Full wwPDB X-ray Structure Validation Report (i)

Nov 1, 2023 – 01:59 PM JST

PDB ID	:	5I9D
Title	:	Crystal structure of designed pentatricopeptide repeat protein dPPR-U8A2 in complex with its target RNA U8A2
Authors	:	Shen, C.; Zhang, D.; Guan, Z.; Zou, T.; Yin, P.
Deposited on	:	2016-02-20
Resolution	:	2.60 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 (i) 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 (1)) were used in the production of this report:

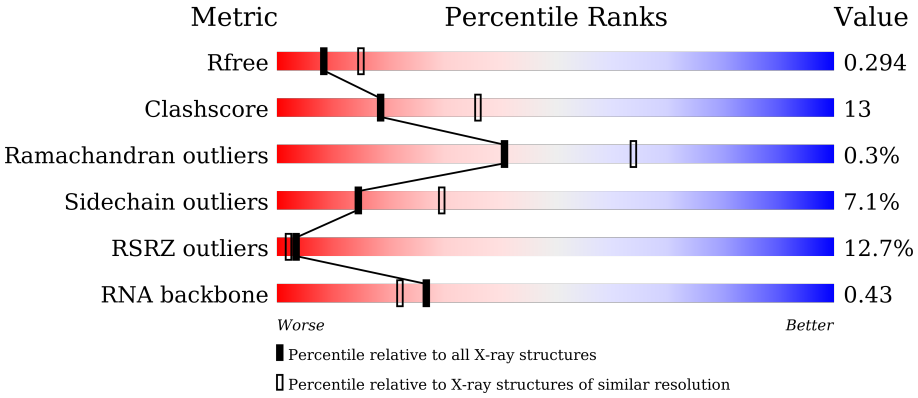
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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	3163 (2.60-2.60)
Clashscore	141614	3518 (2.60-2.60)
Ramachandran outliers	138981	3455 (2.60-2.60)
Sidechain outliers	138945	3455 (2.60-2.60)
RSRZ outliers	127900	3104 (2.60-2.60)
RNA backbone	3102	1040 (2.90-2.30)

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 <=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	460	10%; 60%; 16%; •; 22%
2	B	18	33%; 11%; 11%; 6%; 39%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 3017 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 pentatricopeptide repeat protein dPPR-U8A2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	360	2778	1793	425	540	20	0	0	0

- Molecule 2 is a RNA chain called RNA (5'-R(*GP*GP*GP*G*UP*UP*UP*UP*AP*AP*UP*UP*UP*UP*CP*CP*CP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	B	11	198	89	24	75	10	0	0	1

- Molecule 3 is water.

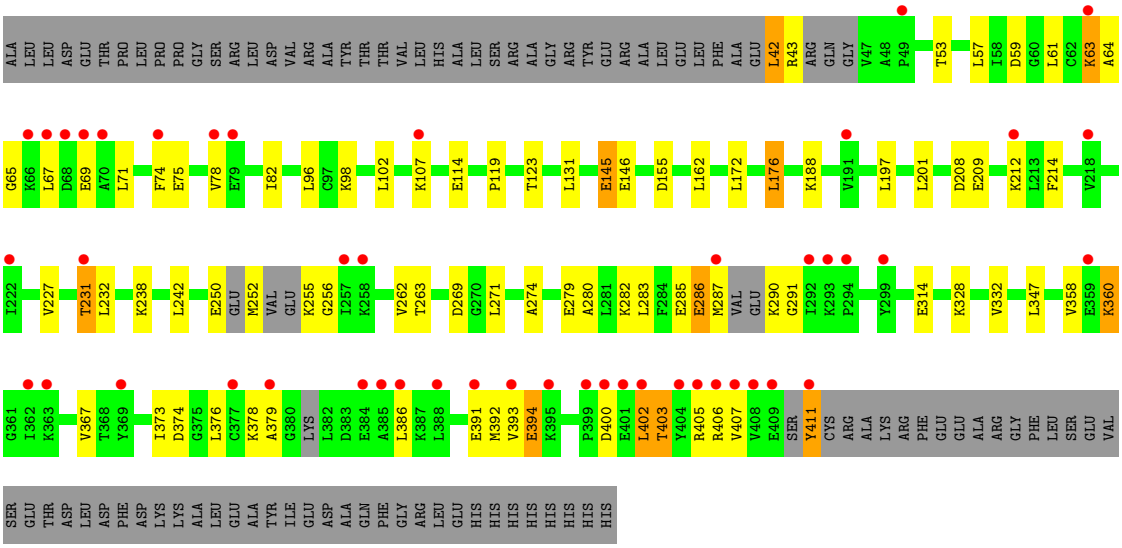
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	35	35	35	0	0
			Total	O		
3	B	6	6	6	0	0

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.

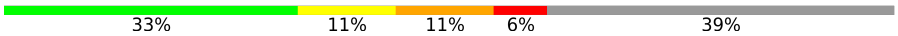
• Molecule 1: pentatricopeptide repeat protein dPPR-U8A2

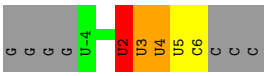
Chain A:



• Molecule 2: RNA (5'-R(*GP*GP*GP*G*UP*UP*UP*UP*AP*AP*UP*UP*UP*UP*CP*CP*CP*C)-3')

Chain B:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	52.55Å 84.90Å 95.90Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.08 – 2.60 46.08 – 2.60	Depositor EDS
% Data completeness (in resolution range)	99.7 (46.08-2.60) 96.1 (46.08-2.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	4.69 (at 2.61Å)	Xtriage
Refinement program	PHENIX (1.10.1_2155)	Depositor
R, R_{free}	0.267 , 0.293 0.268 , 0.294	Depositor DCC
R_{free} test set	704 reflections (5.11%)	wwPDB-VP
Wilson B-factor (Å^2)	39.7	Xtriage
Anisotropy	0.559	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.38 , 59.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.90	EDS
Total number of atoms	3017	wwPDB-VP
Average B, all atoms (Å^2)	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 12.34% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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	0.72	1/2804 (0.0%)	0.86	2/3762 (0.1%)
2	B	1.17	3/218 (1.4%)	0.82	0/336
All	All	0.76	4/3022 (0.1%)	0.85	2/4098 (0.0%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	3	U	O3'-P	-7.13	1.52	1.61
2	B	4	U	O3'-P	-6.70	1.53	1.61
2	B	2	U	O3'-P	-6.51	1.53	1.61
1	A	155	ASP	CB-CG	-5.00	1.41	1.51

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	286	GLU	CB-CA-C	-5.57	99.26	110.40
1	A	286	GLU	N-CA-CB	-5.09	101.44	110.60

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	2778	0	2909	79	1
2	B	198	0	99	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	35	0	0	26	0
3	B	6	0	0	0	0
All	All	3017	0	3008	79	1

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 13.

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:A:209:GLU:CA	3:A:502:HOH:O	1.93	1.17
1:A:209:GLU:C	3:A:502:HOH:O	1.93	1.04
1:A:286:GLU:N	1:A:286:GLU:OE1	1.90	1.04
1:A:42:LEU:HD13	1:A:43:ARG:H	1.22	1.00
1:A:286:GLU:HG3	3:A:524:HOH:O	1.63	0.97
1:A:407:VAL:CB	3:A:501:HOH:O	2.13	0.96
1:A:208:ASP:O	3:A:502:HOH:O	1.85	0.92
1:A:255:LYS:HG2	1:A:256:GLY:H	1.35	0.90
1:A:285:GLU:O	1:A:286:GLU:OE1	1.92	0.88
1:A:407:VAL:O	3:A:504:HOH:O	1.95	0.84
1:A:114:GLU:OE2	3:A:503:HOH:O	1.95	0.83
1:A:405:ARG:NH2	3:A:506:HOH:O	2.10	0.83
1:A:286:GLU:CG	3:A:524:HOH:O	2.20	0.83
1:A:285:GLU:C	1:A:286:GLU:OE1	2.15	0.82
1:A:407:VAL:HG23	3:A:501:HOH:O	1.78	0.82
1:A:407:VAL:CG2	3:A:501:HOH:O	2.29	0.80
1:A:238:LYS:NZ	3:A:508:HOH:O	2.14	0.80
1:A:407:VAL:N	3:A:501:HOH:O	1.84	0.79
1:A:42:LEU:CD1	1:A:43:ARG:H	1.96	0.79
1:A:209:GLU:HA	3:A:502:HOH:O	1.69	0.78
1:A:208:ASP:C	3:A:502:HOH:O	2.20	0.78
1:A:42:LEU:HD13	1:A:43:ARG:N	1.99	0.78
1:A:407:VAL:HB	3:A:501:HOH:O	1.80	0.77
1:A:252:MET:O	3:A:505:HOH:O	2.04	0.74
1:A:286:GLU:CB	3:A:524:HOH:O	2.36	0.73
1:A:42:LEU:HD12	1:A:42:LEU:N	2.04	0.73
1:A:290:LYS:HG3	1:A:291:GLY:N	2.04	0.72
1:A:411:TYR:N	3:A:504:HOH:O	2.21	0.72
1:A:403:THR:O	3:A:501:HOH:O	2.08	0.71
1:A:286:GLU:OE2	1:A:290:LYS:NZ	2.25	0.68
1:A:61:LEU:HD13	1:A:69:GLU:HG3	1.79	0.65

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:242:LEU:HD11	1:A:274:ALA:CB	2.27	0.65
1:A:212:LYS:HB2	3:A:502:HOH:O	1.96	0.64
1:A:286:GLU:CD	1:A:290:LYS:HD2	2.18	0.64
1:A:59:ASP:OD1	1:A:63:LYS:HE3	1.98	0.63
1:A:269:ASP:OD2	3:A:509:HOH:O	2.15	0.63
1:A:255:LYS:HG2	1:A:256:GLY:N	2.12	0.61
1:A:242:LEU:HD11	1:A:274:ALA:HB2	1.83	0.60
1:A:286:GLU:HB3	3:A:524:HOH:O	2.00	0.60
1:A:172:LEU:HD21	1:A:201:LEU:HD23	1.84	0.59
1:A:63:LYS:HA	1:A:64:ALA:HB2	1.85	0.57
1:A:64:ALA:HB1	1:A:65:GLY:CA	2.35	0.57
1:A:102:LEU:HD21	1:A:131:LEU:HD23	1.86	0.57
1:A:283:LEU:O	1:A:286:GLU:CB	2.54	0.56
1:A:283:LEU:O	1:A:286:GLU:HB2	2.06	0.55
1:A:286:GLU:HG2	1:A:286:GLU:O	2.05	0.55
1:A:67:LEU:HD23	1:A:71:LEU:HD11	1.89	0.55
1:A:59:ASP:OD1	1:A:63:LYS:CE	2.55	0.55
1:A:176:LEU:CD2	1:A:197:LEU:HD22	2.37	0.55
1:A:290:LYS:HG3	1:A:291:GLY:H	1.69	0.54
1:A:98:LYS:HE3	3:A:510:HOH:O	2.08	0.53
1:A:402:LEU:CD2	1:A:406:ARG:CZ	2.87	0.53
1:A:279:GLU:HA	1:A:282:LYS:HD2	1.92	0.52
1:A:227:VAL:O	1:A:231:THR:HG23	2.10	0.51
1:A:53:THR:HG22	1:A:57:LEU:HD13	1.91	0.51
1:A:42:LEU:CD1	1:A:42:LEU:N	2.72	0.49
1:A:119:PRO:HB3	1:A:123:THR:HG21	1.92	0.49
1:A:367:VAL:HG13	2:B:5:U:N1	2.27	0.49
1:A:332:VAL:HG13	2:B:4:U:C2	2.48	0.48
1:A:271:LEU:HB2	1:A:280:ALA:HB2	1.96	0.47
1:A:286:GLU:OE1	1:A:290:LYS:HD2	2.15	0.47
1:A:75:GLU:O	1:A:78:VAL:HG22	2.15	0.46
1:A:374:ASP:OD1	1:A:378:LYS:HE2	2.15	0.46
1:A:176:LEU:HD22	1:A:197:LEU:HD22	1.96	0.46
1:A:347:LEU:HD22	1:A:379:ALA:CB	2.46	0.45
1:A:392:MET:HE1	1:A:403:THR:HG21	1.98	0.45
1:A:347:LEU:HD21	1:A:376:LEU:HD23	1.98	0.45
1:A:391:GLU:HA	1:A:394:GLU:HG2	2.00	0.43
1:A:67:LEU:CD2	1:A:71:LEU:HD11	2.49	0.42
1:A:67:LEU:HD23	1:A:71:LEU:CD1	2.49	0.42
1:A:214:PHE:CD2	1:A:232:LEU:HD11	2.55	0.42
1:A:286:GLU:CD	1:A:290:LYS:NZ	2.73	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:82:ILE:HD12	1:A:82:ILE:N	2.35	0.41
1:A:145:GLU:HG2	1:A:146:GLU:N	2.34	0.41
1:A:67:LEU:HD21	1:A:96:LEU:CD2	2.51	0.41
1:A:74:PHE:O	1:A:78:VAL:HG13	2.20	0.41
1:A:262:VAL:HG13	2:B:2:U:C2	2.56	0.41
1:A:63:LYS:NZ	3:A:513:HOH:O	2.54	0.40
1:A:209:GLU:N	3:A:502:HOH:O	2.26	0.40

All (1) 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:212:LYS:NZ	1:A:360:LYS:O[1_655]	2.12	0.08

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	348/460 (76%)	319 (92%)	28 (8%)	1 (0%)	41 64

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	360	LYS

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	308/393 (78%)	286 (93%)	22 (7%)	14 29

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

Mol	Chain	Res	Type
1	A	42	LEU
1	A	63	LYS
1	A	107	LYS
1	A	145	GLU
1	A	162	LEU
1	A	176	LEU
1	A	188	LYS
1	A	231	THR
1	A	250	GLU
1	A	263	THR
1	A	287	MET
1	A	314	GLU
1	A	328	LYS
1	A	358	VAL
1	A	373	ILE
1	A	386	LEU
1	A	393	VAL
1	A	394	GLU
1	A	400	ASP
1	A	402	LEU
1	A	403	THR
1	A	411	TYR

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

5.3.3 RNA (i)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	B	9/18 (50%)	3 (33%)	0

All (3) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	B	2	U

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Mol	Chain	Res	Type
2	B	3	U
2	B	6	C

There are no RNA pucker outliers to report.

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 (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	360/460 (78%)	0.80	47 (13%) 3 2	28, 48, 80, 107	0
2	B	11/18 (61%)	-0.61	0 100 100	36, 40, 62, 64	0
All	All	371/478 (77%)	0.76	47 (12%) 3 2	28, 48, 80, 107	0

All (47) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	287	MET	5.7
1	A	408	VAL	5.5
1	A	363	LYS	5.3
1	A	404	TYR	5.0
1	A	409	GLU	4.8
1	A	401	GLU	4.6
1	A	402	LEU	4.6
1	A	257	ILE	4.4
1	A	66	LYS	4.1
1	A	79	GLU	4.0
1	A	405	ARG	3.9
1	A	386	LEU	3.7
1	A	69	GLU	3.6
1	A	379	ALA	3.6
1	A	411	TYR	3.6
1	A	67	LEU	3.5
1	A	362	ILE	3.3
1	A	191	VAL	3.3
1	A	406	ARG	3.3
1	A	68	ASP	3.3
1	A	377	CYS	3.3
1	A	385	ALA	3.3
1	A	218	VAL	3.0
1	A	384	GLU	3.0

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Mol	Chain	Res	Type	RSRZ
1	A	359	GLU	2.9
1	A	399	PRO	2.9
1	A	49	PRO	2.8
1	A	395	LYS	2.7
1	A	391	GLU	2.7
1	A	388	LEU	2.7
1	A	407	VAL	2.5
1	A	292	ILE	2.4
1	A	222	ILE	2.4
1	A	231	THR	2.4
1	A	212	LYS	2.3
1	A	63	LYS	2.3
1	A	78	VAL	2.2
1	A	400	ASP	2.2
1	A	107	LYS	2.2
1	A	74	PHE	2.2
1	A	294	PRO	2.1
1	A	258	LYS	2.1
1	A	293	LYS	2.1
1	A	393	VAL	2.1
1	A	299	TYR	2.1
1	A	70	ALA	2.0
1	A	369	TYR	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.