



# Full wwPDB X-ray Structure Validation Report ⓘ

Oct 4, 2023 – 07:41 PM EDT

PDB ID : 6UD5  
Title : Crystal structure of human tryptophan 2,3-dioxygenase in complex with carbon monoxide and tryptophan  
Authors : Pham, K.N.; Lewis-Ballester, A.; Yeh, S.R.  
Deposited on : 2019-09-18  
Resolution : 2.05 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

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>.

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

MolProbity : **FAILED**  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtrriage (Phenix) : 1.13  
EDS : **FAILED**  
buster-report : 1.1.7 (2018)  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.35.1

## 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.05 Å.

There are no overall percentile quality scores available for this entry.

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

## 2 Entry composition i

There are 5 unique types of molecules in this entry. The entry contains 12705 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, 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 Tryptophan 2,3-dioxygenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	351	2946	1891	518	526	11	0	0	0
1	B	347	2898	1864	504	519	11	0	0	0
1	C	343	2825	1816	494	504	11	0	0	0
1	D	353	2963	1902	523	527	11	0	0	0

There are 32 discrepancies between the modelled and reference sequences:

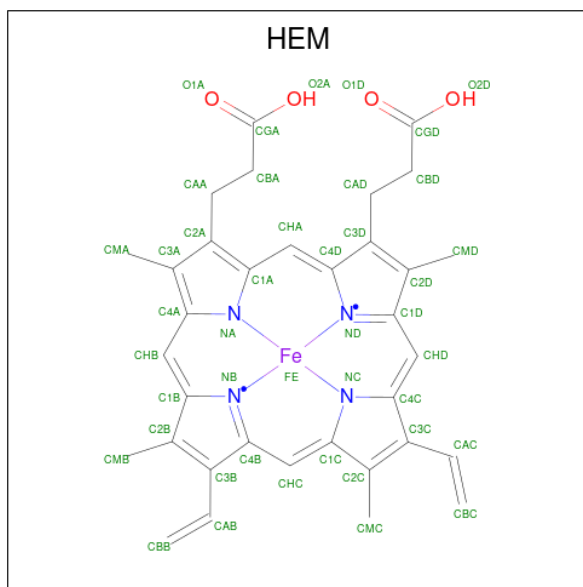
Chain	Residue	Modelled	Actual	Comment	Reference
A	17	MET	-	initiating methionine	UNP P48775
A	390	GLU	-	expression tag	UNP P48775
A	391	HIS	-	expression tag	UNP P48775
A	392	HIS	-	expression tag	UNP P48775
A	393	HIS	-	expression tag	UNP P48775
A	394	HIS	-	expression tag	UNP P48775
A	395	HIS	-	expression tag	UNP P48775
A	396	HIS	-	expression tag	UNP P48775
B	17	MET	-	initiating methionine	UNP P48775
B	390	GLU	-	expression tag	UNP P48775
B	391	HIS	-	expression tag	UNP P48775
B	392	HIS	-	expression tag	UNP P48775
B	393	HIS	-	expression tag	UNP P48775
B	394	HIS	-	expression tag	UNP P48775
B	395	HIS	-	expression tag	UNP P48775
B	396	HIS	-	expression tag	UNP P48775
C	17	MET	-	initiating methionine	UNP P48775
C	390	GLU	-	expression tag	UNP P48775
C	391	HIS	-	expression tag	UNP P48775
C	392	HIS	-	expression tag	UNP P48775
C	393	HIS	-	expression tag	UNP P48775

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Chain	Residue	Modelled	Actual	Comment	Reference
C	394	HIS	-	expression tag	UNP P48775
C	395	HIS	-	expression tag	UNP P48775
C	396	HIS	-	expression tag	UNP P48775
D	17	MET	-	initiating methionine	UNP P48775
D	390	GLU	-	expression tag	UNP P48775
D	391	HIS	-	expression tag	UNP P48775
D	392	HIS	-	expression tag	UNP P48775
D	393	HIS	-	expression tag	UNP P48775
D	394	HIS	-	expression tag	UNP P48775
D	395	HIS	-	expression tag	UNP P48775
D	396	HIS	-	expression tag	UNP P48775

- Molecule 2 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula:  $C_{34}H_{32}FeN_4O_4$ ).



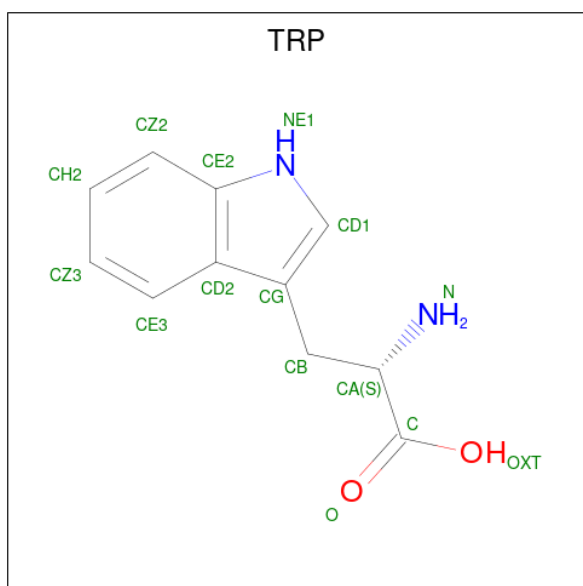
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
2	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
2	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
2	C	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
2	D	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

- Molecule 3 is CARBON MONOXIDE (three-letter code: CMO) (formula: CO).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			2	1	1		
3	B	1	Total	C	O	0	0
			2	1	1		
3	C	1	Total	C	O	0	0
			2	1	1		
3	D	1	Total	C	O	0	0
			2	1	1		

- Molecule 4 is TRYPTOPHAN (three-letter code: TRP) (formula:  $C_{11}H_{12}N_2O_2$ ) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			15	11	2	2		
4	A	1	Total	C	N	O	0	0
			15	11	2	2		
4	B	1	Total	C	N	O	0	0
			15	11	2	2		
4	B	1	Total	C	N	O	0	0
			15	11	2	2		
4	C	1	Total	C	N	O	0	0
			15	11	2	2		
4	C	1	Total	C	N	O	0	0
			15	11	2	2		
4	D	1	Total	C	N	O	0	0
			15	11	2	2		
4	D	1	Total	C	N	O	0	0
			15	11	2	2		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	202	Total	O	0	0
			202	202		
5	B	214	Total	O	0	0
			214	214		
5	C	155	Total	O	0	0
			155	155		
5	D	202	Total	O	0	0
			202	202		

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

### 3 Data and refinement statistics

EDS failed to run properly - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	144.72Å 154.49Å 88.31Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.97 – 2.05	Depositor
% Data completeness (in resolution range)	96.4 (19.97-2.05)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.84 (at 2.06Å)	Xtrriage
Refinement program	REFMAC 5.8.0253	Depositor
R, $R_{free}$	0.183 , 0.217	Depositor
Wilson B-factor (Å <sup>2</sup> )	32.3	Xtrriage
Anisotropy	0.011	Xtrriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	12705	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	40.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.22% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 4 Model quality [i](#)

### 4.1 Standard geometry [i](#)

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

### 4.2 Too-close contacts [i](#)

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

### 4.3 Torsion angles [i](#)

#### 4.3.1 Protein backbone [i](#)

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

#### 4.3.2 Protein sidechains [i](#)

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

#### 4.3.3 RNA [i](#)

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

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

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

### 4.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

### 4.6 Ligand geometry [i](#)

16 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
4	TRP	B	502	-	14,16,16	0.87	1 (7%)	16,22,22	1.10	2 (12%)
2	HEM	C	500	1,3	41,50,50	1.30	5 (12%)	45,82,82	1.86	12 (26%)
4	TRP	A	502	-	14,16,16	0.78	1 (7%)	16,22,22	1.09	2 (12%)
2	HEM	D	500	1,3	41,50,50	1.36	6 (14%)	45,82,82	1.82	12 (26%)
4	TRP	C	503	-	14,16,16	0.83	1 (7%)	16,22,22	1.15	1 (6%)
4	TRP	A	503	-	14,16,16	0.78	1 (7%)	16,22,22	1.15	3 (18%)
4	TRP	B	503	-	14,16,16	0.80	1 (7%)	16,22,22	1.09	1 (6%)
2	HEM	B	500	1,3	41,50,50	1.36	6 (14%)	45,82,82	1.80	12 (26%)
3	CMO	A	501	2	0,1,1	-	-	-	-	-
2	HEM	A	500	1,3	41,50,50	1.32	7 (17%)	45,82,82	1.75	10 (22%)
3	CMO	C	501	2	0,1,1	-	-	-	-	-
3	CMO	D	501	2	0,1,1	-	-	-	-	-
4	TRP	D	502	-	14,16,16	0.79	0	16,22,22	0.97	0
4	TRP	D	503	-	14,16,16	0.79	1 (7%)	16,22,22	1.08	2 (12%)
3	CMO	B	501	2	0,1,1	-	-	-	-	-
4	TRP	C	502	-	14,16,16	0.80	1 (7%)	16,22,22	1.11	1 (6%)

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	TRP	B	502	-	-	3/7/8/8	0/2/2/2
2	HEM	C	500	1,3	-	2/12/54/54	-
4	TRP	A	502	-	-	1/7/8/8	0/2/2/2
2	HEM	D	500	1,3	-	2/12/54/54	-
4	TRP	C	503	-	-	0/7/8/8	0/2/2/2
4	TRP	A	503	-	-	0/7/8/8	0/2/2/2
4	TRP	B	503	-	-	0/7/8/8	0/2/2/2
2	HEM	B	500	1,3	-	4/12/54/54	-
2	HEM	A	500	1,3	-	2/12/54/54	-
4	TRP	D	502	-	-	1/7/8/8	0/2/2/2
4	TRP	D	503	-	-	0/7/8/8	0/2/2/2
4	TRP	C	502	-	-	2/7/8/8	0/2/2/2

All (31) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	500	HEM	C1B-NB	-3.49	1.34	1.40
2	B	500	HEM	C1B-NB	-3.37	1.34	1.40
2	A	500	HEM	C1B-NB	-3.21	1.34	1.40
2	C	500	HEM	C1B-NB	-3.09	1.35	1.40
2	D	500	HEM	FE-NB	3.04	2.11	1.96
2	B	500	HEM	C4D-ND	-2.91	1.35	1.40
2	B	500	HEM	FE-NB	2.82	2.10	1.96
2	A	500	HEM	FE-NB	2.81	2.10	1.96
2	C	500	HEM	FE-NB	2.79	2.10	1.96
2	A	500	HEM	C4D-ND	-2.63	1.35	1.40
2	D	500	HEM	C4D-ND	-2.62	1.35	1.40
2	C	500	HEM	C4D-ND	-2.60	1.35	1.40
2	A	500	HEM	CHB-C1B	2.43	1.41	1.35
2	B	500	HEM	CHB-C1B	2.38	1.41	1.35
2	A	500	HEM	C3B-C4B	2.37	1.49	1.44
2	C	500	HEM	C3B-C4B	2.31	1.49	1.44
4	B	502	TRP	OXT-C	-2.29	1.23	1.30
4	C	503	TRP	OXT-C	-2.26	1.23	1.30
2	C	500	HEM	CHB-C1B	2.24	1.40	1.35
2	B	500	HEM	C1D-ND	-2.21	1.34	1.38
2	D	500	HEM	CHB-C1B	2.18	1.40	1.35
2	D	500	HEM	C1D-ND	-2.18	1.34	1.38
2	D	500	HEM	C4B-NB	-2.16	1.34	1.38
4	B	503	TRP	OXT-C	-2.10	1.23	1.30
4	C	502	TRP	OXT-C	-2.09	1.23	1.30
4	A	503	TRP	OXT-C	-2.06	1.23	1.30
4	D	503	TRP	OXT-C	-2.06	1.23	1.30
4	A	502	TRP	OXT-C	-2.05	1.23	1.30
2	B	500	HEM	O2D-CGD	-2.05	1.23	1.30
2	A	500	HEM	C1D-ND	-2.01	1.34	1.38
2	A	500	HEM	C1D-C2D	2.01	1.48	1.44

All (58) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	500	HEM	C1B-NB-C4B	4.73	109.96	105.07
2	B	500	HEM	CHC-C4B-NB	4.50	129.32	124.43
2	D	500	HEM	CHC-C4B-NB	4.30	129.10	124.43
2	A	500	HEM	CHC-C4B-NB	4.27	129.07	124.43
2	B	500	HEM	C1B-NB-C4B	4.17	109.38	105.07
2	A	500	HEM	C1B-NB-C4B	4.17	109.38	105.07
2	C	500	HEM	CHC-C4B-NB	4.12	128.91	124.43

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	500	HEM	C1B-NB-C4B	4.08	109.28	105.07
2	B	500	HEM	CHD-C1D-ND	3.93	128.70	124.43
2	D	500	HEM	CBD-CAD-C3D	-3.89	101.82	112.63
2	A	500	HEM	CBD-CAD-C3D	-3.84	101.97	112.63
2	C	500	HEM	CBD-CAD-C3D	-3.76	102.19	112.63
2	C	500	HEM	CHA-C4D-ND	3.69	128.93	124.38
2	D	500	HEM	CHA-C4D-ND	3.66	128.90	124.38
2	B	500	HEM	CBD-CAD-C3D	-3.56	102.74	112.63
2	B	500	HEM	CHA-C4D-ND	3.37	128.54	124.38
2	A	500	HEM	CHD-C1D-ND	3.36	128.08	124.43
2	C	500	HEM	CHD-C1D-ND	3.34	128.06	124.43
2	A	500	HEM	CHA-C4D-ND	3.21	128.35	124.38
2	C	500	HEM	CHB-C1B-NB	3.06	128.16	124.38
4	C	503	TRP	OXT-C-O	-2.99	117.30	124.09
2	D	500	HEM	CHD-C1D-ND	2.98	127.67	124.43
2	B	500	HEM	CHD-C1D-C2D	-2.91	120.44	124.98
2	C	500	HEM	CBA-CAA-C2A	-2.83	107.80	112.62
2	B	500	HEM	CHB-C1B-NB	2.72	127.74	124.38
2	C	500	HEM	CHD-C1D-C2D	-2.71	120.74	124.98
4	B	503	TRP	OXT-C-O	-2.62	118.13	124.09
2	A	500	HEM	CHD-C1D-C2D	-2.62	120.89	124.98
2	D	500	HEM	CHA-C4D-C3D	-2.57	120.51	125.33
2	A	500	HEM	CHA-C4D-C3D	-2.55	120.54	125.33
4	C	502	TRP	OXT-C-O	-2.51	118.39	124.09
4	A	503	TRP	OXT-C-CA	2.51	121.92	113.38
2	D	500	HEM	O2D-CGD-O1D	-2.50	117.07	123.30
4	B	502	TRP	OXT-C-O	-2.50	118.42	124.09
2	D	500	HEM	CMD-C2D-C1D	2.48	128.82	125.04
2	D	500	HEM	O2D-CGD-CBD	2.47	121.95	114.03
2	C	500	HEM	CMD-C2D-C1D	2.44	128.76	125.04
4	A	503	TRP	OXT-C-O	-2.43	118.58	124.09
2	D	500	HEM	CHB-C1B-NB	2.41	127.36	124.38
2	A	500	HEM	CHB-C1B-NB	2.37	127.31	124.38
2	A	500	HEM	CBA-CAA-C2A	-2.37	108.58	112.62
2	C	500	HEM	CHA-C4D-C3D	-2.36	120.89	125.33
2	C	500	HEM	O2D-CGD-CBD	2.36	121.60	114.03
2	A	500	HEM	CMD-C2D-C1D	2.34	128.60	125.04
4	D	503	TRP	OXT-C-CA	2.33	121.31	113.38
2	B	500	HEM	CHA-C4D-C3D	-2.32	120.98	125.33
4	D	503	TRP	OXT-C-O	-2.31	118.85	124.09
2	D	500	HEM	CHD-C1D-C2D	-2.29	121.41	124.98
4	A	502	TRP	OXT-C-CA	2.26	121.07	113.38

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	500	HEM	O2D-CGD-CBD	2.25	121.25	114.03
2	B	500	HEM	C4B-C3B-C2B	-2.22	105.36	107.11
4	A	502	TRP	OXT-C-O	-2.15	119.21	124.09
2	B	500	HEM	CAD-CBD-CGD	2.14	118.21	113.60
2	B	500	HEM	O2D-CGD-O1D	-2.08	118.10	123.30
4	B	502	TRP	CH2-CZ2-CE2	-2.05	117.13	120.08
2	C	500	HEM	O2A-CGA-CBA	2.03	120.57	114.03
4	A	503	TRP	CH2-CZ2-CE2	-2.01	117.19	120.08
2	D	500	HEM	CAD-CBD-CGD	2.01	117.93	113.60

There are no chirality outliers.

All (17) torsion outliers are listed below:

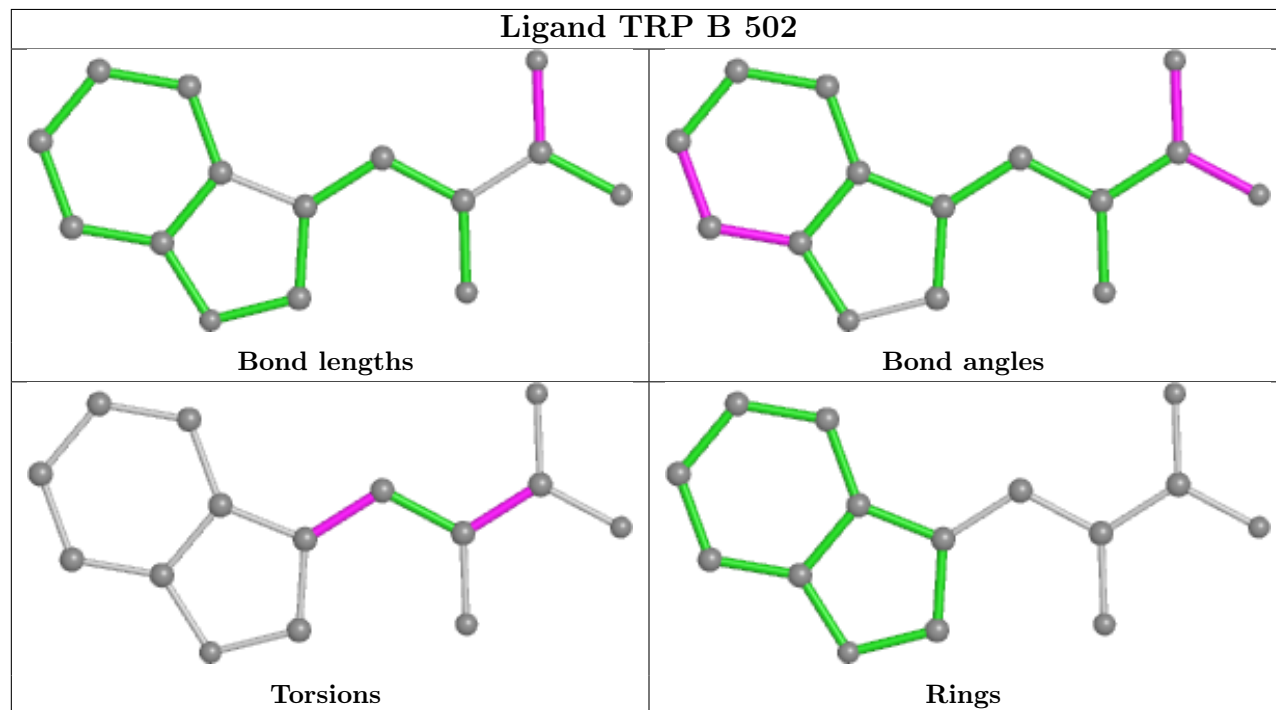
Mol	Chain	Res	Type	Atoms
4	A	502	TRP	CA-CB-CG-CD1
4	B	502	TRP	CA-CB-CG-CD1
4	C	502	TRP	CA-CB-CG-CD1
4	D	502	TRP	CA-CB-CG-CD1
4	B	502	TRP	OXT-C-CA-CB
2	A	500	HEM	CAA-CBA-CGA-O2A
4	B	502	TRP	O-C-CA-CB
2	C	500	HEM	CAA-CBA-CGA-O1A
2	A	500	HEM	CAA-CBA-CGA-O1A
2	B	500	HEM	CAA-CBA-CGA-O2A
2	B	500	HEM	CAA-CBA-CGA-O1A
2	C	500	HEM	CAA-CBA-CGA-O2A
2	D	500	HEM	CAA-CBA-CGA-O2A
2	D	500	HEM	CAA-CBA-CGA-O1A
4	C	502	TRP	OXT-C-CA-CB
2	B	500	HEM	CAD-CBD-CGD-O2D
2	B	500	HEM	CAD-CBD-CGD-O1D

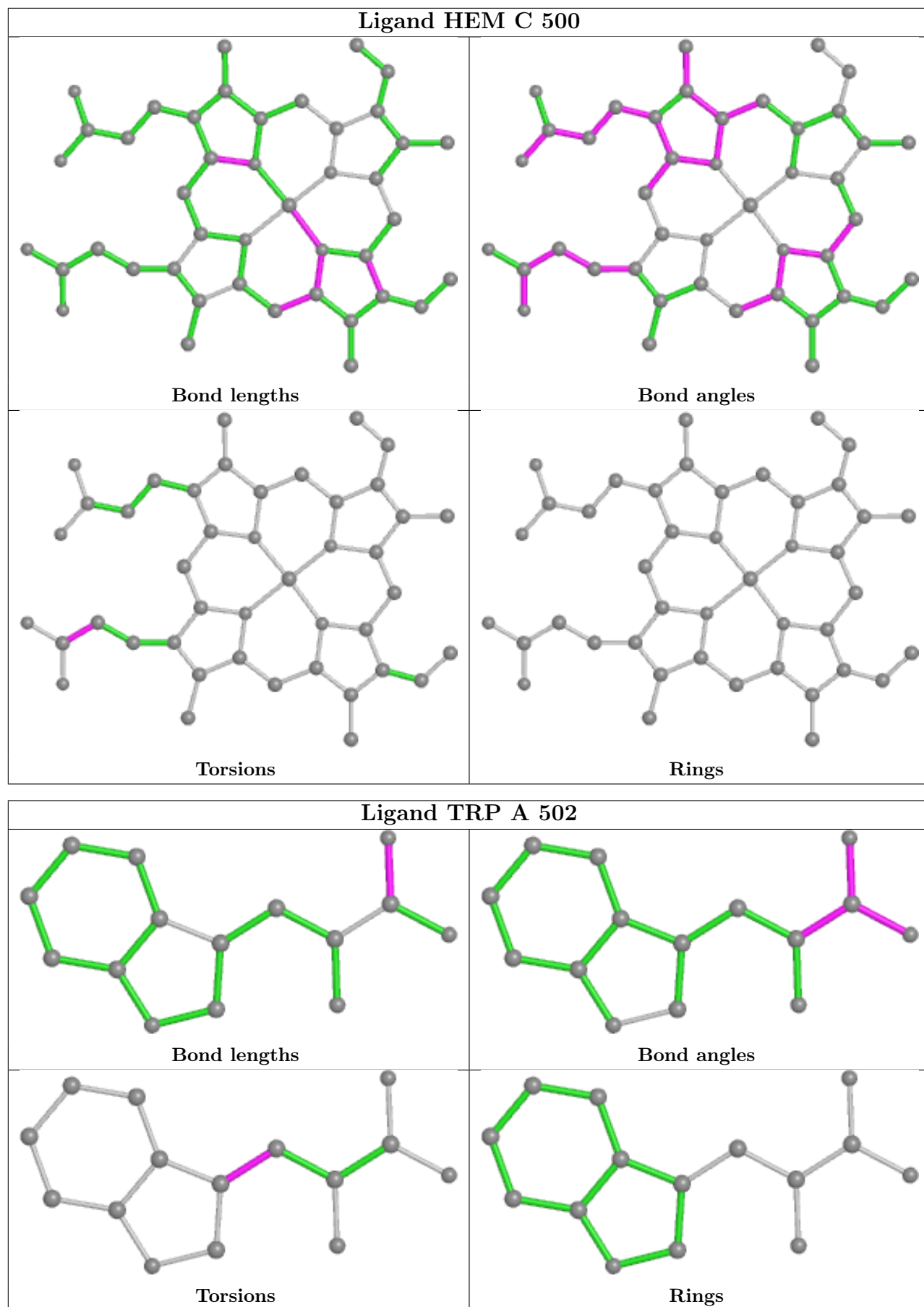
There are no ring outliers.

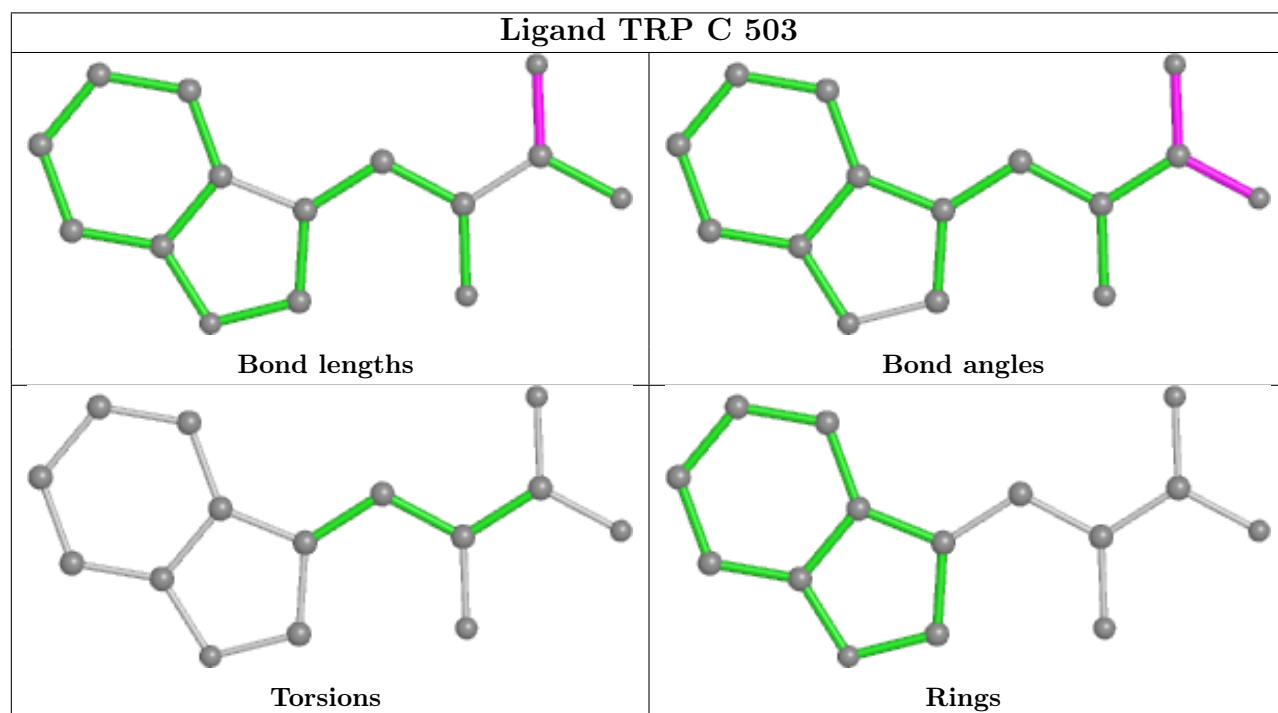
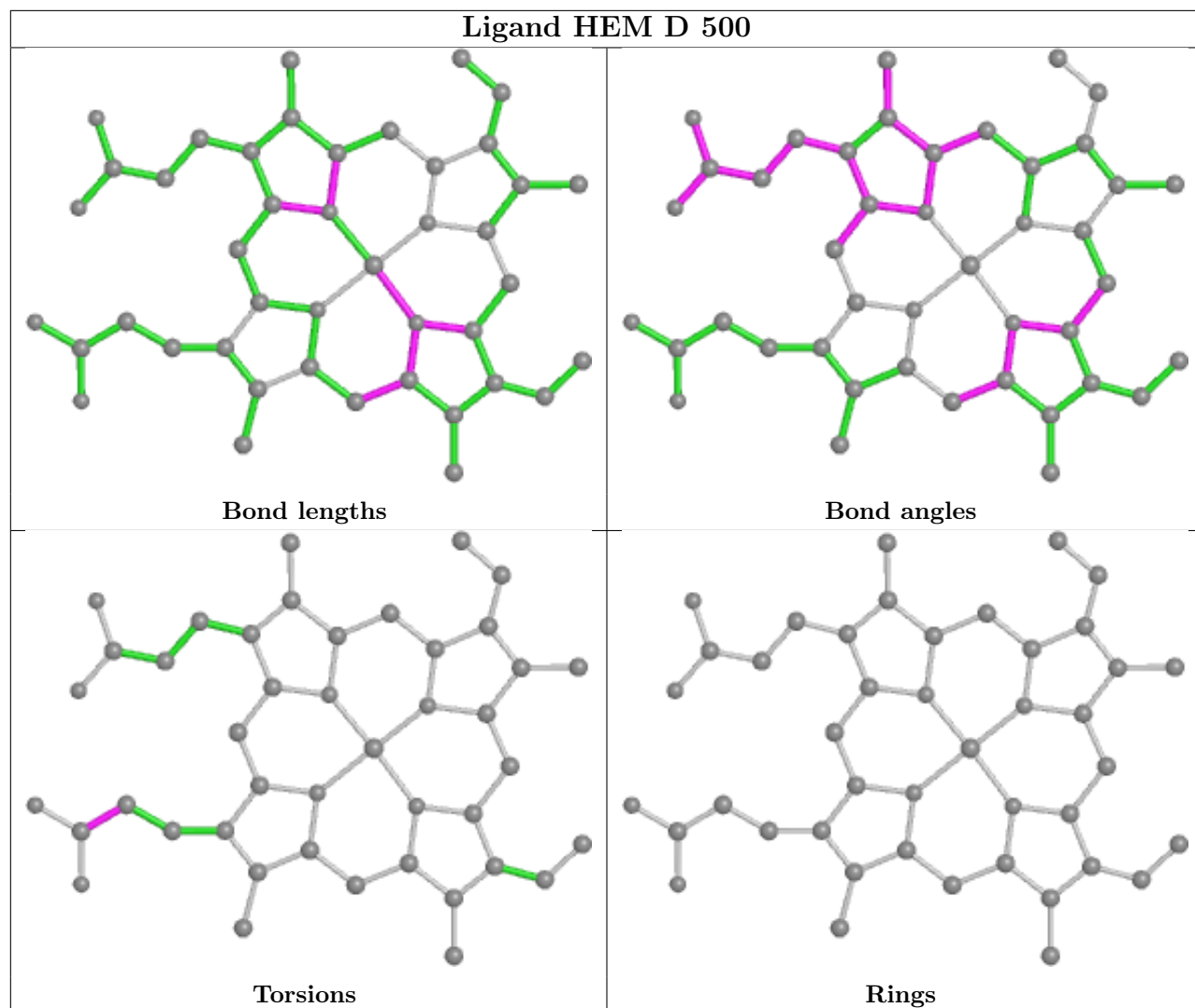
No monomer is involved in short contacts.

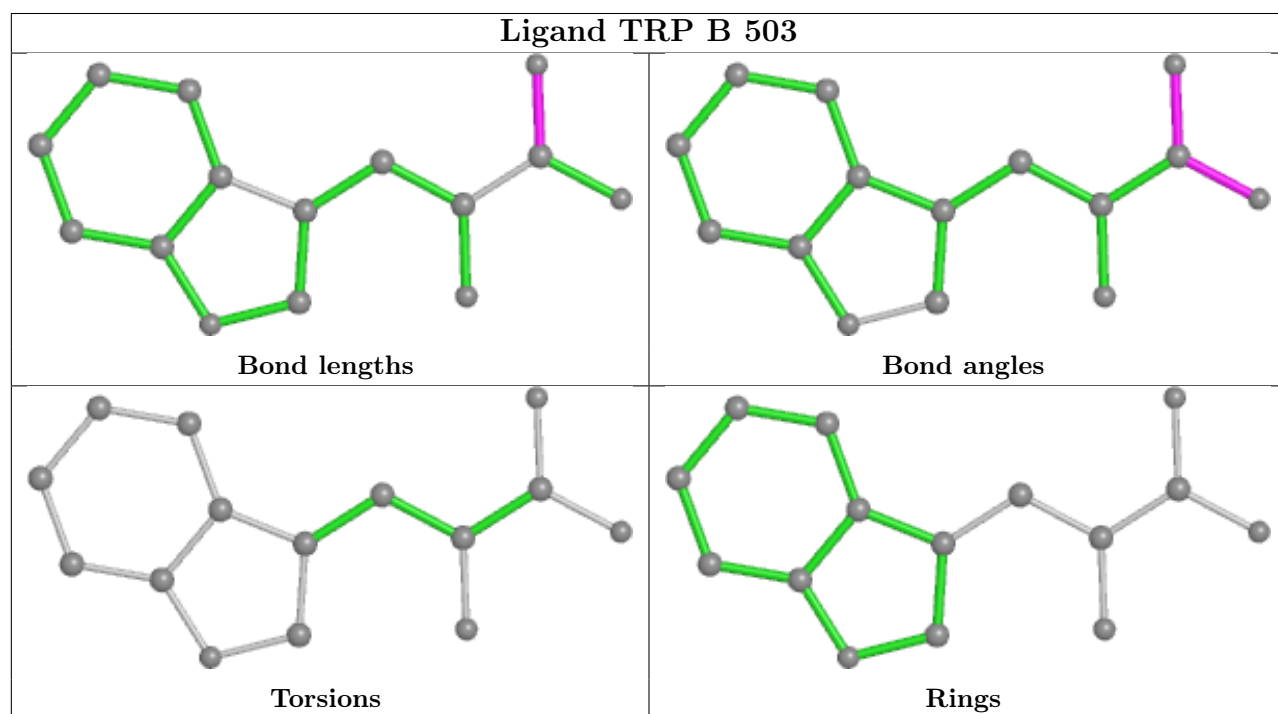
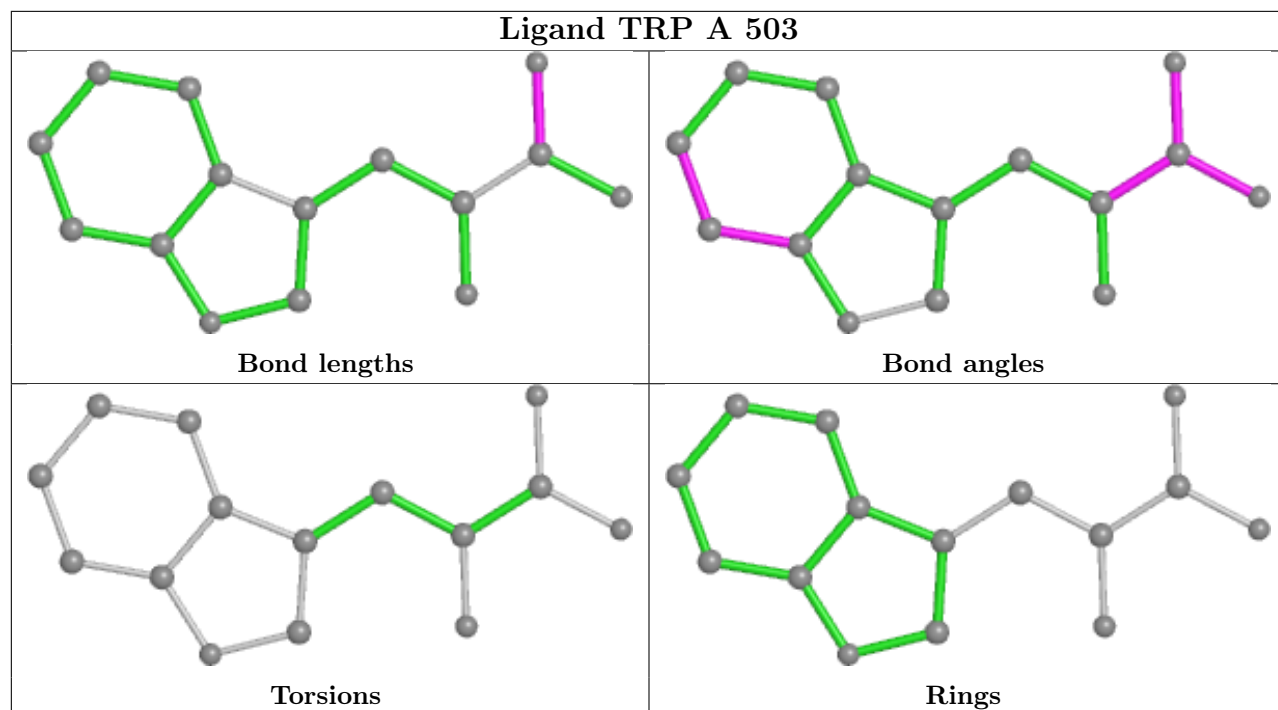
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

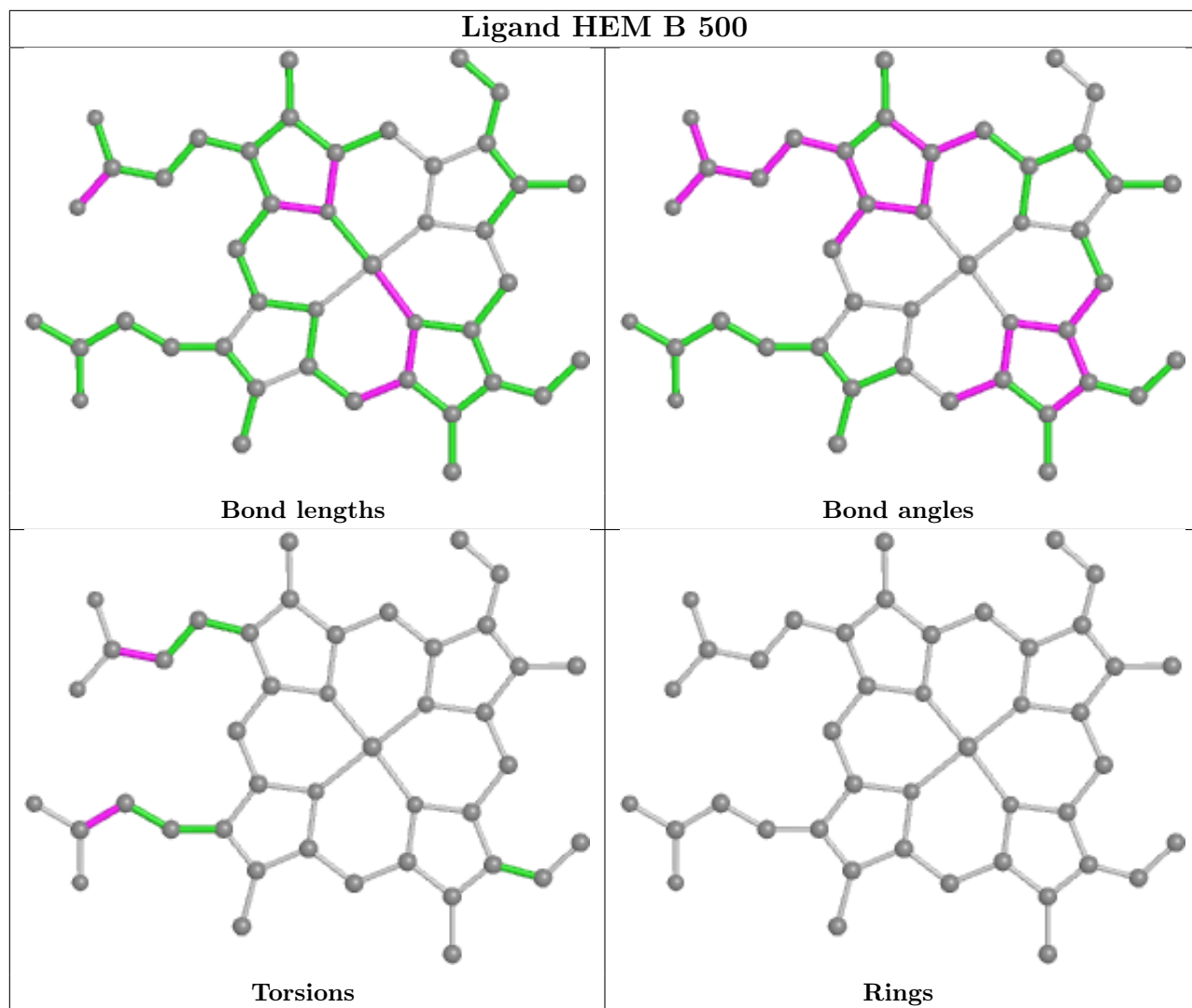


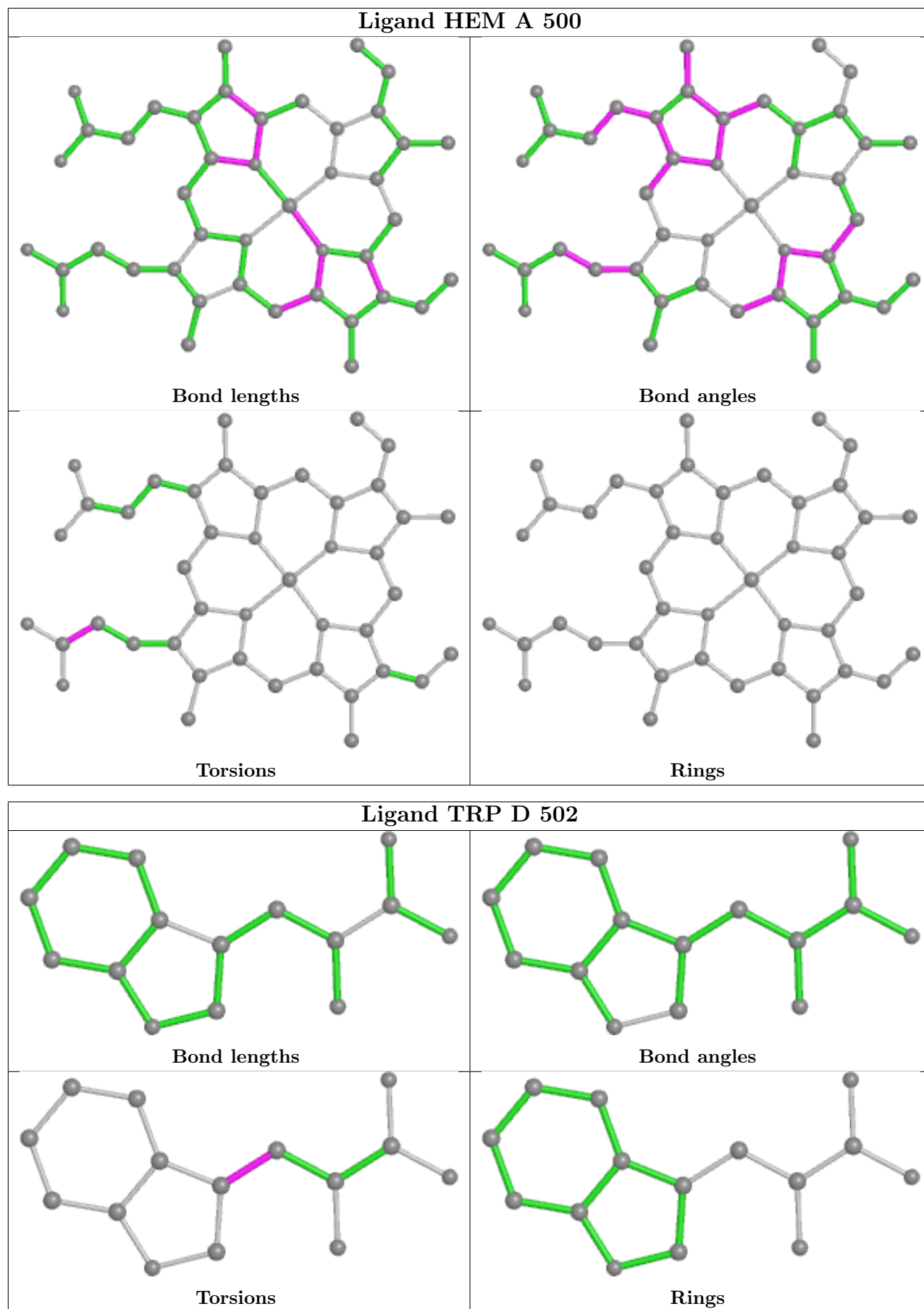


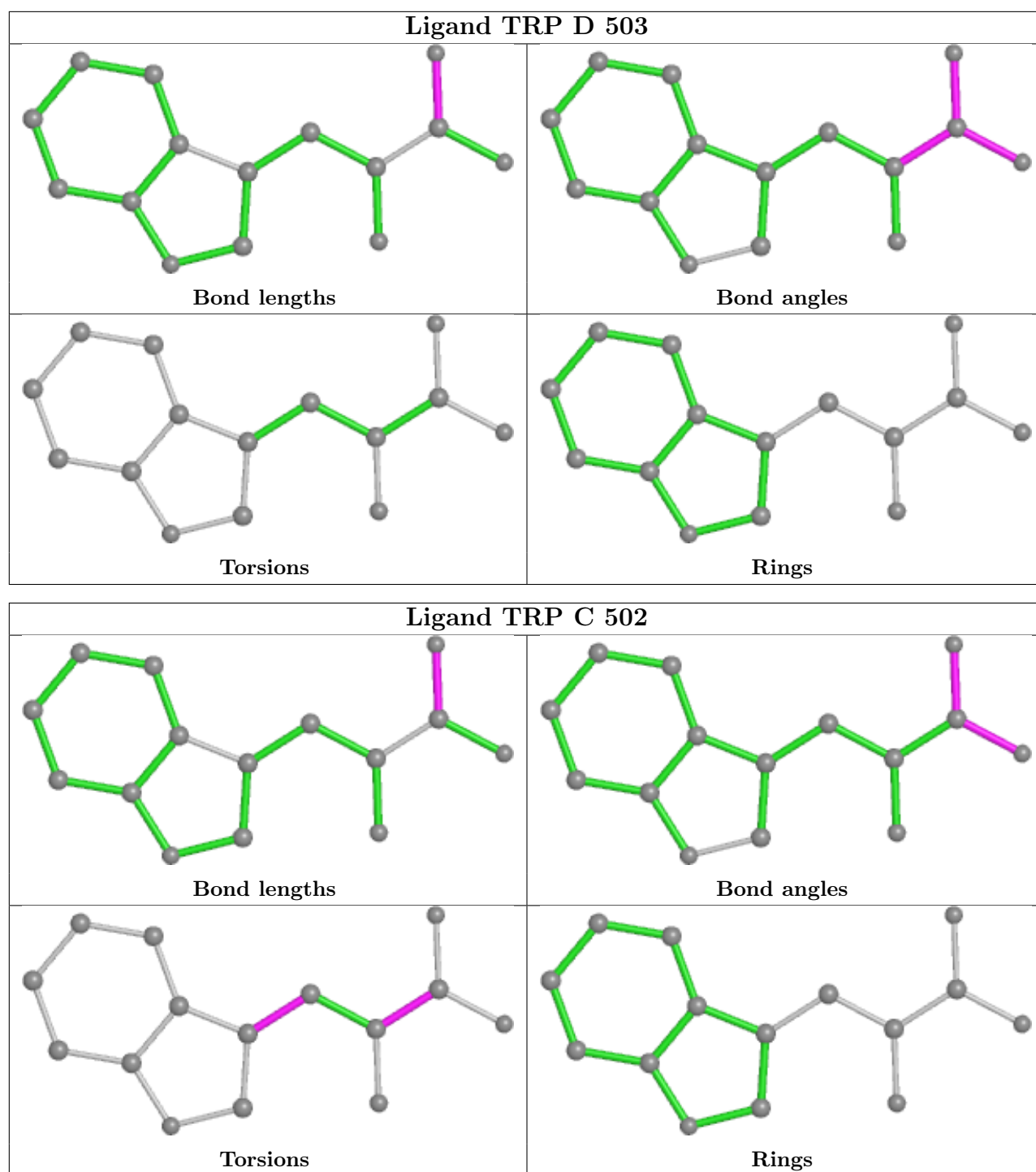












#### 4.7 Other polymers [\(i\)](#)

There are no such residues in this entry.

#### 4.8 Polymer linkage issues [\(i\)](#)

There are no chain breaks in this entry.

## 5 Fit of model and data [i](#)

### 5.1 Protein, DNA and RNA chains [i](#)

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

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

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

### 5.3 Carbohydrates [i](#)

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

### 5.4 Ligands [i](#)

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

### 5.5 Other polymers [i](#)

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