



wwPDB EM Validation Summary Report ⓘ

Mar 9, 2026 – 09:04 AM UTC

PDB ID : 7TIC / pdb_00007tic
EMDB ID : EMD-25569
Title : Structure of the yeast clamp loader (Replication Factor C RFC) bound to the sliding clamp (Proliferating Cell Nuclear Antigen PCNA) in an autoinhibited conformation
Authors : Gaubitz, C.; Liu, X.; Pajak, J.; Stone, N.; Hayes, J.; Demo, G.; Kelch, B.A.
Deposited on : 2022-01-13
Resolution : 3.90 Å (reported)
Based on initial model : 1SXJ

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.




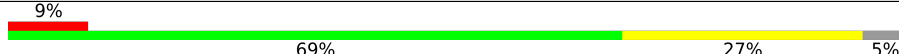
The types of validation reports are described at

<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
Mogul : 2022.3.0, CSD as543be (2022)
MolProbity : 4-5-2 with Phenix2.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
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

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Mol	Chain	Length	Quality of chain
5	E	354	
6	F	264	
6	G	264	
6	H	264	

2 Entry composition [i](#)

There are 9 unique types of molecules in this entry. The entry contains 20132 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 Replication factor C subunit 1.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	477	3774	2399	662	695	18	0	0

- Molecule 2 is a protein called Replication factor C subunit 4.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	B	314	2467	1555	440	459	13	0	0

- Molecule 3 is a protein called Replication factor C subunit 3.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
3	C	322	2546	1605	445	488	8	0	0

- Molecule 4 is a protein called Replication factor C subunit 2.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
4	D	322	2555	1618	439	488	10	0	0

- Molecule 5 is a protein called Replication factor C subunit 5.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
5	E	337	2662	1687	463	494	18	0	0

- Molecule 6 is a protein called Proliferating cell nuclear antigen.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
6	F	254	1995	1277	314	394	10	0	0

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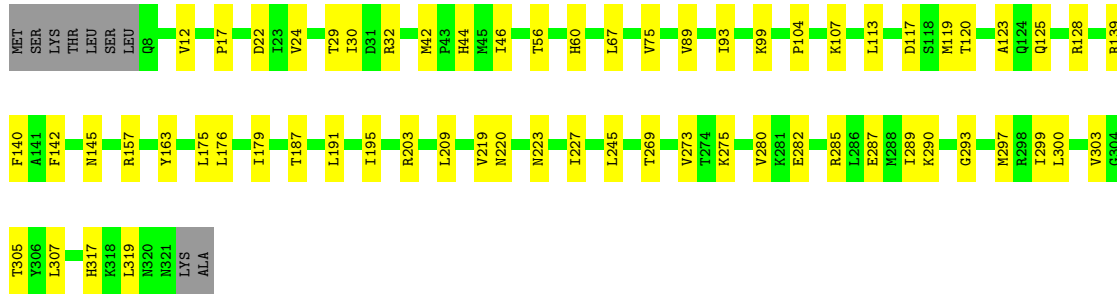
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Mol	Chain	Residues	Atoms					AltConf	Trace
6	G	255	Total	C	N	O	S	0	0
			2003	1281	316	396	10		
6	H	252	Total	C	N	O	S	0	0
			1975	1262	311	392	10		

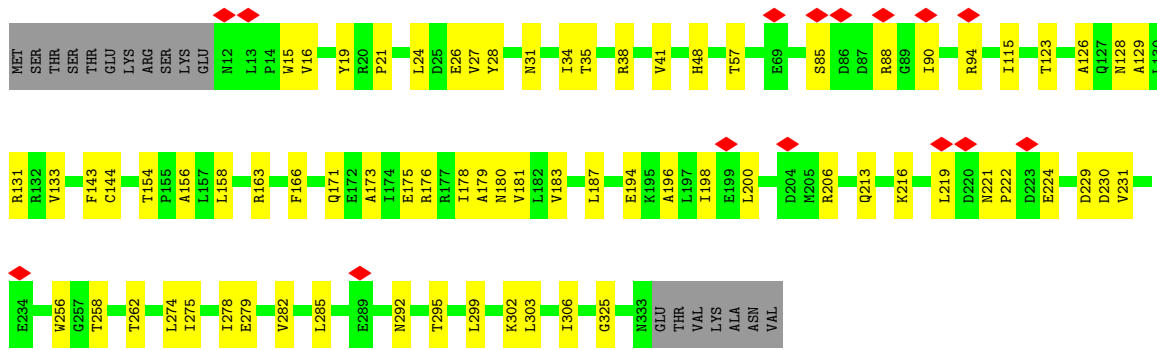
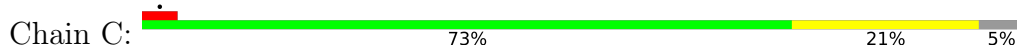
There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
F	-5	GLY	-	expression tag	UNP P15873
F	-4	PRO	-	expression tag	UNP P15873
F	-3	HIS	-	expression tag	UNP P15873
F	-2	MET	-	expression tag	UNP P15873
F	-1	ALA	-	expression tag	UNP P15873
F	0	SER	-	expression tag	UNP P15873
G	-5	GLY	-	expression tag	UNP P15873
G	-4	PRO	-	expression tag	UNP P15873
G	-3	HIS	-	expression tag	UNP P15873
G	-2	MET	-	expression tag	UNP P15873
G	-1	ALA	-	expression tag	UNP P15873
G	0	SER	-	expression tag	UNP P15873
H	-5	GLY	-	expression tag	UNP P15873
H	-4	PRO	-	expression tag	UNP P15873
H	-3	HIS	-	expression tag	UNP P15873
H	-2	MET	-	expression tag	UNP P15873
H	-1	ALA	-	expression tag	UNP P15873
H	0	SER	-	expression tag	UNP P15873

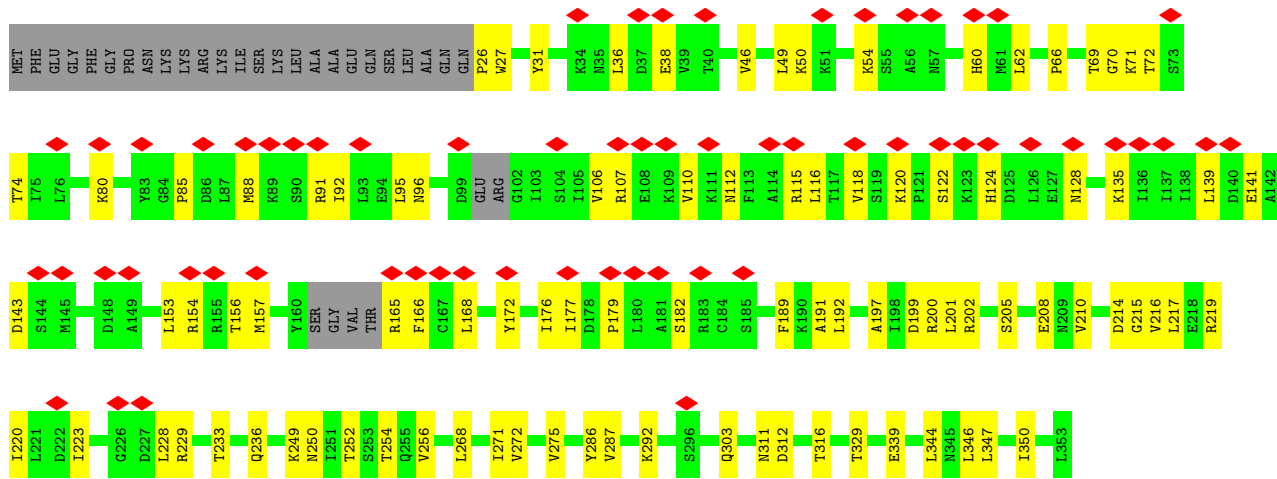
- Molecule 7 is PHOSPHOTHIOPHOSPHORIC ACID-ADENYLATE ESTER (CCD ID: AGS) (formula: C₁₀H₁₆N₅O₁₂P₃S) (labeled as "Ligand of Interest" by depositor).



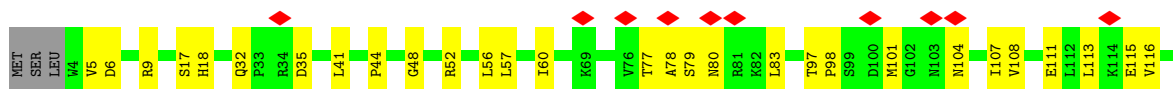
• Molecule 3: Replication factor C subunit 3

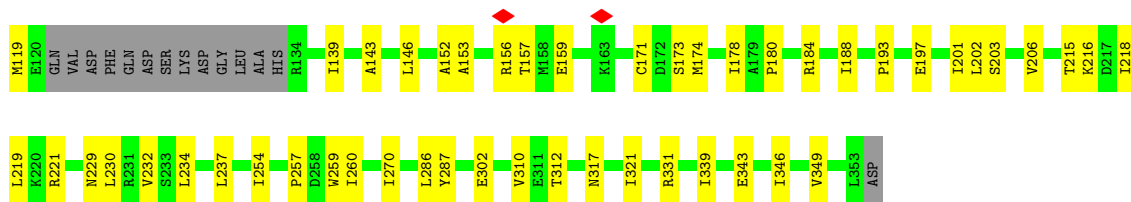


• Molecule 4: Replication factor C subunit 2

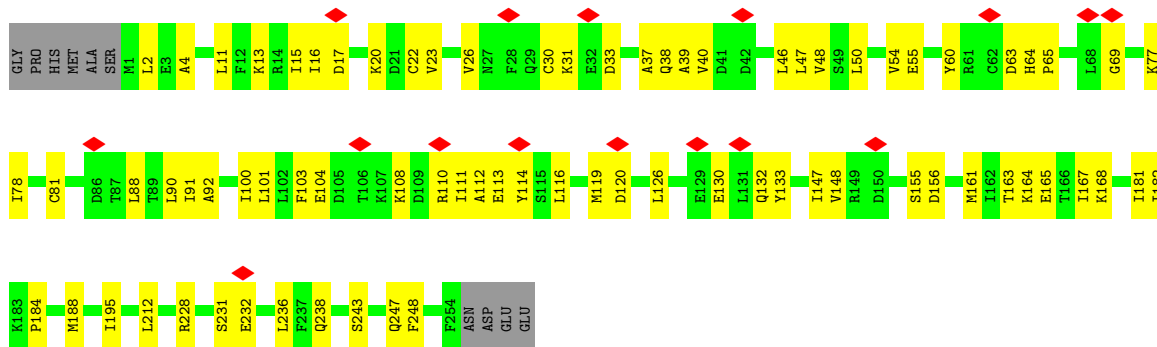


• Molecule 5: Replication factor C subunit 5

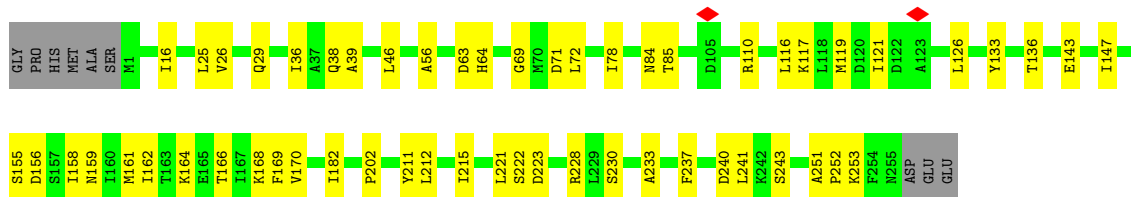
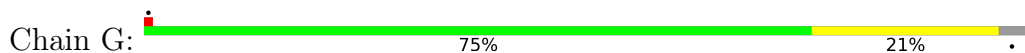




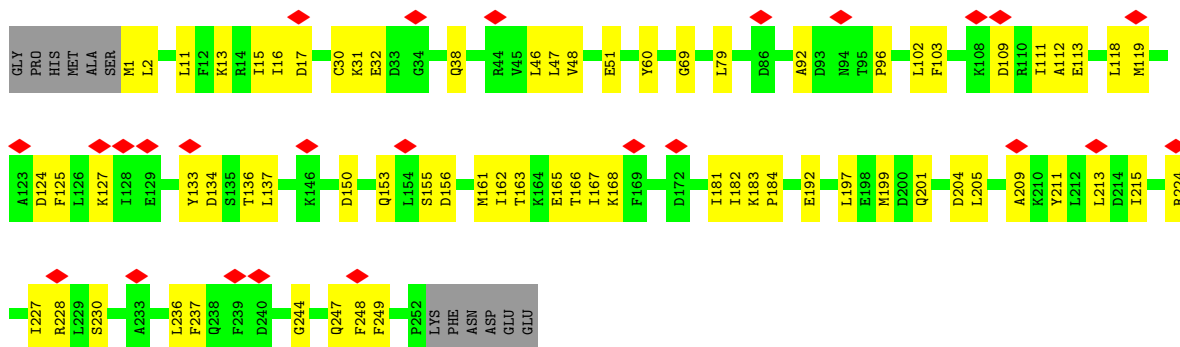
• Molecule 6: Proliferating cell nuclear antigen



• Molecule 6: Proliferating cell nuclear antigen



• Molecule 6: Proliferating cell nuclear antigen



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	68227	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	50	Depositor
Minimum defocus (nm)	1100	Depositor
Maximum defocus (nm)	2400	Depositor
Magnification	130000	Depositor
Image detector	GATAN K2 SUMMIT (4k x 4k)	Depositor
Maximum map value	14.462	Depositor
Minimum map value	-8.129	Depositor
Average map value	-0.000	Depositor
Map value standard deviation	1.000	Depositor
Recommended contour level	0.8	Depositor
Map size (Å)	128.139, 142.965, 133.434	wwPDB
Map dimensions	126, 135, 121	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.059, 1.059, 1.059	Depositor

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: AGS, MG, ADP

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	0.13	0/3850	0.35	0/5199
2	B	0.10	0/2502	0.29	0/3374
3	C	0.12	0/2586	0.34	0/3499
4	D	0.12	0/2598	0.35	0/3510
5	E	0.12	0/2699	0.33	0/3646
6	F	0.13	0/2025	0.37	0/2731
6	G	0.11	0/2033	0.32	0/2742
6	H	0.13	0/2004	0.36	0/2704
All	All	0.12	0/20297	0.34	0/27405

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	3774	0	3817	74	0
2	B	2467	0	2553	45	0
3	C	2546	0	2577	44	0
4	D	2555	0	2587	64	0
5	E	2662	0	2790	48	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	F	1995	0	2019	48	0
6	G	2003	0	2025	34	0
6	H	1975	0	1997	53	0
7	A	31	0	12	3	0
7	B	31	0	12	3	0
7	C	31	0	12	2	0
7	D	31	0	12	1	0
8	A	1	0	0	0	0
8	B	1	0	0	0	0
8	C	1	0	0	0	0
8	D	1	0	0	0	0
9	E	27	0	12	1	0
All	All	20132	0	20425	388	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 388 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)
6:H:51:GLU:O	6:H:244:GLY:HA3	1.78	0.81
3:C:219:LEU:HD11	3:C:231:VAL:HG21	1.63	0.80
4:D:141:GLU:HG3	5:E:156:ARG:HH21	1.52	0.74
5:E:18:HIS:ND1	5:E:197:GLU:OE1	2.19	0.74
2:B:305:THR:HG22	2:B:307:LEU:H	1.54	0.72

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

There are no protein backbone outliers to report in this entry.

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	412/742 (56%)	412 (100%)	0	100	100
2	B	275/283 (97%)	275 (100%)	0	100	100
3	C	279/296 (94%)	279 (100%)	0	100	100
4	D	287/312 (92%)	287 (100%)	0	100	100
5	E	309/324 (95%)	309 (100%)	0	100	100
6	F	229/237 (97%)	229 (100%)	0	100	100
6	G	230/237 (97%)	230 (100%)	0	100	100
6	H	227/237 (96%)	227 (100%)	0	100	100
All	All	2248/2668 (84%)	2248 (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. 5 of 36 such sidechains are listed below:

Mol	Chain	Res	Type
6	F	38	GLN
6	H	132	GLN
6	F	58	GLN
6	G	132	GLN
2	B	177	GLN

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 9 ligands modelled in this entry, 4 are monoatomic - leaving 5 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
7	AGS	A	901	8	32,33,33	0.48	1 (3%)	45,52,52	0.68	1 (2%)
9	ADP	E	401	-	28,29,29	1.41	4 (14%)	43,45,45	1.83	9 (20%)
7	AGS	D	401	8	32,33,33	0.52	1 (3%)	45,52,52	0.67	1 (2%)
7	AGS	C	401	8	32,33,33	0.48	1 (3%)	45,52,52	0.66	1 (2%)
7	AGS	B	401	8	32,33,33	0.49	1 (3%)	45,52,52	0.68	1 (2%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
7	AGS	A	901	8	-	5/21/38/38	0/3/3/3
9	ADP	E	401	-	-	0/16/32/32	0/3/3/3
7	AGS	D	401	8	-	7/21/38/38	0/3/3/3
7	AGS	C	401	8	-	2/21/38/38	0/3/3/3
7	AGS	B	401	8	-	2/21/38/38	0/3/3/3

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
9	E	401	ADP	C5-C4	4.68	1.47	1.39
9	E	401	ADP	C5-C6	2.70	1.48	1.41
9	E	401	ADP	C8-N7	2.37	1.36	1.31
9	E	401	ADP	C5-N7	-2.31	1.34	1.39
7	D	401	AGS	PG-S1G	2.16	1.95	1.90

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
9	E	401	ADP	C5-C4-N3	-5.87	118.64	126.72
9	E	401	ADP	N3-C4-N9	4.55	134.90	127.17
7	A	901	AGS	PB-O3B-PG	-3.74	119.48	133.17
7	B	401	AGS	PB-O3B-PG	-3.72	119.55	133.17
9	E	401	ADP	C2-N3-C4	3.66	120.78	111.83

There are no chirality outliers.

5 of 16 torsion outliers are listed below:

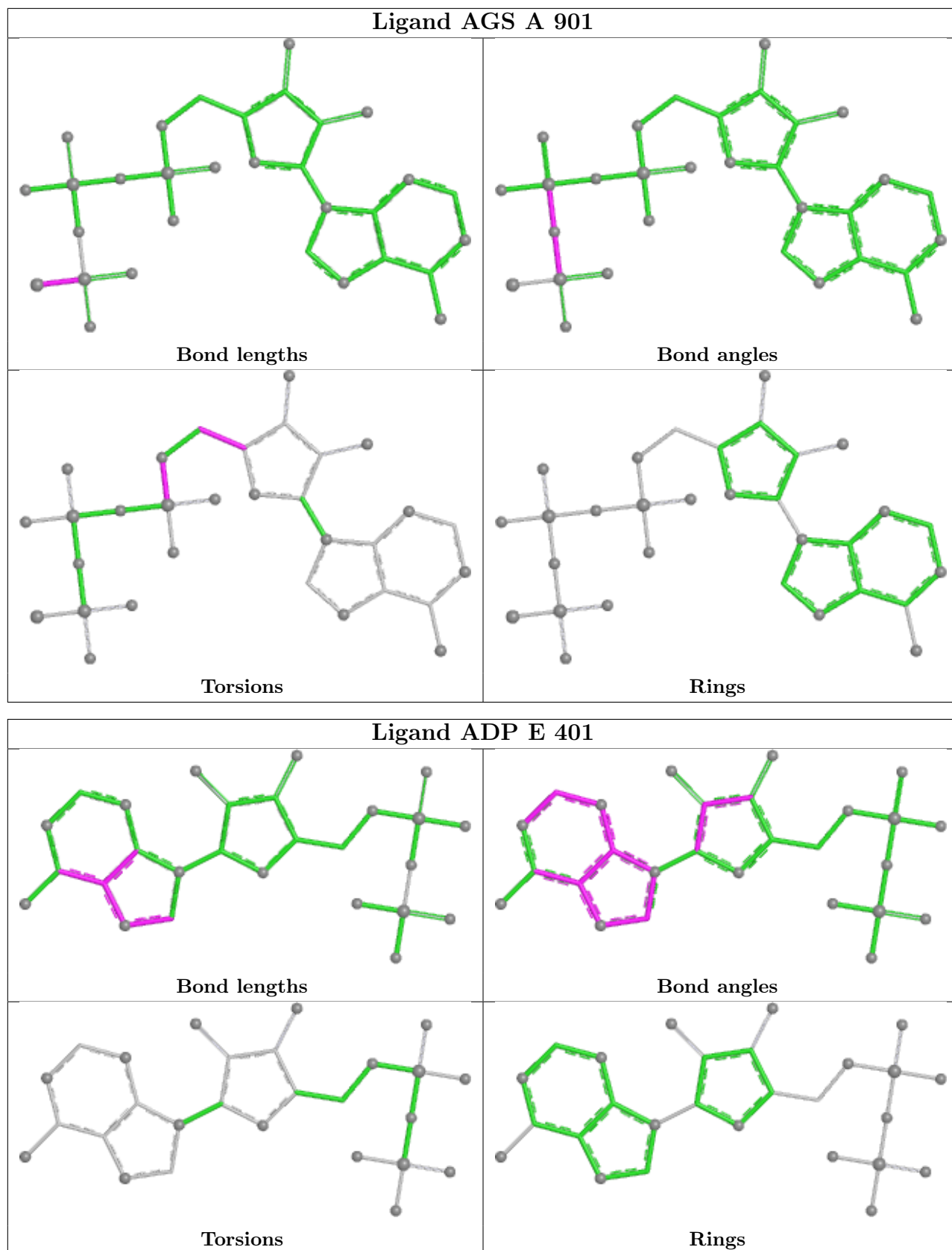
Mol	Chain	Res	Type	Atoms
7	A	901	AGS	C5'-O5'-PA-O1A
7	A	901	AGS	C5'-O5'-PA-O3A
7	A	901	AGS	O4'-C4'-C5'-O5'
7	B	401	AGS	PB-O3B-PG-O3G
7	C	401	AGS	PB-O3B-PG-O3G

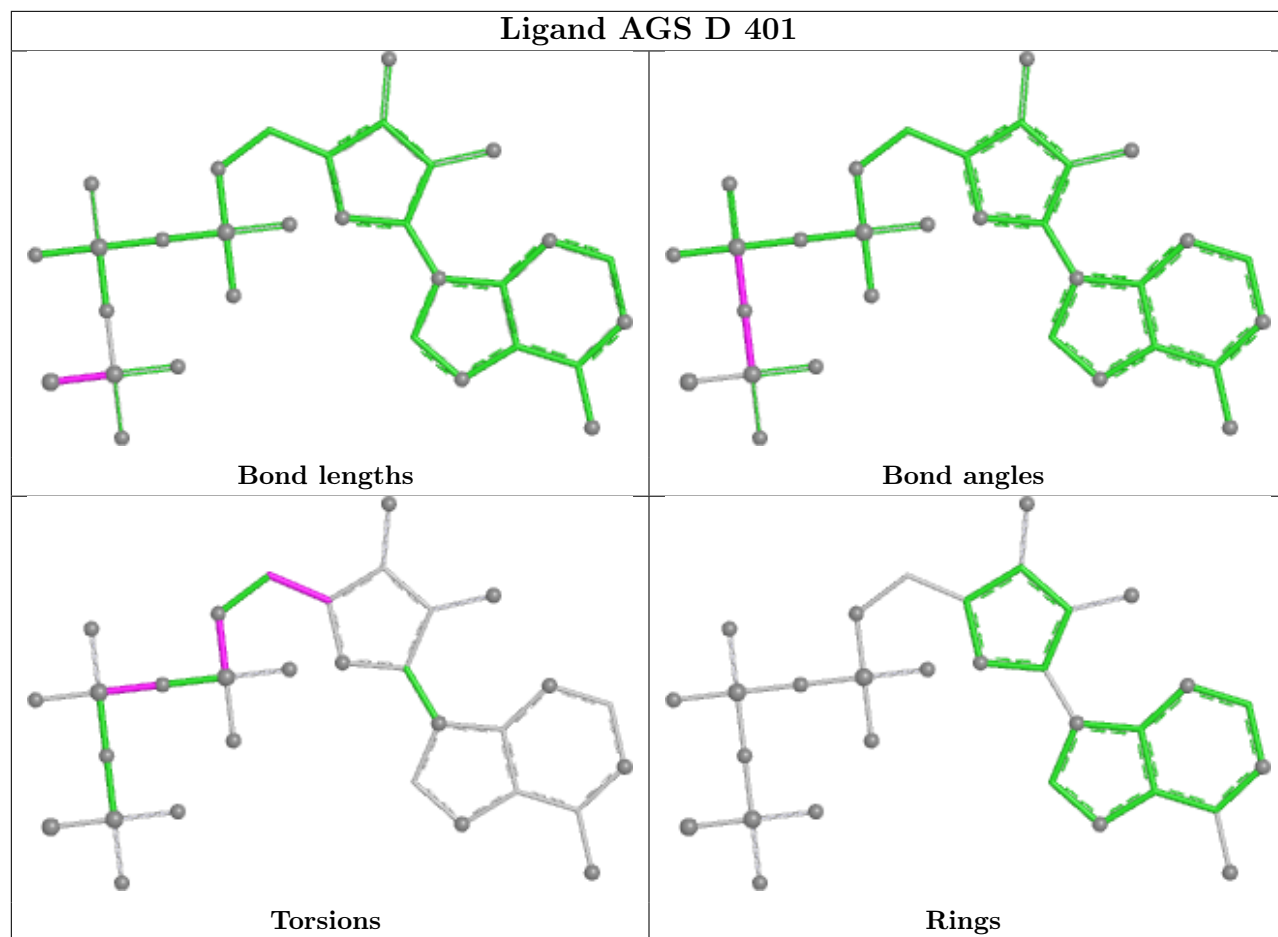
There are no ring outliers.

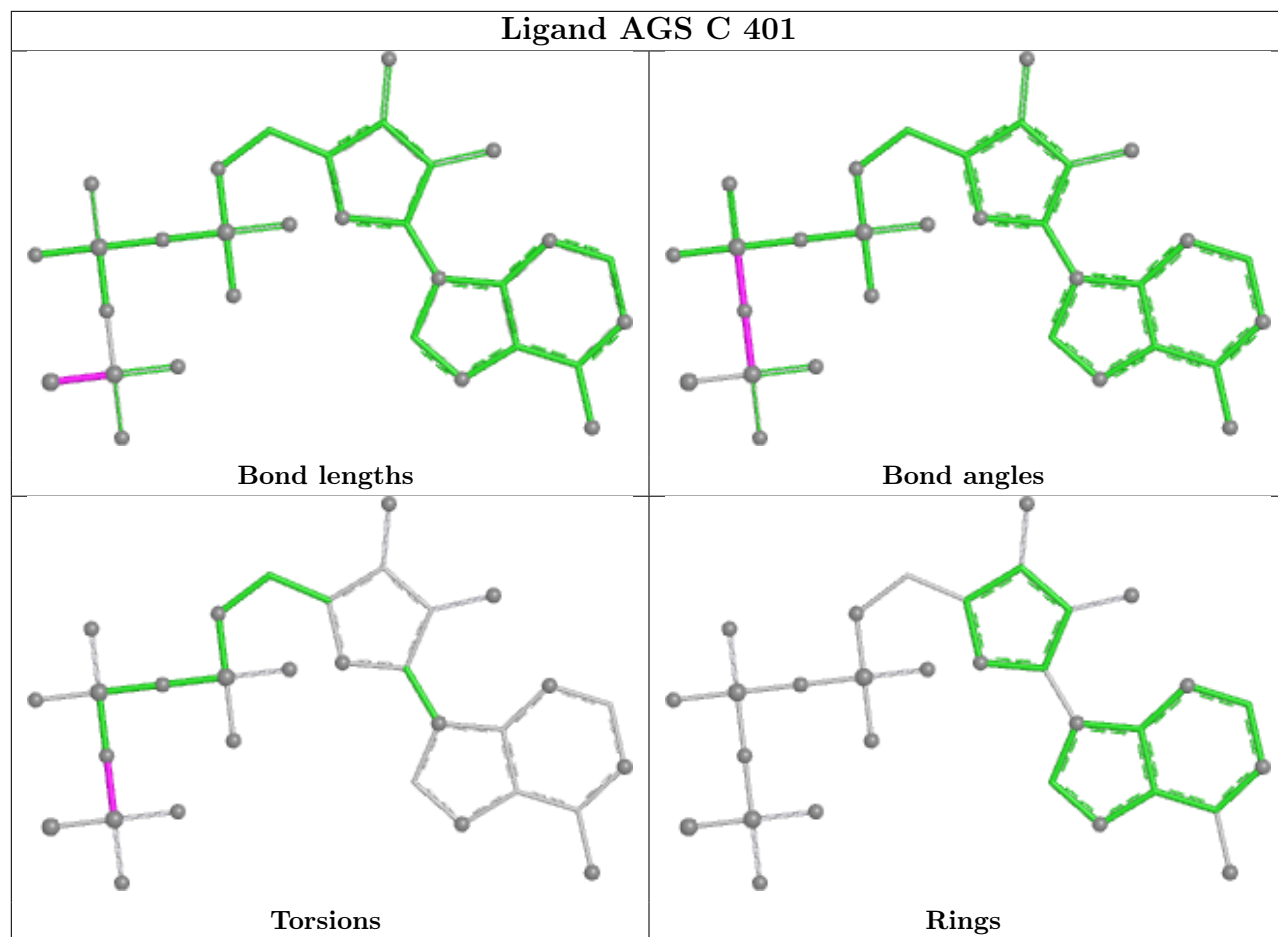
5 monomers are involved in 10 short contacts:

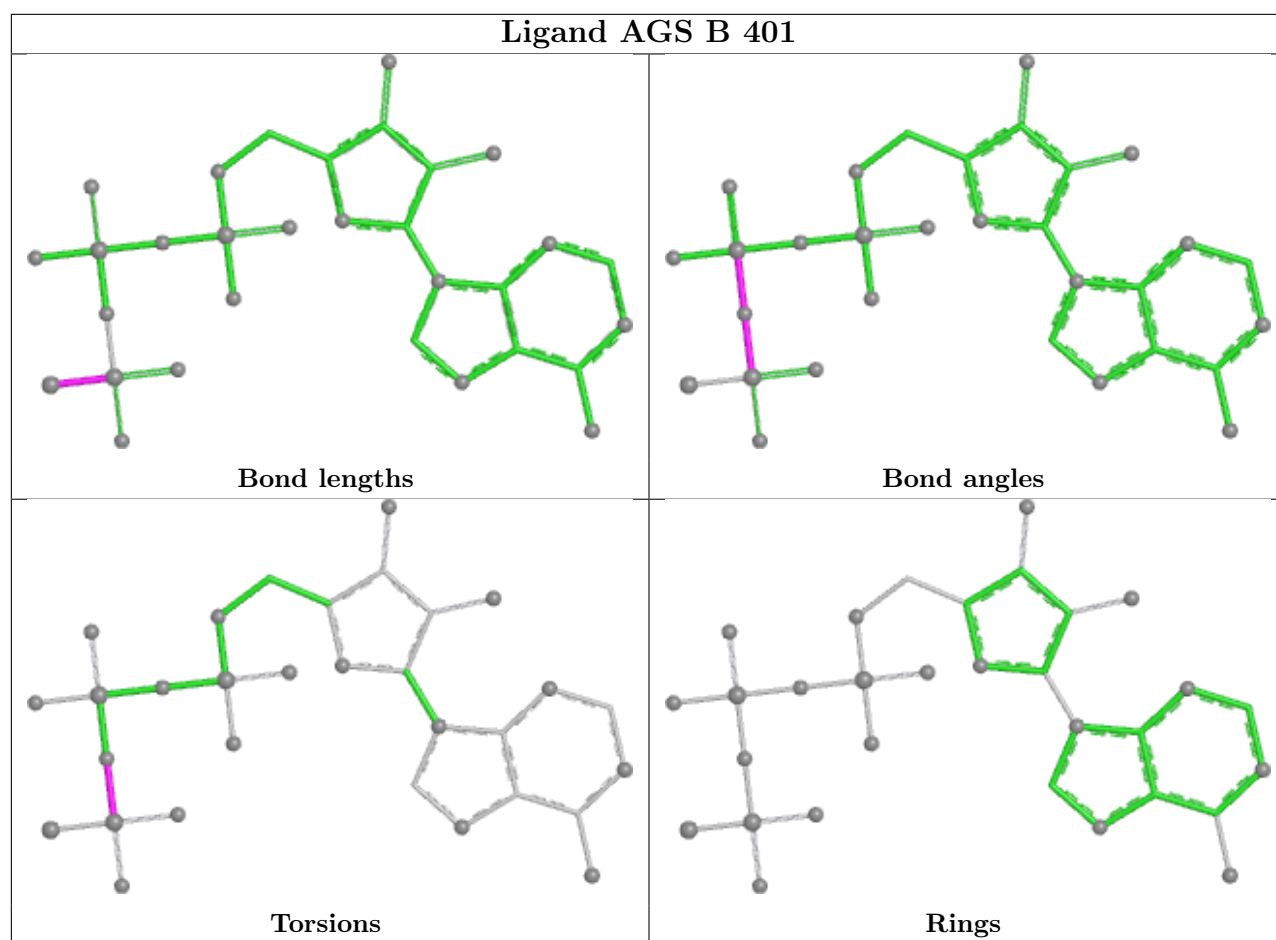
Mol	Chain	Res	Type	Clashes	Symm-Clashes
7	A	901	AGS	3	0
9	E	401	ADP	1	0
7	D	401	AGS	1	0
7	C	401	AGS	2	0
7	B	401	AGS	3	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.









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.

