



Full wwPDB X-ray Structure Validation Report ⓘ

Sep 5, 2023 – 03:44 PM EDT

PDB ID : 4E52
Title : Crystal structure of Haemophilus Eagan 4A polysaccharide bound human lung surfactant protein D
Authors : Shrive, A.K.; Greenhough, T.J.
Deposited on : 2012-03-13
Resolution : 1.70 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.35
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) : 2.35

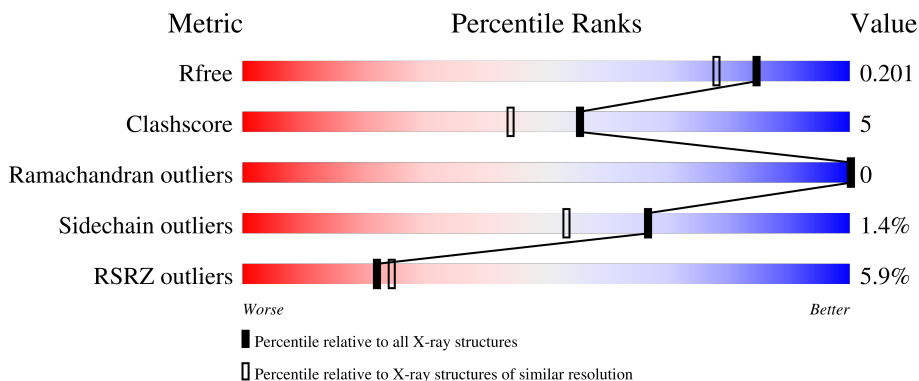
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.70 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}	130704	4298 (1.70-1.70)
Clashscore	141614	4695 (1.70-1.70)
Ramachandran outliers	138981	4610 (1.70-1.70)
Sidechain outliers	138945	4610 (1.70-1.70)
RSRZ outliers	127900	4222 (1.70-1.70)

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	177	
1	B	177	
1	C	177	
2	D	2	
2	E	2	

2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 4067 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.

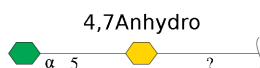
- Molecule 1 is a protein called Pulmonary surfactant-associated protein D.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	152	1161	728	198	230	5	0	0	0
1	B	152	1161	728	198	230	5	0	0	0
1	C	152	1161	728	198	230	5	0	0	0

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	179	GLY	-	expression tag	UNP P35247
A	180	SER	-	expression tag	UNP P35247
B	179	GLY	-	expression tag	UNP P35247
B	180	SER	-	expression tag	UNP P35247
C	179	GLY	-	expression tag	UNP P35247
C	180	SER	-	expression tag	UNP P35247

- Molecule 2 is an oligosaccharide called 4,7-anhydro-3-deoxy-D-manno-oct-2-ulosonic acid-(5-1)-L-glycero- α -D-manno-heptopyranose.



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
			Total	C	O			
2	D	2	22	12	10	0	0	0
2	E	2	22	12	10	0	0	0

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

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

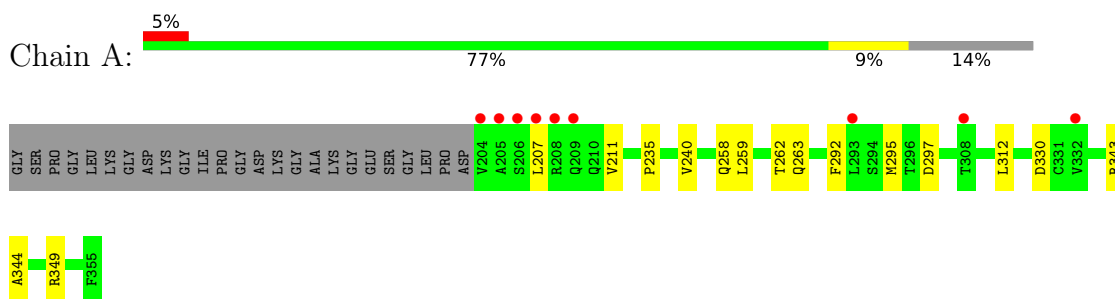
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	190	Total O 190 190	0	0
4	B	192	Total O 192 192	0	0
4	C	149	Total O 149 149	0	0

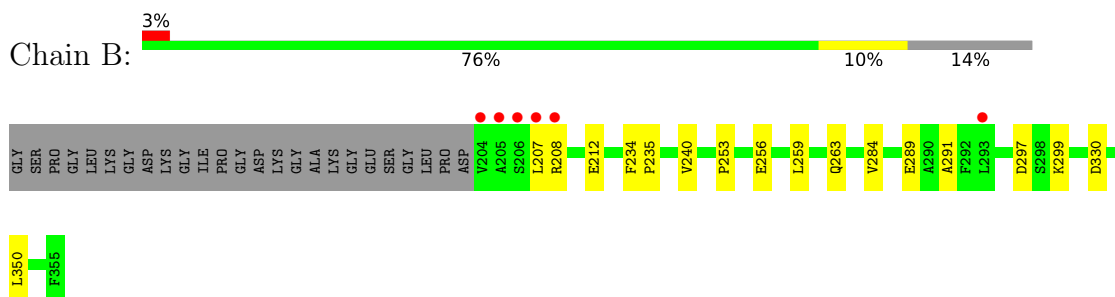
3 Residue-property plots [i](#)

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.

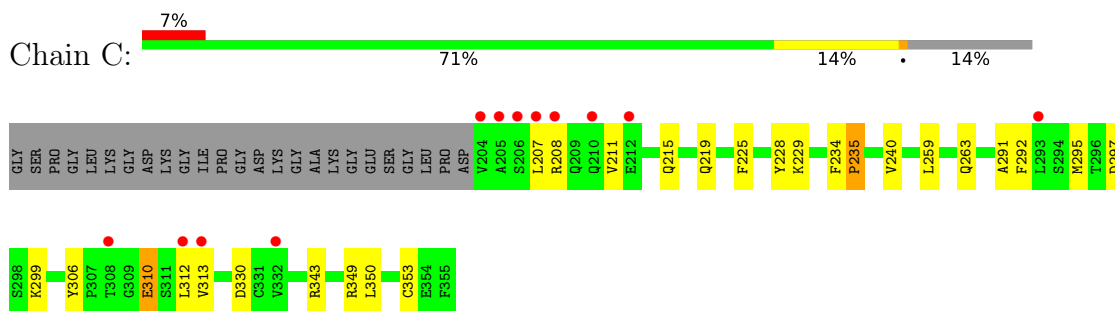
- Molecule 1: Pulmonary surfactant-associated protein D



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- Molecule 1: Pulmonary surfactant-associated protein D



- Molecule 2: 4,7-anhydro-3-deoxy-D-manno-oct-2-ulosonic acid-(5-1)-L-glycero-alpha-D-manno-heptopyranose



GMHL
KD52

- Molecule 2: 4,7-anhydro-3-deoxy-D-manno-oct-2-ulosonic acid-(5-1)-L-glycero-alpha-D-manno-heptopyranose

Chain E:

100%GMHL
KD52

4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	55.35Å 107.99Å 55.65Å 90.00° 92.14° 90.00°	Depositor
Resolution (Å)	26.75 – 1.70 26.75 – 1.70	Depositor EDS
% Data completeness (in resolution range)	99.8 (26.75-1.70) 99.9 (26.75-1.70)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.00 (at 1.70Å)	Xtrriage
Refinement program	CNS	Depositor
R, R_{free}	0.192 , 0.210 0.183 , 0.201	Depositor DCC
R_{free} test set	3624 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	20.9	Xtrriage
Anisotropy	0.246	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 44.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.007 for l,k,-h 0.037 for h,-k,-l 0.026 for l,-k,h	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	4067	wwPDB-VP
Average B, all atoms (Å ²)	24.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.33% 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: KD5, GMH, 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	0.33	0/1183	0.56	0/1598
1	B	0.32	0/1183	0.55	0/1598
1	C	0.31	0/1183	0.54	0/1598
All	All	0.32	0/3549	0.55	0/4794

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	1161	0	1119	9	0
1	B	1161	0	1119	10	0
1	C	1161	0	1119	19	0
2	D	22	0	17	0	0
2	E	22	0	17	0	0
3	A	3	0	0	0	0
3	B	3	0	0	0	0
3	C	3	0	0	0	0
4	A	190	0	0	0	0
4	B	192	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	C	149	0	0	2	0
All	All	4067	0	3391	35	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 5.

