



# Full wwPDB X-ray Structure Validation Report ⓘ

Dec 12, 2023 – 05:40 pm GMT

PDB ID : 2XQK  
Title : X-ray Structure of human butyrylcholinesterase inhibited by pure enantiomer VX-(S)  
Authors : Wandhammer, M.; Carletti, E.; Gillon, E.; Masson, P.; Goeldner, M.; Noort, D.; Nachon, F.  
Deposited on : 2010-09-02  
Resolution : 2.40 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

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

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

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

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

MolProbity : 4.02b-467  
Mogul : 1.8.4, CSD as541be (2020)  
Xtrriage (Phenix) : 1.13  
EDS : 2.36  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.36

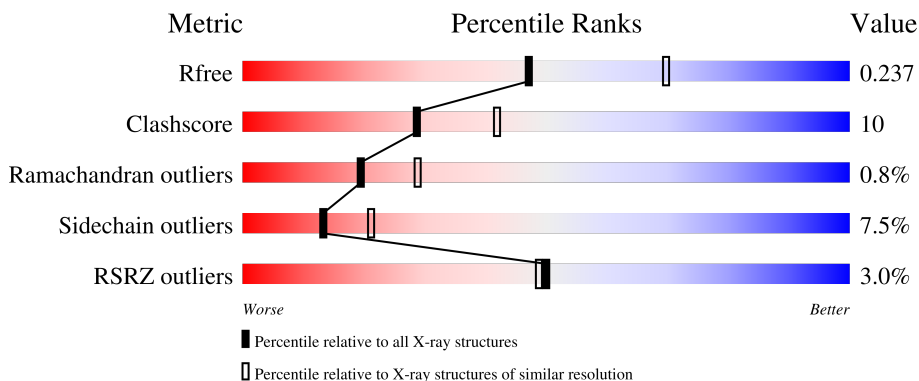
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*



The reported resolution of this entry is 2.40 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	3907 (2.40-2.40)
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (2.40-2.40)

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  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	527	 3% 82% 15% ..
2	B	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
11	NAG	A	1547	-	-	-	X
12	UNX	A	1551	-	-	-	X
12	UNX	A	1559	-	-	-	X
12	UNX	A	1565	-	-	-	X

## 2 Entry composition [i](#)

There are 13 unique types of molecules in this entry. The entry contains 4771 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	4265	2755	713	781	16	0	10	0

There are 4 discrepancies between the modelled and reference sequences:

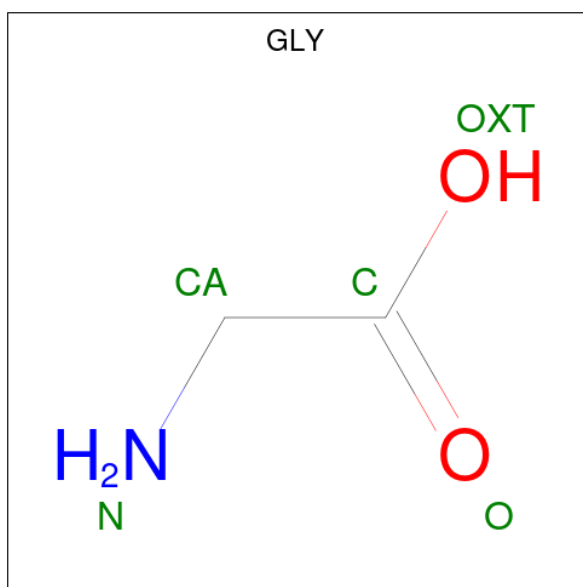
Chain	Residue	Modelled	Actual	Comment	Reference
A	17	GLN	ASN	engineered mutation	UNP P06276
A	455	GLN	ASN	engineered mutation	UNP P06276
A	481	GLN	ASN	engineered mutation	UNP P06276
A	486	GLN	ASN	engineered mutation	UNP P06276

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



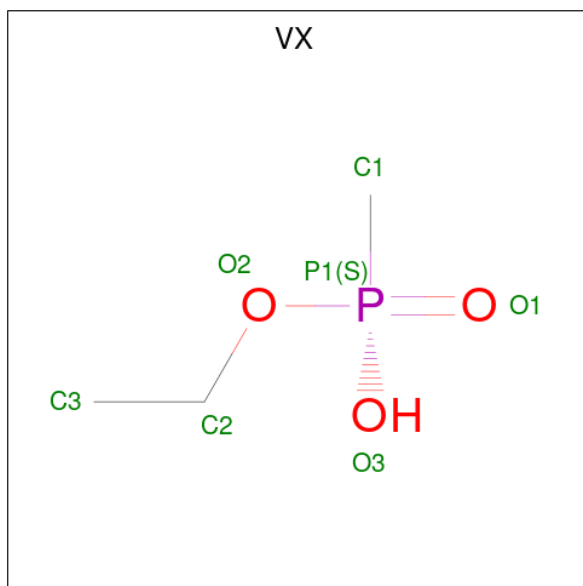
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	B	2	28	16	2	10	0	0	0

- Molecule 3 is GLYCINE (three-letter code: GLY) (formula: C<sub>2</sub>H<sub>5</sub>NO<sub>2</sub>).



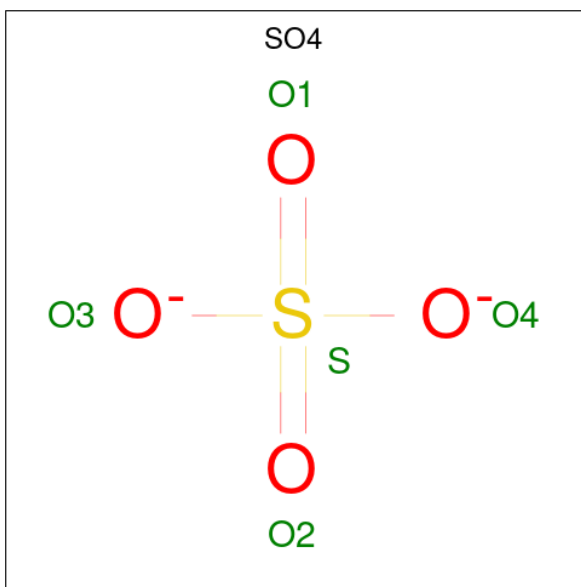
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
3	A	1	5	2	1	2	0	0

- Molecule 4 is O-ETHYLMETHYLPHOSPHONIC ACID ESTER GROUP (three-letter code: VX) (formula: C<sub>3</sub>H<sub>9</sub>O<sub>3</sub>P).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	O	P		
4	A	1	6	3	2	1	0	0

- Molecule 5 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



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

- Molecule 6 is CALCIUM ION (three-letter code: CA) (formula: Ca).

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

- Molecule 7 is SODIUM ION (three-letter code: NA) (formula: Na).

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

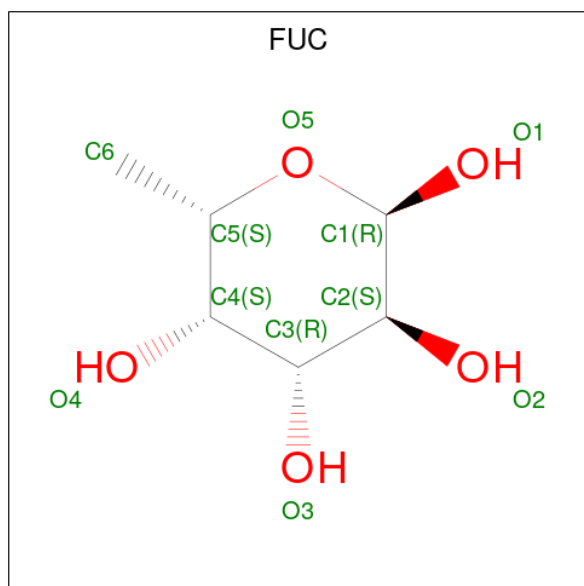
- Molecule 8 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

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

- Molecule 9 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
9	A	1	Total K 1 1	0	0

- Molecule 10 is alpha-L-fucopyranose (three-letter code: FUC) (formula:  $C_6H_{12}O_5$ ).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
10	A	1	Total C O 10 6 4	0	0
10	A	1	Total C O 10 6 4	0	0

- Molecule 11 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula:  $C_8H_{15}NO_6$ ).



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

- Molecule 12 is UNKNOWN ATOM OR ION (three-letter code: UNX) (formula: X).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
12	A	25	Total	X	0	0
			25	25		

- Molecule 13 is water.

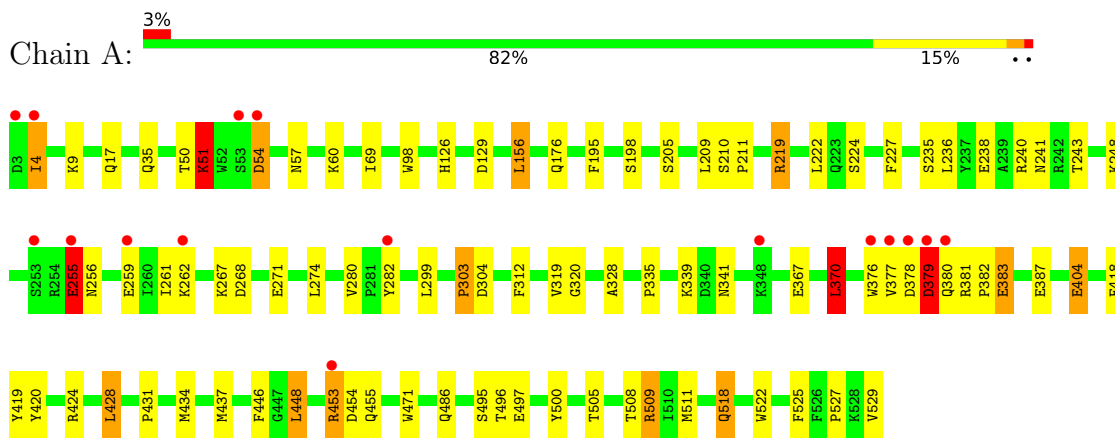
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
13	A	323	Total	O	0	0
			323	323		



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

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

- Molecule 1: CHOLINESTERASE



- Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-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, $\alpha$ , $\beta$ , $\gamma$	154.92Å 154.92Å 127.39Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.53 – 2.40 41.53 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.5 (41.53-2.40) 99.5 (41.53-2.40)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.81 (at 2.39Å)	Xtrriage
Refinement program	REFMAC 5.5.0102	Depositor
R, $R_{free}$	0.157 , 0.217 0.186 , 0.237	Depositor DCC
$R_{free}$ test set	1216 reflections (4.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	36.5	Xtrriage
Anisotropy	0.760	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 46.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	4771	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	41.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.17% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

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

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: SO4, CL, CA, UNX, VX, NA, FUC, K, NAG

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	1.13	5/4413 (0.1%)	0.94	5/5989 (0.1%)

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	255	GLU	CB-CG	8.15	1.67	1.52
1	A	404	GLU	CG-CD	6.05	1.61	1.51
1	A	255	GLU	CG-CD	5.48	1.60	1.51
1	A	446	PHE	CE2-CZ	5.40	1.47	1.37
1	A	420	TYR	CE2-CZ	5.26	1.45	1.38

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	370	LEU	CA-CB-CG	7.65	132.90	115.30
1	A	219	ARG	NE-CZ-NH1	-7.15	116.72	120.30
1	A	448	LEU	CB-CG-CD2	5.69	120.68	111.00
1	A	219	ARG	CG-CD-NE	-5.41	100.44	111.80
1	A	448	LEU	CA-CB-CG	5.37	127.66	115.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4265	0	4173	80	0
2	B	28	0	24	4	0
3	A	5	0	2	2	0
4	A	6	0	8	1	0
5	A	10	0	0	0	0
6	A	1	0	0	0	0
7	A	1	0	0	0	0
8	A	2	0	0	0	0
9	A	1	0	0	0	0
10	A	20	0	20	4	0
11	A	84	0	78	9	0
12	A	25	0	0	0	0
13	A	323	0	0	12	0
All	All	4771	0	4305	85	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 (85) 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:241:ASN:HD21	11:A:1546:NAG:C1	1.38	1.36
1:A:4:ILE:H	1:A:4:ILE:HD12	1.10	1.16
1:A:241:ASN:ND2	11:A:1546:NAG:C1	2.08	1.15
1:A:453:ARG:HG3	1:A:453:ARG:NH1	1.52	1.12
1:A:4:ILE:HD12	1:A:4:ILE:N	1.69	1.07
1:A:453:ARG:HH11	1:A:453:ARG:CG	1.69	1.03
1:A:50:THR:O	1:A:51:LYS:HB3	1.62	0.96
1:A:4:ILE:H	1:A:4:ILE:CD1	1.81	0.92
1:A:453:ARG:HG3	1:A:453:ARG:HH11	0.75	0.85
1:A:328:ALA:HA	1:A:434:MET:HE3	1.58	0.85
1:A:404:GLU:HG2	13:A:2232:HOH:O	1.80	0.81
1:A:453:ARG:NH1	1:A:453:ARG:CG	2.36	0.80
1:A:367[B]:GLU:OE1	13:A:2210:HOH:O	1.99	0.79
1:A:35:GLN:HG2	13:A:2032:HOH:O	1.82	0.78
1:A:509:ARG:HH11	1:A:509:ARG:HG2	1.50	0.77
1:A:518:GLN:HE21	1:A:518:GLN:H	1.35	0.73
1:A:304:ASP:HB3	13:A:2061:HOH:O	1.88	0.73
11:A:1546:NAG:O6	10:A:1548:FUC:C1	2.37	0.72
1:A:320:GLY:HA3	1:A:419:TYR:CE1	2.26	0.71
1:A:522:TRP:O	1:A:527:PRO:HD3	1.90	0.71
4:A:1530:VX:H3	13:A:2165:HOH:O	1.91	0.69

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:267:LYS:HE3	1:A:271:GLU:OE2	1.93	0.68
1:A:328:ALA:HA	1:A:434:MET:CE	2.25	0.67
1:A:57:ASN:HD21	11:A:1543:NAG:HN2	1.43	0.65
1:A:209:LEU:HD12	1:A:312:PHE:HB3	1.77	0.64
1:A:57:ASN:ND2	11:A:1543:NAG:N2	2.46	0.64
1:A:320:GLY:HA3	1:A:419:TYR:CZ	2.34	0.63
1:A:518:GLN:H	1:A:518:GLN:NE2	1.98	0.61
1:A:434:MET:HE2	1:A:437:MET:CE	2.30	0.61
1:A:497:GLU:OE2	13:A:2290:HOH:O	2.16	0.61
1:A:455:GLN:HA	13:A:2261:HOH:O	2.01	0.60
1:A:381:ARG:HB3	1:A:383:GLU:OE1	2.02	0.59
1:A:176[A]:GLN:NE2	13:A:2115:HOH:O	2.36	0.58
1:A:509:ARG:HH11	1:A:509:ARG:CG	2.16	0.58
1:A:227:PHE:CE1	1:A:303:PRO:HB2	2.39	0.57
1:A:129:ASP:OD1	3:A:1531:GLY:N	2.38	0.57
1:A:434:MET:CE	1:A:437:MET:CE	2.83	0.56
1:A:156:LEU:HD22	1:A:261:ILE:HD11	1.88	0.56
1:A:379:ASP:HB3	1:A:381:ARG:HG3	1.87	0.56
1:A:256:ASN:HD21	11:A:1545:NAG:C1	2.20	0.55
10:A:1541:FUC:C1	2:B:1:NAG:O6	2.55	0.55
1:A:339:LYS:O	1:A:431:PRO:HG3	2.08	0.54
1:A:255:GLU:H	1:A:255:GLU:CD	2.11	0.54
1:A:509:ARG:NH1	13:A:2300:HOH:O	2.36	0.52
1:A:205:SER:HB3	1:A:222:LEU:HD21	1.92	0.51
1:A:227:PHE:CD1	1:A:227:PHE:C	2.83	0.51
1:A:377:VAL:HG13	1:A:377:VAL:O	2.12	0.50
1:A:50:THR:O	1:A:51:LYS:CB	2.45	0.50
1:A:4:ILE:N	1:A:4:ILE:CD1	2.39	0.49
1:A:256:ASN:HD21	11:A:1545:NAG:C7	2.26	0.49
1:A:227:PHE:CD1	1:A:303:PRO:HB2	2.48	0.49
1:A:434:MET:HE2	1:A:437:MET:HE3	1.96	0.48
1:A:341:ASN:ND2	2:B:1:NAG:H83	2.29	0.48
1:A:98:TRP:HE1	3:A:1531:GLY:N	2.12	0.47
1:A:383:GLU:O	1:A:387:GLU:HG3	2.14	0.47
1:A:424:ARG:NH1	1:A:428:LEU:HD12	2.30	0.47
10:A:1541:FUC:H5	2:B:1:NAG:O6	2.14	0.47
1:A:434:MET:HE1	1:A:437:MET:HE1	1.98	0.46
1:A:256:ASN:ND2	11:A:1545:NAG:C1	2.79	0.46
1:A:319:VAL:O	1:A:418:PHE:HA	2.16	0.45
1:A:222:LEU:HD12	1:A:222:LEU:N	2.31	0.45
1:A:320:GLY:HA3	1:A:419:TYR:CD1	2.52	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:455:GLN:N	13:A:2261:HOH:O	2.49	0.45
1:A:335:PRO:HD2	13:A:2201:HOH:O	2.17	0.44
1:A:381:ARG:HA	1:A:382:PRO:HD2	1.88	0.44
1:A:198:SER:HA	1:A:224:SER:O	2.17	0.44
1:A:256:ASN:ND2	11:A:1545:NAG:O7	2.50	0.44
1:A:525:PHE:CZ	1:A:529:VAL:HG23	2.53	0.43
1:A:509:ARG:HG2	13:A:2300:HOH:O	2.18	0.43
1:A:376:TRP:C	1:A:378:ASP:HA	2.39	0.43
1:A:434:MET:CE	1:A:437:MET:HE3	2.47	0.43
1:A:500:TYR:CZ	1:A:511[A]:MET:HB2	2.54	0.43
1:A:378:ASP:O	1:A:379:ASP:O	2.37	0.43
1:A:370:LEU:C	1:A:370:LEU:HD13	2.39	0.42
1:A:156:LEU:CD2	1:A:261:ILE:HD11	2.49	0.42
1:A:156:LEU:HD13	1:A:243:THR:HG21	2.02	0.42
1:A:210:SER:HA	1:A:211:PRO:HD2	1.85	0.42
1:A:267:LYS:HD2	1:A:267:LYS:HA	1.66	0.42
1:A:256:ASN:HB3	1:A:259:GLU:HB2	2.02	0.41
1:A:235:SER:OG	1:A:238[B]:GLU:HG3	2.21	0.41
1:A:509:ARG:CG	1:A:509:ARG:NH1	2.79	0.41
10:A:1541:FUC:H5	2:B:1:NAG:C6	2.50	0.41
1:A:126[A]:HIS:CE1	1:A:448:LEU:HD13	2.56	0.41
1:A:434:MET:HE2	1:A:437:MET:SD	2.61	0.41
1:A:299:LEU:HD23	1:A:299:LEU:HA	1.89	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	535/527 (102%)	509 (95%)	22 (4%)	4 (1%)	22 32

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	51	LYS
1	A	496	THR
1	A	379	ASP
1	A	54	ASP

### 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	462/452 (102%)	428 (93%)	34 (7%)	13 22

All (34) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	ILE
1	A	9	LYS
1	A	17	GLN
1	A	51	LYS
1	A	54	ASP
1	A	60	LYS
1	A	69	ILE
1	A	156	LEU
1	A	195	PHE
1	A	219	ARG
1	A	236	LEU
1	A	240	ARG
1	A	248	LYS
1	A	255	GLU
1	A	262	LYS
1	A	268	ASP
1	A	274	LEU
1	A	280	VAL
1	A	282	TYR
1	A	303	PRO
1	A	370	LEU
1	A	379	ASP
1	A	380	GLN

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Mol	Chain	Res	Type
1	A	383	GLU
1	A	428	LEU
1	A	453	ARG
1	A	454	ASP
1	A	471	TRP
1	A	486	GLN
1	A	495	SER
1	A	505	THR
1	A	508	THR
1	A	509	ARG
1	A	518	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	17	GLN
1	A	57	ASN
1	A	71	GLN
1	A	214	HIS
1	A	241	ASN
1	A	275	ASN
1	A	289	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](#)

2 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	0.99	0	17,19,21	1.98	4 (23%)
2	NAG	B	2	2	14,14,15	0.77	0	17,19,21	2.42	5 (29%)

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	-	2/6/23/26	0/1/1/1

There are no bond length outliers.

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	2	NAG	C3-C4-C5	-6.49	98.67	110.24
2	B	1	NAG	C3-C4-C5	-5.23	100.90	110.24
2	B	2	NAG	O5-C5-C6	4.80	114.73	107.20
2	B	1	NAG	C1-C2-N2	-3.36	104.74	110.49
2	B	2	NAG	O6-C6-C5	-2.53	102.61	111.29
2	B	2	NAG	O4-C4-C5	2.48	115.44	109.30
2	B	2	NAG	C2-N2-C7	2.43	126.36	122.90
2	B	1	NAG	C2-N2-C7	2.40	126.32	122.90
2	B	1	NAG	O5-C5-C6	2.19	110.64	107.20

There are no chirality outliers.

All (6) torsion outliers are listed below:

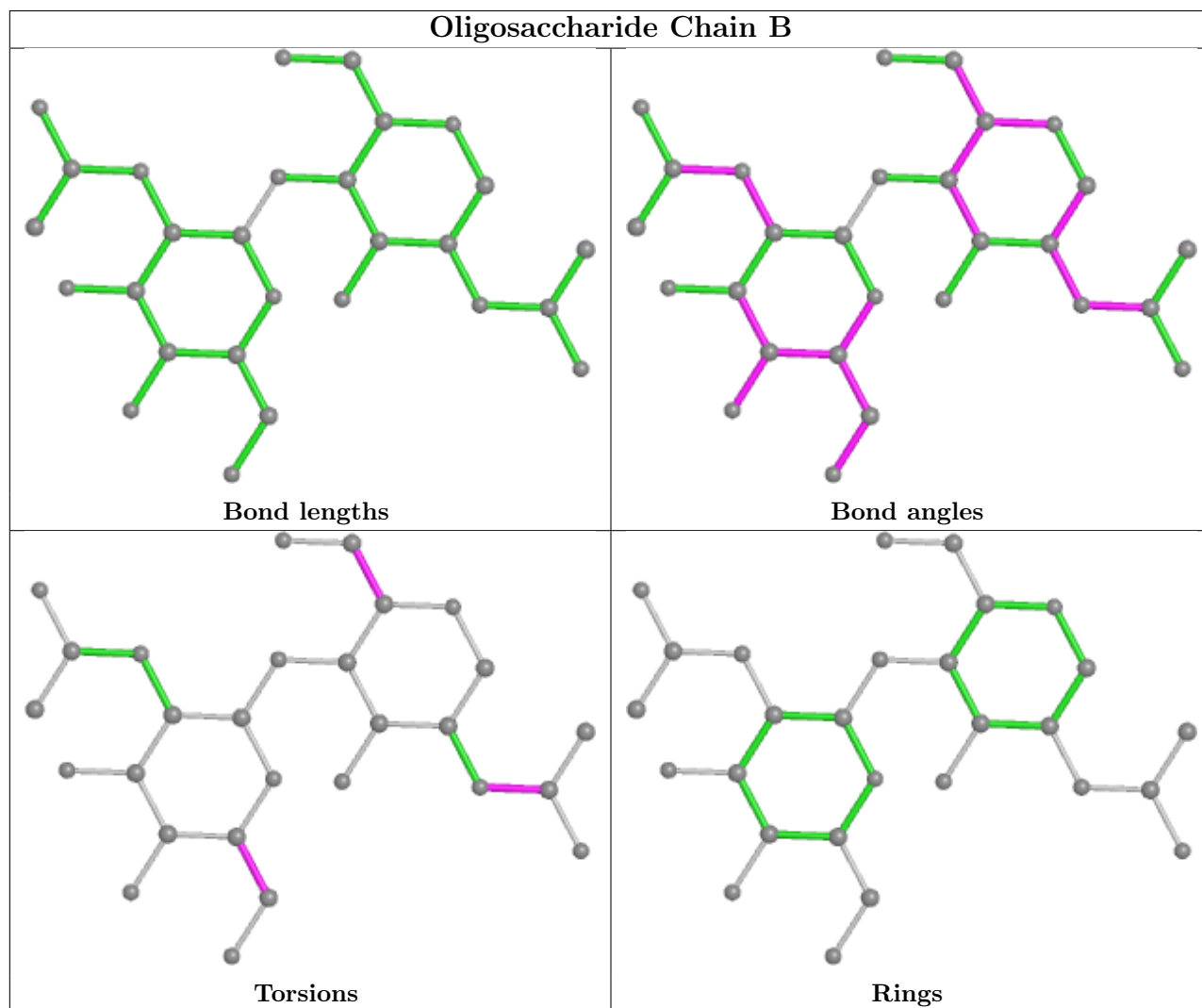
Mol	Chain	Res	Type	Atoms
2	B	2	NAG	C4-C5-C6-O6
2	B	1	NAG	C8-C7-N2-C2
2	B	1	NAG	O7-C7-N2-C2
2	B	1	NAG	O5-C5-C6-O6
2	B	1	NAG	C4-C5-C6-O6
2	B	2	NAG	O5-C5-C6-O6

There are no ring outliers.

1 monomer is involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	1	NAG	4	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 42 ligands modelled in this entry, 5 are monoatomic and 25 are unknown - leaving 12 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
11	NAG	A	1546	-	14,14,15	0.52	0	17,19,21	1.24	3 (17%)
3	GLY	A	1531	-	4,4,4	0.96	0	3,4,4	0.68	0
5	SO4	A	1533	-	4,4,4	0.09	0	6,6,6	0.44	0
11	NAG	A	1543	-	14,14,15	0.76	0	17,19,21	1.95	5 (29%)
11	NAG	A	1544	1	14,14,15	0.89	0	17,19,21	1.93	1 (5%)
5	SO4	A	1532	-	4,4,4	0.21	0	6,6,6	0.69	0
11	NAG	A	1545	-	14,14,15	0.61	0	17,19,21	1.37	2 (11%)
10	FUC	A	1541	-	10,10,11	0.89	0	14,14,16	1.94	6 (42%)
4	VX	A	1530	1	2,5,6	0.67	0	1,5,8	0.57	0
10	FUC	A	1548	-	10,10,11	0.68	0	14,14,16	1.25	1 (7%)
11	NAG	A	1542	1	14,14,15	1.24	1 (7%)	17,19,21	2.06	8 (47%)
11	NAG	A	1547	-	14,14,15	0.69	0	17,19,21	1.84	4 (23%)

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
11	NAG	A	1546	-	-	2/6/23/26	0/1/1/1
3	GLY	A	1531	-	-	0/2/2/2	-
11	NAG	A	1543	-	-	4/6/23/26	0/1/1/1
11	NAG	A	1544	1	-	0/6/23/26	0/1/1/1
11	NAG	A	1545	-	-	1/6/23/26	0/1/1/1
10	FUC	A	1541	-	-	-	0/1/1/1
4	VX	A	1530	1	-	0/1/3/4	-
10	FUC	A	1548	-	-	-	0/1/1/1
11	NAG	A	1542	1	-	2/6/23/26	0/1/1/1
11	NAG	A	1547	-	-	2/6/23/26	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
11	A	1542	NAG	C1-C2	3.10	1.57	1.52

All (30) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
11	A	1544	NAG	C1-O5-C5	6.57	121.09	112.19
11	A	1547	NAG	C2-N2-C7	4.59	129.44	122.90
11	A	1542	NAG	C2-N2-C7	4.43	129.21	122.90
11	A	1547	NAG	C1-C2-N2	4.00	117.33	110.49
11	A	1545	NAG	O5-C5-C6	3.68	112.97	107.20
10	A	1541	FUC	C1-C2-C3	3.67	114.17	109.67
11	A	1543	NAG	C2-N2-C7	3.65	128.11	122.90
11	A	1542	NAG	C8-C7-N2	3.52	122.07	116.10
10	A	1541	FUC	C2-C3-C4	3.46	116.89	110.89
11	A	1543	NAG	C1-C2-N2	3.41	116.31	110.49
10	A	1548	FUC	C3-C4-C5	3.21	114.78	109.77
11	A	1543	NAG	O5-C5-C6	3.13	112.11	107.20
11	A	1543	NAG	C8-C7-N2	3.02	121.22	116.10
11	A	1543	NAG	O7-C7-C8	-2.95	116.58	122.06
11	A	1545	NAG	C2-N2-C7	2.69	126.74	122.90
11	A	1547	NAG	C1-O5-C5	2.59	115.69	112.19
11	A	1542	NAG	C3-C4-C5	-2.56	105.68	110.24
10	A	1541	FUC	C3-C4-C5	2.53	113.71	109.77
11	A	1542	NAG	C1-C2-N2	2.37	114.53	110.49
11	A	1547	NAG	C3-C4-C5	2.34	114.42	110.24
11	A	1542	NAG	O4-C4-C5	2.32	115.05	109.30
11	A	1542	NAG	O5-C5-C6	2.28	110.77	107.20
10	A	1541	FUC	C1-O5-C5	2.25	117.88	112.78
11	A	1542	NAG	O3-C3-C2	2.19	114.00	109.47
11	A	1546	NAG	O4-C4-C5	2.08	114.46	109.30
11	A	1542	NAG	O7-C7-C8	-2.07	118.21	122.06
10	A	1541	FUC	O5-C1-C2	2.05	113.93	110.77
11	A	1546	NAG	C8-C7-N2	2.04	119.55	116.10
10	A	1541	FUC	O5-C5-C4	2.03	113.16	109.52
11	A	1546	NAG	O7-C7-C8	-2.02	118.31	122.06

There are no chirality outliers.

All (11) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
11	A	1543	NAG	O5-C5-C6-O6
11	A	1543	NAG	C4-C5-C6-O6
11	A	1547	NAG	C1-C2-N2-C7
11	A	1542	NAG	C8-C7-N2-C2
11	A	1542	NAG	O7-C7-N2-C2
11	A	1543	NAG	C8-C7-N2-C2

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Mol	Chain	Res	Type	Atoms
11	A	1543	NAG	O7-C7-N2-C2
11	A	1546	NAG	C8-C7-N2-C2
11	A	1546	NAG	O7-C7-N2-C2
11	A	1547	NAG	O5-C5-C6-O6
11	A	1545	NAG	C4-C5-C6-O6

There are no ring outliers.

7 monomers are involved in 15 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
11	A	1546	NAG	3	0
3	A	1531	GLY	2	0
11	A	1543	NAG	2	0
11	A	1545	NAG	4	0
10	A	1541	FUC	3	0
4	A	1530	VX	1	0
10	A	1548	FUC	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, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q < 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	527/527 (100%)	0.02	16 (3%) 50 49	22, 37, 66, 91	15 (2%)

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	255	GLU	4.4
1	A	377	VAL	4.2
1	A	378	ASP	4.0
1	A	54	ASP	3.9
1	A	53	SER	3.3
1	A	3	ASP	3.3
1	A	379	ASP	3.1
1	A	253	SER	3.0
1	A	282	TYR	2.9
1	A	4	ILE	2.8
1	A	453	ARG	2.7
1	A	259	GLU	2.6
1	A	376	TRP	2.3
1	A	380	GLN	2.2
1	A	262	LYS	2.1
1	A	348	LYS	2.0

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

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

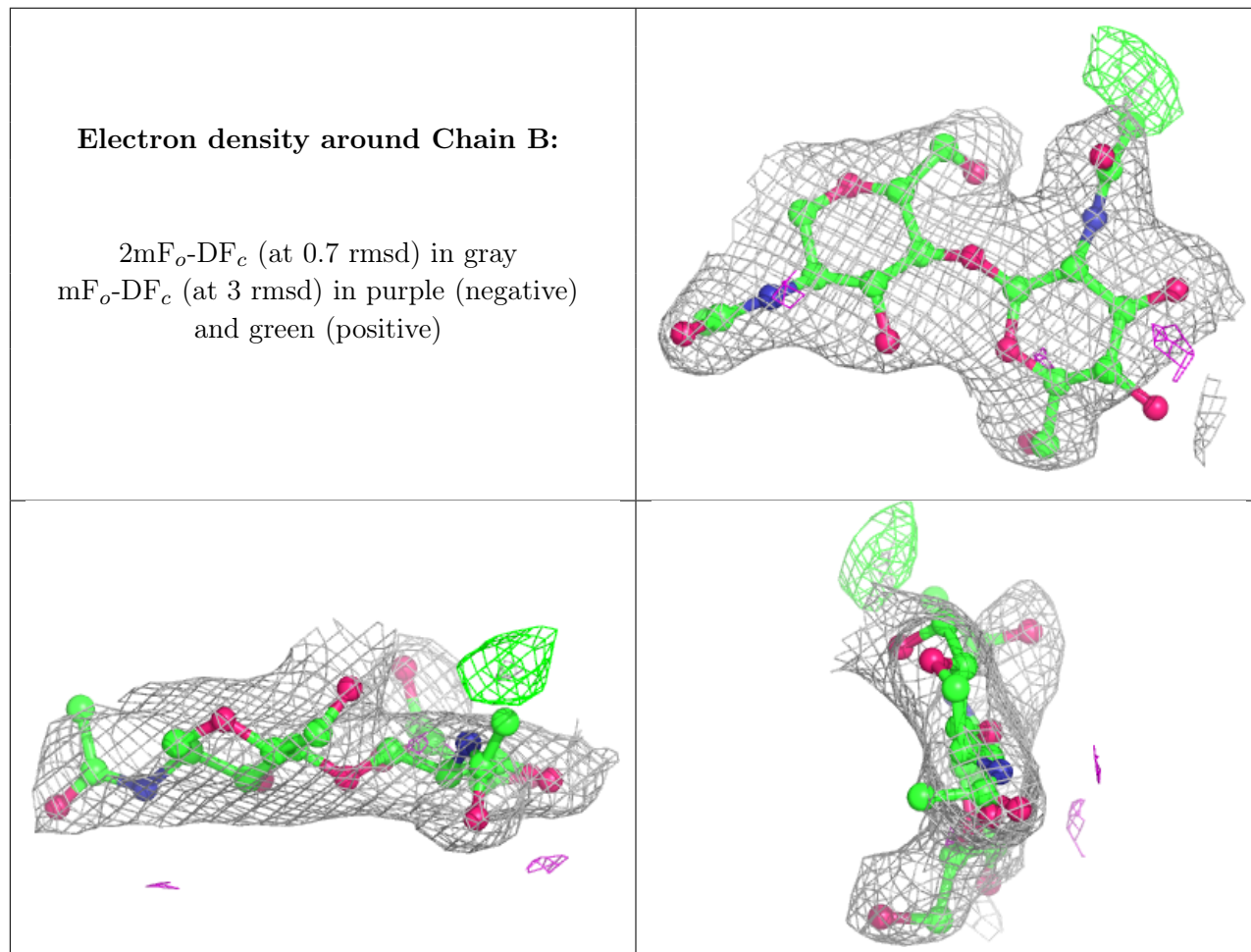
### 6.3 Carbohydrates [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum,

median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	NAG	B	2	14/15	0.80	0.27	67,78,82,82	0
2	NAG	B	1	14/15	0.97	0.21	37,50,54,60	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, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
12	UNX	A	1551	1/1	0.28	0.72	39,39,39,39	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
12	UNX	A	1561	1/1	0.55	0.23	37,37,37,37	0
11	NAG	A	1547	14/15	0.58	0.55	126,131,132,132	0
12	UNX	A	1550	1/1	0.59	0.30	23,23,23,23	0
12	UNX	A	1564	1/1	0.66	0.35	39,39,39,39	0
11	NAG	A	1543	14/15	0.68	0.32	92,99,101,102	0
12	UNX	A	1557	1/1	0.68	0.21	24,24,24,24	0
12	UNX	A	1565	1/1	0.70	0.43	31,31,31,31	0
12	UNX	A	1549	1/1	0.74	0.19	42,42,42,42	0
12	UNX	A	1555	1/1	0.74	0.40	41,41,41,41	0
11	NAG	A	1544	14/15	0.75	0.25	53,69,76,77	0
11	NAG	A	1545	14/15	0.76	0.38	109,114,115,116	0
10	FUC	A	1548	10/11	0.78	0.39	78,83,85,85	0
11	NAG	A	1542	14/15	0.78	0.26	56,65,68,68	0
12	UNX	A	1559	1/1	0.79	0.47	35,35,35,35	0
12	UNX	A	1552	1/1	0.80	0.72	17,17,17,17	0
12	UNX	A	1560	1/1	0.82	0.30	23,23,23,23	0
12	UNX	A	1570	1/1	0.83	0.23	28,28,28,28	0
10	FUC	A	1541	10/11	0.84	0.28	84,87,88,88	0
12	UNX	A	1562	1/1	0.85	0.14	28,28,28,28	0
12	UNX	A	1566	1/1	0.85	0.30	34,34,34,34	0
8	CL	A	1536	1/1	0.85	0.07	81,81,81,81	0
12	UNX	A	1556	1/1	0.86	0.16	14,14,14,14	0
9	K	A	1538	1/1	0.87	0.12	91,91,91,91	1
12	UNX	A	1568	1/1	0.87	0.27	19,19,19,19	0
11	NAG	A	1546	14/15	0.87	0.31	101,106,113,113	0
12	UNX	A	1573	1/1	0.87	0.36	32,32,32,32	0
12	UNX	A	1572	1/1	0.88	0.26	18,18,18,18	0
6	CA	A	1534	1/1	0.89	0.17	79,79,79,79	0
12	UNX	A	1553	1/1	0.89	0.55	20,20,20,20	0
7	NA	A	1535	1/1	0.90	0.28	42,42,42,42	1
12	UNX	A	1558	1/1	0.90	0.36	37,37,37,37	0
12	UNX	A	1569	1/1	0.90	0.38	20,20,20,20	0
12	UNX	A	1567	1/1	0.92	0.33	10,10,10,10	0
12	UNX	A	1563	1/1	0.92	0.09	34,34,34,34	0
8	CL	A	1537	1/1	0.94	0.07	68,68,68,68	0
5	SO4	A	1533	5/5	0.95	0.15	68,68,70,71	5
12	UNX	A	1571	1/1	0.96	0.22	28,28,28,28	0
3	GLY	A	1531	5/5	0.96	0.07	41,43,45,46	0
12	UNX	A	1554	1/1	0.96	0.19	43,43,43,43	0
5	SO4	A	1532	5/5	0.97	0.14	28,29,33,34	5
4	VX	A	1530	6/7	0.98	0.19	28,34,49,54	0



## 6.5 Other polymers [i](#)

There are no such residues in this entry.