



Full wwPDB X-ray Structure Validation Report ⓘ

May 23, 2020 – 10:51 am BST

PDB ID : 4FPX
Title : Crystal Structure of Shikimate Dehydrogenase (aroE) Q237N Mutant from Helicobacter pylori
Authors : Cheng, W.C.; Chen, T.J.; Wang, W.C.
Deposited on : 2012-06-23
Resolution : 2.40 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 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

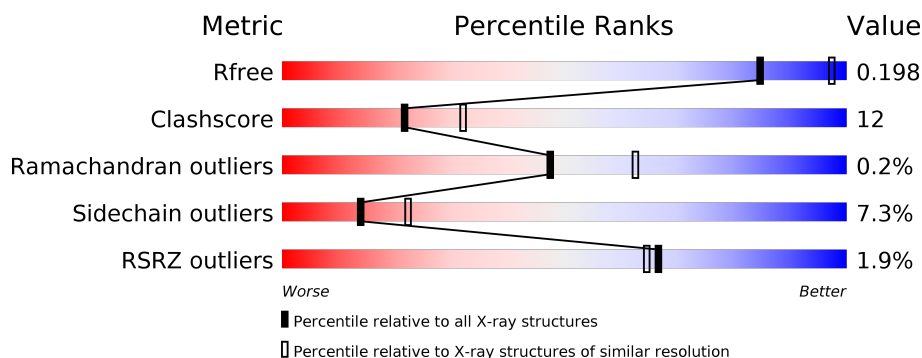
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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	3907 (2.40-2.40)
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (2.40-2.40)

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 ≥ 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	271	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red 0%, red 1%, green 1%, green 73%, yellow 73%, yellow 93%, orange 93%, orange 95%, grey 95%);"></div> <div style="display: flex; justify-content: space-between; width: 90%; margin: 0 auto;"> % 73% 20% • • </div> </div>
1	B	271	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red 0%, red 3%, green 3%, green 70%, yellow 70%, yellow 92%, orange 92%, orange 95%, grey 95%);"></div> <div style="display: flex; justify-content: space-between; width: 90%; margin: 0 auto;"> 3% 70% 22% • 5% </div> </div>

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4095 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	260	Total	C	N	O	S	0	0	0
			2037	1328	335	364	10			
1	B	257	Total	C	N	O	S	0	0	0
			2016	1317	329	360	10			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	237	ASN	GLN	ENGINEERED MUTATION	UNP P56119
A	264	LEU	-	EXPRESSION TAG	UNP P56119
A	265	GLU	-	EXPRESSION TAG	UNP P56119
A	266	HIS	-	EXPRESSION TAG	UNP P56119
A	267	HIS	-	EXPRESSION TAG	UNP P56119
A	268	HIS	-	EXPRESSION TAG	UNP P56119
A	269	HIS	-	EXPRESSION TAG	UNP P56119
A	270	HIS	-	EXPRESSION TAG	UNP P56119
A	271	HIS	-	EXPRESSION TAG	UNP P56119
B	237	ASN	GLN	ENGINEERED MUTATION	UNP P56119
B	264	LEU	-	EXPRESSION TAG	UNP P56119
B	265	GLU	-	EXPRESSION TAG	UNP P56119
B	266	HIS	-	EXPRESSION TAG	UNP P56119
B	267	HIS	-	EXPRESSION TAG	UNP P56119
B	268	HIS	-	EXPRESSION TAG	UNP P56119
B	269	HIS	-	EXPRESSION TAG	UNP P56119
B	270	HIS	-	EXPRESSION TAG	UNP P56119
B	271	HIS	-	EXPRESSION TAG	UNP P56119

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	21	Total	O	0	0
			21	21		

Continued on next page...

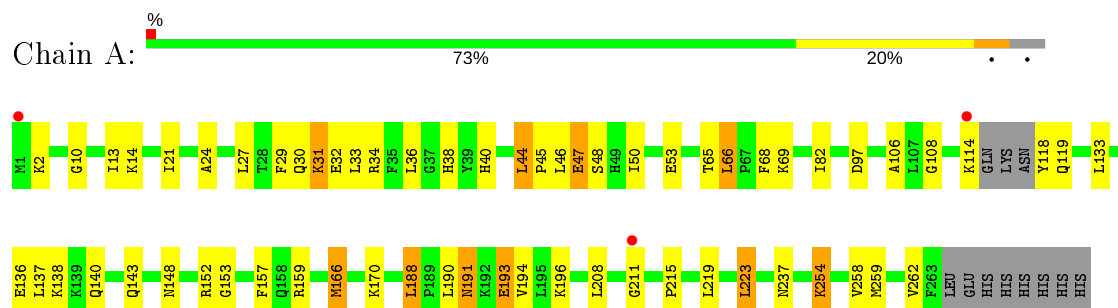
Continued from previous page...

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	21	Total	O	0	0
			21	21		

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



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	45.61 Å 46.03 Å 119.19 Å 90.00° 99.52° 90.00°	Depositor
Resolution (Å)	30.00 – 2.40 23.51 – 2.40	Depositor EDS
% Data completeness (in resolution range)	97.0 (30.00-2.40) 97.1 (23.51-2.40)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.44 (at 2.41 Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.193 , 0.239 0.194 , 0.198	Depositor DCC
R_{free} test set	965 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å ²)	30.5	Xtriage
Anisotropy	0.108	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 53.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.038 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	4095	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.29% 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

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	0.89	2/2083 (0.1%)	0.67	1/2804 (0.0%)
1	B	0.87	2/2061 (0.1%)	0.65	0/2774
All	All	0.88	4/4144 (0.1%)	0.66	1/5578 (0.0%)

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

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	32	GLU	CG-CD	5.90	1.60	1.51
1	A	193	GLU	CB-CG	5.34	1.62	1.52
1	A	193	GLU	CG-CD	5.17	1.59	1.51
1	B	86	CYS	CB-SG	-5.11	1.73	1.81

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	190	LEU	CA-CB-CG	5.45	127.84	115.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	211	GLY	Peptide

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	2037	0	2073	51	0
1	B	2016	0	2051	47	0
2	A	21	0	0	4	0
2	B	21	0	0	1	0
All	All	4095	0	4124	97	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 12.

All (97) 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:31:LYS:N	1:B:31:LYS:HE3	1.70	1.04
1:B:31:LYS:H	1:B:31:LYS:HE3	0.88	1.04
1:B:33:LEU:O	1:B:34:ARG:HB2	1.57	0.99
1:B:31:LYS:H	1:B:31:LYS:CE	1.80	0.94
1:B:66:LEU:HD13	1:B:66:LEU:O	1.77	0.84
1:A:191:ASN:HD22	1:A:194:VAL:H	1.29	0.80
1:A:44:LEU:HD21	1:A:53:GLU:HG3	1.63	0.79
1:B:33:LEU:O	1:B:34:ARG:CB	2.33	0.76
1:B:38:HIS:HD2	1:B:40:HIS:NE2	1.84	0.75
1:A:136:GLU:HG3	1:A:140:GLN:NE2	2.03	0.74
1:A:38:HIS:HD2	1:A:40:HIS:NE2	1.90	0.70
1:A:21:ILE:HB	1:A:259:MET:HG2	1.75	0.69
1:B:176:ILE:N	1:B:176:ILE:CD1	2.56	0.68
1:A:191:ASN:ND2	1:A:194:VAL:H	1.93	0.67
1:A:31:LYS:H	1:A:31:LYS:HD2	1.59	0.66
1:B:246:SER:O	1:B:249:GLN:HG3	1.96	0.64
1:A:196:LYS:HG2	1:A:223:LEU:HD21	1.79	0.64
1:A:254:LYS:HE2	1:A:254:LYS:HA	1.82	0.61
1:A:10:GLY:HA3	1:A:13:ILE:HD13	1.81	0.61
1:A:14:LYS:HE3	1:B:11:ASN:OD1	2.00	0.61
1:A:31:LYS:H	1:A:31:LYS:CD	2.11	0.60
1:B:38:HIS:CD2	1:B:40:HIS:NE2	2.69	0.60
1:A:47:GLU:HG2	1:A:47:GLU:O	2.03	0.58

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:66:LEU:H	1:A:66:LEU:HD22	1.70	0.57
1:A:196:LYS:CG	1:A:223:LEU:HD21	2.34	0.57
1:B:175:LEU:C	1:B:176:ILE:HD12	2.25	0.57
1:B:109:PHE:HE2	1:B:137:LEU:HD21	1.69	0.56
1:A:33:LEU:O	1:A:34:ARG:HB2	2.05	0.56
1:B:196:LYS:HG2	1:B:223:LEU:HD21	1.88	0.55
1:B:191:ASN:HD22	1:B:194:VAL:H	1.55	0.54
1:A:136:GLU:HG3	1:A:140:GLN:HE22	1.72	0.54
1:B:229:ASP:OD1	1:B:231:LYS:HG2	2.07	0.53
1:B:108:GLY:HA3	1:B:237:ASN:OD1	2.09	0.53
1:B:169:PRO:HD2	1:B:198:TYR:OH	2.09	0.53
1:A:191:ASN:ND2	1:A:193:GLU:H	2.07	0.52
1:B:176:ILE:N	1:B:176:ILE:HD12	2.24	0.52
1:B:70:GLU:O	1:B:74:GLN:HG2	2.10	0.52
1:A:133:LEU:HD21	1:A:208:LEU:HD11	1.91	0.51
1:A:44:LEU:CD1	1:A:48:SER:HB2	2.40	0.51
1:A:159:ARG:HH11	1:A:159:ARG:HG2	1.75	0.51
1:A:188:LEU:HD13	1:A:215:PRO:HB2	1.92	0.51
1:B:48:SER:O	1:B:71:ARG:NH2	2.43	0.50
1:B:251:PRO:HG2	1:B:254:LYS:HB2	1.94	0.50
1:B:143:GLN:NE2	2:B:310:HOH:O	2.43	0.50
1:B:135:CYS:SG	1:B:160:LEU:HD21	2.52	0.50
1:A:106:ALA:HB1	1:A:136:GLU:HB2	1.94	0.50
1:A:65:THR:HA	1:A:69:LYS:NZ	2.26	0.50
1:B:3:LEU:HG	1:B:38:HIS:HE1	1.78	0.49
1:A:65:THR:OG1	1:A:66:LEU:HD22	2.13	0.48
1:B:176:ILE:HD13	1:B:176:ILE:N	2.28	0.48
1:A:31:LYS:HG2	1:A:32:GLU:OE2	2.14	0.48
1:A:196:LYS:HG3	1:A:219:LEU:HD11	1.96	0.48
1:A:44:LEU:HD13	1:A:48:SER:HB2	1.96	0.48
1:A:136:GLU:OE2	1:A:140:GLN:NE2	2.46	0.48
1:B:109:PHE:CE2	1:B:137:LEU:HD21	2.49	0.48
1:B:191:ASN:ND2	1:B:194:VAL:H	2.11	0.47
1:A:50:ILE:HD11	1:A:68:PHE:HB3	1.97	0.47
1:B:135:CYS:O	1:B:139:LYS:HG3	2.14	0.47
1:B:29:PHE:O	1:B:33:LEU:HB2	2.14	0.47
1:A:191:ASN:ND2	1:A:193:GLU:N	2.63	0.47
1:A:170:LYS:HE2	2:A:308:HOH:O	2.15	0.46
1:A:30:GLN:O	1:A:34:ARG:N	2.38	0.46
1:B:165:PHE:CG	1:B:169:PRO:HG3	2.51	0.46
1:B:66:LEU:C	1:B:66:LEU:HD13	2.36	0.45

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:221:LYS:HB2	1:B:227:PHE:CE2	2.52	0.45
1:A:136:GLU:CG	1:A:140:GLN:NE2	2.79	0.45
1:A:36:LEU:HA	2:A:303:HOH:O	2.16	0.45
1:A:138:LYS:HA	1:A:138:LYS:HD2	1.82	0.45
1:A:148:ASN:O	1:A:166:MET:HA	2.16	0.45
1:A:136:GLU:CD	1:A:140:GLN:HE21	2.20	0.45
1:B:168:PRO:HA	1:B:169:PRO:HD3	1.81	0.45
1:B:46:LEU:O	1:B:71:ARG:NH1	2.46	0.44
1:A:133:LEU:O	1:A:137:LEU:HG	2.17	0.44
1:A:24:ALA:CB	1:A:262:VAL:HG11	2.48	0.43
1:A:44:LEU:HD13	1:A:45:PRO:O	2.19	0.43
1:B:65:THR:HA	1:B:69:LYS:HE2	2.00	0.43
1:A:24:ALA:HB1	1:A:262:VAL:HG11	2.00	0.42
1:B:109:PHE:CZ	1:B:113:LEU:HD11	2.55	0.42
1:B:88:ALA:C	1:B:103:ASN:HD22	2.23	0.42
1:B:196:LYS:HG3	1:B:219:LEU:HD11	2.00	0.42
1:A:53:GLU:OE1	1:A:53:GLU:HA	2.20	0.42
1:B:103:ASN:OD1	1:B:105:ASP:HB2	2.19	0.42
1:B:173:PHE:O	1:B:202:GLY:HA2	2.19	0.42
1:A:258:VAL:O	1:A:262:VAL:HG22	2.20	0.42
1:A:47:GLU:HB3	2:A:314:HOH:O	2.19	0.42
1:A:65:THR:HA	1:A:69:LYS:HZ1	1.85	0.42
1:A:118:TYR:N	2:A:316:HOH:O	2.53	0.42
1:B:45:PRO:O	1:B:48:SER:HB2	2.19	0.42
1:A:153:GLY:O	1:A:157:PHE:HD2	2.02	0.42
1:B:11:ASN:HA	1:B:12:PRO:HA	1.91	0.41
1:B:67:PRO:HD2	1:B:68:PHE:CE2	2.55	0.41
1:A:108:GLY:HA3	1:A:237:ASN:OD1	2.20	0.41
1:A:29:PHE:O	1:A:33:LEU:HG	2.21	0.41
1:B:73:PHE:CE1	1:B:87:GLY:HA2	2.56	0.41
1:B:195:LEU:HD12	1:B:195:LEU:HA	1.95	0.40
1:A:82:ILE:HG12	1:A:82:ILE:O	2.22	0.40
1:B:21:ILE:HD11	1:B:238:ALA:CB	2.51	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	256/271 (94%)	247 (96%)	9 (4%)	0	100	100
1	B	251/271 (93%)	237 (94%)	13 (5%)	1 (0%)	34	48
All	All	507/542 (94%)	484 (96%)	22 (4%)	1 (0%)	47	62

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	34	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	220/231 (95%)	203 (92%)	17 (8%)	13	20
1	B	218/231 (94%)	203 (93%)	15 (7%)	15	25
All	All	438/462 (95%)	406 (93%)	32 (7%)	14	22

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	LYS
1	A	27	LEU
1	A	31	LYS
1	A	44	LEU
1	A	46	LEU

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	47	GLU
1	A	66	LEU
1	A	97	ASP
1	A	114	LYS
1	A	119	GLN
1	A	143	GLN
1	A	152	ARG
1	A	166	MET
1	A	188	LEU
1	A	191	ASN
1	A	223	LEU
1	A	254	LYS
1	B	2	LYS
1	B	31	LYS
1	B	32	GLU
1	B	33	LEU
1	B	46	LEU
1	B	47	GLU
1	B	66	LEU
1	B	114	LYS
1	B	143	GLN
1	B	148	ASN
1	B	150	SER
1	B	176	ILE
1	B	184	LEU
1	B	186	ASN
1	B	252	TYR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	38	HIS
1	A	63	ASN
1	A	119	GLN
1	A	140	GLN
1	A	186	ASN
1	A	191	ASN
1	A	228	GLN
1	B	22	HIS
1	B	30	GLN
1	B	38	HIS
1	B	143	GLN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	B	186	ASN
1	B	191	ASN
1	B	228	GLN
1	B	249	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 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, 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	260/271 (95%)	-0.20	3 (1%) 79 77	16, 27, 41, 55	0
1	B	257/271 (94%)	-0.12	7 (2%) 54 52	17, 27, 44, 58	0
All	All	517/542 (95%)	-0.16	10 (1%) 66 64	16, 27, 42, 58	0

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	211	GLY	4.9
1	A	1	MET	3.1
1	B	1	MET	2.8
1	B	257	GLU	2.8
1	B	96	ASN	2.7
1	B	247	ALA	2.2
1	B	261	SER	2.2
1	B	34	ARG	2.1
1	B	97	ASP	2.1
1	A	114	LYS	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 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.