



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 03:23 PM UTC

PDB ID : 4IRF / pdb_00004irf
Title : Preliminary structural investigations of a malarial protein secretion system
Authors : Egea, P.F.
Deposited on : 2013-01-14
Resolution : 1.65 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
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

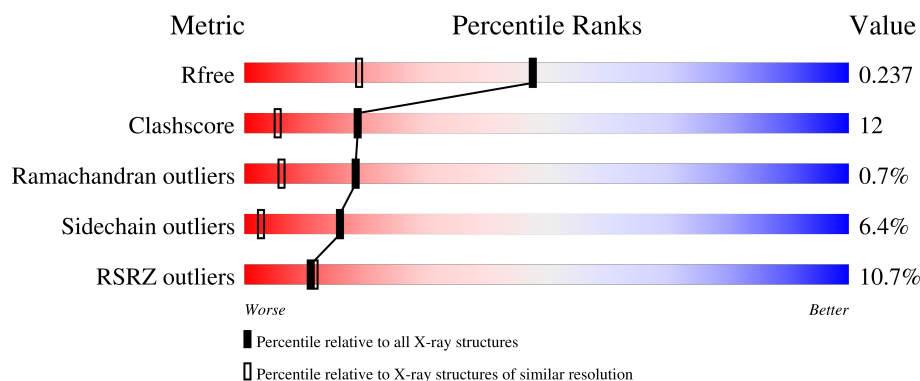
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.65 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	2563 (1.66-1.66)
Clashscore	190562	2662 (1.66-1.66)
Ramachandran outliers	187476	2621 (1.66-1.66)
Sidechain outliers	187428	2621 (1.66-1.66)
RSRZ outliers	180081	2564 (1.66-1.66)

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	156	10% 72% 15% 5% 7%
1	B	156	10% 75% 14% • 8%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2470 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 MALARIAL CLPB2 ATPASE/HSP101 PROTEIN.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
1	A	145	Total	C	N	O	0	3	0
			1131	719	195	217			
1	B	144	Total	C	N	O	0	1	0
			1116	704	192	220			

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	expression tag	UNP Q8IIJ8
A	153	LEU	-	expression tag	UNP Q8IIJ8
A	154	VAL	-	expression tag	UNP Q8IIJ8
A	155	PRO	-	expression tag	UNP Q8IIJ8
A	156	ARG	-	expression tag	UNP Q8IIJ8
B	1	MET	-	expression tag	UNP Q8IIJ8
B	153	LEU	-	expression tag	UNP Q8IIJ8
B	154	VAL	-	expression tag	UNP Q8IIJ8
B	155	PRO	-	expression tag	UNP Q8IIJ8
B	156	ARG	-	expression tag	UNP Q8IIJ8

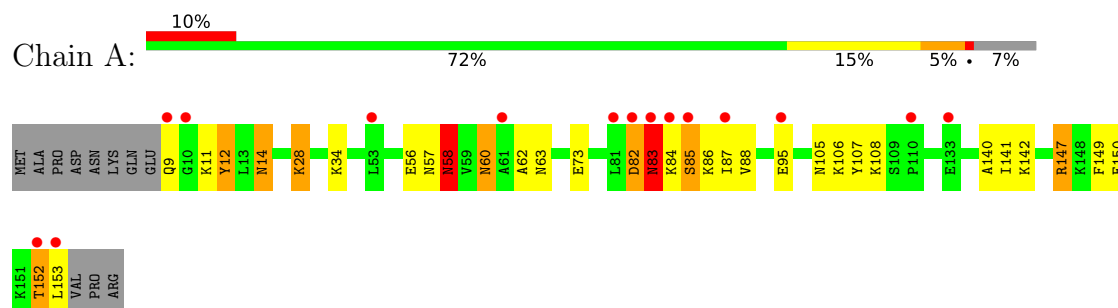
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	112	Total	O	0	0
			112	112		
2	B	111	Total	O	0	0
			111	111		

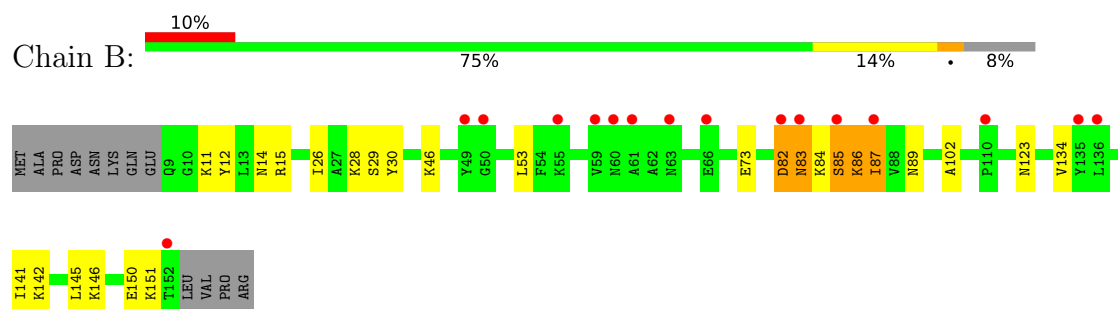
3 Residue-property plots [i](#)

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: MALARIAL CLPB2 ATPASE/HSP101 PROTEIN



• Molecule 1: MALARIAL CLPB2 ATPASE/HSP101 PROTEIN



4 Data and refinement statistics

Property	Value	Source
Space group	P 2 21 21	Depositor
Cell constants a, b, c, α , β , γ	31.78Å 92.08Å 96.98Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	66.78 – 1.65 66.78 – 1.65	Depositor EDS
% Data completeness (in resolution range)	99.0 (66.78-1.65) 99.4 (66.78-1.65)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.40 (at 1.64Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.1_1168)	Depositor
R, R_{free}	0.214 , 0.234 0.223 , 0.237	Depositor DCC
R_{free} test set	3520 reflections (9.99%)	wwPDB-VP
Wilson B-factor (Å ²)	28.2	Xtriage
Anisotropy	0.448	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 49.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.023 for -h,l,k	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	2470	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.11% 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

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	1.11	8/1151 (0.7%)	1.56	10/1555 (0.6%)
1	B	0.94	5/1135 (0.4%)	0.96	6/1533 (0.4%)
All	All	1.03	13/2286 (0.6%)	1.30	16/3088 (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	1
1	B	0	1
All	All	0	2

All (13) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	141[A]	ILE	CA-C	9.15	1.64	1.52
1	A	141[B]	ILE	CA-C	9.15	1.64	1.52
1	A	12	TYR	C-O	-7.51	1.15	1.23
1	B	142	LYS	C-N	-7.28	1.24	1.33
1	A	14	ASN	C-O	-6.47	1.16	1.24
1	A	105[A]	ASN	CA-C	6.43	1.61	1.52
1	A	105[B]	ASN	CA-C	6.43	1.61	1.52
1	B	141	ILE	C-O	-6.07	1.17	1.24
1	A	147	ARG	C-N	-6.04	1.26	1.33
1	B	89	ASN	C-O	-5.68	1.17	1.24
1	A	12	TYR	CA-C	-5.19	1.46	1.52
1	B	12	TYR	C-O	-5.08	1.18	1.23
1	B	14	ASN	CA-C	-5.03	1.46	1.52

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	57	ASN	O-C-N	24.52	152.42	122.26
1	A	58	ASN	CA-C-N	17.98	144.85	122.37
1	A	58	ASN	C-N-CA	17.98	144.85	122.37
1	A	57	ASN	CA-C-N	-17.49	97.07	122.07
1	A	57	ASN	C-N-CA	-17.49	97.07	122.07
1	A	58	ASN	O-C-N	-12.93	105.46	122.40
1	B	142	LYS	O-C-N	-8.00	112.86	122.22
1	A	141[A]	ILE	CA-C-O	7.86	129.50	121.17
1	A	141[B]	ILE	CA-C-O	7.86	129.50	121.17
1	B	86	LYS	N-CA-C	5.90	119.25	109.46
1	B	141	ILE	CA-C-N	-5.83	111.89	120.28
1	B	141	ILE	C-N-CA	-5.83	111.89	120.28
1	A	105[A]	ASN	CA-C-O	5.75	126.60	120.10
1	A	105[B]	ASN	CA-C-O	5.75	126.60	120.10
1	B	134	VAL	N-CA-C	-5.30	107.19	111.91
1	B	14	ASN	N-CA-C	5.21	117.37	111.11

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	58	ASN	Mainchain
1	B	151	LYS	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	1131	0	1159	40	1
1	B	1116	0	1122	20	0
2	A	112	0	0	6	2
2	B	111	0	0	3	0
All	All	2470	0	2281	54	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 12.

All (54) 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:28:LYS:NZ	1:A:83:ASN:HA	1.47	1.28
1:A:60:ASN:OD1	1:A:63:ASN:ND2	1.80	1.15
1:B:28:LYS:C	1:B:29[B]:SER:CA	2.37	0.97
1:A:28:LYS:HZ3	1:A:83:ASN:HA	1.32	0.88
1:A:28:LYS:HZ1	1:A:83:ASN:CA	1.88	0.87
1:A:34:LYS:CD	1:A:88:VAL:CG2	2.52	0.87
1:A:28:LYS:HZ1	1:A:83:ASN:HA	1.09	0.85
1:A:95:GLU:OE2	1:B:102:ALA:CB	2.25	0.84
1:B:46:LYS:NZ	2:B:243:HOH:O	1.96	0.84
1:B:146:LYS:NZ	1:B:150:GLU:OE2	2.12	0.83
1:A:149:PHE:O	1:A:152:THR:HB	1.81	0.81
1:A:34:LYS:CD	1:A:88:VAL:HG22	2.11	0.80
1:A:34:LYS:CE	1:A:88:VAL:CG2	2.59	0.79
1:A:95:GLU:OE2	1:B:102:ALA:HB1	1.82	0.79
1:A:34:LYS:HD2	1:A:88:VAL:HG23	1.67	0.77
1:B:29[B]:SER:CA	1:B:30:TYR:N	2.48	0.76
1:A:82:ASP:OD1	1:A:82:ASP:N	2.22	0.73
1:A:86:LYS:O	2:A:293:HOH:O	2.05	0.72
1:B:29[C]:SER:N	1:B:29[C]:SER:C	2.48	0.72
1:A:34:LYS:HD2	1:A:88:VAL:CG2	2.19	0.72
1:A:34:LYS:HD3	1:A:88:VAL:HG22	1.72	0.72
1:A:34:LYS:HE3	1:A:88:VAL:CG2	2.20	0.71
1:A:34:LYS:HE3	1:A:88:VAL:HG21	1.78	0.65
1:B:82:ASP:OD1	1:B:82:ASP:N	2.21	0.64
1:A:34:LYS:CE	1:A:88:VAL:HG21	2.28	0.64
1:A:28:LYS:NZ	1:A:83:ASN:CA	2.42	0.61
1:A:60:ASN:OD1	1:A:63:ASN:CG	2.44	0.61
1:A:9:GLN:OE1	1:A:9:GLN:N	2.35	0.60
1:B:85:SER:HA	2:B:287:HOH:O	2.02	0.59
1:B:82:ASP:O	1:B:85:SER:OG	2.22	0.57
1:B:26:ILE:O	1:B:29[B]:SER:OG	2.24	0.54
1:A:142:LYS:NZ	1:B:123:ASN:ND2	2.56	0.54
1:B:73:GLU:HG2	2:B:257:HOH:O	2.09	0.52
1:A:142:LYS:HZ1	1:B:123:ASN:ND2	2.07	0.52
1:A:95:GLU:OE2	1:B:102:ALA:CA	2.58	0.51
1:A:60:ASN:OD1	1:A:63:ASN:HB2	2.11	0.51
1:A:106:LYS:HE3	1:A:107:TYR:CE1	2.46	0.51
1:A:82:ASP:C	1:A:84:LYS:H	2.19	0.50
1:A:95:GLU:OE2	1:B:102:ALA:HA	2.12	0.50
1:A:28:LYS:HZ1	1:A:83:ASN:CB	2.25	0.49
1:B:82:ASP:C	1:B:84:LYS:H	2.19	0.49
1:A:60:ASN:ND2	1:A:62:ALA:H	2.11	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:56:GLU:C	1:A:58:ASN:H	2.01	0.48
1:A:82:ASP:O	1:A:85:SER:OG	2.26	0.48
1:A:86:LYS:N	2:A:282:HOH:O	2.45	0.48
1:A:60:ASN:OD1	1:A:63:ASN:CB	2.62	0.47
1:A:152:THR:HG22	1:A:153:LEU:CD2	2.44	0.46
1:A:147:ARG:NE	2:A:296:HOH:O	1.97	0.46
1:A:12:TYR:HB2	2:A:304:HOH:O	2.17	0.45
1:A:150:GLU:OE1	2:A:284:HOH:O	2.21	0.43
1:B:86:LYS:HG2	1:B:87:ILE:N	2.35	0.42
1:B:145:LEU:HD23	1:B:145:LEU:HA	1.89	0.42
1:B:15:ARG:HH11	1:B:15:ARG:HD3	1.75	0.41
1:A:140:ALA:HA	2:A:299:HOH:O	2.20	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:73:GLU:OE1	1:A:108[B]:LYS:NZ[3_555]	1.77	0.43
2:A:248:HOH:O	2:A:268:HOH:O[1_455]	1.89	0.31
2:A:281:HOH:O	2:A:287:HOH:O[1_455]	2.02	0.18

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	146/156 (94%)	145 (99%)	0	1 (1%)	18	6
1	B	144/156 (92%)	142 (99%)	1 (1%)	1 (1%)	18	6
All	All	290/312 (93%)	287 (99%)	1 (0%)	2 (1%)	18	6

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	83	ASN
1	B	83	ASN

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	120/132 (91%)	111 (92%)	9 (8%)	12	2
1	B	119/132 (90%)	113 (95%)	6 (5%)	22	5
All	All	239/264 (90%)	224 (94%)	15 (6%)	16	3

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	11	LYS
1	A	14	ASN
1	A	28	LYS
1	A	60	ASN
1	A	82	ASP
1	A	83	ASN
1	A	85	SER
1	A	87	ILE
1	A	152	THR
1	B	11	LYS
1	B	53	LEU
1	B	82	ASP
1	B	83	ASN
1	B	85	SER
1	B	87	ILE

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	9	GLN
1	A	74	GLN

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Mol	Chain	Res	Type
1	A	128	ASN
1	B	74	GLN
1	B	89	ASN
1	B	123	ASN
1	B	128	ASN

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](#)

There are no ligands in this entry.

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	145/156 (92%)	0.69	15 (10%)	12 12	16, 34, 54, 96	3 (2%)
1	B	144/156 (92%)	0.91	16 (11%)	10 11	15, 37, 62, 87	1 (0%)
All	All	289/312 (92%)	0.80	31 (10%)	11 11	15, 35, 62, 96	4 (1%)

All (31) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	152	THR	6.1
1	B	85	SER	3.7
1	B	49	TYR	3.3
1	B	82	ASP	3.3
1	A	153	LEU	3.0
1	B	61	ALA	3.0
1	A	95	GLU	2.9
1	B	55	LYS	2.8
1	B	83	ASN	2.7
1	B	110	PRO	2.7
1	A	81	LEU	2.6
1	A	85	SER	2.6
1	B	136	LEU	2.6
1	A	83	ASN	2.6
1	B	135	TYR	2.5
1	A	152	THR	2.4
1	B	59	VAL	2.4
1	B	87	ILE	2.4
1	A	9	GLN	2.4
1	B	60	ASN	2.4
1	B	66	GLU	2.3
1	A	82	ASP	2.3
1	A	53	LEU	2.3
1	A	84	LYS	2.3

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Mol	Chain	Res	Type	RSRZ
1	A	110	PRO	2.2
1	B	50	GLY	2.2
1	B	63	ASN	2.2
1	A	133	GLU	2.2
1	A	87	ILE	2.1
1	A	61	ALA	2.1
1	A	10	GLY	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](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.