



Full wwPDB NMR Structure Validation Report ⓘ

Apr 26, 2016 – 07:04 PM BST

PDB ID : 2B1U
Title : Solution structure of Calmodulin-like Skin Protein C terminal domain
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Deposited on : 2005-09-16

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
<http://wwpdb.org/validation/2016/NMRValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

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
Mogul : unknown
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
RCI : v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV : Wang et al. (2010)
ShiftChecker : rb-20027457
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20027457

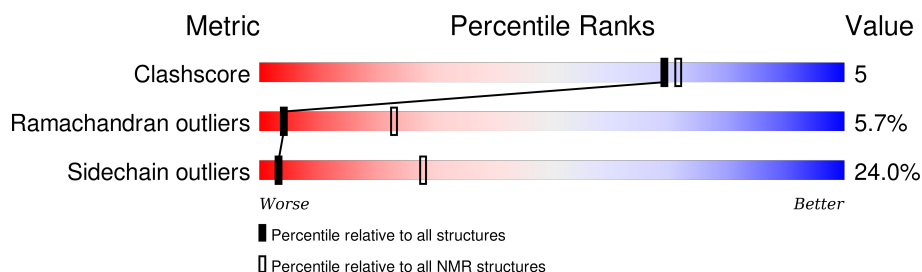
1 Overall quality at a glance

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	114402	11133
Ramachandran outliers	111179	9975
Sidechain outliers	111093	9958

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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	71	

2 Ensemble composition and analysis

This entry contains 20 models. Model 8 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:78-A:91, A:96-A:144 (63)	0.50	8

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 4 clusters and 1 single-model cluster was found.

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

3 Entry composition [i](#)

There is only 1 type of molecule in this entry. The entry contains 1083 atoms, of which 525 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Calmodulin-like protein 5.

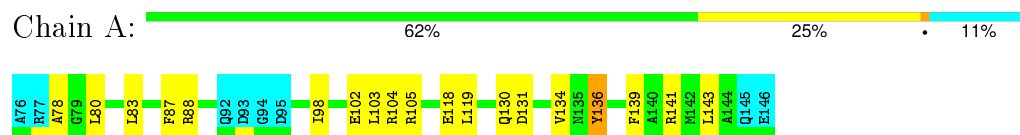
Mol	Chain	Residues	Atoms						Trace
1	A	71	Total	C	H	N	O	S	0
			1083	339	525	101	115	3	

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: Calmodulin-like protein 5

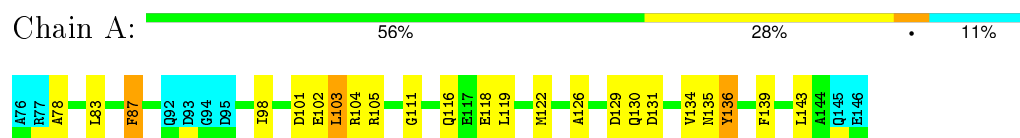


4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

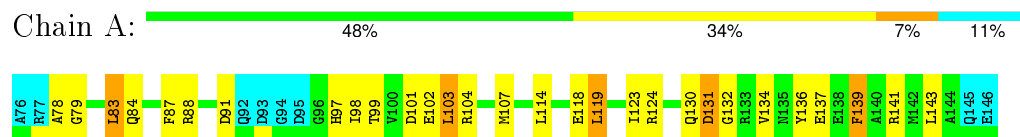
4.2.1 Score per residue for model 1

- Molecule 1: Calmodulin-like protein 5



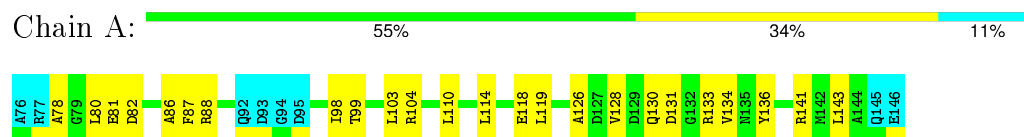
4.2.2 Score per residue for model 2

- Molecule 1: Calmodulin-like protein 5



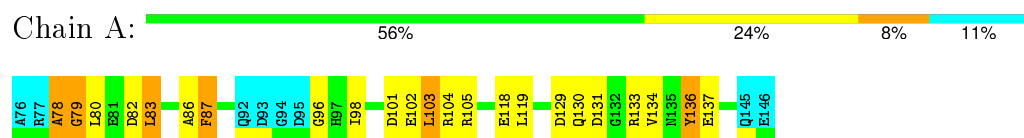
4.2.3 Score per residue for model 3

- Molecule 1: Calmodulin-like protein 5



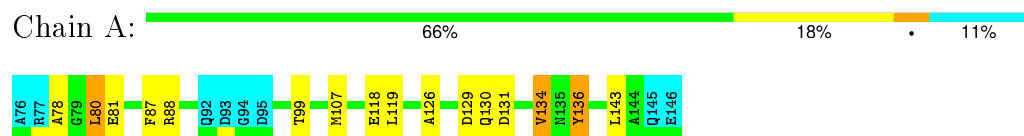
4.2.4 Score per residue for model 4

- Molecule 1: Calmodulin-like protein 5



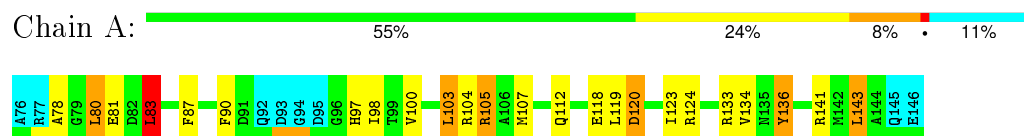
4.2.5 Score per residue for model 5

- Molecule 1: Calmodulin-like protein 5



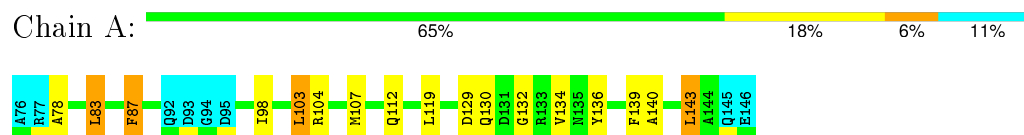
4.2.6 Score per residue for model 6

- Molecule 1: Calmodulin-like protein 5



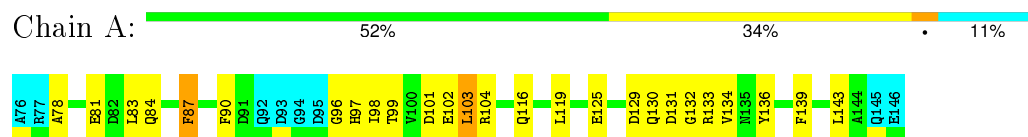
4.2.7 Score per residue for model 7

- Molecule 1: Calmodulin-like protein 5



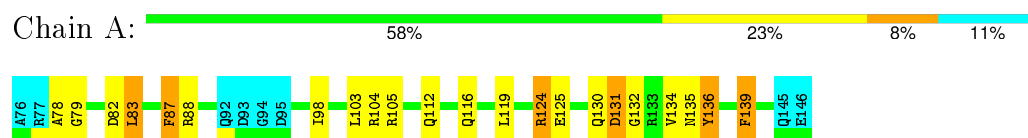
4.2.8 Score per residue for model 8 (medoid)

- Molecule 1: Calmodulin-like protein 5



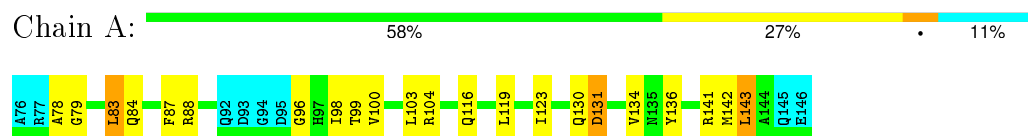
4.2.9 Score per residue for model 9

- Molecule 1: Calmodulin-like protein 5



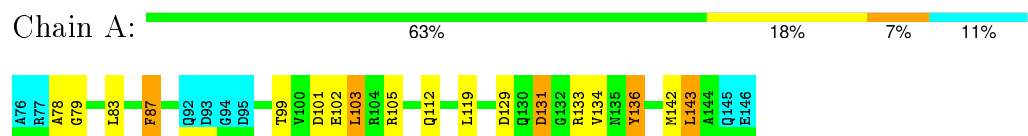
4.2.10 Score per residue for model 10

- Molecule 1: Calmodulin-like protein 5



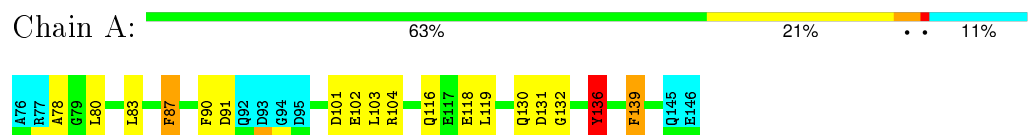
4.2.11 Score per residue for model 11

- Molecule 1: Calmodulin-like protein 5



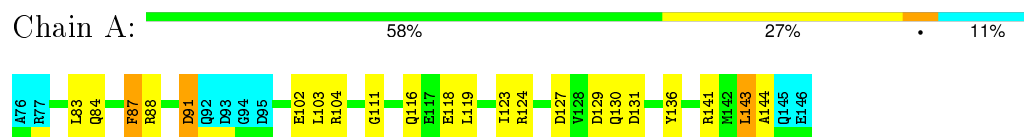
4.2.12 Score per residue for model 12

- Molecule 1: Calmodulin-like protein 5



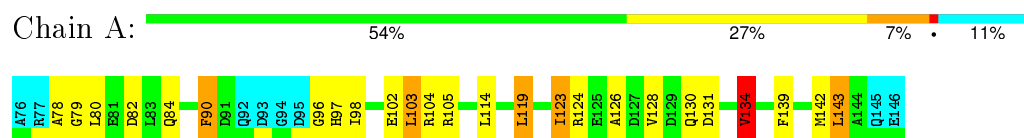
4.2.13 Score per residue for model 13

- Molecule 1: Calmodulin-like protein 5



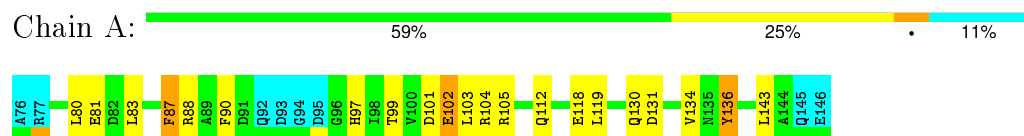
4.2.14 Score per residue for model 14

- Molecule 1: Calmodulin-like protein 5



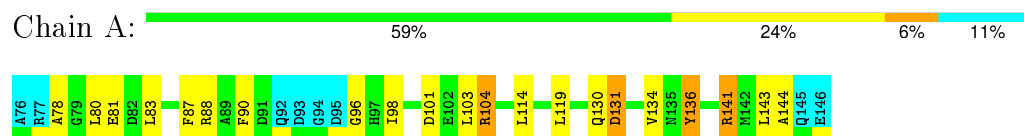
4.2.15 Score per residue for model 15

- Molecule 1: Calmodulin-like protein 5



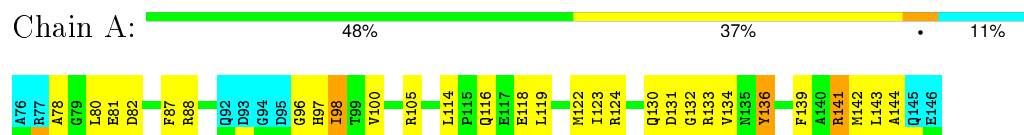
4.2.16 Score per residue for model 16

- Molecule 1: Calmodulin-like protein 5



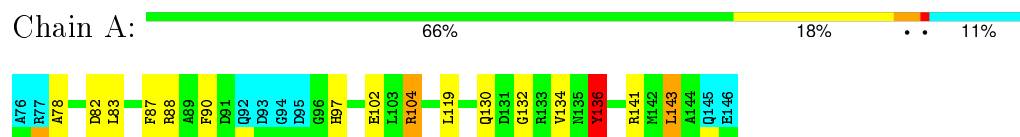
4.2.17 Score per residue for model 17

- Molecule 1: Calmodulin-like protein 5



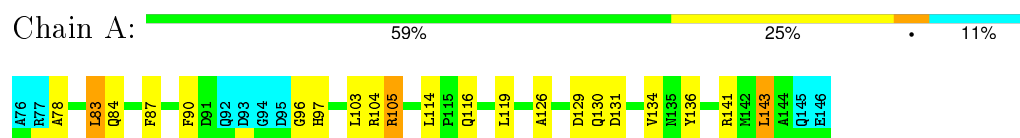
4.2.18 Score per residue for model 18

- Molecule 1: Calmodulin-like protein 5



4.2.19 Score per residue for model 19

- Molecule 1: Calmodulin-like protein 5



4.2.20 Score per residue for model 20

- Molecule 1: Calmodulin-like protein 5



5 Refinement protocol and experimental data overview

The models were refined using the following method: *torsion angle dynamics, coupled with simulated annealing, followed by restrained energy minimization.*

Of the 400 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	1.2
AMBER	refinement	5.0

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)	BMRB entry 6841
Number of chemical shift lists	1
Total number of shifts	491
Number of shifts mapped to atoms	491
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

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	0.56±0.01	0±0/501 (0.0±0.0%)	1.07±0.04	1±1/676 (0.1±0.2%)
All	All	0.56	0/10020 (0.0%)	1.07	16/13520 (0.1%)

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	3.8±1.6
All	All	0	76

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	83	LEU	CB-CG-CD2	-6.50	99.96	111.00	2	4
1	A	136	TYR	CB-CG-CD2	-6.21	117.27	121.00	4	1
1	A	133	ARG	NE-CZ-NH2	-5.93	117.33	120.30	11	3
1	A	141	ARG	NE-CZ-NH2	-5.89	117.35	120.30	6	1
1	A	83	LEU	CB-CG-CD1	-5.83	101.09	111.00	19	4
1	A	143	LEU	CB-CG-CD2	5.32	120.04	111.00	11	1
1	A	136	TYR	CB-CG-CD1	-5.09	117.95	121.00	18	1
1	A	107	MET	CA-CB-CG	-5.08	104.67	113.30	5	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)
1	A	87	PHE	Sidechain	17
1	A	104	ARG	Sidechain	14
1	A	136	TYR	Sidechain	13
1	A	78	ALA	Peptide	9
1	A	90	PHE	Sidechain	5
1	A	105	ARG	Sidechain	4
1	A	139	PHE	Sidechain	3
1	A	98	ILE	Peptide	2
1	A	133	ARG	Sidechain	2
1	A	142	MET	Peptide	1
1	A	97	HIS	Peptide	1
1	A	88	ARG	Sidechain	1
1	A	96	GLY	Peptide	1
1	A	124	ARG	Sidechain	1
1	A	141	ARG	Sidechain	1
1	A	79	GLY	Peptide	1

6.2 Too-close contacts ⓘ

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	494	472	472	4±3
All	All	9880	9440	9440	88

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 5.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:98:ILE:HD13	1:A:103:LEU:HD12	0.73	1.58	7	2
1:A:98:ILE:HG22	1:A:136:TYR:CE2	0.72	2.19	4	2
1:A:83:LEU:HD11	1:A:143:LEU:HD13	0.69	1.62	19	2
1:A:87:PHE:CE1	1:A:103:LEU:HD21	0.65	2.27	15	8
1:A:143:LEU:HD12	1:A:143:LEU:C	0.64	2.13	14	1
1:A:103:LEU:HD11	1:A:139:PHE:CE2	0.62	2.29	7	1
1:A:143:LEU:C	1:A:143:LEU:HD12	0.62	2.15	13	2
1:A:83:LEU:HD11	1:A:143:LEU:CD1	0.59	2.28	19	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:98:ILE:CD1	1:A:103:LEU:HD12	0.56	2.31	7	3
1:A:79:GLY:O	1:A:83:LEU:HD12	0.54	2.03	9	1
1:A:87:PHE:CD1	1:A:98:ILE:HG21	0.54	2.37	1	1
1:A:87:PHE:CZ	1:A:103:LEU:HD21	0.53	2.39	4	2
1:A:83:LEU:HD22	1:A:143:LEU:HB3	0.52	1.81	6	1
1:A:83:LEU:HD11	1:A:87:PHE:CE2	0.52	2.40	2	1
1:A:83:LEU:CD1	1:A:87:PHE:CZ	0.51	2.93	2	1
1:A:80:LEU:HA	1:A:143:LEU:HD21	0.51	1.81	14	1
1:A:80:LEU:HD23	1:A:81:GLU:N	0.51	2.21	6	6
1:A:83:LEU:HD11	1:A:87:PHE:CZ	0.50	2.40	2	1
1:A:107:MET:SD	1:A:119:LEU:HD23	0.50	2.46	2	1
1:A:98:ILE:HD13	1:A:103:LEU:CD1	0.50	2.34	14	1
1:A:126:ALA:HB1	1:A:134:VAL:CG2	0.49	2.37	1	3
1:A:119:LEU:HD12	1:A:123:ILE:CD1	0.48	2.38	14	1
1:A:83:LEU:HD13	1:A:143:LEU:HD12	0.48	1.85	2	1
1:A:83:LEU:HD12	1:A:87:PHE:CE1	0.47	2.45	6	1
1:A:79:GLY:O	1:A:83:LEU:HD23	0.47	2.10	4	1
1:A:90:PHE:CB	1:A:102:GLU:HB3	0.46	2.40	14	2
1:A:83:LEU:HD12	1:A:143:LEU:HD13	0.46	1.85	8	1
1:A:80:LEU:HA	1:A:83:LEU:HD23	0.46	1.88	6	1
1:A:140:ALA:HA	1:A:143:LEU:HD23	0.45	1.86	7	1
1:A:80:LEU:C	1:A:80:LEU:HD23	0.45	2.32	4	2
1:A:90:PHE:CG	1:A:102:GLU:HB3	0.45	2.47	8	2
1:A:126:ALA:HB1	1:A:134:VAL:HG12	0.44	1.90	14	1
1:A:126:ALA:HB1	1:A:134:VAL:HG21	0.44	1.89	19	2
1:A:83:LEU:HD13	1:A:107:MET:CE	0.44	2.43	7	1
1:A:83:LEU:CB	1:A:143:LEU:HD22	0.44	2.43	7	1
1:A:143:LEU:O	1:A:143:LEU:HD23	0.44	2.12	3	1
1:A:141:ARG:O	1:A:144:ALA:HB3	0.43	2.13	16	2
1:A:87:PHE:HB3	1:A:136:TYR:CE2	0.43	2.48	15	1
1:A:87:PHE:CZ	1:A:139:PHE:CD1	0.43	3.05	9	2
1:A:120:ASP:HA	1:A:123:ILE:HD12	0.43	1.91	6	1
1:A:83:LEU:O	1:A:86:ALA:HB3	0.43	2.14	4	1
1:A:86:ALA:HB2	1:A:110:LEU:HD11	0.43	1.91	3	1
1:A:82:ASP:OD2	1:A:110:LEU:HD13	0.43	2.14	3	1
1:A:98:ILE:CG1	1:A:134:VAL:CG2	0.43	2.97	4	1
1:A:83:LEU:CD1	1:A:87:PHE:CE1	0.42	3.02	6	1
1:A:143:LEU:CD1	1:A:143:LEU:C	0.42	2.86	13	1
1:A:83:LEU:O	1:A:87:PHE:CD1	0.42	2.72	13	1
1:A:90:PHE:HB3	1:A:102:GLU:HB3	0.42	1.91	18	1
1:A:87:PHE:CD1	1:A:103:LEU:HD21	0.42	2.50	13	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:87:PHE:CZ	1:A:139:PHE:CG	0.42	3.08	12	1
1:A:134:VAL:HG11	1:A:139:PHE:CD2	0.41	2.51	2	1
1:A:104:ARG:HG2	1:A:114:LEU:HD23	0.41	1.92	16	1
1:A:80:LEU:HB2	1:A:144:ALA:HB2	0.41	1.91	16	1
1:A:83:LEU:CB	1:A:143:LEU:HD13	0.41	2.45	18	1
1:A:139:PHE:CD1	1:A:139:PHE:C	0.41	2.94	1	1
1:A:78:ALA:HB1	1:A:82:ASP:CG	0.41	2.35	4	1
1:A:102:GLU:HG2	1:A:103:LEU:N	0.41	2.31	15	1
1:A:126:ALA:CB	1:A:134:VAL:HG12	0.41	2.46	14	1
1:A:98:ILE:HG22	1:A:136:TYR:CD2	0.40	2.49	4	1
1:A:126:ALA:CB	1:A:134:VAL:CG1	0.40	2.99	14	1
1:A:91:ASP:HB2	1:A:136:TYR:CD2	0.40	2.51	13	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	63/71 (89%)	49±2 (78±3%)	10±2 (16±3%)	4±1 (6±2%)	4	23
All	All	1260/1420 (89%)	981 (78%)	207 (16%)	72 (6%)	4	23

All 12 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	131	ASP	17
1	A	130	GLN	14
1	A	78	ALA	9
1	A	129	ASP	8
1	A	132	GLY	7
1	A	96	GLY	6
1	A	79	GLY	5
1	A	111	GLY	2
1	A	97	HIS	1
1	A	134	VAL	1

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Mol	Chain	Res	Type	Models (Total)
1	A	144	ALA	1
1	A	128	VAL	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	49/55 (89%)	37±4 (76±7%)	12±4 (24±7%)	3	28
All	All	980/1100 (89%)	745 (76%)	235 (24%)	3	28

All 40 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	119	LEU	20
1	A	103	LEU	15
1	A	136	TYR	13
1	A	143	LEU	13
1	A	134	VAL	12
1	A	118	GLU	11
1	A	88	ARG	10
1	A	105	ARG	8
1	A	116	GLN	8
1	A	101	ASP	8
1	A	99	THR	7
1	A	97	HIS	7
1	A	102	GLU	7
1	A	141	ARG	7
1	A	84	GLN	6
1	A	124	ARG	6
1	A	112	GLN	6
1	A	114	LEU	5
1	A	142	MET	5
1	A	123	ILE	5
1	A	98	ILE	5
1	A	131	ASP	5
1	A	83	LEU	5

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Mol	Chain	Res	Type	Models (Total)
1	A	82	ASP	4
1	A	122	MET	3
1	A	104	ARG	3
1	A	91	ASP	3
1	A	80	LEU	3
1	A	137	GLU	3
1	A	125	GLU	3
1	A	100	VAL	3
1	A	130	GLN	3
1	A	135	ASN	3
1	A	139	PHE	3
1	A	107	MET	2
1	A	128	VAL	1
1	A	133	ARG	1
1	A	117	GLU	1
1	A	120	ASP	1
1	A	127	ASP	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 [i](#)

The completeness of assignment taking into account all chemical shift lists is 49% for the well-defined parts and 48% for the entire structure.

7.1 Chemical shift list 1

File name: BMRB entry 6841

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	491
Number of shifts mapped to atoms	491
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
$^{13}\text{C}_\alpha$	0	—	—
$^{13}\text{C}_\beta$	0	—	—
$^{13}\text{C}'$	0	—	—
^{15}N	64	0.89 ± 0.60	None needed (imprecise)

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 49%, i.e. 373 atoms were assigned a chemical shift out of a possible 769. 0 out of 11 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	181/311 (58%)	123/124 (99%)	0/126 (0%)	58/61 (95%)
Sidechain	180/416 (43%)	180/241 (75%)	0/152 (0%)	0/23 (0%)

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	Total	¹ H	¹³ C	¹⁵ N
Aromatic	12/42 (29%)	12/23 (52%)	0/18 (0%)	0/1 (0%)
Overall	373/769 (49%)	315/388 (81%)	0/296 (0%)	58/85 (68%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 48%, i.e. 413 atoms were assigned a chemical shift out of a possible 864. 0 out of 11 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹ H	¹³ C	¹⁵ N
Backbone	200/351 (57%)	136/140 (97%)	0/142 (0%)	64/69 (93%)
Sidechain	201/471 (43%)	201/273 (74%)	0/170 (0%)	0/28 (0%)
Aromatic	12/42 (29%)	12/23 (52%)	0/18 (0%)	0/1 (0%)
Overall	413/864 (48%)	349/436 (80%)	0/330 (0%)	64/98 (65%)

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.

Random coil index (RCI) for chain A:

