



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 05:09 PM UTC

PDB ID : 1APY / pdb_00001apy
Title : HUMAN ASPARTYLGLUCOSAMINIDASE
Authors : Rouvinen, J.; Oinonen, C.
Deposited on : 1995-06-14
Resolution : 2.00 Å(reported)

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

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtrriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

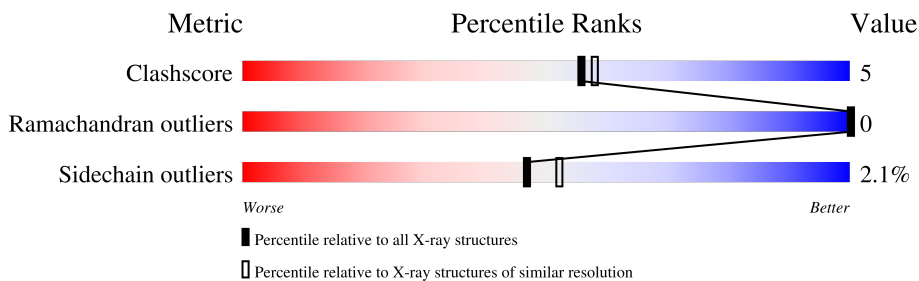
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	162	84% 15% ..
1	C	162	89% 10% ..
2	B	141	84% 16%
2	D	141	83% 17%
3	E	3	100%

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 4838 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.

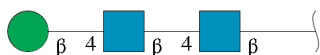
- Molecule 1 is a protein called ASPARTYLGLUCOSAMINIDASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	161	1203	746	208	239	10	0	0	0
1	C	161	1203	746	208	239	10	0	0	0

- Molecule 2 is a protein called ASPARTYLGLUCOSAMINIDASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	141	1057	665	183	201	8	0	0	0
2	D	141	1057	665	183	201	8	0	0	0

- Molecule 3 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
			Total	C	N	O			
3	E	3	39	22	2	15	0	0	0

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: C₈H₁₅NO₆).



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

- Molecule 5 is water.


Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	80	80	80	0	0
5	B	47	47	47	0	0
5	C	64	64	64	0	0
5	D	46	46	46	0	0

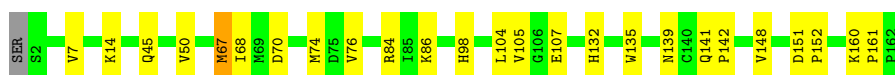
3 Residue-property plots

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. 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. 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.


Note EDS was not executed.

- Molecule 1: ASPARTYLGLUCOSAMINIDASE

Chain A:  84% 15% ..




- Molecule 1: ASPARTYLGLUCOSAMINIDASE

Chain C:  89% 10% ..




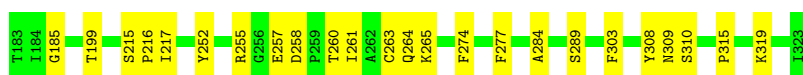
- Molecule 2: ASPARTYLGLUCOSAMINIDASE

Chain B:  84% 16% ..



- Molecule 2: ASPARTYLGLUCOSAMINIDASE

Chain D:  83% 17% ..



- Molecule 3: beta-D-mannopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose

Chain E:  100%



4 Data and refinement statistics

Xtrriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 61	Depositor
Cell constants a, b, c, α , β , γ	98.40Å 98.40Å 134.50Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	8.00 – 2.00	Depositor
% Data completeness (in resolution range)	(Not available) (8.00-2.00)	Depositor
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR	Depositor
R, R_{free}	0.169 , 0.224	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	4838	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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	0.45	0/1230	0.98	4/1674 (0.2%)
1	C	0.45	0/1230	0.95	2/1674 (0.1%)
2	B	0.44	0/1079	0.89	2/1457 (0.1%)
2	D	0.44	0/1079	0.90	2/1457 (0.1%)
All	All	0.45	0/4618	0.93	10/6262 (0.2%)

There are no bond length outliers.

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	310	SER	N-CA-C	-6.89	104.34	112.89
1	C	105	VAL	N-CA-C	6.19	119.16	108.95
1	A	105	VAL	N-CA-C	6.18	117.83	108.80
1	A	98	HIS	N-CA-C	5.80	120.36	112.88
2	B	274	PHE	CA-C-N	5.78	125.45	119.56
2	B	274	PHE	C-N-CA	5.78	125.45	119.56
2	D	258	ASP	N-CA-C	-5.75	102.34	109.64
1	A	84	ARG	N-CA-C	5.22	118.93	112.24
1	C	14	LYS	N-CA-C	5.21	117.63	111.33
1	A	86	LYS	N-CA-C	5.06	117.58	111.40

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

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	1203	0	1148	15	0
1	C	1203	0	1148	12	0
2	B	1057	0	1030	14	0
2	D	1057	0	1030	12	0
3	E	39	0	34	0	0
4	A	14	0	13	0	0
4	B	14	0	13	0	0
4	C	14	0	13	0	0
5	A	80	0	0	0	0
5	B	47	0	0	0	0
5	C	64	0	0	0	0
5	D	46	0	0	0	0
All	All	4838	0	4429	42	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.

All (42) 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:A:14:LYS:HB3	2:B:306:MET:HE2	1.69	0.73
1:A:160:LYS:HG2	1:A:161:PRO:HD2	1.74	0.69
2:B:302:GLN:NE2	2:B:319:LYS:HD3	2.14	0.62
2:D:252:TYR:HB3	2:D:257:GLU:HG3	1.82	0.61
1:C:67:MET:HB3	2:D:216:PRO:HA	1.83	0.60
2:B:237:GLY:O	2:B:241:MET:HB2	2.01	0.60
1:C:65:ASP:HB3	2:D:216:PRO:HD3	1.86	0.57
1:A:160:LYS:HG2	1:A:161:PRO:CD	2.34	0.57
1:C:81:ASP:O	1:C:106:GLY:HA2	2.05	0.56
1:C:75:ASP:HB3	1:C:96:LEU:CD1	2.36	0.56
2:B:268:SER:O	2:B:272:LYS:HG2	2.05	0.55
2:B:217:ILE:HD12	2:D:217:ILE:HD12	1.90	0.54
2:B:273:HIS:CE1	1:C:74:MET:SD	3.01	0.53
1:A:76:VAL:HG11	2:B:218:PRO:HG3	1.92	0.52
1:C:75:ASP:HB3	1:C:96:LEU:HD11	1.94	0.49
1:A:132:HIS:O	1:A:135:TRP:HB3	2.14	0.48
2:D:185:GLY:HA2	2:D:199:THR:HG22	1.96	0.48
1:A:67:MET:HB2	2:B:216:PRO:HA	1.96	0.47
1:A:67:MET:HG2	1:A:68:ILE:N	2.29	0.47

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:311:GLU:HG3	2:B:312:LYS:N	2.29	0.47
2:D:308:TYR:CE2	2:D:315:PRO:HD3	2.49	0.47
1:A:7:VAL:HG22	2:B:188:VAL:HG22	1.97	0.47
2:D:284:ALA:HA	2:D:289:SER:O	2.15	0.47
1:A:148:VAL:CG2	1:A:152:PRO:HG3	2.45	0.46
2:D:261:ILE:O	2:D:265:LYS:HG3	2.17	0.45
1:A:70:ASP:O	1:A:74:MET:HA	2.17	0.44
2:B:284:ALA:HA	2:B:289:SER:O	2.17	0.43
2:B:308:TYR:CE2	2:B:315:PRO:HG3	2.52	0.43
2:D:274:PHE:O	2:D:277:PHE:HD1	2.01	0.43
1:A:148:VAL:HG23	1:A:152:PRO:HG3	2.01	0.43
2:D:303:PHE:O	2:D:319:LYS:HA	2.19	0.42
2:B:242:ARG:HD3	1:C:74:MET:O	2.19	0.42
1:C:125:THR:O	1:C:129:GLN:HG3	2.20	0.42
1:C:67:MET:HG2	2:D:215:SER:O	2.19	0.42
2:D:260:THR:O	2:D:264:GLN:HG3	2.20	0.41
1:C:79:VAL:HA	1:C:104:LEU:O	2.20	0.41
1:A:45:GLN:HA	1:A:50:VAL:O	2.20	0.41
1:A:107:GLU:HG2	1:C:107:GLU:CD	2.45	0.41
1:A:141:GLN:HA	1:A:142:PRO:HA	1.83	0.41
2:B:244:LEU:N	2:B:244:LEU:HD22	2.35	0.41
1:C:30:ALA:O	1:C:34:VAL:HG23	2.20	0.40
1:A:151:ASP:HA	1:A:152:PRO:HD3	1.96	0.40

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	159/162 (98%)	152 (96%)	7 (4%)	0	100	100
1	C	159/162 (98%)	154 (97%)	5 (3%)	0	100	100

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	B	139/141 (99%)	132 (95%)	7 (5%)	0	100	100
2	D	139/141 (99%)	136 (98%)	3 (2%)	0	100	100
All	All	596/606 (98%)	574 (96%)	22 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	129/130 (99%)	126 (98%)	3 (2%)	44	49
1	C	129/130 (99%)	127 (98%)	2 (2%)	55	62
2	B	110/110 (100%)	108 (98%)	2 (2%)	51	58
2	D	110/110 (100%)	107 (97%)	3 (3%)	39	42
All	All	478/480 (100%)	468 (98%)	10 (2%)	47	52

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	67	MET
1	A	104	LEU
1	A	139	ASN
2	B	259	PRO
2	B	263	CYS
1	C	17	THR
1	C	75	ASP
2	D	255	ARG
2	D	263	CYS
2	D	309	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	139	ASN
1	A	141	GLN
2	B	194	HIS
2	B	264	GLN
2	B	271	GLN
2	B	273	HIS
2	B	302	GLN
1	C	87	ASN
1	C	129	GLN
2	D	264	GLN
2	D	309	ASN
2	D	313	ASN
2	D	314	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	$\# Z > 2$
3	NAG	E	1	3,2	14,14,15	0.83	1 (7%)	17,19,21	1.21	1 (5%)
3	NAG	E	2	3	14,14,15	0.85	0	17,19,21	1.22	2 (11%)
3	BMA	E	3	3	11,11,12	1.20	1 (9%)	15,15,17	1.65	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
3	NAG	E	1	3,2	-	0/6/23/26	0/1/1/1
3	NAG	E	2	3	-	0/6/23/26	0/1/1/1
3	BMA	E	3	3	-	1/2/19/22	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	E	3	BMA	C4-C5	2.31	1.57	1.53
3	E	1	NAG	C1-C2	2.29	1.55	1.52

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	E	3	BMA	C1-C2-C3	-4.08	103.71	109.64
3	E	2	NAG	O4-C4-C3	-3.02	103.25	110.38
3	E	3	BMA	O5-C1-C2	-2.85	103.98	110.79
3	E	1	NAG	O7-C7-C8	-2.38	117.82	122.05
3	E	2	NAG	C1-O5-C5	2.17	115.09	112.19

There are no chirality outliers.

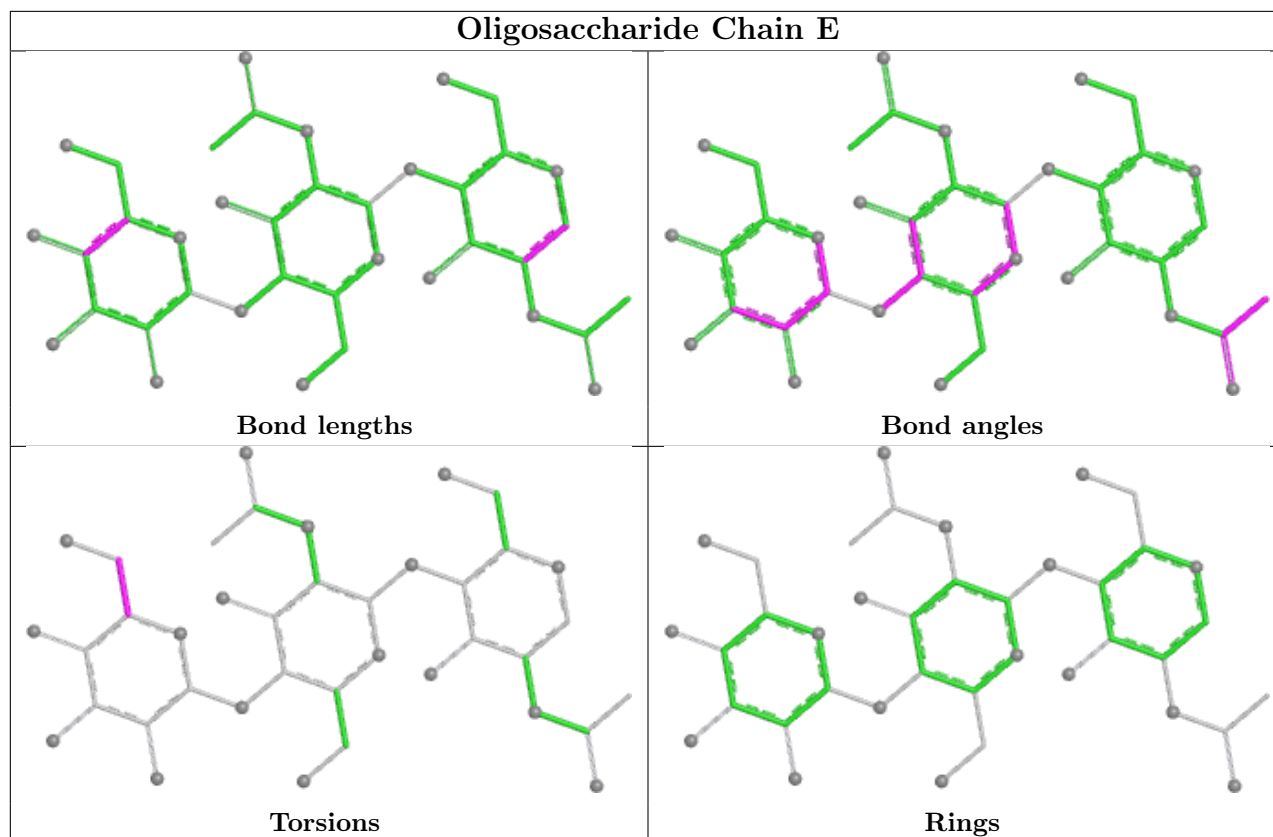
All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	E	3	BMA	O5-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$
4	NAG	C	521	1	14,14,15	0.97	1 (7%)	17,19,21	2.03	1 (5%)
4	NAG	A	501	1	14,14,15	1.22	3 (21%)	17,19,21	1.65	4 (23%)
4	NAG	B	511	2	14,14,15	0.61	0	17,19,21	1.55	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
4	NAG	C	521	1	-	0/6/23/26	0/1/1/1
4	NAG	A	501	1	-	0/6/23/26	0/1/1/1
4	NAG	B	511	2	-	0/6/23/26	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	501	NAG	C4-C5	2.35	1.58	1.53
4	C	521	NAG	C1-C2	2.21	1.55	1.52
4	A	501	NAG	C3-C2	2.13	1.57	1.52
4	A	501	NAG	C4-C3	2.03	1.57	1.52

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	C	521	NAG	C1-O5-C5	7.45	122.17	112.19
4	B	511	NAG	C1-O5-C5	4.11	117.69	112.19
4	A	501	NAG	C1-C2-N2	-4.08	104.01	110.43
4	A	501	NAG	O5-C1-C2	3.28	116.37	111.29
4	A	501	NAG	C6-C5-C4	2.41	118.93	113.02
4	A	501	NAG	C1-O5-C5	2.12	115.03	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 [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

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.