



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 12, 2017 – 09:00 pm GMT

PDB ID : 2I0M  
Title : Crystal structure of the phosphate transport system regulatory protein PhoU from *Streptococcus pneumoniae*  
Authors : Zhang, R.; Li, H.; Abdullah, J.; Joachimiak, A.; Midwest Center for Structural Genomics (MCSG)  
Deposited on : 2006-08-10  
Resolution : 2.40 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

---

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

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.9-1692
EDS	:	trunk28620
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	recalc28949

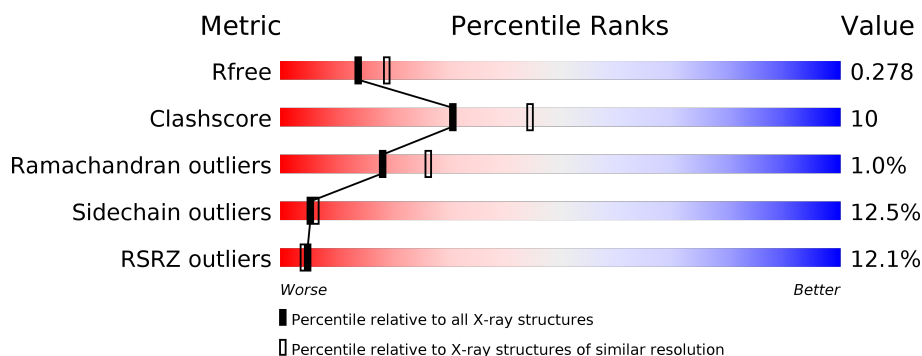
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.40 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))
$R_{free}$	100719	3166 (2.40-2.40)
Clashscore	112137	3674 (2.40-2.40)
Ramachandran outliers	110173	3616 (2.40-2.40)
Sidechain outliers	110143	3617 (2.40-2.40)
RSRZ outliers	101464	3195 (2.40-2.40)

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  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	216	<div> <div>12%</div> <div>65%</div> <div>26%</div> <div>5%</div> <div>.</div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 1645 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 Phosphate transport system protein phoU.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	207	Total	C	N	O	S	0	0	0
			1618	1028	266	314	10			

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	3	Total	Zn	0	0
			3	3		

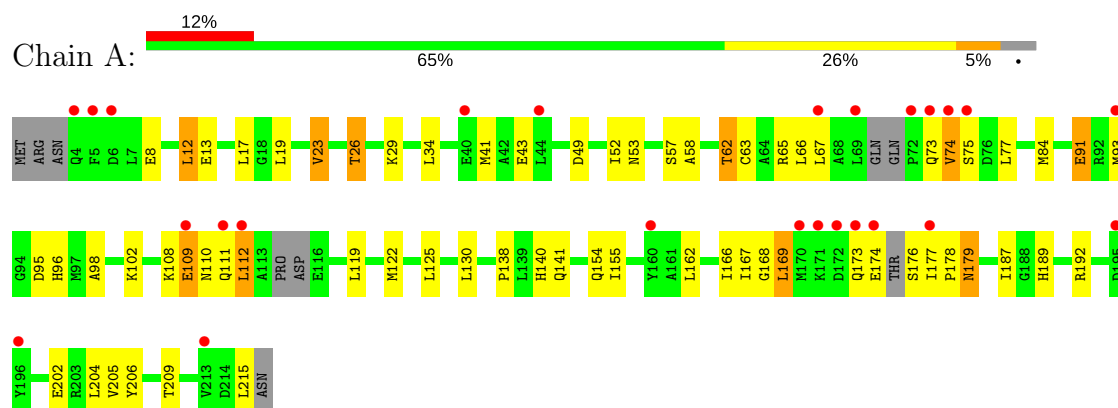
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	24	Total	O	0	0
			24	24		

### 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: Phosphate transport system protein phoU



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	72.55Å 88.97Å 75.79Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	32.72 – 2.40 32.72 – 2.31	Depositor EDS
% Data completeness (in resolution range)	98.7 (32.72-2.40) 98.1 (32.72-2.31)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.29 (at 2.31Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.235 , 0.286 0.233 , 0.278	Depositor DCC
$R_{free}$ test set	465 reflections (5.00%)	DCC
Wilson B-factor (Å <sup>2</sup> )	39.7	Xtriage
Anisotropy	0.443	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 72.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	1645	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.64% 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: ZN

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	0.54	0/1635	0.68	0/2198

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	1618	0	1641	34	3
2	A	3	0	0	0	0
3	A	24	0	0	3	3
All	All	1645	0	1641	34	3

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 (34) 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:96:HIS:HD2	1:A:189:HIS:ND1	1.80	0.78

*Continued on next page...*

*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:108:LYS:H	1:A:179:ASN:HD21	1.32	0.77
1:A:8:GLU:HG2	1:A:66:LEU:HD21	1.72	0.70
1:A:29:LYS:HG2	1:A:41:MET:HE2	1.73	0.69
1:A:140:HIS:HB3	3:A:222:HOH:O	1.98	0.63
1:A:29:LYS:HG2	1:A:41:MET:CE	2.30	0.61
1:A:177:ILE:N	1:A:178:PRO:HD2	2.18	0.58
1:A:111:GLN:HB2	1:A:112:LEU:HB3	1.86	0.57
1:A:202:GLU:HA	1:A:205:VAL:HG12	1.86	0.57
1:A:162:LEU:O	1:A:166:ILE:HG13	2.06	0.56
1:A:13:GLU:OE2	1:A:140:HIS:HE1	1.90	0.54
1:A:122:MET:CE	1:A:187:ILE:HG22	2.38	0.54
1:A:96:HIS:CD2	1:A:189:HIS:ND1	2.69	0.54
1:A:58:ALA:O	1:A:62:THR:HG23	2.09	0.53
1:A:122:MET:HE1	1:A:187:ILE:HG22	1.90	0.53
1:A:62:THR:HA	1:A:65:ARG:HG2	1.91	0.53
1:A:29:LYS:HE3	3:A:229:HOH:O	2.09	0.52
1:A:74:VAL:HG23	1:A:75:SER:H	1.75	0.51
1:A:63:CYS:HB3	1:A:84:MET:CE	2.41	0.51
1:A:12:LEU:HD11	1:A:63:CYS:SG	2.51	0.50
1:A:205:VAL:O	1:A:209:THR:HB	2.11	0.49
1:A:17:LEU:HD11	1:A:138:PRO:HG3	1.95	0.48
1:A:192:ARG:NH2	3:A:235:HOH:O	2.47	0.47
1:A:23:VAL:HA	1:A:26:THR:HG23	1.98	0.45
1:A:202:GLU:OE1	1:A:215:LEU:N	2.43	0.44
1:A:109:GLU:HA	1:A:110:ASN:C	2.38	0.44
1:A:98:ALA:O	1:A:102:LYS:HG3	2.18	0.43
1:A:174:GLU:O	1:A:176:SER:HB2	2.19	0.43
1:A:167:ILE:HG13	1:A:168:GLY:N	2.33	0.43
1:A:52:ILE:HG22	1:A:91:GLU:HB2	2.01	0.43
1:A:63:CYS:HB3	1:A:84:MET:HE2	2.01	0.42
1:A:66:LEU:HA	1:A:66:LEU:HD23	1.86	0.41
1:A:93:MET:HE1	1:A:130:LEU:HD13	2.03	0.41
1:A:125:LEU:HD23	1:A:155:ILE:HG13	2.03	0.41

All (3) 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:95:ASP:OD1	3:A:233:HOH:O[4_566]	1.99	0.21
1:A:53:ASN:ND2	3:A:233:HOH:O[4_566]	2.05	0.15
1:A:49:ASP:OD2	3:A:233:HOH:O[4_566]	2.18	0.02

## 5.3 Torsion angles

### 5.3.1 Protein backbone

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	199/216 (92%)	195 (98%)	2 (1%)	2 (1%)	18	26

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	74	VAL
1	A	169	LEU

### 5.3.2 Protein sidechains

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	176/185 (95%)	154 (88%)	22 (12%)	5	6

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	12	LEU
1	A	19	LEU
1	A	23	VAL
1	A	26	THR
1	A	34	LEU
1	A	43	GLU
1	A	57	SER
1	A	62	THR
1	A	67	LEU

*Continued on next page...*



*Continued from previous page...*

Mol	Chain	Res	Type
1	A	73	GLN
1	A	77	LEU
1	A	91	GLU
1	A	109	GLU
1	A	112	LEU
1	A	119	LEU
1	A	141	GLN
1	A	154	GLN
1	A	169	LEU
1	A	173	GLN
1	A	179	ASN
1	A	204	LEU
1	A	206	TYR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	53	ASN
1	A	73	GLN
1	A	96	HIS
1	A	140	HIS
1	A	157	GLN
1	A	179	ASN
1	A	199	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 carbohydrates in this entry.

## 5.6 Ligand geometry

Of 3 ligands modelled in this entry, 3 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 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 ⓘ

### 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<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	207/216 (95%)	0.73	25 (12%) 5 4	34, 44, 60, 65	0

All (25) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	72	PRO	7.0
1	A	173	GLN	5.9
1	A	170	MET	5.4
1	A	69	LEU	5.3
1	A	111	GLN	4.6
1	A	177	ILE	4.5
1	A	174	GLU	3.8
1	A	74	VAL	3.5
1	A	172	ASP	3.4
1	A	213	VAL	3.2
1	A	5	PHE	3.2
1	A	67	LEU	3.1
1	A	112	LEU	3.0
1	A	73	GLN	3.0
1	A	4	GLN	2.8
1	A	93	MET	2.6
1	A	44	LEU	2.6
1	A	160	TYR	2.6
1	A	196	TYR	2.5
1	A	109	GLU	2.4
1	A	6	ASP	2.3
1	A	75	SER	2.3
1	A	195	ASP	2.1
1	A	40	GLU	2.1
1	A	171	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 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
2	ZN	A	219	1/1	0.98	0.03	-3.83	46,46,46,46	0
2	ZN	A	217	1/1	0.98	0.04	-	57,57,57,57	0
2	ZN	A	218	1/1	0.89	0.07	-	52,52,52,52	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.