Full wwPDB X-ray Structure Validation Report (i)

Mar 5, 2024 – 11:31 AM EST

PDB ID	:	2HK2
Title	:	Crystal structure of mevalonate diphosphate decarboxylase from Staphylococcus aureus (monoclinic form)
Authors	:	Byres, E.; Hunter, W.N.
Deposited on	:	2006-07-03
Resolution	:	2.30 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 (i) 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 (1)) were used in the production of this report:

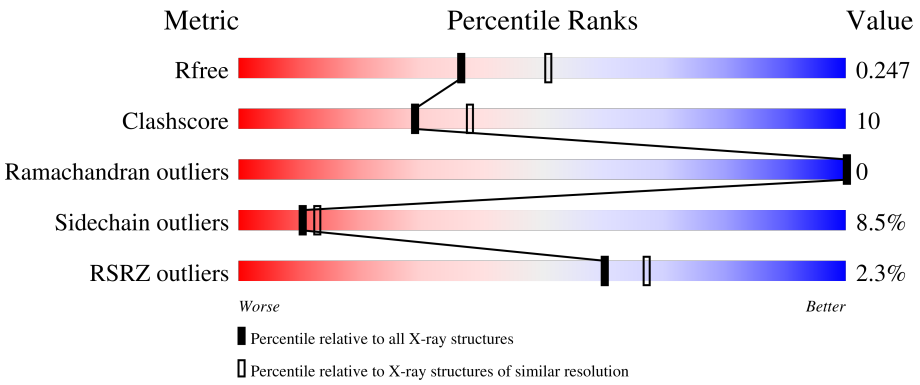
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	5042 (2.30-2.30)
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)
RSRZ outliers	127900	4938 (2.30-2.30)

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 <=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	331	2% 80% 17% •
1	B	331	3% 74% 21% •

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 5661 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 Diphosphomevalonate decarboxylase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	331	2628	1663	439	513	13	0	1	0
1	B	331	2627	1661	440	513	13	0	1	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1000	HIS	-	cloning artifact	UNP Q2FJ52
A	1001	MET	-	cloning artifact	UNP Q2FJ52
A	1002	LEU	-	cloning artifact	UNP Q2FJ52
A	1003	GLU	-	cloning artifact	UNP Q2FJ52
B	1000	HIS	-	cloning artifact	UNP Q2FJ52
B	1001	MET	-	cloning artifact	UNP Q2FJ52
B	1002	LEU	-	cloning artifact	UNP Q2FJ52
B	1003	GLU	-	cloning artifact	UNP Q2FJ52

- Molecule 2 is water.

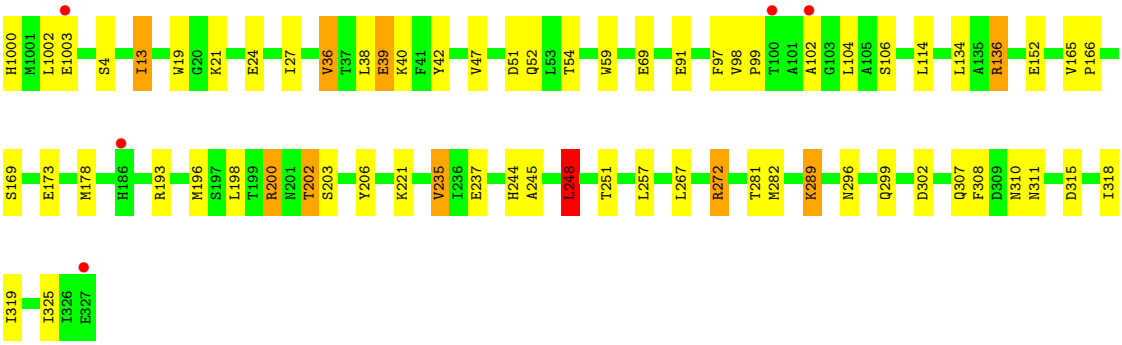
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
2	A	207	207	207	0	0
2	B	199	199	199	0	0

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.

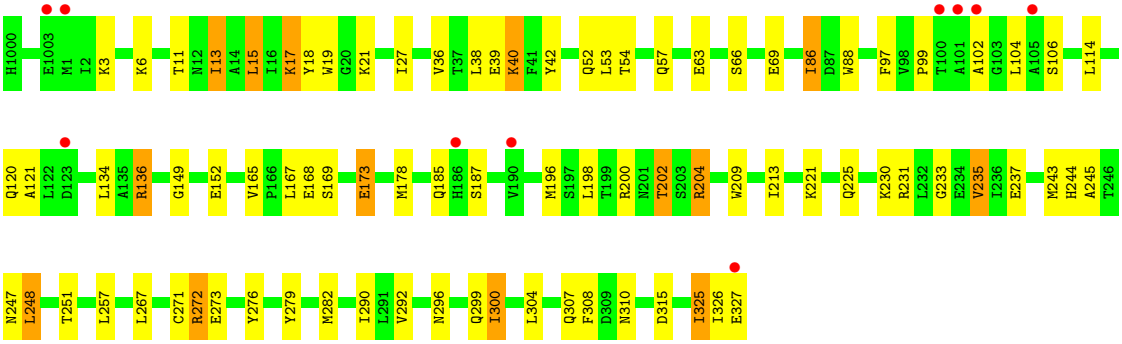
• Molecule 1: Diphosphomevalonate decarboxylase

Chain A:



• Molecule 1: Diphosphomevalonate decarboxylase

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	85.50Å 53.06Å 100.88Å 90.00° 94.82° 90.00°	Depositor
Resolution (Å)	46.92 – 2.30 46.93 – 2.30	Depositor EDS
% Data completeness (in resolution range)	100.0 (46.92-2.30) 100.0 (46.93-2.30)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	0.10	Depositor
$< I/\sigma(I) >$ [1]	4.09 (at 2.29Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.191 , 0.249 0.191 , 0.247	Depositor DCC
R_{free} test set	2030 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å^2)	14.9	Xtriage
Anisotropy	0.339	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.39 , 39.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.46$, $< L^2 > = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	5661	wwPDB-VP
Average B, all atoms (Å^2)	14.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 17.02% of the height of the origin peak. No significant pseudotranslation is detected.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ 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	0.89	0/2684	0.95	9/3627 (0.2%)
1	B	0.85	1/2685 (0.0%)	0.93	10/3627 (0.3%)
All	All	0.87	1/5369 (0.0%)	0.94	19/7254 (0.3%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	271	CYS	CB-SG	-5.03	1.73	1.81

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	136	ARG	NE-CZ-NH2	-12.11	114.24	120.30
1	B	272	ARG	NE-CZ-NH2	-10.33	115.14	120.30
1	B	204	ARG	NE-CZ-NH1	9.61	125.10	120.30
1	A	272	ARG	NE-CZ-NH2	-9.47	115.56	120.30
1	B	136	ARG	NE-CZ-NH2	-8.96	115.82	120.30
1	B	204	ARG	NE-CZ-NH2	-7.96	116.32	120.30
1	A	235	VAL	CB-CA-C	-7.90	96.39	111.40
1	A	136	ARG	NE-CZ-NH1	7.52	124.06	120.30
1	B	248	LEU	CA-CB-CG	7.26	132.01	115.30
1	B	272	ARG	NE-CZ-NH1	6.49	123.55	120.30
1	A	272	ARG	NE-CZ-NH1	6.34	123.47	120.30
1	A	248	LEU	CA-CB-CG	5.89	128.84	115.30
1	B	204	ARG	CD-NE-CZ	5.81	131.74	123.60
1	B	235	VAL	CB-CA-C	-5.65	100.67	111.40
1	A	302	ASP	CB-CG-OD1	5.26	123.04	118.30
1	B	231	ARG	NE-CZ-NH2	-5.18	117.71	120.30
1	A	98	VAL	CB-CA-C	-5.17	101.57	111.40
1	A	302	ASP	CB-CG-OD2	-5.10	113.71	118.30
1	B	15	LEU	CB-CG-CD1	5.09	119.65	111.00

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	2628	0	2576	49	0
1	B	2627	0	2570	53	0
2	A	207	0	0	6	0
2	B	199	0	0	9	0
All	All	5661	0	5146	100	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 10.

All (100) 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:69:GLU:HB2	2:A:1170:HOH:O	1.41	1.18
1:A:106:SER:HA	2:A:1148:HOH:O	1.60	1.02
1:A:59:TRP:HZ3	1:A:91:GLU:HG2	1.26	1.00
1:B:106:SER:HA	2:B:1172:HOH:O	1.67	0.94
1:A:198:LEU:O	1:A:202:THR:HB	1.73	0.87
1:B:198:LEU:O	1:B:202:THR:HB	1.75	0.86
1:B:120:GLN:HG2	1:B:325:ILE:HD13	1.59	0.85
1:A:59:TRP:CZ3	1:A:91:GLU:HG2	2.15	0.81
1:A:27:ILE:O	1:A:136:ARG:HD3	1.80	0.81
1:A:202:THR:CG2	1:A:251:THR:H	1.95	0.80
1:B:27:ILE:O	1:B:136:ARG:HD3	1.86	0.76
1:B:244:HIS:HD2	2:B:1117:HOH:O	1.70	0.75
1:B:202:THR:CG2	1:B:251:THR:H	2.00	0.74
1:A:13[A]:ILE:HG12	1:A:178:MET:SD	2.29	0.72
1:A:237:GLU:OE2	1:A:272:ARG:NH2	2.26	0.69
1:B:237:GLU:OE2	1:B:272:ARG:NH2	2.26	0.68
1:A:165:VAL:HG22	1:A:166:PRO:HD2	1.76	0.67
1:B:315:ASP:OD1	2:B:1178:HOH:O	2.12	0.67
1:A:99:PRO:HD2	1:A:104:LEU:HD22	1.76	0.67
1:A:244:HIS:HD2	2:A:1128:HOH:O	1.76	0.67

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:202:THR:HG23	1:A:251:THR:H	1.62	0.65
1:B:13:ILE:HG23	1:B:38:LEU:HD11	1.79	0.65
1:A:27:ILE:O	1:A:136:ARG:CD	2.48	0.61
1:A:42:TYR:CE1	1:A:97:PHE:CD1	2.88	0.61
1:A:21:LYS:HD2	1:A:24:GLU:HA	1.84	0.59
1:B:18:TYR:OH	1:B:21:LYS:HE3	2.02	0.58
1:B:69:GLU:HG2	2:B:1173:HOH:O	2.05	0.57
1:A:1000:HIS:HB3	1:A:1003:GLU:HG2	1.84	0.57
1:A:178:MET:HE3	1:A:289:LYS:HB3	1.87	0.57
1:A:13[A]:ILE:HD11	1:A:281:THR:HG21	1.87	0.56
1:A:1000:HIS:HD2	1:A:1002:LEU:H	1.53	0.55
1:B:267:LEU:HD12	1:B:308:PHE:HE2	1.70	0.55
1:A:59:TRP:HZ3	1:A:91:GLU:CG	2.09	0.55
1:B:13:ILE:HG12	1:B:178:MET:SD	2.46	0.55
1:A:245:ALA:HA	1:B:248:LEU:HD23	1.88	0.55
1:B:152:GLU:OE2	1:B:221:LYS:HE2	2.07	0.54
1:B:221:LYS:HE3	2:B:1019:HOH:O	2.07	0.54
1:A:202:THR:HG21	1:A:251:THR:H	1.72	0.53
1:A:200:ARG:NH1	2:A:1158:HOH:O	2.30	0.53
1:A:99:PRO:O	1:A:102:ALA:HB3	2.10	0.52
1:A:169:SER:OG	1:A:173:GLU:OE2	2.11	0.52
1:B:202:THR:HG21	1:B:251:THR:H	1.73	0.51
1:A:152:GLU:OE2	1:A:221:LYS:HE2	2.10	0.51
1:A:1000:HIS:CD2	1:A:1002:LEU:H	2.28	0.51
1:B:99:PRO:O	1:B:102:ALA:HB3	2.11	0.51
1:A:19:TRP:CZ3	1:A:196:MET:HB3	2.46	0.51
1:A:59:TRP:CZ3	1:A:91:GLU:CG	2.90	0.50
1:B:282:MET:HE1	2:B:1134:HOH:O	2.10	0.50
1:A:13[A]:ILE:CG2	1:A:38:LEU:HD11	2.41	0.50
1:A:267:LEU:HD12	1:A:308:PHE:HE2	1.77	0.49
1:B:202:THR:HG23	1:B:251:THR:H	1.74	0.49
1:B:19:TRP:HZ2	1:B:247:ASN:HD21	1.61	0.48
1:B:27:ILE:O	1:B:136:ARG:CD	2.58	0.48
1:A:36:VAL:HG13	1:A:318:ILE:HD12	1.96	0.48
1:A:296:ASN:HA	1:A:299:GLN:HE21	1.78	0.47
1:B:272:ARG:HD2	2:B:1093:HOH:O	2.14	0.47
1:B:19:TRP:CZ3	1:B:196:MET:HB3	2.49	0.47
1:B:169:SER:OG	1:B:173:GLU:OE2	2.23	0.47
1:A:178:MET:CE	1:A:289:LYS:HB3	2.45	0.47
1:A:202:THR:HG23	1:A:251:THR:N	2.28	0.47
1:B:209:TRP:CZ2	1:B:213:ILE:HD13	2.50	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:99:PRO:CD	1:A:104:LEU:HD22	2.42	0.46
1:B:237:GLU:CD	1:B:272:ARG:HH22	2.16	0.46
1:A:244:HIS:HE1	1:A:282:MET:O	1.98	0.46
1:A:248:LEU:HD23	1:B:245:ALA:HA	1.97	0.45
1:A:244:HIS:CD2	2:A:1128:HOH:O	2.59	0.45
1:B:99:PRO:HG2	1:B:104:LEU:HD22	1.97	0.45
1:B:17:LYS:HG2	1:B:243:MET:SD	2.57	0.45
1:B:42:TYR:CE1	1:B:97:PHE:CD1	3.04	0.45
1:A:203:SER:HB3	1:A:206:TYR:HB2	1.97	0.45
1:B:3:LYS:HE2	1:B:88:TRP:CH2	2.51	0.45
1:B:296:ASN:HA	1:B:299:GLN:HE21	1.81	0.44
1:B:6:LYS:HG2	1:B:326:ILE:HB	1.99	0.44
1:B:149:GLY:HA2	1:B:173:GLU:HG2	2.01	0.43
1:B:178:MET:HA	1:B:290:ILE:O	2.19	0.43
1:A:296:ASN:ND2	2:A:1140:HOH:O	2.48	0.43
1:B:267:LEU:HD12	1:B:308:PHE:CE2	2.51	0.43
1:B:167:LEU:HD23	1:B:167:LEU:HA	1.88	0.42
1:B:40:LYS:HE2	1:B:315:ASP:O	2.19	0.42
1:B:168:GLU:O	1:B:225:GLN:NE2	2.49	0.42
1:B:282:MET:HB2	1:B:282:MET:HE2	1.67	0.42
1:A:21:LYS:O	1:A:200:ARG:HD2	2.18	0.42
1:A:178:MET:HE3	1:A:178:MET:HB3	1.92	0.42
1:B:276:TYR:HB3	1:B:300:ILE:HD11	2.01	0.42
1:B:292:VAL:HG21	1:B:300:ILE:HG12	2.02	0.42
1:B:13:ILE:HG12	1:B:178:MET:CE	2.50	0.41
1:B:13:ILE:HG12	1:B:178:MET:HE1	2.02	0.41
1:A:39:GLU:HB2	1:A:319:ILE:HB	2.02	0.41
1:A:51:ASP:OD1	1:A:52:GLN:NE2	2.53	0.41
1:B:3:LYS:HE3	1:B:86:ILE:HD11	2.03	0.41
1:B:267:LEU:HD13	1:B:304:LEU:HA	2.02	0.41
1:B:11:THR:HG22	2:B:1172:HOH:O	2.20	0.41
1:B:282:MET:CE	2:B:1134:HOH:O	2.69	0.41
1:A:4:SER:HA	1:A:47:VAL:O	2.20	0.41
1:B:185:GLN:HG2	1:B:187:SER:O	2.21	0.40
1:B:3:LYS:HB3	1:B:121:ALA:O	2.22	0.40
1:A:198:LEU:O	1:A:202:THR:CB	2.57	0.40
1:A:237:GLU:CD	1:A:272:ARG:HH22	2.22	0.40
1:B:202:THR:HG23	1:B:251:THR:N	2.35	0.40
1:B:233:GLY:HA3	1:B:279:TYR:CD1	2.56	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	330/331 (100%)	323 (98%)	7 (2%)	0	100	100
1	B	330/331 (100%)	322 (98%)	8 (2%)	0	100	100
All	All	660/662 (100%)	645 (98%)	15 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	283/282 (100%)	263 (93%)	20 (7%)	14	19
1	B	283/282 (100%)	254 (90%)	29 (10%)	7	8
All	All	566/564 (100%)	517 (91%)	49 (9%)	10	12

All (49) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	13[A]	ILE
1	A	13[B]	ILE
1	A	36	VAL
1	A	39	GLU
1	A	40	LYS
1	A	54	THR
1	A	114	LEU
1	A	134	LEU

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Mol	Chain	Res	Type
1	A	193	ARG
1	A	200	ARG
1	A	202	THR
1	A	235	VAL
1	A	248	LEU
1	A	257	LEU
1	A	289	LYS
1	A	307	GLN
1	A	310	ASN
1	A	311	ASN
1	A	315	ASP
1	A	325	ILE
1	B	13	ILE
1	B	15	LEU
1	B	17	LYS
1	B	36	VAL
1	B	39	GLU
1	B	40	LYS
1	B	52	GLN
1	B	53	LEU
1	B	54	THR
1	B	57	GLN
1	B	63	GLU
1	B	66	SER
1	B	86	ILE
1	B	114	LEU
1	B	134	LEU
1	B	165	VAL
1	B	173	GLU
1	B	200	ARG
1	B	202	THR
1	B	204	ARG
1	B	230	LYS
1	B	235	VAL
1	B	257	LEU
1	B	273	GLU
1	B	300	ILE
1	B	307	GLN
1	B	310	ASN
1	B	325	ILE
1	B	327	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (16)

such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1000	HIS
1	A	52	GLN
1	A	55	GLN
1	A	96	ASN
1	A	212	HIS
1	A	244	HIS
1	A	296	ASN
1	A	299	GLN
1	A	311	ASN
1	B	52	GLN
1	B	96	ASN
1	B	186	HIS
1	B	244	HIS
1	B	247	ASN
1	B	296	ASN
1	B	299	GLN

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 (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	331/331 (100%)	-0.34	5 (1%)	73	79	2, 11, 29, 42	0
1	B	331/331 (100%)	-0.27	10 (3%)	50	57	2, 13, 32, 42	0
All	All	662/662 (100%)	-0.30	15 (2%)	60	67	2, 12, 31, 42	0

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	186	HIS	5.1
1	B	186	HIS	4.7
1	B	102	ALA	3.9
1	B	1003	GLU	3.2
1	B	100	THR	3.1
1	B	1	MET	3.1
1	A	102	ALA	2.8
1	B	190	VAL	2.5
1	B	101	ALA	2.5
1	B	327	GLU	2.5
1	A	1003	GLU	2.4
1	A	100	THR	2.3
1	A	327	GLU	2.2
1	B	123	ASP	2.1
1	B	105	ALA	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.