wwPDB EM Validation Summary Report (i)

May 12, 2024 – 10:33 am BST

PDB ID	:	6RIP
EMDB ID	:	EMD-4893
Title	:	Cryo-EM structure of E. coli RNA polymerase backtracked elongation complex in swiveled state
Authors	:	Abdelkareem, M.; Saint-Andre, C.; Takacs, M.; Papai, G.; Crucifix, C.; Guo, X.; Ortiz, J.; Weixlbaumer, A.
Deposited on	:	2019-04-24
Resolution	:	3.40 Å(reported)
Based on initial model	:	6ALH

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 (i) 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 (i)) were used in the production of this report:

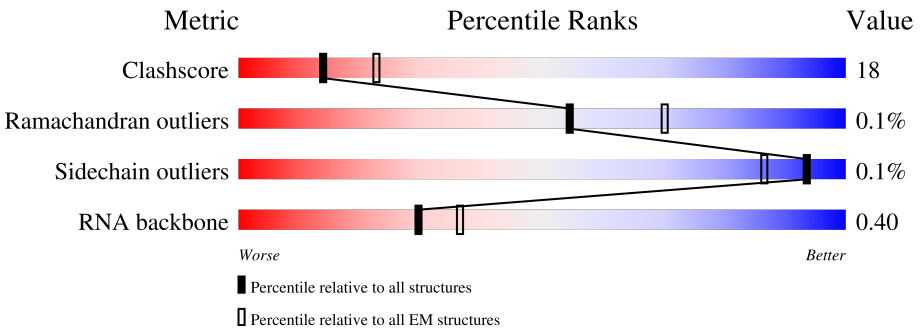
EMDB validation analysis	:	0.0.1.dev92
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ	:	1.9.13
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 3.40 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
RNA backbone	4643	859

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 <=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	N	39	18%; 26%; 36%; 38%
2	T	39	18%; 21%; 51%; 10%; 18%
3	A	329	•; 50%; 19%; 31%
3	B	329	•; 46%; 24%; 30%
4	C	1342	5%; 63%; 35%; •
5	D	1407	5%; 59%; 35%; 5%
6	E	91	55%; 25%; 20%

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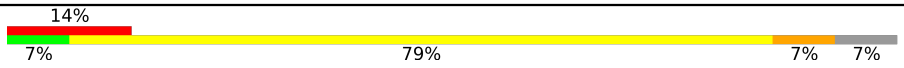
Mol	Chain	Length	Quality of chain
7	R	14	

2 Entry composition (i)

There are 9 unique types of molecules in this entry. The entry contains 26346 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 Non-template DNA.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
1	N	24	489	232	89	144	24	0	0

- Molecule 2 is a DNA chain called Template DNA.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
2	T	32	655	311	124	189	31	0	0

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

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	A	228	1768	1102	312	348	6	0	0
3	B	229	1772	1104	313	349	6	0	0

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

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
4	C	1319	10407	6530	1814	2020	43	0	0

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

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
5	D	1336	10397	6533	1854	1960	50	0	0

- Molecule 6 is a protein called DNA-directed RNA polymerase subunit omega.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
6	E	73	582	355	111	115	1	0	0

- Molecule 7 is a RNA chain called RNA.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
7	R	13	273	123	46	92	12	0	0

- Molecule 8 is ZINC ION (three-letter code: ZN) (formula: Zn).

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

- Molecule 9 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

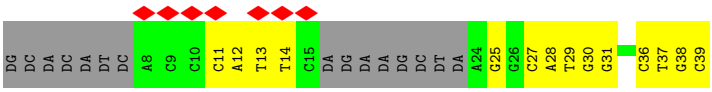
Mol	Chain	Residues	Atoms		AltConf
			Total	Mg	
9	D	1	1	1	0

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.

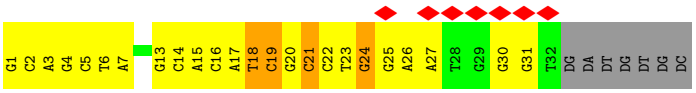
• Molecule 1: Non-template DNA

Chain N: 18% 26% 36% 38%



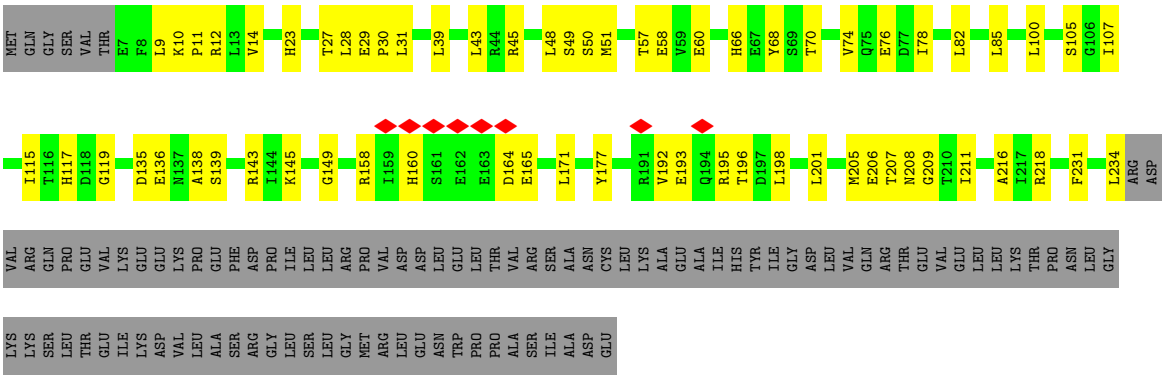
• Molecule 2: Template DNA

Chain T: 18% 21% 51% 10% 18%



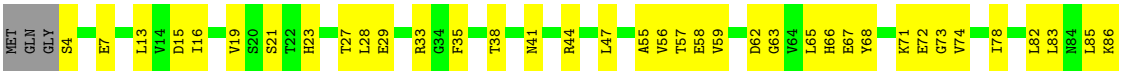
• Molecule 3: DNA-directed RNA polymerase subunit alpha

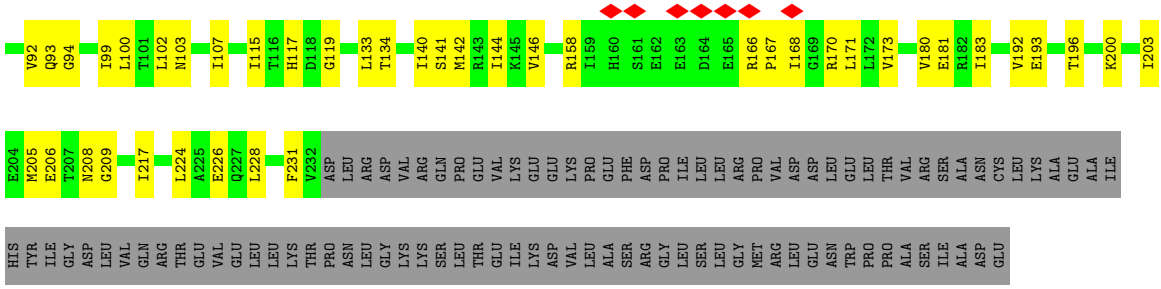
Chain A: 50% 19% 31%



• Molecule 3: DNA-directed RNA polymerase subunit alpha

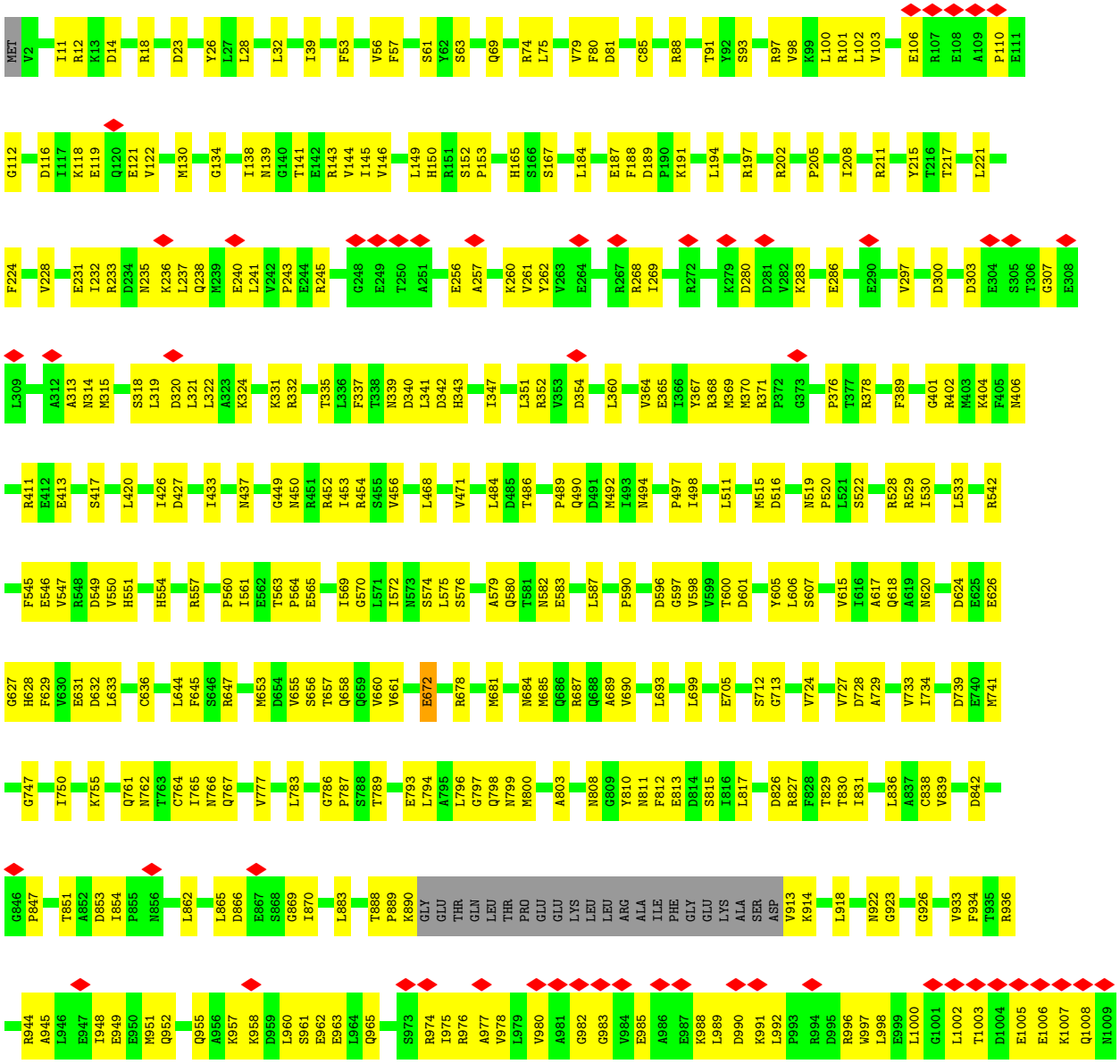
Chain B: 46% 24% 30%





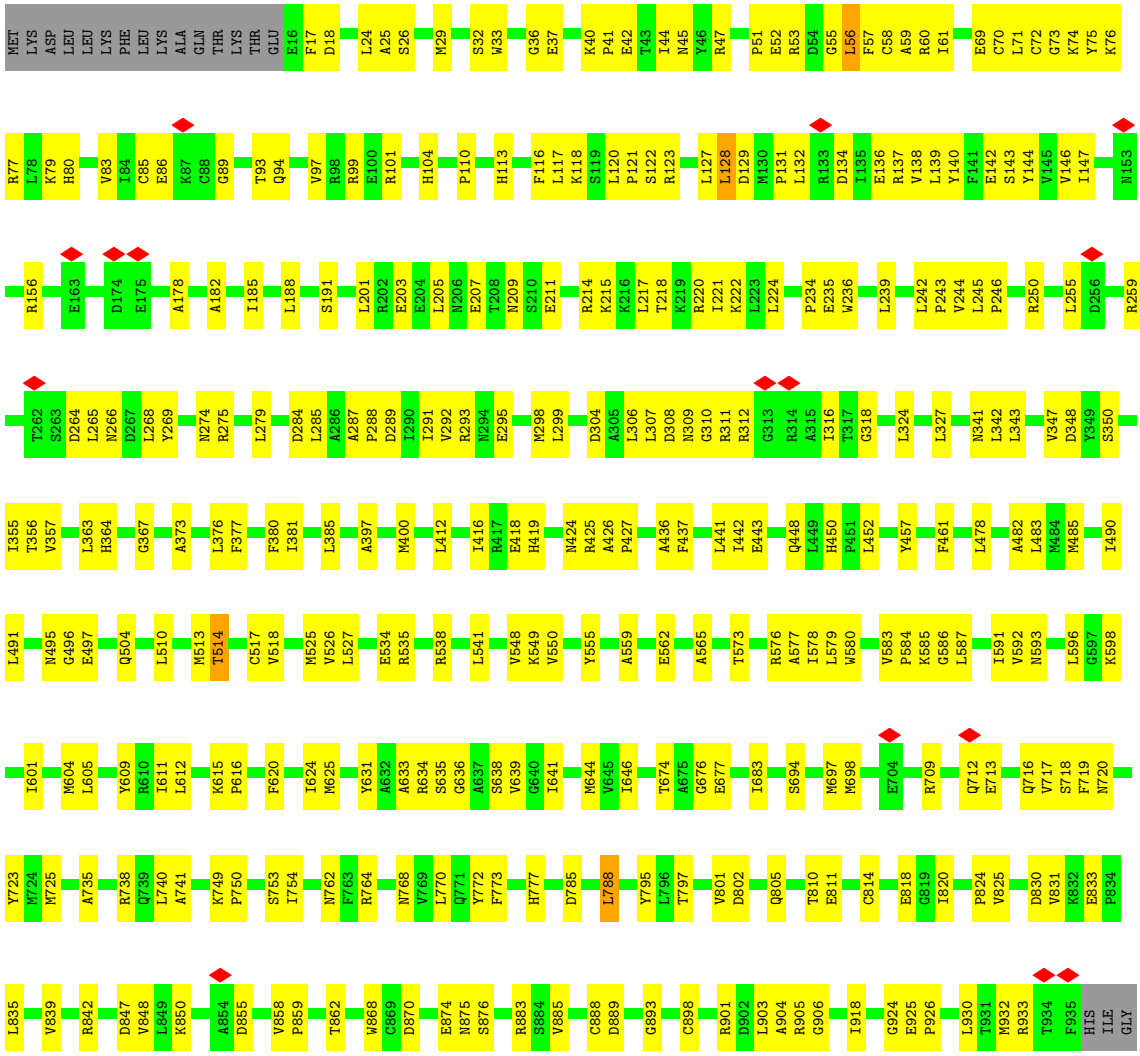
- Molecule 4: DNA-directed RNA polymerase subunit beta

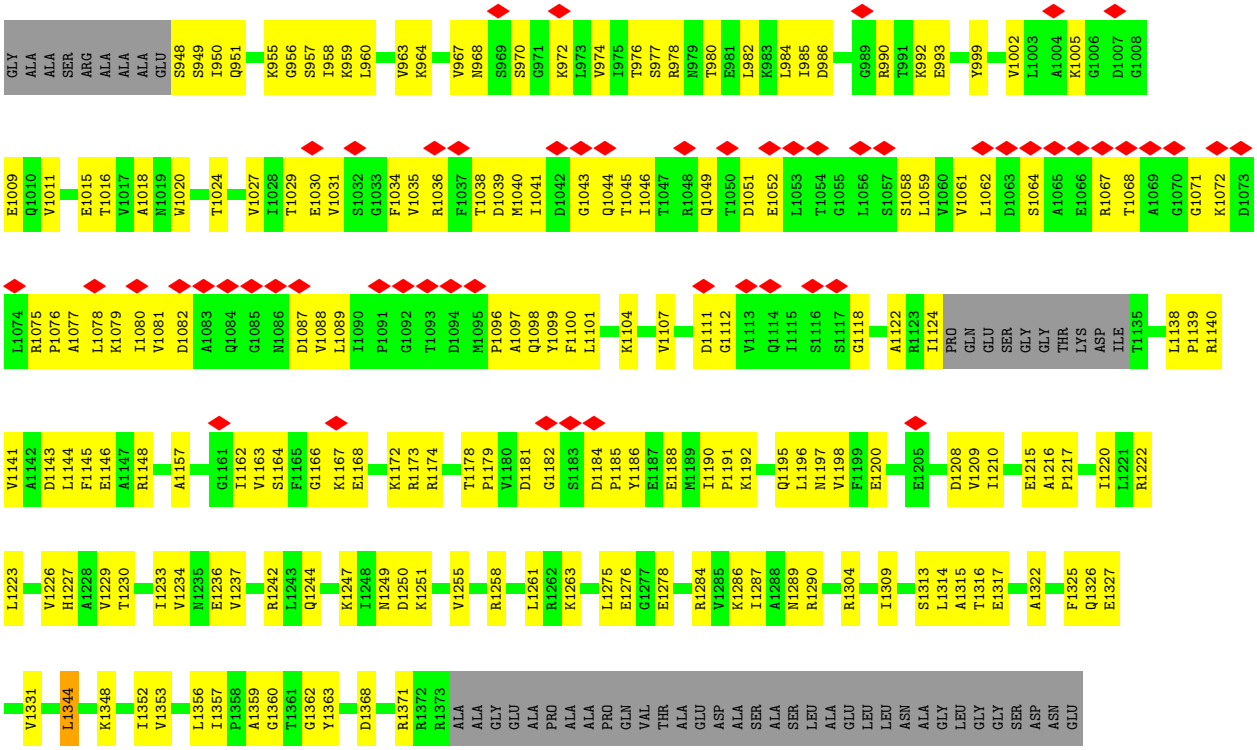
Chain C:



- Molecule 5: DNA-directed RNA polymerase subunit beta'

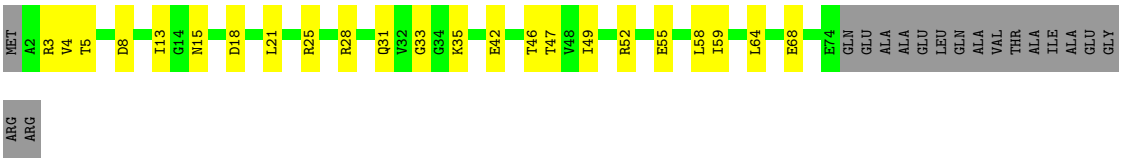
Chain D:





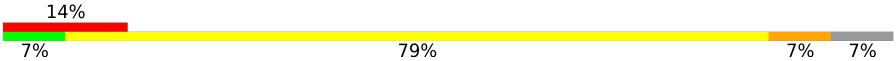
- Molecule 6: DNA-directed RNA polymerase subunit omega

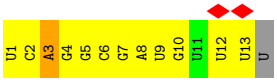
Chain E:



- Molecule 7: RNA

Chain R:





4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	102899	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 ($e^-/Å^2$)	49	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	4.193	Depositor
Minimum map value	-2.058	Depositor
Average map value	0.014	Depositor
Map value standard deviation	0.129	Depositor
Recommended contour level	0.6	Depositor
Map size (Å)	307.29602, 307.29602, 307.29602	wwPDB
Map dimensions	288, 288, 288	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.067, 1.067, 1.067	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: MG, ZN

