Full wwPDB NMR Structure Validation Report (i)

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PDB ID	:	2M5H
Title	:	NMR structure note: solution structure of monomeric human FAM96A
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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*
A user guide is available at
https://www.wwpdb.org/validation/2017/NMRValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

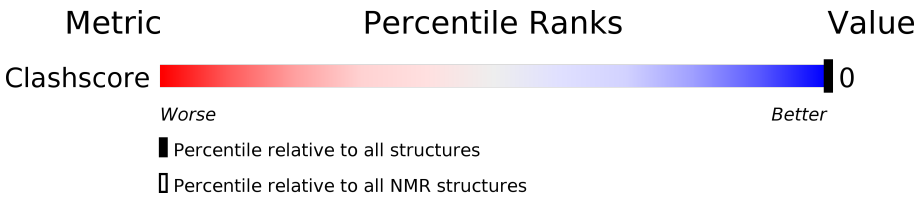
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	2.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

1 Overall quality at a glance (i)

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	158937	12864

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 >=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 <=5%

Mol	Chain	Length	Quality of chain
1	A	139	87% 13%

2 Ensemble composition and analysis (i)

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: *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:33-A:119, A:125-A:158 (121)	0.48	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 5 clusters and 5 single-model clusters were found.

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

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 2276 atoms, of which 1141 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called MIP18 family protein FAM96A.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	139	2276	709	1141	195	223	8	0

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	27	MET	-	EXPRESSION TAG	UNP Q9H5X1
A	161	GLN	-	EXPRESSION TAG	UNP Q9H5X1
A	162	LEU	-	EXPRESSION TAG	UNP Q9H5X1
A	163	GLU	-	EXPRESSION TAG	UNP Q9H5X1
A	164	HIS	-	EXPRESSION TAG	UNP Q9H5X1
A	165	HIS	-	EXPRESSION TAG	UNP Q9H5X1

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: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

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: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.2 Score per residue for model 2

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.3 Score per residue for model 3

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.4 Score per residue for model 4

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.5 Score per residue for model 5

- Molecule 1: MIP18 family protein FAM96A

Chain A: 86% 13%

M27 R28 Q29 P30 R31 I32 R48 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.6 Score per residue for model 6

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.7 Score per residue for model 7

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.8 Score per residue for model 8

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.9 Score per residue for model 9

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.10 Score per residue for model 10

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.11 Score per residue for model 11

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.12 Score per residue for model 12 (medoid)

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.13 Score per residue for model 13

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.14 Score per residue for model 14

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.15 Score per residue for model 15

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.16 Score per residue for model 16

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.17 Score per residue for model 17

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.18 Score per residue for model 18

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.19 Score per residue for model 19

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

4.2.20 Score per residue for model 20

- Molecule 1: MIP18 family protein FAM96A

Chain A: 87% 13%

M27 R28 Q29 P30 R31 I32 E120 G121 T122 H123 S124 P159 D160 Q161 L162 E163 H164 H165

5 Refinement protocol and experimental data overview (i)

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

Of the 100 calculated structures, 20 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	9.0
DYANA	refinement	2.1
CYANA	structure solution	2.1

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)	input_cs.cif
Number of chemical shift lists	1
Total number of shifts	1735
Number of shifts mapped to atoms	1735
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 (i)

6.1 Standard geometry (i)

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

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	0.1±0.2
All	All	0	1

There are no bond-length outliers.

There are no bond-angle outliers.

There are no chirality outliers.

All unique planar outliers are listed below.

Mol	Chain	Res	Type	Group	Models (Total)
1	A	48	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
All	All	19660	20000	0	-

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	0	-	-	-	-
All	All	0	-	-	-	-

There are no Ramachandran outliers.

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	0	-	-	-
All	All	0	-	-	-

There are no protein residues with a non-rotameric sidechain to report.

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 (i)

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: input_cs.cif

Chemical shift list name: *assigned_chem_shift_list_1*

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	1735
Number of shifts mapped to atoms	1735
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	3

7.1.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	138	-0.88 ± 0.10	Should be applied
$^{13}C_{\beta}$	136	0.04 ± 0.12	None needed (< 0.5 ppm)
$^{13}C'$	126	-0.68 ± 0.23	Should be applied
^{15}N	121	0.92 ± 0.34	Should be applied

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 89%, i.e. 1378 atoms were assigned a chemical shift out of a possible 1554. 21 out of 25 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	573/593 (97%)	231/236 (98%)	233/242 (96%)	109/115 (95%)
Sidechain	781/905 (86%)	481/526 (91%)	287/341 (84%)	13/38 (34%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	24/56 (43%)	24/30 (80%)	0/24 (0%)	0/2 (0%)
Overall	1378/1554 (89%)	736/792 (93%)	520/607 (86%)	122/155 (79%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 87%, i.e. 1560 atoms were assigned a chemical shift out of a possible 1795. 22 out of 26 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	646/679 (95%)	261/270 (97%)	264/278 (95%)	121/131 (92%)
Sidechain	888/1039 (85%)	549/607 (90%)	324/386 (84%)	15/46 (33%)
Aromatic	26/77 (34%)	26/42 (62%)	0/30 (0%)	0/5 (0%)
Overall	1560/1795 (87%)	836/919 (91%)	588/694 (85%)	136/182 (75%)

7.1.4 Statistically unusual chemical shifts (i)

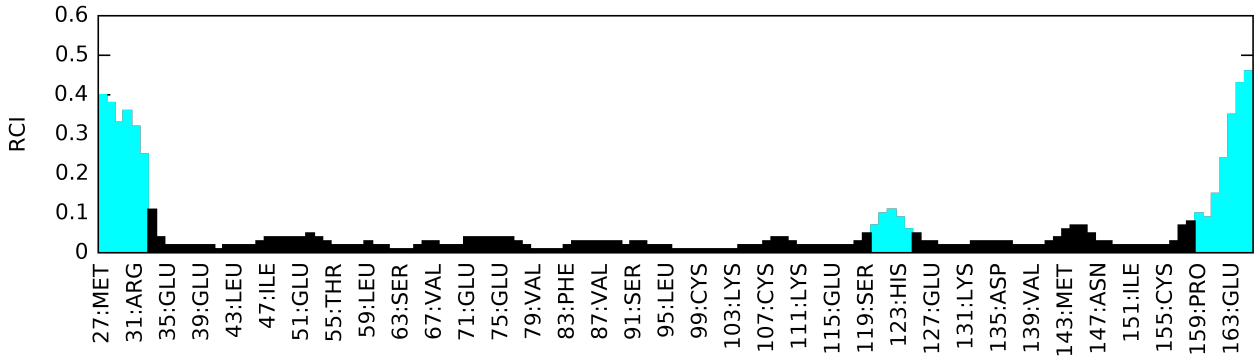
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	36	LYS	HE3	1.86	3.86 – 1.96	-5.5
1	A	36	LYS	HE2	1.92	3.87 – 1.97	-5.2
1	A	36	LYS	HD3	0.42	2.75 – 0.45	-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:


RCI
0.6
0.5
0.4
0.3
0.2
0.1
0
27:MET
31:ARG
35:GLU
39:GLU
43:LEU
47:ILE
51:GLU
55:THR
59:LEU
63:SER
67:VAL
71:GLU
75:GLU
79:VAL
83:PHE
87:VAL
91:SER
95:LEU
99:CYS
103:LYS
107:CYS
111:LYS
115:GLU
119:SER
123:HIS
127:GLU
131:LYS
135:ASP
139:VAL
143:MET
147:ASN
151:ILE
155:CYS
159:PRO
163:GLU