



# Full wwPDB NMR Structure Validation Report ⓘ

Sep 11, 2017 – 04:47 AM EDT

PDB ID : 5NR5  
Title : NMR structure and <sup>1</sup>H, <sup>13</sup>C and <sup>15</sup>N signal assignments for Dictyostelium discoideum MATA protein  
Authors : Neuhaus, D.; Hedgethorpe, K.; Yang, J.-C.  
Deposited on : unknown

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 : rb-20029824  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : rb-20029824

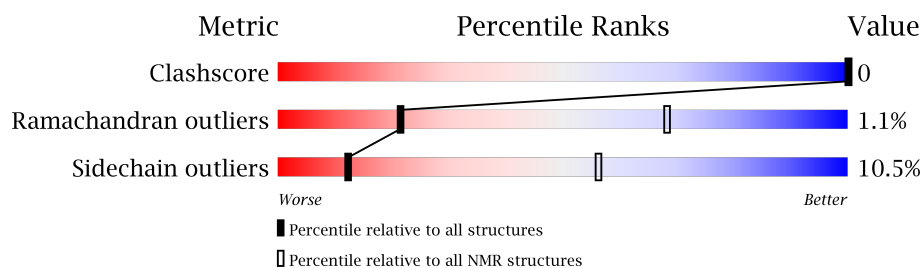
# 1 Overall quality at a glance

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	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	113	

## 2 Ensemble composition and analysis ⓘ

This entry contains 30 models. Model 27 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *lowest energy*.

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:1-A:12 (12)	0.67	29
2	A:35-A:77 (43)	0.19	27
3	A:95-A:103 (9)	0.84	23

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 7 clusters and 3 single-model clusters were found.

Cluster number	Models
1	2, 6, 10, 13, 18, 19, 20, 22, 23, 24
2	3, 11, 12, 17, 21, 27, 29
3	4, 14
4	26, 30
5	1, 28
6	5, 9
7	16, 25
Single-model clusters	7; 8; 15

### 3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 1795 atoms, of which 921 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called MatA protein.

Mol	Chain	Residues	Atoms						Trace
1	A	113	Total	C	H	N	O	S	0
			1795	548	921	148	174	4	

There are 6 discrepancies between the modelled and reference sequences:

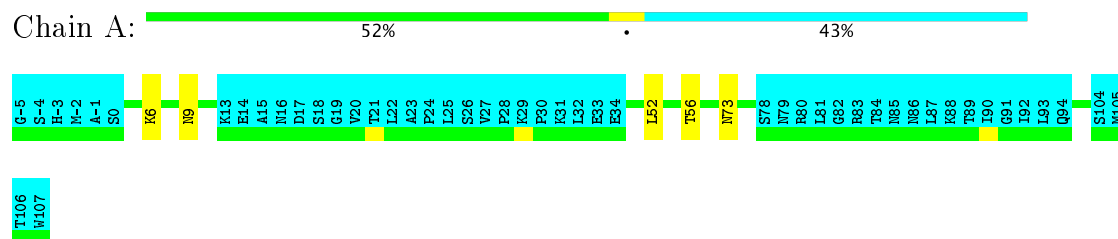
Chain	Residue	Modelled	Actual	Comment	Reference
A	-5	GLY	-	expression tag	UNP Q54HW9
A	-4	SER	-	expression tag	UNP Q54HW9
A	-3	HIS	-	expression tag	UNP Q54HW9
A	-2	MET	-	expression tag	UNP Q54HW9
A	-1	ALA	-	expression tag	UNP Q54HW9
A	0	SER	-	expression tag	UNP Q54HW9

## 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: MatA protein

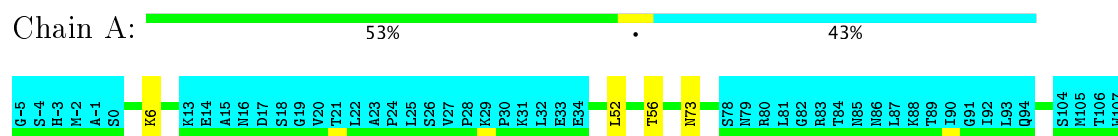


### 4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

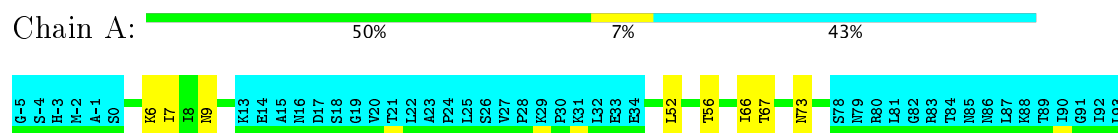
#### 4.2.1 Score per residue for model 1

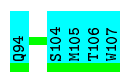
- Molecule 1: MatA protein



#### 4.2.2 Score per residue for model 2

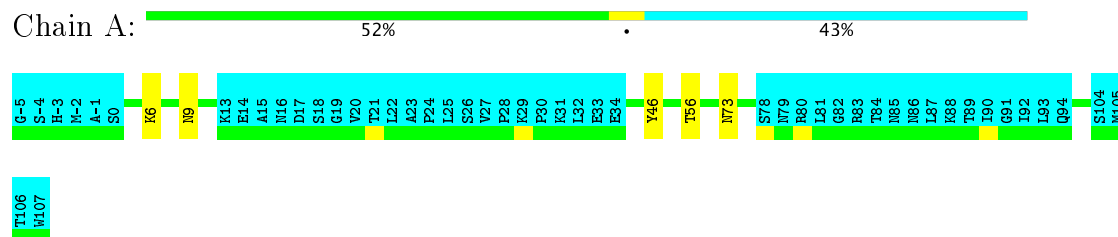
- Molecule 1: MatA protein





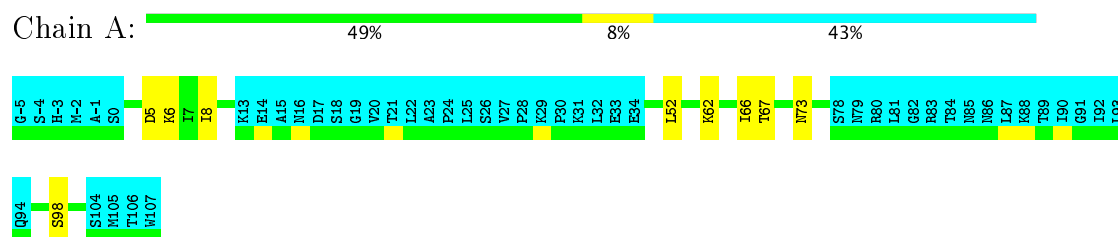
### 4.2.3 Score per residue for model 3

- Molecule 1: MatA protein



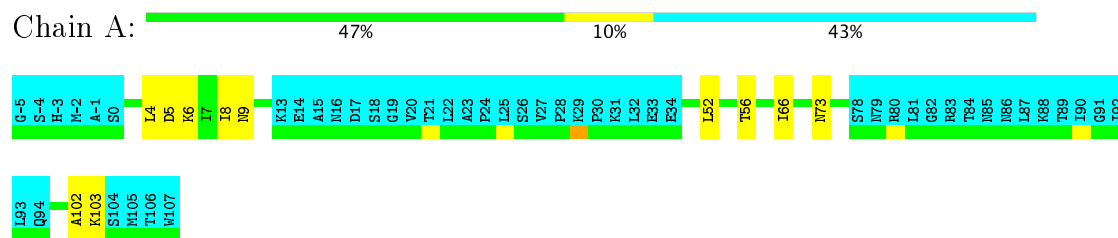
### 4.2.4 Score per residue for model 4

- Molecule 1: MatA protein



### 4.2.5 Score per residue for model 5

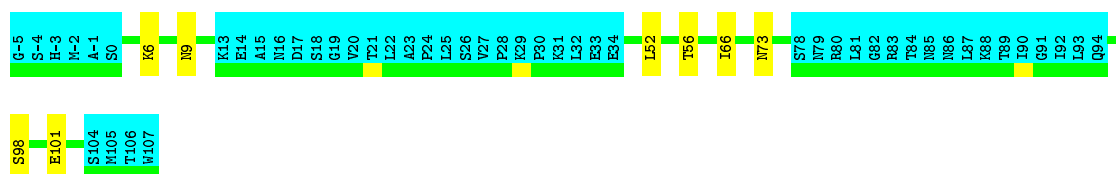
- Molecule 1: MatA protein



