



wwPDB EM Validation Summary Report ⓘ

Aug 23, 2026 – 03:40 pm BST

PDB ID : 8AB6 / pdb_00008ab6
EMDB ID : EMD-15312
Title : Complex III2 from *Yarrowia lipolytica*, combined datasets, consensus refinement
Authors : Wieferig, J.P.; Kuhlbrandt, W.
Deposited on : 2022-07-04
Resolution : 2.00 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:

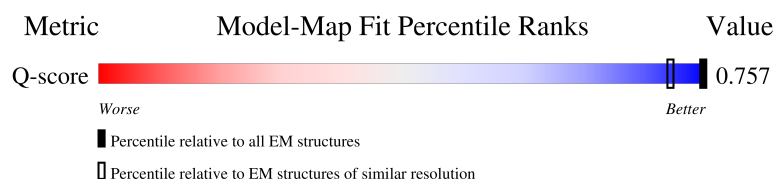
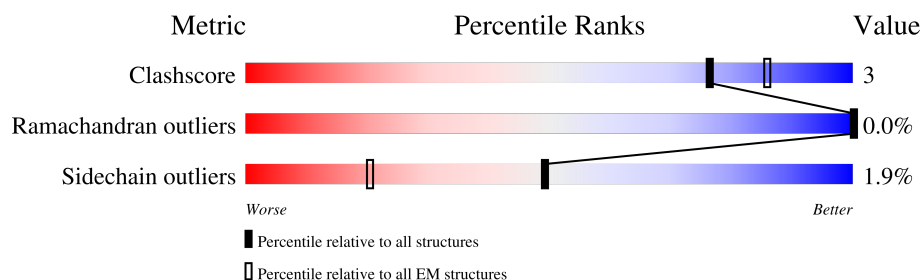
EMDB validation analysis : 0.0.1.dev133
Mogul : 1.8.4, CSD as541be (2020)
MolProbity : 4-5-2 with Phenix2.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics : 202505.v01 (Using data 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 i

The following experimental techniques were used to determine the structure:
ELECTRON MICROSCOPY

The reported resolution of this entry is 2.00 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.



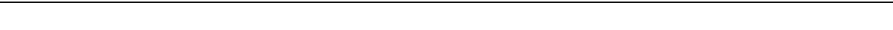
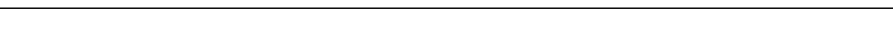
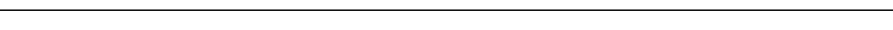
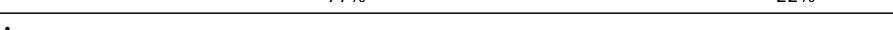
Metric	Whole archive (#Entries)	EM structures (#Entries)	Similar EM resolution (#Entries, resolution range(Å))
Clashscore	229148	23984	-
Ramachandran outliers	224038	23583	-
Sidechain outliers	223484	23102	-
Q-score	-	25397	1659 (1.50 - 2.50)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the EM map (all-atom inclusion $< 40\%$). The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	C	385	
1	N	385	
2	E	225	
2	P	225	

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Mol	Chain	Length	Quality of chain
3	G	128	 91% 5% . .
3	R	128	 93% . . .
4	F	137	 7% 47% . . 48%
4	Q	137	 7% 47% . . 48%
5	A	474	 87% 5% . 8%
5	L	474	 86% 6% 8%
6	B	417	 87% 9% .
6	M	417	 86% 10% . .
7	D	330	 70% . 26%
7	O	330	 72% . 26%
8	H	93	 88% . 9%
8	S	93	 88% . 9%
9	I	69	 77% . 22%
9	T	69	 77% . 22%
10	J	82	 88% . 9%
10	U	82	 83% 9% 9%

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
17	HEC	D	401	X	-	-	-
17	HEC	O	401	X	-	-	-

2 Entry composition

There are 18 unique types of molecules in this entry. The entry contains 32914 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.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	C	383	Total	C	N	O	S	1	0
			3055	2066	474	497	18		
1	N	383	Total	C	N	O	S	0	0
			3052	2064	474	496	18		

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

Mol	Chain	Residues	Atoms					AltConf	Trace
2	P	63	Total	C	N	O	S	0	0
			478	305	78	91	4		
2	E	63	Total	C	N	O	S	1	0
			481	307	78	92	4		

- Molecule 3 is a protein called Cytochrome b-c1 complex subunit 7.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	G	124	Total	C	N	O	S	0	0
			994	640	162	190	2		
3	R	124	Total	C	N	O	S	0	0
			994	640	162	190	2		

- Molecule 4 is a protein called YALI0F24673p.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	F	71	Total	C	N	O	S	0	0
			579	361	99	115	4		
4	Q	71	Total	C	N	O	S	0	0
			579	361	99	115	4		

- Molecule 5 is a protein called YALI0A14806p.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	A	438	Total	C	N	O	S	0	0
			3446	2154	603	682	7		
5	L	438	Total	C	N	O	S	0	0
			3446	2154	603	682	7		

- Molecule 6 is a protein called Cytochrome b-c1 complex subunit 2, mitochondrial.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	B	402	Total	C	N	O	S	0	0
			3008	1907	516	583	2		
6	M	402	Total	C	N	O	S	0	0
			3008	1907	516	583	2		

- Molecule 7 is a protein called YALI0A17468p.

Mol	Chain	Residues	Atoms					AltConf	Trace
7	D	244	Total	C	N	O	S	0	0
			1893	1210	323	352	8		
7	O	244	Total	C	N	O	S	0	0
			1893	1210	323	352	8		

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

Mol	Chain	Residues	Atoms					AltConf	Trace
8	H	85	Total	C	N	O	S	0	0
			690	459	118	111	2		
8	S	85	Total	C	N	O	S	0	0
			690	459	118	111	2		

- Molecule 9 is a protein called Complex III subunit 9.

Mol	Chain	Residues	Atoms					AltConf	Trace
9	I	54	Total	C	N	O	S	0	0
			452	297	76	78	1		
9	T	54	Total	C	N	O	S	0	0
			452	297	76	78	1		

- Molecule 10 is a protein called YALI0C12210p.

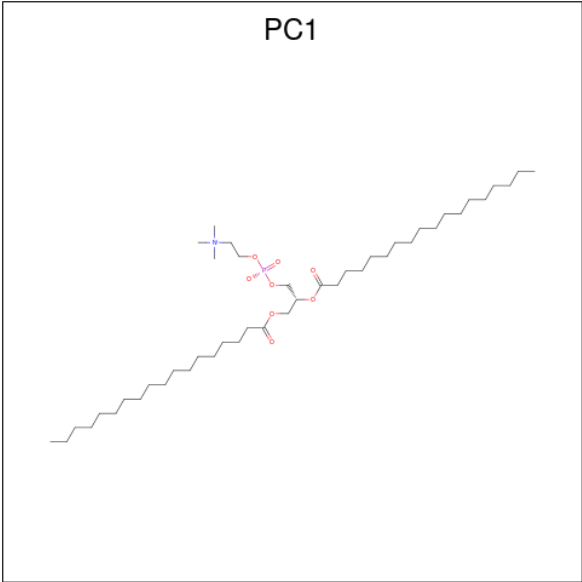
Mol	Chain	Residues	Atoms				AltConf	Trace
10	J	75	Total	C	N	O	0	0
			598	403	99	96		

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Mol	Chain	Residues	Atoms				AltConf	Trace
10	U	75	Total	C	N	O	0	0
			598	403	99	96		

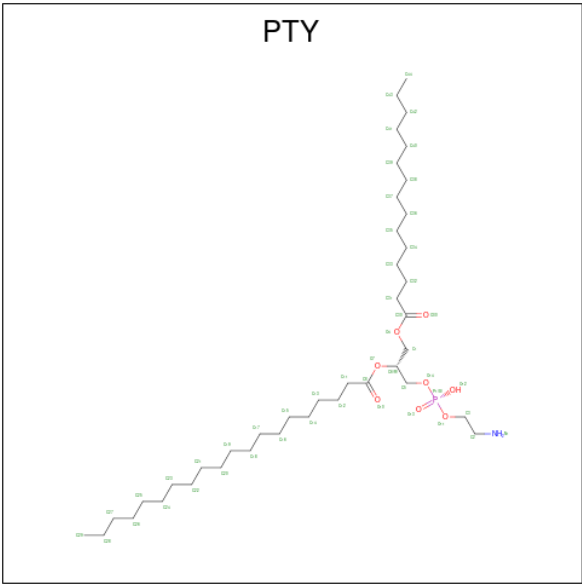
- # HEM

- Molecule 12 is 1,2-DIACYL-SN-GLYCERO-3-PHOSPHOCHOLINE (CCD ID: PC1) (formula: $C_{44}H_{88}NO_8P$).



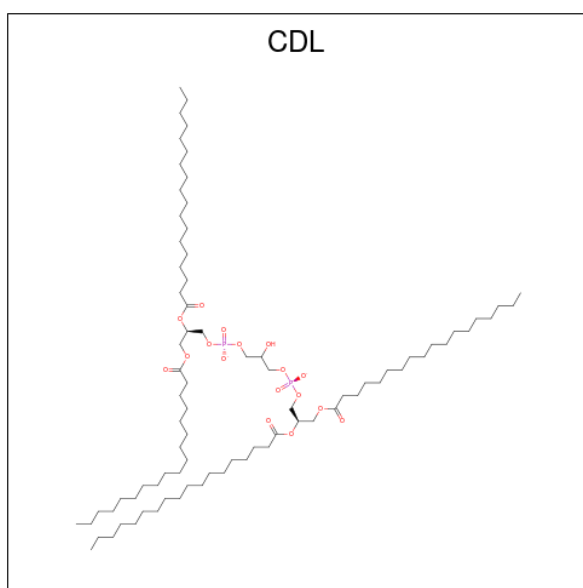
Mol	Chain	Residues	Atoms					AltConf
12	C	1	Total	C	N	O	P	0
			38	28	1	8	1	
12	I	1	Total	C	N	O	P	0
			32	22	1	8	1	
12	N	1	Total	C	N	O	P	0
			38	28	1	8	1	
12	T	1	Total	C	N	O	P	0
			32	22	1	8	1	

- Molecule 13 is PHOSPHATIDYLETHANOLAMINE (CCD ID: PTY) (formula: C₄₀H₈₀NO₈P).



Mol	Chain	Residues	Atoms					AltConf
13	C	1	Total	C	N	O	P	0
			41	31	1	8	1	
13	P	1	Total	C	N	O	P	0
			41	31	1	8	1	
13	N	1	Total	C	N	O	P	0
			41	31	1	8	1	
13	E	1	Total	C	N	O	P	0
			41	31	1	8	1	

- Molecule 14 is CARDIOLIPIN (CCD ID: CDL) (formula: $C_{81}H_{156}O_{17}P_2$).



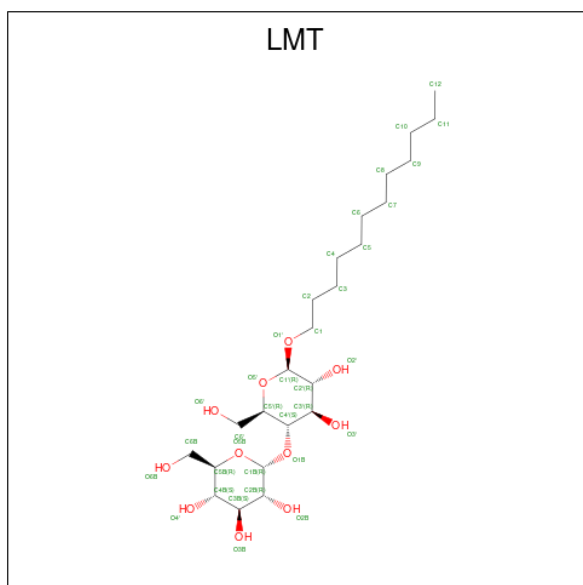
Mol	Chain	Residues	Atoms				AltConf
14	C	1	Total	C	O	P	0
			48	29	17	2	
14	A	1	Total	C	O	P	0
			42	25	15	2	
14	A	1	Total	C	O	P	0
			47	30	15	2	
14	H	1	Total	C	O	P	0
			50	31	17	2	
14	H	1	Total	C	O	P	0
			39	20	17	2	
14	N	1	Total	C	O	P	0
			48	29	17	2	
14	L	1	Total	C	O	P	0
			42	25	15	2	
14	L	1	Total	C	O	P	0
			47	30	15	2	

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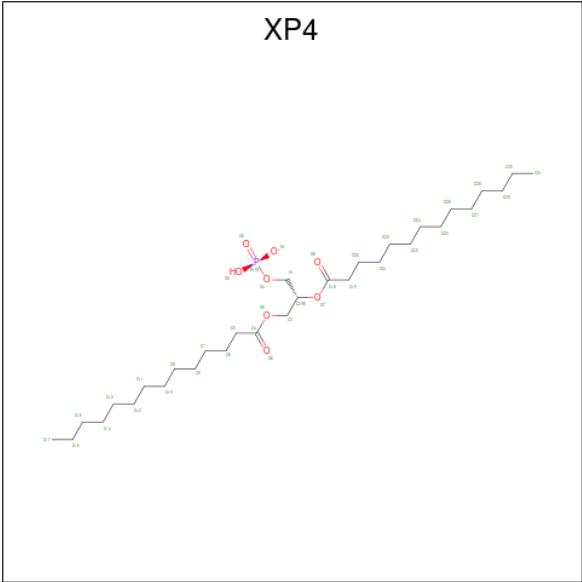
Mol	Chain	Residues	Atoms				AltConf
14	S	1	Total	C	O	P	0
			50	31	17	2	
14	S	1	Total	C	O	P	0
			39	20	17	2	

- Molecule 15 is DODECYL-BETA-D-MALTOSE (CCD ID: LMT) (formula: $C_{24}H_{46}O_{11}$).



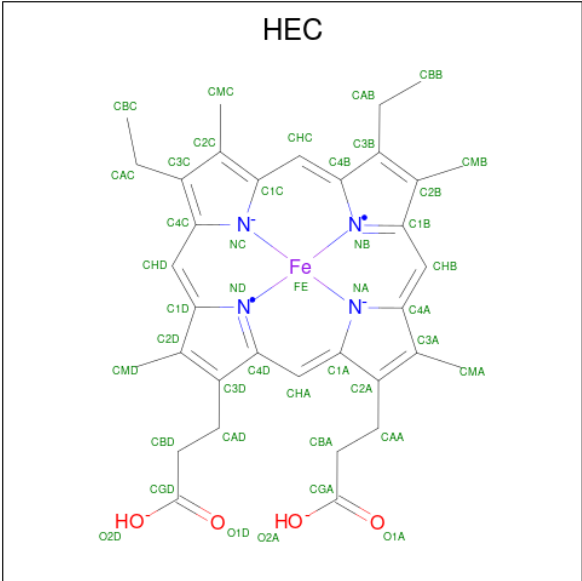
Mol	Chain	Residues	Atoms				AltConf
15	C	1	Total	C	O		0
			35	24	11		
15	P	1	Total	C	O		0
			35	24	11		
15	J	1	Total	C	O		0
			35	24	11		
15	N	1	Total	C	O		0
			35	24	11		

- Molecule 16 is 1,2-DIMYRISTOYL-SN-GLYCERO-3-PHOSPHATE (CCD ID: XP4) (formula: $C_{31}H_{60}O_8P$).



Mol	Chain	Residues	Atoms				AltConf
16	A	1	Total	C	O	P	0
			24	15	8	1	
16	L	1	Total	C	O	P	0
			24	15	8	1	

- Molecule 17 is HEME C (CCD ID: HEC) (formula: $C_{34}H_{36}FeN_4O_4$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					AltConf
17	D	1	Total	C	Fe	N	O	0
			43	34	1	4	4	

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Mol	Chain	Residues	Atoms					AltConf
17	O	1	Total	C	Fe	N	O	0
			43	34	1	4	4	

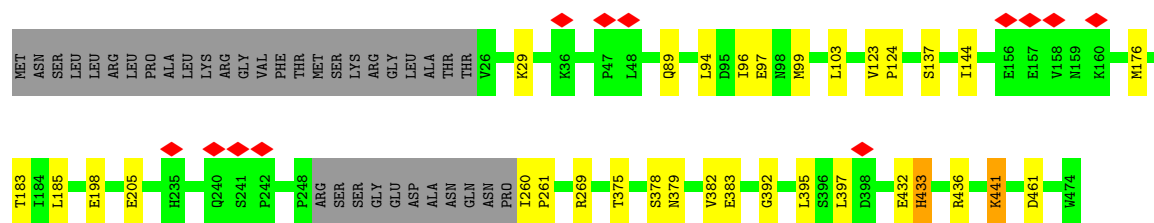
- Molecule 18 is water.

Mol	Chain	Residues	Atoms		AltConf
18	C	143	Total	O	0
			143	143	
18	P	31	Total	O	0
			31	31	
18	G	81	Total	O	0
			81	81	
18	F	3	Total	O	0
			3	3	
18	A	165	Total	O	0
			165	165	
18	B	56	Total	O	0
			56	56	
18	D	124	Total	O	0
			124	124	
18	H	46	Total	O	0
			46	46	
18	I	17	Total	O	0
			17	17	
18	J	6	Total	O	0
			6	6	
18	N	138	Total	O	0
			138	138	
18	E	37	Total	O	0
			37	37	
18	R	72	Total	O	0
			72	72	
18	Q	2	Total	O	0
			2	2	
18	L	157	Total	O	0
			157	157	
18	M	56	Total	O	0
			56	56	
18	O	122	Total	O	0
			122	122	
18	S	46	Total	O	0
			46	46	

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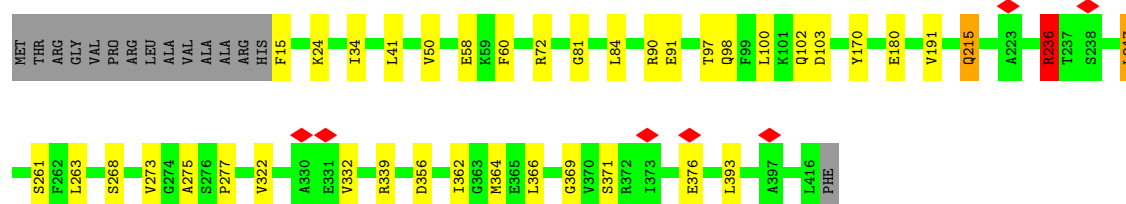
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Mol	Chain	Residues	Atoms		AltConf
18	T	16	Total 16	O 16	0
18	U	8	Total 8	O 8	0



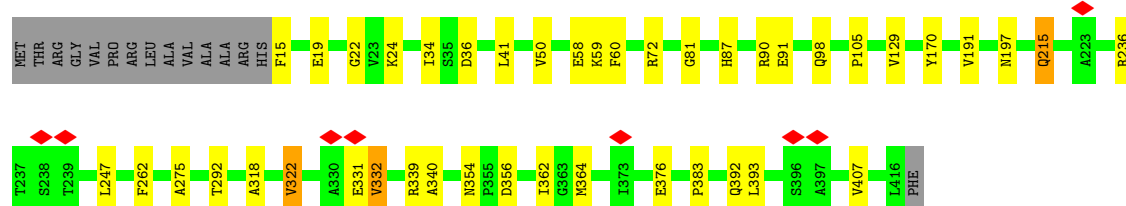
- Molecule 6: Cytochrome b-c1 complex subunit 2, mitochondrial

Chain B: 87% 9%



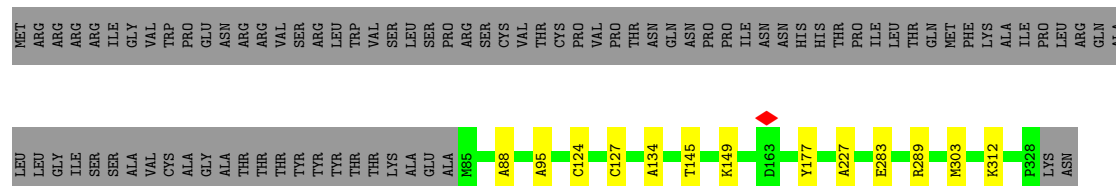
- Molecule 6: Cytochrome b-c1 complex subunit 2, mitochondrial

Chain M: 86% 10%



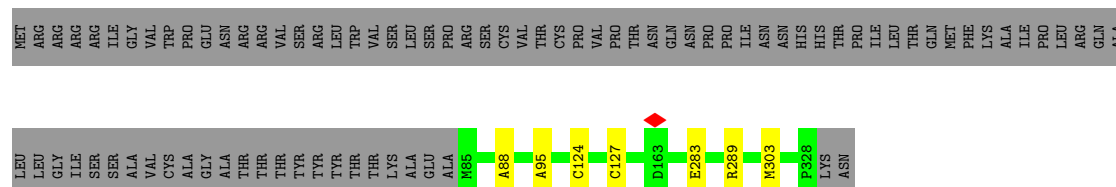
- Molecule 7: YALI0A17468p

Chain D: 70% 26%



- Molecule 7: YALI0A17468p

Chain O: 72% 26%



- Molecule 8: Cytochrome b-c1 complex subunit 8

Chain H:  88% 9%



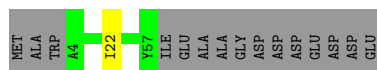
- Molecule 8: Cytochrome b-c1 complex subunit 8

Chain S:  88% 9%



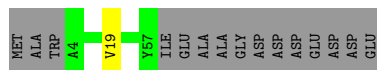
- Molecule 9: Complex III subunit 9

Chain I:  77% 22%



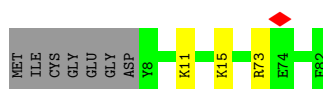
- Molecule 9: Complex III subunit 9

Chain T:  77% 22%



- Molecule 10: YALI0C12210p

Chain J:  88% 9%



- Molecule 10: YALI0C12210p

Chain U:  83% 9% 9%



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C2	Depositor
Number of particles used	1419666	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	55	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	Not provided	
Image detector	GATAN K3 BIOQUANTUM (6k x 4k)	Depositor
Maximum map value	0.487	Depositor
Minimum map value	-0.188	Depositor
Average map value	0.000	Depositor
Map value standard deviation	0.009	Depositor
Recommended contour level	0.029	Depositor
Map size (Å)	301.32, 301.32, 301.32	wwPDB
Map dimensions	360, 360, 360	wwPDB
Map angles (°)	90.0, 90.0, 90.0	wwPDB
Pixel spacing (Å)	0.837, 0.837, 0.837	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: HEM, PTY, XP4, HEC, LMT, PC1, CDL

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# $ Z > 5$	RMSZ	# $ Z > 5$
1	C	0.54	0/3159	0.95	2/4313 (0.0%)
1	N	0.54	0/3153	0.95	2/4305 (0.0%)
2	E	0.54	0/493	1.05	2/662 (0.3%)
2	P	0.53	0/487	1.00	1/654 (0.2%)
3	G	0.53	0/1012	0.97	1/1373 (0.1%)
3	R	0.53	0/1012	0.98	2/1373 (0.1%)
4	F	0.58	0/595	1.12	1/805 (0.1%)
4	Q	0.54	0/595	1.17	3/805 (0.4%)
5	A	0.58	3/3510 (0.1%)	1.08	7/4768 (0.1%)
5	L	0.55	1/3510 (0.0%)	1.08	8/4768 (0.2%)
6	B	0.54	0/3069	1.06	5/4178 (0.1%)
6	M	0.55	0/3069	1.08	5/4178 (0.1%)
7	D	0.53	0/1950	1.05	3/2656 (0.1%)
7	O	0.54	0/1950	1.05	5/2656 (0.2%)
8	H	0.52	0/717	0.99	1/975 (0.1%)
8	S	0.50	0/717	0.97	1/975 (0.1%)
9	I	0.45	0/465	0.99	0/629
9	T	0.46	0/465	1.00	0/629
10	J	0.52	0/620	1.03	0/846
10	U	0.53	0/620	1.04	0/846
All	All	0.54	4/31168 (0.0%)	1.03	49/42394 (0.1%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	433	HIS	CB-CG	-9.23	1.37	1.50
5	A	433	HIS	CA-CB	-6.48	1.43	1.53
5	A	433	HIS	CG-CD2	-5.92	1.29	1.35
5	L	433	HIS	CB-CG	-5.41	1.42	1.50

The worst 5 of 49 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	433	HIS	N-CA-CB	-16.11	85.31	110.44
5	L	433	HIS	CB-CA-C	-11.62	91.10	110.85
7	D	283	GLU	CB-CA-C	-9.63	97.11	111.27
7	D	289	ARG	CG-CD-NE	-9.11	91.97	112.00
7	O	283	GLU	CB-CA-C	-9.10	97.90	111.27

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	3055	0	3118	14	0
1	N	3052	0	3113	12	0
2	E	481	0	478	2	0
2	P	478	0	473	13	0
3	G	994	0	1022	3	0
3	R	994	0	1022	3	0
4	F	579	0	511	6	0
4	Q	579	0	511	3	0
5	A	3446	0	3369	18	0
5	L	3446	0	3369	15	0
6	B	3008	0	2991	22	0
6	M	3008	0	2991	30	0
7	D	1893	0	1834	16	0
7	O	1893	0	1834	11	0
8	H	690	0	673	2	0
8	S	690	0	673	2	0
9	I	452	0	435	1	0
9	T	452	0	435	1	0
10	J	598	0	615	0	0
10	U	598	0	615	4	0
11	C	86	0	60	7	0
11	N	86	0	60	4	0
12	C	38	0	50	2	0
12	I	32	0	38	2	0
12	N	38	0	50	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
12	T	32	0	38	3	0
13	C	41	0	58	4	0
13	E	41	0	58	3	0
13	N	41	0	58	9	0
13	P	41	0	58	14	0
14	A	89	0	85	3	0
14	C	48	0	40	1	0
14	H	89	0	66	5	0
14	L	89	0	85	0	0
14	N	48	0	40	1	0
14	S	89	0	66	5	0
15	C	35	0	46	1	0
15	J	35	0	46	1	0
15	N	35	0	46	1	0
15	P	35	0	46	0	0
16	A	24	0	22	0	0
16	L	24	0	22	0	0
17	D	43	0	32	10	0
17	O	43	0	32	8	0
18	A	165	0	0	1	0
18	B	56	0	0	0	0
18	C	143	0	0	2	0
18	D	124	0	0	0	0
18	E	37	0	0	0	0
18	F	3	0	0	0	0
18	G	81	0	0	0	0
18	H	46	0	0	0	0
18	I	17	0	0	0	0
18	J	6	0	0	0	0
18	L	157	0	0	1	0
18	M	56	0	0	0	0
18	N	138	0	0	0	0
18	O	122	0	0	0	0
18	P	31	0	0	1	0
18	Q	2	0	0	0	0
18	R	72	0	0	0	0
18	S	46	0	0	0	0
18	T	16	0	0	0	0
18	U	8	0	0	0	0
All	All	32914	0	31284	188	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 3.

The worst 5 of 188 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)
7:O:124:CYS:SG	17:O:401:HEC:HBB3	1.61	1.41
7:D:124:CYS:SG	17:D:401:HEC:HBB3	1.61	1.38
2:P:84:VAL:CG2	13:P:302:PTY:H441	1.69	1.22
7:D:124:CYS:SG	17:D:401:HEC:CBB	2.33	1.16
7:O:124:CYS:SG	17:O:401:HEC:CBB	2.32	1.16

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	382/385 (99%)	375 (98%)	7 (2%)	0	100	100
1	N	381/385 (99%)	374 (98%)	7 (2%)	0	100	100
2	E	62/225 (28%)	61 (98%)	1 (2%)	0	100	100
2	P	61/225 (27%)	59 (97%)	2 (3%)	0	100	100
3	G	122/128 (95%)	122 (100%)	0	0	100	100
3	R	122/128 (95%)	122 (100%)	0	0	100	100
4	F	69/137 (50%)	67 (97%)	2 (3%)	0	100	100
4	Q	69/137 (50%)	67 (97%)	2 (3%)	0	100	100
5	A	434/474 (92%)	424 (98%)	10 (2%)	0	100	100
5	L	434/474 (92%)	422 (97%)	12 (3%)	0	100	100
6	B	400/417 (96%)	383 (96%)	16 (4%)	1 (0%)	36	35
6	M	400/417 (96%)	386 (96%)	14 (4%)	0	100	100
7	D	242/330 (73%)	238 (98%)	4 (2%)	0	100	100
7	O	242/330 (73%)	238 (98%)	4 (2%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
8	H	83/93 (89%)	82 (99%)	1 (1%)	0	100	100
8	S	83/93 (89%)	82 (99%)	1 (1%)	0	100	100
9	I	52/69 (75%)	51 (98%)	1 (2%)	0	100	100
9	T	52/69 (75%)	51 (98%)	1 (2%)	0	100	100
10	J	73/82 (89%)	71 (97%)	2 (3%)	0	100	100
10	U	73/82 (89%)	71 (97%)	2 (3%)	0	100	100
All	All	3836/4680 (82%)	3746 (98%)	89 (2%)	1 (0%)	100	100

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
6	B	369	GLY

5.3.2 Protein sidechains ⓘ

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	C	332/333 (100%)	330 (99%)	2 (1%)	78	85
1	N	331/333 (99%)	329 (99%)	2 (1%)	78	85
2	E	51/182 (28%)	48 (94%)	3 (6%)	18	14
2	P	50/182 (28%)	49 (98%)	1 (2%)	48	54
3	G	113/117 (97%)	110 (97%)	3 (3%)	39	42
3	R	113/117 (97%)	111 (98%)	2 (2%)	51	58
4	F	61/123 (50%)	60 (98%)	1 (2%)	55	62
4	Q	61/123 (50%)	61 (100%)	0	100	100
5	A	377/407 (93%)	370 (98%)	7 (2%)	50	56
5	L	377/407 (93%)	367 (97%)	10 (3%)	39	42
6	B	311/322 (97%)	296 (95%)	15 (5%)	23	21
6	M	311/322 (97%)	301 (97%)	10 (3%)	34	35

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
7	D	192/268 (72%)	192 (100%)	0	100	100
7	O	192/268 (72%)	192 (100%)	0	100	100
8	H	67/71 (94%)	67 (100%)	0	100	100
8	S	67/71 (94%)	67 (100%)	0	100	100
9	I	46/57 (81%)	46 (100%)	0	100	100
9	T	46/57 (81%)	46 (100%)	0	100	100
10	J	63/68 (93%)	60 (95%)	3 (5%)	23	21
10	U	63/68 (93%)	62 (98%)	1 (2%)	55	62
All	All	3224/3896 (83%)	3164 (98%)	60 (2%)	49	56

5 of 60 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
6	B	376	GLU
6	M	322	VAL
2	E	55	ASP
6	M	292	THR
10	U	73	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 43 such sidechains are listed below:

Mol	Chain	Res	Type
4	Q	109	GLN
6	M	354	ASN
4	Q	132	HIS
6	M	122	GLN
7	O	90	HIS

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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

30 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$
14	CDL	N	505	-	47,47,99	0.40	0	53,59,111	0.72	1 (1%)
15	LMT	C	506	-	36,36,36	0.41	0	47,47,47	1.10	3 (6%)
13	PTY	P	302	-	40,40,49	0.38	0	43,45,54	0.57	0
14	CDL	S	701	-	49,49,99	0.35	0	55,61,111	0.63	0
12	PC1	I	201	-	31,31,53	0.38	0	37,39,61	0.64	0
13	PTY	E	301	-	40,40,49	0.39	0	43,45,54	0.43	0
12	PC1	C	503	-	37,37,53	0.60	0	43,45,61	1.01	4 (9%)
11	HEM	N	501	1	50,50,50	1.61	8 (16%)	66,82,82	1.85	19 (28%)
14	CDL	H	701	-	49,49,99	0.35	0	55,61,111	0.58	0
14	CDL	A	3002	-	46,46,99	0.36	0	51,56,111	0.85	3 (5%)
14	CDL	C	505	-	47,47,99	0.40	0	53,59,111	0.73	1 (1%)
11	HEM	C	502	1	50,50,50	1.62	7 (14%)	66,82,82	1.94	17 (25%)
14	CDL	S	702	-	38,38,99	0.38	0	44,50,111	0.97	2 (4%)
14	CDL	L	3001	-	41,41,99	0.38	0	45,51,111	0.80	2 (4%)
15	LMT	P	301	-	36,36,36	0.42	0	47,47,47	0.85	2 (4%)
12	PC1	N	503	-	37,37,53	0.60	0	43,45,61	0.91	3 (6%)
11	HEM	N	502	1	50,50,50	1.63	9 (18%)	66,82,82	2.01	19 (28%)
17	HEC	D	401	7	50,50,50	2.67	26 (52%)	68,82,82	2.83	35 (51%)
12	PC1	T	201	-	31,31,53	0.36	0	37,39,61	0.52	0
13	PTY	C	504	-	40,40,49	0.32	0	43,45,54	0.76	1 (2%)
14	CDL	A	3001	-	41,41,99	0.41	0	45,51,111	0.63	1 (2%)
15	LMT	N	506	-	36,36,36	0.40	0	47,47,47	1.04	3 (6%)
14	CDL	H	702	-	38,38,99	0.37	0	44,50,111	0.97	2 (4%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
16	XP4	A	3003	-	23,23,39	1.33	2 (8%)	27,28,44	1.83	8 (29%)
11	HEM	C	501	1	50,50,50	1.60	8 (16%)	66,82,82	1.87	18 (27%)
16	XP4	L	3003	-	23,23,39	1.34	2 (8%)	27,28,44	1.75	7 (25%)
15	LMT	J	101	-	36,36,36	0.43	0	47,47,47	1.27	4 (8%)
17	HEC	O	401	7	50,50,50	2.67	26 (52%)	68,82,82	2.83	35 (51%)
14	CDL	L	3002	-	46,46,99	0.34	0	51,56,111	0.83	3 (5%)
13	PTY	N	504	-	40,40,49	0.31	0	43,45,54	0.63	1 (2%)

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
14	CDL	N	505	-	-	30/57/57/110	-
15	LMT	C	506	-	-	16/21/61/61	0/2/2/2
13	PTY	P	302	-	-	25/44/44/53	-
14	CDL	S	701	-	-	29/59/59/110	-
12	PC1	I	201	-	-	15/35/35/57	-
13	PTY	E	301	-	-	27/44/44/53	-
12	PC1	C	503	-	-	11/41/41/57	-
11	HEM	N	501	1	-	4/14/54/54	-
14	CDL	H	701	-	-	28/59/59/110	-
14	CDL	A	3002	-	-	27/54/54/110	-
14	CDL	C	505	-	-	29/57/57/110	-
11	HEM	C	502	1	-	4/14/54/54	-
14	CDL	S	702	-	-	27/48/48/110	-
14	CDL	L	3001	-	-	20/48/48/110	-
15	LMT	P	301	-	-	6/21/61/61	0/2/2/2
17	HEC	D	401	7	1/1/3/7	8/14/54/54	-
11	HEM	N	502	1	-	4/14/54/54	-
12	PC1	N	503	-	-	11/41/41/57	-
12	PC1	T	201	-	-	10/35/35/57	-
13	PTY	C	504	-	-	32/44/44/53	-
14	CDL	A	3001	-	-	14/48/48/110	-
15	LMT	N	506	-	-	12/21/61/61	0/2/2/2

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
14	CDL	H	702	-	-	27/48/48/110	-
16	XP4	A	3003	-	-	0/24/24/41	-
11	HEM	C	501	1	-	4/14/54/54	-
16	XP4	L	3003	-	-	0/24/24/41	-
15	LMT	J	101	-	-	10/21/61/61	0/2/2/2
17	HEC	O	401	7	1/1/3/7	8/14/54/54	-
14	CDL	L	3002	-	-	26/54/54/110	-
13	PTY	N	504	-	-	29/44/44/53	-

The worst 5 of 88 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
17	O	401	HEC	C4B-NB	-5.85	1.30	1.40
17	D	401	HEC	C4B-NB	-5.83	1.30	1.40
11	C	502	HEM	FE-NB	5.60	2.12	1.94
11	N	501	HEM	FE-NB	5.53	2.12	1.94
11	C	501	HEM	FE-NB	5.48	2.11	1.94

The worst 5 of 194 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
17	O	401	HEC	C1B-C2B-C3B	-9.23	97.25	106.96
17	D	401	HEC	C1B-C2B-C3B	-9.13	97.35	106.96
17	D	401	HEC	C2B-C1B-NB	6.60	117.79	109.88
17	O	401	HEC	C2B-C1B-NB	6.57	117.75	109.88
17	O	401	HEC	CAA-CBA-CGA	-6.26	100.13	113.60

All (2) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
17	D	401	HEC	NA
17	O	401	HEC	NA

5 of 493 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
12	I	201	PC1	C11-O13-P-O12
12	I	201	PC1	C11-O13-P-O14
12	I	201	PC1	C11-O13-P-O11
12	T	201	PC1	C11-O13-P-O12

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Mol	Chain	Res	Type	Atoms
12	T	201	PC1	C11-O13-P-O14

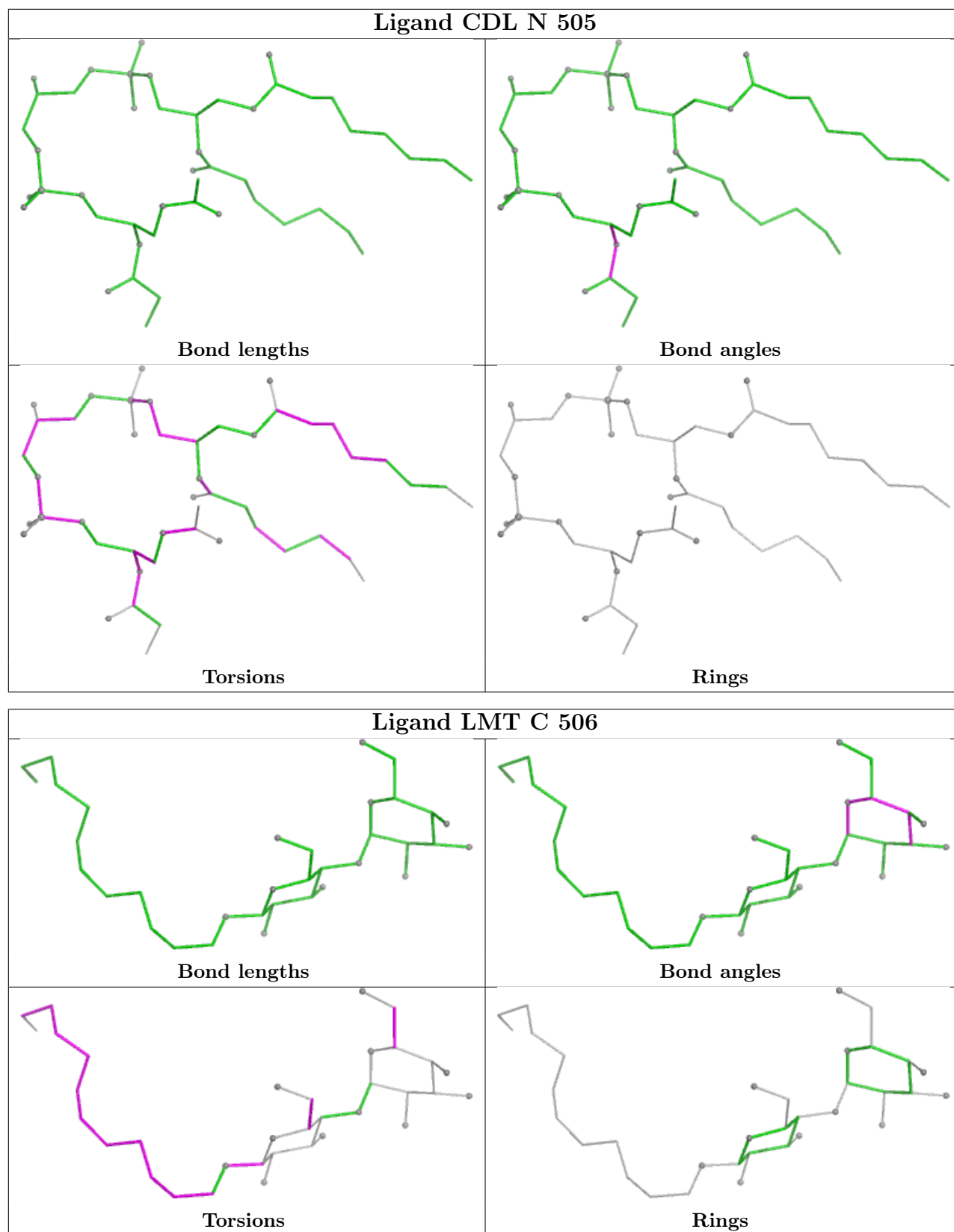
There are no ring outliers.

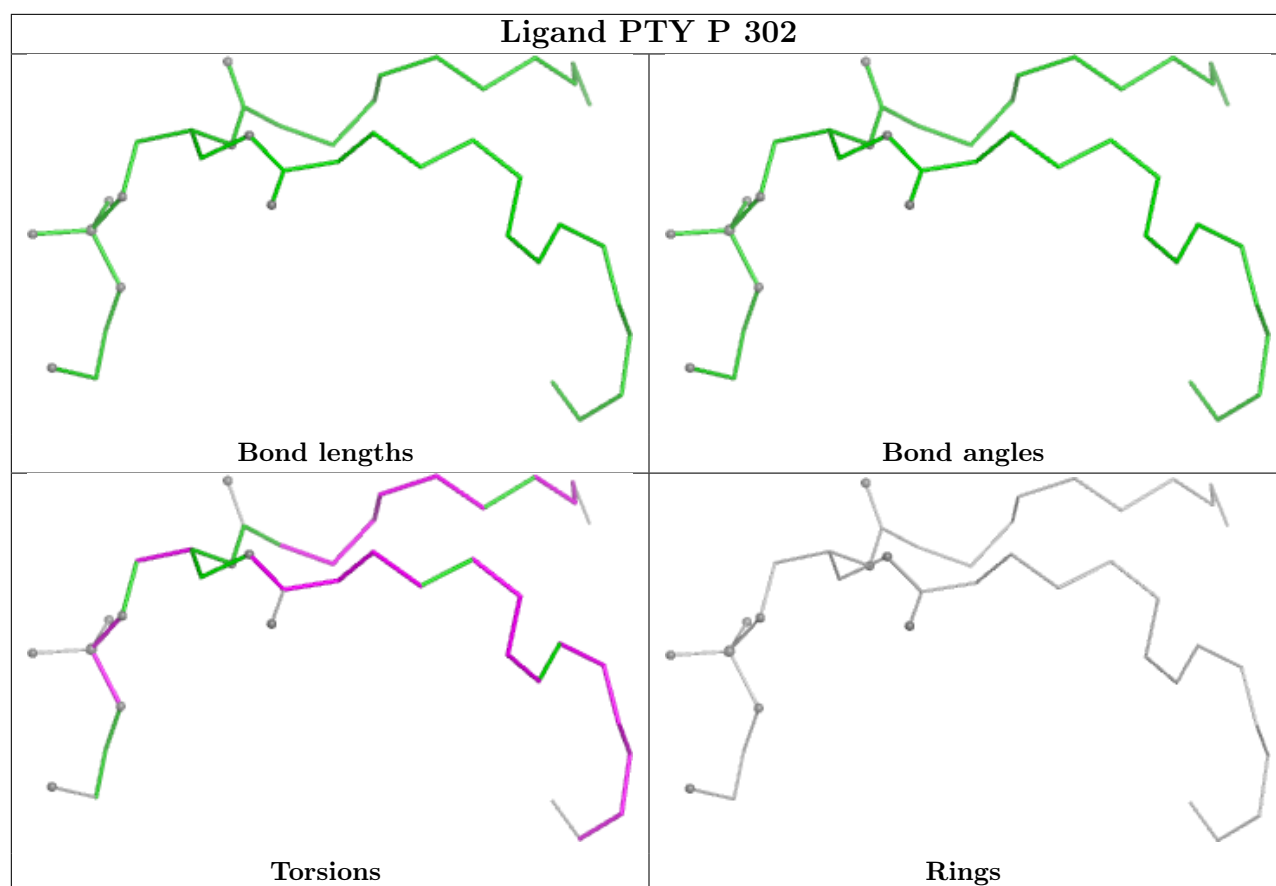
24 monomers are involved in 83 short contacts:

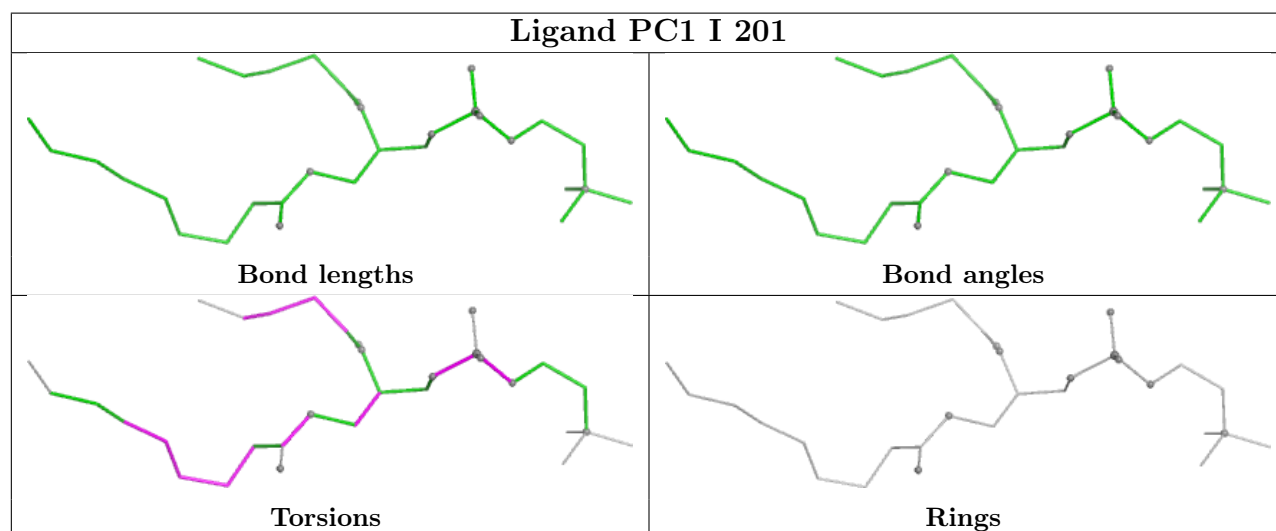
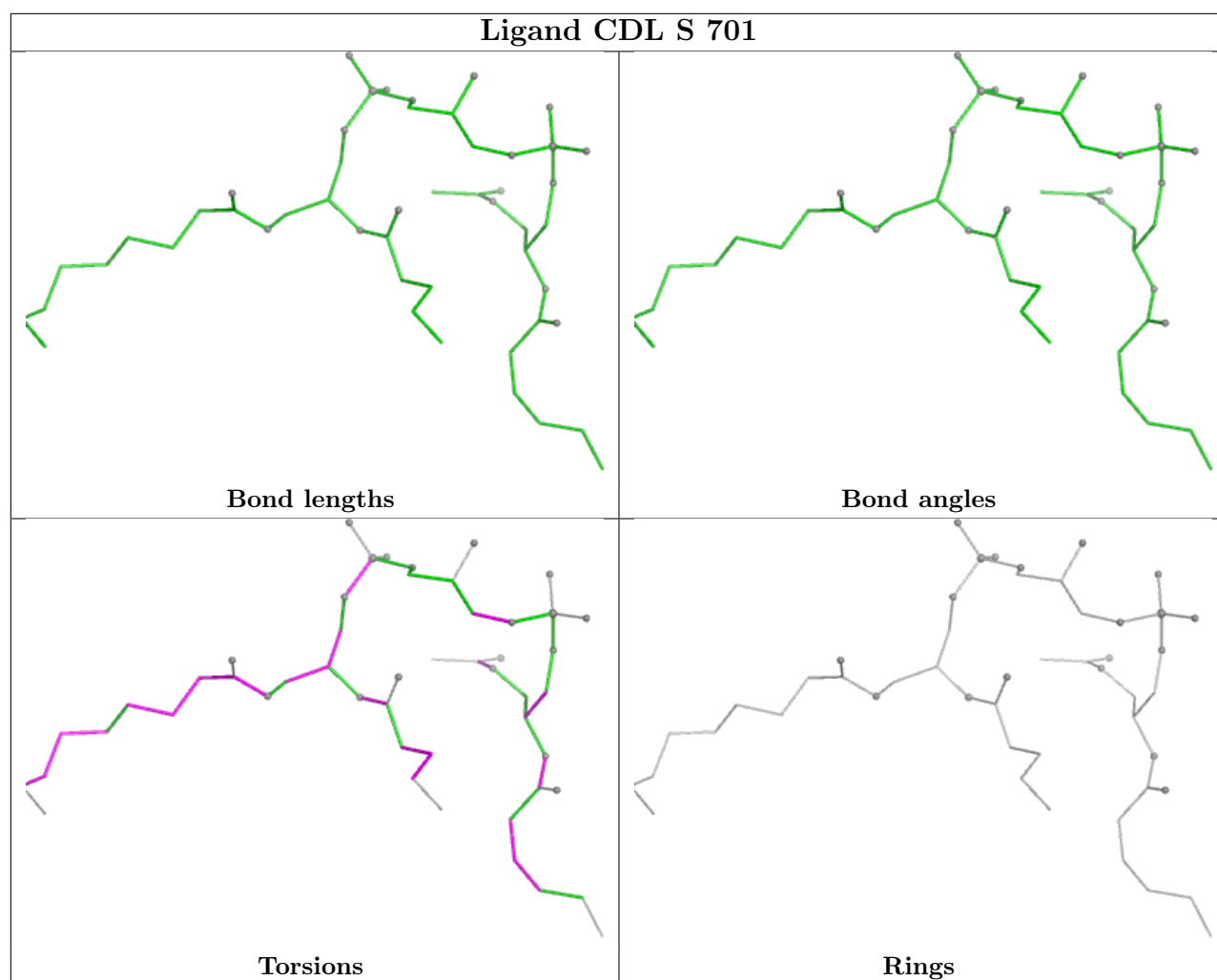
Mol	Chain	Res	Type	Clashes	Symm-Clashes
14	N	505	CDL	1	0
15	C	506	LMT	1	0
13	P	302	PTY	14	0
14	S	701	CDL	2	0
12	I	201	PC1	2	0
13	E	301	PTY	3	0
12	C	503	PC1	2	0
11	N	501	HEM	4	0
14	H	701	CDL	1	0
14	A	3002	CDL	2	0
14	C	505	CDL	1	0
11	C	502	HEM	2	0
14	S	702	CDL	4	0
12	N	503	PC1	1	0
17	D	401	HEC	10	0
12	T	201	PC1	3	0
13	C	504	PTY	4	0
14	A	3001	CDL	2	0
15	N	506	LMT	1	0
14	H	702	CDL	5	0
11	C	501	HEM	5	0
15	J	101	LMT	1	0
17	O	401	HEC	8	0
13	N	504	PTY	9	0

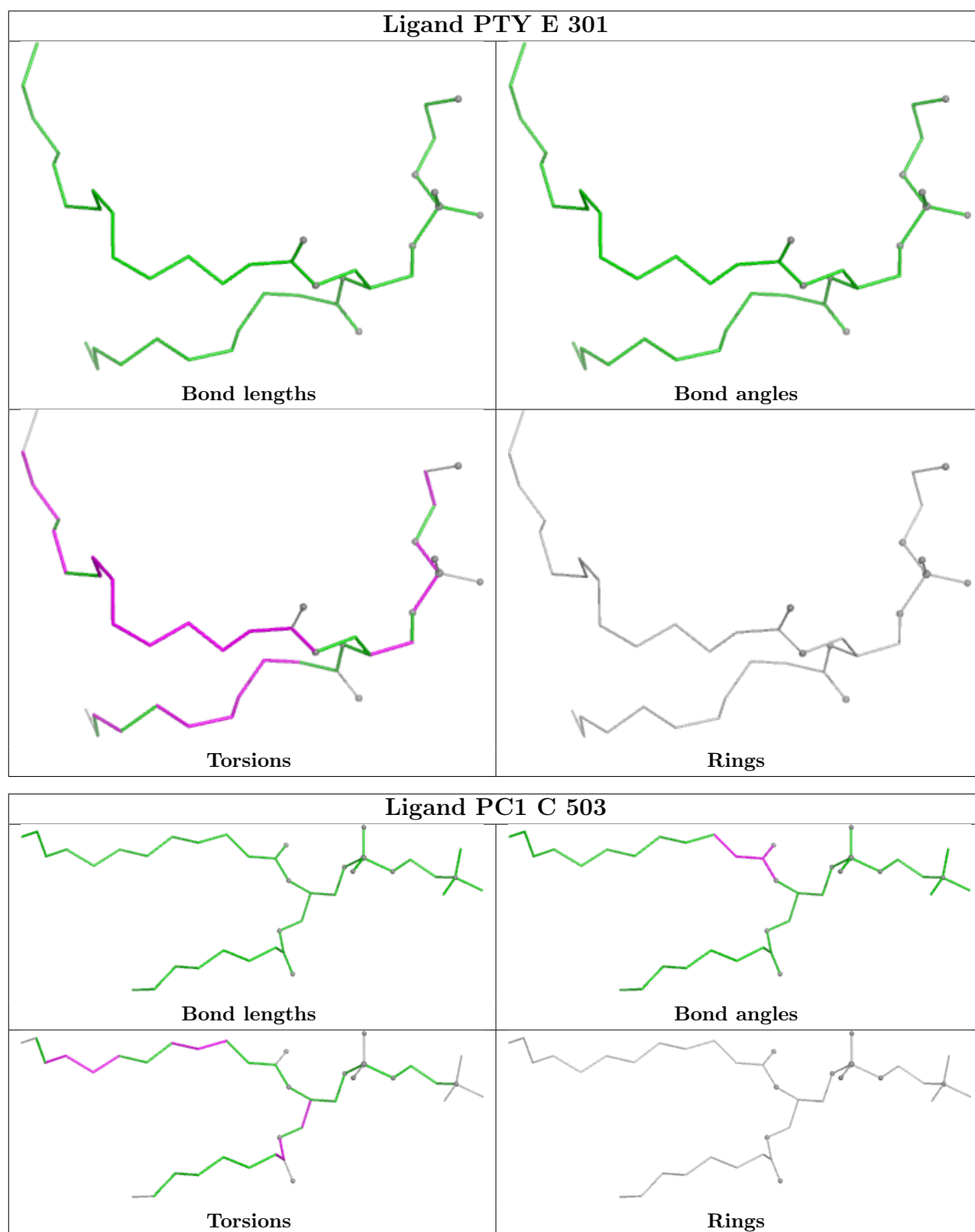
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

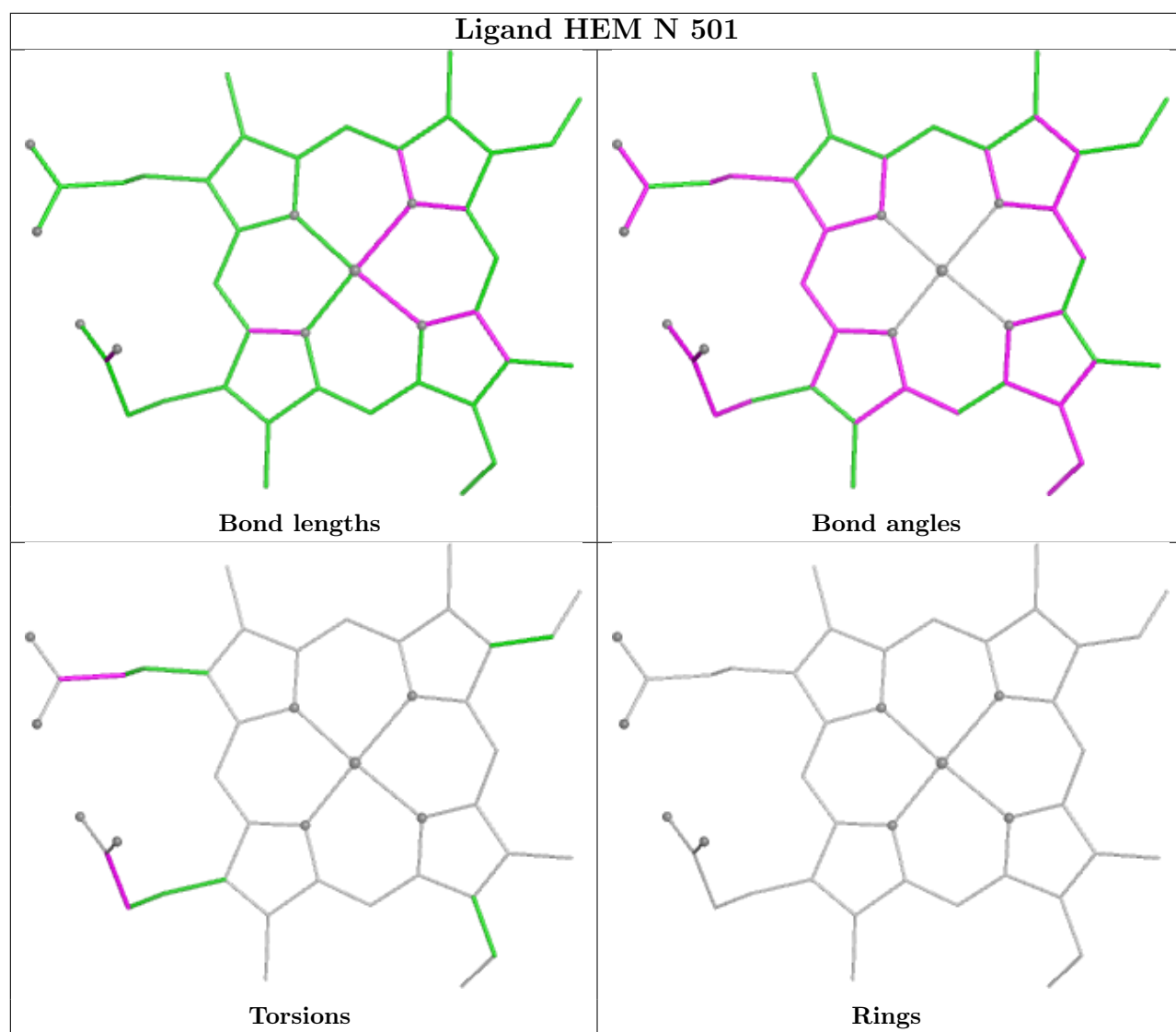
equivalents in the CSD to analyse the geometry.

