



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 03:16 PM UTC

PDB ID : 2XMB / pdb_00002xmb
Title : G117H mutant of human butyrylcholinesterase in complex with sulfate
Authors : Nachon, F.; Carletti, E.; Wandhammer, M.; Nicolet, Y.; Schopfer, L.M.; Mas-
son, P.; Lockridge, O.
Deposited on : 2010-07-27
Resolution : 2.10 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
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

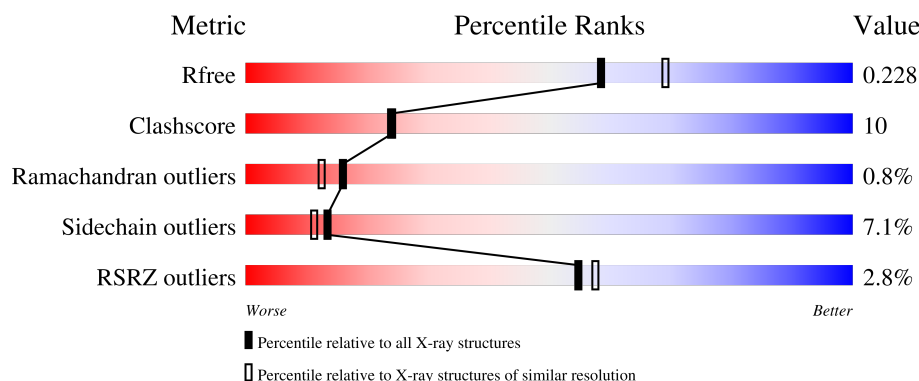
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

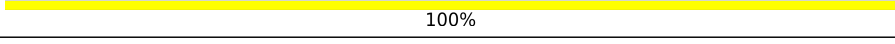
The reported resolution of this entry is 2.10 Å.

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	6658 (2.10-2.10)
Clashscore	190562	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)
RSRZ outliers	180081	6662 (2.10-2.10)

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	 3% 79% 15% 5%
2	B	3	 67% 33%
2	D	3	 100%
3	C	2	 50% 50%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard

residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	NAG	D	1	X	-	-	-
6	NA	A	1533	-	-	-	X

2 Entry composition [i](#)

There are 10 unique types of molecules in this entry. The entry contains 4778 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.

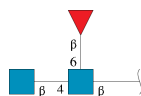
- Molecule 1 is a protein called CHOLINESTERASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	527	Total	C	N	O	S	0	0	0
			4209	2716	708	770	15			

There are 5 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	17	GLN	ASN	engineered mutation	UNP P06276
A	117	HIS	GLY	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 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[beta-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	3	Total	C	N	O	0	0	0
			38	22	2	14			
2	D	3	Total	C	N	O	0	0	0
			38	22	2	14			

- Molecule 3 is an oligosaccharide called beta-L-fucopyranose-(1-6)-2-acetamido-2-deoxy-beta-D-glucopyranose.



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

- Molecule 4 is UNKNOWN ATOM OR ION (CCD ID: UNX) (formula: X).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	23	Total	X	0	0
			23	23		

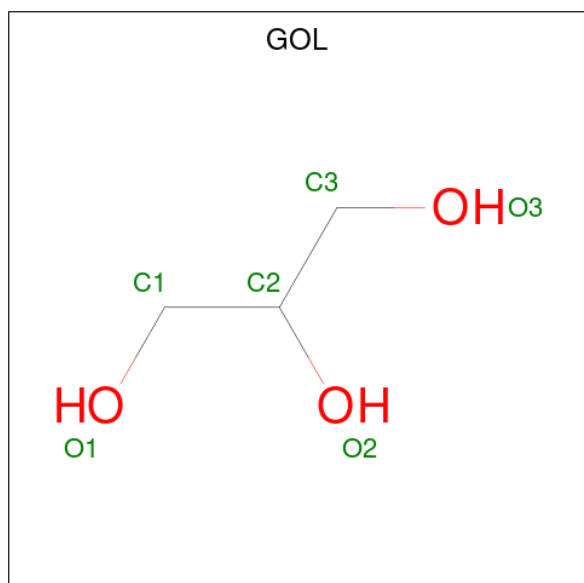
- Molecule 5 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	7	Total	Cl	0	0
			7	7		

- Molecule 6 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	Na	0	0
			1	1		

- Molecule 7 is GLYCEROL (CCD ID: GOL) (formula: C₃H₈O₃).



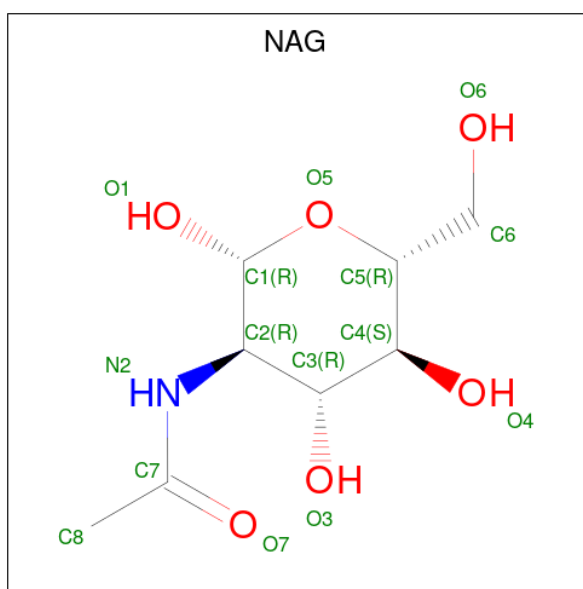
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 8 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



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

- Molecule 9 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: C₈H₁₅NO₆).



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

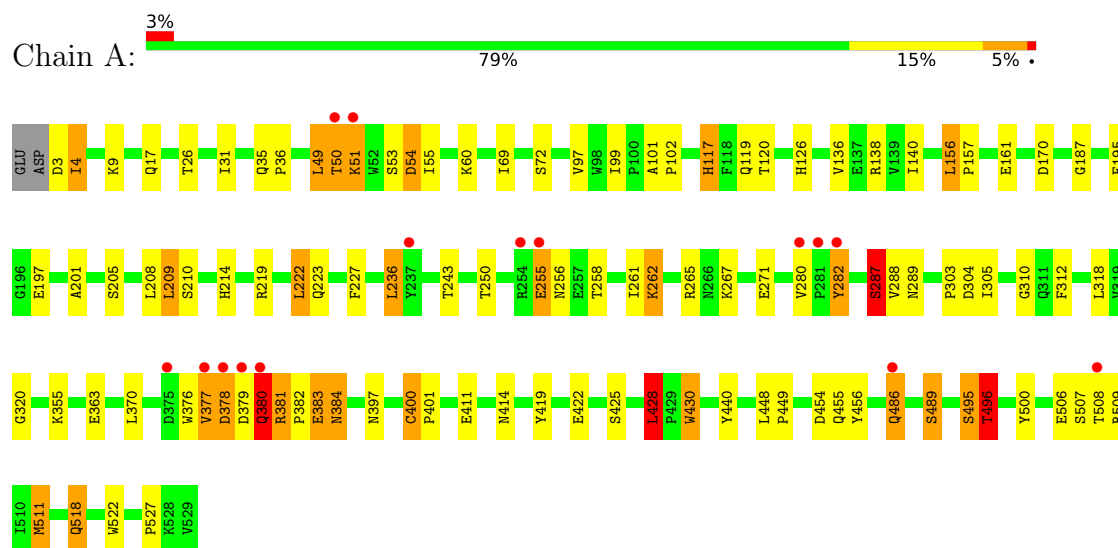
- Molecule 10 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
10	A	380	Total	O	0	0
			380	380		

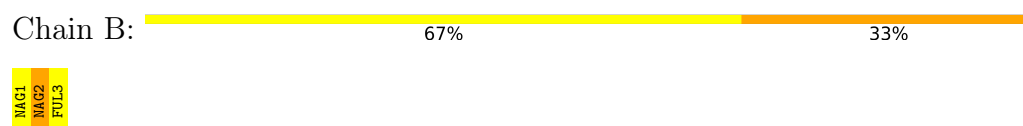
3 Residue-property plots

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.

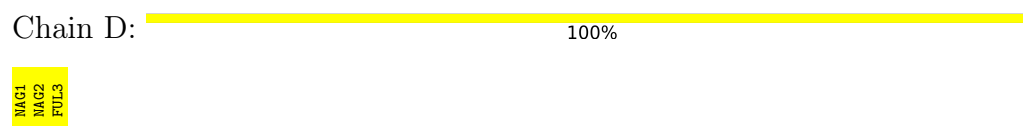
- Molecule 1: CHOLINESTERASE



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



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



- Molecule 3: beta-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	154.80Å 154.80Å 134.65Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.66 – 2.10 37.66 – 2.10	Depositor EDS
% Data completeness (in resolution range)	99.7 (37.66-2.10) 99.7 (37.66-2.10)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.92 (at 2.10Å)	Xtriage
Refinement program	REFMAC 5.5.0102	Depositor
R, R_{free}	0.168 , 0.208 0.200 , 0.228	Depositor DCC
R_{free} test set	1422 reflections (2.98%)	wwPDB-VP
Wilson B-factor (Å ²)	33.5	Xtriage
Anisotropy	0.191	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 43.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	4778	wwPDB-VP
Average B, all atoms (Å ²)	41.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.41% 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: CL, UNX, FUL, SO4, NAG, GOL, NA

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

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	1.35	14/4329 (0.3%)	1.22	24/5877 (0.4%)

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

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

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	377	VAL	CA-CB	11.07	1.67	1.53
1	A	496	THR	CA-CB	8.22	1.67	1.53
1	A	383	GLU	C-N	6.66	1.42	1.33
1	A	36	PRO	CA-C	6.12	1.57	1.52
1	A	201	ALA	CA-CB	5.77	1.62	1.53
1	A	287	SER	C-O	-5.71	1.17	1.23
1	A	31	ILE	CA-C	5.50	1.57	1.53
1	A	222	LEU	C-O	5.44	1.30	1.24
1	A	384	ASN	C-N	5.41	1.41	1.33
1	A	136	VAL	CA-C	5.38	1.60	1.52
1	A	411	GLU	C-O	-5.25	1.17	1.24
1	A	126	HIS	CA-C	5.18	1.59	1.52
1	A	209	LEU	CG-CD2	-5.16	1.35	1.52
1	A	208	LEU	N-CA	5.05	1.52	1.46

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	377	VAL	N-CA-C	-8.65	94.57	106.85
1	A	496	THR	N-CA-CB	6.75	121.90	110.49
1	A	495	SER	N-CA-C	-6.75	100.30	110.28
1	A	210	SER	CA-C-N	-6.67	112.83	119.56
1	A	210	SER	C-N-CA	-6.67	112.83	119.56
1	A	397	ASN	N-CA-C	6.54	120.47	112.23
1	A	219	ARG	NE-CZ-NH2	6.26	124.83	119.20
1	A	377	VAL	CB-CA-C	6.21	119.61	111.53
1	A	414	ASN	N-CA-C	6.07	119.46	110.48
1	A	219	ARG	NE-CZ-NH1	-6.00	115.50	121.50
1	A	380	GLN	CA-C-N	5.93	132.38	121.70
1	A	380	GLN	C-N-CA	5.93	132.38	121.70
1	A	170	ASP	N-CA-C	-5.88	104.78	111.07
1	A	305	ILE	N-CA-C	-5.87	104.79	110.72
1	A	428	LEU	CA-C-N	-5.79	113.79	120.04
1	A	428	LEU	C-N-CA	-5.79	113.79	120.04
1	A	31	ILE	CA-C-N	-5.56	114.24	119.85
1	A	31	ILE	C-N-CA	-5.56	114.24	119.85
1	A	496	THR	N-CA-C	-5.45	99.20	110.80
1	A	377	VAL	N-CA-CB	5.34	118.40	111.83
1	A	400	CYS	CA-C-N	-5.30	113.17	119.05
1	A	400	CYS	C-N-CA	-5.30	113.17	119.05
1	A	430	TRP	CA-C-N	-5.00	115.41	120.21
1	A	430	TRP	C-N-CA	-5.00	115.41	120.21

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	376	TRP	Peptide

5.2 Too-close contacts ⓘ

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4209	0	4103	83	0
2	B	38	0	34	1	0
2	D	38	0	34	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	24	0	22	1	0
4	A	23	0	0	0	0
5	A	7	0	0	0	0
6	A	1	0	0	0	0
7	A	6	0	8	0	0
8	A	10	0	0	1	0
9	A	42	0	39	1	0
10	A	380	0	0	18	0
All	All	4778	0	4240	86	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 10.

All (86) 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)
10:A:2370:HOH:O	3:C:2:FUL:O3	1.63	1.15
1:A:282:TYR:O	1:A:282:TYR:HD2	1.34	1.06
1:A:379:ASP:HB3	1:A:381:ARG:HB2	1.43	1.00
1:A:282:TYR:O	1:A:282:TYR:CD2	2.23	0.92
1:A:518:GLN:H	1:A:518:GLN:NE2	1.70	0.89
1:A:518:GLN:H	1:A:518:GLN:HE21	0.90	0.89
1:A:156:LEU:HD13	1:A:243:THR:HG21	1.56	0.85
1:A:363:GLU:HG2	10:A:2247:HOH:O	1.76	0.84
1:A:518:GLN:HE21	1:A:518:GLN:N	1.74	0.84
1:A:267:LYS:HE3	1:A:271:GLU:OE1	1.79	0.82
1:A:379:ASP:CB	1:A:381:ARG:HB2	2.12	0.80
1:A:262:LYS:HE3	10:A:2183:HOH:O	1.80	0.79
1:A:255:GLU:H	1:A:255:GLU:CD	1.93	0.77
1:A:156:LEU:CD1	1:A:243:THR:HG21	2.16	0.74
1:A:156:LEU:HD22	1:A:261:ILE:HD11	1.67	0.74
1:A:4:ILE:H	1:A:4:ILE:HD12	1.57	0.70
1:A:4:ILE:HD12	1:A:4:ILE:N	2.08	0.68
1:A:304:ASP:OD1	10:A:2207:HOH:O	2.12	0.68
1:A:50:THR:O	1:A:51:LYS:HE2	1.99	0.62
1:A:3:ASP:N	10:A:2001:HOH:O	2.33	0.61
1:A:119:GLN:NE2	1:A:288:VAL:HG13	2.16	0.60
1:A:428:LEU:HD21	1:A:440:TYR:CD2	2.38	0.59
1:A:522:TRP:O	1:A:527:PRO:HD3	2.03	0.58
1:A:486:GLN:HA	1:A:486:GLN:NE2	2.18	0.58
1:A:508:THR:HG21	10:A:2145:HOH:O	2.03	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
9:A:1545:NAG:H62	10:A:2376:HOH:O	2.03	0.57
1:A:377:VAL:HA	1:A:378:ASP:HB2	1.86	0.57
1:A:209:LEU:HD23	1:A:312:PHE:HB3	1.87	0.56
1:A:428:LEU:HD21	1:A:440:TYR:CG	2.39	0.56
10:A:2364:HOH:O	2:B:2:NAG:H4	2.05	0.56
1:A:377:VAL:HA	1:A:378:ASP:CB	2.37	0.55
1:A:262:LYS:CE	10:A:2183:HOH:O	2.46	0.54
1:A:120:THR:HG21	10:A:2107:HOH:O	2.08	0.54
1:A:161:GLU:OE1	1:A:265:ARG:NH1	2.40	0.54
1:A:320:GLY:HA3	1:A:419:TYR:CE1	2.43	0.54
1:A:54:ASP:HB3	10:A:2035:HOH:O	2.07	0.54
1:A:227:PHE:CD2	1:A:227:PHE:C	2.85	0.54
1:A:50:THR:O	1:A:51:LYS:CE	2.57	0.53
1:A:53:SER:O	1:A:54:ASP:OD2	2.28	0.52
1:A:214:HIS:HE1	10:A:2216:HOH:O	1.92	0.50
1:A:495:SER:O	1:A:496:THR:CB	2.60	0.49
1:A:489:SER:HB3	10:A:2322:HOH:O	2.13	0.49
1:A:255:GLU:CD	1:A:255:GLU:N	2.63	0.49
1:A:54:ASP:OD2	1:A:54:ASP:C	2.56	0.49
1:A:157:PRO:HG2	1:A:236:LEU:HG	1.94	0.49
1:A:197:GLU:HA	1:A:223:GLN:O	2.14	0.48
1:A:255:GLU:OE1	1:A:256:ASN:N	2.47	0.48
1:A:318:LEU:C	1:A:318:LEU:HD23	2.40	0.47
1:A:250:THR:HB	1:A:267:LYS:HE2	1.94	0.47
1:A:289:ASN:ND2	10:A:2196:HOH:O	2.46	0.47
1:A:280:VAL:HG23	1:A:289:ASN:HD22	1.81	0.46
1:A:310:GLY:HA2	1:A:312:PHE:CE2	2.51	0.46
1:A:495:SER:O	1:A:496:THR:OG1	2.30	0.46
1:A:303:PRO:HD2	10:A:2207:HOH:O	2.16	0.45
1:A:400:CYS:N	1:A:401:PRO:CD	2.80	0.45
1:A:320:GLY:HA3	1:A:419:TYR:CD1	2.51	0.45
1:A:500:TYR:CZ	1:A:511:MET:HB2	2.51	0.45
1:A:507:SER:O	1:A:507:SER:OG	2.27	0.45
1:A:51:LYS:HE2	1:A:51:LYS:HB3	1.77	0.44
1:A:4:ILE:N	1:A:4:ILE:CD1	2.76	0.44
1:A:17:GLN:NE2	1:A:26:THR:OG1	2.50	0.44
1:A:101:ALA:HA	1:A:102:PRO:C	2.43	0.44
1:A:428:LEU:CD2	1:A:440:TYR:CD2	3.01	0.44
1:A:227:PHE:CE2	1:A:303:PRO:HB2	2.52	0.44
1:A:511:MET:HE2	1:A:511:MET:HB3	1.74	0.44
1:A:140:ILE:HD12	1:A:187:GLY:CA	2.48	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:449:PRO:HA	1:A:456:TYR:CD1	2.53	0.43
1:A:117:HIS:ND1	8:A:1538:SO4:O3	2.51	0.43
1:A:102:PRO:O	1:A:138:ARG:NH2	2.48	0.43
1:A:282:TYR:CD2	1:A:282:TYR:C	2.95	0.43
1:A:500:TYR:CE1	1:A:511:MET:HB2	2.54	0.42
1:A:205:SER:HB3	1:A:222:LEU:HD21	2.01	0.42
1:A:380:GLN:HA	1:A:384:ASN:ND2	2.34	0.42
1:A:428:LEU:HD12	1:A:430:TRP:HB2	2.02	0.42
1:A:49:LEU:HD12	1:A:50:THR:H	1.84	0.42
1:A:267:LYS:HA	1:A:267:LYS:HD2	1.92	0.42
1:A:486:GLN:HA	1:A:486:GLN:HE21	1.85	0.41
1:A:378:ASP:O	1:A:379:ASP:HB2	2.20	0.41
1:A:509:ARG:HB2	10:A:2340:HOH:O	2.19	0.41
1:A:287:SER:HB3	10:A:2196:HOH:O	2.21	0.41
1:A:97:VAL:CG1	1:A:99:ILE:HD11	2.51	0.41
1:A:419:TYR:CD2	1:A:419:TYR:C	2.99	0.41
1:A:425:SER:HB3	1:A:428:LEU:HD23	2.03	0.40
1:A:54:ASP:CG	1:A:55:ILE:N	2.80	0.40
1:A:381:ARG:HA	1:A:382:PRO:HD2	1.90	0.40
1:A:355:LYS:HE2	10:A:2245:HOH:O	2.21	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	525/529 (99%)	502 (96%)	19 (4%)	4 (1%)	16 12

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	496	THR

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Mol	Chain	Res	Type
1	A	378	ASP
1	A	380	GLN
1	A	381	ARG

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	453/455 (100%)	421 (93%)	32 (7%)	13 11

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	ILE
1	A	9	LYS
1	A	35	GLN
1	A	49	LEU
1	A	50	THR
1	A	51	LYS
1	A	54	ASP
1	A	60	LYS
1	A	69	ILE
1	A	72	SER
1	A	117	HIS
1	A	156	LEU
1	A	195	PHE
1	A	236	LEU
1	A	255	GLU
1	A	258	THR
1	A	262	LYS
1	A	282	TYR
1	A	287	SER
1	A	370	LEU
1	A	380	GLN
1	A	383	GLU
1	A	422	GLU

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Mol	Chain	Res	Type
1	A	428	LEU
1	A	448	LEU
1	A	454	ASP
1	A	455	GLN
1	A	486	GLN
1	A	489	SER
1	A	506	GLU
1	A	511	MET
1	A	518	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	17	GLN
1	A	214	HIS
1	A	289	ASN
1	A	311	GLN
1	A	486	GLN
1	A	517	GLN
1	A	518	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 ⓘ

8 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	1.59	2 (14%)	17,19,21	2.89	9 (52%)
2	NAG	B	2	2	14,14,15	0.50	0	17,19,21	1.93	5 (29%)
2	FUL	B	3	2	10,10,11	1.11	1 (10%)	14,14,16	3.21	7 (50%)
3	NAG	C	1	3,1	14,14,15	1.36	1 (7%)	17,19,21	2.25	5 (29%)
3	FUL	C	2	3	10,10,11	1.15	0	14,14,16	3.33	5 (35%)
2	NAG	D	1	1,2	14,14,15	1.01	1 (7%)	17,19,21	2.42	5 (29%)
2	NAG	D	2	2	14,14,15	1.54	2 (14%)	17,19,21	2.77	7 (41%)
2	FUL	D	3	2	10,10,11	0.74	0	14,14,16	1.15	2 (14%)

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	-	4/6/23/26	0/1/1/1
2	NAG	B	2	2	-	0/6/23/26	0/1/1/1
2	FUL	B	3	2	-	-	0/1/1/1
3	NAG	C	1	3,1	-	4/6/23/26	0/1/1/1
3	FUL	C	2	3	-	-	0/1/1/1
2	NAG	D	1	1,2	1/1/5/7	4/6/23/26	0/1/1/1
2	NAG	D	2	2	-	3/6/23/26	0/1/1/1
2	FUL	D	3	2	-	-	0/1/1/1

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	2	NAG	C1-C2	4.17	1.58	1.52
3	C	1	NAG	C1-C2	3.78	1.57	1.52
2	B	1	NAG	O5-C1	-3.43	1.37	1.43
2	B	1	NAG	C2-N2	-3.34	1.40	1.46
2	D	2	NAG	C2-N2	2.43	1.50	1.46
2	B	3	FUL	C4-C3	2.19	1.58	1.52
2	D	1	NAG	C4-C5	2.02	1.57	1.53

All (45) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	2	FUL	C1-C2-C3	-10.89	93.78	109.64

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	2	NAG	C2-N2-C7	7.58	133.06	122.90
2	B	3	FUL	C1-C2-C3	-7.36	98.93	109.64
2	D	1	NAG	C2-N2-C7	5.92	130.84	122.90
2	D	2	NAG	C1-O5-C5	5.79	119.95	112.19
2	B	1	NAG	C1-C2-N2	-5.49	101.78	110.43
2	B	1	NAG	C3-C4-C5	-5.36	100.51	110.23
2	B	3	FUL	C3-C4-C5	5.26	117.80	109.81
2	D	1	NAG	C1-C2-N2	-5.10	102.40	110.43
3	C	1	NAG	O5-C5-C6	5.04	117.47	107.66
2	B	2	NAG	C1-O5-C5	4.70	118.49	112.19
3	C	1	NAG	C8-C7-N2	4.45	123.50	116.12
2	B	3	FUL	C1-O5-C5	-4.42	102.53	112.97
3	C	1	NAG	O7-C7-C8	-3.92	115.07	122.05
2	B	1	NAG	C6-C5-C4	3.68	122.06	113.02
2	B	1	NAG	O5-C1-C2	-3.68	105.60	111.29
2	B	1	NAG	C2-N2-C7	3.44	127.51	122.90
3	C	2	FUL	C3-C4-C5	3.32	114.87	109.81
2	D	2	NAG	C3-C4-C5	3.18	116.01	110.23
3	C	1	NAG	C1-C2-N2	3.16	115.41	110.43
2	B	1	NAG	O6-C6-C5	3.14	122.02	111.33
2	B	2	NAG	O6-C6-C5	-3.11	100.73	111.33
2	B	1	NAG	O7-C7-N2	-3.07	116.55	121.98
2	B	1	NAG	C1-O5-C5	3.02	116.23	112.19
2	B	3	FUL	O2-C2-C1	3.00	116.09	109.22
2	B	3	FUL	O5-C1-C2	-2.93	103.79	110.79
2	B	2	NAG	C6-C5-C4	-2.81	106.11	113.02
2	D	1	NAG	O4-C4-C3	2.75	116.87	110.38
2	D	1	NAG	C1-O5-C5	2.73	115.84	112.19
2	B	3	FUL	O5-C5-C6	2.69	113.23	107.40
2	D	3	FUL	C3-C4-C5	2.65	113.85	109.81
2	D	3	FUL	O5-C5-C4	2.64	114.31	109.55
2	D	1	NAG	O4-C4-C5	2.58	115.69	109.32
3	C	2	FUL	O4-C4-C3	-2.54	104.39	110.38
2	B	1	NAG	O4-C4-C3	-2.46	104.57	110.38
2	D	2	NAG	O5-C5-C4	2.46	116.81	110.83
2	D	2	NAG	C4-C3-C2	2.42	114.57	111.02
2	D	2	NAG	O7-C7-N2	2.36	126.15	121.98
2	D	2	NAG	O7-C7-C8	-2.29	117.97	122.05
3	C	2	FUL	C6-C5-C4	-2.25	108.97	113.08
2	B	2	NAG	O7-C7-C8	-2.24	118.06	122.05
2	B	3	FUL	C2-C3-C4	2.18	114.70	110.86
3	C	1	NAG	C3-C4-C5	-2.18	106.27	110.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	2	NAG	O3-C3-C2	2.13	113.82	109.40
3	C	2	FUL	C2-C3-C4	-2.05	107.26	110.86

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	D	1	NAG	C1

All (15) torsion outliers are listed below:

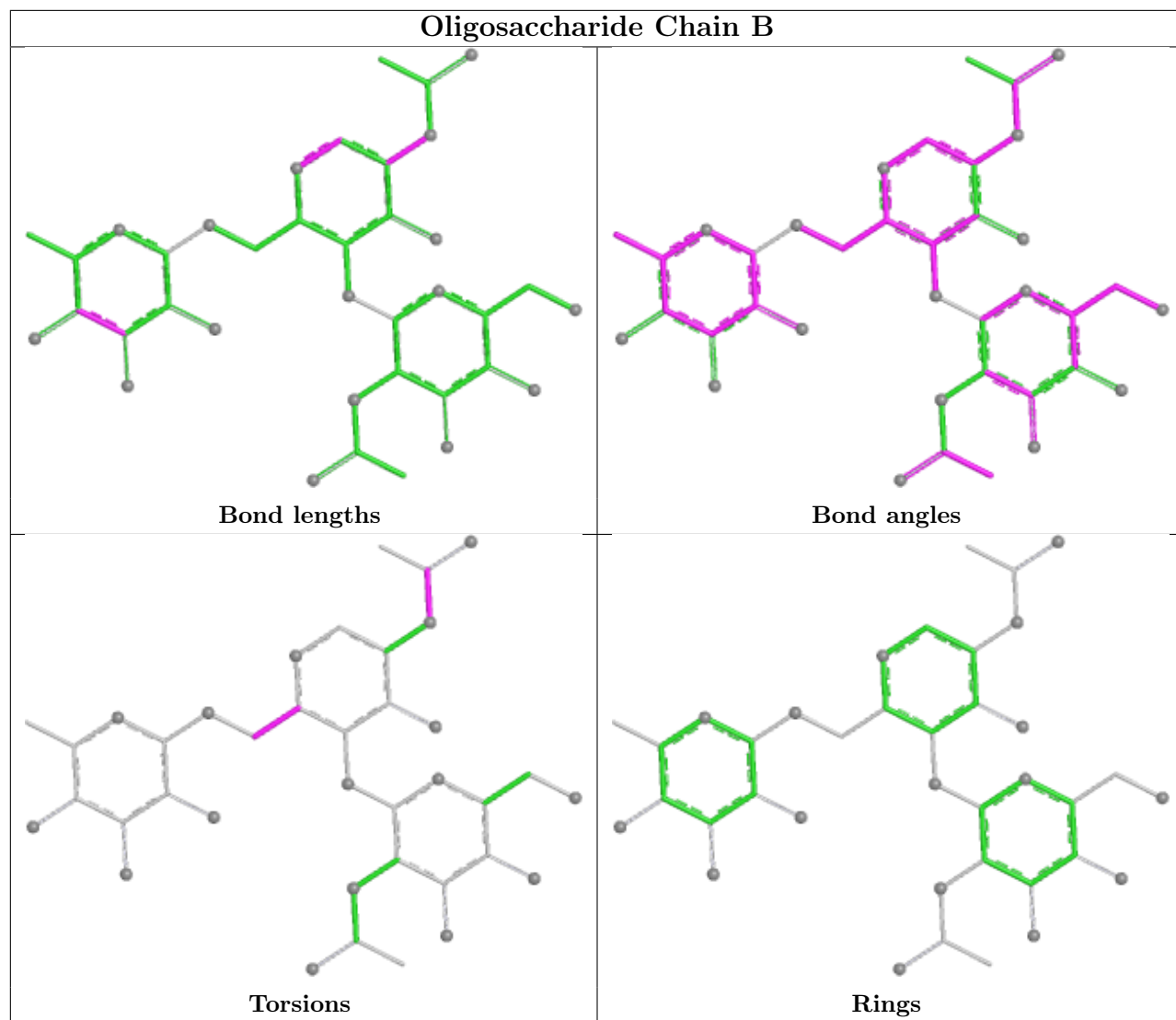
Mol	Chain	Res	Type	Atoms
2	D	1	NAG	C4-C5-C6-O6
3	C	1	NAG	O5-C5-C6-O6
2	D	1	NAG	O5-C5-C6-O6
2	D	2	NAG	O5-C5-C6-O6
3	C	1	NAG	C4-C5-C6-O6
2	B	1	NAG	C4-C5-C6-O6
2	B	1	NAG	C8-C7-N2-C2
2	B	1	NAG	O7-C7-N2-C2
2	D	1	NAG	C8-C7-N2-C2
2	D	1	NAG	O7-C7-N2-C2
3	C	1	NAG	C8-C7-N2-C2
3	C	1	NAG	O7-C7-N2-C2
2	B	1	NAG	O5-C5-C6-O6
2	D	2	NAG	C4-C5-C6-O6
2	D	2	NAG	C3-C2-N2-C7

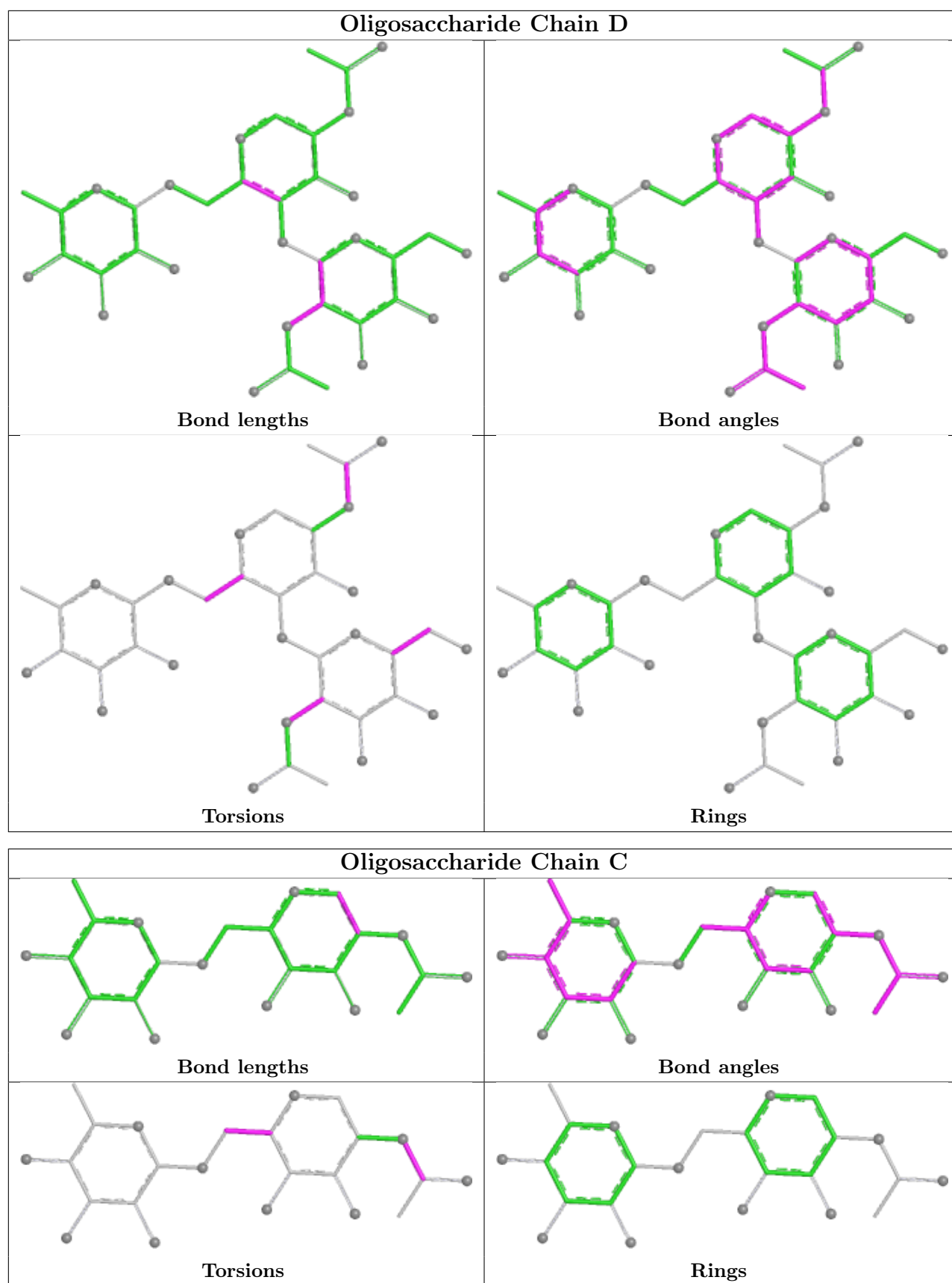
There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	2	FUL	1	0
2	B	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

Of 37 ligands modelled in this entry, 23 are unknown and 8 are monoatomic - leaving 6 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	$\# Z > 2$
8	SO4	A	1538	-	4,4,4	0.51	0	6,6,6	1.16	1 (16%)
8	SO4	A	1537	-	4,4,4	0.67	0	6,6,6	1.05	1 (16%)
7	GOL	A	1536	-	5,5,5	0.60	0	5,5,5	1.01	0
9	NAG	A	1544	1	14,14,15	1.20	1 (7%)	17,19,21	3.71	7 (41%)
9	NAG	A	1545	1	14,14,15	0.57	0	17,19,21	2.81	2 (11%)
9	NAG	A	1546	1	14,14,15	1.16	1 (7%)	17,19,21	2.23	6 (35%)

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
7	GOL	A	1536	-	-	0/4/4/4	-
9	NAG	A	1546	1	-	0/6/23/26	0/1/1/1
9	NAG	A	1544	1	-	4/6/23/26	0/1/1/1
9	NAG	A	1545	1	-	0/6/23/26	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
9	A	1544	NAG	O5-C1	2.78	1.48	1.43
9	A	1546	NAG	C1-C2	2.55	1.55	1.52

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
9	A	1544	NAG	C1-O5-C5	12.64	129.13	112.19
9	A	1545	NAG	C1-O5-C5	10.56	126.34	112.19

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
9	A	1546	NAG	C1-O5-C5	5.10	119.03	112.19
9	A	1544	NAG	C2-N2-C7	-4.60	116.73	122.90
9	A	1546	NAG	C2-N2-C7	3.84	128.05	122.90
9	A	1546	NAG	C1-C2-N2	3.57	116.06	110.43
9	A	1544	NAG	O3-C3-C2	-3.42	102.30	109.40
9	A	1546	NAG	O5-C5-C6	3.31	114.11	107.66
9	A	1544	NAG	C3-C4-C5	3.28	116.18	110.23
9	A	1544	NAG	C4-C3-C2	2.67	114.93	111.02
9	A	1546	NAG	O4-C4-C5	2.51	115.50	109.32
9	A	1544	NAG	C8-C7-N2	2.43	120.14	116.12
9	A	1544	NAG	O7-C7-C8	-2.38	117.82	122.05
9	A	1545	NAG	O5-C5-C4	2.33	116.49	110.83
8	A	1538	SO4	O4-S-O2	2.16	120.83	109.56
9	A	1546	NAG	C3-C4-C5	-2.04	106.53	110.23
8	A	1537	SO4	O3-S-O2	-2.01	99.05	109.56

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
9	A	1544	NAG	C8-C7-N2-C2
9	A	1544	NAG	O7-C7-N2-C2
9	A	1544	NAG	C4-C5-C6-O6
9	A	1544	NAG	O5-C5-C6-O6

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
8	A	1538	SO4	1	0
9	A	1545	NAG	1	0

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%)	-0.11	15 (2%) 55 57	21, 37, 71, 110	5 (0%)

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	377	VAL	7.6
1	A	237	TYR	5.1
1	A	280	VAL	3.3
1	A	282	TYR	3.3
1	A	379	ASP	3.1
1	A	281	PRO	2.9
1	A	50	THR	2.8
1	A	378	ASP	2.3
1	A	375	ASP	2.3
1	A	254	ARG	2.2
1	A	51	LYS	2.1
1	A	255	GLU	2.1
1	A	486	GLN	2.1
1	A	380	GLN	2.0
1	A	508	THR	2.0

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

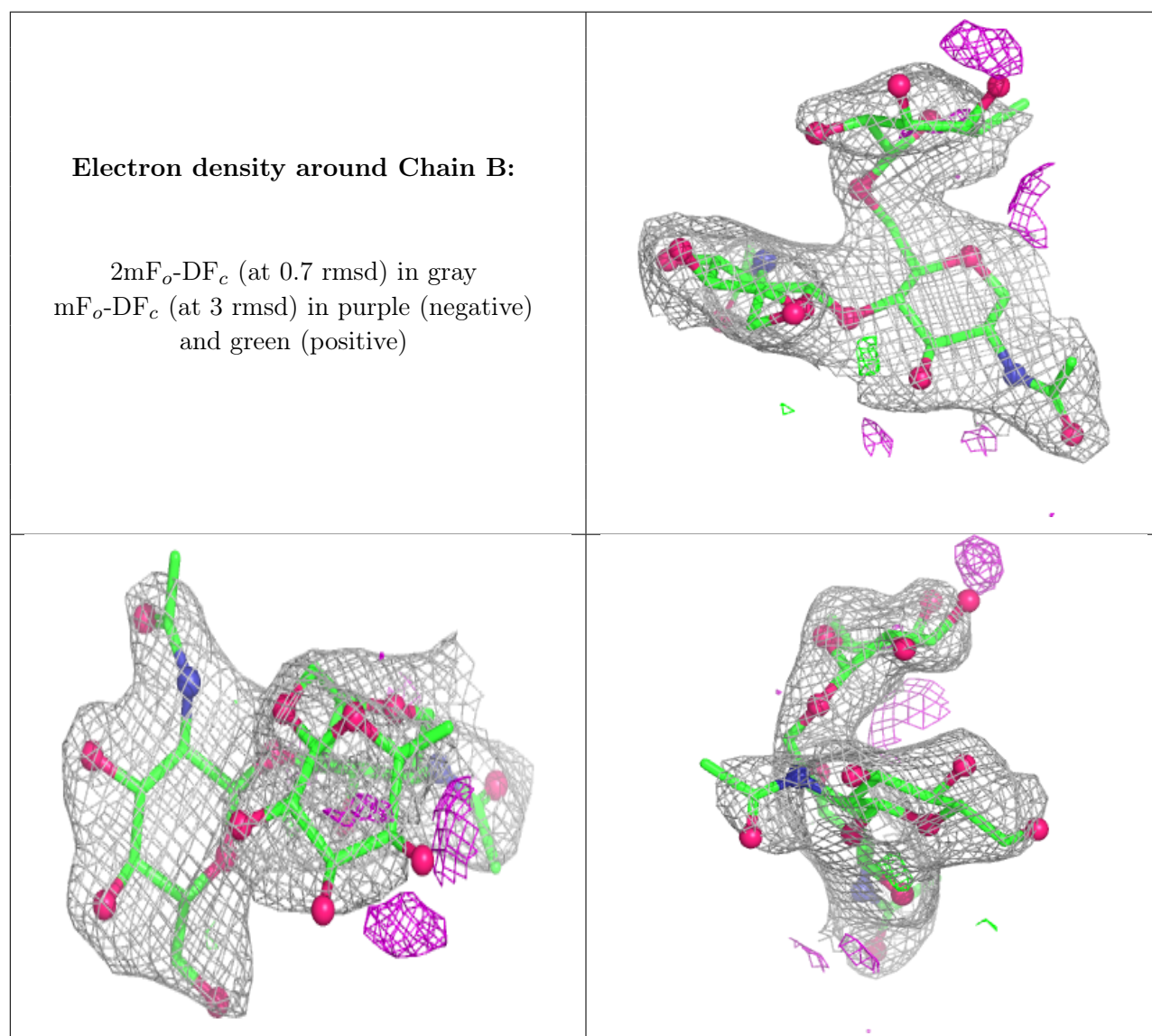
There are no non-standard protein/DNA/RNA residues in this entry.

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.

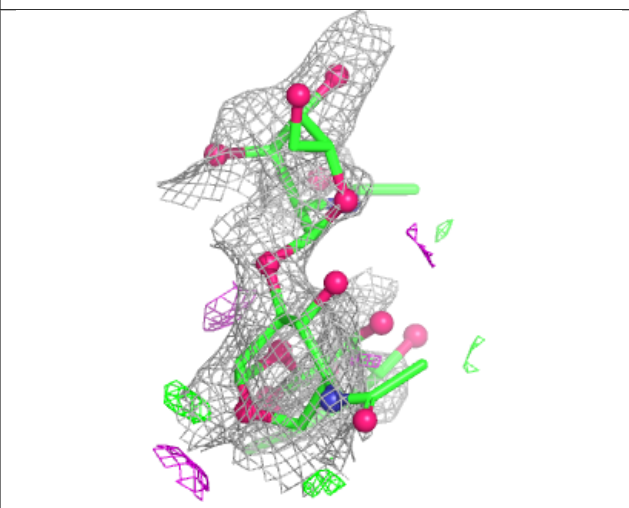
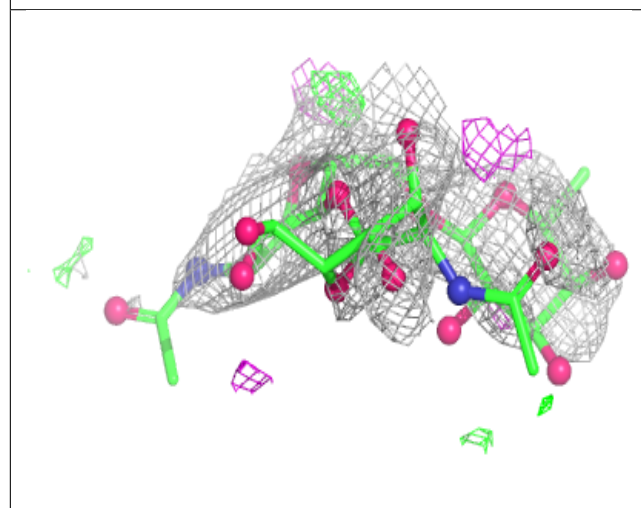
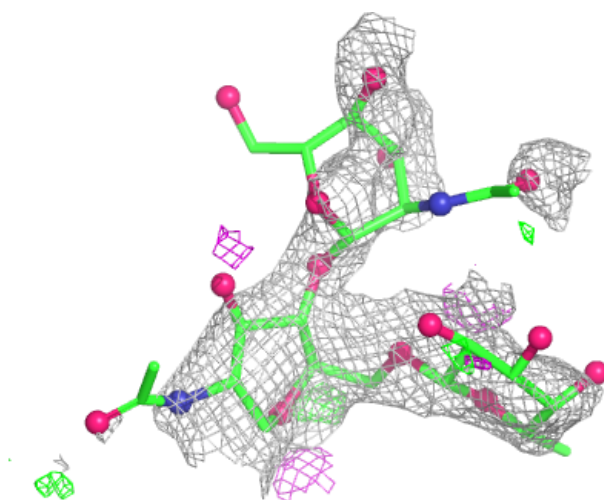
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	NAG	D	2	14/15	0.48	0.19	107,110,111,112	0
2	FUL	B	3	10/11	0.75	0.17	76,80,83,84	0
2	NAG	D	1	14/15	0.79	0.15	80,95,102,102	0
2	FUL	D	3	10/11	0.84	0.17	105,106,107,109	0
3	FUL	C	2	10/11	0.85	0.24	38,45,47,47	10
3	NAG	C	1	14/15	0.89	0.12	50,56,58,65	0
2	NAG	B	2	14/15	0.89	0.11	68,74,77,78	0
2	NAG	B	1	14/15	0.93	0.09	41,54,60,70	0

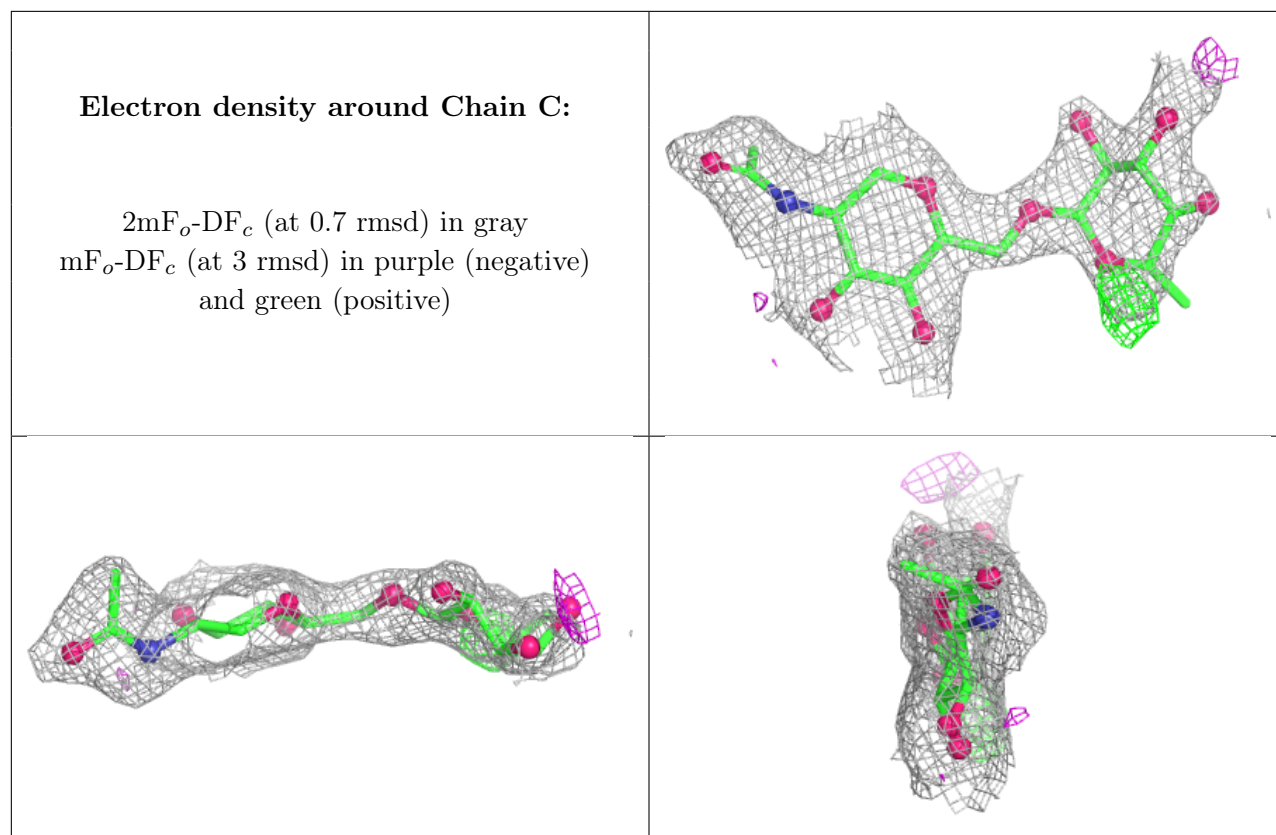
The following is a graphical depiction of the model fit to experimental electron density for oligosaccharide. Each fit is shown from different orientation to approximate a three-dimensional view.



Electron density around Chain D:

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





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, 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	UNX	A	1560	1/1	0.34	0.25	47,47,47,47	0
6	NA	A	1533	1/1	0.49	0.47	93,93,93,93	0
9	NAG	A	1544	14/15	0.63	0.17	63,71,73,74	0
9	NAG	A	1546	14/15	0.63	0.13	78,89,91,92	0
4	UNX	A	1567	1/1	0.66	0.17	35,35,35,35	0
4	UNX	A	1562	1/1	0.72	0.23	57,57,57,57	0
4	UNX	A	1551	1/1	0.78	0.18	44,44,44,44	0
5	CL	A	1565	1/1	0.80	0.20	82,82,82,82	0
4	UNX	A	1559	1/1	0.80	0.19	33,33,33,33	0
4	UNX	A	1557	1/1	0.81	0.13	49,49,49,49	0
4	UNX	A	1558	1/1	0.81	0.15	45,45,45,45	0
4	UNX	A	1566	1/1	0.82	0.16	40,40,40,40	0
4	UNX	A	1574	1/1	0.84	0.10	41,41,41,41	0
5	CL	A	1531	1/1	0.84	0.17	78,78,78,78	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	UNX	A	1563	1/1	0.84	0.24	28,28,28,28	0
9	NAG	A	1545	14/15	0.86	0.11	42,58,68,73	0
4	UNX	A	1569	1/1	0.87	0.17	48,48,48,48	0
5	CL	A	1564	1/1	0.88	0.19	77,77,77,77	0
4	UNX	A	1554	1/1	0.88	0.14	45,45,45,45	0
5	CL	A	1532	1/1	0.88	0.16	81,81,81,81	0
4	UNX	A	1555	1/1	0.89	0.10	37,37,37,37	0
4	UNX	A	1561	1/1	0.90	0.15	16,16,16,16	0
5	CL	A	1530	1/1	0.90	0.12	76,76,76,76	0
8	SO4	A	1538	5/5	0.91	0.12	34,41,44,45	5
4	UNX	A	1556	1/1	0.91	0.11	40,40,40,40	0
4	UNX	A	1571	1/1	0.91	0.14	39,39,39,39	0
4	UNX	A	1568	1/1	0.91	0.17	58,58,58,58	0
5	CL	A	1534	1/1	0.92	0.22	60,60,60,60	0
4	UNX	A	1553	1/1	0.92	0.09	38,38,38,38	0
4	UNX	A	1570	1/1	0.92	0.19	39,39,39,39	0
4	UNX	A	1575	1/1	0.92	0.08	31,31,31,31	0
4	UNX	A	1552	1/1	0.93	0.08	47,47,47,47	0
7	GOL	A	1536	6/6	0.93	0.09	42,44,50,51	0
4	UNX	A	1572	1/1	0.93	0.09	37,37,37,37	0
4	UNX	A	1550	1/1	0.95	0.11	35,35,35,35	0
5	CL	A	1535	1/1	0.95	0.16	60,60,60,60	0
8	SO4	A	1537	5/5	0.97	0.12	20,26,29,32	5

6.5 Other polymers

There are no such residues in this entry.