



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 1, 2024 – 04:54 am BST

PDB ID : 8R48
Title : Structure of plastidial phosphorylase Pho1 from Solanum tuberosum at 2.2 Angstrom resolution
Authors : Koulas, S.M.; Leonidas, D.D.
Deposited on : 2023-11-13
Resolution : 2.24 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 types of validation reports are described at

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

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.8.4, CSD as541be (2020)
Xtriage (Phenix) : 1.13
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

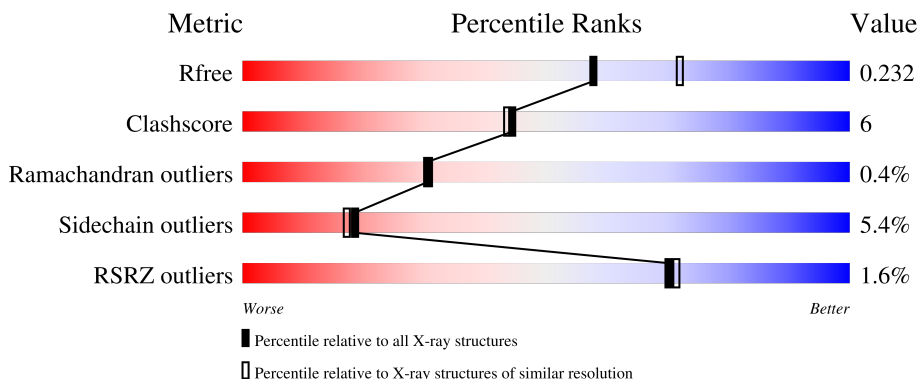
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.24 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	3139 (2.26-2.22)
Clashscore	180529	3381 (2.26-2.22)
Ramachandran outliers	177936	3334 (2.26-2.22)
Sidechain outliers	177891	3335 (2.26-2.22)
RSRZ outliers	164620	3138 (2.26-2.22)

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 $\leq 5\%$. 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	916	 0% 76% 13% 9%

2 Entry composition [i](#)

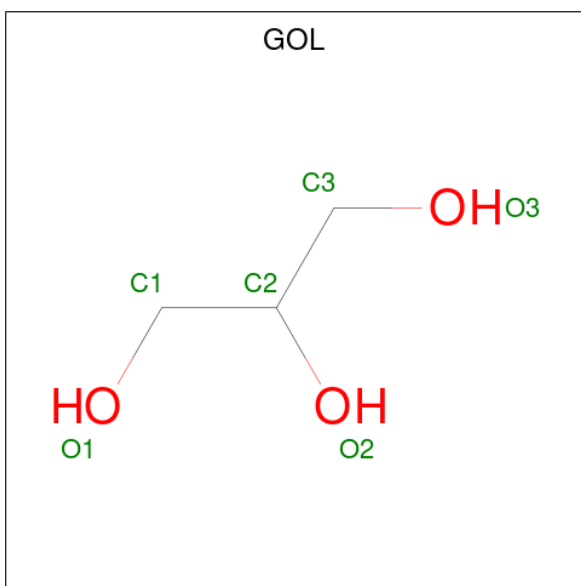
There are 3 unique types of molecules in this entry. The entry contains 7004 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Alpha-1,4 glucan phosphorylase L-1 isozyme, chloroplastic/a myloplastic.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	830	6663	4258	1116	1263	1	25	0	0	0

- Molecule 2 is GLYCEROL (three-letter code: GOL) (formula: C₃H₈O₃).



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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	323	Total 323	O 323	0	0

4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	127.11Å 127.11Å 118.69Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	80.84 – 2.24 80.84 – 2.24	Depositor EDS
% Data completeness (in resolution range)	99.9 (80.84-2.24) 99.9 (80.84-2.24)	Depositor EDS
R_{merge}	0.16	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.57 (at 2.25Å)	Xtrriage
Refinement program	REFMAC 5.8.0258	Depositor
R, R_{free}	0.176 , 0.229 0.178 , 0.232	Depositor DCC
R_{free} test set	2603 reflections (4.85%)	wwPDB-VP
Wilson B-factor (Å ²)	38.8	Xtrriage
Anisotropy	0.057	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 32.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	0.036 for -h,-k,l	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7004	wwPDB-VP
Average B, all atoms (Å ²)	46.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.87% 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 [i](#)

5.1 Standard geometry [i](#)

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

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	0.61	3/6789 (0.0%)	0.91	0/9188

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	780	GLU	CD-OE2	5.65	1.31	1.25
1	A	38	GLU	CD-OE2	5.59	1.31	1.25
1	A	389	GLU	CD-OE1	5.24	1.31	1.25

There are no bond angle outliers.

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	6663	0	6538	78	1
2	A	18	0	24	5	0
3	A	323	0	0	2	0
All	All	7004	0	6562	78	1

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 6.

All (78) 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:120:ASN:ND2	1:A:122:GLU:HG3	1.70	1.06
1:A:120:ASN:HD22	1:A:122:GLU:HG3	1.29	0.96
1:A:421:ASP:O	1:A:423:ASN:N	2.03	0.92
1:A:210:THR:H	2:A:1003:GOL:H31	1.37	0.89
1:A:643:ILE:HD12	1:A:742:SER:HB3	1.55	0.88
1:A:666:LYS:CE	1:A:820:GLU:OE1	2.29	0.81
1:A:537:SER:HA	1:A:540:VAL:HG22	1.65	0.78
1:A:666:LYS:HE3	1:A:820:GLU:OE1	1.84	0.76
1:A:822:LYS:HG2	1:A:839:ILE:HG23	1.68	0.75
1:A:322:ARG:HG2	1:A:322:ARG:O	1.89	0.72
1:A:421:ASP:HB3	1:A:424:LYS:HB3	1.74	0.69
1:A:643:ILE:HD12	1:A:742:SER:CB	2.21	0.68
1:A:210:THR:N	2:A:1003:GOL:H31	2.08	0.68
1:A:319:SER:O	1:A:322:ARG:HD3	1.95	0.66
1:A:668:MET:O	1:A:676:ARG:HD3	1.96	0.65
1:A:647:ARG:HE	2:A:1001:GOL:H11	1.61	0.64
1:A:251:VAL:HG13	1:A:255:ASP:HB2	1.82	0.62
1:A:666:LYS:HE2	1:A:820:GLU:OE1	2.00	0.61
1:A:822:LYS:HG2	1:A:839:ILE:CG2	2.30	0.61
1:A:617:ARG:HH11	1:A:617:ARG:HG3	1.68	0.58
1:A:236:TYR:CE2	1:A:237:LYS:HG3	2.41	0.56
1:A:239:ARG:O	1:A:240:THR:C	2.44	0.56
1:A:386:TRP:HB2	1:A:391:MET:HE3	1.89	0.54
1:A:120:ASN:HD22	1:A:122:GLU:CG	2.11	0.54
1:A:860:PHE:HB3	1:A:861:PRO:HD3	1.89	0.54
1:A:537:SER:CA	1:A:540:VAL:HG22	2.37	0.54
1:A:748:ILE:HG22	1:A:772:GLY:HA2	1.89	0.53
1:A:115:LYS:NZ	3:A:1103:HOH:O	2.41	0.53
1:A:120:ASN:HD21	1:A:122:GLU:HG3	1.66	0.53
1:A:647:ARG:HE	2:A:1001:GOL:C1	2.22	0.53
1:A:643:ILE:CD1	1:A:742:SER:HB3	2.35	0.52
1:A:89:MET:HG2	1:A:340:HIS:CB	2.40	0.51
1:A:337:ASN:O	1:A:338:ASP:CB	2.58	0.51
1:A:131:ALA:HA	1:A:184:TRP:CE3	2.45	0.50
1:A:537:SER:HA	1:A:540:VAL:CG2	2.41	0.49
1:A:433:ARG:NH1	1:A:440:LEU:HD13	2.28	0.49
1:A:661:ILE:HG21	1:A:724:VAL:HG21	1.94	0.48
1:A:617:ARG:HG3	1:A:617:ARG:NH1	2.28	0.48
1:A:817:ARG:O	1:A:820:GLU:HB2	2.13	0.48
1:A:413:ILE:O	1:A:416:LYS:O	2.32	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:568:TRP:CD2	1:A:762:LLP:HD2	2.49	0.47
1:A:160:GLY:O	1:A:246:LEU:HA	2.16	0.46
1:A:582:LYS:NZ	1:A:611:GLU:OE2	2.45	0.46
1:A:392:GLN:HG2	1:A:399:VAL:HG11	1.97	0.46
1:A:386:TRP:HB2	1:A:391:MET:CE	2.45	0.45
1:A:84:ALA:O	1:A:156:ALA:HA	2.17	0.45
1:A:900:ILE:HD13	1:A:900:ILE:HA	1.87	0.44
1:A:82:LYS:HE3	1:A:329:PRO:O	2.17	0.44
1:A:822:LYS:O	1:A:826:ARG:HG3	2.17	0.44
1:A:89:MET:HG2	1:A:340:HIS:HB3	1.98	0.43
1:A:236:TYR:CD2	1:A:237:LYS:HG3	2.53	0.43
1:A:335:GLN:OE1	1:A:372:ALA:HB3	2.18	0.43
1:A:532:VAL:HG23	1:A:756:SER:HB2	2.00	0.43
1:A:187:ILE:O	1:A:187:ILE:CG2	2.66	0.43
1:A:835:TYR:O	1:A:839:ILE:HD12	2.18	0.43
1:A:170:GLN:HG3	1:A:177:GLN:HG3	2.00	0.43
1:A:237:LYS:HE2	1:A:237:LYS:HB3	1.79	0.43
1:A:822:LYS:O	1:A:826:ARG:CG	2.67	0.43
1:A:103:ASN:HB3	1:A:235:GLY:O	2.19	0.43
1:A:667:LYS:HA	1:A:667:LYS:HE2	2.01	0.42
1:A:206:GLY:O	1:A:207:LYS:HD3	2.19	0.42
1:A:415:LEU:HD13	1:A:415:LEU:HA	1.77	0.42
1:A:520:ASN:O	1:A:524:VAL:HG23	2.19	0.42
1:A:642:ASP:OD1	1:A:746:GLU:OE2	2.37	0.42
1:A:754:GLU:HA	1:A:754:GLU:OE1	2.20	0.42
1:A:150:ALA:HB2	1:A:242:ILE:HG12	2.02	0.42
1:A:699:LYS:NZ	3:A:1113:HOH:O	2.52	0.42
1:A:137:GLY:H	2:A:1001:GOL:H32	1.85	0.42
1:A:813:VAL:HG12	1:A:813:VAL:O	2.19	0.42
1:A:838:LEU:O	1:A:841:SER:OG	2.33	0.41
1:A:39:PHE:C	1:A:41:PRO:HD3	2.41	0.41
1:A:137:GLY:HA2	1:A:762:LLP:H5'2	2.02	0.41
1:A:297:LEU:HD23	1:A:297:LEU:HA	1.78	0.41
1:A:279:ILE:HA	1:A:295:LEU:HD11	2.03	0.41
1:A:361:ASN:HD22	1:A:361:ASN:HA	1.66	0.41
1:A:823:GLU:HA	1:A:823:GLU:OE1	2.21	0.41
1:A:719:GLY:O	1:A:723:LYS:HE2	2.21	0.40
1:A:153:ASN:O	1:A:912:ALA:HA	2.22	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:46:GLU:OE2	1:A:73:TYR:OH[6_764]	2.13	0.07

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	825/916 (90%)	792 (96%)	30 (4%)	3 (0%)	30 31

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	422	LEU
1	A	848	PHE
1	A	441	PRO

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	707/786 (90%)	669 (95%)	38 (5%)	18 17

All (38) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	44	SER
1	A	81	MET
1	A	122	GLU

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Mol	Chain	Res	Type
1	A	130	ASP
1	A	178	GLU
1	A	180	VAL
1	A	186	GLU
1	A	199	SER
1	A	243	SER
1	A	251	VAL
1	A	259	SER
1	A	297	LEU
1	A	322	ARG
1	A	338	ASP
1	A	378	VAL
1	A	387	SER
1	A	392	GLN
1	A	393	LYS
1	A	415	LEU
1	A	422	LEU
1	A	423	ASN
1	A	442	SER
1	A	446	GLU
1	A	587	GLU
1	A	601	LYS
1	A	646	LYS
1	A	651	TYR
1	A	676	ARG
1	A	678	THR
1	A	737	LEU
1	A	775	ASP
1	A	787	GLU
1	A	799	GLU
1	A	811	LYS
1	A	826	ARG
1	A	865	GLU
1	A	871	ASP
1	A	891	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	120	ASN
1	A	123	ASN
1	A	340	HIS

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Mol	Chain	Res	Type
1	A	361	ASN
1	A	558	ASN
1	A	679	ASN
1	A	747	HIS
1	A	770	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](#)

1 non-standard protein/DNA/RNA residue is 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
1	LLP	A	762	1	23,24,25	1.14	3 (13%)	25,32,34	0.64	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
1	LLP	A	762	1	-	5/16/17/19	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	762	LLP	P-OP2	-2.78	1.44	1.54
1	A	762	LLP	C3-C2	-2.60	1.38	1.40
1	A	762	LLP	P-OP3	-2.06	1.46	1.54

There are no bond angle outliers.

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	762	LLP	C5'-OP4-P-OP2
1	A	762	LLP	C5'-OP4-P-OP3
1	A	762	LLP	CG-CD-CE-NZ
1	A	762	LLP	C6-C5-C5'-OP4
1	A	762	LLP	C4-C5-C5'-OP4

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	762	LLP	2	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

3 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	GOL	A	1002	-	5,5,5	0.14	0	5,5,5	0.44	0
2	GOL	A	1001	-	5,5,5	0.09	0	5,5,5	0.05	0
2	GOL	A	1003	-	5,5,5	0.18	0	5,5,5	0.31	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	GOL	A	1002	-	-	2/4/4/4	-
2	GOL	A	1001	-	-	0/4/4/4	-
2	GOL	A	1003	-	-	4/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1003	GOL	O1-C1-C2-C3
2	A	1002	GOL	O1-C1-C2-C3
2	A	1003	GOL	C1-C2-C3-O3
2	A	1002	GOL	O1-C1-C2-O2
2	A	1003	GOL	O1-C1-C2-O2
2	A	1003	GOL	O2-C2-C3-O3

There are no ring outliers.

2 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1001	GOL	3	0
2	A	1003	GOL	2	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	829/916 (90%)	-0.40	13 (1%) 70 71	24, 42, 74, 143	0

All (13) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	444	VAL	5.0
1	A	511	ILE	4.4
1	A	442	SER	4.1
1	A	379	LEU	3.8
1	A	443	SER	3.4
1	A	322	ARG	2.6
1	A	848	PHE	2.6
1	A	380	PRO	2.5
1	A	445	ALA	2.5
1	A	512	PRO	2.3
1	A	23	ALA	2.2
1	A	422	LEU	2.1
1	A	378	VAL	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [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
1	LLP	A	762	24/25	0.96	0.07	31,33,55,60	0

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, 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(\AA^2)	Q<0.9
2	GOL	A	1002	6/6	0.90	0.16	62,74,83,84	0
2	GOL	A	1001	6/6	0.91	0.13	54,61,64,66	0
2	GOL	A	1003	6/6	0.92	0.12	50,56,63,64	0

6.5 Other polymers [i](#)

There are no such residues in this entry.