Full wwPDB X-ray Structure Validation Report ⓘ

Mar 31, 2025 – 10:16 PM JST

PDB ID	:	8ZX3 / pdb_00008zx3
Title	:	Structure-Based Mechanism and Specificity of Human Galactosyltransferase B3GalT5
Authors	:	Lo, J.M.; Ma, C.
Deposited on	:	2024-06-13
Resolution	:	2.09 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:

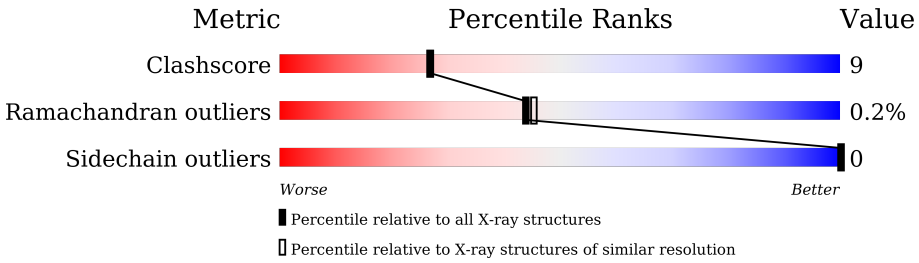
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	2.0rc1
EDS	:	FAILED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.42

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.09 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	180529	6893 (2.10-2.10)
Ramachandran outliers	177936	6839 (2.10-2.10)
Sidechain outliers	177891	6840 (2.10-2.10)

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 <=5%

Note EDS failed to run properly.

Mol	Chain	Length	Quality of chain
1	A	278	82% 13%
1	B	278	72% 23%
2	E	2	100%
2	G	2	50% 50%
3	F	2	100%
4	H	6	67% 33%
5	I	2	50% 50%
5	J	2	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	FUC	F	2	X	-	-	-

2 Entry composition (i)

There are 11 unique types of molecules in this entry. The entry contains 5161 atoms, of which 149 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-1,3-galactosyltransferase 5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	267	Total	C	N	O	S	0	2	0
			2201	1427	371	390	13			
1	B	266	Total	C	N	O	S	0	0	0
			2189	1418	370	388	13			

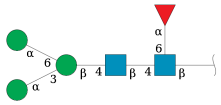
- Molecule 2 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	2	Total	C	H	N	O	0	0	0
			55	16	27	2	10			
2	G	2	Total	C	N	O		0	0	0
			28	16	2	10				

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

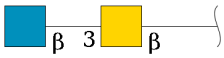
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	F	2	Total	C	N	O	0	0	0
			24	14	1	9			

- Molecule 4 is an oligosaccharide called alpha-D-mannopyranose-(1-3)-[alpha-D-mannopyranose-(1-6)]beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf	Trace
4	H	6	Total C H N O 127 40 56 2 29	0	0	0

- Molecule 5 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-3)-2-acetamido-2-deoxy-beta-D-galactopyranose.

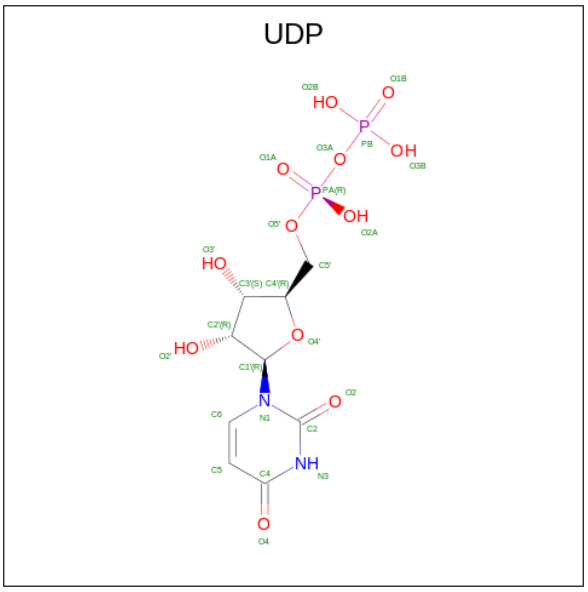


Mol	Chain	Residues	Atoms	ZeroOcc	AltConf	Trace
5	I	2	Total C H N O 43 16 14 2 11	0	0	0
5	J	2	Total C N O 29 16 2 11	0	0	0

- Molecule 6 is MANGANESE (II) ION (CCD ID: MN) (formula: Mn) (labeled as "Ligand of Interest" by depositor).

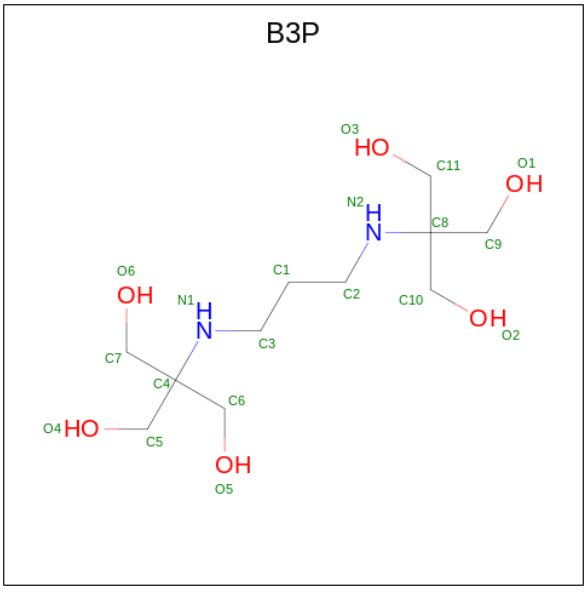
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	1	Total Mn 1 1	0	0
6	B	1	Total Mn 1 1	0	0

- Molecule 7 is URIDINE-5'-DIPHOSPHATE (CCD ID: UDP) (formula: $C_9H_{14}N_2O_{12}P_2$) (labeled as "Ligand of Interest" by depositor).



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

- Molecule 8 is 2-[3-(2-HYDROXY-1,1-DIHYDROXYMETHYL-ETHYLAMINO)-PROPYLAMINO]-2-HYDROXYMETHYL-PROPANE-1,3-DIOL (CCD ID: B3P) (formula: $C_{11}H_{26}N_2O_6$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
8	A	1	Total	C	H	N	O	0	0
			45	11	26	2	6		

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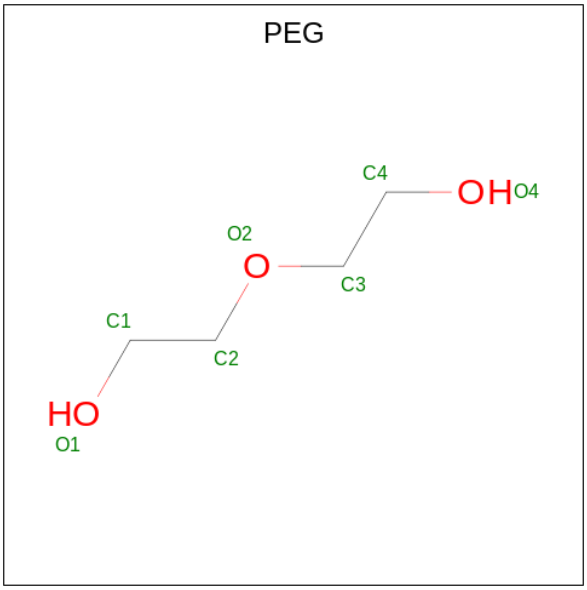
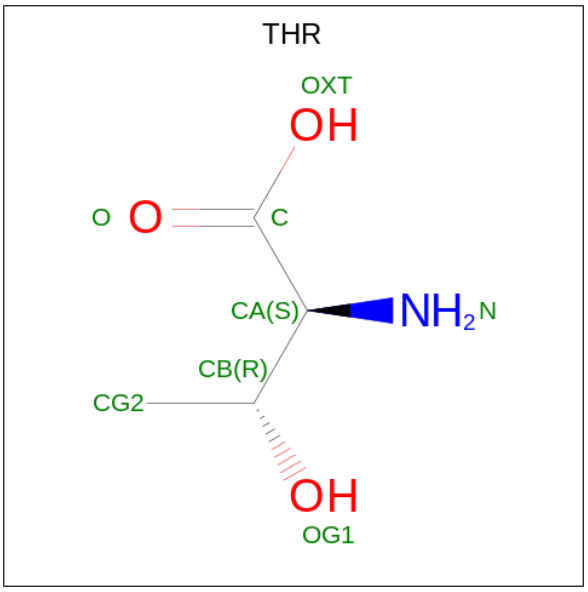
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
8	B	1	Total	C	H	N	O	0	0
			45	11	26	2	6		

- Molecule 9 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
9	A	1	Total	C	O		0	0
			7	4	3			
9	A	1	Total	C	O		0	0
			7	4	3			

- Molecule 10 is THREONINE (CCD ID: THR) (formula: $C_4H_9NO_3$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
10	A	1	Total C N O 7 4 1 2	0	0
10	B	1	Total C N O 7 4 1 2	0	0

- Molecule 11 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
11	A	215	Total O 215 215	0	0
11	B	80	Total O 80 80	0	0

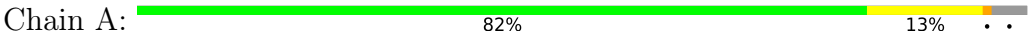
3 Residue-property plots (i)

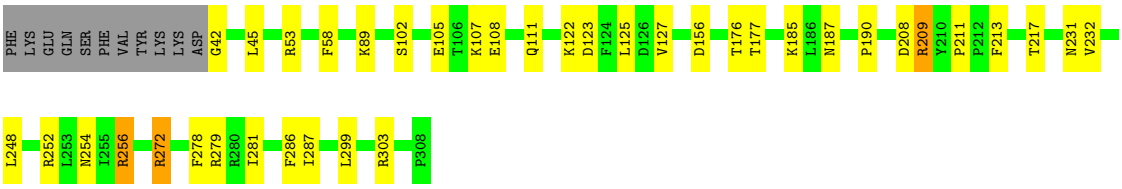
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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.

Note EDS failed to run properly.

• Molecule 1: Beta-1,3-galactosyltransferase 5

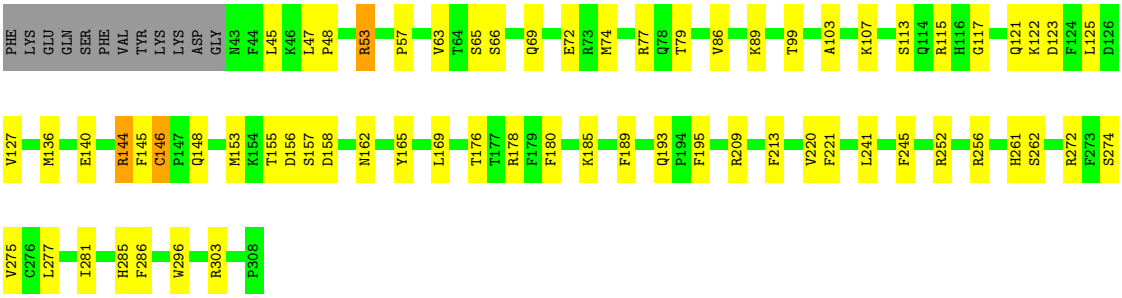
Chain A:





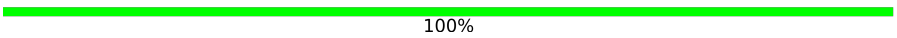
• Molecule 1: Beta-1,3-galactosyltransferase 5

Chain B:



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

Chain E:

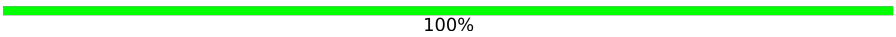


• Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain G:

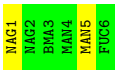
• Molecule 3: alpha-L-fucopyranose-(1-6)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain F:



• Molecule 4: alpha-D-mannopyranose-(1-3)-[alpha-D-mannopyranose-(1-6)]beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-[alpha-L-fucopyranose-(1-6)]2-acetamido-2-deoxy-beta-D-glucopyranose

Chain H:

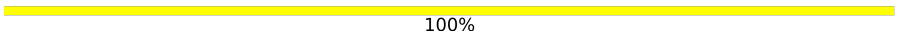


• Molecule 5: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-3)-2-acetamido-2-deoxy-beta-D-galactopyranose

Chain I:

• Molecule 5: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-3)-2-acetamido-2-deoxy-beta-D-galactopyranose

Chain J:



4 Data and refinement statistics (i)

EDS failed to run properly - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	47.54Å 86.37Å 86.89Å 90.00° 95.26° 90.00°	Depositor
Resolution (Å)	26.47 – 2.09	Depositor
% Data completeness (in resolution range)	95.1 (26.47-2.09)	Depositor
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.41 (at 1.88Å)	Xtriage
Refinement program	PHENIX 1.19.1_4122	Depositor
R, R_{free}	0.202 , 0.229	Depositor
Wilson B-factor (Å^2)	18.5	Xtriage
Anisotropy	0.135	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	5161	wwPDB-VP
Average B, all atoms (Å^2)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.87% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: NAG, PEG, MAN, MN, BMA, FUC, NGA, B3P, UDP

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	0.63	0/2266	0.83	0/3064
1	B	0.60	1/2248 (0.0%)	0.79	1/3040 (0.0%)
All	All	0.61	1/4514 (0.0%)	0.81	1/6104 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	6
1	B	0	7
All	All	0	13

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	145	PHE	C-N	10.30	1.57	1.34

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	145	PHE	C-N-CA	-5.84	107.09	121.70

There are no chirality outliers.

All (13) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	209	ARG	Sidechain

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Mol	Chain	Res	Type	Group
1	A	256	ARG	Sidechain
1	A	272	ARG	Sidechain
1	A	279	ARG	Sidechain
1	A	303	ARG	Sidechain
1	A	53	ARG	Sidechain
1	B	144	ARG	Sidechain
1	B	178	ARG	Sidechain
1	B	256	ARG	Sidechain
1	B	272	ARG	Sidechain
1	B	303	ARG	Sidechain
1	B	53	ARG	Sidechain
1	B	77	ARG	Sidechain

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	2201	0	2194	27	0
1	B	2189	0	2175	56	0
2	E	28	27	25	0	0
2	G	28	0	25	1	0
3	F	24	0	22	0	0
4	H	71	56	61	0	0
5	I	29	14	26	1	0
5	J	29	0	26	1	0
6	A	1	0	0	0	0
6	B	1	0	0	0	0
7	A	25	0	11	1	0
7	B	25	0	11	1	0
8	A	19	26	26	0	0
8	B	19	26	26	0	0
9	A	14	0	20	1	0
10	A	7	0	4	0	0
10	B	7	0	4	0	0
11	A	215	0	0	5	0
11	B	80	0	0	6	0
All	All	5012	149	4656	85	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 9.

All (85) 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:74:MET:HE1	1:B:115:ARG:NH2	1.56	1.20
1:B:74:MET:CE	1:B:115:ARG:HH22	1.64	1.10
1:B:74:MET:HE1	1:B:115:ARG:HH22	0.74	0.89
1:B:45:LEU:HB2	1:B:121:GLN:HG2	1.66	0.78
1:A:102:SER:OG	1:A:105:GLU:HG3	1.87	0.74
1:B:140:GLU:CG	1:B:144:ARG:HE	2.03	0.72
1:B:140:GLU:CD	1:B:144:ARG:HE	1.96	0.69
1:B:252:ARG:HD2	11:B:521:HOH:O	1.92	0.69
1:A:42:GLY:N	11:A:503:HOH:O	2.26	0.68
1:A:272:ARG:HD2	11:A:506:HOH:O	1.92	0.68
1:B:47:LEU:HD12	1:B:48:PRO:HD2	1.76	0.68
1:A:156:ASP:OD1	7:A:402:UDP:H4'	1.95	0.67
1:B:185:LYS:HD3	1:B:213:PHE:CE2	2.31	0.65
1:B:103:ALA:O	1:B:107:LYS:HG3	1.96	0.65
1:A:107:LYS:O	1:A:111:GLN:HG3	1.98	0.64
1:B:176:THR:O	11:B:501:HOH:O	2.16	0.61
1:B:156:ASP:HB3	11:B:504:HOH:O	2.00	0.60
1:B:53:ARG:HH11	1:B:53:ARG:HB2	1.66	0.60
1:A:211:PRO:HG3	1:A:248:LEU:HD23	1.82	0.60
1:B:274:SER:OG	1:B:277:LEU:HB3	2.02	0.59
1:B:99:THR:HG22	1:B:121:GLN:HE21	1.66	0.59
5:I:1:NGA:H83	5:I:2:NAG:H82	1.85	0.59
1:B:65:SER:HA	7:B:402:UDP:O2'	2.03	0.58
1:A:156:ASP:OD2	1:A:217:THR:HA	2.04	0.58
1:B:153:MET:HG3	1:B:220:VAL:HG22	1.86	0.57
1:A:299:LEU:HB3	9:A:405:PEG:H12	1.87	0.57
1:B:66:SER:HB2	1:B:69:GLN:HG3	1.88	0.55
1:A:232:VAL:HG21	1:A:252:ARG:HG2	1.90	0.54
1:A:254:ASN:HD22	1:A:256:ARG:HH22	1.56	0.54
1:B:99:THR:CG2	1:B:123:ASP:HA	2.37	0.53
1:B:140:GLU:HG3	1:B:144:ARG:HE	1.73	0.51
1:A:187:ASN:HA	1:A:209:ARG:HH12	1.74	0.51
1:A:278:PHE:HA	1:A:281:ILE:HG12	1.93	0.50
1:B:156:ASP:CB	11:B:504:HOH:O	2.59	0.50
1:A:232:VAL:CG2	1:A:252:ARG:HG2	2.42	0.50
1:A:176:THR:HG23	1:A:177:THR:HG23	1.93	0.50
1:A:187:ASN:HA	1:A:209:ARG:NH1	2.27	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:79:THR:HG22	1:B:296:TRP:CG	2.47	0.50
1:B:285:HIS:CD2	1:B:286:PHE:H	2.30	0.49
1:B:99:THR:HG22	1:B:121:GLN:NE2	2.28	0.49
1:B:74:MET:CE	1:B:115:ARG:NH2	2.44	0.49
1:B:99:THR:HG21	1:B:123:ASP:HA	1.94	0.48
1:B:140:GLU:OE2	1:B:144:ARG:NE	2.46	0.48
1:B:275:VAL:HG23	11:B:537:HOH:O	2.12	0.48
1:B:189:PHE:CE1	1:B:209:ARG:HG2	2.48	0.48
1:B:158:ASP:OD1	1:B:158:ASP:N	2.46	0.48
1:B:74:MET:HE1	1:B:115:ARG:CZ	2.35	0.48
1:B:121:GLN:HG3	1:B:122:LYS:N	2.30	0.47
1:B:86:VAL:O	1:B:89:LYS:HB2	2.13	0.47
1:A:209:ARG:HH11	1:A:209:ARG:HB3	1.80	0.46
1:B:121:GLN:CG	1:B:122:LYS:N	2.77	0.46
1:B:274:SER:OG	1:B:277:LEU:CB	2.63	0.46
1:B:136:MET:HE3	1:B:245:PHE:HE2	1.80	0.46
2:G:1:NAG:H61	2:G:2:NAG:H4	1.98	0.46
1:A:108:GLU:HG3	11:A:638:HOH:O	2.15	0.46
1:B:72:GLU:HB3	1:B:157:SER:HB2	1.98	0.46
1:A:45:LEU:HD11	1:A:123:ASP:HB2	1.97	0.45
1:B:63:VAL:HG22	1:B:155:THR:CG2	2.47	0.45
1:A:58:PHE:CB	1:A:89:LYS:HB3	2.46	0.45
1:B:146:CYS:C	1:B:148:GLN:H	2.19	0.45
1:B:57:PRO:HG3	1:B:146:CYS:SG	2.57	0.45
1:B:125:LEU:HG	1:B:127:VAL:HG13	1.99	0.44
1:A:190:PRO:HD2	1:A:208:ASP:O	2.18	0.44
1:A:231:ASN:HB2	11:A:572:HOH:O	2.17	0.44
1:B:241:LEU:HD13	5:J:2:NAG:H62	1.98	0.44
1:B:72:GLU:OE1	1:B:72:GLU:N	2.48	0.44
1:B:193:GLN:HB3	1:B:195:PHE:CE2	2.54	0.43
1:A:125:LEU:HG	1:A:127:VAL:HG13	2.01	0.43
1:B:261:HIS:CG	1:B:262:SER:N	2.87	0.43
1:B:165:TYR:CE2	1:B:169:LEU:HD11	2.53	0.43
1:A:42:GLY:O	1:A:122:LYS:HE3	2.19	0.43
1:B:180:PHE:CD2	1:B:221:PHE:HB3	2.54	0.42
1:A:185:LYS:HD3	1:A:213:PHE:CE2	2.54	0.42
1:B:136:MET:CE	1:B:245:PHE:HE2	2.33	0.42
1:A:272:ARG:CD	11:A:506:HOH:O	2.61	0.42
1:B:121:GLN:HG3	1:B:122:LYS:H	1.83	0.41
1:B:99:THR:HG23	1:B:123:ASP:HA	2.02	0.41
1:B:140:GLU:HG3	1:B:144:ARG:NE	2.35	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:176:THR:HB	11:B:568:HOH:O	2.19	0.41
1:A:105:GLU:O	1:A:108:GLU:HG2	2.21	0.41
1:B:45:LEU:CB	1:B:121:GLN:HG2	2.42	0.41
1:B:162:ASN:HB3	1:B:281:ILE:O	2.21	0.41
1:B:113:SER:O	1:B:117:GLY:N	2.52	0.41
1:A:286:PHE:O	1:A:287[A]:ILE:HD13	2.21	0.40
1:B:136:MET:CE	1:B:245:PHE:CE2	3.04	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	267/278 (96%)	259 (97%)	8 (3%)	0	100 100
1	B	264/278 (95%)	248 (94%)	15 (6%)	1 (0%)	30 29
All	All	531/556 (96%)	507 (96%)	23 (4%)	1 (0%)	44 45

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	146	CYS

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	246/255 (96%)	246 (100%)	0	100	100
1	B	244/255 (96%)	244 (100%)	0	100	100
All	All	490/510 (96%)	490 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	111	GLN
1	A	254	ASN
1	B	121	GLN
1	B	297	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)

16 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	NAG	E	1	1,2	14,14,15	0.45	0	17,19,21	0.59	0
2	NAG	E	2	2	14,14,15	0.41	0	17,19,21	0.65	0
3	NAG	F	1	1,3	14,14,15	0.41	0	17,19,21	0.94	0
3	FUC	F	2	3	10,10,11	0.33	0	14,14,16	0.40	0
2	NAG	G	1	1,2	14,14,15	0.42	0	17,19,21	0.56	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
2	NAG	G	2	2	14,14,15	0.41	0	17,19,21	0.64	1 (5%)
4	NAG	H	1	4,1	14,14,15	0.43	0	17,19,21	1.00	2 (11%)
4	NAG	H	2	4	14,14,15	0.45	0	17,19,21	0.84	0
4	BMA	H	3	4	11,11,12	0.69	0	15,15,17	0.57	0
4	MAN	H	4	4	11,11,12	0.35	0	15,15,17	0.53	0
4	MAN	H	5	4	11,11,12	0.38	0	15,15,17	0.71	1 (6%)
4	FUC	H	6	4	10,10,11	0.32	0	14,14,16	0.66	0
5	NGA	I	1	5	15,15,15	0.31	0	21,21,21	1.84	3 (14%)
5	NAG	I	2	5	14,14,15	0.42	0	17,19,21	0.75	0
5	NGA	J	1	5	15,15,15	0.28	0	21,21,21	2.02	4 (19%)
5	NAG	J	2	5	14,14,15	0.42	0	17,19,21	0.76	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	NAG	E	1	1,2	-	0/6/23/26	0/1/1/1
2	NAG	E	2	2	-	4/6/23/26	0/1/1/1
3	NAG	F	1	1,3	-	4/6/23/26	0/1/1/1
3	FUC	F	2	3	1/1/4/5	-	0/1/1/1
2	NAG	G	1	1,2	-	0/6/23/26	0/1/1/1
2	NAG	G	2	2	-	4/6/23/26	0/1/1/1
4	NAG	H	1	4,1	-	2/6/23/26	0/1/1/1
4	NAG	H	2	4	-	0/6/23/26	0/1/1/1
4	BMA	H	3	4	-	0/2/19/22	0/1/1/1
4	MAN	H	4	4	-	0/2/19/22	0/1/1/1
4	MAN	H	5	4	-	0/2/19/22	0/1/1/1
4	FUC	H	6	4	-	-	0/1/1/1
5	NGA	I	1	5	-	0/6/26/26	0/1/1/1
5	NAG	I	2	5	-	0/6/23/26	0/1/1/1
5	NGA	J	1	5	-	2/6/26/26	0/1/1/1
5	NAG	J	2	5	-	0/6/23/26	0/1/1/1

There are no bond length outliers.

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	I	1	NGA	C1-C2-C3	-6.20	102.08	110.54

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	J	1	NGA	O5-C1-C2	-6.11	103.38	109.52
5	J	1	NGA	C1-C2-N2	3.87	115.22	110.73
5	J	1	NGA	C1-C2-C3	-3.85	105.30	110.54
5	I	1	NGA	O1-C1-C2	3.11	115.68	109.22
5	I	1	NGA	C1-O5-C5	-2.95	108.10	113.66
5	J	1	NGA	O1-C1-C2	2.89	115.23	109.22
4	H	1	NAG	C2-N2-C7	2.52	126.49	122.90
2	G	2	NAG	C1-O5-C5	2.25	115.24	112.19
4	H	1	NAG	O5-C1-C2	2.15	114.69	111.29
4	H	5	MAN	C1-O5-C5	2.00	114.90	112.19

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
3	F	2	FUC	C1

All (16) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	G	2	NAG	C8-C7-N2-C2
2	G	2	NAG	O7-C7-N2-C2
4	H	1	NAG	C8-C7-N2-C2
5	J	1	NGA	C8-C7-N2-C2
5	J	1	NGA	O7-C7-N2-C2
4	H	1	NAG	O7-C7-N2-C2
2	G	2	NAG	O5-C5-C6-O6
2	E	2	NAG	O5-C5-C6-O6
2	G	2	NAG	C4-C5-C6-O6
2	E	2	NAG	C8-C7-N2-C2
3	F	1	NAG	C8-C7-N2-C2
2	E	2	NAG	O7-C7-N2-C2
3	F	1	NAG	O7-C7-N2-C2
2	E	2	NAG	C4-C5-C6-O6
3	F	1	NAG	C4-C5-C6-O6
3	F	1	NAG	O5-C5-C6-O6

There are no ring outliers.

5 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	I	1	NGA	1	0

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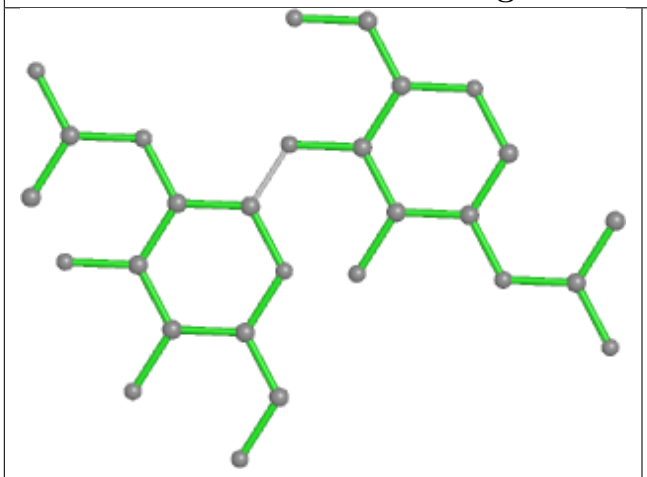
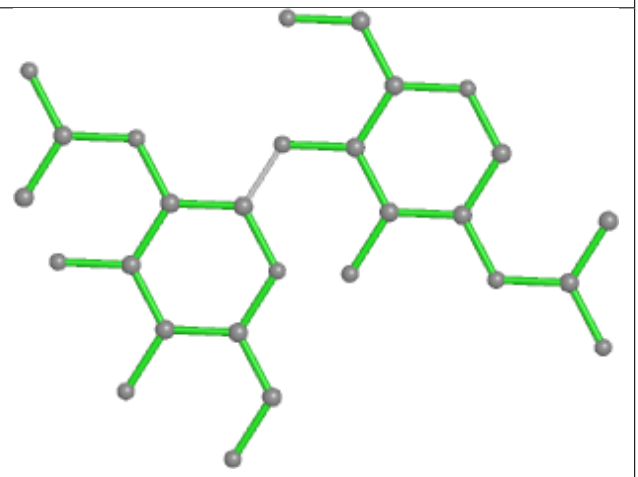
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	G	1	NAG	1	0
5	J	2	NAG	1	0
2	G	2	NAG	1	0
5	I	2	NAG	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.

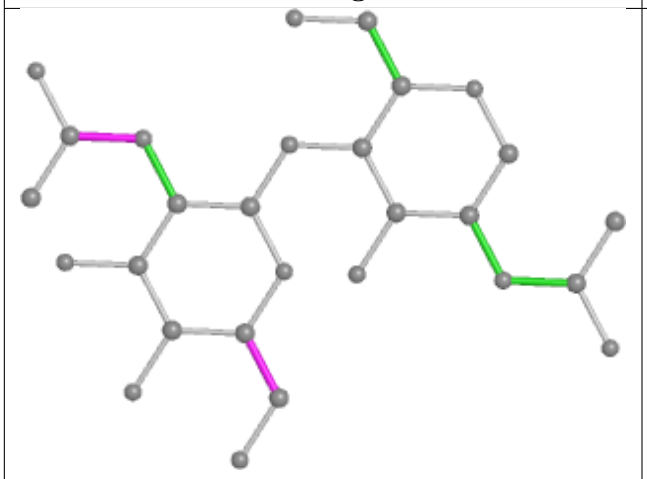
Oligosaccharide Chain E



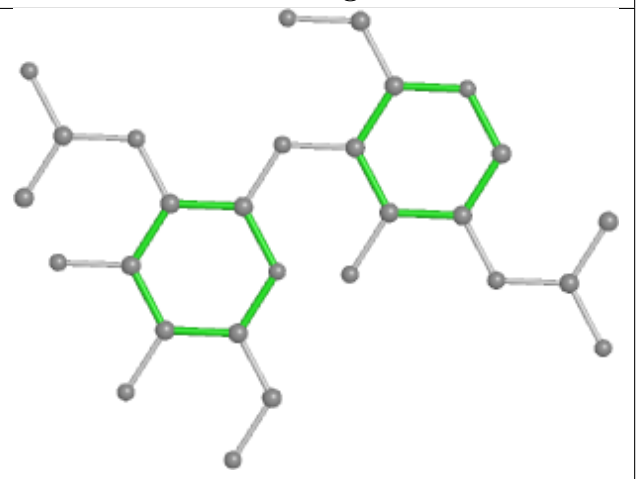
Bond lengths



Bond angles

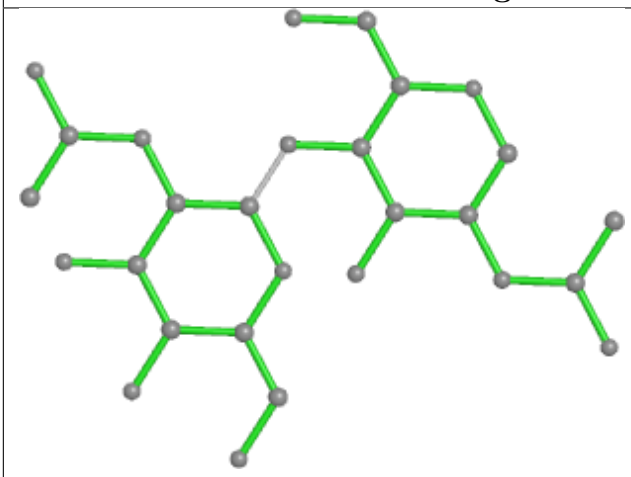


Torsions

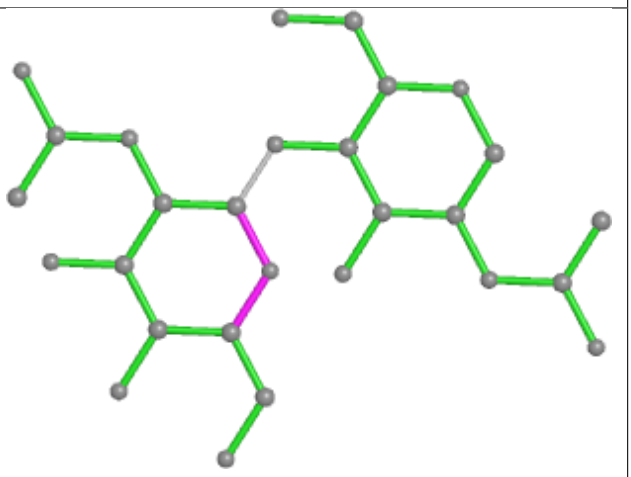


Rings

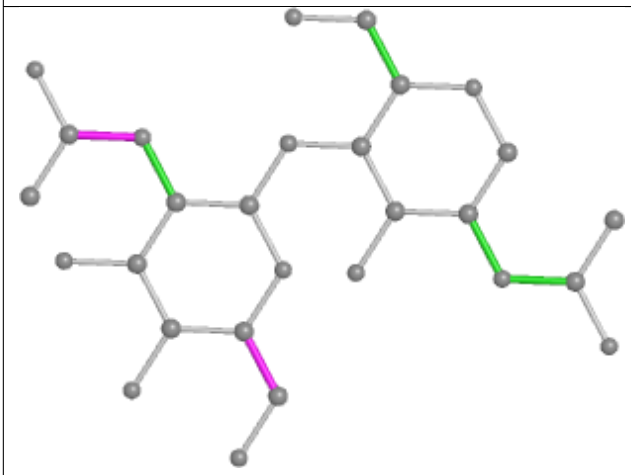
Oligosaccharide Chain G



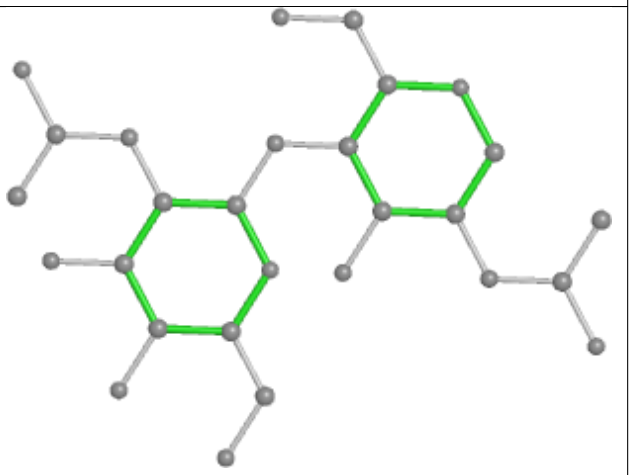
Bond lengths



Bond angles

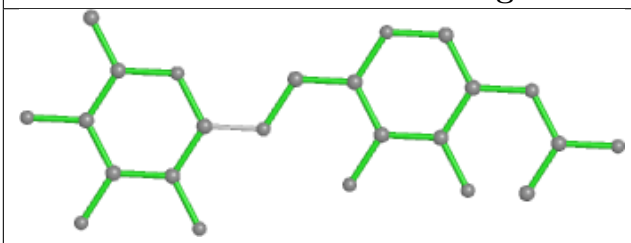


Torsions

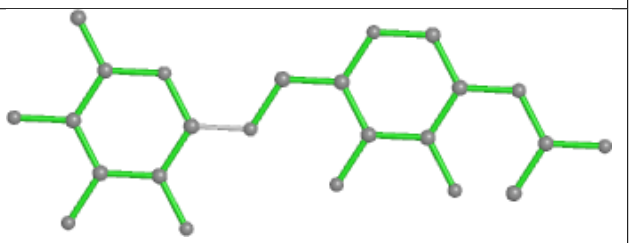


Rings

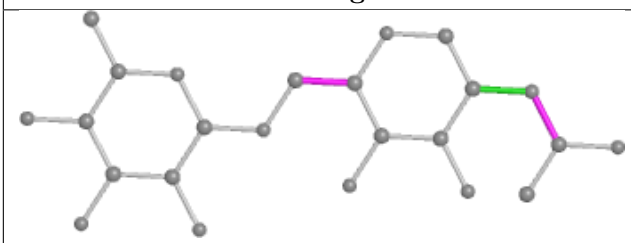
Oligosaccharide Chain F



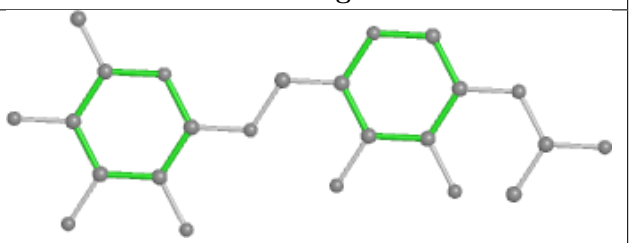
Bond lengths



Bond angles

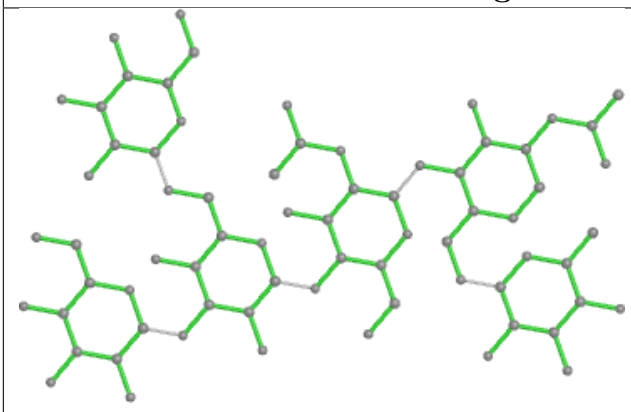


Torsions

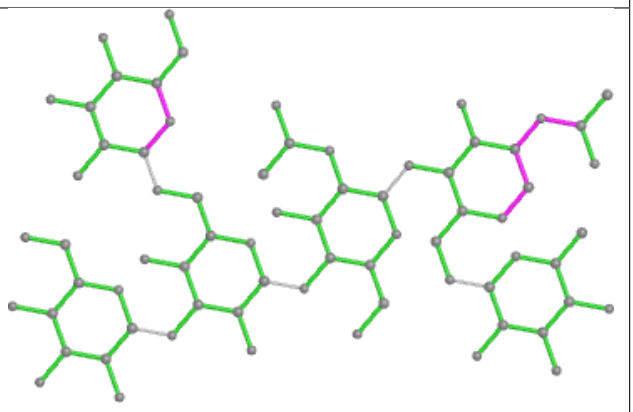


Rings

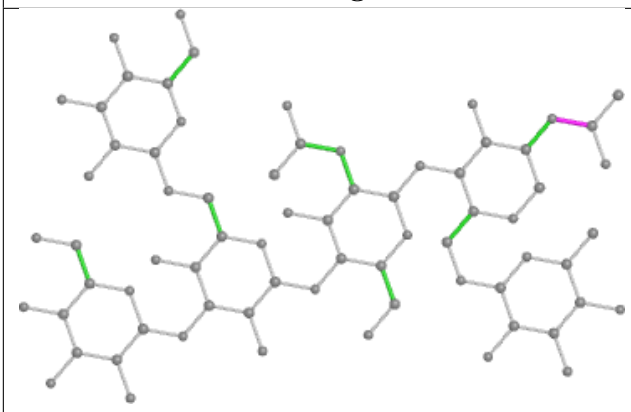
Oligosaccharide Chain H



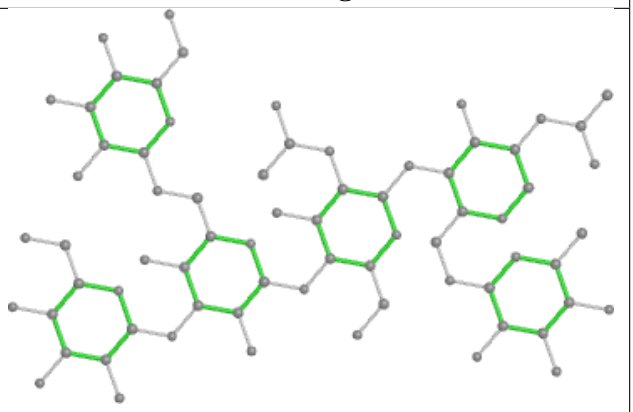
Bond lengths



Bond angles

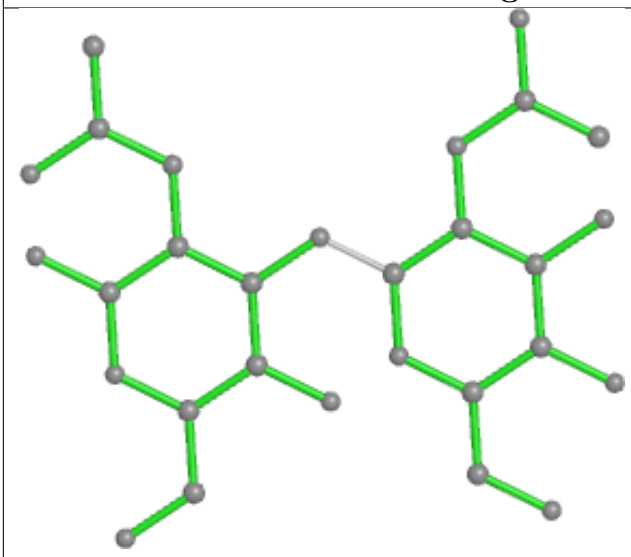


Torsions

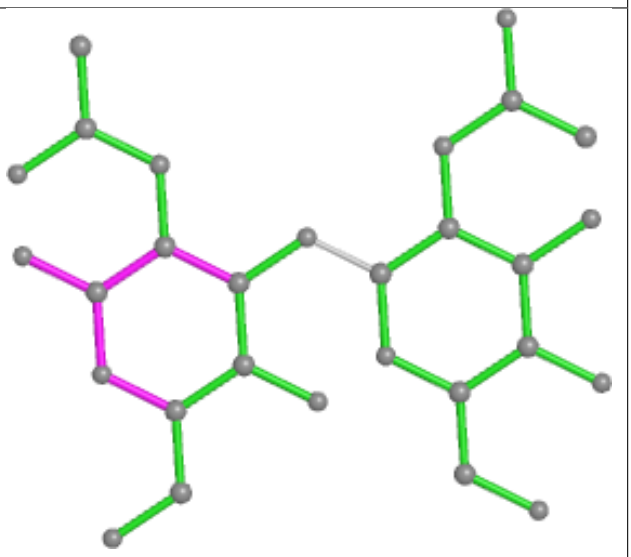


Rings

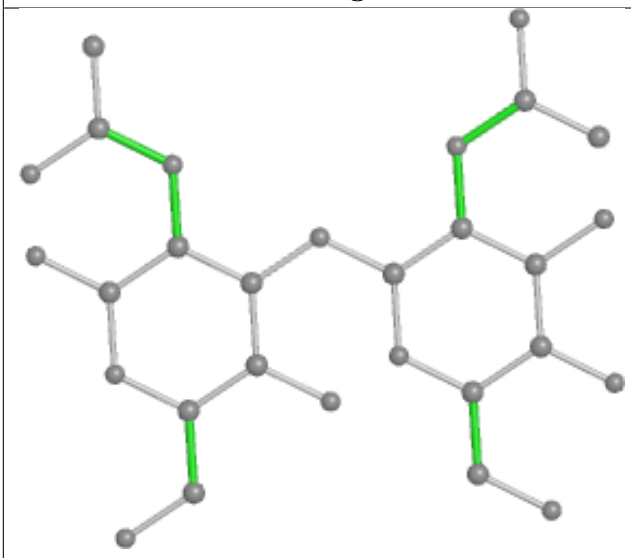
Oligosaccharide Chain I



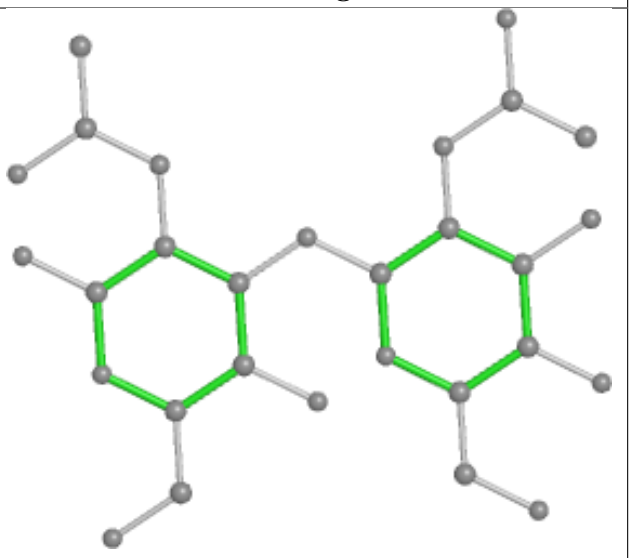
Bond lengths



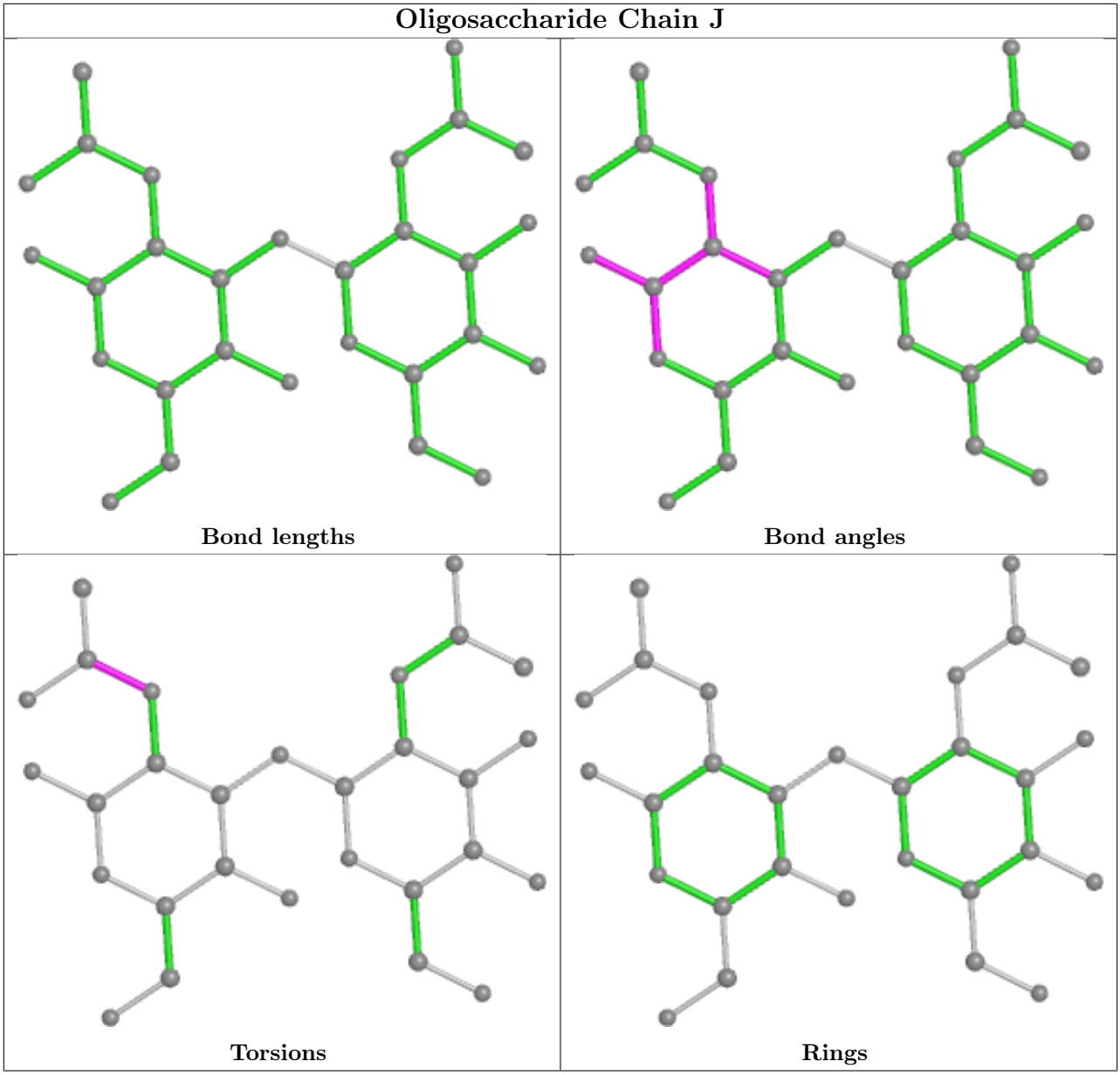
Bond angles



Torsions



Rings



5.6 Ligand geometry (i)

Of 10 ligands modelled in this entry, 2 are monoatomic - leaving 8 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	$\#\|Z\|>2$
10	THR	B	404	-	5,6,7	0.85	0	4,7,9	0.62	0
9	PEG	A	405	-	6,6,6	0.12	0	5,5,5	0.12	0
7	UDP	A	402	6	24,26,26	0.55	0	37,40,40	0.63	1 (2%)
9	PEG	A	404	-	6,6,6	0.09	0	5,5,5	0.09	0
10	THR	A	406	-	5,6,7	1.01	1 (20%)	4,7,9	0.59	0
8	B3P	B	403	-	18,18,18	0.83	0	21,23,23	0.94	1 (4%)
8	B3P	A	403	-	18,18,18	0.97	0	21,23,23	1.37	2 (9%)
7	UDP	B	402	6	24,26,26	0.49	0	37,40,40	0.46	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
10	THR	B	404	-	-	2/6/6/8	-
9	PEG	A	405	-	-	3/4/4/4	-
7	UDP	A	402	6	-	0/16/32/32	0/2/2/2
9	PEG	A	404	-	-	2/4/4/4	-
10	THR	A	406	-	-	2/6/6/8	-
8	B3P	B	403	-	-	2/28/28/28	-
8	B3P	A	403	-	-	2/28/28/28	-
7	UDP	B	402	6	-	4/16/32/32	0/2/2/2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
10	A	406	THR	OXT-C	-2.23	1.23	1.30

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
8	A	403	B3P	O1-C9-C8	-3.21	105.13	111.63
7	A	402	UDP	PA-O3A-PB	2.60	141.75	132.83
8	A	403	B3P	C2-N2-C8	-2.34	112.76	116.08
8	B	403	B3P	C2-N2-C8	-2.16	113.01	116.08

There are no chirality outliers.

All (17) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
7	B	402	UDP	C5'-O5'-PA-O1A
7	B	402	UDP	C5'-O5'-PA-O2A
7	B	402	UDP	C5'-O5'-PA-O3A
10	A	406	THR	C-CA-CB-CG2
9	A	404	PEG	O1-C1-C2-O2
9	A	405	PEG	O1-C1-C2-O2
9	A	405	PEG	O2-C3-C4-O4
8	B	403	B3P	C9-C8-N2-C2
10	A	406	THR	N-CA-CB-CG2
9	A	404	PEG	C1-C2-O2-C3
8	A	403	B3P	C10-C8-N2-C2
10	B	404	THR	OXT-C-CA-CB
8	B	403	B3P	C10-C8-N2-C2
9	A	405	PEG	C4-C3-O2-C2
10	B	404	THR	O-C-CA-CB
7	B	402	UDP	PA-O3A-PB-O3B
8	A	403	B3P	C9-C8-N2-C2

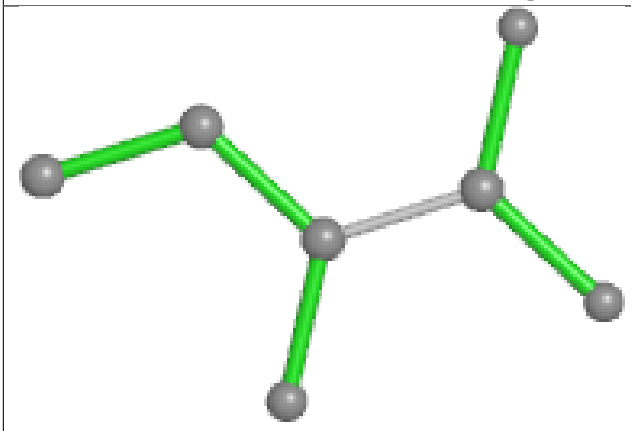
There are no ring outliers.

3 monomers are involved in 3 short contacts:

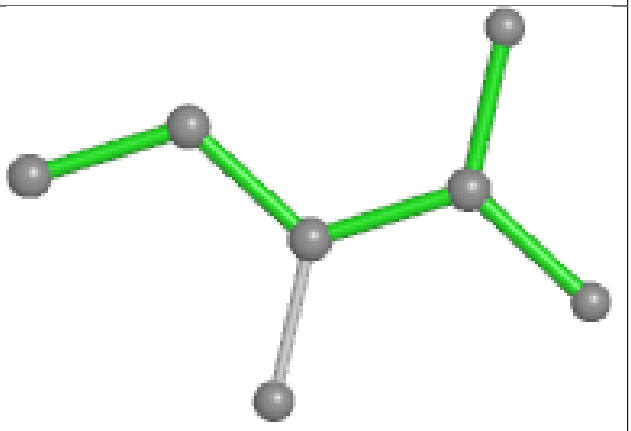
Mol	Chain	Res	Type	Clashes	Symm-Clashes
9	A	405	PEG	1	0
7	A	402	UDP	1	0
7	B	402	UDP	1	0

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 then 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.

