



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 7, 2020 – 02:19 PM BST

PDB ID : 5NN4
Title : Crystal structure of human lysosomal acid-alpha-glucosidase, GAA, in complex with N-acetyl-cysteine
Authors : Roig-Zamboni, V.; Cobucci-Ponzano, B.; Iacono, R.; Ferrara, M.C.; Germany, S.; Parenti, G.; Bourne, Y.; Moracci, M.
Deposited on : 2017-04-08
Resolution : 1.83 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 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 : 2.13.1
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) : 2.13.1

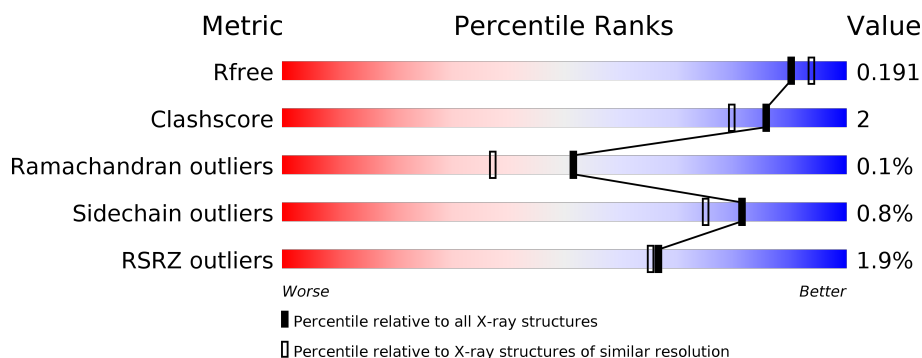
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.83 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	4003 (1.86-1.82)
Clashscore	141614	4233 (1.86-1.82)
Ramachandran outliers	138981	4185 (1.86-1.82)
Sidechain outliers	138945	4186 (1.86-1.82)
RSRZ outliers	127900	3957 (1.86-1.82)

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 on 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 $\leq 5\%$. 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	872	<div> <div>2%</div> <div> <div></div> <div>93%</div> <div></div> </div> </div>
2	B	3	<div> <div>67%</div> <div>33%</div> </div>
2	F	3	<div> <div>100%</div> </div>
3	C	3	<div> <div>33%</div> <div>67%</div> </div>
4	D	2	<div> <div>100%</div> </div>
5	E	4	<div> <div>50%</div> <div>50%</div> </div>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
10	GOL	A	1026	-	-	X	-
11	EDO	A	1042	-	-	-	X
2	NAG	F	2	-	-	-	X
2	FUC	F	3	-	-	-	X

2 Entry composition [i](#)

There are 12 unique types of molecules in this entry. The entry contains 7880 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.

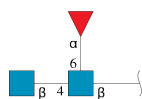
- Molecule 1 is a protein called Lysosomal alpha-glucosidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	847	Total	C	N	O	S	0	17	0
			6775	4346	1141	1256	32			

There are 3 discrepancies between the modelled and reference sequences:

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



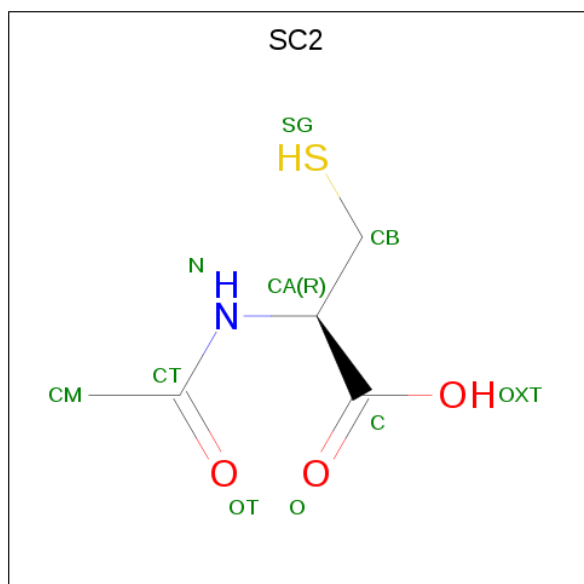
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
4	D	2	Total	C	N	O	0	0	0
			28	16	2	10			

- 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 N-ACETYL-L-CYSTEINE (three-letter code: SC2) (formula: C₅H₉NO₃S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
6	A	1	Total	C	N	O	S	0	0
			10	5	1	3	1		
6	A	1	Total	C	N	O	S	0	0
			10	5	1	3	1		

- Molecule 7 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



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		
7	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 8 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	2	Total	Cl	0	0
			2	2		

- Molecule 9 is TRIETHYLENE GLYCOL (three-letter code: PGE) (formula: C₆H₁₄O₄).



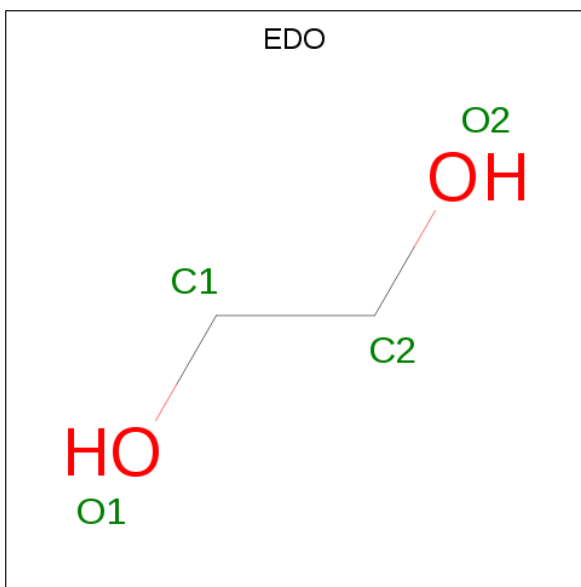
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	A	1	Total	C	O	0	0
			10	6	4		

- Molecule 10 is GLYCEROL (three-letter code: 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		

- Molecule 11 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



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

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

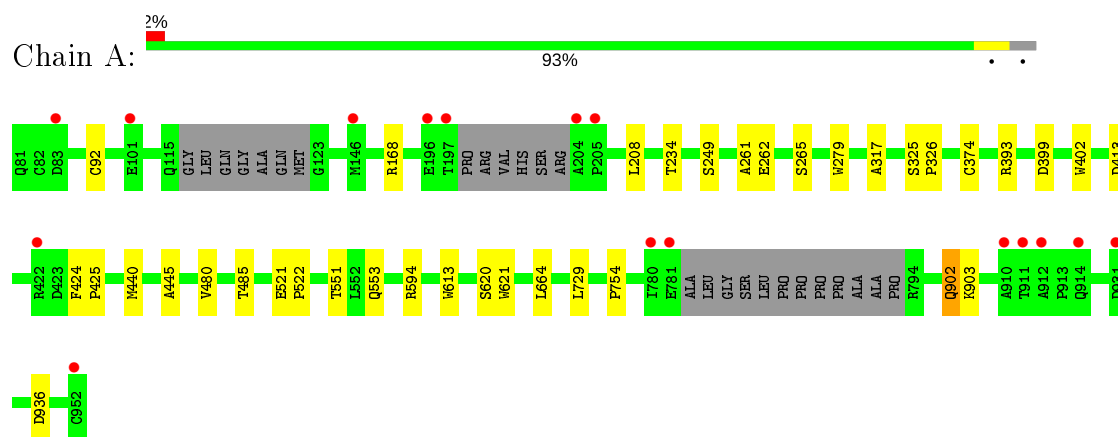
- Molecule 12 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
12	A	776	Total	O	0	0
			776	776		

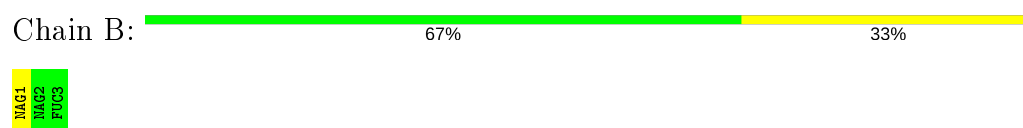
3 Residue-property plots [i](#)

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.

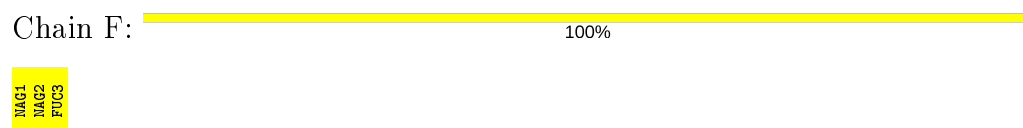
- Molecule 1: Lysosomal alpha-glucosidase



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



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



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



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

Chain D:  100%

GLU1
GLU2

- 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:  50% 50%

GLU1
GLU2
MAN3
MAN4

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	97.44Å 102.30Å 129.07Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.66 – 1.83 47.62 – 1.83	Depositor EDS
% Data completeness (in resolution range)	99.2 (47.66-1.83) 99.3 (47.62-1.83)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.55 (at 1.83Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.154 , 0.178 0.166 , 0.191	Depositor DCC
R_{free} test set	5639 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å ²)	22.5	Xtriage
Anisotropy	0.159	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 44.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.019 for k,h,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7880	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.44% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, PGE, NAG, CL, EDO, BMA, SO4, MAN, SC2, FUC

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	0.42	0/7019	0.64	2/9585 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	594	ARG	NE-CZ-NH2	-5.53	117.53	120.30
1	A	413	ASP	CB-CG-OD2	-5.01	113.79	118.30

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

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	6775	0	6574	28	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	20	0	16	1	0
7	A	20	0	0	0	0
8	A	2	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
9	A	10	0	14	0	0
10	A	12	0	16	6	0
11	A	72	0	108	1	0
12	A	776	0	0	13	0
All	All	7880	0	6898	31	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 (31) 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:902[B]:GLN:CG	12:A:1115:HOH:O	1.84	1.24
1:A:168[B]:ARG:HD3	12:A:1104:HOH:O	0.96	1.11
1:A:393[A]:ARG:NH1	12:A:1108:HOH:O	1.86	1.08
1:A:393[B]:ARG:NH1	12:A:1107:HOH:O	1.78	1.02
1:A:393[B]:ARG:NH2	12:A:1109:HOH:O	1.99	0.94
1:A:902[B]:GLN:HG3	12:A:1115:HOH:O	1.57	0.91
1:A:902[B]:GLN:HG2	12:A:1115:HOH:O	1.59	0.79
1:A:551:THR:OG1	1:A:553:GLN:OE1	2.00	0.79
8:A:1023:CL:CL	12:A:1793:HOH:O	2.49	0.67
1:A:168[A]:ARG:NH2	12:A:1111:HOH:O	2.26	0.64
1:A:168[B]:ARG:CD	12:A:1104:HOH:O	1.80	0.62
1:A:902[B]:GLN:NE2	12:A:1115:HOH:O	2.36	0.57
1:A:621:TRP:HD1	10:A:1026:GOL:H32	1.71	0.55
1:A:664:LEU:HD13	1:A:754:PRO:HG3	1.88	0.55
6:A:1017:SC2:HA	12:A:1769:HOH:O	2.10	0.51
1:A:521:GLU:N	1:A:522:PRO:HA	2.25	0.51
1:A:620:SER:HB2	10:A:1026:GOL:H31	1.93	0.50
1:A:621:TRP:CD1	10:A:1026:GOL:H32	2.49	0.47
1:A:621:TRP:H	10:A:1026:GOL:C3	2.30	0.45
10:A:1026:GOL:C1	12:A:1628:HOH:O	2.66	0.44
1:A:445:ALA:HB1	1:A:485:THR:HB	2.01	0.43
1:A:621:TRP:H	10:A:1026:GOL:H32	1.84	0.43
1:A:261:ALA:HB1	1:A:262:GLU:HA	2.01	0.43
1:A:279:TRP:CE3	1:A:317:ALA:HB2	2.54	0.43
1:A:325:SER:N	1:A:326:PRO:HA	2.34	0.42
1:A:234:THR:HA	1:A:249:SER:O	2.18	0.42
1:A:374:CYS:HB2	1:A:402:TRP:HB2	2.01	0.42
1:A:92:CYS:O	1:A:92:CYS:SG	2.79	0.41
1:A:208:LEU:CD2	11:A:1032:EDO:H21	2.51	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:903:LYS:HD2	1:A:936:ASP:OD1	2.20	0.40
1:A:424:PHE:HB3	1:A:425:PRO:HD3	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	856/872 (98%)	838 (98%)	17 (2%)	1 (0%)	51 37

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	741/742 (100%)	734 (99%)	7 (1%)	78 71

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

Mol	Chain	Res	Type
1	A	265	SER

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Mol	Chain	Res	Type
1	A	399	ASP
1	A	440	MET
1	A	613	TRP
1	A	729	LEU
1	A	902[A]	GLN
1	A	902[B]	GLN

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

Mol	Chain	Res	Type
1	A	900	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

13 non-standard protein/DNA/RNA residues 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	$\# Z > 2$
5	NAG	E	1	1,5	14,14,15	0.78	1 (7%)	17,19,21	1.09	2 (11%)
2	NAG	F	1	1,2	14,14,15	0.67	0	17,19,21	1.01	1 (5%)
3	NAG	C	1	1,3	14,14,15	0.63	0	17,19,21	0.97	1 (5%)
4	NAG	D	1	1,4	14,14,15	0.55	0	17,19,21	0.81	0
2	NAG	B	1	1,2	14,14,15	0.44	0	17,19,21	0.92	1 (5%)
4	NAG	D	2	4	14,14,15	0.62	0	17,19,21	0.94	0
2	NAG	F	2	2	14,14,15	0.49	0	17,19,21	0.80	1 (5%)
2	FUC	F	3	2	10,10,11	0.52	0	14,14,16	1.04	2 (14%)
2	NAG	B	2	2	14,14,15	0.46	0	17,19,21	0.79	0
5	MAN	E	4	5	11,11,12	0.56	0	15,15,17	0.71	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	NAG	C	2	3	14,14,15	0.51	0	17,19,21	0.64	0
5	NAG	E	2	5	14,14,15	0.46	0	17,19,21	0.74	0
2	FUC	B	3	2	10,10,11	0.58	0	14,14,16	0.67	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
5	NAG	E	1	1,5	-	0/6/23/26	0/1/1/1
2	NAG	F	1	1,2	-	1/6/23/26	0/1/1/1
3	NAG	C	1	1,3	-	0/6/23/26	0/1/1/1
2	FUC	F	3	2	-	-	0/1/1/1
2	NAG	B	1	1,2	-	0/6/23/26	0/1/1/1
4	NAG	D	2	4	-	2/6/23/26	0/1/1/1
2	NAG	F	2	2	-	0/6/23/26	0/1/1/1
4	NAG	D	1	1,4	-	0/6/23/26	0/1/1/1
2	NAG	B	2	2	-	2/6/23/26	0/1/1/1
5	MAN	E	4	5	-	2/2/19/22	0/1/1/1
3	NAG	C	2	3	-	0/6/23/26	0/1/1/1
5	NAG	E	2	5	-	0/6/23/26	0/1/1/1
2	FUC	B	3	2	-	-	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	E	1	NAG	O5-C1	-2.38	1.39	1.43

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	E	1	NAG	O5-C1-C2	-2.54	107.28	111.29
2	F	1	NAG	C1-C2-N2	2.21	114.26	110.49
2	B	1	NAG	O5-C1-C2	-2.18	107.84	111.29
2	F	3	FUC	C1-O5-C5	2.15	117.65	112.78
2	F	3	FUC	O5-C5-C4	2.10	113.29	109.52
3	C	1	NAG	C1-O5-C5	-2.08	109.38	112.19
5	E	1	NAG	O4-C4-C3	2.06	115.11	110.35
2	F	2	NAG	O5-C5-C6	2.05	110.42	107.20

There are no chirality outliers.

All (7) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	E	4	MAN	O5-C5-C6-O6
4	D	2	NAG	C4-C5-C6-O6
4	D	2	NAG	O5-C5-C6-O6
5	E	4	MAN	C4-C5-C6-O6
2	B	2	NAG	C4-C5-C6-O6
2	B	2	NAG	O5-C5-C6-O6
2	F	1	NAG	C4-C5-C6-O6

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates ⓘ

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	0.44	0	17,19,21	0.92	1 (5%)
2	NAG	B	2	2	14,14,15	0.46	0	17,19,21	0.79	0
2	FUC	B	3	2	10,10,11	0.58	0	14,14,16	0.67	0
3	NAG	C	1	1,3	14,14,15	0.63	0	17,19,21	0.97	1 (5%)
3	NAG	C	2	3	14,14,15	0.51	0	17,19,21	0.64	0
3	BMA	C	3	3	11,11,12	0.37	0	15,15,17	0.96	1 (6%)
4	NAG	D	1	1,4	14,14,15	0.55	0	17,19,21	0.81	0
4	NAG	D	2	4	14,14,15	0.62	0	17,19,21	0.94	0
5	NAG	E	1	1,5	14,14,15	0.78	1 (7%)	17,19,21	1.09	2 (11%)
5	NAG	E	2	5	14,14,15	0.46	0	17,19,21	0.74	0
5	BMA	E	3	5	11,11,12	0.36	0	15,15,17	0.98	1 (6%)
5	MAN	E	4	5	11,11,12	0.56	0	15,15,17	0.71	0
2	NAG	F	1	1,2	14,14,15	0.67	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
2	NAG	F	2	2	14,14,15	0.49	0	17,19,21	0.80	1 (5%)
2	FUC	F	3	2	10,10,11	0.52	0	14,14,16	1.04	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	-	2/6/23/26	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	-	0/6/23/26	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	-	1/6/23/26	0/1/1/1
2	NAG	F	2	2	-	0/6/23/26	0/1/1/1
2	FUC	F	3	2	-	-	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	E	1	NAG	O5-C1	-2.38	1.39	1.43

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	E	3	BMA	O5-C5-C6	3.02	111.94	107.20
3	C	3	BMA	C1-C2-C3	2.55	112.80	109.67
5	E	1	NAG	O5-C1-C2	-2.54	107.28	111.29
2	F	1	NAG	C1-C2-N2	2.21	114.26	110.49
2	B	1	NAG	O5-C1-C2	-2.18	107.84	111.29
2	F	3	FUC	C1-O5-C5	2.15	117.65	112.78
2	F	3	FUC	O5-C5-C4	2.10	113.29	109.52
3	C	1	NAG	C1-O5-C5	-2.08	109.38	112.19

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	E	1	NAG	O4-C4-C3	2.06	115.11	110.35
2	F	2	NAG	O5-C5-C6	2.05	110.42	107.20

There are no chirality outliers.

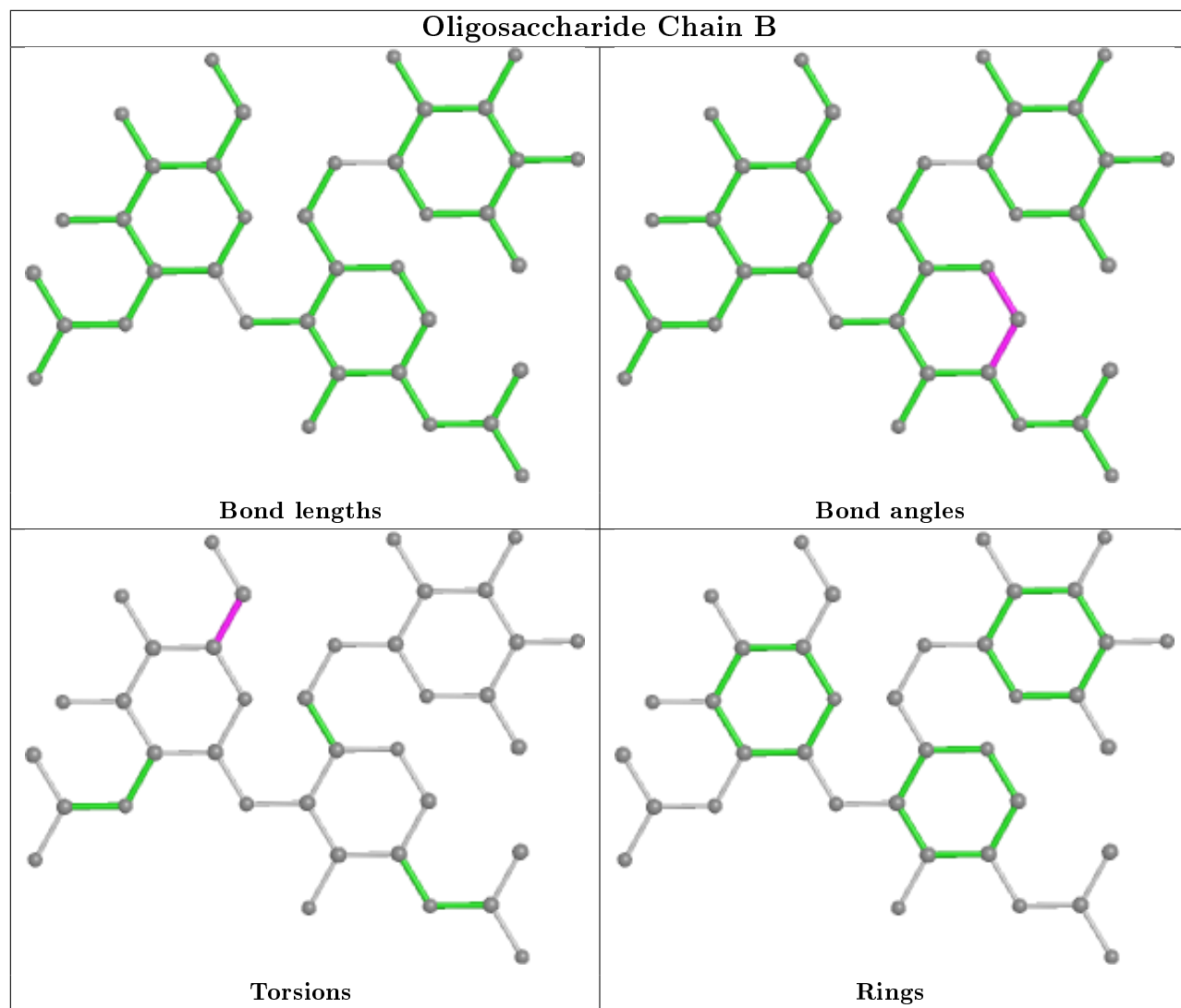
All (9) torsion outliers are listed below:

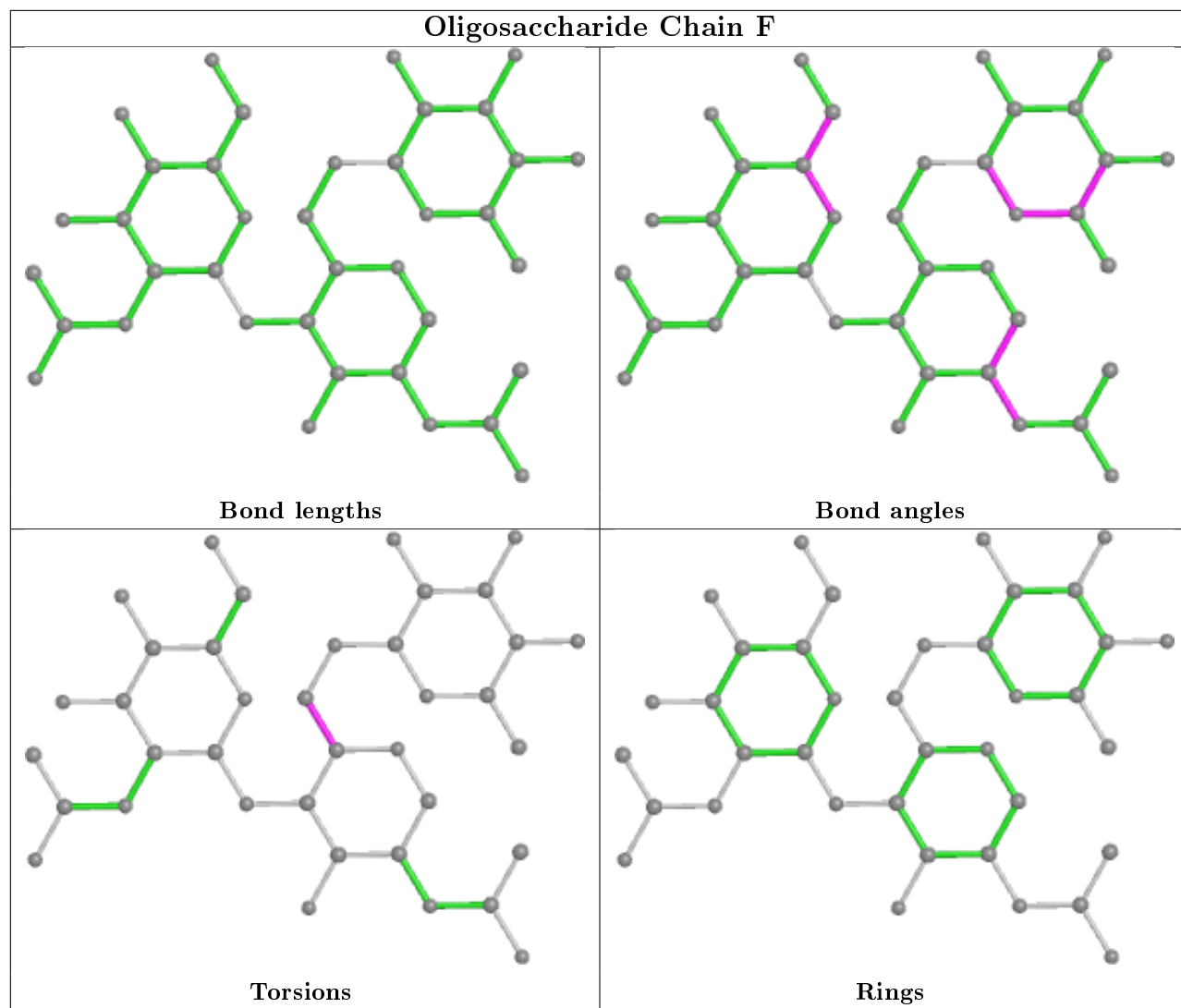
Mol	Chain	Res	Type	Atoms
5	E	4	MAN	O5-C5-C6-O6
4	D	2	NAG	C4-C5-C6-O6
4	D	2	NAG	O5-C5-C6-O6
5	E	4	MAN	C4-C5-C6-O6
5	E	3	BMA	O5-C5-C6-O6
5	E	3	BMA	C4-C5-C6-O6
2	B	2	NAG	C4-C5-C6-O6
2	B	2	NAG	O5-C5-C6-O6
2	F	1	NAG	C4-C5-C6-O6

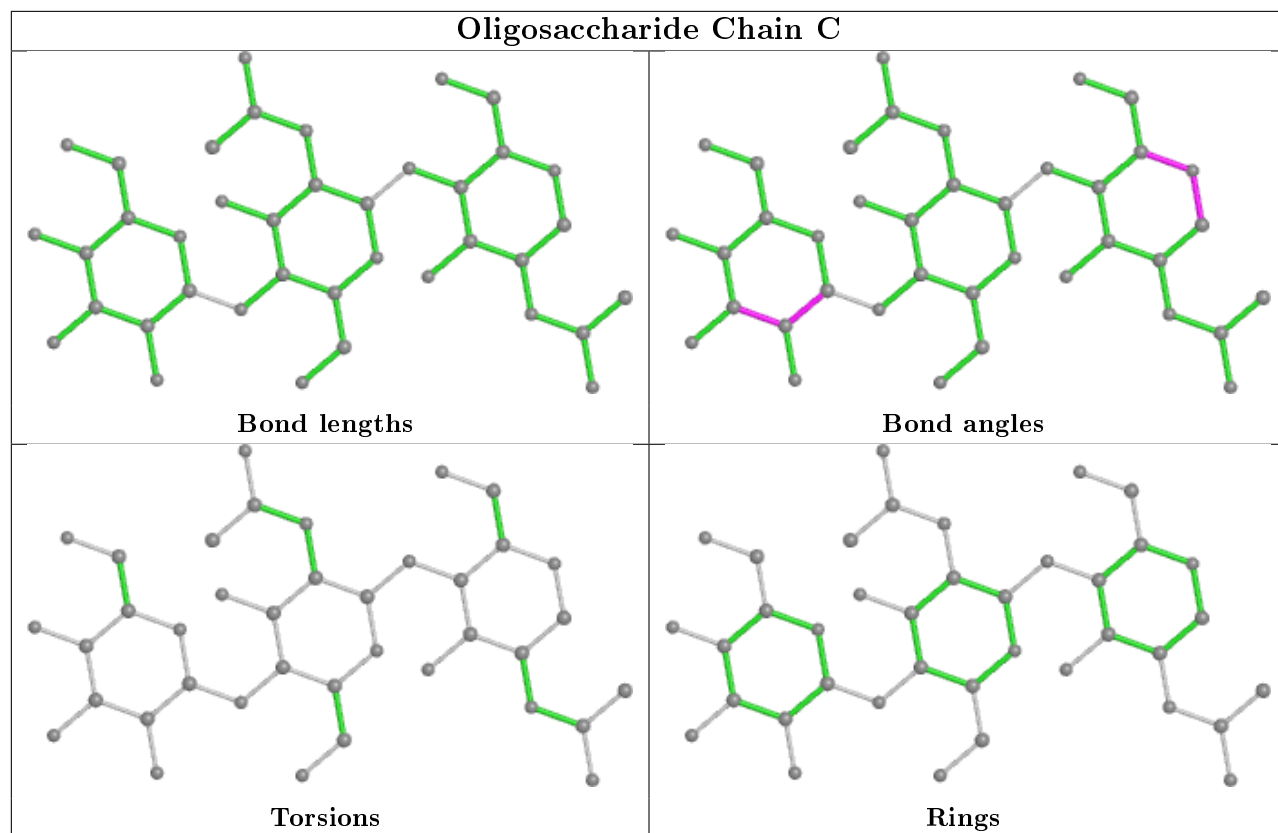
There are no ring outliers.

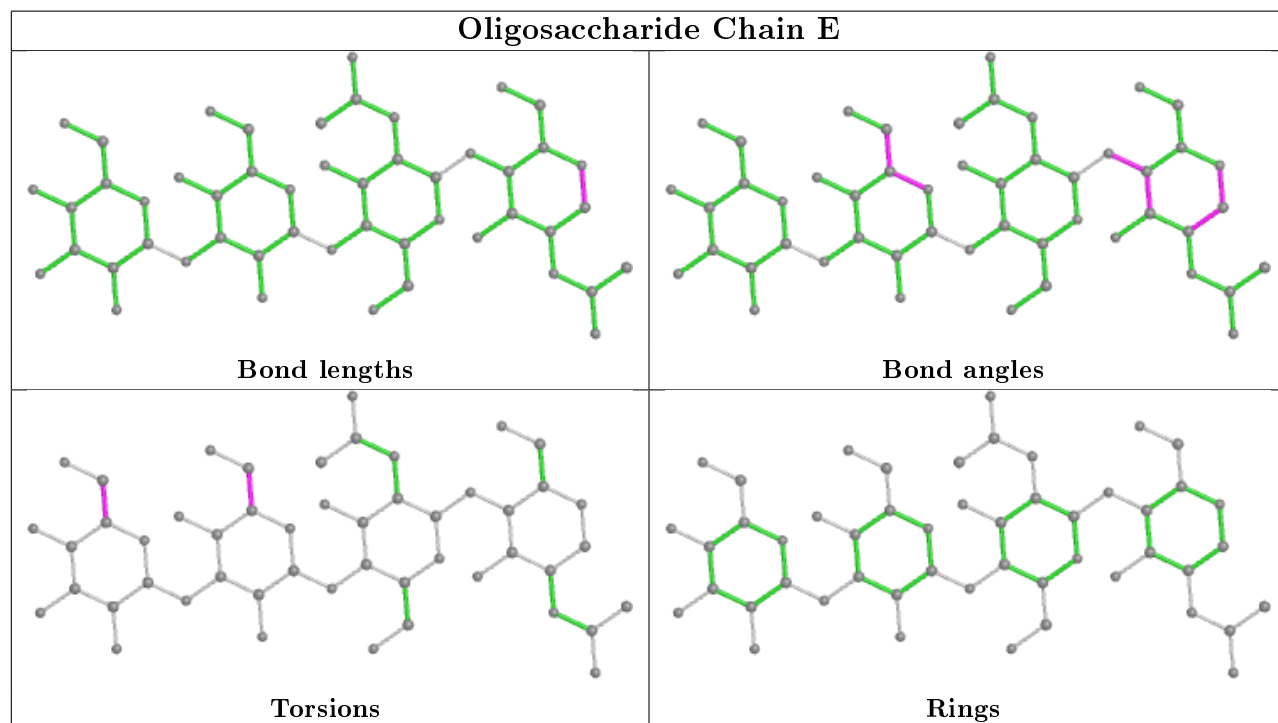
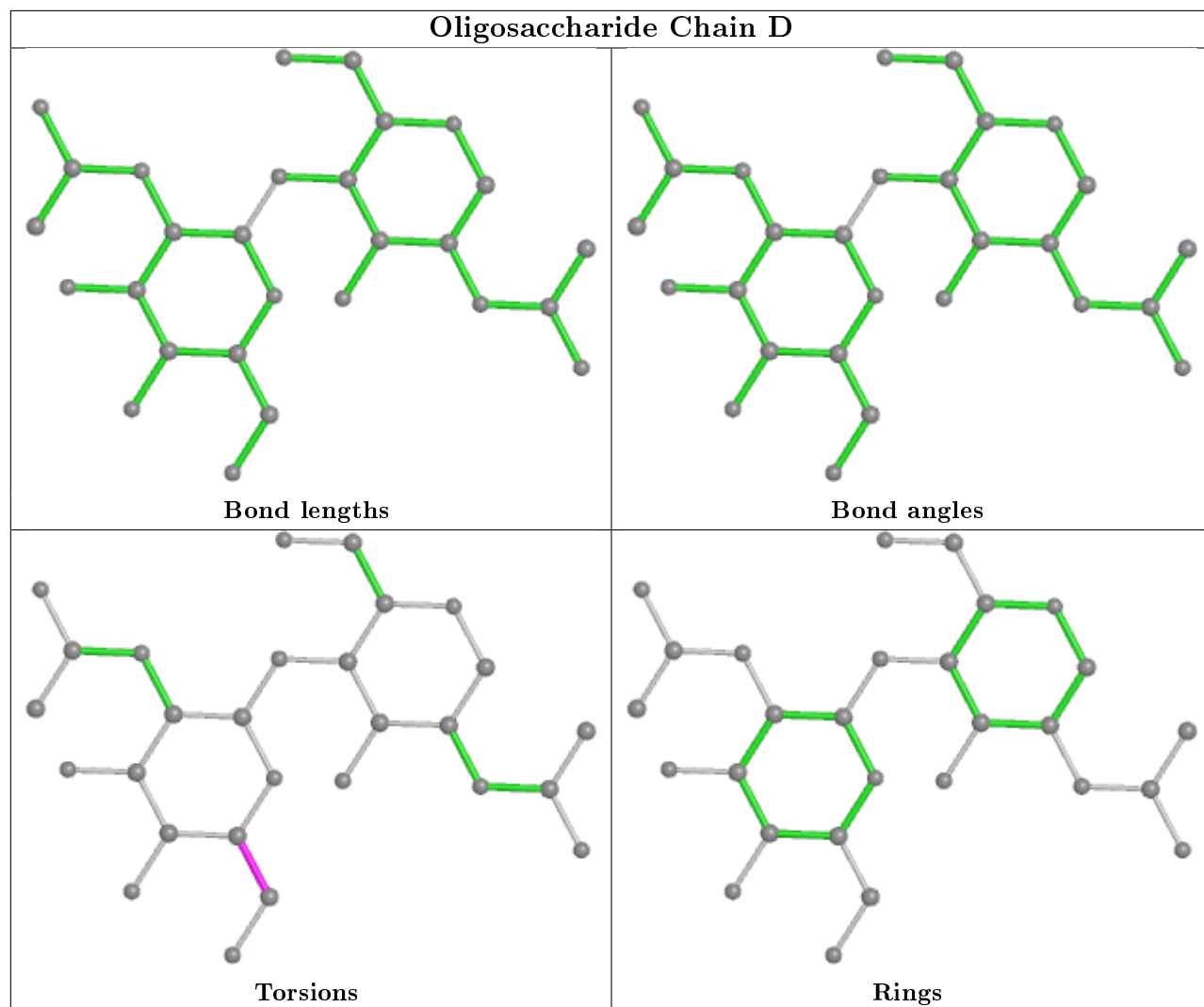
No monomer is involved in short contacts.

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









5.6 Ligand geometry

Of 29 ligands modelled in this entry, 2 are monoatomic - leaving 27 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
7	SO4	A	1021	-	4,4,4	0.35	0	6,6,6	0.09	0
11	EDO	A	1037	-	3,3,3	0.46	0	2,2,2	0.40	0
11	EDO	A	1040	-	3,3,3	0.53	0	2,2,2	0.21	0
11	EDO	A	1032	-	3,3,3	0.55	0	2,2,2	0.12	0
11	EDO	A	1039	-	3,3,3	0.37	0	2,2,2	0.44	0
11	EDO	A	1033	-	3,3,3	0.39	0	2,2,2	0.43	0
11	EDO	A	1027	-	3,3,3	0.69	0	2,2,2	0.25	0
10	GOL	A	1025	-	5,5,5	0.32	0	5,5,5	0.14	0
11	EDO	A	1028	-	3,3,3	0.41	0	2,2,2	0.43	0
6	SC2	A	1016	-	6,9,9	0.30	0	6,11,11	2.14	2 (33%)
11	EDO	A	1035	-	3,3,3	0.50	0	2,2,2	0.18	0
11	EDO	A	1038	-	3,3,3	0.50	0	2,2,2	0.16	0
6	SC2	A	1017	-	6,9,9	0.42	0	6,11,11	1.98	2 (33%)
11	EDO	A	1043	-	3,3,3	0.48	0	2,2,2	0.26	0
11	EDO	A	1031	-	3,3,3	0.41	0	2,2,2	0.39	0
7	SO4	A	1019	-	4,4,4	0.43	0	6,6,6	0.22	0
10	GOL	A	1026	-	5,5,5	0.16	0	5,5,5	0.60	0
11	EDO	A	1034	-	3,3,3	0.44	0	2,2,2	0.35	0
11	EDO	A	1029	-	3,3,3	0.45	0	2,2,2	0.41	0
7	SO4	A	1020	-	4,4,4	0.37	0	6,6,6	0.43	0
11	EDO	A	1036	-	3,3,3	0.39	0	2,2,2	0.38	0
9	PGE	A	1024	-	9,9,9	0.46	0	8,8,8	0.38	0
7	SO4	A	1018	-	4,4,4	0.24	0	6,6,6	0.23	0
11	EDO	A	1044	-	3,3,3	0.50	0	2,2,2	0.22	0
11	EDO	A	1030	-	3,3,3	0.50	0	2,2,2	0.25	0
11	EDO	A	1041	-	3,3,3	0.51	0	2,2,2	0.28	0
11	EDO	A	1042	-	3,3,3	0.50	0	2,2,2	0.19	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
11	EDO	A	1040	-	-	1/1/1/1	-
11	EDO	A	1032	-	-	1/1/1/1	-
11	EDO	A	1039	-	-	0/1/1/1	-
11	EDO	A	1033	-	-	1/1/1/1	-
11	EDO	A	1027	-	-	1/1/1/1	-
10	GOL	A	1025	-	-	4/4/4/4	-
11	EDO	A	1028	-	-	0/1/1/1	-
6	SC2	A	1016	-	-	2/6/10/10	-
11	EDO	A	1035	-	-	1/1/1/1	-
11	EDO	A	1038	-	-	1/1/1/1	-
6	SC2	A	1017	-	-	5/6/10/10	-
11	EDO	A	1043	-	-	1/1/1/1	-
11	EDO	A	1031	-	-	0/1/1/1	-
11	EDO	A	1037	-	-	0/1/1/1	-
10	GOL	A	1026	-	-	0/4/4/4	-
11	EDO	A	1034	-	-	0/1/1/1	-
11	EDO	A	1029	-	-	1/1/1/1	-
11	EDO	A	1036	-	-	0/1/1/1	-
9	PGE	A	1024	-	-	5/7/7/7	-
11	EDO	A	1044	-	-	0/1/1/1	-
11	EDO	A	1030	-	-	1/1/1/1	-
11	EDO	A	1041	-	-	0/1/1/1	-
11	EDO	A	1042	-	-	1/1/1/1	-

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	1016	SC2	CA-N-CT	3.82	126.64	122.44
6	A	1017	SC2	CA-N-CT	2.87	125.59	122.44
6	A	1016	SC2	CB-CA-N	-2.64	107.51	111.28
6	A	1017	SC2	CM-CT-N	2.59	120.49	116.10

There are no chirality outliers.

All (26) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
10	A	1025	GOL	C1-C2-C3-O3
10	A	1025	GOL	O2-C2-C3-O3

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Mol	Chain	Res	Type	Atoms
6	A	1017	SC2	C-CA-CB-SG
6	A	1017	SC2	N-CA-CB-SG
6	A	1016	SC2	OT-CT-N-CA
6	A	1016	SC2	CM-CT-N-CA
6	A	1017	SC2	OT-CT-N-CA
6	A	1017	SC2	CM-CT-N-CA
9	A	1024	PGE	O3-C5-C6-O4
10	A	1025	GOL	O1-C1-C2-C3
11	A	1033	EDO	O1-C1-C2-O2
11	A	1027	EDO	O1-C1-C2-O2
11	A	1035	EDO	O1-C1-C2-O2
9	A	1024	PGE	O1-C1-C2-O2
9	A	1024	PGE	O2-C3-C4-O3
11	A	1038	EDO	O1-C1-C2-O2
11	A	1030	EDO	O1-C1-C2-O2
11	A	1042	EDO	O1-C1-C2-O2
10	A	1025	GOL	O1-C1-C2-O2
11	A	1032	EDO	O1-C1-C2-O2
11	A	1029	EDO	O1-C1-C2-O2
9	A	1024	PGE	C4-C3-O2-C2
9	A	1024	PGE	C3-C4-O3-C5
11	A	1040	EDO	O1-C1-C2-O2
11	A	1043	EDO	O1-C1-C2-O2
6	A	1017	SC2	C-CA-N-CT

There are no ring outliers.

3 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
11	A	1032	EDO	1	0
6	A	1017	SC2	1	0
10	A	1026	GOL	6	0

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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, 95th 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	847/872 (97%)	-0.22	16 (1%) 66 65	14, 22, 38, 83	0

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	952	CYS	4.5
1	A	205	PRO	4.1
1	A	197	THR	3.8
1	A	781	GLU	3.2
1	A	914	GLN	3.0
1	A	912	ALA	3.0
1	A	196	GLU	2.7
1	A	204	ALA	2.6
1	A	83	ASP	2.2
1	A	911	THR	2.2
1	A	780	ILE	2.2
1	A	101	GLU	2.2
1	A	422	ARG	2.2
1	A	910	ALA	2.1
1	A	146	MET	2.0
1	A	931	ASP	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, 95th 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
5	MAN	E	4	11/12	0.55	0.36	67,90,99,101	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
2	NAG	F	2	14/15	0.63	0.47	76,97,111,120	0
2	FUC	F	3	10/11	0.71	0.41	73,81,87,91	0
4	NAG	D	2	14/15	0.76	0.34	61,72,83,89	0
2	NAG	B	2	14/15	0.82	0.34	48,59,72,72	0
3	NAG	C	2	14/15	0.85	0.26	43,48,63,72	0
2	NAG	F	1	14/15	0.89	0.24	39,57,70,79	0
2	FUC	B	3	10/11	0.91	0.40	61,69,76,81	0
2	NAG	B	1	14/15	0.92	0.23	30,38,47,51	0
3	NAG	C	1	14/15	0.94	0.10	23,27,32,34	0
5	NAG	E	2	14/15	0.94	0.11	27,31,38,42	0
4	NAG	D	1	14/15	0.94	0.14	24,31,50,52	0
5	NAG	E	1	14/15	0.97	0.08	21,23,27,29	0

6.3 Carbohydrates

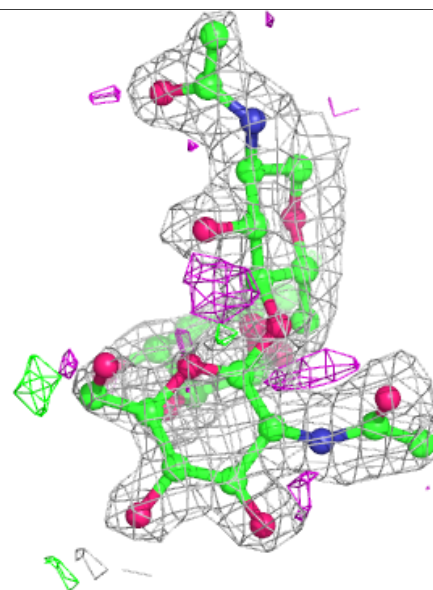
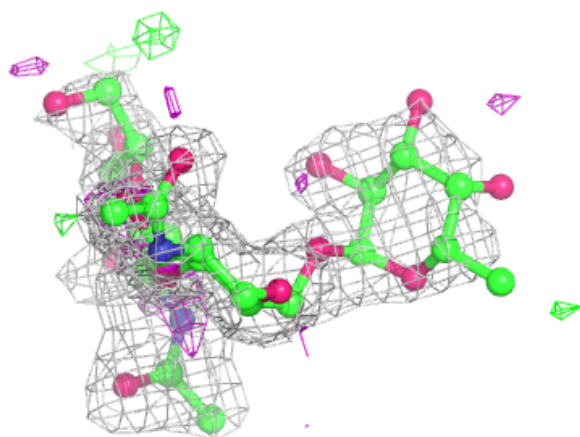
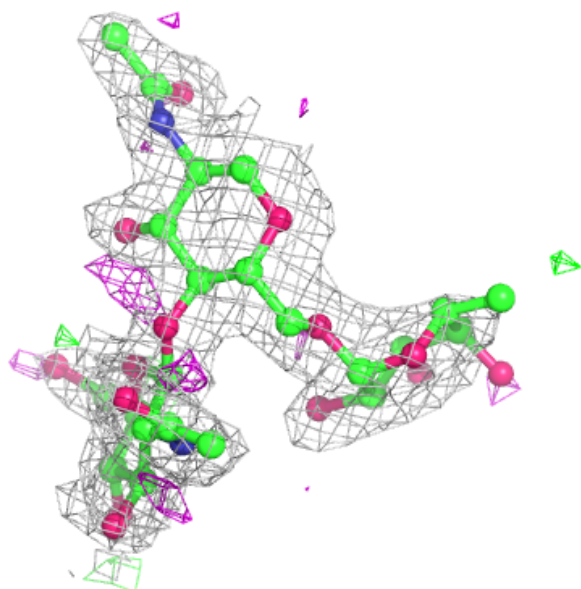
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
5	MAN	E	4	11/12	0.55	0.36	67,90,99,101	0
2	NAG	F	2	14/15	0.63	0.47	76,97,111,120	0
2	FUC	F	3	10/11	0.71	0.41	73,81,87,91	0
4	NAG	D	2	14/15	0.76	0.34	61,72,83,89	0
3	BMA	C	3	11/12	0.78	0.36	71,81,84,86	0
5	BMA	E	3	11/12	0.81	0.25	48,68,76,79	0
2	NAG	B	2	14/15	0.82	0.34	48,59,72,72	0
3	NAG	C	2	14/15	0.85	0.26	43,48,63,72	0
2	NAG	F	1	14/15	0.89	0.24	39,57,70,79	0
2	FUC	B	3	10/11	0.91	0.40	61,69,76,81	0
2	NAG	B	1	14/15	0.92	0.23	30,38,47,51	0
5	NAG	E	2	14/15	0.94	0.11	27,31,38,42	0
3	NAG	C	1	14/15	0.94	0.10	23,27,32,34	0
4	NAG	D	1	14/15	0.94	0.14	24,31,50,52	0
5	NAG	E	1	14/15	0.97	0.08	21,23,27,29	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.

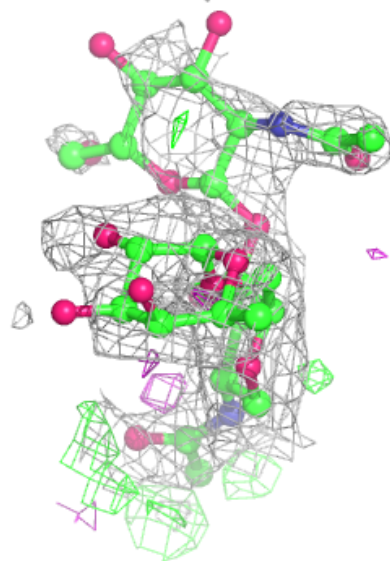
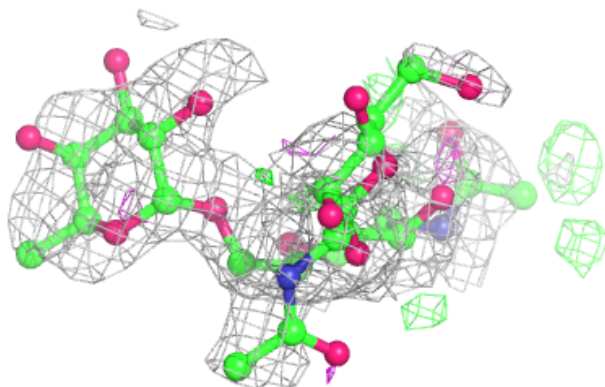
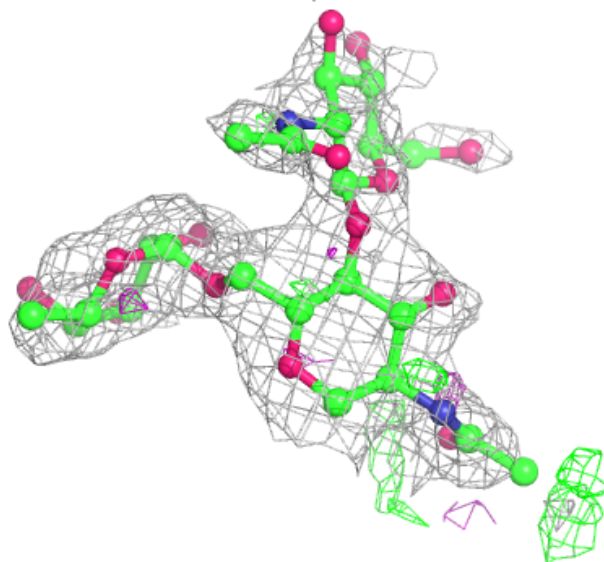
Electron density around Chain B:

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



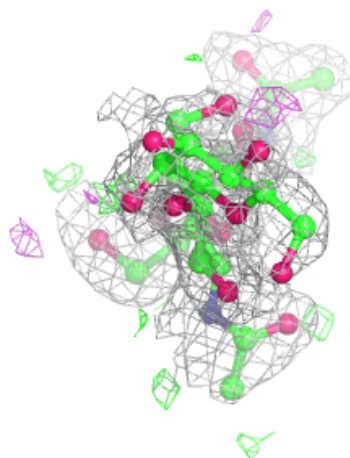
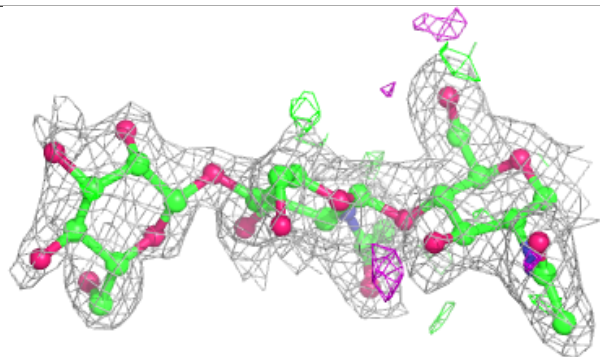
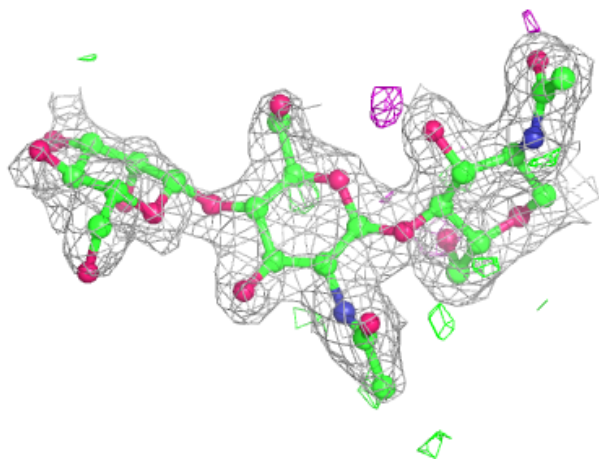
Electron density around Chain F:

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



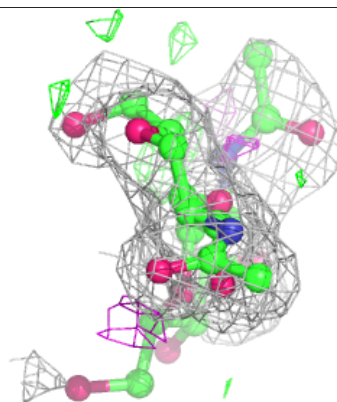
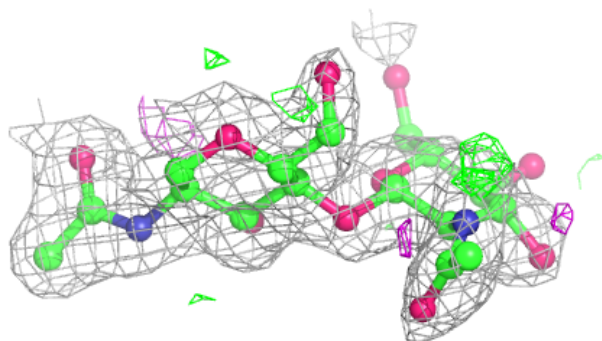
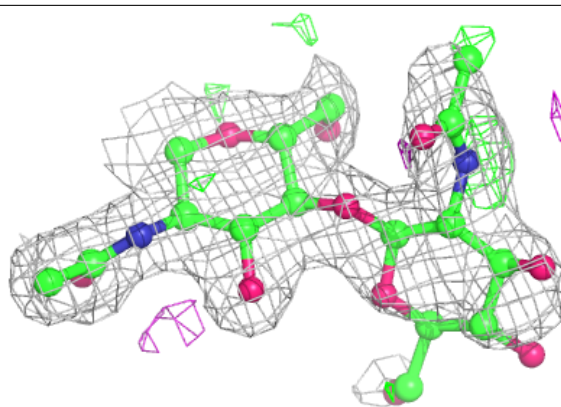
Electron density around Chain C:

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

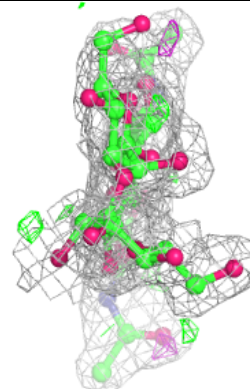
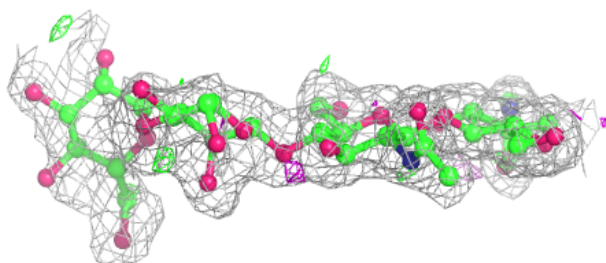
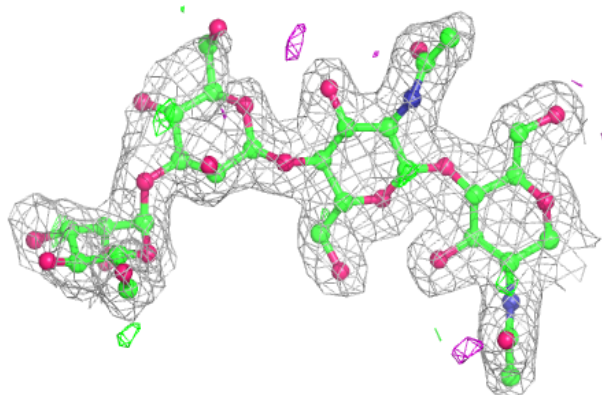


Electron density around Chain D:

$2mF_o-DF_c$ (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, 95th 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
10	GOL	A	1025	6/6	0.73	0.27	59,64,64,70	0
11	EDO	A	1038	4/4	0.73	0.22	57,57,58,65	0
11	EDO	A	1027	4/4	0.74	0.29	42,42,45,47	0
11	EDO	A	1041	4/4	0.74	0.34	52,55,55,56	0
11	EDO	A	1042	4/4	0.77	0.43	59,61,64,64	0
11	EDO	A	1030	4/4	0.79	0.13	50,52,52,56	0
6	SC2	A	1017	10/10	0.79	0.21	40,53,63,71	10
11	EDO	A	1029	4/4	0.79	0.18	56,59,60,65	0
10	GOL	A	1026	6/6	0.80	0.20	30,36,41,50	0
9	PGE	A	1024	10/10	0.84	0.15	57,61,71,73	0
11	EDO	A	1034	4/4	0.84	0.16	52,54,59,60	0
11	EDO	A	1043	4/4	0.84	0.20	51,52,54,55	0
11	EDO	A	1036	4/4	0.84	0.19	47,51,53,55	0
11	EDO	A	1028	4/4	0.86	0.12	48,52,53,54	0
11	EDO	A	1040	4/4	0.88	0.34	57,57,59,60	0
11	EDO	A	1032	4/4	0.88	0.19	39,43,47,50	0
7	SO4	A	1020	5/5	0.89	0.25	46,53,79,80	0
11	EDO	A	1035	4/4	0.89	0.21	40,46,48,55	0
11	EDO	A	1033	4/4	0.90	0.27	44,44,49,51	0
11	EDO	A	1031	4/4	0.90	0.15	53,55,55,62	0
11	EDO	A	1044	4/4	0.90	0.12	55,55,60,65	0
7	SO4	A	1021	5/5	0.91	0.28	65,84,91,101	0
7	SO4	A	1019	5/5	0.92	0.20	56,63,73,75	0
11	EDO	A	1039	4/4	0.94	0.30	28,38,40,44	0
8	CL	A	1023	1/1	0.94	0.10	52,52,52,52	0
11	EDO	A	1037	4/4	0.94	0.11	29,40,46,49	0
6	SC2	A	1016	10/10	0.95	0.13	32,38,47,48	0
8	CL	A	1022	1/1	0.96	0.04	59,59,59,59	0
7	SO4	A	1018	5/5	0.99	0.09	31,31,33,36	0

6.5 Other polymers ⓘ

There are no such residues in this entry.