



# Full wwPDB NMR Structure Validation Report ⓘ

Feb 13, 2017 – 01:21 am GMT

PDB ID : 2MVB  
Title : NMR structure of the protein NP\_344732.1 from Streptococcus pneumoniae TIGR4  
Authors : Dutta, S.K.; Serrano, P.; Geralt, M.; Wuthrich, K.; Joint Center for Structural Genomics (JCSG)  
Deposited on : 2014-10-01

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  
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)  
RCI : v\_1n\_11\_5\_13\_A (Berjanski et al., 2005)  
PANAV : Wang et al. (2010)  
ShiftChecker : trunk28760  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : recalc28949

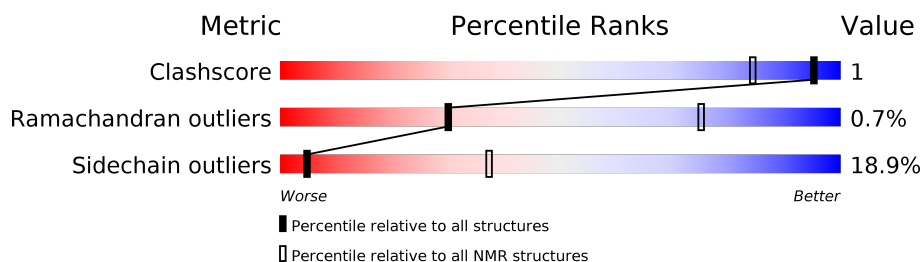
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*SOLUTION NMR*

The overall completeness of chemical shifts assignment is 85%.

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	125131	11601
Ramachandran outliers	121729	10391
Sidechain outliers	121581	10367

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	165	 73% 10% 18%

## 2 Ensemble composition and analysis

This entry contains 20 models. Model 12 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *closest to the average*.

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:26-A:35, A:40-A:165 (136)	0.53	12

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 3 clusters. No single-model clusters were found.

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

### 3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 2396 atoms, of which 1104 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Uncharacterized protein.

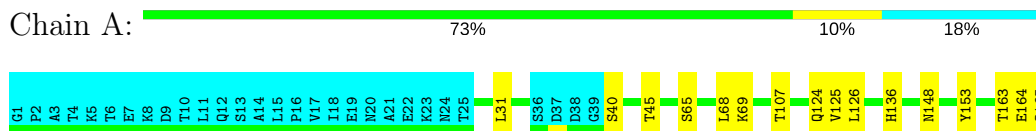
Mol	Chain	Residues	Atoms					Trace
1	A	165	Total	C	H	N	O	0
			2396	809	1104	216	267	

## 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: Uncharacterized protein

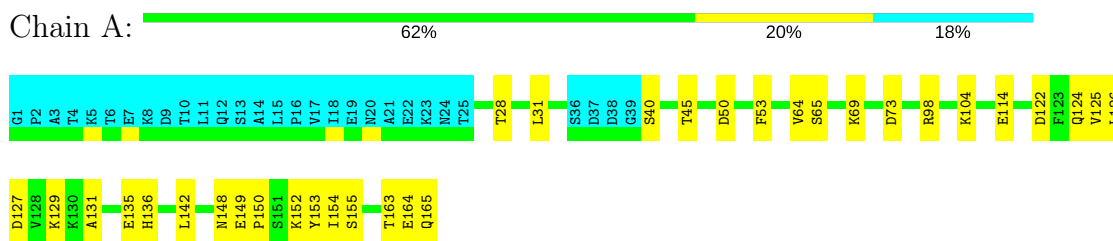


### 4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

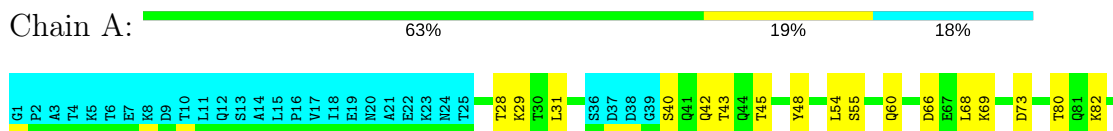
#### 4.2.1 Score per residue for model 1

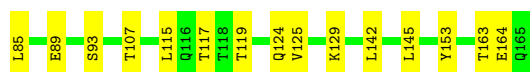
- Molecule 1: Uncharacterized protein



#### 4.2.2 Score per residue for model 2

- Molecule 1: Uncharacterized protein





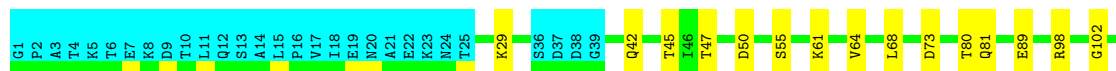
### 4.2.3 Score per residue for model 3

- Molecule 1: Uncharacterized protein



### 4.2.4 Score per residue for model 4

- Molecule 1: Uncharacterized protein



### 4.2.5 Score per residue for model 5

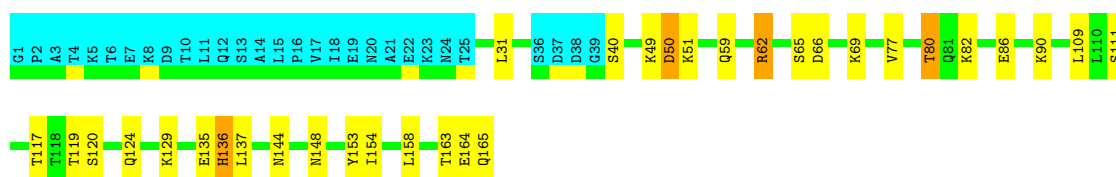
- Molecule 1: Uncharacterized protein



### 4.2.6 Score per residue for model 6

- Molecule 1: Uncharacterized protein

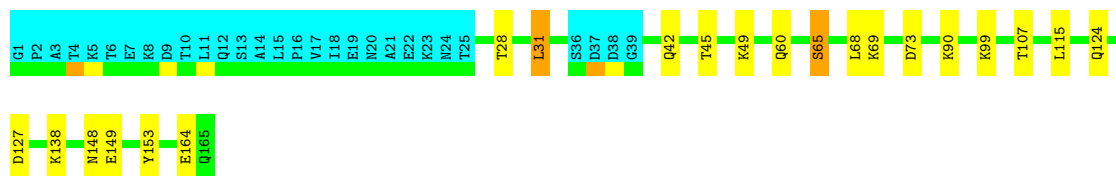




#### 4.2.7 Score per residue for model 7

- Molecule 1: Uncharacterized protein

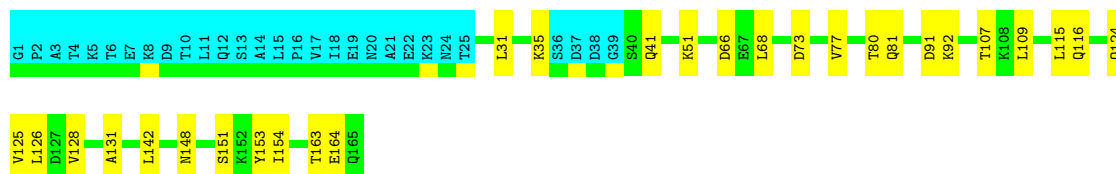
Chain A: 70% 12% 18%



#### 4.2.8 Score per residue for model 8

- Molecule 1: Uncharacterized protein

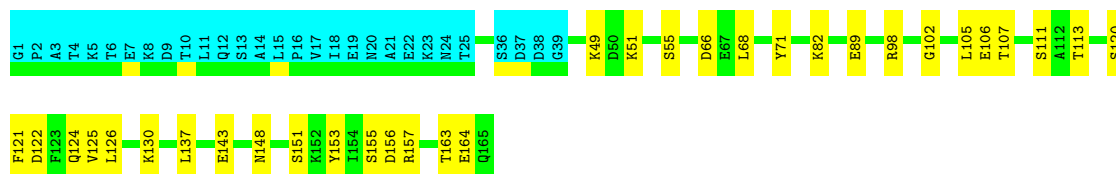
Chain A: 65% 17% 18%



#### 4.2.9 Score per residue for model 9

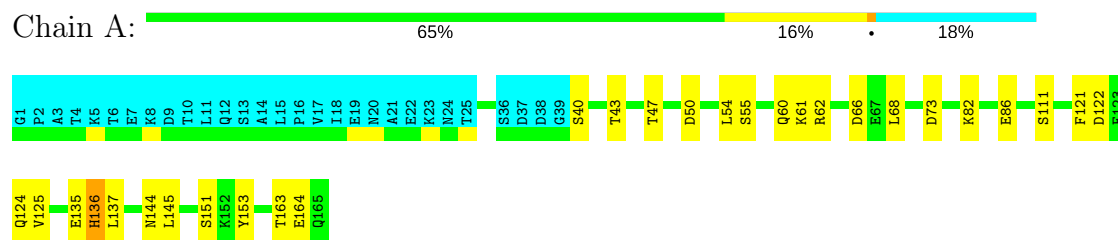
- Molecule 1: Uncharacterized protein

Chain A: 63% 19% 18%



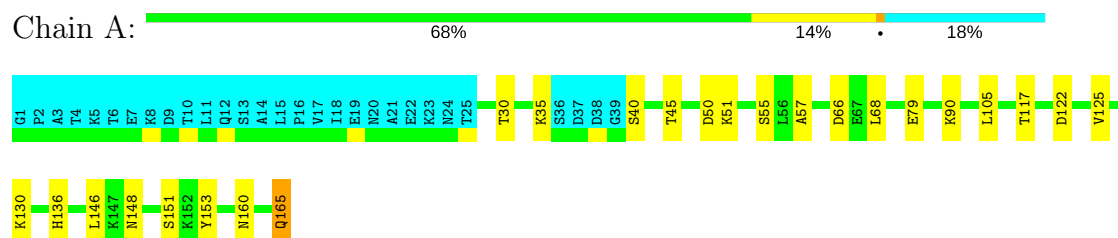
#### 4.2.10 Score per residue for model 10

- Molecule 1: Uncharacterized protein



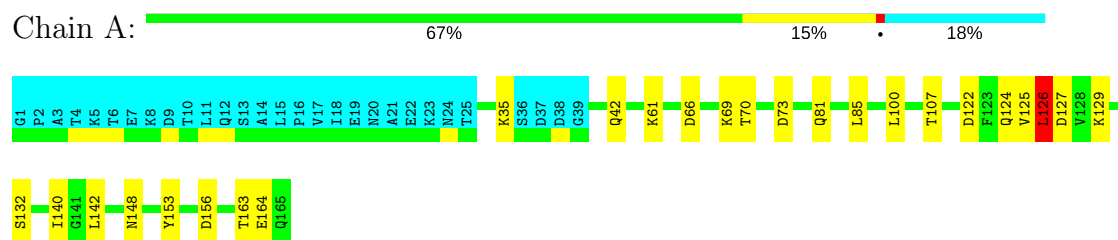
#### 4.2.11 Score per residue for model 11

- Molecule 1: Uncharacterized protein



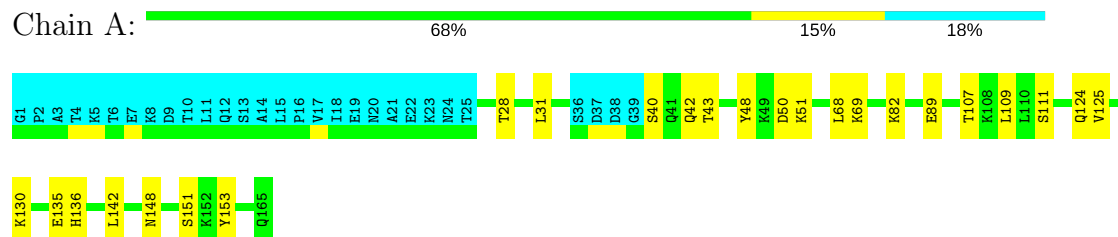
#### 4.2.12 Score per residue for model 12 (medoid)

- Molecule 1: Uncharacterized protein



#### 4.2.13 Score per residue for model 13

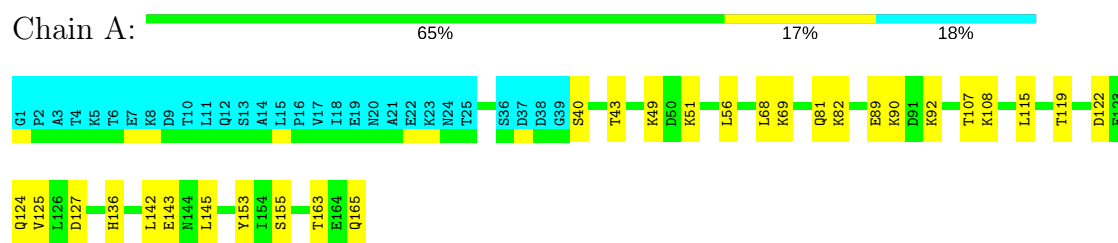
- Molecule 1: Uncharacterized protein





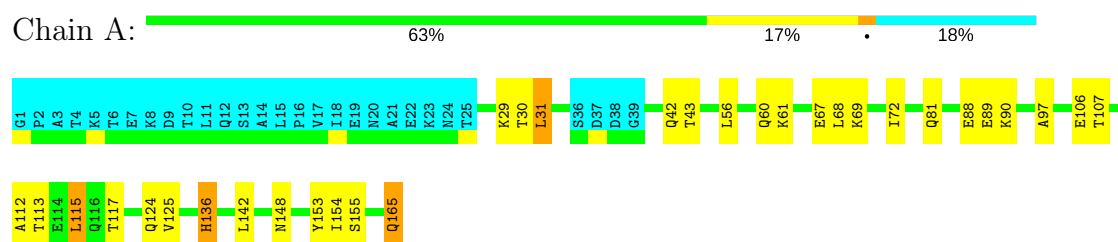
#### 4.2.14 Score per residue for model 14

- Molecule 1: Uncharacterized protein



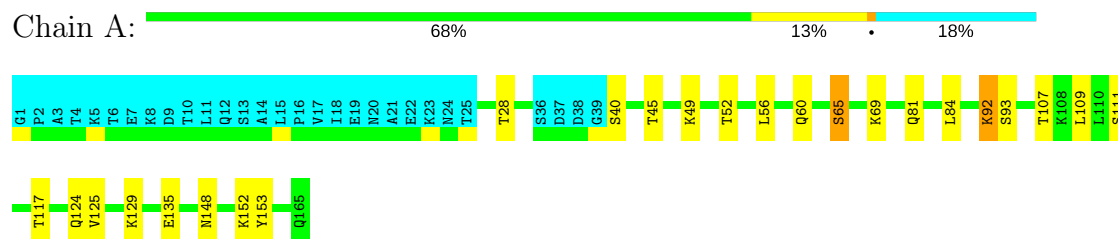
#### 4.2.15 Score per residue for model 15

- Molecule 1: Uncharacterized protein



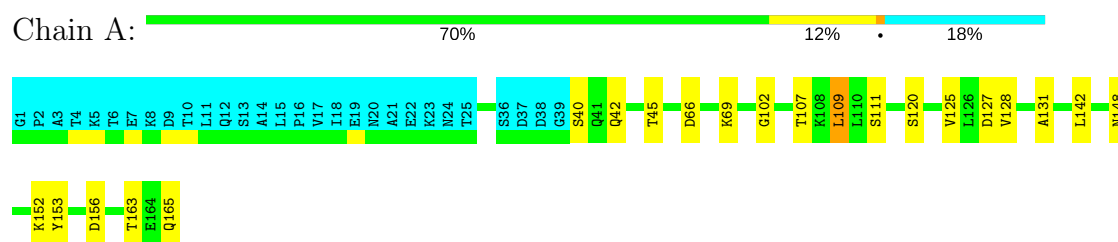
#### 4.2.16 Score per residue for model 16

- Molecule 1: Uncharacterized protein



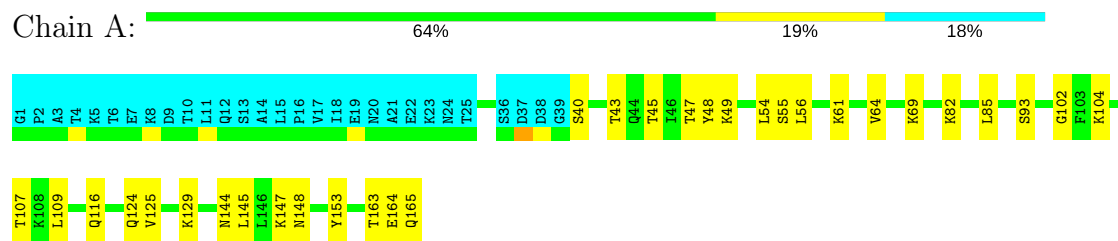
#### 4.2.17 Score per residue for model 17

- Molecule 1: Uncharacterized protein



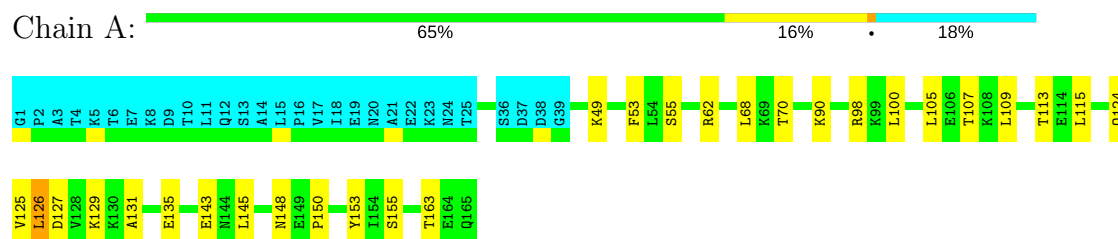
## 4.2.18 Score per residue for model 18

- Molecule 1: Uncharacterized protein



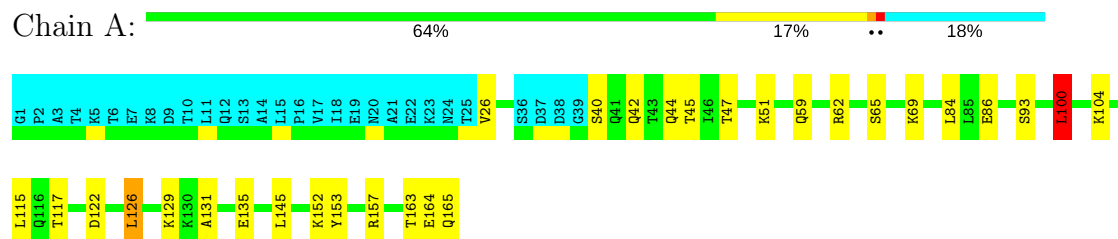
## 4.2.19 Score per residue for model 19

- Molecule 1: Uncharacterized protein



## 4.2.20 Score per residue for model 20

- Molecule 1: Uncharacterized protein



## 5 Refinement protocol and experimental data overview

The models were refined using the following method: *molecular dynamics*.

Of the 80 calculated structures, 20 were deposited, based on the following criterion: *target function*.

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

Software name	Classification	Version
CYANA	structure solution	3.0
OPAL	refinement	
CNS	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)	2mvp_cs.str
Number of chemical shift lists	1
Total number of shifts	1898
Number of shifts mapped to atoms	1898
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	85%

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	0.54±0.01	0±0/1092 (0.0±0.0%)	0.97±0.02	1±1/1470 (0.0±0.0%)
All	All	0.54	0/21840 (0.0%)	0.97	10/29400 (0.0%)

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	Planarity
1	A	0.0±0.0	0.3±0.5
All	All	0	7

There are no bond-length outliers.

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	115	LEU	CB-CG-CD2	5.85	120.94	111.00	15	1
1	A	31	LEU	CB-CG-CD2	5.64	120.60	111.00	7	3
1	A	100	LEU	CB-CG-CD2	5.64	120.59	111.00	20	2
1	A	62	ARG	NE-CZ-NH1	5.49	123.05	120.30	19	1
1	A	98	ARG	NE-CZ-NH2	-5.33	117.63	120.30	4	1
1	A	126	LEU	CB-CG-CD2	5.18	119.80	111.00	12	1
1	A	105	LEU	CB-CG-CD2	5.11	119.68	111.00	11	1

There are no chirality outliers.

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

Mol	Chain	Res	Type	Group	Models (Total)
1	A	48	TYR	Sidechain	3

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Mol	Chain	Res	Type	Group	Models (Total)
1	A	164	GLU	Peptide	1
1	A	68	LEU	Peptide	1
1	A	62	ARG	Sidechain	1
1	A	71	TYR	Sidechain	1

## 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	1081	936	1125	3±2
All	All	21620	18720	22500	53

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:31:LEU:HD21	1:A:154:ILE:HG23	0.65	1.67	1	4
1:A:121:PHE:CE1	1:A:137:LEU:HD21	0.58	2.33	9	2
1:A:102:GLY:CA	1:A:125:VAL:HG13	0.57	2.29	4	5
1:A:45:THR:HB	1:A:57:ALA:HB3	0.56	1.77	11	1
1:A:126:LEU:HD11	1:A:131:ALA:CB	0.55	2.32	1	1
1:A:126:LEU:HD22	1:A:127:ASP:N	0.53	2.18	19	2
1:A:126:LEU:HD21	1:A:131:ALA:HB2	0.52	1.82	8	4
1:A:100:LEU:HD12	1:A:126:LEU:HD22	0.51	1.83	20	2
1:A:102:GLY:HA3	1:A:125:VAL:HG13	0.50	1.84	9	3
1:A:102:GLY:HA2	1:A:125:VAL:HG13	0.49	1.84	4	2
1:A:126:LEU:HD22	1:A:127:ASP:H	0.49	1.66	19	1
1:A:77:VAL:HG23	1:A:109:LEU:HD23	0.48	1.83	8	2
1:A:136:HIS:HB3	1:A:137:LEU:HD12	0.48	1.85	6	2
1:A:126:LEU:HD13	1:A:128:VAL:N	0.47	2.25	8	1
1:A:126:LEU:HD11	1:A:131:ALA:HB3	0.46	1.87	1	1
1:A:30:THR:HG23	1:A:165:GLN:H	0.46	1.70	15	1
1:A:30:THR:HG21	1:A:165:GLN:CG	0.45	2.41	11	1
1:A:31:LEU:HD23	1:A:164:GLU:HG2	0.45	1.88	3	1
1:A:64:VAL:HG11	1:A:68:LEU:HD22	0.44	1.88	5	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:80:THR:HB	1:A:109:LEU:HD22	0.44	1.89	8	2
1:A:31:LEU:HD11	1:A:154:ILE:HG23	0.43	1.91	15	1
1:A:53:PHE:CZ	1:A:150:PRO:HA	0.42	2.48	1	1
1:A:97:ALA:HB2	1:A:136:HIS:CD2	0.42	2.48	15	1
1:A:72:ILE:HD13	1:A:112:ALA:O	0.42	2.15	15	1
1:A:48:TYR:HA	1:A:54:LEU:HD23	0.42	1.91	18	2
1:A:26:VAL:CG1	1:A:47:THR:HG23	0.41	2.45	20	1
1:A:53:PHE:CE1	1:A:150:PRO:HA	0.41	2.50	19	1
1:A:105:LEU:HD23	1:A:106:GLU:N	0.41	2.31	9	1
1:A:109:LEU:HD12	1:A:111:SER:H	0.41	1.75	17	1
1:A:128:VAL:HA	1:A:131:ALA:HB3	0.41	1.93	17	1
1:A:81:GLN:O	1:A:85:LEU:HD22	0.40	2.17	12	1
1:A:158:LEU:C	1:A:158:LEU:HD13	0.40	2.37	6	1
1:A:30:THR:C	1:A:31:LEU:HD22	0.40	2.36	15	1

## 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	135/165 (82%)	120±3 (89±2%)	14±3 (10±2%)	1±1 (1±1%)	30	75
All	All	2700/3300 (82%)	2398 (89%)	283 (10%)	19 (1%)	30	75

All 7 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	65	SER	5
1	A	135	GLU	4
1	A	64	VAL	3
1	A	50	ASP	3
1	A	92	LYS	2
1	A	146	LEU	1
1	A	49	LYS	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	123/147 (84%)	100±3 (81±3%)	23±3 (19±3%)	5	37
All	All	2460/2940 (84%)	1996 (81%)	464 (19%)	5	37

All 88 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	153	TYR	20
1	A	124	GLN	16
1	A	148	ASN	16
1	A	107	THR	15
1	A	163	THR	14
1	A	69	LYS	13
1	A	68	LEU	11
1	A	125	VAL	11
1	A	40	SER	11
1	A	164	GLU	11
1	A	45	THR	10
1	A	122	ASP	10
1	A	42	GLN	10
1	A	142	LEU	9
1	A	129	LYS	9
1	A	73	ASP	9
1	A	165	GLN	9
1	A	49	LYS	8
1	A	136	HIS	8
1	A	115	LEU	8
1	A	66	ASP	8
1	A	89	GLU	8
1	A	145	LEU	7
1	A	43	THR	7
1	A	55	SER	7
1	A	51	LYS	7
1	A	82	LYS	7
1	A	117	THR	7
1	A	50	ASP	6

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Mol	Chain	Res	Type	Models (Total)
1	A	90	LYS	6
1	A	60	GLN	6
1	A	151	SER	6
1	A	65	SER	6
1	A	111	SER	6
1	A	155	SER	6
1	A	28	THR	5
1	A	61	LYS	5
1	A	81	GLN	5
1	A	127	ASP	5
1	A	109	LEU	5
1	A	56	LEU	4
1	A	93	SER	4
1	A	47	THR	4
1	A	143	GLU	4
1	A	29	LYS	4
1	A	152	LYS	4
1	A	144	ASN	4
1	A	126	LEU	4
1	A	130	LYS	4
1	A	59	GLN	3
1	A	62	ARG	3
1	A	156	ASP	3
1	A	157	ARG	3
1	A	86	GLU	3
1	A	135	GLU	3
1	A	113	THR	3
1	A	120	SER	3
1	A	98	ARG	3
1	A	35	LYS	3
1	A	119	THR	3
1	A	80	THR	3
1	A	104	LYS	3
1	A	138	LYS	2
1	A	85	LEU	2
1	A	31	LEU	2
1	A	70	THR	2
1	A	84	LEU	2
1	A	41	GLN	2
1	A	116	GLN	2
1	A	92	LYS	2
1	A	149	GLU	2

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Mol	Chain	Res	Type	Models (Total)
1	A	132	SER	2
1	A	99	LYS	1
1	A	54	LEU	1
1	A	79	GLU	1
1	A	106	GLU	1
1	A	44	GLN	1
1	A	105	LEU	1
1	A	140	ILE	1
1	A	91	ASP	1
1	A	147	LYS	1
1	A	160	ASN	1
1	A	88	GLU	1
1	A	114	GLU	1
1	A	108	LYS	1
1	A	67	GLU	1
1	A	100	LEU	1
1	A	52	THR	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 ⓘ

There are no chain breaks in this entry.

## 7 Chemical shift validation

The completeness of assignment taking into account all chemical shift lists is 85% for the well-defined parts and 82% for the entire structure.

### 7.1 Chemical shift list 1

File name: 2mvp\_cs.str

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	1898
Number of shifts mapped to atoms	1898
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	1

#### 7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction $\pm$ precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	165	$2.16 \pm 0.05$	Should be applied
$^{13}\text{C}_\beta$	159	$2.42 \pm 0.08$	Should be applied
$^{13}\text{C}'$	0	—	None (insufficient data)
$^{15}\text{N}$	159	$-3.30 \pm 0.19$	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 85%, i.e. 1458 atoms were assigned a chemical shift out of a possible 1711. 0 out of 26 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	$^1\text{H}$	$^{13}\text{C}$	$^{15}\text{N}$
Backbone	538/674 (80%)	269/269 (100%)	136/272 (50%)	133/133 (100%)
Sidechain	853/963 (89%)	528/559 (94%)	311/363 (86%)	14/41 (34%)

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	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Aromatic	67/74 (91%)	35/40 (88%)	32/32 (100%)	0/2 (0%)
Overall	1458/1711 (85%)	832/868 (96%)	479/667 (72%)	147/176 (84%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 82%, i.e. 1662 atoms were assigned a chemical shift out of a possible 2027. 0 out of 29 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Backbone	647/815 (79%)	323/325 (99%)	165/330 (50%)	159/160 (99%)
Sidechain	948/1138 (83%)	582/660 (88%)	350/431 (81%)	16/47 (34%)
Aromatic	67/74 (91%)	35/40 (88%)	32/32 (100%)	0/2 (0%)
Overall	1662/2027 (82%)	940/1025 (92%)	547/793 (69%)	175/209 (84%)

#### 7.1.4 Statistically unusual chemical shifts [i](#)

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	150	PRO	HG3	0.24	3.56 – 0.26	-5.1

#### 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:

