



## wwPDB EM Validation Summary 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 wwPDB EM Validation Summary 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>.

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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

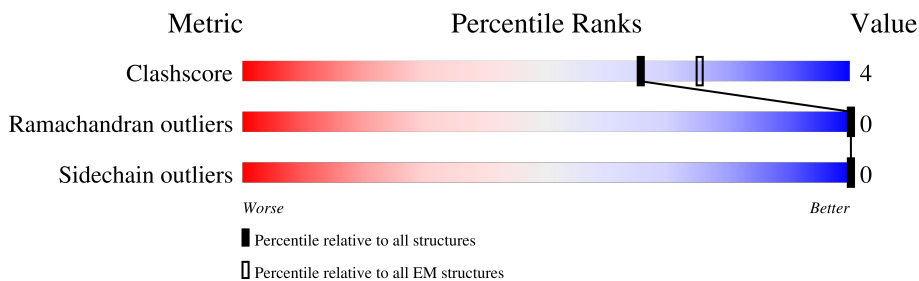
# 1 Overall quality at a glance

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...*

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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

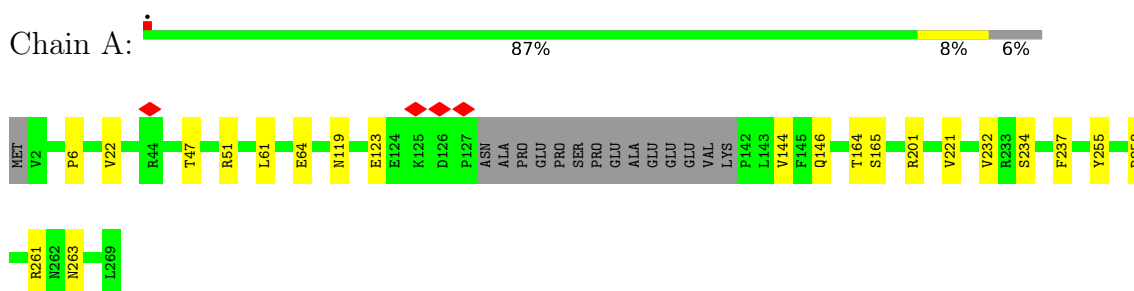
- Molecule 6 is a protein called Radial spoke protein 10.

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

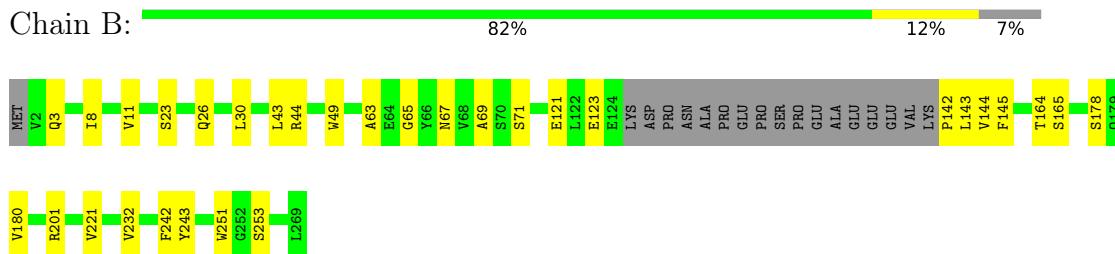
### 3 Residue-property plots [i](#)

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.

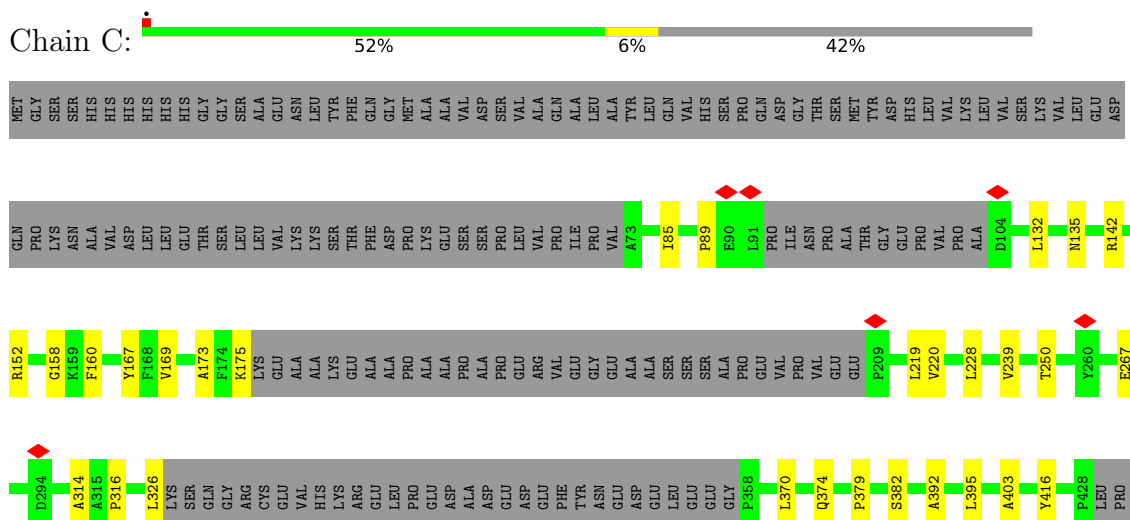
- Molecule 1: Radial spoke protein 9



- Molecule 1: Radial spoke protein 9



- Molecule 2: Flagellar radial spoke protein 4



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

• Molecule 3: Flagellar radial spoke protein 6



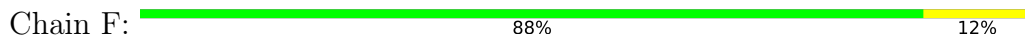
MET ALA  
ALA ASP  
VAL VAL  
GLY VAL  
GLN GLN  
ALA LEU  
ALA ALA  
PHE TRP  
GLY GLY  
GLU VAL  
VAL VAL  
GLN THR  
GLN LYS  
VAL LYS  
THR THR  
THR THR  
GLN GLN  
GLY GLY  
ALA ALA  
SER SER  
ILE ILE  
TVR TVR  
GLU GLU  
GLY GLY  
LEU LEU  
LYS LYS  
ALA ALA  
ALA ALA  
LEU LEU  
LEU LEU  
LYS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

VAL PRO  
LEU VAL  
PRO VAL  
ALA ALA  
SER SER  
ALA ALA  
ALA ALA  
A72 A72  
K78 K78  
A79 A79  
S80 S80  
P85 P85  
E86 E86  
P87 P87  
VAL VAL  
LEU LEU  
ASP ASP  
PRO PRO  
GLU GLU  
SER SER  
GLY GLY  
GLU GLU  
PRO PRO  
LEU LEU  
ILE ILE  
ALA ASP  
PRO PRO  
D100 D100  
L116 L116  
R138 R138  
L139 L139  
R145 R145  
R151 R151  
F156 F156  
Y163 Y163  
E167 E167  
A179 A179  
F180 F180  
E181 E181  
G182 G182  
L186 L186  
S201 S201  
L204 L204

L208 L208  
T230 T230  
E247 E247  
D274 D274  
D275 D275  
S276 S276  
A277 A277  
D283 D283  
E292 E292  
M293 M293  
A294 A294  
M298 M298  
D318 D318  
P319 P319  
P320 P320  
ASP ASP  
GLU GLU  
GLU GLU  
GLU GLU  
PRO PRO  
LEU LEU  
LYS LYS  
M329 M329  
L346 L346  
A350 A350  
P353 P353  
P361 P361  
P362 P362  
W365 W365  
S373 S373  
T376 T376  
Q379 Q379  
V380 V380  
A381 A381  
R387 R387  
T401 T401  
K410 K410  
E414 E414  
P430 P430

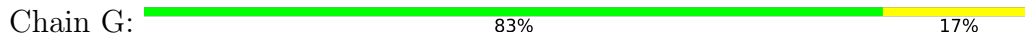
ALA ALA  
ALA GLY  
VAL VAL  
GLU GLU  
GLY GLY  
GLN GLN  
LEU LEU  
LEU LEU  
LEU LEU  
CYS CYS  
ASN ASN  
ASP ASP  
LEU LEU  
PRO PRO  
PRO PRO  
LYS LYS  
PRO PRO  
ALA ALA  
PRO PRO  
PRO PRO  
GLU GLU  
GLU GLU  
ASP ASP  
GLU GLU

• Molecule 4: Flagellar radial spoke protein 6



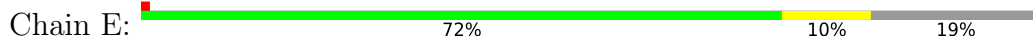
X500 X500  
X507 X507

• Molecule 5: Flagellar radial spoke protein 10



X-5 X-5  
X0 X0

• Molecule 6: Radial spoke protein 10



MET ALA  
ALA ASP  
ASP ASP  
GLU GLU  
LEU LEU  
PRO PRO  
PRO PRO  
GLN GLN  
PRO PRO  
VAL VAL  
TRP TRP  
GLY GLY  
PRO PRO  
LEU LEU  
ASP ASP  
ASP ASP  
GLY GLY  
HIS HIS  
PRO PRO  
GLY GLY  
L25 L25  
G26 G26  
P31 P31  
PRO PRO  
PRO PRO  
PRO PRO  
MET MET  
GLY GLY  
GLU GLU  
ASP ASP  
ASP ASP  
GLU GLU  
GLU GLU  
LYS LYS  
PRO PRO  
G45 G45  
E53 E53  
R57 R57  
T64 T64  
A70 A70  
V71 V71  
G79 G79  
K80 K80  
K81 K81  
H82 H82  
G83 G83  
V88 V88  
Y89 Y89

P90 P90  
W99 W99  
V100 V100  
E101 E101  
D102 D102  
Q105 Q105  
Y112 Y112  
A124 A124  
R127 R127  
G169 G169  
K176 K176  
Y182 Y182  
V190 V190  
K211 K211  
E212 E212  
F213 F213  
SER SER  
VAL VAL  
ALA ALA

## 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.



The worst 5 of 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

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

There are no chain breaks in this entry.

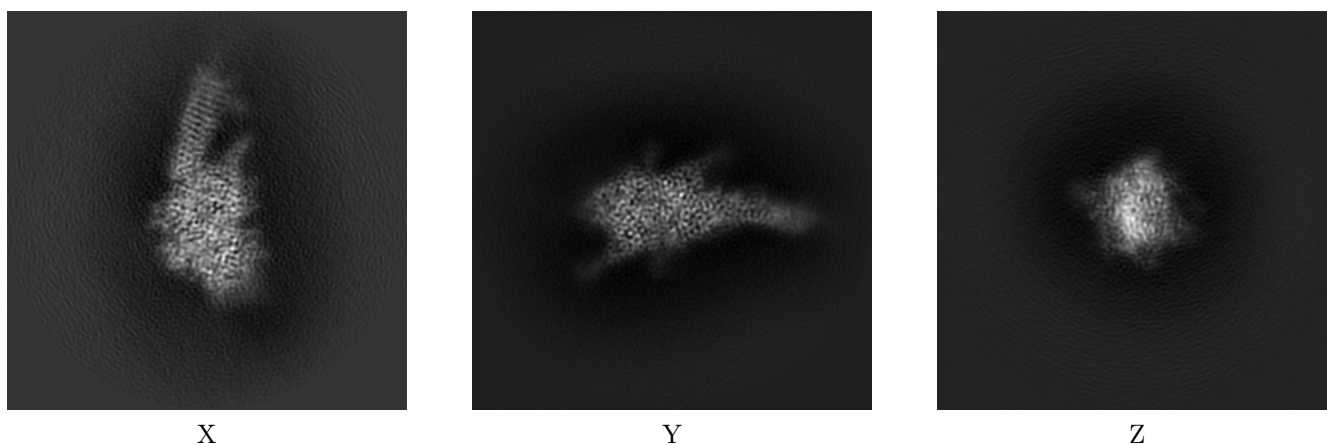
## 6 Map visualisation [i](#)

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](#)

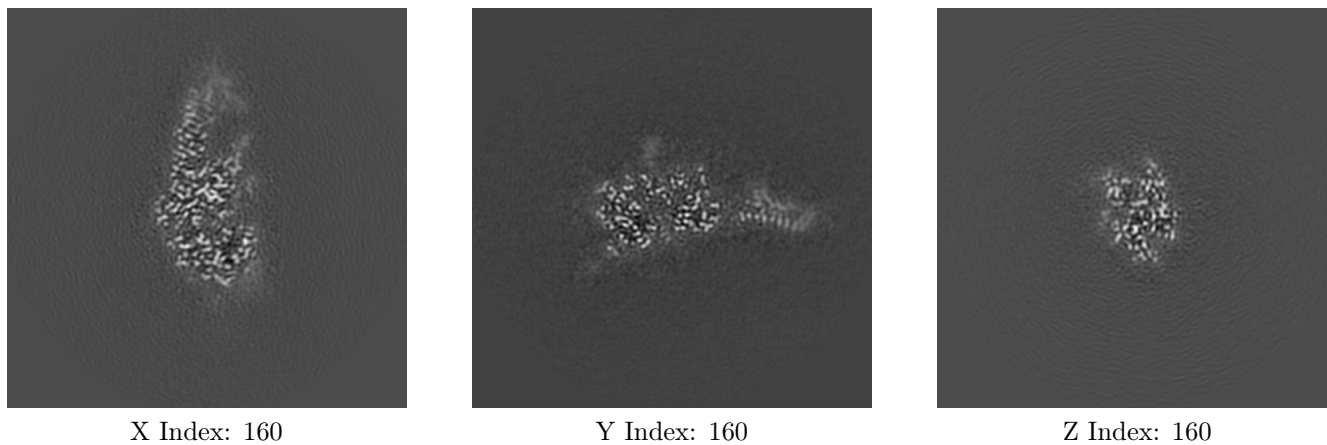
#### 6.1.1 Primary map



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

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

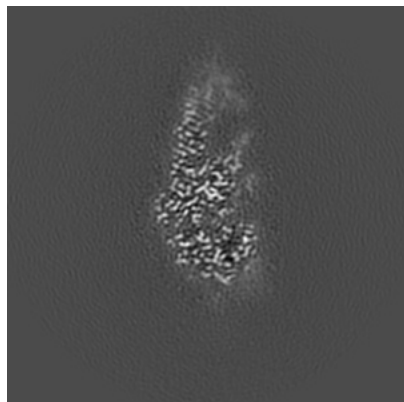
#### 6.2.1 Primary map



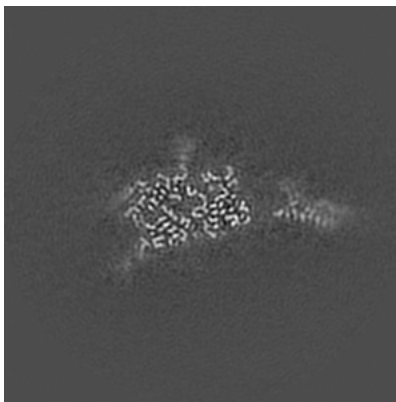
The images above show central slices of the map in three orthogonal directions.

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

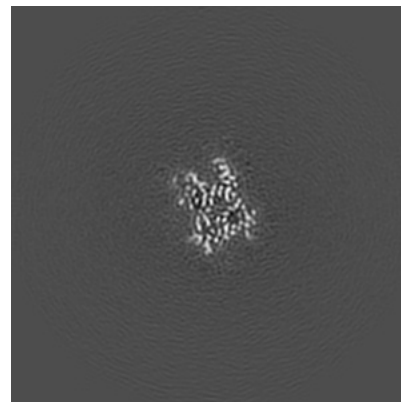
### 6.3.1 Primary map



X Index: 160



Y Index: 163



Z Index: 167

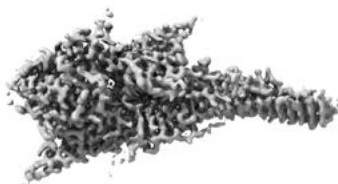
The images above show the largest variance slices of the map in three orthogonal directions.

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

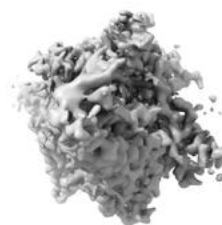
### 6.4.1 Primary map



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.

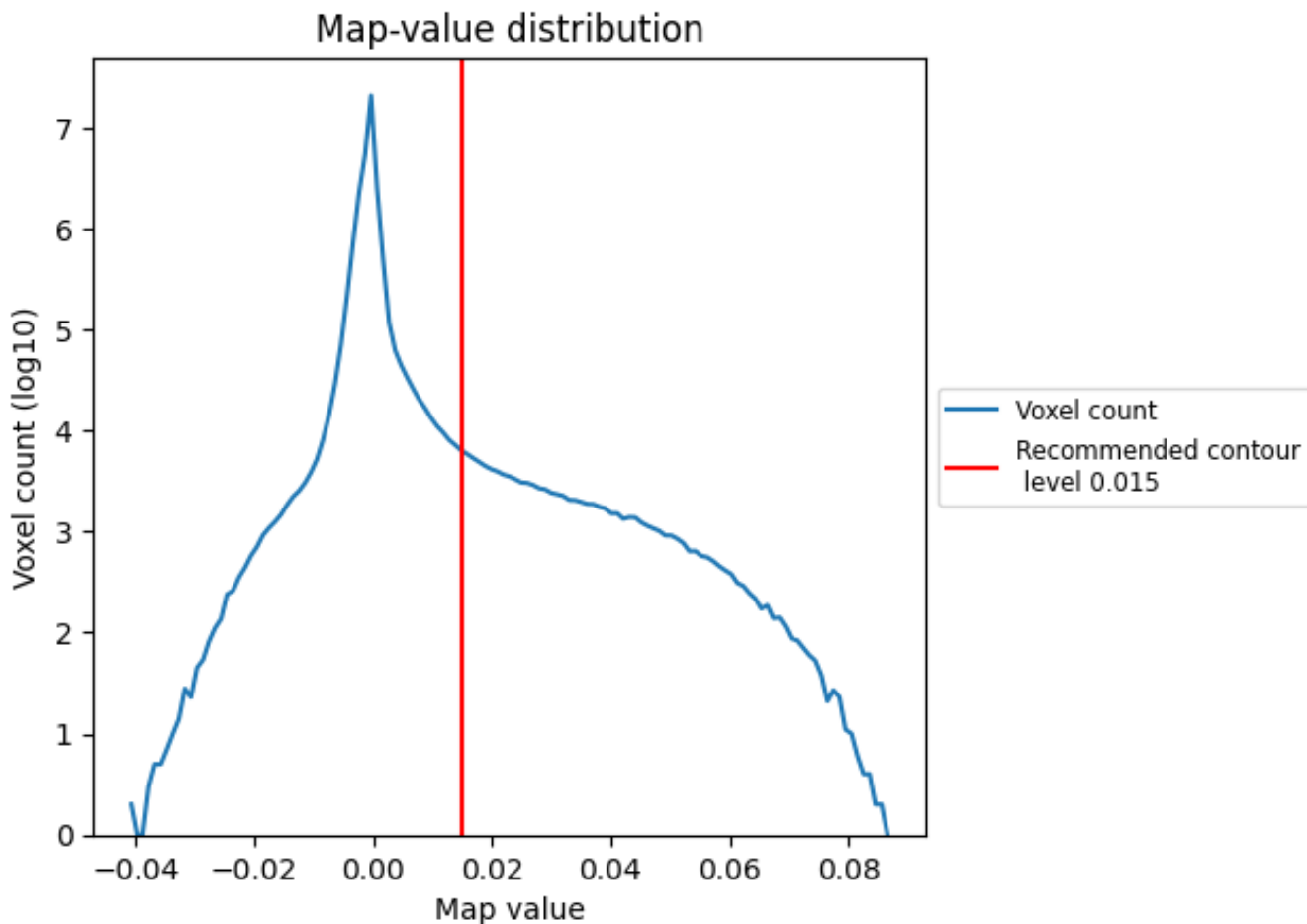
## 6.5 Mask visualisation

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

## 7 Map analysis [i](#)

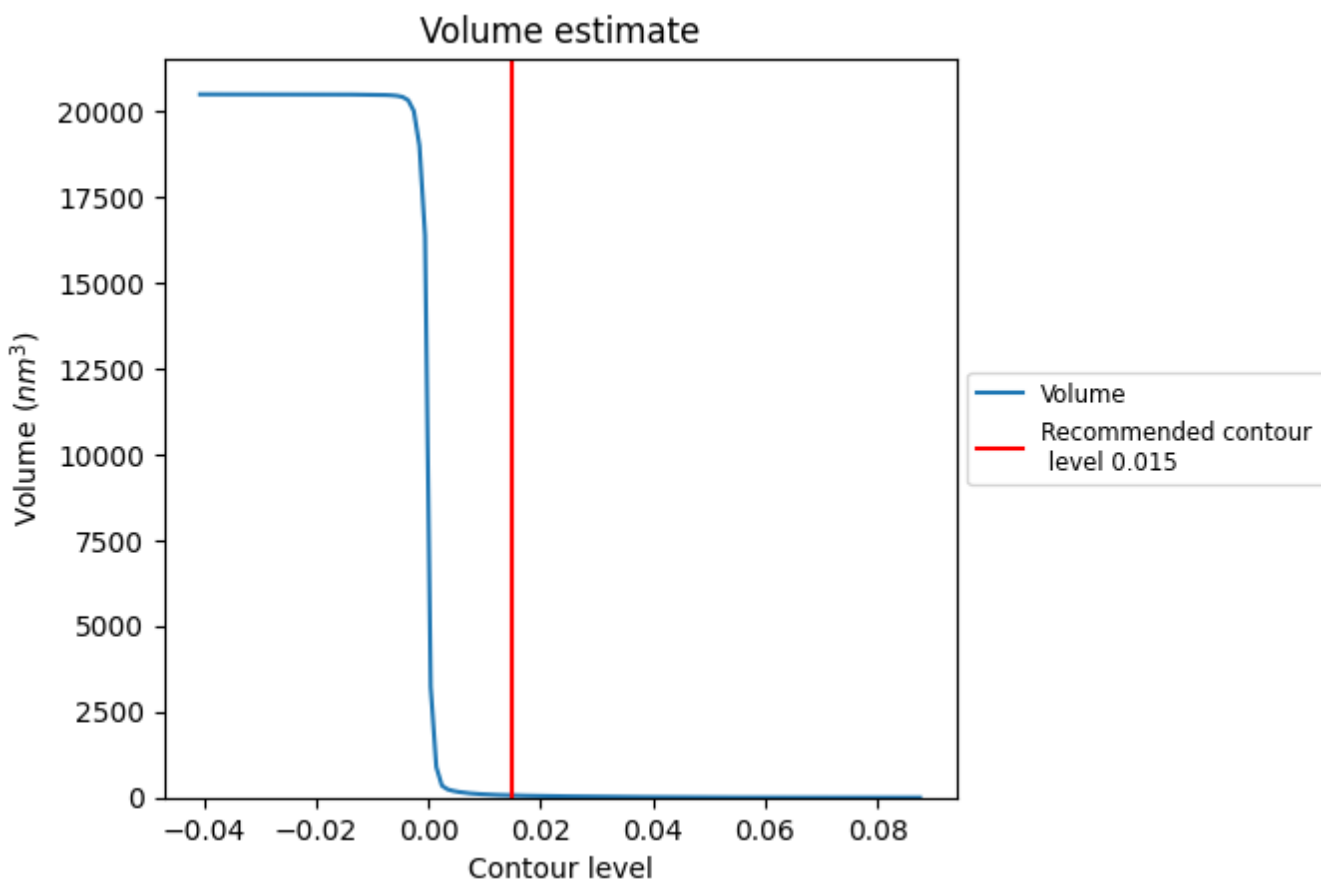
This section contains the results of statistical analysis of the map.

### 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 [\(i\)](#)

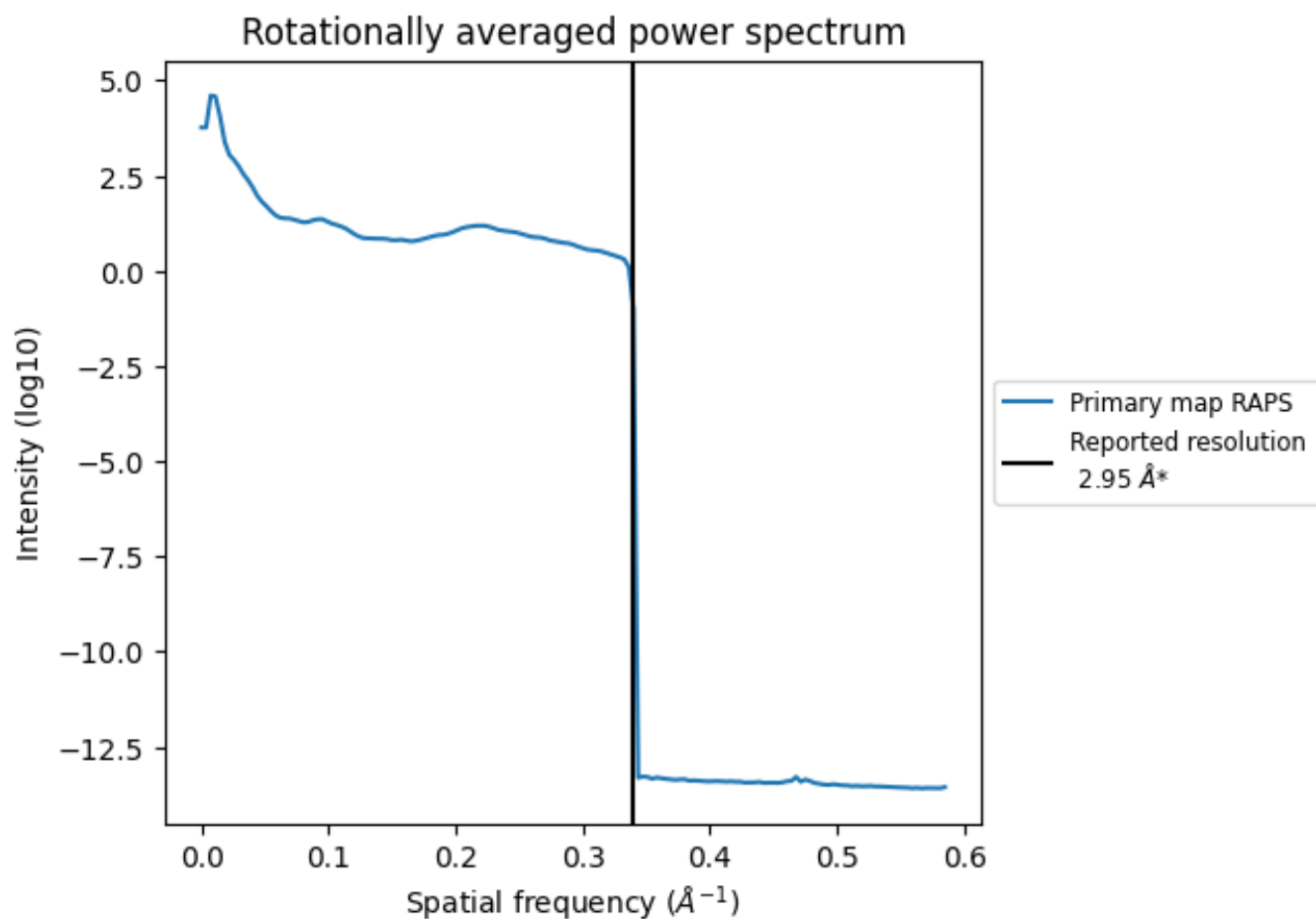


The volume at the recommended contour level is 63 nm<sup>3</sup>; this corresponds to an approximate mass of 57 kDa.

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  $0.339 \text{\AA}^{-1}$

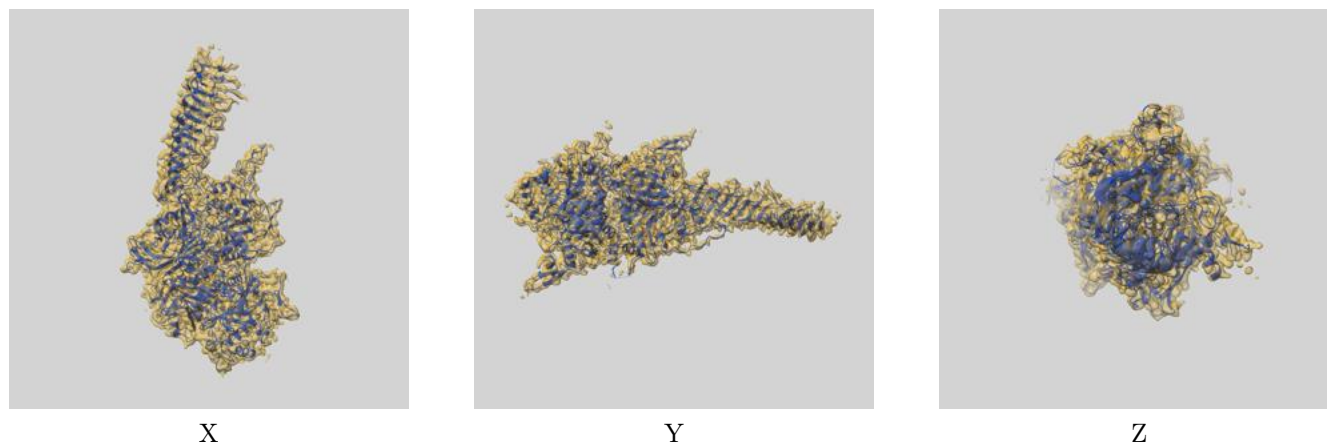
## 8 Fourier-Shell correlation

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

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

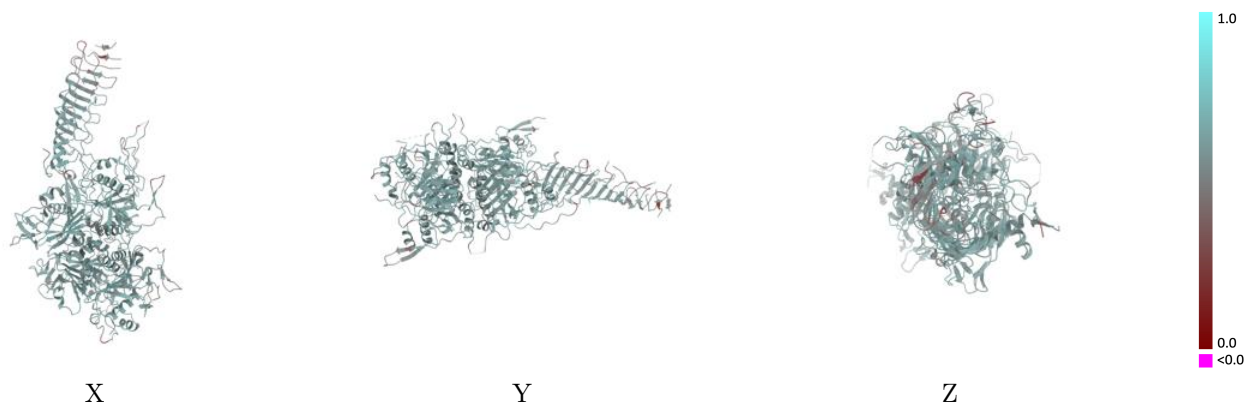
This section contains information regarding the fit between EMDB map EMD-22444 and PDB model 7JR9. Per-residue inclusion information can be found in section [3](#) on page [5](#).

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



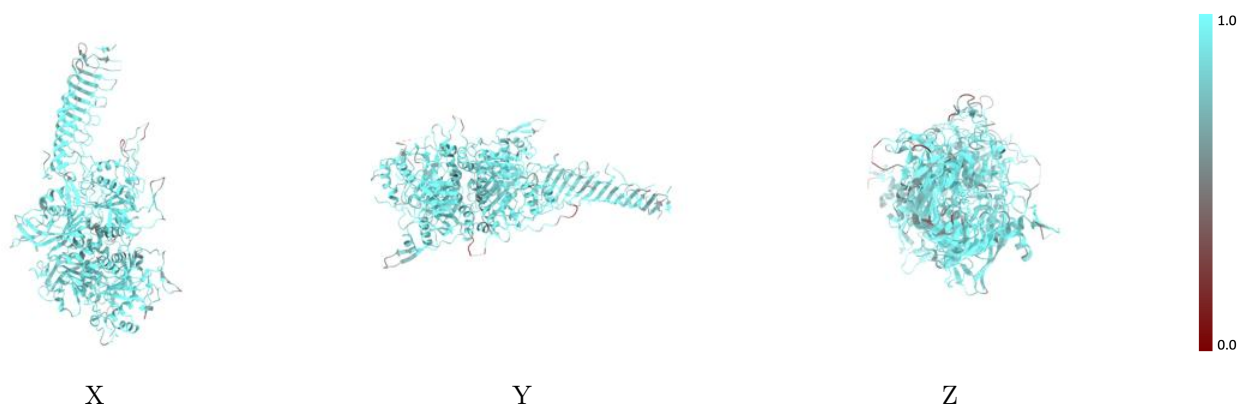
The images above show the 3D surface view of the map at the recommended contour level 0.015 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



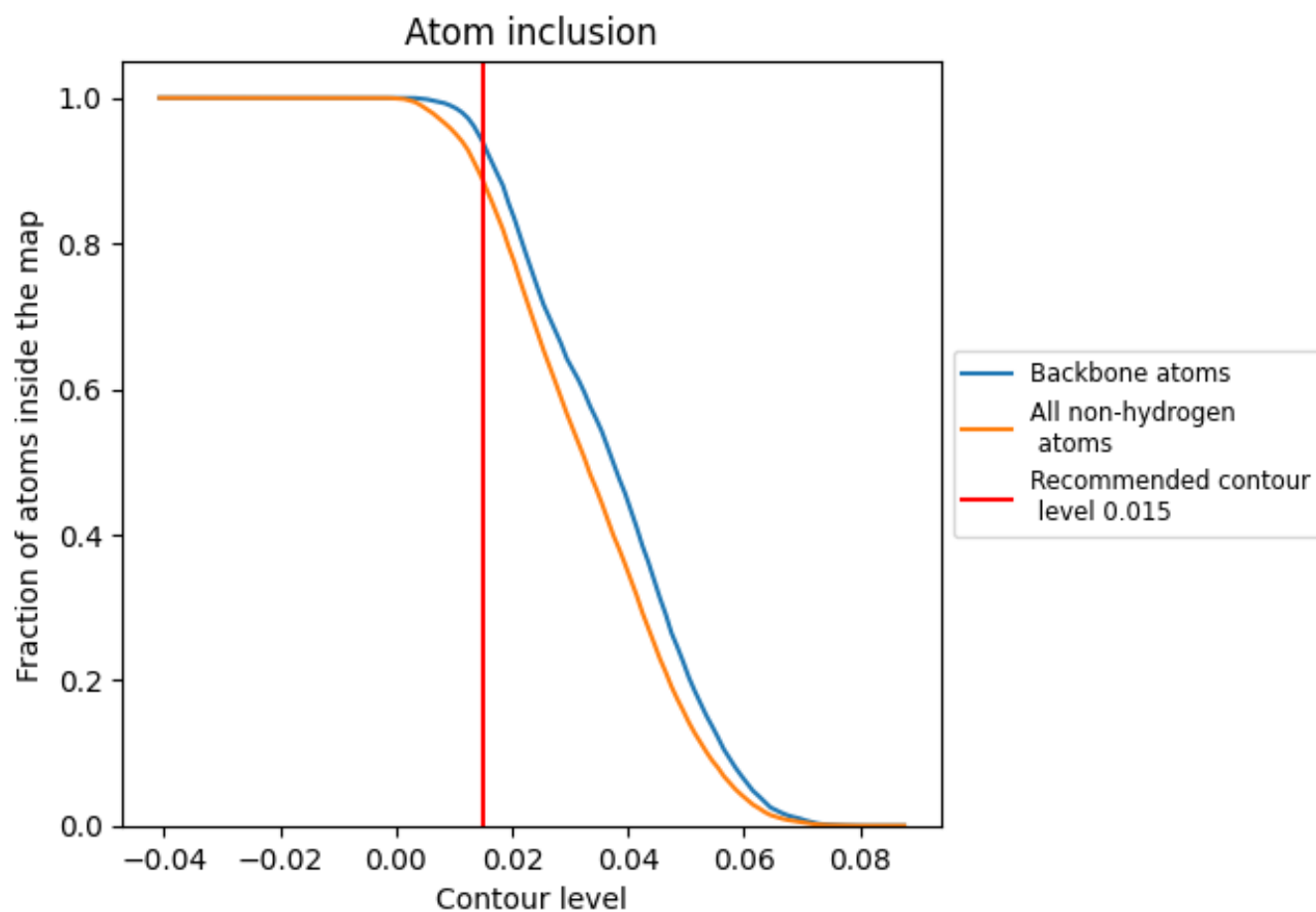
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions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

