Full wwPDB X-ray Structure Validation Report ⓘ

Mar 4, 2026 – 11:02 PM UTC

PDB ID	:	6VBG / pdb_00006vbg
Title	:	Lactose permease complex with thiodigalactoside and nanobody 9043
Authors	:	Kumar, H.; Stroud, R.M.; Kaback, H.R.; Finer-Moore, J.; Smirnova, I.; Kasho, V.; Pardon, E.; Steyart, J.
Deposited on	:	2019-12-18
Resolution	:	2.80 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:

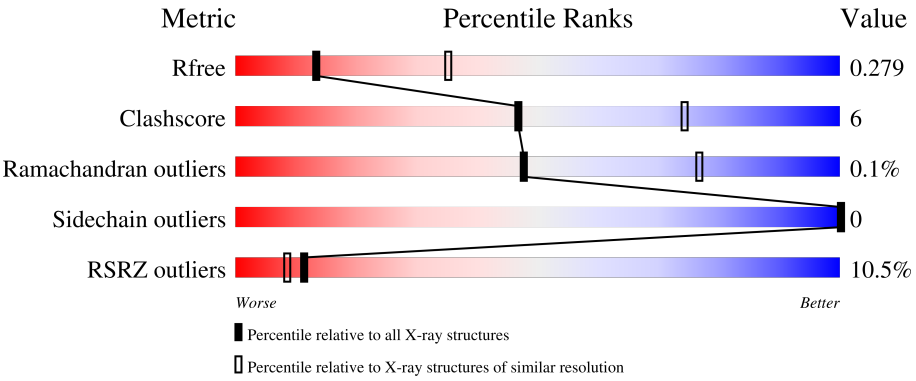
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal 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 (i)

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

The reported resolution of this entry is 2.80 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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% 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	417	7% 81% 14% 5%
1	B	417	11% 83% 12% 5%
2	C	121	15% 79% 21%
2	D	121	13% 84% 12% .
3	E	2	100%

Continued on next page...

Continued from previous page...

Mol	Chain	Length	Quality of chain
3	F	2	

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 16923 atoms, of which 8498 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 Galactoside permease.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	396	Total	C	H	N	O	S	0	0	0
			6365	2155	3201	478	509	22			
1	B	397	Total	C	H	N	O	S	0	0	0
			6379	2159	3207	479	512	22			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	46	TRP	GLY	engineered mutation	UNP C6FW78
A	262	TRP	GLY	engineered mutation	UNP C6FW78
B	46	TRP	GLY	engineered mutation	UNP C6FW78
B	262	TRP	GLY	engineered mutation	UNP C6FW78

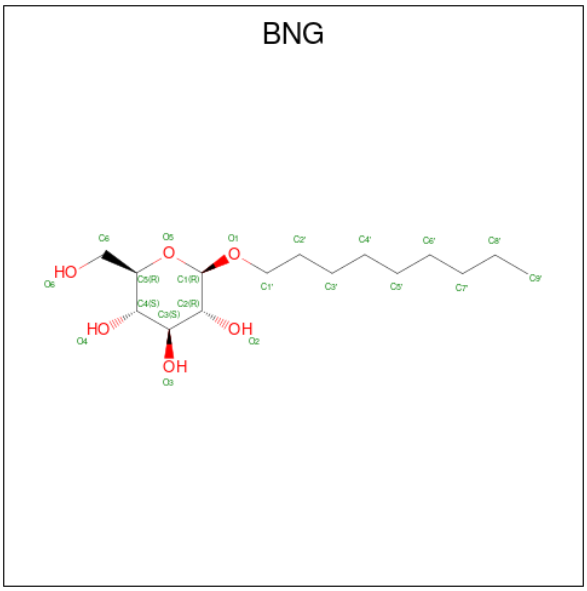
- Molecule 2 is a protein called nanobody 9043.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	C	121	Total	C	H	N	O	S	0	0	0
			1848	587	902	175	180	4			
2	D	117	Total	C	H	N	O	S	0	0	0
			1780	563	874	163	176	4			

- Molecule 3 is an oligosaccharide called beta-D-galactopyranose-(1-1)-1-thio-beta-D-galactopyranose.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	E	2	Total	C	H	O	S	0	0	0
			45	12	22	10	1			
3	F	2	Total	C	H	O	S	0	0	0
			45	12	22	10	1			

- Molecule 4 is nonyl beta-D-glucopyranoside (CCD ID: BNG) (formula: $C_{15}H_{30}O_6$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C H O 51 15 30 6	0	0
4	A	1	Total C H O 51 15 30 6	0	0
4	C	1	Total C H O 51 15 30 6	0	0
4	C	1	Total C H O 51 15 30 6	0	0
4	B	1	Total C H O 51 15 30 6	0	0
4	B	1	Total C H O 51 15 30 6	0	0
4	B	1	Total C H O 51 15 30 6	0	0
4	B	1	Total C H O 51 15 30 6	0	0
4	D	1	Total C H O 51 15 30 6	0	0

- Molecule 5 is water.

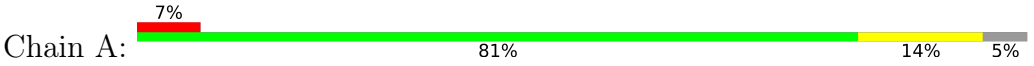
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total O 1 1	0	0
5	B	1	Total O 1 1	0	0

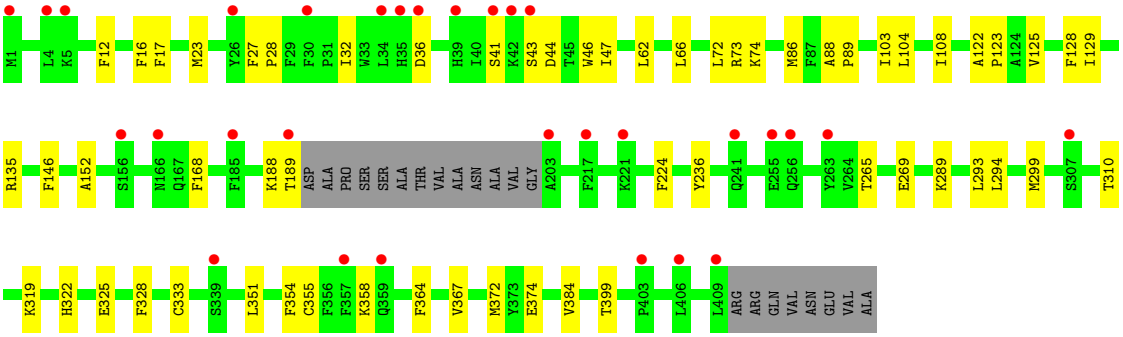
3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

• Molecule 1: Galactoside permease

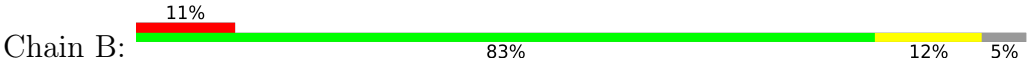
Chain A:

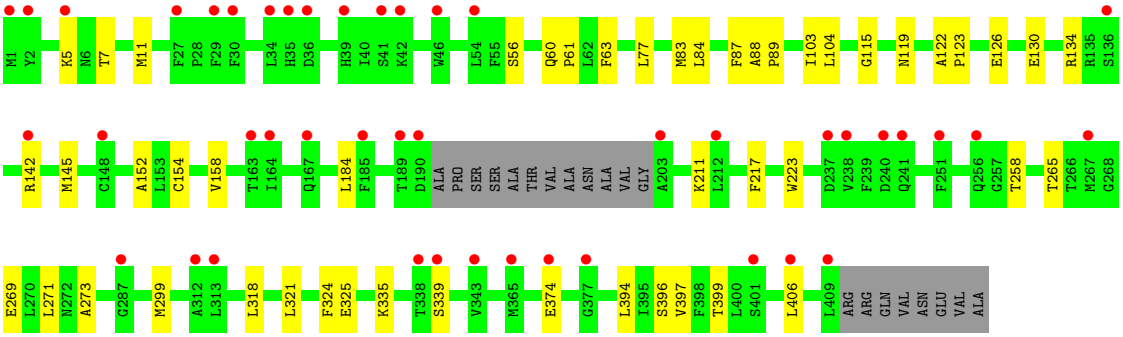




• Molecule 1: Galactoside permease

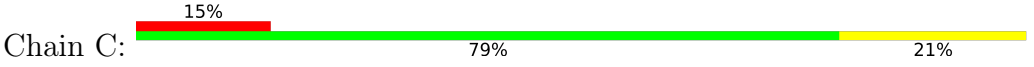
Chain B:

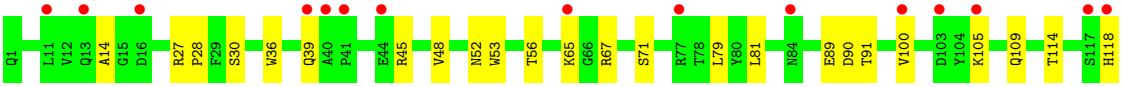




• Molecule 2: nanobody 9043

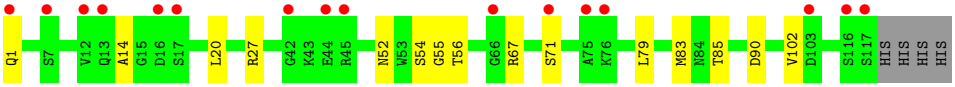
Chain C:





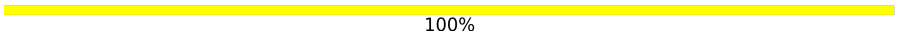
• Molecule 2: nanobody 9043

Chain D:



• Molecule 3: beta-D-galactopyranose-(1-1)-1-thio-beta-D-galactopyranose

Chain E:



• Molecule 3: beta-D-galactopyranose-(1-1)-1-thio-beta-D-galactopyranose

Chain F:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 65	Depositor
Cell constants a, b, c, α, β, γ	151.27Å 151.27Å 182.48Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	39.06 – 2.80 39.06 – 2.80	Depositor EDS
% Data completeness (in resolution range)	96.9 (39.06-2.80) 81.8 (39.06-2.80)	Depositor EDS
R_{merge}	0.22	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	0.42 (at 2.81Å)	Xtriage
Refinement program	PHENIX 1.15.2_3472, PHENIX 1.15.2_3472	Depositor
R, R_{free}	0.239 , 0.275 0.243 , 0.279	Depositor DCC
R_{free} test set	2002 reflections (3.44%)	wwPDB-VP
Wilson B-factor (Å^2)	49.7	Xtriage
Anisotropy	0.192	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 28.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	0.056 for h,-h-k,-l	Xtriage
F_o,F_c correlation	0.88	EDS
Total number of atoms	16923	wwPDB-VP
Average B, all atoms (Å^2)	81.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.70% 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: GAL, YIO, BNG

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	0.14	0/3263	0.35	0/4421
1	B	0.16	0/3271	0.36	0/4432
2	C	0.21	0/968	0.41	0/1310
2	D	0.16	0/924	0.40	0/1250
All	All	0.16	0/8426	0.37	0/11413

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3164	3201	3204	42	1
1	B	3172	3207	3208	30	0
2	C	946	902	902	19	1
2	D	906	874	874	10	0
3	E	23	22	21	0	0
3	F	23	22	21	1	0
4	A	42	60	60	2	0
4	B	84	120	120	1	0
4	C	42	60	60	2	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	D	21	30	30	0	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
All	All	8425	8498	8500	96	1

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 6.

