Full wwPDB X-ray Structure Validation Report ⓘ

Aug 28, 2023 – 02:24 PM JST

PDB ID	:	5B6V
Title	:	A three dimensional movie of structural changes in bacteriorhodopsin: resting state structure
Authors	:	Nango, E.; Royant, A.; Nakane, T.; Tanaka, T.; Arima, T.; Neutze, R.; Iwata, S.
Deposited on	:	2016-06-02
Resolution	:	2.00 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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:

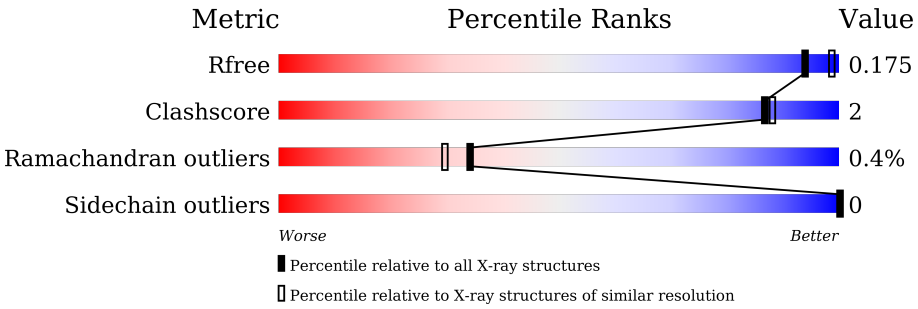
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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))
R_{free}	130704	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)

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%

Mol	Chain	Length	Quality of chain
1	A	248	91% · 7%

2 Entry composition

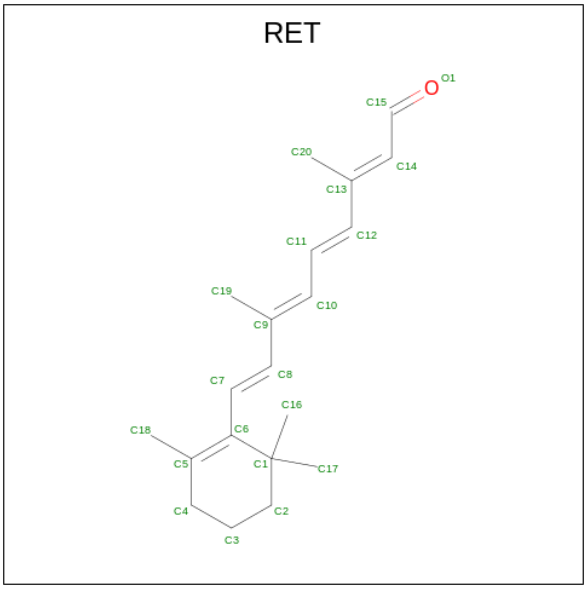
There are 12 unique types of molecules in this entry. The entry contains 4374 atoms, of which 2328 are hydrogens and 0 are deuteriums.

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 Bacteriorhodopsin.

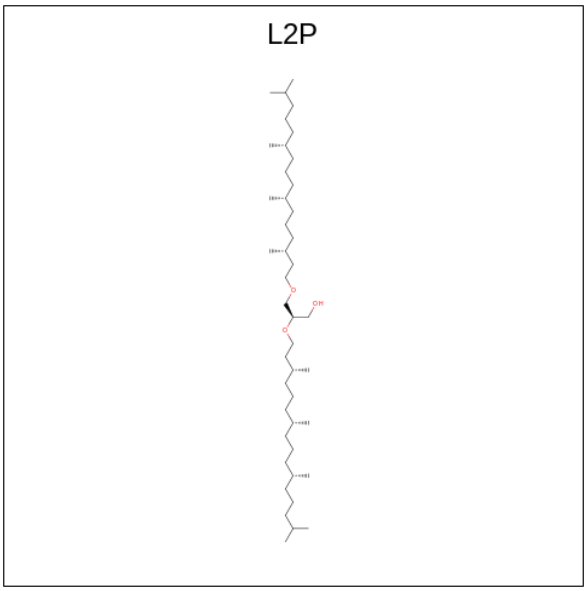
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	231	3628	1199	1841	272	307	9	0	0	0

- Molecule 2 is RETINAL (three-letter code: RET) (formula: $C_{20}H_{28}O$).



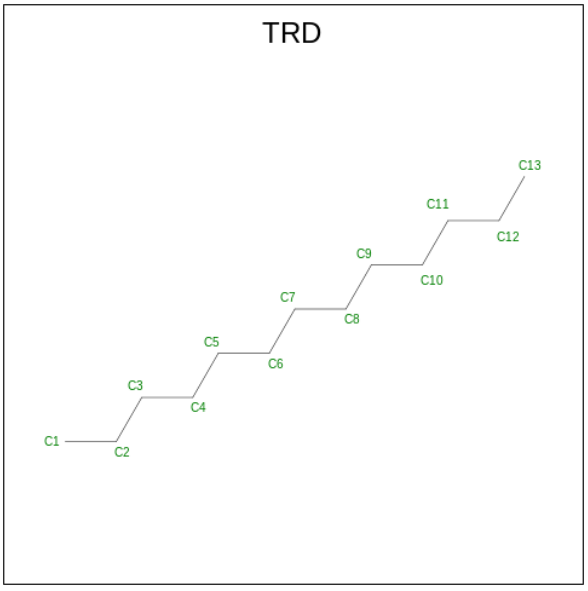
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	H			
2	A	1	48	20	28		0	0

- Molecule 3 is 2,3-DI-PHYTANYL-GLYCEROL (three-letter code: L2P) (formula: $C_{43}H_{88}O_3$).



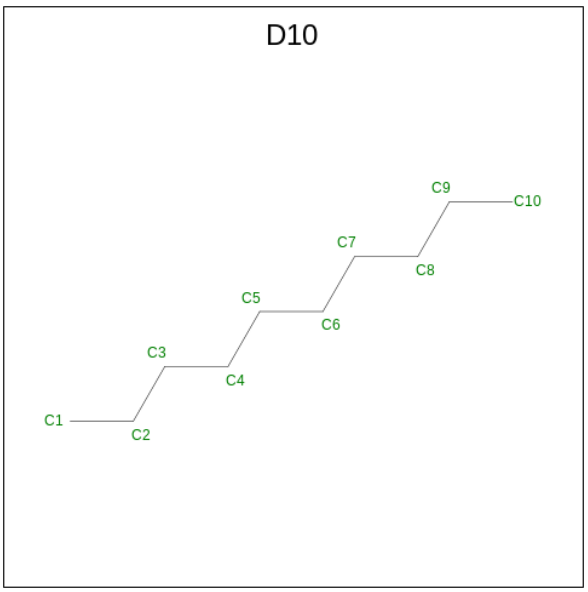
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	H	O	0	0
			71	23	46	2		
3	A	1	Total	C	H	O	0	0
			65	21	43	1		
3	A	1	Total	C	H	O	0	0
			134	43	88	3		

- Molecule 4 is TRIDECANE (three-letter code: TRD) (formula: $C_{13}H_{28}$).



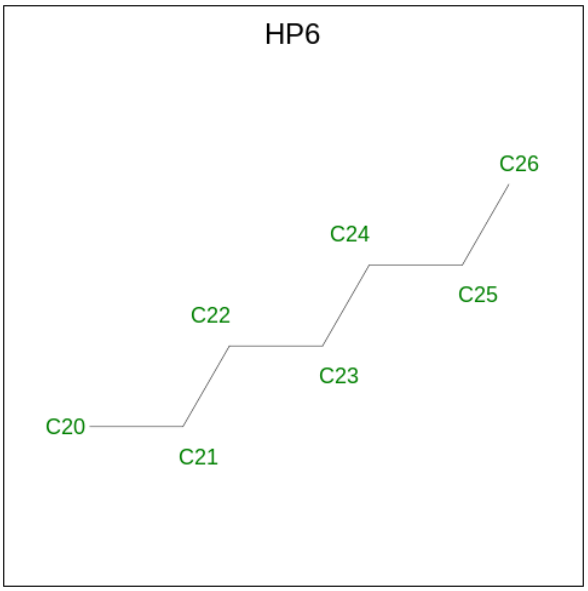
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	H	0	0
			41	13	28		

- Molecule 5 is DECANE (three-letter code: D10) (formula: $C_{10}H_{22}$).



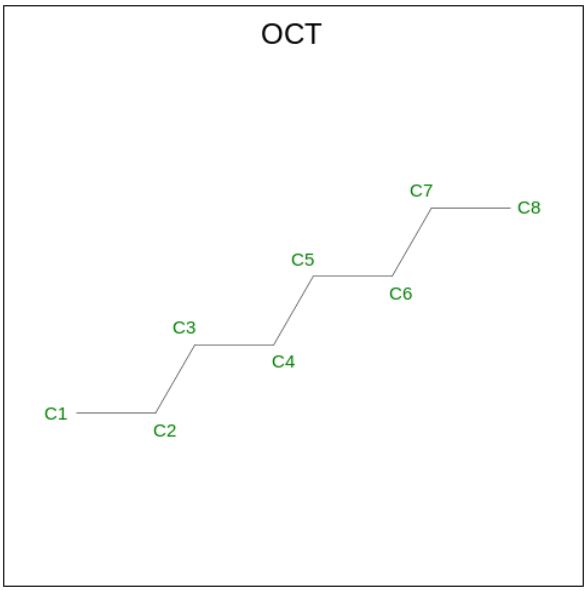
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total C H 32 10 22	0	0

- Molecule 6 is HEPTANE (three-letter code: HP6) (formula: C_7H_{16}).



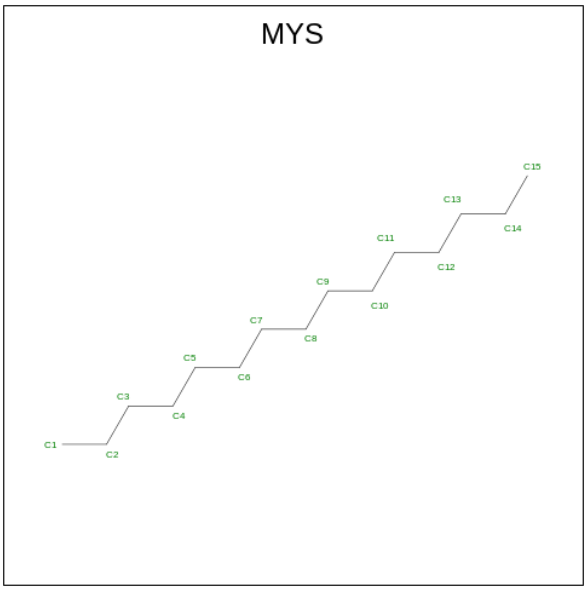
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	1	Total C H 23 7 16	0	0

- Molecule 7 is N-OCTANE (three-letter code: OCT) (formula: C_8H_{18}).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	H	0	0
			26	8	18		
7	A	1	Total	C	H	0	0
			26	8	18		
7	A	1	Total	C	H	0	0
			26	8	18		

- Molecule 8 is PENTADECANE (three-letter code: MYS) (formula: $C_{15}H_{32}$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	A	1	Total	C	H	0	0
			47	15	32		

