Full wwPDB X-ray Structure Validation Report ⓘ

Sep 16, 2025 – 04:17 pm BST

PDB ID	:	9GSW / pdb_00009gsw
Title	:	Crystal structure of human lysosomal acid-alpha-glucosidase, GAA, in complex with iminosugar compound 4d
Authors	:	Sulzenbacher, G.; Roig-Zamboni, V.; Moracci, M.; Parenti, G.; Py, S.
Deposited on	:	2024-09-16
Resolution	:	1.95 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:

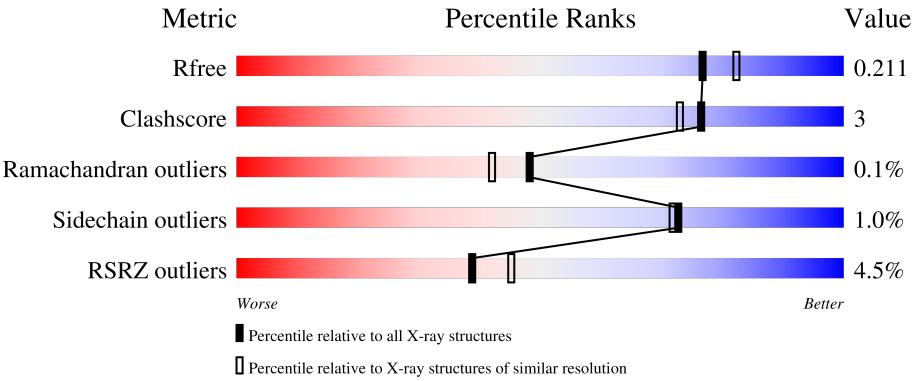
MolProbity	:	4-5-2 with Phenix2.0rc1
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0rc1
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.006 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	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 1.95 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	3187 (1.96-1.96)
Clashscore	180529	3412 (1.96-1.96)
Ramachandran outliers	177936	3390 (1.96-1.96)
Sidechain outliers	177891	3390 (1.96-1.96)
RSRZ outliers	164620	3186 (1.96-1.96)

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	952	4% 82% 7% 11%
2	B	3	33% 67%
2	F	3	100%
3	C	3	33% 67%
4	D	2	100%

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Mol	Chain	Length	Quality of chain
5	E	4	100%

2 Entry composition

There are 13 unique types of molecules in this entry. The entry contains 7816 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.

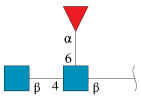
- Molecule 1 is a protein called Lysosomal alpha-glucosidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	847	Total	C	N	O	S	0	8	0
			6712	4306	1128	1246	32			

There are 3 discrepancies between the modelled and reference sequences:

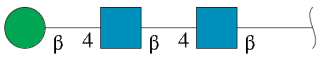
Chain	Residue	Modelled	Actual	Comment	Reference
A	199	ARG	HIS	variant	UNP P10253
A	223	HIS	ARG	variant	UNP P10253
A	780	ILE	VAL	variant	UNP P10253

- Molecule 2 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	3	Total	C	N	O	0	0	0
			38	22	2	14			
2	F	3	Total	C	N	O	0	0	0
			38	22	2	14			

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



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

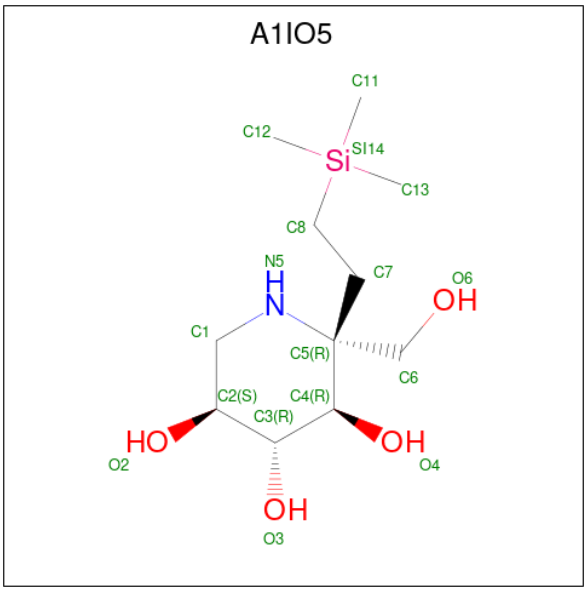
- Molecule 4 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.

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

- Molecule 5 is an oligosaccharide called alpha-D-mannopyranose-(1-3)-beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.

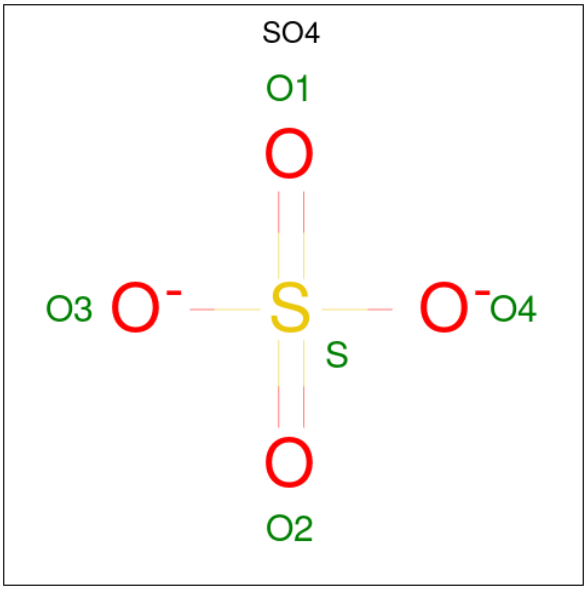
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
5	E	4	Total	C	N	O	0	0	0
			50	28	2	20			

- Molecule 6 is (2 {R},3 {R},4 {R},5 {S})-2-(hydroxymethyl)-2-(2-trimethylsilylethyl)piperidine-3,4,5-triol (CCD ID: A1IO5) (formula: $C_{11}H_{25}NO_4Si$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
6	A	1	Total	C	N	O	Si	0	0
			17	11	1	4	1		

- Molecule 7 is SULFATE ION (CCD ID: SO4) (formula: O_4S).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
7	A	1	Total	O	S		0	0
			5	4	1			
7	A	1	Total	O	S		0	0
			5	4	1			
7	A	1	Total	O	S		0	0
			5	4	1			

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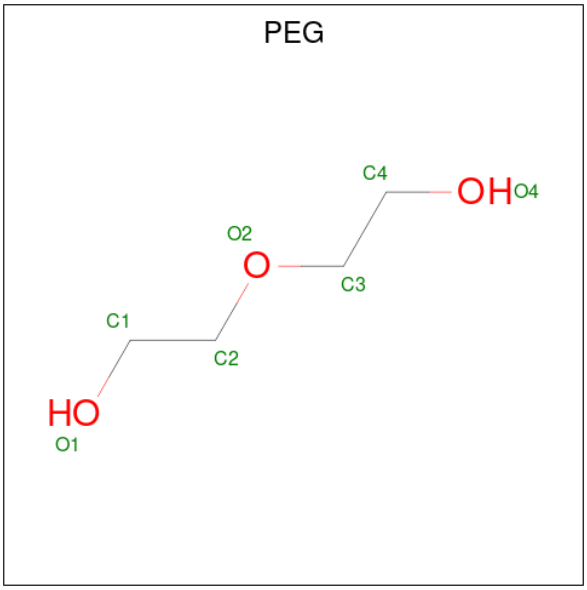
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	A	1	Total O S 5 4 1	0	0
7	A	1	Total O S 5 4 1	0	0
7	A	1	Total O S 5 4 1	0	0

- Molecule 8 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

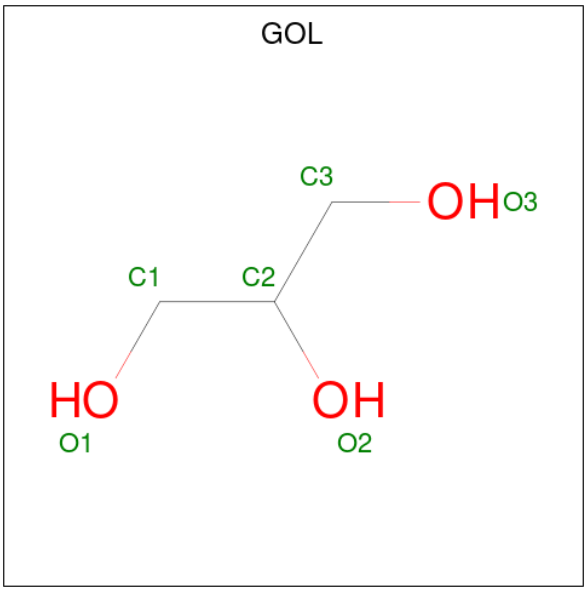
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	3	Total Cl 3 3	0	0

- Molecule 9 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$) (labeled as "Ligand of Interest" by depositor).



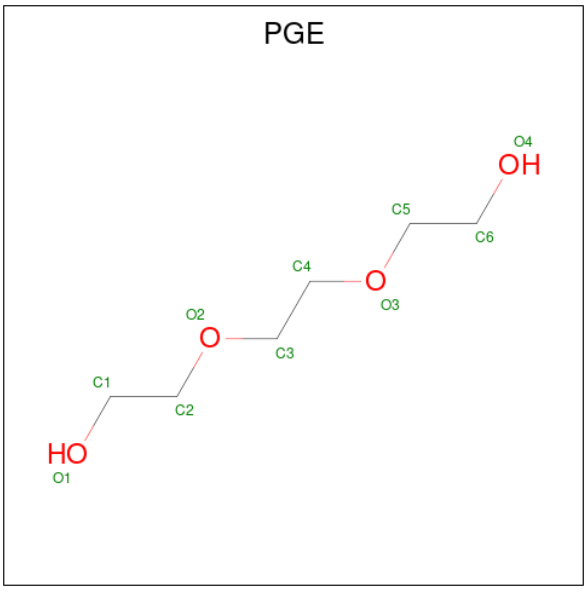
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
9	A	1	Total C O 7 4 3	0	0

- Molecule 10 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



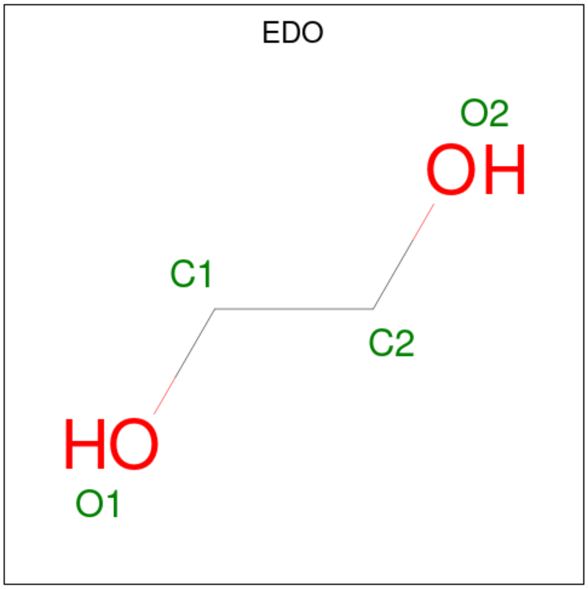
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
10	A	1	Total	C	O	0	0
			6	3	3		
10	A	1	Total	C	O	0	0
			6	3	3		
10	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 11 is TRIETHYLENE GLYCOL (CCD ID: PGE) (formula: $C_6H_{14}O_4$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
11	A	1	Total	C	O	0	0
			10	6	4		

- Molecule 12 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
12	A	1	Total C O 4 2 2	0	0
12	A	1	Total C O 4 2 2	0	0
12	A	1	Total C O 4 2 2	0	0
12	A	1	Total C O 4 2 2	0	0
12	A	1	Total C O 4 2 2	0	0
12	A	1	Total C O 4 2 2	0	0
12	A	1	Total C O 4 2 2	0	0
12	A	1	Total C O 4 2 2	0	0
12	A	1	Total C O 4 2 2	0	0
12	A	1	Total C O 4 2 2	0	0

- Molecule 13 is water.

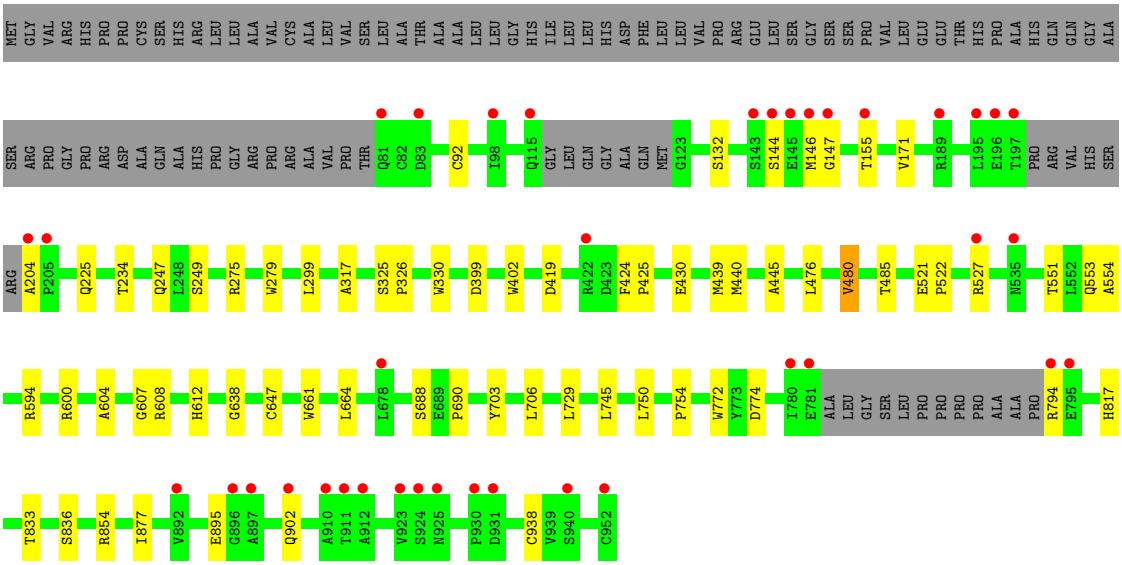
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
13	A	786	Total O 786 786	0	0

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 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.

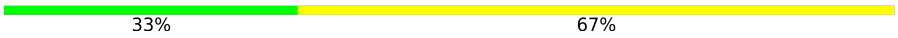
• Molecule 1: Lysosomal alpha-glucosidase

Chain A:



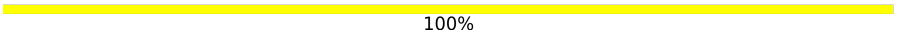
• Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose

Chain B:



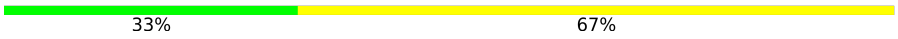
• Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose

Chain F:



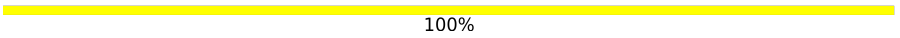
• Molecule 3: beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain C:



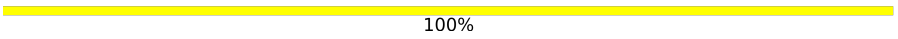
• Molecule 4: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain D:



• Molecule 5: alpha-D-mannopyranose-(1-3)-beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain E:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	97.03Å 102.72Å 129.32Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.71 – 1.95 47.71 – 1.95	Depositor EDS
% Data completeness (in resolution range)	99.9 (47.71-1.95) 99.9 (47.71-1.95)	Depositor EDS
R_{merge}	0.23	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.29 (at 1.95Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.167 , 0.207 0.173 , 0.211	Depositor DCC
R_{free} test set	4741 reflections (2.83%)	wwPDB-VP
Wilson B-factor (Å^2)	23.7	Xtriage
Anisotropy	0.375	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.37 , 50.9	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	7816	wwPDB-VP
Average B, all atoms (Å^2)	41.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.55% 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: CL, GOL, FUC, NAG, SO4, PEG, A1IO5, EDO, PGE, BMA, CSO, MAN

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	0.97	0/6927	1.17	1/9462 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	594	ARG	CB-CA-C	-5.14	101.64	109.50

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	6712	0	6496	38	0
2	B	38	0	34	0	0
2	F	38	0	34	0	0
3	C	39	0	34	0	0
4	D	28	0	25	0	0
5	E	50	0	43	0	0
6	A	17	0	0	0	0
7	A	30	0	0	0	0
8	A	3	0	0	0	0
9	A	7	0	10	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
10	A	18	0	24	0	0
11	A	10	0	14	0	0
12	A	40	0	60	1	0
13	A	786	0	0	10	0
All	All	7816	0	6774	39	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 3.

All (39) 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)
12:A:1018:EDO:C2	12:A:1018:EDO:O2	1.98	1.10
1:A:551:THR:OG1	1:A:553[A]:GLN:OE1	1.94	0.86
1:A:527[B]:ARG:NH1	1:A:551:THR:HG21	2.08	0.69
1:A:938:CSO:OD	13:A:1102:HOH:O	2.12	0.65
1:A:664:LEU:HD13	1:A:754:PRO:HG3	1.78	0.65
1:A:275:ARG:NH1	13:A:1107:HOH:O	2.31	0.62
1:A:132:SER:OG	13:A:1101:HOH:O	2.01	0.57
1:A:430:GLU:OE2	13:A:1103:HOH:O	2.17	0.57
1:A:521:GLU:N	1:A:522:PRO:HA	2.20	0.56
1:A:325:SER:N	1:A:326:PRO:HA	2.22	0.54
1:A:234:THR:HA	1:A:249:SER:O	2.08	0.53
1:A:155:THR:HG23	13:A:1319:HOH:O	2.07	0.53
1:A:608:ARG:NH1	13:A:1114:HOH:O	2.43	0.50
1:A:833:THR:HA	1:A:836:SER:OG	2.11	0.50
1:A:299:LEU:C	1:A:299:LEU:HD23	2.39	0.47
1:A:703:TYR:HA	1:A:706:LEU:HG	1.97	0.46
1:A:774:ASP:OD2	1:A:794:ARG:NH1	2.41	0.46
1:A:247:GLN:HA	1:A:330:TRP:O	2.16	0.45
1:A:279:TRP:CE3	1:A:317:ALA:HB2	2.52	0.45
1:A:92:CYS:O	1:A:92:CYS:SG	2.74	0.45
1:A:247:GLN:HG2	13:A:1257:HOH:O	2.16	0.45
1:A:607:GLY:HA3	1:A:638:GLY:O	2.17	0.45
1:A:854[B]:ARG:NH2	1:A:877:ILE:HD13	2.33	0.45
1:A:445:ALA:HB1	1:A:485:THR:HB	1.99	0.44
1:A:424:PHE:HB3	1:A:425:PRO:HD3	2.00	0.43
1:A:147:GLY:HA3	1:A:171:VAL:O	2.18	0.43
1:A:745:LEU:HA	1:A:750:LEU:O	2.19	0.43
1:A:146:MET:HE2	1:A:146:MET:HB3	1.81	0.42
1:A:600:ARG:O	1:A:612:HIS:CE1	2.72	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:772:TRP:HB3	1:A:817:HIS:HB3	2.02	0.42
1:A:204:ALA:HB2	13:A:1775:HOH:O	2.19	0.42
1:A:647:CYS:H	1:A:661:TRP:CG	2.38	0.42
1:A:551:THR:HG23	1:A:554:ALA:H	1.84	0.42
1:A:419:ASP:HB2	13:A:1331:HOH:O	2.19	0.42
1:A:476:LEU:C	1:A:476:LEU:HD23	2.45	0.42
1:A:688:SER:OG	1:A:690:PRO:HD2	2.21	0.40
1:A:402:TRP:HA	1:A:439:MET:O	2.21	0.40
1:A:604:ALA:HA	13:A:1249:HOH:O	2.21	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	846/952 (89%)	823 (97%)	22 (3%)	1 (0%)	48 42

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	480	VAL

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	731/805 (91%)	724 (99%)	7 (1%)	73 72

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	144	SER
1	A	225	GLN
1	A	399	ASP
1	A	440	MET
1	A	480	VAL
1	A	729	LEU
1	A	902	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	81	GLN
1	A	188	ASN
1	A	401	GLN
1	A	562	HIS
1	A	692	GLN
1	A	902	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)

1 non-standard protein/DNA/RNA residue is 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	$\#\|Z\| > 2$
1	CSO	A	938	1	3,6,7	0.80	0	0,6,8	-	-

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
1	CSO	A	938	1	-	0/1/5/7	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	938	CSO	1	0

5.5 Carbohydrates (i)

15 monosaccharides are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	NAG	B	1	1,2	14,14,15	0.62	0	17,19,21	1.29	1 (5%)
2	NAG	B	2	2	14,14,15	0.43	0	17,19,21	1.08	2 (11%)
2	FUC	B	3	2	10,10,11	0.42	0	14,14,16	0.99	0
3	NAG	C	1	1,3	14,14,15	0.49	0	17,19,21	0.98	0
3	NAG	C	2	3	14,14,15	0.48	0	17,19,21	1.20	1 (5%)
3	BMA	C	3	3	11,11,12	0.32	0	15,15,17	1.22	3 (20%)
4	NAG	D	1	1,4	14,14,15	0.60	0	17,19,21	1.08	2 (11%)
4	NAG	D	2	4	14,14,15	0.48	0	17,19,21	1.23	2 (11%)
5	NAG	E	1	1,5	14,14,15	0.53	0	17,19,21	1.01	1 (5%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
5	NAG	E	2	5	14,14,15	0.33	0	17,19,21	0.96	1 (5%)
5	BMA	E	3	5	11,11,12	0.37	0	15,15,17	1.60	3 (20%)
5	MAN	E	4	5	11,11,12	0.34	0	15,15,17	0.92	1 (6%)
2	NAG	F	1	1,2	14,14,15	0.43	0	17,19,21	1.03	1 (5%)
2	NAG	F	2	2	14,14,15	0.40	0	17,19,21	1.28	4 (23%)
2	FUC	F	3	2	10,10,11	0.58	0	14,14,16	1.53	2 (14%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	NAG	B	1	1,2	-	0/6/23/26	0/1/1/1
2	NAG	B	2	2	-	0/6/23/26	0/1/1/1
2	FUC	B	3	2	-	-	0/1/1/1
3	NAG	C	1	1,3	-	0/6/23/26	0/1/1/1
3	NAG	C	2	3	-	2/6/23/26	0/1/1/1
3	BMA	C	3	3	-	0/2/19/22	0/1/1/1
4	NAG	D	1	1,4	-	0/6/23/26	0/1/1/1
4	NAG	D	2	4	-	2/6/23/26	0/1/1/1
5	NAG	E	1	1,5	-	0/6/23/26	0/1/1/1
5	NAG	E	2	5	-	0/6/23/26	0/1/1/1
5	BMA	E	3	5	-	2/2/19/22	0/1/1/1
5	MAN	E	4	5	-	2/2/19/22	0/1/1/1
2	NAG	F	1	1,2	-	0/6/23/26	0/1/1/1
2	NAG	F	2	2	-	2/6/23/26	0/1/1/1
2	FUC	F	3	2	-	-	0/1/1/1

There are no bond length outliers.

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	E	3	BMA	O5-C5-C6	5.05	115.13	107.20
2	B	1	NAG	O5-C1-C2	-4.30	104.50	111.29
2	F	1	NAG	O5-C1-C2	-3.58	105.63	111.29
3	C	3	BMA	O5-C5-C6	2.85	111.68	107.20
4	D	2	NAG	C1-C2-N2	-2.70	105.87	110.49
2	F	3	FUC	O5-C5-C4	2.68	114.33	109.52

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	E	4	MAN	O5-C5-C6	2.55	111.20	107.20
2	F	3	FUC	O5-C1-C2	-2.49	106.93	110.77
3	C	3	BMA	O5-C1-C2	-2.30	107.22	110.77
2	F	2	NAG	C3-C4-C5	-2.29	106.15	110.24
5	E	2	NAG	C6-C5-C4	-2.29	107.64	113.00
5	E	1	NAG	O5-C1-C2	-2.27	107.70	111.29
2	B	2	NAG	C4-C3-C2	2.21	114.26	111.02
3	C	2	NAG	C1-C2-N2	-2.21	106.71	110.49
2	F	2	NAG	O5-C5-C6	2.21	110.67	107.20
2	F	2	NAG	O5-C5-C4	-2.16	105.58	110.83
2	F	2	NAG	C1-O5-C5	2.13	115.08	112.19
5	E	3	BMA	C3-C4-C5	-2.11	106.48	110.24
4	D	2	NAG	C4-C3-C2	2.10	114.09	111.02
3	C	3	BMA	C1-O5-C5	-2.09	109.36	112.19
4	D	1	NAG	O6-C6-C5	-2.08	104.14	111.29
5	E	3	BMA	O5-C5-C4	-2.05	105.83	110.83
4	D	1	NAG	O5-C1-C2	-2.04	108.07	111.29
2	B	2	NAG	O5-C1-C2	-2.01	108.12	111.29

There are no chirality outliers.

All (10) torsion outliers are listed below:

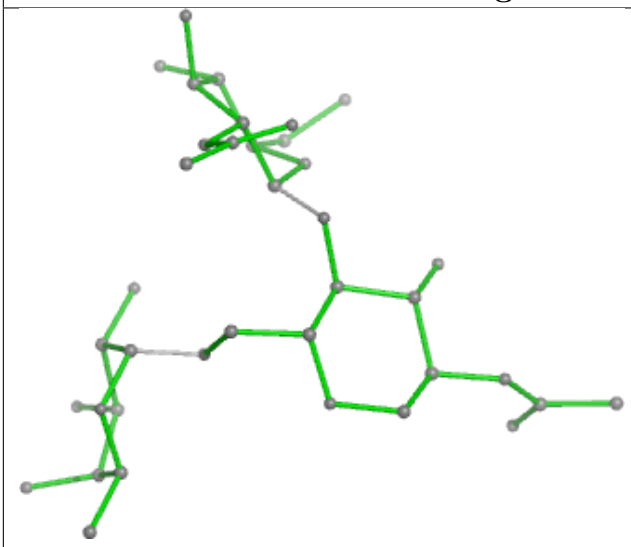
Mol	Chain	Res	Type	Atoms
5	E	4	MAN	O5-C5-C6-O6
5	E	3	BMA	O5-C5-C6-O6
5	E	3	BMA	C4-C5-C6-O6
5	E	4	MAN	C4-C5-C6-O6
4	D	2	NAG	C4-C5-C6-O6
4	D	2	NAG	O5-C5-C6-O6
3	C	2	NAG	O5-C5-C6-O6
3	C	2	NAG	C4-C5-C6-O6
2	F	2	NAG	O5-C5-C6-O6
2	F	2	NAG	C4-C5-C6-O6

There are no ring outliers.

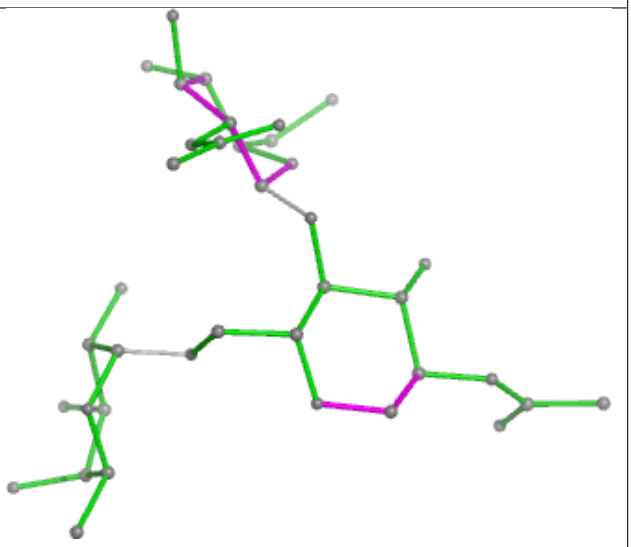
No monomer is involved in short contacts.

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

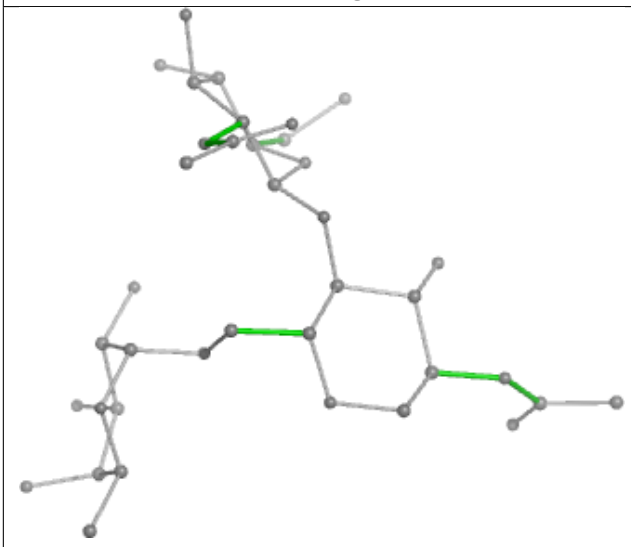
Oligosaccharide Chain B



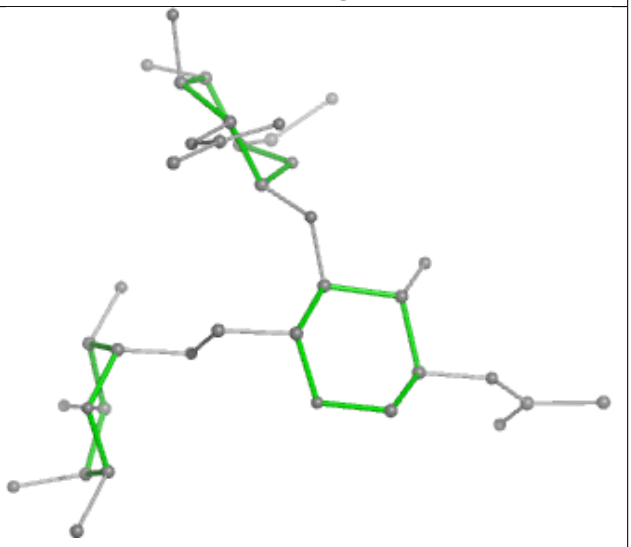
Bond lengths



Bond angles

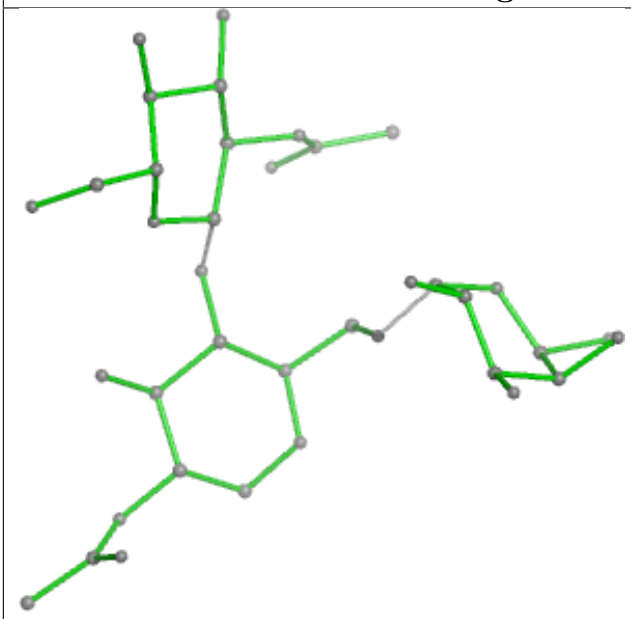


Torsions

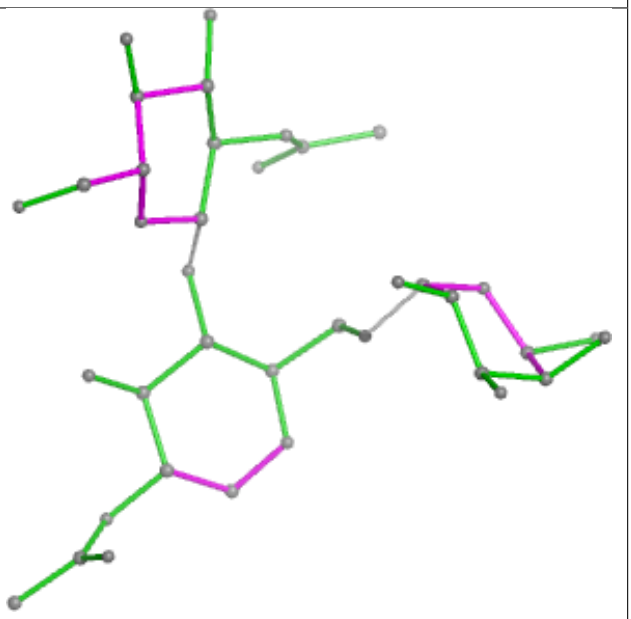


Rings

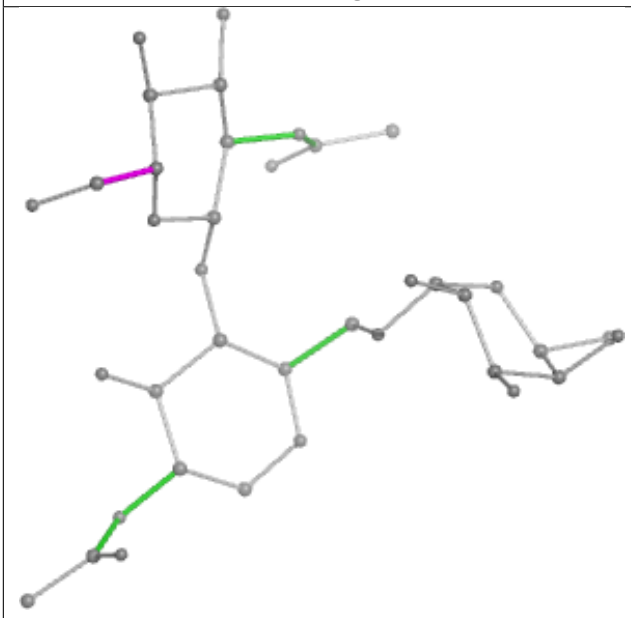
Oligosaccharide Chain F



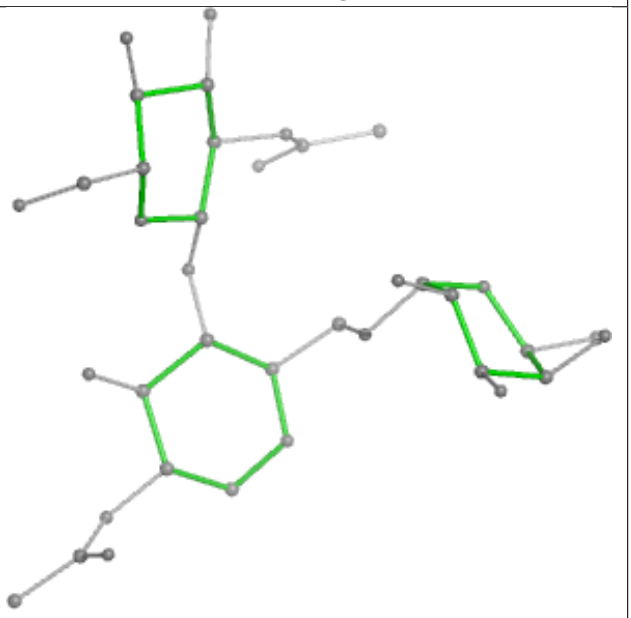
Bond lengths



Bond angles

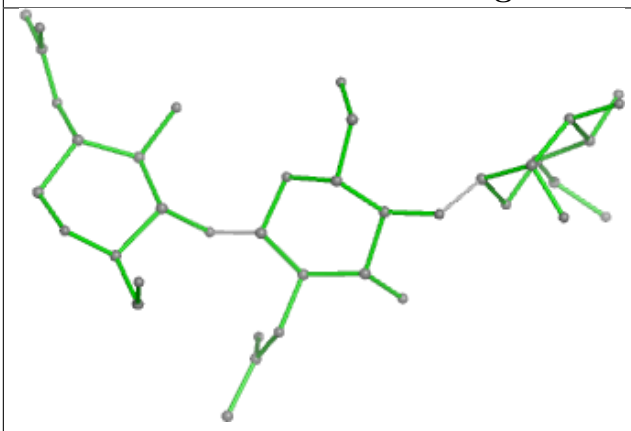


Torsions

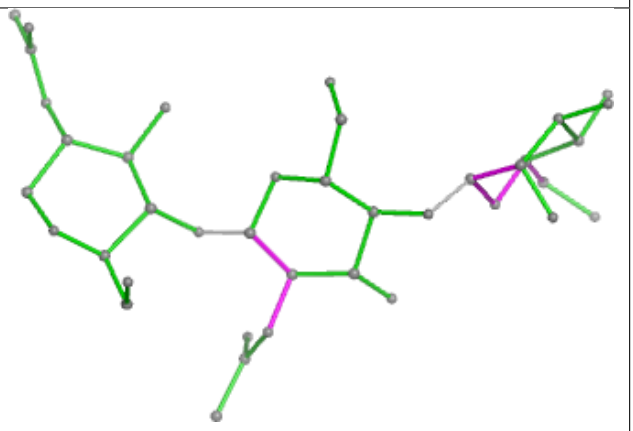


Rings

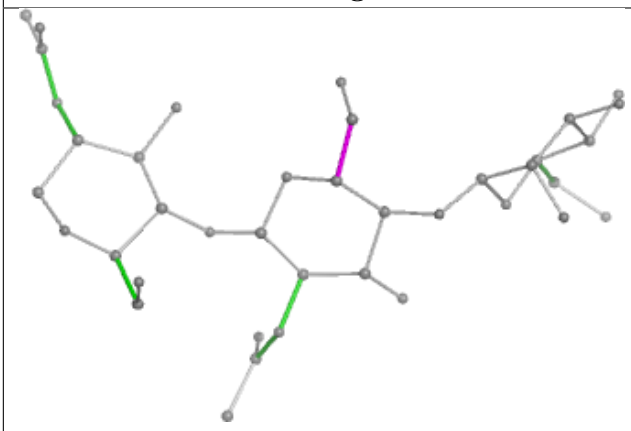
Oligosaccharide Chain C



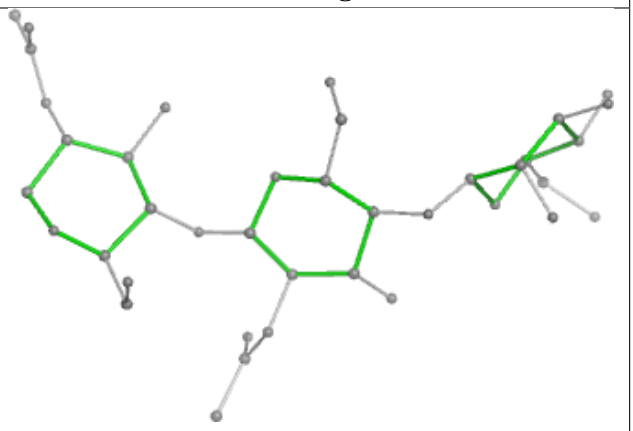
Bond lengths



Bond angles

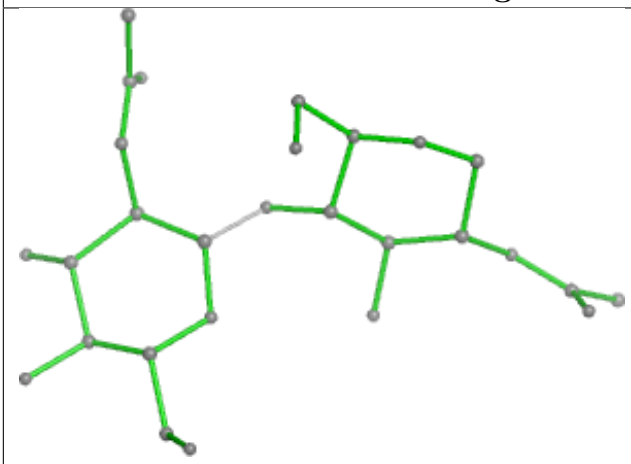


Torsions

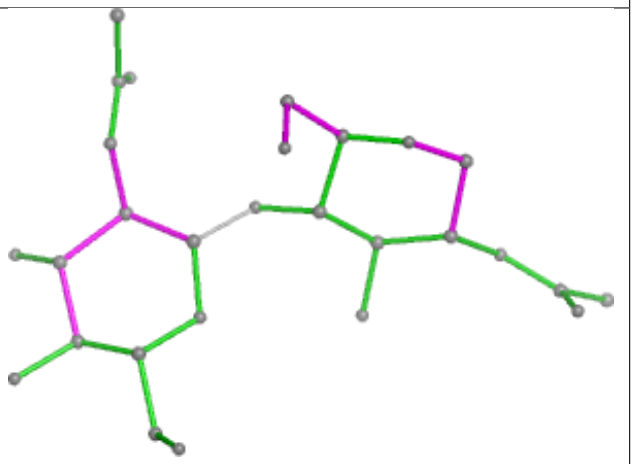


Rings

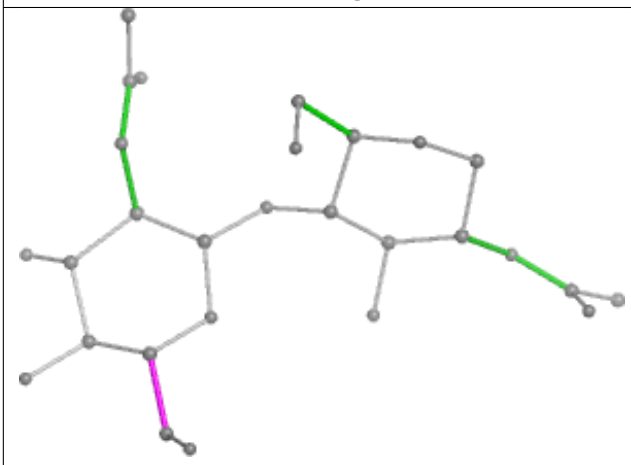
Oligosaccharide Chain D



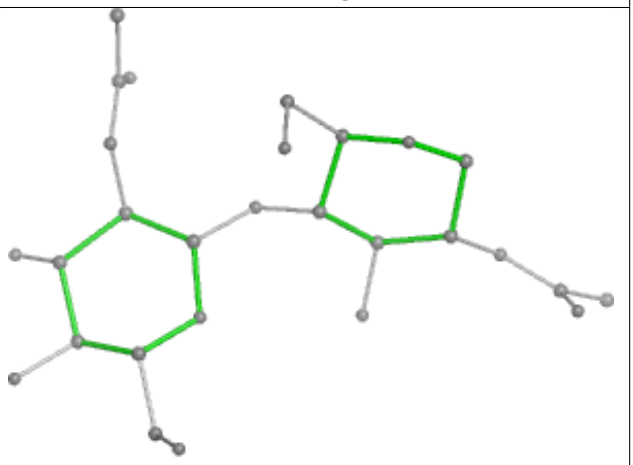
Bond lengths



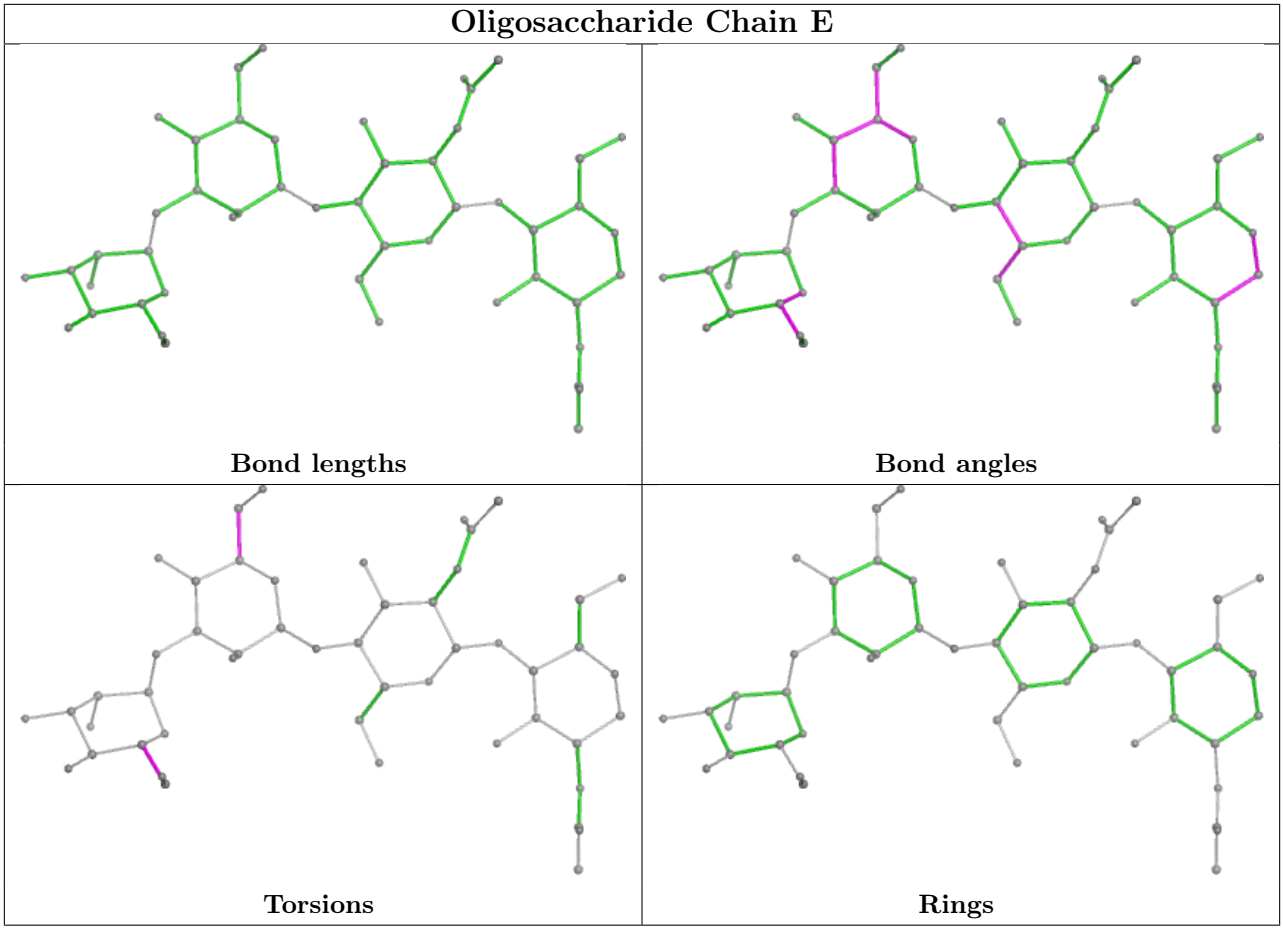
Bond angles



Torsions



Rings



5.6 Ligand geometry (i)

Of 25 ligands modelled in this entry, 3 are monoatomic - leaving 22 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	$\#\|Z\| > 2$
12	EDO	A	1023	-	3,3,3	0.06	0	2,2,2	0.16	0
9	PEG	A	1011	-	6,6,6	0.23	0	5,5,5	0.24	0
7	SO4	A	1004	-	4,4,4	0.36	0	6,6,6	0.11	0
12	EDO	A	1025	-	3,3,3	0.11	0	2,2,2	0.31	0
6	A1IO5	A	1001	-	13,17,17	1.11	1 (7%)	20,26,26	1.18	3 (15%)
12	EDO	A	1022	-	3,3,3	0.09	0	2,2,2	0.16	0
7	SO4	A	1005	-	4,4,4	0.37	0	6,6,6	0.12	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
12	EDO	A	1020	-	3,3,3	0.05	0	2,2,2	0.16	0
10	GOL	A	1012	-	5,5,5	0.15	0	5,5,5	0.25	0
7	SO4	A	1006	-	4,4,4	0.36	0	6,6,6	0.14	0
11	PGE	A	1013	-	9,9,9	0.27	0	8,8,8	0.17	0
12	EDO	A	1017	-	3,3,3	0.16	0	2,2,2	0.23	0
12	EDO	A	1018	-	3,3,3	6.26	1 (33%)	2,2,2	0.26	0
10	GOL	A	1014	-	5,5,5	0.16	0	5,5,5	0.42	0
7	SO4	A	1003	-	4,4,4	0.31	0	6,6,6	0.10	0
12	EDO	A	1019	-	3,3,3	0.28	0	2,2,2	0.53	0
7	SO4	A	1002	-	4,4,4	0.37	0	6,6,6	0.19	0
7	SO4	A	1007	-	4,4,4	0.21	0	6,6,6	0.29	0
12	EDO	A	1016	-	3,3,3	0.17	0	2,2,2	0.30	0
10	GOL	A	1015	-	5,5,5	0.09	0	5,5,5	0.25	0
12	EDO	A	1021	-	3,3,3	0.07	0	2,2,2	0.18	0
12	EDO	A	1024	-	3,3,3	0.09	0	2,2,2	0.18	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
12	EDO	A	1016	-	-	0/1/1/1	-
10	GOL	A	1015	-	-	0/4/4/4	-
12	EDO	A	1025	-	-	0/1/1/1	-
6	A1IO5	A	1001	-	-	0/10/30/30	0/1/1/1
11	PGE	A	1013	-	-	1/7/7/7	-
12	EDO	A	1017	-	-	1/1/1/1	-
12	EDO	A	1023	-	-	1/1/1/1	-
9	PEG	A	1011	-	-	1/4/4/4	-
12	EDO	A	1018	-	-	1/1/1/1	-
12	EDO	A	1021	-	-	0/1/1/1	-
10	GOL	A	1014	-	-	3/4/4/4	-
12	EDO	A	1022	-	-	0/1/1/1	-
12	EDO	A	1024	-	-	0/1/1/1	-
12	EDO	A	1019	-	-	1/1/1/1	-
12	EDO	A	1020	-	-	1/1/1/1	-
10	GOL	A	1012	-	-	1/4/4/4	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
12	A	1018	EDO	O2-C2	10.84	1.98	1.42
6	A	1001	A1IO5	C3-C4	-2.09	1.49	1.53

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
6	A	1001	A1IO5	C6-C5-N5	-2.20	105.87	110.75
6	A	1001	A1IO5	C2-C3-C4	-2.14	108.08	110.48
6	A	1001	A1IO5	C12-SI14-C8	2.02	115.07	109.06

There are no chirality outliers.

All (11) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
10	A	1014	GOL	C1-C2-C3-O3
10	A	1014	GOL	O2-C2-C3-O3
12	A	1019	EDO	O1-C1-C2-O2
9	A	1011	PEG	O1-C1-C2-O2
12	A	1018	EDO	O1-C1-C2-O2
10	A	1012	GOL	O1-C1-C2-O2
10	A	1014	GOL	O1-C1-C2-C3
12	A	1023	EDO	O1-C1-C2-O2
12	A	1017	EDO	O1-C1-C2-O2
12	A	1020	EDO	O1-C1-C2-O2
11	A	1013	PGE	C1-C2-O2-C3

There are no ring outliers.

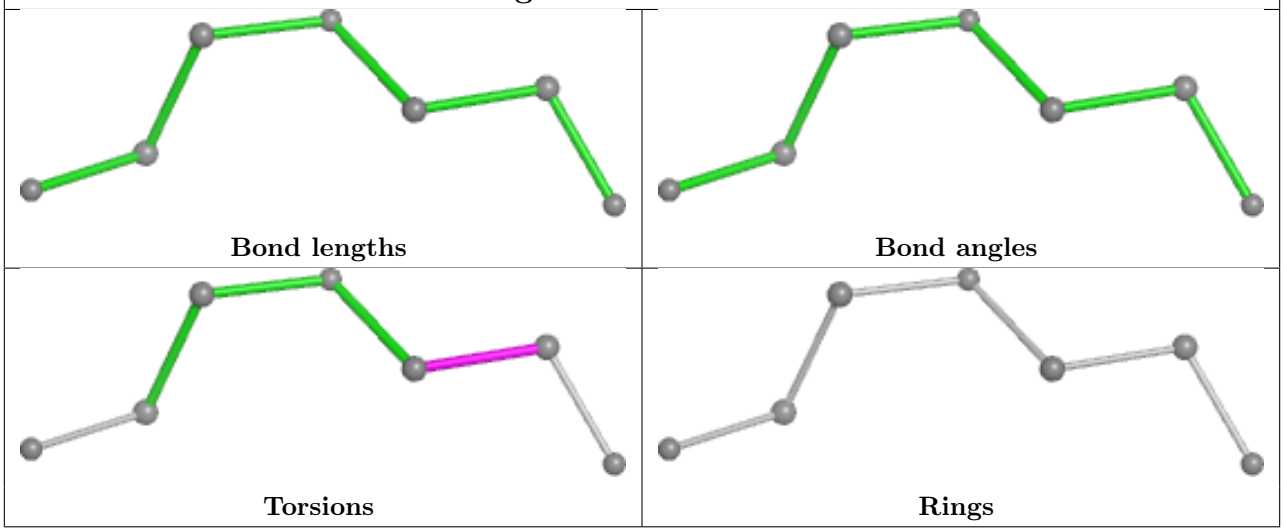
1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
12	A	1018	EDO	1	0

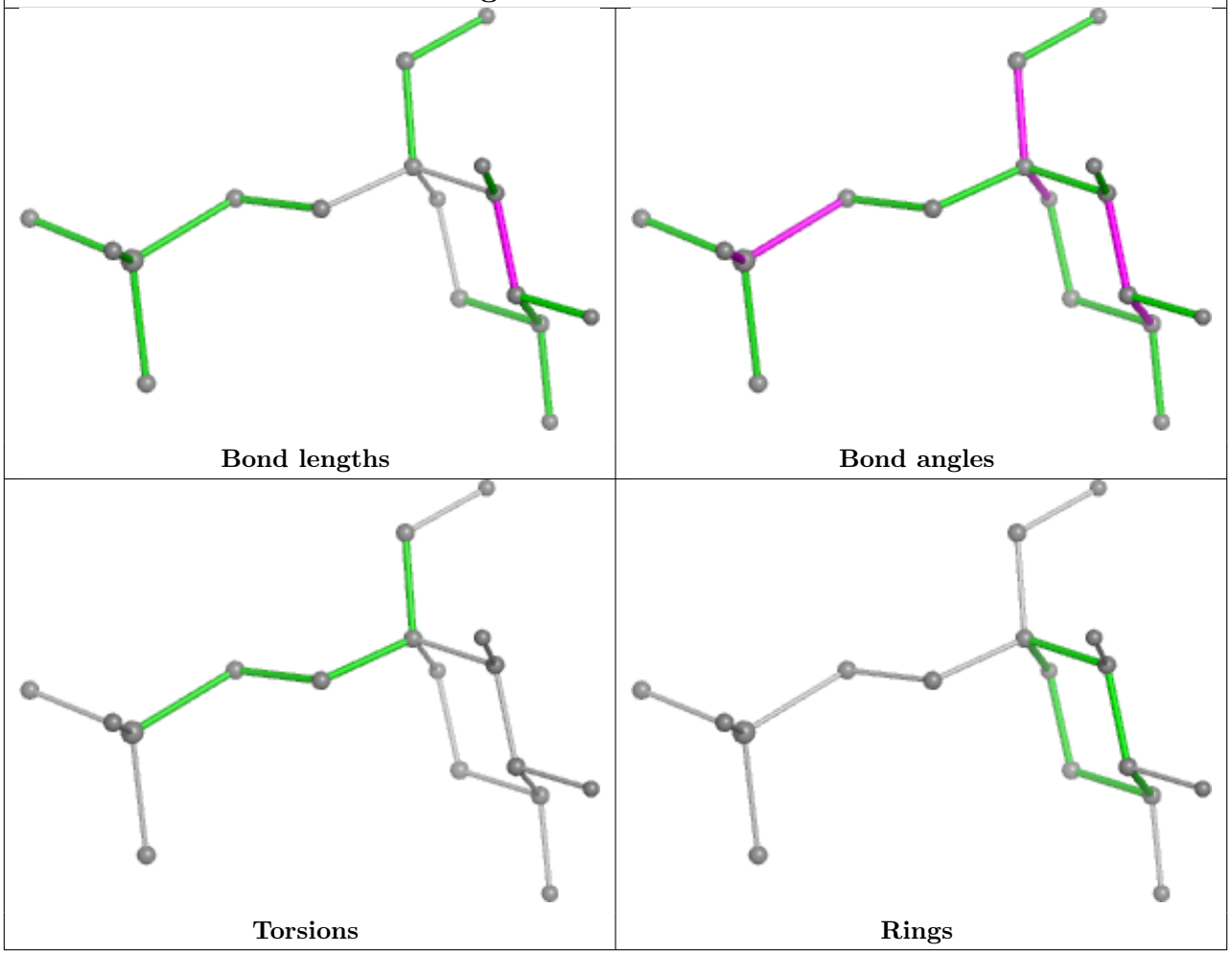
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less 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 PEG A 1011



Ligand A1IO5 A 1001



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	846/952 (88%)	0.32	38 (4%) 39 45	22, 37, 54, 94	8 (0%)

All (38) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	146	MET	5.5
1	A	205	PRO	4.7
1	A	195	LEU	4.6
1	A	197	THR	4.4
1	A	204	ALA	4.3
1	A	897	ALA	4.3
1	A	527[A]	ARG	4.2
1	A	911	THR	4.0
1	A	780	ILE	4.0
1	A	781	GLU	3.8
1	A	144	SER	3.6
1	A	924	SER	3.5
1	A	81	GLN	3.2
1	A	923	VAL	3.1
1	A	931	ASP	3.0
1	A	940	SER	3.0
1	A	83	ASP	2.7
1	A	145	GLU	2.7
1	A	535	ASN	2.6
1	A	912	ALA	2.6
1	A	952	CYS	2.6
1	A	910	ALA	2.6
1	A	678	LEU	2.5
1	A	189	ARG	2.5
1	A	147	GLY	2.5
1	A	196	GLU	2.5
1	A	422	ARG	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	115	GLN	2.4
1	A	896	GLY	2.4
1	A	98	ILE	2.3
1	A	795	GLU	2.3
1	A	155	THR	2.3
1	A	925	ASN	2.2
1	A	794	ARG	2.2
1	A	902	GLN	2.2
1	A	930	PRO	2.2
1	A	143	SER	2.1
1	A	892	VAL	2.0

6.2 Non-standard residues in protein, DNA, RNA chains (i)

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
1	CSO	A	938	7/8	0.97	0.07	41,42,48,53	0

6.3 Carbohydrates (i)

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	BMA	C	3	11/12	0.30	0.19	95,101,110,110	0
5	MAN	E	4	11/12	0.36	0.18	86,109,126,134	0
2	NAG	F	2	14/15	0.42	0.21	95,116,145,151	0
5	BMA	E	3	11/12	0.65	0.16	79,91,96,103	0
2	FUC	F	3	10/11	0.66	0.23	80,96,105,111	0
2	NAG	B	2	14/15	0.69	0.19	61,75,85,88	0
4	NAG	D	2	14/15	0.69	0.17	75,82,102,103	0
2	FUC	B	3	10/11	0.74	0.17	69,75,88,89	0
3	NAG	C	2	14/15	0.77	0.18	57,68,79,87	0
2	NAG	F	1	14/15	0.82	0.16	59,76,80,99	0
4	NAG	D	1	14/15	0.92	0.10	38,46,57,65	0

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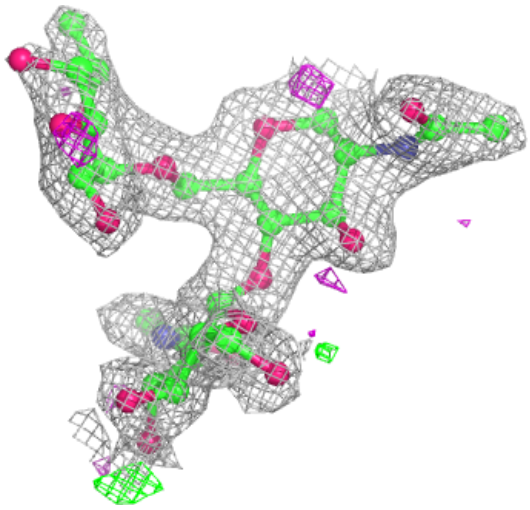
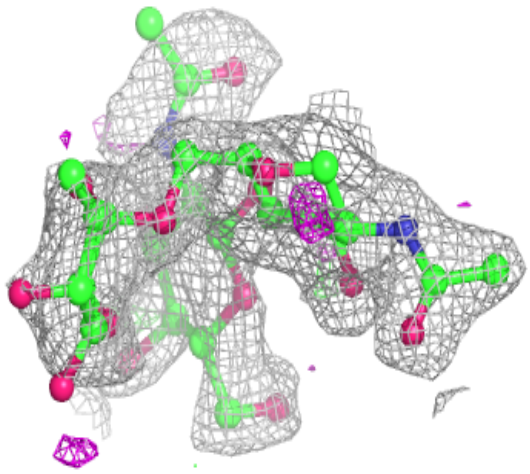
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	NAG	B	1	14/15	0.93	0.10	42,48,57,59	0
5	NAG	E	2	14/15	0.93	0.10	37,48,56,70	0
3	NAG	C	1	14/15	0.95	0.09	36,42,47,53	0
5	NAG	E	1	14/15	0.97	0.07	34,40,45,47	0

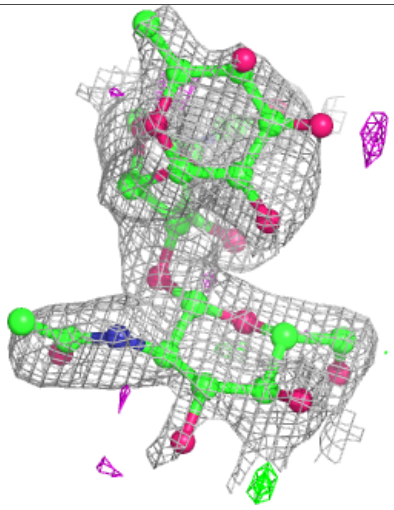
The following is a graphical depiction of the model fit to experimental electron density for oligosaccharide. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around Chain B:

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

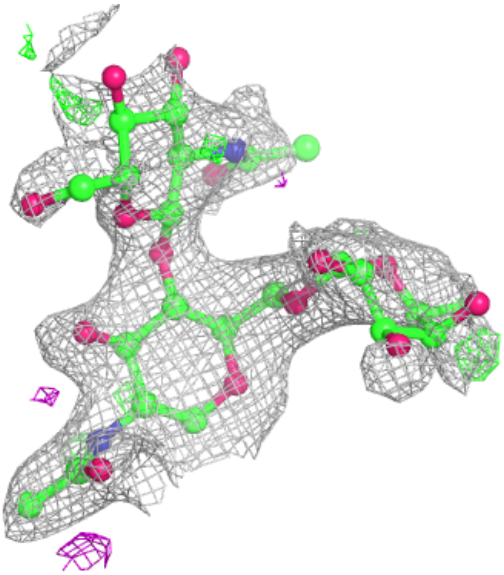


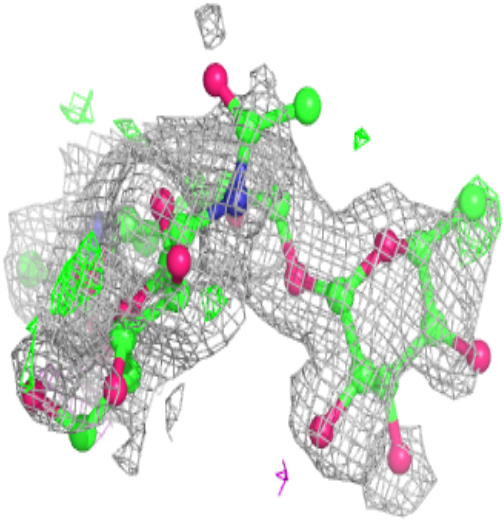


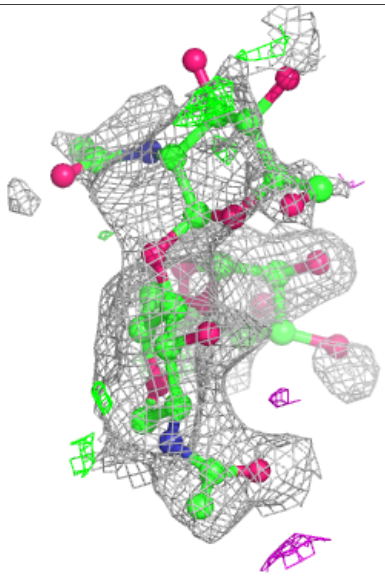


Electron density around Chain F:

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

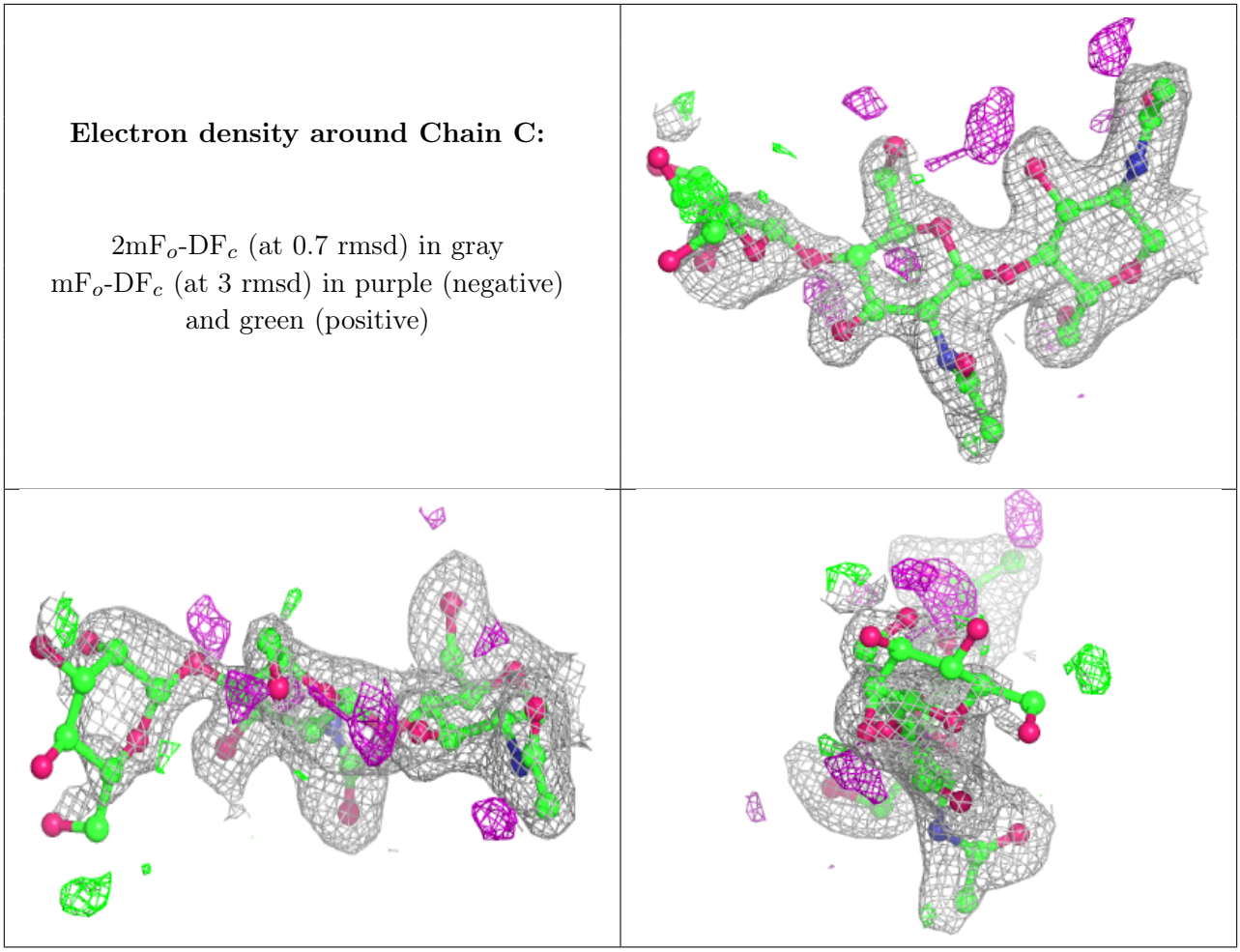






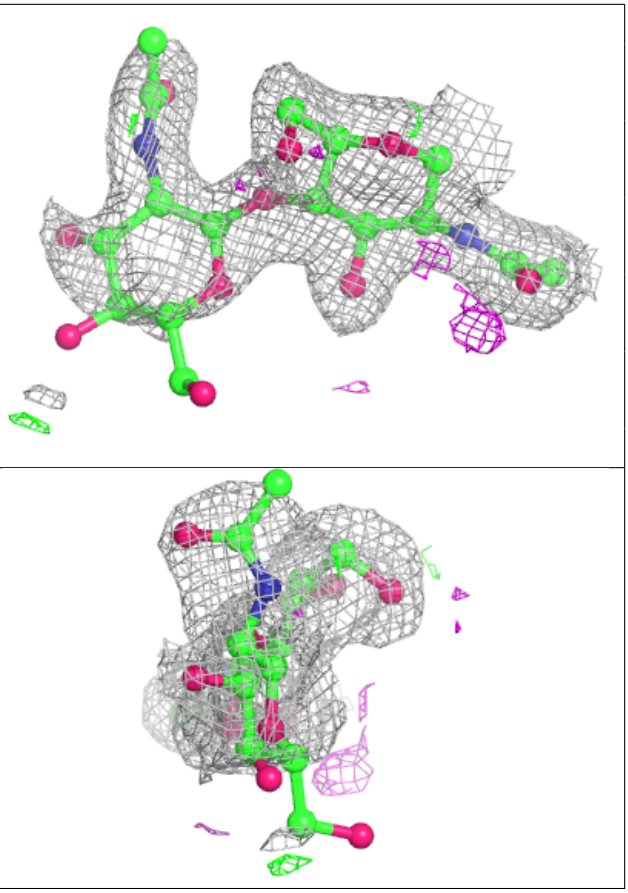
Electron density around Chain C:

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



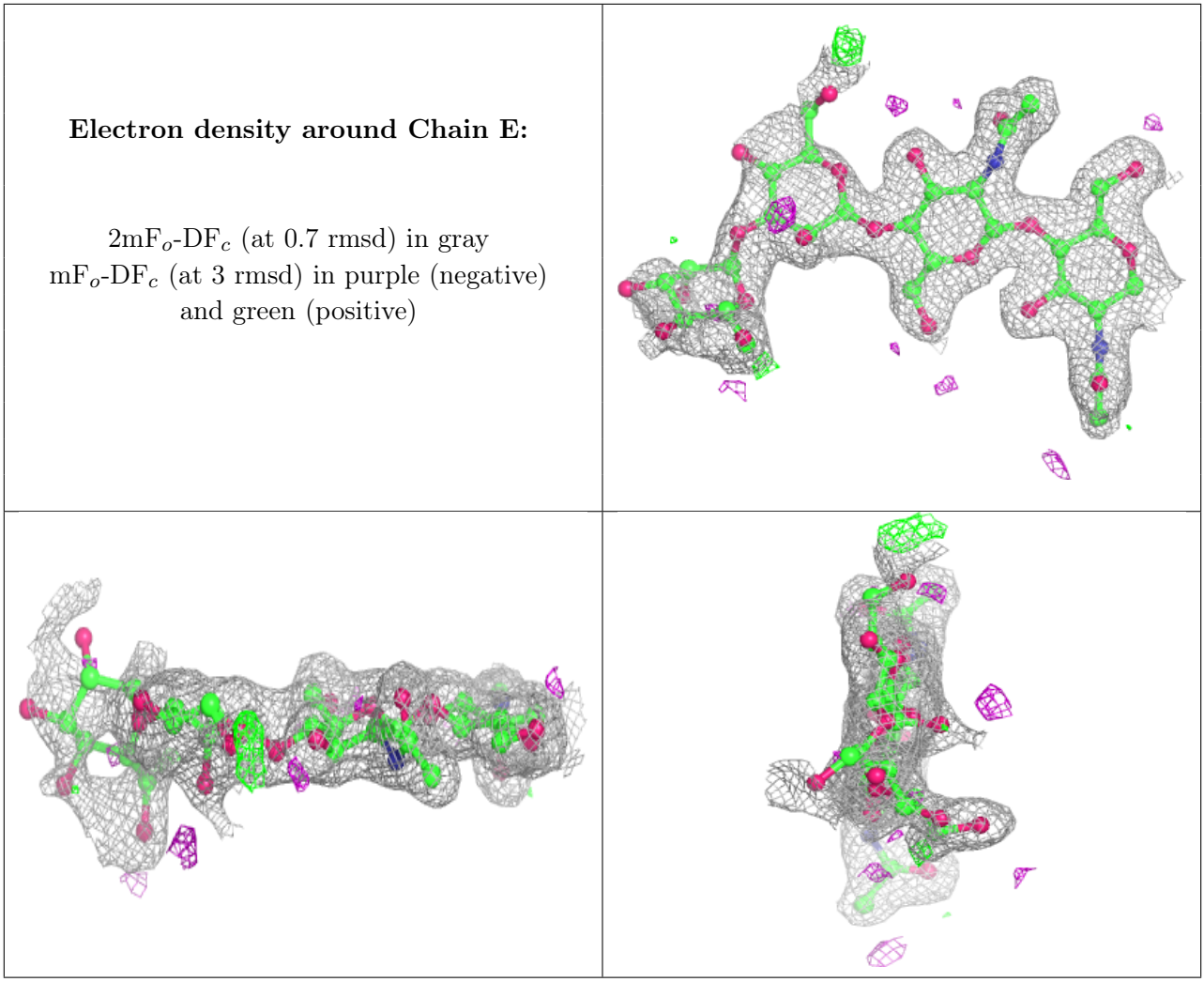
Electron density around Chain D:

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



Electron density around Chain E:

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



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
9	PEG	A	1011	7/7	0.74	0.28	72,82,92,92	0
12	EDO	A	1022	4/4	0.75	0.21	79,82,83,87	0
7	SO4	A	1003	5/5	0.76	0.14	76,77,90,91	0
12	EDO	A	1020	4/4	0.76	0.25	76,78,79,83	0
7	SO4	A	1005	5/5	0.76	0.15	73,85,99,107	0
12	EDO	A	1018	4/4	0.77	0.28	59,62,65,69	0
12	EDO	A	1016	4/4	0.78	0.27	64,68,72,76	0
12	EDO	A	1017	4/4	0.79	0.22	78,78,79,80	0
12	EDO	A	1019	4/4	0.79	0.24	53,59,62,65	0

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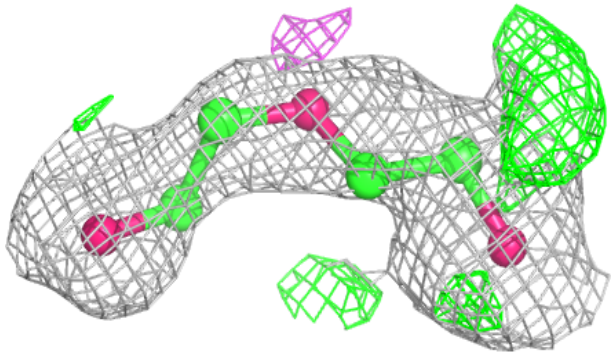
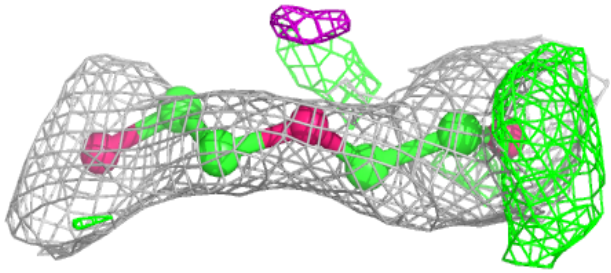
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
12	EDO	A	1021	4/4	0.80	0.24	75,76,77,77	0
7	SO4	A	1004	5/5	0.81	0.17	75,88,97,99	0
11	PGE	A	1013	10/10	0.84	0.22	64,68,75,77	0
7	SO4	A	1006	5/5	0.85	0.12	66,70,75,77	0
12	EDO	A	1023	4/4	0.85	0.19	61,67,70,71	0
8	CL	A	1010	1/1	0.86	0.21	91,91,91,91	0
12	EDO	A	1024	4/4	0.87	0.18	61,64,65,76	0
12	EDO	A	1025	4/4	0.89	0.19	65,68,73,77	0
10	GOL	A	1014	6/6	0.91	0.16	43,52,57,58	0
8	CL	A	1008	1/1	0.92	0.13	72,72,72,72	0
10	GOL	A	1012	6/6	0.92	0.14	44,52,53,58	0
8	CL	A	1009	1/1	0.93	0.18	73,73,73,73	0
10	GOL	A	1015	6/6	0.95	0.10	42,45,48,51	0
7	SO4	A	1007	5/5	0.95	0.14	41,46,51,52	0
7	SO4	A	1002	5/5	0.96	0.08	51,53,57,58	0
6	A1IO5	A	1001	17/17	0.98	0.07	29,32,36,37	0

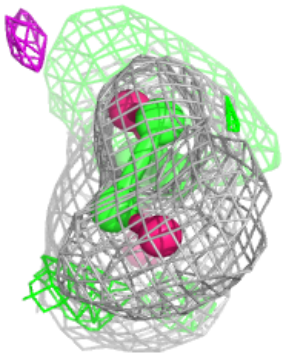
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around PEG A 1011:

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

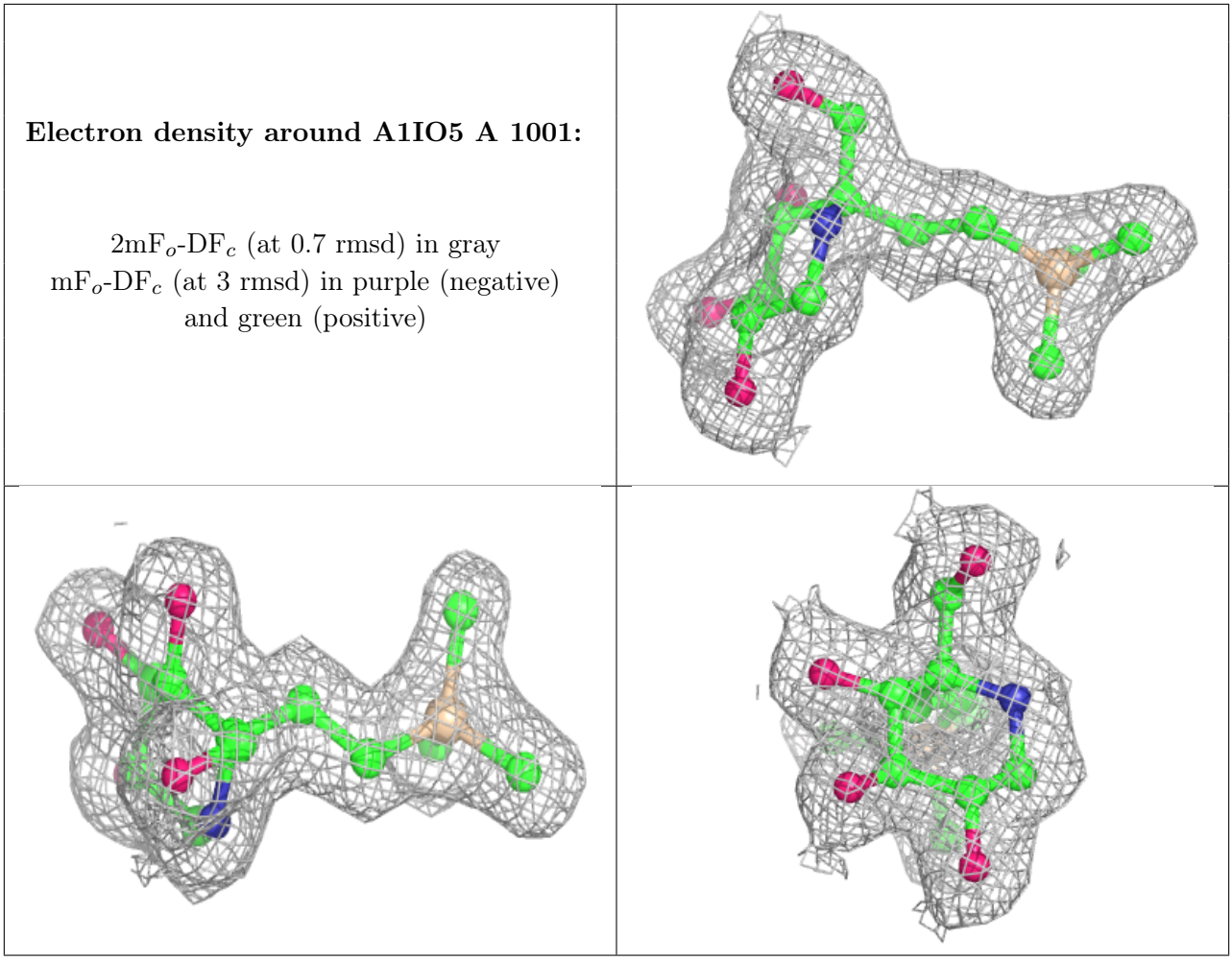






Electron density around A1IO5 A 1001:

$2mF_o$-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.