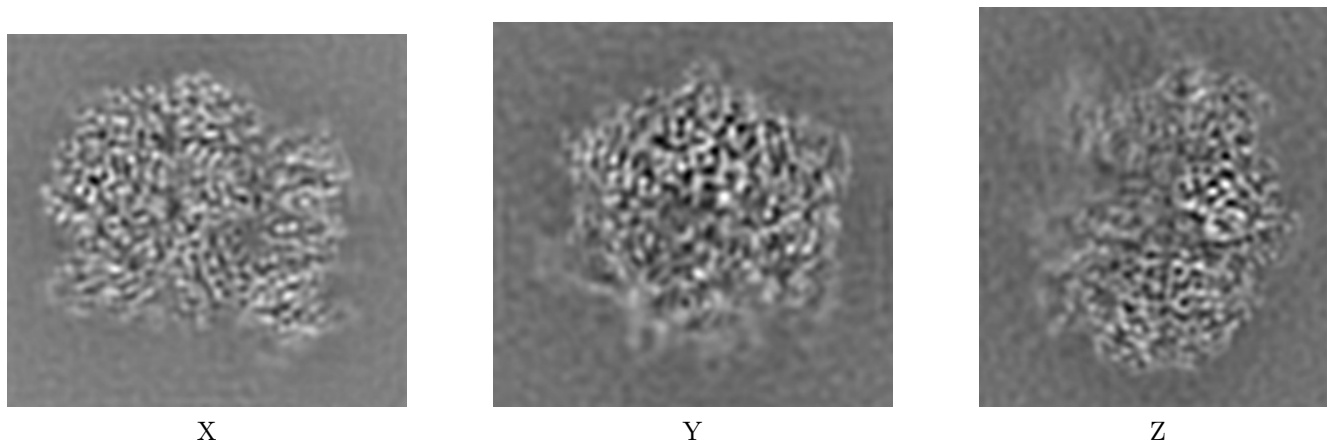
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-25569. These allow visual inspection of the internal detail of the map and identification of artifacts.

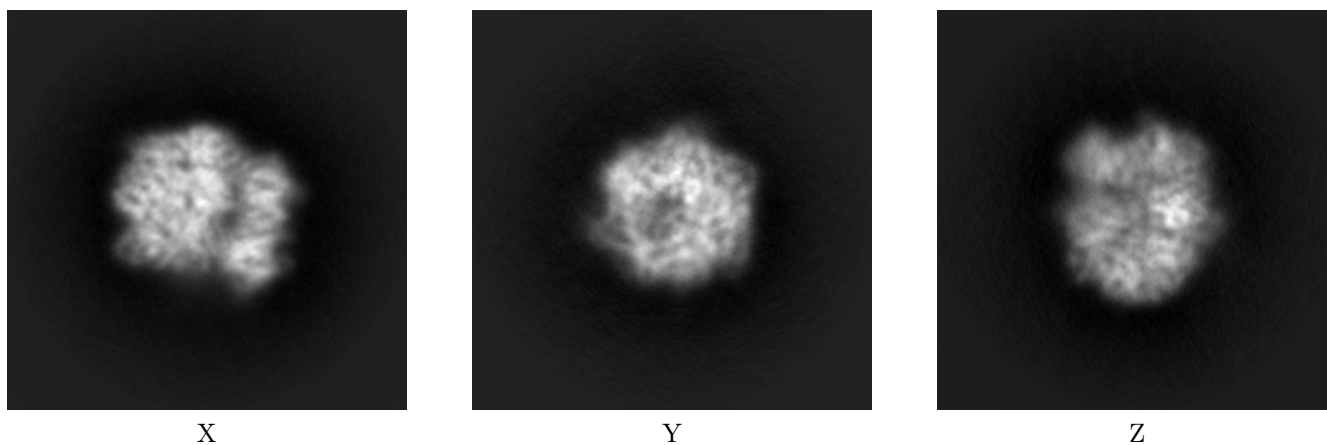
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

6.1.1 Primary map



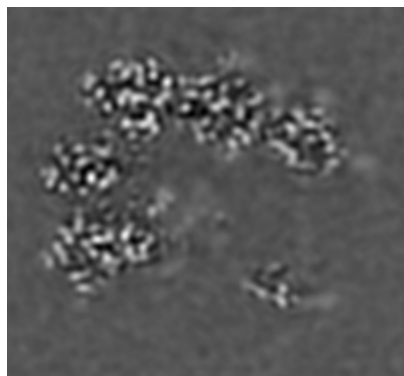
6.1.2 Raw map



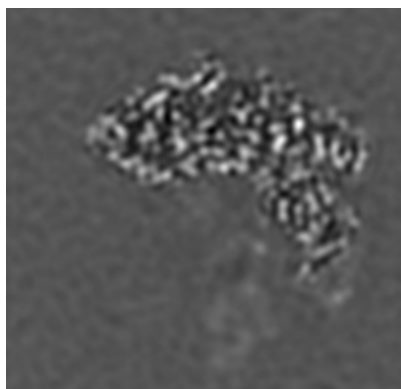
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

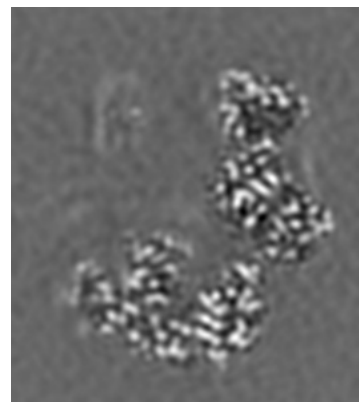
6.2.1 Primary map



X Index: 60

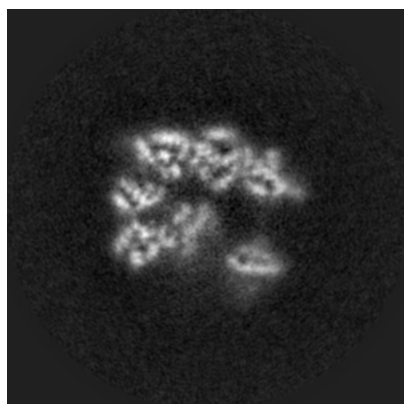


Y Index: 67

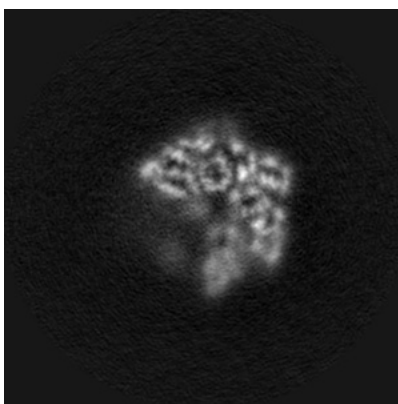


Z Index: 63

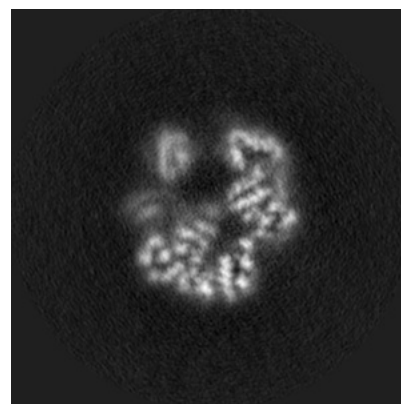
6.2.2 Raw map



X Index: 120



Y Index: 120

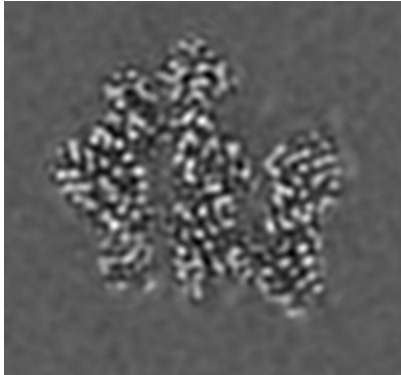


Z Index: 120

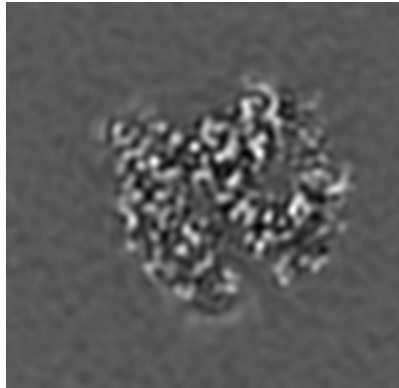
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

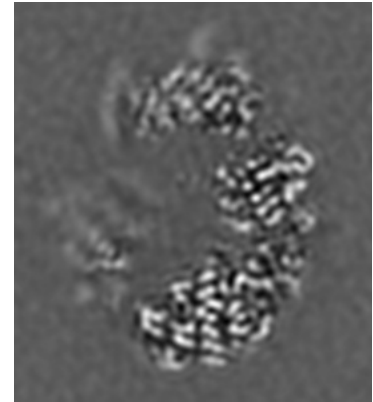
6.3.1 Primary map



X Index: 77

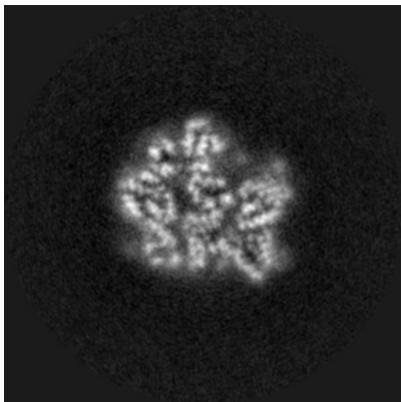


Y Index: 34

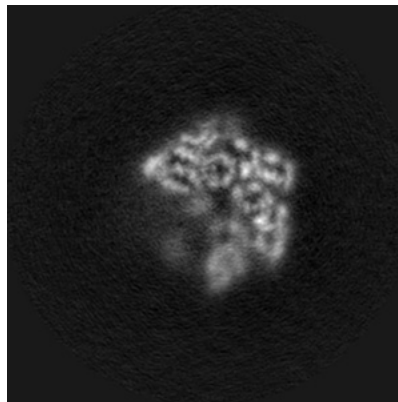


Z Index: 73

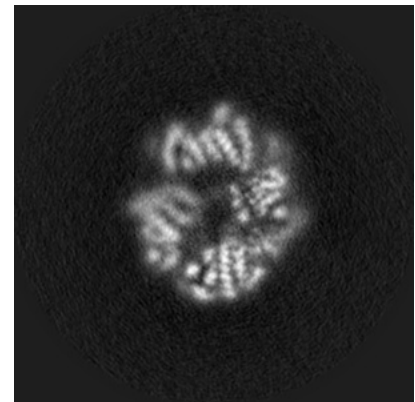
6.3.2 Raw map



X Index: 138



Y Index: 119

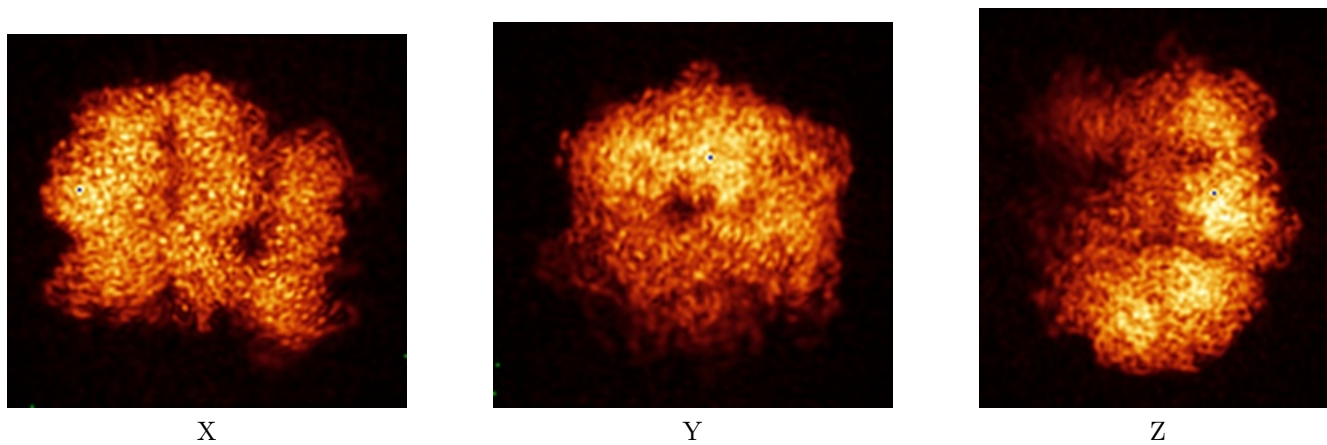


Z Index: 129

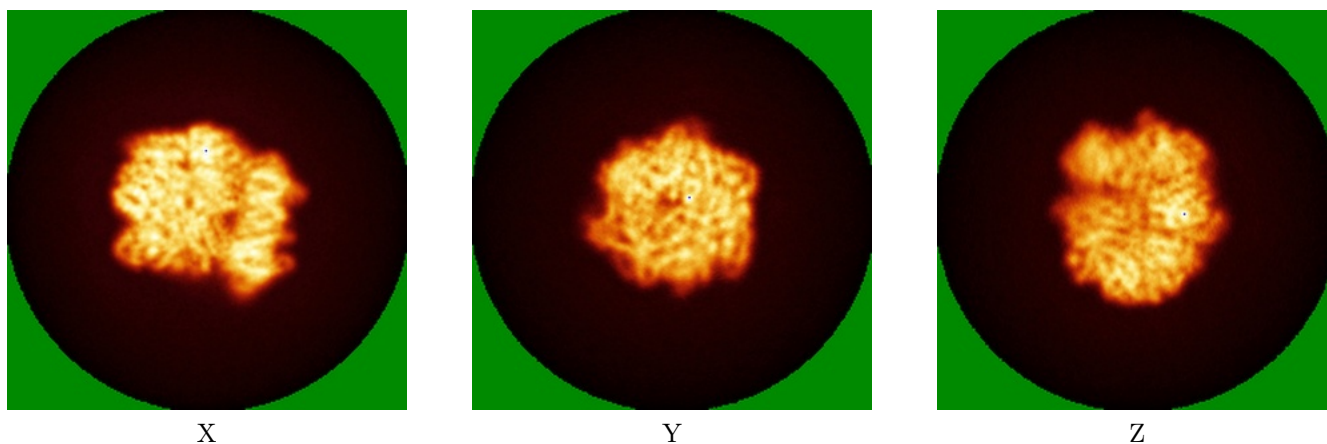
The images above show the largest variance slices of the map in three orthogonal directions.

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

6.4.1 Primary map



6.4.2 Raw map



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](#)

This section was not generated.

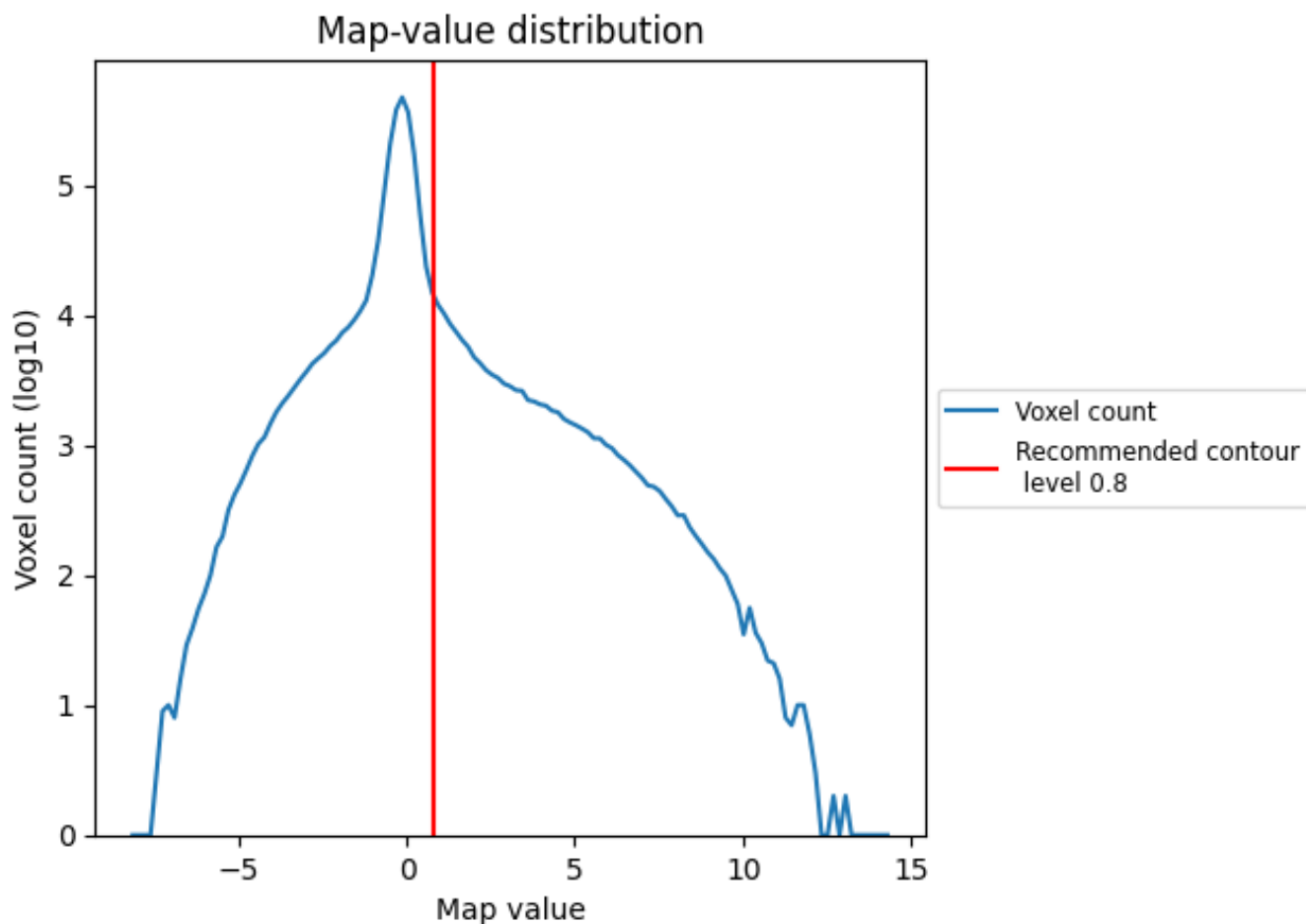
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

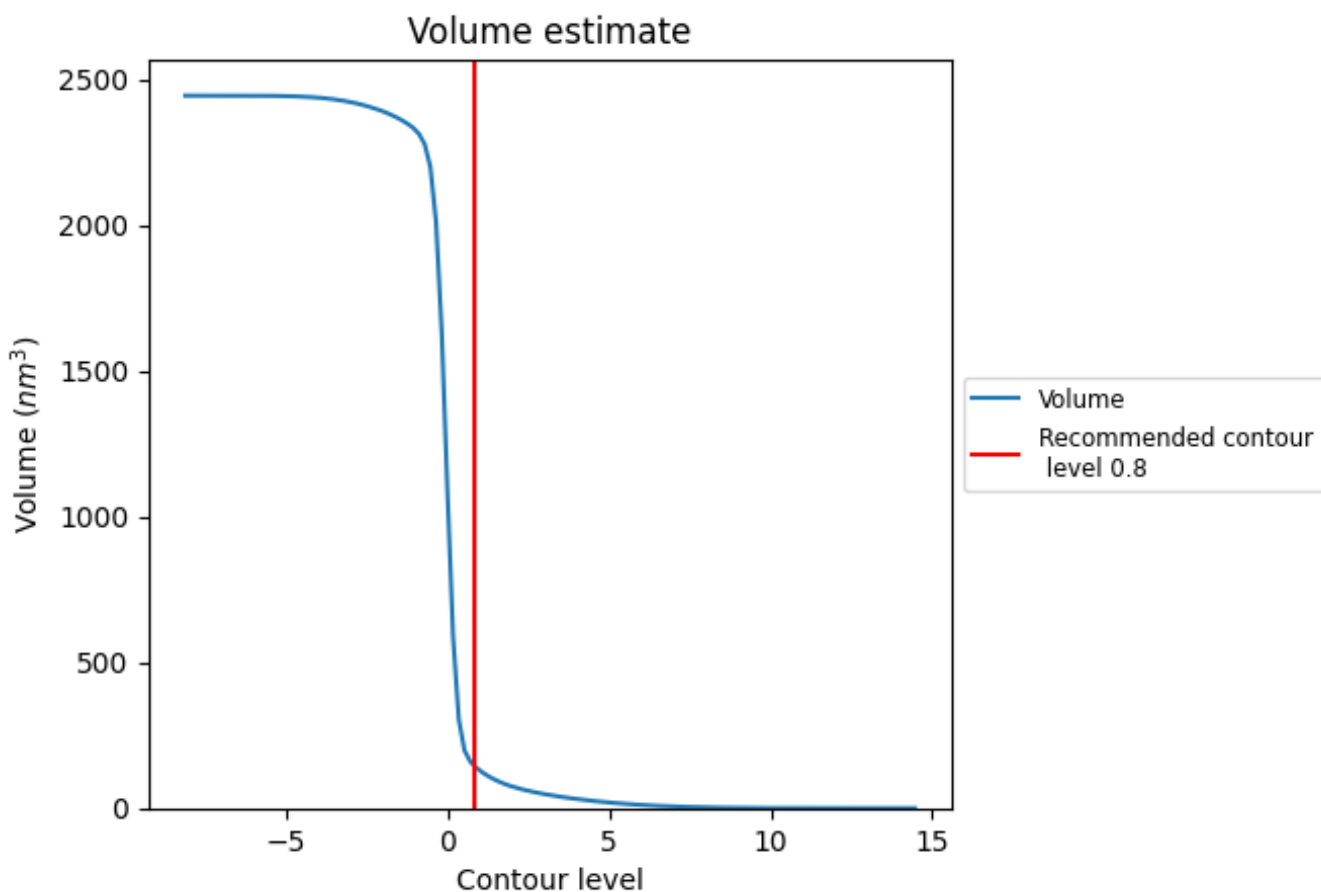
This section contains the results of statistical analysis of the map.

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 148 nm³; this corresponds to an approximate mass of 134 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.

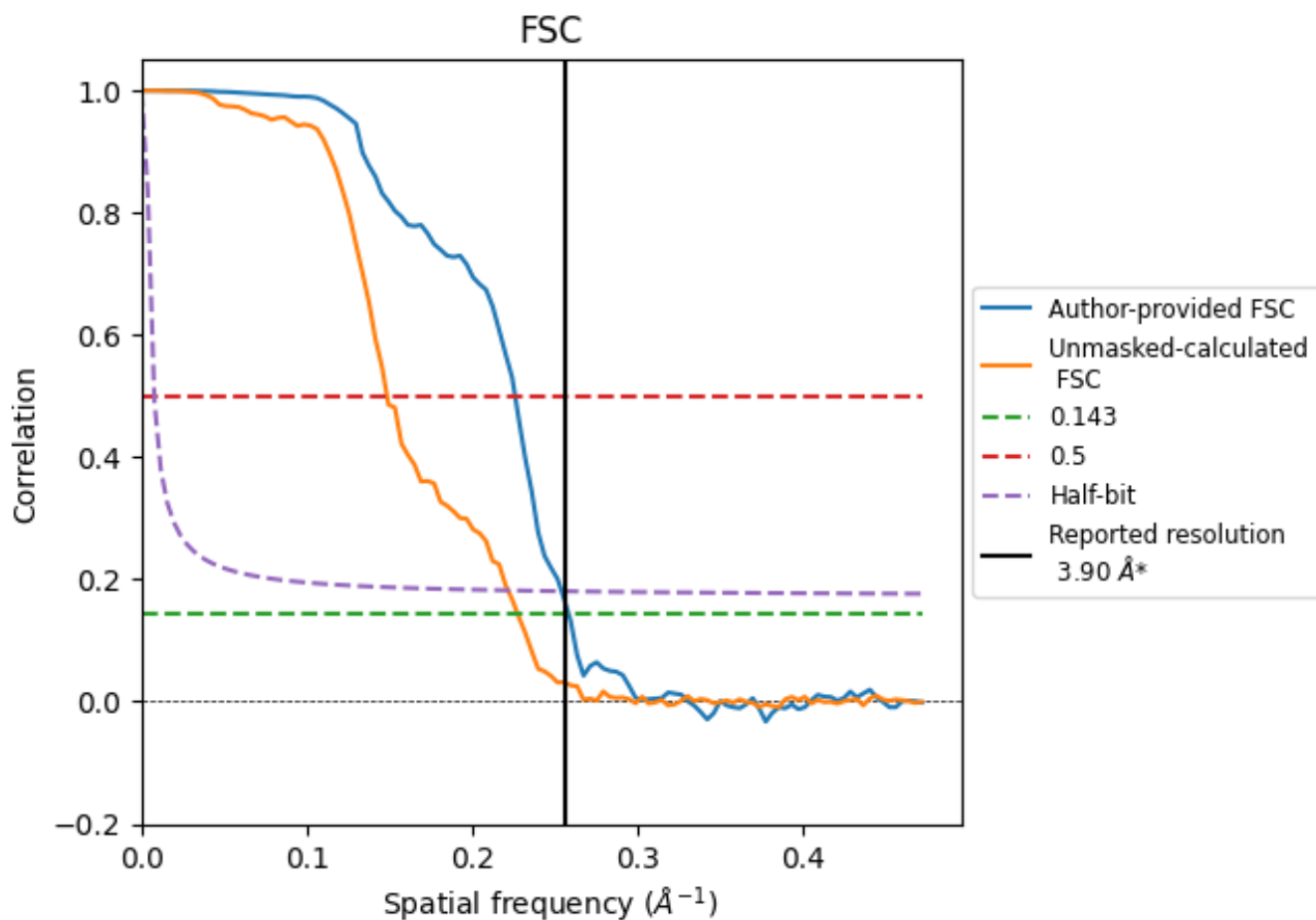
7.3 Rotationally averaged power spectrum [i](#)

This section was not generated. The rotationally averaged power spectrum is only generated for cubic maps.

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 0.256 Å⁻¹

8.2 Resolution estimates [i](#)

Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.90	-	-
Author-provided FSC curve	3.87	4.42	3.93
Unmasked-calculated*	4.39	6.73	4.51

*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 4.39 differs from the reported value 3.9 by more than 10 %

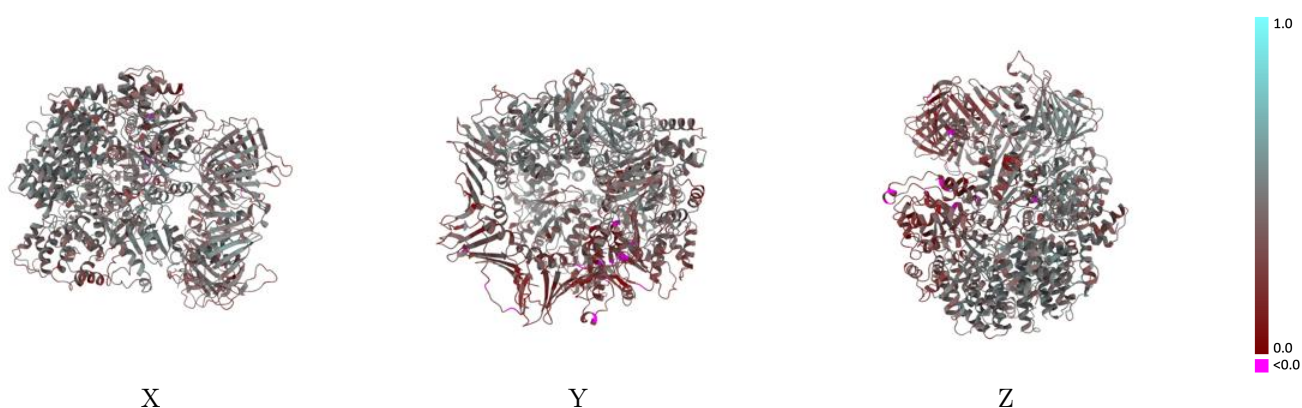
9 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-25569 and PDB model 7TIC. Per-residue inclusion information can be found in section 3 on page 8.

9.1 Map-model overlay [i](#)

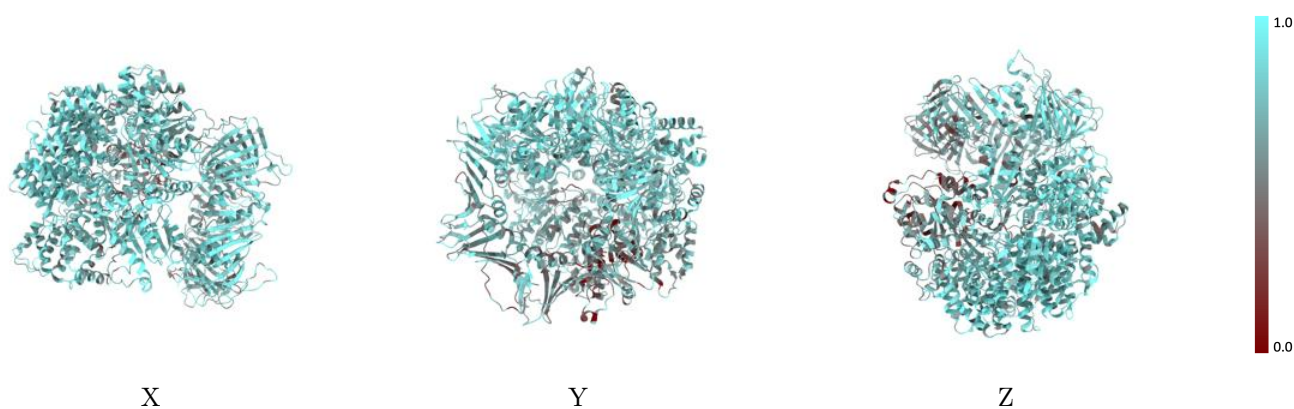
This section was not generated.

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



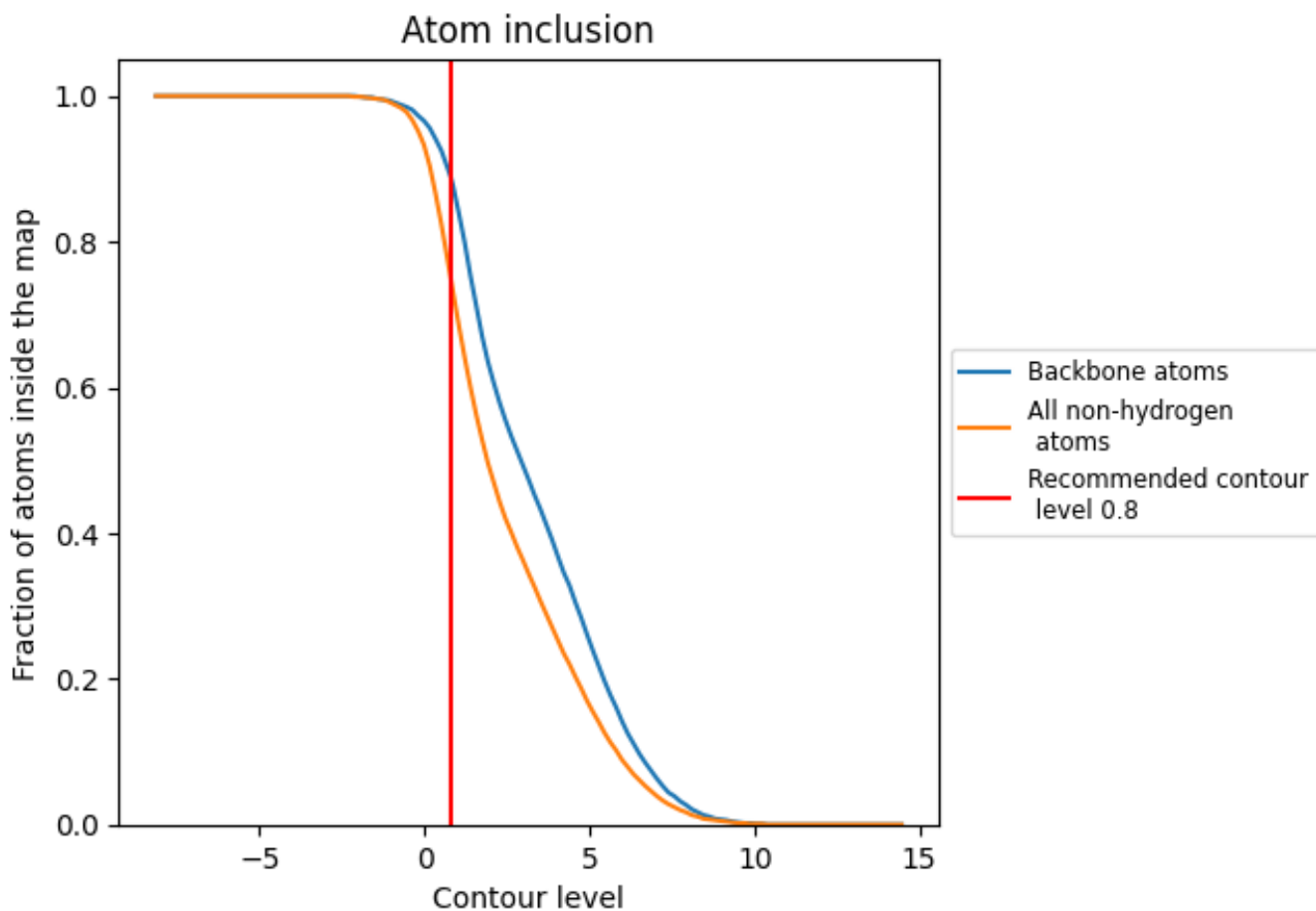
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.8).



















9.4 Atom inclusion [i](#)



At the recommended contour level, 89% of all backbone atoms, 75% 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 (0.8) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.7500	 0.3950
A	 0.8100	 0.4390
B	 0.8410	 0.4620
C	 0.7460	 0.3780
D	 0.6330	 0.3200
E	 0.7800	 0.4230
F	 0.7060	 0.3510
G	 0.7990	 0.4410
H	 0.6320	 0.3070

