Full wwPDB NMR Structure Validation Report (i)

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PDB ID	:	2K61
Title	:	Solution structure of CaM complexed to DAPk peptide
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Deposited on	:	2008-07-02

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 (i) symbol.

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

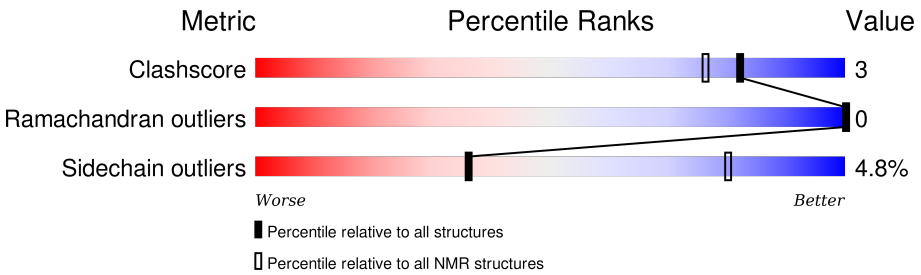
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Mogul	:	unknown
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	rb-20027457
Ideal 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 (i)

The following experimental techniques were used to determine the structure:
SOLUTION NMR

The overall completeness of chemical shifts assignment is 40%.

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 <=5%

Mol	Chain	Length	Quality of chain
1	A	148	86% 12% •

2 Ensemble composition and analysis (i)

This entry contains 1 models. Identification of well-defined residues and clustering analysis are not possible.

3 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 2241 atoms, of which 1084 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Calmodulin.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	146	2237	707	1084	185	252	9	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	60	ASP	ASN	ENGINEERED	UNP P62158

- Molecule 2 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms	
			Total	Ca
2	A	3	3	3

- Molecule 3 is TERBIUM(III) ION (three-letter code: TB) (formula: Tb).

Mol	Chain	Residues	Atoms	
			Total	Tb
3	A	1	1	1

4 Residue-property plots (i)

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

Chain A:

5 Refinement protocol and experimental data overview (i)

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

Of the 1 calculated structures, 1 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	structure solution	
X-PLOR NIH	refinement	

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 7425, BMRB entry 7424, BMRB entry 15852,
Number of chemical shift lists	
Total number of shifts	
Number of shifts mapped to atoms	
Number of unparsed shifts	
Number of shifts with mapping errors	
Number of shifts with mapping warnings	
Assignment completeness (well-defined parts)	

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)

Bond lengths and bond angles in the following residue types are not validated in this section: CA, TB

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	1153	1084	1082	7
All	All	1157	1084	1082	7

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 3.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)
1:A:92:PHE:HA	1:A:108:VAL:HG21	0.60	1.72
1:A:93:ASP:HB2	1:A:100:ILE:HG12	0.49	1.84
1:A:55:VAL:HG11	1:A:71:MET:HB2	0.48	1.84
1:A:98:GLY:O	1:A:137:ASN:HA	0.45	2.11
1:A:27:ILE:HB	1:A:63:ILE:HB	0.44	1.89
1:A:35:VAL:O	1:A:39:LEU:HG	0.41	2.15
1:A:92:PHE:HB2	1:A:100:ILE:HD13	0.40	1.93

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	144/148 (97%)	141 (98%)	3 (2%)	0 (0%)	100	100
All	All	144/148 (97%)	141 (98%)	3 (2%)	0 (0%)	100	100

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	125/126 (99%)	119 (95%)	6 (5%)	36	80
All	All	125/126 (99%)	119 (95%)	6 (5%)	36	80

All 6 residues with a non-rotameric sidechain are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type
1	A	58	ASP
1	A	129	ASP
1	A	68	PHE
1	A	112	LEU
1	A	116	LEU
1	A	60	ASP

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)

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

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 40% for the well-defined parts and 40% for the entire structure.

7.1 Chemical shift list 1

File name: BMRB entry 7423

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	623
Number of shifts mapped to atoms	623
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 (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	129	0.29 ± 0.23	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	113	1.31 ± 0.16	Should be applied
$^{13}C'$	123	-0.01 ± 0.12	None needed (< 0.5 ppm)
^{15}N	129	0.15 ± 0.15	None needed (< 0.5 ppm)

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 35%, i.e. 613 atoms were assigned a chemical shift out of a possible 1742. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	502/726 (69%)	127/290 (44%)	248/292 (85%)	127/144 (88%)
Sidechain	111/920 (12%)	0/531 (0%)	111/352 (32%)	0/37 (0%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	0/96 (0%)	0/52 (0%)	0/42 (0%)	0/2 (0%)
Overall	613/1742 (35%)	127/873 (15%)	359/686 (52%)	127/183 (69%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 35%, i.e. 613 atoms were assigned a chemical shift out of a possible 1742. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	502/726 (69%)	127/290 (44%)	248/292 (85%)	127/144 (88%)
Sidechain	111/920 (12%)	0/531 (0%)	111/352 (32%)	0/37 (0%)
Aromatic	0/96 (0%)	0/52 (0%)	0/42 (0%)	0/2 (0%)
Overall	613/1742 (35%)	127/873 (15%)	359/686 (52%)	127/183 (69%)

7.1.4 Statistically unusual chemical shifts (i)

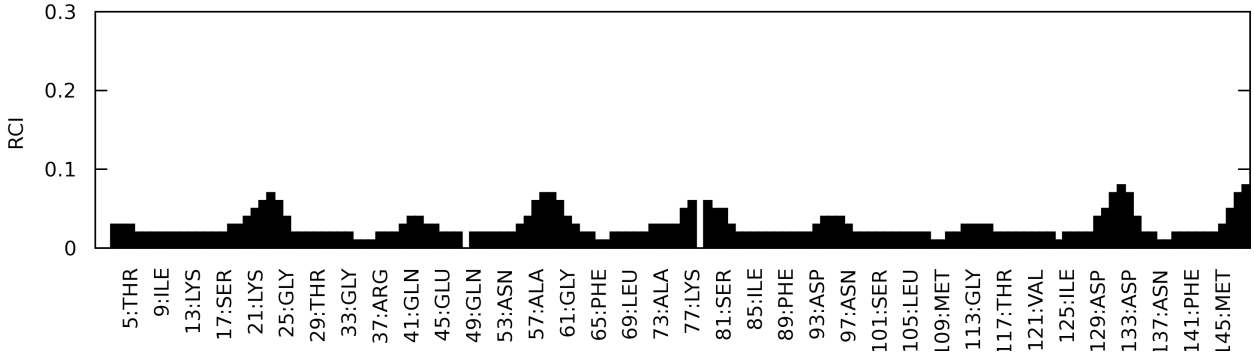
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	29	THR	H	11.73	11.34 – 5.14	5.6

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:



7.2 Chemical shift list 2

File name: BMRB entry 7424

Chemical shift list name: *assigned_chem_shift_list_1*

7.2.1 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	457
Number of shifts mapped to atoms	457
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

7.2.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	96	0.43 ± 0.24	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	80	1.41 ± 0.11	Should be applied
$^{13}C'$	89	0.22 ± 0.29	None needed (< 0.5 ppm)
^{15}N	96	0.33 ± 0.42	None needed (< 0.5 ppm)

7.2.3 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 26%, i.e. 447 atoms were assigned a chemical shift out of a possible 1742. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	369/726 (51%)	94/290 (32%)	181/292 (62%)	94/144 (65%)
Sidechain	78/920 (8%)	0/531 (0%)	78/352 (22%)	0/37 (0%)
Aromatic	0/96 (0%)	0/52 (0%)	0/42 (0%)	0/2 (0%)
Overall	447/1742 (26%)	94/873 (11%)	259/686 (38%)	94/183 (51%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 26%, i.e. 447 atoms were assigned a chemical shift out of a possible 1742. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	369/726 (51%)	94/290 (32%)	181/292 (62%)	94/144 (65%)
Sidechain	78/920 (8%)	0/531 (0%)	78/352 (22%)	0/37 (0%)
Aromatic	0/96 (0%)	0/52 (0%)	0/42 (0%)	0/2 (0%)
Overall	447/1742 (26%)	94/873 (11%)	259/686 (38%)	94/183 (51%)

7.2.4 Statistically unusual chemical shifts (i)

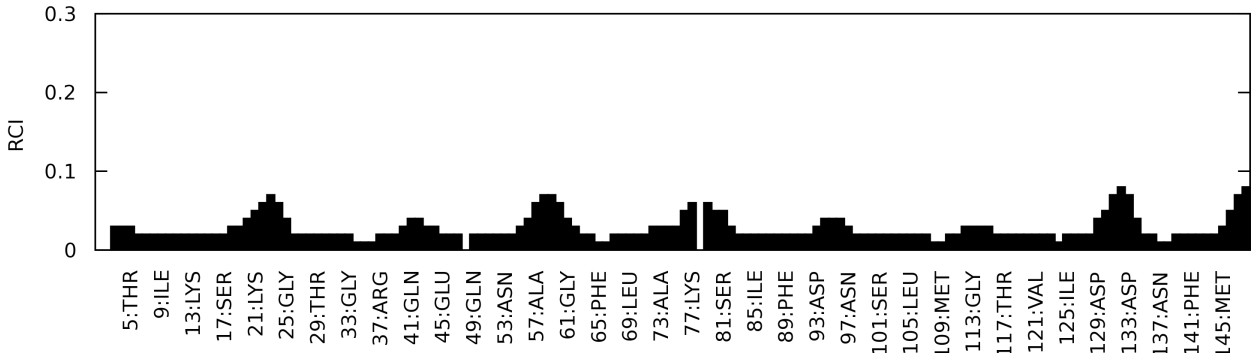
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	13	LYS	H	11.49	11.24 – 5.14	5.4

7.2.5 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:



7.3 Chemical shift list 3

File name: BMRB entry 7425

Chemical shift list name: *assigned_chem_shift_list_1*

7.3.1 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	441
Number of shifts mapped to atoms	441
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	2

7.3.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	112	0.18 ± 0.13	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	0	—	—
$^{13}C'$	105	-0.11 ± 0.09	None needed (< 0.5 ppm)
^{15}N	112	-0.04 ± 0.27	None needed (< 0.5 ppm)

7.3.3 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 25%, i.e. 433 atoms were assigned a chemical shift out of a possible 1742. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	433/726 (60%)	110/290 (38%)	213/292 (73%)	110/144 (76%)
Sidechain	0/920 (0%)	0/531 (0%)	0/352 (0%)	0/37 (0%)
Aromatic	0/96 (0%)	0/52 (0%)	0/42 (0%)	0/2 (0%)
Overall	433/1742 (25%)	110/873 (13%)	213/686 (31%)	110/183 (60%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 25%, i.e. 433 atoms were assigned a chemical shift out of a possible 1742. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	433/726 (60%)	110/290 (38%)	213/292 (73%)	110/144 (76%)
Sidechain	0/920 (0%)	0/531 (0%)	0/352 (0%)	0/37 (0%)
Aromatic	0/96 (0%)	0/52 (0%)	0/42 (0%)	0/2 (0%)
Overall	433/1742 (25%)	110/873 (13%)	213/686 (31%)	110/183 (60%)

7.3.4 Statistically unusual chemical shifts (i)

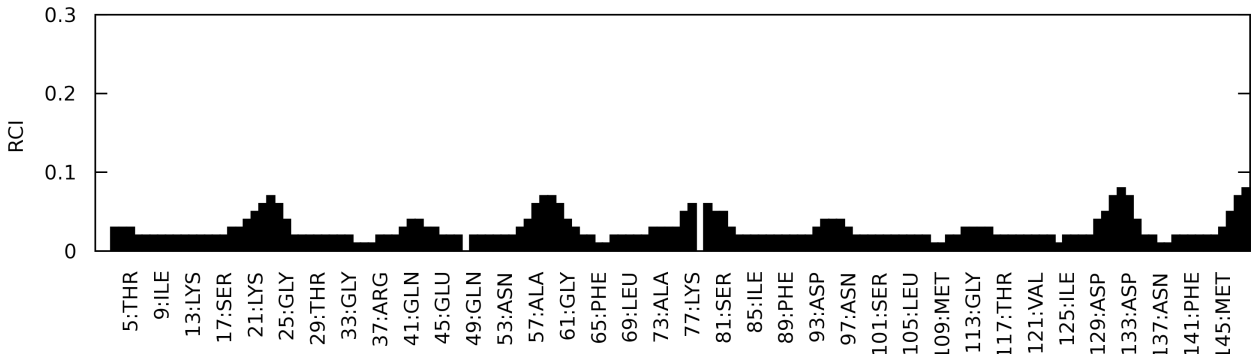
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	51	MET	H	12.46	11.26 – 5.26	7.0
1	A	32	LEU	H	12.57	11.47 – 4.97	6.7

7.3.5 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:



7.4 Chemical shift list 4

File name: BMRB entry 15852

Chemical shift list name: *assigned_ chem_ shift_ list_ 1*

7.4.1 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	704
Number of shifts mapped to atoms	704
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

7.4.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	144	0.54 ± 0.10	Should be applied
$^{13}C_{\beta}$	132	1.15 ± 0.08	Should be applied
$^{13}C'$	140	0.24 ± 0.08	None needed (< 0.5 ppm)
^{15}N	144	0.41 ± 0.25	None needed (< 0.5 ppm)

7.4.3 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 40%, i.e. 694 atoms were assigned a chemical shift out of a possible 1742. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	564/726 (78%)	142/290 (49%)	280/292 (96%)	142/144 (99%)
Sidechain	130/920 (14%)	0/531 (0%)	130/352 (37%)	0/37 (0%)
Aromatic	0/96 (0%)	0/52 (0%)	0/42 (0%)	0/2 (0%)
Overall	694/1742 (40%)	142/873 (16%)	410/686 (60%)	142/183 (78%)

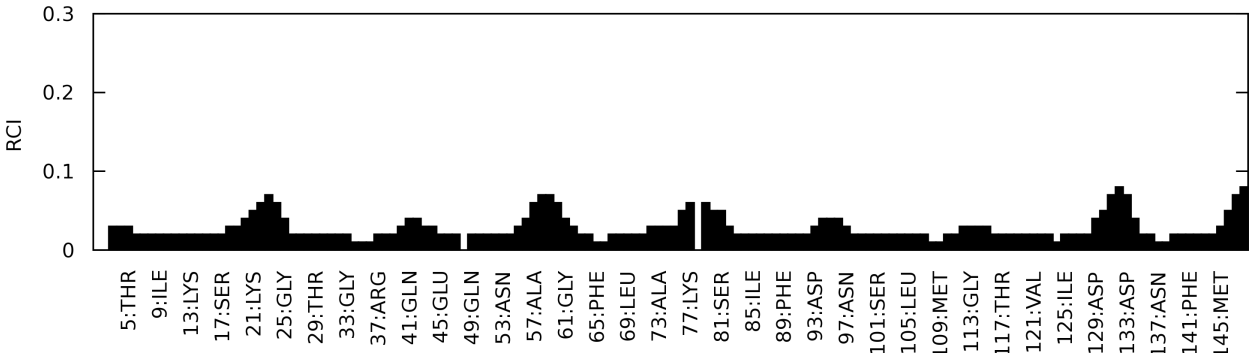
The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 40%, i.e. 694 atoms were assigned a chemical shift out of a possible 1742. 0 out of 16 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	564/726 (78%)	142/290 (49%)	280/292 (96%)	142/144 (99%)
Sidechain	130/920 (14%)	0/531 (0%)	130/352 (37%)	0/37 (0%)
Aromatic	0/96 (0%)	0/52 (0%)	0/42 (0%)	0/2 (0%)
Overall	694/1742 (40%)	142/873 (16%)	410/686 (60%)	142/183 (78%)

7.4.4 Statistically unusual chemical shifts (i)

There are no statistically unusual chemical shifts.

7.4.5 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: