



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 05:41 AM UTC

PDB ID : 5LA2 / pdb_00005la2
Title : The mechanism by which arabinoxylanases can recognise highly decorated xy-
lans
Authors : Basle, A.; Labourel, A.; Cuskin, F.; Jackson, A.; Crouch, L.; Rogowski, A.;
Gilbert, H.
Deposited on : 2016-06-13
Resolution : 1.65 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

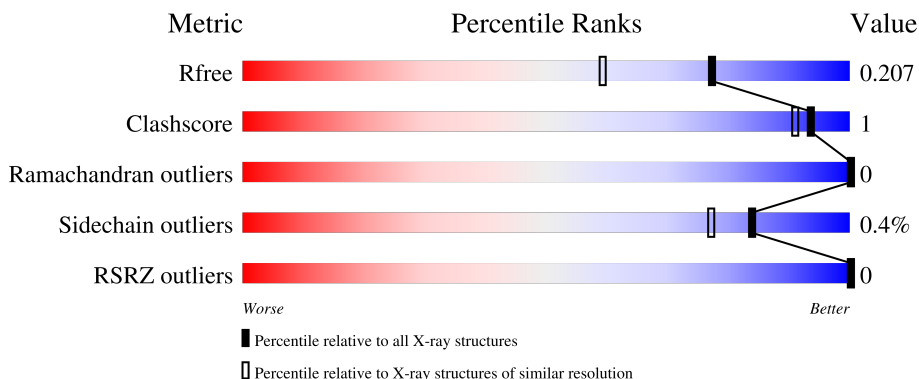
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.65 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	2563 (1.66-1.66)
Clashscore	190562	2662 (1.66-1.66)
Ramachandran outliers	187476	2621 (1.66-1.66)
Sidechain outliers	187428	2621 (1.66-1.66)
RSRZ outliers	180081	2564 (1.66-1.66)

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	491	 92% • 5%
1	B	491	 91% • 5%
2	C	5	 100%
2	D	5	 100%

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 8373 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.

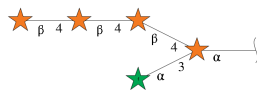
- Molecule 1 is a protein called Carbohydrate binding family 6.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	464	Total	C	N	O	S	0	8	0
			3667	2342	624	694	7			
1	B	465	Total	C	N	O	S	0	8	0
			3665	2342	618	698	7			

There are 24 discrepancies between the modelled and reference sequences:

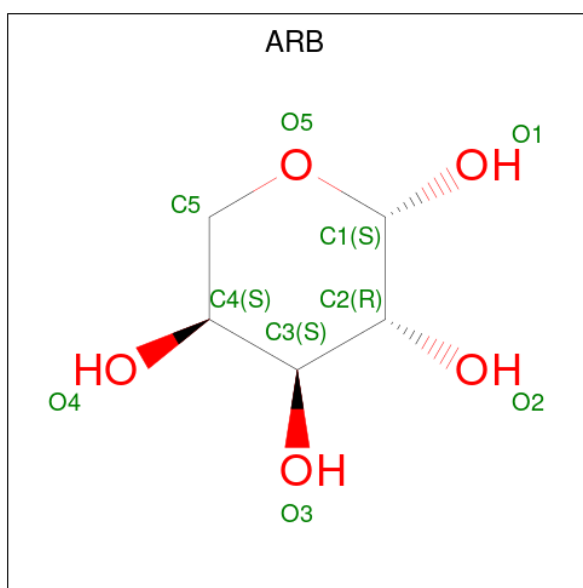
Chain	Residue	Modelled	Actual	Comment	Reference
A	34	MET	-	initiating methionine	UNP A0A0J9WZQ7
A	35	ALA	-	expression tag	UNP A0A0J9WZQ7
A	36	SER	-	expression tag	UNP A0A0J9WZQ7
A	279	SER	GLU	conflict	UNP A0A0J9WZQ7
A	517	LEU	-	expression tag	UNP A0A0J9WZQ7
A	518	GLU	-	expression tag	UNP A0A0J9WZQ7
A	519	HIS	-	expression tag	UNP A0A0J9WZQ7
A	520	HIS	-	expression tag	UNP A0A0J9WZQ7
A	521	HIS	-	expression tag	UNP A0A0J9WZQ7
A	522	HIS	-	expression tag	UNP A0A0J9WZQ7
A	523	HIS	-	expression tag	UNP A0A0J9WZQ7
A	524	HIS	-	expression tag	UNP A0A0J9WZQ7
B	34	MET	-	initiating methionine	UNP A0A0J9WZQ7
B	35	ALA	-	expression tag	UNP A0A0J9WZQ7
B	36	SER	-	expression tag	UNP A0A0J9WZQ7
B	279	SER	GLU	conflict	UNP A0A0J9WZQ7
B	517	LEU	-	expression tag	UNP A0A0J9WZQ7
B	518	GLU	-	expression tag	UNP A0A0J9WZQ7
B	519	HIS	-	expression tag	UNP A0A0J9WZQ7
B	520	HIS	-	expression tag	UNP A0A0J9WZQ7
B	521	HIS	-	expression tag	UNP A0A0J9WZQ7
B	522	HIS	-	expression tag	UNP A0A0J9WZQ7
B	523	HIS	-	expression tag	UNP A0A0J9WZQ7
B	524	HIS	-	expression tag	UNP A0A0J9WZQ7

- Molecule 2 is an oligosaccharide called beta-D-xylopyranose-(1-4)-beta-D-xylopyranose-(1-4)-beta-D-xylopyranose-(1-4)-[alpha-L-arabinofuranose-(1-3)]alpha-D-xylopyranose.



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
2	C	5	Total	C	O	0	0	0
			46	25	21			
2	D	5	Total	C	O	0	0	0
			46	25	21			

- Molecule 3 is beta-L-arabinopyranose (CCD ID: ARB) (formula: C₅H₁₀O₅).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			10	5	5		
3	B	1	Total	C	O	0	0
			10	5	5		

- Molecule 4 is CALCIUM ION (CCD ID: CA) (formula: Ca).

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

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	457	Total 457	O 457	0	0
5	B	466	Total 466	O 466	0	0

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	76.27Å 123.18Å 125.38Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.43 – 1.65 48.43 – 1.65	Depositor EDS
% Data completeness (in resolution range)	98.6 (48.43-1.65) 93.7 (48.43-1.65)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.01 (at 1.65Å)	Xtrriage
Refinement program	REFMAC 5.8.0135	Depositor
R, R_{free}	0.146 , 0.199 0.159 , 0.207	Depositor DCC
R_{free} test set	6940 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å ²)	18.8	Xtrriage
Anisotropy	0.169	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 35.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.44$, $\langle L^2 \rangle = 0.26$	Xtrriage
Estimated twinning fraction	0.156 for -h,l,k	Xtrriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	8373	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.44% 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: XYS, AHR, ARB, XYP, CA

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	0.81	1/3797 (0.0%)	0.87	0/5180
1	B	0.82	0/3795	0.87	0/5180
All	All	0.81	1/7592 (0.0%)	0.87	0/10360

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	314	PRO	CA-C	6.31	1.55	1.51

There are no bond angle outliers.

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	3667	0	3489	7	0
1	B	3665	0	3483	14	0
2	C	46	0	8	0	0
2	D	46	0	8	0	0
3	A	10	0	10	0	0
3	B	10	0	10	0	0
4	A	3	0	0	0	0
4	B	3	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	457	0	0	0	0
5	B	466	0	0	4	0
All	All	8373	0	7008	20	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 1.

The worst 5 of 20 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:169:HIS:HB2	1:B:192[B]:MET:HE1	1.78	0.65
1:A:280[B]:TYR:HE2	1:A:293:ASP:OD2	1.84	0.60
1:B:280[B]:TYR:HE2	1:B:293:ASP:OD2	1.85	0.58
1:A:280[B]:TYR:CE2	1:A:293:ASP:OD2	2.59	0.55
1:B:280[B]:TYR:CE2	1:B:293:ASP:OD2	2.61	0.53

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	466/491 (95%)	453 (97%)	13 (3%)	0	100	100
1	B	467/491 (95%)	453 (97%)	14 (3%)	0	100	100
All	All	933/982 (95%)	906 (97%)	27 (3%)	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	373/387 (96%)	373 (100%)	0	100	100
1	B	374/387 (97%)	371 (99%)	3 (1%)	73	60
All	All	747/774 (96%)	744 (100%)	3 (0%)	84	77

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

Mol	Chain	Res	Type
1	B	165	LEU
1	B	337	LEU
1	B	438	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	145	GLN
1	B	444	ASN

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](#)

10 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	XYS	C	1	2	10,10,10	0.60	0	14,14,14	0.87	1 (7%)
2	XYP	C	2	2	9,9,10	0.63	0	10,12,14	1.40	1 (10%)
2	XYP	C	3	2	9,9,10	0.84	0	10,12,14	1.20	1 (10%)
2	XYP	C	4	2	9,9,10	0.72	0	10,12,14	1.28	1 (10%)
2	AHR	C	5	2	9,9,10	0.60	0	11,12,14	1.17	1 (9%)
2	XYS	D	1	2	10,10,10	0.89	0	14,14,14	1.49	3 (21%)
2	XYP	D	2	2	9,9,10	0.51	0	10,12,14	1.00	1 (10%)
2	XYP	D	3	2	9,9,10	1.07	0	10,12,14	1.12	1 (10%)
2	XYP	D	4	2	9,9,10	0.87	0	10,12,14	1.83	4 (40%)
2	AHR	D	5	2	9,9,10	0.73	0	11,12,14	1.13	2 (18%)

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	XYS	C	1	2	-	-	0/1/1/1
2	XYP	C	2	2	-	-	0/1/1/1
2	XYP	C	3	2	-	-	0/1/1/1
2	XYP	C	4	2	-	-	0/1/1/1
2	AHR	C	5	2	-	1/2/15/18	0/1/1/1
2	XYS	D	1	2	-	-	0/1/1/1
2	XYP	D	2	2	-	-	0/1/1/1
2	XYP	D	3	2	-	-	0/1/1/1
2	XYP	D	4	2	-	-	0/1/1/1
2	AHR	D	5	2	-	2/2/15/18	0/1/1/1

There are no bond length outliers.

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	1	XYS	O3-C3-C4	-4.22	101.44	110.05
2	D	4	XYP	C5-O5-C1	3.03	116.31	111.42
2	C	5	AHR	O2-C2-C3	3.02	117.37	111.43

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	4	XYP	C5-C4-C3	-3.02	105.25	109.64
2	C	2	XYP	C5-C4-C3	2.92	113.89	109.64

There are no chirality outliers.