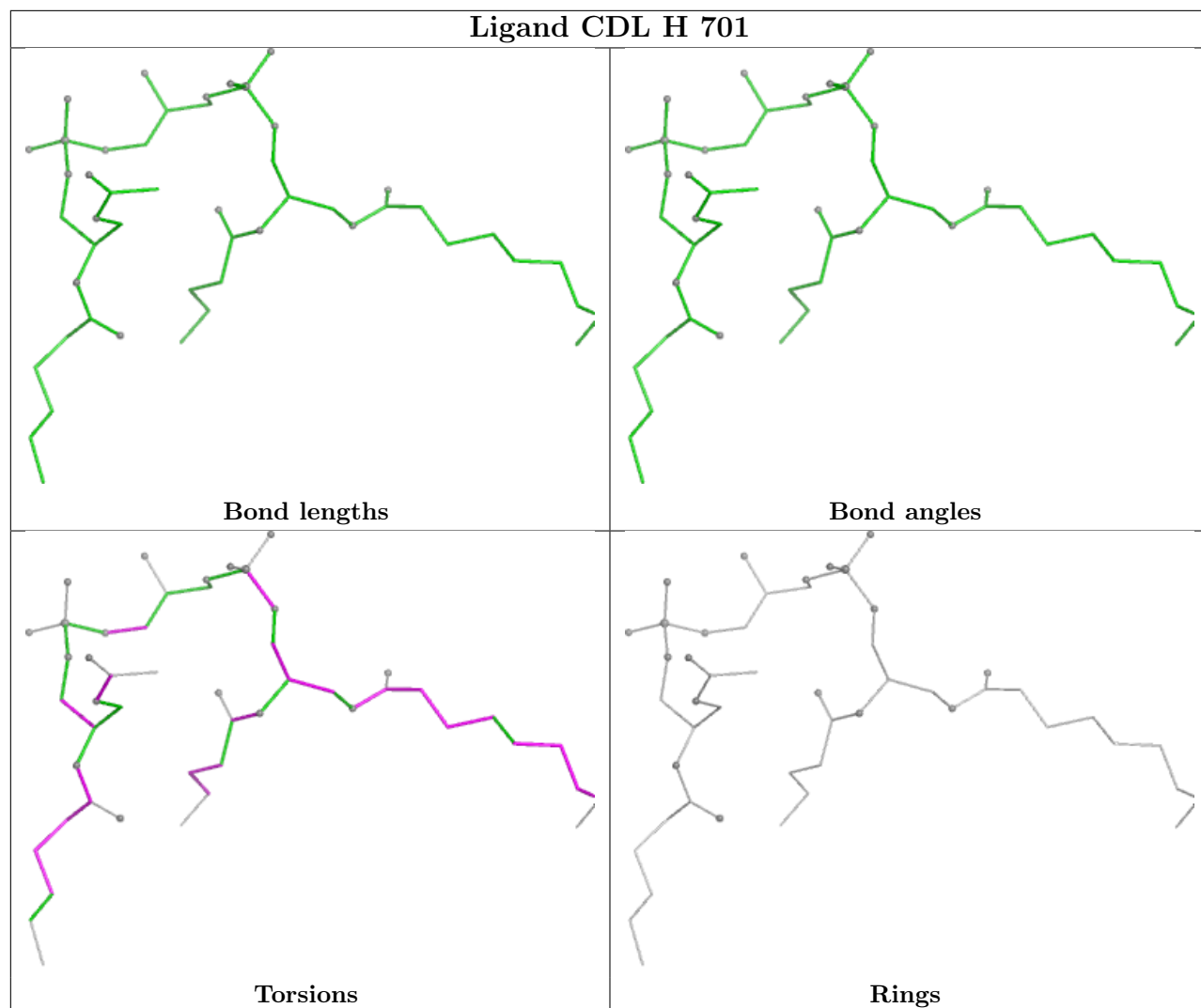


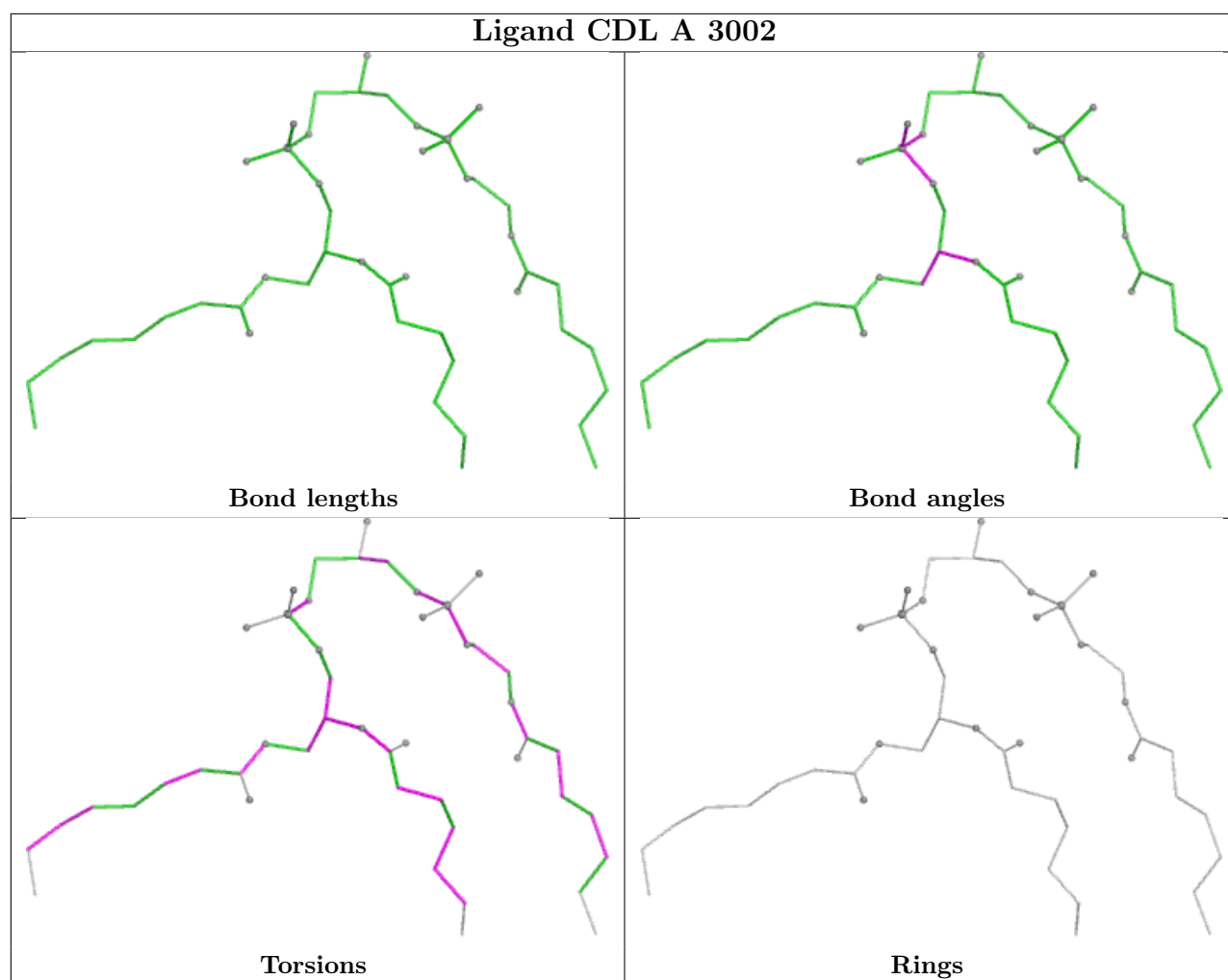


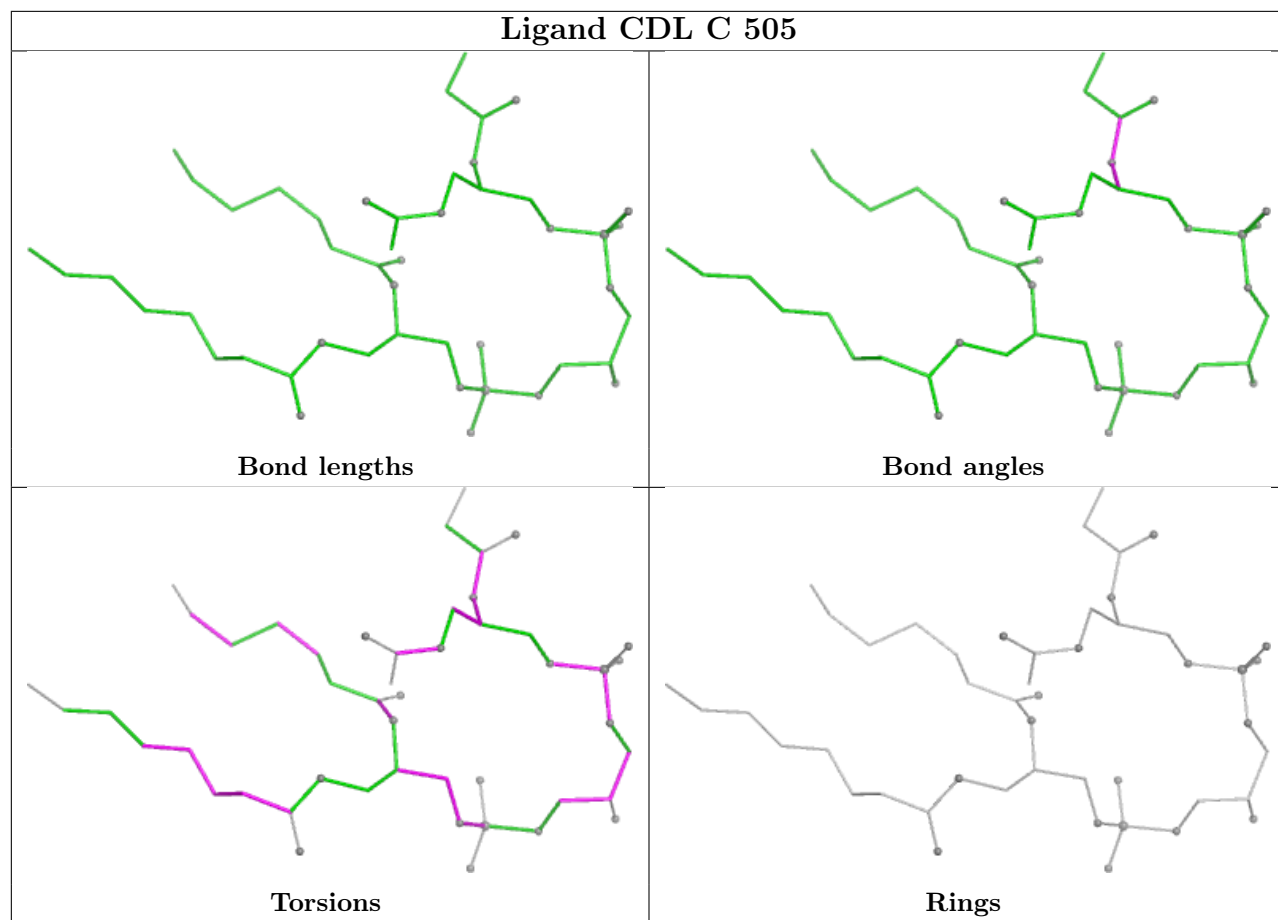


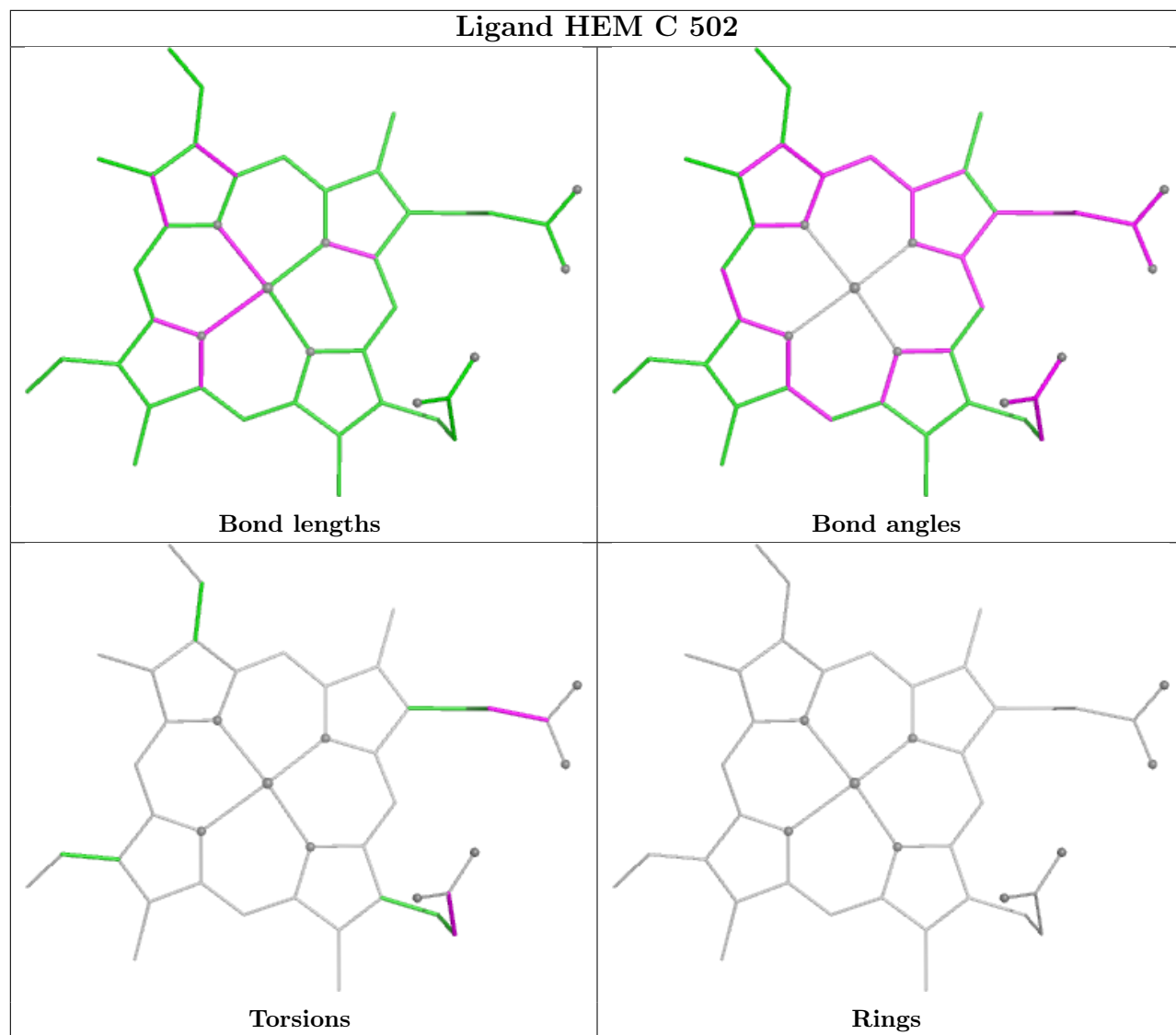


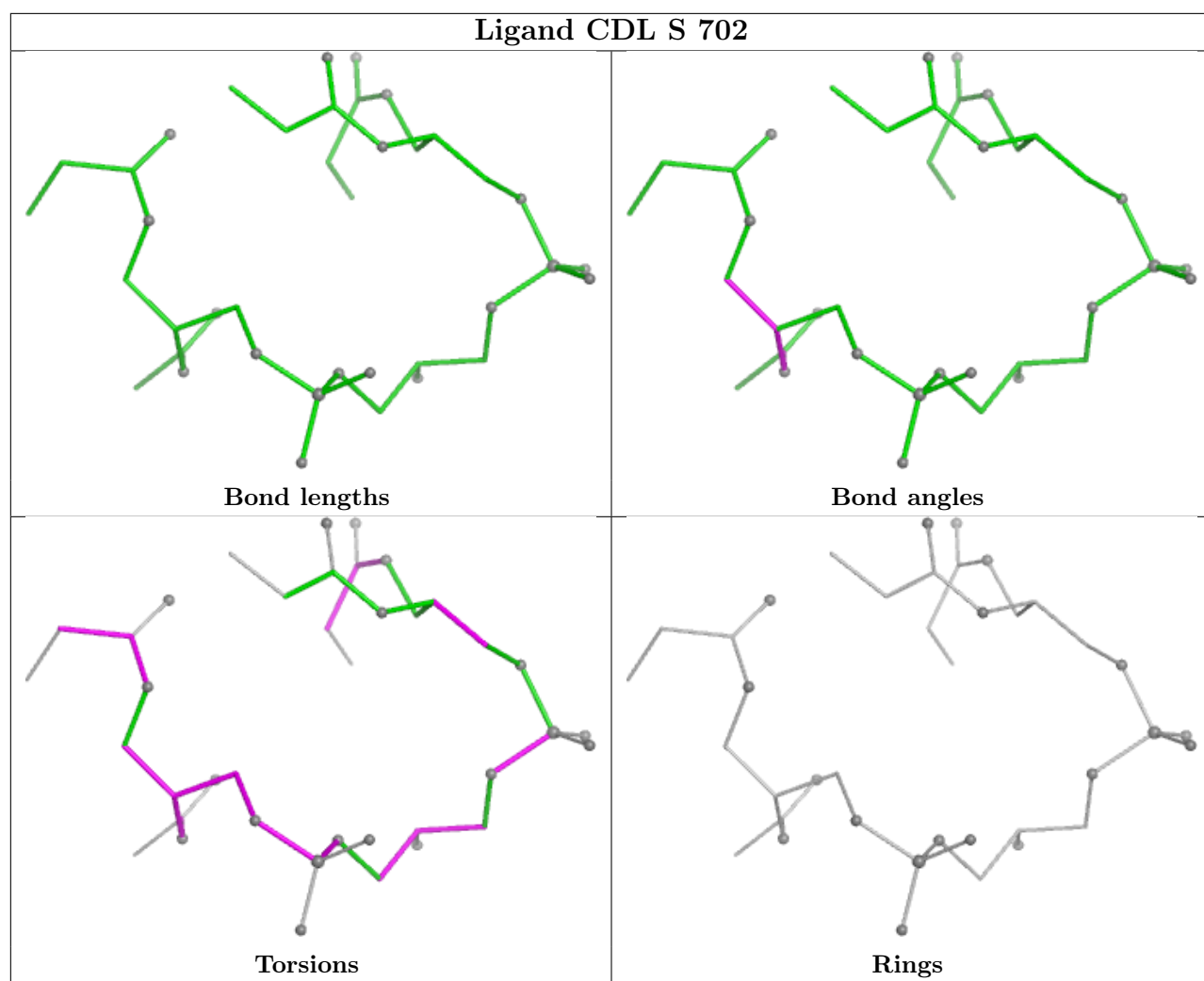


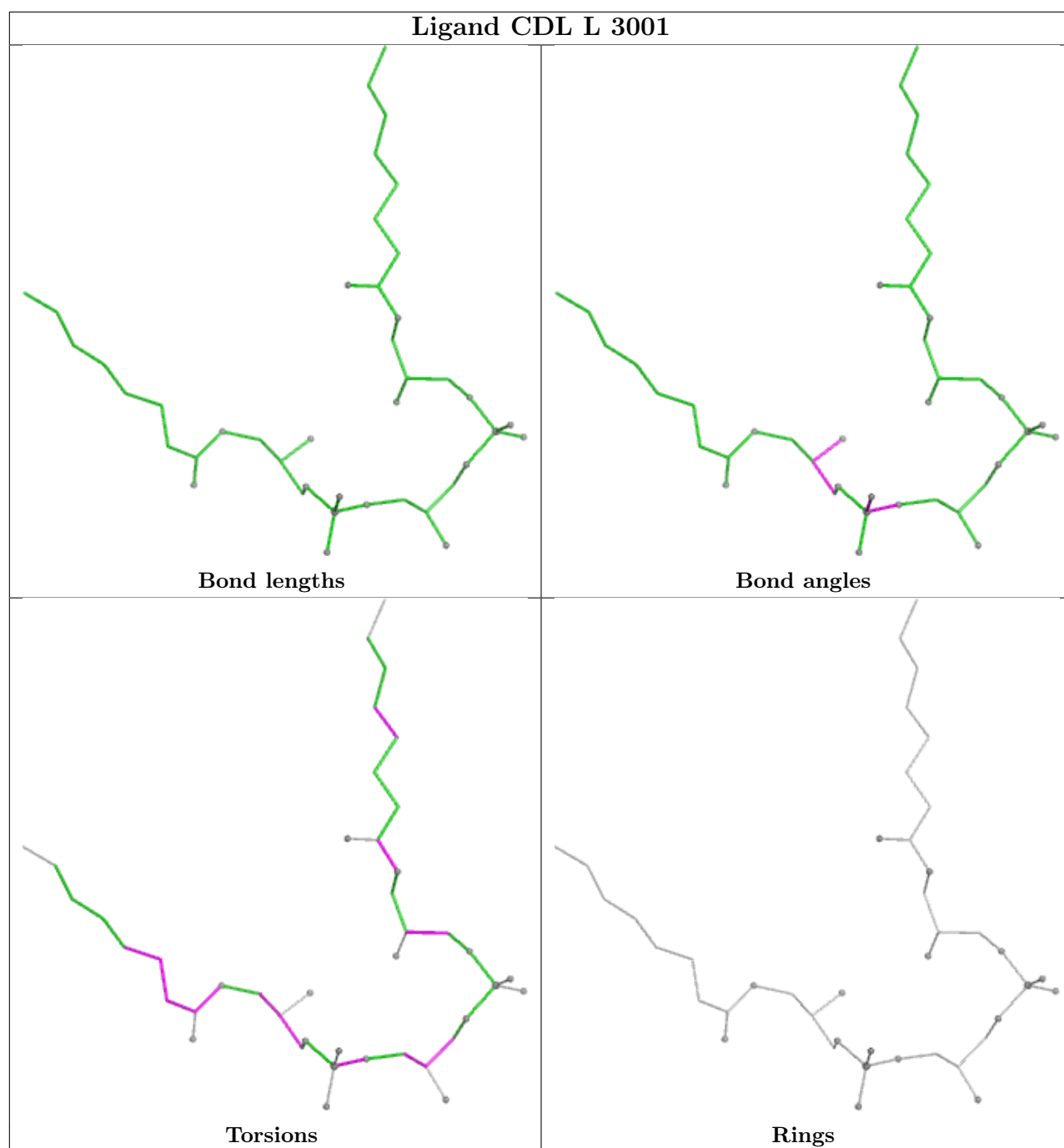


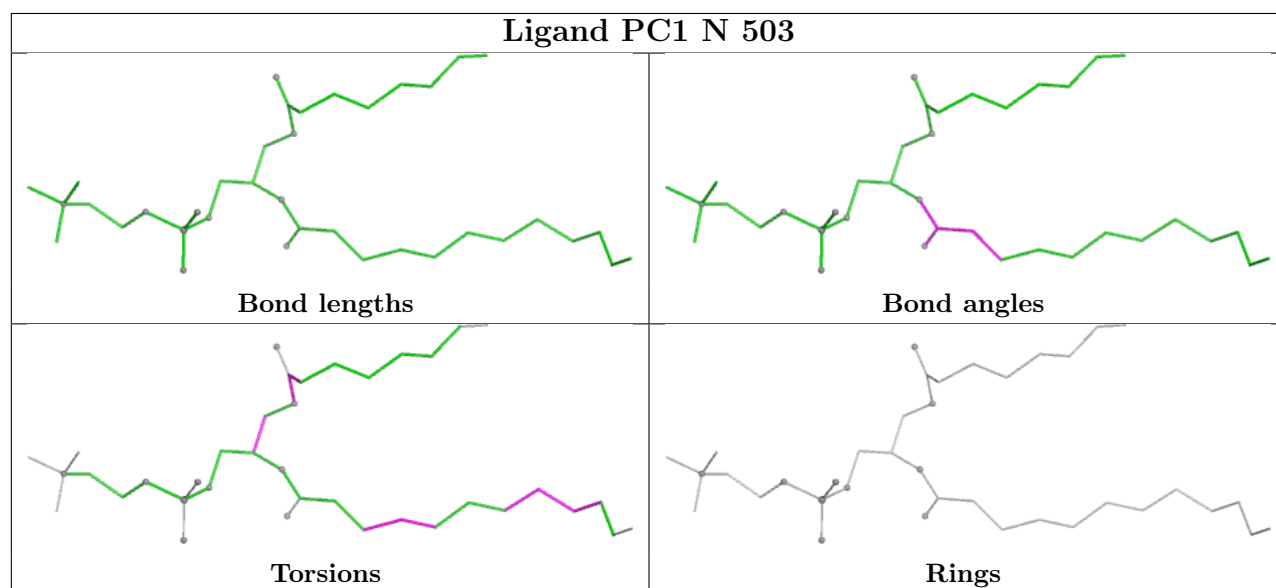
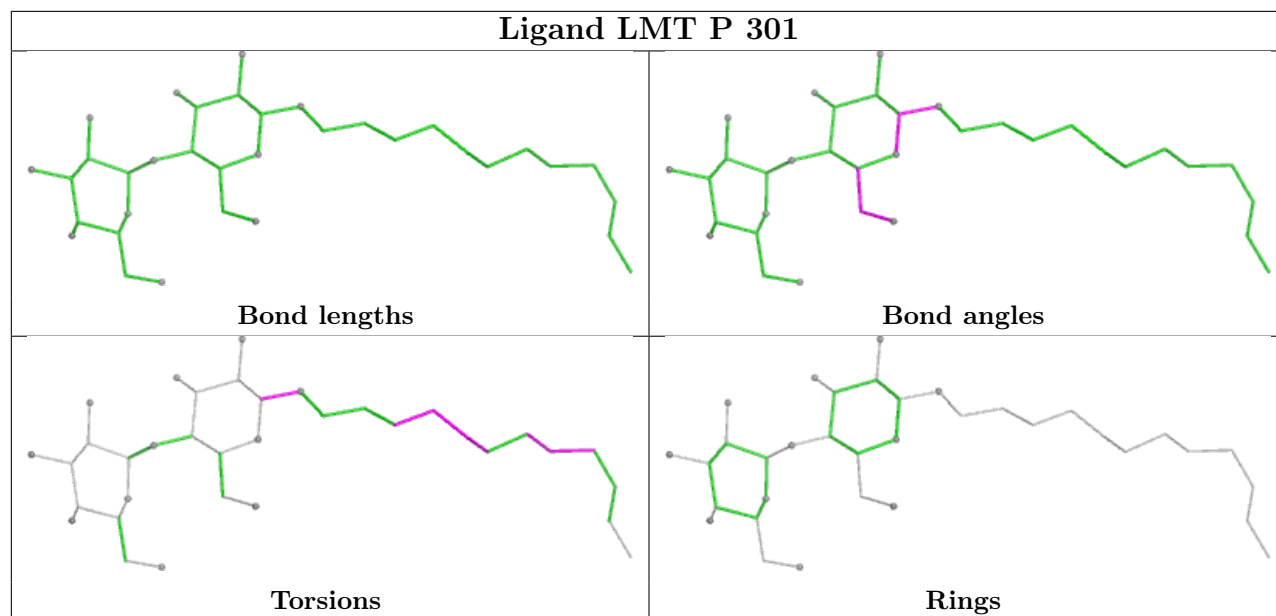


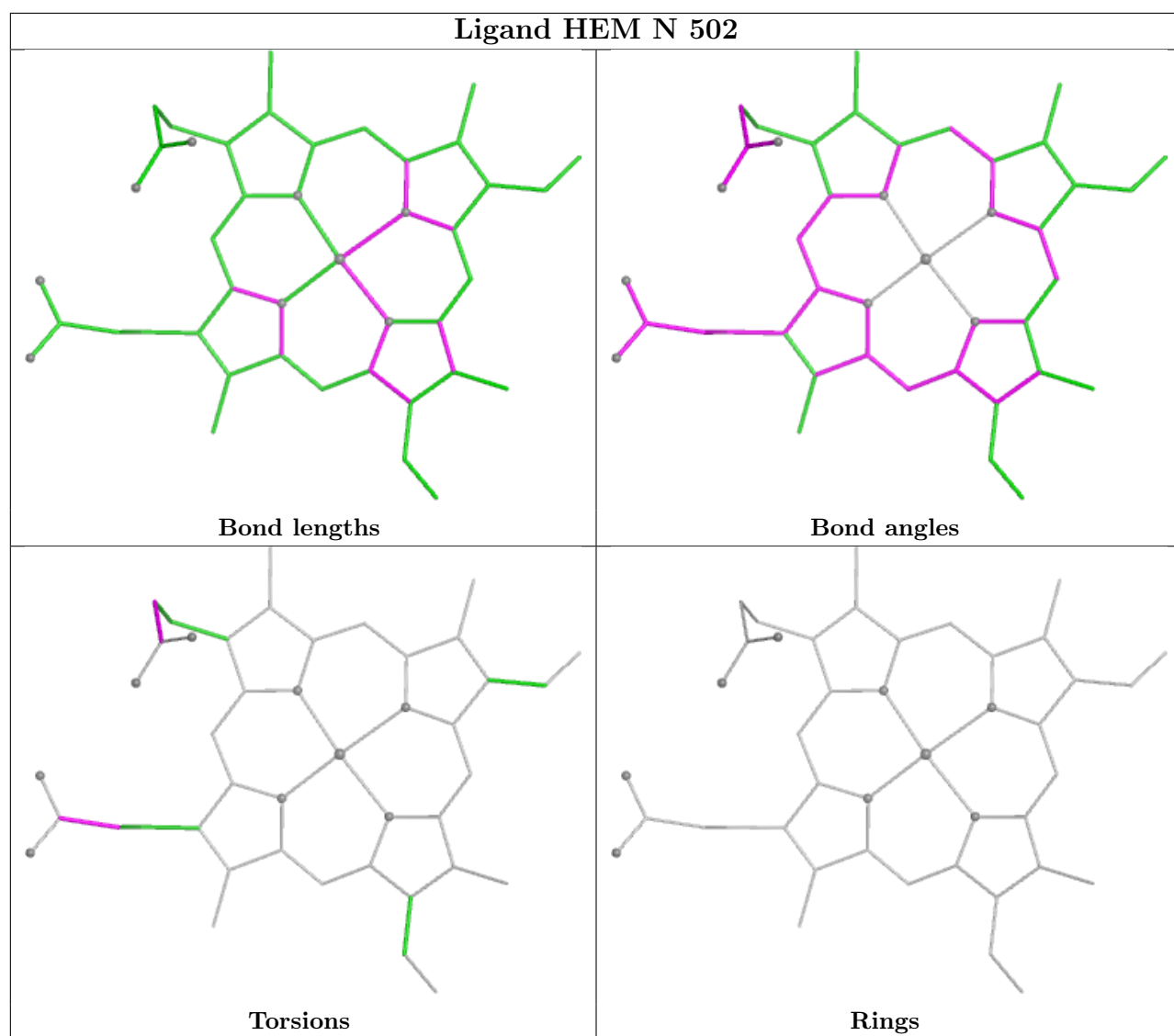


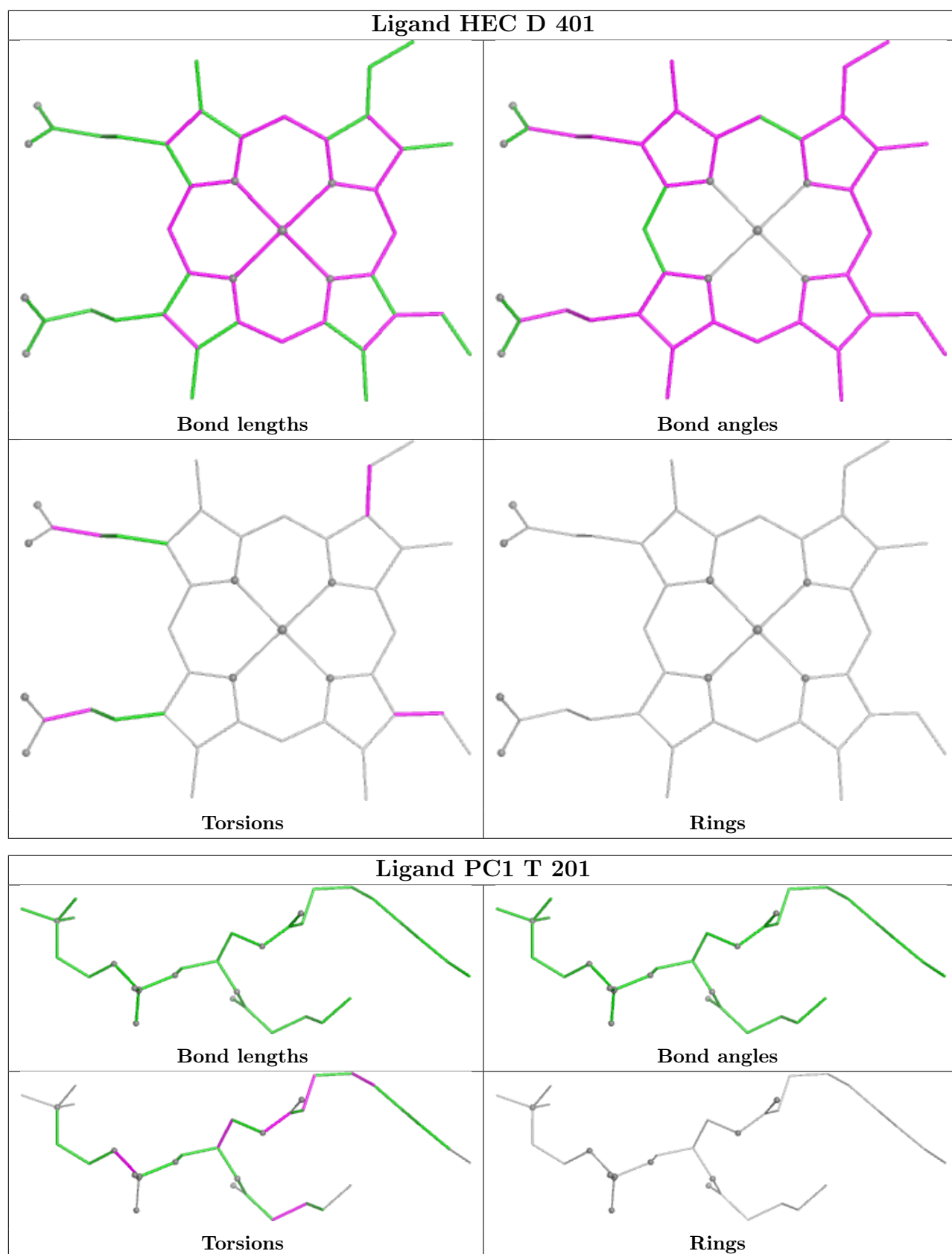


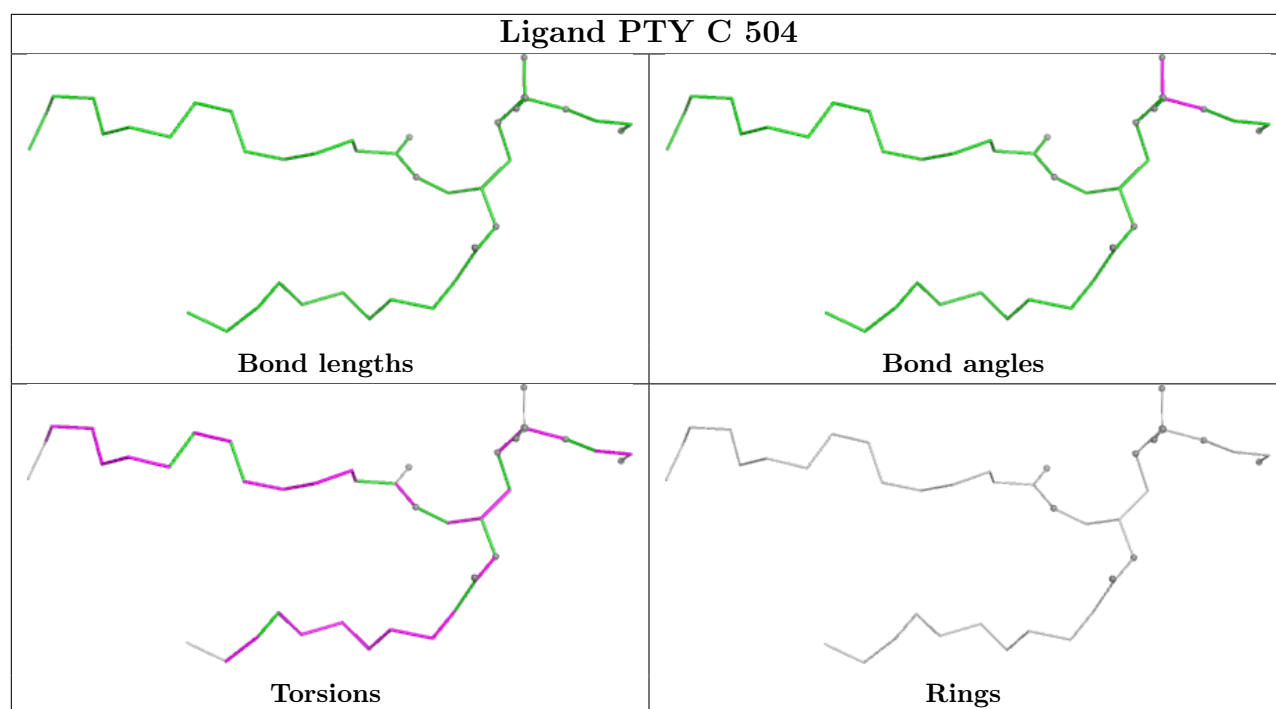


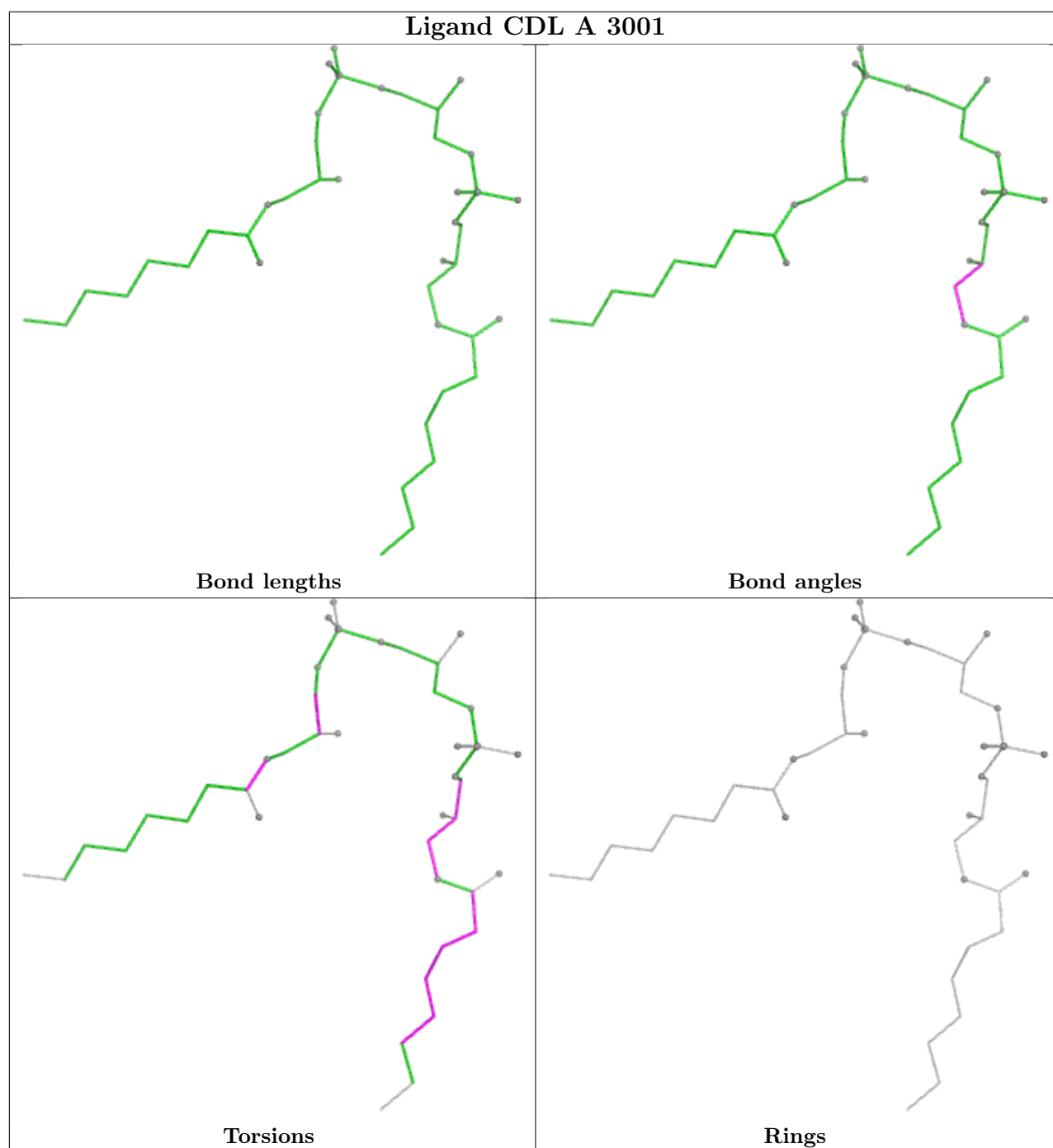


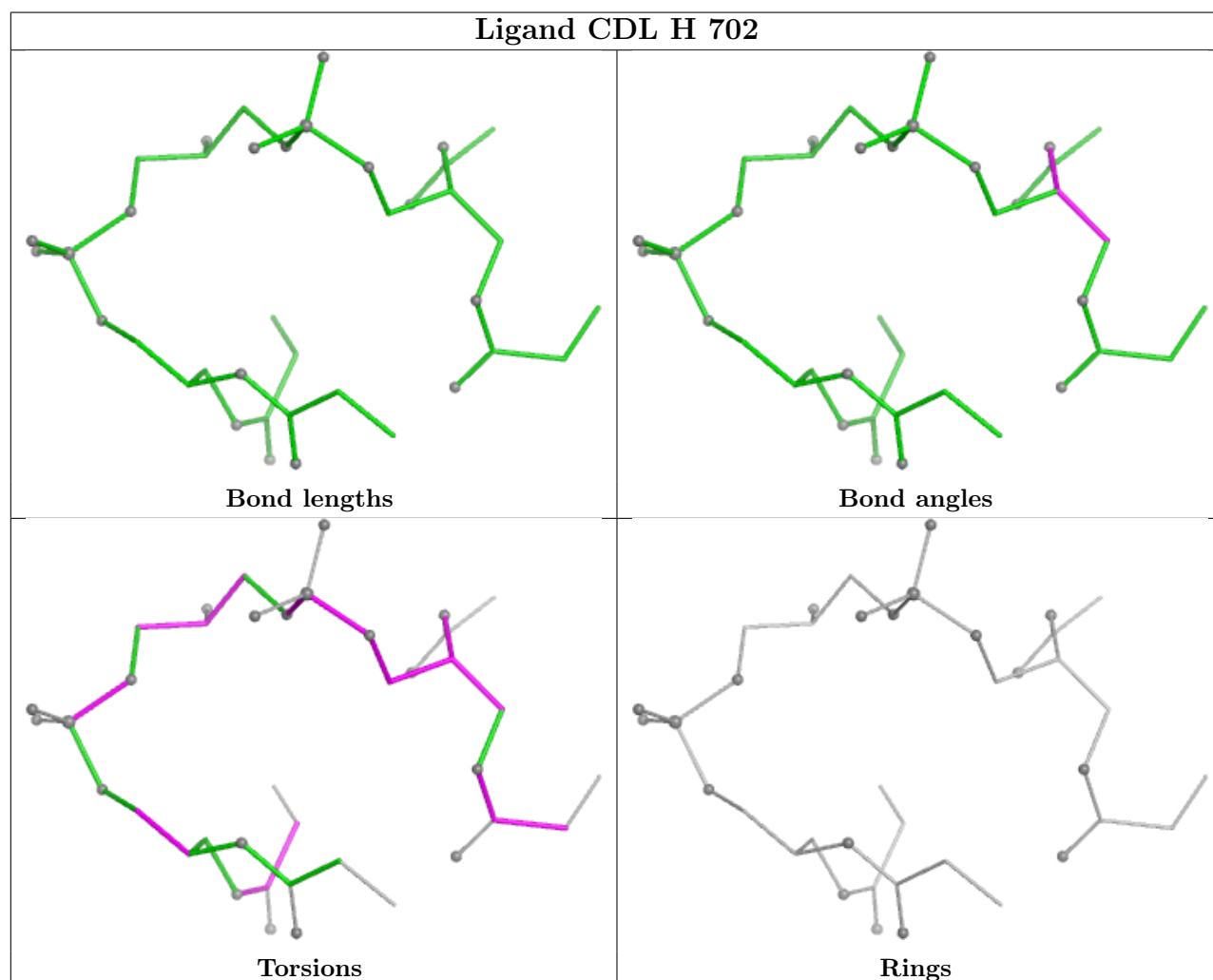
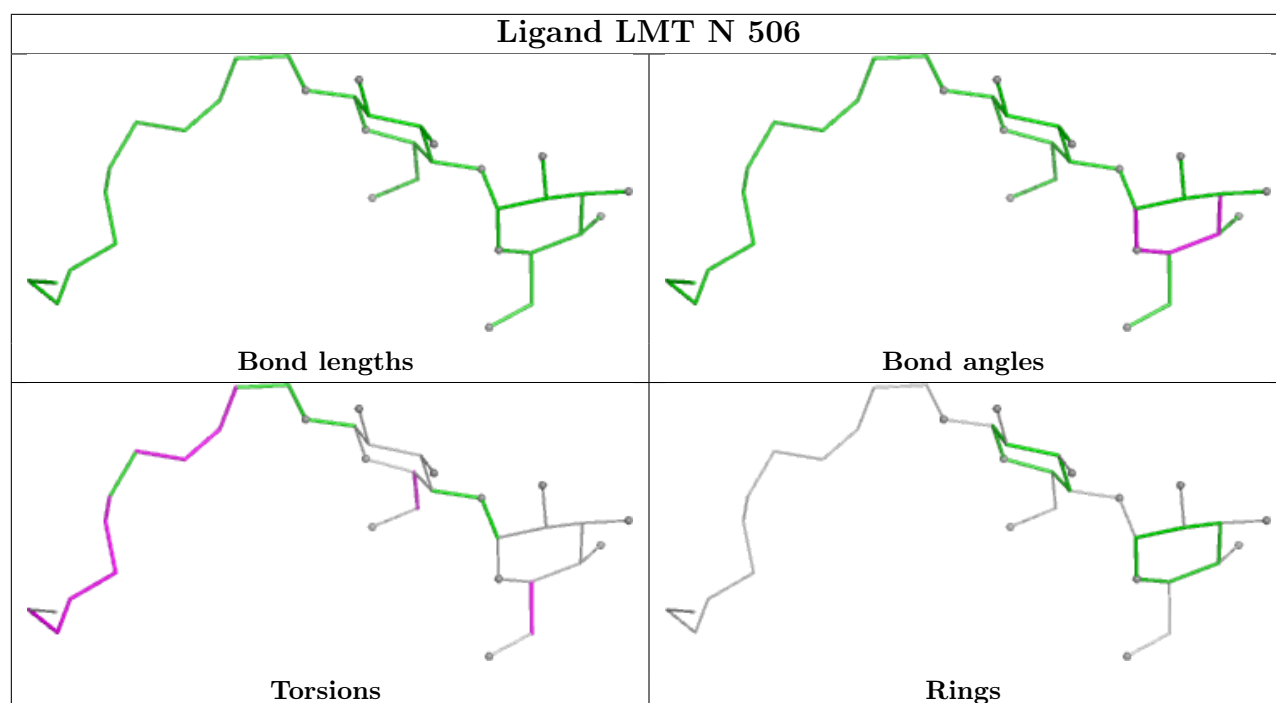


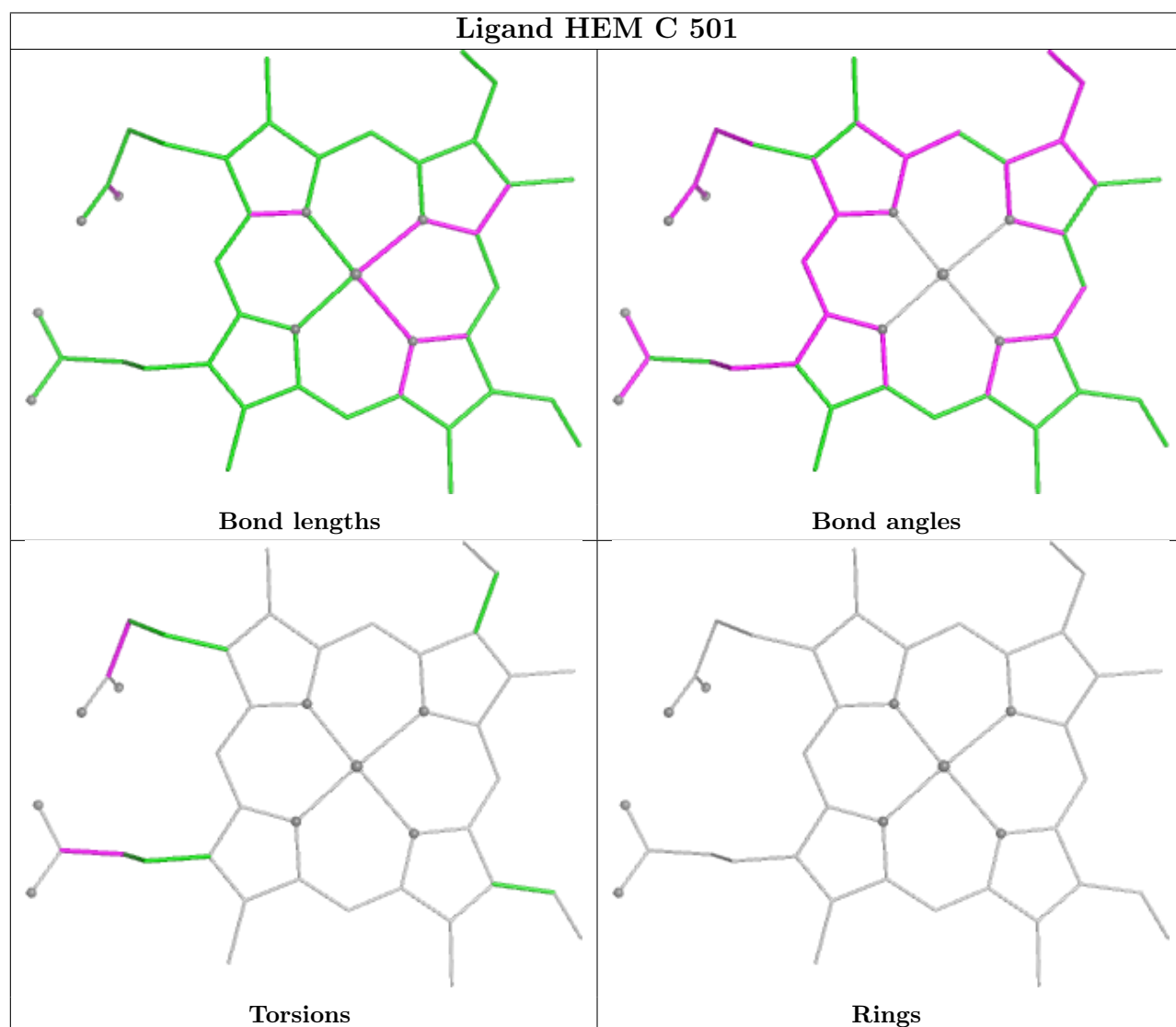
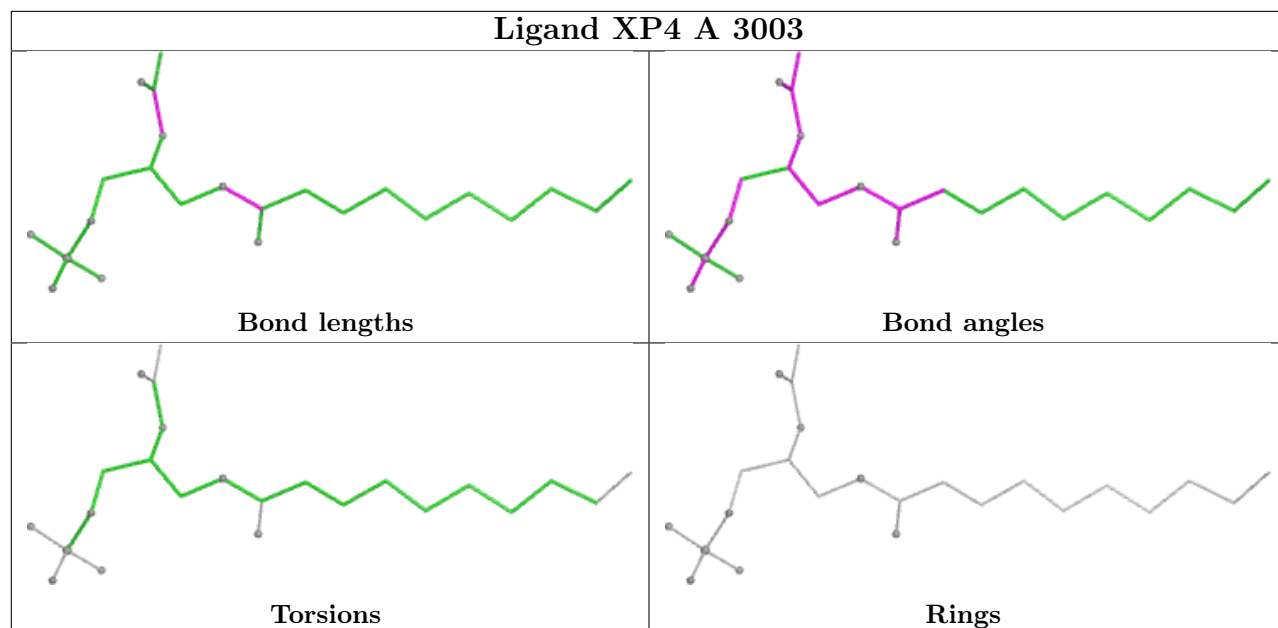


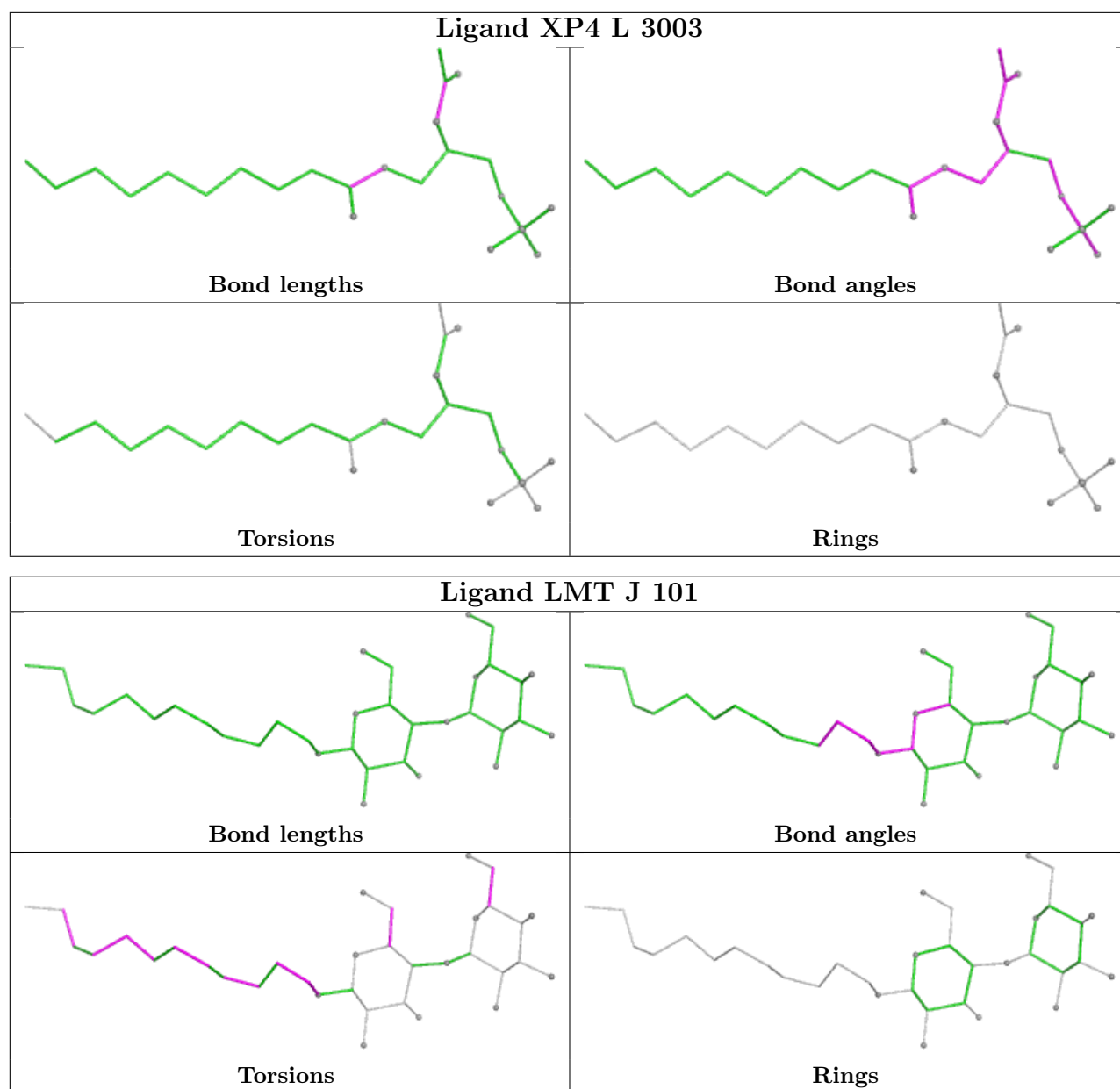


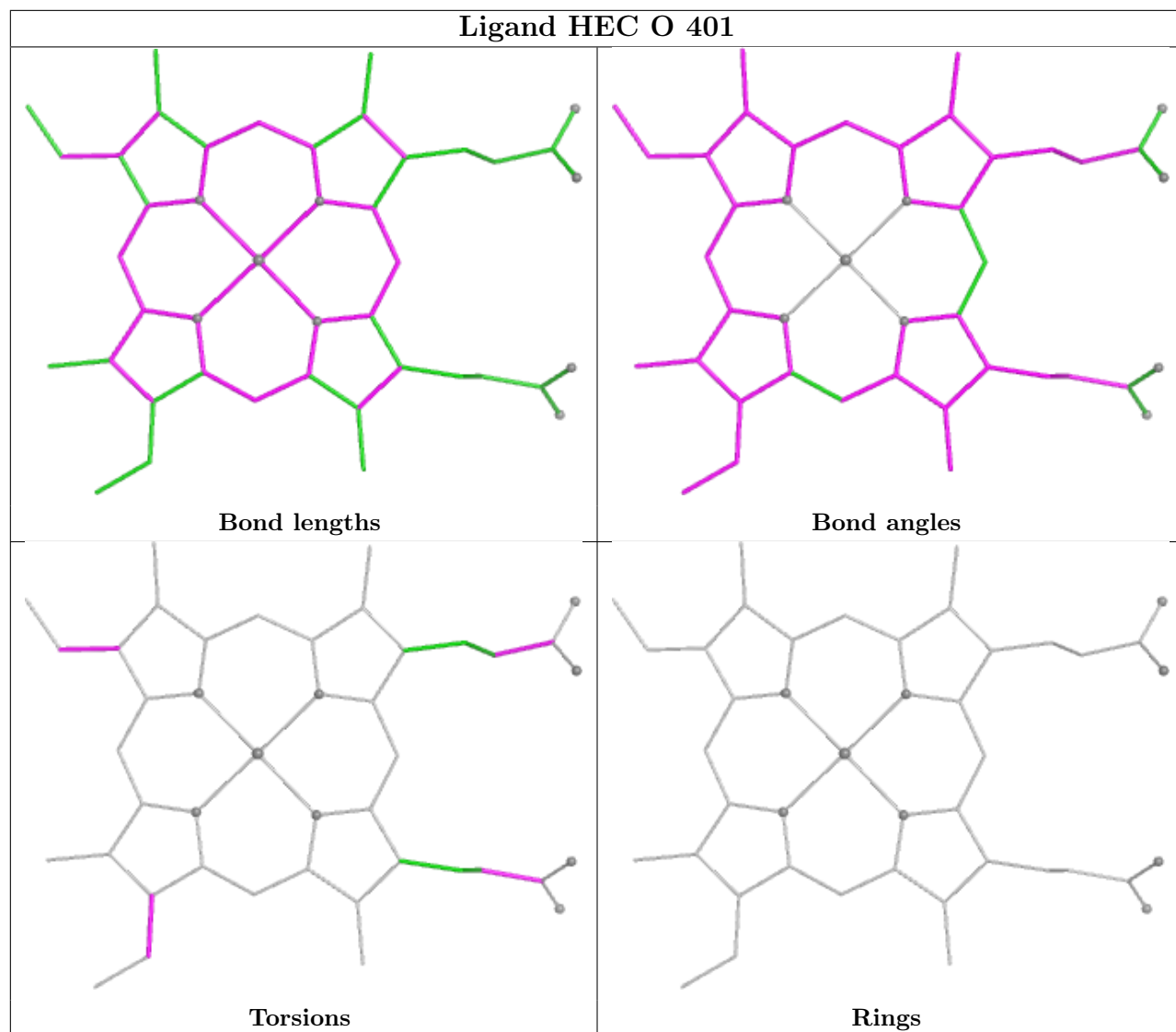


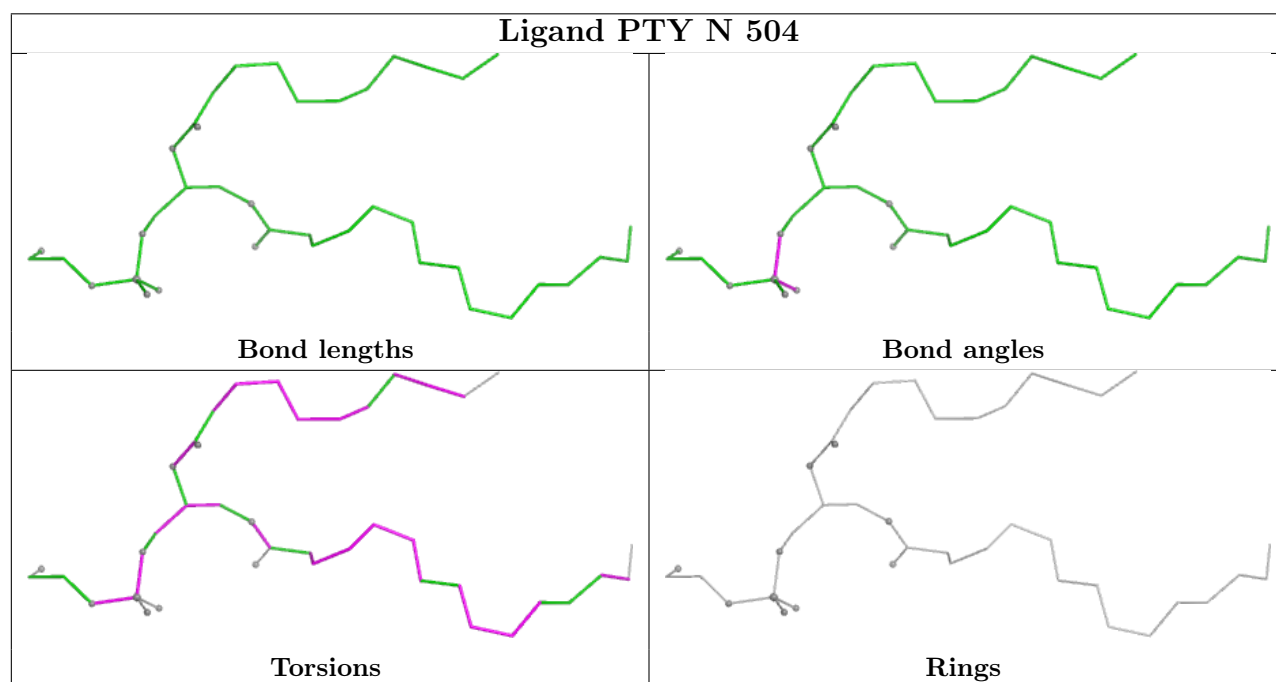
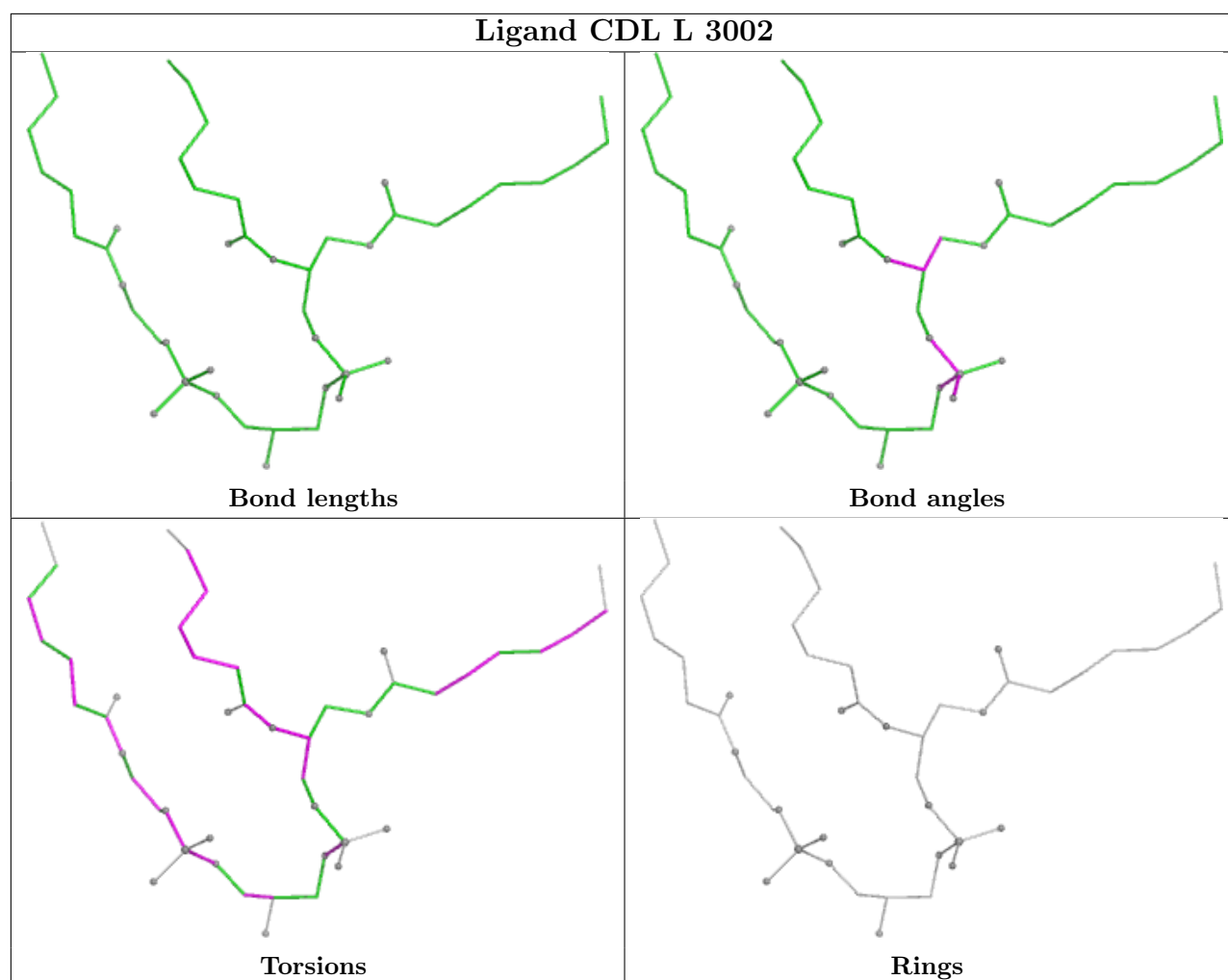












5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

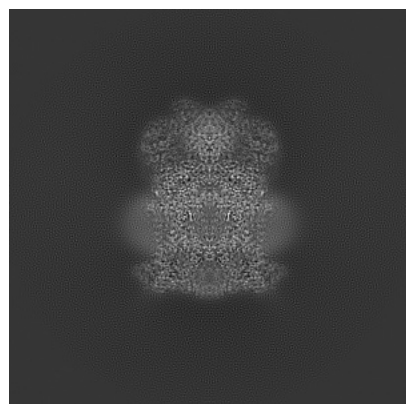
6 Map visualisation [i](#)

This section contains visualisations of the EMDB entry EMD-15312. These allow visual inspection of the internal detail of the map and identification of artifacts.

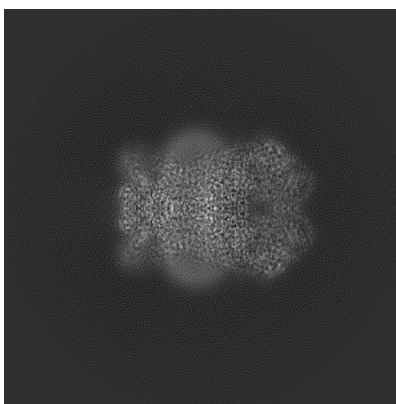
Images derived from a raw map, generated by summing the deposited half-maps, are presented below the corresponding image components of the primary map to allow further visual inspection and comparison with those of the primary map.

6.1 Orthogonal projections [i](#)

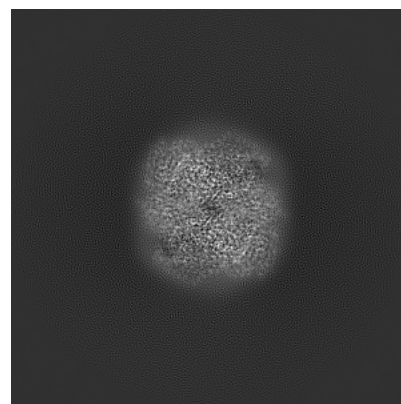
6.1.1 Primary map



X

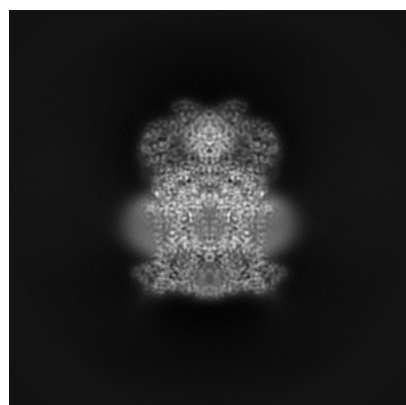


Y

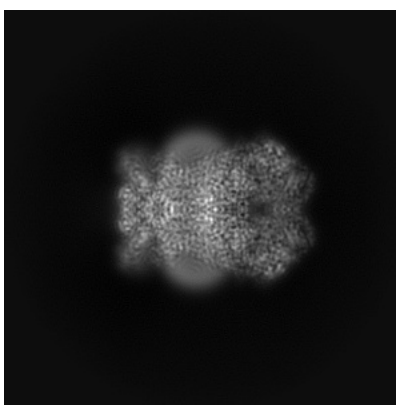


Z

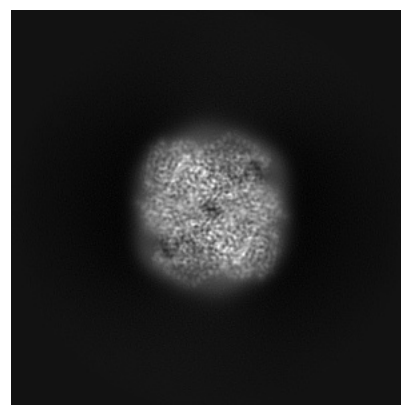
6.1.2 Raw map



X



Y

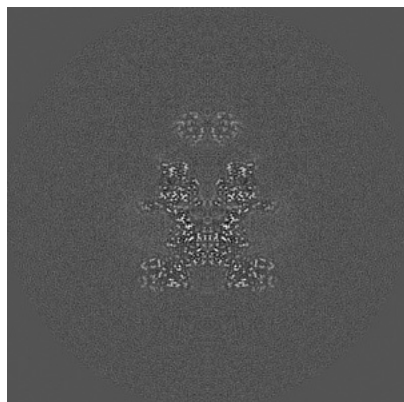


Z

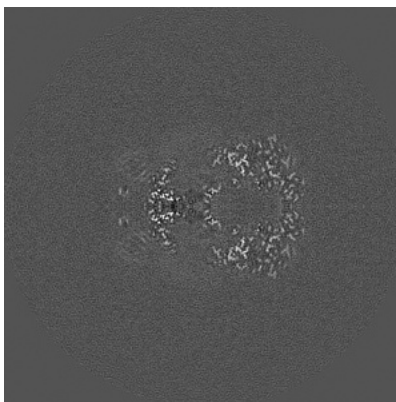
The images above show the map projected in three orthogonal directions.

6.2 Central slices [i](#)

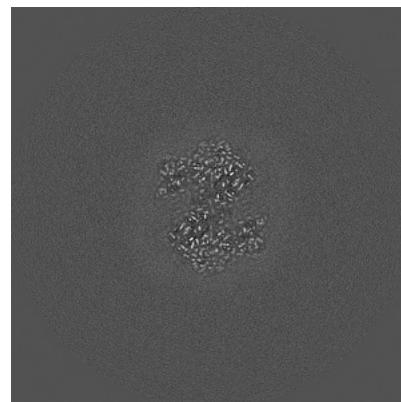
6.2.1 Primary map



X Index: 180

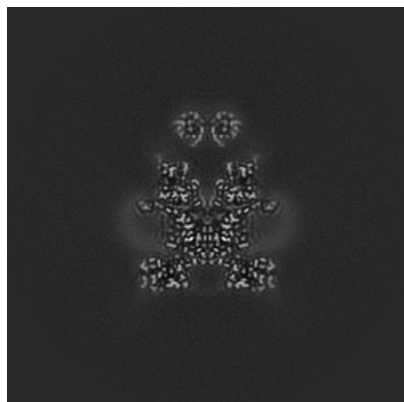


Y Index: 180

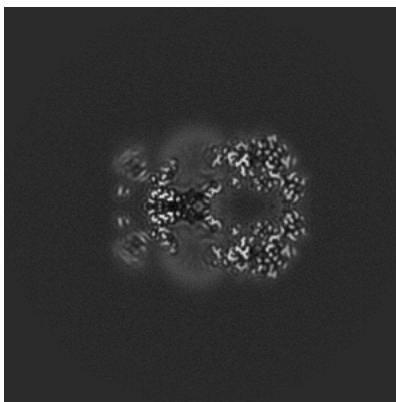


Z Index: 180

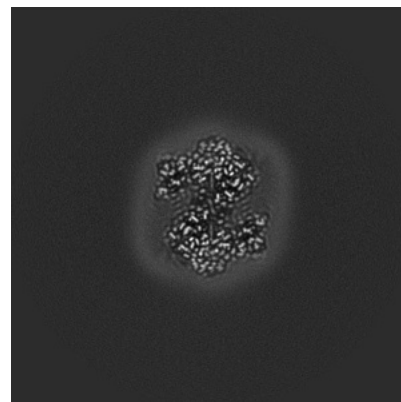
6.2.2 Raw map



X Index: 180



Y Index: 180

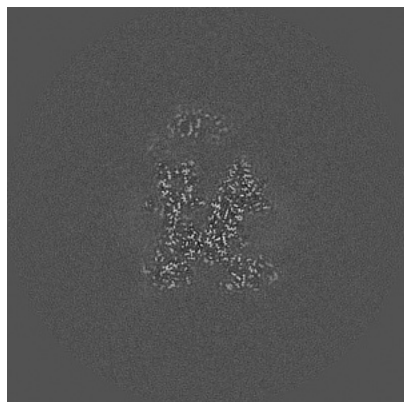


Z Index: 180

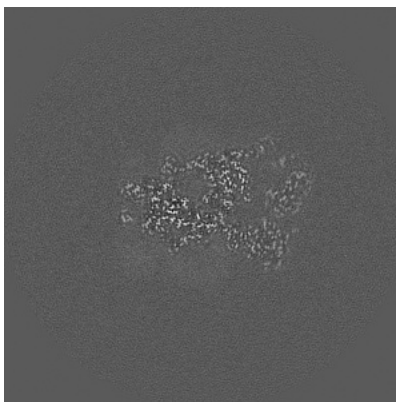
The images above show central slices of the map in three orthogonal directions.

6.3 Largest variance slices [i](#)

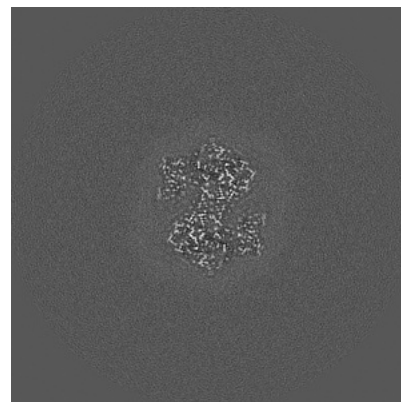
6.3.1 Primary map



X Index: 186

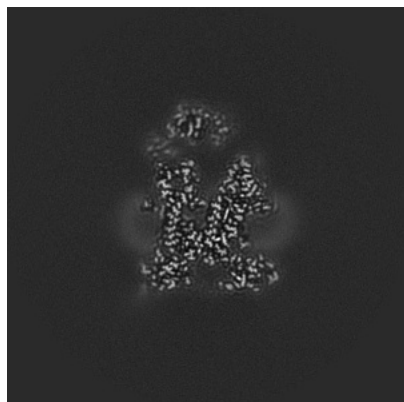


Y Index: 166

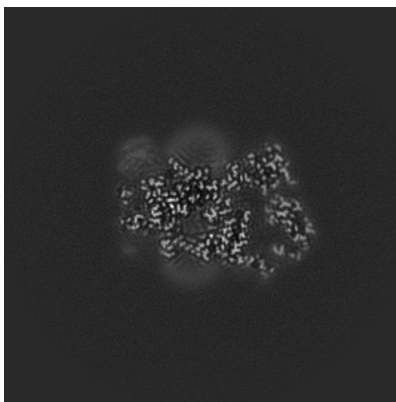


Z Index: 182

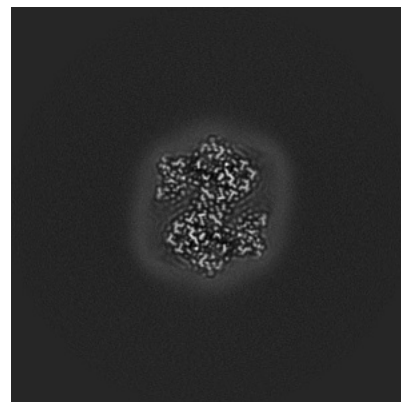
6.3.2 Raw map



X Index: 186



Y Index: 195

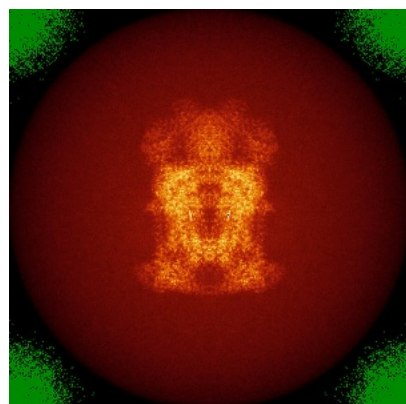


Z Index: 182

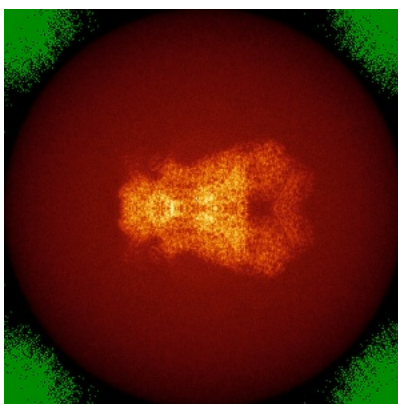
The images above show the largest variance slices of the map in three orthogonal directions.

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

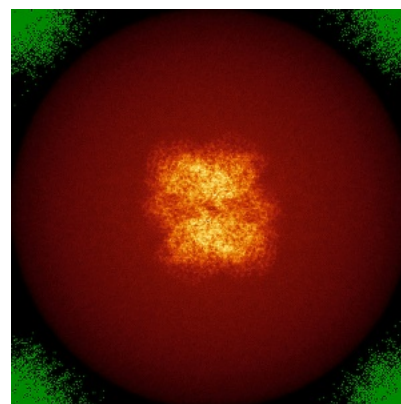
6.4.1 Primary map



X

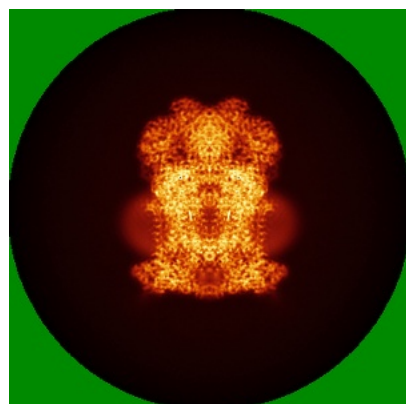


Y

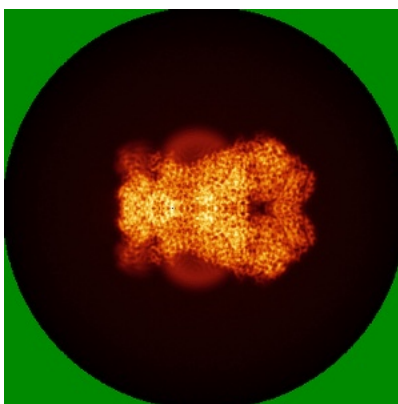


Z

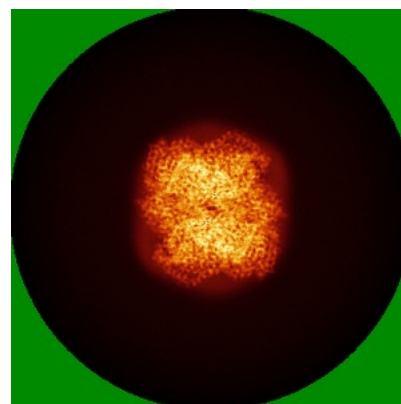
6.4.2 Raw map



X



Y

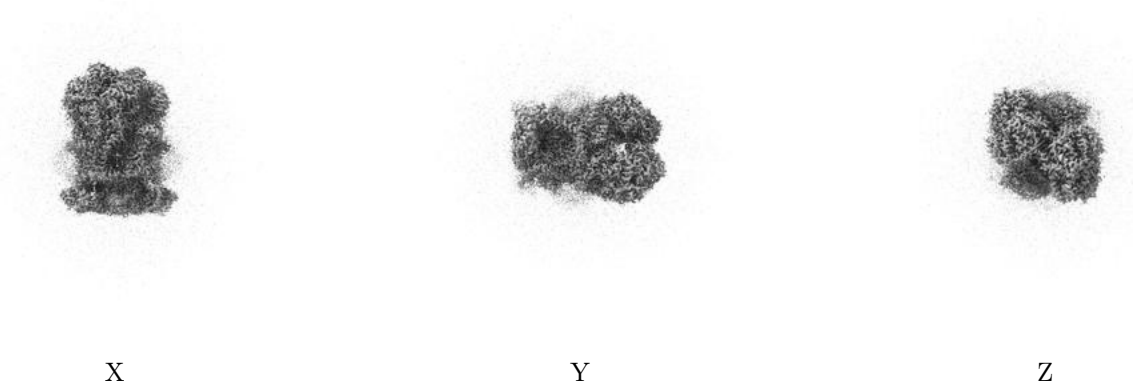


Z

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.

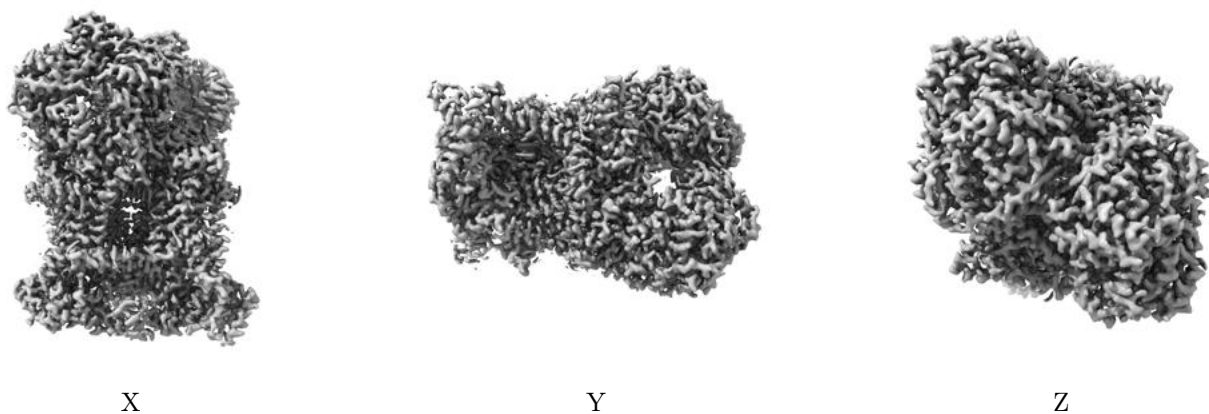
6.5 Orthogonal surface views [i](#)

6.5.1 Primary map



The images above show the 3D surface view of the map at the recommended contour level 0.029. 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.

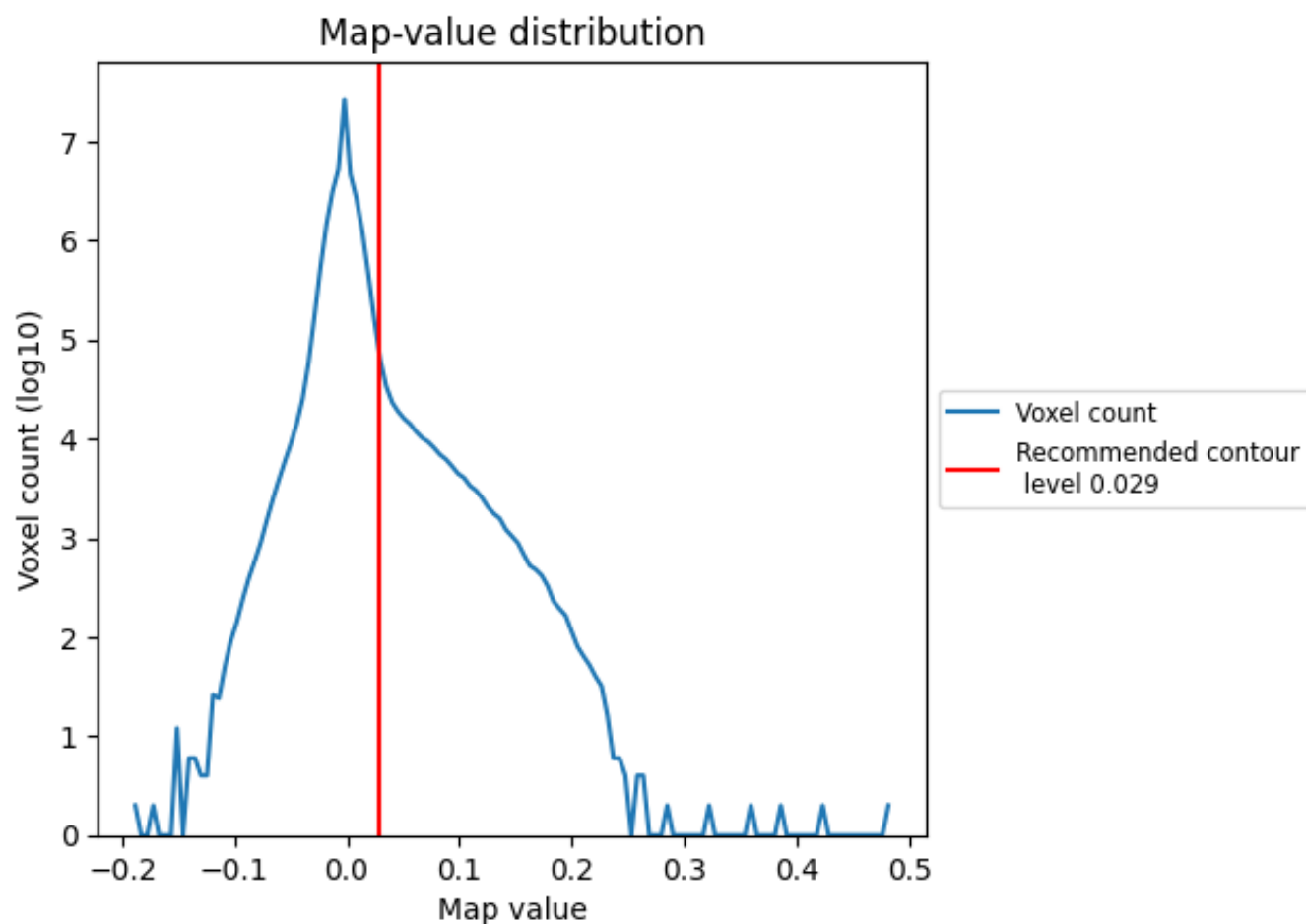
6.6 Mask visualisation [i](#)

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

7 Map analysis [i](#)

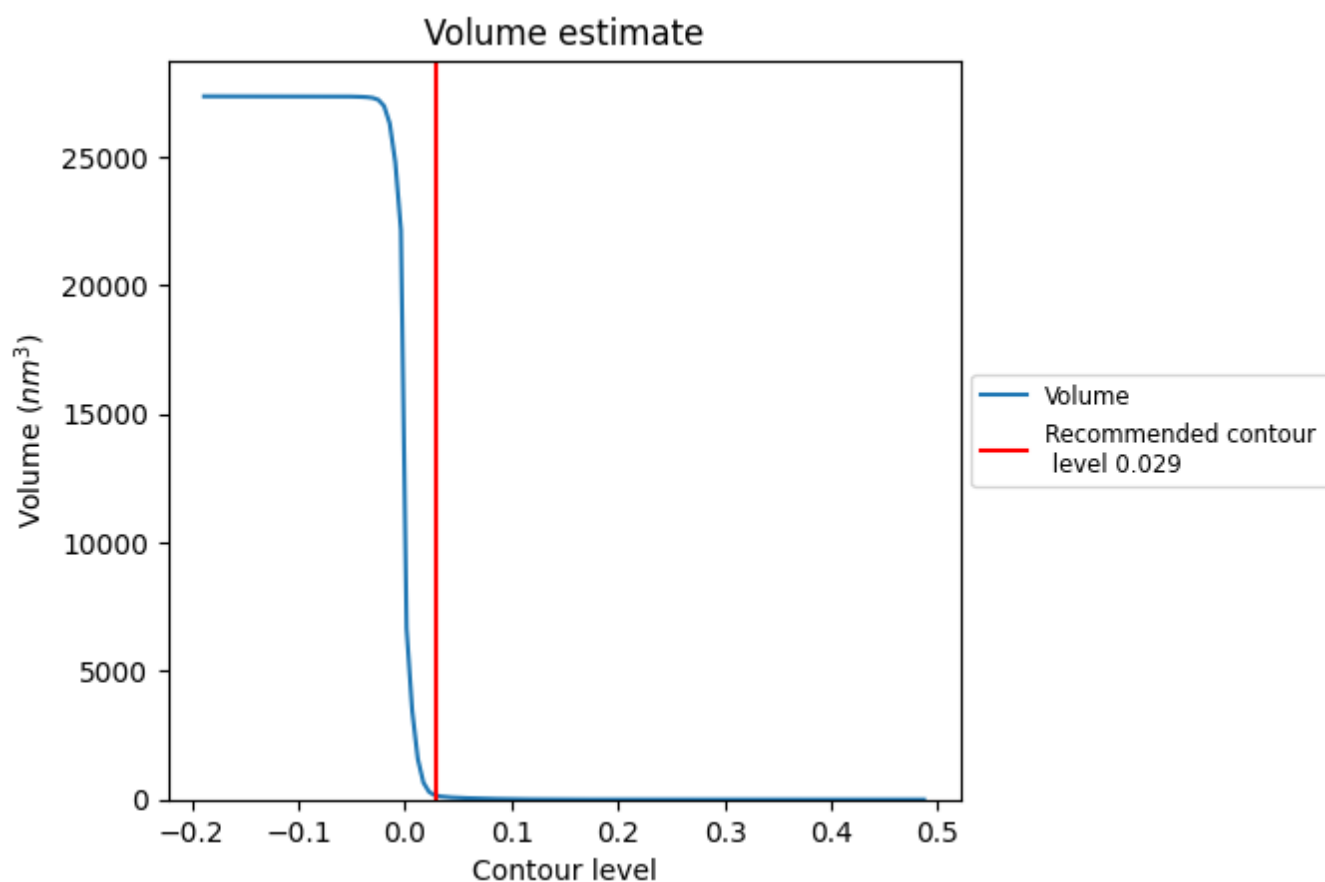
This section contains the results of statistical analysis of the map.

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.

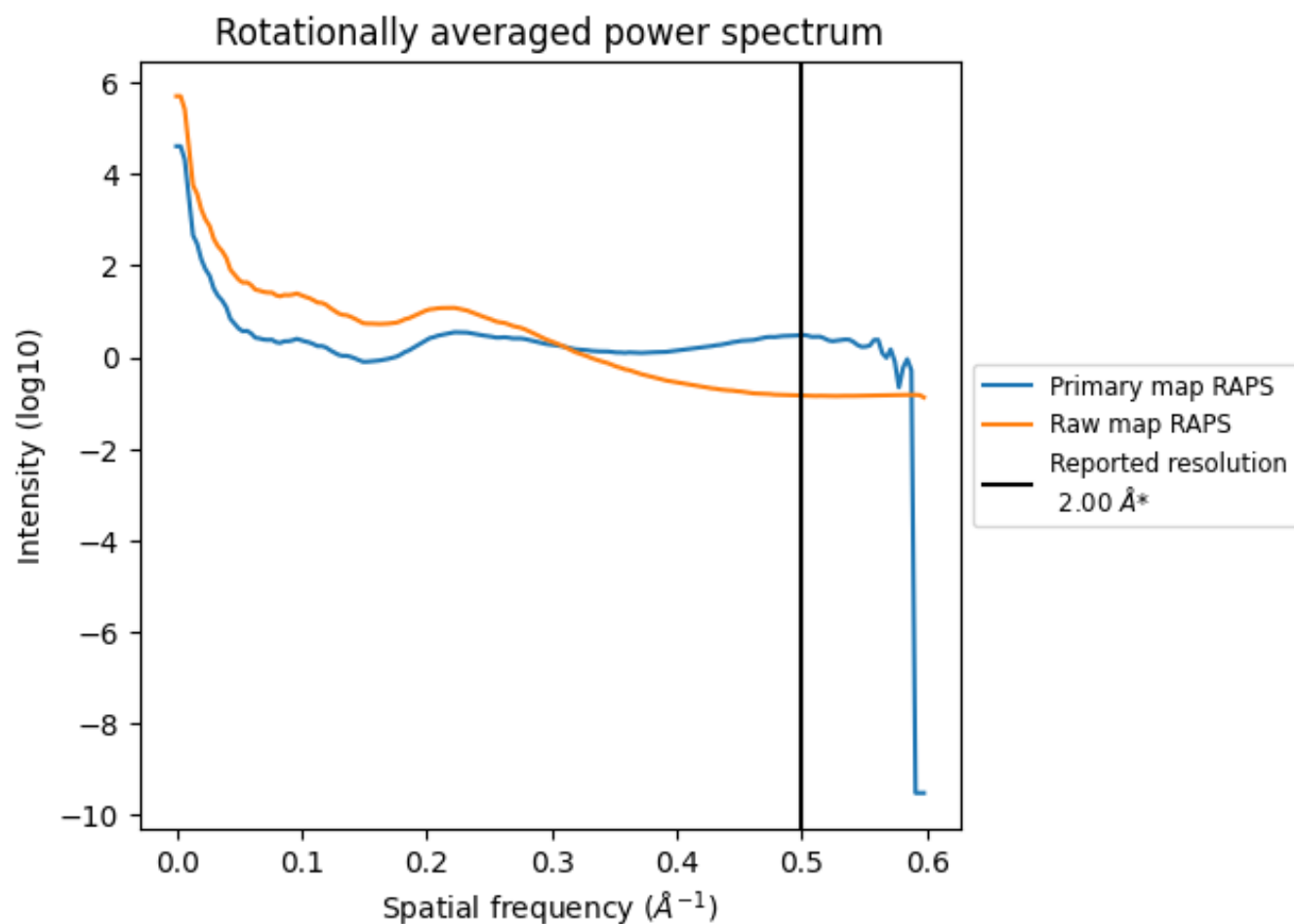
7.2 Volume estimate [i](#)



The volume at the recommended contour level is 161 nm^3 ; this corresponds to an approximate mass of 146 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 ⓘ

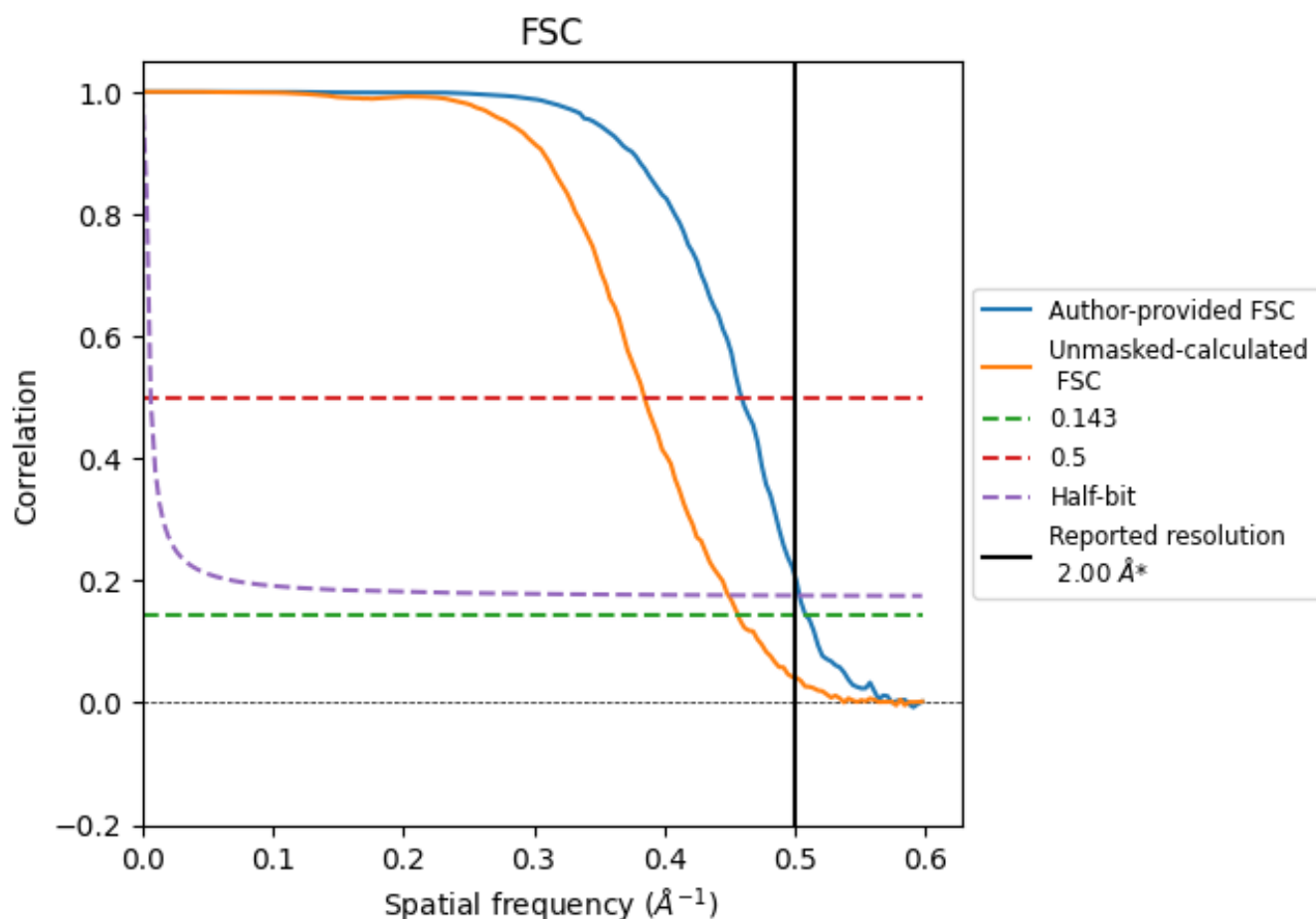


*Reported resolution corresponds to spatial frequency of 0.500 Å⁻¹

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 0.500 $\text{\AA}^{-1}$

8.2 Resolution estimates [i](#)

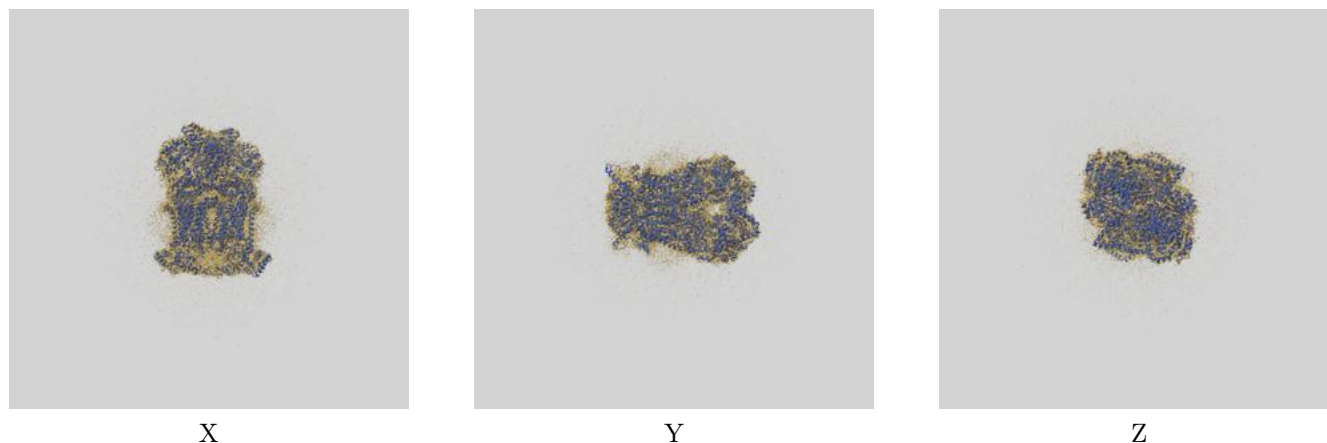
Resolution estimate (Å)	Estimation criterion (FSC cut-off)		
	0.143	0.5	Half-bit
Reported by author	2.00	-	-
Author-provided FSC curve	1.97	2.18	1.99
Unmasked-calculated*	2.19	2.60	2.23

*Resolution estimate based on FSC curve calculated by comparison of deposited half-maps.

9 Map-model fit [i](#)

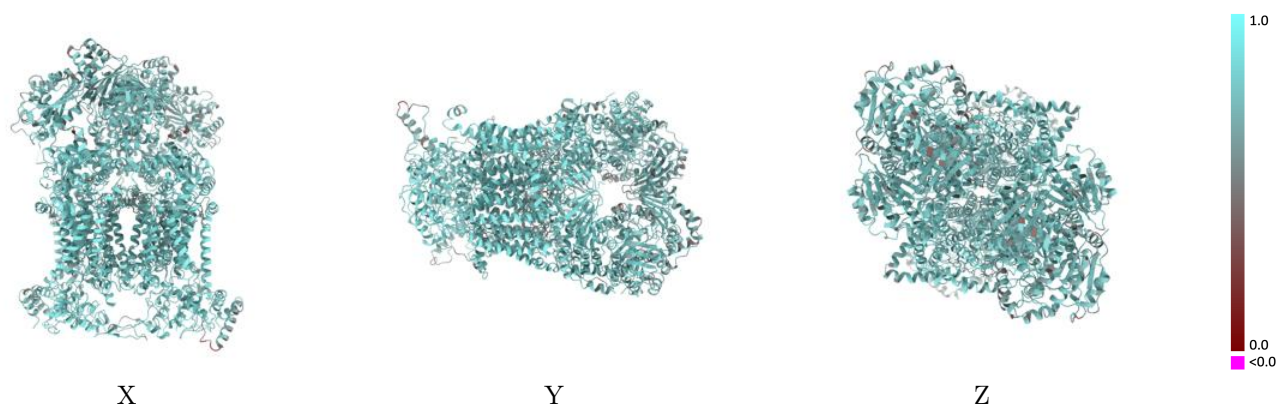
This section contains information regarding the fit between EMDB map EMD-15312 and PDB model 8AB6. Per-residue inclusion information can be found in section [3](#) on page [13](#).

9.1 Map-model overlay [i](#)



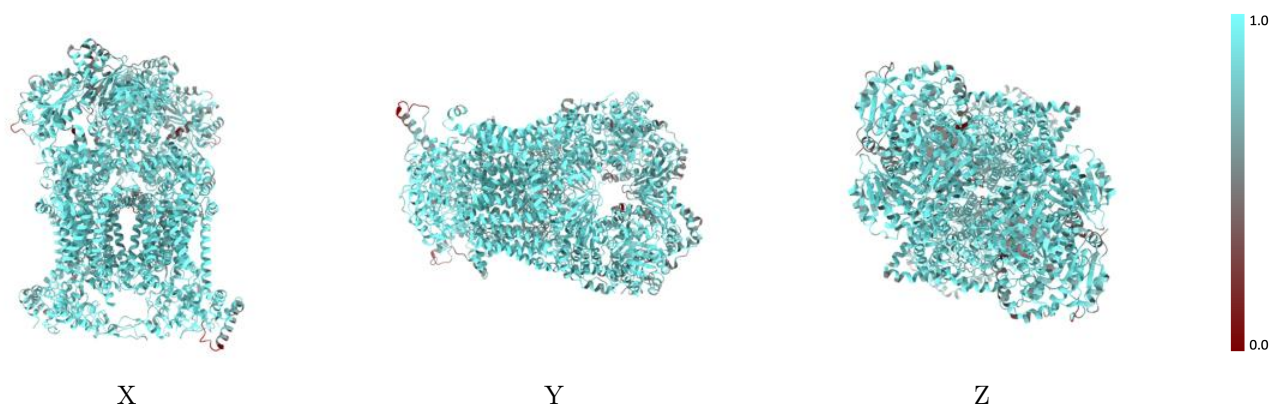
The images above show the 3D surface view of the map at the recommended contour level 0.029 at 50% transparency in yellow overlaid with a ribbon representation of the model coloured in blue. These images allow for the visual assessment of the quality of fit between the atomic model and the map.

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



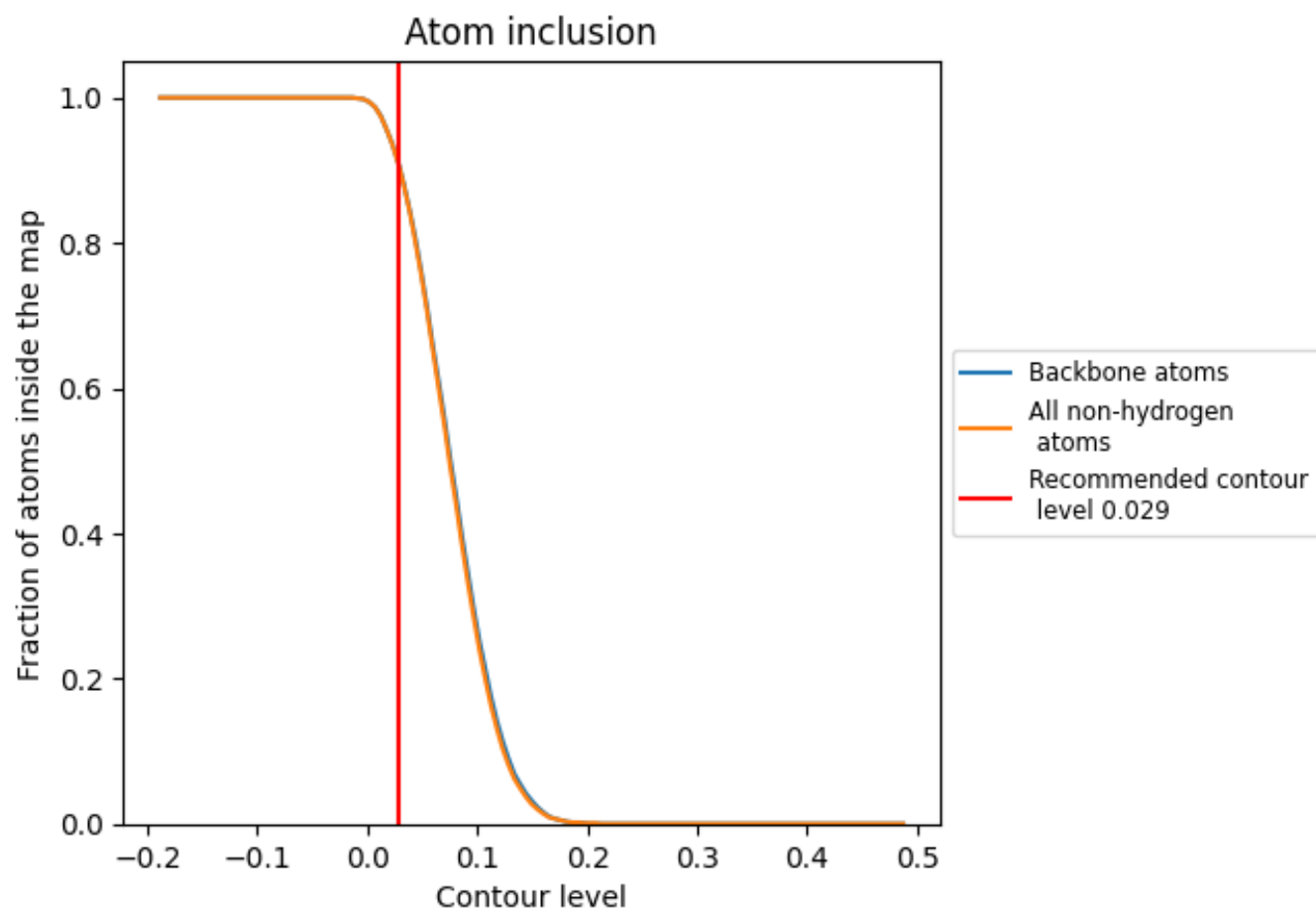
The images above show the model with each residue coloured according to its Q-score. This shows their resolvability in the map with higher Q-score values reflecting better resolvability. Please note: Q-score is calculating the resolvability of atoms, and thus high values are only expected at resolutions 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 (0.029).

9.4 Atom inclusion ⓘ



At the recommended contour level, 91% of all backbone atoms, 90% 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 (0.029) and Q-score for the entire model and for each chain.

Chain	Atom inclusion	Q-score
All	 0.9050	 0.7570
A	 0.8800	 0.7360
B	 0.8680	 0.7170
C	 0.9690	 0.8080
D	 0.9460	 0.7860
E	 0.9380	 0.7870
F	 0.7030	 0.6340
G	 0.9290	 0.7860
H	 0.9320	 0.7640
I	 0.9640	 0.7900
J	 0.8620	 0.7250
L	 0.8780	 0.7370
M	 0.8690	 0.7160
N	 0.9670	 0.8070
O	 0.9470	 0.7860
P	 0.9160	 0.7670
Q	 0.7020	 0.6420
R	 0.9260	 0.7860
S	 0.9300	 0.7620
T	 0.9540	 0.7890
U	 0.8790	 0.7430