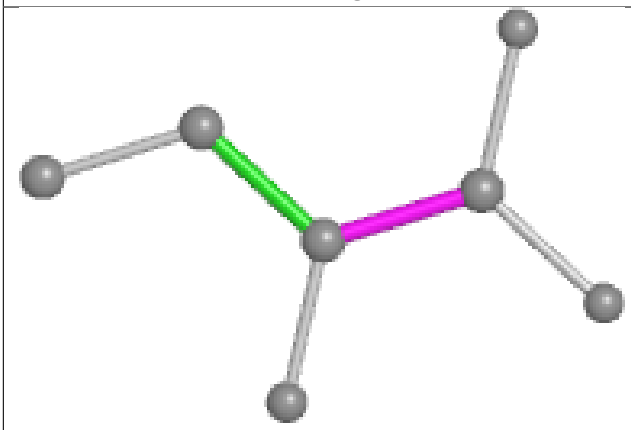
Ligand THR B 404



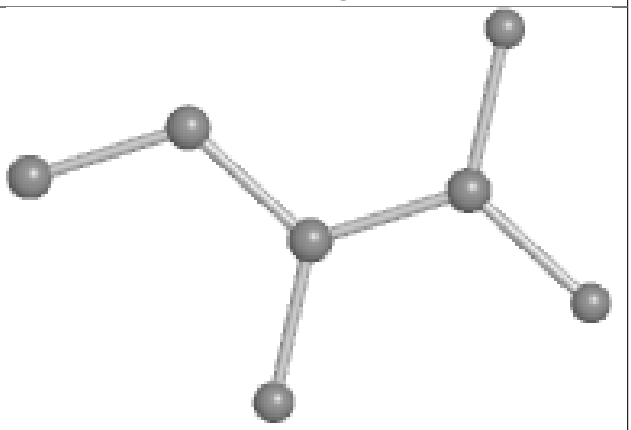
Bond lengths



Bond angles

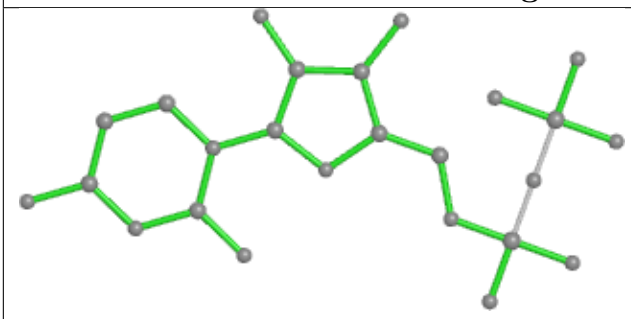


Torsions

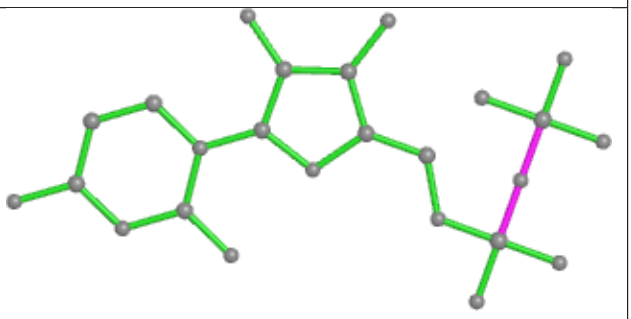


Rings

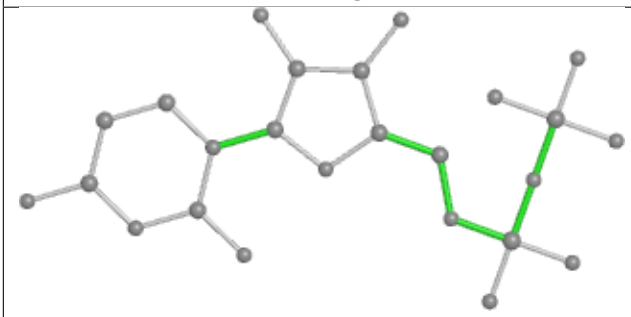
Ligand UDP A 402



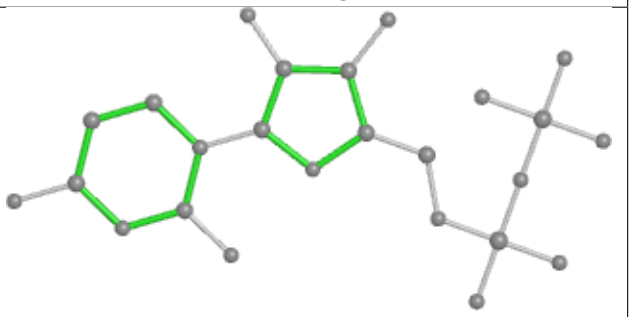
Bond lengths



Bond angles

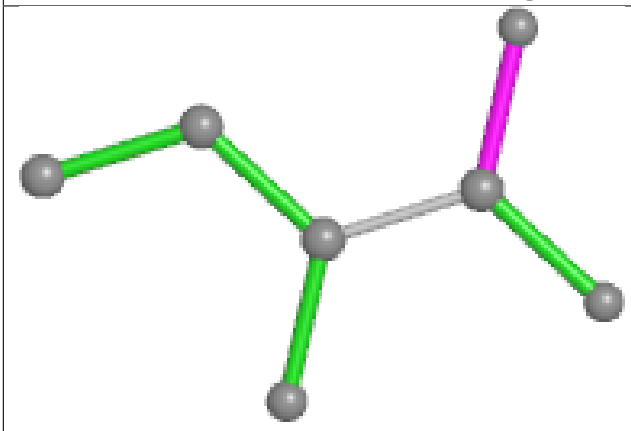


Torsions

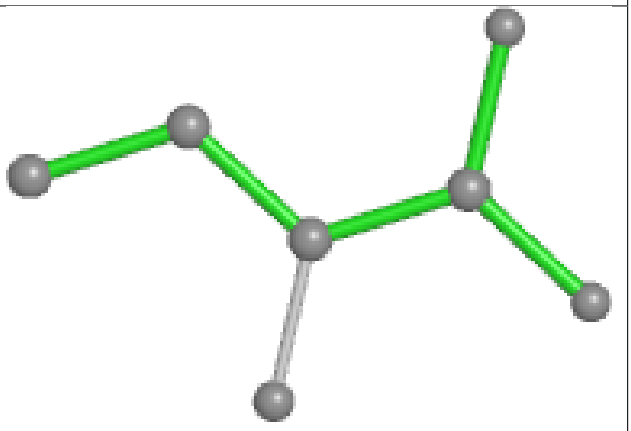


Rings

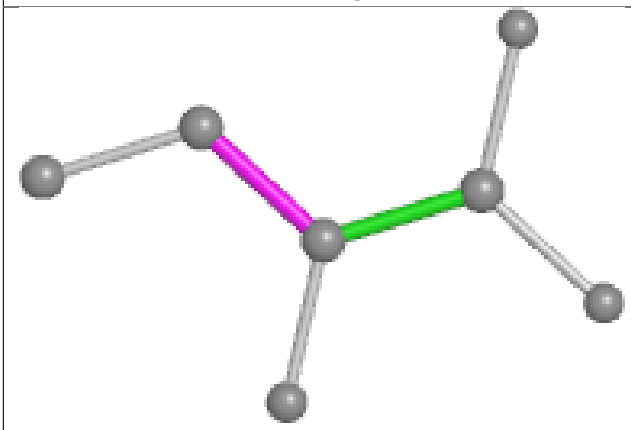
Ligand THR A 406



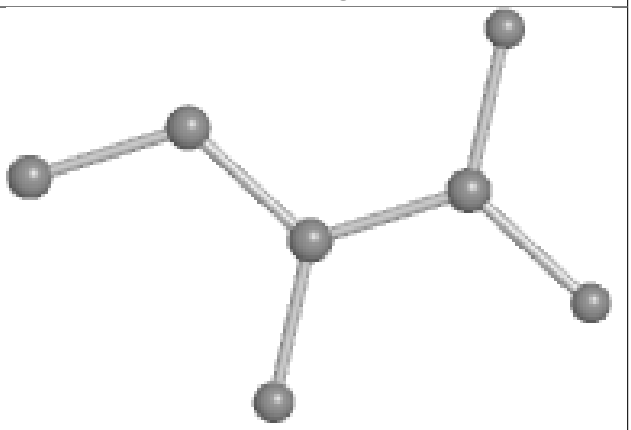
Bond lengths



Bond angles

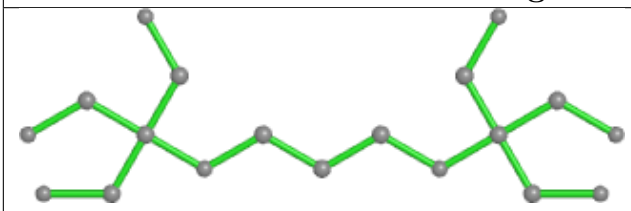


Torsions

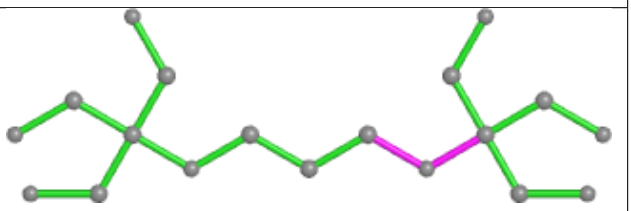


Rings

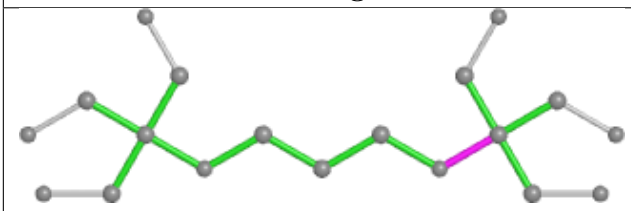
Ligand B3P B 403



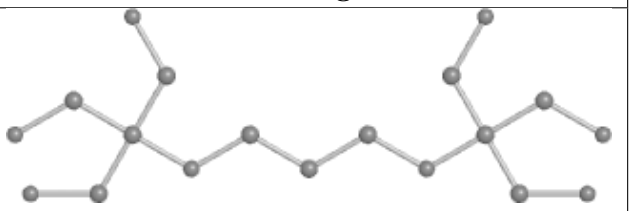
Bond lengths



Bond angles

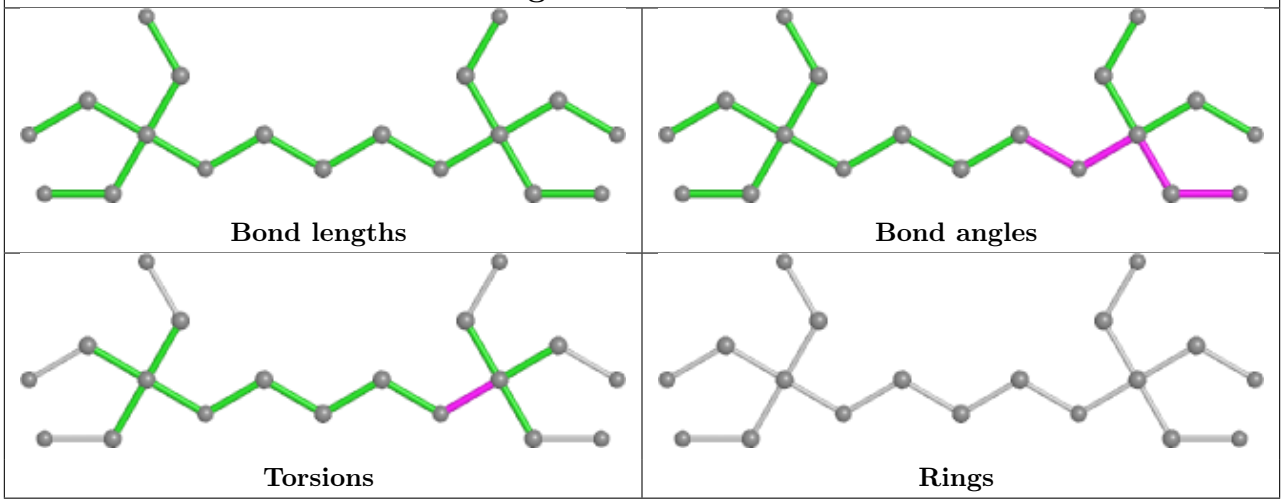


Torsions

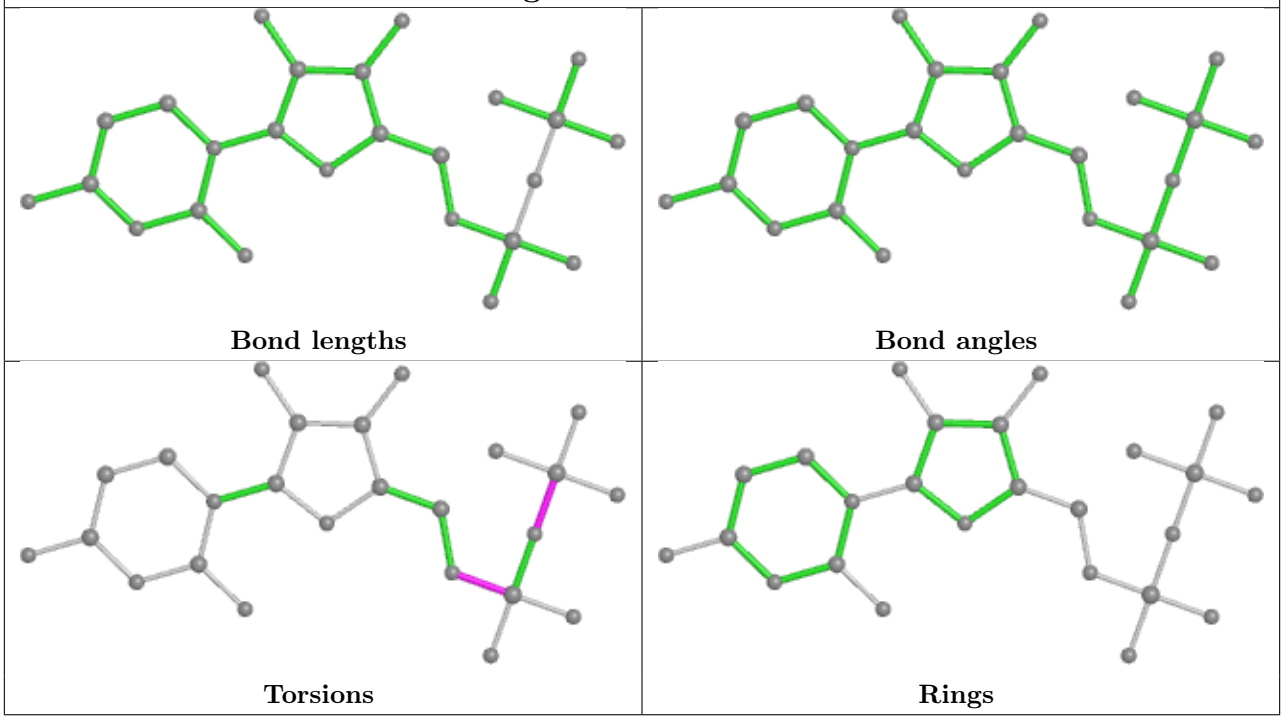


Rings

Ligand B3P A 403



Ligand UDP B 402



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

EDS failed to run properly - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS failed to run properly - this section is therefore empty.

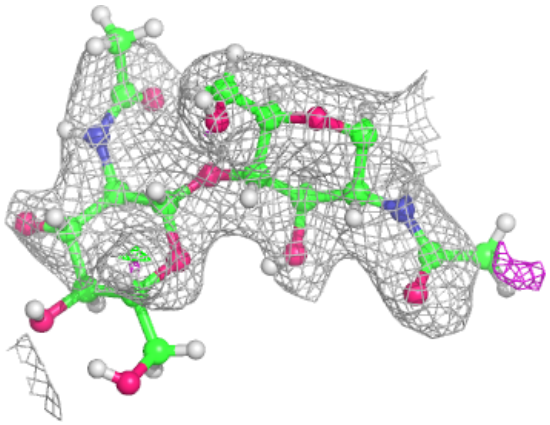
6.3 Carbohydrates

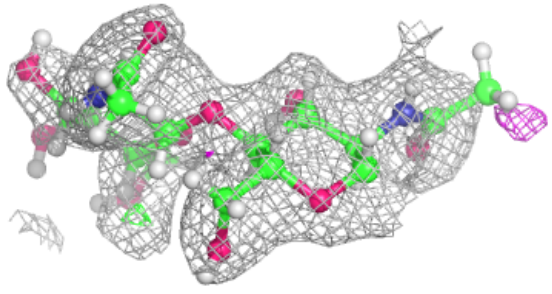
EDS failed to run properly - this section is therefore empty.

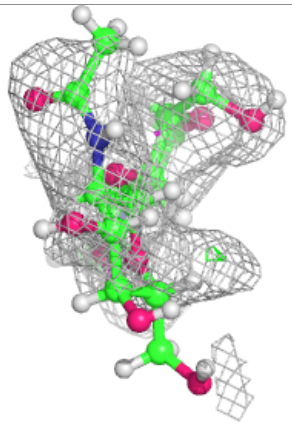
The following is a graphical depiction of the model fit to experimental electron density for oligosaccharide. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around Chain E:

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

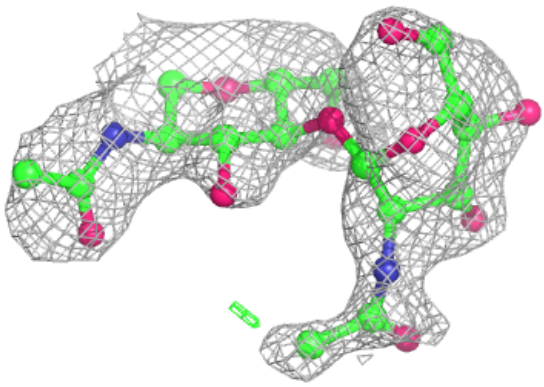


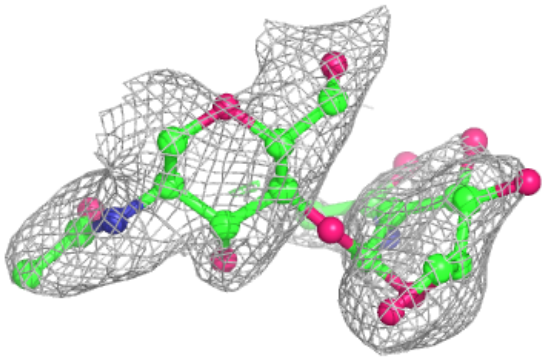


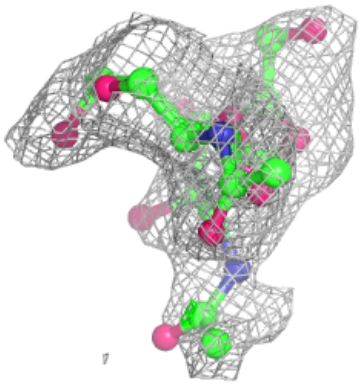


Electron density around Chain G:

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

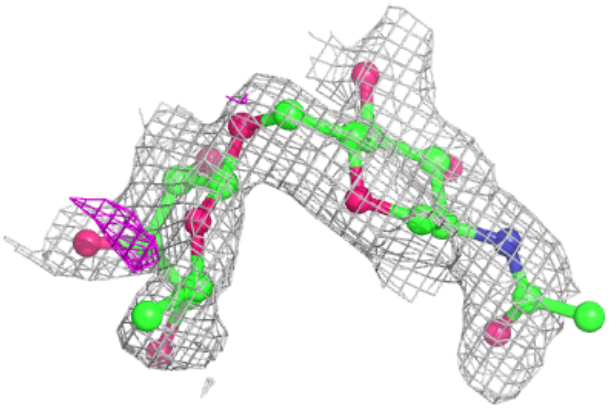


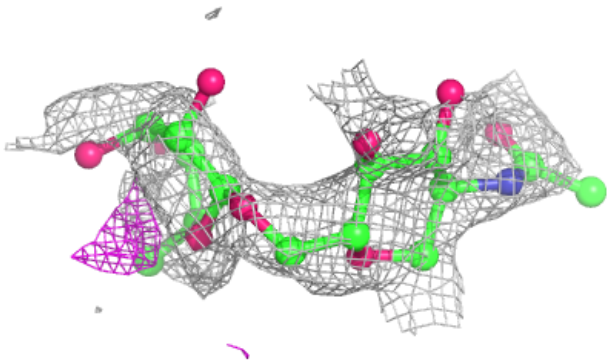


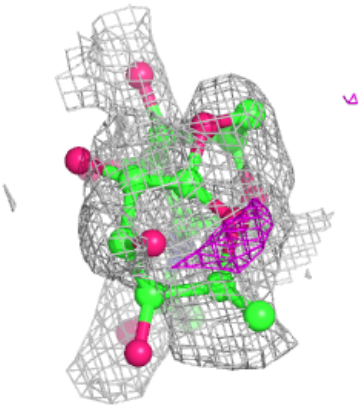


Electron density around Chain F:

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

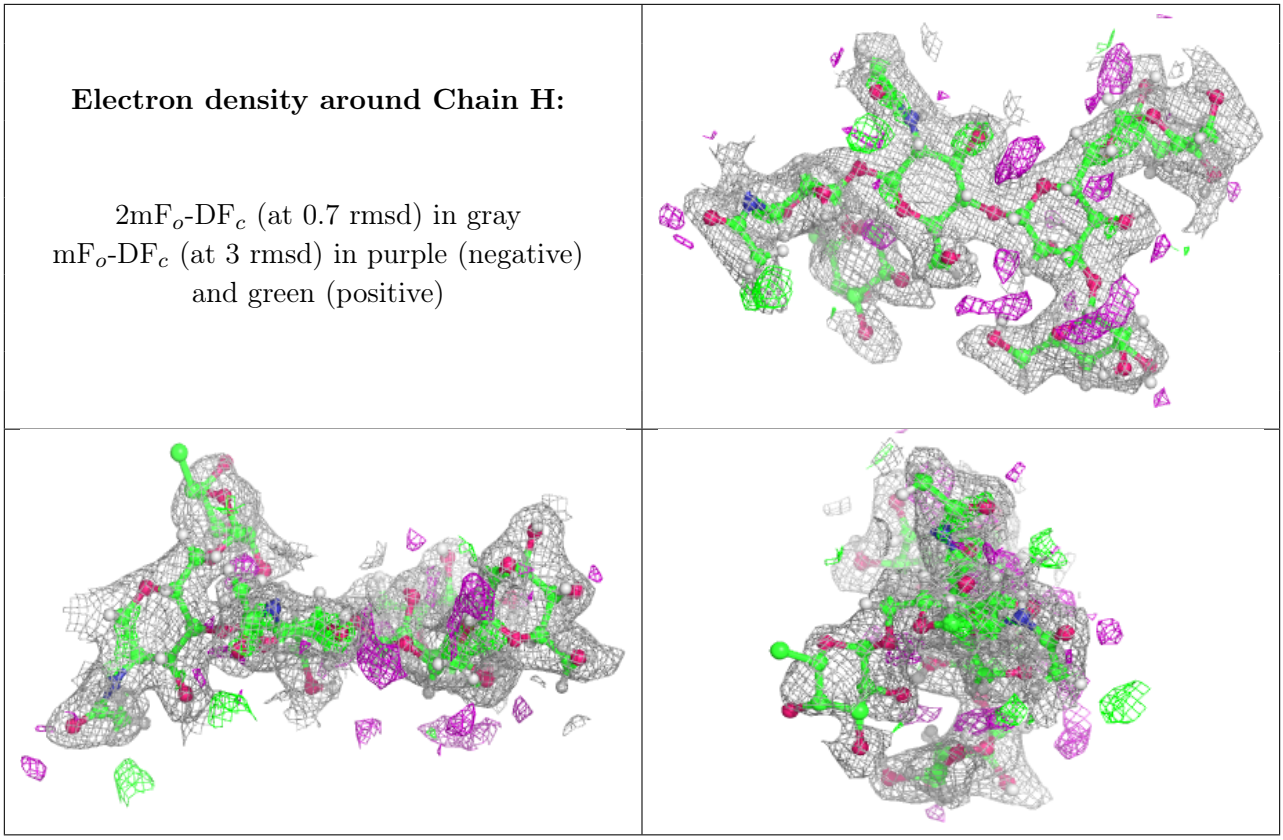






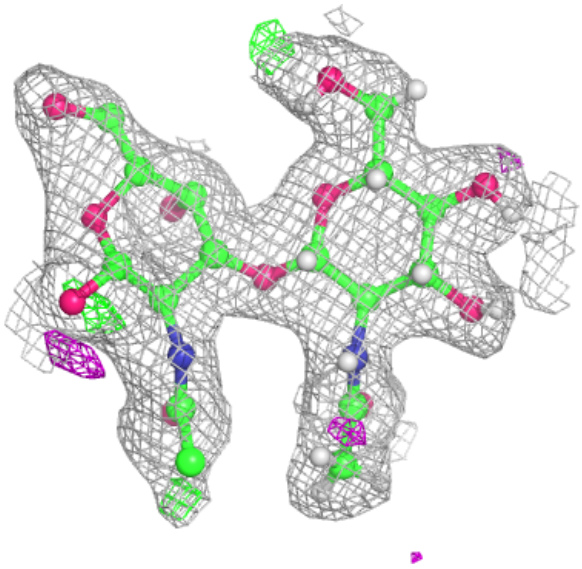
Electron density around Chain H:

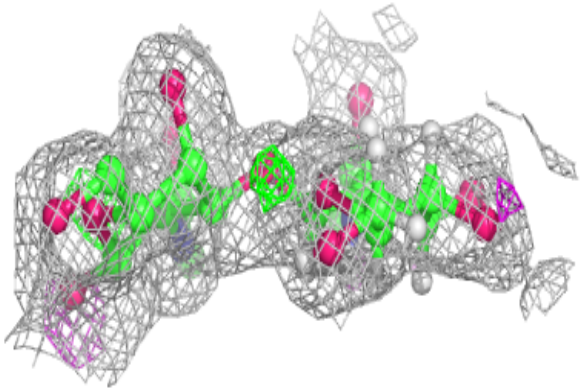
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

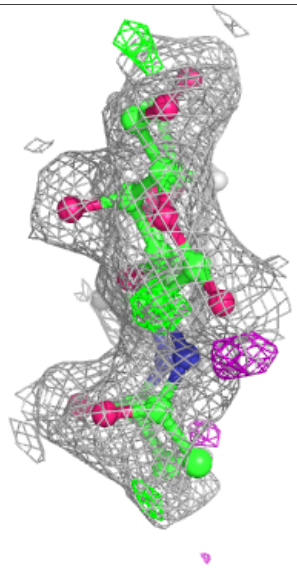


Electron density around Chain I:

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

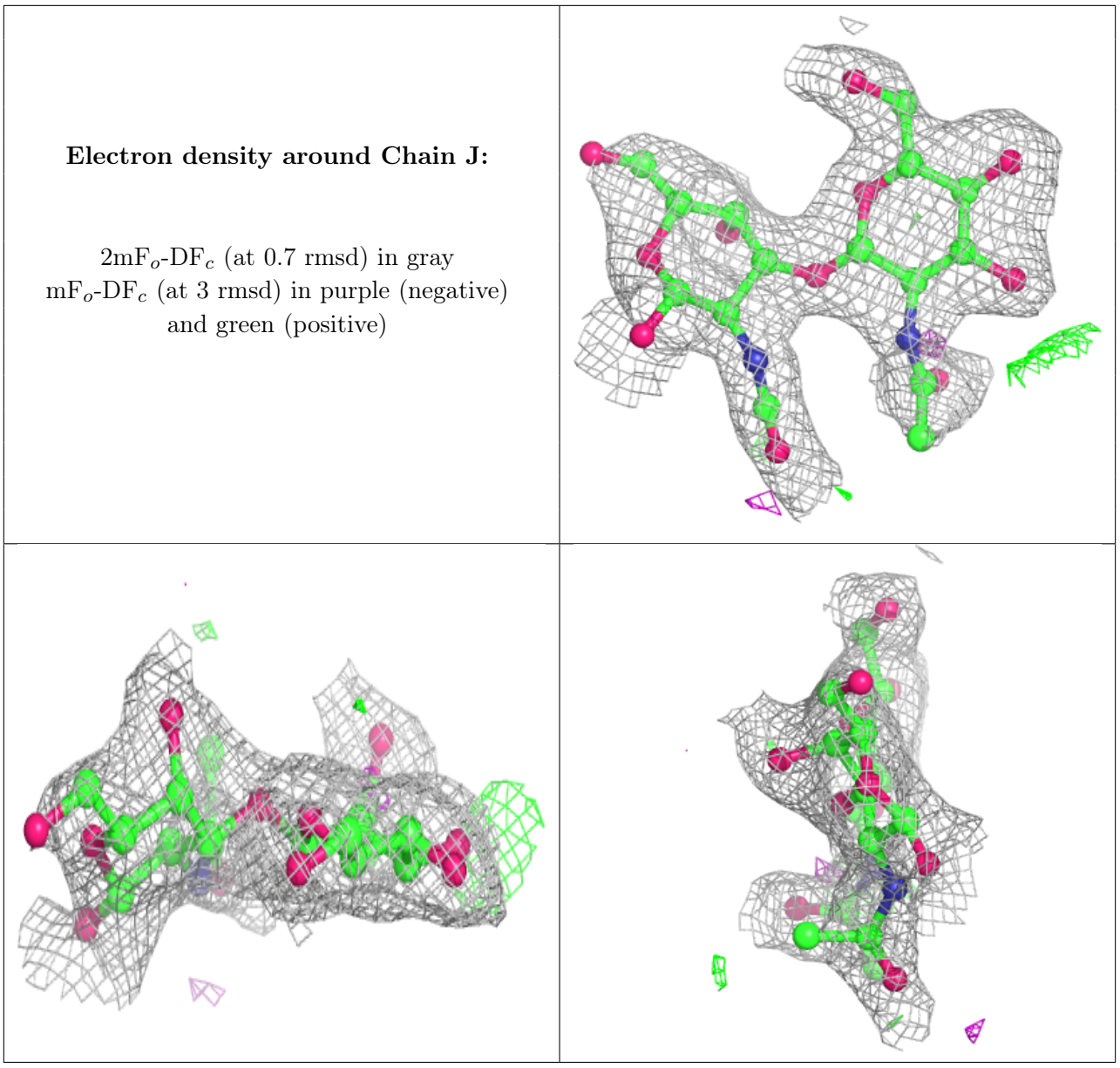






Electron density around Chain J:

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



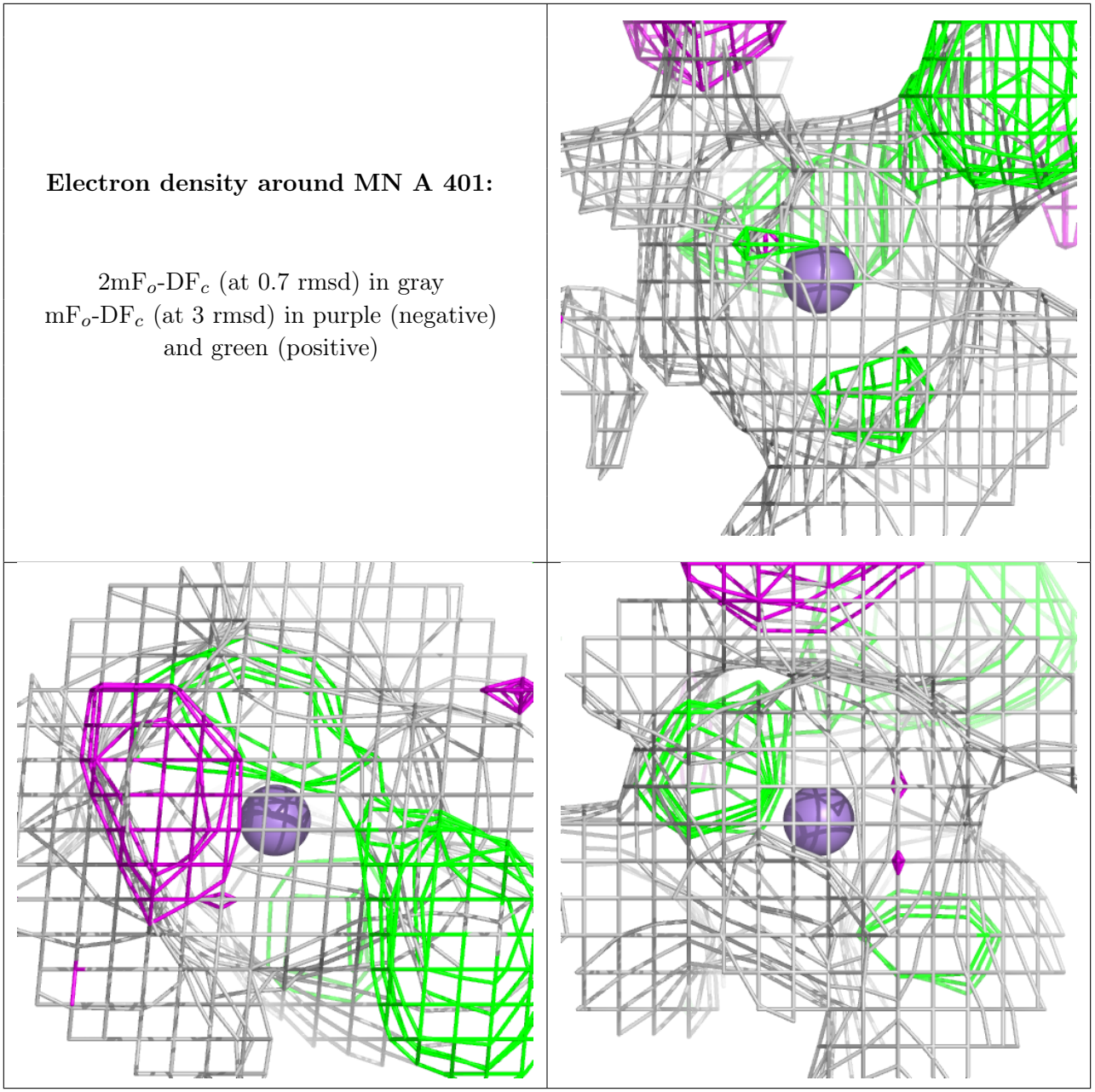
6.4 Ligands (i)

EDS failed to run properly - this section is therefore empty.

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.

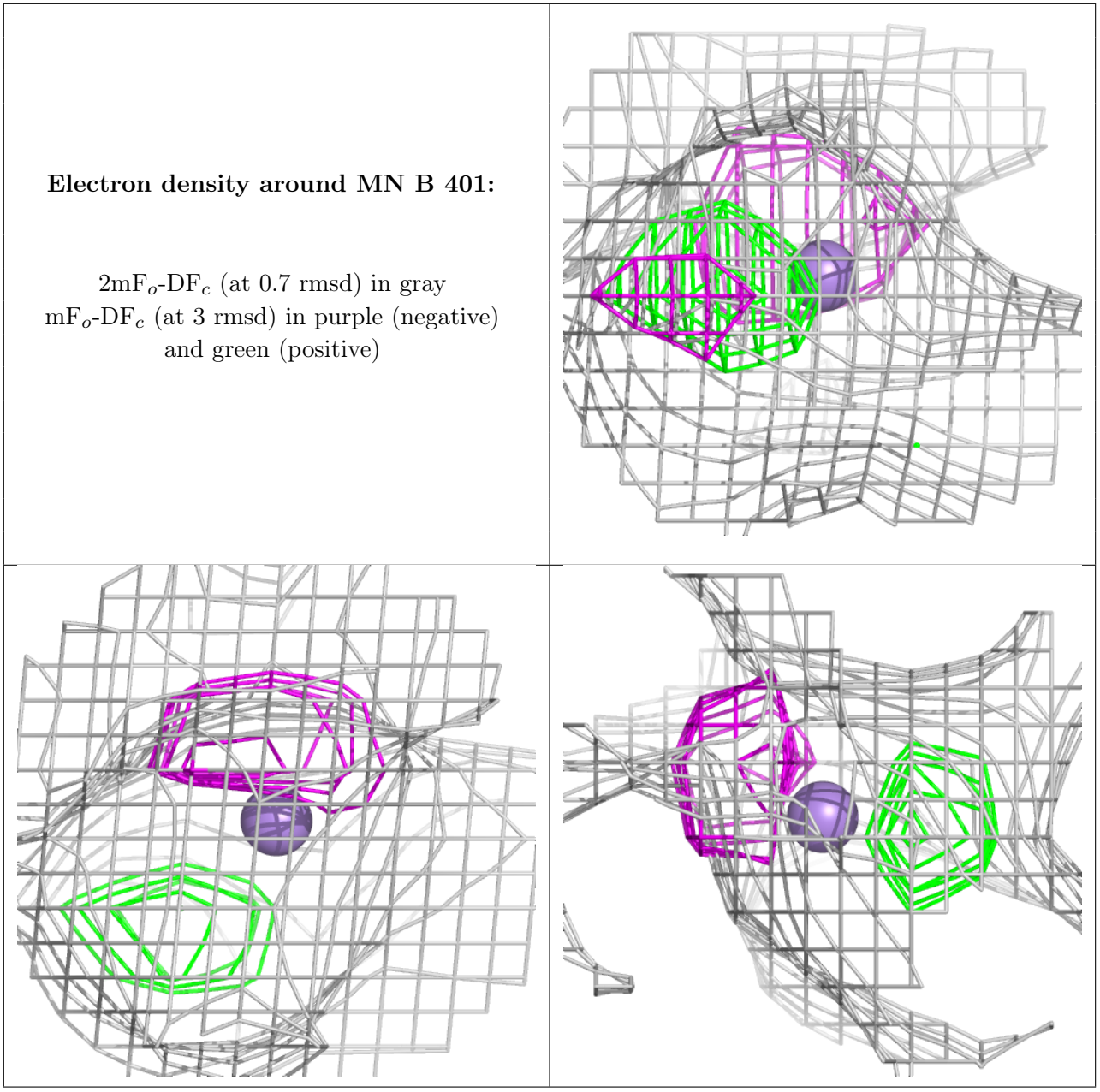
Electron density around MN A 401:

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



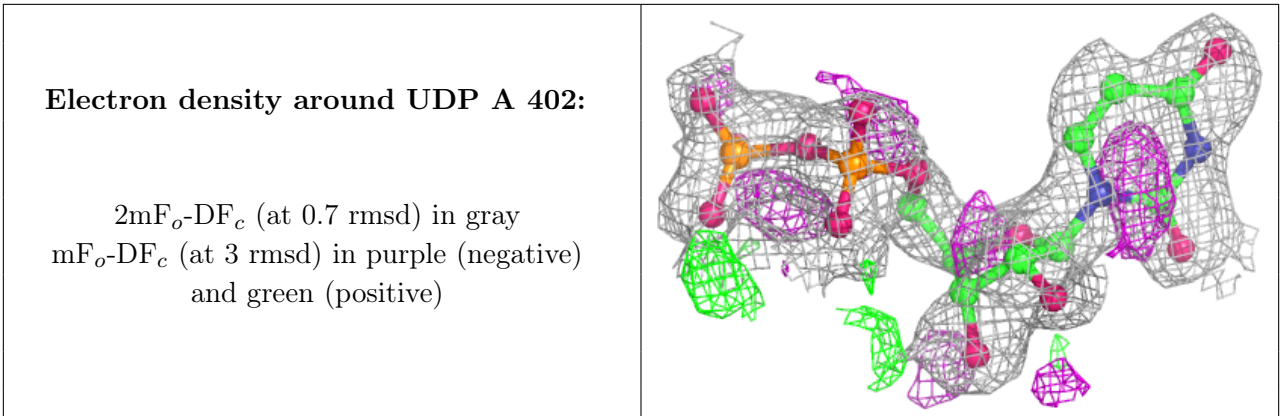
Electron density around MN B 401:

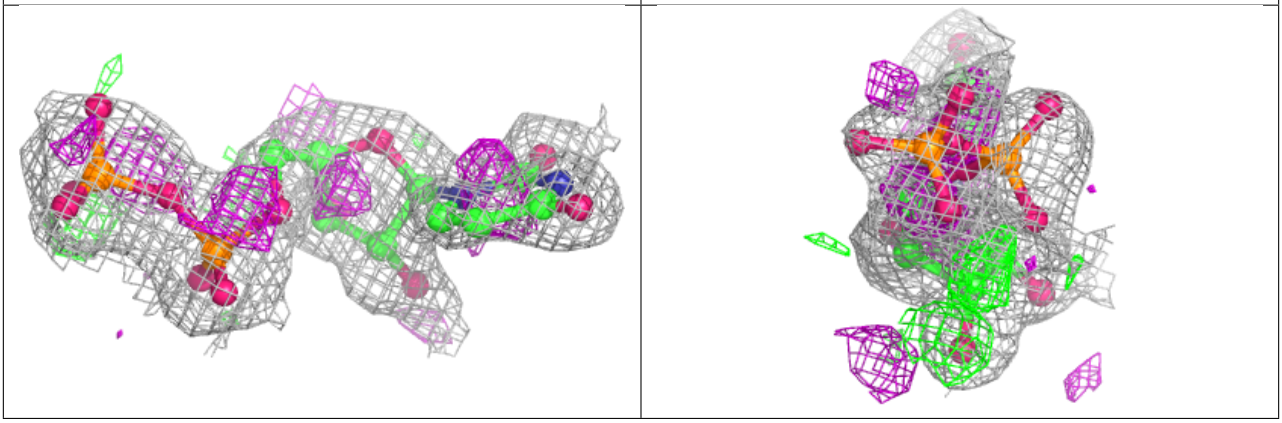
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)



Electron density around UDP A 402:

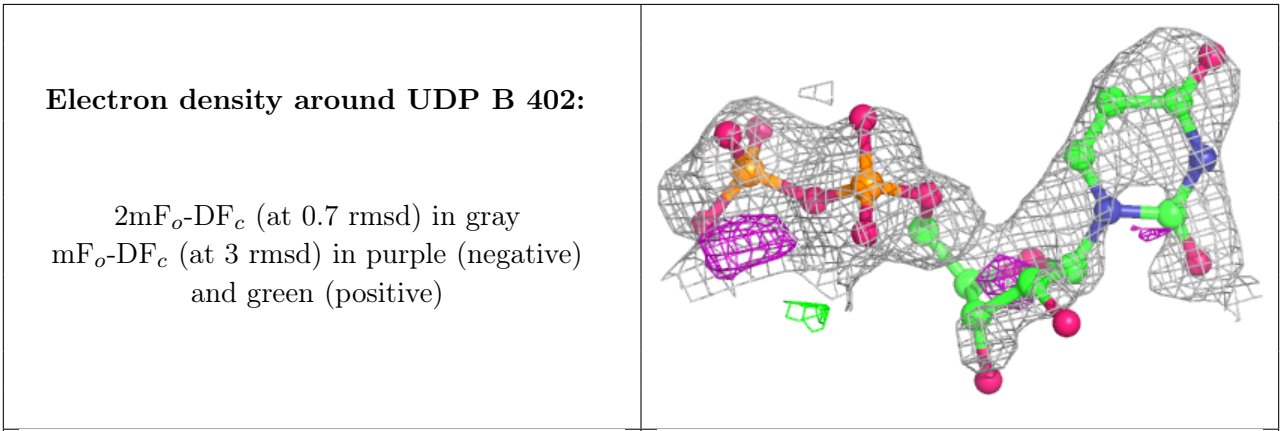
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

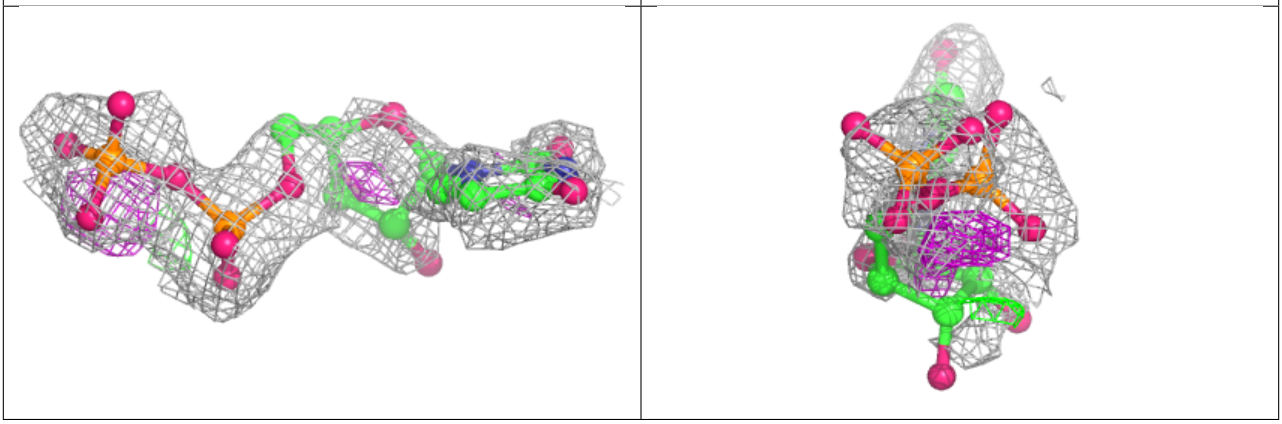




Electron density around UDP B 402:

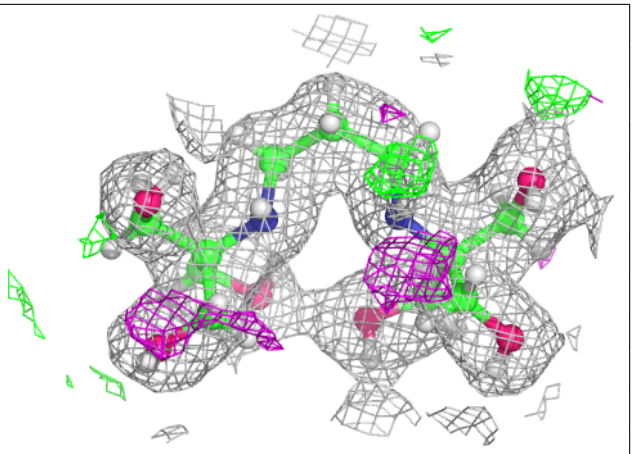
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

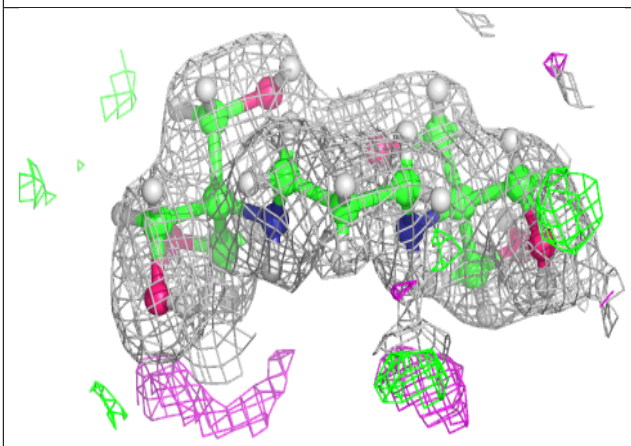


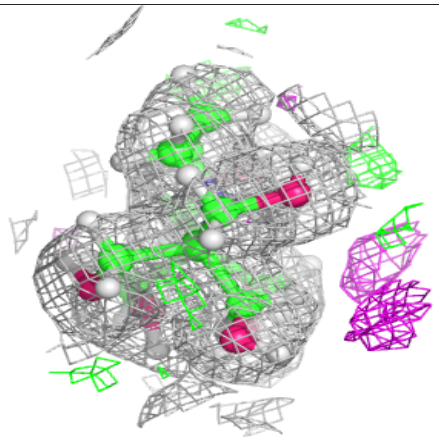


Electron density around B3P A 403:

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

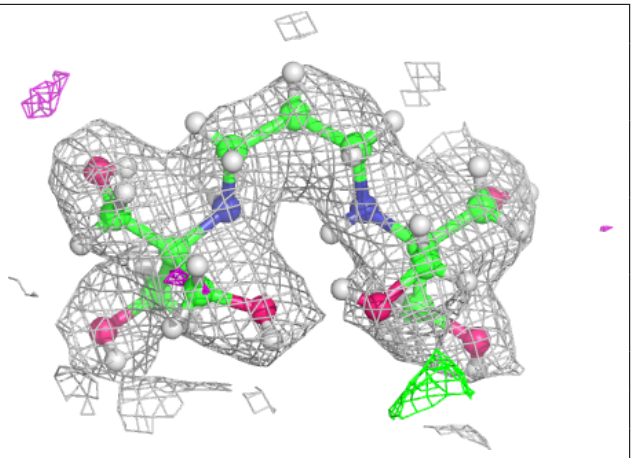


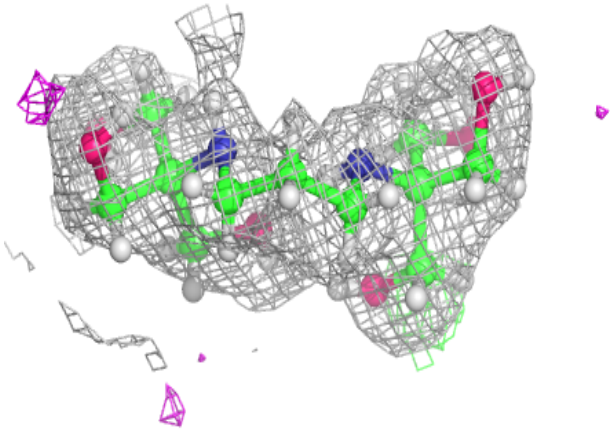


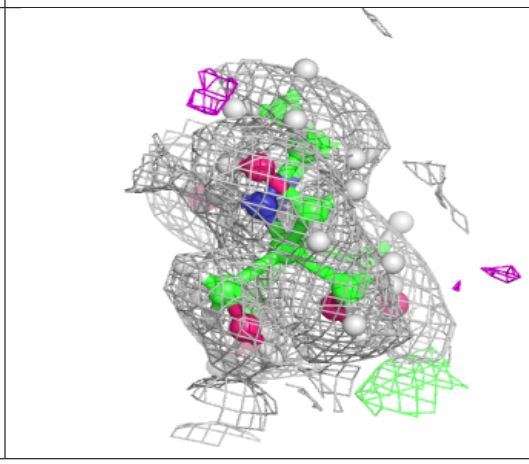


Electron density around B3P B 403:

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

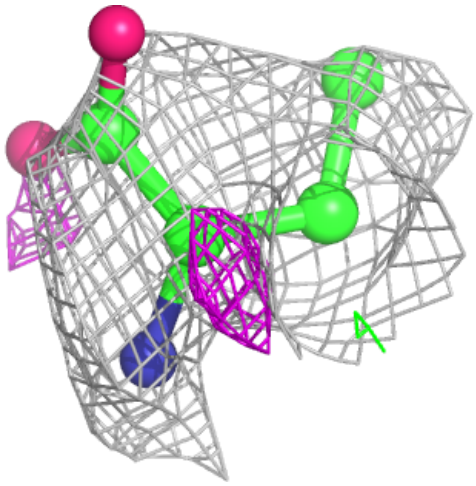


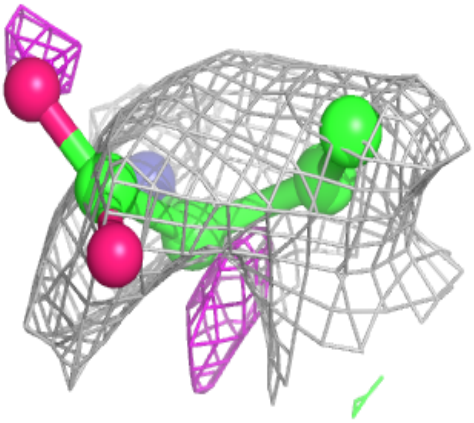


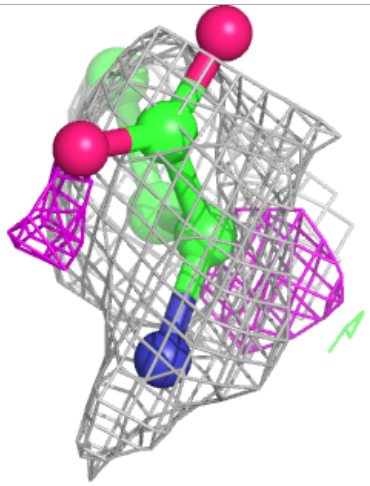


Electron density around THR A 406:

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

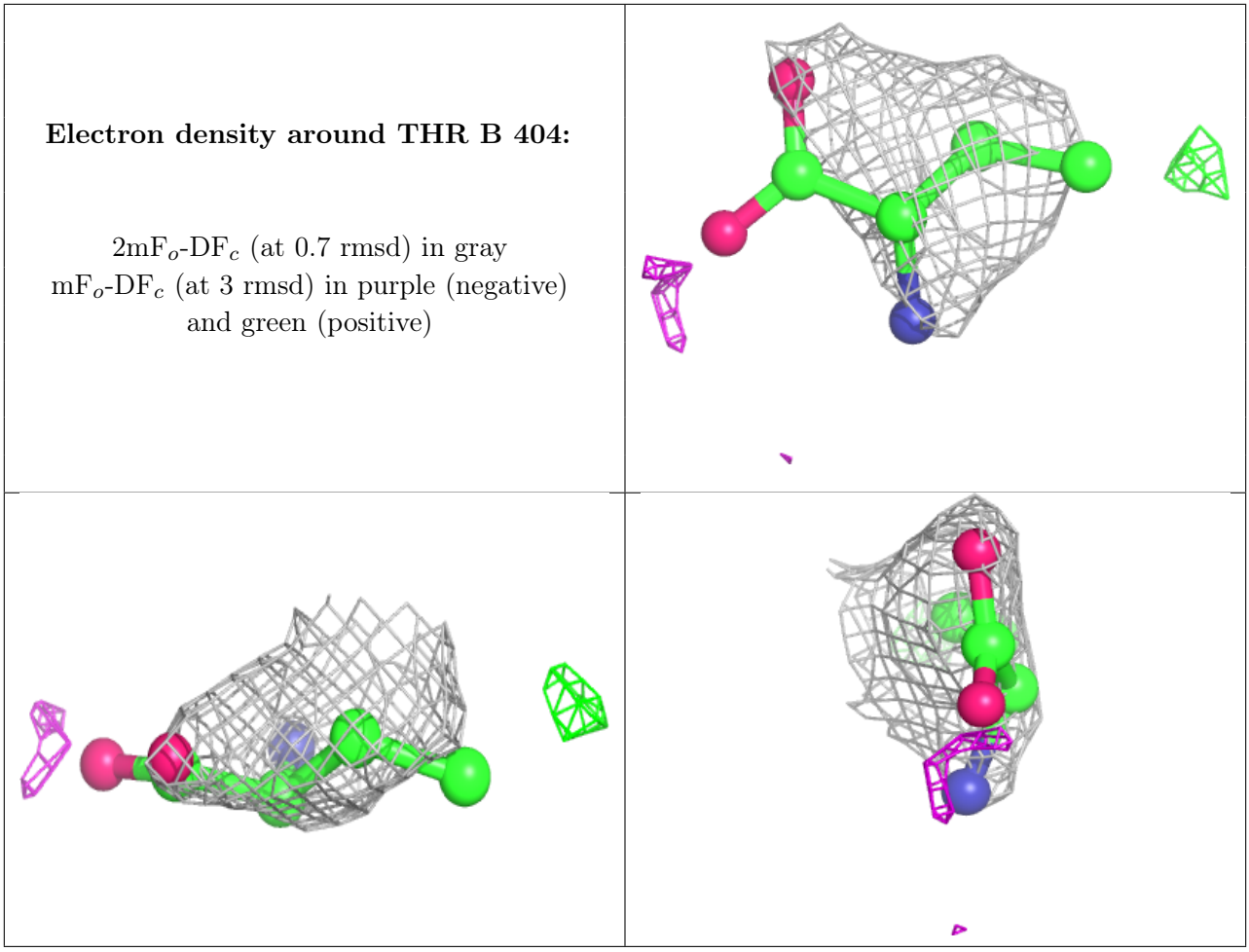






Electron density around THR B 404:

$2mF_o$-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)

EDS failed to run properly - this section is therefore empty.