



## wwPDB EM Validation Summary Report ⓘ

Mar 8, 2026 – 01:50 AM UTC

PDB ID : 6CA0 / pdb\_00006ca0  
EMDB ID : EMD-7439  
Title : Cryo-EM structure of E. coli RNAP sigma70 open complex  
Authors : Narayanan, A.; Vago, F.; Li, K.; Qayyum, M.Z.; Yernool, D.; Jiang, W.;  
Murakami, K.S.  
Deposited on : 2018-01-29  
Resolution : 5.75 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:

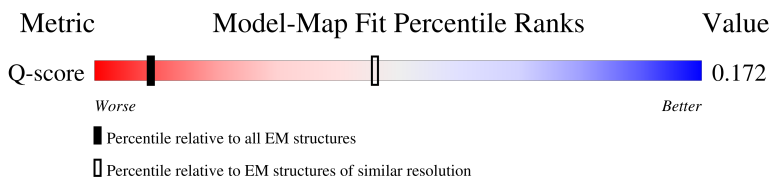
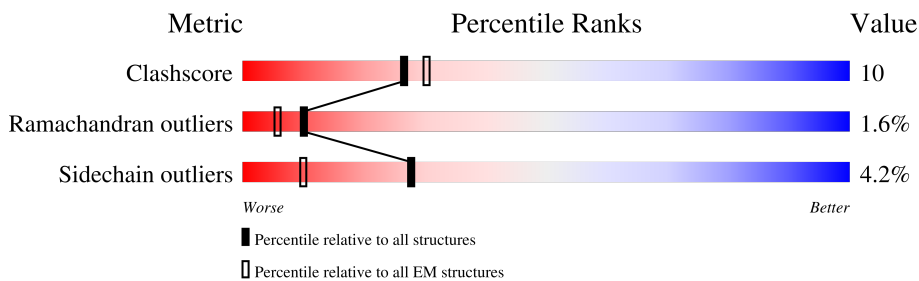
EMDB validation analysis : 0.0.1.dev132  
MolProbity : 4-5-2 with Phenix2.0  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)  
MapQ : 1.9.13  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.49

# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:  
*ELECTRON MICROSCOPY*

The reported resolution of this entry is 5.75 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.



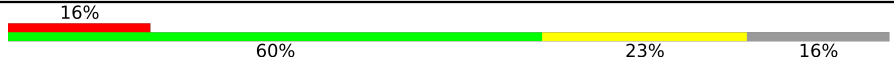
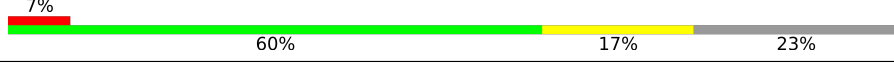

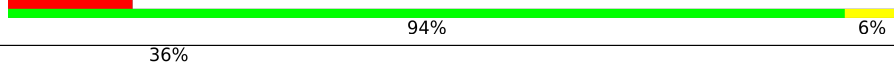

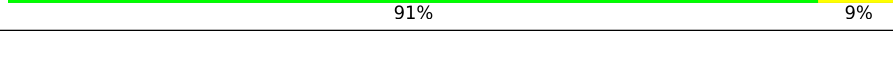
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	476 ( 5.25 - 6.25 )

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	329	<p>46% 22% 30%</p>
1	B	329	<p>41% 27% 31%</p>
2	C	1342	<p>70% 28%</p>
3	D	1407	<p>10% 67% 27%</p>

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Mol	Chain	Length	Quality of chain
4	E	91	
5	F	613	
6	G	45	
7	H	35	
8	I	11	
9	J	11	

## 2 Entry composition [i](#)

There are 11 unique types of molecules in this entry. The entry contains 31098 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
			Total	C	N	O	S		
1	A	230	Total	C	N	O	S	0	0
			1787	1112	317	352	6		
1	B	228	Total	C	N	O	S	0	0
			1767	1100	312	349	6		

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

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	C	1340	Total	C	N	O	S	0	0
			10570	6631	1841	2055	43		

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

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	D	1352	Total	C	N	O	S	0	0
			10428	6547	1855	1976	50		

- Molecule 4 is a protein called DNA-directed RNA polymerase subunit omega.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
4	E	76	Total	C	N	O	S	0	0
			605	368	115	121	1		

- Molecule 5 is a protein called RNA polymerase sigma factor RpoD.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
5	F	472	Total	C	N	O	S	0	0
			3845	2408	685	729	23		

- Molecule 6 is a DNA chain called DNA (45-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
6	G	45	923	441	165	272	45	0	0

- Molecule 7 is a DNA chain called DNA (35-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
7	H	35	719	343	131	210	35	0	0

- Molecule 8 is a DNA chain called DNA (5'-D(P\*TP\*CP\*TP\*GP\*AP\*CP\*GP\*CP\*GP\*GP\*C)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
8	I	11	225	106	41	67	11	0	0

- Molecule 9 is a DNA chain called DNA (5'-D(P\*GP\*CP\*CP\*GP\*CP\*GP\*TP\*CP\*AP\*GP\*A)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
9	J	11	226	106	44	65	11	0	0

