wwPDB EM Validation Summary Report

Feb 29, 2024 – 10:09 PM JST

PDB ID	:	8X84
EMDB ID	:	EMD-38135
Title	:	The cryo-EM structure of insect gustatory receptor Gr43a I418A from Drosophila melanogaster in complex with fructose and calcium
Authors	:	Ma, D.; Guo, J.
Deposited on	:	2023-11-27
Resolution	:	3.10 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*
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.

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

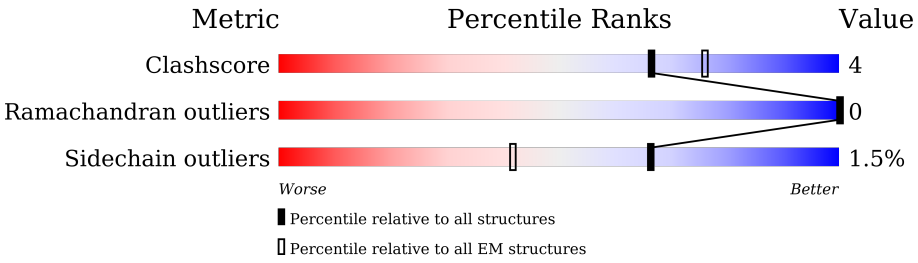
EMDB validation analysis	:	FAILED
Mogul	:	1.8.5 (274361), CSD as541be (2020)
MolProbity	:	4.02b-467
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
MapQ	:	FAILED
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
ELECTRON MICROSCOPY

The reported resolution of this entry is 3.10 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	158937	4297
Ramachandran outliers	154571	4023
Sidechain outliers	154315	3826

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 >=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%

Mol	Chain	Length	Quality of chain
1	A	443	78% 7% 14%
1	B	443	79% 7% 14%
1	C	443	79% 7% 14%
1	D	443	79% 6% 14%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 24582 atoms, of which 12492 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 Gustatory receptor for sugar taste 43a.

Mol	Chain	Residues	Atoms						AltConf	Trace
1	A	381	Total	C	H	N	O	S	0	0
			6120	1953	3111	514	524	18		
1	B	381	Total	C	H	N	O	S	0	0
			6120	1953	3111	514	524	18		
1	C	381	Total	C	H	N	O	S	0	0
			6120	1953	3111	514	524	18		
1	D	381	Total	C	H	N	O	S	0	0
			6120	1953	3111	514	524	18		

There are 68 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	418	ALA	ILE	engineered mutation	UNP Q9V4K2
A	428	LEU	-	expression tag	UNP Q9V4K2
A	429	GLU	-	expression tag	UNP Q9V4K2
A	430	GLY	-	expression tag	UNP Q9V4K2
A	431	GLY	-	expression tag	UNP Q9V4K2
A	432	SER	-	expression tag	UNP Q9V4K2
A	433	SER	-	expression tag	UNP Q9V4K2
A	434	GLY	-	expression tag	UNP Q9V4K2
A	435	GLY	-	expression tag	UNP Q9V4K2
A	436	TRP	-	expression tag	UNP Q9V4K2
A	437	SER	-	expression tag	UNP Q9V4K2
A	438	HIS	-	expression tag	UNP Q9V4K2
A	439	PRO	-	expression tag	UNP Q9V4K2
A	440	GLN	-	expression tag	UNP Q9V4K2
A	441	PHE	-	expression tag	UNP Q9V4K2
A	442	GLU	-	expression tag	UNP Q9V4K2
A	443	LYS	-	expression tag	UNP Q9V4K2
B	418	ALA	ILE	engineered mutation	UNP Q9V4K2
B	428	LEU	-	expression tag	UNP Q9V4K2
B	429	GLU	-	expression tag	UNP Q9V4K2
B	430	GLY	-	expression tag	UNP Q9V4K2
B	431	GLY	-	expression tag	UNP Q9V4K2

