Full wwPDB X-ray Structure Validation Report (i)

Sep 29, 2024 – 05:48 PM EDT

PDB ID	:	4RPF
Title	:	Crystal structure of homoserine kinase from Yersinia pestis Nepal516, NYSGRC target 032715
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Deposited on	:	2014-10-30
Resolution	:	2.30 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 (i) 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 (1)) were used in the production of this report:

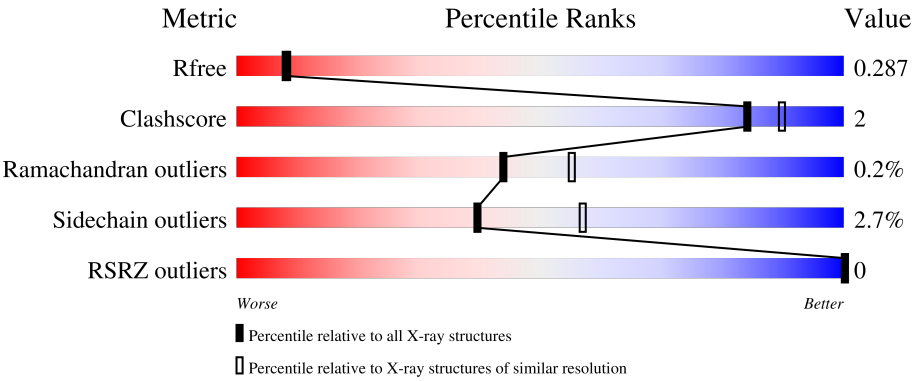
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)

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 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 >=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	310	93% 7%
1	B	310	92% 8%
1	C	310	93% 6% •

Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.39

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 7122 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.

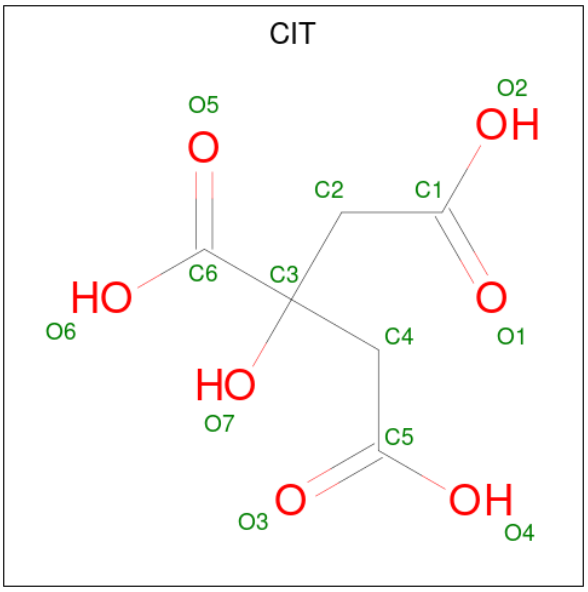
- Molecule 1 is a protein called Homoserine kinase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	310	Total	C	N	O	S	0	1	0
			2337	1471	407	435	24			
1	B	310	Total	C	N	O	S	0	0	0
			2329	1466	404	435	24			
1	C	309	Total	C	N	O	S	0	0	0
			2324	1464	403	433	24			

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	SER	-	expression tag	UNP Q1CMW6
B	0	SER	-	expression tag	UNP Q1CMW6
C	0	SER	-	expression tag	UNP Q1CMW6

- Molecule 2 is CITRIC ACID (three-letter code: CIT) (formula: $C_6H_8O_7$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 13 6 7	0	0
2	B	1	Total C O 13 6 7	0	0
2	C	1	Total C O 13 6 7	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	27	Total O 27 27	0	0
3	B	38	Total O 38 38	0	0
3	C	28	Total O 28 28	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: Homoserine kinase

Chain A:

- Molecule 1: Homoserine kinase

Chain B:

- Molecule 1: Homoserine kinase

Chain C:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	162.86Å 93.66Å 107.62Å 90.00° 90.14° 90.00°	Depositor
Resolution (Å)	40.72 – 2.30 40.72 – 2.30	Depositor EDS
% Data completeness (in resolution range)	97.4 (40.72-2.30) 97.4 (40.72-2.30)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	0.08	Depositor
$< I/\sigma(I) >$ [1]	1.96 (at 2.31Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.240 , 0.291 0.242 , 0.287	Depositor DCC
R_{free} test set	2050 reflections (2.91%)	wwPDB-VP
Wilson B-factor (Å^2)	47.3	Xtriage
Anisotropy	0.179	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 27.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.016 for -1/2*h-3/2*k,-1/2*h+1/2*k,-l 0.014 for -1/2*h+3/2*k,1/2*h+1/2*k,-l 0.460 for 1/2*h-3/2*k,-1/2*h-1/2*k,-l 0.447 for 1/2*h+3/2*k,1/2*h-1/2*k,-l 0.013 for -h,-k,l	Xtriage
Reported twinning fraction	0.490 for H, K, L 0.328 for 1/2H-3/2K, -1/2H-1/2K, -L 0.182 for 1/2H+3/2K, 1/2H-1/2K, -L	Depositor
Outliers	0 of 70485 reflections	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	7122	wwPDB-VP
Average B, all atoms (Å^2)	58.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.27% 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

5.1 Standard geometry

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

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	0.34	0/2388	0.57	0/3234
1	B	0.33	0/2377	0.57	0/3220
1	C	0.32	0/2372	0.55	0/3215
All	All	0.33	0/7137	0.56	0/9669

There are no bond length outliers.

There are no bond angle outliers.

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	2337	0	2308	10	0
1	B	2329	0	2295	9	0
1	C	2324	0	2293	13	0
2	A	13	0	5	0	0
2	B	13	0	5	2	0
2	C	13	0	5	1	0
3	A	27	0	0	0	0
3	B	38	0	0	0	0
3	C	28	0	0	0	0
All	All	7122	0	6911	31	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 2.

All (31) 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:C:14:SER:O	1:C:228:ASP:HB2	2.03	0.59
1:B:100:ALA:O	1:B:104:VAL:HG23	2.09	0.52
1:A:2:VAL:HG13	1:A:307:LEU:HD21	1.91	0.51
1:A:182:VAL:HG12	1:A:264:PRO:HD3	1.93	0.50
1:A:205:ARG:HB2	1:B:19:VAL:HG11	1.95	0.49
1:C:98:SER:N	2:C:401:CIT:O2	2.38	0.48
1:C:190:ILE:CD1	1:C:234:TYR:O	2.64	0.46
1:B:12:ASN:OD1	1:B:17:PHE:HA	2.15	0.46
1:A:33:GLY:HA2	1:A:90:MET:HE2	1.98	0.46
1:C:238:LEU:C	1:C:239:LEU:HD23	2.37	0.45
1:B:0:SER:OG	1:B:1:MET:N	2.48	0.45
1:C:190:ILE:HD13	1:C:234:TYR:O	2.17	0.45
1:C:182:VAL:HG13	1:C:264:PRO:HG3	1.99	0.44
1:B:97:GLY:HA2	2:B:401:CIT:O3	2.17	0.44
1:B:262:SER:OG	2:B:401:CIT:O6	2.35	0.44
1:C:238:LEU:O	1:C:239:LEU:HD23	2.18	0.43
1:C:15:VAL:HB	1:C:226:MET:HA	2.00	0.43
1:C:90:MET:HG3	1:C:91:PRO:HD2	2.01	0.43
1:C:205:ARG:HD2	1:C:205:ARG:C	2.39	0.43
1:C:132:GLY:O	1:C:136:GLY:N	2.52	0.43
1:A:14:SER:O	1:A:228:ASP:HB2	2.19	0.43
1:A:232:GLU:O	1:A:236:THR:HG23	2.19	0.43
1:A:33:GLY:HA2	1:A:90:MET:CE	2.49	0.42
1:A:8:ALA:HB2	1:A:90:MET:HE1	2.02	0.42
1:B:68:CYS:HA	1:B:130:LEU:HD11	2.02	0.42
1:B:187:ALA:O	1:B:190:ILE:HG22	2.19	0.42
1:C:13:VAL:O	1:C:14:SER:HB3	2.20	0.41
1:A:11:GLY:O	1:A:12:ASN:HB2	2.19	0.41
1:A:90:MET:HG3	1:A:91:PRO:HD2	2.02	0.41
1:C:205:ARG:C	1:C:205:ARG:CD	2.90	0.40
1:B:132:GLY:HA2	1:B:137:SER:C	2.41	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	309/310 (100%)	301 (97%)	7 (2%)	1 (0%)	37 47
1	B	308/310 (99%)	298 (97%)	9 (3%)	1 (0%)	37 47
1	C	307/310 (99%)	300 (98%)	7 (2%)	0	100 100
All	All	924/930 (99%)	899 (97%)	23 (2%)	2 (0%)	44 55

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	13	VAL
1	B	13	VAL

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	245/244 (100%)	237 (97%)	8 (3%)	33 48
1	B	244/244 (100%)	236 (97%)	8 (3%)	33 48
1	C	244/244 (100%)	239 (98%)	5 (2%)	50 68
All	All	733/732 (100%)	712 (97%)	21 (3%)	40 54

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	198	GLN

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Mol	Chain	Res	Type
1	A	207	LEU
1	A	266	LEU
1	A	273	GLN
1	A	292	GLU
1	A	299	ARG
1	A	306[A]	ARG
1	A	306[B]	ARG
1	B	90	MET
1	B	169	SER
1	B	175	MET
1	B	186	GLU
1	B	207	LEU
1	B	255	LEU
1	B	266	LEU
1	B	299	ARG
1	C	18	ASP
1	C	90	MET
1	C	205	ARG
1	C	266	LEU
1	C	299	ARG

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	62	GLN
1	A	142	ASN
1	A	198	GLN
1	A	289	GLN
1	B	157	GLN
1	B	285	ASN
1	C	48	ASN
1	C	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 (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	CIT	A	401	-	12,12,12	1.17	1 (8%)	17,17,17	1.56	2 (11%)
2	CIT	B	401	-	12,12,12	1.20	1 (8%)	17,17,17	1.17	2 (11%)
2	CIT	C	401	-	12,12,12	1.19	1 (8%)	17,17,17	1.32	2 (11%)

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	CIT	A	401	-	-	5/16/16/16	-
2	CIT	B	401	-	-	0/16/16/16	-
2	CIT	C	401	-	-	3/16/16/16	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	401	CIT	C3-C6	-2.45	1.50	1.53
2	C	401	CIT	C3-C6	-2.34	1.51	1.53
2	B	401	CIT	C3-C6	-2.32	1.51	1.53

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	401	CIT	O7-C3-C6	-3.54	103.94	108.96

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	C	401	CIT	C4-C3-C6	-2.81	103.82	110.03
2	C	401	CIT	O3-C5-C4	-2.52	115.81	122.95
2	A	401	CIT	C4-C3-C2	2.44	115.58	109.31
2	B	401	CIT	C4-C3-C6	-2.44	104.63	110.03
2	B	401	CIT	O6-C6-C3	2.33	117.61	113.14

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	401	CIT	C3-C4-C5-O4
2	C	401	CIT	C3-C4-C5-O3
2	A	401	CIT	C1-C2-C3-O7
2	A	401	CIT	C2-C3-C6-O6
2	A	401	CIT	C1-C2-C3-C6
2	A	401	CIT	C1-C2-C3-C4
2	A	401	CIT	C2-C3-C6-O5
2	C	401	CIT	C1-C2-C3-C6

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	401	CIT	2	0
2	C	401	CIT	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

6.1 Protein, DNA and RNA chains

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^{th} 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	310/310 (100%)	-0.68	0	100	100	32, 55, 80, 107	1 (0%)
1	B	310/310 (100%)	-0.70	0	100	100	38, 56, 79, 94	0
1	C	309/310 (99%)	-0.63	0	100	100	36, 56, 80, 110	0
All	All	929/930 (99%)	-0.67	0	100	100	32, 56, 80, 110	1 (0%)

There are no RSRZ outliers to report.

6.2 Non-standard residues in protein, DNA, RNA chains

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no monosaccharides in this entry.

6.4 Ligands

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^{th} 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	CIT	C	401	13/13	0.95	0.08	37,42,72,83	0
2	CIT	A	401	13/13	0.97	0.06	42,54,72,84	0
2	CIT	B	401	13/13	0.98	0.06	37,56,73,88	0

6.5 Other polymers (i)

There are no such residues in this entry.