



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 21, 2023 – 06:19 PM EDT

PDB ID : 2Q8A  
Title : Structure of the malaria antigen AMA1 in complex with a growth-inhibitory antibody  
Authors : Gupta, A.; Murphy, V.J.; Anders, R.F.; Batchelor, A.H.  
Deposited on : 2007-06-10  
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

<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>.

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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 : 2.35  
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) : 2.35

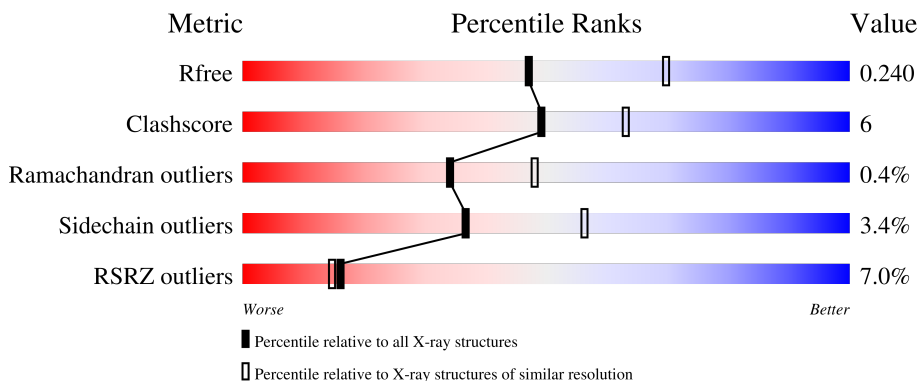
# 1 Overall quality at a glance

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))
$R_{free}$	130704	3907 (2.40-2.40)
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (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 of 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	336	 3% 82% 11% • 6%
2	L	214	 5% 85% 14% •
3	H	210	 14% 80% 14% • 5%

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 5791 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 Apical membrane antigen 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	316	2501	1580	421	483	17	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	103	GLY	-	expression tag	UNP Q7KQK5

- Molecule 2 is a protein called 1F9 light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	L	214	1591	1006	260	318	7	0	0	0

- Molecule 3 is a protein called 1F9 heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	H	199	1452	916	236	293	7	0	0	0

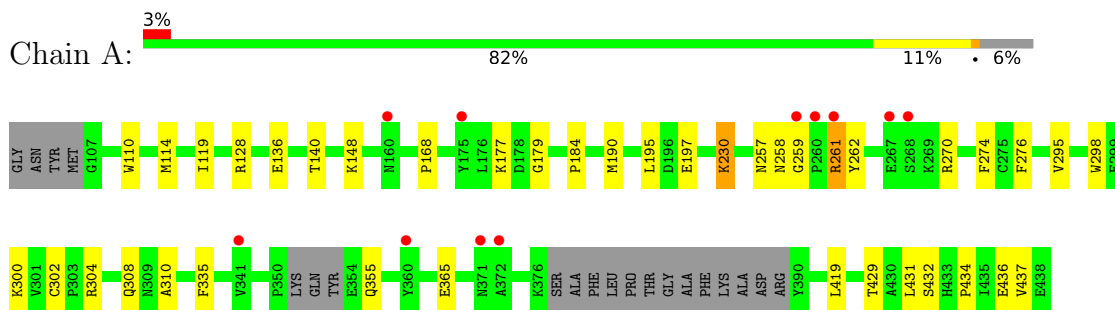
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	166	Total 166	O 166	0	0
4	L	43	Total 43	O 43	0	0
4	H	38	Total 38	O 38	0	0

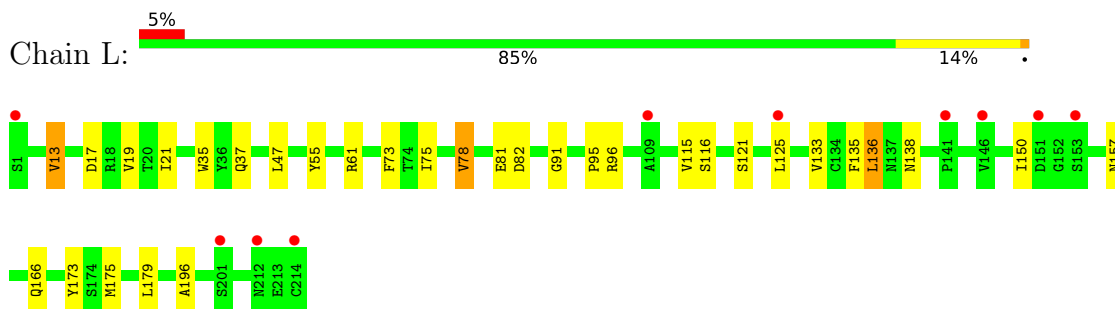
### 3 Residue-property plots [i](#)

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.

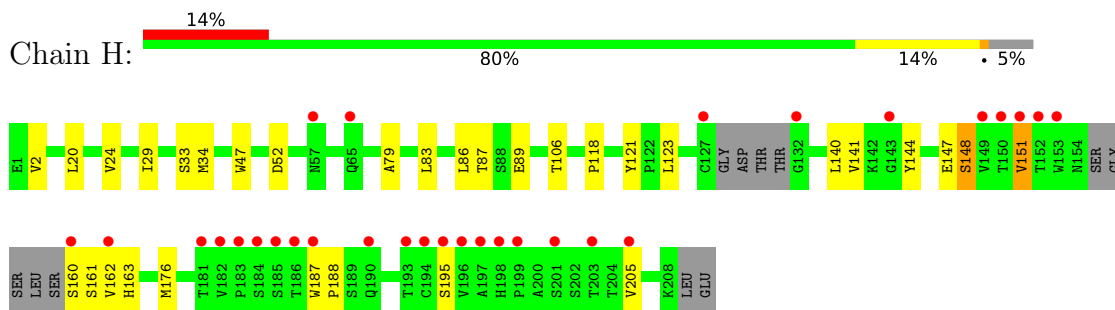
- Molecule 1: Apical membrane antigen 1



- Molecule 2: 1F9 light chain



- Molecule 3: 1F9 heavy chain



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	189.76Å 51.20Å 91.52Å 90.00° 111.09° 90.00°	Depositor
Resolution (Å)	38.92 – 2.40 38.84 – 2.40	Depositor EDS
% Data completeness (in resolution range)	100.0 (38.92-2.40) 99.9 (38.84-2.40)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.06	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.23 (at 2.39Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.202 , 0.244 0.200 , 0.240	Depositor DCC
$R_{free}$ test set	1647 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	36.5	Xtrriage
Anisotropy	0.336	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 45.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	5791	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	36.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.18% 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	0.43	0/2563	0.58	0/3472
2	L	0.41	0/1629	0.55	0/2227
3	H	0.38	0/1488	0.56	0/2041
All	All	0.41	0/5680	0.57	0/7740

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 [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	2501	0	2345	30	0
2	L	1591	0	1462	20	0
3	H	1452	0	1346	21	0
4	A	166	0	0	0	0
4	H	38	0	0	0	0
4	L	43	0	0	0	0
All	All	5791	0	5153	63	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 6.

All (63) 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:304:ARG:NH1	1:A:436:GLU:OE2	2.06	0.88
1:A:335:PHE:HD1	1:A:434:PRO:HB2	1.56	0.70
3:H:87:THR:HG22	3:H:89:GLU:H	1.60	0.67
1:A:190:MET:HG3	3:H:2:VAL:HG21	1.76	0.67
1:A:429:THR:HG22	1:A:431:LEU:H	1.59	0.66
3:H:147:GLU:O	3:H:148:SER:HB2	1.95	0.66
1:A:274:PHE:HB3	1:A:276:PHE:HD2	1.60	0.66
1:A:230:LYS:H	1:A:230:LYS:HD2	1.61	0.65
3:H:118:PRO:HB3	3:H:144:TYR:HB3	1.79	0.63
2:L:133:VAL:HG11	3:H:123:LEU:HD13	1.79	0.63
1:A:197:GLU:HG2	2:L:55:TYR:CE1	2.37	0.59
1:A:230:LYS:H	1:A:230:LYS:CD	2.13	0.59
2:L:166:GLN:HG3	2:L:173:TYR:CZ	2.39	0.57
1:A:335:PHE:CD1	1:A:434:PRO:HB2	2.39	0.57
1:A:259:GLY:C	1:A:261:ARG:H	2.08	0.57
1:A:230:LYS:HD2	1:A:230:LYS:N	2.19	0.57
2:L:61:ARG:NH1	2:L:82:ASP:OD1	2.39	0.56
2:L:21:ILE:HD12	2:L:73:PHE:HD2	1.71	0.56
1:A:168:PRO:HB3	1:A:184:PRO:HA	1.89	0.54
1:A:429:THR:HG22	1:A:431:LEU:N	2.23	0.53
1:A:110:TRP:HB3	1:A:114:MET:HG2	1.91	0.52
3:H:121:TYR:HB2	3:H:140:LEU:HB3	1.90	0.52
2:L:35:TRP:CE2	2:L:73:PHE:HB2	2.46	0.51
2:L:35:TRP:CD2	2:L:73:PHE:HB2	2.46	0.50
2:L:115:VAL:HA	2:L:135:PHE:O	2.11	0.50
2:L:136:LEU:HD12	2:L:196:ALA:HB2	1.93	0.50
2:L:138:ASN:HD21	3:H:163:HIS:HE1	1.59	0.50
2:L:21:ILE:HD12	2:L:73:PHE:CD2	2.47	0.49
3:H:123:LEU:HD21	3:H:140:LEU:HB2	1.94	0.49
1:A:190:MET:HG3	3:H:2:VAL:CG2	2.43	0.48
2:L:121:SER:O	2:L:125:LEU:HB2	2.14	0.47
1:A:429:THR:CG2	1:A:431:LEU:H	2.26	0.47
3:H:24:VAL:HG21	3:H:29:ILE:HD11	1.97	0.47
2:L:150:ILE:HD11	2:L:179:LEU:HD21	1.96	0.46
1:A:190:MET:CG	3:H:2:VAL:HG21	2.44	0.46
1:A:304:ARG:HH11	1:A:304:ARG:HG2	1.81	0.46
2:L:91:GLY:HA2	2:L:96:ARG:HG2	1.98	0.46
1:A:257:ASN:ND2	1:A:365:GLU:OE1	2.48	0.45
3:H:187:TRP:CG	3:H:188:PRO:HA	2.52	0.45
2:L:17:ASP:O	2:L:78:VAL:HG22	2.17	0.45
2:L:37:GLN:HB2	2:L:47:LEU:HD11	1.99	0.45
2:L:61:ARG:HG3	2:L:75:ILE:HG23	1.98	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:119:ILE:HD11	1:A:429:THR:HG23	1.99	0.44
3:H:151:VAL:HA	3:H:195:SER:O	2.17	0.44
3:H:20:LEU:HD22	3:H:106:THR:HG21	1.99	0.44
1:A:259:GLY:HA3	1:A:262:TYR:HB2	1.99	0.44
3:H:34:MET:HG3	3:H:79:ALA:HB2	1.99	0.44
3:H:141:VAL:HB	3:H:176:MET:HG3	2.00	0.44
1:A:298:TRP:O	1:A:302:CYS:HB2	2.18	0.43
1:A:308:GLN:HG3	1:A:437:VAL:HB	1.99	0.43
3:H:160:SER:C	3:H:162:VAL:H	2.21	0.43
1:A:179:GLY:O	1:A:274:PHE:HZ	2.01	0.43
1:A:136:GLU:HA	1:A:140:THR:O	2.18	0.43
2:L:13:VAL:HG11	2:L:19:VAL:HG22	2.01	0.42
1:A:429:THR:HB	1:A:432:SER:OG	2.19	0.42
3:H:24:VAL:CB	3:H:29:ILE:HD11	2.48	0.42
2:L:138:ASN:ND2	3:H:163:HIS:HE1	2.18	0.42
3:H:24:VAL:HG11	3:H:29:ILE:HD11	2.00	0.42
1:A:310:ALA:HB1	1:A:419:LEU:HD22	2.02	0.41
1:A:177:LYS:HA	1:A:274:PHE:CE2	2.55	0.41
2:L:95:PRO:HA	3:H:47:TRP:CZ3	2.56	0.41
1:A:148:LYS:O	1:A:295:VAL:HG22	2.21	0.41
1:A:274:PHE:CB	1:A:276:PHE:HD2	2.31	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	310/336 (92%)	296 (96%)	13 (4%)	1 (0%)	41	55
2	L	212/214 (99%)	202 (95%)	10 (5%)	0	100	100
3	H	193/210 (92%)	184 (95%)	7 (4%)	2 (1%)	15	23
All	All	715/760 (94%)	682 (95%)	30 (4%)	3 (0%)	34	48



All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	H	148	SER
1	A	261	ARG
3	H	161	SER

### 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	270/296 (91%)	263 (97%)	7 (3%)	46	66
2	L	168/191 (88%)	161 (96%)	7 (4%)	30	47
3	H	157/183 (86%)	151 (96%)	6 (4%)	33	51
All	All	595/670 (89%)	575 (97%)	20 (3%)	37	56

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	128	ARG
1	A	195	LEU
1	A	230	LYS
1	A	258	ASN
1	A	270	ARG
1	A	300	LYS
1	A	355	GLN
2	L	13	VAL
2	L	78	VAL
2	L	81	GLU
2	L	116	SER
2	L	136	LEU
2	L	157	ASN
2	L	175	MET
3	H	33	SER
3	H	52	ASP
3	H	83	LEU
3	H	86	LEU

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Mol	Chain	Res	Type
3	H	151	VAL
3	H	205	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	258	ASN
2	L	107	ASN
2	L	138	ASN
2	L	161	ASN
3	H	3	GLN
3	H	154	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 monosaccharides 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, 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	316/336 (94%)	0.33	11 (3%) 44 43	27, 35, 45, 54	0
2	L	214/214 (100%)	0.37	10 (4%) 31 30	32, 35, 39, 41	0
3	H	199/210 (94%)	0.78	30 (15%) 2 1	31, 36, 41, 44	0
All	All	729/760 (95%)	0.47	51 (6%) 16 15	27, 35, 42, 54	0

All (51) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	H	196	VAL	5.5
3	H	183	PRO	4.5
1	A	267	GLU	4.5
3	H	182	VAL	4.5
3	H	184	SER	4.3
1	A	268	SER	4.1
2	L	214	CYS	3.9
3	H	190	GLN	3.9
2	L	153	SER	3.9
3	H	186	THR	3.7
3	H	127	CYS	3.7
3	H	195	SER	3.5
3	H	65	GLN	3.4
3	H	197	ALA	3.3
2	L	212	ASN	3.3
1	A	260	PRO	3.3
1	A	160	ASN	3.1
3	H	160	SER	3.1
3	H	181	THR	3.0
3	H	205	VAL	2.9
2	L	109	ALA	2.9
3	H	153	TRP	2.9
1	A	360	TYR	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	175	TYR	2.8
3	H	203	THR	2.8
3	H	201	SER	2.8
3	H	149	VAL	2.7
3	H	151	VAL	2.7
1	A	261	ARG	2.6
3	H	152	THR	2.6
3	H	132	GLY	2.6
3	H	194	CYS	2.6
3	H	187	TRP	2.6
2	L	201	SER	2.6
3	H	199	PRO	2.5
1	A	371	ASN	2.5
3	H	185	SER	2.5
1	A	372	ALA	2.4
3	H	143	GLY	2.3
2	L	1	SER	2.2
3	H	150	THR	2.2
3	H	57	ASN	2.2
3	H	162	VAL	2.2
2	L	141	PRO	2.2
2	L	151	ASP	2.2
2	L	146	VAL	2.1
1	A	341	VAL	2.1
3	H	193	THR	2.1
2	L	125	LEU	2.1
3	H	198	HIS	2.0
1	A	259	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 monosaccharides 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.