All (96) 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)
2:C:27:ARG:NH2	4:C:502:BNG:O2	2.02	0.92
1:A:355:CYS:SG	4:A:701:BNG:O3	2.38	0.79
1:B:374:GLU:OE2	2:D:27:ARG:NH1	2.16	0.78
2:D:67:ARG:NH2	2:D:90:ASP:OD2	2.27	0.68
2:C:67:ARG:NH1	2:C:90:ASP:OD2	2.33	0.61
2:D:52:ASN:ND2	2:D:56:THR:OG1	2.35	0.60
1:A:72:LEU:O	1:A:189:THR:HG21	2.02	0.59
2:D:52:ASN:ND2	2:D:54:SER:OG	2.35	0.59
2:C:52:ASN:ND2	2:C:56:THR:OG1	2.35	0.58
1:B:217:PHE:O	1:B:223:TRP:NE1	2.36	0.57
1:B:299:MET:HG3	1:B:325:GLU:HG3	1.85	0.57
1:B:406:LEU:H	1:B:406:LEU:HD23	1.69	0.57
1:A:73:ARG:O	1:A:74:LYS:HG2	2.05	0.57
1:A:88:ALA:HB3	1:A:89:PRO:HD3	1.85	0.56
1:A:86:MET:HE1	1:B:83:MET:SD	2.45	0.56
1:A:299:MET:HG3	1:A:325:GLU:HG3	1.88	0.56
2:C:91:THR:HG23	2:C:114:THR:HA	1.88	0.56
1:B:126:GLU:OE2	3:F:1:YIO:O2	2.24	0.56
1:B:394:LEU:HA	1:B:397:VAL:HG23	1.88	0.55
1:A:41:SER:OG	1:A:43:SER:HB2	2.08	0.54
1:B:88:ALA:HB3	1:B:89:PRO:HD3	1.88	0.54
2:C:100:VAL:HG21	2:C:105:LYS:HD3	1.88	0.53
1:B:152:ALA:HB2	1:B:269:GLU:HB2	1.90	0.53
2:C:118:HIS:O	2:C:119:HIS:HB2	2.09	0.52
1:A:41:SER:OG	1:A:43:SER:N	2.43	0.52
1:A:32:ILE:O	1:A:36:ASP:HB2	2.11	0.51
1:B:60:GLN:N	1:B:61:PRO:HD2	2.25	0.51
2:D:52:ASN:OD1	2:D:55:GLY:N	2.43	0.51
1:B:396:SER:HA	1:B:399:THR:OG1	2.10	0.51
1:A:122:ALA:HB3	1:A:123:PRO:HD3	1.93	0.50

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:41:SER:HG	1:A:43:SER:HB2	1.76	0.50
2:D:71:SER:O	2:D:79:LEU:HD12	2.12	0.49
1:A:103:ILE:HG13	1:A:104:LEU:N	2.29	0.48
1:A:236:TYR:HH	1:A:322:HIS:HD1	1.61	0.48
1:A:46:TRP:CZ2	4:C:502:BNG:H5'2	2.49	0.48
2:C:36:TRP:HB2	2:C:48:VAL:HG23	1.96	0.48
1:B:318:LEU:HD23	1:B:321:LEU:HD12	1.96	0.48
2:D:20:LEU:HG	2:D:83:MET:HE2	1.96	0.48
2:C:65:LYS:O	2:C:65:LYS:HD3	2.14	0.47
2:C:89:GLU:H	2:C:89:GLU:CD	2.21	0.47
1:A:152:ALA:HB2	1:A:269:GLU:HB2	1.95	0.47
1:A:364:PHE:O	1:A:367:VAL:HG22	2.14	0.47
1:A:374:GLU:O	2:C:28:PRO:HD3	2.15	0.47
1:A:44:ASP:HA	1:A:47:ILE:HG12	1.96	0.47
2:C:39:GLN:OE1	2:C:45:ARG:N	2.48	0.46
1:A:168:PHE:HD1	4:B:801:BNG:H4'2	1.80	0.46
1:B:145:MET:HG3	1:B:273:ALA:HB1	1.98	0.45
1:A:44:ASP:CG	1:A:103:ILE:HD13	2.41	0.45
2:D:1:GLN:HB3	2:D:27:ARG:HE	1.81	0.45
1:B:115:GLY:HA2	1:B:119:ASN:HB2	1.98	0.45
1:A:41:SER:HB3	1:A:44:ASP:OD2	2.16	0.45
1:B:60:GLN:HA	1:B:63:PHE:HB2	1.99	0.45
2:C:36:TRP:NE1	2:C:81:LEU:HB2	2.32	0.45
2:C:39:GLN:OE1	2:C:45:ARG:CA	2.65	0.45
1:B:56:SER:O	1:B:60:GLN:HG2	2.17	0.44
1:A:16:PHE:CE2	1:A:129:ILE:HG21	2.52	0.44
1:A:372:MET:HE1	1:A:384:VAL:HB	1.98	0.44
1:B:5:LYS:O	1:B:5:LYS:HG3	2.18	0.44
2:C:14:ALA:HB3	2:C:120:HIS:HB3	2.00	0.44
1:B:335:LYS:O	1:B:339:SER:OG	2.21	0.44
1:A:188:LYS:HD3	1:A:188:LYS:HA	1.82	0.44
1:A:74:LYS:O	1:A:74:LYS:HG3	2.17	0.44
1:B:103:ILE:HG13	1:B:104:LEU:N	2.33	0.44
1:B:265:THR:O	1:B:269:GLU:HG2	2.17	0.44
1:A:27:PHE:HB3	1:A:28:PRO:HD3	2.00	0.43
1:B:122:ALA:HB3	1:B:123:PRO:HD3	2.00	0.43
1:A:62:LEU:O	1:A:66:LEU:HG	2.18	0.43
1:A:224:PHE:HB3	1:A:399:THR:HG22	2.01	0.43
1:B:7:THR:O	1:B:11:MET:HG2	2.19	0.43
1:B:211:LYS:O	1:B:211:LYS:HD3	2.19	0.43
1:A:12:PHE:HB3	1:A:129:ILE:HD12	2.01	0.42

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:C:105:LYS:O	2:C:105:LYS:HG2	2.20	0.42
1:B:77:LEU:HB3	1:B:184:LEU:HD21	2.01	0.42
1:A:265:THR:HG22	1:A:319:LYS:HE3	2.02	0.42
1:B:142:ARG:HA	1:B:145:MET:HE3	2.02	0.42
1:A:294:LEU:HD23	1:A:328:PHE:CD1	2.54	0.42
1:A:333:CYS:HB2	1:A:354:PHE:CZ	2.55	0.42
1:B:84:LEU:O	1:B:87:PHE:HB2	2.19	0.42
1:A:74:LYS:HB3	1:A:128:PHE:CZ	2.55	0.42
1:A:289:LYS:O	1:A:293:LEU:HG	2.20	0.42
1:B:130:GLU:OE2	1:B:134:ARG:NH1	2.53	0.41
1:B:154:CYS:O	1:B:158:VAL:HG23	2.19	0.41
1:A:17:PHE:HB2	1:A:146:PHE:HB3	2.02	0.41
1:A:310:THR:O	2:C:56:THR:HG21	2.21	0.41
1:A:41:SER:HG	1:A:43:SER:N	2.19	0.41
1:A:104:LEU:O	1:A:108:ILE:HD12	2.20	0.41
1:A:351:LEU:HA	1:A:355:CYS:SG	2.60	0.41
2:C:105:LYS:O	2:C:105:LYS:CG	2.68	0.41
1:B:258:THR:HG21	2:D:102:VAL:HG21	2.03	0.41
1:A:125:VAL:O	1:A:129:ILE:HG12	2.20	0.41
2:D:85:THR:HG22	2:D:85:THR:O	2.21	0.41
1:B:271:LEU:HD21	1:B:324:PHE:CE1	2.56	0.40
1:A:23:MET:CE	1:A:122:ALA:HB2	2.52	0.40
1:A:358:LYS:HE3	4:A:701:BNG:H5	2.04	0.40
2:C:30:SER:O	2:C:53:TRP:HB2	2.21	0.40
2:C:71:SER:O	2:C:79:LEU:HD22	2.22	0.40

All (1) 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)
1:A:135:ARG:HH21	2:C:109:GLN:O[6_654]	1.55	0.05

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	392/417 (94%)	377 (96%)	15 (4%)	0	100	100
1	B	393/417 (94%)	377 (96%)	16 (4%)	0	100	100
2	C	119/121 (98%)	113 (95%)	6 (5%)	0	100	100
2	D	115/121 (95%)	111 (96%)	3 (3%)	1 (1%)	14	41
All	All	1019/1076 (95%)	978 (96%)	40 (4%)	1 (0%)	48	77

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	D	14	ALA

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	333/348 (96%)	333 (100%)	0	100	100
1	B	334/348 (96%)	334 (100%)	0	100	100
2	C	98/98 (100%)	98 (100%)	0	100	100
2	D	94/98 (96%)	94 (100%)	0	100	100
All	All	859/892 (96%)	859 (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 (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	100	GLN
1	A	205	HIS
1	A	219	GLN
1	A	241	GLN
1	A	340	GLN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
2	C	13	GLN
2	C	82	GLN
2	C	119	HIS
1	B	38	ASN
1	B	167	GLN
1	B	219	GLN
1	B	256	GLN
1	B	359	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	$\#\|Z\| > 2$
3	YIO	E	1	3	11,12,12	2.27	1 (9%)	15,17,17	1.17	1 (6%)
3	GAL	E	2	3	11,11,12	1.86	3 (27%)	15,15,17	1.07	1 (6%)
3	YIO	F	1	3	11,12,12	2.18	1 (9%)	15,17,17	1.63	3 (20%)
3	GAL	F	2	3	11,11,12	1.79	3 (27%)	15,15,17	0.84	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
3	YIO	E	1	3	-	2/2/22/22	0/1/1/1
3	GAL	E	2	3	-	0/2/19/22	0/1/1/1
3	YIO	F	1	3	-	0/2/22/22	0/1/1/1
3	GAL	F	2	3	-	0/2/19/22	0/1/1/1

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	E	1	YIO	O5-C1	6.94	1.53	1.42
3	F	1	YIO	O5-C1	6.50	1.52	1.42
3	E	2	GAL	O5-C1	3.97	1.50	1.43
3	F	2	GAL	O5-C1	3.78	1.50	1.43
3	E	2	GAL	O3-C3	2.44	1.49	1.43
3	E	2	GAL	C2-C3	-2.30	1.49	1.52
3	F	2	GAL	O3-C3	2.29	1.48	1.43
3	F	2	GAL	C2-C3	-2.19	1.49	1.52

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	F	1	YIO	O5-C1-C2	4.75	116.87	110.32
3	E	1	YIO	O5-C1-C2	3.39	115.00	110.32
3	E	2	GAL	C2-C3-C4	2.55	115.35	110.86
3	F	1	YIO	O5-C5-C4	2.31	113.86	109.70
3	F	1	YIO	C1-O5-C5	2.27	116.62	112.55

There are no chirality outliers.

All (2) torsion outliers are listed below:

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

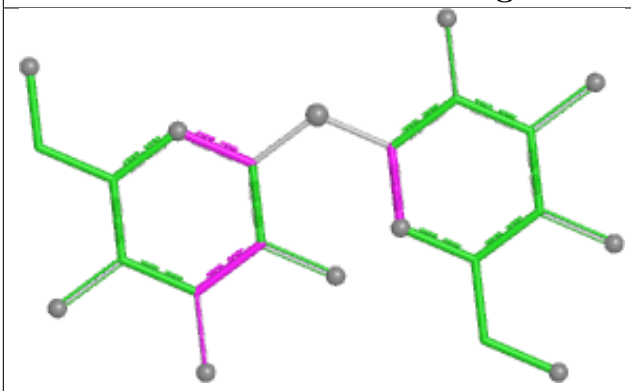
There are no ring outliers.

1 monomer is involved in 1 short contact:

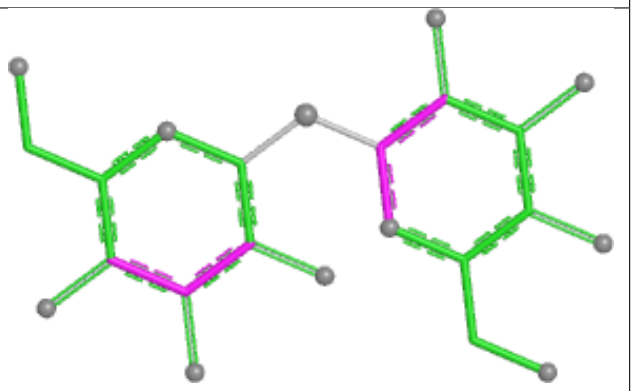
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	F	1	YIO	1	0

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

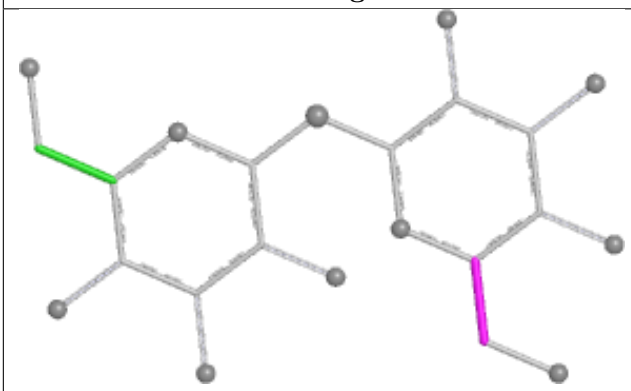
Oligosaccharide Chain E



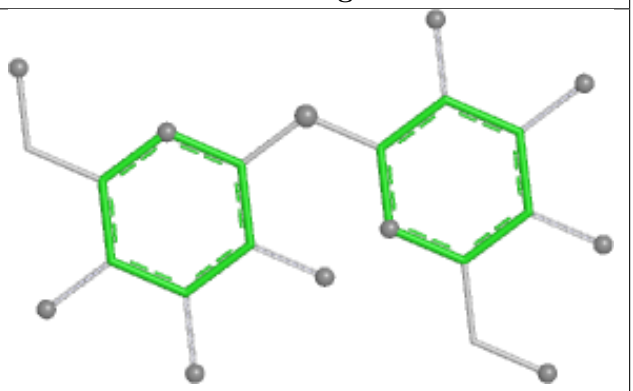
Bond lengths



Bond angles

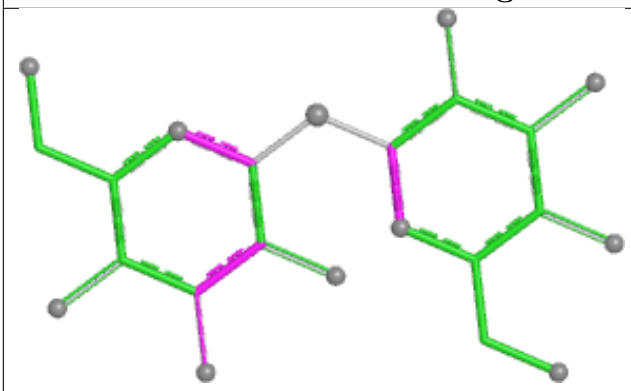


Torsions

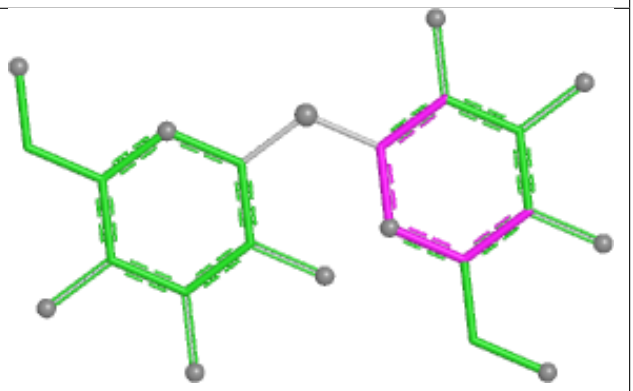


Rings

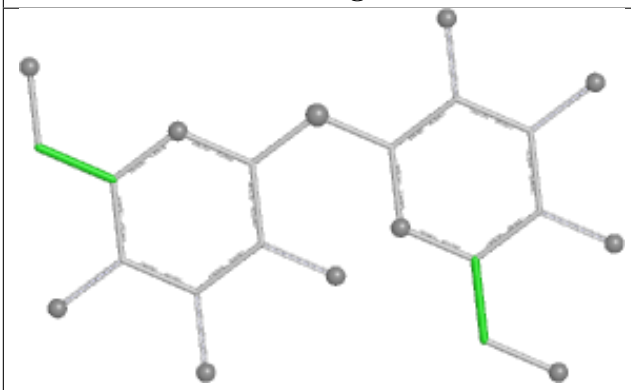
Oligosaccharide Chain F



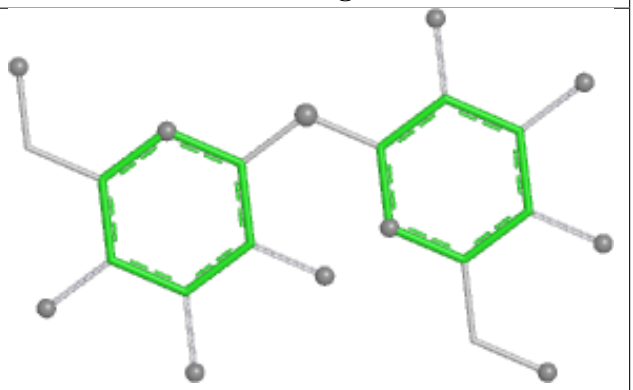
Bond lengths



Bond angles



Torsions



Rings

5.6 Ligand geometry (i)

9 ligands 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	$\#\|Z\| > 2$
4	BNG	A	702	-	21,21,21	1.14	2 (9%)	26,26,26	1.04	0
4	BNG	B	804	-	21,21,21	1.09	1 (4%)	26,26,26	0.85	0
4	BNG	C	501	-	21,21,21	1.05	1 (4%)	26,26,26	1.02	2 (7%)
4	BNG	B	801	-	21,21,21	1.17	1 (4%)	26,26,26	1.52	4 (15%)
4	BNG	B	803	-	21,21,21	1.15	2 (9%)	26,26,26	0.94	1 (3%)
4	BNG	C	502	-	21,21,21	1.21	2 (9%)	26,26,26	1.32	2 (7%)
4	BNG	B	802	-	21,21,21	1.25	2 (9%)	26,26,26	1.51	3 (11%)
4	BNG	A	701	-	21,21,21	1.12	2 (9%)	26,26,26	0.94	1 (3%)
4	BNG	D	601	-	21,21,21	1.17	2 (9%)	26,26,26	1.05	1 (3%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	BNG	A	702	-	-	1/12/32/32	0/1/1/1
4	BNG	B	804	-	-	5/12/32/32	0/1/1/1
4	BNG	C	501	-	-	6/12/32/32	0/1/1/1
4	BNG	B	801	-	-	5/12/32/32	0/1/1/1
4	BNG	B	803	-	-	7/12/32/32	0/1/1/1
4	BNG	C	502	-	-	8/12/32/32	0/1/1/1
4	BNG	B	802	-	-	7/12/32/32	0/1/1/1
4	BNG	A	701	-	-	8/12/32/32	0/1/1/1
4	BNG	D	601	-	-	4/12/32/32	0/1/1/1

All (15) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	801	BNG	O5-C1	4.06	1.52	1.41
4	C	502	BNG	O5-C1	4.04	1.52	1.41
4	B	803	BNG	O5-C1	3.86	1.51	1.41
4	A	701	BNG	O5-C1	3.57	1.51	1.41
4	D	601	BNG	O5-C1	3.46	1.50	1.41
4	A	702	BNG	O5-C1	3.43	1.50	1.41
4	B	804	BNG	O5-C1	3.42	1.50	1.41
4	B	802	BNG	O5-C1	3.27	1.50	1.41
4	B	802	BNG	O1-C1	-3.19	1.34	1.40
4	C	501	BNG	O5-C1	3.09	1.49	1.41
4	C	502	BNG	O1-C1	-2.61	1.35	1.40
4	D	601	BNG	O1-C1	-2.36	1.36	1.40
4	B	803	BNG	O1-C1	-2.14	1.36	1.40
4	A	701	BNG	O1-C1	-2.09	1.36	1.40
4	A	702	BNG	O1-C1	-2.00	1.36	1.40

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	C	502	BNG	O1-C1-C2	4.84	115.63	108.27
4	B	802	BNG	C3-C4-C5	4.57	118.53	110.23
4	B	801	BNG	O1-C1-C2	3.71	113.90	108.27
4	B	802	BNG	O5-C5-C4	3.53	116.06	109.70
4	B	801	BNG	C1'-O1-C1	3.26	119.25	113.68
4	B	801	BNG	O5-C1-O1	-2.91	103.17	110.04
4	C	502	BNG	C1'-O1-C1	-2.73	109.02	113.68
4	D	601	BNG	C1'-O1-C1	2.53	118.00	113.68
4	B	802	BNG	C6-C5-C4	-2.37	107.20	113.02
4	B	801	BNG	O5-C1-C2	2.32	115.14	110.37
4	A	701	BNG	O5-C5-C4	2.26	113.78	109.70
4	C	501	BNG	O1-C1-C2	-2.17	104.98	108.27
4	C	501	BNG	C1-C2-C3	2.11	114.45	110.01
4	B	803	BNG	O1-C1-C2	2.00	111.32	108.27

There are no chirality outliers.

All (51) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	C	501	BNG	O5-C1-O1-C1'
4	C	501	BNG	C2'-C1'-O1-C1
4	B	801	BNG	O5-C1-O1-C1'
4	C	502	BNG	C1'-C2'-C3'-C4'

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms
4	A	701	BNG	C4-C5-C6-O6
4	A	701	BNG	O5-C5-C6-O6
4	B	803	BNG	C4-C5-C6-O6
4	B	803	BNG	O5-C5-C6-O6
4	C	502	BNG	O5-C1-O1-C1'
4	C	502	BNG	O5-C5-C6-O6
4	A	701	BNG	C2-C1-O1-C1'
4	C	502	BNG	C2-C1-O1-C1'
4	C	502	BNG	C4-C5-C6-O6
4	A	701	BNG	O5-C1-O1-C1'
4	B	802	BNG	O1-C1'-C2'-C3'
4	B	803	BNG	C2-C1-O1-C1'
4	B	804	BNG	O5-C1-O1-C1'
4	C	502	BNG	O1-C1'-C2'-C3'
4	B	802	BNG	C2'-C1'-O1-C1
4	B	803	BNG	O5-C1-O1-C1'
4	A	701	BNG	C2'-C3'-C4'-C5'
4	D	601	BNG	C2-C1-O1-C1'
4	B	804	BNG	C4-C5-C6-O6
4	C	501	BNG	O1-C1'-C2'-C3'
4	B	801	BNG	C2-C1-O1-C1'
4	D	601	BNG	C1'-C2'-C3'-C4'
4	C	501	BNG	C4'-C5'-C6'-C7'
4	B	802	BNG	O5-C5-C6-O6
4	B	804	BNG	O5-C5-C6-O6
4	C	502	BNG	C5'-C6'-C7'-C8'
4	A	701	BNG	C3'-C4'-C5'-C6'
4	B	802	BNG	C5'-C6'-C7'-C8'
4	C	501	BNG	C5'-C6'-C7'-C8'
4	B	803	BNG	C3'-C4'-C5'-C6'
4	B	804	BNG	C3'-C4'-C5'-C6'
4	A	702	BNG	C3'-C4'-C5'-C6'
4	C	502	BNG	C3'-C4'-C5'-C6'
4	B	802	BNG	C4'-C5'-C6'-C7'
4	C	501	BNG	C3'-C4'-C5'-C6'
4	D	601	BNG	C3'-C4'-C5'-C6'
4	A	701	BNG	C4'-C5'-C6'-C7'
4	B	802	BNG	C3'-C4'-C5'-C6'
4	B	802	BNG	C1'-C2'-C3'-C4'
4	B	804	BNG	C4'-C5'-C6'-C7'
4	B	801	BNG	C3'-C4'-C5'-C6'
4	B	803	BNG	C2'-C3'-C4'-C5'

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms
4	B	801	BNG	C4'-C5'-C6'-C7'
4	B	801	BNG	C1'-C2'-C3'-C4'
4	D	601	BNG	O1-C1'-C2'-C3'
4	B	803	BNG	C4'-C5'-C6'-C7'
4	A	701	BNG	C6'-C7'-C8'-C9'

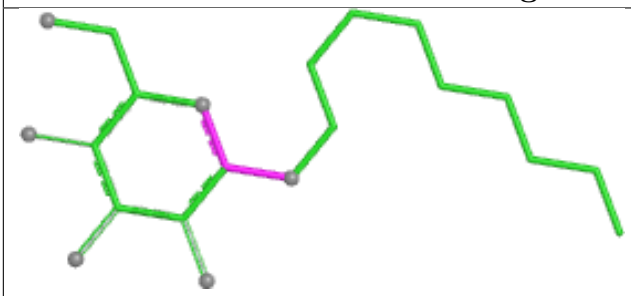
There are no ring outliers.

3 monomers are involved in 5 short contacts:

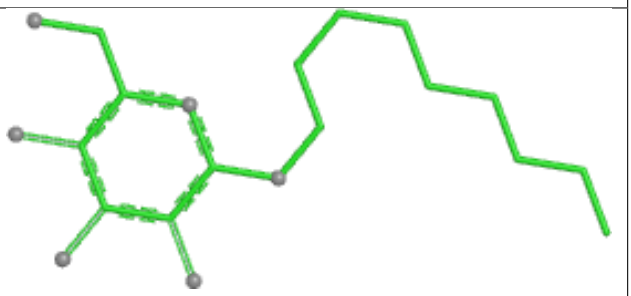
Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	801	BNG	1	0
4	C	502	BNG	2	0
4	A	701	BNG	2	0

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.

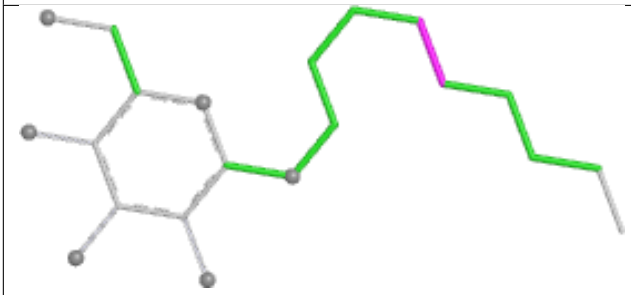
Ligand BNG A 702



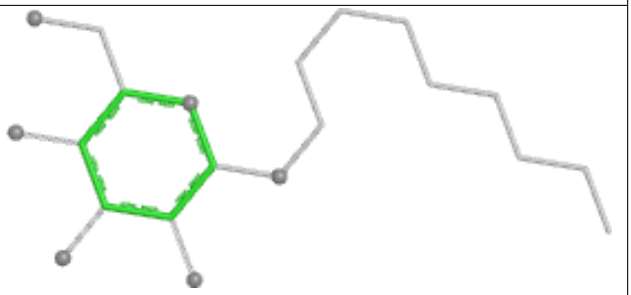
Bond lengths



Bond angles

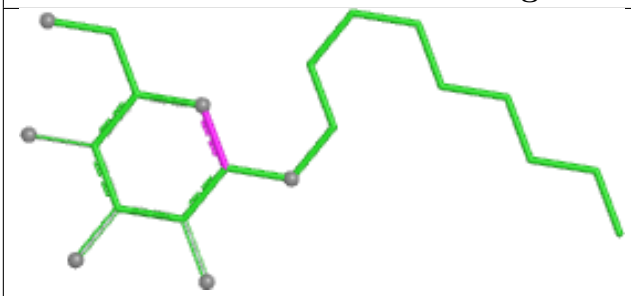


Torsions

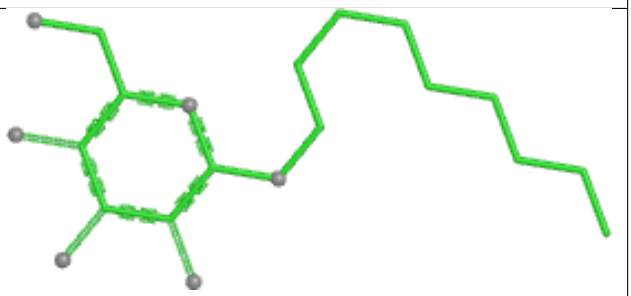


Rings

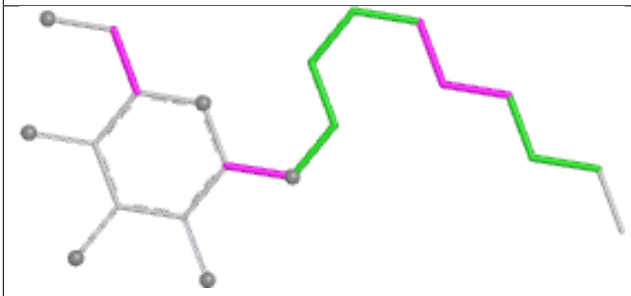
Ligand BNG B 804



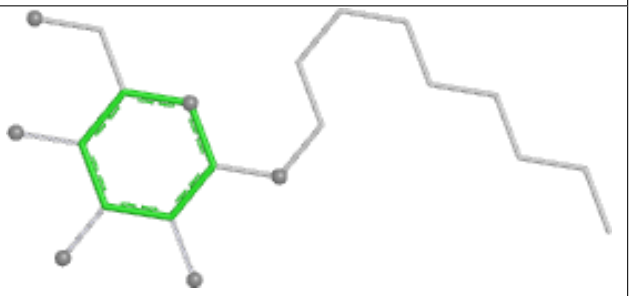
Bond lengths



Bond angles

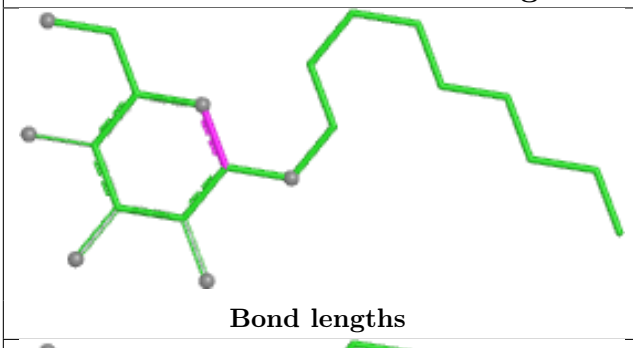


Torsions

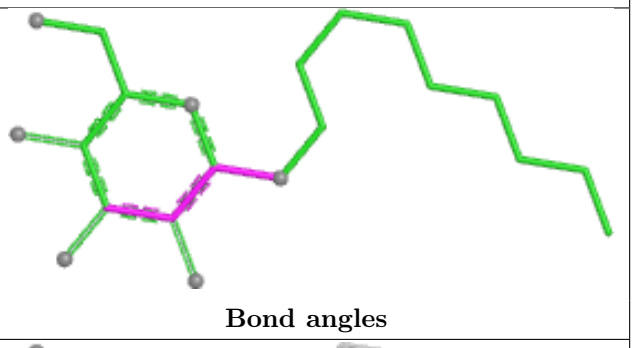


Rings

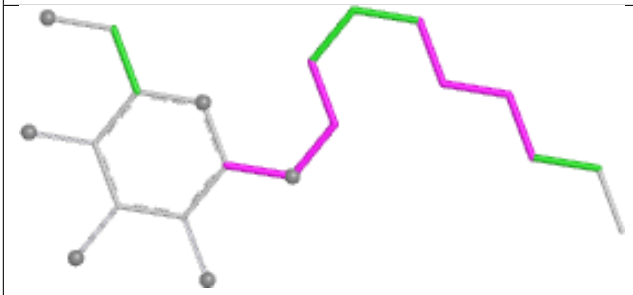
Ligand BNG C 501



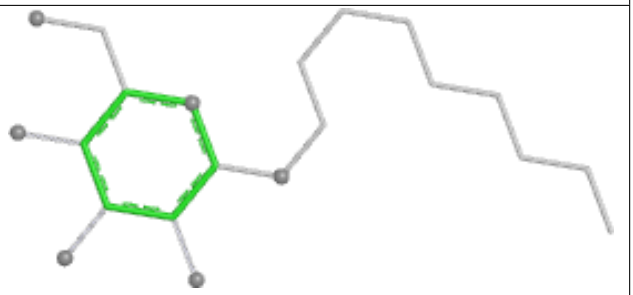
Bond lengths



Bond angles

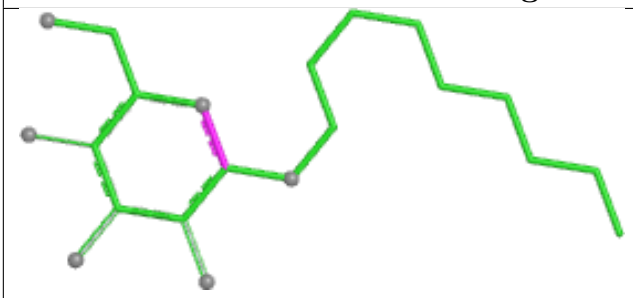


Torsions

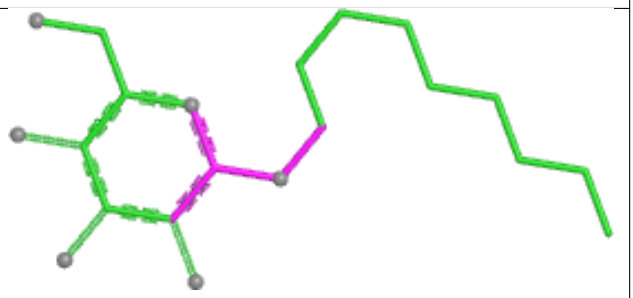


Rings

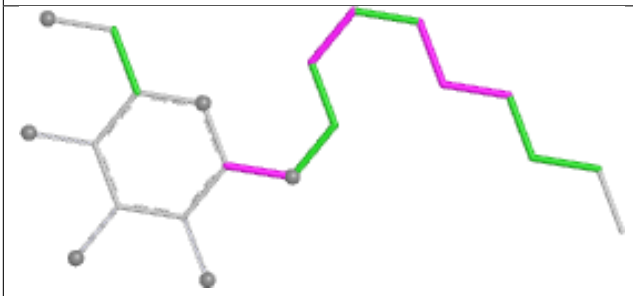
Ligand BNG B 801



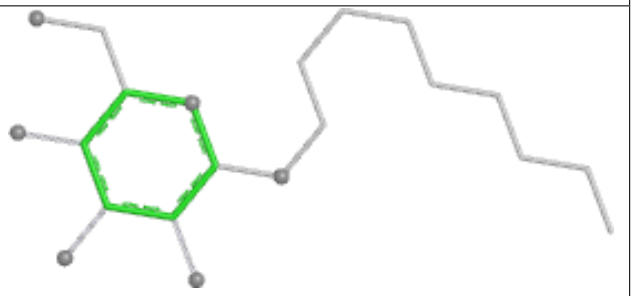
Bond lengths



Bond angles

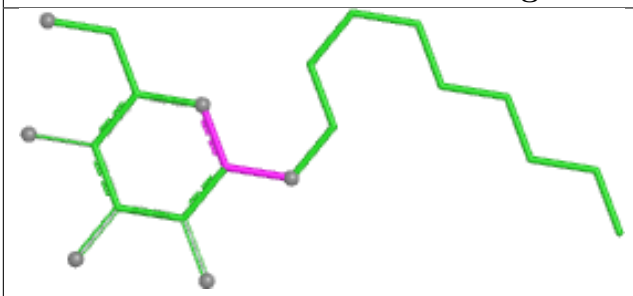


Torsions

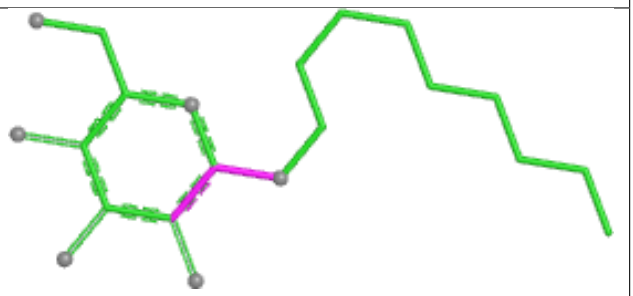


Rings

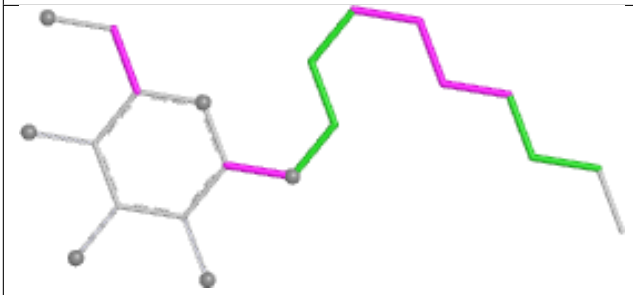
Ligand BNG B 803



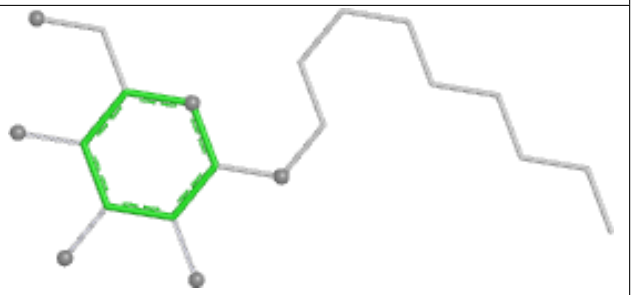
Bond lengths



Bond angles

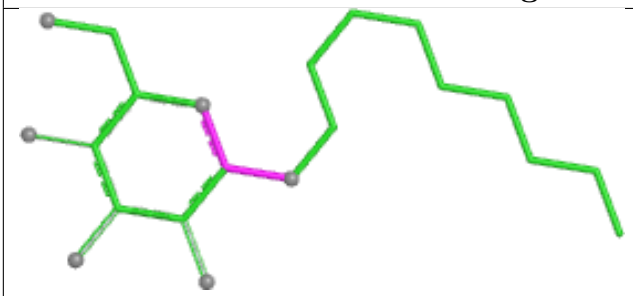


Torsions

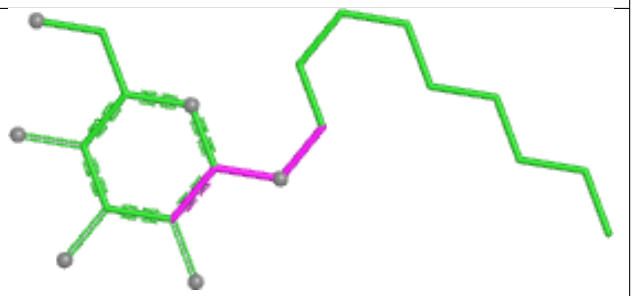


Rings

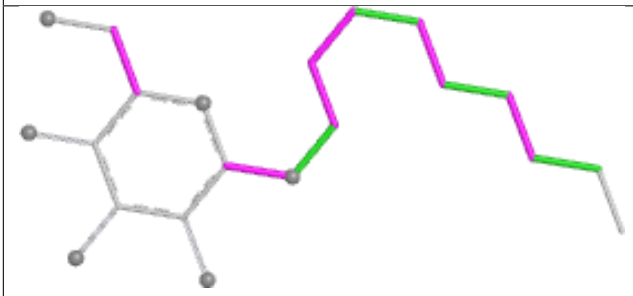
Ligand BNG C 502



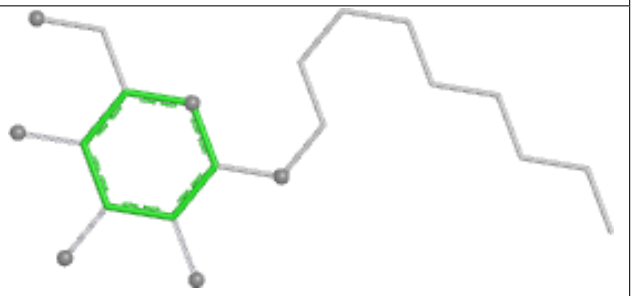
Bond lengths



Bond angles

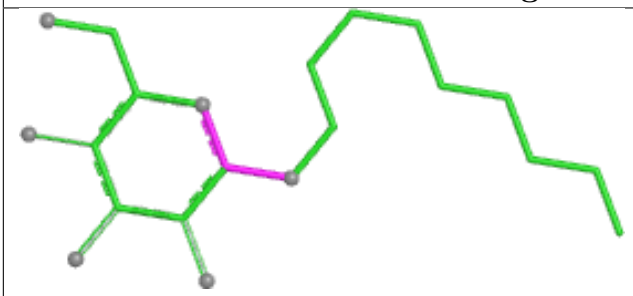


Torsions

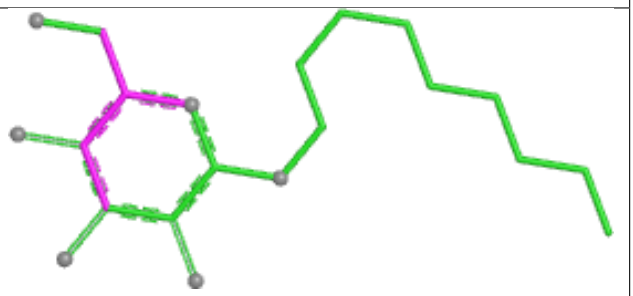


Rings

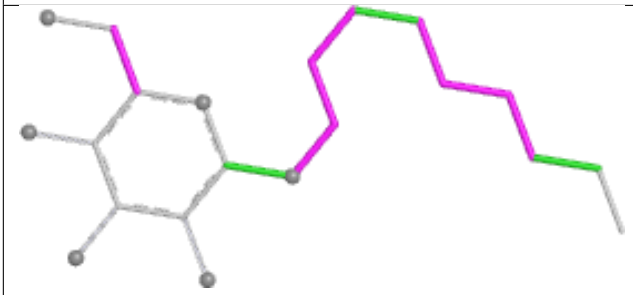
Ligand BNG B 802



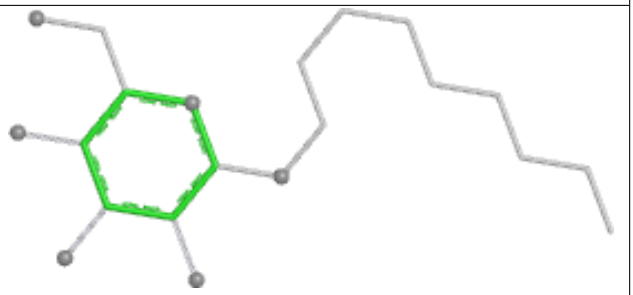
Bond lengths



Bond angles

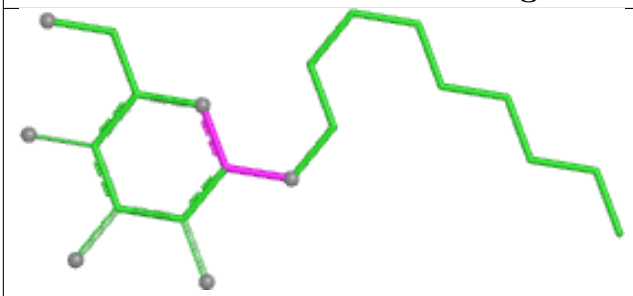


Torsions

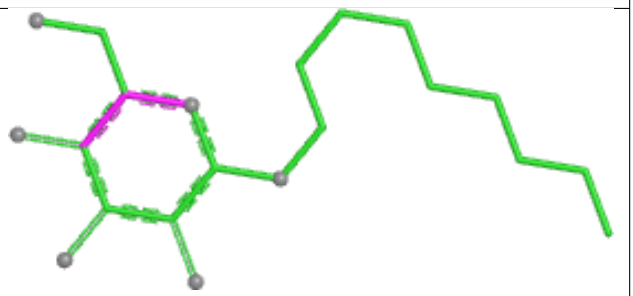


Rings

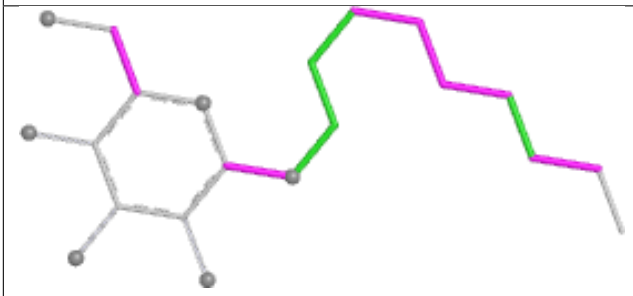
Ligand BNG A 701



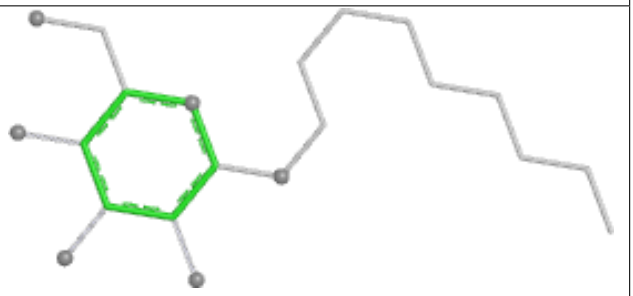
Bond lengths



Bond angles

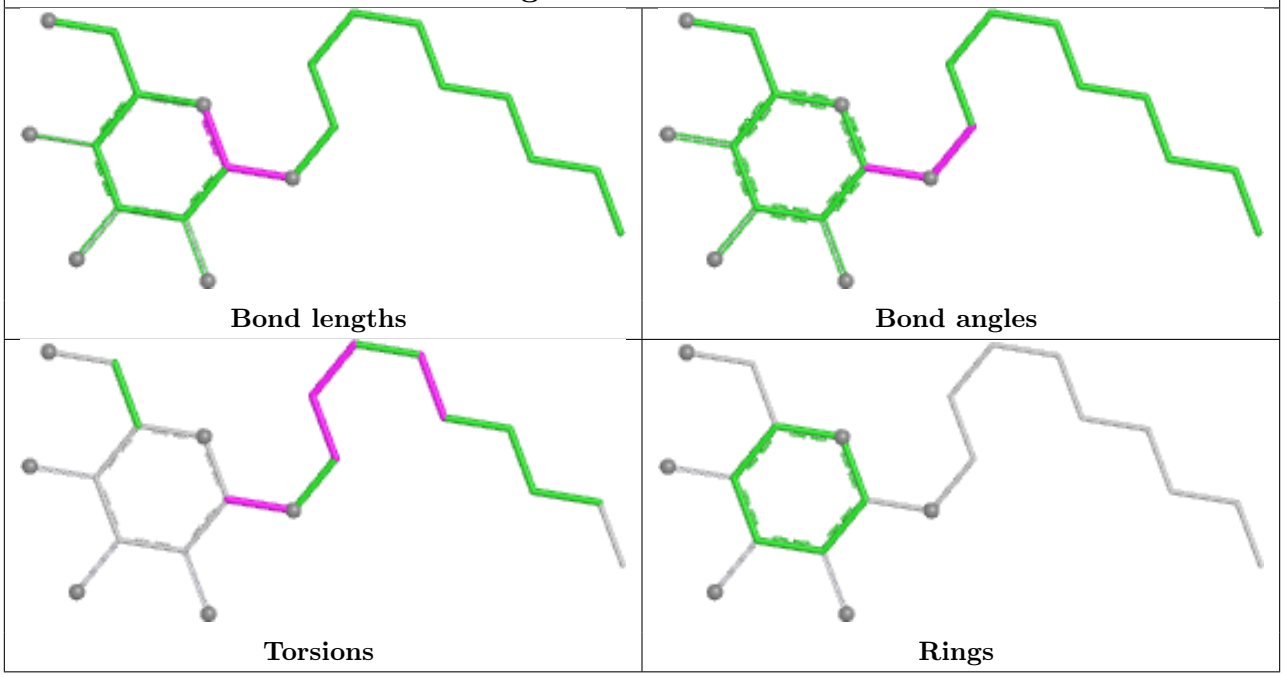


Torsions



Rings

Ligand BNG D 601



5.7 Other polymers

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, 95^{th} 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	396/417 (94%)	0.75	30 (7%) 20 14	59, 76, 109, 145	0
1	B	397/417 (95%)	0.81	44 (11%) 10 7	57, 75, 109, 134	0
2	C	121/121 (100%)	0.95	18 (14%) 5 4	58, 76, 115, 152	0
2	D	117/121 (96%)	0.81	16 (13%) 6 5	57, 74, 109, 127	0
All	All	1031/1076 (95%)	0.80	108 (10%) 11 8	57, 76, 111, 152	0

All (108) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	203	ALA	8.1
2	C	120	HIS	5.6
1	A	36	ASP	4.8
1	A	39	HIS	4.8
2	C	44	GLU	4.4
1	B	203	ALA	4.2
1	A	241	GLN	4.2
1	B	241	GLN	4.2
2	C	119	HIS	4.2
1	B	401	SER	4.2
1	B	409	LEU	4.0
1	B	339	SER	3.9
1	A	42	LYS	3.8
1	B	312	ALA	3.8
1	A	339	SER	3.7
1	B	190	ASP	3.7
2	D	12	VAL	3.7
2	C	105	LYS	3.6
1	B	148	CYS	3.5
2	C	118	HIS	3.5
1	A	35	HIS	3.5

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
2	D	116	SER	3.4
1	B	36	ASP	3.4
1	B	406	LEU	3.4
1	A	403	PRO	3.4
1	B	313	LEU	3.3
1	B	29	PHE	3.3
2	D	42	GLY	3.2
1	A	41	SER	3.2
2	D	103	ASP	3.1
1	A	189	THR	3.1
1	B	46	TRP	3.1
2	C	84	ASN	3.0
1	B	5	LYS	3.0
2	D	16	ASP	3.0
1	A	1	MET	3.0
1	B	256	GLN	2.9
1	A	34	LEU	2.9
2	C	121	HIS	2.9
1	B	27	PHE	2.9
1	A	256	GLN	2.9
1	B	189	THR	2.9
1	A	26	TYR	2.8
2	D	66	GLY	2.8
1	B	237	ASP	2.8
1	A	4	LEU	2.8
1	A	409	LEU	2.8
1	B	39	HIS	2.8
2	D	117	SER	2.7
2	D	1	GLN	2.7
1	A	30	PHE	2.7
2	D	71	SER	2.7
1	A	5	LYS	2.6
2	C	65	LYS	2.6
1	B	163	THR	2.6
2	D	45	ARG	2.6
1	B	377	GLY	2.6
1	B	185	PHE	2.6
1	B	343	VAL	2.6
1	B	1	MET	2.6
1	A	357	PHE	2.6
1	B	287	GLY	2.5
2	C	11	LEU	2.5

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	B	338	THR	2.5
2	D	17	SER	2.5
1	A	406	LEU	2.4
1	B	365	MET	2.4
1	A	43	SER	2.4
2	D	13	GLN	2.4
2	C	103	ASP	2.4
1	B	136	SER	2.4
1	A	255	GLU	2.3
1	B	238	VAL	2.3
1	A	166	ASN	2.3
2	C	13	GLN	2.3
2	D	76	LYS	2.3
1	B	35	HIS	2.2
1	A	185	PHE	2.2
2	D	44	GLU	2.2
1	A	359	GLN	2.2
2	C	16	ASP	2.2
2	C	100	VAL	2.2
1	A	156	SER	2.2
1	B	41	SER	2.2
1	B	212	LEU	2.2
1	A	307	SER	2.2
1	B	34	LEU	2.2
2	C	117	SER	2.2
1	B	374	GLU	2.2
2	C	40	ALA	2.2
2	D	75	ALA	2.2
1	B	240	ASP	2.1
1	B	267	MET	2.1
1	B	42	LYS	2.1
1	A	217	PHE	2.1
2	C	77	ARG	2.1
1	B	164	ILE	2.1
2	C	39	GLN	2.1
1	A	221	LYS	2.1
2	C	41	PRO	2.1
1	B	54	LEU	2.1
1	B	142	ARG	2.1
1	B	30	PHE	2.1
1	B	251	PHE	2.1
2	D	7	SER	2.0

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	B	167	GLN	2.0
1	A	263	TYR	2.0
1	B	2	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)

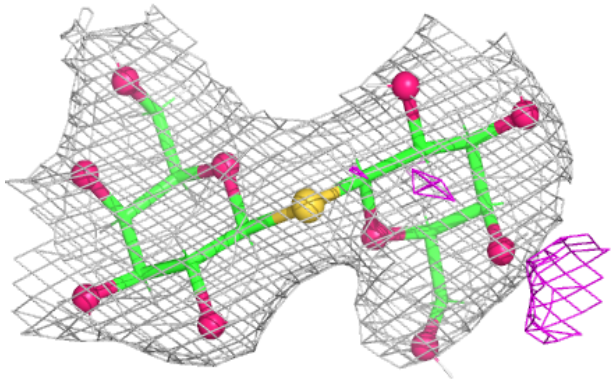
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9'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

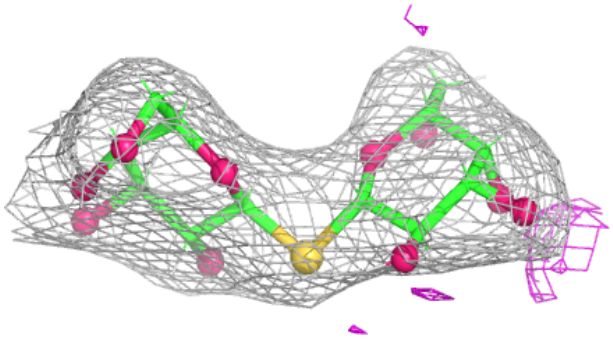
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
3	YIO	E	1	12/12	0.93	0.13	64,76,92,97	0
3	YIO	F	1	12/12	0.94	0.13	59,76,96,97	0
3	GAL	E	2	11/12	0.95	0.09	46,63,75,81	0
3	GAL	F	2	11/12	0.95	0.10	47,67,80,92	0

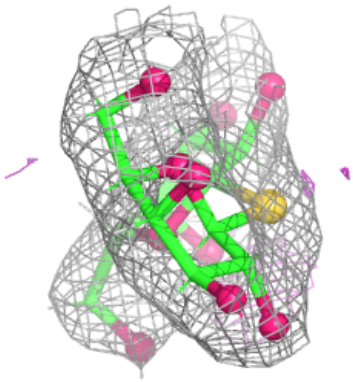
The following is a graphical depiction of the model fit to experimental electron density for oligosaccharide. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around Chain E:

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

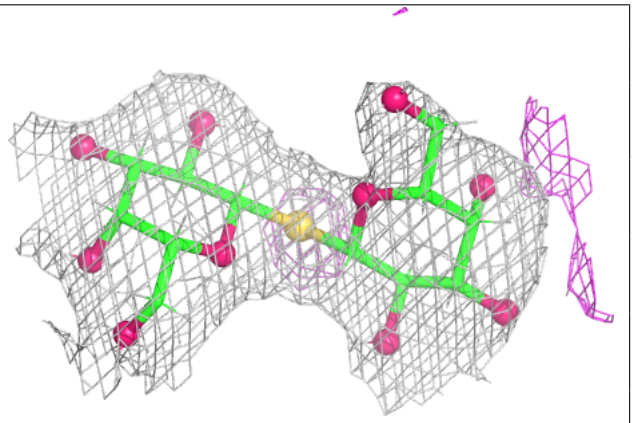


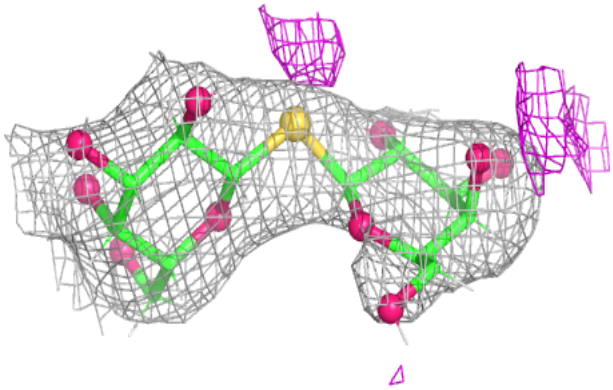


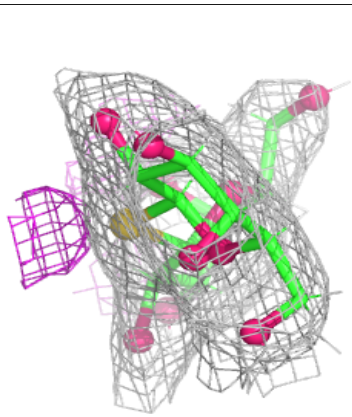


Electron density around Chain F:

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







6.4 Ligands

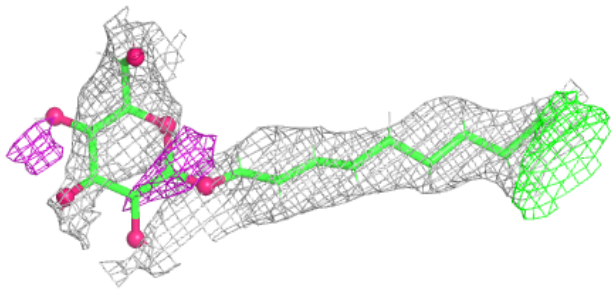
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9'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

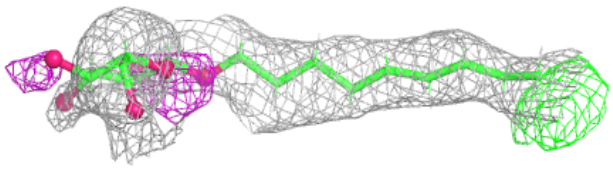
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
4	BNG	A	702	21/21	0.57	0.22	80,106,149,155	0
4	BNG	B	804	21/21	0.60	0.24	78,109,141,150	0
4	BNG	C	501	21/21	0.67	0.26	75,126,162,173	0
4	BNG	B	801	21/21	0.70	0.30	86,117,141,144	0
4	BNG	D	601	21/21	0.73	0.31	81,115,138,149	0
4	BNG	B	803	21/21	0.77	0.34	58,102,118,121	0
4	BNG	A	701	21/21	0.78	0.31	76,102,125,134	0
4	BNG	C	502	21/21	0.80	0.27	84,125,153,164	0
4	BNG	B	802	21/21	0.82	0.26	74,111,137,150	0

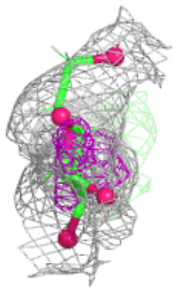
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around BNG A 702:

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

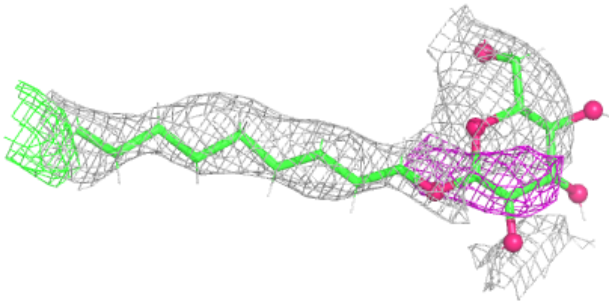


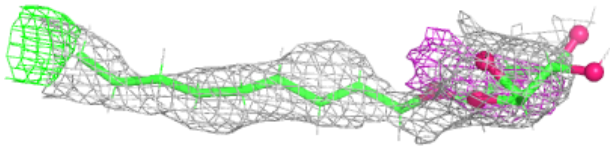


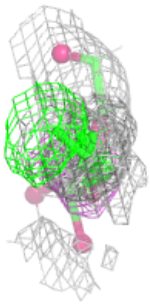


Electron density around BNG B 804:

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

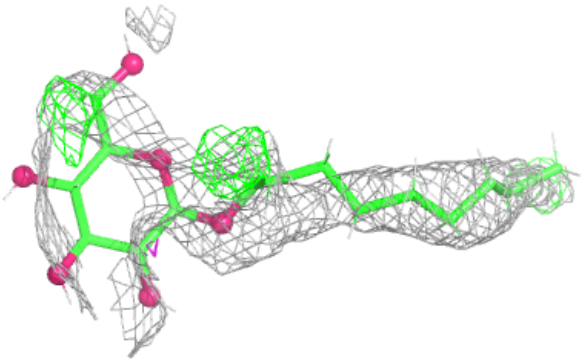


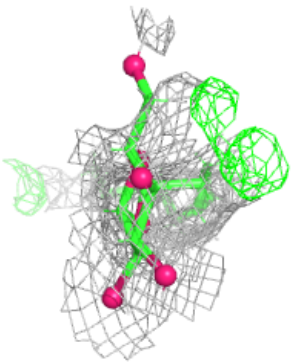




Electron density around BNG C 501:

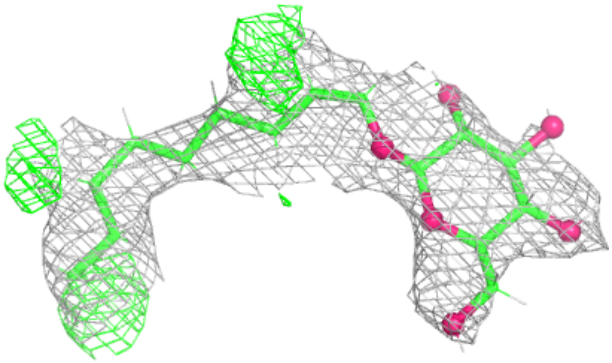
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

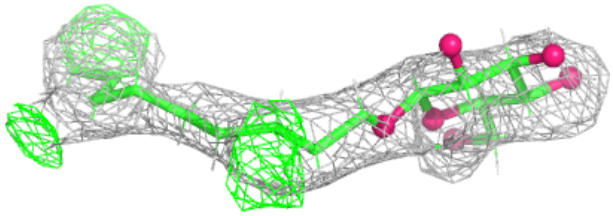


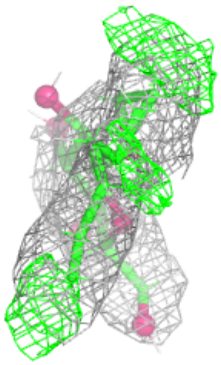


Electron density around BNG B 801:

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

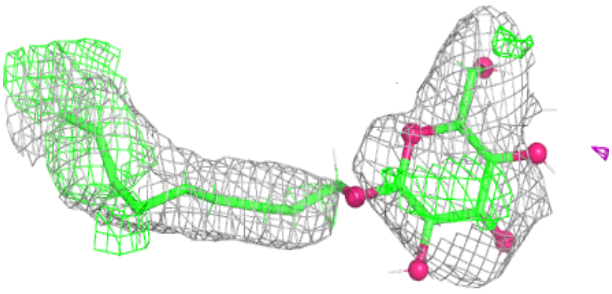


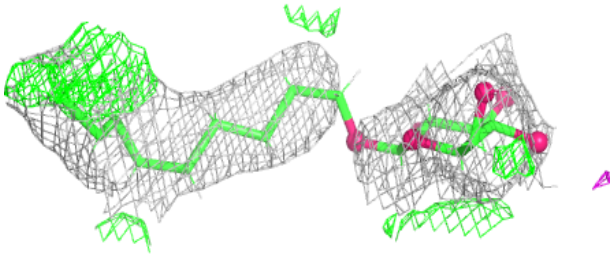


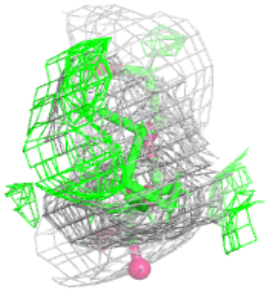


Electron density around BNG D 601:

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

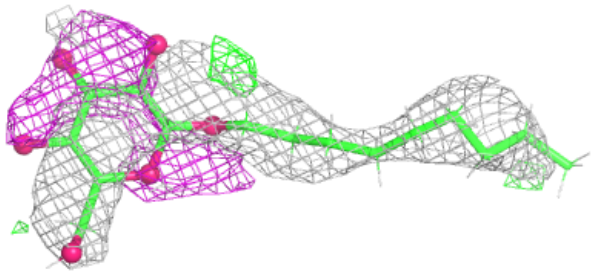


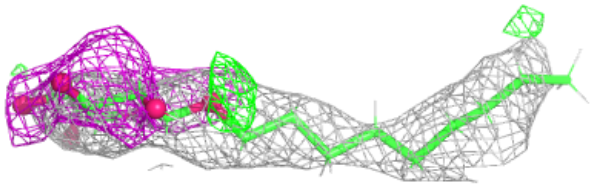


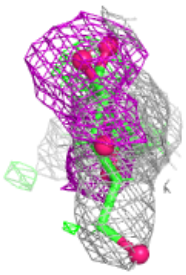


Electron density around BNG B 803:

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

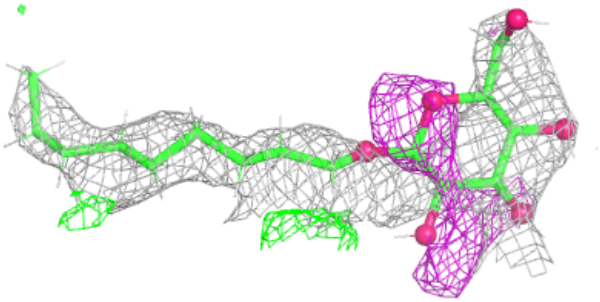


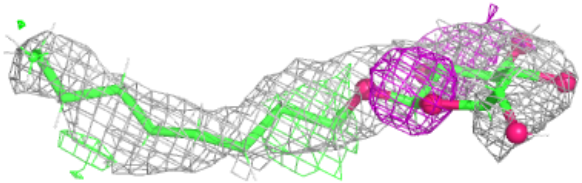


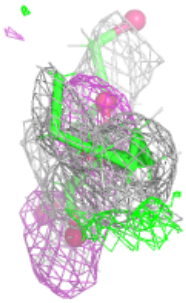


Electron density around BNG A 701:

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

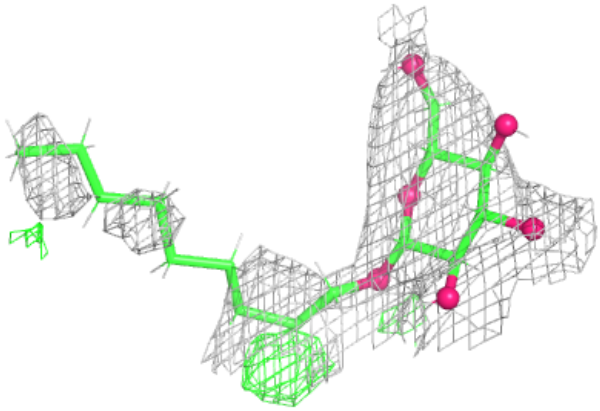


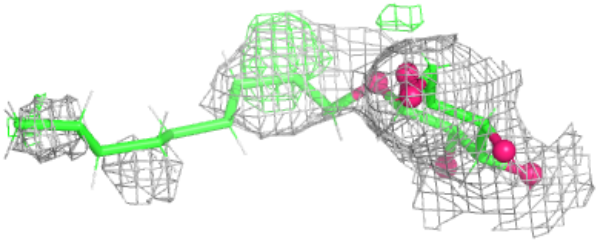


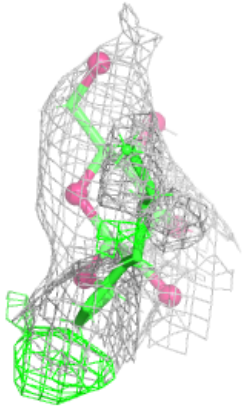


Electron density around BNG C 502:

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

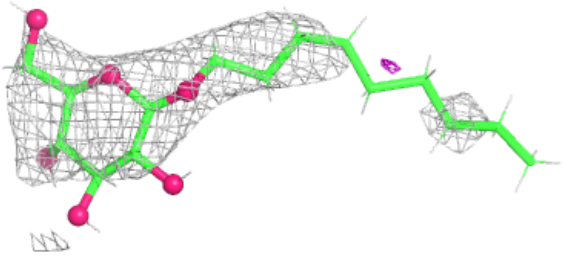


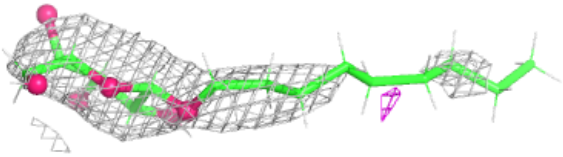


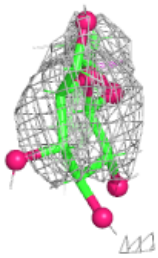


Electron density around BNG B 802:

$2mF_o$-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.