wwPDB X-ray Structure Validation Summary Report (i)

Feb 21, 2022 – 05:03 pm GMT

PDB ID	:	7OLY
Title	:	Structure of activin A in complex with an ActRIIB-Alk4 fusion reveal insight into activin receptor interactions
Authors	:	Hakansson, M.; Rose, N.C.; Castonguay, R.; Logan, D.T.; Krishnan, L.
Deposited on	:	2021-05-20
Resolution	:	3.27 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

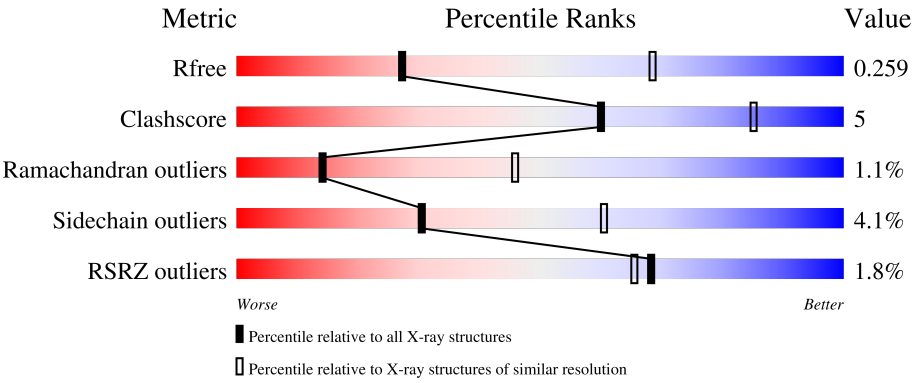
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.26
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0267
CCP4	:	7.1.010 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.26

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 3.27 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}	130704	1191 (3.30-3.22)
Clashscore	141614	1251 (3.30-3.22)
Ramachandran outliers	138981	1229 (3.30-3.22)
Sidechain outliers	138945	1228 (3.30-3.22)
RSRZ outliers	127900	1154 (3.30-3.22)

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	116	84% 16%
2	C	133	3% 63% 8% 29%
3	H	225	% 83% 13%
4	K	121	4% 46% 19% 35%
5	L	221	% 86% 12%

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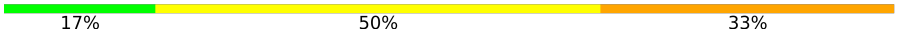
Mol	Chain	Length	Quality of chain
6	B	6	

2 Entry composition (i)

There are 8 unique types of molecules in this entry. The entry contains 5718 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 Inhibin beta A chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	116	Total	C	N	O	S	0	0	0
			904	567	155	169	13			

- Molecule 2 is a protein called Activin receptor type-2B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	95	Total	C	N	O	S	0	0	0
			781	478	138	155	10			

There are 17 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	135	GLY	-	linker	UNP Q13705
C	136	GLY	-	linker	UNP Q13705
C	137	GLY	-	linker	UNP Q13705
C	138	THR	-	linker	UNP Q13705
C	139	HIS	-	linker	UNP Q13705
C	140	THR	-	linker	UNP Q13705
C	141	CYS	-	linker	UNP Q13705
C	142	PRO	-	linker	UNP Q13705
C	143	PRO	-	linker	UNP Q13705
C	144	CYS	-	linker	UNP Q13705
C	145	PRO	-	linker	UNP Q13705
C	146	ALA	-	linker	UNP Q13705
C	147	PRO	-	linker	UNP Q13705
C	148	GLU	-	linker	UNP Q13705
C	149	LEU	-	linker	UNP Q13705
C	150	LEU	-	linker	UNP Q13705
C	151	GLY	-	linker	UNP Q13705

- Molecule 3 is a protein called Fab heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	H	219	Total	C	N	O	S	0	0	0
			1625	1024	268	328	5			

- Molecule 4 is a protein called Activin receptor type-1B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	K	79	Total	C	N	O	S	0	0	0
			609	377	104	116	12			

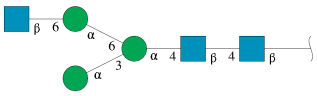
There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
K	127	THR	-	linker	UNP P36896
K	128	GLY	-	linker	UNP P36896
K	129	GLY	-	linker	UNP P36896
K	130	GLY	-	linker	UNP P36896
K	131	THR	-	linker	UNP P36896
K	132	HIS	-	linker	UNP P36896
K	133	THR	-	linker	UNP P36896
K	134	CYS	-	linker	UNP P36896
K	135	PRO	-	linker	UNP P36896
K	136	PRO	-	linker	UNP P36896
K	137	CYS	-	linker	UNP P36896
K	138	PRO	-	linker	UNP P36896
K	139	ALA	-	linker	UNP P36896
K	140	PRO	-	linker	UNP P36896
K	141	GLU	-	linker	UNP P36896
K	142	LEU	-	linker	UNP P36896
K	143	LEU	-	linker	UNP P36896
K	144	GLY	-	linker	UNP P36896

- Molecule 5 is a protein called Fab light chain.

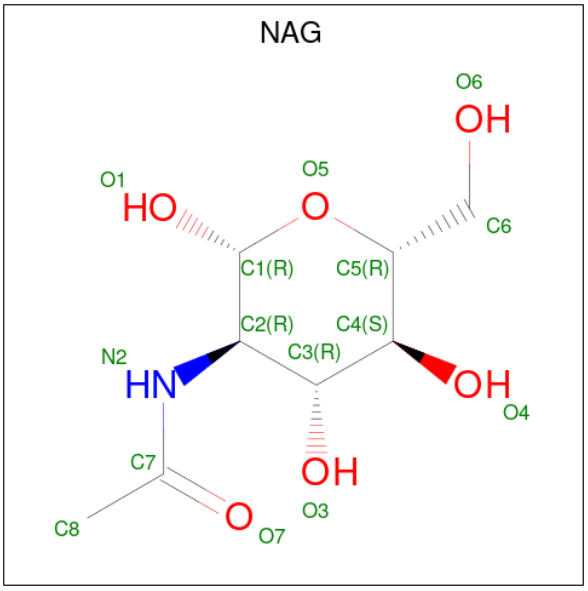
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	L	220	Total	C	N	O	S	0	0	0
			1695	1062	285	343	5			

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



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf	Trace
6	B	6	Total C N O 75 42 3 30	0	0	0

- Molecule 7 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: $C_8H_{15}NO_6$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	C	1	Total C N O 14 8 1 5	0	0

- Molecule 8 is water.

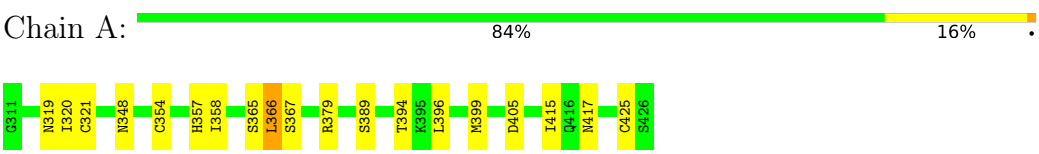
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	C	1	Total O 1 1	0	0
8	H	5	Total O 5 5	0	0
8	L	9	Total O 9 9	0	0

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.

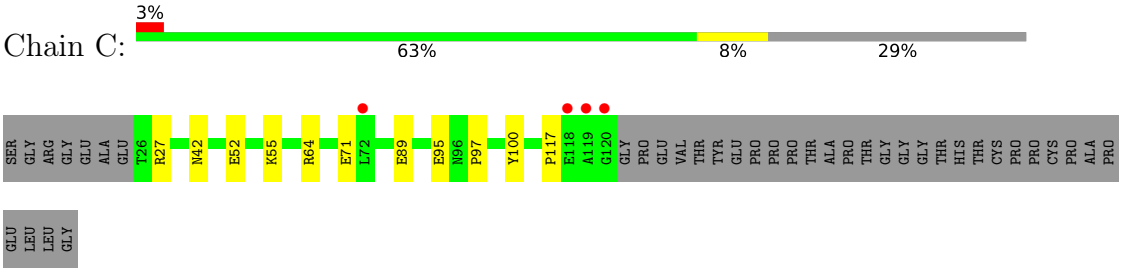
• Molecule 1: Inhibin beta A chain

Chain A:



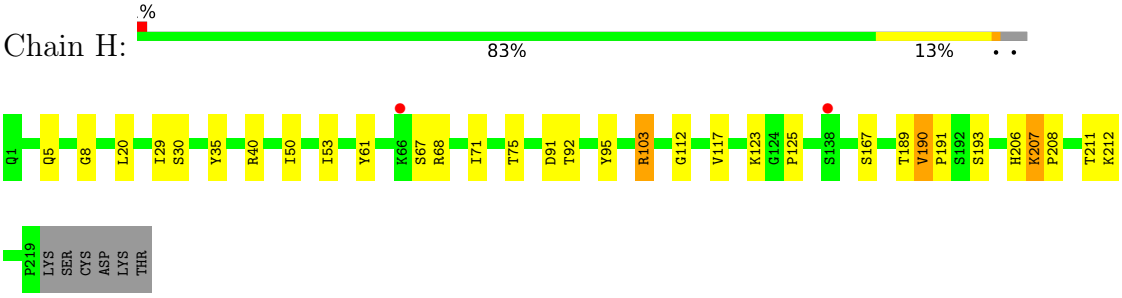
• Molecule 2: Activin receptor type-2B

Chain C:



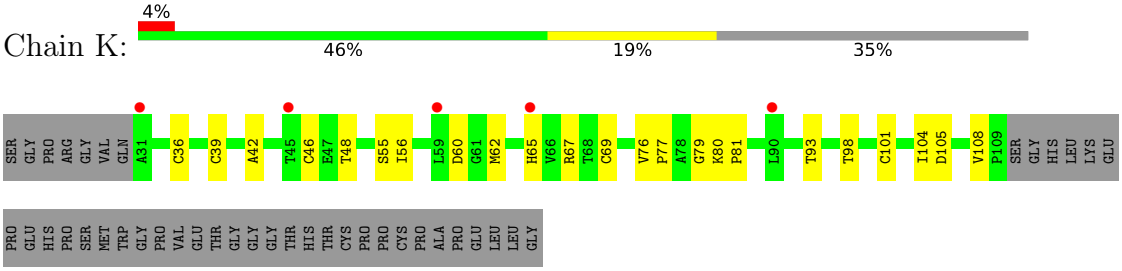
• Molecule 3: Fab heavy chain

Chain H:



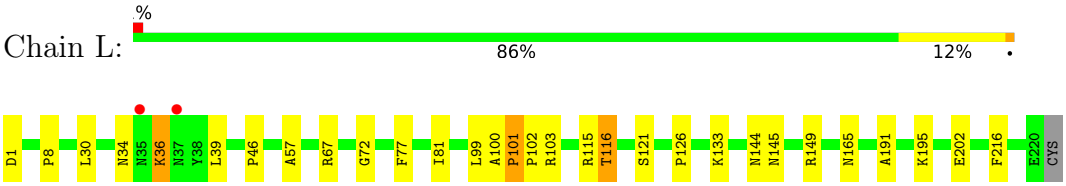
• Molecule 4: Activin receptor type-1B

Chain K:



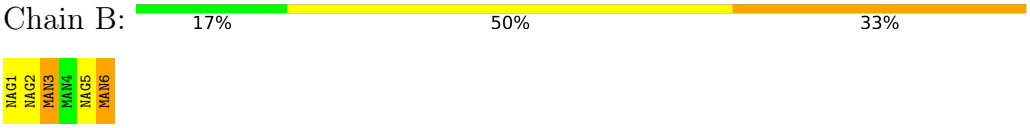
• Molecule 5: Fab light chain

Chain L:



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

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 61 2 2	Depositor
Cell constants a, b, c, α, β, γ	68.38Å 68.38Å 975.54Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	49.25 – 3.27 49.25 – 3.27	Depositor EDS
% Data completeness (in resolution range)	99.7 (49.25-3.27) 99.7 (49.25-3.27)	Depositor EDS
R_{merge}	0.32	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.05 (at 3.25Å)	Xtriage
Refinement program	BUSTER 2.11.8, REFMAC 5.8.0267	Depositor
R, R_{free}	0.234 , 0.269 0.231 , 0.259	Depositor DCC
R_{free} test set	1209 reflections (5.26%)	wwPDB-VP
Wilson B-factor (Å^2)	109.8	Xtriage
Anisotropy	0.099	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	(Not available) , (Not available)	EDS
L-test for twinning[2]	$< \|L\| > = 0.39$, $< L^2 > = 0.21$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	5718	wwPDB-VP
Average B, all atoms (Å^2)	112.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.14% 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, MAN

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	0.37	0/927	0.54	0/1248
2	C	0.32	0/799	0.47	0/1079
3	H	0.43	0/1665	0.62	0/2275
4	K	0.41	0/621	0.60	0/844
5	L	0.48	0/1732	0.63	0/2354
All	All	0.42	0/5744	0.59	0/7800

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	904	0	856	9	0
2	C	781	0	688	5	0
3	H	1625	0	1601	13	0
4	K	609	0	576	14	0
5	L	1695	0	1649	13	0
6	B	75	0	64	1	0
7	C	14	0	13	0	0
8	C	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
8	H	5	0	0	0	0
8	L	9	0	0	0	0
All	All	5718	0	5447	51	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 5.

The worst 5 of 51 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)
5:L:30:LEU:HG	5:L:36:LYS:HB3	1.55	0.89
3:H:92:THR:HG22	3:H:117:VAL:H	1.40	0.86
3:H:29:ILE:HD11	3:H:75:THR:HA	1.81	0.62
1:A:357:HIS:ND1	1:A:358:ILE:HG23	2.16	0.59
5:L:1:ASP:HA	5:L:102:PRO:HG3	1.84	0.59

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	114/116 (98%)	103 (90%)	9 (8%)	2 (2%)	8 35
2	C	93/133 (70%)	88 (95%)	5 (5%)	0	100 100
3	H	217/225 (96%)	201 (93%)	16 (7%)	0	100 100
4	K	77/121 (64%)	66 (86%)	10 (13%)	1 (1%)	12 41
5	L	218/221 (99%)	197 (90%)	16 (7%)	5 (2%)	6 29
All	All	719/816 (88%)	655 (91%)	56 (8%)	8 (1%)	14 46

5 of 8 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
5	L	36	LYS
5	L	101	PRO
5	L	103	ARG
5	L	145	ASN
4	K	62	MET

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	102/102 (100%)	97 (95%)	5 (5%)	25	55
2	C	85/113 (75%)	83 (98%)	2 (2%)	49	72
3	H	189/195 (97%)	178 (94%)	11 (6%)	20	50
4	K	71/104 (68%)	69 (97%)	2 (3%)	43	69
5	L	192/193 (100%)	186 (97%)	6 (3%)	40	67
All	All	639/707 (90%)	613 (96%)	26 (4%)	30	60

5 of 26 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	H	190	VAL
3	H	212	LYS
5	L	165	ASN
3	H	207	LYS
4	K	60	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
5	L	43	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)

6 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	$\#\|Z\| > 2$
6	NAG	B	1	2,6	14,14,15	0.37	0	17,19,21	1.54	3 (17%)
6	NAG	B	2	6	14,14,15	0.42	0	17,19,21	1.23	2 (11%)
6	MAN	B	3	6	11,11,12	0.53	0	15,15,17	1.13	1 (6%)
6	MAN	B	4	6	11,11,12	0.51	0	15,15,17	0.73	0
6	NAG	B	5	6	14,14,15	0.36	0	17,19,21	0.77	1 (5%)
6	MAN	B	6	6	11,11,12	0.66	0	15,15,17	1.53	2 (13%)

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
6	NAG	B	1	2,6	-	2/6/23/26	0/1/1/1
6	NAG	B	2	6	-	0/6/23/26	0/1/1/1
6	MAN	B	3	6	-	2/2/19/22	0/1/1/1
6	MAN	B	4	6	-	2/2/19/22	0/1/1/1
6	NAG	B	5	6	-	1/6/23/26	0/1/1/1
6	MAN	B	6	6	-	0/2/19/22	0/1/1/1

There are no bond length outliers.

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
6	B	1	NAG	C1-O5-C5	4.67	118.52	112.19
6	B	6	MAN	C1-O5-C5	4.62	118.46	112.19
6	B	2	NAG	O5-C1-C2	3.14	116.25	111.29
6	B	1	NAG	O5-C1-C2	3.02	116.06	111.29
6	B	3	MAN	C1-O5-C5	2.79	115.97	112.19

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	B	4	MAN	O5-C5-C6-O6
6	B	4	MAN	C4-C5-C6-O6
6	B	1	NAG	C4-C5-C6-O6
6	B	1	NAG	O5-C5-C6-O6
6	B	3	MAN	C4-C5-C6-O6

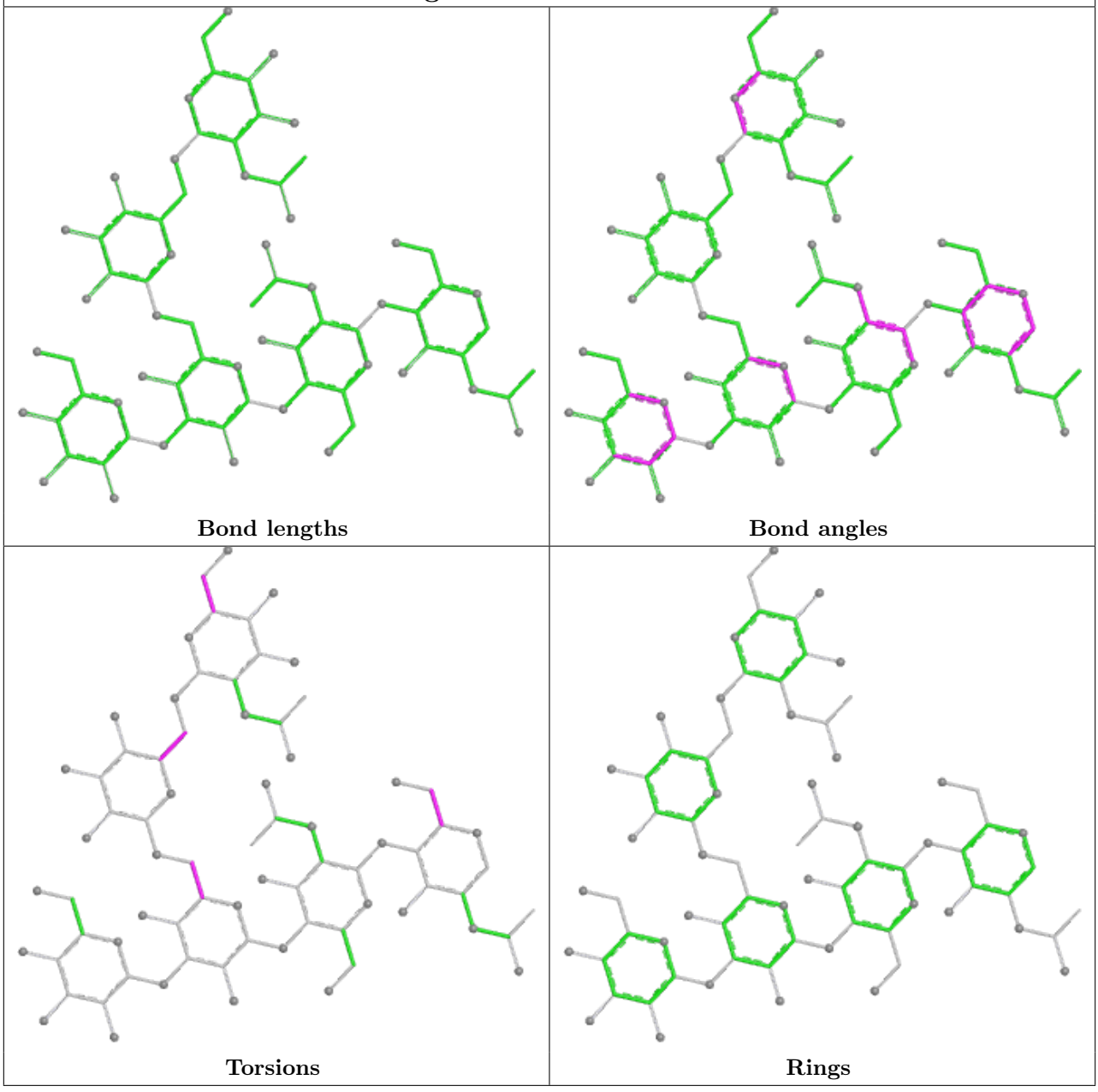
There are no ring outliers.

2 monomers are involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	B	3	MAN	1	0
6	B	6	MAN	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 B



5.6 Ligand geometry (i)

1 ligand is 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	$\#\|Z\|>2$
7	NAG	C	701	2	14,14,15	0.38	0	17,19,21	0.81	1 (5%)

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
7	NAG	C	701	2	-	0/6/23/26	0/1/1/1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
7	C	701	NAG	C1-O5-C5	2.78	115.96	112.19

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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	116/116 (100%)	-0.15	0 100 100	104, 120, 145, 154	0
2	C	95/133 (71%)	-0.12	4 (4%) 36 33	118, 129, 156, 163	0
3	H	219/225 (97%)	-0.17	2 (0%) 84 84	73, 101, 129, 137	0
4	K	79/121 (65%)	0.40	5 (6%) 20 19	104, 138, 160, 164	0
5	L	220/221 (99%)	-0.05	2 (0%) 84 84	70, 93, 126, 144	0
All	All	729/816 (89%)	-0.06	13 (1%) 68 65	70, 113, 148, 164	0

The worst 5 of 13 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	K	45	THR	4.2
4	K	65	HIS	3.5
2	C	119	ALA	3.5
5	L	37	ASN	3.3
2	C	120	GLY	2.9

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

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

6.3 Carbohydrates

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
6	MAN	B	4	11/12	0.68	0.31	181,181,183,183	0

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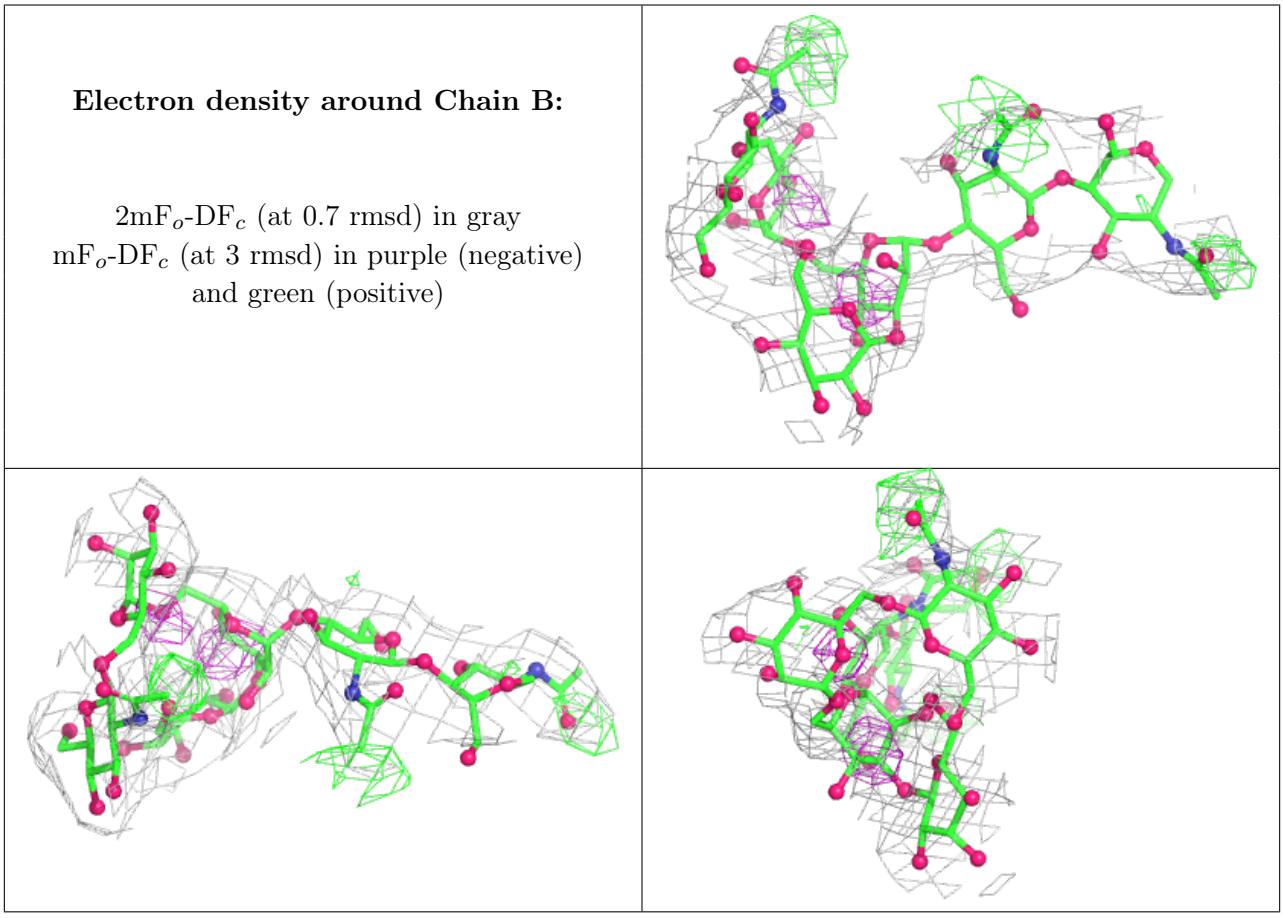
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
6	MAN	B	6	11/12	0.71	0.29	179,179,179,179	0
6	MAN	B	3	11/12	0.72	0.34	175,178,179,180	0
6	NAG	B	5	14/15	0.79	0.27	183,184,184,184	0
6	NAG	B	2	14/15	0.84	0.17	166,168,171,173	0
6	NAG	B	1	14/15	0.92	0.14	156,158,161,163	0

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.



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
7	NAG	C	701	14/15	0.71	0.24	166,167,167,167	0

6.5 Other polymers (i)

There are no such residues in this entry.