



# wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 7, 2020 – 05:28 PM BST

PDB ID : 6HJD  
Title : Cholera toxin classical B-pentamer in complex with Lewis-x  
Authors : Krengel, U.; Heim, J.B.  
Deposited on : 2018-09-03  
Resolution : 1.54 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto: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.

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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  
buster-report : 1.1.7 (2018)  
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

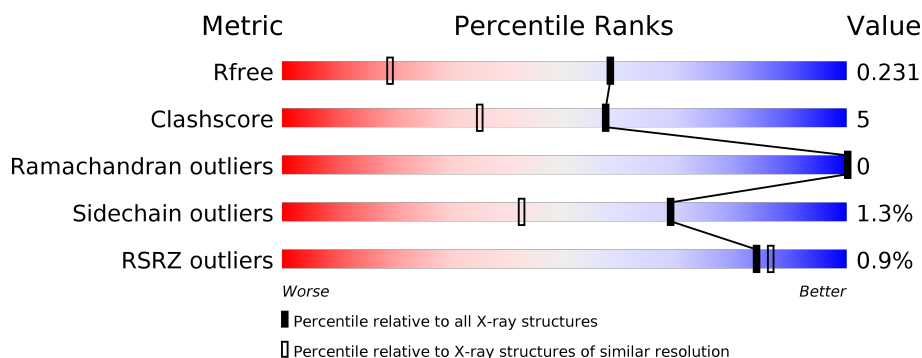
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.54 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.













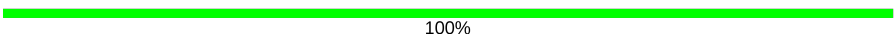
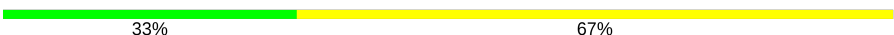
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	2556 (1.56-1.52)
Clashscore	141614	2634 (1.56-1.52)
Ramachandran outliers	138981	2580 (1.56-1.52)
Sidechain outliers	138945	2577 (1.56-1.52)
RSRZ outliers	127900	2524 (1.56-1.52)

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  $\geq 3$ , 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	103	<div> <div style="width: 100%;"> <div style="width: 88%;"></div> <div style="width: 12%;"></div> </div> <div>88% 12%</div> </div>
1	B	103	<div> <div style="width: 100%;"> <div style="width: 93%;"></div> <div style="width: 7%;"></div> </div> <div>93% 7%</div> </div>
1	C	103	<div> <div style="width: 100%;"> <div style="width: 83%;"></div> <div style="width: 17%;"></div> </div> <div>83% 17%</div> </div>
1	D	103	<div> <div style="width: 100%;"> <div style="width: 89%;"></div> <div style="width: 10%;"></div> </div> <div>89% 10%</div> </div>
1	E	103	<div> <div style="width: 100%;"> <div style="width: 95%;"></div> <div style="width: 5%;"></div> </div> <div>95%</div> </div>
1	F	103	<div> <div style="width: 100%;"> <div style="width: 3%;"></div> <div style="width: 83%;"></div> <div style="width: 17%;"></div> </div> <div>3% 83% 17%</div> </div>

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Mol	Chain	Length	Quality of chain
1	G	103	 90% 7%
1	H	103	 91% 9%
1	I	103	 91% 9%
1	J	103	 92% 7%
2	K	3	 67% 33%
2	L	3	 67% 33%
2	N	3	 67% 33%
2	P	3	 67% 33%
2	Q	3	 67% 33%
2	R	3	 67% 33%
3	M	3	 100%
3	O	3	 33% 67%

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
3	NAG	O	1[B]	X	-	-	-

## 2 Entry composition [i](#)

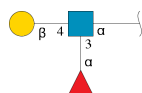
There are 7 unique types of molecules in this entry. The entry contains 9841 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Cholera toxin B subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	103	Total	C	N	O	S	0	8	0
			867	547	146	168	6			
1	B	103	Total	C	N	O	S	0	8	0
			876	556	148	166	6			
1	C	103	Total	C	N	O	S	0	10	0
			889	565	151	167	6			
1	D	103	Total	C	N	O	S	0	7	0
			861	544	149	161	7			
1	E	103	Total	C	N	O	S	0	8	0
			875	555	151	163	6			
1	F	103	Total	C	N	O	S	0	11	0
			891	571	153	161	6			
1	G	103	Total	C	N	O	S	0	9	0
			877	561	148	161	7			
1	H	103	Total	C	N	O	S	0	6	0
			852	538	148	159	7			
1	I	103	Total	C	N	O	S	0	9	0
			874	554	149	165	6			
1	J	103	Total	C	N	O	S	0	6	0
			856	543	148	159	6			

- Molecule 2 is an oligosaccharide called alpha-L-fucopyranose-(1-3)-[beta-D-galactopyranose-(1-4)]2-acetamido-2-deoxy-alpha-D-glucopyranose.



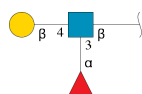
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	K	3	Total	C	N	O	0	0	0
			36	20	1	15			
2	L	3	Total	C	N	O	0	0	0
			36	20	1	15			

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	N	3	Total	C	N	O	0	0	0
			36	20	1	15			
2	P	3	Total	C	N	O	0	0	0
			36	20	1	15			
2	Q	3	Total	C	N	O	0	0	0
			36	20	1	15			
2	R	3	Total	C	N	O	0	0	0
			36	20	1	15			

- Molecule 3 is an oligosaccharide called alpha-L-fucopyranose-(1-3)-[beta-D-galactopyranose-(1-4)]2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	M	3	Total	C	N	O	0	0	0
			36	20	1	15			
3	O	3	Total	C	N	O	0	3	0
			72	40	2	30			

- Molecule 4 is CALCIUM ION (three-letter code: CA) (formula: Ca).

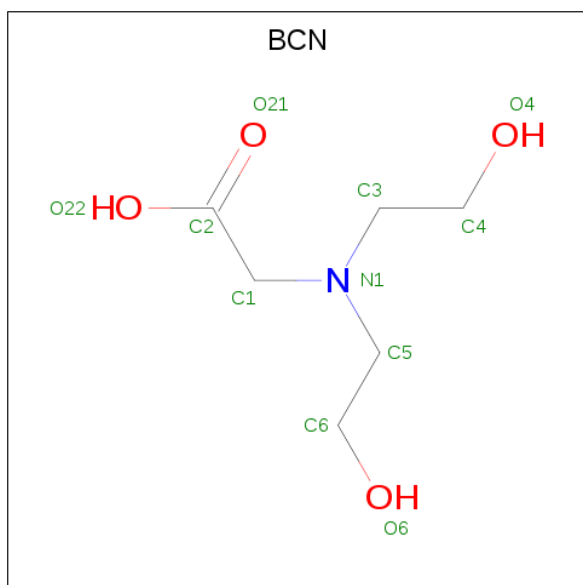
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	G	1	Total	Ca	0	0
			1	1		
4	J	1	Total	Ca	0	0
			1	1		
4	D	1	Total	Ca	0	0
			1	1		
4	E	1	Total	Ca	0	0
			1	1		
4	H	1	Total	Ca	0	0
			1	1		
4	B	1	Total	Ca	0	0
			1	1		
4	I	1	Total	Ca	0	0
			1	1		
4	C	1	Total	Ca	0	0
			1	1		

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Ca	0	0
			1	1		
4	F	1	Total	Ca	0	0
			1	1		

- Molecule 5 is BICINE (three-letter code: BCN) (formula:  $C_6H_{13}NO_4$ ).



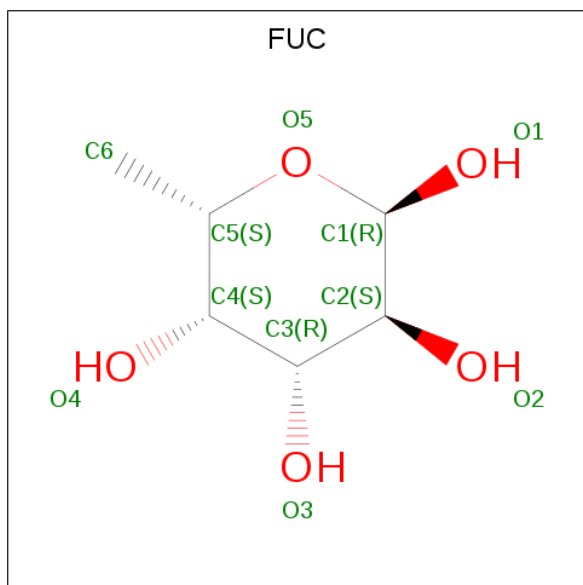
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	N	O	0	0
			11	6	1	4		
5	B	1	Total	C	N	O	0	0
			11	6	1	4		
5	D	1	Total	C	N	O	0	0
			11	6	1	4		
5	D	1	Total	C	N	O	0	0
			11	6	1	4		
5	F	1	Total	C	N	O	0	0
			11	6	1	4		
5	G	1	Total	C	N	O	0	0
			11	6	1	4		
5	G	1	Total	C	N	O	0	0
			11	6	1	4		
5	I	1	Total	C	N	O	0	0
			11	6	1	4		
5	I	1	Total	C	N	O	0	0
			11	6	1	4		

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	J	1	Total	C	N	O	0	0
			11	6	1	4		

- Molecule 6 is alpha-L-fucopyranose (three-letter code: FUC) (formula: C<sub>6</sub>H<sub>12</sub>O<sub>5</sub>) (labeled as "Ligand of Interest" by author).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	F	1	Total	C	O	0	0
			11	6	5		

- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	68	Total	O	0	0
			68	68		
7	B	82	Total	O	0	0
			82	82		
7	C	67	Total	O	0	0
			67	67		
7	D	68	Total	O	0	0
			68	68		
7	E	97	Total	O	0	0
			97	97		
7	F	62	Total	O	0	0
			62	62		
7	G	58	Total	O	0	0
			58	58		

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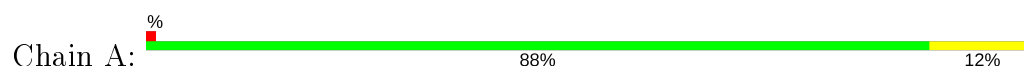
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	H	52	Total 52	O 52	0	0
7	I	56	Total 56	O 56	0	0
7	J	58	Total 58	O 58	0	0



### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

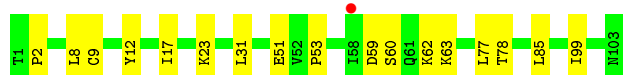
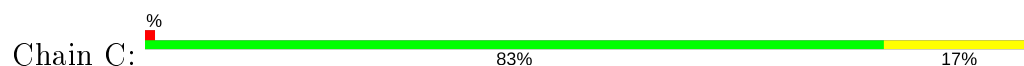
- Molecule 1: Cholera toxin B subunit



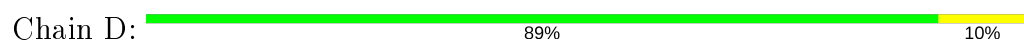
- Molecule 1: Cholera toxin B subunit



- Molecule 1: Cholera toxin B subunit



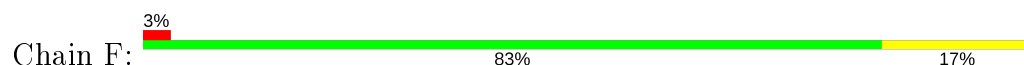
- Molecule 1: Cholera toxin B subunit



- Molecule 1: Cholera toxin B subunit



- Molecule 1: Cholera toxin B subunit





- Molecule 1: Cholera toxin B subunit

Chain G: 90% 7%



- Molecule 1: Cholera toxin B subunit

Chain H: 91% 9%



- Molecule 1: Cholera toxin B subunit

Chain I: 91% 9%



- Molecule 1: Cholera toxin B subunit

Chain J: 92% 7%



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

Chain K: 67% 33%



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

Chain L: 67% 33%



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

Chain N:  67% 33%



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

Chain P:  67% 33%



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

Chain Q:  67% 33%



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

Chain R:  67% 33%



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

Chain M:  100%



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

Chain O:  33% 67%



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	82.97Å 108.29Å 115.62Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	79.16 – 1.54 79.04 – 1.54	Depositor EDS
% Data completeness (in resolution range)	99.8 (79.16-1.54) 99.9 (79.04-1.54)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.65 (at 1.54Å)	Xtriage
Refinement program	REFMAC 5.8.0230, PHENIX	Depositor
R, $R_{free}$	0.193 , 0.224 0.200 , 0.231	Depositor DCC
$R_{free}$ test set	7676 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	15.6	Xtriage
Anisotropy	0.400	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 38.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	9841	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.51% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: BCN, NAG, CA, NDG, GAL, 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	0.86	1/894 (0.1%)	0.83	0/1209
1	B	0.84	0/910	0.81	0/1227
1	C	0.85	0/920	0.89	2/1241 (0.2%)
1	D	0.81	2/896 (0.2%)	0.84	1/1206 (0.1%)
1	E	0.79	0/909	0.85	0/1223
1	F	0.79	0/935	0.84	0/1258
1	G	0.78	1/916 (0.1%)	0.83	0/1232
1	H	0.84	1/879 (0.1%)	0.83	0/1185
1	I	0.80	0/907	0.86	0/1221
1	J	0.77	0/884	0.83	1/1192 (0.1%)
All	All	0.81	5/9050 (0.1%)	0.84	4/12194 (0.0%)

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	A	0	2
1	D	0	1
1	F	0	2
1	G	0	1
1	H	0	1
1	I	0	1
All	All	0	8

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	29	GLU	CD-OE1	-6.74	1.18	1.25
1	H	29	GLU	CD-OE1	6.56	1.32	1.25

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	66	GLU	CD-OE1	5.87	1.32	1.25
1	G	36	GLU	CD-OE1	5.58	1.31	1.25
1	A	79	GLU	CD-OE2	-5.42	1.19	1.25

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	J	67	ARG	NE-CZ-NH1	-6.56	117.02	120.30
1	C	59[A]	ASP	CB-CA-C	5.49	121.38	110.40
1	C	59[B]	ASP	CB-CA-C	5.49	121.38	110.40
1	D	27	TYR	CB-CG-CD1	-5.03	117.98	121.00

There are no chirality outliers.

5 of 8 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	49	GLN	Peptide
1	A	73	ARG	Sidechain
1	D	49	GLN	Peptide
1	F	35	ARG	Sidechain
1	F	73	ARG	Sidechain

## 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	867	0	871	8	0
1	B	876	0	888	6	0
1	C	889	0	910	21	0
1	D	861	0	890	16	0
1	E	875	0	898	8	0
1	F	891	0	935	15	0
1	G	877	0	918	15	0
1	H	852	0	868	5	0
1	I	874	0	897	5	0
1	J	856	0	873	5	0
2	K	36	0	30	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	L	36	0	30	0	0
2	N	36	0	30	1	0
2	P	36	0	30	0	0
2	Q	36	0	30	0	0
2	R	36	0	30	0	0
3	M	36	0	33	0	0
3	O	72	0	66	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0
4	D	1	0	0	0	0
4	E	1	0	0	0	0
4	F	1	0	0	0	0
4	G	1	0	0	0	0
4	H	1	0	0	0	0
4	I	1	0	0	0	0
4	J	1	0	0	0	0
5	A	11	0	10	0	0
5	B	11	0	10	0	0
5	D	22	0	20	0	0
5	F	11	0	10	0	0
5	G	22	0	20	0	0
5	I	22	0	20	0	0
5	J	11	0	10	0	0
6	F	11	0	12	0	0
7	A	68	0	0	0	0
7	B	82	0	0	0	0
7	C	67	0	0	6	0
7	D	68	0	0	1	0
7	E	97	0	0	1	0
7	F	62	0	0	2	0
7	G	58	0	0	3	0
7	H	52	0	0	2	0
7	I	56	0	0	1	0
7	J	58	0	0	1	0
All	All	9841	0	9339	89	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 5.

The worst 5 of 89 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:D:35[B]:ARG:HH11	1:D:35[B]:ARG:HG3	1.21	1.04
1:E:23[B]:LYS:HZ2	1:E:23[B]:LYS:HB3	1.44	0.83
1:D:35[B]:ARG:NH1	1:D:35[B]:ARG:HG3	1.92	0.81
1:H:51:GLU:OE1	7:H:301:HOH:O	2.00	0.78
1:A:26:SER:OG	1:A:41[B]:THR:HG22	1.85	0.77

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	109/103 (106%)	108 (99%)	1 (1%)	0	100	100
1	B	110/103 (107%)	106 (96%)	4 (4%)	0	100	100
1	C	112/103 (109%)	108 (96%)	4 (4%)	0	100	100
1	D	109/103 (106%)	107 (98%)	2 (2%)	0	100	100
1	E	110/103 (107%)	109 (99%)	1 (1%)	0	100	100
1	F	113/103 (110%)	111 (98%)	2 (2%)	0	100	100
1	G	111/103 (108%)	109 (98%)	2 (2%)	0	100	100
1	H	107/103 (104%)	105 (98%)	2 (2%)	0	100	100
1	I	110/103 (107%)	107 (97%)	3 (3%)	0	100	100
1	J	107/103 (104%)	105 (98%)	2 (2%)	0	100	100
All	All	1098/1030 (107%)	1075 (98%)	23 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar



resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	97/89 (109%)	97 (100%)	0	100	100
1	B	98/89 (110%)	95 (97%)	3 (3%)	40	11
1	C	100/89 (112%)	100 (100%)	0	100	100
1	D	97/89 (109%)	94 (97%)	3 (3%)	40	11
1	E	98/89 (110%)	97 (99%)	1 (1%)	76	55
1	F	101/89 (114%)	99 (98%)	2 (2%)	55	24
1	G	99/89 (111%)	94 (95%)	5 (5%)	24	3
1	H	95/89 (107%)	95 (100%)	0	100	100
1	I	98/89 (110%)	95 (97%)	3 (3%)	40	11
1	J	95/89 (107%)	93 (98%)	2 (2%)	53	22
All	All	978/890 (110%)	959 (98%)	19 (2%)	69	26

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	F	20[B]	LEU
1	G	23[B]	LYS
1	I	55	SER
1	F	20[A]	LEU
1	I	91	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	103	ASN
1	G	94	HIS
1	J	3	GLN
1	F	21	ASN
1	I	21	ASN

### 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 ⓘ

27 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	NDG	K	1	2	15,15,15	0.26	0	21,21,21	0.88	1 (4%)
2	FUC	K	2	2	10,10,11	0.48	0	14,14,16	0.60	0
2	GAL	K	3	2	11,11,12	0.41	0	15,15,17	0.64	0
2	NDG	L	1	2	15,15,15	0.25	0	21,21,21	1.14	3 (14%)
2	FUC	L	2	2	10,10,11	0.54	0	14,14,16	0.74	0
2	GAL	L	3	2	11,11,12	0.50	0	15,15,17	0.66	0
3	NAG	M	1	3	15,15,15	0.25	0	21,21,21	0.65	0
3	FUC	M	2	3	10,10,11	0.57	0	14,14,16	0.63	0
3	GAL	M	3	3	11,11,12	0.55	0	15,15,17	0.68	0
2	NDG	N	1	2	15,15,15	0.27	0	21,21,21	1.01	1 (4%)
2	FUC	N	2	2	10,10,11	0.59	0	14,14,16	0.94	0
2	GAL	N	3	2	11,11,12	0.38	0	15,15,17	0.49	0
3	NAG	O	1[A]	3	15,15,15	0.32	0	21,21,21	1.67	3 (14%)
3	NAG	O	1[B]	3	15,15,15	0.27	0	21,21,21	0.79	1 (4%)
3	FUC	O	2[A]	3	10,10,11	0.43	0	14,14,16	0.56	0
3	FUC	O	2[B]	3	10,10,11	0.55	0	14,14,16	0.55	0
3	GAL	O	3[A]	3	11,11,12	0.57	0	15,15,17	1.38	1 (6%)
3	GAL	O	3[B]	3	11,11,12	0.60	0	15,15,17	0.65	0
2	NDG	P	1	2	15,15,15	0.21	0	21,21,21	0.84	1 (4%)
2	FUC	P	2	2	10,10,11	0.51	0	14,14,16	0.65	0
2	GAL	P	3	2	11,11,12	0.44	0	15,15,17	0.75	0
2	NDG	Q	1	2	15,15,15	0.36	0	21,21,21	1.56	2 (9%)
2	FUC	Q	2	2	10,10,11	0.44	0	14,14,16	0.60	0
2	GAL	Q	3	2	11,11,12	0.40	0	15,15,17	0.61	0
2	NDG	R	1	2	15,15,15	0.25	0	21,21,21	0.88	1 (4%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	FUC	R	2	2	10,10,11	0.57	0	14,14,16	0.51	0
2	GAL	R	3	2	11,11,12	0.44	0	15,15,17	0.93	0

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	NDG	K	1	2	-	0/6/26/26	0/1/1/1
2	FUC	K	2	2	-	-	0/1/1/1
2	GAL	K	3	2	-	0/2/19/22	0/1/1/1
2	NDG	L	1	2	-	0/6/26/26	0/1/1/1
2	FUC	L	2	2	-	-	0/1/1/1
2	GAL	L	3	2	-	1/2/19/22	0/1/1/1
3	NAG	M	1	3	-	0/6/26/26	0/1/1/1
3	FUC	M	2	3	-	-	0/1/1/1
3	GAL	M	3	3	-	0/2/19/22	0/1/1/1
2	NDG	N	1	2	-	4/6/26/26	0/1/1/1
2	FUC	N	2	2	-	-	0/1/1/1
2	GAL	N	3	2	-	0/2/19/22	0/1/1/1
3	NAG	O	1[A]	3	-	0/6/26/26	0/1/1/1
3	NAG	O	1[B]	3	1/1/6/7	0/6/26/26	0/1/1/1
3	FUC	O	2[A]	3	-	-	0/1/1/1
3	FUC	O	2[B]	3	-	-	0/1/1/1
3	GAL	O	3[A]	3	-	2/2/19/22	0/1/1/1
3	GAL	O	3[B]	3	-	0/2/19/22	0/1/1/1
2	NDG	P	1	2	-	0/6/26/26	0/1/1/1
2	FUC	P	2	2	-	-	0/1/1/1
2	GAL	P	3	2	-	1/2/19/22	0/1/1/1
2	NDG	Q	1	2	-	2/6/26/26	0/1/1/1
2	FUC	Q	2	2	-	-	0/1/1/1
2	GAL	Q	3	2	-	2/2/19/22	0/1/1/1
2	NDG	R	1	2	-	2/6/26/26	0/1/1/1
2	FUC	R	2	2	-	-	0/1/1/1
2	GAL	R	3	2	-	0/2/19/22	0/1/1/1

There are no bond length outliers.

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	Q	1	NDG	O5-C1-C2	5.95	115.50	109.52
3	O	1[A]	NAG	O5-C1-C2	5.52	115.06	109.52
3	O	3[A]	GAL	C1-C2-C3	4.14	114.76	109.67
2	L	1	NDG	C1-C2-N2	-3.50	106.67	110.73
2	P	1	NDG	O5-C1-C2	3.27	112.80	109.52

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
3	O	1[B]	NAG	C1

5 of 14 torsion outliers are listed below:

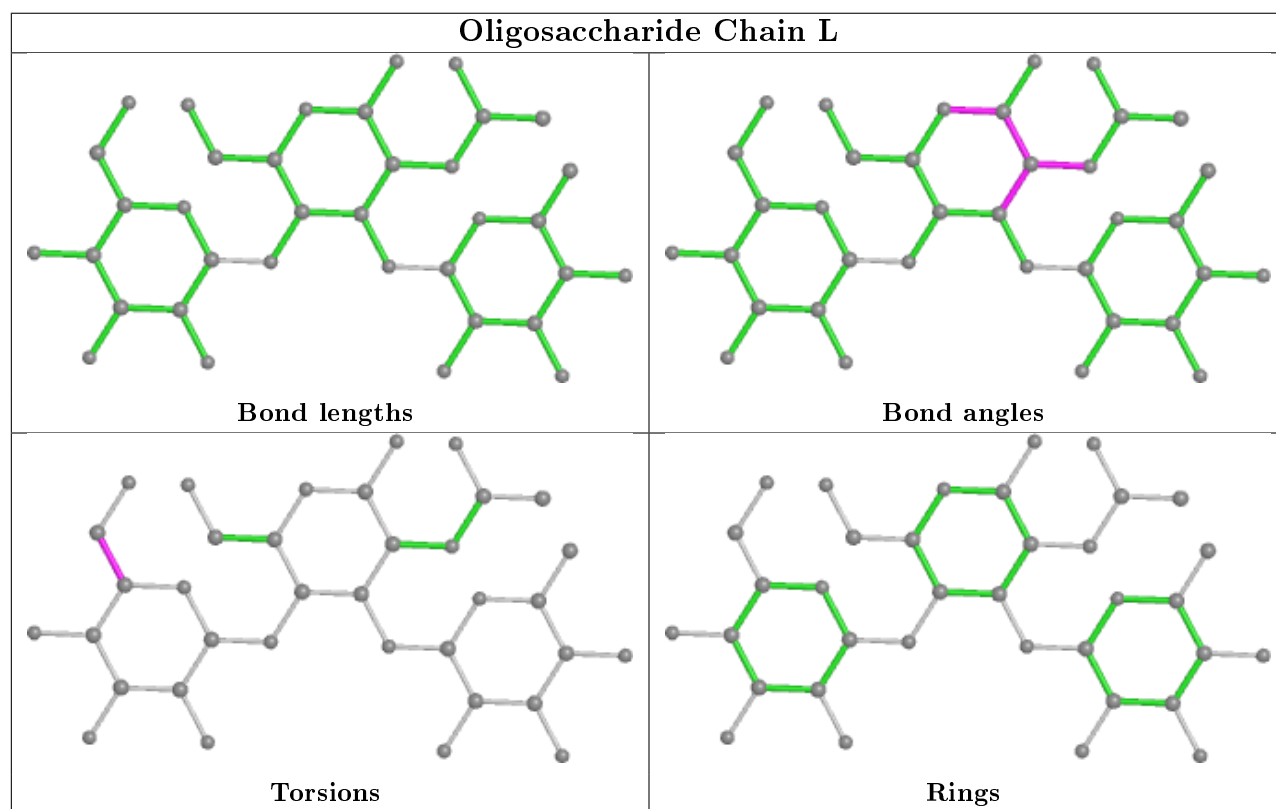
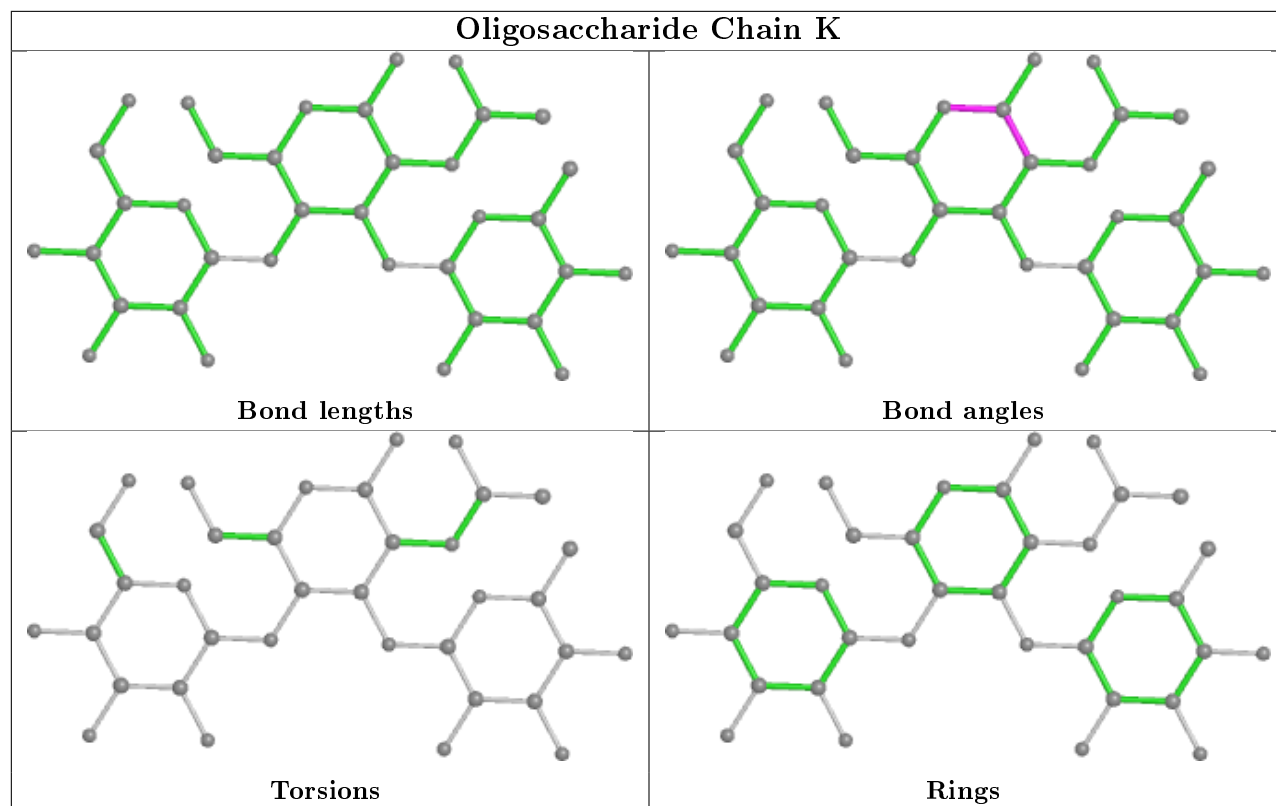
Mol	Chain	Res	Type	Atoms
2	Q	3	GAL	O5-C5-C6-O6
3	O	3[A]	GAL	O5-C5-C6-O6
2	Q	3	GAL	C4-C5-C6-O6
2	N	1	NDG	O5-C5-C6-O6
3	O	3[A]	GAL	C4-C5-C6-O6

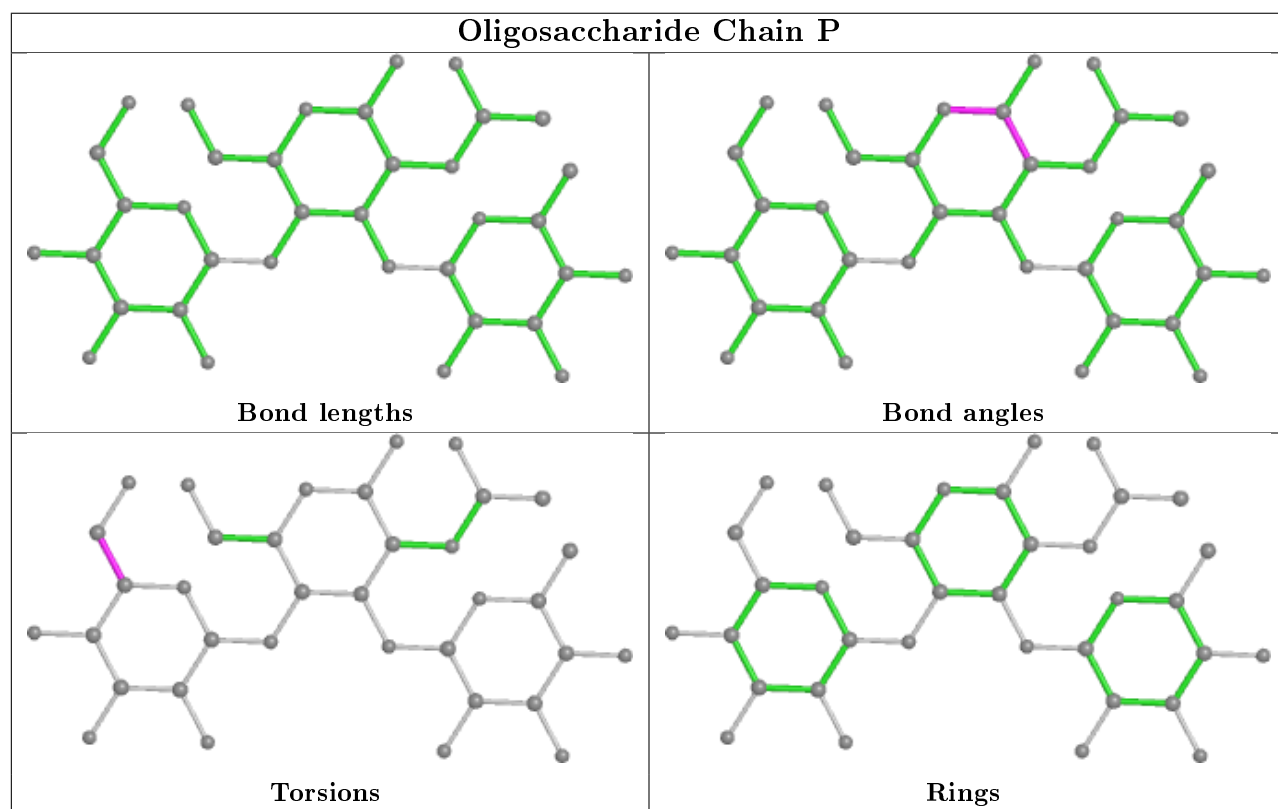
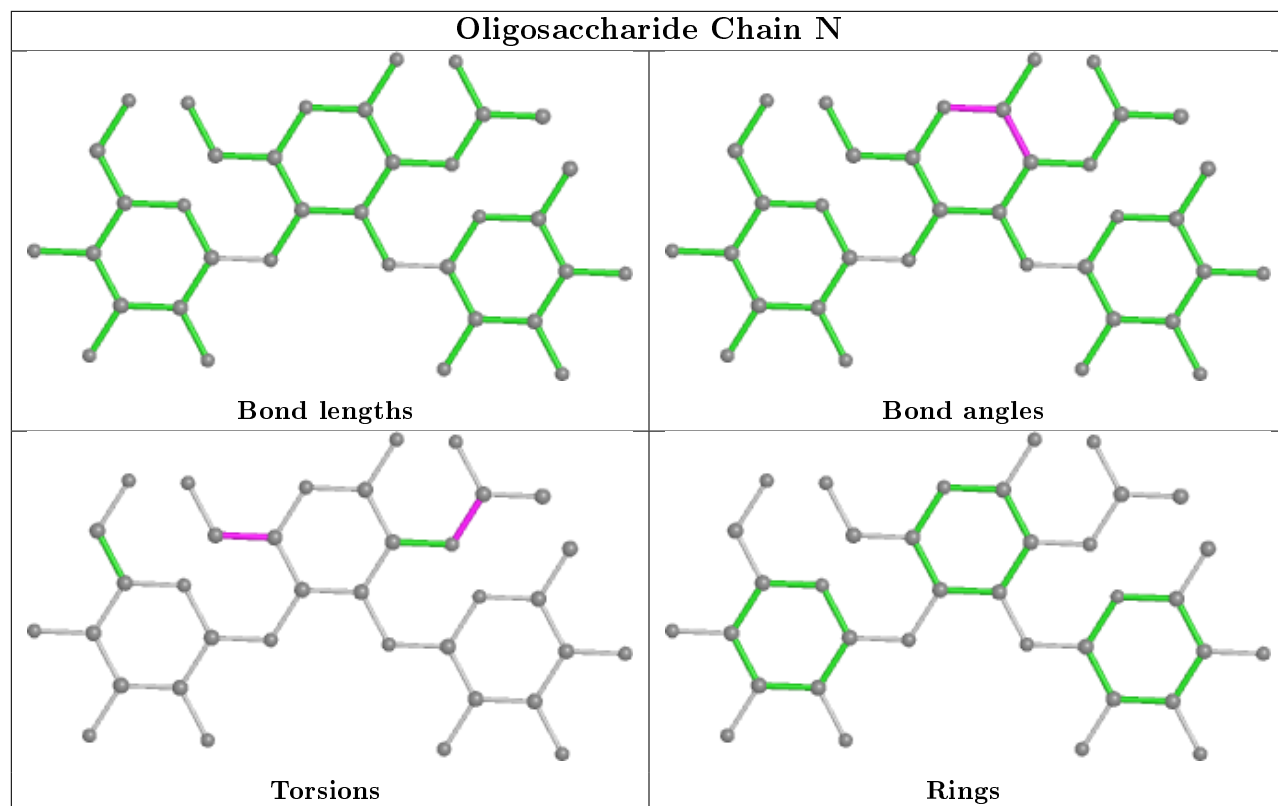
There are no ring outliers.

1 monomer is involved in 1 short contact:

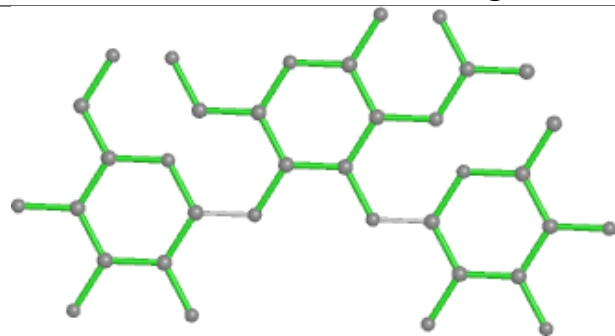
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	N	1	NDG	1	0

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

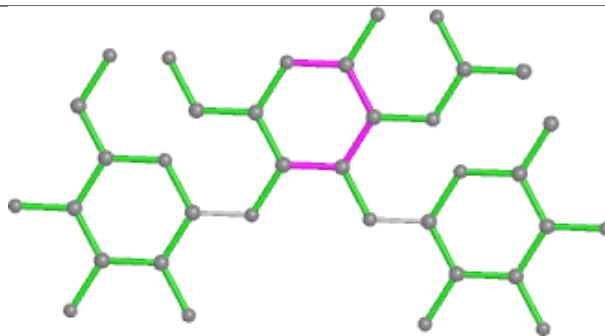




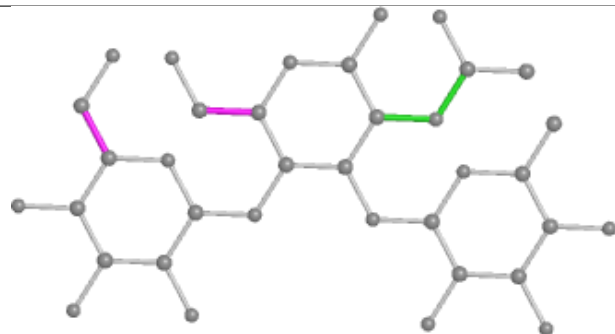
## Oligosaccharide Chain Q



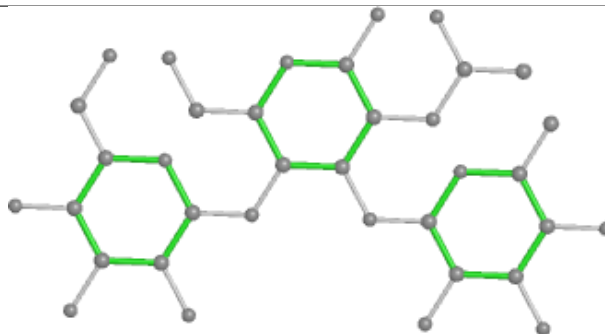
Bond lengths



Bond angles

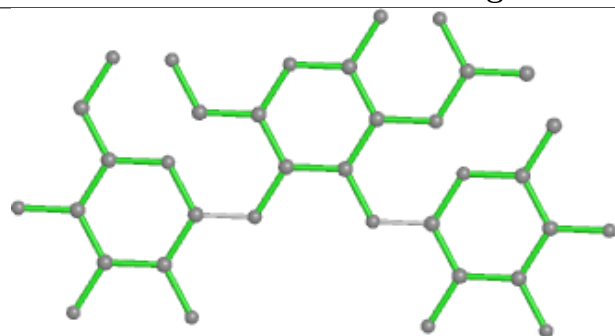


Torsions

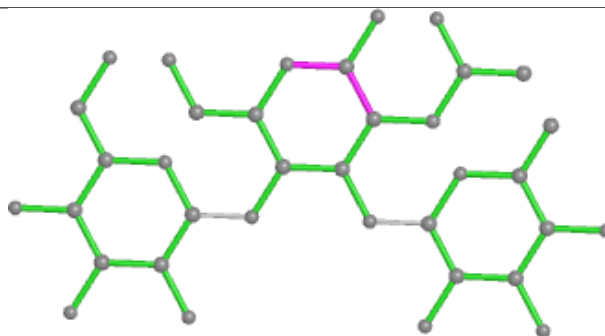


Rings

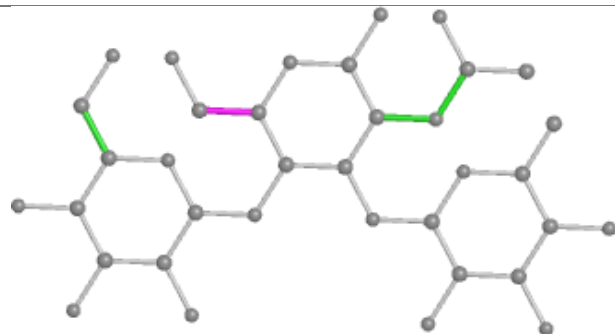
## Oligosaccharide Chain R



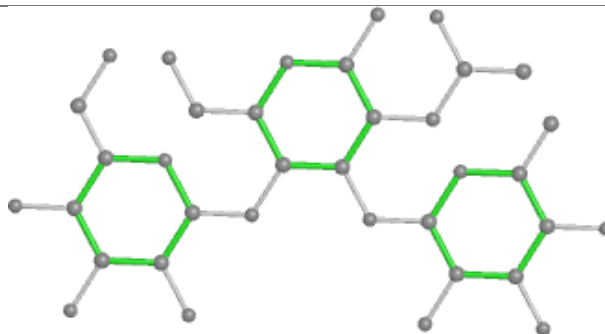
Bond lengths



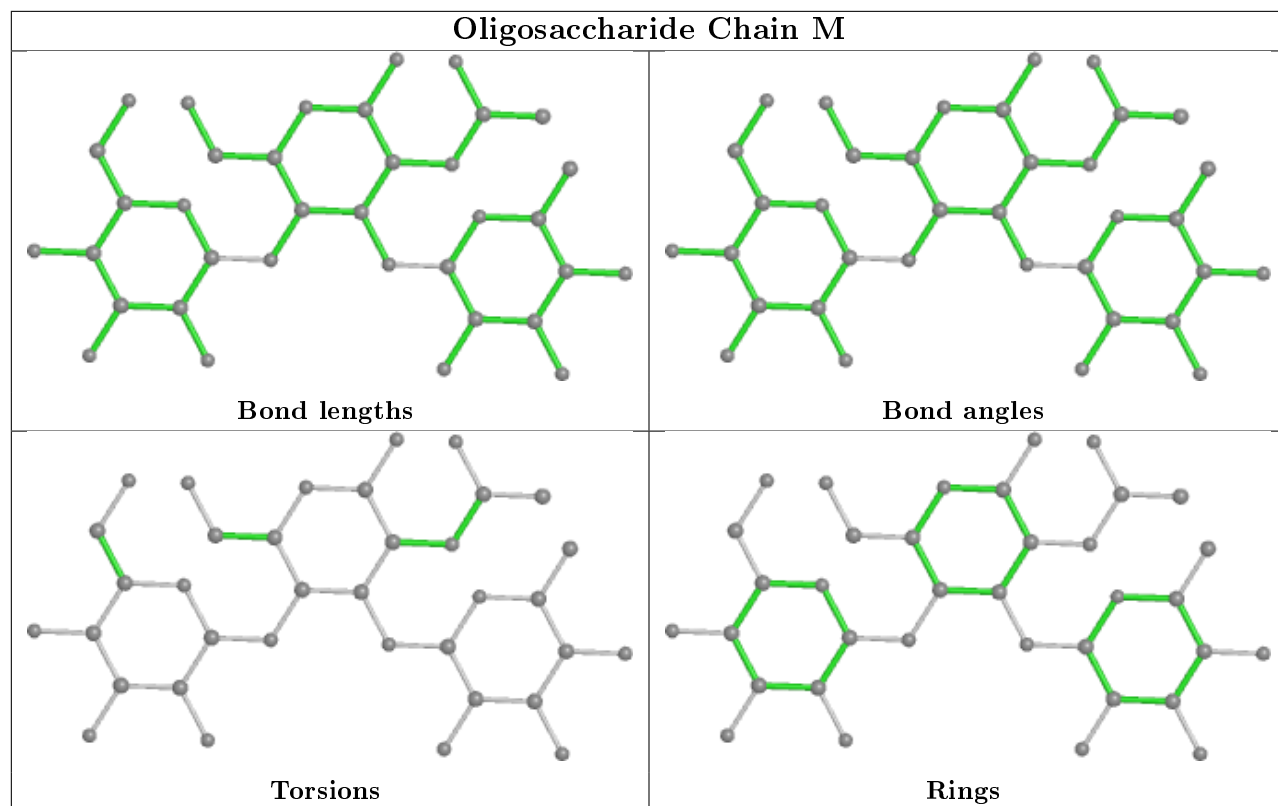
Bond angles



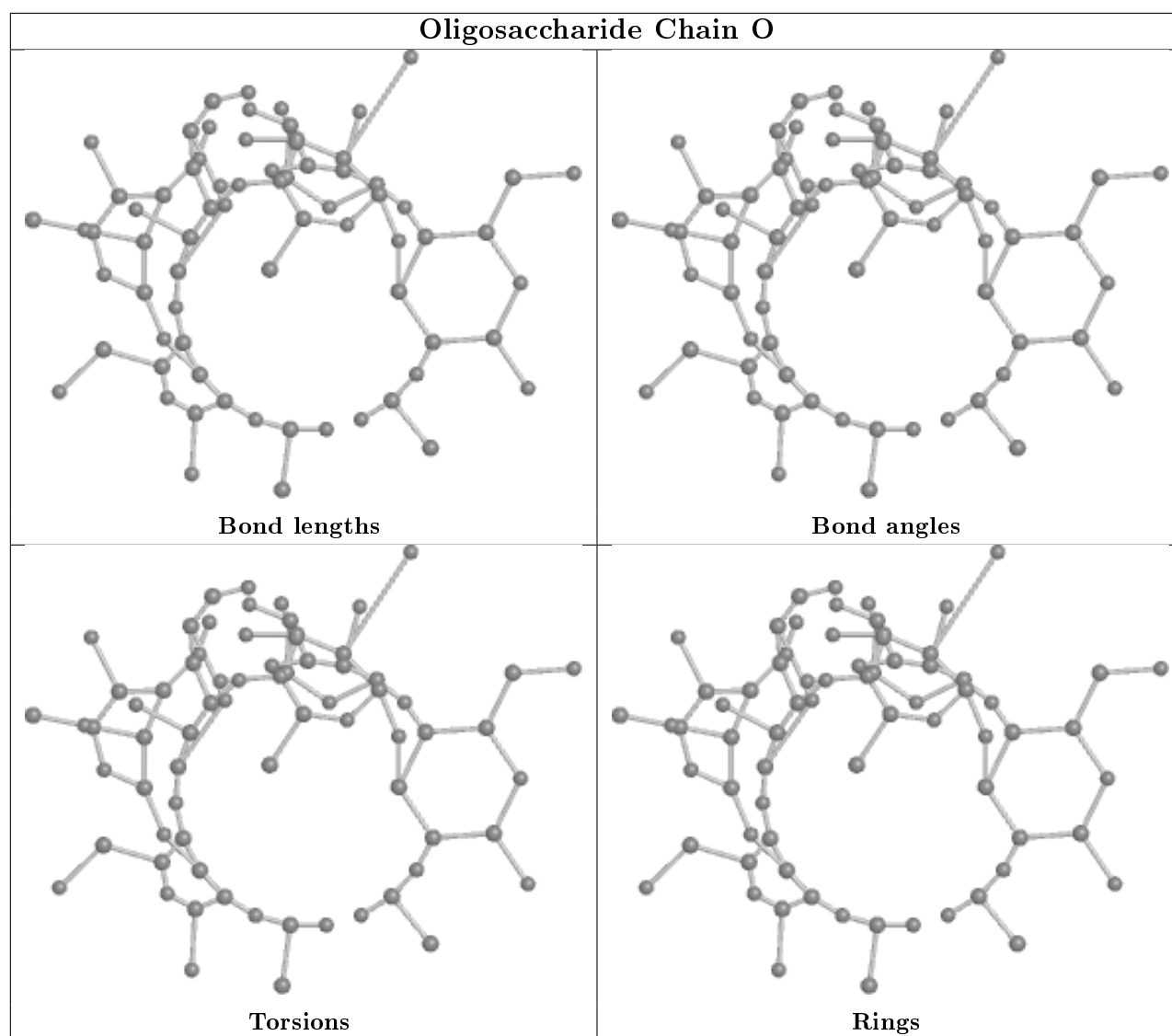
Torsions



Rings







## 5.6 Ligand geometry [i](#)

Of 21 ligands modelled in this entry, 10 are monoatomic - leaving 11 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	$\# Z  > 2$
5	BCN	I	203	4	7,10,10	0.47	0	8,11,11	1.13	0
5	BCN	J	202	4	7,10,10	0.45	0	8,11,11	0.83	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
5	BCN	I	202	4	7,10,10	0.21	0	8,11,11	0.72	0
5	BCN	G	203	4	7,10,10	0.43	0	8,11,11	0.61	0
5	BCN	F	202	4	7,10,10	0.34	0	8,11,11	0.98	0
5	BCN	G	202	4	7,10,10	0.47	0	8,11,11	1.19	1 (12%)
5	BCN	B	202	4	7,10,10	0.36	0	8,11,11	1.00	0
5	BCN	A	202	4	7,10,10	0.76	0	8,11,11	1.14	1 (12%)
5	BCN	D	202	4	7,10,10	0.61	0	8,11,11	0.78	0
6	FUC	F	203	-	11,11,11	0.74	0	15,16,16	1.22	1 (6%)
5	BCN	D	203	4	7,10,10	0.33	0	8,11,11	0.74	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	BCN	I	203	4	-	2/8/10/10	-
5	BCN	J	202	4	-	2/8/10/10	-
5	BCN	I	202	4	-	2/8/10/10	-
5	BCN	G	203	4	-	2/8/10/10	-
5	BCN	F	202	4	-	0/8/10/10	-
5	BCN	G	202	4	-	1/8/10/10	-
5	BCN	B	202	4	-	2/8/10/10	-
5	BCN	A	202	4	-	3/8/10/10	-
5	BCN	D	202	4	-	5/8/10/10	-
6	FUC	F	203	-	-	-	0/1/1/1
5	BCN	D	203	4	-	4/8/10/10	-

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	F	203	FUC	C4-C3-C2	-2.31	106.79	110.82
5	A	202	BCN	C1-N1-C5	2.08	115.69	111.29
5	G	202	BCN	O4-C4-C3	-2.07	102.61	111.19

There are no chirality outliers.

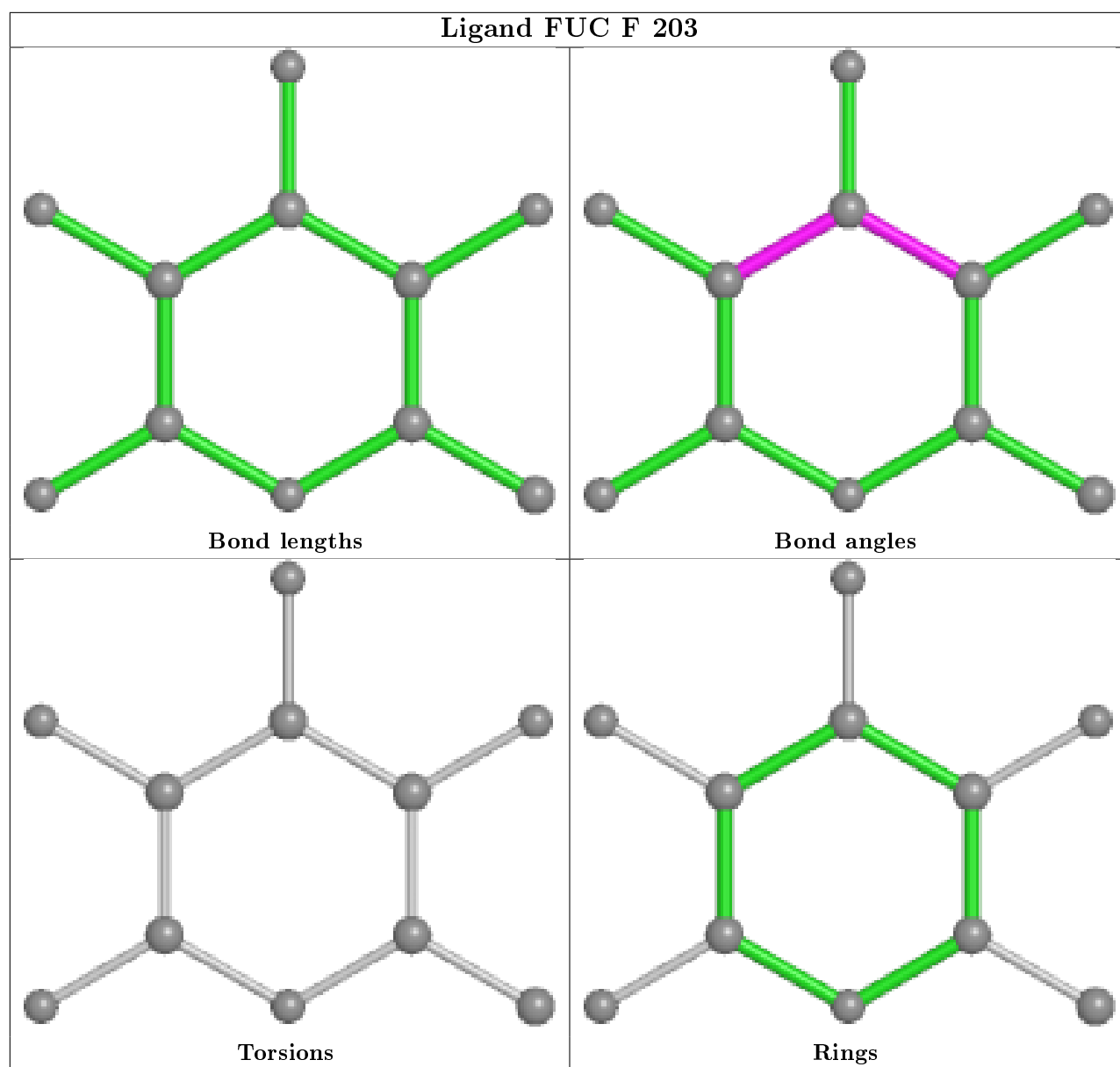
5 of 23 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	D	202	BCN	N1-C3-C4-O4
5	D	203	BCN	N1-C3-C4-O4
5	I	202	BCN	C2-C1-N1-C5
5	D	203	BCN	C2-C1-N1-C5
5	I	202	BCN	C2-C1-N1-C3

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 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	103/103 (100%)	-0.18	1 (0%) 82 85	12, 18, 28, 48	0
1	B	103/103 (100%)	-0.24	0 100 100	11, 15, 25, 36	0
1	C	103/103 (100%)	-0.11	1 (0%) 82 85	11, 17, 30, 43	0
1	D	103/103 (100%)	-0.31	0 100 100	11, 17, 27, 34	0
1	E	103/103 (100%)	-0.34	1 (0%) 82 85	11, 15, 21, 45	0
1	F	103/103 (100%)	0.05	3 (2%) 51 58	12, 20, 32, 42	0
1	G	103/103 (100%)	-0.10	0 100 100	12, 20, 31, 40	0
1	H	103/103 (100%)	-0.21	0 100 100	11, 17, 26, 34	0
1	I	103/103 (100%)	-0.17	1 (0%) 82 85	11, 19, 28, 39	0
1	J	103/103 (100%)	-0.12	2 (1%) 66 72	12, 20, 30, 38	0
All	All	1030/1030 (100%)	-0.17	9 (0%) 84 86	11, 18, 29, 48	0

The worst 5 of 9 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	103	ASN	4.0
1	J	103	ASN	3.9
1	C	58[A]	ILE	3.2
1	F	13[A]	HIS	3.1
1	E	103	ASN	2.4

### 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 ⓘ

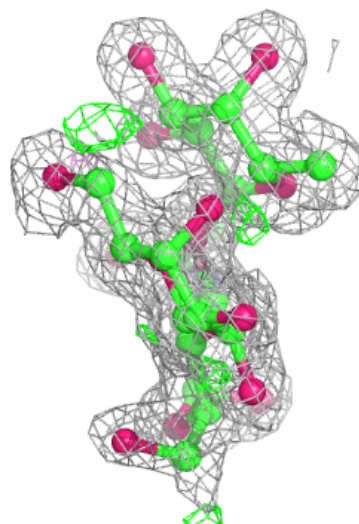
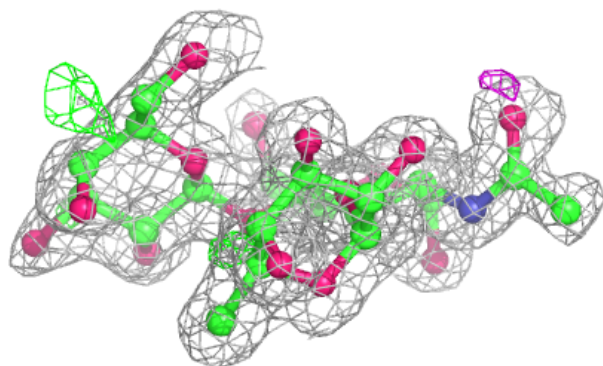
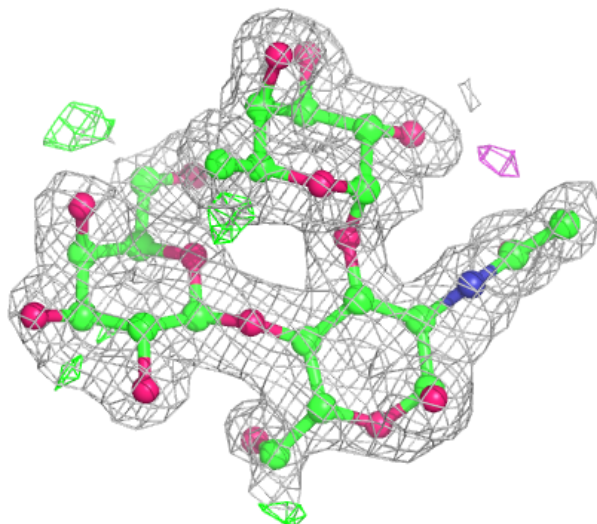
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	GAL	R	3	11/12	0.72	0.15	33,36,37,40	11
2	NDG	Q	1	15/15	0.75	0.21	27,32,36,39	15
2	GAL	Q	3	11/12	0.78	0.22	39,41,43,47	11
2	GAL	N	3	11/12	0.78	0.15	33,35,39,39	11
2	NDG	R	1	15/15	0.79	0.13	25,31,34,36	15
2	GAL	P	3	11/12	0.81	0.15	29,34,36,36	11
2	FUC	Q	2	10/11	0.81	0.15	17,24,26,28	10
3	GAL	M	3	11/12	0.82	0.14	27,29,30,34	11
2	NDG	K	1	15/15	0.84	0.11	20,26,28,29	15
3	FUC	M	2	10/11	0.84	0.14	15,17,18,22	10
3	GAL	O	3[A]	11/12	0.85	0.15	17,17,18,18	11
2	NDG	P	1	15/15	0.85	0.13	22,28,30,30	15
3	GAL	O	3[B]	11/12	0.85	0.15	19,20,21,22	11
2	FUC	R	2	10/11	0.86	0.14	20,21,23,24	10
2	GAL	K	3	11/12	0.86	0.11	26,27,30,30	11
2	NDG	N	1	15/15	0.86	0.13	21,29,34,39	15
3	NAG	M	1	15/15	0.87	0.12	20,25,29,30	15
2	FUC	K	2	10/11	0.89	0.09	17,18,19,20	10
2	FUC	P	2	10/11	0.91	0.10	19,21,23,26	10
2	FUC	N	2	10/11	0.91	0.13	15,17,20,20	10
2	FUC	L	2	10/11	0.91	0.09	12,13,14,15	0
3	FUC	O	2[A]	10/11	0.92	0.12	12,13,14,16	10
3	FUC	O	2[B]	10/11	0.92	0.12	13,14,15,16	10
3	NAG	O	1[B]	15/15	0.92	0.11	16,17,18,18	15
3	NAG	O	1[A]	15/15	0.92	0.11	15,17,19,20	15
2	GAL	L	3	11/12	0.94	0.08	11,13,16,20	0
2	NDG	L	1	15/15	0.95	0.08	12,13,17,17	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.

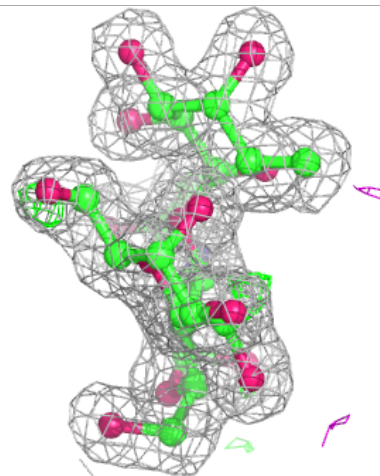
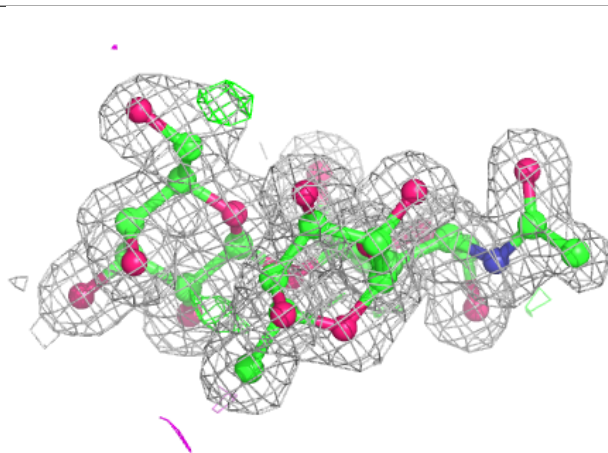
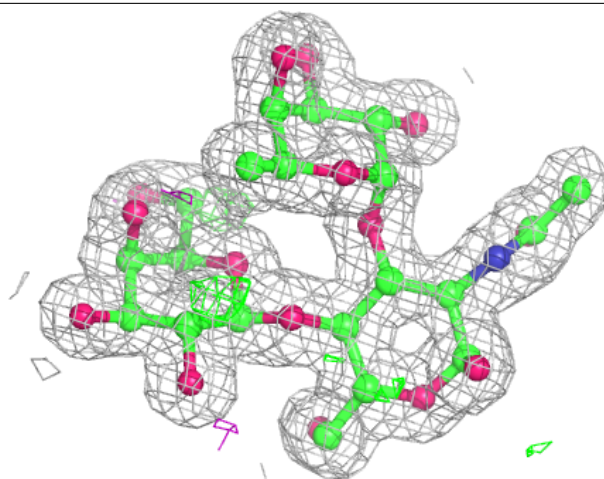
**Electron density around Chain K:**

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



**Electron density around Chain L:**

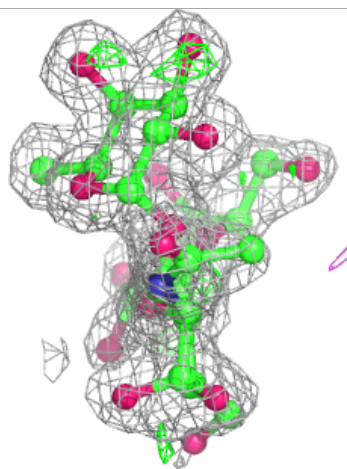
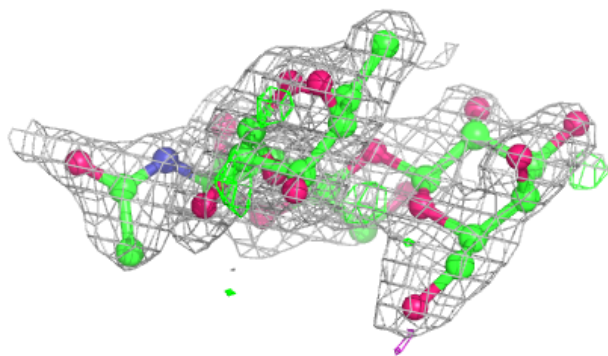
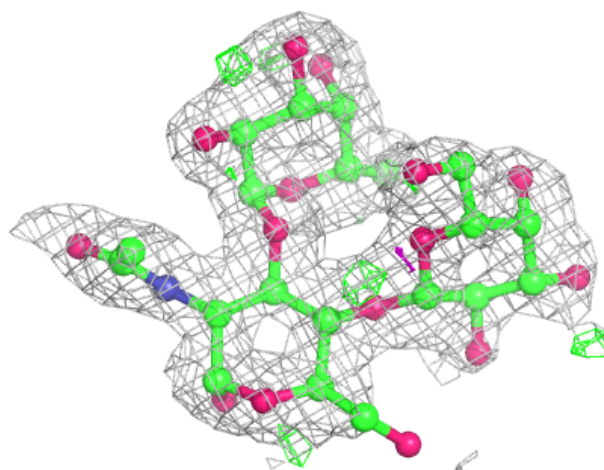
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





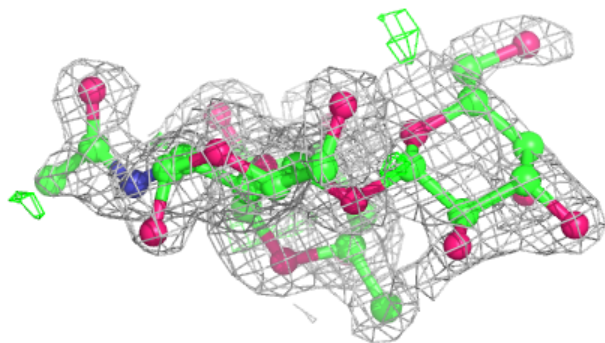
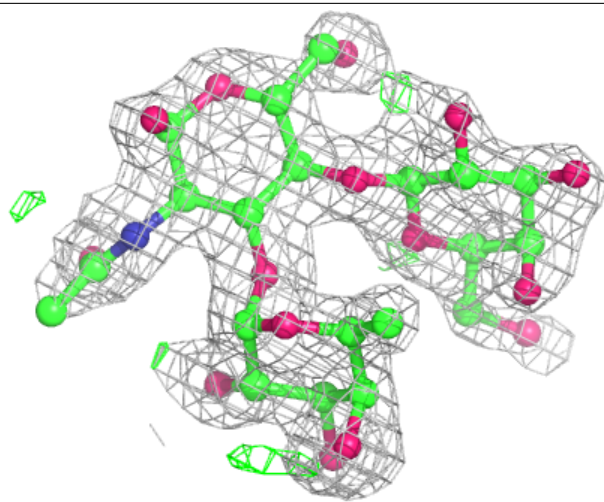
**Electron density around Chain N:**

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



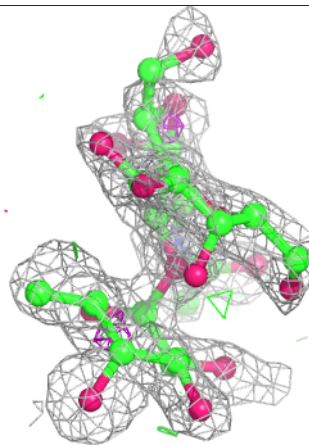
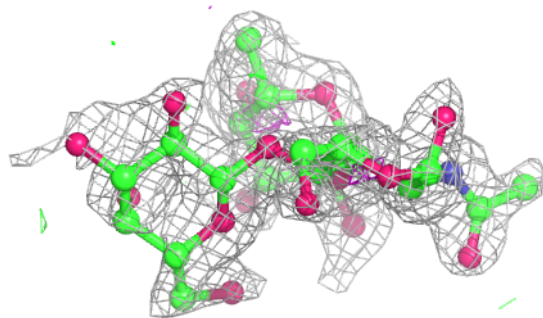
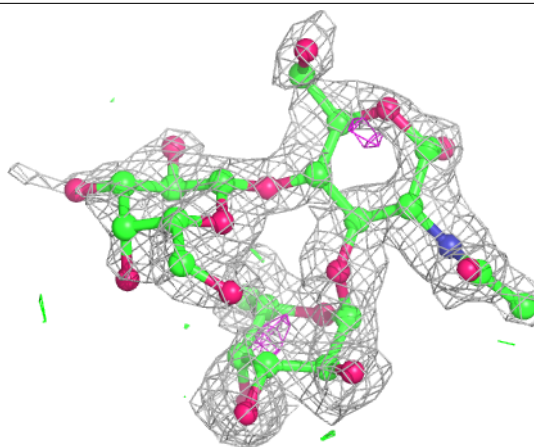
**Electron density around Chain P:**

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



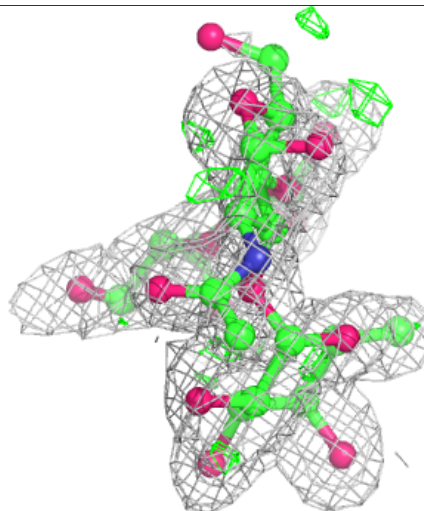
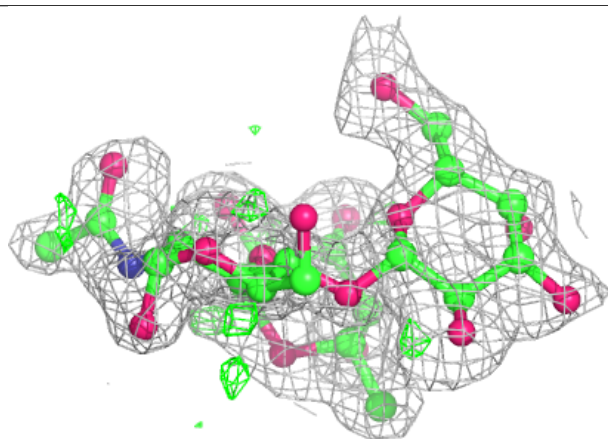
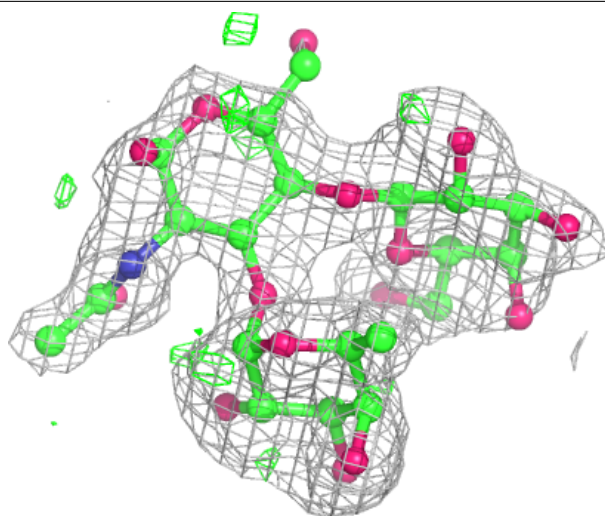
**Electron density around Chain Q:**

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



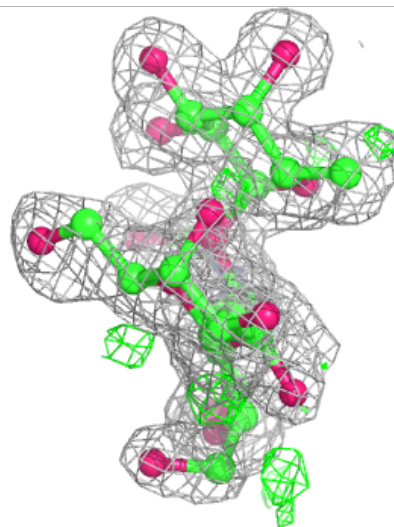
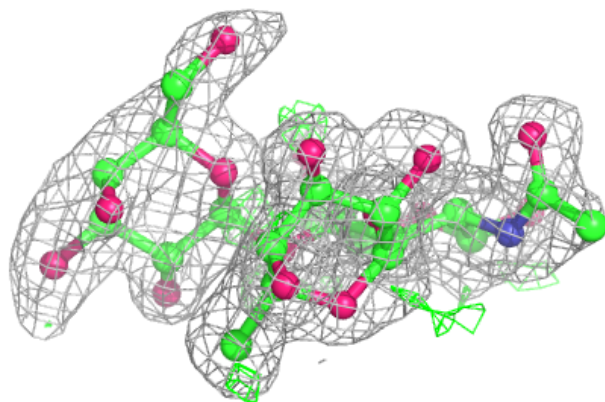
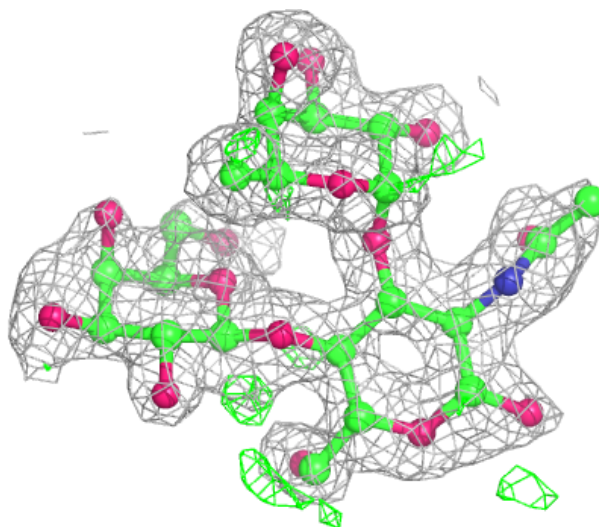
**Electron density around Chain R:**

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

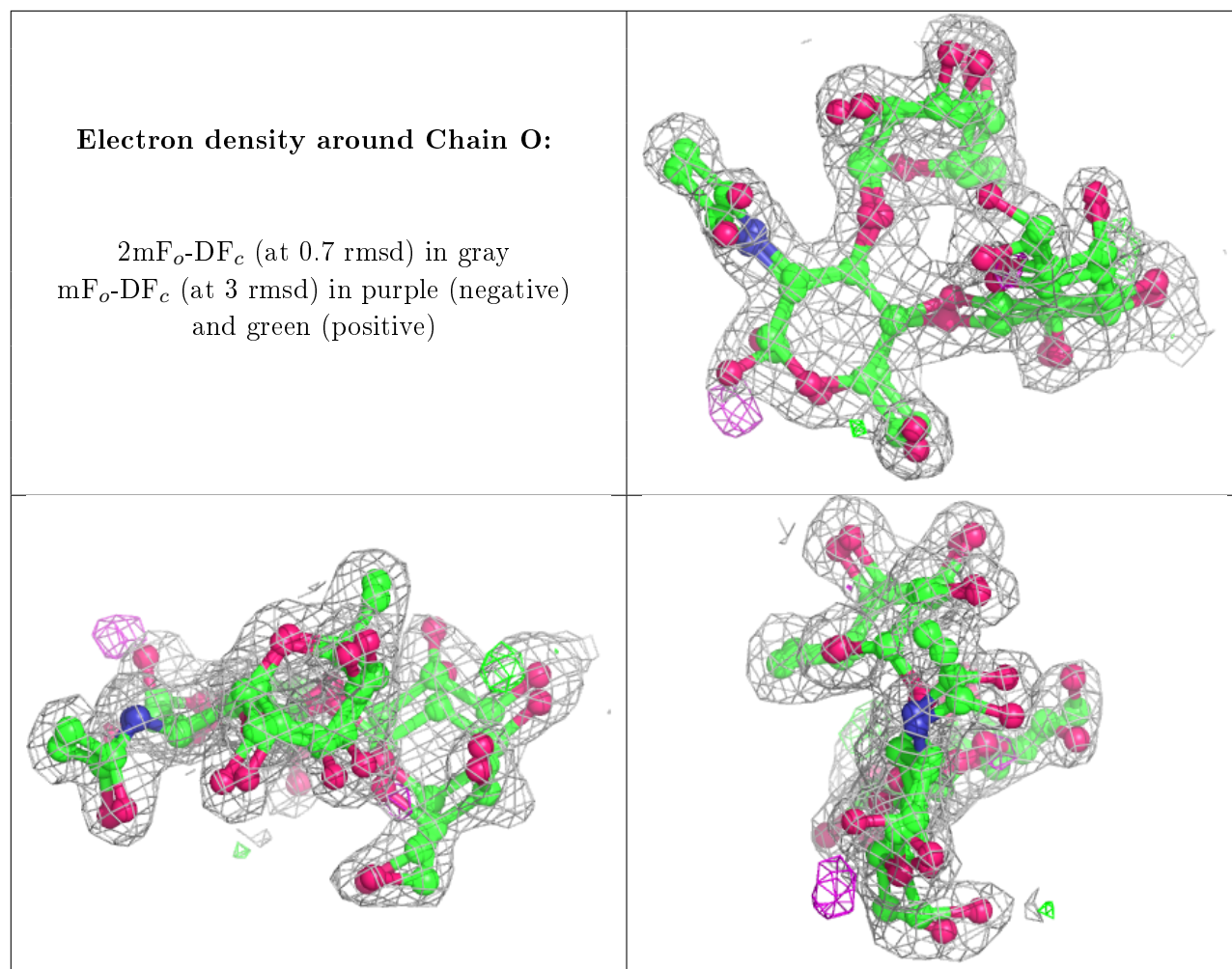


**Electron density around Chain M:**

$2mF_o-DF_c$  (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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
6	FUC	F	203	11/11	0.70	0.15	29,32,34,36	11
5	BCN	B	202	11/11	0.92	0.10	16,20,25,26	0
5	BCN	A	202	11/11	0.92	0.08	17,24,25,26	0
5	BCN	G	203	11/11	0.92	0.09	16,23,27,27	0
5	BCN	F	202	11/11	0.93	0.09	15,21,24,26	0
5	BCN	D	202	11/11	0.93	0.07	18,20,27,28	0
5	BCN	J	202	11/11	0.93	0.09	16,23,26,26	0
5	BCN	I	203	11/11	0.94	0.07	18,20,23,24	0
5	BCN	G	202	11/11	0.94	0.08	15,20,24,26	0
5	BCN	I	202	11/11	0.94	0.09	17,21,27,29	0

*Continued on next page...*

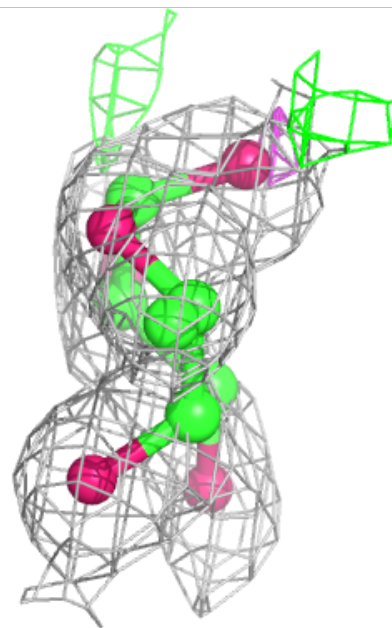
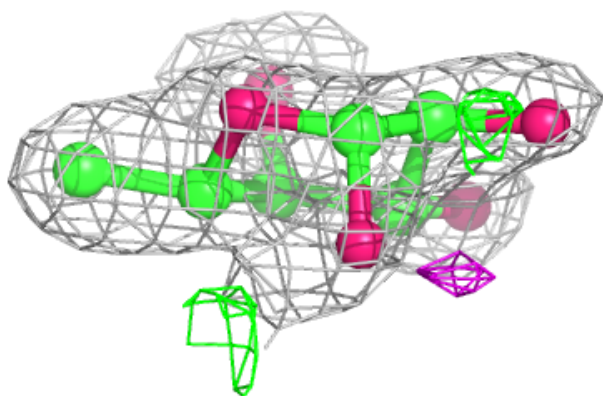
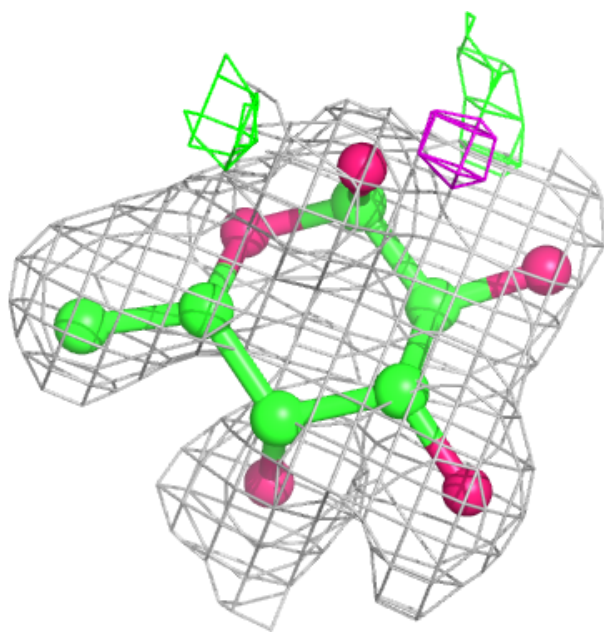
*Continued from previous page...*

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
5	BCN	D	203	11/11	0.94	0.09	18,21,23,24	0
4	CA	H	201	1/1	0.98	0.05	14,14,14,14	0
4	CA	I	201	1/1	0.99	0.05	14,14,14,14	0
4	CA	J	201	1/1	0.99	0.06	14,14,14,14	0
4	CA	C	201	1/1	0.99	0.05	15,15,15,15	0
4	CA	E	201	1/1	0.99	0.05	14,14,14,14	0
4	CA	A	201	1/1	0.99	0.04	15,15,15,15	0
4	CA	B	201	1/1	1.00	0.03	16,16,16,16	0
4	CA	G	201	1/1	1.00	0.05	15,15,15,15	0
4	CA	D	201	1/1	1.00	0.04	15,15,15,15	0
4	CA	F	201	1/1	1.00	0.04	15,15,15,15	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 FUC F 203:**

$2mF_o - DF_c$  (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.