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	N	0.92	0/546	0.94	0/837
2	T	1.17	1/735 (0.1%)	1.13	6/1133 (0.5%)
3	A	0.76	0/1790	0.70	1/2426 (0.0%)
3	B	0.67	0/1794	0.70	0/2432
4	C	0.79	2/10573 (0.0%)	0.68	1/14265 (0.0%)
5	D	0.73	4/10554 (0.0%)	0.69	2/14248 (0.0%)
6	E	0.64	0/584	0.69	0/786
7	R	1.04	0/304	1.17	0/472
All	All	0.78	7/26880 (0.0%)	0.72	10/36599 (0.0%)

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	D	514	THR	CA-CB	-5.96	1.37	1.53
5	D	772	TYR	CD1-CE1	-5.88	1.30	1.39
5	D	457	TYR	CD2-CE2	-5.33	1.31	1.39
5	D	457	TYR	CD1-CE1	-5.32	1.31	1.39
4	C	672	GLU	CA-C	-5.31	1.39	1.52

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	T	24	DG	OP1-P-O3'	-10.89	81.24	105.20
2	T	24	DG	OP2-P-O3'	-9.91	83.39	105.20
2	T	19	DC	O4'-C4'-C3'	-7.73	101.36	106.00
5	D	1344	LEU	CA-CB-CG	-7.66	97.69	115.30
2	T	25	DG	OP1-P-OP2	6.89	129.94	119.60

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	N	489	0	271	23	0
2	T	655	0	360	29	0
3	A	1768	0	1793	54	0
3	B	1772	0	1799	80	0
4	C	10407	0	10420	367	0
5	D	10397	0	10618	391	0
6	E	582	0	593	17	0
7	R	273	0	140	15	0
8	D	2	0	0	0	0
9	D	1	0	0	0	0
All	All	26346	0	25994	919	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 18.

The worst 5 of 919 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)
3:B:166:ARG:HD3	3:B:170:ARG:NH1	1.70	1.06
3:B:166:ARG:HD3	3:B:170:ARG:CZ	1.88	1.04
3:B:166:ARG:CD	3:B:170:ARG:NH1	2.21	1.03
5:D:1049:GLN:O	5:D:1058:SER:HB2	1.62	0.98
1:N:39:DC:O2	2:T:1:DG:N2	1.98	0.96

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	
3	A	226/329 (69%)	189 (84%)	37 (16%)	0	100	100
3	B	227/329 (69%)	187 (82%)	40 (18%)	0	100	100
4	C	1315/1342 (98%)	1076 (82%)	238 (18%)	1 (0%)	51	82
5	D	1330/1407 (94%)	1114 (84%)	215 (16%)	1 (0%)	51	82
6	E	71/91 (78%)	58 (82%)	13 (18%)	0	100	100
All	All	3169/3498 (91%)	2624 (83%)	543 (17%)	2 (0%)	54	82

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
5	D	56	LEU
4	C	1062	PRO

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	
3	A	196/286 (68%)	196 (100%)	0	100	100
3	B	197/286 (69%)	197 (100%)	0	100	100
4	C	1138/1157 (98%)	1138 (100%)	0	100	100
5	D	1121/1168 (96%)	1117 (100%)	4 (0%)	91	95
6	E	63/75 (84%)	63 (100%)	0	100	100
All	All	2715/2972 (91%)	2711 (100%)	4 (0%)	93	98

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
5	D	128	LEU
5	D	1222	ARG
5	D	1233	ILE
5	D	1255	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 28 such sidechains are listed below:

Mol	Chain	Res	Type
4	C	1256	GLN
5	D	1367	GLN
5	D	232	ASN
5	D	1010	GLN
4	C	1313	HIS

5.3.3 RNA (i)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
7	R	12/14 (85%)	4 (33%)	0

All (4) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
7	R	3	A
7	R	4	G
7	R	12	U
7	R	13	U

There are no RNA pucker outliers to report.

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.

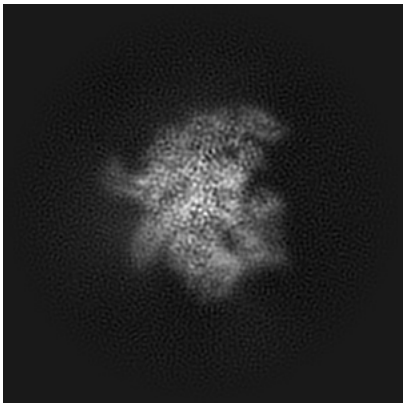
6 Map visualisation (i)

This section contains visualisations of the EMDB entry EMD-4893. 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



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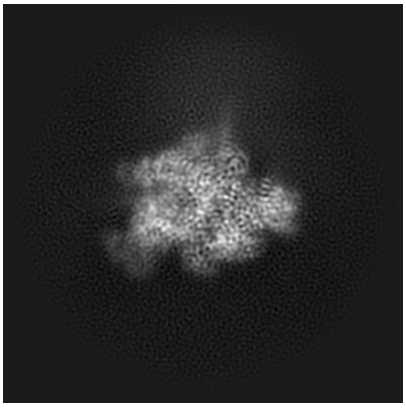
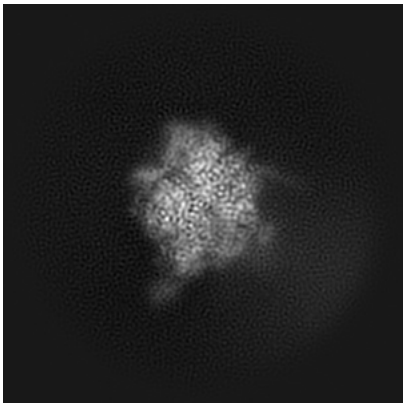


Y

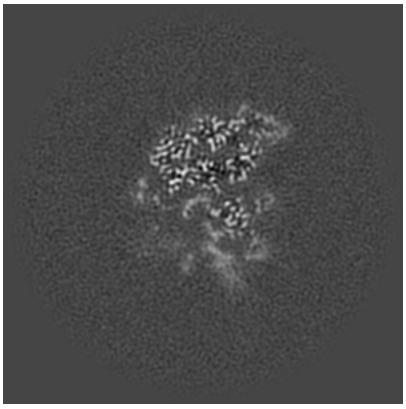


Z

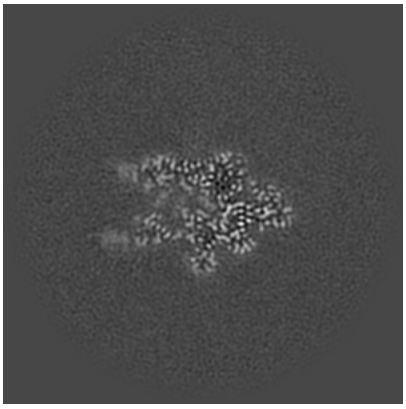
The images above show the map projected in three orthogonal directions.

