



wwPDB EM Validation Summary Report ⓘ

May 13, 2024 – 10:32 pm BST

PDB ID : 6Z16
EMDB ID : EMD-11027
Title : Structure of the Mrp antiporter complex
Authors : Steiner, J.; Sazanov, L.A.
Deposited on : 2020-05-12
Resolution : 2.98 Å (reported)
Based on initial models : 4HEA, 6CFW

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.dev92
Mogul : 1.8.4, CSD as541be (2020)
MolProbity : 4.02b-467
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36.2

PERCENTILES INFOmissingINFO

1 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 30250 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 Multisubunit Na⁺/H⁺ antiporter, A subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	788	Total	C	N	O	S	0	0
			6221	4180	979	1029	33		
1	a	788	Total	C	N	O	S	0	0
			6221	4180	979	1029	33		

- Molecule 2 is a protein called Multisubunit Na⁺/H⁺ antiporter, B subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	138	Total	C	N	O	S	0	0
			1070	716	167	182	5		
2	b	138	Total	C	N	O	S	0	0
			1070	716	167	182	5		

- Molecule 3 is a protein called Multisubunit Na⁺/H⁺ antiporter, C subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	C	107	Total	C	N	O	S	0	0
			802	531	128	137	6		
3	c	107	Total	C	N	O	S	0	0
			802	531	128	137	6		

- Molecule 4 is a protein called Multisubunit Na⁺/H⁺ antiporter, D subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	D	489	Total	C	N	O	S	0	0
			3796	2570	577	635	14		
4	d	489	Total	C	N	O	S	0	0
			3796	2570	577	635	14		

- Molecule 5 is a protein called Multisubunit Na⁺/H⁺ antiporter, E subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	E	158	Total	C	N	O	S	0	0
			1274	860	193	215	6		
5	e	158	Total	C	N	O	S	0	0
			1274	860	193	215	6		

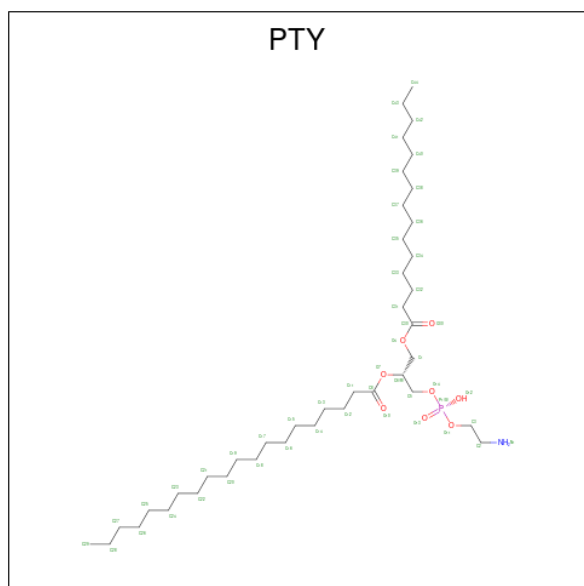
- Molecule 6 is a protein called Multisubunit Na⁺/H⁺ antiporter, F subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	F	88	Total	C	N	O	S	0	0
			648	431	103	110	4		
6	f	88	Total	C	N	O	S	0	0
			648	431	103	110	4		

- Molecule 7 is a protein called Multisubunit Na⁺/H⁺ antiporter, G subunit.

Mol	Chain	Residues	Atoms					AltConf	Trace
7	G	104	Total	C	N	O	S	0	0
			804	527	137	137	3		
7	g	104	Total	C	N	O	S	0	0
			804	527	137	137	3		

- Molecule 8 is PHOSPHATIDYLETHANOLAMINE (three-letter code: PTY) (formula: C₄₀H₈₀NO₈P).



Mol	Chain	Residues	Atoms					AltConf
8	A	1	Total	C	N	O	P	0
			30	20	1	8	1	

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Mol	Chain	Residues	Atoms					AltConf
8	A	1	Total	C	N	O	P	0
			34	24	1	8	1	
8	A	1	Total	C	N	O	P	0
			43	33	1	8	1	
8	A	1	Total	C	N	O	P	0
			40	30	1	8	1	
8	A	1	Total	C	N	O	P	0
			47	37	1	8	1	
8	A	1	Total	C	N	O	P	0
			34	24	1	8	1	
8	A	1	Total	C	N	O	P	0
			47	37	1	8	1	
8	B	1	Total	C	N	O	P	0
			34	24	1	8	1	
8	D	1	Total	C	N	O	P	0
			34	24	1	8	1	
8	D	1	Total	C	N	O	P	0
			39	29	1	8	1	
8	D	1	Total	C	N	O	P	0
			43	33	1	8	1	
8	E	1	Total	C	N	O	P	0
			34	24	1	8	1	
8	F	1	Total	C	N	O	P	0
			50	40	1	8	1	
8	F	1	Total	C	N	O	P	0
			33	23	1	8	1	
8	a	1	Total	C	N	O	P	0
			30	20	1	8	1	
8	a	1	Total	C	N	O	P	0
			34	24	1	8	1	
8	a	1	Total	C	N	O	P	0
			43	33	1	8	1	
8	a	1	Total	C	N	O	P	0
			40	30	1	8	1	
8	a	1	Total	C	N	O	P	0
			47	37	1	8	1	
8	a	1	Total	C	N	O	P	0
			34	24	1	8	1	
8	a	1	Total	C	N	O	P	0
			47	37	1	8	1	
8	d	1	Total	C	N	O	P	0
			34	24	1	8	1	

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Mol	Chain	Residues	Atoms					AltConf
8	d	1	Total	C	N	O	P	0
			39	29	1	8	1	
8	d	1	Total	C	N	O	P	0
			43	33	1	8	1	
8	f	1	Total	C	N	O	P	0
			50	40	1	8	1	
8	f	1	Total	C	N	O	P	0
			33	23	1	8	1	

- Molecule 9 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms		AltConf
9	A	1	Total	K	0
			1	1	
9	C	1	Total	K	0
			1	1	
9	a	1	Total	K	0
			1	1	
9	c	1	Total	K	0
			1	1	

SEQUENCE-PLOTS INFOmissingINFO

2 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	285688	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 ($e^-/\text{\AA}^2$)	88	Depositor
Minimum defocus (nm)	Not provided	
Maximum defocus (nm)	Not provided	
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor

3 Model quality

3.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: K, PTY

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

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.38	0/6402	0.59	2/8721 (0.0%)
1	a	0.36	0/6402	0.57	0/8721
2	B	0.36	0/1097	0.66	0/1497
2	b	0.35	0/1097	0.65	0/1497
3	C	0.34	0/816	0.58	0/1105
3	c	0.33	0/816	0.57	0/1105
4	D	0.39	0/3893	0.61	3/5315 (0.1%)
4	d	0.38	0/3893	0.59	3/5315 (0.1%)
5	E	0.34	0/1304	0.59	1/1768 (0.1%)
5	e	0.33	0/1304	0.59	1/1768 (0.1%)
6	F	0.35	0/654	0.58	0/886
6	f	0.34	0/654	0.59	0/886
7	G	0.33	0/820	0.63	0/1117
7	g	0.33	0/820	0.62	0/1117
All	All	0.36	0/29972	0.59	10/40818 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
5	E	0	1

There are no bond length outliers.

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	d	192	LEU	CA-CB-CG	7.09	131.62	115.30
4	D	192	LEU	CA-CB-CG	6.29	129.78	115.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	e	112	LEU	CA-CB-CG	6.28	129.74	115.30
5	E	112	LEU	CA-CB-CG	6.19	129.53	115.30
4	D	416	LEU	CB-CG-CD1	-5.73	101.26	111.00

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
5	E	120	ASP	Peptide

3.2 Too-close contacts [i](#)

Due to software issues we are unable to calculate clashes - this section is therefore empty.

3.3 Torsion angles [i](#)

3.3.1 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	A	786/821 (96%)	752 (96%)	34 (4%)	0	100	100
1	a	786/821 (96%)	746 (95%)	40 (5%)	0	100	100
2	B	136/140 (97%)	128 (94%)	8 (6%)	0	100	100
2	b	136/140 (97%)	130 (96%)	6 (4%)	0	100	100
3	C	105/109 (96%)	102 (97%)	3 (3%)	0	100	100
3	c	105/109 (96%)	102 (97%)	3 (3%)	0	100	100
4	D	487/490 (99%)	469 (96%)	18 (4%)	0	100	100
4	d	487/490 (99%)	470 (96%)	17 (4%)	0	100	100
5	E	156/158 (99%)	148 (95%)	8 (5%)	0	100	100
5	e	156/158 (99%)	148 (95%)	8 (5%)	0	100	100
6	F	86/91 (94%)	82 (95%)	4 (5%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
6	f	86/91 (94%)	83 (96%)	3 (4%)	0	100	100
7	G	102/119 (86%)	95 (93%)	7 (7%)	0	100	100
7	g	102/119 (86%)	95 (93%)	7 (7%)	0	100	100
All	All	3716/3856 (96%)	3550 (96%)	166 (4%)	0	100	100

There are no Ramachandran outliers to report.

3.3.2 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	A	659/690 (96%)	658 (100%)	1 (0%)	93	98
1	a	659/690 (96%)	658 (100%)	1 (0%)	93	98
2	B	116/118 (98%)	116 (100%)	0	100	100
2	b	116/118 (98%)	116 (100%)	0	100	100
3	C	85/86 (99%)	85 (100%)	0	100	100
3	c	85/86 (99%)	85 (100%)	0	100	100
4	D	409/411 (100%)	409 (100%)	0	100	100
4	d	409/411 (100%)	409 (100%)	0	100	100
5	E	143/143 (100%)	141 (99%)	2 (1%)	67	86
5	e	143/143 (100%)	141 (99%)	2 (1%)	67	86
6	F	69/72 (96%)	69 (100%)	0	100	100
6	f	69/72 (96%)	69 (100%)	0	100	100
7	G	86/97 (89%)	86 (100%)	0	100	100
7	g	86/97 (89%)	86 (100%)	0	100	100
All	All	3134/3234 (97%)	3128 (100%)	6 (0%)	93	98

5 of 6 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	a	50	LYS
5	e	8	ASN
5	e	72	ASN
5	E	8	ASN
1	A	50	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
2	b	31	HIS
7	g	90	HIS
7	G	90	HIS
1	a	138	ASN
1	a	158	HIS

3.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

3.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

3.6 Ligand geometry [i](#)

Of 30 ligands modelled in this entry, 4 are monoatomic - leaving 26 for Mogul analysis.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
8	PTY	a	901	-	29,29,49	0.37	0	32,34,54	0.30	0
8	PTY	F	1802	-	32,32,49	0.37	0	35,37,54	0.31	0
8	PTY	a	905	-	46,46,49	0.30	0	49,51,54	0.25	0
8	PTY	A	902	-	33,33,49	1.04	3 (9%)	36,38,54	0.31	0
8	PTY	E	201	-	33,33,49	1.07	3 (9%)	36,38,54	0.56	0
8	PTY	F	1801	-	49,49,49	0.30	0	52,54,54	0.47	1 (1%)
8	PTY	d	502	-	38,38,49	0.32	0	41,43,54	0.30	0
8	PTY	a	904	-	39,39,49	0.35	0	42,44,54	0.37	0
8	PTY	a	906	-	33,33,49	1.08	3 (9%)	36,38,54	0.59	1 (2%)
8	PTY	a	907	-	46,46,49	0.32	0	49,51,54	0.51	1 (2%)
8	PTY	D	501	-	33,33,49	0.33	0	36,38,54	0.35	0
8	PTY	d	501	-	33,33,49	0.33	0	36,38,54	0.35	0
8	PTY	A	901	-	29,29,49	0.36	0	32,34,54	0.30	0
8	PTY	d	503	-	42,42,49	0.36	0	45,47,54	0.52	1 (2%)
8	PTY	a	903	-	42,42,49	0.33	0	45,47,54	0.28	0
8	PTY	A	905	-	46,46,49	0.30	0	49,51,54	0.26	0
8	PTY	A	904	-	39,39,49	0.34	0	42,44,54	0.39	0
8	PTY	f	1802	-	32,32,49	0.36	0	35,37,54	0.31	0
8	PTY	A	906	-	33,33,49	1.07	3 (9%)	36,38,54	0.59	1 (2%)
8	PTY	D	502	-	38,38,49	0.31	0	41,43,54	0.32	0
8	PTY	A	907	-	46,46,49	0.32	0	49,51,54	0.51	1 (2%)
8	PTY	D	503	-	42,42,49	0.35	0	45,47,54	0.52	1 (2%)
8	PTY	B	201	-	33,33,49	1.08	3 (9%)	36,38,54	0.56	0
8	PTY	A	903	-	42,42,49	0.33	0	45,47,54	0.28	0
8	PTY	f	1801	-	49,49,49	0.29	0	52,54,54	0.45	0
8	PTY	a	902	-	33,33,49	1.04	3 (9%)	36,38,54	0.31	0

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
8	PTY	a	901	-	-	5/33/33/53	-
8	PTY	F	1802	-	-	5/36/36/53	-
8	PTY	a	905	-	-	10/50/50/53	-
8	PTY	A	902	-	-	9/37/37/53	-
8	PTY	E	201	-	-	16/37/37/53	-
8	PTY	F	1801	-	-	13/53/53/53	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
8	PTY	d	502	-	-	9/42/42/53	-
8	PTY	a	904	-	-	12/43/43/53	-
8	PTY	a	906	-	-	10/37/37/53	-
8	PTY	a	907	-	-	10/50/50/53	-
8	PTY	D	501	-	-	10/37/37/53	-
8	PTY	d	501	-	-	5/37/37/53	-
8	PTY	A	901	-	-	7/33/33/53	-
8	PTY	d	503	-	-	13/46/46/53	-
8	PTY	a	903	-	-	8/46/46/53	-
8	PTY	A	905	-	-	11/50/50/53	-
8	PTY	A	904	-	-	12/43/43/53	-
8	PTY	f	1802	-	-	5/36/36/53	-
8	PTY	A	906	-	-	10/37/37/53	-
8	PTY	D	502	-	-	10/42/42/53	-
8	PTY	A	907	-	-	11/50/50/53	-
8	PTY	D	503	-	-	12/46/46/53	-
8	PTY	B	201	-	-	13/37/37/53	-
8	PTY	A	903	-	-	8/46/46/53	-
8	PTY	f	1801	-	-	15/53/53/53	-
8	PTY	a	902	-	-	6/37/37/53	-

The worst 5 of 18 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
8	B	201	PTY	P1-O12	-4.08	1.36	1.55
8	A	906	PTY	P1-O12	-4.06	1.36	1.55
8	E	201	PTY	P1-O12	-4.03	1.36	1.55
8	a	906	PTY	P1-O12	-4.03	1.36	1.55
8	A	902	PTY	P1-O12	-3.98	1.36	1.55

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
8	F	1801	PTY	O4-C1-C6	2.21	114.86	108.43
8	d	503	PTY	C6-O7-C8	2.09	122.94	117.79
8	A	907	PTY	C6-O7-C8	2.09	122.94	117.79
8	a	907	PTY	C6-O7-C8	2.09	122.93	117.79
8	A	906	PTY	C6-O7-C8	2.08	122.92	117.79

There are no chirality outliers.

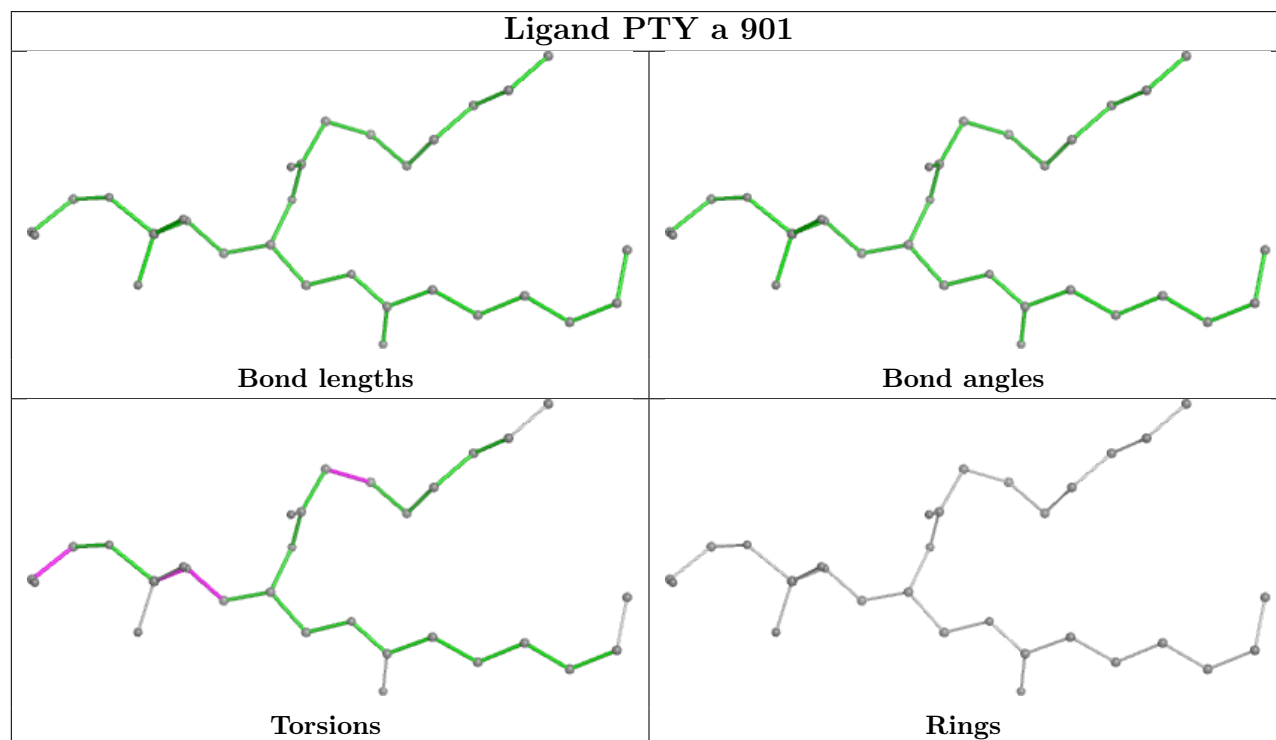
5 of 255 torsion outliers are listed below:

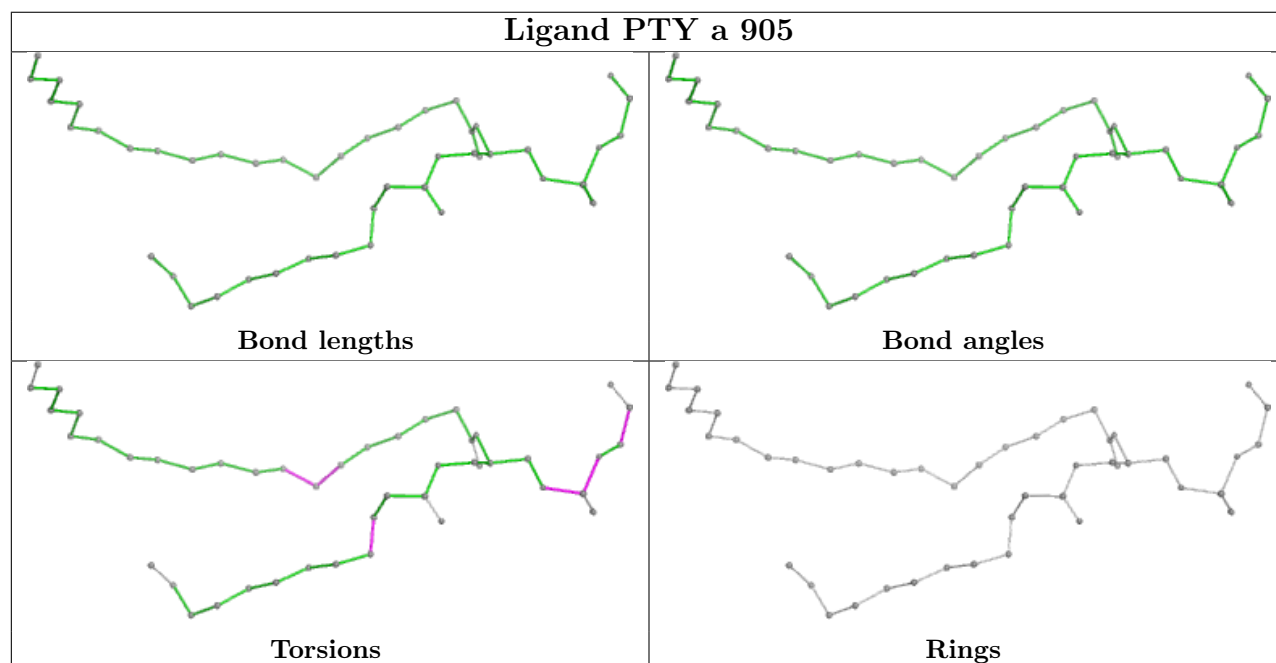
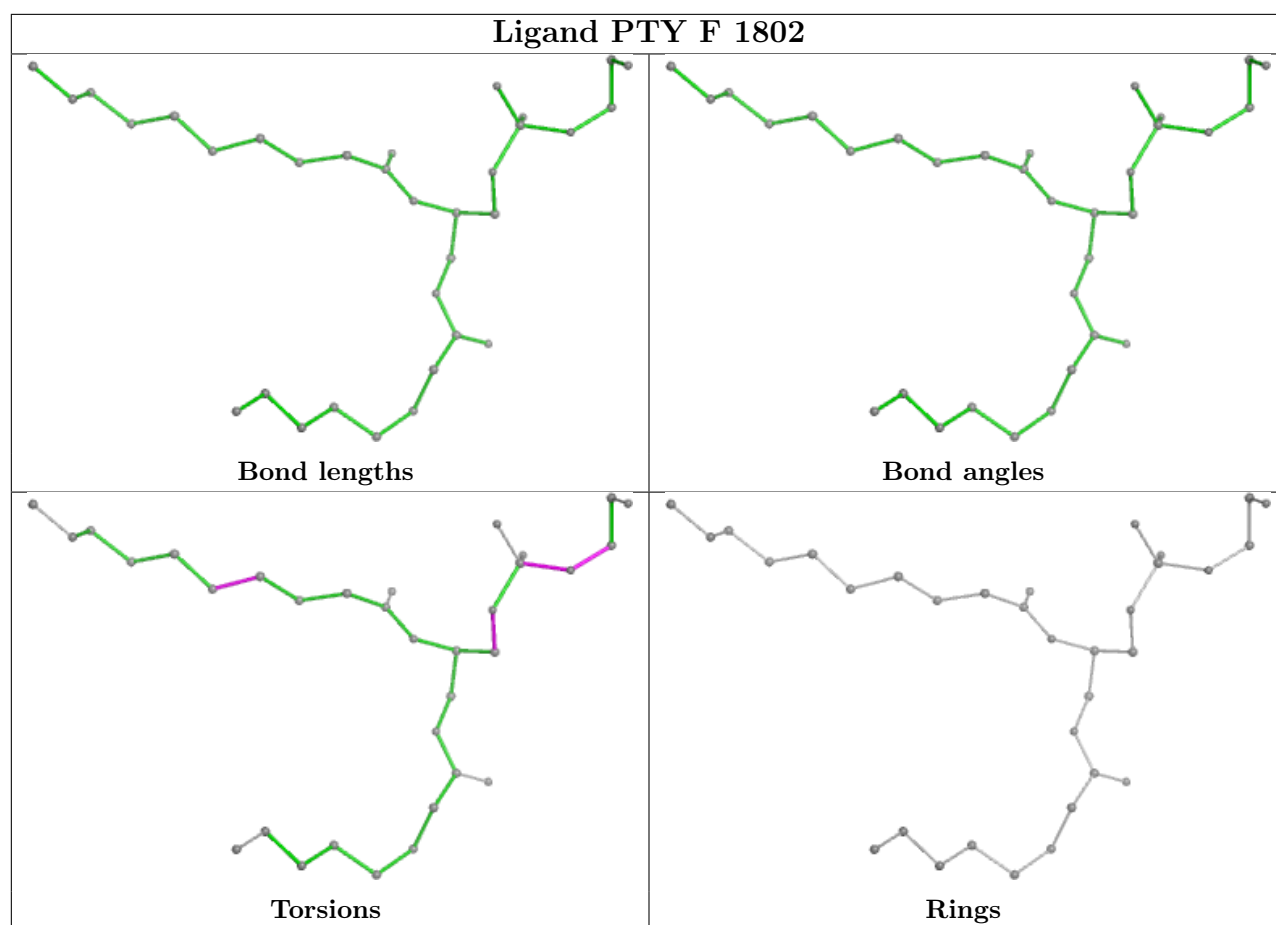
Mol	Chain	Res	Type	Atoms
8	A	901	PTY	N1-C2-C3-O11
8	A	902	PTY	N1-C2-C3-O11
8	A	902	PTY	C5-O14-P1-O13
8	A	903	PTY	C5-O14-P1-O12
8	A	903	PTY	C5-O14-P1-O13

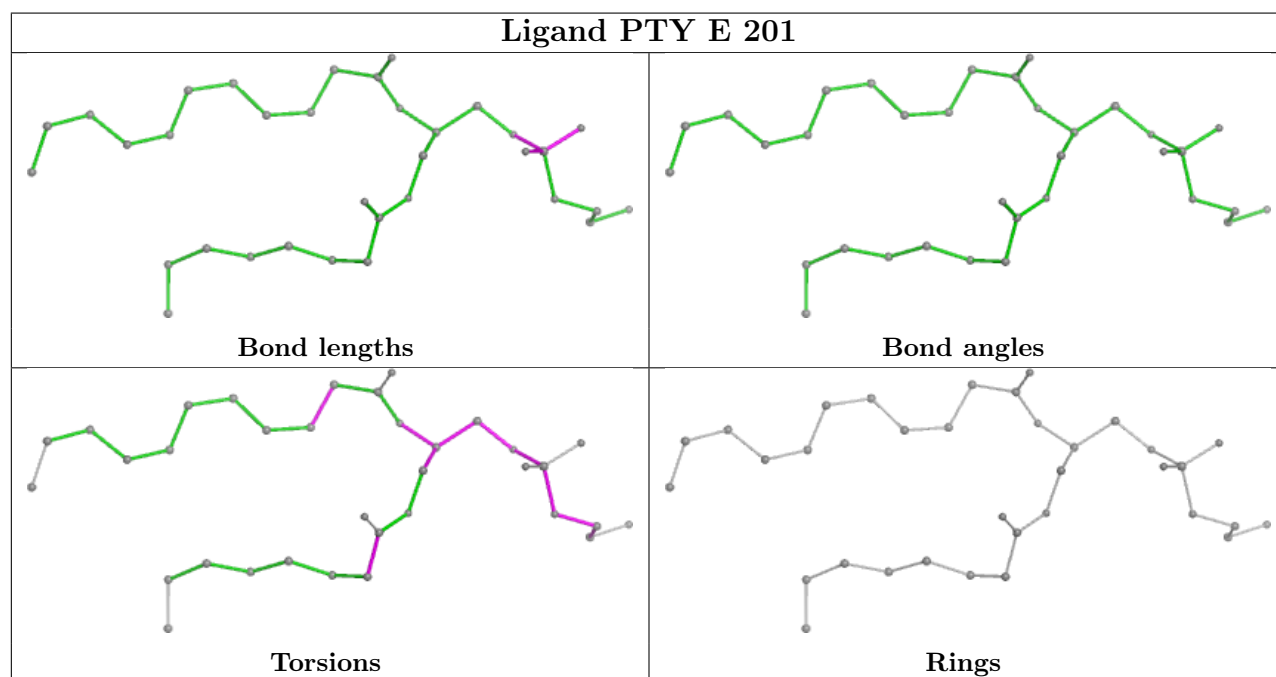
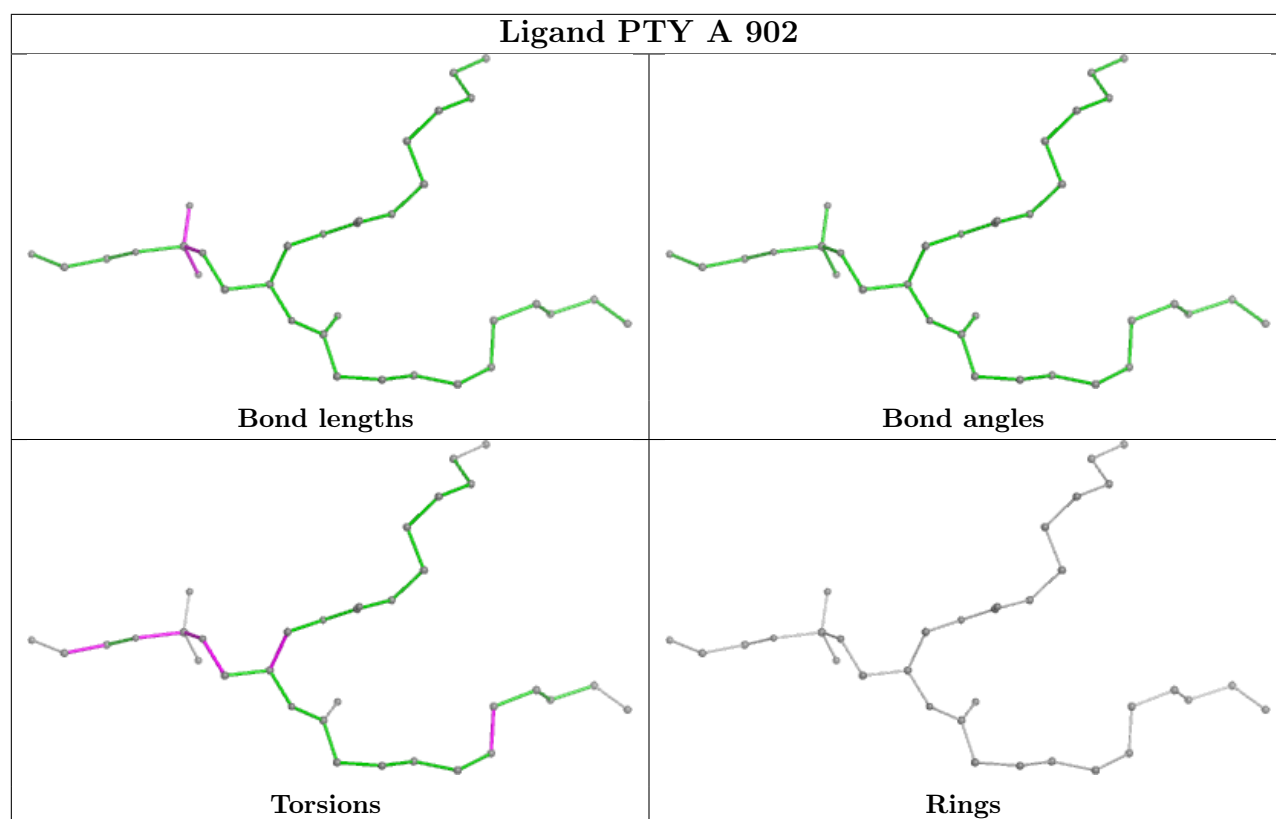
There are no ring outliers.

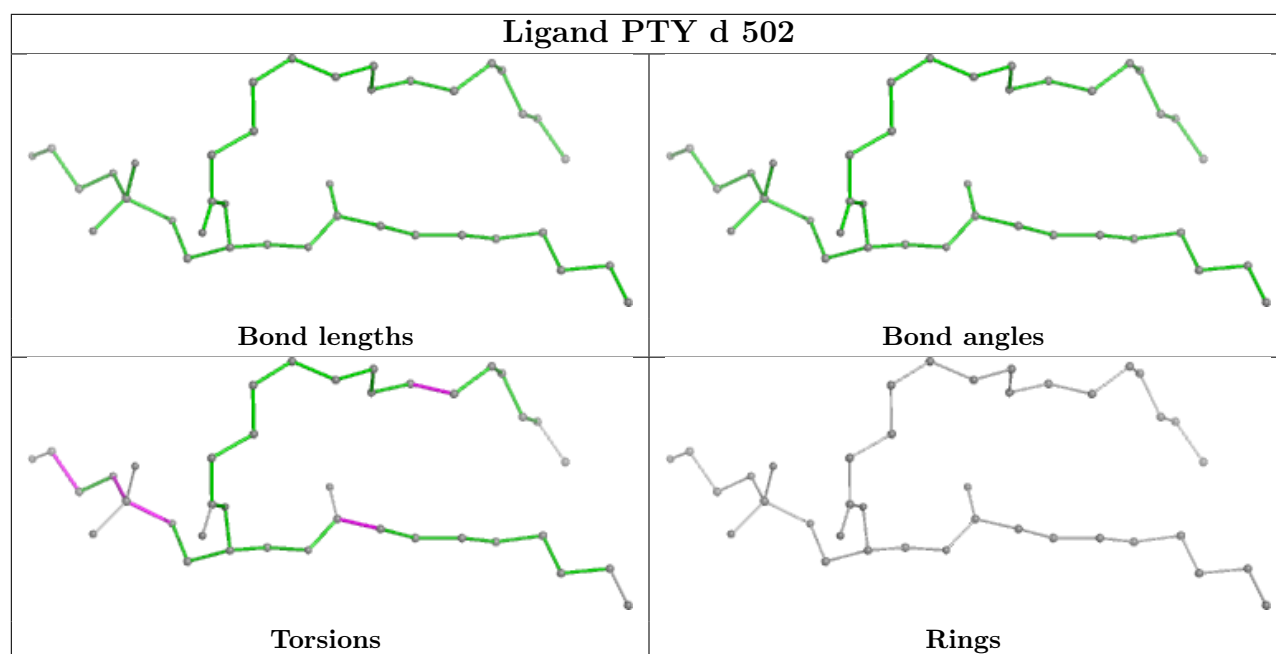
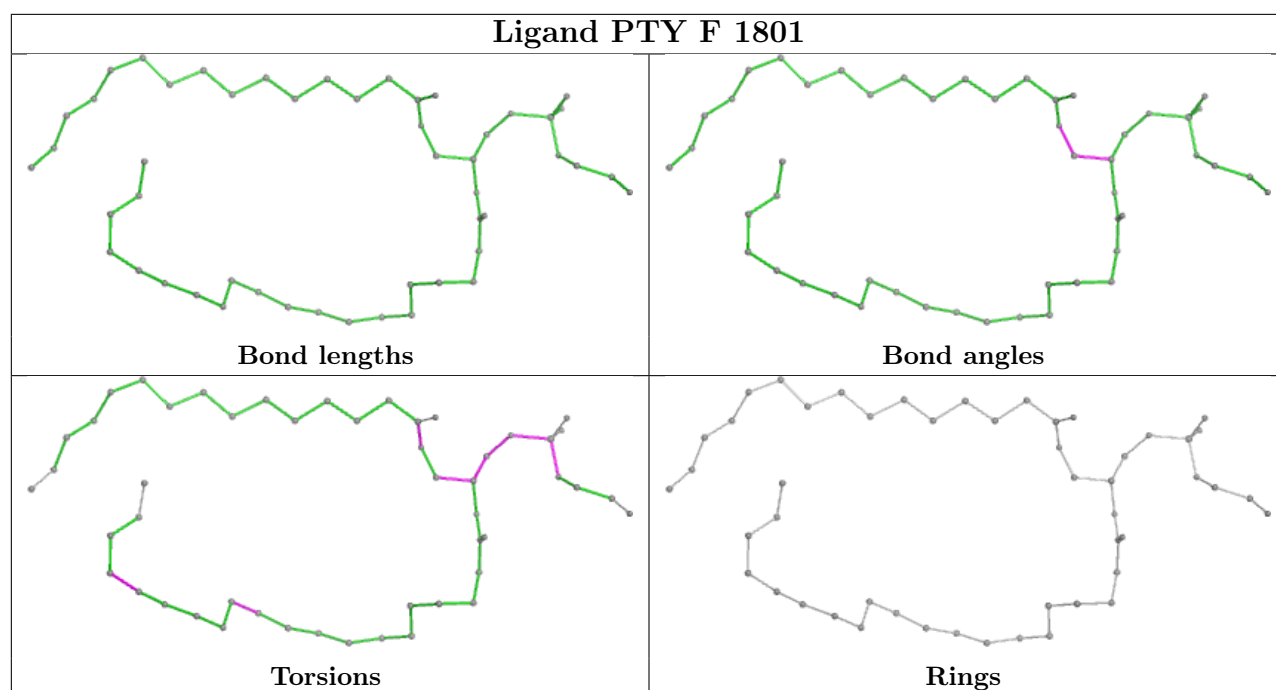
No monomer is involved in short contacts.

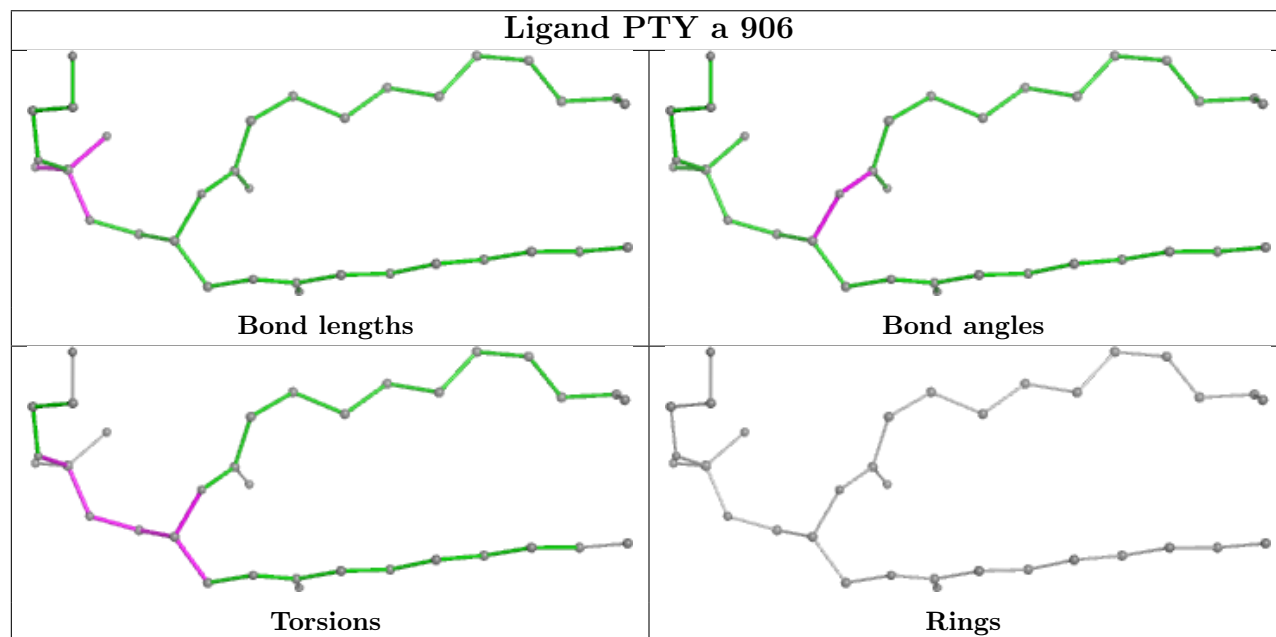
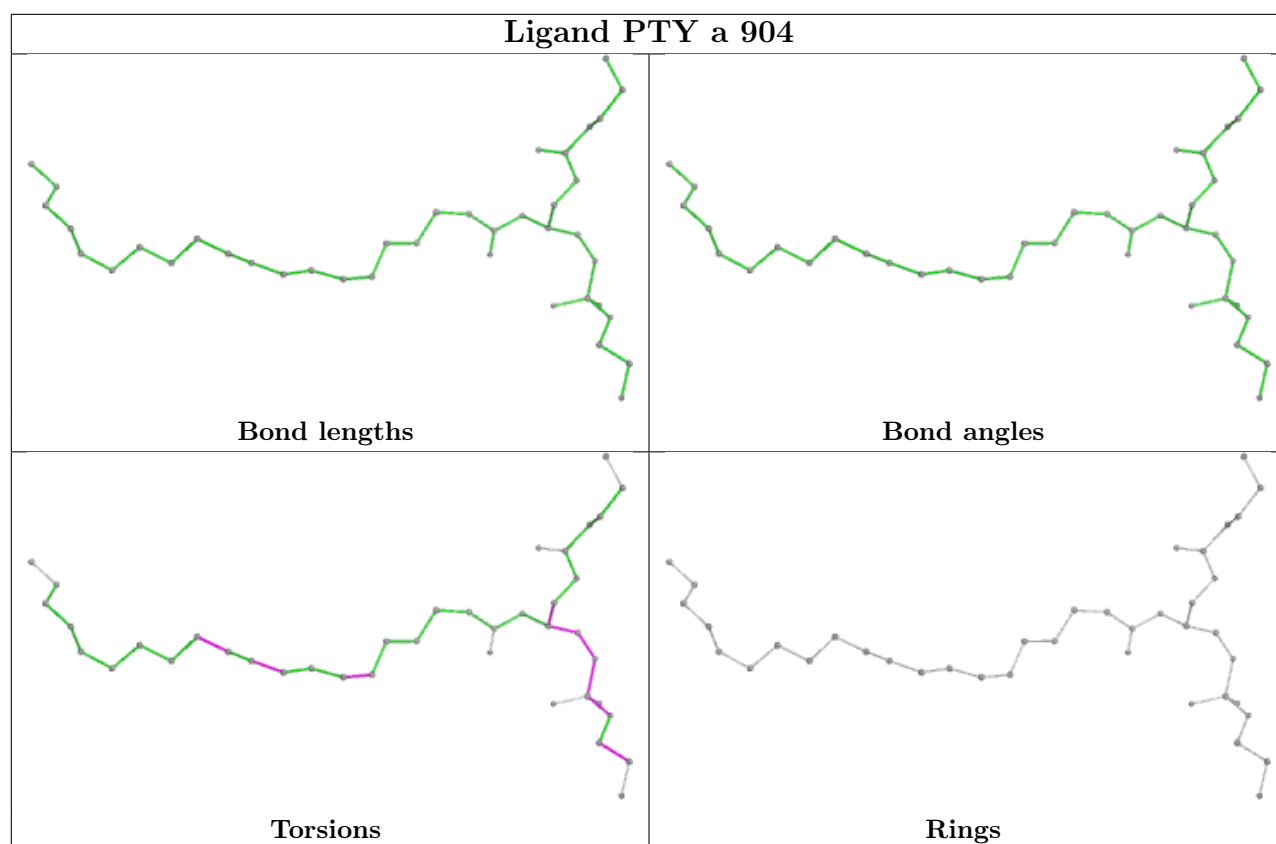
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

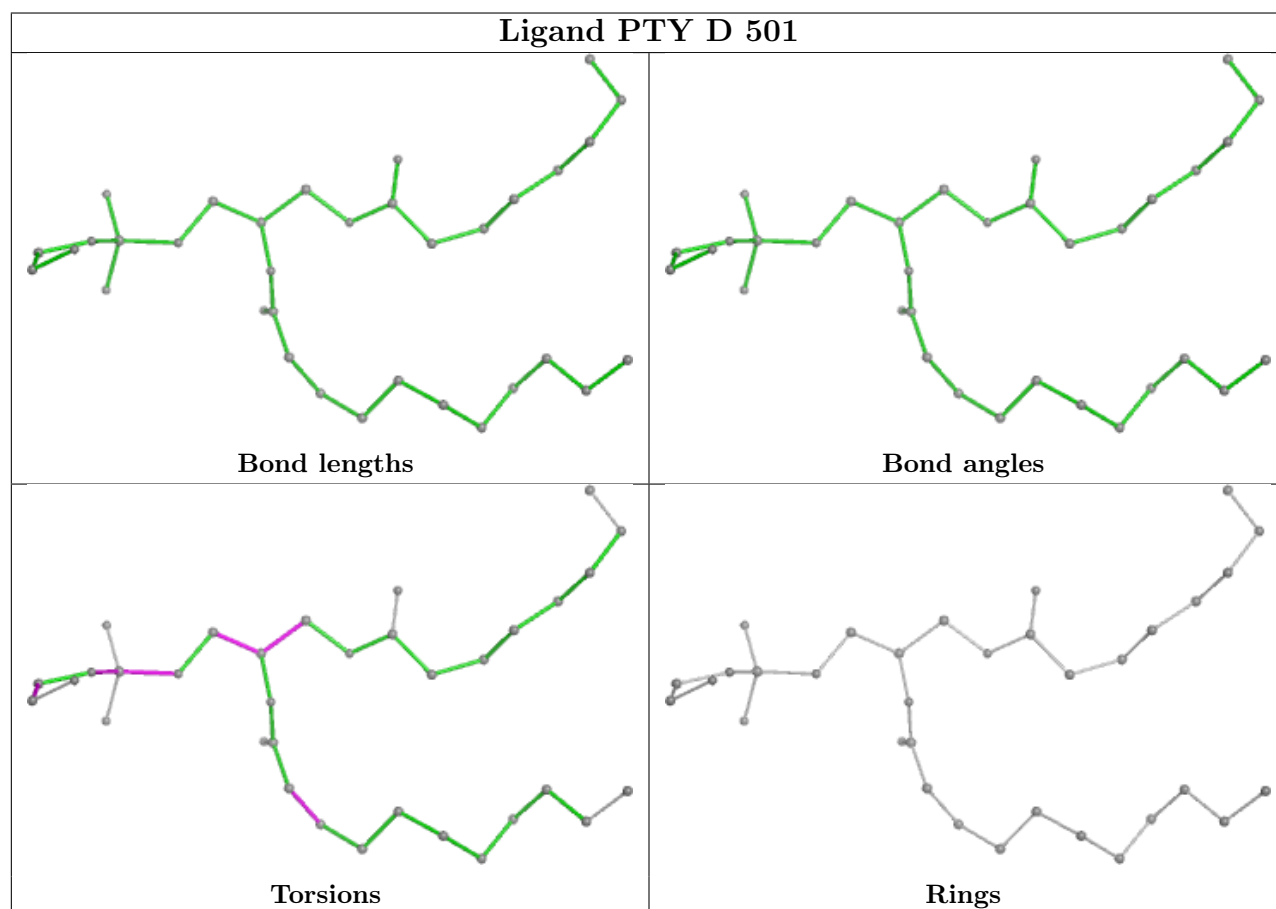
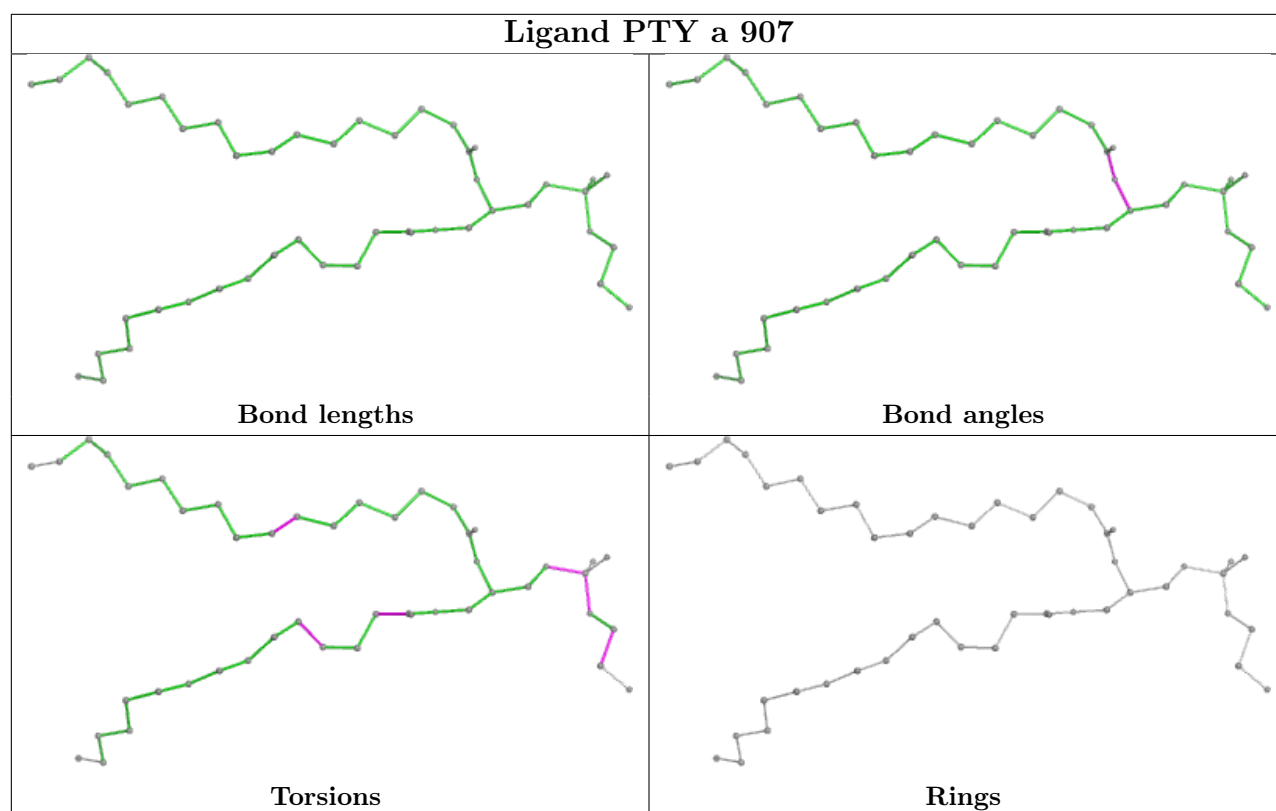


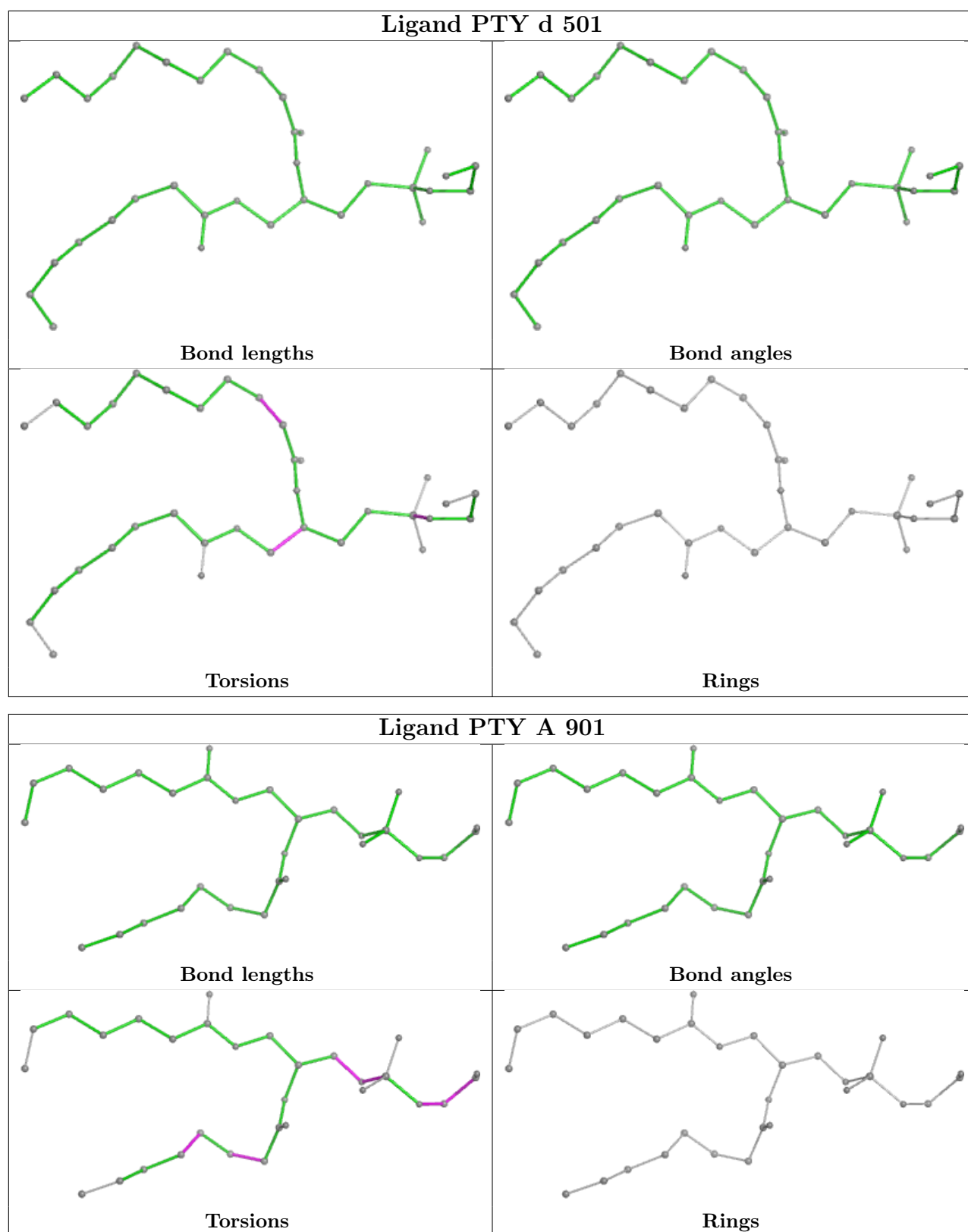


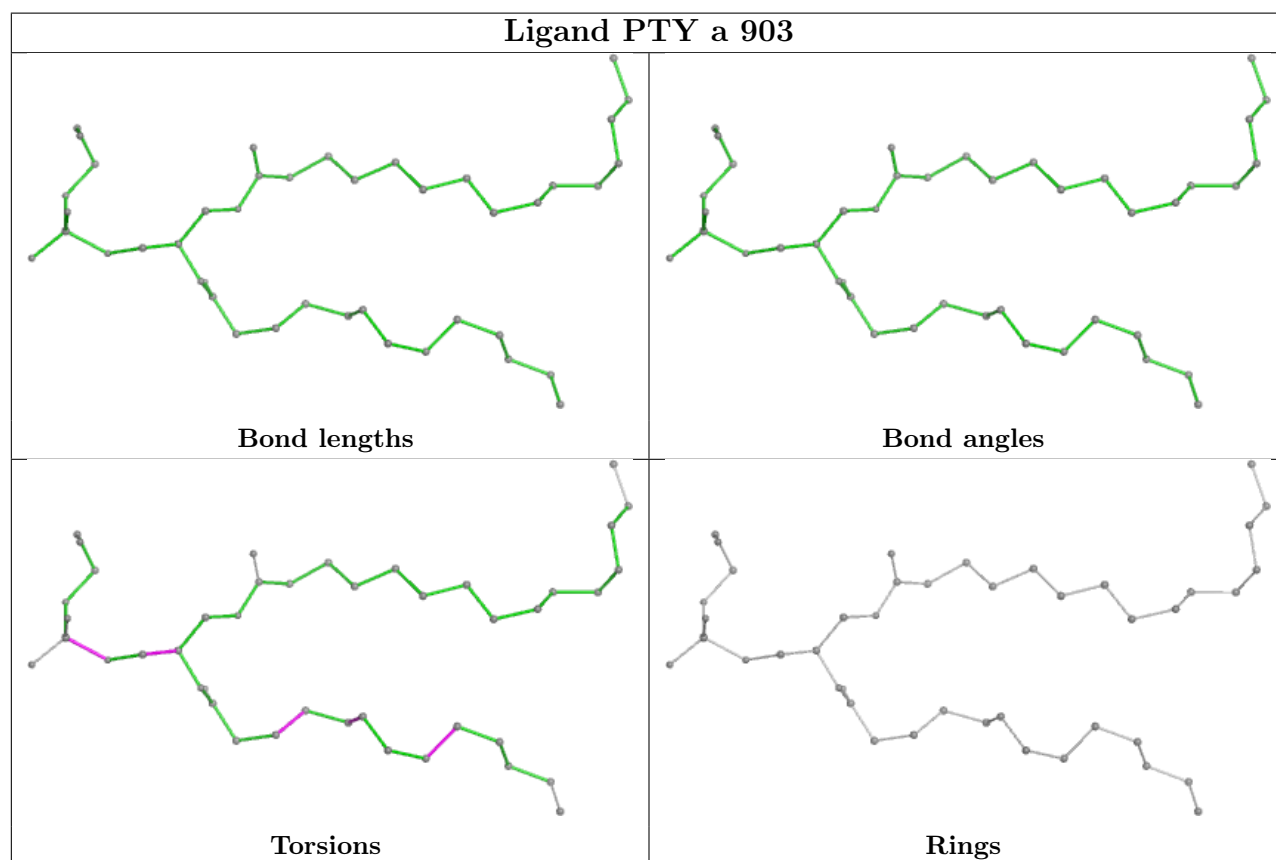
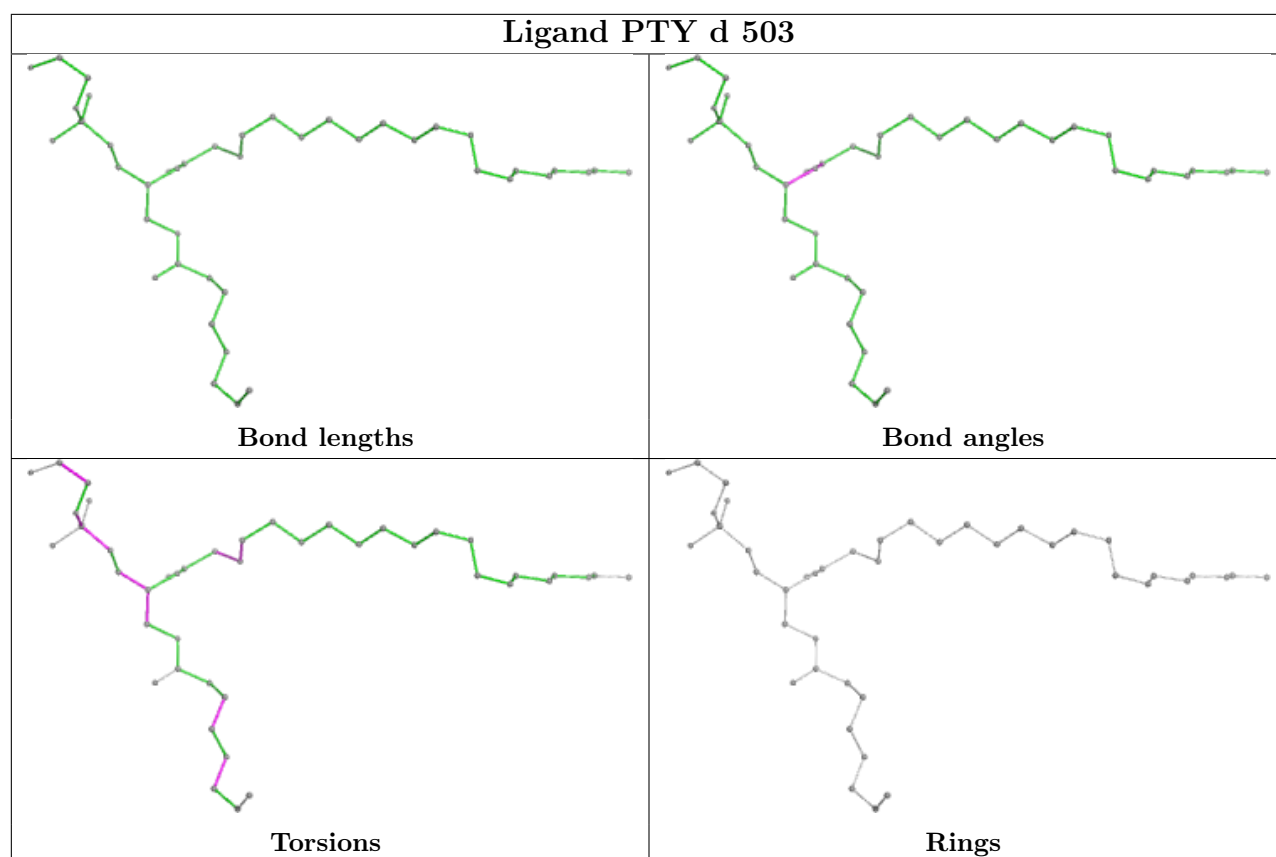


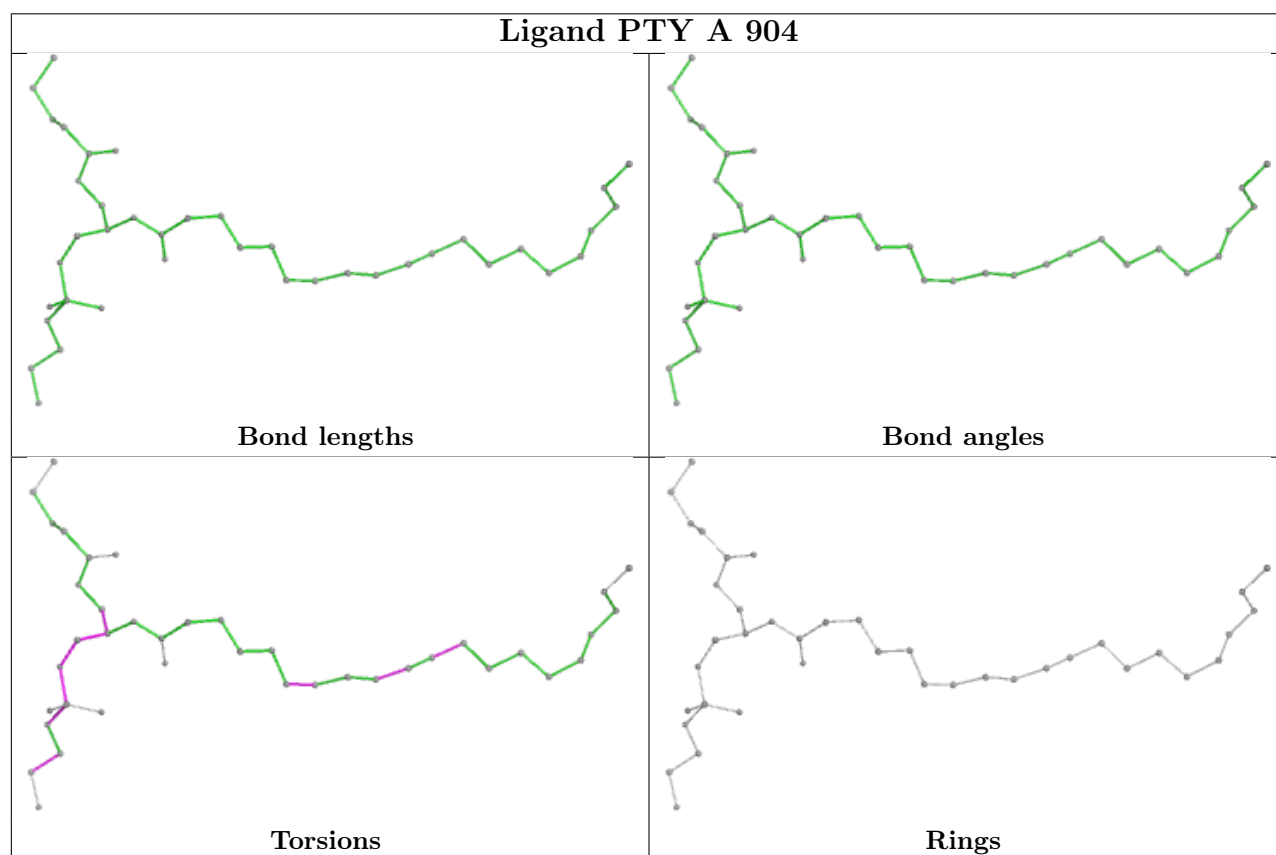
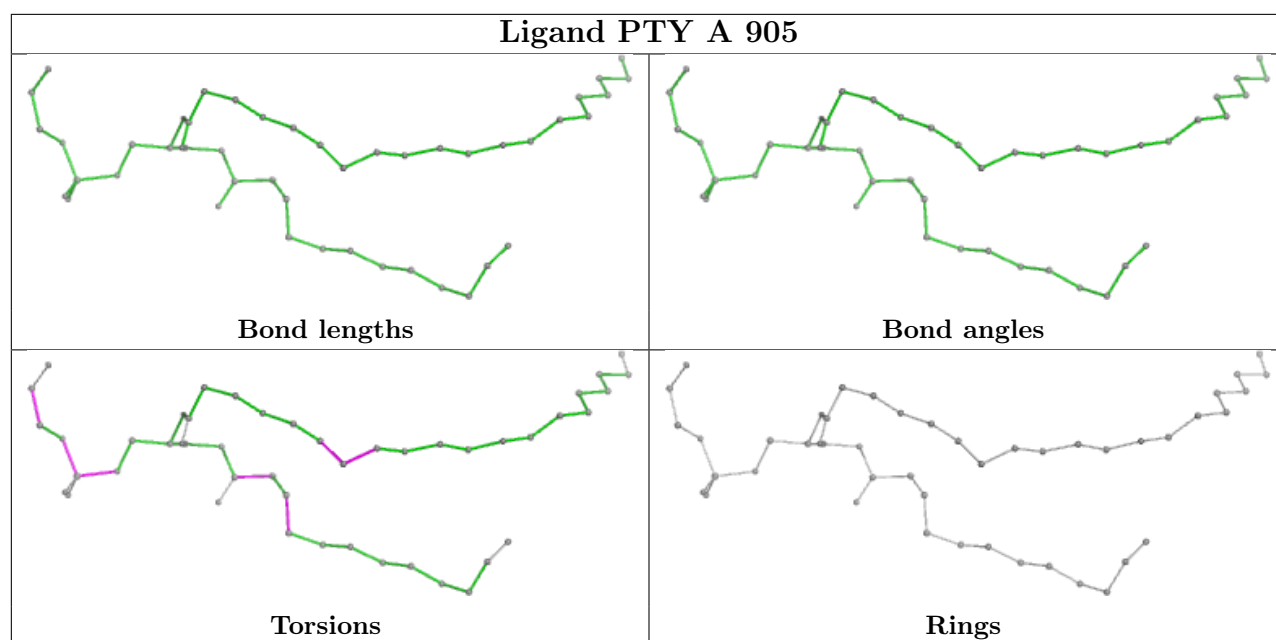


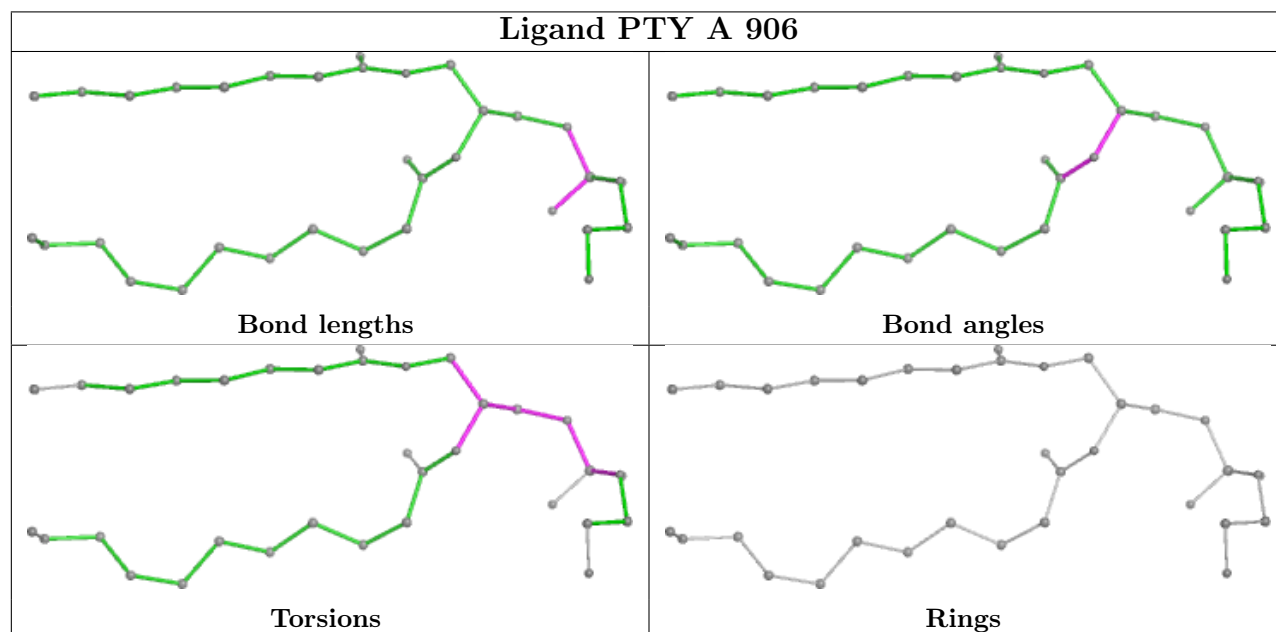
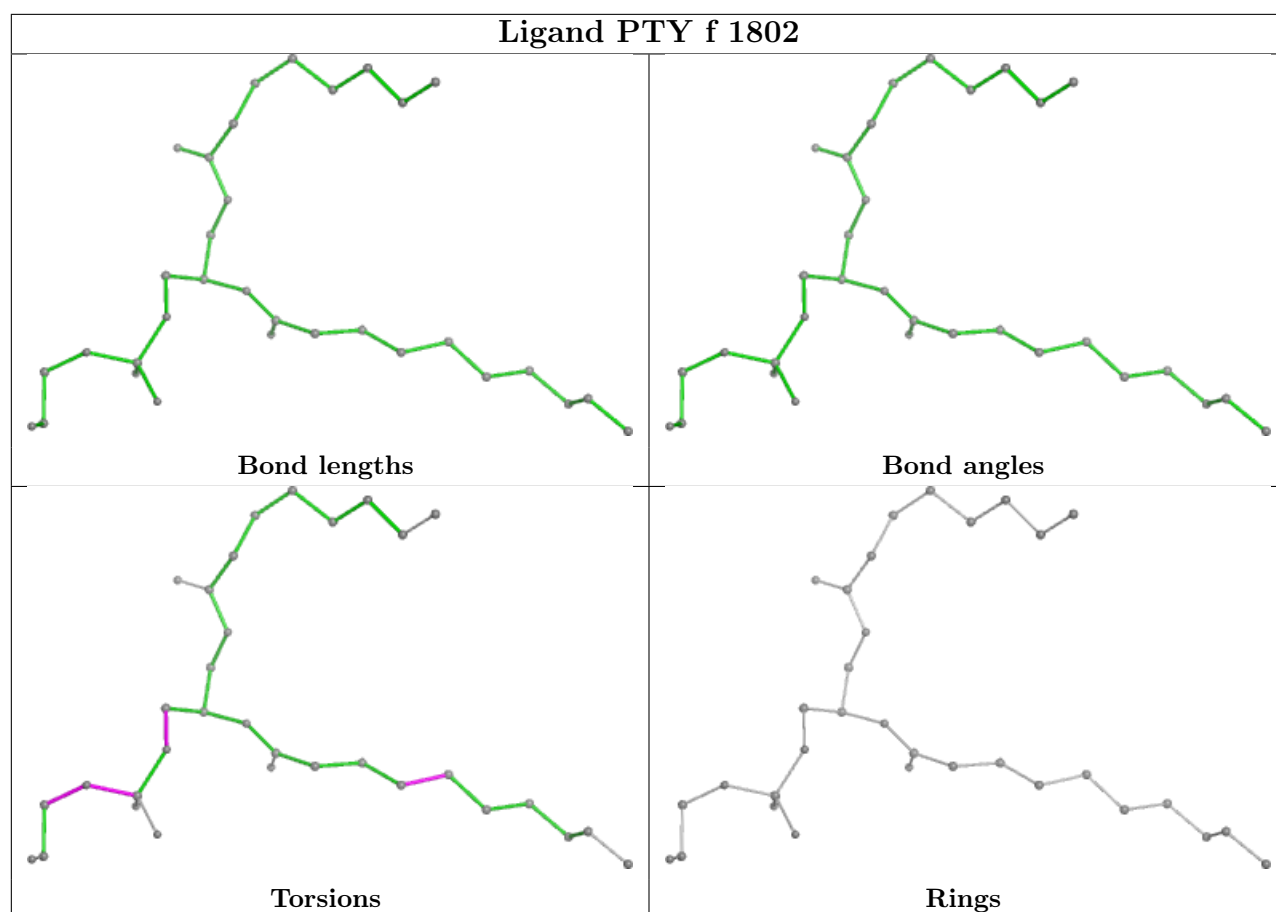


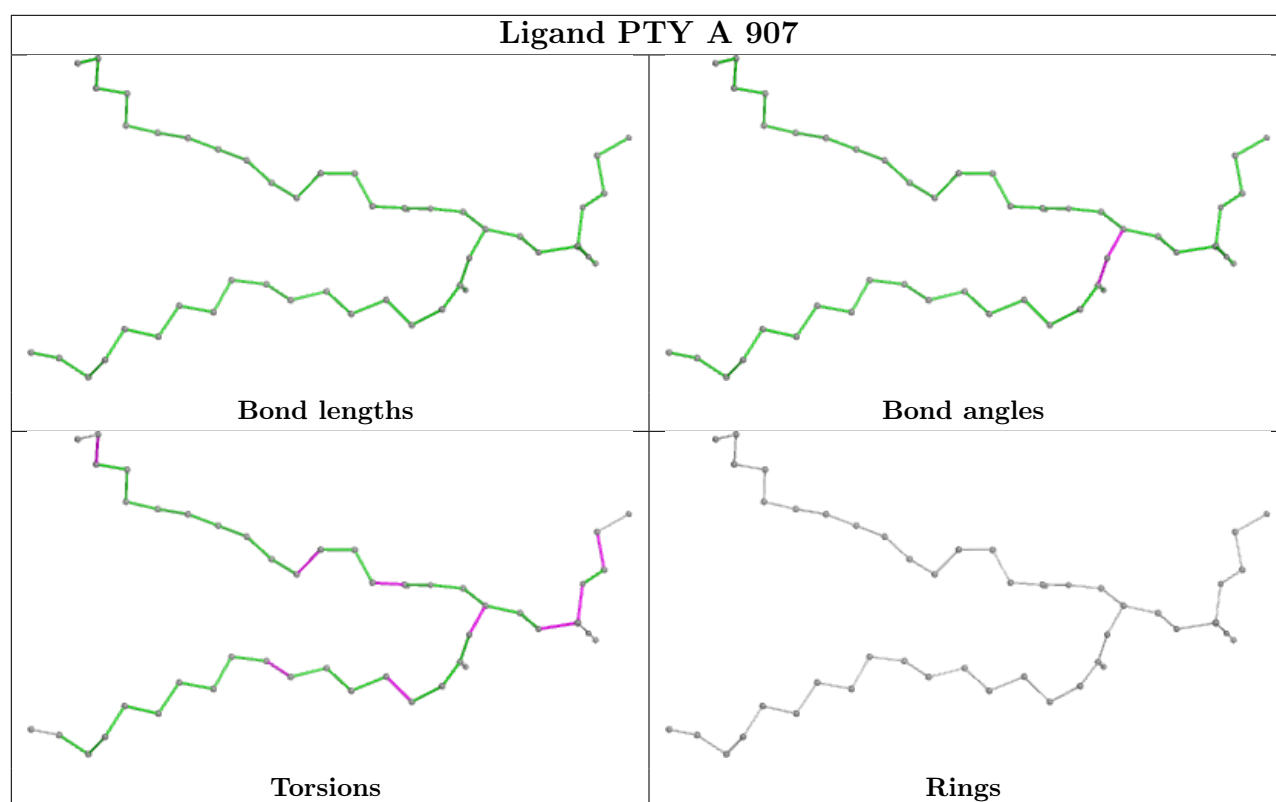
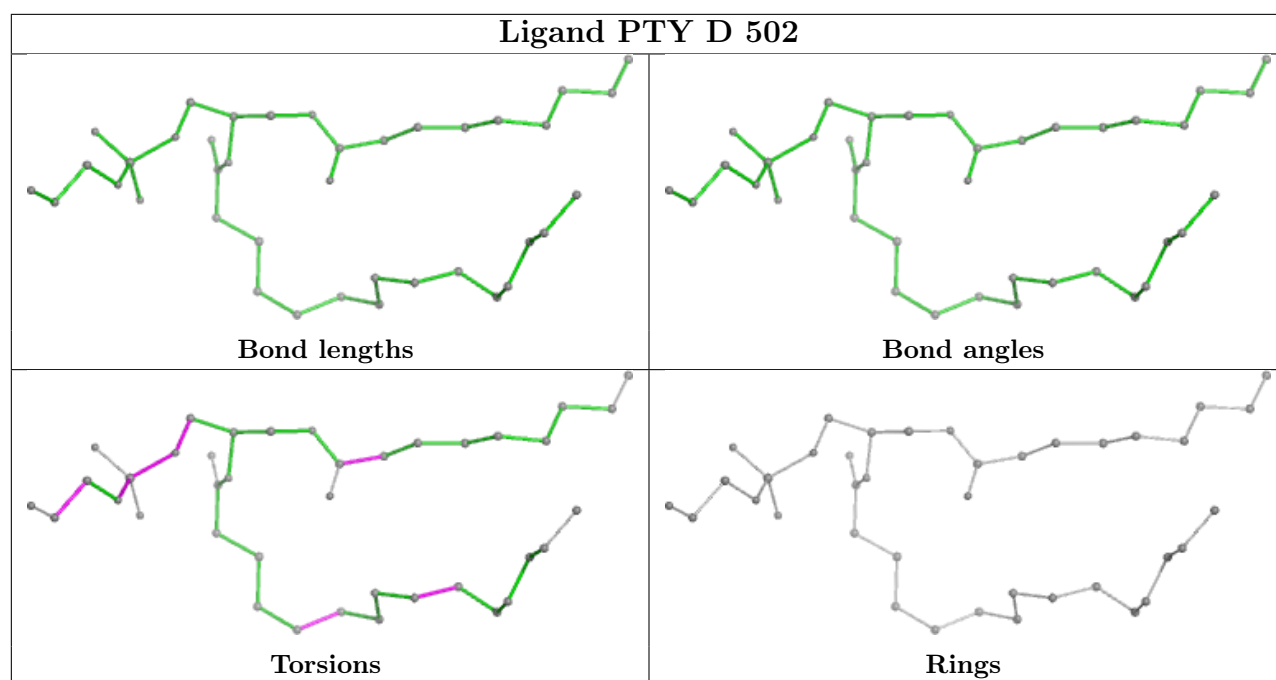


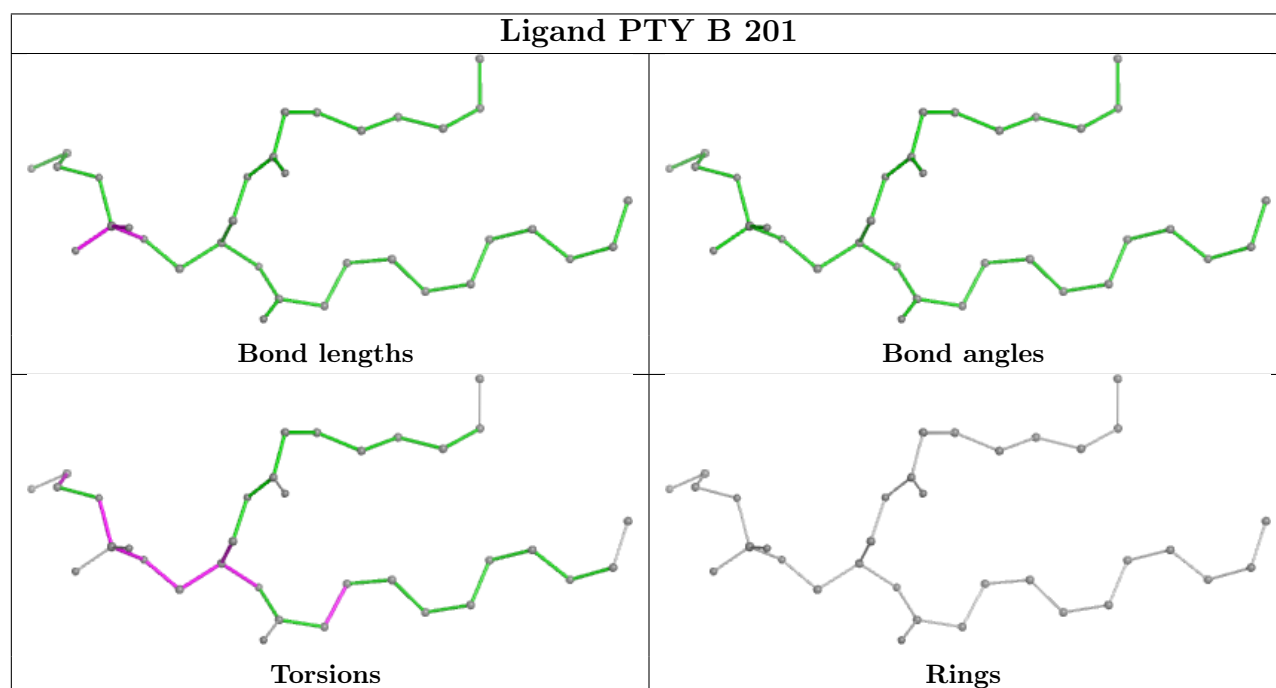
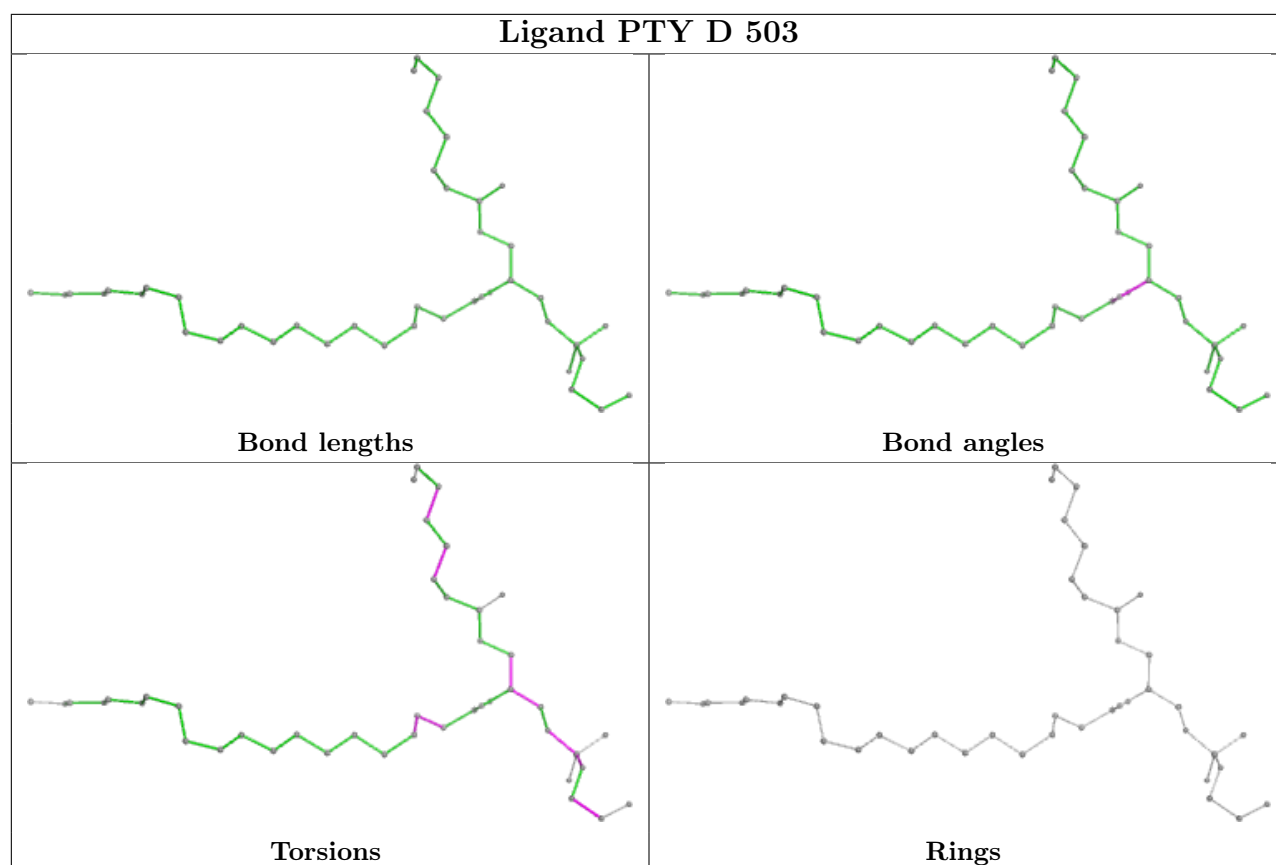


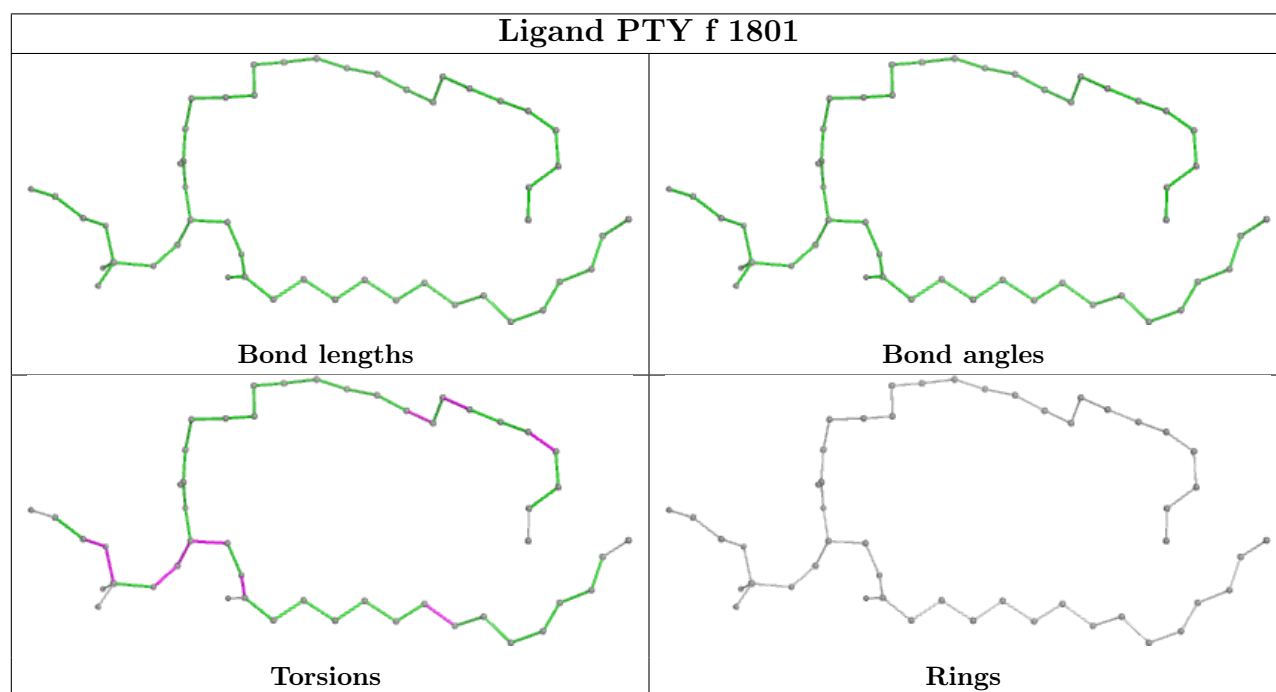
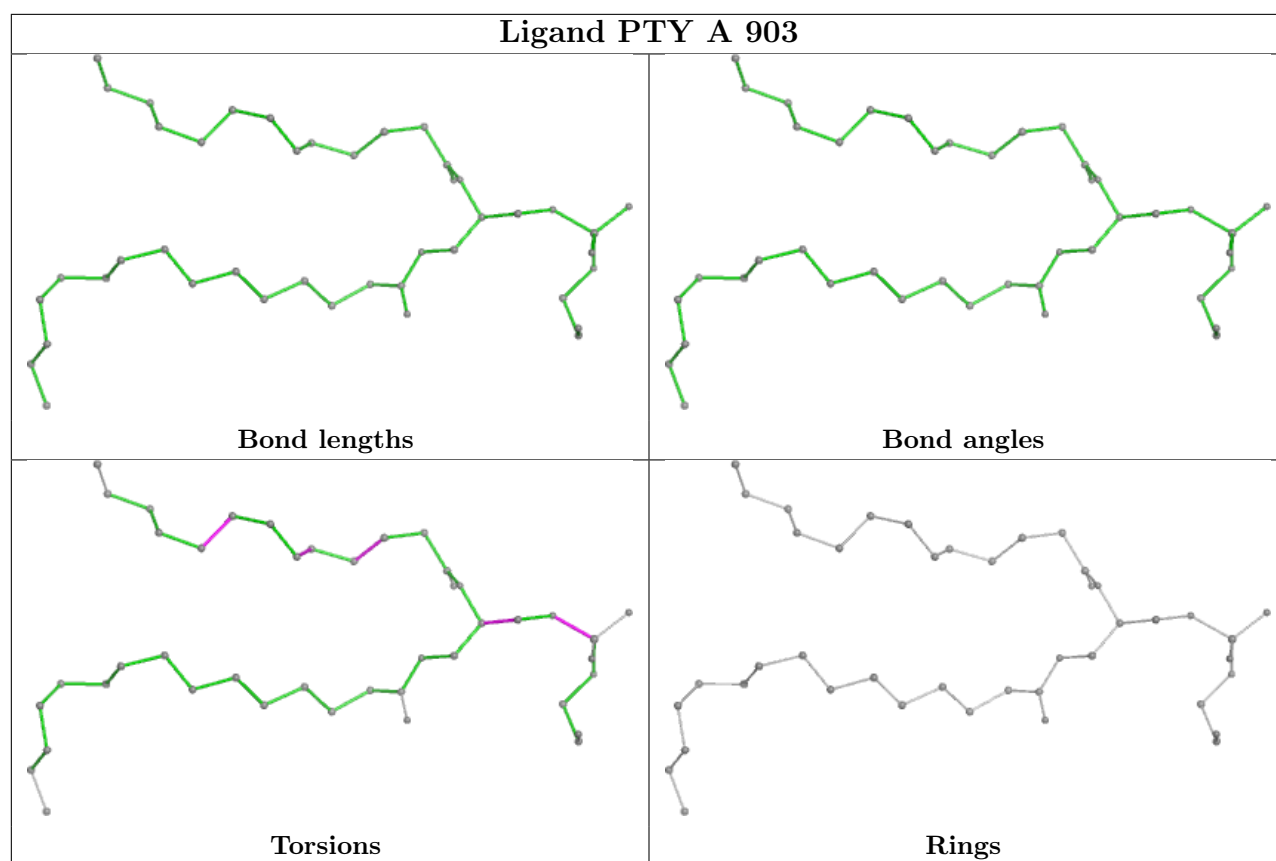


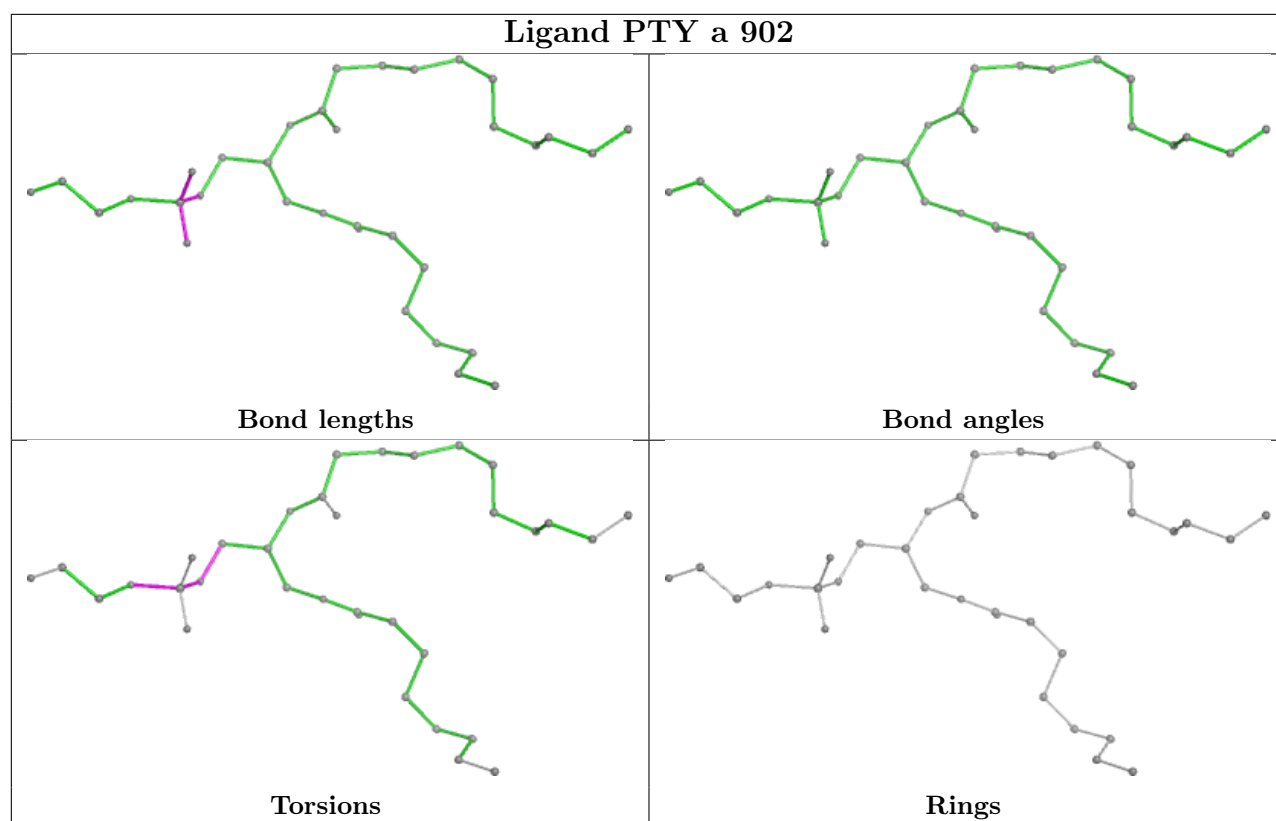












3.7 Other polymers [i](#)

There are no such residues in this entry.

3.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

4 Map visualisation

This section contains visualisations of the EMDB entry EMD-11027. These allow visual inspection of the internal detail of the map and identification of artifacts.

No raw map or half-maps were deposited for this entry and therefore no images, graphs, etc. pertaining to the raw map can be shown.

4.1 Orthogonal projections

This section was not generated.

4.2 Central slices

This section was not generated.

4.3 Largest variance slices

This section was not generated.

4.4 Orthogonal standard-deviation projections (False-color)

This section was not generated.

4.5 Orthogonal surface views

This section was not generated.

4.6 Mask visualisation

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

5 Map analysis ⓘ

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

5.1 Map-value distribution ⓘ

This section was not generated.

5.2 Volume estimate versus contour level ⓘ

This section was not generated.

5.3 Rotationally averaged power spectrum ⓘ

This section was not generated. The rotationally averaged power spectrum had issues being displayed.

6 Fourier-Shell correlation

This section was not generated. No FSC curve or half-maps provided.

7 Map-model fit

This section was not generated.