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Chain	Residue	Modelled	Actual	Comment	Reference
B	432	SER	-	expression tag	UNP Q9V4K2
B	433	SER	-	expression tag	UNP Q9V4K2
B	434	GLY	-	expression tag	UNP Q9V4K2
B	435	GLY	-	expression tag	UNP Q9V4K2
B	436	TRP	-	expression tag	UNP Q9V4K2
B	437	SER	-	expression tag	UNP Q9V4K2
B	438	HIS	-	expression tag	UNP Q9V4K2
B	439	PRO	-	expression tag	UNP Q9V4K2
B	440	GLN	-	expression tag	UNP Q9V4K2
B	441	PHE	-	expression tag	UNP Q9V4K2
B	442	GLU	-	expression tag	UNP Q9V4K2
B	443	LYS	-	expression tag	UNP Q9V4K2
C	418	ALA	ILE	engineered mutation	UNP Q9V4K2
C	428	LEU	-	expression tag	UNP Q9V4K2
C	429	GLU	-	expression tag	UNP Q9V4K2
C	430	GLY	-	expression tag	UNP Q9V4K2
C	431	GLY	-	expression tag	UNP Q9V4K2
C	432	SER	-	expression tag	UNP Q9V4K2
C	433	SER	-	expression tag	UNP Q9V4K2
C	434	GLY	-	expression tag	UNP Q9V4K2
C	435	GLY	-	expression tag	UNP Q9V4K2
C	436	TRP	-	expression tag	UNP Q9V4K2
C	437	SER	-	expression tag	UNP Q9V4K2
C	438	HIS	-	expression tag	UNP Q9V4K2
C	439	PRO	-	expression tag	UNP Q9V4K2
C	440	GLN	-	expression tag	UNP Q9V4K2
C	441	PHE	-	expression tag	UNP Q9V4K2
C	442	GLU	-	expression tag	UNP Q9V4K2
C	443	LYS	-	expression tag	UNP Q9V4K2
D	418	ALA	ILE	engineered mutation	UNP Q9V4K2
D	428	LEU	-	expression tag	UNP Q9V4K2
D	429	GLU	-	expression tag	UNP Q9V4K2
D	430	GLY	-	expression tag	UNP Q9V4K2
D	431	GLY	-	expression tag	UNP Q9V4K2
D	432	SER	-	expression tag	UNP Q9V4K2
D	433	SER	-	expression tag	UNP Q9V4K2
D	434	GLY	-	expression tag	UNP Q9V4K2
D	435	GLY	-	expression tag	UNP Q9V4K2
D	436	TRP	-	expression tag	UNP Q9V4K2
D	437	SER	-	expression tag	UNP Q9V4K2
D	438	HIS	-	expression tag	UNP Q9V4K2
D	439	PRO	-	expression tag	UNP Q9V4K2

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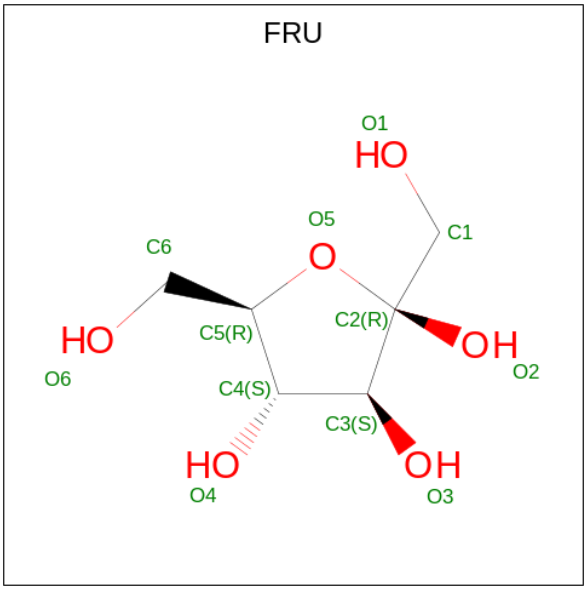
Chain	Residue	Modelled	Actual	Comment	Reference
D	440	GLN	-	expression tag	UNP Q9V4K2
D	441	PHE	-	expression tag	UNP Q9V4K2
D	442	GLU	-	expression tag	UNP Q9V4K2
D	443	LYS	-	expression tag	UNP Q9V4K2

- Molecule 2 is CALCIUM ION (three-letter code: CA) (formula: Ca) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
2	A	2	Total	Ca	0
			2	2	

- Molecule 3 is beta-D-fructofuranose (three-letter code: FRU) (formula: $C_6H_{12}O_6$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				AltConf
3	A	1	Total	C	H	O	0
			24	6	12	6	
3	B	1	Total	C	H	O	0
			24	6	12	6	
3	C	1	Total	C	H	O	0
			24	6	12	6	
3	D	1	Total	C	H	O	0
			24	6	12	6	

- Molecule 4 is water.

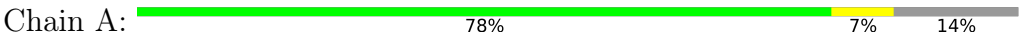
Mol	Chain	Residues	Atoms	AltConf
4	A	1	Total O 1 1	0
4	B	1	Total O 1 1	0
4	C	1	Total O 1 1	0
4	D	1	Total O 1 1	0

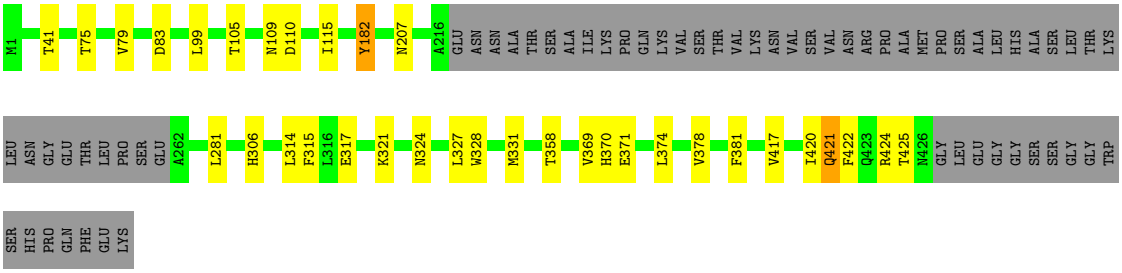
3 Residue-property plots (i)

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.

• Molecule 1: Gustatory receptor for sugar taste 43a

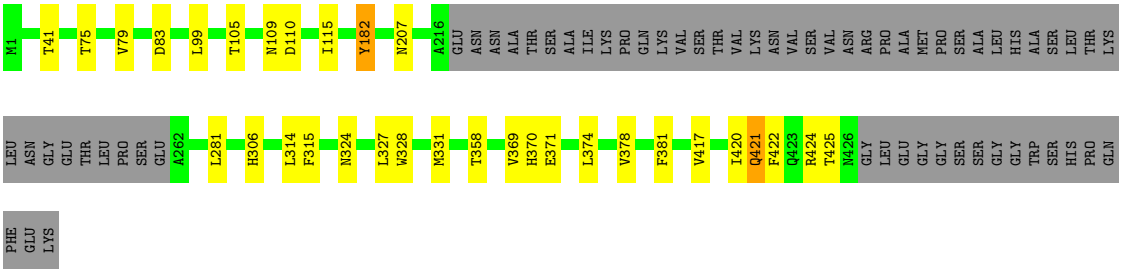
Chain A:





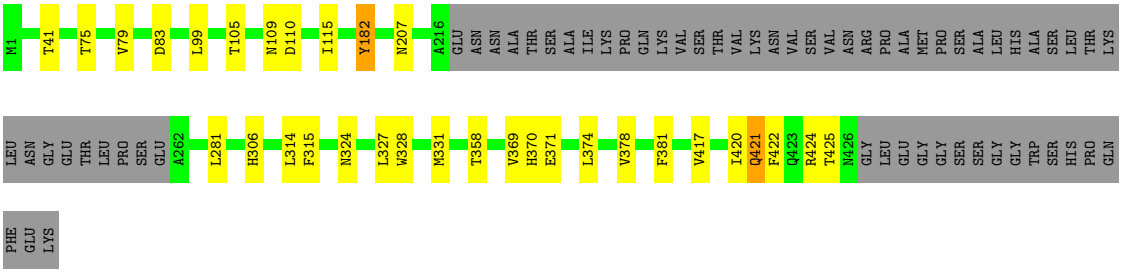
• Molecule 1: Gustatory receptor for sugar taste 43a

Chain B:



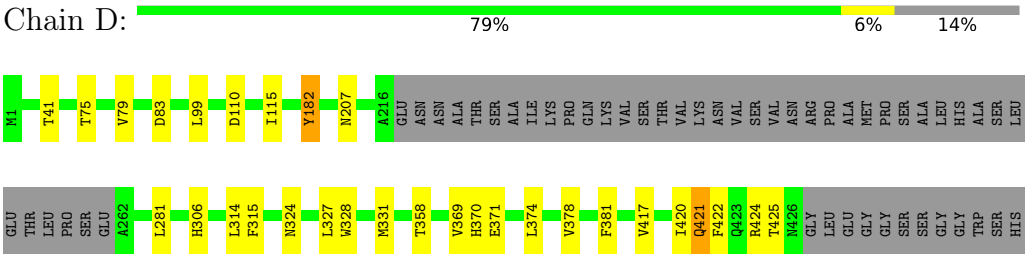
• Molecule 1: Gustatory receptor for sugar taste 43a

Chain C:



• Molecule 1: Gustatory receptor for sugar taste 43a

Chain D:


79%
6%
14%
M1 T41 T75 V79 D83 L99 D110 I115 Y182 N207 A216 GLU ASN ASN ALA THR SER ALA ILE LYS PRO GLN LYS VAL SER THR VAL LYS ASN VAL SER VAL ASN ARG PRO ALA MET PRO SER ALA LEU HIS ALA SER LEU THR LYS LEU ASN GLY
GLU THR LEU PRO SER GLU A262 L281 H306 L314 F315 N324 L327 W328 M331 T358 V369 H370 E371 L374 V378 F381 V417 I420 Q421 F422 Q423 R424 T425 N426 GLY LEU GLU GLY GLY SER SER GLY GLY TRP SER HIS PRO GLN PHE GLU LYS

4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	84051	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 ($e^-/Å^2$)	52	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	1500	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (4k 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: FRU, CA

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	0.25	0/3067	0.46	0/4160
1	B	0.25	0/3067	0.46	0/4160
1	C	0.25	0/3067	0.46	0/4160
1	D	0.25	0/3067	0.46	0/4160
All	All	0.25	0/12268	0.46	0/16640

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	3009	3111	3112	32	0
1	B	3009	3111	3112	31	0
1	C	3009	3111	3112	30	0
1	D	3009	3111	3112	29	0
2	A	2	0	0	0	0
3	A	12	12	11	2	0
3	B	12	12	11	2	0
3	C	12	12	11	2	0
3	D	12	12	11	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0
4	D	1	0	0	0	0
All	All	12090	12492	12492	99	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 4.

The worst 5 of 99 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:207:ASN:OD1	1:A:358:THR:OG1	1.98	0.82
1:C:207:ASN:OD1	1:C:358:THR:OG1	1.98	0.81
1:D:207:ASN:OD1	1:D:358:THR:OG1	1.98	0.80
1:B:207:ASN:OD1	1:B:358:THR:OG1	1.98	0.80
1:B:83:ASP:OD2	3:B:501:FRU:O2	2.04	0.76

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	377/443 (85%)	374 (99%)	3 (1%)	0	100	100
1	B	377/443 (85%)	374 (99%)	3 (1%)	0	100	100
1	C	377/443 (85%)	374 (99%)	3 (1%)	0	100	100
1	D	377/443 (85%)	374 (99%)	3 (1%)	0	100	100
All	All	1508/1772 (85%)	1496 (99%)	12 (1%)	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	328/379 (86%)	323 (98%)	5 (2%)	65	85
1	B	328/379 (86%)	323 (98%)	5 (2%)	65	85
1	C	328/379 (86%)	323 (98%)	5 (2%)	65	85
1	D	328/379 (86%)	323 (98%)	5 (2%)	65	85
All	All	1312/1516 (86%)	1292 (98%)	20 (2%)	66	85

5 of 20 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	421	GLN
1	D	370	HIS
1	D	421	GLN
1	D	381	PHE
1	B	182	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	421	GLN
1	D	173	HIS
1	C	173	HIS
1	B	421	GLN
1	C	421	GLN

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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 6 ligands modelled in this entry, 2 are monoatomic - leaving 4 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	$\#\|Z\| > 2$
3	FRU	D	501	-	11,12,12	1.72	3 (27%)	10,18,18	0.95	0
3	FRU	C	501	-	11,12,12	1.72	3 (27%)	10,18,18	0.95	0
3	FRU	B	501	-	11,12,12	1.72	3 (27%)	10,18,18	0.95	0
3	FRU	A	503	-	11,12,12	1.72	3 (27%)	10,18,18	0.94	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
3	FRU	D	501	-	-	3/5/24/24	0/1/1/1
3	FRU	C	501	-	-	3/5/24/24	0/1/1/1
3	FRU	B	501	-	-	3/5/24/24	0/1/1/1
3	FRU	A	503	-	-	3/5/24/24	0/1/1/1

The worst 5 of 12 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	503	FRU	O5-C2	3.69	1.49	1.43
3	B	501	FRU	O5-C2	3.69	1.49	1.43
3	C	501	FRU	O5-C2	3.69	1.49	1.43
3	D	501	FRU	O5-C2	3.69	1.49	1.43
3	A	503	FRU	O5-C5	2.39	1.49	1.43

There are no bond angle outliers.

There are no chirality outliers.

5 of 12 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	503	FRU	O1-C1-C2-O5
3	B	501	FRU	O1-C1-C2-O5
3	C	501	FRU	O1-C1-C2-O5
3	D	501	FRU	O1-C1-C2-O5
3	A	503	FRU	O1-C1-C2-C3

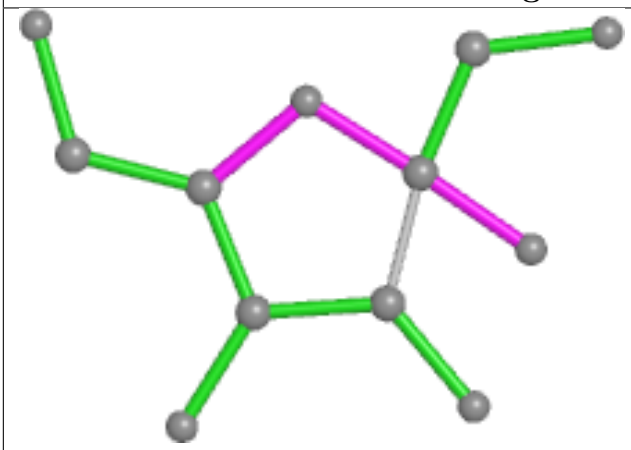
There are no ring outliers.

4 monomers are involved in 8 short contacts:

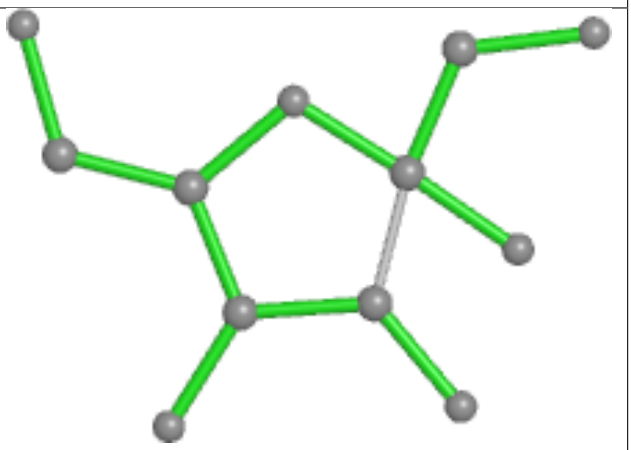
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	D	501	FRU	2	0
3	C	501	FRU	2	0
3	B	501	FRU	2	0
3	A	503	FRU	2	0

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 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.

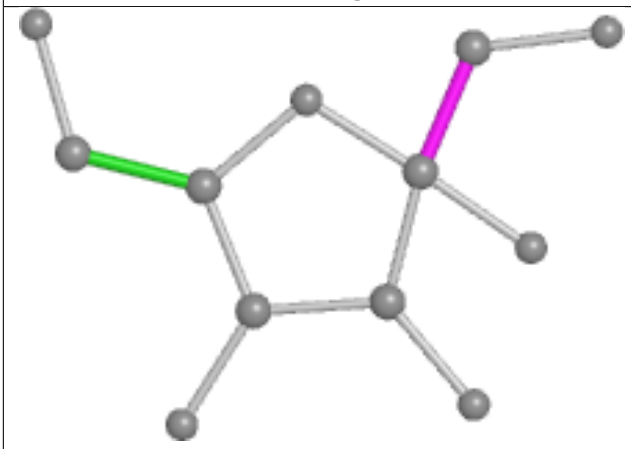
Ligand FRU D 501



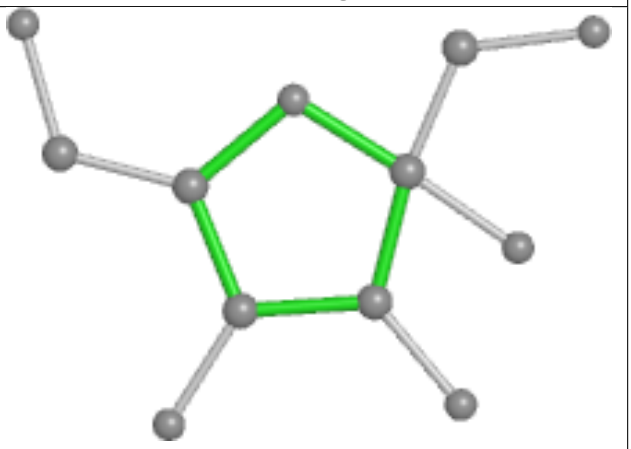
Bond lengths



Bond angles

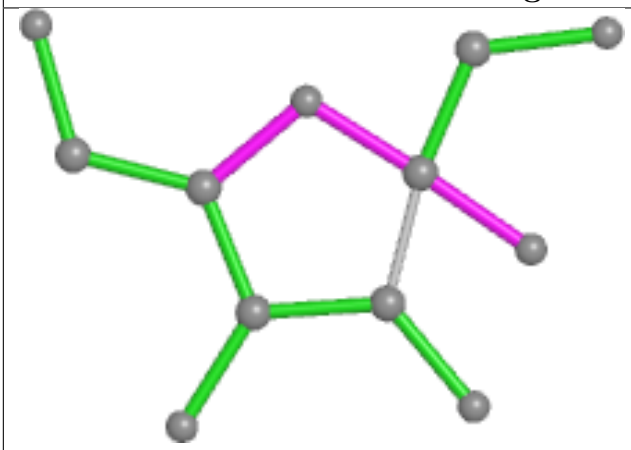


Torsions

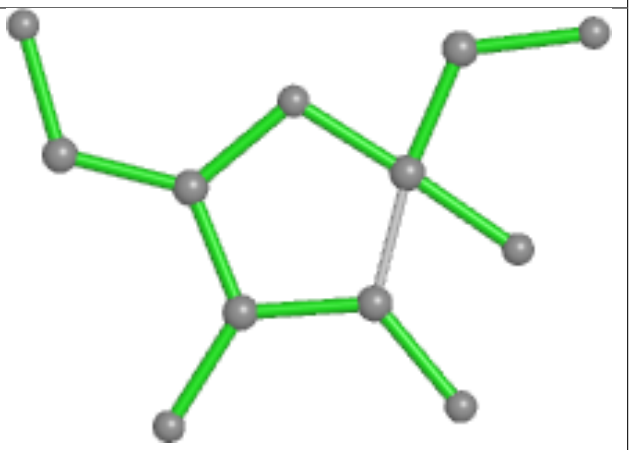


Rings

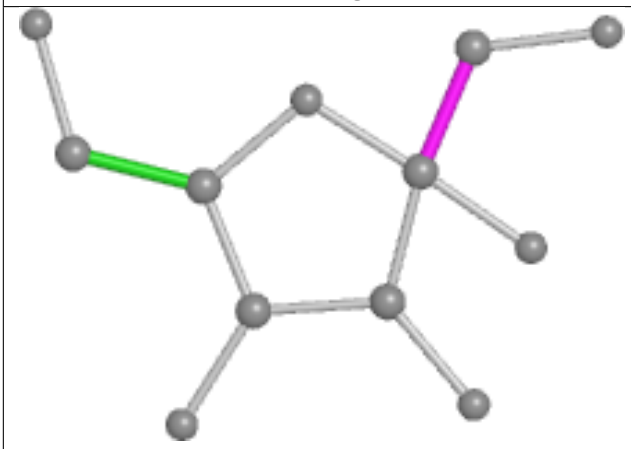
Ligand FRU C 501



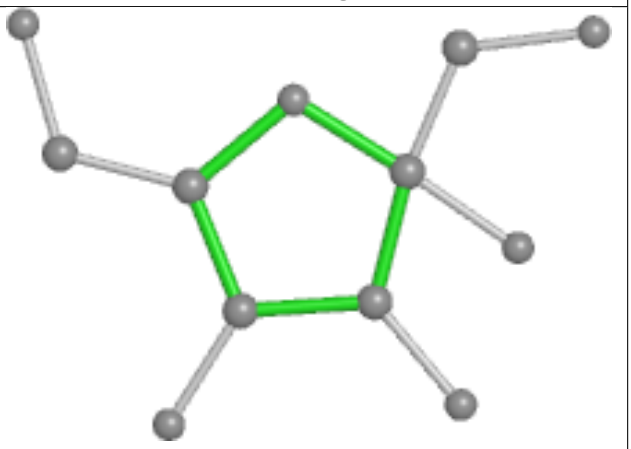
Bond lengths



Bond angles

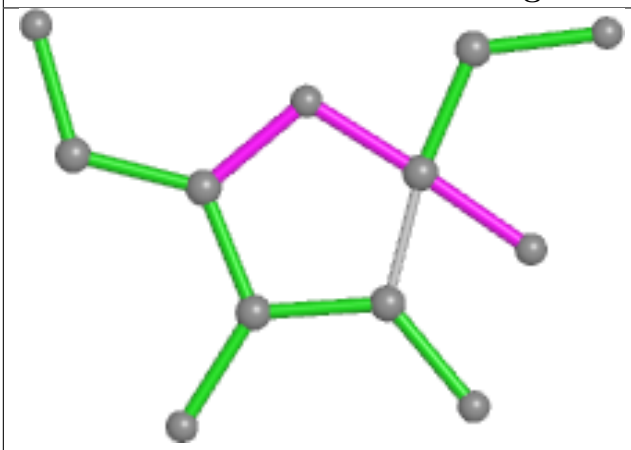


Torsions

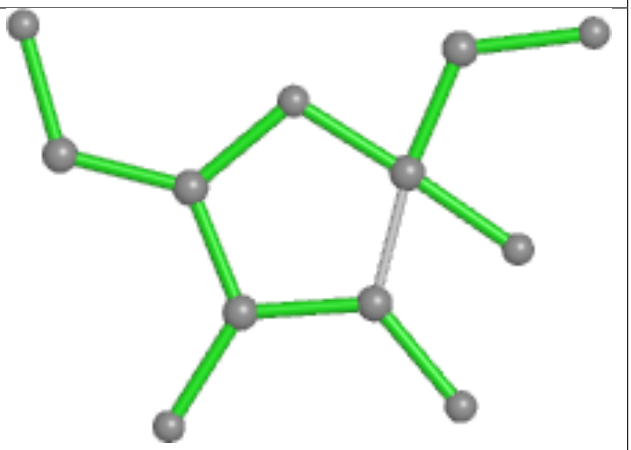


Rings

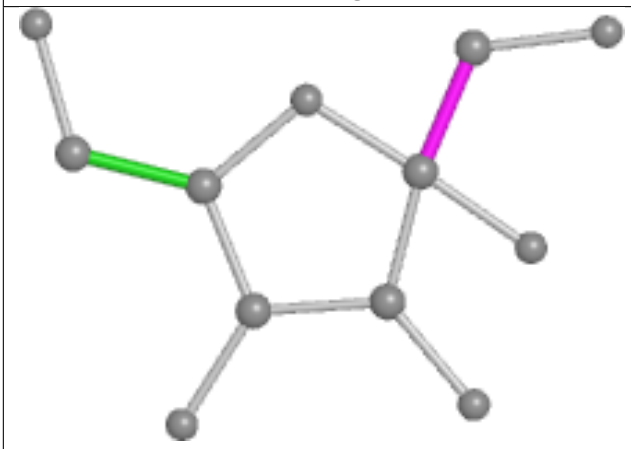
Ligand FRU B 501



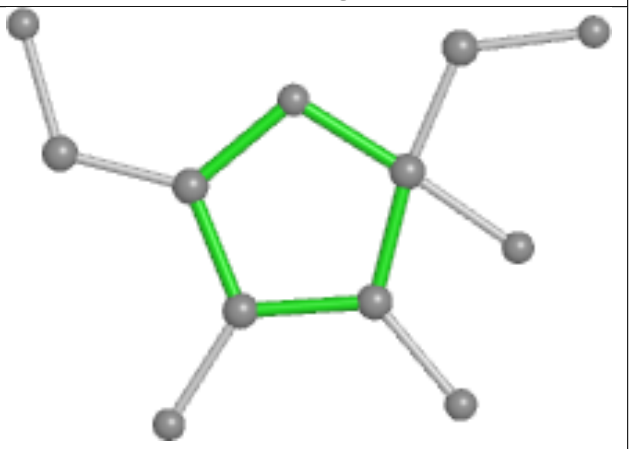
Bond lengths



Bond angles

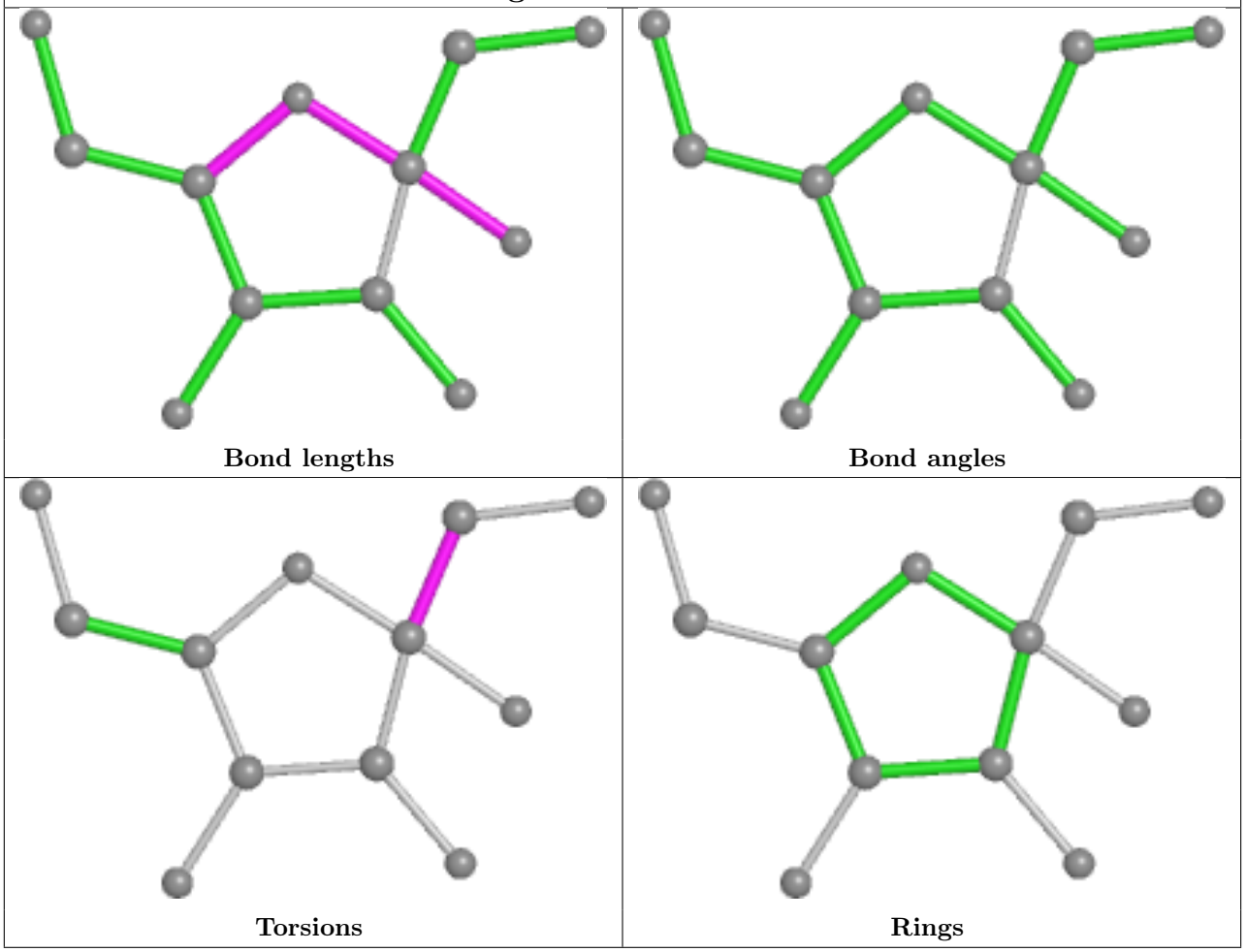


Torsions



Rings

Ligand FRU A 503



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.