



Full wwPDB NMR Structure Validation Report ⓘ

May 1, 2019 – 08:31 PM EDT

PDB ID : 5L6R
Title : PrP226* - Solution-state NMR structure of truncated human prion protein
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Deposited on : 2016-05-31

This is a Full wwPDB NMR 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/NMRValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Percentile statistics	:	20171227.v01 (using entries in the PDB archive December 27th 2017)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	rb-20031633
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20031633

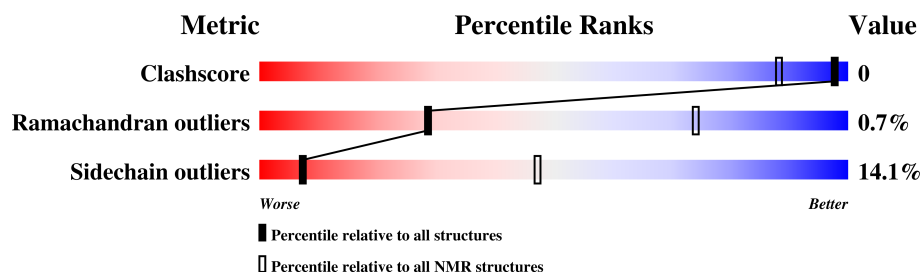
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment is 78%.

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)	NMR archive (#Entries)
Clashscore	136327	12091
Ramachandran outliers	132723	10835
Sidechain outliers	132532	10811

The table below summarises the geometric issues observed across the polymeric chains and their fit to the experimental data. The red, orange, yellow and green segments indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. A cyan segment indicates the fraction of residues that are not part of the well-defined cores, and 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	145	

2 Ensemble composition and analysis

This entry contains 20 models. Model 8 is the overall representative, medoid model (most similar to other models).

The following residues are included in the computation of the global validation metrics.

Well-defined (core) protein residues			
Well-defined core	Residue range (total)	Backbone RMSD (Å)	Medoid model
1	A:105-A:113 (9)	0.64	3
2	A:122-A:165, A:175-A:226 (96)	0.28	8

Ill-defined regions of proteins are excluded from the global statistics.

Ligands and non-protein polymers are included in the analysis.

The models can be grouped into 5 clusters. No single-model clusters were found.

Cluster number	Models
1	1, 4, 10, 12, 19
2	3, 11, 13, 14, 16
3	2, 5, 9, 18
4	8, 15, 17, 20
5	6, 7

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 2249 atoms, of which 1087 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Major prion protein.

Mol	Chain	Residues	Atoms						Trace
1	A	145	Total	C	H	N	O	S	0
			2249	716	1087	215	220	11	

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	227	GLY	-	expression tag	UNP P04156
A	228	GLY	-	expression tag	UNP P04156
A	229	HIS	-	expression tag	UNP P04156
A	230	HIS	-	expression tag	UNP P04156
A	231	HIS	-	expression tag	UNP P04156
A	232	HIS	-	expression tag	UNP P04156
A	233	HIS	-	expression tag	UNP P04156
A	234	HIS	-	expression tag	UNP P04156

4 Residue-property plots [i](#)

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA and DNA chains in the entry. The first graphic is the same as shown in the summary in section 1 of this report. The second graphic shows the sequence where residues are colour-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. Stretches of 2 or more consecutive residues without any outliers are shown as green connectors. Residues which are classified as ill-defined in the NMR ensemble, are shown in cyan with an underline colour-coded according to the previous scheme. Residues which were present in the experimental sample, but not modelled in the final structure are shown in grey.

