



wwPDB EM Validation Summary Report ⓘ

Jun 17, 2025 – 09:46 AM JST

PDB ID : 6M4G / pdb_00006m4g
EMDB ID : EMD-30077
Title : Structural mechanism of nucleosome dynamics governed by human histone variants H2A.B and H2A.Z.2.2
Authors : Zhou, M.; Dai, L.C.; Li, C.M.; Shi, L.X.; Huang, Y.; Guo, Z.Q.
Deposited on : 2020-03-06
Resolution : 2.80 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.dev118
MolProbity : 4-5-2 with Phenix2.0rc1
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.44

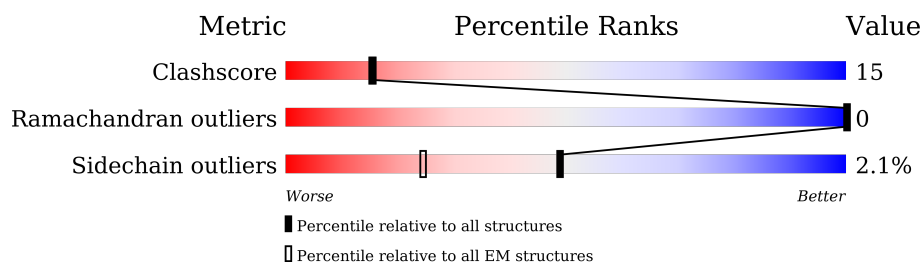
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.80 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.



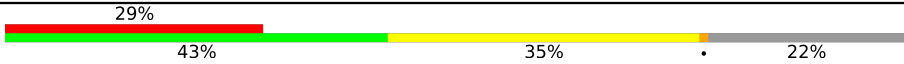

Metric	Whole archive (#Entries)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

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	I	147	<div> <div>18%</div> <div>29%</div> <div>34%</div> <div>37%</div> </div>
2	J	147	<div> <div>17%</div> <div>36%</div> <div>27%</div> <div>37%</div> </div>
3	A	136	<div> <div>37%</div> <div>17%</div> <div>46%</div> </div>
3	E	136	<div> <div>39%</div> <div>15%</div> <div>46%</div> </div>
4	B	103	<div> <div>51%</div> <div>21%</div> <div>26%</div> </div>
4	F	103	<div> <div>52%</div> <div>20%</div> <div>26%</div> </div>
5	D	126	<div> <div>17%</div> <div>47%</div> <div>23%</div> <div>30%</div> </div>
5	H	126	<div> <div>17%</div> <div>43%</div> <div>27%</div> <div>30%</div> </div>

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Mol	Chain	Length	Quality of chain
6	C	115	
6	G	115	

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 9010 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 DNA chain called DNA (93-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
1	I	93	Total	C	N	O	P	0	0
			1924	909	365	557	93		

- Molecule 2 is a DNA chain called DNA (93-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
2	J	93	Total	C	N	O	P	0	0
			1888	898	338	559	93		

- Molecule 3 is a protein called Histone H3.1.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	A	74	Total	C	N	O	S	0	0
			599	381	110	104	4		
3	E	74	Total	C	N	O	S	0	0
			599	381	110	104	4		

- Molecule 4 is a protein called Histone H4.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	B	76	Total	C	N	O	S	0	0
			610	387	118	104	1		
4	F	76	Total	C	N	O	S	0	0
			610	387	118	104	1		

- Molecule 5 is a protein called Histone H2B type 2-E.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	D	88	Total	C	N	O	S	0	0
			685	433	121	129	2		
5	H	88	Total	C	N	O	S	0	0
			685	433	121	129	2		

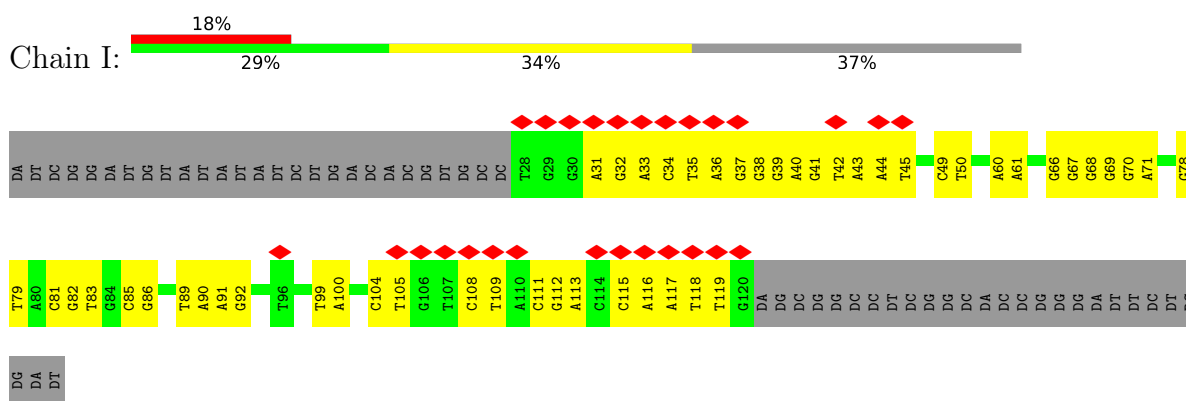
- Molecule 6 is a protein called Histone H2A-Bbd type 2/3.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	C	90	Total	C	N	O	S	0	0
			705	439	128	137	1		
6	G	90	Total	C	N	O	S	0	0
			705	439	128	137	1		

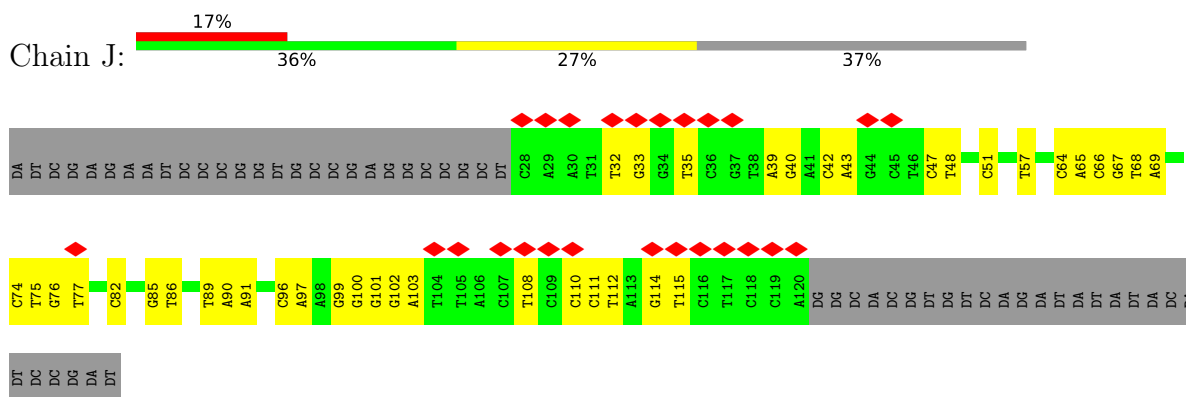
3 Residue-property plots [i](#)

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.

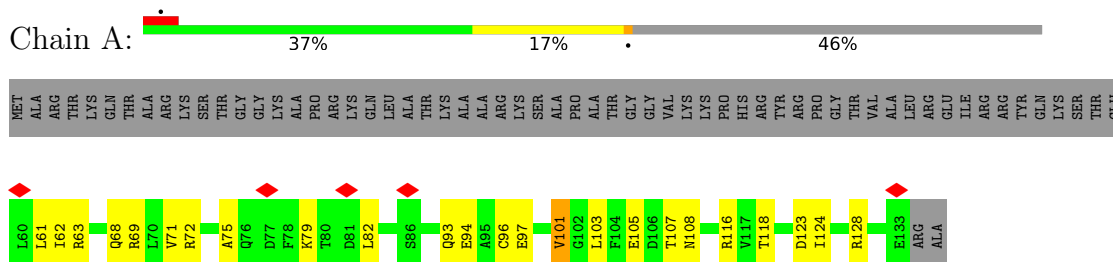
• Molecule 1: DNA (93-MER)



• Molecule 2: DNA (93-MER)



• Molecule 3: Histone H3.1



• Molecule 3: Histone H3.1

Chain E: 

MET ALA ARG THR LYS GLN THR ALA ARG LYS SER THR GLY GLY LYS ALA PRO ARG LYS GLN LEU THR ALA LYS ALA ARG LYS LYS PRO HIS ARG TYR ARG PRO GLY THR VAL ALA LEU ARG GLU ILE ARG ARG TYR GLN LYS SER THR GLU

L60 L61 I62 B63 Q68 R69 L70 V71 R72 D77 F78 K79 T80 L81 L82 R83 S86 Q93 C96 E97 V101 G102 L103 F104 E105 D106 T107 H113 A114 K115 P121 T124 R128 E133 ARG ALA

• Molecule 4: Histone H4

Chain B: 

MET SER GLY ARG GLY LYS GLY LYS GLY LEU LYS GLY GLY ALA LYS ARG HIS ARG LYS VAL LEU LEU ASP N25 R35 R36 L37 G42 E53 V57 L62 E63 N64 V65 T66 R67 A69 T73 E74 H75 A76 K77 R78 K79 T80 V81 T82 D85 R92

R93 G94 R95 T96 L97 F98 G99 F100 GLY GLY

• Molecule 4: Histone H4

Chain F: 

MET SER GLY ARG GLY LYS GLY LYS GLY LEU LYS GLY GLY ALA LYS ARG HIS ARG LYS VAL LEU LEU ASP N25 R35 R36 L37 I50 E53 V57 L62 E63 N64 V65 D68 A69 V70 T71 T72 T73 E74 H75 A76 K77 R78 K79 T80 V81 T82 D85

K91 R92 Q93 G94 R95 T96 L97 F100 GLY GLY


• Molecule 5: Histone H2B type 2-E

Chain D: 

MET PRO GLU PRO ALA LYS SER ALA PRO PRO LYS LYS SER LYS LYS ALA VAL THR LYS ALA GLN LYS LYS ASP T90 S91 R92 E93 L100 E105 L106 A107 K108 H109 A110 G114 T115 K116 A117 V118 Y121 T122 S123 SER LYS

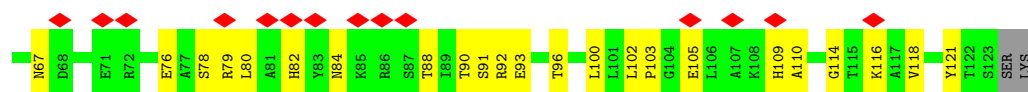
S64 P65 V66 N67 D68 E71 R72 E76 R79 L80 A81 H82 Y83 N84 K85 R86 S87 T88 I89 T90 S91 R92 E93 L100 E105 L106 A107 K108 H109 A110 G114 T115 K116 A117 V118 Y121 T122 S123 SER LYS

• Molecule 5: Histone H2B type 2-E

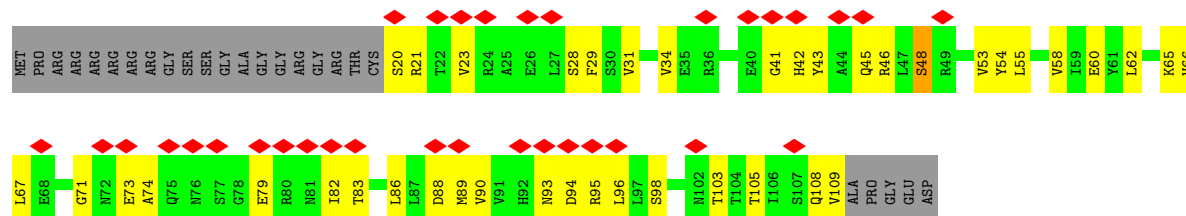
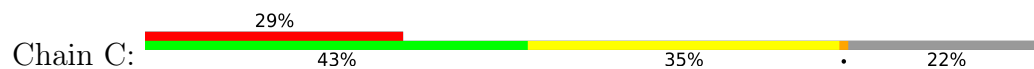
Chain H: 

MET PRO GLU PRO ALA LYS SER ALA PRO PRO LYS LYS SER LYS LYS ALA VAL THR LYS ALA GLN LYS LYS ASP T90 S91 R92 E93 L100 E105 L106 A107 K108 H109 A110 G114 T115 K116 A117 V118 Y121 T122 S123 SER LYS

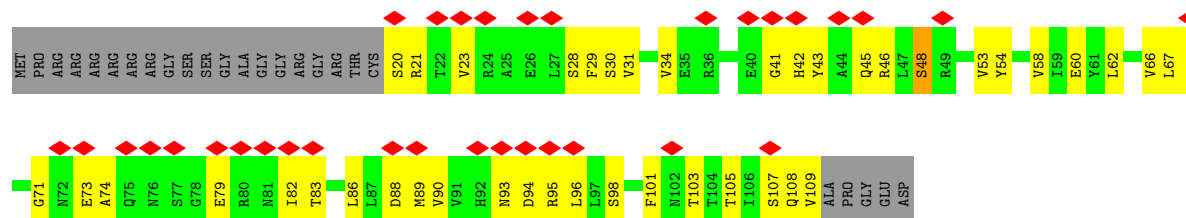
S36 T39 Y40 V41 Y42 L45 K46 Q47 V48 H49 P50 D51 T52 S55 S56 S57 M62 M63 S64



• Molecule 6: Histone H2A-Bbd type 2/3



• Molecule 6: Histone H2A-Bbd type 2/3



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	62980	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 ($e^-/\text{\AA}^2$)	50	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	GATAN K2 QUANTUM (4k x 4k)	Depositor
Maximum map value	33.184	Depositor
Minimum map value	-17.691	Depositor
Average map value	-0.002	Depositor
Map value standard deviation	1.046	Depositor
Recommended contour level	7.5	Depositor
Map size (Å)	249.59999, 249.59999, 249.59999	wwPDB
Map dimensions	240, 240, 240	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.04, 1.04, 1.04	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	I	0.35	0/2162	0.68	0/3339
2	J	0.32	0/2113	0.55	0/3254
3	A	0.26	0/606	0.59	0/813
3	E	0.26	0/606	0.59	0/813
4	B	0.25	0/617	0.56	0/827
4	F	0.25	0/617	0.56	0/827
5	D	0.21	0/696	0.57	0/938
5	H	0.21	0/696	0.57	0/938
6	C	0.31	0/713	0.62	0/968
6	G	0.31	0/713	0.62	0/968
All	All	0.30	0/9539	0.60	0/13685

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

Mol	Chain	#Chirality outliers	#Planarity outliers
1	I	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	I	117	DA	Sidechain

5.2 Too-close contacts ⓘ

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	I	1924	0	1041	43	0
2	J	1888	0	1045	30	0
3	A	599	0	630	22	0
3	E	599	0	630	21	0
4	B	610	0	653	25	0
4	F	610	0	653	31	0
5	D	685	0	703	33	0
5	H	685	0	703	40	0
6	C	705	0	717	45	0
6	G	705	0	717	48	0
All	All	9010	0	7492	239	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 15.

The worst 5 of 239 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:D:110:ALA:HB1	6:C:58:VAL:HG23	1.43	1.00
4:F:95:ARG:HH21	6:C:105:THR:CG2	1.81	0.92
5:H:110:ALA:HB1	6:G:58:VAL:HG23	1.50	0.92
5:H:62:MET:HE1	6:G:66:VAL:HG11	1.53	0.91
5:D:62:MET:HE1	6:C:66:VAL:HG11	1.60	0.81

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	
3	A	72/136 (53%)	71 (99%)	1 (1%)	0	100	100
3	E	72/136 (53%)	71 (99%)	1 (1%)	0	100	100
4	B	74/103 (72%)	72 (97%)	2 (3%)	0	100	100
4	F	74/103 (72%)	72 (97%)	2 (3%)	0	100	100
5	D	86/126 (68%)	85 (99%)	1 (1%)	0	100	100
5	H	86/126 (68%)	85 (99%)	1 (1%)	0	100	100
6	C	88/115 (76%)	83 (94%)	5 (6%)	0	100	100
6	G	88/115 (76%)	83 (94%)	5 (6%)	0	100	100
All	All	640/960 (67%)	622 (97%)	18 (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	
3	A	64/111 (58%)	63 (98%)	1 (2%)	58	85
3	E	64/111 (58%)	63 (98%)	1 (2%)	58	85
4	B	63/79 (80%)	61 (97%)	2 (3%)	34	68
4	F	63/79 (80%)	61 (97%)	2 (3%)	34	68
5	D	75/106 (71%)	74 (99%)	1 (1%)	65	88
5	H	75/106 (71%)	74 (99%)	1 (1%)	65	88
6	C	79/96 (82%)	77 (98%)	2 (2%)	42	75
6	G	79/96 (82%)	77 (98%)	2 (2%)	42	75
All	All	562/784 (72%)	550 (98%)	12 (2%)	49	80

5 of 12 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
5	H	116	LYS
6	C	48	SER
6	G	109	VAL
6	C	109	VAL
5	D	116	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 25 such sidechains are listed below:

Mol	Chain	Res	Type
6	C	45	GLN
6	C	108	GLN
6	G	108	GLN
6	C	93	ASN
6	G	33	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](#)

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.

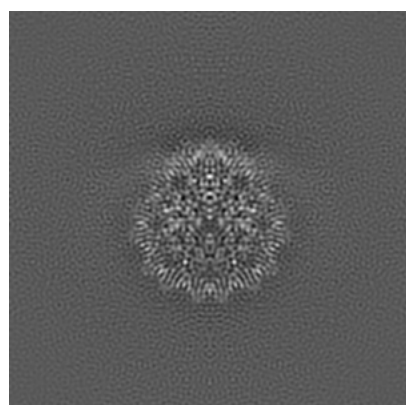
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-30077. These allow visual inspection of the internal detail of the map and identification of artifacts.

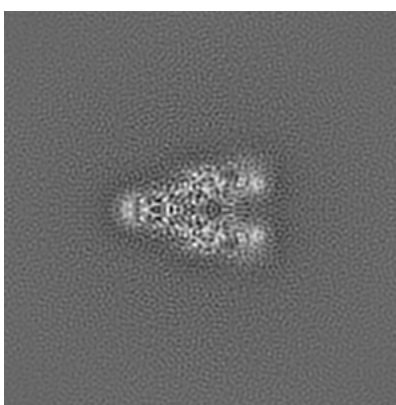
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

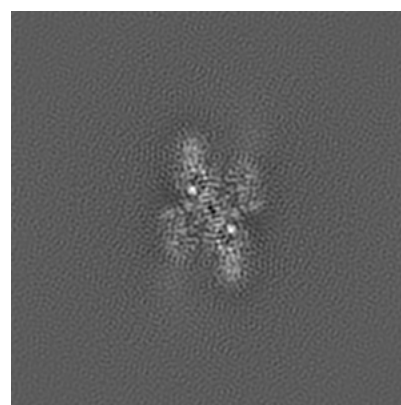
6.1.1 Primary map



X



Y

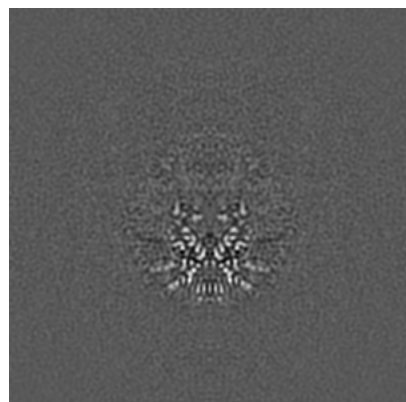


Z

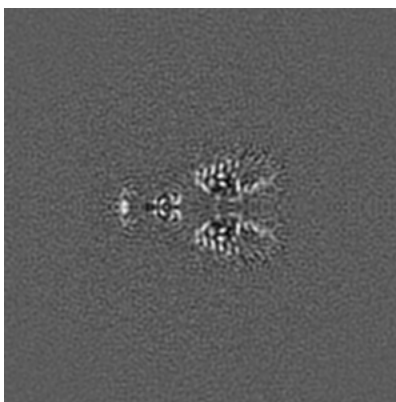
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

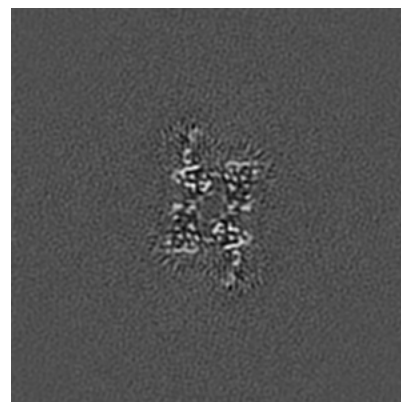
6.2.1 Primary map



X Index: 120



Y Index: 120

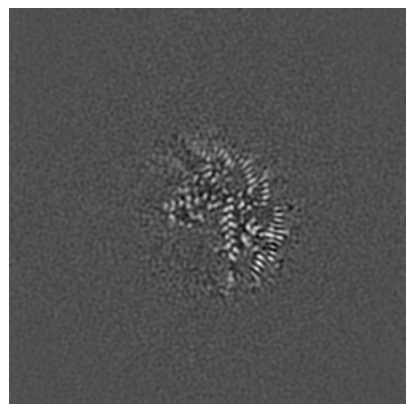


Z Index: 120

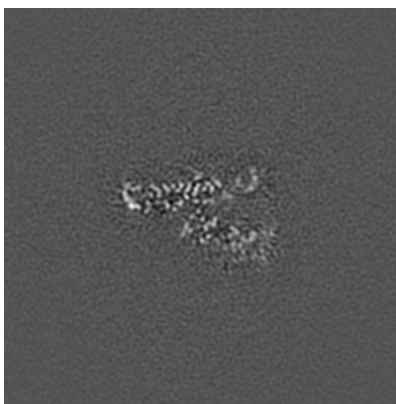
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

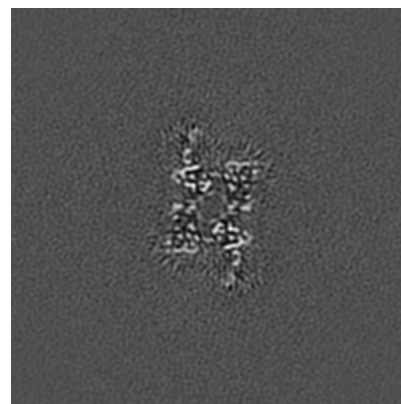
6.3.1 Primary map



X Index: 109



Y Index: 108

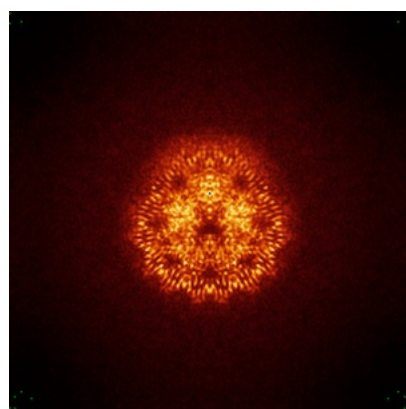


Z Index: 120

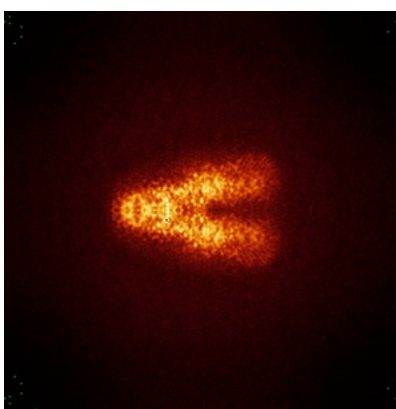
The images above show the largest variance slices of the map in three orthogonal directions.

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

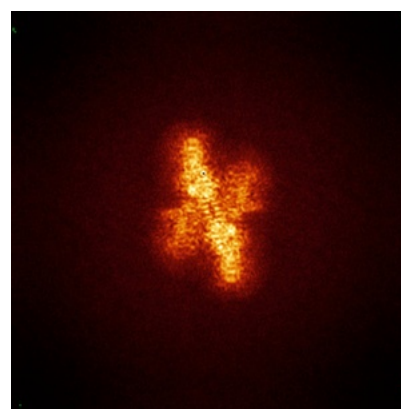
6.4.1 Primary map



X



Y



Z

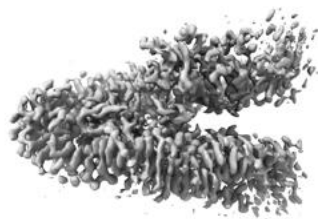
The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

6.5 Orthogonal surface views [i](#)

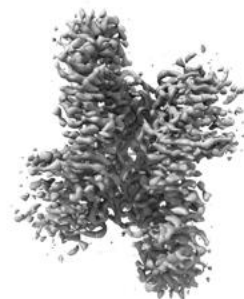
6.5.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 7.5. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

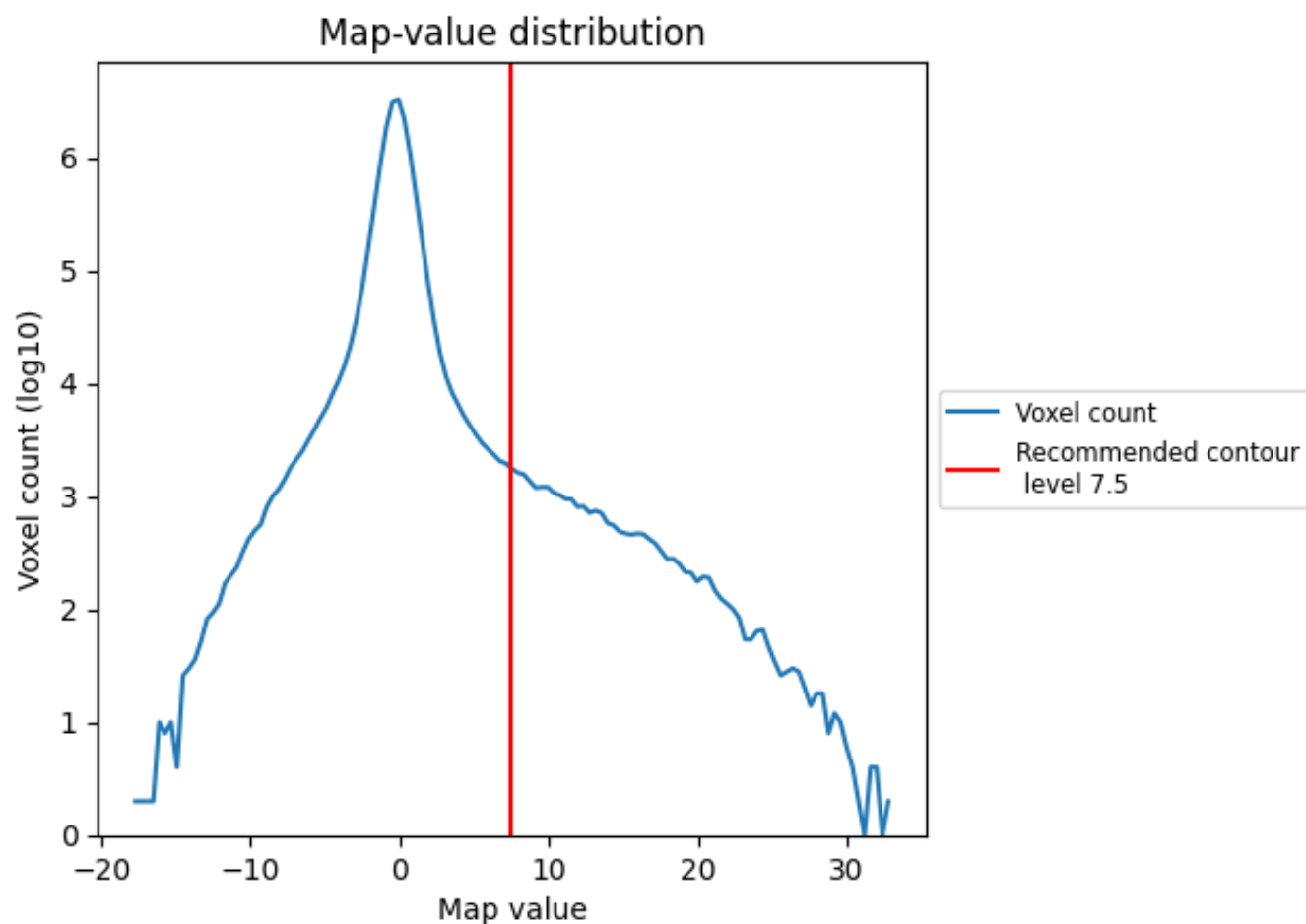
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

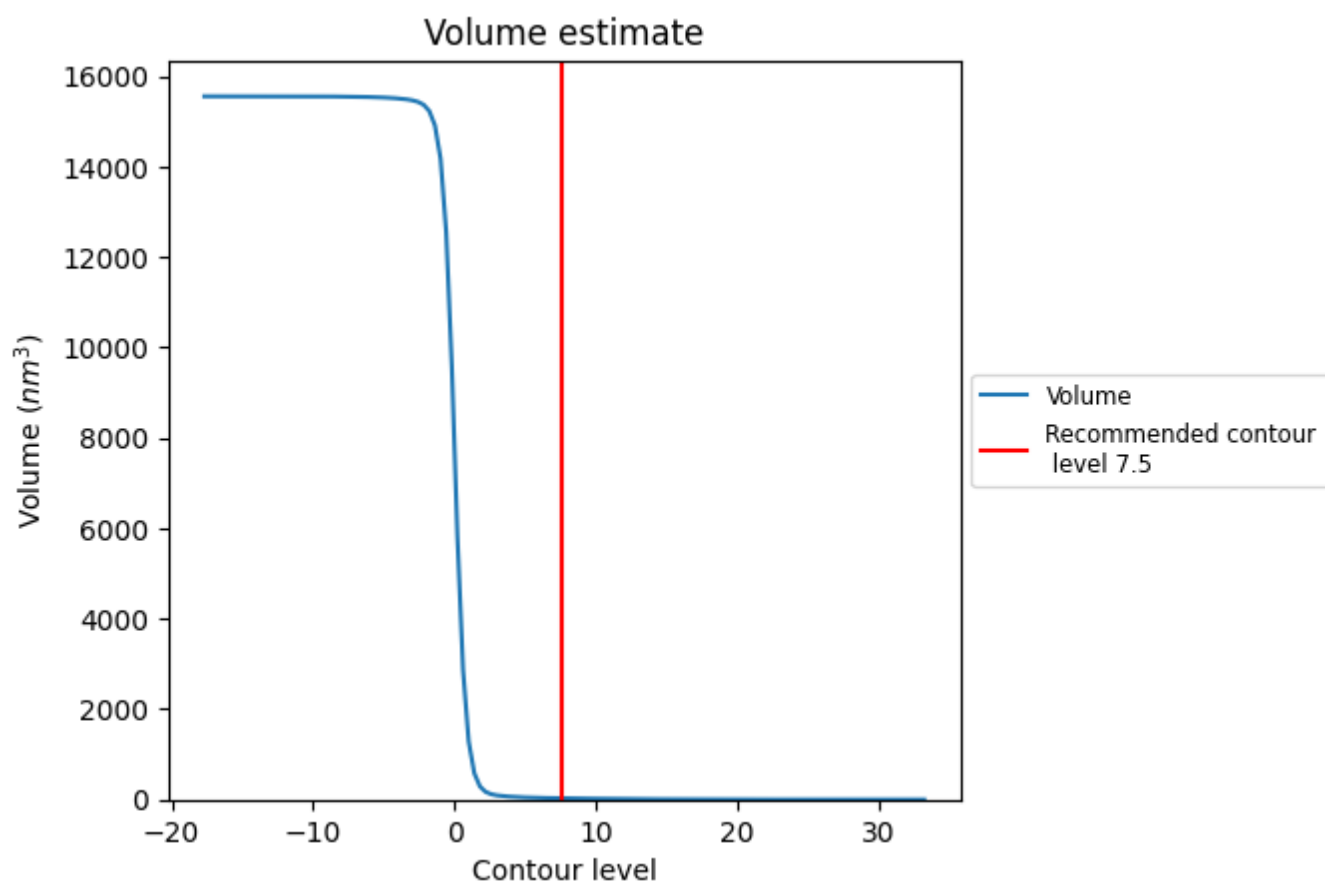
This section contains the results of statistical analysis of the map.

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.

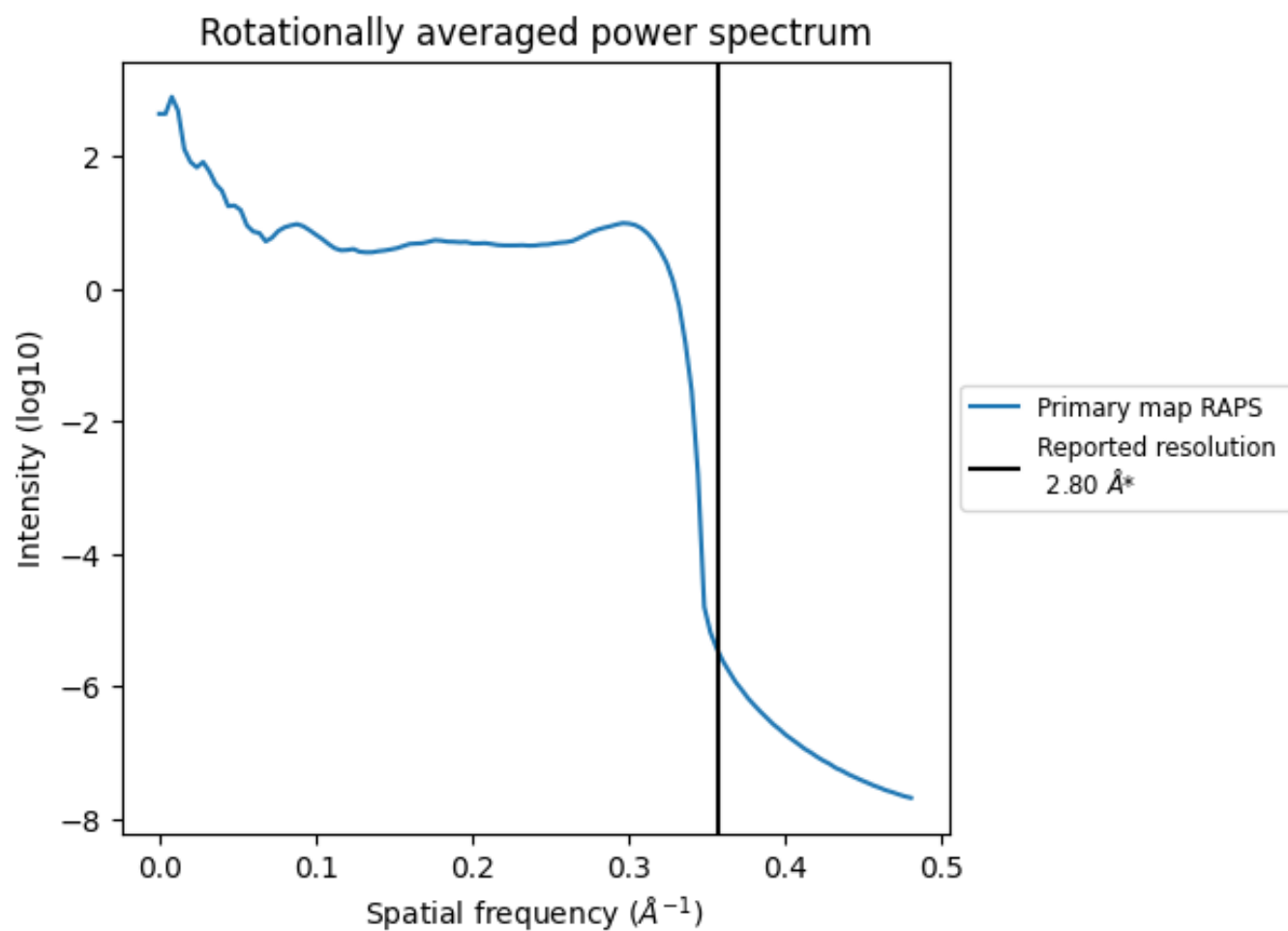
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 29 nm³; this corresponds to an approximate mass of 26 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 0.357 Å⁻¹

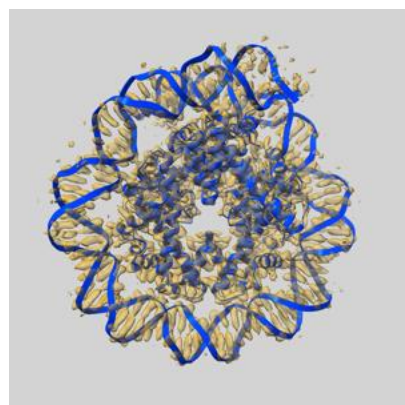
8 Fourier-Shell correlation

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

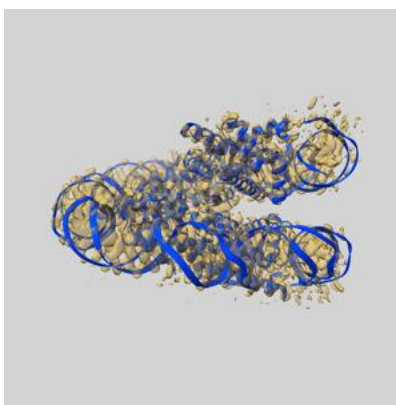
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-30077 and PDB model 6M4G. Per-residue inclusion information can be found in section [3](#) on page [6](#).

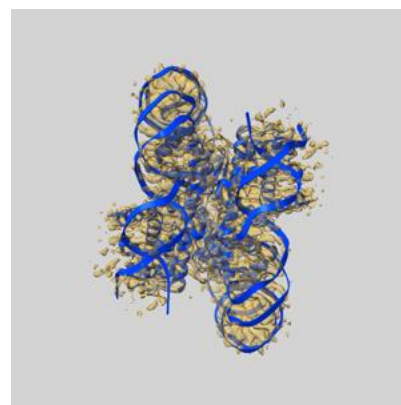
9.1 Map-model overlay [i](#)



