



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 7, 2026 – 02:05 AM UTC

PDB ID : 2XBO / pdb_00002xbo
Title : Equine Rhinitis A Virus in Complex with its Sialic Acid Receptor
Authors : Fry, E.E.; Tuthill, T.J.; Harlos, K.; Walter, T.S.; Rowlands, D.J.; Stuart, D.I.
Deposited on : 2010-04-14
Resolution : 4.00 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 ⓘ 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
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

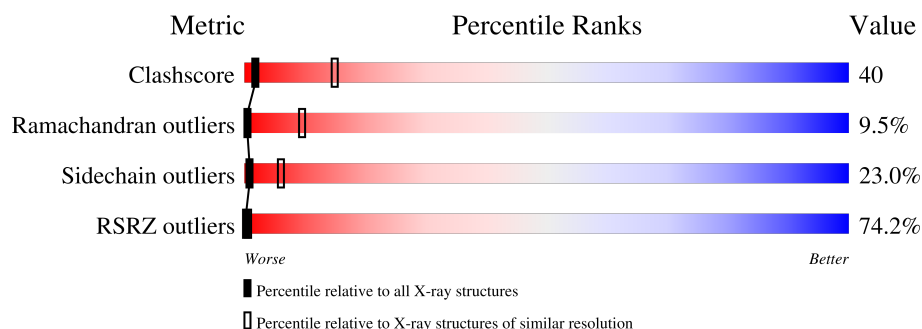
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 4.00 Å.

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



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	190562	1129 (4.20-3.80)
Ramachandran outliers	187476	1064 (4.20-3.80)
Sidechain outliers	187428	1055 (4.20-3.80)
RSRZ outliers	180081	1082 (4.20-3.80)

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 $\leq 5\%$. 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	1	248	
2	2	230	
3	3	226	
4	4	80	
5	A	3	

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5415 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 P1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	1	247	Total	C	N	O	S	0	0	1
			1929	1240	330	351	8			

- Molecule 2 is a protein called P1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	2	200	Total	C	N	O	S	0	0	0
			1554	997	266	284	7			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
2	85	SER	GLY	conflict	UNP B9VV85

- Molecule 3 is a protein called P1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	3	226	Total	C	N	O	S	0	0	0
			1723	1112	279	326	6			

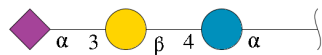
There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
3	59	LYS	ARG	conflict	UNP B9VV85
3	107	TYR	ARG	conflict	UNP B9VV85

- Molecule 4 is a protein called P1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	4	22	Total	C	N	O	S	0	0	1
			166	101	29	35	1			

- Molecule 5 is an oligosaccharide called N-acetyl-alpha-neuraminic acid-(2-3)-beta-D-galactopyranose-(1-4)-alpha-D-glucopyranose.

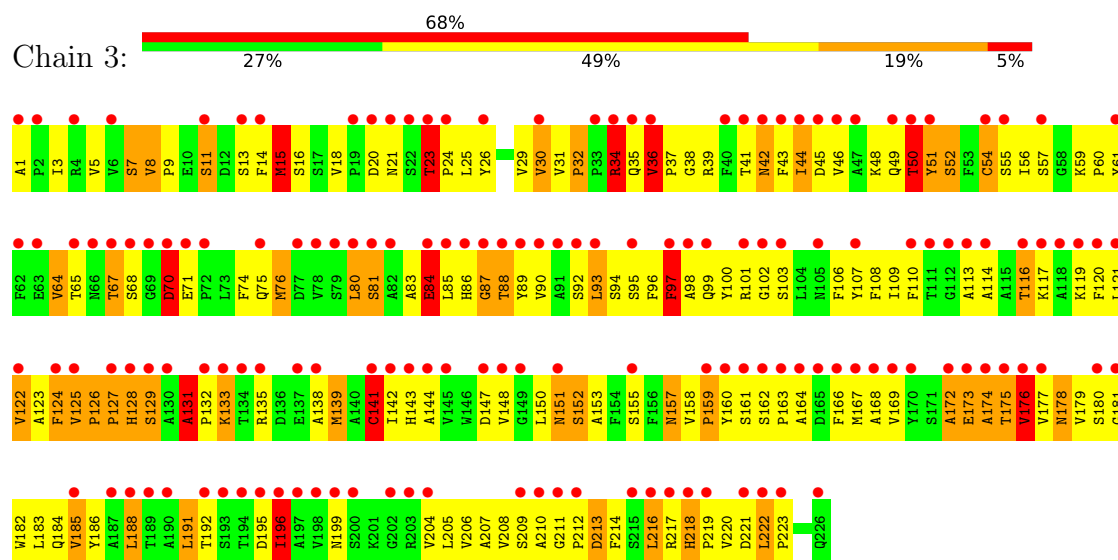


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
5	A	3	Total	C	N	O	0	0	0
			43	23	1	19			

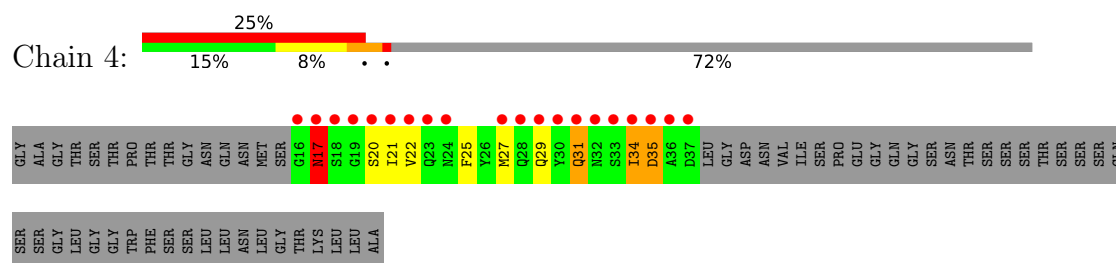
- Molecule 1: P1



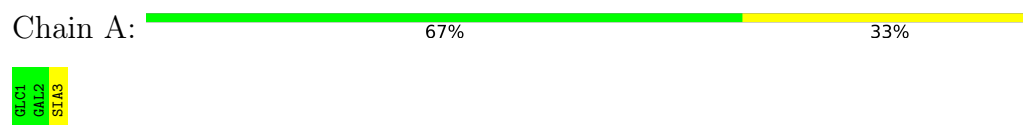
- Molecule 3: P1



- Molecule 4: P1



- Molecule 5: N-acetyl-alpha-neuraminic acid-(2-3)-beta-D-galactopyranose-(1-4)-alpha-D-glucopyranose



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	344.80Å 531.40Å 488.30Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 4.00 20.00 – 4.00	Depositor EDS
% Data completeness (in resolution range)	7.8 (20.00-4.00) 7.7 (20.00-4.00)	Depositor EDS
R_{merge}	0.37	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$	-	Xtriage
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.247 , (Not available) 0.245 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	(Not available)	Xtriage
Anisotropy	(Not available)	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 143.6	EDS
L-test for twinning ¹	$\langle L \rangle =$ (Not available), $\langle L^2 \rangle =$ (Not available)	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.07	EDS
Total number of atoms	5415	wwPDB-VP
Average B, all atoms (Å ²)	13.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *(Not available)*

¹Theoretical 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: GAL, GLC, SIA

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	1	1.17	4/1993 (0.2%)	1.77	72/2723 (2.6%)
2	2	1.27	7/1608 (0.4%)	1.76	57/2208 (2.6%)
3	3	1.25	7/1774 (0.4%)	1.67	54/2427 (2.2%)
4	4	1.25	0/168	1.56	4/226 (1.8%)
All	All	1.23	18/5543 (0.3%)	1.73	187/7584 (2.5%)

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

Mol	Chain	#Chirality outliers	#Planarity outliers
1	1	0	1
2	2	0	1
3	3	0	2
All	All	0	4

The worst 5 of 18 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	1	24	MET	SD-CE	9.73	2.03	1.79
3	3	176	VAL	CA-CB	7.08	1.62	1.54
3	3	15	MET	SD-CE	6.53	1.95	1.79
3	3	176	VAL	CA-C	6.04	1.59	1.52
2	2	32	THR	CA-CB	6.03	1.61	1.53

The worst 5 of 187 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	1	207	CYS	N-CA-C	14.31	131.30	112.12

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	1	203	ASP	N-CA-C	-11.94	92.79	110.46
2	2	94	PHE	N-CA-C	-11.91	98.32	111.07
3	3	8	VAL	CA-C-N	10.78	133.31	119.84
3	3	8	VAL	C-N-CA	10.78	133.31	119.84

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	1	208	TYR	Sidechain
2	2	177	TYR	Sidechain
3	3	26	TYR	Sidechain
3	3	51	TYR	Sidechain

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	1	1929	0	1864	183	0
2	2	1554	0	1523	125	0
3	3	1723	0	1680	152	0
4	4	166	0	146	8	0
5	A	43	0	37	0	0
All	All	5415	0	5250	428	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 40.

The worst 5 of 428 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)
1:1:24:MET:SD	1:1:24:MET:CE	2.03	1.44
2:2:80:ILE:HG22	2:2:82:PRO:HD3	1.29	1.11
2:2:213:MET:HE1	2:2:215:VAL:HG22	1.23	1.10
2:2:163:LEU:HD12	2:2:171:VAL:HG23	1.37	1.04
3:3:116:THR:HG23	3:3:191:LEU:HD11	1.42	1.00

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	1	245/248 (99%)	173 (71%)	41 (17%)	31 (13%)	0	4
2	2	198/230 (86%)	154 (78%)	27 (14%)	17 (9%)	0	10
3	3	224/226 (99%)	181 (81%)	28 (12%)	15 (7%)	1	15
4	4	20/80 (25%)	12 (60%)	6 (30%)	2 (10%)	0	8
All	All	687/784 (88%)	520 (76%)	102 (15%)	65 (10%)	0	9

5 of 65 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	1	5	GLY
1	1	9	GLU
1	1	10	PRO
1	1	21	PRO
1	1	22	VAL

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	1	208/210 (99%)	157 (76%)	51 (24%)	1	5
2	2	176/203 (87%)	136 (77%)	40 (23%)	1	6
3	3	190/190 (100%)	149 (78%)	41 (22%)	1	6

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
4	4	18/65 (28%)	14 (78%)	4 (22%)	1	6
All	All	592/668 (89%)	456 (77%)	136 (23%)	1	6

5 of 136 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	3	142	ILE
3	3	161	SER
3	3	213	ASP
1	1	241	THR
1	1	237	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
3	3	42	ASN
3	3	184	GLN
4	4	24	ASN
4	4	17	ASN
1	1	244	ASN

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](#)

3 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
5	GLC	A	1	5	12,12,12	0.69	0	17,17,17	0.68	0
5	GAL	A	2	5	11,11,12	0.64	0	15,15,17	0.64	0
5	SIA	A	3	5	20,20,21	1.12	3 (15%)	21,28,31	1.28	3 (14%)

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	GLC	A	1	5	-	2/2/22/22	0/1/1/1
5	GAL	A	2	5	-	2/2/19/22	0/1/1/1
5	SIA	A	3	5	-	2/18/34/38	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	3	SIA	C7-C6	-2.31	1.50	1.52
5	A	3	SIA	C4-C5	-2.28	1.51	1.53
5	A	3	SIA	C6-C5	-2.05	1.49	1.53

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	3	SIA	C8-C7-C6	-3.22	107.00	113.05
5	A	3	SIA	O1B-C1-C2	2.38	118.89	112.71
5	A	3	SIA	O1A-C1-C2	-2.07	118.39	122.85

There are no chirality outliers.

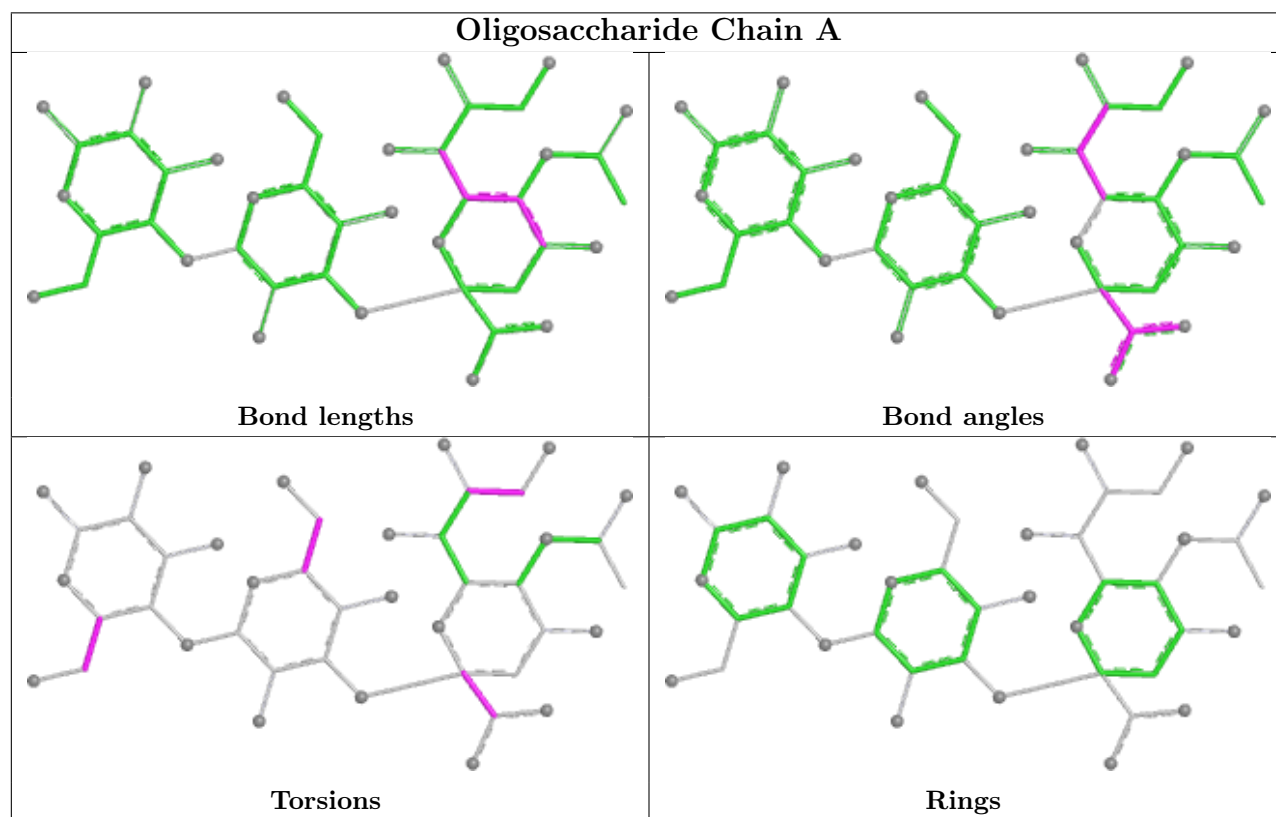
5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	2	GAL	O5-C5-C6-O6
5	A	1	GLC	O5-C5-C6-O6
5	A	2	GAL	C4-C5-C6-O6
5	A	1	GLC	C4-C5-C6-O6
5	A	3	SIA	O8-C8-C9-O9

There are no ring outliers.

No monomer is involved in short contacts.

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



5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	1	247/248 (99%)	3.03	182 (73%) 0 1	2, 10, 44, 101	0
2	2	200/230 (86%)	3.06	160 (80%) 0 0	2, 6, 43, 88	0
3	3	226/226 (100%)	2.85	154 (68%) 0 1	2, 4, 26, 61	0
4	4	22/80 (27%)	4.40	20 (90%) 0 0	15, 37, 55, 71	0
All	All	695/784 (88%)	3.02	516 (74%) 0 0	2, 6, 44, 101	0

The worst 5 of 516 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	3	145	VAL	10.8
4	4	24	ASN	9.4
1	1	44	GLU	8.8
1	1	176	ALA	8.2
3	3	116	THR	8.2

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.

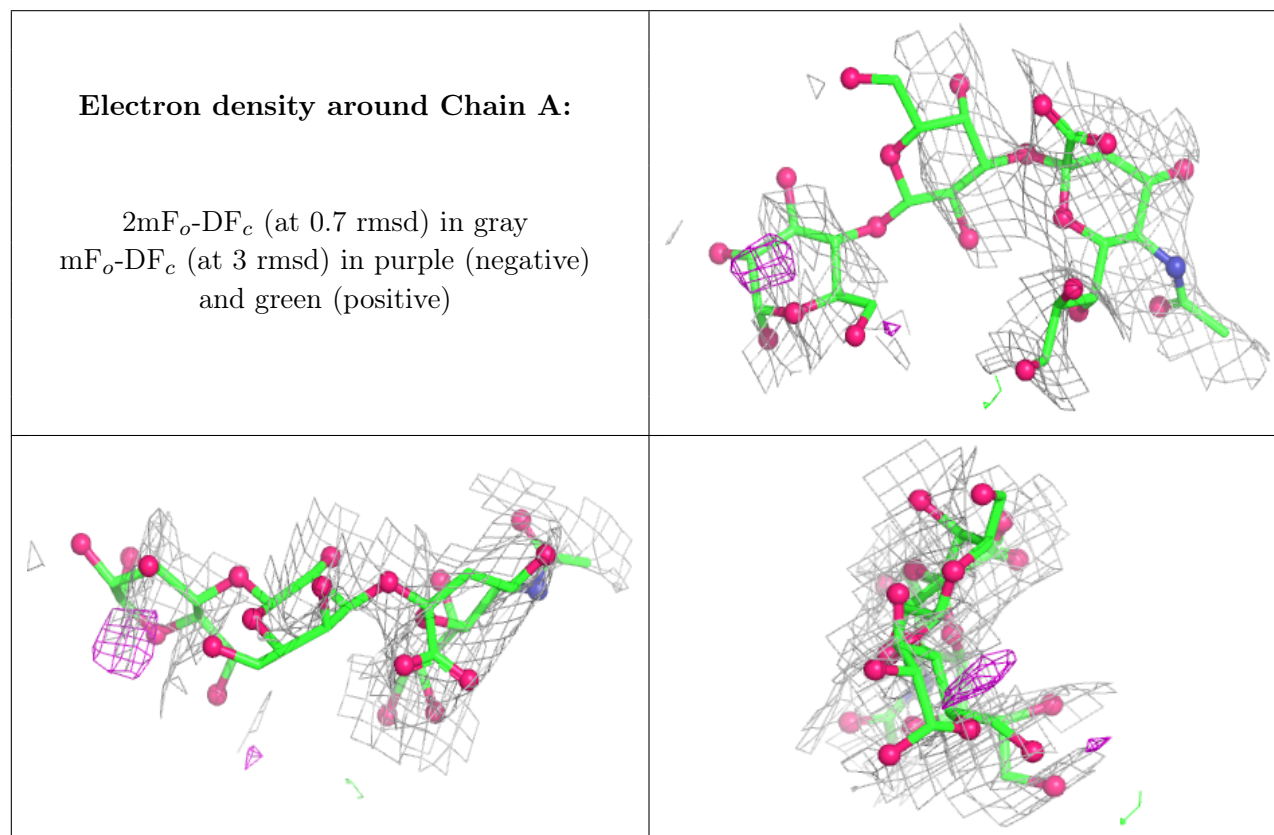
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
5	GLC	A	1	12/12	-	-	62,73,74,75	12
5	GAL	A	2	11/12	-	-	35,47,53,55	11

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
5	SIA	A	3	20/21	-	-	3,18,26,27	20

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 [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.