



## Full wwPDB EM Validation Report ⓘ

Nov 17, 2022 – 05:53 AM EST

PDB ID : 7JR9  
EMDB ID : EMD-22444  
Title : Chlamydomonas reinhardtii radial spoke minimal head complex  
Authors : Grossman-Haham, I.; Coudray, N.; Yu, Z.; Wang, F.; Bhabha, G.; Vale, R.D.  
Deposited on : 2020-08-11  
Resolution : 2.95 Å (reported)

This is a Full wwPDB EM Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto: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

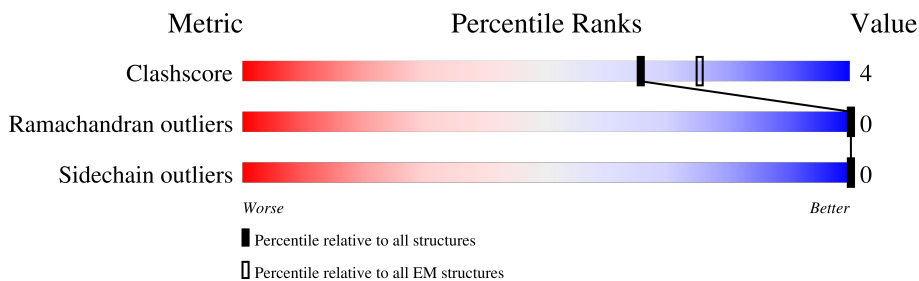
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 2.95 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  $\geq 3$ , 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	269	
1	B	269	
2	C	486	
3	D	459	
4	F	8	
5	G	6	
6	E	216	

## 2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 10021 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 Radial spoke protein 9.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	254	Total	C	N	O	S	0	0
			1970	1258	333	374	5		
1	B	251	Total	C	N	O	S	0	0
			1946	1243	329	369	5		

- Molecule 2 is a protein called Flagellar radial spoke protein 4.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	C	280	Total	C	N	O	S	0	0
			2110	1349	362	393	6		

There are 21 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	-20	MET	-	expression tag	UNP Q01656
C	-19	GLY	-	expression tag	UNP Q01656
C	-18	SER	-	expression tag	UNP Q01656
C	-17	SER	-	expression tag	UNP Q01656
C	-16	HIS	-	expression tag	UNP Q01656
C	-15	HIS	-	expression tag	UNP Q01656
C	-14	HIS	-	expression tag	UNP Q01656
C	-13	HIS	-	expression tag	UNP Q01656
C	-12	HIS	-	expression tag	UNP Q01656
C	-11	HIS	-	expression tag	UNP Q01656
C	-10	GLY	-	expression tag	UNP Q01656
C	-9	GLY	-	expression tag	UNP Q01656
C	-8	SER	-	expression tag	UNP Q01656
C	-7	ALA	-	expression tag	UNP Q01656
C	-6	GLU	-	expression tag	UNP Q01656
C	-5	ASN	-	expression tag	UNP Q01656
C	-4	LEU	-	expression tag	UNP Q01656
C	-3	TYR	-	expression tag	UNP Q01656
C	-2	PHE	-	expression tag	UNP Q01656

*Continued on next page...*

*Continued from previous page...*

Chain	Residue	Modelled	Actual	Comment	Reference
C	-1	GLN	-	expression tag	UNP Q01656
C	0	GLY	-	expression tag	UNP Q01656

- Molecule 3 is a protein called Flagellar radial spoke protein 6.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	D	339	2574	1637	442	483	12	0	0

- Molecule 4 is a protein called Flagellar radial spoke protein 6.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
4	F	8	40	24	8	8	0	0

- Molecule 5 is a protein called Flagellar radial spoke protein 10.

Mol	Chain	Residues	Atoms				AltConf	Trace
			Total	C	N	O		
5	G	6	30	18	6	6	0	0

- Molecule 6 is a protein called Radial spoke protein 10.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
6	E	176	1351	862	226	254	9	0	0

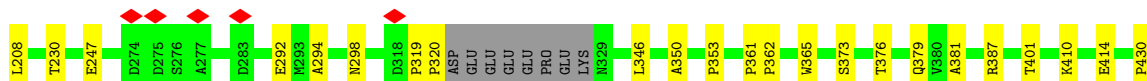
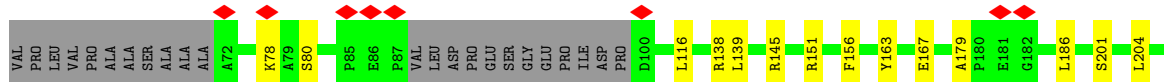


PRO PRO  
PRO ALA  
PRO VAL  
VAL VAL  
ALA GLN  
GLU PHE  
GLY GLY  
GLU ALA  
VAL THR  
GLU GLN  
GLN LYS  
LEU LEU  
LEU LYS  
LEU LYS  
PRO ALA  
PRO PRO  
PRO PRO  
PRO PRO  
GLU GLU  
GLU ALA  
ALA ALA  
ALA ASP  
GLU

• Molecule 3: Flagellar radial spoke protein 6

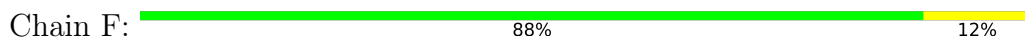


MET  
ALA  
ALA  
ASP  
VAL  
VAL  
GLY  
GLN  
ALA  
LEU  
ALA  
ALA  
PHE  
GLY  
GLU  
VAL  
GLN  
GLN  
VAL  
LYS  
THR  
THR  
GLN  
GLN  
GLY  
GLY  
SER  
ALA  
ILE  
TVR  
GLU  
GLY  
LEU  
LYS  
ALA  
ALA  
LEU  
LEU  
LYS  
VAL  
LEU  
GLU  
ASP  
ARG  
PRO  
VAL  
ASN  
ALA  
VAL  
GLU  
ALA  
LEU  
GLU  
THR  
SER  
VAL  
LEU  
SER  
THR  
PRO  
PRO  
ALA  
ALA  
ASN  
LEU  
SER

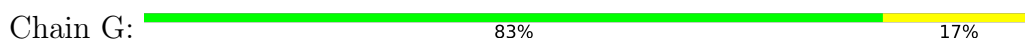


ALA  
ALA  
GLY  
VAL  
GLU  
GLY  
GLY  
GLN  
LEU  
LEU  
LEU  
LEU  
CYS  
ASN  
ASP  
LEU  
PRO  
PRO  
LYS  
PRO  
ALA  
PRO  
PRO  
PRO  
GLU  
GLU  
GLU  
ASP  
GLU

• Molecule 4: Flagellar radial spoke protein 6



• Molecule 5: Flagellar radial spoke protein 10



• Molecule 6: Radial spoke protein 10



MET  
ALA  
ASP  
ASP  
GLU  
LEU  
PRO  
PRO  
GLN  
PRO  
VAL  
TRP  
GLY  
PRO  
LEU  
ASP  
ASP  
GLY  
HIS  
GLY  
L295  
G286  
P31  
PRO  
PRO  
PRO  
MET  
MET  
GLY  
GLU  
GLU  
ASP  
ASP  
GLU  
GLU  
LYS  
PRO  
G45  
E53  
R57  
T64  
A70  
V71  
G79  
K80  
K81  
H82  
G83  
V88  
Y89



## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	251088	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 ( $e^-/\text{\AA}^2$ )	73.3	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	130000	Depositor
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	0.088	Depositor
Minimum map value	-0.041	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	0.002	Depositor
Recommended contour level	0.015	Depositor
Map size ( $\text{\AA}$ )	273.6, 273.6, 273.6	wwPDB
Map dimensions	320, 320, 320	wwPDB
Map angles ( $^\circ$ )	90.0, 90.0, 90.0	wwPDB
Pixel spacing ( $\text{\AA}$ )	0.855, 0.855, 0.855	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	A	0.42	0/2013	0.54	0/2738
1	B	0.44	0/1988	0.55	0/2704
2	C	0.41	0/2162	0.53	0/2944
3	D	0.42	0/2654	0.51	0/3630
6	E	0.39	0/1395	0.56	0/1877
All	All	0.42	0/10212	0.54	0/13893

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1970	0	1948	12	0
1	B	1946	0	1926	17	0
2	C	2110	0	2087	17	0
3	D	2574	0	2467	21	0
4	F	40	0	10	1	0
5	G	30	0	8	1	0
6	E	1351	0	1235	13	0
All	All	10021	0	9681	80	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 4.



All (80) 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)
2:C:158:GLY:HA3	2:C:416:TYR:O	1.97	0.65
3:D:376:THR:HB	3:D:379:GLN:HE21	1.64	0.61
6:E:71:VAL:HG22	6:E:88:VAL:HG22	1.82	0.60
1:B:23:SER:HB3	1:B:26:GLN:HG2	1.84	0.60
6:E:112:TYR:OH	6:E:127:ARG:NH1	2.36	0.57
3:D:292:GLU:O	3:D:298:ASN:ND2	2.38	0.56
1:A:234:SER:OG	1:A:237:PHE:O	2.24	0.56
1:A:123:GLU:HG2	1:A:144:VAL:HG12	1.87	0.56
6:E:100:VAL:HB	6:E:105:GLN:HG3	1.87	0.56
3:D:78:LYS:HE3	3:D:204:LEU:HB2	1.89	0.55
2:C:85:ILE:HA	2:C:142:ARG:HE	1.71	0.54
2:C:152:ARG:HB3	2:C:173:ALA:HB3	1.89	0.54
3:D:350:ALA:O	3:D:387:ARG:NH2	2.37	0.54
6:E:182:TYR:O	6:E:190:VAL:HA	2.07	0.53
2:C:169:VAL:HG22	2:C:220:VAL:HG12	1.89	0.53
1:A:6:PRO:HG2	1:A:47:THR:HG21	1.91	0.53
1:B:44:ARG:NH2	1:B:67:ASN:O	2.43	0.52
1:B:123:GLU:HG2	1:B:144:VAL:HG12	1.92	0.52
1:B:8:ILE:HD11	1:B:30:LEU:HD13	1.91	0.52
3:D:151:ARG:HB3	3:D:167:GLU:HG2	1.92	0.51
6:E:57:ARG:HB2	6:E:79:GLY:HA2	1.92	0.51
1:B:221:VAL:HG22	1:B:232:VAL:HG22	1.92	0.51
3:D:201:SER:HB3	3:D:208:LEU:HD23	1.94	0.50
3:D:294:ALA:HB2	3:D:381:ALA:HB1	1.92	0.50
2:C:314:ALA:HB1	2:C:379:PRO:HB3	1.93	0.50
3:D:230:THR:OG1	3:D:247:GLU:OE1	2.30	0.50
1:A:22:VAL:HA	1:A:51:ARG:HH11	1.78	0.49
6:E:105:GLN:OE1	6:E:124:ALA:N	2.46	0.49
1:B:11:VAL:HG12	1:B:243:TYR:HE1	1.78	0.49
2:C:250:THR:N	2:C:267:GLU:OE2	2.46	0.49
6:E:81:LYS:HB2	6:E:102:ASP:HA	1.93	0.48
6:E:70:ALA:HB2	6:E:90:PRO:HD3	1.95	0.48
1:A:51:ARG:HB3	1:A:61:LEU:HD23	1.96	0.48
3:D:116:LEU:HD12	3:D:401:THR:HG23	1.96	0.48
3:D:353:PRO:HG3	3:D:414:GLU:HB3	1.95	0.48
1:A:164:THR:OG1	1:A:165:SER:N	2.47	0.47
1:B:43:LEU:HD13	1:B:65:GLY:HA3	1.95	0.47
1:B:242:PHE:HD1	1:B:253:SER:HB3	1.79	0.47
1:A:261:ARG:NH1	1:A:263:ASN:OD1	2.46	0.47
6:E:64:THR:HG23	6:E:71:VAL:HG12	1.96	0.47

*Continued on next page...*

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:C:89:PRO:HD3	2:C:142:ARG:HH22	1.80	0.47
6:E:169:GLY:N	6:E:176:LYS:O	2.46	0.47
1:B:71:SER:OG	1:B:178:SER:OG	2.34	0.46
2:C:219:LEU:HB3	2:C:228:LEU:HD23	1.98	0.46
3:D:387:ARG:HD3	3:D:410:LYS:HE3	1.98	0.45
1:A:255:TYR:OH	1:A:258:ASP:O	2.26	0.45
1:B:142:PRO:HB2	1:B:143:LEU:H	1.61	0.45
1:A:64:GLU:OE2	1:A:201:ARG:NH1	2.43	0.44
3:D:430:PRO:HG3	4:F:500:UNK:H2	1.82	0.44
2:C:132:LEU:HD23	2:C:135:ASN:HD22	1.83	0.44
1:B:3:GLN:NE2	1:B:251:TRP:O	2.40	0.44
6:E:83:GLY:O	6:E:99:TRP:N	2.47	0.44
1:B:164:THR:OG1	1:B:165:SER:N	2.49	0.44
6:E:112:TYR:HH	6:E:127:ARG:HH11	1.63	0.44
1:A:119:ASN:HB3	1:A:146:GLN:HB3	2.00	0.44
1:B:165:SER:O	1:B:201:ARG:N	2.51	0.44
1:A:221:VAL:HG22	1:A:232:VAL:HG22	1.99	0.44
3:D:156:PHE:HB2	3:D:163:TYR:HB2	2.00	0.44
1:B:8:ILE:HA	1:B:11:VAL:HG22	2.01	0.43
2:C:85:ILE:HG22	2:C:142:ARG:HG3	1.99	0.43
2:C:382:SER:HB2	2:C:392:ALA:HB3	2.00	0.43
1:B:121:GLU:HA	1:B:145:PHE:O	2.19	0.42
3:D:373:SER:OG	3:D:376:THR:OG1	2.33	0.42
5:G:0:UNK:HA	6:E:26:GLY:HA2	2.01	0.42
1:A:165:SER:O	1:A:201:ARG:N	2.49	0.42
1:B:69:ALA:O	1:B:180:VAL:N	2.45	0.42
3:D:319:PRO:HA	3:D:320:PRO:HD3	1.96	0.42
3:D:179:ALA:HB2	3:D:186:LEU:HG	2.02	0.42
1:B:49:TRP:H	1:B:63:ALA:HA	1.85	0.41
2:C:160:PHE:HB2	2:C:167:TYR:HB2	2.02	0.41
2:C:239:VAL:HG11	2:C:326:LEU:HD21	2.01	0.41
2:C:403:ALA:HB2	2:C:416:TYR:HD1	1.84	0.41
3:D:80:SER:OG	3:D:138:ARG:NH2	2.45	0.41
3:D:139:LEU:HD13	3:D:208:LEU:HD13	2.03	0.41
3:D:361:PRO:HA	3:D:362:PRO:HD3	1.95	0.41
2:C:152:ARG:HB2	2:C:175:LYS:H	1.85	0.41
2:C:316:PRO:HA	2:C:395:LEU:HD11	2.02	0.41
2:C:370:LEU:HB2	2:C:374:GLN:HB3	2.03	0.40
3:D:145:ARG:HH12	3:D:208:LEU:HB2	1.87	0.40
3:D:346:LEU:HD13	3:D:365:TRP:CD2	2.56	0.40

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	250/269 (93%)	243 (97%)	7 (3%)	0	100	100
1	B	247/269 (92%)	241 (98%)	6 (2%)	0	100	100
2	C	272/486 (56%)	259 (95%)	13 (5%)	0	100	100
3	D	333/459 (72%)	325 (98%)	8 (2%)	0	100	100
6	E	172/216 (80%)	167 (97%)	5 (3%)	0	100	100
All	All	1274/1699 (75%)	1235 (97%)	39 (3%)	0	100	100

There are no Ramachandran outliers to report.

### 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	208/221 (94%)	208 (100%)	0	100	100
1	B	205/221 (93%)	205 (100%)	0	100	100
2	C	216/387 (56%)	216 (100%)	0	100	100
3	D	264/357 (74%)	264 (100%)	0	100	100
6	E	129/164 (79%)	129 (100%)	0	100	100
All	All	1022/1350 (76%)	1022 (100%)	0	100	100

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

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	262	ASN
2	C	135	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](#)

There are no chain breaks in this entry.

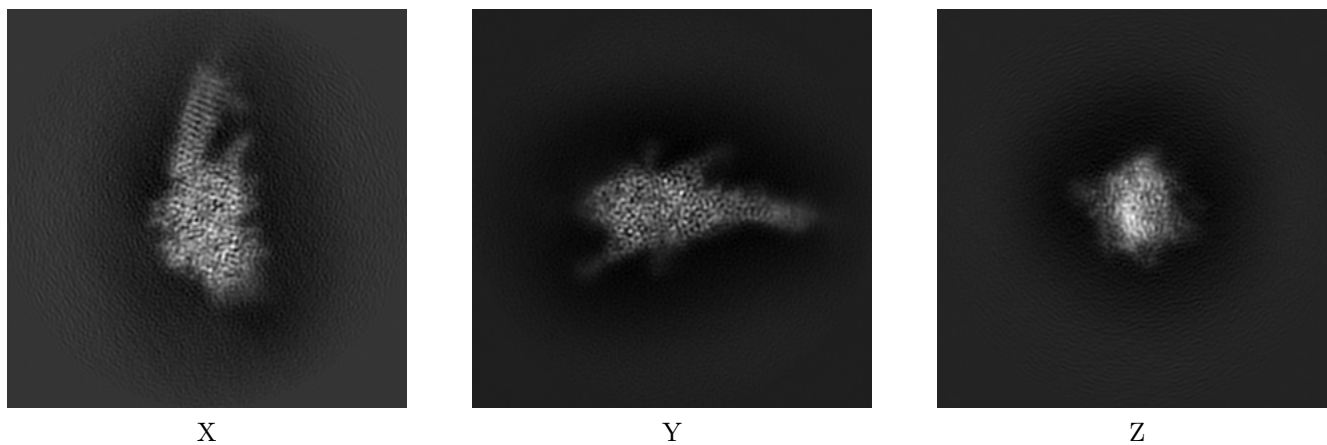
## 6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-22444. 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](#)

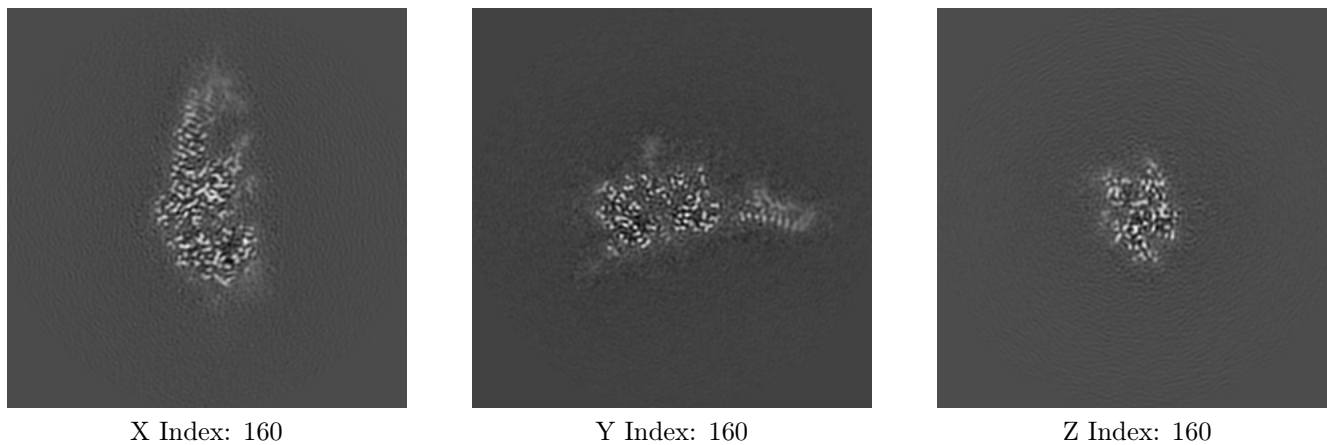
#### 6.1.1 Primary map



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

### 6.2 Central slices [i](#)

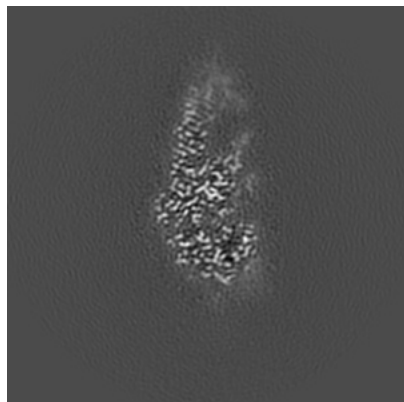
#### 6.2.1 Primary map



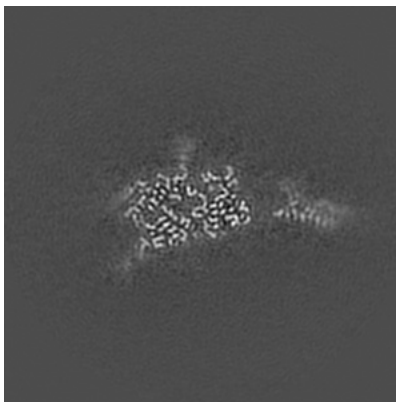
The images above show central slices of the map in three orthogonal directions.

## 6.3 Largest variance slices [i](#)

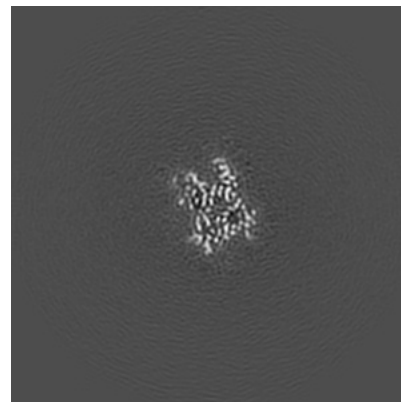
### 6.3.1 Primary map



X Index: 160



Y Index: 163



Z Index: 167

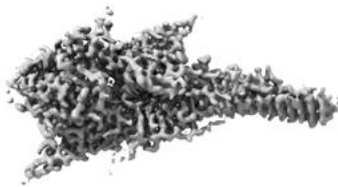
The images above show the largest variance slices of the map in three orthogonal directions.

## 6.4 Orthogonal surface views [i](#)

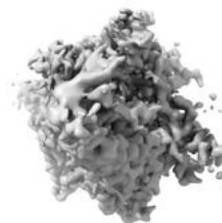
### 6.4.1 Primary map



X



Y



Z

The images above show the 3D surface view of the map at the recommended contour level 0.015. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

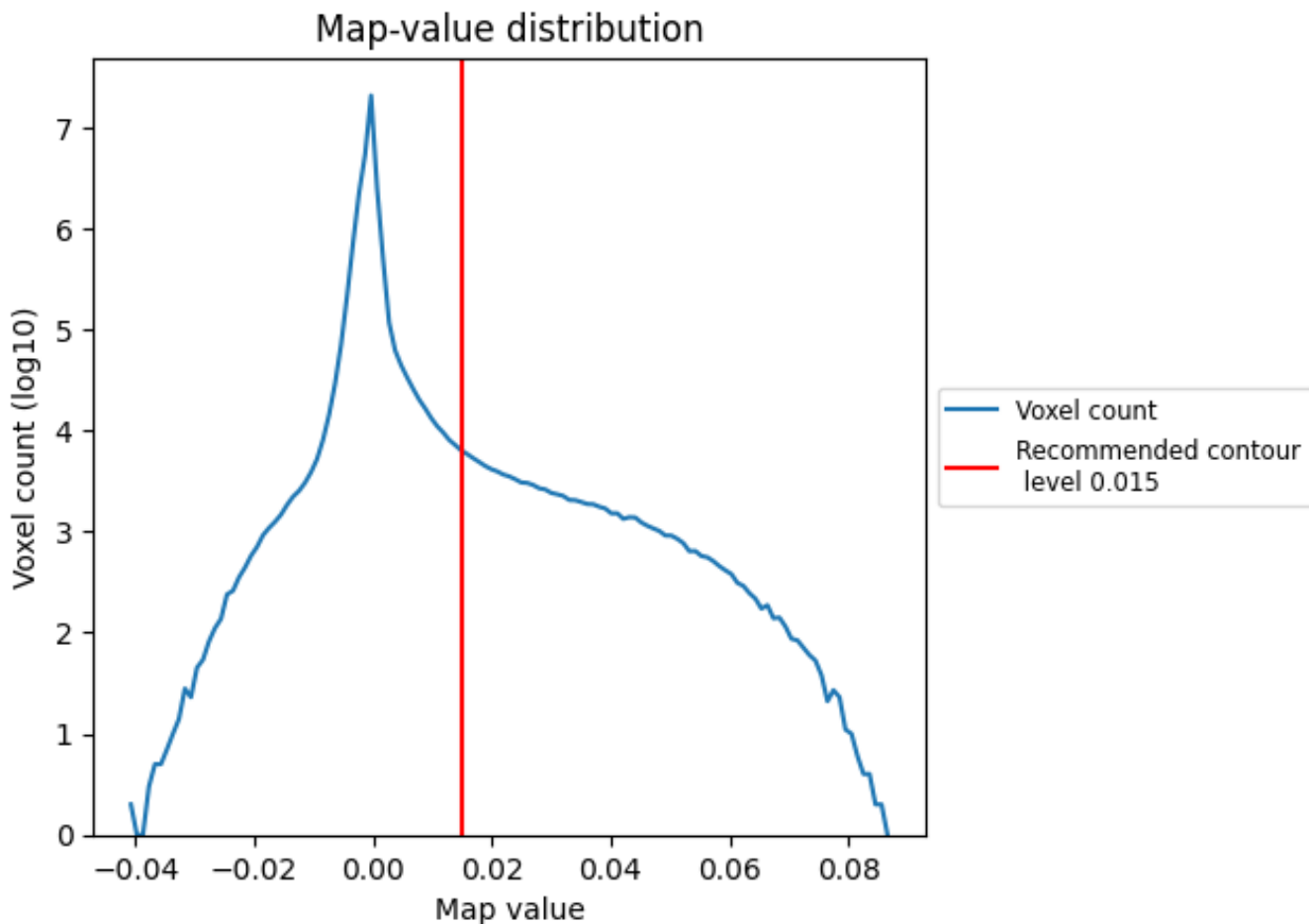
## 6.5 Mask visualisation

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.

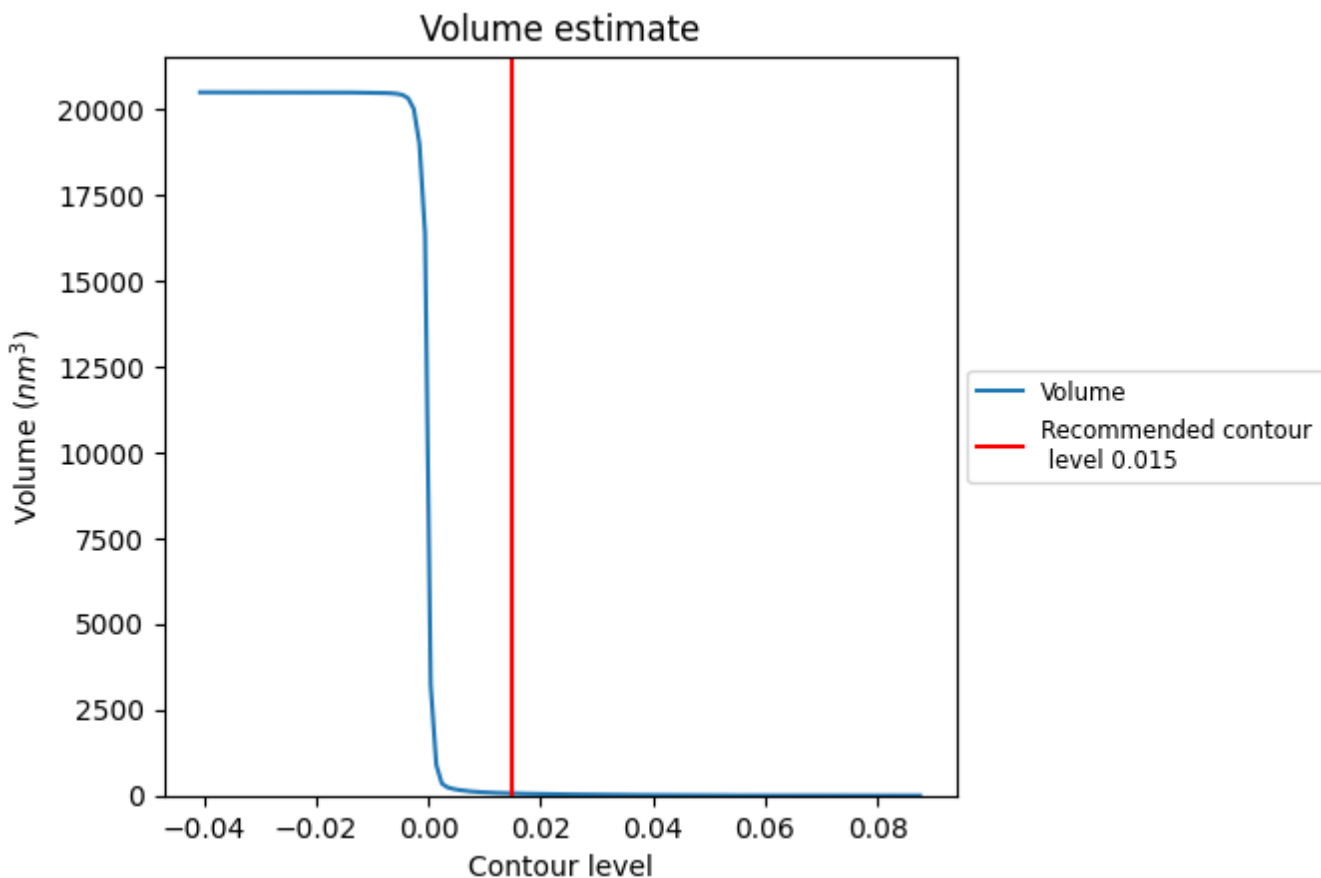
### 7.1 Map-value distribution [i](#)



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.



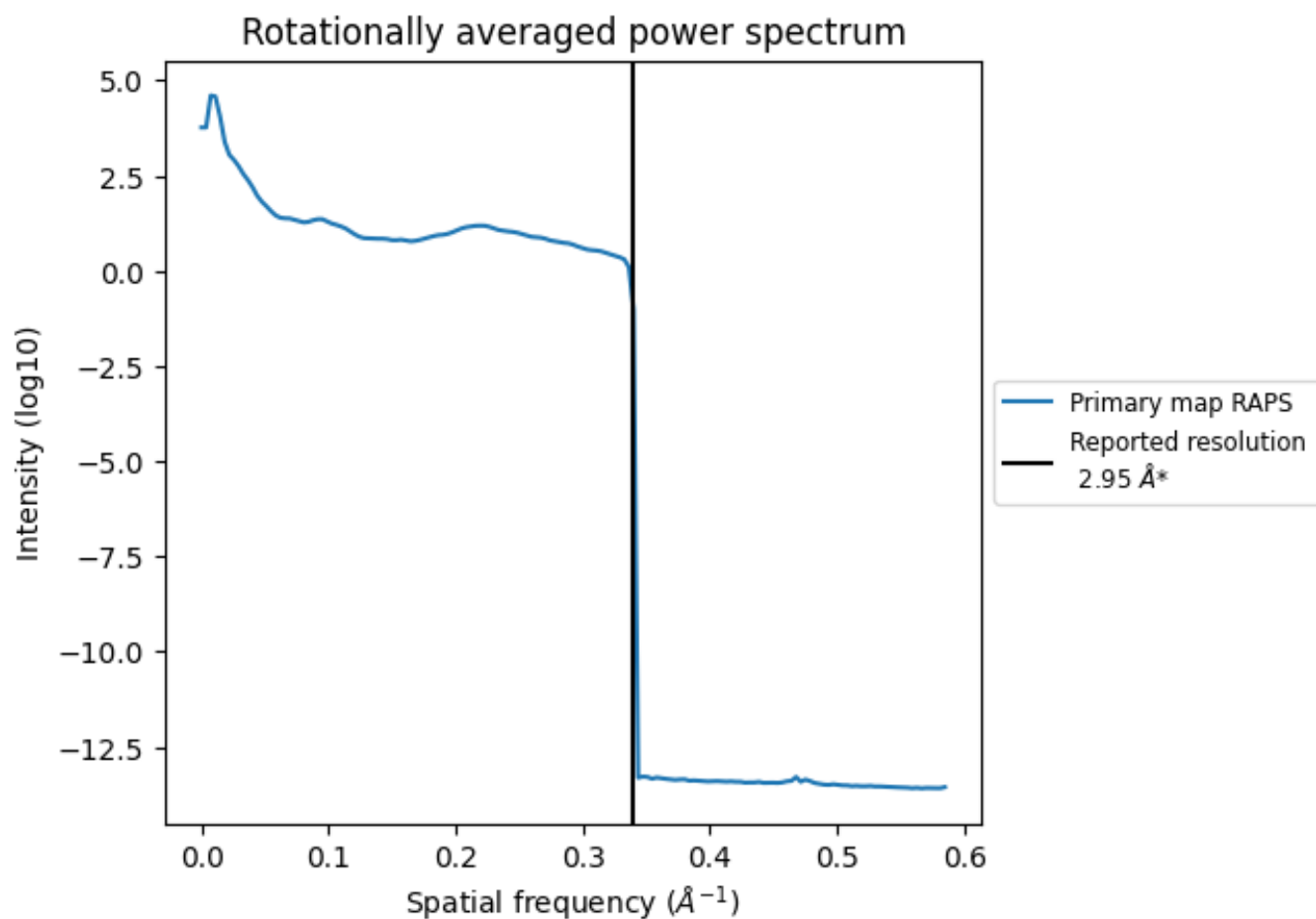
## 7.2 Volume estimate [\(i\)](#)



The volume at the recommended contour level is  $63 \text{ nm}^3$ ; this corresponds to an approximate mass of 57 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 0.339 Å<sup>-1</sup>

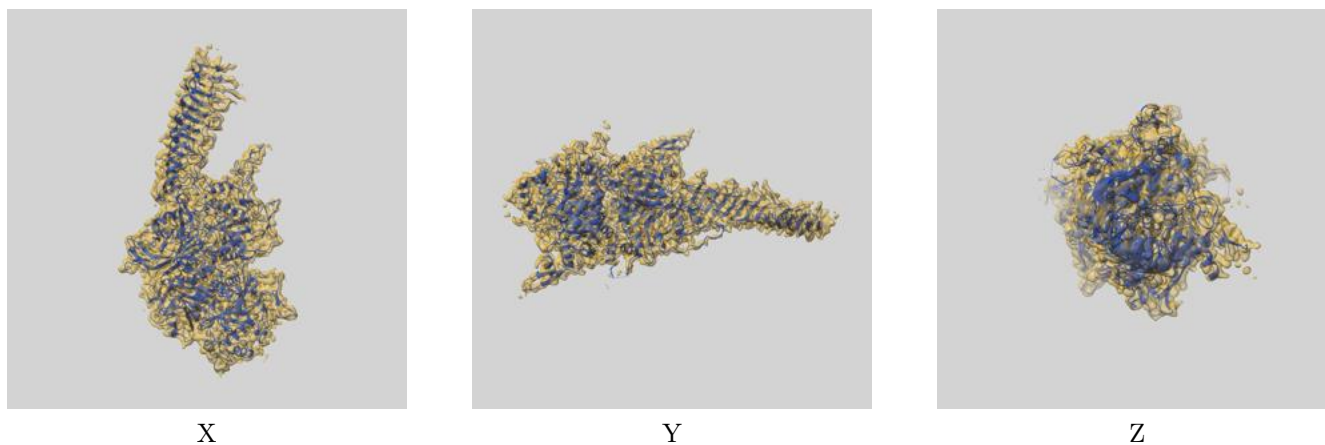
## 8 Fourier-Shell correlation

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

## 9 Map-model fit [i](#)

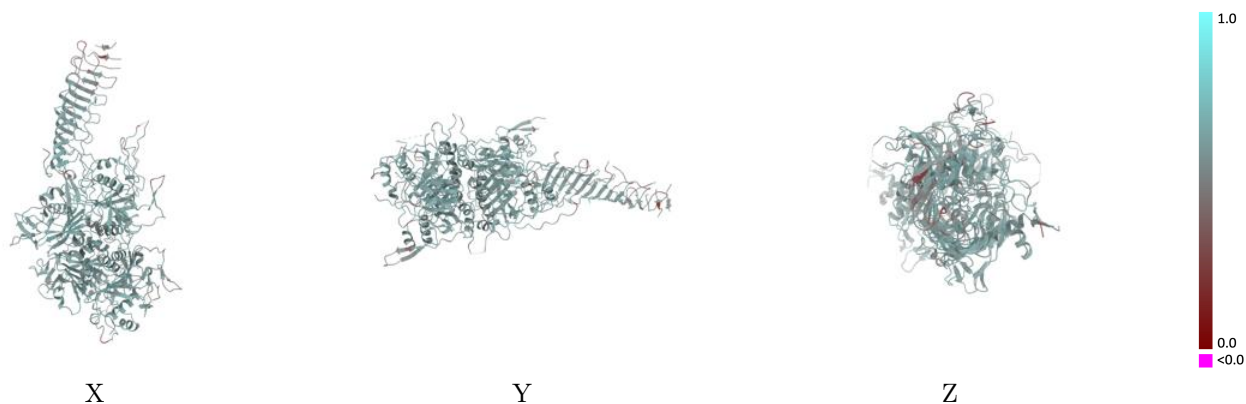
This section contains information regarding the fit between EMDB map EMD-22444 and PDB model 7JR9. Per-residue inclusion information can be found in section 3 on page 5.

### 9.1 Map-model overlay [i](#)



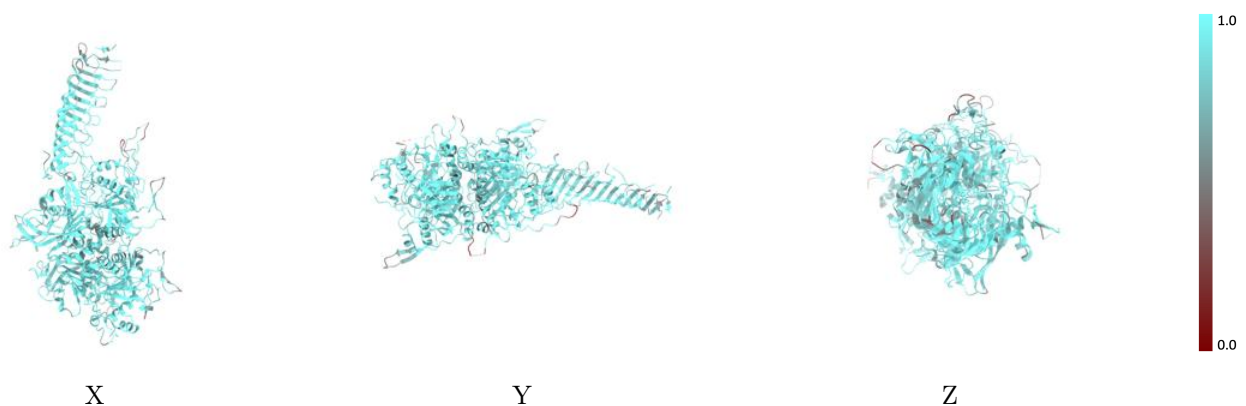
The images above show the 3D surface view of the map at the recommended contour level 0.015 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



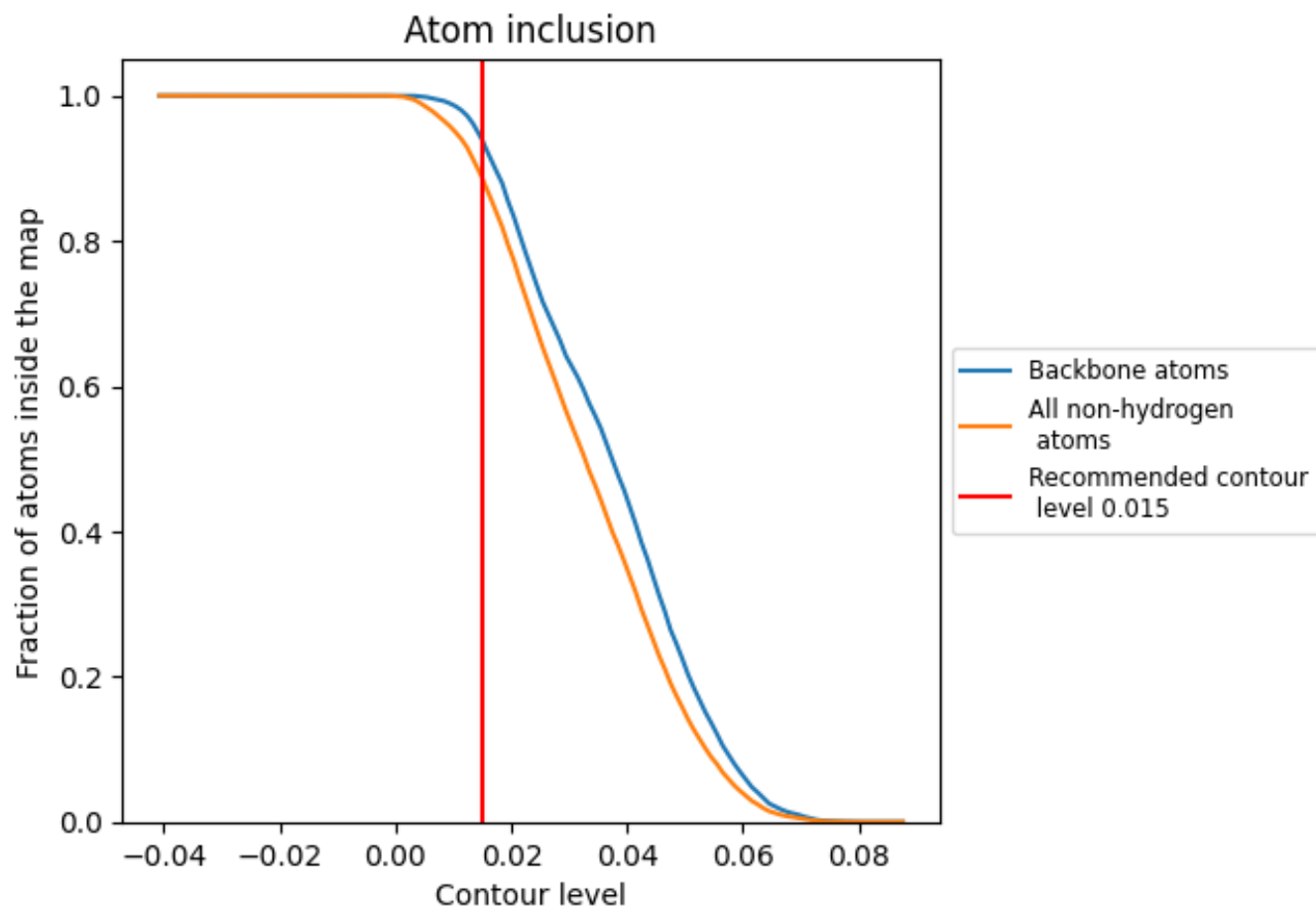
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.015).

















## 9.4 Atom inclusion [i](#)



At the recommended contour level, 94% of all backbone atoms, 89% 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 (0.015) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8866	 0.5750
A	 0.8983	 0.5840
B	 0.9175	 0.5930
C	 0.8824	 0.5710
D	 0.8796	 0.5770
E	 0.8457	 0.5400
F	 0.9000	 0.4750
G	 0.8333	 0.5180

