



# Full wwPDB X-ray Structure Validation Report ⓘ

Nov 9, 2024 – 11:30 am GMT

PDB ID : 4P45  
Title : X-ray structure of human glutamate carboxypeptidase II (GCPII) in complex with a phosphoramidate inhibitor JRB-4-73  
Authors : Novakova, Z.; Barinka, C.  
Deposited on : 2014-03-11  
Resolution : 1.87 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](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.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.39

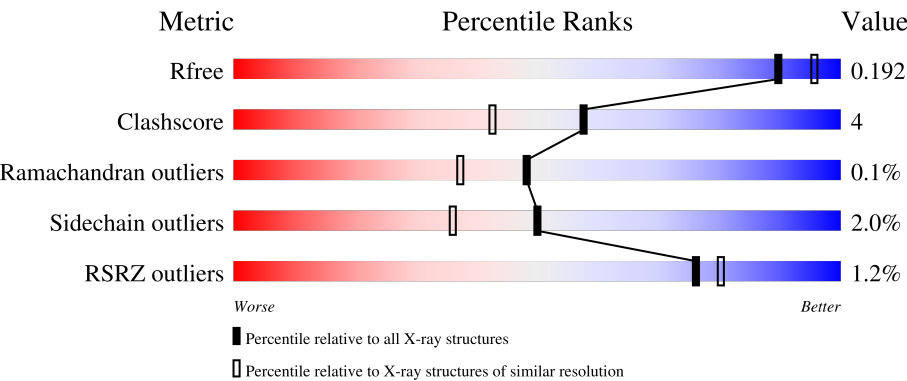
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.87 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.



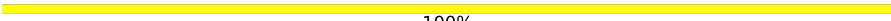
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R <sub>free</sub>	164625	1090 (1.88-1.88)
Clashscore	180529	1144 (1.88-1.88)
Ramachandran outliers	177936	1135 (1.88-1.88)
Sidechain outliers	177891	1135 (1.88-1.88)
RSRZ outliers	164620	1090 (1.88-1.88)

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  $\geq 3$ , 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	707	<div><div>%</div><div><div></div><div>89%</div><div>8%</div><div>.</div></div></div>
2	B	2	<div><div></div><div>50%</div><div>50%</div></div>
3	C	3	<div><div></div><div>67%</div><div>33%</div></div>
3	D	3	<div><div></div><div>67%</div><div>33%</div></div>
4	E	3	<div><div></div><div>33%</div><div>33%</div><div>33%</div></div>

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Mol	Chain	Length	Quality of chain
5	F	4	 100%

## 2 Entry composition [i](#)

There are 11 unique types of molecules in this entry. The entry contains 6634 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 Glutamate carboxypeptidase 2.

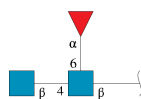
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	690	Total	C	N	O	S	0	49	0
			5779	3708	969	1081	21			

- 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	B	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	C	3	Total	C	N	O	0	0	0
			38	22	2	14			
3	D	3	Total	C	N	O	0	0	0
			38	22	2	14			

- Molecule 4 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.



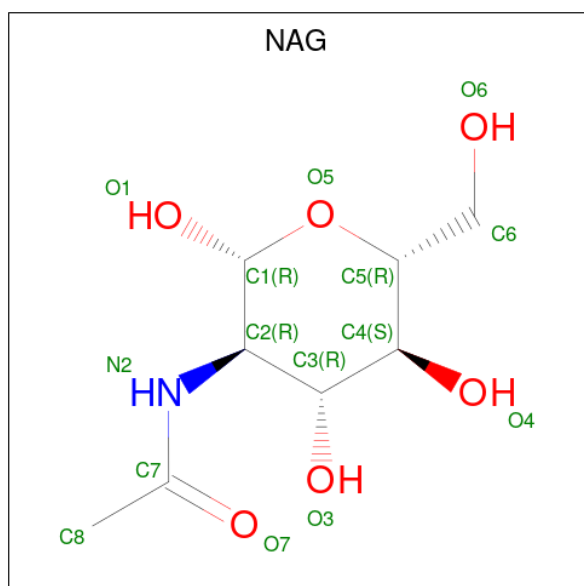
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
4	E	3	Total	C	N	O	0	0	0
			39	22	2	15			

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



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

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



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

- Molecule 7 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	2	Total	Zn	0	0
			2	2		

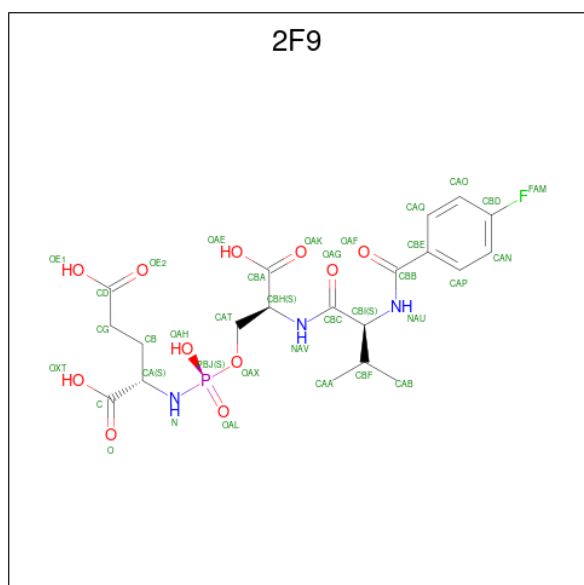
- Molecule 8 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	1	Total	Ca	0	0
			1	1		

- Molecule 9 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	1	Total	Cl	0	0
			1	1		

- Molecule 10 is N-(4-fluorobenzoyl)-L-valyl-O-[(S)-{[(1S)-1,3-dicarboxypropyl]amino}(hydroxy)phosphoryl]-L-serine (three-letter code: 2F9) (formula: C<sub>20</sub>H<sub>27</sub>FN<sub>3</sub>O<sub>11</sub>P).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
10	A	1	Total	C	F	N	O	P	0	0
			36	20	1	3	11	1		

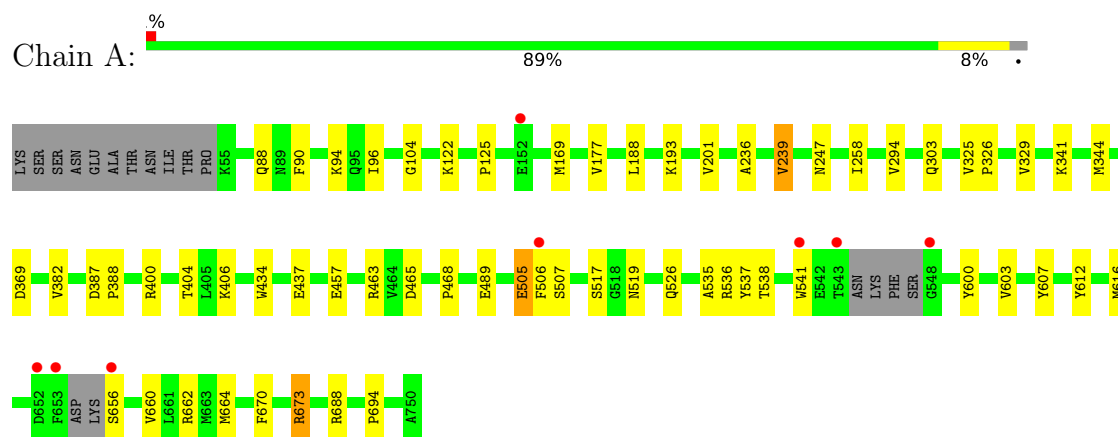
- Molecule 11 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
11	A	594	Total 594	O 594	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.

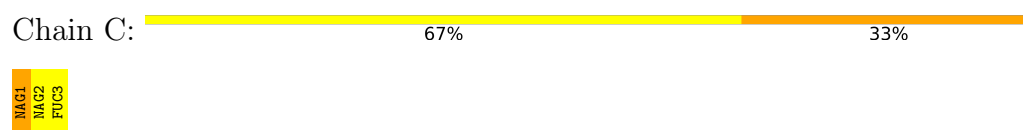
#### • Molecule 1: Glutamate carboxypeptidase 2



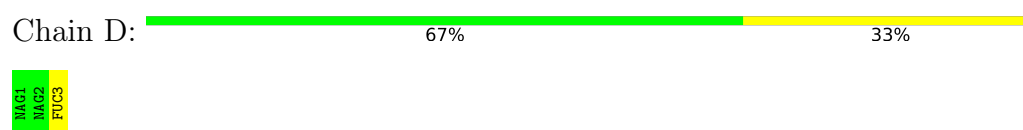
#### • Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose



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



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





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

Chain E:  33% 33% 33%

MAG1  
MAG2  
BMA3

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

Chain F:  100%

MAG1  
MAG2  
BMA3  
MAN4

## 4 Data and refinement statistics

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	101.44Å 130.31Å 158.75Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	28.18 – 1.87 28.18 – 1.87	Depositor EDS
% Data completeness (in resolution range)	100.0 (28.18-1.87) 99.8 (28.18-1.87)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.34 (at 1.87Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, $R_{free}$	0.162 , 0.193 0.162 , 0.192	Depositor DCC
$R_{free}$ test set	4333 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	21.0	Xtriage
Anisotropy	0.023	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 48.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	6634	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.92% 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: CA, NAG, FUC, 2F9, CL, ZN, BMA, MAN

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 5$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z  > 5$	RMSZ	$\# Z  > 5$
1	A	0.91	2/6018 (0.0%)	0.75	3/8150 (0.0%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	434	TRP	CE3-CZ3	5.78	1.48	1.38
1	A	670	PHE	CE1-CZ	5.11	1.47	1.37

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	673	ARG	NE-CZ-NH2	-5.79	117.40	120.30
1	A	465	ASP	CB-CG-OD1	5.67	123.40	118.30
1	A	673	ARG	NE-CZ-NH1	5.06	122.83	120.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	5779	0	5616	47	0
2	B	28	0	25	2	0
3	C	38	0	34	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	D	38	0	34	1	0
4	E	39	0	34	2	0
5	F	50	0	43	0	0
6	A	28	0	26	0	0
7	A	2	0	0	0	0
8	A	1	0	0	0	0
9	A	1	0	0	0	0
10	A	36	0	23	0	0
11	A	594	0	0	16	0
All	All	6634	0	5835	52	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 4.

All (52) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:660[A]:VAL:O	1:A:664[A]:MET:HG2	1.43	1.17
1:A:463:ARG:NH1	1:A:536[B]:ARG:HH12	1.42	1.17
1:A:463:ARG:NH1	1:A:536[B]:ARG:NH1	1.98	1.11
1:A:463:ARG:CZ	1:A:536[B]:ARG:NH1	2.28	0.96
1:A:88[B]:GLN:OE1	11:A:1286:HOH:O	1.98	0.81
1:A:463:ARG:HH12	1:A:536[B]:ARG:HH12	1.31	0.79
11:A:1207:HOH:O	2:B:2:NAG:H81	1.84	0.77
1:A:656[B]:SER:O	11:A:901:HOH:O	2.05	0.74
1:A:612:TYR:CZ	1:A:616:MET:HG3	2.32	0.65
1:A:688[B]:ARG:NH2	11:A:1059:HOH:O	2.15	0.61
1:A:603[A]:VAL:HG13	1:A:607:TYR:CZ	2.40	0.56
1:A:517[A]:SER:HB2	1:A:694:PRO:HG3	1.86	0.56
1:A:603[A]:VAL:CG1	1:A:607:TYR:CE2	2.89	0.56
11:A:1179:HOH:O	4:E:2:NAG:C8	2.53	0.56
1:A:517[B]:SER:HB2	1:A:694:PRO:HG3	1.87	0.55
11:A:1179:HOH:O	4:E:2:NAG:H83	2.05	0.55
1:A:400:ARG:O	1:A:404[B]:THR:HG23	2.07	0.54
11:A:1178:HOH:O	3:C:1:NAG:H83	2.07	0.54
1:A:177:VAL:HG12	1:A:188:LEU:HD11	1.89	0.54
1:A:236:ALA:O	1:A:239[A]:VAL:HG13	2.07	0.54
1:A:526[A]:GLN:NE2	11:A:1447:HOH:O	2.37	0.53
1:A:505:GLU:HG3	1:A:506:PHE:CD1	2.43	0.53
1:A:535:ALA:C	1:A:536[B]:ARG:HG3	2.29	0.53
1:A:437:GLU:OE1	11:A:902:HOH:O	2.19	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:457[A]:GLU:OE2	1:A:538:THR:OG1	2.24	0.51
1:A:188:LEU:HD21	1:A:329[A]:VAL:HG11	1.93	0.50
1:A:169:MET:HA	1:A:344:MET:O	2.12	0.50
1:A:88[B]:GLN:CD	11:A:1286:HOH:O	2.45	0.49
1:A:188:LEU:CD2	1:A:329[A]:VAL:HG11	2.42	0.49
1:A:603[A]:VAL:CG1	1:A:607:TYR:CZ	2.97	0.48
1:A:96[B]:ILE:HD13	11:A:1073:HOH:O	2.13	0.47
1:A:94[B]:LYS:HE2	11:A:1328:HOH:O	2.15	0.46
1:A:94[B]:LYS:HE2	11:A:1467:HOH:O	2.15	0.45
1:A:239[A]:VAL:HG22	1:A:247:ASN:ND2	2.32	0.45
1:A:489:GLU:H	1:A:489:GLU:CD	2.21	0.45
1:A:505:GLU:HG3	1:A:506:PHE:CE1	2.52	0.44
1:A:656[B]:SER:CB	11:A:901:HOH:O	2.62	0.44
1:A:468:PRO:HG2	1:A:603[B]:VAL:HG21	2.00	0.43
1:A:258:ILE:HD13	1:A:294:VAL:HB	2.01	0.43
1:A:468:PRO:CG	1:A:603[B]:VAL:HG21	2.47	0.43
1:A:387:ASP:HA	1:A:388:PRO:HA	1.89	0.43
1:A:325:VAL:HB	1:A:326:PRO:HD2	1.99	0.43
1:A:177:VAL:HG13	1:A:201[B]:VAL:HG22	2.01	0.42
1:A:90:PHE:CZ	1:A:94[A]:LYS:HD2	2.54	0.42
1:A:177:VAL:HG12	1:A:188:LEU:CD1	2.50	0.42
1:A:104:GLY:O	1:A:406:LYS:HD3	2.20	0.42
1:A:656[B]:SER:OG	11:A:901:HOH:O	2.11	0.42
11:A:1413:HOH:O	2:B:2:NAG:H83	2.20	0.41
1:A:369:ASP:OD2	1:A:662[B]:ARG:NH2	2.34	0.41
1:A:177:VAL:CG1	1:A:201[B]:VAL:HG22	2.51	0.41
1:A:125:PRO:HG2	3:D:3:FUC:H63	2.04	0.40
1:A:239[A]:VAL:HG22	1:A:247:ASN:CG	2.42	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	730/707 (103%)	714 (98%)	15 (2%)	1 (0%)	48 37

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	382	VAL

### 5.3.2 Protein sidechains ⓘ

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	634/603 (105%)	621 (98%)	13 (2%)	48 34

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	122	LYS
1	A	193	LYS
1	A	239[A]	VAL
1	A	239[B]	VAL
1	A	303	GLN
1	A	341	LYS
1	A	505	GLU
1	A	507	SER
1	A	519	ASN
1	A	537	TYR
1	A	541	TRP
1	A	600	TYR
1	A	673	ARG

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

Mol	Chain	Res	Type
1	A	136	ASN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

15 non-standard protein/DNA/RNA residues are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z  > 2$	Counts	RMSZ	$\# Z  > 2$
6	NAG	A	809	1	14,14,15	0.37	0	17,19,21	2.23	3 (17%)
3	NAG	C	1	1,3	14,14,15	0.79	0	17,19,21	1.37	1 (5%)
2	NAG	B	2	2	14,14,15	0.57	0	17,19,21	1.10	1 (5%)
2	NAG	B	1	1,2	14,14,15	0.65	0	17,19,21	0.97	1 (5%)
3	NAG	C	2	3	14,14,15	0.54	0	17,19,21	1.45	1 (5%)
6	NAG	A	810	1	14,14,15	0.63	0	17,19,21	1.49	3 (17%)
5	NAG	F	1	5,1	14,14,15	0.80	0	17,19,21	1.44	3 (17%)
5	NAG	F	2	5	14,14,15	0.70	0	17,19,21	1.39	2 (11%)
3	FUC	D	3	3	10,10,11	0.68	0	14,14,16	0.89	0
3	FUC	C	3	3	10,10,11	0.67	0	14,14,16	1.00	1 (7%)
3	NAG	D	2	3	14,14,15	0.51	0	17,19,21	1.06	0
3	NAG	D	1	1,3	14,14,15	0.73	0	17,19,21	0.89	0
4	NAG	E	2	4	14,14,15	0.77	0	17,19,21	1.10	2 (11%)
4	NAG	E	1	1,4	14,14,15	0.95	0	17,19,21	0.86	0
5	MAN	F	4	5	11,11,12	0.70	0	15,15,17	1.29	1 (6%)

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
6	NAG	A	809	1	–	2/6/23/26	0/1/1/1
3	NAG	C	1	1,3	–	2/6/23/26	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	NAG	B	2	2	-	2/6/23/26	0/1/1/1
2	NAG	B	1	1,2	-	0/6/23/26	0/1/1/1
3	NAG	C	2	3	-	1/6/23/26	0/1/1/1
6	NAG	A	810	1	-	0/6/23/26	0/1/1/1
5	NAG	F	1	5,1	-	2/6/23/26	0/1/1/1
5	NAG	F	2	5	-	2/6/23/26	0/1/1/1
3	FUC	D	3	3	-	-	0/1/1/1
3	FUC	C	3	3	-	-	0/1/1/1
3	NAG	D	2	3	-	2/6/23/26	0/1/1/1
3	NAG	D	1	1,3	-	0/6/23/26	0/1/1/1
4	NAG	E	2	4	-	2/6/23/26	0/1/1/1
4	NAG	E	1	1,4	-	2/6/23/26	0/1/1/1
5	MAN	F	4	5	-	0/2/19/22	0/1/1/1

There are no bond length outliers.

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	809	NAG	C1-O5-C5	7.80	122.77	112.19
3	C	2	NAG	C1-O5-C5	4.29	118.01	112.19
5	F	1	NAG	C1-O5-C5	4.05	117.68	112.19
6	A	810	NAG	C1-O5-C5	3.58	117.04	112.19
5	F	4	MAN	O5-C5-C6	3.36	112.47	107.20
3	C	1	NAG	C1-C2-N2	-2.93	105.49	110.49
5	F	2	NAG	C3-C4-C5	-2.73	105.37	110.24
6	A	809	NAG	C4-C3-C2	-2.65	107.14	111.02
4	E	2	NAG	C1-C2-N2	-2.36	106.45	110.49
5	F	1	NAG	O4-C4-C5	-2.30	103.58	109.30
4	E	2	NAG	C8-C7-N2	2.22	119.86	116.10
3	C	3	FUC	C1-C2-C3	-2.18	106.99	109.67
6	A	810	NAG	O3-C3-C2	2.14	113.90	109.47
6	A	810	NAG	C2-N2-C7	-2.13	119.87	122.90
2	B	2	NAG	C2-N2-C7	2.11	125.90	122.90
6	A	809	NAG	C6-C5-C4	-2.10	108.09	113.00
2	B	1	NAG	O5-C5-C6	2.09	110.48	107.20
5	F	2	NAG	C8-C7-N2	2.03	119.53	116.10
5	F	1	NAG	O5-C1-C2	-2.02	108.10	111.29

There are no chirality outliers.

All (17) torsion outliers are listed below:



Mol	Chain	Res	Type	Atoms
6	A	809	NAG	C4-C5-C6-O6
2	B	2	NAG	C8-C7-N2-C2
2	B	2	NAG	O7-C7-N2-C2
3	C	1	NAG	C8-C7-N2-C2
3	C	1	NAG	O7-C7-N2-C2
4	E	1	NAG	C8-C7-N2-C2
4	E	1	NAG	O7-C7-N2-C2
4	E	2	NAG	C8-C7-N2-C2
4	E	2	NAG	O7-C7-N2-C2
5	F	2	NAG	C8-C7-N2-C2
5	F	2	NAG	O7-C7-N2-C2
6	A	809	NAG	O5-C5-C6-O6
5	F	1	NAG	C4-C5-C6-O6
5	F	1	NAG	O5-C5-C6-O6
3	D	2	NAG	C4-C5-C6-O6
3	D	2	NAG	O5-C5-C6-O6
3	C	2	NAG	O5-C5-C6-O6

There are no ring outliers.

4 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	1	NAG	1	0
2	B	2	NAG	2	0
3	D	3	FUC	1	0
4	E	2	NAG	2	0

## 5.5 Carbohydrates [i](#)

15 monosaccharides are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z  > 2$	Counts	RMSZ	$\# Z  > 2$
2	NAG	B	1	1,2	14,14,15	0.65	0	17,19,21	0.97	1 (5%)
2	NAG	B	2	2	14,14,15	0.57	0	17,19,21	1.10	1 (5%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
3	NAG	C	1	1,3	14,14,15	0.79	0	17,19,21	1.37	1 (5%)
3	NAG	C	2	3	14,14,15	0.54	0	17,19,21	1.45	1 (5%)
3	FUC	C	3	3	10,10,11	0.67	0	14,14,16	1.00	1 (7%)
3	NAG	D	1	1,3	14,14,15	0.73	0	17,19,21	0.89	0
3	NAG	D	2	3	14,14,15	0.51	0	17,19,21	1.06	0
3	FUC	D	3	3	10,10,11	0.68	0	14,14,16	0.89	0
4	NAG	E	1	1,4	14,14,15	0.95	0	17,19,21	0.86	0
4	NAG	E	2	4	14,14,15	0.77	0	17,19,21	1.10	2 (11%)
4	BMA	E	3	4	11,11,12	0.54	0	15,15,17	0.93	1 (6%)
5	NAG	F	1	5,1	14,14,15	0.80	0	17,19,21	1.44	3 (17%)
5	NAG	F	2	5	14,14,15	0.70	0	17,19,21	1.39	2 (11%)
5	BMA	F	3	5	11,11,12	0.60	0	15,15,17	0.97	1 (6%)
5	MAN	F	4	5	11,11,12	0.70	0	15,15,17	1.29	1 (6%)

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

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

There are no bond length outliers.

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	2	NAG	C1-O5-C5	4.29	118.01	112.19
5	F	1	NAG	C1-O5-C5	4.05	117.68	112.19
5	F	4	MAN	O5-C5-C6	3.36	112.47	107.20
3	C	1	NAG	C1-C2-N2	-2.93	105.49	110.49
5	F	2	NAG	C3-C4-C5	-2.73	105.37	110.24
4	E	2	NAG	C1-C2-N2	-2.36	106.45	110.49
5	F	1	NAG	O4-C4-C5	-2.30	103.58	109.30
5	F	3	BMA	C1-O5-C5	2.25	115.24	112.19
4	E	2	NAG	C8-C7-N2	2.22	119.86	116.10
3	C	3	FUC	C1-C2-C3	-2.18	106.99	109.67
4	E	3	BMA	C3-C4-C5	2.12	114.01	110.24
2	B	2	NAG	C2-N2-C7	2.11	125.90	122.90
2	B	1	NAG	O5-C5-C6	2.09	110.48	107.20
5	F	2	NAG	C8-C7-N2	2.03	119.53	116.10
5	F	1	NAG	O5-C1-C2	-2.02	108.10	111.29

There are no chirality outliers.

All (17) torsion outliers are listed below:

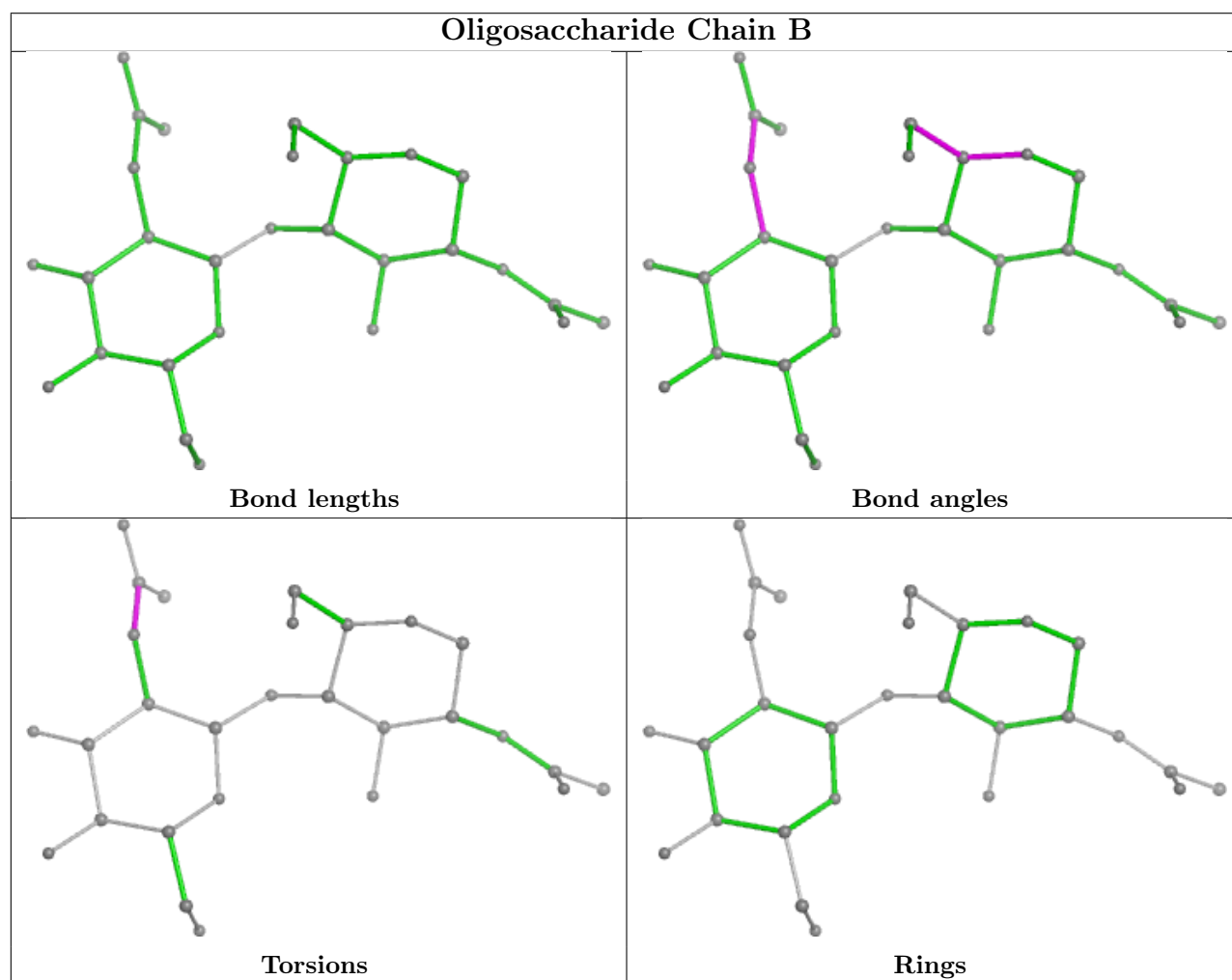
Mol	Chain	Res	Type	Atoms
2	B	2	NAG	C8-C7-N2-C2
2	B	2	NAG	O7-C7-N2-C2
3	C	1	NAG	C8-C7-N2-C2
3	C	1	NAG	O7-C7-N2-C2
4	E	1	NAG	C8-C7-N2-C2
4	E	1	NAG	O7-C7-N2-C2
4	E	2	NAG	C8-C7-N2-C2
4	E	2	NAG	O7-C7-N2-C2
5	F	2	NAG	C8-C7-N2-C2
5	F	2	NAG	O7-C7-N2-C2
4	E	3	BMA	C4-C5-C6-O6
4	E	3	BMA	O5-C5-C6-O6
5	F	1	NAG	C4-C5-C6-O6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

