



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 12, 2024 – 10:18 AM EDT

PDB ID : 5T03
Title : Crystal structure of heparan sulfate 6-O-sulfotransferase with bound PAP and glucuronic acid containing hexasaccharide substrate
Authors : Pedersen, L.C.; Moon, A.F.; Krahn, J.M.; Liu, J.
Deposited on : 2016-08-15
Resolution : 2.10 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 : 2022.3.0, CSD as543be (2022)
Xtrriage (Phenix) : 1.20.1
EDS : 3.0
buster-report : 1.1.7 (2018)
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4 : 9.0.003 (Gargrove)
Density-Fitness : 1.0.11
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.39

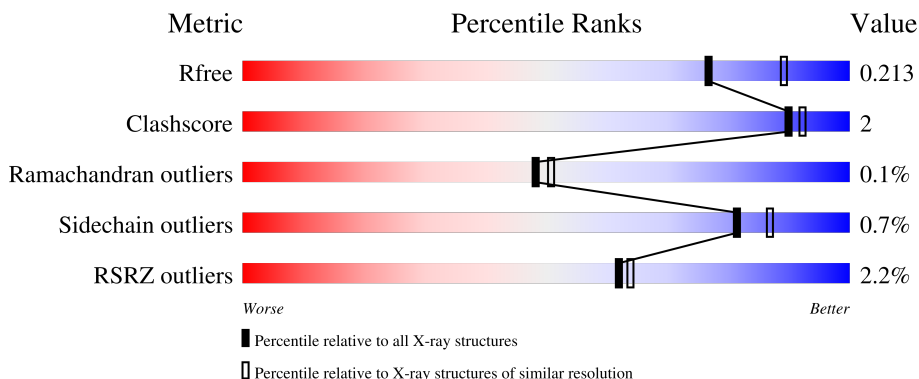
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.10 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}	164625	6234 (2.10-2.10)
Clashscore	180529	6893 (2.10-2.10)
Ramachandran outliers	177936	6839 (2.10-2.10)
Sidechain outliers	177891	6840 (2.10-2.10)
RSRZ outliers	164620	6234 (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 $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	692	 93%
1	B	692	 92% 5%
2	C	6	 33% 50% 17%
2	E	6	 17% 67% 17%
3	D	4	 25% 75%

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Mol	Chain	Length	Quality of chain
3	F	4	

2 Entry composition

There are 10 unique types of molecules in this entry. The entry contains 11901 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called maltose binding protein - heparan sulfate 6-O-sulfotransferase isoform 3 fusion protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	670	5243	3338	891	988	26	0	2	0
1	B	675	5285	3369	897	992	27	0	6	0

There are 26 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	MET	-	initiating methionine	UNP P0AEY0
A	82	ALA	ASP	engineered mutation	UNP P0AEY0
A	83	ALA	LYS	engineered mutation	UNP P0AEY0
A	172	ALA	GLU	engineered mutation	UNP P0AEY0
A	173	ALA	ASN	engineered mutation	UNP P0AEY0
A	239	ALA	LYS	engineered mutation	UNP P0AEY0
A	359	ALA	GLU	engineered mutation	UNP P0AEY0
A	362	ALA	LYS	engineered mutation	UNP P0AEY0
A	363	ALA	ASP	engineered mutation	UNP P0AEY0
A	367	ASN	-	linker	UNP P0AEY0
A	368	ALA	-	linker	UNP P0AEY0
A	369	ALA	-	linker	UNP P0AEY0
A	370	ALA	-	linker	UNP P0AEY0
B	0	MET	-	initiating methionine	UNP P0AEY0
B	82	ALA	ASP	engineered mutation	UNP P0AEY0
B	83	ALA	LYS	engineered mutation	UNP P0AEY0
B	172	ALA	GLU	engineered mutation	UNP P0AEY0
B	173	ALA	ASN	engineered mutation	UNP P0AEY0
B	239	ALA	LYS	engineered mutation	UNP P0AEY0
B	359	ALA	GLU	engineered mutation	UNP P0AEY0
B	362	ALA	LYS	engineered mutation	UNP P0AEY0
B	363	ALA	ASP	engineered mutation	UNP P0AEY0
B	367	ASN	-	linker	UNP P0AEY0
B	368	ALA	-	linker	UNP P0AEY0

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Chain	Residue	Modelled	Actual	Comment	Reference
B	369	ALA	-	linker	UNP P0AEY0
B	370	ALA	-	linker	UNP P0AEY0

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



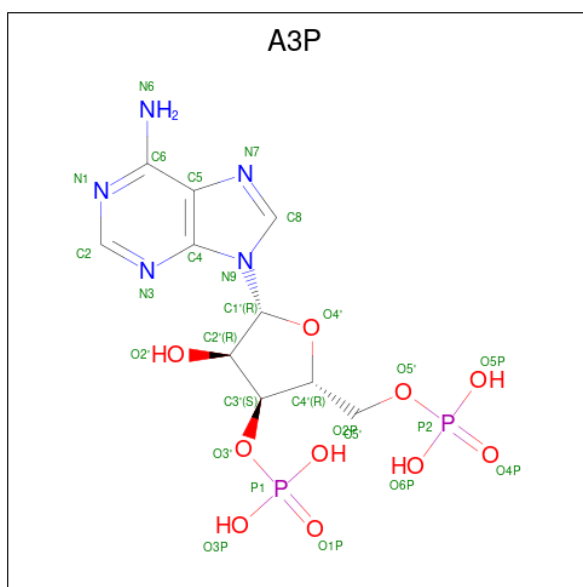
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	C	6	81	36	3	39	3	0	0	0
2	E	6	96	42	4	46	4	0	4	0

- Molecule 3 is an oligosaccharide called alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose.



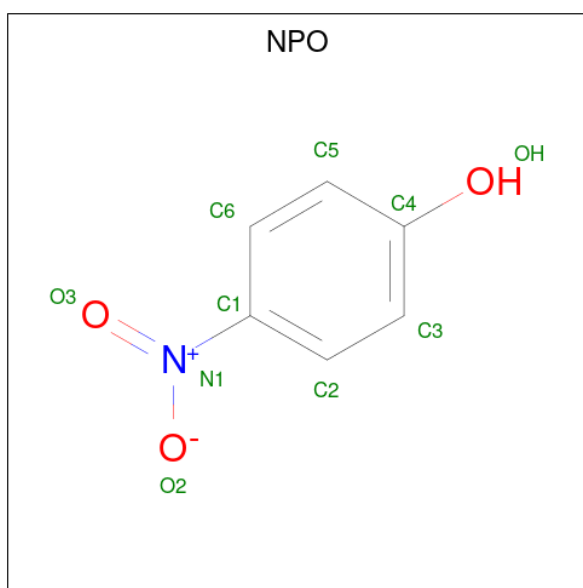
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf	Trace
			Total	C O			
3	D	4	45	24 21	0	0	0
3	F	4	45	24 21	0	0	0

- Molecule 4 is ADENOSINE-3'-5'-DIPHOSPHATE (three-letter code: A3P) (formula: C₁₀H₁₅N₅O₁₀P₂).



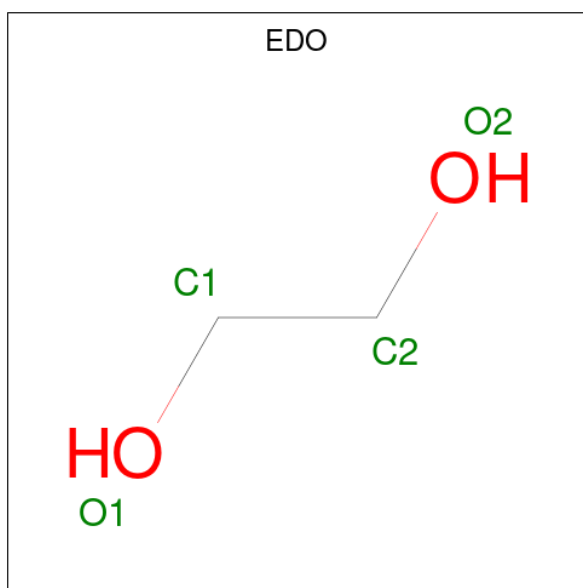
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
			Total	C	N	O			P
4	A	1	Total	C	N	O	P	0	0
			27	10	5	10	2		
4	B	1	Total	C	N	O	P	0	0
			27	10	5	10	2		

- Molecule 5 is P-NITROPHENOL (three-letter code: NPO) (formula: $C_6H_5NO_3$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
5	A	1	Total	C	N	O	0	0
			10	6	1	3		
5	B	1	Total	C	N	O	0	1
			10	6	1	3		

- Molecule 6 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C₂H₆O₂).



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

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

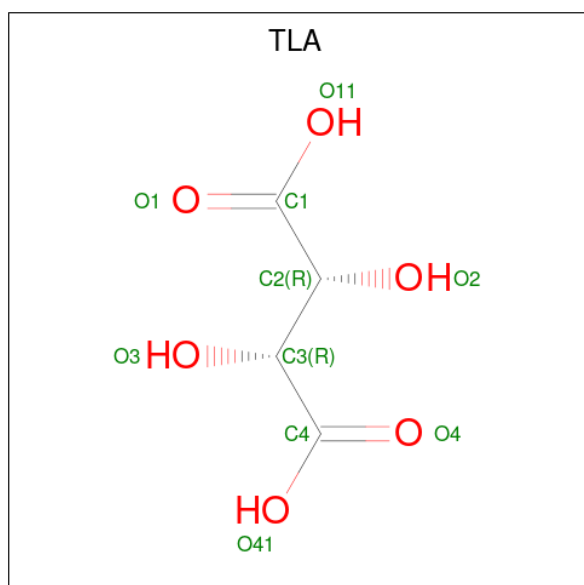
- Molecule 7 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	A	3	Total Cl 3 3	0	0
7	B	2	Total Cl 2 2	0	0

- Molecule 8 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	4	Total Na 4 4	0	0
8	B	2	Total Na 2 2	0	1

- Molecule 9 is L(+)-TARTARIC ACID (three-letter code: TLA) (formula: C₄H₆O₆).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
9	A	1	Total C O 10 4 6	0	0
9	A	1	Total C O 10 4 6	0	0
9	B	1	Total C O 10 4 6	0	0
9	B	1	Total C O 10 4 6	0	0

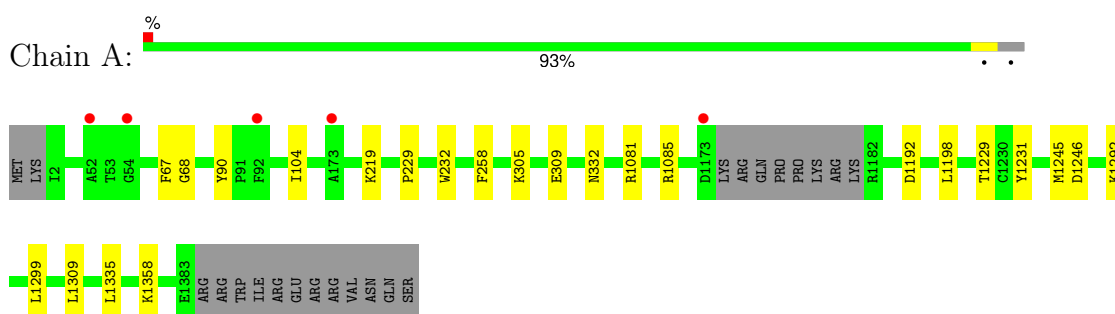
- Molecule 10 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
10	A	490	Total O 491 491	0	1
10	B	425	Total O 426 426	0	3

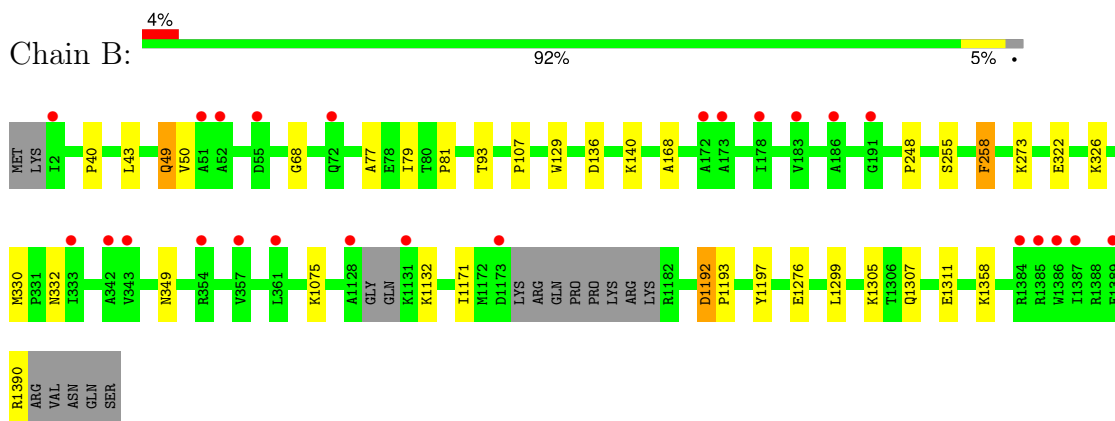
3 Residue-property plots [i](#)

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: maltose binding protein - heparan sulfate 6-O-sulfotransferase isoform 3 fusion protein



- Molecule 1: maltose binding protein - heparan sulfate 6-O-sulfotransferase isoform 3 fusion protein



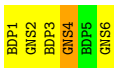
- Molecule 2: 2-deoxy-2-(sulfoamino)-alpha-D-glucopyranose-(1-4)-beta-D-glucopyranuronic acid-(1-4)-2-deoxy-2-(sulfoamino)-alpha-D-glucopyranose-(1-4)-beta-D-glucopyranuronic acid-(1-4)-2-deoxy-2-(sulfoamino)-alpha-D-glucopyranose-(1-4)-beta-D-glucopyranuronic acid



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

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

Chain E:  17% 67% 17%


BDP1
GNS2
BDP3
GNS4
BDP5
GNS6

- Molecule 3: alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose

Chain D:  25% 75%


GLC1
GLC2
GLC3
GLC4

- Molecule 3: alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose

Chain F:  50% 50%


GLC1
GLC2
GLC4

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	75.78Å 128.40Å 179.72Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.65 – 2.10 38.65 – 2.10	Depositor EDS
% Data completeness (in resolution range)	99.5 (38.65-2.10) 95.4 (38.65-2.10)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.14 (at 2.10Å)	Xtrriage
Refinement program	PHENIX (1.10.1_2155: ???)	Depositor
R, R_{free}	0.173 , 0.212 0.174 , 0.213	Depositor DCC
R_{free} test set	2274 reflections (2.24%)	wwPDB-VP
Wilson B-factor (Å ²)	29.6	Xtrriage
Anisotropy	0.279	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 50.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	11901	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.34% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: GNS, A3P, CL, BDP, NA, EDO, GLC, TLA, NPO

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	0.32	0/5366	0.49	0/7286
1	B	0.33	0/5409	0.49	0/7349
All	All	0.32	0/10775	0.49	0/14635

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	5243	0	5021	14	0
1	B	5285	0	5020	23	0
2	C	81	0	40	1	0
2	E	96	0	47	2	0
3	D	45	0	39	0	0
3	F	45	0	39	0	0
4	A	27	0	11	0	0
4	B	27	0	11	0	0
5	A	10	0	4	0	0
5	B	10	0	4	0	0
6	A	44	0	66	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	B	20	0	30	0	0
7	A	3	0	0	0	0
7	B	2	0	0	1	0
8	A	4	0	0	0	0
8	B	2	0	0	0	0
9	A	20	0	8	0	0
9	B	20	0	7	0	0
10	A	491	0	0	3	1
10	B	426	0	0	4	1
All	All	11901	0	10347	37	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 2.

All (37) 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:1132:LYS:HB2	2:E:4[A]:GNS:O3S	2.01	0.61
1:A:219:LYS:NZ	10:A:1510:HOH:O	2.37	0.56
1:B:258:PHE:CD1	1:B:330:MET:HG2	2.41	0.56
1:B:349:ASN:OD1	10:B:1501:HOH:O	2.17	0.55
1:B:49[A]:GLN:HG2	1:B:50:VAL:HG13	1.89	0.54
1:B:68:GLY:HA3	1:B:332:ASN:O	2.08	0.53
1:B:1197:TYR:OH	10:B:1502:HOH:O	2.19	0.53
10:A:1505:HOH:O	2:C:2:GNS:N2	2.34	0.51
1:A:1292:LYS:NZ	10:A:1509:HOH:O	2.37	0.51
1:B:248:PRO:O	1:B:255:SER:OG	2.25	0.51
1:B:40:PRO:HG2	1:B:43:LEU:HB3	1.94	0.49
1:A:1299:LEU:HD11	1:A:1358:LYS:HA	1.94	0.49
1:A:1245:MET:HE3	1:A:1245:MET:HB2	1.69	0.48
1:B:49[A]:GLN:HG2	1:B:50:VAL:N	2.28	0.48
1:B:322:GLU:O	1:B:326:LYS:HG2	2.14	0.47
1:B:1132:LYS:HD2	2:E:4[A]:GNS:O2S	2.14	0.47
1:A:1229:THR:HG22	1:A:1231:TYR:H	1.80	0.46
1:A:68:GLY:HA3	1:A:332:ASN:O	2.16	0.46
1:A:309:GLU:HG2	1:B:1390:ARG:HH22	1.82	0.45
1:A:1198:LEU:HD11	1:A:1335:LEU:HD22	1.97	0.45
1:A:229:PRO:HA	1:A:232:TRP:CE2	2.51	0.44
1:B:1276:GLU:OE2	10:B:1503:HOH:O	2.21	0.44
1:B:129:TRP:NE1	1:B:248:PRO:HG2	2.33	0.44
1:B:1075:LYS:NZ	10:B:1522:HOH:O	2.43	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:1299:LEU:HD11	1:B:1358:LYS:HA	2.00	0.44
1:B:79:ILE:HG22	1:B:81:PRO:HD3	2.01	0.43
1:A:67:PHE:HB3	1:A:104:ILE:HD13	2.00	0.42
1:B:1305:LYS:HG3	7:B:1419:CL:CL	2.57	0.42
1:A:1081:ARG:O	1:A:1085:ARG:NH1	2.47	0.42
1:B:136:ASP:OD2	1:B:140:LYS:NZ	2.45	0.42
1:B:1307:GLN:O	1:B:1311:GLU:HG3	2.20	0.42
1:B:93:THR:HB	1:B:107:PRO:HB2	2.00	0.41
1:A:90:TYR:CE1	1:A:305:LYS:HG2	2.55	0.41
1:B:1192:ASP:HA	1:B:1193:PRO:HD3	1.91	0.41
1:A:1309:LEU:HD23	1:A:1309:LEU:HA	1.93	0.41
1:A:1335:LEU:HD12	1:A:1335:LEU:HA	1.93	0.40
1:B:77:ALA:HB2	1:B:273:LYS:HE3	2.03	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)
10:A:1823:HOH:O	10:B:1876:HOH:O[2_454]	2.17	0.03

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	668/692 (96%)	653 (98%)	15 (2%)	0	100	100
1	B	675/692 (98%)	660 (98%)	14 (2%)	1 (0%)	48	51
All	All	1343/1384 (97%)	1313 (98%)	29 (2%)	1 (0%)	48	51

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	168	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	535/582 (92%)	532 (99%)	3 (1%)	84 89
1	B	532/582 (91%)	527 (99%)	5 (1%)	75 82
All	All	1067/1164 (92%)	1059 (99%)	8 (1%)	81 87

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

Mol	Chain	Res	Type
1	A	258	PHE
1	A	1192	ASP
1	A	1246	ASP
1	B	49[A]	GLN
1	B	49[B]	GLN
1	B	258	PHE
1	B	1171	ILE
1	B	1192	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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

21 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	BDP	C	1	2,5	12,12,13	0.84	0	14,17,19	1.24	1 (7%)
2	GNS	C	2	2	15,15,16	0.74	0	17,22,24	1.50	2 (11%)
2	BDP	C	3	2	12,12,13	0.81	0	14,17,19	0.71	0
2	GNS	C	4	2	15,15,16	0.61	0	17,22,24	1.53	2 (11%)
2	BDP	C	5	8,2	12,12,13	0.83	0	14,17,19	0.71	0
2	GNS	C	6	2	15,15,16	0.62	0	17,22,24	1.72	3 (17%)
3	GLC	D	1	3	12,12,12	0.53	0	17,17,17	0.57	0
3	GLC	D	2	3	11,11,12	0.66	0	15,15,17	0.93	1 (6%)
3	GLC	D	3	3	11,11,12	0.62	0	15,15,17	0.97	1 (6%)
3	GLC	D	4	3	11,11,12	0.50	0	15,15,17	1.04	1 (6%)
2	BDP	E	1[A]	2,5	12,12,13	0.83	0	14,17,19	1.16	1 (7%)
2	GNS	E	2[A]	2	15,15,16	0.54	0	17,22,24	1.96	4 (23%)
2	BDP	E	3[A]	2	12,12,13	0.84	0	14,17,19	1.09	1 (7%)
2	GNS	E	4[A]	2	15,15,16	0.55	0	17,22,24	1.88	5 (29%)
2	GNS	E	4[B]	2	15,15,16	0.67	0	17,22,24	1.47	1 (5%)
2	BDP	E	5	2	12,12,13	0.86	0	14,17,19	0.89	0
2	GNS	E	6	2	15,15,16	0.65	0	17,22,24	1.71	2 (11%)
3	GLC	F	1	3	12,12,12	0.48	0	17,17,17	0.48	0
3	GLC	F	2	3	11,11,12	0.58	0	15,15,17	0.96	1 (6%)
3	GLC	F	3	3	11,11,12	0.59	0	15,15,17	0.79	0
3	GLC	F	4	3	11,11,12	0.49	0	15,15,17	1.36	1 (6%)

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	BDP	C	1	2,5	-	0/4/21/24	0/1/1/1
2	GNS	C	2	2	-	0/7/24/27	0/1/1/1
2	BDP	C	3	2	-	0/4/21/24	0/1/1/1
2	GNS	C	4	2	-	1/7/24/27	0/1/1/1
2	BDP	C	5	8,2	-	1/4/21/24	0/1/1/1
2	GNS	C	6	2	-	1/7/24/27	0/1/1/1
3	GLC	D	1	3	-	0/2/22/22	0/1/1/1
3	GLC	D	2	3	-	0/2/19/22	0/1/1/1
3	GLC	D	3	3	-	0/2/19/22	0/1/1/1
3	GLC	D	4	3	-	0/2/19/22	0/1/1/1
2	BDP	E	1[A]	2,5	-	0/4/21/24	0/1/1/1
2	GNS	E	2[A]	2	-	2/7/24/27	0/1/1/1
2	BDP	E	3[A]	2	-	0/4/21/24	0/1/1/1
2	GNS	E	4[A]	2	-	0/7/24/27	0/1/1/1
2	GNS	E	4[B]	2	-	0/7/24/27	0/1/1/1
2	BDP	E	5	2	-	0/4/21/24	0/1/1/1
2	GNS	E	6	2	-	0/7/24/27	0/1/1/1
3	GLC	F	1	3	-	1/2/22/22	0/1/1/1
3	GLC	F	2	3	-	0/2/19/22	0/1/1/1
3	GLC	F	3	3	-	0/2/19/22	0/1/1/1
3	GLC	F	4	3	-	0/2/19/22	0/1/1/1

There are no bond length outliers.

All (27) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	6	GNS	O2S-S1-O3S	-5.26	108.67	120.36
2	E	4[B]	GNS	O2S-S1-O3S	-5.12	108.97	120.36
2	E	6	GNS	O2S-S1-O3S	-5.06	109.11	120.36
2	E	2[A]	GNS	O2S-S1-O3S	-4.93	109.39	120.36
2	C	2	GNS	O2S-S1-O3S	-4.92	109.42	120.36
2	E	2[A]	GNS	C1-O5-C5	4.83	118.66	112.19
2	E	4[A]	GNS	C3-C2-N2	-4.54	104.36	110.32
2	C	4	GNS	O2S-S1-O3S	-4.36	110.67	120.36
3	F	4	GLC	C1-O5-C5	4.04	117.60	112.19
2	E	4[A]	GNS	O2S-S1-O3S	-4.02	111.41	120.36
2	E	6	GNS	C1-O5-C5	3.14	116.39	112.19
3	D	4	GLC	C1-O5-C5	3.05	116.27	112.19
2	C	2	GNS	O5-C1-C2	-2.93	106.76	111.29
2	E	1[A]	BDP	C1-C2-C3	2.88	113.84	109.64
2	C	1	BDP	C1-C2-C3	2.68	113.55	109.64
3	D	3	GLC	O5-C1-C2	-2.60	104.59	110.79
2	E	4[A]	GNS	C3-C4-C5	-2.43	105.83	110.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	6	GNS	O5-C1-C2	-2.33	107.69	111.29
2	C	4	GNS	C1-O5-C5	2.31	115.28	112.19
2	C	6	GNS	C1-O5-C5	2.28	115.24	112.19
2	E	4[A]	GNS	O5-C5-C6	2.22	111.99	107.66
2	E	4[A]	GNS	O4-C4-C3	-2.19	105.22	110.38
3	F	2	GLC	O5-C5-C6	2.17	111.89	107.66
2	E	2[A]	GNS	C3-C2-N2	-2.06	107.61	110.32
3	D	2	GLC	C1-O5-C5	2.06	114.95	112.19
2	E	3[A]	BDP	C3-C4-C5	-2.03	105.80	109.30
2	E	2[A]	GNS	O4-C4-C3	-2.03	105.59	110.38

There are no chirality outliers.

All (6) torsion outliers are listed below:

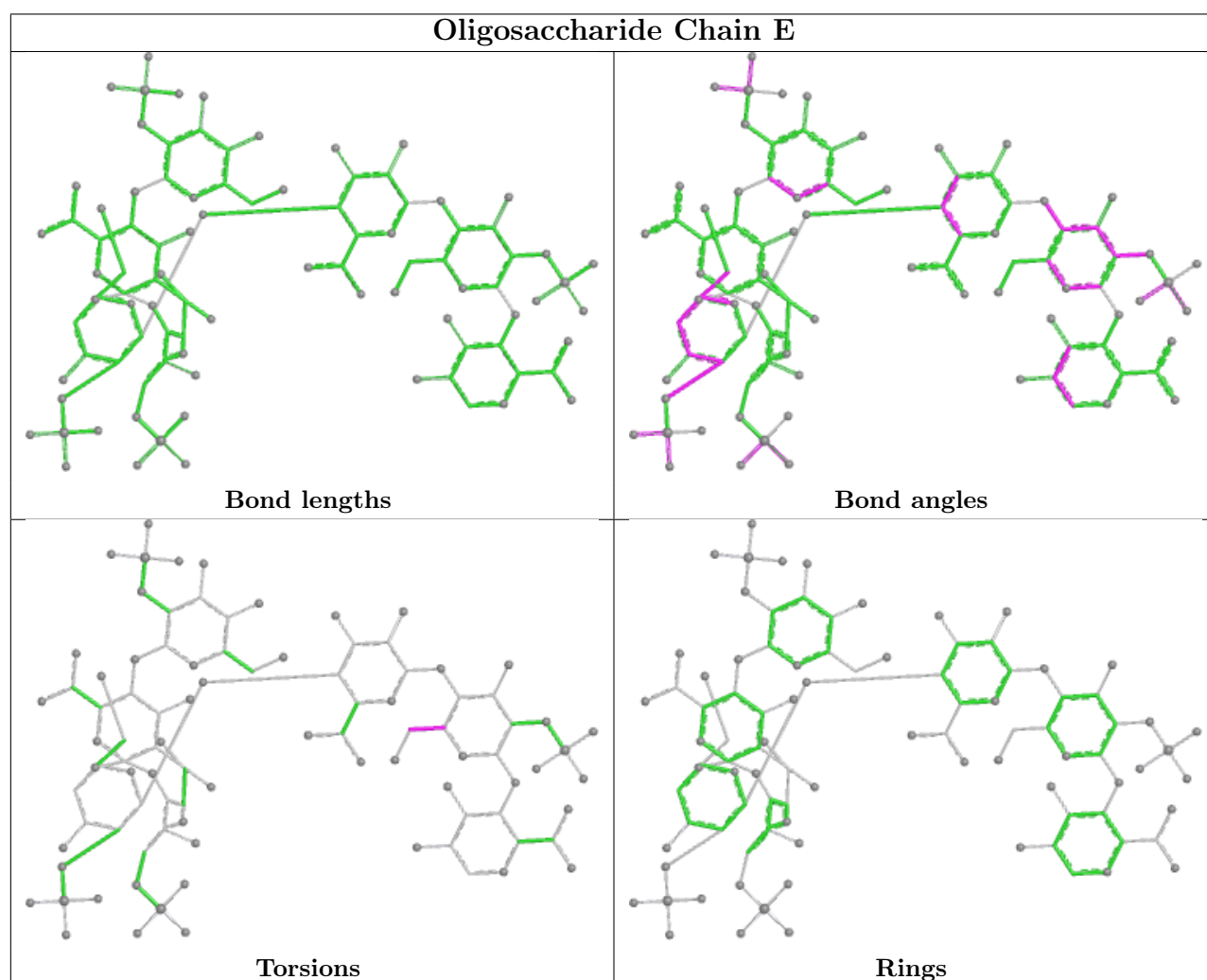
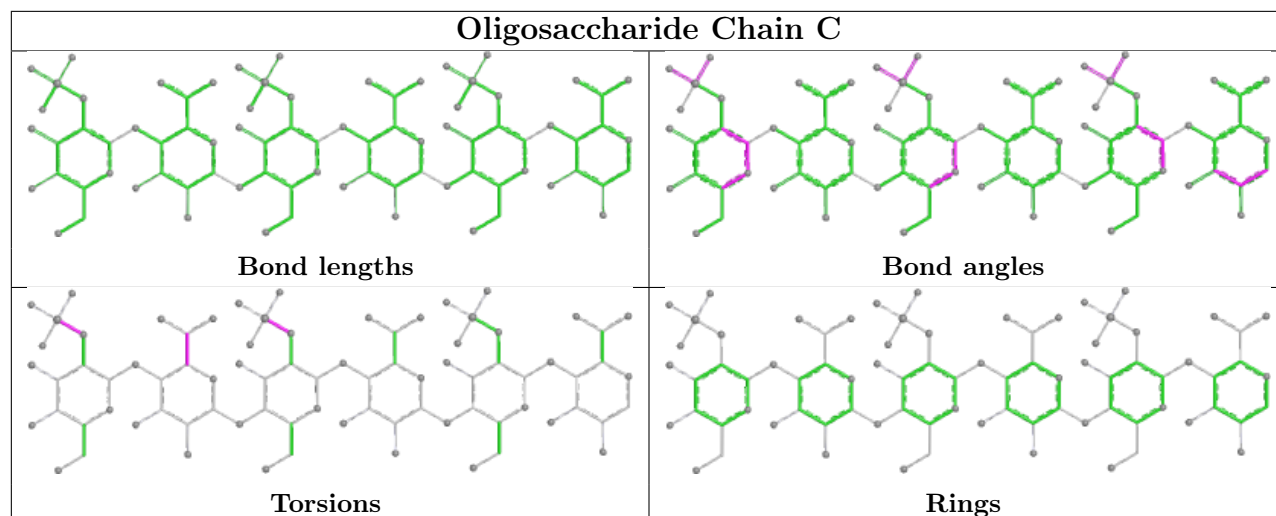
Mol	Chain	Res	Type	Atoms
2	E	2[A]	GNS	O5-C5-C6-O6
2	E	2[A]	GNS	C4-C5-C6-O6
3	F	1	GLC	C4-C5-C6-O6
2	C	5	BDP	O5-C5-C6-O6A
2	C	4	GNS	C2-N2-S1-O2S
2	C	6	GNS	C2-N2-S1-O3S

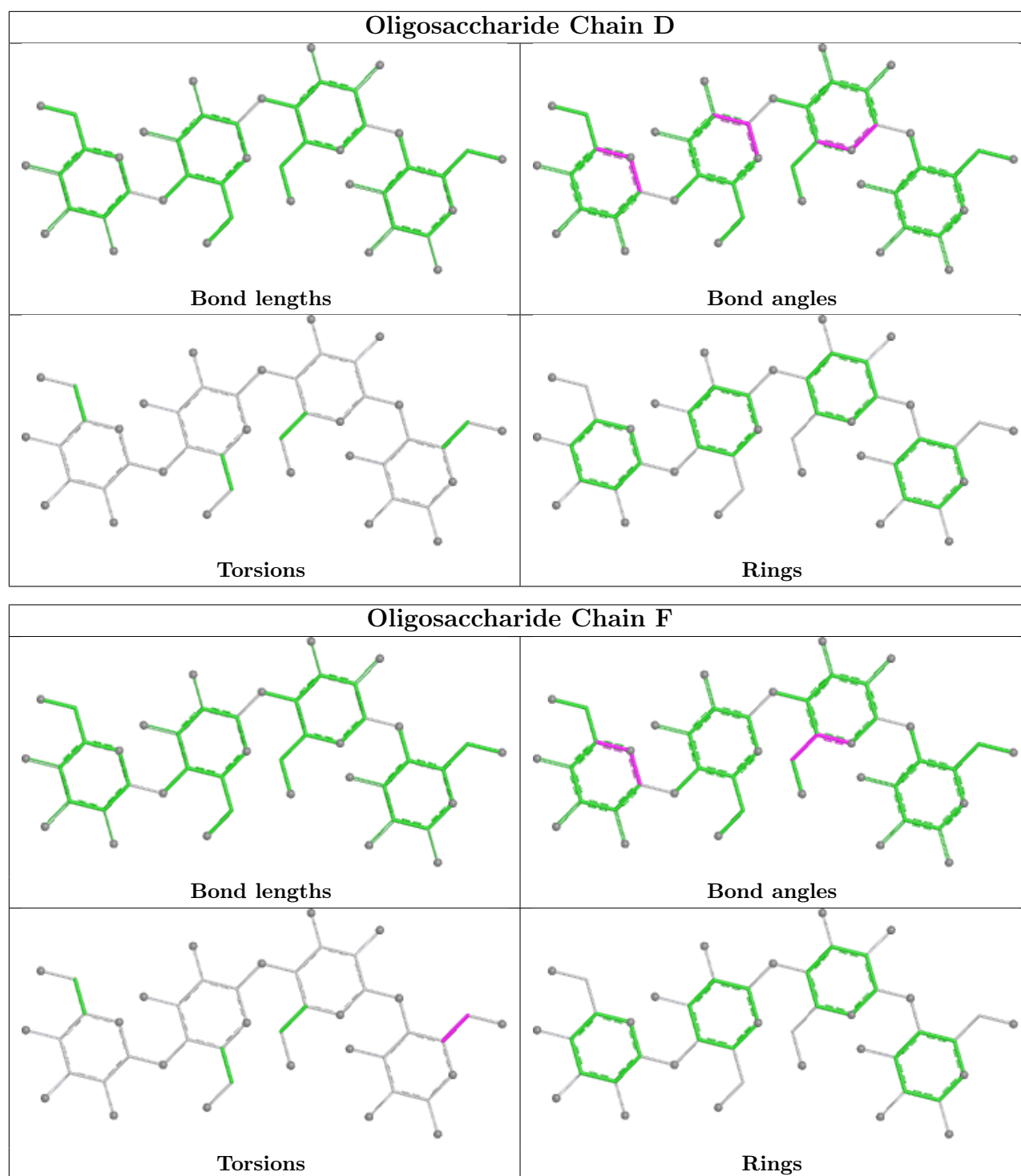
There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	2	GNS	1	0
2	E	4[A]	GNS	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 oligosaccharide.





5.6 Ligand geometry [i](#)

Of 35 ligands modelled in this entry, 11 are monoatomic - leaving 24 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The

Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
4	A3P	B	1401	-	25,29,29	0.72	0	31,45,45	0.79	1 (3%)
5	NPO	A	1408	2	10,10,10	0.94	0	11,13,13	0.95	0
6	EDO	A	1421	-	3,3,3	0.44	0	2,2,2	0.58	0
6	EDO	A	1418	-	3,3,3	0.42	0	2,2,2	0.34	0
6	EDO	B	1414	-	3,3,3	0.44	0	2,2,2	0.61	0
6	EDO	A	1415	-	3,3,3	0.39	0	2,2,2	0.46	0
6	EDO	B	1413	-	3,3,3	0.57	0	2,2,2	0.36	0
6	EDO	A	1414	-	3,3,3	0.44	0	2,2,2	0.39	0
9	TLA	B	1422	8	9,9,9	1.00	0	12,12,12	1.02	0
6	EDO	B	1416	-	3,3,3	0.49	0	2,2,2	0.48	0
9	TLA	B	1423	-	9,9,9	1.03	0	12,12,12	1.46	3 (25%)
6	EDO	B	1415	-	3,3,3	0.39	0	2,2,2	0.55	0
6	EDO	A	1417	-	3,3,3	0.42	0	2,2,2	0.52	0
5	NPO	B	1408[A]	2	10,10,10	0.96	0	11,13,13	1.39	2 (18%)
6	EDO	A	1420	-	3,3,3	0.53	0	2,2,2	0.08	0
6	EDO	A	1422	-	3,3,3	0.46	0	2,2,2	0.48	0
6	EDO	A	1413	-	3,3,3	0.36	0	2,2,2	0.80	0
6	EDO	A	1419	-	3,3,3	0.46	0	2,2,2	0.42	0
6	EDO	A	1423	-	3,3,3	0.53	0	2,2,2	0.23	0
9	TLA	A	1431	8	9,9,9	0.99	0	12,12,12	0.99	0
6	EDO	B	1417	-	3,3,3	0.51	0	2,2,2	0.51	0
6	EDO	A	1416	-	3,3,3	0.49	0	2,2,2	0.43	0
9	TLA	A	1432	-	9,9,9	1.01	0	12,12,12	1.21	1 (8%)
4	A3P	A	1401	-	25,29,29	0.73	0	31,45,45	0.67	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	A3P	B	1401	-	-	0/11/31/31	0/3/3/3
5	NPO	A	1408	2	-	0/2/4/4	0/1/1/1
6	EDO	A	1421	-	-	1/1/1/1	-
6	EDO	A	1418	-	-	0/1/1/1	-
6	EDO	B	1414	-	-	0/1/1/1	-
6	EDO	A	1415	-	-	1/1/1/1	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
6	EDO	B	1413	-	-	0/1/1/1	-
6	EDO	A	1414	-	-	0/1/1/1	-
9	TLA	B	1422	8	-	0/12/12/12	-
6	EDO	B	1416	-	-	0/1/1/1	-
9	TLA	B	1423	-	-	3/12/12/12	-
6	EDO	B	1415	-	-	0/1/1/1	-
6	EDO	A	1417	-	-	0/1/1/1	-
5	NPO	B	1408[A]	2	-	0/2/4/4	0/1/1/1
6	EDO	A	1420	-	-	0/1/1/1	-
6	EDO	A	1422	-	-	1/1/1/1	-
6	EDO	A	1413	-	-	1/1/1/1	-
6	EDO	A	1419	-	-	0/1/1/1	-
6	EDO	A	1423	-	-	1/1/1/1	-
9	TLA	A	1431	8	-	0/12/12/12	-
6	EDO	B	1417	-	-	1/1/1/1	-
6	EDO	A	1416	-	-	0/1/1/1	-
9	TLA	A	1432	-	-	0/12/12/12	-
4	A3P	A	1401	-	-	0/11/31/31	0/3/3/3

There are no bond length outliers.

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	1408[A]	NPO	C6-C1-N1	-2.69	116.98	119.34
9	B	1423	TLA	O11-C1-C2	2.57	120.45	113.31
5	B	1408[A]	NPO	C2-C1-N1	2.57	121.58	119.34
4	A	1401	A3P	C5-C6-N6	2.23	123.71	120.31
9	B	1423	TLA	O41-C4-C3	2.17	119.35	113.31
4	B	1401	A3P	C5-C6-N6	2.15	123.59	120.31
9	B	1423	TLA	C3-C2-C1	2.04	114.35	109.82
9	A	1432	TLA	O11-C1-C2	2.00	118.88	113.31

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	A	1423	EDO	O1-C1-C2-O2
9	B	1423	TLA	C2-C3-C4-O4
6	B	1417	EDO	O1-C1-C2-O2
9	B	1423	TLA	C2-C3-C4-O41
6	A	1413	EDO	O1-C1-C2-O2

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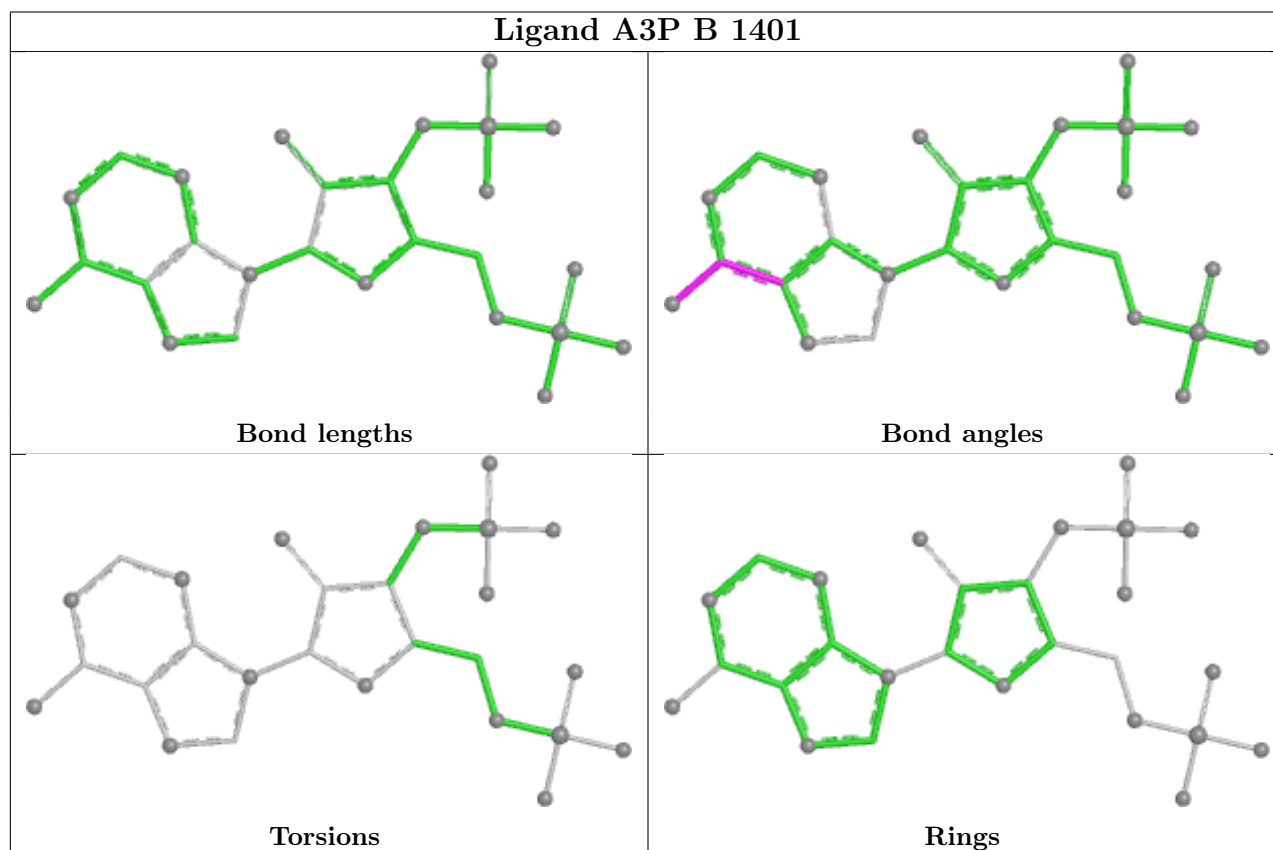
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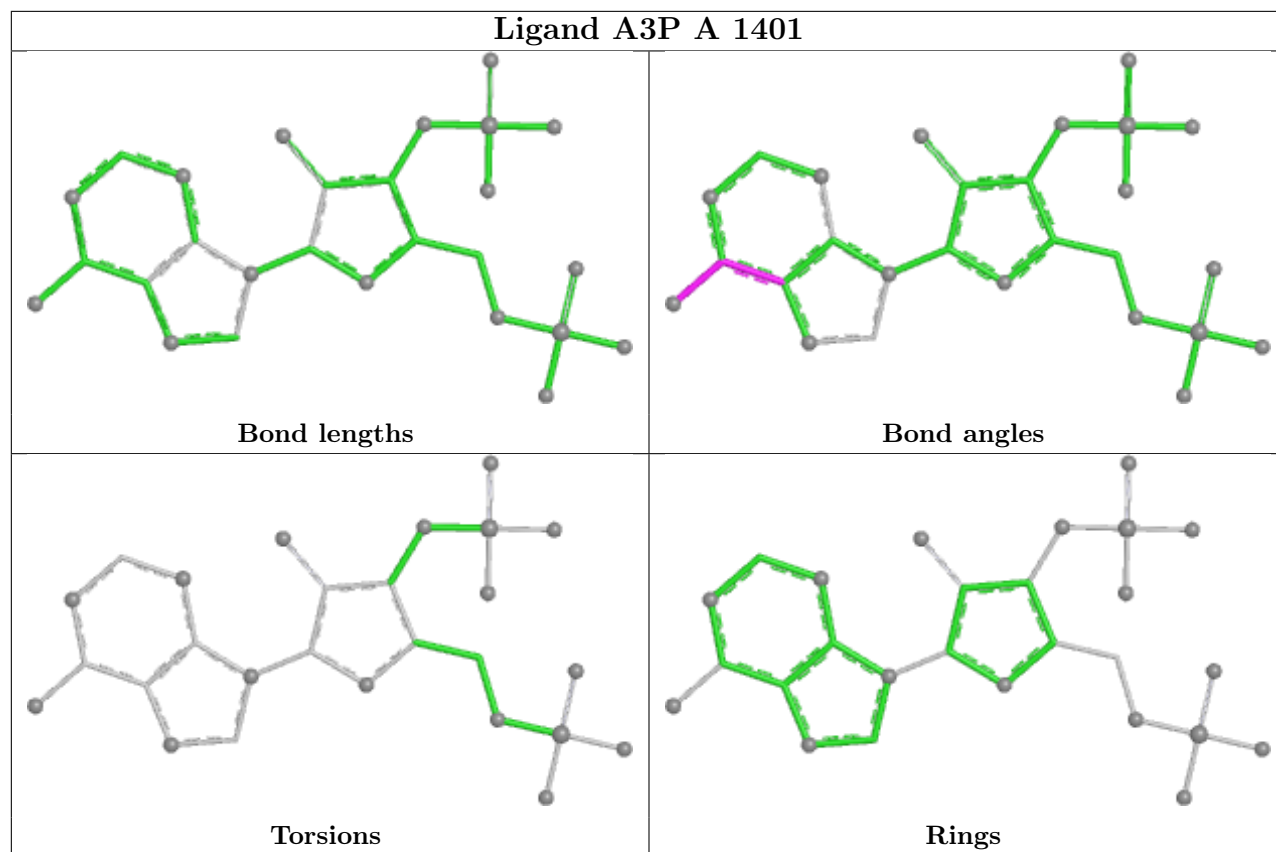
Mol	Chain	Res	Type	Atoms
6	A	1415	EDO	O1-C1-C2-O2
6	A	1422	EDO	O1-C1-C2-O2
6	A	1421	EDO	O1-C1-C2-O2
9	B	1423	TLA	O3-C3-C4-O4

There are no ring outliers.

No monomer is involved in short contacts.

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	670/692 (96%)	-0.44	5 (0%) 84 85	17, 31, 57, 98	2 (0%)
1	B	675/692 (97%)	-0.03	25 (3%) 45 48	11, 38, 70, 108	7 (1%)
All	All	1345/1384 (97%)	-0.24	30 (2%) 62 64	11, 33, 65, 108	9 (0%)

All (30) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	1387	ILE	5.1
1	B	1386	TRP	4.9
1	B	1128	ALA	4.4
1	B	55	ASP	3.7
1	A	92	PHE	3.6
1	A	54	GLY	3.4
1	B	178	ILE	3.2
1	B	354	ARG	3.2
1	B	191	GLY	3.1
1	A	52	ALA	3.1
1	A	1173	ASP	3.0
1	B	186	ALA	2.8
1	B	2	ILE	2.7
1	B	52	ALA	2.7
1	B	1384	ARG	2.7
1	B	343	VAL	2.6
1	B	51	ALA	2.5
1	B	172	ALA	2.5
1	B	183	VAL	2.5
1	B	1389	GLU	2.5
1	B	173	ALA	2.4
1	B	1173	ASP	2.3
1	B	361	LEU	2.2
1	B	333	ILE	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	342	ALA	2.2
1	B	1131	LYS	2.2
1	B	357	VAL	2.1
1	B	1385	ARG	2.1
1	A	173	ALA	2.1
1	B	72[A]	GLN	2.1

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

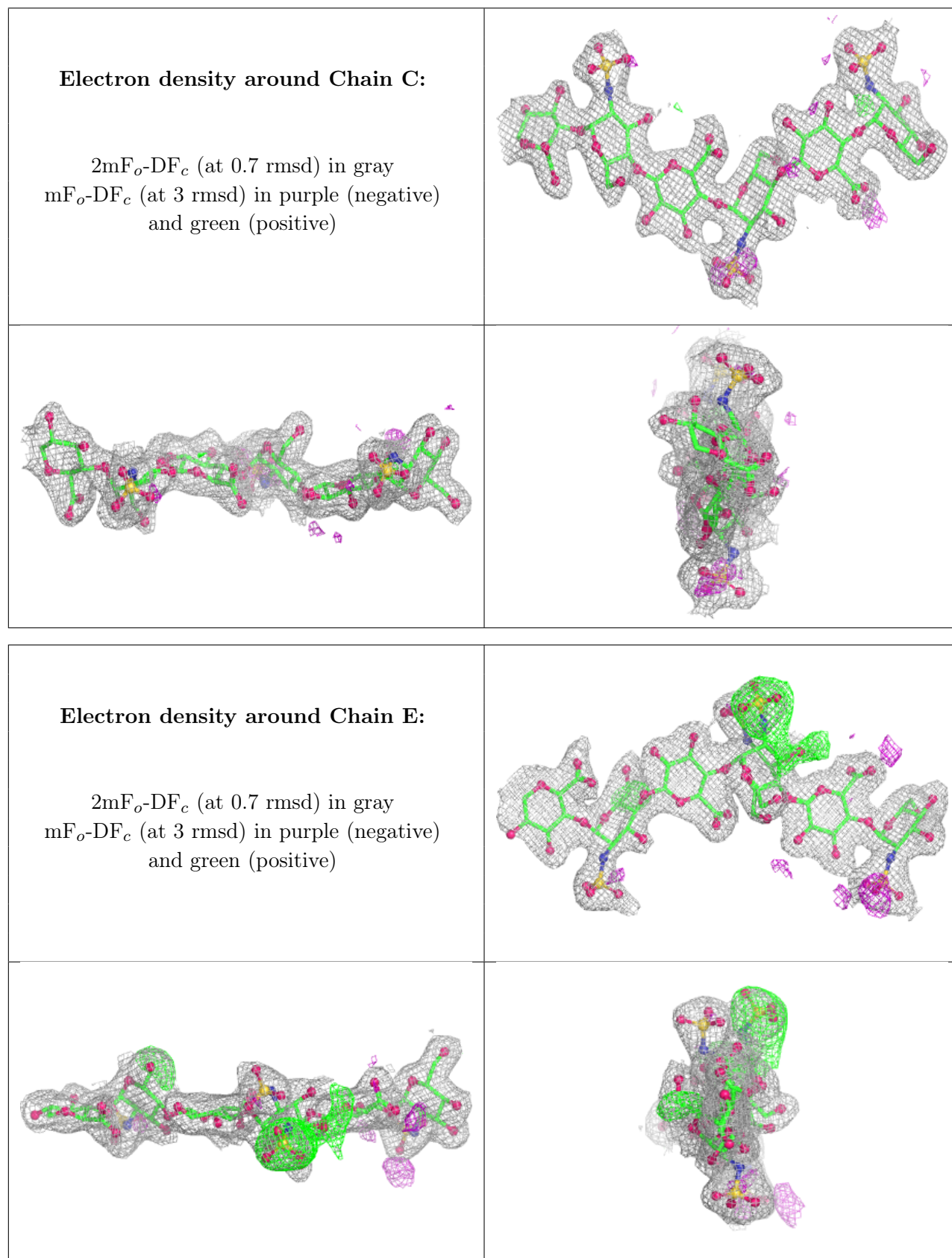
There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [i](#)

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

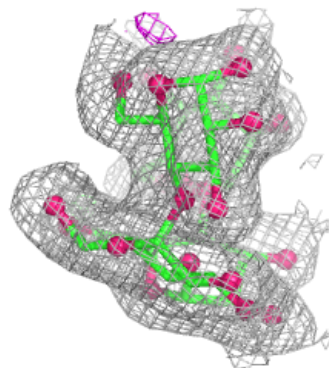
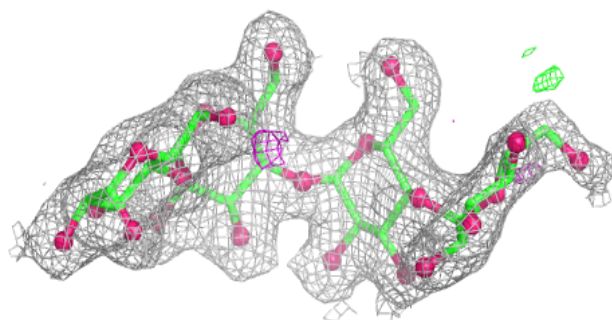
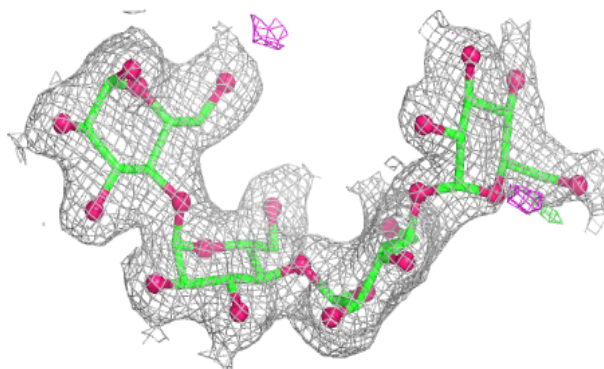
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q < 0.9
3	GLC	F	4	11/12	0.71	0.13	59,63,66,69	0
2	GNS	E	2[A]	15/16	0.72	0.14	55,59,66,69	15
2	BDP	E	1[A]	12/13	0.79	0.11	52,61,67,68	12
3	GLC	D	4	11/12	0.82	0.13	34,43,51,53	11
2	GNS	C	2	15/16	0.84	0.09	45,55,74,83	0
2	BDP	C	3	12/13	0.85	0.09	38,44,53,59	0
3	GLC	F	2	11/12	0.86	0.10	35,36,41,44	0
2	BDP	C	1	12/13	0.88	0.07	45,50,55,56	0
3	GLC	F	1	12/12	0.88	0.10	25,32,36,38	0
2	BDP	E	3[A]	12/13	0.90	0.09	34,42,53,53	12
2	GNS	E	4[A]	15/16	0.91	0.11	27,34,44,49	15
3	GLC	F	3	11/12	0.91	0.08	35,38,45,47	0
2	GNS	E	4[B]	15/16	0.91	0.11	25,30,34,36	15
2	GNS	C	4	15/16	0.93	0.08	29,37,44,47	0
3	GLC	D	3	11/12	0.96	0.06	23,29,35,35	0
2	BDP	C	5	12/13	0.96	0.06	21,25,30,32	0
2	BDP	E	5	12/13	0.96	0.06	18,23,25,26	0
3	GLC	D	1	12/12	0.97	0.05	22,26,30,30	0
3	GLC	D	2	11/12	0.97	0.04	18,22,24,25	0
2	GNS	C	6	15/16	0.97	0.06	18,23,28,28	0
2	GNS	E	6	15/16	0.97	0.05	16,20,28,33	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.

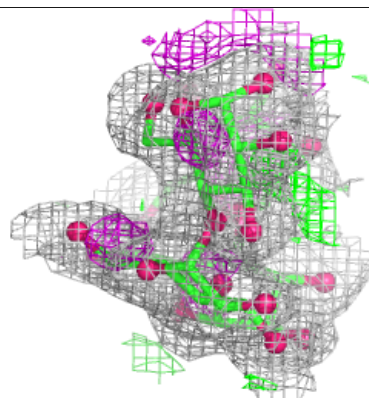
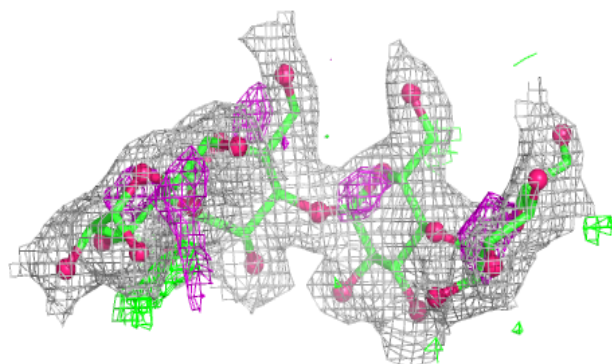
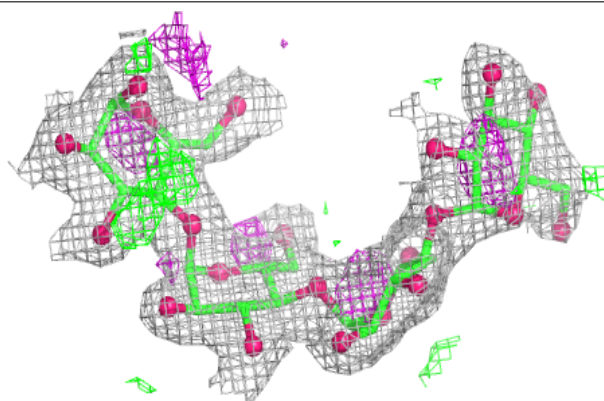


Electron density around Chain D:

$2mF_o-DF_c$ (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)



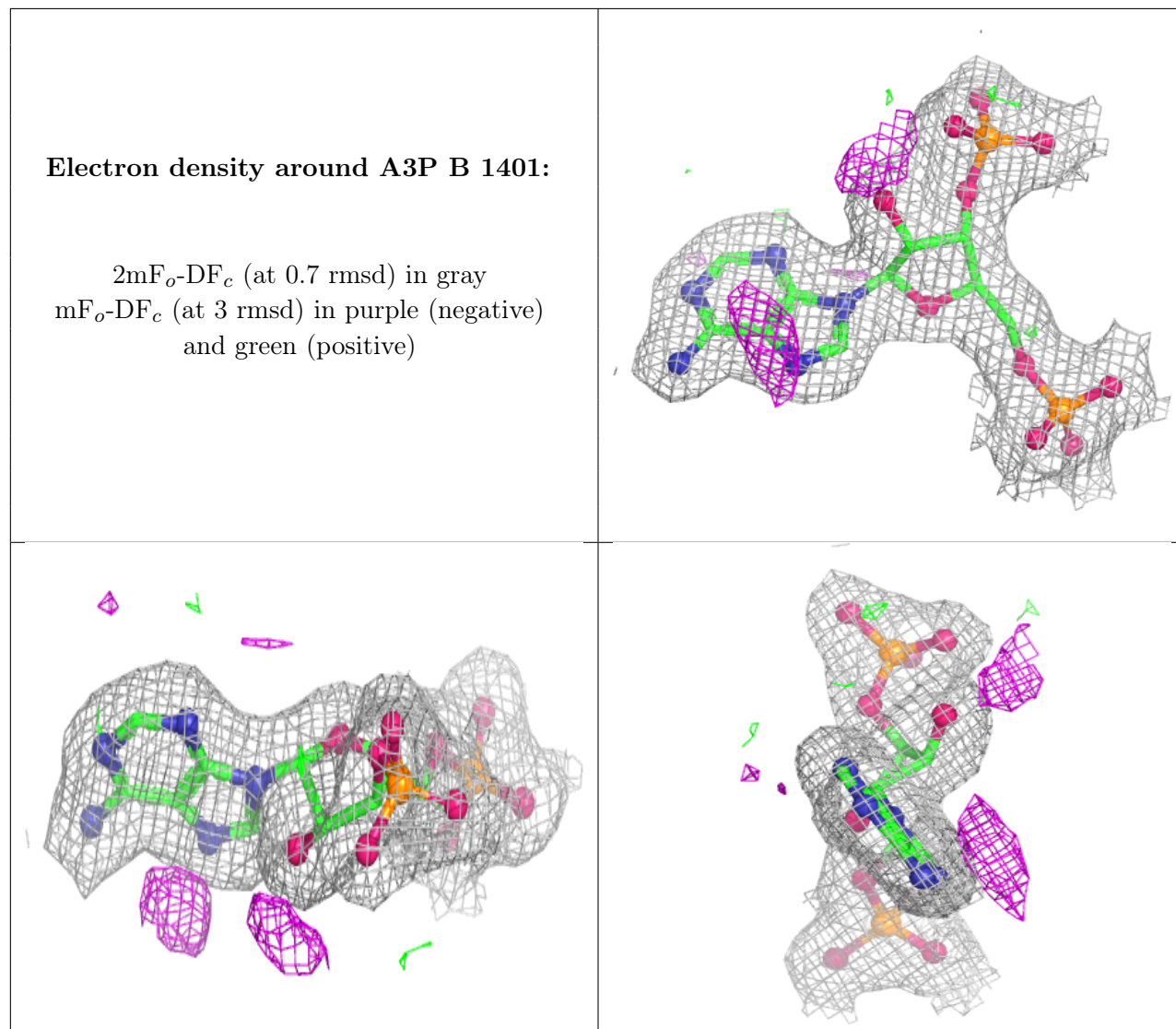
6.4 Ligands

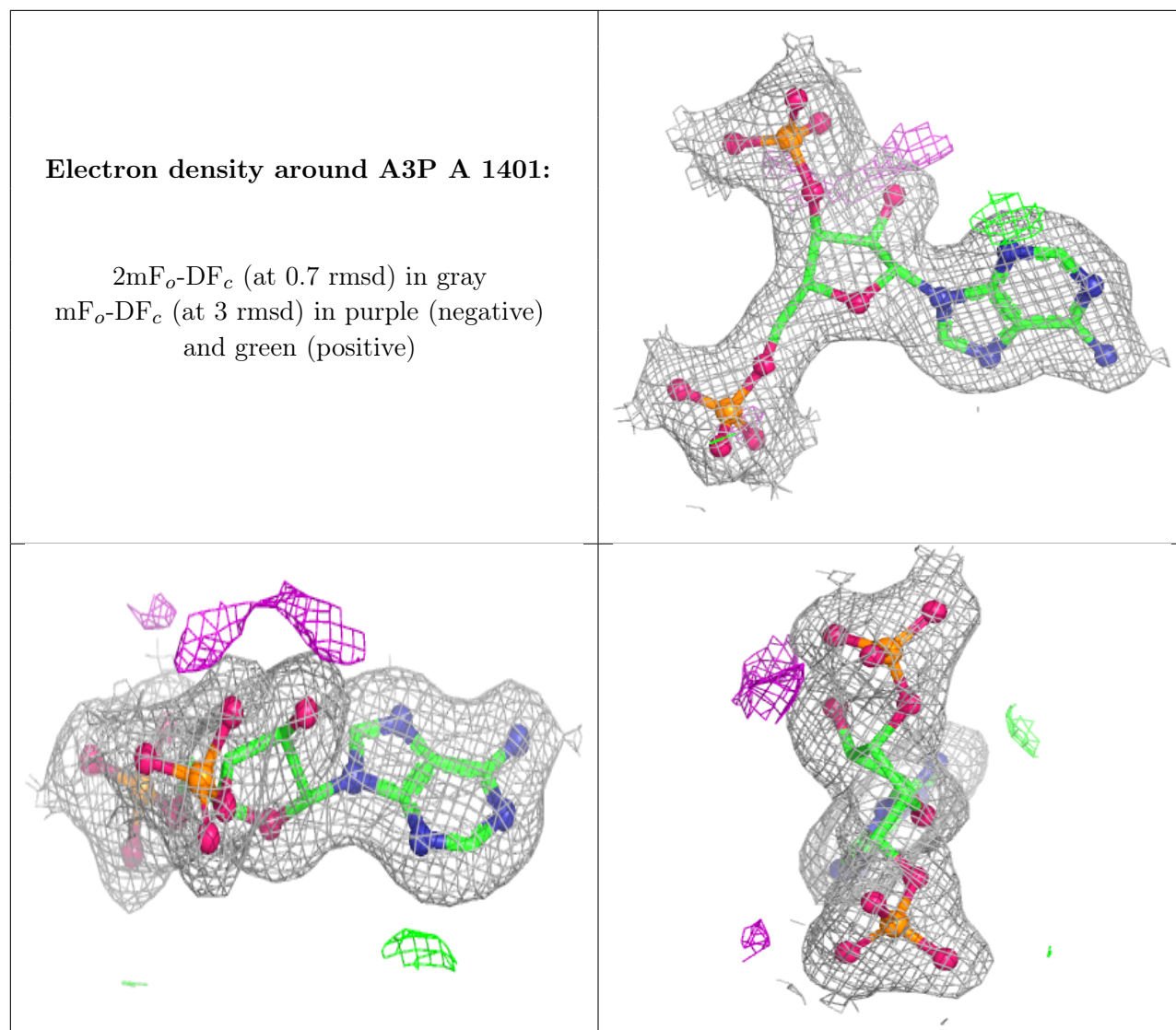
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
6	EDO	B	1416	4/4	0.75	0.22	44,45,46,48	0
8	NA	A	1427	1/1	0.76	0.13	54,54,54,54	0
9	TLA	A	1432	10/10	0.78	0.10	52,57,62,70	0
6	EDO	B	1417	4/4	0.80	0.15	37,41,49,56	0
8	NA	B	1421[A]	1/1	0.82	0.14	56,56,56,56	1
6	EDO	A	1421	4/4	0.83	0.15	33,38,43,57	0
6	EDO	A	1420	4/4	0.83	0.19	30,32,39,41	0
5	NPO	B	1408[A]	10/10	0.84	0.15	60,62,68,72	10
8	NA	A	1430	1/1	0.85	0.11	69,69,69,69	0
6	EDO	A	1418	4/4	0.87	0.13	36,38,43,46	0
6	EDO	B	1413	4/4	0.88	0.11	22,29,30,30	0
6	EDO	A	1423	4/4	0.89	0.12	31,33,42,46	0
6	EDO	A	1422	4/4	0.89	0.13	47,49,57,64	0
6	EDO	B	1414	4/4	0.89	0.13	38,43,49,50	0
9	TLA	A	1431	10/10	0.90	0.07	33,40,44,50	0
6	EDO	A	1416	4/4	0.91	0.10	25,28,29,38	0
8	NA	A	1429	1/1	0.91	0.13	40,40,40,40	0
8	NA	A	1428	1/1	0.92	0.11	38,38,38,38	1
6	EDO	A	1414	4/4	0.92	0.11	37,38,39,39	0
6	EDO	A	1413	4/4	0.92	0.13	45,49,55,55	0
8	NA	B	1420	1/1	0.93	0.07	43,43,43,43	0
9	TLA	B	1422	10/10	0.93	0.07	38,43,49,51	0
9	TLA	B	1423	10/10	0.93	0.10	33,47,54,56	0
5	NPO	A	1408	10/10	0.94	0.07	40,42,53,60	0
6	EDO	A	1419	4/4	0.95	0.11	33,36,36,37	0
6	EDO	A	1415	4/4	0.96	0.07	21,33,36,47	0
6	EDO	A	1417	4/4	0.96	0.08	25,26,26,32	0
6	EDO	B	1415	4/4	0.96	0.07	26,26,31,31	0
7	CL	A	1425	1/1	0.97	0.12	45,45,45,45	0
7	CL	B	1418	1/1	0.97	0.06	47,47,47,47	0
4	A3P	B	1401	27/27	0.98	0.05	15,19,22,25	0
7	CL	B	1419	1/1	0.98	0.16	35,35,35,35	0
7	CL	A	1426	1/1	0.98	0.13	52,52,52,52	0
4	A3P	A	1401	27/27	0.99	0.04	16,20,23,25	0
7	CL	A	1424	1/1	1.00	0.05	28,28,28,28	0

The following is a graphical depiction of the model fit to experimental electron density of all

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





6.5 Other polymers [i](#)

There are no such residues in this entry.