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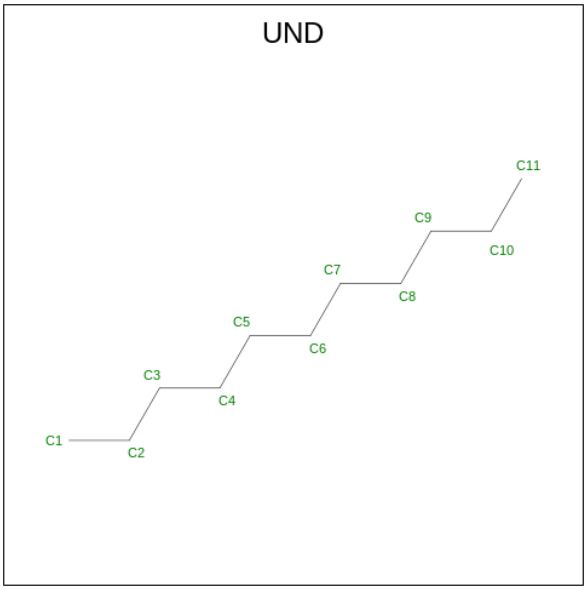
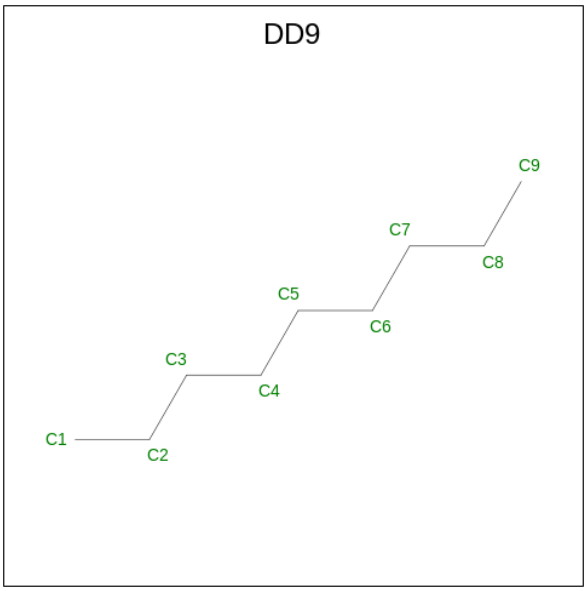
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	1	Total C H 47 15 32	0	0

- Molecule 9 is UNDECANE (three-letter code: UND) (formula: $C_{11}H_{24}$).



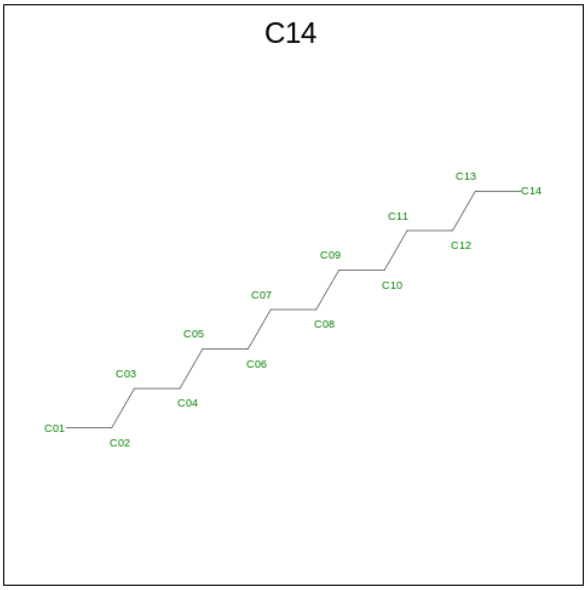
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
9	A	1	Total C H 35 11 24	0	0
9	A	1	Total C H 35 11 24	0	0

- Molecule 10 is nonane (three-letter code: DD9) (formula: C_9H_{20}).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
10	A	1	Total	C	H	0	0
			29	9	20		

- Molecule 11 is TETRADECANE (three-letter code: C14) (formula: $C_{14}H_{30}$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
11	A	1	Total	C	H	0	0
			44	14	30		

- Molecule 12 is water.

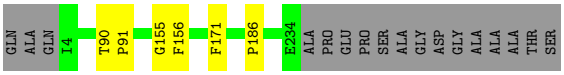
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
12	A	17	Total O 17 17	0	0

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.

- Molecule 1: Bacteriorhodopsin

Chain A:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 63	Depositor
Cell constants a, b, c, α, β, γ	62.50Å 62.50Å 112.00Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	21.91 – 2.00 21.91 – 1.77	Depositor EDS
% Data completeness (in resolution range)	100.0 (21.91-2.00) 97.0 (21.91-1.77)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	34.18 (at 1.77Å)	Xtriage
Refinement program	PHENIX 1.10.1_2155	Depositor
R, R_{free}	0.150 , 0.175 0.151 , 0.175	Depositor DCC
R_{free} test set	1186 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å^2)	3.6	Xtriage
Anisotropy	2.504	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 87.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.084 for h,-h-k,-l	Xtriage
F_o,F_c correlation	0.86	EDS
Total number of atoms	4374	wwPDB-VP
Average B, all atoms (Å^2)	62.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.75% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: HP6, RET, DD9, L2P, TRD, D10, C14, OCT, MYS, UND

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	0/1835	0.41	0/2506

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	1787	1841	1841	3	0
2	A	20	28	27	4	0
3	A	93	177	172	3	0
4	A	13	28	28	0	0
5	A	10	22	22	0	0
6	A	7	16	16	0	0
7	A	24	54	54	0	0
8	A	30	64	64	0	0
9	A	22	48	48	0	0
10	A	9	20	20	0	0
11	A	14	30	30	0	0
12	A	17	0	0	0	0
All	All	2046	2328	2322	9	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 2.

All (9) 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)
2:A:300:RET:H171	2:A:300:RET:H8	1.81	0.62
3:A:600:L2P:H552	3:A:600:L2P:H591	1.86	0.58
1:A:186:PRO:HB3	2:A:300:RET:H183	1.98	0.46
2:A:300:RET:H171	2:A:300:RET:C8	2.44	0.45
2:A:300:RET:H8	2:A:300:RET:H161	1.98	0.45
1:A:156:PHE:HB3	1:A:171:PHE:CZ	2.52	0.45
3:A:609:L2P:H592	3:A:609:L2P:H172	2.02	0.42
1:A:90:THR:N	1:A:91:PRO:HD2	2.35	0.42
3:A:609:L2P:H151	3:A:609:L2P:H541	2.03	0.40

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	A	229/248 (92%)	227 (99%)	1 (0%)	1 (0%)	34 30

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	155	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	A	185/194 (95%)	185 (100%)	0	100 100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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)

16 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	$\#\|Z\|>2$
7	OCT	A	613	-	7,7,7	0.31	0	6,6,6	0.65	0
9	UND	A	614	-	10,10,10	0.31	0	9,9,9	0.74	0
3	L2P	A	600	-	24,24,45	0.82	0	26,27,53	0.82	1 (3%)
5	D10	A	602	-	9,9,9	0.31	0	8,8,8	0.69	0
8	MYS	A	606	-	14,14,14	0.30	0	13,13,13	0.78	0
8	MYS	A	610	-	14,14,14	0.30	0	13,13,13	0.82	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
6	HP6	A	603	-	6,6,6	0.32	0	5,5,5	0.64	0
11	C14	A	612	-	13,13,13	0.31	0	12,12,12	0.81	0
10	DD9	A	611	-	8,8,8	0.30	0	7,7,7	0.76	0
2	RET	A	300	1	20,20,21	0.76	0	27,27,28	1.71	8 (29%)
7	OCT	A	605	-	7,7,7	0.30	0	6,6,6	0.73	0
7	OCT	A	604	-	7,7,7	0.28	0	6,6,6	0.77	0
9	UND	A	607	-	10,10,10	0.31	0	9,9,9	0.78	0
3	L2P	A	609	-	45,45,45	0.79	0	51,53,53	0.79	2 (3%)
3	L2P	A	608	-	21,21,45	0.69	0	22,24,53	0.88	0
4	TRD	A	601	-	12,12,12	0.30	0	11,11,11	0.80	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
7	OCT	A	613	-	-	2/5/5/5	-
9	UND	A	614	-	-	2/8/8/8	-
3	L2P	A	600	-	-	16/25/25/51	-
5	D10	A	602	-	-	4/7/7/7	-
8	MYS	A	606	-	-	7/12/12/12	-
8	MYS	A	610	-	-	4/12/12/12	-
6	HP6	A	603	-	-	1/4/4/4	-
11	C14	A	612	-	-	3/11/11/11	-
10	DD9	A	611	-	-	1/6/6/6	-
2	RET	A	300	1	-	0/13/30/31	0/1/1/1
7	OCT	A	605	-	-	0/5/5/5	-
7	OCT	A	604	-	-	1/5/5/5	-
9	UND	A	607	-	-	4/8/8/8	-
3	L2P	A	609	-	-	17/51/51/51	-
3	L2P	A	608	-	-	8/22/22/51	-
4	TRD	A	601	-	-	6/10/10/10	-

There are no bond length outliers.

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	300	RET	C19-C9-C8	3.93	124.27	118.08

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	300	RET	C3-C4-C5	-3.07	108.60	114.08
2	A	300	RET	C10-C11-C12	-2.63	115.01	123.22
3	A	609	L2P	C26-C25-C23	-2.21	108.78	115.92
2	A	300	RET	C2-C3-C4	-2.17	106.52	111.38
2	A	300	RET	C8-C9-C10	-2.16	115.63	118.94
3	A	600	L2P	C51-C52-C53	-2.15	108.97	115.92
2	A	300	RET	C11-C10-C9	-2.14	124.25	127.31
3	A	609	L2P	C16-C15-C13	-2.09	109.17	115.92
2	A	300	RET	C18-C5-C6	-2.03	122.25	124.53
2	A	300	RET	C19-C9-C10	-2.01	120.11	122.92

There are no chirality outliers.

All (76) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	609	L2P	C41-C42-C43-C44
3	A	609	L2P	O1-C1-C2-O2
3	A	600	L2P	C49-C48-C50-C51
3	A	609	L2P	C44-C43-C45-C46
3	A	608	L2P	C25-C26-C27-C28
3	A	609	L2P	C48-C50-C51-C52
3	A	609	L2P	C23-C25-C26-C27
3	A	600	L2P	C51-C52-C53-C55
3	A	609	L2P	C25-C26-C27-C28
3	A	600	L2P	C43-C45-C46-C47
3	A	609	L2P	C53-C55-C56-C57
3	A	600	L2P	O1-C1-C2-O2
3	A	600	L2P	O2-C41-C42-C43
8	A	610	MYS	C7-C8-C9-C10
10	A	611	DD9	C3-C4-C5-C6
4	A	601	TRD	C3-C4-C5-C6
5	A	602	D10	C5-C6-C7-C8
9	A	614	UND	C5-C6-C7-C8
5	A	602	D10	C3-C4-C5-C6
11	A	612	C14	C08-C09-C10-C11
8	A	606	MYS	C4-C5-C6-C7
4	A	601	TRD	C7-C8-C9-C10
5	A	602	D10	C6-C7-C8-C9
8	A	606	MYS	C6-C7-C8-C9
8	A	606	MYS	C11-C12-C13-C14
3	A	600	L2P	C56-C57-C58-C60
9	A	607	UND	C7-C8-C9-C10

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Mol	Chain	Res	Type	Atoms
8	A	610	MYS	C4-C5-C6-C7
9	A	614	UND	C7-C8-C9-C10
3	A	609	L2P	C43-C45-C46-C47
8	A	606	MYS	C3-C4-C5-C6
11	A	612	C14	C10-C11-C12-C13
3	A	600	L2P	C51-C52-C53-C54
3	A	600	L2P	C56-C57-C58-C59
3	A	609	L2P	C2-C1-O1-C11
8	A	610	MYS	C10-C11-C12-C13
3	A	608	L2P	C13-C15-C16-C17
3	A	609	L2P	C41-C42-C43-C45
3	A	609	L2P	O1-C1-C2-C3
4	A	601	TRD	C1-C2-C3-C4
7	A	604	OCT	C3-C4-C5-C6
3	A	600	L2P	C45-C46-C47-C48
8	A	606	MYS	C2-C3-C4-C5
3	A	600	L2P	C47-C48-C50-C51
3	A	600	L2P	C46-C47-C48-C49
7	A	613	OCT	C4-C5-C6-C7
3	A	608	L2P	C15-C16-C17-C18
11	A	612	C14	C02-C03-C04-C05
4	A	601	TRD	C5-C6-C7-C8
6	A	603	HP6	C21-C22-C23-C24
5	A	602	D10	C2-C3-C4-C5
3	A	600	L2P	C54-C53-C55-C56
3	A	609	L2P	C46-C47-C48-C49
3	A	600	L2P	C46-C47-C48-C50
4	A	601	TRD	C4-C5-C6-C7
3	A	608	L2P	C23-C25-C26-C27
3	A	609	L2P	C42-C41-O2-C2
7	A	613	OCT	C5-C6-C7-C8
3	A	608	L2P	C16-C17-C18-C20
3	A	609	L2P	C46-C47-C48-C50
8	A	606	MYS	C12-C13-C14-C15
4	A	601	TRD	C9-C10-C11-C12
3	A	609	L2P	C12-C11-O1-C1
3	A	600	L2P	C1-C2-O2-C41
3	A	608	L2P	C16-C17-C18-C19
3	A	609	L2P	C56-C57-C58-C60
8	A	610	MYS	C6-C7-C8-C9
9	A	607	UND	C3-C4-C5-C6
3	A	608	L2P	C22-C23-C25-C26

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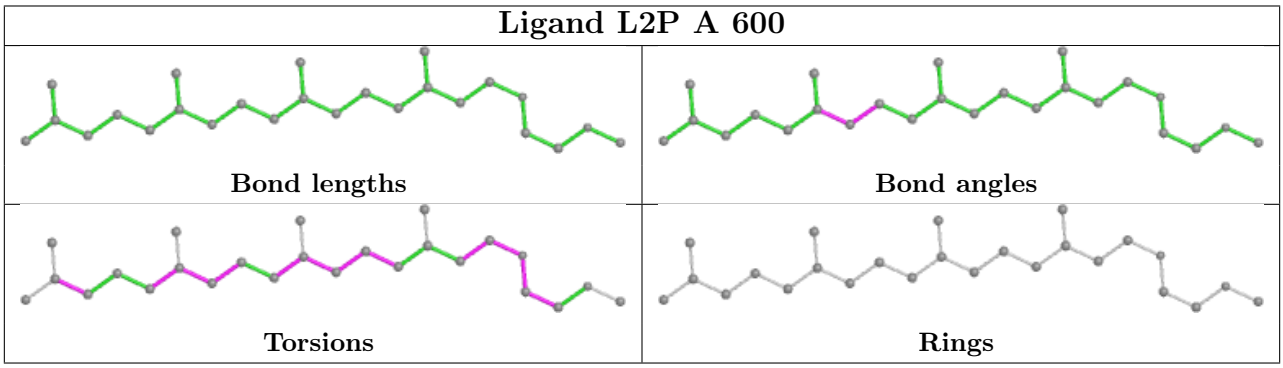
Mol	Chain	Res	Type	Atoms
8	A	606	MYS	C5-C6-C7-C8
9	A	607	UND	C1-C2-C3-C4
9	A	607	UND	C6-C7-C8-C9
3	A	608	L2P	C24-C23-C25-C26
3	A	600	L2P	C50-C51-C52-C53
3	A	609	L2P	C42-C43-C45-C46
3	A	600	L2P	C42-C41-O2-C2

There are no ring outliers.

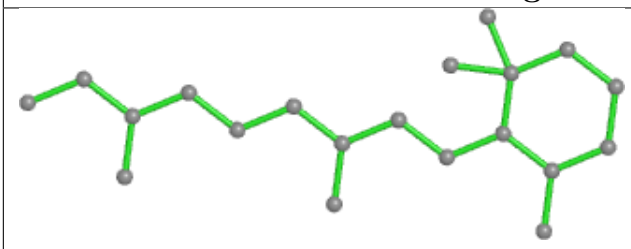
3 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	600	L2P	1	0
2	A	300	RET	4	0
3	A	609	L2P	2	0

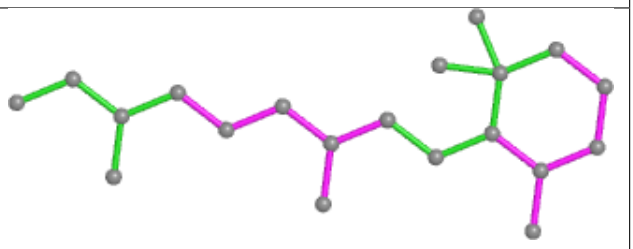
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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



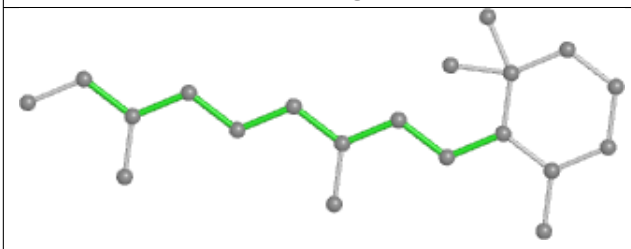
Ligand RET A 300



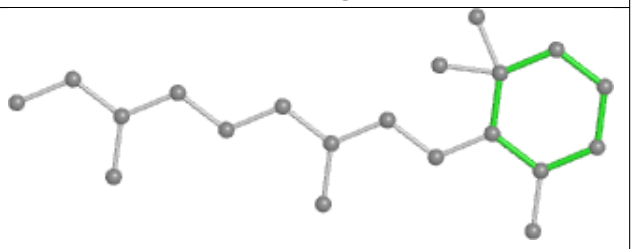
Bond lengths



Bond angles

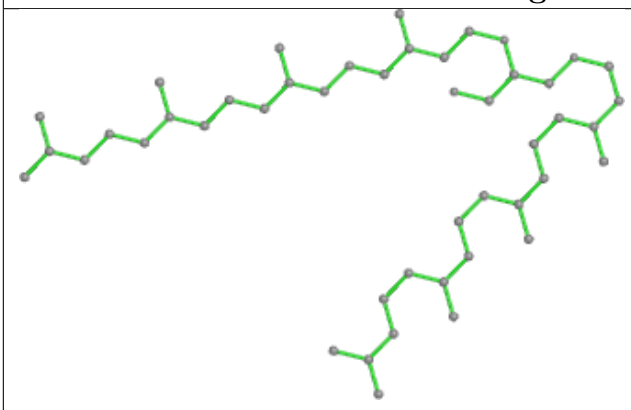


Torsions

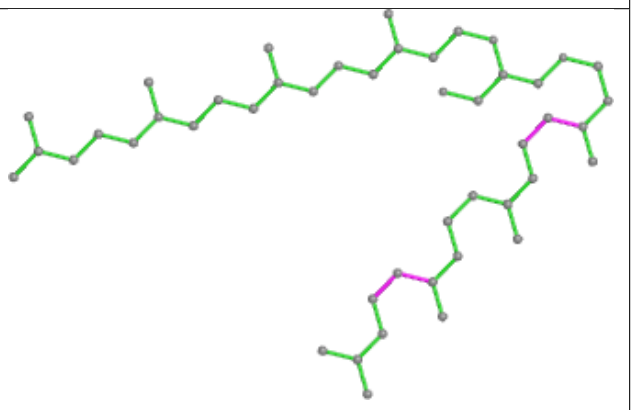


Rings

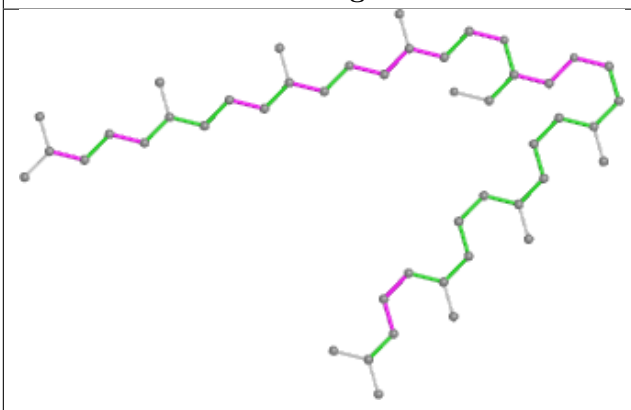
Ligand L2P A 609



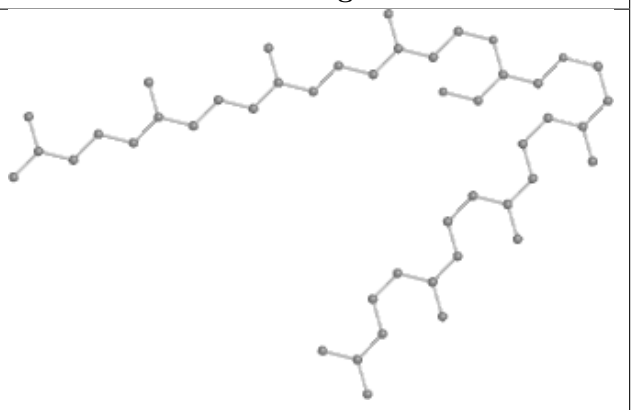
Bond lengths



Bond angles

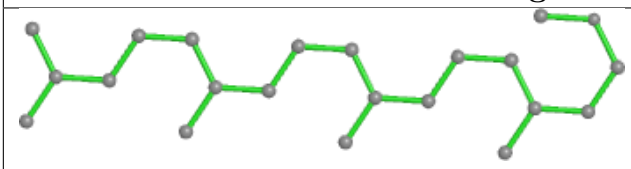


Torsions

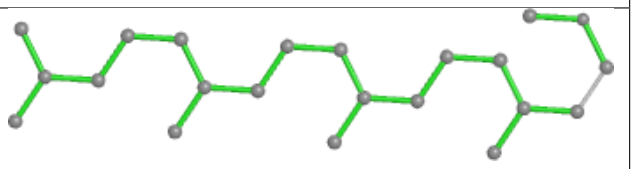


Rings

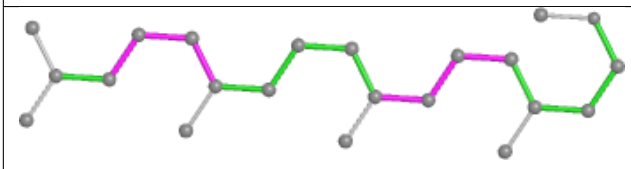
Ligand L2P A 608



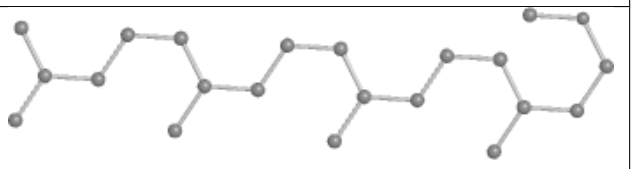
Bond lengths



Bond angles



Torsions



Rings

5.7 Other polymers

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

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

6.3 Carbohydrates

Unable to reproduce the depositors R factor - this section is therefore empty.

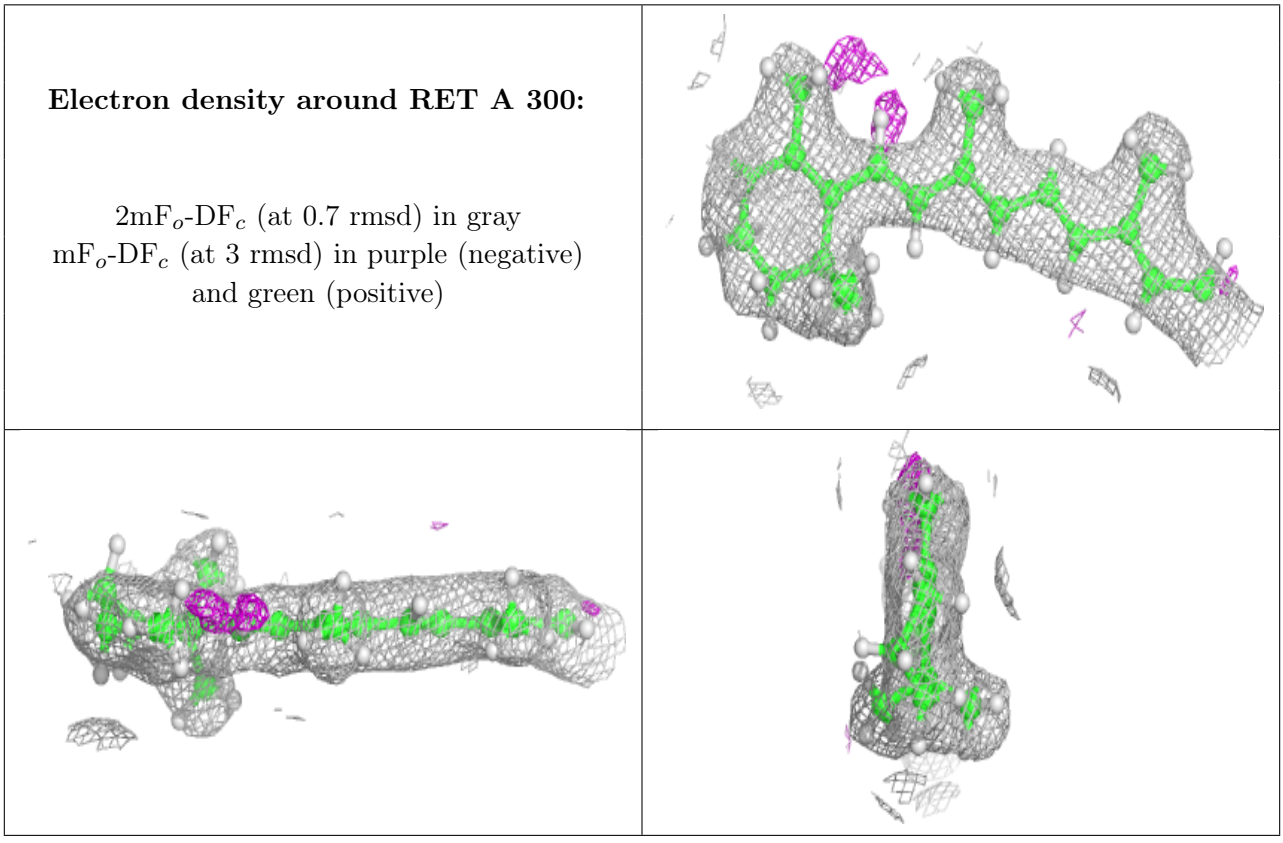
6.4 Ligands

Unable to reproduce the depositors R factor - this section is therefore empty.

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

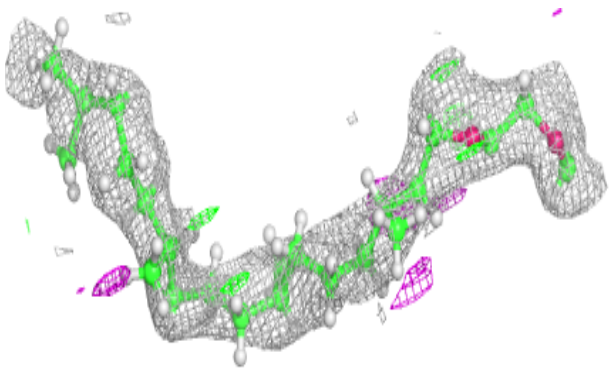
Electron density around RET A 300:

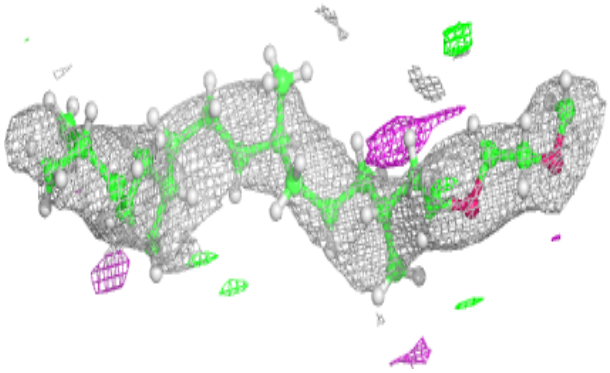
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

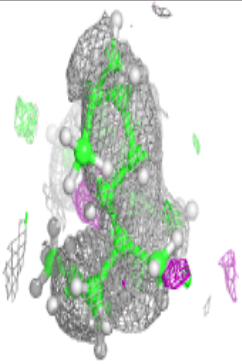


Electron density around L2P A 600:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

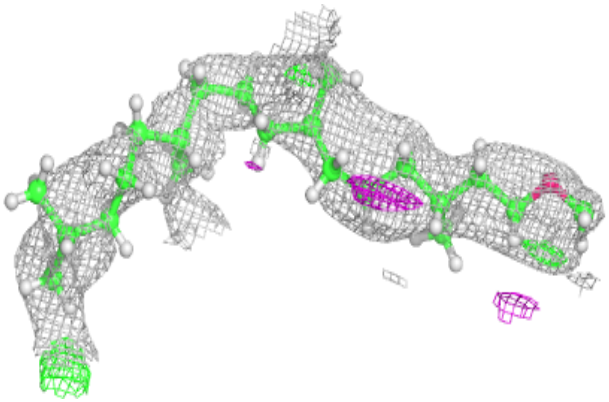


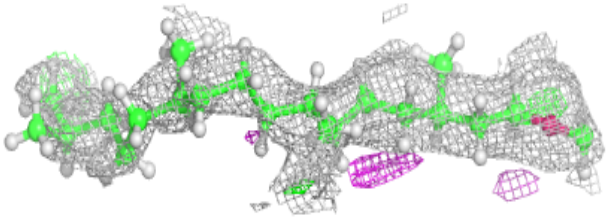


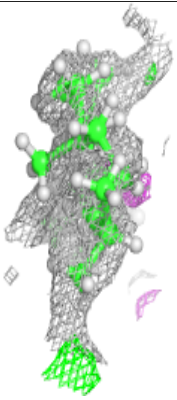


Electron density around L2P A 608:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

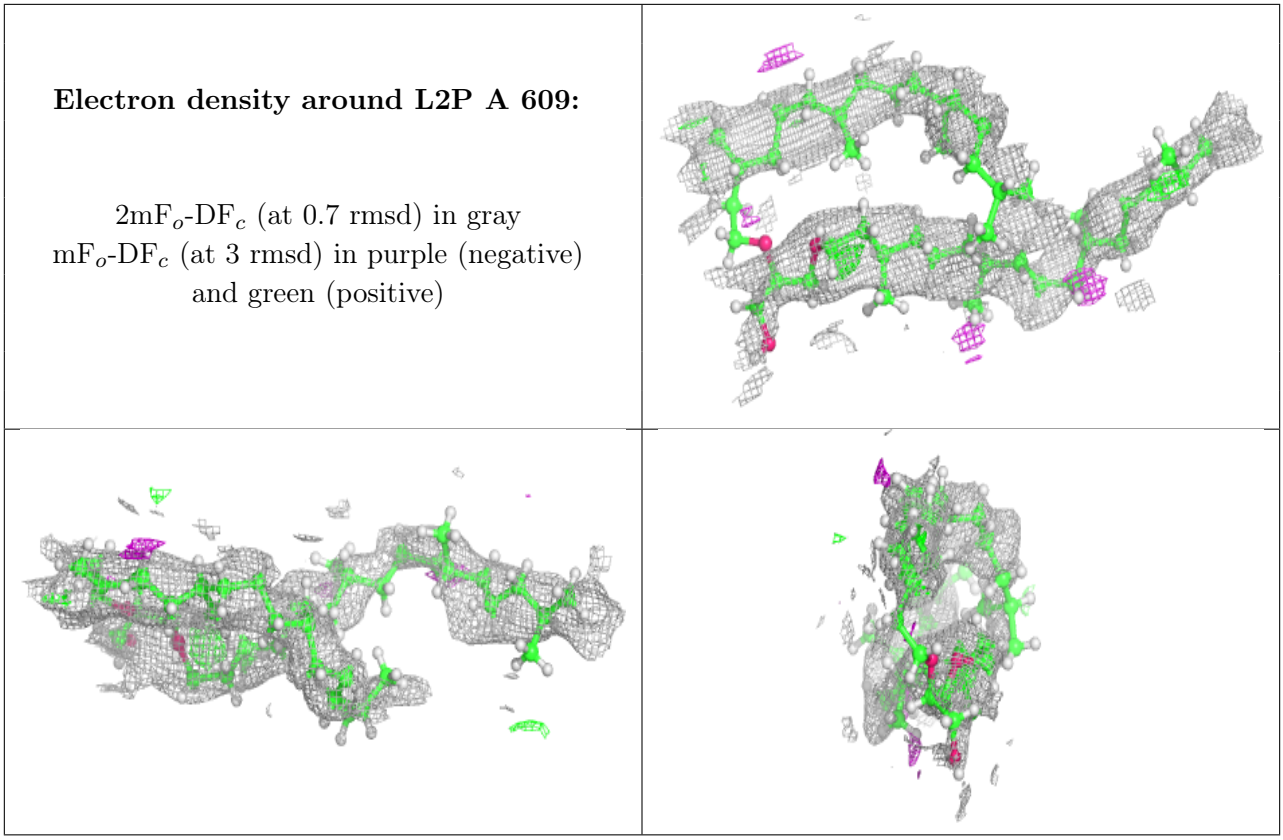






Electron density around L2P A 609:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)



6.5 Other polymers (i)

Unable to reproduce the depositors R factor - this section is therefore empty.