



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 05:15 PM UTC

PDB ID : 2ZL6 / pdb_00002zl6
Title : Atomic resolution structural characterization of recognition of histo-blood group antigens by Norwalk virus
Authors : Choi, J.M.; Huston, A.M.; Estes, M.K.; Prasad, B.V.V.
Deposited on : 2008-04-02
Resolution : 1.43 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

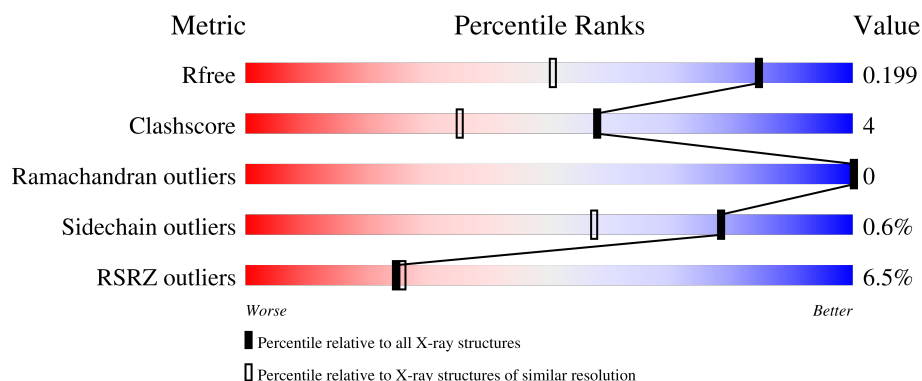
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.43 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	3234 (1.46-1.42)
Clashscore	190562	3289 (1.46-1.42)
Ramachandran outliers	187476	3248 (1.46-1.42)
Sidechain outliers	187428	3248 (1.46-1.42)
RSRZ outliers	180081	3234 (1.46-1.42)

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	295	6% 89% 7% ••
1	B	295	6% 91% 6% •
2	C	5	60% 40%

2 Entry composition [i](#)

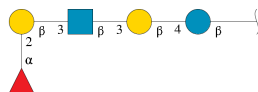
There are 5 unique types of molecules in this entry. The entry contains 5233 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 58 kd capsid protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	286	Total	C	N	O	S	0	5	0
			2176	1397	358	413	8			
1	B	287	Total	C	N	O	S	0	2	0
			2170	1390	359	413	8			

- Molecule 2 is an oligosaccharide called alpha-L-fucopyranose-(1-2)-beta-D-galactopyranose-(1-3)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-3)-beta-D-galactopyranose-(1-4)-beta-D-glucopyranose.

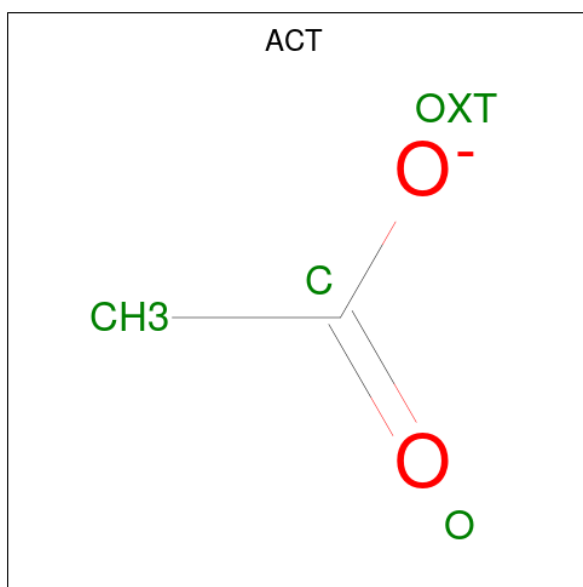


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	5	Total	C	N	O	0	0	0
			58	32	1	25			

- Molecule 3 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Mg	0	0
			1	1		
3	B	1	Total	Mg	0	0
			1	1		

- Molecule 4 is ACETATE ION (CCD ID: ACT) (formula: C₂H₃O₂).



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

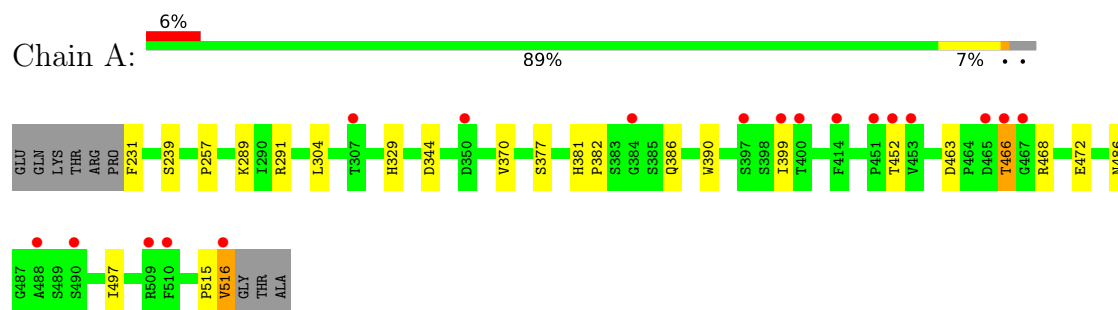
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	419	Total	O	0	0
			419	419		
5	B	404	Total	O	0	0
			404	404		

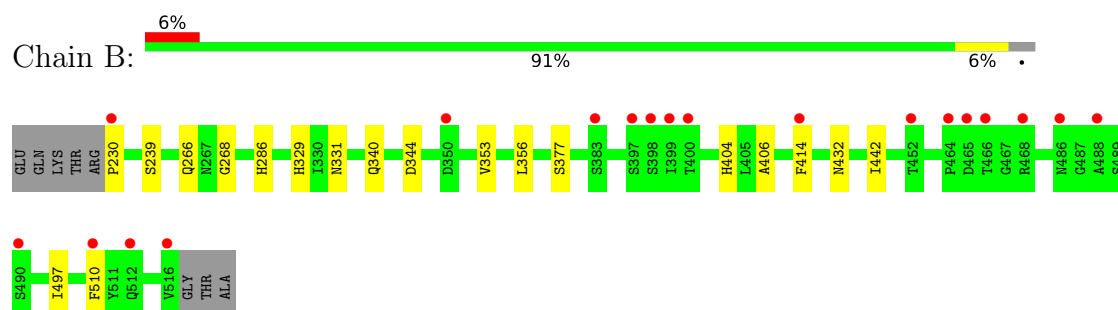
3 Residue-property plots [i](#)

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: 58 kd capsid protein



- Molecule 1: 58 kd capsid protein



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



4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	83.51Å 83.51Å 162.93Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	40.45 – 1.43 40.45 – 1.43	Depositor EDS
% Data completeness (in resolution range)	95.5 (40.45-1.43) 95.5 (40.45-1.43)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.12 (at 1.43Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.179 , 0.200 0.178 , 0.199	Depositor DCC
R_{free} test set	5880 reflections (4.82%)	wwPDB-VP
Wilson B-factor (Å ²)	14.7	Xtriage
Anisotropy	0.107	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 44.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.017 for -h,-k,l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	5233	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.01% 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: GAL, ACT, FUC, BGC, NAG, MG

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	0.70	0/2262	0.81	0/3103
1	B	0.69	0/2248	0.82	0/3084
All	All	0.70	0/4510	0.81	0/6187

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2176	0	2113	24	0
1	B	2170	0	2094	15	0
2	C	58	0	51	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	4	0	3	1	0
5	A	419	0	0	6	1
5	B	404	0	0	3	1
All	All	5233	0	4261	39	1

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 4.

All (39) 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:B:266:GLN:HE22	1:B:406:ALA:H	1.07	1.00
1:A:291:ARG:HD2	1:A:370:VAL:HG22	1.62	0.81
1:A:515:PRO:O	1:A:516:VAL:HB	1.89	0.71
1:A:231:PHE:N	5:A:818:HOH:O	2.27	0.68
1:A:291:ARG:CD	1:A:370:VAL:HG22	2.25	0.65
1:A:329:HIS:HE1	1:A:377:SER:OG	1.79	0.65
1:A:386:GLN:NE2	5:A:810:HOH:O	2.30	0.64
1:A:486:ASN:HB2	1:A:516:VAL:HG23	1.80	0.64
1:B:286:HIS:HD2	5:B:736:HOH:O	1.81	0.64
5:A:522:HOH:O	1:B:286:HIS:HE1	1.81	0.63
1:B:329:HIS:HE1	1:B:377:SER:OG	1.80	0.63
1:A:329:HIS:HD2	1:A:344:ASP:OD1	1.82	0.62
1:B:329:HIS:HD2	1:B:344:ASP:OD1	1.82	0.60
1:A:291:ARG:HD2	1:A:370:VAL:CG2	2.30	0.60
1:A:304[B]:LEU:HD11	4:A:520:ACT:O	2.05	0.57
1:B:230:PRO:N	5:B:932:HOH:O	2.38	0.56
1:A:399:ILE:H	1:A:399:ILE:HD12	1.68	0.56
1:A:466:THR:HG23	1:A:468:ARG:H	1.71	0.55
1:A:239:SER:HB3	1:A:497:ILE:HG23	1.92	0.52
1:B:414:PHE:CZ	1:B:510:PHE:CD1	2.99	0.51
1:A:452:THR:HG22	1:A:452:THR:O	2.11	0.51
1:B:331:ASN:HD21	1:B:340:GLN:NE2	2.09	0.50
1:A:289:LYS:CE	5:A:622:HOH:O	2.60	0.49
1:A:466:THR:HG23	1:A:468:ARG:HB2	1.94	0.48
1:B:404:HIS:HD2	5:B:883:HOH:O	1.97	0.48
1:B:414:PHE:CZ	1:B:510:PHE:HD1	2.31	0.48
1:A:257:PRO:HD3	1:A:390:TRP:CZ2	2.50	0.47
1:A:289:LYS:HE2	5:A:622:HOH:O	2.14	0.47
1:A:472:GLU:HG3	5:A:814:HOH:O	2.15	0.47
1:B:266:GLN:HE22	1:B:406:ALA:N	1.92	0.45
1:A:257:PRO:HD3	1:A:390:TRP:CE2	2.52	0.45
1:B:239:SER:HB3	1:B:497:ILE:HG23	1.99	0.44
1:B:268:GLY:HA2	1:B:442:ILE:HD11	2.00	0.42
1:B:353:VAL:HG11	1:B:356:LEU:HD12	2.02	0.41
1:A:463:ASP:OD2	1:A:466:THR:HG22	2.21	0.41
1:B:268:GLY:HA2	1:B:442:ILE:CD1	2.50	0.41
1:A:381:HIS:HA	1:A:382:PRO:C	2.46	0.41
1:A:486:ASN:CB	1:A:516:VAL:HG23	2.49	0.40
1:A:466:THR:CG2	1:A:468:ARG:H	2.34	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:A:586:HOH:O	5:B:1083:HOH:O[2_655]	2.18	0.02

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	289/295 (98%)	285 (99%)	4 (1%)	0	100	100
1	B	287/295 (97%)	283 (99%)	4 (1%)	0	100	100
All	All	576/590 (98%)	568 (99%)	8 (1%)	0	100	100

There are no Ramachandran outliers to report.

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	248/250 (99%)	246 (99%)	2 (1%)	73	48
1	B	246/250 (98%)	245 (100%)	1 (0%)	84	69
All	All	494/500 (99%)	491 (99%)	3 (1%)	78	57

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	466	THR
1	A	516	VAL
1	B	432	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (18) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	267	ASN
1	A	329	HIS
1	A	337	HIS
1	A	394	ASN
1	A	404	HIS
1	A	444	HIS
1	A	449	GLN
1	B	266	GLN
1	B	286	HIS
1	B	329	HIS
1	B	334	GLN
1	B	340	GLN
1	B	381	HIS
1	B	394	ASN
1	B	404	HIS
1	B	432	ASN
1	B	439	GLN
1	B	449	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 ⓘ

5 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	BGC	C	1	2	12,12,12	0.95	0	17,17,17	0.80	0
2	GAL	C	2	2	11,11,12	0.53	0	15,15,17	1.02	1 (6%)
2	NAG	C	3	2	14,14,15	1.24	1 (7%)	17,19,21	1.13	2 (11%)
2	GAL	C	4	2	11,11,12	0.48	0	15,15,17	0.91	0
2	FUC	C	5	2	10,10,11	0.61	0	14,14,16	0.81	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	BGC	C	1	2	-	0/2/22/22	0/1/1/1
2	GAL	C	2	2	-	0/2/19/22	0/1/1/1
2	NAG	C	3	2	-	0/6/23/26	0/1/1/1
2	GAL	C	4	2	-	0/2/19/22	0/1/1/1
2	FUC	C	5	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	3	NAG	C1-C2	2.70	1.56	1.52

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	2	GAL	C1-O5-C5	3.04	116.26	112.19
2	C	3	NAG	O3-C3-C2	2.32	114.23	109.40
2	C	3	NAG	C1-O5-C5	2.25	115.21	112.19

There are no chirality outliers.

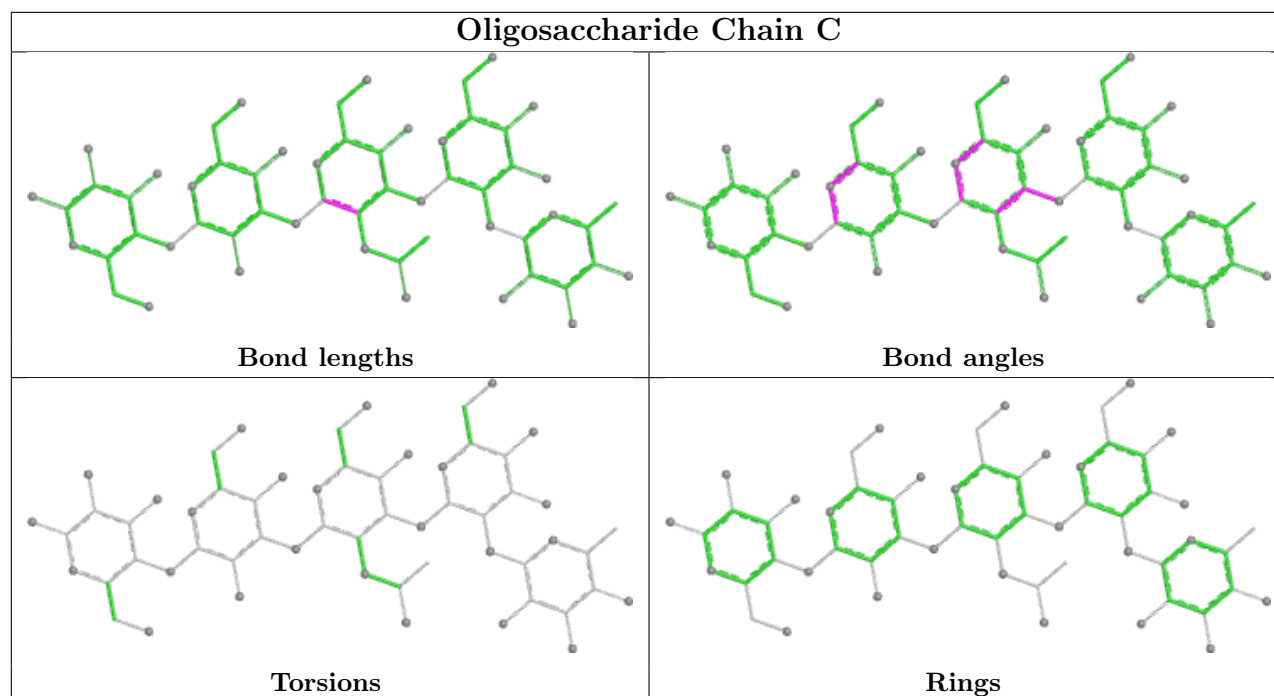
There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 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	$\# Z > 2$
4	ACT	A	520	-	3,3,3	0.81	0	3,3,3	1.34	0

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	520	ACT	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

6.1 Protein, DNA and RNA chains

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	286/295 (96%)	0.12	18 (6%) 26 27	6, 14, 29, 35	5 (1%)
1	B	287/295 (97%)	0.13	19 (6%) 24 25	7, 14, 30, 35	2 (0%)
All	All	573/590 (97%)	0.12	37 (6%) 25 26	6, 14, 30, 35	7 (1%)

All (37) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	414	PHE	7.7
1	A	452	THR	5.4
1	B	516	VAL	5.2
1	A	466	THR	5.2
1	A	400	THR	5.2
1	B	399	ILE	4.8
1	A	414	PHE	4.7
1	B	452	THR	4.4
1	A	516	VAL	4.4
1	A	488	ALA	4.3
1	A	399	ILE	3.9
1	B	486	ASN	3.8
1	A	510	PHE	3.8
1	B	510	PHE	3.5
1	A	465	ASP	3.4
1	A	397	SER	3.0
1	B	490	SER	3.0
1	B	464	PRO	2.9
1	B	488	ALA	2.8
1	A	384	GLY	2.7
1	B	400	THR	2.7
1	A	490	SER	2.5
1	B	512	GLN	2.5
1	A	467	GLY	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	465	ASP	2.4
1	B	230	PRO	2.3
1	B	468	ARG	2.2
1	A	350	ASP	2.2
1	B	398	SER	2.2
1	B	350	ASP	2.2
1	A	453	VAL	2.2
1	A	307	THR	2.1
1	A	451	PRO	2.1
1	B	466	THR	2.1
1	A	509	ARG	2.1
1	B	397	SER	2.0
1	B	383	SER	2.0

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

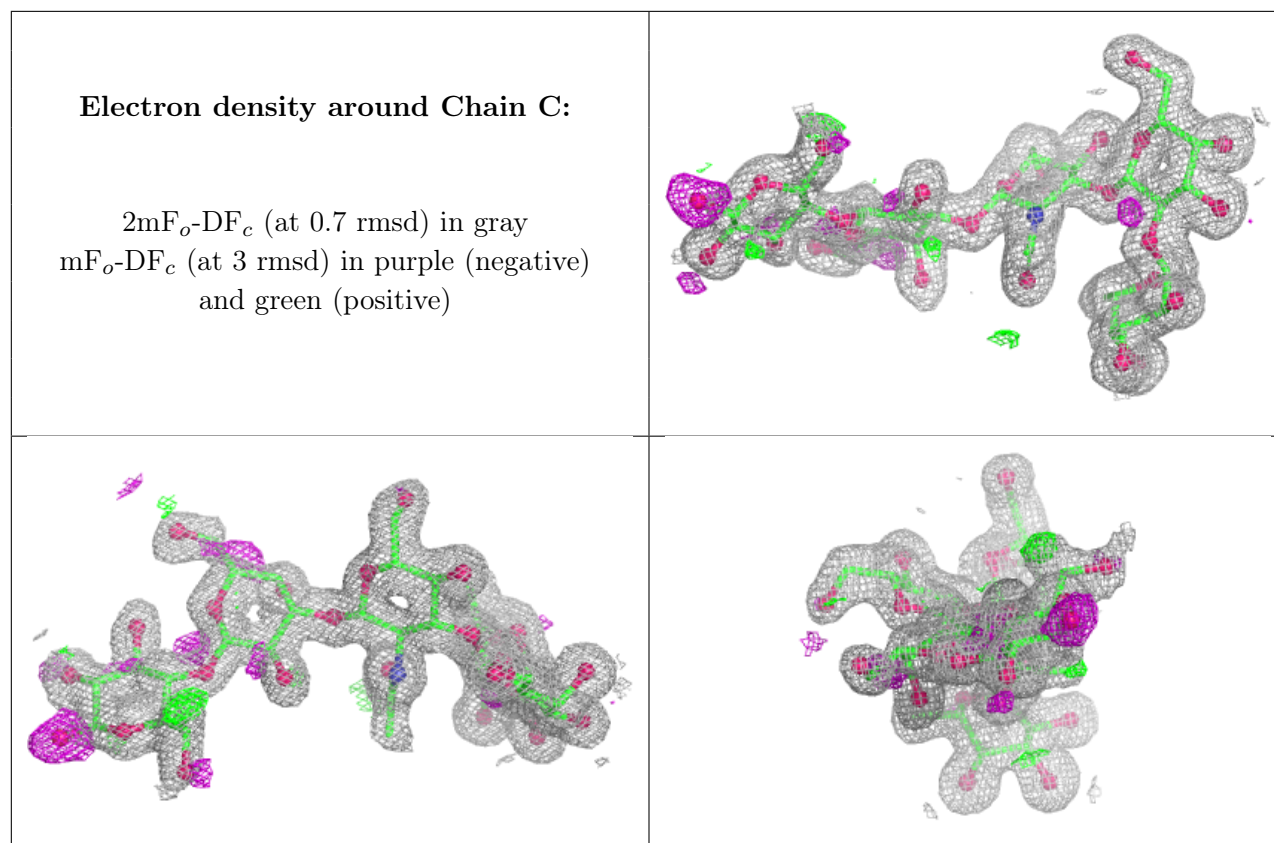
There are no non-standard protein/DNA/RNA residues in this entry.

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	BGC	C	1	12/12	0.76	0.14	28,31,35,36	0
2	GAL	C	2	11/12	0.92	0.10	25,26,29,31	0
2	NAG	C	3	14/15	0.92	0.09	19,23,26,30	0
2	GAL	C	4	11/12	0.95	0.07	16,18,22,24	0
2	FUC	C	5	10/11	0.97	0.06	16,16,17,17	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
4	ACT	A	520	4/4	0.84	0.16	18,20,21,22	0
3	MG	B	520	1/1	0.98	0.09	20,20,20,20	0
3	MG	A	1	1/1	0.98	0.07	19,19,19,19	0

6.5 Other polymers [i](#)

There are no such residues in this entry.