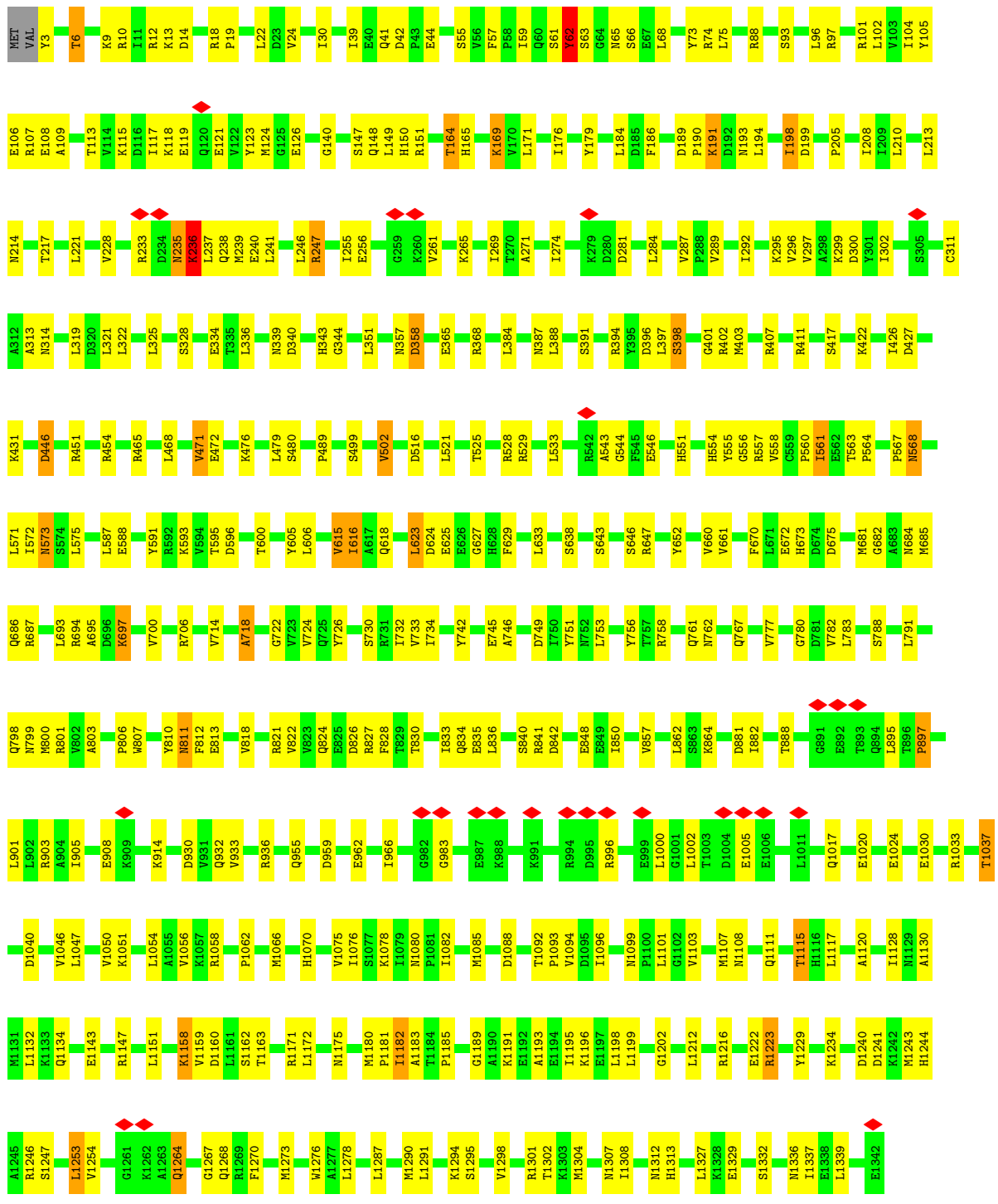
- Molecule 10 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

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

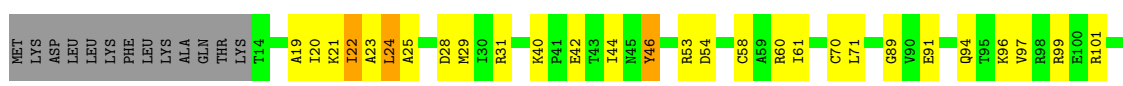
- Molecule 11 is ZINC ION (CCD ID: ZN) (formula: Zn).

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



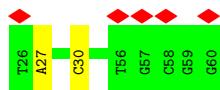


• Molecule 3: DNA-directed RNA polymerase subunit beta'

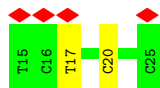
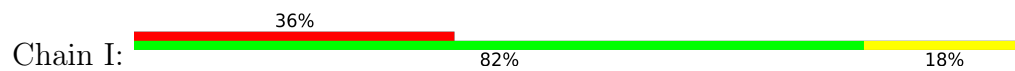




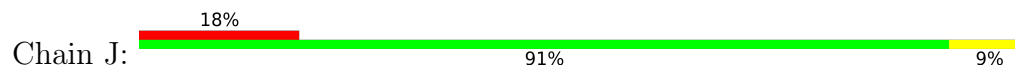




- Molecule 8: DNA (5'-D(P\*TP\*CP\*TP\*GP\*AP\*CP\*GP\*CP\*GP\*GP\*C)-3')



- Molecule 9: DNA (5'-D(P\*GP\*CP\*CP\*GP\*CP\*GP\*TP\*CP\*AP\*GP\*A)-3')



## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	96067	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 ( $e^-/\text{\AA}^2$ )	45	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	0.069	Depositor
Minimum map value	-0.022	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.004	Depositor
Recommended contour level	0.015	Depositor
Map size (Å)	315.84, 315.84, 315.84	wwPDB
Map dimensions	240, 240, 240	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.316, 1.316, 1.316	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, 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	0.35	0/1809	1.04	2/2451 (0.1%)
1	B	0.37	0/1789	1.08	6/2425 (0.2%)
2	C	0.35	0/10739	1.03	28/14489 (0.2%)
3	D	0.36	0/10586	1.05	17/14303 (0.1%)
4	E	0.20	0/607	0.55	0/817
5	F	0.38	0/3896	1.07	11/5236 (0.2%)
6	G	0.27	0/1034	0.54	0/1594
7	H	0.25	0/806	0.49	0/1242
8	I	0.20	0/251	0.44	0/385
9	J	0.26	0/253	0.44	0/388
All	All	0.35	0/31770	1.00	64/43330 (0.1%)

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	3
3	D	0	3
All	All	0	6

There are no bond length outliers.

