



wwPDB EM Validation Summary Report ⓘ

Dec 12, 2022 – 12:44 am GMT

PDB ID : 5A20
EMDB ID : EMD-2993
Title : Structure of bacteriophage SPP1 head-to-tail interface filled with DNA and tape measure protein
Authors : Chaban, Y.; Lurz, R.; Brasiles, S.; Cornilleau, C.; Karreman, M.; Zinn-Justin, S.; Tavares, P.; Orlova, E.V.
Deposited on : 2015-05-06
Resolution : 7.60 Å(reported)

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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) : 2.31.3

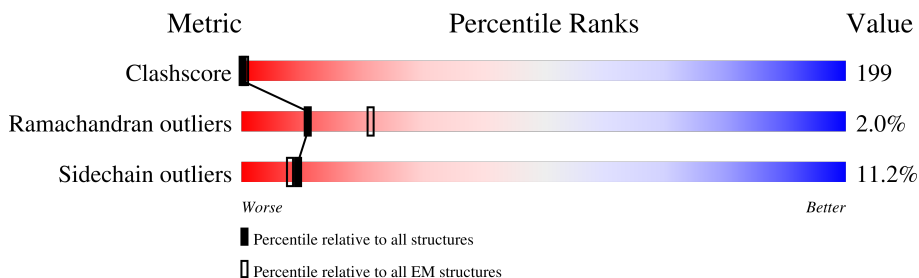
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 7.60 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

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	503	
1	B	503	
2	C	102	
2	D	102	
3	E	109	
3	F	109	
4	G	134	
5	H	177	

2 Entry composition i

There are 5 unique types of molecules in this entry. The entry contains 12799 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 PORTAL PROTEIN.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	440	Total	C	N	O	S	0	1
			3573	2259	589	711	14		
1	B	440	Total	C	N	O	S	0	1
			3573	2259	589	711	14		

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	365	LYS	ASN	conflict	UNP P54309
B	365	LYS	ASN	conflict	UNP P54309

- Molecule 2 is a protein called 15 PROTEIN.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	C	99	Total	C	N	O	S	0	0
			790	502	134	149	5		
2	D	99	Total	C	N	O	S	0	0
			790	502	134	149	5		

- Molecule 3 is a protein called HEAD COMPLETION PROTEIN GP16.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	E	109	Total	C	N	O	S	0	0
			891	569	145	175	2		
3	F	109	Total	C	N	O	S	0	0
			891	569	145	175	2		

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	6	ARG	PRO	conflict	UNP O48446
F	6	ARG	PRO	conflict	UNP O48446

- Molecule 4 is a protein called TAIL-TO-HEAD JOINING PROTEIN GP17.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
4	G	133	1047	667	172	204	4	0	0

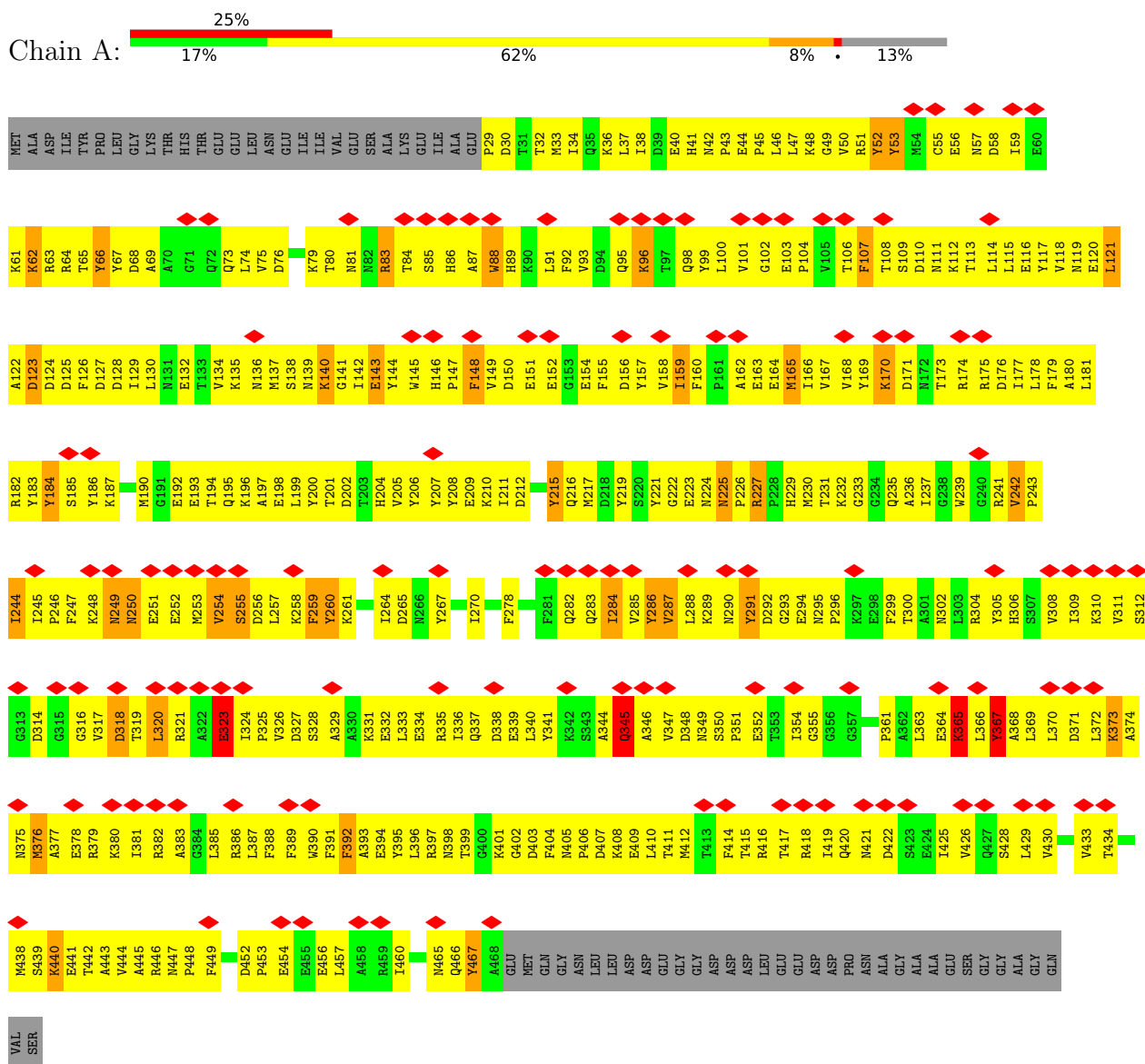
- Molecule 5 is a protein called MAJOR TAIL PROTEIN GP17.1.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
5	H	161	1244	776	205	263	0	0

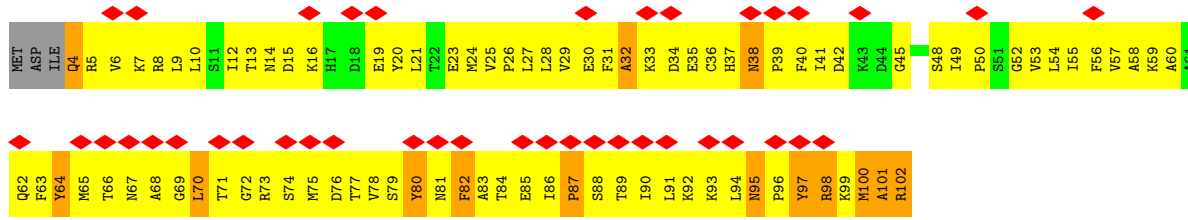
3 Residue-property plots

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.

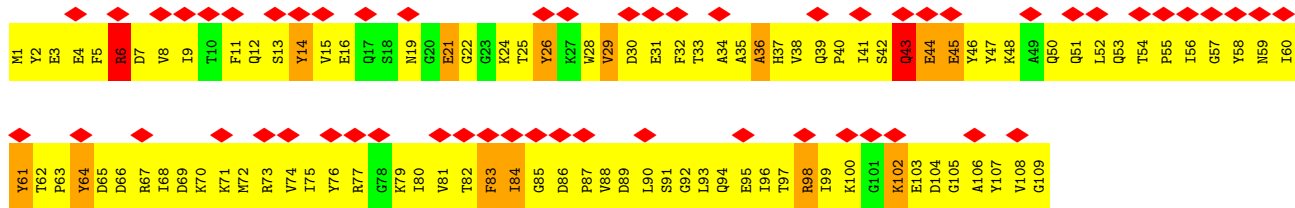
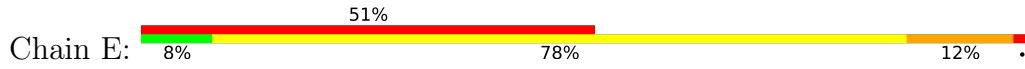
- Molecule 1: PORTAL PROTEIN



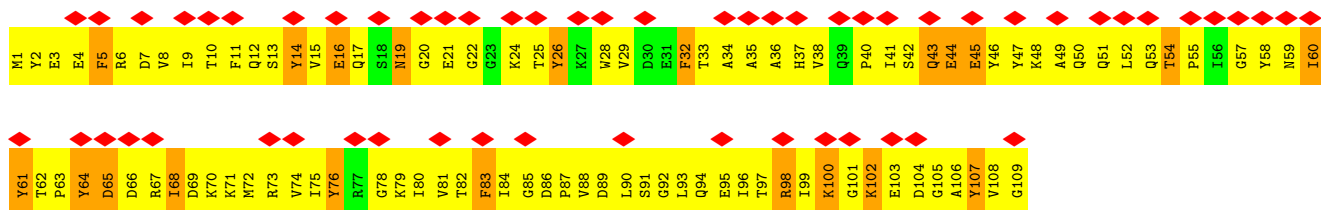
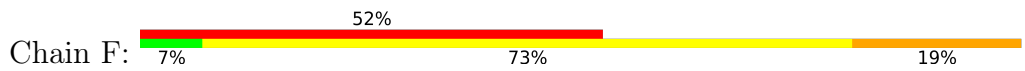
- Molecule 1: PORTAL PROTEIN



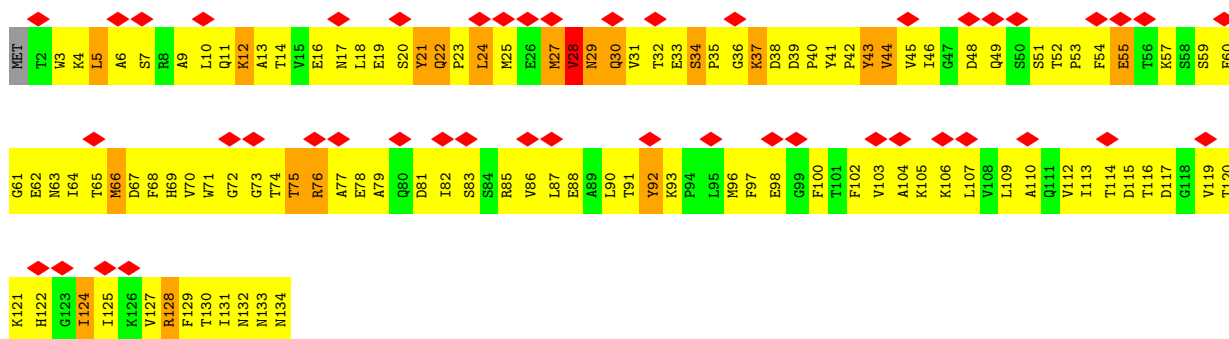
• Molecule 3: HEAD COMPLETION PROTEIN GP16



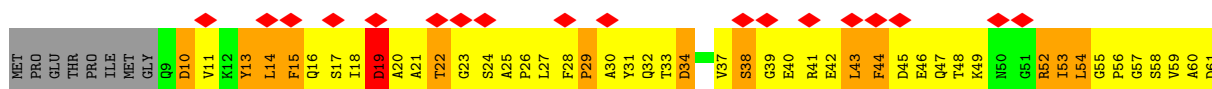
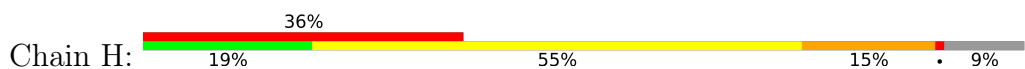
• Molecule 3: HEAD COMPLETION PROTEIN GP16

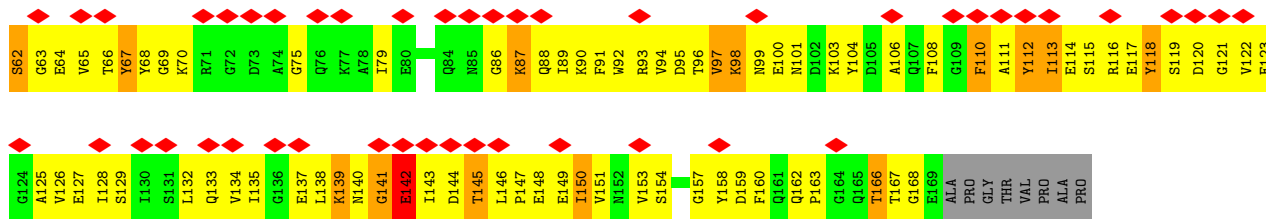


• Molecule 4: TAIL-TO-HEAD JOINING PROTEIN GP17



• Molecule 5: MAJOR TAIL PROTEIN GP17.1





4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C6	Depositor
Number of particles used	14000	Depositor
Resolution determination method	Not provided	
CTF correction method	EACH PARTICLE	Depositor
Microscope	FEI TECNAI F30	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	20	Depositor
Minimum defocus (nm)	900	Depositor
Maximum defocus (nm)	3600	Depositor
Magnification	39000	Depositor
Image detector	KODAK SO-163 FILM	Depositor
Maximum map value	0.437	Depositor
Minimum map value	-0.312	Depositor
Average map value	0.004	Depositor
Map value standard deviation	0.023	Depositor
Recommended contour level	0.06	Depositor
Map size (\AA)	276.0, 276.0, 276.0	wwPDB
Map dimensions	240, 240, 240	wwPDB
Map angles ($^\circ$)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (\AA)	1.15, 1.15, 1.15	Depositor

5 Model quality

5.1 Standard geometry

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	0.99	0/3651	1.07	0/4941
1	B	0.99	0/3651	1.07	0/4941
2	C	0.99	0/805	1.09	0/1085
2	D	0.99	0/805	1.09	0/1085
3	E	1.02	0/911	1.14	0/1229
3	F	1.02	0/911	1.11	0/1229
4	G	0.97	0/1069	1.11	1/1451 (0.1%)
5	H	1.21	2/1264 (0.2%)	1.36	3/1703 (0.2%)
All	All	1.01	2/13067 (0.0%)	1.11	4/17664 (0.0%)

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	6
1	B	0	6
2	C	0	4
2	D	0	4
3	E	0	2
3	F	0	2
4	G	0	3
5	H	0	5
All	All	0	32

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	H	141	GLY	C-N	18.96	1.77	1.34
5	H	53	ILE	C-N	16.64	1.72	1.34

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	H	141	GLY	CA-C-N	-22.88	66.86	117.20
5	H	53	ILE	O-C-N	-19.53	91.46	122.70
5	H	141	GLY	C-N-CA	-11.11	93.92	121.70
4	G	44	VAL	CB-CA-C	-5.01	101.89	111.40

There are no chirality outliers.

5 of 32 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	123	ASP	Peptide
1	A	255	SER	Peptide
1	A	282	GLN	Peptide
1	A	323	GLU	Peptide
1	A	365	LYS	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	3573	0	3416	1326	0
1	B	3573	0	3414	1396	0
2	C	790	0	795	628	0
2	D	790	0	794	554	0
3	E	891	0	855	606	0
3	F	891	0	858	600	0
4	G	1047	0	1027	550	0
5	H	1244	0	1160	571	0
All	All	12799	0	12319	5006	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 199.

The worst 5 of 5006 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)
1:A:438:MET:SD	1:B:434:THR:HA	1.26	1.74

Continued on next page...

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:C:99:LYS:CA	2:D:101:ALA:HA	1.22	1.69
4:G:100:PHE:CE1	5:H:45:ASP:HB3	1.33	1.62
1:A:259:PHE:CZ	1:B:90:LYS:HD3	1.32	1.61
1:A:259:PHE:CE2	1:B:90:LYS:HD3	1.35	1.58

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	438/503 (87%)	426 (97%)	7 (2%)	5 (1%)	14	52
1	B	438/503 (87%)	426 (97%)	7 (2%)	5 (1%)	14	52
2	C	97/102 (95%)	90 (93%)	4 (4%)	3 (3%)	4	27
2	D	97/102 (95%)	90 (93%)	4 (4%)	3 (3%)	4	27
3	E	107/109 (98%)	98 (92%)	7 (6%)	2 (2%)	8	38
3	F	107/109 (98%)	98 (92%)	7 (6%)	2 (2%)	8	38
4	G	131/134 (98%)	122 (93%)	6 (5%)	3 (2%)	6	34
5	H	155/177 (88%)	140 (90%)	7 (4%)	8 (5%)	2	19
All	All	1570/1739 (90%)	1490 (95%)	49 (3%)	31 (2%)	11	38

5 of 31 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	284	ILE
1	A	287	VAL
1	B	284	ILE
1	B	287	VAL
2	C	95	ASN

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	388/436 (89%)	349 (90%)	39 (10%)	7	25
1	B	388/436 (89%)	349 (90%)	39 (10%)	7	25
2	C	88/91 (97%)	81 (92%)	7 (8%)	12	35
2	D	88/91 (97%)	81 (92%)	7 (8%)	12	35
3	E	94/94 (100%)	81 (86%)	13 (14%)	3	17
3	F	94/94 (100%)	77 (82%)	17 (18%)	1	10
4	G	117/118 (99%)	102 (87%)	15 (13%)	4	18
5	H	130/142 (92%)	111 (85%)	19 (15%)	3	15
All	All	1387/1502 (92%)	1231 (89%)	156 (11%)	9	21

5 of 156 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	F	65	ASP
5	H	28	PHE
3	F	98	ARG
4	G	37	LYS
5	H	110	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 53 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	405	ASN
2	C	38	ASN
5	H	16	GLN
1	B	420	GLN
1	B	465	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 monosaccharides 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](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
5	H	4

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	H	137:GLU	C	138:LEU	N	2.84
1	H	57:GLY	C	58:SER	N	2.60
1	H	141:GLY	C	142:GLU	N	1.77
1	H	53:ILE	C	54:LEU	N	1.72

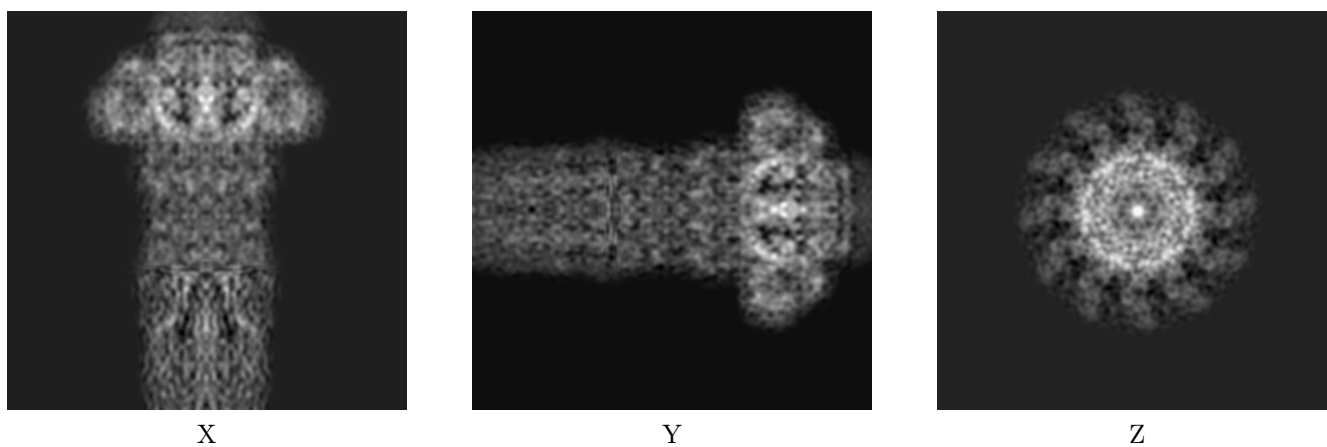
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-2993. 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](#)

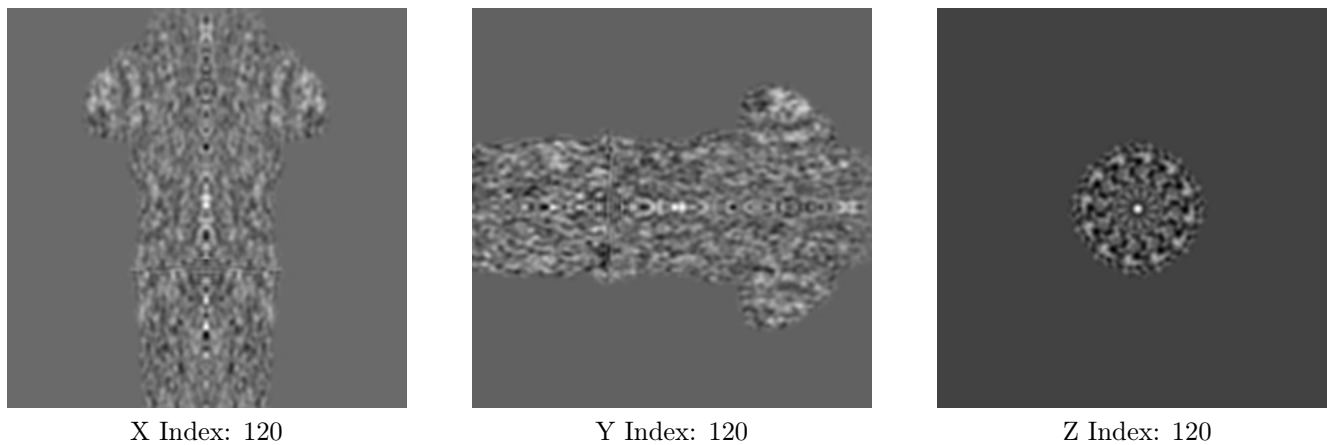
6.1.1 Primary map



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

6.2 Central slices [i](#)

6.2.1 Primary map



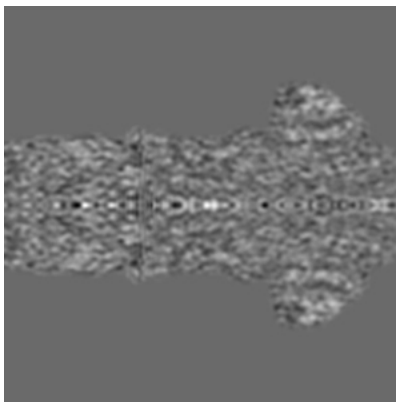
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

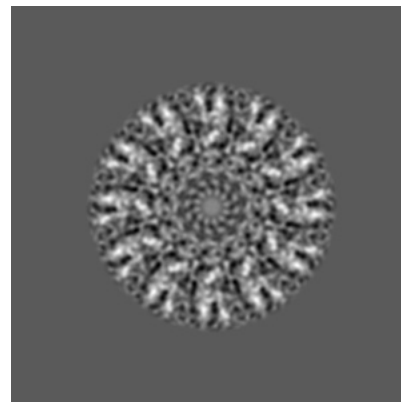
6.3.1 Primary map



X Index: 120



Y Index: 119



Z Index: 173

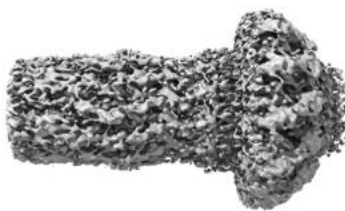
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal surface views [i](#)

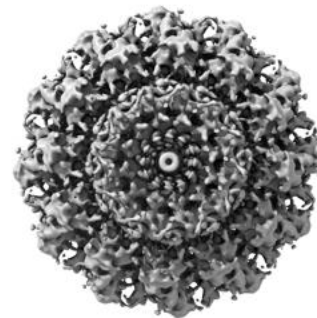
6.4.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.06. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

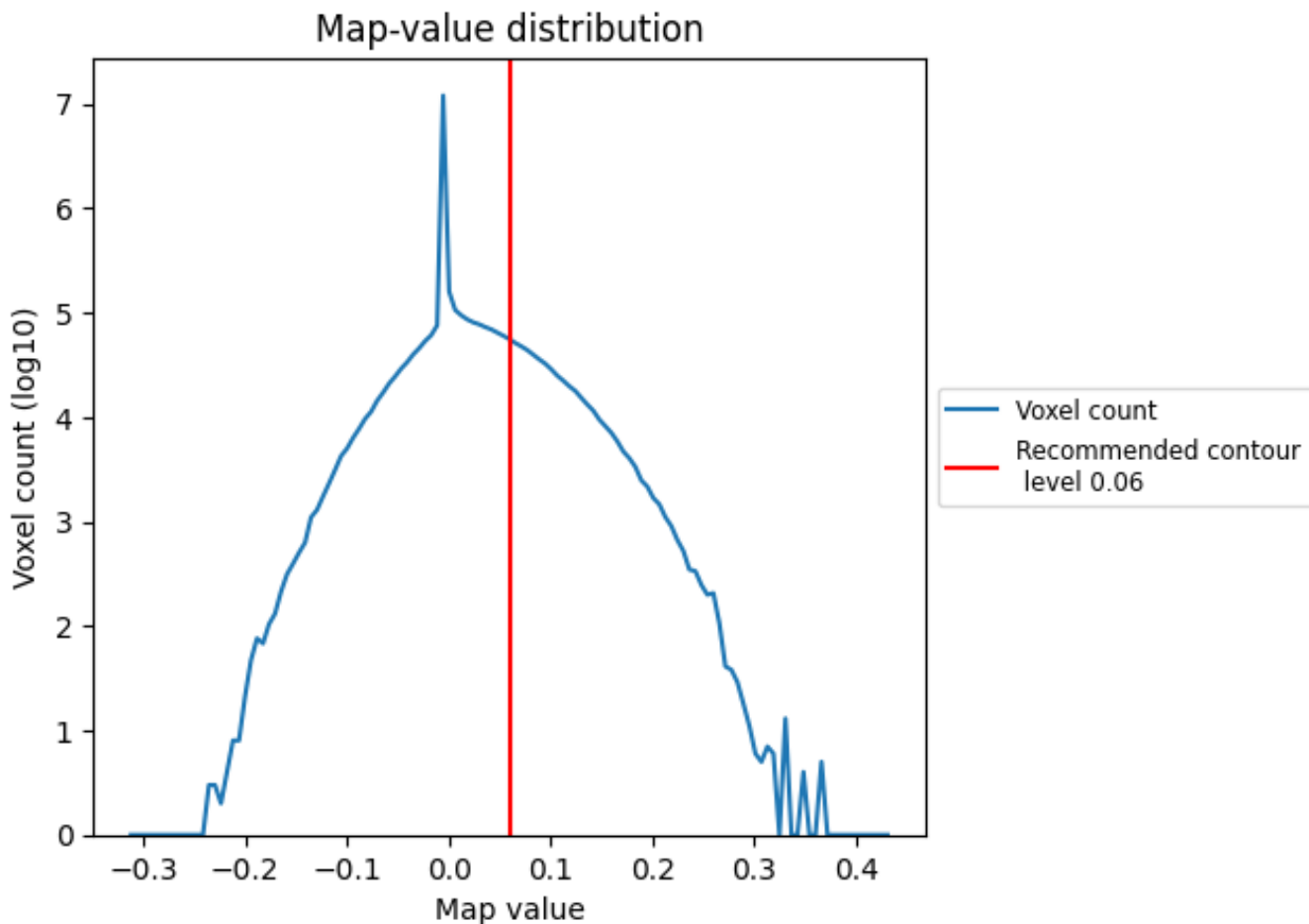
6.5 Mask visualisation

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

7 Map analysis [i](#)

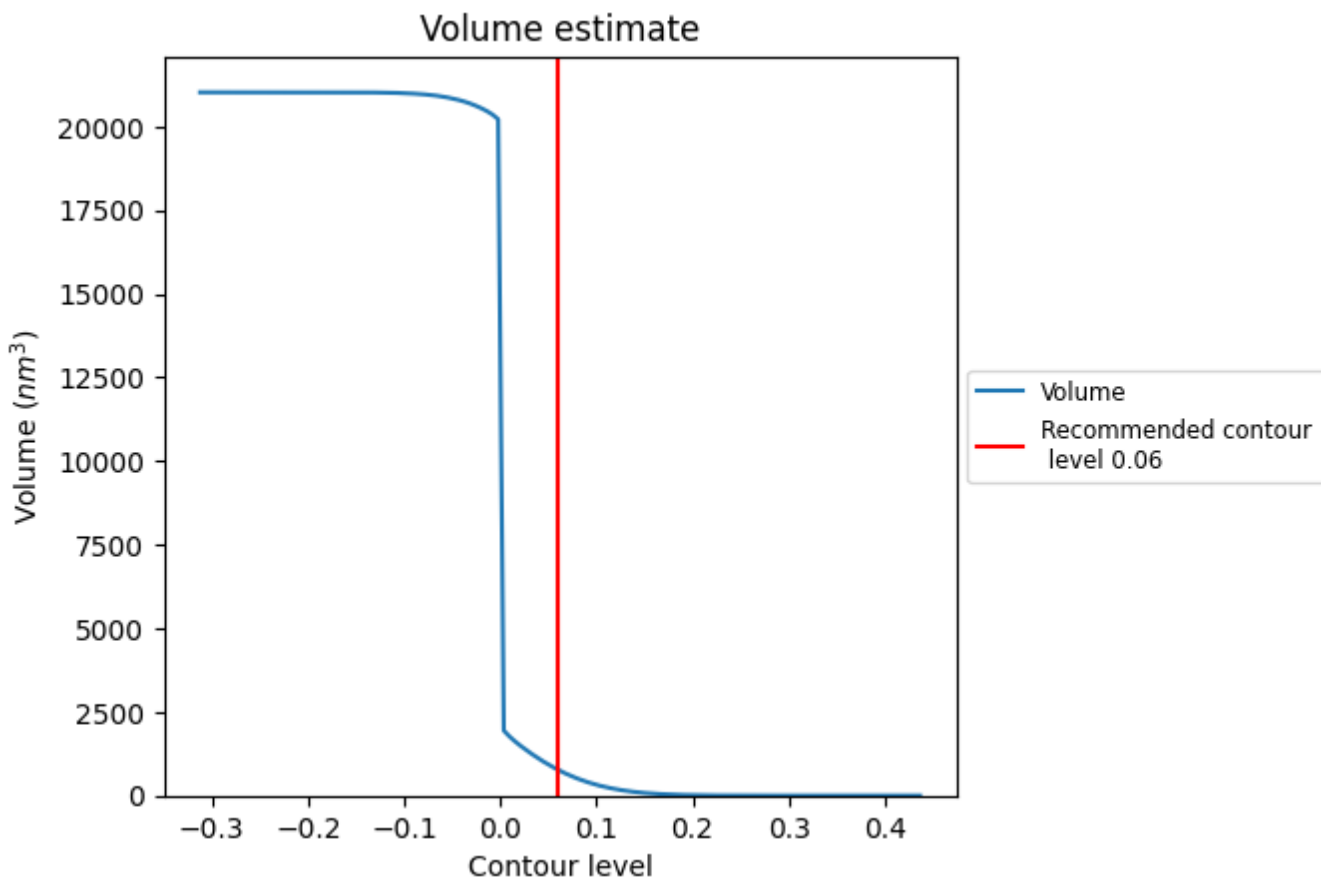
This section contains the results of statistical analysis of the map.

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.

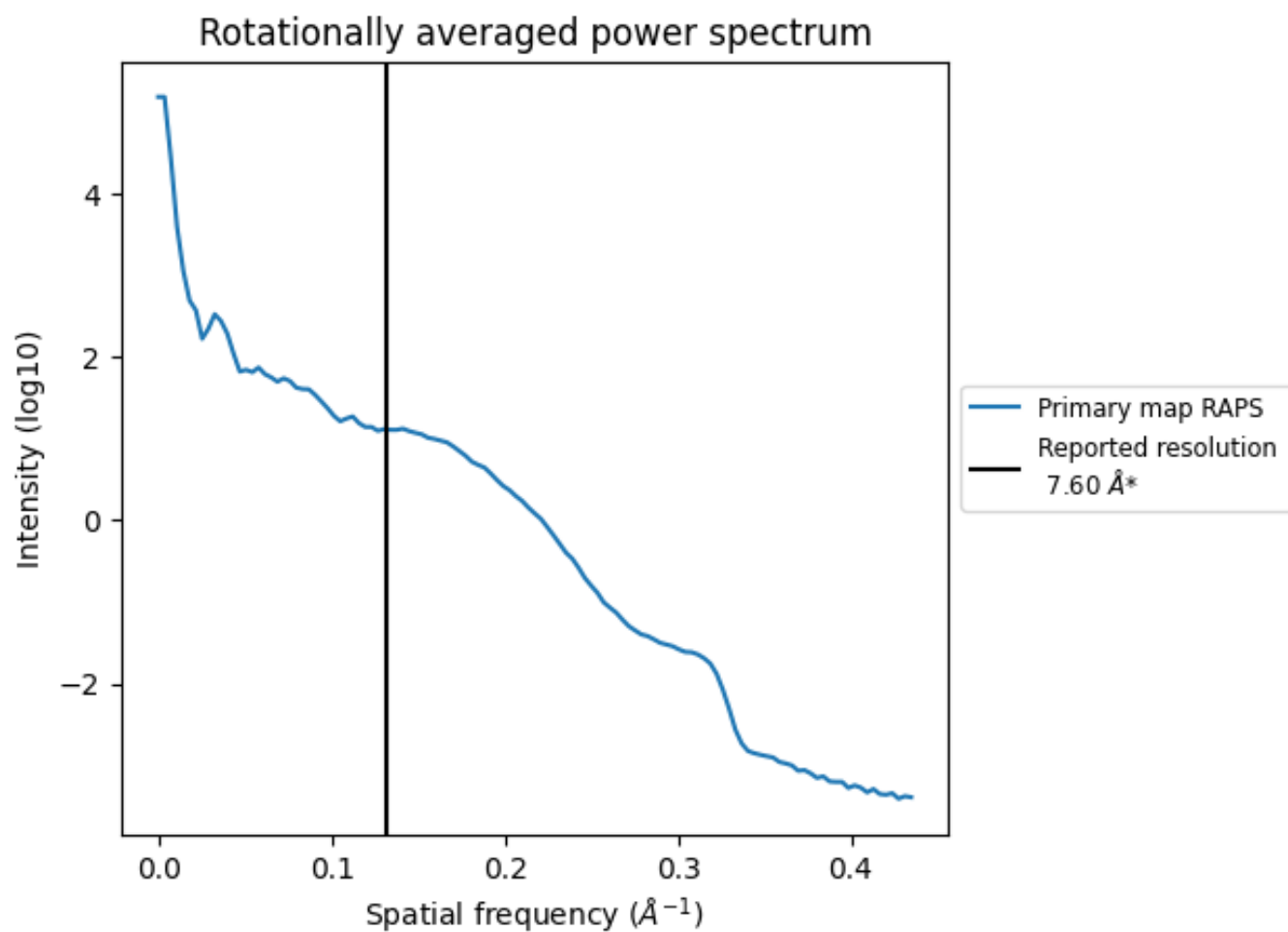
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 772 nm³; this corresponds to an approximate mass of 697 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 0.132 Å⁻¹

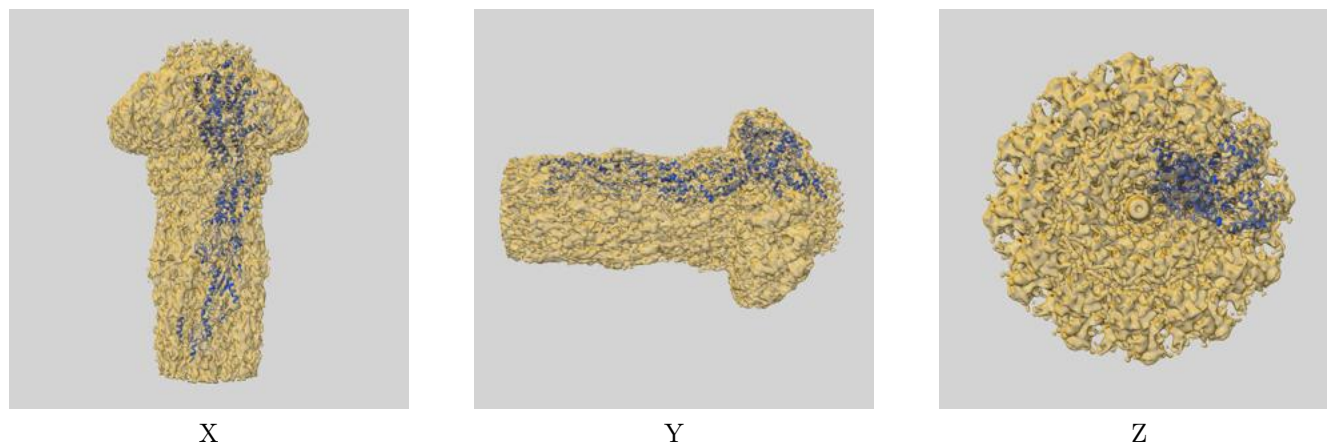
8 Fourier-Shell correlation

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

9 Map-model fit [i](#)

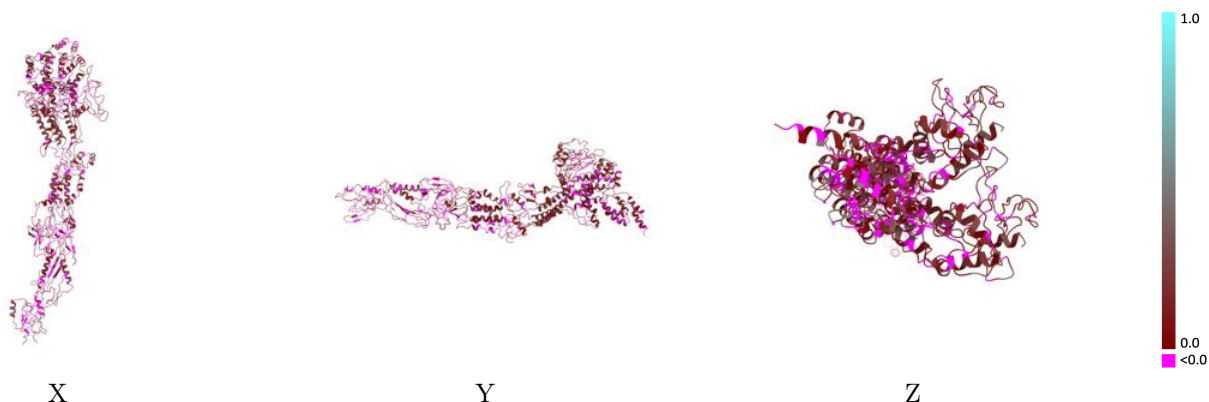
This section contains information regarding the fit between EMDB map EMD-2993 and PDB model 5A20. Per-residue inclusion information can be found in section 3 on page 5.

9.1 Map-model overlay [i](#)



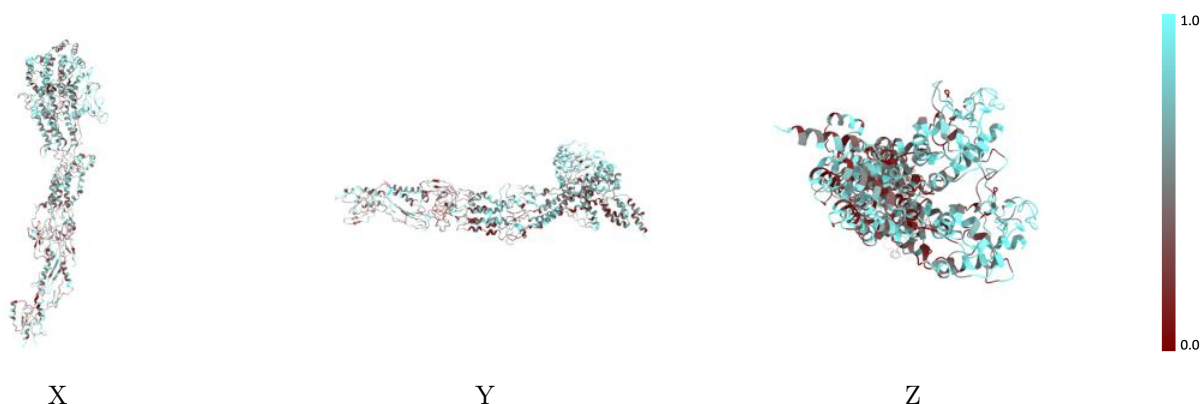
The images above show the 3D surface view of the map at the recommended contour level 0.06 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



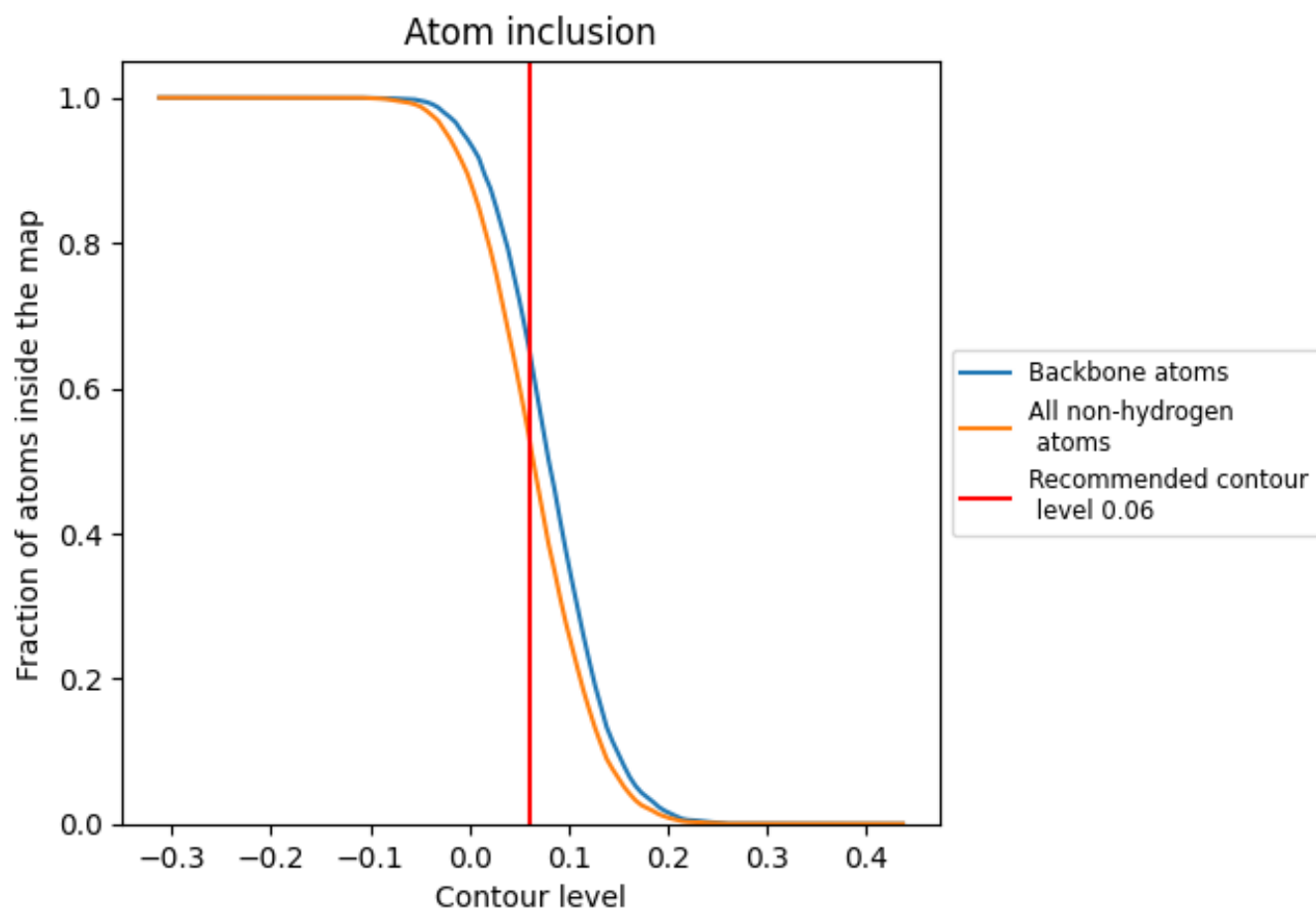
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.06).



















9.4 Atom inclusion [i](#)



At the recommended contour level, 66% of all backbone atoms, 53% 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 (0.06) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.5338	 0.0970
A	 0.5795	 0.1200
B	 0.5761	 0.1160
C	 0.4845	 0.0850
D	 0.4832	 0.0790
E	 0.4161	 0.0440
F	 0.4046	 0.0530
G	 0.5528	 0.0940
H	 0.5049	 0.0690

