



wwPDB X-ray Structure Validation Summary Report ⓘ

Jan 2, 2024 – 06:16 pm GMT

PDB ID : 5E98
Title : Crystal structure of human heparanase in complex with HepMer M04S02a
Authors : Wu, L.; Davies, G.J.
Deposited on : 2015-10-14
Resolution : 1.63 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 : 4.02b-467
Mogul : 1.8.4, CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.36
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) : 2.36

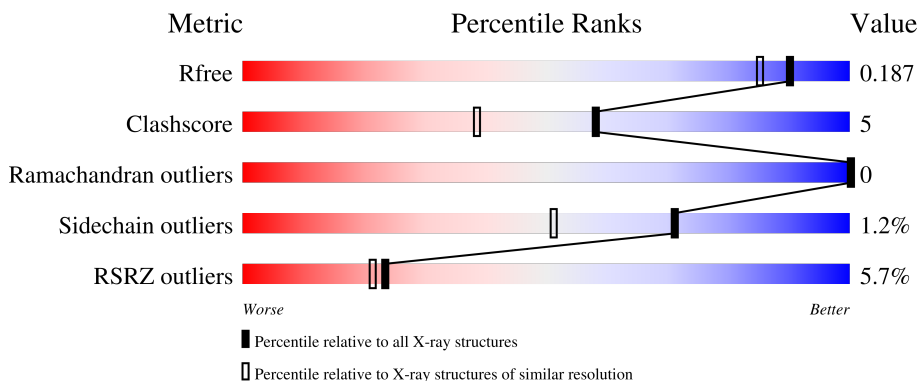
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

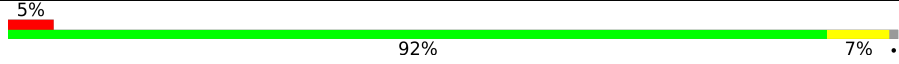
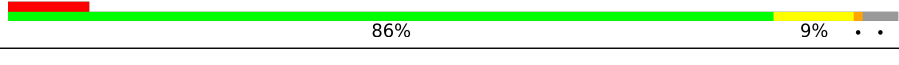
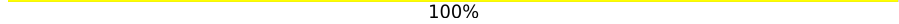
The reported resolution of this entry is 1.63 Å.

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	3122 (1.66-1.62)
Clashscore	141614	3268 (1.66-1.62)
Ramachandran outliers	138981	3215 (1.66-1.62)
Sidechain outliers	138945	3215 (1.66-1.62)
RSRZ outliers	127900	3079 (1.66-1.62)

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	389	 5% 92% 7%
2	B	77	 9% 86% 9%
3	C	3	 100%

2 Entry composition i

There are 8 unique types of molecules in this entry. The entry contains 7773 atoms, of which 3784 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 Heparanase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
1	A	385	6166	1977	3103	523	552	11	145	1	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	155	ASP	-	expression tag	UNP Q9Y251
A	156	PRO	-	expression tag	UNP Q9Y251
A	157	GLY	-	expression tag	UNP Q9Y251
A	307	ARG	LYS	conflict	UNP Q9Y251

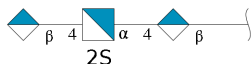
- Molecule 2 is a protein called Heparanase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	H	N	O			
2	B	74	1185	383	599	95	108	20	0	0

There are 3 discrepancies between the modelled and reference sequences:

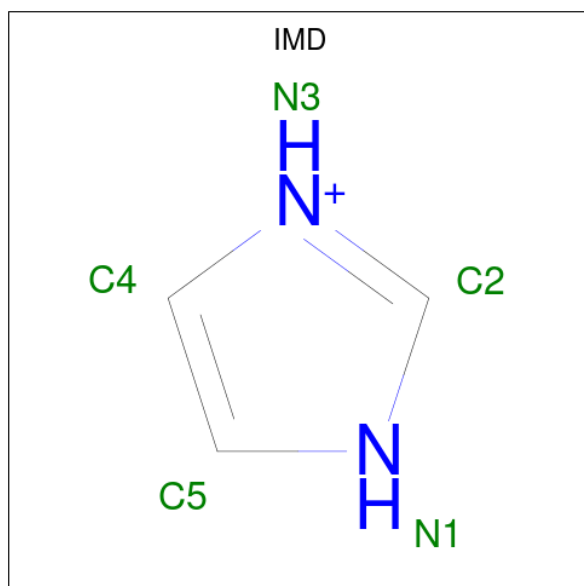
Chain	Residue	Modelled	Actual	Comment	Reference
B	33	ASP	-	expression tag	UNP Q9Y251
B	34	PRO	-	expression tag	UNP Q9Y251
B	35	GLY	-	expression tag	UNP Q9Y251

- Molecule 3 is an oligosaccharide called beta-D-glucopyranuronic acid-(1-4)-2-deoxy-2-(sulfo amino)-alpha-D-glucopyranose-(1-4)-beta-D-glucopyranuronic acid.



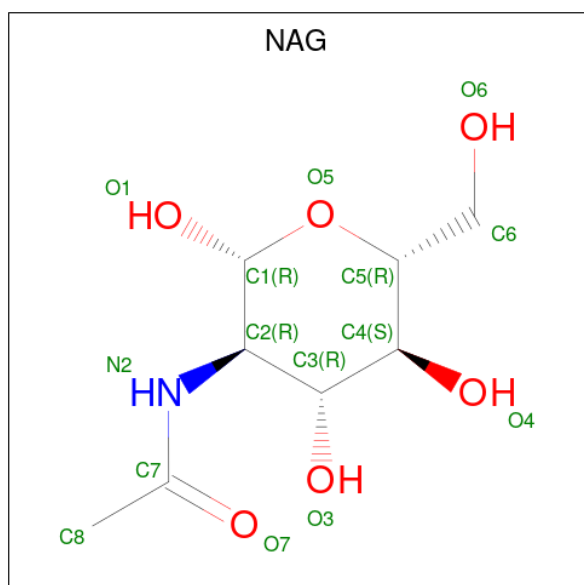
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
3	C	3	65	18	26	1	19	1	8	0	0

- Molecule 4 is IMIDAZOLE (three-letter code: IMD) (formula: $C_3H_5N_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	H	N		
4	A	1	13	3	8	2	0	0

- Molecule 5 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: $C_8H_{15}NO_6$).

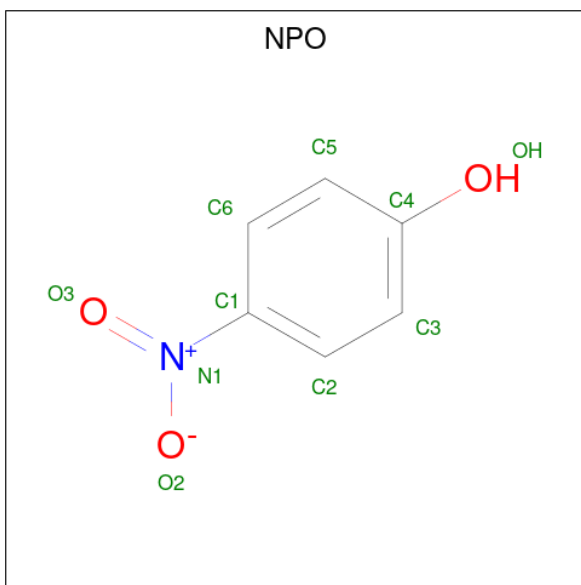


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	H	N	O	3	0
			28	8	14	1	5		
5	A	1	Total	C	H	N	O	3	0
			28	8	14	1	5		
5	A	1	Total	C	H	N	O	3	0
			28	8	14	1	5		

- Molecule 6 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	Cl	0	0
			1	1		

- Molecule 7 is P-NITROPHENOL (three-letter code: NPO) (formula: C₆H₅NO₃).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
7	A	1	Total	C	H	N	O	2	0
			16	6	6	1	3		

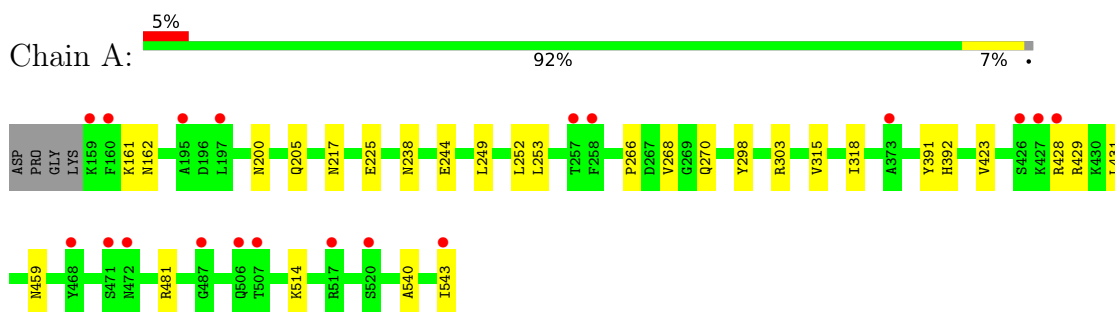
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	210	Total	O	0	0
			210	210		
8	B	33	Total	O	0	0
			33	33		

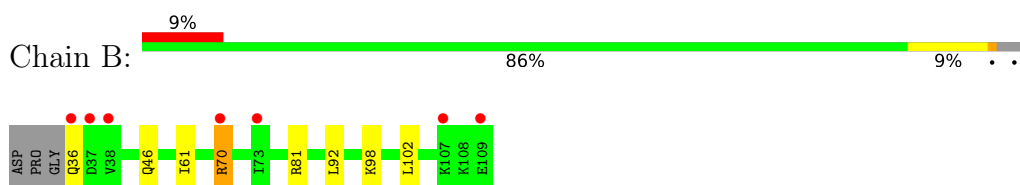
3 Residue-property plots [i](#)

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.

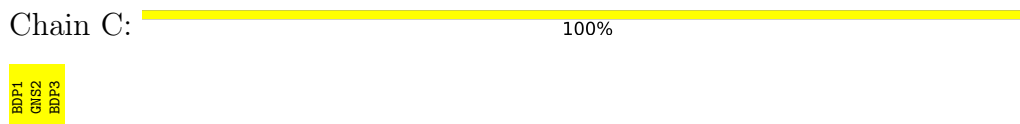
- Molecule 1: Heparanase



- Molecule 2: Heparanase



- Molecule 3: beta-D-glucopyranuronic acid-(1-4)-2-deoxy-2-(sulfoamino)-alpha-D-glucopyranose-(1-4)-beta-D-glucopyranuronic acid



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	45.79Å 71.29Å 77.92Å 90.00° 95.06° 90.00°	Depositor
Resolution (Å)	38.45 – 1.63 38.42 – 1.63	Depositor EDS
% Data completeness (in resolution range)	99.5 (38.45-1.63) 99.5 (38.42-1.63)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.58 (at 1.63Å)	Xtrriage
Refinement program	REFMAC 5.8.0258	Depositor
R, R_{free}	0.170 , 0.206 0.180 , 0.187	Depositor DCC
R_{free} test set	3148 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å ²)	27.6	Xtrriage
Anisotropy	0.254	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.41 , 44.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	7773	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.50% 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: IMD, GNS, BDP, CL, NPO, NAG

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	0.76	1/3137 (0.0%)	0.89	1/4243 (0.0%)
2	B	0.71	0/600	0.86	0/814
All	All	0.75	1/3737 (0.0%)	0.88	1/5057 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	225	GLU	CD-OE2	7.75	1.34	1.25

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	481	ARG	NE-CZ-NH1	5.06	122.83	120.30

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	3063	3103	3097	29	0
2	B	586	599	597	8	0
3	C	39	26	20	0	0
4	A	5	8	5	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	42	42	39	12	0
6	A	1	0	0	0	0
7	A	10	6	4	0	0
8	A	210	0	0	9	0
8	B	33	0	0	5	0
All	All	3989	3784	3762	36	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.

The worst 5 of 36 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:A:459:ASN:HD21	5:A:1004:NAG:C1	0.97	1.57
1:A:200:ASN:HD21	5:A:1002:NAG:C1	1.24	1.47
1:A:238:ASN:HD21	5:A:1003:NAG:C1	1.27	1.45
1:A:459:ASN:ND2	5:A:1004:NAG:C1	1.77	1.40
1:A:238:ASN:ND2	5:A:1003:NAG:C1	2.08	1.16