The worst 5 of 64 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	567	PRO	CA-C-N	10.67	142.30	121.18
2	C	567	PRO	C-N-CA	10.67	142.30	121.18
2	C	722	GLY	N-CA-C	9.45	122.67	110.20
2	C	236	LYS	N-CA-C	8.35	121.46	111.02

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	57	PHE	C-N-CD	-8.18	102.60	120.60

There are no chirality outliers.

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	C	198	ILE	Peptide
2	C	236	LYS	Peptide
2	C	595	THR	Peptide
3	D	715	LYS	Peptide
3	D	901	ARG	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	1787	0	1810	47	0
1	B	1767	0	1789	62	0
2	C	10570	0	10582	239	0
3	D	10428	0	10573	236	0
4	E	605	0	612	14	0
5	F	3845	0	3913	57	0
6	G	923	0	510	10	0
7	H	719	0	396	2	0
8	I	225	0	124	2	0
9	J	226	0	123	1	0
10	D	1	0	0	0	0
11	D	2	0	0	0	0
All	All	31098	0	30432	608	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 608 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)
5:F:360:ASP:O	5:F:364:ARG:HB2	1.80	0.80
2:C:1033:ARG:O	2:C:1037:THR:HB	1.86	0.73
3:D:362:ARG:H	3:D:365:GLN:HE21	1.38	0.72
2:C:557:ARG:HD3	2:C:587:LEU:HB3	1.71	0.71
3:D:1075:ARG:HH21	3:D:1173:ARG:HD3	1.56	0.70

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	228/329 (69%)	201 (88%)	25 (11%)	2 (1%)	14	50
1	B	226/329 (69%)	202 (89%)	21 (9%)	3 (1%)	9	41
2	C	1338/1342 (100%)	1200 (90%)	115 (9%)	23 (2%)	7	36
3	D	1348/1407 (96%)	1189 (88%)	134 (10%)	25 (2%)	6	31
4	E	74/91 (81%)	67 (90%)	7 (10%)	0	100	100
5	F	466/613 (76%)	427 (92%)	32 (7%)	7 (2%)	8	39
All	All	3680/4111 (90%)	3286 (89%)	334 (9%)	60 (2%)	10	37

5 of 60 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	21	SER
2	C	62	TYR
2	C	246	LEU
2	C	398	SER
2	C	625	GLU

### 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	198/286 (69%)	189 (96%)	9 (4%)	24	46
1	B	196/286 (68%)	187 (95%)	9 (5%)	24	45
2	C	1155/1157 (100%)	1107 (96%)	48 (4%)	26	48
3	D	1111/1168 (95%)	1056 (95%)	55 (5%)	22	42
4	E	65/75 (87%)	65 (100%)	0	100	100
5	F	420/540 (78%)	409 (97%)	11 (3%)	40	61
All	All	3145/3512 (90%)	3013 (96%)	132 (4%)	28	48

5 of 132 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	D	1088	VAL
3	D	1331	VAL
5	F	516	ASP
2	C	782	VAL
2	C	777	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 48 such sidechains are listed below:

Mol	Chain	Res	Type
3	D	320	ASN
3	D	504	GLN
3	D	365	GLN
3	D	450	HIS
3	D	929	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 oligosaccharides 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.

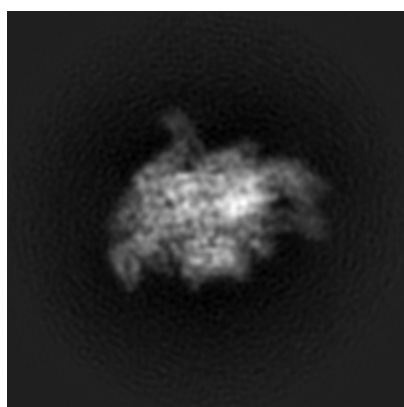
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-7439. These allow visual inspection of the internal detail of the map and identification of artifacts.

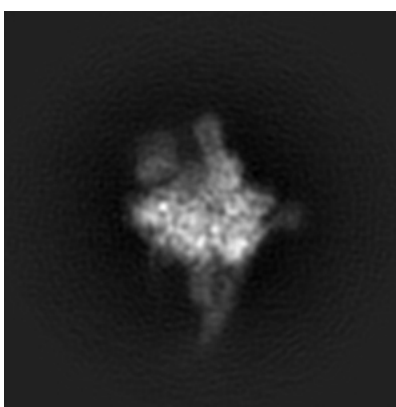
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

