



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 08:47 AM UTC

PDB ID : 1U19 / pdb_00001u19
Title : Crystal Structure of Bovine Rhodopsin at 2.2 Angstroms Resolution
Authors : Okada, T.; Sugihara, M.; Bondar, A.N.; Elstner, M.; Entel, P.; Buss, V.
Deposited on : 2004-07-15
Resolution : 2.20 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

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>.

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)
Xtriage (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

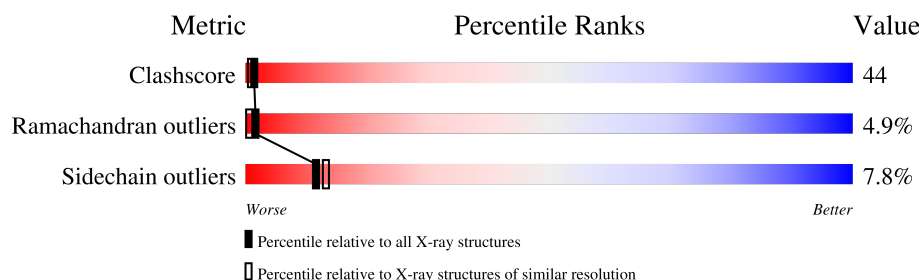
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)

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 $\leq 5\%$

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	349	48% 42% 10%
1	B	349	43% 47% 10%
2	C	3	33% 33% 33%
3	D	2	50% 50%
3	F	2	100%
4	E	4	50% 50%

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
8	PLM	B	1407	-	X	-	-

2 Entry composition [i](#)

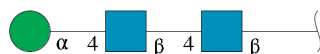
There are 11 unique types of molecules in this entry. The entry contains 5948 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Rhodopsin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	349	Total	C	N	O	S	0	0	0
			2749	1818	424	481	26			
1	B	349	Total	C	N	O	S	0	0	0
			2749	1818	424	481	26			

- Molecule 2 is an oligosaccharide called alpha-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	3	Total	C	N	O	0	0	0
			39	22	2	15			

- Molecule 3 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	D	2	Total	C	N	O	0	0	0
			28	16	2	10			
3	F	2	Total	C	N	O	0	0	0
			28	16	2	10			

- Molecule 4 is an oligosaccharide called beta-D-mannopyranose-(1-3)-beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
4	E	4	Total	C	N	O	0	0	0
			50	28	2	20			

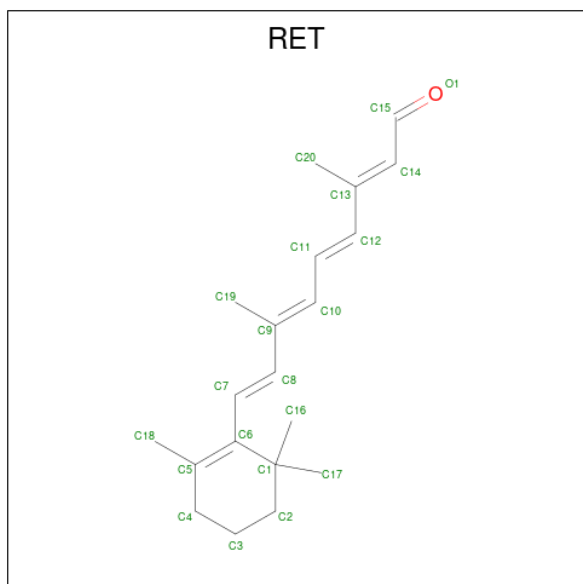
- Molecule 5 is MERCURY (II) ION (CCD ID: HG) (formula: Hg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	3	Total	Hg	0	0
			3	3		
5	B	3	Total	Hg	0	0
			3	3		

- Molecule 6 is ZINC ION (CCD ID: ZN) (formula: Zn).

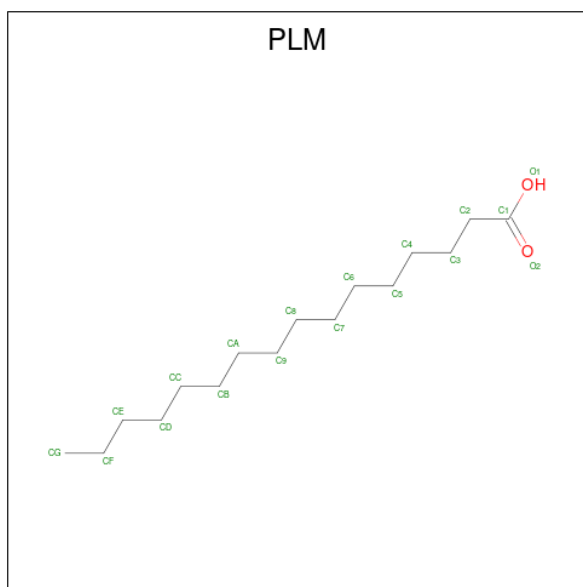
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	4	Total	Zn	0	0
			4	4		
6	B	3	Total	Zn	0	0
			3	3		

- Molecule 7 is RETINAL (CCD ID: RET) (formula: C₂₀H₂₈O).



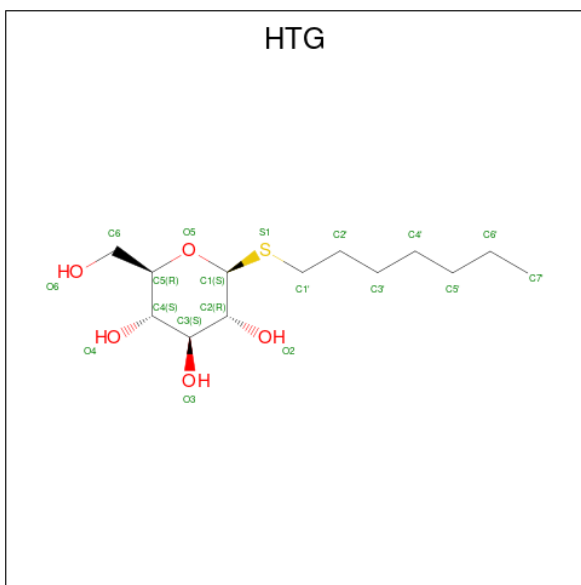
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	A	1	Total C 20 20	0	0
7	B	1	Total C 20 20	0	0

- Molecule 8 is PALMITIC ACID (CCD ID: PLM) (formula: $C_{16}H_{32}O_2$).



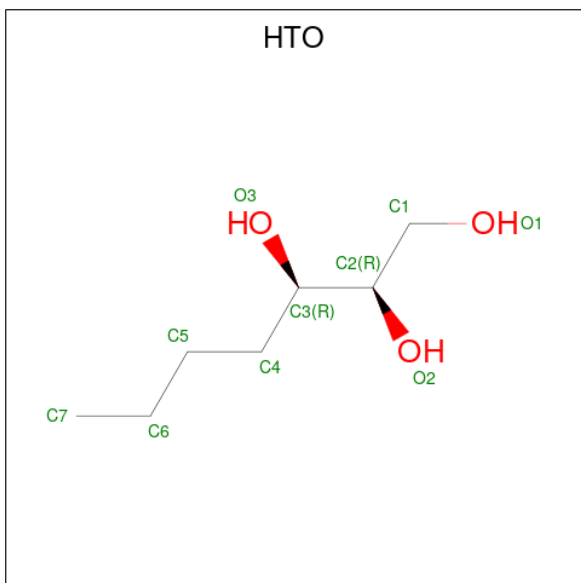
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	1	Total C O 17 16 1	0	0
8	A	1	Total C O 17 16 1	0	0
8	A	1	Total C 16 16	0	0
8	B	1	Total C O 17 16 1	0	0
8	B	1	Total C O 17 16 1	0	0
8	B	1	Total C 16 16	0	0

- Molecule 9 is heptyl 1-thio-beta-D-glucopyranoside (CCD ID: HTG) (formula: $C_{13}H_{26}O_5S$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
9	A	1	Total	C	O	S	0	0
			19	13	5	1		
9	B	1	Total	C	O	S	0	0
			19	13	5	1		
9	B	1	Total	C	O	S	0	0
			19	13	5	1		
9	B	1	Total	C	O	S	0	0
			19	13	5	1		

- Molecule 10 is HEPTANE-1,2,3-TRIOL (CCD ID: HTO) (formula: $C_7H_{16}O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
10	B	1	Total	C	O	0	0
			10	7	3		

- Molecule 11 is water.

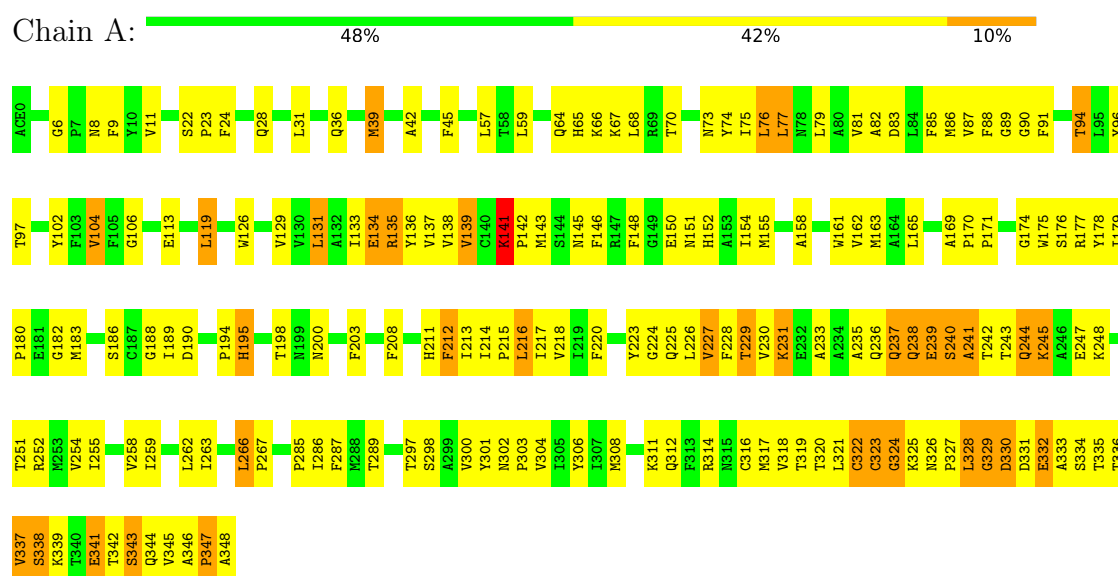
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
11	A	37	Total	O	0	0
			37	37		
11	B	29	Total	O	0	0
			29	29		

3 Residue-property plots

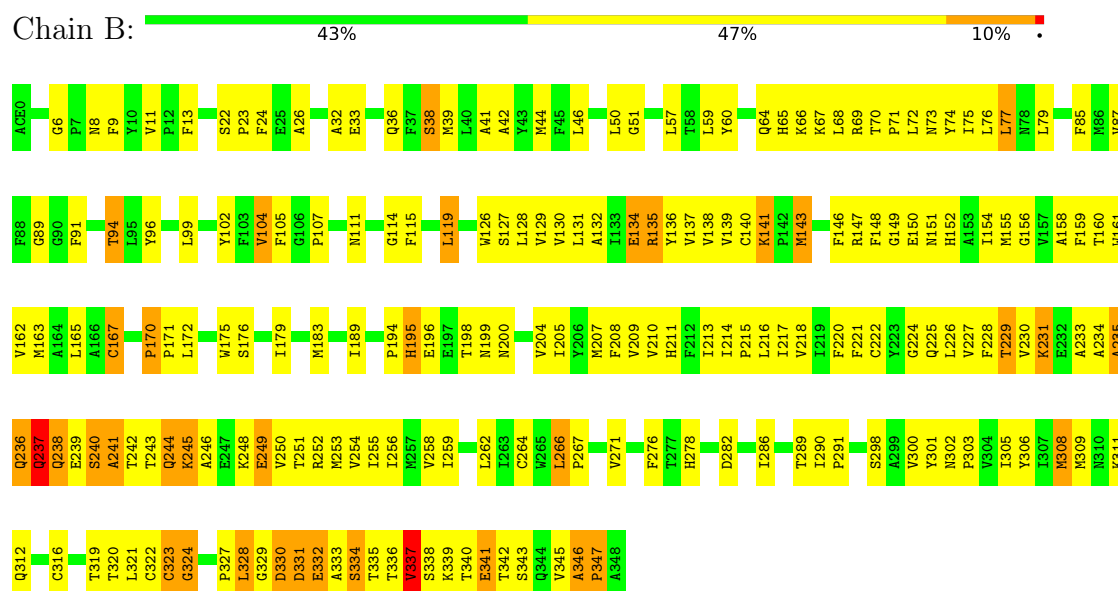
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded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

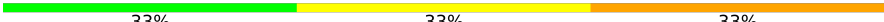
• Molecule 1: Rhodopsin



• Molecule 1: Rhodopsin



- Molecule 2: α -D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain C:  33% 33% 33%

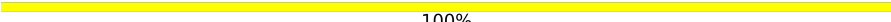
NAG1
NAG2
MAN3

- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain D:  50% 50%

NAG1
NAG2

- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain F:  100%

NAG1
NAG2

- Molecule 4: beta-D-mannopyranose-(1-3)-beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain E:  50% 50%

NAG1
NAG2
BMA3
BMA4

4 Data and refinement statistics

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

Property	Value	Source
Space group	P 41	Depositor
Cell constants a, b, c, α , β , γ	96.68Å 96.68Å 150.20Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.20	Depositor
% Data completeness (in resolution range)	85.4 (50.00-2.20)	Depositor
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.200 , 0.222	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	5948	wwPDB-VP
Average B, all atoms (Å ²)	58.0	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: HTG, HTO, MAN, ACE, NAG, RET, ZN, HG, PLM, BMA

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	0.79	3/2831 (0.1%)	1.06	8/3859 (0.2%)
1	B	0.77	1/2831 (0.0%)	1.09	8/3859 (0.2%)
All	All	0.78	4/5662 (0.1%)	1.07	16/7718 (0.2%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	339	LYS	CA-C	6.24	1.57	1.52
1	B	199	ASN	CA-C	-5.80	1.47	1.53
1	A	39	MET	SD-CE	5.74	1.93	1.79
1	A	317	MET	SD-CE	5.62	1.93	1.79

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	346	ALA	CA-C-N	6.83	128.37	119.84
1	B	346	ALA	C-N-CA	6.83	128.37	119.84
1	A	141	LYS	CA-C-N	6.76	126.22	118.85
1	A	141	LYS	C-N-CA	6.76	126.22	118.85
1	A	343	SER	N-CA-C	-6.42	105.31	113.02

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	A	2749	0	2706	238	1
1	B	2749	0	2706	289	0
2	C	39	0	34	1	0
3	D	28	0	25	2	0
3	F	28	0	25	0	0
4	E	50	0	43	0	0
5	A	3	0	0	0	0
5	B	3	0	0	0	0
6	A	4	0	0	0	0
6	B	3	0	0	0	0
7	A	20	0	27	1	0
7	B	20	0	27	1	0
8	A	50	0	89	4	0
8	B	50	0	89	5	0
9	A	19	0	26	0	0
9	B	57	0	78	3	1
10	B	10	0	16	1	0
11	A	37	0	0	3	0
11	B	29	0	0	4	0
All	All	5948	0	5891	521	1

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 44.

The worst 5 of 521 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)
1:A:65:HIS:HB3	1:A:337:VAL:HG22	1.26	1.15
1:B:312:GLN:HA	1:B:332:GLU:HG2	1.28	1.15
1:B:239:GLU:HB2	1:B:245:LYS:HD2	1.33	1.10
1:B:337:VAL:HB	1:B:343:SER:HA	1.35	1.08
1:B:245:LYS:HE3	1:B:245:LYS:HA	1.33	1.05

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:344:GLN:NE2	9:B:1509:HTG:O6[4_564]	2.04	0.16

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	347/349 (99%)	293 (84%)	36 (10%)	18 (5%)	1	0
1	B	347/349 (99%)	288 (83%)	43 (12%)	16 (5%)	2	1
All	All	694/698 (99%)	581 (84%)	79 (11%)	34 (5%)	1	0

5 of 34 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	145	ASN
1	A	195	HIS
1	A	212	PHE
1	A	240	SER
1	A	241	ALA

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	296/296 (100%)	274 (93%)	22 (7%)	13	14
1	B	296/296 (100%)	272 (92%)	24 (8%)	11	12
All	All	592/592 (100%)	546 (92%)	46 (8%)	11	13

5 of 46 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	134	GLU

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Mol	Chain	Res	Type
1	B	237	GLN
1	B	135	ARG
1	B	229	THR
1	B	245	LYS

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

Mol	Chain	Res	Type
1	B	237	GLN
1	B	244	GLN
1	B	8	ASN
1	B	64	GLN
1	B	73	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 ⓘ

11 monosaccharides 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	$\# Z > 2$
2	NAG	C	1	2,1	14,14,15	0.57	0	17,19,21	0.85	0
2	NAG	C	2	2	14,14,15	0.75	0	17,19,21	0.93	1 (5%)
2	MAN	C	3	2	11,11,12	0.91	0	15,15,17	0.78	0
3	NAG	D	1	3,1	14,14,15	0.64	0	17,19,21	0.70	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	NAG	D	2	3	14,14,15	0.62	0	17,19,21	0.90	1 (5%)
4	NAG	E	1	1,4	14,14,15	0.44	0	17,19,21	0.72	0
4	NAG	E	2	4	14,14,15	0.45	0	17,19,21	1.10	1 (5%)
4	BMA	E	3	4	11,11,12	0.74	0	15,15,17	0.60	0
4	BMA	E	4	4	11,11,12	0.90	0	15,15,17	0.89	1 (6%)
3	NAG	F	1	3,1	14,14,15	0.57	0	17,19,21	0.82	1 (5%)
3	NAG	F	2	3	14,14,15	0.69	0	17,19,21	0.79	1 (5%)

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
2	NAG	C	1	2,1	-	2/6/23/26	0/1/1/1
2	NAG	C	2	2	-	4/6/23/26	0/1/1/1
2	MAN	C	3	2	-	2/2/19/22	0/1/1/1
3	NAG	D	1	3,1	-	4/6/23/26	0/1/1/1
3	NAG	D	2	3	-	2/6/23/26	0/1/1/1
4	NAG	E	1	1,4	-	4/6/23/26	0/1/1/1
4	NAG	E	2	4	-	5/6/23/26	0/1/1/1
4	BMA	E	3	4	-	2/2/19/22	0/1/1/1
4	BMA	E	4	4	-	0/2/19/22	0/1/1/1
3	NAG	F	1	3,1	-	2/6/23/26	0/1/1/1
3	NAG	F	2	3	-	4/6/23/26	0/1/1/1

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	E	2	NAG	C2-N2-C7	-3.49	118.22	122.90
3	D	2	NAG	C2-N2-C7	-2.87	119.05	122.90
4	E	4	BMA	C1-O5-C5	2.40	115.41	112.19
2	C	2	NAG	C8-C7-N2	2.14	119.67	116.12
3	F	2	NAG	C2-N2-C7	-2.06	120.14	122.90

There are no chirality outliers.

5 of 31 torsion outliers are listed below:

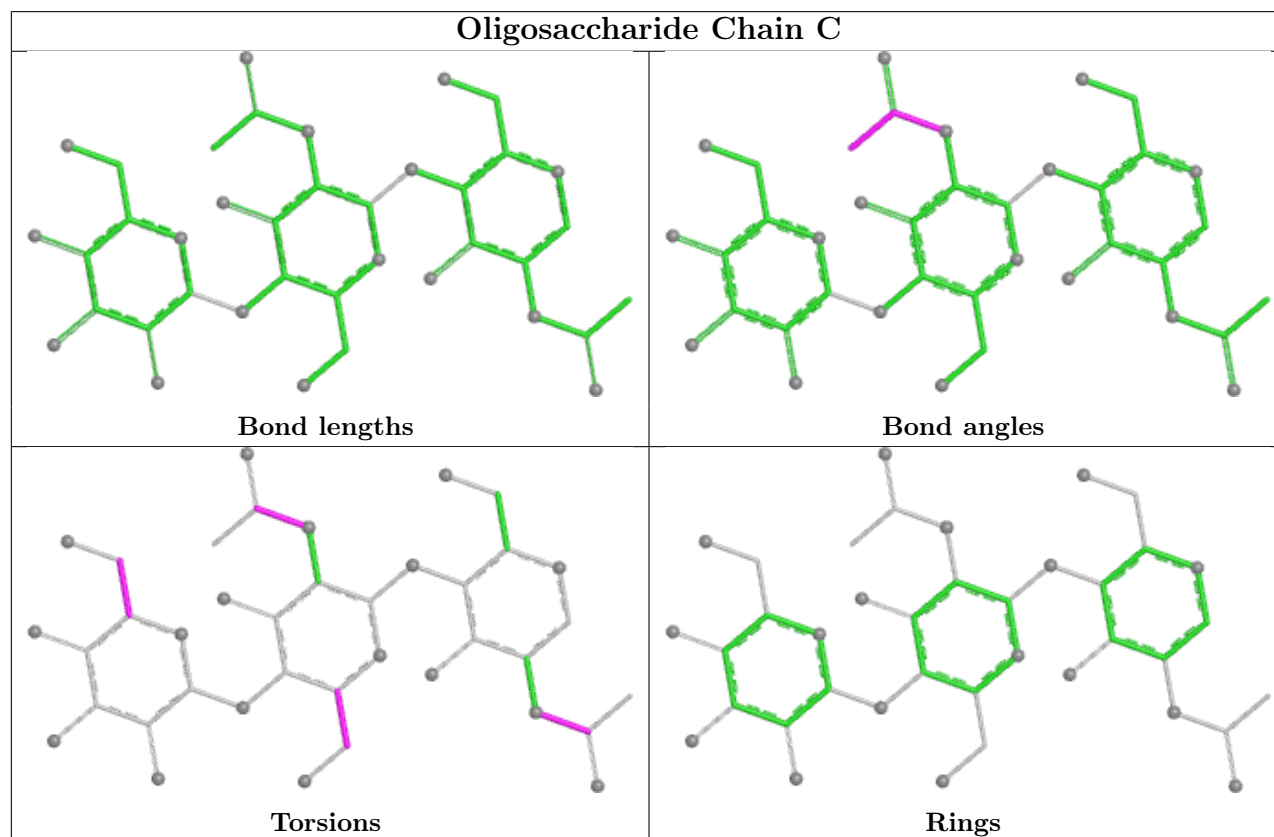
Mol	Chain	Res	Type	Atoms
2	C	1	NAG	C8-C7-N2-C2
2	C	1	NAG	O7-C7-N2-C2
3	D	1	NAG	C8-C7-N2-C2
3	D	1	NAG	O7-C7-N2-C2
3	F	1	NAG	C8-C7-N2-C2

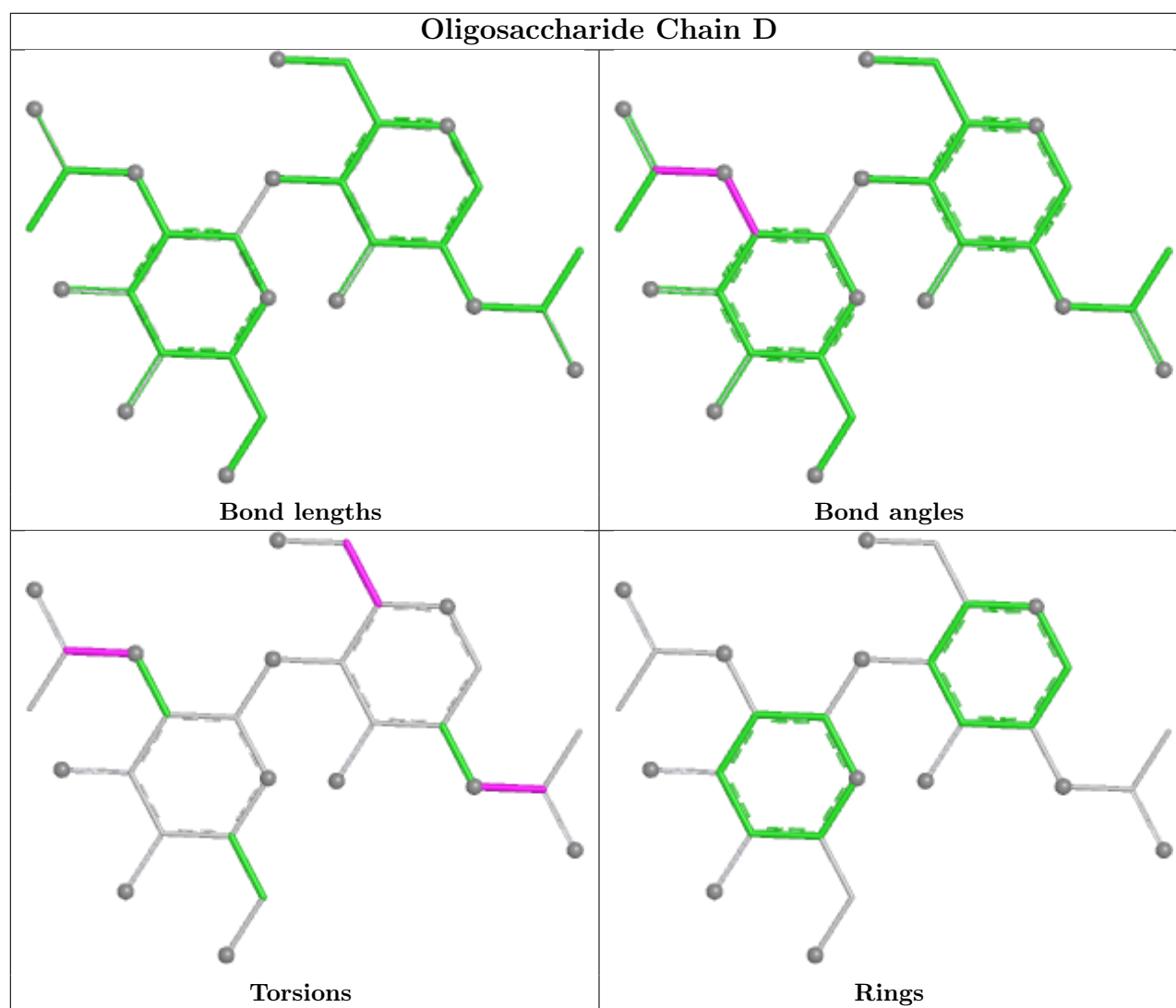
There are no ring outliers.

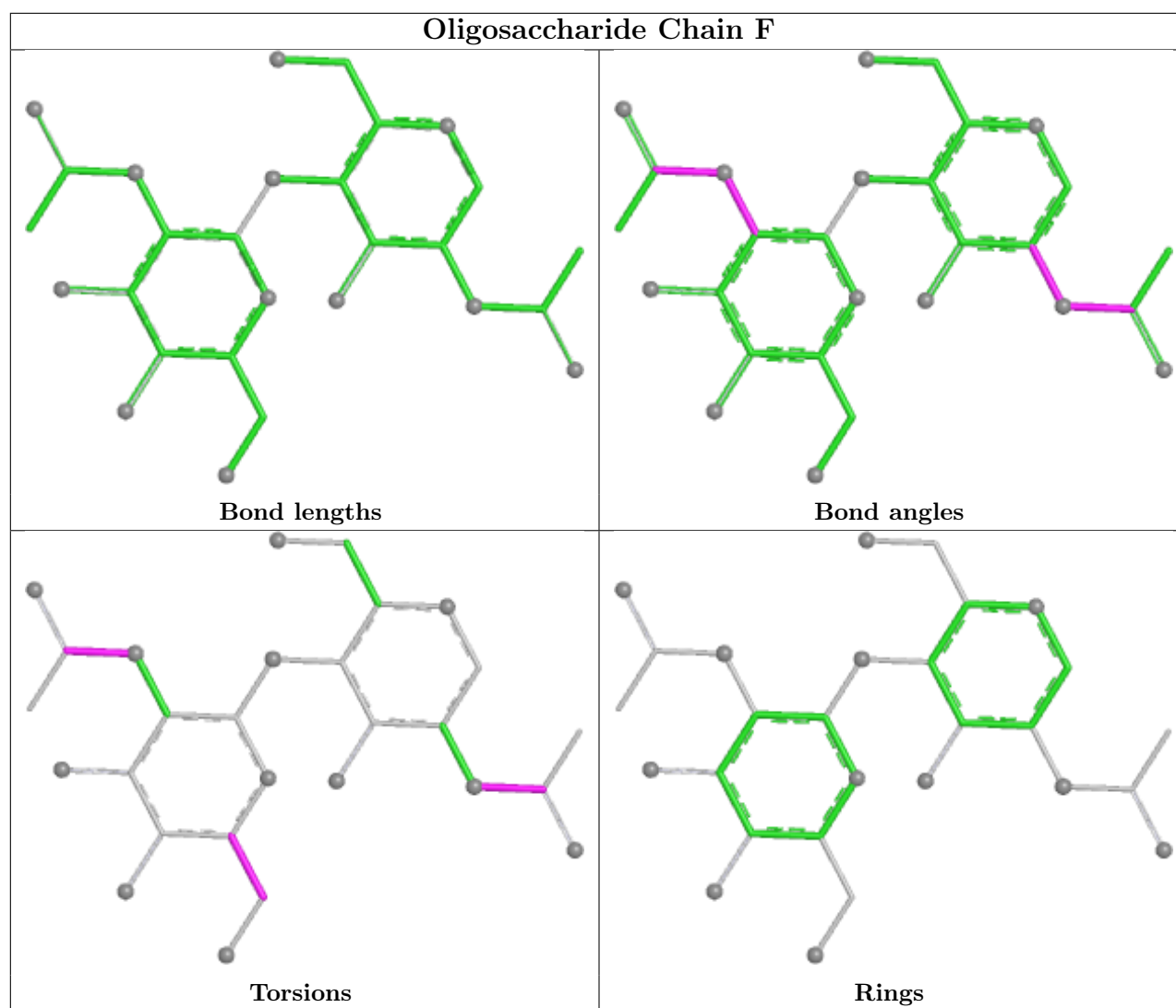
4 monomers are involved in 3 short contacts:

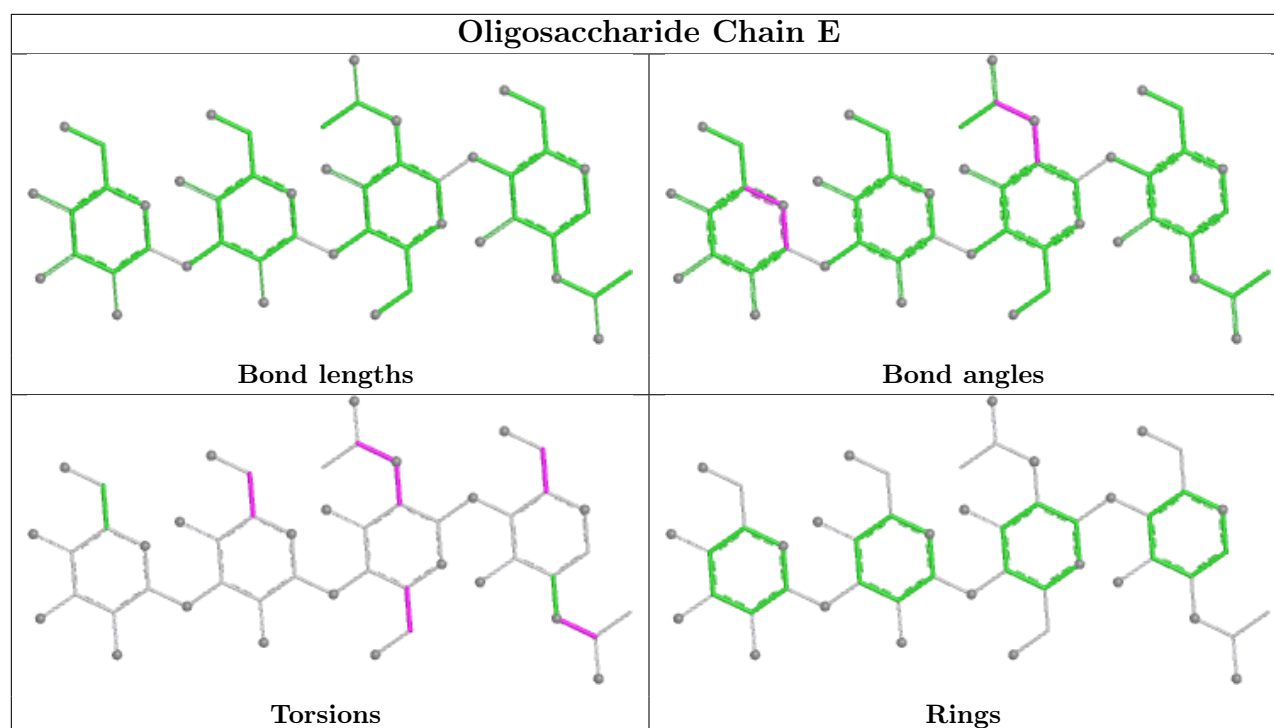
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	D	2	NAG	2	0
3	D	1	NAG	2	0
2	C	2	NAG	1	0
2	C	1	NAG	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.









5.6 Ligand geometry [i](#)

Of 26 ligands modelled in this entry, 13 are monoatomic - leaving 13 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
7	RET	B	1296	1	20,20,21	2.62	5 (25%)	27,27,28	1.71	8 (29%)
9	HTG	B	1509	-	19,19,19	3.03	8 (42%)	23,24,24	2.07	3 (13%)
8	PLM	A	1410	-	15,15,17	2.13	3 (20%)	14,14,17	3.42	7 (50%)
8	PLM	B	1407	-	15,15,17	1.99	3 (20%)	14,14,17	3.42	8 (57%)
10	HTO	B	1401	-	9,9,9	1.81	1 (11%)	10,10,10	1.09	1 (10%)
9	HTG	A	1507	-	19,19,19	3.10	8 (42%)	23,24,24	2.01	2 (8%)
9	HTG	B	1508	-	19,19,19	2.41	6 (31%)	23,24,24	2.20	2 (8%)
8	PLM	A	1322	1	15,16,17	0.24	0	14,15,17	0.68	0
9	HTG	B	1506	-	19,19,19	3.17	8 (42%)	23,24,24	1.70	2 (8%)
8	PLM	B	1322	1	15,16,17	0.47	0	14,15,17	0.42	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
8	PLM	A	1323	1	15,16,17	0.33	0	14,15,17	0.51	0
8	PLM	B	1323	1	15,16,17	0.46	0	14,15,17	0.44	0
7	RET	A	1296	1	20,20,21	2.02	3 (15%)	27,27,28	1.82	9 (33%)

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
7	RET	B	1296	1	-	1/13/30/31	0/1/1/1
9	HTG	B	1509	-	-	4/10/30/30	0/1/1/1
8	PLM	A	1410	-	-	5/13/13/15	-
8	PLM	B	1407	-	-	6/13/13/15	-
10	HTO	B	1401	-	-	2/10/10/10	-
9	HTG	A	1507	-	-	4/10/30/30	0/1/1/1
9	HTG	B	1508	-	-	4/10/30/30	0/1/1/1
8	PLM	A	1322	1	-	11/14/14/15	-
9	HTG	B	1506	-	-	2/10/30/30	0/1/1/1
8	PLM	B	1322	1	-	10/14/14/15	-
8	PLM	A	1323	1	-	10/14/14/15	-
8	PLM	B	1323	1	-	9/14/14/15	-
7	RET	A	1296	1	-	1/13/30/31	0/1/1/1

The worst 5 of 45 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
9	B	1506	HTG	O5-C1	9.52	1.57	1.42
9	A	1507	HTG	O5-C1	9.07	1.56	1.42
9	B	1509	HTG	O5-C1	8.23	1.55	1.42
9	B	1508	HTG	O5-C1	6.88	1.53	1.42
7	B	1296	RET	C14-C13	6.24	1.38	1.33

The worst 5 of 42 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
9	B	1508	HTG	C1'-S1-C1	9.64	121.26	100.45
9	B	1509	HTG	C1'-S1-C1	8.86	119.58	100.45
9	A	1507	HTG	C1'-S1-C1	8.56	118.93	100.45

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
8	B	1407	PLM	CD-CC-CB	8.30	156.30	114.37
8	A	1410	PLM	CD-CC-CB	8.20	155.82	114.37

There are no chirality outliers.

5 of 69 torsion outliers are listed below:

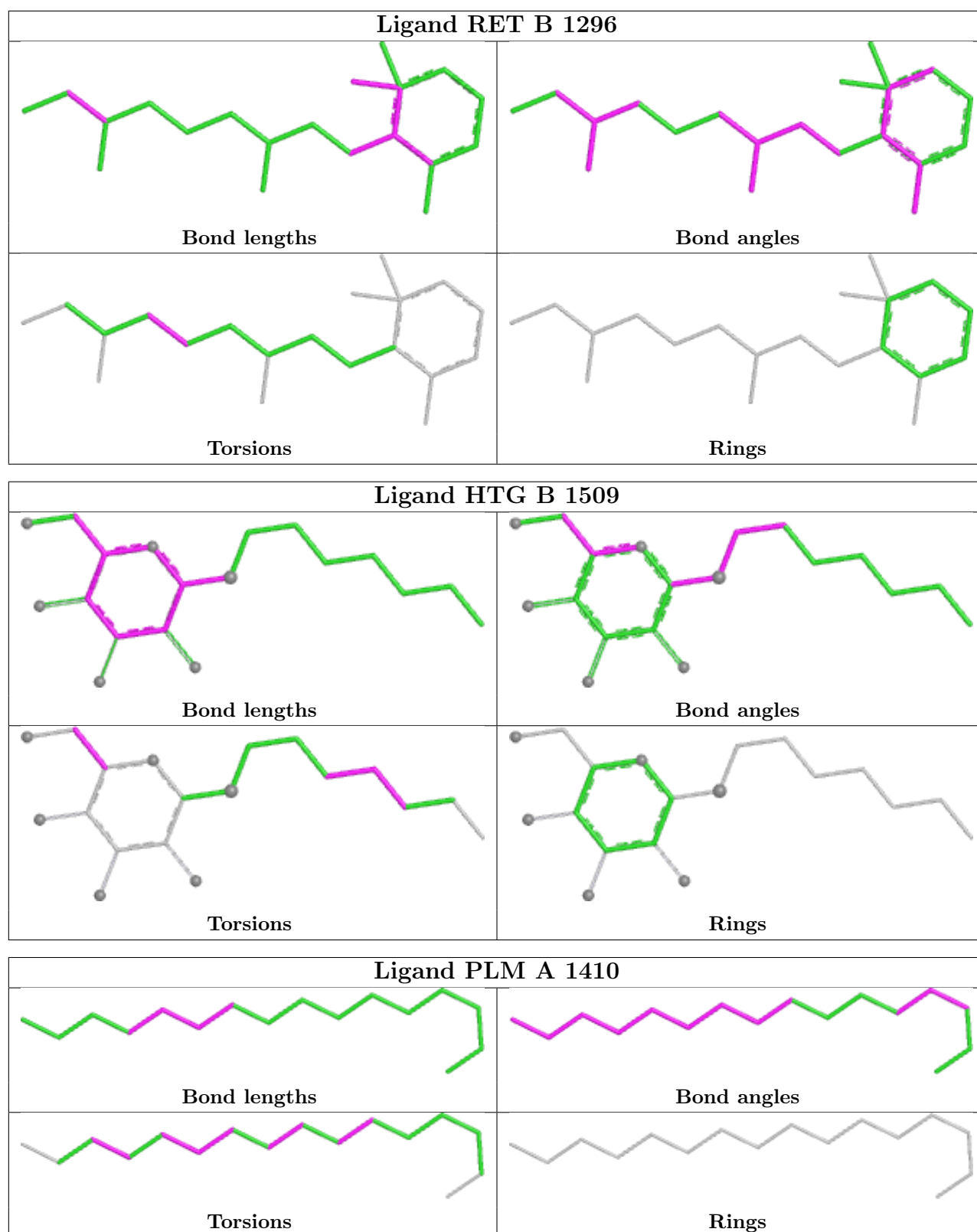
Mol	Chain	Res	Type	Atoms
7	A	1296	RET	C10-C11-C12-C13
7	B	1296	RET	C10-C11-C12-C13
8	A	1322	PLM	O2-C1-C2-C3
8	A	1323	PLM	O2-C1-C2-C3
8	B	1407	PLM	CA-CB-CC-CD

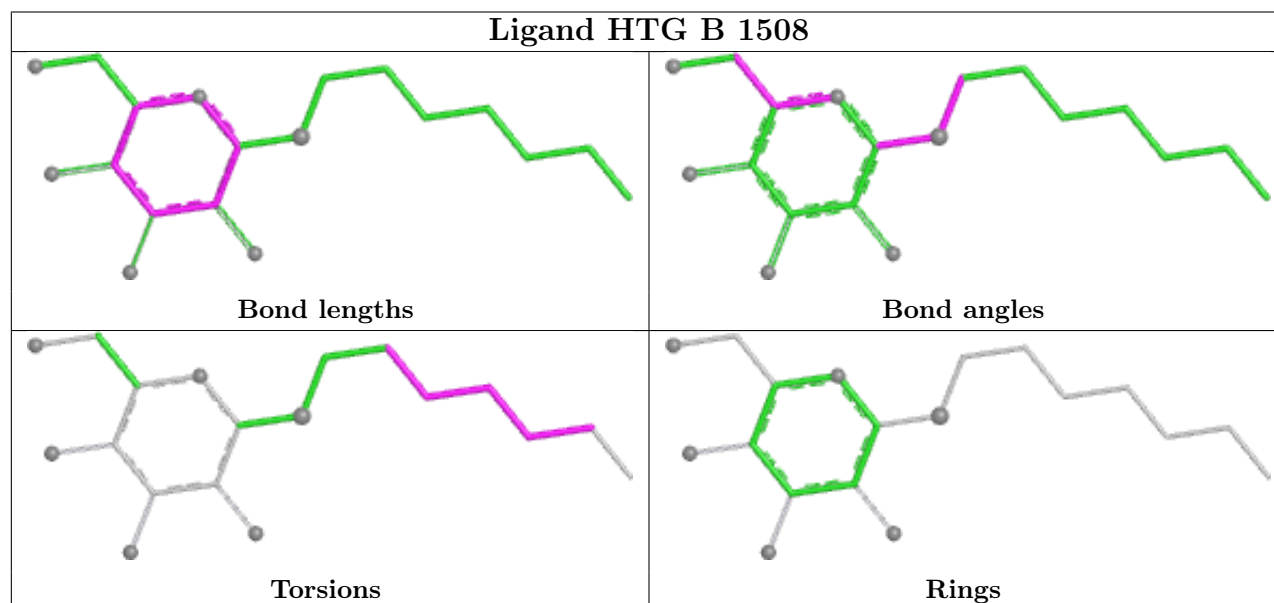
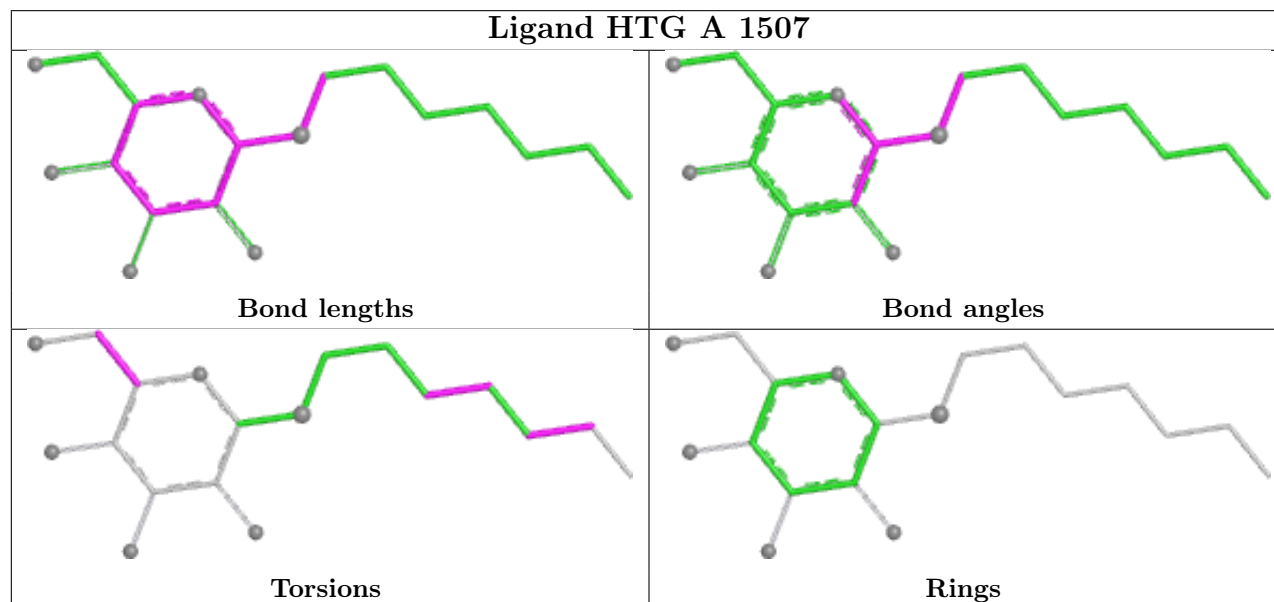
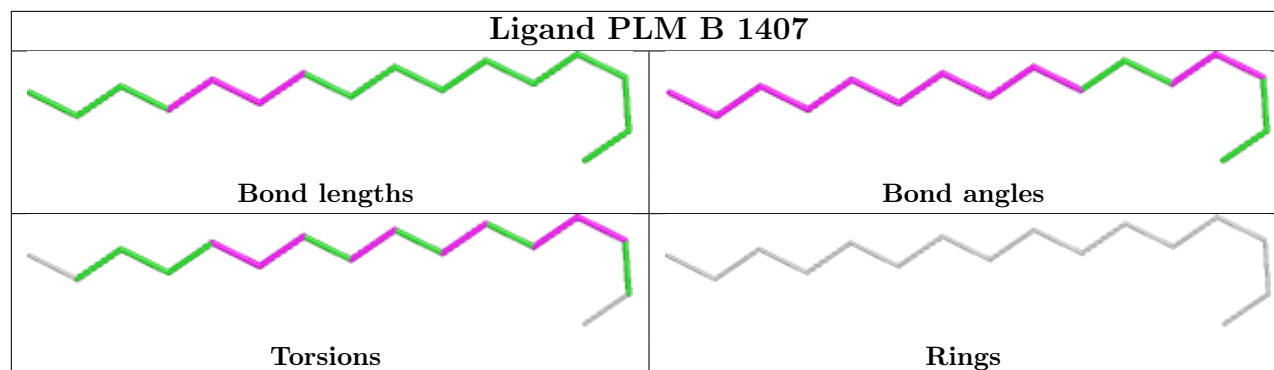
There are no ring outliers.

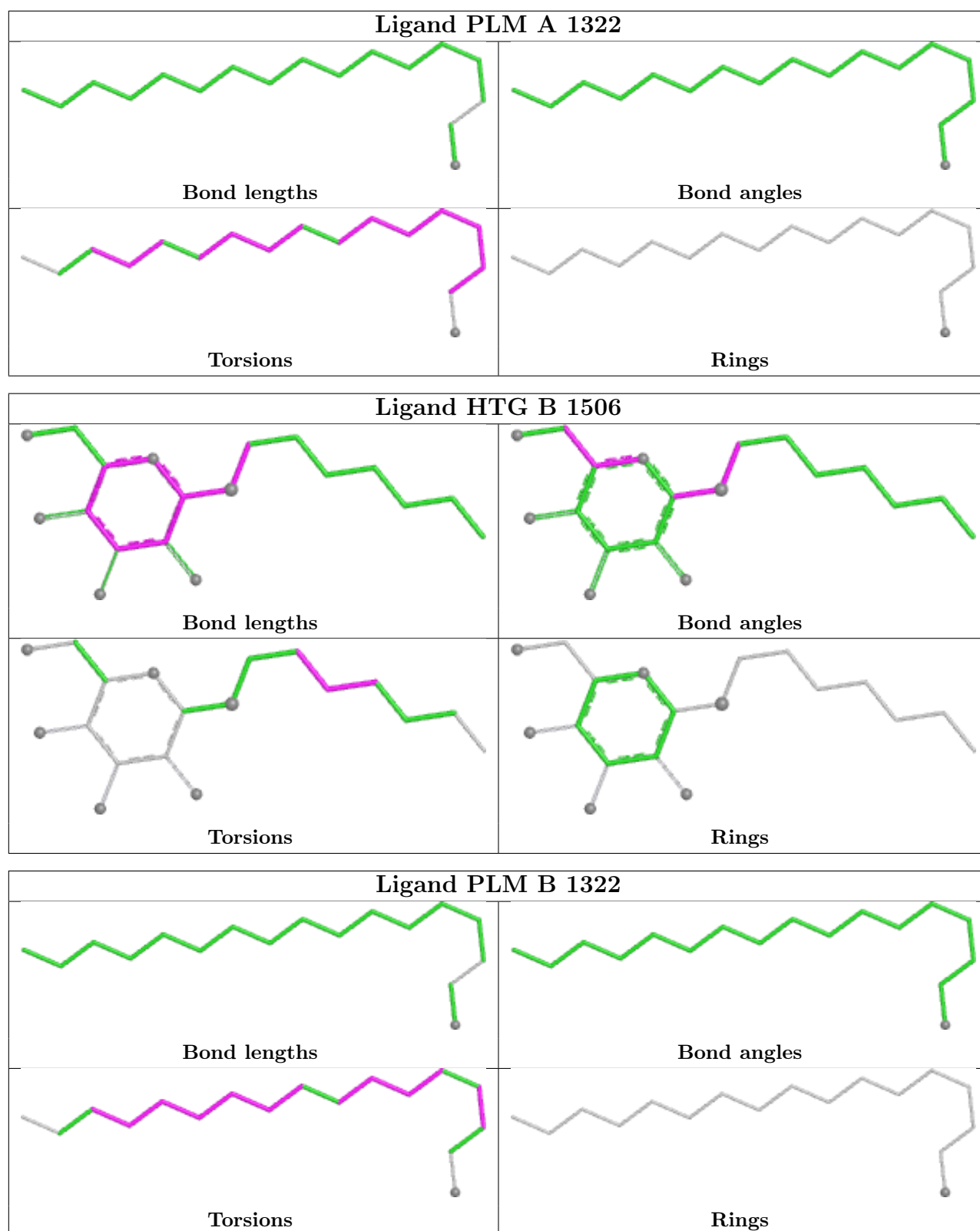
10 monomers are involved in 15 short contacts:

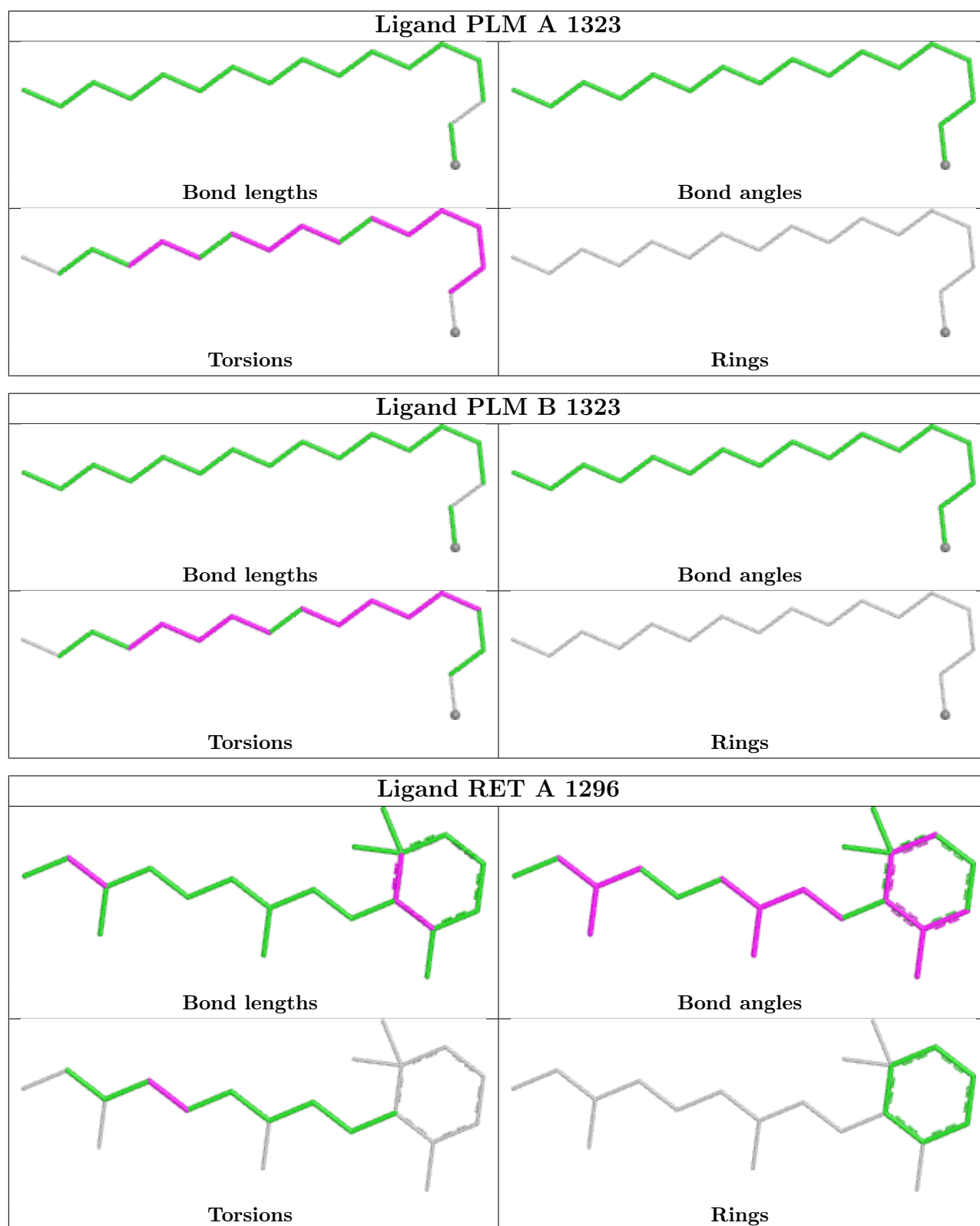
Mol	Chain	Res	Type	Clashes	Symm-Clashes
7	B	1296	RET	1	0
9	B	1509	HTG	1	1
8	A	1410	PLM	1	0
8	B	1407	PLM	1	0
10	B	1401	HTO	1	0
9	B	1508	HTG	2	0
8	A	1322	PLM	3	0
8	B	1322	PLM	2	0
8	B	1323	PLM	3	0
7	A	1296	RET	1	0

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 ⓘ

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.