wwPDB X-ray Structure Validation Summary Report (i)

May 16, 2020 – 10:48 am BST

PDB ID	:	6GIO
Title	:	Structure of Amino Acid Amide Racemase from Ochrobactrum anthropi
Authors	:	Frese, A.; Grogan, G.
Deposited on	:	2018-05-14
Resolution	:	1.87 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 following versions of software and data (see references (1)) were used in the production of this report:

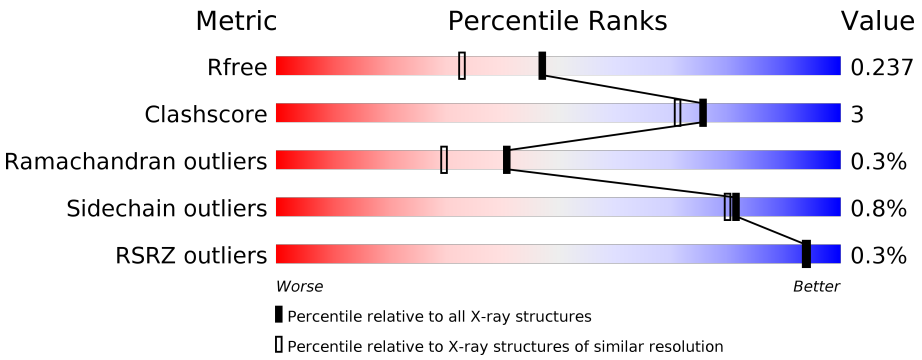
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 1.87 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	9470 (1.90-1.86)
Clashscore	141614	10282 (1.90-1.86)
Ramachandran outliers	138981	10152 (1.90-1.86)
Sidechain outliers	138945	10152 (1.90-1.86)
RSRZ outliers	127900	9303 (1.90-1.86)

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 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 <=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	439	90% 7% ••
1	B	439	91% 8% •
1	C	439	% 89% 10% •
1	D	439	93% 5% •

2 Entry composition (i)

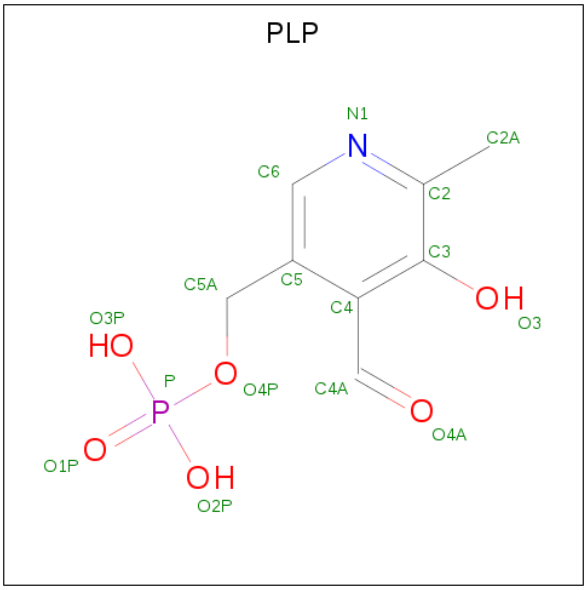
There are 4 unique types of molecules in this entry. The entry contains 13590 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Amino acid amide racemase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	D	434	3229	2038	577	601	13	0	0	0
1	A	433	3220	2034	576	598	12	0	0	0
1	B	435	3250	2051	584	603	12	0	0	0
1	C	436	3243	2047	580	604	12	0	0	0

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (three-letter code: PLP) (formula: $C_8H_{10}NO_6P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	D	1	15	8	1	5	1	0	0
2	A	1	15	8	1	5	1	0	0

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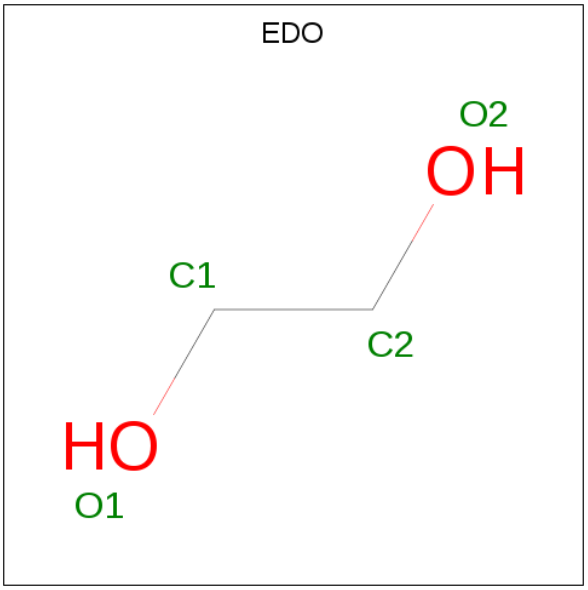
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	B	1	15	8	1	5	1	0	0
2	C	1	15	8	1	5	1	0	0

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
3	B	1	4	2	2	0	0

- Molecule 4 is water.

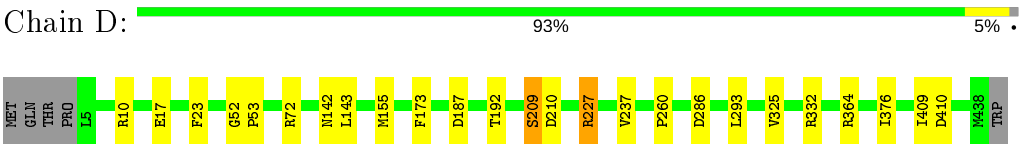
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	D	141	141	141	0	0
4	A	140	140	140	0	0
4	B	173	173	173	0	0
4	C	130	130	130	0	0

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.

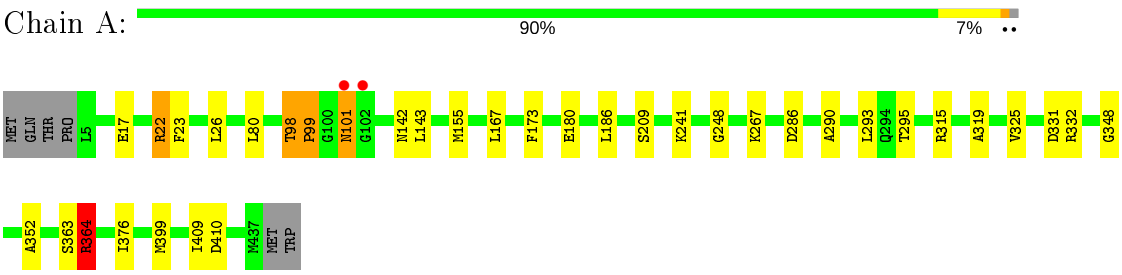
- Molecule 1: Amino acid amide racemase

Chain D:



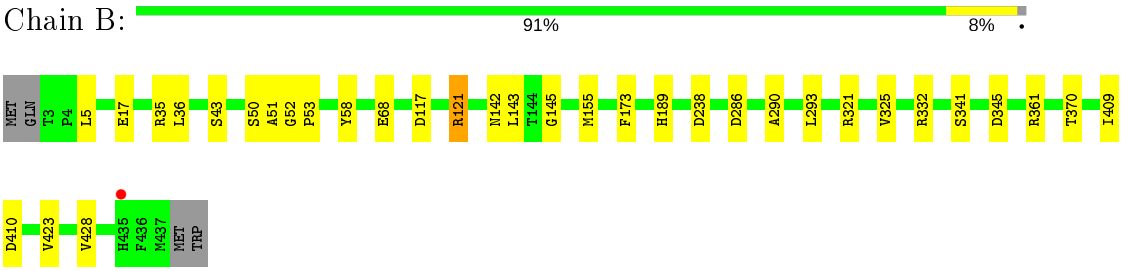
- Molecule 1: Amino acid amide racemase

Chain A:



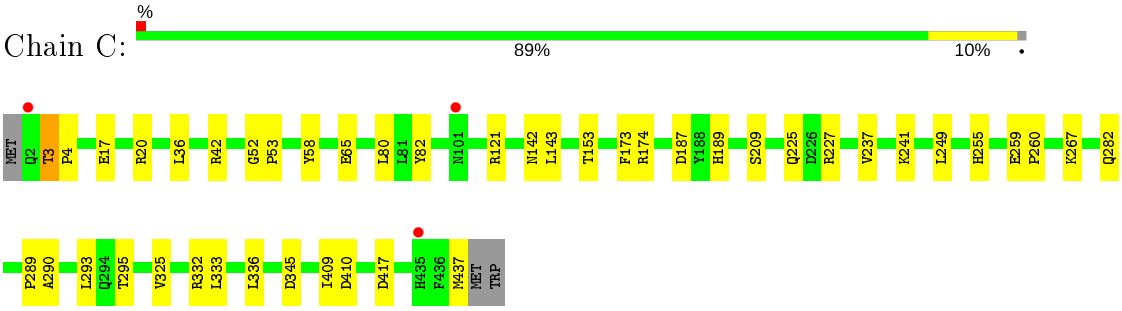
- Molecule 1: Amino acid amide racemase

Chain B:



- Molecule 1: Amino acid amide racemase

Chain C:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	64.60Å 134.98Å 88.77Å 90.00° 90.25° 90.00°	Depositor
Resolution (Å)	64.60 – 1.87 58.27 – 1.87	Depositor EDS
% Data completeness (in resolution range)	98.4 (64.60-1.87) 98.4 (58.27-1.87)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.72 (at 1.87Å)	Xtriage
Refinement program	REFMAC 5.8.0218	Depositor
R, R_{free}	0.185 , 0.230 0.194 , 0.237	Depositor DCC
R_{free} test set	5982 reflections (4.86%)	wwPDB-VP
Wilson B-factor (Å^2)	23.7	Xtriage
Anisotropy	0.430	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 42.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	0.038 for h,-k,-l	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	13590	wwPDB-VP
Average B, all atoms (Å^2)	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.74% 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)

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

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	0.72	2/3285 (0.1%)	0.78	2/4467 (0.0%)
1	B	0.69	0/3316	0.77	1/4507 (0.0%)
1	C	0.64	0/3309	0.77	1/4501 (0.0%)
1	D	0.67	0/3294	0.76	0/4479
All	All	0.68	2/13204 (0.0%)	0.77	4/17954 (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	2
1	B	0	1
1	C	0	1
1	D	0	1
All	All	0	5

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	99	PRO	N-CA	12.28	1.68	1.47
1	A	98	THR	C-N	5.32	1.44	1.34

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	99	PRO	CA-N-CD	-7.16	101.48	111.50
1	A	99	PRO	N-CA-C	-6.72	94.64	112.10
1	C	174	ARG	NE-CZ-NH1	5.15	122.88	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	321	ARG	NE-CZ-NH1	5.06	122.83	120.30

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	22	ARG	Sidechain
1	A	364	ARG	Sidechain
1	B	121	ARG	Sidechain
1	C	121	ARG	Sidechain
1	D	10	ARG	Sidechain

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	3220	0	3221	29	0
1	B	3250	0	3270	21	0
1	C	3243	0	3243	31	0
1	D	3229	0	3227	15	0
2	A	15	0	6	1	0
2	B	15	0	6	1	0
2	C	15	0	6	1	0
2	D	15	0	6	0	0
3	B	4	0	6	0	0
4	A	140	0	0	3	0
4	B	173	0	0	2	0
4	C	130	0	0	3	0
4	D	141	0	0	0	0
All	All	13590	0	12991	81	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.

The worst 5 of 81 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:99:PRO:CA	1:A:99:PRO:N	1.68	1.44
1:C:225:GLN:HE22	1:C:259:GLU:H	1.21	0.88
1:A:101:ASN:H	1:A:101:ASN:HD22	1.16	0.87
1:B:325:VAL:HG13	1:B:409:ILE:HD11	1.64	0.79
1:C:325:VAL:HG13	1:C:409:ILE:HD11	1.63	0.79

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	431/439 (98%)	415 (96%)	14 (3%)	2 (0%)	29	17
1	B	433/439 (99%)	418 (96%)	15 (4%)	0	100	100
1	C	434/439 (99%)	417 (96%)	15 (4%)	2 (0%)	29	17
1	D	432/439 (98%)	417 (96%)	14 (3%)	1 (0%)	47	37
All	All	1730/1756 (98%)	1667 (96%)	58 (3%)	5 (0%)	41	30

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	209	SER
1	A	209	SER
1	C	267	LYS
1	A	267	LYS
1	C	209	SER

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	333/345 (96%)	329 (99%)	4 (1%)	71	67
1	B	340/345 (99%)	338 (99%)	2 (1%)	86	86
1	C	337/345 (98%)	334 (99%)	3 (1%)	78	76
1	D	335/345 (97%)	333 (99%)	2 (1%)	86	86
All	All	1345/1380 (98%)	1334 (99%)	11 (1%)	81	80

5 of 11 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	315	ARG
1	A	364	ARG
1	C	3	THR
1	A	155	MET
1	B	155	MET

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 21 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	418	GLN
1	B	142	ASN
1	C	142	ASN
1	A	294	GLN
1	C	189	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 carbohydrates in this entry.

5.6 Ligand geometry (i)

5 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	$\#\|Z\| > 2$
2	PLP	A	501	1	15,15,16	3.13	3 (20%)	20,22,23	1.63	5 (25%)
2	PLP	C	501	1	15,15,16	3.72	3 (20%)	20,22,23	1.27	2 (10%)
2	PLP	B	501	1	15,15,16	3.45	3 (20%)	20,22,23	1.83	6 (30%)
2	PLP	D	501	1	15,15,16	3.44	3 (20%)	20,22,23	1.58	5 (25%)
3	EDO	B	502	-	3,3,3	0.58	0	2,2,2	0.37	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
2	PLP	A	501	1	-	0/6/6/8	0/1/1/1
2	PLP	C	501	1	-	0/6/6/8	0/1/1/1
2	PLP	B	501	1	-	0/6/6/8	0/1/1/1
2	PLP	D	501	1	-	0/6/6/8	0/1/1/1
3	EDO	B	502	-	-	0/1/1/1	-

The worst 5 of 12 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	501	PLP	C3-C2	10.06	1.51	1.40
2	B	501	PLP	C5-C4	9.48	1.51	1.40
2	D	501	PLP	C3-C2	9.02	1.49	1.40
2	C	501	PLP	C5-C4	8.38	1.49	1.40
2	A	501	PLP	C5-C4	8.27	1.49	1.40

The worst 5 of 18 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	501	PLP	C4A-C4-C5	3.78	124.82	120.94
2	B	501	PLP	C3-C4-C5	-3.59	114.86	118.74
2	A	501	PLP	O4P-C5A-C5	3.55	116.12	109.35
2	A	501	PLP	C3-C4-C5	-3.40	115.07	118.74
2	B	501	PLP	C2A-C2-C3	-3.28	116.83	120.89

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	501	PLP	1	0
2	C	501	PLP	1	0
2	B	501	PLP	1	0

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	433/439 (98%)	-0.32	2 (0%)	91	91	19, 27, 40, 70	0
1	B	435/439 (99%)	-0.33	1 (0%)	95	95	18, 26, 41, 91	0
1	C	436/439 (99%)	-0.21	3 (0%)	87	88	18, 29, 48, 82	0
1	D	434/439 (98%)	-0.31	0	100	100	18, 27, 42, 60	0
All	All	1738/1756 (98%)	-0.29	6 (0%)	94	94	18, 27, 43, 91	0

The worst 5 of 6 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	435	HIS	3.5
1	C	435	HIS	3.0
1	A	101	ASN	3.0
1	A	102	GLY	2.9
1	C	2	GLN	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)

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, 95th 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(Å^2)	Q<0.9
2	PLP	C	501	15/16	0.95	0.13	27,32,36,37	0
2	PLP	D	501	15/16	0.96	0.11	23,28,32,36	0
3	EDO	B	502	4/4	0.96	0.10	21,24,24,25	0
2	PLP	B	501	15/16	0.97	0.11	30,34,35,35	0
2	PLP	A	501	15/16	0.98	0.08	23,29,34,35	0

6.5 Other polymers (i)

There are no such residues in this entry.