



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 26, 2026 – 03:56 AM EDT

PDB ID : 8ZLD / pdb_00008zld
Title : Crystal structure of PfHO from Plasmodium falciparum at 2.78 Å
Authors : Caaveiro, J.M.M.; Senoo, A.
Deposited on : 2024-05-18
Resolution : 2.78 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

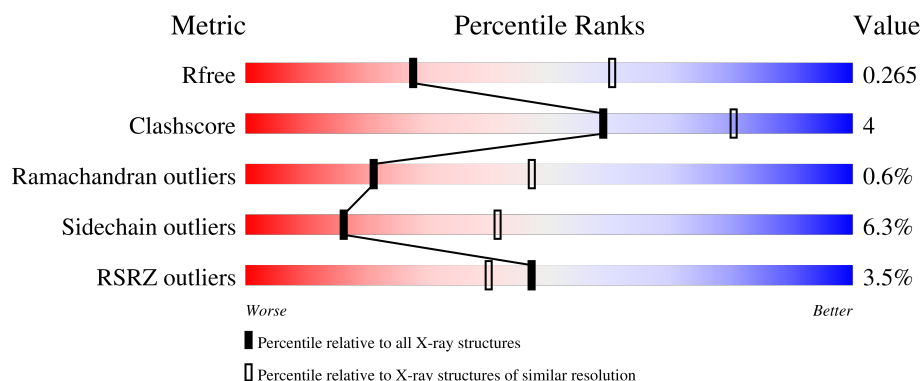
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.78 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	5248 (2.80-2.76)
Clashscore	190562	5693 (2.80-2.76)
Ramachandran outliers	187476	5590 (2.80-2.76)
Sidechain outliers	187428	5592 (2.80-2.76)
RSRZ outliers	180081	5251 (2.80-2.76)

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	232	
1	B	232	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3108 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.

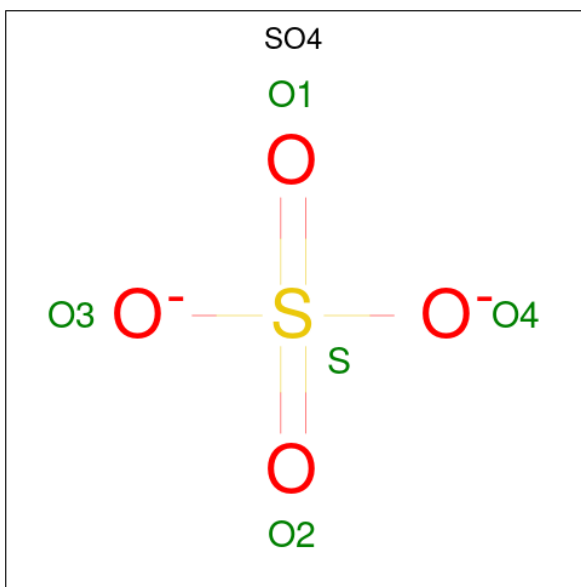
- Molecule 1 is a protein called Heme oxygenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	183	Total	C	N	O	S	0	0	0
			1536	1000	244	282	10			
1	B	184	Total	C	N	O	S	0	1	0
			1547	1005	249	283	10			

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	82	MET	-	initiating methionine	UNP Q8IJS6
A	83	ALA	-	expression tag	UNP Q8IJS6
A	306	LEU	-	expression tag	UNP Q8IJS6
A	307	GLU	-	expression tag	UNP Q8IJS6
A	308	HIS	-	expression tag	UNP Q8IJS6
A	309	HIS	-	expression tag	UNP Q8IJS6
A	310	HIS	-	expression tag	UNP Q8IJS6
A	311	HIS	-	expression tag	UNP Q8IJS6
A	312	HIS	-	expression tag	UNP Q8IJS6
A	313	HIS	-	expression tag	UNP Q8IJS6
B	82	MET	-	initiating methionine	UNP Q8IJS6
B	83	ALA	-	expression tag	UNP Q8IJS6
B	306	LEU	-	expression tag	UNP Q8IJS6
B	307	GLU	-	expression tag	UNP Q8IJS6
B	308	HIS	-	expression tag	UNP Q8IJS6
B	309	HIS	-	expression tag	UNP Q8IJS6
B	310	HIS	-	expression tag	UNP Q8IJS6
B	311	HIS	-	expression tag	UNP Q8IJS6
B	312	HIS	-	expression tag	UNP Q8IJS6
B	313	HIS	-	expression tag	UNP Q8IJS6

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).