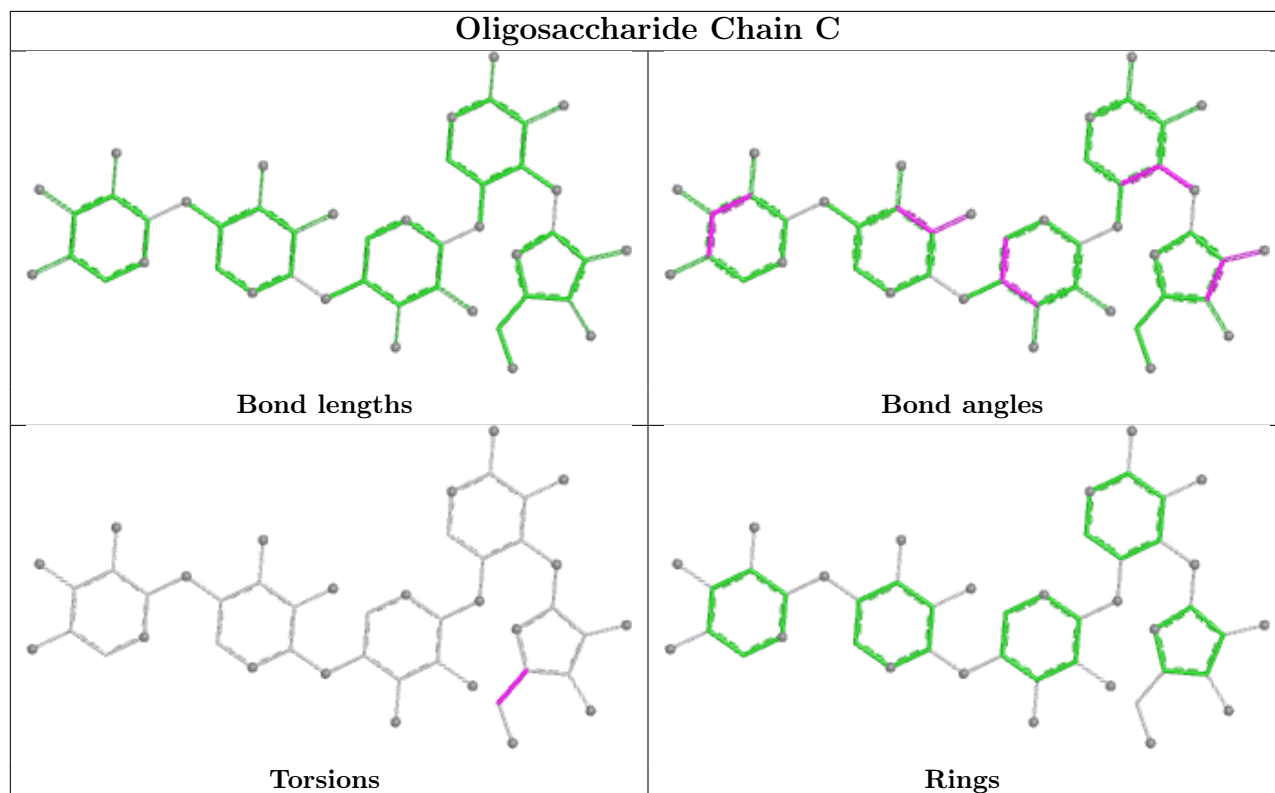
All (3) torsion outliers are listed below:

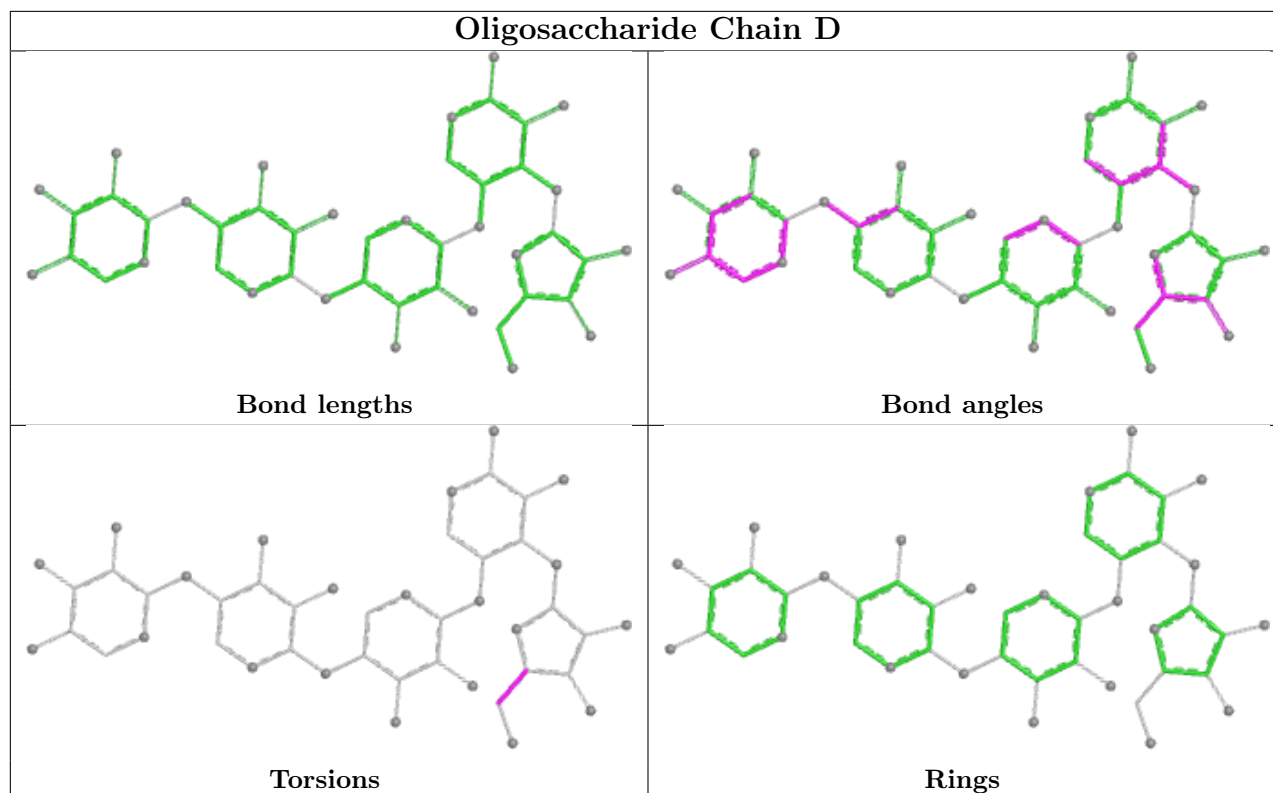
Mol	Chain	Res	Type	Atoms
2	D	5	AHR	C3-C4-C5-O5
2	D	5	AHR	O4-C4-C5-O5
2	C	5	AHR	O4-C4-C5-O5

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 8 ligands modelled in this entry, 6 are monoatomic - leaving 2 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$
3	ARB	A	606	-	10,10,10	0.88	1 (10%)	14,14,14	0.90	0
3	ARB	B	606	-	10,10,10	0.70	0	14,14,14	1.25	2 (14%)

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	ARB	A	606	-	-	-	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	ARB	B	606	-	-	-	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	606	ARB	O5-C1	2.03	1.46	1.43

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	606	ARB	O3-C3-C4	2.03	114.20	110.05
3	B	606	ARB	C5-C4-C3	2.03	112.60	109.64

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 [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	464/491 (94%)	-1.32	0 100 100	10, 19, 31, 56	8 (1%)
1	B	465/491 (94%)	-1.30	0 100 100	10, 20, 32, 68	8 (1%)
All	All	929/982 (94%)	-1.31	0 100 100	10, 20, 31, 68	16 (1%)

There are no RSRZ outliers to report.

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

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

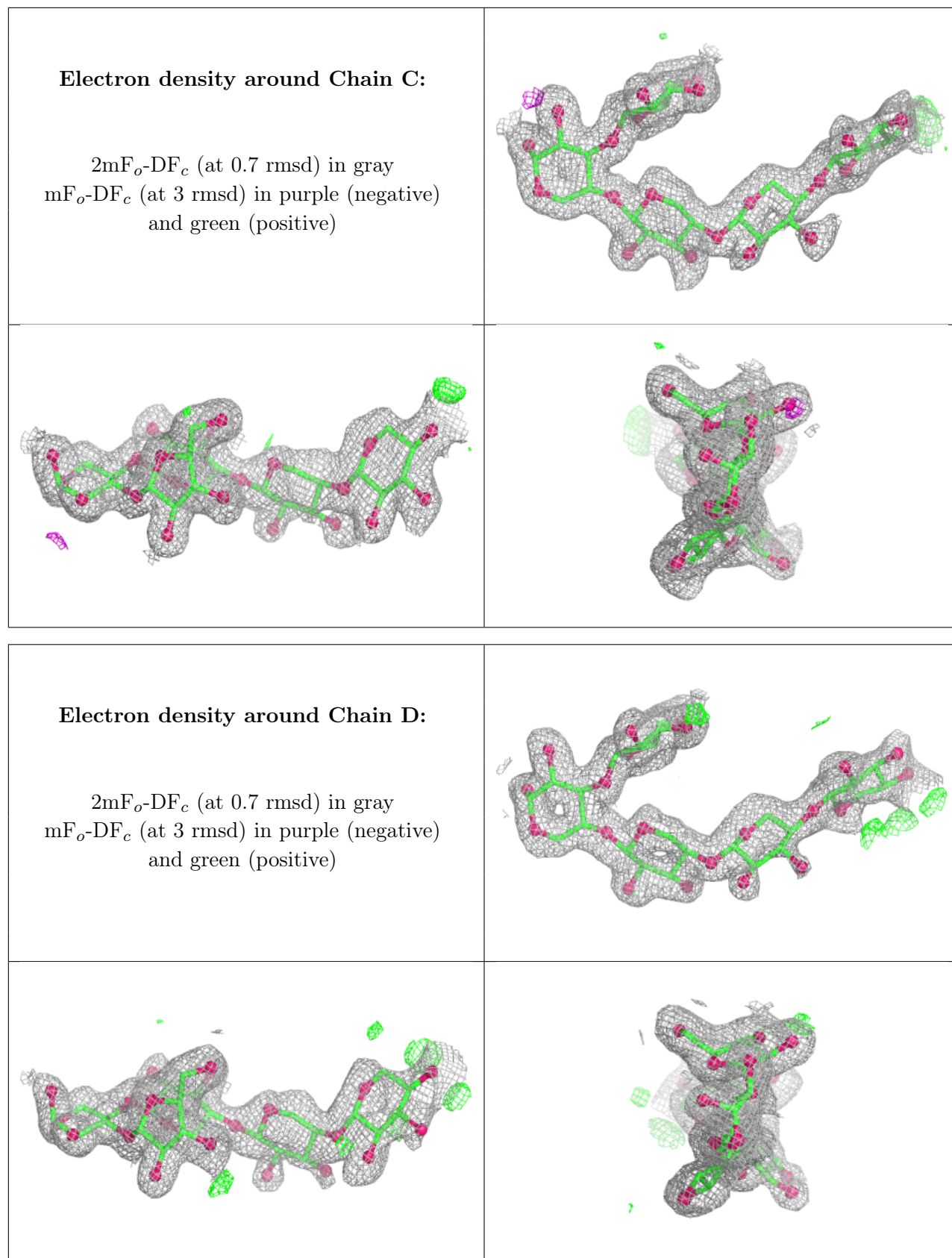
6.3 Carbohydrates [i](#)

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	XYP	D	4	9/10	0.95	0.08	48,51,63,63	0
2	XYP	C	4	9/10	0.98	0.05	39,41,51,54	0
2	XYP	D	3	9/10	0.98	0.05	41,46,49,55	0
2	XYP	C	3	9/10	0.98	0.05	36,40,44,48	0
2	XYS	D	1	10/10	0.99	0.04	28,30,31,35	0
2	XYP	D	2	9/10	0.99	0.04	33,36,41,42	0
2	XYS	C	1	10/10	0.99	0.03	23,25,28,29	0
2	XYP	C	2	9/10	0.99	0.03	28,30,34,39	0
2	AHR	D	5	9/10	0.99	0.03	21,23,26,26	0
2	AHR	C	5	9/10	1.00	0.02	17,20,21,22	0

The following is a graphical depiction of the model fit to experimental electron density for oligosac-

charide. 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	ARB	A	606	10/10	0.99	0.04	21,26,38,42	0
3	ARB	B	606	10/10	0.99	0.04	21,31,34,46	0
4	CA	A	607	1/1	1.00	0.03	18,18,18,18	0
4	CA	A	608	1/1	1.00	0.02	18,18,18,18	0
4	CA	A	609	1/1	1.00	0.01	18,18,18,18	0
4	CA	B	607	1/1	1.00	0.03	19,19,19,19	0
4	CA	B	608	1/1	1.00	0.01	17,17,17,17	0
4	CA	B	609	1/1	1.00	0.01	18,18,18,18	0

6.5 Other polymers [i](#)

There are no such residues in this entry.