### 4.2.6 Score per residue for model 6

- Molecule 1: MatA protein

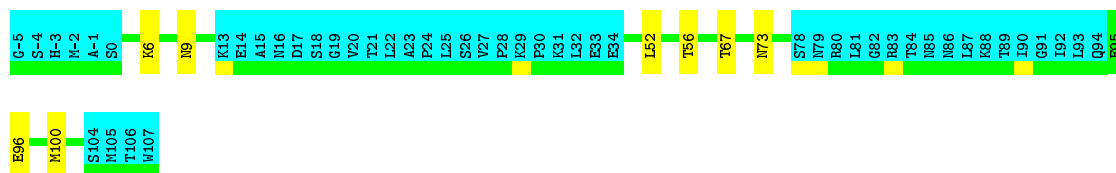




#### 4.2.7 Score per residue for model 7

- Molecule 1: MatA protein

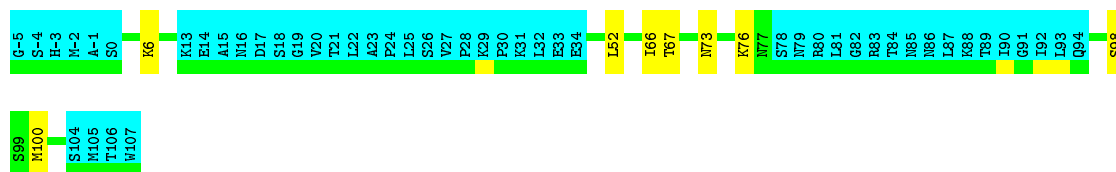
Chain A:



#### 4.2.8 Score per residue for model 8

- Molecule 1: MatA protein

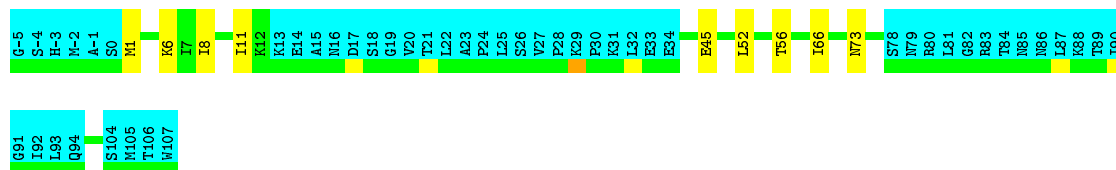
Chain A:



#### 4.2.9 Score per residue for model 9

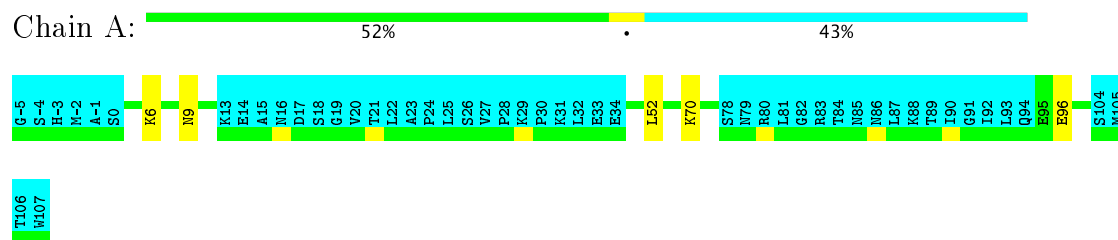
- Molecule 1: MatA protein

Chain A:



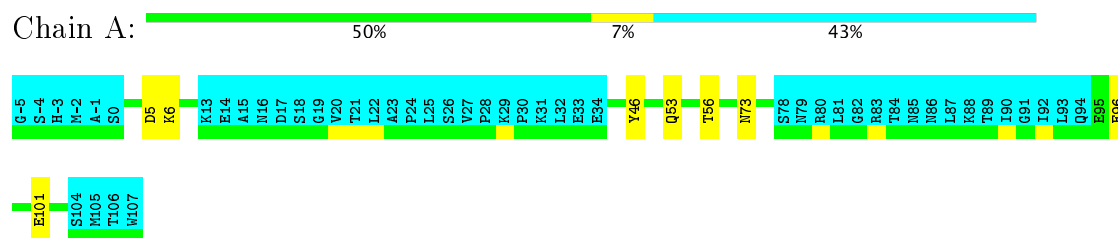
#### 4.2.10 Score per residue for model 10

- Molecule 1: MatA protein



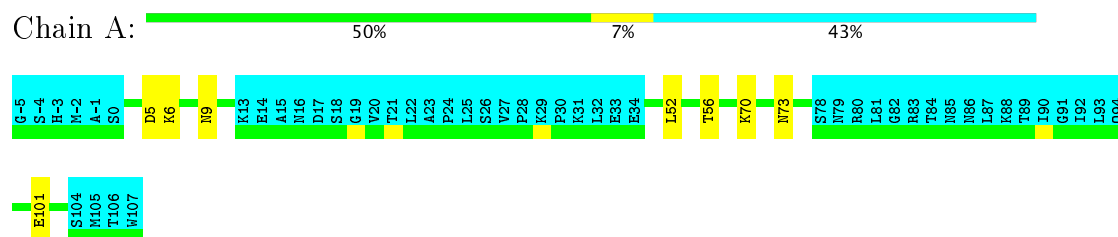
#### 4.2.11 Score per residue for model 11

- Molecule 1: MatA protein



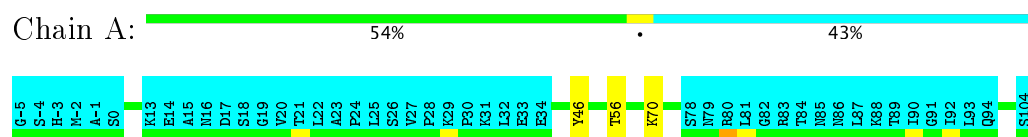
#### 4.2.12 Score per residue for model 12

- Molecule 1: MatA protein



#### 4.2.13 Score per residue for model 13

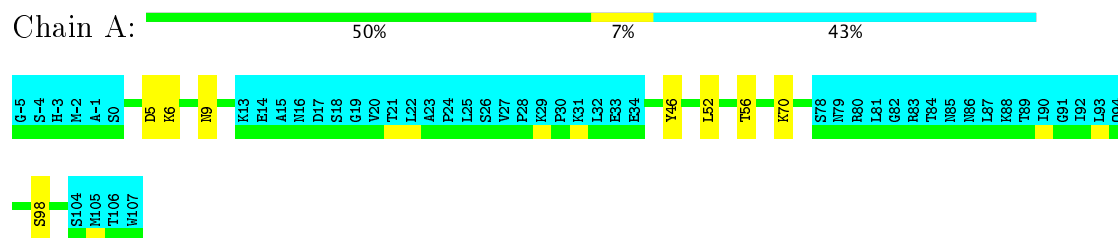
- Molecule 1: MatA protein



#### 4.2.14 Score per residue for model 14

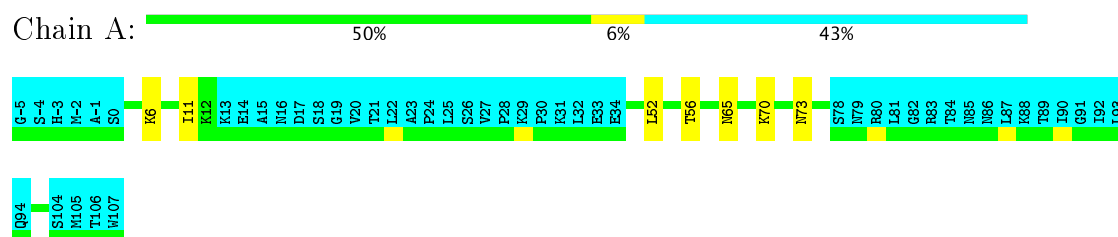
- Molecule 1: MatA protein





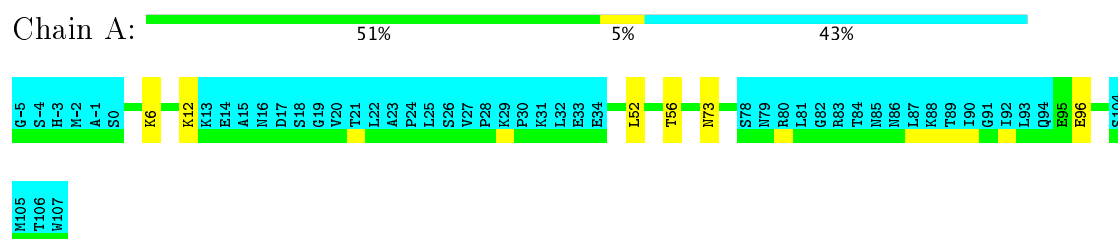
#### 4.2.15 Score per residue for model 15

- Molecule 1: MatA protein



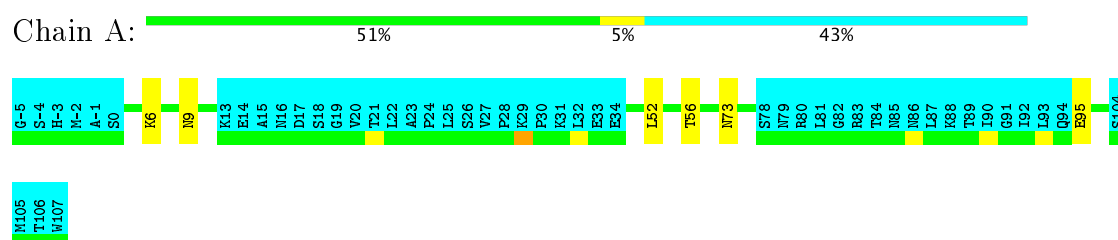
#### 4.2.16 Score per residue for model 16

- Molecule 1: MatA protein



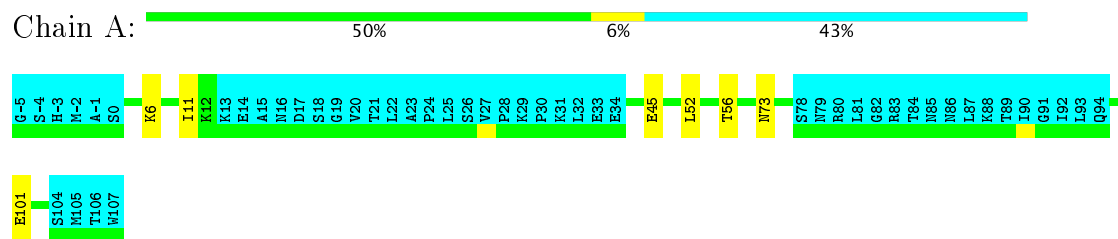
#### 4.2.17 Score per residue for model 17

- Molecule 1: MatA protein



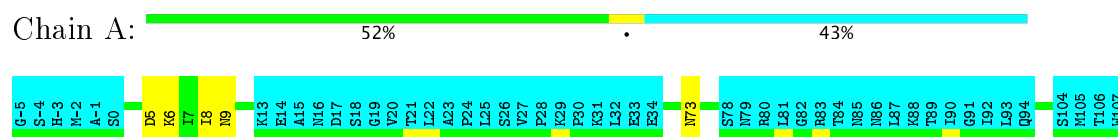
### 4.2.18 Score per residue for model 18

- Molecule 1: MatA protein



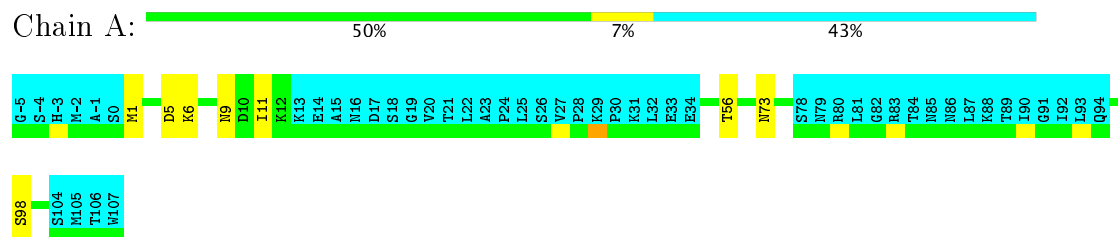
### 4.2.19 Score per residue for model 19

- Molecule 1: MatA protein



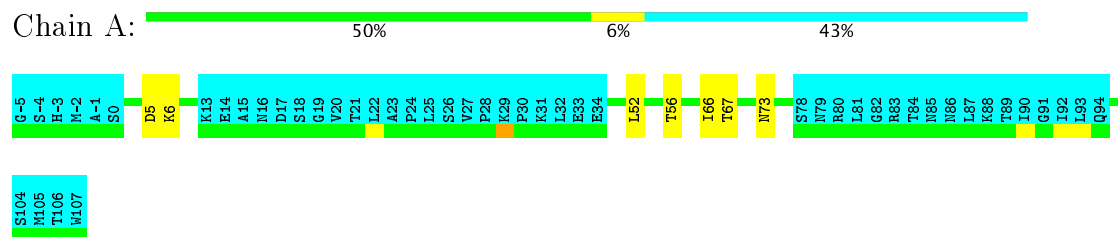
### 4.2.20 Score per residue for model 20

- Molecule 1: MatA protein



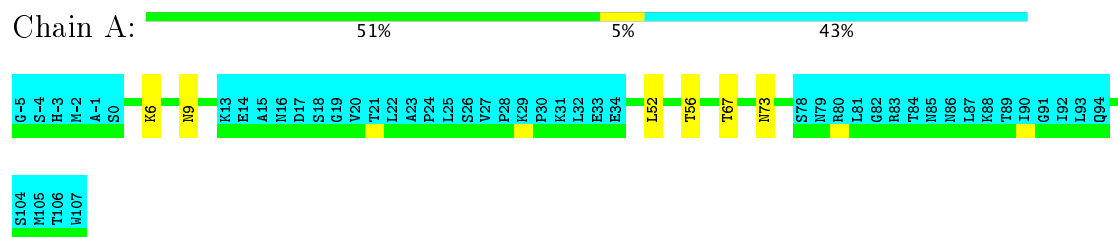
### 4.2.21 Score per residue for model 21

- Molecule 1: MatA protein



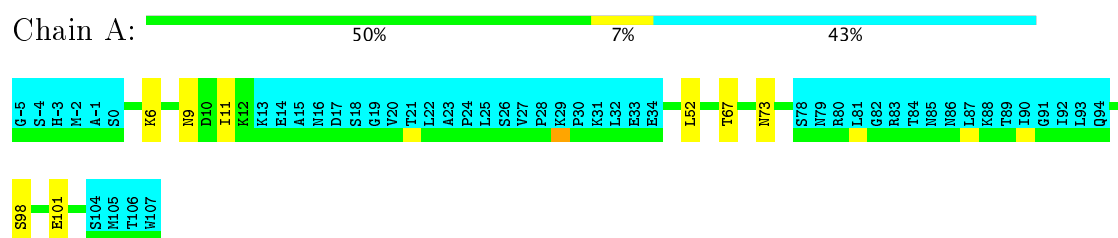
## 4.2.22 Score per residue for model 22

- Molecule 1: MatA protein



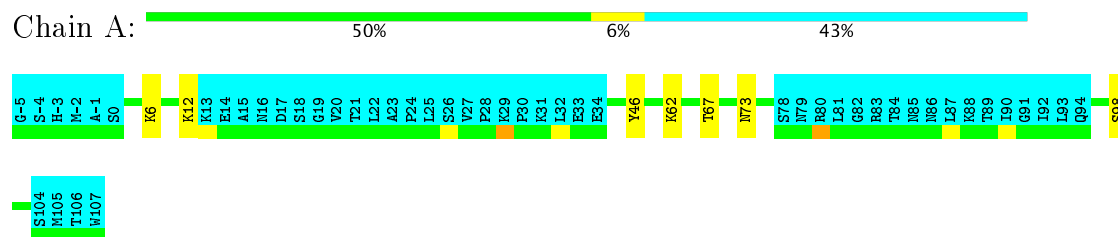
## 4.2.23 Score per residue for model 23

- Molecule 1: MatA protein



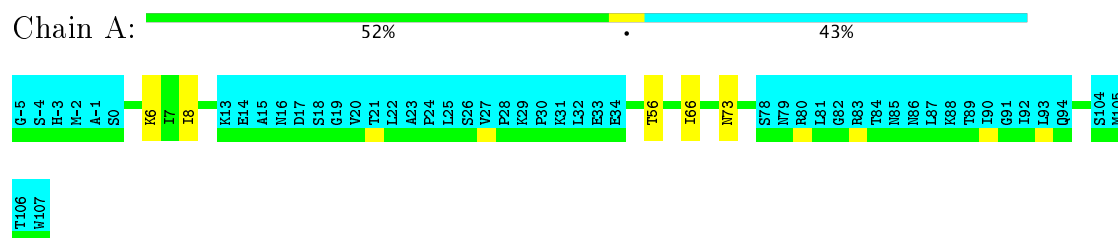
## 4.2.24 Score per residue for model 24

- Molecule 1: MatA protein



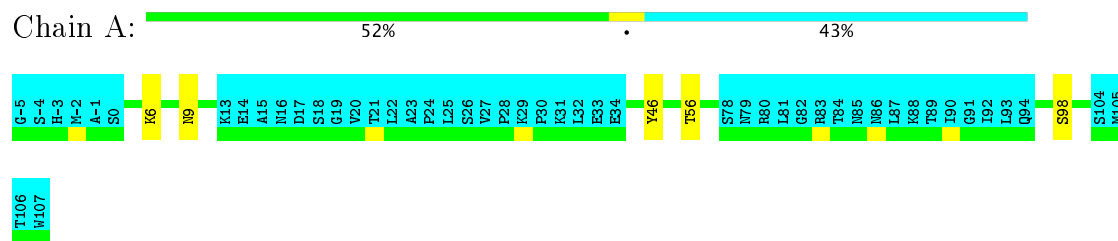
## 4.2.25 Score per residue for model 25

- Molecule 1: MatA protein



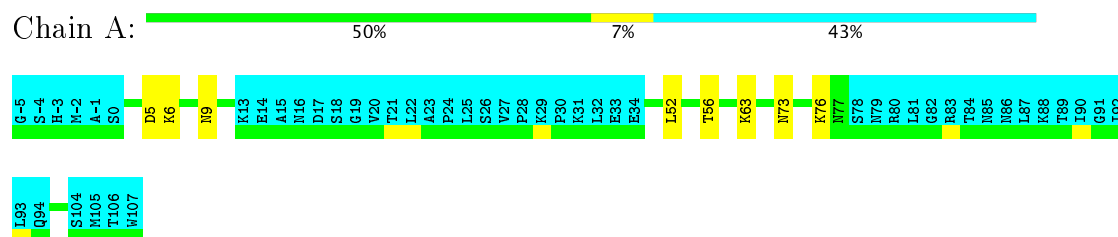
## 4.2.26 Score per residue for model 26

- Molecule 1: MatA protein



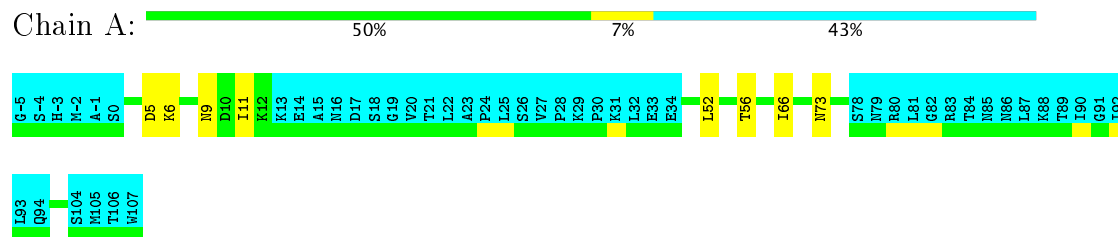
## 4.2.27 Score per residue for model 27 (medoid)

- Molecule 1: MatA protein



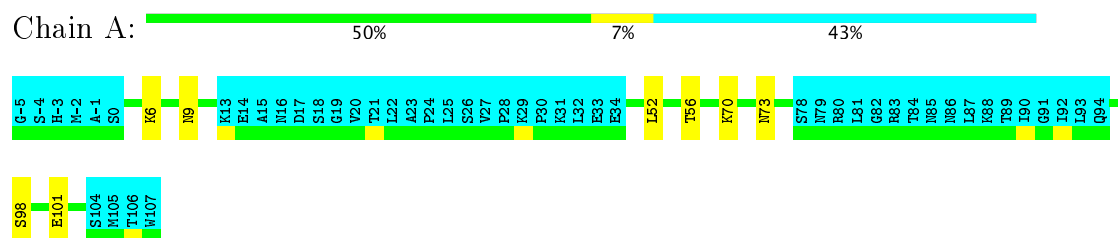
## 4.2.28 Score per residue for model 28

- Molecule 1: MatA protein



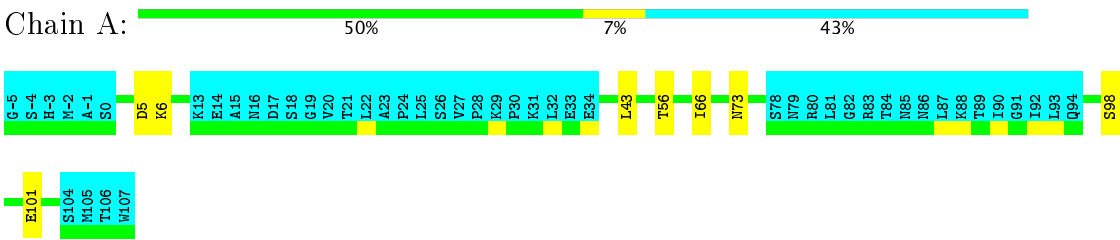
## 4.2.29 Score per residue for model 29

- Molecule 1: MatA protein



4.2.30 Score per residue for model 30

● Molecule 1: MatA protein



## 5 Refinement protocol and experimental data overview

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

Of the 50 calculated structures, 30 were deposited, based on the following criterion: *structures with the lowest energy*.