X



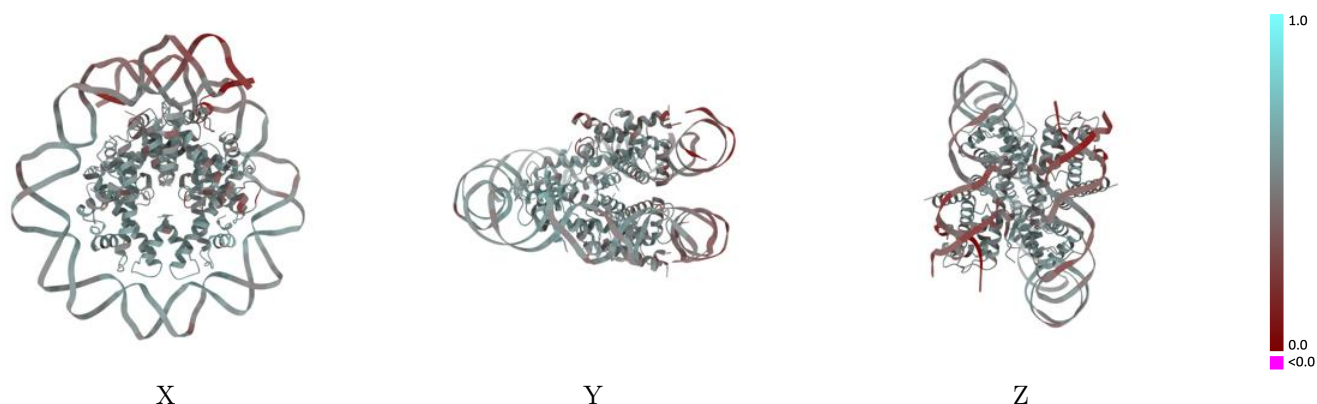
Y



Z

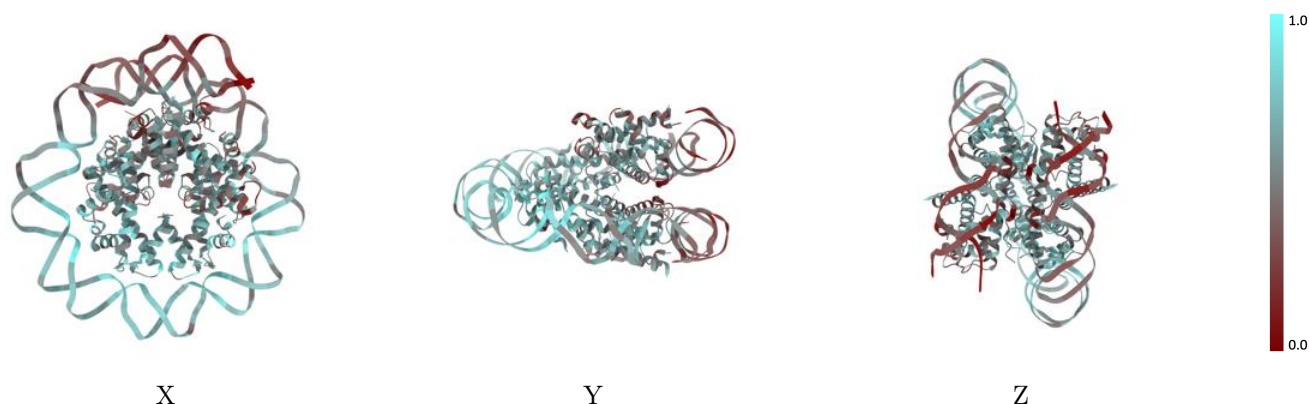
The images above show the 3D surface view of the map at the recommended contour level 7.5 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



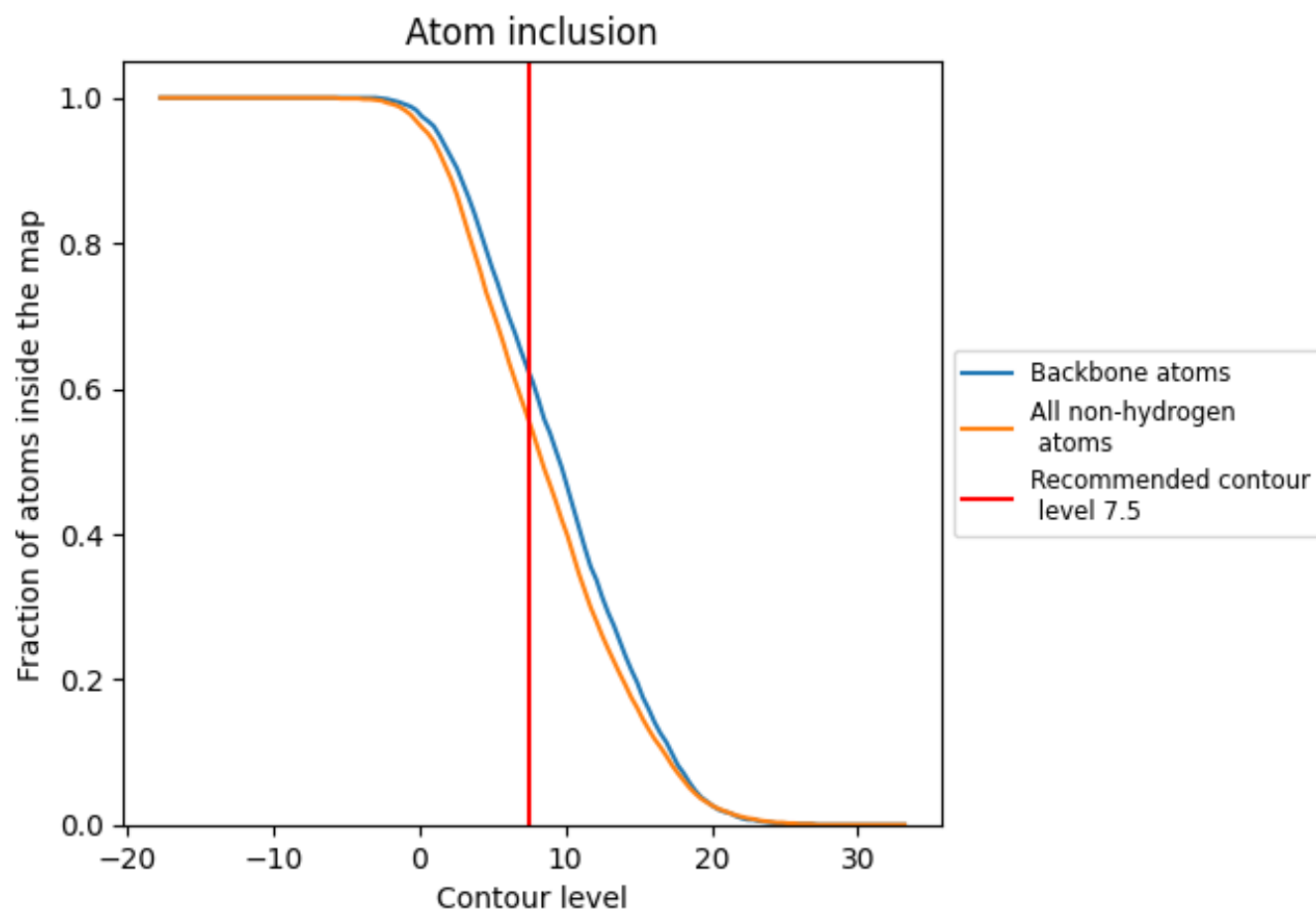
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (7.5).

9.4 Atom inclusion [i](#)



At the recommended contour level, 62% of all backbone atoms, 56% 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 (7.5) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div></div> 0.5550	<div></div> 0.4930
A	<div></div> 0.6650	<div></div> 0.5590
B	<div></div> 0.6540	<div></div> 0.5640
C	<div></div> 0.4640	<div></div> 0.4450
D	<div></div> 0.5120	<div></div> 0.5020
E	<div></div> 0.6610	<div></div> 0.5610
F	<div></div> 0.6550	<div></div> 0.5650
G	<div></div> 0.4640	<div></div> 0.4490
H	<div></div> 0.5100	<div></div> 0.4970
I	<div></div> 0.5320	<div></div> 0.4560
J	<div></div> 0.5460	<div></div> 0.4710

