



## wwPDB EM Validation Summary Report ⓘ

Oct 7, 2024 – 02:15 PM JST

PDB ID : 8K66  
EMDB ID : EMD-36918  
Title : Cryo-EM structure of *Oryza sativa* HKT2;1 at 2.5 angstrom  
Authors : Wang, X.; Shen, X.; Qu, Y.; Wang, C.; Shen, H.  
Deposited on : 2023-07-25  
Resolution : 2.53 Å (reported)

This is a wwPDB EM 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/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>.

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

EMDB validation analysis : **FAILED**  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
MolProbity : 4.02b-467  
buster-report : 1.1.7 (2018)  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
MapQ : **FAILED**  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.39

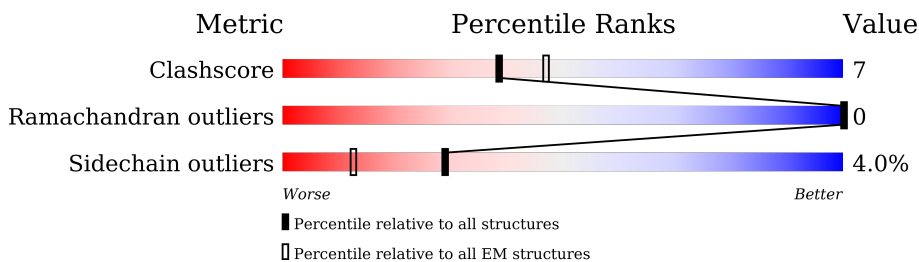
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 2.53 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)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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  $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	543	 67% 13% • 18%
1	B	543	 68% 13% • 18%

## 2 Entry composition i

There are 8 unique types of molecules in this entry. The entry contains 7620 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.

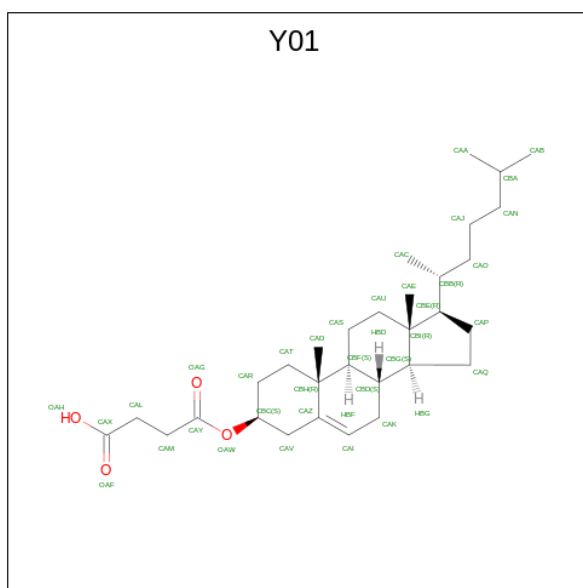
- Molecule 1 is a protein called Cation transporter HKT2;1.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	443	3514	2349	558	590	17	1	0
1	B	443	3514	2349	558	590	17	1	0

There are 26 discrepancies between the modelled and reference sequences:

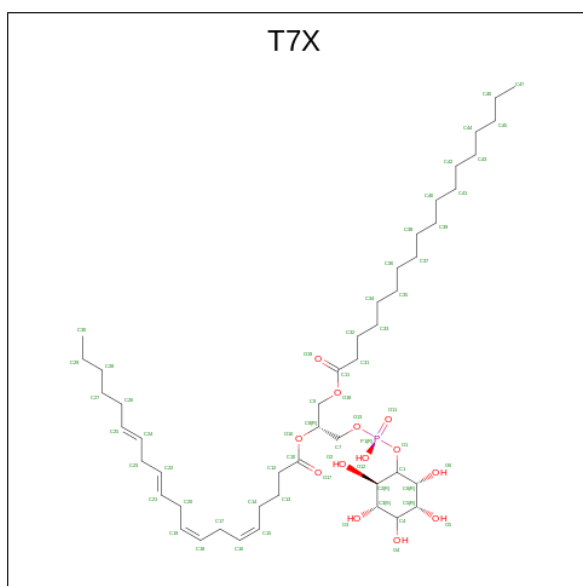
Chain	Residue	Modelled	Actual	Comment	Reference
A	-12	MET	-	initiating methionine	UNP Q0D9S3
A	-11	ALA	-	expression tag	UNP Q0D9S3
A	-10	ASP	-	expression tag	UNP Q0D9S3
A	-9	TYR	-	expression tag	UNP Q0D9S3
A	-8	LYS	-	expression tag	UNP Q0D9S3
A	-7	ASP	-	expression tag	UNP Q0D9S3
A	-6	ASP	-	expression tag	UNP Q0D9S3
A	-5	ASP	-	expression tag	UNP Q0D9S3
A	-4	ASP	-	expression tag	UNP Q0D9S3
A	-3	LYS	-	expression tag	UNP Q0D9S3
A	-2	GLY	-	expression tag	UNP Q0D9S3
A	-1	GLY	-	expression tag	UNP Q0D9S3
A	0	ARG	-	expression tag	UNP Q0D9S3
B	-12	MET	-	initiating methionine	UNP Q0D9S3
B	-11	ALA	-	expression tag	UNP Q0D9S3
B	-10	ASP	-	expression tag	UNP Q0D9S3
B	-9	TYR	-	expression tag	UNP Q0D9S3
B	-8	LYS	-	expression tag	UNP Q0D9S3
B	-7	ASP	-	expression tag	UNP Q0D9S3
B	-6	ASP	-	expression tag	UNP Q0D9S3
B	-5	ASP	-	expression tag	UNP Q0D9S3
B	-4	ASP	-	expression tag	UNP Q0D9S3
B	-3	LYS	-	expression tag	UNP Q0D9S3
B	-2	GLY	-	expression tag	UNP Q0D9S3
B	-1	GLY	-	expression tag	UNP Q0D9S3
B	0	ARG	-	expression tag	UNP Q0D9S3

- Molecule 2 is CHOLESTEROL HEMISUCCINATE (three-letter code: Y01) (formula:  $C_{31}H_{50}O_4$ ).



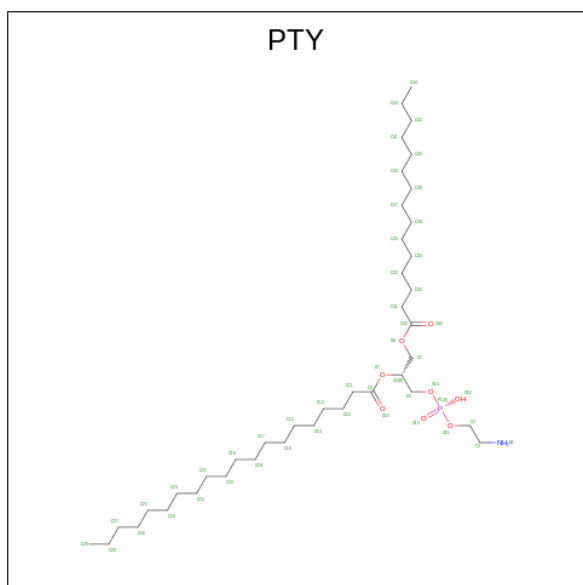
Mol	Chain	Residues	Atoms			AltConf
2	A	1	Total	C	O	0
			35	31	4	
2	A	1	Total	C	O	0
			35	31	4	
2	B	1	Total	C	O	0
			35	31	4	
2	B	1	Total	C	O	0
			35	31	4	

- Molecule 3 is Phosphatidylinositol (three-letter code: T7X) (formula:  $C_{47}H_{83}O_{13}P$ ).



Mol	Chain	Residues	Atoms				AltConf
			Total	C	O	P	
3	A	1	46	32	13	1	0
3	B	1	46	32	13	1	0

- Molecule 4 is PHOSPHATIDYLETHANOLAMINE (three-letter code: PTY) (formula:  $C_{40}H_{80}NO_8P$ ).



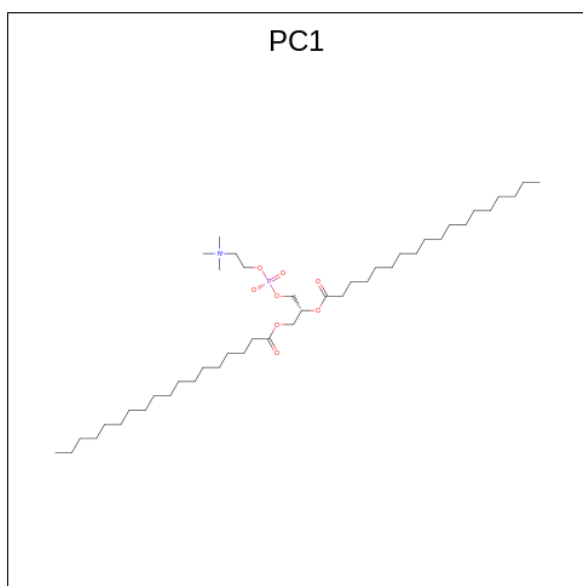
Mol	Chain	Residues	Atoms					AltConf
			Total	C	N	O	P	
4	A	1	34	24	1	8	1	0
4	B	1	34	24	1	8	1	0

- Molecule 5 is CHOLESTEROL (three-letter code: CLR) (formula:  $C_{27}H_{46}O$ ).



Mol	Chain	Residues	Atoms			AltConf
5	A	1	Total	C	O	0
			28	27	1	
5	B	1	Total	C	O	0
			28	27	1	

- Molecule 6 is 1,2-DIACYL-SN-GLYCERO-3-PHOSPHOCHOLINE (three-letter code: PC1) (formula:  $C_{44}H_{88}NO_8P$ ).



Mol	Chain	Residues	Atoms				AltConf	
6	A	1	Total	C	N	O	P	0
			51	41	1	8	1	

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Mol	Chain	Residues	Atoms					AltConf
			Total	C	N	O	P	
6	B	1	51	41	1	8	1	0

- Molecule 7 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		AltConf
			Total	Na	
7	A	2	2	2	0
7	B	2	2	2	0

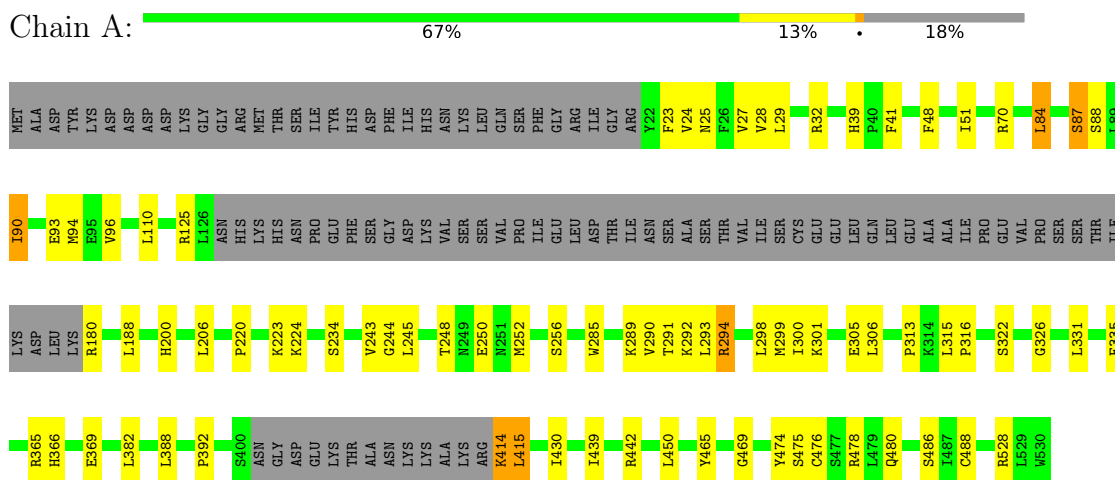
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		AltConf
			Total	O	
8	A	65	65	65	0
8	B	65	65	65	0

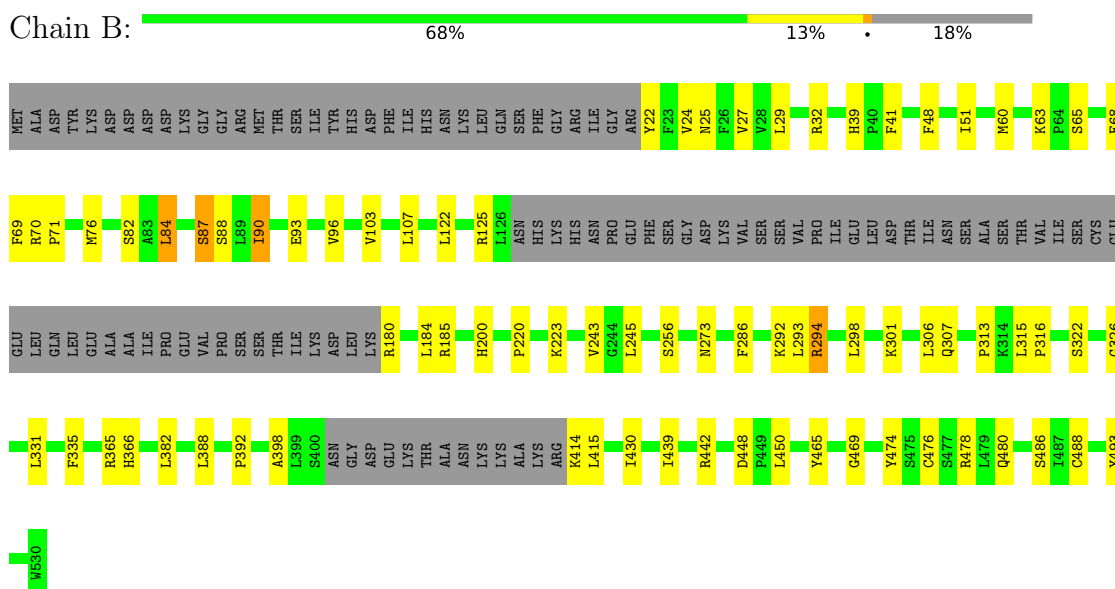
### 3 Residue-property plots

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.

- Molecule 1: Cation transporter HKT2;1



- Molecule 1: Cation transporter HKT2;1





## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	501277	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 ( $e^-/\text{\AA}^2$ )	50	Depositor
Minimum defocus (nm)	1200	Depositor
Maximum defocus (nm)	2200	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor

## 5 Model quality

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: PTY, PC1, NA, Y01, CLR, T7X

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	0.30	0/3605	0.43	0/4893
1	B	0.29	0/3605	0.42	0/4893
All	All	0.30	0/7210	0.43	0/9786

There are no bond length outliers.

There are no bond angle outliers.

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	3514	0	3674	52	0
1	B	3514	0	3674	48	0
2	A	70	0	98	4	0
2	B	70	0	98	3	0
3	A	46	0	0	1	0
3	B	46	0	0	0	0
4	A	34	0	41	1	0
4	B	34	0	41	1	0
5	A	28	0	46	3	0
5	B	28	0	46	1	0
6	A	51	0	76	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	B	51	0	76	2	0
7	A	2	0	0	0	0
7	B	2	0	0	0	0
8	A	65	0	0	10	0
8	B	65	0	0	9	0
All	All	7620	0	7870	109	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 7.

The worst 5 of 109 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:478:ARG:NH1	8:A:701:HOH:O	2.00	0.93
1:B:273:ASN:ND2	8:B:802:HOH:O	2.05	0.89
1:A:382:LEU:HD11	8:A:719:HOH:O	1.78	0.83
1:A:245:LEU:O	8:A:702:HOH:O	2.01	0.79
1:A:188:LEU:HD22	1:A:306:LEU:HD23	1.65	0.77

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 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	438/543 (81%)	431 (98%)	7 (2%)	0	100	100
1	B	438/543 (81%)	431 (98%)	7 (2%)	0	100	100
All	All	876/1086 (81%)	862 (98%)	14 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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 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	391/478 (82%)	375 (96%)	16 (4%)	26	47
1	B	391/478 (82%)	376 (96%)	15 (4%)	28	51
All	All	782/956 (82%)	751 (96%)	31 (4%)	29	48

5 of 31 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	415	LEU
1	B	335	PHE
1	B	65	SER
1	B	415	LEU
1	B	292	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	39	HIS
1	B	200	HIS
1	B	421	ASN
1	A	302	ASN
1	A	421	ASN

### 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 16 ligands modelled in this entry, 4 are monoatomic - leaving 12 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
5	CLR	B	706	-	31,31,31	0.35	0	48,48,48	1.02	4 (8%)
3	T7X	B	704	-	46,46,61	0.97	4 (8%)	56,58,73	1.07	2 (3%)
4	PTY	A	604	-	33,33,49	1.04	4 (12%)	36,38,54	1.12	2 (5%)
6	PC1	A	606	-	50,50,53	0.97	4 (8%)	56,58,61	1.04	2 (3%)
2	Y01	A	601	-	38,38,38	0.71	0	57,57,57	1.30	7 (12%)
5	CLR	A	605	-	31,31,31	0.29	0	48,48,48	0.35	0
2	Y01	B	703	-	38,38,38	0.76	0	57,57,57	1.24	7 (12%)
2	Y01	A	602	-	38,38,38	0.76	0	57,57,57	1.24	8 (14%)
3	T7X	A	603	-	46,46,61	0.97	4 (8%)	56,58,73	1.07	2 (3%)
4	PTY	B	705	-	33,33,49	1.04	4 (12%)	36,38,54	1.12	2 (5%)
2	Y01	B	702	-	38,38,38	0.70	0	57,57,57	1.31	7 (12%)
6	PC1	B	701	-	50,50,53	0.97	4 (8%)	56,58,61	1.04	2 (3%)

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
5	CLR	B	706	-	-	8/10/68/68	0/4/4/4
3	T7X	B	704	-	-	18/41/65/80	0/1/1/1
4	PTY	A	604	-	-	17/37/37/53	-
6	PC1	A	606	-	-	16/54/54/57	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	Y01	A	601	-	-	13/19/77/77	0/4/4/4
5	CLR	A	605	-	-	4/10/68/68	0/4/4/4
2	Y01	B	703	-	-	9/19/77/77	0/4/4/4
2	Y01	A	602	-	-	9/19/77/77	0/4/4/4
3	T7X	A	603	-	-	18/41/65/80	0/1/1/1
4	PTY	B	705	-	-	17/37/37/53	-
2	Y01	B	702	-	-	13/19/77/77	0/4/4/4
6	PC1	B	701	-	-	16/54/54/57	-

The worst 5 of 24 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	B	701	PC1	O21-C2	-2.65	1.40	1.46
3	A	603	T7X	O16-C8	-2.65	1.40	1.46
3	B	704	T7X	O16-C8	-2.64	1.40	1.46
6	A	606	PC1	O21-C2	-2.63	1.40	1.46
4	B	705	PTY	O7-C6	-2.53	1.40	1.46

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	702	Y01	CBI-CBE-CBB	-4.49	112.46	119.49
2	A	601	Y01	CBI-CBE-CBB	-4.47	112.49	119.49
4	A	604	PTY	O7-C8-C11	4.07	120.28	111.50
4	B	705	PTY	O7-C8-C11	4.05	120.24	111.50
3	B	704	T7X	O16-C10-C12	3.76	119.61	111.50

There are no chirality outliers.

5 of 158 torsion outliers are listed below:

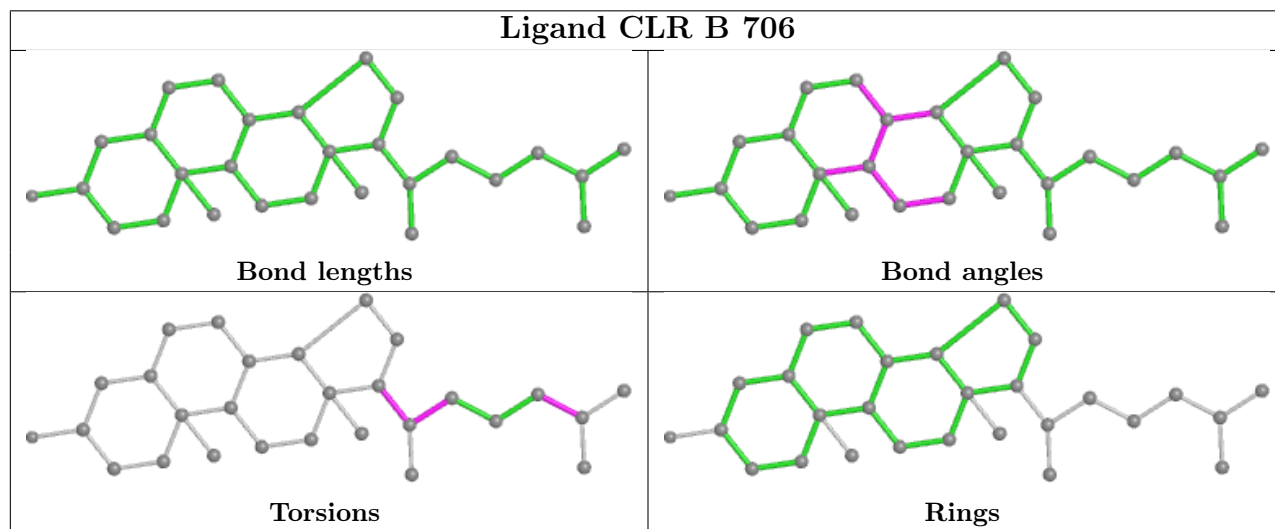
Mol	Chain	Res	Type	Atoms
3	A	603	T7X	C6-C1-O1-P1
3	A	603	T7X	C7-O13-P1-O11
3	B	704	T7X	C6-C1-O1-P1
3	B	704	T7X	C7-O13-P1-O11
4	A	604	PTY	N1-C2-C3-O11

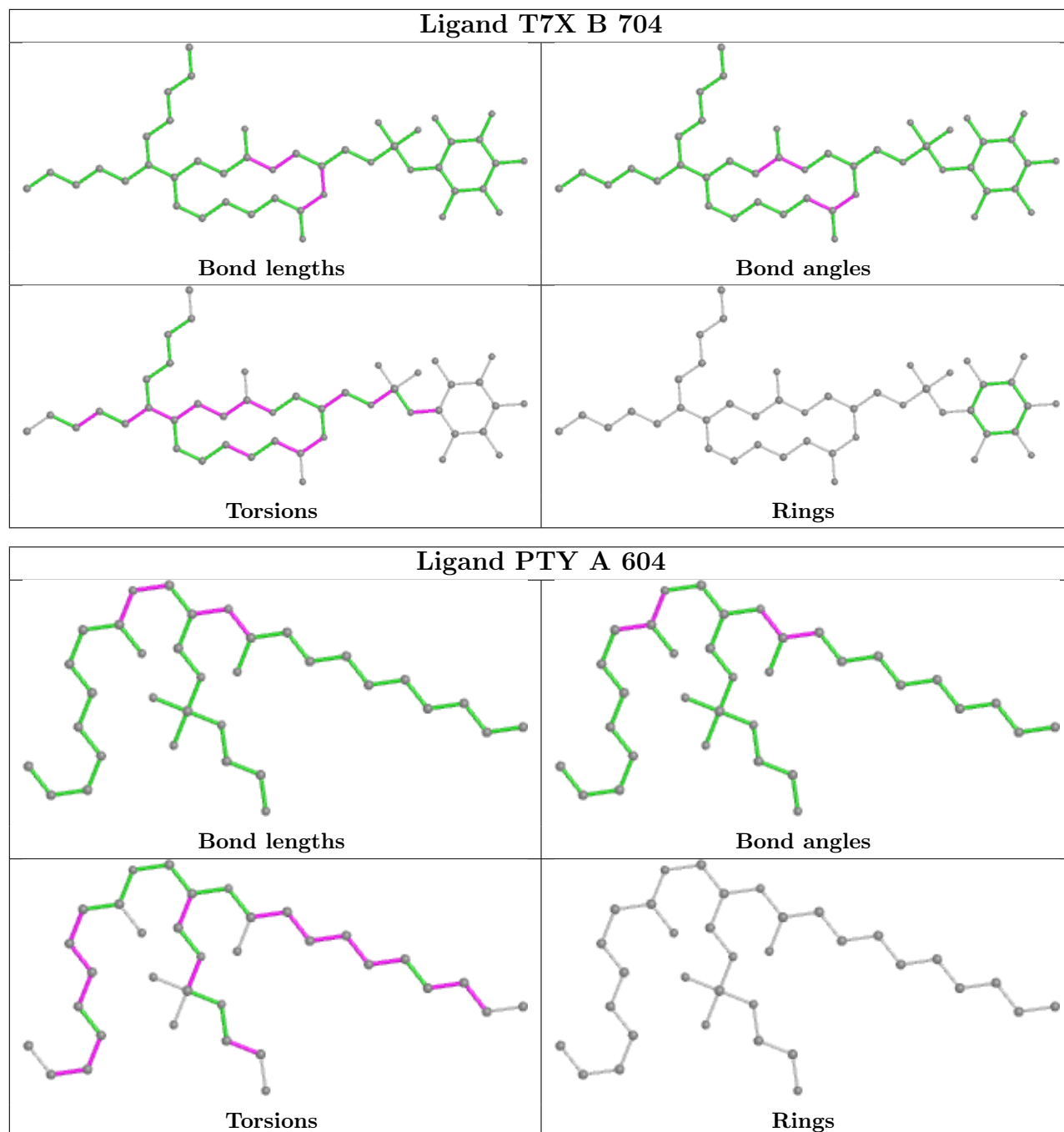
There are no ring outliers.

9 monomers are involved in 18 short contacts:

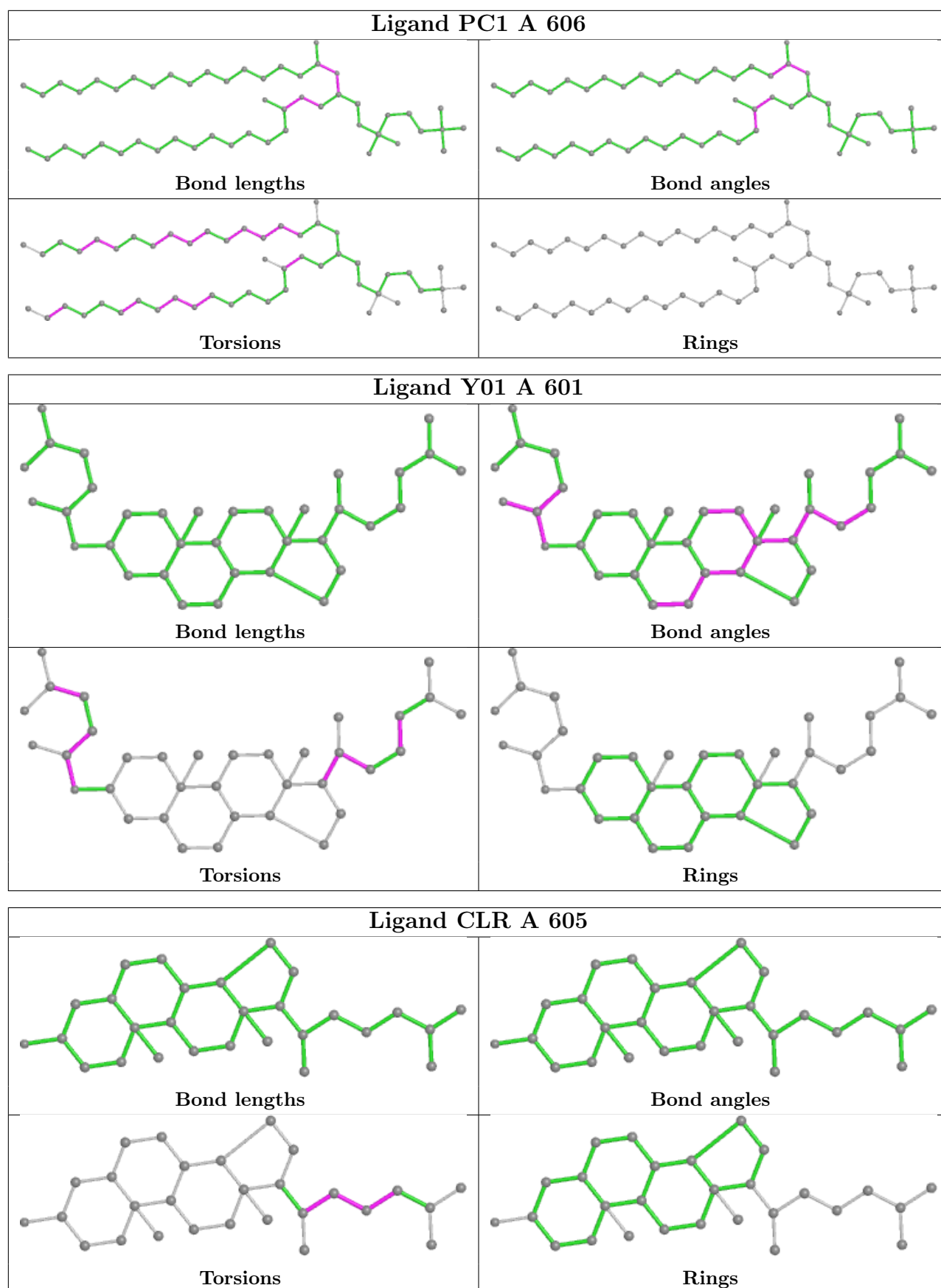
Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	706	CLR	1	0
4	A	604	PTY	1	0
6	A	606	PC1	3	0
2	A	601	Y01	4	0
5	A	605	CLR	3	0
3	A	603	T7X	1	0
4	B	705	PTY	1	0
2	B	702	Y01	3	0
6	B	701	PC1	2	0

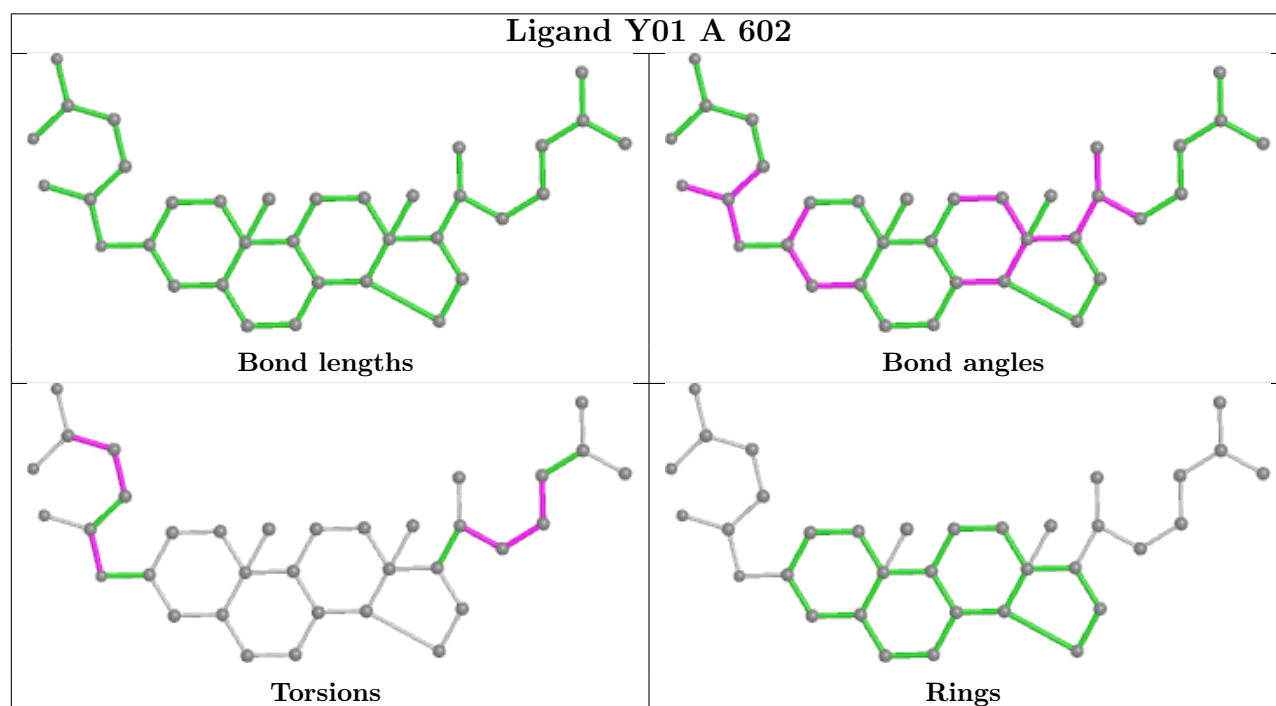
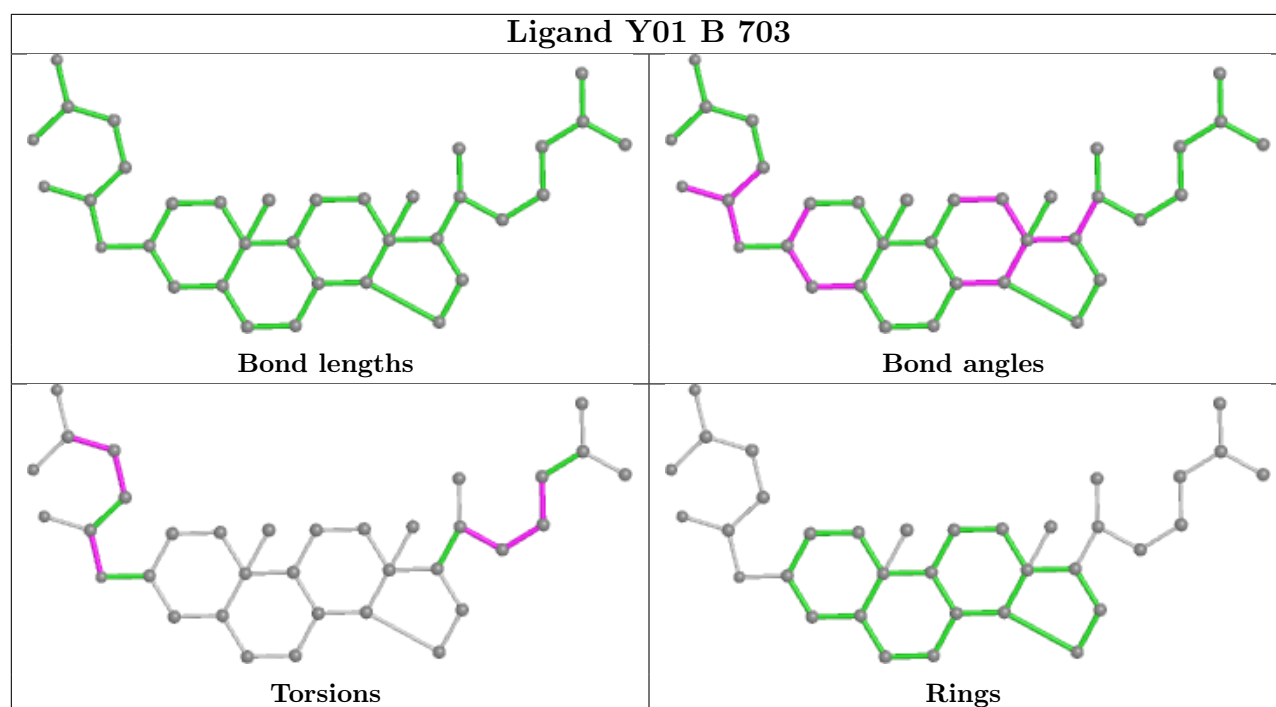
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

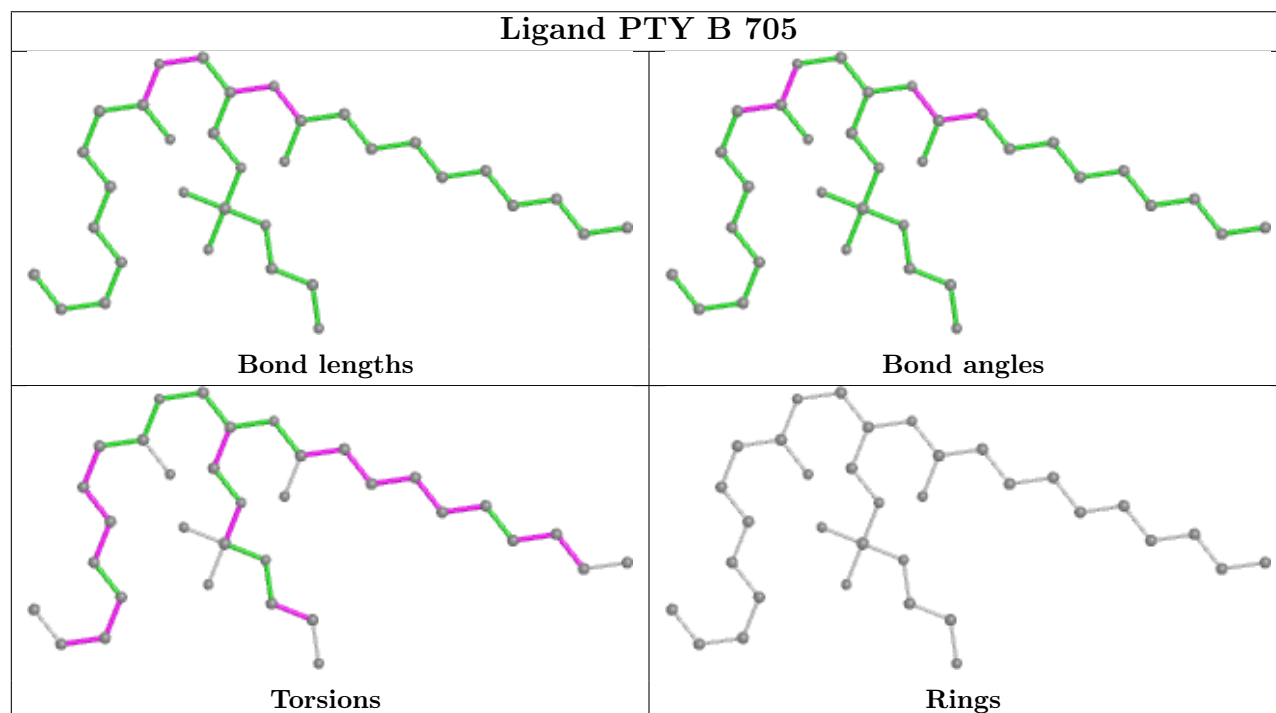
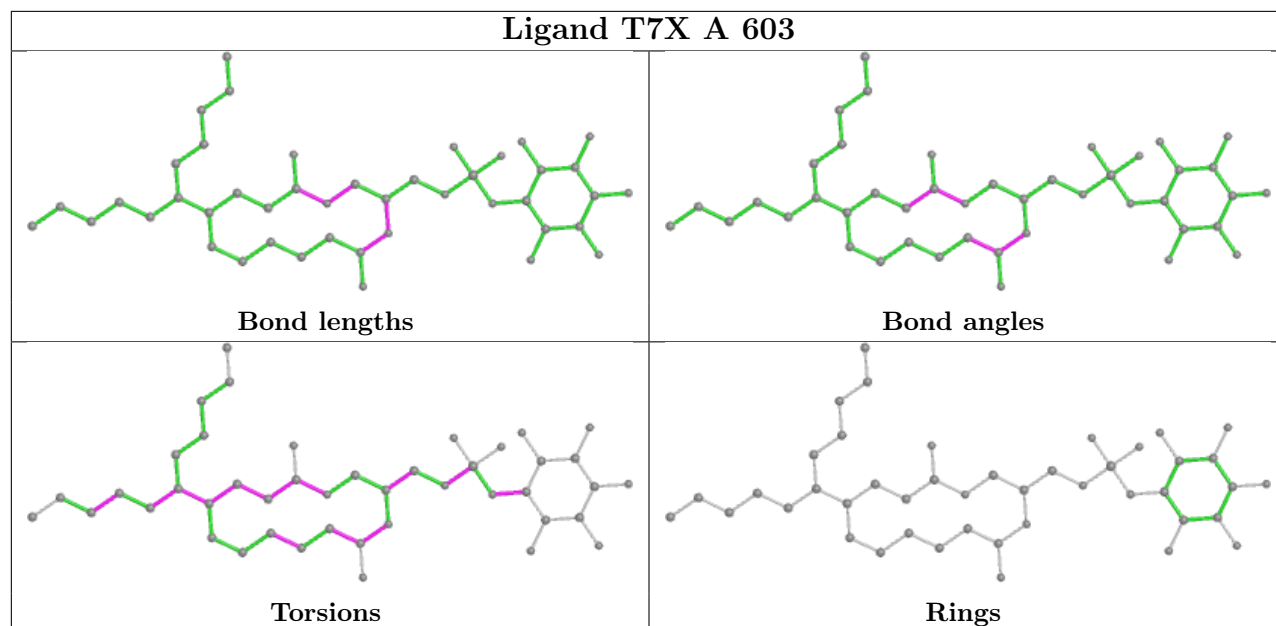


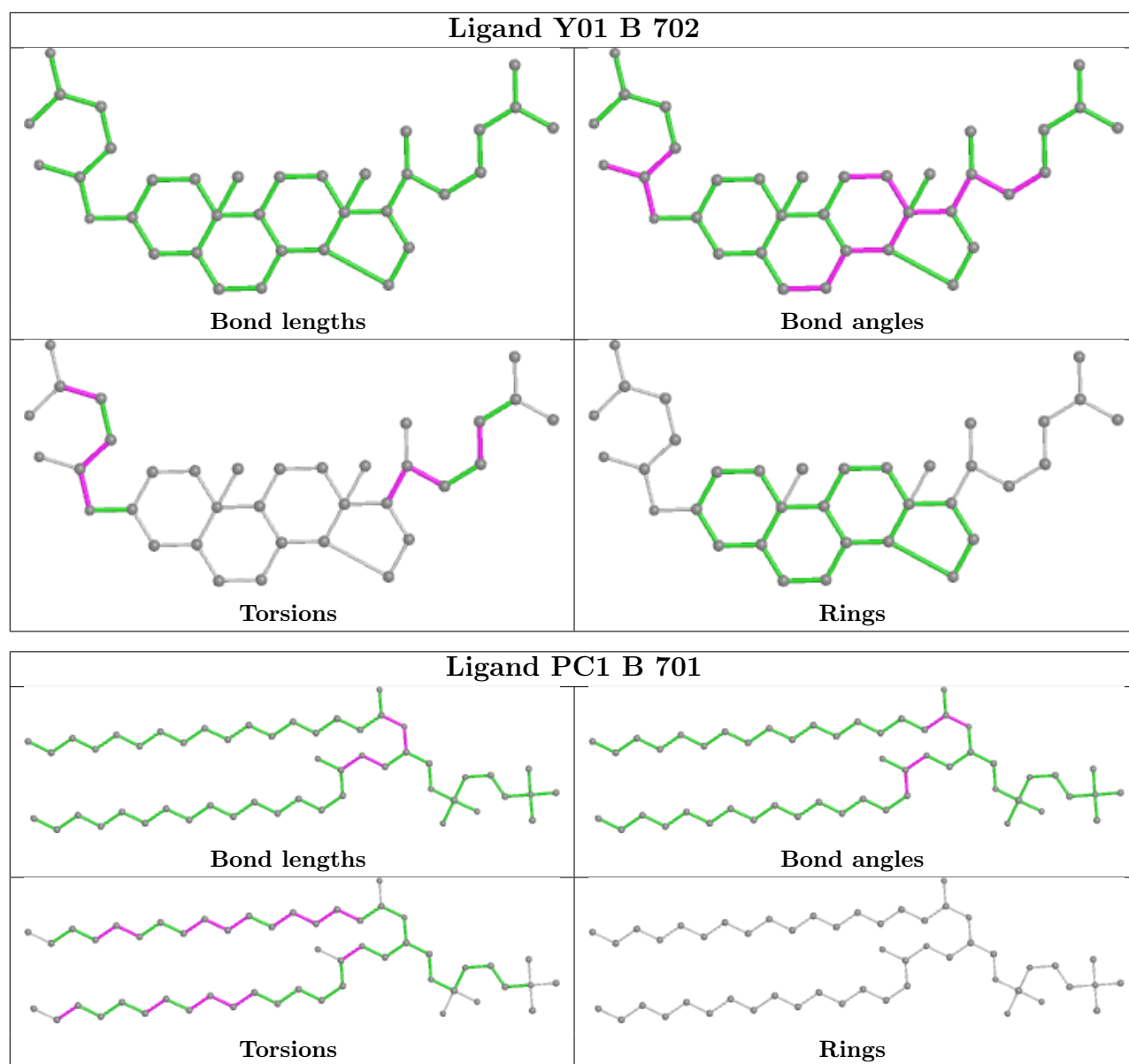












## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.