



wwPDB EM Validation Summary Report ⓘ

Mar 20, 2026 – 02:22 AM UTC

PDB ID : 9FVJ / pdb_00009fvj
EMDB ID : EMD-50811
Title : Xenopus borealis undecorated microtubule - 15 protofilament, 3-start helix
Authors : Troman, L.A.; Moores, C.A.
Deposited on : 2024-06-27
Resolution : 3.20 Å(reported)
Based on initial model : .

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 : **FAILED**
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

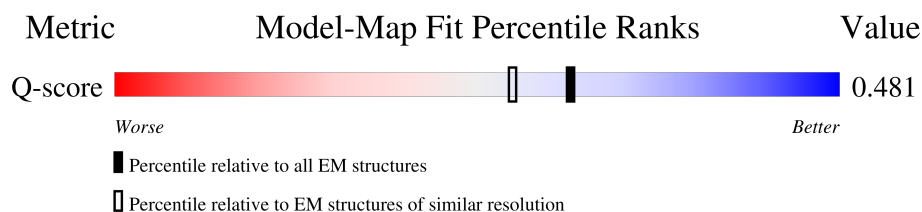
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.20 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	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Q-score	25397	15020 (2.70 - 3.70)

MolProbity failed to run properly - the sequence quality summary graphics cannot be shown.

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 80199 atoms, of which 39315 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.

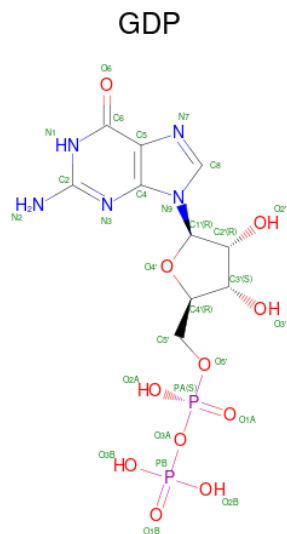
- Molecule 1 is a protein called Tubulin beta chain.

Mol	Chain	Residues	Atoms						AltConf	Trace
1	A	430	Total	C	H	N	O	S	0	0
			6632	2119	3259	578	650	26		
1	B	430	Total	C	H	N	O	S	0	0
			6631	2119	3258	578	650	26		
1	C	430	Total	C	H	N	O	S	0	0
			6631	2119	3258	578	650	26		
1	D	430	Total	C	H	N	O	S	0	0
			6632	2119	3259	578	650	26		
1	E	430	Total	C	H	N	O	S	0	0
			6631	2119	3258	578	650	26		
1	F	430	Total	C	H	N	O	S	0	0
			6632	2119	3259	578	650	26		

- Molecule 2 is a protein called Tubulin alpha chain.

Mol	Chain	Residues	Atoms						AltConf	Trace
2	a	431	Total	C	H	N	O	S	0	0
			6672	2135	3292	576	645	24		
2	b	431	Total	C	H	N	O	S	0	0
			6672	2135	3292	576	645	24		
2	c	431	Total	C	H	N	O	S	0	0
			6672	2135	3292	576	645	24		
2	d	431	Total	C	H	N	O	S	0	0
			6672	2135	3292	576	645	24		
2	e	431	Total	C	H	N	O	S	0	0
			6672	2135	3292	576	645	24		
2	f	431	Total	C	H	N	O	S	0	0
			6672	2135	3292	576	645	24		

- Molecule 3 is GUANOSINE-5'-DIPHOSPHATE (CCD ID: GDP) (formula: C₁₀H₁₅N₅O₁₁P₂) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms						AltConf
3	A	1	Total 29	C 10	H 1	N 5	O 11	P 2	0
3	B	1	Total 29	C 10	H 1	N 5	O 11	P 2	0
3	C	1	Total 29	C 10	H 1	N 5	O 11	P 2	0
3	D	1	Total 29	C 10	H 1	N 5	O 11	P 2	0
3	E	1	Total 29	C 10	H 1	N 5	O 11	P 2	0
3	F	1	Total 29	C 10	H 1	N 5	O 11	P 2	0

- Molecule 4 is GUANOSINE-5'-TRIPHOSPHATE (CCD ID: GTP) (formula: $\text{C}_{10}\text{H}_{16}\text{N}_5\text{O}_{14}\text{P}_3$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms						AltConf
4	a	1	Total	C	H	N	O	P	0
			33	10	1	5	14	3	
4	b	1	Total	C	H	N	O	P	0
			33	10	1	5	14	3	
4	c	1	Total	C	H	N	O	P	0
			33	10	1	5	14	3	
4	d	1	Total	C	H	N	O	P	0
			33	10	1	5	14	3	
4	e	1	Total	C	H	N	O	P	0
			33	10	1	5	14	3	
4	f	1	Total	C	H	N	O	P	0
			33	10	1	5	14	3	

- Molecule 5 is MAGNESIUM ION (CCD ID: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
5	a	1	Total	Mg	0
			1	1	
5	b	1	Total	Mg	0
			1	1	
5	c	1	Total	Mg	0
			1	1	
5	d	1	Total	Mg	0
			1	1	
5	e	1	Total	Mg	0
			1	1	

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Mol	Chain	Residues	Atoms		AltConf
			Total	Mg	
5	f	1	1	1	0

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3 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	466970	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 ($e^-/\text{\AA}^2$)	47.4	Depositor
Minimum defocus (nm)	600	Depositor
Maximum defocus (nm)	2100	Depositor
Magnification	81000	Depositor
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	0.068	Depositor
Minimum map value	-0.026	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.004	Depositor
Recommended contour level	0.015	Depositor
Map size ($\text{\AA}$)	443.872, 443.872, 443.872	wwPDB
Map dimensions	416, 416, 416	wwPDB
Map angles ($^\circ$)	90.0, 90.0, 90.0	wwPDB
Pixel spacing ($\text{\AA}$)	1.067, 1.067, 1.067	Depositor

4 Model quality [i](#)

4.1 Standard geometry [i](#)

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4.2 Too-close contacts [i](#)

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4.3 Torsion angles [i](#)

4.3.1 Protein backbone [i](#)

MolProbity failed to run properly - this section is therefore empty.

4.3.2 Protein sidechains [i](#)

MolProbity failed to run properly - this section is therefore empty.

4.3.3 RNA [i](#)

MolProbity failed to run properly - this section is therefore empty.

4.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

4.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

4.6 Ligand geometry [i](#)

Of 18 ligands modelled in this entry, 6 are monoatomic - leaving 12 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
4	GTP	f	501	5	33,34,34	0.99	2 (6%)	50,54,54	1.60	8 (16%)
4	GTP	a	501	5	33,34,34	0.97	2 (6%)	50,54,54	1.60	8 (16%)
3	GDP	C	501	-	29,30,30	1.20	3 (10%)	45,47,47	1.78	6 (13%)
4	GTP	e	502	5	33,34,34	0.98	2 (6%)	50,54,54	1.60	8 (16%)
3	GDP	E	501	-	29,30,30	1.21	3 (10%)	45,47,47	1.78	6 (13%)
3	GDP	D	501	-	29,30,30	1.20	3 (10%)	45,47,47	1.78	6 (13%)
4	GTP	c	501	5	33,34,34	0.99	3 (9%)	50,54,54	1.60	8 (16%)
4	GTP	d	501	5	33,34,34	0.98	2 (6%)	50,54,54	1.60	8 (16%)
3	GDP	A	501	-	29,30,30	1.19	3 (10%)	45,47,47	1.78	6 (13%)
3	GDP	B	501	-	29,30,30	1.20	3 (10%)	45,47,47	1.78	6 (13%)
4	GTP	b	501	5	33,34,34	0.99	3 (9%)	50,54,54	1.60	8 (16%)
3	GDP	F	501	-	29,30,30	1.20	3 (10%)	45,47,47	1.78	6 (13%)

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
4	GTP	f	501	5	-	9/22/38/38	0/3/3/3
4	GTP	a	501	5	-	9/22/38/38	0/3/3/3
3	GDP	C	501	-	-	4/16/32/32	0/3/3/3
4	GTP	e	502	5	-	9/22/38/38	0/3/3/3
3	GDP	E	501	-	-	4/16/32/32	0/3/3/3
3	GDP	D	501	-	-	4/16/32/32	0/3/3/3
4	GTP	c	501	5	-	9/22/38/38	0/3/3/3
4	GTP	d	501	5	-	9/22/38/38	0/3/3/3
3	GDP	A	501	-	-	4/16/32/32	0/3/3/3
3	GDP	B	501	-	-	4/16/32/32	0/3/3/3
4	GTP	b	501	5	-	9/22/38/38	0/3/3/3
3	GDP	F	501	-	-	4/16/32/32	0/3/3/3

The worst 5 of 32 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	D	501	GDP	C5-C4	3.21	1.47	1.38
3	C	501	GDP	C5-C4	3.20	1.47	1.38
3	F	501	GDP	C5-C4	3.20	1.47	1.38
3	B	501	GDP	C5-C4	3.19	1.47	1.38
3	A	501	GDP	C5-C4	3.18	1.47	1.38

The worst 5 of 84 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	F	501	GDP	C5-C4-N3	-6.32	118.33	128.39
3	C	501	GDP	C5-C4-N3	-6.32	118.33	128.39
3	A	501	GDP	C5-C4-N3	-6.32	118.33	128.39
3	E	501	GDP	C5-C4-N3	-6.32	118.33	128.39
3	D	501	GDP	C5-C4-N3	-6.32	118.34	128.39

There are no chirality outliers.

5 of 78 torsion outliers are listed below:

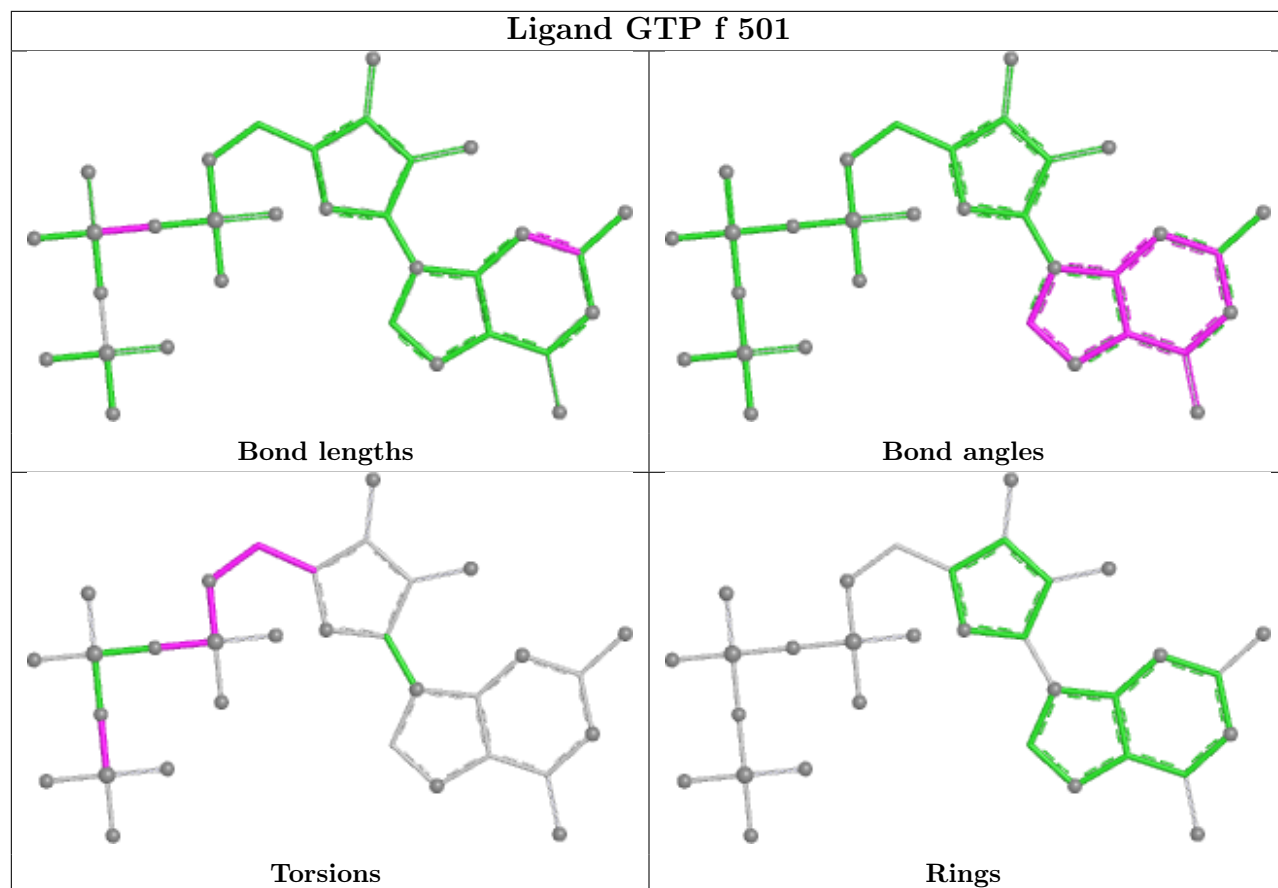
Mol	Chain	Res	Type	Atoms
3	A	501	GDP	C5'-O5'-PA-O3A
3	A	501	GDP	C5'-O5'-PA-O1A
3	A	501	GDP	C5'-O5'-PA-O2A
3	B	501	GDP	C5'-O5'-PA-O3A
3	B	501	GDP	C5'-O5'-PA-O1A

There are no ring outliers.

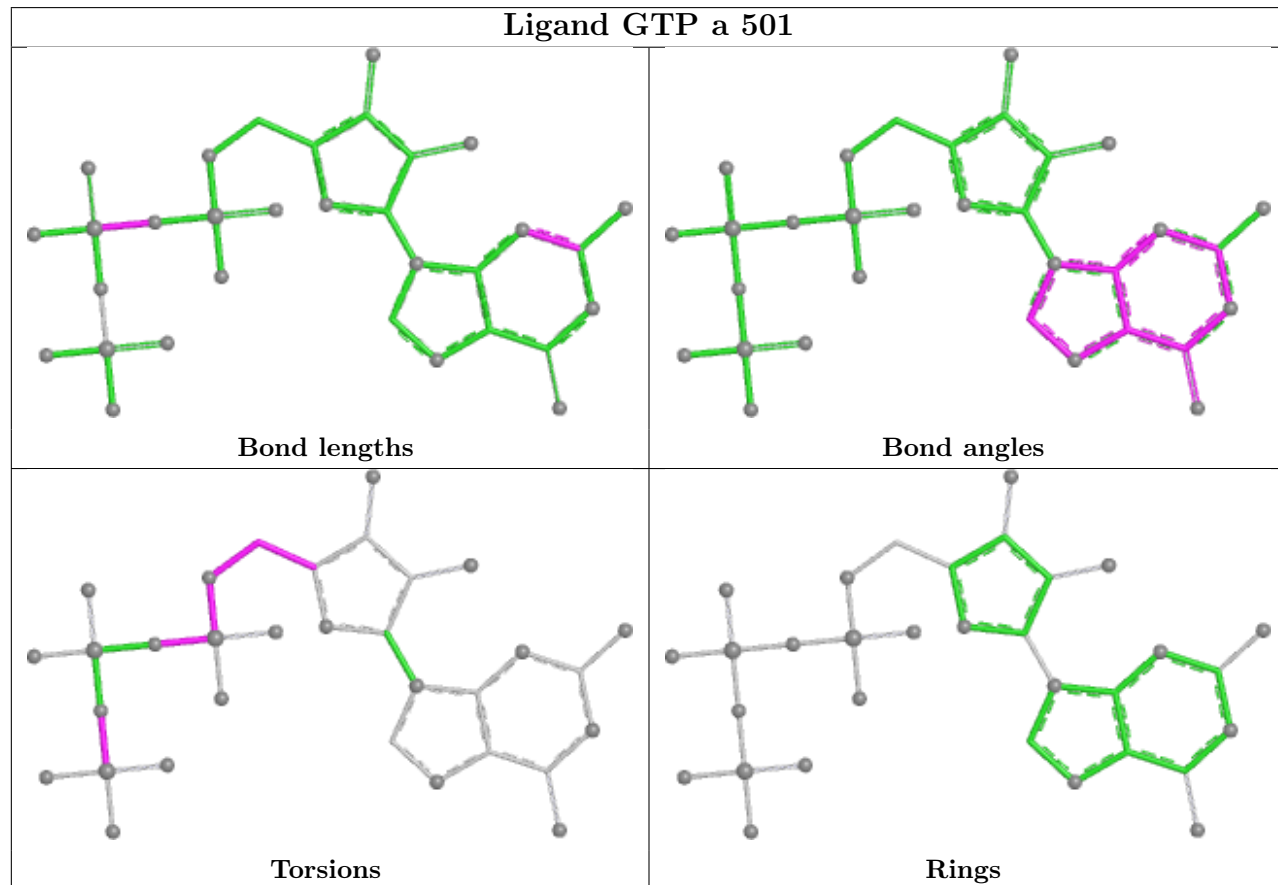
No monomer is involved in short contacts.

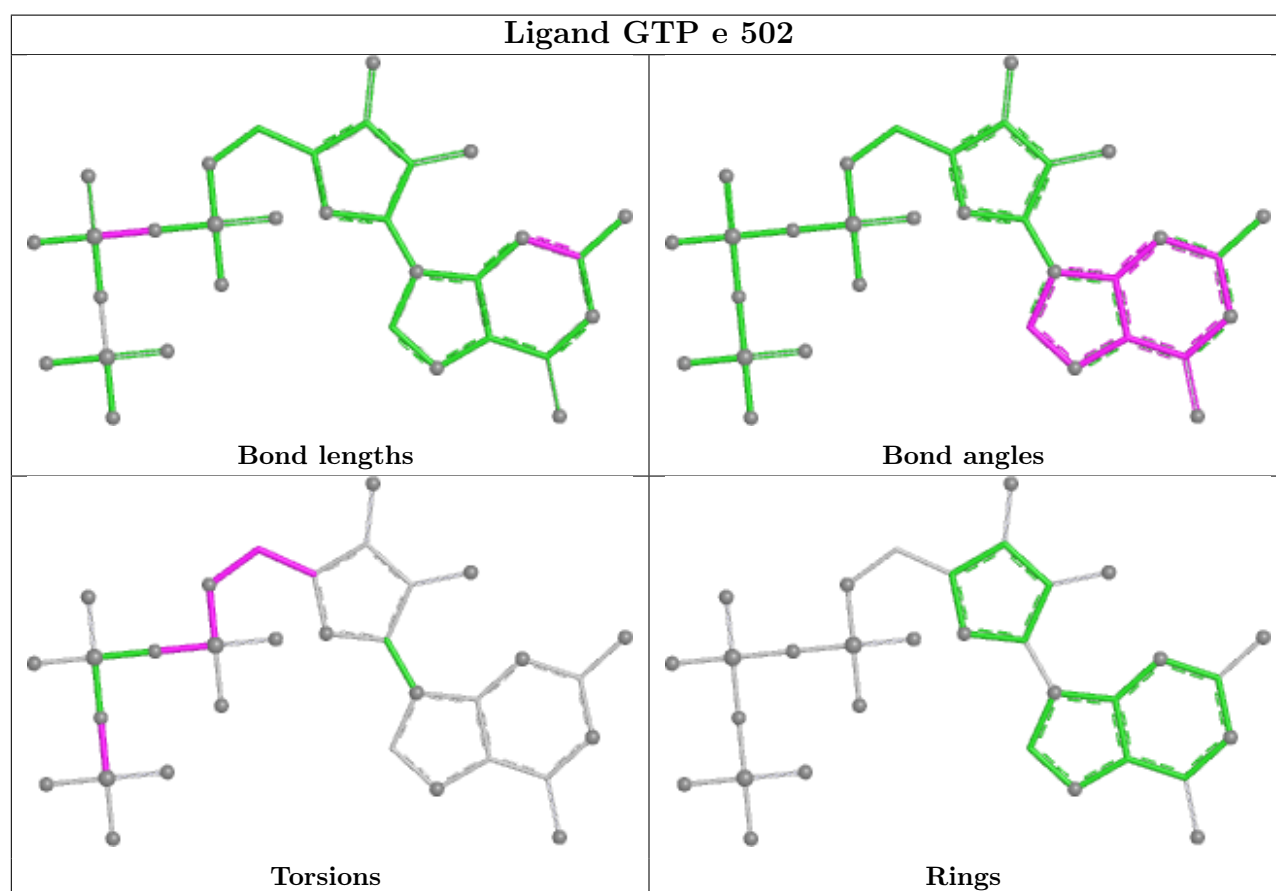
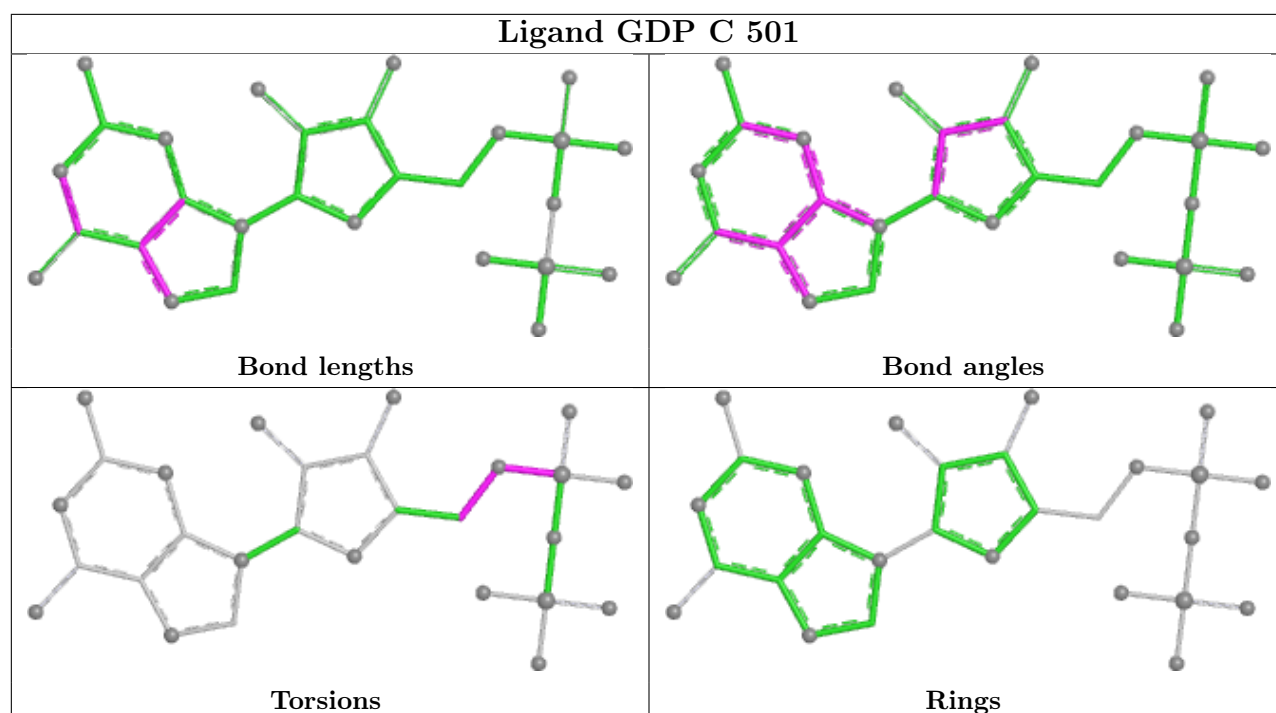
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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.

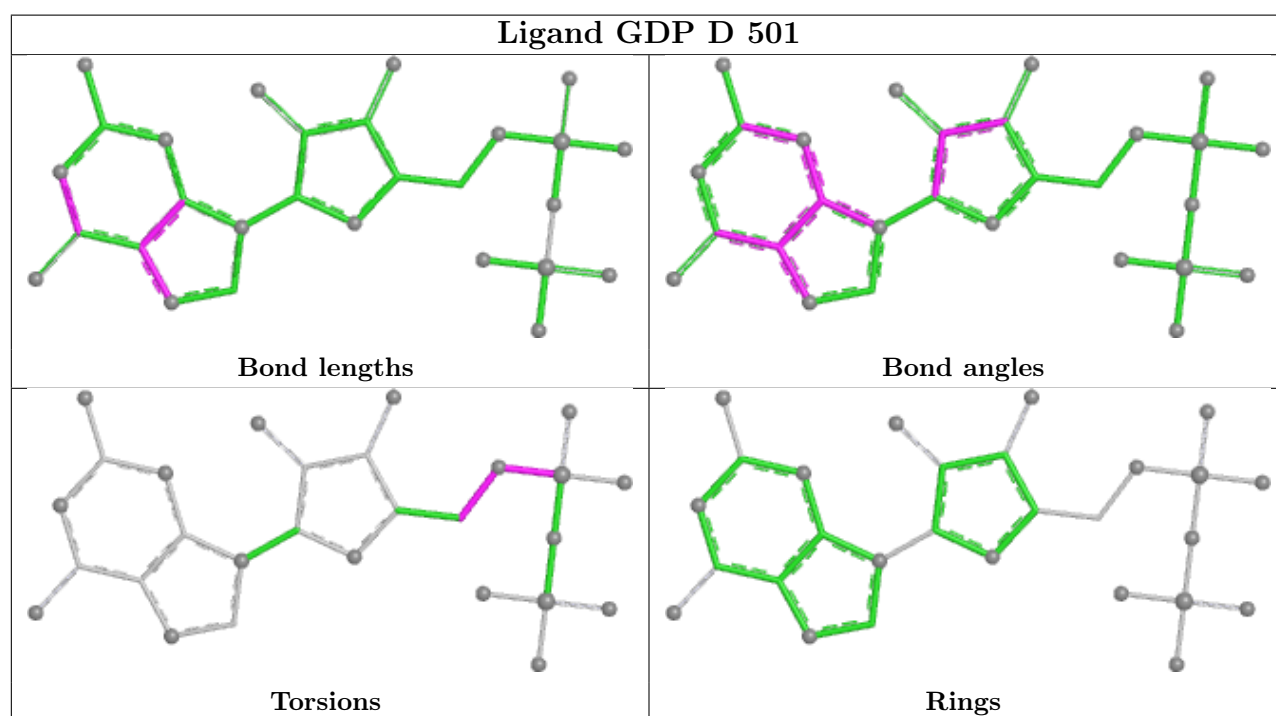
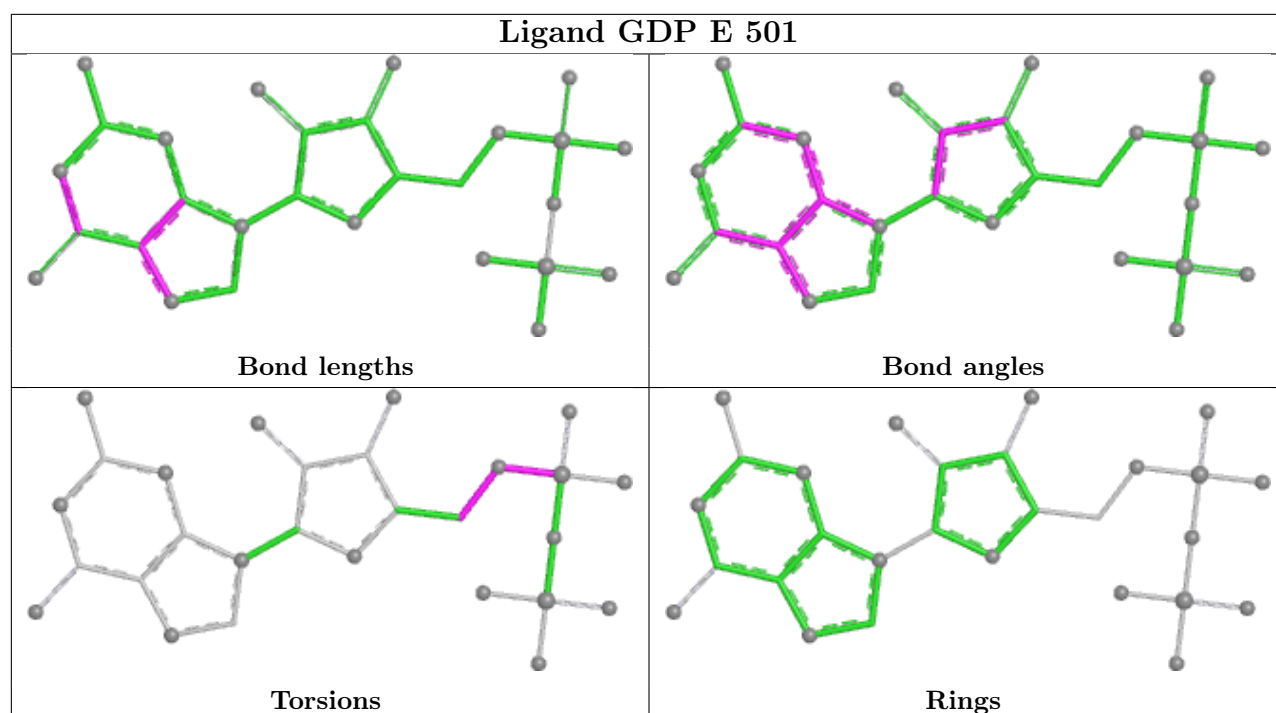
Ligand GTP f 501



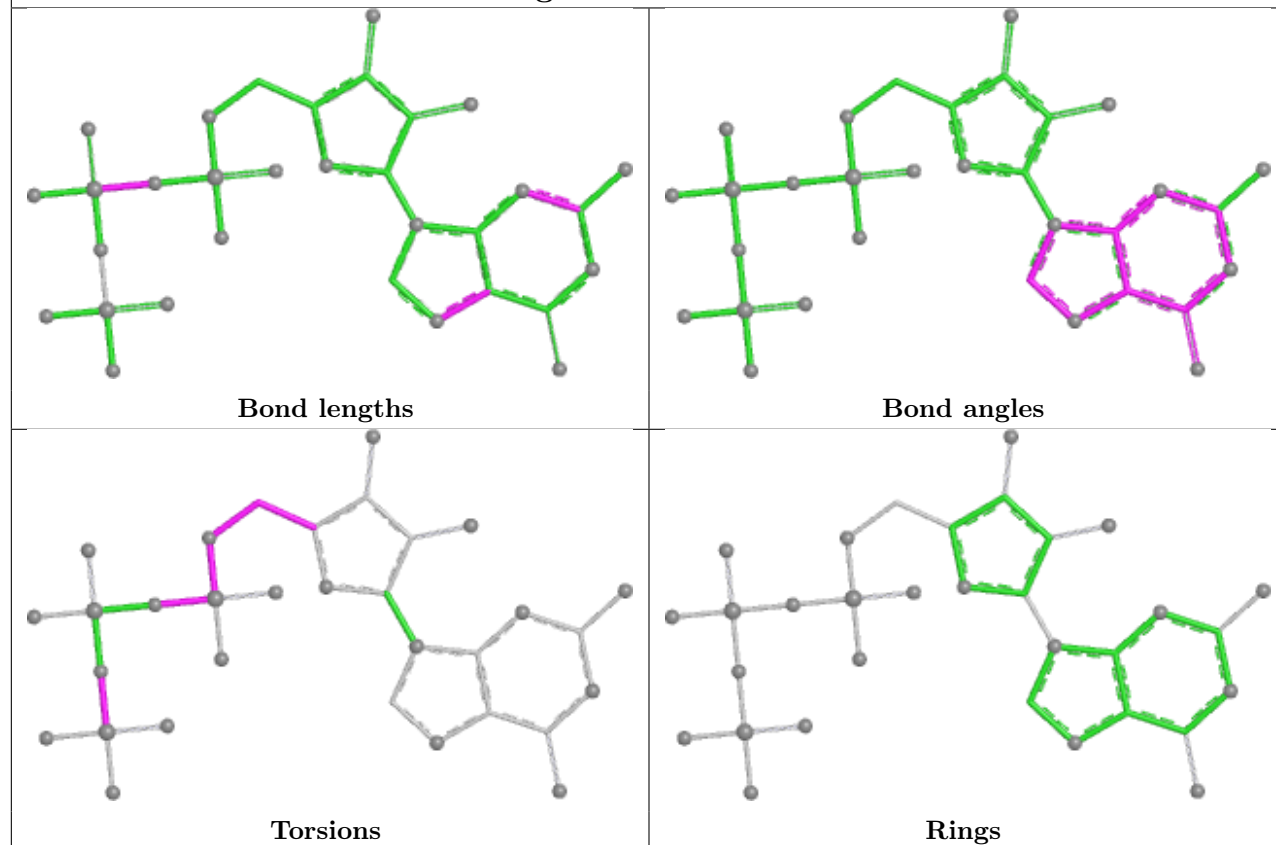
Ligand GTP a 501



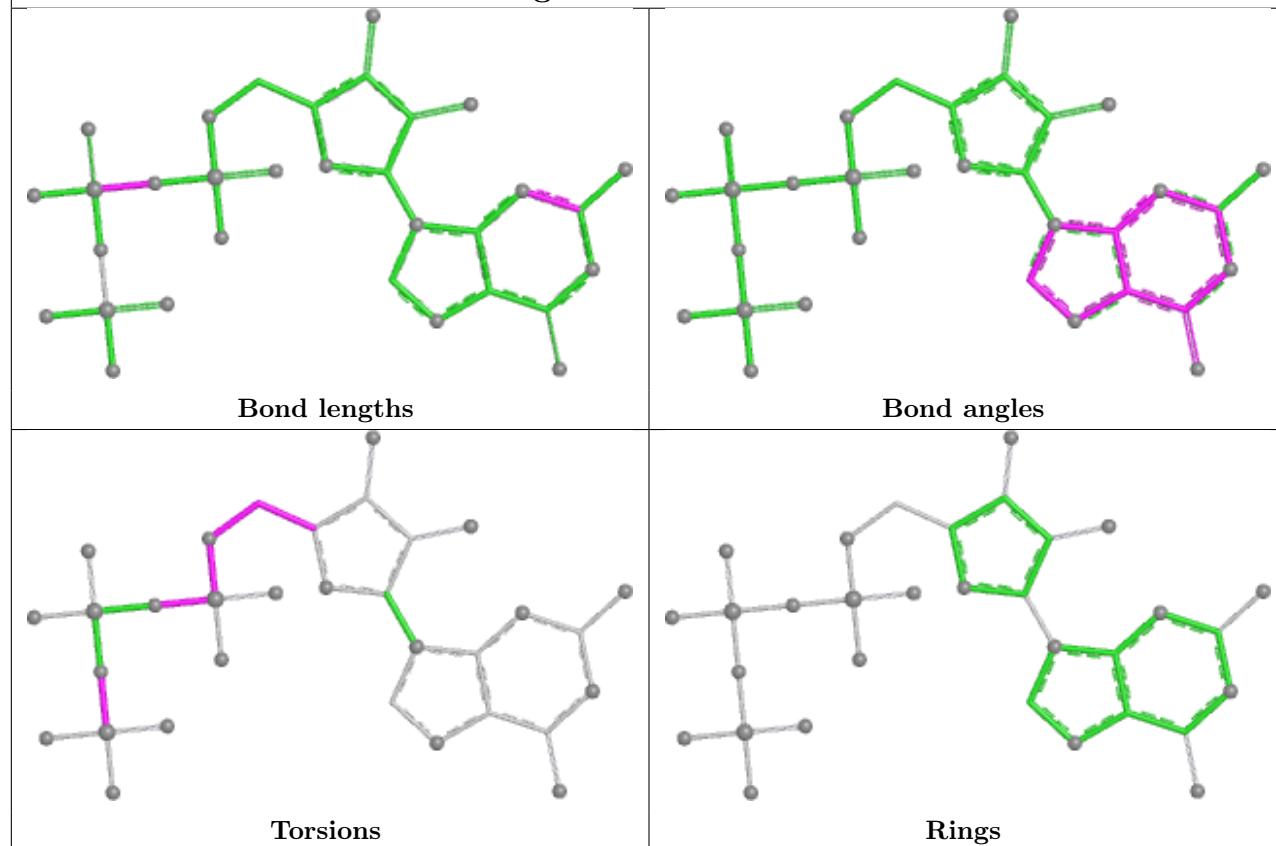


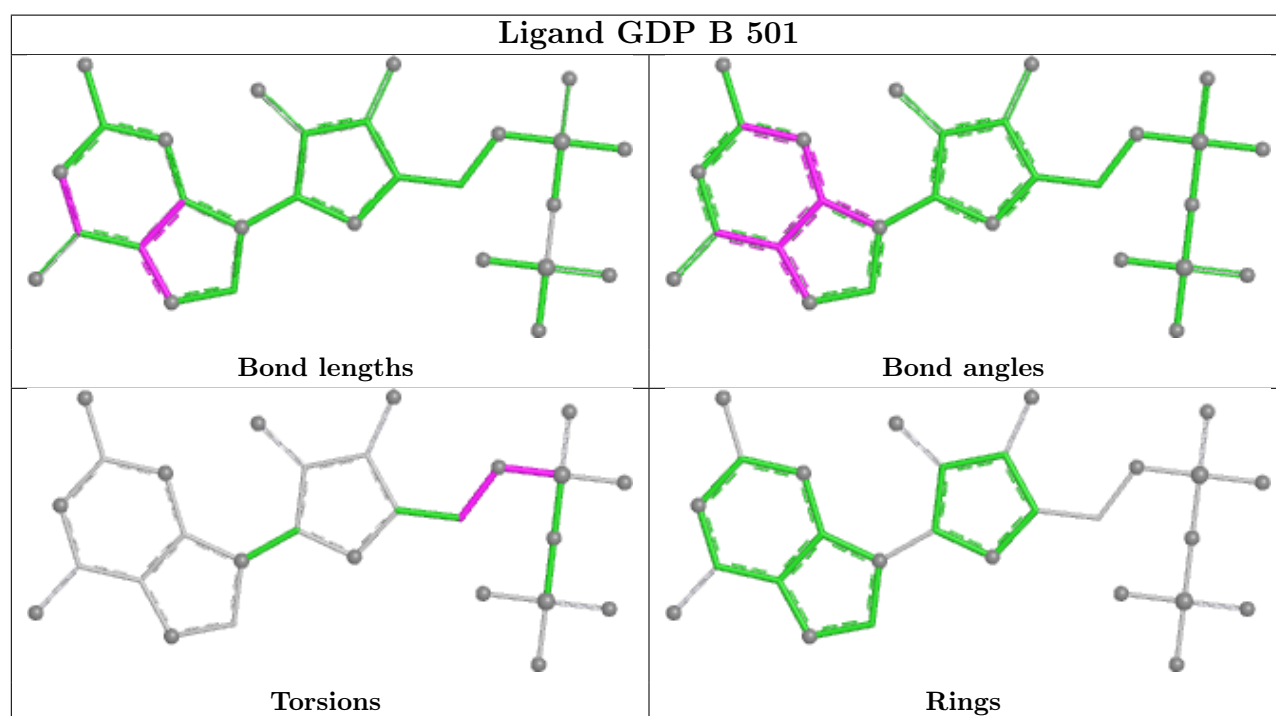
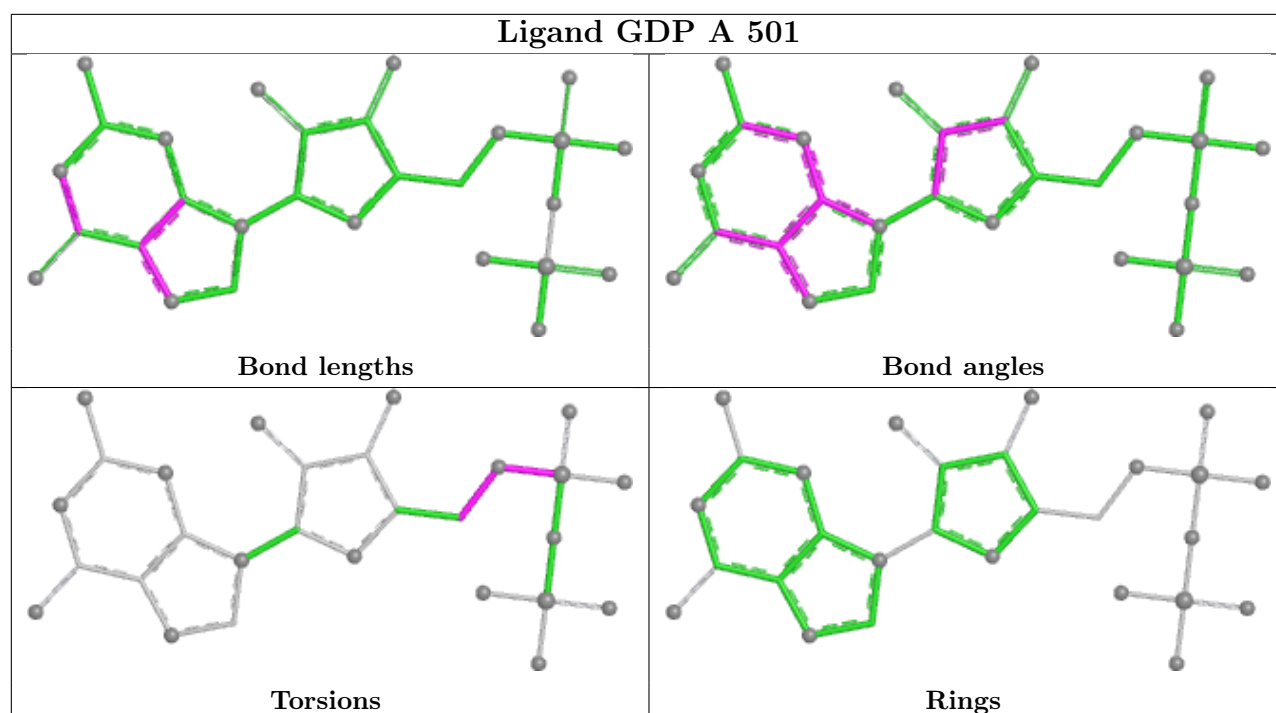


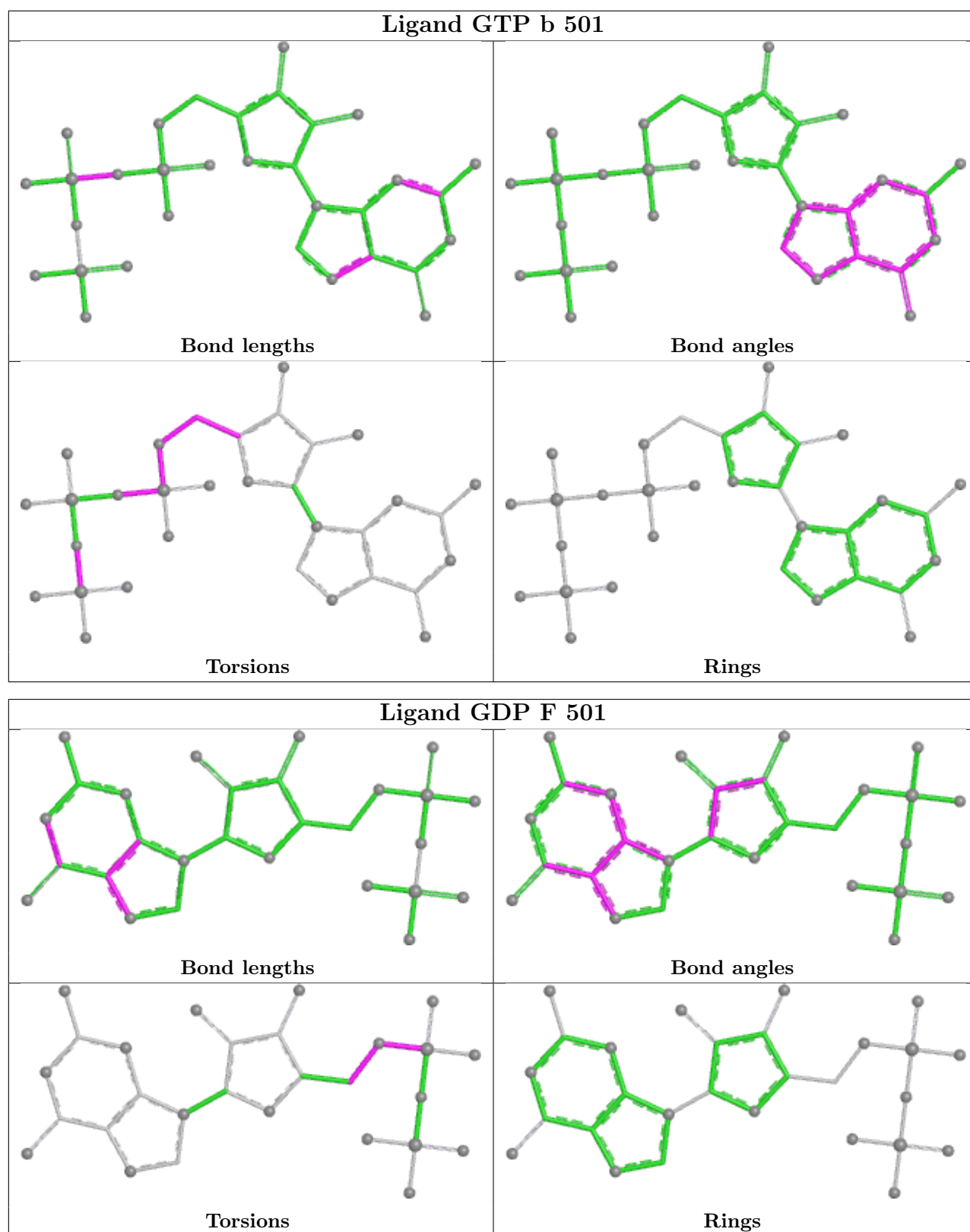
Ligand GTP c 501



Ligand GTP d 501







4.7 Other polymers [i](#)

There are no such residues in this entry.

4.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

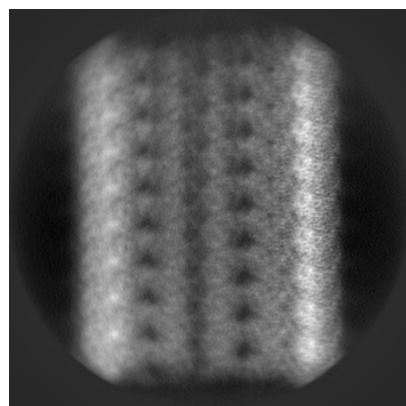
5 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-50811. These allow visual inspection of the internal detail of the map and identification of artifacts.

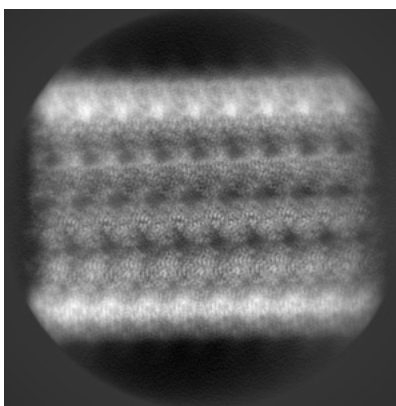
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

5.1 Orthogonal projections [i](#)

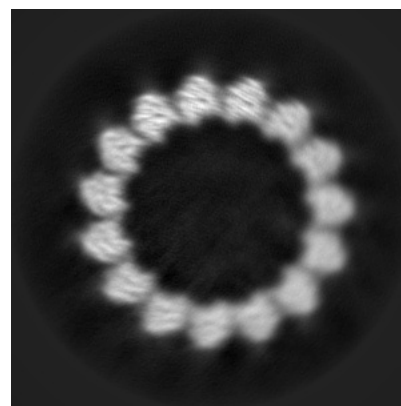
5.1.1 Primary map



X

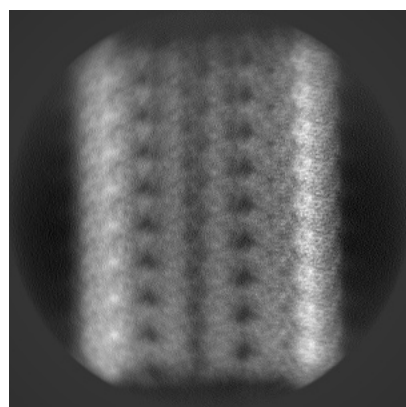


Y

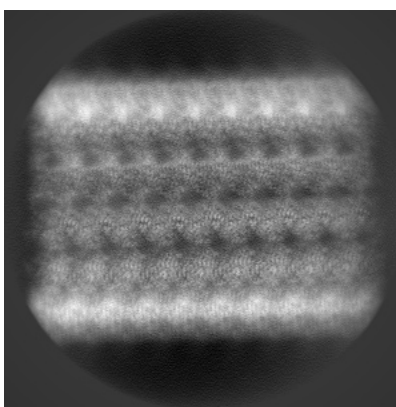


Z

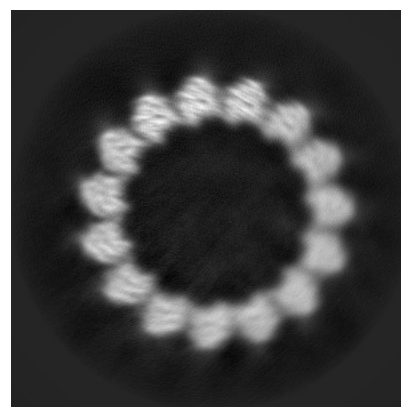
5.1.2 Raw map



X



Y

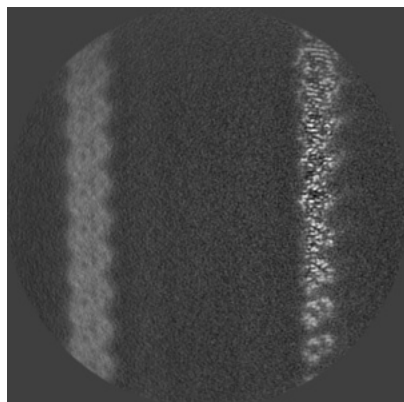


Z

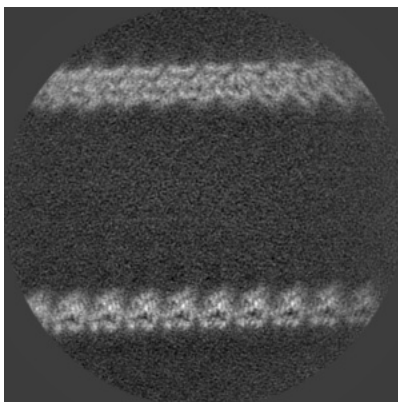
The images above show the map projected in three orthogonal directions.

5.2 Central slices [i](#)

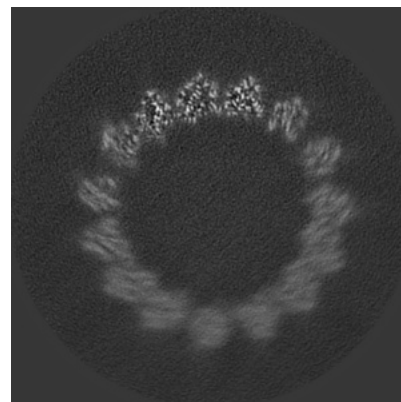
5.2.1 Primary map



X Index: 208

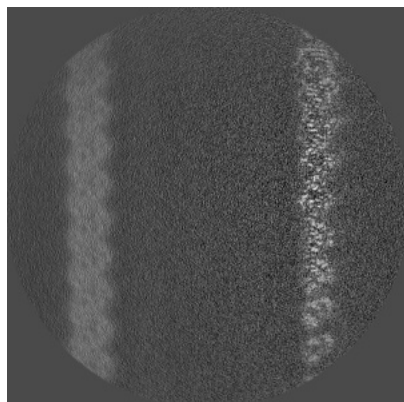


Y Index: 208

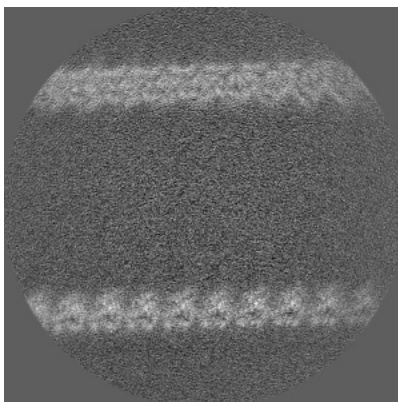


Z Index: 208

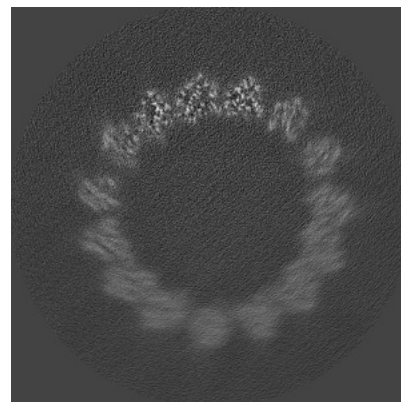
5.2.2 Raw map



X Index: 208



Y Index: 208

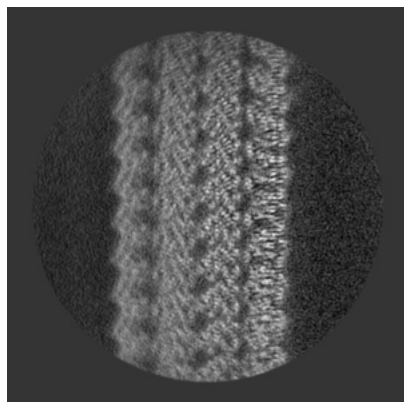


Z Index: 208

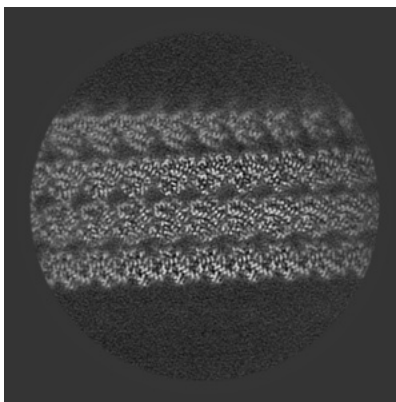
The images above show central slices of the map in three orthogonal directions.

5.3 Largest variance slices [i](#)

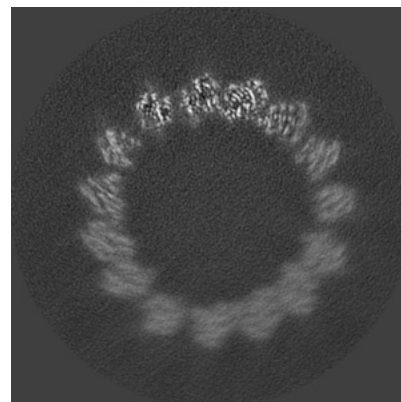
5.3.1 Primary map



X Index: 105

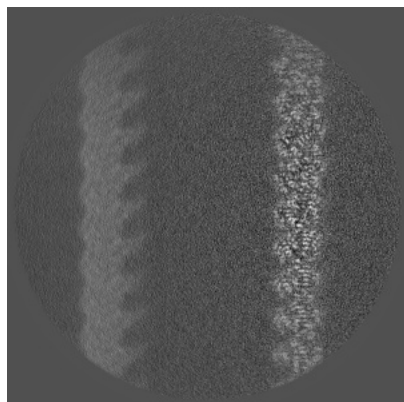


Y Index: 313

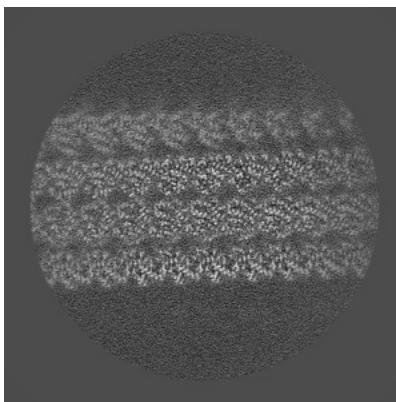


Z Index: 217

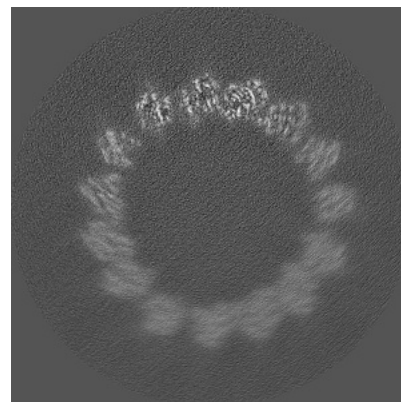
5.3.2 Raw map



X Index: 150



Y Index: 313

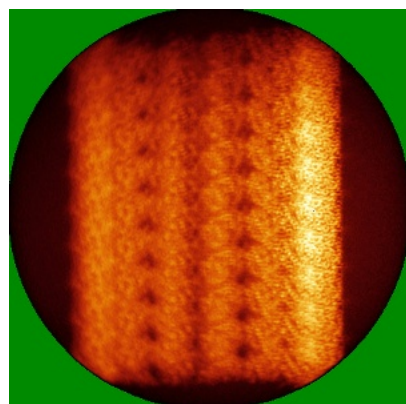


Z Index: 217

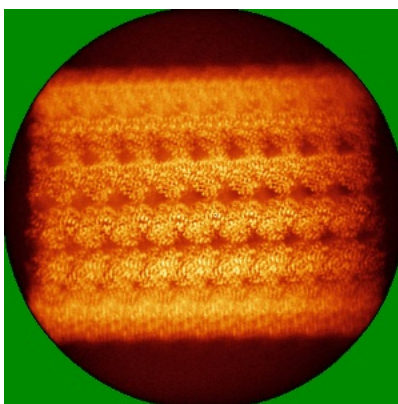
The images above show the largest variance slices of the map in three orthogonal directions.

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

5.4.1 Primary map



X

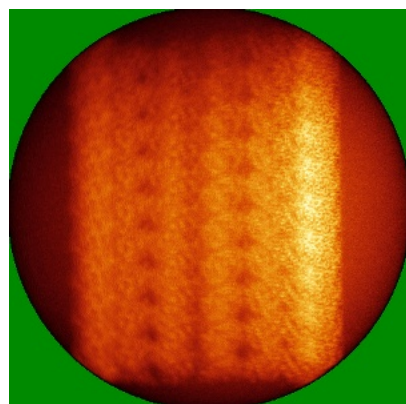


Y

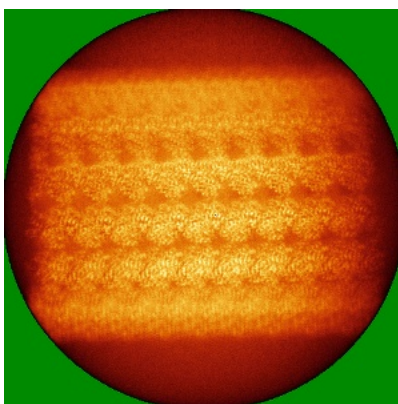


Z

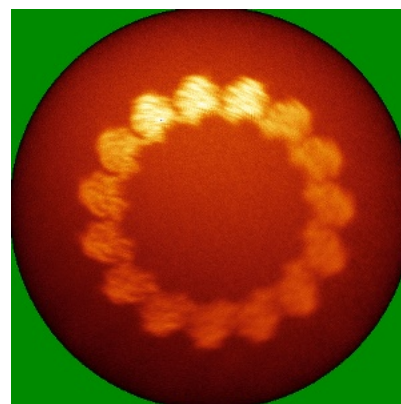
5.4.2 Raw map



X



Y

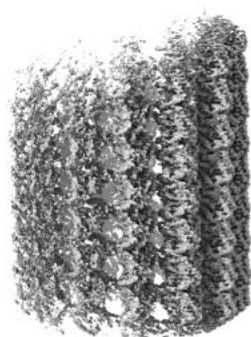


Z

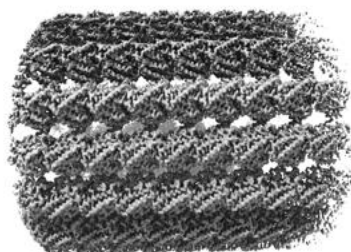
The images above show the map standard deviation projections with false color in three orthogonal directions. Minimum values are shown in green, max in blue, and dark to light orange shades represent small to large values respectively.

5.5 Orthogonal surface views [i](#)

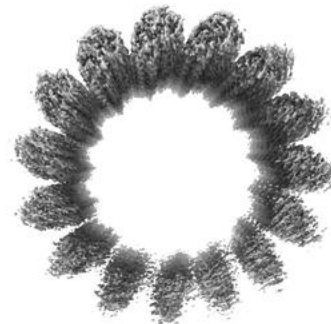
5.5.1 Primary map



X



Y



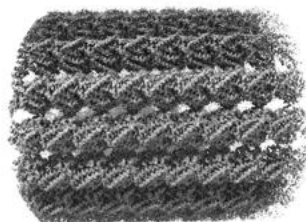
Z

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.

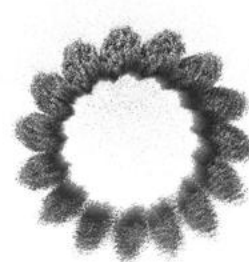
5.5.2 Raw map



X



Y



Z

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.

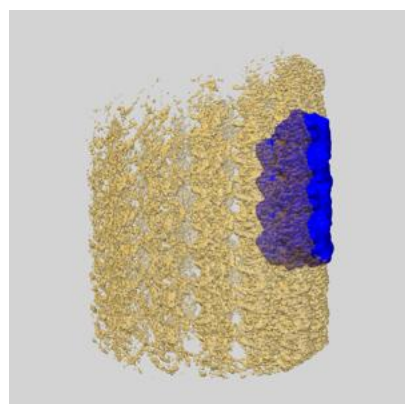
5.6 Mask visualisation [i](#)

This section shows the 3D surface view of the primary map at 50% transparency overlaid with the specified mask at 0% transparency

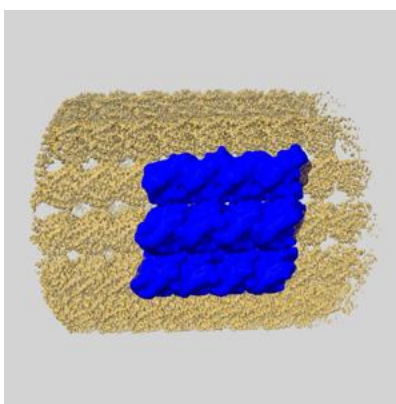
A mask typically either:

- Encompasses the whole structure
- Separates out a domain, a functional unit, a monomer or an area of interest from a larger structure

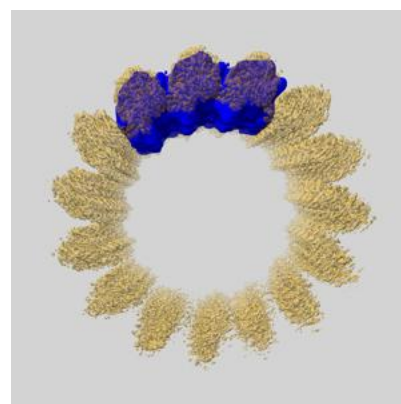
5.6.1 emd_50811_msk_1.map [i](#)



X



Y

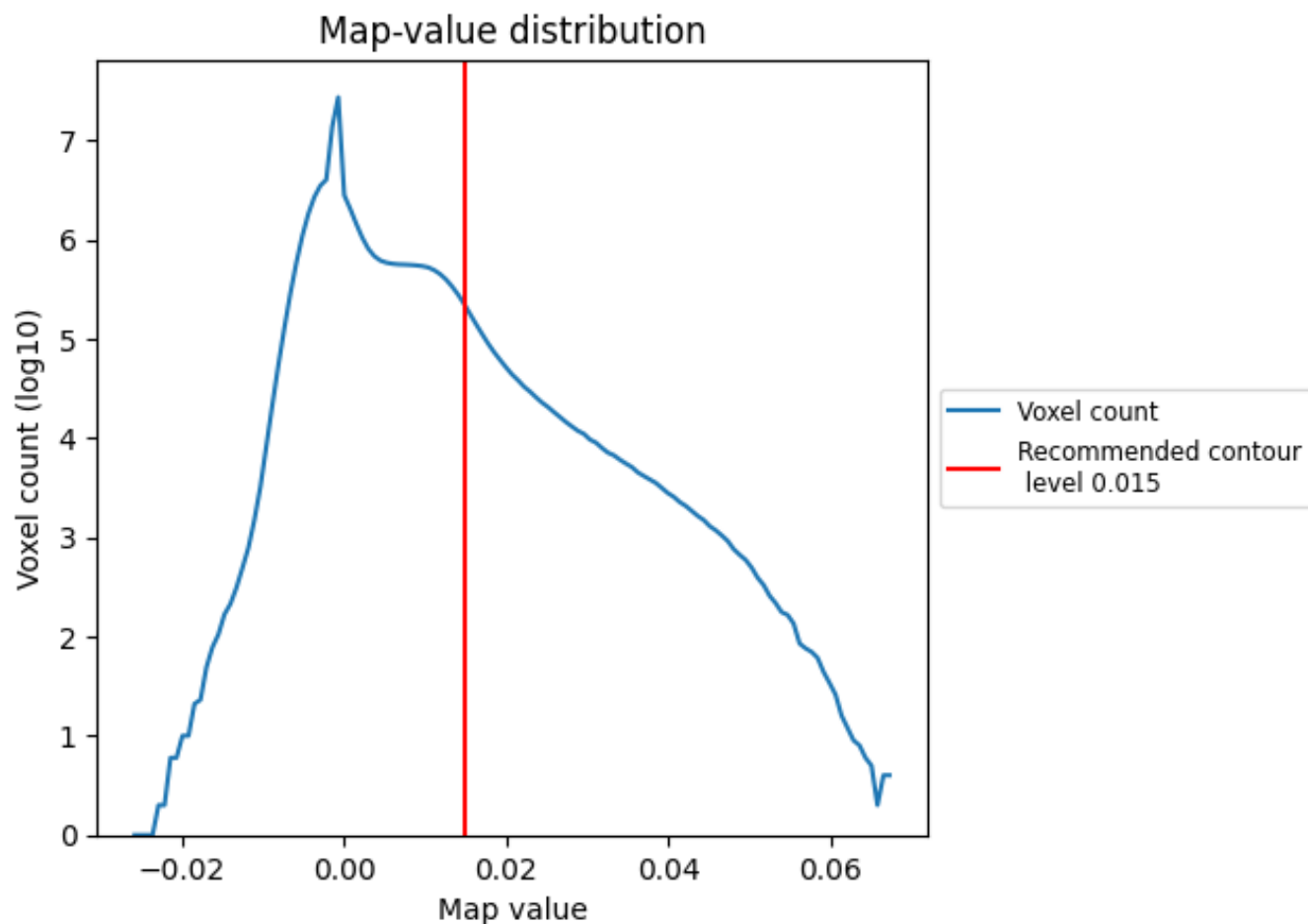


Z

6 Map analysis [i](#)

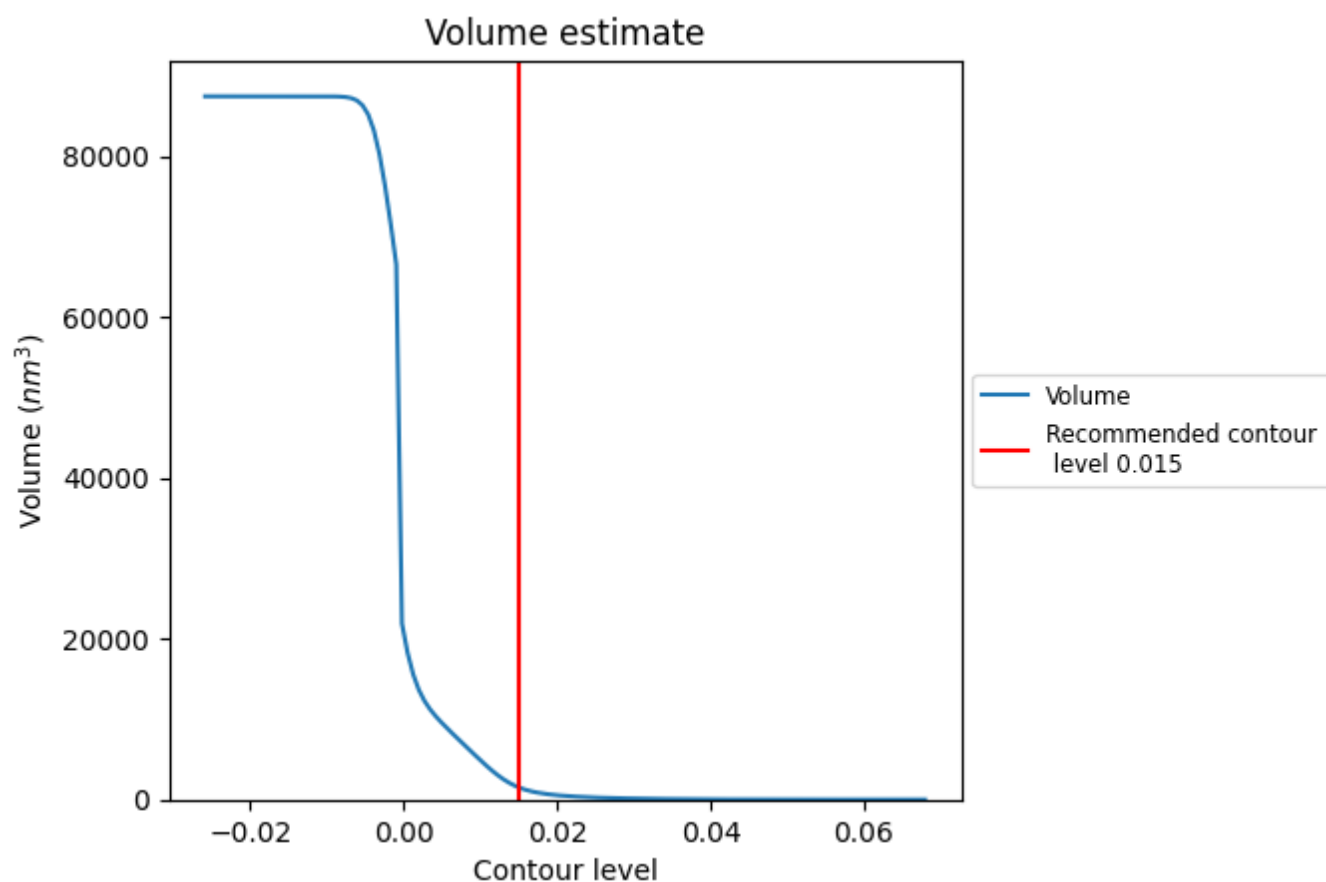
This section contains the results of statistical analysis of the map.

6.1 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.

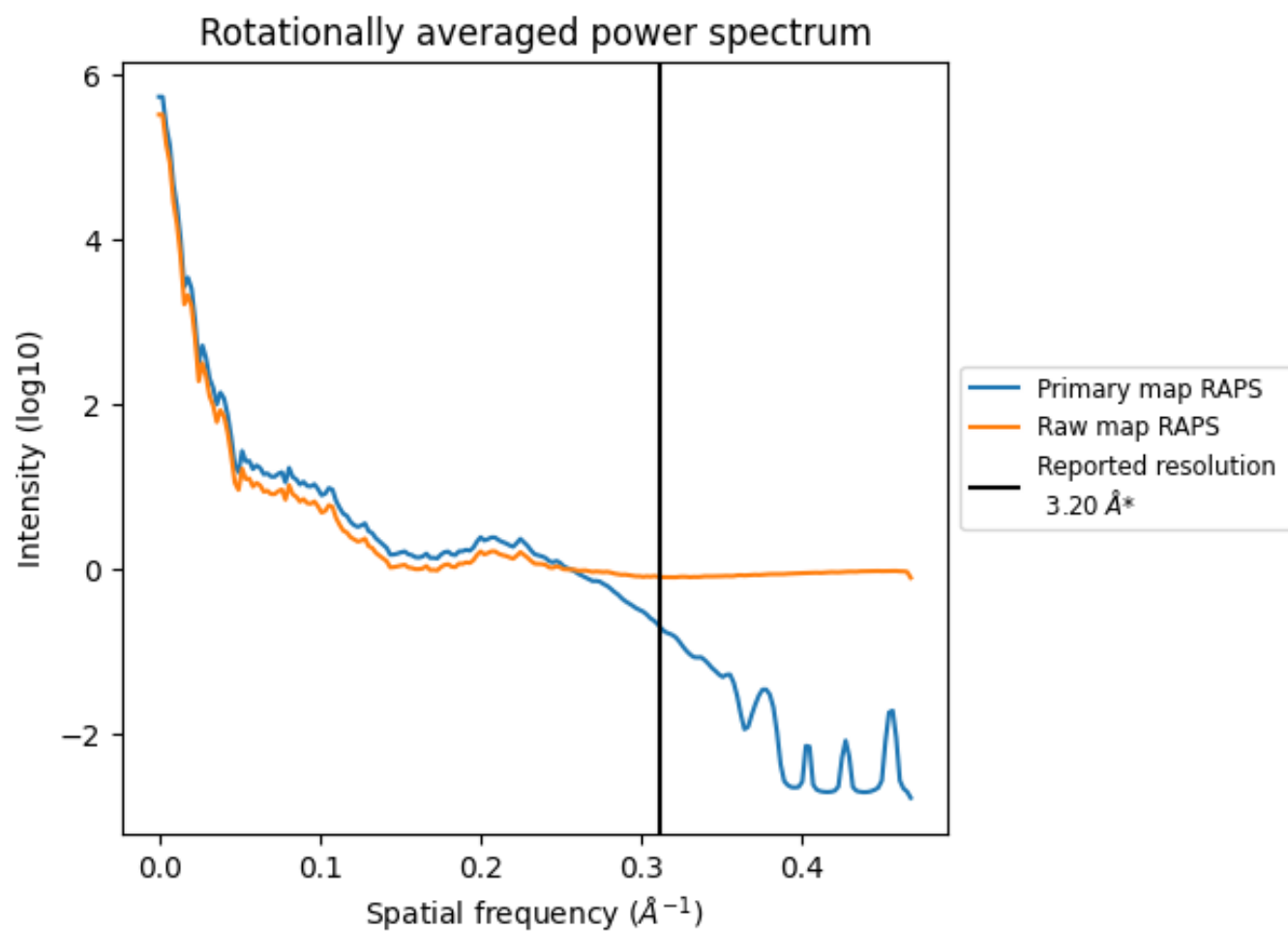
6.2 Volume estimate [i](#)



The volume at the recommended contour level is 1531 nm³; this corresponds to an approximate mass of 1383 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.

6.3 Rotationally averaged power spectrum ⓘ

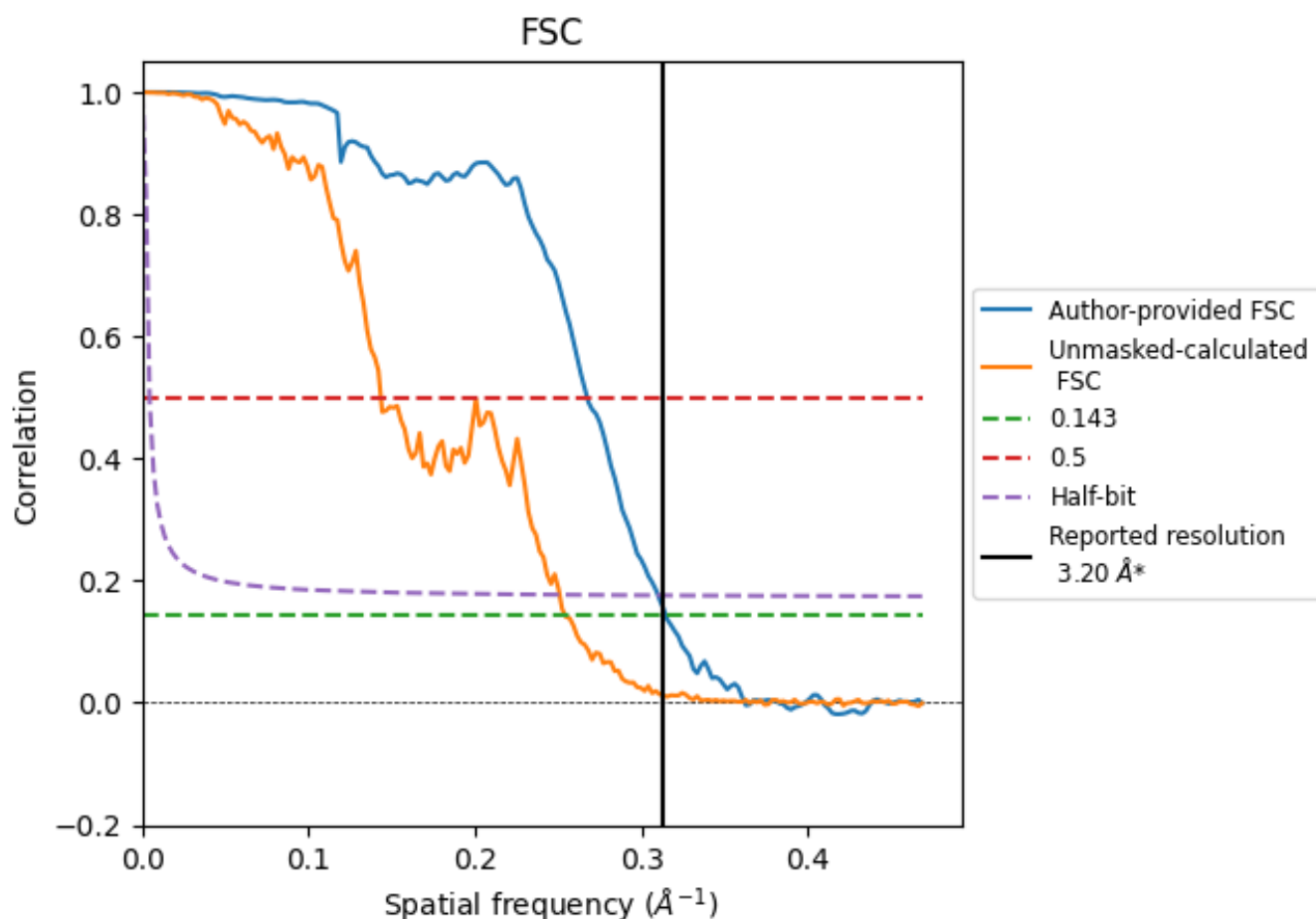


*Reported resolution corresponds to spatial frequency of 0.312 Å⁻¹

7 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.

7.1 FSC [i](#)



*Reported resolution corresponds to spatial frequency of 0.312 $\text{\AA}^{-1}$

7.2 Resolution estimates [i](#)

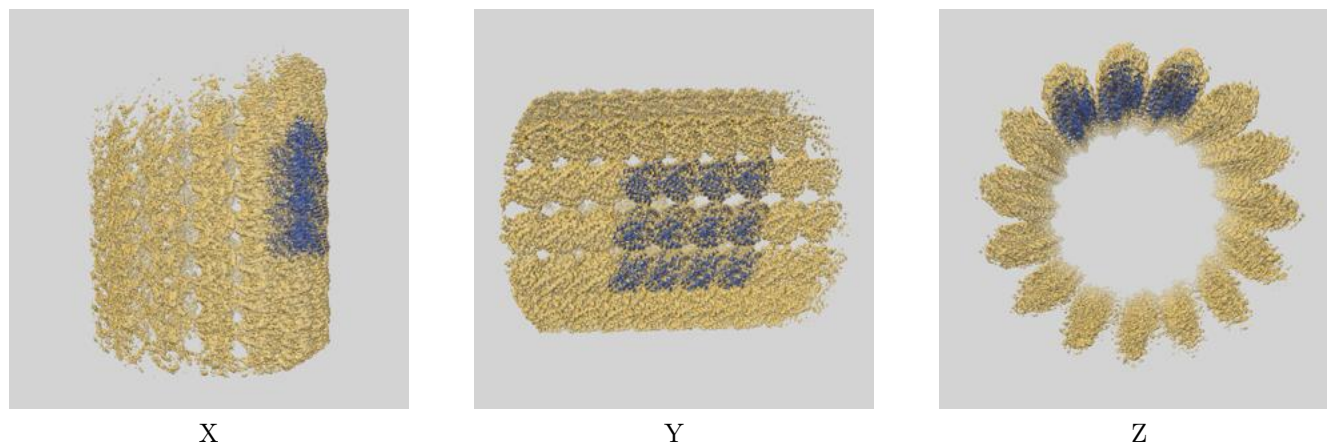
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.20	-	-
Author-provided FSC curve	3.18	3.74	3.23
Unmasked-calculated*	3.94	6.97	3.99

*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 3.94 differs from the reported value 3.2 by more than 10 %

8 Map-model fit [i](#)

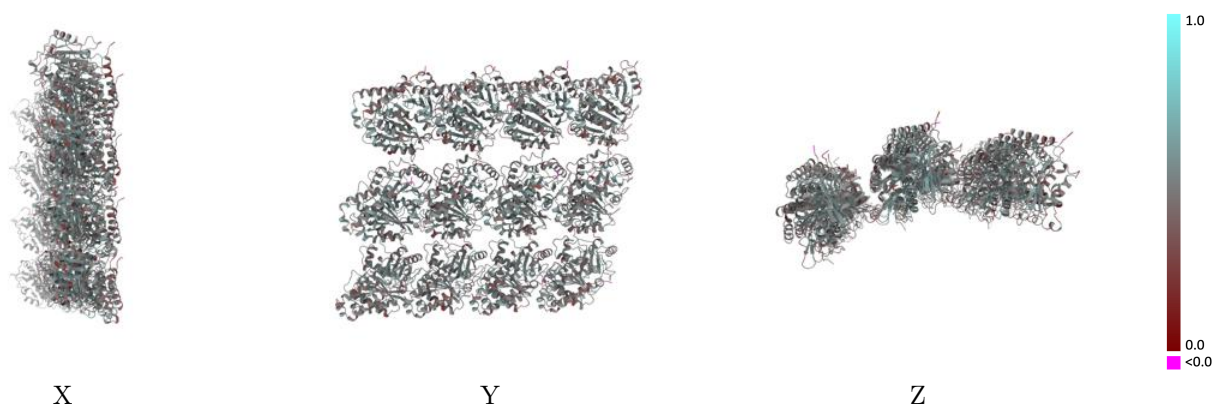
This section contains information regarding the fit between EMDB map EMD-50811 and PDB model 9FVJ. Per-residue inclusion information can be found in section ?? on page ??.

8.1 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.

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

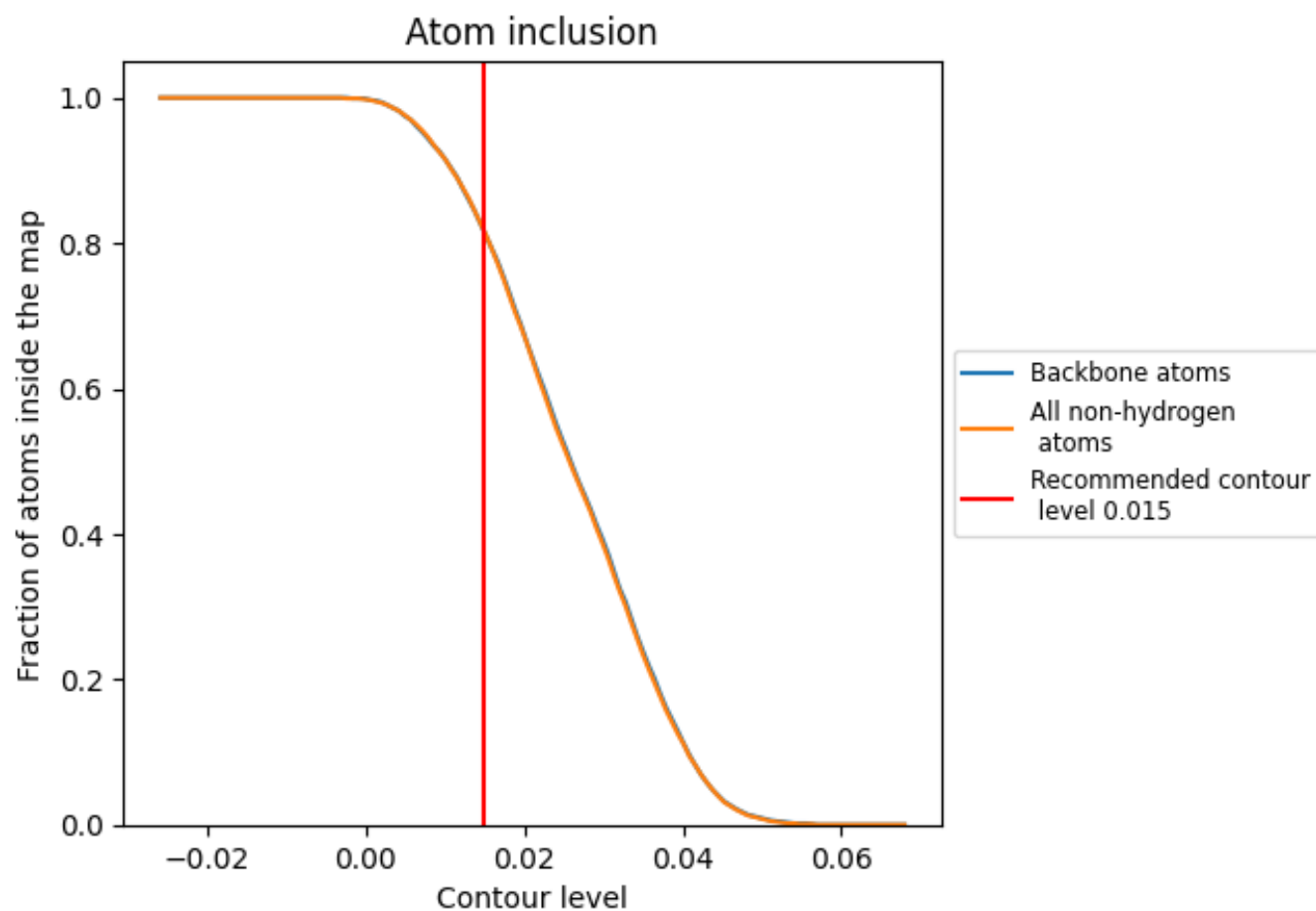


The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions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

8.3 Atom inclusion mapped to coordinate model [i](#)

This section was not generated.

8.4 Atom inclusion [i](#)



At the recommended contour level, 82% of all backbone atoms, 82% of all non-hydrogen atoms, are inside the map.

8.5 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	0.8150	0.4810
A	0.8250	0.4770
B	0.8520	0.4960
C	0.8270	0.4750
D	0.8210	0.4790
E	0.8510	0.5010
F	0.8310	0.4820
a	0.8290	0.4760
b	0.8360	0.4900
c	0.8180	0.4710
d	0.7900	0.4690
e	0.8210	0.4870
f	0.8010	0.4660

