



# wwPDB NMR Structure Validation Summary Report ⓘ

Feb 13, 2017 – 01:05 am GMT

PDB ID : 2MKC  
Title : Cooperative Structure of the Heterotrimeric pre-mRNA Retention and Splicing Complex  
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Deposited on : 2014-02-04

This is a wwPDB NMR Structure Validation Summary Report for a publicly released PDB entry.

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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

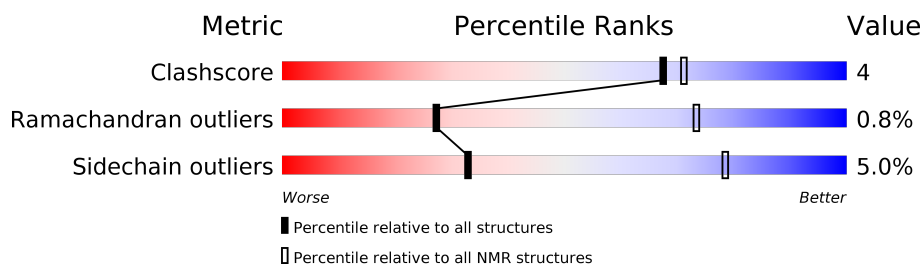
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*SOLUTION NMR*

The overall completeness of chemical shifts assignment is 89%.

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	118	
2	B	23	
3	C	33	

## 2 Ensemble composition and analysis

This entry contains 20 models. Model 13 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:10-A:110, B:206-B:221, C:315-C:321 (124)	0.39	13

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

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

There are 3 unique types of molecules in this entry. The entry contains 2743 atoms, of which 1344 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called U2 snRNP component IST3.

Mol	Chain	Residues	Atoms						Trace
1	A	118	Total	C	H	N	O	S	0
			1880	598	928	162	191	1	

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	GLY	-	EXPRESSION TAG	UNP P40565
A	2	ALA	-	EXPRESSION TAG	UNP P40565
A	3	MET	-	EXPRESSION TAG	UNP P40565
A	4	GLY	-	EXPRESSION TAG	UNP P40565

- Molecule 2 is a protein called Pre-mRNA leakage protein 1.

Mol	Chain	Residues	Atoms						Trace
2	B	23	Total	C	H	N	O	S	0
			346	111	170	25	39	1	

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	200	GLY	-	EXPRESSION TAG	UNP Q07930
B	201	SER	-	EXPRESSION TAG	UNP Q07930

- Molecule 3 is a protein called Pre-mRNA-splicing factor CWC26.

Mol	Chain	Residues	Atoms						Trace
3	C	33	Total	C	H	N	O	S	0
			517	170	246	50	50	1	

There are 2 discrepancies between the modelled and reference sequences:

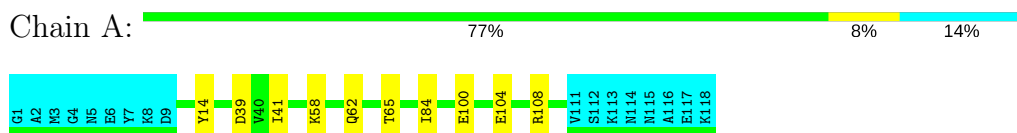
Chain	Residue	Modelled	Actual	Comment	Reference
C	300	GLY	-	EXPRESSION TAG	UNP P46947
C	301	SER	-	EXPRESSION TAG	UNP P46947

## 4 Residue-property plots

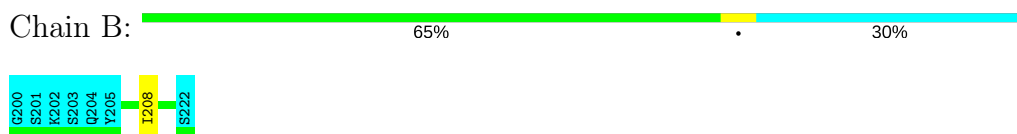
### 4.1 Average score per residue in the NMR ensemble

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.

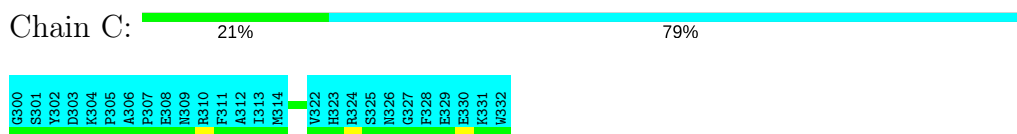
- Molecule 1: U2 snRNP component IST3



- Molecule 2: Pre-mRNA leakage protein 1



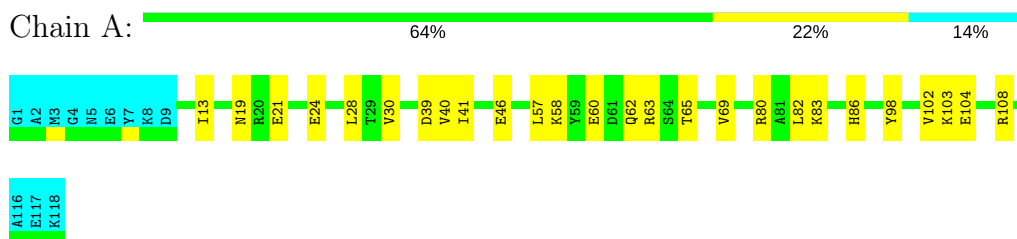
- Molecule 3: Pre-mRNA-splicing factor CWC26



### 4.2 Residue scores for the representative (medoid) model from the NMR ensemble

The representative model is number 13. Colouring as in section 4.1 above.

- Molecule 1: U2 snRNP component IST3



- Molecule 2: Pre-mRNA leakage protein 1

Chain B:  57% 9% 30%



- Molecule 3: Pre-mRNA-splicing factor CWC26

Chain C:  21% 79%



## 5 Refinement protocol and experimental data overview

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

Of the 500 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
CNS	refinement	1.2

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)	2mkc_cs.str
Number of chemical shift lists	1
Total number of shifts	2073
Number of shifts mapped to atoms	2073
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	89%

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

## 6 Model quality

### 6.1 Standard geometry

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	0.75±0.02	0±0/838 (0.0±0.0%)	0.69±0.02	0±0/1132 (0.0±0.0%)
2	B	0.92±0.08	0±0/126 (0.1±0.2%)	0.84±0.03	0±0/172 (0.0±0.0%)
3	C	0.70±0.08	0±0/57 (0.0±0.0%)	0.64±0.09	0±0/77 (0.0±0.0%)
All	All	0.77	2/20420 (0.0%)	0.71	0/27620 (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	0.2±0.4
3	C	0.0±0.0	0.1±0.2
All	All	0	5

All unique bond outliers are listed below.

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)	Models	
								Worst	Total
2	B	215	SER	C-N	-5.48	1.23	1.33	18	2

There are no bond-angle outliers.

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	80	ARG	Sidechain	2
3	C	318	ARG	Sidechain	1
1	A	108	ARG	Sidechain	1
1	A	44	ARG	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	823	805	805	8±2
2	B	123	120	120	1±1
3	C	54	45	45	0±0
All	All	20000	19400	19400	177

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 4.

5 of 72 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:62:GLN:O	1:A:65:THR:HB	0.62	1.94	2	14
1:A:38:VAL:HG12	1:A:110:ILE:HD13	0.62	1.69	20	1
1:A:70:ASP:HA	1:A:73:ASN:ND2	0.60	2.11	15	1
1:A:38:VAL:HG11	1:A:60:GLU:HB2	0.59	1.74	20	1
1:A:33:GLU:HG2	3:C:319:TRP:CD1	0.58	2.34	4	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	101/118 (86%)	99±1 (98±1%)	2±1 (1±1%)	0±0 (0±0%)	54	84
2	B	16/23 (70%)	13±1 (79±7%)	3±1 (18±8%)	1±1 (3±4%)	7	38
3	C	7/33 (21%)	6±1 (80±15%)	1±1 (16±14%)	0±0 (4±7%)	6	30
All	All	2480/3480 (71%)	2351 (95%)	108 (4%)	21 (1%)	27	73

5 of 6 unique Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
2	B	209	MET	7
3	C	321	GLY	6
1	A	61	ASP	3
2	B	208	ILE	3
1	A	17	ASN	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	88/101 (87%)	84±2 (95±2%)	4±2 (5±2%)	33	79
2	B	15/21 (71%)	14±1 (94±6%)	1±1 (6±6%)	28	74
3	C	5/27 (19%)	5±0 (97±7%)	0±0 (3±7%)	50	90
All	All	2160/2980 (72%)	2053 (95%)	107 (5%)	33	78

5 of 36 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	41	ILE	20
1	A	93	ARG	8
1	A	50	GLU	7
2	B	218	LEU	7
1	A	103	LYS	7

### 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 89% for the well-defined parts and 87% for the entire structure.

### 7.1 Chemical shift list 1

File name: 2mkc\_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	2073
Number of shifts mapped to atoms	2073
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	12

#### 7.1.2 Chemical shift referencing

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction $\pm$ precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	174	$-0.08 \pm 0.06$	None needed ( $< 0.5$ ppm)
$^{13}\text{C}_\beta$	156	$-0.03 \pm 0.05$	None needed ( $< 0.5$ ppm)
$^{13}\text{C}'$	104	$-0.08 \pm 0.18$	None needed ( $< 0.5$ ppm)
$^{15}\text{N}$	159	$-0.48 \pm 0.21$	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 89%, i.e. 1373 atoms were assigned a chemical shift out of a possible 1548. 0 out of 19 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	$^1\text{H}$	$^{13}\text{C}$	$^{15}\text{N}$
Backbone	571/610 (94%)	240/243 (99%)	215/248 (87%)	116/119 (97%)
Sidechain	685/810 (85%)	421/473 (89%)	250/298 (84%)	14/39 (36%)

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	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Aromatic	117/128 (91%)	61/67 (91%)	55/59 (93%)	1/2 (50%)
Overall	1373/1548 (89%)	722/783 (92%)	520/605 (86%)	131/160 (82%)

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

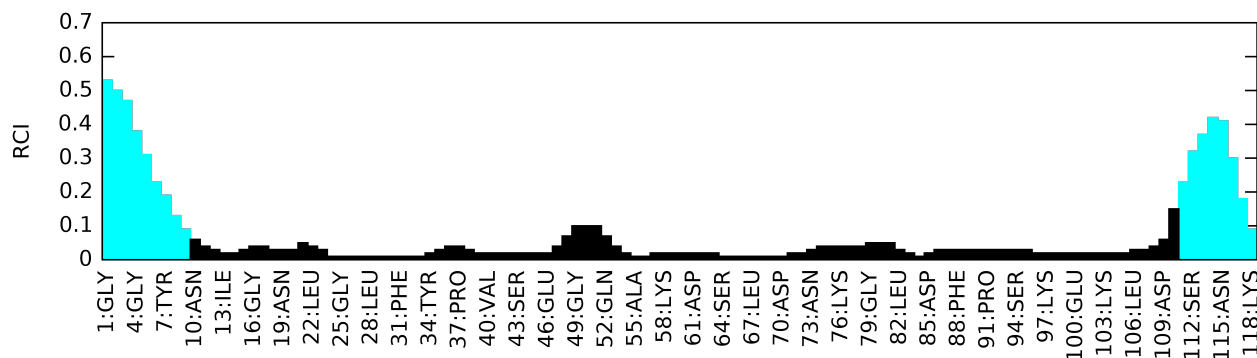
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, ppm	Expected range, ppm	Z-score
1	A	105	GLU	HG3	0.30	3.31 – 1.21	-9.3
1	A	33	GLU	HG2	0.34	3.33 – 1.23	-9.3
1	A	33	GLU	HG3	0.34	3.31 – 1.21	-9.2
3	C	321	GLY	HA2	0.56	5.87 – 2.07	-9.0
3	C	324	ARG	HB2	-0.10	3.15 – 0.45	-7.1
1	A	58	LYS	HB2	0.05	3.03 – 0.53	-6.9
1	A	33	GLU	HB2	0.59	3.08 – 0.98	-6.9
3	C	324	ARG	HH21	9.80	9.06 – 4.56	6.7
1	A	33	GLU	HB3	0.59	3.10 – 0.90	-6.4
3	C	321	GLY	H	4.59	11.63 – 5.03	-5.7
1	A	105	GLU	HG2	1.18	3.33 – 1.23	-5.2
1	A	33	GLU	HA	2.16	6.30 – 2.20	-5.1

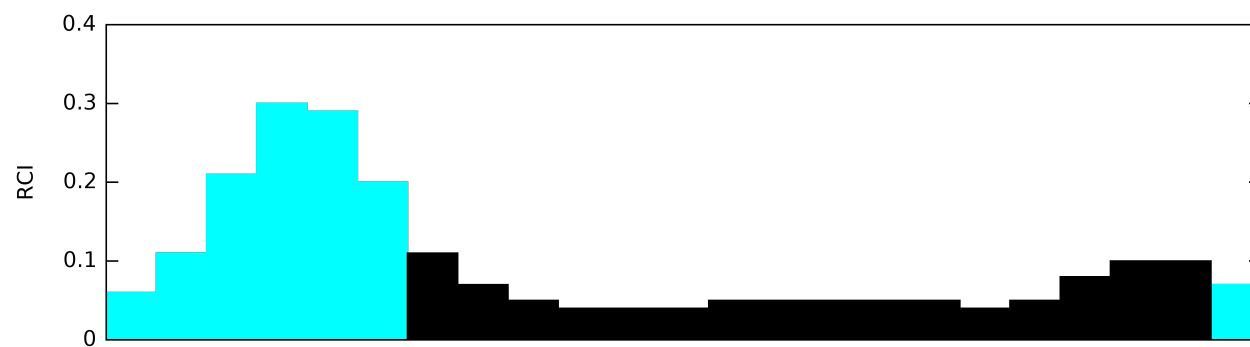
#### 7.1.5 Random Coil Index (RCI) plots [i](#)

The images below report *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:



Random coil index (RCI) for chain B:



Random coil index (RCI) for chain C:

