



# Full wwPDB X-ray Structure Validation Report ⓘ

May 25, 2020 – 10:07 pm BST

PDB ID : 4MGF  
Title : Crystal structure of apo-PhuS, a heme-binding protein from *Pseudomonas aeruginosa*  
Authors : Lee, M.J.Y.; Jia, Z.; Montreal-Kingston Bacterial Structural Genomics Initiative (BSGI)  
Deposited on : 2013-08-28  
Resolution : 2.00 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

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

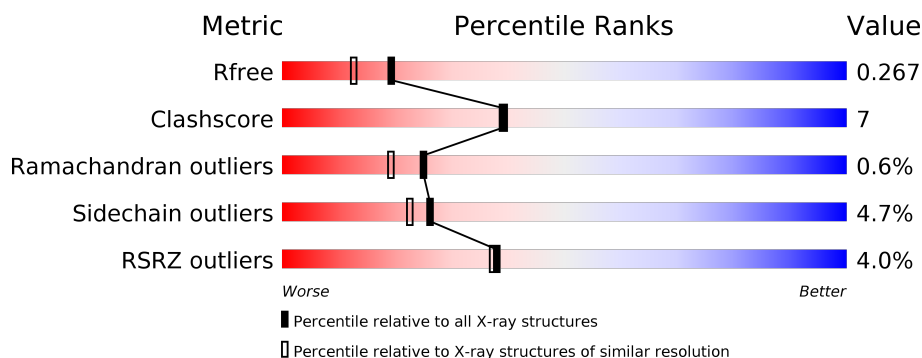
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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))
$R_{free}$	130704	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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 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	360	
1	B	360	

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5847 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 Hemin degrading factor.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	342	Total	C	N	O	S	0	0	0
			2676	1696	486	488	6			
1	B	341	Total	C	N	O	S	0	0	0
			2669	1691	488	484	6			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-5	HIS	-	EXPRESSION TAG	UNP O68880
A	-4	HIS	-	EXPRESSION TAG	UNP O68880
A	-3	HIS	-	EXPRESSION TAG	UNP O68880
A	-2	HIS	-	EXPRESSION TAG	UNP O68880
A	-1	HIS	-	EXPRESSION TAG	UNP O68880
A	0	HIS	-	EXPRESSION TAG	UNP O68880
B	-5	HIS	-	EXPRESSION TAG	UNP O68880
B	-4	HIS	-	EXPRESSION TAG	UNP O68880
B	-3	HIS	-	EXPRESSION TAG	UNP O68880
B	-2	HIS	-	EXPRESSION TAG	UNP O68880
B	-1	HIS	-	EXPRESSION TAG	UNP O68880
B	0	HIS	-	EXPRESSION TAG	UNP O68880

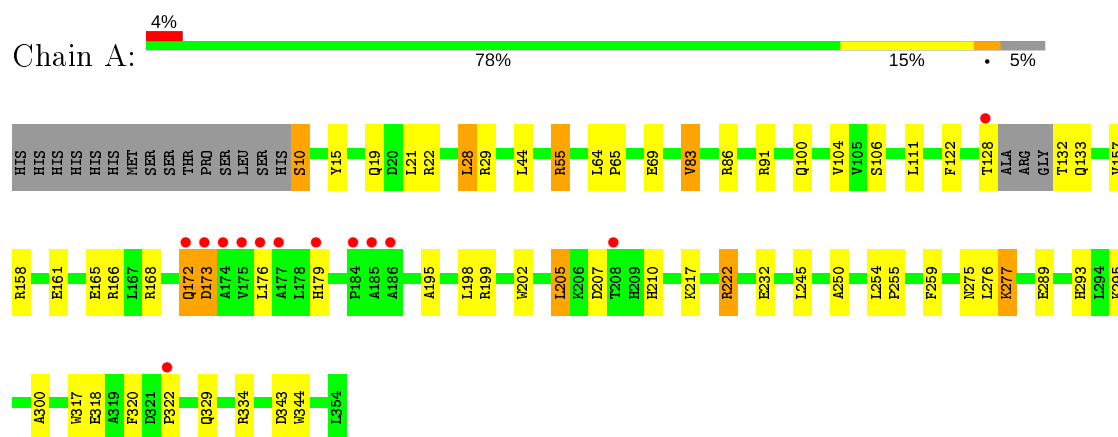
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	249	Total	O	0	0
			249	249		
2	B	253	Total	O	0	0
			253	253		

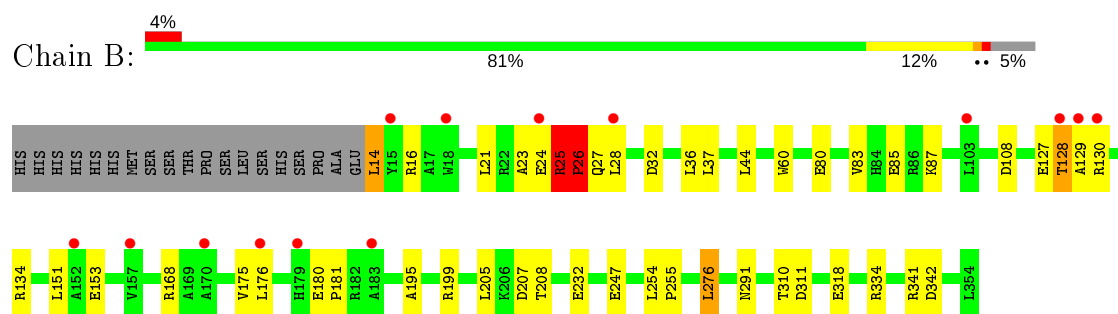
### 3 Residue-property plots [i](#)

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: Hemin degrading factor



- Molecule 1: Hemin degrading factor



## 4 Data and refinement statistics

Property	Value	Source
Space group	I 4	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	186.50 Å   186.50 Å   41.90 Å 90.00°   90.00°   90.00°	Depositor
Resolution (Å)	41.70 – 2.00 41.70 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.0 (41.70-2.00) 99.0 (41.70-2.00)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.78 (at 2.00 Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.1_1168)	Depositor
R, $R_{free}$	0.208 , 0.266 0.210 , 0.267	Depositor DCC
$R_{free}$ test set	2445 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	27.7	Xtriage
Anisotropy	0.626	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 45.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.017 for -k,-h,-l	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	5847	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 16.49% 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 [i](#)

### 5.1 Standard geometry [i](#)

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	0.39	0/2738	0.57	0/3724
1	B	0.43	0/2731	0.62	2/3714 (0.1%)
All	All	0.41	0/5469	0.60	2/7438 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	B	25	ARG	C-N-CD	6.23	141.48	128.40
1	B	26	PRO	CA-N-CD	-5.55	103.73	111.50

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	2676	0	2639	44	0
1	B	2669	0	2638	35	0
2	A	249	0	0	19	0
2	B	253	0	0	13	0
All	All	5847	0	5277	79	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 7.

All (79) 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:B:26:PRO:HD2	1:B:28:LEU:HB2	1.56	0.86
1:B:207:ASP:OD1	2:B:645:HOH:O	1.92	0.85
1:A:161:GLU:OE1	2:A:634:HOH:O	1.99	0.81
1:A:166:ARG:NH1	2:A:565:HOH:O	2.13	0.81
1:A:21:LEU:HD21	1:A:28:LEU:HD23	1.65	0.79
1:B:199:ARG:NH2	1:B:232:GLU:OE1	2.15	0.79
1:A:168:ARG:HD2	2:A:532:HOH:O	1.85	0.75
1:B:342:ASP:OD1	2:B:626:HOH:O	2.05	0.74
1:A:199:ARG:NH2	1:A:232:GLU:OE2	2.21	0.73
1:B:27:GLN:OE1	2:B:643:HOH:O	2.07	0.72
1:A:10:SER:N	2:A:450:HOH:O	2.27	0.68
1:B:318:GLU:OE2	2:B:445:HOH:O	2.11	0.67
1:B:87:LYS:NZ	2:B:534:HOH:O	2.28	0.66
1:B:232:GLU:OE2	2:B:617:HOH:O	2.14	0.66
1:A:173:ASP:OD1	2:A:542:HOH:O	2.14	0.65
1:A:83:VAL:HG13	1:A:293:HIS:HB2	1.79	0.65
1:B:25:ARG:O	1:B:25:ARG:NE	2.32	0.62
1:A:158:ARG:NE	2:A:639:HOH:O	2.26	0.62
1:A:172:GLN:HG3	2:A:628:HOH:O	1.99	0.61
1:A:55:ARG:NH1	2:A:558:HOH:O	2.32	0.61
1:B:128:THR:O	1:B:130:ARG:N	2.24	0.60
1:A:277:LYS:HG2	2:B:469:HOH:O	2.03	0.59
1:B:181:PRO:O	2:B:509:HOH:O	2.16	0.59
1:A:217:LYS:NZ	2:A:647:HOH:O	2.19	0.59
1:A:195:ALA:O	1:A:199:ARG:HG3	2.03	0.58
1:B:24:GLU:OE2	1:B:37:LEU:HD11	2.03	0.58
1:A:100:GLN:NE2	2:A:619:HOH:O	2.29	0.56
1:B:175:VAL:HG13	1:B:176:LEU:N	2.23	0.54
1:B:23:ALA:HB3	2:B:552:HOH:O	2.07	0.54
1:A:343:ASP:OD2	1:A:344:TRP:N	2.41	0.54
1:B:26:PRO:CD	1:B:28:LEU:HB2	2.35	0.53
1:A:318:GLU:OE2	2:A:574:HOH:O	2.19	0.53
1:A:161:GLU:HB3	2:A:634:HOH:O	2.08	0.53
1:B:14:LEU:HD22	1:B:16:ARG:HB2	1.90	0.53
1:A:254:LEU:HD12	1:A:255:PRO:HD2	1.91	0.52
1:B:180:GLU:HG3	1:B:181:PRO:HD2	1.91	0.51
1:A:86:ARG:HD2	1:A:289:GLU:O	2.10	0.51
1:A:259:PHE:HB2	1:A:329:GLN:HB2	1.93	0.50
1:B:195:ALA:O	1:B:199:ARG:HG3	2.12	0.50
1:B:134:ARG:HB2	1:B:151:LEU:HG	1.93	0.50
1:A:277:LYS:NZ	2:A:485:HOH:O	2.42	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:245:LEU:HD22	1:A:317:TRP:CE3	2.48	0.49
1:B:28:LEU:HD21	1:B:36:LEU:HD12	1.93	0.49
1:B:28:LEU:HG	1:B:32:ASP:HB2	1.94	0.48
1:A:207:ASP:OD2	1:A:210:HIS:NE2	2.45	0.48
1:B:108:ASP:HB2	2:B:468:HOH:O	2.13	0.48
1:A:91:ARG:O	1:A:106:SER:HB3	2.14	0.48
1:B:26:PRO:HD2	1:B:28:LEU:H	1.79	0.47
1:B:60:TRP:NE1	2:B:537:HOH:O	2.03	0.46
1:A:55:ARG:HG3	1:A:122:PHE:CE2	2.50	0.46
1:B:334:ARG:NH2	2:B:648:HOH:O	2.14	0.45
1:A:222:ARG:HG2	1:A:320:PHE:HE2	1.80	0.45
1:B:255:PRO:HG2	1:B:341:ARG:HH12	1.81	0.45
1:B:254:LEU:HD12	1:B:255:PRO:HD2	1.99	0.45
1:B:80:GLU:OE1	2:B:624:HOH:O	2.21	0.44
1:A:173:ASP:CG	2:A:542:HOH:O	2.53	0.44
1:A:15:TYR:O	1:A:19:GLN:HG2	2.18	0.44
1:A:202:TRP:HA	1:A:205:LEU:HD22	1.98	0.44
1:A:334:ARG:NH2	2:A:516:HOH:O	2.50	0.44
1:A:275:ASN:ND2	2:A:464:HOH:O	2.38	0.44
1:A:199:ARG:HD3	2:A:590:HOH:O	2.17	0.43
1:B:85:GLU:HB2	1:B:291:ASN:HB2	2.00	0.43
1:A:250:ALA:HB2	1:A:276:LEU:HD21	2.00	0.43
1:A:165:GLU:HA	1:A:168:ARG:HG3	2.01	0.43
1:A:254:LEU:HD21	1:A:344:TRP:HA	2.00	0.43
1:A:28:LEU:HA	1:A:28:LEU:HD12	1.72	0.42
1:A:133:GLN:HA	2:A:602:HOH:O	2.19	0.42
1:A:222:ARG:HG2	1:A:320:PHE:CE2	2.53	0.42
1:A:64:LEU:HB2	1:A:65:PRO:HD3	2.01	0.42
1:A:104:VAL:HB	1:A:111:LEU:HB2	2.02	0.42
1:B:247:GLU:HA	1:B:276:LEU:HD23	2.01	0.42
1:A:276:LEU:C	1:A:277:LYS:HD2	2.40	0.42
1:A:300:ALA:HB2	1:A:322:PRO:HG3	2.01	0.42
1:B:127:GLU:O	1:B:128:THR:C	2.56	0.41
1:A:22:ARG:NH1	2:A:635:HOH:O	2.51	0.41
1:B:310:THR:HG23	1:B:311:ASP:OD1	2.20	0.41
1:B:153:GLU:CD	1:B:153:GLU:H	2.24	0.40
1:B:25:ARG:O	1:B:25:ARG:CD	2.69	0.40
1:B:21:LEU:HB2	1:B:44:LEU:HD11	2.03	0.40

There are no symmetry-related clashes.



## 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	338/360 (94%)	324 (96%)	12 (4%)	2 (1%)	25	19
1	B	339/360 (94%)	317 (94%)	20 (6%)	2 (1%)	25	19
All	All	677/720 (94%)	641 (95%)	32 (5%)	4 (1%)	25	19

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	129	ALA
1	A	173	ASP
1	B	26	PRO
1	A	176	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	269/285 (94%)	252 (94%)	17 (6%)	18	13
1	B	267/285 (94%)	259 (97%)	8 (3%)	41	41
All	All	536/570 (94%)	511 (95%)	25 (5%)	26	22

All (25) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	10	SER
1	A	28	LEU

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Mol	Chain	Res	Type
1	A	29	ARG
1	A	44	LEU
1	A	55	ARG
1	A	69	GLU
1	A	83	VAL
1	A	128	THR
1	A	132	THR
1	A	157	VAL
1	A	172	GLN
1	A	179	HIS
1	A	198	LEU
1	A	205	LEU
1	A	222	ARG
1	A	277	LYS
1	A	295	LYS
1	B	14	LEU
1	B	25	ARG
1	B	83	VAL
1	B	128	THR
1	B	168	ARG
1	B	205	LEU
1	B	208	THR
1	B	276	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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

There are no ligands in this entry.

## 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	342/360 (95%)	0.11	13 (3%) 40 39	8, 22, 44, 69	0
1	B	341/360 (94%)	0.28	14 (4%) 37 36	8, 22, 45, 67	0
All	All	683/720 (94%)	0.19	27 (3%) 38 37	8, 22, 44, 69	0

All (27) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	15	TYR	6.6
1	B	128	THR	6.6
1	A	175	VAL	5.4
1	B	130	ARG	5.2
1	B	129	ALA	5.1
1	A	174	ALA	4.1
1	B	18	TRP	3.5
1	A	186	ALA	3.1
1	B	157	VAL	3.0
1	B	179	HIS	2.9
1	A	208	THR	2.9
1	A	176	LEU	2.8
1	A	128	THR	2.8
1	B	183	ALA	2.7
1	A	322	PRO	2.7
1	B	103	LEU	2.7
1	A	177	ALA	2.5
1	A	184	PRO	2.5
1	B	24	GLU	2.4
1	B	176	LEU	2.3
1	B	28	LEU	2.3
1	A	185	ALA	2.3
1	B	152	ALA	2.3
1	A	173	ASP	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	172	GLN	2.1
1	B	170	ALA	2.1
1	A	179	HIS	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](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.