All (35) 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:C:306:TYR:HD2	1:C:310:GLU:HG2	1.48	0.78
1:A:207:LEU:HD23	1:C:207:LEU:HD21	1.71	0.73
1:C:207:LEU:O	1:C:211:VAL:HG23	2.10	0.52
1:A:207:LEU:O	1:A:211:VAL:HG23	2.11	0.51
1:C:313:VAL:HG12	1:C:313:VAL:O	2.11	0.50
1:C:297:ASP:OD1	1:C:330:ASP:HA	2.11	0.50
1:C:215:GLN:O	1:C:219:GLN:HG2	2.12	0.48
1:C:292:PHE:CD2	1:C:349:ARG:HB2	2.48	0.48
1:B:240:VAL:HG13	1:B:240:VAL:O	2.13	0.48
1:C:306:TYR:CD2	1:C:310:GLU:HG2	2.38	0.48
1:A:297:ASP:OD1	1:A:330:ASP:HA	2.14	0.47
1:B:299:LYS:HD3	4:B:676:HOH:O	2.13	0.47
1:B:208:ARG:HG2	1:B:212:GLU:OE2	2.14	0.47
1:B:297:ASP:OD1	1:B:330:ASP:HA	2.15	0.47
1:C:225:PHE:CE2	1:C:229:LYS:HD3	2.50	0.46
1:A:343:ARG:HG3	1:A:344:ALA:N	2.31	0.46
1:C:343:ARG:HD3	4:C:518:HOH:O	2.15	0.46
1:C:299:LYS:HB3	4:C:572:HOH:O	2.16	0.45
1:C:211:VAL:O	1:C:215:GLN:HG3	2.17	0.45
1:B:207:LEU:HD21	1:C:208:ARG:HG2	2.00	0.44
1:A:295:MET:HG2	1:A:312:LEU:HD21	1.99	0.44
1:C:295:MET:HG2	1:C:312:LEU:CD2	2.48	0.43
1:A:240:VAL:O	1:A:240:VAL:HG13	2.18	0.43
1:A:292:PHE:CD2	1:A:349:ARG:HB2	2.54	0.42
1:C:259:LEU:O	1:C:263:GLN:HG3	2.18	0.42
1:A:258:GLN:O	1:A:262:THR:HG23	2.19	0.42
1:B:259:LEU:O	1:B:263:GLN:HG3	2.19	0.42
1:A:259:LEU:O	1:A:263:GLN:HG3	2.20	0.42
1:C:240:VAL:HG13	1:C:240:VAL:O	2.19	0.41
1:C:234:PHE:HA	1:C:235:PRO:HA	1.85	0.41
1:C:291:ALA:HB2	1:C:350:LEU:HB3	2.03	0.41
1:B:253:PRO:HB2	1:B:256:GLU:OE1	2.21	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:234:PHE:CZ	1:C:353:CYS:SG	3.14	0.41
1:B:291:ALA:HB2	1:B:350:LEU:HB3	2.02	0.41
1:B:284:VAL:HG13	1:B:289:GLU:O	2.21	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	150/177 (85%)	147 (98%)	3 (2%)	0	100	100
1	B	150/177 (85%)	147 (98%)	3 (2%)	0	100	100
1	C	150/177 (85%)	148 (99%)	2 (1%)	0	100	100
All	All	450/531 (85%)	442 (98%)	8 (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	122/138 (88%)	121 (99%)	1 (1%)	81	74
1	B	122/138 (88%)	121 (99%)	1 (1%)	81	74
1	C	122/138 (88%)	119 (98%)	3 (2%)	47	29

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	366/414 (88%)	361 (99%)	5 (1%)	67 53

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	235	PRO
1	B	235	PRO
1	C	228	TYR
1	C	235	PRO
1	C	310	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	210	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](#)

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	GMH	D	1	3,2	14,14,14	2.38	6 (42%)	19,20,20	0.95	1 (5%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	KD5	D	2	2	8,8,15	0.54	0	9,10,21	2.34	4 (44%)
2	GMH	E	1	3,2	14,14,14	2.45	6 (42%)	19,20,20	0.89	1 (5%)
2	KD5	E	2	2	8,8,15	0.75	0	9,10,21	2.22	3 (33%)

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	GMH	D	1	3,2	-	0/6/26/26	0/1/1/1
2	KD5	D	2	2	-	0/2/12/26	0/1/1/1
2	GMH	E	1	3,2	-	0/6/26/26	0/1/1/1
2	KD5	E	2	2	-	2/2/12/26	0/1/1/1

All (12) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	1	GMH	C1-C2	4.51	1.63	1.52
2	D	1	GMH	C1-C2	4.41	1.62	1.52
2	D	1	GMH	O5-C5	4.12	1.50	1.44
2	E	1	GMH	O5-C5	4.09	1.50	1.44
2	E	1	GMH	C3-C2	3.56	1.61	1.52
2	D	1	GMH	C3-C2	3.34	1.60	1.52
2	E	1	GMH	O3-C3	3.04	1.50	1.43
2	D	1	GMH	O3-C3	3.02	1.50	1.43
2	E	1	GMH	O5-C1	2.87	1.50	1.42
2	D	1	GMH	O5-C1	2.87	1.50	1.42
2	E	1	GMH	C4-C5	2.53	1.59	1.52
2	D	1	GMH	C4-C5	2.36	1.58	1.52

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	2	KD5	O7-C4-C5	-4.84	96.58	106.37
2	E	2	KD5	O7-C4-C5	-4.64	97.00	106.37
2	D	2	KD5	C8-C7-C6	-2.94	107.37	114.81
2	E	2	KD5	C4-C5-C6	2.92	106.50	103.20
2	D	2	KD5	C4-C5-C6	2.56	106.10	103.20
2	E	2	KD5	C8-C7-C6	-2.54	108.38	114.81
2	D	1	GMH	C4-C3-C2	-2.37	106.69	110.82

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	2	KD5	O7-C7-C6	2.23	107.00	103.73
2	E	1	GMH	C4-C3-C2	-2.22	106.95	110.82

There are no chirality outliers.

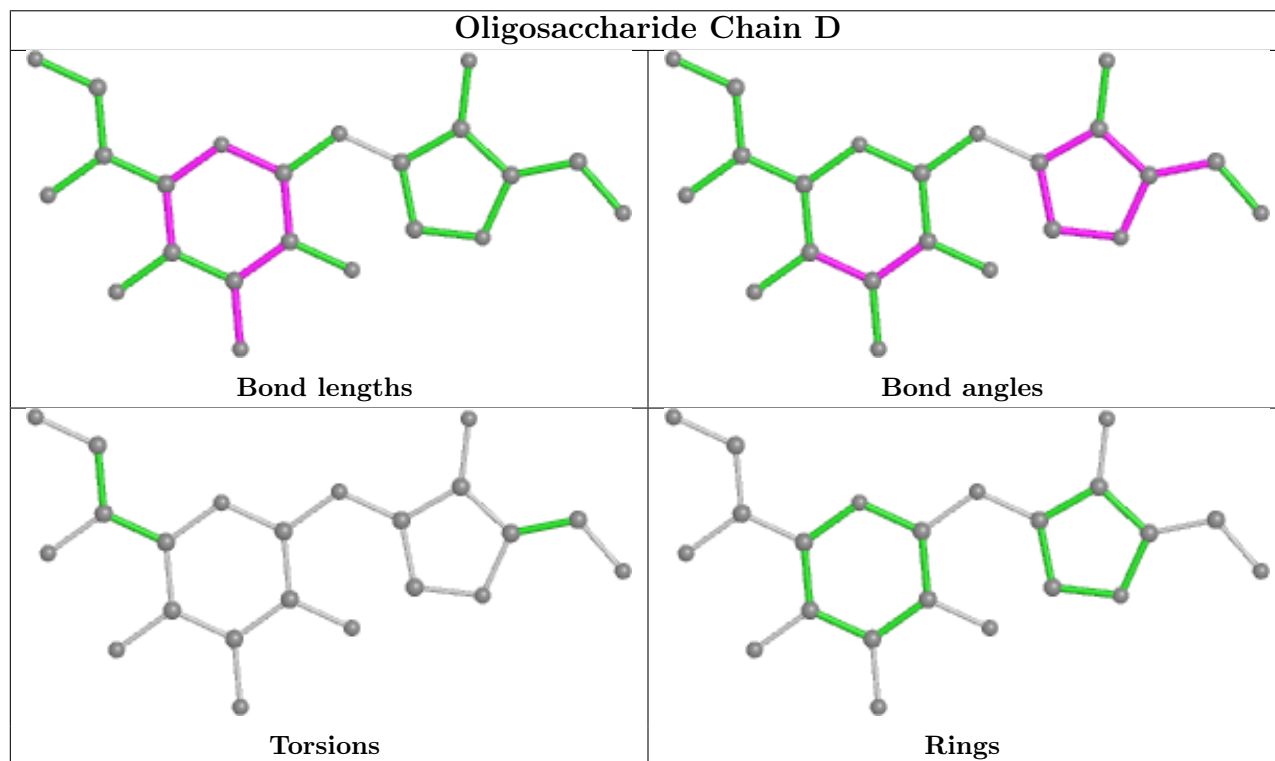
All (2) torsion outliers are listed below:

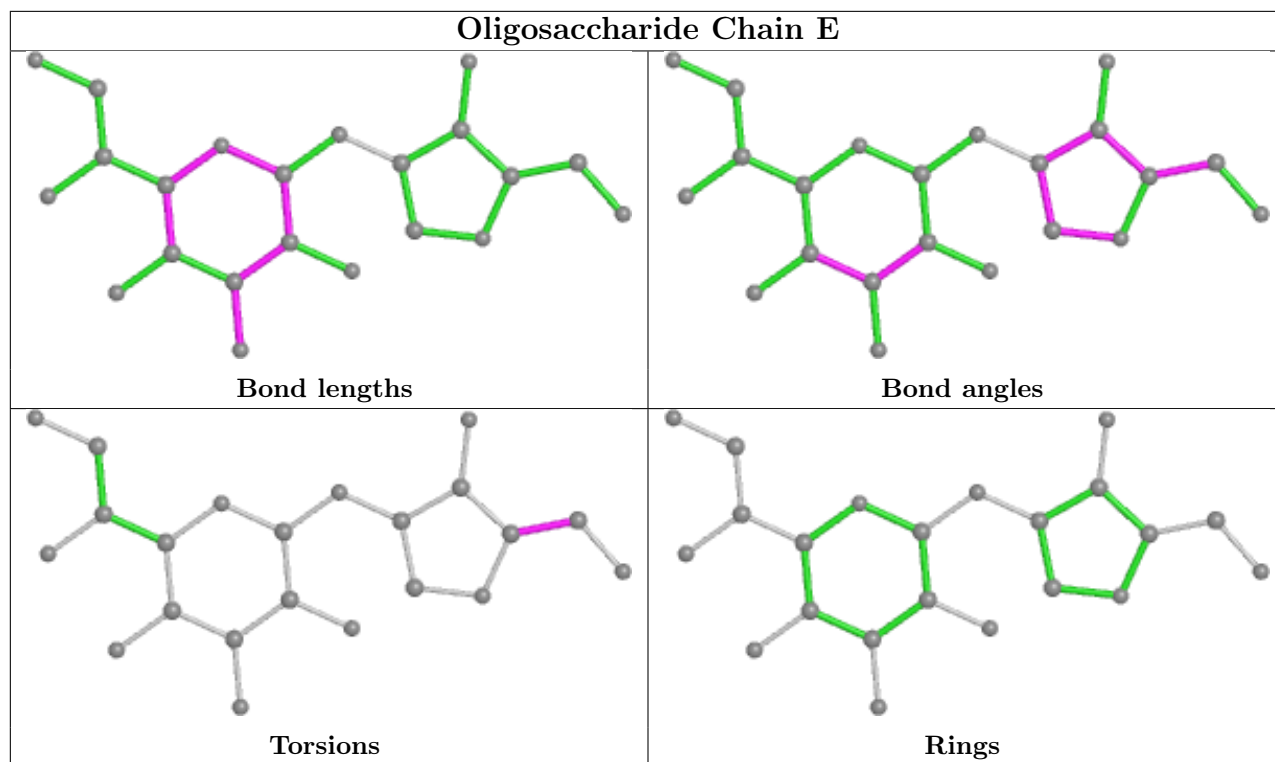
Mol	Chain	Res	Type	Atoms
2	E	2	KD5	O7-C7-C8-O8
2	E	2	KD5	C6-C7-C8-O8

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 9 ligands modelled in this entry, 9 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 [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	152/177 (85%)	0.27	9 (5%) 22 24	13, 21, 41, 50	0
1	B	152/177 (85%)	0.23	6 (3%) 39 44	14, 20, 36, 49	0
1	C	152/177 (85%)	0.45	12 (7%) 12 14	14, 22, 41, 50	0
All	All	456/531 (85%)	0.32	27 (5%) 22 24	13, 21, 41, 50	0

All (27) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	204	VAL	10.0
1	A	204	VAL	9.4
1	B	207	LEU	8.9
1	B	204	VAL	8.5
1	A	205	ALA	8.1
1	C	205	ALA	8.0
1	C	313	VAL	6.2
1	B	205	ALA	5.2
1	C	208	ARG	5.1
1	A	206	SER	5.1
1	A	208	ARG	4.9
1	A	207	LEU	4.7
1	A	209	GLN	4.7
1	C	206	SER	4.3
1	B	208	ARG	4.2
1	C	332	VAL	3.2
1	B	293	LEU	3.2
1	C	308	THR	3.1
1	C	293	LEU	3.0
1	C	207	LEU	2.5
1	A	293	LEU	2.3
1	C	210	GLN	2.2
1	C	212	GLU	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	206	SER	2.2
1	A	308	THR	2.1
1	A	332	VAL	2.1
1	C	312	LEU	2.1

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](#)

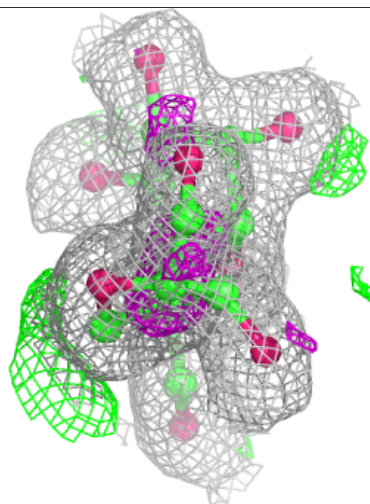
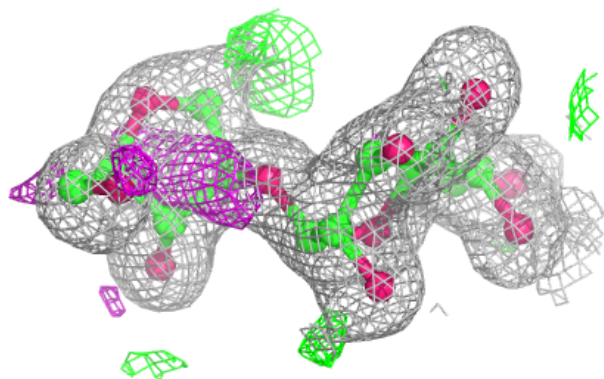
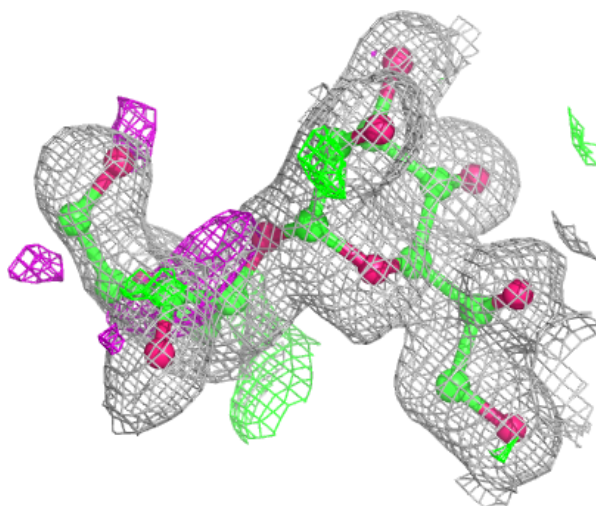
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q < 0.9' lists the number of atoms with occupancy less than 0.9.

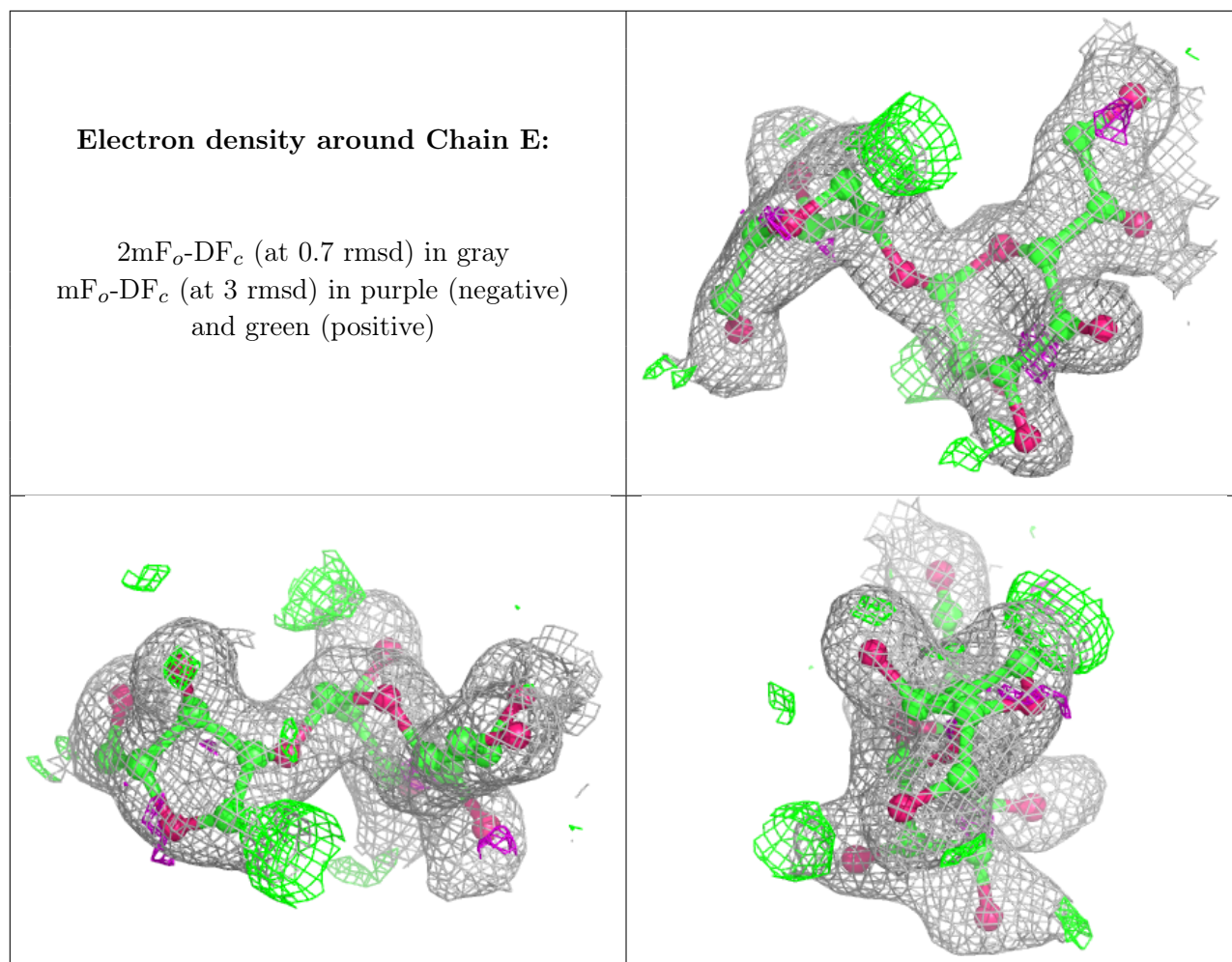
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q < 0.9
2	KD5	D	2	8/15	0.68	0.23	28,31,34,36	0
2	KD5	E	2	8/15	0.70	0.21	31,33,35,37	0
2	GMH	E	1	14/14	0.88	0.15	20,30,34,34	0
2	GMH	D	1	14/14	0.89	0.11	18,27,30,30	0

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.

Electron density around Chain D:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)





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	CA	C	403	1/1	0.95	0.05	23,23,23,23	0
3	CA	B	403	1/1	0.98	0.05	24,24,24,24	0
3	CA	B	402	1/1	0.99	0.05	17,17,17,17	0
3	CA	A	402	1/1	0.99	0.05	17,17,17,17	0
3	CA	C	402	1/1	0.99	0.05	18,18,18,18	0
3	CA	A	403	1/1	0.99	0.05	19,19,19,19	0
3	CA	C	401	1/1	1.00	0.07	16,16,16,16	0
3	CA	A	401	1/1	1.00	0.06	17,17,17,17	0
3	CA	B	401	1/1	1.00	0.06	15,15,15,15	0

6.5 Other polymers [i](#)

There are no such residues in this entry.