



wwPDB EM Validation Summary Report ⓘ

Aug 4, 2026 – 09:14 AM EDT

PDB ID : 8UGF / pdb_00008ugf
EMDB ID : EMD-42223
Title : In-situ complex III, state III
Authors : Zheng, W.; Zhang, K.; Zhu, J.
Deposited on : 2023-10-05
Resolution : 3.60 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.dev133
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) : 2.50

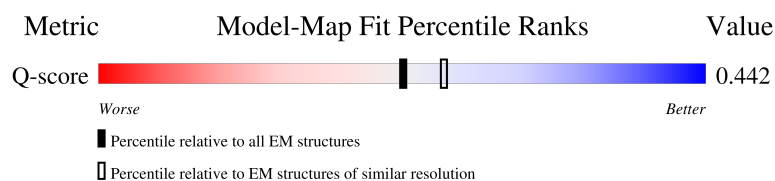
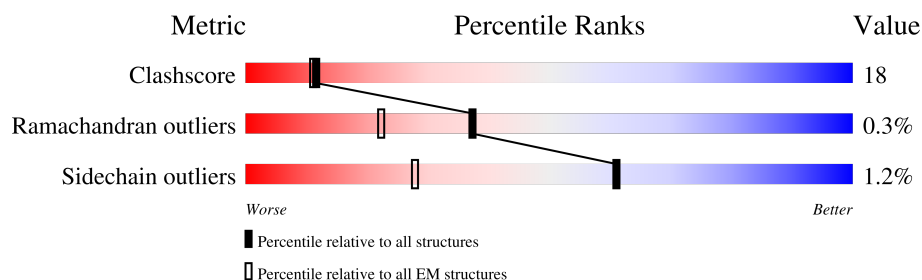
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.60 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.



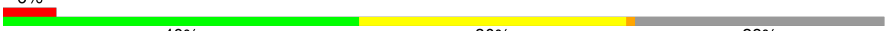
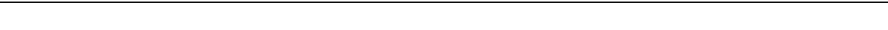
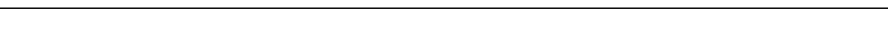
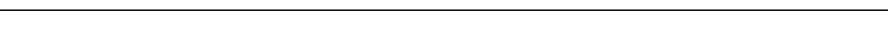
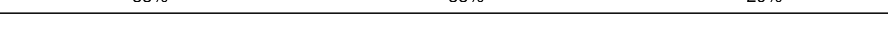
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	12797 (3.10 - 4.10)

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	3A	480	
1	3N	480	
2	3B	453	
2	3O	453	

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Mol	Chain	Length	Quality of chain
3	3C	379	
3	3P	379	
4	3D	325	
4	3Q	325	
5	3E	274	
5	3I	274	
5	3R	274	
5	3V	274	
6	3F	111	
6	3S	111	
7	3G	82	
7	3T	82	
8	3H	91	
8	3U	91	
9	3J	64	
9	3W	64	
10	3X	56	
10	3Y	56	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
15	HEC	3D	501	X	-	-	-
15	HEC	3Q	501	X	-	-	-
16	FES	3E	301	-	-	X	-

2 Entry composition

There are 17 unique types of molecules in this entry. The entry contains 33551 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 Cytochrome b-c1 complex subunit 1, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	3A	440	Total	C	N	O	S	0	0
			3411	2131	599	662	19		
1	3N	445	Total	C	N	O	S	1	0
			3424	2162	606	637	19		

- Molecule 2 is a protein called Cytochrome b-c1 complex subunit 2, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	3B	418	Total	C	N	O	S	0	0
			3138	1965	555	610	8		
2	3O	417	Total	C	N	O	S	0	0
			3124	1960	554	602	8		

- Molecule 3 is a protein called Cytochrome b.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	3C	379	Total	C	N	O	S	0	0
			3025	2031	471	502	21		
3	3P	379	Total	C	N	O	S	0	0
			3024	2031	471	501	21		

- Molecule 4 is a protein called Cytochrome c1, heme protein, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	3D	237	Total	C	N	O	S	0	0
			1888	1205	325	342	16		
4	3Q	239	Total	C	N	O	S	0	0
			1904	1215	327	346	16		

- Molecule 5 is a protein called Cytochrome b-c1 complex subunit Rieske, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	3E	196	Total	C	N	O	S	0	0
			1518	955	265	291	7		
5	3I	47	Total	C	N	O	S	0	0
			337	210	62	64	1		
5	3R	196	Total	C	N	O	S	0	0
			1518	955	265	291	7		
5	3V	31	Total	C	N	O	S	0	0
			223	137	45	40	1		

- Molecule 6 is a protein called Cytochrome b-c1 complex subunit 7.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	3F	98	Total	C	N	O	S	0	0
			868	557	152	157	2		
6	3S	98	Total	C	N	O	S	0	0
			868	557	152	157	2		

- Molecule 7 is a protein called Cytochrome b-c1 complex subunit 8.

Mol	Chain	Residues	Atoms					AltConf	Trace
7	3G	74	Total	C	N	O	S	0	0
			628	411	116	99	2		
7	3T	74	Total	C	N	O	S	0	0
			628	411	116	99	2		

- Molecule 8 is a protein called Cytochrome b-c1 complex subunit 6, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
8	3H	65	Total	C	N	O	S	0	0
			533	325	97	106	5		
8	3U	65	Total	C	N	O	S	0	0
			533	325	97	106	5		

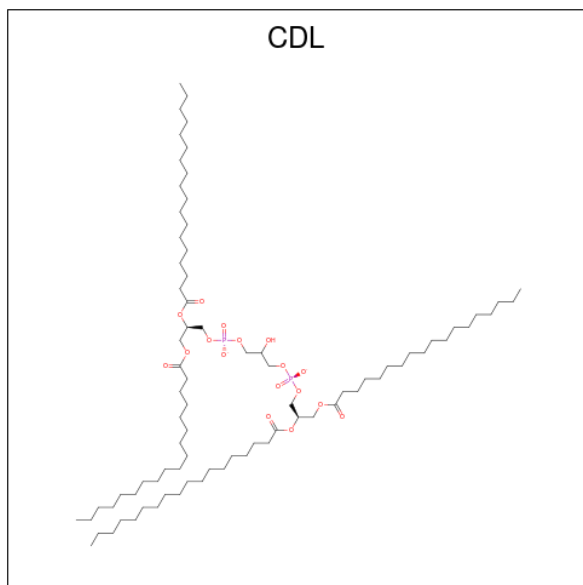
- Molecule 9 is a protein called Ubiquinol-cytochrome c reductase complex 7.2 kDa protein.

Mol	Chain	Residues	Atoms				AltConf	Trace
9	3J	56	Total	C	N	O	0	0
			464	305	82	77		
9	3W	56	Total	C	N	O	0	0
			464	305	82	77		

- Molecule 10 is a protein called Cytochrome b-c1 complex subunit 10.

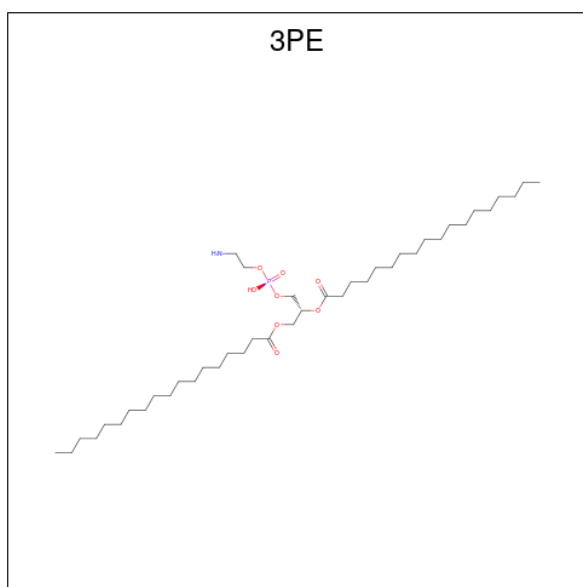
Mol	Chain	Residues	Atoms					AltConf	Trace
10	3X	52	Total	C	N	O	S	0	0
			429	286	75	66	2		
10	3Y	51	Total	C	N	O	S	0	0
			421	281	74	65	1		

- Molecule 11 is CARDIOLIPIN (CCD ID: CDL) (formula: $C_{81}H_{156}O_{17}P_2$).



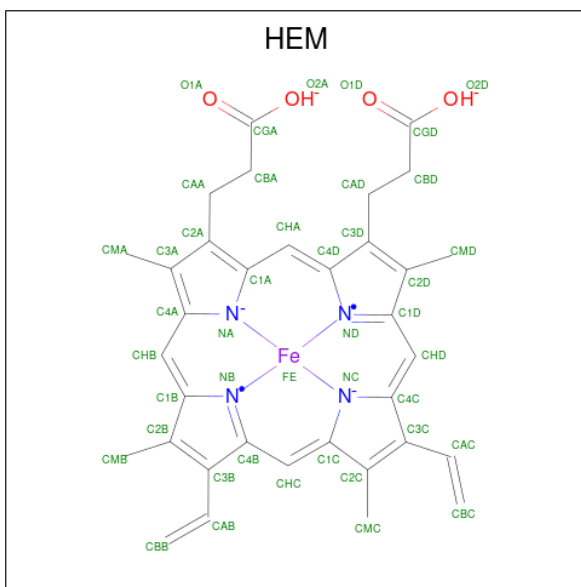
Mol	Chain	Residues	Atoms				AltConf
11	3A	1	Total	C	O	P	0
			58	39	17	2	
11	3C	1	Total	C	O	P	0
			52	33	17	2	
11	3G	1	Total	C	O	P	0
			56	37	17	2	
11	3N	1	Total	C	O	P	0
			43	24	17	2	
11	3T	1	Total	C	O	P	0
			57	38	17	2	
11	3T	1	Total	C	O	P	0
			56	37	17	2	

- Molecule 12 is 1,2-Distearoyl-sn-glycerophosphoethanolamine (CCD ID: 3PE) (formula: $C_{41}H_{82}NO_8P$).



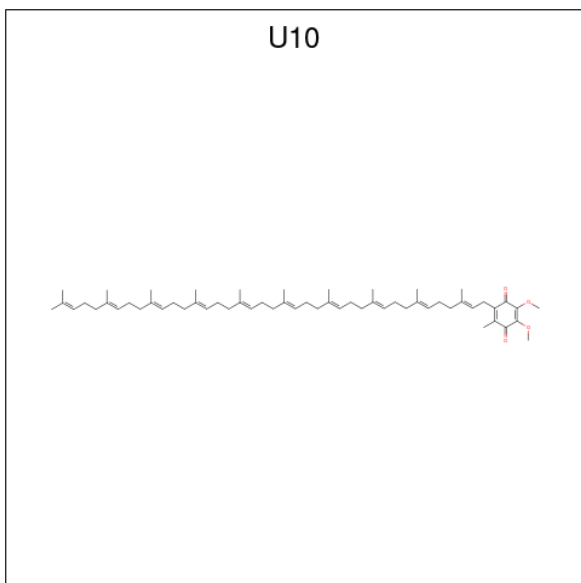
Mol	Chain	Residues	Atoms					AltConf
12	3A	1	Total	C	N	O	P	0
			27	17	1	8	1	
12	3A	1	Total	C	N	O	P	0
			32	22	1	8	1	
12	3C	1	Total	C	N	O	P	0
			35	25	1	8	1	
12	3C	1	Total	C	N	O	P	0
			34	24	1	8	1	
12	3E	1	Total	C	N	O	P	0
			33	23	1	8	1	
12	3G	1	Total	C	N	O	P	0
			29	19	1	8	1	
12	3N	1	Total	C	N	O	P	0
			33	23	1	8	1	
12	3N	1	Total	C	N	O	P	0
			25	15	1	8	1	
12	3P	1	Total	C	N	O	P	0
			33	23	1	8	1	
12	3R	1	Total	C	N	O	P	0
			47	37	1	8	1	
12	3Y	1	Total	C	N	O	P	0
			30	20	1	8	1	

- Molecule 13 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



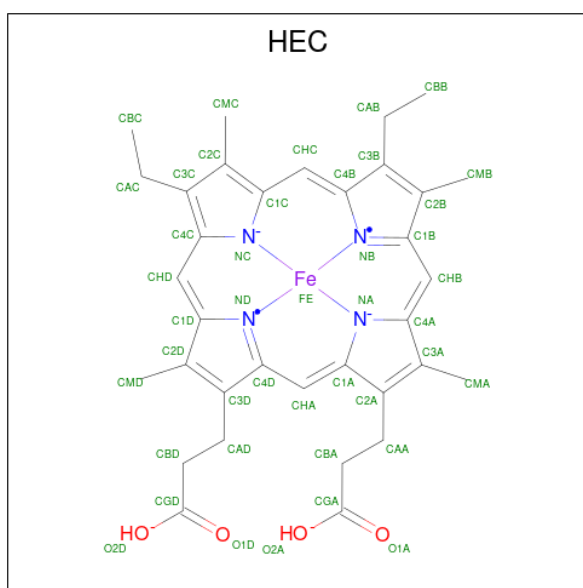
Mol	Chain	Residues	Atoms					AltConf
13	3C	1	Total	C	Fe	N	O	0
			43	34	1	4	4	
13	3C	1	Total	C	Fe	N	O	0
			43	34	1	4	4	
13	3P	1	Total	C	Fe	N	O	0
			43	34	1	4	4	
13	3P	1	Total	C	Fe	N	O	0
			43	34	1	4	4	

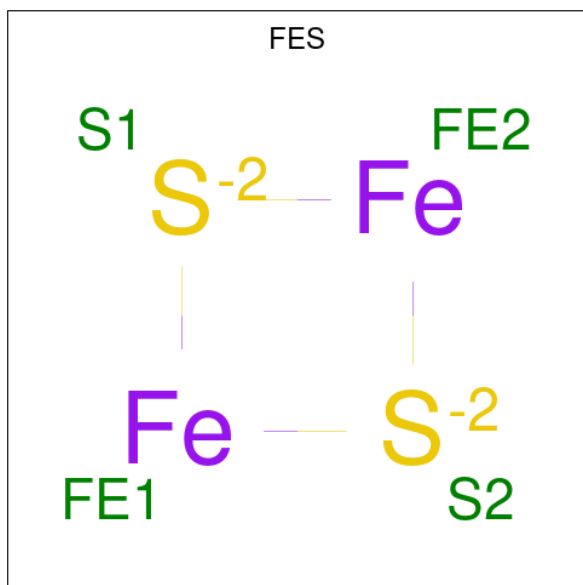
- Molecule 14 is UBIQUINONE-10 (CCD ID: U10) (formula: $C_{59}H_{90}O_4$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms			AltConf
14	3C	1	Total	C	O	0
			28	24	4	
14	3C	1	Total	C	O	0
			23	19	4	
14	3P	1	Total	C	O	0
			32	28	4	
14	3P	1	Total	C	O	0
			32	28	4	

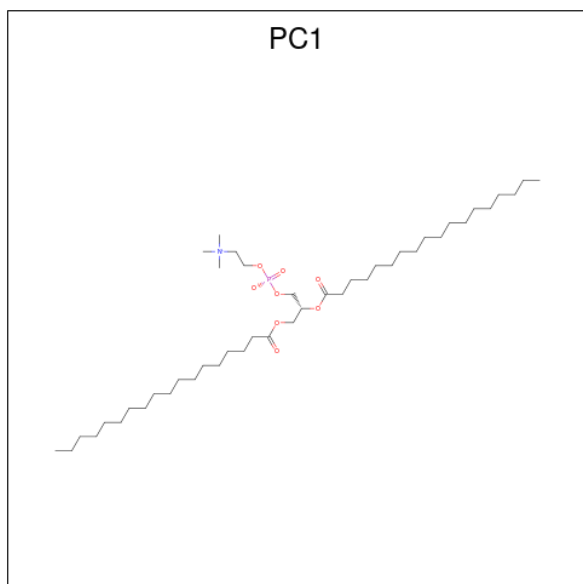
- Molecule 15 is HEME C (CCD ID: HEC) (formula: $C_{34}H_{36}FeN_4O_4$).





Mol	Chain	Residues	Atoms			AltConf
16	3E	1	Total	Fe	S	0
			4	2	2	
16	3R	1	Total	Fe	S	0
			4	2	2	

- Molecule 17 is 1,2-DIACYL-SN-GLYCERO-3-PHOSPHOCHOLINE (CCD ID: PC1) (formula: $C_{44}H_{88}NO_8P$).



Mol	Chain	Residues	Atoms					AltConf
17	3E	1	Total	C	N	O	P	0
			47	37	1	8	1	

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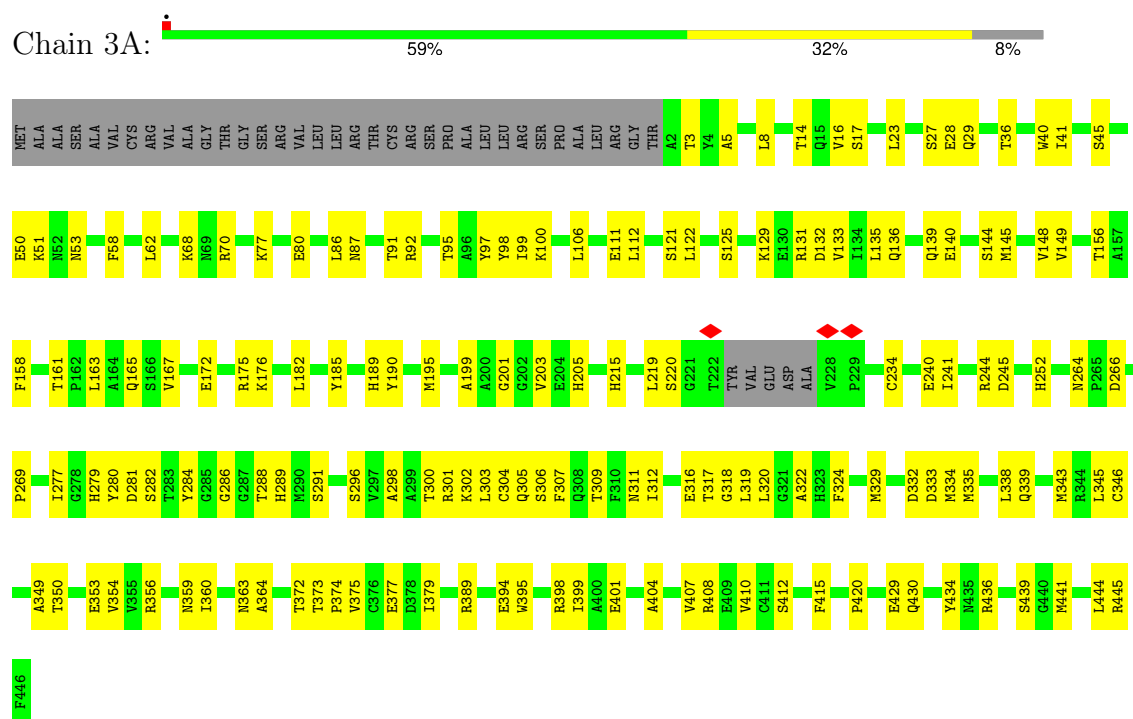
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Mol	Chain	Residues	Atoms					AltConf
17	3R	1	Total	C	N	O	P	0
			45	35	1	8	1	
17	3X	1	Total	C	N	O	P	0
			29	19	1	8	1	

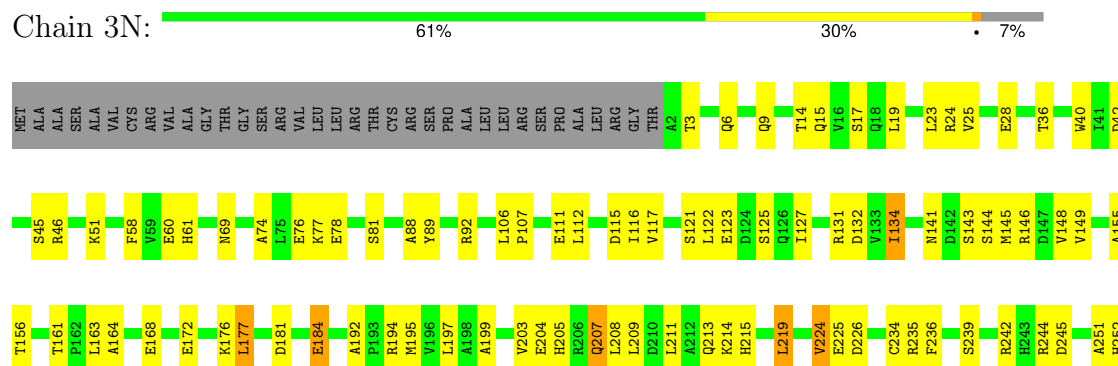
3 Residue-property plots

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and atom inclusion in map density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red diamond above a residue indicates a poor fit to the EM map for this residue (all-atom inclusion < 40%). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

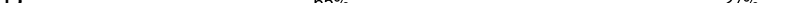
- Molecule 1: Cytochrome b-c1 complex subunit 1, mitochondrial

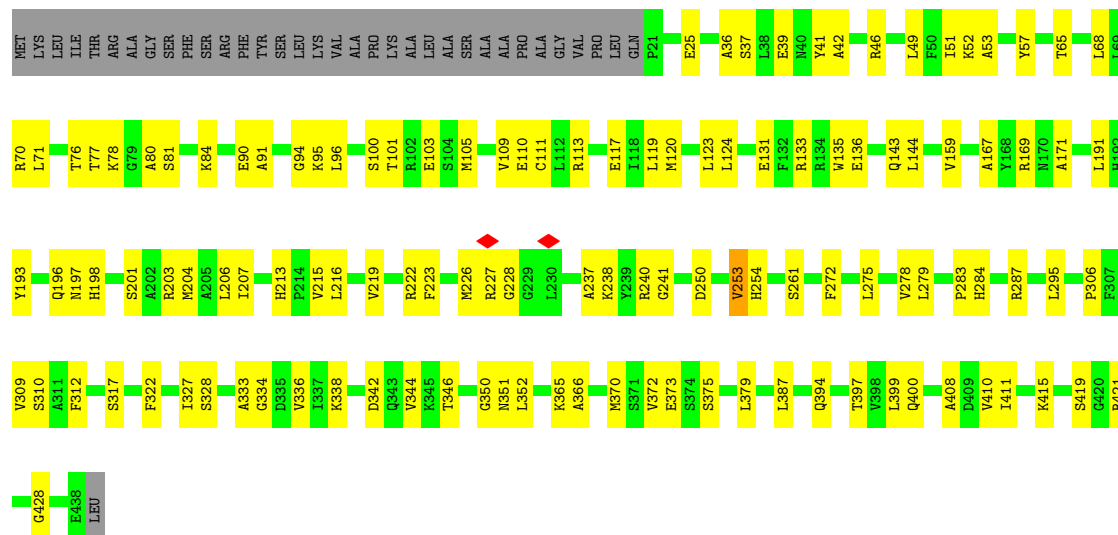


- Molecule 1: Cytochrome b-c1 complex subunit 1, mitochondrial

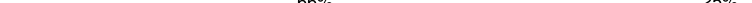


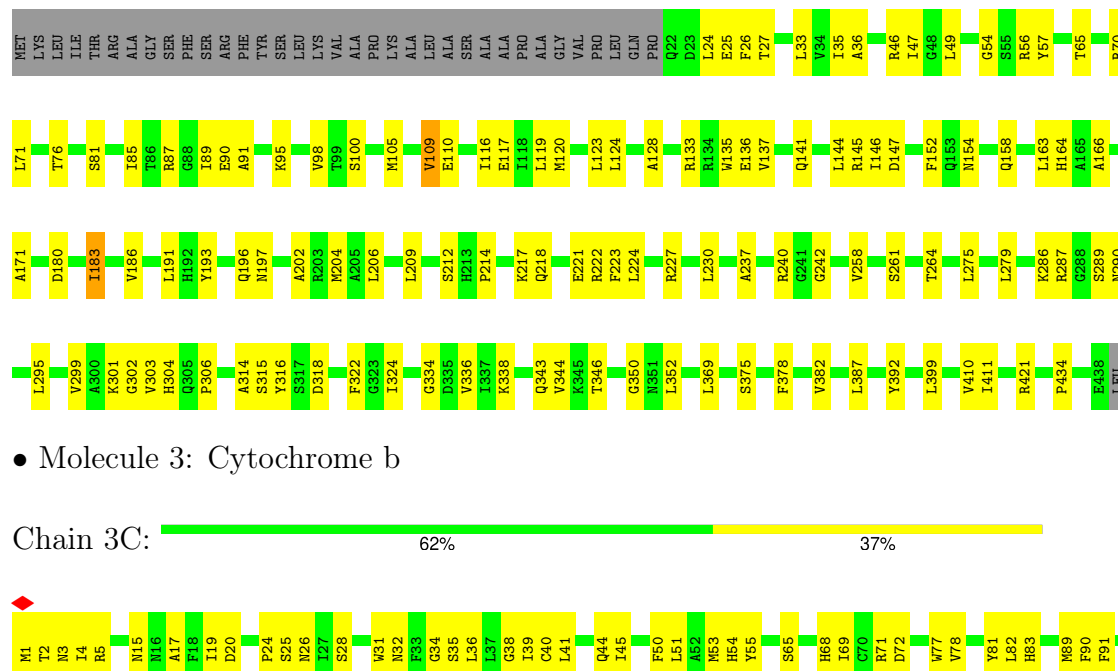
- Molecule 2: Cytochrome b-c1 complex subunit 2, mitochondrial

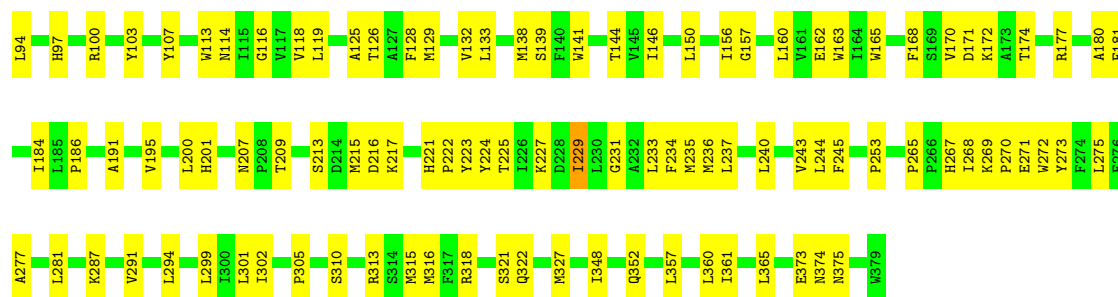
Chain 3B:  65% 27% 8%



- Molecule 2: Cytochrome b-c1 complex subunit 2, mitochondrial

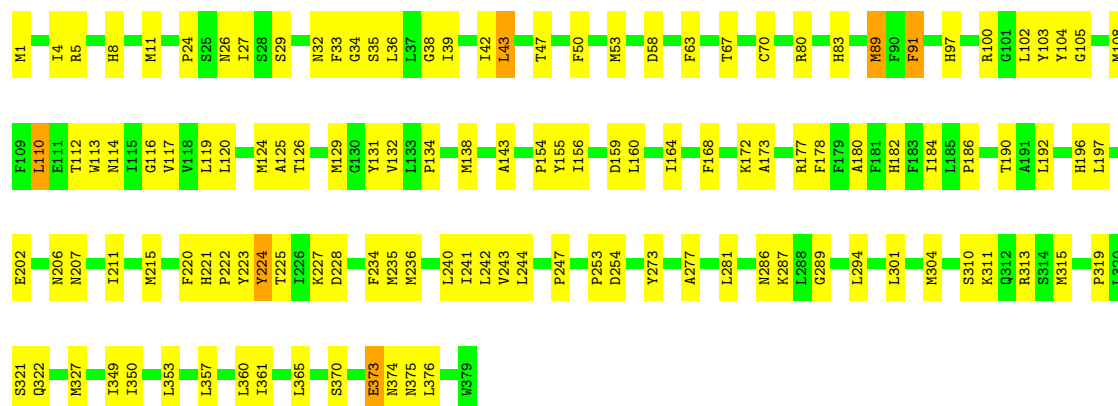
Chain 30: 





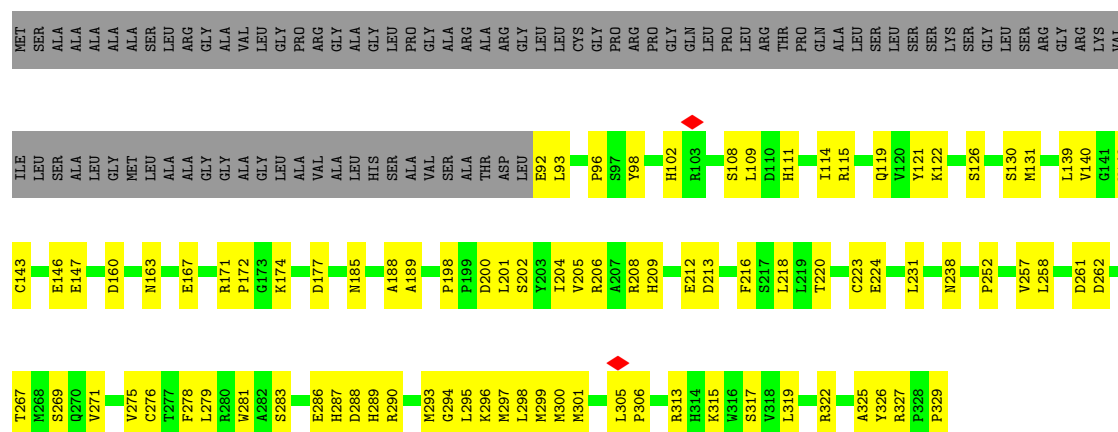
• Molecule 3: Cytochrome b

Chain 3P: 67% 31%



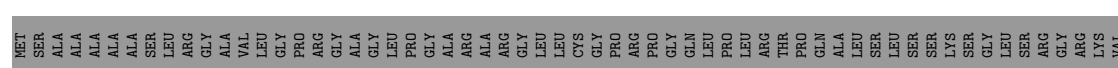
• Molecule 4: Cytochrome c1, heme protein, mitochondrial

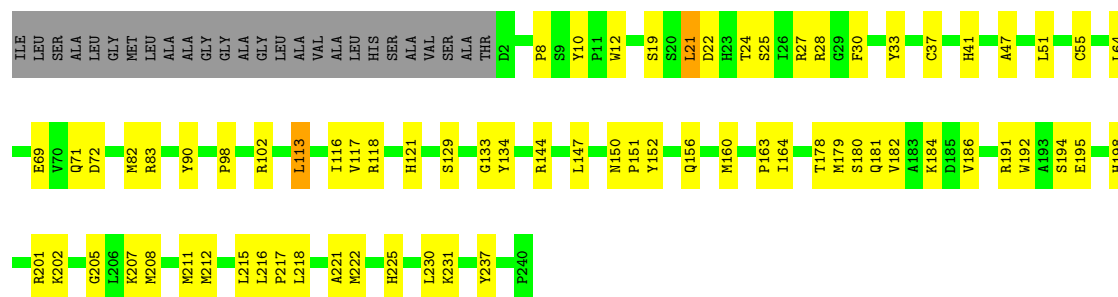
Chain 3D: 46% 27% 27%



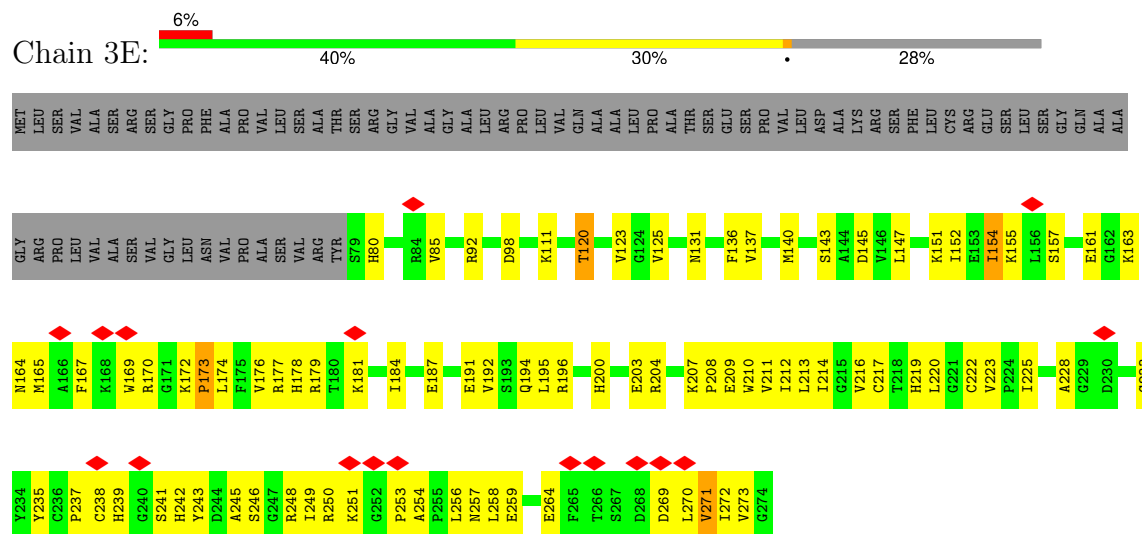
• Molecule 4: Cytochrome c1, heme protein, mitochondrial

Chain 3Q: 51% 22% 26%

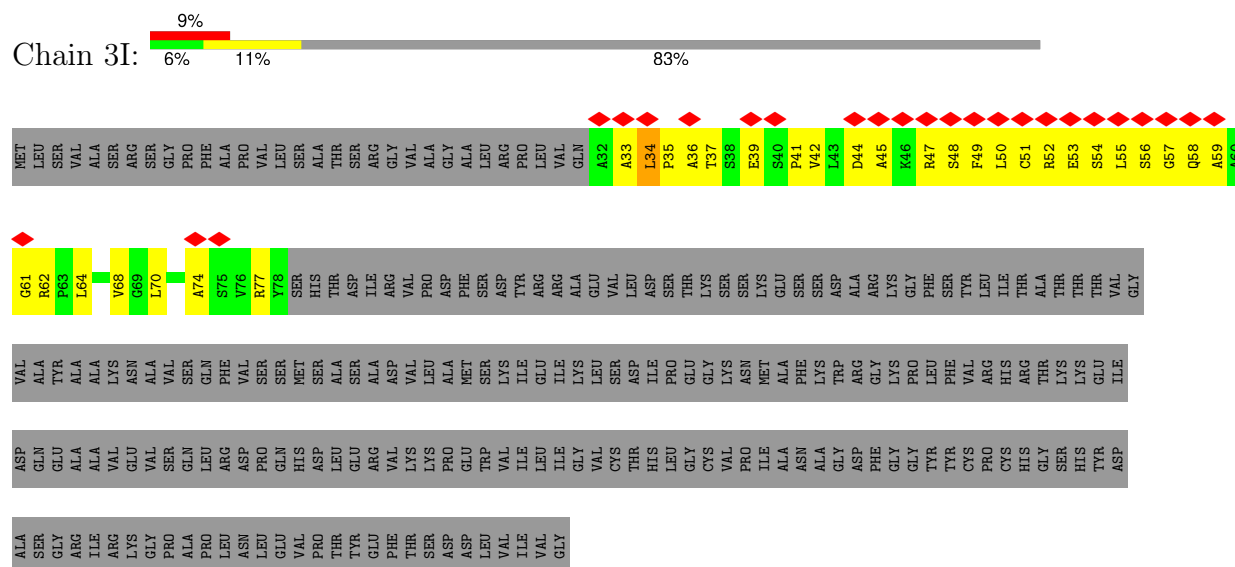




• Molecule 5: Cytochrome b-c1 complex subunit Rieske, mitochondrial



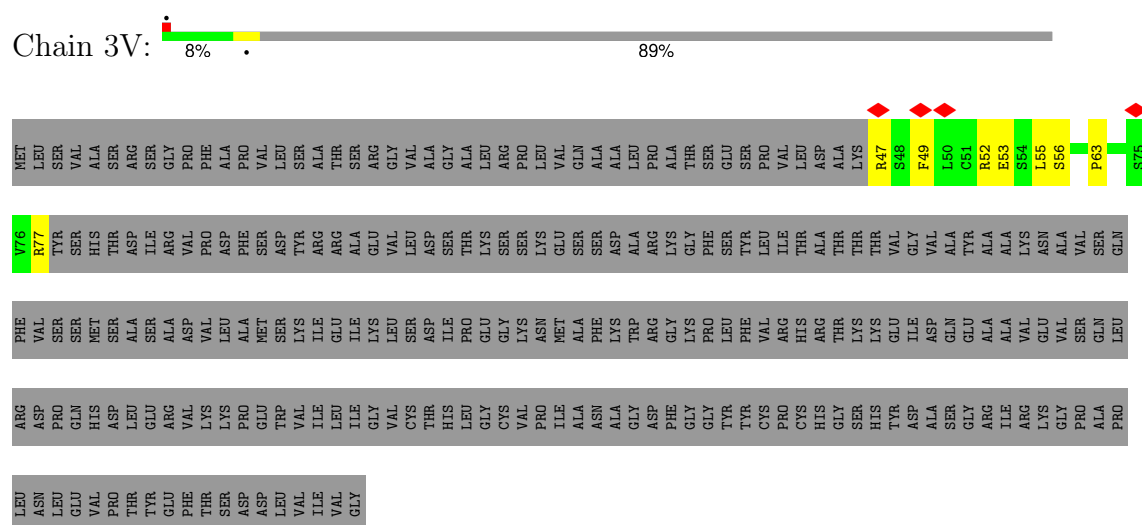
• Molecule 5: Cytochrome b-c1 complex subunit Rieske, mitochondrial



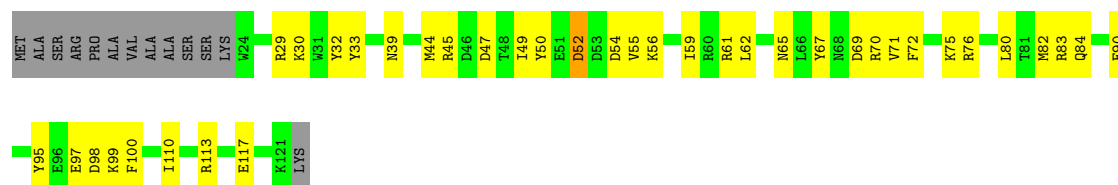
• Molecule 5: Cytochrome b-c1 complex subunit Rieske, mitochondrial



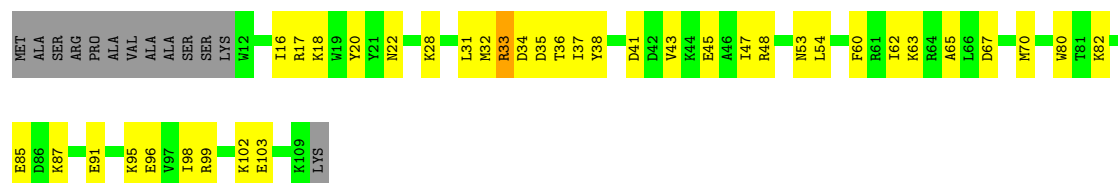
- Molecule 5: Cytochrome b-c1 complex subunit Rieske, mitochondrial



- Molecule 6: Cytochrome b-c1 complex subunit 7



- Molecule 6: Cytochrome b-c1 complex subunit 7



- Molecule 7: Cytochrome b-c1 complex subunit 8

Chain 3G: 

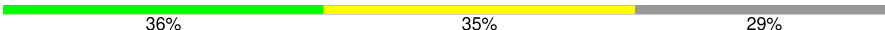


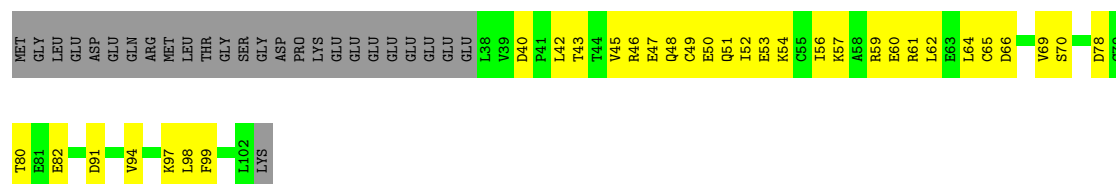
- Molecule 7: Cytochrome b-c1 complex subunit 8

Chain 3T: 

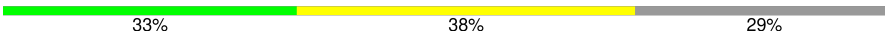


- Molecule 8: Cytochrome b-c1 complex subunit 6, mitochondrial

Chain 3H: 



- Molecule 8: Cytochrome b-c1 complex subunit 6, mitochondrial

Chain 3U: 



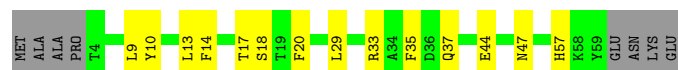
- Molecule 9: Ubiquinol-cytochrome c reductase complex 7.2 kDa protein

Chain 3J: 

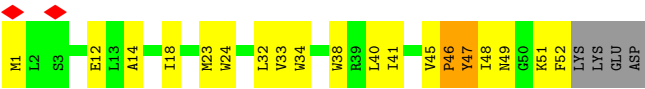


- Molecule 9: Ubiquinol-cytochrome c reductase complex 7.2 kDa protein

Chain 3W: 



- Molecule 10: Cytochrome b-c1 complex subunit 10



● Molecule 10: Cytochrome b-c1 complex subunit 10



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	60000	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 ($e^-/\text{\AA}^2$)	50	Depositor
Minimum defocus (nm)	1300	Depositor
Maximum defocus (nm)	3000	Depositor
Magnification	Not provided	
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	0.763	Depositor
Minimum map value	-0.290	Depositor
Average map value	0.002	Depositor
Map value standard deviation	0.027	Depositor
Recommended contour level	0.12	Depositor
Map size (Å)	425.6, 425.6, 425.6	wwPDB
Map dimensions	320, 320, 320	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	1.33, 1.33, 1.33	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: 3PE, U10, FES, CDL, HEC, HEM, PC1

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	3A	0.20	0/3481	0.37	0/4722
1	3N	0.20	0/3496	0.37	0/4723
2	3B	0.20	0/3190	0.35	0/4317
2	3O	0.18	0/3175	0.32	0/4292
3	3C	0.24	0/3123	0.39	0/4269
3	3P	0.22	0/3122	0.38	0/4269
4	3D	0.21	0/1946	0.42	0/2641
4	3Q	0.20	0/1962	0.36	0/2663
5	3E	0.40	2/1551 (0.1%)	0.61	3/2098 (0.1%)
5	3I	0.87	2/342 (0.6%)	1.74	4/465 (0.9%)
5	3R	0.43	2/1551 (0.1%)	0.92	6/2098 (0.3%)
5	3V	0.20	0/225	0.47	0/303
6	3F	0.21	0/888	0.45	0/1193
6	3S	0.20	0/888	0.36	0/1193
7	3G	0.21	0/648	0.42	0/874
7	3T	0.21	0/649	0.52	0/878
8	3H	0.23	0/539	0.56	0/724
8	3U	0.21	0/539	0.54	0/724
9	3J	0.22	0/476	0.45	0/641
9	3W	0.22	0/476	0.46	1/641 (0.2%)
10	3X	0.21	0/445	0.56	1/608 (0.2%)
10	3Y	0.21	0/437	0.54	0/598
All	All	0.25	6/33149 (0.0%)	0.48	15/44934 (0.0%)

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	3R	198	PRO	CG-CD	-11.64	1.11	1.50
5	3I	41	PRO	CG-CD	-10.41	1.15	1.50
5	3E	173	PRO	CG-CD	-10.23	1.16	1.50
5	3I	41	PRO	CB-CG	-8.94	1.04	1.49

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	3R	198	PRO	CB-CG	-7.38	1.12	1.49

The worst 5 of 15 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	3I	41	PRO	CB-CG-CD	23.05	179.87	106.10
5	3R	198	PRO	CB-CG-CD	21.68	175.49	106.10
5	3R	198	PRO	N-CD-CG	-20.16	72.96	103.20
5	3I	41	PRO	N-CD-CG	-18.36	75.66	103.20
5	3I	41	PRO	CA-CB-CG	-15.94	74.21	104.50

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	3A	3411	0	3309	120	0
1	3N	3424	0	3350	121	0
2	3B	3138	0	3116	93	0
2	3O	3124	0	3108	84	0
3	3C	3025	0	3090	137	0
3	3P	3024	0	3090	108	0
4	3D	1888	0	1834	81	0
4	3Q	1904	0	1848	64	0
5	3E	1518	0	1498	91	0
5	3I	337	0	347	33	0
5	3R	1518	0	1500	89	0
5	3V	223	0	233	12	0
6	3F	868	0	857	37	0
6	3S	868	0	857	31	0
7	3G	628	0	634	30	0
7	3T	628	0	632	32	0
8	3H	533	0	513	26	0
8	3U	533	0	513	32	0
9	3J	464	0	467	24	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
9	3W	464	0	467	15	0
10	3X	429	0	430	16	0
10	3Y	421	0	418	12	0
11	3A	58	0	60	4	0
11	3C	52	0	48	5	0
11	3G	56	0	56	7	0
11	3N	43	0	30	5	0
11	3T	113	0	114	17	0
12	3A	59	0	66	9	0
12	3C	69	0	86	7	0
12	3E	33	0	40	6	0
12	3G	29	0	32	2	0
12	3N	58	0	62	15	0
12	3P	33	0	40	0	0
12	3R	47	0	71	8	0
12	3Y	30	0	34	4	0
13	3C	86	0	60	10	0
13	3P	86	0	60	7	0
14	3C	51	0	54	10	0
14	3P	64	0	78	12	0
15	3D	42	0	32	1	0
15	3Q	43	0	32	3	0
16	3E	4	0	0	4	0
16	3R	4	0	0	1	0
17	3E	47	0	68	7	0
17	3R	45	0	64	5	0
17	3X	29	0	32	4	0
All	All	33551	0	33330	1182	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 18.

The worst 5 of 1182 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)
9:3J:53:TRP:O	9:3J:57:LYS:HE3	1.42	1.19
9:3J:53:TRP:CE2	9:3J:57:LYS:HG2	1.91	1.05
5:3E:217:CYS:HB3	16:3E:301:FES:S1	1.99	1.02
14:3P:503:U10:H4M3	14:3P:503:U10:H3M3	1.46	0.96
14:3C:503:U10:H4M2	14:3C:503:U10:H3M2	1.49	0.92

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	3A	436/480 (91%)	408 (94%)	27 (6%)	1 (0%)	43	72
1	3N	444/480 (92%)	409 (92%)	34 (8%)	1 (0%)	43	72
2	3B	414/453 (91%)	393 (95%)	21 (5%)	0	100	100
2	3O	413/453 (91%)	384 (93%)	29 (7%)	0	100	100
3	3C	377/379 (100%)	356 (94%)	21 (6%)	0	100	100
3	3P	377/379 (100%)	358 (95%)	17 (4%)	2 (0%)	24	57
4	3D	235/325 (72%)	217 (92%)	18 (8%)	0	100	100
4	3Q	237/325 (73%)	221 (93%)	16 (7%)	0	100	100
5	3E	194/274 (71%)	170 (88%)	22 (11%)	2 (1%)	12	45
5	3I	45/274 (16%)	36 (80%)	9 (20%)	0	100	100
5	3R	194/274 (71%)	166 (86%)	26 (13%)	2 (1%)	12	45
5	3V	29/274 (11%)	28 (97%)	1 (3%)	0	100	100
6	3F	96/111 (86%)	95 (99%)	1 (1%)	0	100	100
6	3S	96/111 (86%)	95 (99%)	0	1 (1%)	12	45
7	3G	70/82 (85%)	69 (99%)	1 (1%)	0	100	100
7	3T	72/82 (88%)	68 (94%)	4 (6%)	0	100	100
8	3H	63/91 (69%)	60 (95%)	3 (5%)	0	100	100
8	3U	63/91 (69%)	59 (94%)	4 (6%)	0	100	100
9	3J	54/64 (84%)	50 (93%)	4 (7%)	0	100	100
9	3W	54/64 (84%)	53 (98%)	1 (2%)	0	100	100
10	3X	50/56 (89%)	44 (88%)	4 (8%)	2 (4%)	2	20
10	3Y	49/56 (88%)	43 (88%)	6 (12%)	0	100	100
All	All	4062/5178 (78%)	3782 (93%)	269 (7%)	11 (0%)	37	65

5 of 11 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	3A	350	THR
5	3E	271	VAL
3	3P	224	TYR
5	3R	158	ASP
6	3S	33	ARG

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	3A	367/397 (92%)	365 (100%)	2 (0%)	81	80
1	3N	372/397 (94%)	357 (96%)	15 (4%)	28	54
2	3B	328/355 (92%)	327 (100%)	1 (0%)	86	83
2	3O	327/355 (92%)	324 (99%)	3 (1%)	70	76
3	3C	332/332 (100%)	329 (99%)	3 (1%)	70	76
3	3P	332/332 (100%)	327 (98%)	5 (2%)	57	70
4	3D	202/258 (78%)	202 (100%)	0	100	100
4	3Q	204/258 (79%)	201 (98%)	3 (2%)	57	70
5	3E	166/225 (74%)	165 (99%)	1 (1%)	78	79
5	3I	36/225 (16%)	34 (94%)	2 (6%)	19	47
5	3R	166/225 (74%)	164 (99%)	2 (1%)	63	73
5	3V	24/225 (11%)	24 (100%)	0	100	100
6	3F	90/99 (91%)	89 (99%)	1 (1%)	65	74
6	3S	90/99 (91%)	90 (100%)	0	100	100
7	3G	67/73 (92%)	66 (98%)	1 (2%)	57	70
7	3T	67/73 (92%)	67 (100%)	0	100	100
8	3H	62/85 (73%)	61 (98%)	1 (2%)	55	69
8	3U	62/85 (73%)	62 (100%)	0	100	100
9	3J	46/52 (88%)	46 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
9	3W	46/52 (88%)	46 (100%)	0	100	100
10	3X	42/46 (91%)	42 (100%)	0	100	100
10	3Y	41/46 (89%)	40 (98%)	1 (2%)	43	63
All	All	3469/4294 (81%)	3428 (99%)	41 (1%)	61	73

5 of 41 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	3O	154	ASN
4	3Q	21	LEU
2	3O	183	ILE
3	3P	91	PHE
4	3Q	113	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 37 such sidechains are listed below:

Mol	Chain	Res	Type
3	3P	374	ASN
5	3R	242	HIS
4	3Q	71	GLN
4	3Q	166	ASN
4	3D	245	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry

32 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	$\# Z > 2$
16	FES	3R	301	5	0,4,4	-	-	-		
12	3PE	3A	503	-	31,31,50	0.33	0	34,36,55	0.50	0
11	CDL	3G	102	-	55,55,99	0.35	0	61,67,111	0.60	1 (1%)
12	3PE	3P	505	-	32,32,50	0.33	0	35,37,55	0.38	0
11	CDL	3T	102	-	55,55,99	0.36	0	61,67,111	0.52	1 (1%)
12	3PE	3E	302	-	32,32,50	0.34	0	35,37,55	0.45	0
12	3PE	3Y	101	-	29,29,50	0.35	0	32,34,55	0.42	0
14	U10	3P	504	-	32,32,63	0.76	1 (3%)	40,41,79	1.01	5 (12%)
11	CDL	3C	505	-	51,51,99	0.36	0	57,63,111	0.45	0
14	U10	3C	503	-	28,28,63	0.95	2 (7%)	36,37,79	1.12	6 (16%)
14	U10	3C	504	-	23,23,63	0.93	2 (8%)	30,31,79	1.21	5 (16%)
15	HEC	3Q	501	4	50,50,50	2.84	26 (52%)	68,82,82	2.51	26 (38%)
17	PC1	3X	101	-	28,28,53	0.37	0	34,36,61	0.40	0
12	3PE	3C	507	-	33,33,50	0.33	0	36,38,55	0.40	0
11	CDL	3N	502	-	42,42,99	0.39	0	48,54,111	0.57	1 (2%)
12	3PE	3C	506	-	34,34,50	0.32	0	37,39,55	0.45	0
13	HEM	3P	502	3	50,50,50	1.60	9 (18%)	67,82,82	1.61	12 (17%)
13	HEM	3C	502	3	50,50,50	1.60	9 (18%)	67,82,82	1.65	12 (17%)
16	FES	3E	301	5	0,4,4	-	-	-		
11	CDL	3A	501	-	57,57,99	0.35	0	63,69,111	0.52	0
13	HEM	3C	501	3	50,50,50	1.60	9 (18%)	67,82,82	1.70	12 (17%)
11	CDL	3T	101	7	56,56,99	0.35	0	62,68,111	0.42	0
12	3PE	3N	501	-	31,31,50	0.34	0	34,36,55	0.40	0
17	PC1	3R	303	-	44,44,53	0.30	0	50,52,61	0.33	0
17	PC1	3E	303	-	46,46,53	0.29	0	52,54,61	0.29	0
12	3PE	3G	101	-	28,28,50	0.34	0	31,33,55	0.42	0
14	U10	3P	503	-	32,32,63	0.86	3 (9%)	40,41,79	1.31	5 (12%)
15	HEC	3D	501	4	48,49,50	2.93	25 (52%)	66,80,82	2.37	23 (34%)
12	3PE	3R	302	-	46,46,50	0.28	0	49,51,55	0.42	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
12	3PE	3N	503	-	24,24,50	0.38	0	27,29,55	0.60	0
12	3PE	3A	502	-	26,26,50	0.36	0	29,31,55	0.71	1 (3%)
13	HEM	3P	501	3	50,50,50	1.61	9 (18%)	67,82,82	1.67	11 (16%)

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
16	FES	3R	301	5	-	-	0/1/1/1
12	3PE	3A	503	-	-	7/35/35/54	-
11	CDL	3G	102	-	-	14/66/66/110	-
12	3PE	3P	505	-	-	5/36/36/54	-
11	CDL	3T	102	-	-	17/66/66/110	-
12	3PE	3E	302	-	-	2/36/36/54	-
12	3PE	3Y	101	-	-	8/33/33/54	-
14	U10	3P	504	-	-	8/26/50/87	0/1/1/1
11	CDL	3C	505	-	-	11/62/62/110	-
14	U10	3C	503	-	-	4/21/45/87	0/1/1/1
14	U10	3C	504	-	-	3/15/39/87	0/1/1/1
15	HEC	3Q	501	4	1/1/3/7	7/14/54/54	-
17	PC1	3X	101	-	-	9/32/32/57	-
12	3PE	3C	507	-	-	12/37/37/54	-
11	CDL	3N	502	-	-	14/53/53/110	-
12	3PE	3C	506	-	-	5/38/38/54	-
13	HEM	3P	502	3	-	8/14/54/54	-
13	HEM	3C	502	3	-	6/14/54/54	-
16	FES	3E	301	5	-	-	0/1/1/1
11	CDL	3A	501	-	-	10/68/68/110	-
13	HEM	3C	501	3	-	5/14/54/54	-
11	CDL	3T	101	7	-	16/67/67/110	-
12	3PE	3N	501	-	-	7/35/35/54	-
17	PC1	3R	303	-	-	8/48/48/57	-
17	PC1	3E	303	-	-	5/50/50/57	-
12	3PE	3G	101	-	-	6/32/32/54	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
14	U10	3P	503	-	-	6/26/50/87	0/1/1/1
15	HEC	3D	501	4	1/1/2/7	6/13/53/54	-
12	3PE	3R	302	-	-	12/50/50/54	-
12	3PE	3N	503	-	-	7/28/28/54	-
12	3PE	3A	502	-	-	2/30/30/54	-
13	HEM	3P	501	3	-	5/14/54/54	-

The worst 5 of 95 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
15	3Q	501	HEC	C3B-C2B	5.19	1.48	1.36
15	3D	501	HEC	C3B-C2B	5.15	1.47	1.36
15	3D	501	HEC	C3D-C2D	5.11	1.47	1.36
15	3D	501	HEC	C2A-C3A	5.10	1.47	1.36
13	3P	501	HEM	FE-NB	5.05	2.10	1.94

The worst 5 of 121 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
15	3Q	501	HEC	C1B-C2B-C3B	-5.97	100.70	106.98
15	3D	501	HEC	C1B-C2B-C3B	-5.84	100.84	106.98
13	3C	501	HEM	CHC-C4B-NB	5.56	130.40	124.42
15	3D	501	HEC	C1C-C2C-C3C	-5.51	100.50	106.82
13	3P	501	HEM	CHC-C4B-NB	5.48	130.32	124.42

All (2) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
15	3D	501	HEC	NA
15	3Q	501	HEC	NA

5 of 235 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
11	3A	501	CDL	C1-CA2-OA2-PA1
11	3A	501	CDL	C1-CB2-OB2-PB2
11	3C	505	CDL	CA3-OA5-PA1-OA2
11	3C	505	CDL	CA3-OA5-PA1-OA3
11	3C	505	CDL	CB2-OB2-PB2-OB3

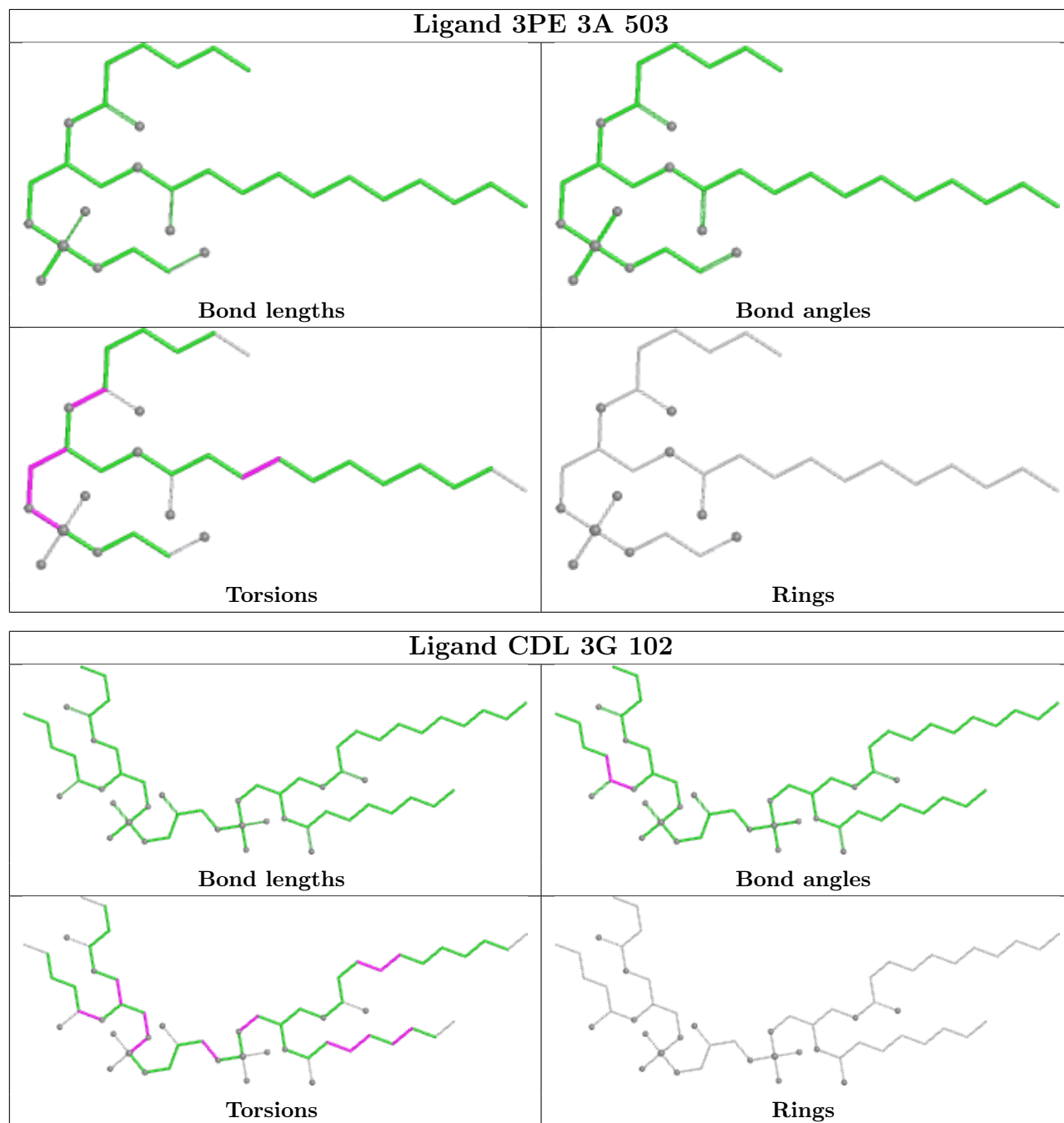
There are no ring outliers.

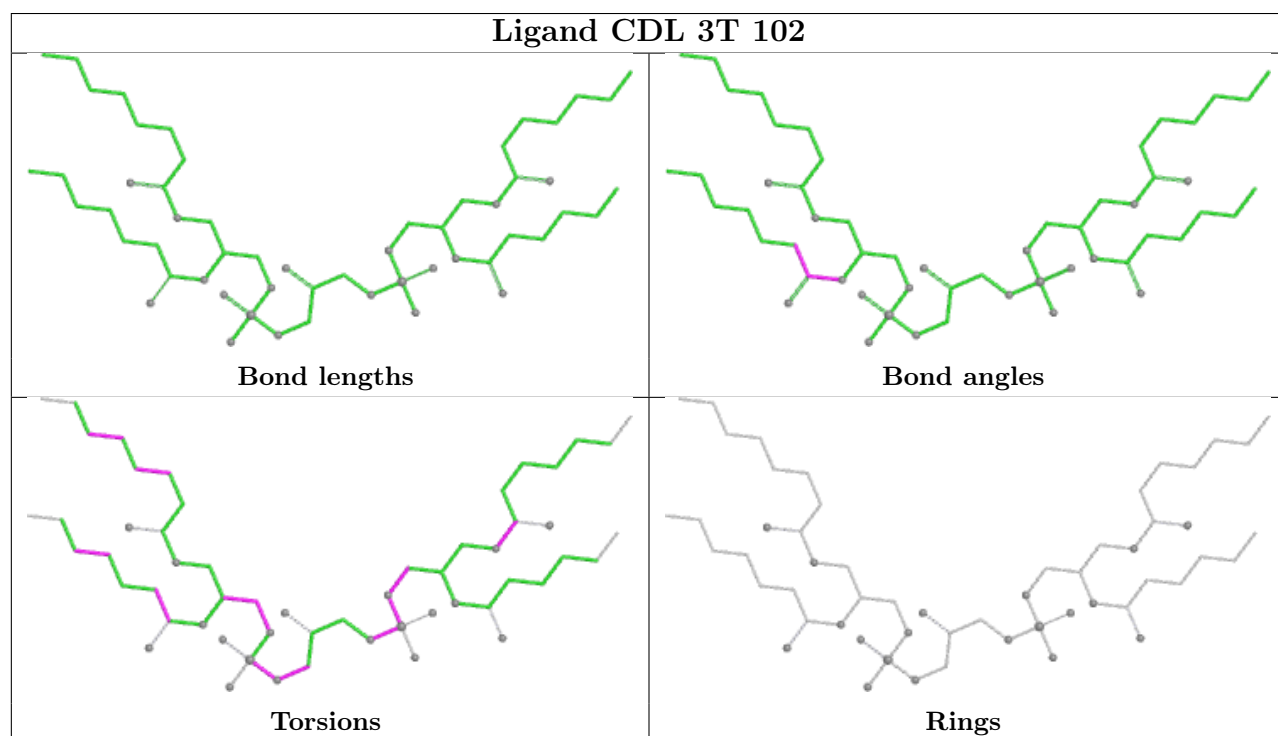
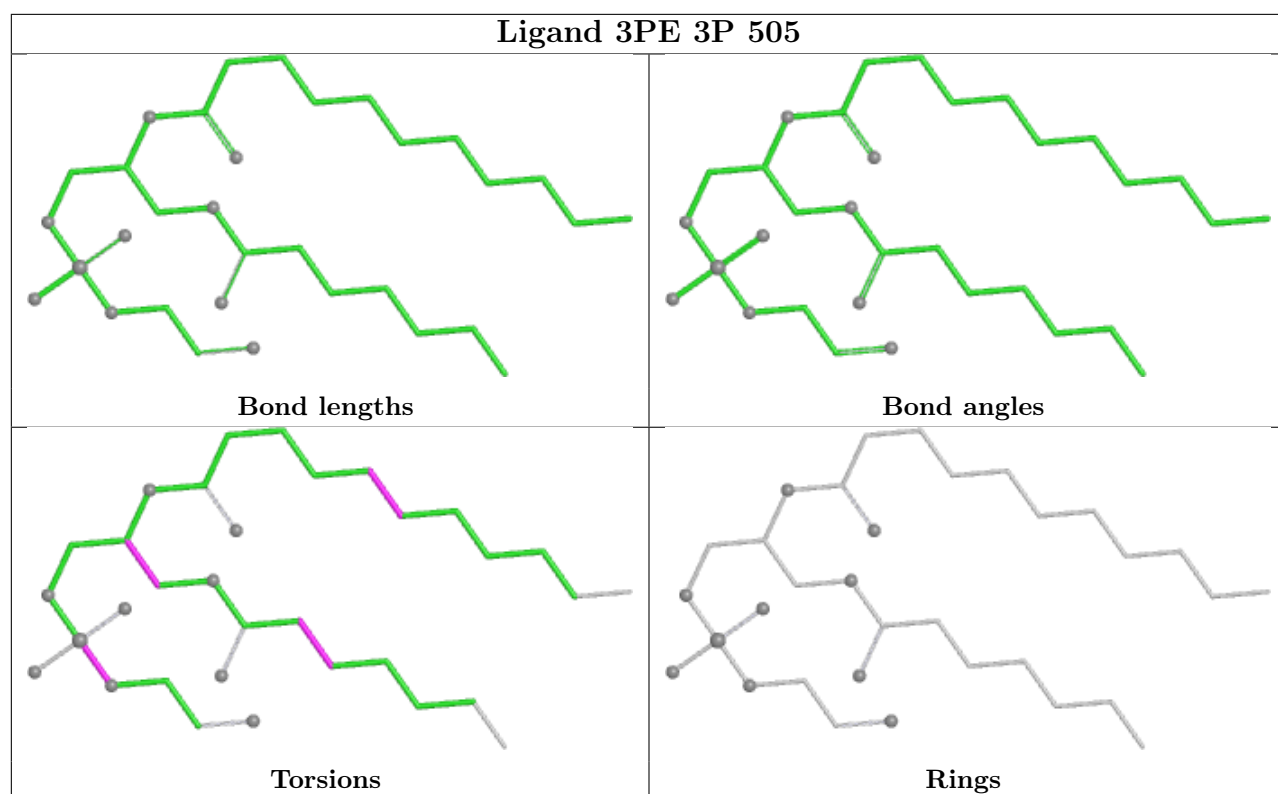
31 monomers are involved in 145 short contacts:

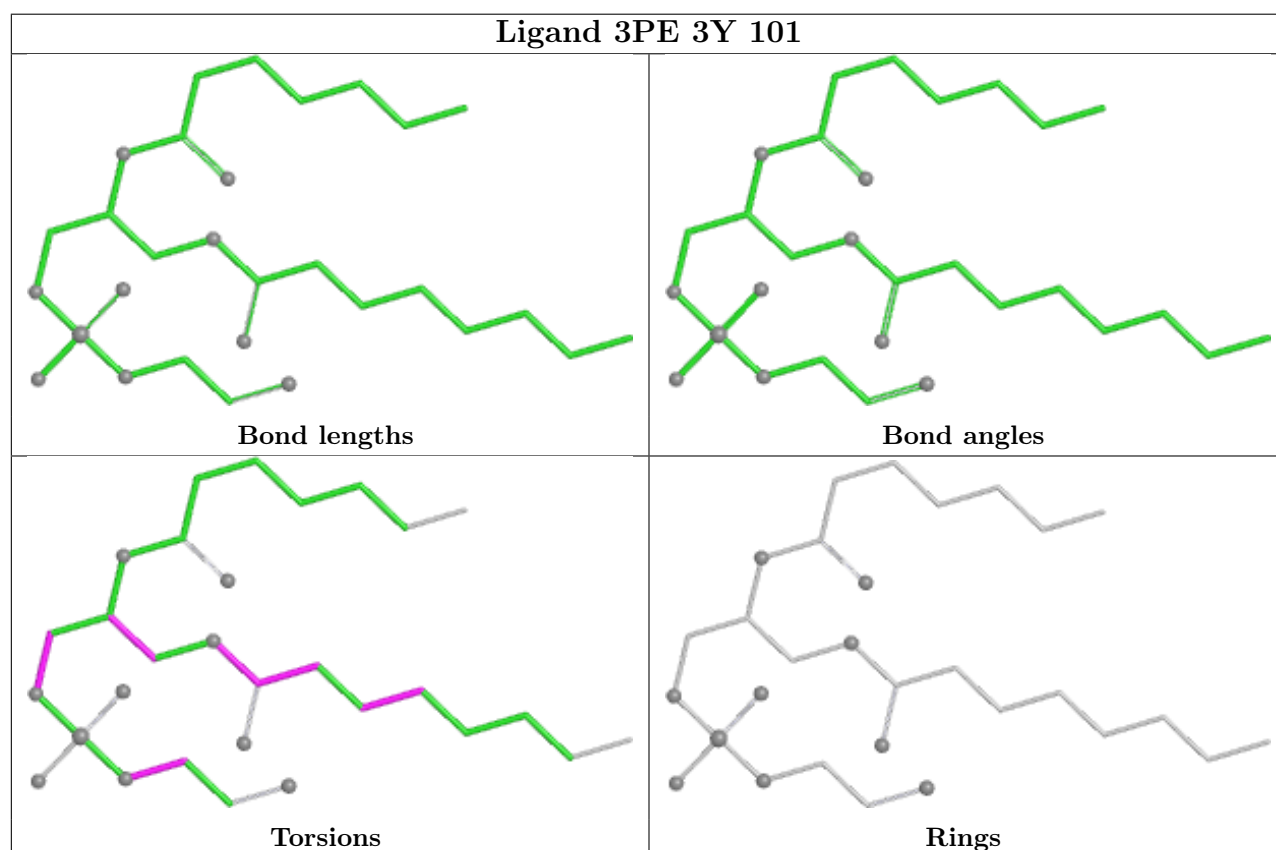
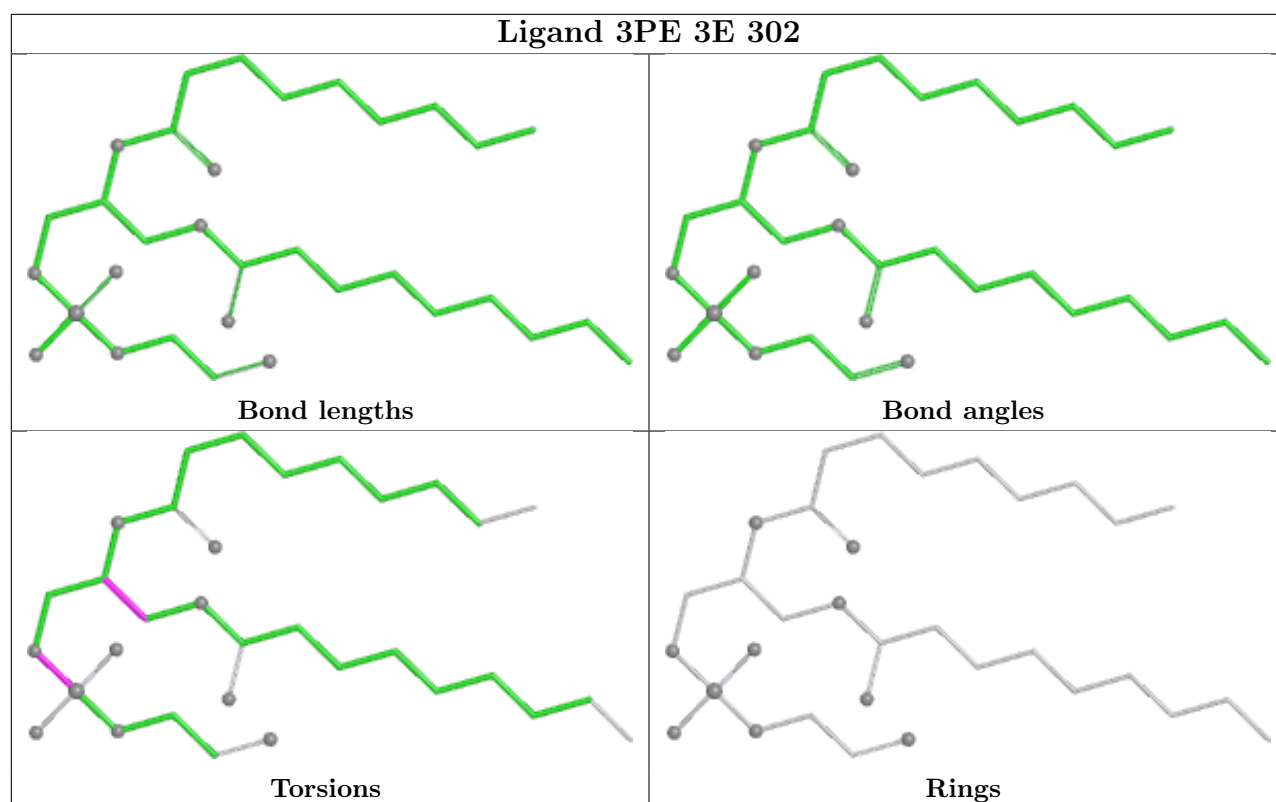
Mol	Chain	Res	Type	Clashes	Symm-Clashes
16	3R	301	FES	1	0
12	3A	503	3PE	4	0
11	3G	102	CDL	7	0
11	3T	102	CDL	8	0
12	3E	302	3PE	6	0
12	3Y	101	3PE	4	0
14	3P	504	U10	5	0
11	3C	505	CDL	5	0
14	3C	503	U10	6	0
14	3C	504	U10	4	0
15	3Q	501	HEC	3	0
17	3X	101	PC1	4	0
12	3C	507	3PE	5	0
11	3N	502	CDL	5	0
12	3C	506	3PE	2	0
13	3P	502	HEM	4	0
13	3C	502	HEM	5	0
16	3E	301	FES	4	0
11	3A	501	CDL	4	0
13	3C	501	HEM	5	0
11	3T	101	CDL	10	0
12	3N	501	3PE	6	0
17	3R	303	PC1	5	0
17	3E	303	PC1	7	0
12	3G	101	3PE	2	0
14	3P	503	U10	7	0
15	3D	501	HEC	1	0
12	3R	302	3PE	8	0
12	3N	503	3PE	9	0
12	3A	502	3PE	5	0
13	3P	501	HEM	3	0

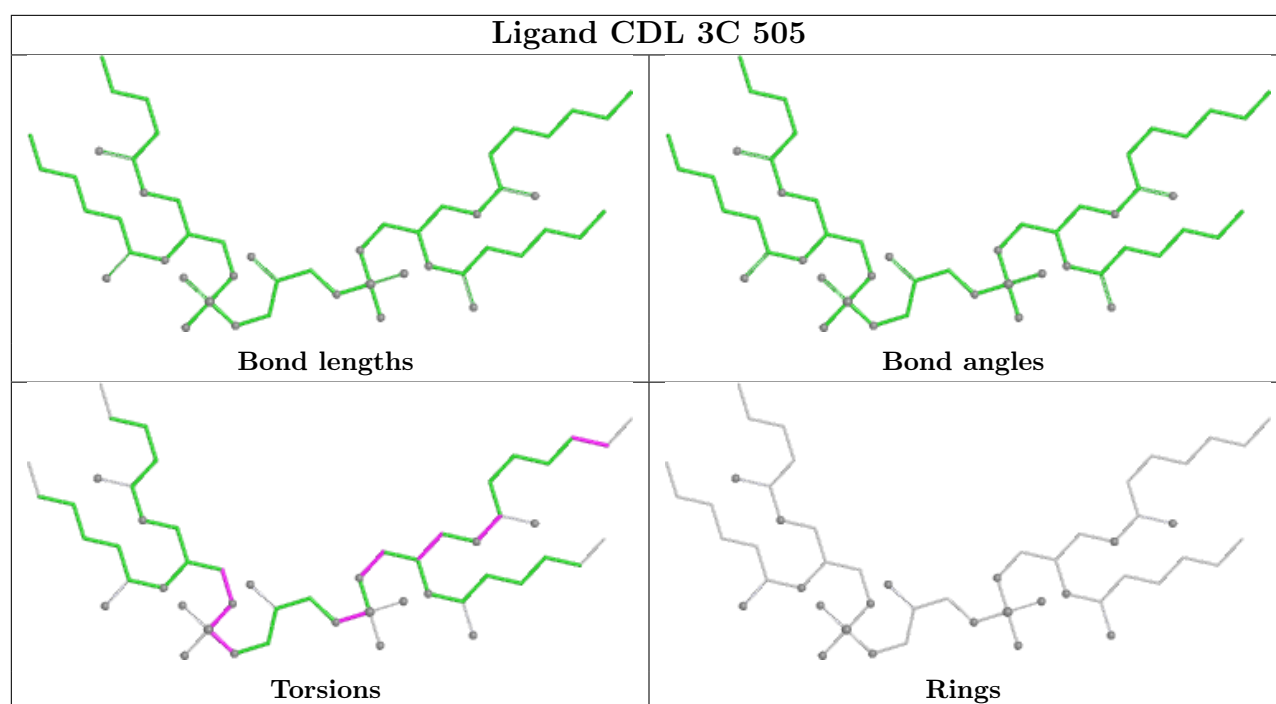
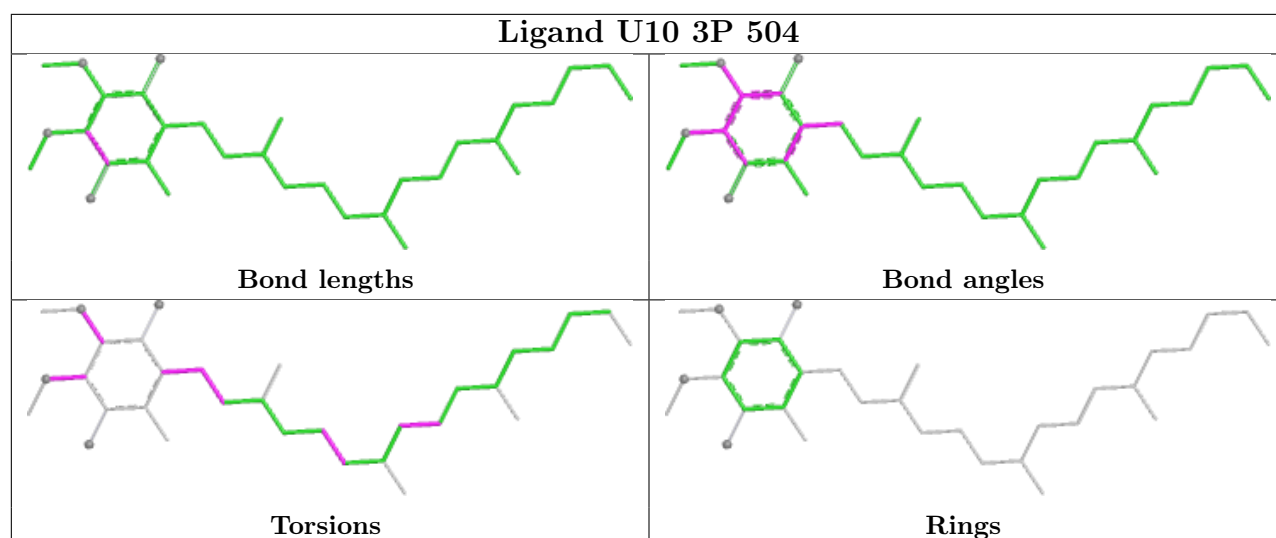
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

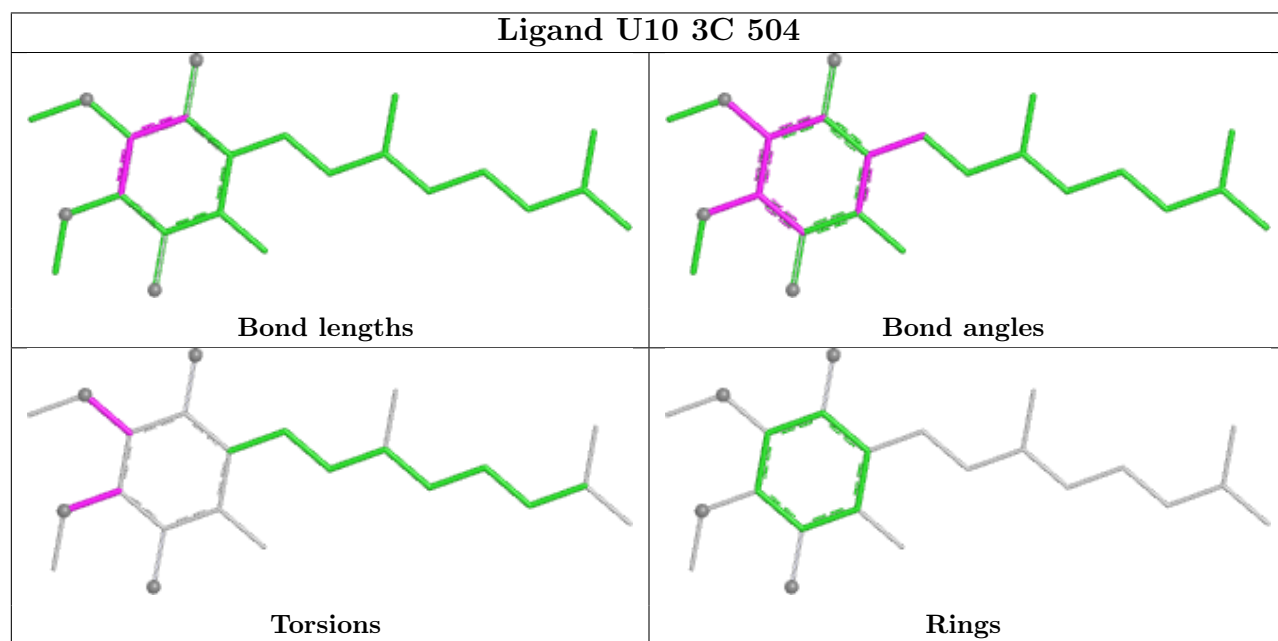
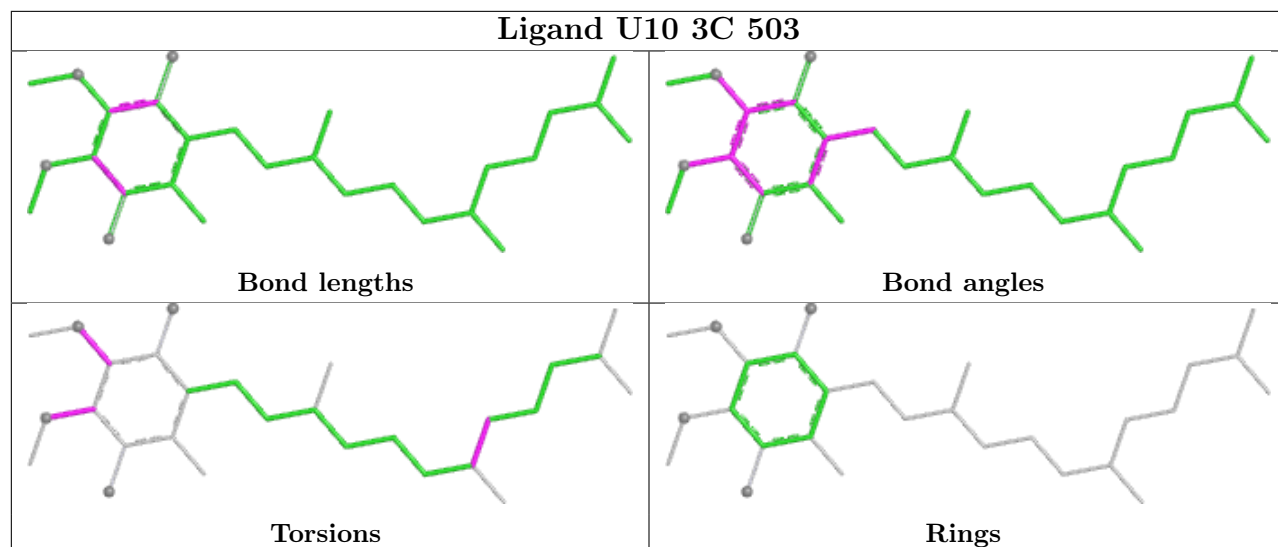
any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



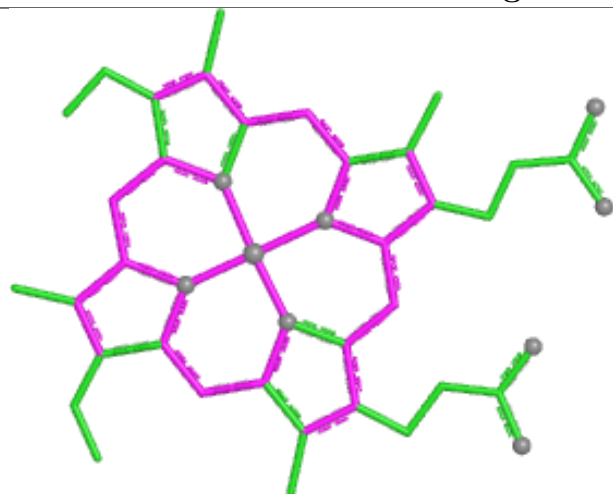




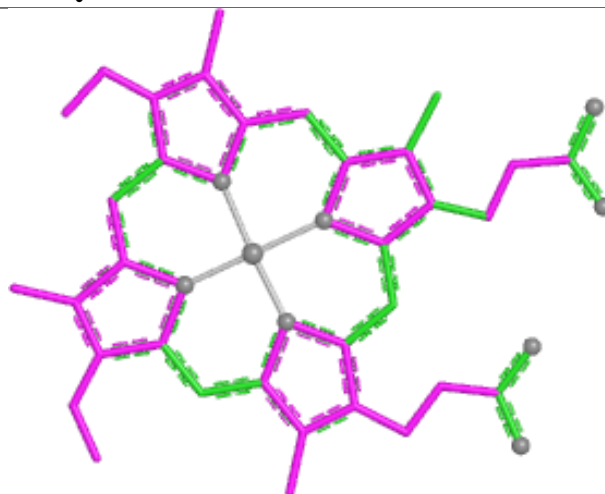




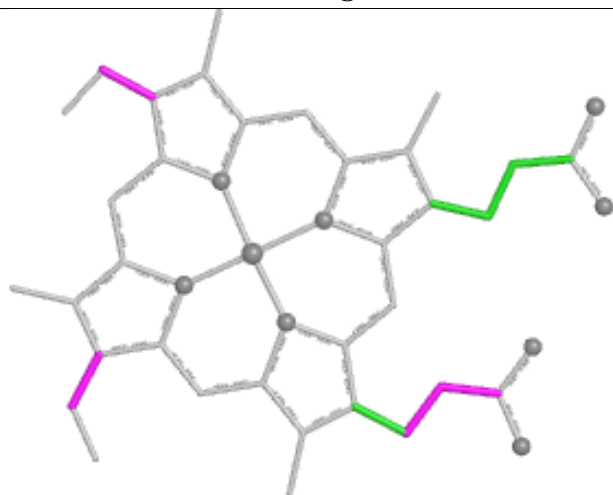
Ligand HEC 3Q 501



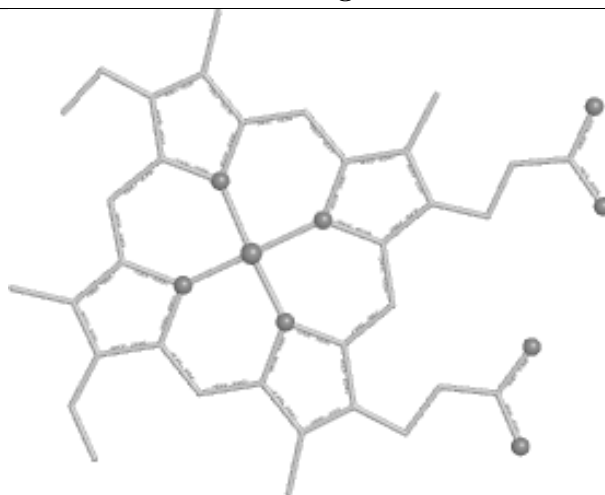
Bond lengths



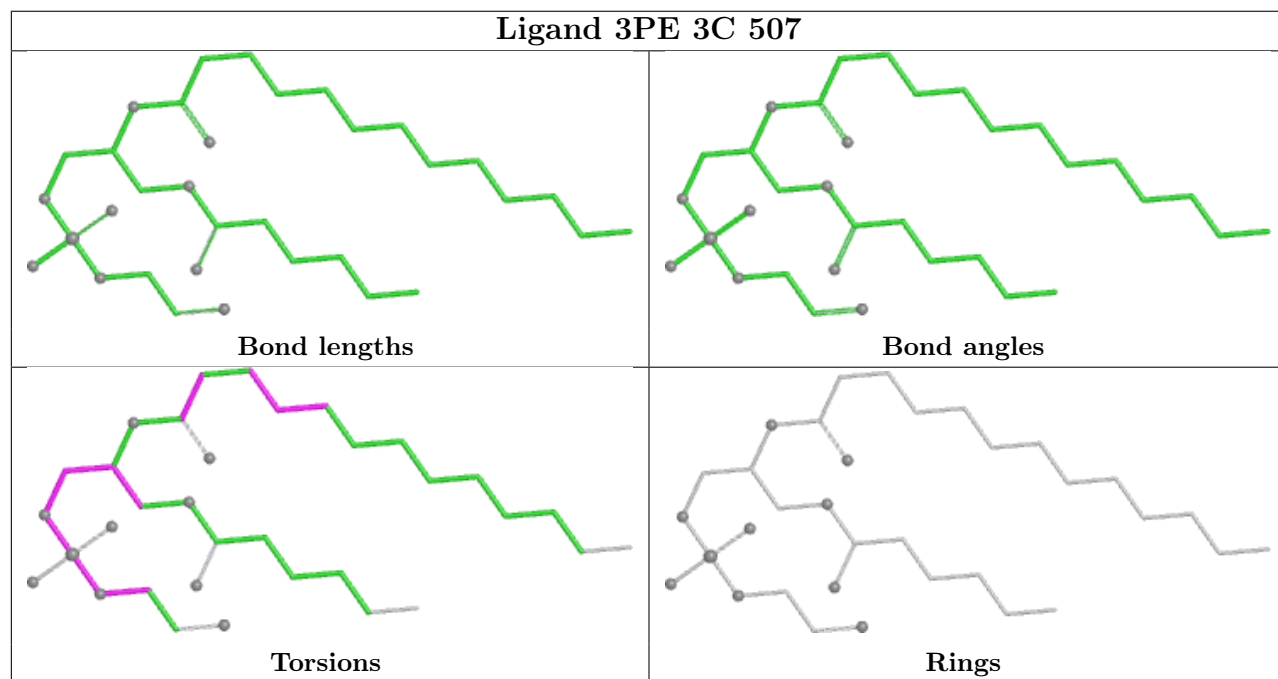
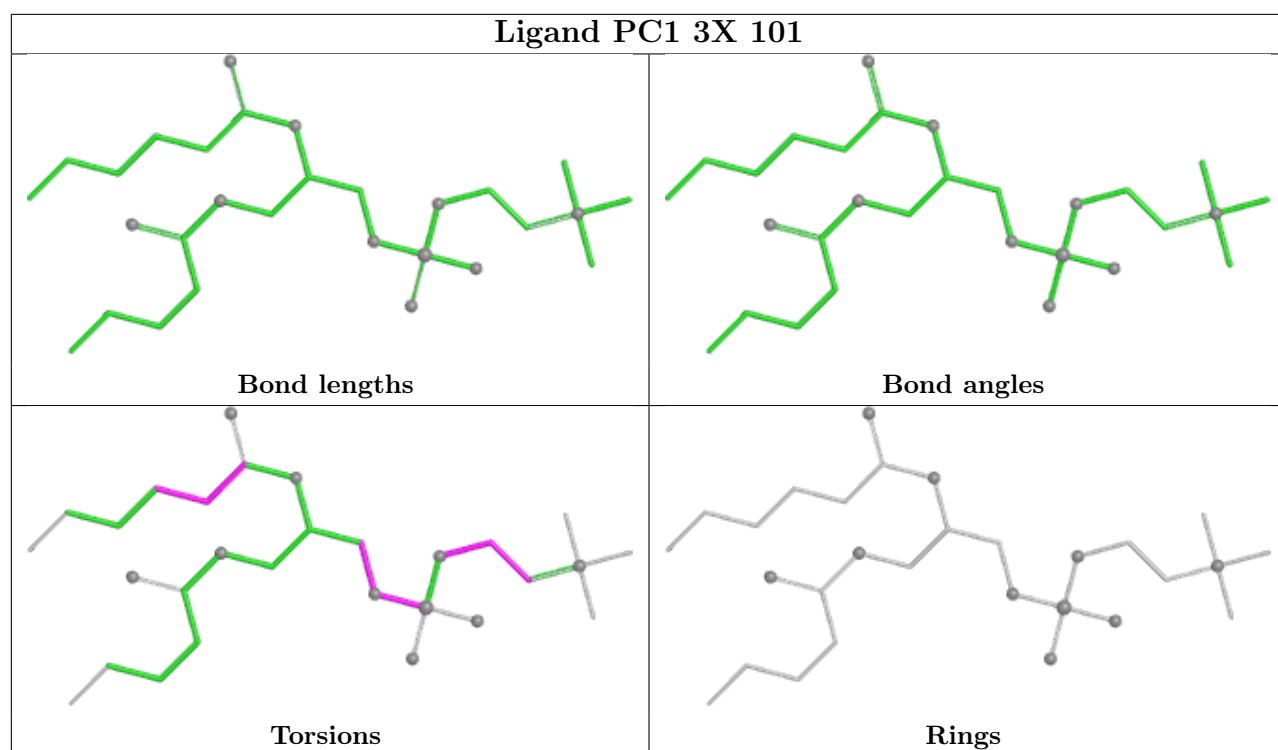
Bond angles

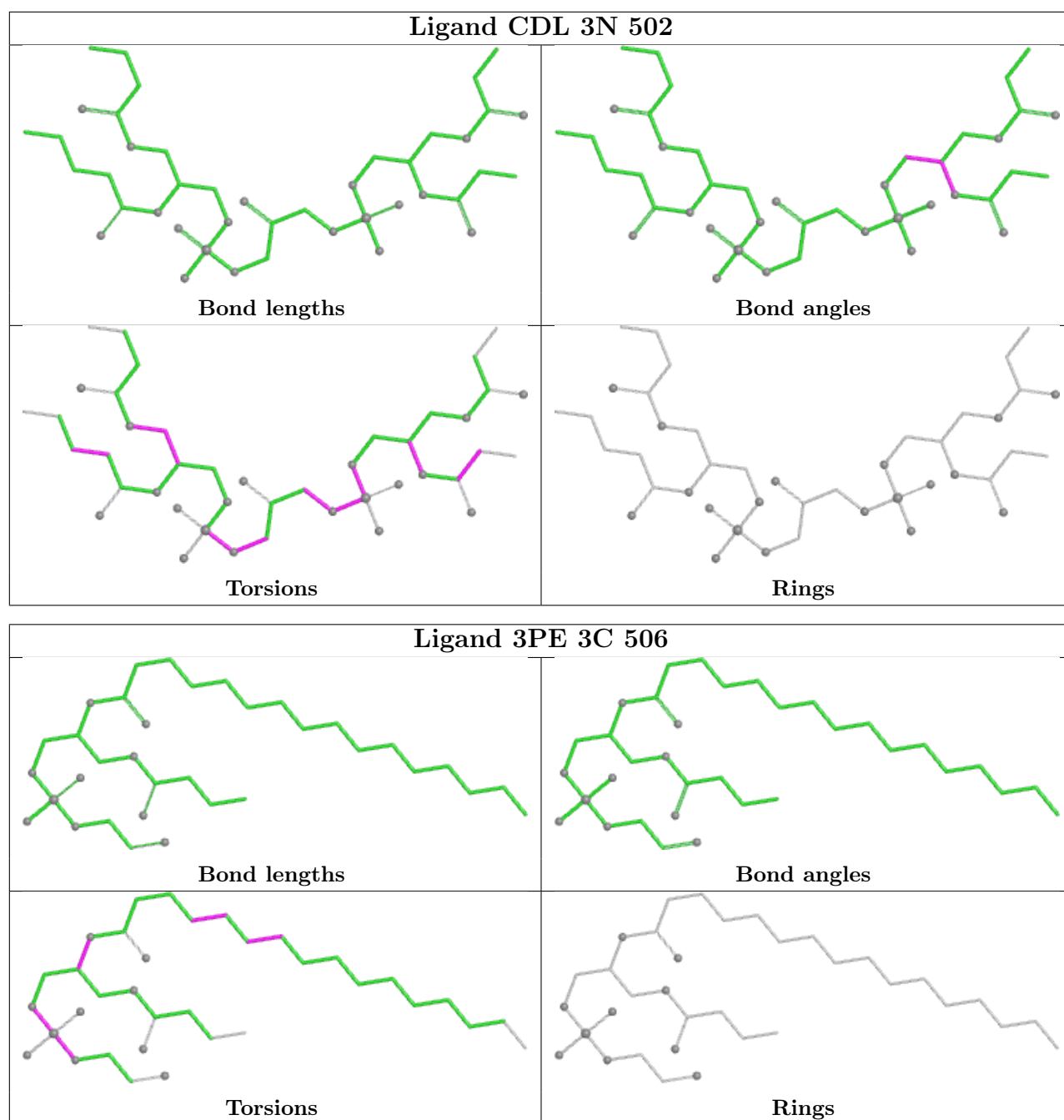


Torsions

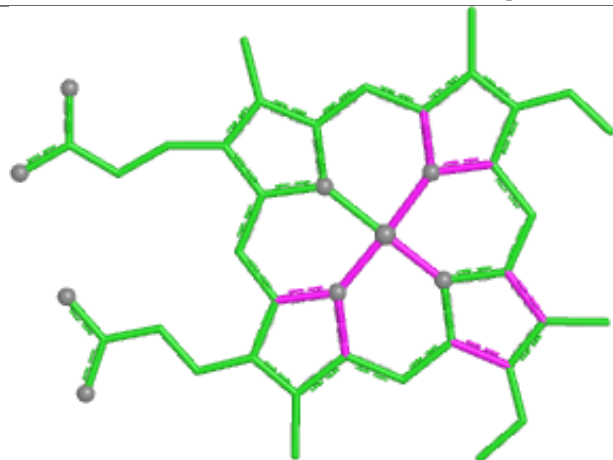


Rings

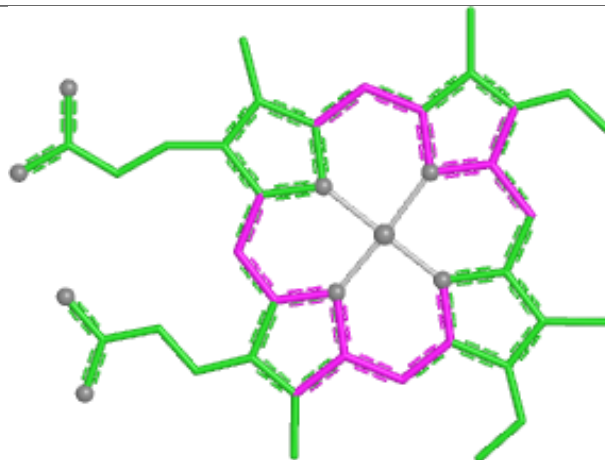




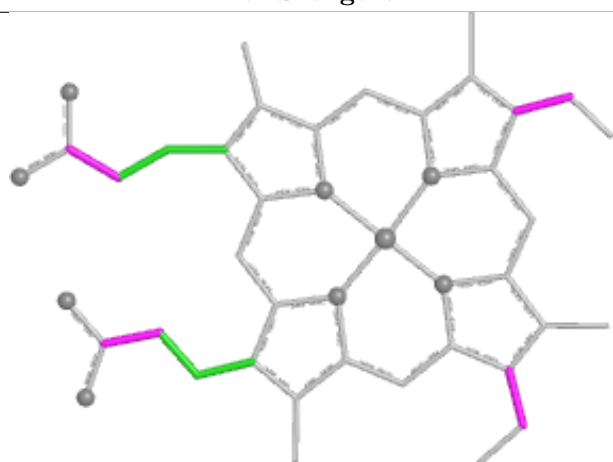
Ligand HEM 3P 502



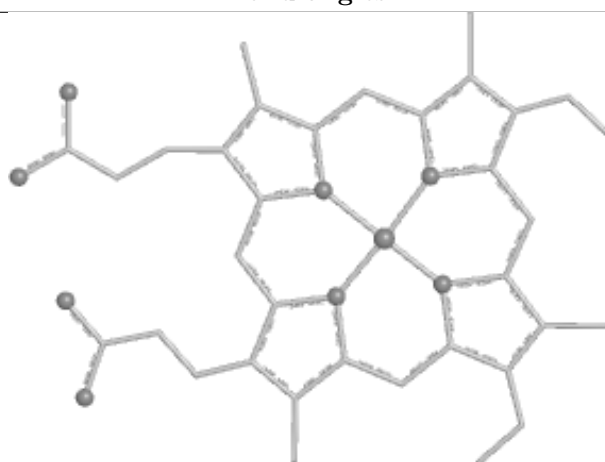
Bond lengths



Bond angles

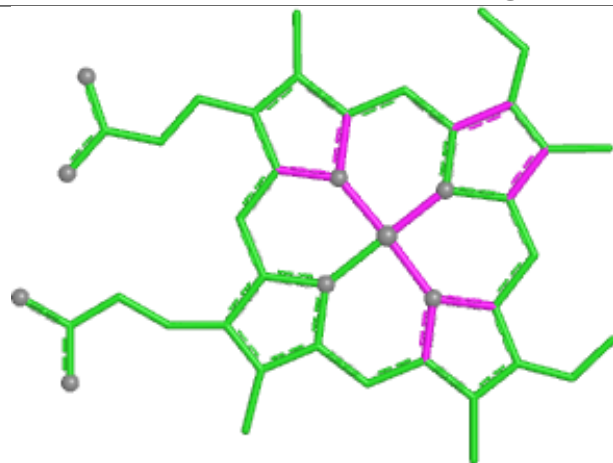


Torsions

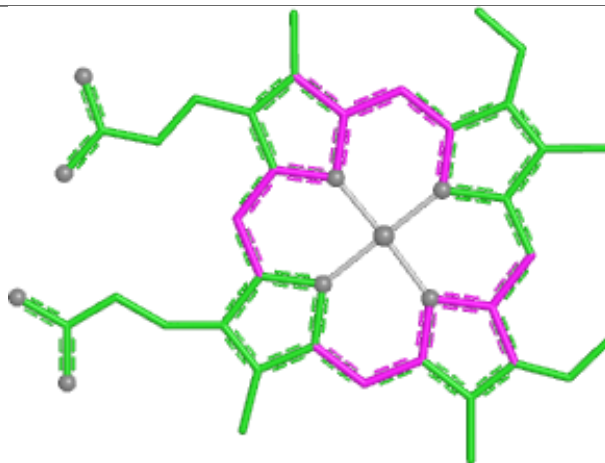


Rings

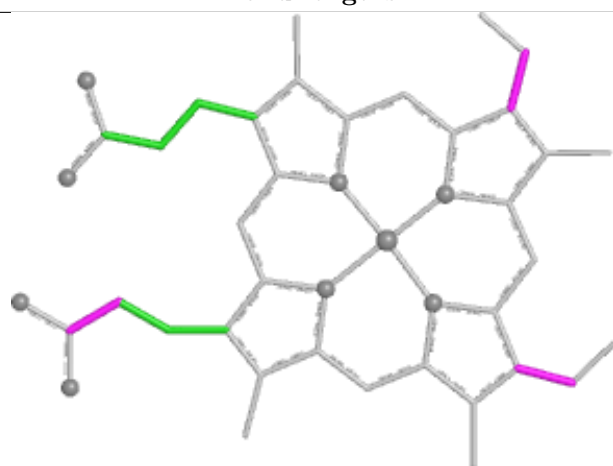
Ligand HEM 3C 502



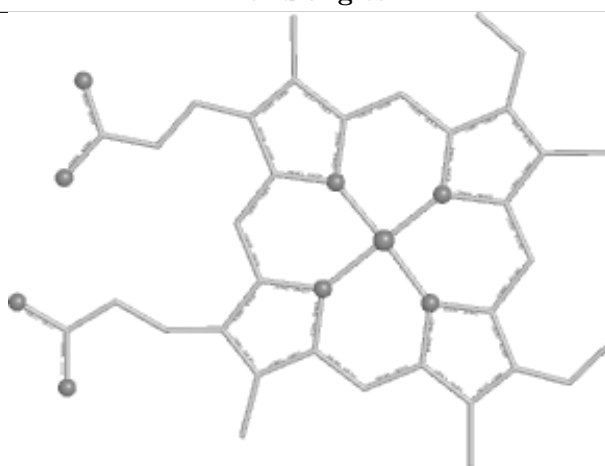
Bond lengths



Bond angles

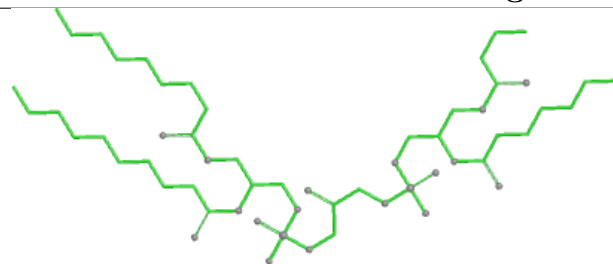


Torsions

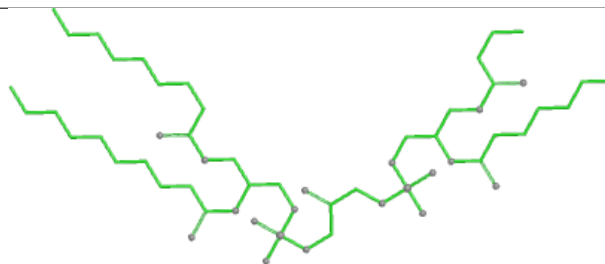


Rings

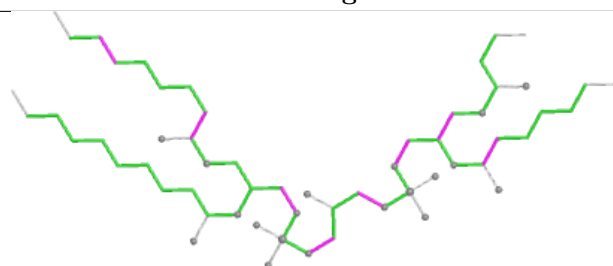
Ligand CDL 3A 501



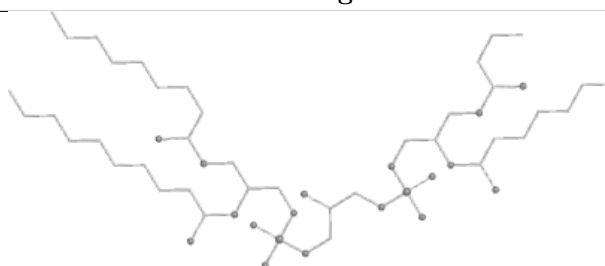
Bond lengths



Bond angles

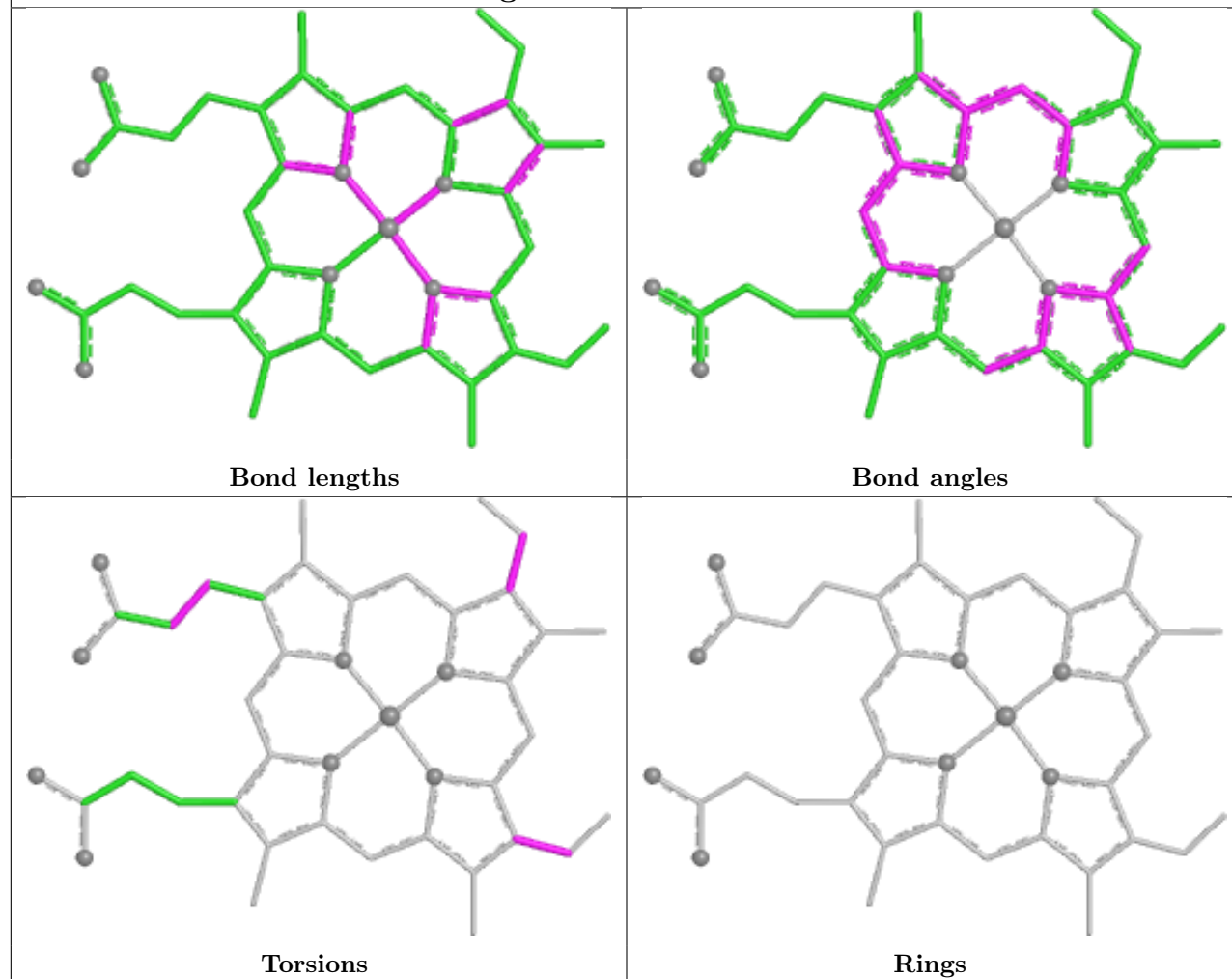


Torsions

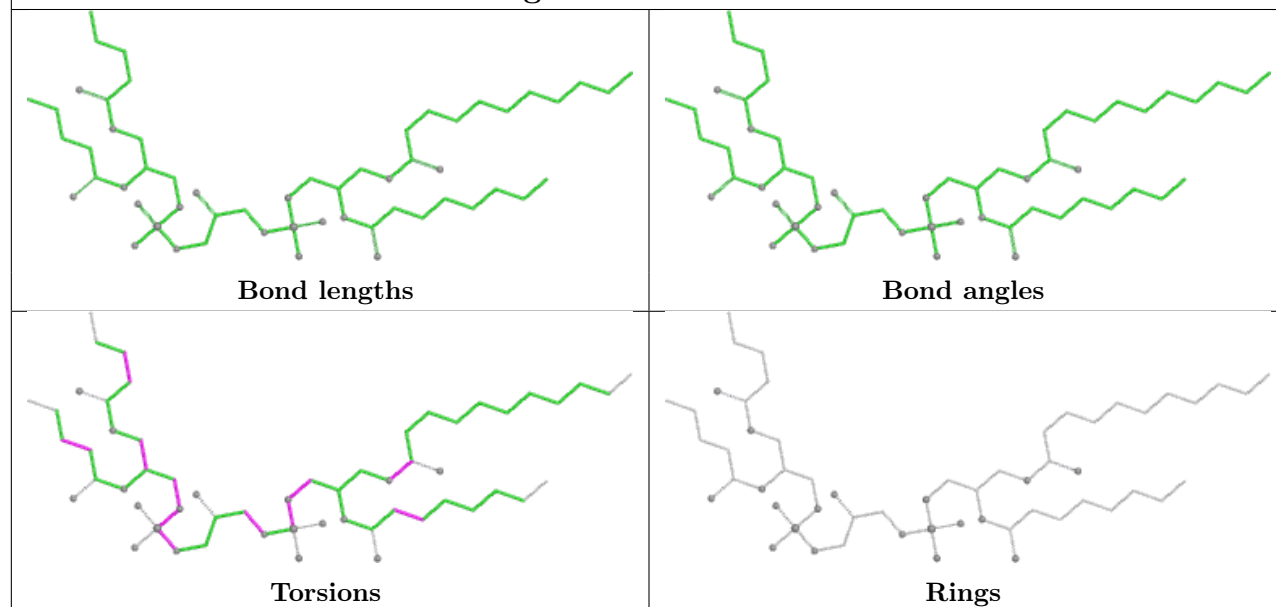


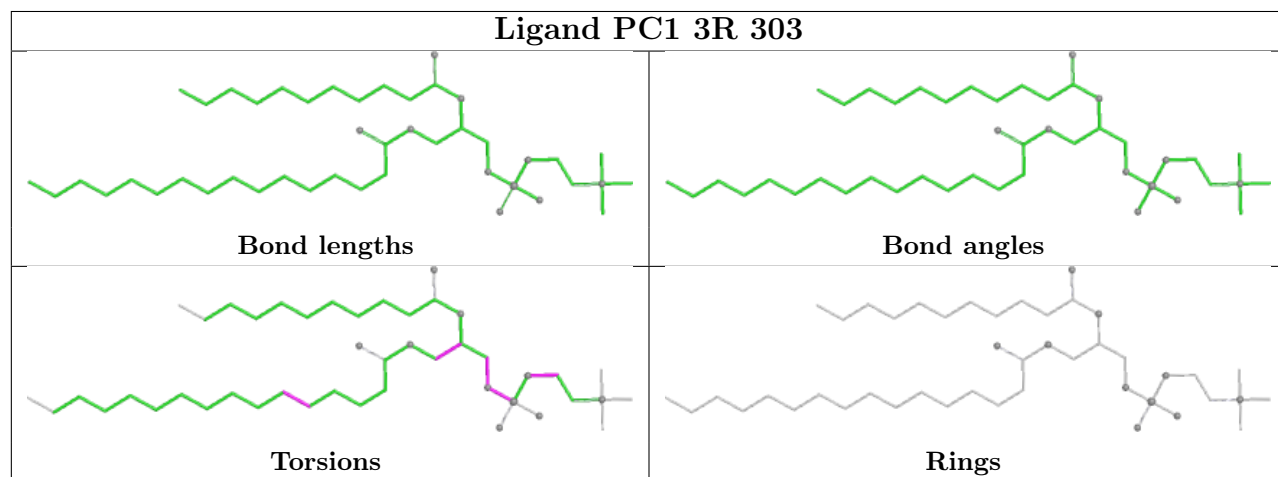
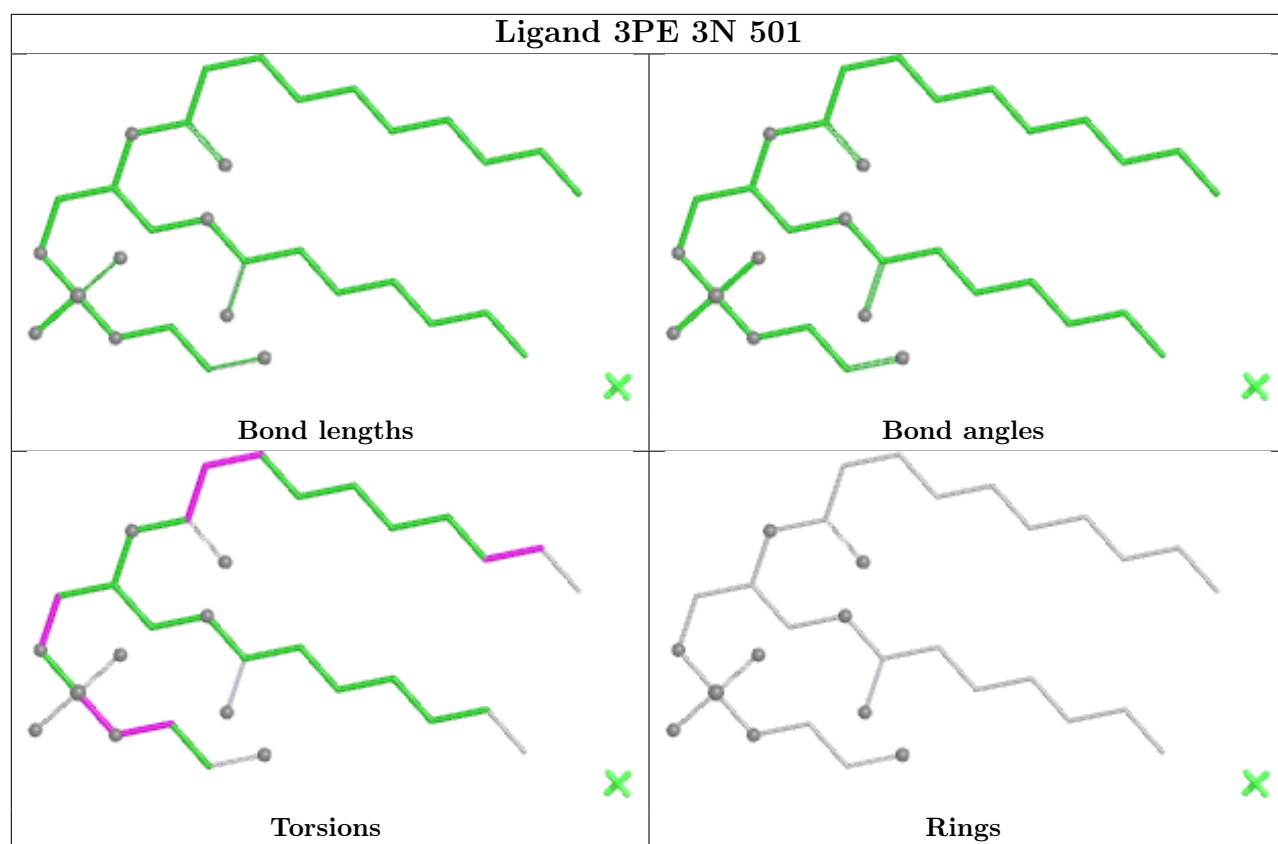
Rings

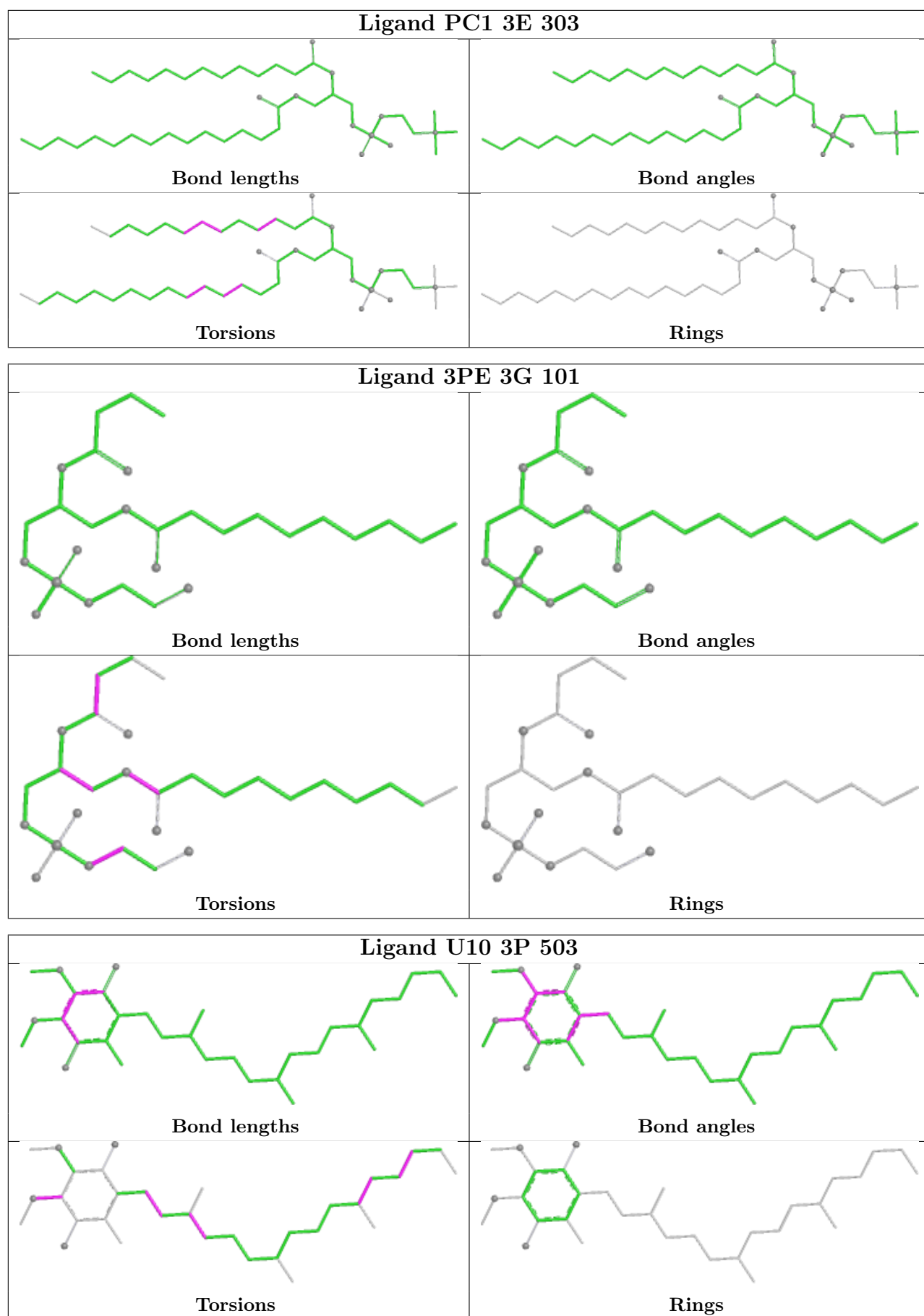
Ligand HEM 3C 501

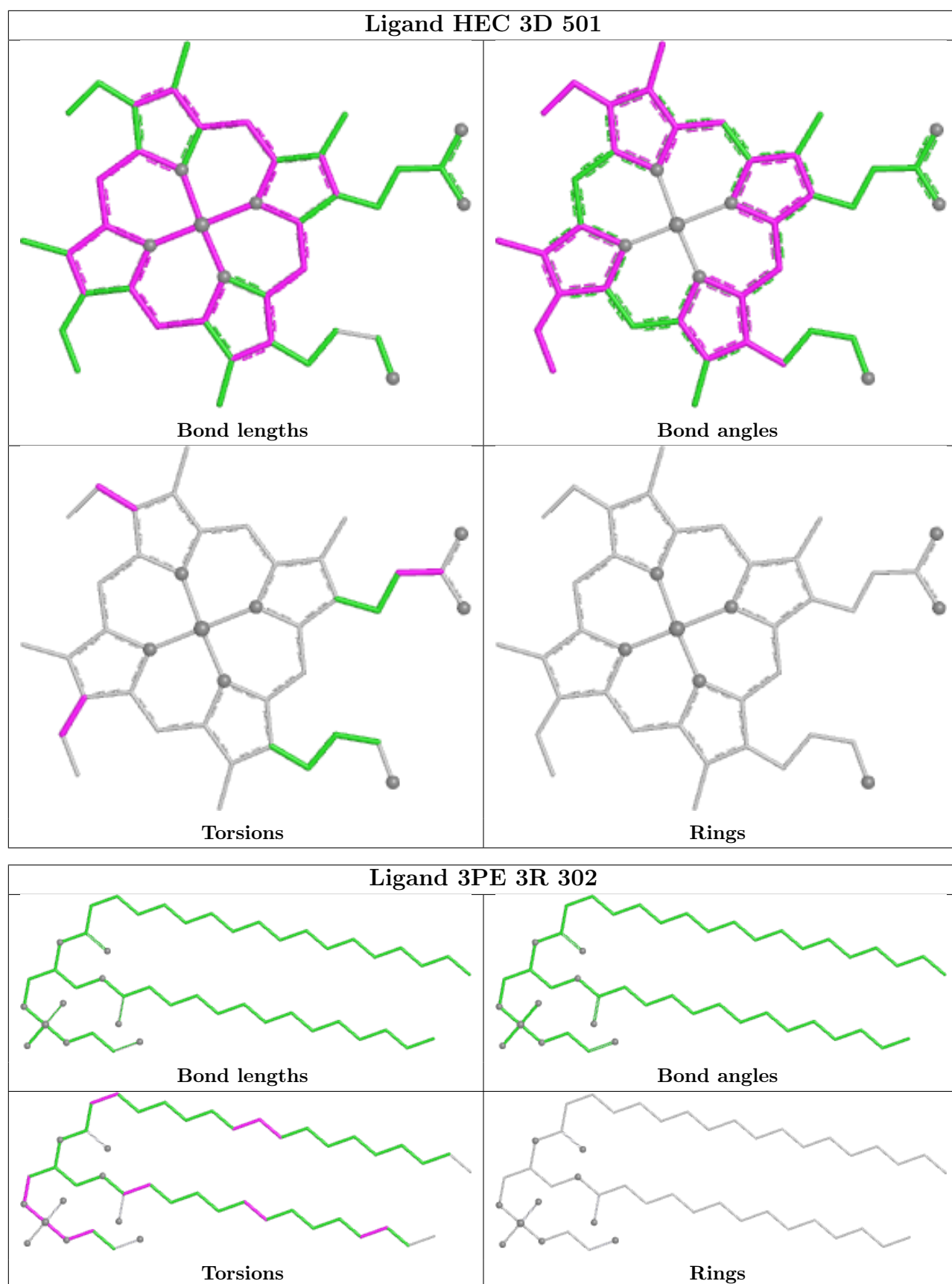


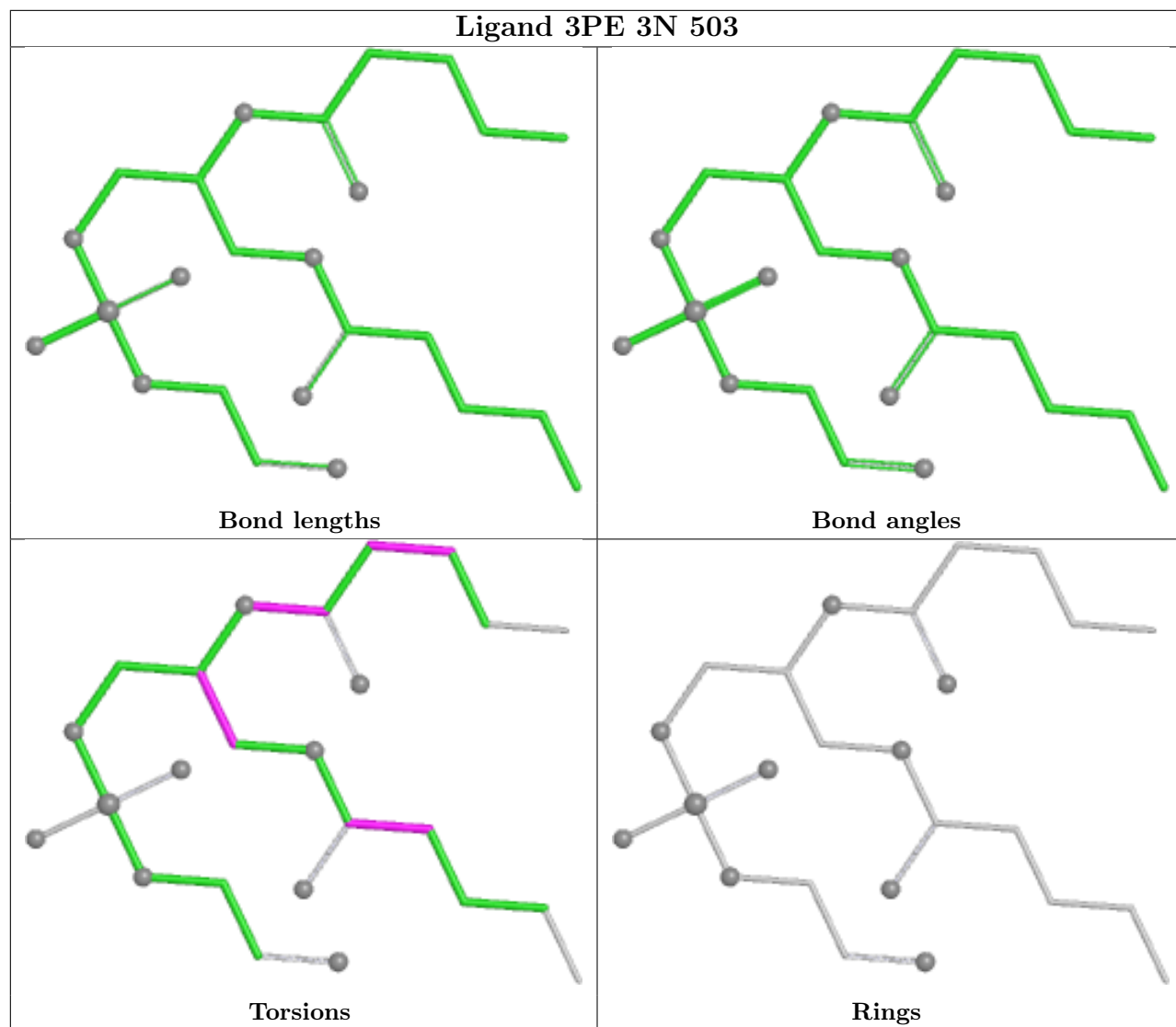
Ligand CDL 3T 101

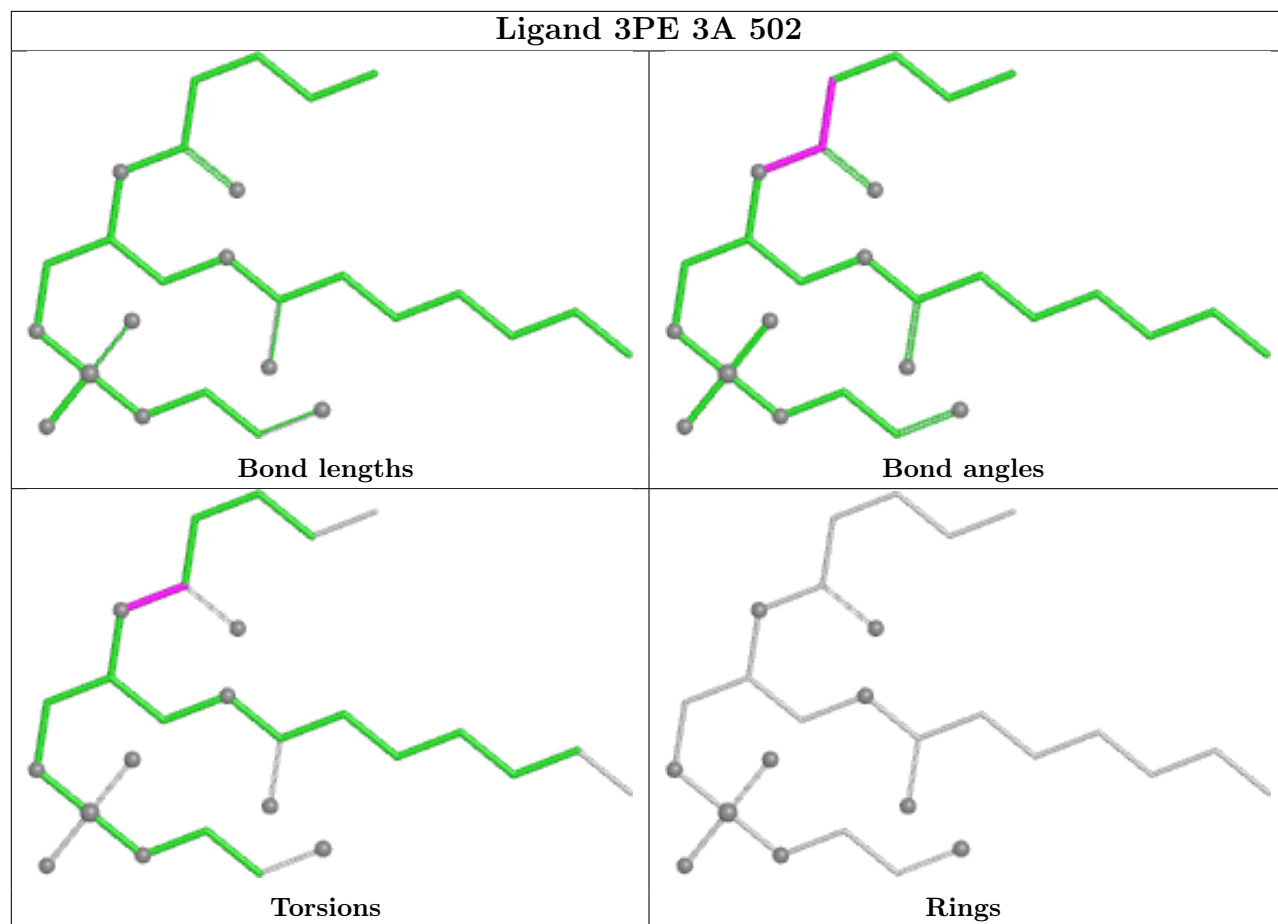


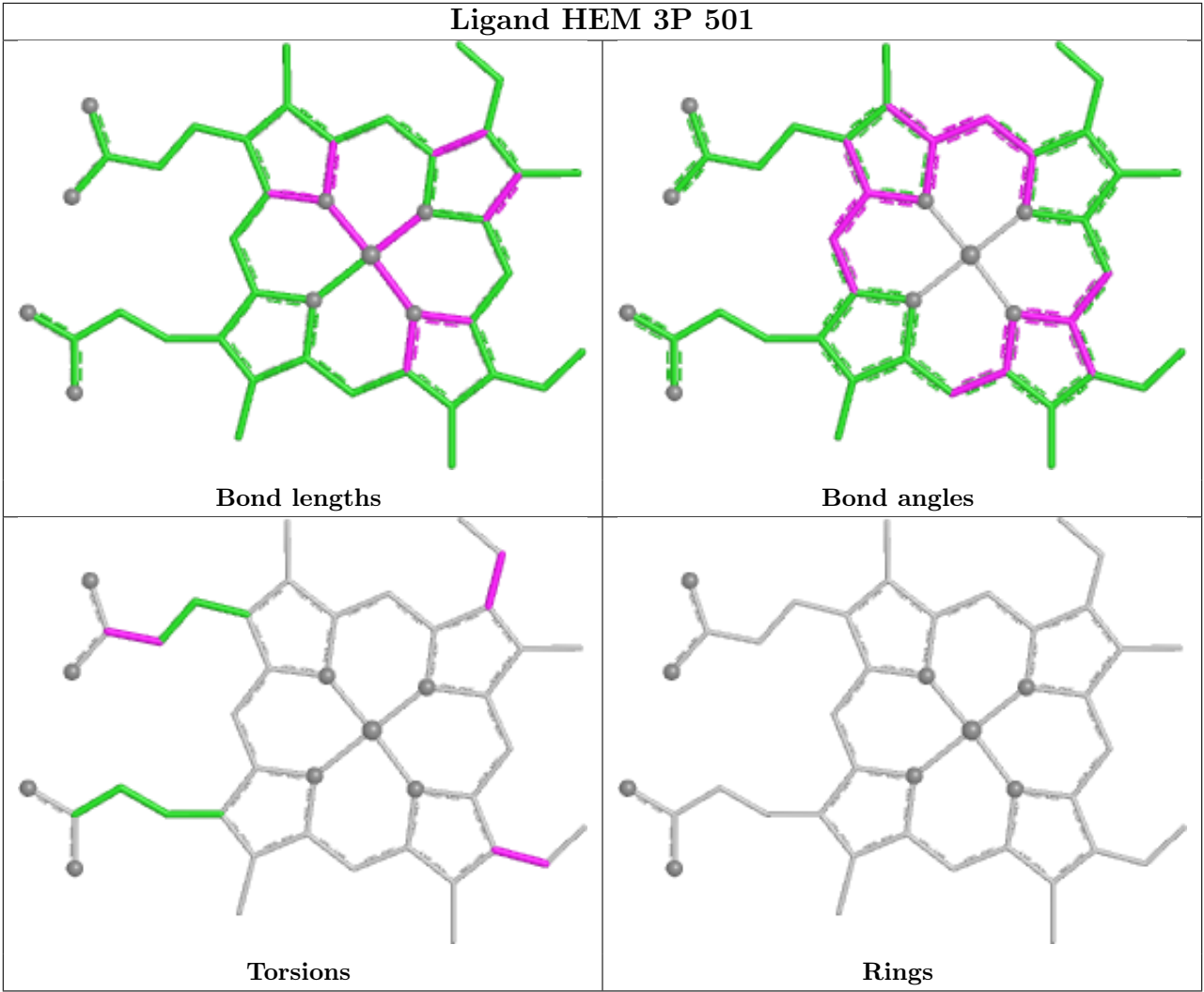












5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

The following chains have linkage breaks:

Mol	Chain	Number of breaks
7	3G	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	3G	75:ASN	C	82:PRO	N	4.66

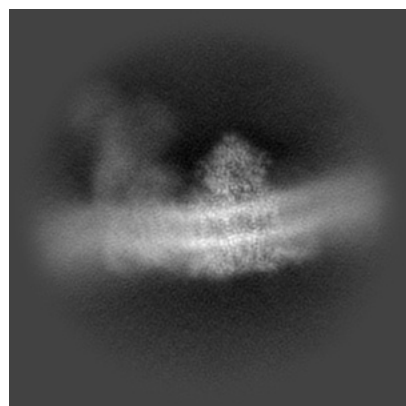
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-42223. These allow visual inspection of the internal detail of the map and identification of artifacts.

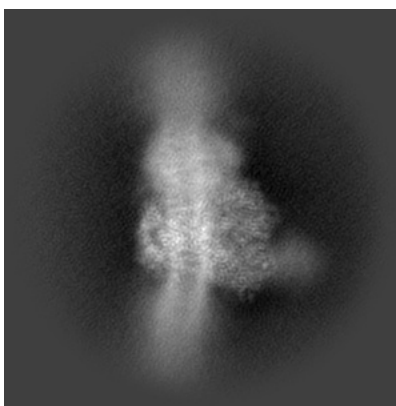
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

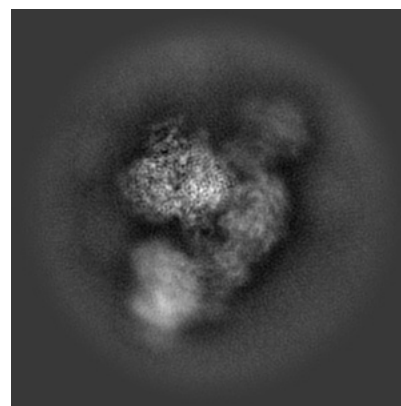
6.1.1 Primary map



X

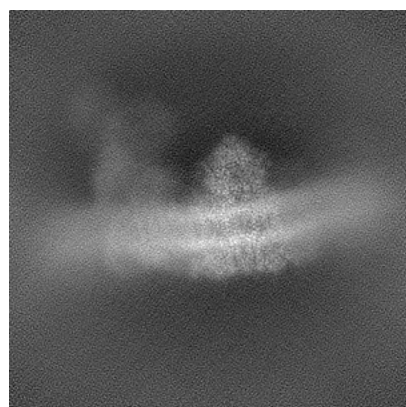


Y

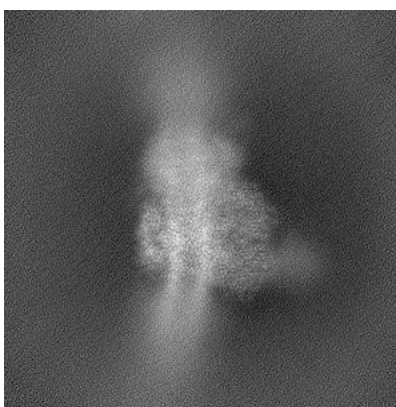


Z

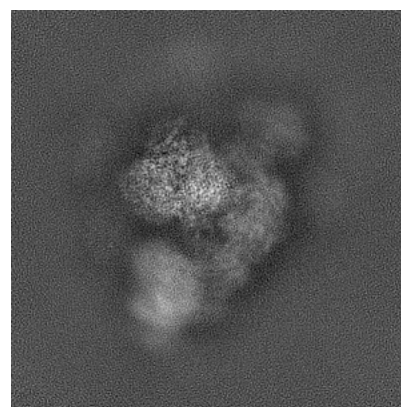
6.1.2 Raw map



X



Y

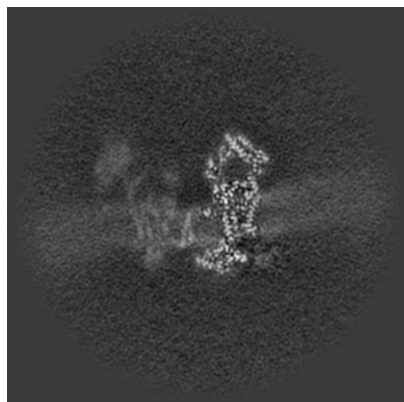


Z

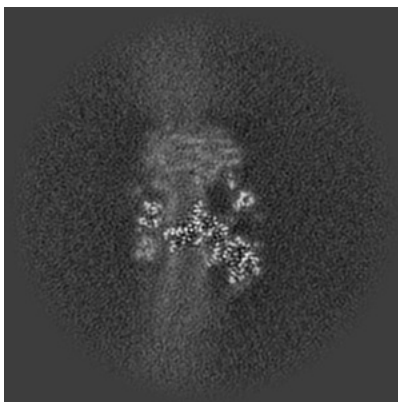
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

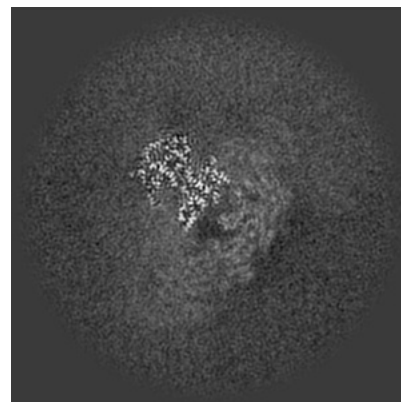
6.2.1 Primary map



X Index: 160

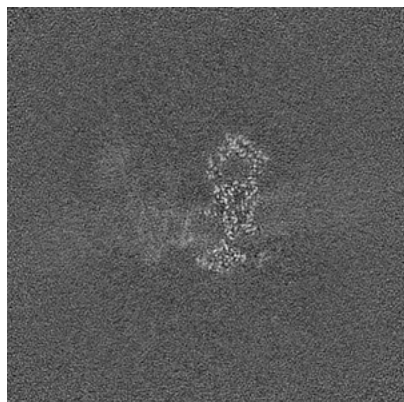


Y Index: 160

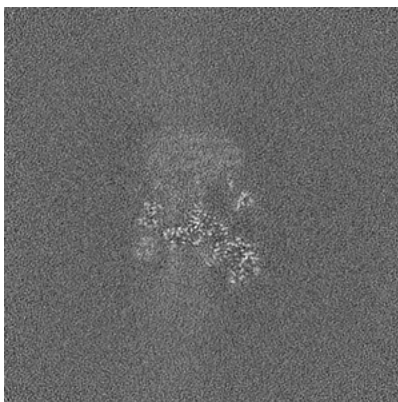


Z Index: 160

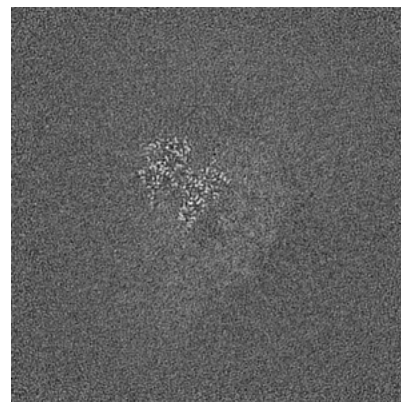
6.2.2 Raw map



X Index: 160



Y Index: 160

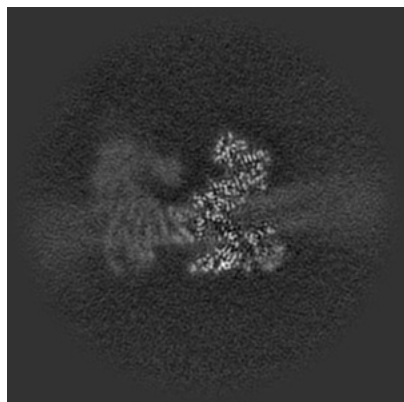


Z Index: 160

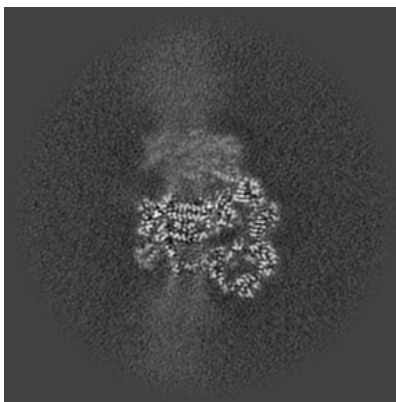
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

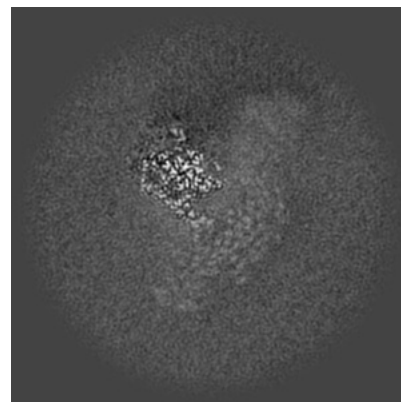
6.3.1 Primary map



X Index: 147

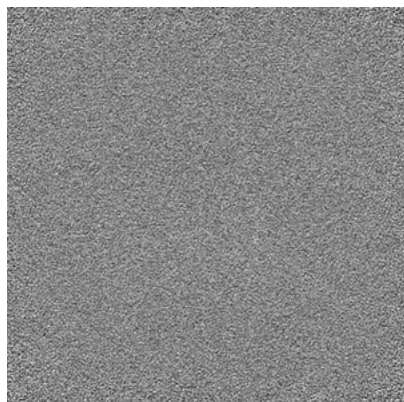


Y Index: 175

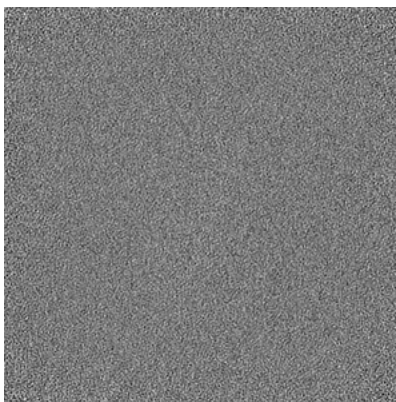


Z Index: 136

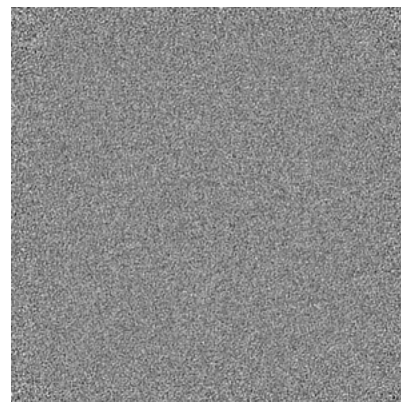
6.3.2 Raw map



X Index: 0



Y Index: 0

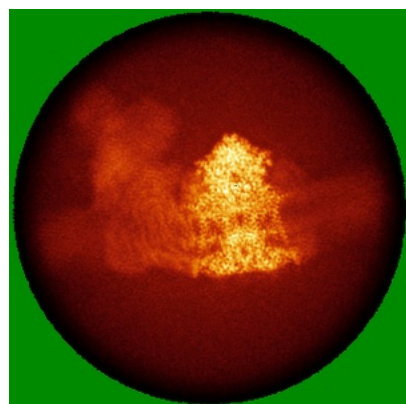


Z Index: 0

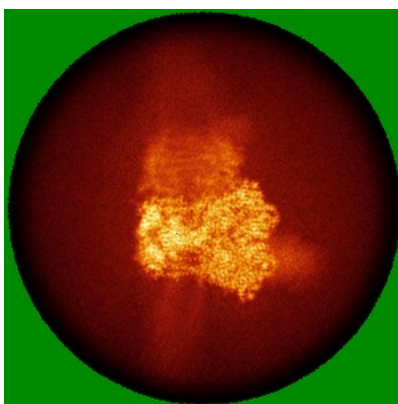
The images above show the largest variance slices of the map in three orthogonal directions.

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

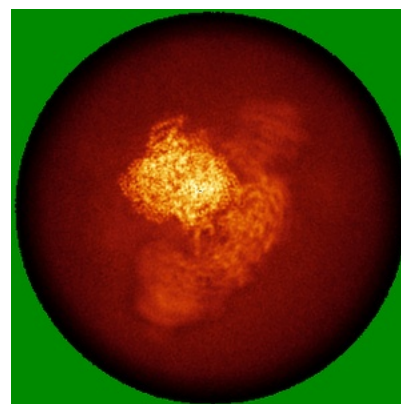
6.4.1 Primary map



X

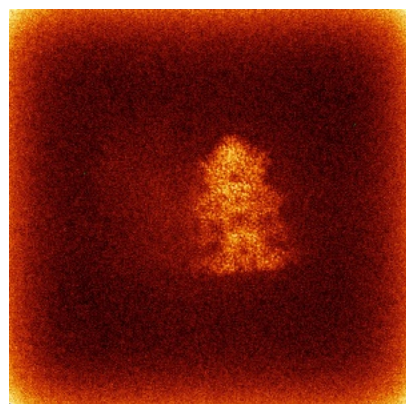


Y

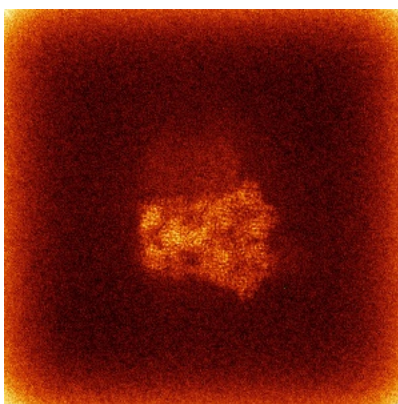


Z

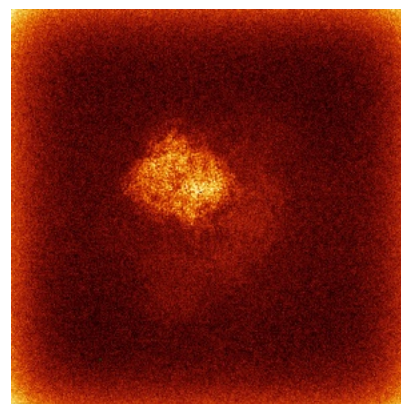
6.4.2 Raw map



X



Y

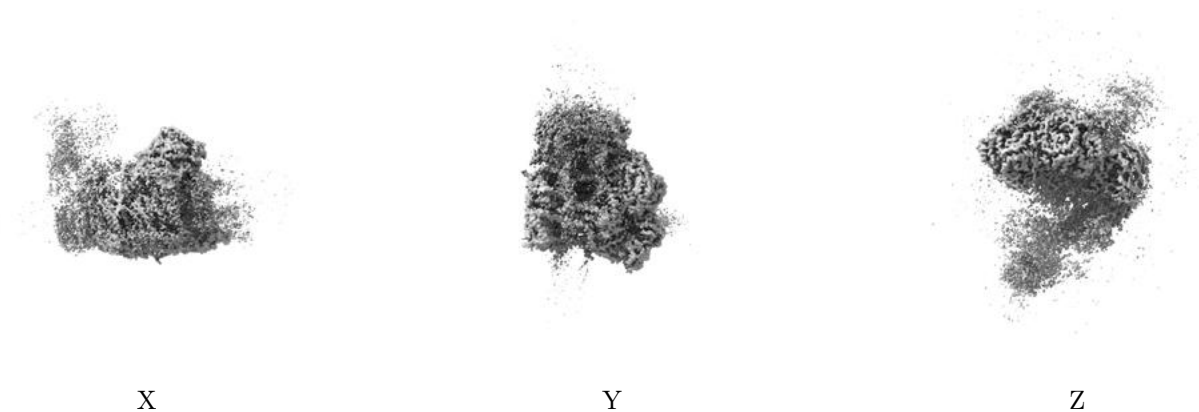


Z

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.

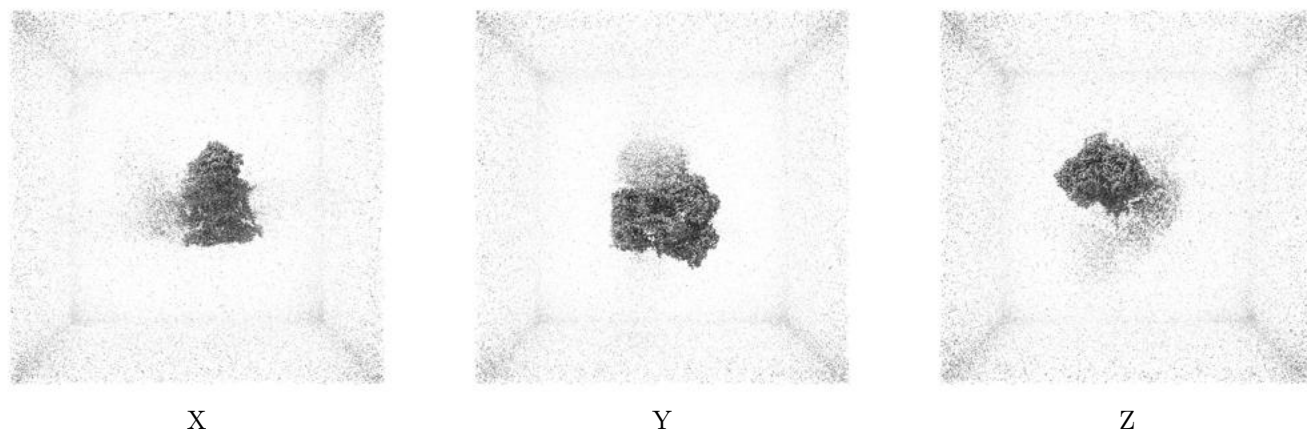
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.12. 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.

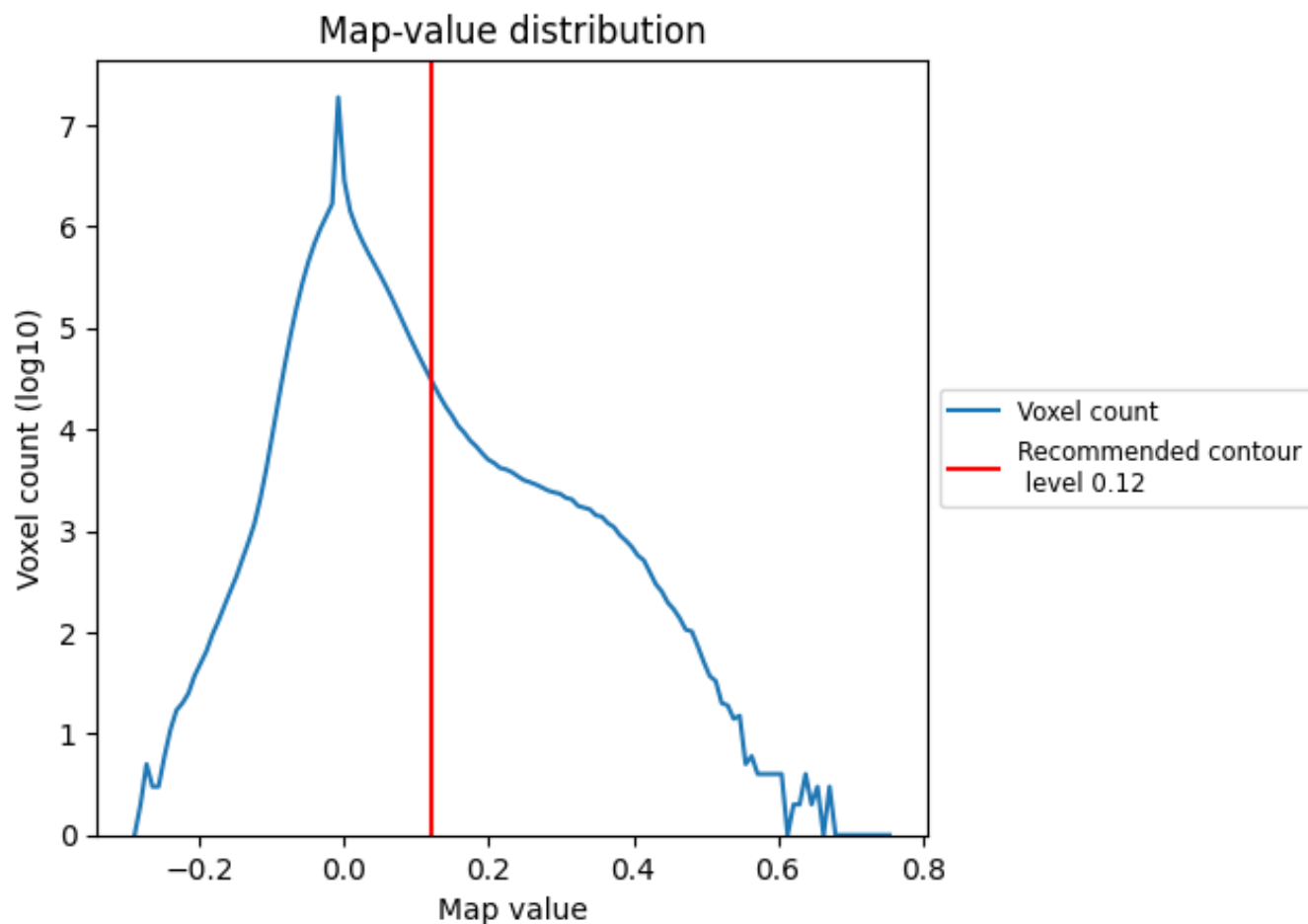
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

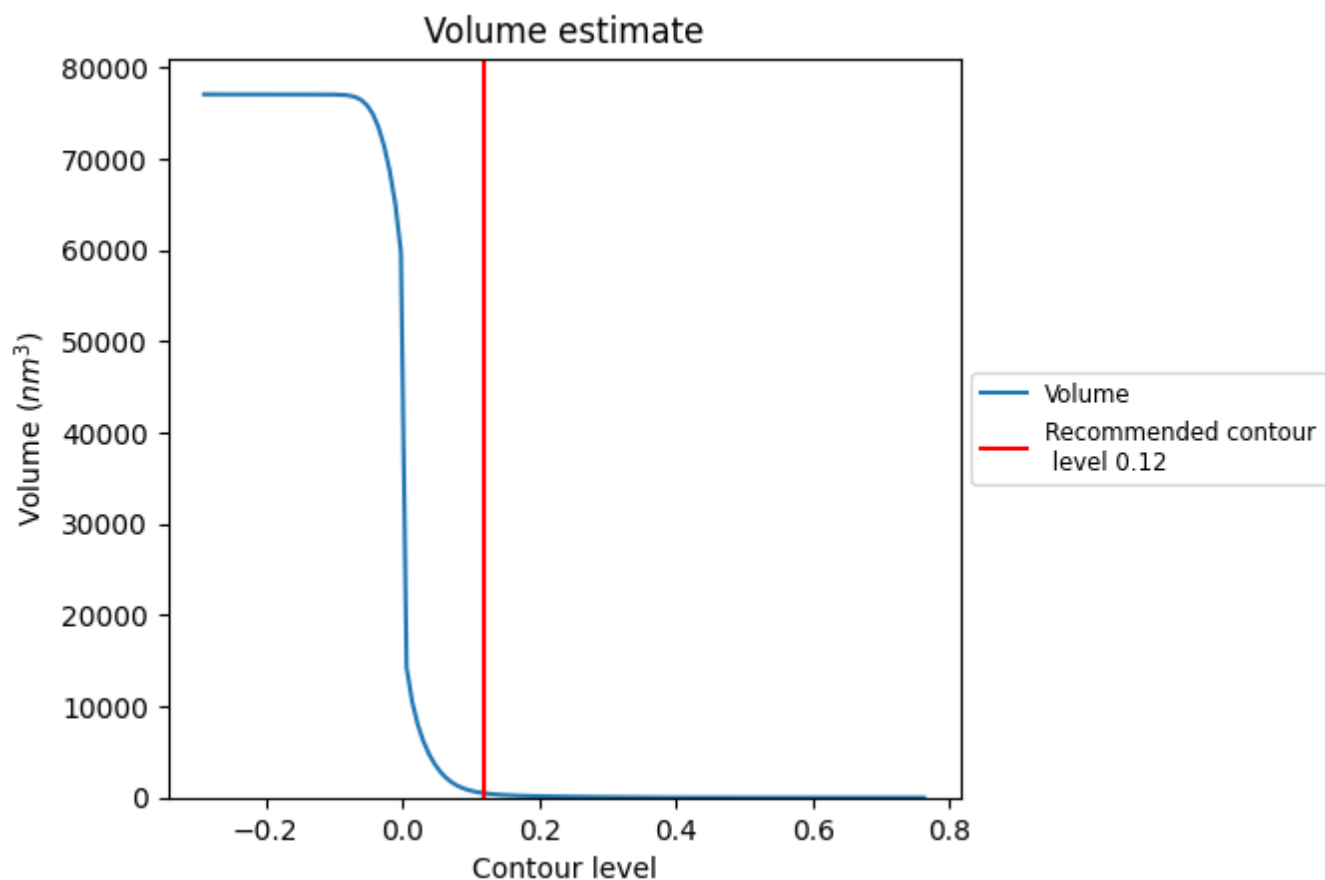
This section contains the results of statistical analysis of the map.

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.

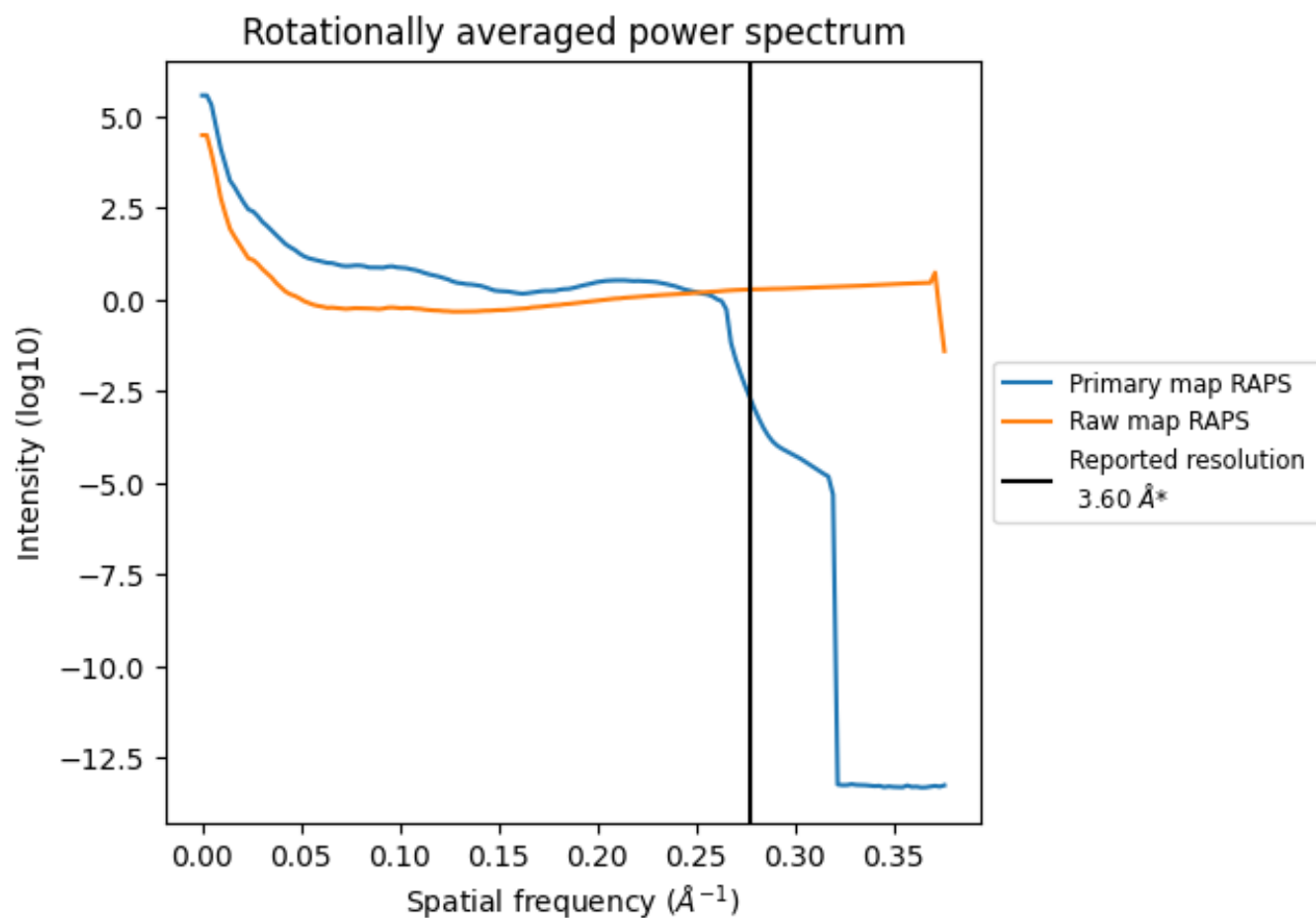
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 472 nm^3 ; this corresponds to an approximate mass of 426 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 ⓘ

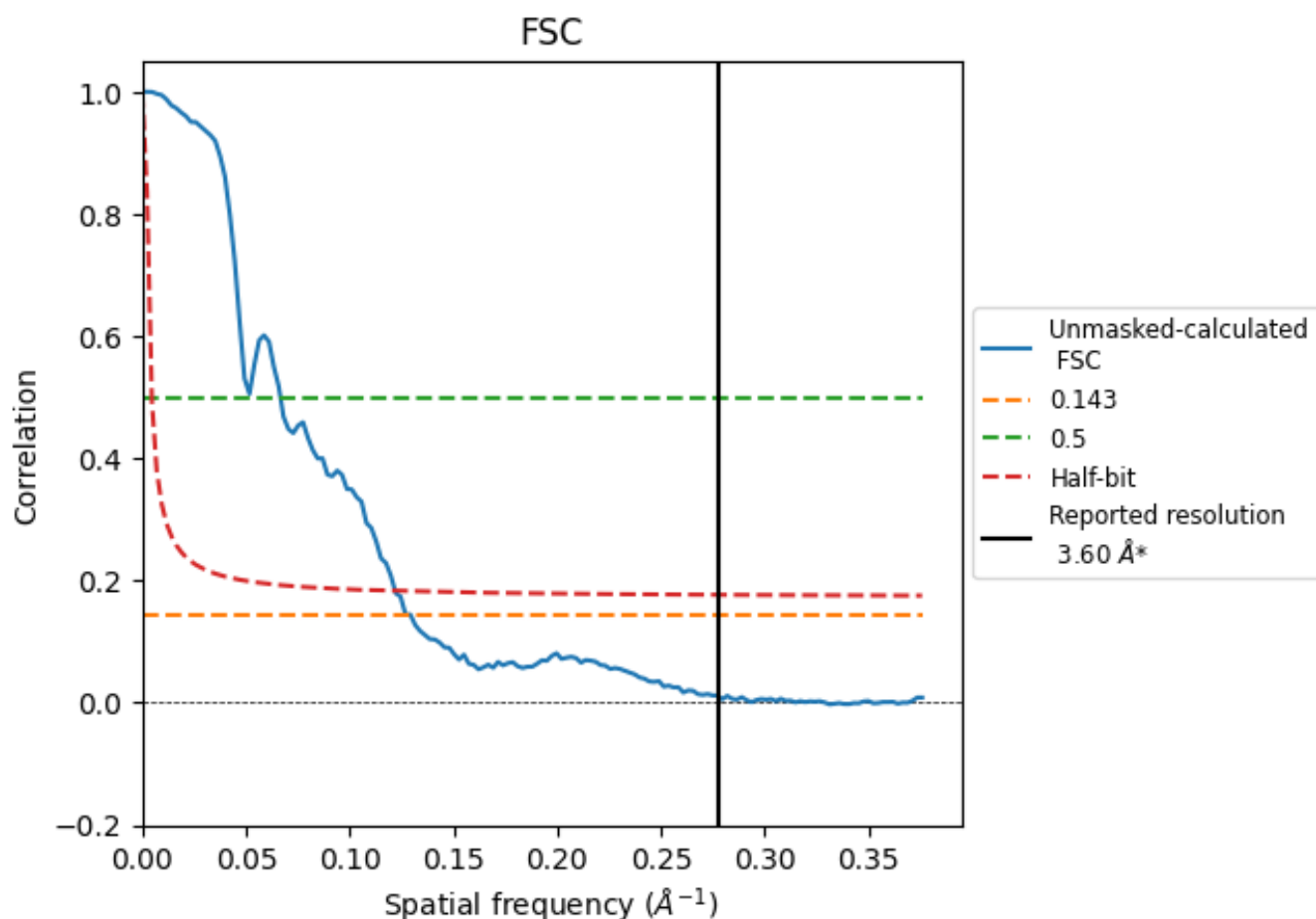


*Reported resolution corresponds to spatial frequency of 0.278 Å⁻¹

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 0.278 Å⁻¹

8.2 Resolution estimates [i](#)

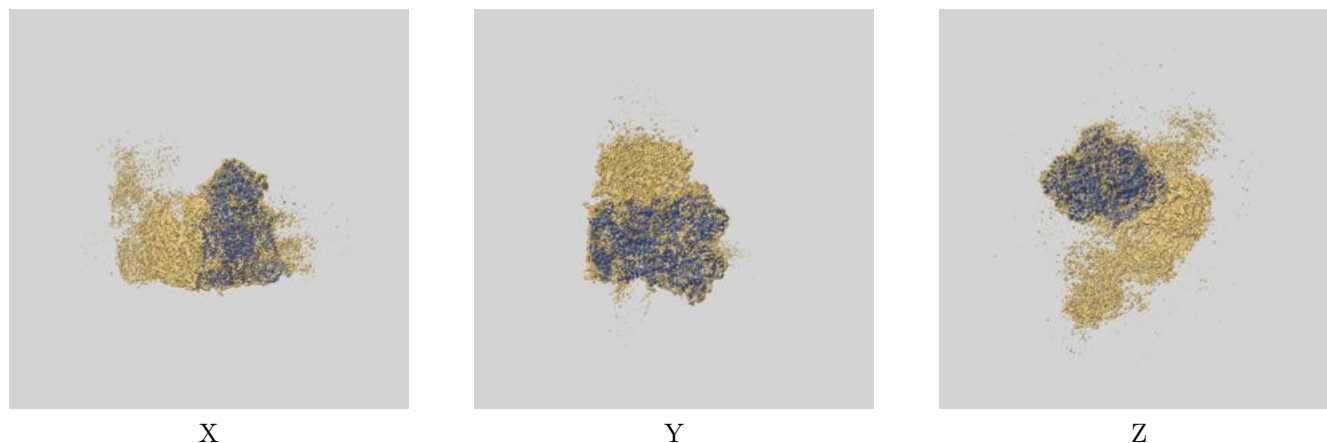
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	3.60	-	-
Author-provided FSC curve	-	-	-
Unmasked-calculated*	7.73	15.02	8.20

*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 7.73 differs from the reported value 3.6 by more than 10 %

9 Map-model fit [i](#)

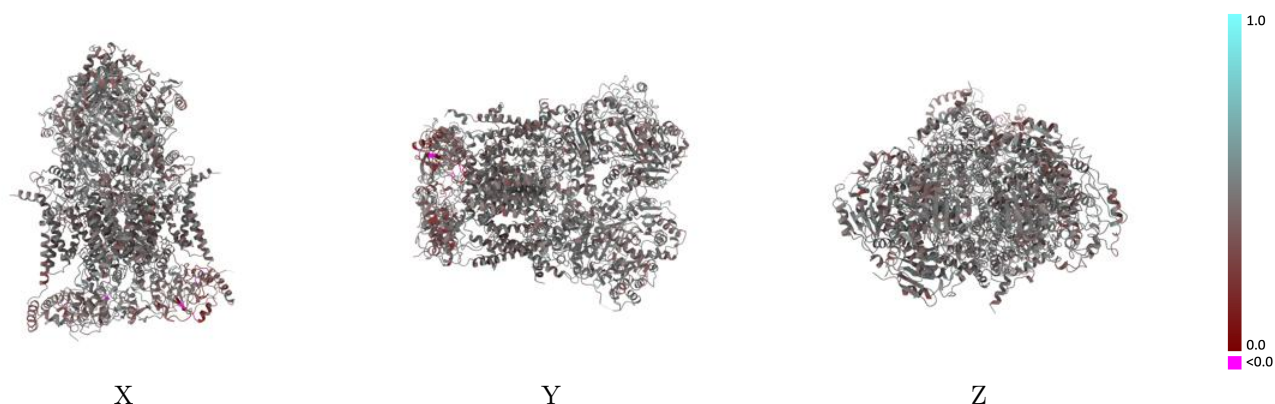
This section contains information regarding the fit between EMDB map EMD-42223 and PDB model 8UGF. Per-residue inclusion information can be found in section [3](#) on page [12](#).

9.1 Map-model overlay [i](#)



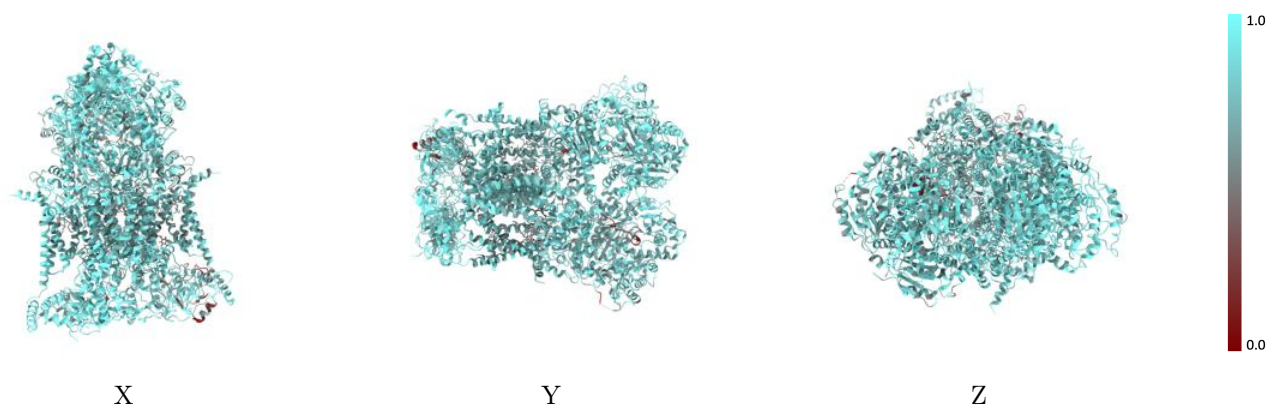
The images above show the 3D surface view of the map at the recommended contour level 0.12 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



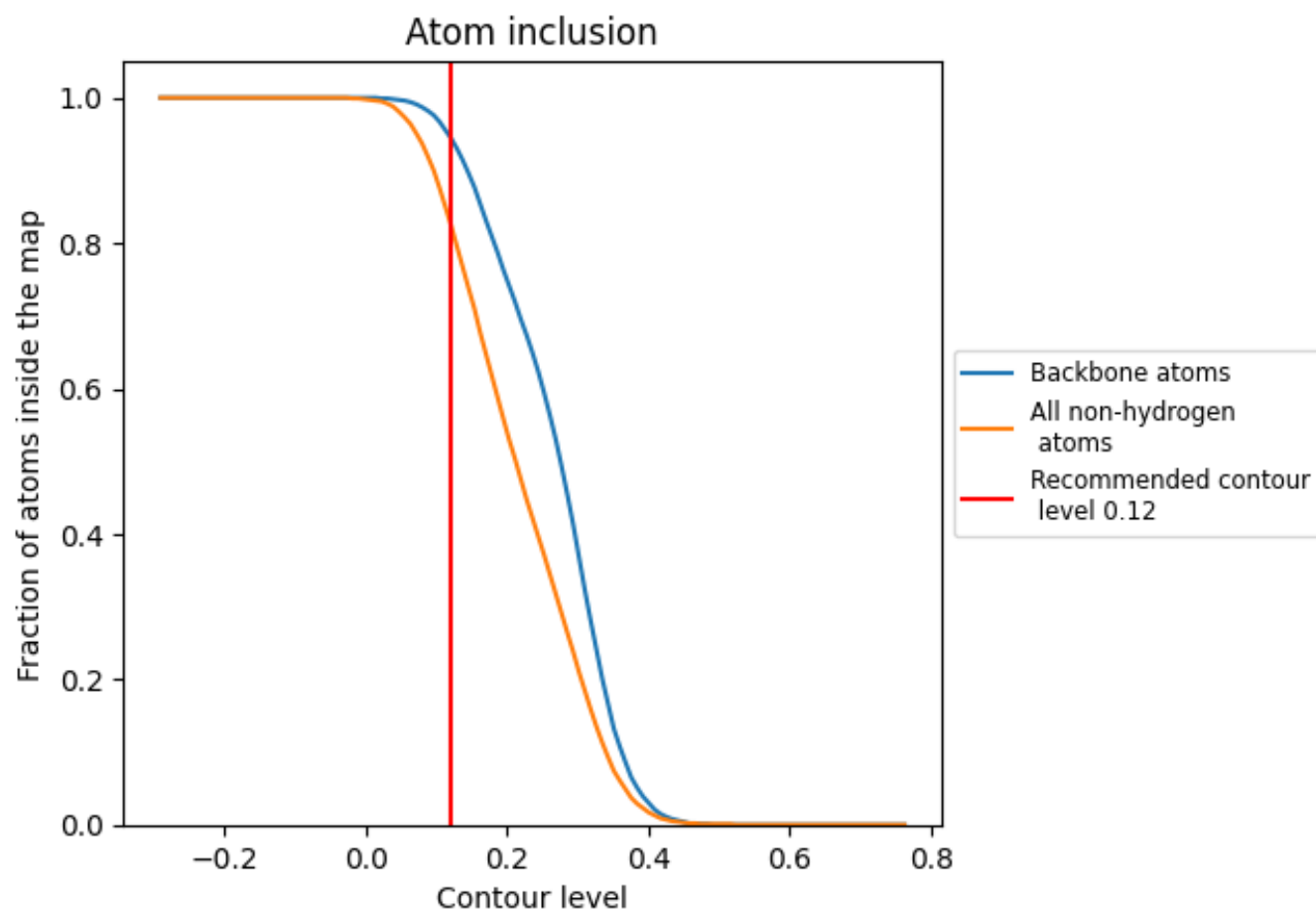
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.12).

9.4 Atom inclusion [i](#)



At the recommended contour level, 95% of all backbone atoms, 83% 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 (0.12) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.8280	 0.4420
3A	 0.7940	 0.4550
3B	 0.8290	 0.4570
3C	 0.8040	 0.4520
3D	 0.8730	 0.4550
3E	 0.7130	 0.3690
3F	 0.8250	 0.4540
3G	 0.7800	 0.4530
3H	 0.8450	 0.3860
3I	 0.3960	 0.3580
3J	 0.8100	 0.4310
3N	 0.8850	 0.4570
3O	 0.8720	 0.4540
3P	 0.8630	 0.4580
3Q	 0.9160	 0.4610
3R	 0.7040	 0.3430
3S	 0.8720	 0.4600
3T	 0.8650	 0.4460
3U	 0.9020	 0.4190
3V	 0.6840	 0.4260
3W	 0.8980	 0.4620
3X	 0.8070	 0.4310
3Y	 0.7470	 0.4410

