



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 10, 2026 – 10:42 AM UTC

PDB ID : 5GQG / pdb_00005gqg
Title : Crystal structure of lacto-N-biosidase LnbX from Bifidobacterium longum subsp. longum, galacto-N-biose complex
Authors : Yamada, C.; Arakawa, T.; Katayama, T.; Fushinobu, S.
Deposited on : 2016-08-07
Resolution : 2.70 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

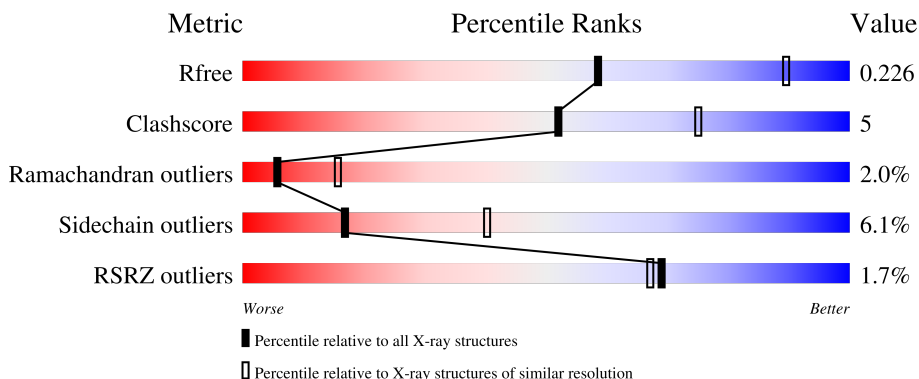
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

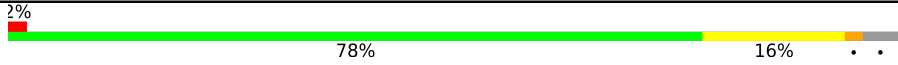
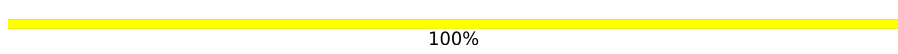
The reported resolution of this entry is 2.70 Å.

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	3538 (2.70-2.70)
Clashscore	190562	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)
RSRZ outliers	180081	3538 (2.70-2.70)

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	606	
1	B	606	
2	C	2	
2	D	2	

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 9107 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.

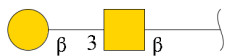
- Molecule 1 is a protein called Lacto-N-biosidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	582	Total	C	N	O	S	0	0	0
			4468	2760	772	924	12			
1	B	582	Total	C	N	O	S	0	0	0
			4468	2760	772	924	12			

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	30	MET	-	expression tag	UNP A0A024QYS6
A	626	ALA	-	expression tag	UNP A0A024QYS6
A	627	ALA	-	expression tag	UNP A0A024QYS6
A	628	LEU	-	expression tag	UNP A0A024QYS6
A	629	GLU	-	expression tag	UNP A0A024QYS6
A	630	HIS	-	expression tag	UNP A0A024QYS6
A	631	HIS	-	expression tag	UNP A0A024QYS6
A	632	HIS	-	expression tag	UNP A0A024QYS6
A	633	HIS	-	expression tag	UNP A0A024QYS6
A	634	HIS	-	expression tag	UNP A0A024QYS6
A	635	HIS	-	expression tag	UNP A0A024QYS6
B	30	MET	-	expression tag	UNP A0A024QYS6
B	626	ALA	-	expression tag	UNP A0A024QYS6
B	627	ALA	-	expression tag	UNP A0A024QYS6
B	628	LEU	-	expression tag	UNP A0A024QYS6
B	629	GLU	-	expression tag	UNP A0A024QYS6
B	630	HIS	-	expression tag	UNP A0A024QYS6
B	631	HIS	-	expression tag	UNP A0A024QYS6
B	632	HIS	-	expression tag	UNP A0A024QYS6
B	633	HIS	-	expression tag	UNP A0A024QYS6
B	634	HIS	-	expression tag	UNP A0A024QYS6
B	635	HIS	-	expression tag	UNP A0A024QYS6

- Molecule 2 is an oligosaccharide called beta-D-galactopyranose-(1-3)-2-acetamido-2-deoxy-beta-D-galactopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	2	Total	C	N	O	0	0	0
			26	14	1	11			
2	D	2	Total	C	N	O	0	0	0
			26	14	1	11			

- Molecule 3 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	Ca	0	0
			2	2		
3	B	2	Total	Ca	0	0
			2	2		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	56	Total	O	0	0
			56	56		
4	B	59	Total	O	0	0
			59	59		

NGA1
GAL2

- Molecule 2: beta-D-galactopyranose-(1-3)-2-acetamido-2-deoxy-beta-D-galactopyranose

Chain D:



NGA1
GAL2

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	64.10Å 144.06Å 144.44Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	102.00 – 2.70 102.00 – 2.70	Depositor EDS
% Data completeness (in resolution range)	99.7 (102.00-2.70) 99.8 (102.00-2.70)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.63 (at 2.69Å)	Xtriage
Refinement program	REFMAC 5.8.0155	Depositor
R, R_{free}	0.190 , 0.253 (Not available) , 0.226	Depositor DCC
R_{free} test set	1801 reflections (4.78%)	wwPDB-VP
Wilson B-factor (Å ²)	47.7	Xtriage
Anisotropy	0.087	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 34.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.018 for -h,l,k	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	9107	wwPDB-VP
Average B, all atoms (Å ²)	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.58% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: CA, NGA, GAL

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	0.85	0/4567	1.01	6/6224 (0.1%)
1	B	0.82	0/4567	0.98	6/6224 (0.1%)
All	All	0.84	0/9134	1.00	12/12448 (0.1%)

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

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

There are no bond length outliers.

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	385	TRP	N-CA-C	7.27	114.76	108.22
1	B	114	ILE	N-CA-C	-6.42	102.96	110.21
1	B	494	SER	N-CA-C	6.12	117.50	108.86
1	A	102	HIS	N-CA-C	6.06	120.74	112.68
1	A	443	TRP	N-CA-C	5.96	118.54	111.33

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	310	TYR	Peptide

5.2 Too-close contacts ⓘ

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4468	0	4135	48	1
1	B	4468	0	4135	39	0
2	C	26	0	24	0	0
2	D	26	0	24	1	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	56	0	0	1	0
4	B	59	0	0	2	0
All	All	9107	0	8318	88	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 5.

The worst 5 of 88 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:473:HIS:CG	1:B:601:LEU:HD13	2.01	0.96
1:B:473:HIS:CG	1:B:601:LEU:CD1	2.69	0.76
1:A:90:LEU:HD23	1:A:96:PHE:CE2	2.26	0.70
1:B:198:ASP:N	1:B:198:ASP:OD1	2.31	0.64
1:A:247:ALA:HB2	1:A:254:MET:HE1	1.79	0.62

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)
1:A:123:ASP:OD2	1:A:519:SER:OG[1_655]	2.00	0.20

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	580/606 (96%)	517 (89%)	50 (9%)	13 (2%)	5	14
1	B	580/606 (96%)	508 (88%)	62 (11%)	10 (2%)	7	19
All	All	1160/1212 (96%)	1025 (88%)	112 (10%)	23 (2%)	6	16

5 of 23 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	56	GLY
1	A	123	ASP
1	A	582	GLY
1	B	311	GLY
1	A	57	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	470/491 (96%)	441 (94%)	29 (6%)	16	39
1	B	470/491 (96%)	442 (94%)	28 (6%)	17	41
All	All	940/982 (96%)	883 (94%)	57 (6%)	17	40

5 of 57 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	618	ARG

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Mol	Chain	Res	Type
1	B	590	LYS
1	B	89	LEU
1	B	585	PRO
1	B	418	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	528	ASN
1	B	460	GLN
1	B	226	ASN
1	A	613	ASN
1	B	457	ASN

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 ⓘ

4 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	NGA	C	1	2	15,15,15	0.55	0	21,21,21	1.60	4 (19%)
2	GAL	C	2	2	11,11,12	0.71	0	15,15,17	1.51	2 (13%)
2	NGA	D	1	2	15,15,15	0.67	0	21,21,21	1.41	1 (4%)
2	GAL	D	2	2	11,11,12	0.45	0	15,15,17	1.12	1 (6%)

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	NGA	C	1	2	-	2/6/26/26	0/1/1/1
2	GAL	C	2	2	-	2/2/19/22	0/1/1/1
2	NGA	D	1	2	-	0/6/26/26	0/1/1/1
2	GAL	D	2	2	-	1/2/19/22	0/1/1/1

There are no bond length outliers.

