



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 10, 2020 – 12:51 AM BST

PDB ID : 5VU4  
Title : Crystal structure of the A/Hong Kong/1/1968 (H3N2) influenza virus hemagglutinin G225Q/L226A mutant in complex with 6'-SLN  
Authors : Wu, N.C.; Wilson, I.A.  
Deposited on : 2017-05-18  
Resolution : 2.25 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.

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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

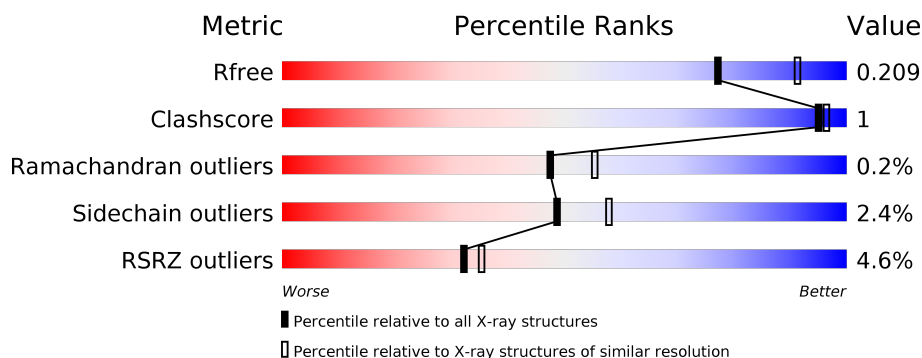
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.25 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	1377 (2.26-2.26)
Clashscore	141614	1487 (2.26-2.26)
Ramachandran outliers	138981	1449 (2.26-2.26)
Sidechain outliers	138945	1450 (2.26-2.26)
RSRZ outliers	127900	1356 (2.26-2.26)

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	323	<div> <div>0%</div> <div> <div></div> <div>93%</div> <div>5%</div> <div>..</div> </div> </div>
1	C	323	<div> <div>2%</div> <div> <div></div> <div>93%</div> <div></div> <div>..</div> </div> </div>
1	E	323	<div> <div>6%</div> <div> <div></div> <div>94%</div> <div>5%</div> <div>.</div> </div> </div>
2	B	174	<div> <div>4%</div> <div> <div></div> <div>97%</div> <div></div> <div>..</div> </div> </div>
2	D	174	<div> <div>10%</div> <div> <div></div> <div>95%</div> <div></div> <div>..</div> </div> </div>
2	F	174	<div> <div>9%</div> <div> <div></div> <div>96%</div> <div></div> <div>...</div> </div> </div>

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Mol	Chain	Length	Quality of chain
3	G	3	 33% 67%
4	H	2	 100%
4	K	2	 50% 50%
4	M	2	 100%
5	I	2	 50% 50%
6	J	5	 20% 60% 20%
7	L	4	 50% 50%

## 2 Entry composition

There are 10 unique types of molecules in this entry. The entry contains 12575 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 Hemagglutinin HA1 chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	317	Total	C	N	O	S	0	0	0
			2445	1531	430	471	13			
1	C	317	Total	C	N	O	S	0	0	0
			2445	1531	430	471	13			
1	E	321	Total	C	N	O	S	0	0	0
			2481	1552	439	477	13			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	7	ALA	-	expression tag	UNP Q91MA7
A	8	ASP	-	expression tag	UNP Q91MA7
A	9	PRO	-	expression tag	UNP Q91MA7
A	10	GLY	-	expression tag	UNP Q91MA7
A	225	GLN	GLY	engineered mutation	UNP Q91MA7
A	226	ALA	LEU	engineered mutation	UNP Q91MA7
C	7	ALA	-	expression tag	UNP Q91MA7
C	8	ASP	-	expression tag	UNP Q91MA7
C	9	PRO	-	expression tag	UNP Q91MA7
C	10	GLY	-	expression tag	UNP Q91MA7
C	225	GLN	GLY	engineered mutation	UNP Q91MA7
C	226	ALA	LEU	engineered mutation	UNP Q91MA7
E	7	ALA	-	expression tag	UNP Q91MA7
E	8	ASP	-	expression tag	UNP Q91MA7
E	9	PRO	-	expression tag	UNP Q91MA7
E	10	GLY	-	expression tag	UNP Q91MA7
E	225	GLN	GLY	engineered mutation	UNP Q91MA7
E	226	ALA	LEU	engineered mutation	UNP Q91MA7

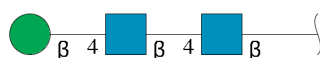
- Molecule 2 is a protein called Hemagglutinin HA2 chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	172	Total	C	N	O	S	0	0	0
			1391	863	243	279	6			
2	D	171	Total	C	N	O	S	0	0	0
			1382	858	241	277	6			
2	F	171	Total	C	N	O	S	0	0	0
			1382	858	241	277	6			

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	123	GLY	ARG	conflict	UNP Q91MA7
D	123	GLY	ARG	conflict	UNP Q91MA7
F	123	GLY	ARG	conflict	UNP Q91MA7

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



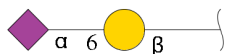
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	G	3	Total	C	N	O	0	0	0
			39	22	2	15			

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



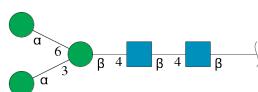
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
4	H	2	Total	C	N	O	0	0	0
			28	16	2	10			
4	K	2	Total	C	N	O	0	0	0
			28	16	2	10			
4	M	2	Total	C	N	O	0	0	0
			28	16	2	10			

- Molecule 5 is an oligosaccharide called N-acetyl-alpha-neuraminic acid-(2-6)-beta-D-galactopyranose.



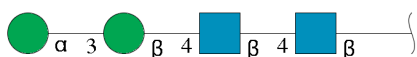
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
5	I	2	Total	C	N	O	0	0	0
			32	17	1	14			

- Molecule 6 is an oligosaccharide called alpha-D-mannopyranose-(1-3)-[alpha-D-mannopyranose-(1-6)]beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



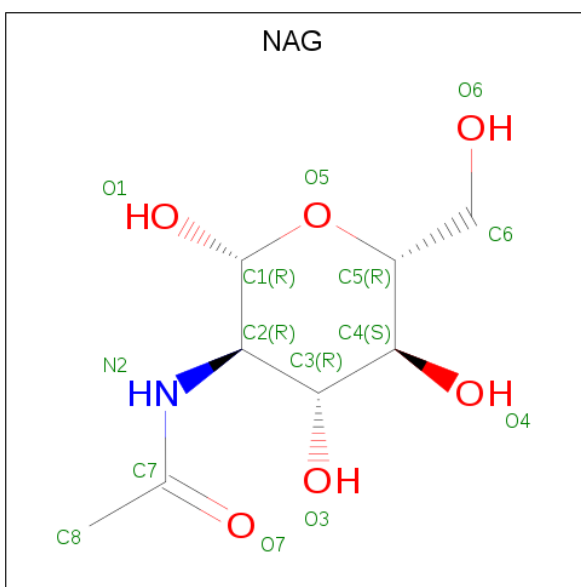
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
6	J	5	Total	C	N	O	0	0	0
			61	34	2	25			

- Molecule 7 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.



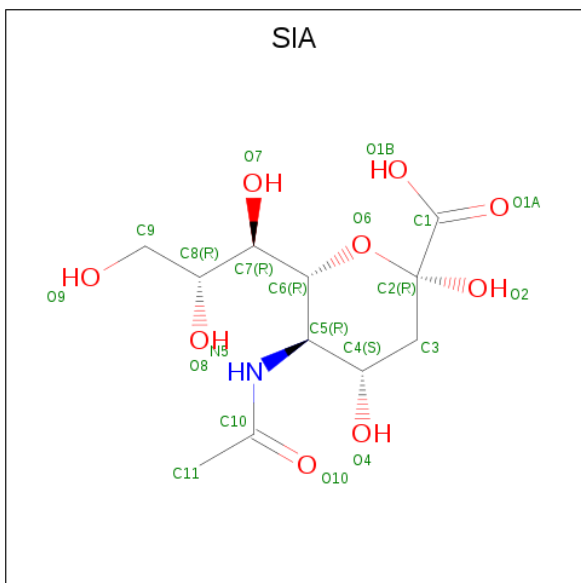
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
7	L	4	Total	C	N	O	0	0	0
			50	28	2	20			

- Molecule 8 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: C<sub>8</sub>H<sub>15</sub>NO<sub>6</sub>).



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

- Molecule 9 is N-acetyl-alpha-neuraminic acid (three-letter code: SIA) (formula:  $C_{11}H_{19}NO_9$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
9	C	1	Total	C	N	O	0	0
			21	11	1	9		
9	E	1	Total	C	N	O	0	0
			21	11	1	9		

- Molecule 10 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	A	128	Total	O	0	0
			128	128		
10	B	81	Total	O	0	0
			81	81		
10	C	191	Total	O	0	0
			191	191		
10	D	77	Total	O	0	0
			77	77		
10	E	128	Total	O	0	0
			128	128		
10	F	80	Total	O	0	0
			80	80		



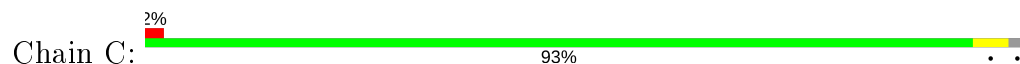
### 3 Residue-property plots [i](#)

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.

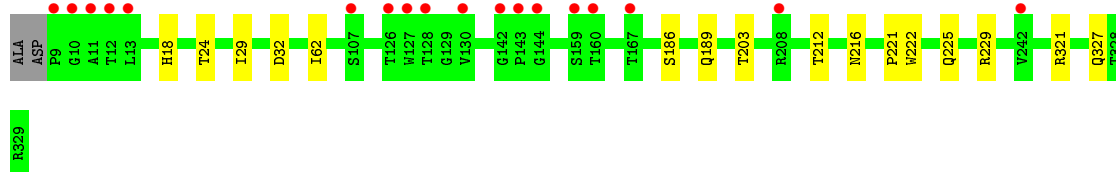
- Molecule 1: Hemagglutinin HA1 chain



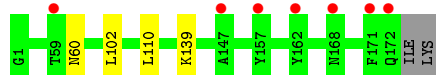
- Molecule 1: Hemagglutinin HA1 chain



- Molecule 1: Hemagglutinin HA1 chain



- Molecule 2: Hemagglutinin HA2 chain



- Molecule 2: Hemagglutinin HA2 chain





- Molecule 2: Hemagglutinin HA2 chain



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



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



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



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



- Molecule 5: N-acetyl-alpha-neuraminic acid-(2-6)-beta-D-galactopyranose



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

Chain J: 

MAG1  
MAG2  
BNA3  
MAN4  
MAN5

- Molecule 7: 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 L: 

MAG1  
MAG2  
BNA3  
MAN4

## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	210.34Å 131.41Å 72.34Å 90.00° 98.65° 90.00°	Depositor
Resolution (Å)	50.00 – 2.25 48.39 – 2.25	Depositor EDS
% Data completeness (in resolution range)	99.4 (50.00-2.25) 99.4 (48.39-2.25)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.08	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.58 (at 2.24Å)	Xtriage
Refinement program	REFMAC 5.8.0135	Depositor
R, $R_{free}$	0.180 , 0.208 0.185 , 0.209	Depositor DCC
$R_{free}$ test set	4563 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	43.6	Xtriage
Anisotropy	0.183	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 39.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	12575	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	55.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.53% 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: GAL, SIA, BMA, NAG, 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	0.43	0/2502	0.68	1/3410 (0.0%)
1	C	0.46	0/2502	0.70	1/3410 (0.0%)
1	E	0.44	0/2538	0.70	2/3457 (0.1%)
2	B	0.43	0/1415	0.66	0/1902
2	D	0.42	0/1406	0.64	0/1890
2	F	0.43	0/1406	0.65	1/1890 (0.1%)
All	All	0.44	0/11769	0.68	5/15959 (0.0%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	E	229	ARG	NE-CZ-NH2	-6.16	117.22	120.30
1	C	167	THR	CB-CA-C	-6.04	95.30	111.60
1	E	229	ARG	NE-CZ-NH1	5.65	123.12	120.30
2	F	38	LEU	CA-CB-CG	5.17	127.20	115.30
1	A	229	ARG	NE-CZ-NH2	-5.06	117.77	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	2445	0	2390	11	0
1	C	2445	0	2390	14	1
1	E	2481	0	2430	7	0
2	B	1391	0	1307	1	0
2	D	1382	0	1299	2	0
2	F	1382	0	1299	1	0
3	G	39	0	34	0	0
4	H	28	0	25	0	0
4	K	28	0	25	0	0
4	M	28	0	25	0	0
5	I	32	0	28	0	0
6	J	61	0	52	1	0
7	L	50	0	43	0	0
8	A	14	0	13	0	0
8	C	14	0	13	0	0
8	E	28	0	26	0	0
9	C	21	0	18	0	0
9	E	21	0	18	0	0
10	A	128	0	0	0	0
10	B	81	0	0	0	0
10	C	191	0	0	0	0
10	D	77	0	0	0	0
10	E	128	0	0	0	0
10	F	80	0	0	0	0
All	All	12575	0	11435	27	1

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

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:203:THR:HG23	1:E:212:THR:HG22	1.65	0.77
1:C:53:ASN:HD21	1:C:276:THR:HG22	1.61	0.65
1:A:212:THR:HG21	1:C:216:ASN:HB3	1.84	0.60
1:A:29:ILE:HD11	2:B:102:LEU:HD23	1.86	0.57
1:C:167:THR:CG2	1:C:244:VAL:HG22	2.35	0.57
1:C:29:ILE:HD11	2:D:102:LEU:HD23	1.88	0.55
1:E:29:ILE:HD11	2:F:102:LEU:HD23	1.87	0.55
1:C:167:THR:HG23	1:C:244:VAL:HG22	1.89	0.53
1:A:222:TRP:CZ2	1:A:225:GLN:HA	2.44	0.53
1:C:244:VAL:HG23	1:E:221:PRO:HG3	1.91	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:222:TRP:CZ2	1:E:225:GLN:HA	2.43	0.52
1:A:222:TRP:CE2	1:A:225:GLN:HA	2.45	0.51
1:C:212:THR:OG1	1:E:216:ASN:CG	2.49	0.51
1:E:222:TRP:CE2	1:E:225:GLN:HA	2.46	0.50
1:A:141:ARG:HH11	1:A:141:ARG:CG	2.25	0.49
1:A:212:THR:CG2	1:C:216:ASN:HB3	2.44	0.47
1:C:53:ASN:ND2	1:C:276:THR:HG22	2.31	0.44
1:A:212:THR:CB	1:C:216:ASN:HB3	2.47	0.44
1:E:203:THR:CG2	1:E:212:THR:HG22	2.43	0.43
1:A:53:ASN:C	1:A:53:ASN:HD22	2.22	0.42
1:A:141:ARG:NH1	1:A:141:ARG:CG	2.81	0.42
1:C:184:HIS:CE1	1:C:216:ASN:ND2	2.88	0.41
1:A:206:THR:C	1:C:221:PRO:HG2	2.40	0.41
1:C:167:THR:HG21	6:J:2:NAG:H82	2.02	0.41
2:D:128:GLU:O	2:D:170:ARG:NH1	2.53	0.41
1:C:225:GLN:HE21	1:C:225:GLN:HB2	1.65	0.41
1:A:53:ASN:HD22	1:A:54:ASN:N	2.19	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:119:GLU:OE1	1:C:119:GLU:OE1[2_558]	2.17	0.03

## 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	315/323 (98%)	309 (98%)	5 (2%)	1 (0%)	41	46
1	C	315/323 (98%)	308 (98%)	6 (2%)	1 (0%)	41	46
1	E	319/323 (99%)	312 (98%)	6 (2%)	1 (0%)	41	46

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	B	170/174 (98%)	161 (95%)	9 (5%)	0	100	100
2	D	169/174 (97%)	159 (94%)	10 (6%)	0	100	100
2	F	169/174 (97%)	160 (95%)	9 (5%)	0	100	100
All	All	1457/1491 (98%)	1409 (97%)	45 (3%)	3 (0%)	47	55

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	62	ILE
1	C	62	ILE
1	E	62	ILE

### 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	278/283 (98%)	269 (97%)	9 (3%)	39	47
1	C	278/283 (98%)	272 (98%)	6 (2%)	52	61
1	E	282/283 (100%)	275 (98%)	7 (2%)	47	56
2	B	146/148 (99%)	143 (98%)	3 (2%)	53	62
2	D	145/148 (98%)	143 (99%)	2 (1%)	67	76
2	F	145/148 (98%)	142 (98%)	3 (2%)	53	62
All	All	1274/1293 (98%)	1244 (98%)	30 (2%)	49	58

All (30) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	18	HIS
1	A	22	ASN
1	A	24	THR
1	A	53	ASN
1	A	141	ARG

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Mol	Chain	Res	Type
1	A	186	SER
1	A	189	GLN
1	A	210	GLN
1	A	307	LYS
2	B	60	ASN
2	B	110	LEU
2	B	139	LYS
1	C	18	HIS
1	C	24	THR
1	C	167	THR
1	C	186	SER
1	C	216	ASN
1	C	227	SER
2	D	60	ASN
2	D	110	LEU
1	E	18	HIS
1	E	24	THR
1	E	32	ASP
1	E	186	SER
1	E	189	GLN
1	E	321	ARG
1	E	327	GLN
2	F	38	LEU
2	F	60	ASN
2	F	110	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	216	ASN
1	A	225	GLN
2	B	53	ASN
2	B	125	GLN
1	C	216	ASN
1	C	225	GLN
2	D	53	ASN
2	D	125	GLN
1	E	225	GLN
2	F	53	ASN
2	F	125	GLN

### 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 ⓘ

20 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
3	NAG	G	1	1,3	14,14,15	0.33	0	17,19,21	0.79	0
3	NAG	G	2	3	14,14,15	0.48	0	17,19,21	1.06	1 (5%)
3	BMA	G	3	3	11,11,12	0.50	0	15,15,17	1.33	2 (13%)
4	NAG	H	1	1,4	14,14,15	0.44	0	17,19,21	0.78	0
4	NAG	H	2	4	14,14,15	0.30	0	17,19,21	0.84	0
5	GAL	I	1	5	12,12,12	0.59	0	17,17,17	0.71	0
5	SIA	I	2	5	17,20,21	0.37	0	21,28,31	0.69	1 (4%)
6	NAG	J	1	1,6	14,14,15	0.28	0	17,19,21	1.00	1 (5%)
6	NAG	J	2	6	14,14,15	0.31	0	17,19,21	1.10	2 (11%)
6	BMA	J	3	6	11,11,12	0.38	0	15,15,17	1.15	1 (6%)
6	MAN	J	4	6	11,11,12	0.29	0	15,15,17	1.12	2 (13%)
6	MAN	J	5	6	11,11,12	0.36	0	15,15,17	0.74	0
4	NAG	K	1	1,4	14,14,15	0.52	0	17,19,21	1.33	2 (11%)
4	NAG	K	2	4	14,14,15	0.43	0	17,19,21	0.94	0
7	NAG	L	1	1,7	14,14,15	0.39	0	17,19,21	0.82	0
7	NAG	L	2	7	14,14,15	0.38	0	17,19,21	1.64	1 (5%)
7	BMA	L	3	7	11,11,12	0.43	0	15,15,17	0.93	0
7	MAN	L	4	7	11,11,12	0.42	0	15,15,17	1.36	2 (13%)
4	NAG	M	1	1,4	14,14,15	0.53	0	17,19,21	1.29	2 (11%)
4	NAG	M	2	4	14,14,15	0.49	0	17,19,21	2.23	3 (17%)

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
3	NAG	G	1	1,3	-	0/6/23/26	0/1/1/1
3	NAG	G	2	3	-	2/6/23/26	0/1/1/1
3	BMA	G	3	3	-	0/2/19/22	0/1/1/1
4	NAG	H	1	1,4	-	0/6/23/26	0/1/1/1
4	NAG	H	2	4	-	2/6/23/26	0/1/1/1
5	GAL	I	1	5	-	2/2/22/22	0/1/1/1
5	SIA	I	2	5	-	0/14/34/38	0/1/1/1
6	NAG	J	1	1,6	-	0/6/23/26	0/1/1/1
6	NAG	J	2	6	-	0/6/23/26	0/1/1/1
6	BMA	J	3	6	-	1/2/19/22	0/1/1/1
6	MAN	J	4	6	-	1/2/19/22	0/1/1/1
6	MAN	J	5	6	-	2/2/19/22	0/1/1/1
4	NAG	K	1	1,4	-	0/6/23/26	0/1/1/1
4	NAG	K	2	4	-	0/6/23/26	0/1/1/1
7	NAG	L	1	1,7	-	0/6/23/26	0/1/1/1
7	NAG	L	2	7	-	0/6/23/26	0/1/1/1
7	BMA	L	3	7	-	1/2/19/22	0/1/1/1
7	MAN	L	4	7	-	0/2/19/22	0/1/1/1
4	NAG	M	1	1,4	-	0/6/23/26	0/1/1/1
4	NAG	M	2	4	-	0/6/23/26	0/1/1/1

There are no bond length outliers.

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	M	2	NAG	C1-O5-C5	6.86	121.49	112.19
7	L	2	NAG	C1-O5-C5	5.39	119.49	112.19
4	K	1	NAG	C1-C2-N2	4.12	117.53	110.49
7	L	4	MAN	C1-O5-C5	3.79	117.33	112.19
3	G	3	BMA	C1-C2-C3	3.59	114.08	109.67
4	M	2	NAG	O5-C5-C6	3.42	112.56	107.20
4	M	2	NAG	C4-C3-C2	3.36	115.94	111.02
3	G	2	NAG	O5-C5-C6	3.35	112.45	107.20
6	J	4	MAN	C1-O5-C5	3.09	116.39	112.19
6	J	2	NAG	C1-O5-C5	2.76	115.93	112.19
6	J	3	BMA	O5-C5-C6	2.68	111.41	107.20
6	J	2	NAG	C1-C2-N2	2.55	114.84	110.49

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	M	1	NAG	O4-C4-C5	2.50	115.50	109.30
4	M	1	NAG	C3-C4-C5	-2.49	105.79	110.24
4	K	1	NAG	C1-O5-C5	2.28	115.28	112.19
5	I	2	SIA	C6-O6-C2	2.24	116.14	111.34
7	L	4	MAN	C3-C4-C5	2.23	114.22	110.24
6	J	4	MAN	O5-C1-C2	-2.20	107.38	110.77
6	J	1	NAG	C1-O5-C5	2.13	115.08	112.19
3	G	3	BMA	C1-O5-C5	2.03	114.95	112.19

There are no chirality outliers.

All (11) torsion outliers are listed below:

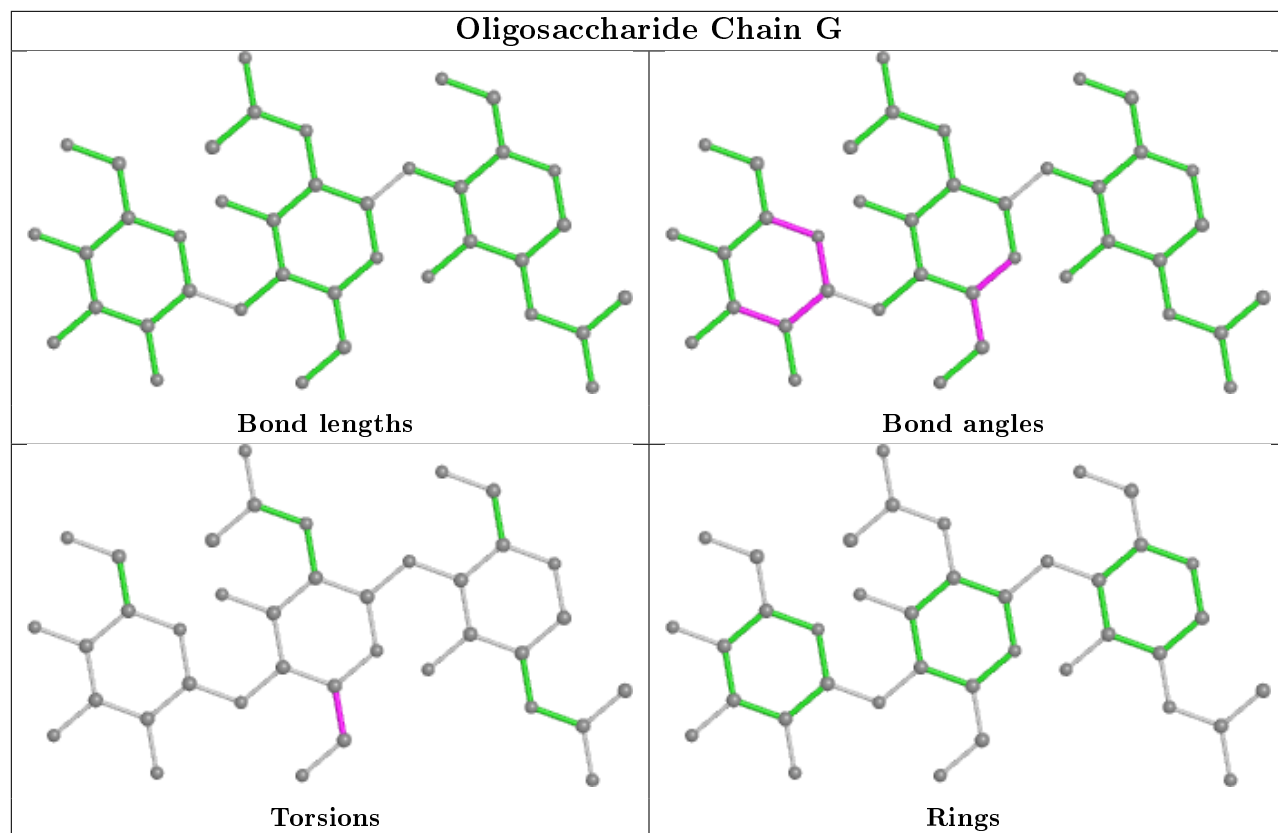
Mol	Chain	Res	Type	Atoms
3	G	2	NAG	O5-C5-C6-O6
3	G	2	NAG	C4-C5-C6-O6
4	H	2	NAG	C4-C5-C6-O6
5	I	1	GAL	O5-C5-C6-O6
4	H	2	NAG	O5-C5-C6-O6
5	I	1	GAL	C4-C5-C6-O6
7	L	3	BMA	O5-C5-C6-O6
6	J	5	MAN	O5-C5-C6-O6
6	J	5	MAN	C4-C5-C6-O6
6	J	3	BMA	O5-C5-C6-O6
6	J	4	MAN	O5-C5-C6-O6

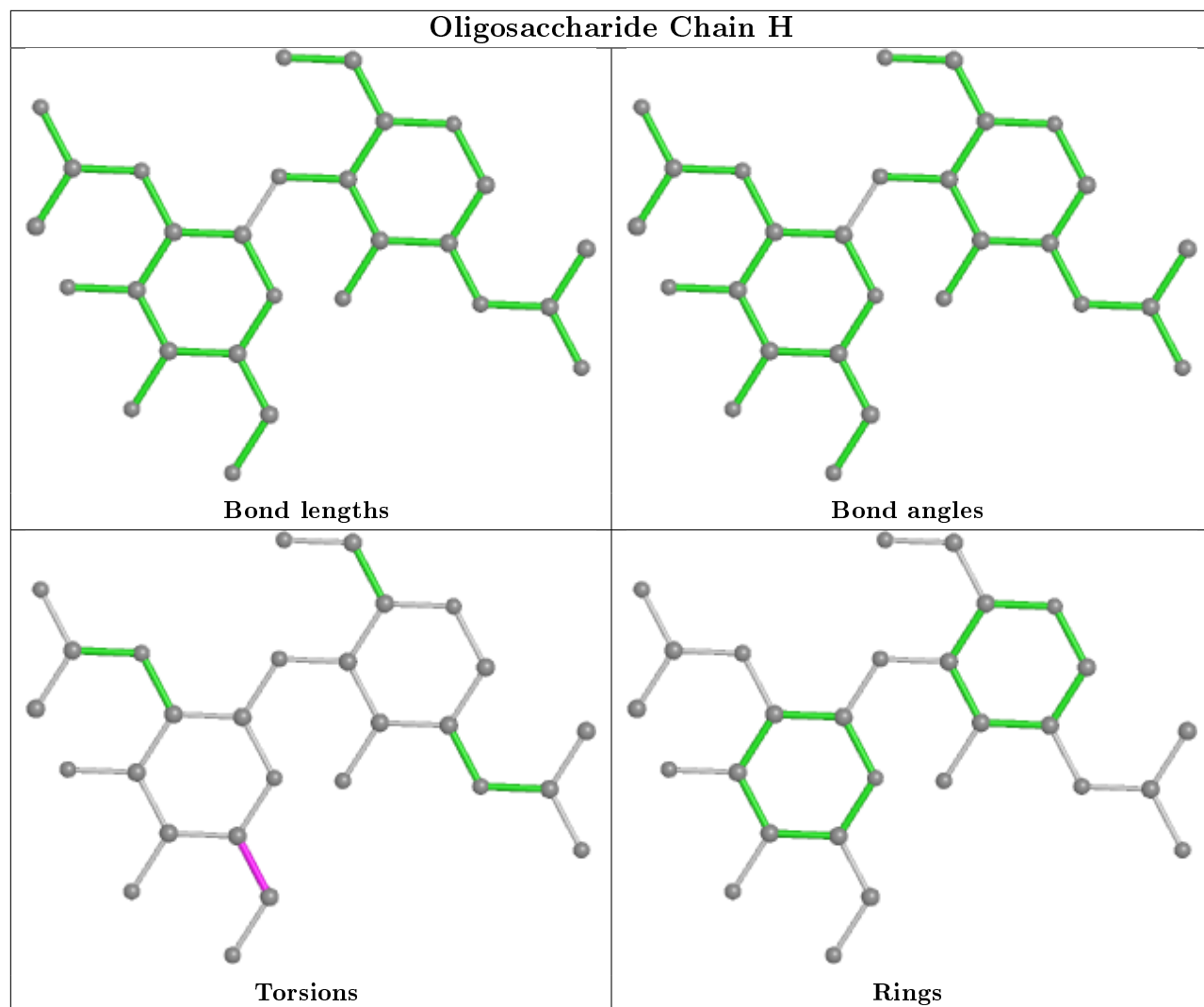
There are no ring outliers.

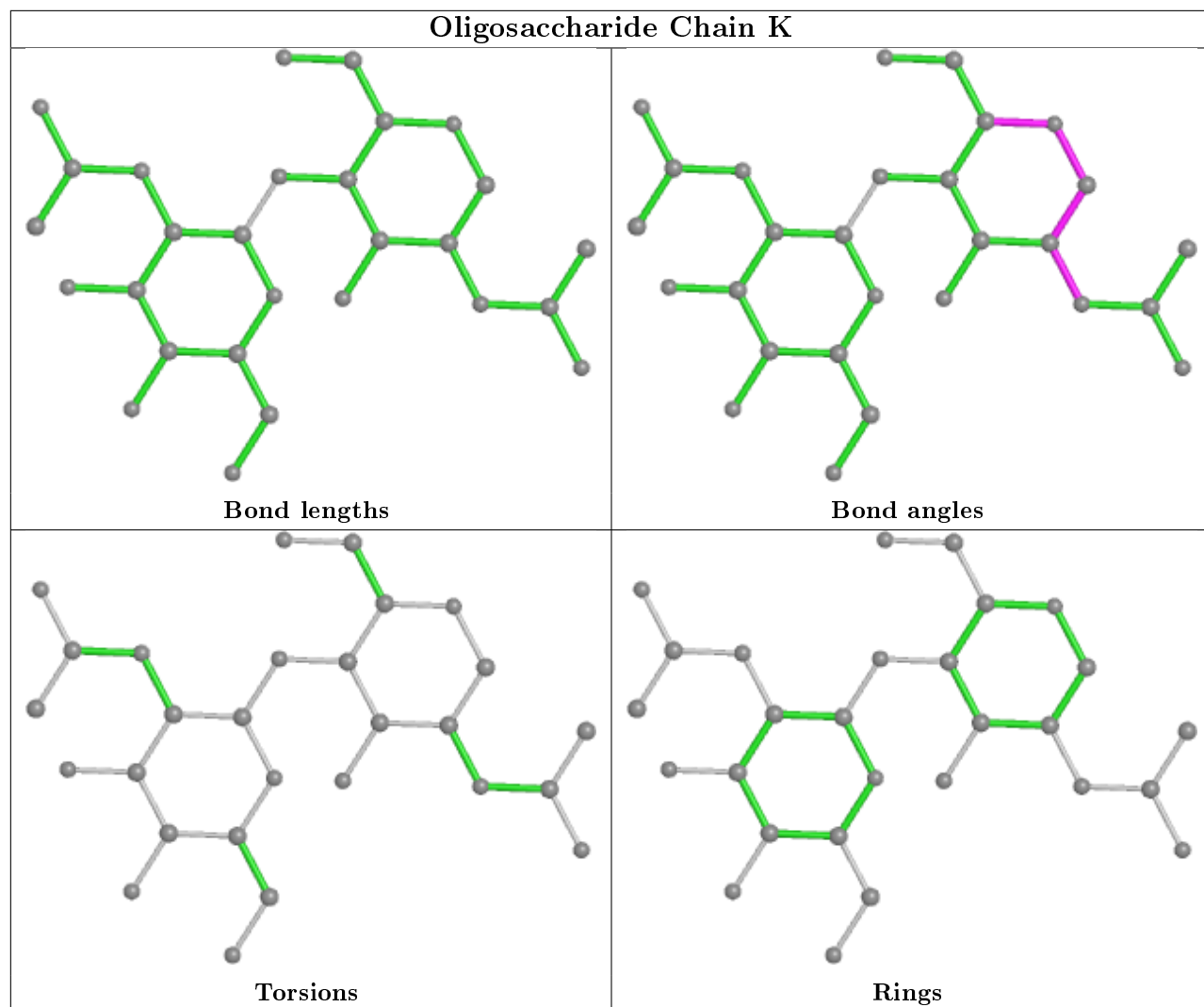
1 monomer is involved in 1 short contact:

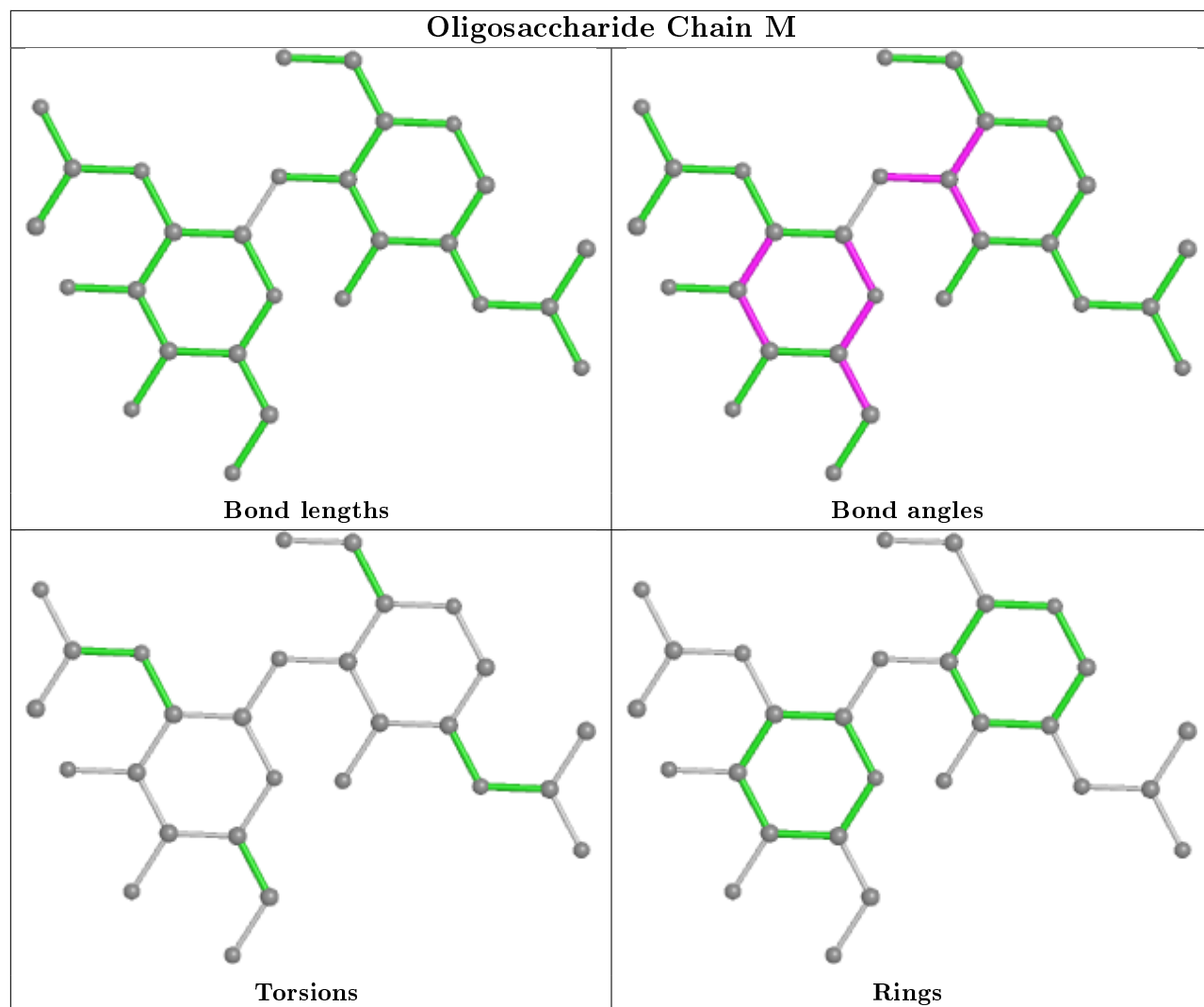
Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	J	2	NAG	1	0

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

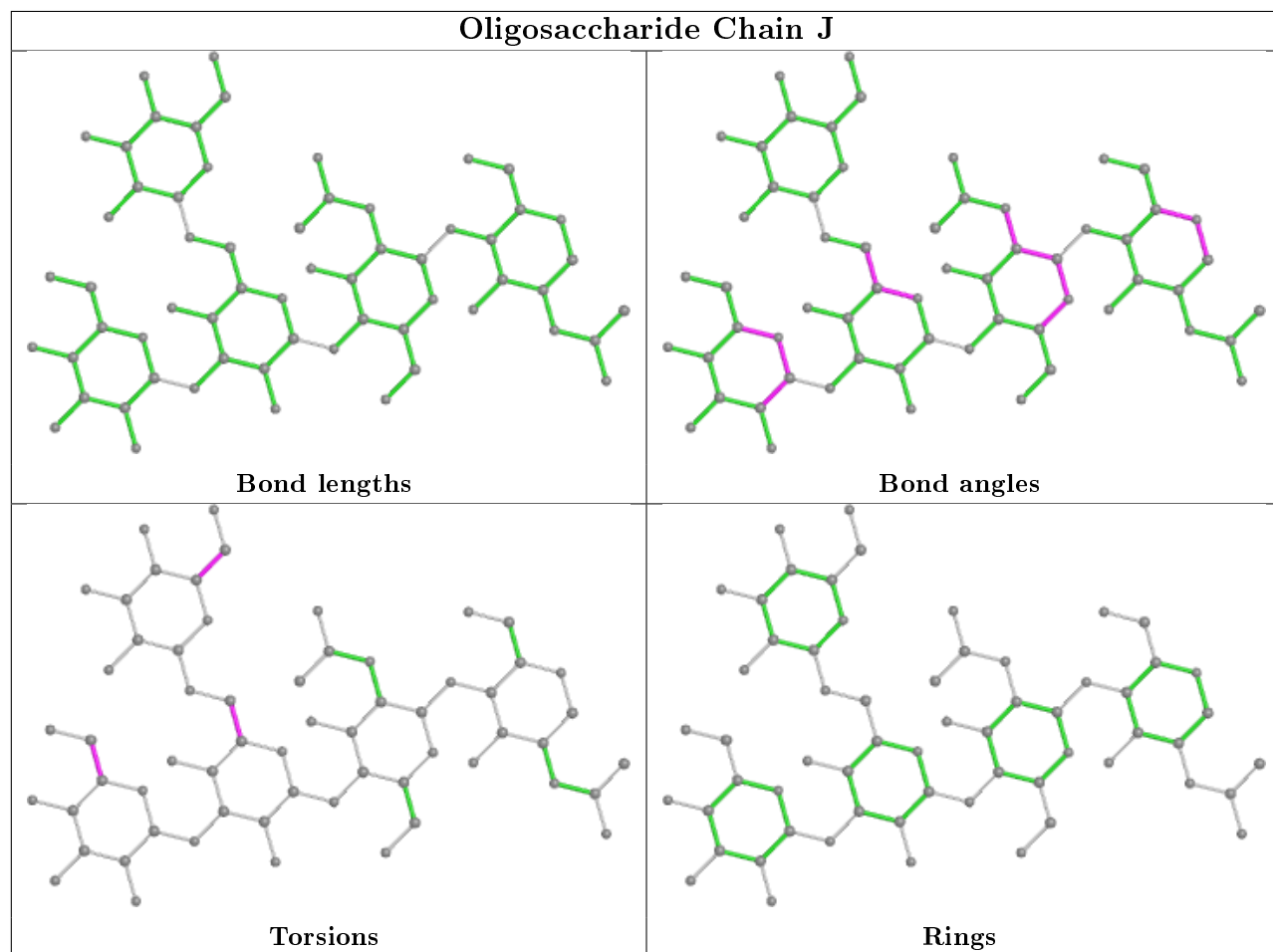
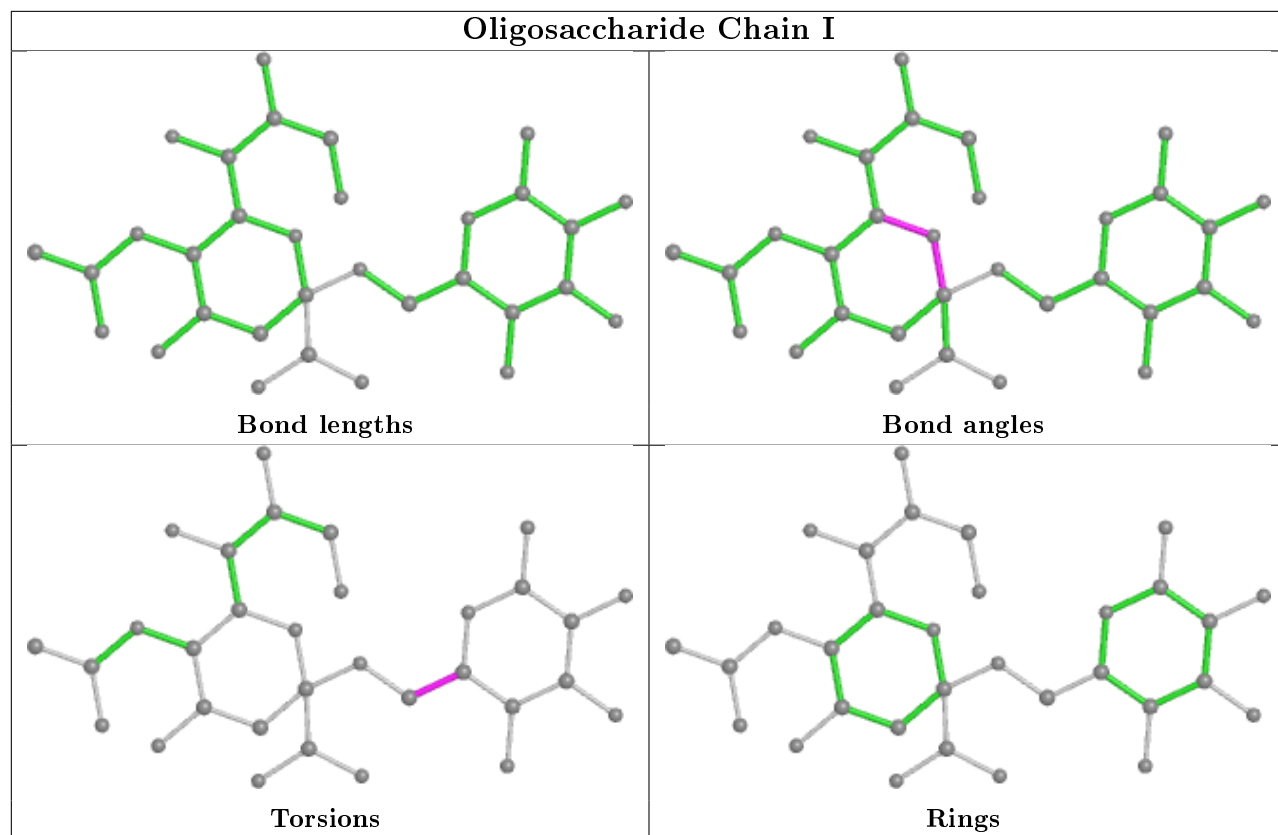


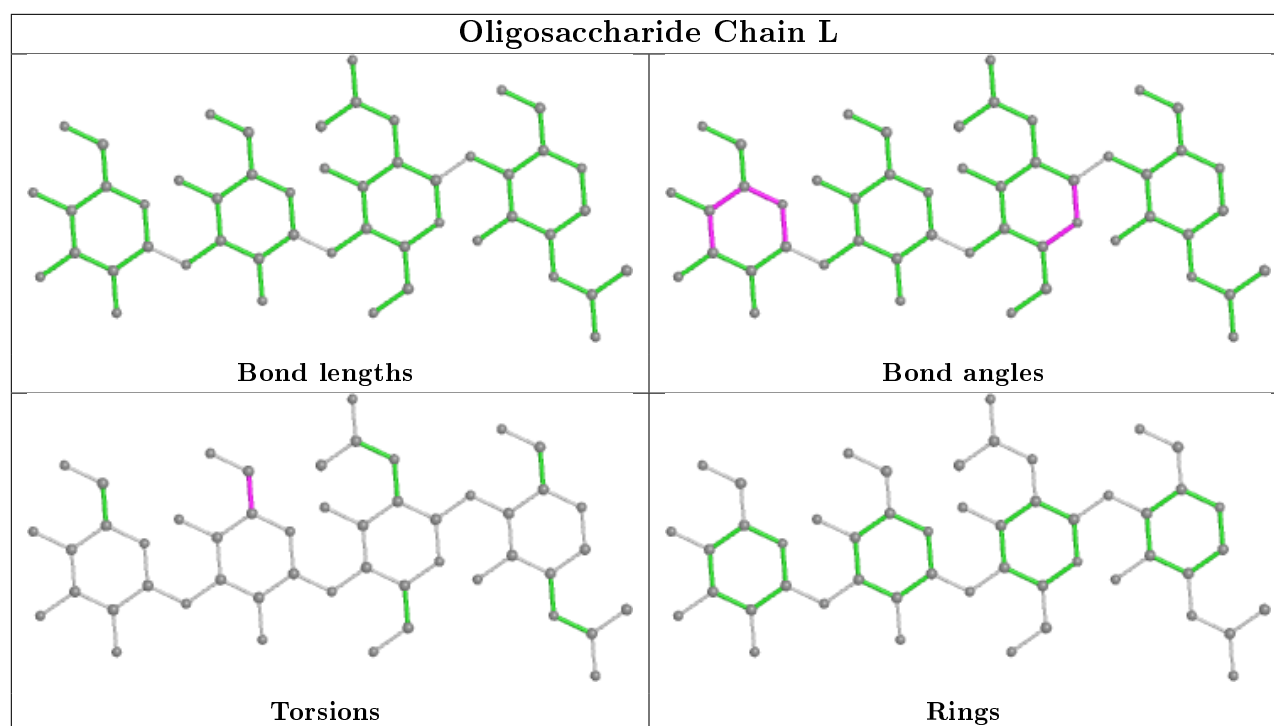












## 5.6 Ligand geometry [i](#)

6 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	$\# Z  > 2$
8	NAG	C	408	1	14,14,15	0.68	0	17,19,21	1.94	3 (17%)
8	NAG	E	408	1	14,14,15	0.34	0	17,19,21	0.82	0
9	SIA	C	409	-	18,21,21	0.83	1 (5%)	21,31,31	0.66	0
8	NAG	E	407	1	14,14,15	0.47	0	17,19,21	1.21	1 (5%)
8	NAG	A	401	1	14,14,15	0.51	0	17,19,21	0.90	0
9	SIA	E	409	-	18,21,21	0.84	2 (11%)	21,31,31	0.54	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
8	NAG	C	408	1	-	0/6/23/26	0/1/1/1
8	NAG	E	408	1	-	0/6/23/26	0/1/1/1
9	SIA	C	409	-	-	0/14/38/38	0/1/1/1
8	NAG	E	407	1	-	0/6/23/26	0/1/1/1
8	NAG	A	401	1	-	0/6/23/26	0/1/1/1
9	SIA	E	409	-	-	1/14/38/38	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
9	C	409	SIA	O2-C2	2.85	1.43	1.39
9	E	409	SIA	O2-C2	2.44	1.43	1.39
9	E	409	SIA	C3-C2	2.09	1.54	1.51

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
8	C	408	NAG	O5-C1-C2	-6.91	100.38	111.29
8	E	407	NAG	C1-O5-C5	3.32	116.69	112.19
8	C	408	NAG	C2-N2-C7	-2.42	119.46	122.90
8	C	408	NAG	C1-O5-C5	2.22	115.19	112.19

There are no chirality outliers.

All (1) torsion outliers are listed below:

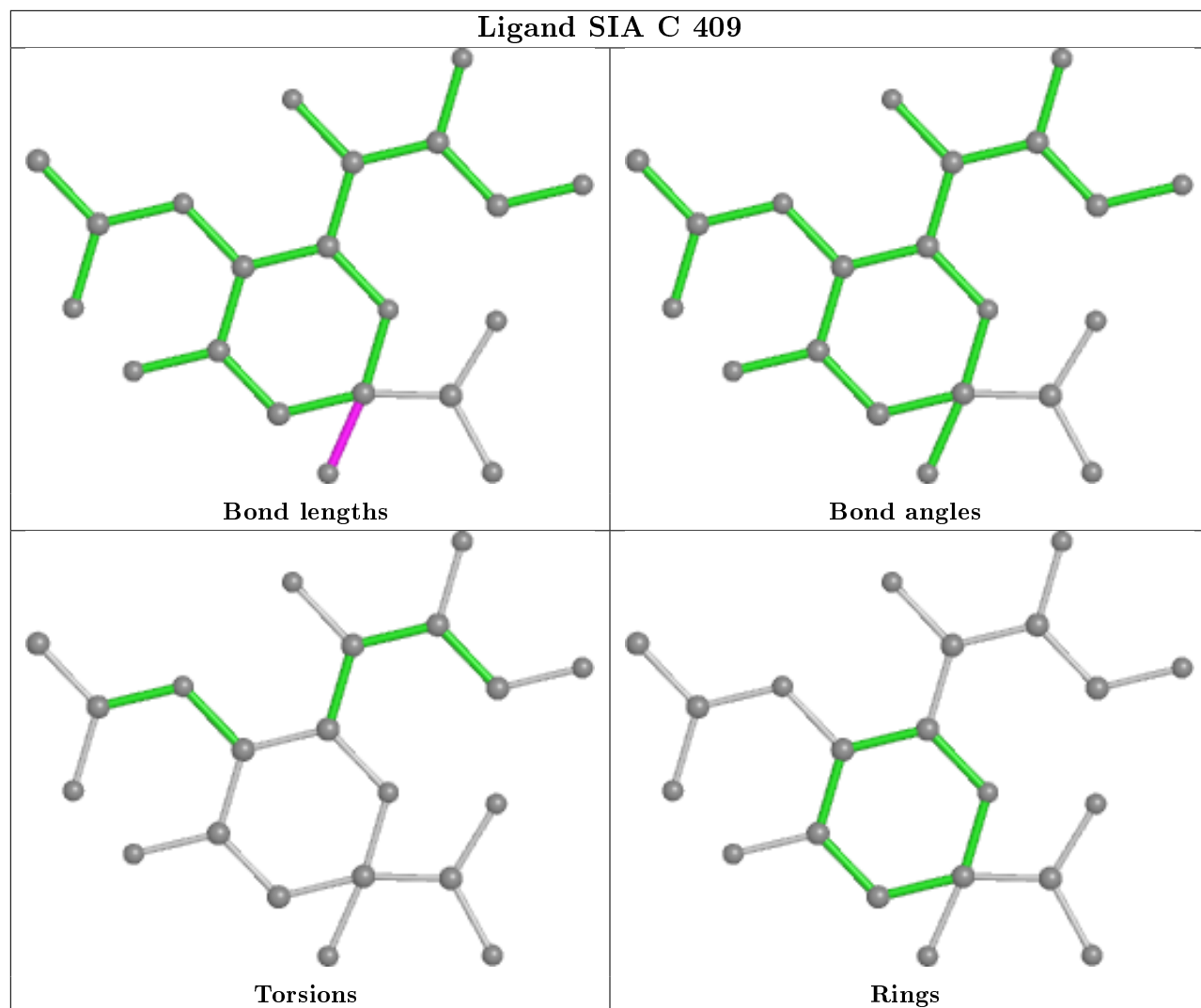
Mol	Chain	Res	Type	Atoms
9	E	409	SIA	O8-C8-C9-O9

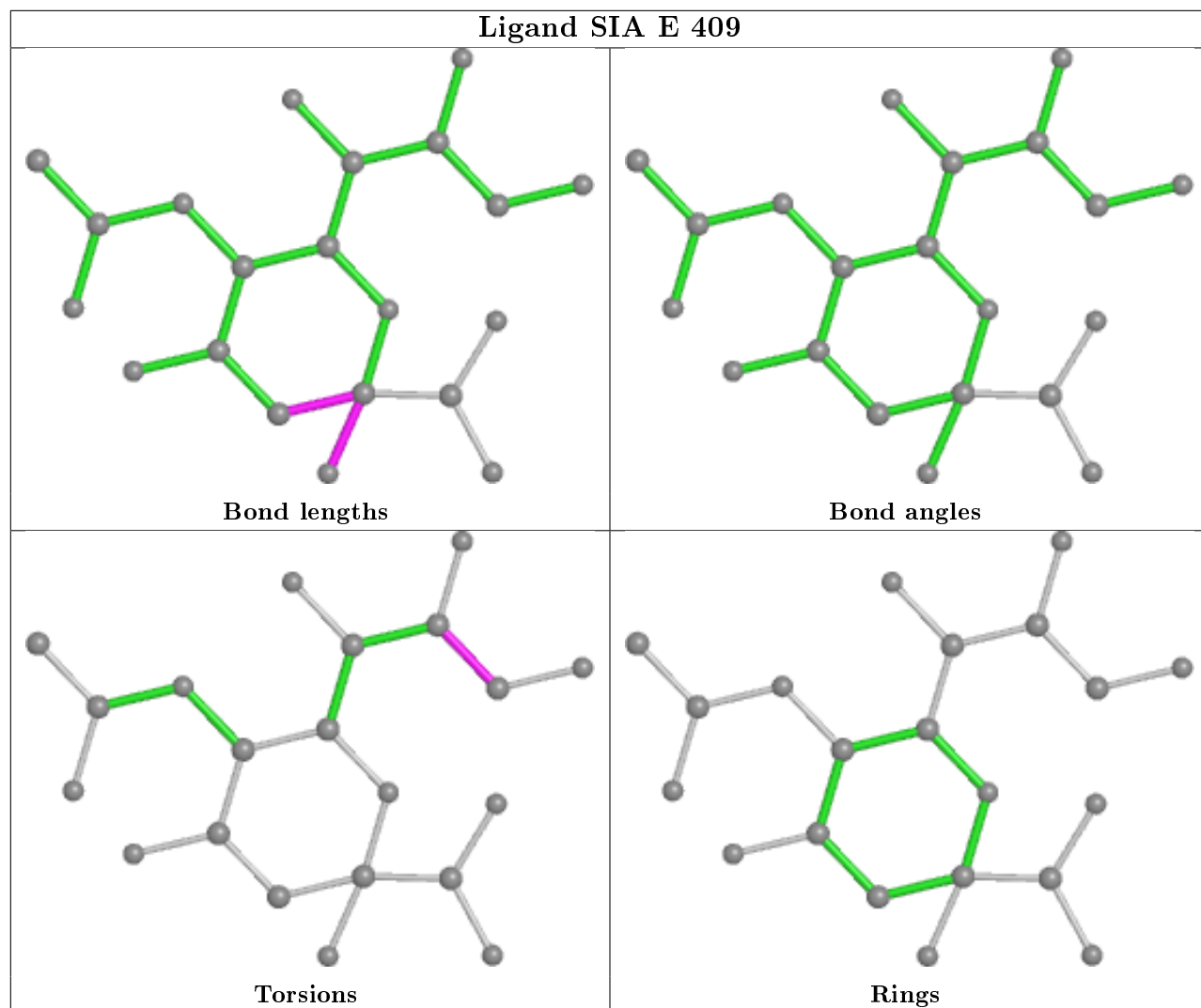
There are no ring outliers.

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.

## Ligand SIA C 409





## 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	317/323 (98%)	-0.09	4 (1%) 77 79	35, 49, 68, 120	0
1	C	317/323 (98%)	-0.04	6 (1%) 66 69	28, 41, 65, 116	0
1	E	321/323 (99%)	0.10	18 (5%) 24 26	31, 51, 85, 130	0
2	B	172/174 (98%)	0.30	7 (4%) 37 40	31, 61, 96, 120	0
2	D	171/174 (98%)	0.52	17 (9%) 7 7	28, 65, 98, 108	0
2	F	171/174 (98%)	0.52	15 (8%) 10 11	30, 65, 99, 119	0
All	All	1469/1491 (98%)	0.15	67 (4%) 32 35	28, 50, 92, 130	0

All (67) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	9	PRO	6.2
2	F	59	THR	5.8
2	F	31	GLY	5.3
2	D	171	PHE	4.7
2	D	143	LYS	4.7
2	F	167	LEU	4.1
2	B	172	GLN	4.0
2	B	171	PHE	3.7
2	D	147	ALA	3.5
1	E	13	LEU	3.5
1	E	126	THR	3.4
2	B	147	ALA	3.4
2	F	29	SER	3.4
1	A	22	ASN	3.4
1	C	222	TRP	3.3
2	D	141	TYR	3.2
1	E	128	THR	3.2
1	C	212	THR	3.2
2	D	168	ASN	3.2

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
2	F	143	LYS	3.1
1	E	11	ALA	3.1
1	A	225	GLN	3.0
1	A	222	TRP	3.0
2	F	147	ALA	3.0
1	E	208	ARG	3.0
2	F	27	GLN	3.0
2	D	29	SER	2.9
1	E	127	TRP	2.9
2	D	31	GLY	2.9
2	D	164	ASP	2.9
1	E	242	VAL	2.8
1	E	159	SER	2.7
2	F	161	VAL	2.7
2	F	171	PHE	2.7
2	D	2	LEU	2.6
2	D	167	LEU	2.6
2	F	32	THR	2.6
1	C	225	GLN	2.6
1	E	10	GLY	2.6
1	E	167	THR	2.5
1	C	189	GLN	2.5
2	D	166	ALA	2.5
1	E	130	VAL	2.4
2	B	157	TYR	2.4
1	E	160	THR	2.4
1	C	22	ASN	2.4
2	B	59	THR	2.3
1	C	103	PRO	2.3
2	F	154	ASN	2.3
2	D	77	ILE	2.3
2	D	140	ILE	2.3
1	E	12	THR	2.3
2	D	160	ASP	2.3
2	B	168	ASN	2.2
1	E	107	SER	2.2
1	E	144	GLY	2.2
1	E	143	PRO	2.2
2	F	16	GLY	2.2
1	E	142	GLY	2.2
2	B	162	TYR	2.1
2	F	142	HIS	2.1

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Mol	Chain	Res	Type	RSRZ
2	D	3	PHE	2.1
1	A	208	ARG	2.0
2	F	156	THR	2.0
2	F	145	ASP	2.0
2	D	18	ILE	2.0
2	D	1	GLY	2.0

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

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

## 6.3 Carbohydrates [i](#)

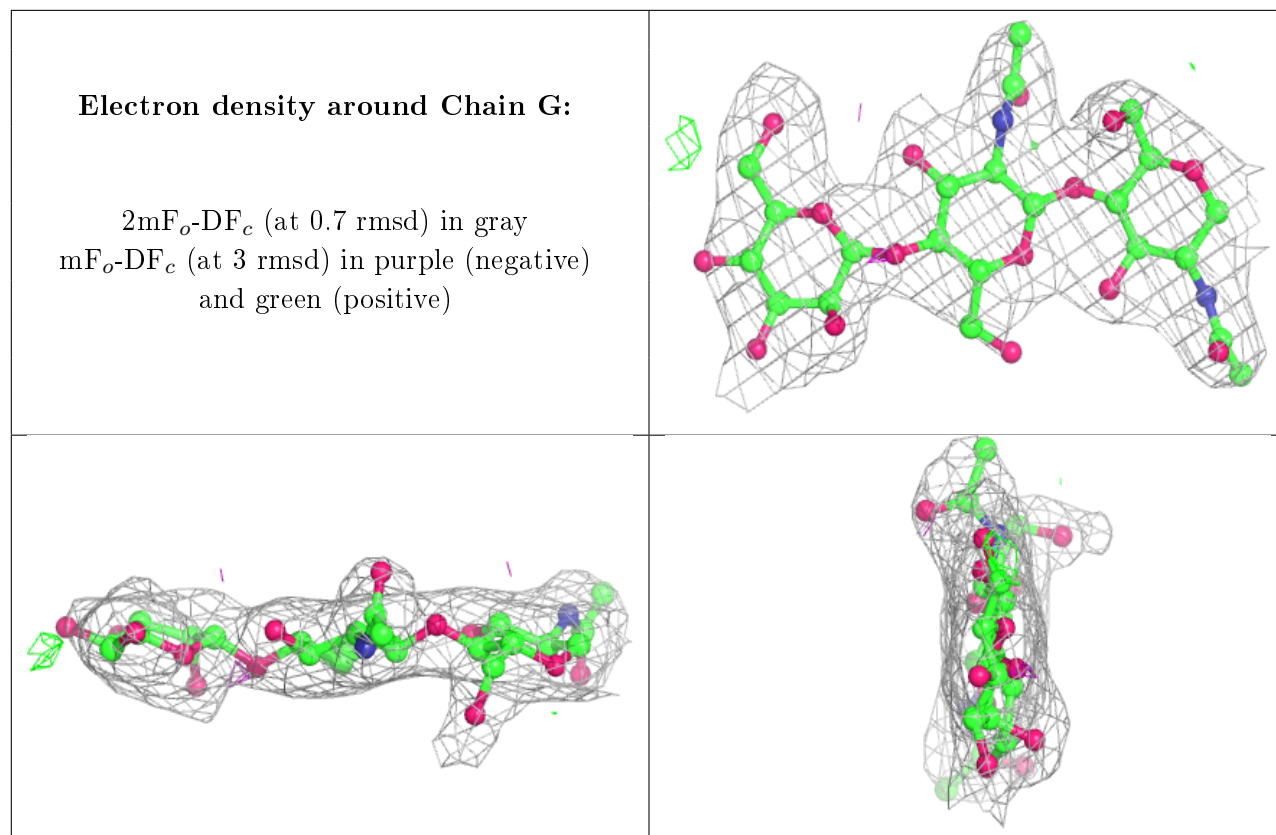
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q<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	MAN	J	5	11/12	0.71	0.28	92,102,104,105	0
5	GAL	I	1	12/12	0.79	0.24	77,90,95,95	0
4	NAG	K	2	14/15	0.80	0.25	74,78,85,88	0
4	NAG	M	2	14/15	0.80	0.26	67,80,88,88	0
7	MAN	L	4	11/12	0.82	0.31	109,112,114,115	0
6	BMA	J	3	11/12	0.83	0.17	76,85,90,98	0
7	BMA	L	3	11/12	0.83	0.21	95,99,101,107	0
4	NAG	H	2	14/15	0.83	0.27	79,85,91,94	0
3	BMA	G	3	11/12	0.85	0.18	82,85,87,89	0
6	MAN	J	4	11/12	0.87	0.32	91,94,97,98	0
6	NAG	J	2	14/15	0.91	0.10	48,56,61,68	0
7	NAG	L	1	14/15	0.91	0.23	64,70,79,81	0
7	NAG	L	2	14/15	0.94	0.27	74,79,86,89	0
4	NAG	K	1	14/15	0.94	0.12	44,49,60,65	0
3	NAG	G	2	14/15	0.94	0.19	55,61,73,77	0
4	NAG	M	1	14/15	0.95	0.15	44,50,55,67	0
4	NAG	H	1	14/15	0.95	0.11	50,55,62,71	0
5	SIA	I	2	20/21	0.95	0.12	57,61,65,65	0
6	NAG	J	1	14/15	0.95	0.12	46,49,52,55	0
3	NAG	G	1	14/15	0.96	0.11	45,52,60,65	0

The following is a graphical depiction of the model fit to experimental electron density for oligosac-

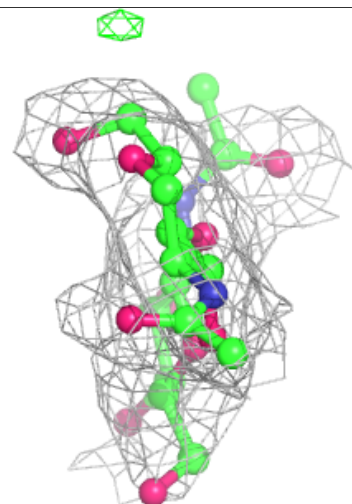
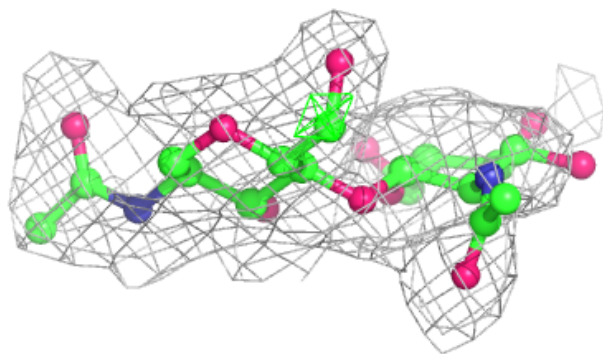
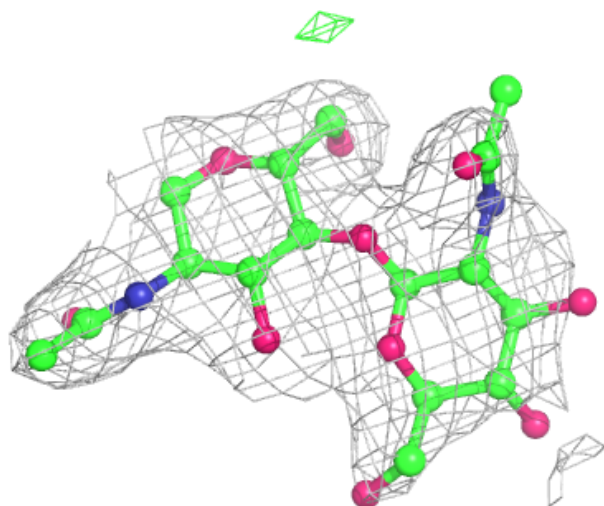


charide. Each fit is shown from different orientation to approximate a three-dimensional view.



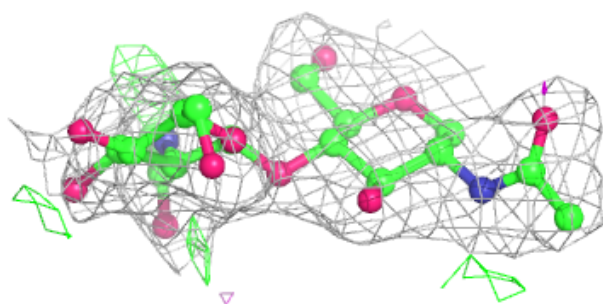
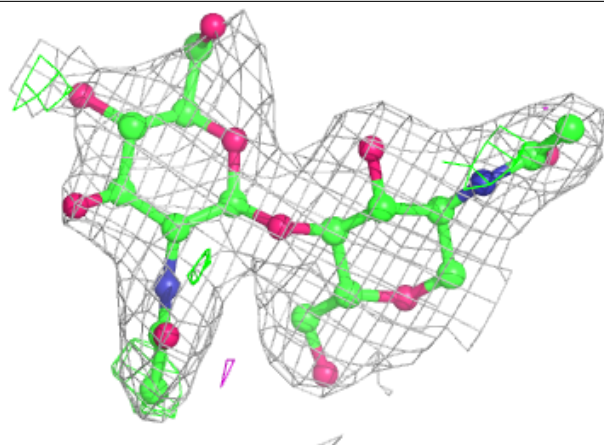
**Electron density around Chain H:**

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



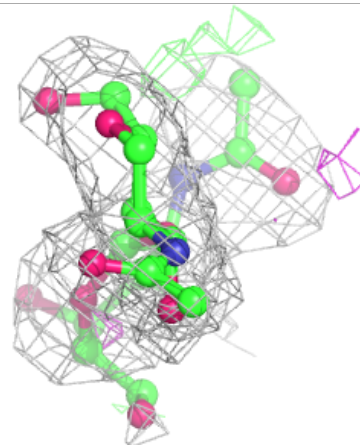
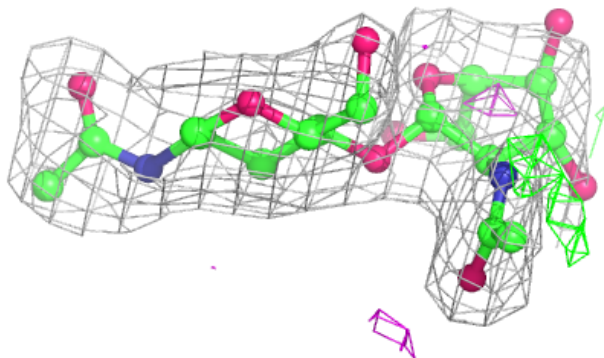
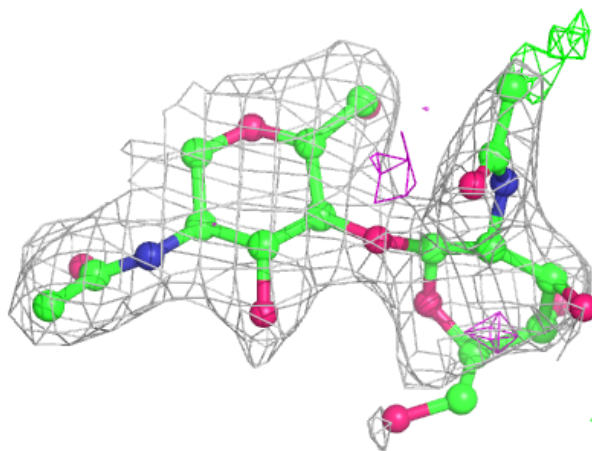
**Electron density around Chain K:**

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



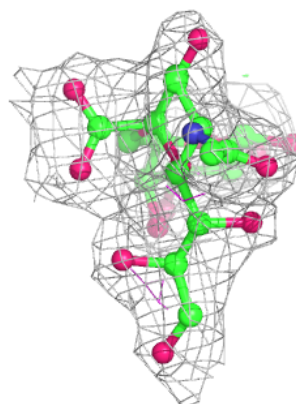
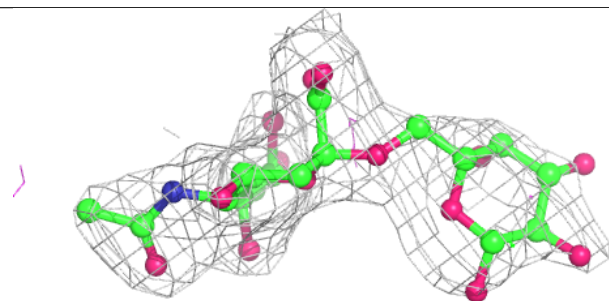
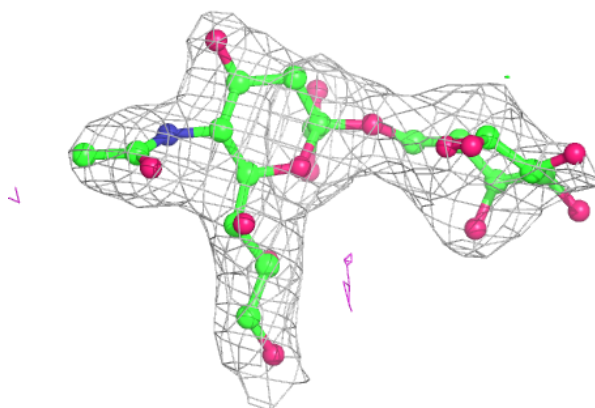
**Electron density around Chain M:**

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



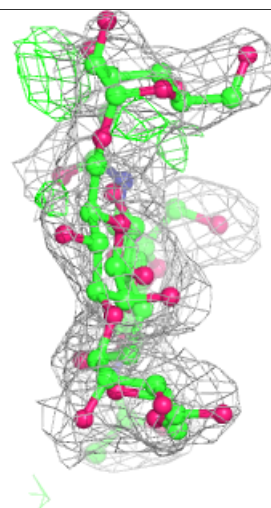
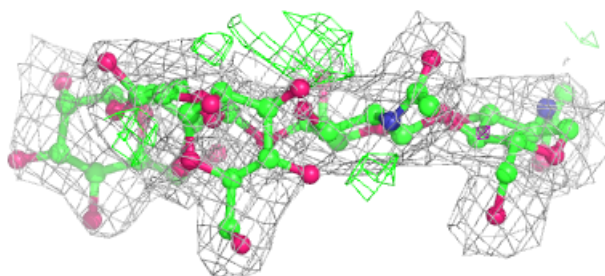
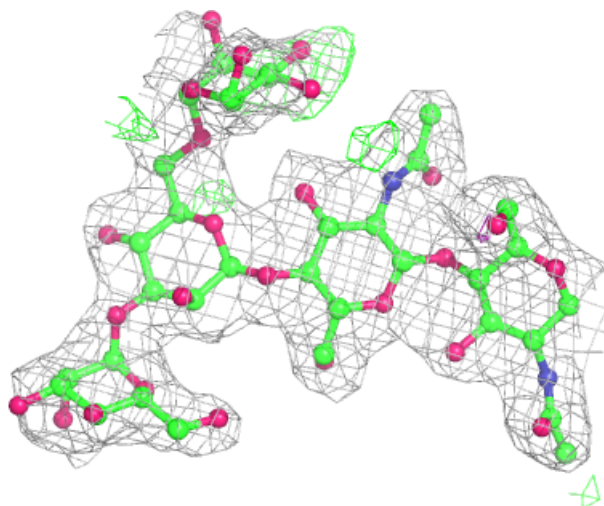
**Electron density around Chain I:**

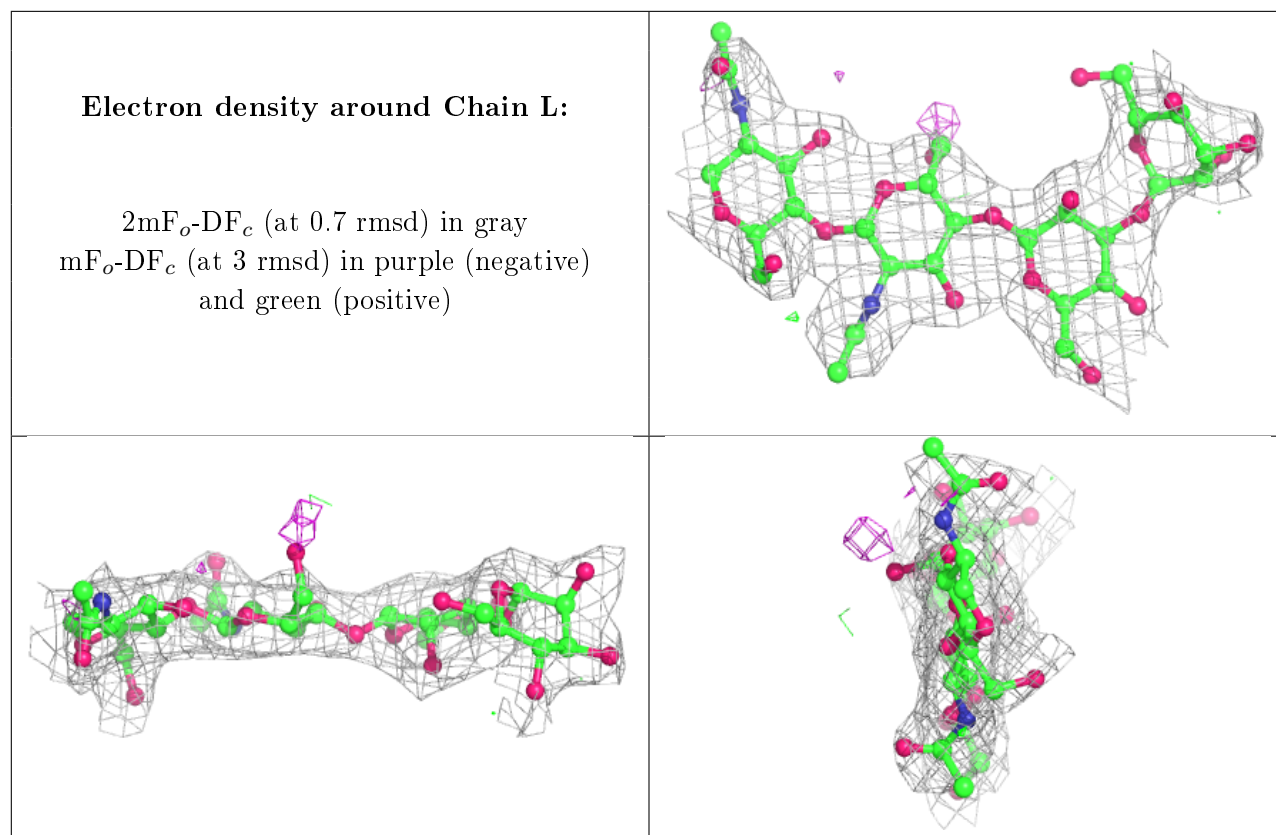
$2mF_o - DF_c$  (at 0.7 rmsd) in gray  
 $mF_o - DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



**Electron density around Chain J:**

$2mF_o-DF_c$  (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.

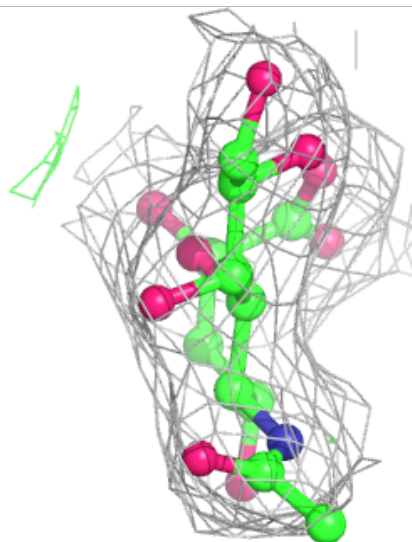
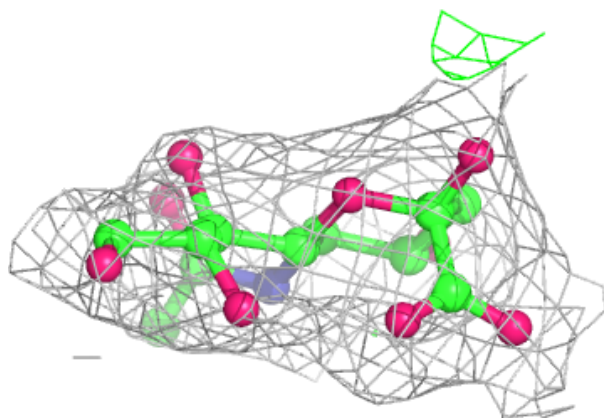
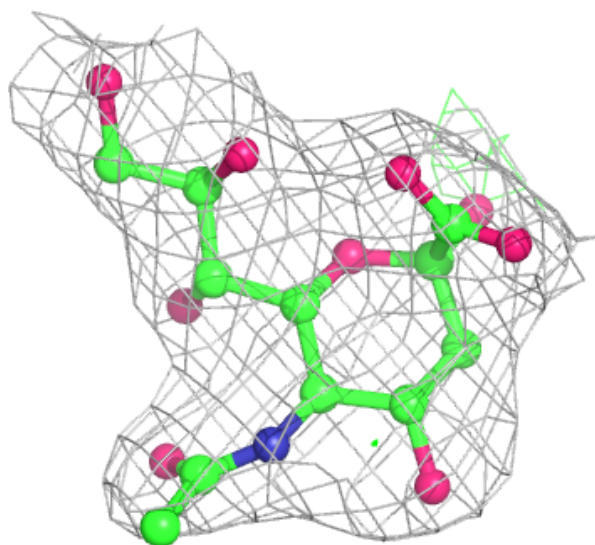
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
8	NAG	A	401	14/15	0.71	0.33	75,90,105,107	0
8	NAG	E	408	14/15	0.75	0.26	74,91,98,102	0
8	NAG	C	408	14/15	0.78	0.29	69,80,82,85	0
8	NAG	E	407	14/15	0.91	0.24	60,69,74,75	0
9	SIA	E	409	21/21	0.92	0.15	69,76,76,80	0
9	SIA	C	409	21/21	0.94	0.12	48,51,53,54	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 SIA E 409:**

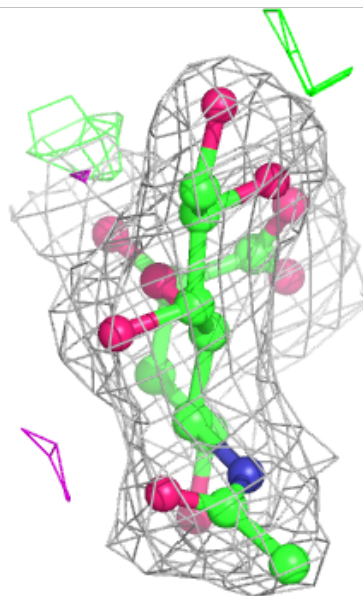
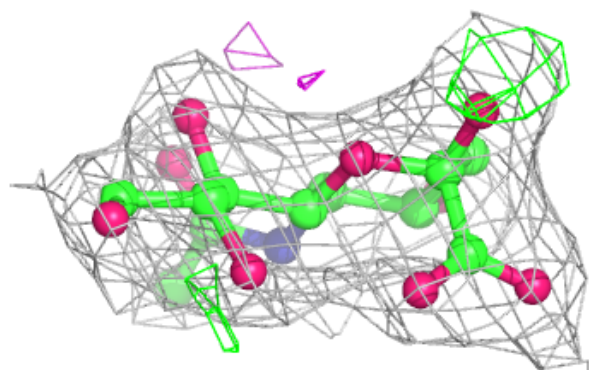
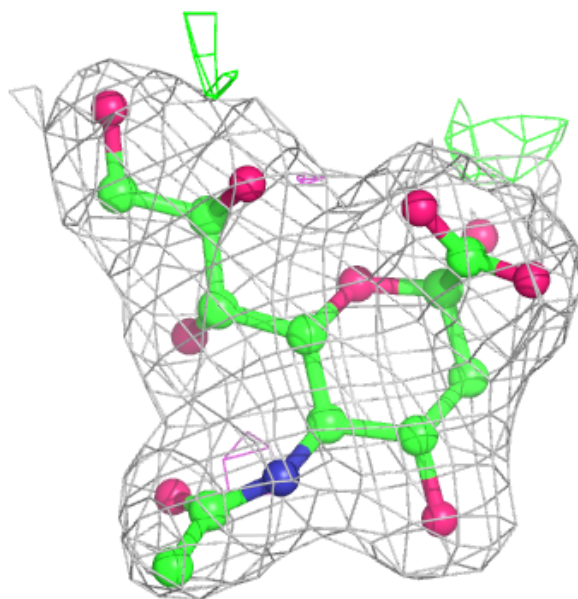
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)





**Electron density around SIA C 409:**

$2mF_o-DF_c$  (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.