



Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 5MS7 / pdb_00005ms7
Title : Crystal structure of the legionella pneumophila effector protein RavZ_20-502
Authors : Pantoom, S.; Vetter, I.R.; Wu, Y.W.
Deposited on : 2016-12-31
Resolution : 2.80 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	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

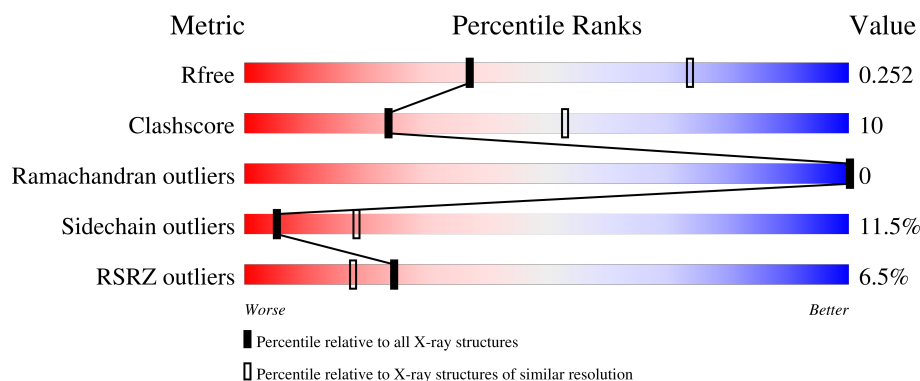
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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}	180053	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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	485	5% 53% 18% • • 24%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2942 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 Legionella pneumophila effector protein RavZ.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	370	Total	C	N	O	S	0	0	0
			2908	1847	472	580	9			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	18	GLY	-	expression tag	UNP Q5ZUV9
A	19	PRO	-	expression tag	UNP Q5ZUV9

- Molecule 2 is BARIUM ION (CCD ID: BA) (formula: Ba).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Ba	0	0
			2	2		

- Molecule 3 is GLYCEROL (CCD ID: GOL) (formula: C₃H₈O₃).



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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	14	Total 14	O 14	0	0

4 Data and refinement statistics

Property	Value	Source
Space group	I 4 2 2	Depositor
Cell constants a, b, c, α , β , γ	222.77 Å 222.77 Å 72.94 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.15 – 2.80 47.15 – 2.80	Depositor EDS
% Data completeness (in resolution range)	100.0 (47.15-2.80) 100.0 (47.15-2.80)	Depositor EDS
R_{merge}	0.19	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.51 (at 2.81 Å)	Xtriage
Refinement program	PHENIX 1.9_1692	Depositor
R, R_{free}	0.207 , 0.254 0.212 , 0.252	Depositor DCC
R_{free} test set	1146 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	86.3	Xtriage
Anisotropy	0.247	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 100.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.28$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	2942	wwPDB-VP
Average B, all atoms (Å ²)	114.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.26% 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

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

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	0.57	0/2961	1.11	18/3999 (0.5%)

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	6

There are no bond length outliers.

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	234	SER	N-CA-C	-10.80	99.68	113.72
1	A	185	ASP	CA-C-N	9.08	128.73	119.56
1	A	185	ASP	C-N-CA	9.08	128.73	119.56
1	A	107	ASN	N-CA-C	7.55	120.82	109.95
1	A	281	ILE	CA-C-N	-7.26	112.44	120.14
1	A	281	ILE	C-N-CA	-7.26	112.44	120.14
1	A	93	ASP	CB-CA-C	-6.65	108.89	116.54
1	A	232	ILE	CB-CA-C	-6.61	102.75	111.81
1	A	400	SER	CB-CA-C	-6.53	109.03	116.54
1	A	382	ILE	N-CA-C	6.53	117.16	110.05
1	A	87	ASP	N-CA-C	5.94	118.32	108.99
1	A	423	LEU	CA-C-N	-5.90	114.55	120.21
1	A	423	LEU	C-N-CA	-5.90	114.55	120.21
1	A	232	ILE	N-CA-C	5.89	115.83	106.88
1	A	274	ALA	N-CA-C	-5.32	104.73	111.11
1	A	198	SER	N-CA-C	5.29	117.85	111.40

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	202	ASP	N-CA-C	5.23	118.41	111.30
1	A	281	ILE	N-CA-C	5.03	119.75	108.88

There are no chirality outliers.

All (6) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	198	SER	Peptide
1	A	232	ILE	Peptide
1	A	233	LYS	Peptide
1	A	274	ALA	Peptide
1	A	90	VAL	Peptide
1	A	91	LEU	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	2908	0	2890	59	0
2	A	2	0	0	0	0
3	A	18	0	23	0	0
4	A	14	0	0	0	0
All	All	2942	0	2913	59	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 10.

All (59) 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:91:LEU:O	1:A:93:ASP:CB	1.88	1.20
1:A:91:LEU:O	1:A:93:ASP:HB2	0.95	1.12
1:A:91:LEU:O	1:A:92:GLU:C	2.28	0.73
1:A:264:ARG:HE	1:A:297:HIS:CE1	2.12	0.67
1:A:91:LEU:HB3	1:A:93:ASP:OD2	1.95	0.66

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:91:LEU:O	1:A:93:ASP:N	2.30	0.65
1:A:294:THR:HG22	1:A:297:HIS:ND1	2.15	0.62
1:A:281:ILE:HD12	1:A:281:ILE:H	1.67	0.59
1:A:400:SER:OG	1:A:401:SER:N	2.35	0.58
1:A:48:THR:OG1	1:A:49:SER:N	2.35	0.56
1:A:107:ASN:HB3	1:A:109:GLN:H	1.71	0.56
1:A:200:GLY:HA2	1:A:248:ASN:HB2	1.86	0.55
1:A:53:PRO:HD3	1:A:309:ASN:HB2	1.88	0.55
1:A:329:LEU:HD11	1:A:373:LEU:HD22	1.88	0.55
1:A:390:LEU:HD13	1:A:422:VAL:HG21	1.89	0.55
1:A:264:ARG:NH1	1:A:268:GLU:OE2	2.40	0.54
1:A:69:HIS:O	1:A:72:TYR:HB2	2.09	0.52
1:A:185:ASP:OD1	1:A:187:LYS:HG3	2.10	0.52
1:A:204:TYR:HA	1:A:207:SER:OG	2.11	0.51
1:A:104:SER:HB3	1:A:107:ASN:HB2	1.92	0.51
1:A:234:SER:HB2	1:A:236:ASP:HB2	1.93	0.50
1:A:91:LEU:O	1:A:93:ASP:CA	2.58	0.48
1:A:287:ILE:HG13	1:A:288:THR:H	1.79	0.47
1:A:175:GLN:O	1:A:175:GLN:HG3	2.14	0.47
1:A:221:ASP:OD1	1:A:244:ARG:NH1	2.48	0.47
1:A:197:ASP:O	1:A:246:ALA:HA	2.14	0.47
1:A:394:VAL:O	1:A:398:MET:HG2	2.13	0.47
1:A:288:THR:OG1	1:A:289:SER:N	2.48	0.47
1:A:223:ILE:HD12	1:A:223:ILE:HA	1.70	0.47
1:A:185:ASP:HA	1:A:186:PRO:HD3	1.59	0.46
1:A:182:ILE:HG21	1:A:191:LEU:HD23	1.98	0.46
1:A:247:TYR:HA	1:A:282:PRO:HD3	1.98	0.45
1:A:382:ILE:O	1:A:426:VAL:HA	2.16	0.45
1:A:166:MET:HE3	1:A:166:MET:HB2	1.84	0.43
1:A:92:GLU:O	1:A:93:ASP:C	2.60	0.43
1:A:294:THR:HG23	1:A:296:GLN:H	1.84	0.43
1:A:87:ASP:OD1	1:A:102:PHE:HB3	2.19	0.43
1:A:204:TYR:O	1:A:207:SER:HB2	2.18	0.42
1:A:69:HIS:HB2	1:A:116:PRO:HG2	2.00	0.42
1:A:222:GLU:O	1:A:226:GLN:HG3	2.19	0.42
1:A:398:MET:HE1	1:A:407:GLN:HG3	2.00	0.42
1:A:107:ASN:CB	1:A:109:GLN:H	2.32	0.42
1:A:247:TYR:HE2	1:A:261:TYR:HB3	1.84	0.42
1:A:423:LEU:HD23	1:A:423:LEU:HA	1.82	0.42
1:A:88:VAL:HG13	1:A:105:LYS:HG3	2.02	0.42
1:A:333:ILE:HD13	1:A:374:ASN:HB3	2.02	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:55:THR:O	1:A:56:SER:OG	2.33	0.41
1:A:323:LYS:HB3	1:A:323:LYS:HE2	1.91	0.41
1:A:373:LEU:HA	1:A:373:LEU:HD23	1.81	0.41
1:A:378:GLY:C	1:A:380:ASN:H	2.28	0.41
1:A:165:GLU:OE1	1:A:244:ARG:NH2	2.54	0.41
1:A:368:LEU:HD23	1:A:393:GLU:HG3	2.02	0.41
1:A:430:ASP:OD1	1:A:430:ASP:N	2.52	0.41
1:A:106:LYS:HG3	1:A:107:ASN:OD1	2.20	0.41
1:A:129:LYS:HB2	1:A:129:LYS:HE3	1.81	0.40
1:A:362:LYS:O	1:A:366:VAL:HG23	2.21	0.40
1:A:114:PHE:CE2	1:A:142:ARG:HD2	2.57	0.40
1:A:155:GLN:HA	1:A:156:PRO:HD3	1.92	0.40
1:A:431:THR:C	1:A:432:ILE:HG12	2.46	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	364/485 (75%)	349 (96%)	15 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	331/433 (76%)	293 (88%)	38 (12%)	5 18

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

Mol	Chain	Res	Type
1	A	50	ILE
1	A	59	VAL
1	A	65	SER
1	A	84	LEU
1	A	90	VAL
1	A	93	ASP
1	A	94	LYS
1	A	139	LEU
1	A	140	ASP
1	A	155	GLN
1	A	161	LEU
1	A	164	VAL
1	A	175	GLN
1	A	185	ASP
1	A	199	ILE
1	A	203	THR
1	A	223	ILE
1	A	227	SER
1	A	232	ILE
1	A	233	LYS
1	A	234	SER
1	A	238	THR
1	A	243	THR
1	A	247	TYR
1	A	257	ASN
1	A	275	GLN
1	A	278	GLU
1	A	279	VAL
1	A	287	ILE
1	A	289	SER
1	A	295	SER
1	A	342	LEU
1	A	364	THR
1	A	375	ASP
1	A	377	LYS
1	A	380	ASN
1	A	394	VAL
1	A	432	ILE

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	103	GLN
1	A	155	GLN
1	A	175	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 2 are monoatomic - leaving 3 for Mogul analysis.

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	GOL	A	605	-	5,5,5	0.40	0	5,5,5	0.18	0
3	GOL	A	603	2	5,5,5	0.42	0	5,5,5	0.34	0
3	GOL	A	604	-	5,5,5	0.34	0	5,5,5	0.26	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
3	GOL	A	605	-	-	2/4/4/4	-
3	GOL	A	603	2	-	2/4/4/4	-
3	GOL	A	604	-	-	2/4/4/4	-

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
3	A	603	GOL	O1-C1-C2-C3
3	A	604	GOL	O1-C1-C2-C3
3	A	605	GOL	O1-C1-C2-C3
3	A	603	GOL	O1-C1-C2-O2
3	A	604	GOL	O1-C1-C2-O2
3	A	605	GOL	O1-C1-C2-O2

There are no ring outliers.

No monomer is involved in short contacts.

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, 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	370/485 (76%)	0.16	24 (6%) 25 18	60, 110, 188, 243	0

All (24) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	94	LYS	5.7
1	A	234	SER	4.8
1	A	432	ILE	4.7
1	A	356	GLY	4.0
1	A	235	THR	3.9
1	A	431	THR	3.8
1	A	171	THR	3.4
1	A	277	THR	3.3
1	A	347	SER	3.1
1	A	91	LEU	3.1
1	A	55	THR	3.0
1	A	48	THR	2.6
1	A	287	ILE	2.6
1	A	87	ASP	2.6
1	A	256	GLY	2.6
1	A	248	ASN	2.5
1	A	92	GLU	2.5
1	A	346	GLN	2.4
1	A	258	CYS	2.3
1	A	175	GLN	2.3
1	A	345	GLN	2.2
1	A	95	PRO	2.0
1	A	274	ALA	2.0
1	A	379	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 oligosaccharides 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($\text{\AA}^2$)	Q<0.9
2	BA	A	602	1/1	0.52	0.12	474,474,474,474	0
3	GOL	A	605	6/6	0.66	0.21	155,168,172,175	0
3	GOL	A	604	6/6	0.77	0.14	131,148,156,156	0
3	GOL	A	603	6/6	0.86	0.16	103,115,131,131	0
2	BA	A	601	1/1	0.99	0.03	128,128,128,128	0

6.5 Other polymers [i](#)

There are no such residues in this entry.