



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 18, 2026 – 05:16 AM UTC

PDB ID : 5BO9 / pdb_00005bo9
Title : Structure of human sialyltransferase ST8SiaIII in complex with CMP-3FNeu5Ac and Sia-6S-LacNAc
Authors : Volkers, G.; Worrall, L.; Strynadka, N.C.J.
Deposited on : 2015-05-27
Resolution : 2.30 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 Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

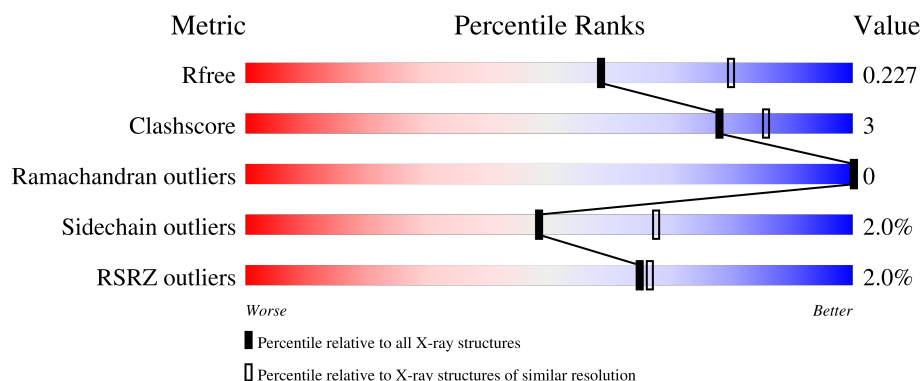
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION



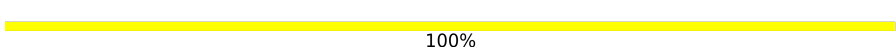
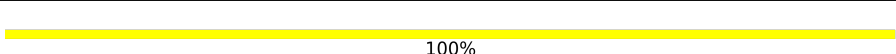
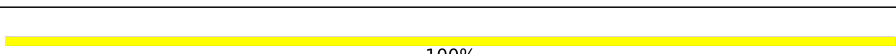
The reported resolution of this entry is 2.30 Å.

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.



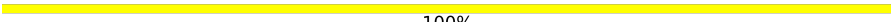
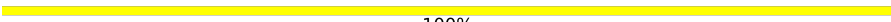

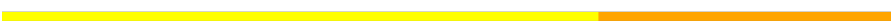
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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 $\leq 5\%$. 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	323	
1	B	323	
2	C	2	
2	E	2	
2	G	2	

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Mol	Chain	Length	Quality of chain
2	H	2	 100%
3	D	3	 100%
4	F	3	 67% 33%
4	I	3	 67% 33%

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 5189 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 Sia-alpha-2,3-Gal-beta-1,4-GlcNAc-R:alpha 2,8-sialyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	286	Total	C	N	O	S	0	0	0
			2353	1521	410	412	10			
1	B	277	Total	C	N	O	S	0	0	0
			2287	1479	397	401	10			

There are 46 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	58	ALA	-	expression tag	UNP O43173
A	59	PRO	-	expression tag	UNP O43173
A	60	GLU	-	expression tag	UNP O43173
A	61	HIS	-	expression tag	UNP O43173
A	62	HIS	-	expression tag	UNP O43173
A	63	HIS	-	expression tag	UNP O43173
A	64	HIS	-	expression tag	UNP O43173
A	65	HIS	-	expression tag	UNP O43173
A	66	HIS	-	expression tag	UNP O43173
A	67	ASP	-	expression tag	UNP O43173
A	68	TYR	-	expression tag	UNP O43173
A	69	ASP	-	expression tag	UNP O43173
A	70	ILE	-	expression tag	UNP O43173
A	71	PRO	-	expression tag	UNP O43173
A	72	THR	-	expression tag	UNP O43173
A	73	THR	-	expression tag	UNP O43173
A	74	GLU	-	expression tag	UNP O43173
A	75	ASN	-	expression tag	UNP O43173
A	76	LEU	-	expression tag	UNP O43173
A	77	TYR	-	expression tag	UNP O43173
A	78	PHE	-	expression tag	UNP O43173
A	79	GLN	-	expression tag	UNP O43173
A	80	GLY	-	expression tag	UNP O43173
B	58	ALA	-	expression tag	UNP O43173

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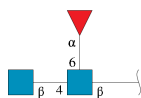
Chain	Residue	Modelled	Actual	Comment	Reference
B	59	PRO	-	expression tag	UNP O43173
B	60	GLU	-	expression tag	UNP O43173
B	61	HIS	-	expression tag	UNP O43173
B	62	HIS	-	expression tag	UNP O43173
B	63	HIS	-	expression tag	UNP O43173
B	64	HIS	-	expression tag	UNP O43173
B	65	HIS	-	expression tag	UNP O43173
B	66	HIS	-	expression tag	UNP O43173
B	67	ASP	-	expression tag	UNP O43173
B	68	TYR	-	expression tag	UNP O43173
B	69	ASP	-	expression tag	UNP O43173
B	70	ILE	-	expression tag	UNP O43173
B	71	PRO	-	expression tag	UNP O43173
B	72	THR	-	expression tag	UNP O43173
B	73	THR	-	expression tag	UNP O43173
B	74	GLU	-	expression tag	UNP O43173
B	75	ASN	-	expression tag	UNP O43173
B	76	LEU	-	expression tag	UNP O43173
B	77	TYR	-	expression tag	UNP O43173
B	78	PHE	-	expression tag	UNP O43173
B	79	GLN	-	expression tag	UNP O43173
B	80	GLY	-	expression tag	UNP O43173

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



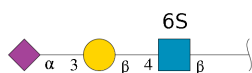
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	2	Total	C	N	O	0	0	0
			28	16	2	10			
2	E	2	Total	C	N	O	0	0	0
			28	16	2	10			
2	G	2	Total	C	N	O	0	0	0
			28	16	2	10			
2	H	2	Total	C	N	O	0	0	0
			28	16	2	10			

- Molecule 3 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.



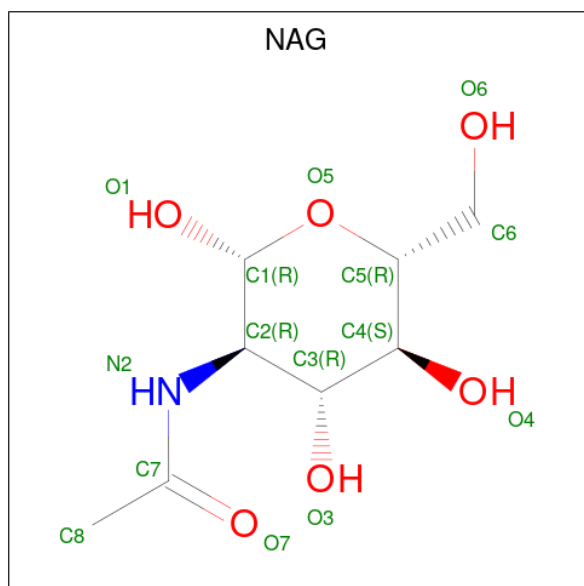
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	D	3	Total	C	N	O	0	0	0
			38	22	2	14			

- Molecule 4 is an oligosaccharide called N-acetyl-alpha-neuraminic acid-(2-3)-beta-D-galactopyranose-(1-4)-2-acetamido-2-deoxy-6-O-sulfo-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	F	3	Total	C	N	O	S	0	0	0
			50	25	2	22	1			
4	I	3	Total	C	N	O	S	0	0	0
			50	25	2	22	1			

- Molecule 5 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: C₈H₁₅NO₆).



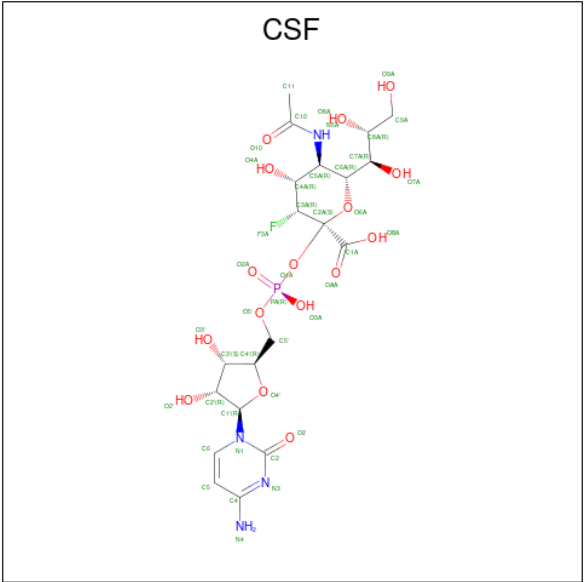
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	N	O	0	0
			14	8	1	5		

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	B	1	Total	C	N	O	0	0
			14	8	1	5		
5	B	1	Total	C	N	O	0	0
			14	8	1	5		

- Molecule 6 is CYTIDINE-5'-MONOPHOSPHATE-3-FLUORO-N-ACETYL-NEURAMINI C ACID (CCD ID: CSF) (formula: C₂₀H₃₀FN₄O₁₆P).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
6	A	1	Total	C	F	N	O	P	17	0
			42	20	1	4	16	1		
6	B	1	Total	C	F	N	O	P	17	0
			42	20	1	4	16	1		

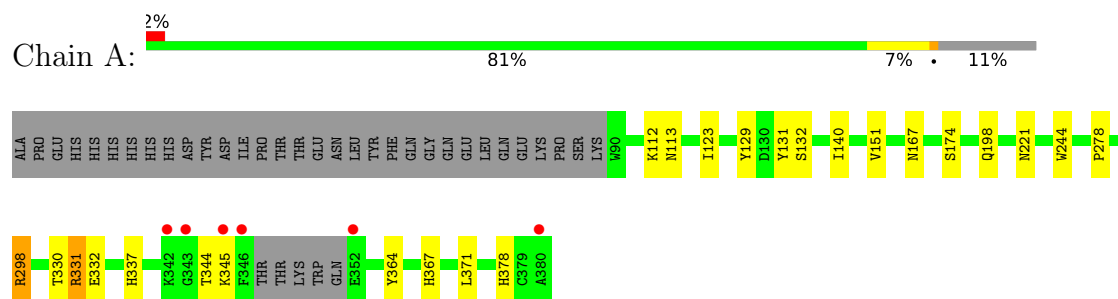
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	90	Total	O	0	0
			90	90		
7	B	83	Total	O	0	0
			83	83		

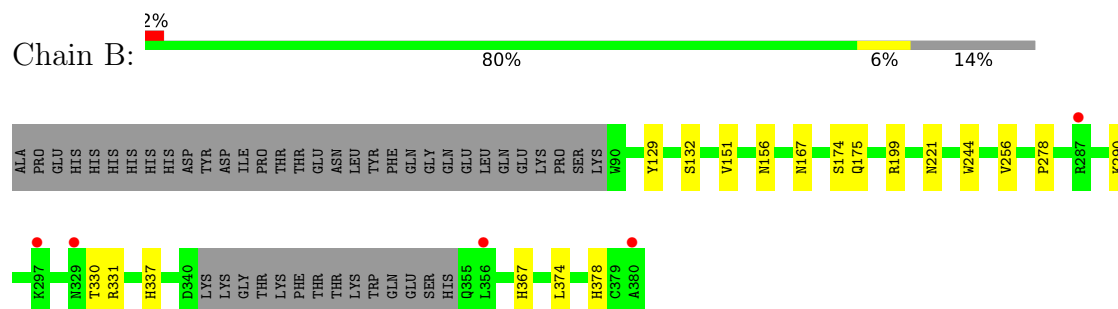
3 Residue-property plots

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.

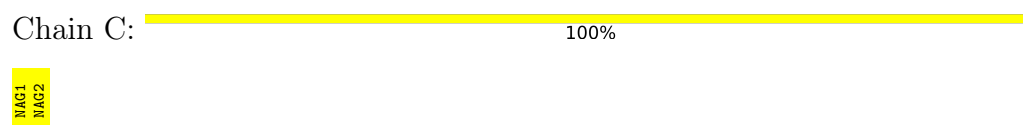
- Molecule 1: Sia-alpha-2,3-Gal-beta-1,4-GlcNAc-R:alpha 2,8-sialyltransferase



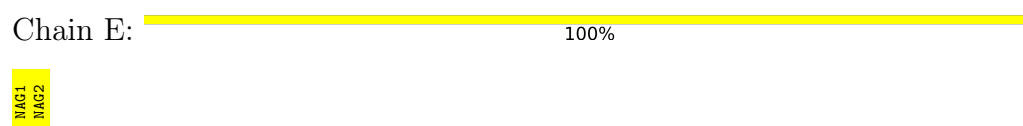
- Molecule 1: Sia-alpha-2,3-Gal-beta-1,4-GlcNAc-R:alpha 2,8-sialyltransferase



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



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




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

Chain G:  100%


MAG1
MAG2

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

Chain H:  100%


MAG1
MAG2

- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose

Chain D:  100%


MAG1
MAG2
FUC3

- Molecule 4: N-acetyl-alpha-neuraminic acid-(2-3)-beta-D-galactopyranose-(1-4)-2-acetamido-2-deoxy-6-O-sulfo-beta-D-glucopyranose

Chain F:  67% 33%

NGS1
GAL2
SIA3

- Molecule 4: N-acetyl-alpha-neuraminic acid-(2-3)-beta-D-galactopyranose-(1-4)-2-acetamido-2-deoxy-6-O-sulfo-beta-D-glucopyranose

Chain I:  67% 33%

NGS1
GAL2
SIA3

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	63.35Å 94.87Å 126.46Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	75.89 – 2.30 75.89 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.9 (75.89-2.30) 99.9 (75.89-2.30)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.96 (at 2.29Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.185 , 0.230 0.191 , 0.227	Depositor DCC
R_{free} test set	1744 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	38.1	Xtriage
Anisotropy	0.246	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 35.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5189	wwPDB-VP
Average B, all atoms (Å ²)	44.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.70% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CSF, FUC, GAL, NGS, NAG, SIA

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	1.00	0/2421	0.99	4/3278 (0.1%)
1	B	0.98	0/2353	0.97	1/3188 (0.0%)
All	All	0.99	0/4774	0.98	5/6466 (0.1%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	140	ILE	CB-CA-C	-7.50	103.18	111.35
1	A	298	ARG	NE-CZ-NH2	7.37	125.83	119.20
1	B	156	ASN	N-CA-C	6.16	120.03	111.90
1	A	298	ARG	NE-CZ-NH1	-6.12	115.38	121.50
1	A	198	GLN	CB-CA-C	-5.10	102.01	110.68

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	2353	0	2291	14	0
1	B	2287	0	2230	9	0
2	C	28	0	25	0	0
2	E	28	0	25	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	G	28	0	25	0	0
2	H	28	0	25	0	0
3	D	38	0	34	0	0
4	F	50	0	34	1	0
4	I	50	0	34	2	0
5	A	14	0	13	6	0
5	B	28	0	26	0	0
6	A	42	0	29	0	0
6	B	42	0	29	0	0
7	A	90	0	0	2	0
7	B	83	0	0	1	0
All	All	5189	0	4820	27	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 (27) 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)
7:B:501:HOH:O	4:I:3:SIA:H111	1.72	0.88
1:B:367:HIS:HD2	1:B:374:LEU:H	1.20	0.86
5:A:401:NAG:H81	7:A:562:HOH:O	1.79	0.82
1:A:113:ASN:HD22	5:A:401:NAG:H83	1.59	0.67
1:A:131:TYR:CE2	1:A:298:ARG:HG2	2.34	0.62
1:A:112:LYS:HG2	5:A:401:NAG:H82	1.81	0.61
1:B:367:HIS:CD2	1:B:374:LEU:H	2.11	0.58
1:A:113:ASN:HA	5:A:401:NAG:H83	1.87	0.56
1:B:175:GLN:HG2	1:B:199:ARG:HD3	1.88	0.55
1:A:244:TRP:CZ2	1:A:278:PRO:HG3	2.44	0.53
1:B:129:TYR:HB2	1:B:132:SER:HB2	1.94	0.50
4:F:3:SIA:O7	4:F:3:SIA:H113	2.13	0.48
1:A:174:SER:HA	1:A:378:HIS:CD2	2.49	0.48
4:I:3:SIA:O6	4:I:3:SIA:H92	2.15	0.47
1:B:167:ASN:O	1:B:337:HIS:HA	2.14	0.47
1:A:129:TYR:HB2	1:A:132:SER:HB2	1.96	0.47
1:A:364:TYR:O	1:A:367:HIS:HB3	2.15	0.47
1:B:331:ARG:HH11	1:B:331:ARG:HA	1.79	0.46
1:A:123:ILE:HD11	7:A:582:HOH:O	2.15	0.46
1:A:330:THR:O	1:A:331:ARG:HB2	2.14	0.46
1:A:167:ASN:O	1:A:337:HIS:HA	2.16	0.45
1:B:244:TRP:CZ2	1:B:278:PRO:HG3	2.50	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:174:SER:HA	1:B:378:HIS:CD2	2.52	0.44
1:B:330:THR:O	1:B:331:ARG:HB2	2.17	0.43
1:A:113:ASN:ND2	5:A:401:NAG:H83	2.28	0.43
1:A:112:LYS:HG2	5:A:401:NAG:C8	2.47	0.43
1:A:330:THR:OG1	1:A:332:GLU:OE1	2.36	0.41

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	282/323 (87%)	270 (96%)	12 (4%)	0	100	100
1	B	273/323 (84%)	265 (97%)	8 (3%)	0	100	100
All	All	555/646 (86%)	535 (96%)	20 (4%)	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	257/294 (87%)	251 (98%)	6 (2%)	44	63
1	B	251/294 (85%)	247 (98%)	4 (2%)	55	73
All	All	508/588 (86%)	498 (98%)	10 (2%)	48	67

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	151	VAL
1	A	221	ASN
1	A	331	ARG
1	A	344	THR
1	A	345	LYS
1	A	371	LEU
1	B	151	VAL
1	B	221	ASN
1	B	256	VAL
1	B	290	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (17) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	107	HIS
1	A	119	ASN
1	A	134	HIS
1	A	156	ASN
1	A	229	ASN
1	A	284	HIS
1	A	291	ASN
1	A	355	GLN
1	B	134	HIS
1	B	156	ASN
1	B	158	HIS
1	B	226	GLN
1	B	229	ASN
1	B	267	HIS
1	B	291	ASN
1	B	367	HIS
1	B	378	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 ⓘ

17 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	C	1	2,1	14,14,15	0.70	0	17,19,21	2.25	7 (41%)
2	NAG	C	2	2	14,14,15	0.65	0	17,19,21	1.62	3 (17%)
3	NAG	D	1	1,3	14,14,15	1.18	1 (7%)	17,19,21	1.37	1 (5%)
3	NAG	D	2	3	14,14,15	0.73	0	17,19,21	1.28	2 (11%)
3	FUC	D	3	3	10,10,11	0.98	1 (10%)	14,14,16	1.11	1 (7%)
2	NAG	E	1	2,1	14,14,15	1.05	1 (7%)	17,19,21	1.87	5 (29%)
2	NAG	E	2	2	14,14,15	0.80	0	17,19,21	1.07	1 (5%)
4	NGS	F	1	4	19,19,19	0.61	0	27,28,28	2.32	5 (18%)
4	GAL	F	2	4	11,11,12	0.40	0	15,15,17	1.28	1 (6%)
4	SIA	F	3	4	20,20,21	1.09	2 (10%)	21,28,31	2.09	7 (33%)
2	NAG	G	1	2,1	14,14,15	0.92	0	17,19,21	2.70	7 (41%)
2	NAG	G	2	2	14,14,15	0.87	1 (7%)	17,19,21	1.50	3 (17%)
2	NAG	H	1	2,1	14,14,15	0.99	1 (7%)	17,19,21	1.53	4 (23%)
2	NAG	H	2	2	14,14,15	0.89	0	17,19,21	1.70	5 (29%)
4	NGS	I	1	4	19,19,19	0.55	0	27,28,28	1.67	4 (14%)
4	GAL	I	2	4	11,11,12	0.53	0	15,15,17	1.50	3 (20%)
4	SIA	I	3	4	20,20,21	1.31	2 (10%)	21,28,31	2.49	6 (28%)

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	C	1	2,1	-	2/6/23/26	0/1/1/1
2	NAG	C	2	2	-	2/6/23/26	0/1/1/1
3	NAG	D	1	1,3	-	0/6/23/26	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	NAG	D	2	3	-	2/6/23/26	0/1/1/1
3	FUC	D	3	3	-	-	0/1/1/1
2	NAG	E	1	2,1	-	2/6/23/26	0/1/1/1
2	NAG	E	2	2	-	0/6/23/26	0/1/1/1
4	NGS	F	1	4	-	1/10/30/30	0/1/1/1
4	GAL	F	2	4	-	1/2/19/22	0/1/1/1
4	SIA	F	3	4	-	4/18/34/38	0/1/1/1
2	NAG	G	1	2,1	-	0/6/23/26	0/1/1/1
2	NAG	G	2	2	-	2/6/23/26	0/1/1/1
2	NAG	H	1	2,1	-	0/6/23/26	0/1/1/1
2	NAG	H	2	2	-	0/6/23/26	0/1/1/1
4	NGS	I	1	4	-	2/10/30/30	0/1/1/1
4	GAL	I	2	4	-	1/2/19/22	0/1/1/1
4	SIA	I	3	4	-	5/18/34/38	0/1/1/1

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	D	1	NAG	O5-C1	-3.61	1.37	1.43
4	I	3	SIA	C4-C5	-2.63	1.50	1.53
2	E	1	NAG	C2-N2	-2.58	1.42	1.46
4	I	3	SIA	C7-C6	2.58	1.56	1.52
4	F	3	SIA	O10-C10	2.42	1.28	1.23
4	F	3	SIA	C4-C5	2.17	1.55	1.53
2	G	2	NAG	C1-C2	-2.14	1.49	1.52
3	D	3	FUC	O2-C2	-2.12	1.38	1.43
2	H	1	NAG	C2-N2	-2.04	1.42	1.46

All (65) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	F	1	NGS	C1-C2-C3	-7.93	99.72	110.54
2	G	1	NAG	C1-O5-C5	7.16	121.78	112.19
4	I	3	SIA	O6-C2-C1	5.93	118.92	107.72
4	I	1	NGS	O8-S-O9	5.00	126.04	108.56
4	F	1	NGS	O8-S-O7A	4.79	125.30	108.56
4	F	1	NGS	O5-C1-C2	-4.75	104.74	109.52
4	I	3	SIA	O6-C2-C3	-4.74	104.18	110.56
4	F	3	SIA	O6-C2-C1	4.74	116.67	107.72
4	I	3	SIA	O9-C9-C8	-4.72	101.25	111.16
4	F	3	SIA	O6-C2-C3	-4.33	104.73	110.56

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	I	3	SIA	O8-C8-C7	4.30	119.32	109.25
2	C	1	NAG	C1-O5-C5	4.28	117.92	112.19
4	I	1	NGS	C1-C2-C3	4.26	116.35	110.54
4	F	1	NGS	C1-C2-N2	4.14	115.53	110.73
2	G	1	NAG	O5-C1-C2	-4.10	104.95	111.29
2	C	1	NAG	O5-C1-C2	-4.04	105.05	111.29
2	E	1	NAG	C2-N2-C7	3.94	128.18	122.90
2	C	2	NAG	C3-C4-C5	3.90	117.31	110.23
2	H	2	NAG	O4-C4-C5	3.86	118.84	109.32
3	D	1	NAG	O5-C1-C2	-3.51	105.85	111.29
4	I	2	GAL	O5-C1-C2	-3.40	102.67	110.79
2	H	1	NAG	C1-C2-N2	-3.33	105.19	110.43
2	C	2	NAG	C1-O5-C5	3.30	116.61	112.19
2	C	1	NAG	C3-C4-C5	3.25	116.12	110.23
4	F	2	GAL	C1-O5-C5	3.25	116.54	112.19
2	E	1	NAG	C1-C2-N2	-3.23	105.34	110.43
2	E	1	NAG	O5-C1-C2	-3.15	106.42	111.29
2	G	1	NAG	O3-C3-C2	-3.15	102.86	109.40
2	E	1	NAG	C1-O5-C5	3.14	116.39	112.19
2	H	1	NAG	O3-C3-C2	-3.13	102.90	109.40
2	H	2	NAG	C1-O5-C5	3.12	116.37	112.19
4	I	1	NGS	C1-C2-N2	-3.10	107.14	110.73
2	C	1	NAG	C1-C2-N2	-3.07	105.59	110.43
4	F	3	SIA	O10-C10-N5	3.01	127.29	121.98
2	G	1	NAG	C4-C3-C2	2.98	115.38	111.02
3	D	2	NAG	C1-O5-C5	2.95	116.14	112.19
4	F	3	SIA	O1B-C1-C2	2.92	120.30	112.71
2	G	1	NAG	O7-C7-C8	-2.90	116.89	122.05
2	G	1	NAG	O5-C5-C6	2.80	113.11	107.66
4	I	3	SIA	O8-C8-C9	-2.74	102.79	109.03
2	C	1	NAG	O6-C6-C5	2.73	120.62	111.33
2	G	2	NAG	C3-C4-C5	-2.70	105.34	110.23
4	F	3	SIA	C8-C7-C6	-2.67	108.04	113.05
2	C	1	NAG	C4-C3-C2	2.52	114.72	111.02
4	I	2	GAL	O2-C2-C1	-2.47	103.57	109.22
4	I	2	GAL	C1-O5-C5	-2.47	108.88	112.19
2	G	1	NAG	C6-C5-C4	-2.46	106.97	113.02
4	I	3	SIA	O1B-C1-C2	2.43	119.03	112.71
4	F	1	NGS	C1-O5-C5	2.43	118.35	113.65
4	I	1	NGS	O6-S-O7A	-2.38	99.66	106.92
4	F	3	SIA	O10-C10-C11	-2.37	117.83	122.05
3	D	3	FUC	C1-C2-C3	-2.37	106.19	109.64

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	H	1	NAG	O5-C1-C2	-2.37	107.63	111.29
3	D	2	NAG	C2-N2-C7	2.36	126.06	122.90
2	E	2	NAG	C1-C2-N2	-2.35	106.73	110.43
2	G	2	NAG	C2-N2-C7	-2.35	119.75	122.90
2	G	2	NAG	O4-C4-C5	2.35	115.10	109.32
2	H	2	NAG	C1-C2-N2	-2.30	106.80	110.43
2	H	1	NAG	C1-O5-C5	2.29	115.25	112.19
2	H	2	NAG	O7-C7-N2	2.25	125.96	121.98
2	H	2	NAG	O7-C7-C8	-2.16	118.21	122.05
2	E	1	NAG	O4-C4-C3	-2.16	105.29	110.38
4	F	3	SIA	C9-C8-C7	2.10	116.45	112.17
2	C	2	NAG	O5-C5-C4	2.07	115.87	110.83
2	C	1	NAG	C6-C5-C4	2.06	118.08	113.02

There are no chirality outliers.

All (24) torsion outliers are listed below:

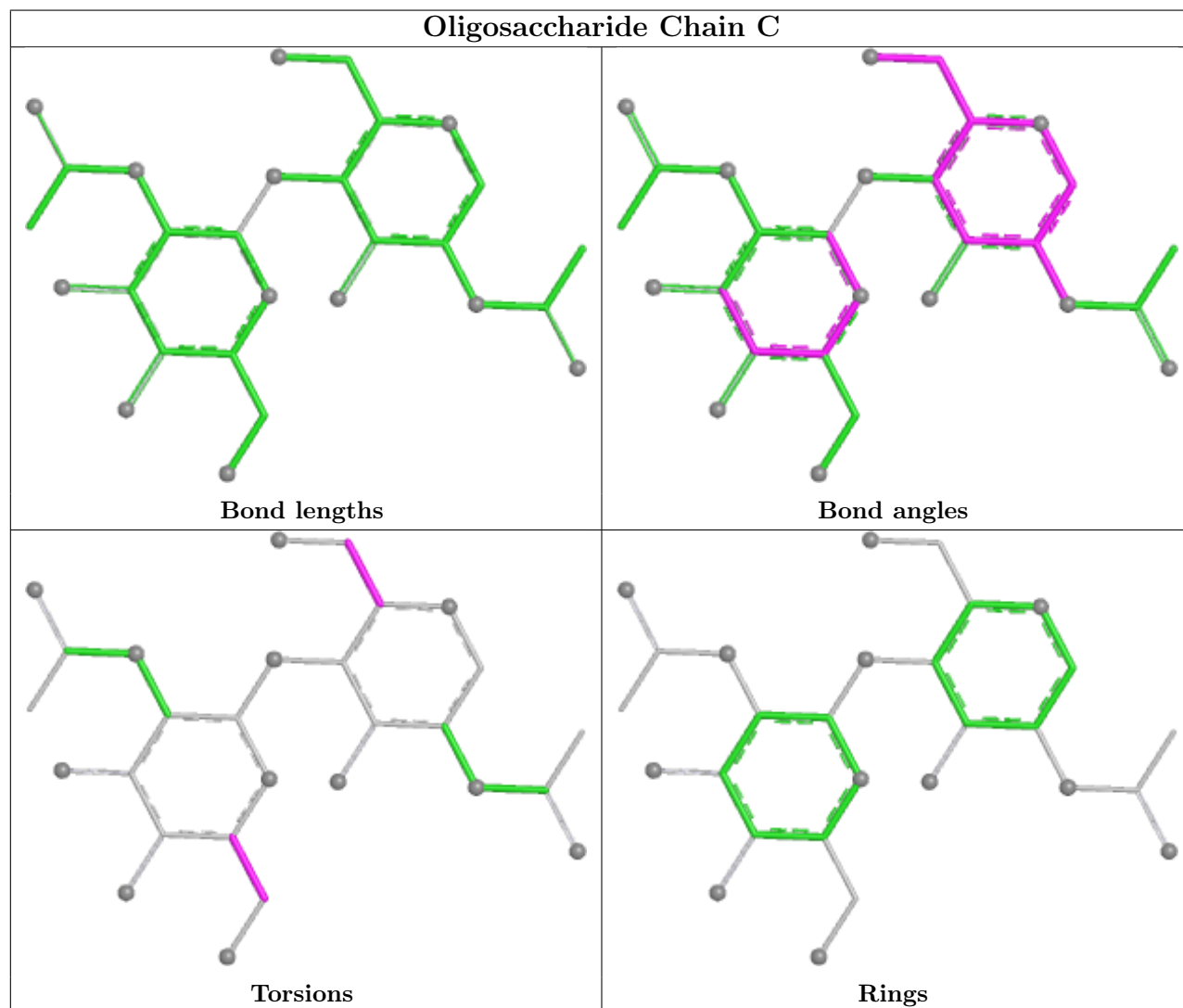
Mol	Chain	Res	Type	Atoms
4	I	3	SIA	C7-C8-C9-O9
4	I	3	SIA	O8-C8-C9-O9
2	C	1	NAG	O5-C5-C6-O6
2	E	1	NAG	C8-C7-N2-C2
2	E	1	NAG	O7-C7-N2-C2
4	F	3	SIA	C11-C10-N5-C5
4	F	3	SIA	O10-C10-N5-C5
4	I	3	SIA	C11-C10-N5-C5
4	I	3	SIA	O10-C10-N5-C5
2	C	1	NAG	C4-C5-C6-O6
2	C	2	NAG	O5-C5-C6-O6
3	D	2	NAG	C4-C5-C6-O6
2	G	2	NAG	C4-C5-C6-O6
3	D	2	NAG	O5-C5-C6-O6
4	I	2	GAL	O5-C5-C6-O6
4	I	1	NGS	C8-C7-N2-C2
2	C	2	NAG	C4-C5-C6-O6
4	I	1	NGS	O7-C7-N2-C2
2	G	2	NAG	O5-C5-C6-O6
4	F	2	GAL	C4-C5-C6-O6
4	I	3	SIA	C6-C7-C8-C9
4	F	3	SIA	O8-C8-C9-O9
4	F	3	SIA	C7-C8-C9-O9
4	F	1	NGS	O5-C5-C6-O6

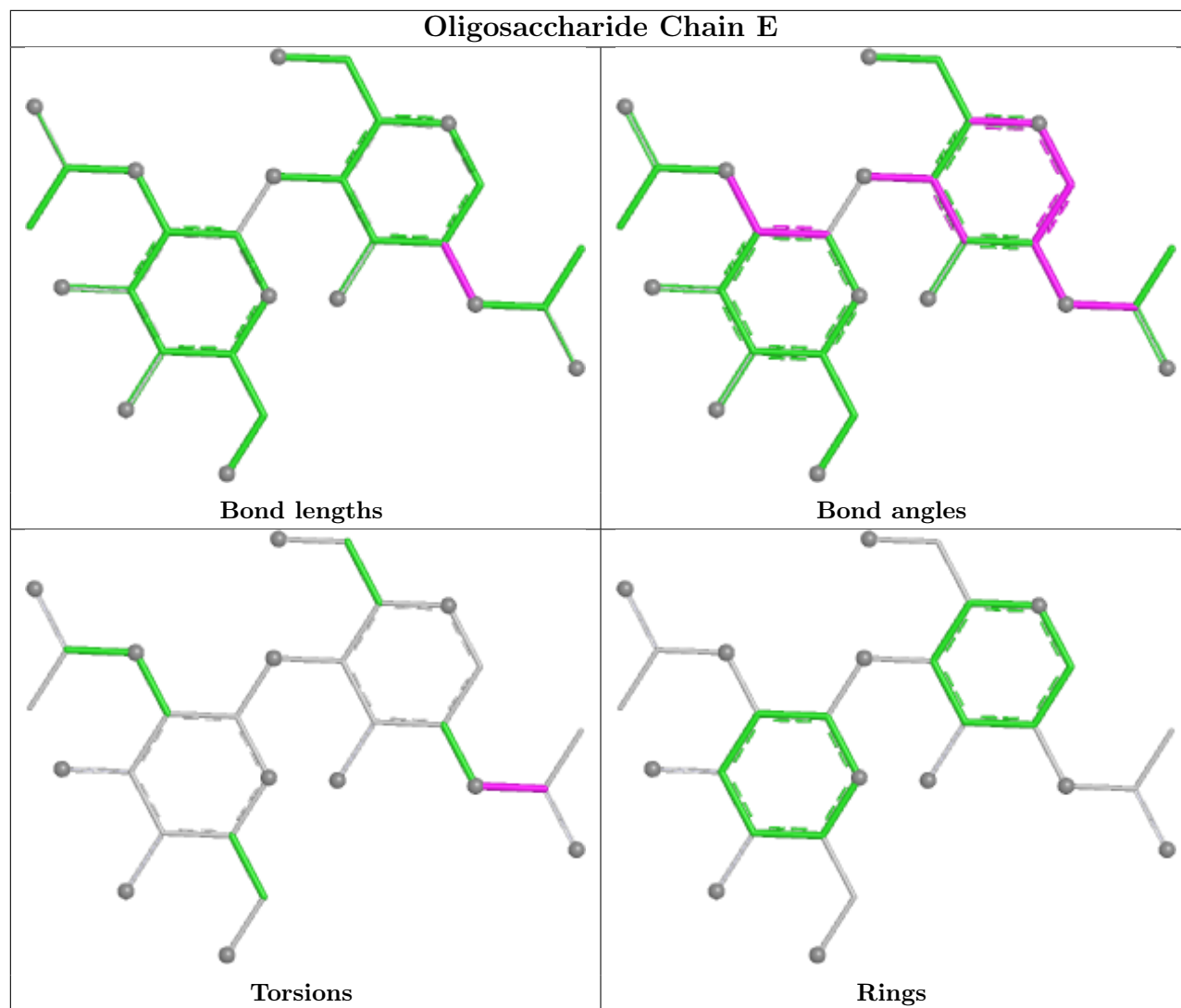
There are no ring outliers.

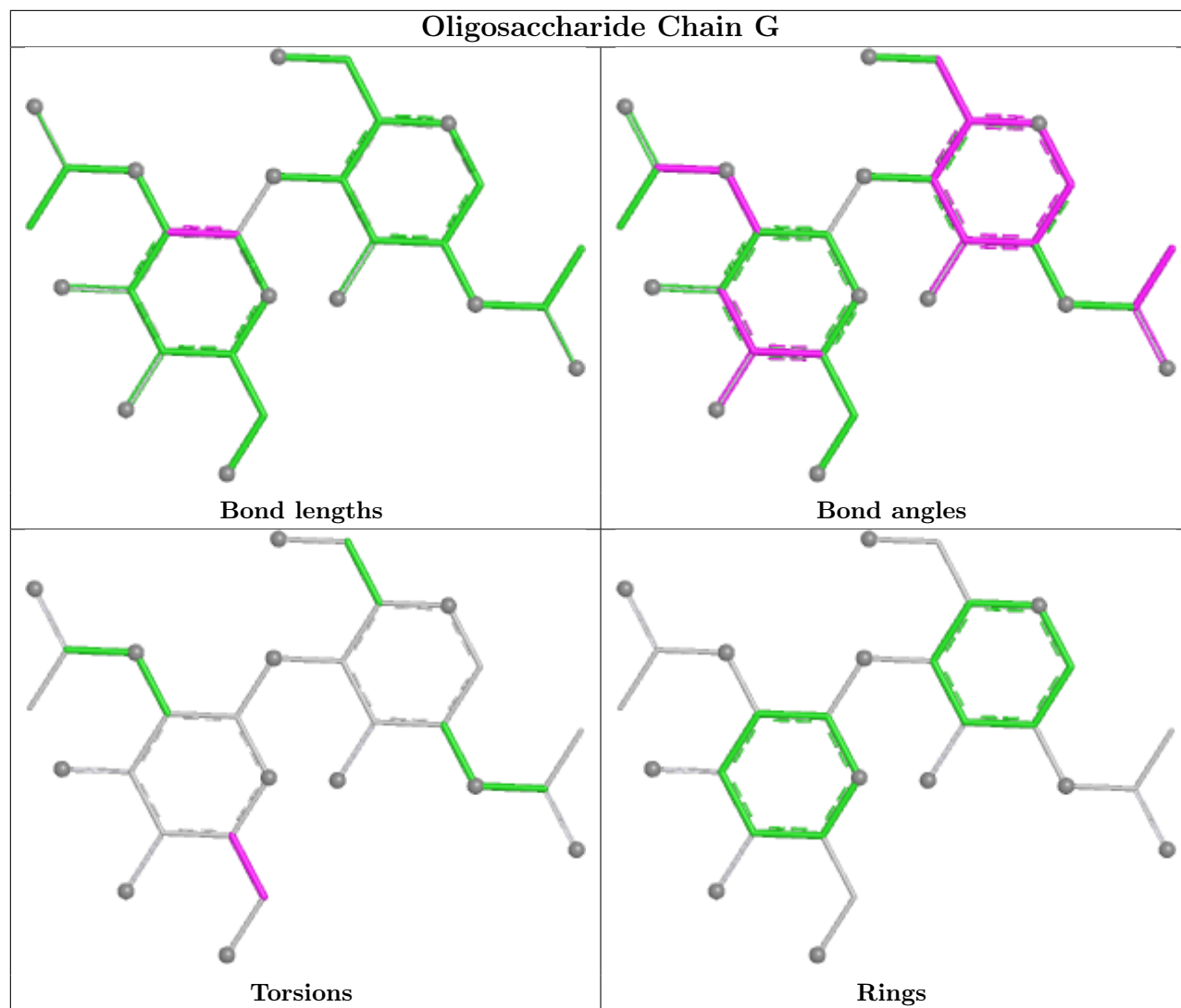
2 monomers are involved in 3 short contacts:

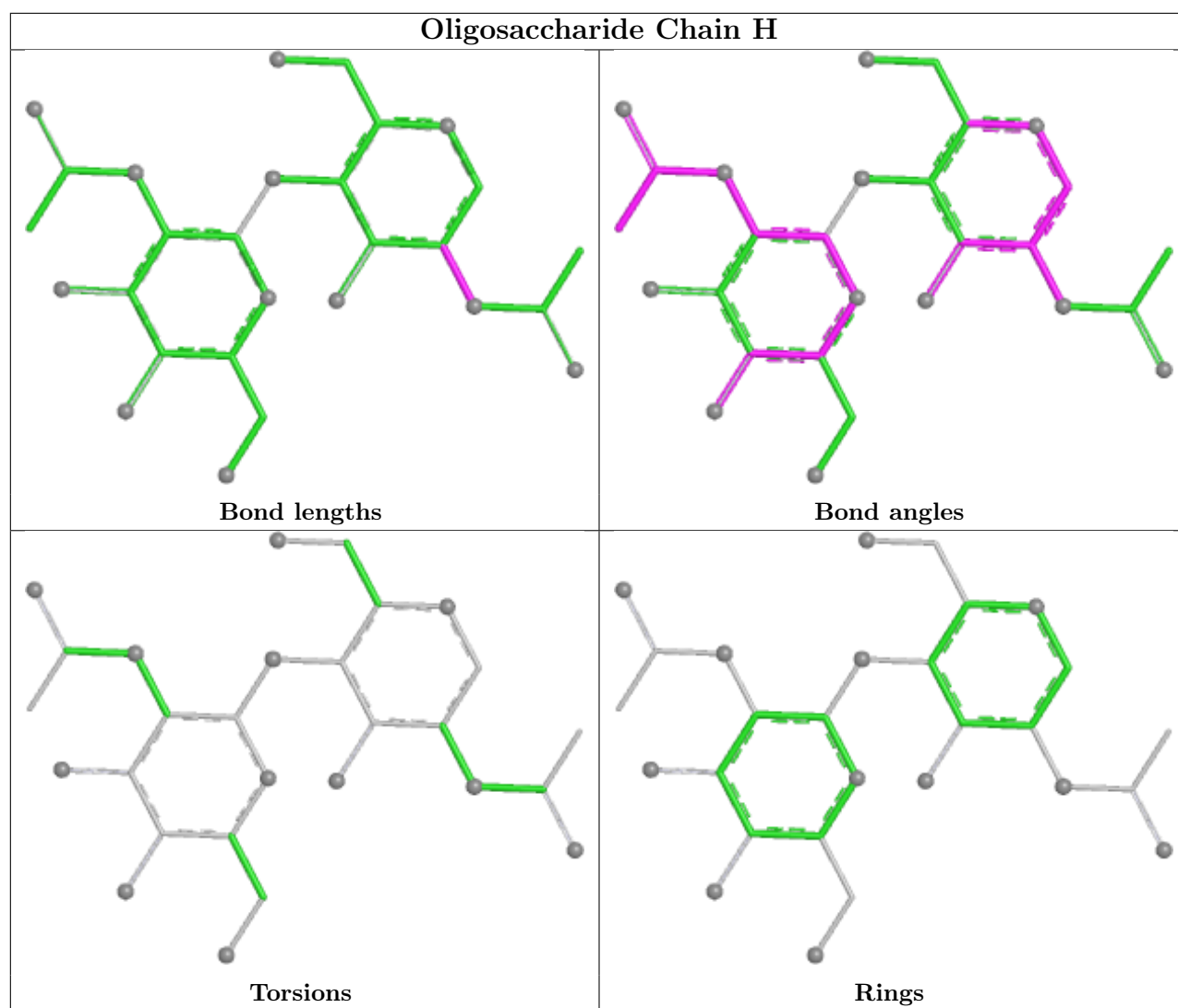
Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	F	3	SIA	1	0
4	I	3	SIA	2	0

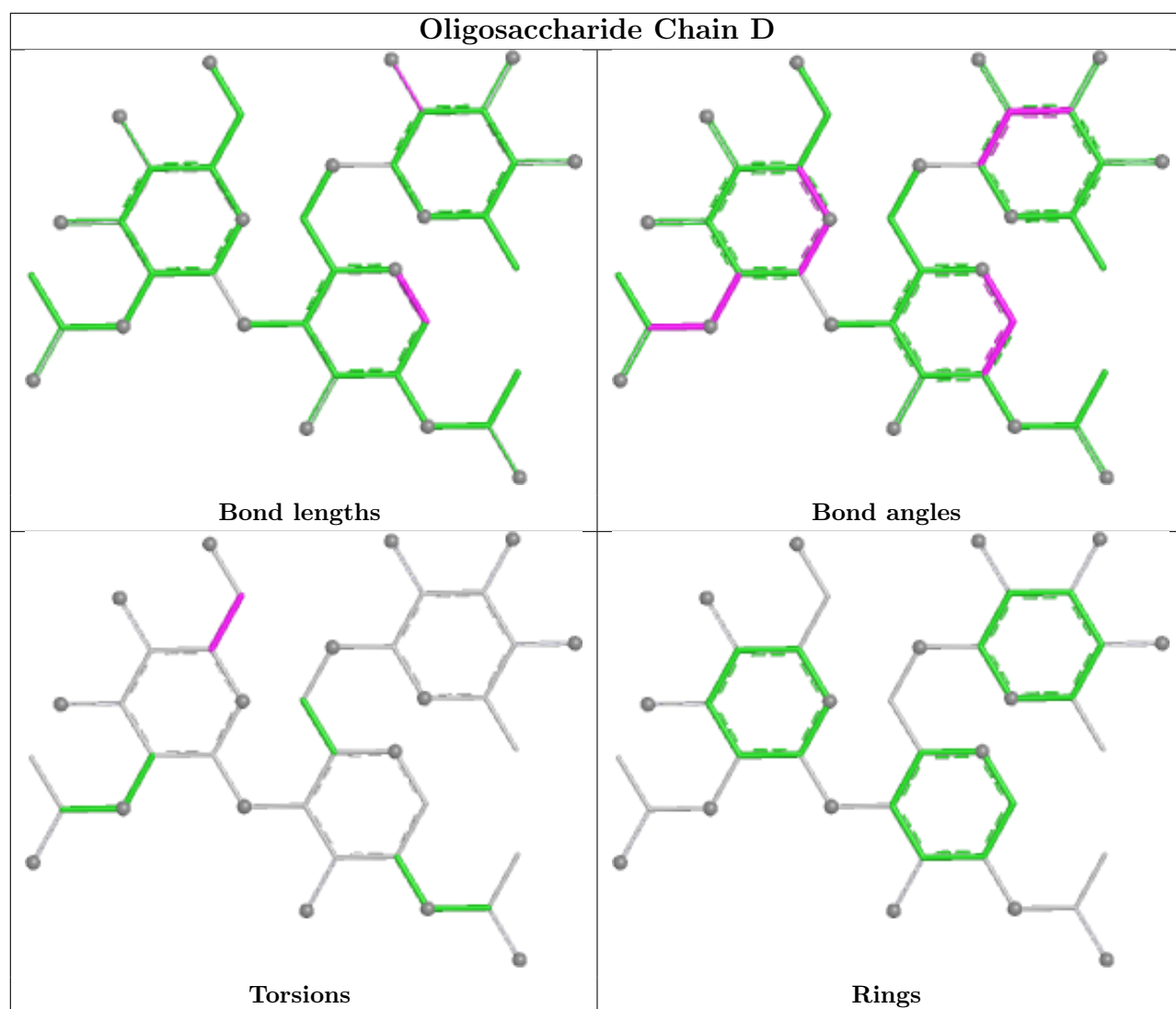
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.

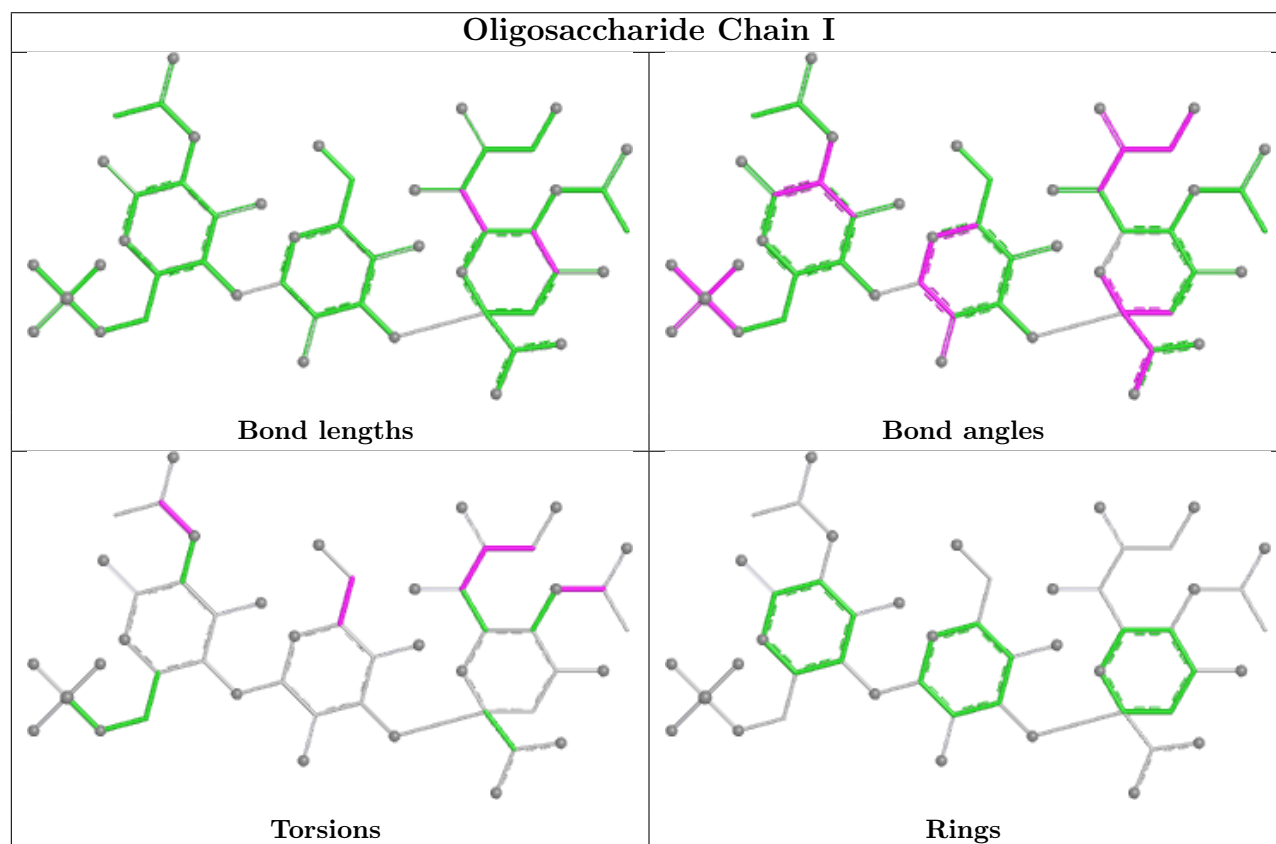
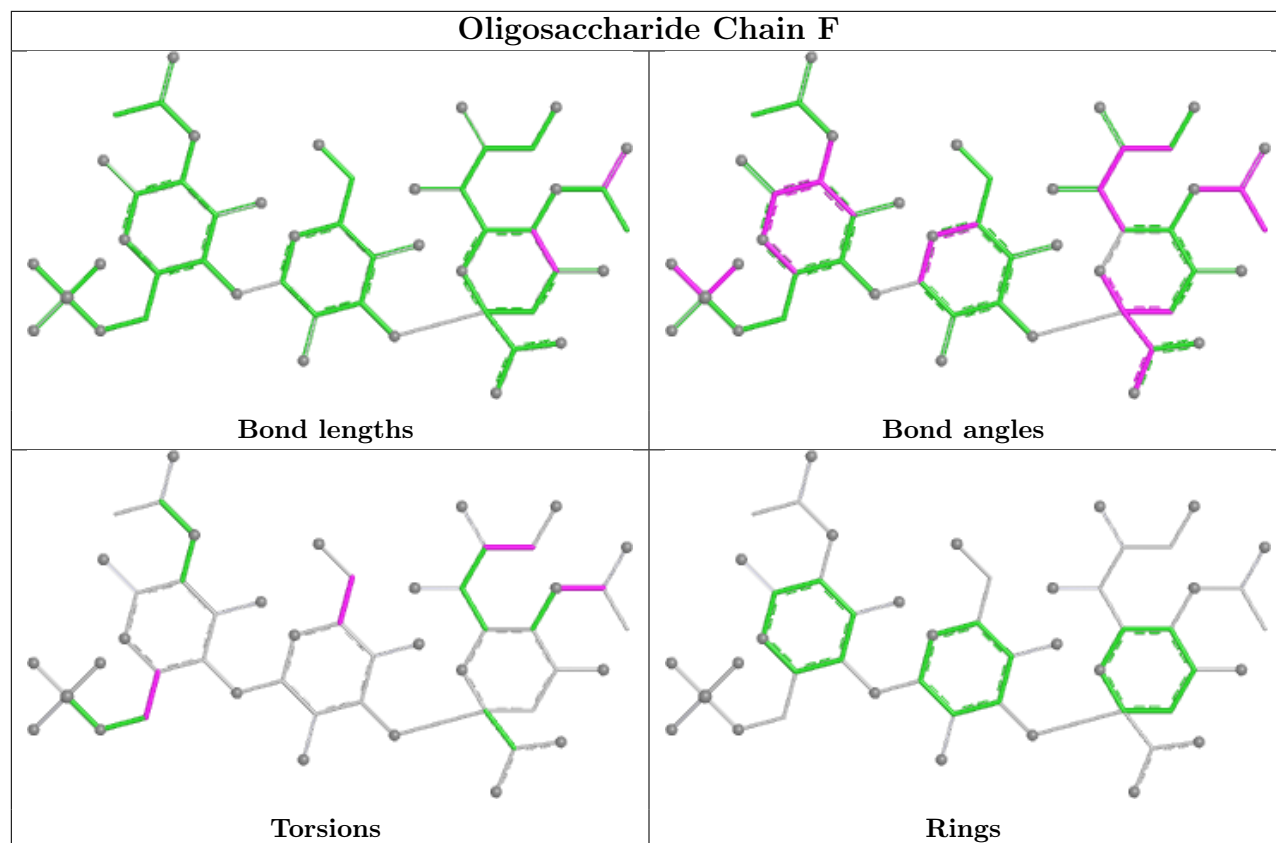












5.6 Ligand geometry

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$
5	NAG	B	406	1	14,14,15	0.81	0	17,19,21	2.72	8 (47%)
6	CSF	A	412	-	42,44,44	0.55	0	54,67,67	1.64	2 (3%)
6	CSF	B	410	-	42,44,44	0.62	1 (2%)	54,67,67	1.43	5 (9%)
5	NAG	B	405	1	14,14,15	0.62	0	17,19,21	2.60	6 (35%)
5	NAG	A	401	1	14,14,15	1.29	1 (7%)	17,19,21	3.96	12 (70%)

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	B	406	1	-	3/6/23/26	0/1/1/1
6	CSF	A	412	-	-	6/30/75/75	0/3/3/3
6	CSF	B	410	-	-	10/30/75/75	0/3/3/3
5	NAG	B	405	1	-	2/6/23/26	0/1/1/1
5	NAG	A	401	1	-	2/6/23/26	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	401	NAG	O4-C4	2.89	1.50	1.43
6	B	410	CSF	PA-O1A	2.18	1.65	1.59

All (33) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	401	NAG	C1-O5-C5	8.22	123.20	112.19
6	A	412	CSF	C3A-C4A-C5A	8.16	119.43	109.87

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	412	CSF	C2A-O6A-C6A	7.45	123.79	114.17
5	B	405	NAG	C1-O5-C5	7.45	122.17	112.19
6	B	410	CSF	C3A-C4A-C5A	7.29	118.41	109.87
5	A	401	NAG	O5-C1-C2	-6.04	101.94	111.29
5	B	406	NAG	C2-N2-C7	5.21	129.88	122.90
5	B	406	NAG	C4-C3-C2	-5.11	103.53	111.02
5	A	401	NAG	C8-C7-N2	5.04	124.47	116.12
5	A	401	NAG	O3-C3-C2	-5.00	99.02	109.40
5	B	406	NAG	O5-C1-C2	-4.75	103.94	111.29
5	A	401	NAG	O4-C4-C3	4.52	121.04	110.38
5	B	406	NAG	C1-C2-N2	4.46	117.46	110.43
5	A	401	NAG	O4-C4-C5	4.45	120.28	109.32
5	A	401	NAG	O7-C7-C8	-4.42	114.18	122.05
5	B	405	NAG	C8-C7-N2	4.28	123.22	116.12
6	B	410	CSF	O2'-C2'-C3'	-4.13	98.57	111.82
5	A	401	NAG	C3-C4-C5	-4.13	102.75	110.23
5	B	405	NAG	O7-C7-C8	-3.34	116.10	122.05
5	A	401	NAG	C2-N2-C7	3.06	127.00	122.90
6	B	410	CSF	C2A-O6A-C6A	2.93	117.95	114.17
5	A	401	NAG	O5-C5-C6	-2.86	102.09	107.66
5	B	406	NAG	O5-C5-C6	2.72	112.96	107.66
5	B	405	NAG	C1-C2-N2	-2.65	106.26	110.43
5	B	406	NAG	O4-C4-C3	2.59	116.47	110.38
6	B	410	CSF	O3'-C3'-C2'	-2.22	104.71	111.82
5	B	406	NAG	O3-C3-C2	2.19	113.94	109.40
5	B	406	NAG	C1-O5-C5	2.18	115.11	112.19
5	A	401	NAG	O5-C5-C4	2.14	116.03	110.83
6	B	410	CSF	O8A-C8A-C7A	2.12	114.21	109.25
5	A	401	NAG	O6-C6-C5	-2.10	104.19	111.33
5	B	405	NAG	O5-C1-C2	-2.09	108.06	111.29
5	B	405	NAG	O3-C3-C4	-2.08	105.48	110.38

There are no chirality outliers.

All (23) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	A	412	CSF	C7A-C8A-C9A-O9A
6	A	412	CSF	O8A-C8A-C9A-O9A
6	A	412	CSF	C2A-O1A-PA-O5'
6	B	410	CSF	C5A-C6A-C7A-C8A
6	B	410	CSF	C5A-C6A-C7A-O7A
6	B	410	CSF	O6A-C6A-C7A-C8A

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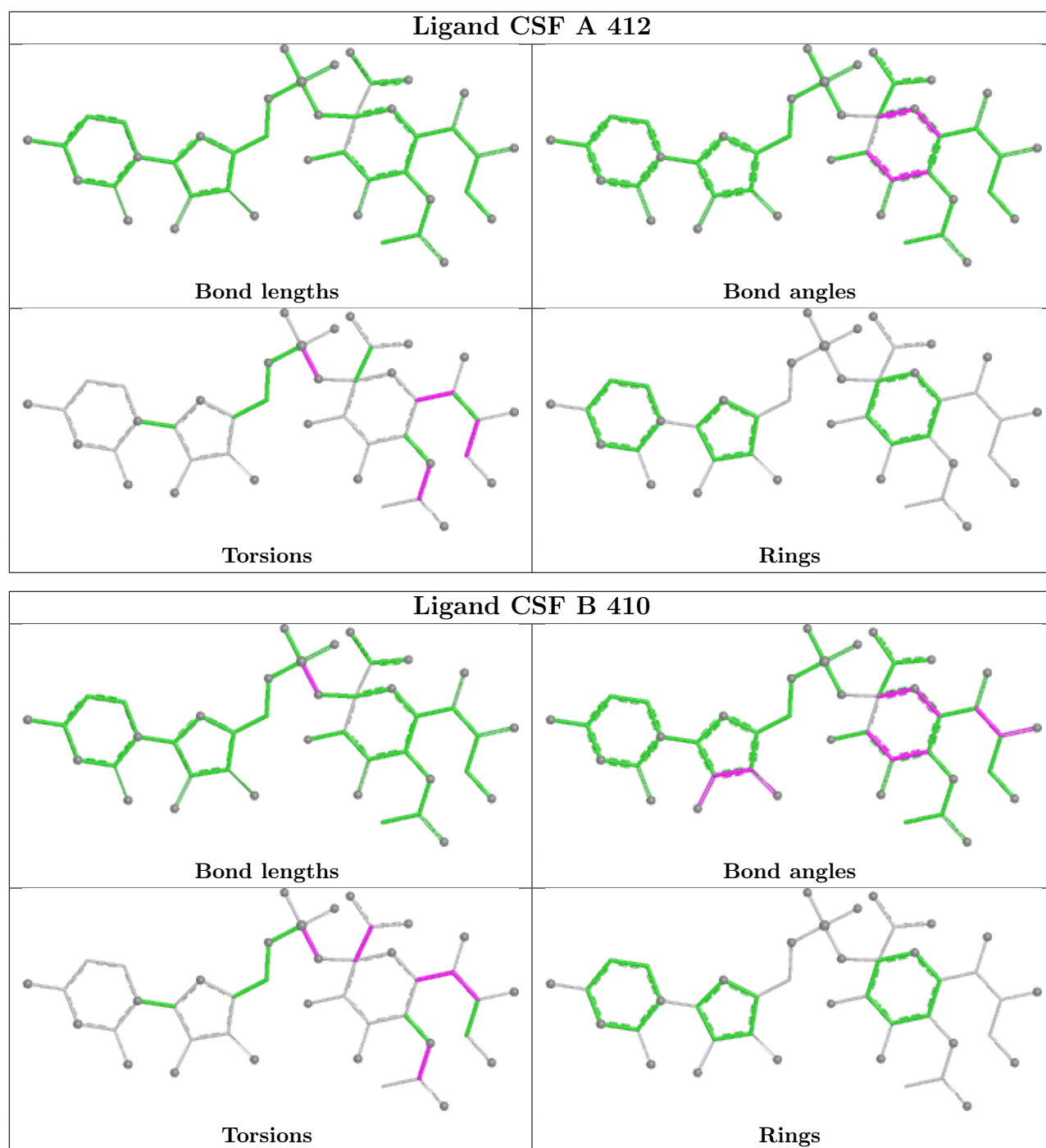
Mol	Chain	Res	Type	Atoms
6	B	410	CSF	O6A-C6A-C7A-O7A
5	A	401	NAG	C8-C7-N2-C2
5	A	401	NAG	O7-C7-N2-C2
5	B	405	NAG	C8-C7-N2-C2
5	B	405	NAG	O7-C7-N2-C2
6	A	412	CSF	C11-C10-N5A-C5A
6	B	410	CSF	C6A-C7A-C8A-O8A
6	B	410	CSF	C11-C10-N5A-C5A
6	A	412	CSF	O10-C10-N5A-C5A
6	B	410	CSF	O10-C10-N5A-C5A
6	B	410	CSF	C2A-O1A-PA-O5'
6	B	410	CSF	OAA-C1A-C2A-O6A
5	B	406	NAG	O5-C5-C6-O6
5	B	406	NAG	C1-C2-N2-C7
6	A	412	CSF	C5A-C6A-C7A-O7A
6	B	410	CSF	C6A-C7A-C8A-C9A
5	B	406	NAG	C3-C2-N2-C7

There are no ring outliers.

1 monomer is involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	401	NAG	6	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 than 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.



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	286/323 (88%)	-0.10	6 (2%) 63 65	25, 39, 65, 98	0
1	B	277/323 (85%)	-0.01	5 (1%) 67 69	27, 41, 72, 93	0
All	All	563/646 (87%)	-0.06	11 (1%) 65 66	25, 40, 70, 98	0

All (11) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	380	ALA	4.8
1	A	342	LYS	4.6
1	B	380	ALA	3.6
1	B	356	LEU	3.2
1	A	352	GLU	3.1
1	A	346	PHE	2.9
1	A	345	LYS	2.7
1	A	343	GLY	2.6
1	B	297	LYS	2.3
1	B	329	ASN	2.1
1	B	287	ARG	2.1

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

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

6.3 Carbohydrates [i](#)

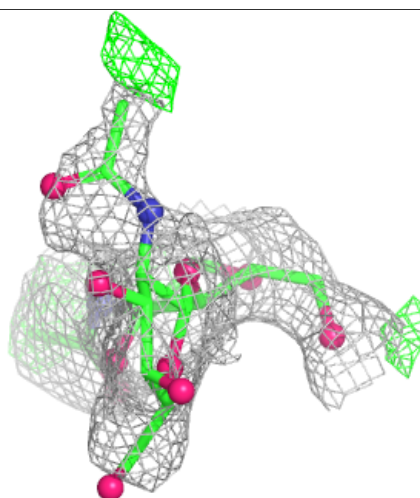
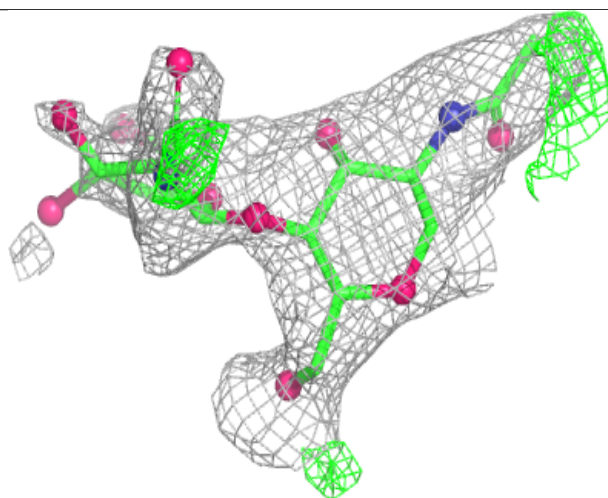
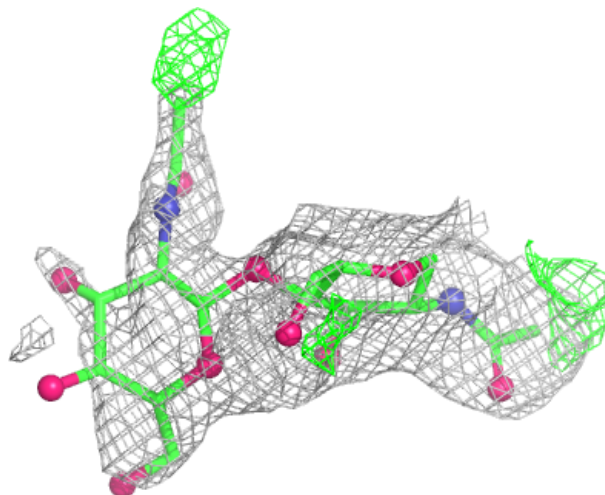
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q < 0.9’ lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
2	NAG	C	2	14/15	0.60	0.16	87,95,100,100	0
2	NAG	C	1	14/15	0.73	0.15	71,76,82,89	0
4	NGS	F	1	19/19	0.75	0.15	77,96,122,125	0
3	NAG	D	2	14/15	0.83	0.11	59,63,68,69	0
4	NGS	I	1	19/19	0.83	0.12	71,81,88,90	0
2	NAG	G	2	14/15	0.84	0.11	44,53,55,62	0
2	NAG	E	2	14/15	0.84	0.11	50,54,68,77	0
2	NAG	H	2	14/15	0.88	0.10	53,60,66,69	0
4	GAL	I	2	11/12	0.89	0.10	44,53,59,60	0
4	SIA	F	3	20/21	0.91	0.09	33,40,55,60	0
4	SIA	I	3	20/21	0.91	0.09	36,44,50,51	0
4	GAL	F	2	11/12	0.92	0.09	41,55,63,64	0
3	FUC	D	3	10/11	0.93	0.09	45,48,51,51	0
2	NAG	E	1	14/15	0.94	0.07	31,37,39,44	0
3	NAG	D	1	14/15	0.95	0.07	38,40,49,52	0
2	NAG	G	1	14/15	0.96	0.07	31,35,42,46	0
2	NAG	H	1	14/15	0.96	0.07	38,42,51,55	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.

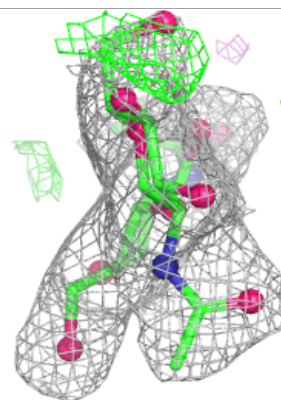
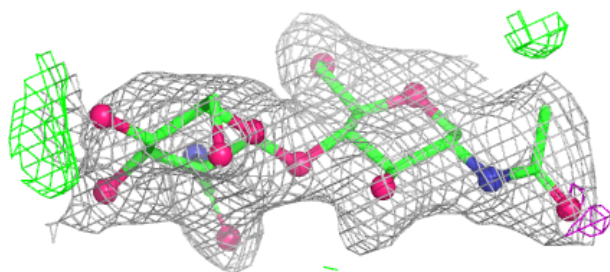
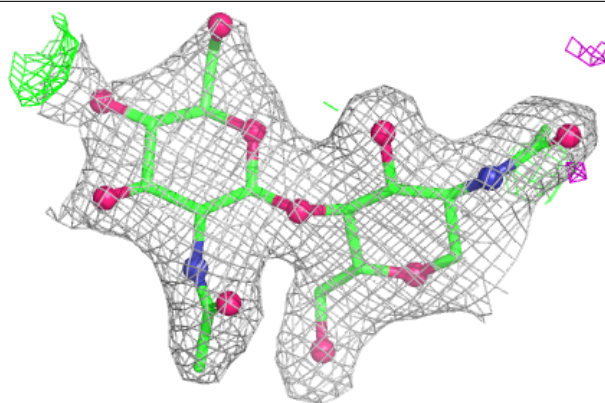
Electron density around Chain C:

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

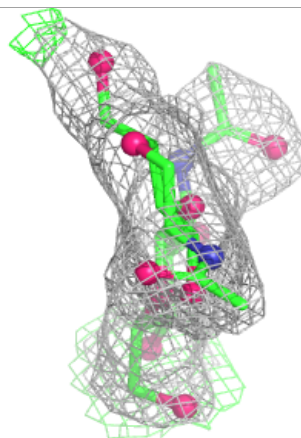
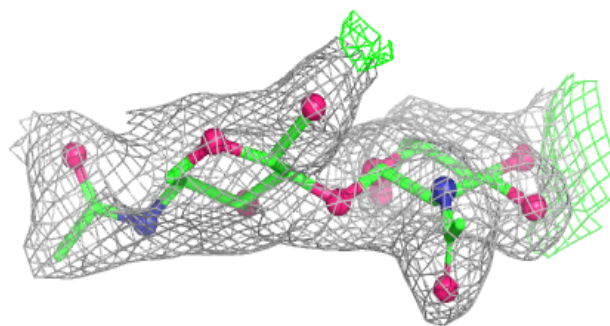
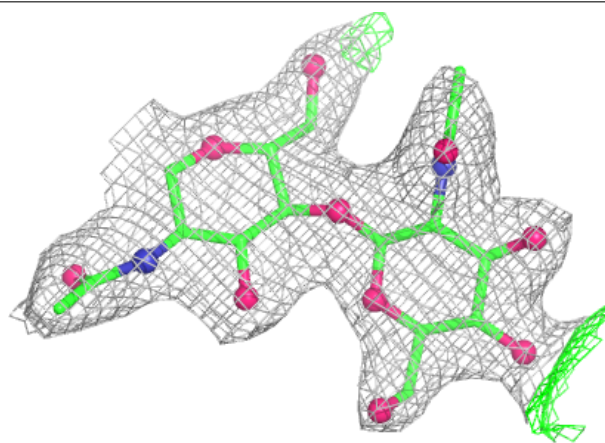


Electron density around Chain E:

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

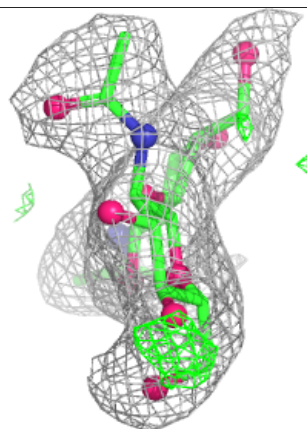
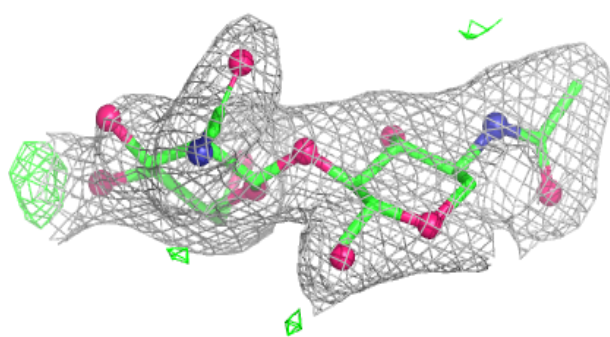
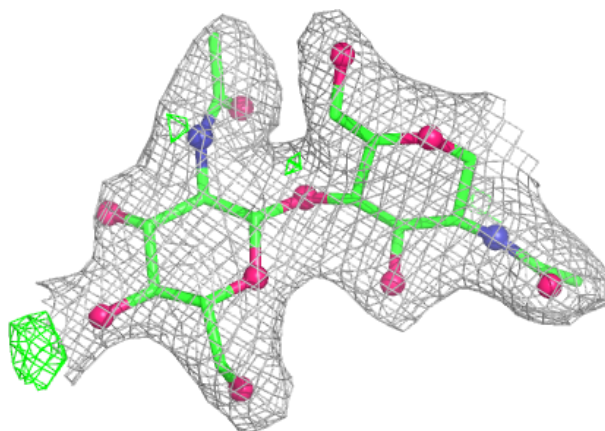
**Electron density around Chain G:**

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



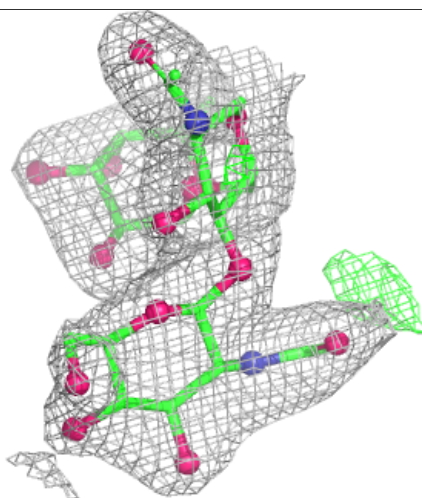
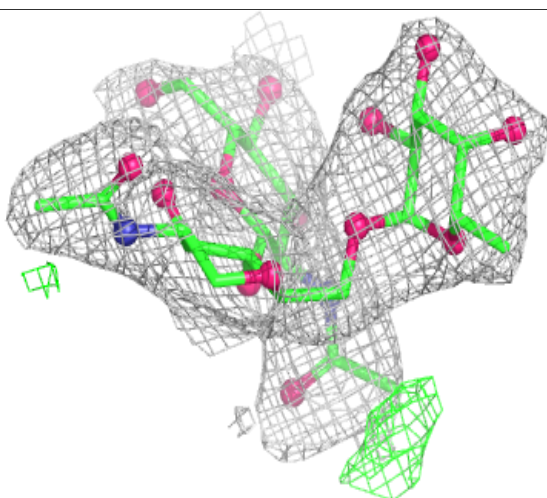
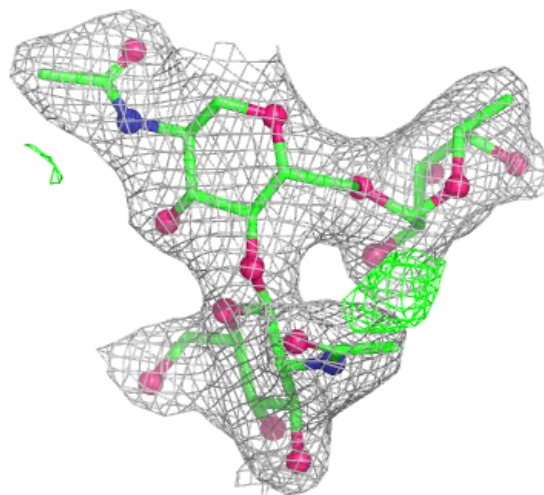
Electron density around Chain H:

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



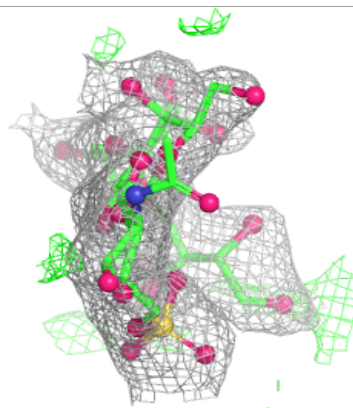
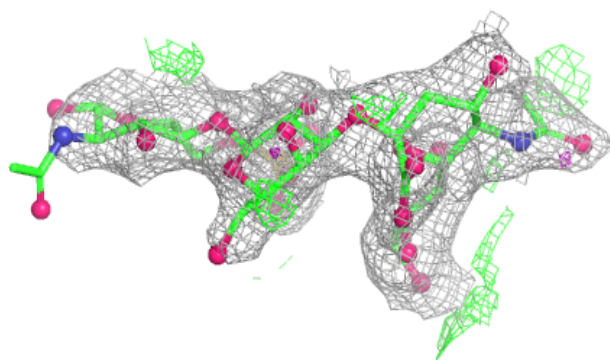
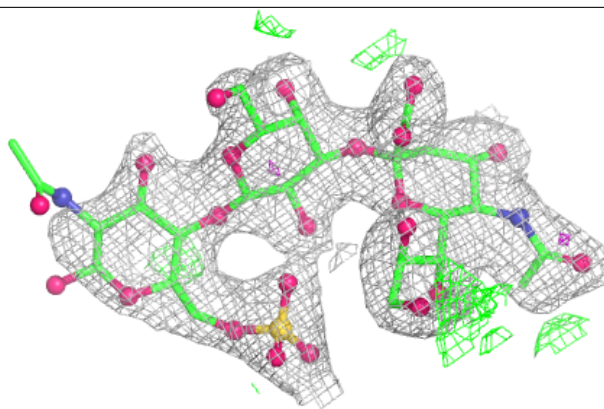
Electron density around Chain D:

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

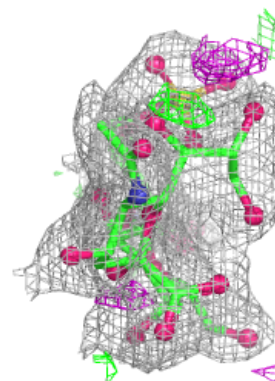
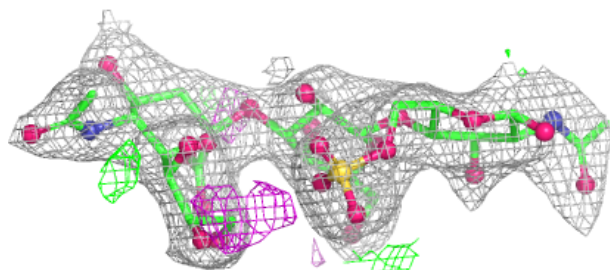
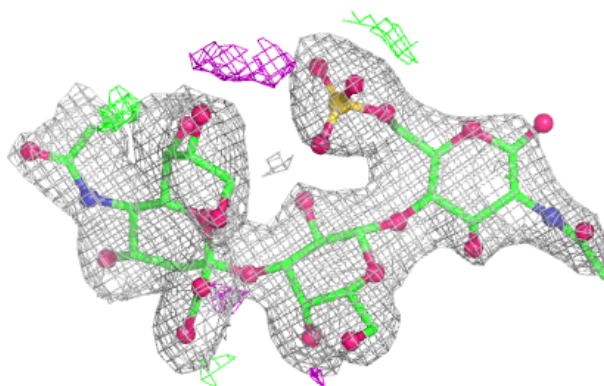


Electron density around Chain F:

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

**Electron density around Chain I:**

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



6.4 Ligands ⓘ

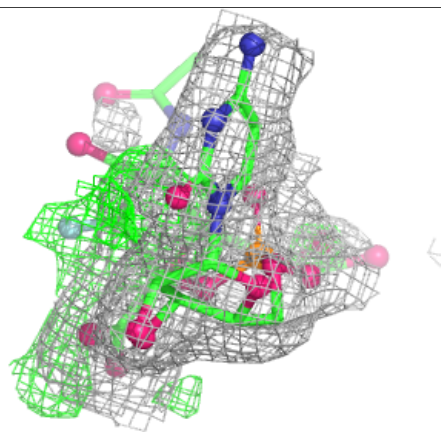
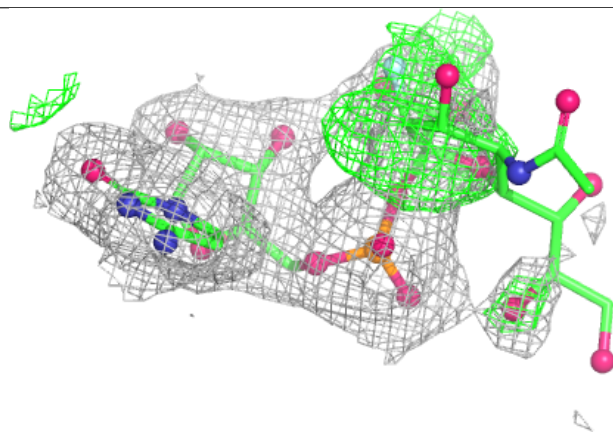
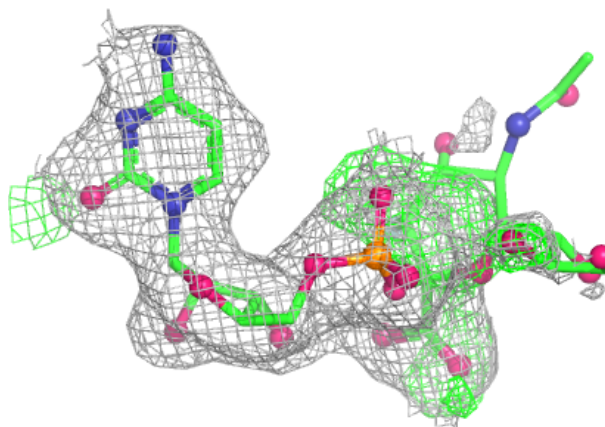
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q<0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
5	NAG	B	406	14/15	0.69	0.16	79,86,98,98	0
5	NAG	B	405	14/15	0.74	0.16	71,78,83,83	0
5	NAG	A	401	14/15	0.86	0.09	31,36,39,43	0
6	CSF	A	412	42/42	0.91	0.09	31,53,108,114	17
6	CSF	B	410	42/42	0.93	0.09	35,54,128,151	17

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.

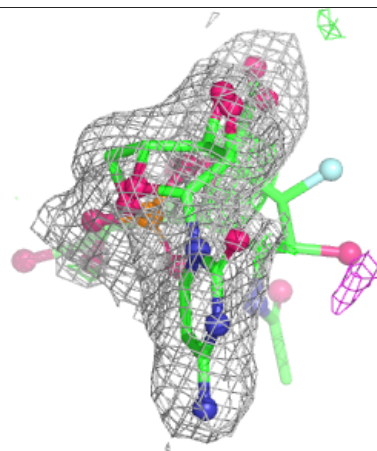
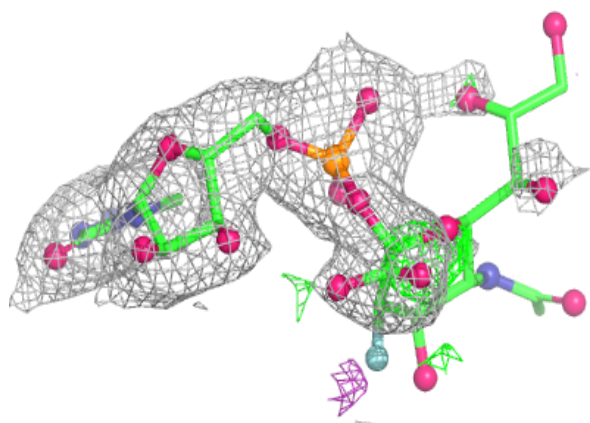
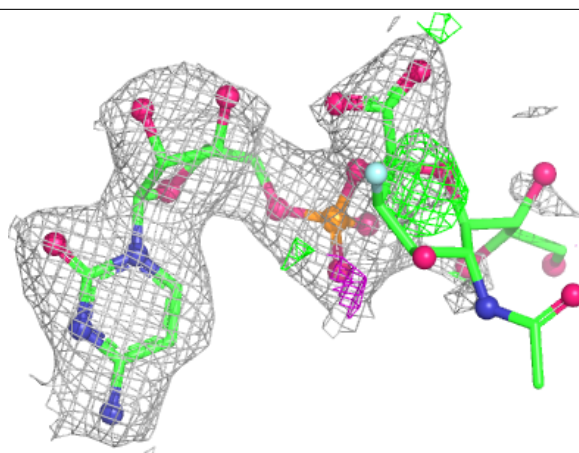
Electron density around CSF A 412:

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 CSF B 410:

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



6.5 Other polymers [i](#)

There are no such residues in this entry.