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

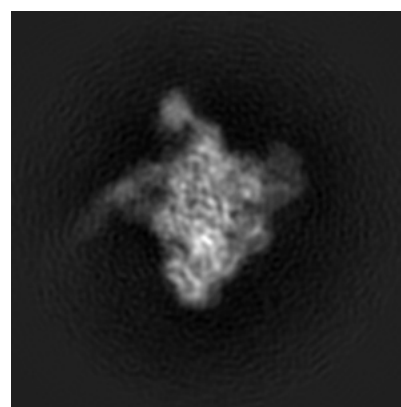
#### 6.1.1 Primary map



X



Y

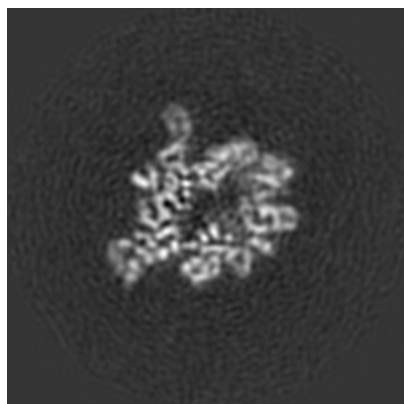


Z

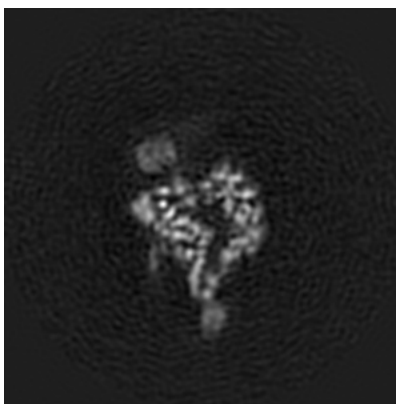
The images above show the map projected in three orthogonal directions.

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

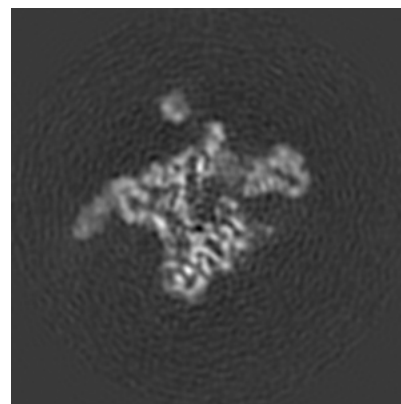
#### 6.2.1 Primary map



X Index: 120



Y Index: 120

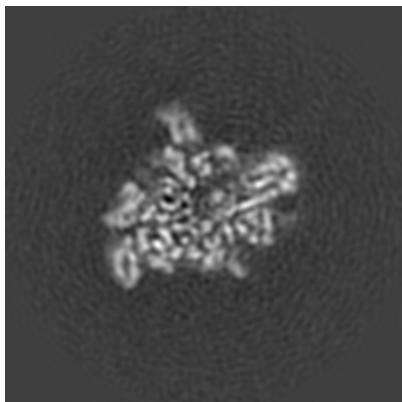


Z Index: 120

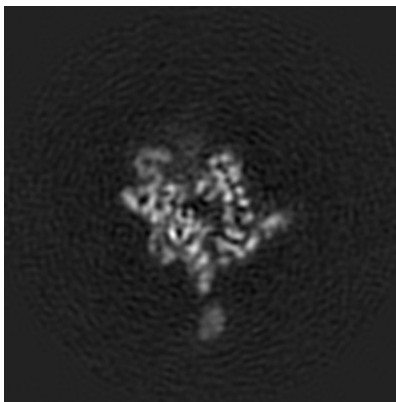
The images above show central slices of the map in three orthogonal directions.

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

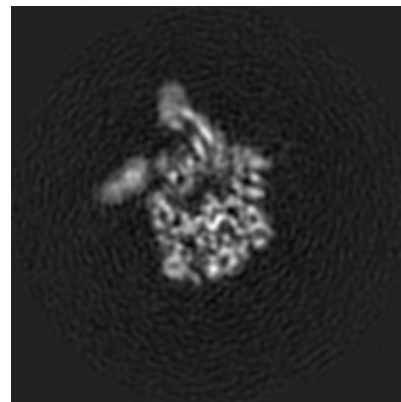
### 6.3.1 Primary map



X Index: 113



Y Index: 113

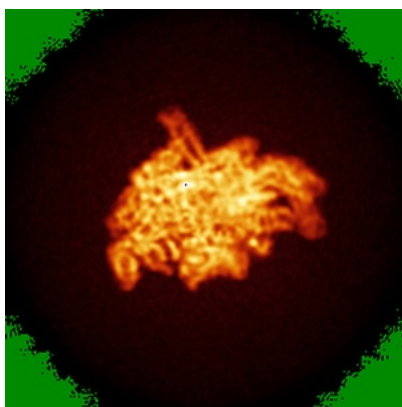


Z Index: 134

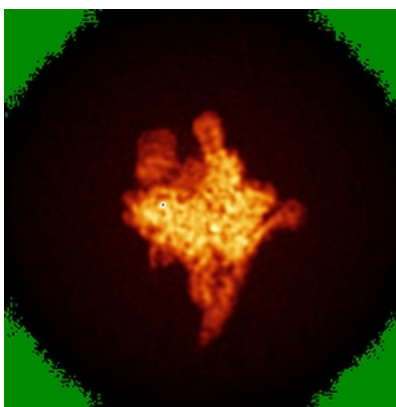
The images above show the largest variance slices of the map in three orthogonal directions.

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

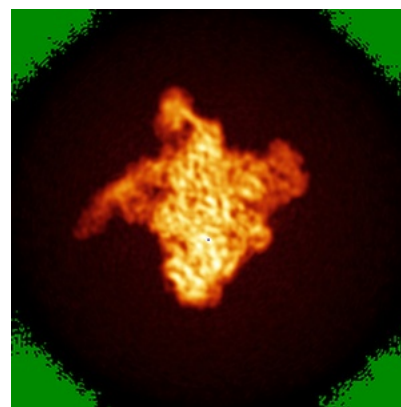
### 6.4.1 Primary map



X



Y

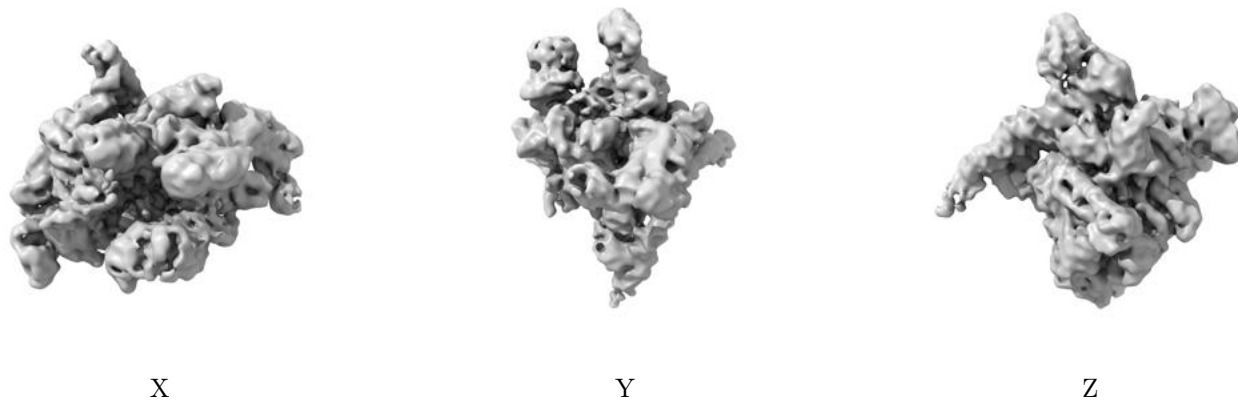


Z

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

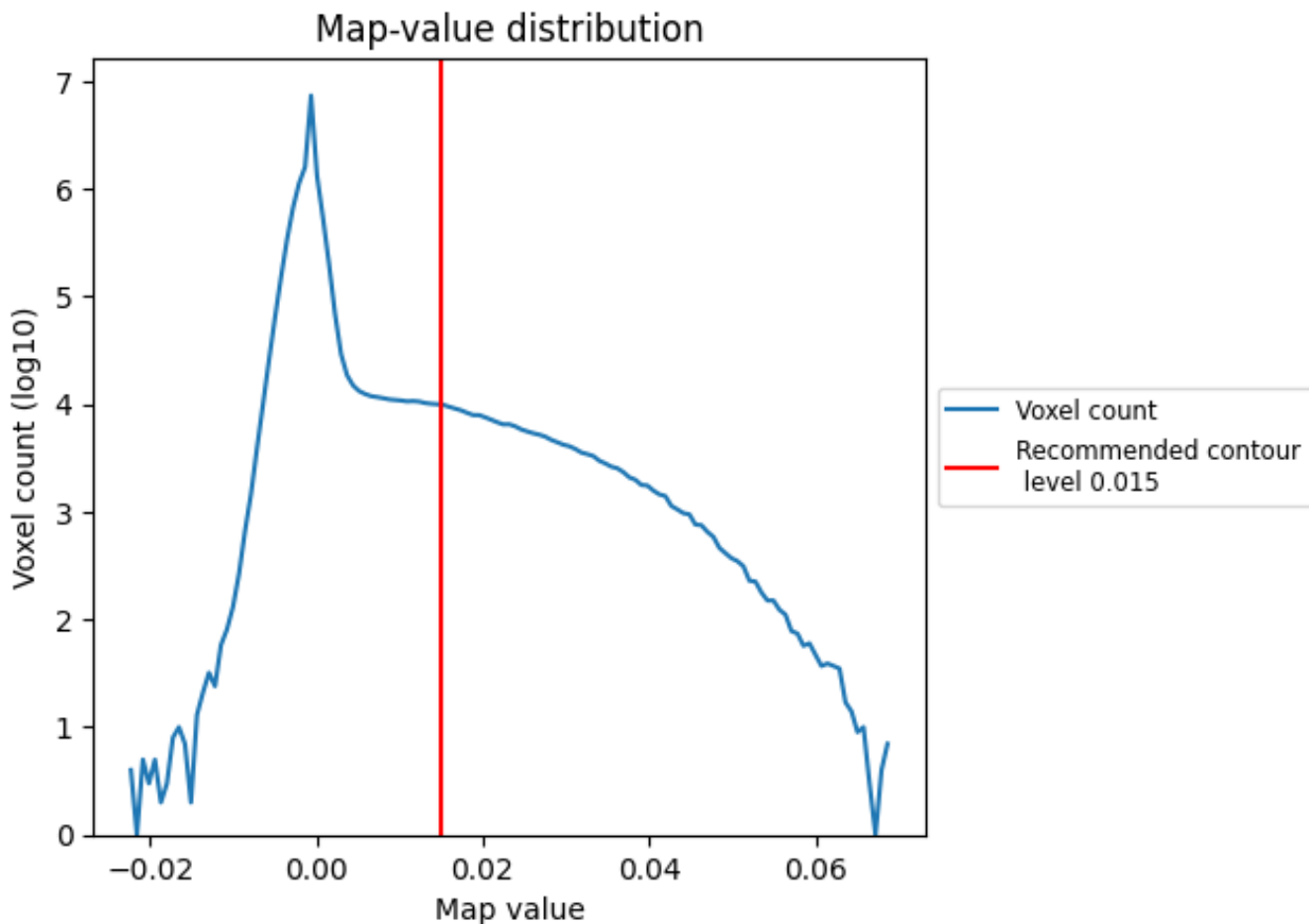
## 6.6 Mask visualisation [i](#)

