



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 28, 2024 – 04:06 PM EDT

PDB ID : 2HI1  
Title : The structure of a putative 4-hydroxythreonine-4-phosphate dehydrogenase from *Salmonella typhimurium*.  
Authors : Cuff, M.E.; Quartey, P.; Holzle, D.; Joachimiak, A.; Midwest Center for Structural Genomics (MCSG)  
Deposited on : 2006-06-28  
Resolution : 2.30 Å(reported)

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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.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtriage (Phenix) : 1.20.1  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.003 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.39

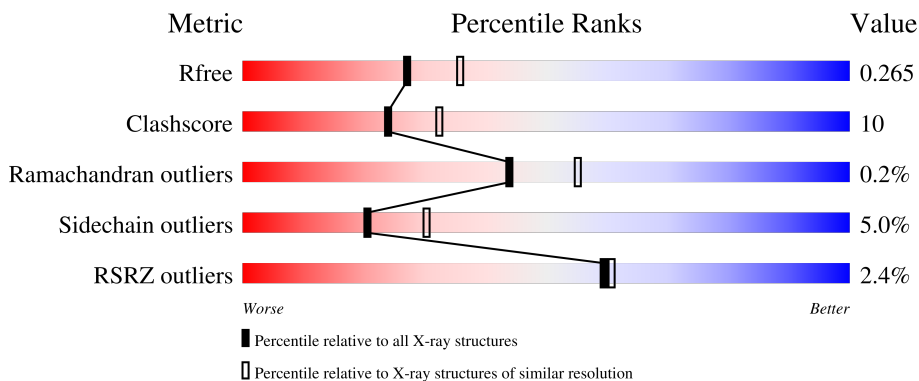
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.30 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))
$R_{free}$	164625	5963 (2.30-2.30)
Clashscore	180529	6698 (2.30-2.30)
Ramachandran outliers	177936	6640 (2.30-2.30)
Sidechain outliers	177891	6640 (2.30-2.30)
RSRZ outliers	164620	5963 (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  $\geq 3$ , 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	330	
1	B	330	

## 2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 5313 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 4-hydroxythreonine-4-phosphate dehydrogenase 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	N	O	S				Se
1	A	325	Total	C	N	O	S	Se	0	2	0
			2465	1566	433	456	3	7			
1	B	321	Total	C	N	O	S	Se	0	1	0
			2426	1545	425	446	3	7			

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	SER	-	cloning artifact	UNP P58718
A	-1	ASN	-	cloning artifact	UNP P58718
A	0	ALA	-	cloning artifact	UNP P58718
A	1	MSE	MET	modified residue	UNP P58718
A	10	MSE	MET	modified residue	UNP P58718
A	154	MSE	MET	modified residue	UNP P58718
A	240	MSE	MET	modified residue	UNP P58718
A	262	MSE	MET	modified residue	UNP P58718
A	266	MSE	MET	modified residue	UNP P58718
A	316	MSE	MET	modified residue	UNP P58718
A	324	MSE	MET	modified residue	UNP P58718
B	-2	SER	-	cloning artifact	UNP P58718
B	-1	ASN	-	cloning artifact	UNP P58718
B	0	ALA	-	cloning artifact	UNP P58718
B	1	MSE	MET	modified residue	UNP P58718
B	10	MSE	MET	modified residue	UNP P58718
B	154	MSE	MET	modified residue	UNP P58718
B	240	MSE	MET	modified residue	UNP P58718
B	262	MSE	MET	modified residue	UNP P58718
B	266	MSE	MET	modified residue	UNP P58718
B	316	MSE	MET	modified residue	UNP P58718
B	324	MSE	MET	modified residue	UNP P58718

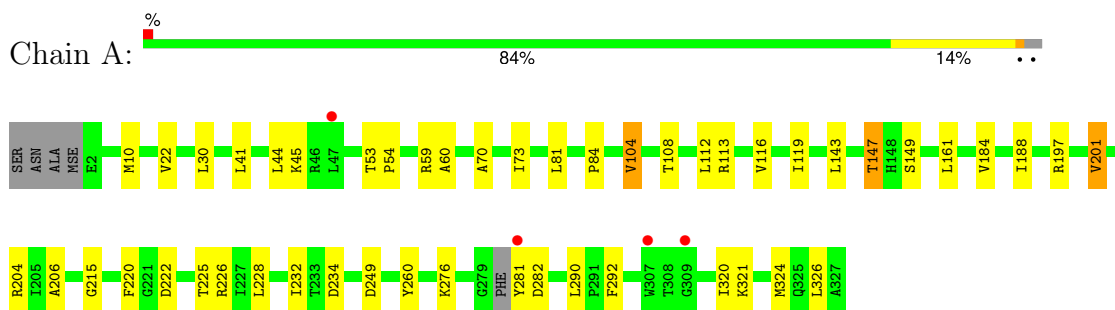
- Molecule 2 is water.

<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
2	A	229	Total 229	O 229	0	0
2	B	193	Total 193	O 193	0	0

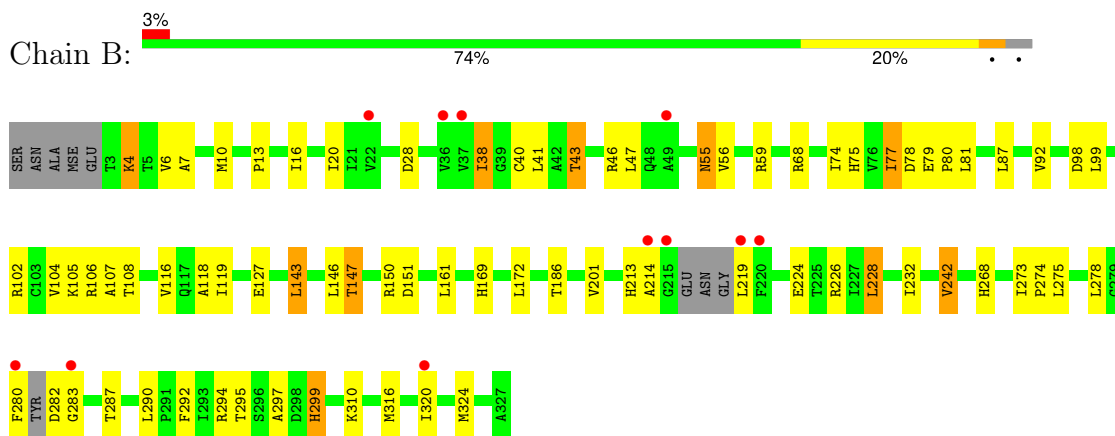
### 3 Residue-property plots [i](#)

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: 4-hydroxythreonine-4-phosphate dehydrogenase 2



- Molecule 1: 4-hydroxythreonine-4-phosphate dehydrogenase 2



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	77.66Å 92.89Å 101.33Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	39.90 – 2.30 39.90 – 2.30	Depositor EDS
% Data completeness (in resolution range)	90.6 (39.90-2.30) 90.5 (39.90-2.30)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.08 (at 2.29Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.187 , 0.266 0.187 , 0.265	Depositor DCC
$R_{free}$ test set	1560 reflections (5.18%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	38.0	Xtrriage
Anisotropy	0.703	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 31.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	5313	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	55.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.81% 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	0.63	0/2506	0.72	1/3393 (0.0%)
1	B	0.58	0/2463	0.72	3/3334 (0.1%)
All	All	0.60	0/4969	0.72	4/6727 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	226	ARG	NE-CZ-NH1	-7.63	116.49	120.30
1	B	226	ARG	NE-CZ-NH2	7.26	123.93	120.30
1	A	249	ASP	CB-CG-OD1	6.18	123.86	118.30
1	B	143	LEU	CB-CG-CD1	-5.74	101.24	111.00

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	282	ASP	Peptide

### 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	2465	0	2523	36	0
1	B	2426	0	2488	62	0
2	A	229	0	0	7	0
2	B	193	0	0	4	0
All	All	5313	0	5011	98	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 (98) 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:30:LEU:CD2	1:A:324:MSE:HE1	1.62	1.27
1:B:282:ASP:HB3	1:B:283:GLY:CA	1.81	1.09
1:B:282:ASP:HB3	1:B:283:GLY:HA2	1.31	1.08
1:B:201:VAL:HB	2:B:447:HOH:O	1.57	1.04
1:A:30:LEU:HD23	1:A:324:MSE:HE1	1.42	1.00
1:A:321:LYS:HA	1:A:324:MSE:HE3	1.48	0.95
1:B:282:ASP:CB	1:B:283:GLY:HA2	1.91	0.95
1:B:38:ILE:HD11	1:B:107:ALA:HB2	1.47	0.95
1:A:30:LEU:HD21	1:A:324:MSE:HE1	1.41	0.95
1:A:30:LEU:CD2	1:A:324:MSE:CE	2.49	0.89
1:B:10:MSE:HE1	1:B:99:LEU:HD21	1.55	0.86
1:A:320:ILE:HG22	1:A:324:MSE:HE2	1.55	0.85
1:B:10:MSE:HE1	1:B:99:LEU:CD2	2.12	0.79
1:A:22:VAL:HG11	1:A:53:THR:HG23	1.66	0.77
1:A:30:LEU:HD21	1:A:324:MSE:CE	2.15	0.77
1:B:38:ILE:HG22	1:B:77:ILE:HB	1.66	0.77
1:A:119:ILE:HD12	1:A:292:PHE:CE1	2.24	0.73
1:B:98:ASP:OD2	1:B:102:ARG:NH1	2.22	0.73
1:B:40:CYS:SG	1:B:43:THR:HG23	2.29	0.72
1:B:81:LEU:HD13	1:B:99:LEU:HD22	1.70	0.72
1:B:297:ALA:HB3	1:B:299:HIS:CE1	2.24	0.71
1:B:10:MSE:CE	1:B:99:LEU:CD2	2.69	0.71
1:B:10:MSE:CE	1:B:99:LEU:HD21	2.22	0.69
1:B:10:MSE:HE3	1:B:13:PRO:HB3	1.73	0.69
1:B:40:CYS:HB3	1:B:43:THR:HG23	1.76	0.66
1:A:45:LYS:HE2	2:A:547:HOH:O	1.97	0.64
1:B:280:PHE:C	1:B:282:ASP:N	2.52	0.63

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:281:TYR:N	2:A:549:HOH:O	2.32	0.63
1:B:119:ILE:HD12	1:B:292:PHE:CE1	2.35	0.62
1:A:70:ALA:HB3	1:A:73:ILE:HD12	1.82	0.62
1:B:40:CYS:SG	1:B:43:THR:CG2	2.87	0.62
1:A:143:LEU:O	1:A:147:THR:HB	1.99	0.61
1:B:4:LYS:H	1:B:4:LYS:HD2	1.65	0.60
1:B:80:PRO:O	1:B:102:ARG:NH2	2.34	0.60
1:B:294:ARG:HG2	1:B:295:THR:N	2.16	0.60
1:B:40:CYS:CB	1:B:43:THR:HG23	2.33	0.59
1:B:59:ARG:NH1	1:B:75:HIS:HE1	2.01	0.58
1:B:143:LEU:HD11	1:B:294:ARG:HD3	1.85	0.58
1:A:104:VAL:O	1:A:108:THR:HG23	2.03	0.58
1:B:55:ASN:N	1:B:55:ASN:OD1	2.39	0.56
1:B:92:VAL:HG11	1:B:127:GLU:HG2	1.87	0.56
1:B:10:MSE:CE	1:B:99:LEU:HD23	2.35	0.55
1:A:228:LEU:O	1:A:232:ILE:HG12	2.06	0.55
1:A:276:LYS:HE2	1:A:281:TYR:CE2	2.41	0.55
1:A:113[B]:ARG:HH11	1:A:113[B]:ARG:HB3	1.75	0.52
1:A:147:THR:CG2	1:A:149:SER:OG	2.58	0.52
1:B:273:ILE:N	1:B:274:PRO:HD2	2.24	0.52
1:B:320:ILE:O	1:B:324:MSE:HG3	2.10	0.52
1:A:215:GLY:HA2	2:A:426:HOH:O	2.11	0.51
1:B:232:ILE:HG23	1:B:242:VAL:HG22	1.92	0.51
1:B:38:ILE:HD11	1:B:107:ALA:CB	2.30	0.51
1:A:59:ARG:CD	2:A:548:HOH:O	2.59	0.50
1:B:79:GLU:O	1:B:99:LEU:HD11	2.11	0.50
1:B:278:LEU:HB2	1:B:280:PHE:CE1	2.47	0.50
1:B:104:VAL:O	1:B:108:THR:HG23	2.12	0.49
1:A:81:LEU:HD23	1:A:84:PRO:HA	1.95	0.48
1:B:213:HIS:O	1:B:214:ALA:C	2.50	0.48
1:B:10:MSE:CE	1:B:13:PRO:HB3	2.43	0.47
1:B:282:ASP:HB3	1:B:283:GLY:HA3	1.86	0.47
1:A:321:LYS:CA	1:A:324:MSE:HE3	2.34	0.47
1:A:147:THR:HG23	1:A:149:SER:OG	2.15	0.47
1:A:222:ASP:O	1:A:226:ARG:HB2	2.14	0.47
1:B:56:VAL:HG21	1:B:74:ILE:HG13	1.96	0.47
1:B:105:LYS:HA	1:B:146:LEU:HD13	1.96	0.46
1:B:147:THR:HG21	1:B:290:LEU:HD22	1.98	0.46
1:B:59:ARG:HH12	1:B:68:ARG:HB3	1.80	0.45
1:A:59:ARG:HD3	2:A:548:HOH:O	2.15	0.45
1:A:22:VAL:HG12	1:A:54:PRO:HD2	1.99	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:20:ILE:HD12	1:B:316:MSE:HB2	1.98	0.45
1:B:68:ARG:HG3	2:B:382:HOH:O	2.17	0.45
1:B:224:GLU:HA	1:B:228:LEU:HB2	1.98	0.45
1:B:46:ARG:HE	1:B:46:ARG:HB3	1.56	0.45
1:A:147:THR:HG21	1:A:290:LEU:HD22	2.00	0.44
1:B:6:VAL:HG22	1:B:118:ALA:HB3	1.97	0.44
1:B:287:THR:O	2:B:512:HOH:O	2.21	0.44
1:A:184:VAL:O	1:A:188:ILE:HG13	2.18	0.44
1:B:59:ARG:NH1	2:B:425:HOH:O	2.50	0.44
1:B:4:LYS:HB3	1:B:4:LYS:HE3	1.90	0.43
1:B:7:ALA:HB2	1:B:116:VAL:HG11	2.00	0.43
1:B:143:LEU:CD1	1:B:294:ARG:HD3	2.46	0.43
1:B:294:ARG:CG	1:B:295:THR:N	2.82	0.43
1:B:68:ARG:H	1:B:75:HIS:CE1	2.36	0.43
1:B:16:ILE:O	1:B:20:ILE:HG12	2.19	0.42
1:B:151:ASP:HB3	1:B:186:THR:HG21	2.00	0.42
1:B:143:LEU:HD11	1:B:294:ARG:CD	2.49	0.42
1:B:81:LEU:HD21	1:B:87:LEU:HD13	2.00	0.42
1:A:324:MSE:HG2	2:A:354:HOH:O	2.20	0.42
1:B:169:HIS:H	1:B:268:HIS:CD2	2.38	0.42
1:A:41:LEU:HD22	1:A:60:ALA:HB2	2.02	0.42
1:A:10:MSE:HE1	1:A:44:LEU:HG	2.01	0.42
1:B:81:LEU:HD13	1:B:99:LEU:CD2	2.44	0.41
1:A:220:PHE:HB2	1:A:225:THR:HG23	2.02	0.41
1:A:201:VAL:N	2:A:504:HOH:O	2.54	0.41
1:A:197:ARG:NH1	1:A:326:LEU:O	2.53	0.41
1:A:206:ALA:HB2	1:A:260:TYR:CD1	2.56	0.40
1:B:79:GLU:OE1	1:B:106:ARG:HD3	2.21	0.40
1:A:22:VAL:CG1	1:A:54:PRO:HD2	2.51	0.40
1:B:172:LEU:HD12	1:B:172:LEU:HA	1.92	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	323/330 (98%)	314 (97%)	9 (3%)	0	100	100
1	B	316/330 (96%)	309 (98%)	6 (2%)	1 (0%)	37	47
All	All	639/660 (97%)	623 (98%)	15 (2%)	1 (0%)	44	55

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	78	ASP

### 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	255/249 (102%)	246 (96%)	9 (4%)	31	46
1	B	251/249 (101%)	234 (93%)	17 (7%)	13	18
All	All	506/498 (102%)	480 (95%)	26 (5%)	20	29

All (26) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	104	VAL
1	A	112	LEU
1	A	116	VAL
1	A	147	THR
1	A	161	LEU
1	A	201	VAL
1	A	204[A]	ARG
1	A	204[B]	ARG
1	A	234	ASP
1	B	4	LYS
1	B	28	ASP
1	B	38	ILE

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Mol	Chain	Res	Type
1	B	41	LEU
1	B	43	THR
1	B	47	LEU
1	B	55	ASN
1	B	77	ILE
1	B	147	THR
1	B	150	ARG
1	B	161	LEU
1	B	219	LEU
1	B	228	LEU
1	B	242	VAL
1	B	275	LEU
1	B	299	HIS
1	B	310	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	55	ASN
1	A	139	HIS
1	A	169	HIS
1	B	75	HIS
1	B	268	HIS

### 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 oligosaccharides 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	318/330 (96%)	0.08	4 (1%) 74 75	24, 50, 65, 80	2 (0%)
1	B	314/330 (95%)	0.45	11 (3%) 47 49	27, 62, 71, 80	1 (0%)
All	All	632/660 (95%)	0.27	15 (2%) 59 61	24, 54, 70, 80	3 (0%)

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	283	GLY	4.4
1	B	220	PHE	4.1
1	B	219	LEU	3.9
1	B	36	VAL	3.5
1	B	214	ALA	3.2
1	A	281	TYR	3.2
1	B	22	VAL	3.1
1	B	215	GLY	2.5
1	B	37	VAL	2.5
1	A	47	LEU	2.4
1	A	307	TRP	2.3
1	B	49	ALA	2.3
1	B	280	PHE	2.2
1	A	309	GLY	2.1
1	B	320	ILE	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

There are no ligands in this entry.

## 6.5 Other polymers

There are no such residues in this entry.