



# Full wwPDB X-ray Structure Validation Report ⓘ

May 13, 2020 – 01:52 am BST

PDB ID : 4FQ7  
Title : Crystal structure of the maleate isomerase Iso from Pseudomonas putida S16  
Authors : Lu, Y.; Chen, D.; Zhang, Z.; Li, Q.; Wu, G.; Xu, P.  
Deposited on : 2012-06-25  
Resolution : 3.00 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](mailto: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.

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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) : 1.13  
EDS : 2.11  
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) : 2.11

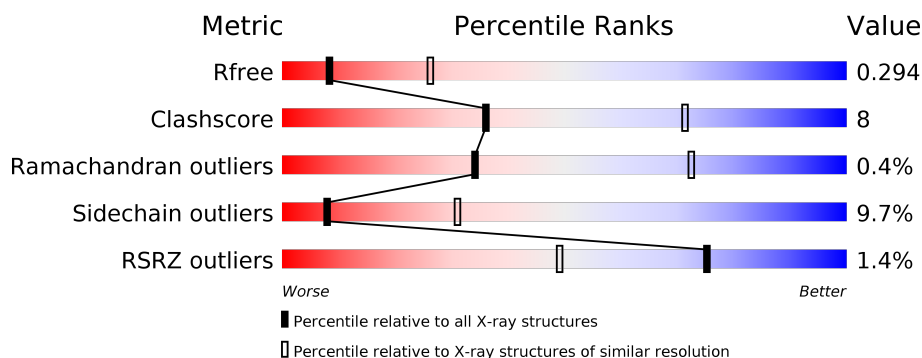
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 3.00 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))
$R_{free}$	130704	2092 (3.00-3.00)
Clashscore	141614	2416 (3.00-3.00)
Ramachandran outliers	138981	2333 (3.00-3.00)
Sidechain outliers	138945	2336 (3.00-3.00)
RSRZ outliers	127900	1990 (3.00-3.00)

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  $\geq 3$ , 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	281	<div> <div> <div></div> <div>69%</div> <div>17%</div> <div>•</div> <div>12%</div> </div> </div>
1	B	281	<div> <div> <div>2%</div> <div>65%</div> <div>20%</div> <div>•</div> <div>12%</div> </div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3732 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 Maleate cis-trans isomerase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	248	Total	C	N	O	S	0	0	0
			1860	1159	332	353	16			
1	B	248	Total	C	N	O	S	0	0	0
			1860	1159	332	353	16			

There are 60 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-20	MET	-	EXPRESSION TAG	UNP F8G0M3
A	-19	GLY	-	EXPRESSION TAG	UNP F8G0M3
A	-18	SER	-	EXPRESSION TAG	UNP F8G0M3
A	-17	SER	-	EXPRESSION TAG	UNP F8G0M3
A	-16	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	-15	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	-14	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	-13	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	-12	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	-11	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	-10	SER	-	EXPRESSION TAG	UNP F8G0M3
A	-9	SER	-	EXPRESSION TAG	UNP F8G0M3
A	-8	GLY	-	EXPRESSION TAG	UNP F8G0M3
A	-7	LEU	-	EXPRESSION TAG	UNP F8G0M3
A	-6	VAL	-	EXPRESSION TAG	UNP F8G0M3
A	-5	PRO	-	EXPRESSION TAG	UNP F8G0M3
A	-4	ARG	-	EXPRESSION TAG	UNP F8G0M3
A	-3	GLY	-	EXPRESSION TAG	UNP F8G0M3
A	-2	SER	-	EXPRESSION TAG	UNP F8G0M3
A	-1	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	0	MET	-	EXPRESSION TAG	UNP F8G0M3
A	1	VAL	-	EXPRESSION TAG	UNP F8G0M3
A	253	LEU	-	EXPRESSION TAG	UNP F8G0M3
A	254	GLU	-	EXPRESSION TAG	UNP F8G0M3
A	255	HIS	-	EXPRESSION TAG	UNP F8G0M3

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Chain	Residue	Modelled	Actual	Comment	Reference
A	256	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	257	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	258	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	259	HIS	-	EXPRESSION TAG	UNP F8G0M3
A	260	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	-20	MET	-	EXPRESSION TAG	UNP F8G0M3
B	-19	GLY	-	EXPRESSION TAG	UNP F8G0M3
B	-18	SER	-	EXPRESSION TAG	UNP F8G0M3
B	-17	SER	-	EXPRESSION TAG	UNP F8G0M3
B	-16	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	-15	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	-14	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	-13	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	-12	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	-11	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	-10	SER	-	EXPRESSION TAG	UNP F8G0M3
B	-9	SER	-	EXPRESSION TAG	UNP F8G0M3
B	-8	GLY	-	EXPRESSION TAG	UNP F8G0M3
B	-7	LEU	-	EXPRESSION TAG	UNP F8G0M3
B	-6	VAL	-	EXPRESSION TAG	UNP F8G0M3
B	-5	PRO	-	EXPRESSION TAG	UNP F8G0M3
B	-4	ARG	-	EXPRESSION TAG	UNP F8G0M3
B	-3	GLY	-	EXPRESSION TAG	UNP F8G0M3
B	-2	SER	-	EXPRESSION TAG	UNP F8G0M3
B	-1	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	0	MET	-	EXPRESSION TAG	UNP F8G0M3
B	1	VAL	-	EXPRESSION TAG	UNP F8G0M3
B	253	LEU	-	EXPRESSION TAG	UNP F8G0M3
B	254	GLU	-	EXPRESSION TAG	UNP F8G0M3
B	255	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	256	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	257	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	258	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	259	HIS	-	EXPRESSION TAG	UNP F8G0M3
B	260	HIS	-	EXPRESSION TAG	UNP F8G0M3

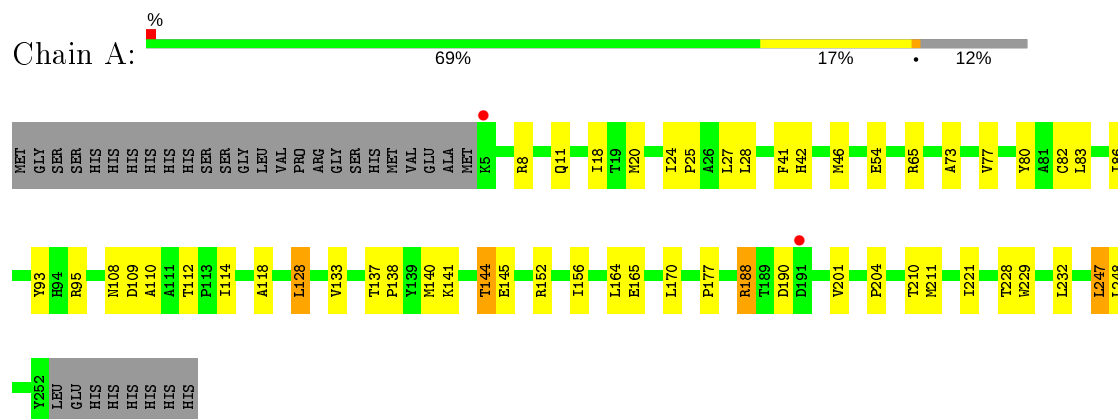
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	4	Total O 4 4	0	0
2	B	8	Total O 8 8	0	0

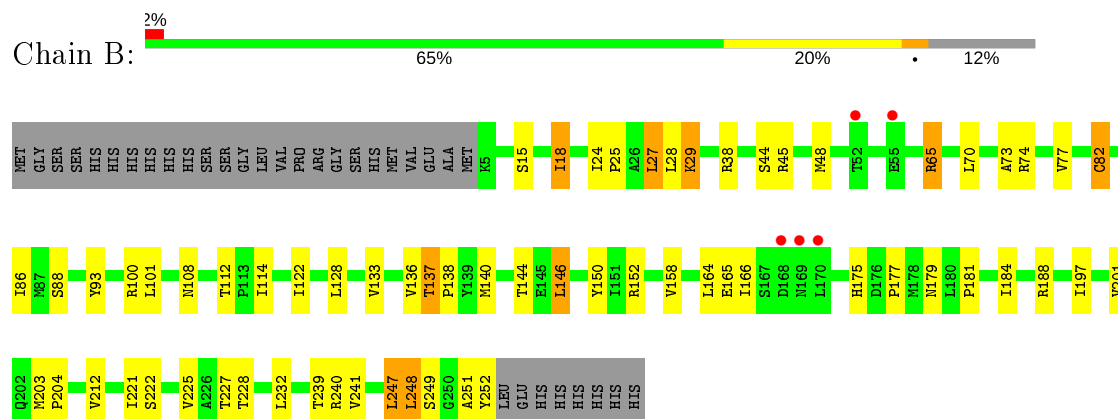
### 3 Residue-property plots

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: Maleate cis-trans isomerase



- Molecule 1: Maleate cis-trans isomerase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 61 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	66.47Å 66.47Å 413.84Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 3.00 41.24 – 3.00	Depositor EDS
% Data completeness (in resolution range)	99.5 (50.00-3.00) 99.8 (41.24-3.00)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	5.39 (at 3.01Å)	Xtriage
Refinement program	REFMAC 5.6.0117	Depositor
R, $R_{free}$	0.241 , 0.300 0.236 , 0.294	Depositor DCC
$R_{free}$ test set	575 reflections (4.85%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	54.7	Xtriage
Anisotropy	0.040	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 27.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.45$ , $\langle L^2 \rangle = 0.28$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.90	EDS
Total number of atoms	3732	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.11% 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

### 5.1 Standard geometry

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	0.37	0/1886	0.55	0/2562
1	B	0.37	0/1886	0.56	0/2562
All	All	0.37	0/3772	0.55	0/5124

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

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	1860	0	1904	25	0
1	B	1860	0	1904	42	0
2	A	4	0	0	0	0
2	B	8	0	0	0	0
All	All	3732	0	3808	60	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 8.

All (60) 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:B:65:ARG:HG2	1:B:65:ARG:HH11	1.22	1.01

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:65:ARG:CG	1:B:65:ARG:HH11	1.85	0.89
1:B:65:ARG:HG2	1:B:65:ARG:NH1	1.92	0.83
1:B:138:PRO:HA	1:B:164:LEU:HB2	1.66	0.78
1:B:137:THR:OG1	1:B:144:THR:HG22	1.87	0.75
1:A:188:ARG:HD2	1:A:190:ASP:OD2	1.95	0.67
1:B:140:MET:HA	1:B:165:GLU:HG2	1.79	0.64
1:B:27:LEU:HD21	1:B:225:VAL:HG12	1.80	0.63
1:A:46:MET:CE	1:A:80:TYR:HE1	2.13	0.61
1:A:8:ARG:HD2	1:B:18:ILE:HD11	1.83	0.60
1:A:73:ALA:HB1	1:B:18:ILE:HD12	1.84	0.60
1:B:247:LEU:O	1:B:251:ALA:HB2	2.02	0.59
1:B:247:LEU:O	1:B:251:ALA:CB	2.53	0.56
1:A:24:ILE:HG23	1:A:228:THR:HG22	1.88	0.56
1:B:65:ARG:CG	1:B:65:ARG:NH1	2.55	0.56
1:A:83:LEU:HD13	1:A:118:ALA:HA	1.89	0.55
1:A:46:MET:HE2	1:A:80:TYR:HE1	1.71	0.55
1:A:86:ILE:HG23	1:A:93:TYR:HD1	1.71	0.55
1:A:18:ILE:HD13	1:B:73:ALA:HB1	1.89	0.55
1:B:82:CYS:H	1:B:201:VAL:HG11	1.73	0.54
1:A:138:PRO:HA	1:A:164:LEU:HB2	1.90	0.54
1:B:25:PRO:O	1:B:29:LYS:HB2	2.10	0.52
1:A:25:PRO:HA	1:A:41:PHE:CZ	2.45	0.51
1:A:128:LEU:HD22	1:A:221:ILE:HD11	1.92	0.51
1:B:222:SER:H	1:B:225:VAL:HG22	1.76	0.51
1:B:88:SER:HA	1:B:146:LEU:HD22	1.92	0.51
1:A:18:ILE:CD1	1:B:73:ALA:HB1	2.41	0.50
1:A:140:MET:O	1:A:144:THR:HG23	2.11	0.50
1:B:137:THR:HG1	1:B:144:THR:HG22	1.76	0.49
1:B:175:HIS:CE1	1:B:179:ASN:HD22	2.30	0.49
1:A:42:HIS:CE1	1:B:18:ILE:HG13	2.48	0.49
1:B:15:SER:HA	1:B:45:ARG:HE	1.77	0.49
1:B:101:LEU:HB3	1:B:114:ILE:HD12	1.94	0.48
1:B:251:ALA:HA	1:B:252:TYR:HA	1.55	0.48
1:B:221:ILE:HD11	1:B:247:LEU:HG	1.95	0.48
1:A:8:ARG:HD2	1:B:18:ILE:CD1	2.44	0.48
1:B:137:THR:OG1	1:B:144:THR:CG2	2.59	0.47
1:A:82:CYS:HA	1:A:201:VAL:HG21	1.96	0.47
1:A:152:ARG:HA	1:A:156:ILE:O	2.14	0.47
1:B:241:VAL:HB	1:B:248:LEU:HG	1.97	0.46
1:B:122:ILE:HD11	1:B:150:TYR:HE2	1.81	0.46
1:A:141:LYS:O	1:A:145:GLU:HG2	2.17	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:93:TYR:OH	1:B:100:ARG:NH2	2.48	0.45
1:B:203:MET:HA	1:B:204:PRO:HD2	1.88	0.44
1:A:177:PRO:HG3	1:A:204:PRO:HB2	1.98	0.44
1:B:239:THR:OG1	1:B:251:ALA:HB3	2.18	0.44
1:A:229:TRP:CD1	1:A:247:LEU:HD22	2.53	0.43
1:B:177:PRO:HG3	1:B:204:PRO:HB2	1.99	0.43
1:B:86:ILE:HG23	1:B:93:TYR:HD1	1.84	0.43
1:B:240:ARG:HA	1:B:249:SER:HA	2.00	0.43
1:A:11:GLN:HE22	1:A:20:MET:HB3	1.84	0.43
1:A:188:ARG:HD3	1:A:188:ARG:HA	1.71	0.42
1:B:181:PRO:HA	1:B:212:VAL:HG22	2.01	0.42
1:B:184:ILE:HD11	1:B:197:ILE:HG13	2.01	0.42
1:B:136:VAL:HB	1:B:197:ILE:O	2.20	0.42
1:A:110:ALA:O	1:A:112:THR:HG23	2.20	0.42
1:B:24:ILE:HD11	1:B:227:THR:HB	2.02	0.41
1:B:152:ARG:HG3	1:B:158:VAL:HG23	2.02	0.41
1:B:44:SER:HB2	1:B:70:LEU:HG	2.03	0.41
1:A:170:LEU:HD22	1:B:74:ARG:HE	1.86	0.40

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	246/281 (88%)	229 (93%)	17 (7%)	0	100	100
1	B	246/281 (88%)	234 (95%)	10 (4%)	2 (1%)	19	57
All	All	492/562 (88%)	463 (94%)	27 (6%)	2 (0%)	34	72

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	82	CYS
1	B	48	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	201/231 (87%)	181 (90%)	20 (10%)	7	29
1	B	201/231 (87%)	182 (90%)	19 (10%)	8	32
All	All	402/462 (87%)	363 (90%)	39 (10%)	8	31

All (39) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	27	LEU
1	A	28	LEU
1	A	54	GLU
1	A	65	ARG
1	A	77	VAL
1	A	95	ARG
1	A	108	ASN
1	A	109	ASP
1	A	114	ILE
1	A	128	LEU
1	A	133	VAL
1	A	137	THR
1	A	144	THR
1	A	165	GLU
1	A	188	ARG
1	A	210	THR
1	A	211	MET
1	A	232	LEU
1	A	247	LEU
1	A	248	LEU
1	B	18	ILE
1	B	27	LEU

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Mol	Chain	Res	Type
1	B	28	LEU
1	B	29	LYS
1	B	38	ARG
1	B	65	ARG
1	B	77	VAL
1	B	108	ASN
1	B	112	THR
1	B	128	LEU
1	B	133	VAL
1	B	137	THR
1	B	146	LEU
1	B	166	ILE
1	B	188	ARG
1	B	228	THR
1	B	232	LEU
1	B	247	LEU
1	B	248	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	11	GLN
1	A	108	ASN
1	B	175	HIS

### 5.3.3 RNA ⓘ

There are no RNA molecules 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

There are no ligands in this entry.

## 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 [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	248/281 (88%)	-0.36	2 (0%) 86 65	31, 52, 73, 90	0
1	B	248/281 (88%)	-0.20	5 (2%) 65 36	32, 57, 96, 113	0
All	All	496/562 (88%)	-0.28	7 (1%) 75 49	31, 55, 85, 113	0

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	168	ASP	3.3
1	B	169	ASN	2.9
1	B	170	LEU	2.9
1	A	191	ASP	2.4
1	B	52	THR	2.3
1	B	55	GLU	2.2
1	A	5	LYS	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](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.