Full wwPDB X-ray Structure Validation Report (i)

Sep 10, 2025 – 04:13 pm BST

PDB ID	:	9G0V / pdb_00009g0v
Title	:	Human LTC4 synthase in complex with compound 1
Authors	:	Srinivas, H.
Deposited on	:	2024-07-08
Resolution	:	2.78 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 (i) 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 (i)) were used in the production of this report:

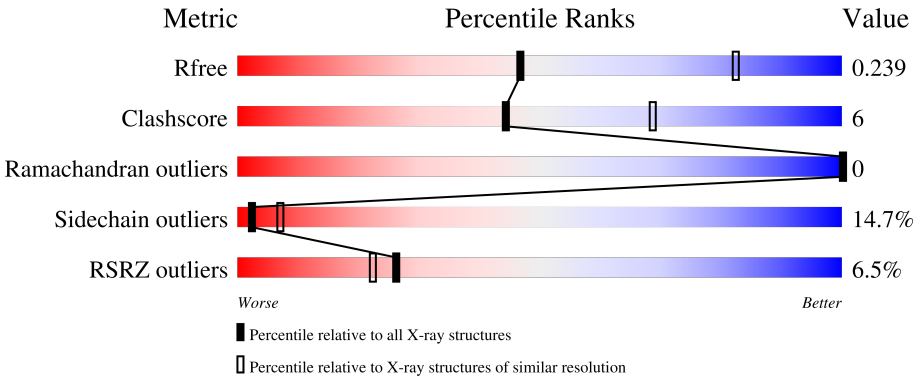
MolProbity	:	4-5-2 with Phenix2.0rc1
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0rc1
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.006 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.45.1

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 2.78 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}	164625	4924 (2.80-2.76)
Clashscore	180529	5458 (2.80-2.76)
Ramachandran outliers	177936	5386 (2.80-2.76)
Sidechain outliers	177891	5388 (2.80-2.76)
RSRZ outliers	164620	4926 (2.80-2.76)

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% The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	157	6% 72% 13% • 11%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 1178 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.

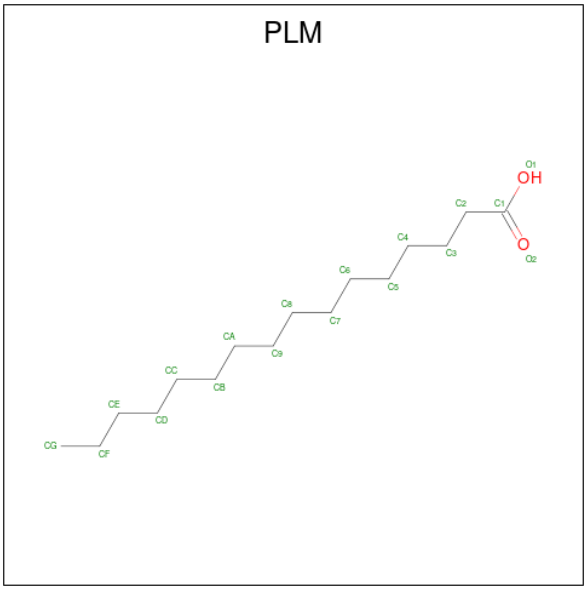
- Molecule 1 is a protein called Leukotriene C4 synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	139	Total	C	N	O	S	0	0	0
			1072	714	182	174	2			

There are 8 discrepancies between the modelled and reference sequences:

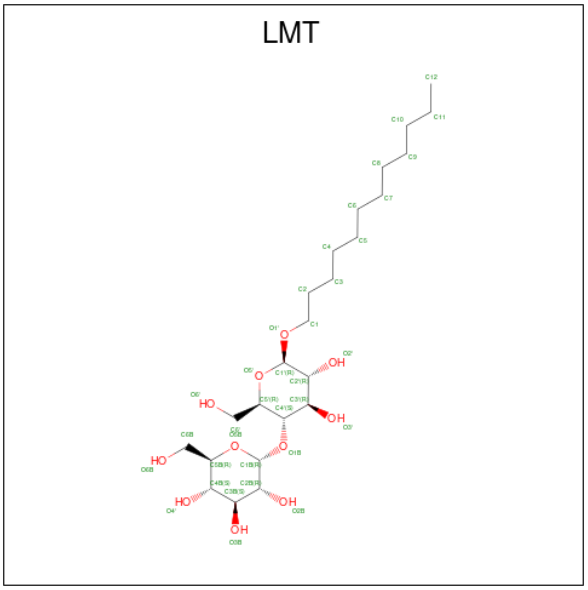
Chain	Residue	Modelled	Actual	Comment	Reference
A	-6	MET	-	initiating methionine	UNP Q16873
A	-5	HIS	-	expression tag	UNP Q16873
A	-4	HIS	-	expression tag	UNP Q16873
A	-3	HIS	-	expression tag	UNP Q16873
A	-2	HIS	-	expression tag	UNP Q16873
A	-1	HIS	-	expression tag	UNP Q16873
A	0	HIS	-	expression tag	UNP Q16873
A	1	GLY	-	expression tag	UNP Q16873

- Molecule 2 is PALMITIC ACID (CCD ID: PLM) (formula: $C_{16}H_{32}O_2$).



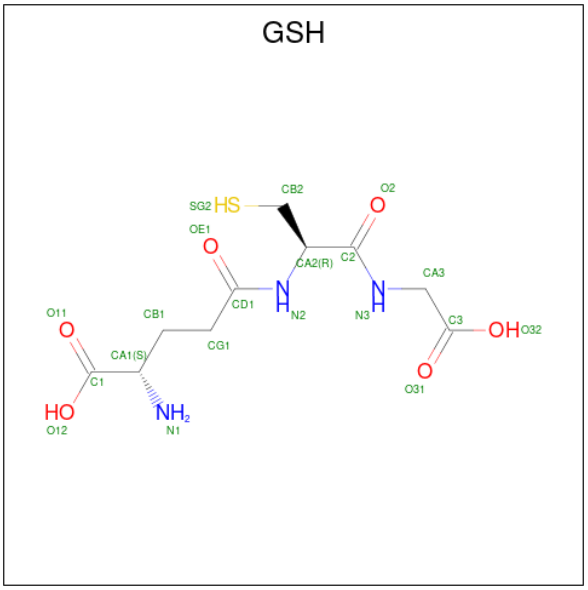
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C 11 11	0	0
2	A	1	Total C 8 8	0	0

- Molecule 3 is DODECYL-BETA-D-MALTOSIDE (CCD ID: LMT) (formula: $C_{24}H_{46}O_{11}$).



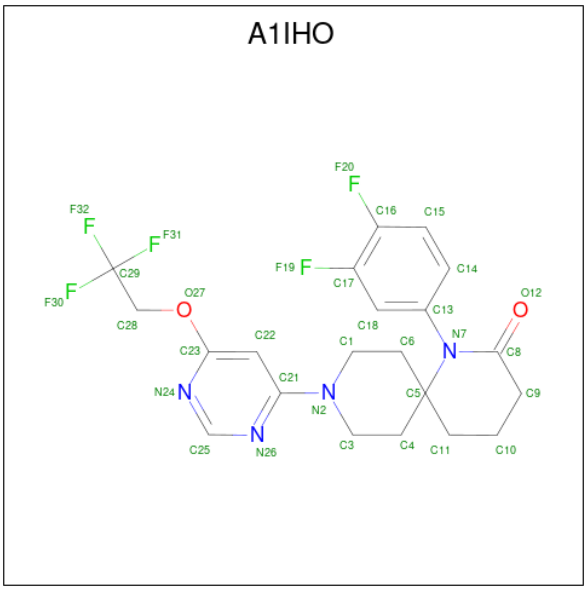
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O 35 24 11	0	0

- Molecule 4 is GLUTATHIONE (CCD ID: GSH) (formula: $C_{10}H_{17}N_3O_6S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	S	0	0
			20	10	3	6	1		

- Molecule 5 is 1-[3,4-bis(fluoranyl)phenyl]-9-[6-[2,2,2-tris(fluoranyl)ethoxy]pyrimidin-4-yl]-1,9-diazaspiro[5.5]undecan-2-one (CCD ID: A1IHO) (formula: $C_{21}H_{21}F_5N_4O_2$) (labeled as "Ligand of Interest" by depositor).

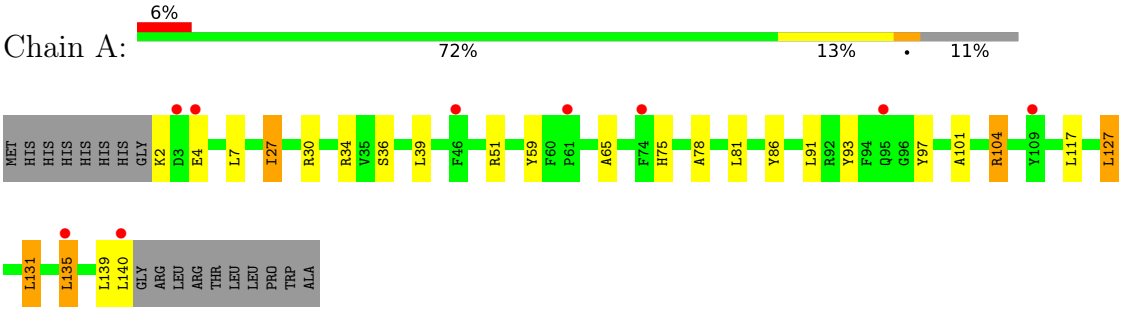


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	F	N	O	0	0
			32	21	5	4	2		

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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). 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: Leukotriene C4 synthase



4 Data and refinement statistics (i)

Property	Value	Source
Space group	F 2 3	Depositor
Cell constants a, b, c, α, β, γ	170.64Å 170.64Å 170.64Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.70 – 2.78 19.70 – 2.78	Depositor EDS
% Data completeness (in resolution range)	91.0 (19.70-2.78) 90.7 (19.70-2.78)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.61 (at 2.79Å)	Xtriage
Refinement program	BUSTER 2.11.8	Depositor
R, R_{free}	0.249 , 0.256 0.243 , 0.239	Depositor DCC
R_{free} test set	457 reflections (4.37%)	wwPDB-VP
Wilson B-factor (Å^2)	118.0	Xtriage
Anisotropy	0.000	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 101.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.049 for k,h,-l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	1178	wwPDB-VP
Average B, all atoms (Å^2)	140.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.00% 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: PLM, A1IHO, GSH, LMT

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	0.66	0/1101	1.07	0/1504

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	1072	0	1097	14	0
2	A	19	0	33	1	0
3	A	35	0	46	0	0
4	A	20	0	15	3	0
5	A	32	0	0	0	0
All	All	1178	0	1191	14	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 6.

All (14) 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:101:ALA:O	1:A:104:ARG:HD3	2.01	0.59
1:A:75:HIS:HD2	1:A:78:ALA:H	1.55	0.55
1:A:65:ALA:HA	2:A:201:PLM:HF1	1.90	0.53
1:A:104:ARG:NE	4:A:204:GSH:SG2	2.83	0.51
1:A:93:TYR:HE2	4:A:204:GSH:SG2	2.35	0.49
1:A:127:LEU:HD23	1:A:131:LEU:HD13	1.96	0.48
1:A:36:SER:O	1:A:39:LEU:HB2	2.16	0.46
1:A:93:TYR:CE2	4:A:204:GSH:SG2	3.07	0.45
1:A:27:ILE:HD12	1:A:30:ARG:HD2	1.98	0.45
1:A:135:LEU:HD22	1:A:139:LEU:HD13	1.99	0.45
1:A:75:HIS:CD2	1:A:78:ALA:H	2.33	0.44
1:A:75:HIS:HD2	1:A:78:ALA:N	2.16	0.42
1:A:27:ILE:HD12	1:A:27:ILE:HA	1.93	0.41
1:A:59:TYR:HB3	1:A:86:TYR:OH	2.20	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	137/157 (87%)	135 (98%)	2 (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 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	102/120 (85%)	87 (85%)	15 (15%)	2 7

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	LYS
1	A	4	GLU
1	A	7	LEU
1	A	27	ILE
1	A	34	ARG
1	A	51	ARG
1	A	81	LEU
1	A	91	LEU
1	A	97	TYR
1	A	104	ARG
1	A	117	LEU
1	A	127	LEU
1	A	131	LEU
1	A	135	LEU
1	A	140	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	75	HIS

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

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

5 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	$\#\|Z\| > 2$
2	PLM	A	203	-	7,7,17	0.66	0	6,6,17	0.44	0
5	A1IHO	A	205	-	34,35,35	1.13	3 (8%)	45,52,52	2.49	13 (28%)
3	LMT	A	202	-	36,36,36	1.10	1 (2%)	47,47,47	1.27	6 (12%)
2	PLM	A	201	-	10,10,17	0.71	0	9,9,17	0.53	0
4	GSH	A	204	-	18,19,19	0.59	0	23,24,24	0.70	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
2	PLM	A	203	-	-	4/5/5/15	-
5	A1IHO	A	205	-	-	5/14/43/43	0/4/4/4
3	LMT	A	202	-	-	10/21/61/61	0/2/2/2
2	PLM	A	201	-	-	6/8/8/15	-
4	GSH	A	204	-	-	6/24/24/24	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	202	LMT	O1'-C1'	2.90	1.45	1.40
5	A	205	A1IHO	C6-C5	2.48	1.57	1.53
5	A	205	A1IHO	C11-C5	2.43	1.57	1.53
5	A	205	A1IHO	C4-C5	2.13	1.56	1.53

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	A	205	A1IHO	C25-N26-C21	8.51	122.38	114.94
5	A	205	A1IHO	C25-N24-C23	8.16	120.62	114.48
5	A	205	A1IHO	N26-C25-N24	-5.40	120.16	128.60
3	A	202	LMT	O1B-C4'-C3'	3.96	117.83	107.28
5	A	205	A1IHO	C6-C5-C11	-3.90	102.19	110.06
5	A	205	A1IHO	C9-C8-N7	3.46	124.78	117.26
5	A	205	A1IHO	C22-C23-N24	-3.42	119.76	124.57
5	A	205	A1IHO	O12-C8-C9	-3.28	113.73	121.32
3	A	202	LMT	C4B-C3B-C2B	3.00	116.06	110.82
5	A	205	A1IHO	C3-N2-C1	2.90	117.91	111.52
5	A	205	A1IHO	C22-C21-N26	-2.83	117.84	122.73
5	A	205	A1IHO	C6-C5-N7	2.80	117.26	110.55
3	A	202	LMT	C1B-O1B-C4'	-2.64	111.43	117.96
3	A	202	LMT	C3'-C4'-C5'	-2.58	105.02	110.93
3	A	202	LMT	O5B-C5B-C4B	2.52	114.28	109.69
3	A	202	LMT	C3B-C4B-C5B	2.37	114.47	110.24
5	A	205	A1IHO	C18-C13-N7	2.12	122.21	119.62
5	A	205	A1IHO	C15-C14-C13	2.03	123.00	120.32
5	A	205	A1IHO	C11-C10-C9	-2.01	106.89	111.38

There are no chirality outliers.

All (31) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	202	LMT	C2'-C1'-O1'-C1
3	A	202	LMT	O5'-C1'-O1'-C1
4	A	204	GSH	N2-CA2-CB2-SG2
4	A	204	GSH	C2-CA2-CB2-SG2
5	A	205	A1IHO	C22-C23-O27-C28
5	A	205	A1IHO	N24-C23-O27-C28
5	A	205	A1IHO	O27-C28-C29-F32
5	A	205	A1IHO	O27-C28-C29-F31
5	A	205	A1IHO	O27-C28-C29-F30
4	A	204	GSH	N2-CD1-CG1-CB1
4	A	204	GSH	OE1-CD1-CG1-CB1
2	A	201	PLM	CC-CD-CE-CF
2	A	201	PLM	CA-CB-CC-CD
3	A	202	LMT	O1'-C1-C2-C3
2	A	201	PLM	C9-CA-CB-CC
2	A	203	PLM	C4-C5-C6-C7
2	A	201	PLM	CB-CC-CD-CE
3	A	202	LMT	C4-C5-C6-C7
2	A	203	PLM	C5-C6-C7-C8

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Mol	Chain	Res	Type	Atoms
2	A	203	PLM	C3-C4-C5-C6
2	A	201	PLM	C8-C9-CA-CB
2	A	203	PLM	C1-C2-C3-C4
3	A	202	LMT	C9-C10-C11-C12
4	A	204	GSH	O2-C2-CA2-N2
3	A	202	LMT	C4B-C5B-C6B-O6B
4	A	204	GSH	N3-C2-CA2-N2
2	A	201	PLM	C7-C8-C9-CA
3	A	202	LMT	C11-C10-C9-C8
3	A	202	LMT	C3-C4-C5-C6
3	A	202	LMT	C2-C3-C4-C5
3	A	202	LMT	C2B-C1B-O1B-C4'

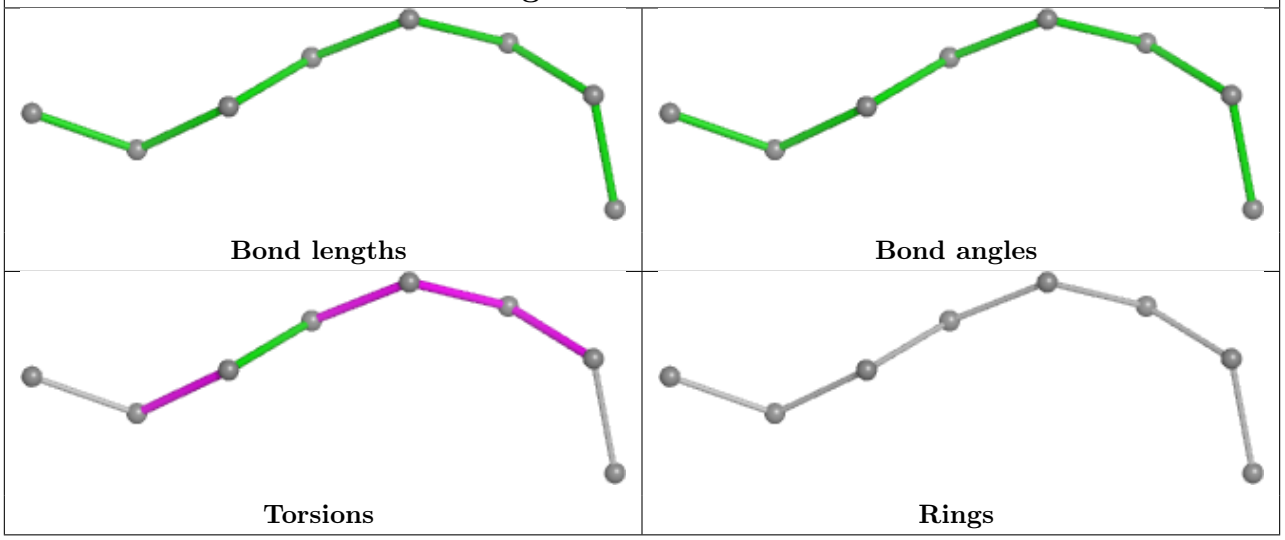
There are no ring outliers.

2 monomers are involved in 4 short contacts:

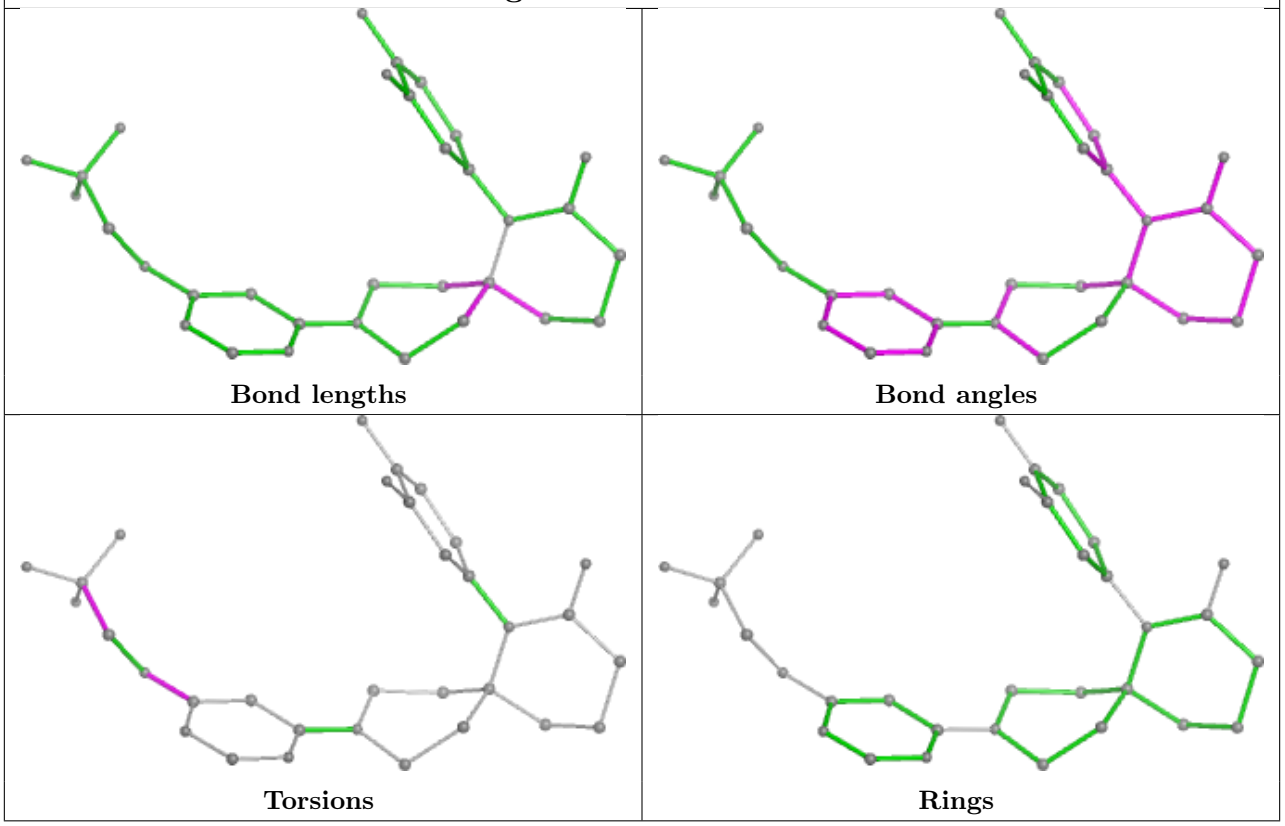
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	201	PLM	1	0
4	A	204	GSH	3	0

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.

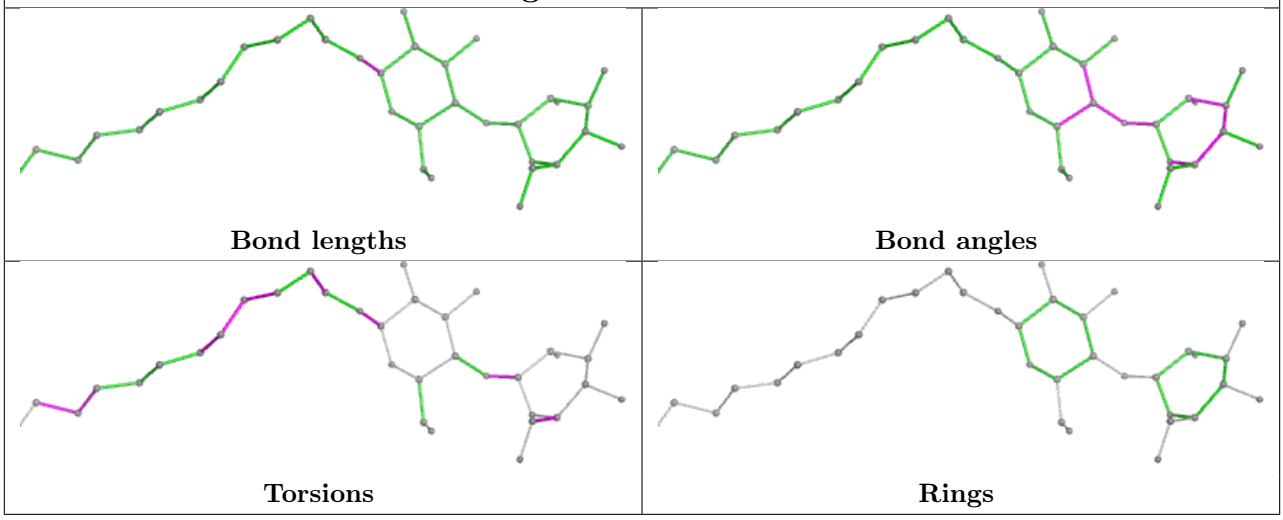
Ligand PLM A 203



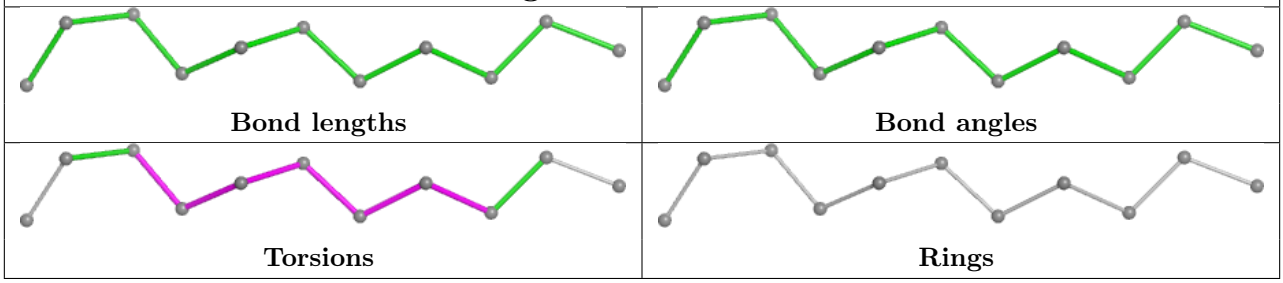
Ligand A1IHO A 205



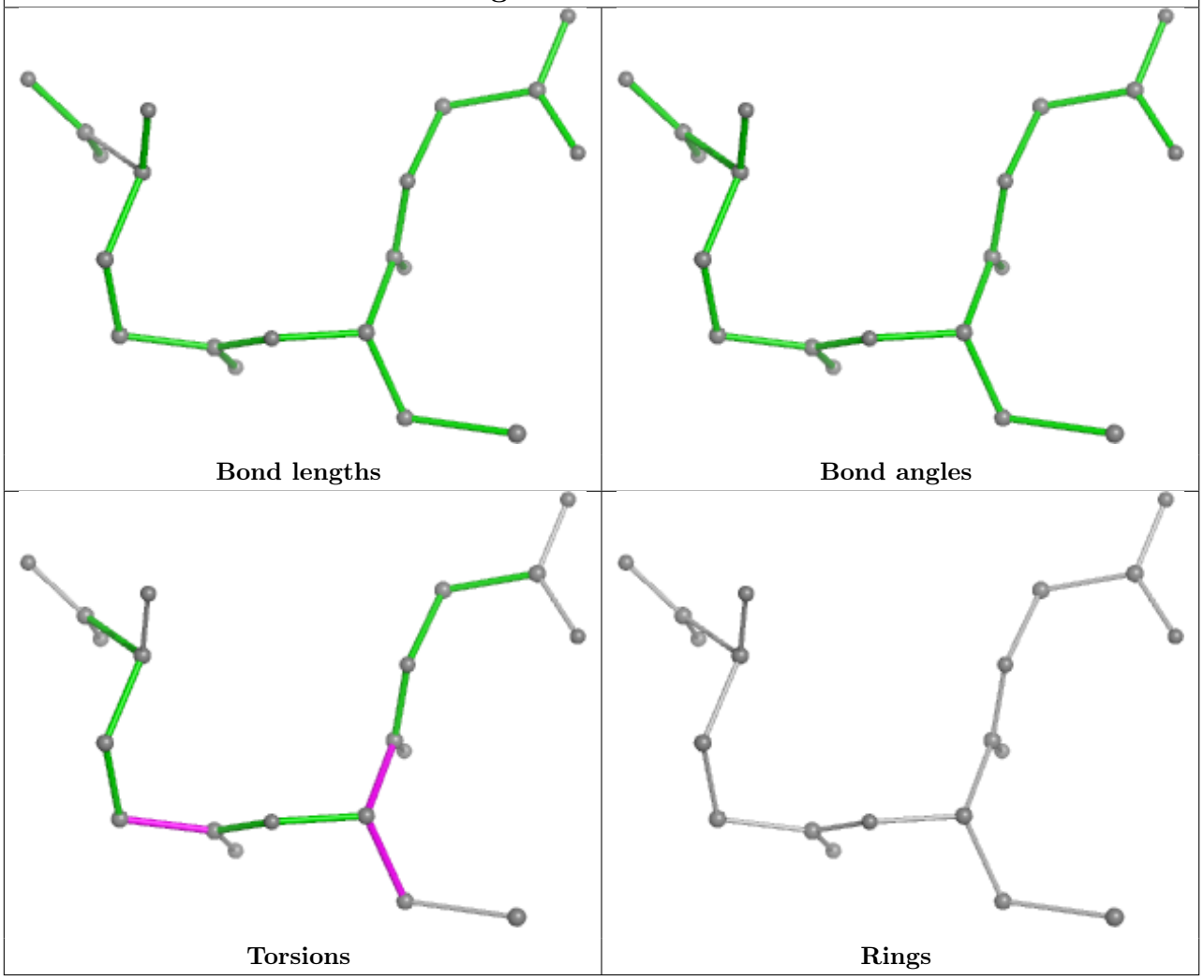
Ligand LMT A 202



Ligand PLM A 201



Ligand GSH A 204



5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95^{th} percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å^2)	Q<0.9
1	A	139/157 (88%)	0.63	9 (6%) 26 22	100, 132, 173, 182	0

All (9) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	74	PHE	3.2
1	A	3	ASP	3.0
1	A	140	LEU	3.0
1	A	135	LEU	2.8
1	A	4	GLU	2.4
1	A	95	GLN	2.3
1	A	46	PHE	2.1
1	A	109	TYR	2.0
1	A	61	PRO	2.0

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no oligosaccharides in this entry.

6.4 Ligands

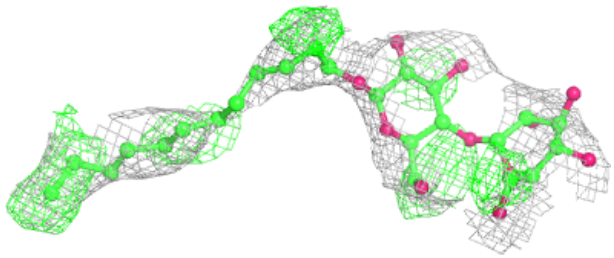
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

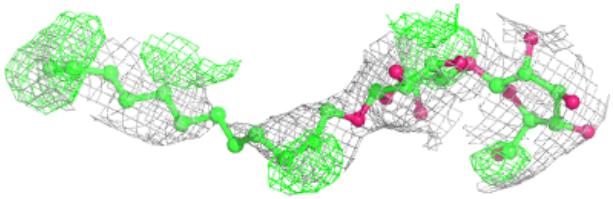
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
3	LMT	A	202	35/35	0.41	0.24	206,207,207,207	0
4	GSH	A	204	20/20	0.75	0.26	199,201,203,203	0
2	PLM	A	203	8/18	0.83	0.32	151,151,151,151	0
5	A1IHO	A	205	32/32	0.89	0.16	145,146,150,150	0
2	PLM	A	201	11/18	0.94	0.18	109,109,111,111	0

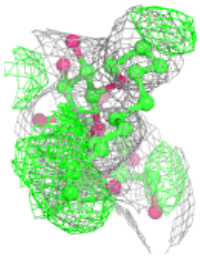
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around LMT A 202:

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

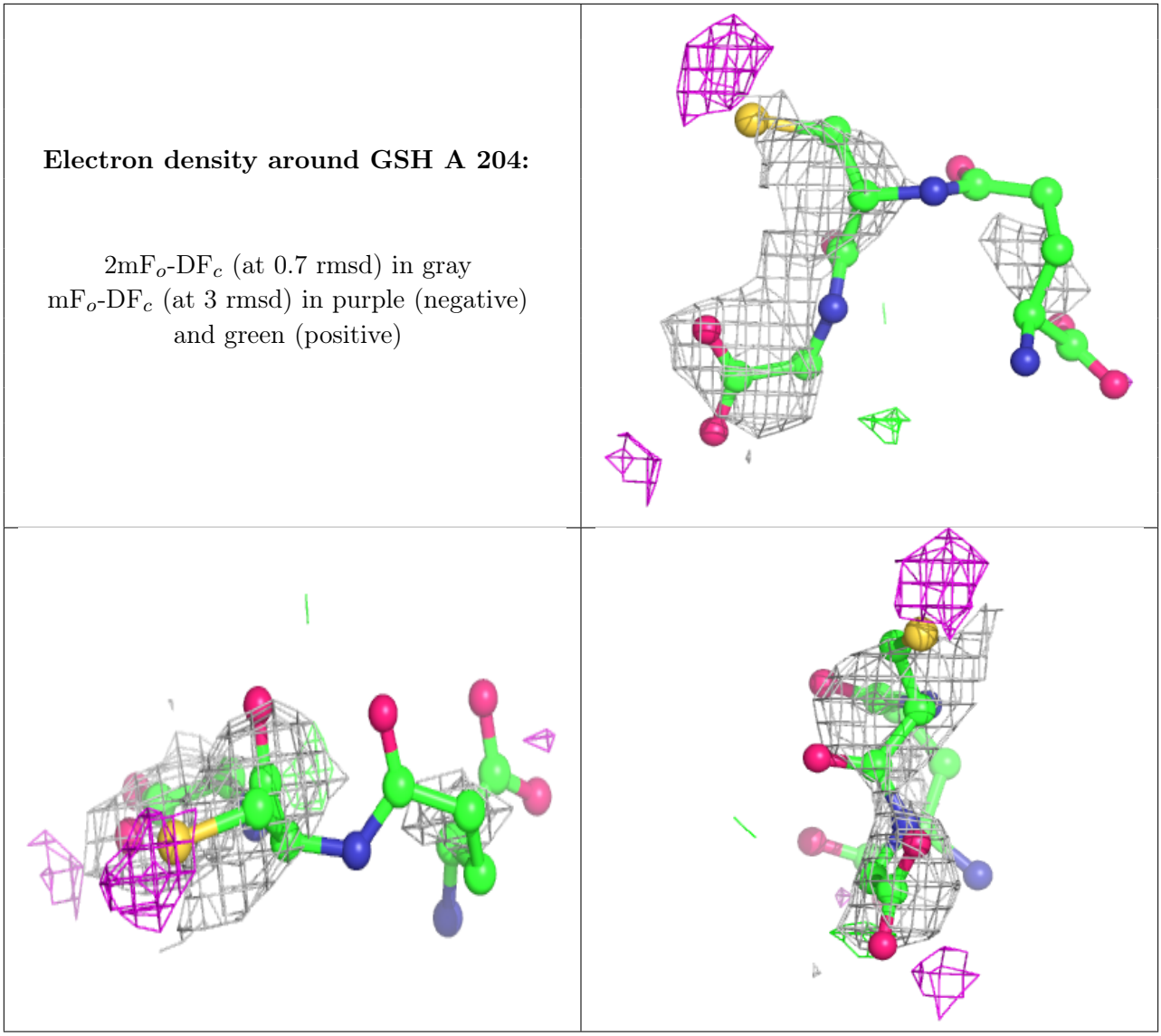






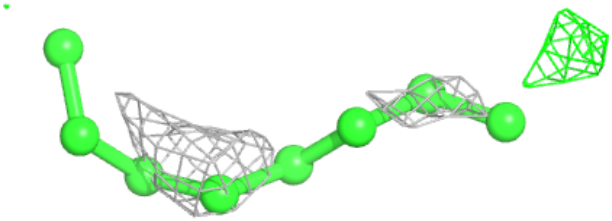
Electron density around GSH A 204:

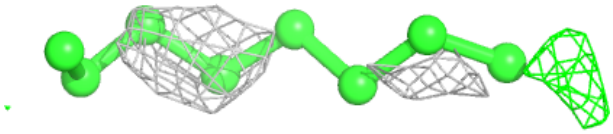
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

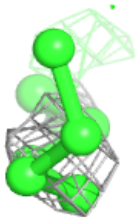


Electron density around PLM A 203:

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

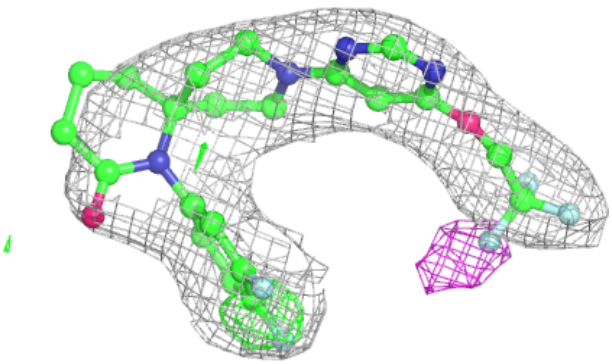


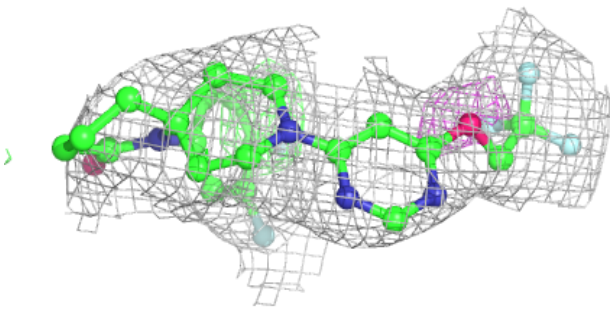


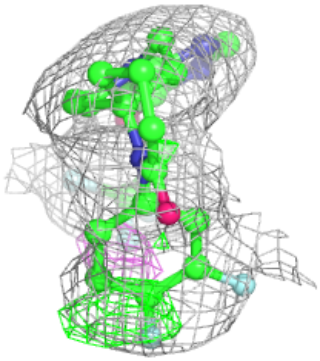


Electron density around A1IHO A 205:

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

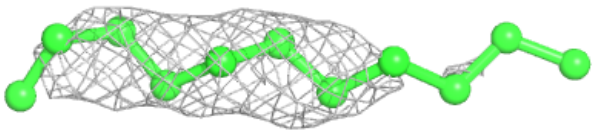


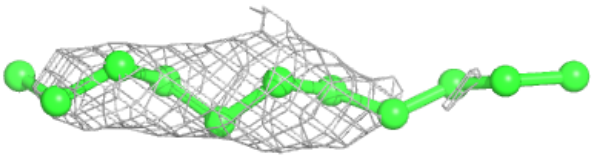


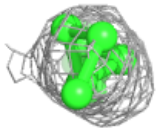


Electron density around PLM A 201:

$2mF_o$-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

There are no such residues in this entry.