



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 25, 2026 – 05:42 PM EDT

PDB ID : 4MWT / pdb_00004mwt
Title : Crystal structure of human PPCA (trigonal crystal form 2)
Authors : Kolli, N.; Garman, S.C.
Deposited on : 2013-09-25
Resolution : 3.85 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

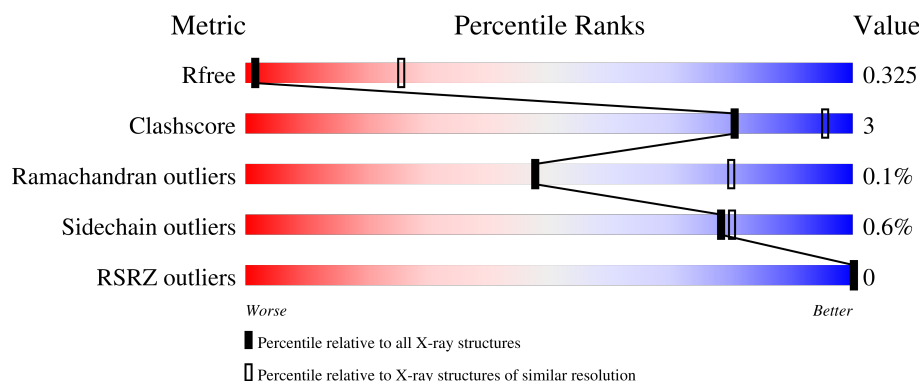
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.85 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	1165 (4.02-3.70)
Clashscore	190562	1207 (4.02-3.70)
Ramachandran outliers	187476	1149 (4.02-3.70)
Sidechain outliers	187428	1142 (4.02-3.70)
RSRZ outliers	180081	1164 (4.02-3.70)

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	428	90% 7% .
1	B	428	90% 7% .
2	C	3	100%

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 6677 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 Lysosomal protective protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	413	Total	C	N	O	S	0	0	0
			3298	2112	547	620	19			
1	B	413	Total	C	N	O	S	0	0	0
			3298	2112	547	620	19			

There are 72 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	TYR	deletion	UNP P10619
A	?	-	GLU	deletion	UNP P10619
A	?	-	LYS	deletion	UNP P10619
A	?	-	ASP	deletion	UNP P10619
A	?	-	THR	deletion	UNP P10619
A	?	-	VAL	deletion	UNP P10619
A	?	-	VAL	deletion	UNP P10619
A	?	-	VAL	deletion	UNP P10619
A	?	-	GLN	deletion	UNP P10619
A	?	-	ASP	deletion	UNP P10619
A	?	-	LEU	deletion	UNP P10619
A	?	-	GLY	deletion	UNP P10619
A	?	-	ASN	deletion	UNP P10619
A	?	-	ILE	deletion	UNP P10619
A	?	-	PHE	deletion	UNP P10619
A	?	-	THR	deletion	UNP P10619
A	?	-	ARG	deletion	UNP P10619
A	?	-	LEU	deletion	UNP P10619
A	?	-	PRO	deletion	UNP P10619
A	?	-	LEU	deletion	UNP P10619
A	?	-	LYS	deletion	UNP P10619
A	?	-	ARG	deletion	UNP P10619
A	?	-	MET	deletion	UNP P10619
A	?	-	TRP	deletion	UNP P10619
A	?	-	HIS	deletion	UNP P10619

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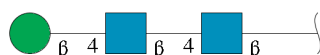
Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	GLN	deletion	UNP P10619
A	?	-	ALA	deletion	UNP P10619
A	?	-	LEU	deletion	UNP P10619
A	?	-	LEU	deletion	UNP P10619
A	?	-	ARG	deletion	UNP P10619
A	453	HIS	-	expression tag	UNP P10619
A	454	HIS	-	expression tag	UNP P10619
A	455	HIS	-	expression tag	UNP P10619
A	456	HIS	-	expression tag	UNP P10619
A	457	HIS	-	expression tag	UNP P10619
A	458	HIS	-	expression tag	UNP P10619
B	?	-	TYR	deletion	UNP P10619
B	?	-	GLU	deletion	UNP P10619
B	?	-	LYS	deletion	UNP P10619
B	?	-	ASP	deletion	UNP P10619
B	?	-	THR	deletion	UNP P10619
B	?	-	VAL	deletion	UNP P10619
B	?	-	VAL	deletion	UNP P10619
B	?	-	VAL	deletion	UNP P10619
B	?	-	GLN	deletion	UNP P10619
B	?	-	ASP	deletion	UNP P10619
B	?	-	LEU	deletion	UNP P10619
B	?	-	GLY	deletion	UNP P10619
B	?	-	ASN	deletion	UNP P10619
B	?	-	ILE	deletion	UNP P10619
B	?	-	PHE	deletion	UNP P10619
B	?	-	THR	deletion	UNP P10619
B	?	-	ARG	deletion	UNP P10619
B	?	-	LEU	deletion	UNP P10619
B	?	-	PRO	deletion	UNP P10619
B	?	-	LEU	deletion	UNP P10619
B	?	-	LYS	deletion	UNP P10619
B	?	-	ARG	deletion	UNP P10619
B	?	-	MET	deletion	UNP P10619
B	?	-	TRP	deletion	UNP P10619
B	?	-	HIS	deletion	UNP P10619
B	?	-	GLN	deletion	UNP P10619
B	?	-	ALA	deletion	UNP P10619
B	?	-	LEU	deletion	UNP P10619
B	?	-	LEU	deletion	UNP P10619
B	?	-	ARG	deletion	UNP P10619
B	453	HIS	-	expression tag	UNP P10619

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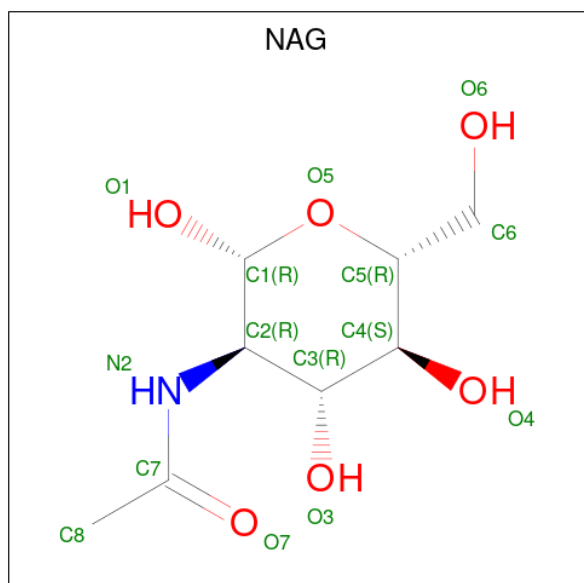
Chain	Residue	Modelled	Actual	Comment	Reference
B	454	HIS	-	expression tag	UNP P10619
B	455	HIS	-	expression tag	UNP P10619
B	456	HIS	-	expression tag	UNP P10619
B	457	HIS	-	expression tag	UNP P10619
B	458	HIS	-	expression tag	UNP P10619

- Molecule 2 is an oligosaccharide called beta-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
2	C	3	Total	C	N	O	0	0	0
			39	22	2	15			

- Molecule 3 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: $C_8H_{15}NO_6$).



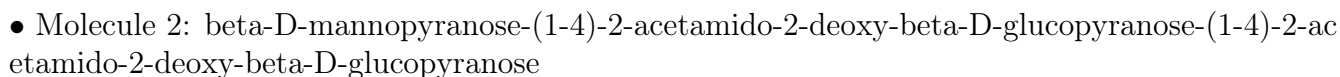
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			14	8	1	5		
3	B	1	Total	C	N	O	0	0
			14	8	1	5		

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

- Molecule 1: Lysosomal protective protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	134.57Å 134.57Å 99.78Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	45.86 – 3.85 45.86 – 3.85	Depositor EDS
% Data completeness (in resolution range)	95.1 (45.86-3.85) 95.1 (45.86-3.85)	Depositor EDS
R_{merge}	0.17	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.06 (at 3.88Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.323 , 0.325 0.327 , 0.325	Depositor DCC
R_{free} test set	465 reflections (4.56%)	wwPDB-VP
Wilson B-factor (Å ²)	83.3	Xtriage
Anisotropy	0.181	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 77.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.41$, $\langle L^2 \rangle = 0.23$	Xtriage
Estimated twinning fraction	0.358 for -h,-k,l	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	6677	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 5.80% 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: BMA, NAG

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	0.60	0/3389	0.79	0/4607
1	B	0.56	0/3389	0.77	0/4607
All	All	0.58	0/6778	0.78	0/9214

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	3298	0	3154	17	0
1	B	3298	0	3154	17	0
2	C	39	0	34	0	0
3	A	14	0	13	0	0
3	B	28	0	26	0	0
All	All	6677	0	6381	34	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 3.

The worst 5 of 34 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:367:TYR:HA	1:B:422:LEU:O	2.09	0.52
1:A:367:TYR:HA	1:A:422:LEU:O	2.10	0.51
1:B:445:ARG:NH1	1:B:452:TYR:O	2.43	0.50
1:A:445:ARG:NH1	1:A:452:TYR:O	2.45	0.50
1:B:177:GLY:O	1:B:178:ASN:C	2.55	0.50

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	409/428 (96%)	387 (95%)	21 (5%)	1 (0%)	43	74
1	B	409/428 (96%)	389 (95%)	20 (5%)	0	100	100
All	All	818/856 (96%)	776 (95%)	41 (5%)	1 (0%)	48	80

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	215	GLN

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	360/374 (96%)	358 (99%)	2 (1%)	78	80

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	360/374 (96%)	358 (99%)	2 (1%)	78	80
All	All	720/748 (96%)	716 (99%)	4 (1%)	78	80

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	100	SER
1	A	168	SER
1	B	100	SER
1	B	168	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 18 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	233	GLN
1	B	360	GLN
1	B	350	ASN
1	A	350	ASN
1	B	185	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](#)

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
2	NAG	C	1	1,2	14,14,15	0.76	0	17,19,21	1.44	3 (17%)
2	NAG	C	2	2	14,14,15	0.64	0	17,19,21	1.24	2 (11%)
2	BMA	C	3	2	11,11,12	0.52	0	15,15,17	1.54	3 (20%)

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	NAG	C	1	1,2	-	0/6/23/26	0/1/1/1
2	NAG	C	2	2	-	2/6/23/26	0/1/1/1
2	BMA	C	3	2	-	1/2/19/22	0/1/1/1

There are no bond length outliers.

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	3	BMA	C3-C4-C5	4.21	117.86	110.23
2	C	1	NAG	O5-C1-C2	-2.79	106.97	111.29
2	C	2	NAG	O5-C1-C2	-2.69	107.13	111.29
2	C	2	NAG	O7-C7-C8	-2.42	117.75	122.05
2	C	1	NAG	O3-C3-C4	-2.39	104.74	110.38

There are no chirality outliers.

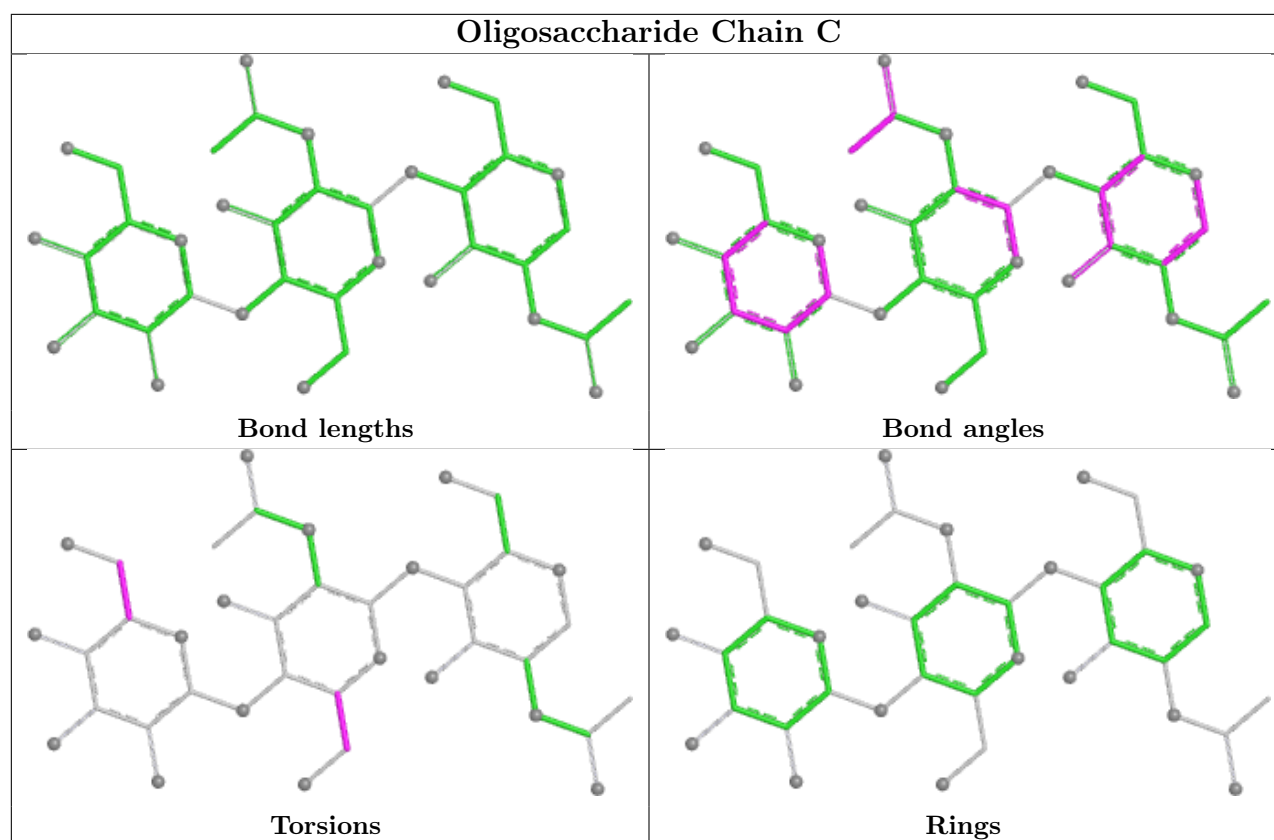
All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	2	NAG	O5-C5-C6-O6
2	C	3	BMA	O5-C5-C6-O6
2	C	2	NAG	C4-C5-C6-O6

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](#)

3 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	$\# Z > 2$
3	NAG	A	504	1	14,14,15	0.47	0	17,19,21	1.01	1 (5%)
3	NAG	B	502	1	14,14,15	0.77	0	17,19,21	0.74	0
3	NAG	B	501	1	14,14,15	0.65	0	17,19,21	0.89	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	NAG	A	504	1	-	2/6/23/26	0/1/1/1
3	NAG	B	502	1	-	1/6/23/26	0/1/1/1
3	NAG	B	501	1	-	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(°)	Ideal(°)
3	A	504	NAG	O5-C1-C2	-2.46	107.48	111.29

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	504	NAG	O5-C5-C6-O6
3	A	504	NAG	C4-C5-C6-O6
3	B	502	NAG	O5-C5-C6-O6

There are no ring outliers.

No monomer is involved in short contacts.

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	A	413/428 (96%)	-0.91	0 100 100	50, 71, 101, 133	0
1	B	413/428 (96%)	-0.86	0 100 100	52, 83, 117, 152	0
All	All	826/856 (96%)	-0.89	0 100 100	50, 77, 113, 152	0

There are no RSRZ outliers to report.

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

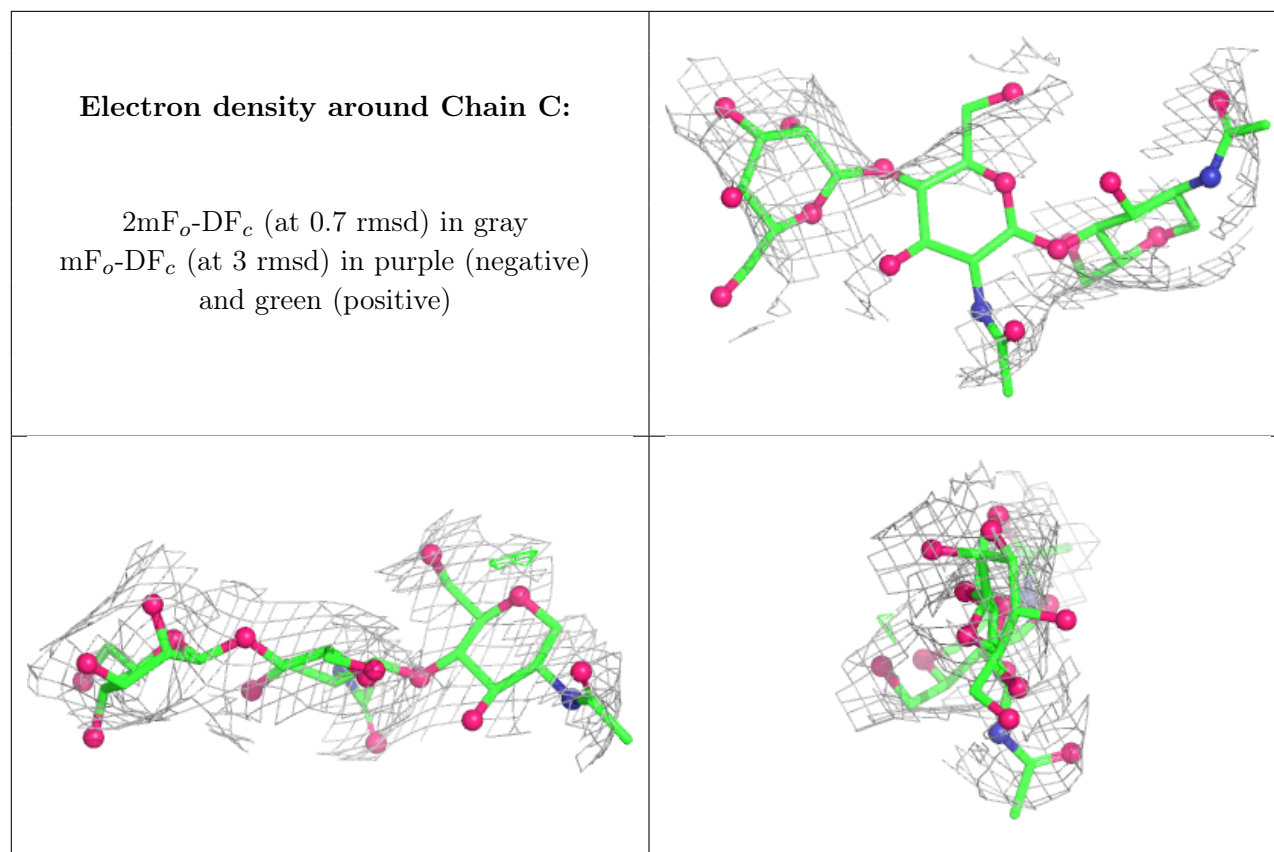
There are no non-standard protein/DNA/RNA residues in this entry.

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
2	BMA	C	3	11/12	0.96	0.07	159,168,174,174	0
2	NAG	C	2	14/15	0.97	0.06	148,155,159,161	0
2	NAG	C	1	14/15	0.99	0.06	130,137,152,152	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 [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($\text{\AA}^2$)	Q<0.9
3	NAG	A	504	14/15	0.98	0.07	143,151,160,160	0
3	NAG	B	501	14/15	0.98	0.08	148,158,162,162	0
3	NAG	B	502	14/15	0.98	0.06	151,157,162,163	0

6.5 Other polymers [i](#)

There are no such residues in this entry.