



# Full wwPDB NMR Structure Validation Report ⓘ

Sep 6, 2023 – 10:12 am BST

PDB ID : 7ZAP  
BMRB ID : 34715  
Title : Solution structure of RBM39 RRM1 bound to U1 snRNA stem loop 3  
Authors : Campagne, S.; Allain, F.H.  
Deposited on : 2022-03-22

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

<https://www.wwpdb.org/validation/2017/NMRValidationReportHelp>

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  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
wwPDB-RCI : v\_1n\_11\_5\_13\_A (Berjanski et al., 2005)  
PANAV : Wang et al. (2010)  
wwPDB-ShiftChecker : v1.2  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.35

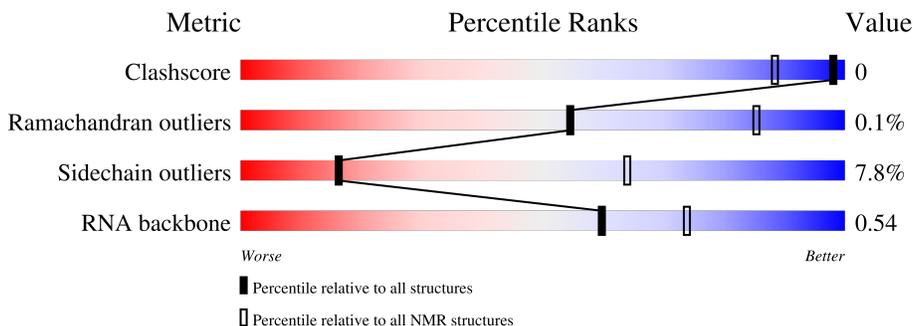
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*SOLUTION NMR*

The overall completeness of chemical shifts assignment is 67%.

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	158937	12864
Ramachandran outliers	154571	11451
Sidechain outliers	154315	11428
RNA backbone	4643	676

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	97	 66% 30%
2	B	28	 86% 14%

## 2 Ensemble composition and analysis i

This entry contains 20 models. Model 6 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *fewest violations*.

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:151-A:185, A:196-A:228 (68)	0.18	6

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 2 clusters and 3 single-model clusters were found.

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

### 3 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2430 atoms, of which 1082 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called RNA-binding protein 39.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	97	1536	469	780	143	140	4	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	141	MET	-	initiating methionine	UNP G3XAC6

- Molecule 2 is a RNA chain called U1 snRNA SL3.

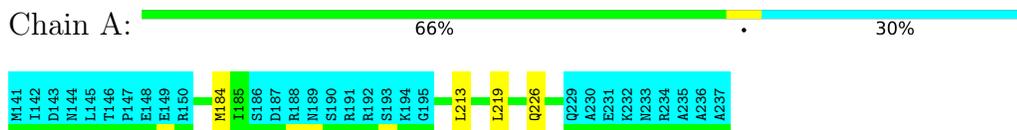
Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	P	
2	B	28	894	266	302	106	193	27	0

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

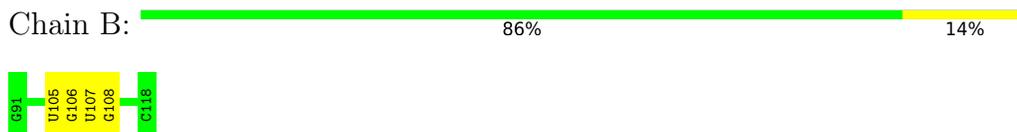
### 4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA, DNA and oligosaccharide 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: RNA-binding protein 39



- Molecule 2: U1 snRNA SL3

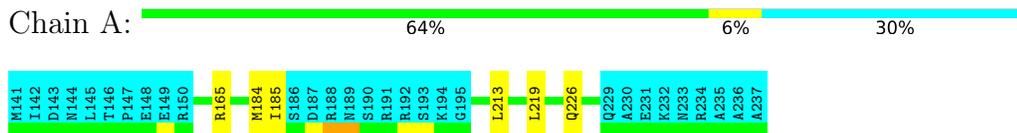


### 4.2 Scores per residue for each member of the ensemble

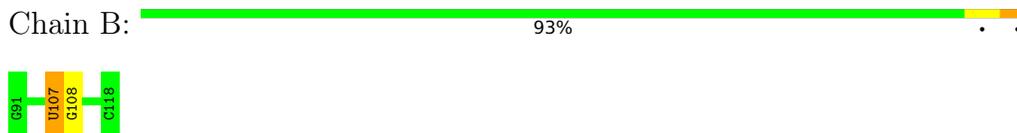
Colouring as in section 4.1 above.

#### 4.2.1 Score per residue for model 1

- Molecule 1: RNA-binding protein 39

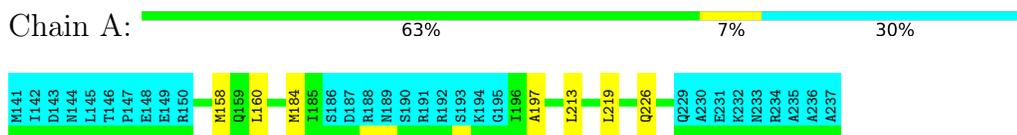


- Molecule 2: U1 snRNA SL3

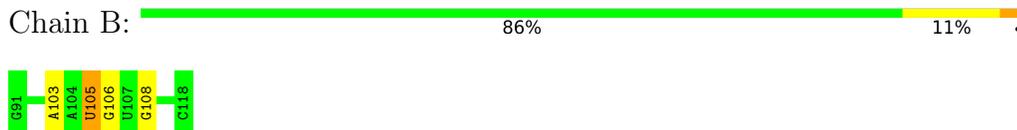


### 4.2.2 Score per residue for model 2

- Molecule 1: RNA-binding protein 39

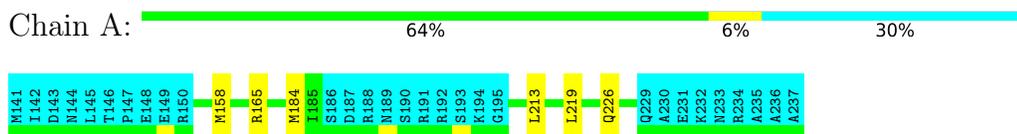


- Molecule 2: U1 snRNA SL3

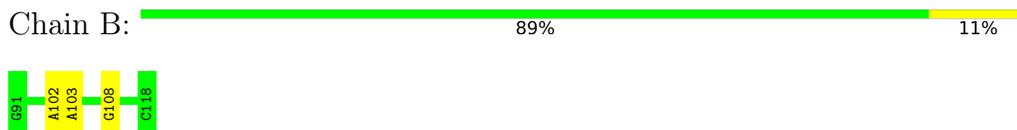


### 4.2.3 Score per residue for model 3

- Molecule 1: RNA-binding protein 39

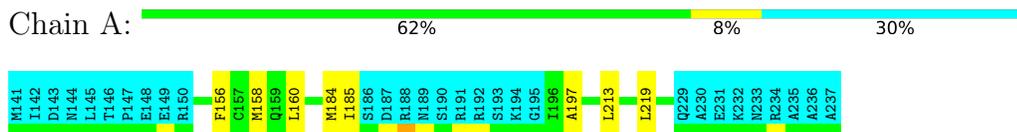


- Molecule 2: U1 snRNA SL3

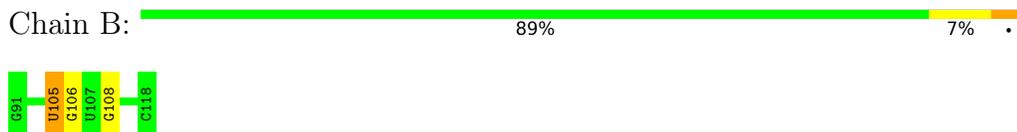


### 4.2.4 Score per residue for model 4

- Molecule 1: RNA-binding protein 39

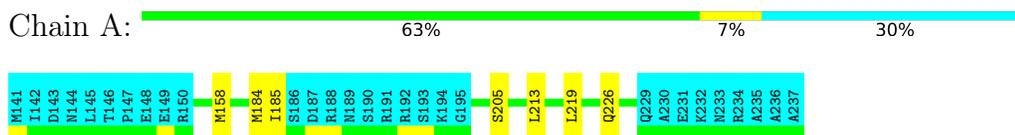


- Molecule 2: U1 snRNA SL3

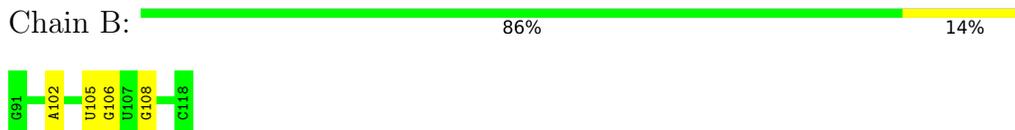


### 4.2.5 Score per residue for model 5

- Molecule 1: RNA-binding protein 39

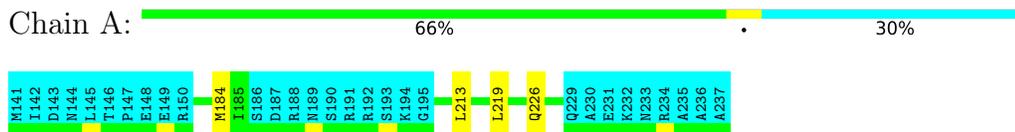


- Molecule 2: U1 snRNA SL3

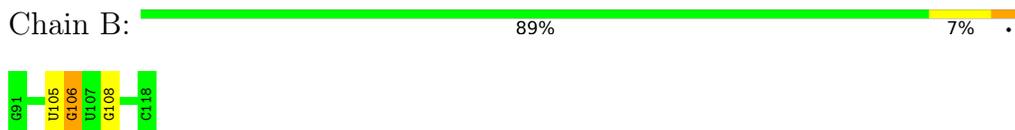


### 4.2.6 Score per residue for model 6 (medoid)

- Molecule 1: RNA-binding protein 39

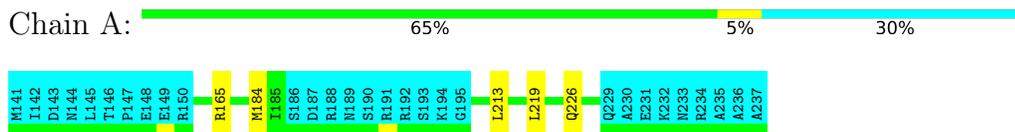


- Molecule 2: U1 snRNA SL3

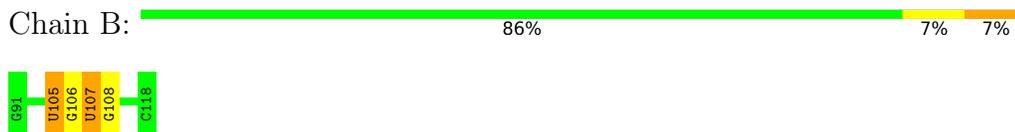


### 4.2.7 Score per residue for model 7

- Molecule 1: RNA-binding protein 39

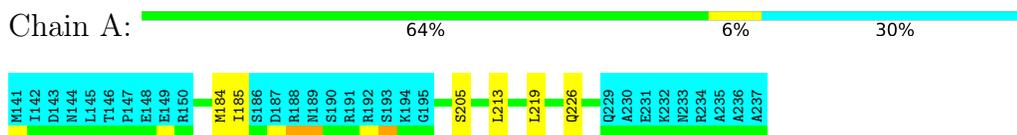


- Molecule 2: U1 snRNA SL3

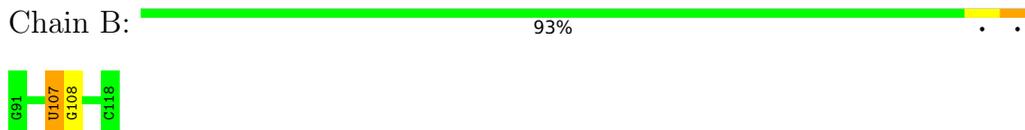


### 4.2.8 Score per residue for model 8

- Molecule 1: RNA-binding protein 39

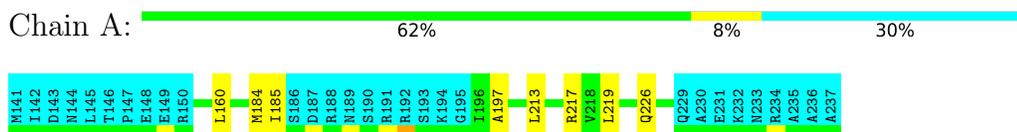


- Molecule 2: U1 snRNA SL3

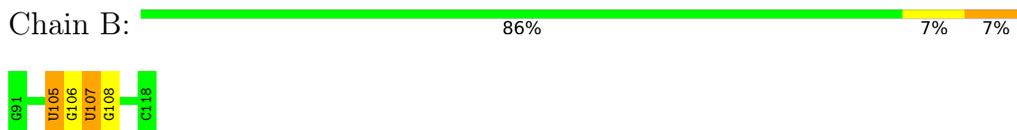


### 4.2.9 Score per residue for model 9

- Molecule 1: RNA-binding protein 39

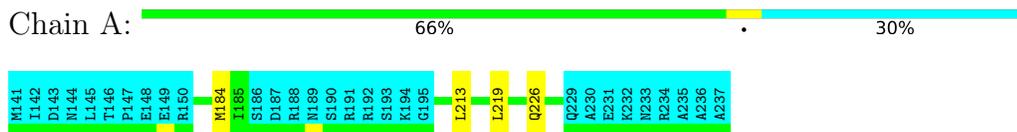


- Molecule 2: U1 snRNA SL3

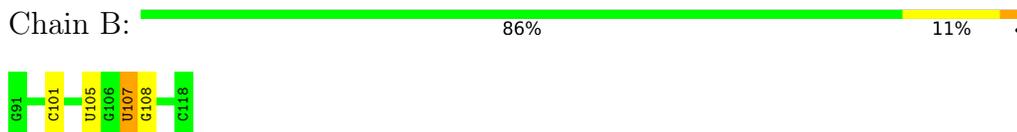


### 4.2.10 Score per residue for model 10

- Molecule 1: RNA-binding protein 39

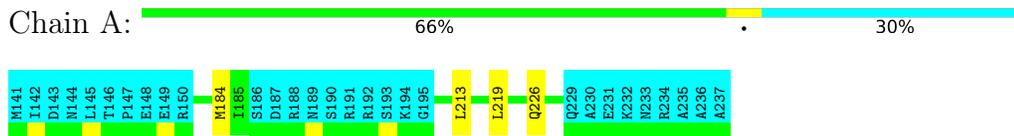


- Molecule 2: U1 snRNA SL3

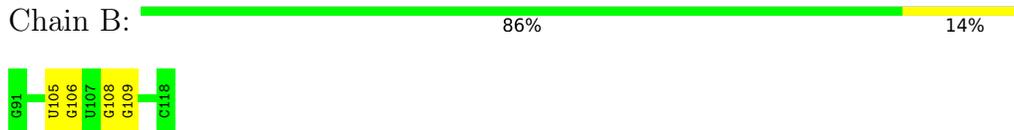


### 4.2.11 Score per residue for model 11

- Molecule 1: RNA-binding protein 39

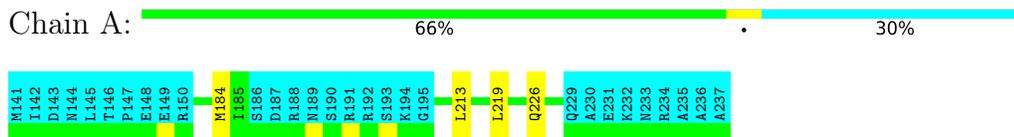


- Molecule 2: U1 snRNA SL3

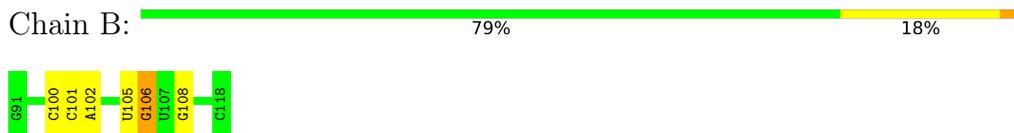


### 4.2.12 Score per residue for model 12

- Molecule 1: RNA-binding protein 39

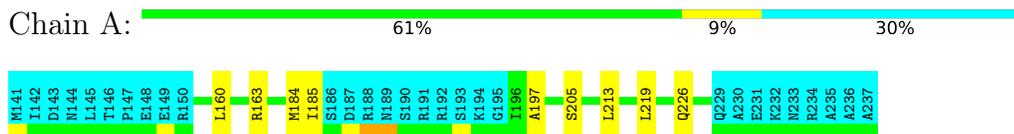


- Molecule 2: U1 snRNA SL3

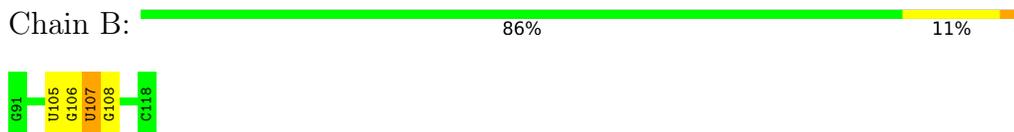


### 4.2.13 Score per residue for model 13

- Molecule 1: RNA-binding protein 39

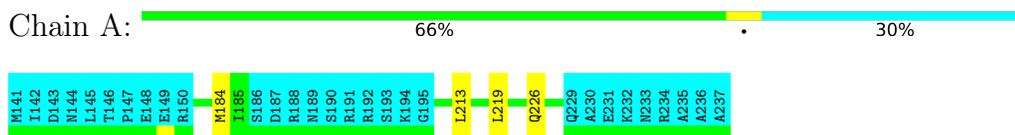


- Molecule 2: U1 snRNA SL3

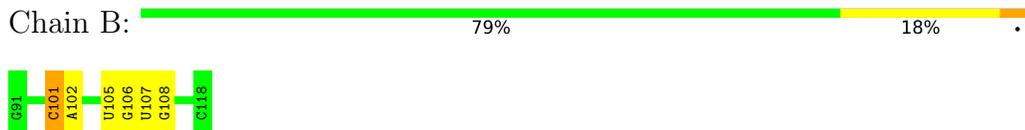


#### 4.2.14 Score per residue for model 14

- Molecule 1: RNA-binding protein 39

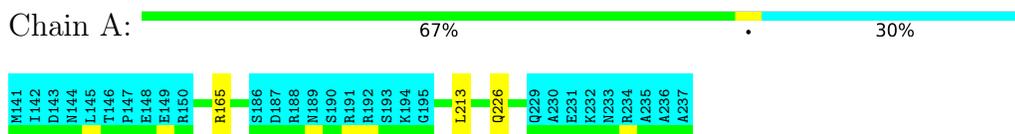


- Molecule 2: U1 snRNA SL3

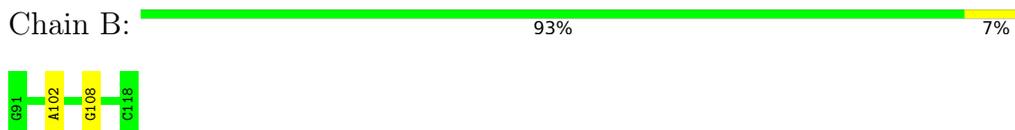


#### 4.2.15 Score per residue for model 15

- Molecule 1: RNA-binding protein 39

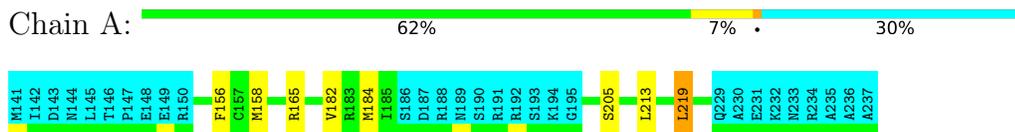


- Molecule 2: U1 snRNA SL3

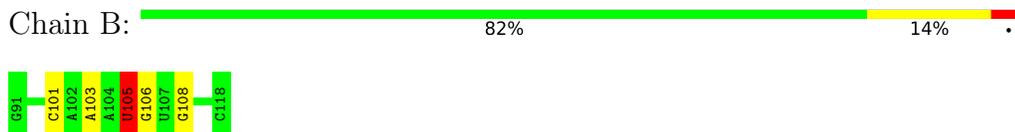


#### 4.2.16 Score per residue for model 16

- Molecule 1: RNA-binding protein 39

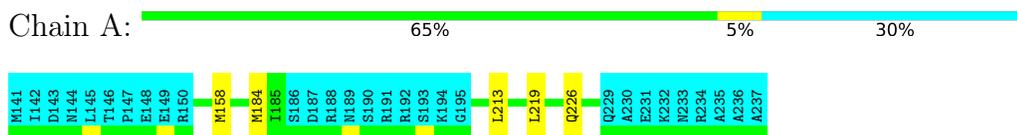


- Molecule 2: U1 snRNA SL3

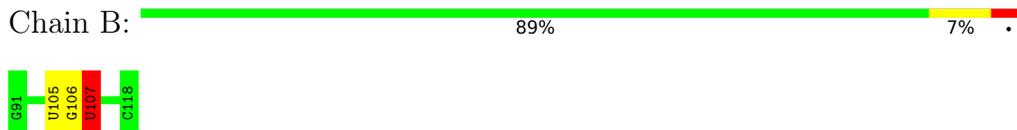


### 4.2.17 Score per residue for model 17

- Molecule 1: RNA-binding protein 39

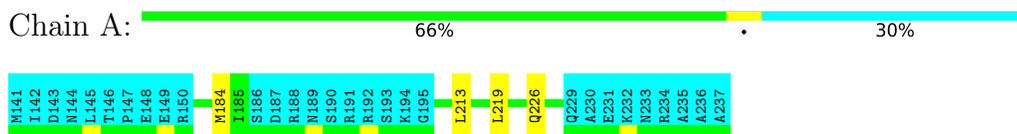


- Molecule 2: U1 snRNA SL3

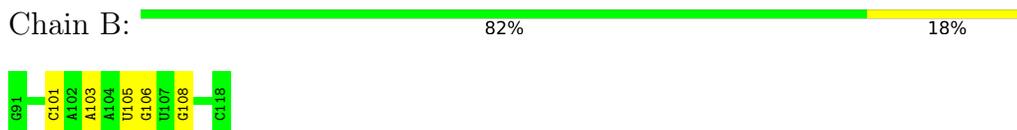


### 4.2.18 Score per residue for model 18

- Molecule 1: RNA-binding protein 39

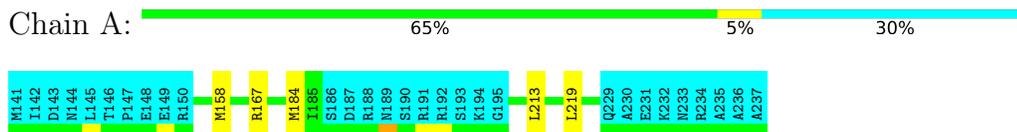


- Molecule 2: U1 snRNA SL3

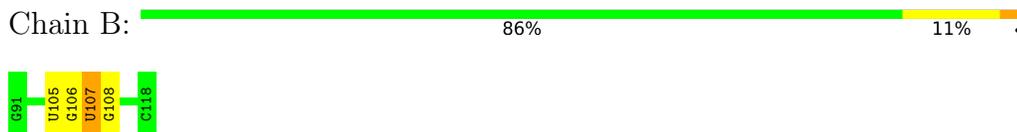


### 4.2.19 Score per residue for model 19

- Molecule 1: RNA-binding protein 39

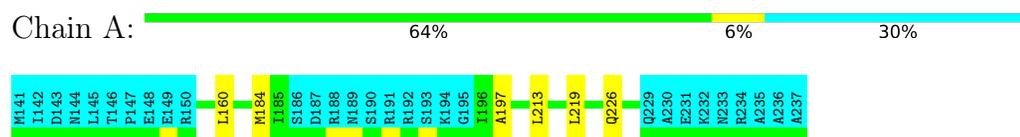


- Molecule 2: U1 snRNA SL3

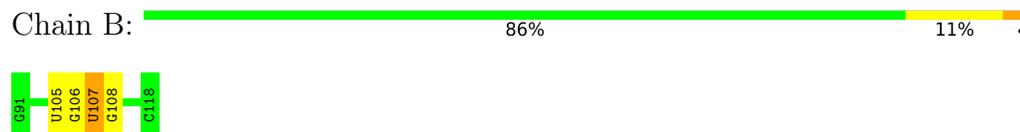


#### 4.2.20 Score per residue for model 20

- Molecule 1: RNA-binding protein 39



- Molecule 2: U1 snRNA SL3



## 5 Refinement protocol and experimental data overview

The models were refined using the following method: *DGSA-distance geometry simulated annealing*.

Of the 500 calculated structures, 20 were deposited, based on the following criterion: *structures with the least restraint violations*.

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

Software name	Classification	Version
Amber	refinement	21
CYANA	structure calculation	3.1

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)	working_cs.cif
Number of chemical shift lists	1
Total number of shifts	1248
Number of shifts mapped to atoms	1248
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	67%

## 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	0.46±0.00	0±0/535 ( 0.0± 0.0%)	0.71±0.01	0±0/726 ( 0.0± 0.0%)
2	B	0.99±0.01	0±0/661 ( 0.0± 0.0%)	1.44±0.01	1±1/1028 ( 0.1± 0.1%)
All	All	0.80	0/23920 ( 0.0%)	1.20	14/35080 ( 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
2	B	0.0±0.0	0.1±0.4
All	All	0	3

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
2	B	107	U	O4'-C1'-N1	6.19	113.15	108.20	7	9
2	B	106	G	O4'-C1'-N9	5.30	112.44	108.20	12	3
2	B	103	A	O4'-C1'-N9	5.12	112.30	108.20	2	1
2	B	101	C	O4'-C1'-N1	5.05	112.24	108.20	12	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)
2	B	100	C	Sidechain	1
2	B	105	U	Sidechain	1
2	B	107	U	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	527	554	554	0±1
2	B	592	302	304	0±0
All	All	22380	17120	17160	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 0.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:156:PHE:CZ	2:B:105:U:C2	0.52	2.97	4	2
1:A:160:LEU:CD2	1:A:197:ALA:HB3	0.43	2.43	13	4
2:B:101:C:H2'	2:B:102:A:C8	0.41	2.50	14	1
2:B:105:U:O2	2:B:105:U:C2'	0.41	2.69	2	5
1:A:160:LEU:CD1	1:A:197:ALA:HB3	0.40	2.46	9	1

## 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	68/97 (70%)	67±1 (99±1%)	1±1 (1±1%)	0±0 (0±0%)	54	85
All	All	1360/1940 (70%)	1343 (99%)	16 (1%)	1 (0%)	54	85

All 1 unique Ramachandran outliers are listed below.

