



# Full wwPDB X-ray Structure Validation Report ⓘ

Oct 10, 2021 – 08:53 PM EDT

PDB ID : 3EIB  
Title : Crystal structure of K270N variant of LL-diaminopimelate aminotransferase from Arabidopsis thaliana  
Authors : Watanabe, N.; Clay, M.D.; van Belkum, M.J.; Cherney, M.M.; Vederas, J.C.; James, M.N.G.  
Deposited on : 2008-09-15  
Resolution : 1.85 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  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.23.2  
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) : 2.23.2

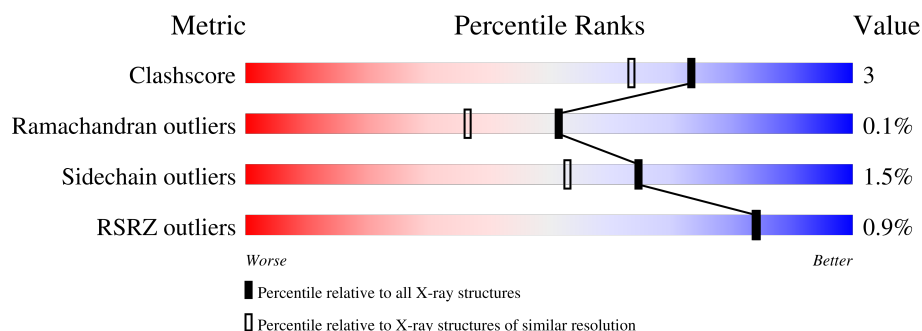
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.85 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))
Clashscore	141614	2625 (1.86-1.86)
Ramachandran outliers	138981	2592 (1.86-1.86)
Sidechain outliers	138945	2592 (1.86-1.86)
RSRZ outliers	127900	2436 (1.86-1.86)

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	432	
1	B	432	

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 7435 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 LL-diaminopimelate aminotransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	412	Total	C	N	O	S	0	0	0
			3183	2025	536	606	16			
1	B	411	Total	C	N	O	S	0	0	0
			3173	2019	533	605	16			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	270	ASN	LYS	engineered mutation	UNP Q93ZN9
A	427	HIS	-	expression tag	UNP Q93ZN9
A	428	HIS	-	expression tag	UNP Q93ZN9
A	429	HIS	-	expression tag	UNP Q93ZN9
A	430	HIS	-	expression tag	UNP Q93ZN9
A	431	HIS	-	expression tag	UNP Q93ZN9
A	432	HIS	-	expression tag	UNP Q93ZN9
B	270	ASN	LYS	engineered mutation	UNP Q93ZN9
B	427	HIS	-	expression tag	UNP Q93ZN9
B	428	HIS	-	expression tag	UNP Q93ZN9
B	429	HIS	-	expression tag	UNP Q93ZN9
B	430	HIS	-	expression tag	UNP Q93ZN9
B	431	HIS	-	expression tag	UNP Q93ZN9
B	432	HIS	-	expression tag	UNP Q93ZN9

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (three-letter code: PLP) (formula: C<sub>8</sub>H<sub>10</sub>NO<sub>6</sub>P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			16	8	1	6	1		
2	B	1	Total	C	N	O	P	0	0
			16	8	1	6	1		

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	O	S	0	0
			5	4	1		
3	A	1	Total	O	S	0	0
			5	4	1		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	B	1	Total	O	S	0	0
			5	4	1		
3	B	1	Total	O	S	0	0
			5	4	1		
3	B	1	Total	O	S	0	0
			5	4	1		

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 5 is water.

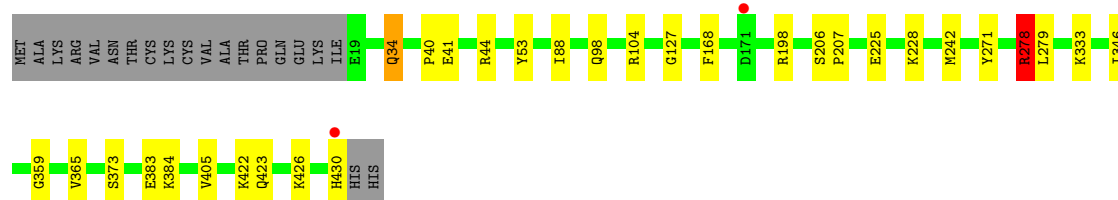
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	517	Total	O	0	0
			517	517		
5	B	499	Total	O	0	0
			499	499		

### 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.

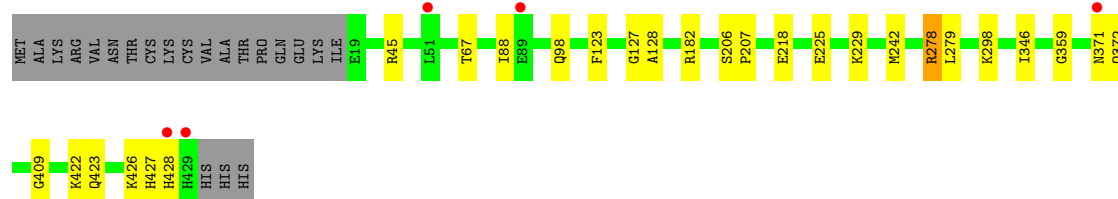
- Molecule 1: LL-diaminopimelate aminotransferase

Chain A: 



- Molecule 1: LL-diaminopimelate aminotransferase

Chain B: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	103.05Å 103.05Å 171.98Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	39.59 – 1.85 39.61 – 1.85	Depositor EDS
% Data completeness (in resolution range)	91.3 (39.59-1.85) 91.4 (39.61-1.85)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.06	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.62 (at 1.85Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.162 , 0.197 0.164 , (Not available)	Depositor DCC
$R_{free}$ test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	23.2	Xtriage
Anisotropy	0.030	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 58.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.020 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.97	EDS
Total number of atoms	7435	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.59% 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

Bond lengths and bond angles in the following residue types are not validated in this section: PLP, SO4, GOL

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	0.73	0/3262	0.66	1/4422 (0.0%)
1	B	0.72	0/3251	0.67	2/4407 (0.0%)
All	All	0.73	0/6513	0.66	3/8829 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	278	ARG	NE-CZ-NH2	-8.50	116.05	120.30
1	B	278	ARG	NE-CZ-NH1	6.87	123.74	120.30
1	A	278	ARG	NE-CZ-NH2	-5.77	117.42	120.30

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	3183	0	3085	21	0
1	B	3173	0	3078	19	0
2	A	16	0	7	0	0
2	B	16	0	8	1	0
3	A	10	0	0	0	0
3	B	15	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	6	0	8	0	0
5	A	517	0	0	7	0
5	B	499	0	0	14	0
All	All	7435	0	6186	41	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 3.

All (41) 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:423:GLN:HG2	5:B:1283:HOH:O	1.64	0.95
1:A:225:GLU:HG3	5:A:718:HOH:O	1.76	0.85
1:A:228:LYS:HD3	5:A:768:HOH:O	1.81	0.79
1:B:242:MET:HG2	5:B:950:HOH:O	1.88	0.73
5:A:657:HOH:O	1:B:88:ILE:HD11	1.94	0.68
2:B:433:PLP:H2A2	5:B:1036:HOH:O	1.92	0.68
1:A:88:ILE:CD1	5:B:857:HOH:O	2.43	0.65
1:A:34:GLN:HG3	1:A:168:PHE:CD2	2.32	0.64
1:A:34:GLN:HG3	1:A:168:PHE:CG	2.32	0.64
1:A:41:GLU:OE1	1:A:44:ARG:NH1	2.31	0.63
1:B:225:GLU:HG3	5:B:960:HOH:O	1.99	0.63
5:A:505:HOH:O	1:B:88:ILE:HD12	2.04	0.57
1:A:88:ILE:HD12	5:B:857:HOH:O	2.05	0.57
1:A:88:ILE:HD11	5:B:941:HOH:O	2.05	0.56
1:B:426:LYS:HE3	5:B:1174:HOH:O	2.04	0.56
1:A:346:ILE:HD11	1:A:359:GLY:HA3	1.88	0.56
1:A:40:PRO:HB2	5:A:682:HOH:O	2.11	0.51
1:B:298:LYS:HG3	5:B:1237:HOH:O	2.11	0.50
1:B:98:GLN:HG3	1:B:123:PHE:CD2	2.50	0.47
1:A:242:MET:HB2	1:A:271:TYR:CE1	2.50	0.47
1:A:206:SER:HA	1:A:207:PRO:C	2.36	0.46
1:A:228:LYS:HE3	5:A:757:HOH:O	2.15	0.45
1:B:371:ASN:C	1:B:372:GLN:HG3	2.37	0.45
1:B:67:THR:HG21	1:B:409:GLY:HA2	1.99	0.44
1:A:34:GLN:CG	1:A:168:PHE:CD2	3.01	0.43
1:B:426:LYS:CE	5:B:1174:HOH:O	2.63	0.43
1:B:206:SER:HA	1:B:207:PRO:C	2.39	0.43
1:B:127:GLY:HA3	1:B:278:ARG:NH2	2.35	0.42
1:B:218:GLU:HB3	5:B:981:HOH:O	2.20	0.42
1:B:128:ALA:HA	5:B:832:HOH:O	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:365:VAL:HG22	1:A:405:VAL:HB	2.01	0.41
1:A:423:GLN:HG2	5:A:494:HOH:O	2.20	0.41
1:B:426:LYS:HD2	1:B:427:HIS:NE2	2.36	0.41
1:A:98:GLN:HG2	1:A:104:ARG:HD3	2.02	0.41
1:A:333:LYS:NZ	1:A:333:LYS:HB2	2.35	0.41
1:B:45:ARG:NH1	5:B:1228:HOH:O	2.48	0.41
1:A:422:LYS:O	1:A:426:LYS:HB3	2.21	0.41
1:A:53:TYR:OH	1:A:383:GLU:OE2	2.32	0.40
1:B:422:LYS:HG2	5:B:1011:HOH:O	2.22	0.40
1:A:127:GLY:HA3	1:A:278:ARG:NH2	2.37	0.40
1:B:346:ILE:HD11	1:B:359:GLY:HA3	2.03	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	410/432 (95%)	403 (98%)	6 (2%)	1 (0%)	47	33
1	B	409/432 (95%)	402 (98%)	7 (2%)	0	100	100
All	All	819/864 (95%)	805 (98%)	13 (2%)	1 (0%)	51	36

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	278	ARG

### 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	338/356 (95%)	332 (98%)	6 (2%)	59	45
1	B	337/356 (95%)	333 (99%)	4 (1%)	71	62
All	All	675/712 (95%)	665 (98%)	10 (2%)	65	53

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	34	GLN
1	A	198	ARG
1	A	279	LEU
1	A	373	SER
1	A	384	LYS
1	A	430	HIS
1	B	182	ARG
1	B	229	LYS
1	B	279	LEU
1	B	428	HIS

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

Mol	Chain	Res	Type
1	A	57	GLN
1	A	248	ASN
1	B	142	ASN

### 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 monosaccharides in this entry.

## 5.6 Ligand geometry

8 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z  > 2$	Counts	RMSZ	$\# Z  > 2$
3	SO4	B	434	-	4,4,4	0.36	0	6,6,6	0.18	0
4	GOL	A	436	-	5,5,5	0.34	0	5,5,5	0.30	0
2	PLP	B	433	-	16,16,16	1.43	2 (12%)	20,23,23	1.92	7 (35%)
2	PLP	A	433	-	16,16,16	1.46	3 (18%)	20,23,23	2.11	6 (30%)
3	SO4	A	434	-	4,4,4	0.35	0	6,6,6	0.17	0
3	SO4	A	435	-	4,4,4	0.40	0	6,6,6	0.09	0
3	SO4	B	435	-	4,4,4	0.37	0	6,6,6	0.10	0
3	SO4	B	436	-	4,4,4	0.37	0	6,6,6	0.34	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	GOL	A	436	-	-	4/4/4/4	-
2	PLP	B	433	-	-	5/8/8/8	0/1/1/1
2	PLP	A	433	-	-	5/8/8/8	0/1/1/1

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	433	PLP	C4-C4A	3.59	1.54	1.46
2	A	433	PLP	C4-C4A	2.86	1.53	1.46
2	A	433	PLP	P-O1P	2.79	1.59	1.50
2	B	433	PLP	P-O1P	2.22	1.57	1.50
2	A	433	PLP	C3-C2	-2.01	1.38	1.40

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	433	PLP	O3P-P-O4P	4.51	118.73	106.73
2	A	433	PLP	O4A-C4A-C4	-4.44	115.25	124.91
2	B	433	PLP	C3-C4-C5	3.66	121.07	118.26
2	B	433	PLP	O4A-C4A-C4	-3.63	117.01	124.91
2	B	433	PLP	O3P-P-O4P	3.60	116.30	106.73
2	A	433	PLP	C3-C4-C5	3.05	120.60	118.26
2	A	433	PLP	O4P-C5A-C5	2.87	114.81	109.35
2	B	433	PLP	C3-C4-C4A	-2.37	116.53	119.90
2	B	433	PLP	O3-C3-C2	2.33	122.56	117.49
2	B	433	PLP	C4-C3-C2	-2.17	118.84	120.19
2	B	433	PLP	O4P-C5A-C5	2.04	113.23	109.35
2	A	433	PLP	O2P-P-O1P	-2.02	102.77	110.68
2	A	433	PLP	O3-C3-C2	2.02	121.89	117.49

There are no chirality outliers.

All (14) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	433	PLP	C3-C4-C4A-O4A
2	A	433	PLP	C5-C4-C4A-O4A
2	A	433	PLP	C5A-O4P-P-O1P
2	A	433	PLP	C5A-O4P-P-O2P
2	A	433	PLP	C5A-O4P-P-O3P
2	B	433	PLP	C3-C4-C4A-O4A
2	B	433	PLP	C5-C4-C4A-O4A
2	B	433	PLP	C5A-O4P-P-O1P
2	B	433	PLP	C5A-O4P-P-O2P
2	B	433	PLP	C5A-O4P-P-O3P
4	A	436	GOL	O1-C1-C2-C3
4	A	436	GOL	O1-C1-C2-O2
4	A	436	GOL	O2-C2-C3-O3
4	A	436	GOL	C1-C2-C3-O3

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	433	PLP	1	0

## 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	412/432 (95%)	-0.42	2 (0%) 91 91	15, 21, 33, 44	0
1	B	411/432 (95%)	-0.42	5 (1%) 79 79	15, 21, 32, 58	0
All	All	823/864 (95%)	-0.42	7 (0%) 84 84	15, 21, 33, 58	0

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	428	HIS	5.3
1	A	430	HIS	5.0
1	B	429	HIS	4.8
1	B	51	LEU	3.5
1	A	171	ASP	3.3
1	B	371	ASN	3.2
1	B	89	GLU	2.1

### 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](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q< 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	SO4	B	435	5/5	0.84	0.19	104,104,105,105	0
3	SO4	A	435	5/5	0.86	0.28	117,117,117,117	0
4	GOL	A	436	6/6	0.90	0.21	39,43,44,45	0
3	SO4	B	434	5/5	0.94	0.14	63,64,64,65	0
3	SO4	B	436	5/5	0.95	0.16	52,53,53,53	0
2	PLP	B	433	16/16	0.95	0.16	18,43,46,47	0
3	SO4	A	434	5/5	0.97	0.09	54,55,55,57	0
2	PLP	A	433	16/16	0.97	0.14	17,36,40,42	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.