



wwPDB EM Validation Summary Report ⓘ

Mar 9, 2026 – 06:32 AM UTC

PDB ID : 9KFI / pdb_00009kfi
EMDB ID : EMD-62297
Title : Cryo-EM structure of the human relaxin family peptide receptor 3 in complex with relaxin-3 and G protein
Authors : Chen, Y.; Zhou, Q.T.; Yan, S.Y.; Yan, J.H.; Yang, D.H.; Chen, J.; Wang, M.W.
Deposited on : 2024-11-06
Resolution : 2.91 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.dev132
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data in the EMDB archive up until May 2025)
MapQ : 1.9.13
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

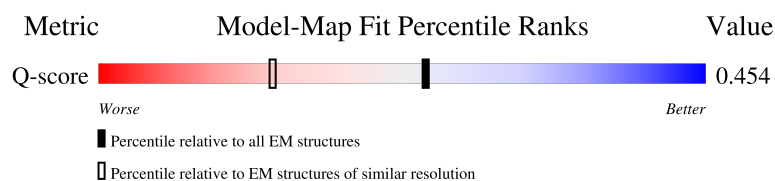
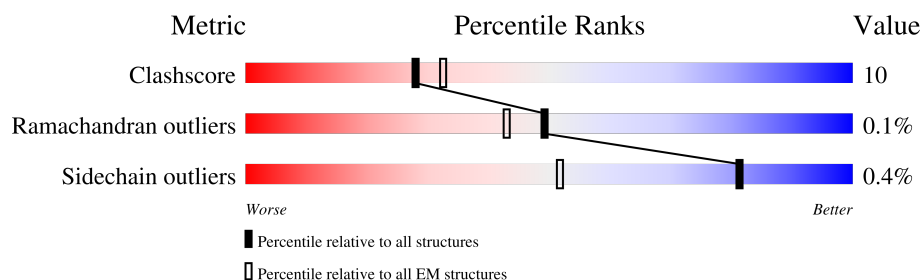
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.91 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.



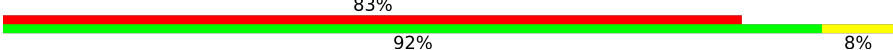
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	12972 (2.41 - 3.41)

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	C	773	
2	G	55	
3	I	355	
4	S	248	

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Mol	Chain	Length	Quality of chain
5	T	338	 83% 17%
6	B	22	 23% 64% 36%
7	A	24	 83% 92% 8%

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 9293 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 Soluble cytochrome b562,Relaxin-3 receptor 1,LgBiT.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	C	307	Total	C	N	O	S	0	0
			2435	1611	410	394	20		

There are 29 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	-130	MET	-	initiating methionine	UNP P0ABE7
C	-129	LYS	-	expression tag	UNP P0ABE7
C	-128	THR	-	expression tag	UNP P0ABE7
C	-127	ILE	-	expression tag	UNP P0ABE7
C	-126	ILE	-	expression tag	UNP P0ABE7
C	-125	ALA	-	expression tag	UNP P0ABE7
C	-124	LEU	-	expression tag	UNP P0ABE7
C	-123	SER	-	expression tag	UNP P0ABE7
C	-122	TYR	-	expression tag	UNP P0ABE7
C	-121	ILE	-	expression tag	UNP P0ABE7
C	-120	PHE	-	expression tag	UNP P0ABE7
C	-119	CYS	-	expression tag	UNP P0ABE7
C	-118	LEU	-	expression tag	UNP P0ABE7
C	-117	VAL	-	expression tag	UNP P0ABE7
C	-116	PHE	-	expression tag	UNP P0ABE7
C	-115	ALA	-	expression tag	UNP P0ABE7
C	-114	HIS	-	expression tag	UNP P0ABE7
C	-113	HIS	-	expression tag	UNP P0ABE7
C	-112	HIS	-	expression tag	UNP P0ABE7
C	-111	HIS	-	expression tag	UNP P0ABE7
C	-110	HIS	-	expression tag	UNP P0ABE7
C	-109	HIS	-	expression tag	UNP P0ABE7
C	-108	HIS	-	expression tag	UNP P0ABE7
C	-107	HIS	-	expression tag	UNP P0ABE7
C	-106	HIS	-	expression tag	UNP P0ABE7
C	-105	HIS	-	expression tag	UNP P0ABE7
C	-98	TRP	MET	engineered mutation	UNP P0ABE7
C	-3	ILE	HIS	engineered mutation	UNP P0ABE7

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Chain	Residue	Modelled	Actual	Comment	Reference
C	1	LEU	ARG	engineered mutation	UNP P0ABE7

- Molecule 2 is a protein called Guanine nucleotide-binding protein G(I)/G(S)/G(O) subunit gamma-2.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	G	55	Total	C	N	O	S	0	0
			424	266	75	80	3		

- Molecule 3 is a protein called Guanine nucleotide-binding protein G(i) subunit alpha-2.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	I	219	Total	C	N	O	S	0	0
			1757	1120	290	335	12		

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
I	47	ASN	SER	engineered mutation	UNP P04899
I	204	ALA	GLY	engineered mutation	UNP P04899
I	246	ALA	GLU	engineered mutation	UNP P04899
I	327	SER	ALA	engineered mutation	UNP P04899

- Molecule 4 is a protein called scFv16.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	S	230	Total	C	N	O	S	0	0
			1771	1125	293	343	10		

- Molecule 5 is a protein called Guanine nucleotide-binding protein G(I)/G(S)/G(T) subunit beta-1.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	T	338	Total	C	N	O	S	0	0
			2601	1604	467	509	21		

- Molecule 6 is a protein called Relaxin-3 B chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	B	22	Total	C	N	O	S	0	0
			174	110	35	27	2		

- Molecule 7 is a protein called Relaxin-3 A chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
7	A	24	Total	C	N	O	S	0	0
			131	76	24	27	4		

GLU ARG
LEU ILE
THR PRO
ASP ASP
GLY SER
MET MET
LEU PHE
PHE ARG
VAL VAL
THR ILE
ASN ASN
SER SER

- Molecule 2: Guanine nucleotide-binding protein G(I)/G(S)/G(O) subunit gamma-2

Chain G: 87% 13%

S8 A23 A34 A35 D36 L50 S57 E58 N59 P60 F61 R62

- Molecule 3: Guanine nucleotide-binding protein G(i) subunit alpha-2

Chain I: 50% 11% 38%

MET GLY CYS THR V5 S6 G27 E28 K29 R32 G40 ALA GLY GLU S44 K54 ILE ILE HIS GLU VAL ASP GLY TYR SER ASP LEU GLU G184 I185 V186 K193 D201 F224 L228 V234 E237 D238 N242 R243 M244 M248 D252 C255 N256 L267 K272

PHE ALA ASP PRO SER ARG ASP ARG GLN LEU PHE ALA LEU SER CYS THR K54 ILE ILE HIS GLU VAL ASP GLY TYR SER ASP LEU GLU G184 I185 V186 K193 D201 F224 L228 V234 E237 D238 N242 R243 M244 M248 D252 C255 N256 L267 K272

TYR TYR LEU ASN ASP LEU GLU ARG ILE ALA GLN SER ASP TYR ILE PRO THR GLN ASP VAL LEU ARG THR ARG VAL LYS THR G184 I185 V186 K193 D201 F224 L228 V234 E237 D238 N242 R243 M244 M248 D252 C255 N256 L267 K272

D273 E276 I279 F288 Y291 N295 E299 Q305 S306 K307 F308 E309 D310 L311 K318 H323 F324 T325 C326 D329 F335 F336 F337 D342 K346 C352 F355

- Molecule 4: scFv16

Chain S: 77% 15% 7%

MET V2 E6 V12 L20 F27 A28 F29 M34 H35 W36 Q39 A40 K43 V48 I51 S52 T57 I58 V64 R67 I70 L79 M83 L86 R87 S88 E89 D90 Y95 T115 S120 ALA GLY GLY GLY SER GLY GLY

GLY SER GLY GLY GLY SER ALA D137 I157 H167 T172 R180 L188 V199 R202 F212 E220 E222 T243 R244 L245 E246 L247

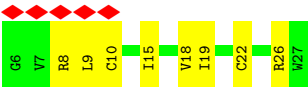
- Molecule 5: Guanine nucleotide-binding protein G(I)/G(S)/G(T) subunit beta-1

Chain T: 83% 17%

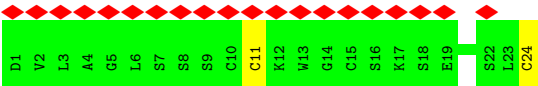
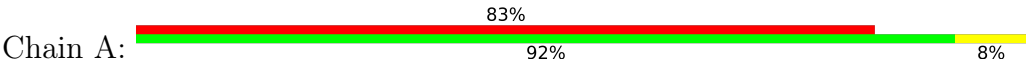
E3 Q6 Q9 I18 R22 C25 A26 D27 L30 T34 D38 I43 Q44 M45 L51 L55 M61 V71 Q75 L79 I93 W99 V100 V112 D118 N119 Y124 T128 N132 V135 G144 L152 D153 Q156

S161 G162 D163 L192 T196 F199 C204 D228 T243 C250 R251 R256 Q259 E260 L261 M262 T263 H266 I269 L270 C271 T274 L286 Y289 D290 V296 L300 V315 S316 C317 M325 A326 V327 L336 W339 R340

- Molecule 6: Relaxin-3 B chain



● Molecule 7: Relaxin-3 A chain



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	364523	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TALOS ARCTICA	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	80	Depositor
Minimum defocus (nm)	1200	Depositor
Maximum defocus (nm)	2200	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor
Maximum map value	2.708	Depositor
Minimum map value	-0.002	Depositor
Average map value	0.001	Depositor
Map value standard deviation	0.019	Depositor
Recommended contour level	0.01	Depositor
Map size (Å)	274.176, 274.176, 274.176	wwPDB
Map dimensions	256, 256, 256	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.071, 1.071, 1.071	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	C	0.26	0/2496	0.48	0/3389
2	G	0.16	0/430	0.28	0/580
3	I	0.23	0/1787	0.39	0/2397
4	S	0.22	0/1815	0.40	0/2461
5	T	0.27	0/2648	0.41	0/3589
6	B	0.19	0/177	0.44	0/234
7	A	0.17	0/130	0.52	0/175
All	All	0.24	0/9483	0.42	0/12825

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	C	2435	0	2538	91	0
2	G	424	0	436	6	0
3	I	1757	0	1737	27	0
4	S	1771	0	1709	22	0
5	T	2601	0	2505	39	0
6	B	174	0	173	8	0
7	A	131	0	87	4	0
All	All	9293	0	9185	177	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 10.

The worst 5 of 177 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:I:255:CYS:O	3:I:318:LYS:NZ	2.20	0.74
3:I:272:LYS:HD3	3:I:324:PHE:HB3	1.69	0.73
5:T:161:SER:OG	5:T:163:ASP:OD1	2.07	0.73
1:C:297:ARG:O	1:C:320:ARG:NH2	2.22	0.72
5:T:25:CYS:SG	5:T:259:GLN:NE2	2.65	0.70

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	C	301/773 (39%)	271 (90%)	29 (10%)	1 (0%)	36	64
2	G	53/55 (96%)	53 (100%)	0	0	100	100
3	I	213/355 (60%)	198 (93%)	15 (7%)	0	100	100
4	S	226/248 (91%)	216 (96%)	10 (4%)	0	100	100
5	T	336/338 (99%)	322 (96%)	14 (4%)	0	100	100
6	B	20/22 (91%)	19 (95%)	1 (5%)	0	100	100
7	A	22/24 (92%)	21 (96%)	1 (4%)	0	100	100
All	All	1171/1815 (64%)	1100 (94%)	70 (6%)	1 (0%)	49	76

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	145	ASP

5.3.2 Protein sidechains ⓘ

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	C	266/636 (42%)	264 (99%)	2 (1%)	73	89
2	G	45/45 (100%)	45 (100%)	0	100	100
3	I	193/309 (62%)	193 (100%)	0	100	100
4	S	195/199 (98%)	195 (100%)	0	100	100
5	T	281/281 (100%)	279 (99%)	2 (1%)	76	91
6	B	17/17 (100%)	17 (100%)	0	100	100
7	A	8/21 (38%)	8 (100%)	0	100	100
All	All	1005/1508 (67%)	1001 (100%)	4 (0%)	81	94

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

Mol	Chain	Res	Type
1	C	160	MET
1	C	406	ARG
5	T	243	THR
5	T	250	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 12 such sidechains are listed below:

Mol	Chain	Res	Type
4	S	3	GLN
4	S	142	GLN
5	T	340	ASN
5	T	6	GLN
2	G	18	GLN

5.3.3 RNA ⓘ

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 oligosaccharides 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.

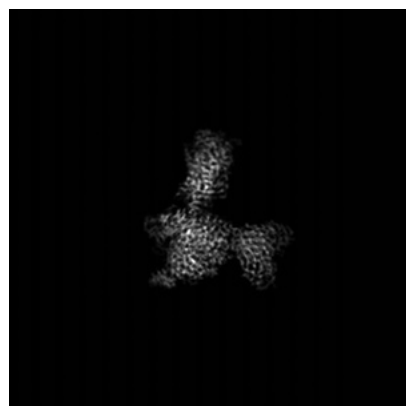
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-62297. These allow visual inspection of the internal detail of the map and identification of artifacts.

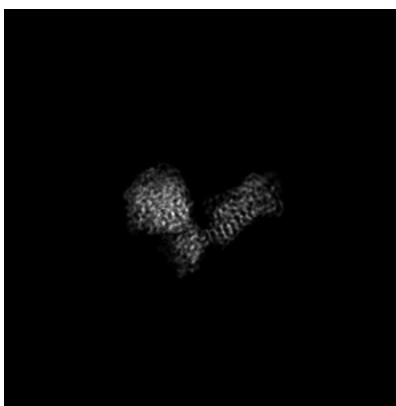
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

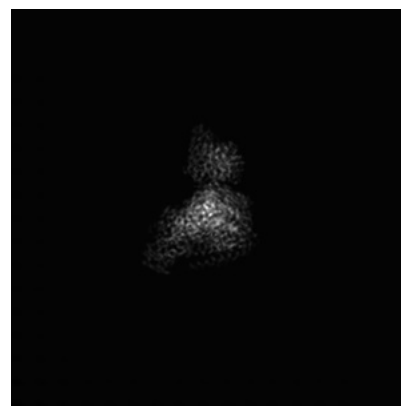
6.1.1 Primary map



X

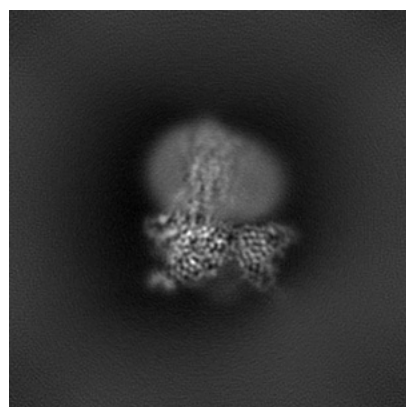


Y

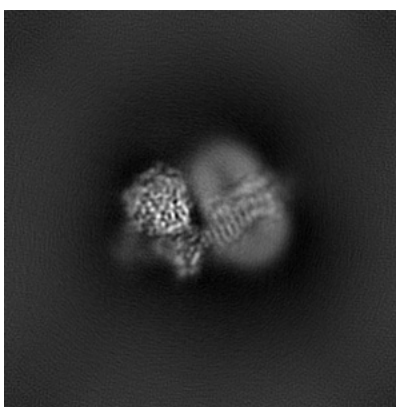


Z

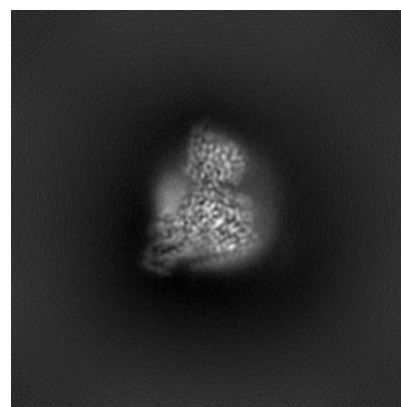
6.1.2 Raw map



X



Y



Z

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

6.2 Central slices [i](#)

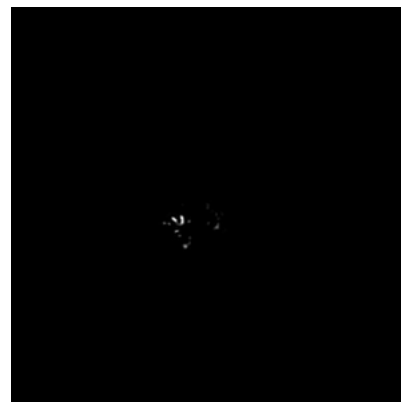
6.2.1 Primary map



X Index: 128

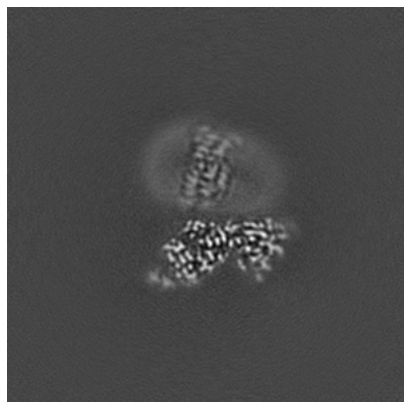


Y Index: 128

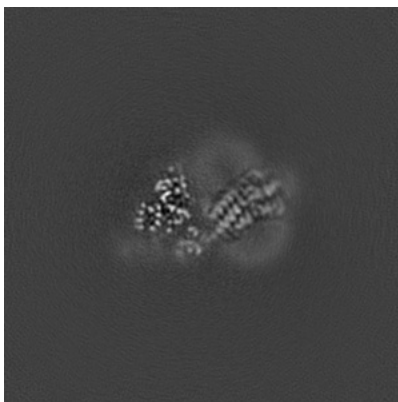


Z Index: 128

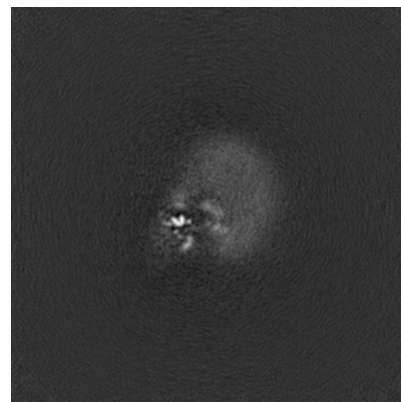
6.2.2 Raw map



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: 128

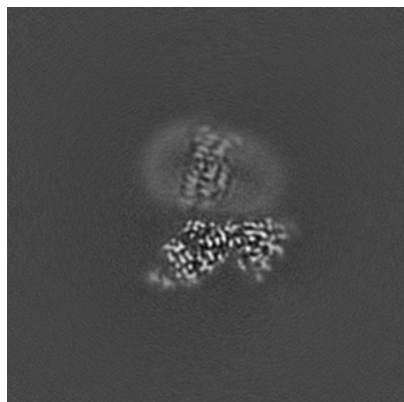


Y Index: 126

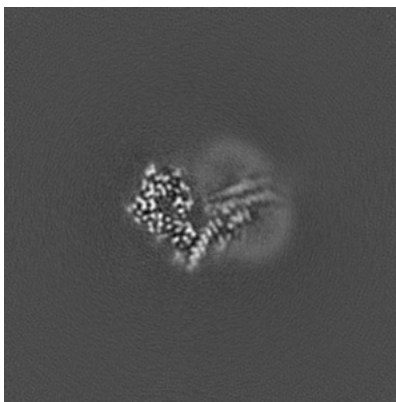


Z Index: 107

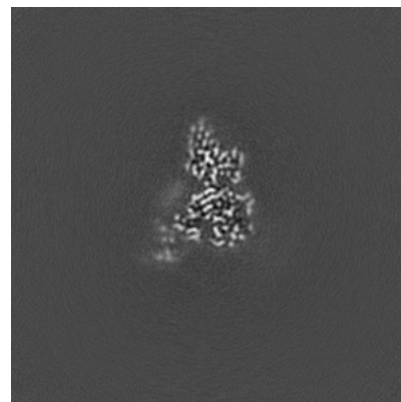
6.3.2 Raw map



X Index: 128



Y Index: 117

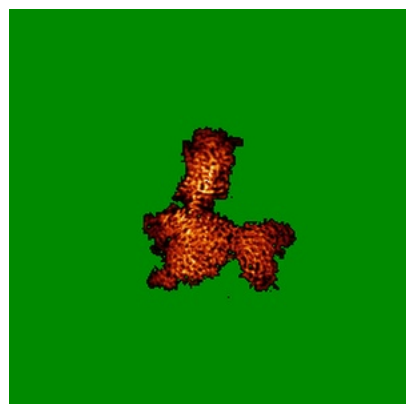


Z Index: 107

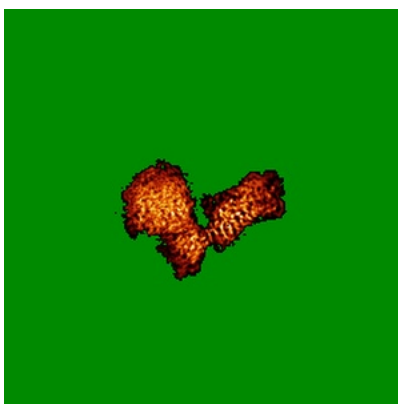
The images above show the largest variance slices of the map in three orthogonal directions.

6.4 Orthogonal standard-deviation projections (False-color) [i](#)

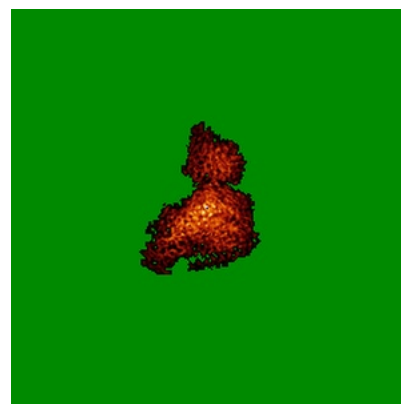
6.4.1 Primary map



X

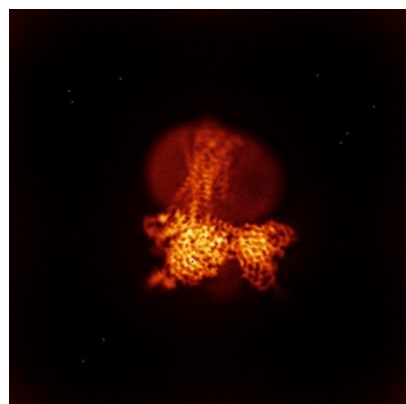


Y

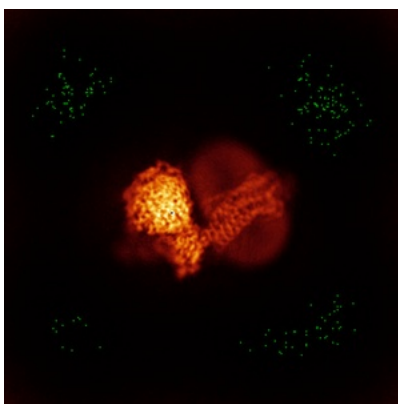


Z

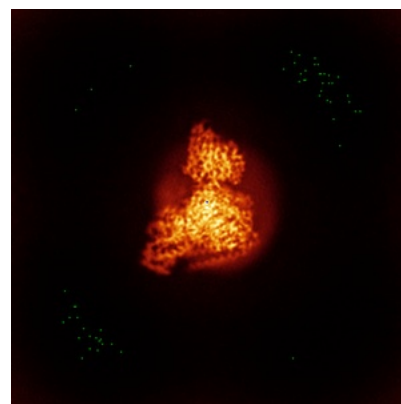
6.4.2 Raw map



X



Y

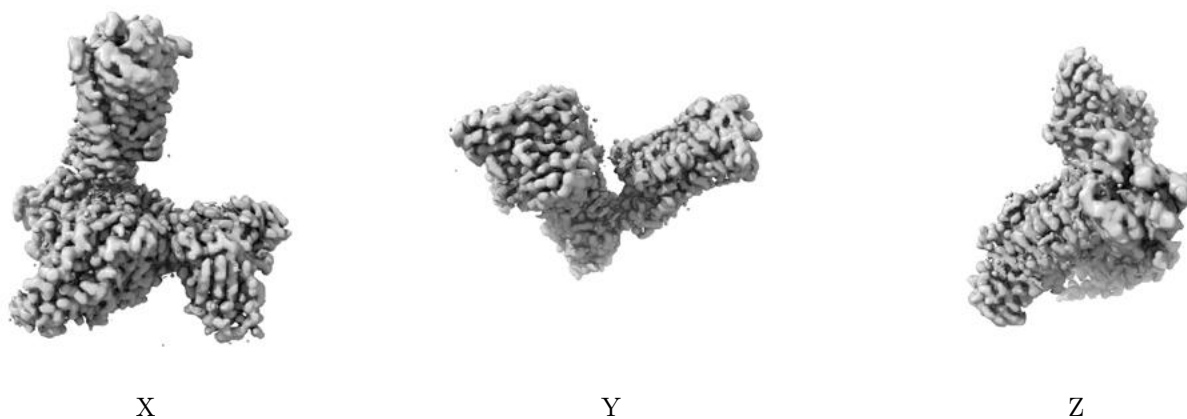


Z

The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

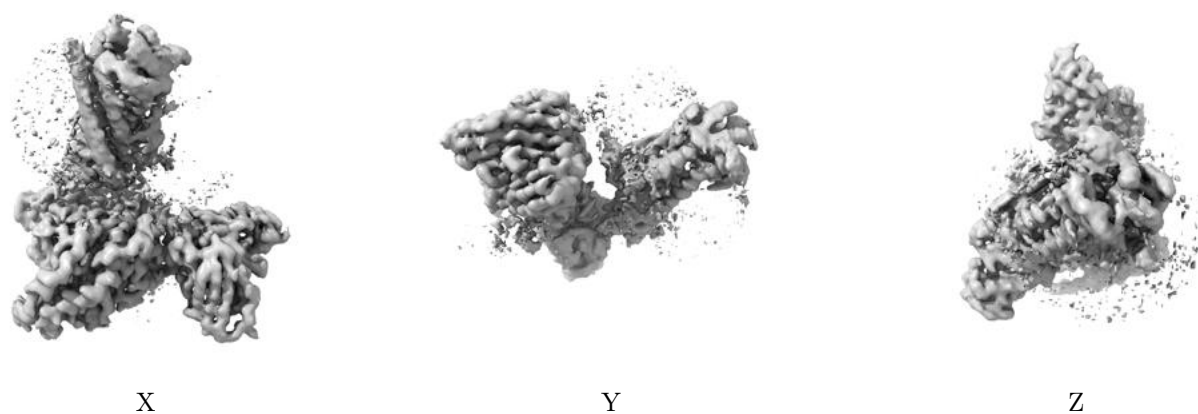
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.01. These images, in conjunction with the slice images, may facilitate assessment of whether an appropriate contour level has been provided.

6.5.2 Raw map



These images show the 3D surface of the raw map. The raw map's contour level was selected so that its surface encloses the same volume as the primary map does at its recommended contour level.

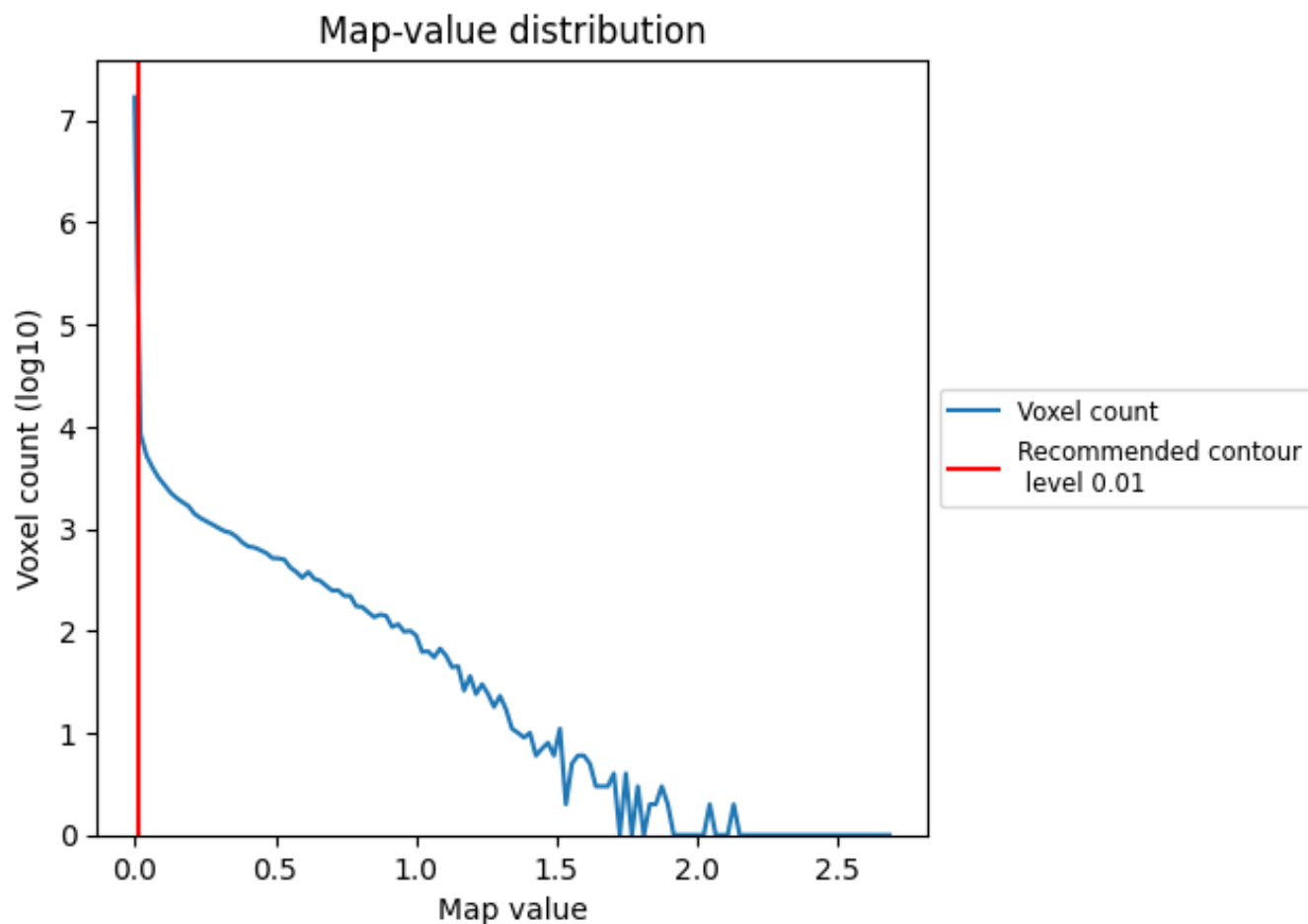
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

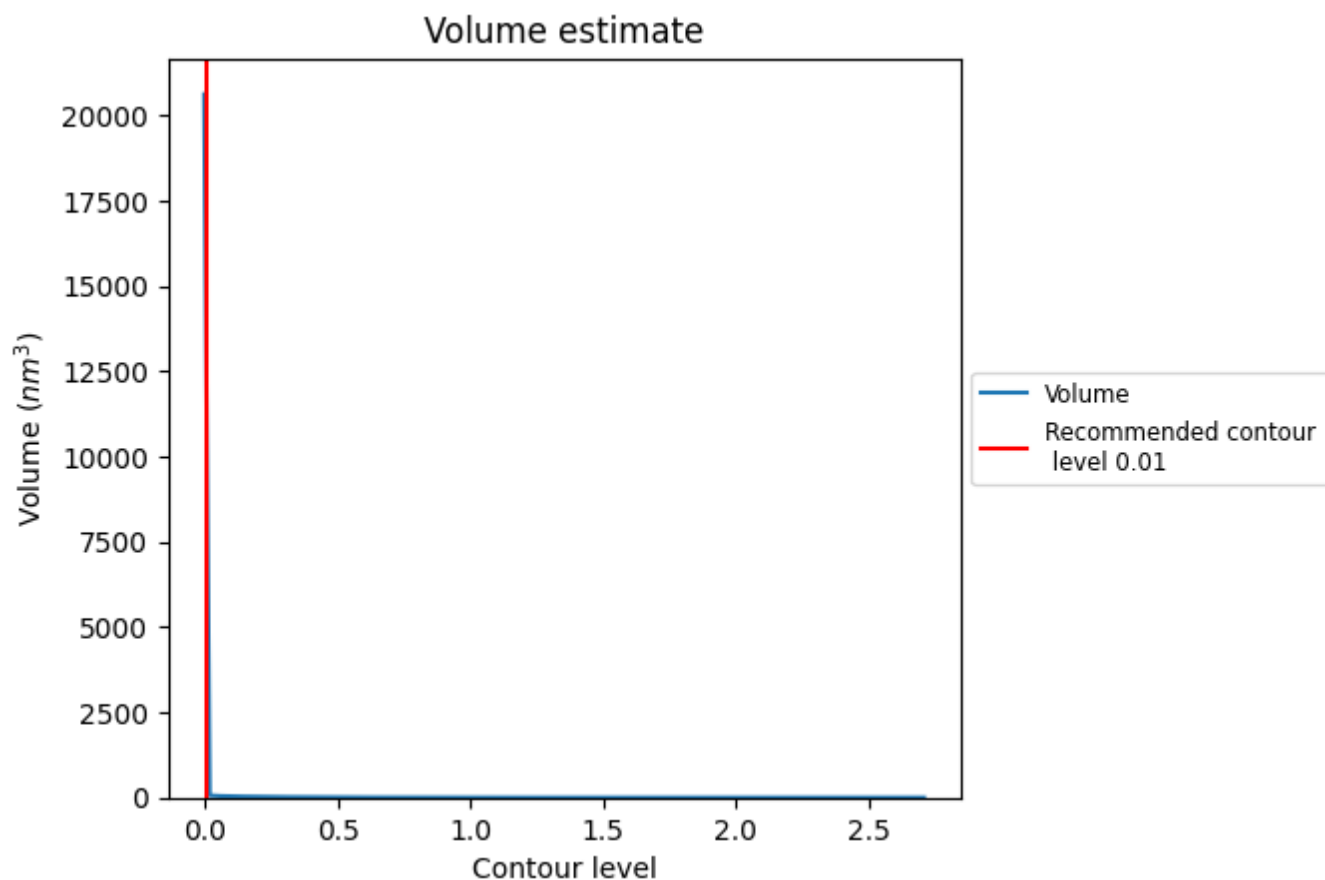
This section contains the results of statistical analysis of the map.

7.1 Map-value distribution [i](#)



The map-value distribution is plotted in 128 intervals along the x-axis. The y-axis is logarithmic. A spike in this graph at zero usually indicates that the volume has been masked.

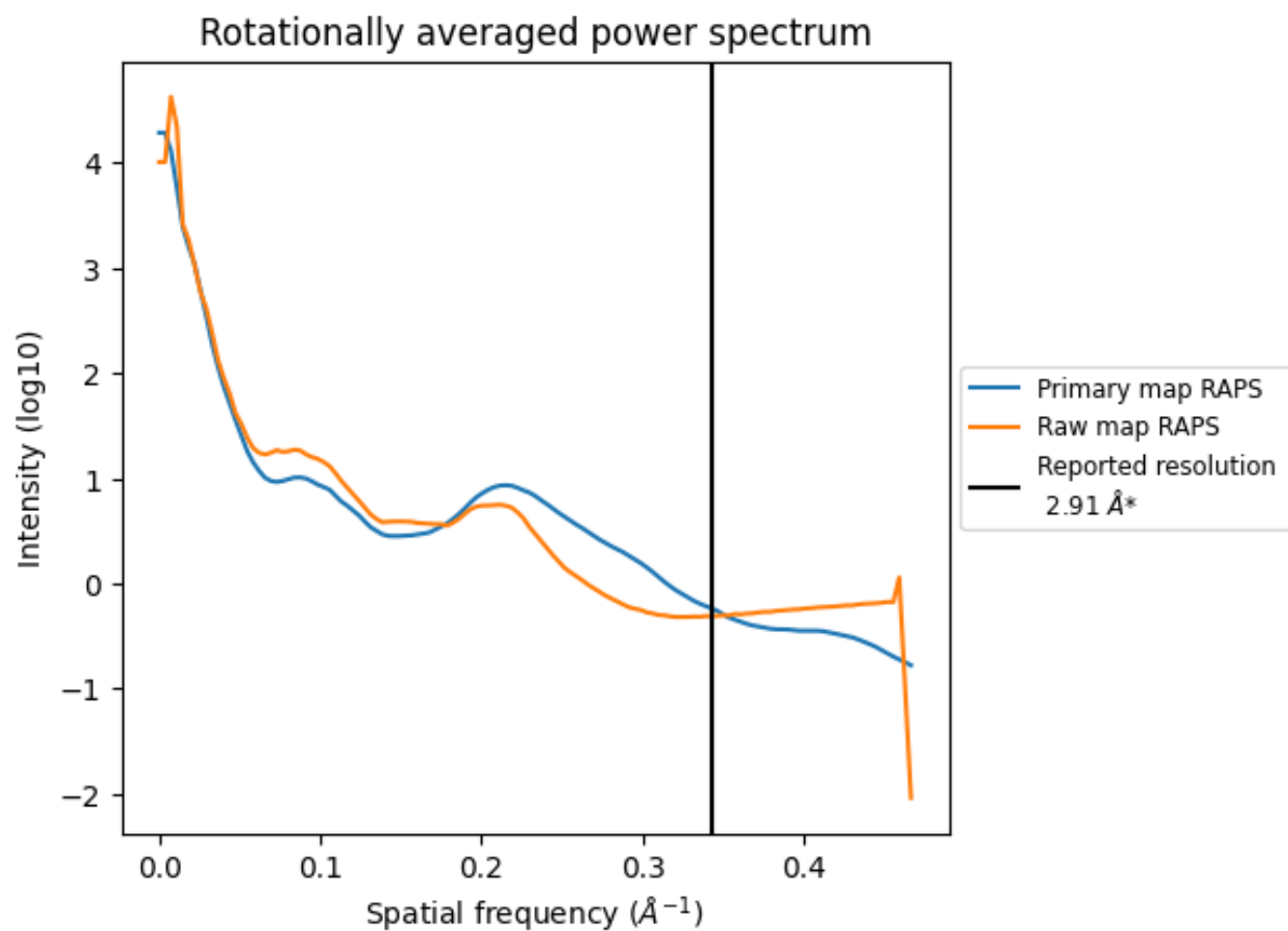
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 9180 nm^3 ; this corresponds to an approximate mass of 8293 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 ⓘ

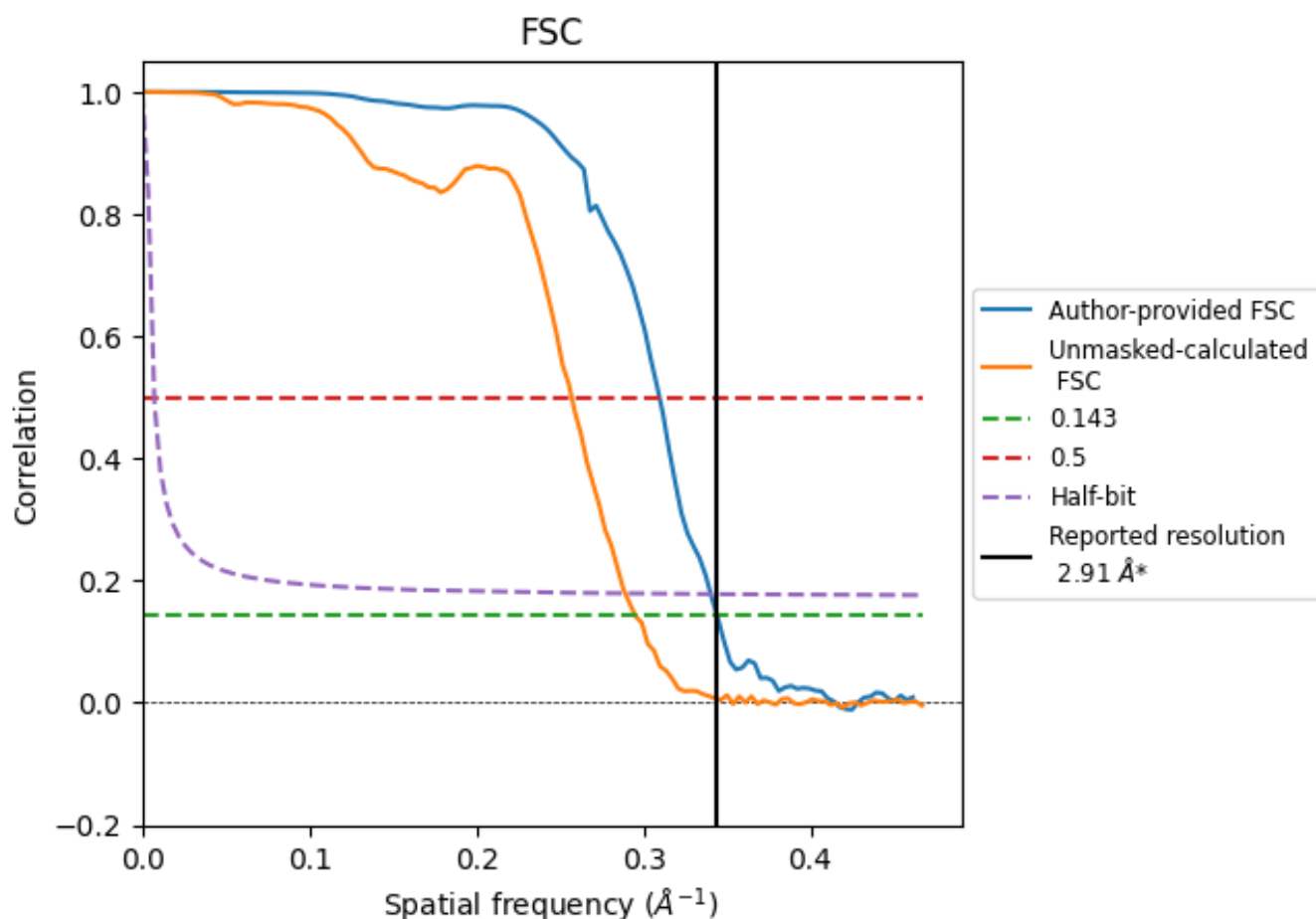


*Reported resolution corresponds to spatial frequency of 0.344 Å⁻¹

8 Fourier-Shell correlation [i](#)

Fourier-Shell Correlation (FSC) is the most commonly used method to estimate the resolution of single-particle and subtomogram-averaged maps. The shape of the curve depends on the imposed symmetry, mask and whether or not the two 3D reconstructions used were processed from a common reference. The reported resolution is shown as a black line. A curve is displayed for the half-bit criterion in addition to lines showing the 0.143 gold standard cut-off and 0.5 cut-off.

8.1 FSC [i](#)



*Reported resolution corresponds to spatial frequency of 0.344 $\text{\AA}^{-1}$

8.2 Resolution estimates [i](#)

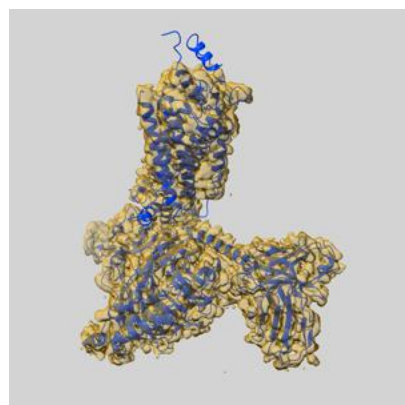
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	2.91	-	-
Author-provided FSC curve	2.91	3.23	2.94
Unmasked-calculated*	3.39	3.89	3.46

*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps. The value from deposited half-maps intersecting FSC 0.143 CUT-OFF 3.39 differs from the reported value 2.91 by more than 10 %

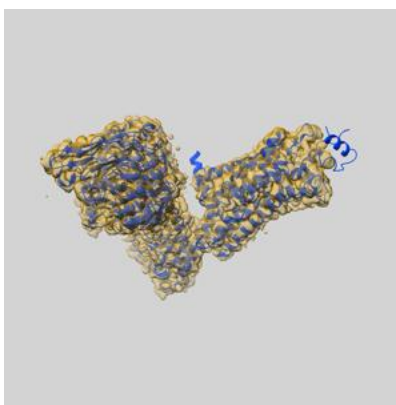
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-62297 and PDB model 9KFI. Per-residue inclusion information can be found in section [3](#) on page [7](#).

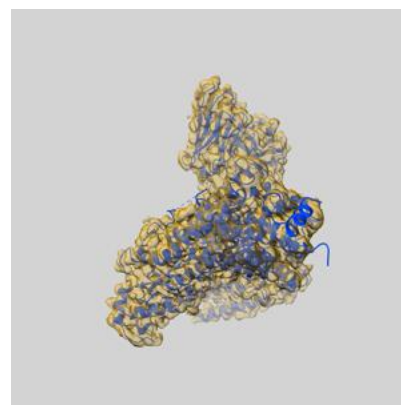
9.1 Map-model overlay [i](#)



X



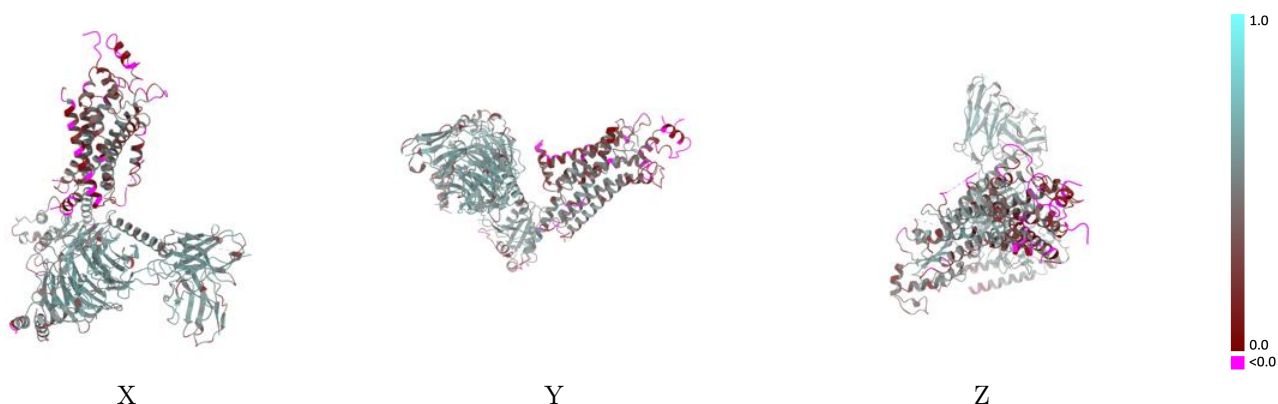
Y



Z

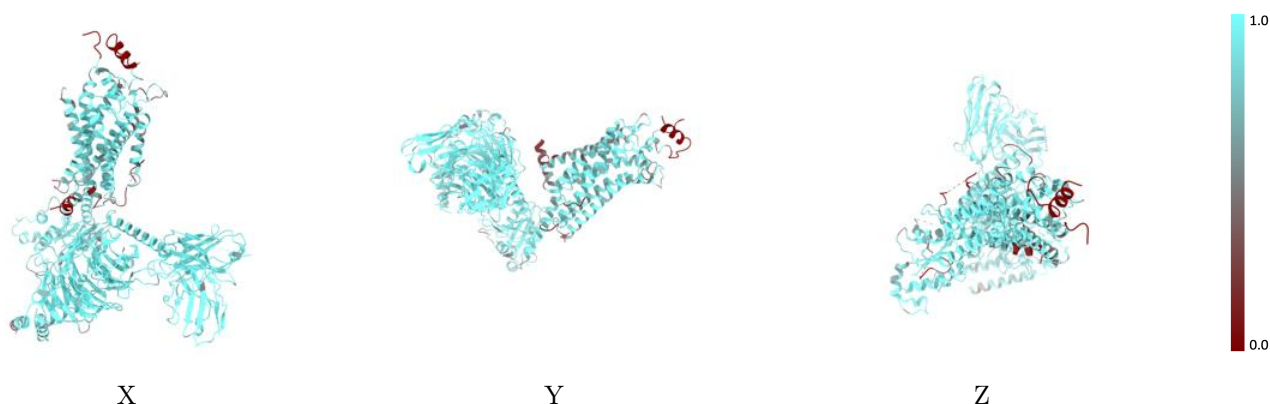
The images above show the 3D surface view of the map at the recommended contour level 0.01 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



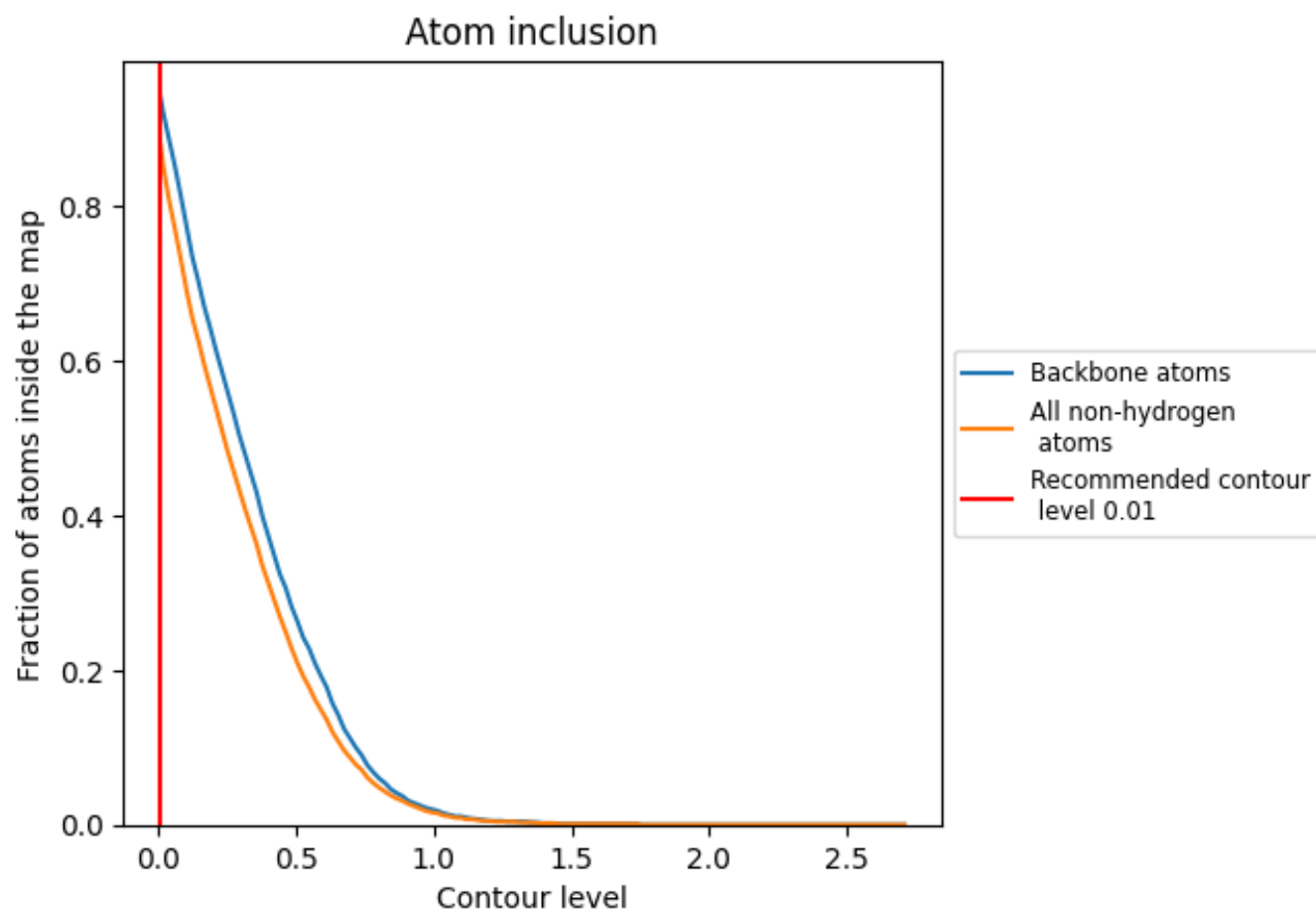
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.01).

9.4 Atom inclusion [i](#)



At the recommended contour level, 94% of all backbone atoms, 88% 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 (0.01) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.8790	0.4540
A	0.1910	-0.0120
B	0.7150	0.2610
C	0.7810	0.3000
G	0.8660	0.4460
I	0.9030	0.4720
S	0.9450	0.5370
T	0.9550	0.5660

1.0

0.0

<0.0