



wwPDB X-ray Structure Validation Summary Report

Feb 26, 2014 – 03:15 PM GMT

PDB ID : 2EF5
Title : Crystal structure of the arginase from thermus thermophilus
Authors : Kumarevel, T.S.; Karthe, P.; Kuramitsu, S.; Yokoyama, S.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)
Deposited on : 2007-02-20
Resolution : 2.00 Å(reported)

This is a wwPDB validation summary report for a publicly released PDB entry.

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

A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

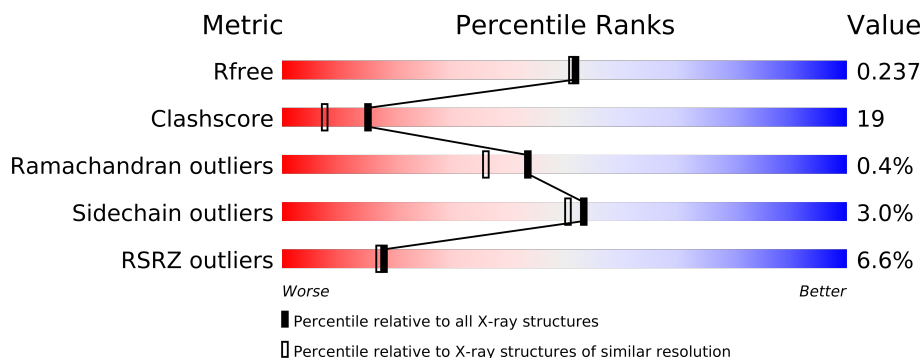
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.15 2013
Xtriage (Phenix)	:	dev-1323
EDS	:	stable22639
Percentile statistics	:	21963
Refmac	:	5.8.0049
CCP4	:	6.3.0 (Settle)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP)	:	stable22683

1 Overall quality at a glance

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))
R_{free}	66092	4888 (2.00-2.00)
Clashscore	79885	6188 (2.00-2.00)
Ramachandran outliers	78287	6102 (2.00-2.00)
Sidechain outliers	78261	6100 (2.00-2.00)
RSRZ outliers	66119	4890 (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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	290	
1	B	290	
1	D	290	
1	E	290	
1	F	290	
1	G	290	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
2	MN	G	1502	-	X
4	LYS	A	3001	X	X

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Mol	Type	Chain	Res	Geometry	Electron density
4	LYS	B	3006	-	X
4	LYS	D	3002	-	X
4	LYS	E	3003	-	X
4	LYS	F	3004	-	X
4	LYS	G	3005	-	X

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 13060 atoms, of which 0 are hydrogen and 0 are deuterium.

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.

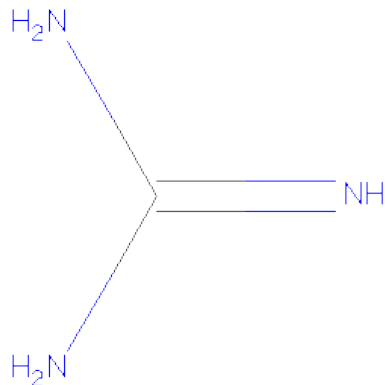
- Molecule 1 is a protein called Arginase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	273	Total	C	N	O	S	0	0	0
			2052	1300	363	382	7			
1	B	273	Total	C	N	O	S	0	0	0
			2052	1300	363	382	7			
1	D	273	Total	C	N	O	S	0	0	0
			2052	1300	363	382	7			
1	E	273	Total	C	N	O	S	0	0	0
			2052	1300	363	382	7			
1	F	273	Total	C	N	O	S	0	0	0
			2052	1300	363	382	7			
1	G	273	Total	C	N	O	S	0	0	0
			2052	1300	363	382	7			

- Molecule 2 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

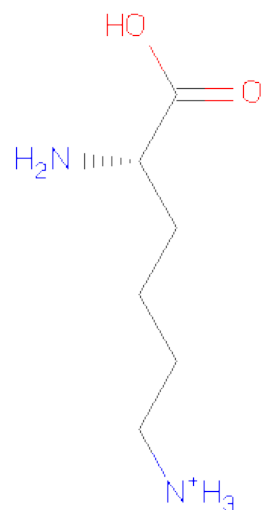
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	G	2	Total	Mn	0	0
			2	2		
2	D	2	Total	Mn	0	0
			2	2		
2	E	2	Total	Mn	0	0
			2	2		
2	B	2	Total	Mn	0	0
			2	2		
2	A	2	Total	Mn	0	0
			2	2		
2	F	2	Total	Mn	0	0
			2	2		

- Molecule 3 is GUANIDINE (three-letter code: GAI) (formula: CH₅N₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	N	0	0
			4	1	3		
3	A	1	Total	C	N	0	0
			4	1	3		
3	B	1	Total	C	N	0	0
			4	1	3		
3	D	1	Total	C	N	0	0
			4	1	3		
3	E	1	Total	C	N	0	0
			4	1	3		
3	G	1	Total	C	N	0	0
			4	1	3		

- Molecule 4 is LYSINE (three-letter code: LYS) (formula: C₆H₁₅N₂O₂).



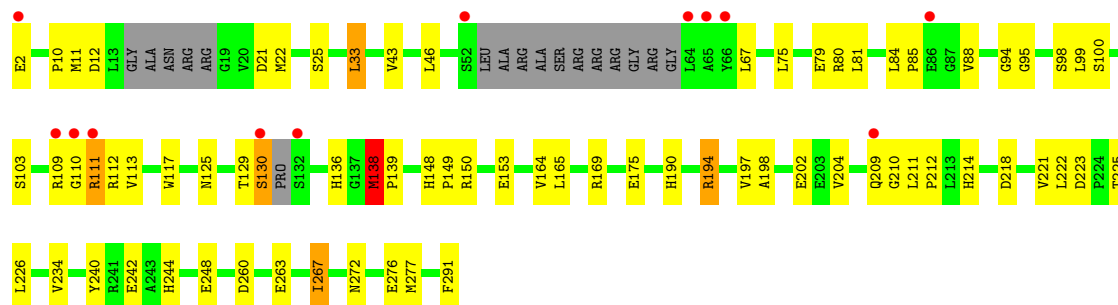
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			10	6	2	2		
4	B	1	Total	C	N	O	0	0
			10	6	2	2		
4	D	1	Total	C	N	O	0	0
			10	6	2	2		
4	E	1	Total	C	N	O	0	0
			10	6	2	2		
4	F	1	Total	C	N	O	0	0
			10	6	2	2		
4	G	1	Total	C	N	O	0	0
			10	6	2	2		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	100	Total	O	0	0
			100	100		
5	B	116	Total	O	0	0
			116	116		
5	D	91	Total	O	0	0
			91	91		
5	E	132	Total	O	0	0
			132	132		
5	F	103	Total	O	0	0
			103	103		
5	G	110	Total	O	0	0
			110	110		

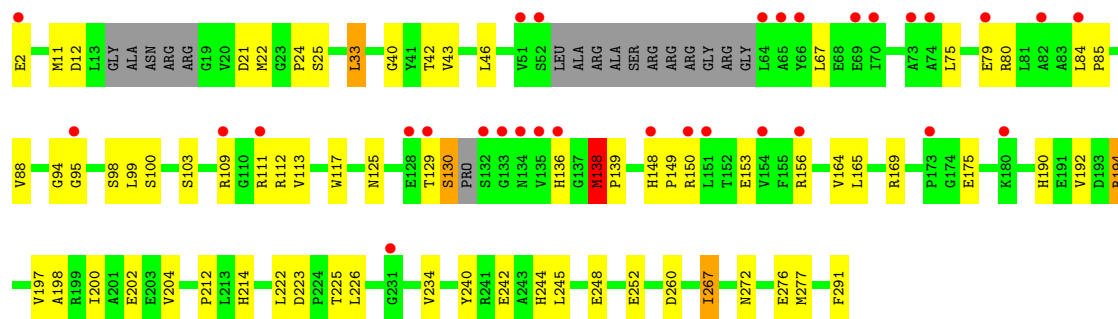
- Molecule 1: Arginase

Chain E:



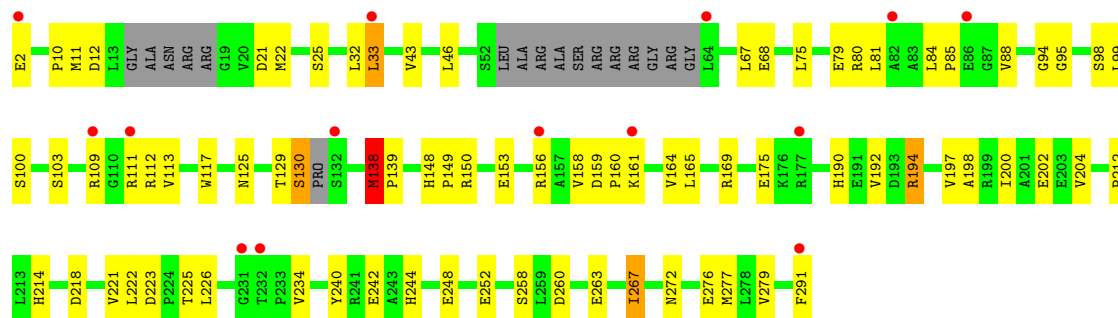
- Molecule 1: Arginase

Chain F:



- Molecule 1: Arginase

Chain G:



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	150.79Å 97.48Å 126.46Å 90.00° 108.66° 90.00°	Depositor
Resolution (Å)	19.98 – 2.00 45.15 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.0 (19.98-2.00) 99.1 (45.15-2.00)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.36 (at 2.00Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.233 , 0.236 0.234 , 0.237	Depositor DCC
R_{free} test set	1149 reflections (0.99%)	DCC
Wilson B-factor (Å ²)	23.1	Xtriage
Anisotropy	0.553	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 37.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Outliers	0 of 115940 reflections	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	13060	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.22% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality ⓘ

5.1 Standard geometry ⓘ

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

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	0.32	0/2083	0.66	1/2828 (0.0%)
1	B	0.33	0/2083	0.69	2/2828 (0.1%)
1	D	0.31	0/2083	0.66	1/2828 (0.0%)
1	E	0.35	0/2083	0.68	1/2828 (0.0%)
1	F	0.29	0/2083	0.66	1/2828 (0.0%)
1	G	0.34	0/2083	0.67	1/2828 (0.0%)
All	All	0.32	0/12498	0.67	7/16968 (0.0%)

There are no bond length outliers.

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	F	95	GLY	N-CA-C	-8.12	92.81	113.10
1	E	95	GLY	N-CA-C	-7.98	93.16	113.10
1	G	95	GLY	N-CA-C	-7.64	94.00	113.10
1	B	95	GLY	N-CA-C	-7.52	94.30	113.10
1	A	95	GLY	N-CA-C	-7.52	94.30	113.10

There are no chirality outliers.

There are no planarity outliers.

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2052	0	2101	70	0
1	B	2052	0	2101	69	2
1	D	2052	0	2101	59	0
1	E	2052	0	2101	120	0
1	F	2052	0	2101	78	0
1	G	2052	0	2101	138	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
2	D	2	0	0	0	0
2	E	2	0	0	0	0
2	F	2	0	0	0	0
2	G	2	0	0	0	0
3	A	8	0	8	0	0
3	B	4	0	4	0	0
3	D	4	0	4	0	0
3	E	4	0	4	0	0
3	G	4	0	4	0	0
4	A	10	0	12	16	0
4	B	10	0	12	3	0
4	D	10	0	12	3	0
4	E	10	0	12	9	0
4	F	10	0	12	12	2
4	G	10	0	12	11	2
5	A	100	0	0	6	0
5	B	116	0	0	2	0
5	D	91	0	0	1	0
5	E	132	0	0	5	0
5	F	103	0	0	6	0
5	G	110	0	0	3	0
All	All	13060	0	12702	474	4

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 19.

The worst 5 of 474 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
4:A:3001:LYS:NZ	4:A:3001:LYS:CE	1.69	1.52
1:E:111:ARG:HH22	1:G:161:LYS:N	0.99	1.40
4:E:3003:LYS:NZ	4:E:3003:LYS:CE	1.81	1.40
1:E:111:ARG:NH2	1:G:161:LYS:N	1.77	1.32
1:E:21:ASP:O	4:E:3003:LYS:HE2	1.42	1.20

All (4) symmetry-related close contacts are listed below. The label for Atom-2 includes the sym-

metry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:79:GLU:O	1:B:111:ARG:NH2[2_555]	1.79	0.41
1:B:83:ALA:N	1:B:111:ARG:NH2[2_555]	1.91	0.29
4:F:3004:LYS:NZ	4:G:3005:LYS:OXT[2_556]	2.08	0.12
4:F:3004:LYS:CB	4:G:3005:LYS:CB[2_556]	2.10	0.10

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	265/290 (91%)	258 (97%)	6 (2%)	1 (0%)	43	36
1	B	265/290 (91%)	259 (98%)	5 (2%)	1 (0%)	43	36
1	D	265/290 (91%)	258 (97%)	6 (2%)	1 (0%)	43	36
1	E	265/290 (91%)	260 (98%)	4 (2%)	1 (0%)	43	36
1	F	265/290 (91%)	259 (98%)	5 (2%)	1 (0%)	43	36
1	G	265/290 (91%)	258 (97%)	6 (2%)	1 (0%)	43	36
All	All	1590/1740 (91%)	1552 (98%)	32 (2%)	6 (0%)	43	36

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	138	MET
1	B	138	MET
1	D	138	MET
1	F	138	MET
1	E	138	MET

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	218/231 (94%)	212 (97%)	6 (3%)	56	54
1	B	218/231 (94%)	212 (97%)	6 (3%)	56	54
1	D	218/231 (94%)	212 (97%)	6 (3%)	56	54
1	E	218/231 (94%)	211 (97%)	7 (3%)	51	47
1	F	218/231 (94%)	212 (97%)	6 (3%)	56	54
1	G	218/231 (94%)	212 (97%)	6 (3%)	56	54
All	All	1308/1386 (94%)	1271 (97%)	37 (3%)	53	54

5 of 37 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	267	ILE
1	E	130	SER
1	G	194	ARG
1	D	291	PHE
1	E	33	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 31 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	214	HIS
1	E	148	HIS
1	G	148	HIS
1	E	125	ASN
1	E	190	HIS

5.3.3 RNA ⓘ

There are no RNA chains in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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

5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

5.6 Ligand geometry

Of 24 ligands modelled in this entry, 12 are monoatomic - leaving 12 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$
3	GAI	A	1001	-	3,3,3	1.59	0	3,3,3	1.27	0
3	GAI	A	1004	-	3,3,3	1.68	1 (33%)	3,3,3	1.26	0
4	LYS	A	3001	1,4	9,9,9	2.82	6 (66%)	10,10,10	3.66	7 (70%)
3	GAI	B	1006	-	3,3,3	1.62	0	3,3,3	1.19	0
4	LYS	B	3006	-	9,9,9	1.22	1 (11%)	10,10,10	3.42	6 (60%)
3	GAI	D	1002	-	3,3,3	1.66	0	3,3,3	1.22	0
4	LYS	D	3002	-	9,9,9	1.65	3 (33%)	10,10,10	4.19	3 (30%)
3	GAI	E	1003	-	3,3,3	1.76	1 (33%)	3,3,3	1.26	0
4	LYS	E	3003	4	9,9,9	3.38	4 (44%)	10,10,10	2.17	4 (40%)
4	LYS	F	3004	4	9,9,9	1.43	2 (22%)	10,10,10	1.63	2 (20%)
3	GAI	G	1005	-	3,3,3	1.39	0	3,3,3	1.22	0
4	LYS	G	3005	4	9,9,9	2.72	5 (55%)	10,10,10	2.51	6 (60%)

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	GAI	A	1001	-	-	0/0/0/0	0/0/0/0
3	GAI	A	1004	-	-	0/0/0/0	0/0/0/0
4	LYS	A	3001	1,4	-	0/9/9/9	0/0/0/0
3	GAI	B	1006	-	-	0/0/0/0	0/0/0/0
4	LYS	B	3006	-	-	0/9/9/9	0/0/0/0
3	GAI	D	1002	-	-	0/0/0/0	0/0/0/0
4	LYS	D	3002	-	-	0/9/9/9	0/0/0/0
3	GAI	E	1003	-	-	0/0/0/0	0/0/0/0
4	LYS	E	3003	4	-	0/9/9/9	0/0/0/0
4	LYS	F	3004	4	-	0/9/9/9	0/0/0/0
3	GAI	G	1005	-	-	0/0/0/0	0/0/0/0

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	LYS	G	3005	4	-	0/9/9/9	0/0/0/0

The worst 5 of 23 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	E	3003	LYS	CE-NZ	8.14	1.81	1.48
4	A	3001	LYS	CE-NZ	5.13	1.69	1.48
4	G	3005	LYS	CE-NZ	4.41	1.66	1.48
4	G	3005	LYS	CG-CB	4.23	1.72	1.52
4	E	3003	LYS	CE-CD	4.05	1.73	1.50

The worst 5 of 28 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	D	3002	LYS	C-CA-N	-11.58	90.20	109.36
4	B	3006	LYS	C-CA-N	-6.14	99.20	109.36
4	A	3001	LYS	CG-CB-CA	5.87	134.10	113.11
4	A	3001	LYS	OXT-C-CA	5.50	129.21	116.88
4	B	3006	LYS	CD-CG-CB	-5.11	95.02	113.64

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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	273/290 (94%)	0.05	8 (2%) 49 49	15, 27, 42, 52	0
1	B	273/290 (94%)	0.28	16 (5%) 22 21	12, 25, 43, 53	0
1	D	273/290 (94%)	0.35	22 (8%) 12 11	14, 28, 46, 55	0
1	E	273/290 (94%)	0.15	12 (4%) 33 32	12, 22, 40, 53	0
1	F	273/290 (94%)	0.50	31 (11%) 6 5	17, 31, 47, 54	0
1	G	273/290 (94%)	0.14	14 (5%) 27 26	13, 24, 41, 53	0
All	All	1638/1740 (94%)	0.25	103 (6%) 18 19	12, 26, 44, 55	0

The worst 5 of 103 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	F	52	SER	7.9
1	B	65	ALA	6.8
1	D	65	ALA	6.8
1	F	64	LEU	6.8
1	B	52	SER	6.3

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

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

6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

6.4 Ligands ⓘ

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	RSR	LLDF	B-factors(Å ²)	Q<0.9
4	LYS	F	3004	10/10	0.99	52.59	57,58,59,61	0
4	LYS	G	3005	10/10	0.98	50.97	56,57,59,59	0
4	LYS	E	3003	10/10	0.96	31.74	56,58,58,58	0
4	LYS	B	3006	10/10	0.70	27.84	54,56,57,57	0
4	LYS	D	3002	10/10	0.75	18.46	55,56,58,60	0
4	LYS	A	3001	10/10	0.70	13.27	54,55,57,57	0
2	MN	G	1502	1/1	0.20	6.05	36,36,36,36	0
2	MN	B	1602	1/1	0.17	0.77	32,32,32,32	0
3	GAI	E	1003	4/4	0.10	0.57	12,13,13,15	0
3	GAI	A	1004	4/4	0.10	0.10	20,20,21,22	0
3	GAI	G	1005	4/4	0.10	-0.14	14,16,16,16	0
3	GAI	B	1006	4/4	0.10	-0.51	14,15,15,16	0
3	GAI	A	1001	4/4	0.09	-0.68	20,20,21,21	0
2	MN	D	1202	1/1	0.08	-0.70	30,30,30,30	0
3	GAI	D	1002	4/4	0.08	-1.02	19,20,20,21	0
2	MN	D	1201	1/1	0.07	-1.21	43,43,43,43	0
2	MN	F	1402	1/1	0.06	-1.32	31,31,31,31	0
2	MN	A	1101	1/1	0.07	-2.12	42,42,42,42	0
2	MN	B	1601	1/1	0.06	-2.34	38,38,38,38	0
2	MN	F	1401	1/1	0.07	-2.42	47,47,47,47	0
2	MN	A	1102	1/1	0.05	-2.86	28,28,28,28	0
2	MN	E	1301	1/1	0.04	-3.42	30,30,30,30	0
2	MN	E	1302	1/1	0.02	-3.53	16,16,16,16	0
2	MN	G	1501	1/1	0.05	-3.66	40,40,40,40	0

6.5 Other polymers ⓘ

There are no such residues in this entry.