



Full wwPDB X-ray Structure Validation Report ⓘ

May 5, 2019 – 02:04 PM EDT

PDB ID : 1E40
Title : Tris/maltotriose complex of chimaeric amylase from *B. amyloliquefaciens* and *B. licheniformis* at 2.2Å
Authors : Brzozowski, A.M.; Lawson, D.M.; Turkenburg, J.P.; Bisgaard-Frantzen, H.; Svendsen, A.; Borchert, T.V.; Dauter, Z.; Wilson, K.S.; Davies, G.J.
Deposited on : 2000-06-27
Resolution : 2.20 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.8.0 (224370), CSD as540be (2019)
Xtriage (Phenix) : 1.13
EDS : rb-20031633
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)
Refmac : 5.8.0158
CCP4 : 7.0 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20031633

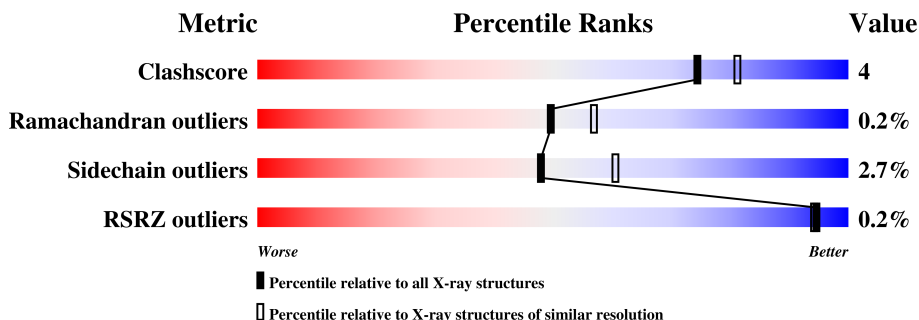
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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	122126	5027 (2.20-2.20)
Ramachandran outliers	120053	4952 (2.20-2.20)
Sidechain outliers	120020	4953 (2.20-2.20)
RSRZ outliers	108989	4245 (2.20-2.20)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	483	<div> <div style="width: 87%;"></div> <div style="width: 11%;"></div> <div style="width: 2%;"></div> </div> <div>87% 11% .</div>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	TRS	A	601	-	X	-	-

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 4519 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 ALPHA-AMYLASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	483	Total	C	N	O	S	9	11	0
			3932	2490	679	757	6			

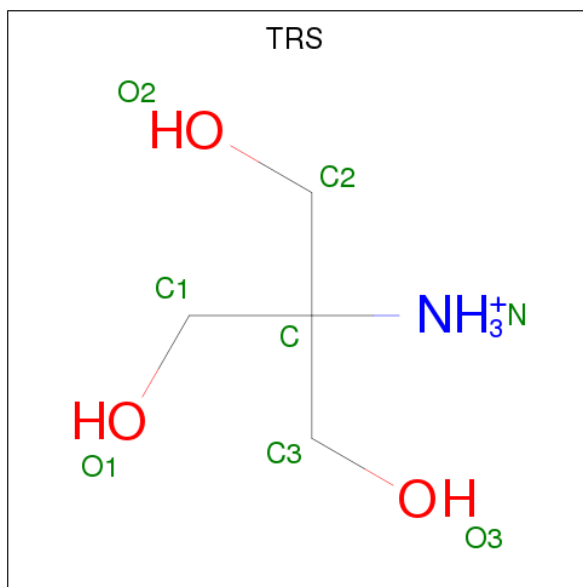
- Molecule 2 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	4	Total	Ca	0	0
			4	4		

- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

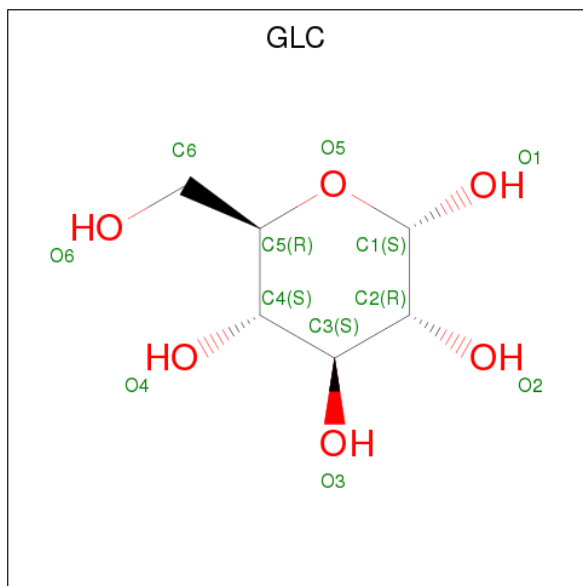
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Na	0	0
			1	1		

- Molecule 4 is 2-AMINO-2-HYDROXYMETHYL-PROPANE-1,3-DIOL (three-letter code: TRS) (formula: C₄H₁₂NO₃).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			8	4	1	3		

- Molecule 5 is ALPHA-D-GLUCOSE (three-letter code: GLC) (formula: $C_6H_{12}O_6$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			11	6	5		
5	A	1	Total	C	O	0	0
			11	6	5		
5	A	1	Total	C	O	0	1
			13	6	7		

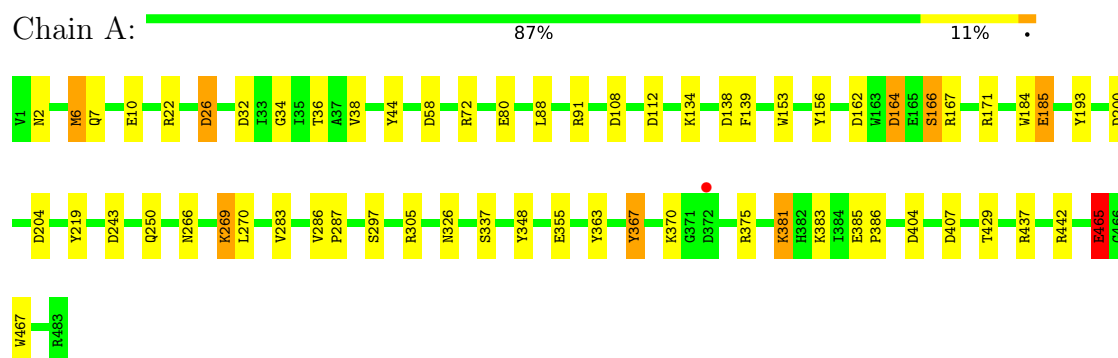
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	539	Total 539	O 539	2	0

3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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: ALPHA-AMYLASE



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	52.72Å 78.27Å 238.86Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.20 43.73 – 2.22	Depositor EDS
% Data completeness (in resolution range)	94.0 (20.00-2.20) 96.9 (43.73-2.22)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	9.07 (at 2.22Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.130 , 0.210 0.136 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	13.0	Xtriage
Anisotropy	0.363	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 59.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	4519	wwPDB-VP
Average B, all atoms (Å ²)	16.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.45% 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: NA, CA, GLC, TRS

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	0.61	1/4102 (0.0%)	1.31	41/5568 (0.7%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	442	ARG	CB-CG	11.84	1.84	1.52

All (41) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	108	ASP	CB-CG-OD2	11.28	128.45	118.30
1	A	156	TYR	CB-CG-CD2	-10.71	114.58	121.00
1	A	162	ASP	CB-CG-OD1	10.16	127.44	118.30
1	A	305	ARG	NE-CZ-NH2	-9.73	115.44	120.30
1	A	167	ARG	NE-CZ-NH2	-9.48	115.56	120.30
1	A	91	ARG	NE-CZ-NH2	-9.35	115.62	120.30
1	A	442	ARG	CD-NE-CZ	9.25	136.56	123.60
1	A	91	ARG	NE-CZ-NH1	8.70	124.65	120.30
1	A	156	TYR	CB-CG-CD1	7.74	125.64	121.00
1	A	72	ARG	NE-CZ-NH1	7.67	124.14	120.30
1	A	162	ASP	CB-CG-OD2	-7.67	111.39	118.30
1	A	72	ARG	NE-CZ-NH2	-7.59	116.50	120.30
1	A	437	ARG	NE-CZ-NH1	-7.01	116.80	120.30
1	A	442	ARG	CA-CB-CG	-7.00	97.99	113.40
1	A	204	ASP	CB-CG-OD2	6.86	124.47	118.30
1	A	72	ARG	CD-NE-CZ	6.83	133.16	123.60
1	A	171	ARG	NE-CZ-NH2	6.56	123.58	120.30
1	A	465	GLU	OE1-CD-OE2	6.48	131.08	123.30
1	A	167	ARG	NE-CZ-NH1	6.43	123.52	120.30
1	A	404	ASP	CB-CG-OD1	6.31	123.98	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	367	TYR	CA-C-O	-6.20	107.08	120.10
1	A	200	ASP	CB-CG-OD2	6.20	123.88	118.30
1	A	80	GLU	OE1-CD-OE2	-5.98	116.13	123.30
1	A	243	ASP	CB-CG-OD1	5.97	123.68	118.30
1	A	348	TYR	CB-CG-CD2	5.87	124.52	121.00
1	A	355	GLU	OE1-CD-OE2	-5.61	116.57	123.30
1	A	164	ASP	CB-CG-OD2	-5.59	113.27	118.30
1	A	367	TYR	CA-C-N	5.53	127.25	116.20
1	A	26	ASP	CB-CG-OD2	5.46	123.21	118.30
1	A	22	ARG	NE-CZ-NH2	-5.42	117.59	120.30
1	A	442	ARG	NE-CZ-NH2	5.36	122.98	120.30
1	A	58	ASP	CB-CG-OD2	5.29	123.06	118.30
1	A	156	TYR	CZ-CE2-CD2	-5.26	115.06	119.80
1	A	348	TYR	CB-CG-CD1	-5.25	117.85	121.00
1	A	219	TYR	CB-CG-CD2	-5.24	117.85	121.00
1	A	138	ASP	CB-CG-OD1	5.24	123.02	118.30
1	A	167	ARG	CD-NE-CZ	5.22	130.90	123.60
1	A	219	TYR	CB-CG-CD1	5.21	124.12	121.00
1	A	437	ARG	NE-CZ-NH2	5.18	122.89	120.30
1	A	185	GLU	OE1-CD-OE2	-5.16	117.11	123.30
1	A	32	ASP	CB-CG-OD1	5.09	122.88	118.30

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	3932	0	3669	26	0
2	A	4	0	0	0	0
3	A	1	0	0	0	0
4	A	8	0	12	0	0
5	A	35	0	23	2	0
6	A	539	0	0	10	0
All	All	4519	0	3704	27	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 4.

All (27) 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:367:TYR:CZ	6:A:2415:HOH:O	2.34	0.80
1:A:26:ASP:CG	6:A:2038:HOH:O	2.34	0.66
1:A:370:LYS:HG3	6:A:2008:HOH:O	1.96	0.66
1:A:26:ASP:CB	6:A:2038:HOH:O	2.46	0.62
5:A:801:GLC:H61	6:A:2537:HOH:O	2.01	0.58
1:A:7:GLN:HE22	1:A:326:ASN:HB2	1.72	0.55
1:A:184:TRP:CD2	1:A:185:GLU:HA	2.44	0.53
1:A:270[B]:LEU:HD12	1:A:283:VAL:HG21	1.91	0.51
1:A:112:ASP:OD1	1:A:134:LYS:NZ	2.40	0.50
1:A:38[A]:VAL:HG21	1:A:88:LEU:HD13	1.94	0.48
1:A:269:LYS:HE3	6:A:2336:HOH:O	2.13	0.47
1:A:184:TRP:CG	1:A:185:GLU:HA	2.49	0.47
1:A:164:ASP:OD1	1:A:166:SER:HB2	2.14	0.47
1:A:36:THR:HB	5:A:801:GLC:H62	1.96	0.47
1:A:286:VAL:HB	1:A:287:PRO:HD3	1.97	0.46
1:A:2:ASN:HA	6:A:2003:HOH:O	2.14	0.46
1:A:266:ASN:ND2	6:A:2341:HOH:O	2.39	0.46
1:A:465:GLU:HB3	1:A:467:TRP:HD1	1.80	0.46
1:A:26:ASP:HB2	6:A:2038:HOH:O	2.14	0.45
1:A:34:GLY:HA3	6:A:2441:HOH:O	2.15	0.44
1:A:375:ARG:HG2	1:A:375:ARG:HH11	1.83	0.43
1:A:7:GLN:O	1:A:363:TYR:HB2	2.19	0.43
1:A:385:GLU:N	1:A:386:PRO:CD	2.81	0.43
1:A:139:PHE:HB2	1:A:153:TRP:HB2	1.99	0.43
1:A:407:ASP:O	1:A:429:THR:HA	2.19	0.42
1:A:6:MET:CE	1:A:363:TYR:HA	2.49	0.41
1:A:381:LYS:O	1:A:385:GLU:HG3	2.21	0.41

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	492/483 (102%)	473 (96%)	18 (4%)	1 (0%)	49 57

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	337	SER

5.3.2 Protein sidechains ⓘ

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	415/404 (103%)	402 (97%)	13 (3%)	43 55

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	6	MET
1	A	10	GLU
1	A	44	TYR
1	A	166	SER
1	A	193	TYR
1	A	250[A]	GLN
1	A	250[B]	GLN
1	A	269	LYS
1	A	297[A]	SER
1	A	297[B]	SER
1	A	381	LYS
1	A	383	LYS
1	A	465	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	7	GLN
1	A	25	ASN
1	A	66	GLN
1	A	132	GLN
1	A	246	GLN
1	A	333	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](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 10 ligands modelled in this entry, 5 are monoatomic - leaving 5 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	TRS	A	601	-	7,7,7	2.00	3 (42%)	9,9,9	2.48	7 (77%)
5	GLC	A	801	5	11,11,12	0.97	1 (9%)	15,15,17	1.88	3 (20%)
5	GLC	A	802	5	11,11,12	1.23	1 (9%)	15,15,17	2.25	2 (13%)
5	GLC	A	803[A]	-	12,12,12	0.82	0	17,17,17	1.81	5 (29%)
5	GLC	A	803[B]	-	12,12,12	0.79	0	17,17,17	1.74	5 (29%)

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	TRS	A	601	-	-	0/9/9/9	0/0/0/0
5	GLC	A	801	5	-	0/2/19/22	0/1/1/1
5	GLC	A	802	5	-	0/2/19/22	0/1/1/1
5	GLC	A	803[A]	-	-	0/2/22/22	0/1/1/1
5	GLC	A	803[B]	-	-	0/2/22/22	0/1/1/1

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	802	GLC	O5-C1	-2.86	1.39	1.43
4	A	601	TRS	C3-C	-2.53	1.46	1.52
5	A	801	GLC	O5-C1	-2.32	1.40	1.43
4	A	601	TRS	O2-C2	2.91	1.52	1.42
4	A	601	TRS	C-N	2.97	1.59	1.49

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	601	TRS	C2-C-C1	-3.52	101.08	111.06
4	A	601	TRS	O3-C3-C	-3.32	100.87	110.47
5	A	803[B]	GLC	C3-C4-C5	-3.19	104.49	110.23
5	A	803[A]	GLC	C3-C4-C5	-3.19	104.49	110.23
5	A	801	GLC	C3-C4-C5	-2.68	105.41	110.23
4	A	601	TRS	C1-C-N	-2.63	102.14	107.73
4	A	601	TRS	O2-C2-C	-2.03	104.58	110.47
5	A	802	GLC	C3-C4-C5	-2.01	106.62	110.23
5	A	803[B]	GLC	O5-C5-C4	2.17	113.64	109.68
5	A	803[A]	GLC	O5-C5-C4	2.17	113.64	109.68
5	A	801	GLC	O4-C4-C3	2.29	115.67	110.34
4	A	601	TRS	C3-C-C1	2.30	117.59	111.06
5	A	803[B]	GLC	O4-C4-C3	2.33	115.76	110.34
5	A	803[A]	GLC	O4-C4-C3	2.33	115.76	110.34
4	A	601	TRS	C2-C-N	2.44	112.91	107.73
5	A	803[B]	GLC	O3-C3-C2	2.47	116.08	110.34
5	A	803[A]	GLC	O3-C3-C2	2.47	116.08	110.34
4	A	601	TRS	C3-C-C2	2.54	118.26	111.06
5	A	803[B]	GLC	C1-O5-C5	4.11	121.53	113.68
5	A	803[A]	GLC	C1-O5-C5	4.11	121.53	113.68
5	A	801	GLC	C1-O5-C5	5.57	119.78	112.20
5	A	802	GLC	C1-O5-C5	7.63	122.57	112.20

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	801	GLC	2	0

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	483/483 (100%)	-0.99	1 (0%) 94 94	6, 12, 24, 44	2 (0%)

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	372	ASP	2.2

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](#)

There are no carbohydrates in this entry.

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(Å ²)	Q<0.9
5	GLC	A	801	11/12	0.72	0.25	40,42,44,44	0
5	GLC	A	803[A]	12/12	0.89	0.11	27,28,29,29	1
5	GLC	A	803[B]	12/12	0.89	0.11	27,28,28,29	1
5	GLC	A	802	11/12	0.93	0.10	24,29,31,35	0
4	TRS	A	601	8/8	0.94	0.09	13,22,23,23	0
3	NA	A	505	1/1	0.98	0.08	9,9,9,9	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
2	CA	A	502	1/1	0.99	0.05	8,8,8,8	0
2	CA	A	503	1/1	0.99	0.07	17,17,17,17	0
2	CA	A	501	1/1	1.00	0.04	8,8,8,8	0
2	CA	A	504	1/1	1.00	0.04	14,14,14,14	0

6.5 Other polymers [i](#)

There are no such residues in this entry.