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

## 7 Map analysis [i](#)

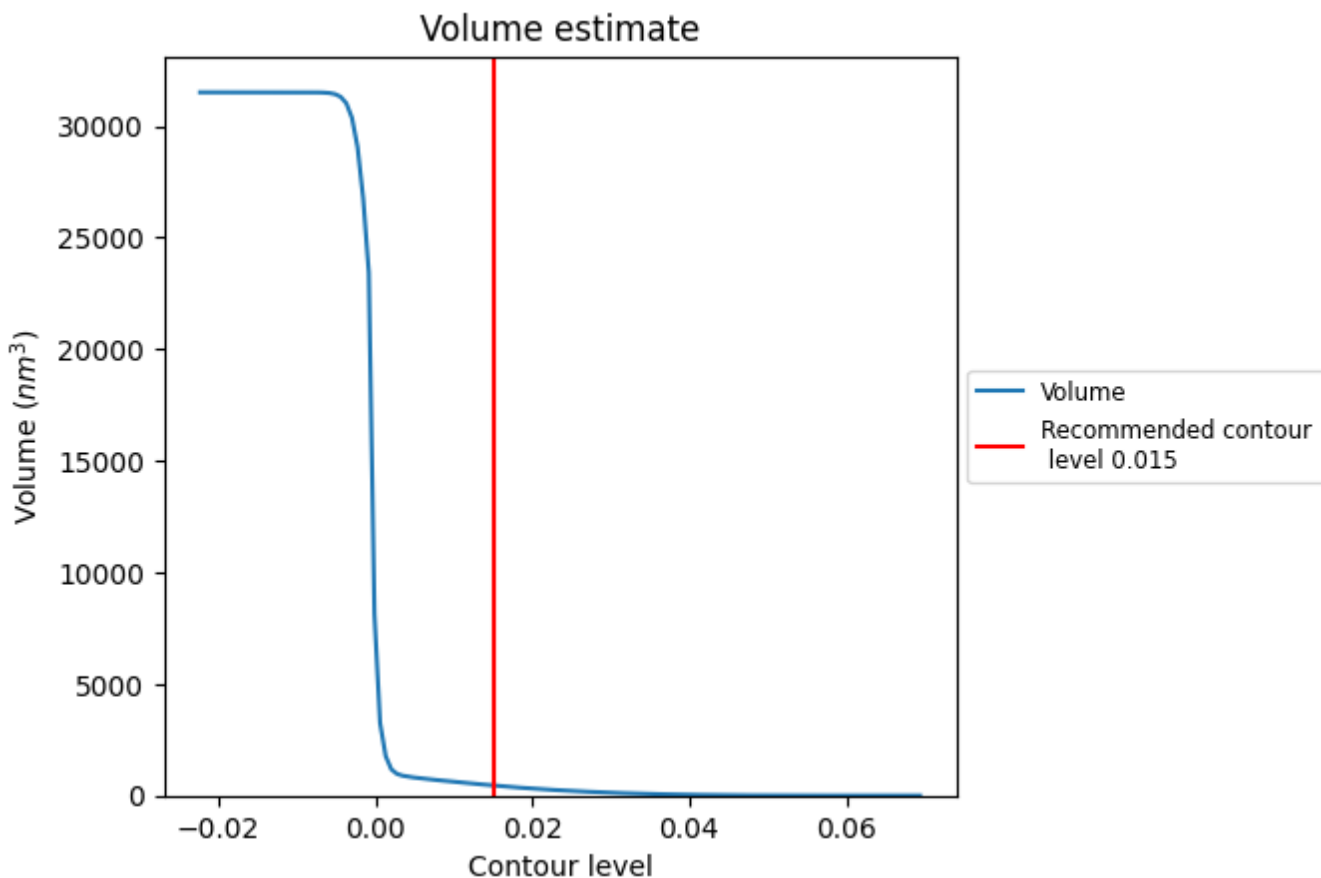
This section contains the results of statistical analysis of the map.

### 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.

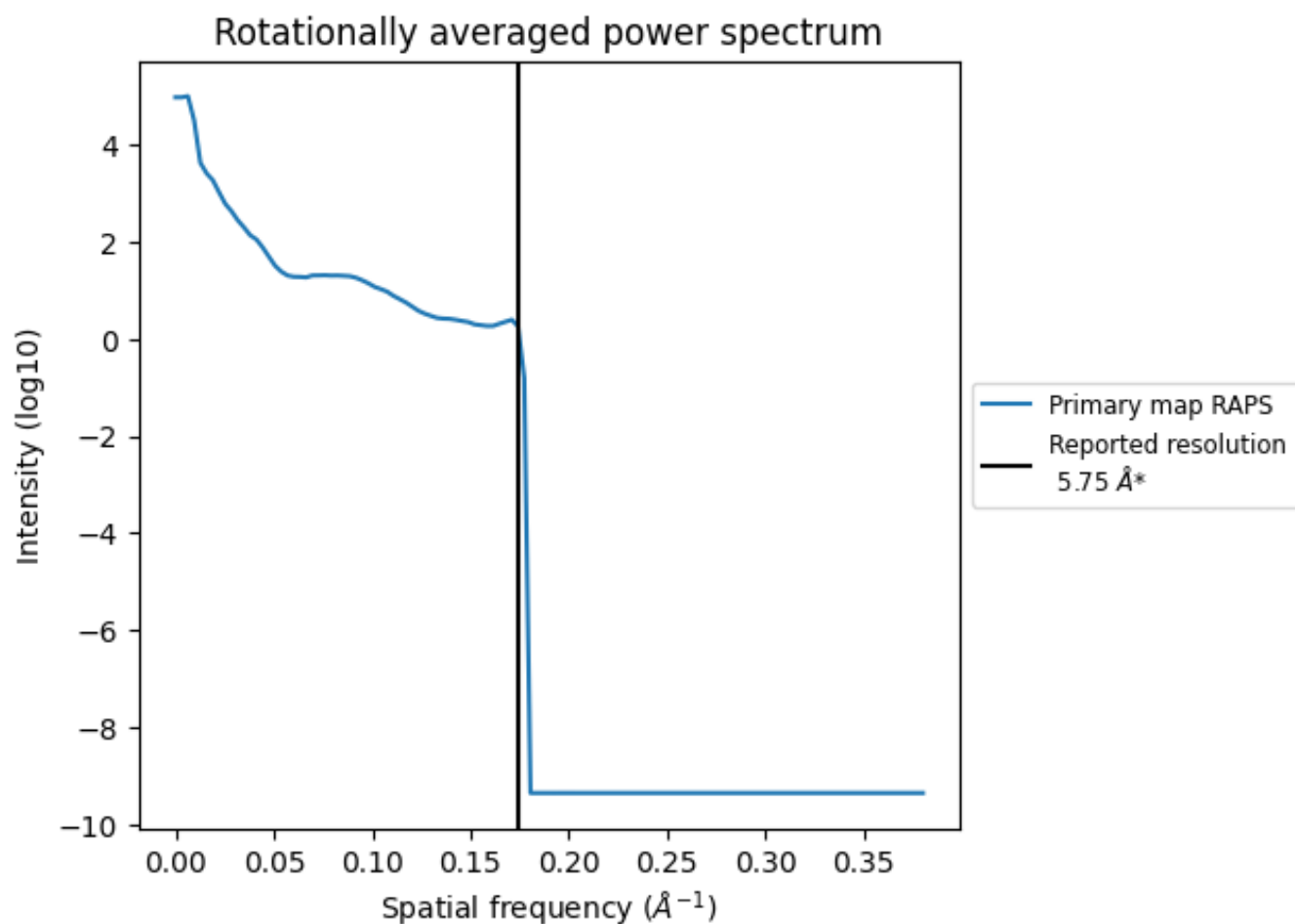
## 7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is 454 nm<sup>3</sup>; this corresponds to an approximate mass of 410 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 0.174 Å<sup>-1</sup>

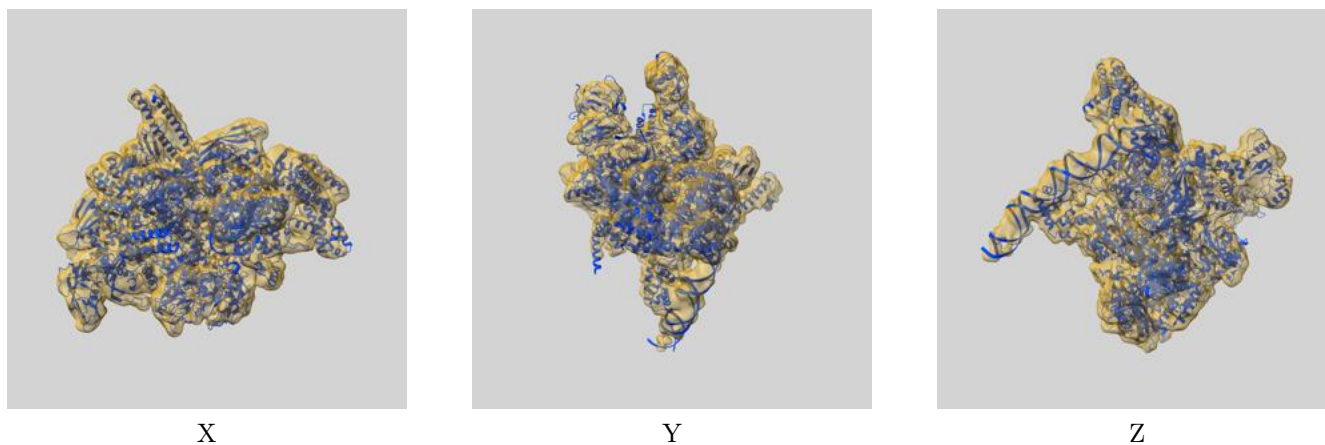
## 8 Fourier-Shell correlation

This section was not generated. No FSC curve or half-maps provided.

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

This section contains information regarding the fit between EMDB map EMD-7439 and PDB model 6CA0. Per-residue inclusion information can be found in section 3 on page 6.

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



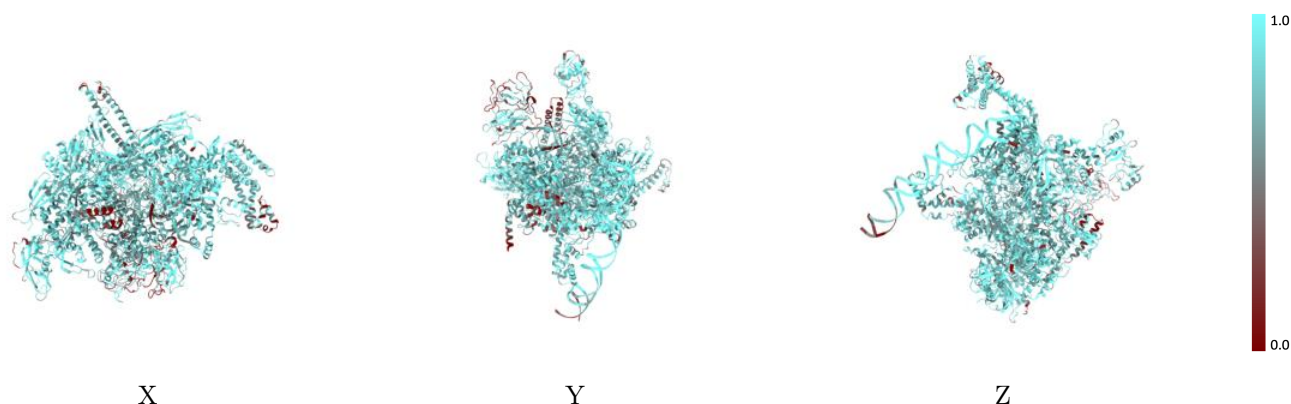
The images above show the 3D surface view of the map at the recommended contour level 0.015 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



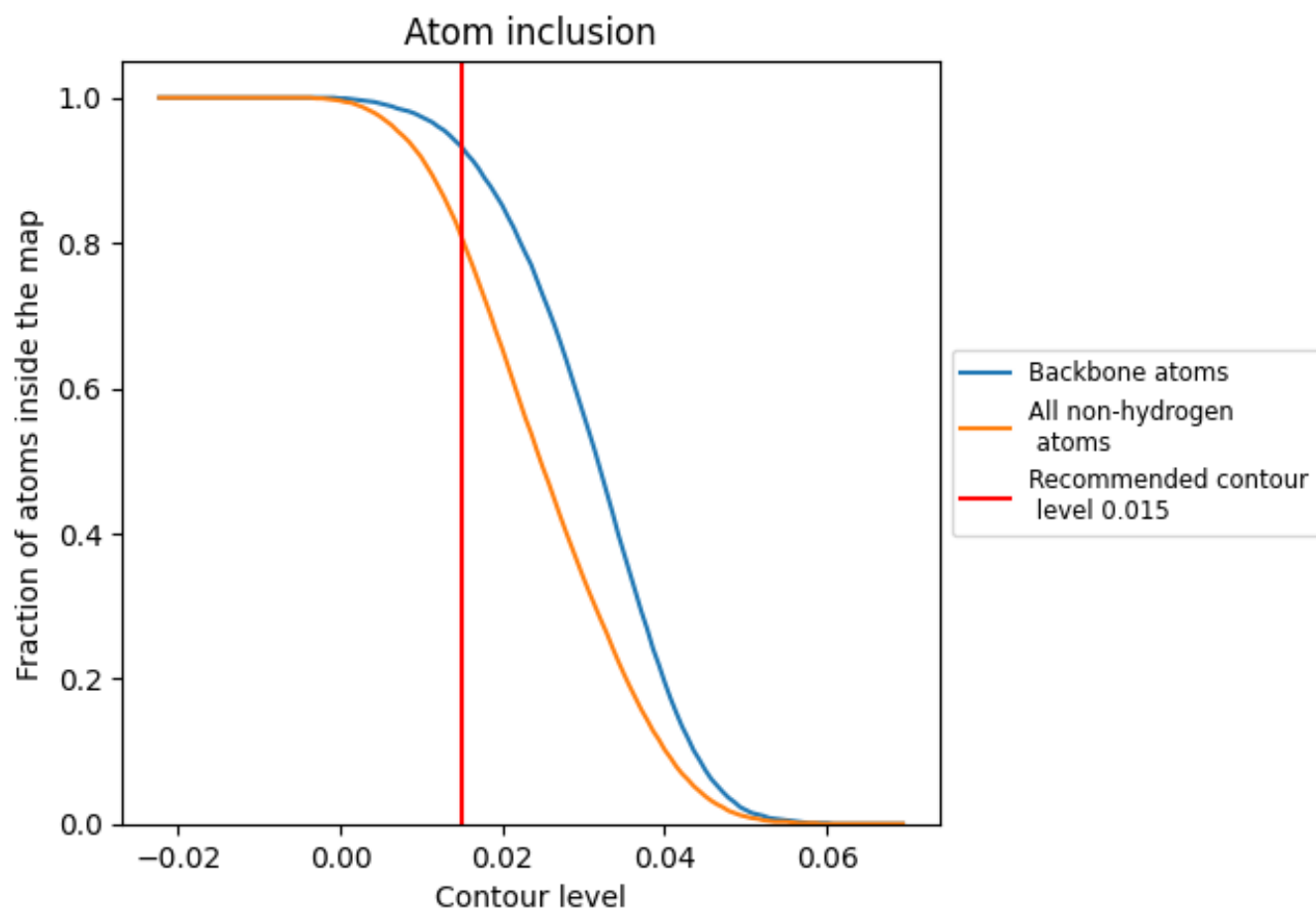
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.015).























## 9.4 Atom inclusion [i](#)



At the recommended contour level, 93% of all backbone atoms, 81% 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 (0.015) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8070	 0.1720
A	 0.8800	 0.1940
B	 0.8600	 0.1720
C	 0.8480	 0.1860
D	 0.7650	 0.1630
E	 0.5960	 0.1730
F	 0.8090	 0.1520
G	 0.8310	 0.1860
H	 0.7870	 0.1550
I	 0.5240	 0.1310
J	 0.6280	 0.1440

