



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 05:50 AM UTC

PDB ID : 2XQG / pdb_00002xqg
Title : X-ray Structure of human butyrylcholinesterase inhibited by racemic VR
Authors : Wandhammer, M.; Carletti, E.; Gillon, E.; Masson, P.; Goeldner, M.; Noort, D.; Nachon, F.
Deposited on : 2010-09-02
Resolution : 2.30 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

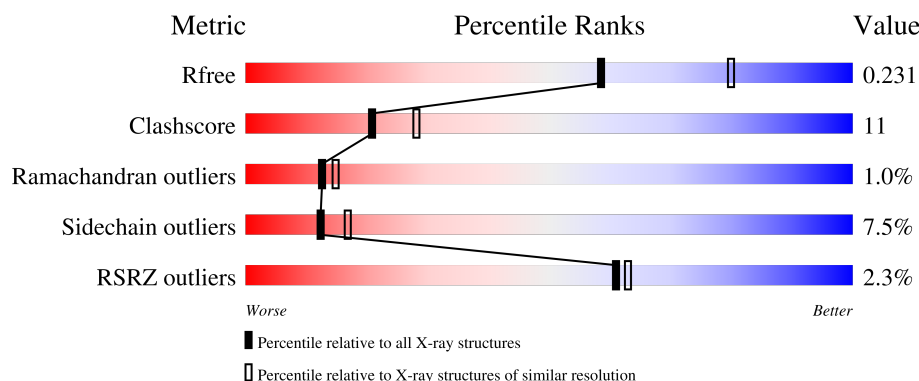
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	527	2% 79% 17% ..
2	B	3	100%
2	C	3	33% 67%

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	C	1	X	-	-	-

2 Entry composition

There are 12 unique types of molecules in this entry. The entry contains 4862 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.

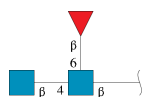
- Molecule 1 is a protein called CHOLINESTERASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	527	4258	2750	712	780	16	0	9	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)-[beta-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose.

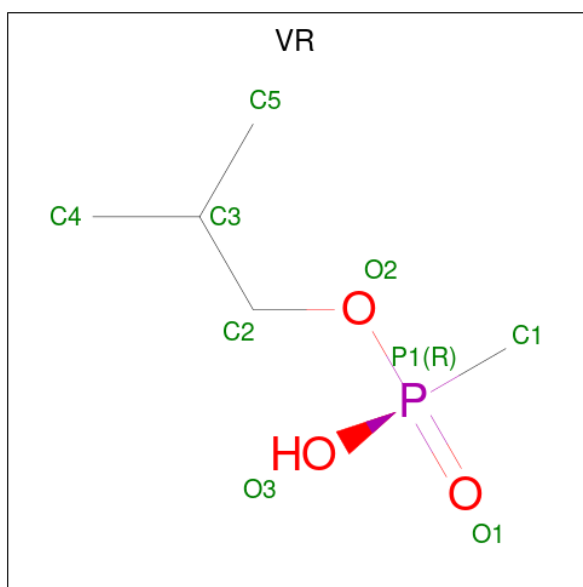


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	B	3	38	22	2	14	0	0	0
2	C	3	38	22	2	14	0	0	0

- Molecule 3 is UNKNOWN ATOM OR ION (CCD ID: UNX) (formula: X).

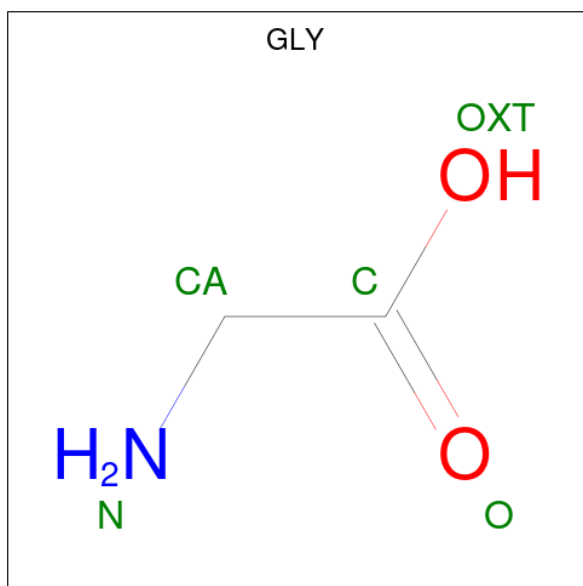
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	23	Total	X	0	0
			23	23		

- Molecule 4 is 2-METHYLPROPYL HYDROGEN (R)-METHYLPHOSPHONATE (CCD ID: VR) (formula: C₅H₁₃O₃P).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	O	P	0	0
			8	5	2	1		

- Molecule 5 is GLYCINE (CCD ID: GLY) (formula: $C_2H_5NO_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	N	O	0	0
			5	2	1	2		

- Molecule 6 is SULFATE ION (CCD ID: SO4) (formula: O_4S).



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

- Molecule 7 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	3	Total	Ca	0	0
			3	3		

- Molecule 8 is BROMIDE ION (CCD ID: BR) (formula: Br).

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

- Molecule 9 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	2	Total	Na	0	0
			2	2		

- Molecule 10 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: C₈H₁₅NO₆).



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

- Molecule 11 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

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

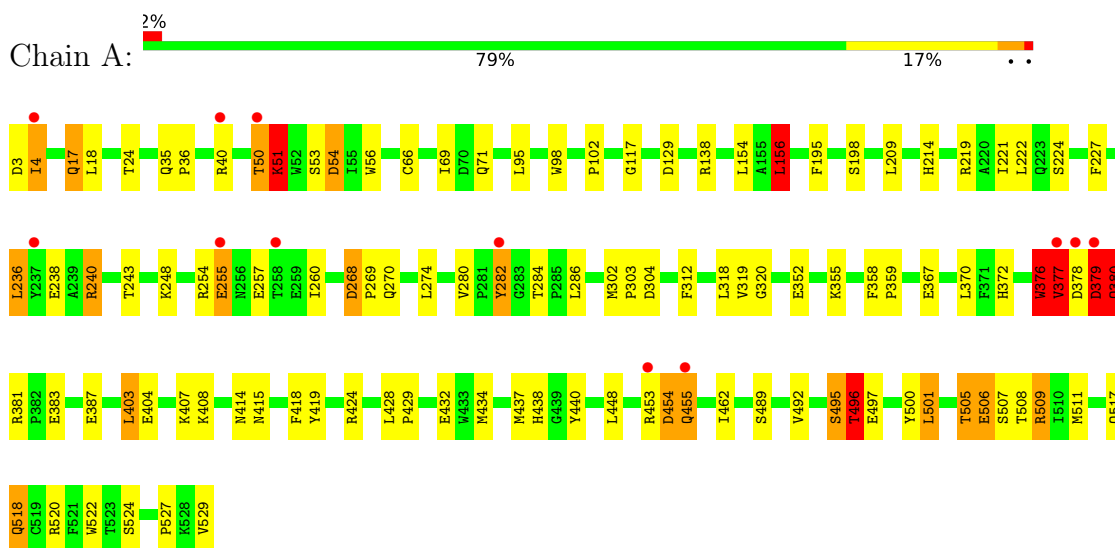
- Molecule 12 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
12	A	419	Total	O	0	0
			419	419		

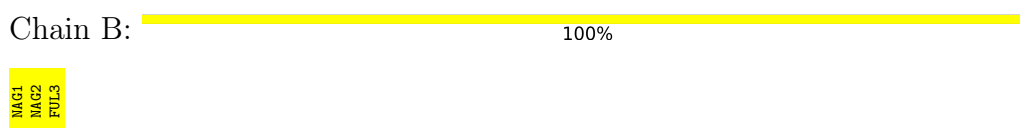
3 Residue-property plots

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



4 Data and refinement statistics

Property	Value	Source
Space group	I 4 2 2	Depositor
Cell constants a, b, c, α , β , γ	154.60Å 154.60Å 127.61Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.51 – 2.30 41.51 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.8 (41.51-2.30) 99.7 (41.51-2.30)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.42 (at 2.29Å)	Xtriage
Refinement program	REFMAC 5.5.0102	Depositor
R, R_{free}	0.162 , 0.215 0.178 , 0.231	Depositor DCC
R_{free} test set	1036 reflections (3.01%)	wwPDB-VP
Wilson B-factor (Å ²)	35.3	Xtriage
Anisotropy	0.421	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 51.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	4862	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.03% 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, CA, UNX, FUL, NAG, NA, SO4, VR, BR

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	1.28	5/4402 (0.1%)	1.19	17/5974 (0.3%)

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	4

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	496	THR	CA-CB	6.61	1.64	1.53
1	A	36	PRO	CA-C	5.68	1.57	1.52
1	A	403	LEU	C-O	-5.63	1.17	1.24
1	A	462	ILE	CA-CB	5.37	1.61	1.54
1	A	501	LEU	CA-C	5.35	1.59	1.52

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	156	LEU	CA-C-N	-8.87	110.74	120.14
1	A	156	LEU	C-N-CA	-8.87	110.74	120.14
1	A	282	TYR	CA-C-N	-7.88	115.41	122.43
1	A	282	TYR	C-N-CA	-7.88	115.41	122.43
1	A	268	ASP	CA-C-N	-7.09	112.33	119.56
1	A	268	ASP	C-N-CA	-7.09	112.33	119.56
1	A	219	ARG	NE-CZ-NH1	-6.21	115.29	121.50
1	A	302	MET	CA-C-N	-6.21	113.29	119.56

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	302	MET	C-N-CA	-6.21	113.29	119.56
1	A	376	TRP	CA-C-N	5.99	132.47	121.70
1	A	376	TRP	C-N-CA	5.99	132.47	121.70
1	A	432	GLU	N-CA-C	5.81	118.36	111.33
1	A	219	ARG	CG-CD-NE	-5.54	99.81	112.00
1	A	454	ASP	N-CA-C	5.29	119.72	113.16
1	A	507	SER	CA-C-N	5.13	128.39	121.05
1	A	507	SER	C-N-CA	5.13	128.39	121.05
1	A	497	GLU	N-CA-C	5.08	117.94	111.69

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	377	VAL	Peptide
1	A	380	GLN	Peptide
1	A	455[A]	GLN	Sidechain
1	A	455[B]	GLN	Sidechain

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	4258	0	4166	94	0
2	B	38	0	34	0	0
2	C	38	0	34	2	0
3	A	23	0	0	1	0
4	A	8	0	12	3	0
5	A	5	0	2	2	0
6	A	10	0	0	1	0
7	A	3	0	0	0	0
8	A	1	0	0	0	0
9	A	2	0	0	0	0
10	A	56	0	52	1	0
11	A	1	0	0	0	0
12	A	419	0	0	22	0
All	All	4862	0	4300	97	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 11.

All (97) 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:4:ILE:H	1:A:4:ILE:HD12	1.01	1.11
1:A:4:ILE:HD12	1:A:4:ILE:N	1.66	1.10
1:A:4:ILE:H	1:A:4:ILE:CD1	1.75	0.98
1:A:455[A]:GLN:NE2	1:A:455[A]:GLN:CD	2.22	0.97
1:A:518:GLN:HE21	1:A:518:GLN:H	1.12	0.97
1:A:408:LYS:HE3	12:A:2243:HOH:O	1.68	0.93
1:A:304:ASP:HB3	12:A:2240:HOH:O	1.73	0.88
1:A:495:SER:HA	12:A:2379:HOH:O	1.75	0.85
1:A:501:LEU:HD11	1:A:508:THR:CG2	2.11	0.81
1:A:496:THR:N	12:A:2379:HOH:O	1.90	0.80
1:A:404:GLU:HG2	12:A:2193:HOH:O	1.83	0.78
1:A:509:ARG:HH11	1:A:509:ARG:HG2	1.47	0.78
1:A:255:GLU:H	1:A:255:GLU:CD	1.93	0.77
1:A:495:SER:CA	12:A:2379:HOH:O	2.35	0.74
1:A:376:TRP:O	12:A:2289:HOH:O	2.04	0.73
1:A:35:GLN:HG2	12:A:2045:HOH:O	1.88	0.72
1:A:227:PHE:CD1	1:A:227:PHE:C	2.72	0.67
1:A:522:TRP:O	1:A:527:PRO:HD3	1.92	0.67
1:A:378:ASP:O	1:A:380:GLN:NE2	2.27	0.67
1:A:495:SER:O	12:A:2377:HOH:O	2.13	0.67
1:A:518:GLN:H	1:A:518:GLN:NE2	1.88	0.67
1:A:17:GLN:HE21	1:A:17:GLN:HA	1.59	0.67
1:A:71:GLN:HG2	12:A:2068:HOH:O	1.96	0.66
1:A:320:GLY:HA3	1:A:419:TYR:CE1	2.31	0.66
1:A:50:THR:O	1:A:51:LYS:HB3	1.94	0.65
1:A:404:GLU:OE1	12:A:2313:HOH:O	2.15	0.63
1:A:282:TYR:O	1:A:282:TYR:HD2	1.82	0.63
1:A:209:LEU:HD12	1:A:312:PHE:HB3	1.82	0.60
1:A:98:TRP:HE1	5:A:1548:GLY:N	1.99	0.60
1:A:51:LYS:N	12:A:2046:HOH:O	2.35	0.58
1:A:377:VAL:HG13	1:A:377:VAL:O	2.03	0.58
1:A:520:ARG:NH2	12:A:2407:HOH:O	2.36	0.57
1:A:320:GLY:HA3	1:A:419:TYR:CZ	2.39	0.57
1:A:501:LEU:HD11	1:A:508:THR:HG22	1.88	0.56
1:A:509:ARG:HH11	1:A:509:ARG:CG	2.19	0.55
1:A:282:TYR:O	1:A:282:TYR:CD2	2.60	0.55
1:A:505:THR:HG23	1:A:506[B]:GLU:OE2	2.07	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:509:ARG:NH1	12:A:2392:HOH:O	2.37	0.55
1:A:376:TRP:HA	1:A:377:VAL:HG12	1.89	0.54
1:A:117:GLY:HA2	4:A:1530:VR:H21C	1.89	0.53
1:A:424:ARG:NH1	1:A:428:LEU:HD23	2.23	0.53
1:A:240:ARG:NH1	1:A:257:GLU:OE2	2.37	0.53
1:A:377:VAL:N	1:A:378:ASP:HA	2.22	0.53
1:A:214:HIS:HE1	12:A:2249:HOH:O	1.90	0.53
1:A:438:HIS:NE2	4:A:1530:VR:H12C	2.24	0.52
1:A:455[A]:GLN:NE2	1:A:455[A]:GLN:CG	2.71	0.52
1:A:379:ASP:O	1:A:381:ARG:HB2	2.10	0.52
2:C:2:NAG:H5	2:C:2:NAG:N2	2.25	0.52
1:A:18:LEU:O	1:A:24:THR:HA	2.09	0.51
1:A:378:ASP:O	1:A:379:ASP:C	2.53	0.51
1:A:129:ASP:OD1	5:A:1548:GLY:N	2.45	0.50
1:A:500:TYR:CZ	1:A:511[A]:MET:HB2	2.47	0.49
1:A:102:PRO:O	1:A:138:ARG:NH2	2.46	0.49
1:A:286:LEU:HD23	4:A:1530:VR:H43C	1.93	0.49
1:A:156:LEU:HD13	1:A:243:THR:HG21	1.95	0.49
1:A:227:PHE:CE1	1:A:303:PRO:HB2	2.48	0.48
1:A:255:GLU:CD	1:A:255:GLU:N	2.68	0.48
1:A:221:ILE:C	1:A:222:LEU:HD12	2.40	0.47
1:A:372[A]:HIS:CE1	12:A:2285:HOH:O	2.68	0.47
1:A:53:SER:O	1:A:54:ASP:CB	2.63	0.46
1:A:56:TRP:CD1	1:A:56:TRP:C	2.93	0.46
1:A:352:GLU:HG3	12:A:2275:HOH:O	2.14	0.45
1:A:198:SER:HA	1:A:224:SER:O	2.16	0.45
1:A:284:THR:HG22	1:A:359:PRO:HG3	1.98	0.45
1:A:383:GLU:CD	1:A:383:GLU:H	2.25	0.45
1:A:319:VAL:O	1:A:418:PHE:HA	2.17	0.45
1:A:318:LEU:C	1:A:318:LEU:HD23	2.42	0.45
1:A:358:PHE:N	1:A:359:PRO:CD	2.80	0.45
1:A:320:GLY:HA3	1:A:419:TYR:CD1	2.52	0.44
1:A:415:ASN:CG	6:A:1549:SO4:O3	2.61	0.44
1:A:380:GLN:HE21	1:A:380:GLN:HA	1.83	0.44
1:A:222:LEU:HD12	1:A:222:LEU:N	2.32	0.44
1:A:372[A]:HIS:CE1	1:A:518:GLN:HA	2.52	0.44
1:A:355:LYS:HE3	1:A:355:LYS:HB2	1.50	0.44
1:A:377:VAL:N	1:A:378:ASP:CA	2.80	0.44
1:A:236:LEU:HD12	1:A:236:LEU:HA	1.69	0.43
1:A:248:LYS:HD3	2:C:3:FUL:H61	2.00	0.43
1:A:376:TRP:C	1:A:378:ASP:HA	2.44	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:3:ASP:N	12:A:2001:HOH:O	2.50	0.43
1:A:66:CYS:SG	12:A:2096:HOH:O	1.92	0.43
1:A:501:LEU:HD11	1:A:508:THR:HG23	1.99	0.43
1:A:372[A]:HIS:HE1	1:A:518:GLN:HA	1.85	0.42
1:A:379:ASP:O	1:A:380:GLN:NE2	2.52	0.42
1:A:95:LEU:HD12	1:A:95:LEU:C	2.45	0.42
1:A:414[B]:ASN:ND2	1:A:414[B]:ASN:H	2.16	0.42
1:A:268:ASP:O	1:A:269:PRO:C	2.62	0.42
1:A:383:GLU:O	1:A:387:GLU:HG3	2.20	0.41
1:A:428:LEU:CD1	1:A:440:TYR:CD2	3.03	0.41
1:A:434:MET:HE2	1:A:437:MET:HE3	2.02	0.41
1:A:428:LEU:HA	1:A:429:PRO:HD3	1.94	0.41
1:A:254:ARG:HB2	1:A:260:ILE:HG13	2.04	0.41
1:A:403:LEU:O	1:A:407:LYS:HG3	2.21	0.40
1:A:40:ARG:NE	12:A:2030:HOH:O	2.54	0.40
1:A:408:LYS:HG3	12:A:2243:HOH:O	2.21	0.40
1:A:509:ARG:CG	1:A:509:ARG:NH1	2.80	0.40
3:A:1513:UNX:UNK	3:A:1514:UNX:UNK	1.64	0.40
10:A:1559:NAG:O6	12:A:2417:HOH:O	2.22	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	534/527 (101%)	515 (96%)	14 (3%)	5 (1%)	14 17

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	54	ASP
1	A	377	VAL

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Mol	Chain	Res	Type
1	A	51	LYS
1	A	496	THR
1	A	379	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	461/452 (102%)	425 (92%)	36 (8%)	11	16

All (36) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	ILE
1	A	17	GLN
1	A	50	THR
1	A	51	LYS
1	A	69	ILE
1	A	154	LEU
1	A	156	LEU
1	A	195	PHE
1	A	236	LEU
1	A	238[A]	GLU
1	A	238[B]	GLU
1	A	240	ARG
1	A	255	GLU
1	A	270	GLN
1	A	274	LEU
1	A	280	VAL
1	A	367	GLU
1	A	370	LEU
1	A	376	TRP
1	A	377	VAL
1	A	379	ASP
1	A	380	GLN
1	A	448	LEU

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Mol	Chain	Res	Type
1	A	453	ARG
1	A	454	ASP
1	A	489	SER
1	A	492	VAL
1	A	495	SER
1	A	505	THR
1	A	506[A]	GLU
1	A	506[B]	GLU
1	A	509	ARG
1	A	517	GLN
1	A	518	GLN
1	A	524	SER
1	A	529	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	17	GLN
1	A	126	HIS
1	A	289	ASN
1	A	311	GLN
1	A	517	GLN
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	2.42	10 (58%)
2	NAG	B	2	2	14,14,15	0.80	0	17,19,21	2.46	4 (23%)
2	FUL	B	3	2	10,10,11	1.01	0	14,14,16	2.54	5 (35%)
2	NAG	C	1	2,1	14,14,15	0.56	0	17,19,21	2.20	3 (17%)
2	NAG	C	2	2	14,14,15	1.41	2 (14%)	17,19,21	2.48	4 (23%)
2	FUL	C	3	2	10,10,11	0.96	0	14,14,16	2.24	7 (50%)

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

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	2	NAG	C1-C2	3.99	1.57	1.52
2	C	2	NAG	C2-N2	2.46	1.50	1.46

All (33) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	2	NAG	C2-N2-C7	8.01	133.64	122.90
2	B	2	NAG	C1-O5-C5	7.56	122.31	112.19
2	C	1	NAG	C1-O5-C5	7.38	122.08	112.19
2	B	3	FUL	C1-C2-C3	-7.05	99.38	109.64
2	B	1	NAG	C3-C4-C5	-5.10	100.98	110.23
2	B	1	NAG	C6-C5-C4	3.81	122.38	113.02
2	C	3	FUL	C1-C2-C3	-3.74	104.19	109.64

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	3	FUL	C1-O5-C5	-3.72	104.20	112.97
2	B	3	FUL	C1-O5-C5	-3.37	105.01	112.97
2	B	1	NAG	O5-C1-C2	-3.31	106.17	111.29
2	C	2	NAG	O7-C7-N2	3.11	127.48	121.98
2	B	2	NAG	C3-C4-C5	-3.08	104.64	110.23
2	C	3	FUL	C3-C4-C5	3.02	114.41	109.81
2	C	1	NAG	C1-C2-N2	-2.95	105.78	110.43
2	B	3	FUL	O5-C5-C6	2.88	113.66	107.40
2	B	2	NAG	O5-C5-C6	2.81	113.13	107.66
2	B	1	NAG	O6-C6-C5	2.79	120.84	111.33
2	B	1	NAG	C8-C7-N2	2.78	120.73	116.12
2	C	1	NAG	O5-C1-C2	2.68	115.44	111.29
2	B	3	FUL	O2-C2-C3	2.67	115.69	110.15
2	C	3	FUL	C6-C5-C4	2.65	117.92	113.08
2	B	1	NAG	C4-C3-C2	2.55	114.75	111.02
2	C	2	NAG	C4-C3-C2	-2.47	107.40	111.02
2	B	1	NAG	C2-N2-C7	2.45	126.19	122.90
2	B	2	NAG	O5-C1-C2	2.39	114.99	111.29
2	C	3	FUL	O2-C2-C1	2.37	114.66	109.22
2	C	3	FUL	O3-C3-C4	2.34	115.90	110.38
2	B	1	NAG	O7-C7-C8	-2.32	117.92	122.05
2	C	2	NAG	O7-C7-C8	-2.27	118.01	122.05
2	B	3	FUL	O2-C2-C1	2.24	114.36	109.22
2	B	1	NAG	C1-C2-N2	-2.15	107.04	110.43
2	C	3	FUL	O2-C2-C3	-2.14	105.72	110.15
2	B	1	NAG	O4-C4-C5	2.04	114.34	109.32

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	C	1	NAG	C1

All (9) torsion outliers are listed below:

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

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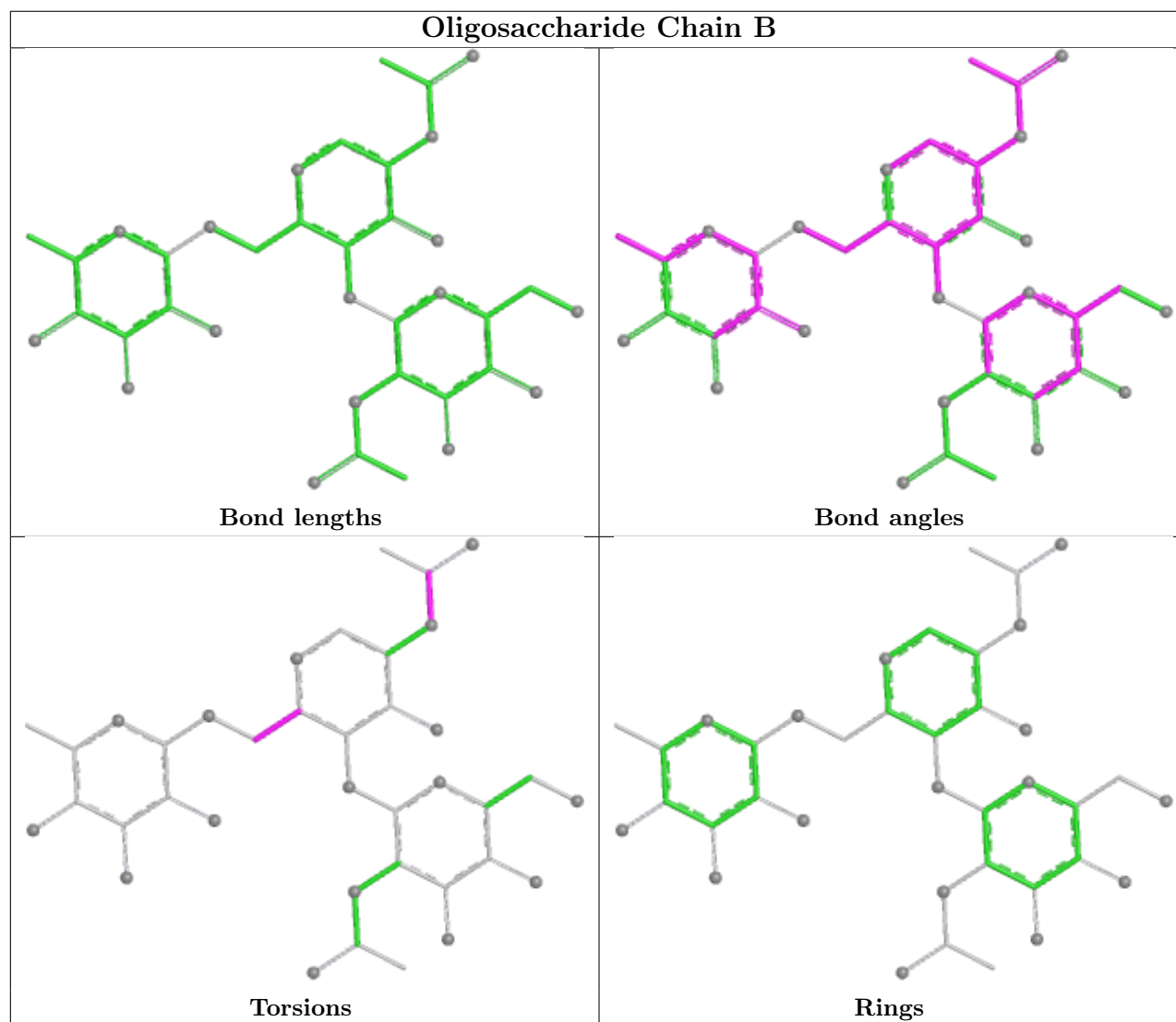
Mol	Chain	Res	Type	Atoms
2	C	2	NAG	C3-C2-N2-C7
2	C	2	NAG	O5-C5-C6-O6

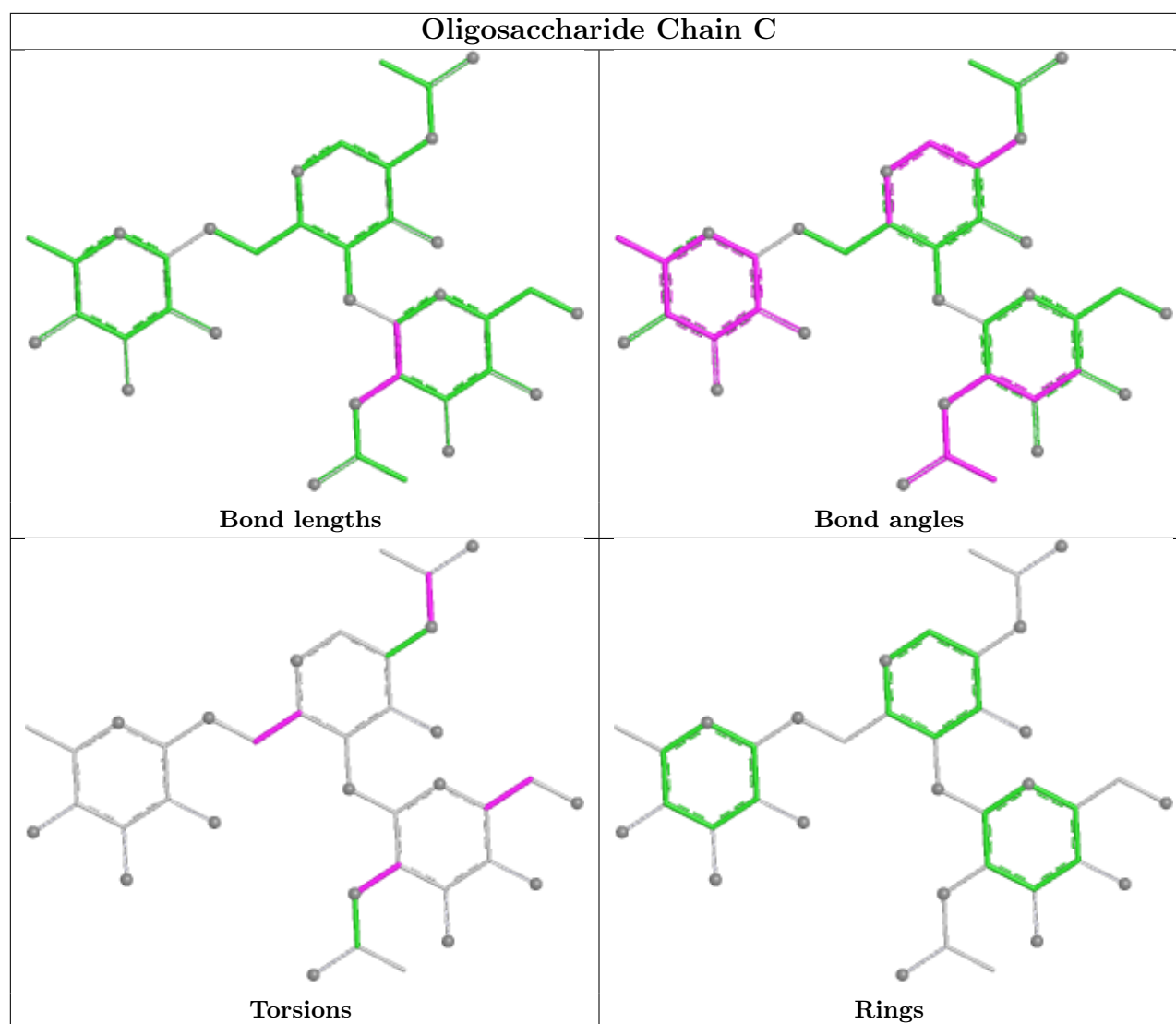
There are no ring outliers.

2 monomers are involved in 2 short contacts:

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

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





5.6 Ligand geometry [i](#)

Of 38 ligands modelled in this entry, 23 are unknown and 7 are monoatomic - leaving 8 for Mogul analysis.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
6	SO4	A	1549	-	4,4,4	0.30	0	6,6,6	0.29	0
10	NAG	A	1562	1	14,14,15	1.01	1 (7%)	17,19,21	1.68	2 (11%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
10	NAG	A	1560	1	14,14,15	0.61	0	17,19,21	2.18	5 (29%)
10	NAG	A	1561	1	14,14,15	0.92	0	17,19,21	1.76	5 (29%)
4	VR	A	1530	1	4,7,8	1.17	1 (25%)	3,8,11	0.55	0
10	NAG	A	1559	1	14,14,15	1.21	1 (7%)	17,19,21	2.10	4 (23%)
6	SO4	A	1550	-	4,4,4	0.32	0	6,6,6	0.38	0
5	GLY	A	1548	-	4,4,4	0.88	0	3,4,4	0.85	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
10	NAG	A	1562	1	-	3/6/23/26	0/1/1/1
10	NAG	A	1560	1	-	4/6/23/26	0/1/1/1
10	NAG	A	1561	1	-	2/6/23/26	0/1/1/1
4	VR	A	1530	1	-	1/3/5/6	-
10	NAG	A	1559	1	-	2/6/23/26	0/1/1/1
5	GLY	A	1548	-	-	2/2/2/2	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
10	A	1559	NAG	C1-C2	3.04	1.56	1.52
10	A	1562	NAG	C1-C2	2.53	1.55	1.52
4	A	1530	VR	O2-C2	-2.18	1.37	1.44

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
10	A	1560	NAG	C1-O5-C5	6.41	120.78	112.19
10	A	1559	NAG	C2-N2-C7	5.06	129.68	122.90
10	A	1559	NAG	C8-C7-N2	4.42	123.45	116.12
10	A	1561	NAG	C1-O5-C5	3.89	117.41	112.19
10	A	1562	NAG	O5-C5-C6	3.79	115.03	107.66
10	A	1559	NAG	O7-C7-C8	-3.23	116.30	122.05
10	A	1562	NAG	C2-N2-C7	3.19	127.17	122.90
10	A	1560	NAG	C3-C4-C5	3.09	115.83	110.23
10	A	1560	NAG	O5-C1-C2	-3.00	106.65	111.29
10	A	1561	NAG	O5-C5-C6	2.96	113.42	107.66

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
10	A	1560	NAG	C8-C7-N2	2.86	120.86	116.12
10	A	1559	NAG	C1-C2-N2	2.45	114.30	110.43
10	A	1561	NAG	O5-C5-C4	-2.26	105.32	110.83
10	A	1560	NAG	O7-C7-C8	-2.15	118.23	122.05
10	A	1561	NAG	O7-C7-N2	2.04	125.59	121.98
10	A	1561	NAG	C6-C5-C4	2.00	117.94	113.02

There are no chirality outliers.

All (14) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
10	A	1560	NAG	O5-C5-C6-O6
10	A	1561	NAG	O5-C5-C6-O6
10	A	1560	NAG	C4-C5-C6-O6
5	A	1548	GLY	OXT-C-CA-N
10	A	1561	NAG	C4-C5-C6-O6
10	A	1559	NAG	C8-C7-N2-C2
10	A	1559	NAG	O7-C7-N2-C2
10	A	1560	NAG	C8-C7-N2-C2
10	A	1560	NAG	O7-C7-N2-C2
10	A	1562	NAG	O5-C5-C6-O6
10	A	1562	NAG	C4-C5-C6-O6
5	A	1548	GLY	O-C-CA-N
10	A	1562	NAG	C1-C2-N2-C7
4	A	1530	VR	O2-C2-C3-C4

There are no ring outliers.

4 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	1549	SO4	1	0
4	A	1530	VR	3	0
10	A	1559	NAG	1	0
5	A	1548	GLY	2	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	527/527 (100%)	-0.35	12 (2%) 61 63	16, 33, 62, 95	23 (4%)

All (12) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	379	ASP	4.1
1	A	377	VAL	3.7
1	A	455[A]	GLN	3.7
1	A	258	THR	3.6
1	A	4	ILE	3.2
1	A	237	TYR	3.1
1	A	50	THR	3.0
1	A	453	ARG	2.8
1	A	282	TYR	2.4
1	A	378	ASP	2.3
1	A	255	GLU	2.2
1	A	40	ARG	2.2

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

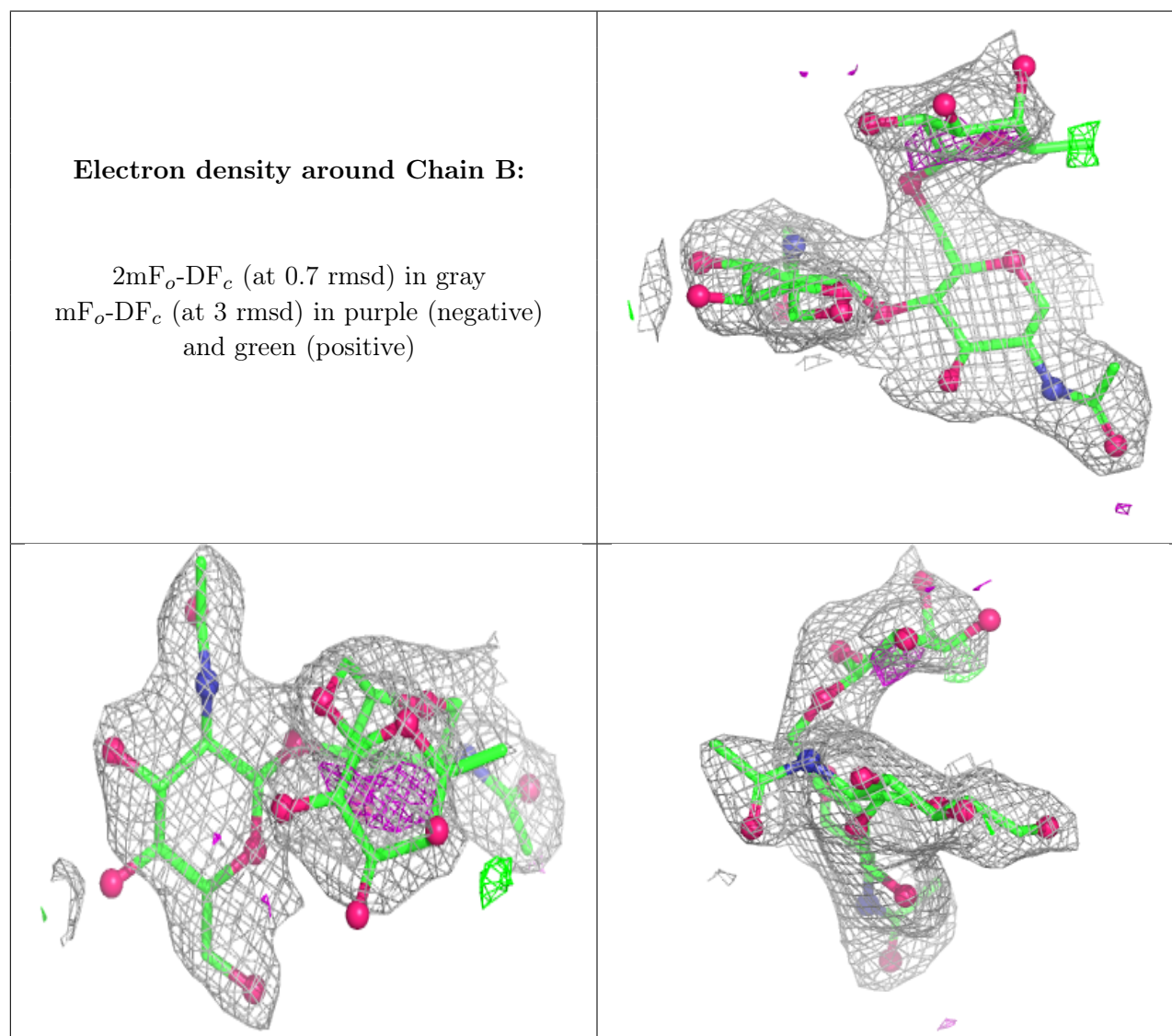
There are no non-standard protein/DNA/RNA residues in this entry.

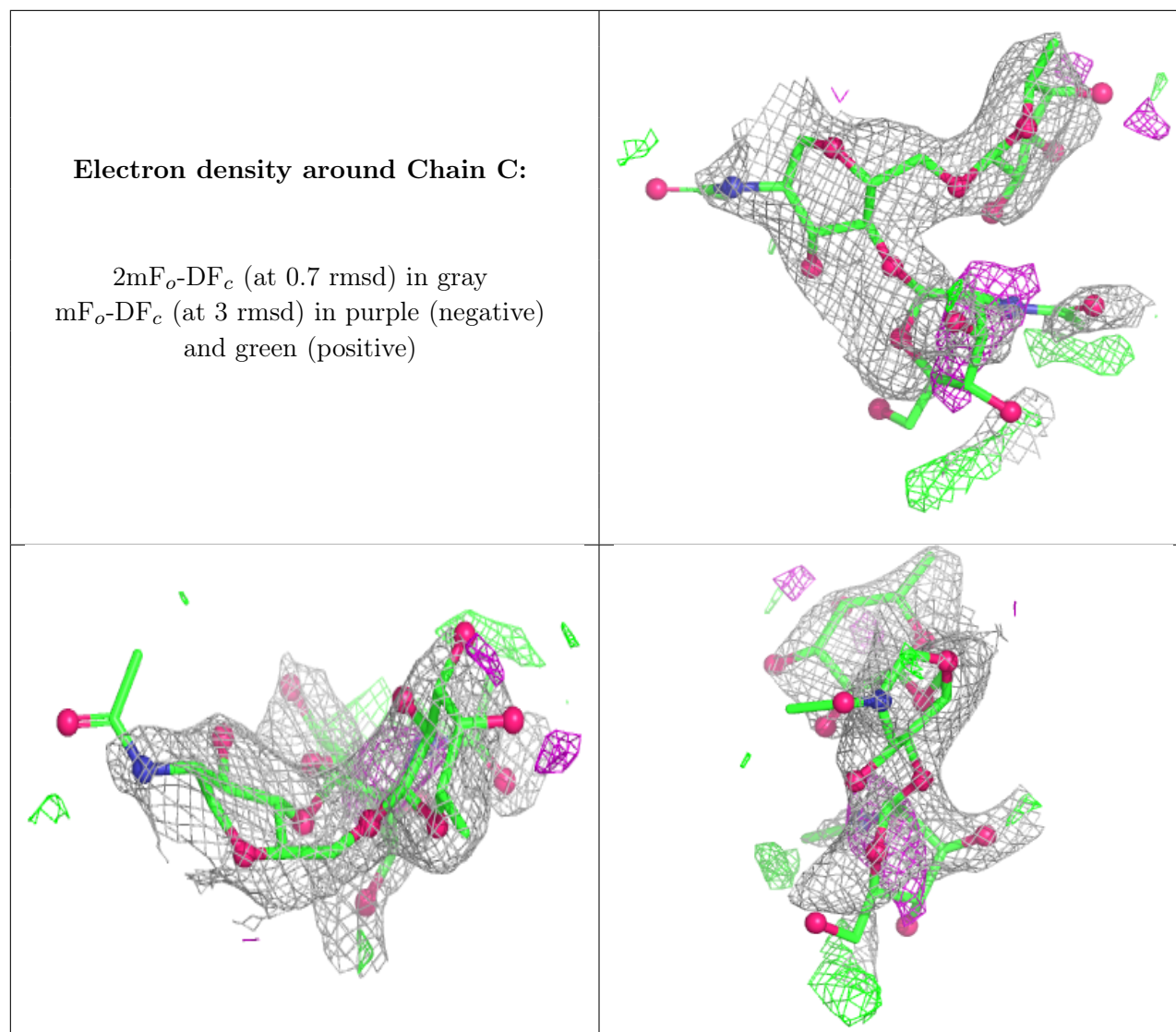
6.3 Carbohydrates [i](#)

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	C	2	14/15	0.31	0.23	93,99,101,101	0
2	FUL	B	3	10/11	0.72	0.18	71,75,76,79	0
2	NAG	B	2	14/15	0.78	0.14	66,71,75,79	0
2	FUL	C	3	10/11	0.78	0.15	75,78,80,80	0
2	NAG	C	1	14/15	0.79	0.13	66,77,86,88	0
2	NAG	B	1	14/15	0.94	0.08	35,49,56,65	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 [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	UNX	A	1501	1/1	0.49	0.26	56,56,56,56	0
10	NAG	A	1560	14/15	0.65	0.15	63,71,76,78	0
3	UNX	A	1512	1/1	0.70	0.17	33,33,33,33	0
10	NAG	A	1562	14/15	0.72	0.14	76,84,90,92	0
10	NAG	A	1561	14/15	0.76	0.15	47,66,73,74	0
10	NAG	A	1559	14/15	0.76	0.14	54,61,64,67	0
3	UNX	A	1519	1/1	0.80	0.18	51,51,51,51	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	UNX	A	1506	1/1	0.82	0.21	23,23,23,23	0
3	UNX	A	1515	1/1	0.83	0.15	34,34,34,34	0
3	UNX	A	1502	1/1	0.83	0.12	47,47,47,47	0
3	UNX	A	1504	1/1	0.84	0.15	26,26,26,26	0
3	UNX	A	1520	1/1	0.86	0.10	45,45,45,45	0
9	NA	A	1567	1/1	0.86	0.37	63,63,63,63	0
3	UNX	A	1507	1/1	0.86	0.40	55,55,55,55	0
3	UNX	A	1505	1/1	0.87	0.09	37,37,37,37	0
11	CL	A	1566	1/1	0.87	0.13	64,64,64,64	0
3	UNX	A	1508	1/1	0.88	0.15	20,20,20,20	0
3	UNX	A	1521	1/1	0.88	0.14	37,37,37,37	0
3	UNX	A	1516	1/1	0.89	0.09	34,34,34,34	0
3	UNX	A	1503	1/1	0.89	0.11	47,47,47,47	0
6	SO4	A	1550	5/5	0.89	0.13	61,61,65,65	5
3	UNX	A	1518	1/1	0.90	0.19	48,48,48,48	0
9	NA	A	1555	1/1	0.90	0.15	60,60,60,60	1
7	CA	A	1551	1/1	0.92	0.12	73,73,73,73	0
3	UNX	A	1522	1/1	0.92	0.21	23,23,23,23	0
3	UNX	A	1523	1/1	0.92	0.19	43,43,43,43	0
3	UNX	A	1513	1/1	0.92	0.10	24,24,24,24	0
3	UNX	A	1514	1/1	0.93	0.10	36,36,36,36	0
3	UNX	A	1510	1/1	0.93	0.09	32,32,32,32	0
3	UNX	A	1511	1/1	0.93	0.11	26,26,26,26	0
3	UNX	A	1517	1/1	0.94	0.12	40,40,40,40	0
5	GLY	A	1548	5/5	0.94	0.09	39,41,42,42	0
7	CA	A	1552	1/1	0.94	0.15	61,61,61,61	0
7	CA	A	1553	1/1	0.94	0.16	66,66,66,66	0
8	BR	A	1554	1/1	0.94	0.08	105,105,105,105	0
6	SO4	A	1549	5/5	0.94	0.09	24,26,27,32	5
3	UNX	A	1509	1/1	0.95	0.07	29,29,29,29	0
4	VR	A	1530	8/9	0.99	0.07	16,26,36,38	0

6.5 Other polymers

There are no such residues in this entry.