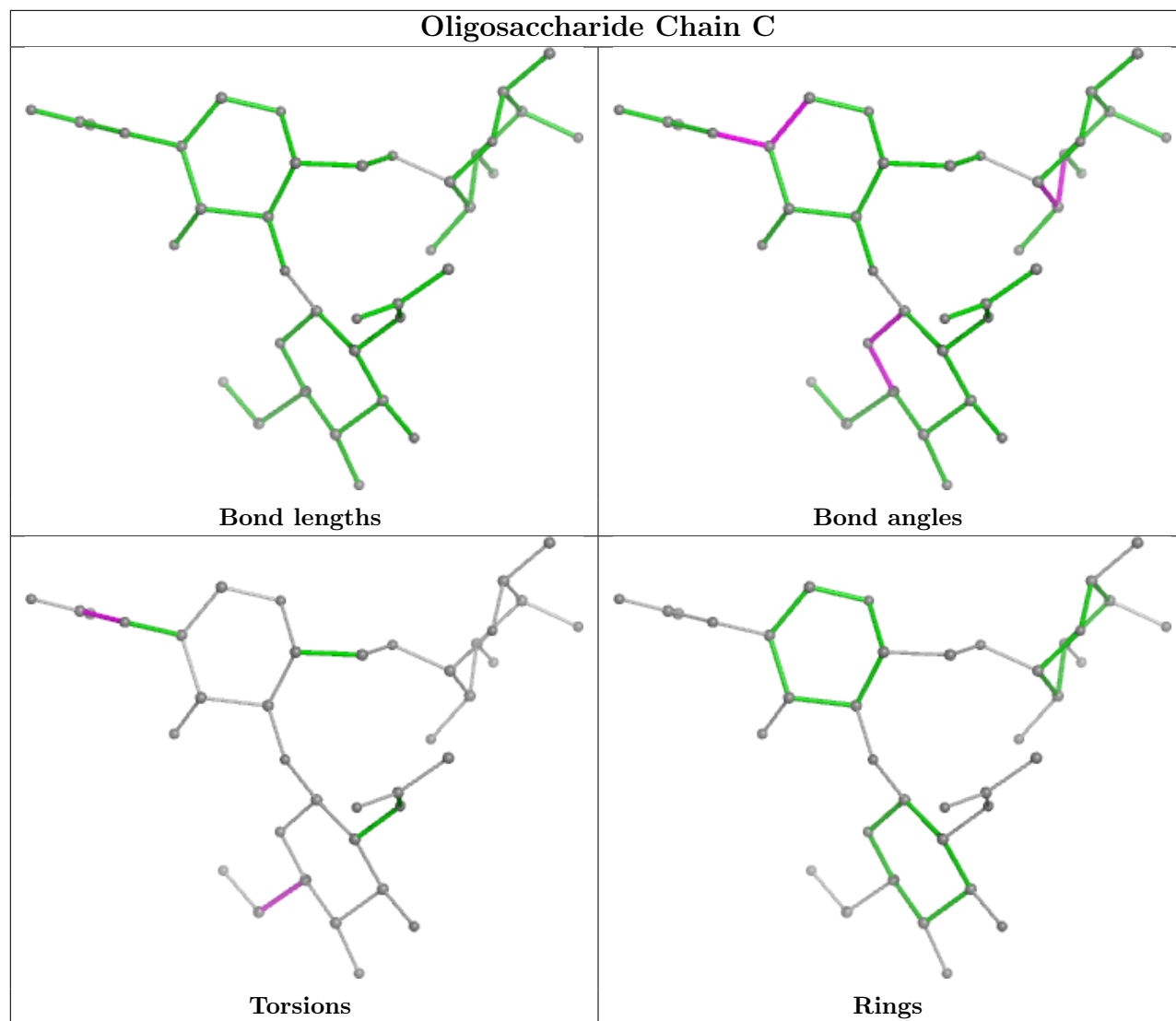
There are no ring outliers.

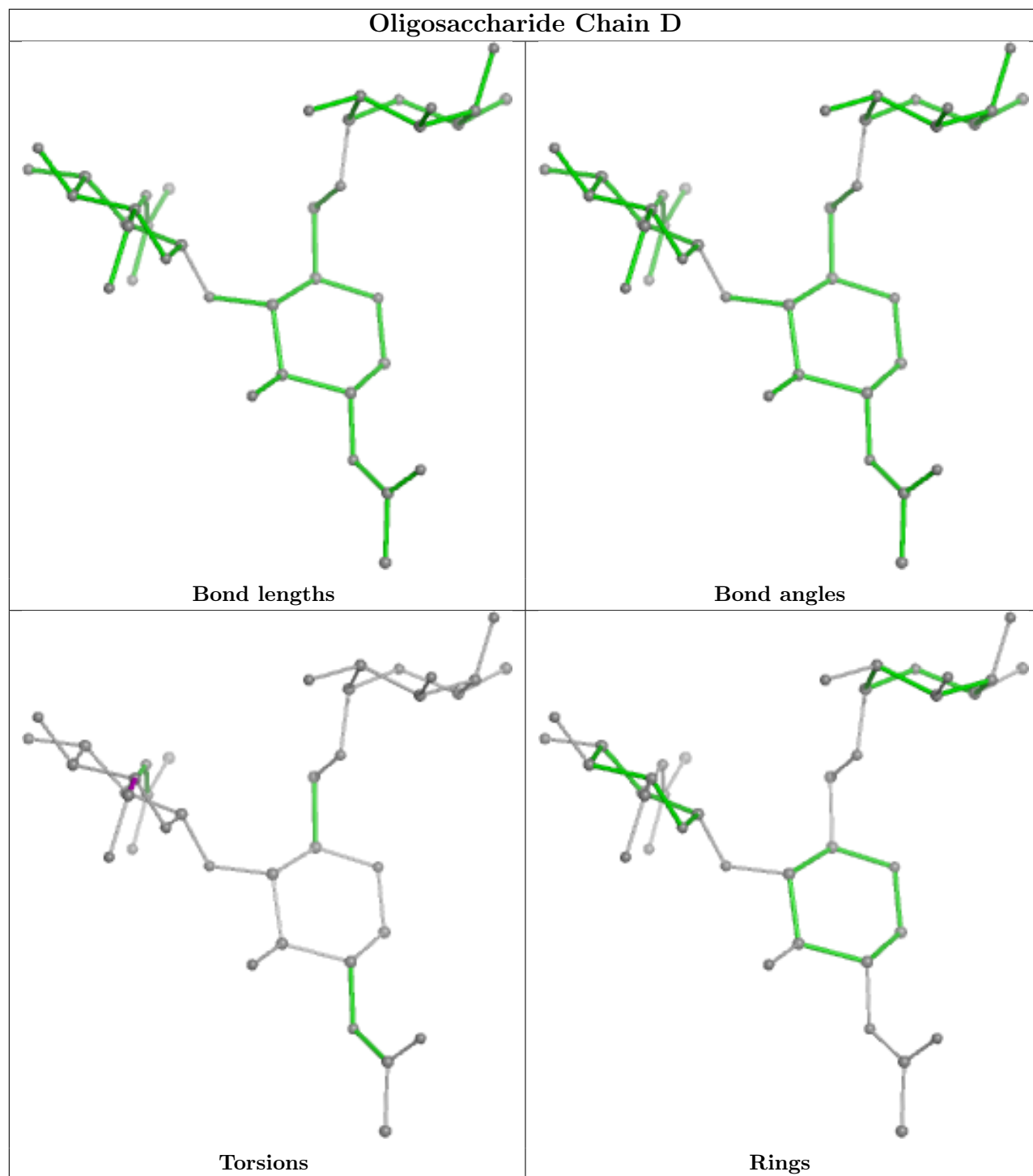
4 monomers are involved in 6 short contacts:

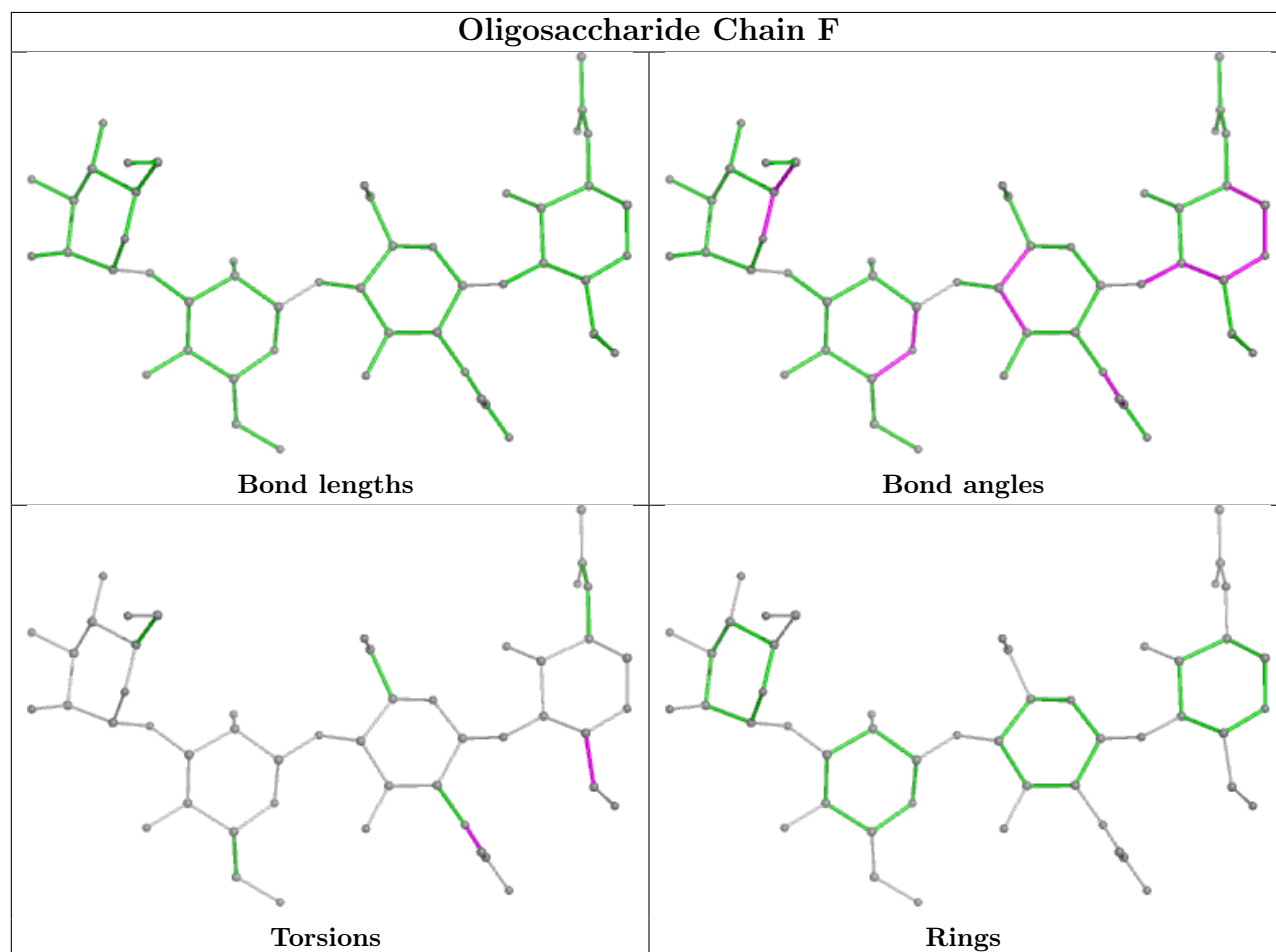
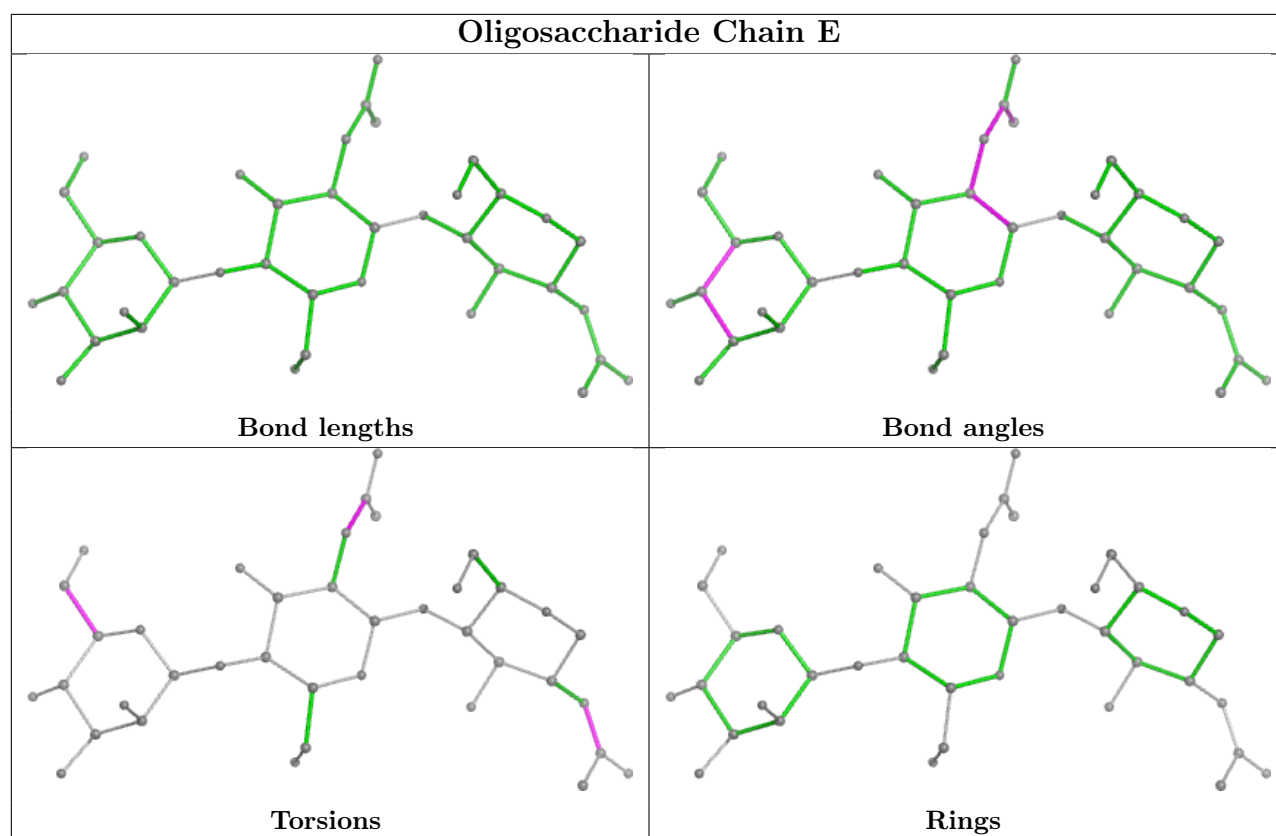
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	1	NAG	1	0
2	B	2	NAG	2	0
3	D	3	FUC	1	0
4	E	2	NAG	2	0

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

Of 7 ligands modelled in this entry, 4 are monoatomic - leaving 3 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
6	NAG	A	810	1	14,14,15	0.63	0	17,19,21	1.49	3 (17%)
6	NAG	A	809	1	14,14,15	0.37	0	17,19,21	2.23	3 (17%)
10	2F9	A	822	7	36,36,36	2.51	10 (27%)	48,50,50	1.16	4 (8%)

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
6	NAG	A	810	1	-	0/6/23/26	0/1/1/1
6	NAG	A	809	1	-	2/6/23/26	0/1/1/1
10	2F9	A	822	7	-	7/43/44/44	0/1/1/1

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
10	A	822	2F9	PBJ-OAL	8.24	1.59	1.46
10	A	822	2F9	FAM-CBD	7.81	1.55	1.36
10	A	822	2F9	CBE-CBB	-3.18	1.43	1.50
10	A	822	2F9	CA-N	3.11	1.51	1.47
10	A	822	2F9	OAE-CBA	-3.09	1.20	1.30
10	A	822	2F9	CBI-NAU	2.94	1.52	1.45
10	A	822	2F9	PBJ-OAH	-2.70	1.49	1.56
10	A	822	2F9	PBJ-N	-2.34	1.58	1.61
10	A	822	2F9	O-C	2.33	1.29	1.22
10	A	822	2F9	CBC-NAV	2.06	1.38	1.34

All (10) bond angle outliers are listed below:



Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	809	NAG	C1-O5-C5	7.80	122.77	112.19
6	A	810	NAG	C1-O5-C5	3.58	117.04	112.19
10	A	822	2F9	OXT-C-CA	2.68	122.33	113.40
10	A	822	2F9	O-C-CA	-2.68	113.47	122.26
6	A	809	NAG	C4-C3-C2	-2.65	107.14	111.02
10	A	822	2F9	PBJ-N-CA	-2.20	118.95	123.83
10	A	822	2F9	CAO-CBD-CAN	-2.15	119.97	122.83
6	A	810	NAG	O3-C3-C2	2.14	113.90	109.47
6	A	810	NAG	C2-N2-C7	-2.13	119.87	122.90
6	A	809	NAG	C6-C5-C4	-2.10	108.09	113.00

There are no chirality outliers.

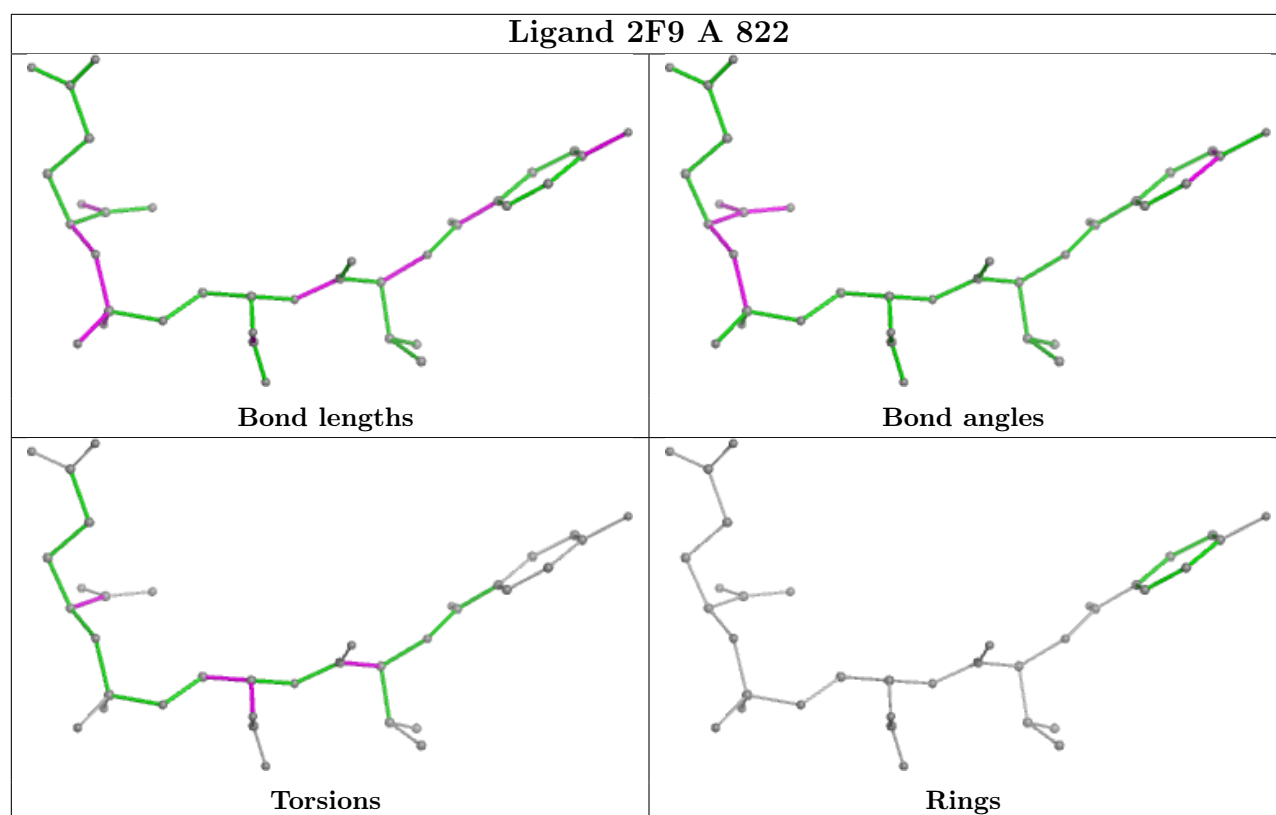
All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
10	A	822	2F9	OAX-CAT-CBH-NAV
6	A	809	NAG	C4-C5-C6-O6
6	A	809	NAG	O5-C5-C6-O6
10	A	822	2F9	OAX-CAT-CBH-CBA
10	A	822	2F9	OAE-CBA-CBH-NAV
10	A	822	2F9	NAV-CBC-CBI-NAU
10	A	822	2F9	O-C-CA-N
10	A	822	2F9	NAV-CBC-CBI-CBF
10	A	822	2F9	OAG-CBC-CBI-NAU

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 [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, 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	690/707 (97%)	-0.47	8 (1%) 76 80	6, 23, 42, 71	47 (6%)

All (8) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	541	TRP	6.0
1	A	656[A]	SER	4.7
1	A	543	THR	3.7
1	A	548	GLY	3.6
1	A	653	PHE	2.8
1	A	506	PHE	2.3
1	A	152	GLU	2.1
1	A	652	ASP	2.0

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

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 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
3	NAG	C	2	14/15	0.63	0.16	69,71,74,75	0
6	NAG	A	809	14/15	0.76	0.13	62,67,70,71	0
2	NAG	B	2	14/15	0.77	0.13	43,52,56,57	0
3	NAG	C	1	14/15	0.78	0.14	49,55,65,65	0
3	FUC	D	3	10/11	0.79	0.15	60,63,65,66	0
3	FUC	C	3	10/11	0.79	0.13	68,70,71,71	0
3	NAG	D	2	14/15	0.81	0.12	53,58,63,64	0
4	NAG	E	2	14/15	0.85	0.12	40,46,53,56	0
5	MAN	F	4	11/12	0.87	0.11	44,46,48,50	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
5	NAG	F	2	14/15	0.89	0.11	36,40,48,49	0
3	NAG	D	1	14/15	0.90	0.10	42,44,52,53	0
6	NAG	A	810	14/15	0.91	0.09	30,46,50,51	0
4	NAG	E	1	14/15	0.94	0.08	30,32,37,39	0
2	NAG	B	1	14/15	0.94	0.08	32,40,44,47	0
5	NAG	F	1	14/15	0.95	0.07	18,26,36,42	0

### 6.3 Carbohydrates

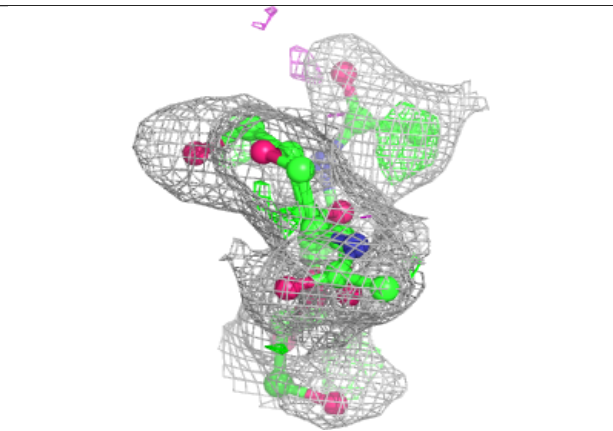
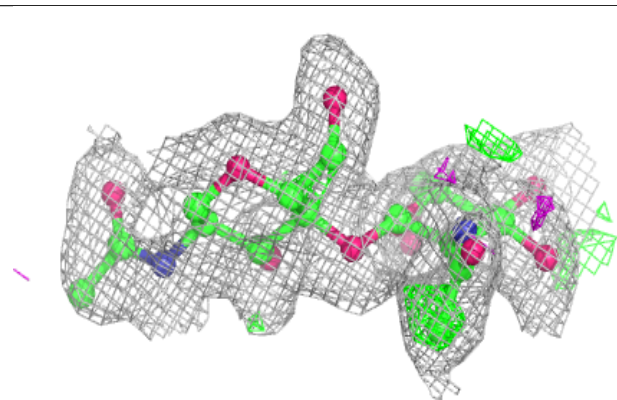
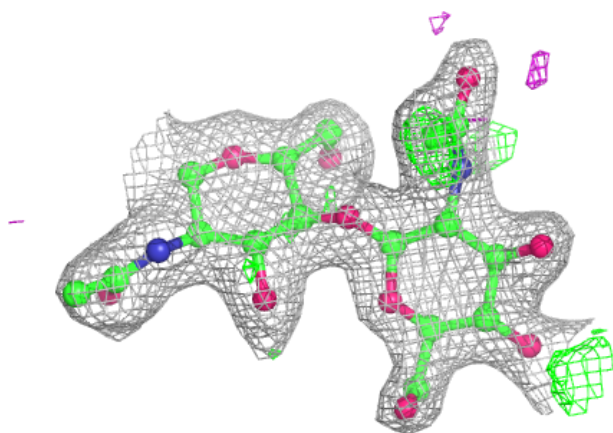
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	NAG	C	2	14/15	0.63	0.16	69,71,74,75	0
4	BMA	E	3	11/12	0.69	0.15	61,65,69,72	0
2	NAG	B	2	14/15	0.77	0.13	43,52,56,57	0
3	NAG	C	1	14/15	0.78	0.14	49,55,65,65	0
3	FUC	D	3	10/11	0.79	0.15	60,63,65,66	0
3	FUC	C	3	10/11	0.79	0.13	68,70,71,71	0
3	NAG	D	2	14/15	0.81	0.12	53,58,63,64	0
4	NAG	E	2	14/15	0.85	0.12	40,46,53,56	0
5	MAN	F	4	11/12	0.87	0.11	44,46,48,50	0
5	BMA	F	3	11/12	0.89	0.09	37,41,43,43	0
5	NAG	F	2	14/15	0.89	0.11	36,40,48,49	0
3	NAG	D	1	14/15	0.90	0.10	42,44,52,53	0
4	NAG	E	1	14/15	0.94	0.08	30,32,37,39	0
2	NAG	B	1	14/15	0.94	0.08	32,40,44,47	0
5	NAG	F	1	14/15	0.95	0.07	18,26,36,42	0

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

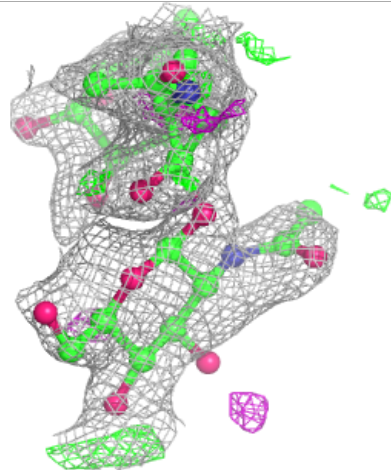
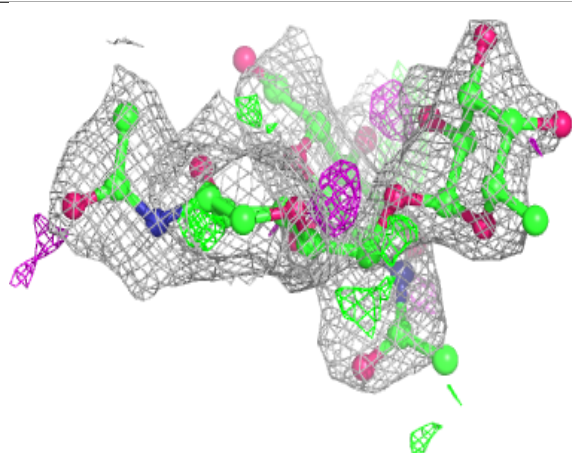
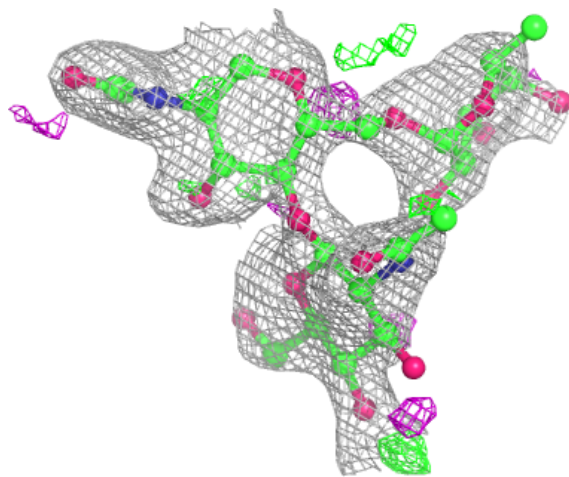
**Electron density around Chain B:**

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



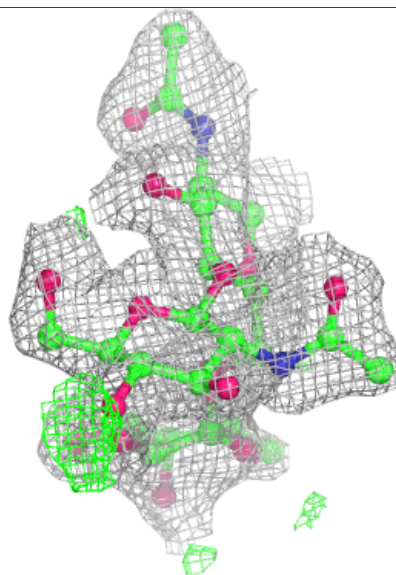
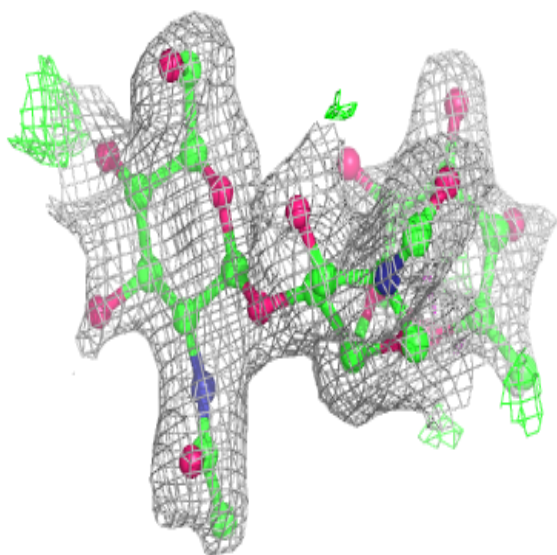
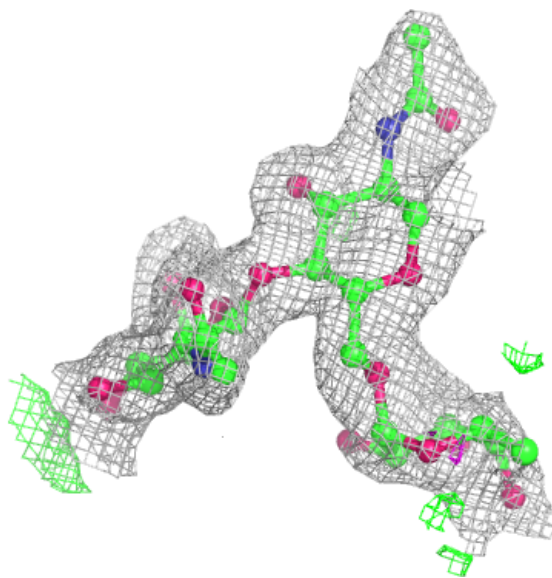
**Electron density around Chain C:**

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



**Electron density around Chain D:**

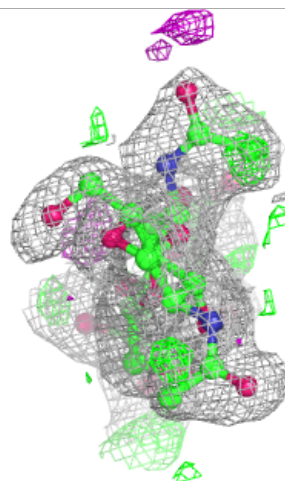
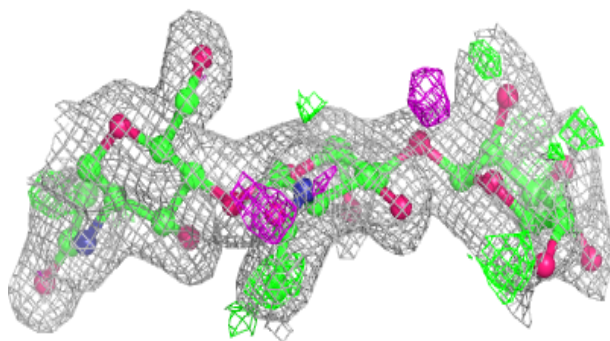
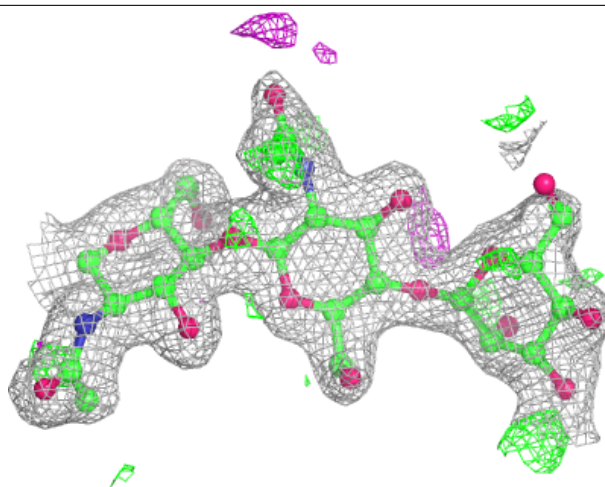
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



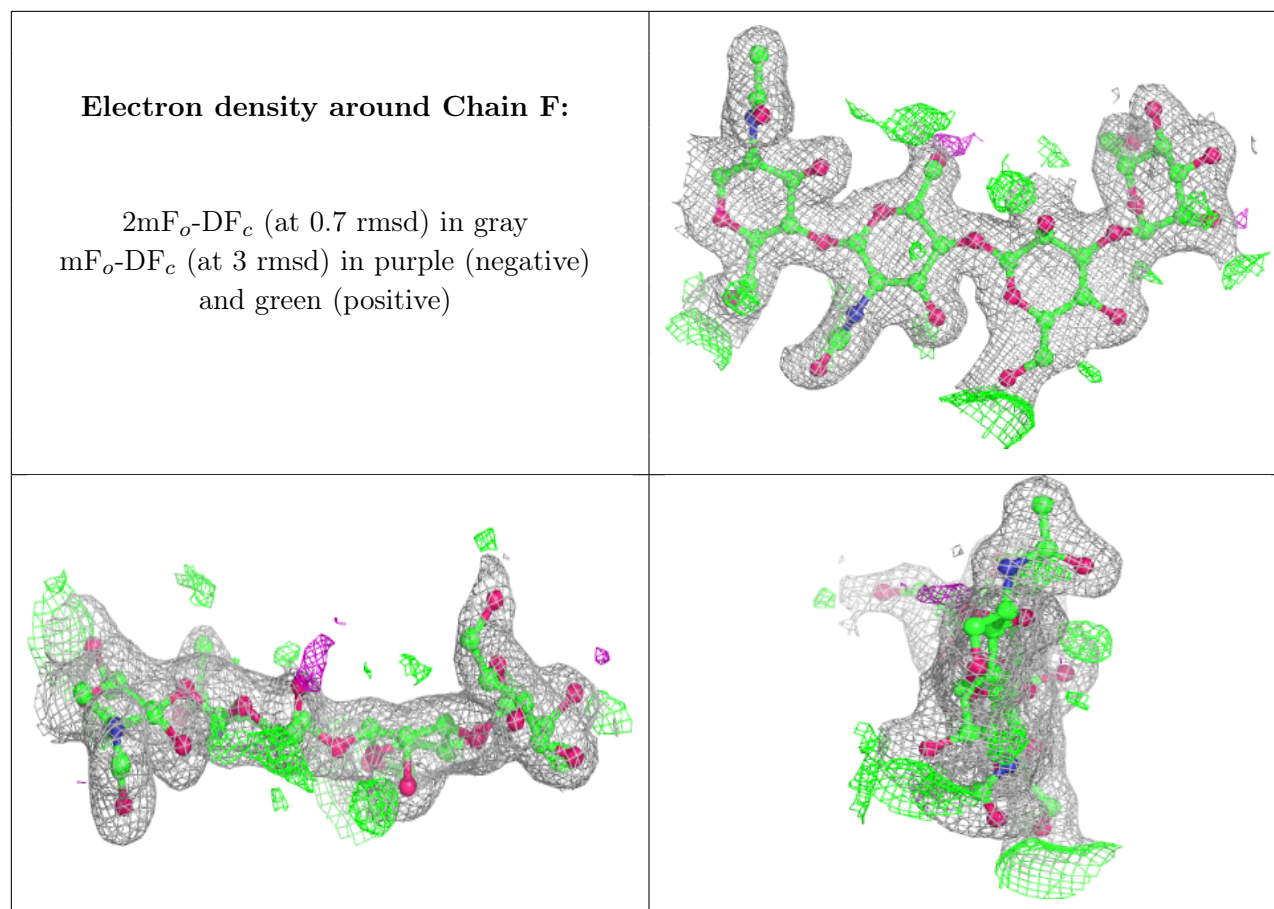


**Electron density around Chain E:**

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





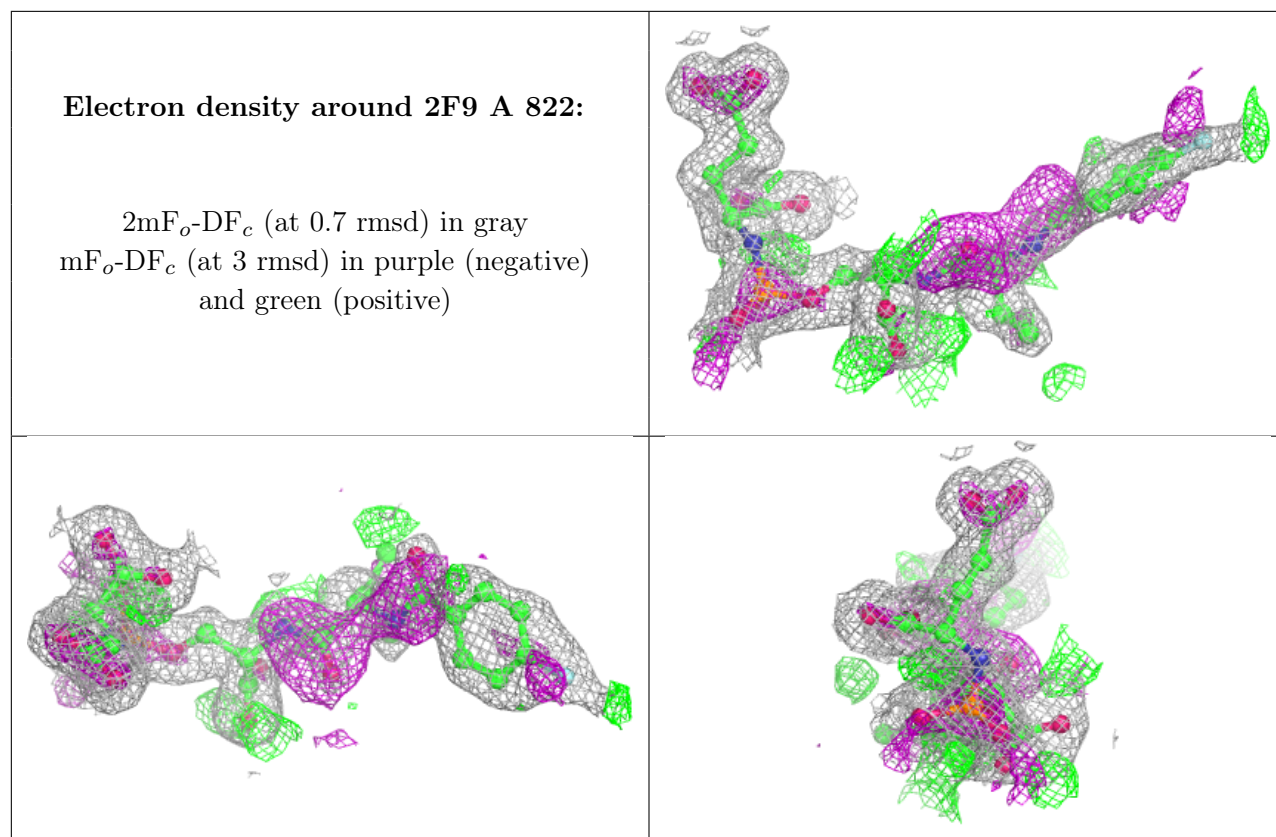


## 6.4 Ligands ⓘ

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<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	NAG	A	809	14/15	0.76	0.13	62,67,70,71	0
6	NAG	A	810	14/15	0.91	0.09	30,46,50,51	0
10	2F9	A	822	36/36	0.96	0.11	7,29,42,47	0
9	CL	A	821	1/1	0.99	0.03	20,20,20,20	0
8	CA	A	820	1/1	1.00	0.01	14,14,14,14	0
7	ZN	A	818	1/1	1.00	0.02	15,15,15,15	0
7	ZN	A	819	1/1	1.00	0.03	16,16,16,16	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.



## 6.5 Other polymers [i](#)

There are no such residues in this entry.