



wwPDB EM Validation Summary Report ⓘ

Mar 27, 2026 – 12:57 AM UTC

PDB ID : 7ON1 / pdb_00007on1
EMDB ID : EMD-12993
Title : Cenp-A nucleosome in complex with Cenp-C
Authors : Yan, K.; Yang, J.; Zhang, Z.; Barford, D.
Deposited on : 2021-05-25
Resolution : 3.35 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

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>.

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

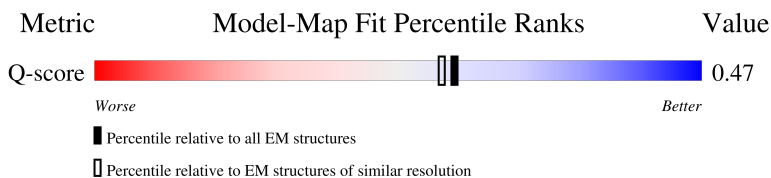
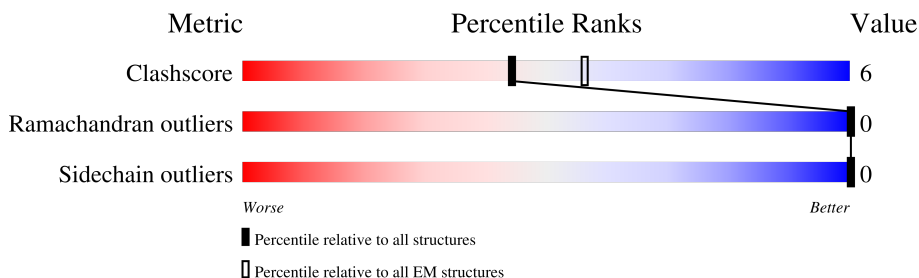
EMDB validation analysis : 0.0.1.dev132
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh &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

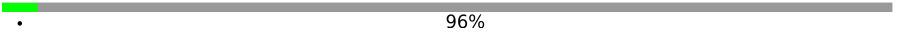
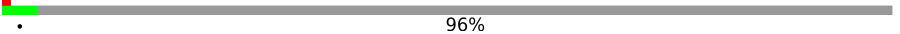
The reported resolution of this entry is 3.35 Å.

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	14390 (2.85 - 3.85)

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 ≥ 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	C	549	 96%
1	D	549	 96%
2	b	105	 60% 15% 25%
2	f	105	 66% 10% 25%

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Mol	Chain	Length	Quality of chain
3	d	133	68% 29%
3	h	133	65% 5% 29%
4	a	231	39% 58%
4	e	231	36% 6% 58%
5	c	134	66% 6% 28%
5	g	134	67% 5% 28%
6	I	147	6% 40% 44% 16%
7	J	123	6% 48% 52%

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 11150 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 BJ4_G0006610.mRNA.1.CDS.1.

Mol	Chain	Residues	Atoms				AltConf	Trace
1	C	21	Total	C	N	O	0	0
			169	107	34	28		
1	D	21	Total	C	N	O	0	0
			173	110	35	28		

- Molecule 2 is a protein called Histone H4.

Mol	Chain	Residues	Atoms				AltConf	Trace
2	b	79	Total	C	N	O	0	0
			625	393	120	112		
2	f	79	Total	C	N	O	0	0
			627	395	120	112		

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
b	-1	GLY	-	expression tag	UNP A0A6A5Q1V3
b	0	ALA	-	expression tag	UNP A0A6A5Q1V3
f	-1	GLY	-	expression tag	UNP A0A6A5Q1V3
f	0	ALA	-	expression tag	UNP A0A6A5Q1V3

- Molecule 3 is a protein called Histone H2B.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	d	95	Total	C	N	O	S	0	0
			735	461	129	144	1		
3	h	94	Total	C	N	O	S	0	0
			729	458	128	142	1		

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
d	-1	GLY	-	expression tag	UNP A0A6A5PZQ7

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Chain	Residue	Modelled	Actual	Comment	Reference
d	0	ALA	-	expression tag	UNP A0A6A5PZQ7
h	-1	GLY	-	expression tag	UNP A0A6A5PZQ7
h	0	ALA	-	expression tag	UNP A0A6A5PZQ7

- Molecule 4 is a protein called BJ4_G0007000.mRNA.1.CDS.1.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	e	97	Total	C	N	O	S	0	0
			781	498	139	140	4		
4	a	97	Total	C	N	O	S	0	0
			781	498	139	140	4		

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
e	-1	GLY	-	expression tag	UNP A0A6A5PV75
e	0	ALA	-	expression tag	UNP A0A6A5PV75
a	-1	GLY	-	expression tag	UNP A0A6A5PV75
a	0	ALA	-	expression tag	UNP A0A6A5PV75

- Molecule 5 is a protein called Histone H2A.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	g	97	Total	C	N	O		0	0
			745	467	146	132			
5	c	97	Total	C	N	O		0	0
			742	464	146	132			

There are 4 discrepancies between the modelled and reference sequences:

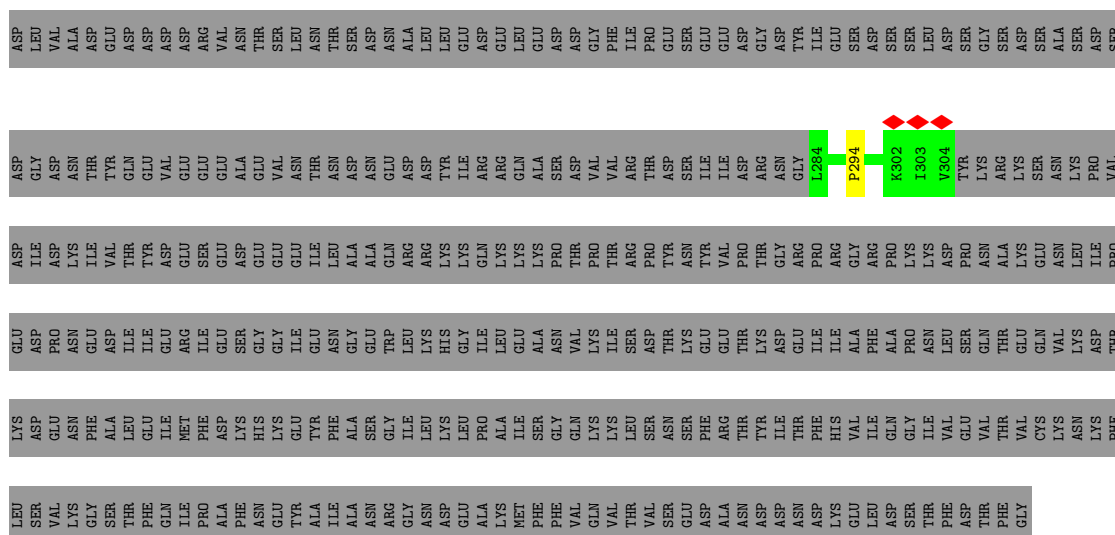
Chain	Residue	Modelled	Actual	Comment	Reference
g	-1	GLY	-	expression tag	UNP A0A6A5Q1K4
g	0	ALA	-	expression tag	UNP A0A6A5Q1K4
c	-1	GLY	-	expression tag	UNP A0A6A5Q1K4
c	0	ALA	-	expression tag	UNP A0A6A5Q1K4

- Molecule 6 is a DNA chain called DNA (152-MER).

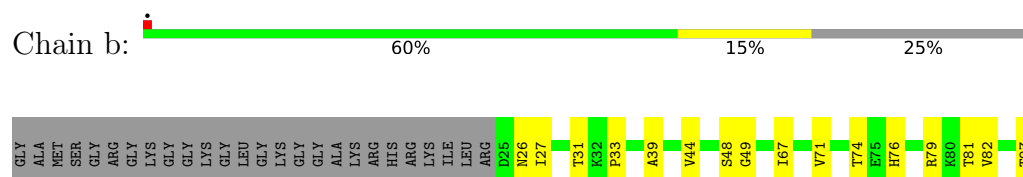
Mol	Chain	Residues	Atoms					AltConf	Trace
6	I	123	Total	C	N	O	P	0	0
			2509	1190	457	739	123		

- Molecule 7 is a DNA chain called DNA (123-MER).

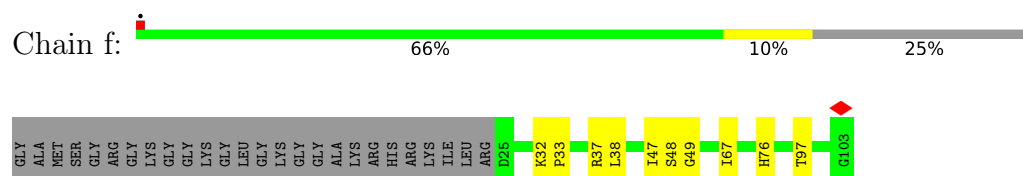
Mol	Chain	Residues	Atoms					AltConf	Trace
7	J	123	Total	C	N	O	P	0	0
			2534	1198	476	737	123		



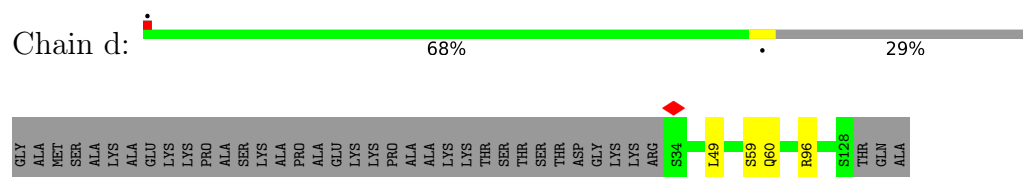
- Molecule 2: Histone H4



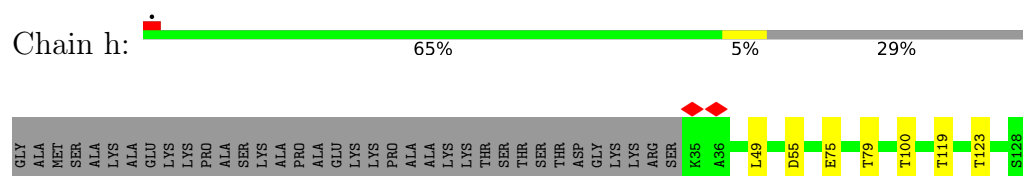
- Molecule 2: Histone H4



- Molecule 3: Histone H2B

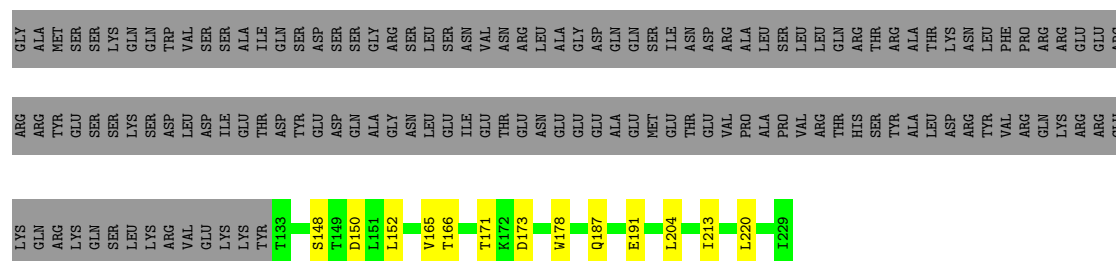


- Molecule 3: Histone H2B

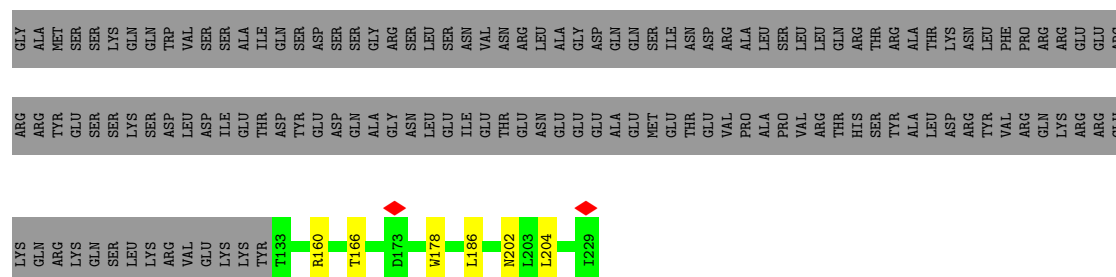


- Molecule 4: BJ4 G0007000.mRNA.1.CDS.1





- Molecule 4: BJ4 G0007000.mRNA.1.CDS.1



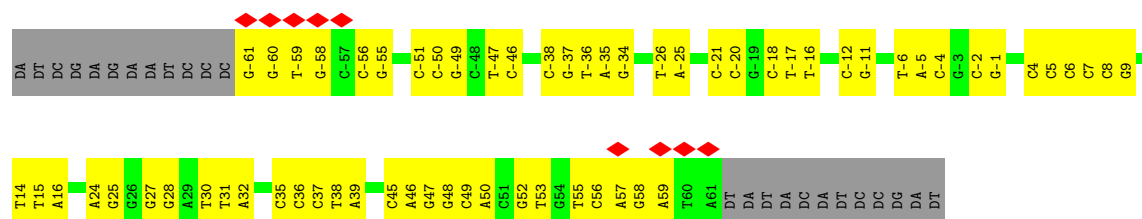
- Molecule 5: Histone H2A



- Molecule 5: Histone H2A

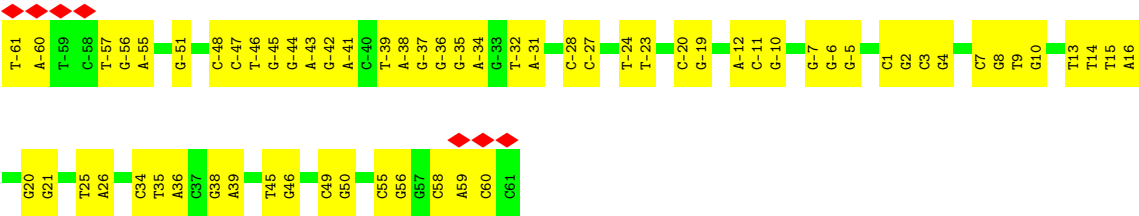


- Molecule 6: DNA (152-MER)



- Molecule 7: DNA (123-MER)





4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	124953	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 ($e^-/\text{\AA}^2$)	39	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	0.057	Depositor
Minimum map value	-0.031	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.001	Depositor
Recommended contour level	0.009	Depositor
Map size (Å)	272.0, 272.0, 272.0	wwPDB
Map dimensions	320, 320, 320	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.85, 0.85, 0.85	Depositor

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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	C	0.09	0/172	0.30	0/233
1	D	0.10	0/176	0.30	0/237
2	b	0.12	0/632	0.31	0/845
2	f	0.12	0/634	0.33	0/848
3	d	0.09	0/745	0.26	0/1003
3	h	0.08	0/739	0.24	0/995
4	a	0.10	0/792	0.30	0/1066
4	e	0.09	0/792	0.26	0/1066
5	c	0.11	0/751	0.29	0/1015
5	g	0.10	0/754	0.29	0/1019
6	I	0.16	0/2811	0.33	0/4333
7	J	0.15	0/2845	0.30	0/4392
All	All	0.13	0/11843	0.30	0/17052

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	C	169	0	162	1	0
1	D	173	0	173	1	0
2	b	625	0	657	13	0
2	f	627	0	664	8	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	d	735	0	753	3	0
3	h	729	0	748	5	0
4	a	781	0	803	5	0
4	e	781	0	803	9	0
5	c	742	0	775	7	0
5	g	745	0	784	6	0
6	I	2509	0	1380	48	0
7	J	2534	0	1379	47	0
All	All	11150	0	9081	129	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 6.

The worst 5 of 129 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)
6:I:-60:DG:N1	7:J:60:DC:N3	2.29	0.79
6:I:-60:DG:N2	7:J:60:DC:O2	2.15	0.77
6:I:-21:DC:N3	7:J:21:DG:N1	2.31	0.74
6:I:-20:DC:O2	7:J:20:DG:N2	2.12	0.73
6:I:-21:DC:O2	7:J:21:DG:N2	2.18	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	C	19/549 (4%)	19 (100%)	0	0	100	100
1	D	19/549 (4%)	18 (95%)	1 (5%)	0	100	100
2	b	77/105 (73%)	75 (97%)	2 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	f	77/105 (73%)	74 (96%)	3 (4%)	0	100	100
3	d	93/133 (70%)	92 (99%)	1 (1%)	0	100	100
3	h	92/133 (69%)	90 (98%)	2 (2%)	0	100	100
4	a	95/231 (41%)	95 (100%)	0	0	100	100
4	e	95/231 (41%)	95 (100%)	0	0	100	100
5	c	95/134 (71%)	93 (98%)	2 (2%)	0	100	100
5	g	95/134 (71%)	95 (100%)	0	0	100	100
All	All	757/2304 (33%)	746 (98%)	11 (2%)	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	C	16/503 (3%)	16 (100%)	0	100	100
1	D	17/503 (3%)	17 (100%)	0	100	100
2	b	65/81 (80%)	65 (100%)	0	100	100
2	f	66/81 (82%)	66 (100%)	0	100	100
3	d	81/109 (74%)	81 (100%)	0	100	100
3	h	80/109 (73%)	80 (100%)	0	100	100
4	a	82/207 (40%)	82 (100%)	0	100	100
4	e	82/207 (40%)	82 (100%)	0	100	100
5	c	75/99 (76%)	75 (100%)	0	100	100
5	g	76/99 (77%)	76 (100%)	0	100	100
All	All	640/1998 (32%)	640 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
5	c	17	GLN
3	h	113	HIS
5	g	17	GLN
4	e	187	GLN
5	g	101	ASN

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](#)

There are no ligands in this entry.

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.

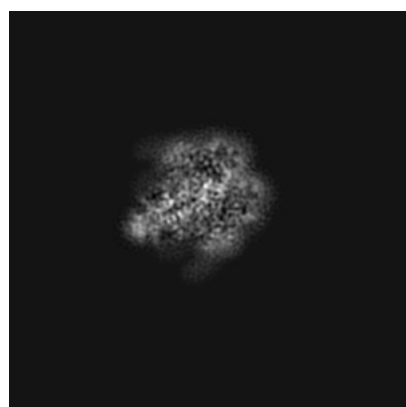
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-12993. These allow visual inspection of the internal detail of the map and identification of artifacts.

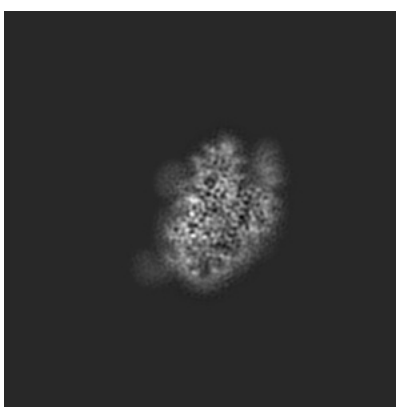
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

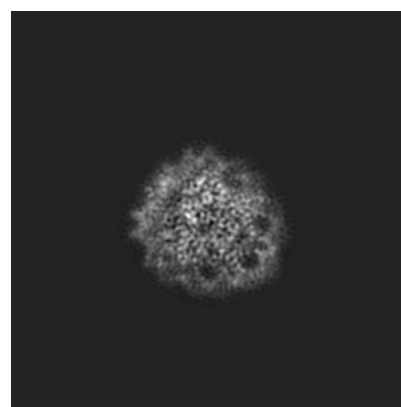
6.1.1 Primary map



X



Y

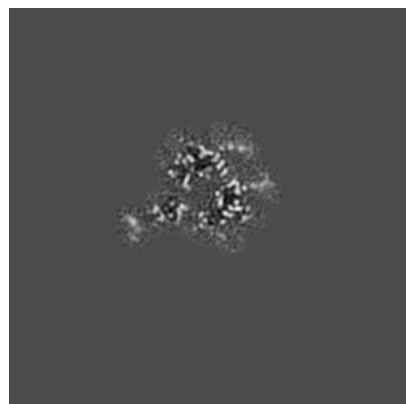


Z

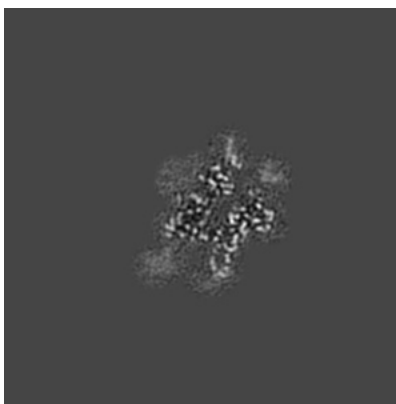
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

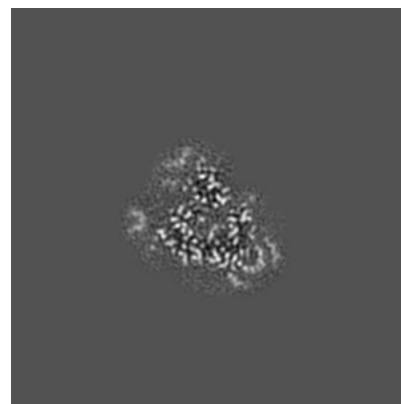
6.2.1 Primary map



X Index: 160



Y Index: 160

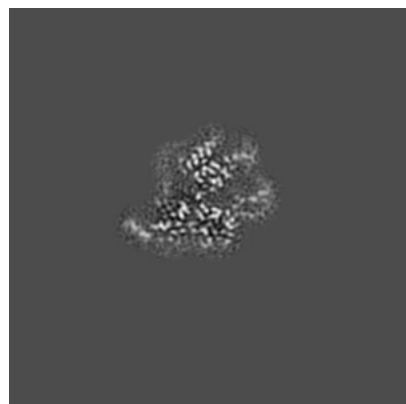


Z Index: 160

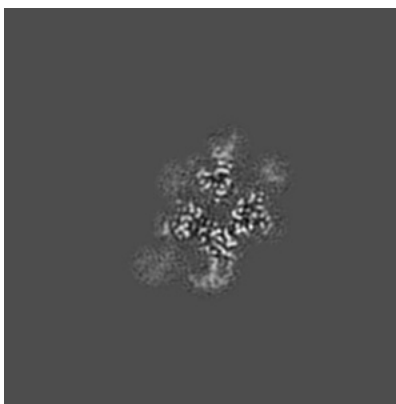
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

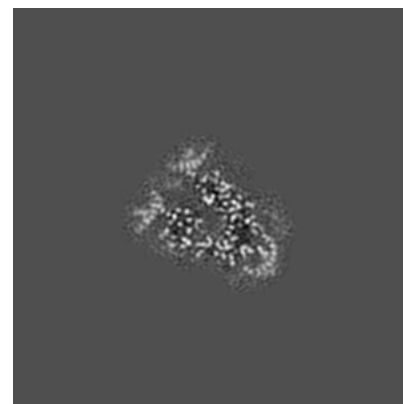
6.3.1 Primary map



X Index: 143



Y Index: 156

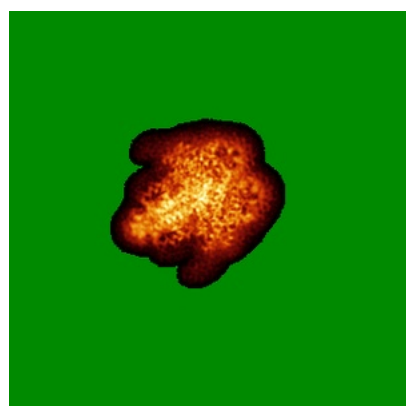


Z Index: 166

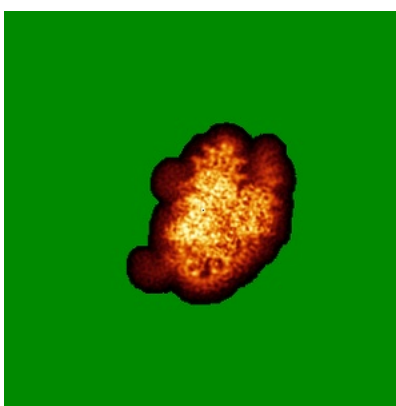
The images above show the largest variance slices of the map in three orthogonal directions.

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

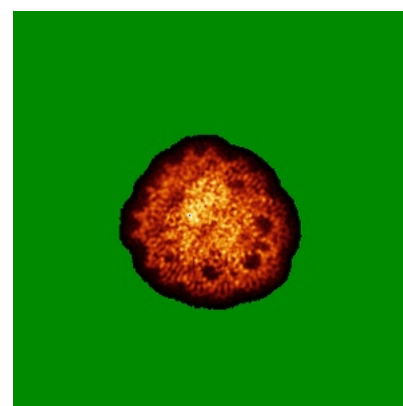
6.4.1 Primary map



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

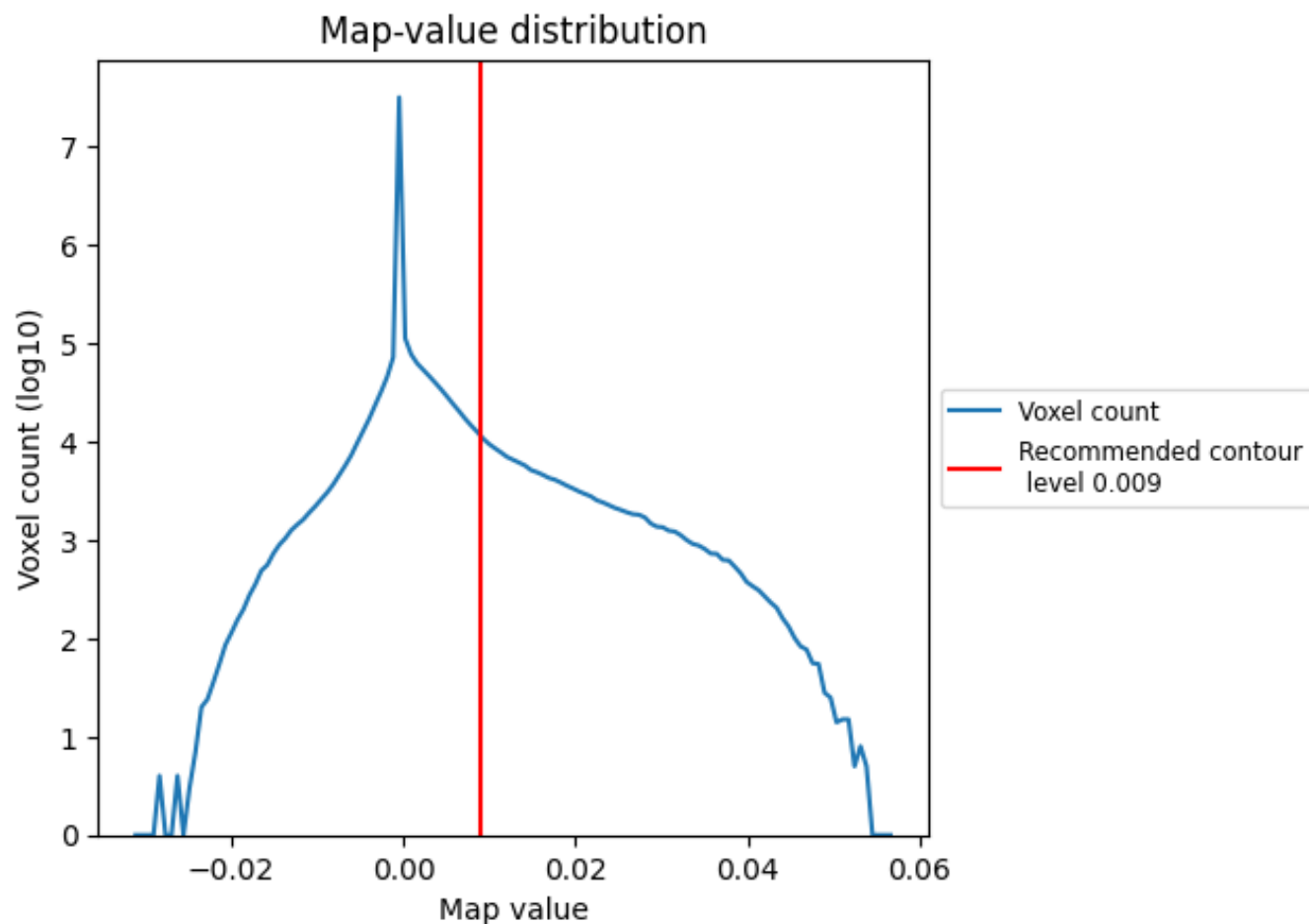
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

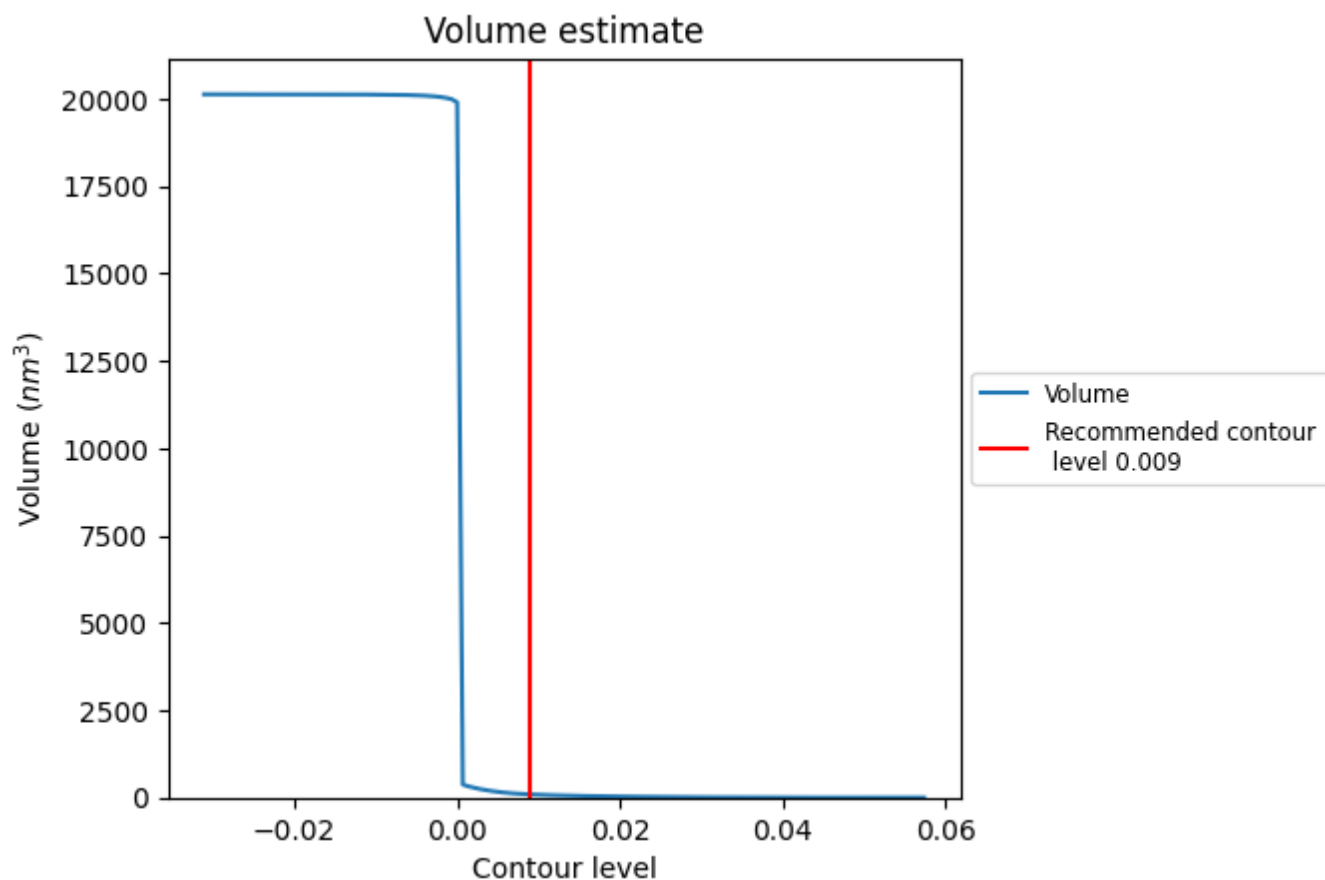
This section contains the results of statistical analysis of the map.

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.

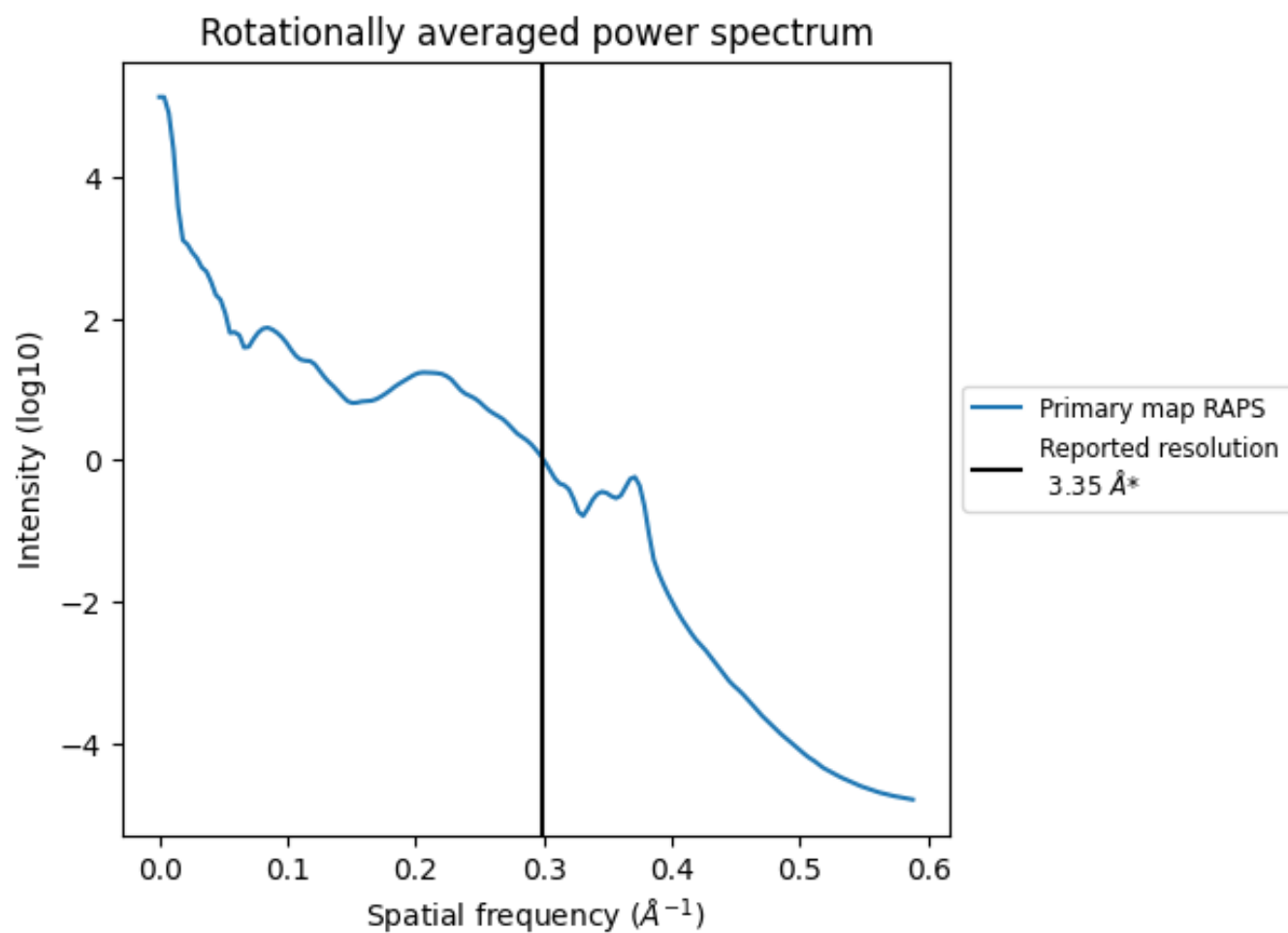
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 90 nm^3 ; this corresponds to an approximate mass of 81 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 0.299 Å⁻¹

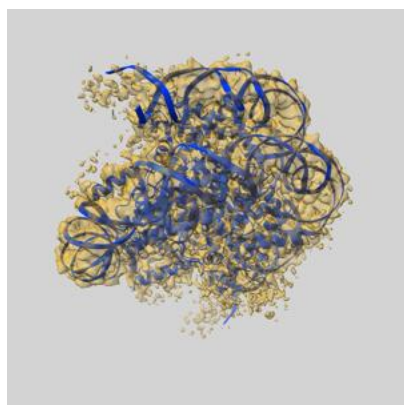
8 Fourier-Shell correlation

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

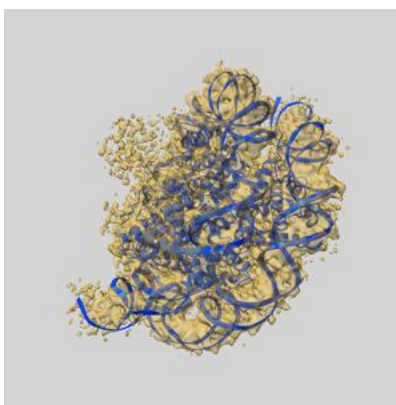
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-12993 and PDB model 7ON1. Per-residue inclusion information can be found in [section 3](#) on [page 7](#).

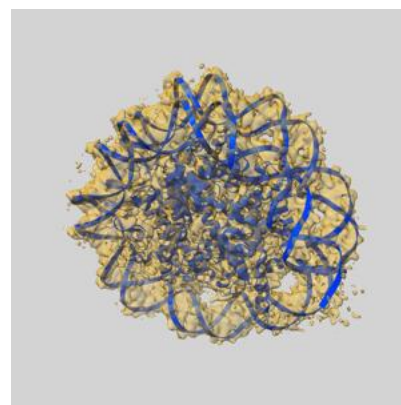
9.1 Map-model overlay [i](#)



X



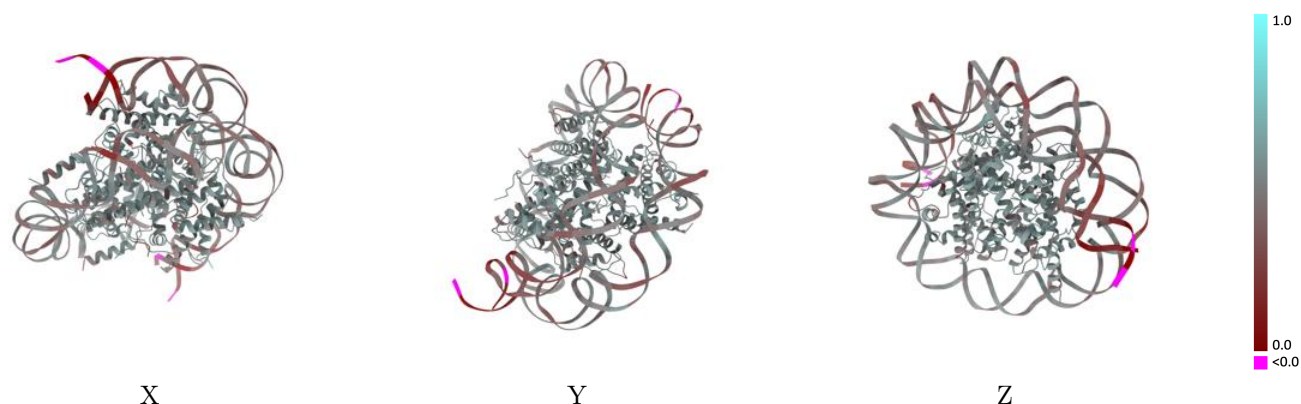
Y



Z

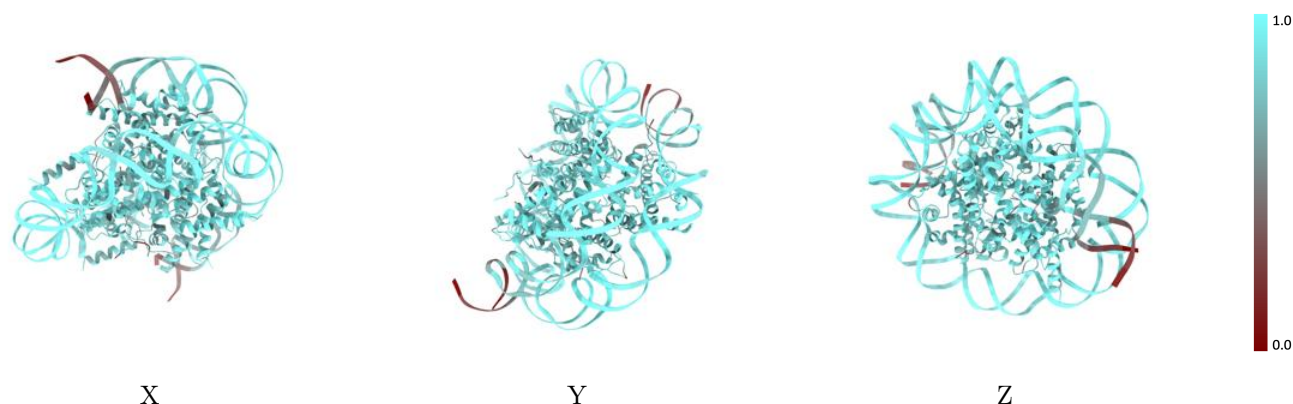
The images above show the 3D surface view of the map at the recommended contour level 0.009 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



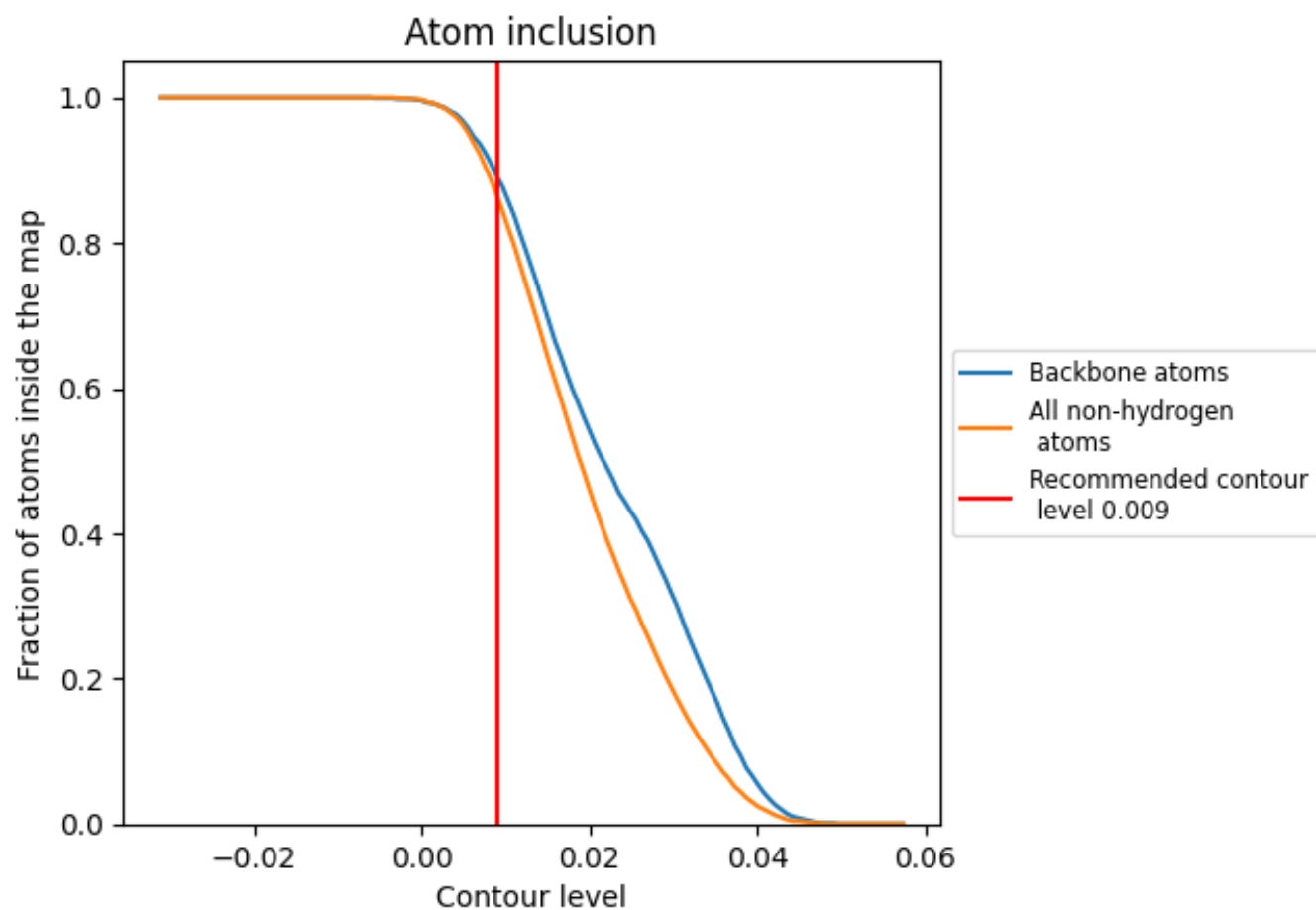
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.009).

9.4 Atom inclusion [i](#)



At the recommended contour level, 89% of all backbone atoms, 86% 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 (0.009) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.8640	0.4700
C	0.7700	0.5150
D	0.7460	0.5020
I	0.8490	0.4050
J	0.8460	0.3930
a	0.8780	0.5130
b	0.9020	0.5470
c	0.8970	0.5390
d	0.8670	0.5180
e	0.8710	0.5250
f	0.8970	0.5390
g	0.8860	0.5290
h	0.8910	0.5260

