



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 12:03 AM UTC

PDB ID : 5CXY / pdb_00005cxy
Title : Structure of a Glycosyltransferase in Complex with Inhibitor
Authors : Volkers, G.; Strynadka, N.C.J.
Deposited on : 2015-07-29
Resolution : 2.15 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

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<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

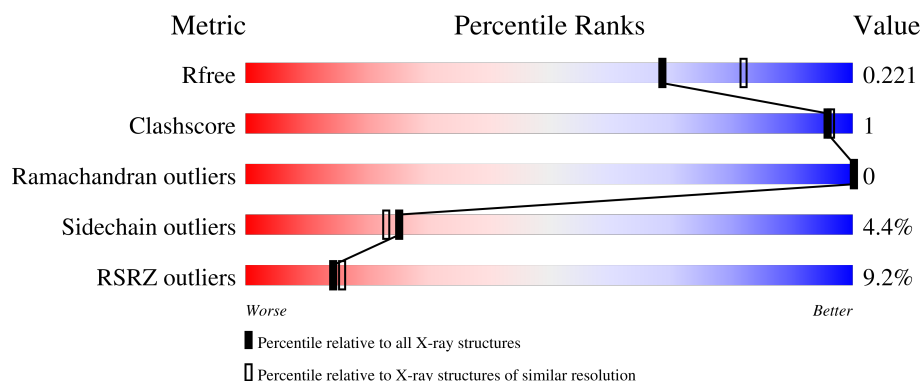
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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	2057 (2.16-2.16)
Clashscore	190562	2159 (2.16-2.16)
Ramachandran outliers	187476	2134 (2.16-2.16)
Sidechain outliers	187428	2133 (2.16-2.16)
RSRZ outliers	180081	2059 (2.16-2.16)

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	5% 85% 5% 10%
1	B	323	12% 83% 7% 10%
2	C	3	33% 67%
3	D	2	100%
3	F	2	100%

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Mol	Chain	Length	Quality of chain
3	G	2	 100%
3	H	2	 100%
4	E	3	 33%  67%

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 5229 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	292	Total	C	N	O	S	0	0	0
			2395	1546	418	421	10			
1	B	292	Total	C	N	O	S	0	0	0
			2410	1558	420	422	10			

There are 46 discrepancies between the modelled and reference sequences:

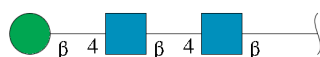
Chain	Residue	Modelled	Actual	Comment	Reference
A	58	ALA	-	expression tag	UNP O43173
A	59	PRO	-	expression tag	UNP O43173
A	60	GLU	-	expression tag	UNP O43173
A	61	HIS	-	expression tag	UNP O43173
A	62	HIS	-	expression tag	UNP O43173
A	63	HIS	-	expression tag	UNP O43173
A	64	HIS	-	expression tag	UNP O43173
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 beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



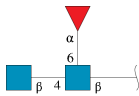
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	3	Total	C	N	O	0	0	0
			39	22	2	15			

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



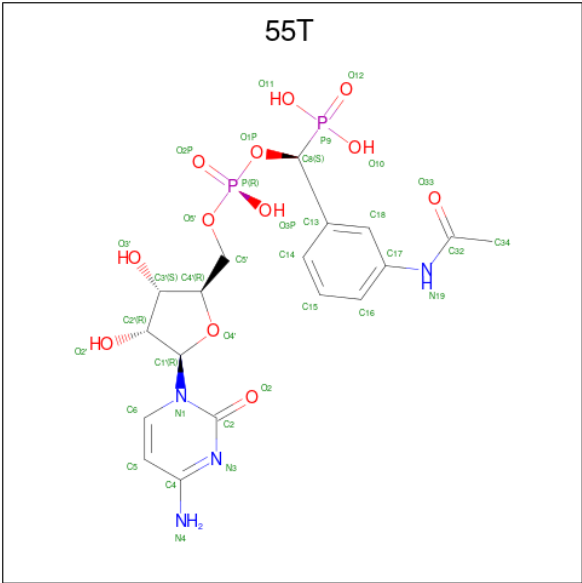
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	D	2	Total	C	N	O	0	0	0
			28	16	2	10			
3	F	2	Total	C	N	O	0	0	0
			28	16	2	10			
3	G	2	Total	C	N	O	0	0	0
			28	16	2	10			
3	H	2	Total	C	N	O	0	0	0
			28	16	2	10			

- Molecule 4 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
4	E	3	Total	C	N	O	0	0	0
			38	22	2	14			

- Molecule 5 is 5'-O-[(R)-[(S)-[3-(acetamino)phenyl](phosphono)methoxy](hydroxy)phosphoryl]cytidine (CCD ID: 55T) (formula: C₁₈H₂₄N₄O₁₂P₂).



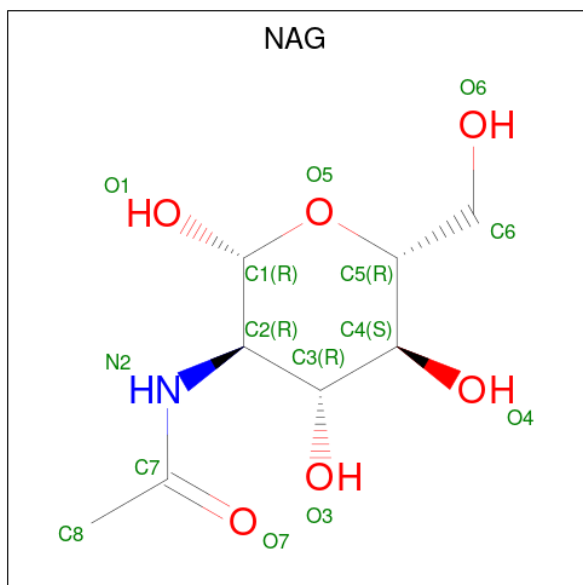
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	N	O	P	0	0
			36	18	4	12	2		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	B	1	Total	C	N	O	P	0	0
			36	18	4	12	2		

- Molecule 6 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: $C_8H_{15}NO_6$).



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

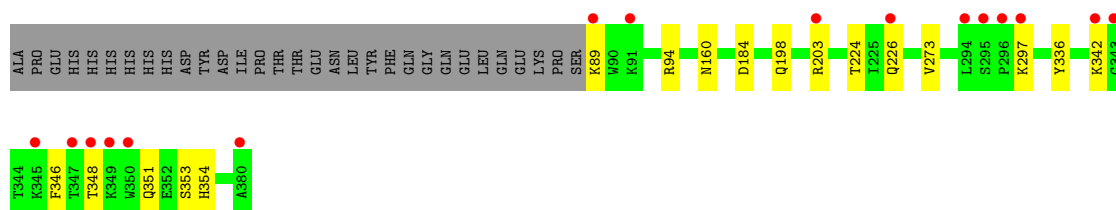
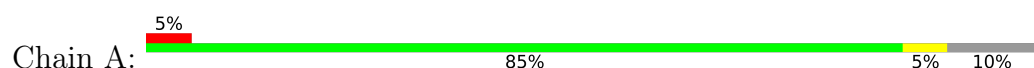
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	82	Total	O	0	0
			82	82		
7	B	53	Total	O	0	0
			53	53		

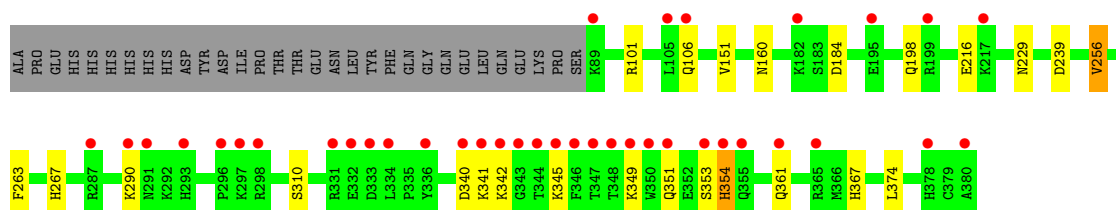
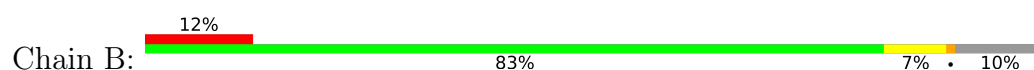
3 Residue-property plots [i](#)

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



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



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

Chain F:  100%

MAG1
MAG2

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

Chain G:  100%

MAG1
MAG2

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

Chain H:  100%

MAG1
MAG2

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

Chain E:  33% 67%

MAG1
MAG2
FUC3

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	72.84Å 96.64Å 124.78Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	52.72 – 2.15 52.72 – 2.15	Depositor EDS
% Data completeness (in resolution range)	100.0 (52.72-2.15) 100.0 (52.72-2.15)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.37 (at 2.16Å)	Xtriage
Refinement program	REFMAC 5.8.0123	Depositor
R, R_{free}	0.198 , 0.235 (Not available) , 0.221	Depositor DCC
R_{free} test set	2407 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å ²)	30.7	Xtriage
Anisotropy	0.397	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 28.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	5229	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.66% 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: BMA, 55T, FUC, NAG

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	1.16	2/2464 (0.1%)	1.03	3/3338 (0.1%)
1	B	1.09	0/2481	1.08	2/3360 (0.1%)
All	All	1.13	2/4945 (0.0%)	1.06	5/6698 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	273	VAL	C-O	-5.17	1.18	1.24
1	A	224	THR	CA-C	-5.17	1.46	1.52

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	354	HIS	N-CA-C	10.54	127.94	114.56
1	A	94	ARG	NE-CZ-NH2	-7.74	112.23	119.20
1	A	94	ARG	CD-NE-CZ	5.82	132.55	124.40
1	A	94	ARG	NE-CZ-NH1	5.70	127.20	121.50
1	B	256	VAL	CB-CA-C	-5.63	103.14	112.26

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	353	SER	Peptide

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	2395	0	2331	4	0
1	B	2410	0	2349	7	0
2	C	39	0	34	0	0
3	D	28	0	25	0	0
3	F	28	0	25	0	0
3	G	28	0	25	0	0
3	H	28	0	25	0	0
4	E	38	0	34	0	0
5	A	36	0	0	2	0
5	B	36	0	0	1	0
6	B	28	0	26	0	0
7	A	82	0	0	0	0
7	B	53	0	0	0	0
All	All	5229	0	4874	11	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 1.

All (11) 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:B:367:HIS:HD2	1:B:374:LEU:H	1.41	0.69
1:B:340:ASP:OD2	1:B:340:ASP:O	2.18	0.60
1:B:101:ARG:HD3	1:B:310:SER:O	2.09	0.53
1:B:263:PHE:O	1:B:267:HIS:HD2	1.95	0.49
1:A:336:TYR:OH	5:A:411:55T:C15	2.61	0.48
1:B:354:HIS:NE2	5:B:407:55T:O11	2.37	0.47
1:A:354:HIS:NE2	5:A:411:55T:O11	2.49	0.44
1:B:367:HIS:CD2	1:B:374:LEU:H	2.28	0.44
1:B:160:ASN:HB3	1:B:184:ASP:OD2	2.20	0.42
1:A:160:ASN:HB3	1:A:184:ASP:OD2	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:336:TYR:HD2	1:A:346:PHE:CE2	2.39	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	290/323 (90%)	284 (98%)	6 (2%)	0	100	100
1	B	290/323 (90%)	280 (97%)	10 (3%)	0	100	100
All	All	580/646 (90%)	564 (97%)	16 (3%)	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	261/294 (89%)	252 (97%)	9 (3%)	32	33
1	B	263/294 (90%)	249 (95%)	14 (5%)	20	17
All	All	524/588 (89%)	501 (96%)	23 (4%)	25	23

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	89	LYS
1	A	198	GLN
1	A	203	ARG
1	A	226	GLN
1	A	297	LYS
1	A	342	LYS
1	A	348	THR
1	A	351	GLN
1	A	353	SER
1	B	106	GLN
1	B	151	VAL
1	B	198	GLN
1	B	216	GLU
1	B	229	ASN
1	B	239	ASP
1	B	256	VAL
1	B	290	LYS
1	B	341	LYS
1	B	342	LYS
1	B	345	LYS
1	B	349	LYS
1	B	351	GLN
1	B	361	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	156	ASN
1	A	283	GLN
1	A	291	ASN
1	A	351	GLN
1	B	106	GLN
1	B	156	ASN
1	B	175	GLN
1	B	267	HIS
1	B	291	ASN
1	B	367	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 ⓘ

14 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	0.48	0	17,19,21	1.45	3 (17%)
2	NAG	C	2	2	14,14,15	0.64	0	17,19,21	0.96	1 (5%)
2	BMA	C	3	2	11,11,12	0.89	0	15,15,17	1.11	0
3	NAG	D	1	3,1	14,14,15	0.94	0	17,19,21	1.75	4 (23%)
3	NAG	D	2	3	14,14,15	0.47	0	17,19,21	1.25	2 (11%)
4	NAG	E	1	4,1	14,14,15	1.09	0	17,19,21	1.73	2 (11%)
4	NAG	E	2	4	14,14,15	1.39	2 (14%)	17,19,21	1.77	5 (29%)
4	FUC	E	3	4	10,10,11	0.52	0	14,14,16	0.59	0
3	NAG	F	1	3,1	14,14,15	1.11	2 (14%)	17,19,21	2.12	5 (29%)
3	NAG	F	2	3	14,14,15	0.73	0	17,19,21	1.44	5 (29%)
3	NAG	G	1	3,1	14,14,15	0.77	0	17,19,21	1.68	5 (29%)
3	NAG	G	2	3	14,14,15	0.75	0	17,19,21	1.45	3 (17%)
3	NAG	H	1	3,1	14,14,15	0.71	0	17,19,21	1.64	2 (11%)
3	NAG	H	2	3	14,14,15	1.09	0	17,19,21	1.48	4 (23%)

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	-	0/6/23/26	0/1/1/1
2	NAG	C	2	2	-	1/6/23/26	0/1/1/1
2	BMA	C	3	2	-	2/2/19/22	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	NAG	D	1	3,1	-	1/6/23/26	0/1/1/1
3	NAG	D	2	3	-	2/6/23/26	0/1/1/1
4	NAG	E	1	4,1	-	0/6/23/26	0/1/1/1
4	NAG	E	2	4	-	0/6/23/26	0/1/1/1
4	FUC	E	3	4	-	-	0/1/1/1
3	NAG	F	1	3,1	-	2/6/23/26	0/1/1/1
3	NAG	F	2	3	-	0/6/23/26	0/1/1/1
3	NAG	G	1	3,1	-	0/6/23/26	0/1/1/1
3	NAG	G	2	3	-	2/6/23/26	0/1/1/1
3	NAG	H	1	3,1	-	0/6/23/26	0/1/1/1
3	NAG	H	2	3	-	2/6/23/26	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	E	2	NAG	C1-C2	3.20	1.56	1.52
3	F	1	NAG	C8-C7	-2.89	1.44	1.50
3	F	1	NAG	C2-N2	-2.37	1.42	1.46
4	E	2	NAG	C3-C2	2.30	1.57	1.52

All (41) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	E	1	NAG	C1-C2-N2	5.45	119.02	110.43
3	F	1	NAG	C2-N2-C7	5.39	130.12	122.90
3	H	1	NAG	C1-O5-C5	4.93	118.79	112.19
3	D	1	NAG	C2-N2-C7	4.10	128.39	122.90
4	E	2	NAG	O5-C5-C6	3.65	114.76	107.66
4	E	2	NAG	C3-C4-C5	-3.50	103.88	110.23
3	F	1	NAG	C1-O5-C5	3.42	116.77	112.19
3	H	2	NAG	O4-C4-C5	3.20	117.20	109.32
3	G	1	NAG	C1-C2-N2	3.03	115.22	110.43
3	G	1	NAG	C4-C3-C2	2.89	115.25	111.02
3	G	1	NAG	O5-C1-C2	-2.87	106.85	111.29
3	H	1	NAG	O5-C1-C2	-2.79	106.98	111.29
3	G	2	NAG	O4-C4-C5	2.77	116.15	109.32
3	D	1	NAG	O7-C7-N2	2.69	126.73	121.98
2	C	1	NAG	O3-C3-C2	-2.62	103.97	109.40
4	E	2	NAG	O4-C4-C5	2.60	115.72	109.32
4	E	2	NAG	O5-C5-C4	-2.57	104.58	110.83
3	G	1	NAG	O4-C4-C3	-2.56	104.35	110.38

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	F	1	NAG	C1-C2-N2	-2.52	106.46	110.43
3	D	1	NAG	C8-C7-N2	-2.52	111.94	116.12
3	H	2	NAG	C2-N2-C7	2.48	126.22	122.90
3	F	2	NAG	C1-O5-C5	-2.46	108.89	112.19
2	C	2	NAG	O3-C3-C2	-2.41	104.39	109.40
3	H	2	NAG	O5-C5-C6	2.40	112.34	107.66
2	C	1	NAG	O5-C5-C6	2.39	112.32	107.66
3	F	2	NAG	C2-N2-C7	2.36	126.06	122.90
3	G	2	NAG	C1-O5-C5	2.34	115.32	112.19
4	E	1	NAG	O5-C5-C6	-2.29	103.21	107.66
2	C	1	NAG	C8-C7-N2	-2.28	112.34	116.12
3	F	1	NAG	O5-C1-C2	-2.27	107.78	111.29
3	G	1	NAG	O7-C7-C8	-2.26	118.02	122.05
3	D	1	NAG	O6-C6-C5	2.25	119.00	111.33
3	D	2	NAG	C2-N2-C7	2.22	125.88	122.90
3	F	2	NAG	C1-C2-N2	-2.19	106.98	110.43
3	D	2	NAG	O4-C4-C3	-2.17	105.26	110.38
3	F	2	NAG	C3-C4-C5	-2.16	106.32	110.23
3	H	2	NAG	C3-C4-C5	-2.10	106.43	110.23
3	F	2	NAG	O4-C4-C5	2.05	114.38	109.32
3	F	1	NAG	O4-C4-C3	-2.03	105.59	110.38
3	G	2	NAG	C4-C3-C2	-2.02	108.06	111.02
4	E	2	NAG	C6-C5-C4	2.02	117.97	113.02

There are no chirality outliers.

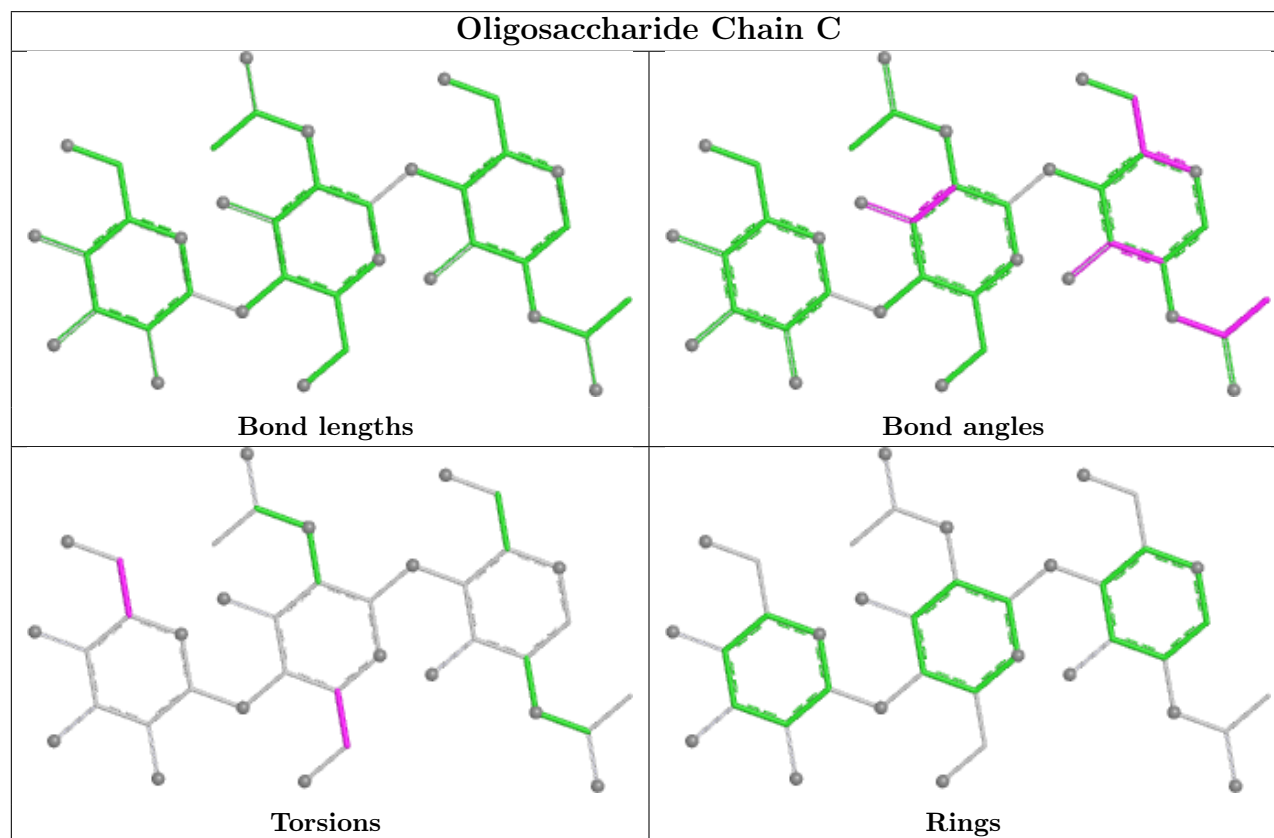
All (12) torsion outliers are listed below:

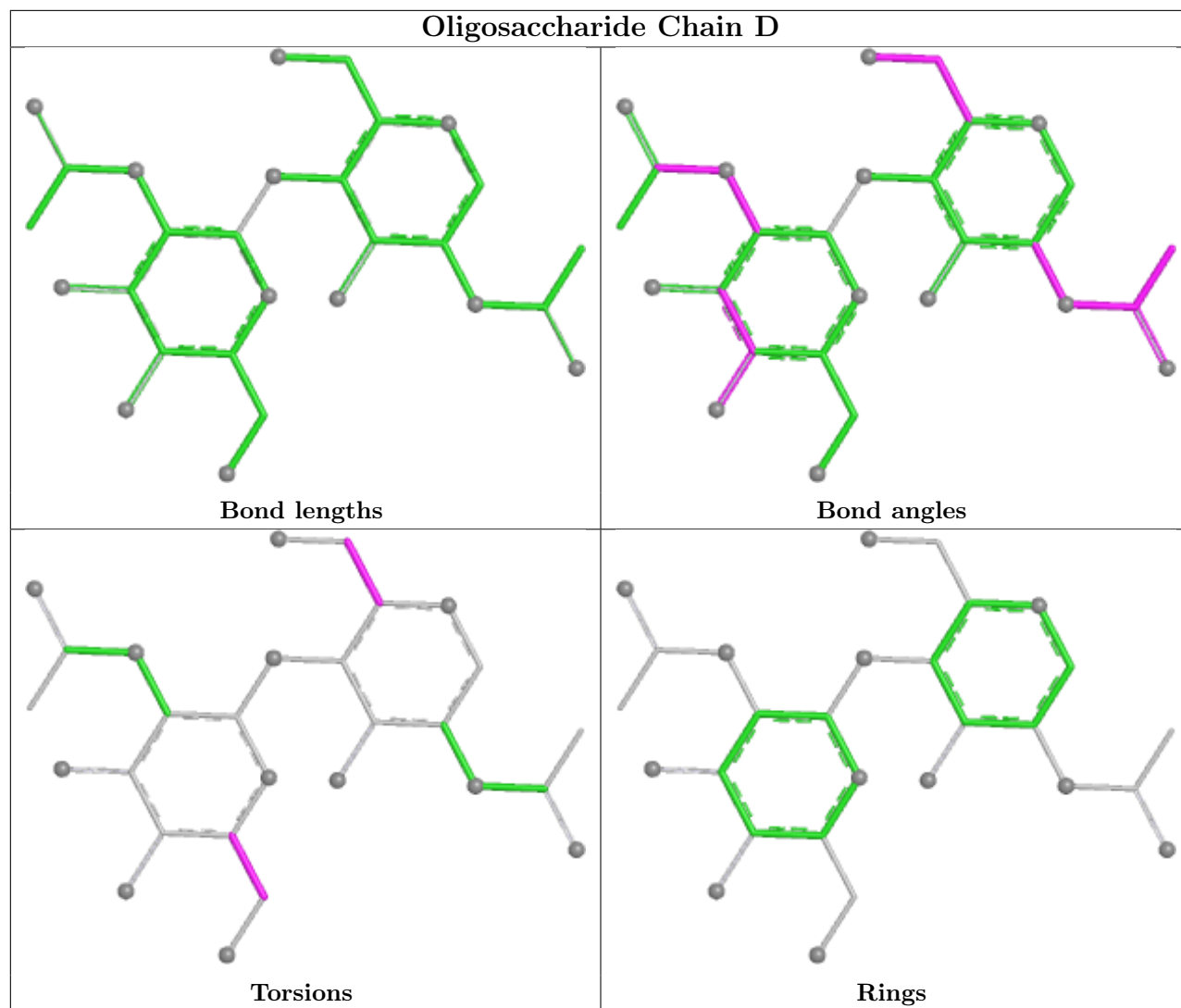
Mol	Chain	Res	Type	Atoms
3	G	2	NAG	O5-C5-C6-O6
2	C	3	BMA	C4-C5-C6-O6
3	F	1	NAG	C8-C7-N2-C2
3	F	1	NAG	O7-C7-N2-C2
2	C	3	BMA	O5-C5-C6-O6
3	D	2	NAG	O5-C5-C6-O6
3	G	2	NAG	C4-C5-C6-O6
3	H	2	NAG	C4-C5-C6-O6
2	C	2	NAG	C4-C5-C6-O6
3	D	1	NAG	C4-C5-C6-O6
3	H	2	NAG	O5-C5-C6-O6
3	D	2	NAG	C4-C5-C6-O6

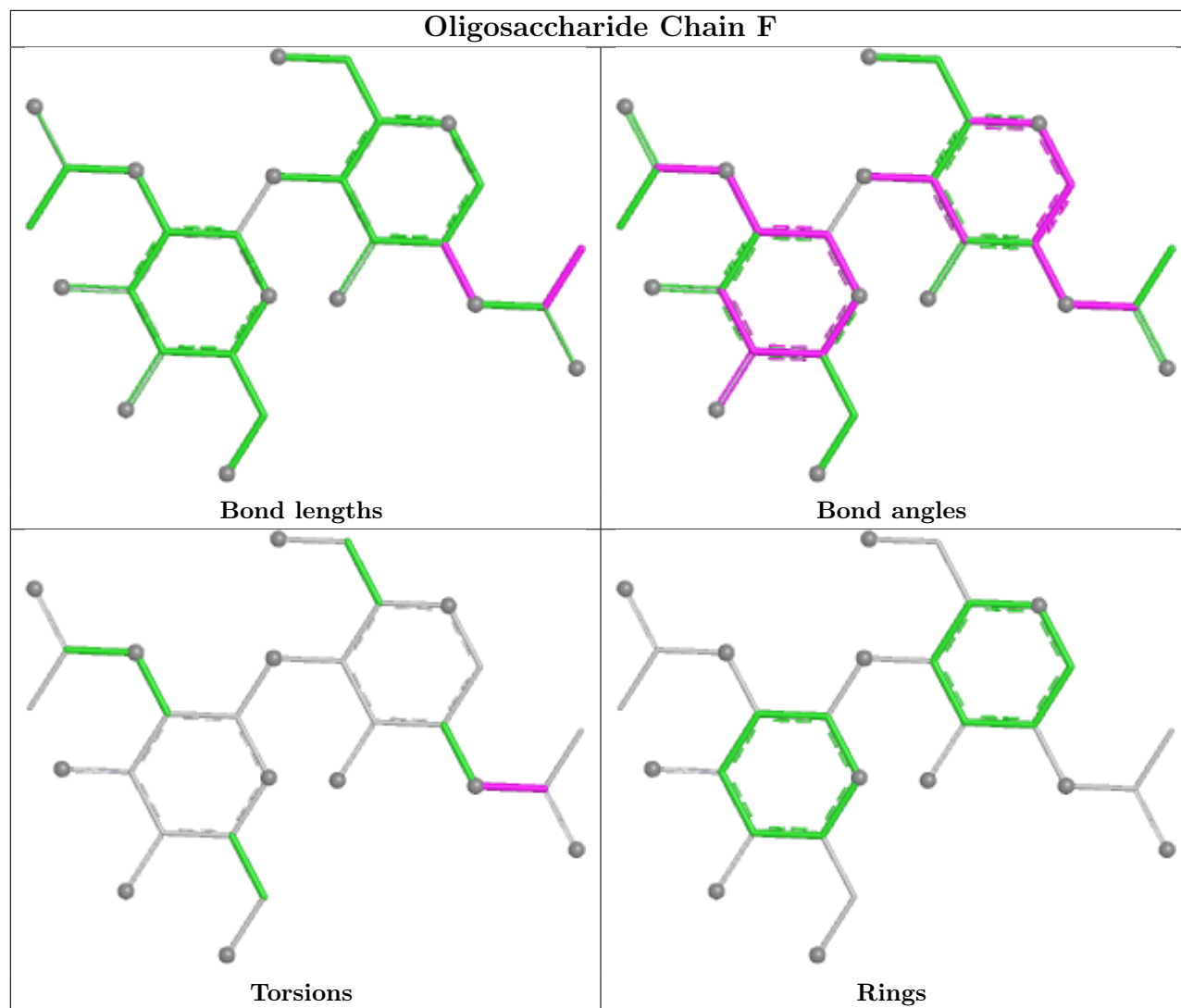
There are no ring outliers.

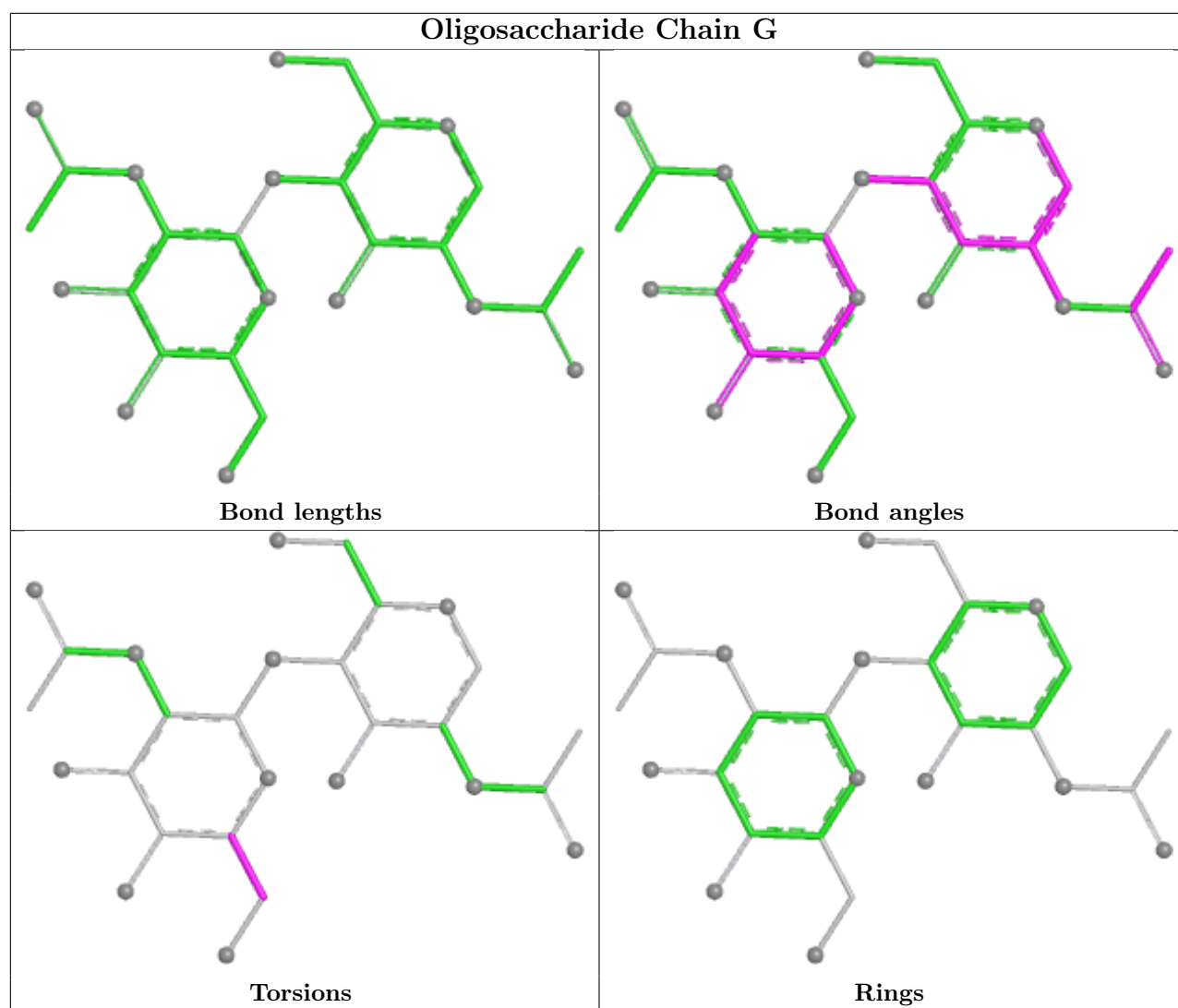
No monomer is involved in short contacts.

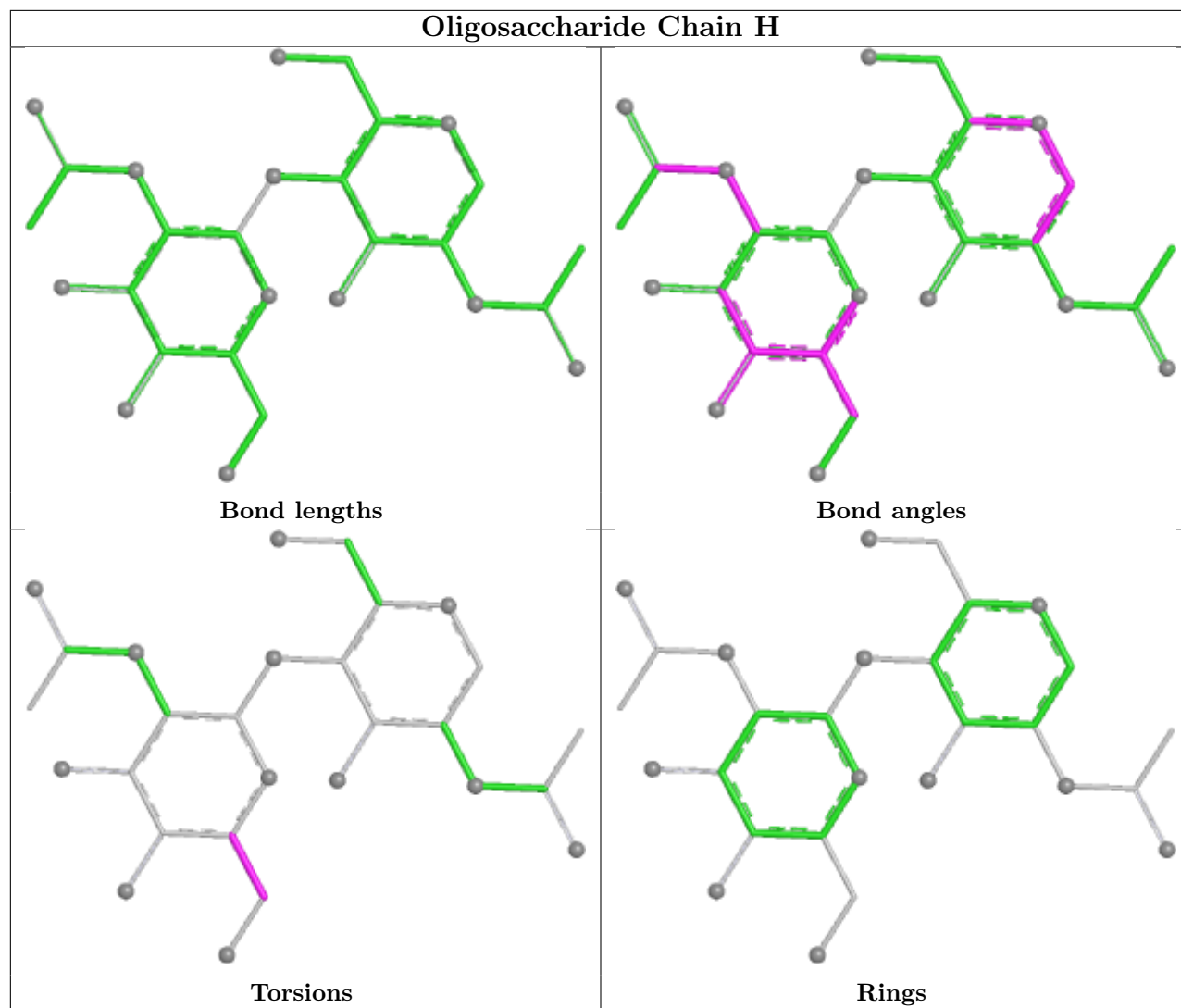
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.

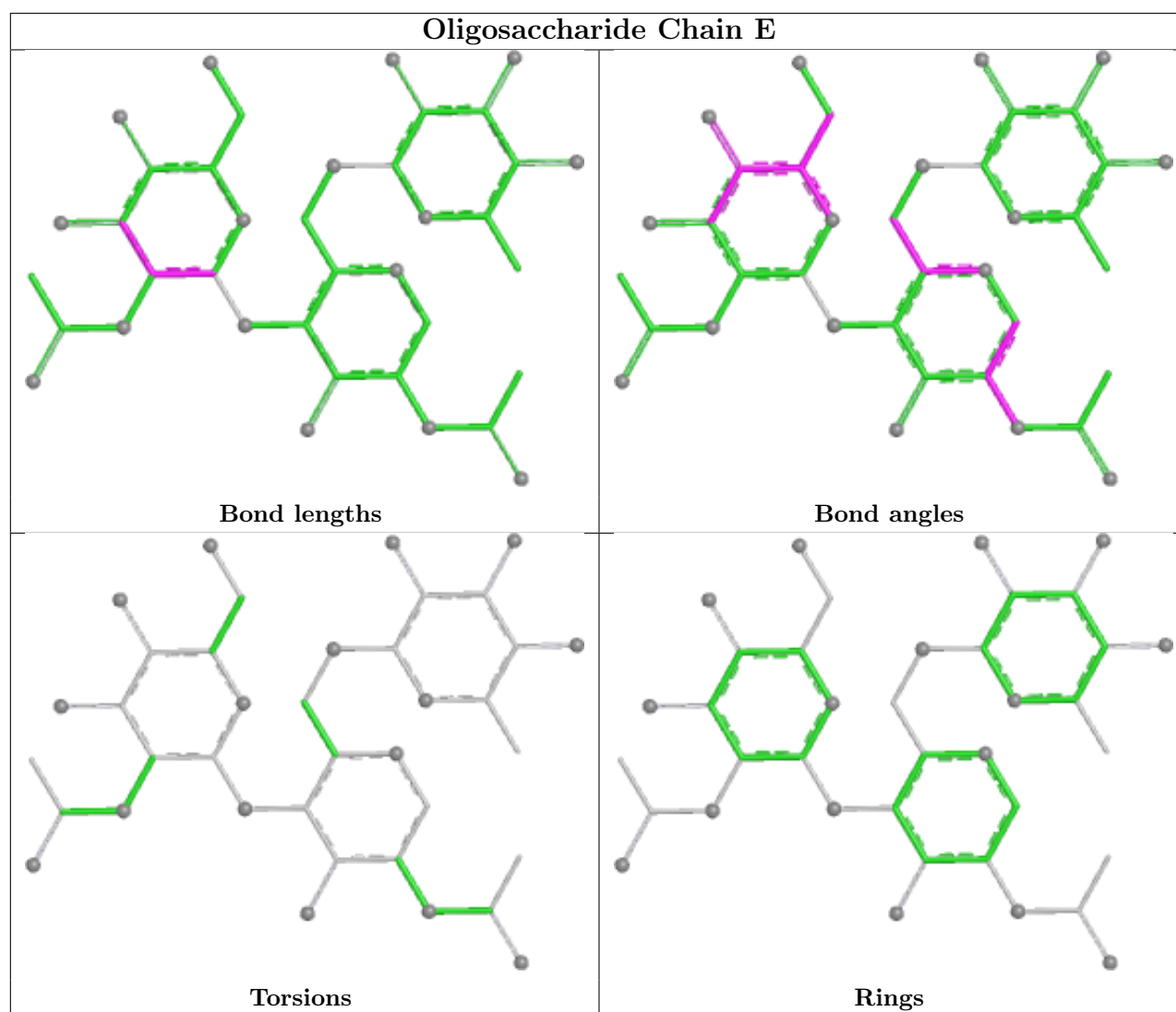












5.6 Ligand geometry [i](#)

4 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	55T	A	411	-	36,38,38	1.11	1 (2%)	51,57,57	1.38	10 (19%)
5	55T	B	407	-	36,38,38	1.16	3 (8%)	51,57,57	1.48	8 (15%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
6	NAG	B	405	1	14,14,15	1.20	2 (14%)	17,19,21	2.78	9 (52%)
6	NAG	B	406	1	14,14,15	1.10	1 (7%)	17,19,21	2.01	4 (23%)

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	55T	A	411	-	-	2/25/45/45	0/3/3/3
5	55T	B	407	-	-	2/25/45/45	0/3/3/3
6	NAG	B	405	1	-	2/6/23/26	0/1/1/1
6	NAG	B	406	1	-	2/6/23/26	0/1/1/1

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	B	407	55T	P9-O12	2.89	1.54	1.49
6	B	406	NAG	C1-C2	2.47	1.55	1.52
6	B	405	NAG	C1-C2	2.47	1.55	1.52
5	B	407	55T	C18-C17	2.43	1.43	1.39
5	B	407	55T	C18-C13	2.23	1.42	1.39
5	A	411	55T	C18-C17	2.17	1.43	1.39
6	B	405	NAG	C4-C5	2.08	1.57	1.53

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	B	405	NAG	C1-O5-C5	5.84	120.01	112.19
6	B	405	NAG	O5-C1-C2	-5.56	102.69	111.29
6	B	406	NAG	C1-O5-C5	5.20	119.15	112.19
5	B	407	55T	O12-P9-C8	-4.33	105.31	113.40
5	A	411	55T	O12-P9-C8	-3.82	106.25	113.40
6	B	405	NAG	C8-C7-N2	3.79	122.40	116.12
6	B	406	NAG	C8-C7-N2	3.30	121.60	116.12
5	B	407	55T	C16-C17-C18	-3.28	115.69	119.66
6	B	406	NAG	O5-C1-C2	-3.25	106.25	111.29
6	B	405	NAG	O4-C4-C5	3.25	117.32	109.32
5	B	407	55T	C15-C16-C17	3.02	123.21	119.73
5	B	407	55T	O33-C32-C34	-2.81	117.05	122.05
5	A	411	55T	O2-C2-N3	-2.80	117.92	122.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	411	55T	O10-P9-O12	-2.79	106.46	113.45
6	B	405	NAG	C2-N2-C7	2.78	126.62	122.90
5	B	407	55T	C34-C32-N19	2.70	119.02	114.95
6	B	405	NAG	O6-C6-C5	2.68	120.45	111.33
5	A	411	55T	C2'-C1'-N1	2.60	120.47	113.25
6	B	406	NAG	C2-N2-C7	2.59	126.37	122.90
5	A	411	55T	C34-C32-N19	2.58	118.83	114.95
5	B	407	55T	C18-C17-N19	2.54	128.37	120.13
6	B	405	NAG	O3-C3-C4	-2.48	104.52	110.38
5	B	407	55T	O2-C2-N3	-2.39	118.56	122.33
5	A	411	55T	N1-C2-N3	2.38	122.93	118.80
6	B	405	NAG	O7-C7-C8	-2.34	117.89	122.05
5	B	407	55T	O11-P9-O12	-2.22	107.88	113.45
6	B	405	NAG	C6-C5-C4	2.21	118.44	113.02
5	A	411	55T	C16-C17-C18	-2.14	117.06	119.66
5	A	411	55T	C18-C17-N19	2.14	127.09	120.13
5	A	411	55T	C15-C16-C17	2.13	122.19	119.73
5	A	411	55T	O33-C32-C34	-2.01	118.48	122.05

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	411	55T	C13-C8-P9-O12
6	B	405	NAG	C8-C7-N2-C2
6	B	405	NAG	O7-C7-N2-C2
6	B	406	NAG	C8-C7-N2-C2
6	B	406	NAG	O7-C7-N2-C2
5	B	407	55T	C13-C8-P9-O12
5	A	411	55T	O1P-C8-P9-O12
5	B	407	55T	O1P-C8-P9-O12

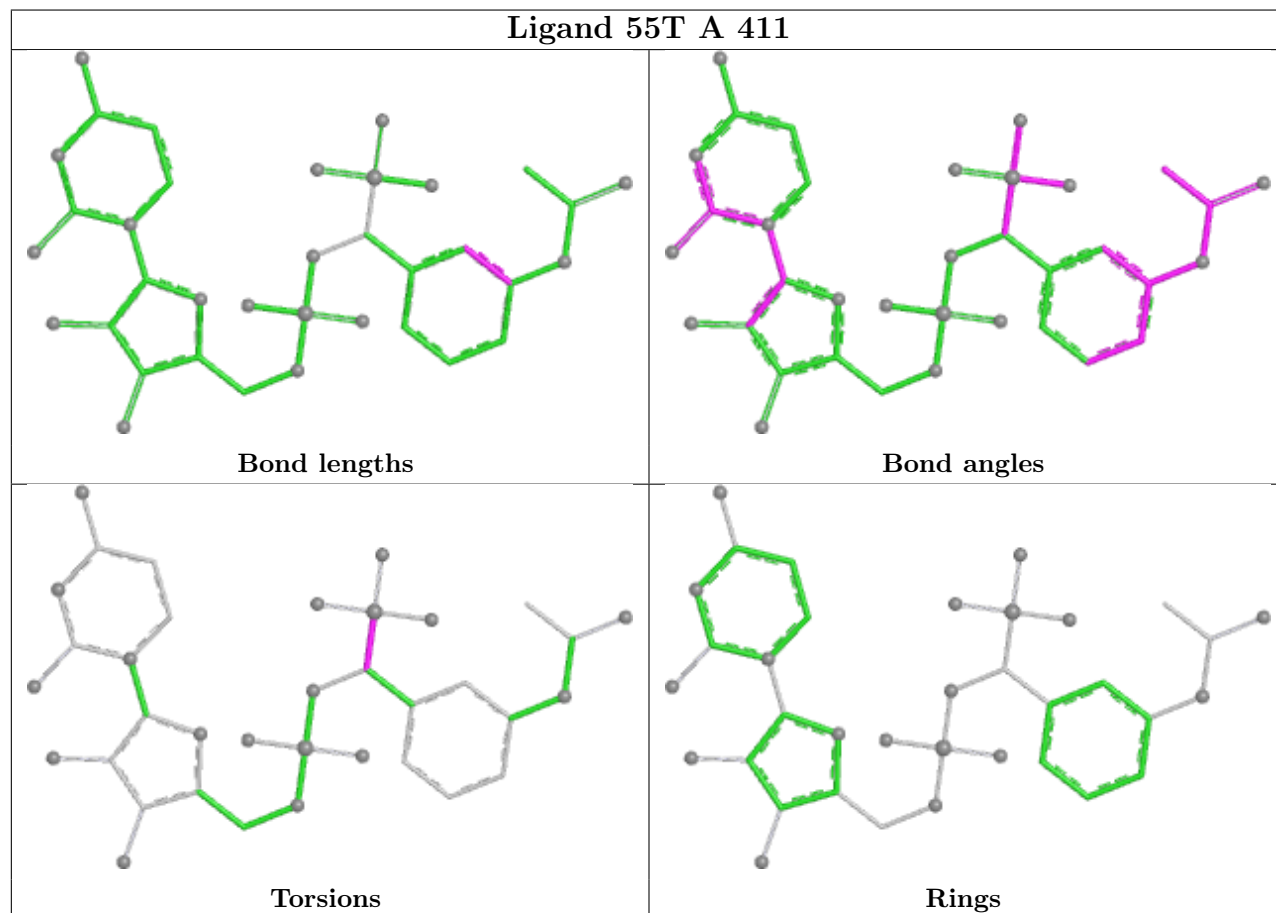
There are no ring outliers.

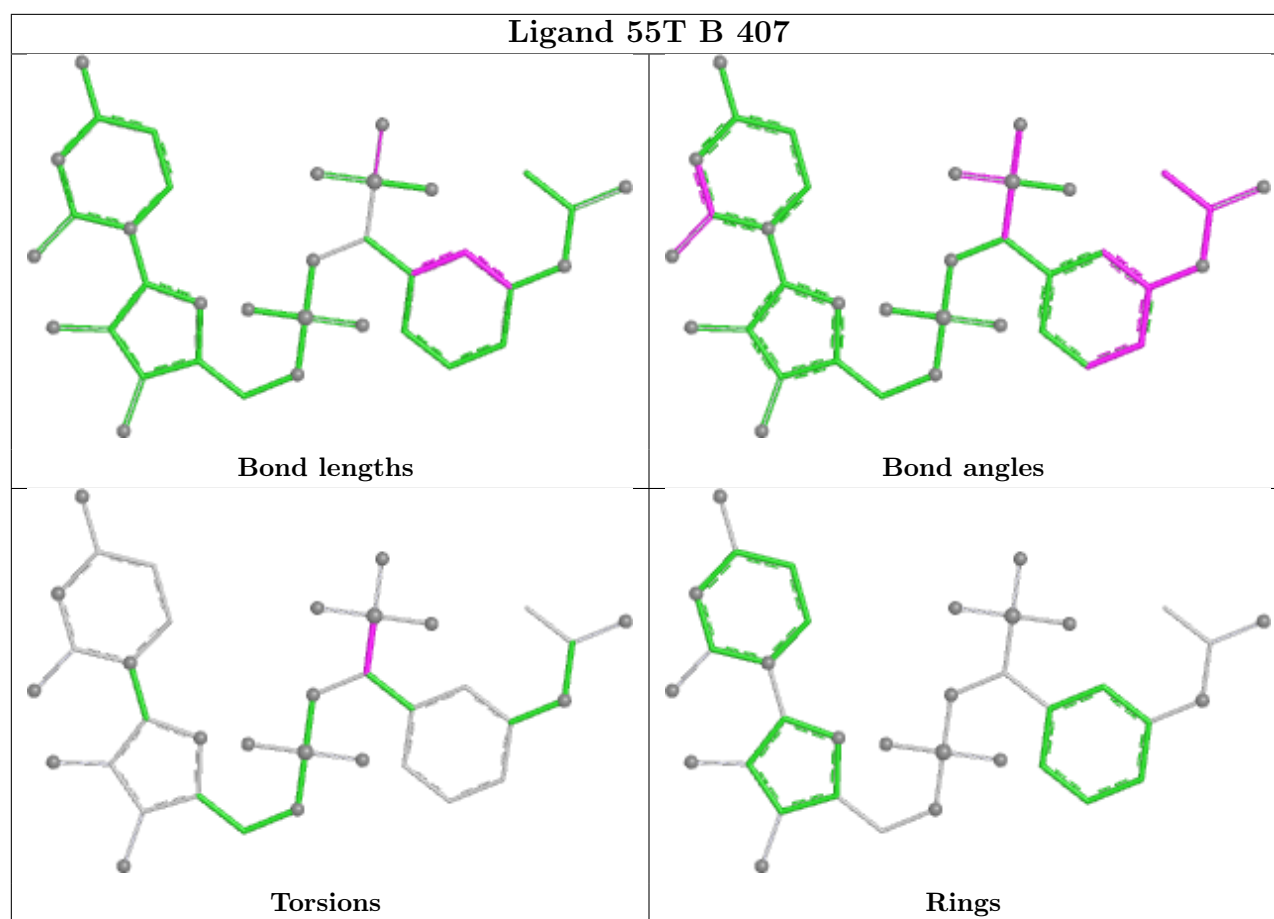
2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	411	55T	2	0
5	B	407	55T	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 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

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, 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	292/323 (90%)	0.06	16 (5%) 30 34	18, 28, 61, 97	0
1	B	292/323 (90%)	0.63	38 (13%) 7 8	20, 36, 83, 140	0
All	All	584/646 (90%)	0.34	54 (9%) 14 16	18, 32, 73, 140	0

All (54) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	380	ALA	9.8
1	B	344	THR	6.8
1	B	346	PHE	6.6
1	A	297	LYS	6.2
1	B	105	LEU	5.5
1	A	348	THR	5.4
1	A	380	ALA	5.3
1	B	341	LYS	5.2
1	B	342	LYS	5.1
1	B	350	TRP	5.0
1	A	89	LYS	4.7
1	B	89	LYS	4.7
1	A	296	PRO	4.7
1	A	350	TRP	4.6
1	B	351	GLN	4.5
1	B	343	GLY	4.4
1	B	347	THR	4.3
1	A	347	THR	4.2
1	B	354	HIS	4.2
1	B	345	LYS	3.7
1	B	348	THR	3.6
1	B	365	ARG	3.3
1	A	295	SER	3.2
1	B	378	HIS	3.2

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Mol	Chain	Res	Type	RSRZ
1	B	349	LYS	3.2
1	B	293	HIS	3.0
1	B	291	ASN	3.0
1	B	199	ARG	2.8
1	A	342	LYS	2.8
1	A	345	LYS	2.8
1	B	297	LYS	2.7
1	B	340	ASP	2.7
1	B	217	LYS	2.7
1	B	287	ARG	2.7
1	B	336	TYR	2.6
1	B	333	ASP	2.5
1	B	296	PRO	2.4
1	B	290	LYS	2.4
1	B	332	GLU	2.3
1	A	294	LEU	2.3
1	A	226	GLN	2.3
1	B	334	LEU	2.3
1	A	349	LYS	2.3
1	B	331	ARG	2.3
1	A	91	LYS	2.3
1	A	203	ARG	2.2
1	B	355	GLN	2.2
1	B	182	LYS	2.2
1	B	195	GLU	2.2
1	B	353	SER	2.1
1	B	106	GLN	2.1
1	B	298	ARG	2.1
1	B	361	GLN	2.0
1	A	343	GLY	2.0

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

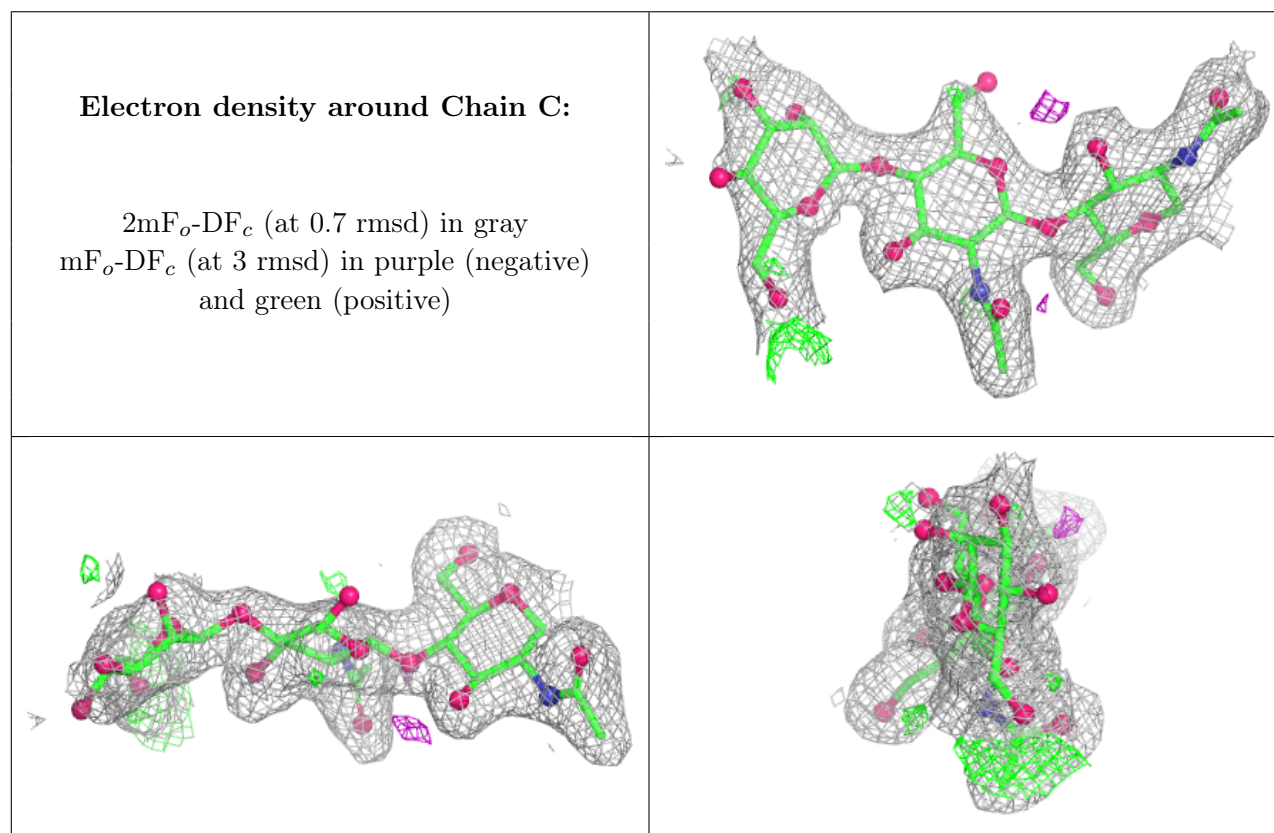
There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

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.

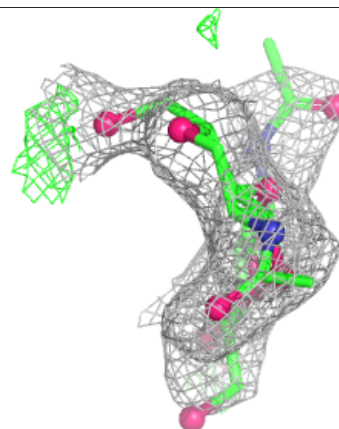
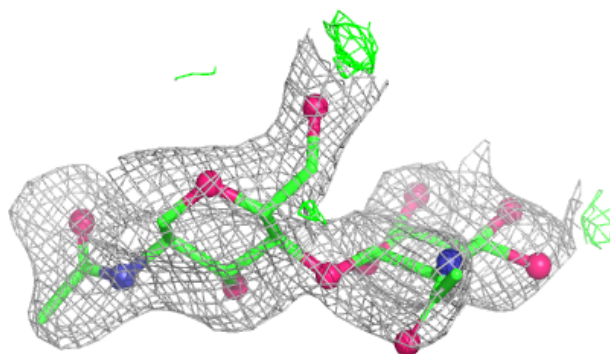
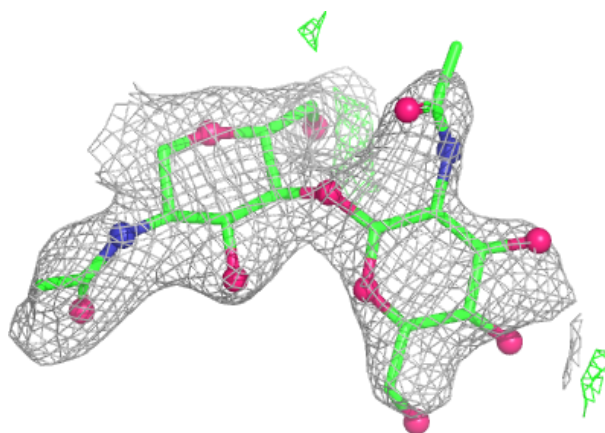
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	NAG	E	2	14/15	0.60	0.19	63,71,78,80	0
2	BMA	C	3	11/12	0.65	0.16	71,80,85,87	0
3	NAG	D	2	14/15	0.66	0.20	79,97,105,108	0
3	NAG	F	2	14/15	0.83	0.13	43,51,66,75	0
3	NAG	D	1	14/15	0.83	0.14	50,60,70,86	0
3	NAG	G	2	14/15	0.84	0.14	41,52,69,71	0
3	NAG	H	2	14/15	0.85	0.12	46,55,64,65	0
2	NAG	C	2	14/15	0.87	0.12	36,51,71,73	0
4	NAG	E	1	14/15	0.93	0.07	27,33,39,45	0
4	FUC	E	3	10/11	0.93	0.08	41,42,45,46	0
3	NAG	H	1	14/15	0.94	0.07	33,39,41,41	0
3	NAG	F	1	14/15	0.95	0.06	22,28,36,36	0
2	NAG	C	1	14/15	0.97	0.05	27,30,33,43	0
3	NAG	G	1	14/15	0.97	0.06	24,29,33,41	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.

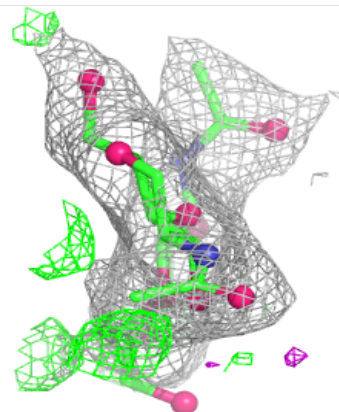
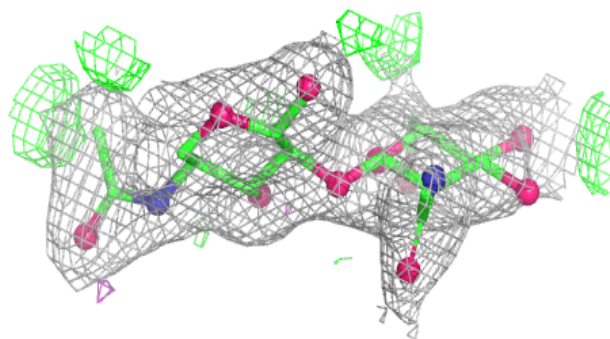
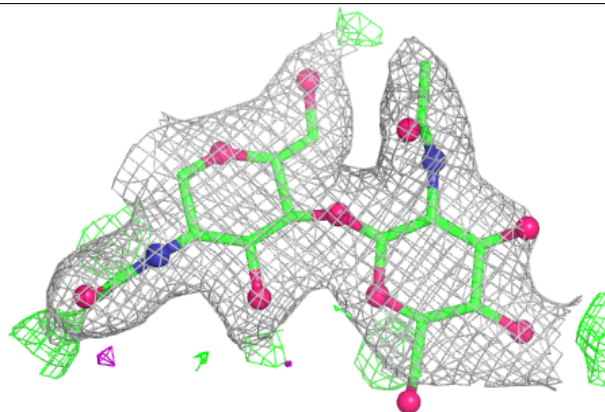


Electron density around Chain D:

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

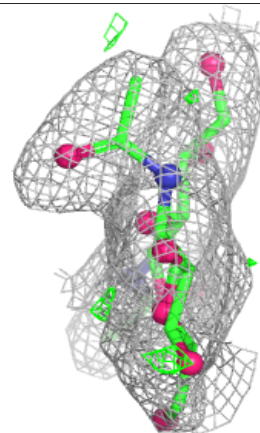
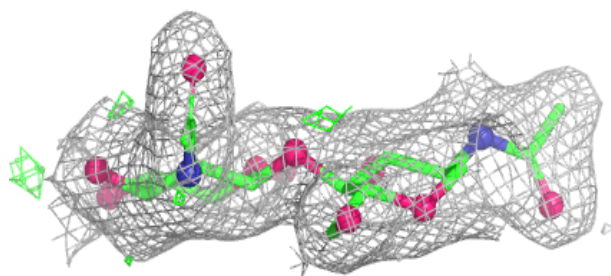
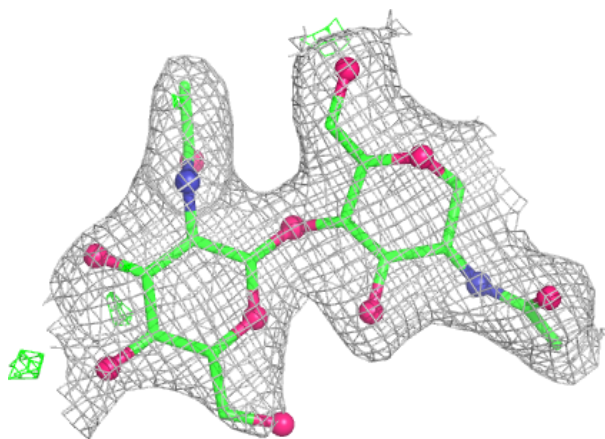
**Electron density around Chain F:**

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



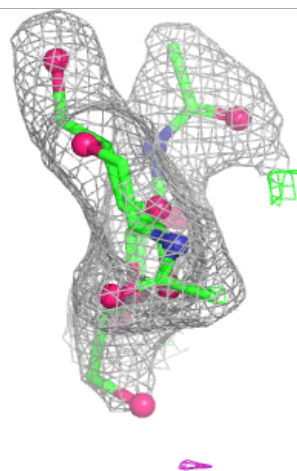
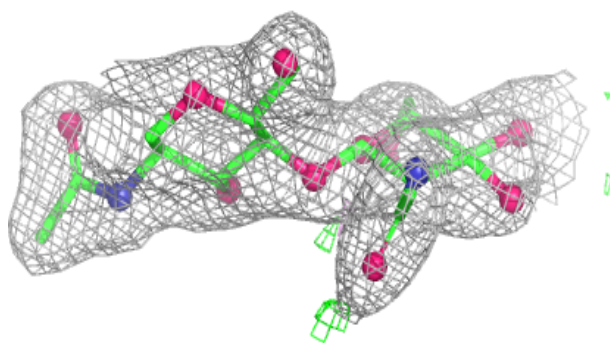
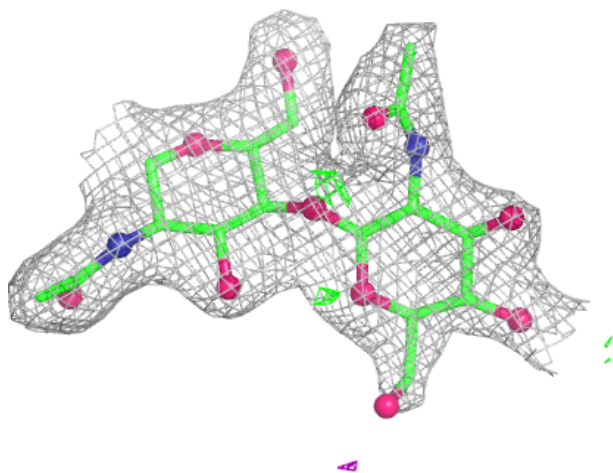
Electron density around Chain G:

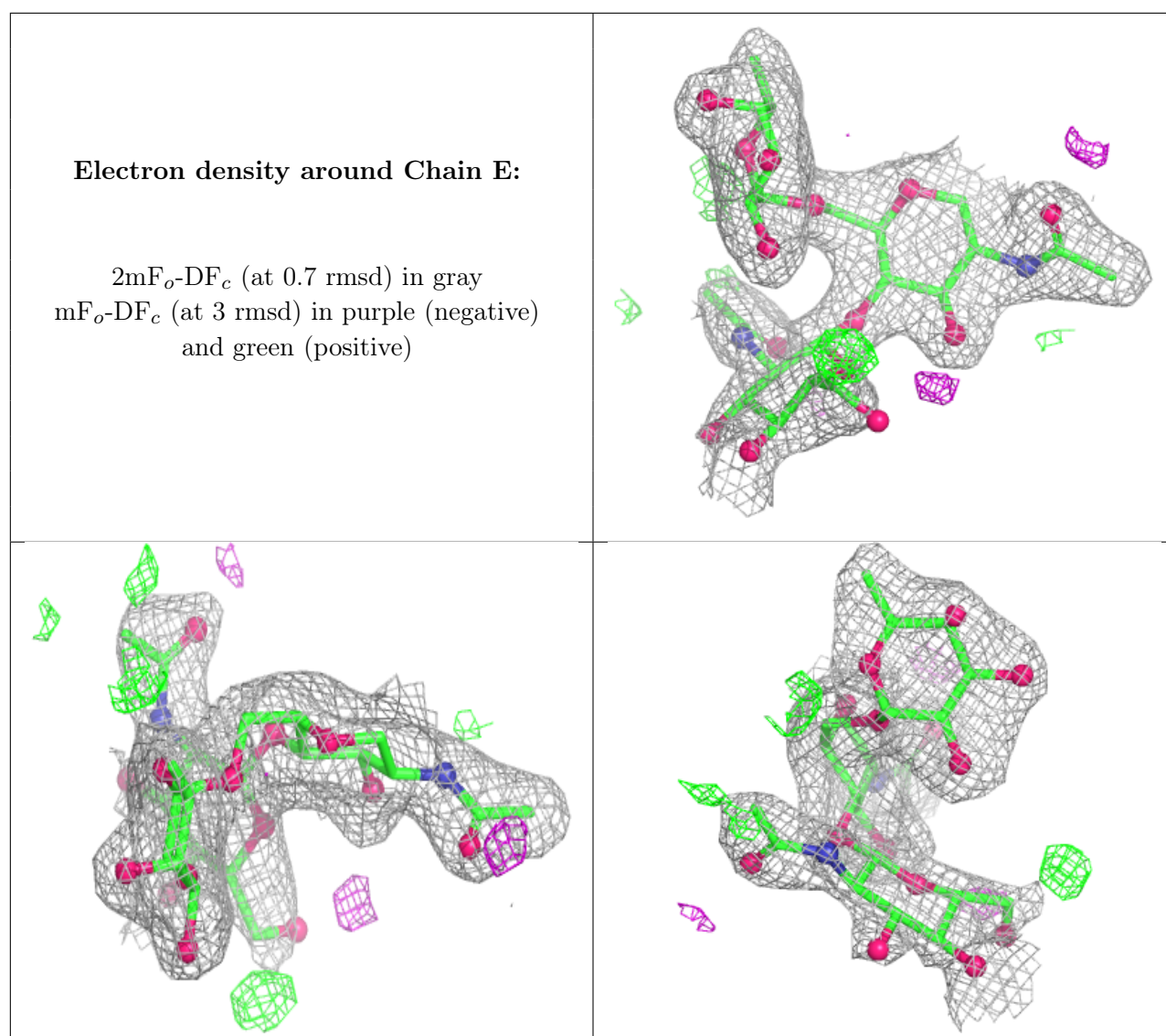
$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



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)





6.4 Ligands [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.

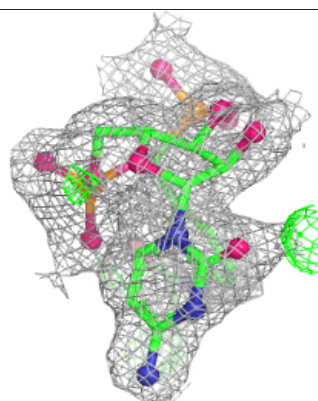
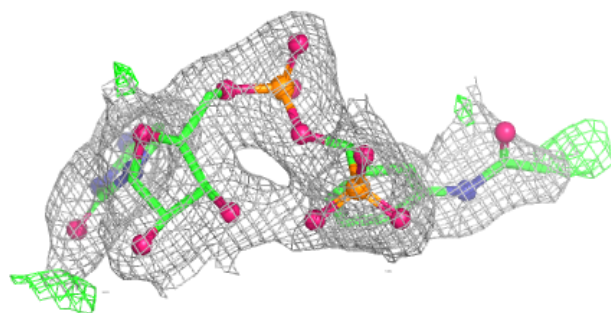
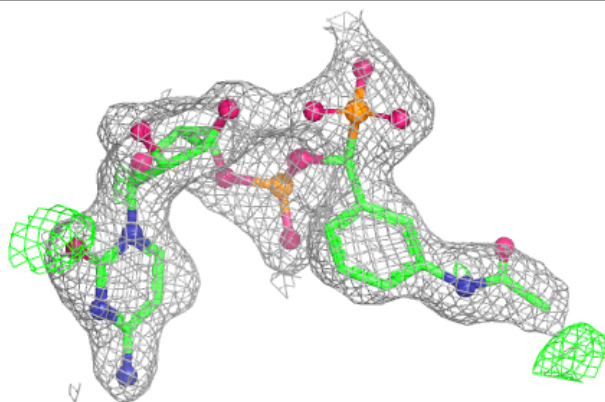
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
6	NAG	B	406	14/15	0.49	0.27	81,93,104,105	0
6	NAG	B	405	14/15	0.79	0.15	50,56,61,64	0
5	55T	B	407	36/36	0.93	0.10	33,44,69,80	0
5	55T	A	411	36/36	0.97	0.07	21,25,62,68	0

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.

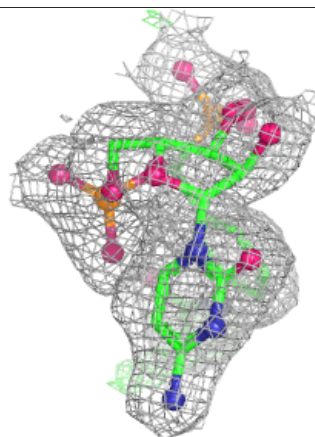
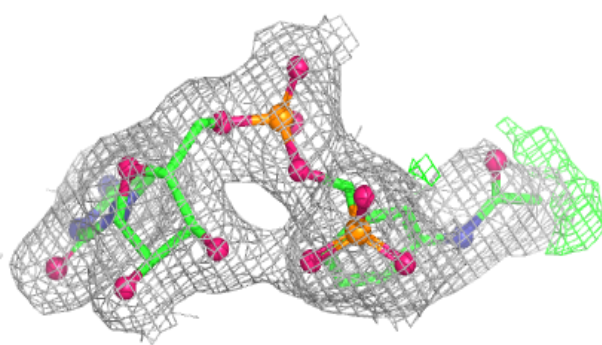
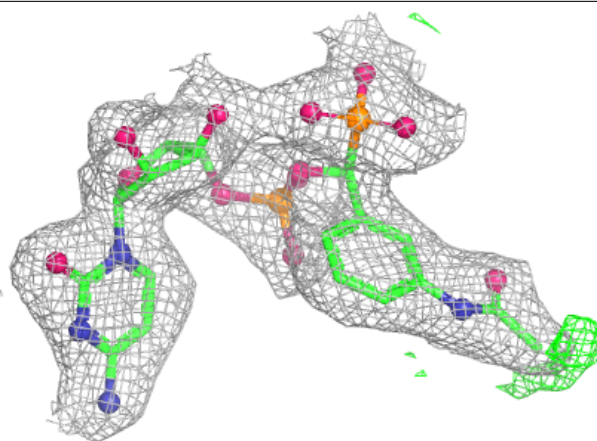
Electron density around 55T B 407:

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



Electron density around 55T A 411:

$2mF_o-DF_c$ (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.