



wwPDB EM Validation Summary Report ⓘ

Mar 23, 2026 – 08:25 PM UTC

PDB ID : 7EH8 / pdb_00007eh8
EMDB ID : EMD-31090
Title : Cryo-EM structure of the hexameric state of C-phycoerythrin from *Thermosynechococcus* sp. O-77
Authors : Minato, T.; Teramoto, T.; Adachi, N.; Hung, N.K.; Yamada, K.; Kawasaki, M.; Akutsu, M.; Moriya, T.; Senda, T.; Ogo, S.; Kakuta, Y.; Yoon, K.S.
Deposited on : 2021-03-28
Resolution : 3.06 Å (reported)
Based on initial model : 7EFW

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>.

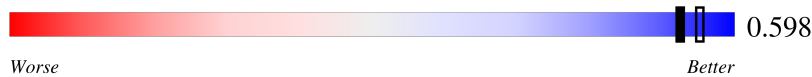
The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

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

i

ELECTRON MICROSCOPY

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	13976 (2.56 - 3.56)

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

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 15773 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.

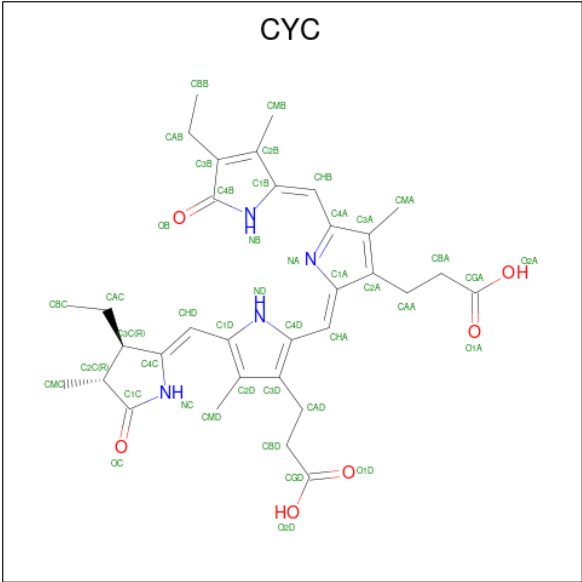
- Molecule 1 is a protein called C-phycocyanin alpha chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	162	Total	C	N	O	S	0	0
			1236	773	214	245	4		
1	C	162	Total	C	N	O	S	0	0
			1236	773	214	245	4		
1	E	162	Total	C	N	O	S	0	0
			1236	773	214	245	4		
1	G	162	Total	C	N	O	S	0	0
			1236	773	214	245	4		
1	I	162	Total	C	N	O	S	0	0
			1236	773	214	245	4		
1	K	162	Total	C	N	O	S	0	0
			1236	773	214	245	4		

- Molecule 2 is a protein called C-phycocyanin beta chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	172	Total	C	N	O	S	1	0
			1268	784	224	252	8		
2	D	172	Total	C	N	O	S	0	0
			1263	779	224	252	8		
2	F	172	Total	C	N	O	S	0	0
			1263	779	224	252	8		
2	H	172	Total	C	N	O	S	0	0
			1263	779	224	252	8		
2	J	172	Total	C	N	O	S	0	0
			1263	779	224	252	8		
2	L	172	Total	C	N	O	S	0	0
			1263	779	224	252	8		

- Molecule 3 is PHYCOCYANOBILIN (CCD ID: CYC) (formula: $C_{33}H_{40}N_4O_6$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				AltConf
3	A	1	Total	C	N	O	0
			43	33	4	6	
3	B	1	Total	C	N	O	0
			43	33	4	6	
3	B	1	Total	C	N	O	0
			43	33	4	6	
3	C	1	Total	C	N	O	0
			43	33	4	6	
3	D	1	Total	C	N	O	0
			43	33	4	6	
3	D	1	Total	C	N	O	0
			43	33	4	6	
3	E	1	Total	C	N	O	0
			43	33	4	6	
3	F	1	Total	C	N	O	0
			43	33	4	6	
3	F	1	Total	C	N	O	0
			43	33	4	6	
3	G	1	Total	C	N	O	0
			43	33	4	6	
3	H	1	Total	C	N	O	0
			43	33	4	6	
3	H	1	Total	C	N	O	0
			43	33	4	6	
3	I	1	Total	C	N	O	0
			43	33	4	6	
3	J	1	Total	C	N	O	0
			43	33	4	6	

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Mol	Chain	Residues	Atoms				AltConf
3	J	1	Total	C	N	O	0
			43	33	4	6	
3	K	1	Total	C	N	O	0
			43	33	4	6	
3	L	1	Total	C	N	O	0
			43	33	4	6	
3	L	1	Total	C	N	O	0
			43	33	4	6	

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

3 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, D3	Depositor
Number of particles used	28120	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS TALOS	Depositor
Voltage (kV)	200	Depositor
Electron dose ($e^-/\text{\AA}^2$)	50.0	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	120000	Depositor
Image detector	FEI FALCON III (4k x 4k)	Depositor
Maximum map value	0.254	Depositor
Minimum map value	-0.157	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.007	Depositor
Recommended contour level	0.067	Depositor
Map size (Å)	352.0, 352.0, 352.0	wwPDB
Map dimensions	400, 400, 400	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.88, 0.88, 0.88	Depositor

4 Model quality [i](#)

4.1 Standard geometry [i](#)

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

4.2 Too-close contacts [i](#)

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

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](#)

6 non-standard protein/DNA/RNA residues are modelled in this entry.

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	$\# Z > 2$
2	MEN	D	72	2	7,8,9	0.91	0	4,9,11	1.08	0
2	MEN	H	72	2	7,8,9	0.92	0	4,9,11	1.07	0
2	MEN	L	72	2	7,8,9	0.91	0	4,9,11	1.05	0
2	MEN	F	72	2	7,8,9	0.91	0	4,9,11	1.08	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	MEN	B	72	2	7,8,9	0.91	0	4,9,11	1.07	0
2	MEN	J	72	2	7,8,9	0.92	0	4,9,11	1.06	0

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
2	MEN	D	72	2	-	0/7/8/10	-
2	MEN	H	72	2	-	0/7/8/10	-
2	MEN	L	72	2	-	0/7/8/10	-
2	MEN	F	72	2	-	0/7/8/10	-
2	MEN	B	72	2	-	0/7/8/10	-
2	MEN	J	72	2	-	0/7/8/10	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

4.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

4.6 Ligand geometry [i](#)

18 ligands are modelled in this entry.

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
3	CYC	K	201	1	46,46,46	3.74	21 (45%)	63,67,67	2.32	15 (23%)
3	CYC	C	201	1	46,46,46	3.74	21 (45%)	63,67,67	2.32	15 (23%)
3	CYC	I	201	1	46,46,46	3.74	21 (45%)	63,67,67	2.32	15 (23%)
3	CYC	J	202	2	46,46,46	3.76	21 (45%)	63,67,67	2.46	15 (23%)
3	CYC	A	201	1	46,46,46	3.74	21 (45%)	63,67,67	2.32	15 (23%)
3	CYC	D	201	2	46,46,46	3.76	22 (47%)	63,67,67	2.35	14 (22%)
3	CYC	F	202	2	46,46,46	3.75	20 (43%)	63,67,67	2.46	15 (23%)
3	CYC	J	201	2	46,46,46	3.76	22 (47%)	63,67,67	2.34	14 (22%)
3	CYC	D	202	2	46,46,46	3.75	21 (45%)	63,67,67	2.46	15 (23%)
3	CYC	E	201	1	46,46,46	3.73	21 (45%)	63,67,67	2.33	15 (23%)
3	CYC	F	201	2	46,46,46	3.76	22 (47%)	63,67,67	2.35	14 (22%)
3	CYC	G	201	1	46,46,46	3.73	21 (45%)	63,67,67	2.32	14 (22%)
3	CYC	H	201	2	46,46,46	3.76	21 (45%)	63,67,67	2.35	14 (22%)
3	CYC	L	201	2	46,46,46	3.76	21 (45%)	63,67,67	2.35	14 (22%)
3	CYC	H	202	2	46,46,46	3.75	20 (43%)	63,67,67	2.46	15 (23%)
3	CYC	B	202	2	46,46,46	3.76	21 (45%)	63,67,67	2.46	15 (23%)
3	CYC	L	202	2	46,46,46	3.75	21 (45%)	63,67,67	2.47	15 (23%)
3	CYC	B	201	2	46,46,46	3.76	21 (45%)	63,67,67	2.35	14 (22%)

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
3	CYC	K	201	1	-	8/26/74/74	0/4/4/4
3	CYC	C	201	1	-	8/26/74/74	0/4/4/4
3	CYC	I	201	1	-	8/26/74/74	0/4/4/4
3	CYC	J	202	2	-	16/26/74/74	0/4/4/4
3	CYC	A	201	1	-	8/26/74/74	0/4/4/4
3	CYC	D	201	2	-	14/26/74/74	0/4/4/4
3	CYC	F	202	2	-	16/26/74/74	0/4/4/4
3	CYC	J	201	2	-	14/26/74/74	0/4/4/4
3	CYC	D	202	2	-	16/26/74/74	0/4/4/4
3	CYC	E	201	1	-	8/26/74/74	0/4/4/4
3	CYC	F	201	2	-	13/26/74/74	0/4/4/4

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	CYC	G	201	1	-	8/26/74/74	0/4/4/4
3	CYC	H	201	2	-	14/26/74/74	0/4/4/4
3	CYC	L	201	2	-	14/26/74/74	0/4/4/4
3	CYC	H	202	2	-	16/26/74/74	0/4/4/4
3	CYC	B	202	2	-	16/26/74/74	0/4/4/4
3	CYC	L	202	2	-	16/26/74/74	0/4/4/4
3	CYC	B	201	2	-	14/26/74/74	0/4/4/4

The worst 5 of 379 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	202	CYC	C4C-NC	10.11	1.56	1.37
3	J	202	CYC	C4C-NC	10.11	1.56	1.37
3	J	201	CYC	C4C-NC	10.10	1.56	1.37
3	B	201	CYC	C4C-NC	10.08	1.56	1.37
3	L	201	CYC	C4C-NC	10.08	1.56	1.37

The worst 5 of 263 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	L	202	CYC	CHA-C4D-ND	-11.20	99.98	125.29
3	F	202	CYC	CHA-C4D-ND	-11.19	100.00	125.29
3	D	202	CYC	CHA-C4D-ND	-11.19	100.02	125.29
3	B	202	CYC	CHA-C4D-ND	-11.18	100.02	125.29
3	H	202	CYC	CHA-C4D-ND	-11.18	100.03	125.29

There are no chirality outliers.

5 of 227 torsion outliers are listed below:

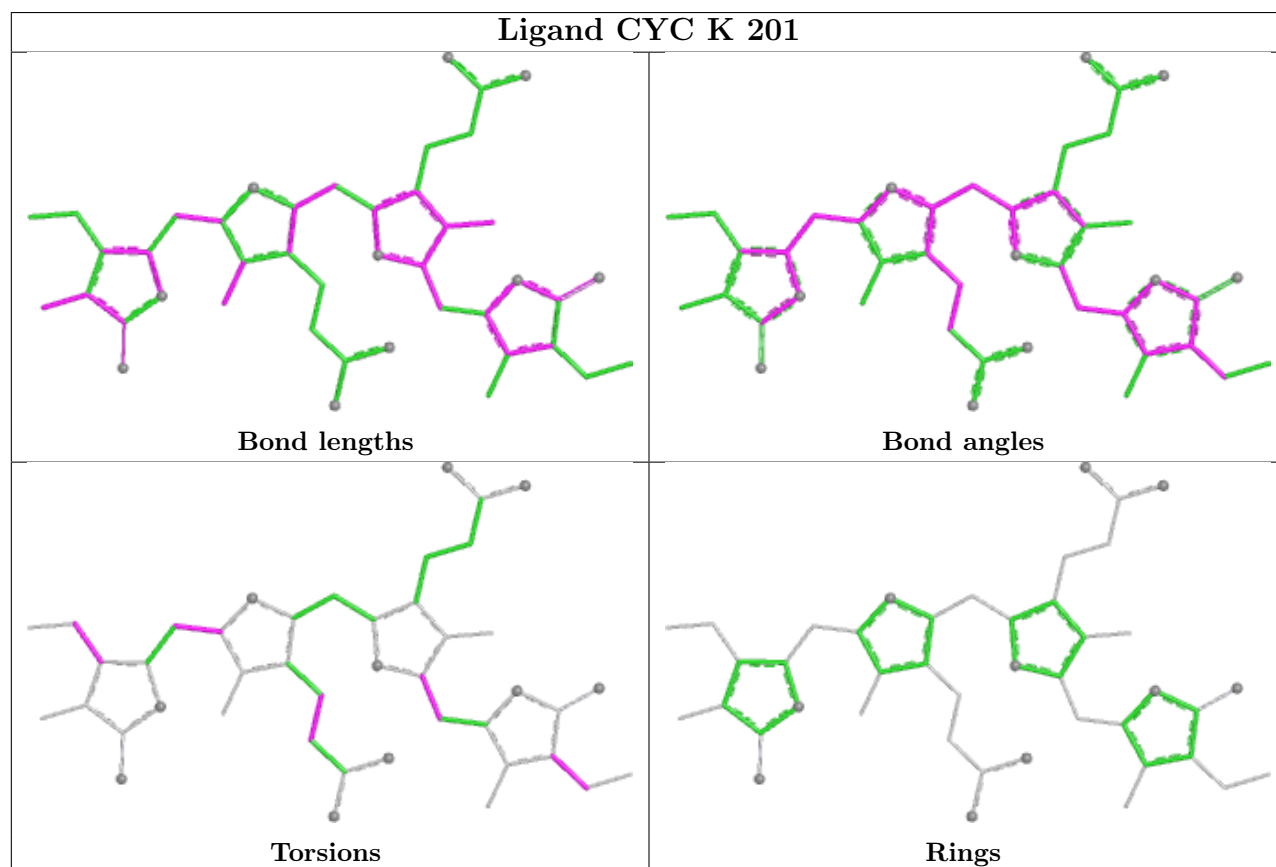
Mol	Chain	Res	Type	Atoms
3	A	201	CYC	NA-C4A-CHB-C1B
3	A	201	CYC	C3A-C4A-CHB-C1B
3	A	201	CYC	C2C-C3C-CAC-CBC
3	A	201	CYC	C4C-C3C-CAC-CBC
3	B	201	CYC	NA-C4A-CHB-C1B

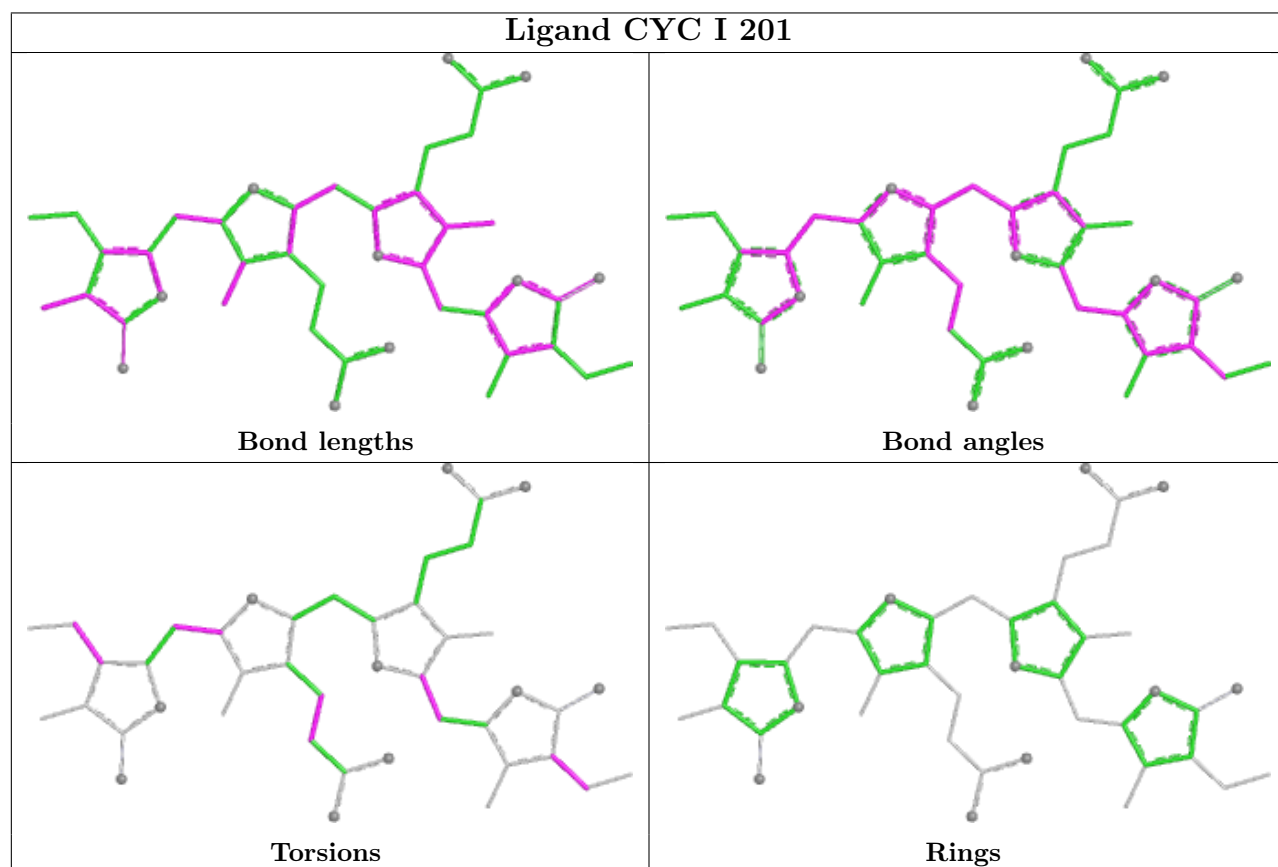
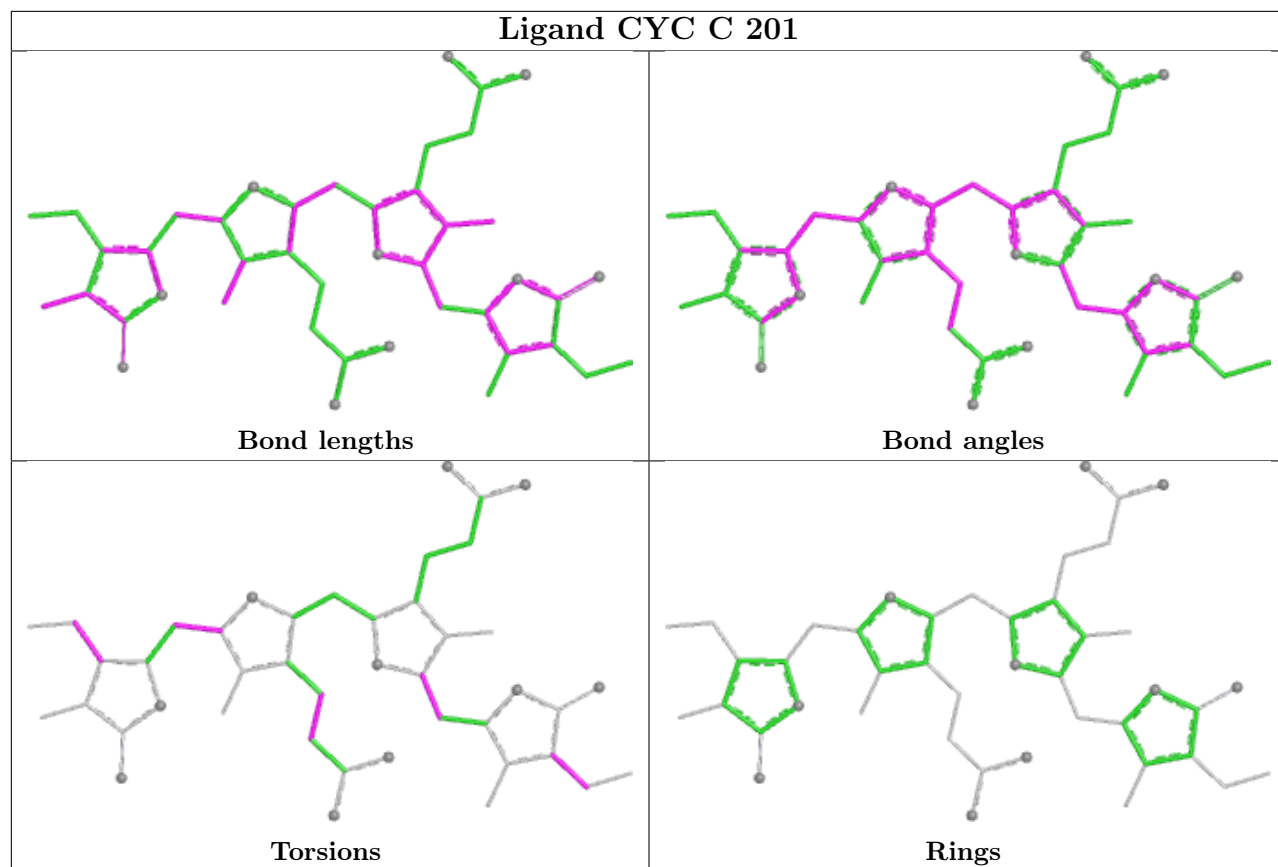
There are no ring outliers.

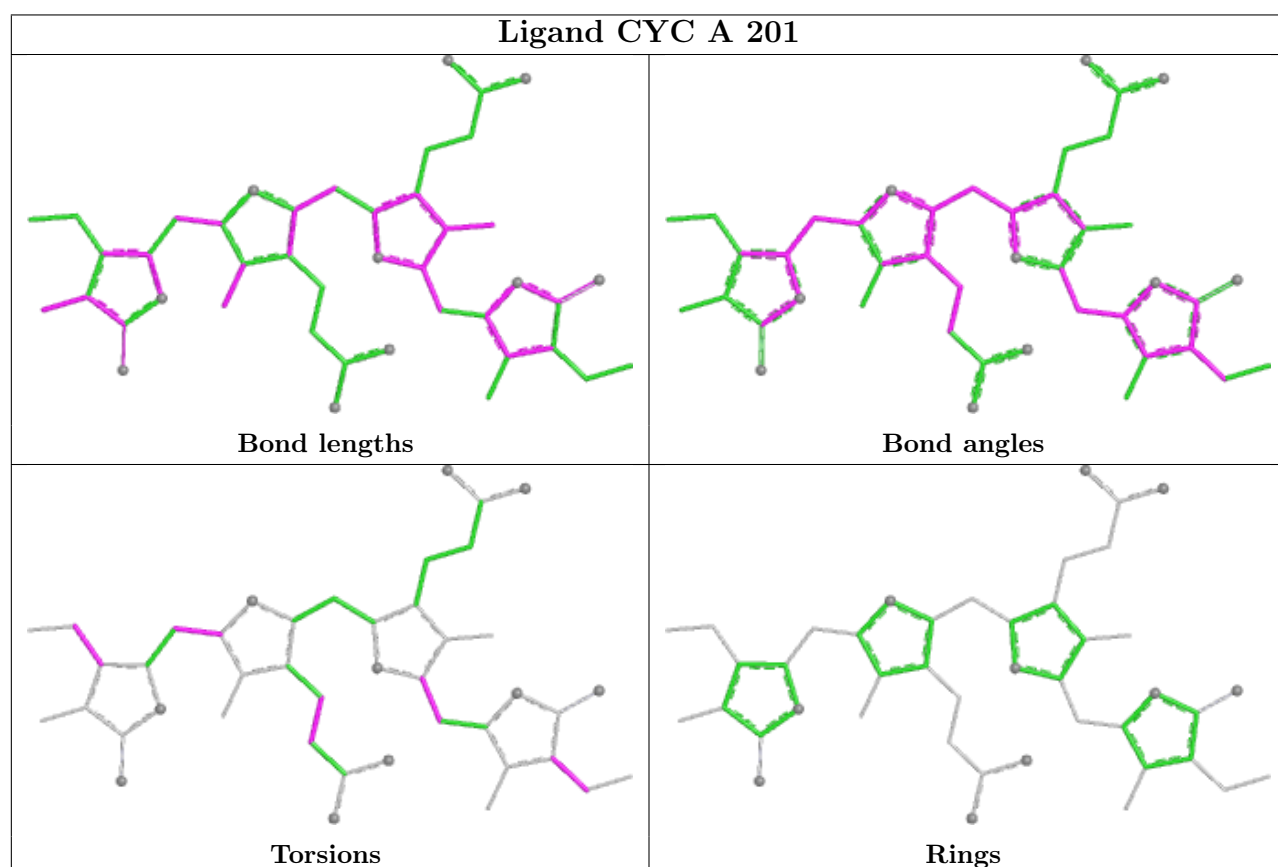
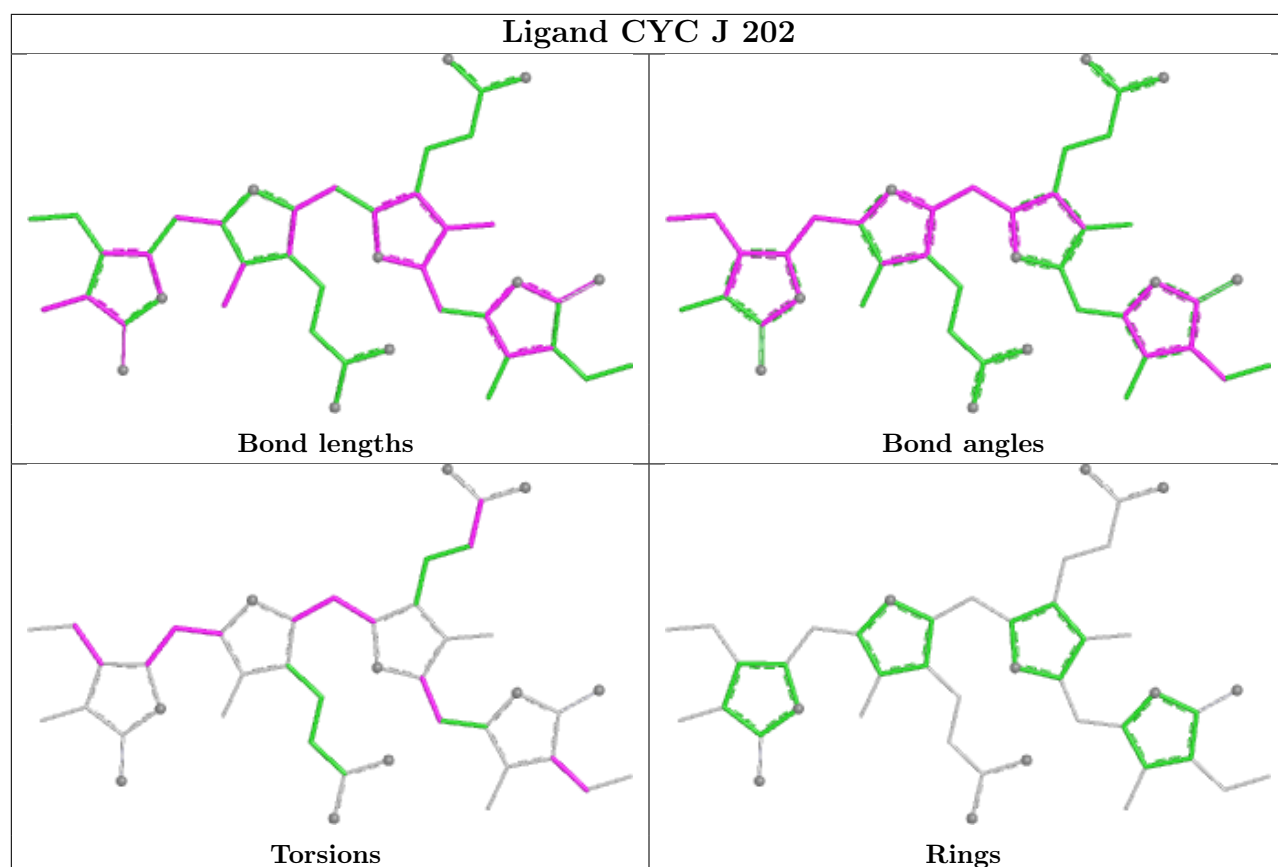
No monomer is involved in short contacts.

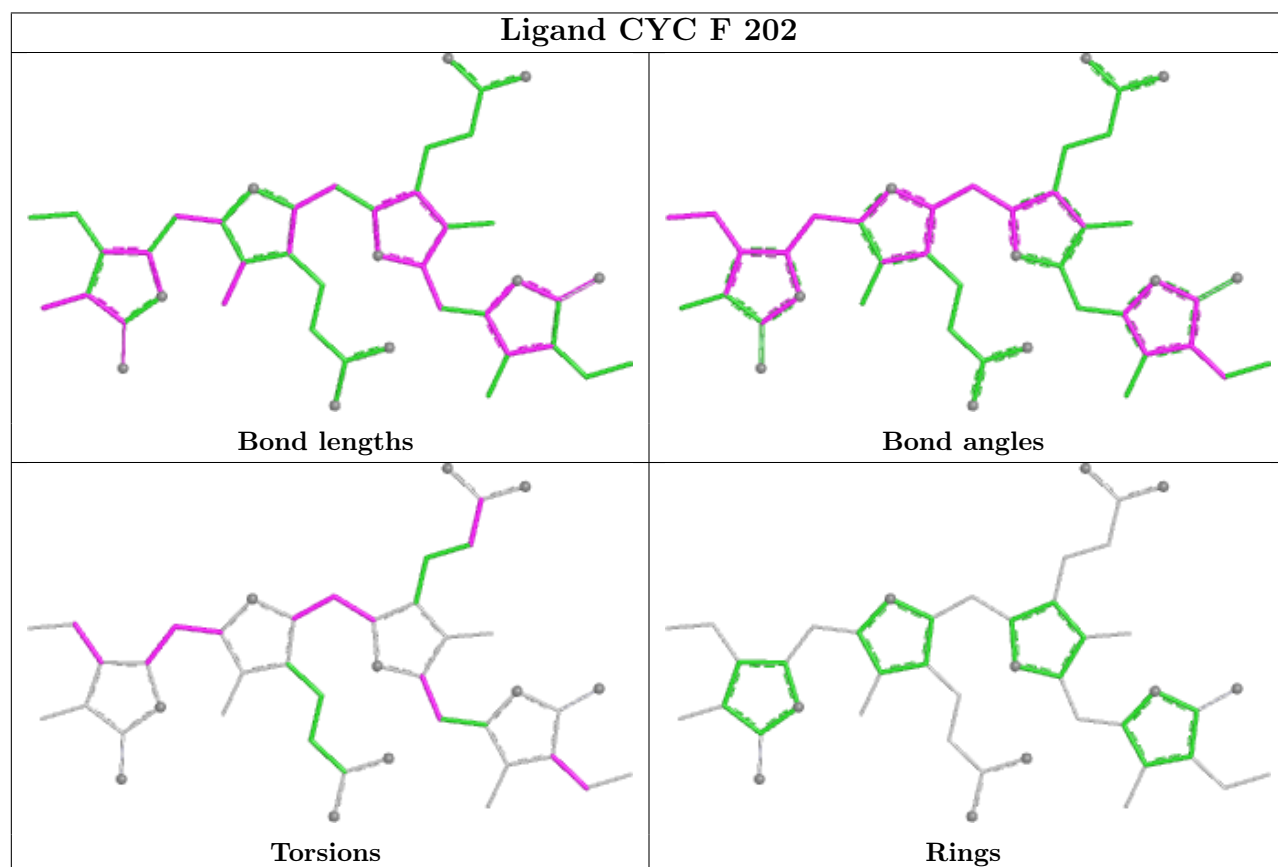
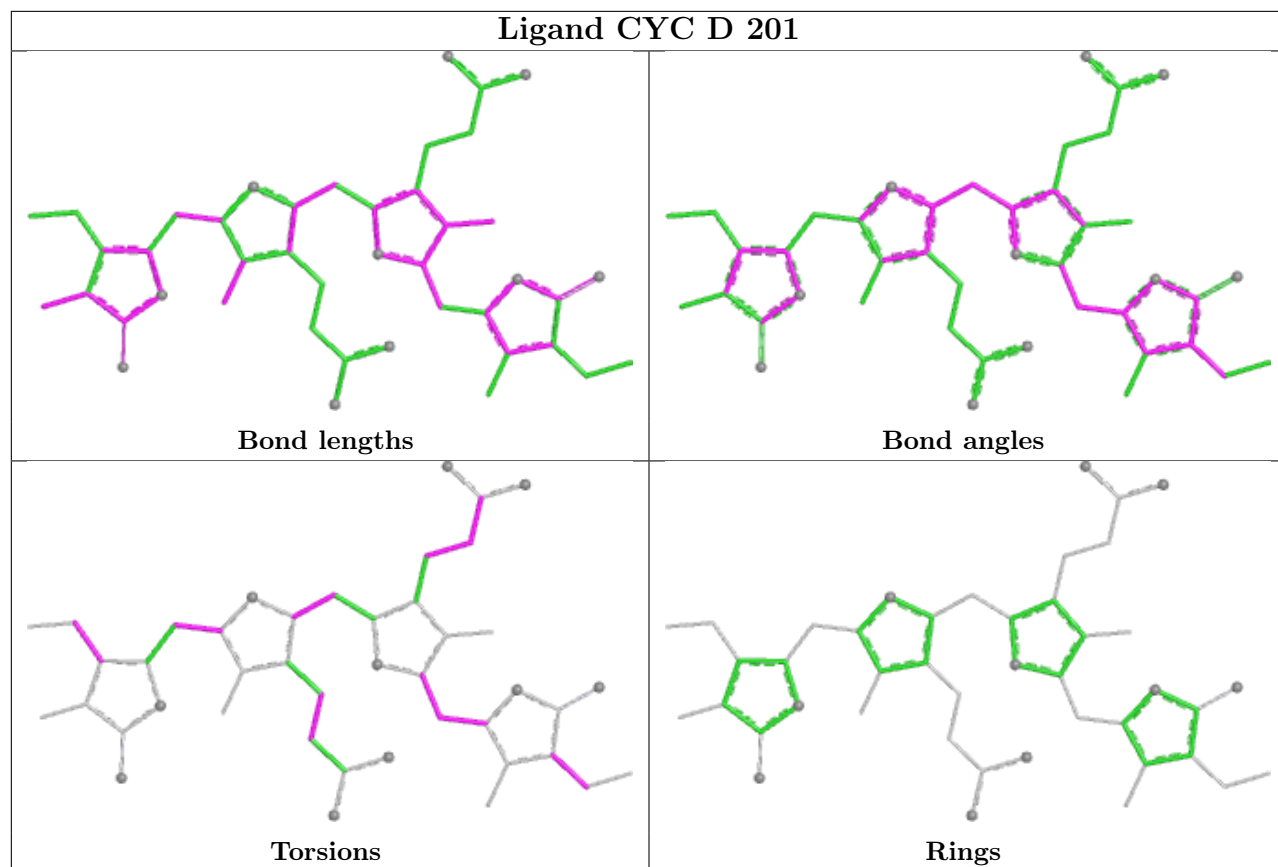
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths,

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.

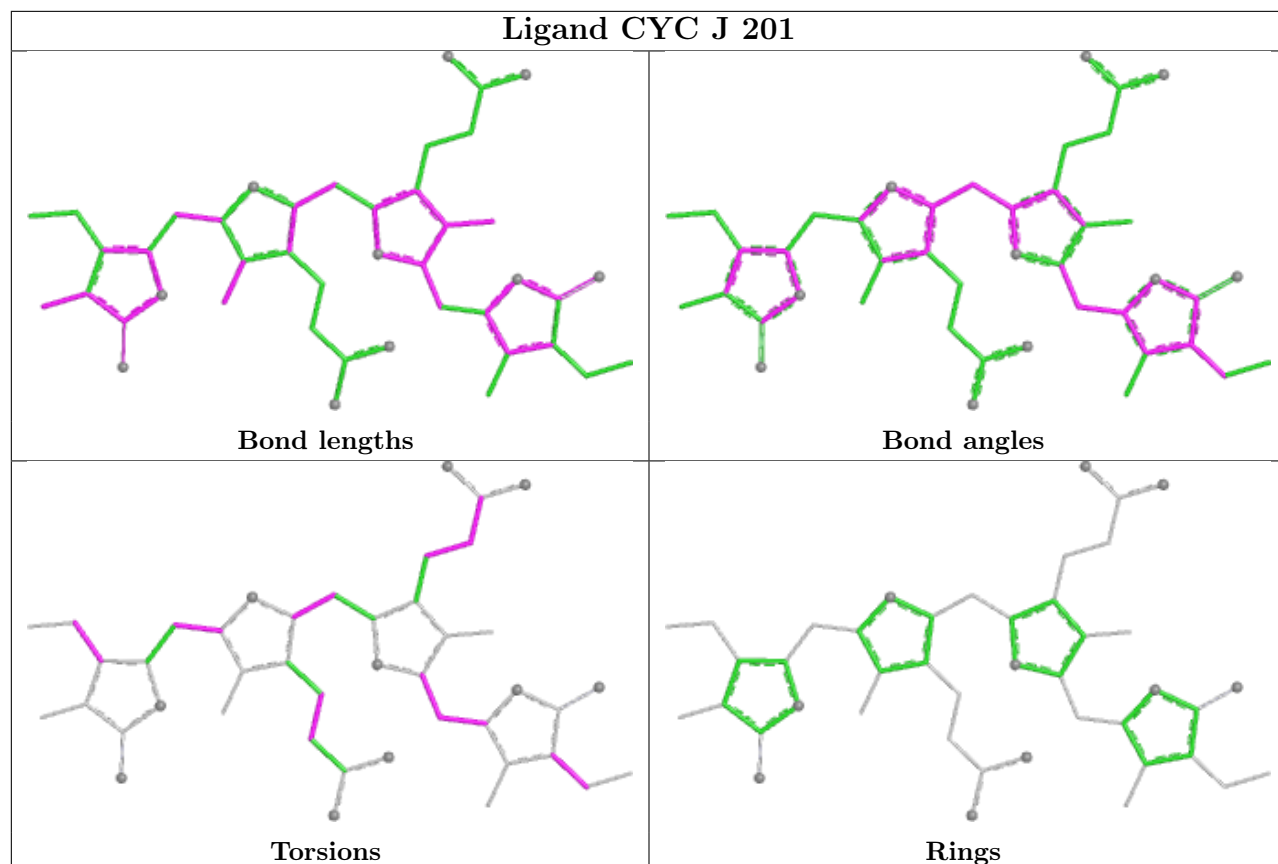




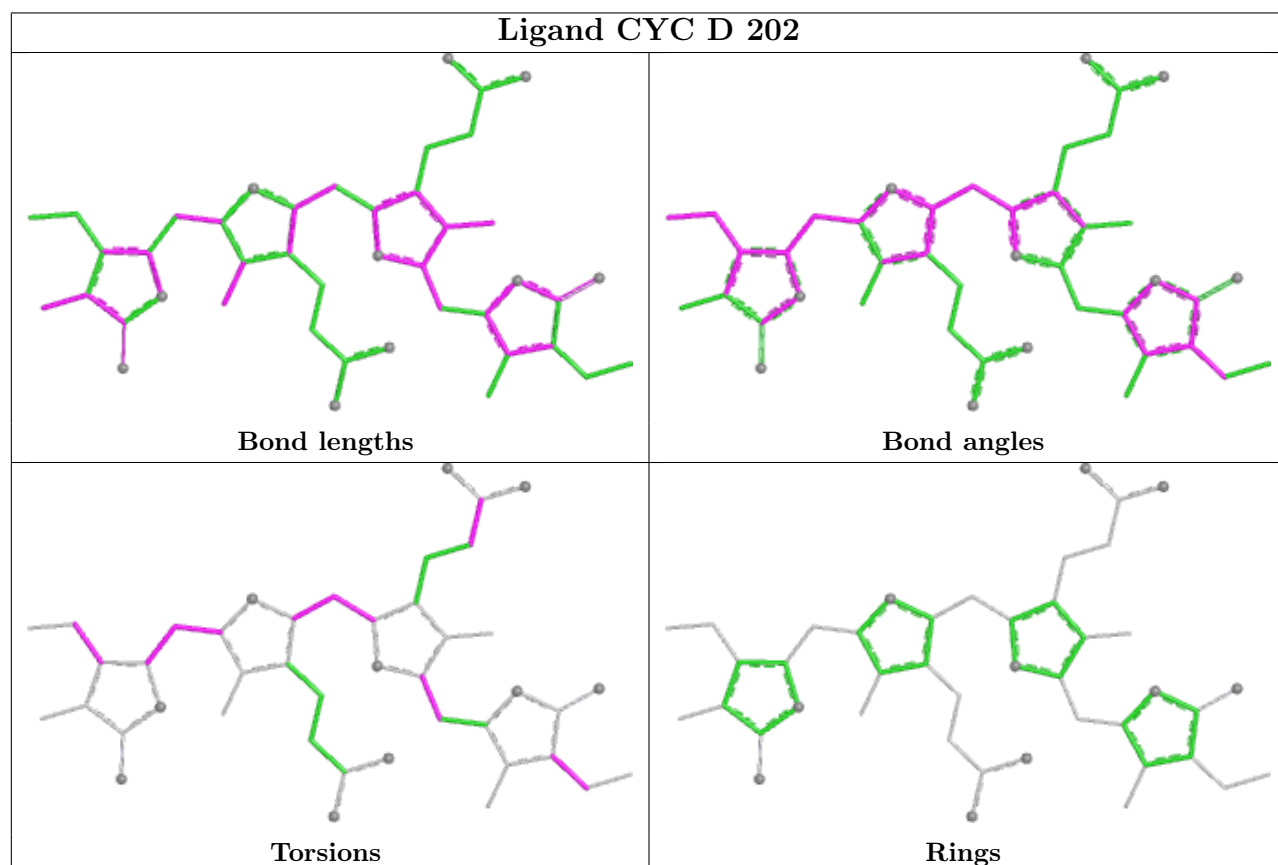




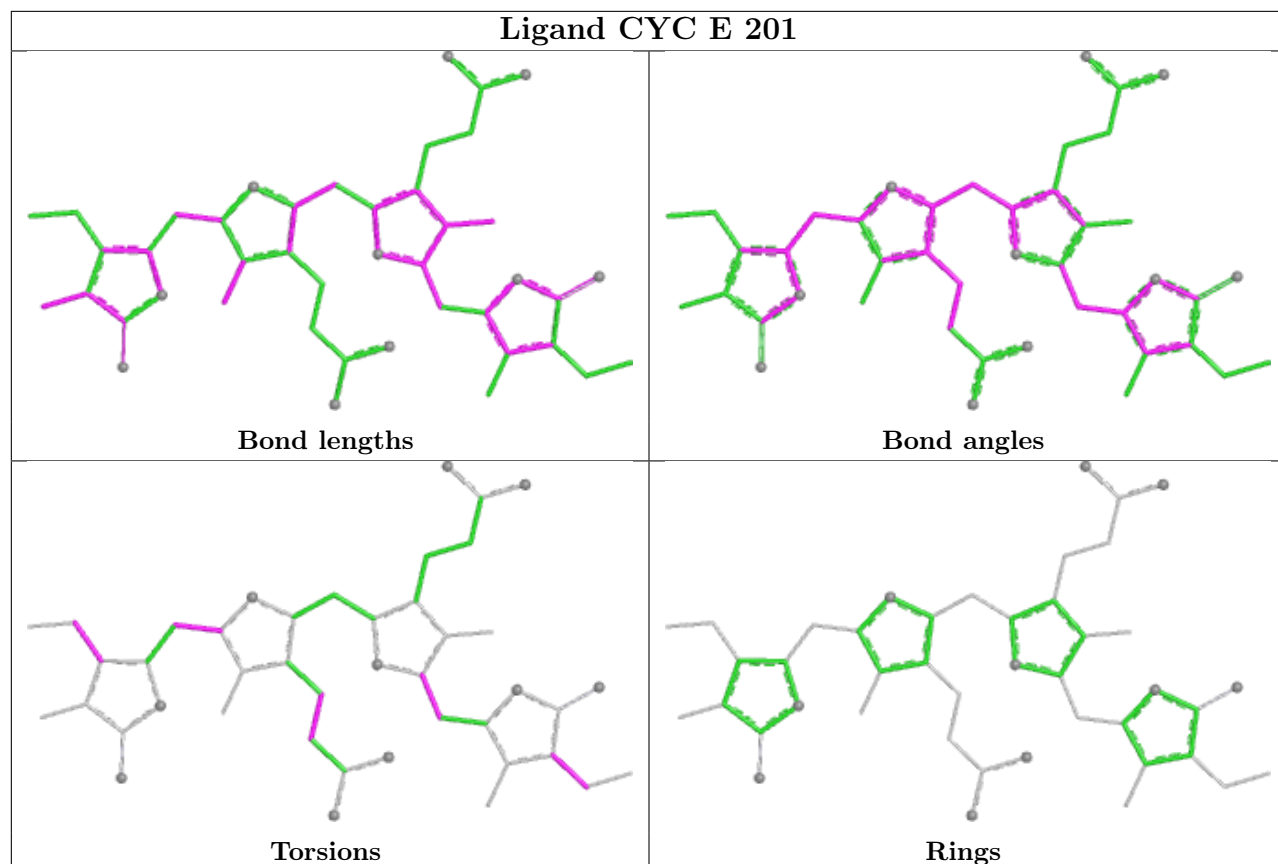
Ligand CYC J 201



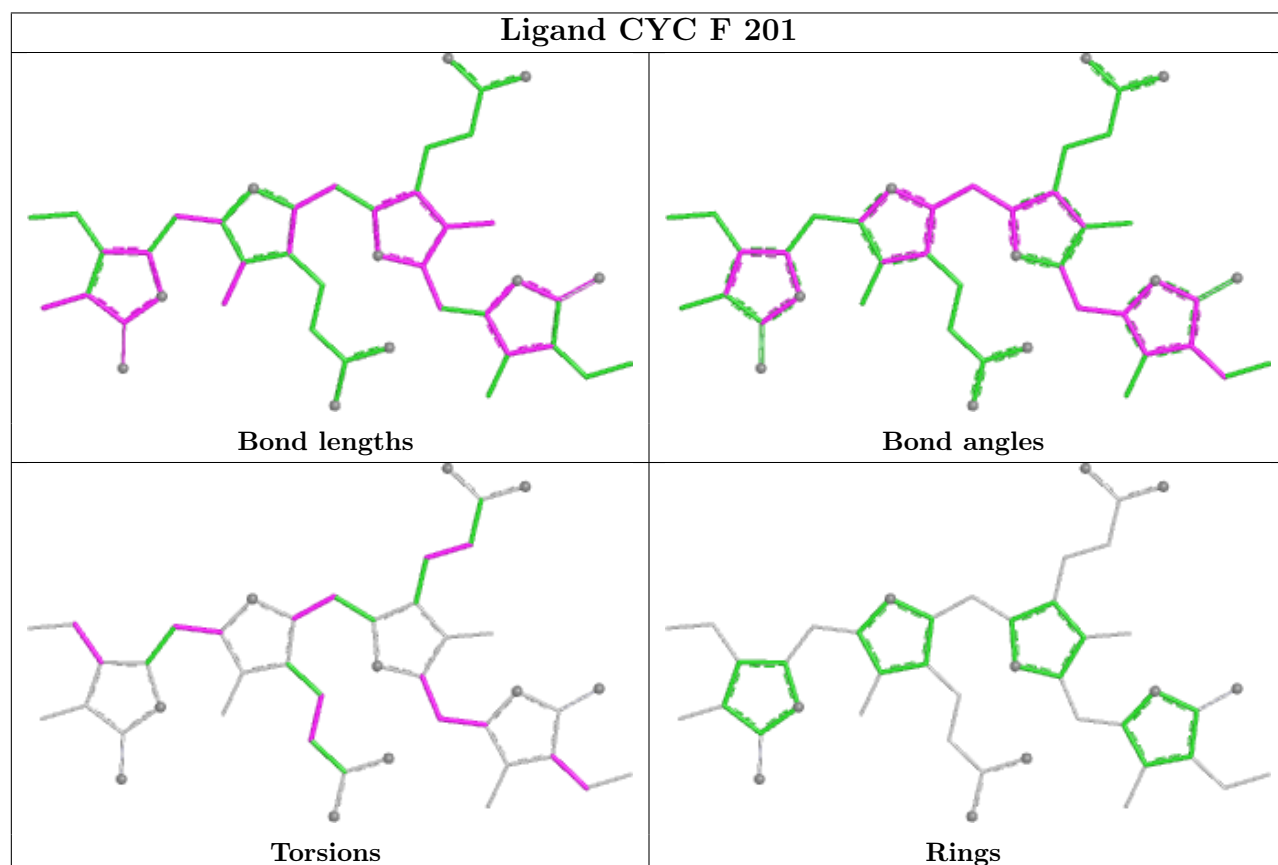
Ligand CYC D 202

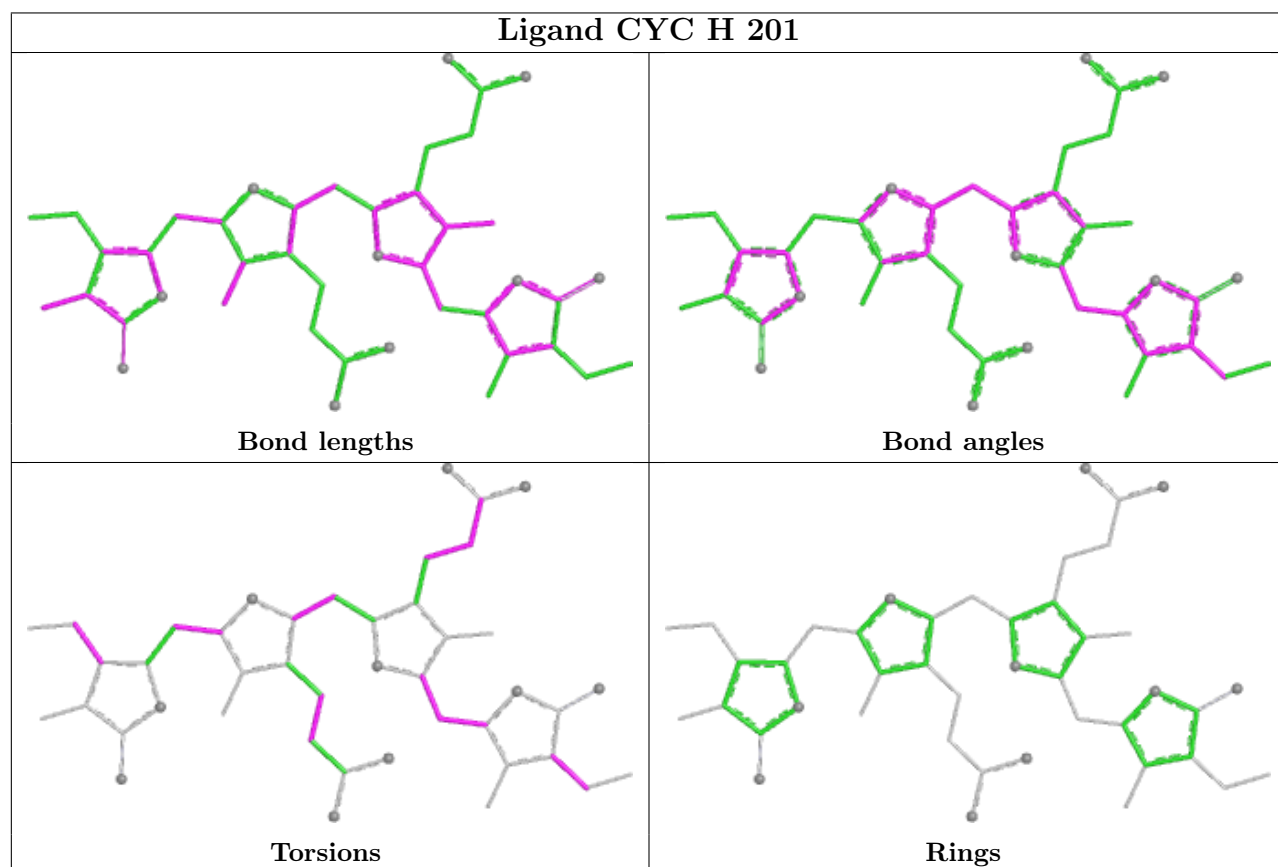
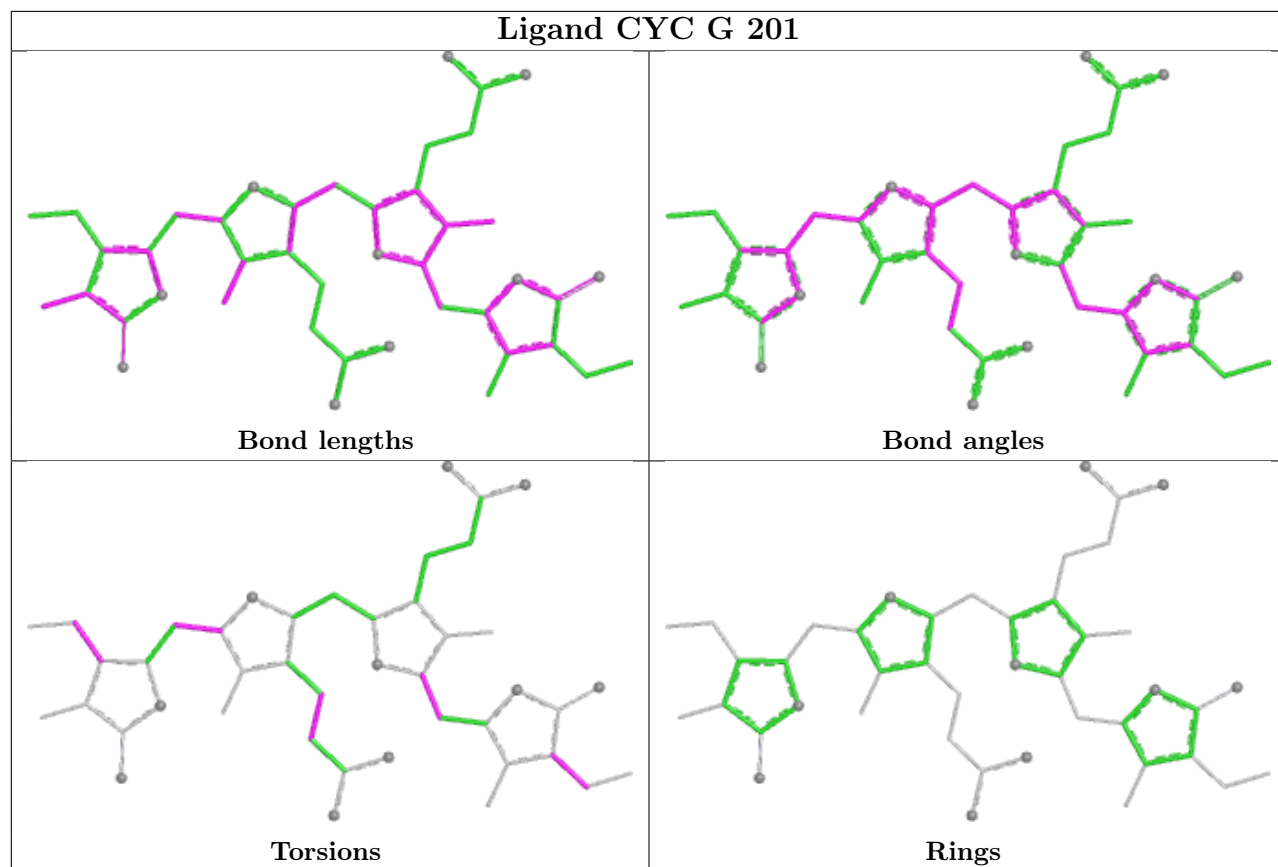


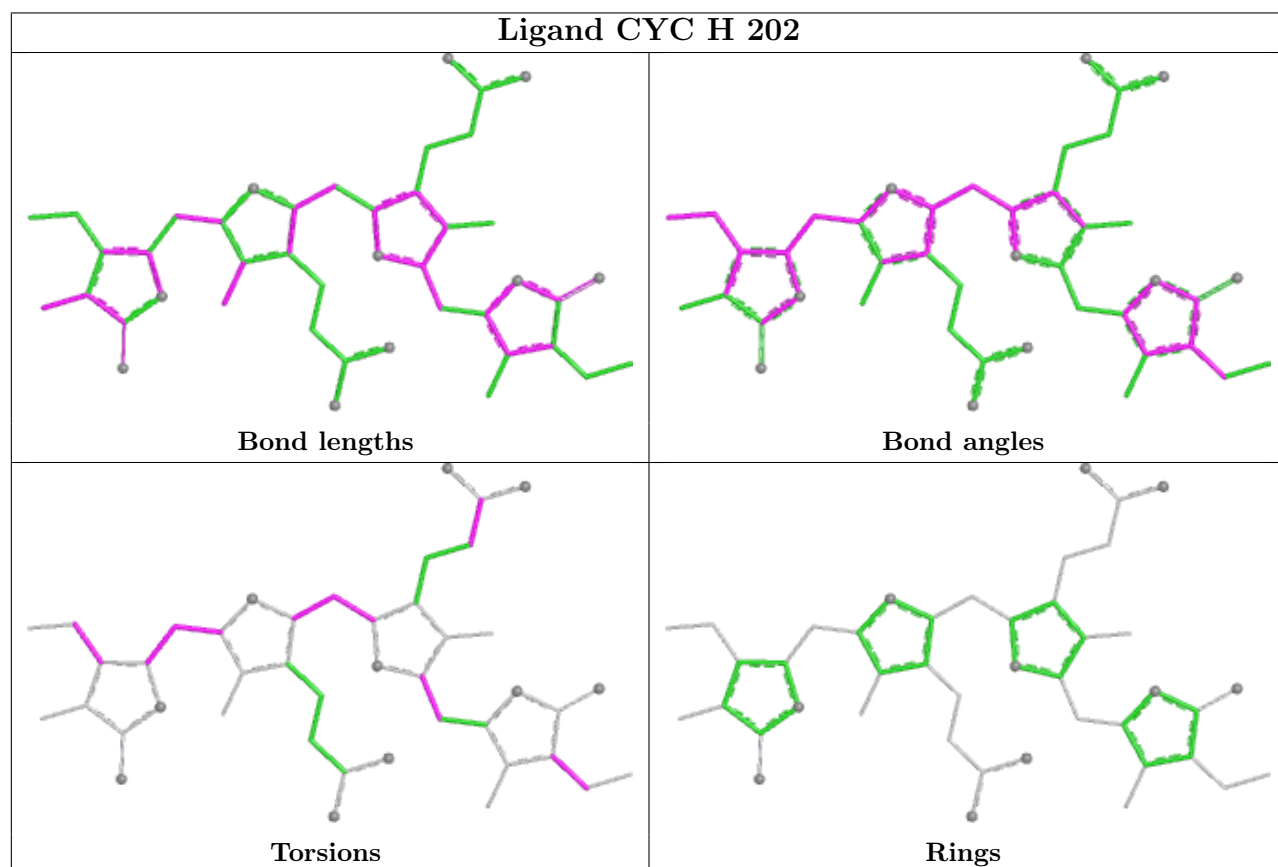
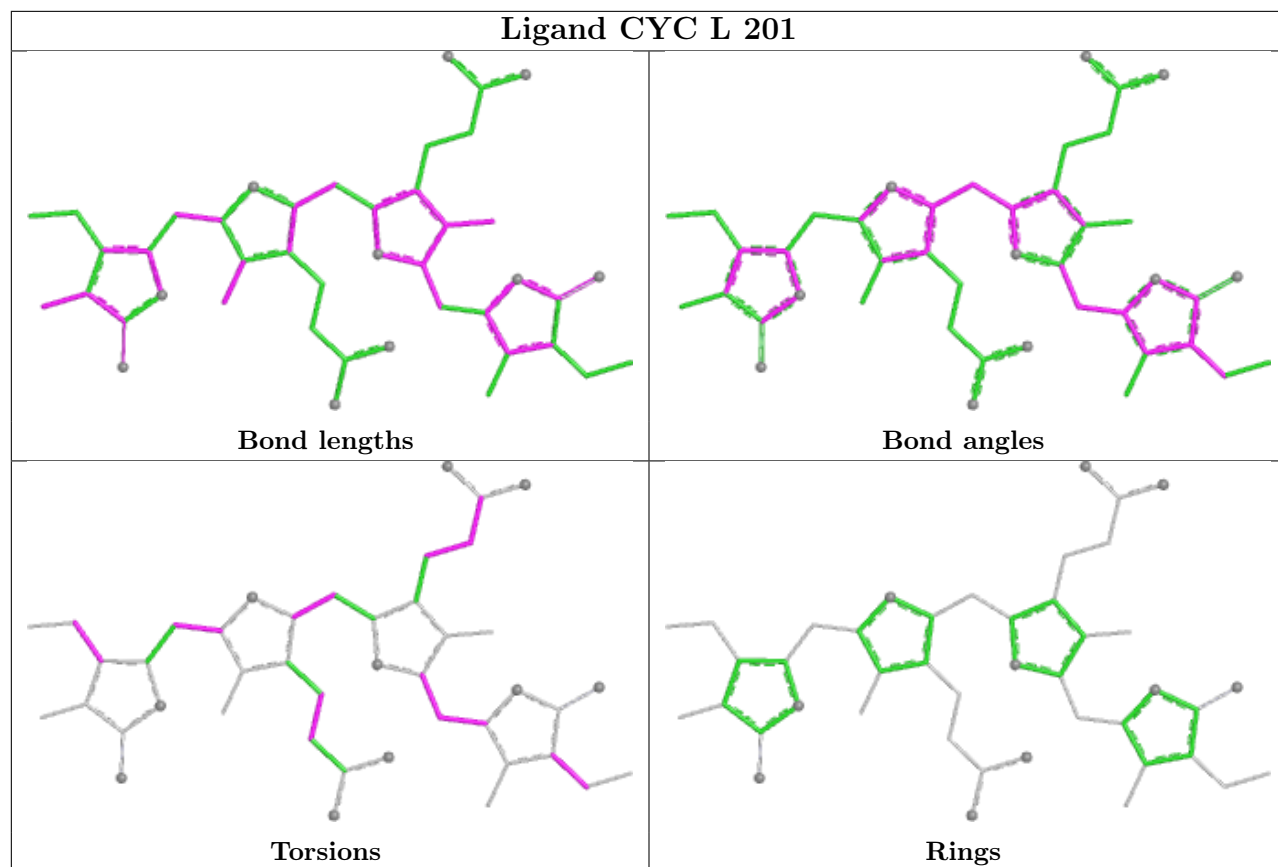
Ligand CYC E 201

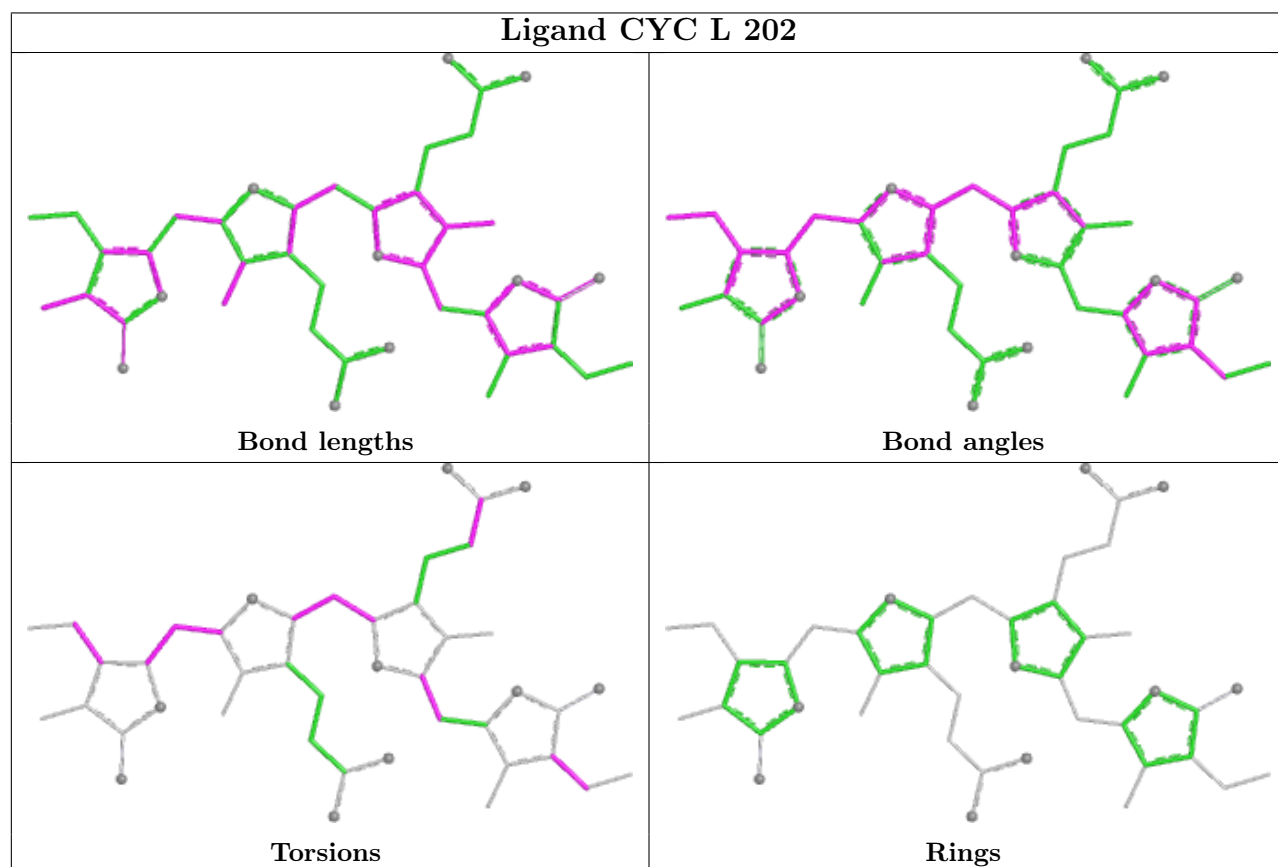
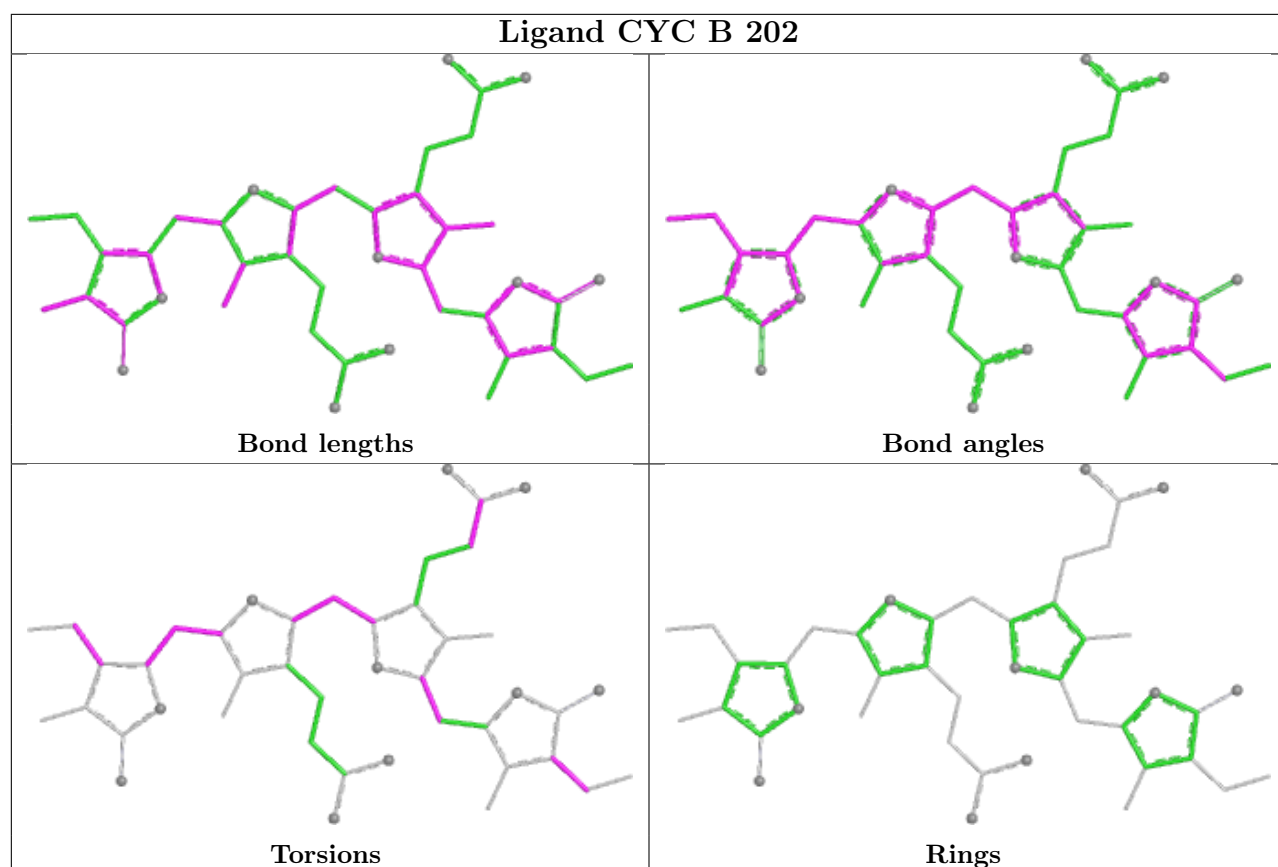


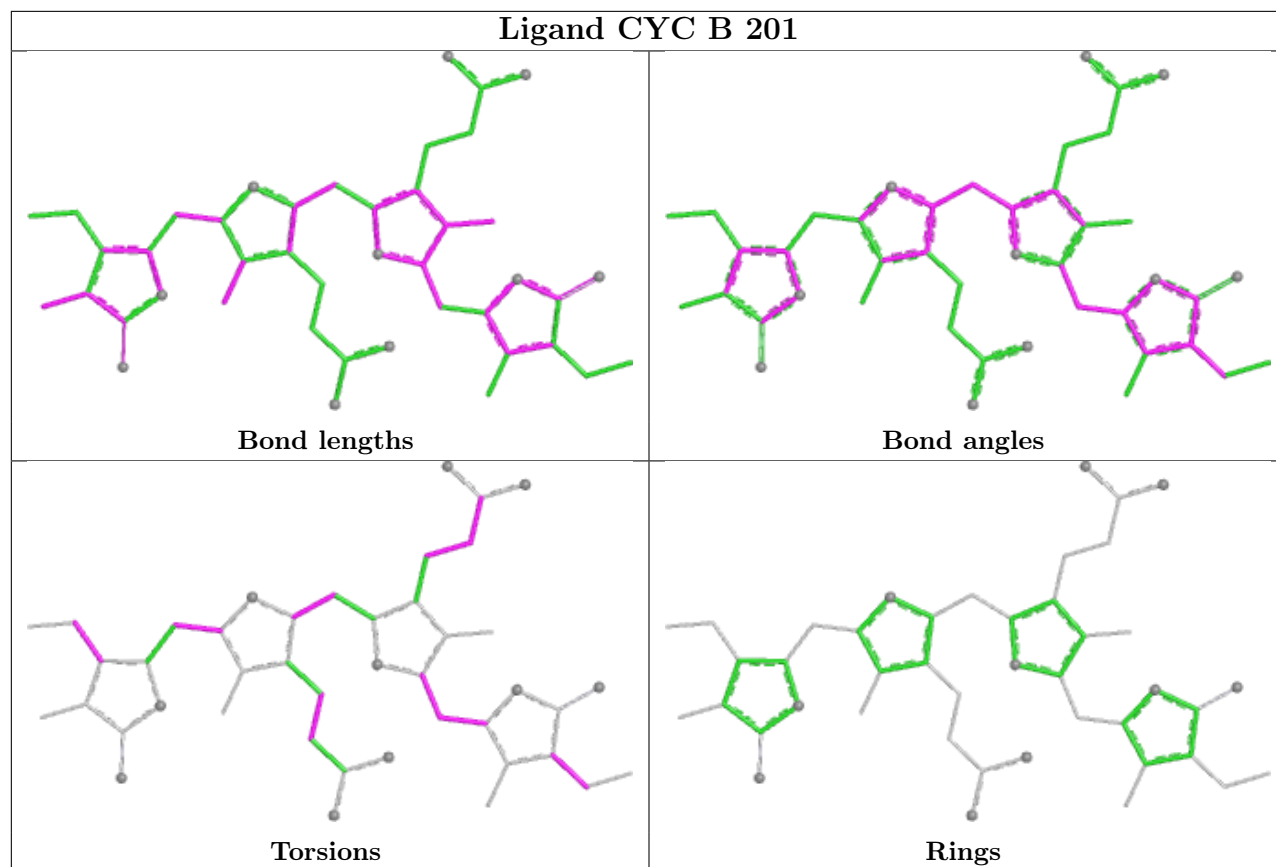
Ligand CYC F 201











4.7 Other polymers [i](#)

There are no such residues in this entry.

4.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

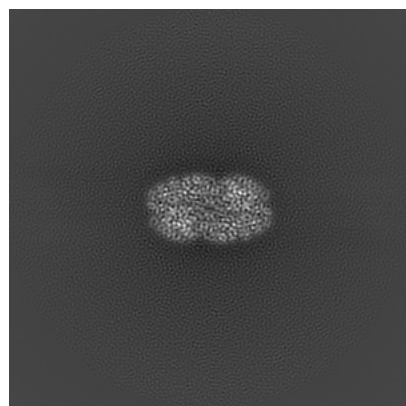
5 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-31090. These allow visual inspection of the internal detail of the map and identification of artifacts.

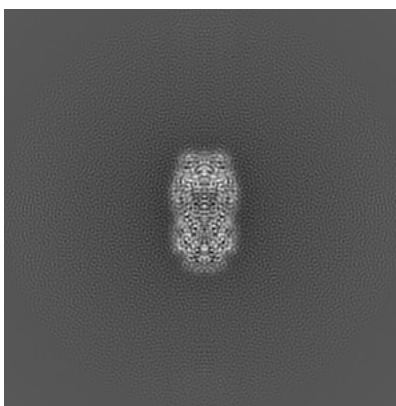
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

5.1 Orthogonal projections [i](#)

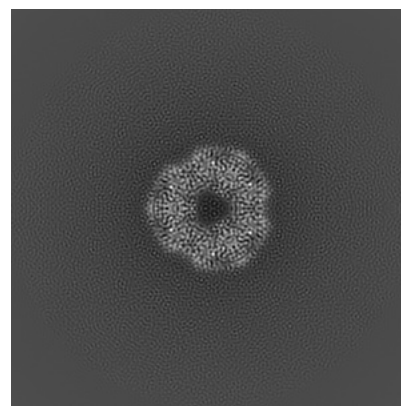
5.1.1 Primary map



X

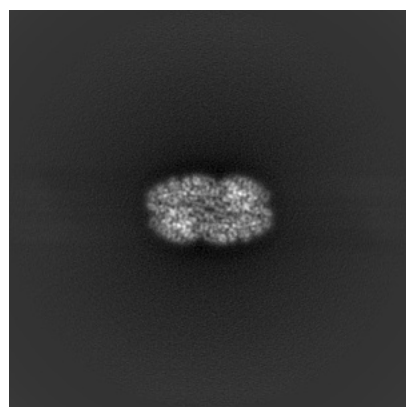


Y

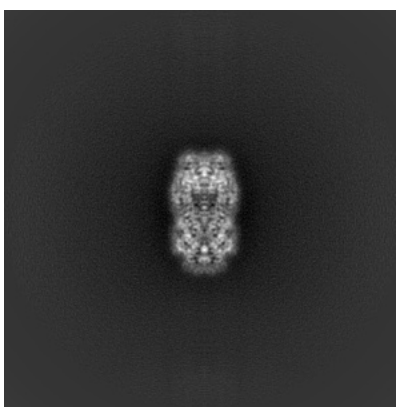


Z

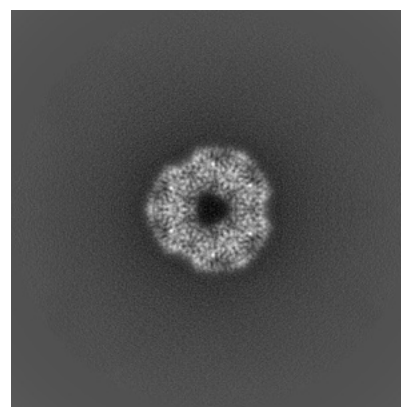
5.1.2 Raw map



X



Y

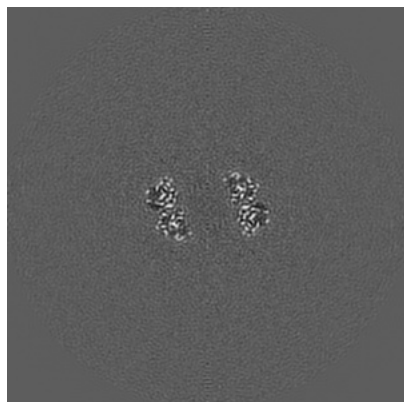


Z

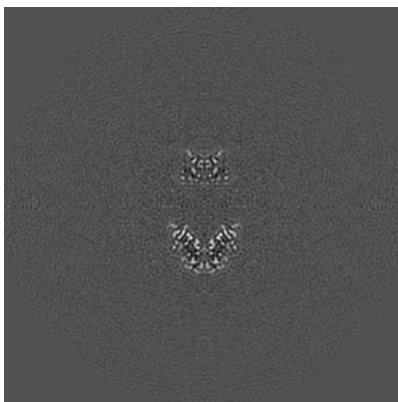
The images above show the map projected in three orthogonal directions.

5.2 Central slices [i](#)

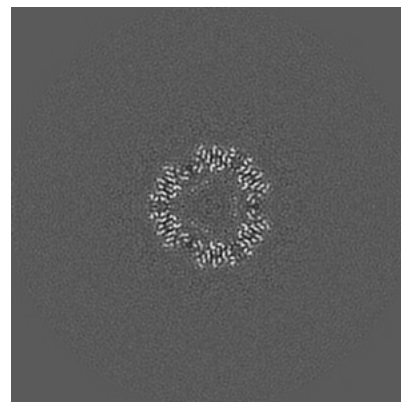
5.2.1 Primary map



X Index: 200

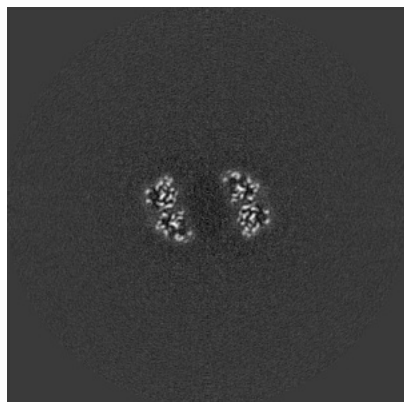


Y Index: 200

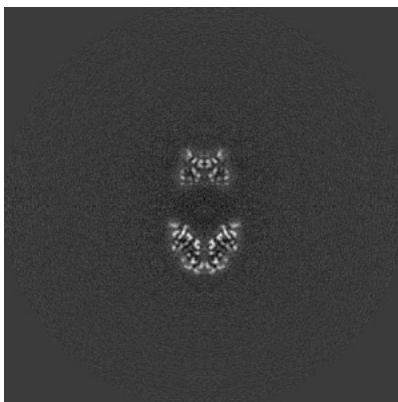


Z Index: 200

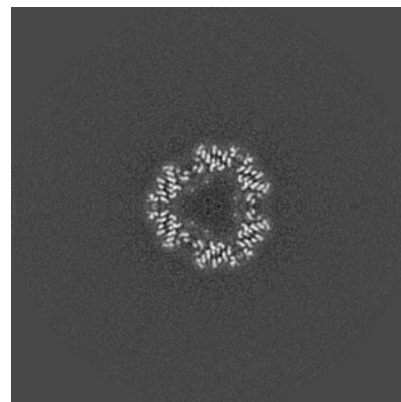
5.2.2 Raw map



X Index: 200



Y Index: 200

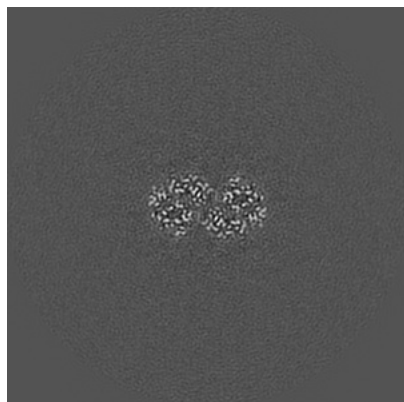


Z Index: 200

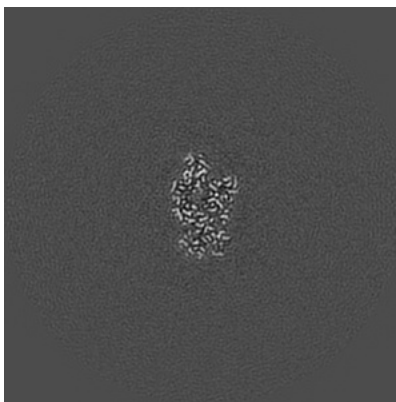
The images above show central slices of the map in three orthogonal directions.

5.3 Largest variance slices [i](#)

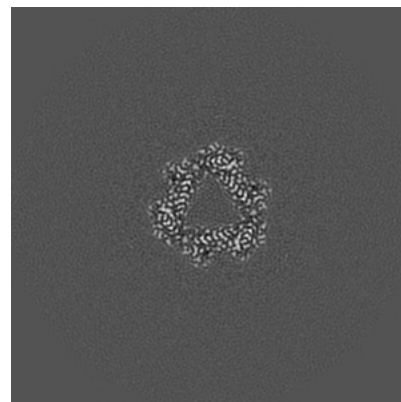
5.3.1 Primary map



X Index: 228

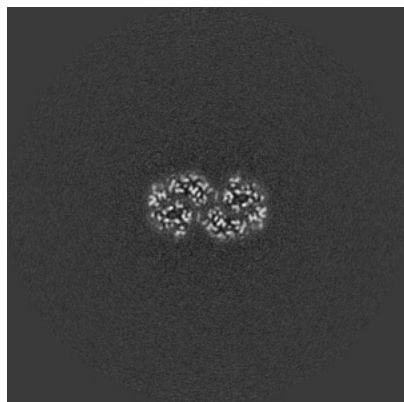


Y Index: 165

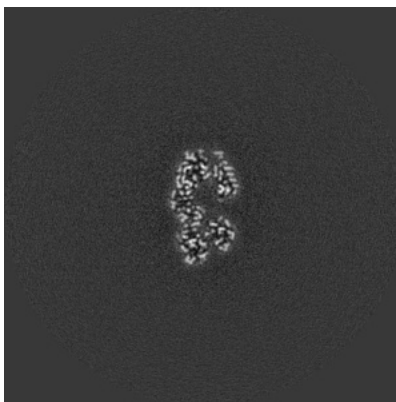


Z Index: 185

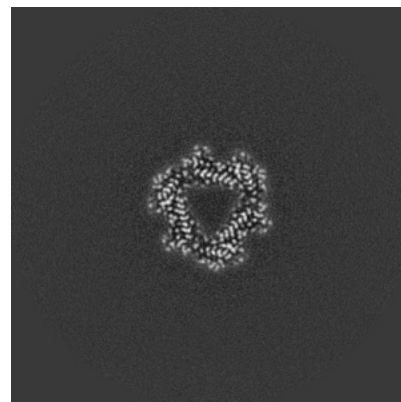
5.3.2 Raw map



X Index: 228



Y Index: 175

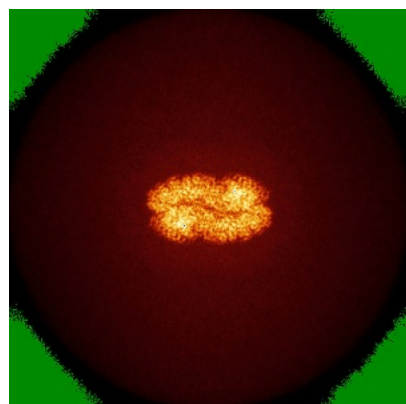


Z Index: 215

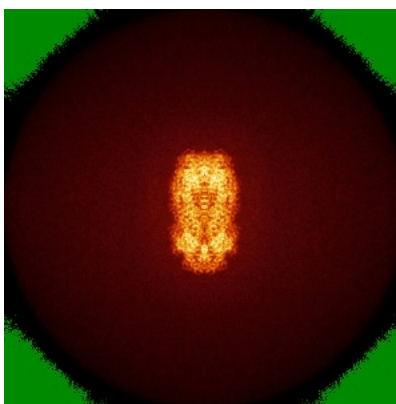
The images above show the largest variance slices of the map in three orthogonal directions.

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

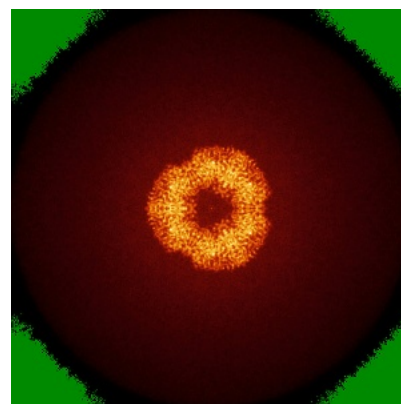
5.4.1 Primary map



X

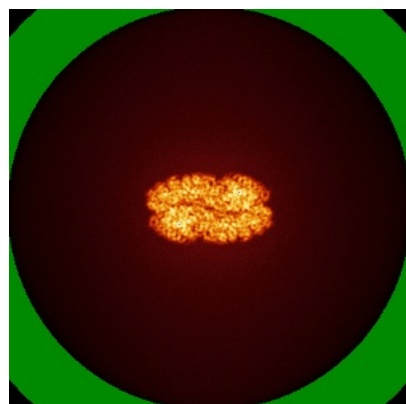


Y

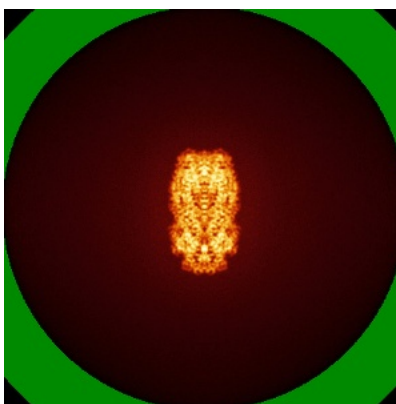


Z

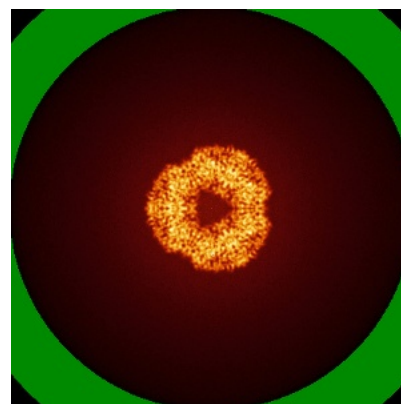
5.4.2 Raw map



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



The images above show the 3D surface view of the map at the recommended contour level 0.067. 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



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.

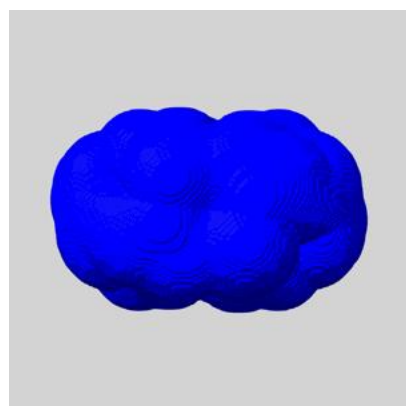
5.6 Mask visualisation [i](#)

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

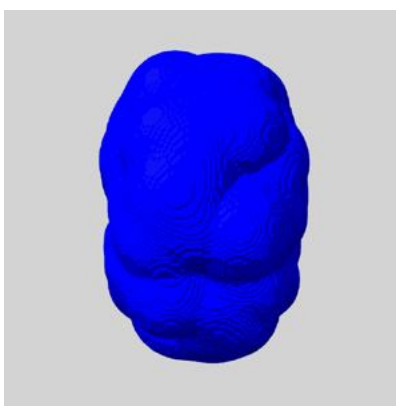
A mask typically either:

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

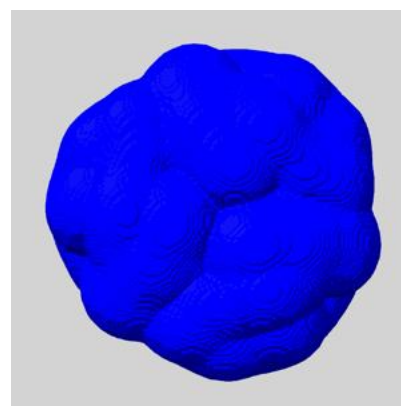
5.6.1 emd_31090_msk_1.map [i](#)



X



Y

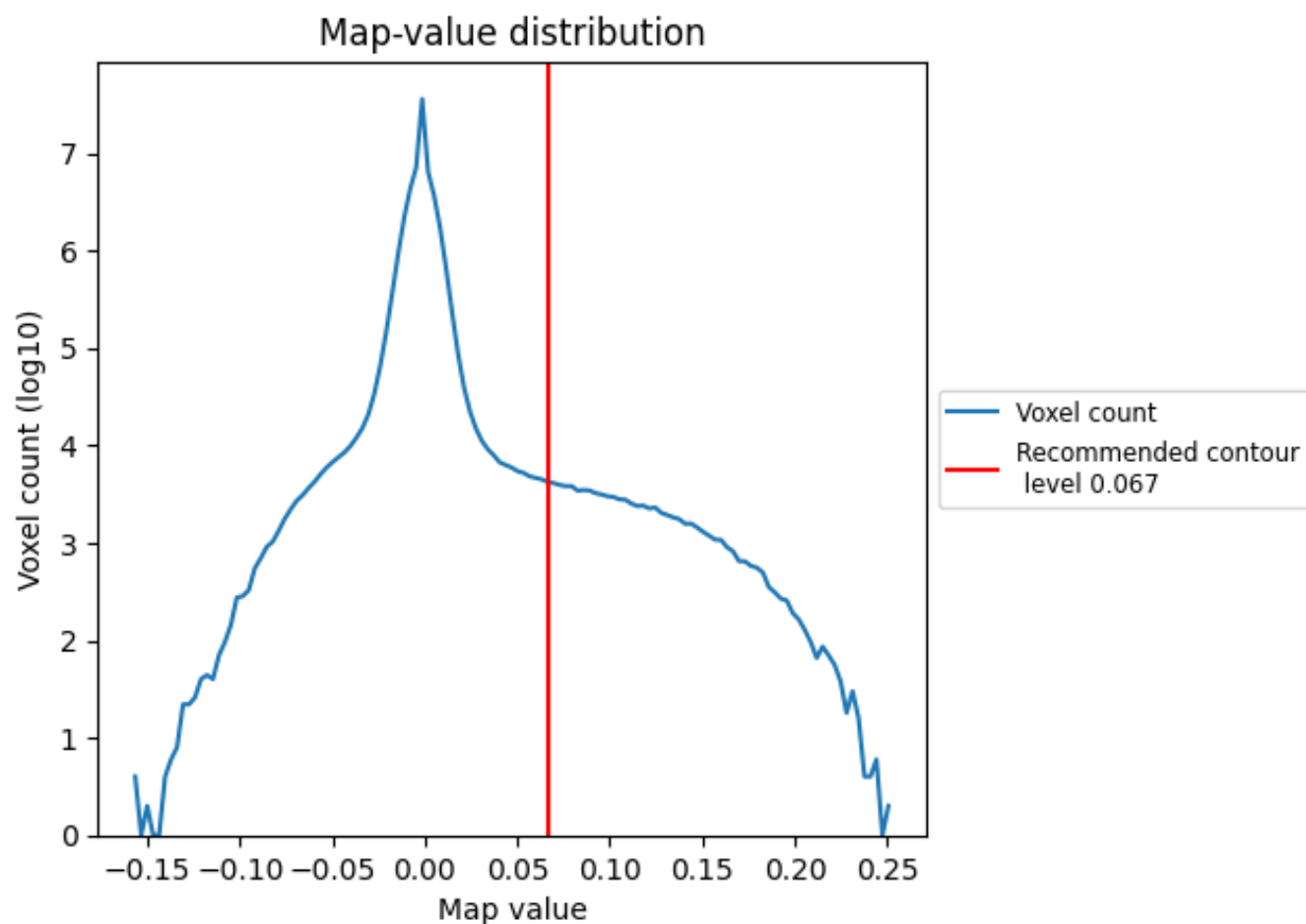


Z

6 Map analysis [i](#)

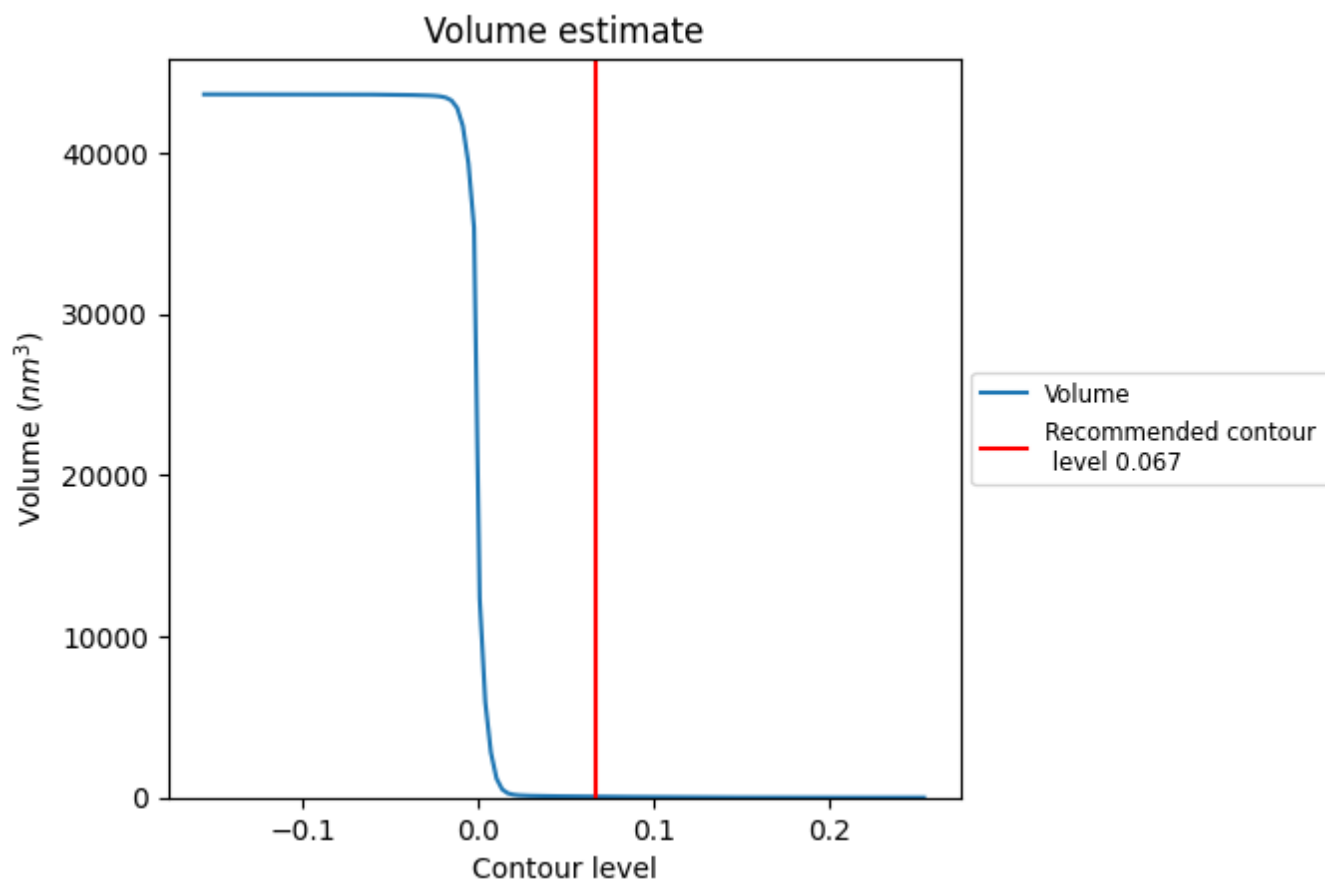
This section contains the results of statistical analysis of the map.

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.

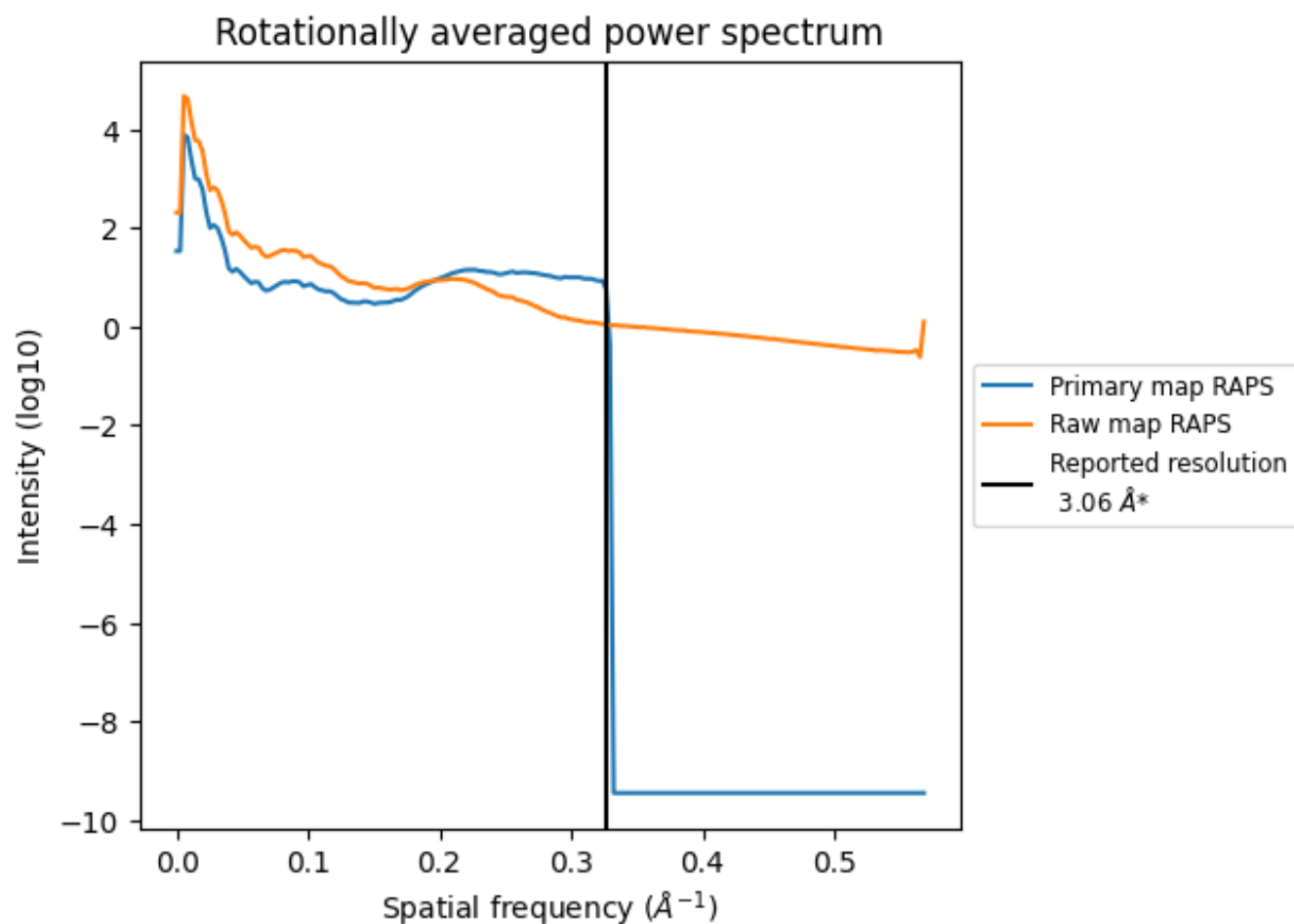
6.2 Volume estimate [i](#)



The volume at the recommended contour level is 57 nm³; this corresponds to an approximate mass of 51 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 ⓘ

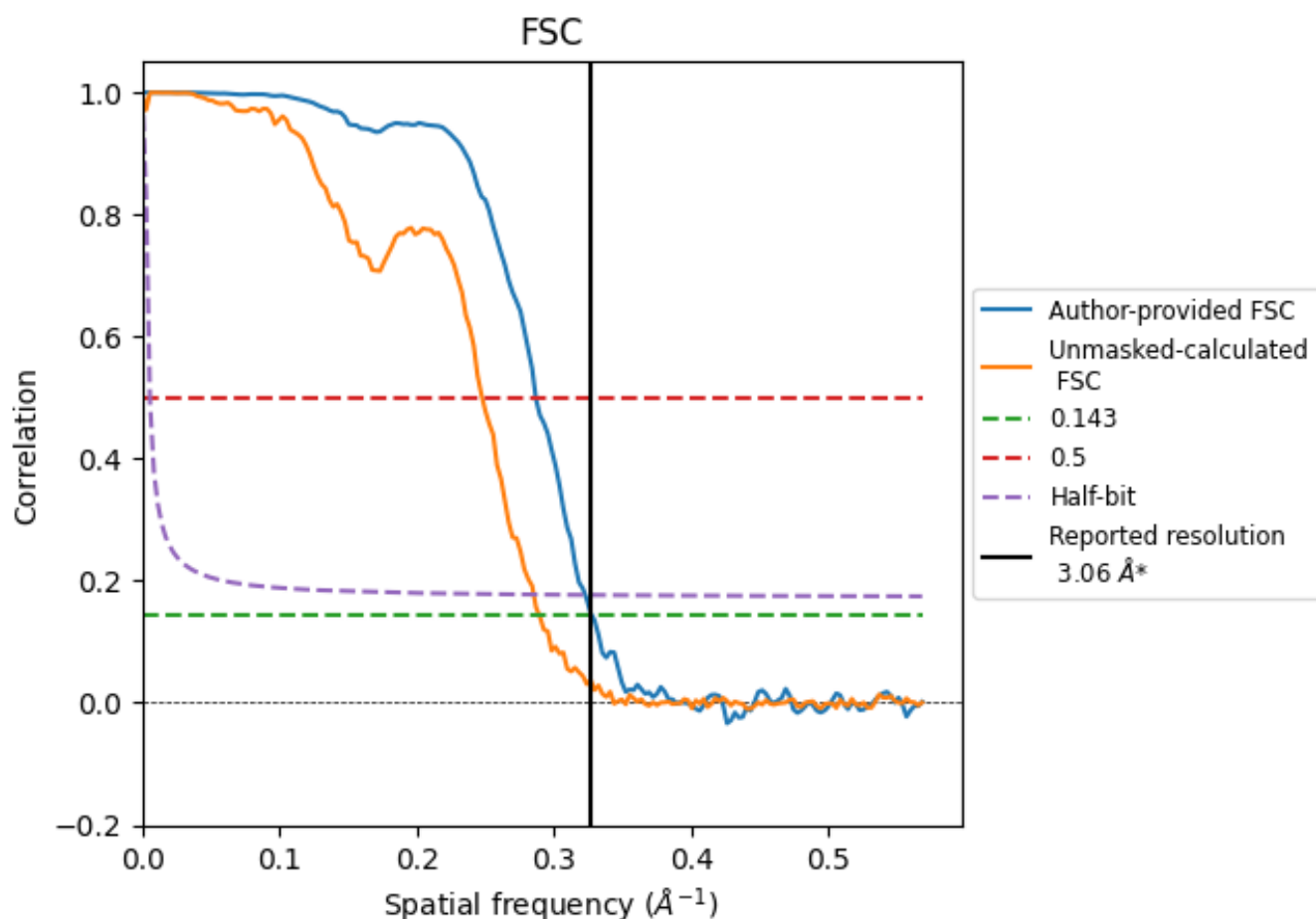


*Reported resolution corresponds to spatial frequency of 0.327 $\text{\AA}^{-1}$

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 0.327 $\text{\AA}^{-1}$

7.2 Resolution estimates [i](#)

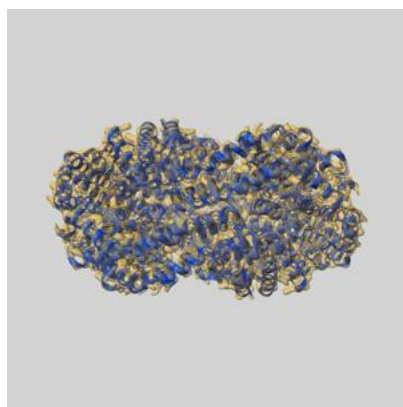
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.06	-	-
Author-provided FSC curve	3.05	3.49	3.10
Unmasked-calculated*	3.46	4.04	3.51

*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 3.46 differs from the reported value 3.06 by more than 10 %

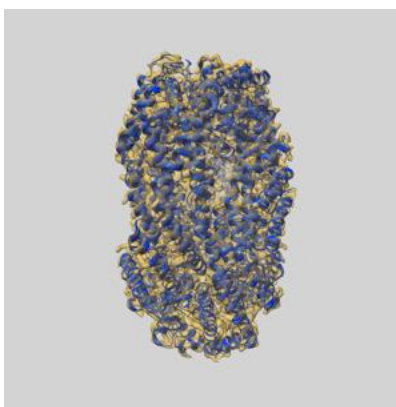
8 Map-model fit [i](#)

This section contains information regarding the fit between EMDB map EMD-31090 and PDB model 7EH8. Per-residue inclusion information can be found in section ?? on page ??.

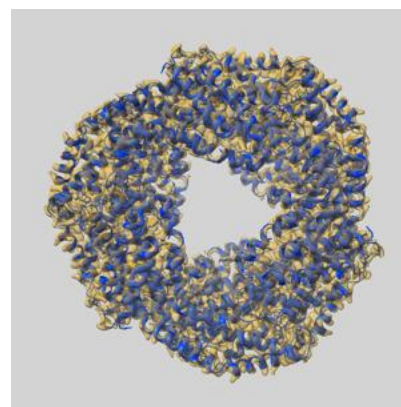
8.1 Map-model overlay [i](#)



X



Y



Z

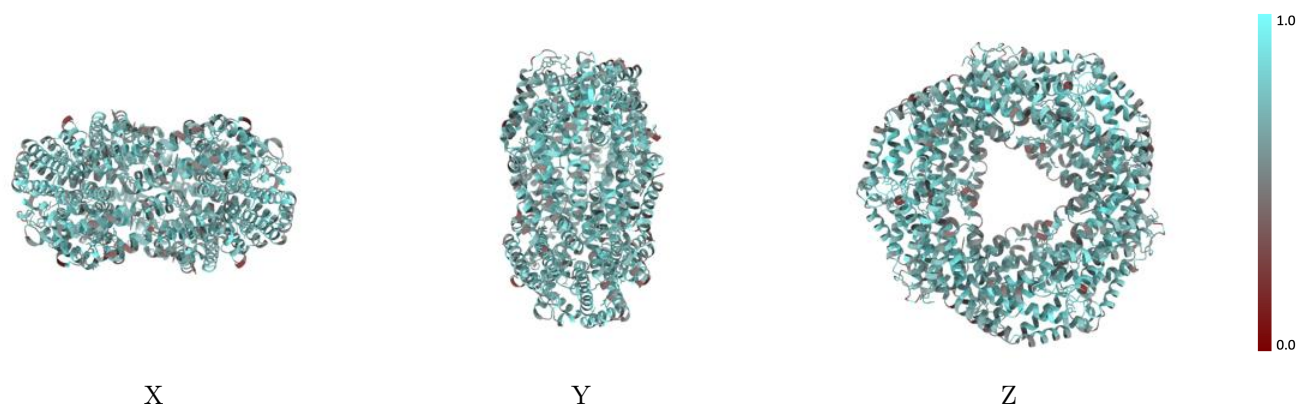
The images above show the 3D surface view of the map at the recommended contour level 0.067 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



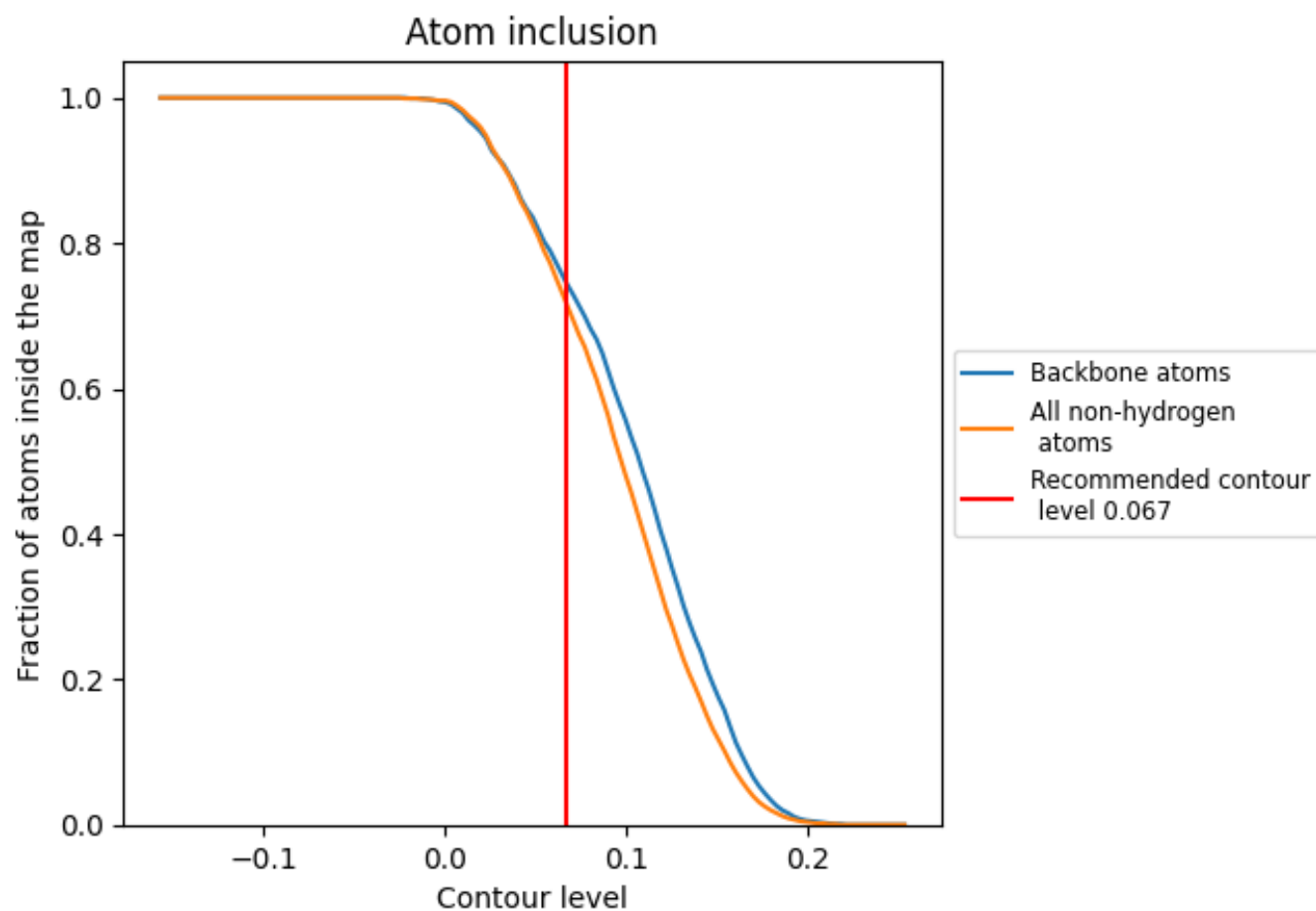
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions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



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 (0.067).

8.4 Atom inclusion [i](#)



At the recommended contour level, 75% of all backbone atoms, 72% 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 (0.067) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	0.7200	0.5980
A	0.7440	0.6000
B	0.6970	0.5960
C	0.7440	0.6000
D	0.6990	0.5940
E	0.7460	0.6020
F	0.6940	0.5950
G	0.7450	0.6010
H	0.6940	0.5940
I	0.7450	0.6010
J	0.7000	0.5960
K	0.7420	0.6010
L	0.6990	0.5950