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	384/389 (99%)	376 (98%)	8 (2%)	0	100	100
2	B	72/77 (94%)	71 (99%)	1 (1%)	0	100	100
All	All	456/466 (98%)	447 (98%)	9 (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	336/338 (99%)	333 (99%)	3 (1%)	78	63
2	B	66/68 (97%)	64 (97%)	2 (3%)	41	14
All	All	402/406 (99%)	397 (99%)	5 (1%)	71	51

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

Mol	Chain	Res	Type
1	A	391	TYR
1	A	392	HIS
1	A	429	ARG
2	B	36	GLN
2	B	70	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	200	ASN
1	A	238	ASN
1	A	270	GLN
1	A	459	ASN
2	B	36	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

3 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
3	BDP	C	1	7,3	12,12,13	1.14	1 (8%)	14,17,19	1.53	4 (28%)
3	GNS	C	2	3	14,15,16	2.89	3 (21%)	17,22,24	1.62	2 (11%)
3	BDP	C	3	3	12,12,13	0.73	0	14,17,19	1.37	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	BDP	C	1	7,3	-	0/4/21/24	0/1/1/1
3	GNS	C	2	3	-	0/7/24/27	0/1/1/1
3	BDP	C	3	3	-	0/4/21/24	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	2	GNS	O2S-S1	8.66	1.52	1.42
3	C	2	GNS	O3S-S1	4.83	1.47	1.42
3	C	2	GNS	S1-N2	3.86	1.64	1.59
3	C	1	BDP	C5-C6	-2.49	1.47	1.53

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	2	GNS	O3S-S1-N2	4.29	116.70	108.87
3	C	2	GNS	O2S-S1-O3S	-3.64	111.57	120.16
3	C	1	BDP	O5-C1-C2	3.07	115.51	110.77
3	C	1	BDP	O2-C2-C3	2.64	115.44	110.14
3	C	3	BDP	C2-C3-C4	2.47	115.17	110.89

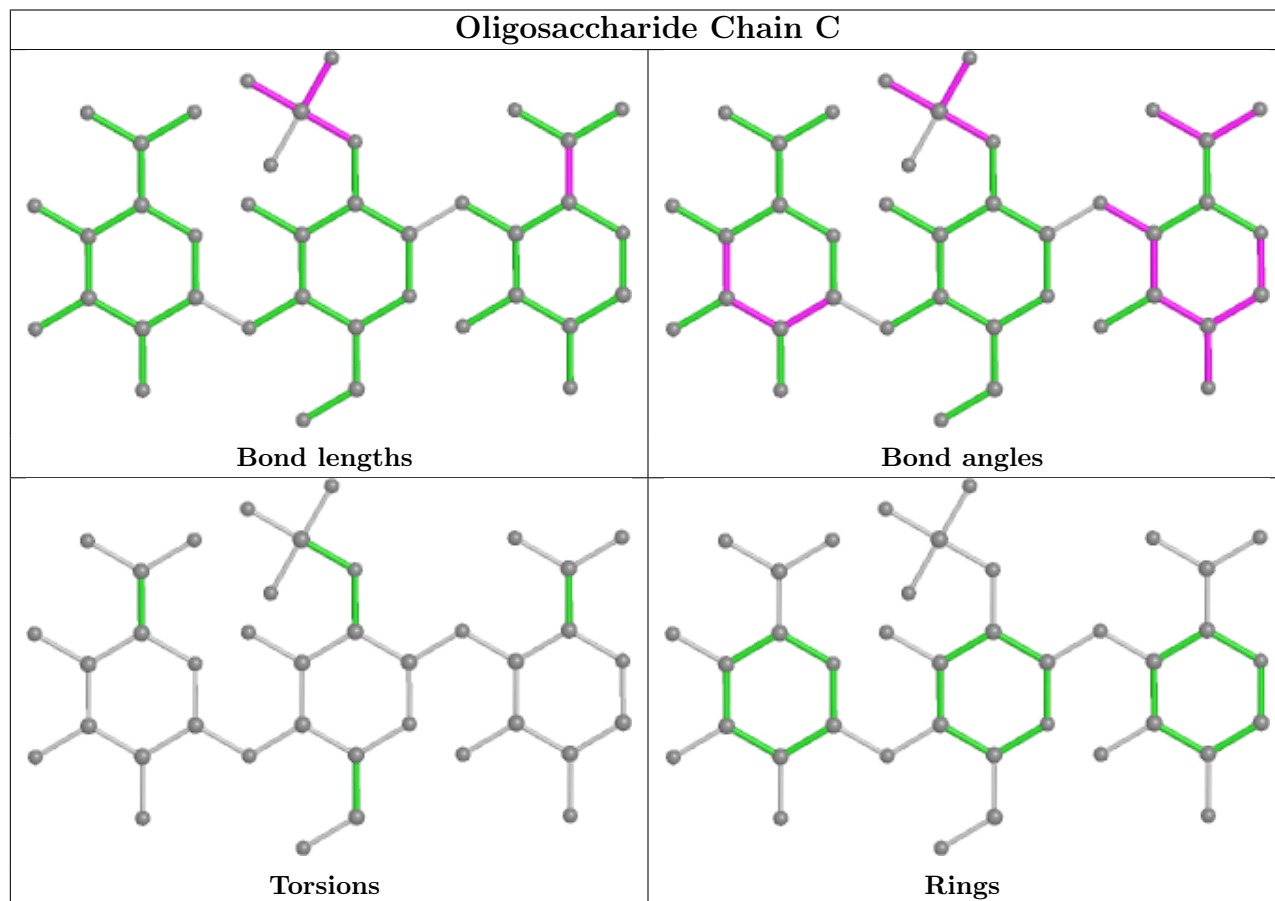
There are no chirality outliers.

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 6 ligands modelled in this entry, 1 is monoatomic - leaving 5 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	IMD	A	1001	-	3,5,5	3.33	3 (100%)	4,5,5	1.15	0
5	NAG	A	1004	-	14,14,15	0.53	0	17,19,21	2.00	6 (35%)
5	NAG	A	1003	-	14,14,15	0.63	0	17,19,21	1.06	1 (5%)
5	NAG	A	1002	-	14,14,15	0.58	0	17,19,21	1.24	2 (11%)
7	NPO	A	1009	3	9,10,10	4.02	1 (11%)	11,13,13	1.48	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
4	IMD	A	1001	-	-	-	0/1/1/1
5	NAG	A	1004	-	-	0/6/23/26	0/1/1/1
5	NAG	A	1003	-	-	2/6/23/26	0/1/1/1
5	NAG	A	1002	-	-	2/6/23/26	0/1/1/1
7	NPO	A	1009	3	-	2/2/4/4	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	A	1009	NPO	O3-N1	11.87	1.42	1.22
4	A	1001	IMD	C5-C4	4.14	1.56	1.37
4	A	1001	IMD	C5-N1	3.02	1.51	1.37
4	A	1001	IMD	C4-N3	2.63	1.49	1.37

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	1004	NAG	C1-C2-N2	-4.06	103.55	110.49
7	A	1009	NPO	O3-N1-C1	3.66	123.97	118.80
5	A	1004	NAG	C4-C3-C2	-3.22	106.29	111.02
7	A	1009	NPO	C2-C1-N1	2.79	121.48	119.38
5	A	1004	NAG	O3-C3-C4	2.45	116.02	110.35

There are no chirality outliers.

5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	1002	NAG	O5-C5-C6-O6

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Mol	Chain	Res	Type	Atoms
5	A	1002	NAG	C4-C5-C6-O6
7	A	1009	NPO	C2-C1-N1-O3
5	A	1003	NAG	C4-C5-C6-O6
7	A	1009	NPO	C6-C1-N1-O3

There are no ring outliers.

3 monomers are involved in 12 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	1004	NAG	4	0
5	A	1003	NAG	4	0
5	A	1002	NAG	4	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 [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	385/389 (98%)	0.28	19 (4%) 29 27	18, 33, 59, 99	1 (0%)
2	B	74/77 (96%)	0.34	7 (9%) 8 6	21, 36, 63, 82	1 (1%)
All	All	459/466 (98%)	0.29	26 (5%) 23 21	18, 34, 60, 99	2 (0%)

The worst 5 of 26 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	426	SER	5.9
1	A	543	ILE	4.8
1	A	159	LYS	4.3
1	A	258	PHE	4.2
1	A	197	LEU	3.8

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

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

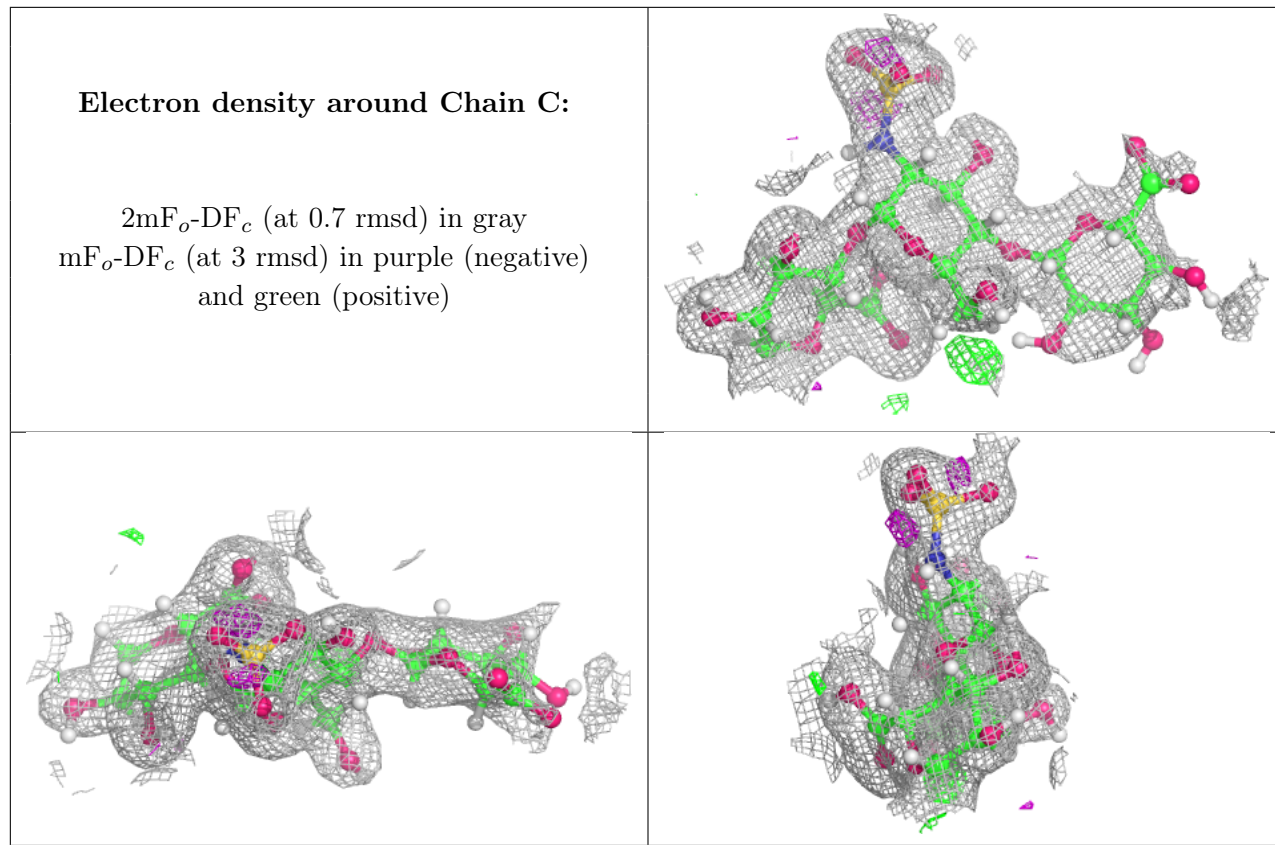
6.3 Carbohydrates [i](#)

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
3	BDP	C	3	12/13	0.82	0.23	71,88,102,103	3
3	BDP	C	1	12/13	0.91	0.08	31,38,41,41	3
3	GNS	C	2	15/16	0.96	0.07	40,43,52,53	2

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(\AA^2)	Q<0.9
5	NAG	A	1002	14/15	0.54	0.36	66,87,92,96	3
5	NAG	A	1004	14/15	0.78	0.18	52,64,72,72	3
5	NAG	A	1003	14/15	0.80	0.23	63,74,84,85	3
4	IMD	A	1001	5/5	0.84	0.12	18,41,43,45	0
7	NPO	A	1009	10/10	0.92	0.14	41,46,64,64	2
6	CL	A	1005	1/1	0.97	0.03	68,68,68,68	0

6.5 Other polymers [i](#)

There are no such residues in this entry.