



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 4, 2023 – 04:59 AM EDT

PDB ID : 6U1C
Title : Apo form of Thermus thermophilus D-alanine-D-alanine ligase
Authors : Pederick, J.L.; Bruning, J.B.
Deposited on : 2019-08-15
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 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
Xtriage (Phenix) : 1.13
EDS : 2.35.1
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) : 2.35.1

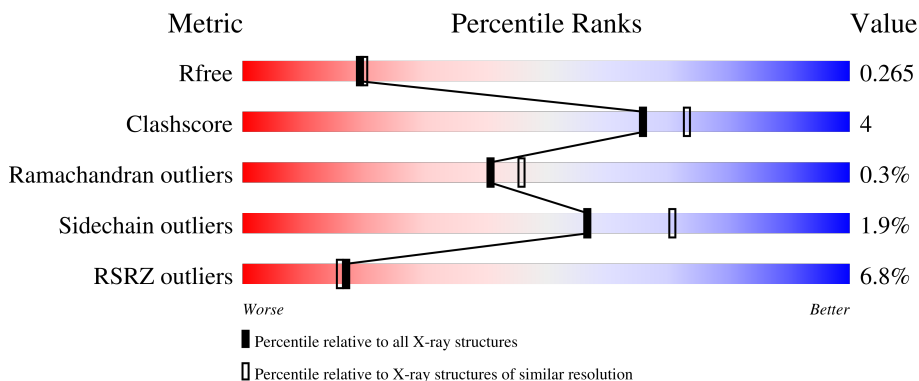
1 Overall quality at a glance

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))
R_{free}	130704	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (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 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	327	 5% 83% 12% 5%
1	B	327	 6% 82% 10% 8%
1	C	327	 6% 84% 8% 8%
1	D	327	 8% 78% 13% 8%

2 Entry composition i

There are 2 unique types of molecules in this entry. The entry contains 9078 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 D-alanine–D-alanine ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	310	2257	1468	387	398	4	0	0	0
1	B	302	2229	1450	372	403	4	0	0	0
1	C	301	2231	1453	376	397	5	0	1	0
1	D	300	2197	1436	358	399	4	0	0	0

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	MET	-	initiating methionine	UNP Q5SHZ3
A	0	GLU	-	expression tag	UNP Q5SHZ3
A	320	HIS	-	expression tag	UNP Q5SHZ3
A	321	HIS	-	expression tag	UNP Q5SHZ3
A	322	HIS	-	expression tag	UNP Q5SHZ3
A	323	HIS	-	expression tag	UNP Q5SHZ3
A	324	HIS	-	expression tag	UNP Q5SHZ3
A	325	HIS	-	expression tag	UNP Q5SHZ3
B	-1	MET	-	initiating methionine	UNP Q5SHZ3
B	0	GLU	-	expression tag	UNP Q5SHZ3
B	320	HIS	-	expression tag	UNP Q5SHZ3
B	321	HIS	-	expression tag	UNP Q5SHZ3
B	322	HIS	-	expression tag	UNP Q5SHZ3
B	323	HIS	-	expression tag	UNP Q5SHZ3
B	324	HIS	-	expression tag	UNP Q5SHZ3
B	325	HIS	-	expression tag	UNP Q5SHZ3
C	-1	MET	-	initiating methionine	UNP Q5SHZ3
C	0	GLU	-	expression tag	UNP Q5SHZ3
C	320	HIS	-	expression tag	UNP Q5SHZ3
C	321	HIS	-	expression tag	UNP Q5SHZ3
C	322	HIS	-	expression tag	UNP Q5SHZ3

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Chain	Residue	Modelled	Actual	Comment	Reference
C	323	HIS	-	expression tag	UNP Q5SHZ3
C	324	HIS	-	expression tag	UNP Q5SHZ3
C	325	HIS	-	expression tag	UNP Q5SHZ3
D	-1	MET	-	initiating methionine	UNP Q5SHZ3
D	0	GLU	-	expression tag	UNP Q5SHZ3
D	320	HIS	-	expression tag	UNP Q5SHZ3
D	321	HIS	-	expression tag	UNP Q5SHZ3
D	322	HIS	-	expression tag	UNP Q5SHZ3
D	323	HIS	-	expression tag	UNP Q5SHZ3
D	324	HIS	-	expression tag	UNP Q5SHZ3
D	325	HIS	-	expression tag	UNP Q5SHZ3

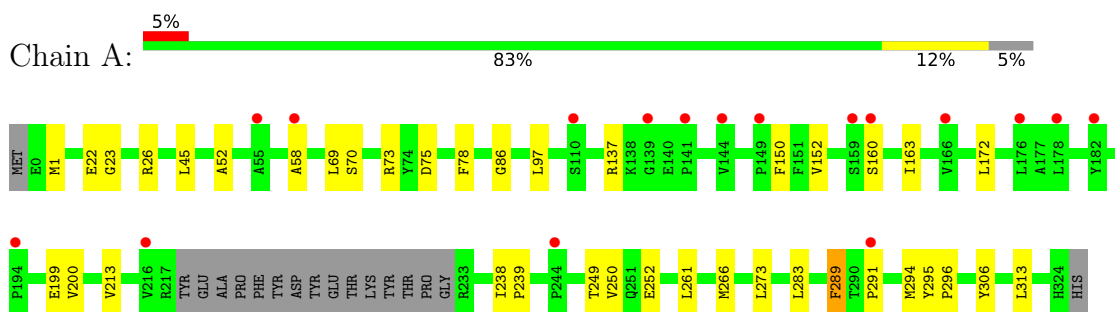
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	37	Total O 37 37	0	0
2	B	41	Total O 41 41	0	0
2	C	46	Total O 46 46	0	0
2	D	40	Total O 40 40	0	0

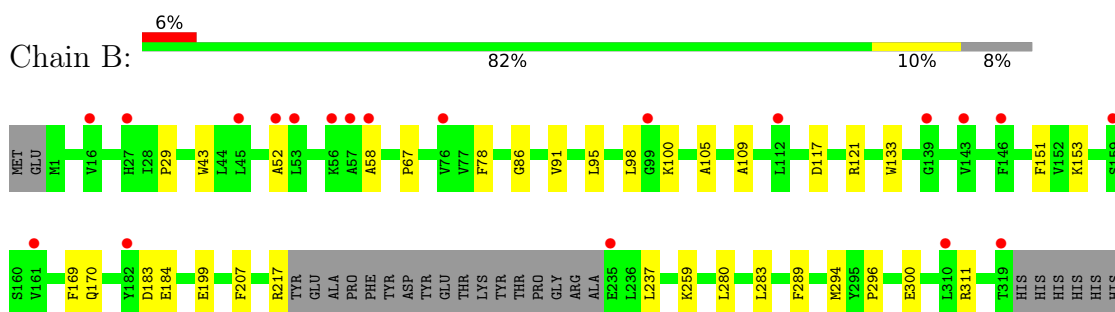
3 Residue-property plots [i](#)

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.

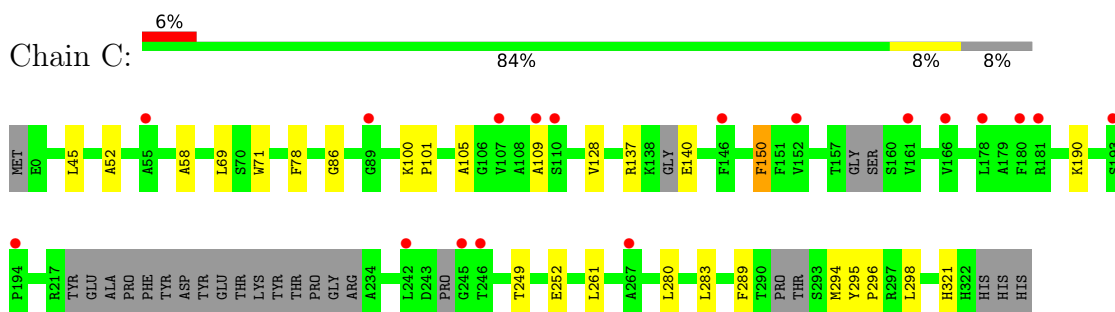
- Molecule 1: D-alanine–D-alanine ligase



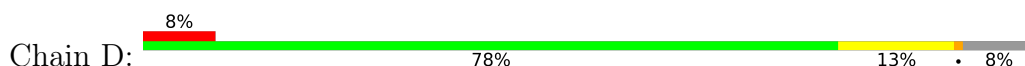
- Molecule 1: D-alanine–D-alanine ligase

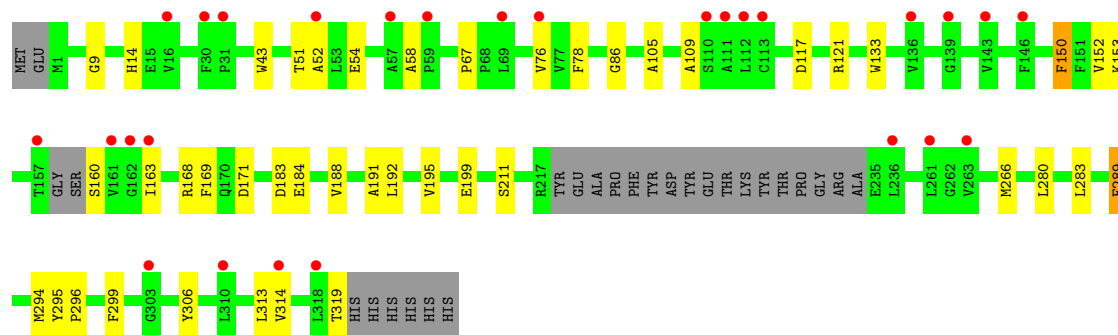


- Molecule 1: D-alanine–D-alanine ligase



- Molecule 1: D-alanine–D-alanine ligase





4 Data and refinement statistics i

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	55.87Å 68.69Å 91.79Å 68.31° 79.71° 65.99°	Depositor
Resolution (Å)	33.25 – 2.20 33.25 – 2.20	Depositor EDS
% Data completeness (in resolution range)	97.8 (33.25-2.20) 97.8 (33.25-2.20)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.51 (at 2.20Å)	Xtrriage
Refinement program	PHENIX 1.16_3549	Depositor
R, R_{free}	0.238 , 0.265 0.238 , 0.265	Depositor DCC
R_{free} test set	2982 reflections (5.18%)	wwPDB-VP
Wilson B-factor (Å ²)	37.7	Xtrriage
Anisotropy	0.666	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 45.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	0.028 for -h,-k,-k+1	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	9078	wwPDB-VP
Average B, all atoms (Å ²)	46.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.33% 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](#)

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	0.26	0/2317	0.43	0/3175
1	B	0.26	0/2286	0.44	0/3130
1	C	0.26	0/2284	0.43	0/3118
1	D	0.26	0/2253	0.44	0/3088
All	All	0.26	0/9140	0.44	0/12511

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 [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	2257	0	2203	20	0
1	B	2229	0	2196	17	0
1	C	2231	0	2197	13	0
1	D	2197	0	2161	23	0
2	A	37	0	0	0	0
2	B	41	0	0	1	0
2	C	46	0	0	0	0
2	D	40	0	0	0	0
All	All	9078	0	8757	71	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 (71) 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:C:249:THR:HA	1:C:252:GLU:HG2	1.85	0.59
1:B:52:ALA:HB1	1:B:58:ALA:HB2	1.85	0.59
1:D:52:ALA:HB1	1:D:58:ALA:HB2	1.84	0.58
1:A:160:SER:HA	1:A:163:ILE:HD12	1.86	0.58
1:D:43:TRP:CE3	1:D:67:PRO:HG3	2.40	0.57
1:D:150:PHE:HA	1:D:191:ALA:H	1.68	0.57
1:D:152:VAL:HG22	1:D:188:VAL:HG22	1.88	0.56
1:D:76:VAL:HG21	1:D:314:VAL:HG13	1.87	0.55
1:B:183:ASP:OD1	1:B:184:GLU:N	2.40	0.55
1:C:45:LEU:HD22	1:C:69:LEU:HD21	1.90	0.54
1:B:280:LEU:HD21	1:B:283:LEU:HD12	1.90	0.54
1:D:9:GLY:O	1:D:14:HIS:ND1	2.33	0.54
1:A:23:GLY:HA3	1:A:291:PRO:HD3	1.91	0.53
1:D:280:LEU:HD21	1:D:283:LEU:HD12	1.91	0.53
1:D:199:GLU:OE1	1:D:294:MET:HG2	2.11	0.51
1:C:261:LEU:HD12	1:C:283:LEU:HD22	1.92	0.51
1:D:153:LYS:HG2	1:D:163:ILE:HG23	1.93	0.51
1:B:43:TRP:CE3	1:B:67:PRO:HG3	2.46	0.50
1:B:105:ALA:HB1	1:B:109:ALA:HB3	1.94	0.50
1:A:249:THR:HA	1:A:252:GLU:HG2	1.93	0.50
1:A:199:GLU:OE1	1:A:294:MET:HG2	2.12	0.50
1:D:296:PRO:HB3	1:D:306:TYR:HD1	1.78	0.49
1:B:217:ARG:NH2	2:B:403:HOH:O	2.44	0.49
1:C:52:ALA:HB1	1:C:58:ALA:HB2	1.95	0.48
1:B:29:PRO:HG3	1:B:311:ARG:HB2	1.95	0.48
1:D:117:ASP:O	1:D:121:ARG:HG3	2.13	0.48
1:D:192:LEU:HB2	1:D:195:VAL:HG21	1.95	0.48
1:C:137[B]:ARG:O	1:C:140:GLU:HB3	2.14	0.47
1:A:200:VAL:HG21	1:A:250:VAL:HG12	1.95	0.47
1:D:266:MET:HB3	1:D:313:LEU:HD21	1.97	0.47
1:A:137:ARG:NH1	1:B:259:LYS:HE2	2.31	0.46
1:A:266:MET:HB3	1:A:313:LEU:HD21	1.98	0.46
1:D:192:LEU:HB2	1:D:195:VAL:CG2	2.45	0.46
1:B:217:ARG:HD2	1:B:237:LEU:HD11	1.98	0.45
1:C:101:PRO:HG3	1:C:321:HIS:CG	2.51	0.45
1:C:294:MET:O	1:C:298:LEU:HG	2.16	0.45
1:A:261:LEU:HD12	1:A:283:LEU:HD22	1.99	0.45
1:D:296:PRO:HB3	1:D:306:TYR:CD1	2.52	0.44
1:A:70:SER:O	1:A:73:ARG:HG2	2.17	0.44
1:D:289:PHE:O	1:D:306:TYR:OH	2.25	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:105:ALA:HB1	1:C:109:ALA:HB3	1.98	0.44
1:B:98:LEU:HB3	1:B:100:LYS:HG2	1.98	0.44
1:D:183:ASP:OD1	1:D:184:GLU:N	2.51	0.44
1:A:22:GLU:O	1:A:26:ARG:HG3	2.17	0.44
1:A:52:ALA:HB1	1:A:58:ALA:HB2	2.00	0.43
1:C:150:PHE:HB3	1:C:190:LYS:HA	2.01	0.43
1:A:45:LEU:HD22	1:A:69:LEU:HD21	2.00	0.43
1:A:295:TYR:HB3	1:A:296:PRO:HD3	2.01	0.43
1:B:151:PHE:HB3	1:B:153:LYS:HE3	2.00	0.43
1:B:207:PHE:CE1	1:B:259:LYS:HE3	2.54	0.43
1:A:150:PHE:CE1	1:A:172:LEU:HD13	2.54	0.42
1:D:51:THR:O	1:D:54:GLU:HG2	2.18	0.42
1:D:168:ARG:NH2	1:D:171:ASP:OD1	2.52	0.42
1:D:211:SER:HB3	1:D:299:PHE:CE2	2.54	0.42
1:A:238:ILE:HA	1:A:239:PRO:HA	1.92	0.42
1:A:200:VAL:HG22	1:A:213:VAL:HG22	2.01	0.42
1:C:295:TYR:HB3	1:C:296:PRO:HD3	2.02	0.42
1:D:105:ALA:HB1	1:D:109:ALA:HB3	2.02	0.42
1:D:295:TYR:HB3	1:D:296:PRO:HD3	2.02	0.41
1:A:289:PHE:O	1:A:306:TYR:OH	2.29	0.41
1:B:199:GLU:OE1	1:B:294:MET:HG2	2.21	0.41
1:B:117:ASP:O	1:B:121:ARG:HG3	2.21	0.41
1:A:97:LEU:HD11	1:B:91:VAL:HA	2.02	0.41
1:C:137[A]:ARG:O	1:C:140:GLU:HB3	2.21	0.41
1:B:296:PRO:O	1:B:300:GLU:HG3	2.21	0.41
1:C:71:TRP:O	1:C:100:LYS:HE3	2.21	0.41
1:A:152:VAL:O	1:A:163:ILE:HA	2.21	0.41
1:A:1:MET:HA	1:A:75:ASP:OD2	2.20	0.40
1:B:95:LEU:HD23	1:B:98:LEU:HD12	2.03	0.40
1:C:128:VAL:HG11	1:C:280:LEU:HD23	2.03	0.40
1:D:160:SER:HA	1:D:163:ILE:HD12	2.02	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	306/327 (94%)	292 (95%)	13 (4%)	1 (0%)	41	46
1	B	298/327 (91%)	293 (98%)	4 (1%)	1 (0%)	41	46
1	C	290/327 (89%)	276 (95%)	13 (4%)	1 (0%)	41	46
1	D	294/327 (90%)	284 (97%)	9 (3%)	1 (0%)	41	46
All	All	1188/1308 (91%)	1145 (96%)	39 (3%)	4 (0%)	41	46

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	86	GLY
1	A	86	GLY
1	B	86	GLY
1	D	86	GLY

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	218/264 (83%)	215 (99%)	3 (1%)	67	80
1	B	222/264 (84%)	217 (98%)	5 (2%)	50	63
1	C	221/264 (84%)	218 (99%)	3 (1%)	67	80
1	D	219/264 (83%)	213 (97%)	6 (3%)	44	57
All	All	880/1056 (83%)	863 (98%)	17 (2%)	57	71

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	78	PHE
1	A	273	LEU
1	A	289	PHE
1	B	78	PHE

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Mol	Chain	Res	Type
1	B	133	TRP
1	B	169	PHE
1	B	170	GLN
1	B	289	PHE
1	C	78	PHE
1	C	150	PHE
1	C	289	PHE
1	D	78	PHE
1	D	133	TRP
1	D	150	PHE
1	D	169	PHE
1	D	289	PHE
1	D	319	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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](#)

There are no ligands in this entry.

5.7 Other polymers [i](#)

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 [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	310/327 (94%)	0.39	17 (5%) 25 24	27, 43, 71, 86	0
1	B	302/327 (92%)	0.46	20 (6%) 18 17	27, 48, 65, 71	0
1	C	301/327 (92%)	0.43	18 (5%) 21 20	26, 43, 64, 72	0
1	D	300/327 (91%)	0.62	27 (9%) 9 8	29, 49, 68, 73	0
All	All	1213/1308 (92%)	0.48	82 (6%) 17 16	26, 46, 68, 86	0

All (82) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	178	LEU	4.2
1	D	31	PRO	4.0
1	D	303	GLY	3.9
1	C	55	ALA	3.9
1	D	146	PHE	3.8
1	B	53	LEU	3.7
1	B	161	VAL	3.6
1	D	163	ILE	3.6
1	C	178	LEU	3.6
1	B	159	SER	3.6
1	A	291	PRO	3.6
1	C	161	VAL	3.4
1	D	57	ALA	3.4
1	C	246	THR	3.4
1	B	45	LEU	3.4
1	D	314	VAL	3.3
1	D	59	PRO	3.2
1	A	144	VAL	3.1
1	D	236	LEU	3.0
1	A	141	PRO	3.0
1	C	107	VAL	3.0

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Mol	Chain	Res	Type	RSRZ
1	D	111	ALA	2.9
1	A	149	PRO	2.9
1	A	139	GLY	2.9
1	D	162	GLY	2.8
1	C	194	PRO	2.8
1	D	263	VAL	2.8
1	A	160	SER	2.8
1	D	139	GLY	2.8
1	C	166	VAL	2.8
1	D	318	LEU	2.6
1	C	110	SER	2.6
1	B	58	ALA	2.6
1	B	99	GLY	2.6
1	A	182	TYR	2.6
1	C	180	PHE	2.6
1	C	146	PHE	2.5
1	B	139	GLY	2.5
1	B	146	PHE	2.5
1	B	57	ALA	2.5
1	C	109	ALA	2.5
1	D	261	LEU	2.5
1	D	52	ALA	2.5
1	D	112	LEU	2.5
1	B	143	VAL	2.4
1	C	152	VAL	2.4
1	C	193	SER	2.4
1	B	52	ALA	2.4
1	D	136	VAL	2.4
1	D	161	VAL	2.4
1	A	159	SER	2.4
1	C	245	GLY	2.3
1	A	176	LEU	2.3
1	A	194	PRO	2.3
1	C	267	ALA	2.3
1	B	16	VAL	2.3
1	B	76	VAL	2.3
1	D	143	VAL	2.3
1	C	89	GLY	2.3
1	D	113	CYS	2.3
1	D	157	THR	2.3
1	C	181	ARG	2.2
1	C	242	LEU	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	56	LYS	2.2
1	B	235	GLU	2.2
1	A	216	VAL	2.2
1	B	310	LEU	2.1
1	A	110	SER	2.1
1	A	166	VAL	2.1
1	A	58	ALA	2.1
1	A	244	PRO	2.1
1	B	182	TYR	2.1
1	D	30	PHE	2.1
1	D	310	LEU	2.0
1	B	319	THR	2.0
1	A	55	ALA	2.0
1	D	76	VAL	2.0
1	B	27	HIS	2.0
1	B	112	LEU	2.0
1	D	69	LEU	2.0
1	D	16	VAL	2.0
1	D	110	SER	2.0

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](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.