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	1	NGA	C1-C2-C3	5.00	117.36	110.54
2	C	1	NGA	C1-C2-C3	4.53	116.72	110.54
2	C	2	GAL	O2-C2-C3	3.22	116.83	110.15
2	C	1	NGA	C1-C2-N2	-2.83	107.44	110.73
2	C	1	NGA	O5-C1-C2	2.58	112.11	109.52

There are no chirality outliers.

All (5) torsion outliers are listed below:

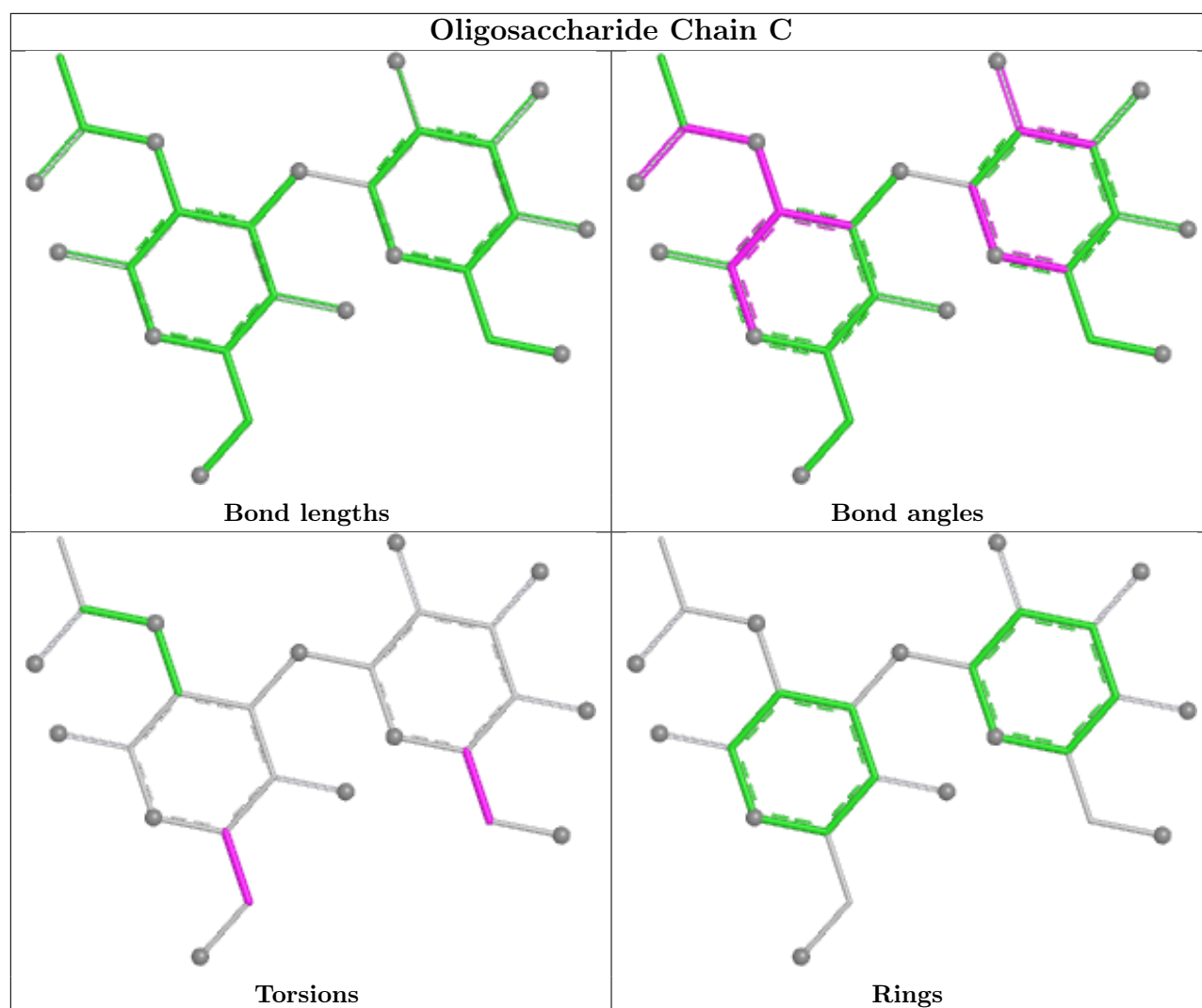
Mol	Chain	Res	Type	Atoms
2	C	2	GAL	O5-C5-C6-O6
2	C	1	NGA	C4-C5-C6-O6
2	C	1	NGA	O5-C5-C6-O6
2	C	2	GAL	C4-C5-C6-O6
2	D	2	GAL	O5-C5-C6-O6

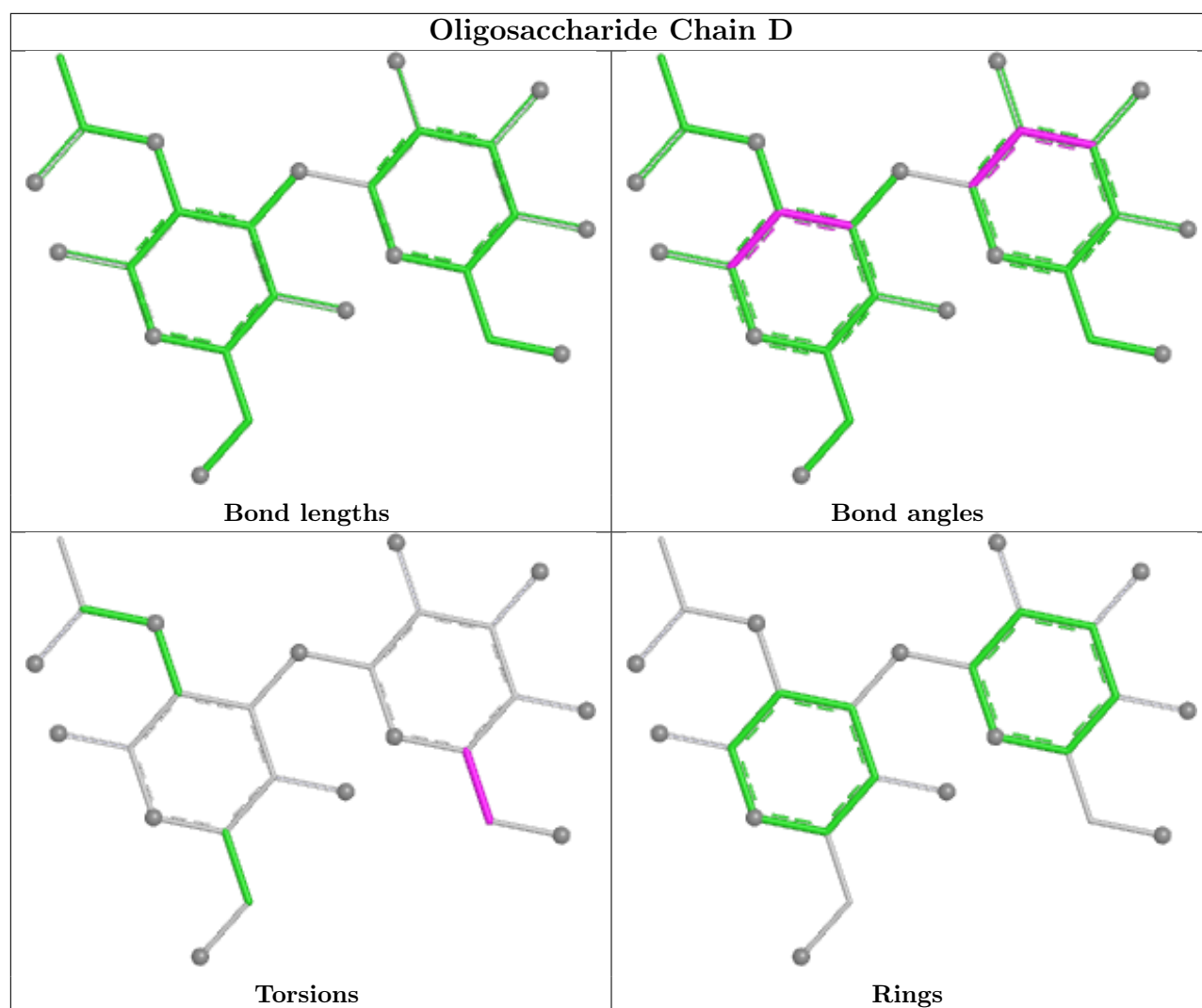
There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	1	NGA	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 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

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.

No monomer is involved in short contacts.

5.7 Other polymers [i](#)

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	582/606 (96%)	-0.03	10 (1%) 69 67	26, 49, 77, 103	0
1	B	582/606 (96%)	-0.04	10 (1%) 69 67	30, 49, 79, 117	0
All	All	1164/1212 (96%)	-0.04	20 (1%) 69 67	26, 49, 78, 117	0

The worst 5 of 20 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	59	ALA	3.1
1	A	627	ALA	2.9
1	B	46	GLY	2.9
1	A	55	HIS	2.8
1	A	624	VAL	2.7

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

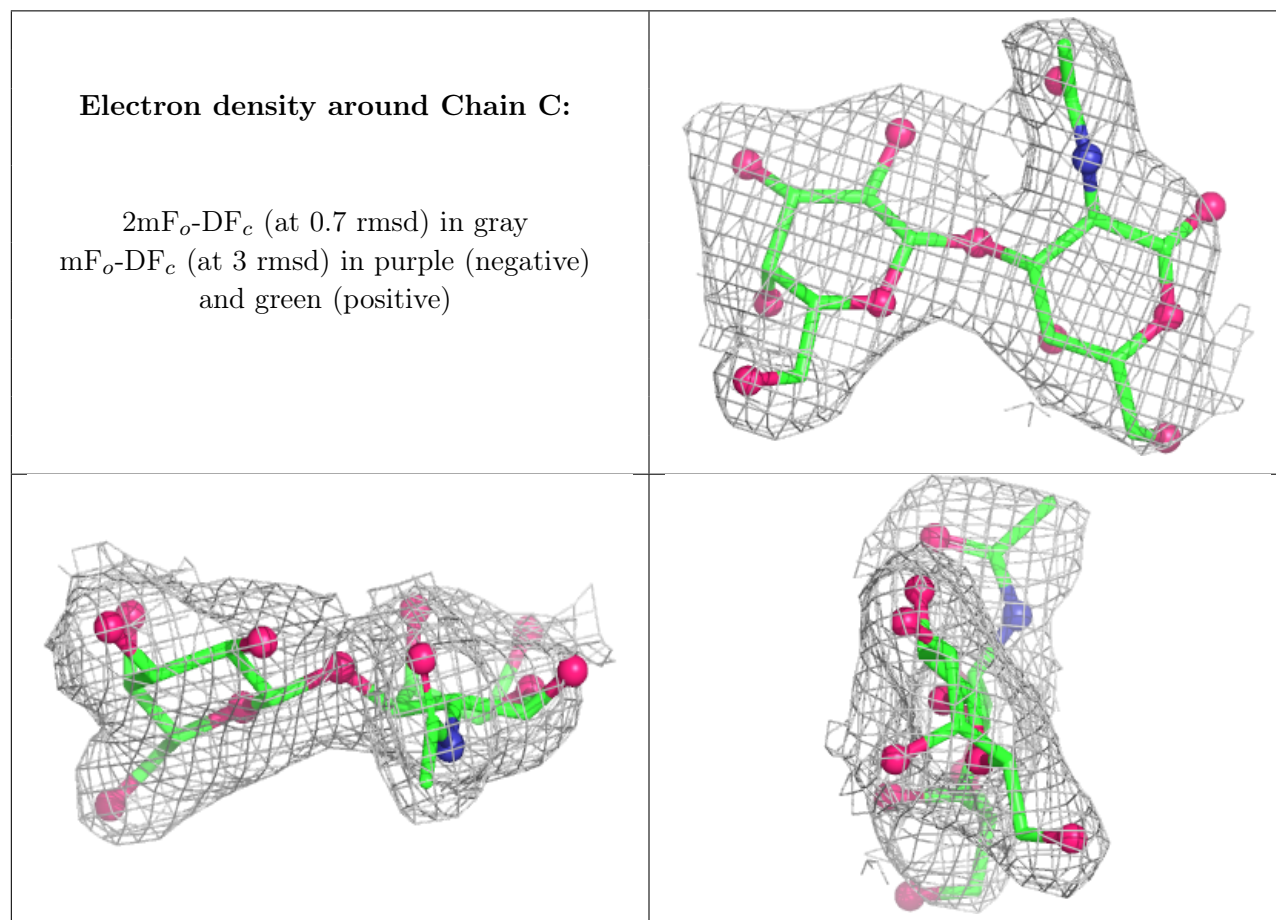
There are no non-standard protein/DNA/RNA residues in this entry.

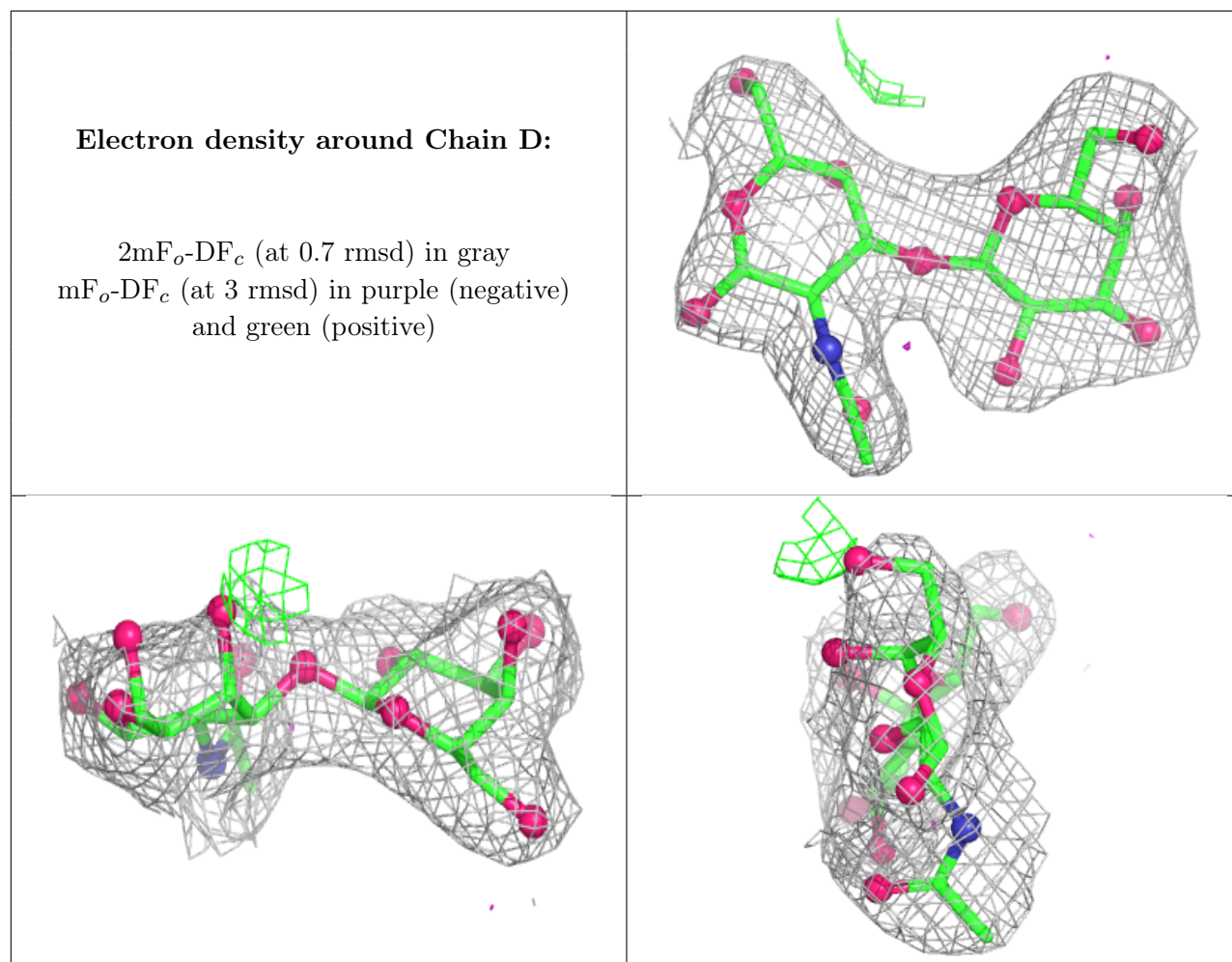
6.3 Carbohydrates [i](#)

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(Å ²)	Q<0.9
2	NGA	D	1	15/15	0.92	0.10	37,51,54,58	0
2	NGA	C	1	15/15	0.93	0.11	46,53,61,62	0
2	GAL	D	2	11/12	0.95	0.07	31,34,37,37	0
2	GAL	C	2	11/12	0.97	0.06	28,32,35,38	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($\text{\AA}^2$)	Q<0.9
3	CA	B	702	1/1	0.91	0.09	78,78,78,78	0
3	CA	A	701	1/1	0.96	0.12	74,74,74,74	0
3	CA	A	702	1/1	0.97	0.12	62,62,62,62	0
3	CA	B	701	1/1	0.99	0.05	66,66,66,66	0

6.5 Other polymers [i](#)

There are no such residues in this entry.