



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 06:40 PM UTC

PDB ID : 4XA2 / pdb_00004xa2
Title : Structure of the Major Type IV pilin of *Acinetobacter baumannii*
Authors : Piepenbrink, K.H.; Sundberg, E.J.
Deposited on : 2014-12-12
Resolution : 1.98 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

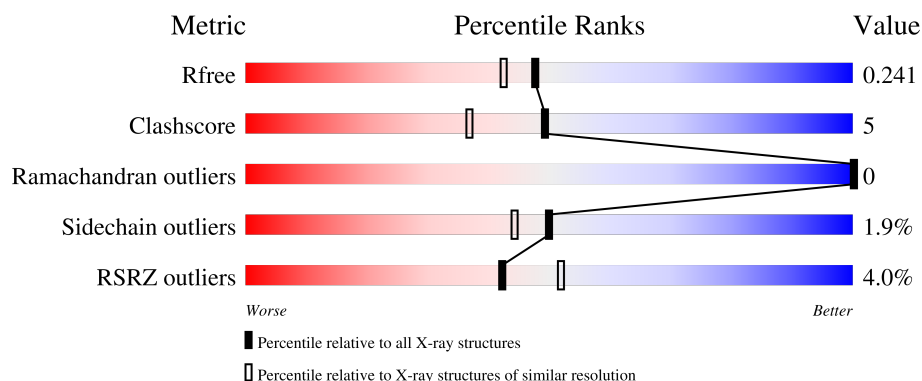
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.98 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	1506 (1.98-1.98)
Clashscore	190562	1534 (1.98-1.98)
Ramachandran outliers	187476	1518 (1.98-1.98)
Sidechain outliers	187428	1518 (1.98-1.98)
RSRZ outliers	180081	1506 (1.98-1.98)

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	498	3% 87% 10% ..
1	B	498	5% 85% 12% ..
2	C	3	67% 33%
2	D	3	100%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 8222 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.

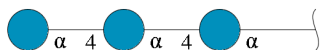
- Molecule 1 is a protein called Maltose-binding periplasmic protein,MBP-PilA: c.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	490	Total	C	N	O	S	0	2	0
			3709	2356	618	725	10			
1	B	488	Total	C	N	O	S	0	3	0
			3697	2348	615	723	11			

There are 18 discrepancies between the modelled and reference sequences:

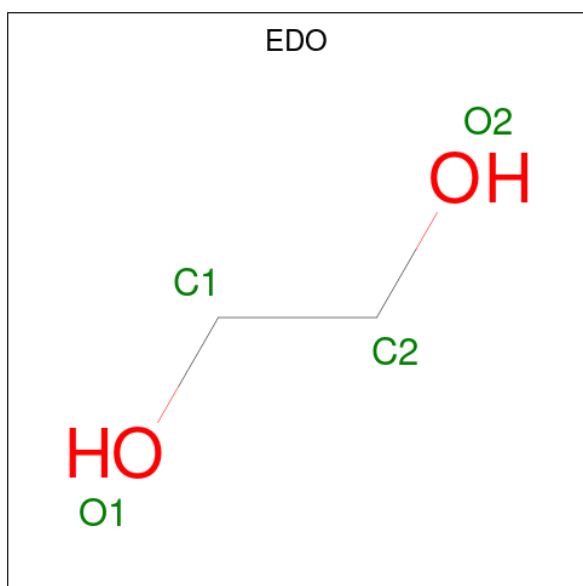
Chain	Residue	Modelled	Actual	Comment	Reference
A	0	MET	-	initiating methionine	UNP P0AEY0
A	82	ALA	ASP	conflict	UNP P0AEY0
A	83	ALA	LYS	conflict	UNP P0AEY0
A	172	ALA	GLU	conflict	UNP P0AEY0
A	173	ALA	ASN	conflict	UNP P0AEY0
A	239	ALA	LYS	conflict	UNP P0AEY0
A	359	ALA	GLU	conflict	UNP P0AEY0
A	362	ALA	LYS	conflict	UNP P0AEY0
A	363	ALA	ASP	conflict	UNP P0AEY0
B	0	MET	-	initiating methionine	UNP P0AEY0
B	82	ALA	ASP	conflict	UNP P0AEY0
B	83	ALA	LYS	conflict	UNP P0AEY0
B	172	ALA	GLU	conflict	UNP P0AEY0
B	173	ALA	ASN	conflict	UNP P0AEY0
B	239	ALA	LYS	conflict	UNP P0AEY0
B	359	ALA	GLU	conflict	UNP P0AEY0
B	362	ALA	LYS	conflict	UNP P0AEY0
B	363	ALA	ASP	conflict	UNP P0AEY0

- Molecule 2 is an oligosaccharide called alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose.



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
2	C	3	Total	C	O	0	0	0
			34	18	16			
2	D	3	Total	C	O	0	0	0
			34	18	16			

- Molecule 3 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).



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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	396	Total	O	0	0
			396	396		
4	B	340	Total	O	0	0
			340	340		

- Molecule 1: Maltose-binding periplasmic protein,MBP-PilA: c



Chain D:  100%

GLC1
GLC2
GLC3

4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	41.02Å 128.30Å 92.50Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.02 – 1.98 41.02 – 1.98	Depositor EDS
% Data completeness (in resolution range)	80.0 (41.02-1.98) 78.6 (41.02-1.98)	Depositor EDS
R_{merge}	0.23	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.36 (at 1.98Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.181 , 0.241 0.182 , 0.241	Depositor DCC
R_{free} test set	2016 reflections (3.01%)	wwPDB-VP
Wilson B-factor (Å ²)	18.0	Xtriage
Anisotropy	0.321	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 50.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.037 for h,-k,-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	8222	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.08% 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: EDO, GLC

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	0.57	2/3791 (0.1%)	0.81	2/5152 (0.0%)
1	B	0.50	0/3782	0.82	2/5141 (0.0%)
All	All	0.54	2/7573 (0.0%)	0.82	4/10293 (0.0%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1047	ALA	C-O	-6.32	1.16	1.24
1	A	1045	THR	C-O	-5.45	1.17	1.24

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	124	ASN	CA-C-N	6.71	127.30	120.38
1	B	124	ASN	C-N-CA	6.71	127.30	120.38
1	A	270	SER	CA-C-N	6.00	126.11	119.87
1	A	270	SER	C-N-CA	6.00	126.11	119.87

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	3709	0	3679	38	0
1	B	3697	0	3666	43	0
2	C	34	0	30	1	0
2	D	34	0	30	0	0
3	A	8	0	12	0	0
3	B	4	0	6	0	0
4	A	396	0	0	15	1
4	B	340	0	0	10	1
All	All	8222	0	7423	81	2

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 81 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:241:ASN:OD1	4:B:1301:HOH:O	1.93	0.84
1:A:18:ASN:OD1	4:A:1675:HOH:O	1.94	0.83
1:B:119:LYS:NZ	4:B:1302:HOH:O	2.15	0.77
1:B:32:GLY:O	4:B:1544:HOH:O	2.02	0.76
1:A:32:GLY:O	4:A:1301:HOH:O	2.06	0.74

All (2) 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)
4:B:1360:HOH:O	4:B:1370:HOH:O[1_655]	2.00	0.20
4:A:1334:HOH:O	4:A:1339:HOH:O[2_657]	2.07	0.13

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	490/498 (98%)	482 (98%)	8 (2%)	0	100	100
1	B	489/498 (98%)	479 (98%)	10 (2%)	0	100	100
All	All	979/996 (98%)	961 (98%)	18 (2%)	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	379/387 (98%)	370 (98%)	9 (2%)	43	35
1	B	379/387 (98%)	374 (99%)	5 (1%)	61	57
All	All	758/774 (98%)	744 (98%)	14 (2%)	50	46

5 of 14 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1098	GLN
1	A	1127	VAL
1	B	1127	VAL
1	B	288	GLU
1	B	317	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	124	ASN
1	A	1072	ASN
1	B	241	ASN
1	B	1098	GLN

5.3.3 RNA [i](#)

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 ⓘ

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	GLC	C	1	2	12,12,12	1.24	1 (8%)	17,17,17	0.84	0
2	GLC	C	2	2	11,11,12	1.62	2 (18%)	15,15,17	0.83	0
2	GLC	C	3	2	11,11,12	1.33	2 (18%)	15,15,17	0.77	0
2	GLC	D	1	2	12,12,12	1.27	1 (8%)	17,17,17	0.92	0
2	GLC	D	2	2	11,11,12	1.41	1 (9%)	15,15,17	0.67	0
2	GLC	D	3	2	11,11,12	1.50	3 (27%)	15,15,17	0.68	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	GLC	C	1	2	-	0/2/22/22	0/1/1/1
2	GLC	C	2	2	-	0/2/19/22	0/1/1/1
2	GLC	C	3	2	-	0/2/19/22	0/1/1/1
2	GLC	D	1	2	-	0/2/22/22	0/1/1/1
2	GLC	D	2	2	-	0/2/19/22	0/1/1/1
2	GLC	D	3	2	-	0/2/19/22	0/1/1/1

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	2	GLC	O5-C1	3.73	1.50	1.43
2	D	1	GLC	O5-C1	3.06	1.50	1.42

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	3	GLC	O5-C1	2.88	1.48	1.43
2	D	3	GLC	O5-C5	2.78	1.48	1.43
2	D	3	GLC	O5-C1	2.77	1.48	1.43

There are no bond angle outliers.

There are no chirality outliers.

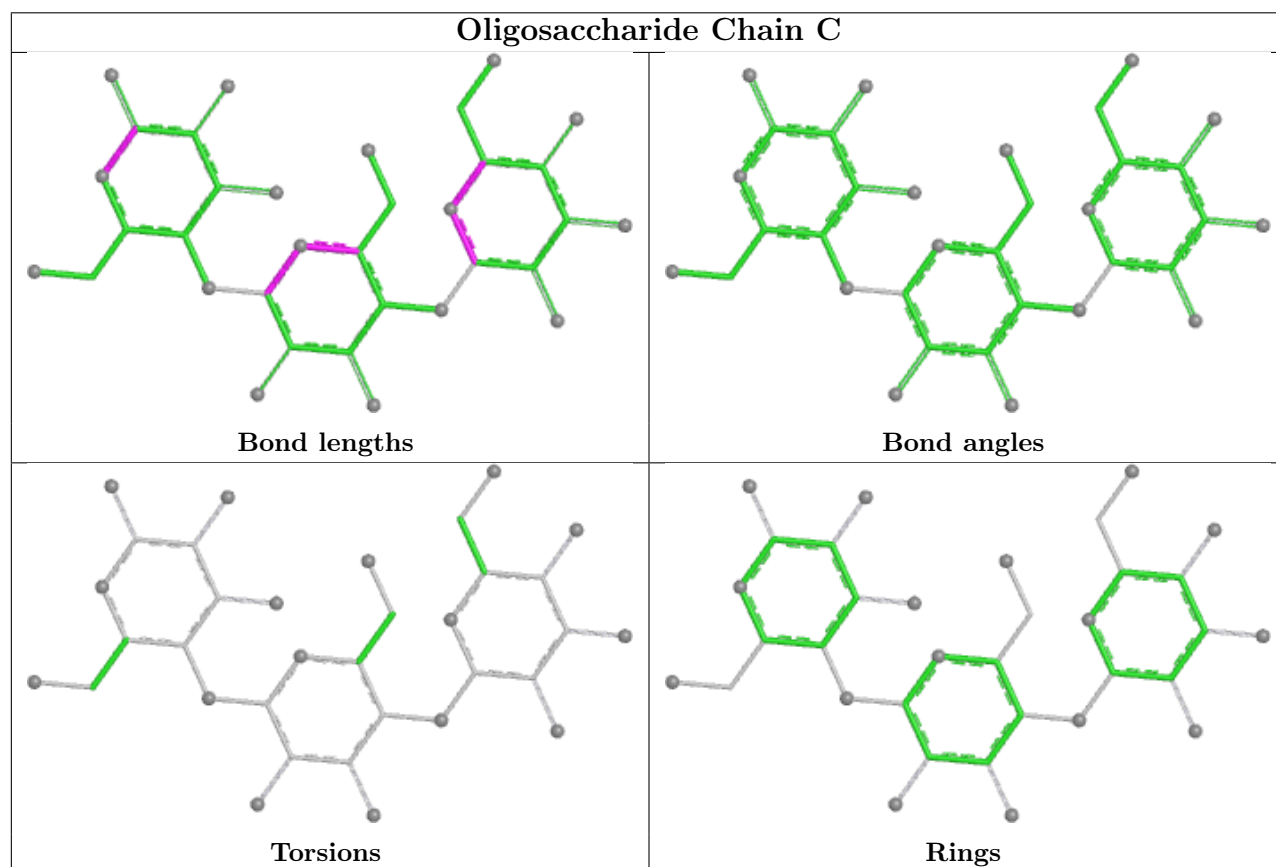
There are no torsion outliers.

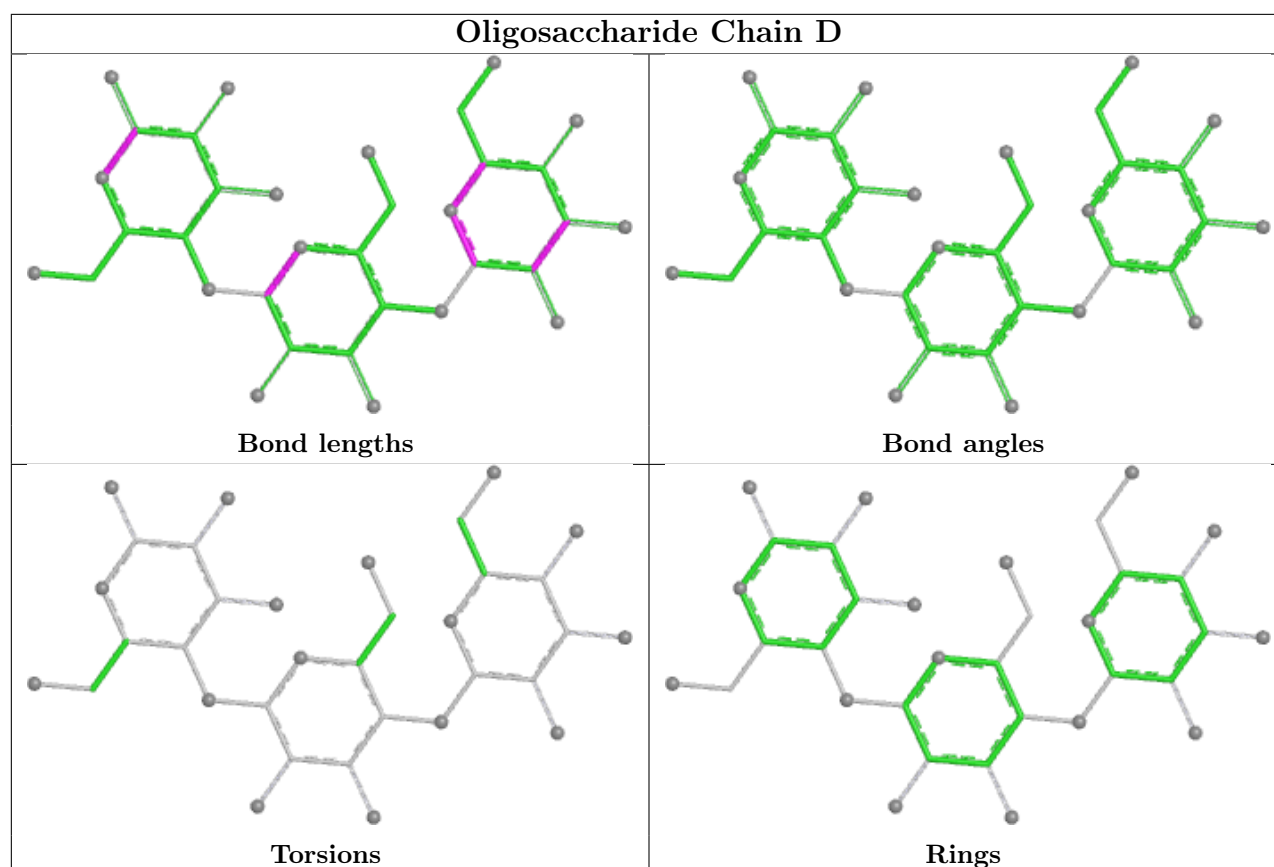
There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	3	GLC	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](#)

3 ligands 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	$\# Z > 2$
3	EDO	B	1202	-	3,3,3	0.42	0	2,2,2	0.34	0
3	EDO	A	1203	-	3,3,3	0.43	0	2,2,2	0.39	0
3	EDO	A	1202	-	3,3,3	0.50	0	2,2,2	0.48	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
3	EDO	B	1202	-	-	1/1/1/1	-
3	EDO	A	1203	-	-	1/1/1/1	-
3	EDO	A	1202	-	-	0/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1203	EDO	O1-C1-C2-O2
3	B	1202	EDO	O1-C1-C2-O2

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 [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, 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	490/498 (98%)	0.06	15 (3%) 51 61	9, 21, 42, 51	2 (0%)
1	B	488/498 (97%)	0.33	24 (4%) 35 44	9, 27, 47, 57	3 (0%)
All	All	978/996 (98%)	0.20	39 (3%) 42 52	9, 24, 45, 57	5 (0%)

The worst 5 of 39 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	125	PRO	4.1
1	B	117	TYR	3.9
1	B	121	LEU	3.6
1	B	137	LYS	3.5
1	A	52	ALA	3.3

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.

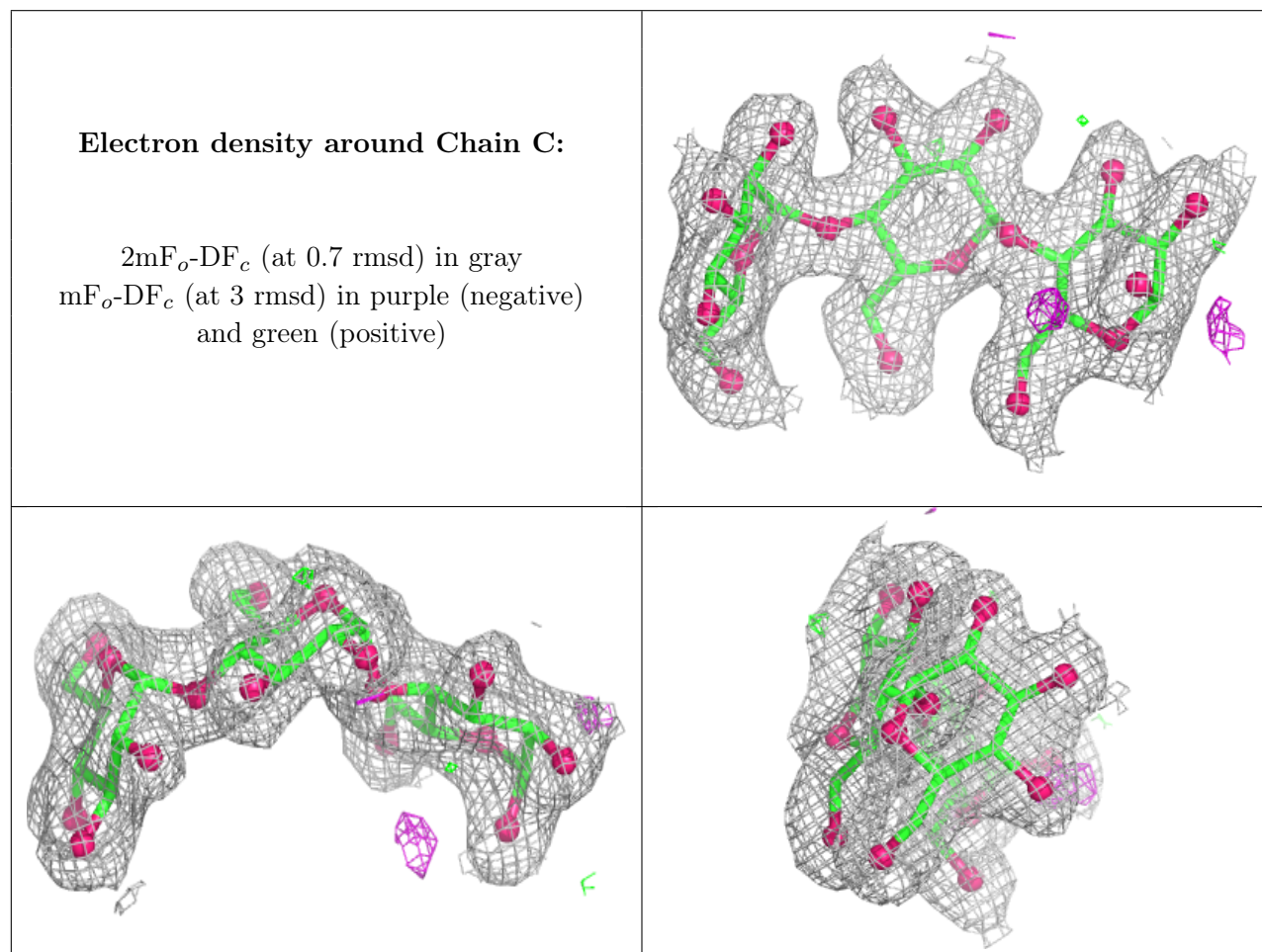
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	GLC	D	1	12/12	0.94	0.07	16,20,28,28	0
2	GLC	D	2	11/12	0.96	0.06	14,16,19,20	0
2	GLC	C	3	11/12	0.97	0.05	10,14,19,21	0
2	GLC	C	1	12/12	0.97	0.05	13,16,19,22	0
2	GLC	C	2	11/12	0.97	0.05	10,12,14,16	0

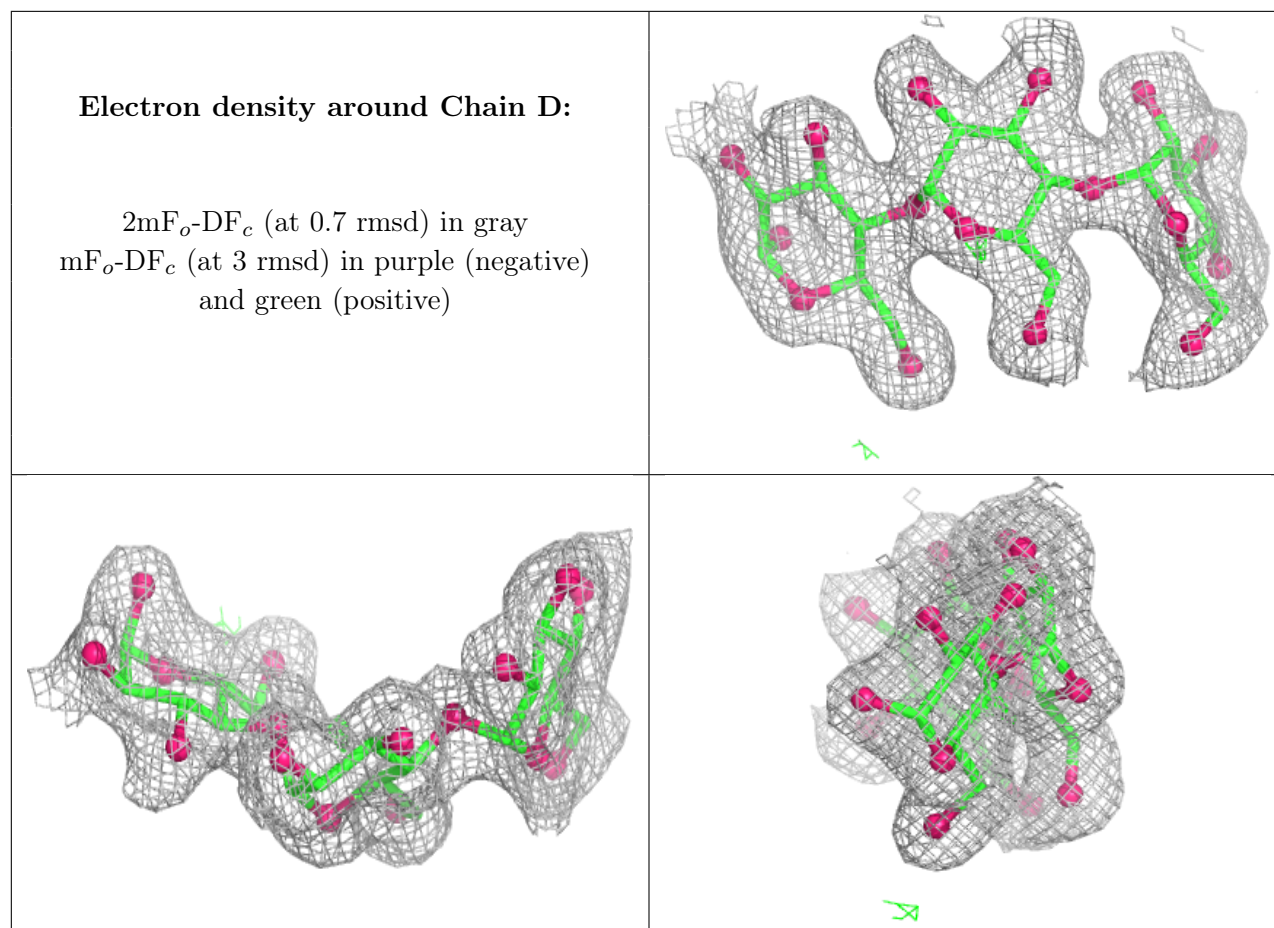
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	GLC	D	3	11/12	0.97	0.05	16,17,19,20	0

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	EDO	A	1202	4/4	0.88	0.10	24,25,26,28	0
3	EDO	A	1203	4/4	0.89	0.09	37,38,41,49	0
3	EDO	B	1202	4/4	0.90	0.14	31,33,36,37	0

6.5 Other polymers [i](#)

There are no such residues in this entry.