Mol	Chain	Res	Type	Models (Total)
1	A	219	LEU	1

### 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	58/82 (71%)	53±1 (92±1%)	5±1 (8±1%)	16	64
All	All	1160/1640 (71%)	1069 (92%)	91 (8%)	16	64

All 10 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	213	LEU	20
1	A	184	MET	19
1	A	219	LEU	19
1	A	226	GLN	17
1	A	158	MET	7
1	A	165	ARG	5
1	A	217	ARG	1
1	A	163	ARG	1
1	A	182	VAL	1
1	A	167	ARG	1

### 6.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers	Suiteness
2	B	27/28 (96%)	3±1 (13±4%)	1±0 (4±2%)	0.54±0.02
All	All	540/560 (96%)	68 (13%)	19 (4%)	0.54

The overall RNA backbone suiteness is 0.54.

All unique RNA backbone outliers are listed below:

Mol	Chain	Res	Type	Models (Total)
2	B	108	G	19
2	B	106	G	14
2	B	105	U	13
2	B	107	U	10
2	B	102	A	4
2	B	101	C	4

*Continued on next page...*

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Mol	Chain	Res	Type	Models (Total)
2	B	103	A	3
2	B	109	G	1

All unique RNA pucker outliers are listed below:

Mol	Chain	Res	Type	Models (Total)
2	B	105	U	14
2	B	107	U	2
2	B	108	G	2
2	B	102	A	1

## 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 monosaccharides 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 i

The completeness of assignment taking into account all chemical shift lists is 67% for the well-defined parts and 65% for the entire structure.

### 7.1 Chemical shift list 1

File name: working\_cs.cif

Chemical shift list name: *RBM39\_1-SL3.str*

#### 7.1.1 Bookkeeping i

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	1248
Number of shifts mapped to atoms	1248
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 i

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction $\pm$ precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	95	$-0.16 \pm 0.12$	None needed (< 0.5 ppm)
$^{13}\text{C}_\beta$	90	$0.13 \pm 0.25$	None needed (< 0.5 ppm)
$^{13}\text{C}'$	90	$-0.18 \pm 0.20$	None needed (< 0.5 ppm)
$^{15}\text{N}$	0	—	None (insufficient data)

#### 7.1.3 Completeness of resonance assignments i

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 67%, i.e. 1005 atoms were assigned a chemical shift out of a possible 1492. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	$^1\text{H}$	$^{13}\text{C}$	$^{15}\text{N}$
Backbone	205/338 (61%)	72/137 (53%)	133/136 (98%)	0/65 (0%)
Sidechain	487/578 (84%)	332/381 (87%)	155/172 (90%)	0/25 (0%)

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	<b>Total</b>	<b><sup>1</sup>H</b>	<b><sup>13</sup>C</b>	<b><sup>15</sup>N</b>
Aromatic	37/49 (76%)	23/24 (96%)	14/25 (56%)	0/0 (—%)
Sugar	191/308 (62%)	105/168 (62%)	86/140 (61%)	0/0 (—%)
Base	85/219 (39%)	43/135 (32%)	42/49 (86%)	0/35 (0%)
Overall	1005/1492 (67%)	575/845 (68%)	430/522 (82%)	0/125 (0%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 65%, i.e. 1236 atoms were assigned a chemical shift out of a possible 1888. 0 out of 17 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	<b>Total</b>	<b><sup>1</sup>H</b>	<b><sup>13</sup>C</b>	<b><sup>15</sup>N</b>
Backbone	283/482 (59%)	98/195 (50%)	185/194 (95%)	0/93 (0%)
Sidechain	640/830 (77%)	433/539 (80%)	206/245 (84%)	1/46 (2%)
Aromatic	37/49 (76%)	23/24 (96%)	14/25 (56%)	0/0 (—%)
Sugar	191/308 (62%)	105/168 (62%)	86/140 (61%)	0/0 (—%)
Base	85/219 (39%)	43/135 (32%)	42/49 (86%)	0/35 (0%)
Overall	1236/1888 (65%)	702/1061 (66%)	533/653 (82%)	1/174 (1%)

#### 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. If well-defined core and ill-defined regions are not identified then it is shown as gray bars.

Random coil index (RCI) for chain A:

