



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 19, 2024 – 09:17 PM EST

PDB ID : 4KC8
Title : Crystal Structure of Endo-1,5-alpha-L-arabinanase from *Thermotoga petrophila* RKU-1 in complex with TRIS
Authors : Nascimento, A.F.Z.; Polo, C.C.; Santos, C.R.; Costa, M.C.M.F.; Mesa, A.N.; Prade, R.A.; Ruller, R.; Squina, F.M.; Murakami, M.T.
Deposited on : 2013-04-24
Resolution : 1.76 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.36
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

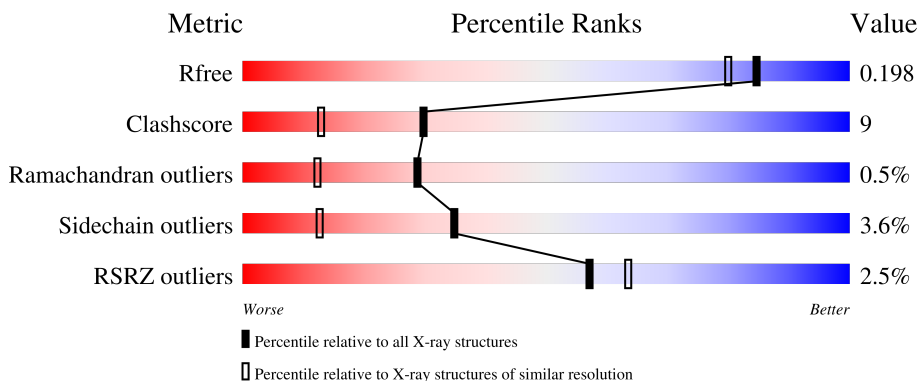
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.76 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	2340 (1.76-1.76)
Clashscore	141614	2466 (1.76-1.76)
Ramachandran outliers	138981	2437 (1.76-1.76)
Sidechain outliers	138945	2437 (1.76-1.76)
RSRZ outliers	127900	2298 (1.76-1.76)

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	474	 6% 75% 19% • 5%
1	B	474	 72% 21% • 5%
1	C	474	 6% 69% 21% • 7%

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
2	TRS	B	501	-	X	-	-

2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 11549 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 Glycoside hydrolase, family 43.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	449	3625	2338	602	675	10	0	6	0
1	B	449	3631	2342	602	677	10	0	8	0
1	C	443	3575	2310	595	660	10	0	4	0

There are 69 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	MET	-	initiating methionine	UNP A5IKD4
A	-1	GLY	-	expression tag	UNP A5IKD4
A	0	SER	-	expression tag	UNP A5IKD4
A	1	SER	-	expression tag	UNP A5IKD4
A	2	HIS	-	expression tag	UNP A5IKD4
A	3	HIS	-	expression tag	UNP A5IKD4
A	4	HIS	-	expression tag	UNP A5IKD4
A	5	HIS	-	expression tag	UNP A5IKD4
A	6	HIS	-	expression tag	UNP A5IKD4
A	7	HIS	-	expression tag	UNP A5IKD4
A	8	SER	-	expression tag	UNP A5IKD4
A	9	SER	-	expression tag	UNP A5IKD4
A	10	GLY	-	expression tag	UNP A5IKD4
A	11	LEU	-	expression tag	UNP A5IKD4
A	12	VAL	-	expression tag	UNP A5IKD4
A	13	PRO	-	expression tag	UNP A5IKD4
A	14	ARG	-	expression tag	UNP A5IKD4
A	15	GLY	-	expression tag	UNP A5IKD4
A	16	SER	-	expression tag	UNP A5IKD4
A	17	HIS	-	expression tag	UNP A5IKD4
A	18	MET	-	expression tag	UNP A5IKD4
A	19	ALA	-	expression tag	UNP A5IKD4
A	20	SER	-	expression tag	UNP A5IKD4

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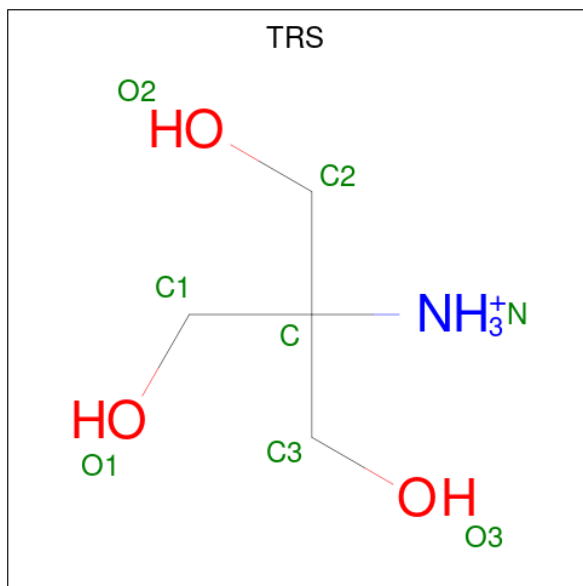
Chain	Residue	Modelled	Actual	Comment	Reference
B	-2	MET	-	initiating methionine	UNP A5IKD4
B	-1	GLY	-	expression tag	UNP A5IKD4
B	0	SER	-	expression tag	UNP A5IKD4
B	1	SER	-	expression tag	UNP A5IKD4
B	2	HIS	-	expression tag	UNP A5IKD4
B	3	HIS	-	expression tag	UNP A5IKD4
B	4	HIS	-	expression tag	UNP A5IKD4
B	5	HIS	-	expression tag	UNP A5IKD4
B	6	HIS	-	expression tag	UNP A5IKD4
B	7	HIS	-	expression tag	UNP A5IKD4
B	8	SER	-	expression tag	UNP A5IKD4
B	9	SER	-	expression tag	UNP A5IKD4
B	10	GLY	-	expression tag	UNP A5IKD4
B	11	LEU	-	expression tag	UNP A5IKD4
B	12	VAL	-	expression tag	UNP A5IKD4
B	13	PRO	-	expression tag	UNP A5IKD4
B	14	ARG	-	expression tag	UNP A5IKD4
B	15	GLY	-	expression tag	UNP A5IKD4
B	16	SER	-	expression tag	UNP A5IKD4
B	17	HIS	-	expression tag	UNP A5IKD4
B	18	MET	-	expression tag	UNP A5IKD4
B	19	ALA	-	expression tag	UNP A5IKD4
B	20	SER	-	expression tag	UNP A5IKD4
C	-2	MET	-	initiating methionine	UNP A5IKD4
C	-1	GLY	-	expression tag	UNP A5IKD4
C	0	SER	-	expression tag	UNP A5IKD4
C	1	SER	-	expression tag	UNP A5IKD4
C	2	HIS	-	expression tag	UNP A5IKD4
C	3	HIS	-	expression tag	UNP A5IKD4
C	4	HIS	-	expression tag	UNP A5IKD4
C	5	HIS	-	expression tag	UNP A5IKD4
C	6	HIS	-	expression tag	UNP A5IKD4
C	7	HIS	-	expression tag	UNP A5IKD4
C	8	SER	-	expression tag	UNP A5IKD4
C	9	SER	-	expression tag	UNP A5IKD4
C	10	GLY	-	expression tag	UNP A5IKD4
C	11	LEU	-	expression tag	UNP A5IKD4
C	12	VAL	-	expression tag	UNP A5IKD4
C	13	PRO	-	expression tag	UNP A5IKD4
C	14	ARG	-	expression tag	UNP A5IKD4
C	15	GLY	-	expression tag	UNP A5IKD4
C	16	SER	-	expression tag	UNP A5IKD4

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Chain	Residue	Modelled	Actual	Comment	Reference
C	17	HIS	-	expression tag	UNP A5IKD4
C	18	MET	-	expression tag	UNP A5IKD4
C	19	ALA	-	expression tag	UNP A5IKD4
C	20	SER	-	expression tag	UNP A5IKD4

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



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

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Ca	0	0
			1	1		
3	B	1	Total	Ca	0	0
			1	1		
3	C	1	Total	Ca	0	0
			1	1		

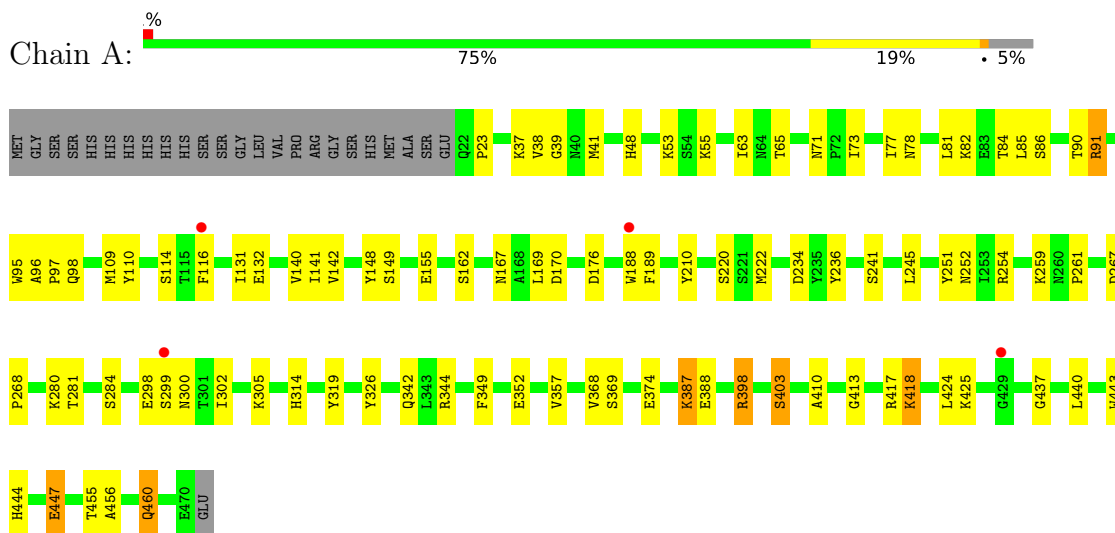
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	241	Total 241	O 241	0	0
4	B	316	Total 316	O 316	0	0
4	C	142	Total 142	O 142	0	0

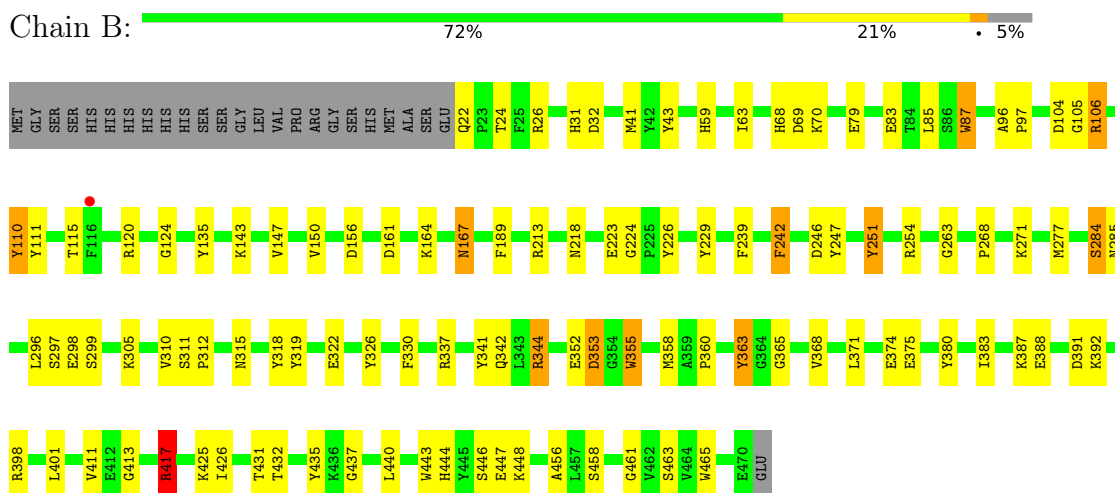
3 Residue-property plots [i](#)

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: Glycoside hydrolase, family 43

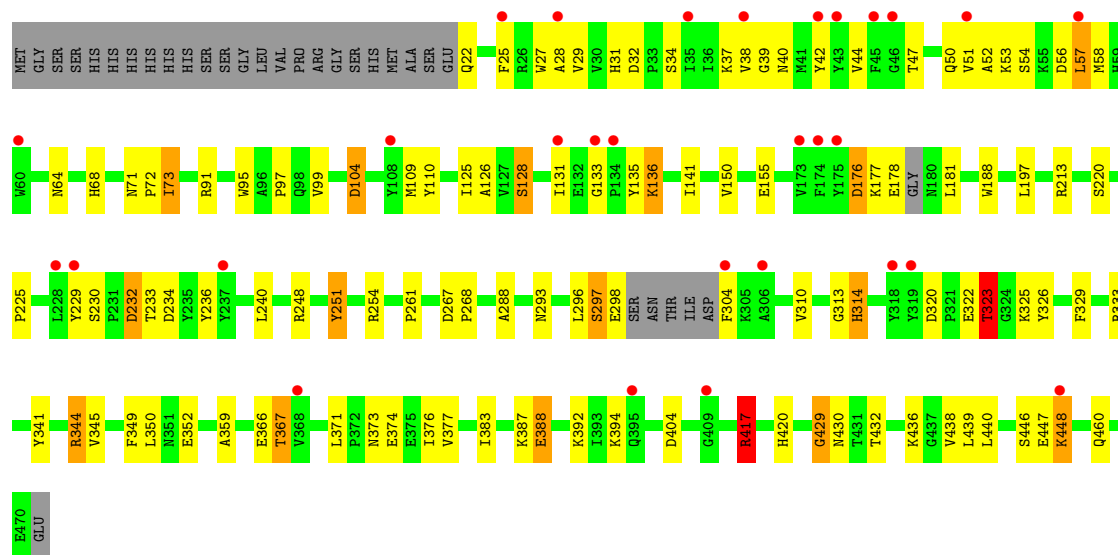


- Molecule 1: Glycoside hydrolase, family 43



- Molecule 1: Glycoside hydrolase, family 43





4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	41.67Å 86.77Å 194.37Å 90.00° 90.07° 90.00°	Depositor
Resolution (Å)	43.38 – 1.76 43.38 – 1.76	Depositor EDS
% Data completeness (in resolution range)	99.2 (43.38-1.76) 99.2 (43.38-1.76)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.70 (at 1.76Å)	Xtriage
Refinement program	REFMAC 5.5.0102	Depositor
R, R_{free}	0.153 , 0.197 0.161 , 0.198	Depositor DCC
R_{free} test set	6836 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	20.3	Xtriage
Anisotropy	0.748	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 32.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.40$, $\langle L^2 \rangle = 0.22$	Xtriage
Estimated twinning fraction	0.467 for h,-k,-l	Xtriage
Reported twinning fraction	0.527 for H, K, L 0.473 for -h,-k,l	Depositor
Outliers	0 of 135737 reflections	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	11549	wwPDB-VP
Average B, all atoms (Å ²)	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.04% 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 i

5.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section: TRS, CA

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	0.95	0/3768	1.03	6/5119 (0.1%)
1	B	1.53	30/3781 (0.8%)	1.38	27/5137 (0.5%)
1	C	0.86	0/3707	0.97	6/5033 (0.1%)
All	All	1.15	30/11256 (0.3%)	1.14	39/15289 (0.3%)

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	B	0	1
1	C	0	2
All	All	0	3

The worst 5 of 30 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	263	GLY	N-CA	-9.72	1.31	1.46
1	B	226	TYR	CG-CD2	7.20	1.48	1.39
1	B	330	PHE	CG-CD2	-6.95	1.28	1.38
1	B	135	TYR	CD1-CE1	-6.94	1.28	1.39
1	B	458	SER	CB-OG	6.83	1.51	1.42

The worst 5 of 39 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	106	ARG	NE-CZ-NH1	9.98	125.29	120.30
1	C	213	ARG	NE-CZ-NH1	8.60	124.60	120.30
1	B	106	ARG	NE-CZ-NH2	-7.94	116.33	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	213	ARG	NE-CZ-NH1	7.80	124.20	120.30
1	B	344	ARG	NE-CZ-NH1	-7.65	116.47	120.30

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	315	ASN	Peptide
1	C	297	SER	Peptide
1	C	322	GLU	Peptide

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	3625	0	3478	61	0
1	B	3631	0	3486	60	1
1	C	3575	0	3436	86	1
2	A	8	0	12	0	0
2	B	8	0	12	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
4	A	241	0	0	7	0
4	B	316	0	0	17	0
4	C	142	0	0	13	1
All	All	11549	0	10424	201	2

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 9.

The worst 5 of 201 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:90:THR:O	1:A:91:ARG:HD2	1.53	1.08

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:341:TYR:CG	4:B:795:HOH:O	2.06	1.06
1:B:31:HIS:CD2	4:B:795:HOH:O	2.17	0.95
1:C:377:VAL:HB	4:C:681:HOH:O	1.70	0.92
1:C:27:TRP:NE1	4:C:730:HOH:O	2.04	0.91

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:233:THR:O	1:C:248:ARG:NH2[1_455]	1.82	0.38
1:B:83[B]:GLU:OE1	4:C:737:HOH:O[2_648]	2.01	0.19

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	453/474 (96%)	428 (94%)	24 (5%)	1 (0%)	47 29
1	B	455/474 (96%)	440 (97%)	15 (3%)	0	100 100
1	C	441/474 (93%)	403 (91%)	32 (7%)	6 (1%)	11 2
All	All	1349/1422 (95%)	1271 (94%)	71 (5%)	7 (0%)	29 12

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	323	THR
1	C	57	LEU
1	C	429	GLY
1	C	448	LYS
1	C	155	GLU

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	391/406 (96%)	375 (96%)	16 (4%)	30	10
1	B	393/406 (97%)	386 (98%)	7 (2%)	59	40
1	C	384/406 (95%)	366 (95%)	18 (5%)	26	7
All	All	1168/1218 (96%)	1127 (96%)	41 (4%)	35	13

5 of 41 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	128	SER
1	C	323	THR
1	C	136	LYS
1	C	232	ASP
1	C	367	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 11 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	430	ASN
1	B	444	HIS
1	C	200	ASN
1	C	167	ASN
1	A	444	HIS

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 3 are monoatomic - leaving 2 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
2	TRS	B	501	-	7,7,7	2.39	3 (42%)	9,9,9	2.63	5 (55%)
2	TRS	A	501	-	7,7,7	0.34	0	9,9,9	0.68	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
2	TRS	B	501	-	-	4/9/9/9	-
2	TRS	A	501	-	-	3/9/9/9	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	501	TRS	C-N	3.94	1.62	1.49
2	B	501	TRS	O3-C3	3.52	1.54	1.42
2	B	501	TRS	C1-C	-2.88	1.44	1.53

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	501	TRS	O3-C3-C	4.52	125.32	111.00
2	B	501	TRS	O1-C1-C	-3.72	99.19	111.00
2	B	501	TRS	O2-C2-C	3.23	121.23	111.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	501	TRS	C2-C-C1	-2.68	102.50	110.81
2	B	501	TRS	C2-C-N	2.66	115.93	107.98

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	501	TRS	N-C-C2-O2
2	B	501	TRS	C1-C-C2-O2
2	B	501	TRS	C2-C-C3-O3
2	A	501	TRS	N-C-C1-O1
2	B	501	TRS	C3-C-C2-O2

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	449/474 (94%)	0.05	4 (0%) 84 89	20, 30, 41, 55	0
1	B	449/474 (94%)	-0.06	1 (0%) 95 96	10, 17, 30, 59	0
1	C	443/474 (93%)	0.64	29 (6%) 18 24	22, 38, 54, 64	1 (0%)
All	All	1341/1422 (94%)	0.21	34 (2%) 57 63	10, 29, 49, 64	1 (0%)

The worst 5 of 34 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	319	TYR	5.6
1	B	116	PHE	5.0
1	C	318	TYR	5.0
1	C	42	TYR	3.9
1	C	35	ILE	3.7

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 monosaccharides 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(\AA^2)	Q<0.9
2	TRS	A	501	8/8	0.89	0.12	32,36,38,53	0
2	TRS	B	501	8/8	0.96	0.09	14,18,22,28	0
3	CA	A	502	1/1	0.96	0.11	53,53,53,53	0
3	CA	C	501	1/1	0.96	0.06	51,51,51,51	0
3	CA	B	502	1/1	0.98	0.04	41,41,41,41	0

6.5 Other polymers [i](#)

There are no such residues in this entry.