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

Software name	Classification	Version
AMBER	refinement	11

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)	5nr5_cs.cif
Number of chemical shift lists	1
Total number of shifts	1347
Number of shifts mapped to atoms	1347
Number of unparsed shifts	0
Number of shifts with mapping errors	0
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](#)

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	0.60±0.01	0±0/508 (0.0±0.0%)	0.90±0.02	0±0/683 (0.0±0.1%)
All	All	0.60	0/15240 (0.0%)	0.90	6/20490 (0.0%)

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	46	TYR	CB-CG-CD1	-6.15	117.31	121.00	11	2
1	A	46	TYR	CB-CG-CD2	-5.93	117.44	121.00	26	4

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	505	540	540	0±0
All	All	15150	16200	16200	-

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 -.

There are no clashes.

## 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	64/113 (57%)	55±1 (86±2%)	8±1 (13±2%)	1±1 (1±1%)	21	68
All	All	1920/3390 (57%)	1653 (86%)	245 (13%)	22 (1%)	21	68

All 5 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	98	SER	10
1	A	11	ILE	6
1	A	8	ILE	4
1	A	102	ALA	1
1	A	52	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	58/100 (58%)	52±2 (89±3%)	6±2 (11±3%)	12	56
All	All	1740/3000 (58%)	1557 (89%)	183 (11%)	12	56

All 26 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	6	LYS	29
1	A	73	ASN	26
1	A	56	THR	24
1	A	52	LEU	20
1	A	9	ASN	17

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Mol	Chain	Res	Type	Models (Total)
1	A	5	ASP	11
1	A	66	ILE	10
1	A	67	THR	8
1	A	101	GLU	7
1	A	70	LYS	6
1	A	96	GLU	4
1	A	12	LYS	2
1	A	76	LYS	2
1	A	100	MET	2
1	A	62	LYS	2
1	A	45	GLU	2
1	A	1	MET	2
1	A	103	LYS	1
1	A	95	GLU	1
1	A	8	ILE	1
1	A	7	ILE	1
1	A	65	ASN	1
1	A	53	GLN	1
1	A	4	LEU	1
1	A	63	LYS	1
1	A	43	LEU	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 87% for the well-defined parts and 85% for the entire structure.

### 7.1 Chemical shift list 1

File name: 5nr5\_cs.cif

Chemical shift list name: *MATA\_shifts\_corrected.bmrB*

#### 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	1347
Number of shifts mapped to atoms	1347
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
$^{13}\text{C}_\alpha$	113	$-0.30 \pm 0.10$	None needed ( $< 0.5$ ppm)
$^{13}\text{C}_\beta$	108	$0.11 \pm 0.06$	None needed ( $< 0.5$ ppm)
$^{13}\text{C}'$	0	—	None (insufficient data)
$^{15}\text{N}$	106	$0.00 \pm 0.16$	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 87%, i.e. 701 atoms were assigned a chemical shift out of a possible 804. 0 out of 9 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	$^1\text{H}$	$^{13}\text{C}$	$^{15}\text{N}$
Backbone	254/318 (80%)	127/127 (100%)	64/128 (50%)	63/63 (100%)
Sidechain	431/470 (92%)	266/272 (98%)	157/181 (87%)	8/17 (47%)

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	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Aromatic	16/16 (100%)	8/8 (100%)	8/8 (100%)	0/0 (—%)
Overall	701/804 (87%)	401/407 (99%)	229/317 (72%)	71/80 (89%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 85%, i.e. 1182 atoms were assigned a chemical shift out of a possible 1386. 0 out of 17 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Backbone	438/557 (79%)	219/222 (99%)	113/226 (50%)	106/109 (97%)
Sidechain	712/794 (90%)	441/463 (95%)	258/299 (86%)	13/32 (41%)
Aromatic	32/35 (91%)	16/18 (89%)	15/15 (100%)	1/2 (50%)
Overall	1182/1386 (85%)	676/703 (96%)	386/540 (71%)	120/143 (84%)

#### 7.1.4 Statistically unusual chemical shifts ⓘ

There are no statistically unusual chemical shifts.

#### 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:

