



Full wwPDB X-ray Structure Validation Report ⓘ

Dec 8, 2023 – 01:55 am GMT

PDB ID : 2VS4
Title : THE BINDING OF UDP-GALACTOSE BY AN ACTIVE SITE MUTANT OF alpha-1,3 GALACTOSYLTRANSFERASE (alpha3GT)
Authors : Tumbale, P.; Jamaluddin, H.; Thiyagarajan, N.; Brew, K.; Acharya, K.R.
Deposited on : 2008-04-18
Resolution : 1.77 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 : 1.8.4, CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.36
buster-report : 1.1.7 (2018)
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

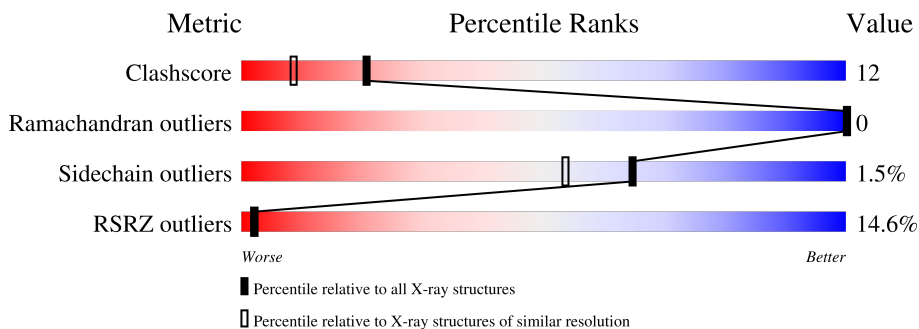
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.77 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	141614	10184 (1.80-1.76)
Ramachandran outliers	138981	10051 (1.80-1.76)
Sidechain outliers	138945	10050 (1.80-1.76)
RSRZ outliers	127900	9032 (1.80-1.76)

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	289	
1	B	289	
2	C	2	
2	D	2	

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
2	NDG	C	1	X	-	-	-
2	NDG	D	1	X	-	-	-

2 Entry composition i

There are 6 unique types of molecules in this entry. The entry contains 6170 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 N-ACETYLLACTOSAMINIDE ALPHA-1,3-GALACTOSYL TRANSFERASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	288	2400	1568	396	424	12	0	4	0
1	B	288	2400	1568	396	424	12	0	3	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	316	GLU	ASP	engineered mutation	UNP P14769
B	316	GLU	ASP	engineered mutation	UNP P14769

- Molecule 2 is an oligosaccharide called beta-D-galactopyranose-(1-4)-2-acetamido-2-deoxy-alpha-D-glucopyranose.

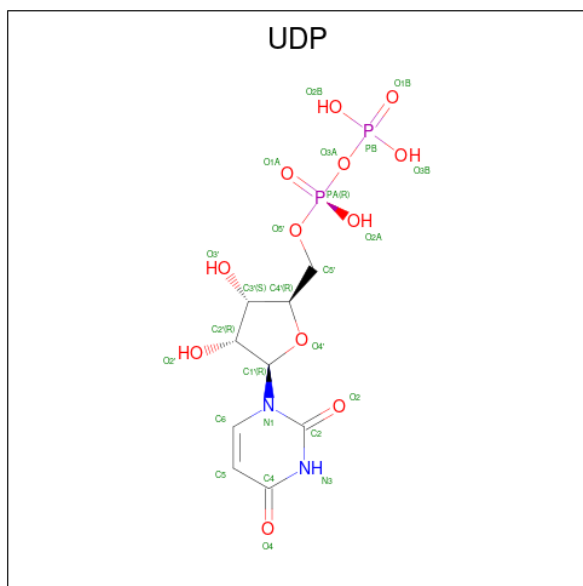


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	C	2	26	14	1	11	0	0	0
2	D	2	26	14	1	11	0	0	0

- Molecule 3 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

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

- Molecule 4 is URIDINE-5'-DIPHOSPHATE (three-letter code: UDP) (formula: $C_9H_{14}N_2O_{12}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	P	0	0
			25	9	2	12	2		
4	B	1	Total	C	N	O	P	0	0
			25	9	2	12	2		

- Molecule 5 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



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

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

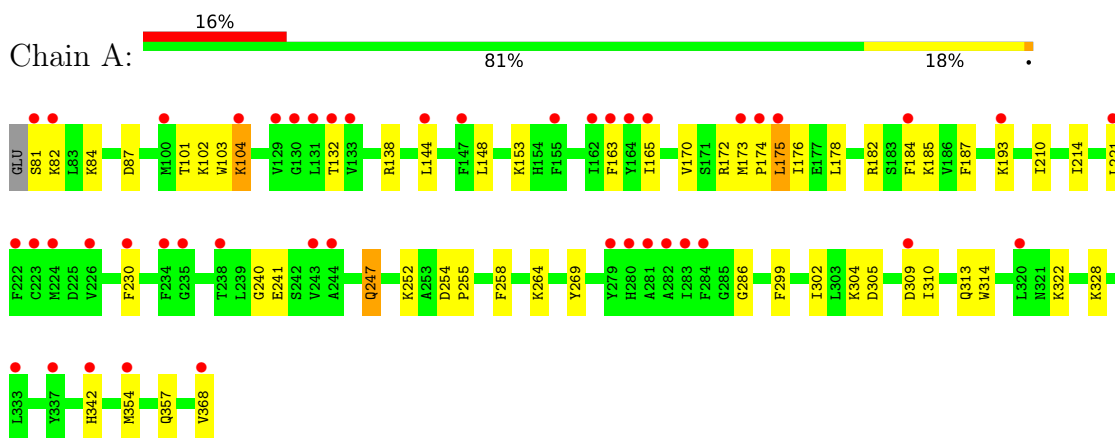
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	622	Total	O	0	0
			622	622		
6	B	632	Total	O	0	0
			632	632		

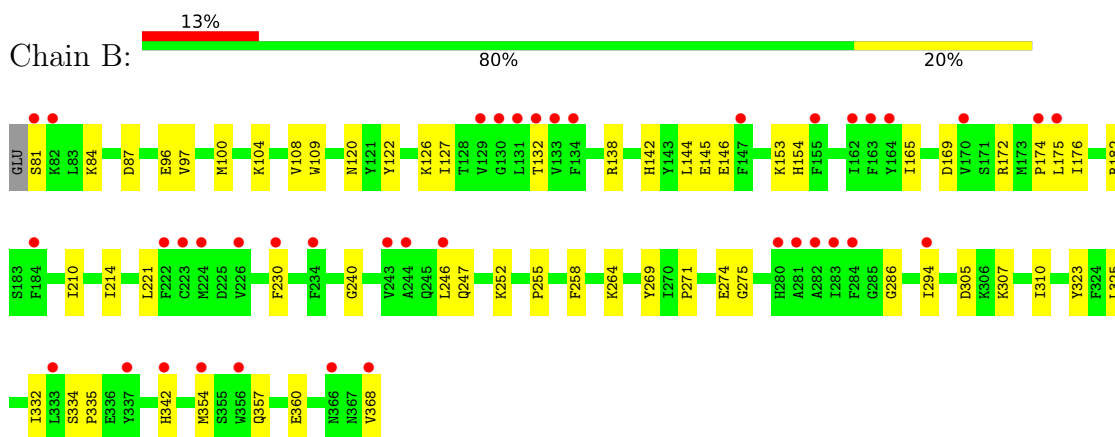
3 Residue-property plots [i](#)

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: N-ACETYLLACTOSAMINIDE ALPHA-1,3-GALACTOSYLTRANSFERAS E




- Molecule 1: N-ACETYLLACTOSAMINIDE ALPHA-1,3-GALACTOSYLTRANSFERAS E



- Molecule 2: beta-D-galactopyranose-(1-4)-2-acetamido-2-deoxy-alpha-D-glucopyranose



- Molecule 2: beta-D-galactopyranose-(1-4)-2-acetamido-2-deoxy-alpha-D-glucopyranose

Chain D:  100%

NDG1
GAL2

4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	45.25Å 94.63Å 94.69Å 90.00° 98.90° 90.00°	Depositor
Resolution (Å)	32.50 – 1.77 32.50 – 1.77	Depositor EDS
% Data completeness (in resolution range)	91.3 (32.50-1.77) 91.4 (32.50-1.77)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.93 (at 1.77Å)	Xtrriage
Refinement program	CNS 1.2	Depositor
R, R_{free}	0.263 , 0.278 0.230 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	17.2	Xtrriage
Anisotropy	0.463	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 35.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	6170	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 28.99 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.6731e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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: GAL, GOL, UDP, MN, NDG

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	0.45	2/2473 (0.1%)	0.63	0/3349
1	B	0.37	0/2473	0.63	0/3349
All	All	0.41	2/4946 (0.0%)	0.63	0/6698

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	247	GLN	C-O	-8.91	1.06	1.23
1	A	247	GLN	CD-OE1	-8.39	1.05	1.24

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	2400	0	2355	64	0
1	B	2400	0	2356	55	0
2	C	26	0	20	0	0
2	D	26	0	20	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	25	0	11	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	25	0	11	0	0
5	A	6	0	7	0	0
5	B	6	0	7	1	0
6	A	622	0	0	33	3
6	B	632	0	0	32	2
All	All	6170	0	4787	119	5

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 12.

All (119) 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:334:SER:HB2	6:B:697:HOH:O	1.46	1.13
1:B:335:PRO:HD2	6:B:697:HOH:O	1.58	1.03
1:B:145:GLU:HG3	6:B:892:HOH:O	1.69	0.90
1:B:368:VAL:HA	6:B:512:HOH:O	1.75	0.85
1:B:342[B]:HIS:ND1	6:B:501:HOH:O	2.01	0.85
1:B:368:VAL:HG12	6:B:584:HOH:O	1.77	0.83
1:B:120:ASN:HB2	6:B:722:HOH:O	1.80	0.80
1:B:360:GLU:CD	6:B:513:HOH:O	2.20	0.80
1:A:176:ILE:HA	6:A:521:HOH:O	1.82	0.79
1:A:172:ARG:NH2	6:A:502:HOH:O	2.14	0.78
1:B:252:LYS:HD2	6:B:869:HOH:O	1.83	0.78
1:A:101:THR:O	6:A:501:HOH:O	2.01	0.78
1:A:153:LYS:HD3	6:A:584:HOH:O	1.86	0.74
1:A:254:ASP:HB3	6:A:793:HOH:O	1.86	0.74
1:A:132:THR:HG23	1:A:221:LEU:HD11	1.71	0.73
1:A:82:LYS:NZ	1:A:84:LYS:HD3	2.04	0.73
1:A:175:LEU:HD23	1:B:175:LEU:HD11	1.73	0.70
1:B:146:GLU:OE1	6:B:502:HOH:O	2.09	0.70
1:B:81:SER:N	6:B:506:HOH:O	2.24	0.70
1:A:104:LYS:N	6:A:501:HOH:O	1.96	0.68
1:B:342[B]:HIS:CE1	6:B:501:HOH:O	2.44	0.68
1:A:252:LYS:HD2	6:A:942:HOH:O	1.94	0.68
1:A:193:LYS:HD3	6:A:1010:HOH:O	1.94	0.67
1:B:210:ILE:HA	1:B:214:ILE:HB	1.75	0.67
1:B:104:LYS:HB3	6:B:667:HOH:O	1.98	0.64
1:B:271:PRO:HG2	1:B:274:GLU:HG3	1.80	0.64
1:A:368:VAL:HG12	6:A:832:HOH:O	1.96	0.63
1:A:255:PRO:HA	1:A:258:PHE:CD1	2.33	0.63

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:304:LYS:CE	6:A:531:HOH:O	2.47	0.62
1:A:193:LYS:HE3	6:A:876:HOH:O	2.01	0.60
1:B:109:TRP:CH2	6:B:697:HOH:O	2.51	0.60
1:B:108:VAL:O	1:B:334:SER:HB3	2.01	0.60
1:A:104:LYS:CA	6:A:501:HOH:O	2.47	0.59
1:B:81:SER:HB2	6:B:879:HOH:O	2.03	0.59
1:A:304:LYS:HE3	6:A:540:HOH:O	2.03	0.59
1:A:313:GLN:HG2	1:A:314:TRP:CD1	2.38	0.58
1:A:185:LYS:HG2	1:A:187:PHE:CE1	2.39	0.58
1:A:174:PRO:CA	6:A:517:HOH:O	2.51	0.57
1:A:252:LYS:NZ	6:A:514:HOH:O	2.38	0.57
1:B:230:PHE:HA	1:B:354[B]:MET:HG2	1.87	0.56
1:A:84:LYS:O	1:A:87:ASP:HB2	2.06	0.56
1:A:174:PRO:HA	6:A:517:HOH:O	2.05	0.56
1:B:109:TRP:CZ2	6:B:697:HOH:O	2.58	0.56
1:B:142:HIS:HD2	6:B:861:HOH:O	1.88	0.56
1:A:313:GLN:HG3	6:A:678:HOH:O	2.05	0.55
1:A:342[A]:HIS:CG	6:A:644:HOH:O	2.58	0.55
1:B:368:VAL:HG21	6:B:794:HOH:O	2.06	0.55
1:A:175:LEU:N	6:A:517:HOH:O	2.39	0.55
1:B:255:PRO:HA	1:B:258:PHE:CD1	2.42	0.54
1:A:309:ASP:CB	6:A:577:HOH:O	2.56	0.54
1:B:138:ARG:NH1	6:B:511:HOH:O	2.41	0.54
1:A:210:ILE:HA	1:A:214:ILE:HB	1.88	0.54
1:A:176:ILE:N	6:A:521:HOH:O	2.40	0.53
1:B:153:LYS:HE3	1:B:154:HIS:CE1	2.44	0.53
1:A:102:LYS:HE3	6:A:932:HOH:O	2.08	0.53
1:A:104:LYS:HA	6:A:501:HOH:O	2.07	0.52
1:B:138:ARG:HH11	1:B:138:ARG:HG3	1.75	0.52
1:A:170:VAL:O	1:A:173:MET:HB3	2.10	0.52
1:B:172:ARG:NH2	6:B:516:HOH:O	2.43	0.52
1:A:148:LEU:HD11	1:A:165:ILE:HD13	1.92	0.50
1:A:81:SER:O	1:A:82:LYS:HB3	2.11	0.50
1:A:230:PHE:HA	1:A:354[A]:MET:HG2	1.94	0.50
1:A:138:ARG:NE	6:A:525:HOH:O	2.45	0.49
1:B:335:PRO:CD	6:B:697:HOH:O	2.35	0.49
1:A:368:VAL:OXT	1:A:368:VAL:HG22	2.12	0.49
1:B:307:LYS:HE2	6:B:748:HOH:O	2.12	0.49
5:B:404:GOL:H12	6:B:836:HOH:O	2.12	0.49
1:A:309:ASP:HB2	6:A:577:HOH:O	2.11	0.49
1:B:109:TRP:CZ3	6:B:697:HOH:O	2.64	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:255:PRO:HA	1:B:258:PHE:CE1	2.48	0.49
1:B:96:GLU:HG2	1:B:97:VAL:HG13	1.95	0.48
1:B:144:LEU:HD23	1:B:174:PRO:HD2	1.94	0.48
1:B:305:ASP:HB3	1:B:310:ILE:O	2.14	0.48
1:A:322:LYS:HE2	6:A:859:HOH:O	2.13	0.48
1:B:126:LYS:CE	6:B:520:HOH:O	2.63	0.46
1:A:304:LYS:NZ	6:A:531:HOH:O	2.48	0.46
1:A:82:LYS:HZ1	1:A:84:LYS:HD3	1.79	0.46
1:B:334:SER:CB	6:B:697:HOH:O	2.28	0.46
1:A:138:ARG:HD3	1:A:138:ARG:HA	1.79	0.45
1:A:82:LYS:HE2	1:A:84:LYS:CG	2.47	0.45
1:B:100:MET:HE1	6:B:667:HOH:O	2.15	0.45
1:B:165:ILE:HD12	1:B:165:ILE:N	2.30	0.45
1:B:264:LYS:HG2	1:B:269:TYR:CZ	2.52	0.45
1:A:304:LYS:CE	6:A:540:HOH:O	2.64	0.45
1:A:144:LEU:HD23	1:A:174:PRO:HD2	1.99	0.45
1:B:252:LYS:CD	6:B:869:HOH:O	2.54	0.44
1:B:132:THR:HG23	1:B:221:LEU:HD11	1.99	0.44
1:B:169:ASP:HB3	1:B:172:ARG:HD3	1.99	0.44
1:B:145:GLU:CG	6:B:892:HOH:O	2.47	0.44
1:A:305:ASP:HB3	1:A:310:ILE:O	2.18	0.43
1:B:240:GLY:O	1:B:286:GLY:HA2	2.18	0.43
1:A:163:PHE:HB2	1:A:184[A]:PHE:HD2	1.83	0.43
1:A:103:TRP:O	1:A:104:LYS:HB2	2.17	0.43
1:A:103:TRP:CE2	1:A:328:LYS:HB3	2.52	0.43
1:A:304:LYS:CD	6:A:531:HOH:O	2.66	0.43
1:A:342[A]:HIS:CD2	6:A:644:HOH:O	2.72	0.43
1:B:122:TYR:CD2	1:B:127:ILE:HD13	2.54	0.42
1:A:264:LYS:HA	1:A:269:TYR:CG	2.53	0.42
1:A:304:LYS:HE2	6:A:531:HOH:O	2.17	0.42
1:A:82:LYS:HZ3	1:A:84:LYS:HD3	1.83	0.42
1:A:82:LYS:CE	1:A:84:LYS:HD3	2.49	0.42
1:B:275:GLY:HA2	1:B:325:LEU:HD13	2.02	0.42
1:A:138:ARG:NH2	6:A:537:HOH:O	2.51	0.42
1:A:255:PRO:HA	1:A:258:PHE:CE1	2.54	0.42
1:B:176:ILE:C	1:B:176:ILE:HD12	2.40	0.42
1:B:175:LEU:N	6:B:529:HOH:O	2.53	0.41
1:A:165:ILE:HG21	1:A:173:MET:CE	2.50	0.41
1:B:252:LYS:HE2	6:B:567:HOH:O	2.19	0.41
1:B:174:PRO:CA	6:B:529:HOH:O	2.68	0.41
1:B:294:ILE:HG12	1:B:323:TYR:CE1	2.56	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:84:LYS:O	1:B:87:ASP:HB2	2.20	0.41
1:A:299:PHE:HA	1:A:302:ILE:HD12	2.01	0.41
1:A:82:LYS:HE2	1:A:84:LYS:HG2	2.02	0.41
1:B:176:ILE:H	1:B:176:ILE:HG13	1.73	0.41
1:A:241:GLU:O	1:A:286:GLY:HA3	2.21	0.41
1:A:240:GLY:O	1:A:286:GLY:HA2	2.20	0.40
1:A:176:ILE:CA	6:A:521:HOH:O	2.51	0.40
1:A:178:LEU:HD11	1:A:184[A]:PHE:CD1	2.56	0.40
1:B:246:LEU:HG	1:B:332:ILE:CG2	2.51	0.40

All (5) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
6:A:540:HOH:O	6:A:554:HOH:O[1_455]	1.91	0.29
6:A:1038:HOH:O	6:A:1056:HOH:O[1_655]	2.10	0.10
6:A:508:HOH:O	6:A:655:HOH:O[2_646]	2.11	0.09
6:B:803:HOH:O	6:B:854:HOH:O[2_555]	2.17	0.03
6:B:773:HOH:O	6:B:874:HOH:O[2_545]	2.18	0.02

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	286/289 (99%)	276 (96%)	10 (4%)	0	100	100
1	B	286/289 (99%)	280 (98%)	6 (2%)	0	100	100
All	All	572/578 (99%)	556 (97%)	16 (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	259/260 (100%)	254 (98%)	5 (2%)	57	43
1	B	259/260 (100%)	256 (99%)	3 (1%)	71	62
All	All	518/520 (100%)	510 (98%)	8 (2%)	65	53

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	104	LYS
1	A	175	LEU
1	A	182	ARG
1	A	247	GLN
1	A	357	GLN
1	B	182	ARG
1	B	247	GLN
1	B	357	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	296	GLN
1	A	313	GLN
1	A	357	GLN
1	B	120	ASN
1	B	296	GLN
1	B	313	GLN
1	B	357	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	NDG	C	1	2	15,15,15	2.08	3 (20%)	21,21,21	1.26	2 (9%)
2	GAL	C	2	2	11,11,12	1.70	2 (18%)	15,15,17	1.42	3 (20%)
2	NDG	D	1	2	15,15,15	2.05	3 (20%)	21,21,21	1.33	2 (9%)
2	GAL	D	2	2	11,11,12	1.70	3 (27%)	15,15,17	1.48	2 (13%)

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	NDG	C	1	2	1/1/6/7	0/6/26/26	0/1/1/1
2	GAL	C	2	2	-	0/2/19/22	0/1/1/1
2	NDG	D	1	2	1/1/6/7	0/6/26/26	0/1/1/1
2	GAL	D	2	2	-	0/2/19/22	0/1/1/1

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	1	NDG	C8-C7	-6.03	1.38	1.50
2	C	1	NDG	C8-C7	-5.98	1.38	1.50
2	D	1	NDG	O3-C3	-3.48	1.34	1.43
2	C	1	NDG	O3-C3	-3.44	1.34	1.43
2	D	2	GAL	O5-C5	-3.44	1.36	1.43
2	C	2	GAL	O5-C5	-3.27	1.36	1.43

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	2	GAL	C4-C5	2.92	1.59	1.53
2	D	2	GAL	C4-C5	2.84	1.59	1.53
2	C	1	NDG	C1-C2	-2.39	1.50	1.52
2	D	1	NDG	O7-C7	-2.03	1.18	1.23
2	D	2	GAL	C4-C3	2.02	1.57	1.52

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	2	GAL	O2-C2-C1	3.13	115.56	109.15
2	C	1	NDG	O5-C5-C6	3.13	114.22	106.44
2	C	2	GAL	O2-C2-C1	2.95	115.20	109.15
2	D	1	NDG	O5-C5-C6	2.91	113.67	106.44
2	D	1	NDG	O5-C1-C2	2.63	112.16	109.52
2	D	2	GAL	C1-O5-C5	2.57	115.67	112.19
2	C	2	GAL	C1-O5-C5	2.43	115.49	112.19
2	C	1	NDG	O5-C1-C2	2.32	111.85	109.52
2	C	2	GAL	O4-C4-C5	2.07	114.44	109.30

All (2) chirality outliers are listed below:

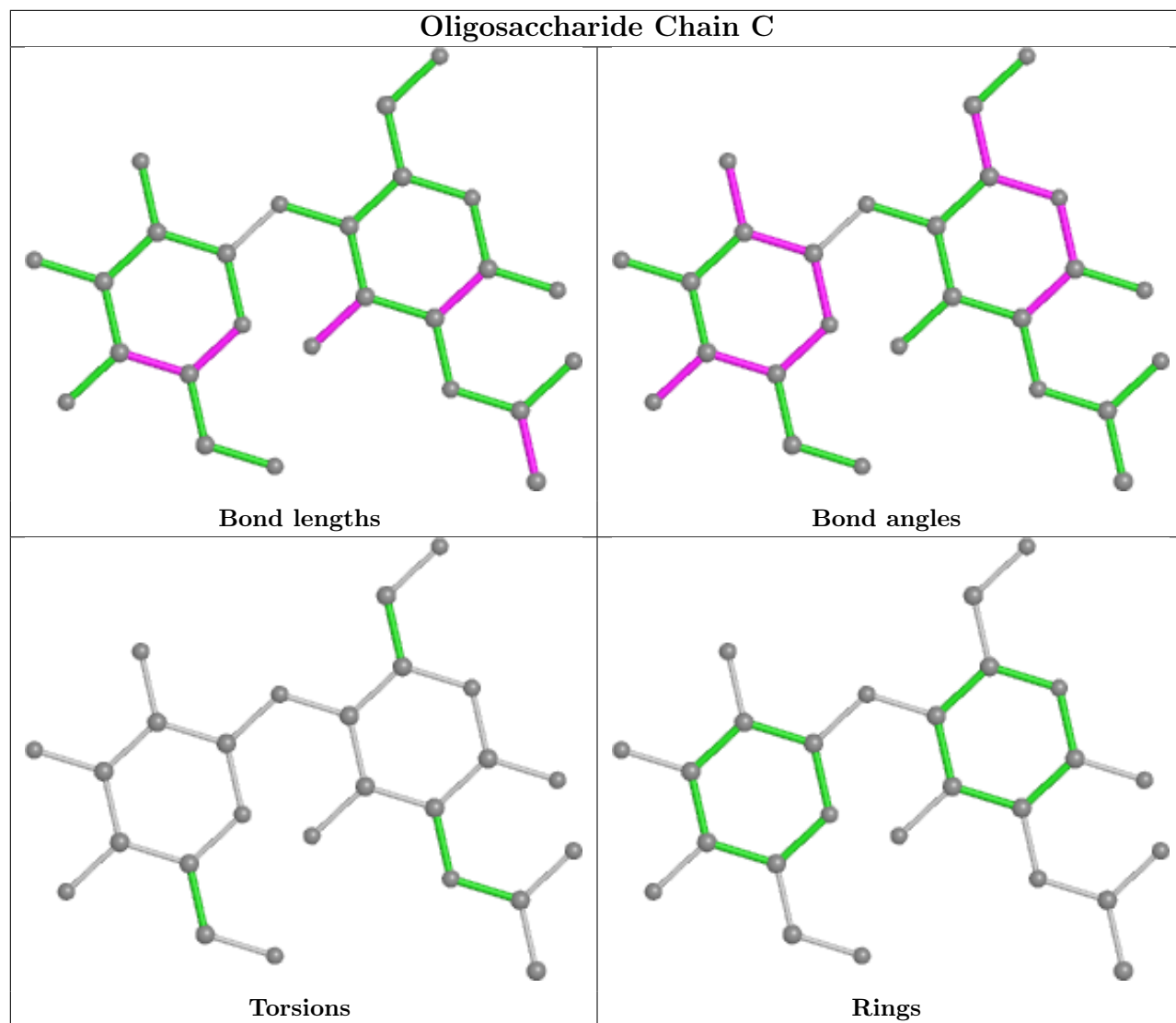
Mol	Chain	Res	Type	Atom
2	C	1	NDG	C1
2	D	1	NDG	C1

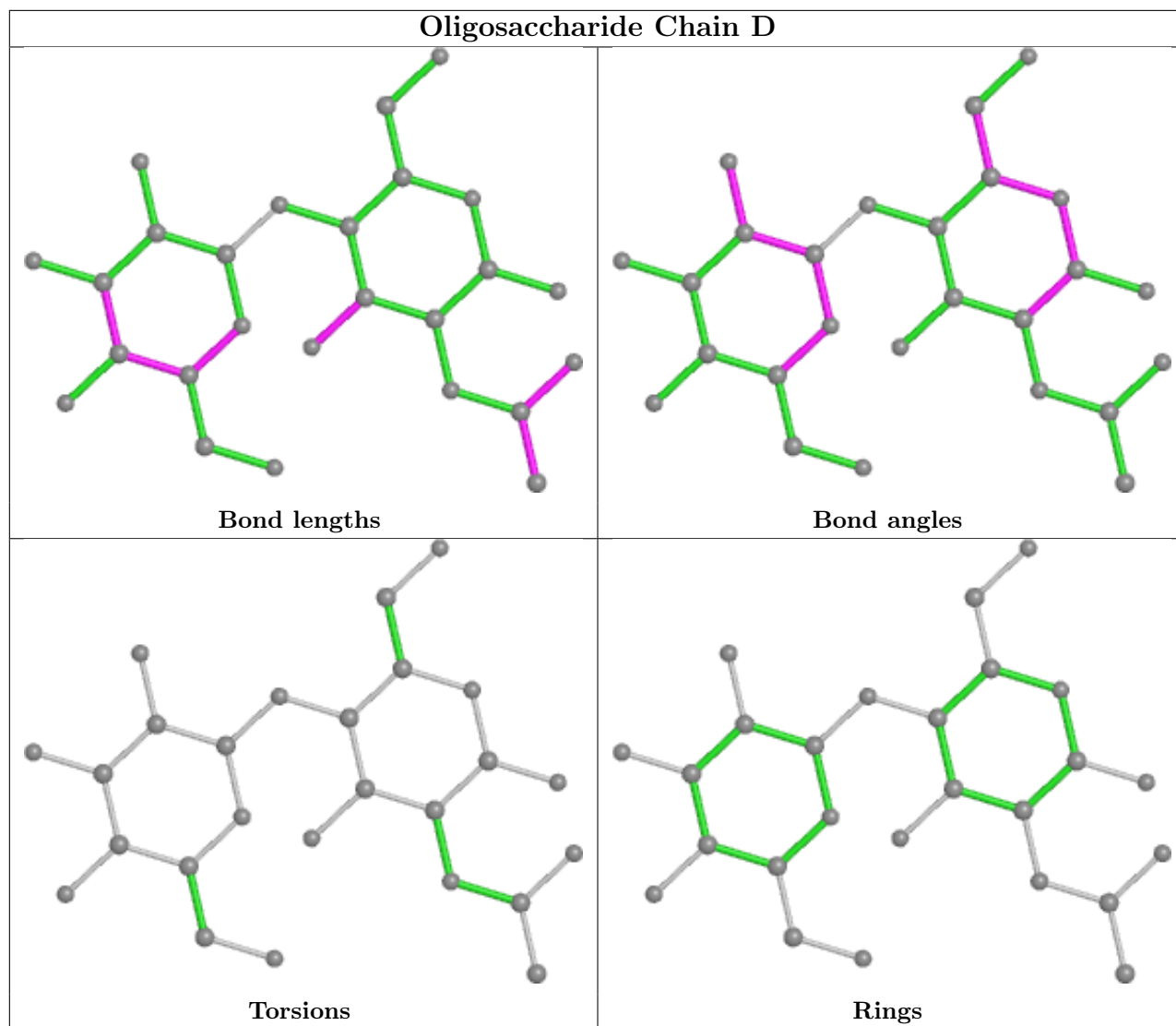
There are no torsion outliers.

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, 2 are monoatomic - leaving 4 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	$\# Z > 2$
5	GOL	B	404	-	5,5,5	1.31	0	5,5,5	0.74	0
5	GOL	A	404	-	5,5,5	1.12	0	5,5,5	0.85	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
4	UDP	B	402	3	24,26,26	2.95	11 (45%)	37,40,40	1.25	5 (13%)
4	UDP	A	402	3	24,26,26	2.93	9 (37%)	37,40,40	1.27	5 (13%)

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
5	GOL	B	404	-	-	2/4/4/4	-
5	GOL	A	404	-	-	0/4/4/4	-
4	UDP	B	402	3	-	1/16/32/32	0/2/2/2
4	UDP	A	402	3	-	1/16/32/32	0/2/2/2

All (20) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	402	UDP	PB-O2B	-7.49	1.26	1.54
4	A	402	UDP	PB-O2B	-7.22	1.27	1.54
4	B	402	UDP	O2-C2	-5.20	1.13	1.23
4	A	402	UDP	O2-C2	-5.19	1.13	1.23
4	A	402	UDP	PB-O3B	-5.14	1.35	1.54
4	B	402	UDP	PB-O3B	-4.92	1.35	1.54
4	A	402	UDP	PB-O1B	-4.74	1.35	1.50
4	A	402	UDP	PA-O1A	-4.66	1.34	1.50
4	B	402	UDP	PB-O1B	-4.63	1.35	1.50
4	B	402	UDP	PA-O1A	-4.38	1.35	1.50
4	A	402	UDP	C2-N1	3.72	1.44	1.38
4	B	402	UDP	C2-N1	3.48	1.44	1.38
4	B	402	UDP	PA-O2A	-3.35	1.39	1.55
4	A	402	UDP	PA-O2A	-3.26	1.40	1.55
4	B	402	UDP	O4'-C4'	-2.68	1.39	1.45
4	A	402	UDP	C1'-N1	2.56	1.55	1.47
4	B	402	UDP	C1'-N1	2.49	1.54	1.47
4	A	402	UDP	O4'-C4'	-2.29	1.39	1.45
4	B	402	UDP	C3'-C2'	-2.16	1.47	1.53
4	B	402	UDP	C6-C5	2.10	1.39	1.35

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	402	UDP	PA-O3A-PB	-2.45	124.42	132.83
4	A	402	UDP	C5-C6-N1	2.31	125.68	121.81
4	B	402	UDP	C5-C6-N1	2.25	125.58	121.81
4	B	402	UDP	O4-C4-C5	-2.23	121.23	125.16
4	A	402	UDP	O4-C4-C5	-2.21	121.27	125.16
4	A	402	UDP	O4'-C1'-N1	2.20	113.38	108.36
4	A	402	UDP	C6-C5-C4	-2.19	116.53	119.52
4	B	402	UDP	PA-O3A-PB	-2.13	125.51	132.83
4	B	402	UDP	O4'-C1'-N1	2.11	113.18	108.36
4	B	402	UDP	C6-C5-C4	-2.09	116.65	119.52

There are no chirality outliers.

All (4) torsion outliers are listed below:

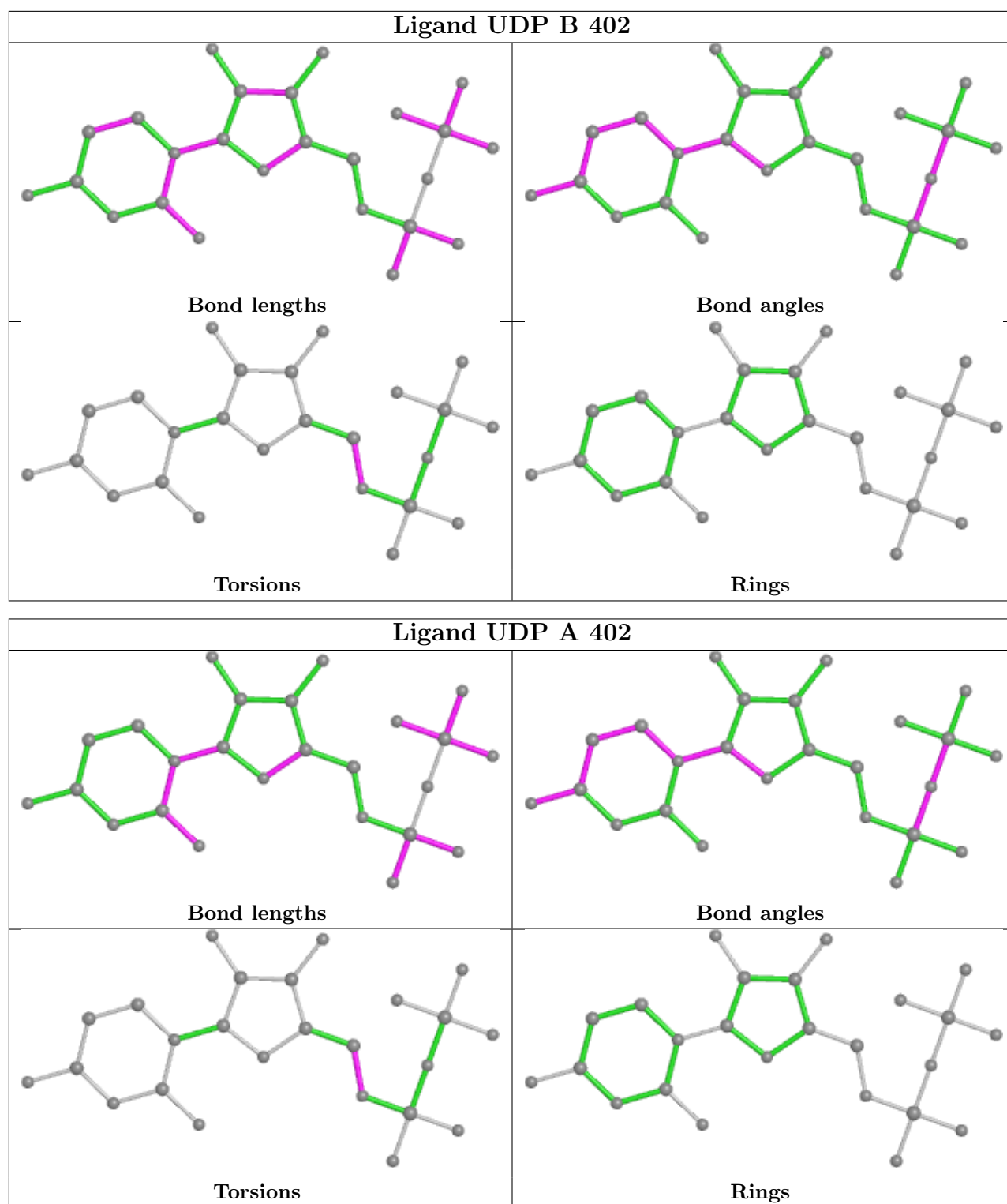
Mol	Chain	Res	Type	Atoms
5	B	404	GOL	C1-C2-C3-O3
5	B	404	GOL	O2-C2-C3-O3
4	B	402	UDP	C4'-C5'-O5'-PA
4	A	402	UDP	C4'-C5'-O5'-PA

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	404	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

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	288/289 (99%)	0.89	45 (15%) 2 1	16, 20, 23, 26	4 (1%)
1	B	288/289 (99%)	0.81	39 (13%) 3 3	16, 20, 22, 25	3 (1%)
All	All	576/578 (99%)	0.85	84 (14%) 2 2	16, 20, 23, 26	7 (1%)

All (84) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	354[A]	MET	21.9
1	B	354[B]	MET	19.8
1	A	184[A]	PHE	18.1
1	B	184[B]	PHE	15.0
1	A	368	VAL	9.0
1	A	81	SER	7.9
1	B	368	VAL	7.5
1	A	100[A]	MET	6.5
1	B	283	ILE	5.2
1	B	342[B]	HIS	5.2
1	B	81	SER	5.0
1	A	283	ILE	4.9
1	A	131	LEU	4.7
1	A	342[A]	HIS	4.6
1	A	175	LEU	4.6
1	B	284	PHE	4.6
1	A	284	PHE	4.2
1	A	82	LYS	4.2
1	B	131	LEU	4.1
1	B	147	PHE	3.7
1	B	174	PRO	3.6
1	B	282	ALA	3.5
1	A	155	PHE	3.5
1	B	280	HIS	3.4

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Mol	Chain	Res	Type	RSRZ
1	A	133	VAL	3.4
1	A	222	PHE	3.4
1	B	175	LEU	3.3
1	B	226	VAL	3.3
1	A	226	VAL	3.2
1	B	162	ILE	3.2
1	A	234	PHE	3.2
1	A	164	TYR	3.2
1	B	82	LYS	3.0
1	B	281	ALA	3.0
1	A	333	LEU	3.0
1	B	134	PHE	3.0
1	B	155	PHE	2.9
1	B	133	VAL	2.9
1	B	170	VAL	2.9
1	B	333	LEU	2.9
1	B	294	ILE	2.8
1	A	174	PRO	2.8
1	B	222	PHE	2.7
1	A	132	THR	2.7
1	A	162	ILE	2.6
1	A	238	THR	2.6
1	B	130	GLY	2.6
1	A	230	PHE	2.6
1	A	163	PHE	2.6
1	A	147	PHE	2.5
1	B	230	PHE	2.5
1	B	129	VAL	2.5
1	B	234	PHE	2.5
1	B	243	VAL	2.5
1	A	224	MET	2.5
1	A	235	GLY	2.5
1	A	281	ALA	2.4
1	A	337	TYR	2.4
1	B	356	TRP	2.4
1	A	282	ALA	2.4
1	A	243	VAL	2.4
1	B	164	TYR	2.3
1	A	244	ALA	2.3
1	A	129	VAL	2.3
1	B	132	THR	2.3
1	A	280	HIS	2.3

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Mol	Chain	Res	Type	RSRZ
1	A	223	CYS	2.3
1	B	163	PHE	2.3
1	B	223	CYS	2.3
1	A	144	LEU	2.2
1	A	221	LEU	2.2
1	A	173	MET	2.2
1	B	244	ALA	2.2
1	A	320	LEU	2.2
1	B	246	LEU	2.2
1	A	193	LYS	2.2
1	B	366	ASN	2.2
1	A	130	GLY	2.2
1	B	337	TYR	2.1
1	B	224	MET	2.1
1	A	309	ASP	2.1
1	A	165	ILE	2.1
1	A	104	LYS	2.1
1	A	279	TYR	2.0

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](#)

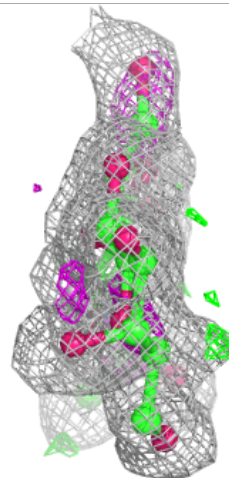
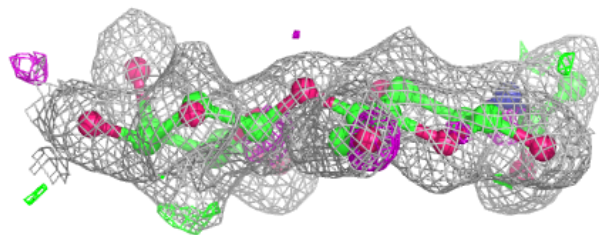
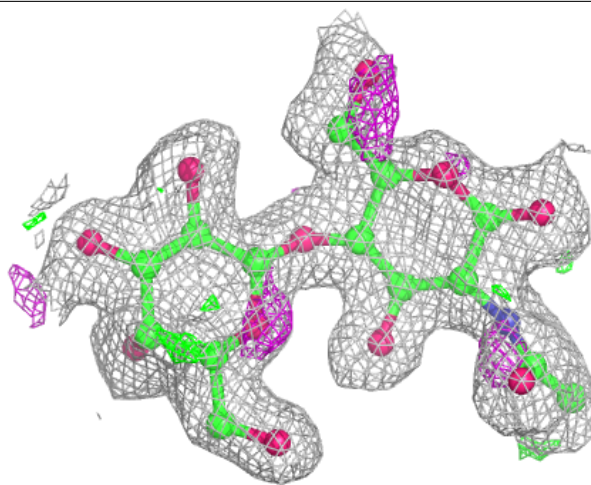
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

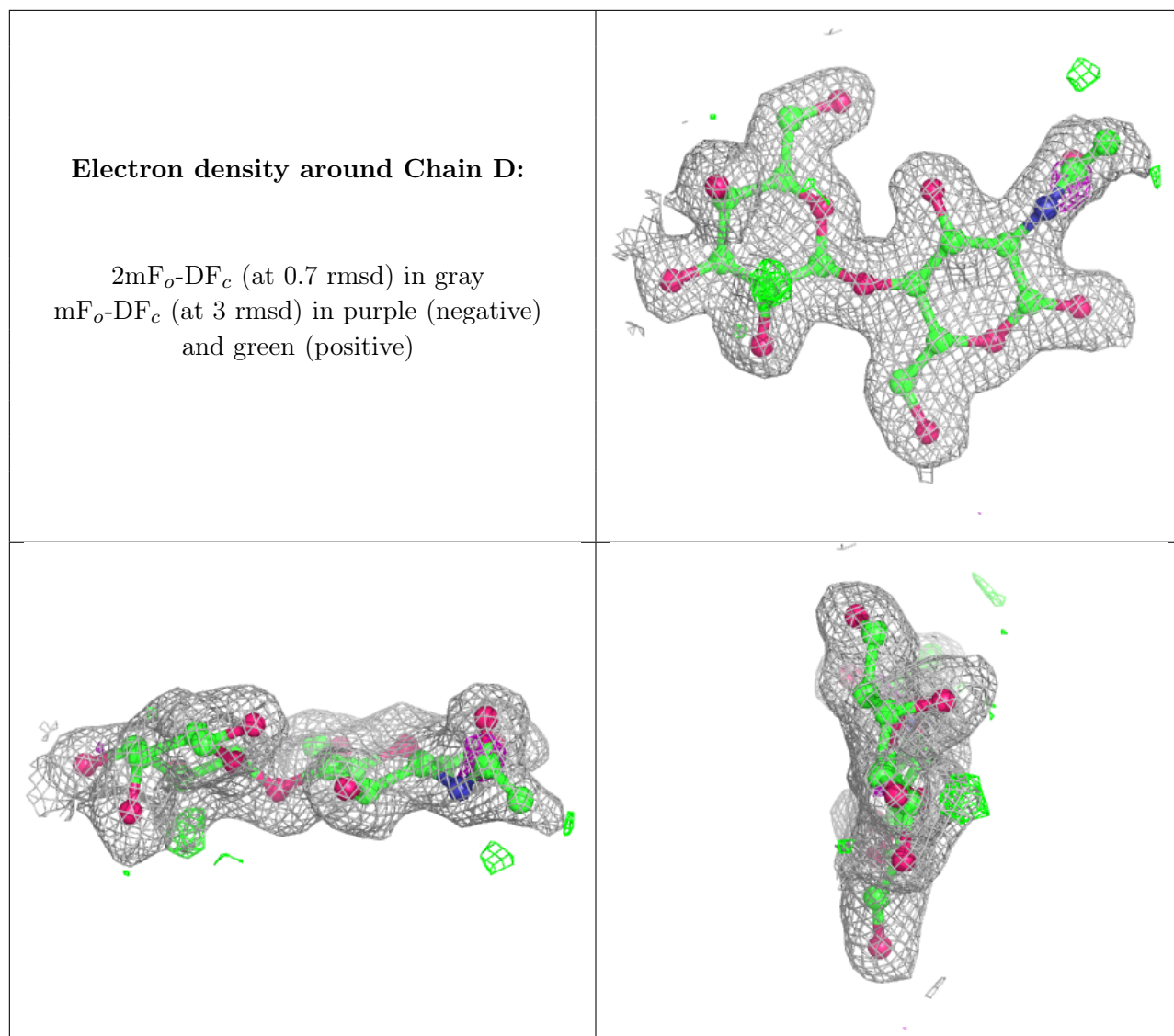
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	NDG	C	1	15/15	0.85	0.17	20,22,25,25	0
2	GAL	C	2	11/12	0.85	0.13	20,22,23,24	0
2	GAL	D	2	11/12	0.86	0.14	19,21,22,23	0
2	NDG	D	1	15/15	0.90	0.15	21,23,25,25	0

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 C:

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



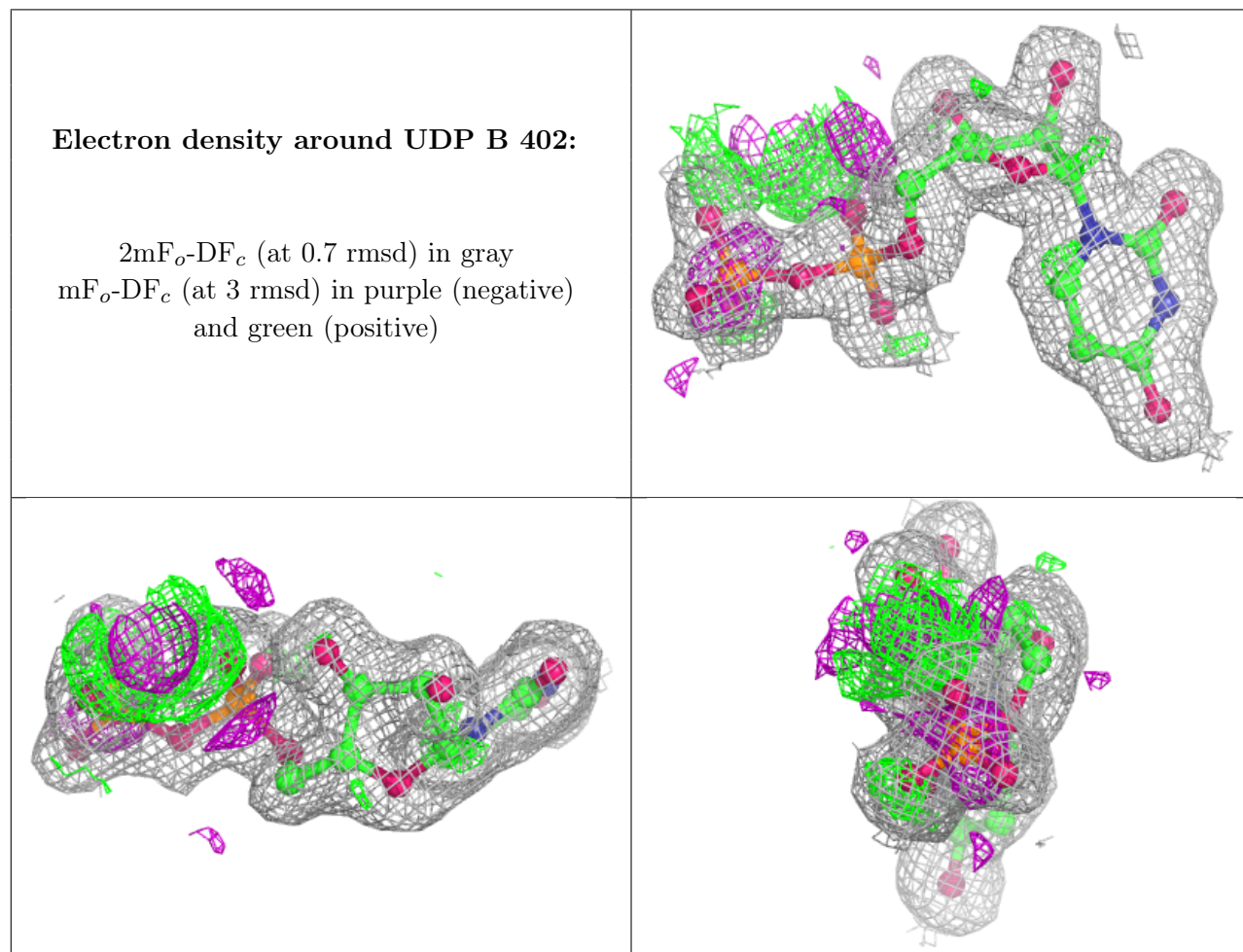


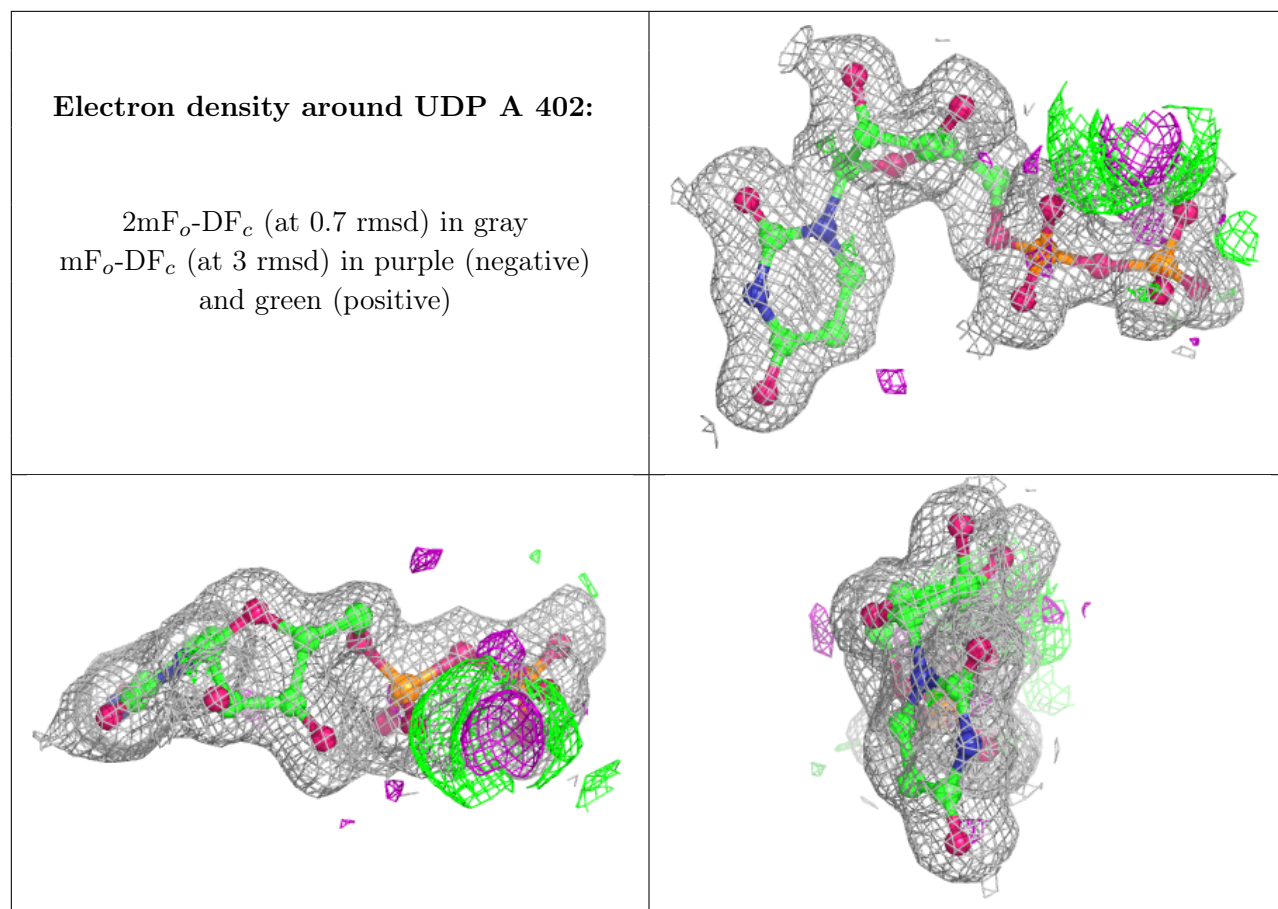
6.4 Ligands [i](#)

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
5	GOL	B	404	6/6	0.82	0.41	23,23,23,25	0
5	GOL	A	404	6/6	0.86	0.17	21,23,25,26	0
4	UDP	B	402	25/25	0.94	0.14	8,18,20,22	0
4	UDP	A	402	25/25	0.96	0.12	12,19,21,22	0
3	MN	A	401	1/1	0.97	0.13	1,1,1,1	0
3	MN	B	401	1/1	1.00	0.10	1,1,1,1	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.





6.5 Other polymers [i](#)

There are no such residues in this entry.