



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 1, 2026 – 10:06 PM UTC

PDB ID : 2AE7 / pdb_00002ae7
Title : Crystal Structure of Human M340H-Beta1,4-Galactosyltransferase-I (M340H-B4GAL-T1) in Complex with Pentasaccharide
Authors : Ramasamy, V.; Ramakrishnan, B.; Boeggeman, E.; Ratner, D.M.; Seeberger, P.H.; Qasba, P.K.
Deposited on : 2005-07-21
Resolution : 2.00 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
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
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

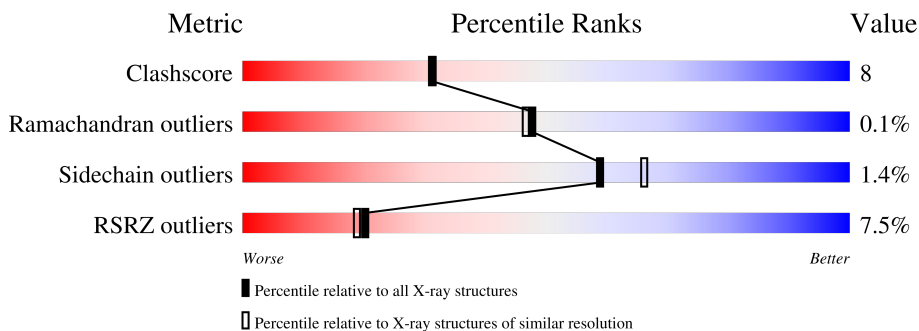
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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))
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	287	 6% 78% 15% • 5%
1	B	287	 3% 78% 16% • 5%
1	C	287	 13% 69% 24% • 5%
2	D	2	 100%
2	F	2	 100%
3	E	3	 100%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	MAN	E	1	X	-	-	-

2 Entry composition [i](#)

There are 9 unique types of molecules in this entry. The entry contains 7413 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 Beta-1,4-galactosyltransferase 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	272	2212	1417	385	399	11	0	0	0
1	B	272	2212	1417	385	399	11	0	0	0
1	C	272	2212	1417	385	399	11	0	0	0

There are 51 discrepancies between the modelled and reference sequences:

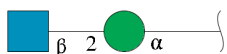
Chain	Residue	Modelled	Actual	Comment	Reference
A	112	ALA	-	SEE REMARK 999	UNP P15291
A	113	SER	-	SEE REMARK 999	UNP P15291
A	114	MET	-	SEE REMARK 999	UNP P15291
A	115	THR	-	SEE REMARK 999	UNP P15291
A	116	GLY	-	SEE REMARK 999	UNP P15291
A	117	GLY	-	SEE REMARK 999	UNP P15291
A	118	GLN	-	SEE REMARK 999	UNP P15291
A	119	GLN	-	SEE REMARK 999	UNP P15291
A	120	MET	-	SEE REMARK 999	UNP P15291
A	121	GLY	-	SEE REMARK 999	UNP P15291
A	122	ARG	-	SEE REMARK 999	UNP P15291
A	123	GLY	-	SEE REMARK 999	UNP P15291
A	124	SER	-	SEE REMARK 999	UNP P15291
A	125	ALA	-	SEE REMARK 999	UNP P15291
A	337	THR	ARG	engineered mutation	UNP P15291
A	338	THR	CYS	engineered mutation	UNP P15291
A	340	HIS	MET	engineered mutation	UNP P15291
B	112	ALA	-	SEE REMARK 999	UNP P15291
B	113	SER	-	SEE REMARK 999	UNP P15291
B	114	MET	-	SEE REMARK 999	UNP P15291
B	115	THR	-	SEE REMARK 999	UNP P15291
B	116	GLY	-	SEE REMARK 999	UNP P15291
B	117	GLY	-	SEE REMARK 999	UNP P15291

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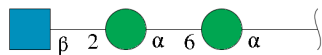
Chain	Residue	Modelled	Actual	Comment	Reference
B	118	GLN	-	SEE REMARK 999	UNP P15291
B	119	GLN	-	SEE REMARK 999	UNP P15291
B	120	MET	-	SEE REMARK 999	UNP P15291
B	121	GLY	-	SEE REMARK 999	UNP P15291
B	122	ARG	-	SEE REMARK 999	UNP P15291
B	123	GLY	-	SEE REMARK 999	UNP P15291
B	124	SER	-	SEE REMARK 999	UNP P15291
B	125	ALA	-	SEE REMARK 999	UNP P15291
B	337	THR	ARG	engineered mutation	UNP P15291
B	338	THR	CYS	engineered mutation	UNP P15291
B	340	HIS	MET	engineered mutation	UNP P15291
C	112	ALA	-	SEE REMARK 999	UNP P15291
C	113	SER	-	SEE REMARK 999	UNP P15291
C	114	MET	-	SEE REMARK 999	UNP P15291
C	115	THR	-	SEE REMARK 999	UNP P15291
C	116	GLY	-	SEE REMARK 999	UNP P15291
C	117	GLY	-	SEE REMARK 999	UNP P15291
C	118	GLN	-	SEE REMARK 999	UNP P15291
C	119	GLN	-	SEE REMARK 999	UNP P15291
C	120	MET	-	SEE REMARK 999	UNP P15291
C	121	GLY	-	SEE REMARK 999	UNP P15291
C	122	ARG	-	SEE REMARK 999	UNP P15291
C	123	GLY	-	SEE REMARK 999	UNP P15291
C	124	SER	-	SEE REMARK 999	UNP P15291
C	125	ALA	-	SEE REMARK 999	UNP P15291
C	337	THR	ARG	engineered mutation	UNP P15291
C	338	THR	CYS	engineered mutation	UNP P15291
C	340	HIS	MET	engineered mutation	UNP P15291

- Molecule 2 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-2)-alpha-D-mannopyranose.



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

- Molecule 3 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-2)-alpha-D-mannopyranose-(1-6)-alpha-D-mannopyranose.

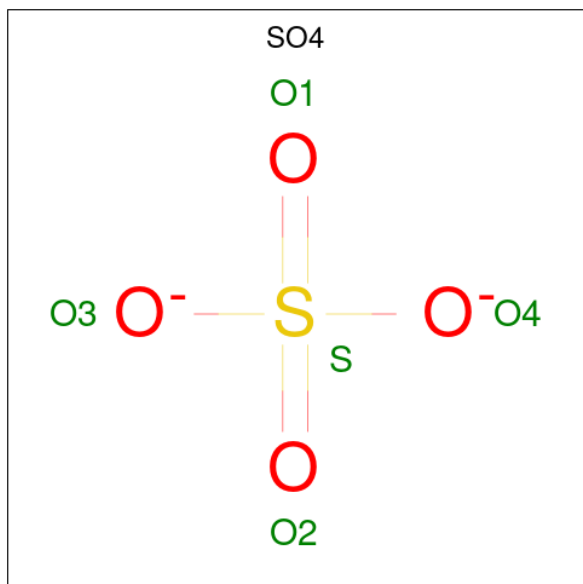


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace	
			Total	C	N				O
3	E	3	37	20	1	16	0	0	0

- Molecule 4 is MANGANESE (II) ION (CCD ID: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Mn		
4	A	1	1	1	0	0
4	B	1	1	1	0	0
4	C	1	1	1	0	0

- Molecule 5 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



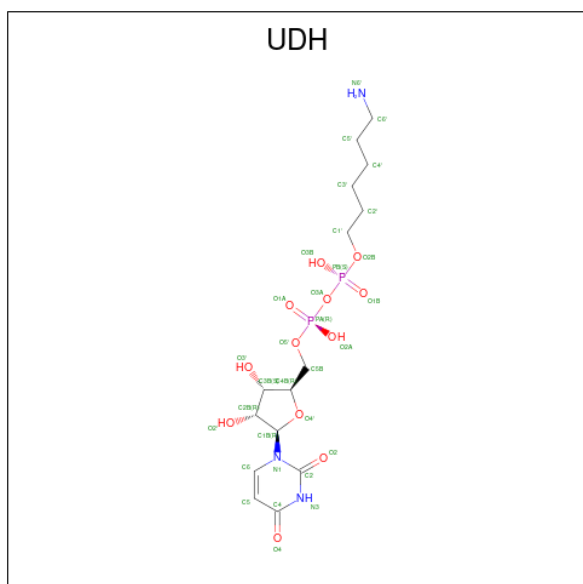
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
5	A	1	5	4	1	0	0
5	A	1	5	4	1	0	0

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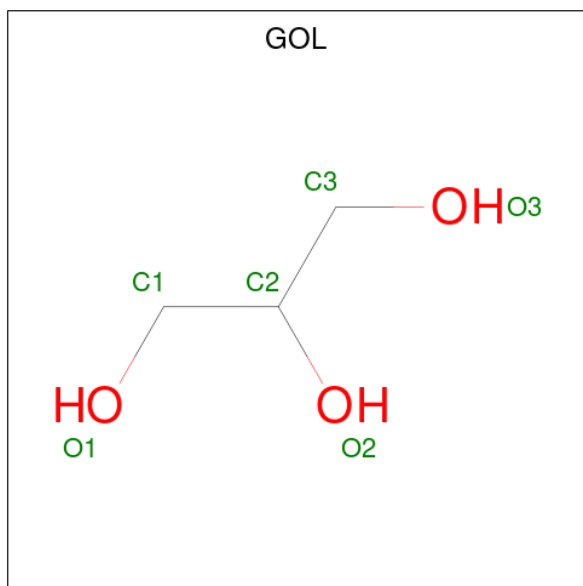
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total O S 5 4 1	0	0
5	A	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0
5	B	1	Total O S 5 4 1	0	0
5	C	1	Total O S 5 4 1	0	0
5	C	1	Total O S 5 4 1	0	0
5	C	1	Total O S 5 4 1	0	0
5	C	1	Total O S 5 4 1	0	0

- Molecule 6 is 6-AMINOHEXYL-URIDINE-C1,5'-DIPHOSPHATE (CCD ID: UDH)
(formula: $C_{15}H_{27}N_3O_{12}P_2$).



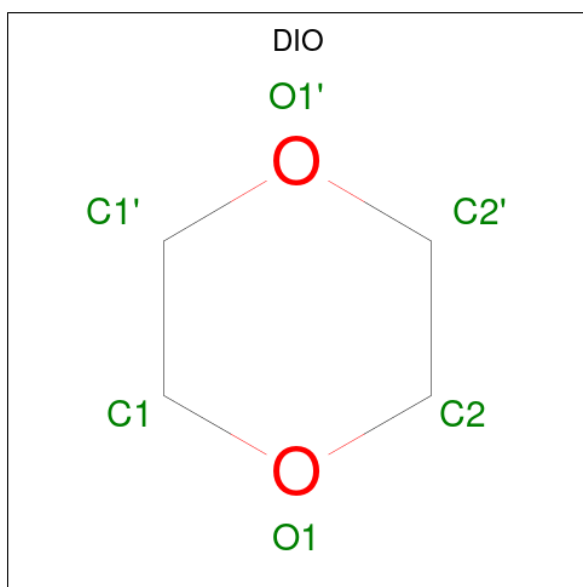
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
6	A	1	Total 32	C 15	N 3	O 12	P 2	0	0
6	B	1	Total 32	C 15	N 3	O 12	P 2	0	0
6	C	1	Total 32	C 15	N 3	O 12	P 2	0	0

- Molecule 7 is GLYCEROL (CCD ID: GOL) (formula: C₃H₈O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
7	A	1	Total 6	C 3	O 3	0	0
7	B	1	Total 6	C 3	O 3	0	0
7	B	1	Total 6	C 3	O 3	0	0
7	B	1	Total 6	C 3	O 3	0	0
7	B	1	Total 6	C 3	O 3	0	0
7	B	1	Total 6	C 3	O 3	0	0
7	C	1	Total 6	C 3	O 3	0	0

- Molecule 8 is 1,4-DIETHYLENE DIOXIDE (CCD ID: DIO) (formula: C₄H₈O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	C	1	Total	C	O	0	0
			6	4	2		

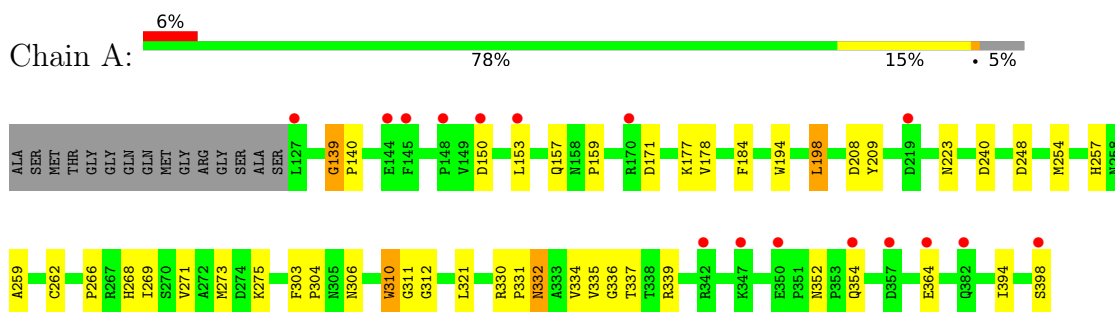
- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	157	Total	O	0	0
			157	157		
9	B	192	Total	O	0	0
			192	192		
9	C	122	Total	O	0	0
			122	122		

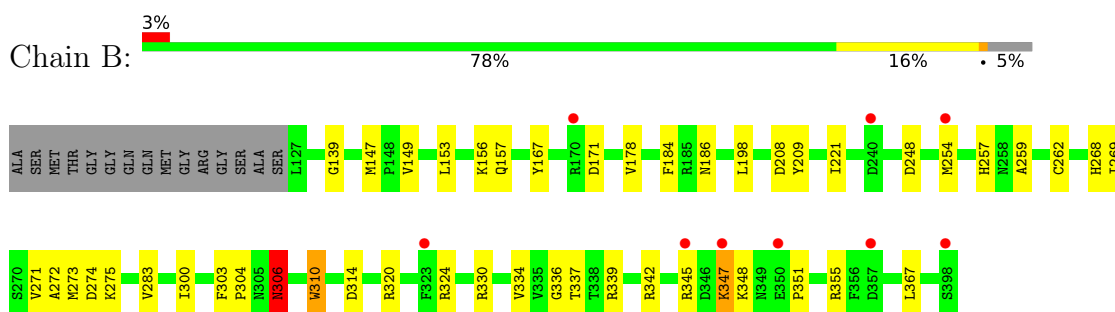
3 Residue-property plots [i](#)

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.

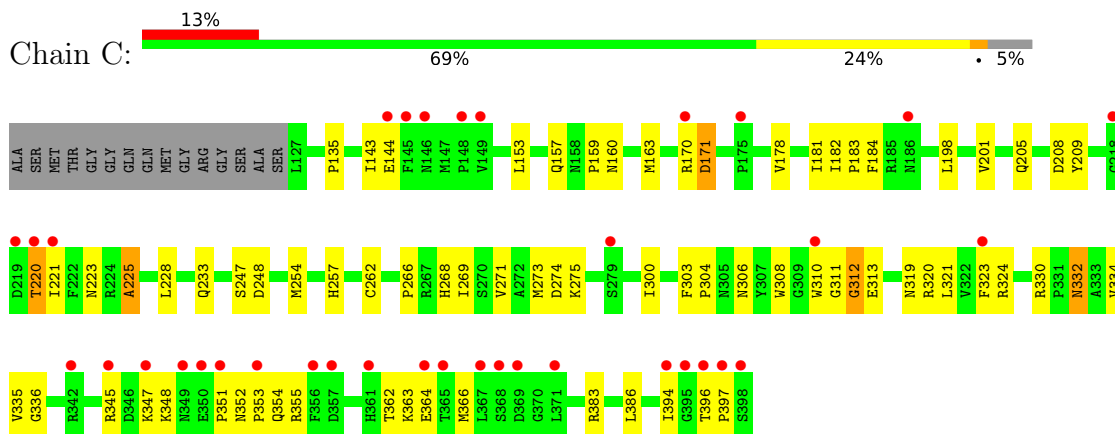
- Molecule 1: Beta-1,4-galactosyltransferase 1



- Molecule 1: Beta-1,4-galactosyltransferase 1



- Molecule 1: Beta-1,4-galactosyltransferase 1



- Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-2)-alpha-D-mannopyranose

Chain D:  100%

MAN1
MAG2

- Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-2)-alpha-D-mannopyranose

Chain F:  100%

MAN1
MAG2

- Molecule 3: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-2)-alpha-D-mannopyranose-(1-6)-alpha-D-mannopyranose

Chain E:  100%

MAN1
MAN2
MAG3

4 Data and refinement statistics i

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	106.98Å 195.17Å 143.92Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.00 – 2.00 40.00 – 2.00	Depositor EDS
% Data completeness (in resolution range)	96.5 (40.00-2.00) 96.5 (40.00-2.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.05 (at 1.98Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.219 , 0.246 0.234 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	26.3	Xtrriage
Anisotropy	0.737	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 43.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.35$	Xtrriage
Estimated twinning fraction	0.000 for 1/2*h-1/2*k,-3/2*h-1/2*k,-l 0.020 for 1/2*h+1/2*k,3/2*h-1/2*k,-l	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	7413	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.12% 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: GOL, DIO, MN, MAN, UDH, NAG, SO4

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	0.51	0/2274	1.05	17/3089 (0.6%)
1	B	0.53	0/2274	1.07	19/3089 (0.6%)
1	C	0.48	0/2274	1.02	18/3089 (0.6%)
All	All	0.51	0/6822	1.05	54/9267 (0.6%)

There are no bond length outliers.

The worst 5 of 54 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	311	GLY	N-CA-C	9.84	125.36	112.18
1	B	269	ILE	N-CA-C	8.95	119.51	111.81
1	B	178	VAL	N-CA-C	8.68	120.32	108.17
1	C	178	VAL	N-CA-C	8.30	119.79	108.17
1	A	178	VAL	N-CA-C	7.29	118.37	108.17

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	2212	0	2157	32	0
1	B	2212	0	2157	33	0
1	C	2212	0	2157	50	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	D	26	0	24	0	0
2	F	26	0	24	0	0
3	E	37	0	33	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0
5	A	20	0	0	0	0
5	B	30	0	0	0	0
5	C	20	0	0	0	0
6	A	32	0	25	0	0
6	B	32	0	25	4	0
6	C	32	0	25	2	0
7	A	6	0	8	1	0
7	B	30	0	40	6	0
7	C	6	0	8	1	0
8	C	6	0	8	2	0
9	A	157	0	0	0	0
9	B	192	0	0	3	0
9	C	122	0	0	1	0
All	All	7413	0	6691	112	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 8.

The worst 5 of 112 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:337:THR:HG21	1:C:135:PRO:HB2	1.57	0.86
1:B:324:ARG:HH12	1:B:367:LEU:HD21	1.43	0.84
1:A:254:MET:HE2	1:A:339:ARG:HG2	1.59	0.84
1:C:332:ASN:ND2	1:C:335:VAL:H	1.82	0.78
1:B:324:ARG:NH1	1:B:367:LEU:HD21	1.98	0.78

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	270/287 (94%)	263 (97%)	7 (3%)	0	100	100
1	B	270/287 (94%)	264 (98%)	6 (2%)	0	100	100
1	C	270/287 (94%)	261 (97%)	8 (3%)	1 (0%)	30	27
All	All	810/861 (94%)	788 (97%)	21 (3%)	1 (0%)	48	46

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	312	GLY

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	243/252 (96%)	241 (99%)	2 (1%)	73	80
1	B	243/252 (96%)	240 (99%)	3 (1%)	63	70
1	C	243/252 (96%)	238 (98%)	5 (2%)	47	52
All	All	729/756 (96%)	719 (99%)	10 (1%)	59	66

5 of 10 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	233	GLN
1	C	332	ASN

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Mol	Chain	Res	Type
1	C	364	GLU
1	B	153	LEU
1	B	306	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 11 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	157	GLN
1	C	295	GLN
1	C	377	GLN
1	C	332	ASN
1	B	186	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](#)

7 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	MAN	D	1	2	12,12,12	1.61	4 (33%)	17,17,17	0.91	0
2	NAG	D	2	2	14,14,15	1.37	3 (21%)	17,19,21	0.83	0
3	MAN	E	1	3	12,12,12	2.50	5 (41%)	17,17,17	0.71	0
3	MAN	E	2	3	11,11,12	2.81	7 (63%)	15,15,17	1.31	2 (13%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	NAG	E	3	3	14,14,15	1.75	4 (28%)	17,19,21	0.95	1 (5%)
2	MAN	F	1	2	12,12,12	1.58	3 (25%)	17,17,17	0.77	0
2	NAG	F	2	2	14,14,15	1.50	3 (21%)	17,19,21	0.87	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	MAN	D	1	2	-	0/2/22/22	0/1/1/1
2	NAG	D	2	2	-	0/6/23/26	0/1/1/1
3	MAN	E	1	3	1/1/5/5	2/2/22/22	0/1/1/1
3	MAN	E	2	3	-	0/2/19/22	0/1/1/1
3	NAG	E	3	3	-	0/6/23/26	0/1/1/1
2	MAN	F	1	2	-	0/2/22/22	0/1/1/1
2	NAG	F	2	2	-	0/6/23/26	0/1/1/1

The worst 5 of 29 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	E	2	MAN	C2-C3	5.12	1.60	1.52
3	E	1	MAN	C4-C5	4.89	1.63	1.53
3	E	1	MAN	C1-C2	4.08	1.61	1.52
3	E	2	MAN	O5-C1	3.77	1.50	1.43
3	E	2	MAN	O5-C5	3.40	1.50	1.43

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	E	2	MAN	C1-O5-C5	3.57	116.98	112.19
3	E	2	MAN	C3-C4-C5	-2.24	106.17	110.23
3	E	3	NAG	C4-C3-C2	-2.21	107.78	111.02

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
3	E	1	MAN	C1

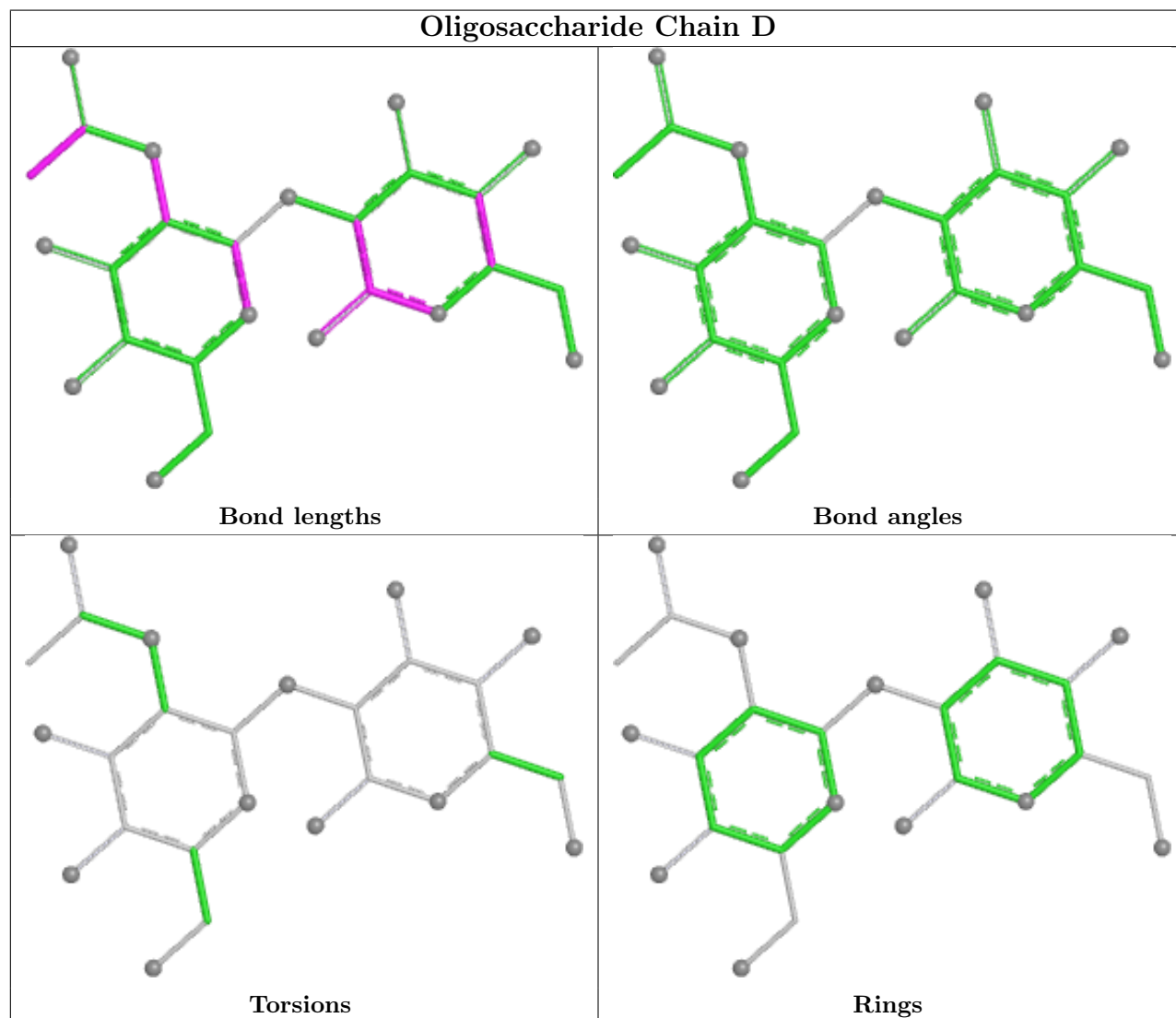
All (2) torsion outliers are listed below:

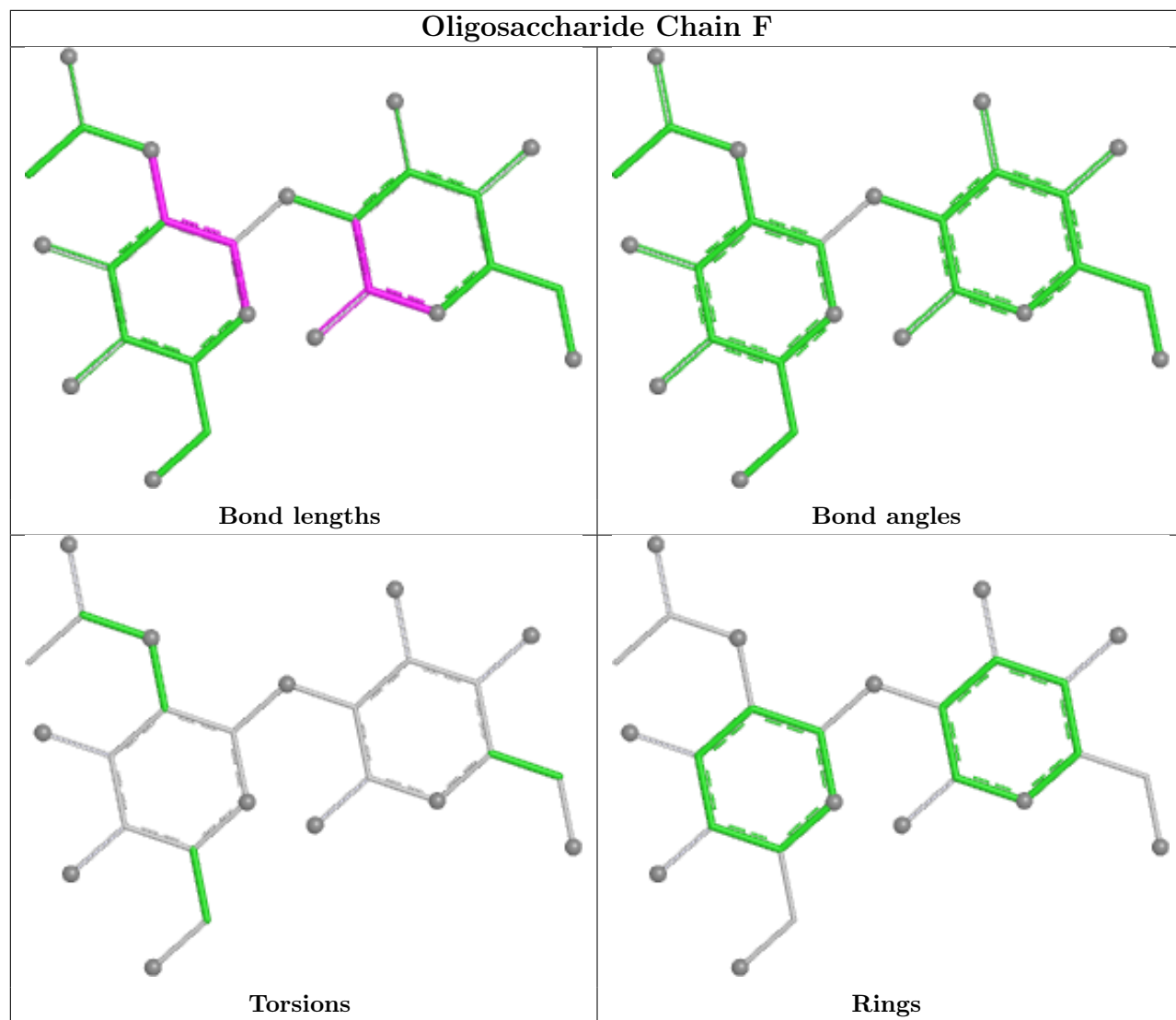
Mol	Chain	Res	Type	Atoms
3	E	1	MAN	O5-C5-C6-O6
3	E	1	MAN	C4-C5-C6-O6

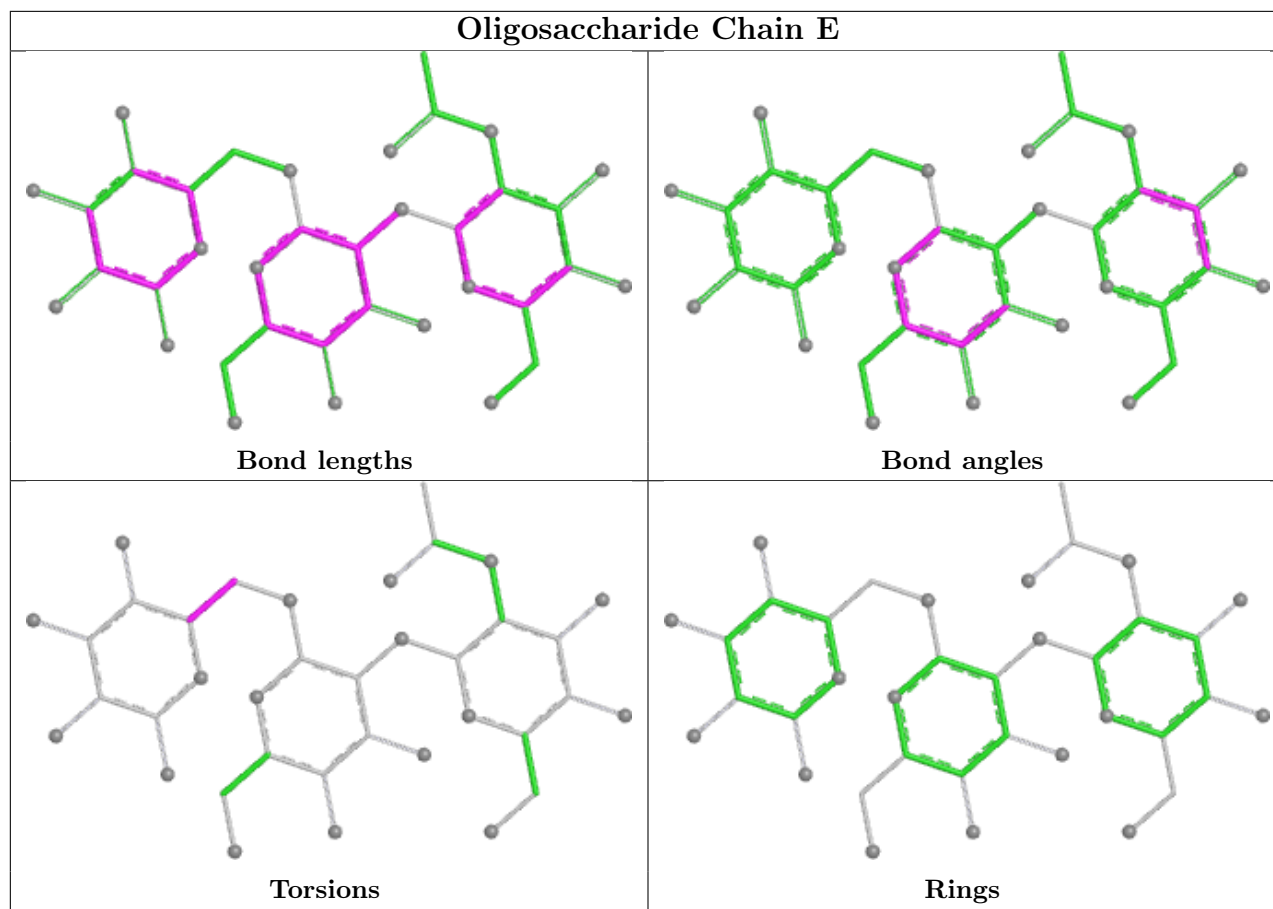
There are no ring outliers.

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 28 ligands modelled in this entry, 3 are monoatomic - leaving 25 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$
7	GOL	B	412	-	5,5,5	0.56	0	5,5,5	1.07	0
5	SO4	C	431	-	4,4,4	1.89	2 (50%)	6,6,6	0.81	0
5	SO4	C	427	-	4,4,4	1.90	2 (50%)	6,6,6	0.79	0
5	SO4	B	428	-	4,4,4	1.86	2 (50%)	6,6,6	0.83	0
7	GOL	B	414	-	5,5,5	0.55	0	5,5,5	0.76	0
5	SO4	B	430	-	4,4,4	1.84	2 (50%)	6,6,6	0.81	0
7	GOL	B	417	-	5,5,5	0.43	0	5,5,5	0.82	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
8	DIO	C	433	-	6,6,6	0.94	0	6,6,6	0.69	0
6	UDH	A	399	4	33,33,33	1.57	5 (15%)	44,47,47	1.49	9 (20%)
5	SO4	A	429	-	4,4,4	1.88	2 (50%)	6,6,6	0.83	0
7	GOL	B	418	-	5,5,5	0.40	0	5,5,5	0.77	0
5	SO4	B	432	-	4,4,4	1.82	2 (50%)	6,6,6	0.84	0
7	GOL	B	413	-	5,5,5	0.51	0	5,5,5	0.91	0
7	GOL	C	416	-	5,5,5	0.47	0	5,5,5	0.85	0
5	SO4	A	419	-	4,4,4	1.82	2 (50%)	6,6,6	0.85	0
6	UDH	B	401	4	33,33,33	1.62	4 (12%)	44,47,47	1.34	5 (11%)
5	SO4	A	421	-	4,4,4	1.83	2 (50%)	6,6,6	0.82	0
5	SO4	C	423	-	4,4,4	1.77	2 (50%)	6,6,6	0.81	0
5	SO4	B	424	-	4,4,4	1.80	2 (50%)	6,6,6	0.85	0
5	SO4	A	420	-	4,4,4	1.79	2 (50%)	6,6,6	0.83	0
5	SO4	B	425	-	4,4,4	1.80	2 (50%)	6,6,6	0.82	0
6	UDH	C	403	4	33,33,33	1.42	3 (9%)	44,47,47	1.46	8 (18%)
5	SO4	C	426	-	4,4,4	1.88	2 (50%)	6,6,6	0.84	0
5	SO4	B	422	-	4,4,4	1.82	1 (25%)	6,6,6	0.85	0
7	GOL	A	415	-	5,5,5	0.64	0	5,5,5	1.00	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
7	GOL	C	416	-	-	0/4/4/4	-
7	GOL	B	412	-	-	4/4/4/4	-
7	GOL	B	418	-	-	2/4/4/4	-
6	UDH	C	403	4	-	1/25/41/41	0/2/2/2
7	GOL	B	414	-	-	2/4/4/4	-
7	GOL	B	413	-	-	4/4/4/4	-
7	GOL	B	417	-	-	2/4/4/4	-
7	GOL	A	415	-	-	3/4/4/4	-
6	UDH	B	401	4	-	4/25/41/41	0/2/2/2
8	DIO	C	433	-	-	-	0/1/1/1
6	UDH	A	399	4	-	4/25/41/41	0/2/2/2

The worst 5 of 39 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	B	401	UDH	PA-O3A	6.37	1.66	1.59
6	A	399	UDH	PA-O3A	5.88	1.65	1.59
6	C	403	UDH	PA-O3A	4.85	1.64	1.59
5	C	427	SO4	O1-S	3.20	1.63	1.44
5	C	431	SO4	O1-S	3.18	1.63	1.44

The worst 5 of 22 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	C	403	UDH	O3A-PB-O1B	-3.81	99.25	110.70
6	A	399	UDH	O3A-PB-O1B	-3.57	99.97	110.70
6	A	399	UDH	O4'-C4B-C3B	-3.45	98.31	105.15
6	B	401	UDH	O3A-PB-O1B	-3.45	100.34	110.70
6	B	401	UDH	O4'-C4B-C3B	-3.27	98.67	105.15

There are no chirality outliers.

5 of 26 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
7	B	412	GOL	O1-C1-C2-O2
7	B	412	GOL	O1-C1-C2-C3
7	B	413	GOL	C1-C2-C3-O3
7	B	414	GOL	O1-C1-C2-O2
7	B	414	GOL	O1-C1-C2-C3

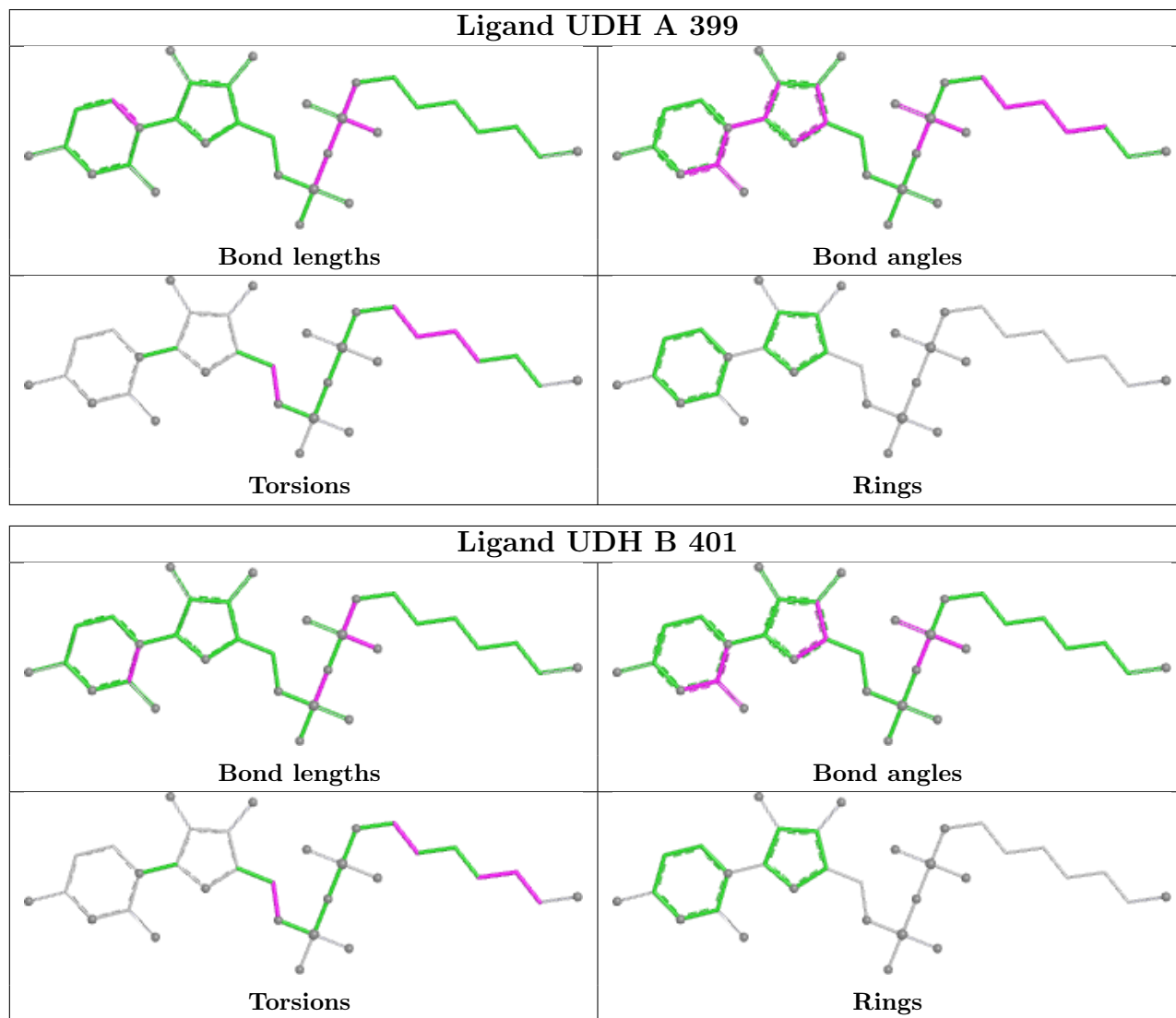
There are no ring outliers.

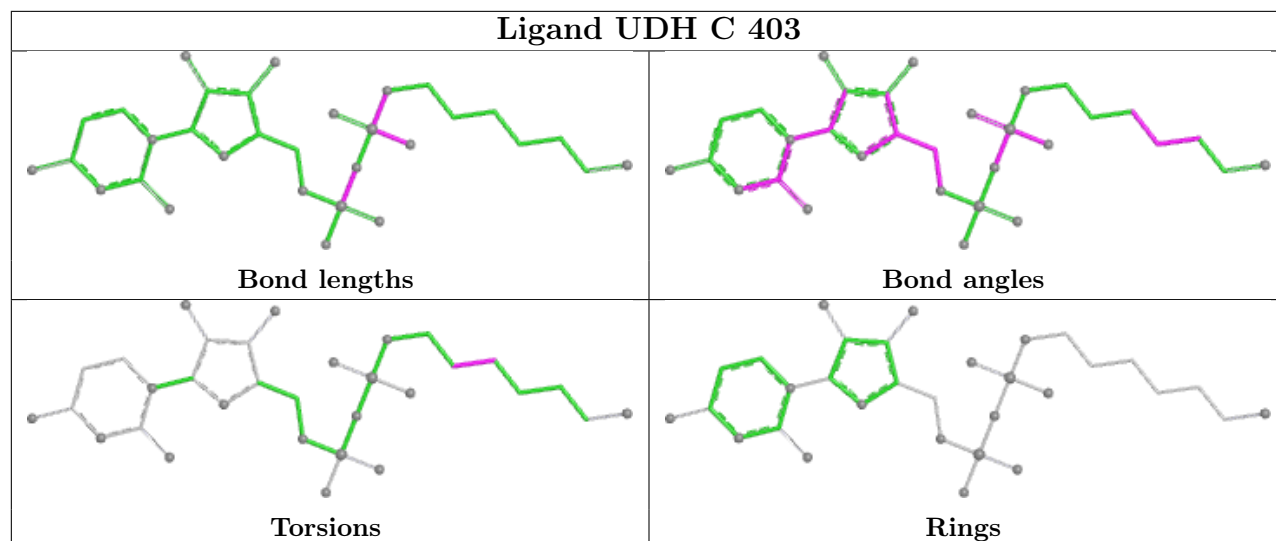
9 monomers are involved in 16 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
7	B	412	GOL	3	0
7	B	414	GOL	1	0
7	B	417	GOL	1	0
8	C	433	DIO	2	0
7	B	418	GOL	1	0
7	C	416	GOL	1	0
6	B	401	UDH	4	0
6	C	403	UDH	2	0
7	A	415	GOL	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 all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will

also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





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	272/287 (94%)	0.37	16 (5%) 28 27	20, 28, 45, 54	0
1	B	272/287 (94%)	0.06	9 (3%) 49 48	17, 25, 38, 51	0
1	C	272/287 (94%)	0.98	36 (13%) 7 6	22, 35, 56, 64	0
All	All	816/861 (94%)	0.47	61 (7%) 20 19	17, 29, 49, 64	0

The worst 5 of 61 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	398	SER	6.8
1	C	347	LYS	4.3
1	C	220	THR	4.3
1	C	144	GLU	3.9
1	C	323	PHE	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.

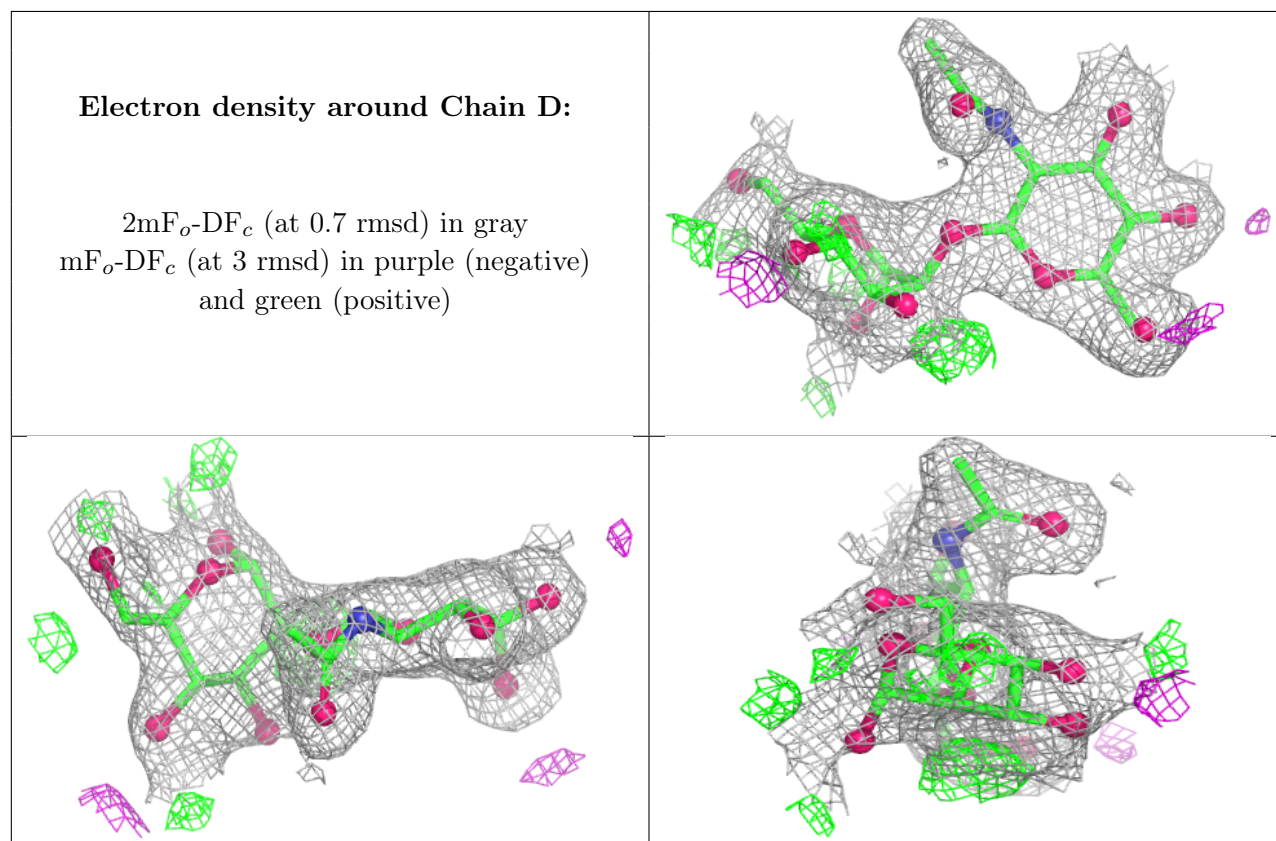
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	MAN	E	1	12/12	0.40	0.31	49,57,57,58	12
2	MAN	F	1	12/12	0.67	0.21	54,61,64,66	0
2	MAN	D	1	12/12	0.74	0.17	39,51,54,56	0

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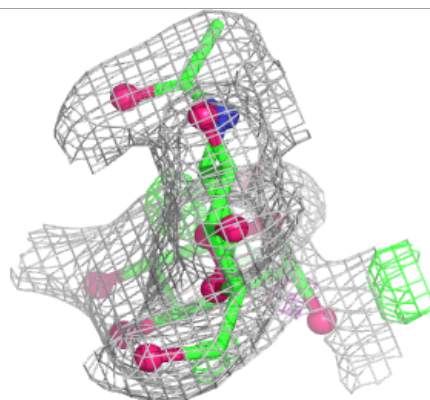
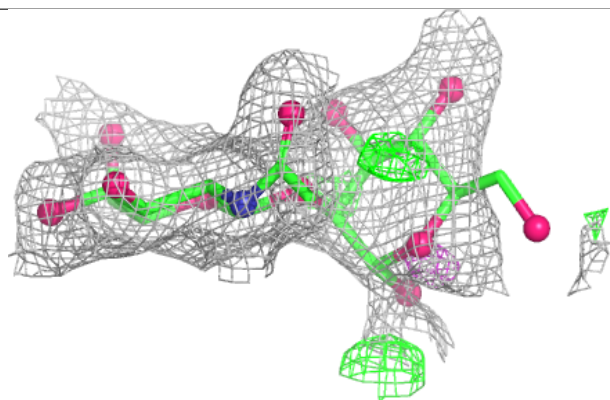
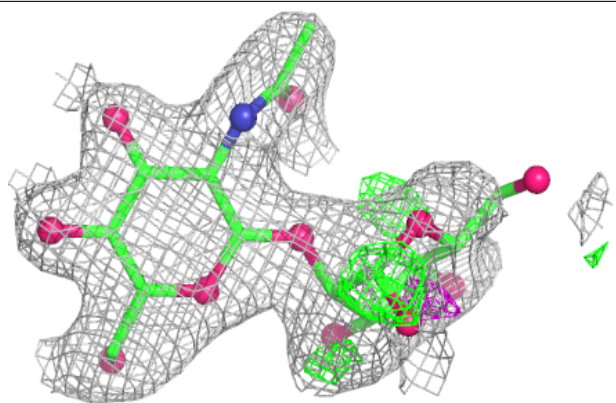
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
3	MAN	E	2	11/12	0.77	0.18	34,46,50,55	0
2	NAG	F	2	14/15	0.92	0.12	45,48,49,51	0
2	NAG	D	2	14/15	0.96	0.07	26,30,32,33	0
3	NAG	E	3	14/15	0.96	0.06	24,26,27,29	0

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.

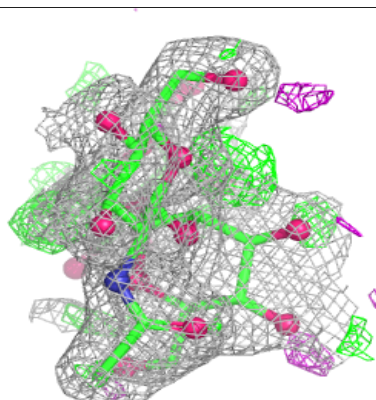
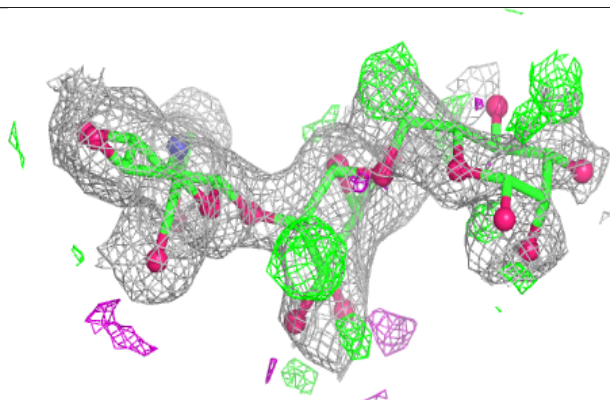
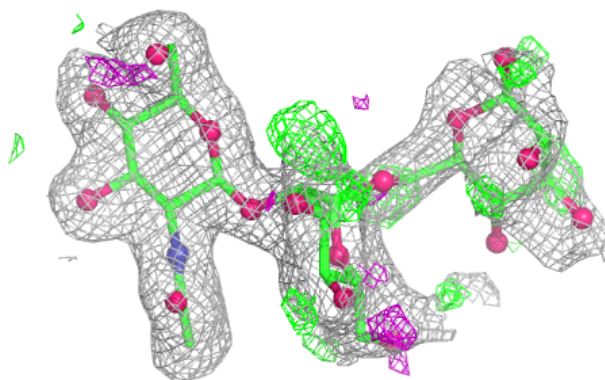


Electron density around Chain F:

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

**Electron density around Chain E:**

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



6.4 Ligands

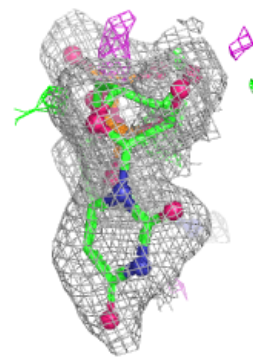
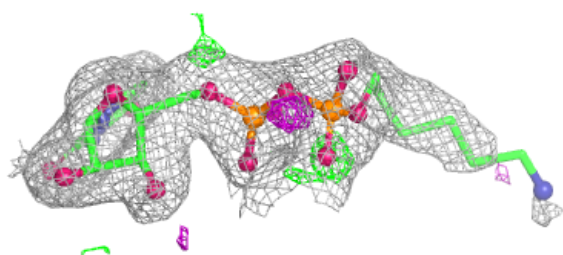
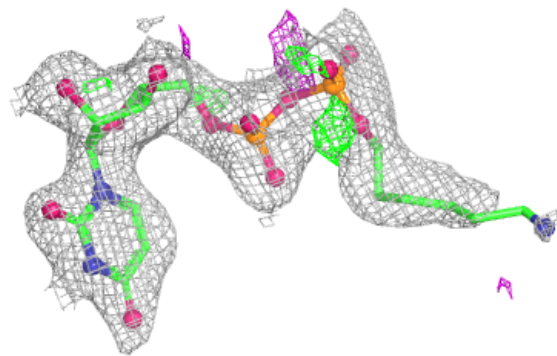
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
5	SO4	C	431	5/5	0.59	0.17	88,88,89,90	0
5	SO4	A	421	5/5	0.69	0.20	84,85,85,85	0
8	DIO	C	433	6/6	0.70	0.29	70,70,70,71	0
5	SO4	B	432	5/5	0.75	0.15	89,89,89,90	0
5	SO4	C	427	5/5	0.77	0.13	73,73,75,75	0
5	SO4	C	426	5/5	0.78	0.18	88,88,88,88	0
5	SO4	B	422	5/5	0.80	0.17	73,73,74,74	0
7	GOL	B	418	6/6	0.81	0.27	62,65,65,65	0
5	SO4	B	428	5/5	0.82	0.16	81,81,81,82	0
7	GOL	B	413	6/6	0.82	0.18	41,44,48,51	0
7	GOL	B	417	6/6	0.84	0.19	47,49,50,53	0
5	SO4	B	424	5/5	0.85	0.17	80,80,80,81	0
5	SO4	B	430	5/5	0.85	0.17	81,81,81,82	0
5	SO4	A	429	5/5	0.86	0.10	72,72,73,74	0
5	SO4	B	425	5/5	0.86	0.16	65,67,67,68	0
5	SO4	A	420	5/5	0.86	0.15	71,73,73,74	0
7	GOL	B	412	6/6	0.87	0.16	32,38,39,40	0
7	GOL	A	415	6/6	0.88	0.17	35,40,41,45	0
5	SO4	A	419	5/5	0.89	0.14	79,79,80,80	0
7	GOL	B	414	6/6	0.90	0.14	31,35,37,37	0
7	GOL	C	416	6/6	0.91	0.13	45,47,48,50	0
6	UDH	C	403	32/32	0.93	0.12	30,38,56,60	0
5	SO4	C	423	5/5	0.94	0.14	48,50,51,52	0
4	MN	C	404	1/1	0.97	0.05	38,38,38,38	0
6	UDH	A	399	32/32	0.97	0.08	26,30,53,56	0
6	UDH	B	401	32/32	0.97	0.09	18,22,51,55	0
4	MN	B	402	1/1	0.99	0.02	25,25,25,25	0
4	MN	A	400	1/1	1.00	0.03	31,31,31,31	0

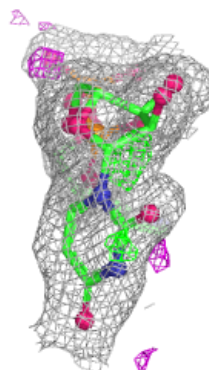
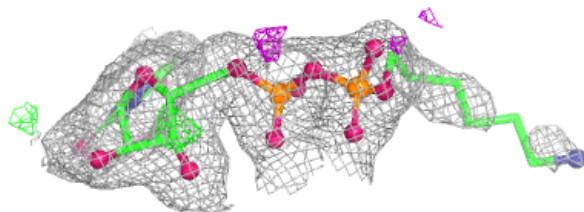
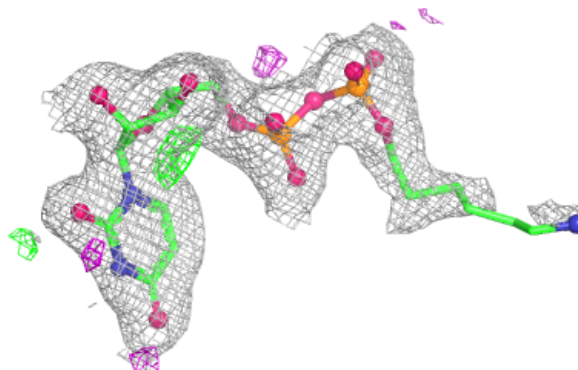
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

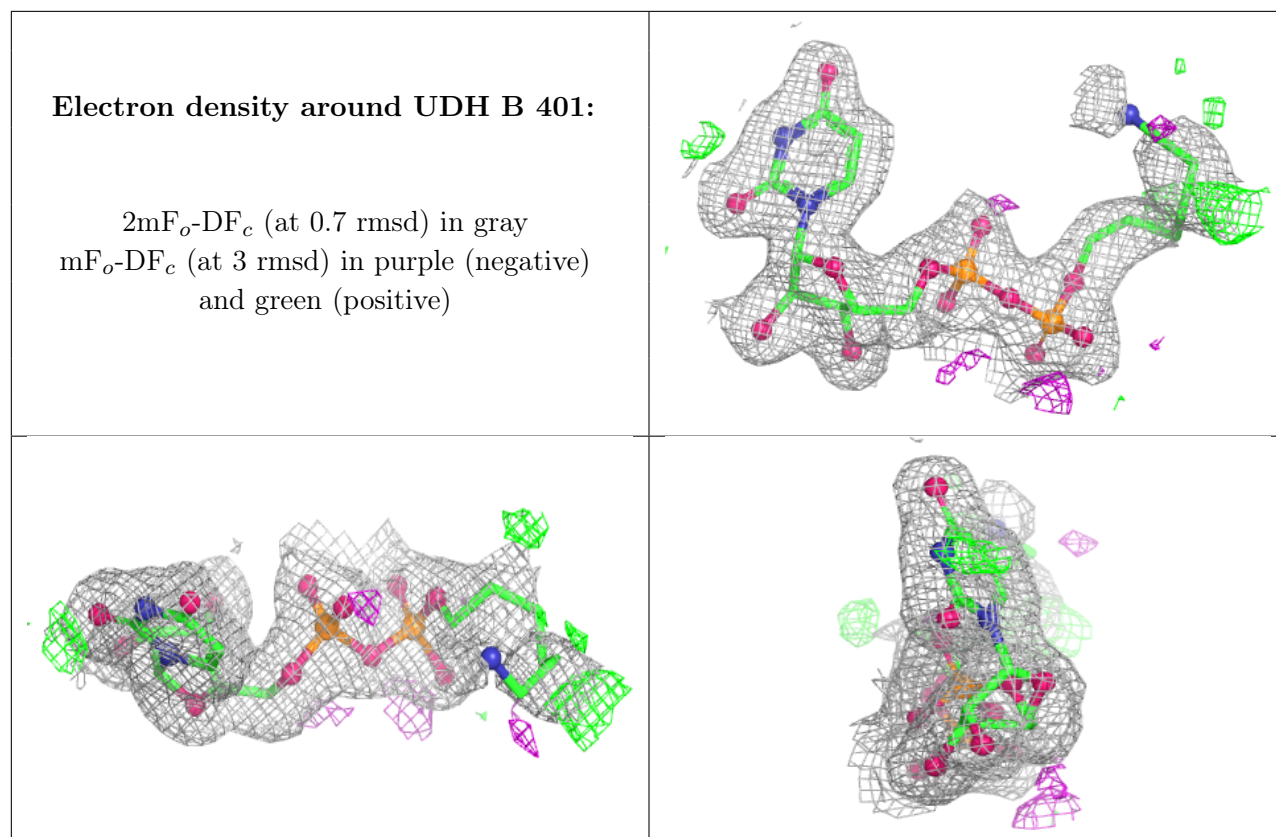
Electron density around UDH C 403:

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

**Electron density around UDH A 399:**

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





6.5 Other polymers [i](#)

There are no such residues in this entry.