



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 12, 2026 – 11:33 AM UTC

PDB ID : 1FNQ / pdb\_00001fnq  
Title : CRYSTAL STRUCTURE ANALYSIS OF THE MUTANT REACTION CENTER PRO L209-> GLU FROM THE PHOTOSYNTHETIC PURPLE BACTERIUM RHODOBACTER SPHAEROIDES  
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Deposited on : 2000-08-23  
Resolution : 2.60 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 : 4-5-2 with Phenix2.0  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtrriage (Phenix) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Buster-report : wwPDB partial adaption of 1.1.7 (2018)  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.49

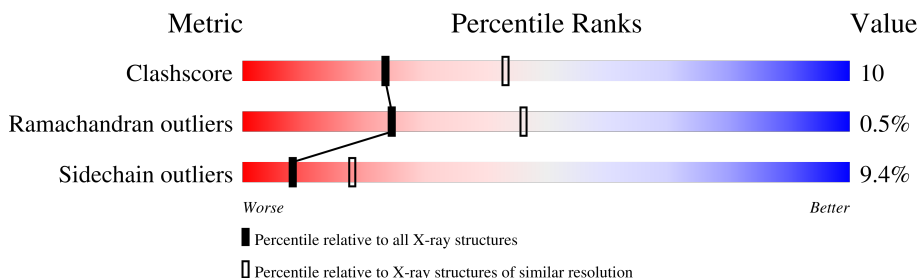
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.60 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)

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  $\geq 3$ , 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  $\leq 5\%$ .

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	L	281	
2	M	307	
3	H	260	

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
4	BCL	L	304	X	-	-	-
4	BCL	M	801	X	-	-	-

## 2 Entry composition

There are 11 unique types of molecules in this entry. The entry contains 7248 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 REACTION CENTER PROTEIN L CHAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	L	281	2234	1507	355	364	8	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
L	209	GLU	PRO	engineered mutation	UNP P02954

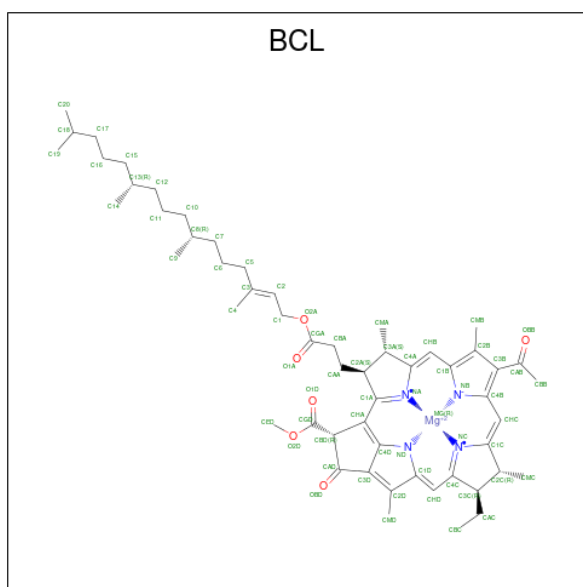
- Molecule 2 is a protein called REACTION CENTER PROTEIN M CHAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	M	302	2404	1603	394	397	10	0	0	0

- Molecule 3 is a protein called REACTION CENTER PROTEIN H CHAIN.

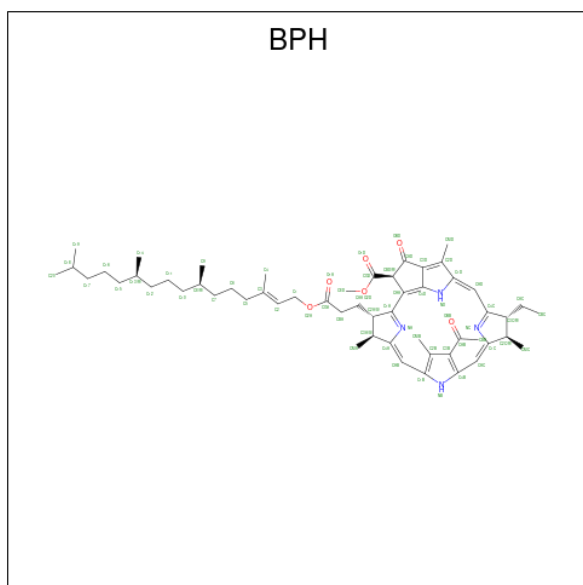
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	H	239	1823	1166	313	335	9	0	0	0

- Molecule 4 is BACTERIOCHLOROPHYLL A (CCD ID: BCL) (formula: C<sub>55</sub>H<sub>74</sub>MgN<sub>4</sub>O<sub>6</sub>).



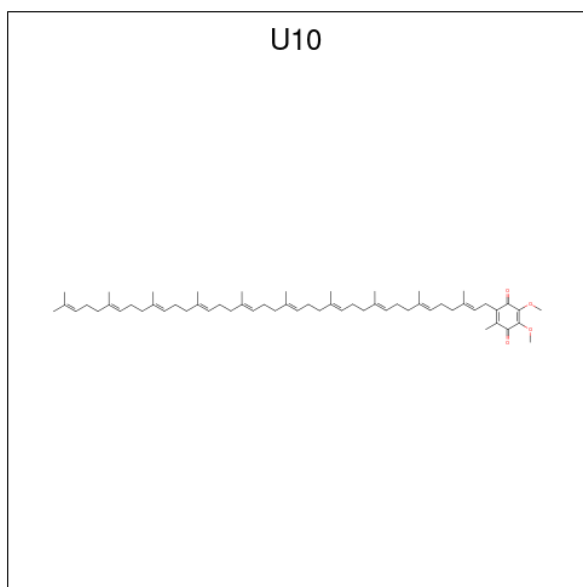
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
			Total	C	Mg	N			O
4	L	1	Total	C	Mg	N	O	0	0
			66	55	1	4	6		
4	L	1	Total	C	Mg	N	O	0	0
			66	55	1	4	6		
4	M	1	Total	C	Mg	N	O	0	0
			66	55	1	4	6		
4	M	1	Total	C	Mg	N	O	0	0
			66	55	1	4	6		

- Molecule 5 is BACTERIOPHEOPHYTIN A (CCD ID: BPH) (formula:  $C_{55}H_{76}N_4O_6$ ).



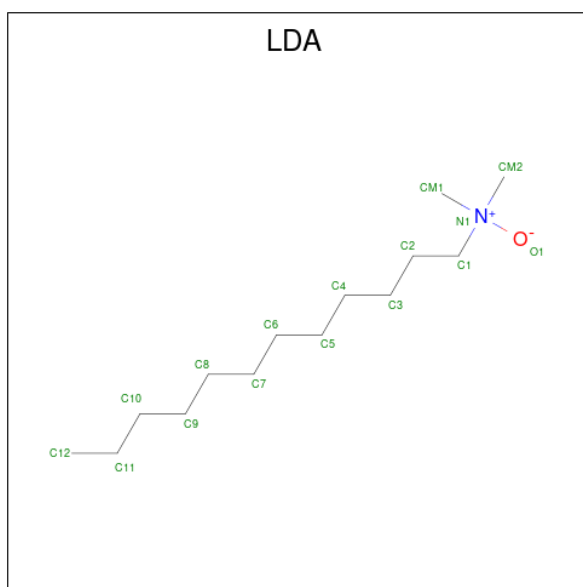
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	L	1	Total	C	N	O	0	0
			65	55	4	6		
5	M	1	Total	C	N	O	0	0
			65	55	4	6		

- Molecule 6 is UBIQUINONE-10 (CCD ID: U10) (formula:  $C_{59}H_{90}O_4$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	L	1	Total	C	O	0	0
			48	44	4		
6	M	1	Total	C	O	0	0
			48	44	4		

- Molecule 7 is LAURYL DIMETHYLAMINE-N-OXIDE (CCD ID: LDA) (formula:  $C_{14}H_{31}NO$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
7	L	1	Total	C	N	O	0	0
			16	14	1	1		
7	M	1	Total	C	N	O	0	0
			16	14	1	1		
7	M	1	Total	C	N	O	0	0
			16	14	1	1		
7	M	1	Total	C	N	O	0	0
			16	14	1	1		
7	M	1	Total	C	N	O	0	0
			16	14	1	1		
7	H	1	Total	C	N	O	0	0
			16	14	1	1		
7	H	1	Total	C	N	O	0	0
			16	14	1	1		

- Molecule 8 is FE (III) ION (CCD ID: FE) (formula: Fe).

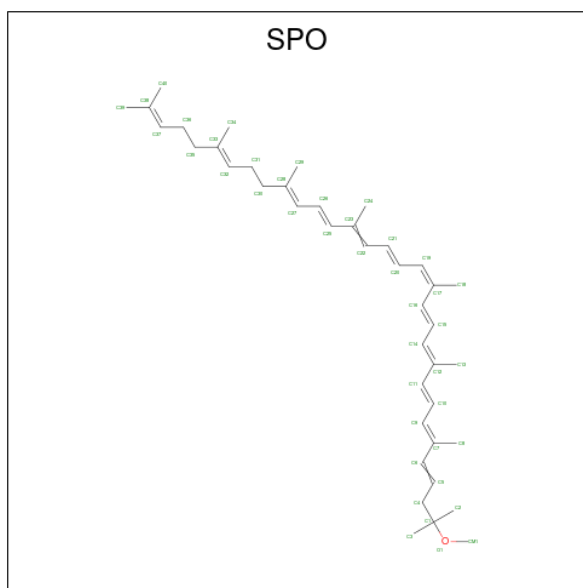
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	M	1	Total	Fe	0	0
			1	1		

- Molecule 9 is PHOSPHATE ION (CCD ID: PO4) (formula: O<sub>4</sub>P).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
9	M	1	Total O P	0	0
			5 4 1		

- Molecule 10 is SPHEROIDENE (CCD ID: SPO) (formula: C<sub>41</sub>H<sub>60</sub>O).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
10	M	1	Total C O	0	0
			42 41 1		

- Molecule 11 is water.

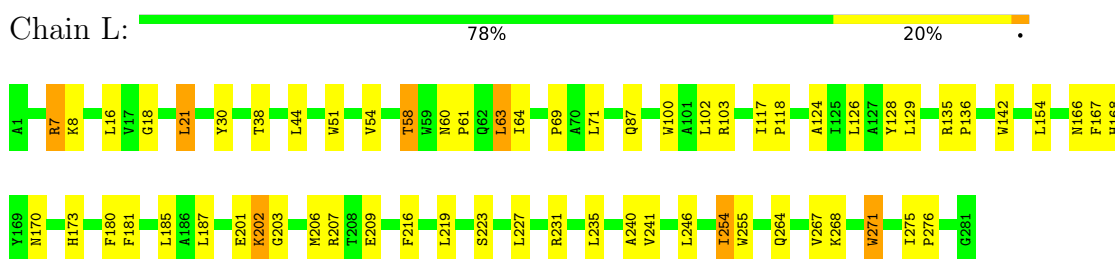
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
11	L	34	Total 34	O 34	0	0
11	M	39	Total 39	O 39	0	0
11	H	64	Total 64	O 64	0	0

### 3 Residue-property plots [i](#)

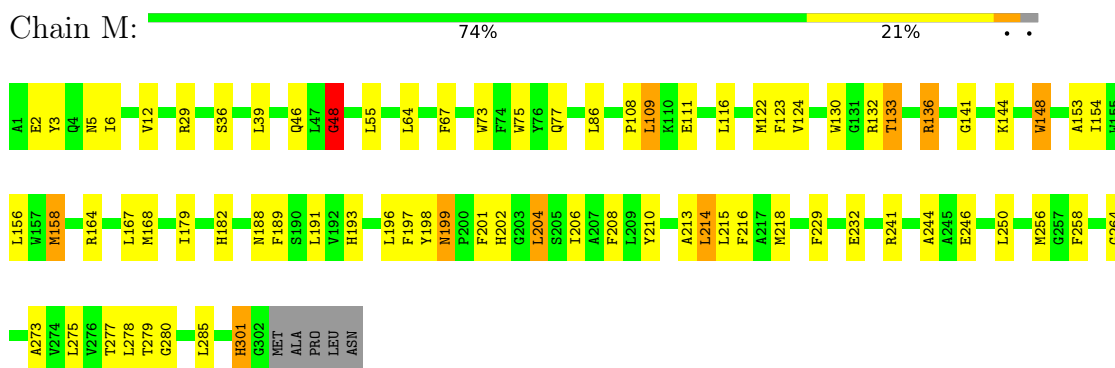
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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.

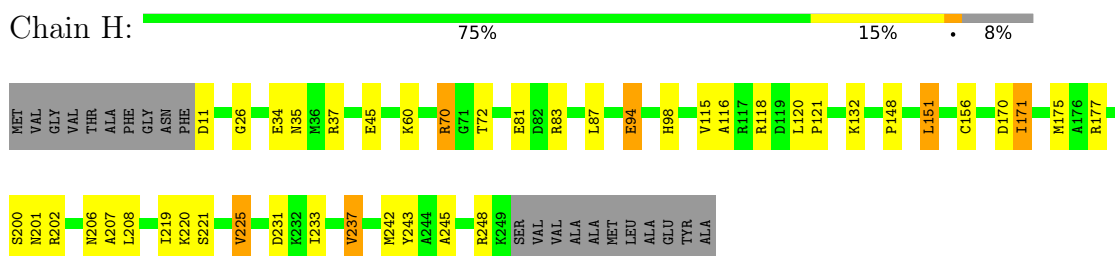
- Molecule 1: REACTION CENTER PROTEIN L CHAIN



- Molecule 2: REACTION CENTER PROTEIN M CHAIN



- Molecule 3: REACTION CENTER PROTEIN H CHAIN



## 4 Data and refinement statistics

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

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	141.53Å 141.53Å 187.55Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 2.60	Depositor
% Data completeness (in resolution range)	93.1 (50.00-2.60)	Depositor
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	CNS 0.3	Depositor
R, $R_{free}$	0.217 , 0.247	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	7248	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	60.0	wwPDB-VP

## 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: U10, BPH, FE, PO4, SPO, LDA, BCL

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	L	0.56	0/2321	0.78	0/3175
2	M	0.54	0/2496	0.79	0/3407
3	H	0.49	0/1871	0.77	0/2545
All	All	0.53	0/6688	0.78	0/9127

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	M	0	2
3	H	0	1
All	All	0	3

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
3	H	118	ARG	Sidechain
2	M	198	TYR	Sidechain
2	M	48	GLY	Peptide

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

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	L	2234	0	2186	41	0
2	M	2404	0	2311	55	0
3	H	1823	0	1831	29	0
4	L	132	0	148	12	0
4	M	132	0	148	17	0
5	L	65	0	76	8	0
5	M	65	0	76	11	0
6	L	48	0	63	1	0
6	M	48	0	63	3	0
7	H	32	0	62	3	0
7	L	16	0	31	0	0
7	M	64	0	124	4	0
8	M	1	0	0	0	0
9	M	5	0	0	0	0
10	M	42	0	60	2	0
11	H	64	0	0	5	0
11	L	34	0	0	1	0
11	M	39	0	0	1	0
All	All	7248	0	7179	146	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 10.

The worst 5 of 146 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:L:304:BCL:HHC	4:L:304:BCL:HBB2	1.43	1.01
4:M:801:BCL:HBB2	4:M:801:BCL:HHC	1.43	0.98
5:L:402:BPH:HHC	5:L:402:BPH:HBB3	1.51	0.92
1:L:202:LYS:HG3	1:L:203:GLY:H	1.36	0.90
1:L:241:VAL:HG21	5:L:402:BPH:HAC2	1.57	0.85

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 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	L	279/281 (99%)	266 (95%)	12 (4%)	1 (0%)	30	51
2	M	300/307 (98%)	281 (94%)	17 (6%)	2 (1%)	18	38
3	H	237/260 (91%)	227 (96%)	9 (4%)	1 (0%)	30	51
All	All	816/848 (96%)	774 (95%)	38 (5%)	4 (0%)	24	46

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	M	301	HIS
3	H	116	ALA
1	L	202	LYS
2	M	48	GLY

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

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	L	220/220 (100%)	200 (91%)	20 (9%)	9	19
2	M	235/240 (98%)	207 (88%)	28 (12%)	5	10
3	H	194/208 (93%)	181 (93%)	13 (7%)	15	33
All	All	649/668 (97%)	588 (91%)	61 (9%)	8	18

5 of 61 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	M	116	LEU
3	H	200	SER
2	M	158	MET
3	H	175	MET
3	H	231	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 13 such sidechains are listed below:

Mol	Chain	Res	Type
2	M	193	HIS
2	M	199	ASN
3	H	206	ASN
3	H	98	HIS
3	H	128	HIS

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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](#)

Of 18 ligands modelled in this entry, 1 is monoatomic - leaving 17 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
4	BCL	L	302	1	69,74,74	1.37	9 (13%)	79,115,115	1.74	9 (11%)
7	LDA	H	706	-	13,15,15	2.23	2 (15%)	14,17,17	0.44	0
9	PO4	M	800	-	4,4,4	2.08	2 (50%)	6,6,6	0.95	0
6	U10	M	501	-	48,48,63	2.02	14 (29%)	60,61,79	1.00	2 (3%)
7	LDA	M	703	-	13,15,15	2.14	1 (7%)	14,17,17	0.51	0
5	BPH	M	401	-	59,70,70	1.77	12 (20%)	59,101,101	2.34	13 (22%)
5	BPH	L	402	-	59,70,70	1.78	10 (16%)	59,101,101	2.31	12 (20%)
7	LDA	M	704	-	13,15,15	2.40	2 (15%)	14,17,17	0.56	0
4	BCL	M	802	2	69,74,74	1.30	8 (11%)	79,115,115	1.84	11 (13%)
4	BCL	L	304	1	69,74,74	1.38	7 (10%)	79,115,115	1.85	9 (11%)
6	U10	L	502	-	48,48,63	1.79	13 (27%)	60,61,79	1.00	4 (6%)
7	LDA	H	702	-	13,15,15	2.71	2 (15%)	14,17,17	0.55	0
7	LDA	M	707	-	13,15,15	1.83	2 (15%)	14,17,17	0.52	0
10	SPO	M	600	-	41,41,41	2.98	19 (46%)	47,50,50	2.25	14 (29%)
4	BCL	M	801	2	69,74,74	1.34	7 (10%)	79,115,115	1.90	9 (11%)
7	LDA	L	705	-	13,15,15	2.34	2 (15%)	14,17,17	0.53	0
7	LDA	M	701	-	13,15,15	2.33	2 (15%)	14,17,17	0.45	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
4	BCL	L	302	1	-	4/41/137/137	-
7	LDA	H	706	-	-	1/13/13/13	-
6	U10	M	501	-	-	7/45/69/87	0/1/1/1
7	LDA	M	703	-	-	4/13/13/13	-
5	BPH	M	401	-	-	12/37/105/105	0/5/6/6
5	BPH	L	402	-	-	7/37/105/105	0/5/6/6
7	LDA	M	704	-	-	1/13/13/13	-
4	BCL	M	802	2	-	9/41/137/137	-
4	BCL	L	304	1	1/1/21/25	8/41/137/137	-
6	U10	L	502	-	-	17/45/69/87	0/1/1/1
7	LDA	H	702	-	-	7/13/13/13	-
7	LDA	M	707	-	-	2/13/13/13	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
10	SPO	M	600	-	-	17/47/47/47	-
4	BCL	M	801	2	1/1/21/25	8/41/137/137	-
7	LDA	L	705	-	-	5/13/13/13	-
7	LDA	M	701	-	-	5/13/13/13	-

The worst 5 of 114 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
10	M	600	SPO	C6-C5	7.97	1.54	1.32
7	H	702	LDA	O1-N1	-7.93	1.22	1.42
10	M	600	SPO	C10-C11	7.78	1.55	1.34
7	M	701	LDA	O1-N1	-7.63	1.23	1.42
7	L	705	LDA	O1-N1	-7.52	1.23	1.42

The worst 5 of 83 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	L	402	BPH	O2D-CGD-CBD	11.85	123.96	110.95
5	M	401	BPH	O2D-CGD-CBD	11.49	123.57	110.95
4	M	801	BCL	C4A-NA-C1A	8.19	110.42	106.68
4	L	302	BCL	C4A-NA-C1A	7.98	110.32	106.68
4	L	304	BCL	O2D-CGD-CBD	7.77	124.81	111.23

All (2) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
4	L	304	BCL	C13
4	M	801	BCL	C8

5 of 114 torsion outliers are listed below:

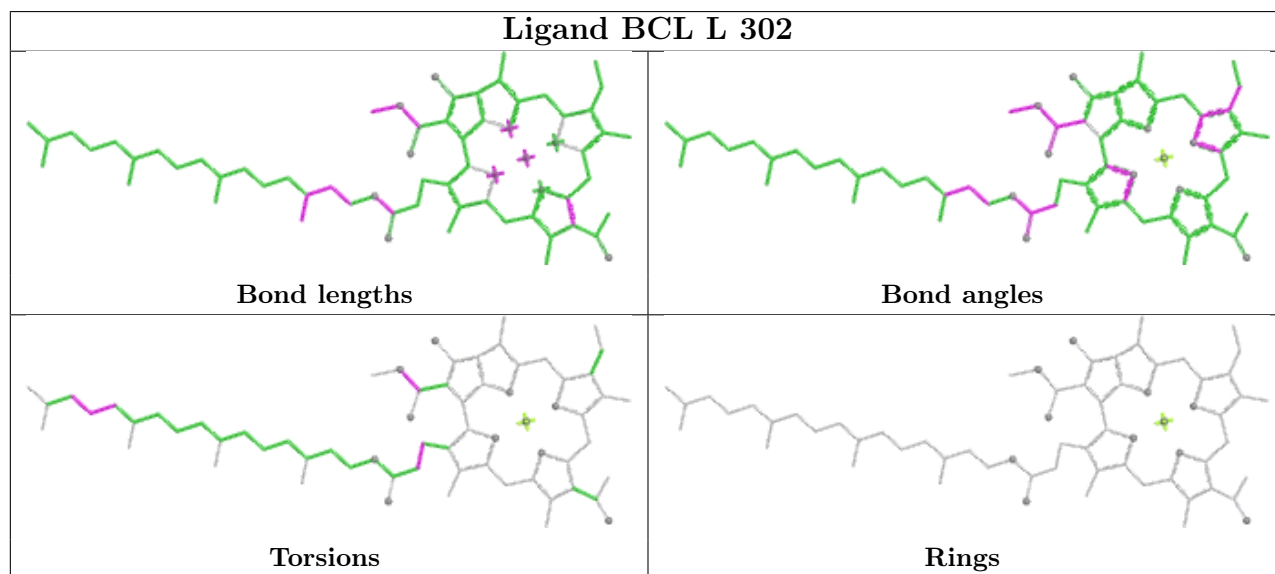
Mol	Chain	Res	Type	Atoms
5	L	402	BPH	C2C-C3C-CAC-CBC
5	M	401	BPH	C4C-C3C-CAC-CBC
5	M	401	BPH	C2C-C3C-CAC-CBC
6	M	501	U10	C24-C26-C27-C28
7	L	705	LDA	C2-C1-N1-O1

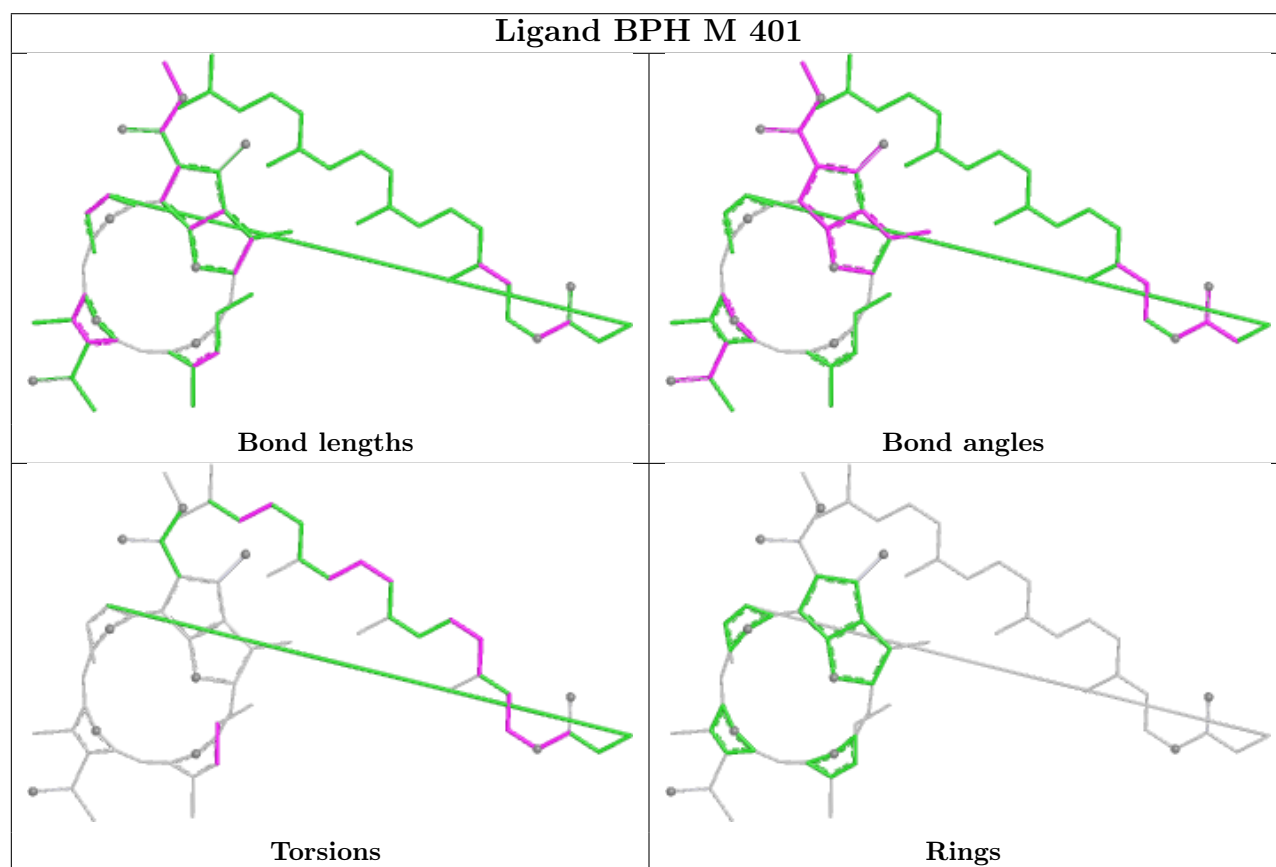
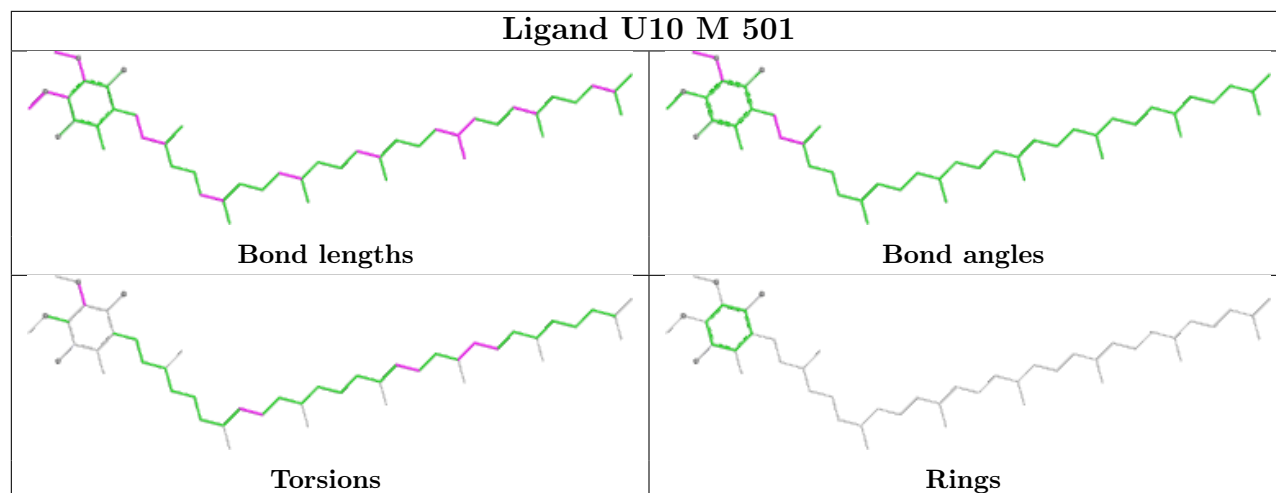
There are no ring outliers.

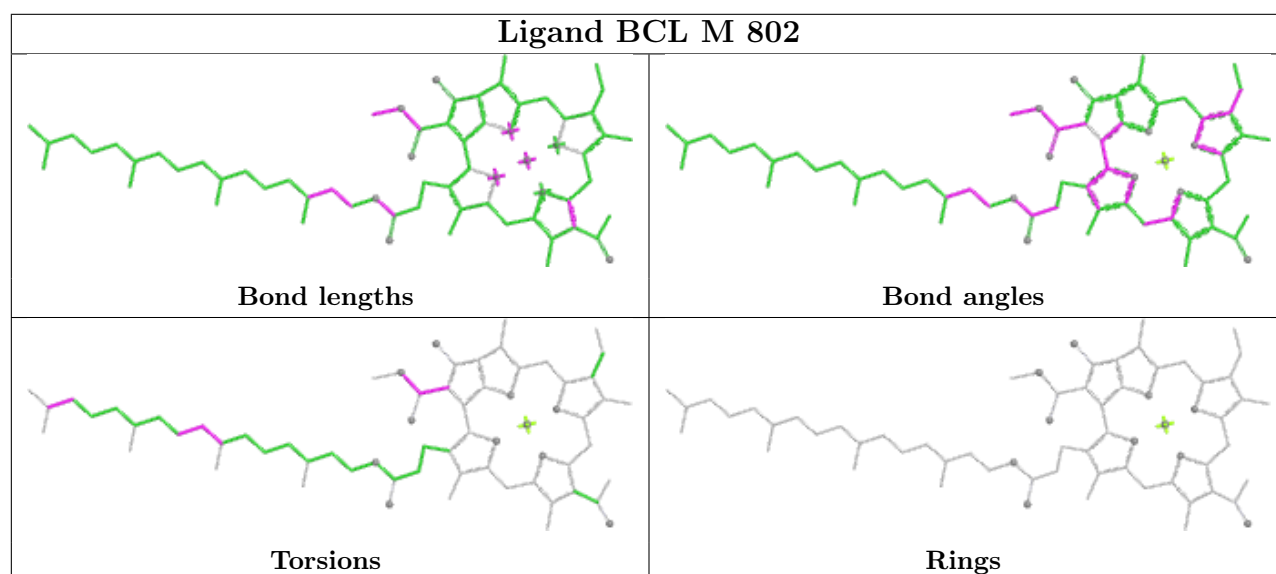
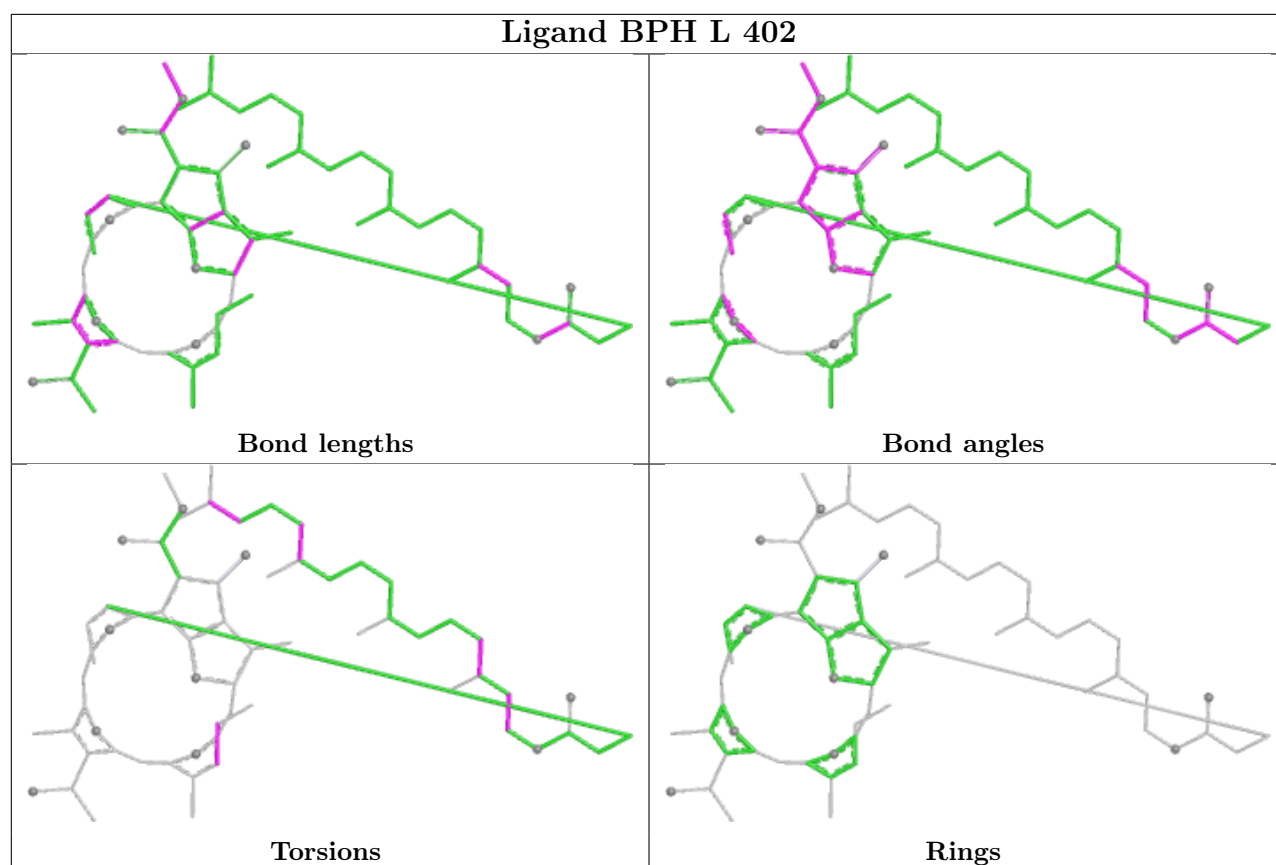
12 monomers are involved in 55 short contacts:

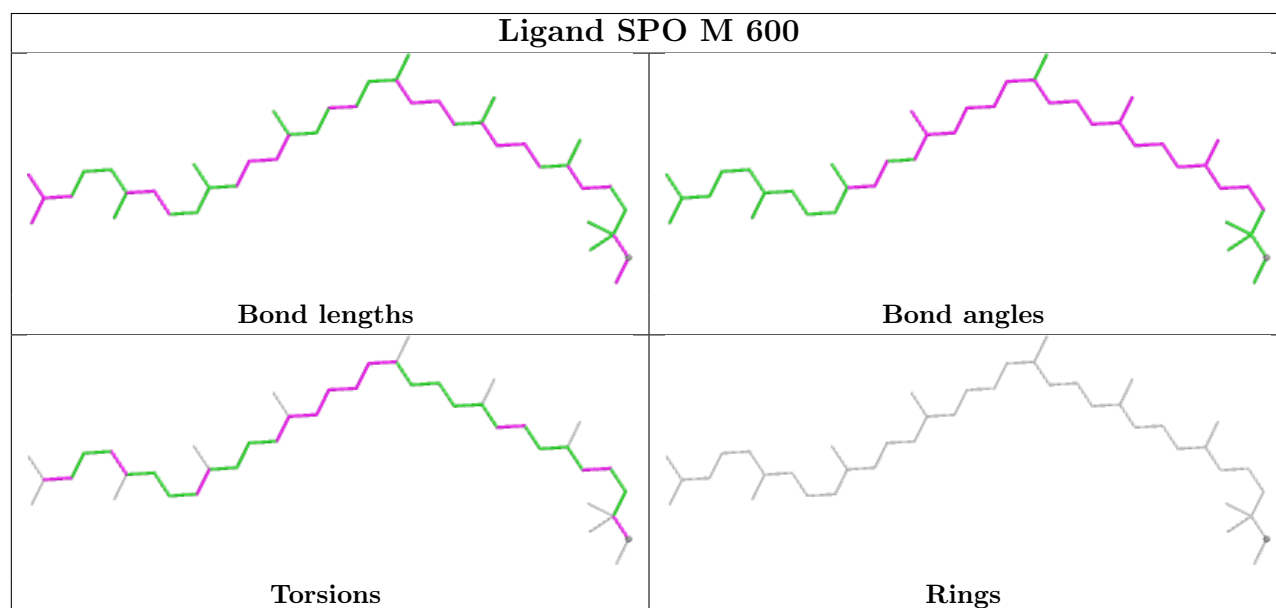
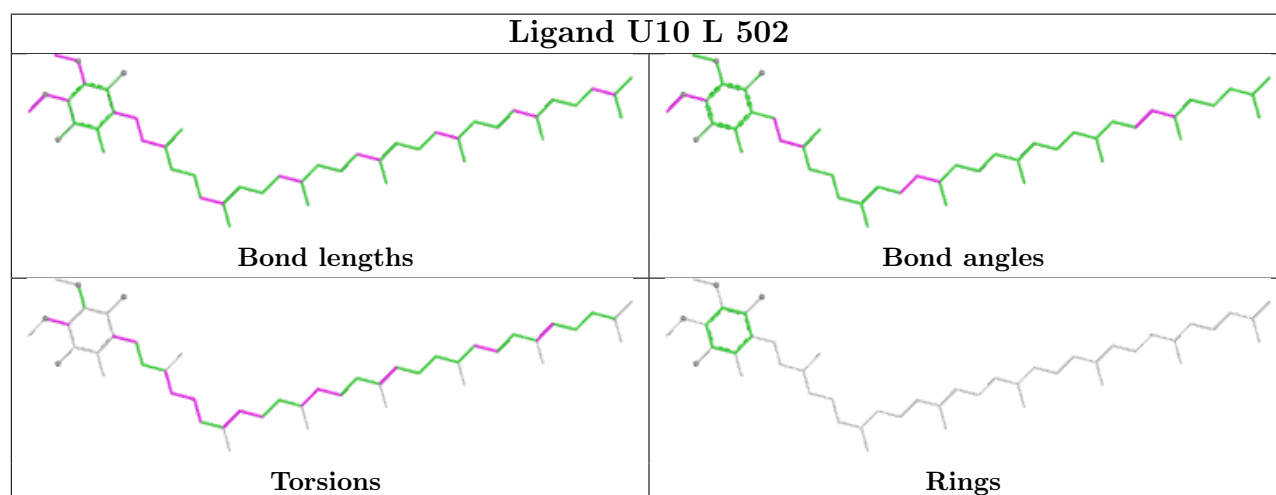
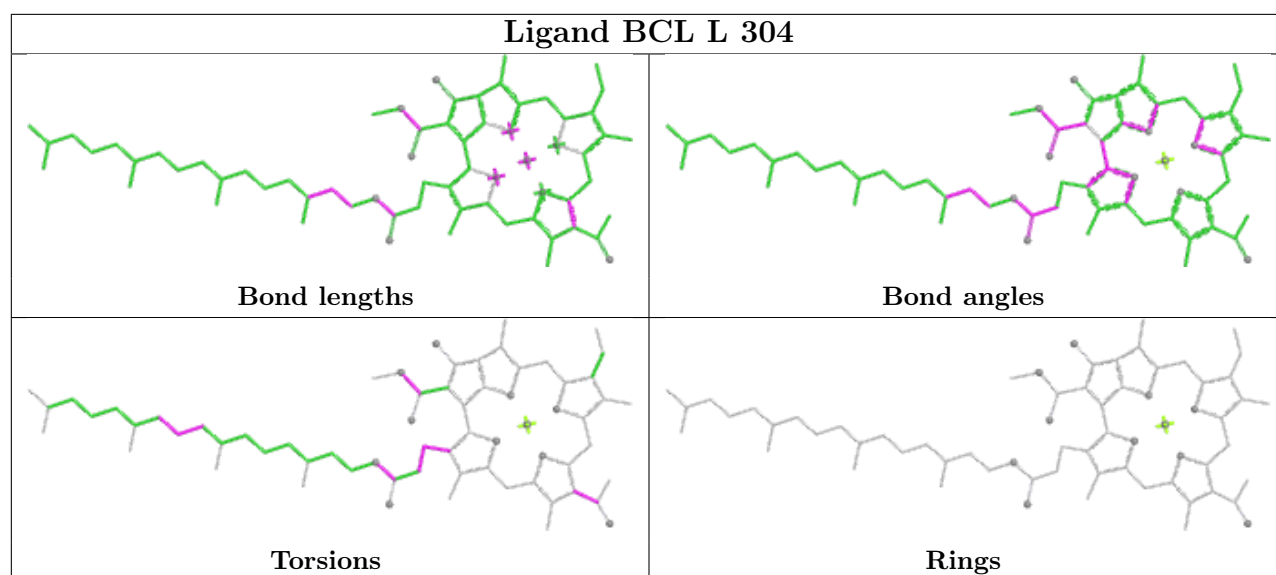
Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	L	302	BCL	7	0
7	H	706	LDA	3	0
6	M	501	U10	3	0
5	M	401	BPH	11	0
5	L	402	BPH	8	0
7	M	704	LDA	3	0
4	M	802	BCL	12	0
4	L	304	BCL	5	0
6	L	502	U10	1	0
10	M	600	SPO	2	0
4	M	801	BCL	7	0
7	M	701	LDA	1	0

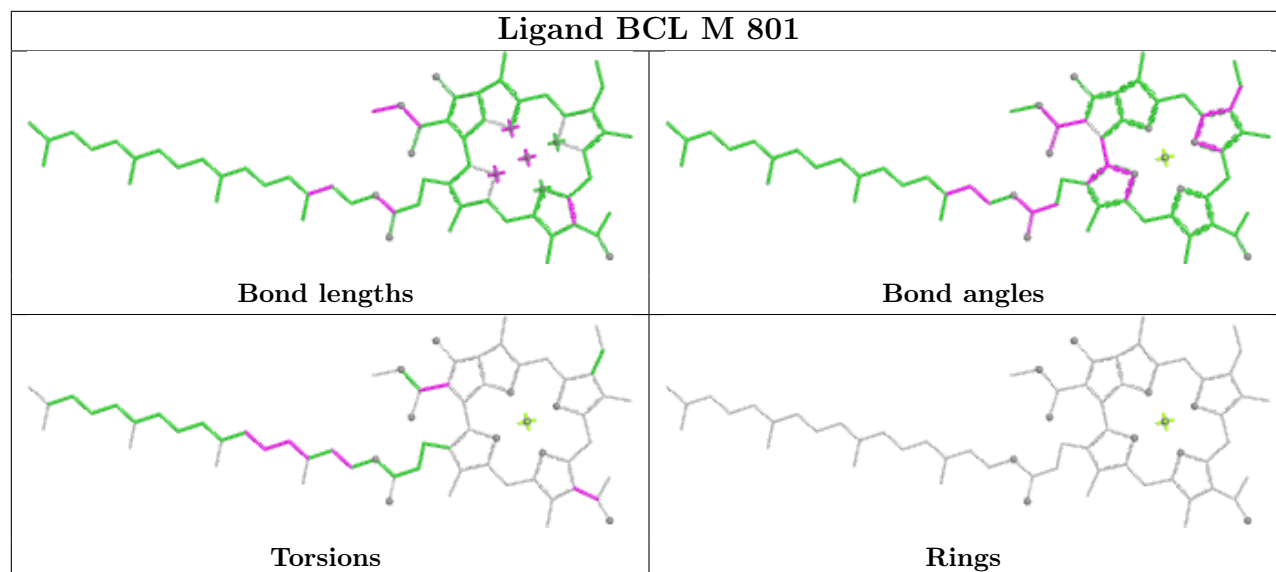
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

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

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

### 6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

### 6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.