



wwPDB EM Validation Summary Report ⓘ

Nov 6, 2022 – 08:10 AM EST

PDB ID : 6D6V
EMDB ID : EMD-7821
Title : CryoEM structure of Tetrahymena telomerase with telomeric DNA at 4.8 Angstrom resolution
Authors : Jiang, J.; Wang, Y.; Susac, L.; Chan, H.; Basu, R.; Zhou, Z.H.; Feigon, J.
Deposited on : 2018-04-22
Resolution : 4.80 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:

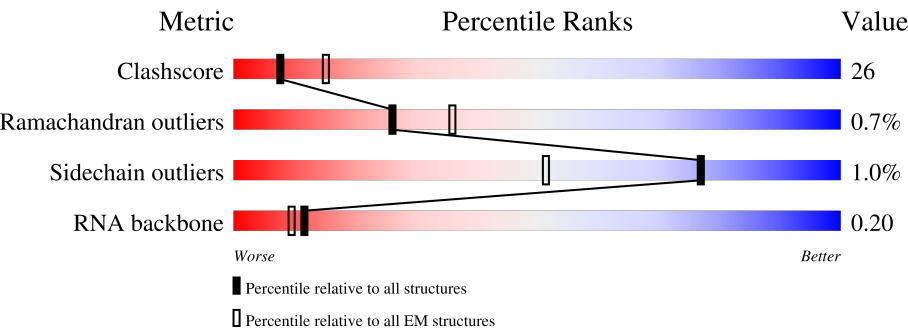
EMDB validation analysis : 0.0.1.dev43
MolProbity : 4.02b-467
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ : 1.9.9
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.31.2

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 4.80 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	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 $\leq 5\%$. 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	1117	<div><div>10%</div><div>42%</div><div>42%</div><div>12%</div></div>
2	D	701	<div><div>14%</div><div>12%</div><div>74%</div></div>
3	F	121	<div><div>28%</div><div>54%</div><div>37%</div><div>7%</div></div>
4	E	269	<div><div>12%</div><div>28%</div><div>26%</div><div>45%</div></div>
5	B	159	<div><div>19%</div><div>10%</div><div>30%</div><div>45%</div><div>16%</div></div>
6	C	19	<div><div>21%</div><div>11%</div><div>58%</div><div>32%</div></div>
7	G	157	<div><div>25%</div><div>77%</div><div>22%</div></div>

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Mol	Chain	Length	Quality of chain
8	H	542	<div><div><div></div><div></div><div></div></div><div>20%15%5%80%</div></div>

2 Entry composition [i](#)

There are 9 unique types of molecules in this entry. The entry contains 17317 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 Telomerase reverse transcriptase.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	980	Total	C	N	O	S	0	0
			8253	5357	1369	1498	29		

- Molecule 2 is a protein called Telomerase-associated protein 82.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	D	185	Total	C	N	O	S	0	0
			1538	985	255	290	8		

- Molecule 3 is a protein called Telomerase holoenzyme TEB heterotrimer Teb3 subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	F	113	Total	C	N	O	S	0	0
			919	580	155	180	4		

- Molecule 4 is a protein called Telomerase holoenzyme Teb2 subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	E	149	Total	C	N	O	S	0	0
			1207	765	211	223	8		

- Molecule 5 is a RNA chain called RNA (159-MER).

Mol	Chain	Residues	Atoms					AltConf	Trace
5	B	159	Total	C	N	O	P	0	0
			3322	1494	568	1102	158		

- Molecule 6 is a DNA chain called DNA (5'-D(P*GP*TP*TP*GP*GP*GP*GP*TP*TP*GP*GP*GP*TP*TP*GP*GP*GP*G)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
6	C	19	Total	C	N	O	P	0	0
			406	190	77	120	19		

- Molecule 7 is a protein called Telomerase-associated protein 50.

Mol	Chain	Residues	Atoms				AltConf	Trace
7	G	157	Total	C	N	O	0	0
			785	471	157	157		

- Molecule 8 is a protein called Telomerase associated protein p65.

Mol	Chain	Residues	Atoms					AltConf	Trace
8	H	108	Total	C	N	O	S	0	0
			886	563	156	162	5		

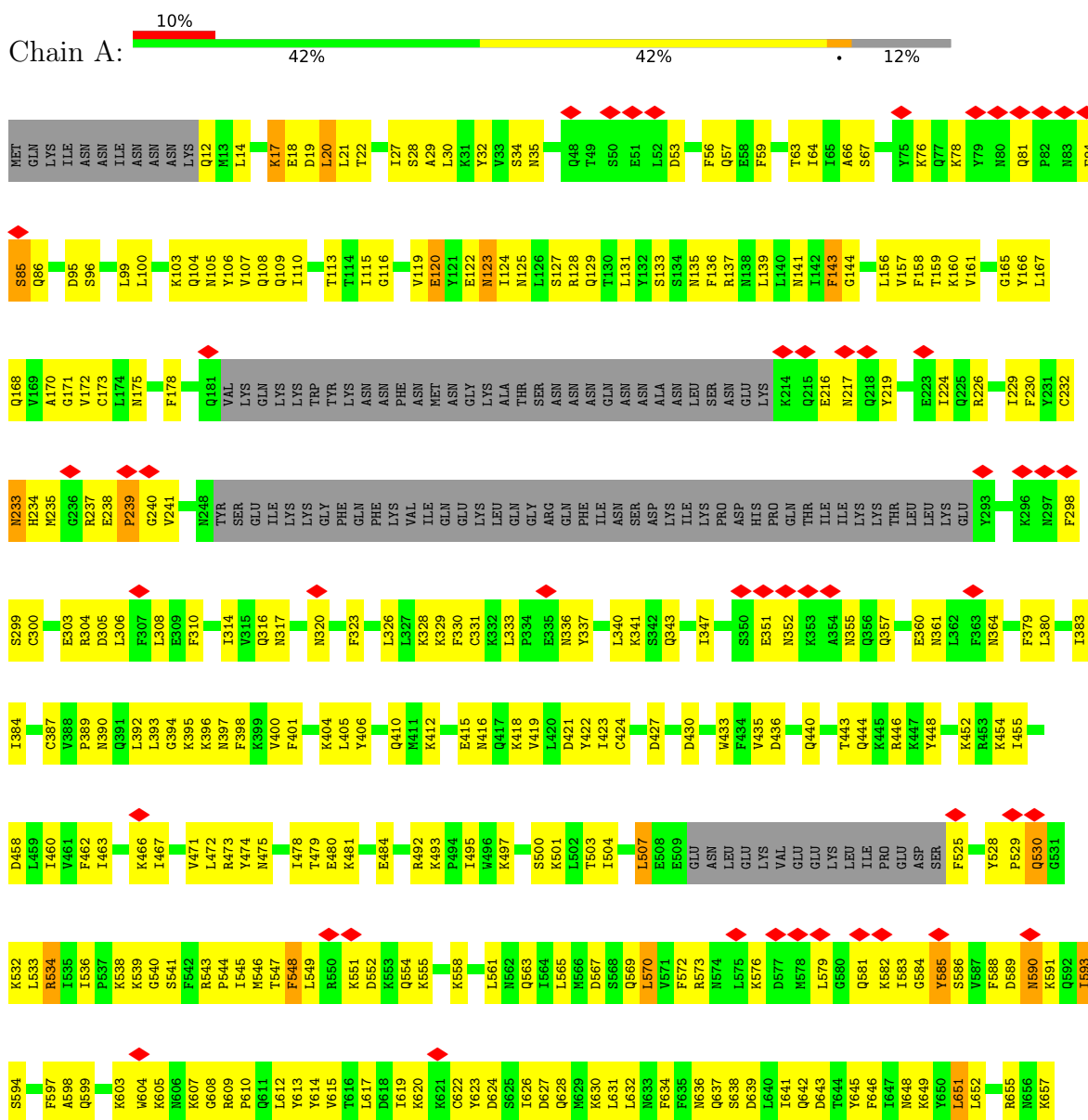
- Molecule 9 is ZINC ION (three-letter code: ZN) (formula: Zn).

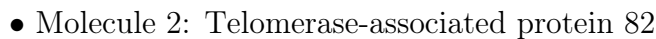
Mol	Chain	Residues	Atoms		AltConf
9	D	1	Total	Zn	0
			1	1	

3 Residue-property plots

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.

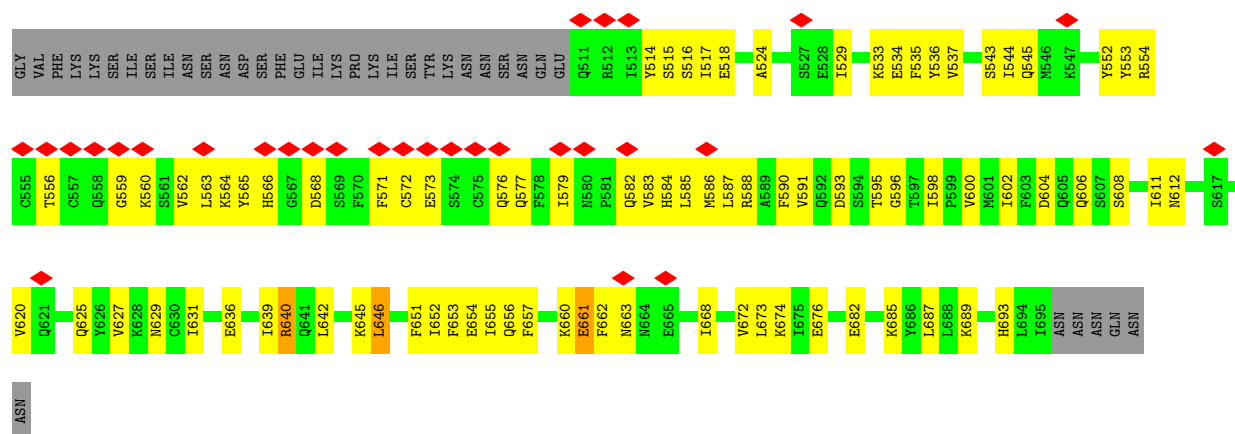
• Molecule 1: Telomerase reverse transcriptase



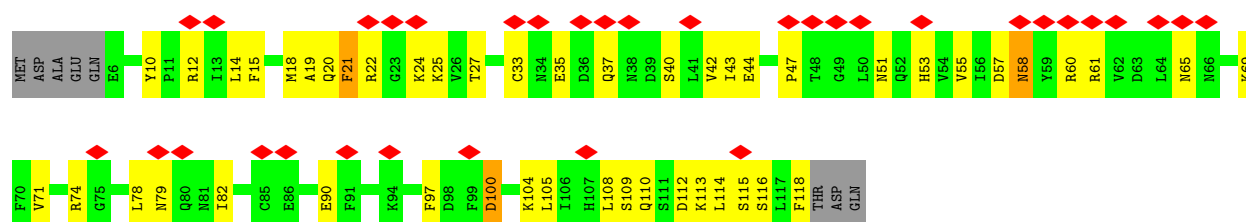


Chain D: 14% 12% 74%

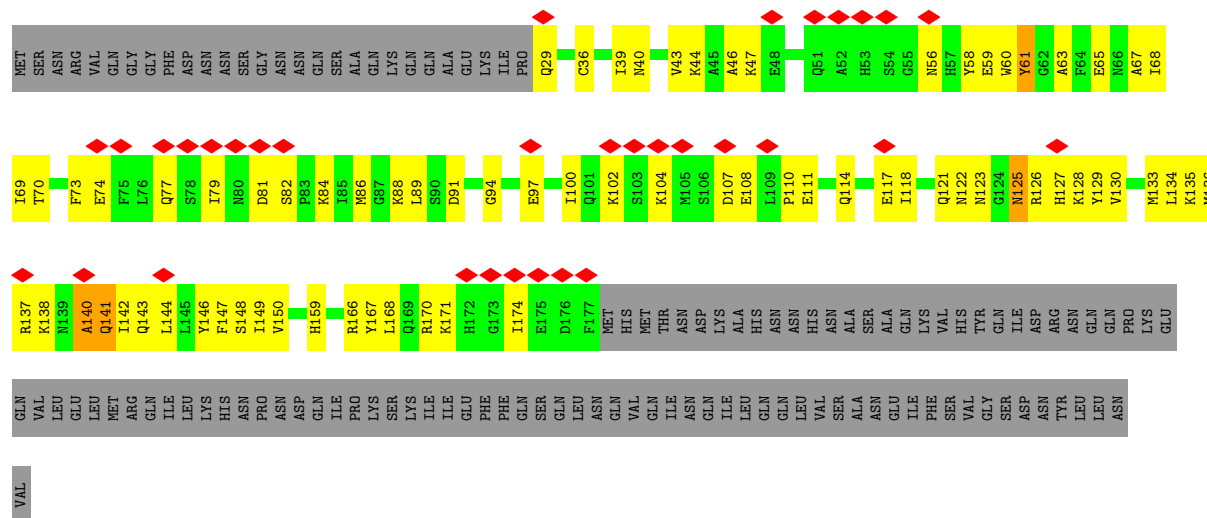
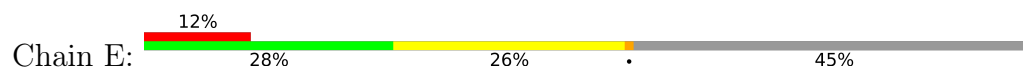




• Molecule 3: Telomerase holoenzyme TEB heterotrimer Teb3 subunit

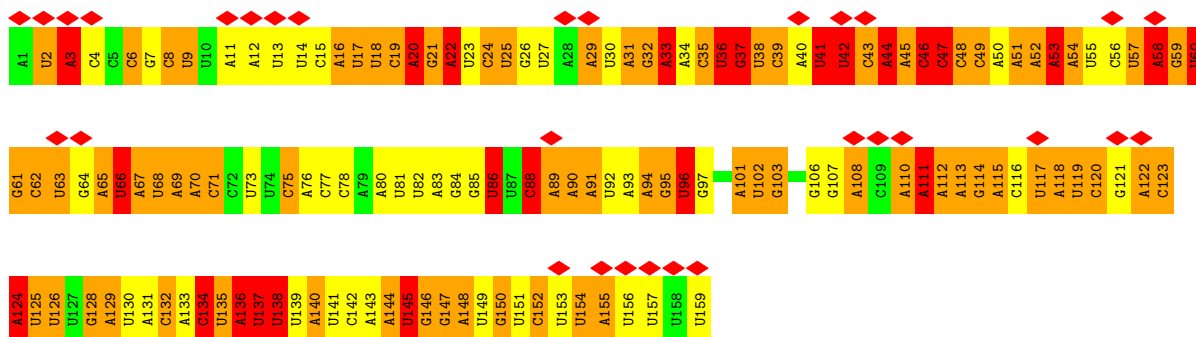


• Molecule 4: Telomerase holoenzyme Teb2 subunit

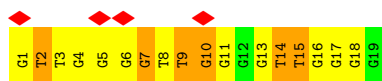
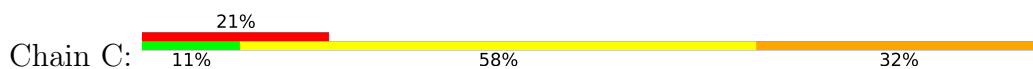


• Molecule 5: RNA (159-MER)

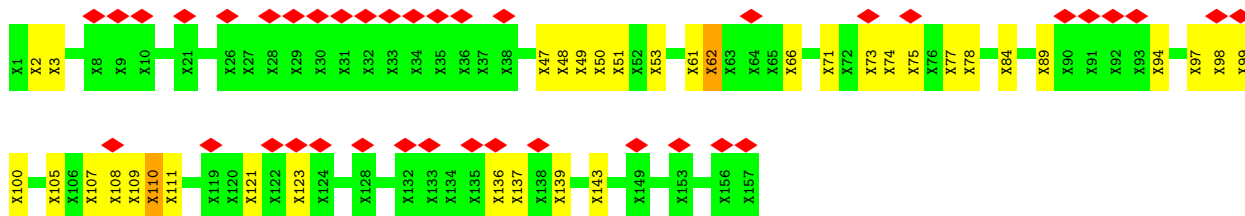
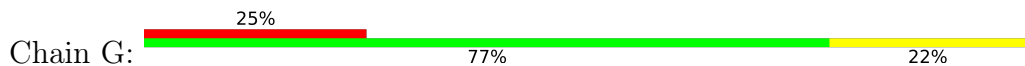




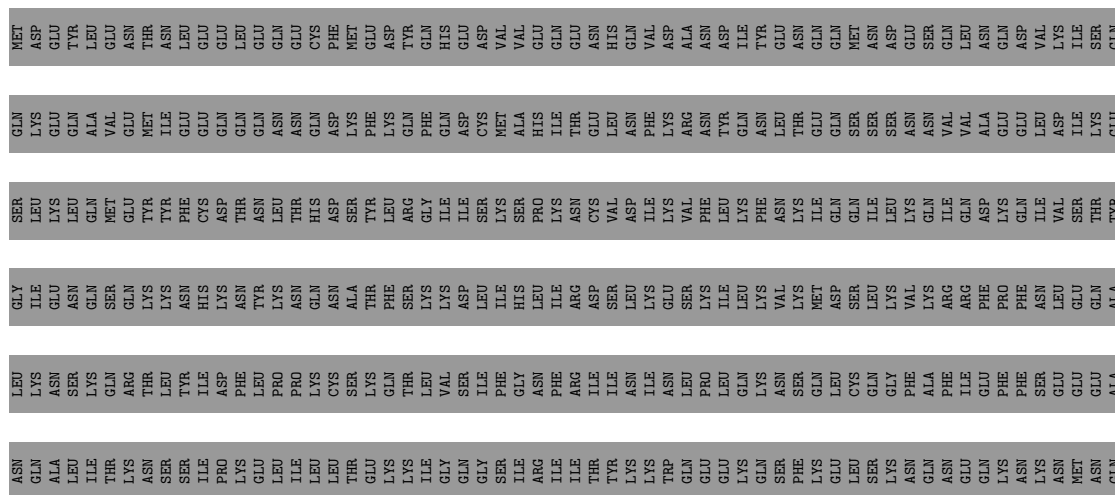
- Molecule 6: DNA (5'-D(P*GP*TP*TP*GP*GP*GP*GP*TP*TP*GP*GP*GP*GP*TP*TP*G P*GP*GP*G)-3')



- Molecule 7: Telomerase-associated protein 50



- Molecule 8: Telomerase associated protein p65





4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	52506	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 ($e^-/\text{\AA}^2$)	52	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	0.156	Depositor
Minimum map value	-0.054	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.006	Depositor
Recommended contour level	0.055	Depositor
Map size (Å)	348.16, 348.16, 348.16	wwPDB
Map dimensions	256, 256, 256	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.36, 1.36, 1.36	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

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	0.73	1/8418 (0.0%)	0.89	16/11318 (0.1%)
2	D	0.69	0/1566	0.77	1/2101 (0.0%)
3	F	0.59	0/934	0.73	0/1262
4	E	0.64	0/1230	0.82	1/1655 (0.1%)
5	B	1.13	9/3711 (0.2%)	2.03	208/5768 (3.6%)
6	C	1.56	2/456 (0.4%)	1.49	10/707 (1.4%)
8	H	0.31	1/899 (0.1%)	0.35	0/1205
All	All	0.84	13/17214 (0.1%)	1.25	236/24016 (1.0%)

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

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	25
3	F	0	4
4	E	0	5
7	G	0	6
All	All	0	40

The worst 5 of 13 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	B	44	A	N9-C4	-6.88	1.33	1.37
6	C	9	DT	C3'-O3'	6.75	1.52	1.44
5	B	33	A	N9-C4	-6.42	1.33	1.37
5	B	47	C	N1-C6	-6.41	1.33	1.37
5	B	69	A	N9-C4	-6.27	1.34	1.37

The worst 5 of 236 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	46	C	O4'-C1'-N1	22.24	125.99	108.20
5	B	47	C	C5-C6-N1	16.33	129.16	121.00
5	B	47	C	C6-N1-C2	-14.86	114.36	120.30
5	B	48	C	C5-C6-N1	14.04	128.02	121.00
5	B	145	U	N1-C2-O2	13.35	132.15	122.80

There are no chirality outliers.

5 of 40 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	122	GLU	Peptide
1	A	144	GLY	Peptide
1	A	17	LYS	Peptide
1	A	217	ASN	Peptide
1	A	84	PHE	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	8253	0	8327	437	0
2	D	1538	0	1524	76	0
3	F	919	0	898	36	0
4	E	1207	0	1198	75	0
5	B	3322	0	1686	140	0
6	C	406	0	216	16	0
7	G	785	0	177	42	0
8	H	886	0	880	73	0
9	D	1	0	0	0	0
All	All	17317	0	14906	795	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 26.

The worst 5 of 795 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)
7:G:98:UNK:HA	7:G:123:UNK:CB	1.28	1.60
1:A:530:GLN:HG2	1:A:757:VAL:CG1	1.13	1.59
7:G:75:UNK:HA	7:G:110:UNK:CB	1.37	1.54
7:G:51:UNK:CB	7:G:73:UNK:O	1.64	1.45
7:G:50:UNK:O	7:G:74:UNK:CB	1.69	1.38

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	970/1117 (87%)	784 (81%)	178 (18%)	8 (1%)	19	59
2	D	183/701 (26%)	162 (88%)	19 (10%)	2 (1%)	14	51
3	F	111/121 (92%)	93 (84%)	18 (16%)	0	100	100
4	E	147/269 (55%)	122 (83%)	24 (16%)	1 (1%)	22	62
8	H	104/542 (19%)	104 (100%)	0	0	100	100
All	All	1515/2750 (55%)	1265 (84%)	239 (16%)	11 (1%)	26	62

5 of 11 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	530	GLN
1	A	123	ASN
4	E	141	GLN
2	D	661	GLU
2	D	662	PHE

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	931/1069 (87%)	920 (99%)	11 (1%)	71	84
2	D	172/657 (26%)	171 (99%)	1 (1%)	86	92
3	F	107/114 (94%)	105 (98%)	2 (2%)	57	75
4	E	132/242 (54%)	132 (100%)	0	100	100
8	H	95/517 (18%)	94 (99%)	1 (1%)	73	85
All	All	1437/2599 (55%)	1422 (99%)	15 (1%)	77	86

5 of 15 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	933	ASN
3	F	100	ASP
1	A	960	PHE
8	H	498	VAL
2	D	640	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 44 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	927	GLN
2	D	576	GLN
1	A	945	GLN
1	A	1023	ASN
2	D	612	ASN

5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
5	B	158/159 (99%)	103 (65%)	14 (8%)

5 of 103 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
5	B	2	U
5	B	3	A

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Mol	Chain	Res	Type
5	B	4	C
5	B	8	C
5	B	9	U

5 of 14 RNA pucker outliers are listed below:

Mol	Chain	Res	Type
5	B	46	C
5	B	53	A
5	B	137	U
5	B	122	A
5	B	136	A

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 1 ligands modelled in this entry, 1 is 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 ⓘ

There are no chain breaks in this entry.

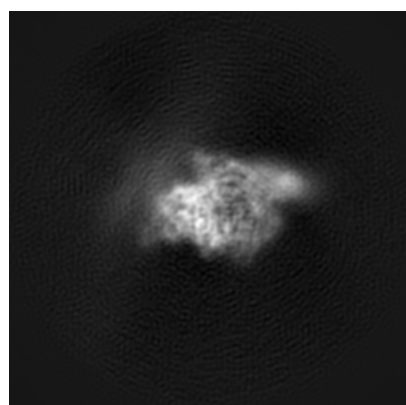
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-7821. These allow visual inspection of the internal detail of the map and identification of artifacts.

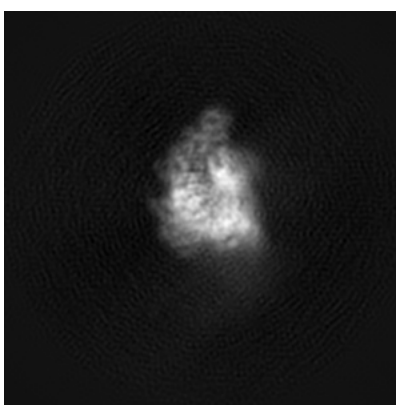
No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

6.1 Orthogonal projections [i](#)

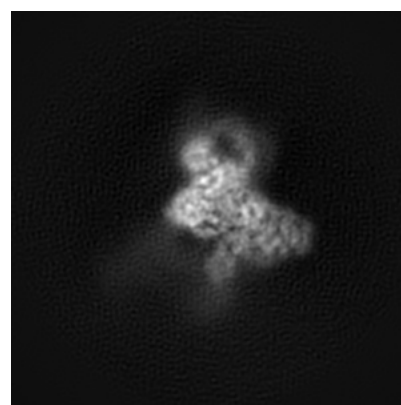
6.1.1 Primary map



X



Y

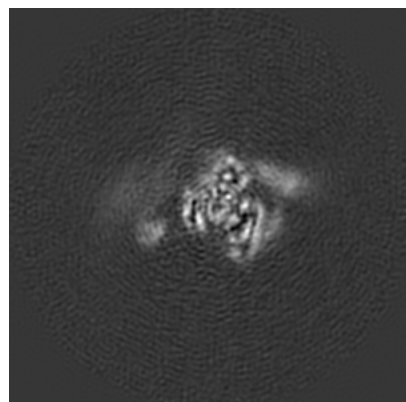


Z

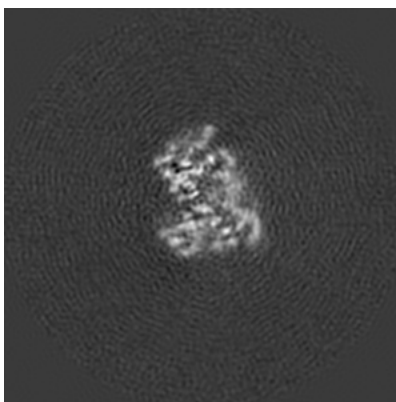
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

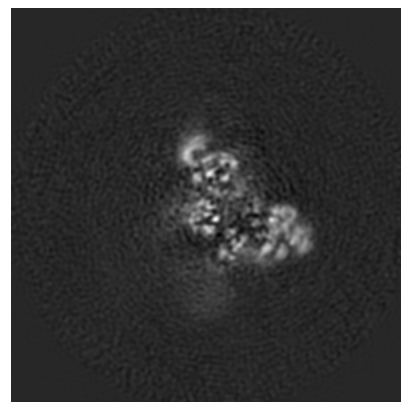
6.2.1 Primary map



X Index: 128



Y Index: 128

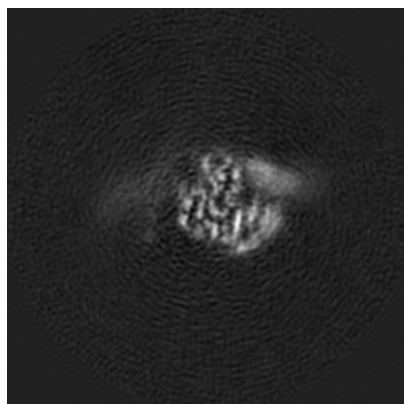


Z Index: 128

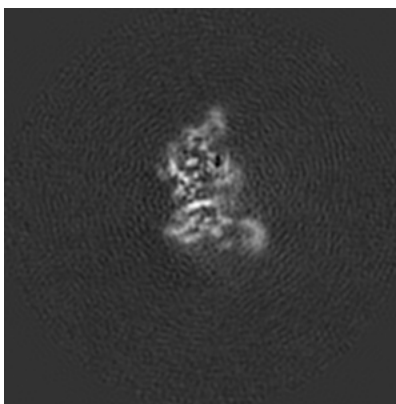
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

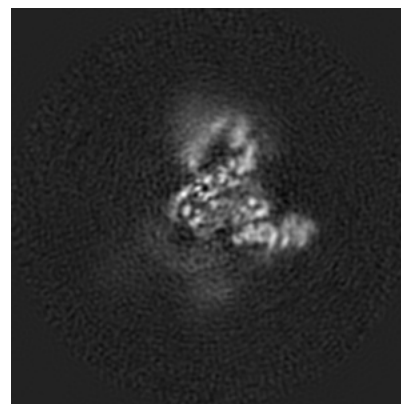
6.3.1 Primary map



X Index: 123



Y Index: 121

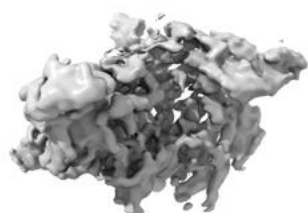


Z Index: 140

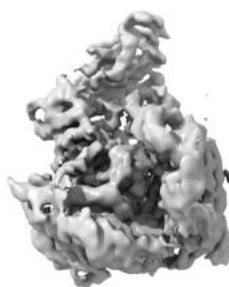
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal surface views [i](#)

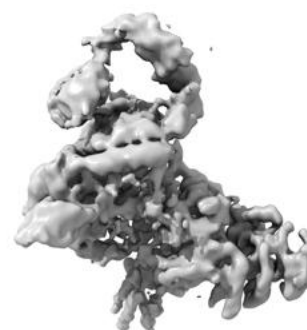
6.4.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.055. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

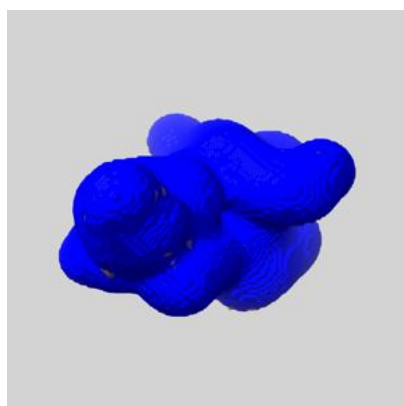
6.5 Mask visualisation [i](#)

This section shows the 3D surface view of the primary map at 50% transparency overlaid with the specified mask at 0% transparency

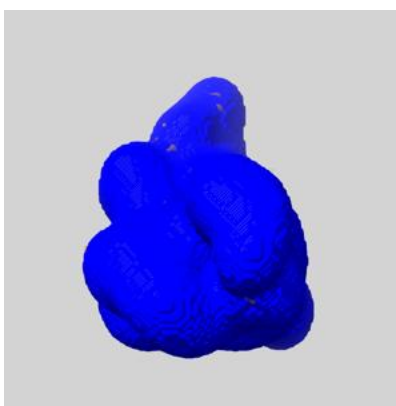
A mask typically either:

- Encompasses the whole structure
- Separates out a domain, a functional unit, a monomer or an area of interest from a larger structure

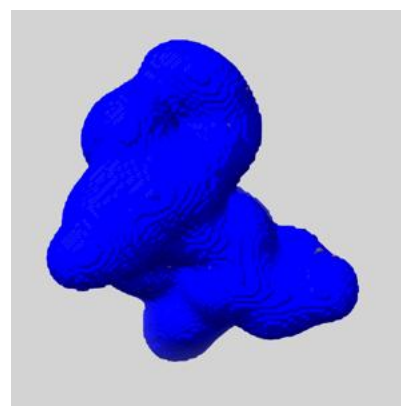
6.5.1 emd_7821_msk_1.map [i](#)



X



Y

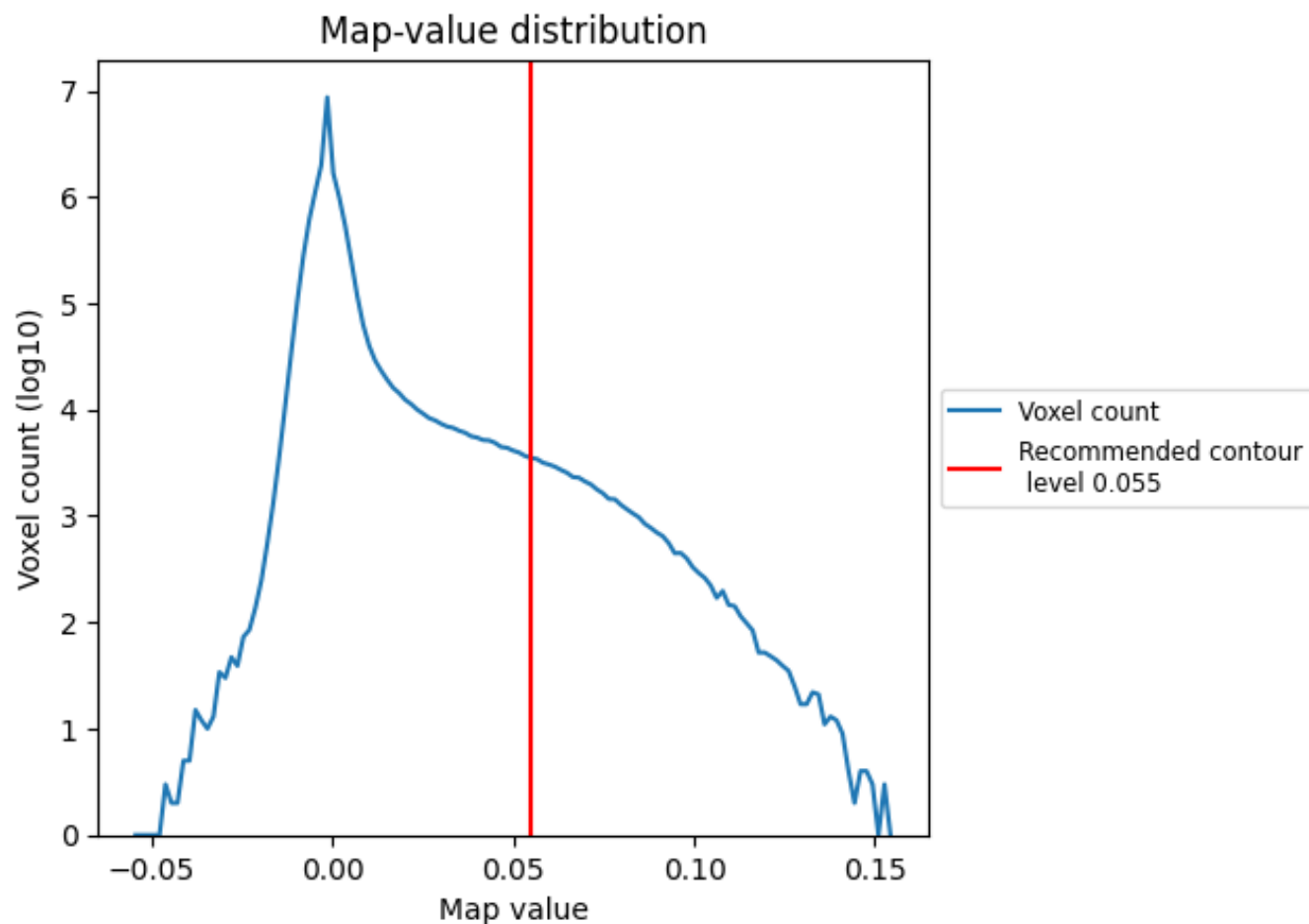


Z

7 Map analysis [i](#)

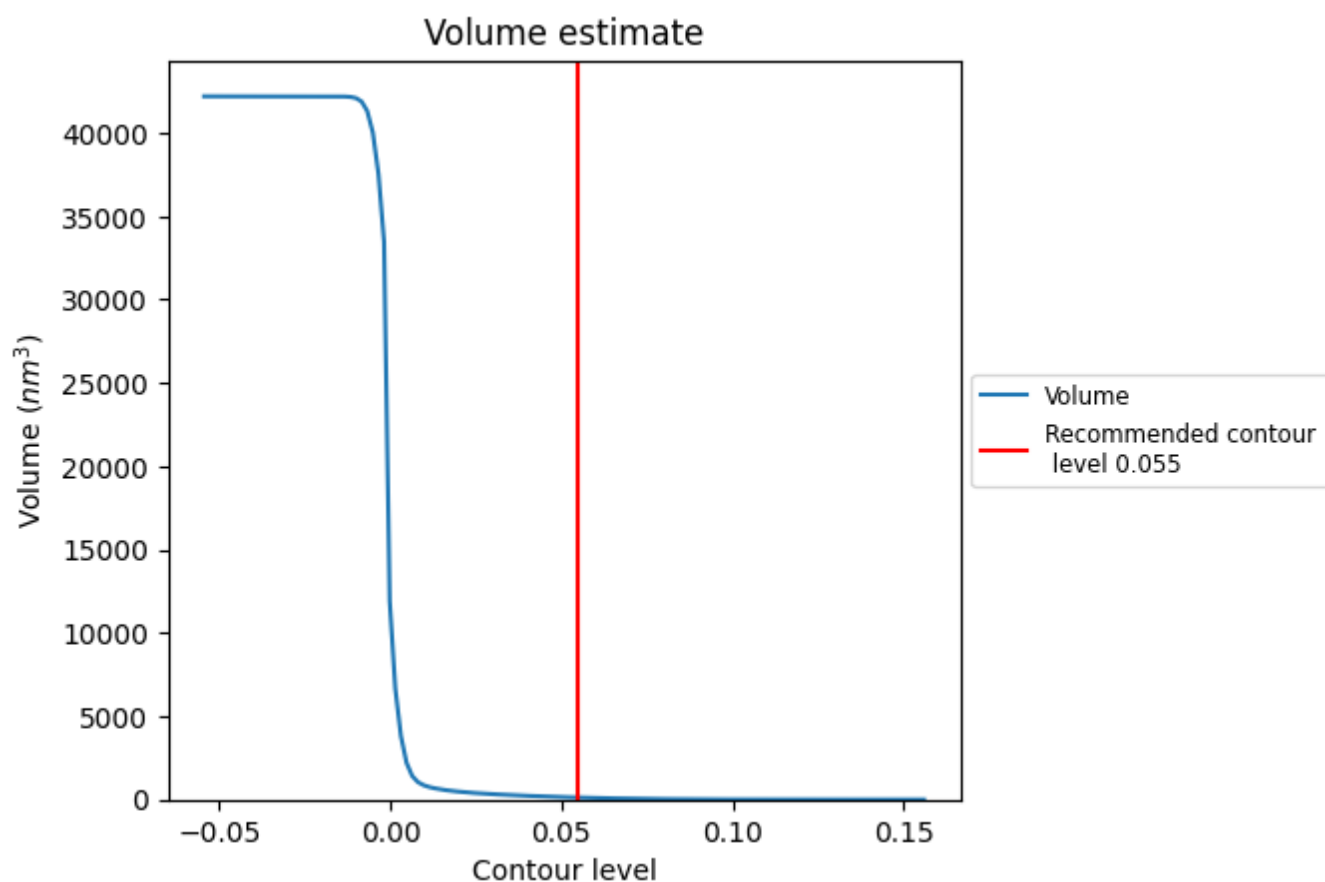
This section contains the results of statistical analysis of the map.

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.

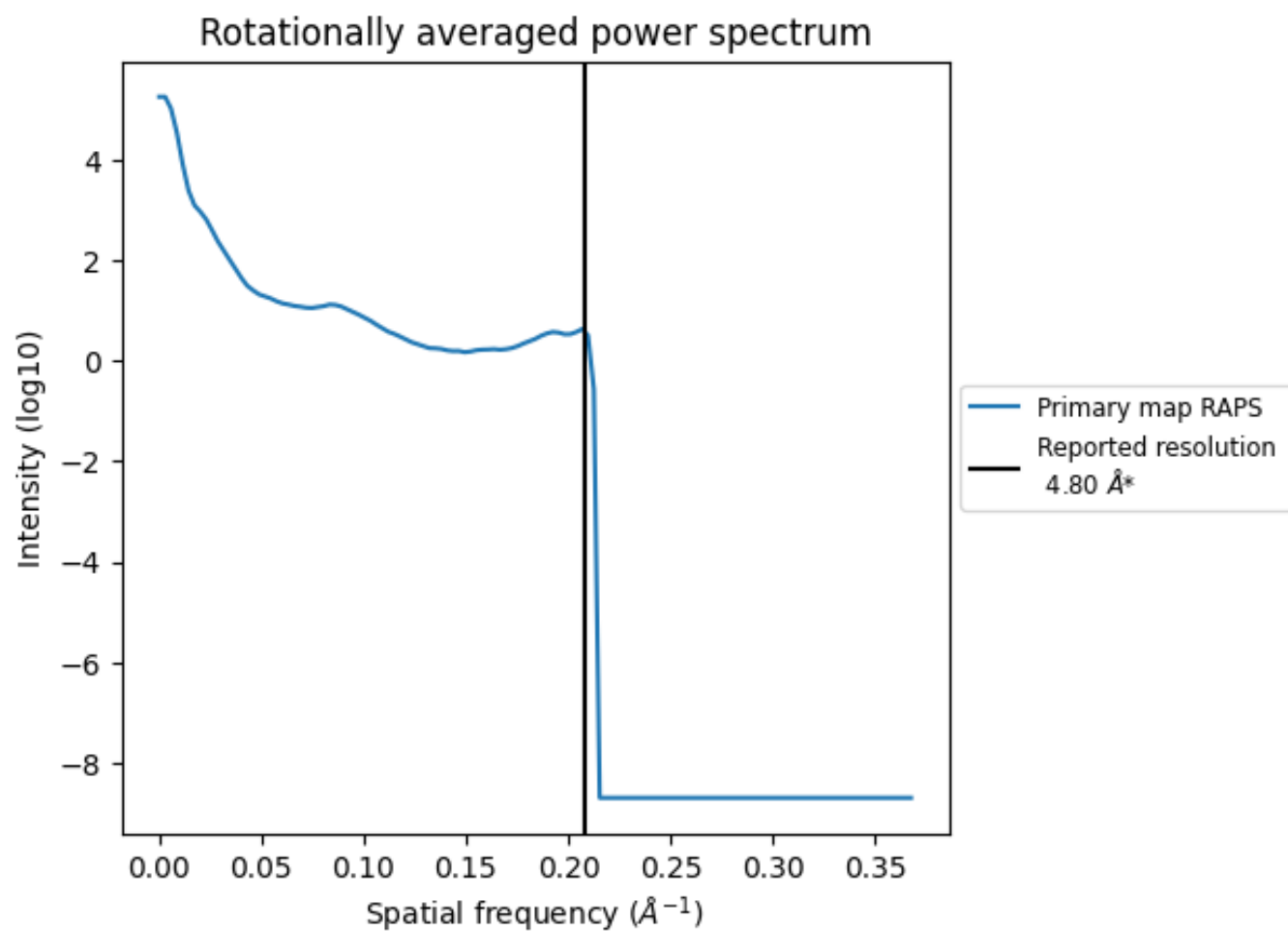
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 121 nm³; this corresponds to an approximate mass of 109 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 0.208 Å⁻¹

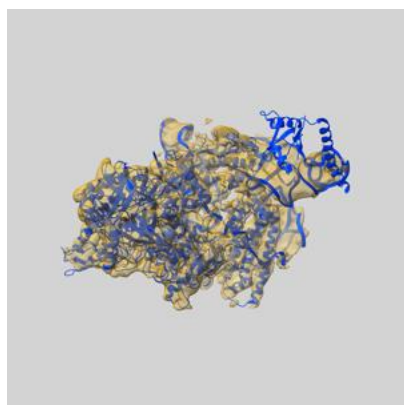
8 Fourier-Shell correlation

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

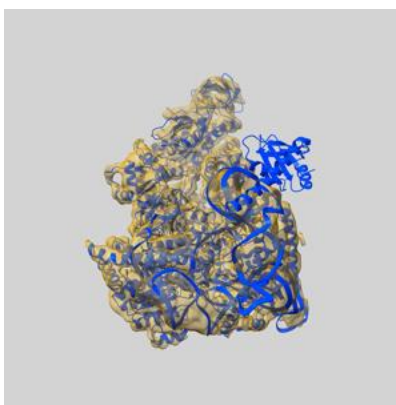
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-7821 and PDB model 6D6V. Per-residue inclusion information can be found in [section 3](#) on [page 6](#).

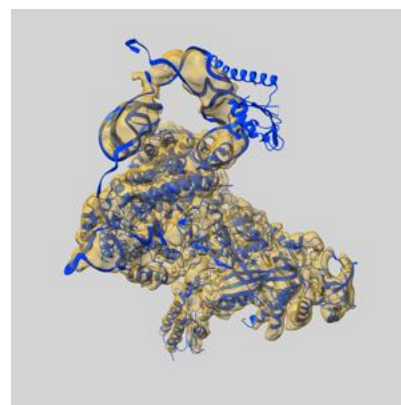
9.1 Map-model overlay [i](#)



X



Y



Z

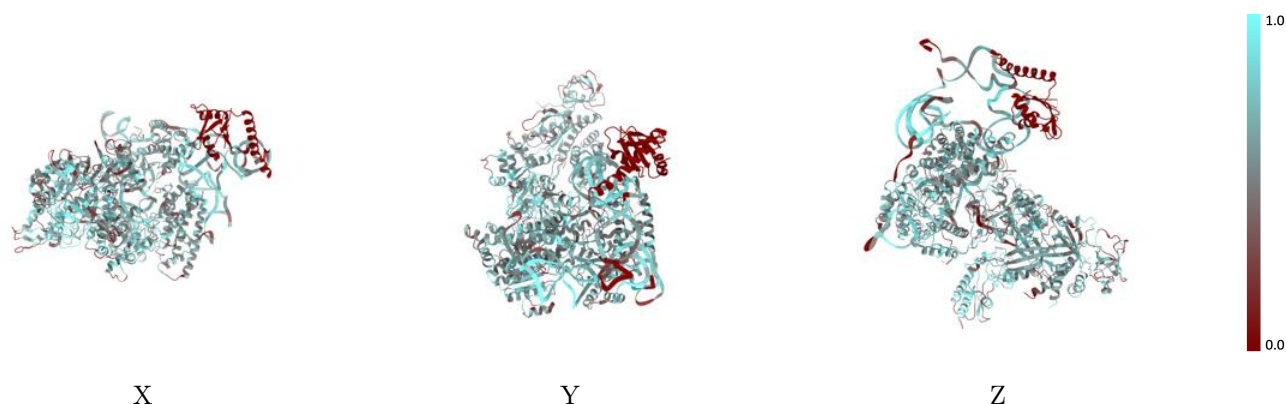
The images above show the 3D surface view of the map at the recommended contour level 0.055 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



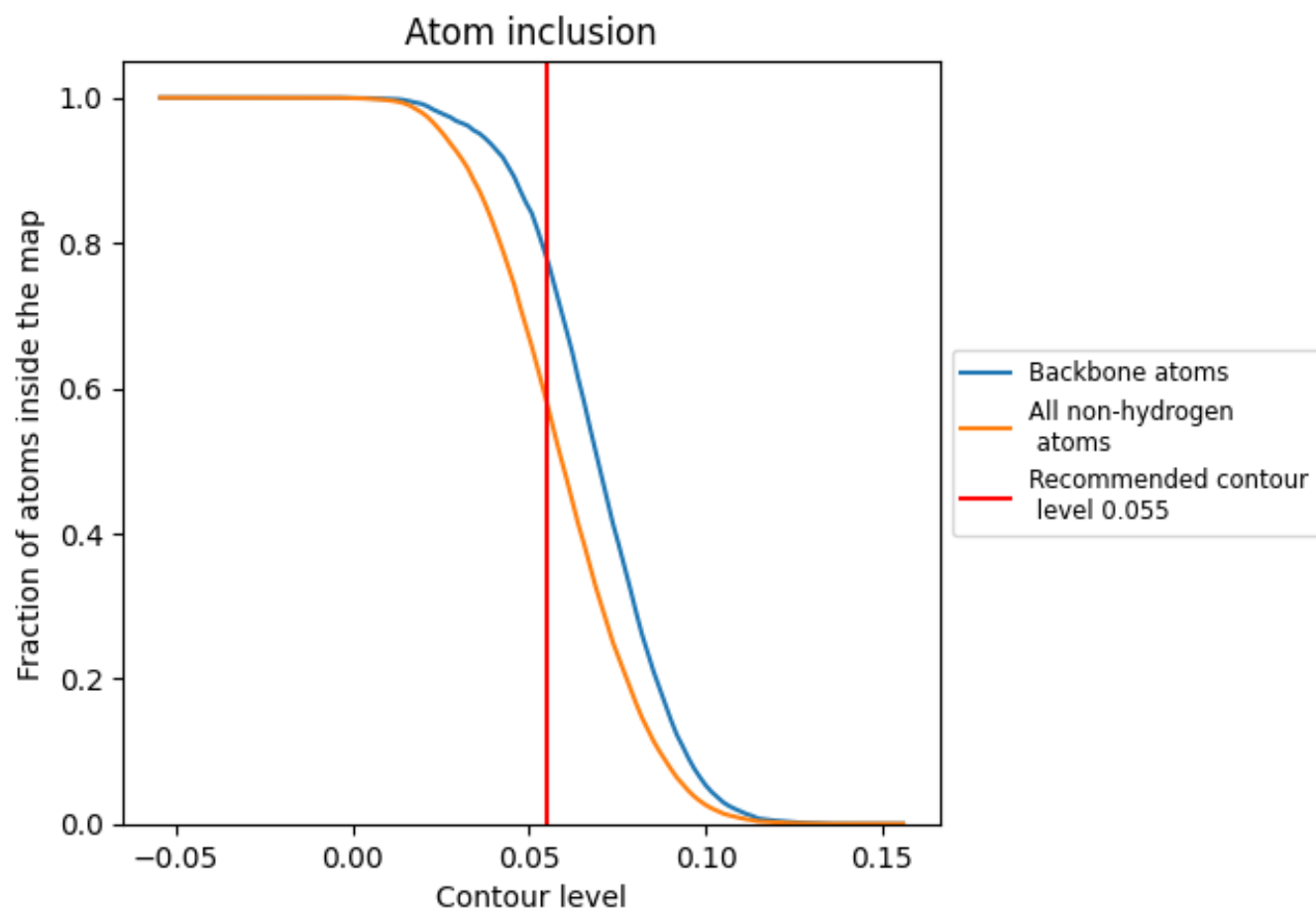
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.055).

9.4 Atom inclusion [i](#)



At the recommended contour level, 78% of all backbone atoms, 58% 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 (0.055) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	<div></div> 0.5808	<div></div> 0.2430
A	<div></div> 0.6162	<div></div> 0.2620
B	<div></div> 0.6451	<div></div> 0.2200
C	<div></div> 0.5640	<div></div> 0.2710
D	<div></div> 0.5780	<div></div> 0.2640
E	<div></div> 0.5631	<div></div> 0.2470
F	<div></div> 0.5199	<div></div> 0.2240
G	<div></div> 0.6955	<div></div> 0.2920
H	<div></div> 0.0023	<div></div> 0.0720

1.0

0.0

<0.0