



# Full wwPDB NMR Structure Validation Report ⓘ

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PDB ID : 1Z1Z  
Title : NMR structure of the gpu tail protein from lambda bacteriophage  
Authors : Edmonds, L.; Maxwell, K.; Davidson, A.; Donaldson, L.W.  
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This is a Full wwPDB NMR 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  
<http://wwpdb.org/validation/2016/NMRValidationReportHelp>  
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:

Cyrange : Kirchner and Güntert (2011)  
NmrClust : Kelley et al. (1996)  
MolProbity : 4.02b-467  
Mogul : unknown  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
RCI : v\_1n\_11\_5\_13\_A (Berjanski et al., 2005)  
PANAV : Wang et al. (2010)  
ShiftChecker : rb-20027457  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : rb-20027457

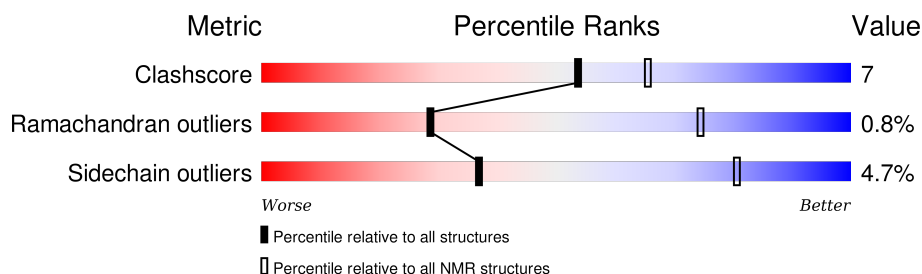
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*SOLUTION NMR*


The overall completeness of chemical shifts assignment is 87%.

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	114402	11133
Ramachandran outliers	111179	9975
Sidechain outliers	111093	9958

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  $\geq 3$ , 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	131	 81% 16% ••

## 2 Ensemble composition and analysis ⓘ

This entry contains 1 models. Identification of well-defined residues and clustering analysis are not possible.

### 3 Entry composition [i](#)

There is only 1 type of molecule in this entry. The entry contains 1956 atoms, of which 941 are hydrogens and 0 are deuteriums.


- Molecule 1 is a protein called Minor tail protein U.

Mol	Chain	Residues	Atoms						Trace
1	A	129	Total	C	H	N	O	S	0
			1956	645	941	157	210	3	

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

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: Minor tail protein U

Chain A:  81% 16% ..



## 5 Refinement protocol and experimental data overview

The models were refined using the following method: *simulated annealing*.

Of the ? calculated structures, 1 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 solution	2.1.3
XPLOR-NIH	refinement	2.9.9

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)	BMRB entry 6434
Number of chemical shift lists	1
Total number of shifts	1537
Number of shifts mapped to atoms	1454
Number of unparsed shifts	0
Number of shifts with mapping errors	83
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	87%

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](#)

There are no covalent bond-length or bond-angle outliers.

There are no bond-length outliers.

There are no bond-angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 6.2 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 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	1015	941	938	13
All	All	1015	941	938	13

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 clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)
1:A:105:SER:HB2	1:A:124:THR:O	0.59	1.98
1:A:81:MET:O	1:A:85:ILE:HB	0.52	2.05
1:A:77:LEU:O	1:A:81:MET:HG2	0.50	2.05
1:A:104:ALA:HA	1:A:125:TYR:CZ	0.50	2.41
1:A:20:GLY:HA2	1:A:23:PHE:CZ	0.48	2.43
1:A:3:HIS:NE2	1:A:52:GLU:HA	0.46	2.25
1:A:110:ARG:O	1:A:120:SER:HB2	0.46	2.11
1:A:111:ARG:HA	1:A:111:ARG:NE	0.45	2.26
1:A:104:ALA:HA	1:A:125:TYR:CE1	0.45	2.45
1:A:20:GLY:HA2	1:A:23:PHE:CE2	0.45	2.47
1:A:19:THR:OG1	1:A:84:ARG:HG2	0.43	2.13
1:A:6:LEU:HD12	1:A:7:ARG:N	0.43	2.28
1:A:6:LEU:O	1:A:10:VAL:HG12	0.42	2.14

## 6.3 Torsion angles [i](#)

### 6.3.1 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 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	127/131 (97%)	119 (94%)	7 (6%)	1 (1%)	29	74
All	All	127/131 (97%)	119 (94%)	7 (6%)	1 (1%)	29	74

All 1 Ramachandran outliers are listed below.

Mol	Chain	Res	Type
1	A	51	GLU

### 6.3.2 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 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	107/109 (98%)	102 (95%)	5 (5%)	37	80
All	All	107/109 (98%)	102 (95%)	5 (5%)	37	80

All 5 residues with a non-rotameric sidechain are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type
1	A	111	ARG
1	A	80	TRP
1	A	125	TYR
1	A	102	MET
1	A	64	ILE

### 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 87% for the well-defined parts and 87% for the entire structure.

### 7.1 Chemical shift list 1

File name: BMRB entry 6434

Chemical shift list name: *assigned\_chem\_shift\_list\_1*

#### 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	1537
Number of shifts mapped to atoms	1454
Number of unparsed shifts	0
Number of shifts with mapping errors	83
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	4

The following assigned chemical shifts were not mapped to the molecules present in the coordinate file.

- Residue not found in structure. All 83 occurrences are reported below.

Chain	Res	Type	Atom	Shift Data		
				Value	Uncertainty	Ambiguity
A	13	LEU	CB	42.314	-1.0	1
A	14	VAL	CG1	19.915	-1.0	1
A	11	SER	HB3	3.865	0.02	1
A	15	PRO	HG2	1.87	0.02	2
A	16	ARG	N	122.126	0.4	1
A	14	VAL	HG21	0.923	0.02	1
A	16	ARG	HG3	1.72	0.02	2
A	14	VAL	CB	32.422	-1.0	1
A	13	LEU	CD1	26.435	-1.0	1
A	16	ARG	CA	56.552	-1.0	1
A	13	LEU	N	121.462	0.4	1
A	19	HIS	C	180.45	-1.0	1
A	19	HIS	H	8.773	0.02	1
A	14	VAL	CG2	22.216	-1.0	1

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Chain	Res	Type	Atom	Shift Data		
				Value	Uncertainty	Ambiguity
A	17	GLY	H	8.465	0.02	1
A	14	VAL	HG13	0.923	0.02	1
A	12	GLY	C	179.737	-1.0	1
A	14	VAL	HG22	0.923	0.02	1
A	15	PRO	HA	4.404	0.02	1
A	17	GLY	HA3	4.108	0.02	2
A	12	GLY	N	110.519	0.4	1
A	12	GLY	HA2	3.929	0.02	2
A	15	PRO	CB	32.12	-1.0	1
A	15	PRO	HD3	3.84	0.02	2
A	15	PRO	HB3	2.24	0.02	2
A	13	LEU	HD11	0.891	0.02	2
A	15	PRO	HG3	1.96	0.02	2
A	17	GLY	CA	45.371	-1.0	1
A	16	ARG	C	177.842	-1.0	1
A	15	PRO	CA	63.1	-1.0	1
A	19	HIS	CA	56.349	-1.0	1
A	16	ARG	HD3	3.182	0.02	1
A	19	HIS	N	119.57	0.4	1
A	14	VAL	HG12	0.923	0.02	1
A	11	SER	CA	58.209	-1.0	1
A	13	LEU	C	180.967	-1.0	1
A	12	GLY	CA	45.142	-1.0	1
A	13	LEU	CG	26.818	-1.0	1
A	13	LEU	H	8.039	0.02	1
A	14	VAL	HG23	0.923	0.02	1
A	15	PRO	CD	51.36	-1.0	1
A	13	LEU	HB2	1.589	0.02	1
A	12	GLY	HA3	4.099	0.02	2
A	16	ARG	CD	44.843	-1.0	1
A	13	LEU	HD23	0.86	0.02	2
A	15	PRO	HD2	3.604	0.02	2
A	14	VAL	HB	2.054	0.02	1
A	11	SER	CB	63.688	-1.0	1
A	15	PRO	HB2	1.85	0.02	2
A	13	LEU	HD12	0.891	0.02	2
A	19	HIS	HA	5.12	0.02	1
A	14	VAL	H	8.107	0.02	1
A	11	SER	HA	4.448	0.02	1
A	16	ARG	CG	26.939	-1.0	1
A	19	HIS	CB	39.671	-1.0	1

