



# wwPDB EM Validation Summary Report ⓘ

May 18, 2024 – 10:13 AM EDT

PDB ID : 6WVK  
EMDB ID : EMD-21921  
Title : Cryo-EM structure of Bacillus subtilis RNA Polymerase in complex with HelD  
Authors : Newing, T.; Tolun, G.; Oakley, A.J.  
Deposited on : 2020-05-06  
Resolution : 3.36 Å(reported)

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

We welcome your comments at [validation@mail.wwpdb.org](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.dev92  
MolProbity : 4.02b-467  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
MapQ : 1.9.13  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.36.2

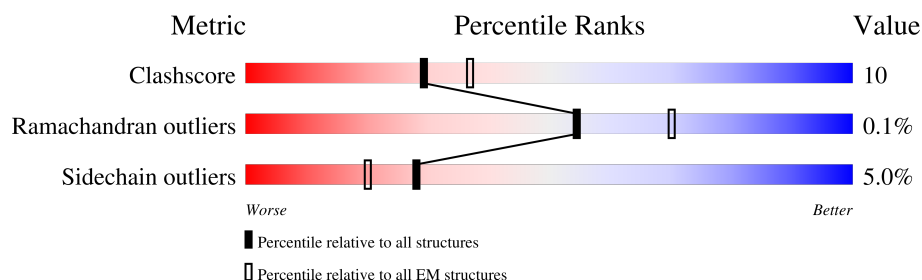
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 3.36 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	314	
1	B	314	
2	C	1193	
3	D	1199	
4	E	69	
5	F	67	
6	H	774	

## 2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 28227 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 DNA-directed RNA polymerase subunit alpha.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	224	Total	C	N	O		0	0
			1691	1069	288	334			
1	B	224	Total	C	N	O		0	0
			1642	1044	279	319			

- Molecule 2 is a protein called DNA-directed RNA polymerase subunit beta.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	C	1099	Total	C	N	O	S	0	0
			8586	5400	1496	1658	32		

- Molecule 3 is a protein called DNA-directed RNA polymerase subunit beta'.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	D	1184	Total	C	N	O	S	0	0
			9149	5782	1621	1703	43		

- Molecule 4 is a protein called UPF0356 protein YkzG.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	E	69	Total	C	N	O	S	0	0
			563	364	89	109	1		

- Molecule 5 is a protein called DNA-directed RNA polymerase subunit omega.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	F	61	Total	C	N	O	S	0	0
			472	299	80	89	4		

- Molecule 6 is a protein called DNA helicase IV.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	H	770	Total	C	N	O	S	0	0
			6121	3902	1058	1130	31		

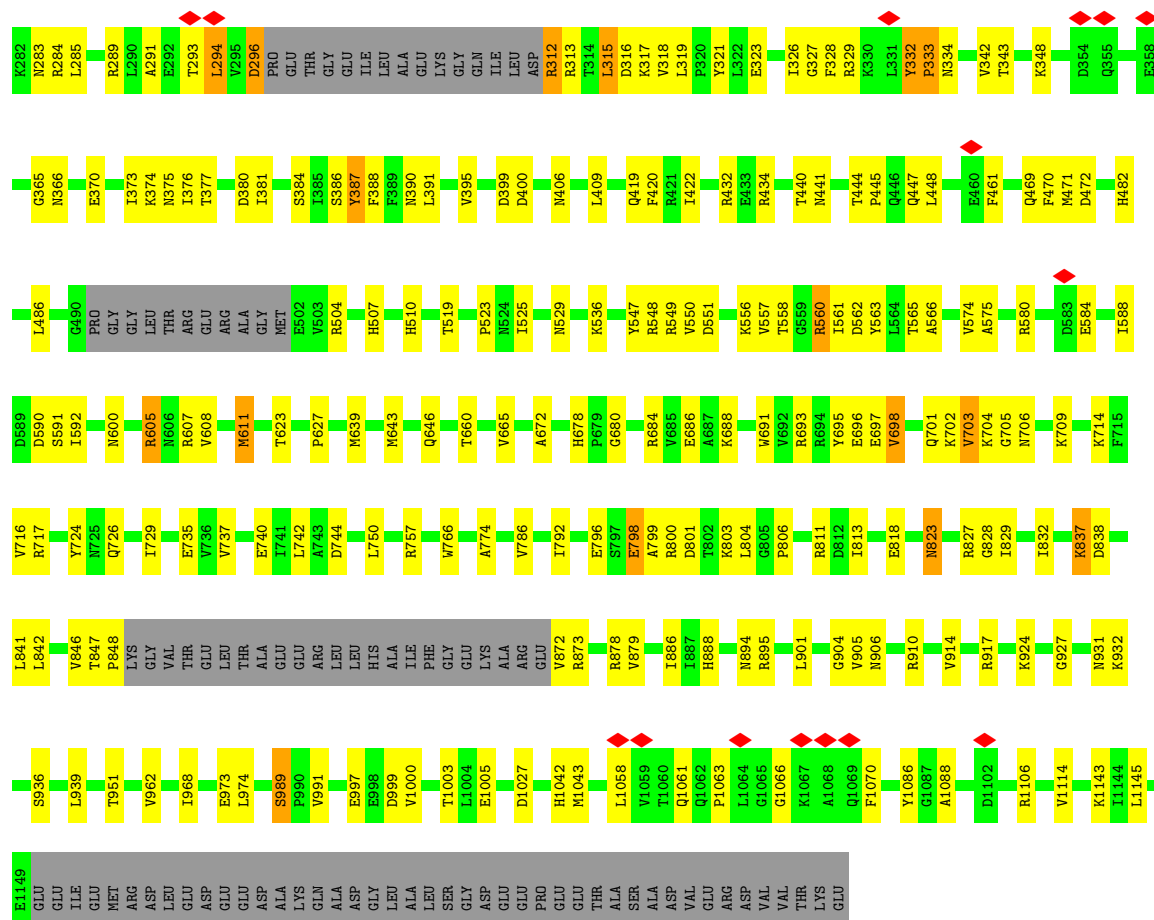
- Molecule 7 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		AltConf
7	D	2	Total	Zn	0
			2	2	

- Molecule 8 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

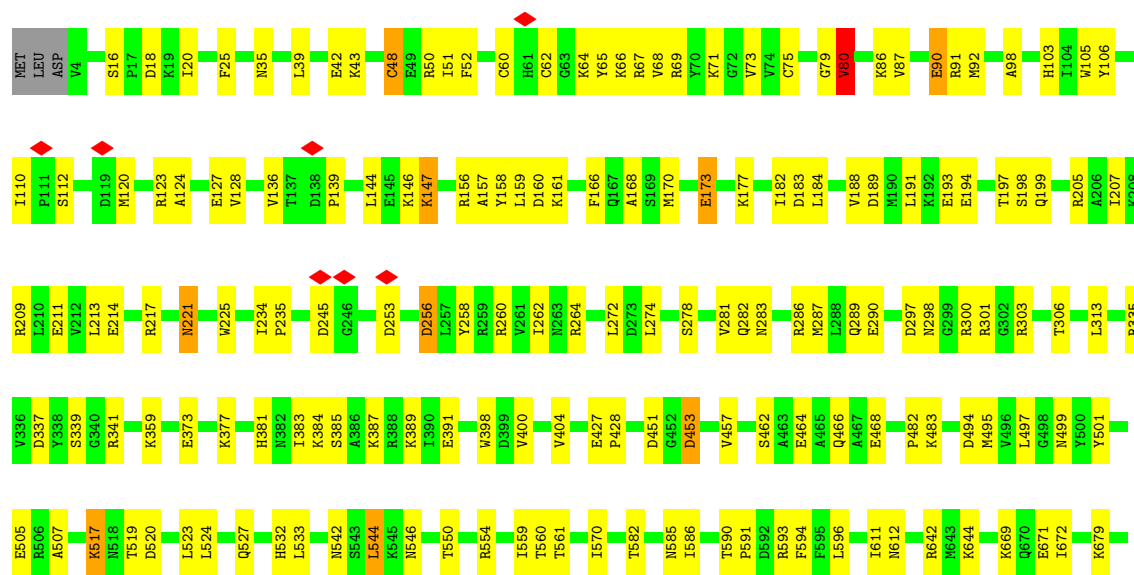
Mol	Chain	Residues	Atoms		AltConf
8	D	1	Total	Mg	0
			1	1	

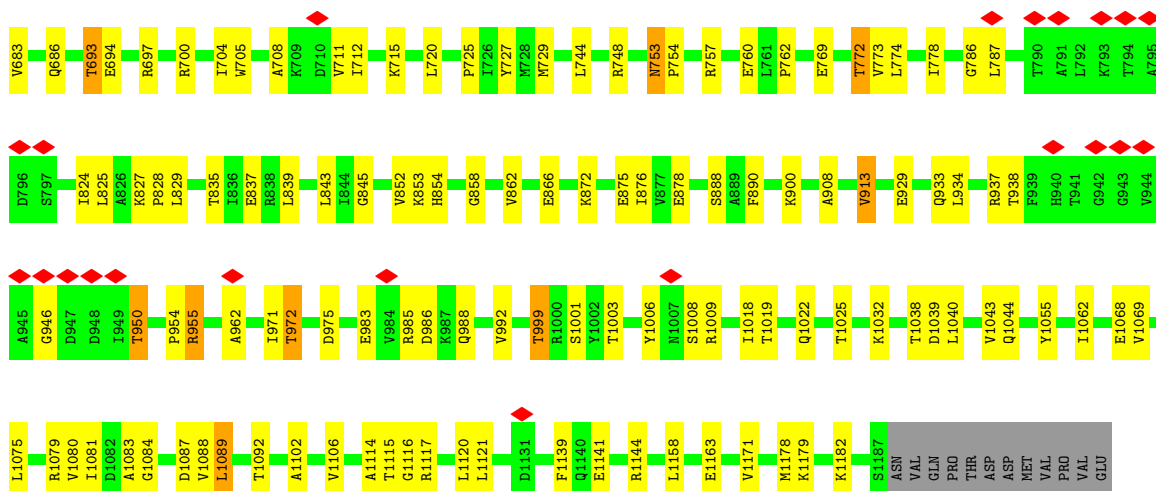




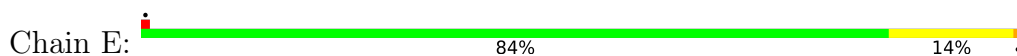
• Molecule 3: DNA-directed RNA polymerase subunit beta'

Chain D: 74% 23%





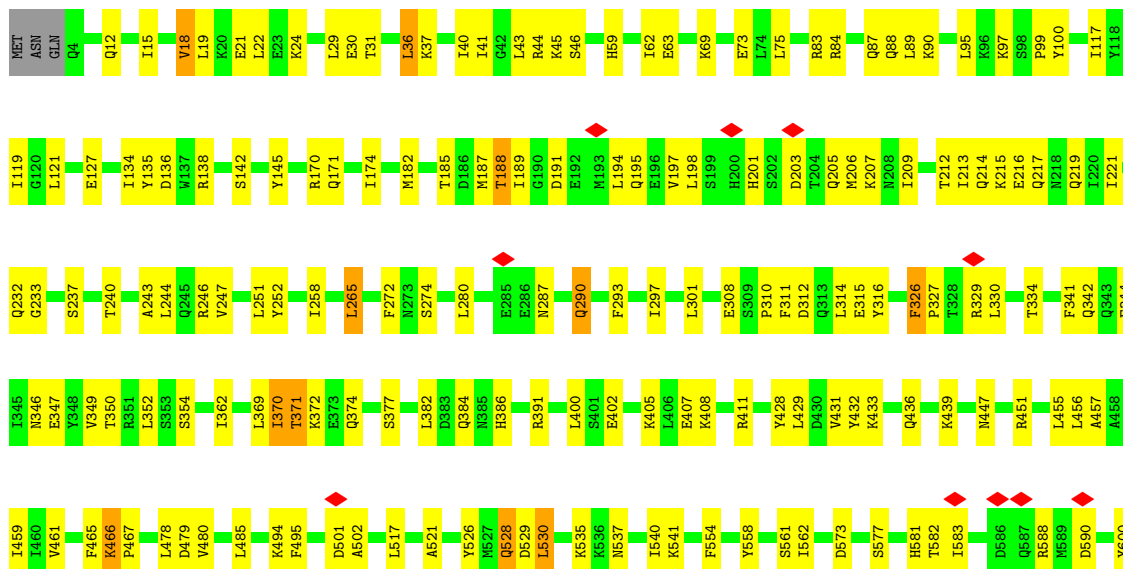
• Molecule 4: UPF0356 protein YkzG



• Molecule 5: DNA-directed RNA polymerase subunit omega



• Molecule 6: DNA helicase IV







## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	65356	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 ( $e^-/\text{\AA}^2$ )	63.6	Depositor
Minimum defocus (nm)	600	Depositor
Maximum defocus (nm)	2800	Depositor
Magnification	59500	Depositor
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	11.467	Depositor
Minimum map value	-6.290	Depositor
Average map value	0.032	Depositor
Map value standard deviation	0.735	Depositor
Recommended contour level	0.535	Depositor
Map size (Å)	141.95999, 162.95999, 137.76	wwPDB
Map dimensions	164, 194, 169	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.84, 0.84, 0.84	Depositor

## 5 Model quality

### 5.1 Standard geometry

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

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	0/1717	0.53	1/2340 (0.0%)
1	B	0.34	0/1667	0.56	1/2278 (0.0%)
2	C	0.35	0/8738	0.54	3/11831 (0.0%)
3	D	0.32	0/9300	0.51	2/12577 (0.0%)
4	E	0.33	0/573	0.43	0/771
5	F	0.27	0/477	0.42	0/639
6	H	0.32	0/6252	0.48	0/8445
All	All	0.33	0/28724	0.51	7/38881 (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
2	C	0	1

There are no bond length outliers.

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	42	ARG	NE-CZ-NH1	5.64	123.12	120.30
2	C	218	ARG	NE-CZ-NH1	5.60	123.10	120.30
3	D	451	ASP	CB-CG-OD1	5.58	123.32	118.30
1	B	30	ARG	NE-CZ-NH1	5.29	122.94	120.30
2	C	263	LYS	N-CA-CB	-5.29	101.08	110.60

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	C	432	ARG	Sidechain

## 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	1691	0	1695	22	0
1	B	1642	0	1630	32	0
2	C	8586	0	8466	179	0
3	D	9149	0	9248	175	0
4	E	563	0	547	6	0
5	F	472	0	488	13	0
6	H	6121	0	5939	169	0
7	D	2	0	0	0	0
8	D	1	0	0	0	0
All	All	28227	0	28013	574	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 10.

The worst 5 of 574 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:C:328:PHE:O	2:C:332:TYR:OH	1.84	0.96
6:H:651:LYS:HE3	6:H:654:GLN:HE22	1.41	0.84
1:B:43:ILE:HD11	1:B:217:LEU:HD13	1.62	0.81
3:D:1084:GLY:HA3	3:D:1114:ALA:HA	1.66	0.76
2:C:317:LYS:HG3	2:C:318:VAL:HG13	1.67	0.74

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	222/314 (71%)	217 (98%)	5 (2%)	0	100	100
1	B	222/314 (71%)	208 (94%)	14 (6%)	0	100	100
2	C	1091/1193 (92%)	987 (90%)	102 (9%)	2 (0%)	47	78
3	D	1182/1199 (99%)	1087 (92%)	93 (8%)	2 (0%)	47	78
4	E	67/69 (97%)	64 (96%)	3 (4%)	0	100	100
5	F	59/67 (88%)	53 (90%)	6 (10%)	0	100	100
6	H	768/774 (99%)	692 (90%)	75 (10%)	1 (0%)	51	82
All	All	3611/3930 (92%)	3308 (92%)	298 (8%)	5 (0%)	54	82

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	D	80	VAL
6	H	326	PHE
2	C	332	TYR
3	D	1038	THR
2	C	962	VAL

### 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	184/273 (67%)	173 (94%)	11 (6%)	19	50
1	B	172/273 (63%)	168 (98%)	4 (2%)	50	75
2	C	928/1026 (90%)	885 (95%)	43 (5%)	27	59
3	D	972/1027 (95%)	924 (95%)	48 (5%)	25	57
4	E	60/65 (92%)	57 (95%)	3 (5%)	24	56
5	F	52/61 (85%)	50 (96%)	2 (4%)	33	63

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
6	H	634/682 (93%)	594 (94%)	40 (6%)	18 49
All	All	3002/3407 (88%)	2851 (95%)	151 (5%)	28 56

5 of 151 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
6	H	127	GLU
6	H	677	CYS
6	H	265	LEU
6	H	377	SER
6	H	769	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
6	H	676	GLN
6	H	771	GLN
2	C	1062	GLN
3	D	753	ASN
6	H	87	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 3 ligands modelled in this entry, 3 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.

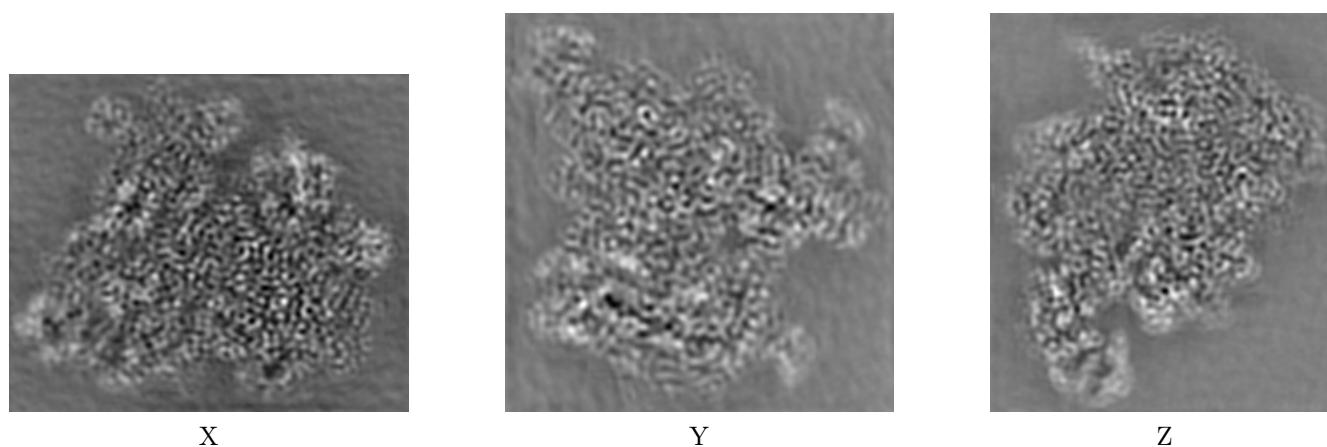
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-21921. 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](#)

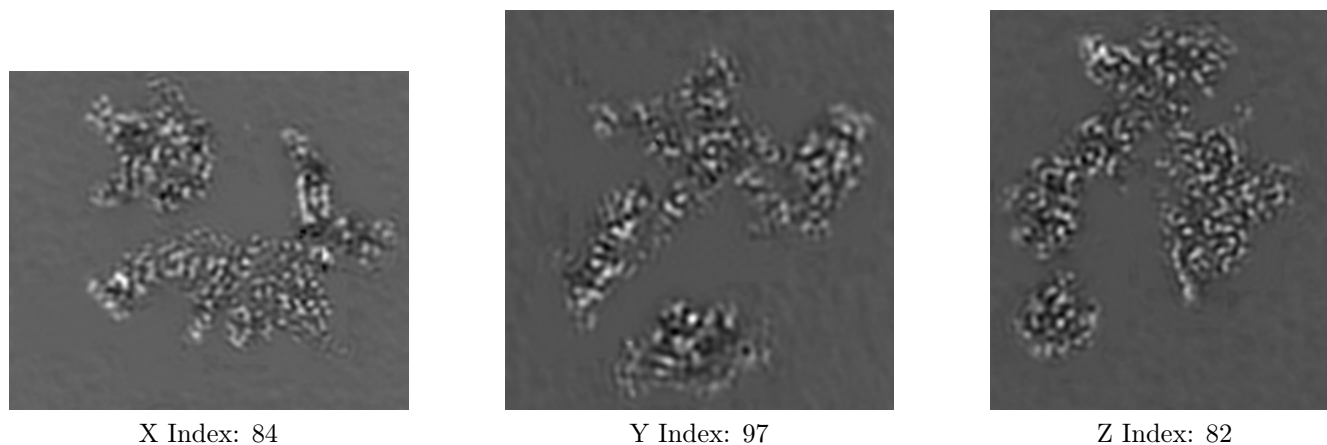
#### 6.1.1 Primary map



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

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

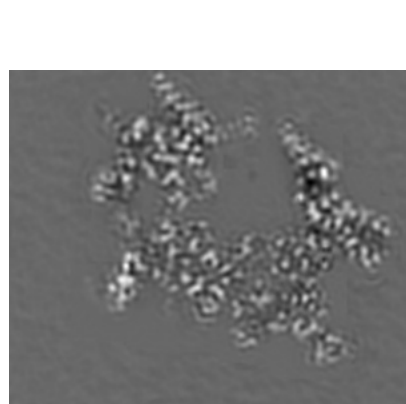
#### 6.2.1 Primary map



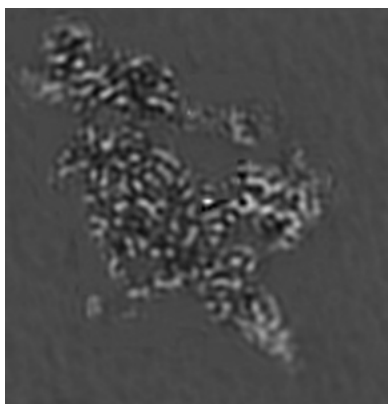
The images above show central slices of the map in three orthogonal directions.

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

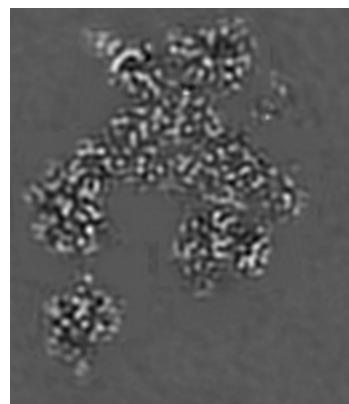
### 6.3.1 Primary map



X Index: 89



Y Index: 141

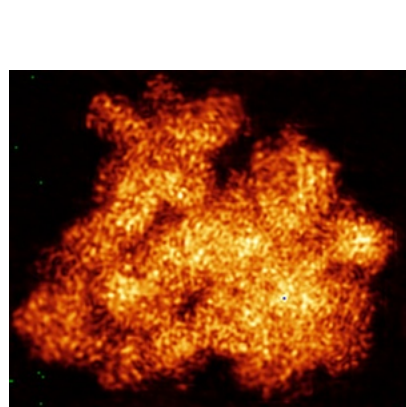


Z Index: 77

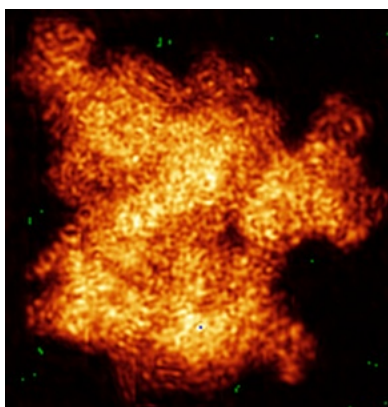
The images above show the largest variance slices of the map in three orthogonal directions.

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

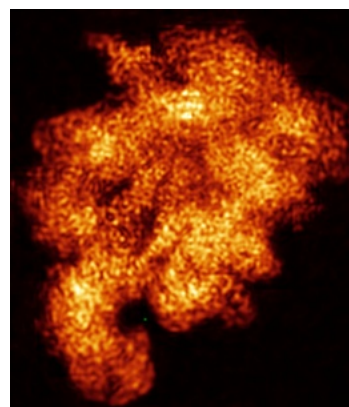
### 6.4.1 Primary map



X



Y



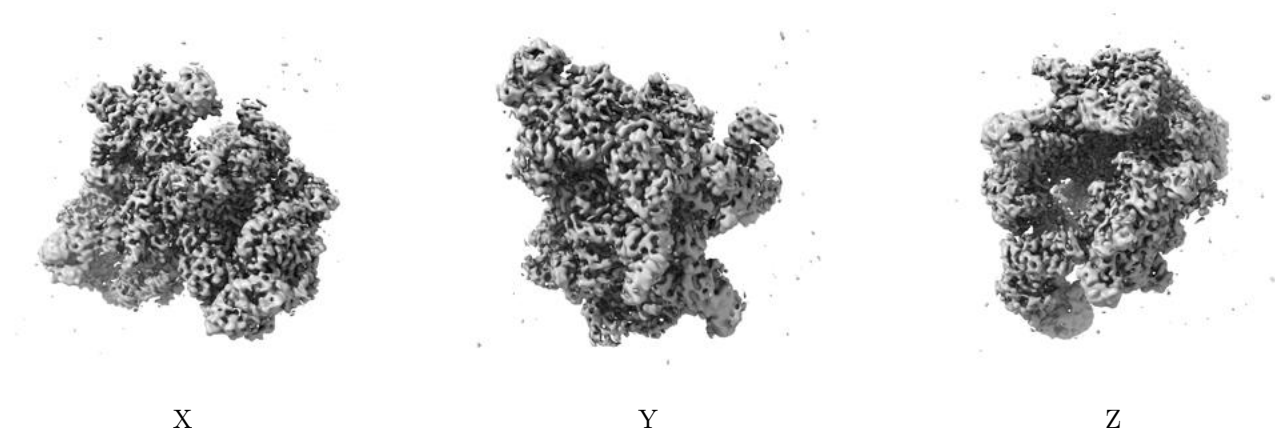
Z

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

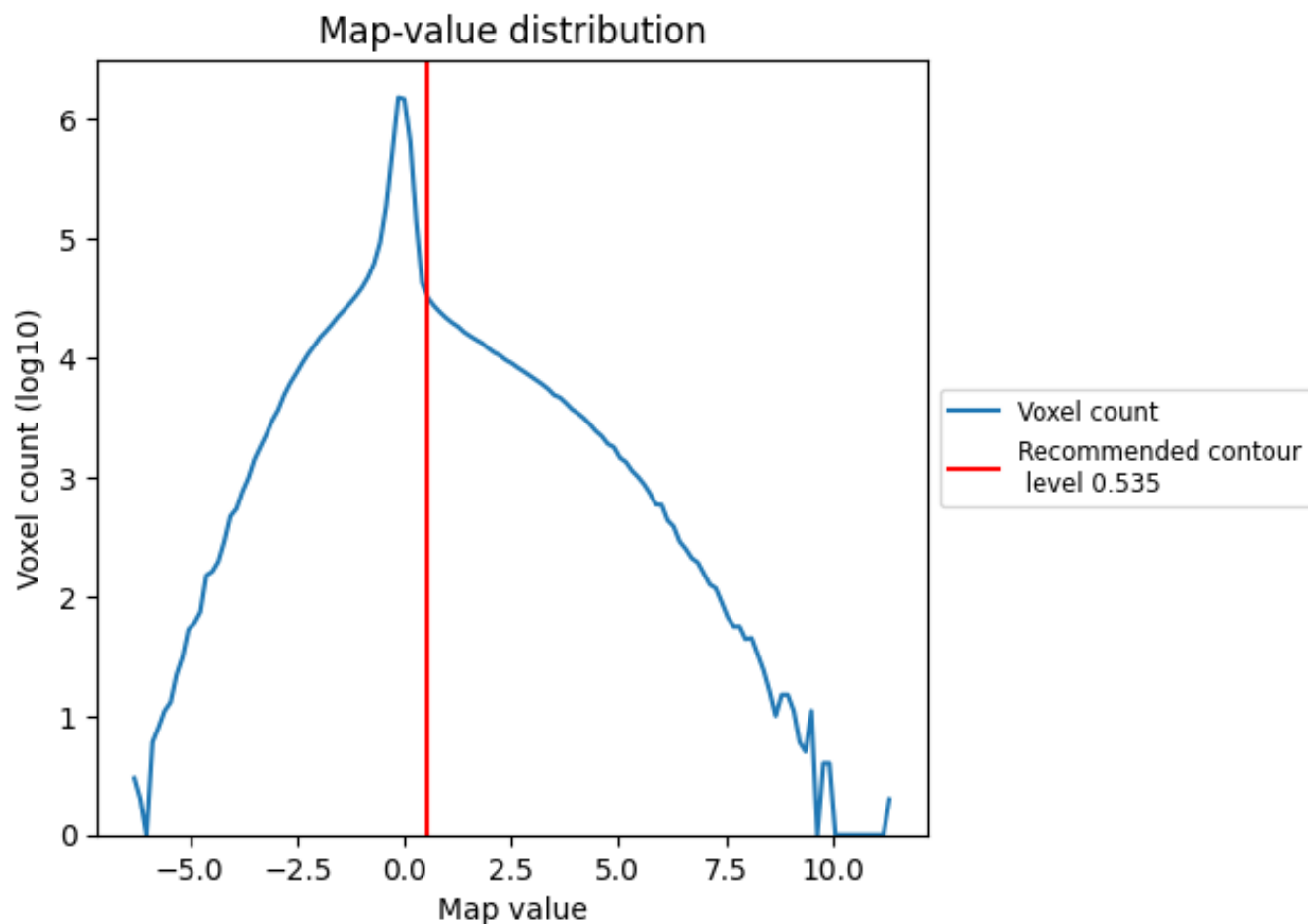
## 6.6 Mask visualisation [i](#)

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

## 7 Map analysis [i](#)

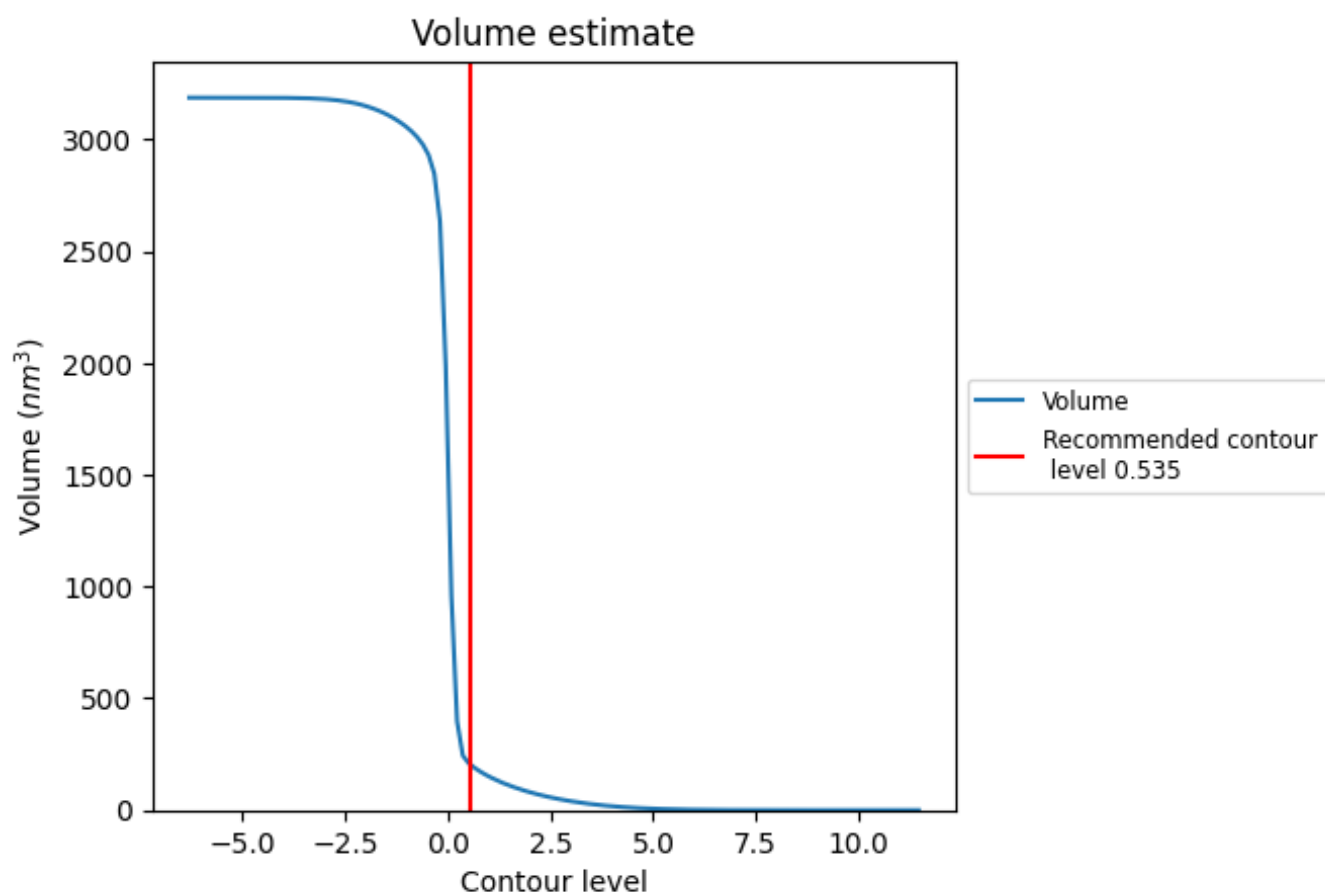
This section contains the results of statistical analysis of the map.

### 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 207 nm<sup>3</sup>; this corresponds to an approximate mass of 187 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.

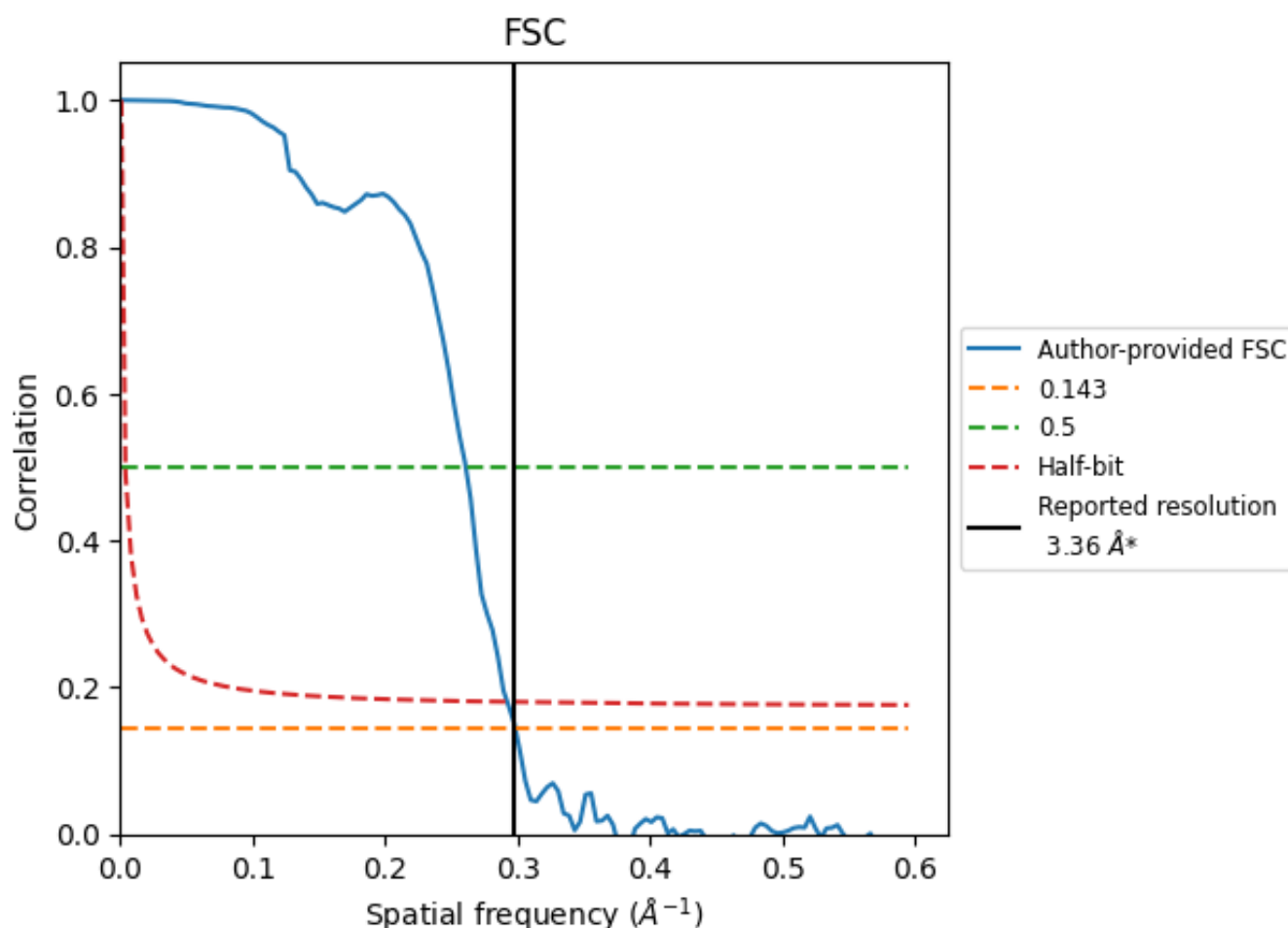
## 7.3 Rotationally averaged power spectrum [i](#)

This section was not generated. The rotationally averaged power spectrum is only generated for cubic maps.

## 8 Fourier-Shell correlation ⓘ

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 ⓘ



\*Reported resolution corresponds to spatial frequency of 0.298 Å<sup>-1</sup>

## 8.2 Resolution estimates [i](#)

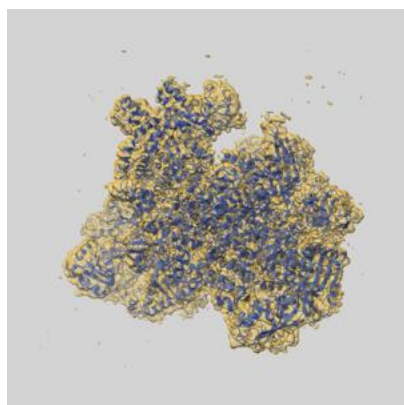
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.36	-	-
Author-provided FSC curve	3.35	3.83	3.42
Unmasked-calculated*	-	-	-

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

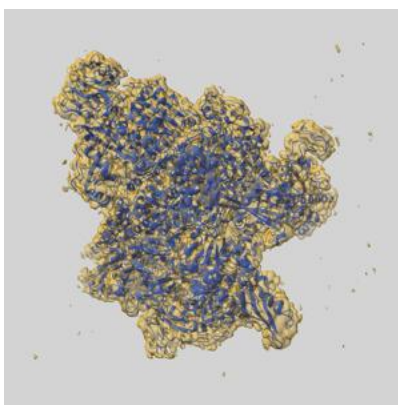
## 9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-21921 and PDB model 6WVK. Per-residue inclusion information can be found in [section 3](#) on [page 5](#).

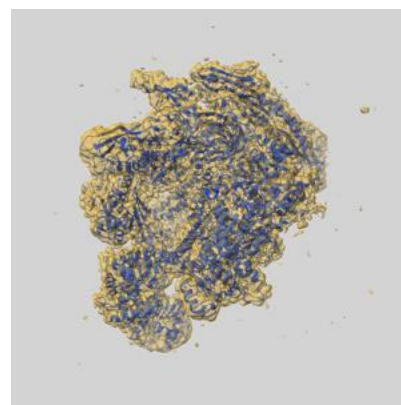
### 9.1 Map-model overlay [i](#)



X



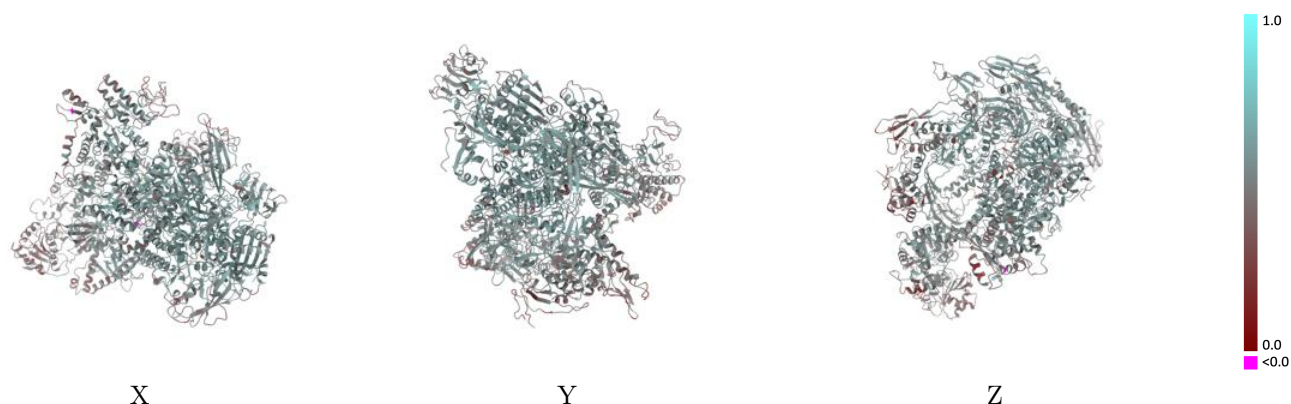
Y



Z

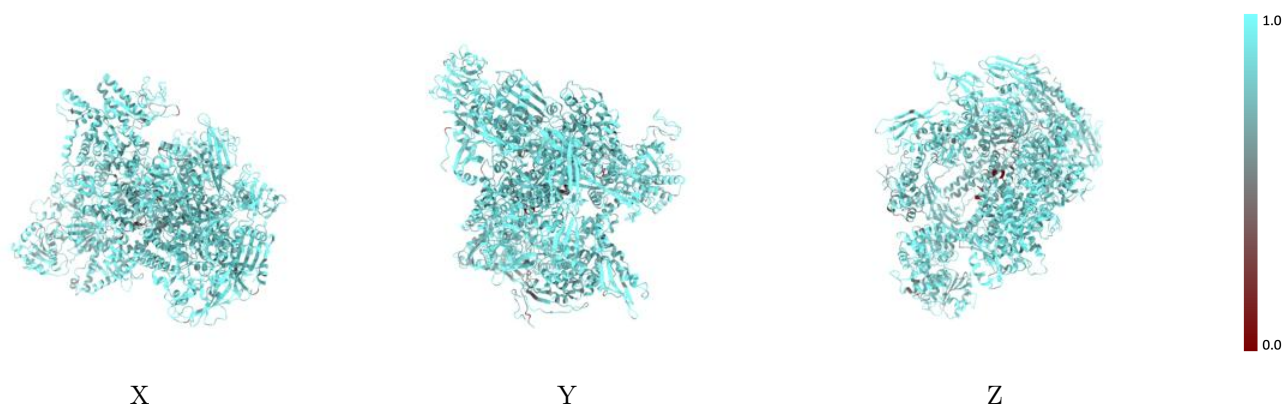
The images above show the 3D surface view of the map at the recommended contour level 0.535 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



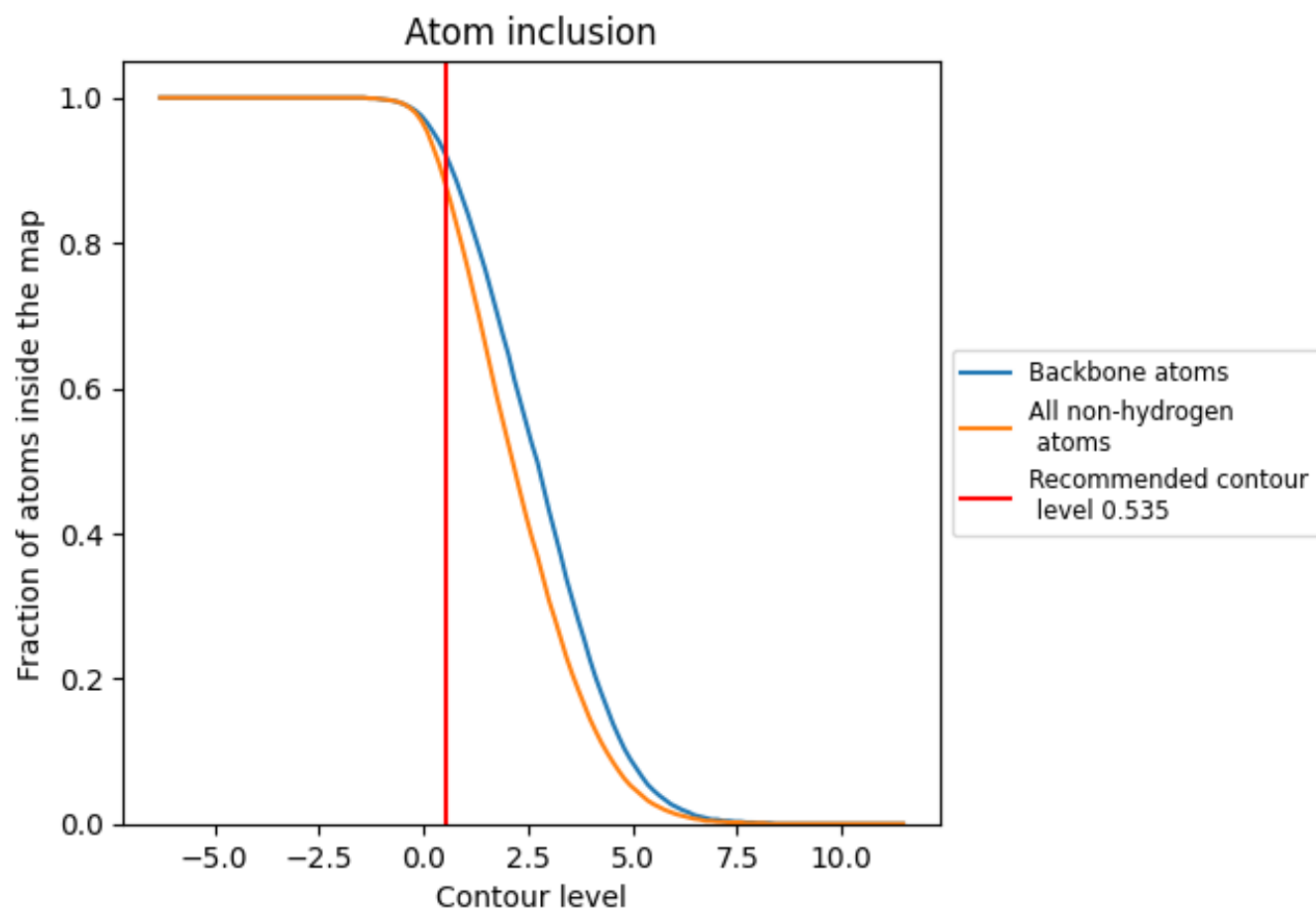
The images above show the model with each residue coloured according its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.535).

## 9.4 Atom inclusion [i](#)



At the recommended contour level, 92% of all backbone atoms, 88% 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 (0.535) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div><div></div></div> 0.8790	<div><div></div></div> 0.5190
A	<div><div></div></div> 0.9060	<div><div></div></div> 0.5550
B	<div><div></div></div> 0.8780	<div><div></div></div> 0.5130
C	<div><div></div></div> 0.8760	<div><div></div></div> 0.5200
D	<div><div></div></div> 0.8830	<div><div></div></div> 0.5310
E	<div><div></div></div> 0.8900	<div><div></div></div> 0.5630
F	<div><div></div></div> 0.8650	<div><div></div></div> 0.5370
H	<div><div></div></div> 0.8720	<div><div></div></div> 0.4840

1.0

0.0

<0.0