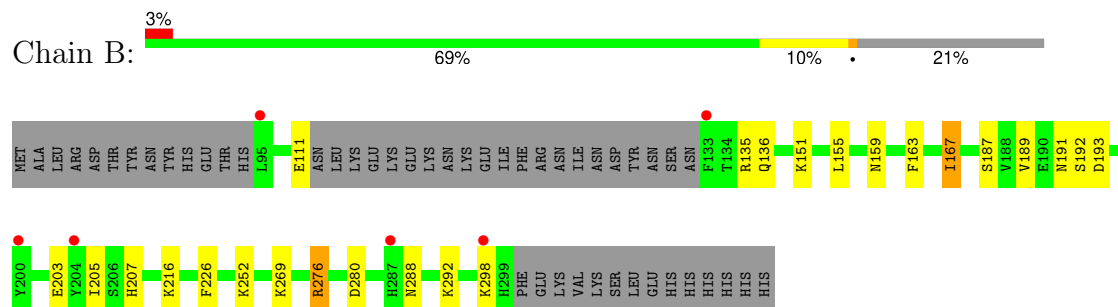


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	10	Total	O	0	0
			10	10		
3	B	5	Total	O	0	0
			5	5		

- Molecule 1: Heme oxygenase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	54.91Å 55.37Å 162.40Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	45.79 – 2.78 45.79 – 2.78	Depositor EDS
% Data completeness (in resolution range)	99.6 (45.79-2.78) 99.6 (45.79-2.78)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.74 (at 2.77Å)	Xtriage
Refinement program	REFMAC 5.8.0238	Depositor
R, R_{free}	0.203 , 0.264 0.208 , 0.265	Depositor DCC
R_{free} test set	573 reflections (4.39%)	wwPDB-VP
Wilson B-factor (Å ²)	62.0	Xtriage
Anisotropy	0.359	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 61.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.43$, $\langle L^2 \rangle = 0.26$	Xtriage
Estimated twinning fraction	0.086 for k,h,-l	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	3108	wwPDB-VP
Average B, all atoms (Å ²)	69.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.04% 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: SO4

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	0.98	0/1571	1.50	8/2119 (0.4%)
1	B	1.05	0/1587	1.52	5/2141 (0.2%)
All	All	1.01	0/3158	1.51	13/4260 (0.3%)

There are no bond length outliers.

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	153	ASP	CA-CB-CG	5.34	117.94	112.60
1	B	191	ASN	CA-C-N	5.33	127.38	120.44
1	B	191	ASN	C-N-CA	5.33	127.38	120.44
1	B	136	GLN	CA-C-N	5.18	127.17	120.44
1	B	136	GLN	C-N-CA	5.18	127.17	120.44
1	A	198	SER	CA-C-N	5.16	128.56	120.82
1	A	198	SER	C-N-CA	5.16	128.56	120.82
1	B	203	GLU	N-CA-C	-5.11	105.61	111.07
1	A	276	ARG	CA-C-N	5.08	127.05	120.44
1	A	276	ARG	C-N-CA	5.08	127.05	120.44
1	A	263	PHE	N-CA-C	-5.04	105.70	111.14
1	A	106	ALA	CA-C-N	5.02	127.25	120.38
1	A	106	ALA	C-N-CA	5.02	127.25	120.38

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	1536	0	1523	20	0
1	B	1547	0	1519	7	0
2	A	5	0	0	0	0
2	B	5	0	0	0	0
3	A	10	0	0	0	0
3	B	5	0	0	0	0
All	All	3108	0	3042	27	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 4.

All (27) 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:133:PHE:HA	1:A:137:THR:HG21	1.70	0.72
1:A:288:ASN:O	1:A:292:LYS:HG3	1.94	0.67
1:B:276:ARG:NH2	1:B:280:ASP:OD1	2.27	0.66
1:A:109:GLU:O	1:A:110:ASN:ND2	2.38	0.56
1:A:109:GLU:C	1:A:110:ASN:ND2	2.64	0.56
1:A:151:LYS:HD3	1:A:205:ILE:HG23	1.89	0.55
1:A:167:ILE:O	1:A:170:GLY:N	2.38	0.52
1:A:200:TYR:CD2	1:A:200:TYR:C	2.89	0.51
1:A:155:LEU:O	1:A:159:ASN:ND2	2.40	0.51
1:A:221:ALA:O	1:A:225:VAL:HG23	2.11	0.50
1:B:155:LEU:O	1:B:159:ASN:ND2	2.40	0.49
1:A:189:VAL:O	1:A:192:SER:OG	2.29	0.49
1:A:147:ASN:HB3	1:A:205:ILE:HD11	1.93	0.49
1:B:135:ARG:HB3	1:B:189:VAL:HG22	1.95	0.48
1:A:226:PHE:CE1	1:A:293:MET:HE1	2.48	0.48
1:A:200:TYR:CE2	1:A:296:LEU:HG	2.50	0.46
1:A:196:SER:HB2	1:A:197:PRO:CD	2.45	0.46
1:A:102:LEU:HB2	1:A:103:PRO:HD3	1.98	0.45
1:A:135:ARG:HB3	1:A:189:VAL:HG22	1.99	0.44
1:A:143:MET:HE2	1:A:143:MET:HB3	1.81	0.44
1:B:151:LYS:HG2	1:B:205:ILE:HG23	1.99	0.43
1:B:163:PHE:O	1:B:167:ILE:HG12	2.19	0.43
1:A:108:ILE:HG22	1:A:108:ILE:O	2.19	0.42
1:B:288:ASN:HB3	1:B:292:LYS:HE3	2.01	0.42
1:B:207:HIS:NE2	1:B:292:LYS:NZ	2.62	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:211:LEU:HD23	1:A:211:LEU:HA	1.91	0.40
1:A:196:SER:HB2	1:A:197:PRO:HD2	2.03	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	179/232 (77%)	168 (94%)	9 (5%)	2 (1%)	11	32
1	B	181/232 (78%)	174 (96%)	7 (4%)	0	100	100
All	All	360/464 (78%)	342 (95%)	16 (4%)	2 (1%)	21	47

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	108	ILE
1	A	248	ILE

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	176/224 (79%)	165 (94%)	11 (6%)	16	41
1	B	176/224 (79%)	165 (94%)	11 (6%)	16	41

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	352/448 (79%)	330 (94%)	22 (6%)	16	41

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

Mol	Chain	Res	Type
1	A	95	LEU
1	A	110	ASN
1	A	137	THR
1	A	140	GLN
1	A	143	MET
1	A	159	ASN
1	A	173	GLN
1	A	187	SER
1	A	191	ASN
1	A	192	SER
1	A	226	PHE
1	B	111	GLU
1	B	167	ILE
1	B	187	SER
1	B	192	SER
1	B	193	ASP
1	B	216	LYS
1	B	226	PHE
1	B	252	LYS
1	B	269	LYS
1	B	276	ARG
1	B	298	LYS

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

Mol	Chain	Res	Type
1	A	140	GLN
1	A	169	ASN
1	A	281	ASN
1	B	140	GLN
1	B	169	ASN
1	B	176	ASN
1	B	281	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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

2 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	SO4	B	401	-	4,4,4	0.32	0	6,6,6	0.29	0
2	SO4	A	401	-	4,4,4	0.32	0	6,6,6	0.15	0

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 [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	183/232 (78%)	0.08	7 (3%)	44 37	51, 70, 113, 120	0
1	B	184/232 (79%)	-0.07	6 (3%)	49 42	33, 59, 99, 121	1 (0%)
All	All	367/464 (79%)	0.00	13 (3%)	47 40	33, 65, 110, 121	1 (0%)

All (13) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	204	TYR	3.1
1	A	291	ASN	3.1
1	B	133	PHE	2.8
1	A	204	TYR	2.8
1	B	200	TYR	2.7
1	B	287[A]	HIS	2.7
1	A	298	LYS	2.6
1	B	95	LEU	2.5
1	A	168	TYR	2.5
1	A	269	LYS	2.4
1	B	298	LYS	2.2
1	A	200	TYR	2.2
1	A	171	PRO	2.1

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	SO4	A	401	5/5	0.98	0.06	47,58,59,60	0
2	SO4	B	401	5/5	0.98	0.05	40,45,49,50	0

6.5 Other polymers [i](#)

There are no such residues in this entry.