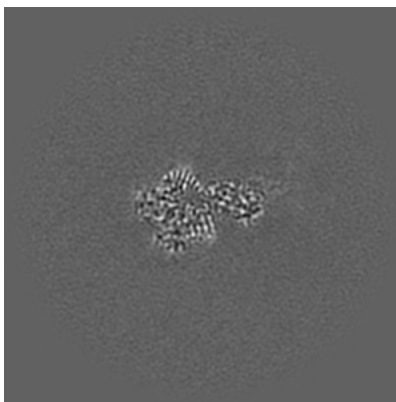
The images above show central slices of the map in three orthogonal directions.

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

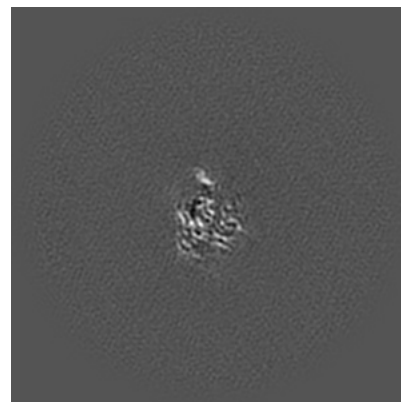
### 6.3.1 Primary map



X Index: 130

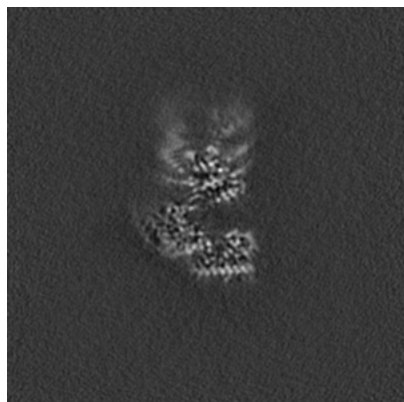


Y Index: 127

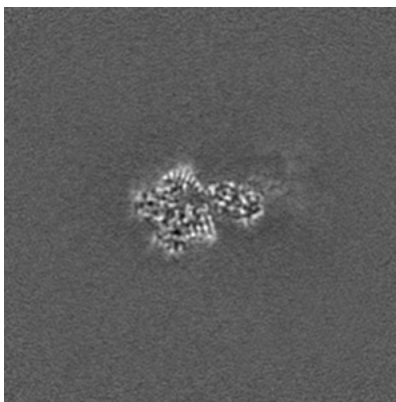


Z Index: 126

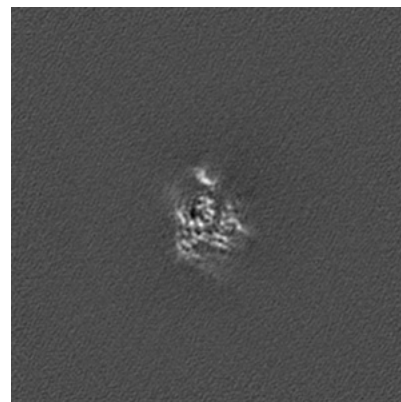
### 6.3.2 Raw map



X Index: 134



Y Index: 127



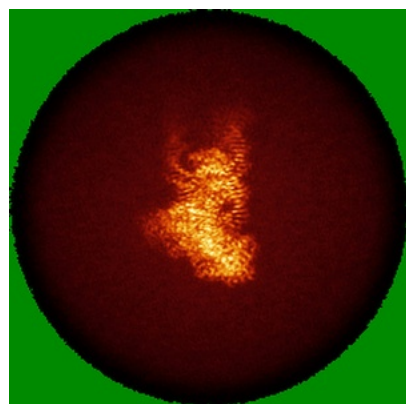
Z Index: 126

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

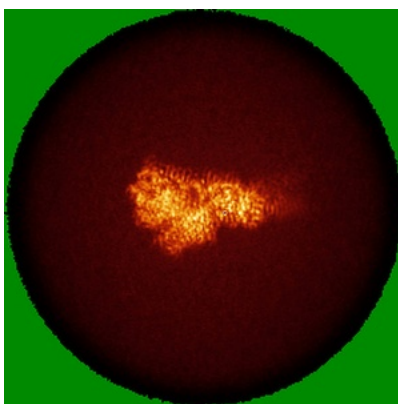


## 6.4 Orthogonal standard-deviation projections (False-color) [i](#)

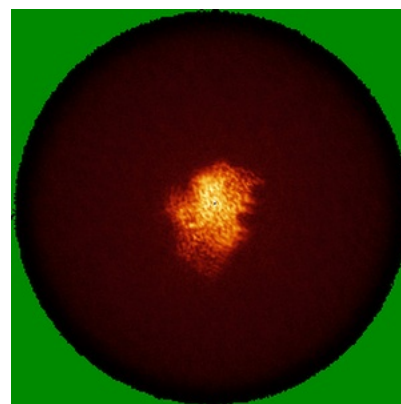
### 6.4.1 Primary map



X

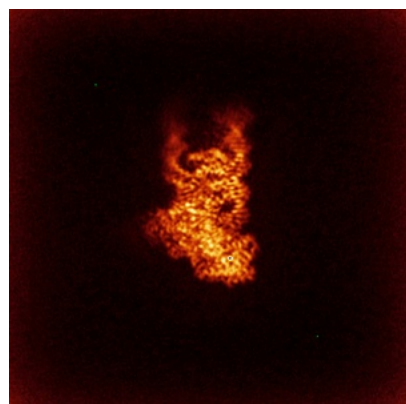


Y

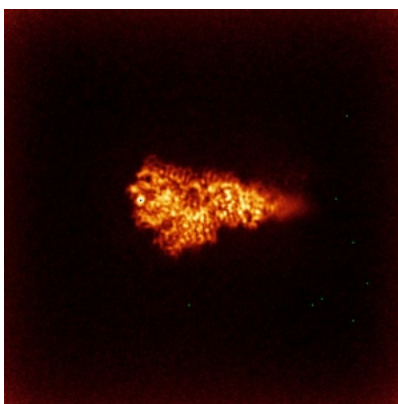


Z

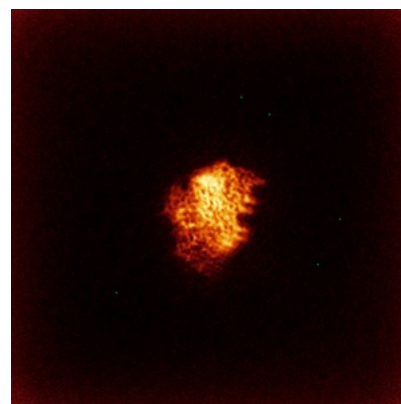
### 6.4.2 Raw map



X



Y



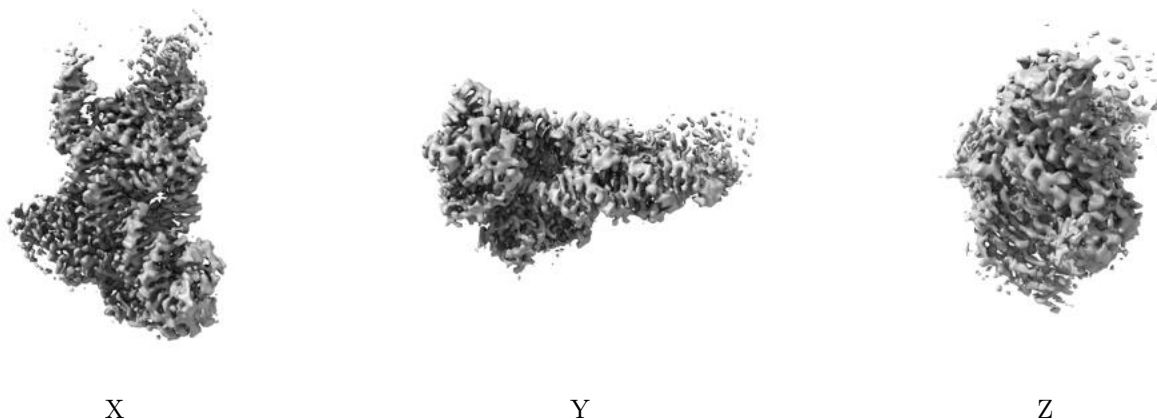
Z

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.



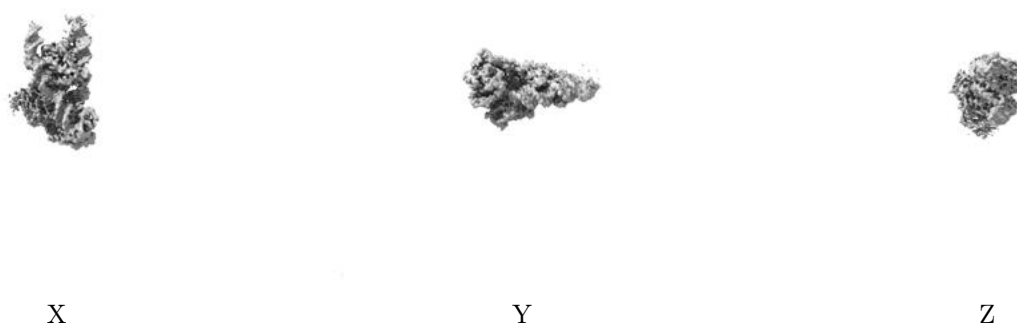
## 6.5 Orthogonal surface views [i](#)

### 6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 5.0. 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.

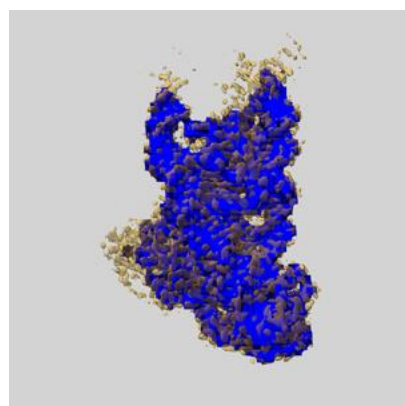
## 6.6 Mask visualisation [i](#)

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

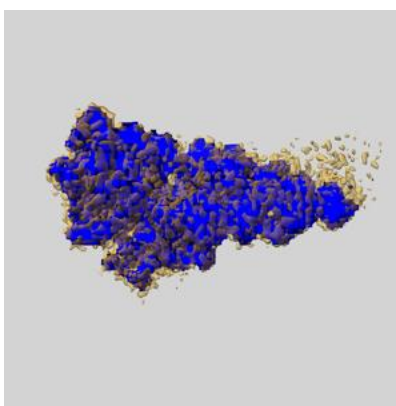
A mask typically either:

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

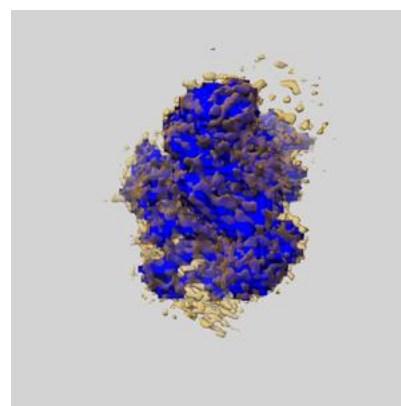
### 6.6.1 emd\_51900\_msk\_1.map [i](#)



X



Y

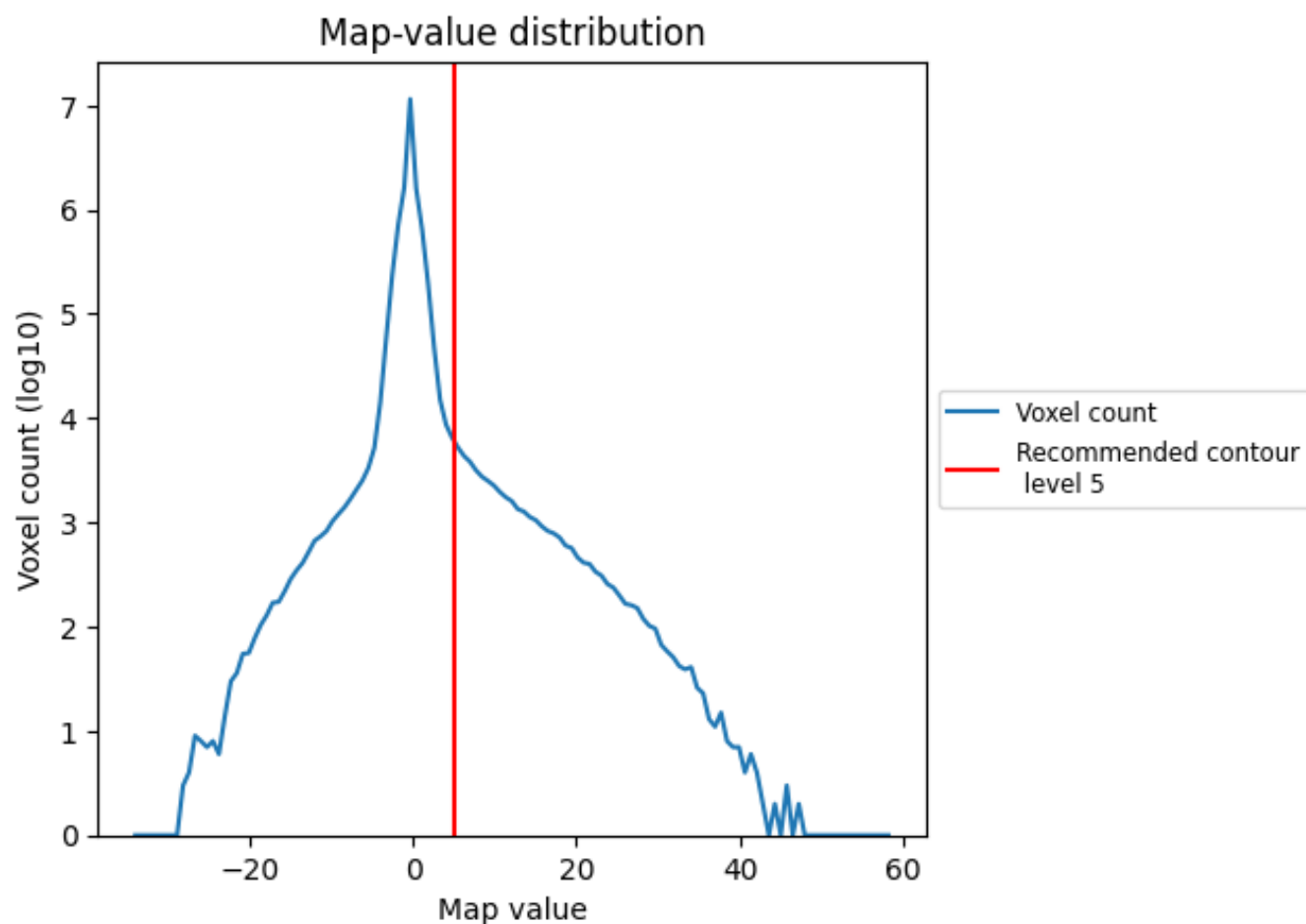


Z

## 7 Map analysis [i](#)

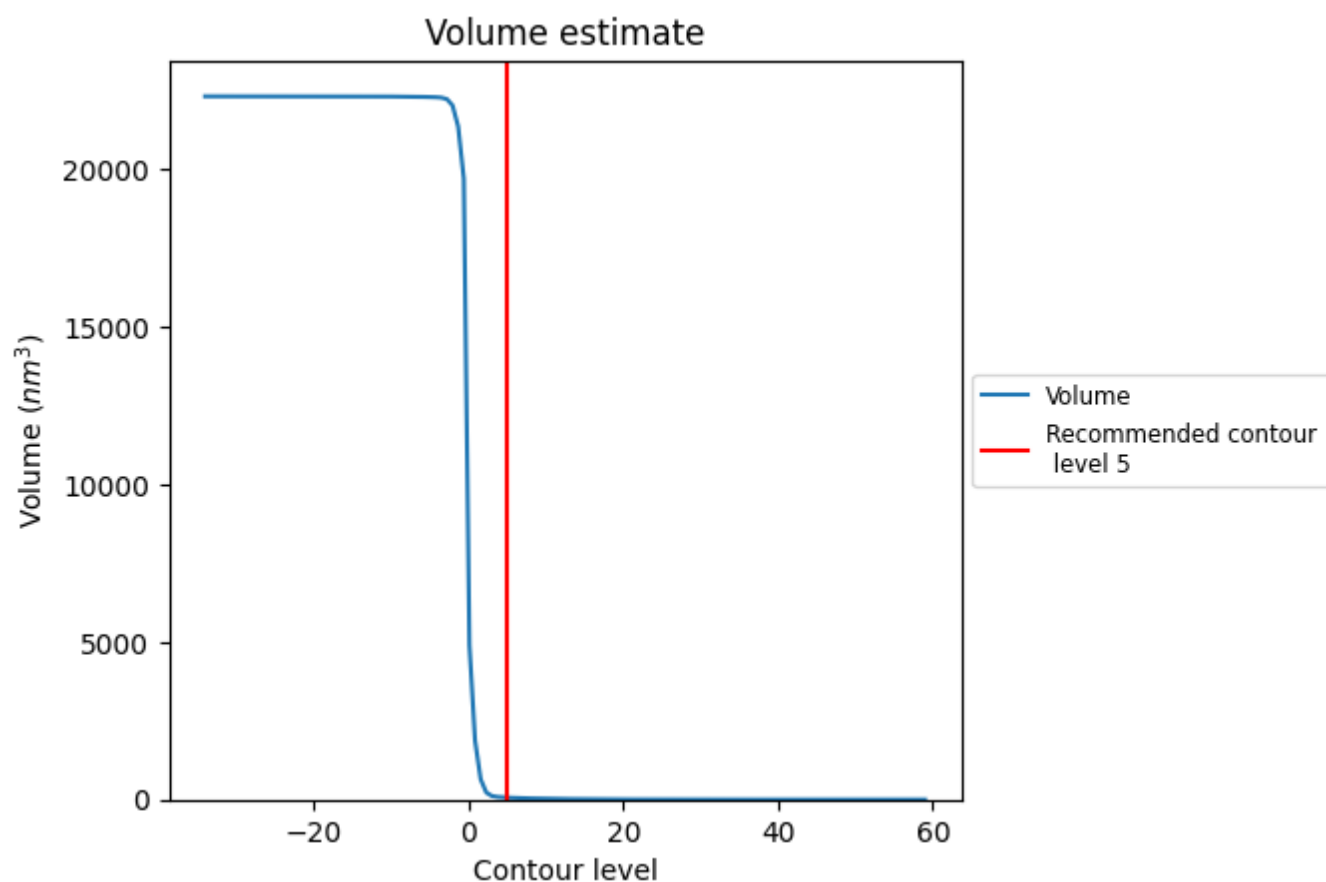
This section contains the results of statistical analysis of the map.

### 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.

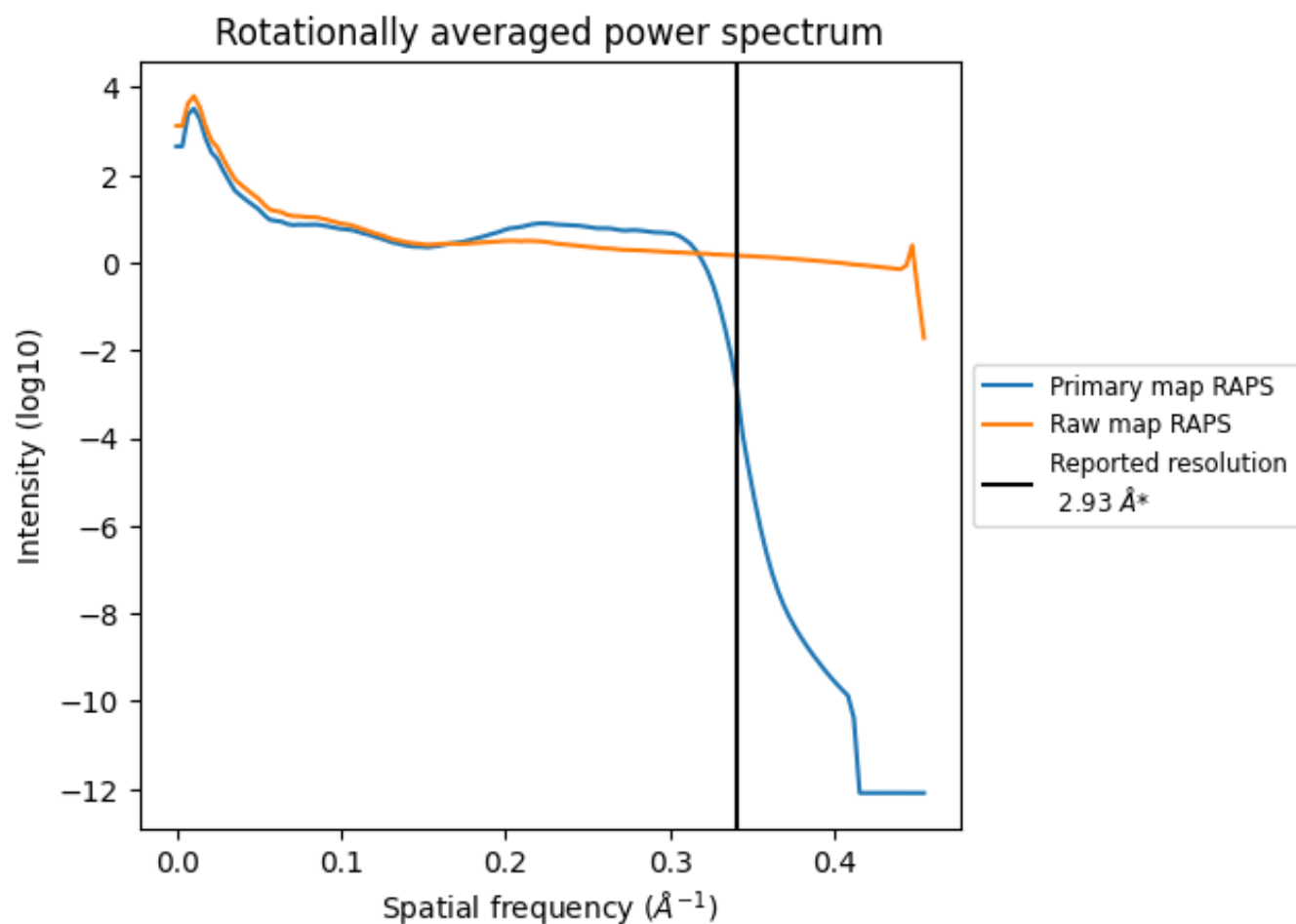
## 7.2 Volume estimate [i](#)



The volume at the recommended contour level is 62 nm<sup>3</sup>; this corresponds to an approximate mass of 56 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 ⓘ

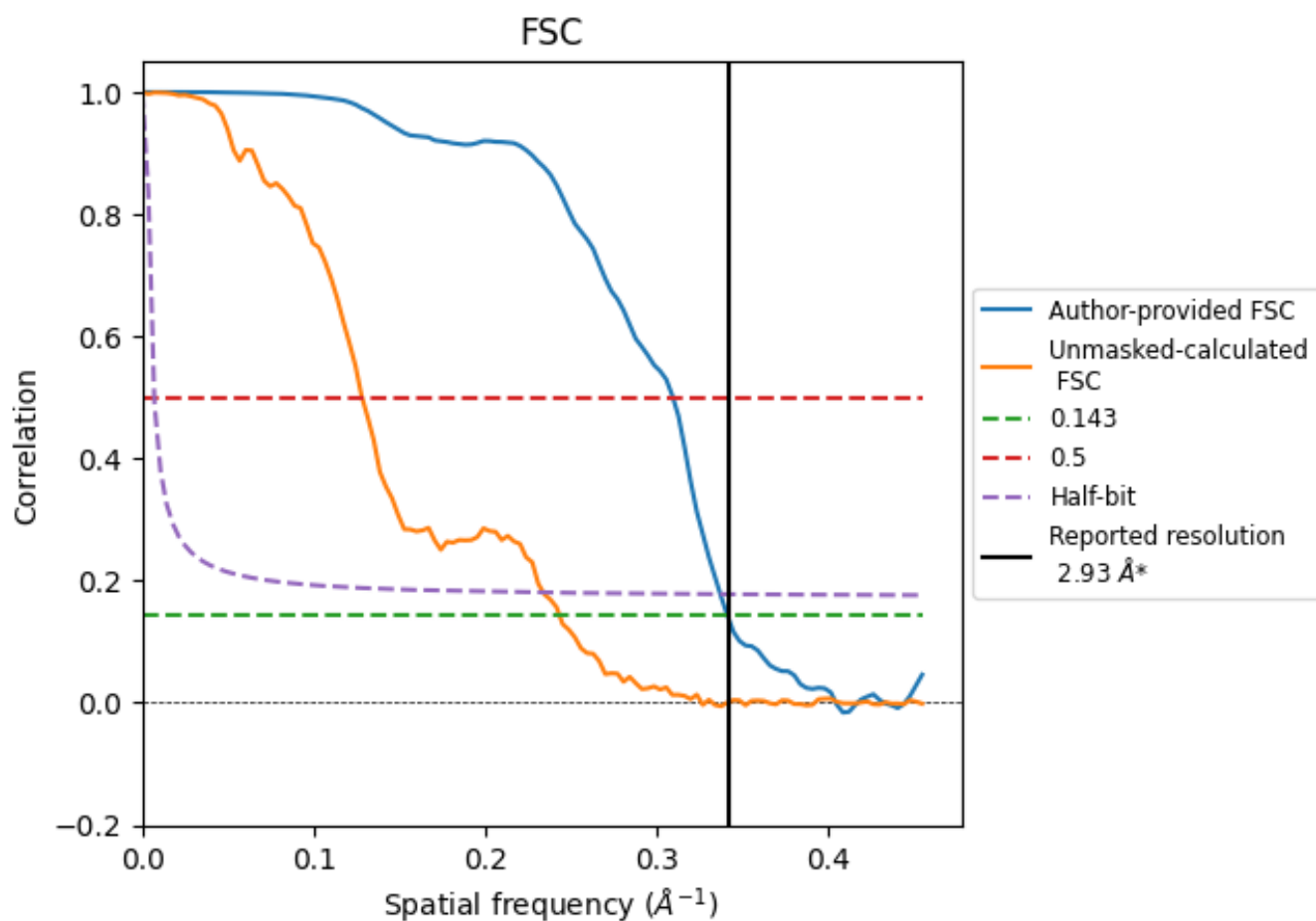


\*Reported resolution corresponds to spatial frequency of 0.341 Å⁻¹

## 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 0.341  $\text{\AA}^{-1}$

## 8.2 Resolution estimates [i](#)

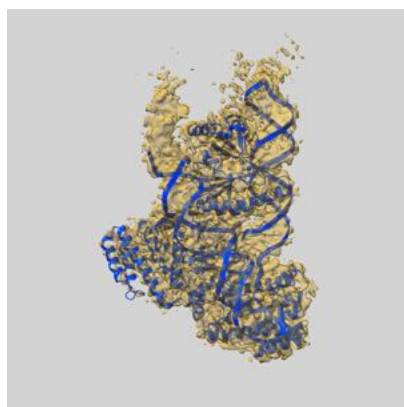
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	2.93	-	-
Author-provided FSC curve	2.93	3.23	2.97
Unmasked-calculated*	4.11	7.81	4.28

\*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps. The value from deposited half-maps intersecting FSC 0.143 CUT-OFF 4.11 differs from the reported value 2.93 by more than 10 %

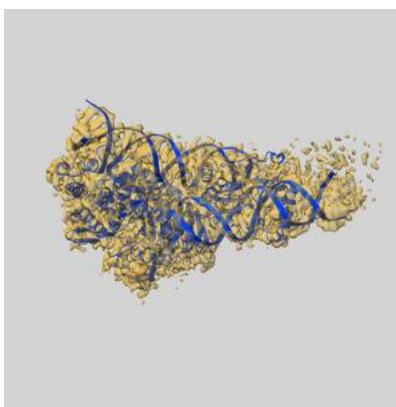
## 9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-51900 and PDB model 9H6T. Per-residue inclusion information can be found in section [3](#) on page [6](#).

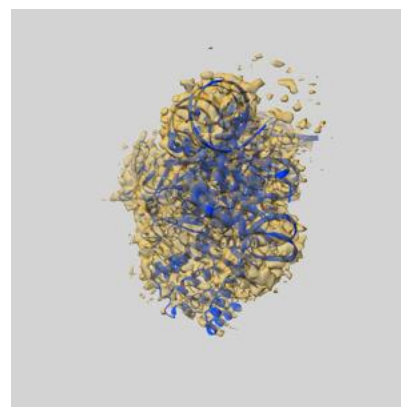
### 9.1 Map-model overlay [i](#)



X



Y

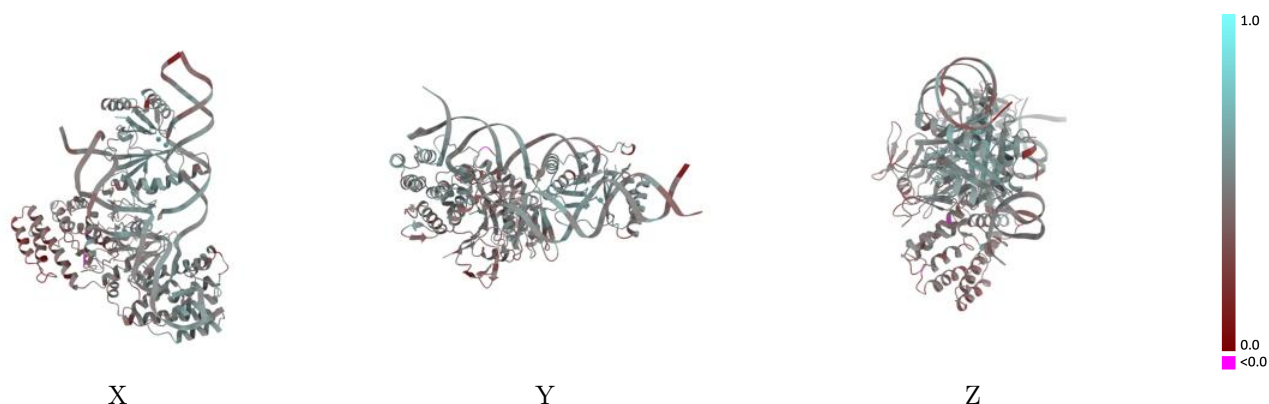


Z

The images above show the 3D surface view of the map at the recommended contour level 5.0 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.

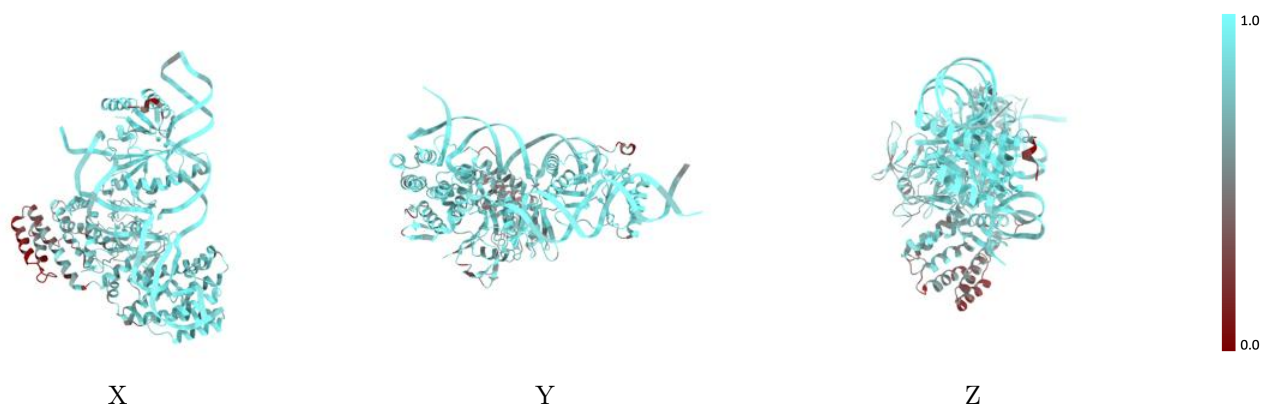


## 9.2 Q-score mapped to coordinate model [i](#)



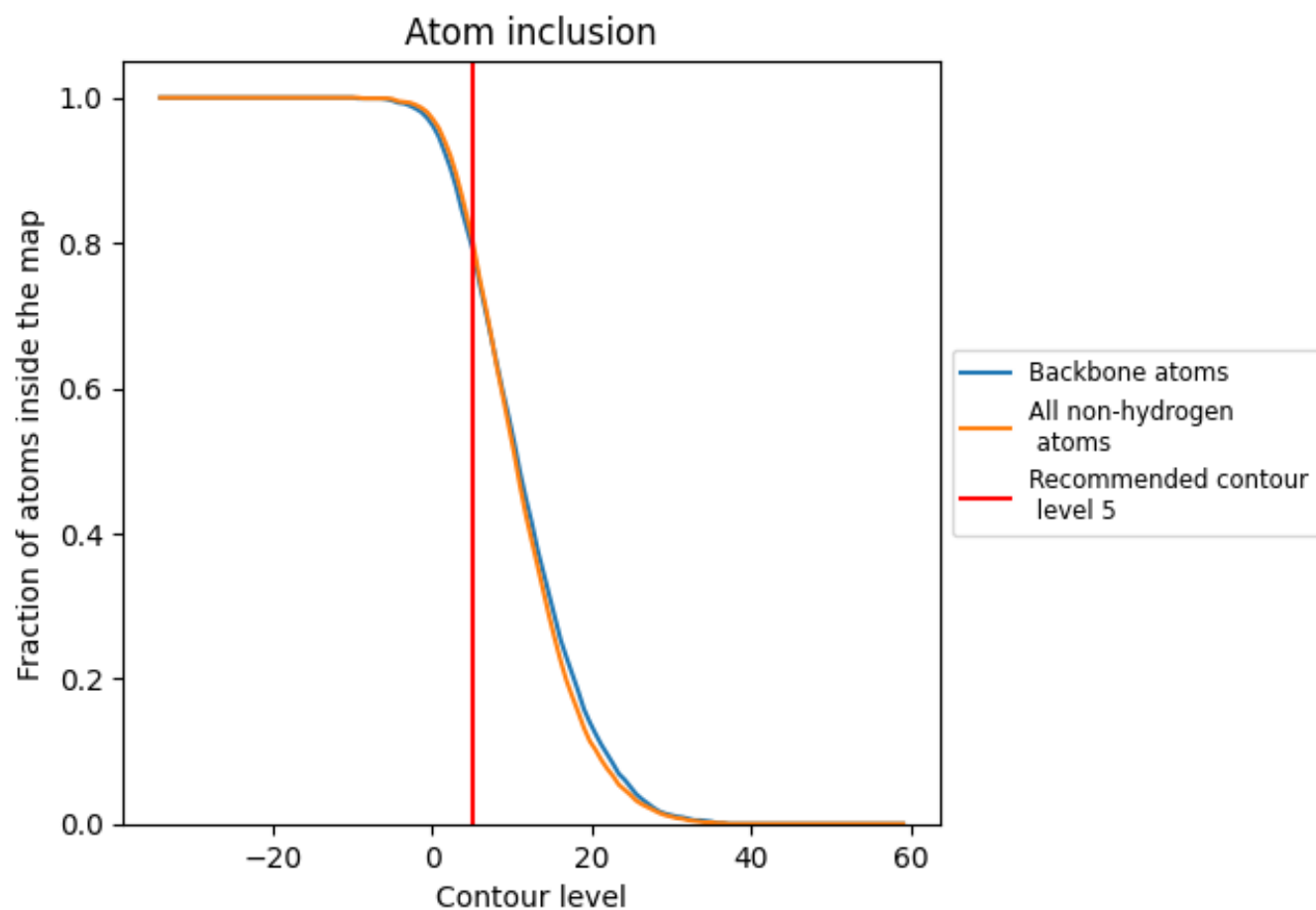
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (5).

## 9.4 Atom inclusion [i](#)



At the recommended contour level, 79% of all backbone atoms, 80% 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 (5) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div><div></div></div> 0.8050	<div><div></div></div> 0.4660
A	<div><div></div></div> 0.8680	<div><div></div></div> 0.5200
B	<div><div></div></div> 0.6860	<div><div></div></div> 0.4130
C	<div><div></div></div> 0.8260	<div><div></div></div> 0.4660
D	<div><div></div></div> 0.8580	<div><div></div></div> 0.5080
E	<div><div></div></div> 0.8850	<div><div></div></div> 0.5290
F	<div><div></div></div> 0.8230	<div><div></div></div> 0.4850
G	<div><div></div></div> 0.8640	<div><div></div></div> 0.4820
H	<div><div></div></div> 0.8830	<div><div></div></div> 0.4720

1.0

0.0

<0.0