



# Full wwPDB NMR Structure Validation Report ⓘ

Feb 13, 2017 – 01:10 am GMT

PDB ID : 2MN6  
Title : Solution structure of dimeric TatA of twin-arginine translocation system from E. coli  
Authors : Zhang, Y.; Hu, Y.; Jin, C.  
Deposited on : 2014-03-31

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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

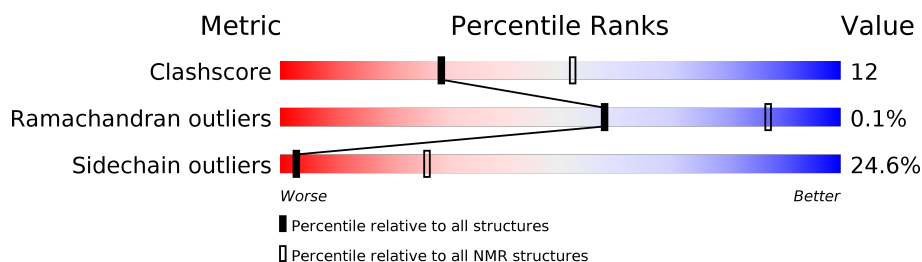
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*SOLUTION NMR*

The overall completeness of chemical shifts assignment is 49%.

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	100	
1	B	100	

## 2 Ensemble composition and analysis

This entry contains 10 models. Model 9 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	B:6-B:44, A:6-A:45 (79)	0.34	9

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. No single-model clusters were found.

Cluster number	Models
1	1, 5, 7, 8, 9, 10
2	2, 3, 4, 6

### 3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 1438 atoms, of which 750 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Sec-independent protein translocase protein TatA.

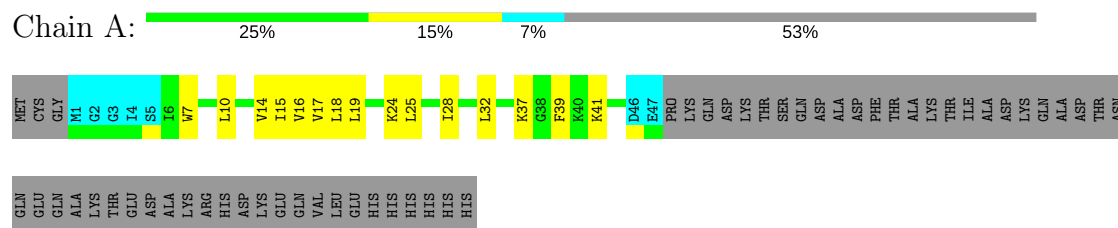
Mol	Chain	Residues	Atoms						Trace
1	B	47	Total	C	H	N	O	S	0
			719	226	375	54	62	2	
1	A	47	Total	C	H	N	O	S	0
			719	226	375	54	62	2	

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-2	MET	-	EXPRESSION TAG	UNP P69428
B	-1	CYS	-	EXPRESSION TAG	UNP P69428
B	0	GLY	-	EXPRESSION TAG	UNP P69428
B	90	LEU	-	EXPRESSION TAG	UNP P69428
B	91	GLU	-	EXPRESSION TAG	UNP P69428
B	92	HIS	-	EXPRESSION TAG	UNP P69428
B	93	HIS	-	EXPRESSION TAG	UNP P69428
B	94	HIS	-	EXPRESSION TAG	UNP P69428
B	95	HIS	-	EXPRESSION TAG	UNP P69428
B	96	HIS	-	EXPRESSION TAG	UNP P69428
B	97	HIS	-	EXPRESSION TAG	UNP P69428
A	-2	MET	-	EXPRESSION TAG	UNP P69428
A	-1	CYS	-	EXPRESSION TAG	UNP P69428
A	0	GLY	-	EXPRESSION TAG	UNP P69428
A	90	LEU	-	EXPRESSION TAG	UNP P69428
A	91	GLU	-	EXPRESSION TAG	UNP P69428
A	92	HIS	-	EXPRESSION TAG	UNP P69428
A	93	HIS	-	EXPRESSION TAG	UNP P69428
A	94	HIS	-	EXPRESSION TAG	UNP P69428
A	95	HIS	-	EXPRESSION TAG	UNP P69428
A	96	HIS	-	EXPRESSION TAG	UNP P69428
A	97	HIS	-	EXPRESSION TAG	UNP P69428

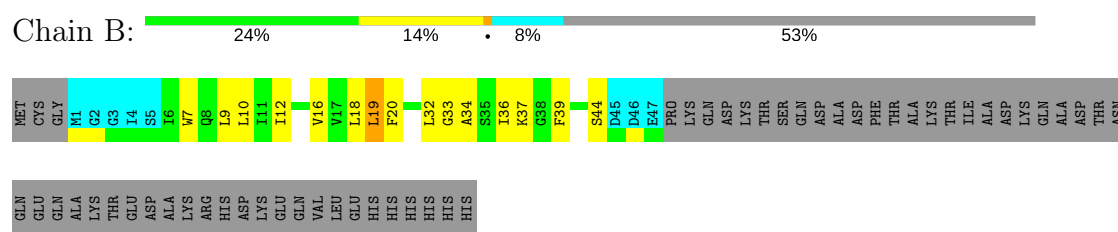


- Molecule 1: Sec-independent protein translocase protein TatA

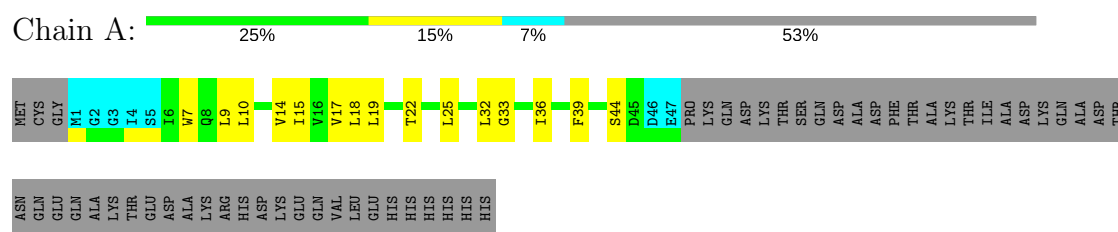


#### 4.2.2 Score per residue for model 2

- Molecule 1: Sec-independent protein translocase protein TatA

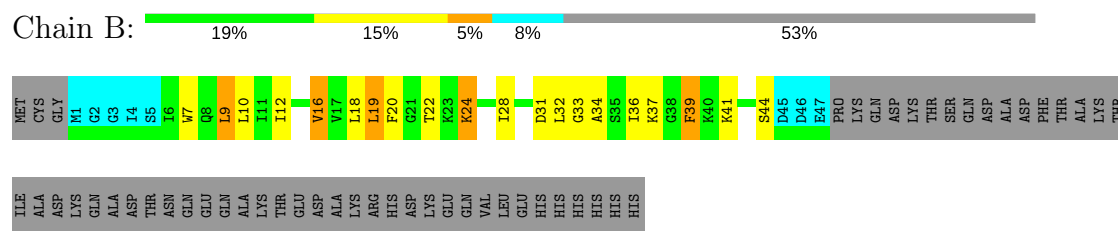


- Molecule 1: Sec-independent protein translocase protein TatA

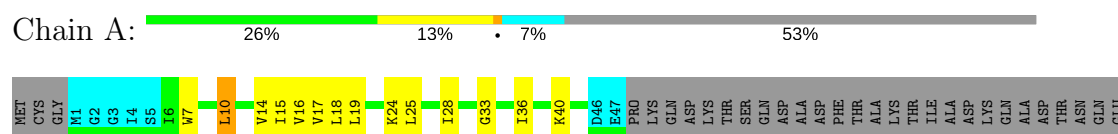


#### 4.2.3 Score per residue for model 3

- Molecule 1: Sec-independent protein translocase protein TatA



- Molecule 1: Sec-independent protein translocase protein TatA



GLN  
ALA  
LYS  
THR  
GLU  
ASP  
ALA  
LYS  
ARG  
HIS  
ASP  
LYS  
GLU  
GLN  
VAL  
LEU  
GLU  
HIS  
HIS  
HIS  
HIS  
HIS

#### 4.2.4 Score per residue for model 4

- Molecule 1: Sec-independent protein translocase protein TatA

Chain B: 23% 15% 8% 53%

MET CYS GLY M1 G2 G3 G4 G5 G6 G7 G8 G9 L10 L11 L12 V16 V17 L18 L19 L20 F20 G21 G22 G23 G24 L25 L26 G26 S27 S28 L28 G29 S30 S31 L32 L33 T36 F39 D45 D46 E47 PRO LYS GLN ASP LYS THR SER GLN ASP ALA ASP PHE THR ALA ALA THR LYS THR ILE ALA ASP LYS

GLN  
ALA  
ASP  
THR  
ASN  
GLN  
GLU  
GLN  
ALA  
LYS  
THR  
GLU  
ASP  
ALA  
LYS  
ARG  
HIS  
ASP  
LYS  
GLU  
VAL  
LEU  
GLU  
HIS  
HIS  
HIS  
HIS  
HIS

- Molecule 1: Sec-independent protein translocase protein TatA

Chain A: 28% 12% 7% 53%

MET CYS GLY M1 G2 G3 G4 G5 G6 G7 G8 G9 L10 L11 L12 V14 V15 V16 V17 L18 L19 T22 L25 G26 S27 K37 K41 D46 E47 PRO LYS GLN ASP LYS THR SER GLN ASP ALA ASP PHE THR ALA ALA THR LYS THR THR ILE ALA ASP LYS GLN ASP THR ASN GLN GLU GLN ALA

LYS  
THR  
GLU  
ASP  
ALA  
LYS  
ARG  
HIS  
ASP  
LYS  
GLU  
GLN  
VAL  
LEU  
GLU  
HIS  
HIS  
HIS  
HIS  
HIS  
HIS

#### 4.2.5 Score per residue for model 5

- Molecule 1: Sec-independent protein translocase protein TatA

Chain B: 23% 14% 8% 53%

MET CYS GLY M1 G2 G3 G4 G5 G6 G7 G8 G9 L10 L11 L12 V16 V17 L18 L19 L20 F20 G21 G22 G23 G24 L25 L26 G26 S27 D31 L32 G33 T36 F39 D45 D46 E47 PRO LYS GLN ASP LYS THR SER GLN ASP ALA ASP PHE THR ALA ALA THR LYS THR ILE ALA ASP LYS

ASP  
THR  
ASN  
GLN  
GLU  
GLN  
ALA  
LYS  
THR  
GLU  
ASP  
ALA  
LYS  
ARG  
HIS  
ASP  
LYS  
GLU  
VAL  
LEU  
GLU  
HIS  
HIS  
HIS  
HIS  
HIS

- Molecule 1: Sec-independent protein translocase protein TatA

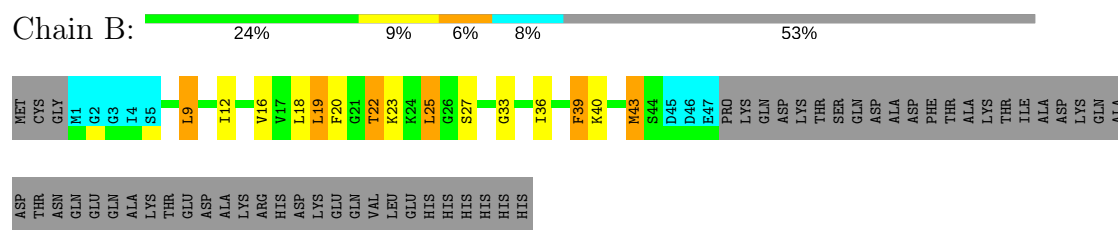
Chain A: 27% 12% 7% 53%

MET CYS GLY M1 G2 G3 G4 G5 G6 G7 G8 G9 L10 L11 L12 V14 V15 V16 V17 L18 L19 T22 D31 L32 G33 T36 F39 K40 S44 D45 D46 E47 PRO LYS GLN ASP LYS THR SER GLN ASP ALA ASP PHE THR ALA ALA THR LYS THR ILE ALA ASP LYS GLN ASP THR ASN GLN

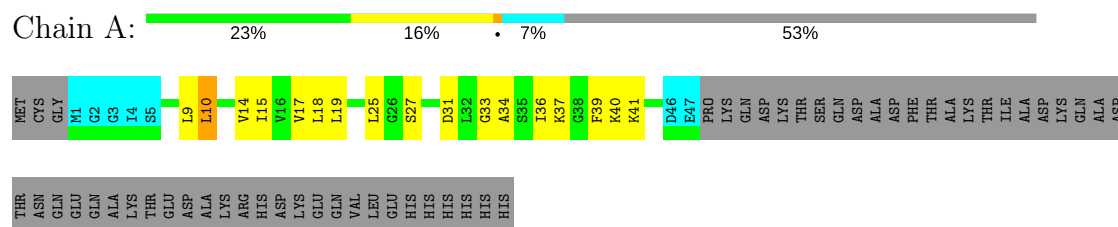
GLU  
GLN  
ALA  
LYS  
THR  
GLU  
ASP  
ALA  
LYS  
ARG  
HIS  
ASP  
LYS  
GLU  
VAL  
LEU  
GLU  
HIS  
HIS  
HIS  
HIS  
HIS

### 4.2.6 Score per residue for model 6

- Molecule 1: Sec-independent protein translocase protein TatA

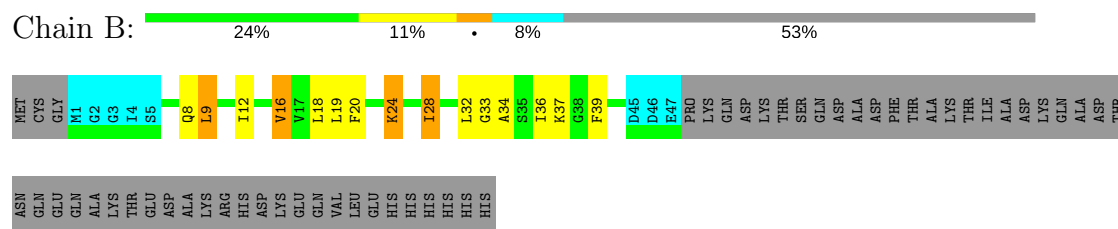


- Molecule 1: Sec-independent protein translocase protein TatA

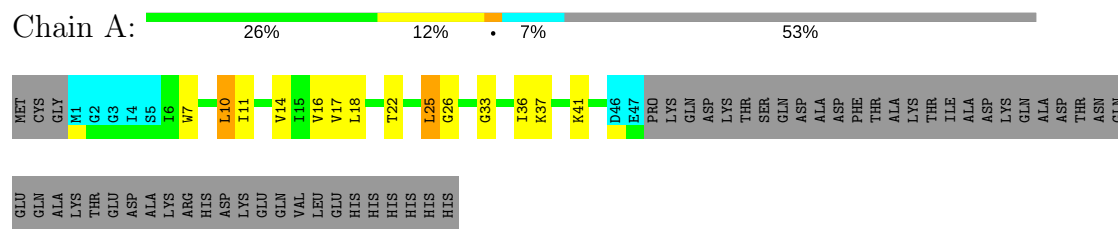


### 4.2.7 Score per residue for model 7

- Molecule 1: Sec-independent protein translocase protein TatA

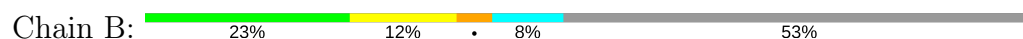


- Molecule 1: Sec-independent protein translocase protein TatA

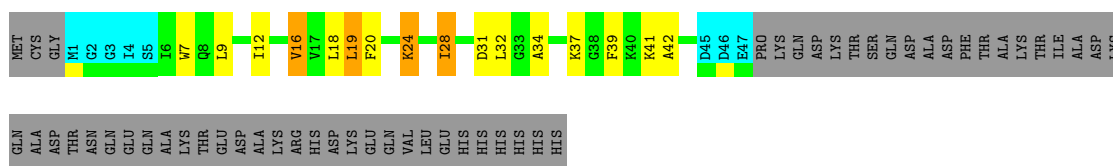


### 4.2.8 Score per residue for model 8

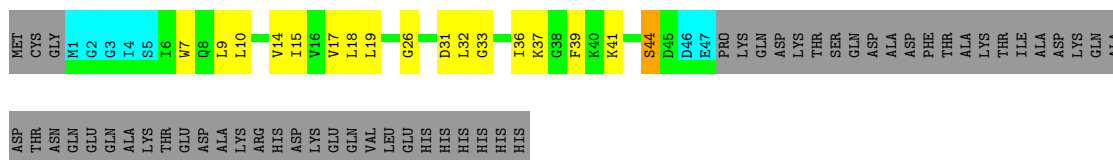
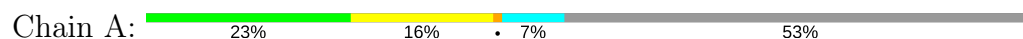
- Molecule 1: Sec-independent protein translocase protein TatA





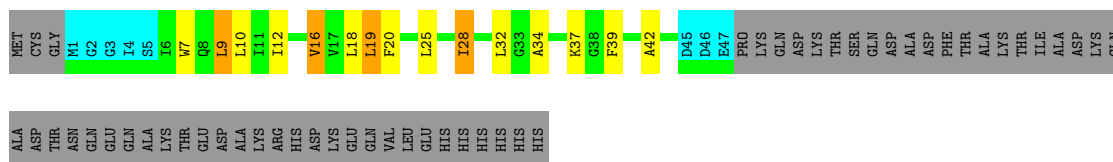
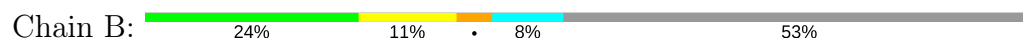


- Molecule 1: Sec-independent protein translocase protein TatA

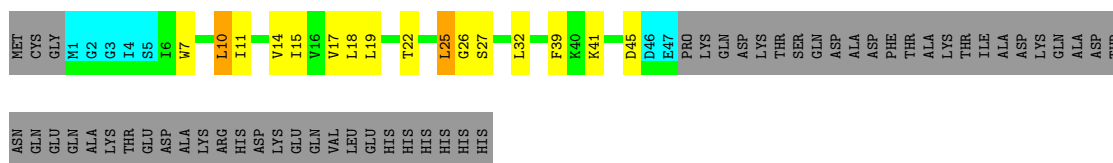
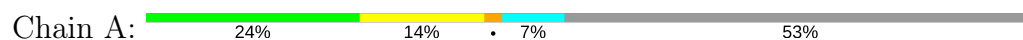


#### 4.2.9 Score per residue for model 9 (medoid)

- Molecule 1: Sec-independent protein translocase protein TatA

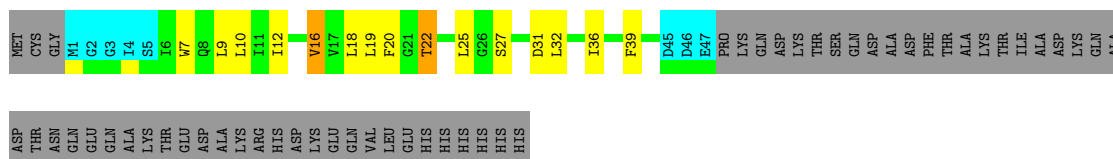
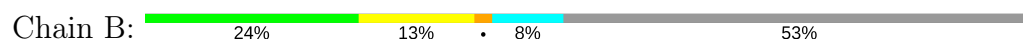


- Molecule 1: Sec-independent protein translocase protein TatA

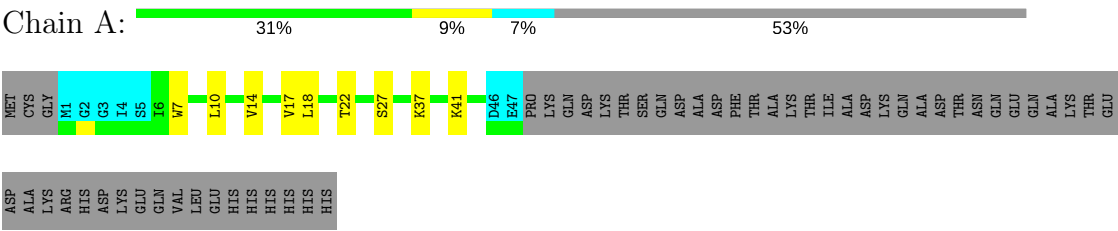


#### 4.2.10 Score per residue for model 10

- Molecule 1: Sec-independent protein translocase protein TatA



● Molecule 1: Sec-independent protein translocase protein TatA



## 5 Refinement protocol and experimental data overview

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

Of the 100 calculated structures, 10 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
X-PLOR NIH	refinement	
X-PLOR NIH	structure solution	

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)	2mn6_cs.str
Number of chemical shift lists	1
Total number of shifts	1096
Number of shifts mapped to atoms	1096
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	49%

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.

There are no bond-length outliers.

There are no bond-angle outliers.

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	297	334	334	10±2
1	B	289	330	330	12±3
All	All	5860	6640	6640	148

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 12.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:B:20:PHE:CZ	1:A:17:VAL:HB	0.89	2.01	10	10
1:B:12:ILE:HG22	1:A:14:VAL:HG21	0.74	1.60	4	10
1:B:28:ILE:HG22	1:A:26:GLY:HA2	0.70	1.62	4	4
1:A:33:GLY:O	1:A:36:ILE:HG22	0.64	1.93	5	6
1:B:16:VAL:HG13	1:B:20:PHE:CE2	0.63	2.29	8	10
1:B:16:VAL:HG23	1:A:14:VAL:HG13	0.61	1.70	5	7
1:B:20:PHE:CE1	1:A:17:VAL:HB	0.59	2.33	2	8
1:B:39:PHE:CD1	1:A:40:LYS:HG2	0.58	2.33	5	3
1:B:36:ILE:HA	1:B:39:PHE:CE2	0.57	2.34	5	1
1:B:12:ILE:CG2	1:A:14:VAL:HG21	0.57	2.30	7	8
1:B:19:LEU:HD22	1:B:20:PHE:CE1	0.57	2.34	3	10
1:B:34:ALA:O	1:B:37:LYS:HG2	0.56	1.99	9	5
1:B:16:VAL:HG13	1:B:20:PHE:HE2	0.56	1.60	8	9

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:B:24:LYS:O	1:B:28:ILE:HG23	0.56	2.00	4	3
1:B:40:LYS:HA	1:B:43:MET:SD	0.56	2.41	6	1
1:B:28:ILE:HG22	1:A:26:GLY:CA	0.55	2.31	4	1
1:A:36:ILE:HA	1:A:39:PHE:CE2	0.54	2.37	5	1
1:A:17:VAL:HG13	1:A:25:LEU:HD13	0.53	1.79	3	3
1:A:37:LYS:O	1:A:41:LYS:HB2	0.52	2.04	7	6
1:A:17:VAL:HG13	1:A:25:LEU:HD11	0.52	1.80	9	1
1:A:24:LYS:O	1:A:28:ILE:HG22	0.51	2.05	1	2
1:B:33:GLY:O	1:B:36:ILE:HG22	0.50	2.06	6	5
1:B:42:ALA:O	1:A:44:SER:HB3	0.49	2.07	8	1
1:B:22:THR:HA	1:B:25:LEU:HD13	0.48	1.84	6	2
1:A:15:ILE:O	1:A:19:LEU:HG	0.48	2.09	2	6
1:B:39:PHE:CE1	1:A:40:LYS:HG2	0.47	2.44	3	1
1:B:9:LEU:HD13	1:A:10:LEU:CD1	0.46	2.40	9	3
1:B:9:LEU:HD13	1:A:10:LEU:HD12	0.46	1.88	9	3
1:A:17:VAL:HA	1:A:25:LEU:HD11	0.46	1.87	6	1
1:A:11:ILE:O	1:A:15:ILE:HG13	0.44	2.11	9	1
1:B:16:VAL:HG21	1:A:14:VAL:HG22	0.44	1.88	3	2
1:B:16:VAL:CG2	1:A:14:VAL:HG22	0.44	2.43	2	2
1:B:24:LYS:O	1:B:28:ILE:HG22	0.43	2.13	3	1
1:B:8:GLN:HG2	1:A:7:TRP:CH2	0.43	2.49	7	1
1:B:20:PHE:CE2	1:A:17:VAL:HB	0.43	2.47	2	1
1:A:34:ALA:O	1:A:37:LYS:HG2	0.42	2.14	6	1
1:B:42:ALA:CB	1:A:41:LYS:HA	0.42	2.45	9	1
1:B:20:PHE:HB3	1:A:22:THR:CG2	0.42	2.44	2	1
1:B:16:VAL:HG22	1:B:20:PHE:CE2	0.41	2.50	3	1
1:A:17:VAL:HG12	1:A:22:THR:HG22	0.41	1.90	4	1
1:A:17:VAL:HG13	1:A:25:LEU:CD1	0.41	2.46	1	1
1:B:37:LYS:O	1:B:41:LYS:HB2	0.41	2.16	8	1
1:B:41:LYS:HA	1:B:44:SER:OG	0.40	2.16	3	1
1:A:22:THR:HA	1:A:25:LEU:CD1	0.40	2.46	7	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	40/100 (40%)	37±1 (93±2%)	3±1 (7±2%)	0±0 (0±0%)	100	100
1	B	39/100 (39%)	37±1 (94±3%)	2±1 (5±3%)	0±0 (0±1%)	48	82
All	All	790/2000 (40%)	739 (94%)	50 (6%)	1 (0%)	58	87

All 1 unique Ramachandran outliers are listed below.

Mol	Chain	Res	Type	Models (Total)
1	B	23	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	32/83 (39%)	26±1 (81±5%)	6±1 (19±5%)	4	36
1	B	31/83 (37%)	22±1 (70±5%)	9±1 (30±5%)	2	17
All	All	630/1660 (38%)	475 (75%)	155 (25%)	3	26

All 32 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	10	LEU	10
1	A	18	LEU	10
1	B	18	LEU	10
1	B	9	LEU	10
1	B	32	LEU	9
1	B	39	PHE	9
1	B	7	TRP	8
1	A	7	TRP	8
1	B	16	VAL	7
1	B	19	LEU	6
1	A	39	PHE	5
1	B	22	THR	5
1	B	27	SER	4
1	B	10	LEU	4
1	A	9	LEU	4
1	A	32	LEU	4

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Mol	Chain	Res	Type	Models (Total)
1	B	25	LEU	4
1	A	16	VAL	4
1	B	31	ASP	4
1	A	27	SER	4
1	A	31	ASP	3
1	B	24	LYS	3
1	A	22	THR	3
1	A	44	SER	3
1	B	28	ILE	3
1	A	25	LEU	2
1	B	44	SER	2
1	B	43	MET	2
1	B	36	ILE	2
1	A	45	ASP	1
1	A	11	ILE	1
1	B	30	SER	1

### 6.3.3 RNA ⓘ

There are no RNA molecules in this entry.

### 6.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

### 6.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

### 6.6 Ligand geometry ⓘ

There are no ligands in this entry.

### 6.7 Other polymers ⓘ

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 49% for the well-defined parts and 49% for the entire structure.

### 7.1 Chemical shift list 1

File name: 2mn6\_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	1096
Number of shifts mapped to atoms	1096
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
$^{13}\text{C}_\alpha$	91	$-0.38 \pm 0.49$	None needed ( $< 0.5$ ppm)
$^{13}\text{C}_\beta$	84	$0.06 \pm 0.18$	None needed ( $< 0.5$ ppm)
$^{13}\text{C}'$	80	$-0.17 \pm 0.31$	None needed ( $< 0.5$ ppm)
$^{15}\text{N}$	87	$0.41 \pm 0.27$	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 49%, i.e. 466 atoms were assigned a chemical shift out of a possible 947. 7 out of 18 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	$^1\text{H}$	$^{13}\text{C}$	$^{15}\text{N}$
Backbone	199/395 (50%)	80/158 (51%)	79/158 (50%)	40/79 (51%)
Sidechain	238/492 (48%)	142/284 (50%)	95/196 (48%)	1/12 (8%)

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	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Aromatic	29/60 (48%)	16/32 (50%)	12/26 (46%)	1/2 (50%)
Overall	466/947 (49%)	238/474 (50%)	186/380 (49%)	42/93 (45%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 49%, i.e. 528 atoms were assigned a chemical shift out of a possible 1088. 7 out of 18 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	<sup>1</sup> H	<sup>13</sup> C	<sup>15</sup> N
Backbone	232/470 (49%)	94/188 (50%)	91/188 (48%)	47/94 (50%)
Sidechain	267/558 (48%)	160/322 (50%)	106/224 (47%)	1/12 (8%)
Aromatic	29/60 (48%)	16/32 (50%)	12/26 (46%)	1/2 (50%)
Overall	528/1088 (49%)	270/542 (50%)	209/438 (48%)	49/108 (45%)

#### 7.1.4 Statistically unusual chemical shifts ⓘ

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	7	TRP	CB	41.32	40.02 – 19.92	5.6

#### 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:

