W O R L D W I D E

wwPDB

P R O T E I N   D A T A   B A N K

wwPDB X-ray Structure Validation Summary Report (i)

Oct 20, 2024 – 11:24 AM EDT

PDB ID	:	1F99
Title	:	CRYSTAL STRUCTURE OF R-PHYCOCYANIN FROM POLYSIPHONIA AT 2.4 A RESOLUTION
Authors	:	Liang, D.C.; Jiang, T.; Chang, W.R.
Deposited on	:	2000-07-09
Resolution	:	2.40 Å(reported)

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

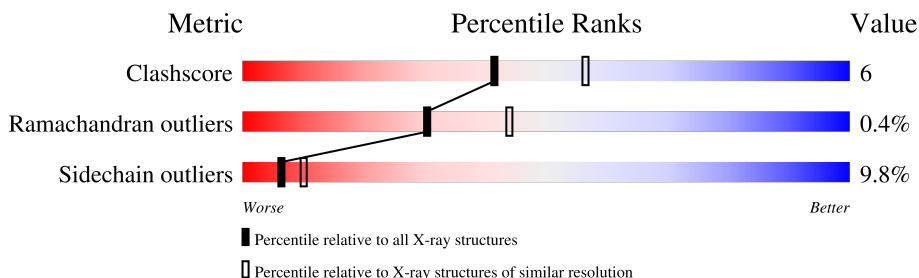|		
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.39

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 2.40 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	Percentile Ranks	Value
Clashscore		6
Ramachandran outliers		0.4%
Sidechain outliers		9.8%

Worse — Better

■ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	180529	5218 (2.40-2.40)
Ramachandran outliers	177936	5158 (2.40-2.40)
Sidechain outliers	177891	5159 (2.40-2.40)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower 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 <=5%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	162	81% 16% •
1	K	162	77% 20% ••
1	M	162	82% 15% •
2	B	172	80% 17% •
2	L	172	82% 15% •
2	N	172	79% 17% ••

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 crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	CYC	K	386	X	-	-	-
5	PEB	B	355	X	-	-	-

2 Entry composition (i)

There are 6 unique types of molecules in this entry. The entry contains 8209 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 R-PHYCOCYANIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	162	Total	C	N	O	S	0	0	0
			1235	776	208	245	6			
1	K	162	Total	C	N	O	S	0	0	0
			1235	776	208	245	6			
1	M	162	Total	C	N	O	S	0	0	0
			1235	776	208	245	6			

- Molecule 2 is a protein called R-PHYCOCYANIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	172	Total	C	N	O	S	0	0	0
			1259	781	222	248	8			
2	L	172	Total	C	N	O	S	0	0	0
			1259	781	222	248	8			
2	N	172	Total	C	N	O	S	0	0	0
			1259	781	222	248	8			

- Molecule 3 is BILIVERDINE IX ALPHA (three-letter code: BLA) (formula: $C_{33}H_{34}N_4O_6$).

BLA
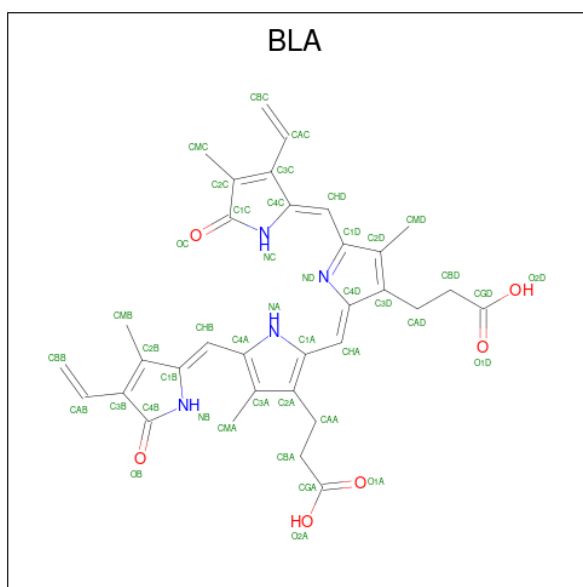
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			43	33	4	6		

- Molecule 4 is PHYCOCYANOBILIN (three-letter code: CYC) (formula: $C_{33}H_{40}N_4O_6$).
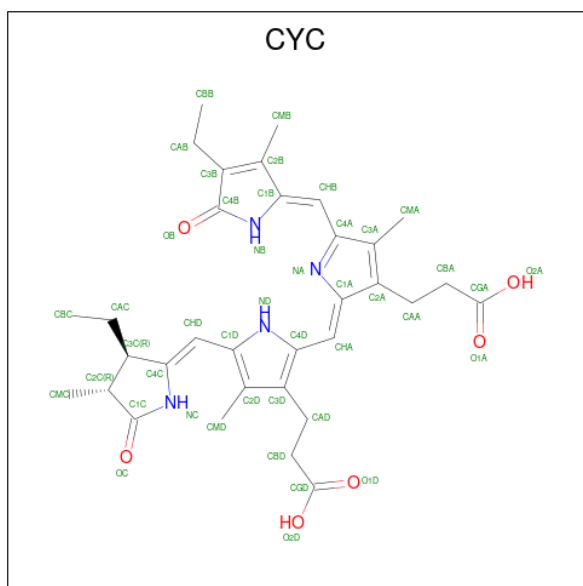
CYC

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

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	M	1	Total 43	C 33	N 4	O 6	0	0
4	N	1	Total 43	C 33	N 4	O 6	0	0

- Molecule 5 is PHYCOERYTHROBILIN (three-letter code: PEB) (formula: $C_{33}H_{40}N_4O_6$).
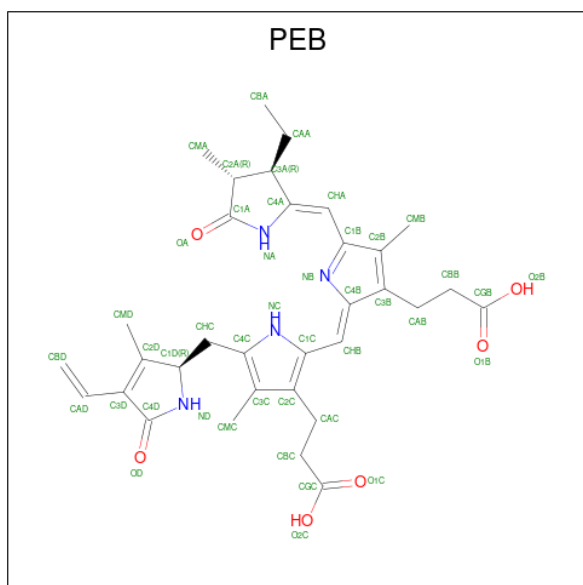
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	B	1	Total 43	C 33	N 4	O 6	0	0
5	L	1	Total 43	C 33	N 4	O 6	0	0
5	N	1	Total 43	C 33	N 4	O 6	0	0

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	56	Total 56	O 56	0	0
6	B	51	Total 51	O 51	0	0
6	K	59	Total 59	O 59	0	0
6	L	62	Total 62	O 62	0	0

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| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	M	46	Total 46	O 46	0	0
6	N	66	Total 66	O 66	0	0

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. 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. 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.
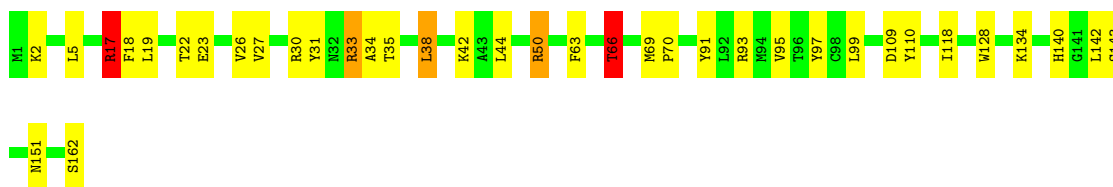
Note EDS was not executed.

• Molecule 1: R-PHYCOCYANIN

Chain A:
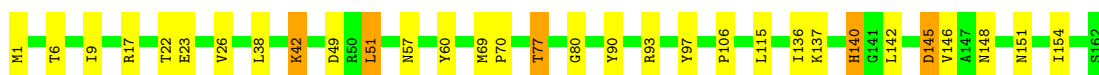
• Molecule 1: R-PHYCOCYANIN

Chain K:

• Molecule 1: R-PHYCOCYANIN

Chain M:

• Molecule 2: R-PHYCOCYANIN

Chain B:
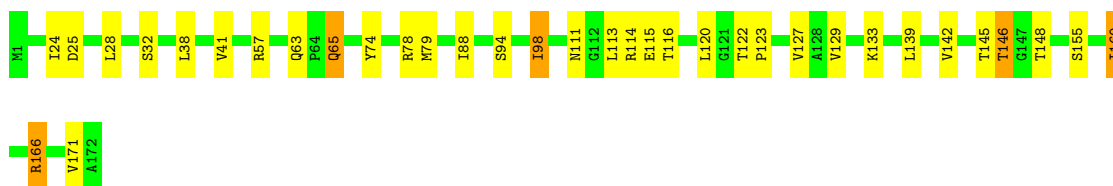
• Molecule 2: R-PHYCOCYANIN

Chain L:

M1 L2 A12 R15 I24 L28 R37 L38 V41 T45 V52 Q65 L66 M79 L83 L90 R91 S94 M97 I98 D107 R108 N111 G112 L113 Q132 T145 T146 S155 L156 I160 R166 A172

• Molecule 2: R-PHYCOCYANIN

Chain N:

79% 17% • •

M1 L2 Q11 S32 E33 R37 L38 D39 V40 V41 T45 N54 R57 A58 L59 Q65 L66 N72 T75 S76 R77 V89 Y95 I98 R108 C109 L110 L113 R114 E115 I131 K135 L139 V142 N143 D144 T145 T146 G147 T148 I160

A170 V171 A172

4 Data and refinement statistics ⓘ

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, α, β, γ	135.10Å 135.10Å 210.00Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	8.00 – 2.40	Depositor
% Data completeness (in resolution range)	75.5 (8.00-2.40)	Depositor
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR	Depositor
R, R_{free}	0.189 , 0.239	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	8209	wwPDB-VP
Average B, all atoms (Å^2)	25.0	wwPDB-VP

5   Model quality ⓘ

5.1   Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: BLA, PEB, CYC

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	0.58	0/1258	1.22	5/1709 (0.3%)
1	K	0.58	0/1258	1.36	14/1709 (0.8%)
1	M	0.58	0/1258	1.27	7/1709 (0.4%)
2	B	0.54	0/1271	1.26	9/1725 (0.5%)
2	L	0.55	0/1271	1.36	8/1725 (0.5%)
2	N	0.56	0/1271	1.33	11/1725 (0.6%)
All	All	0.57	0/7587	1.30	54/10302 (0.5%)

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
2	N	0	1

There are no bond length outliers.

The worst 5 of 54 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	L	37	ARG	NE-CZ-NH2	-13.57	113.51	120.30
1	K	93	ARG	NE-CZ-NH2	-11.72	114.44	120.30
2	L	37	ARG	NE-CZ-NH1	11.52	126.06	120.30
2	B	166	ARG	NE-CZ-NH1	-10.37	115.12	120.30
2	N	114	ARG	NE-CZ-NH2	-9.97	115.32	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	N	45	THR	Mainchain

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	A	1235	0	1212	14	0
1	K	1235	0	1212	13	0
1	M	1235	0	1212	10	0
2	B	1259	0	1271	18	0
2	L	1259	0	1271	9	0
2	N	1259	0	1271	14	0
3	A	43	0	33	3	0
4	B	43	0	38	6	0
4	K	43	0	38	6	0
4	L	43	0	38	4	0
4	M	43	0	38	6	0
4	N	43	0	38	4	0
5	B	43	0	38	1	0
5	L	43	0	38	2	0
5	N	43	0	38	2	0
6	A	56	0	0	0	0
6	B	51	0	0	0	0
6	K	59	0	0	1	0
6	L	62	0	0	0	0
6	M	46	0	0	0	0
6	N	66	0	0	1	0
All	All	8209	0	7786	98	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 6.

The worst 5 of 98 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)
4:B:385:CYC:HMD2	4:B:385:CYC:HC	1.41	0.83
2:N:89:VAL:HG11	2:N:131:ILE:HD12	1.61	0.82

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:M:388:CYC:HC	4:M:388:CYC:HMD2	1.51	0.76
4:L:387:CYC:HMA1	4:L:387:CYC:HB	1.49	0.75
4:B:385:CYC:HMA1	4:B:385:CYC:HB	1.52	0.73

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 X-ray entries followed by that with respect to entries of similar resolution.

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	160/162 (99%)	157 (98%)	3 (2%)	0	100	100
1	K	160/162 (99%)	156 (98%)	4 (2%)	0	100	100
1	M	160/162 (99%)	158 (99%)	2 (1%)	0	100	100
2	B	170/172 (99%)	164 (96%)	5 (3%)	1 (1%)	22	33
2	L	170/172 (99%)	164 (96%)	4 (2%)	2 (1%)	11	16
2	N	170/172 (99%)	166 (98%)	3 (2%)	1 (1%)	22	33
All	All	990/1002 (99%)	965 (98%)	21 (2%)	4 (0%)	30	44

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	146	THR
2	N	146	THR
2	L	111	ASN
2	L	146	THR

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 X-ray entries followed by that with respect to entries of similar

resolution.

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	129/129 (100%)	121 (94%)	8 (6%)	15	26
1	K	129/129 (100%)	116 (90%)	13 (10%)	6	9
1	M	129/129 (100%)	116 (90%)	13 (10%)	6	9
2	B	127/127 (100%)	116 (91%)	11 (9%)	8	13
2	L	127/127 (100%)	112 (88%)	15 (12%)	4	6
2	N	127/127 (100%)	112 (88%)	15 (12%)	4	6
All	All	768/768 (100%)	693 (90%)	75 (10%)	6	10

5 of 75 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	M	136	ILE
2	N	145	THR
1	M	142	LEU
2	N	59	LEU
1	K	44	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 17 such sidechains are listed below:

Mol	Chain	Res	Type
2	N	35	ASN
2	N	72	ASN
1	K	140	HIS
2	L	35	ASN
2	L	72	ASN

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 ⓘ

9 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	CYC	L	387	2	42,46,46	2.99	15 (35%)	52,67,67	2.79	29 (55%)
5	PEB	B	355	2	43,46,46	2.95	16 (37%)	49,67,67	2.18	19 (38%)
5	PEB	N	357	2	43,46,46	2.81	12 (27%)	49,67,67	2.52	21 (42%)
4	CYC	B	385	2	42,46,46	3.15	16 (38%)	52,67,67	2.95	26 (50%)
4	CYC	K	386	1	42,46,46	3.03	15 (35%)	52,67,67	3.24	24 (46%)
4	CYC	N	389	2	42,46,46	2.85	12 (28%)	52,67,67	2.50	25 (48%)
3	BLA	A	384	1	42,46,46	2.65	20 (47%)	54,67,67	2.21	20 (37%)
5	PEB	L	356	2	43,46,46	2.85	13 (30%)	49,67,67	2.24	17 (34%)
4	CYC	M	388	1	42,46,46	2.98	16 (38%)	52,67,67	2.99	23 (44%)

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	CYC	L	387	2	-	12/25/74/74	0/4/4/4
5	PEB	B	355	2	1/1/14/19	8/24/74/74	0/4/4/4
5	PEB	N	357	2	-	8/24/74/74	0/4/4/4
4	CYC	B	385	2	-	11/25/74/74	0/4/4/4
4	CYC	K	386	1	1/1/14/19	14/25/74/74	0/4/4/4
4	CYC	N	389	2	-	11/25/74/74	0/4/4/4
3	BLA	A	384	1	-	8/26/74/74	0/4/4/4

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	PEB	L	356	2	-	8/24/74/74	0/4/4/4
4	CYC	M	388	1	-	11/25/74/74	0/4/4/4

The worst 5 of 135 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	K	386	CYC	C2C-C1C	-13.21	1.40	1.52
4	L	387	CYC	C2C-C1C	-13.12	1.40	1.52
4	N	389	CYC	C2C-C1C	-13.12	1.40	1.52
4	B	385	CYC	C2C-C1C	-12.85	1.40	1.52
5	B	355	PEB	C2A-C1A	-12.81	1.40	1.52

The worst 5 of 204 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	K	386	CYC	C4A-C3A-C2A	-10.67	94.37	106.48
4	M	388	CYC	C4A-C3A-C2A	-8.13	97.25	106.48
4	K	386	CYC	CAA-C2A-C3A	-8.03	112.83	127.87
4	B	385	CYC	C4A-C3A-C2A	-7.93	97.47	106.48
4	M	388	CYC	CAC-C3C-C4C	7.90	132.96	112.67

All (2) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
4	K	386	CYC	C2C
5	B	355	PEB	C2A

5 of 91 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	384	BLA	NA-C4A-CHB-C1B
3	A	384	BLA	C4C-C3C-CAC-CBC
4	B	385	CYC	C3A-C4A-CHB-C1B
4	B	385	CYC	C4C-C3C-CAC-CBC
4	B	385	CYC	ND-C1D-CHD-C4C

There are no ring outliers.
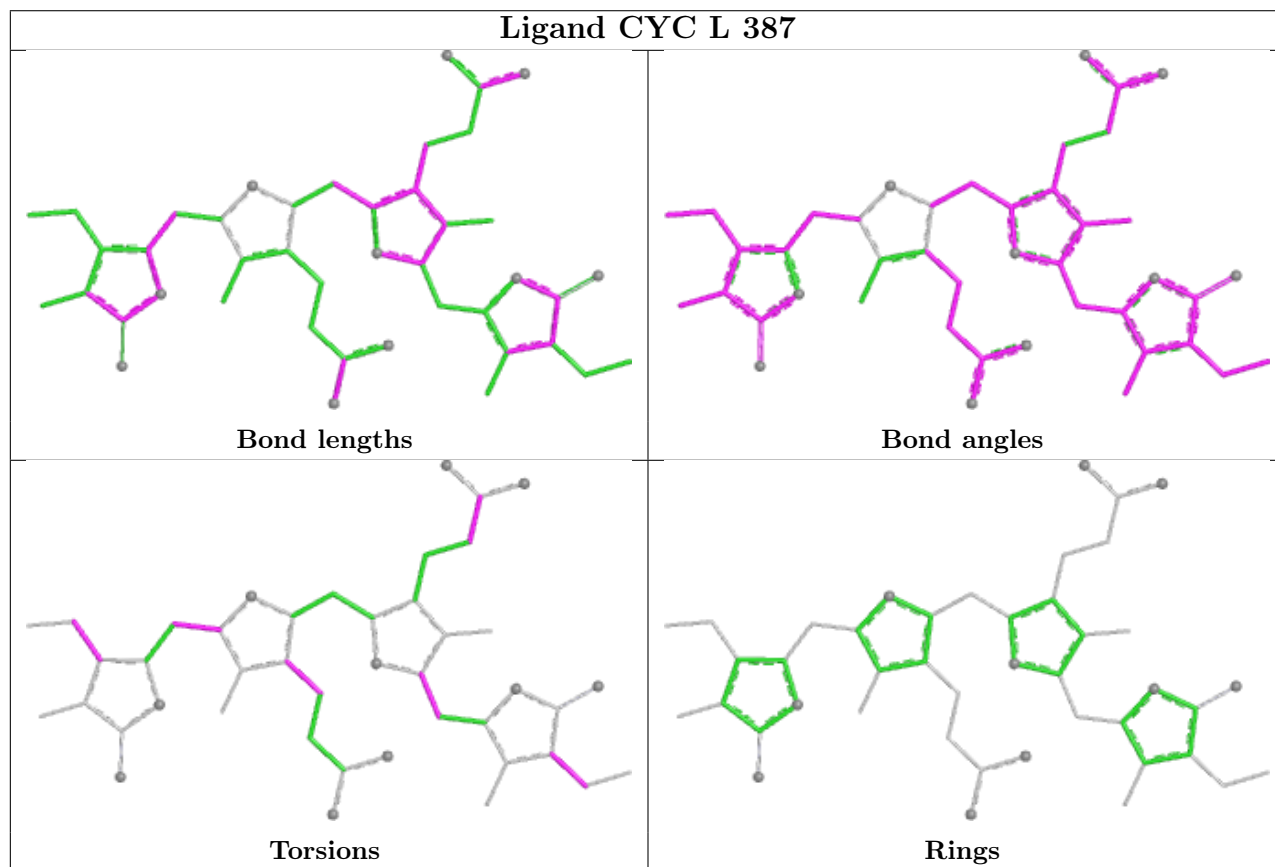
9 monomers are involved in 34 short contacts:

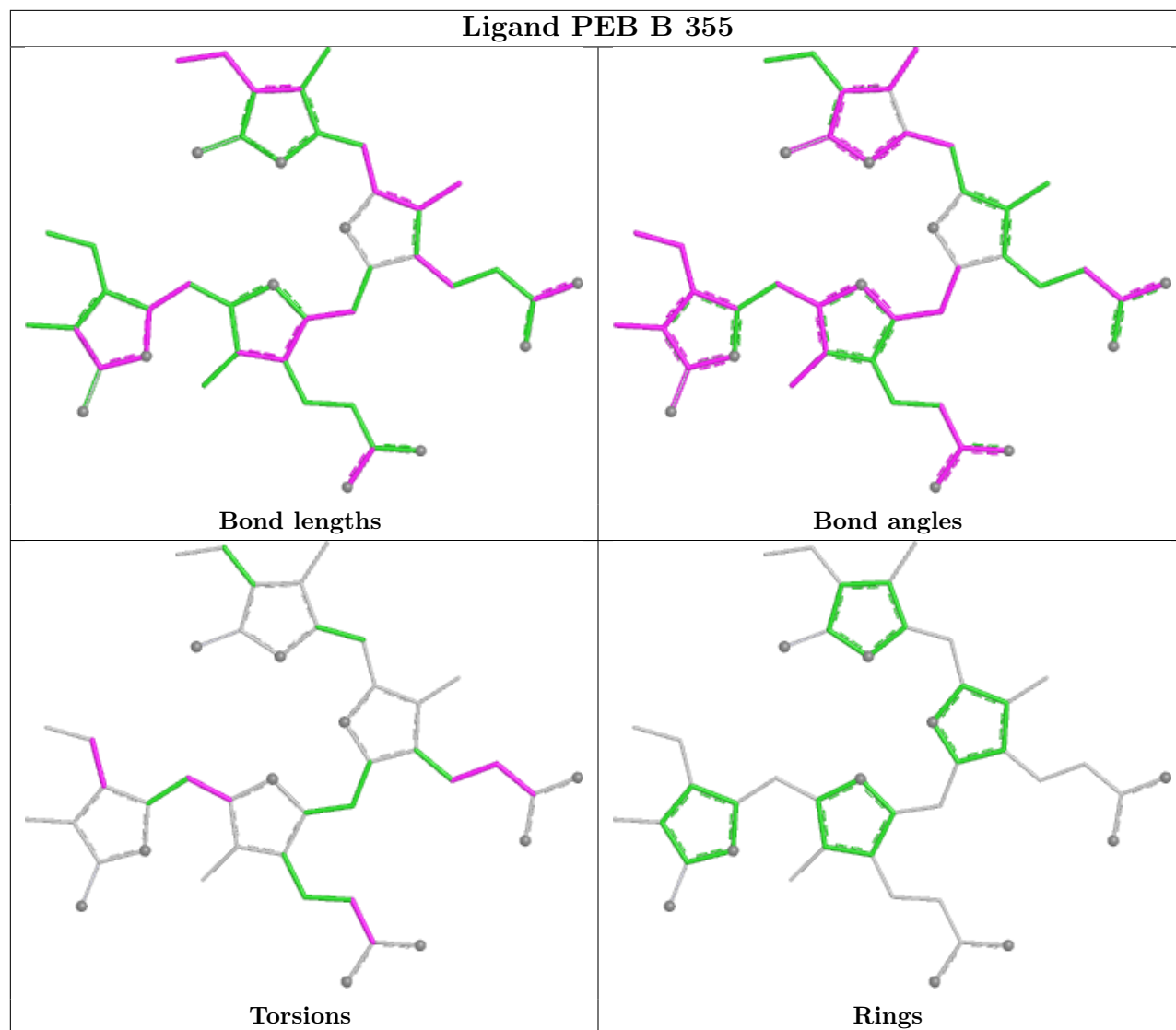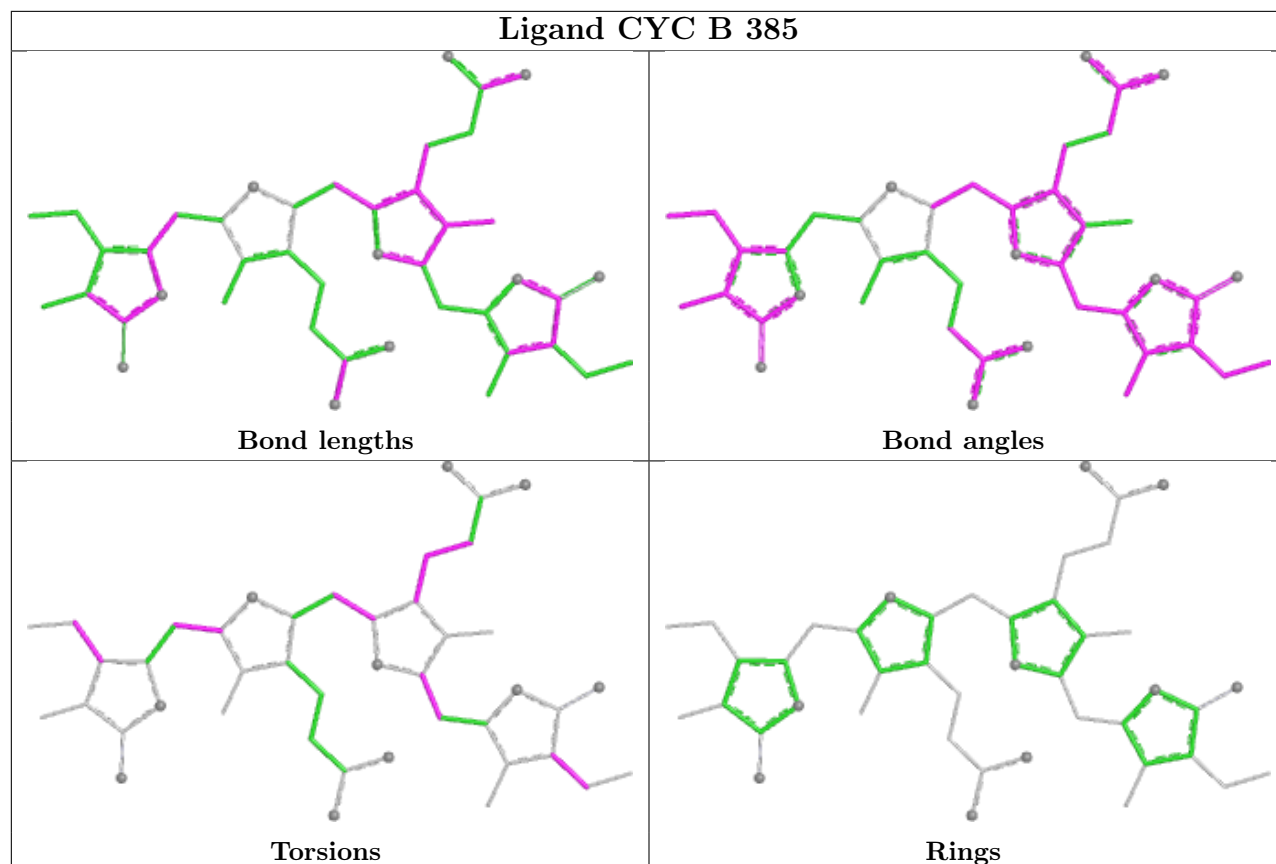| Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	L	387	CYC	4	0

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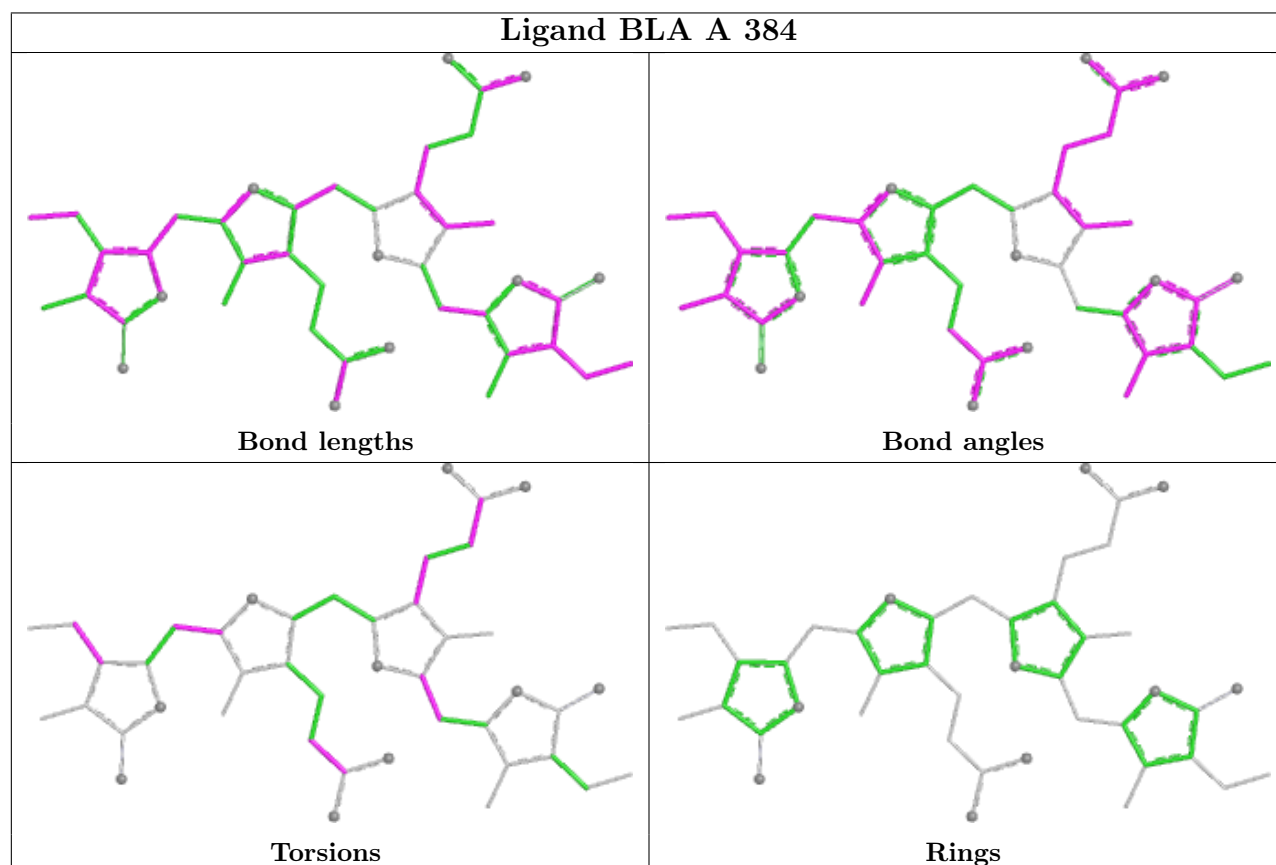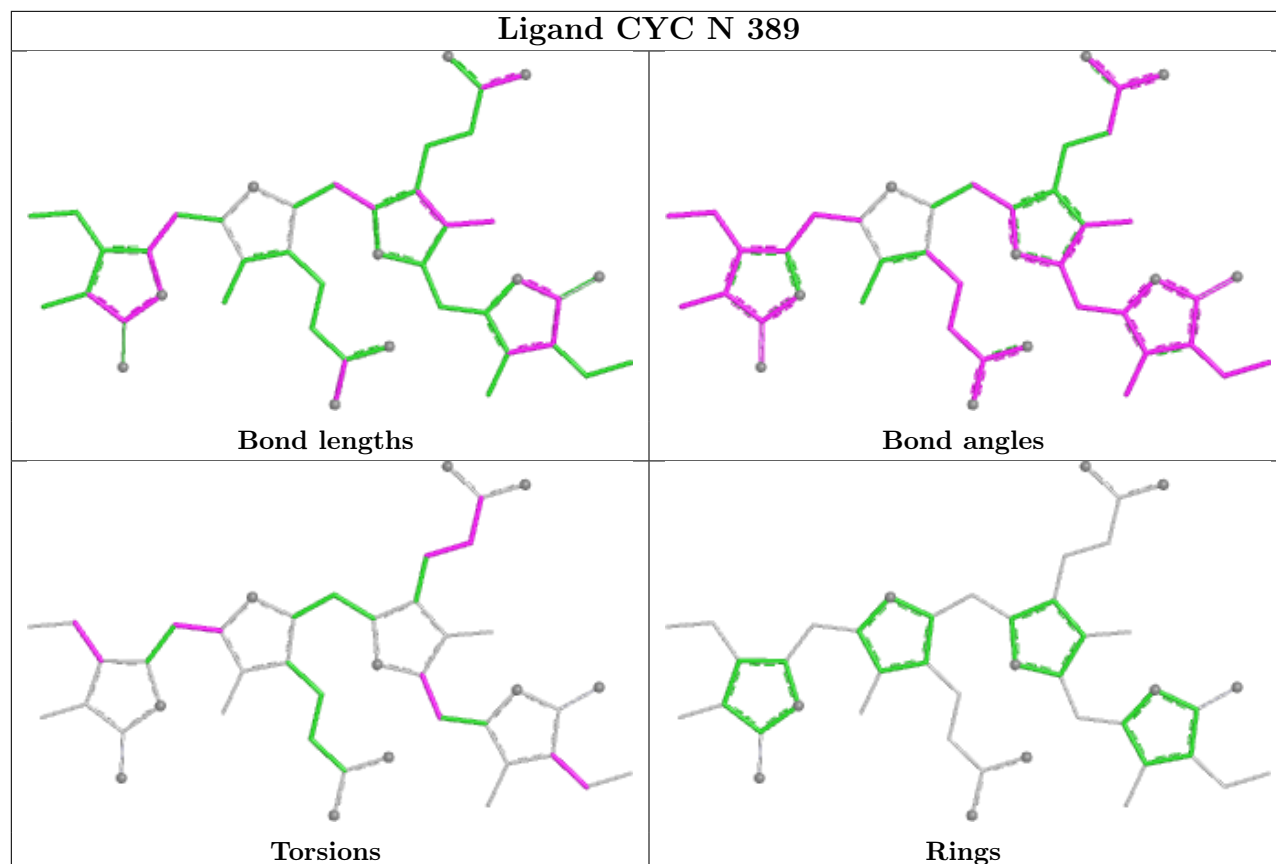| Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	355	PEB	1	0
5	N	357	PEB	2	0
4	B	385	CYC	6	0
4	K	386	CYC	6	0
4	N	389	CYC	4	0
3	A	384	BLA	3	0
5	L	356	PEB	2	0
4	M	388	CYC	6	0

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 then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.
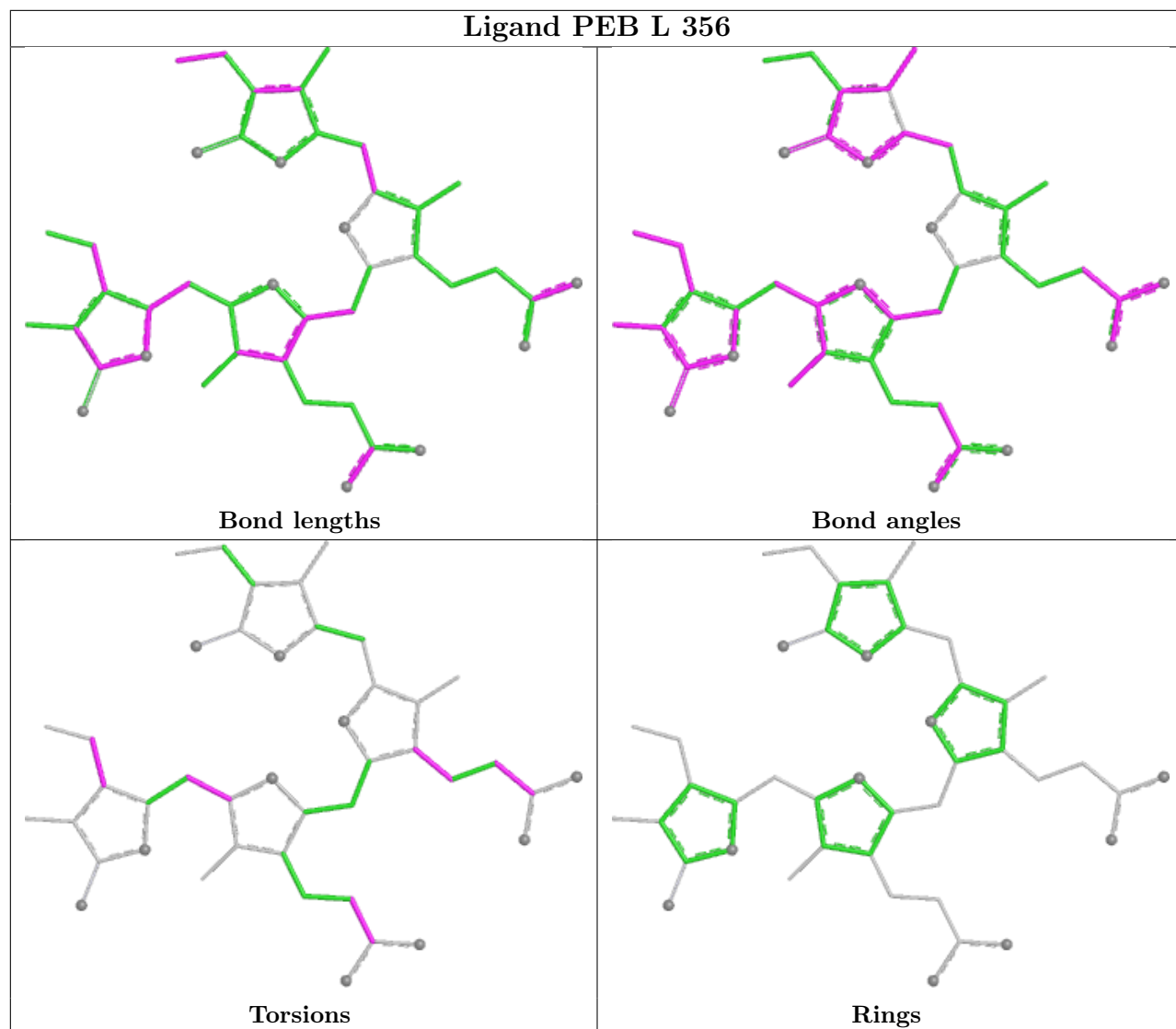
Ligand CYC L 387

Bond lengths

Bond angles

Torsions

Rings

Ligand PEB B 355

Bond lengths

Bond angles

Torsions

Rings

Ligand PEB N 357

Bond lengths

Bond angles

Torsions

Rings

Ligand CYC B 385

Bond lengths

Bond angles

Torsions

Rings

Ligand CYC K 386

Bond lengths

Bond angles

Torsions

Rings

Ligand CYC N 389

Bond lengths

Bond angles

Torsions

Rings

Ligand BLA A 384

Bond lengths

Bond angles

Torsions

Rings

Ligand PEB L 356

Bond lengths

Bond angles

Torsions

Rings

Ligand CYC M 388

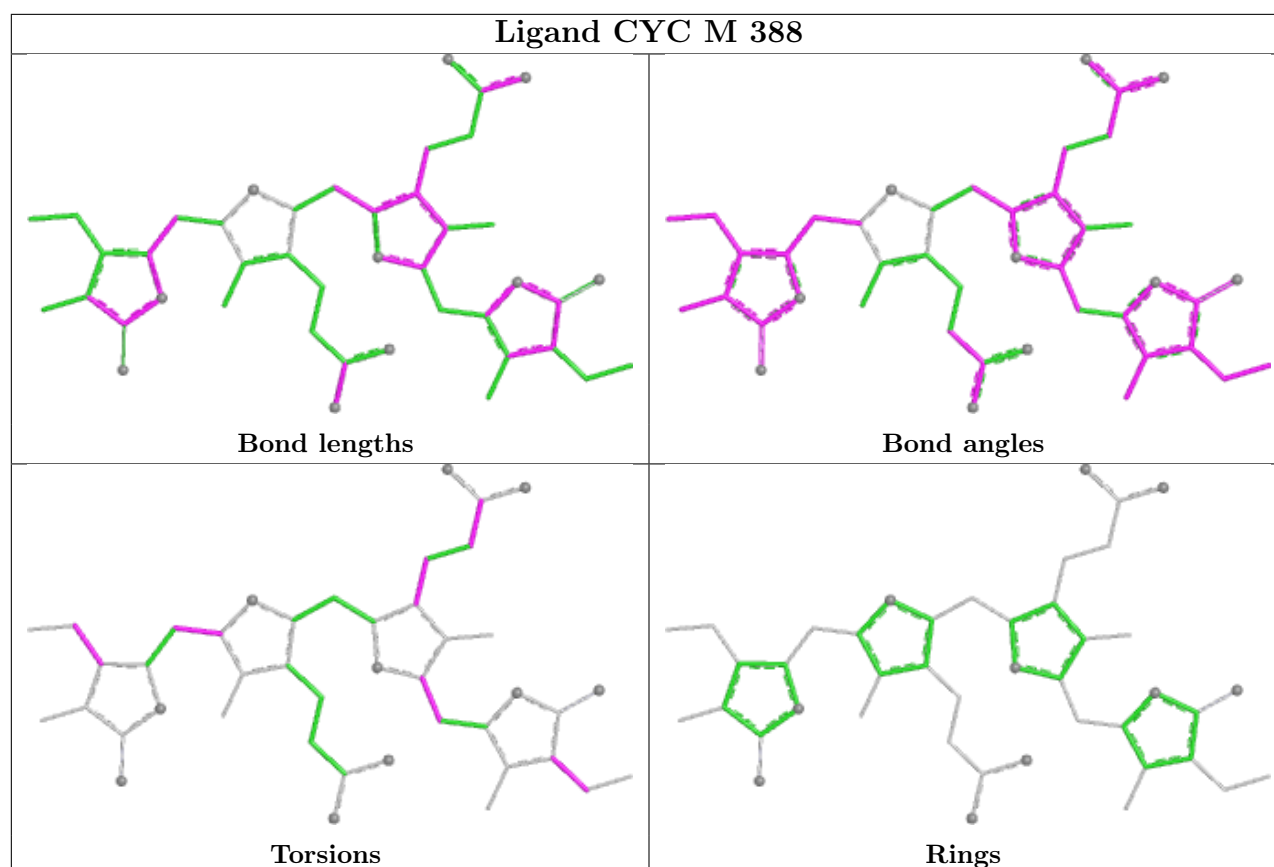

Bond lengths

Bond angles

Torsions

Rings

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 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.