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Chain	Res	Type	Atom	Shift Data		
				Value	Uncertainty	Ambiguity
A	13	LEU	HG	1.56	0.02	1
A	19	HIS	HE1	7.114	0.02	3
A	16	ARG	HD2	3.182	0.02	1
A	17	GLY	N	109.604	0.4	1
A	14	VAL	HA	4.404	0.02	1
A	16	ARG	HB3	1.793	0.02	2
A	13	LEU	CA	55.033	-1.0	1
A	11	SER	HB2	3.865	0.02	1
A	14	VAL	HG11	0.923	0.02	1
A	16	ARG	HA	4.291	0.02	1
A	12	GLY	H	8.388	0.02	1
A	14	VAL	C	177.621	-1.0	1
A	16	ARG	HG2	1.65	0.02	2
A	15	PRO	CG	27.59	-1.0	1
A	14	VAL	CA	60.215	-1.0	1
A	13	LEU	CD2	23.367	-1.0	1
A	16	ARG	CB	30.737	-1.0	1
A	13	LEU	HB3	1.589	0.02	1
A	17	GLY	HA2	3.886	0.02	2
A	16	ARG	H	8.56	0.02	1
A	14	VAL	N	122.452	0.4	1
A	19	HIS	CE1	130.87	-1.0	1
A	13	LEU	HD22	0.86	0.02	2
A	13	LEU	HD13	0.891	0.02	2
A	17	GLY	C	177.74	-1.0	1
A	13	LEU	HA	4.342	0.02	1
A	13	LEU	HD21	0.86	0.02	2
A	16	ARG	HB2	1.842	0.02	2

### 7.1.2 Chemical shift referencing ⓘ

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction $\pm$ precision, <i>ppm</i>	Suggested action
$^{13}\text{C}_\alpha$	136	$-0.64 \pm 0.19$	Should be applied
$^{13}\text{C}_\beta$	128	$0.04 \pm 0.15$	None needed ( $< 0.5$ ppm)
$^{13}\text{C}'$	122	$-2.62 \pm 0.24$	Should be applied
$^{15}\text{N}$	127	$1.01 \pm 0.48$	Should be applied

### 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 87%, i.e. 1316 atoms were assigned a chemical shift out of a possible 1505. 19 out of 21 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Backbone	606/633 (96%)	244/252 (97%)	242/258 (94%)	120/123 (98%)
Sidechain	574/711 (81%)	343/410 (84%)	224/282 (79%)	7/19 (37%)
Aromatic	136/161 (84%)	71/83 (86%)	62/69 (90%)	3/9 (33%)
Overall	1316/1505 (87%)	658/745 (88%)	528/609 (87%)	130/151 (86%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 87%, i.e. 1316 atoms were assigned a chemical shift out of a possible 1505. 19 out of 21 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Backbone	606/633 (96%)	244/252 (97%)	242/258 (94%)	120/123 (98%)
Sidechain	574/711 (81%)	343/410 (84%)	224/282 (79%)	7/19 (37%)
Aromatic	136/161 (84%)	71/83 (86%)	62/69 (90%)	3/9 (33%)
Overall	1316/1505 (87%)	658/745 (88%)	528/609 (87%)	130/151 (86%)

### 7.1.4 Statistically unusual chemical shifts ⓘ

The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, ppm	Expected range, ppm	Z-score
1	A	111	ARG	NE	111.34	92.63 – 76.73	16.8
1	A	28	PRO	HG2	0.12	3.48 – 0.38	-5.8
1	A	27	ARG	HB2	0.29	3.15 – 0.45	-5.6
1	A	28	PRO	HG3	0.24	3.56 – 0.26	-5.1

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

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:

