



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 09:17 AM UTC

PDB ID : 7AMZ / pdb_00007amz
Title : Crystal structure of human Butyrylcholinesterase in complex with N-((2S,3R)-4-((2,2-dimethylpropyl)amino)-3-hydroxy-1-phenylbutan-2-yl)-2,2-diphenyl acetamide
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Deposited on : 2020-10-10
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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

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

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

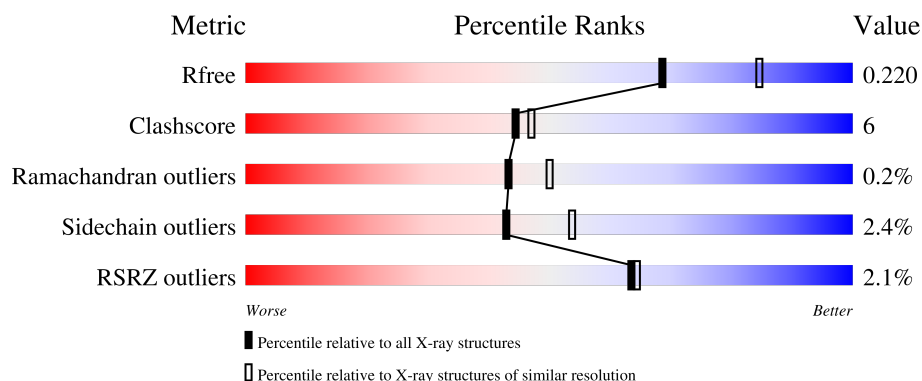
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.25 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}	180053	1898 (2.26-2.26)
Clashscore	190562	2005 (2.26-2.26)
Ramachandran outliers	187476	1965 (2.26-2.26)
Sidechain outliers	187428	1966 (2.26-2.26)
RSRZ outliers	180081	1898 (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 of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	529	2% 84% 15% .
2	B	2	100%
3	C	3	67% 33%
3	D	3	67% 33%

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Mol	Chain	Length	Quality of chain
3	E	3	 67% 33%

2 Entry composition

There are 10 unique types of molecules in this entry. The entry contains 4637 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 Cholinesterase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	527	4235	2733	711	776	15	0	5	0

There are 4 discrepancies between the modelled and reference sequences:

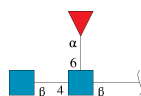
Chain	Residue	Modelled	Actual	Comment	Reference
A	17	GLN	ASN	engineered mutation	UNP P06276
A	455	GLN	ASN	engineered mutation	UNP P06276
A	481	GLN	ASN	engineered mutation	UNP P06276
A	486	GLN	ASN	engineered mutation	UNP P06276

- Molecule 2 is an oligosaccharide called alpha-L-fucopyranose-(1-6)-2-acetamido-2-deoxy-beta-D-glucopyranose.



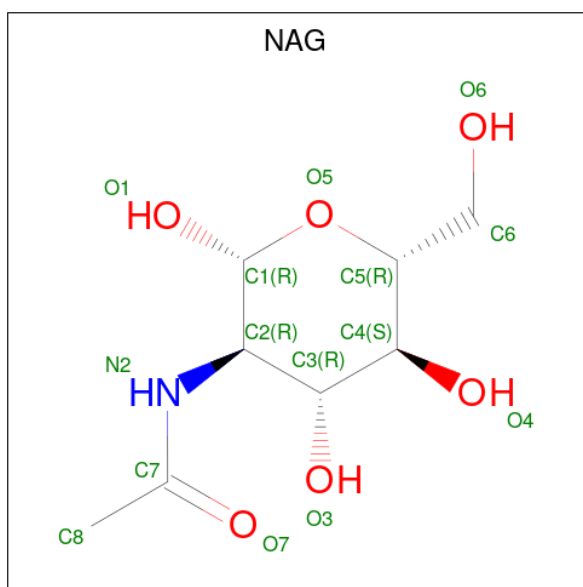
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	B	2	24	14	1	9	0	0	0

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

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: $C_8H_{15}NO_6$).



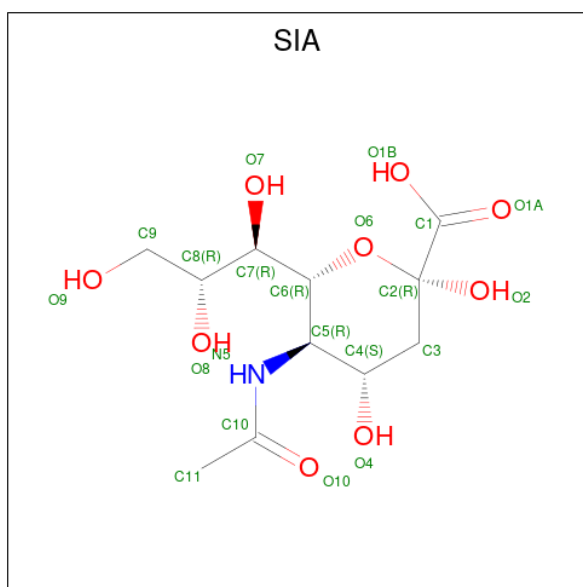
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			14	8	1	5		
4	A	1	Total	C	N	O	0	0
			14	8	1	5		

- Molecule 5 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



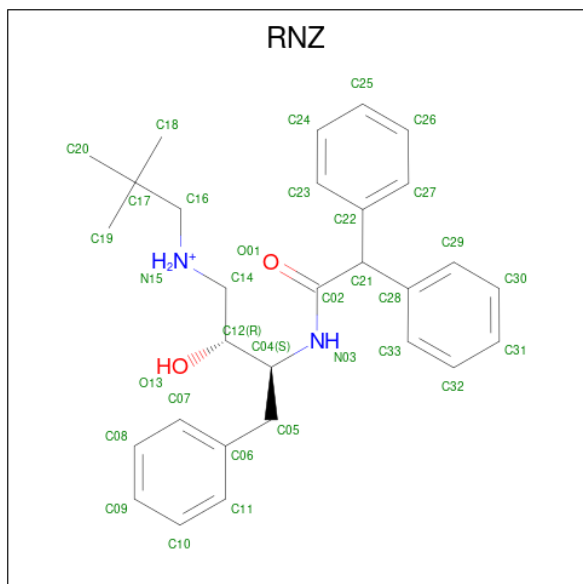
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			6	3	3		
5	A	1	Total	C	O	0	0
			6	3	3		
5	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 6 is N-acetyl-alpha-neuraminic acid (CCD ID: SIA) (formula: $C_{11}H_{19}NO_9$).



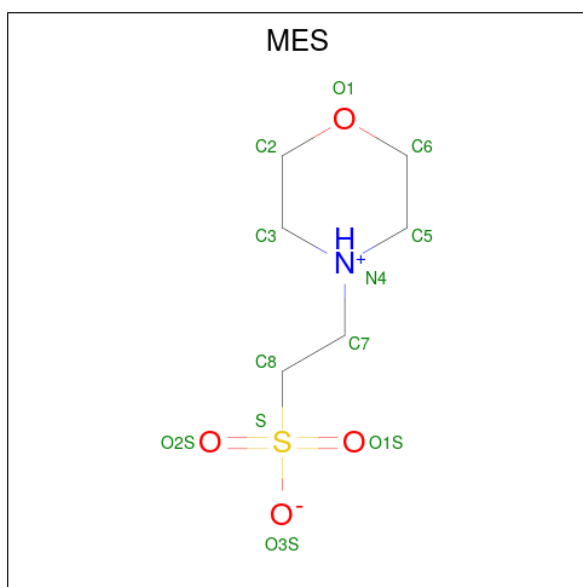
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	A	1	Total	C	N	O	0	0
			21	11	1	9		

- Molecule 7 is 2,2-dimethylpropyl-[(2 {R},3 {S})-3-(2,2-diphenylethanoylamino)-2-oxidan-yl-4-phenyl-butyl]azanium (CCD ID: RNZ) (formula: $C_{29}H_{37}N_2O_2$) (labeled as "Ligand of Interest" by depositor).



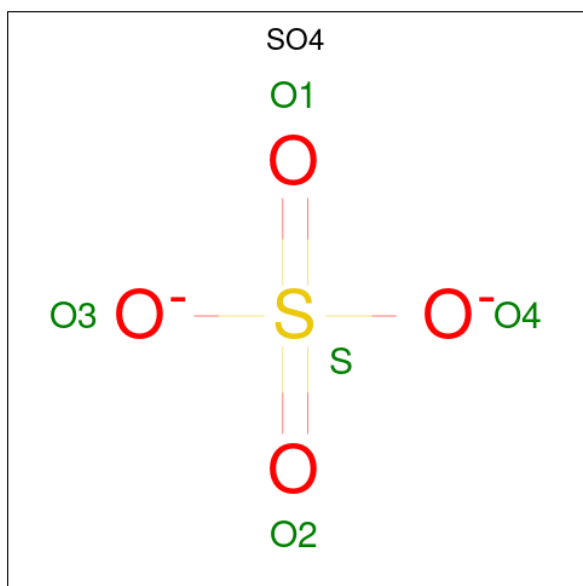
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
7	A	1	Total	C	N	O	0	0
			33	29	2	2		

- Molecule 8 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula: $C_6H_{13}NO_4S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
8	A	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

- Molecule 9 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	A	1	Total	O	S	0	0
			5	4	1		
9	A	1	Total	O	S	0	0
			5	4	1		

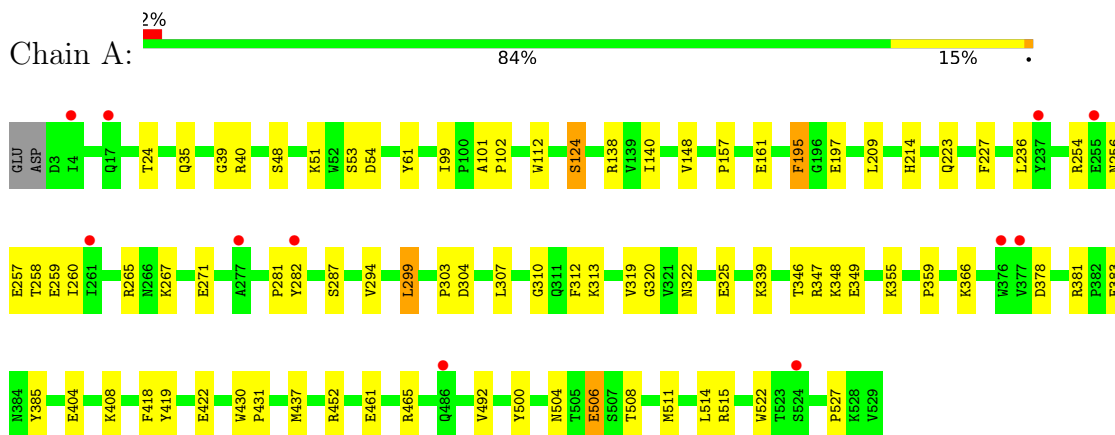
- Molecule 10 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	A	142	Total	O	0	0
			142	142		

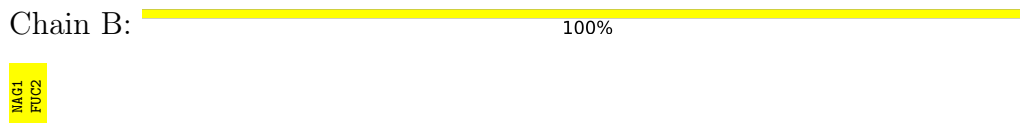
3 Residue-property plots

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

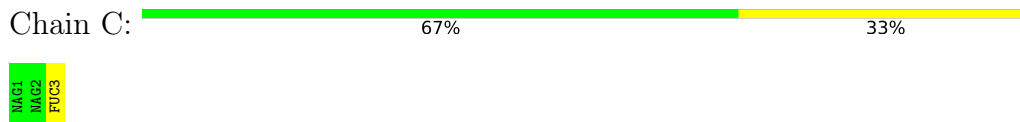
- Molecule 1: Cholinesterase



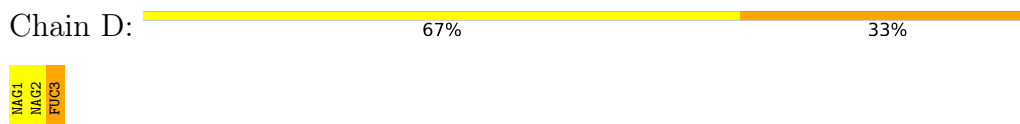
- Molecule 2: alpha-L-fucopyranose-(1-6)-2-acetamido-2-deoxy-beta-D-glucopyranose



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



- Molecule 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



4 Data and refinement statistics

Property	Value	Source
Space group	I 4 2 2	Depositor
Cell constants a, b, c, α , β , γ	154.35Å 154.35Å 128.06Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.81 – 2.25 48.81 – 2.25	Depositor EDS
% Data completeness (in resolution range)	100.0 (48.81-2.25) 100.0 (48.81-2.25)	Depositor EDS
R_{merge}	0.18	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.10 (at 2.24Å)	Xtriage
Refinement program	PHENIX dev_3965	Depositor
R, R_{free}	0.197 , 0.220 0.198 , 0.220	Depositor DCC
R_{free} test set	1106 reflections (3.00%)	wwPDB-VP
Wilson B-factor (Å ²)	47.2	Xtriage
Anisotropy	0.424	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 40.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	4637	wwPDB-VP
Average B, all atoms (Å ²)	54.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.78% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SO4, RNZ, MES, FUC, NAG, GOL, SIA

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

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.38	0/4368	0.54	0/5929

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4235	0	4131	53	0
2	B	24	0	22	0	0
3	C	38	0	34	0	0
3	D	38	0	34	1	0
3	E	38	0	34	0	0
4	A	28	0	26	0	0
5	A	18	0	24	0	0
6	A	21	0	18	0	0
7	A	33	0	0	0	0
8	A	12	0	12	3	0
9	A	10	0	0	0	0
10	A	142	0	0	2	0
All	All	4637	0	4335	53	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 6.

All (53) 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:157:PRO:HG3	1:A:236:LEU:HD12	1.74	0.67
1:A:40:ARG:HD2	1:A:40:ARG:H	1.61	0.65
1:A:209:LEU:HD12	1:A:312:PHE:HB3	1.81	0.63
1:A:257:GLU:HA	1:A:260:ILE:HD12	1.83	0.60
1:A:138:ARG:NH2	10:A:703:HOH:O	2.35	0.60
1:A:500:TYR:CZ	1:A:511:MET:HB2	2.37	0.59
1:A:522:TRP:O	1:A:527:PRO:HD3	2.04	0.57
1:A:99:ILE:HD13	1:A:140:ILE:HG12	1.87	0.55
1:A:227:PHE:CE1	1:A:303:PRO:HB2	2.40	0.54
1:A:514:LEU:HD12	8:A:608:MES:H52	1.89	0.54
1:A:227:PHE:HZ	1:A:307:LEU:HB2	1.74	0.53
1:A:383:GLU:H	1:A:383:GLU:CD	2.17	0.52
1:A:378:ASP:OD2	1:A:381:ARG:HG3	2.10	0.52
1:A:227:PHE:CD1	1:A:303:PRO:HB2	2.45	0.51
1:A:319:VAL:O	1:A:418:PHE:HA	2.11	0.51
1:A:256:ASN:HB3	1:A:259:GLU:HB2	1.93	0.50
1:A:40:ARG:H	1:A:40:ARG:CD	2.25	0.49
1:A:346:THR:OG1	1:A:349:GLU:HG3	2.13	0.48
1:A:282:TYR:HD2	1:A:359:PRO:HB2	1.77	0.48
1:A:61:TYR:CG	1:A:124:SER:HB3	2.48	0.48
1:A:236:LEU:HD22	10:A:701:HOH:O	2.13	0.48
1:A:267:LYS:HD2	1:A:271:GLU:CD	2.39	0.48
1:A:322:ASN:O	1:A:325:GLU:HG2	2.15	0.47
1:A:101:ALA:HA	1:A:102:PRO:C	2.40	0.47
1:A:227:PHE:CD1	1:A:227:PHE:C	2.93	0.46
1:A:320:GLY:HA3	1:A:419:TYR:CE2	2.51	0.46
1:A:347:ARG:HB2	1:A:385:TYR:CZ	2.51	0.46
1:A:281:PRO:HB3	3:D:3:FUC:H61	1.96	0.46
1:A:236:LEU:HD21	1:A:294:VAL:HB	1.98	0.45
1:A:35:GLN:NE2	1:A:48:SER:O	2.47	0.45
1:A:310:GLY:HA2	1:A:312:PHE:CE2	2.51	0.45
1:A:197:GLU:HA	1:A:223:GLN:O	2.17	0.45
1:A:214[A]:HIS:CD2	1:A:313:LYS:HB2	2.52	0.45
1:A:515:ARG:HD3	8:A:608:MES:H32	2.01	0.43
1:A:304:ASP:OD1	1:A:304:ASP:N	2.50	0.43
1:A:39:GLY:O	1:A:265:ARG:HD3	2.19	0.42
1:A:465:ARG:HA	1:A:465:ARG:HD2	1.92	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:515:ARG:NH1	8:A:608:MES:H71	2.34	0.42
1:A:161:GLU:HG3	1:A:258:THR:HG23	2.01	0.42
1:A:254:ARG:HB2	1:A:260:ILE:HG13	2.00	0.42
1:A:515:ARG:HH11	1:A:515:ARG:HG2	1.84	0.42
1:A:506:GLU:H	1:A:506:GLU:HG2	1.56	0.42
1:A:299:LEU:HD23	1:A:299:LEU:HA	1.85	0.41
1:A:40:ARG:HD2	1:A:40:ARG:N	2.33	0.41
1:A:404[A]:GLU:OE2	1:A:408:LYS:HE3	2.20	0.41
1:A:339:LYS:O	1:A:431:PRO:HG3	2.20	0.41
1:A:452:ARG:HD3	1:A:461:GLU:OE2	2.19	0.41
1:A:430:TRP:CG	1:A:437:MET:HE1	2.56	0.41
1:A:422:GLU:HG3	1:A:504:ASN:HB3	2.03	0.41
1:A:24:THR:O	1:A:101:ALA:HB3	2.21	0.41
1:A:320:GLY:HA3	1:A:419:TYR:CZ	2.56	0.40
1:A:355:LYS:HG2	1:A:366:LYS:HE3	2.03	0.40
1:A:112:TRP:HA	1:A:195:PHE:O	2.21	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	530/529 (100%)	508 (96%)	21 (4%)	1 (0%)	43	50

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	506	GLU

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	457/454 (101%)	446 (98%)	11 (2%)	43 54

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	51	LYS
1	A	53	SER
1	A	54	ASP
1	A	124	SER
1	A	148	VAL
1	A	195	PHE
1	A	287	SER
1	A	299	LEU
1	A	348	LYS
1	A	492	VAL
1	A	508	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	77	HIS
1	A	289	ASN
1	A	414	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates ⓘ

11 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	2,1	14,14,15	0.81	1 (7%)	17,19,21	0.46	0
2	FUC	B	2	2	10,10,11	1.31	2 (20%)	14,14,16	1.35	2 (14%)
3	NAG	C	1	1,3	14,14,15	0.36	0	17,19,21	0.63	0
3	NAG	C	2	3	14,14,15	0.48	0	17,19,21	0.72	0
3	FUC	C	3	3	10,10,11	2.78	6 (60%)	14,14,16	1.38	2 (14%)
3	NAG	D	1	1,3	14,14,15	0.45	0	17,19,21	0.76	1 (5%)
3	NAG	D	2	3	14,14,15	0.37	0	17,19,21	0.78	1 (5%)
3	FUC	D	3	3	10,10,11	1.61	2 (20%)	14,14,16	1.86	2 (14%)
3	NAG	E	1	1,3	14,14,15	0.55	0	17,19,21	0.53	0
3	NAG	E	2	3	14,14,15	0.36	0	17,19,21	0.43	0
3	FUC	E	3	3	10,10,11	1.32	2 (20%)	14,14,16	1.01	1 (7%)

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	2,1	-	0/6/23/26	0/1/1/1
2	FUC	B	2	2	-	-	0/1/1/1
3	NAG	C	1	1,3	-	0/6/23/26	0/1/1/1
3	NAG	C	2	3	-	4/6/23/26	0/1/1/1
3	FUC	C	3	3	-	-	0/1/1/1
3	NAG	D	1	1,3	-	4/6/23/26	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
3	NAG	E	1	1,3	-	0/6/23/26	0/1/1/1
3	NAG	E	2	3	-	0/6/23/26	0/1/1/1
3	FUC	E	3	3	-	-	0/1/1/1

All (13) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	3	FUC	C1-C2	5.53	1.65	1.52
3	C	3	FUC	C2-C3	3.98	1.58	1.52
3	D	3	FUC	O5-C5	3.31	1.50	1.43
3	D	3	FUC	C4-C3	2.90	1.59	1.52
3	C	3	FUC	O5-C5	2.73	1.49	1.43
3	C	3	FUC	O3-C3	2.63	1.49	1.43
3	E	3	FUC	C2-C3	2.43	1.56	1.52
2	B	2	FUC	O5-C5	2.43	1.48	1.43
2	B	1	NAG	O5-C1	2.23	1.47	1.43
2	B	2	FUC	C1-C2	2.20	1.57	1.52
3	C	3	FUC	O5-C1	2.19	1.47	1.43
3	C	3	FUC	C4-C5	2.17	1.57	1.52
3	E	3	FUC	C4-C3	2.10	1.57	1.52

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	D	3	FUC	O5-C5-C4	4.22	117.16	109.55
3	D	3	FUC	C3-C4-C5	3.88	115.72	109.81
2	B	2	FUC	C1-O5-C5	3.27	120.68	112.97
3	C	3	FUC	O2-C2-C1	2.79	115.61	109.22
3	C	3	FUC	C1-C2-C3	2.66	113.52	109.64
3	D	2	NAG	C1-O5-C5	2.62	115.69	112.19
2	B	2	FUC	O5-C5-C4	2.17	113.45	109.55
3	E	3	FUC	C1-C2-C3	2.06	112.65	109.64
3	D	1	NAG	C1-O5-C5	2.03	114.91	112.19

There are no chirality outliers.

All (10) torsion outliers are listed below:

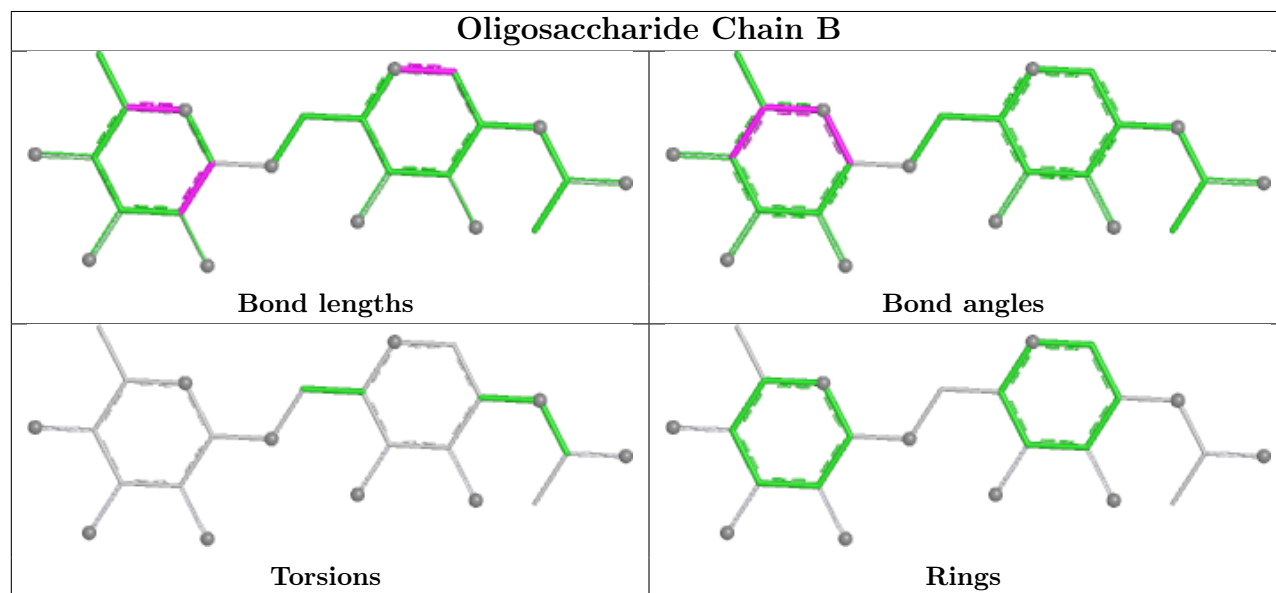
Mol	Chain	Res	Type	Atoms
3	C	2	NAG	C1-C2-N2-C7
3	D	2	NAG	O5-C5-C6-O6
3	C	2	NAG	O5-C5-C6-O6
3	D	1	NAG	O5-C5-C6-O6
3	D	2	NAG	C4-C5-C6-O6
3	C	2	NAG	C4-C5-C6-O6
3	D	1	NAG	C4-C5-C6-O6
3	D	1	NAG	C3-C2-N2-C7
3	D	1	NAG	C1-C2-N2-C7
3	C	2	NAG	C3-C2-N2-C7

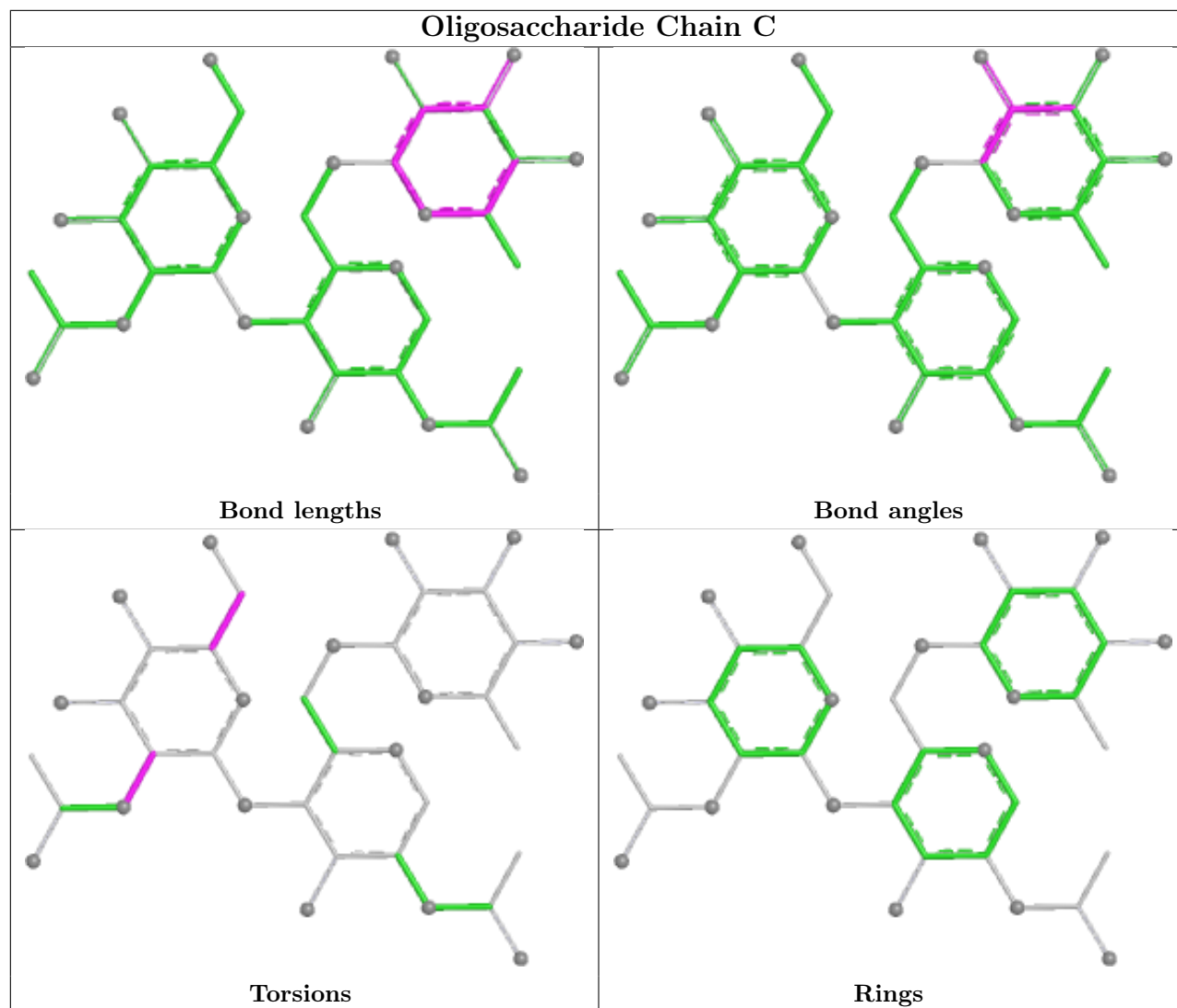
There are no ring outliers.

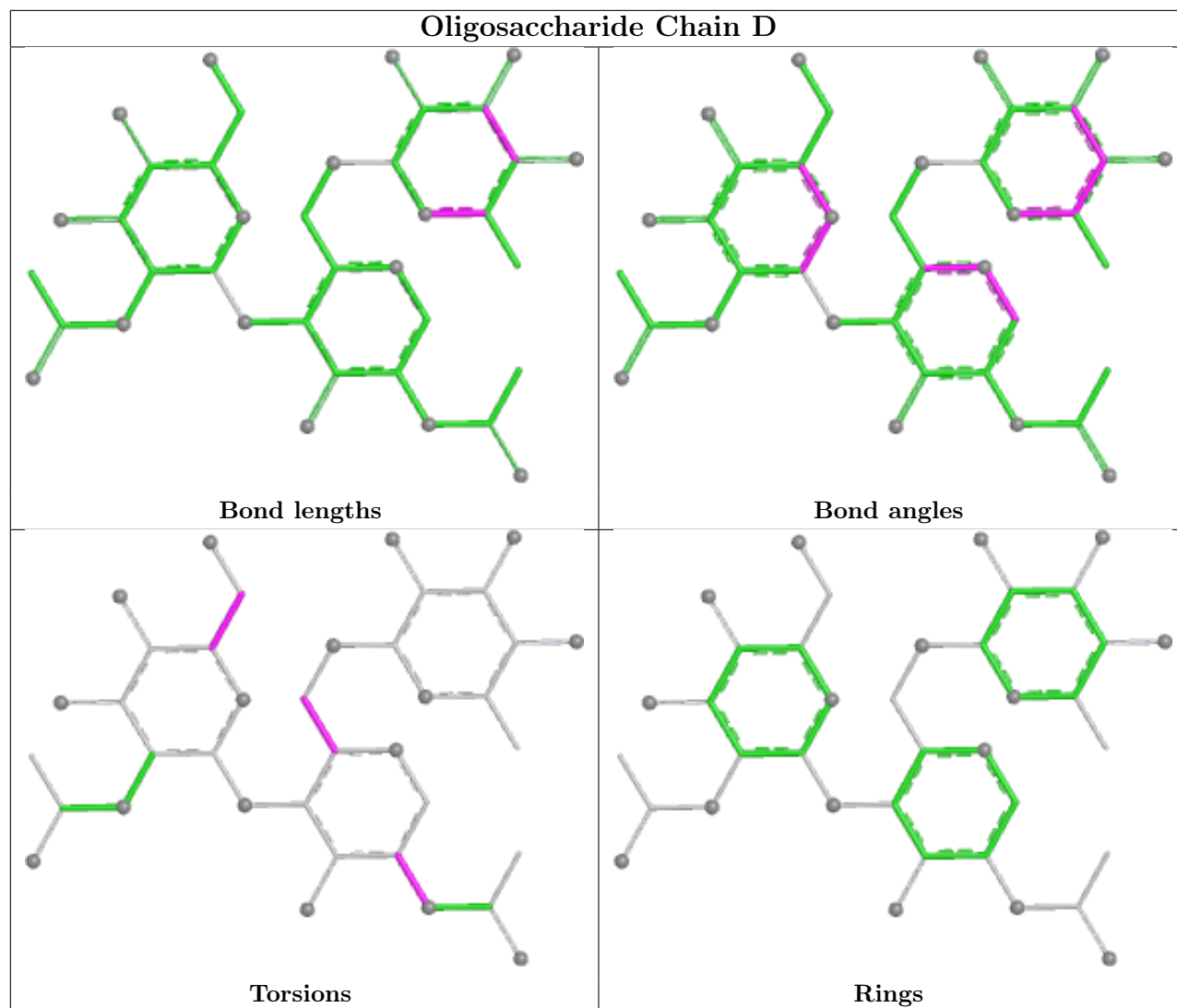
1 monomer is involved in 1 short contact:

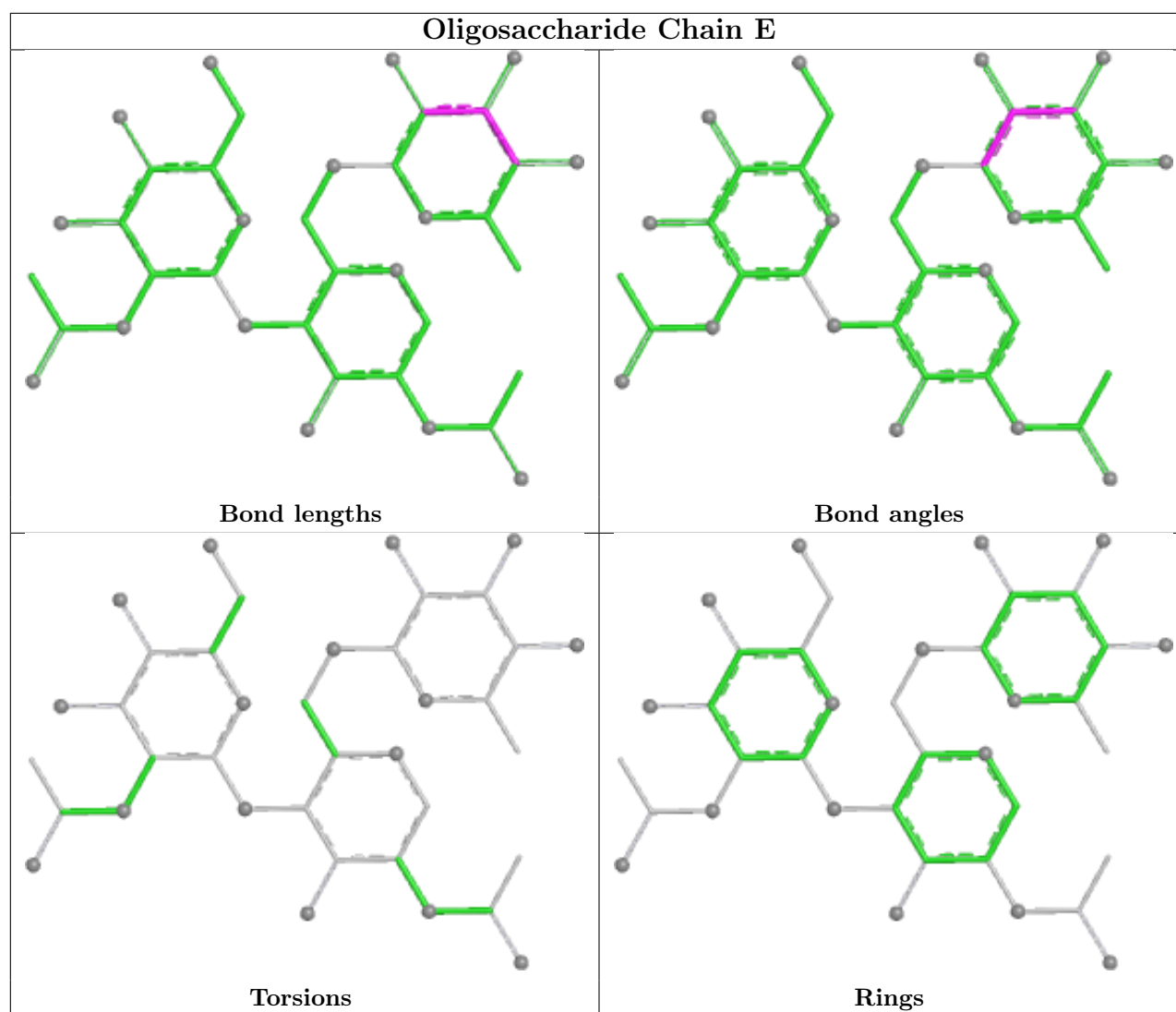
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	D	3	FUC	1	0

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](#)

10 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	MES	A	608	-	12,12,12	1.90	1 (8%)	15,16,16	2.09	3 (20%)
5	GOL	A	605	-	5,5,5	1.35	1 (20%)	5,5,5	0.87	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
7	RNZ	A	607	-	35,35,35	2.76	9 (25%)	45,47,47	1.55	10 (22%)
4	NAG	A	601	1	14,14,15	0.74	1 (7%)	17,19,21	0.52	0
6	SIA	A	606	-	21,21,21	2.10	5 (23%)	24,31,31	2.18	5 (20%)
9	SO4	A	609	-	4,4,4	0.32	0	6,6,6	0.24	0
4	NAG	A	602	1	14,14,15	0.64	0	17,19,21	0.68	1 (5%)
5	GOL	A	603	-	5,5,5	1.32	1 (20%)	5,5,5	1.05	0
9	SO4	A	610	-	4,4,4	0.29	0	6,6,6	0.14	0
5	GOL	A	604	-	5,5,5	1.37	2 (40%)	5,5,5	0.82	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	MES	A	608	-	-	4/6/14/14	0/1/1/1
5	GOL	A	605	-	-	3/4/4/4	-
7	RNZ	A	607	-	-	10/31/31/31	0/3/3/3
4	NAG	A	601	1	-	1/6/23/26	0/1/1/1
6	SIA	A	606	-	-	7/20/38/38	0/1/1/1
4	NAG	A	602	1	-	0/6/23/26	0/1/1/1
5	GOL	A	603	-	-	3/4/4/4	-
5	GOL	A	604	-	-	2/4/4/4	-

All (20) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	A	607	RNZ	C22-C21	9.97	1.66	1.53
7	A	607	RNZ	C14-C12	6.37	1.60	1.52
8	A	608	MES	C8-S	-5.99	1.69	1.77
6	A	606	SIA	O6-C2	5.89	1.49	1.43
7	A	607	RNZ	C14-N15	5.79	1.56	1.47
7	A	607	RNZ	C02-N03	5.09	1.44	1.34
6	A	606	SIA	C7-C6	3.88	1.57	1.52
6	A	606	SIA	C2-C1	3.81	1.59	1.53
7	A	607	RNZ	C23-C22	3.32	1.44	1.39
7	A	607	RNZ	C28-C21	2.80	1.56	1.53
7	A	607	RNZ	C16-C17	2.70	1.60	1.52
6	A	606	SIA	C8-C7	2.49	1.57	1.53

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	603	GOL	C1-C2	2.38	1.60	1.51
6	A	606	SIA	C3-C2	2.36	1.54	1.51
4	A	601	NAG	O5-C1	2.22	1.47	1.43
7	A	607	RNZ	C04-N03	2.22	1.49	1.46
5	A	605	GOL	C1-C2	2.18	1.60	1.51
5	A	604	GOL	C3-C2	2.12	1.59	1.51
5	A	604	GOL	C1-C2	2.11	1.59	1.51
7	A	607	RNZ	O13-C12	-2.06	1.39	1.43

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	606	SIA	O1A-C1-C2	-8.60	109.50	123.85
8	A	608	MES	C5-N4-C3	5.56	120.82	108.84
7	A	607	RNZ	C27-C22-C23	-4.04	113.29	118.30
7	A	607	RNZ	C17-C16-N15	3.50	117.58	113.90
8	A	608	MES	O2S-S-C8	3.28	111.69	106.73
7	A	607	RNZ	C26-C27-C22	2.77	123.96	120.65
7	A	607	RNZ	O01-C02-N03	-2.58	118.33	122.96
7	A	607	RNZ	C28-C21-C02	-2.56	104.94	110.42
6	A	606	SIA	O7-C7-C8	2.49	114.58	108.93
8	A	608	MES	C7-N4-C3	2.44	117.74	111.24
7	A	607	RNZ	O01-C02-C21	-2.41	117.67	122.03
7	A	607	RNZ	C12-C14-N15	2.39	115.08	111.95
7	A	607	RNZ	O13-C12-C04	-2.32	105.30	109.88
7	A	607	RNZ	C05-C04-N03	2.31	113.36	110.08
6	A	606	SIA	O6-C6-C7	2.22	110.11	106.65
6	A	606	SIA	O2-C2-C1	-2.14	106.21	110.73
7	A	607	RNZ	C24-C23-C22	2.13	123.19	120.65
4	A	602	NAG	C1-O5-C5	2.10	115.01	112.19
6	A	606	SIA	O1B-C1-O1A	2.06	130.46	123.86

There are no chirality outliers.

All (30) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	605	GOL	O1-C1-C2-C3
6	A	606	SIA	O1B-C1-C2-O6
7	A	607	RNZ	N15-C16-C17-C20
7	A	607	RNZ	N15-C16-C17-C18
7	A	607	RNZ	C05-C04-C12-O13
7	A	607	RNZ	N03-C04-C12-C14

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Mol	Chain	Res	Type	Atoms
7	A	607	RNZ	N03-C04-C12-O13
7	A	607	RNZ	O13-C12-C14-N15
8	A	608	MES	C8-C7-N4-C3
8	A	608	MES	C7-C8-S-O1S
8	A	608	MES	C7-C8-S-O3S
6	A	606	SIA	O8-C8-C9-O9
6	A	606	SIA	C7-C8-C9-O9
7	A	607	RNZ	N15-C16-C17-C19
6	A	606	SIA	C11-C10-N5-C5
6	A	606	SIA	O10-C10-N5-C5
5	A	603	GOL	O2-C2-C3-O3
7	A	607	RNZ	C04-C12-C14-N15
5	A	603	GOL	C1-C2-C3-O3
5	A	604	GOL	O1-C1-C2-C3
5	A	605	GOL	O1-C1-C2-O2
7	A	607	RNZ	N03-C02-C21-C28
7	A	607	RNZ	O01-C02-C21-C28
5	A	605	GOL	C1-C2-C3-O3
5	A	603	GOL	O1-C1-C2-O2
5	A	604	GOL	O1-C1-C2-O2
8	A	608	MES	C7-C8-S-O2S
6	A	606	SIA	O1A-C1-C2-O2
6	A	606	SIA	O1B-C1-C2-O2
4	A	601	NAG	C4-C5-C6-O6

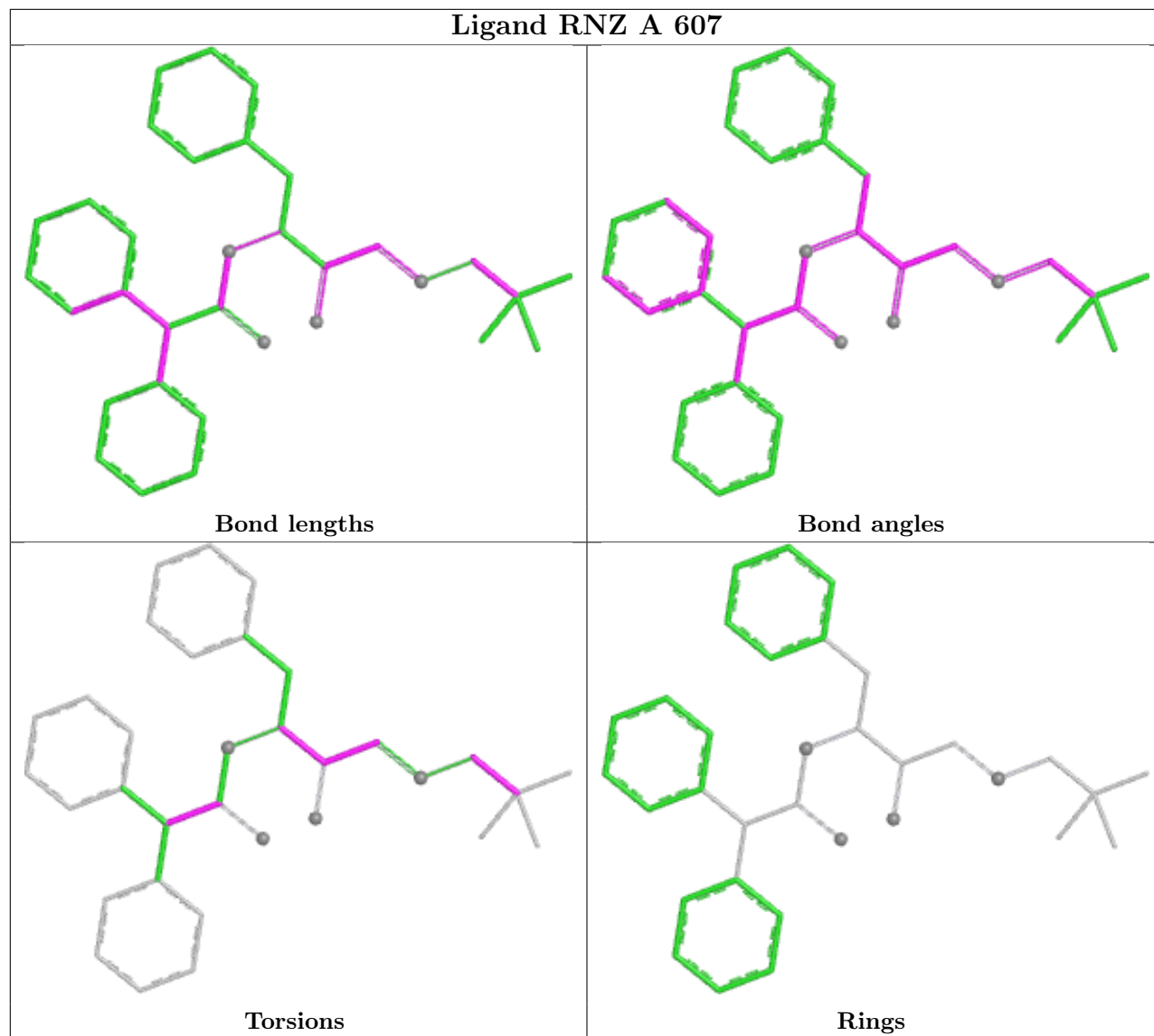
There are no ring outliers.

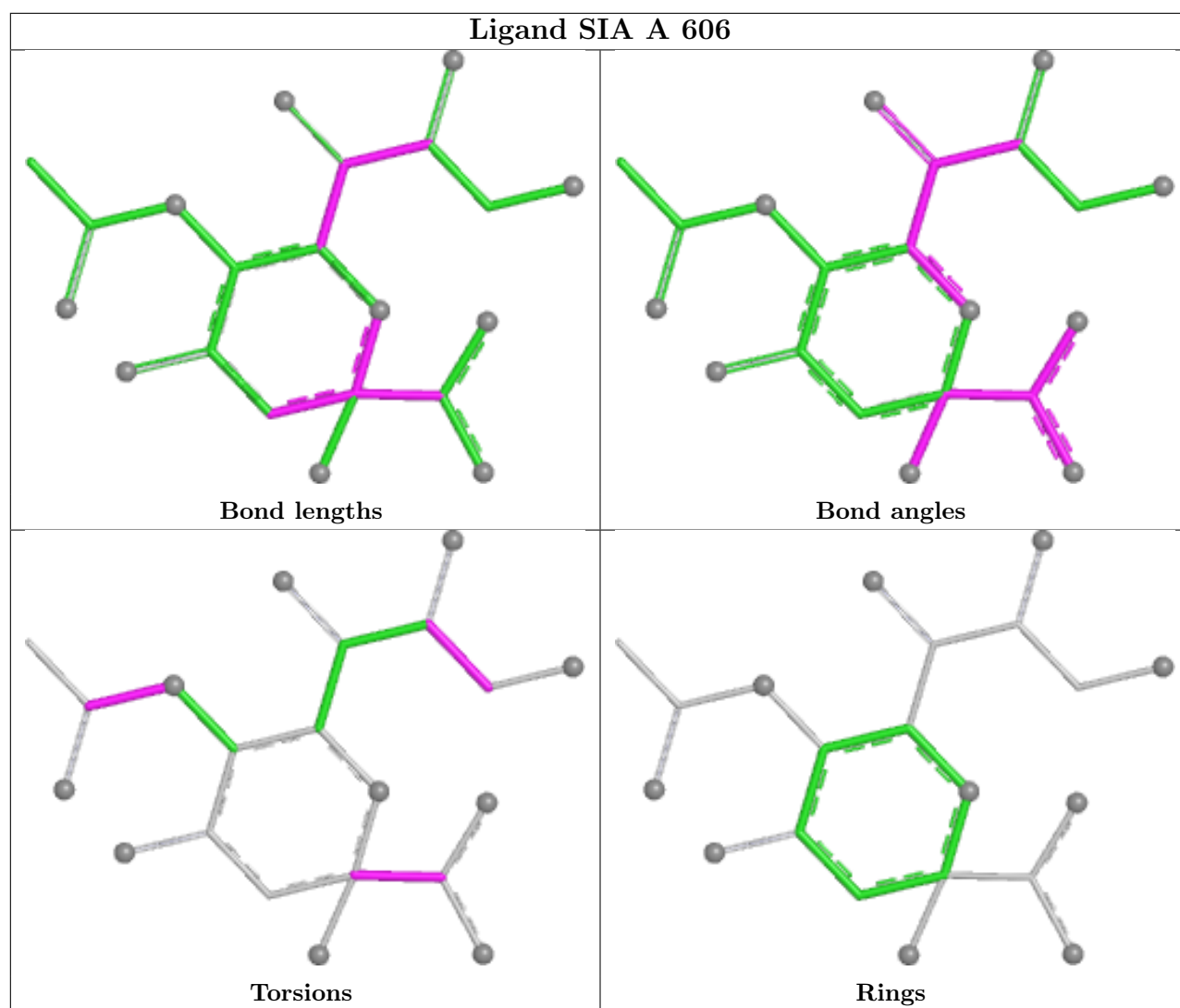
1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
8	A	608	MES	3	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient

equivalents in the CSD to analyse the geometry.





5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data [i](#)

6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ> 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q< 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	527/529 (99%)	0.20	11 (2%) 63 64	22, 49, 77, 106	5 (0%)

All (11) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	282	TYR	4.2
1	A	377	VAL	3.9
1	A	4	ILE	3.0
1	A	237	TYR	2.9
1	A	277	ALA	2.9
1	A	376	TRP	2.6
1	A	261	ILE	2.3
1	A	486	GLN	2.2
1	A	255	GLU	2.1
1	A	524	SER	2.0
1	A	17	GLN	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, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q< 0.9’ lists the number of atoms with occupancy less than 0.9.

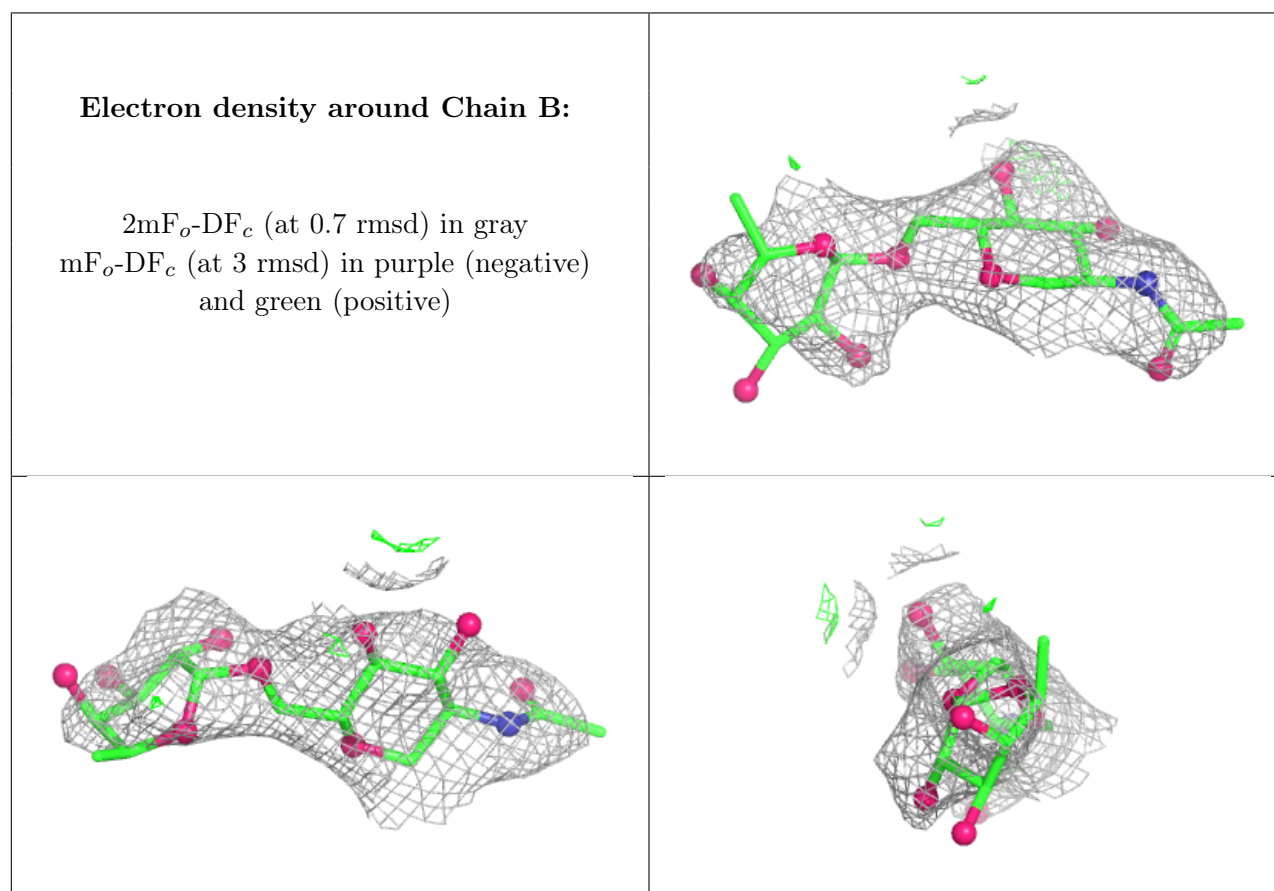
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	NAG	C	2	14/15	0.40	0.18	89,108,119,120	0

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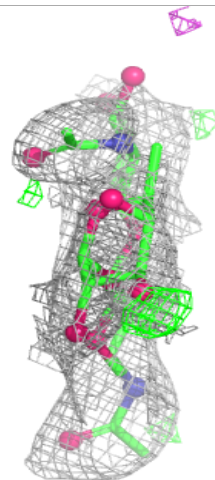
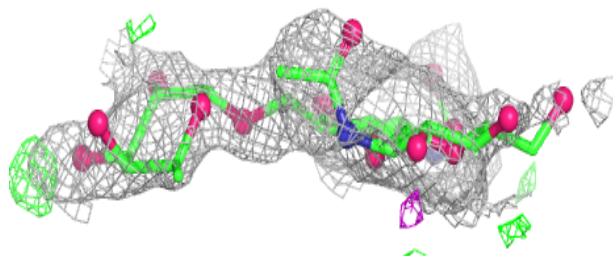
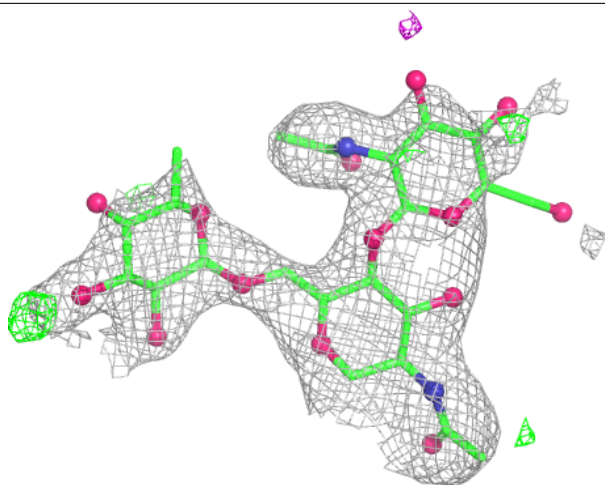
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	NAG	D	2	14/15	0.62	0.16	97,111,114,115	0
2	FUC	B	2	10/11	0.65	0.16	105,109,112,113	0
3	FUC	D	3	10/11	0.69	0.20	87,96,101,106	0
2	NAG	B	1	14/15	0.73	0.11	83,96,103,105	0
3	NAG	E	2	14/15	0.73	0.15	71,80,98,100	0
3	FUC	E	3	10/11	0.73	0.18	64,79,81,82	0
3	NAG	D	1	14/15	0.75	0.13	97,105,111,111	0
3	FUC	C	3	10/11	0.76	0.17	64,76,86,91	0
3	NAG	C	1	14/15	0.77	0.13	73,80,92,96	0
3	NAG	E	1	14/15	0.93	0.09	57,63,68,77	0

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



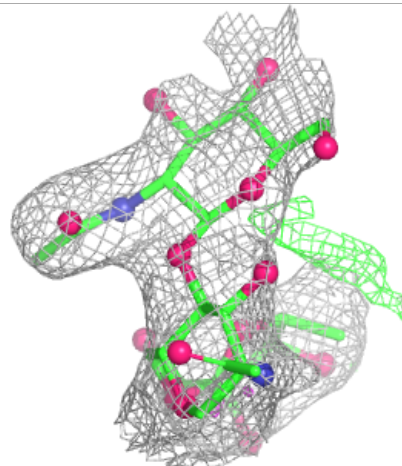
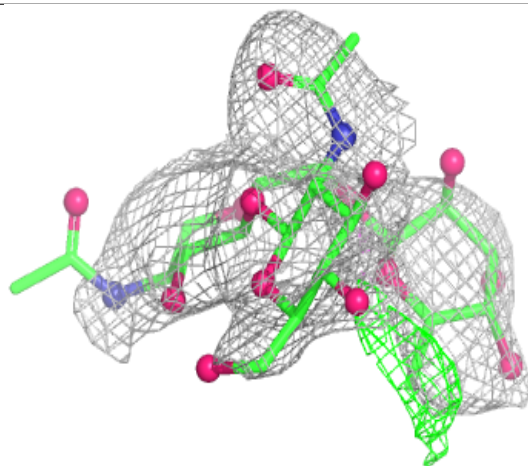
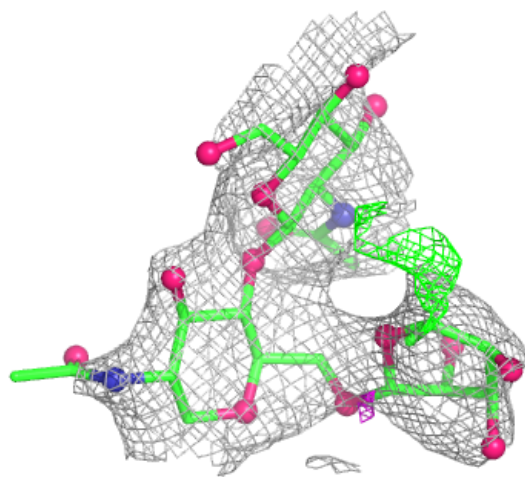
Electron density around Chain C:

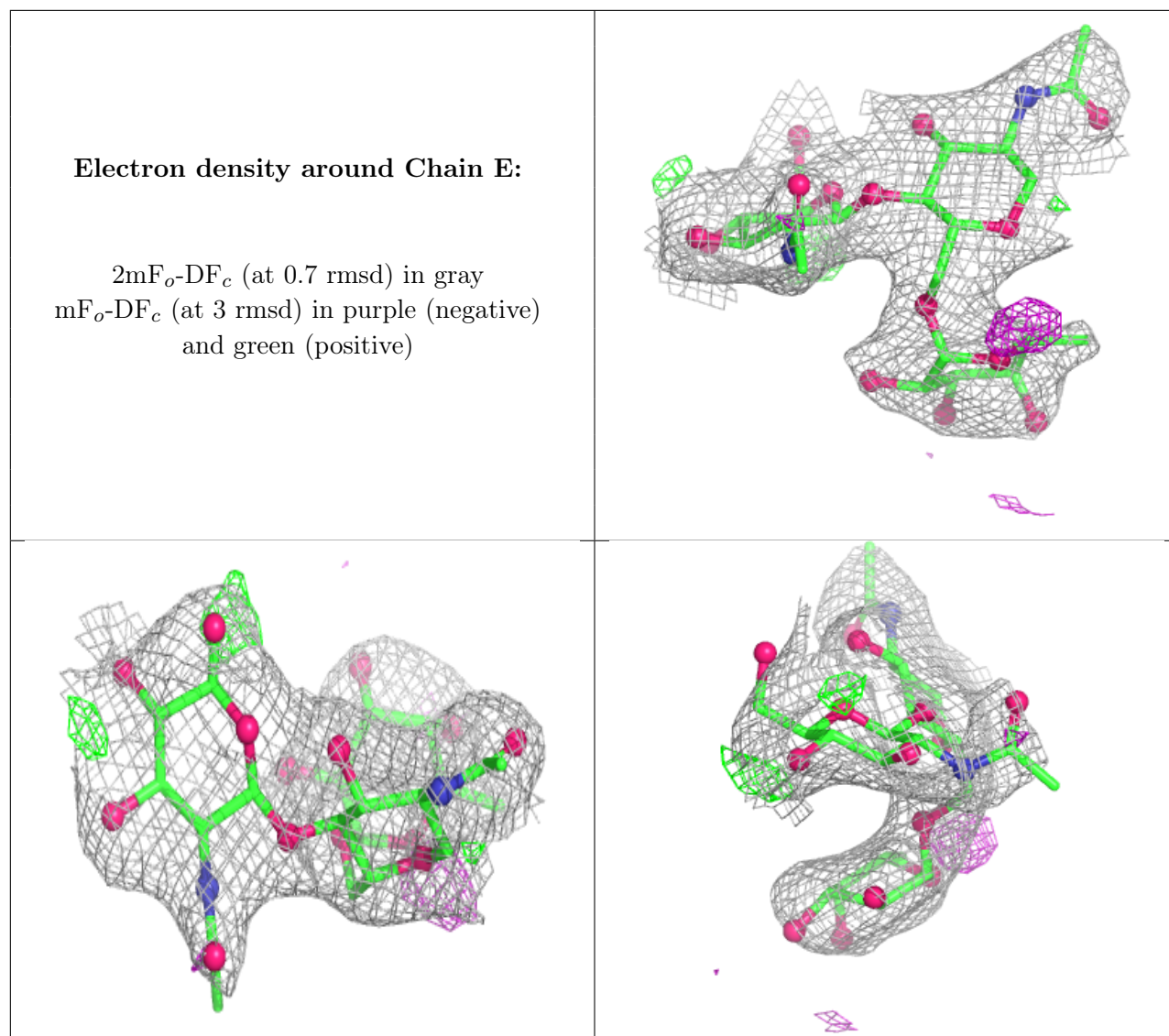
$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around Chain D:

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





6.4 Ligands [i](#)

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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
4	NAG	A	601	14/15	0.56	0.14	88,99,104,105	0
4	NAG	A	602	14/15	0.62	0.17	59,84,93,94	0
6	SIA	A	606	21/21	0.67	0.14	62,75,88,91	0
8	MES	A	608	12/12	0.76	0.15	62,74,94,99	0
5	GOL	A	603	6/6	0.77	0.15	58,64,66,66	0
5	GOL	A	605	6/6	0.78	0.15	56,64,70,77	0
5	GOL	A	604	6/6	0.79	0.18	56,67,70,75	0

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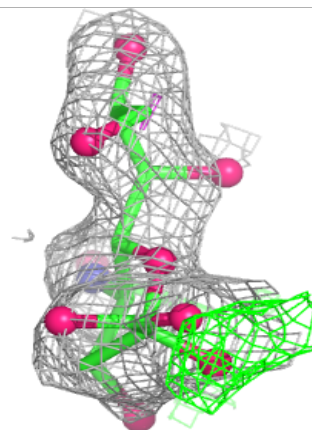
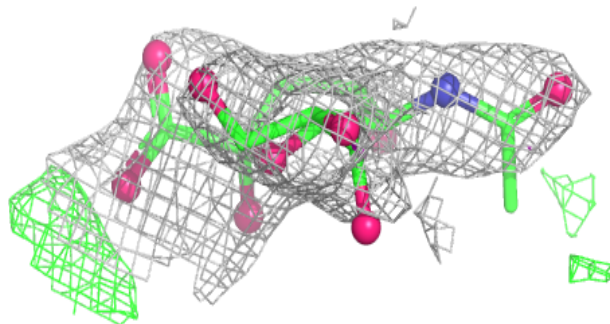
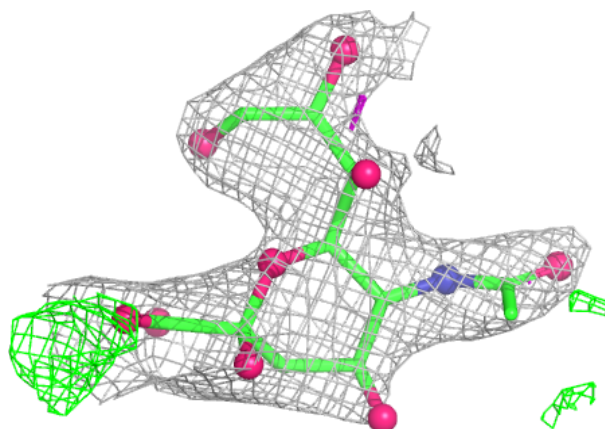
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
9	SO4	A	609	5/5	0.86	0.09	59,74,79,82	0
7	RNZ	A	607	33/33	0.89	0.14	45,52,60,62	0
9	SO4	A	610	5/5	0.93	0.07	75,76,86,87	0

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.

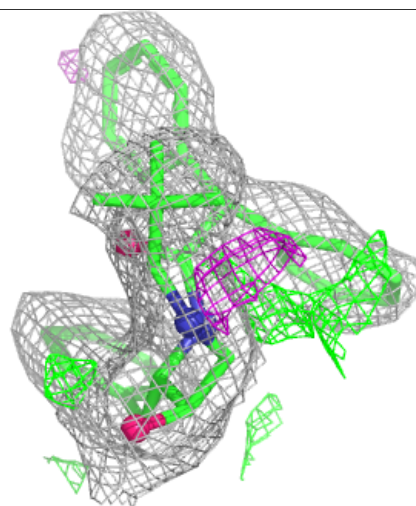
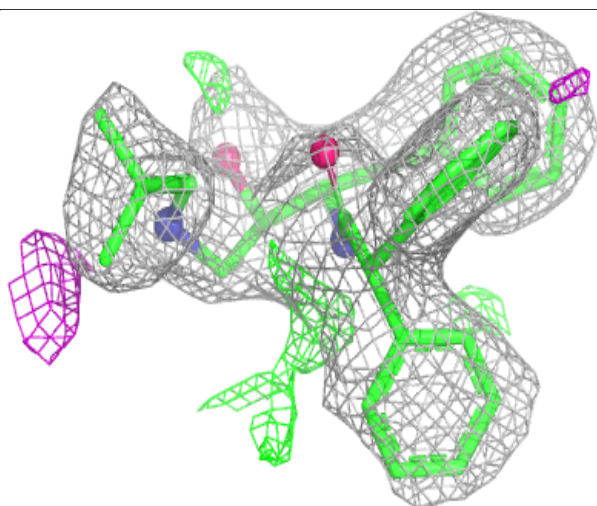
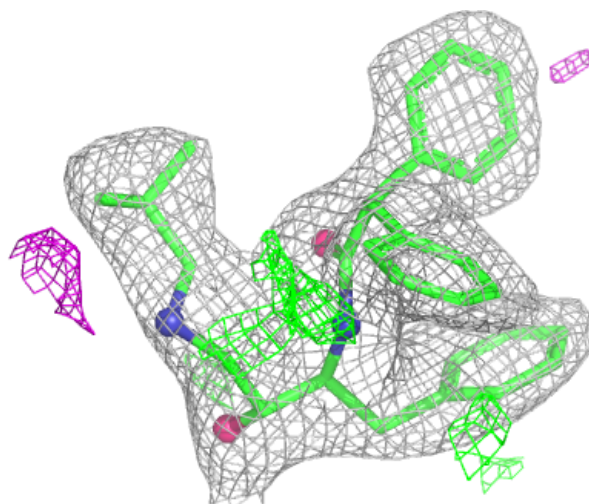
Electron density around SIA A 606:

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 RNZ A 607:

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



6.5 Other polymers ⓘ

There are no such residues in this entry.