



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 15, 2017 – 03:08 am GMT

PDB ID : 2HK8  
Title : Crystal structure of shikimate dehydrogenase from aquifex aeolicus at 2.35 angstrom resolution  
Authors : Gan, J.H.; Prabakaran, P.; Gu, Y.J.; Andrykovitch, M.; Li, Y.; Liu, H.H.; Yan, H.; Ji, X.  
Deposited on : 2006-07-03  
Resolution : 2.35 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](mailto:validation@mail.wwpdb.org)

A user guide is available at

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.9-1692
EDS	:	trunk28620
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	recalc28949

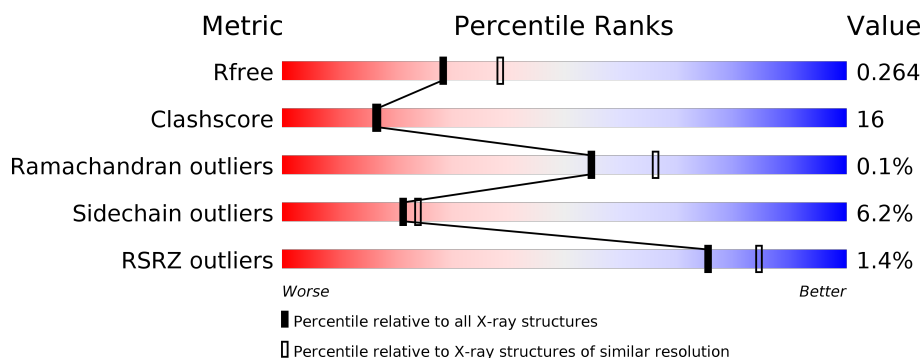
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.35 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))
$R_{free}$	100719	1522 (2.38-2.34)
Clashscore	112137	1626 (2.38-2.34)
Ramachandran outliers	110173	1605 (2.38-2.34)
Sidechain outliers	110143	1606 (2.38-2.34)
RSRZ outliers	101464	1528 (2.38-2.34)

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  $\geq 3$ , 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	269	<div> <div style="width: 2%;"></div> <div style="width: 71%; background-color: green;"></div> <div style="width: 23%; background-color: yellow;"></div> <div style="width: 4%; background-color: orange;"></div> <div style="width: 2%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>71% 23% ..</div>
1	B	269	<div> <div style="width: 2%;"></div> <div style="width: 65%; background-color: green;"></div> <div style="width: 30%; background-color: yellow;"></div> <div style="width: 4%; background-color: orange;"></div> <div style="width: 2%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>65% 30% ..</div>
1	C	269	<div> <div style="width: 2%;"></div> <div style="width: 65%; background-color: green;"></div> <div style="width: 31%; background-color: yellow;"></div> <div style="width: 4%; background-color: orange;"></div> <div style="width: 2%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>65% 31% ..</div>
1	D	269	<div> <div style="width: 2%;"></div> <div style="width: 67%; background-color: green;"></div> <div style="width: 29%; background-color: yellow;"></div> <div style="width: 4%; background-color: orange;"></div> <div style="width: 2%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>67% 29% ..</div>
1	E	269	<div> <div style="width: 2%;"></div> <div style="width: 60%; background-color: green;"></div> <div style="width: 36%; background-color: yellow;"></div> <div style="width: 4%; background-color: orange;"></div> <div style="width: 2%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>60% 36% ..</div>
1	F	269	<div> <div style="width: 68%; background-color: green;"></div> <div style="width: 28%; background-color: yellow;"></div> <div style="width: 4%; background-color: orange;"></div> <div style="width: 2%; background-color: red;"></div> <div style="width: 2%; background-color: grey;"></div> </div> <div>68% 28% ..</div>

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Mol	Chain	Length	Quality of chain
1	G	269	<div> <div>2%</div> <div> <div></div> <div>64%</div> <div>32%</div> <div>..</div> </div> </div>
1	H	269	<div> <div>%</div> <div> <div></div> <div>68%</div> <div>28%</div> <div>..</div> </div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 17423 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 Shikimate dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	266	Total	C	N	O	S	0	0	0
			2103	1378	340	382	3			
1	B	266	Total	C	N	O	S	0	0	0
			2103	1378	340	382	3			
1	C	265	Total	C	N	O	S	0	0	0
			2095	1374	339	379	3			
1	D	266	Total	C	N	O	S	0	0	0
			2103	1378	340	382	3			
1	E	266	Total	C	N	O	S	0	0	0
			2103	1378	340	382	3			
1	F	264	Total	C	N	O	S	0	0	0
			2084	1368	335	378	3			
1	G	266	Total	C	N	O	S	0	0	0
			2103	1378	340	382	3			
1	H	266	Total	C	N	O	S	0	0	0
			2103	1378	340	382	3			

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	195	GLU	LYS	SEE REMARK 999	UNP O67049
A	233	LEU	PHE	SEE REMARK 999	UNP O67049
B	195	GLU	LYS	SEE REMARK 999	UNP O67049
B	233	LEU	PHE	SEE REMARK 999	UNP O67049
C	195	GLU	LYS	SEE REMARK 999	UNP O67049
C	233	LEU	PHE	SEE REMARK 999	UNP O67049
D	195	GLU	LYS	SEE REMARK 999	UNP O67049
D	233	LEU	PHE	SEE REMARK 999	UNP O67049
E	195	GLU	LYS	SEE REMARK 999	UNP O67049
E	233	LEU	PHE	SEE REMARK 999	UNP O67049
F	195	GLU	LYS	SEE REMARK 999	UNP O67049
F	233	LEU	PHE	SEE REMARK 999	UNP O67049
G	195	GLU	LYS	SEE REMARK 999	UNP O67049

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Chain	Residue	Modelled	Actual	Comment	Reference
G	233	LEU	PHE	SEE REMARK 999	UNP O67049
H	195	GLU	LYS	SEE REMARK 999	UNP O67049
H	233	LEU	PHE	SEE REMARK 999	UNP O67049

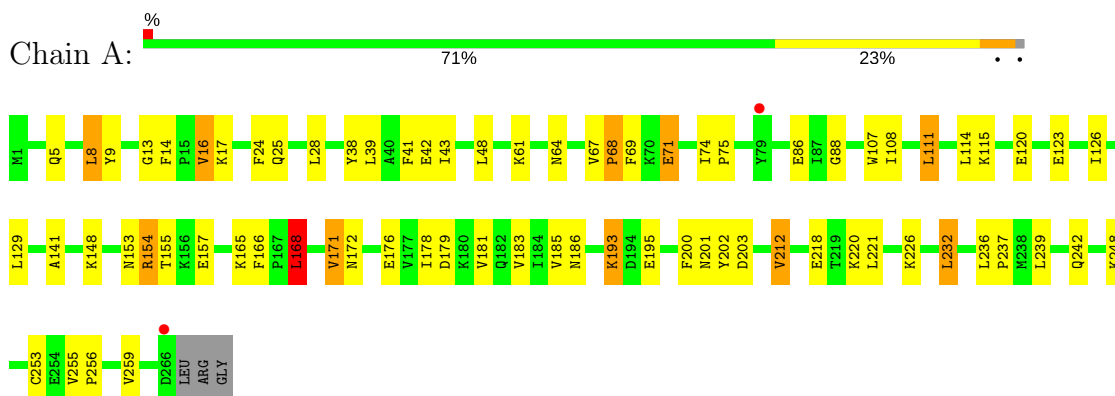
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	99	Total O 99 99	0	0
2	B	82	Total O 82 82	0	0
2	C	66	Total O 66 66	0	0
2	D	90	Total O 90 90	0	0
2	E	61	Total O 61 61	0	0
2	F	69	Total O 69 69	0	0
2	G	80	Total O 80 80	0	0
2	H	79	Total O 79 79	0	0

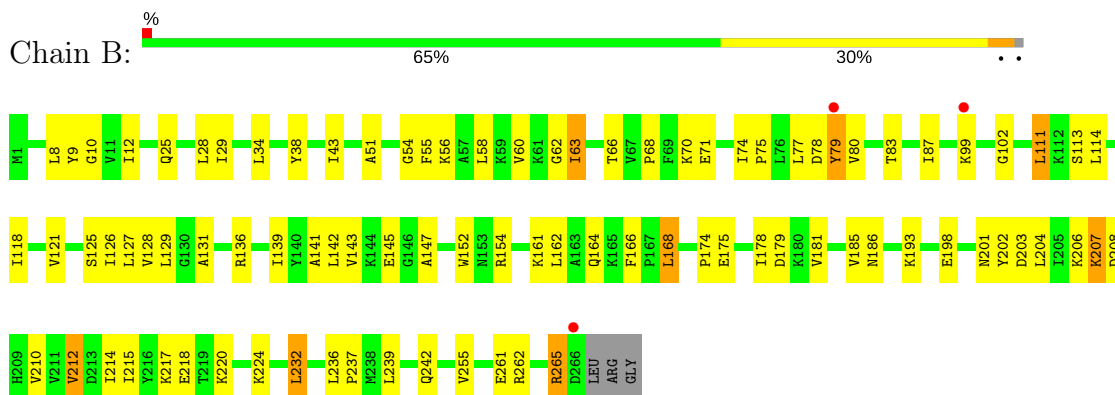
### 3 Residue-property plots [i](#)

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.

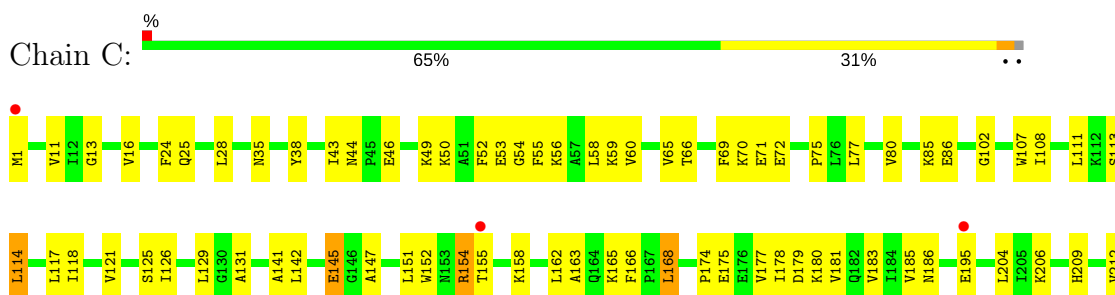
#### • Molecule 1: Shikimate dehydrogenase

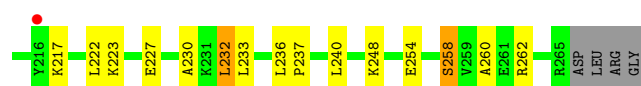


#### • Molecule 1: Shikimate dehydrogenase

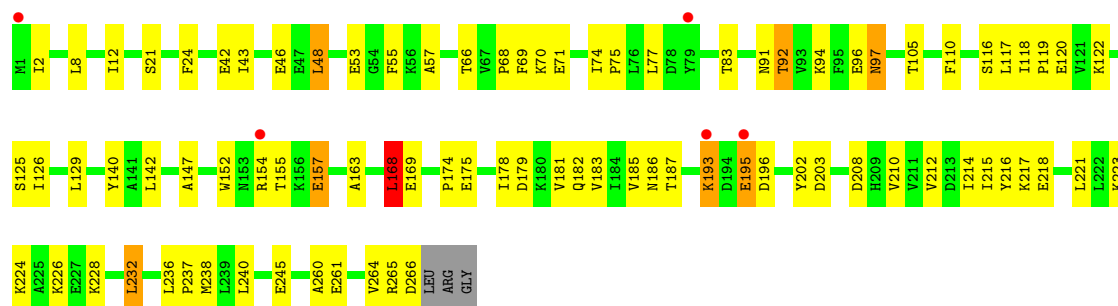


#### • Molecule 1: Shikimate dehydrogenase

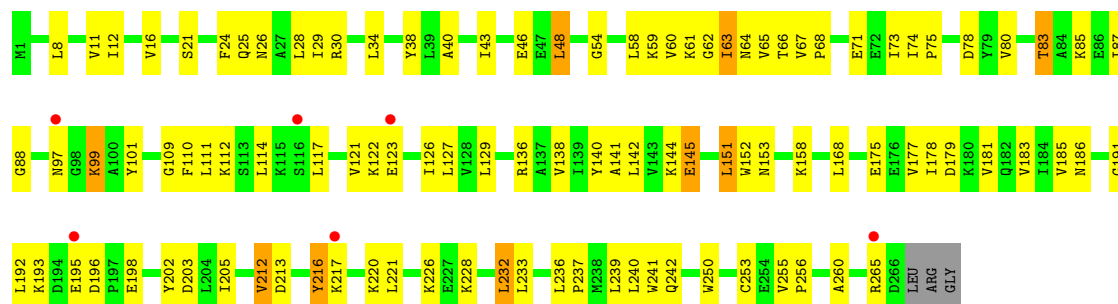




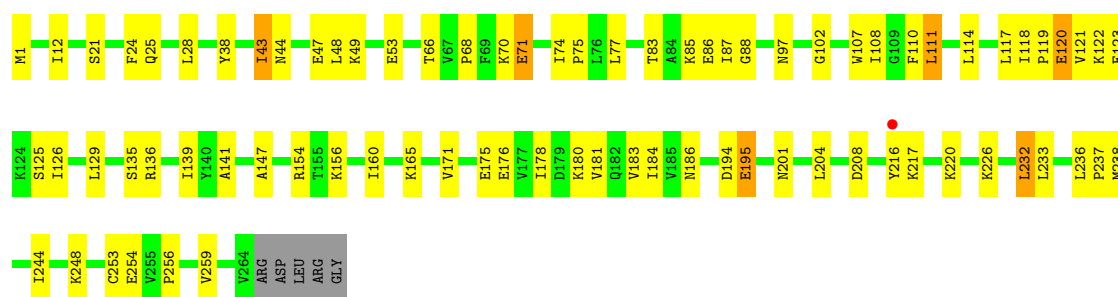
• Molecule 1: Shikimate dehydrogenase



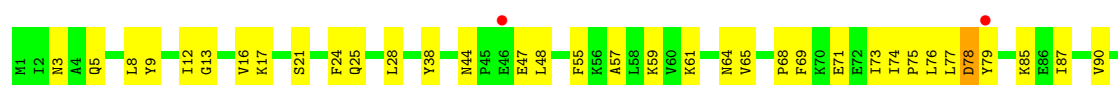
• Molecule 1: Shikimate dehydrogenase

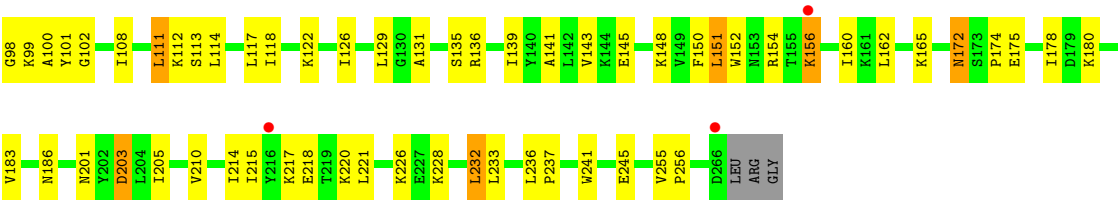


• Molecule 1: Shikimate dehydrogenase

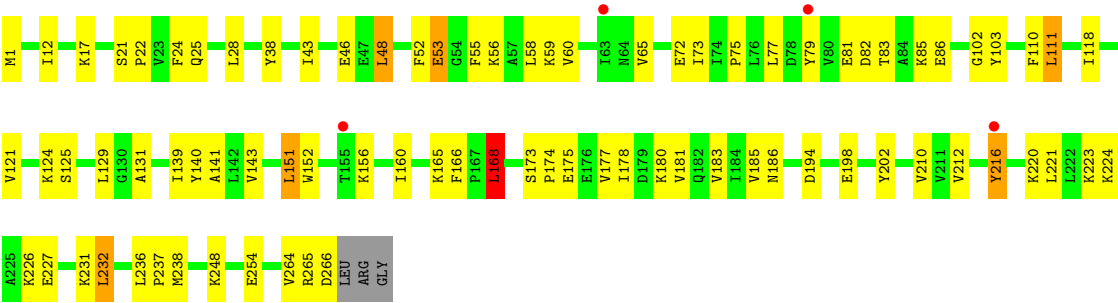


• Molecule 1: Shikimate dehydrogenase





● Molecule 1: Shikimate dehydrogenase





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	37.36Å 73.96Å 192.11Å 94.64° 94.16° 91.81°	Depositor
Resolution (Å)	28.40 – 2.35 28.40 – 2.20	Depositor EDS
% Data completeness (in resolution range)	84.2 (28.40-2.35) 73.4 (28.40-2.20)	Depositor EDS
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.74 (at 2.20Å)	Xtriage
Refinement program	CNS 1.0	Depositor
R, $R_{free}$	0.214 , 0.265 0.214 , 0.264	Depositor DCC
$R_{free}$ test set	3638 reflections (5.08%)	DCC
Wilson B-factor (Å <sup>2</sup> )	28.3	Xtriage
Anisotropy	0.264	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 48.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.053 for h,-k,-h-l	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	17423	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	33.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.71% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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	0.44	0/2145	0.64	1/2900 (0.0%)
1	B	0.44	0/2145	0.61	0/2900
1	C	0.45	0/2137	0.63	0/2889
1	D	0.45	0/2145	0.64	2/2900 (0.1%)
1	E	0.42	0/2145	0.61	0/2900
1	F	0.42	0/2126	0.62	0/2875
1	G	0.44	0/2145	0.63	0/2900
1	H	0.43	0/2145	0.65	3/2900 (0.1%)
All	All	0.44	0/17133	0.63	6/23164 (0.0%)

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	216	TYR	CA-CB-CG	6.13	125.05	113.40
1	A	168	LEU	CA-CB-CG	6.10	129.34	115.30
1	H	216	TYR	CA-CB-CG	5.96	124.73	113.40
1	H	168	LEU	CA-CB-CG	5.85	128.75	115.30
1	D	168	LEU	CA-CB-CG	5.35	127.60	115.30

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	2103	0	2195	51	0
1	B	2103	0	2195	72	0
1	C	2095	0	2191	75	0
1	D	2103	0	2195	70	0
1	E	2103	0	2195	74	0
1	F	2084	0	2178	63	0
1	G	2103	0	2195	77	0
1	H	2103	0	2195	66	0
2	A	99	0	0	1	0
2	B	82	0	0	2	0
2	C	66	0	0	2	0
2	D	90	0	0	3	0
2	E	61	0	0	0	0
2	F	69	0	0	6	0
2	G	80	0	0	10	0
2	H	79	0	0	3	0
All	All	17423	0	17539	538	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 16.

The worst 5 of 538 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:E:111:LEU:HD13	1:E:141:ALA:HB1	1.45	0.98
1:F:111:LEU:HD13	1:F:141:ALA:HB1	1.54	0.86
1:G:226:LYS:HG3	1:G:232:LEU:HG	1.57	0.86
1:E:198:GLU:HG2	1:E:220:LYS:HE3	1.60	0.83
1:C:111:LEU:HD13	1:C:141:ALA:HB1	1.61	0.83

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	264/269 (98%)	258 (98%)	6 (2%)	0	100	100
1	B	264/269 (98%)	258 (98%)	6 (2%)	0	100	100
1	C	263/269 (98%)	257 (98%)	6 (2%)	0	100	100
1	D	264/269 (98%)	257 (97%)	7 (3%)	0	100	100
1	E	264/269 (98%)	256 (97%)	7 (3%)	1 (0%)	38	44
1	F	262/269 (97%)	256 (98%)	6 (2%)	0	100	100
1	G	264/269 (98%)	256 (97%)	8 (3%)	0	100	100
1	H	264/269 (98%)	257 (97%)	6 (2%)	1 (0%)	38	44
All	All	2109/2152 (98%)	2055 (97%)	52 (2%)	2 (0%)	55	66

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	H	265	ARG
1	E	265	ARG

### 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	227/229 (99%)	206 (91%)	21 (9%)	10	10
1	B	227/229 (99%)	215 (95%)	12 (5%)	26	32
1	C	226/229 (99%)	216 (96%)	10 (4%)	33	41
1	D	227/229 (99%)	210 (92%)	17 (8%)	16	17
1	E	227/229 (99%)	212 (93%)	15 (7%)	19	21
1	F	225/229 (98%)	211 (94%)	14 (6%)	21	24
1	G	227/229 (99%)	213 (94%)	14 (6%)	21	24
1	H	227/229 (99%)	218 (96%)	9 (4%)	36	46
All	All	1813/1832 (99%)	1701 (94%)	112 (6%)	21	24

5 of 112 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	122	LYS
1	E	61	LYS
1	H	1	MET
1	D	157	GLU
1	D	195	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 14 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	251	ASN
1	D	97	ASN
1	F	164	GLN
1	C	35	ASN
1	F	97	ASN

### 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](#)

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 [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, 95<sup>th</sup> 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 <sup>2</sup> )	Q < 0.9
1	A	266/269 (98%)	-0.04	2 (0%) 86 92	14, 31, 48, 60	0
1	B	266/269 (98%)	-0.05	3 (1%) 80 88	11, 31, 48, 60	0
1	C	265/269 (98%)	-0.02	4 (1%) 74 83	18, 32, 50, 61	0
1	D	266/269 (98%)	0.01	5 (1%) 67 76	13, 31, 51, 63	0
1	E	266/269 (98%)	0.11	6 (2%) 61 71	18, 34, 52, 65	0
1	F	264/269 (98%)	-0.08	1 (0%) 92 96	18, 33, 49, 61	0
1	G	266/269 (98%)	0.01	5 (1%) 67 76	12, 31, 50, 64	0
1	H	266/269 (98%)	0.04	4 (1%) 74 83	14, 31, 49, 57	0
All	All	2125/2152 (98%)	-0.00	30 (1%) 75 84	11, 32, 50, 65	0

The worst 5 of 30 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	G	79	TYR	5.6
1	H	79	TYR	4.1
1	B	79	TYR	3.4
1	D	195	GLU	3.3
1	E	123	GLU	3.3

### 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](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.