6.2 Central slices (i)

6.2.1 Primary map



X Index: 144



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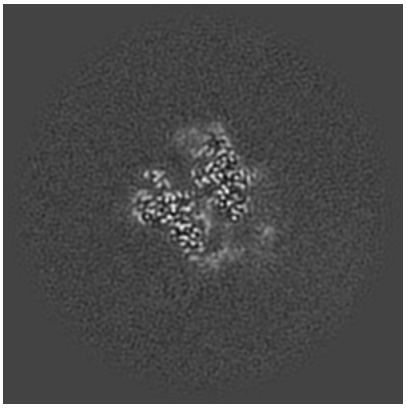
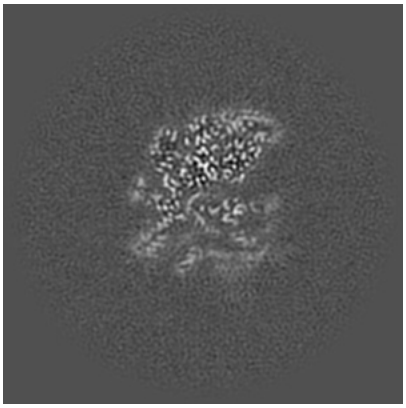


Z Index: 144

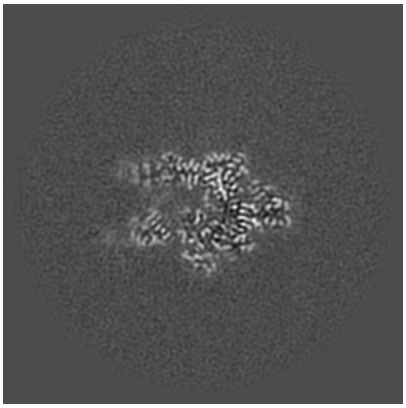
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices (i)

6.3.1 Primary map



X Index: 139



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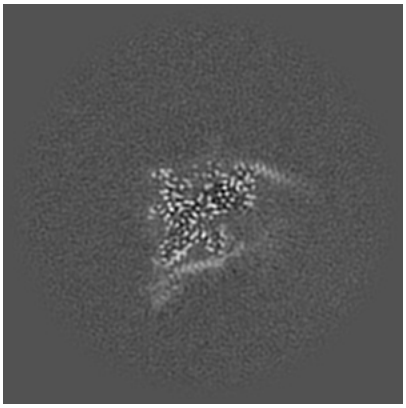
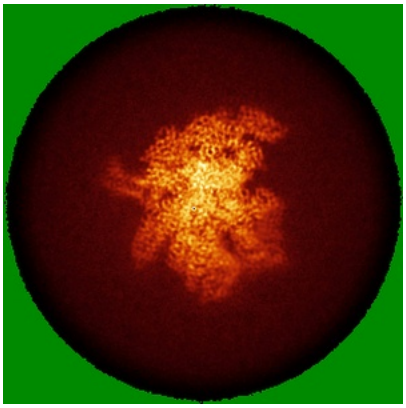


Z Index: 159

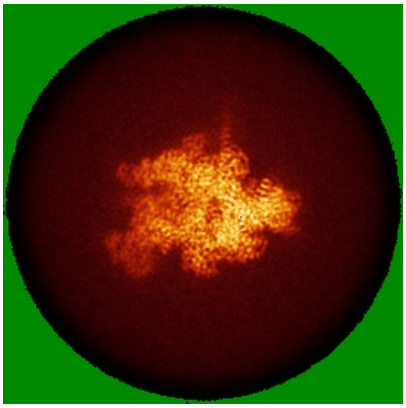
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal standard-deviation projections (False-color) (i)

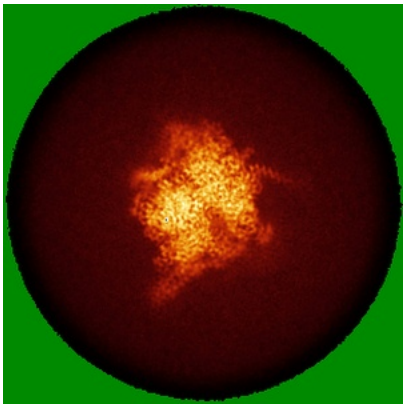
6.4.1 Primary map



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

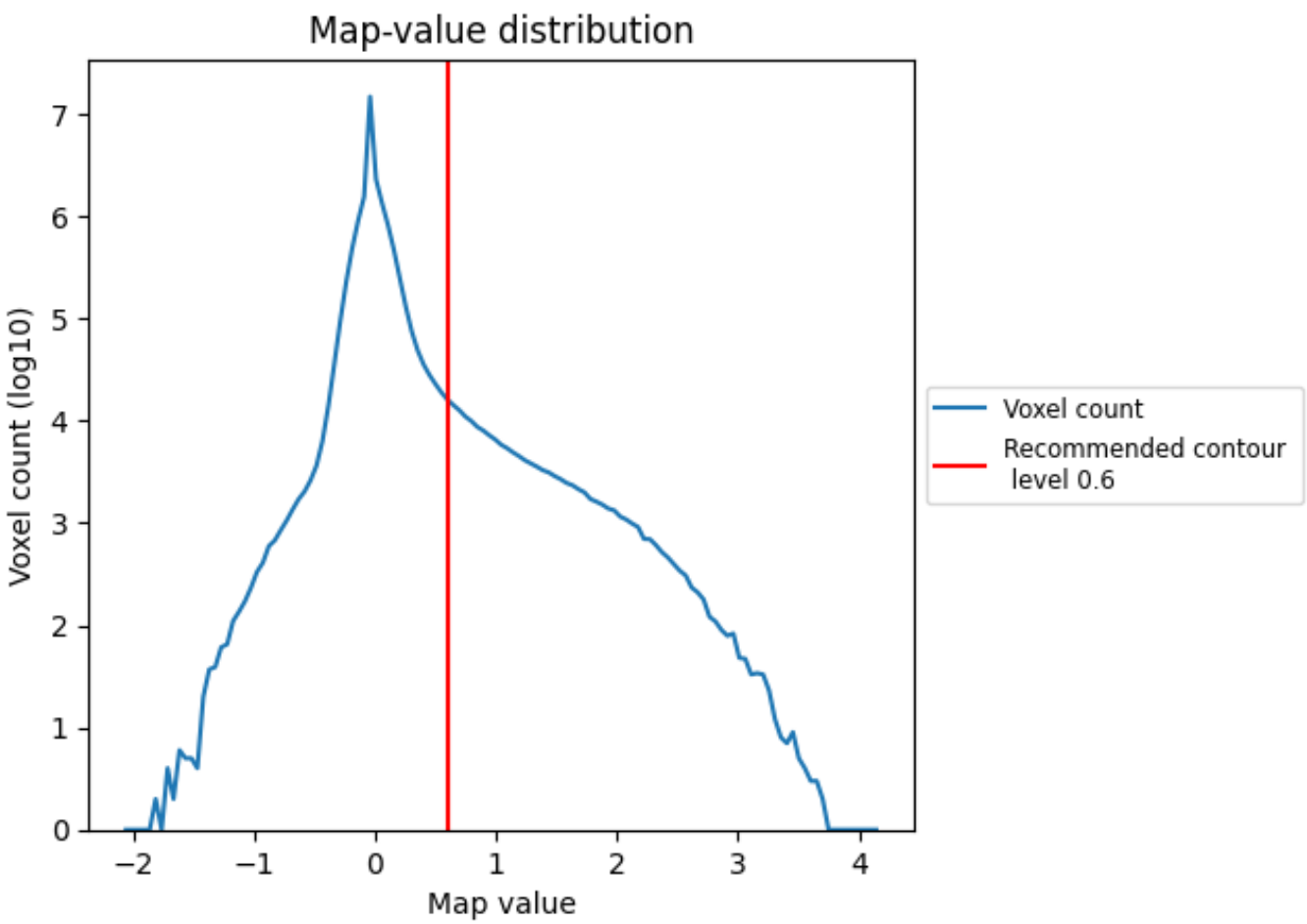
6.6 Mask visualisation (i)

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

7 Map analysis (i)

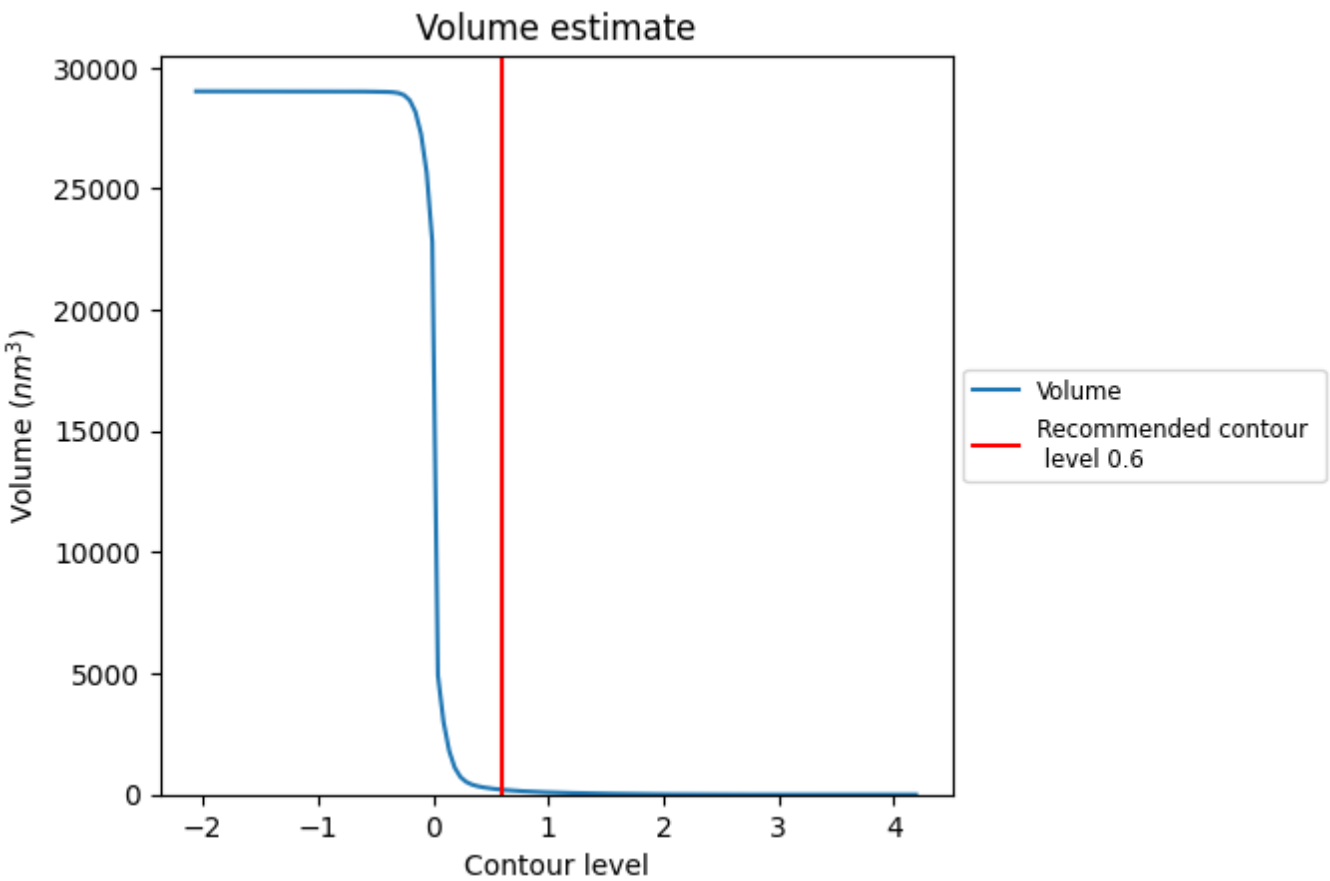
This section contains the results of statistical analysis of the map.

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.

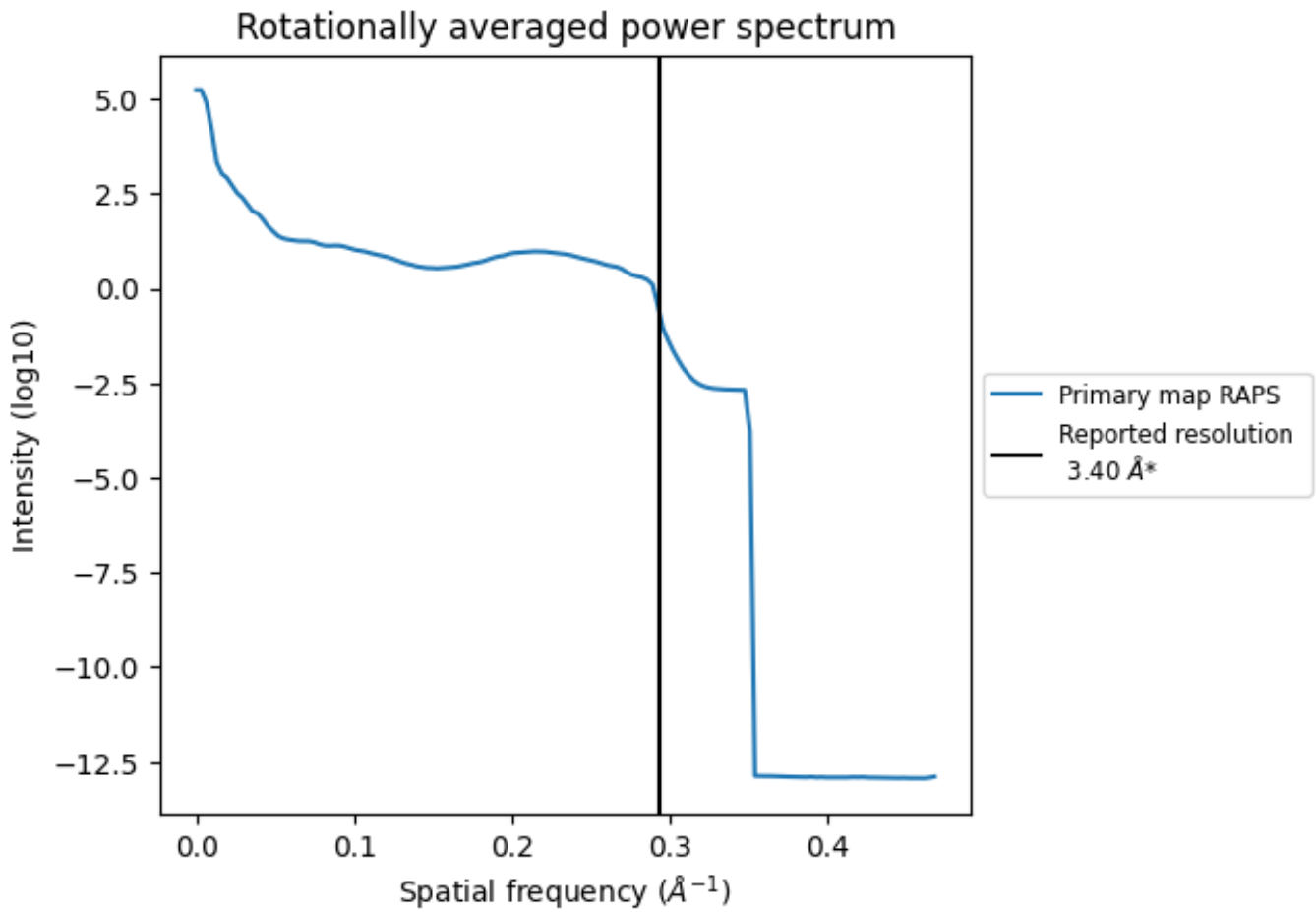
7.2 Volume estimate (i)



The volume at the recommended contour level is 200 nm^3; this corresponds to an approximate mass of 181 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 0.294 Å^{-1}

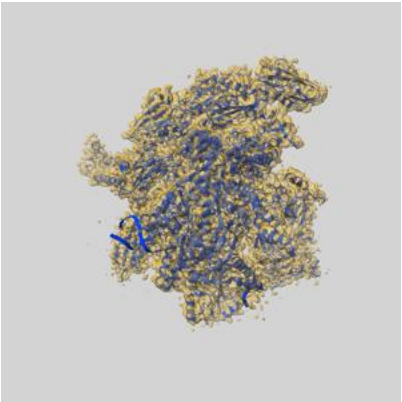
8 Fourier-Shell correlation (i)

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

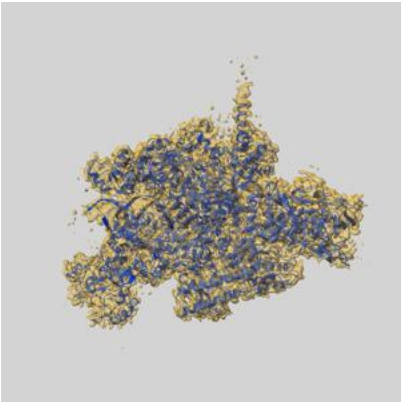
9 Map-model fit (i)

This section contains information regarding the fit between EMDB map EMD-4893 and PDB model 6RIP. Per-residue inclusion information can be found in section 3 on page 6.

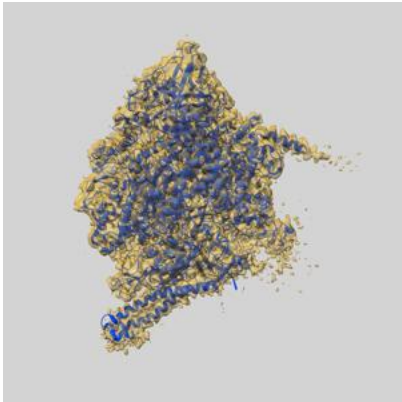
9.1 Map-model overlay (i)



X



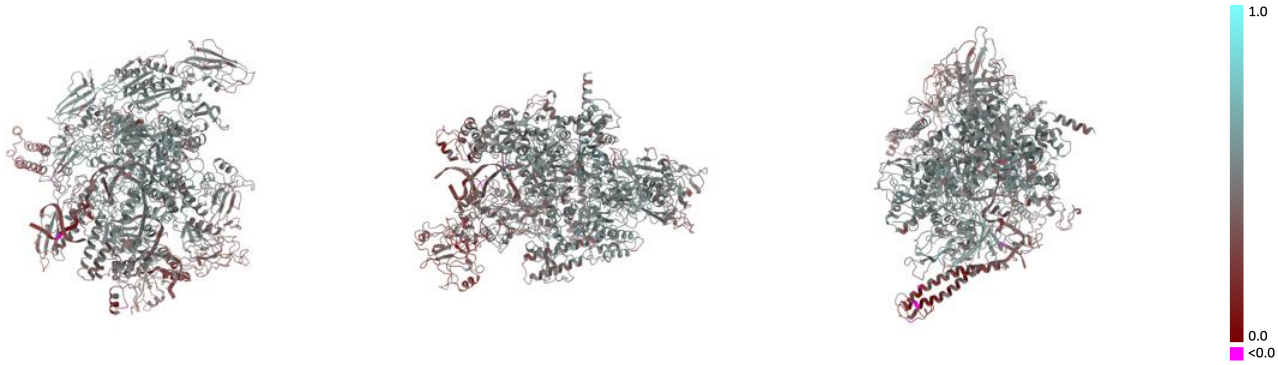
Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.6 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.

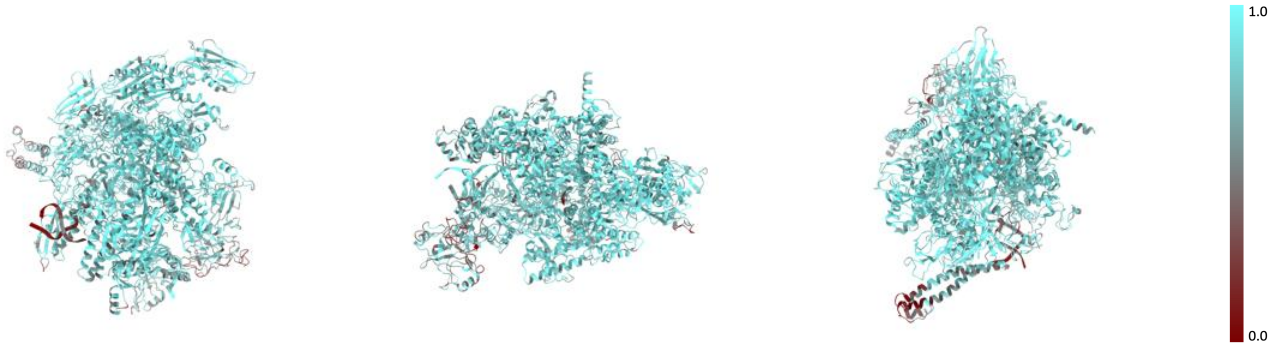
9.2 Q-score mapped to coordinate model (i)



X Y Z

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.

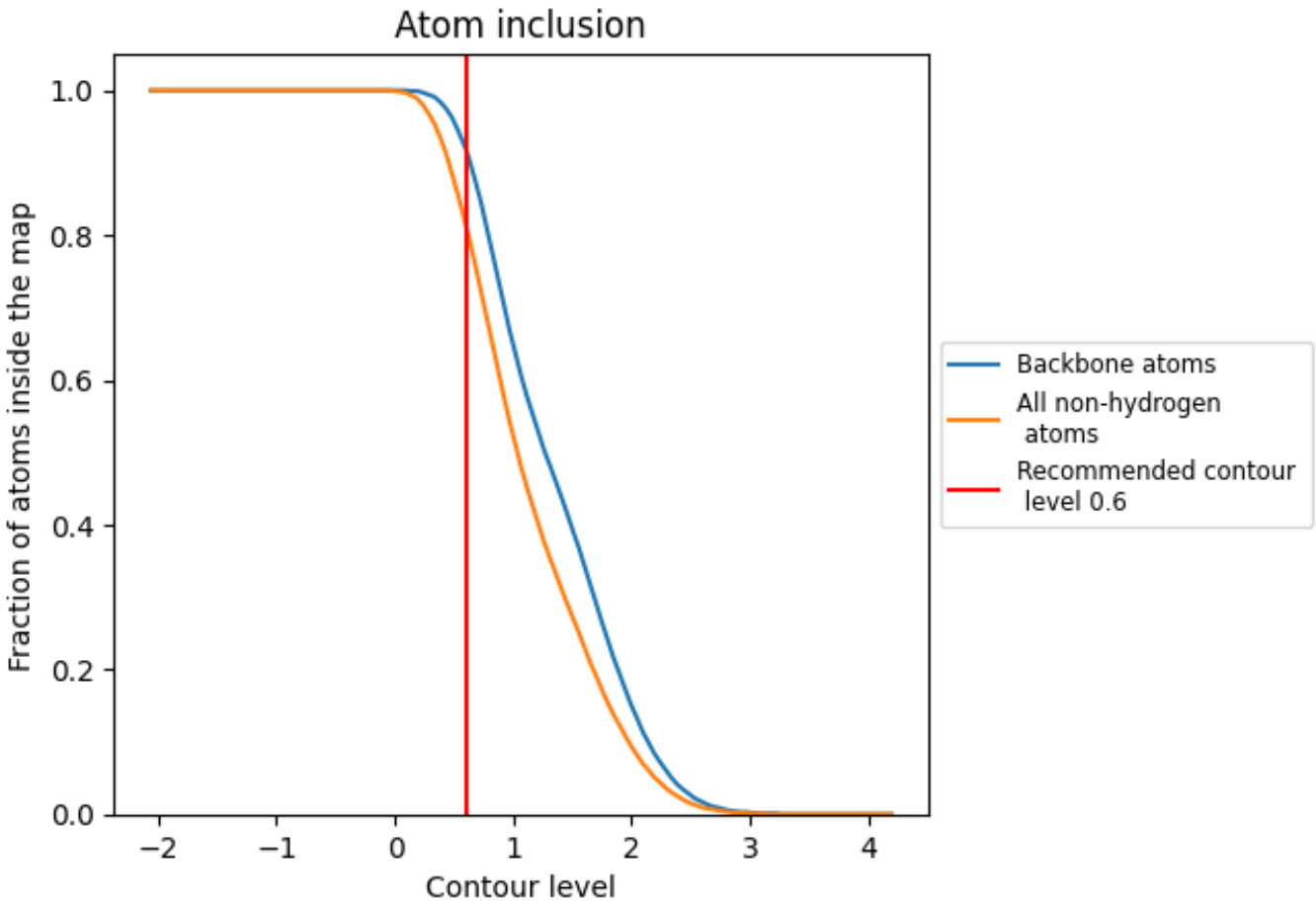
9.3 Atom inclusion mapped to coordinate model (i)



X Y Z

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 (0.6).

9.4 Atom inclusion (i)



At the recommended contour level, 92% of all backbone atoms, 81% of all non-hydrogen atoms, are inside the map.

9.5 Map-model fit summary (i)

The table lists the average atom inclusion at the recommended contour level (0.6) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.8140	0.4560
A	0.8530	0.4940
B	0.8170	0.4640
C	0.8280	0.4650
D	0.8090	0.4550
E	0.8220	0.4750
N	0.5990	0.2930
R	0.7950	0.4000
T	0.7310	0.3310