



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 12:21 PM UTC

PDB ID : 1P0I / pdb_00001p0i
Title : Crystal structure of human butyryl cholinesterase
Authors : Nicolet, Y.; Lockridge, O.; Masson, P.; Fontecilla-Camps, J.C.; Nachon, F.
Deposited on : 2003-04-10
Resolution : 2.00 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

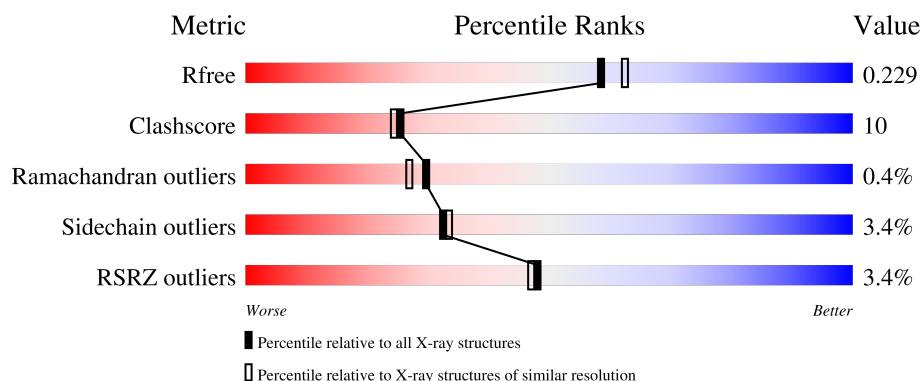
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	B	3	
2	C	3	

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
5	CL	A	702	-	-	X	-
6	BUA	A	606	-	X	-	-
7	MES	A	607	-	-	X	-

2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 4848 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.

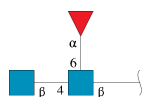
- Molecule 1 is a protein called Cholinesterase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	523	4199	2716	704	763	16	93	4	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 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
			Total	C	N	O			
2	B	3	38	22	2	14	9	0	0
2	C	3	38	22	2	14	6	0	0

- Molecule 3 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: C₈H₁₅NO₆).



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

- Molecule 4 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



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

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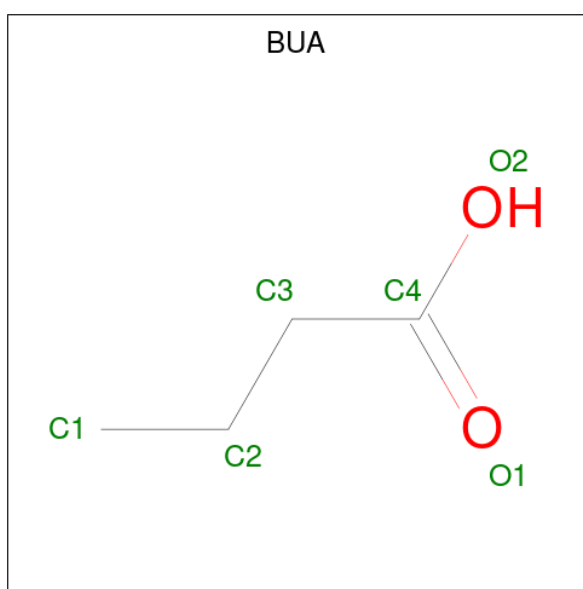
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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	O	S	0	0
			5	4	1		

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

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	2	Total	Cl	0	0
			2	2		

- Molecule 6 is butanoic acid (CCD ID: BUA) (formula: C₄H₈O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	C	O	0	0
			6	4	2		

- Molecule 7 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula: C₆H₁₃NO₄S).



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

- Molecule 8 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



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

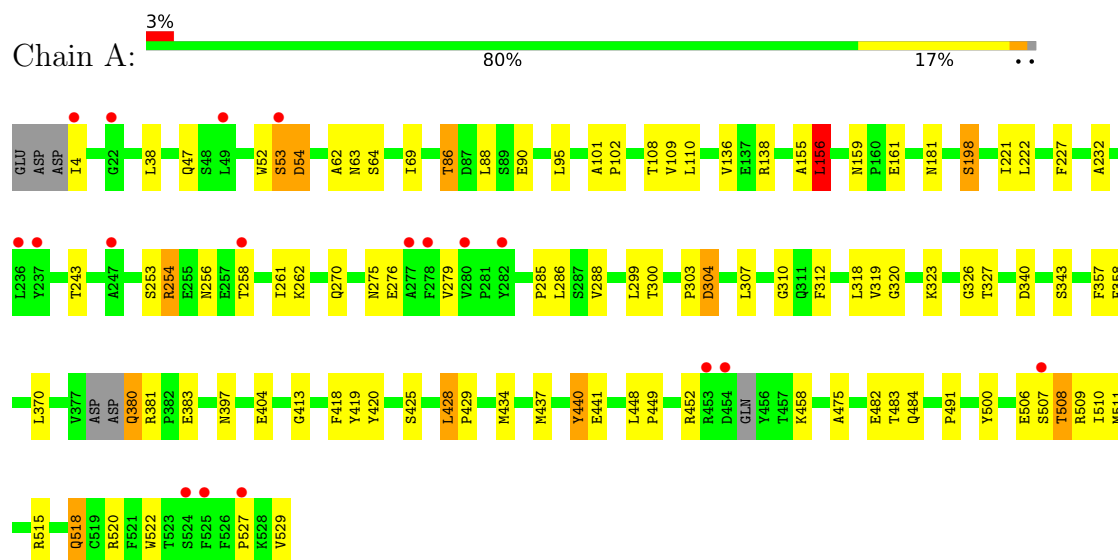
- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	483	Total 483	O 483	2	0

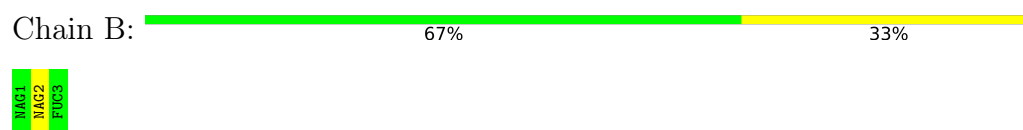
3 Residue-property plots

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.

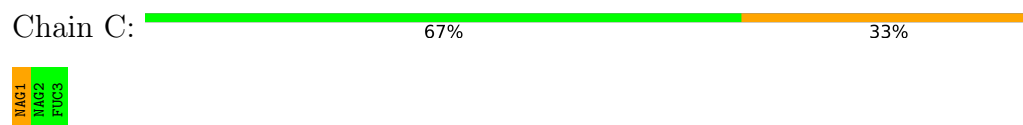
- Molecule 1: Cholinesterase



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



- Molecule 2: 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	154.66Å 154.66Å 127.89Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	55.20 – 2.00 55.20 – 2.00	Depositor EDS
% Data completeness (in resolution range)	93.8 (55.20-2.00) 93.9 (55.20-2.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.33 (at 2.00Å)	Xtriage
Refinement program	CNS 0.9	Depositor
R, R_{free}	0.195 , 0.225 0.202 , 0.229	Depositor DCC
R_{free} test set	2556 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å ²)	29.1	Xtriage
Anisotropy	0.263	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 76.5	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	4848	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.57% 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: NAG, MES, CL, GOL, BUA, SO4, FUC

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

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.75	1/4317 (0.0%)	1.04	24/5856 (0.4%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	434	MET	SD-CE	-5.28	1.66	1.79

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	232	ALA	N-CA-C	8.37	122.78	112.23
1	A	136	VAL	N-CA-C	7.80	118.60	110.72
1	A	437	MET	N-CA-C	7.49	120.42	110.53
1	A	483	THR	N-CA-C	7.33	122.05	113.18
1	A	441	GLU	N-CA-C	-7.04	104.83	113.50
1	A	340	ASP	N-CA-C	6.90	120.59	112.72
1	A	413	GLY	N-CA-C	6.86	123.02	114.37
1	A	326	GLY	N-CA-C	6.50	122.71	114.66
1	A	54	ASP	N-CA-C	-6.38	97.22	110.80
1	A	181	ASN	N-CA-C	5.69	121.65	114.31
1	A	343	SER	N-CA-C	5.67	119.39	111.90
1	A	482	GLU	N-CA-C	-5.59	96.45	107.69
1	A	327	THR	N-CA-C	5.51	117.29	111.28
1	A	109	VAL	N-CA-C	5.45	115.80	108.17
1	A	484	GLN	N-CA-C	5.39	119.98	113.41
1	A	155	ALA	N-CA-C	5.35	118.18	109.24
1	A	440	TYR	N-CA-C	5.34	118.81	112.72
1	A	520	ARG	N-CA-C	-5.28	105.52	111.28
1	A	156	LEU	N-CA-C	-5.18	98.25	108.71
1	A	397	ASN	N-CA-C	5.15	118.72	112.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	358	PHE	CA-C-N	5.12	124.56	119.24
1	A	358	PHE	C-N-CA	5.12	124.56	119.24
1	A	53	SER	N-CA-C	-5.11	102.33	109.69
1	A	275	ASN	N-CA-C	5.10	119.50	113.28

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	4199	0	4104	77	0
2	B	38	0	34	0	0
2	C	38	0	34	1	0
3	A	42	0	39	0	0
4	A	10	0	0	0	0
5	A	2	0	0	3	0
6	A	6	0	8	1	0
7	A	12	0	13	14	0
8	A	18	0	24	1	0
9	A	483	0	0	10	0
All	All	4848	0	4256	79	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 (79) 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:452:ARG:HH22	1:A:458:LYS:HA	1.04	1.18
1:A:323:LYS:HG3	7:A:607:MES:H62	1.29	1.10
1:A:452:ARG:NH2	1:A:458:LYS:HD2	1.68	1.07
1:A:323:LYS:HE2	7:A:607:MES:H61	1.42	1.01
1:A:452:ARG:HH21	1:A:458:LYS:HD2	1.27	0.93
1:A:452:ARG:NH2	1:A:458:LYS:HA	1.82	0.93

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:518:GLN:HE21	1:A:518:GLN:H	0.97	0.91
1:A:323:LYS:HG3	7:A:607:MES:C6	2.05	0.87
1:A:518:GLN:HE21	1:A:518:GLN:N	1.78	0.81
1:A:420:TYR:OH	7:A:607:MES:H62	1.82	0.79
1:A:323:LYS:CE	7:A:607:MES:H61	2.13	0.78
1:A:304:ASP:HB3	9:A:933:HOH:O	1.82	0.78
1:A:452:ARG:HH22	1:A:458:LYS:CA	1.93	0.78
1:A:515:ARG:HH22	7:A:607:MES:H71	1.53	0.74
1:A:518:GLN:H	1:A:518:GLN:NE2	1.81	0.72
1:A:227[A]:PHE:CD2	1:A:303:PRO:HB2	2.28	0.69
1:A:285:PRO:HG2	1:A:357:PHE:CE1	2.28	0.67
1:A:227[A]:PHE:CE2	1:A:303:PRO:HB2	2.30	0.66
1:A:320:GLY:HA3	1:A:419:TYR:CE1	2.30	0.66
1:A:404:GLU:HG2	9:A:928:HOH:O	1.97	0.65
1:A:515:ARG:NH2	7:A:607:MES:H71	2.13	0.64
1:A:62:ALA:O	1:A:86:THR:HG21	1.98	0.64
1:A:515:ARG:HG2	7:A:607:MES:O3S	1.98	0.63
1:A:276:GLU:O	1:A:279:VAL:HG22	1.98	0.63
1:A:420:TYR:CE2	7:A:607:MES:H51	2.34	0.62
9:A:1095:HOH:O	2:C:1:NAG:H83	2.01	0.60
1:A:420:TYR:HE2	7:A:607:MES:H51	1.67	0.60
1:A:156:LEU:HD22	1:A:261:ILE:HD11	1.84	0.59
1:A:320:GLY:HA3	1:A:419:TYR:CZ	2.37	0.59
1:A:420:TYR:OH	7:A:607:MES:C6	2.51	0.58
1:A:161:GLU:HG3	1:A:258:THR:HG23	1.85	0.58
1:A:101:ALA:HA	1:A:102:PRO:C	2.28	0.58
1:A:425:SER:HB3	1:A:428:LEU:HD23	1.87	0.57
1:A:508:THR:HG23	5:A:702:CL:CL	2.42	0.56
1:A:508:THR:CG2	5:A:702:CL:CL	2.91	0.56
1:A:227[A]:PHE:HZ	1:A:307:LEU:HB2	1.71	0.55
1:A:53:SER:HA	9:A:903:HOH:O	2.07	0.54
1:A:319:VAL:O	1:A:418:PHE:HA	2.07	0.54
1:A:288:VAL:HB	8:A:604:GOL:H11	1.90	0.53
1:A:156:LEU:HD13	1:A:243:THR:HG21	1.92	0.52
1:A:515:ARG:NH2	7:A:607:MES:C7	2.71	0.52
1:A:491:PRO:CD	1:A:510:ILE:HD12	2.40	0.52
1:A:110[B]:LEU:HD11	1:A:475:ALA:CB	2.39	0.52
1:A:507:SER:HA	9:A:769:HOH:O	2.09	0.50
1:A:500:TYR:CZ	1:A:511[B]:MET:HB2	2.48	0.49
1:A:222:LEU:HD12	1:A:222:LEU:N	2.27	0.49
1:A:380:GLN:HB2	9:A:1168:HOH:O	2.14	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:428:LEU:HD21	1:A:440:TYR:CD2	2.48	0.48
7:A:607:MES:H52	9:A:975:HOH:O	2.13	0.48
1:A:256:ASN:OD1	1:A:258:THR:N	2.47	0.48
1:A:258:THR:O	1:A:262:LYS:HG3	2.13	0.47
1:A:323:LYS:CG	7:A:607:MES:C6	2.88	0.46
1:A:138:ARG:NH1	9:A:743:HOH:O	2.48	0.46
1:A:310:GLY:HA2	1:A:312:PHE:CE2	2.51	0.46
1:A:253:SER:O	1:A:254:ARG:HD3	2.16	0.46
1:A:300:THR:HG22	9:A:1094:HOH:O	2.15	0.45
1:A:95:LEU:HD12	1:A:95:LEU:C	2.42	0.45
1:A:253:SER:O	1:A:254:ARG:CD	2.64	0.45
1:A:320:GLY:HA3	1:A:419:TYR:CD1	2.52	0.44
1:A:509:ARG:HH11	1:A:509:ARG:HG2	1.83	0.44
1:A:508:THR:HG21	5:A:702:CL:CL	2.55	0.43
1:A:159:ASN:OD1	1:A:161:GLU:HG2	2.18	0.43
1:A:52:TRP:CD1	1:A:52:TRP:C	2.95	0.43
1:A:69:ILE:HD11	1:A:88:LEU:HD11	2.01	0.43
1:A:221:ILE:C	1:A:222:LEU:HD12	2.44	0.42
1:A:64:SER:OG	1:A:86:THR:HG22	2.19	0.42
1:A:156:LEU:HD12	1:A:156:LEU:HA	1.86	0.42
1:A:448:LEU:N	1:A:449:PRO:CD	2.83	0.42
1:A:318:LEU:C	1:A:318:LEU:HD23	2.45	0.42
1:A:383:GLU:OE2	1:A:383:GLU:N	2.49	0.42
1:A:198:SER:HG	6:A:606:BUA:C4	2.30	0.41
1:A:500:TYR:CZ	1:A:511[A]:MET:HB2	2.55	0.41
1:A:38:LEU:HD23	1:A:90:GLU:HB3	2.01	0.41
1:A:380:GLN:HB3	1:A:381:ARG:H	1.32	0.41
1:A:47:GLN:CD	9:A:1115:HOH:O	2.63	0.41
1:A:370:LEU:HD23	1:A:370:LEU:C	2.46	0.41
1:A:63:ASN:HA	1:A:86:THR:HG23	2.04	0.40
1:A:522:TRP:O	1:A:527:PRO:HD3	2.21	0.40
1:A:428:LEU:HD13	1:A:429:PRO:HD2	2.03	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	521/529 (98%)	497 (95%)	22 (4%)	2 (0%)	30	27

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	506	GLU
1	A	54	ASP

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	451/454 (99%)	436 (97%)	15 (3%)	33	34

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	ILE
1	A	86	THR
1	A	108	THR
1	A	156	LEU
1	A	198	SER
1	A	254	ARG
1	A	270	GLN
1	A	286	LEU
1	A	299	LEU
1	A	304	ASP
1	A	380	GLN
1	A	428	LEU
1	A	508	THR
1	A	518	GLN
1	A	529	VAL

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

Mol	Chain	Res	Type
1	A	17	GLN
1	A	35	GLN
1	A	68	ASN
1	A	71	GLN
1	A	77	HIS
1	A	176	GLN
1	A	214	HIS
1	A	275	ASN
1	A	289	ASN
1	A	414	ASN
1	A	518	GLN

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 [i](#)

6 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	0.66	0	17,19,21	0.71	0
2	NAG	B	2	2	14,14,15	0.62	0	17,19,21	0.79	1 (5%)
2	FUC	B	3	2	10,10,11	0.48	0	14,14,16	0.67	0
2	NAG	C	1	2,1	14,14,15	0.64	1 (7%)	17,19,21	0.81	0
2	NAG	C	2	2	14,14,15	0.45	0	17,19,21	0.76	0
2	FUC	C	3	2	10,10,11	0.61	0	14,14,16	0.51	0

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	NAG	B	1	2,1	-	2/6/23/26	0/1/1/1
2	NAG	B	2	2	-	4/6/23/26	0/1/1/1
2	FUC	B	3	2	-	-	0/1/1/1
2	NAG	C	1	2,1	-	2/6/23/26	0/1/1/1
2	NAG	C	2	2	-	2/6/23/26	0/1/1/1
2	FUC	C	3	2	-	-	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	1	NAG	C1-C2	2.08	1.55	1.52

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	2	NAG	C2-N2-C7	-2.48	119.58	122.90

There are no chirality outliers.

All (10) torsion outliers are listed below:

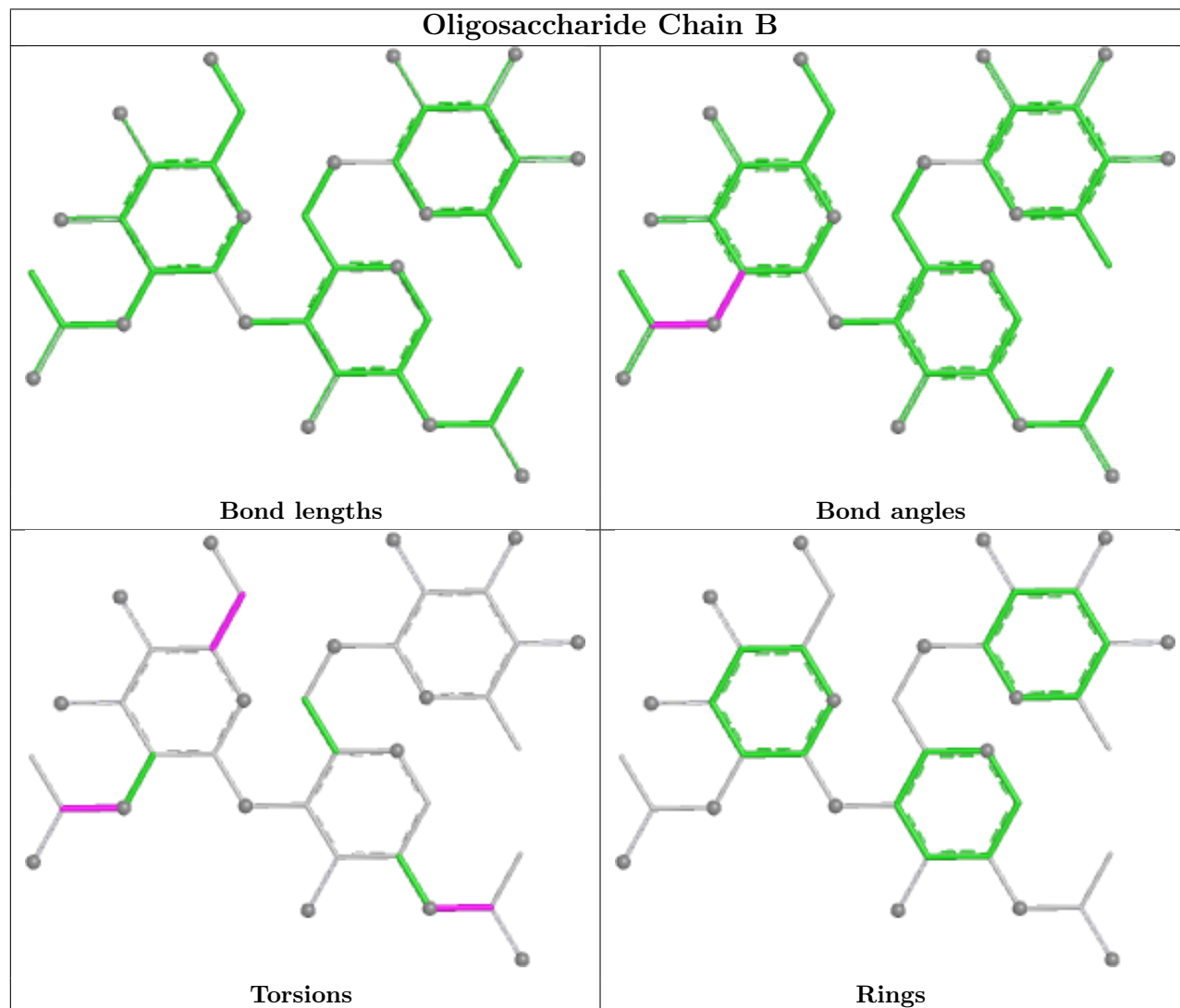
Mol	Chain	Res	Type	Atoms
2	B	1	NAG	C8-C7-N2-C2
2	B	1	NAG	O7-C7-N2-C2
2	B	2	NAG	C8-C7-N2-C2
2	B	2	NAG	O7-C7-N2-C2
2	C	1	NAG	C8-C7-N2-C2
2	B	2	NAG	O5-C5-C6-O6
2	C	1	NAG	O7-C7-N2-C2
2	C	2	NAG	O5-C5-C6-O6
2	C	2	NAG	C4-C5-C6-O6
2	B	2	NAG	C4-C5-C6-O6

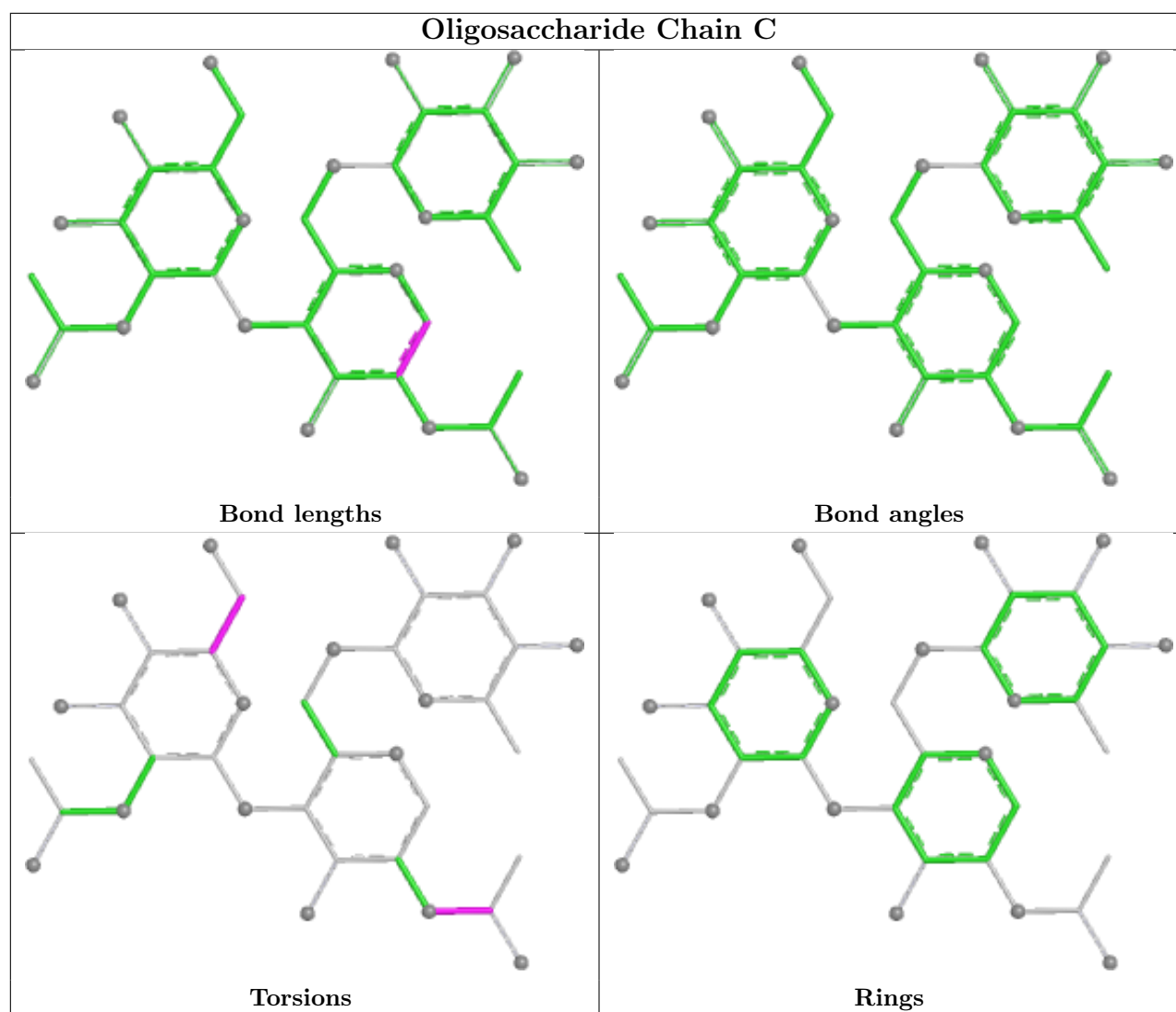
There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	1	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](#)

Of 12 ligands modelled in this entry, 2 are monoatomic - leaving 10 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	GOL	A	605	-	5,5,5	0.40	0	5,5,5	0.33	0
8	GOL	A	604	-	5,5,5	0.34	0	5,5,5	0.46	0
3	NAG	A	538	1	14,14,15	0.80	1 (7%)	17,19,21	0.82	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
6	BUA	A	606	1	5,5,5	3.91	3 (60%)	5,5,5	2.74	3 (60%)
8	GOL	A	603	-	5,5,5	0.48	0	5,5,5	0.45	0
7	MES	A	607	-	12,12,12	1.98	2 (16%)	15,16,16	1.07	1 (6%)
4	SO4	A	602	-	4,4,4	0.55	0	6,6,6	0.32	0
3	NAG	A	536	1	14,14,15	0.64	0	17,19,21	0.83	1 (5%)
4	SO4	A	601	-	4,4,4	0.13	0	6,6,6	0.30	0
3	NAG	A	537	1	14,14,15	0.58	0	17,19,21	0.71	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	GOL	A	605	-	-	2/4/4/4	-
8	GOL	A	604	-	-	2/4/4/4	-
3	NAG	A	538	1	-	2/6/23/26	0/1/1/1
6	BUA	A	606	1	-	2/3/3/3	-
8	GOL	A	603	-	-	2/4/4/4	-
7	MES	A	607	-	-	3/6/14/14	0/1/1/1
3	NAG	A	536	1	-	2/6/23/26	0/1/1/1
3	NAG	A	537	1	-	4/6/23/26	0/1/1/1

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	606	BUA	O1-C4	6.67	1.43	1.22
7	A	607	MES	C8-S	5.57	1.85	1.77
6	A	606	BUA	O2-C4	4.83	1.46	1.30
6	A	606	BUA	C3-C4	2.70	1.56	1.50
7	A	607	MES	O1S-S	2.33	1.51	1.45
3	A	538	NAG	C1-C2	2.09	1.55	1.52

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	606	BUA	O2-C4-O1	-5.09	110.24	123.33
7	A	607	MES	C5-N4-C3	2.90	115.08	108.84
6	A	606	BUA	O1-C4-C3	-2.51	115.13	123.09

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	606	BUA	O2-C4-C3	2.29	121.23	114.00
3	A	536	NAG	C2-N2-C7	-2.10	120.08	122.90

There are no chirality outliers.

All (19) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	536	NAG	C8-C7-N2-C2
3	A	536	NAG	O7-C7-N2-C2
7	A	607	MES	C8-C7-N4-C5
8	A	604	GOL	O1-C1-C2-O2
8	A	604	GOL	O1-C1-C2-C3
3	A	538	NAG	O5-C5-C6-O6
3	A	538	NAG	C4-C5-C6-O6
3	A	537	NAG	C8-C7-N2-C2
3	A	537	NAG	O7-C7-N2-C2
8	A	605	GOL	C1-C2-C3-O3
6	A	606	BUA	C1-C2-C3-C4
7	A	607	MES	N4-C7-C8-S
7	A	607	MES	C8-C7-N4-C3
3	A	537	NAG	C4-C5-C6-O6
3	A	537	NAG	O5-C5-C6-O6
8	A	605	GOL	O2-C2-C3-O3
8	A	603	GOL	C1-C2-C3-O3
6	A	606	BUA	C2-C3-C4-O1
8	A	603	GOL	O2-C2-C3-O3

There are no ring outliers.

3 monomers are involved in 16 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
8	A	604	GOL	1	0
6	A	606	BUA	1	0
7	A	607	MES	14	0

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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	523/529 (98%)	0.06	18 (3%)	48 47	13, 30, 52, 67	45 (8%)

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	277	ALA	4.2
1	A	282	TYR	4.0
1	A	237	TYR	3.1
1	A	53	SER	2.8
1	A	525	PHE	2.8
1	A	454	ASP	2.7
1	A	22	GLY	2.7
1	A	4	ILE	2.5
1	A	236	LEU	2.4
1	A	258	THR	2.4
1	A	507	SER	2.2
1	A	278	PHE	2.2
1	A	280	VAL	2.2
1	A	527	PRO	2.1
1	A	49	LEU	2.0
1	A	453	ARG	2.0
1	A	524	SER	2.0
1	A	247	ALA	2.0

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

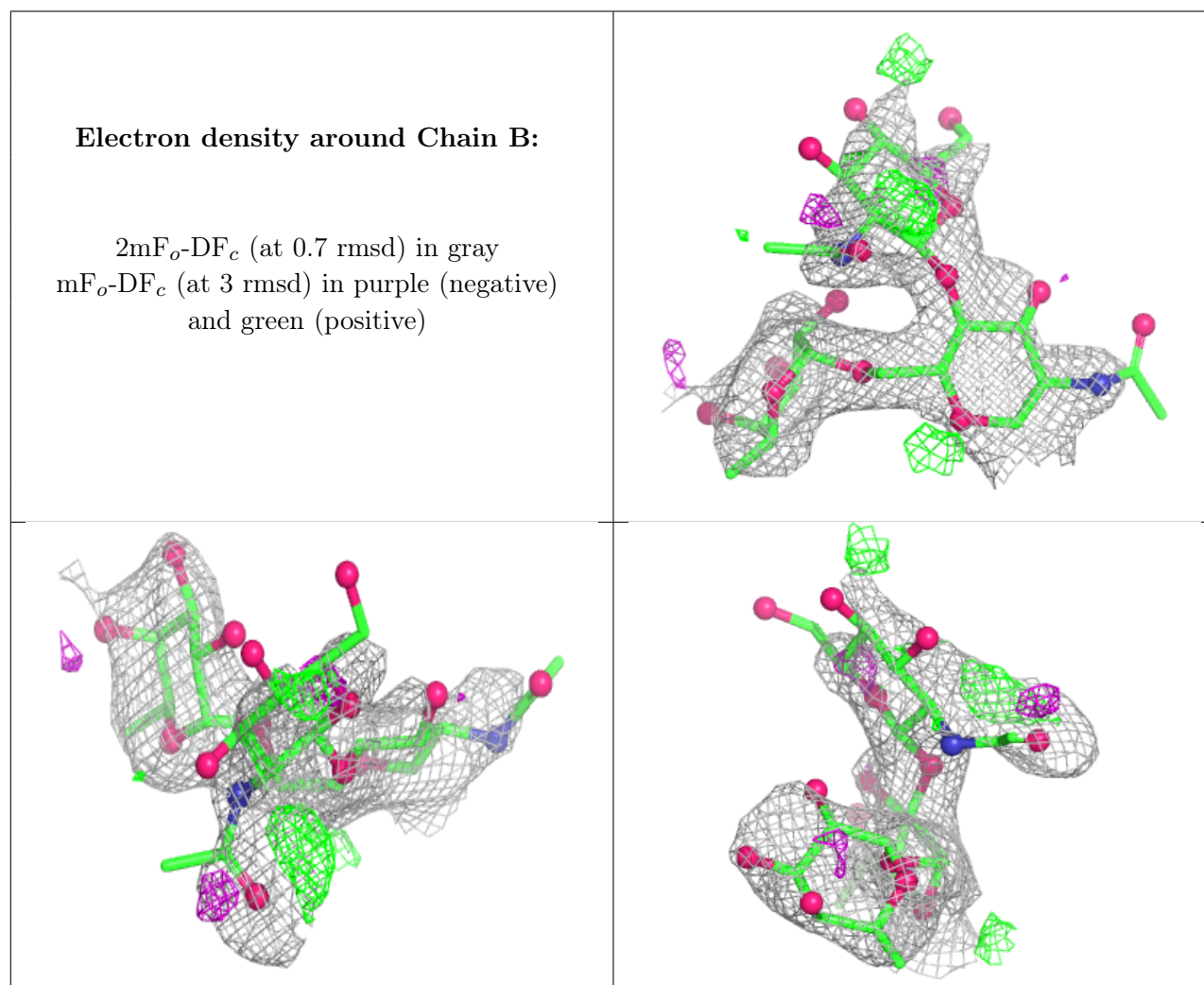
There are no non-standard protein/DNA/RNA residues in this entry.

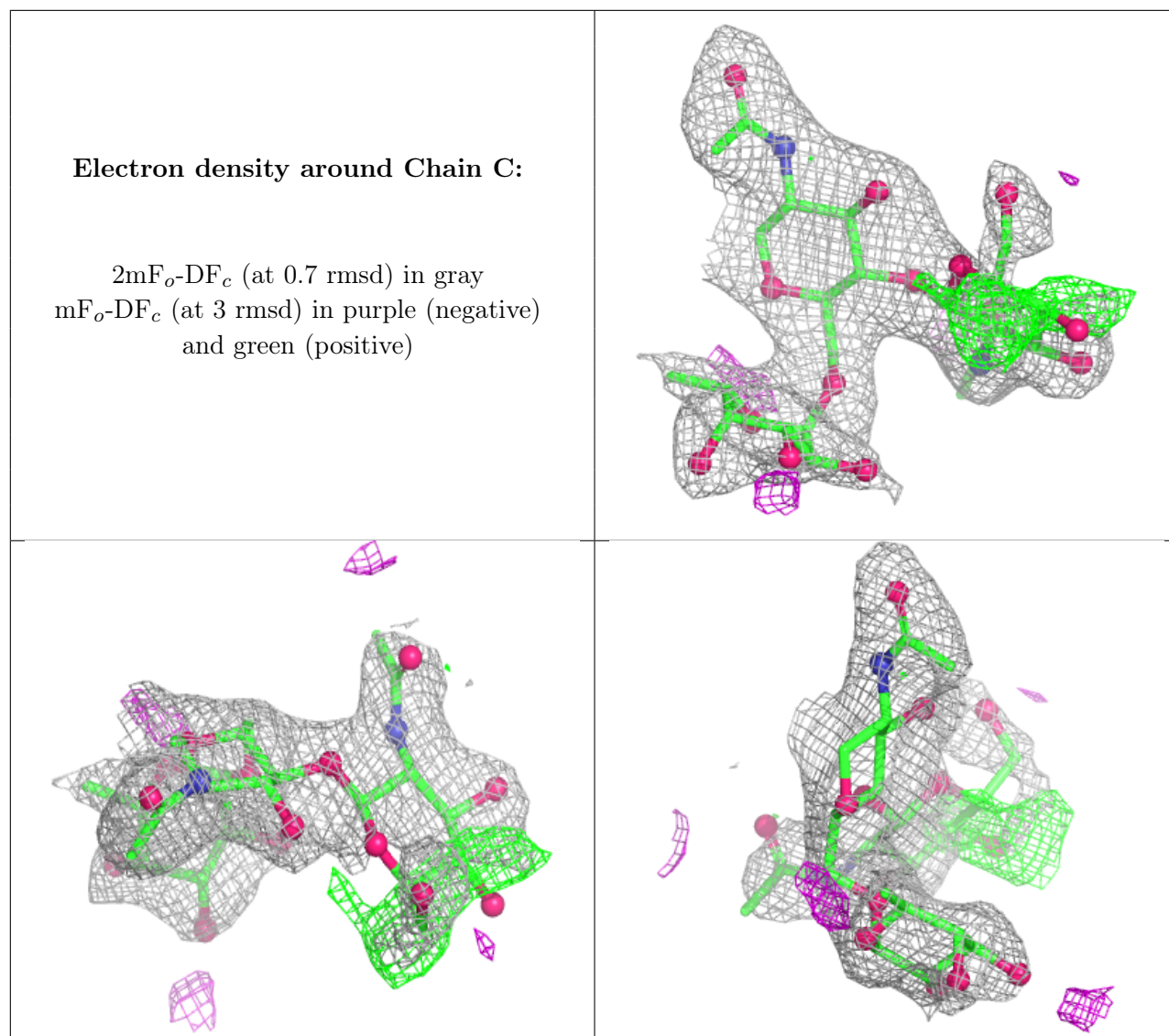
6.3 Carbohydrates ⓘ

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
2	NAG	B	2	14/15	0.55	0.23	49,58,64,66	5
2	NAG	C	2	14/15	0.65	0.17	45,52,58,65	7
2	FUC	C	3	10/11	0.76	0.20	54,58,61,67	1
2	NAG	B	1	14/15	0.83	0.12	43,60,64,67	3
2	FUC	B	3	10/11	0.86	0.12	52,57,61,64	1
2	NAG	C	1	14/15	0.93	0.09	36,45,55,57	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.





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
3	NAG	A	537	14/15	0.70	0.13	54,63,67,69	1
3	NAG	A	538	14/15	0.77	0.14	43,52,63,64	4
3	NAG	A	536	14/15	0.79	0.14	52,58,61,63	0
7	MES	A	607	12/12	0.80	0.17	58,63,77,81	0
4	SO4	A	602	5/5	0.81	0.14	76,77,81,82	0
8	GOL	A	604	6/6	0.86	0.14	48,53,61,68	0
6	BUA	A	606	6/6	0.89	0.15	39,40,43,46	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
8	GOL	A	603	6/6	0.91	0.10	34,41,48,57	0
5	CL	A	701	1/1	0.91	0.17	58,58,58,58	1
5	CL	A	702	1/1	0.92	0.20	59,59,59,59	0
4	SO4	A	601	5/5	0.94	0.08	48,51,53,58	0
8	GOL	A	605	6/6	0.94	0.11	49,52,56,58	0

6.5 Other polymers [i](#)

There are no such residues in this entry.