- Molecule 1: Major prion protein

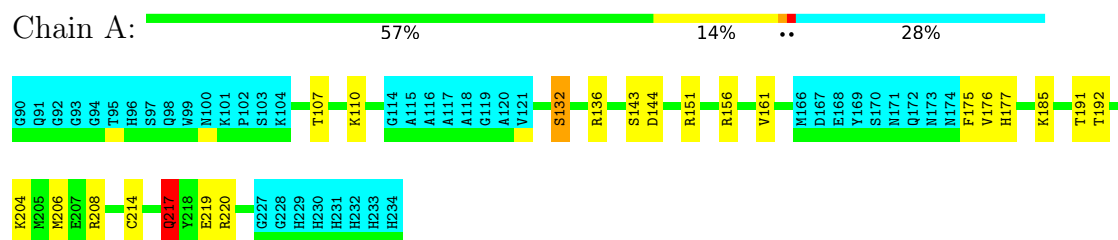


4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

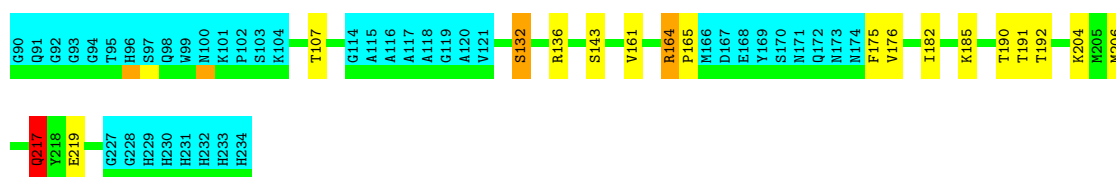
- Molecule 1: Major prion protein



4.2.2 Score per residue for model 2

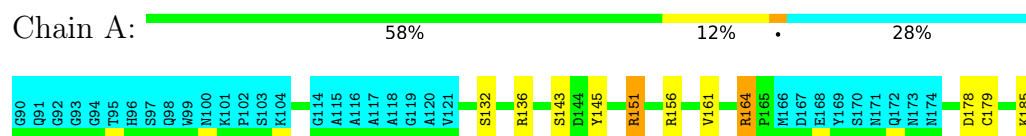
- Molecule 1: Major prion protein





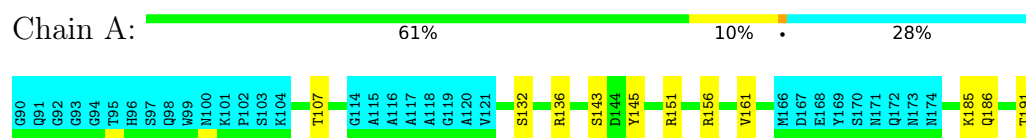
4.2.3 Score per residue for model 3

- Molecule 1: Major prion protein



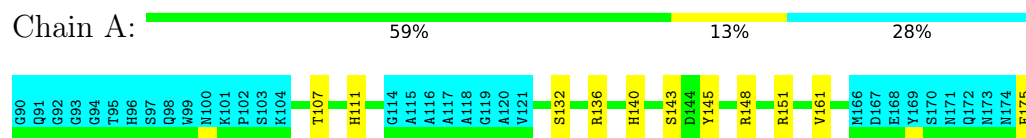
4.2.4 Score per residue for model 4

- Molecule 1: Major prion protein



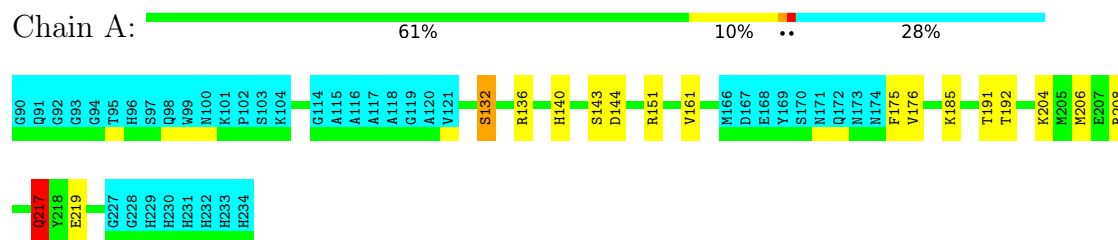
4.2.5 Score per residue for model 5

- Molecule 1: Major prion protein



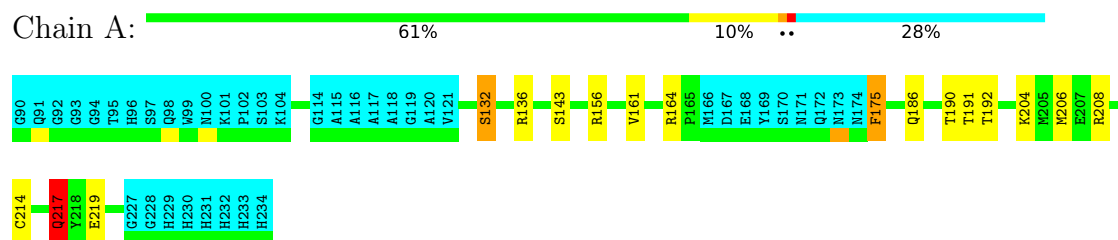
4.2.6 Score per residue for model 6

- Molecule 1: Major prion protein



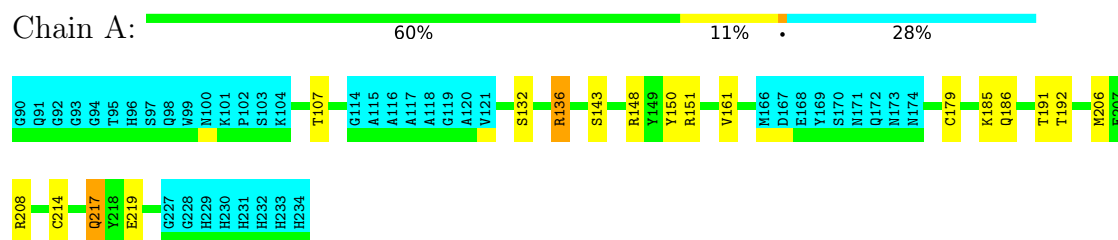
4.2.7 Score per residue for model 7

- Molecule 1: Major prion protein



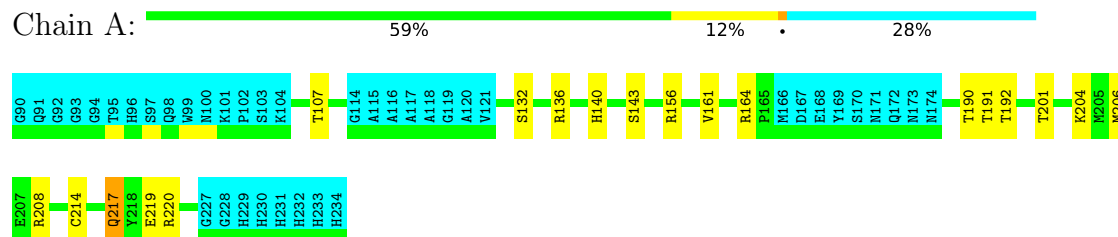
4.2.8 Score per residue for model 8 (medoid)

- Molecule 1: Major prion protein



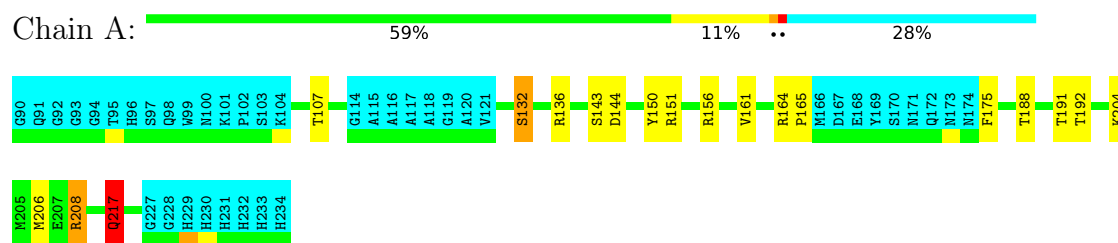
4.2.9 Score per residue for model 9

- Molecule 1: Major prion protein



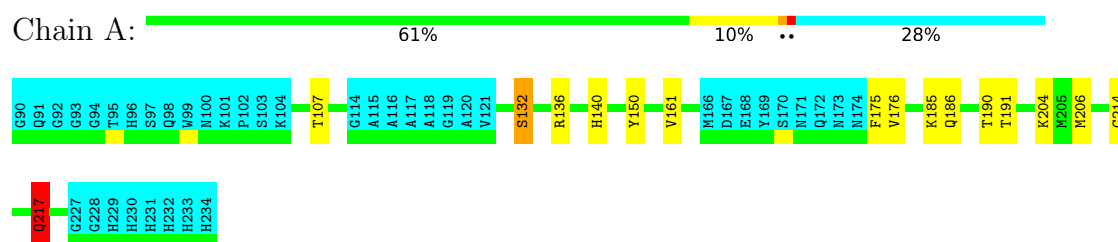
4.2.10 Score per residue for model 10

- Molecule 1: Major prion protein



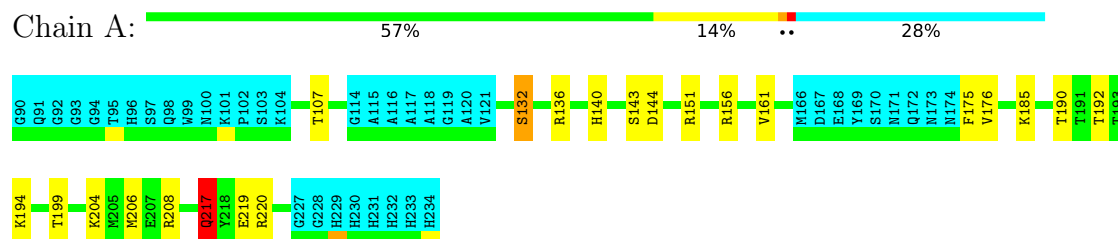
4.2.11 Score per residue for model 11

- Molecule 1: Major prion protein



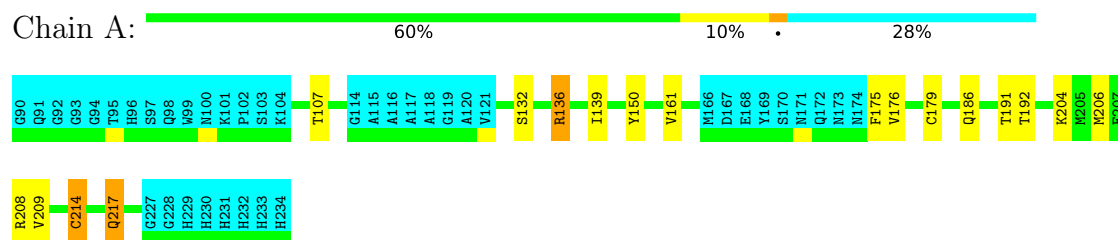
4.2.12 Score per residue for model 12

- Molecule 1: Major prion protein



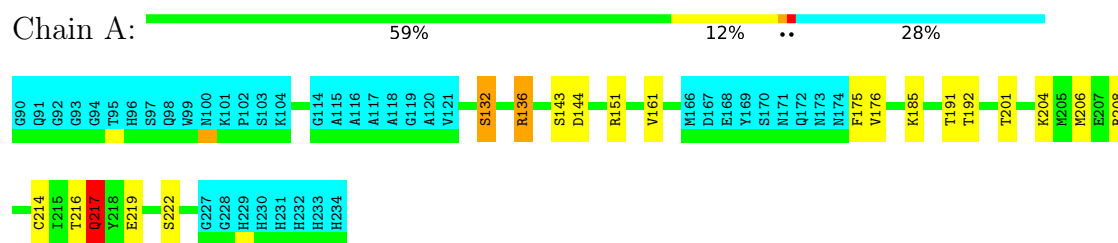
4.2.13 Score per residue for model 13

- Molecule 1: Major prion protein



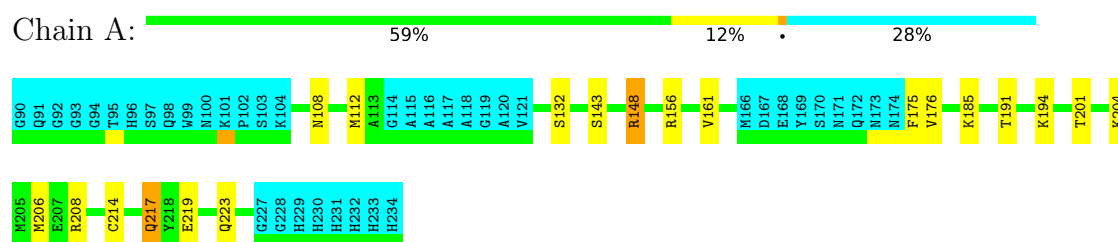
4.2.14 Score per residue for model 14

- Molecule 1: Major prion protein



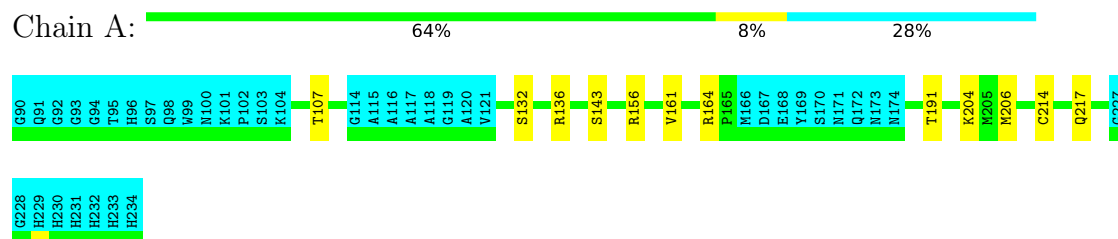
4.2.15 Score per residue for model 15

- Molecule 1: Major prion protein



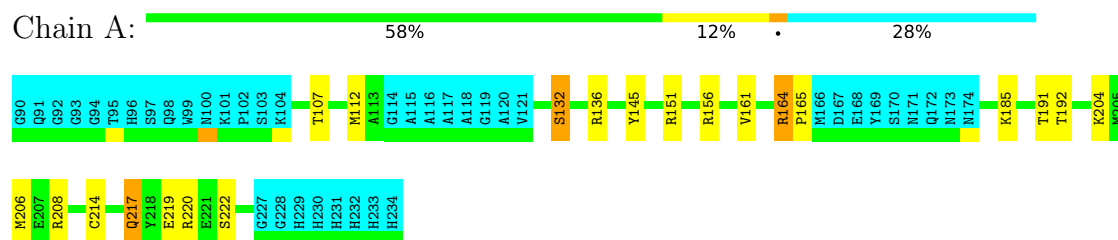
4.2.16 Score per residue for model 16

- Molecule 1: Major prion protein



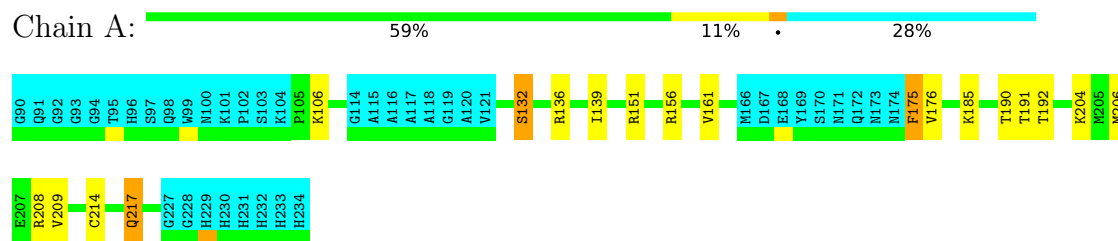
4.2.17 Score per residue for model 17

- Molecule 1: Major prion protein



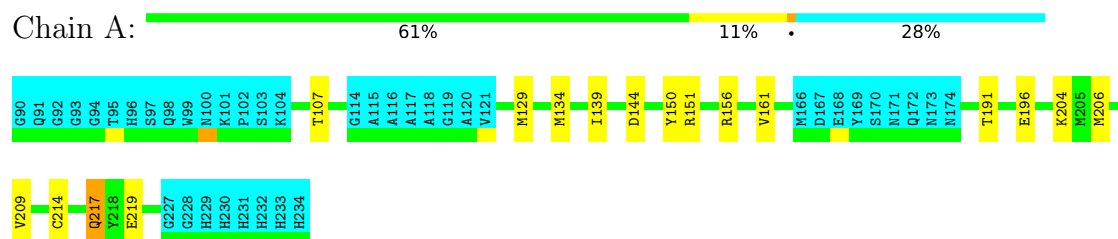
4.2.18 Score per residue for model 18

- Molecule 1: Major prion protein



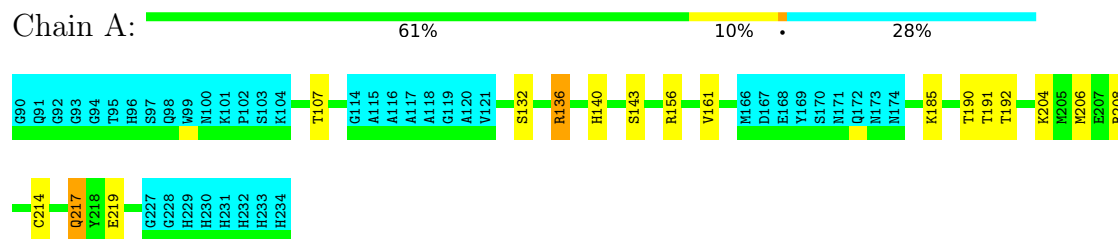
4.2.19 Score per residue for model 19

- Molecule 1: Major prion protein



4.2.20 Score per residue for model 20

- Molecule 1: Major prion protein



5 Refinement protocol and experimental data overview

Of the ? calculated structures, 20 were deposited, based on the following criterion: ?.

The following table shows the software used for structure solution, optimisation and refinement.

Software name	Classification	Version
CYANA	structure calculation	
TALOS	geometry optimization	
YASARA	refinement	

The following table shows chemical shift validation statistics as aggregates over all chemical shift files. Detailed validation can be found in section 7 of this report.

Chemical shift file(s)	5l6r_cs.cif
Number of chemical shift lists	1
Total number of shifts	1435
Number of shifts mapped to atoms	1435
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	78%

No validations of the models with respect to experimental NMR restraints is performed at this time.

6 Model quality [i](#)

6.1 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 (average) 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	0.90±0.01	2±1/889 (0.3±0.1%)	0.95±0.02	4±2/1199 (0.3±0.1%)
All	All	0.90	48/17780 (0.3%)	0.95	83/23980 (0.3%)

All unique bond outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)	Models	
								Worst	Total
1	A	161	VAL	CA-CB	7.66	1.70	1.54	2	20
1	A	161	VAL	CB-CG1	7.65	1.69	1.52	19	20
1	A	217	GLN	CB-CG	5.41	1.67	1.52	14	7
1	A	134	MET	CB-CG	-5.19	1.34	1.51	19	1

All unique angle outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	164	ARG	NE-CZ-NH1	6.55	123.58	120.30	7	5
1	A	151	ARG	NE-CZ-NH1	6.54	123.57	120.30	3	12
1	A	136	ARG	NE-CZ-NH1	6.51	123.56	120.30	7	14
1	A	220	ARG	NE-CZ-NH1	6.45	123.52	120.30	1	5
1	A	156	ARG	NE-CZ-NH1	6.07	123.33	120.30	20	13
1	A	208	ARG	NE-CZ-NH1	5.71	123.15	120.30	9	14
1	A	217	GLN	CB-CG-CD	5.44	125.75	111.60	19	16
1	A	220	ARG	NE-CZ-NH2	-5.43	117.58	120.30	17	2
1	A	148	ARG	NE-CZ-NH1	5.09	122.85	120.30	15	1
1	A	129	MET	CG-SD-CE	5.05	108.28	100.20	19	1

There are no chirality outliers.

There are no planarity outliers.

6.2 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 each 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 averaged over the ensemble.

Mol	Chain	Non-H	H(model)	H(added)	Clashes
1	A	867	830	825	1±1
All	All	17340	16600	16500	17

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 1.

All unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:139:ILE:HG13	1:A:209:VAL:HG12	0.47	1.87	18	3
1:A:136:ARG:CZ	1:A:216:THR:HG21	0.46	2.41	14	1
1:A:132:SER:H	1:A:217:GLN:CD	0.43	2.18	6	10
1:A:175:PHE:CE2	1:A:214:CYS:SG	0.42	3.12	11	3

6.3 Torsion angles

6.3.1 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 PDB entries followed by that with respect to all NMR entries. 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	105/145 (72%)	97±1 (92±1%)	8±1 (7±1%)	1±1 (1±1%)	28	74
All	All	2100/2900 (72%)	1932 (92%)	154 (7%)	14 (1%)	28	74

All 4 unique Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	176	VAL	9
1	A	165	PRO	3
1	A	175	PHE	1
1	A	196	GLU	1

6.3.2 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 PDB entries followed by that with respect to all NMR entries. 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	95/122 (78%)	82±2 (86±2%)	13±2 (14±2%)	7 47
All	All	1900/2440 (78%)	1633 (86%)	267 (14%)	7 47

All 38 unique residues with a non-rotameric sidechain are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	217	GLN	20
1	A	206	MET	20
1	A	204	LYS	19
1	A	132	SER	19
1	A	191	THR	18
1	A	143	SER	15
1	A	214	CYS	14
1	A	219	GLU	14
1	A	107	THR	14
1	A	192	THR	14
1	A	185	LYS	13
1	A	175	PHE	10
1	A	190	THR	8
1	A	186	GLN	7
1	A	136	ARG	7
1	A	140	HIS	6
1	A	144	ASP	6
1	A	164	ARG	5
1	A	150	TYR	5
1	A	145	TYR	4
1	A	201	THR	3
1	A	194	LYS	3
1	A	148	ARG	3
1	A	179	CYS	3
1	A	222	SER	2
1	A	199	THR	2
1	A	112	MET	2
1	A	223	GLN	1
1	A	177	HIS	1

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Mol	Chain	Res	Type	Models (Total)
1	A	188	THR	1
1	A	182	ILE	1
1	A	208	ARG	1
1	A	111	HIS	1
1	A	106	LYS	1
1	A	108	ASN	1
1	A	110	LYS	1
1	A	151	ARG	1
1	A	178	ASP	1

6.3.3 RNA [i](#)

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

6.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

6.6 Ligand geometry [i](#)

There are no ligands in this entry.

6.7 Other polymers [i](#)

There are no such molecules in this entry.

6.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

7 Chemical shift validation

The completeness of assignment taking into account all chemical shift lists is 78% for the well-defined parts and 71% for the entire structure.

7.1 Chemical shift list 1

File name: 5l6r_cs.cif

Chemical shift list name: *PrP226_chemical_shifts.str*

7.1.1 Bookkeeping

The following table shows the results of parsing the chemical shift list and reports the number of nuclei with statistically unusual chemical shifts.

Total number of shifts	1435
Number of shifts mapped to atoms	1435
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	0

7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction \pm precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	127	-0.11 ± 0.17	None needed (< 0.5 ppm)
$^{13}\text{C}_\beta$	112	0.19 ± 0.11	None needed (< 0.5 ppm)
$^{13}\text{C}'$	0	—	None (insufficient data)
^{15}N	129	-0.32 ± 0.09	None needed (< 0.5 ppm)

7.1.3 Completeness of resonance assignments

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 78%, i.e. 1052 atoms were assigned a chemical shift out of a possible 1341. 10 out of 10 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	400/517 (77%)	200/206 (97%)	101/210 (48%)	99/101 (98%)
Sidechain	537/677 (79%)	336/401 (84%)	191/240 (80%)	10/36 (28%)

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	Total	¹ H	¹³ C	¹⁵ N
Aromatic	115/147 (78%)	59/75 (79%)	56/62 (90%)	0/10 (0%)
Overall	1052/1341 (78%)	595/682 (87%)	348/512 (68%)	109/147 (74%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 71%, i.e. 1274 atoms were assigned a chemical shift out of a possible 1783. 11 out of 11 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹ H	¹³ C	¹⁵ N
Backbone	511/715 (71%)	255/285 (89%)	127/290 (44%)	129/140 (92%)
Sidechain	632/845 (75%)	396/502 (79%)	223/298 (75%)	13/45 (29%)
Aromatic	131/223 (59%)	67/113 (59%)	63/85 (74%)	1/25 (4%)
Overall	1274/1783 (71%)	718/900 (80%)	413/673 (61%)	143/210 (68%)

7.1.4 Statistically unusual chemical shifts [i](#)

There are no statistically unusual chemical shifts.

7.1.5 Random Coil Index (RCI) plots [i](#)

The image below reports *random coil index* values for the protein chains in the structure. The height of each bar gives a probability of a given residue to be disordered, as predicted from the available chemical shifts and the amino acid sequence. A value above 0.2 is an indication of significant predicted disorder. The colour of the bar shows whether the residue is in the well-defined core (black) or in the ill-defined residue ranges (cyan), as described in section 2 on ensemble composition.

Random coil index (RCI) for chain A:

