Full wwPDB NMR Structure Validation Report (i)

Apr 21, 2024 – 05:45 PM EDT

PDB ID	:	2M6M
BMRB ID	:	19146
Title	:	Solution structure of RING domain of E3 ubiquitin ligase Doa10
Authors	:	Lim, J.; Son, W.
Deposited on	:	2013-04-06

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 types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

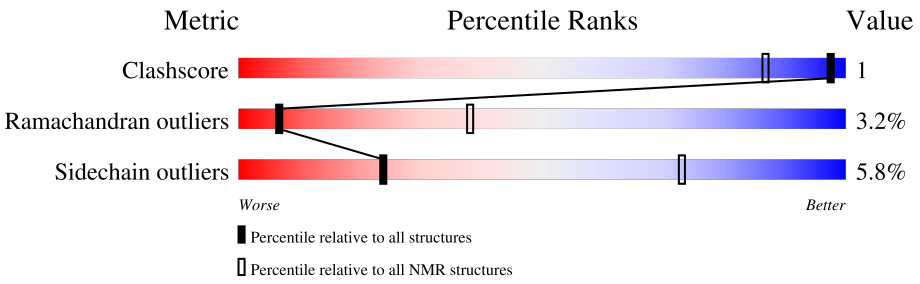
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

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 92%.

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
Ramachandran outliers	154571	11451
Sidechain outliers	154315	11428

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	83	71% 6% 23%

2 Ensemble composition and analysis (i)

This entry contains 19 models. Model 6 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:36-A:99 (64)	0.80	6

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 3 clusters and 2 single-model clusters were found.

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

3 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 1246 atoms, of which 603 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called ERAD-associated E3 ubiquitin-protein ligase DOA10.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	83	1244	395	603	110	128	8	0

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	
			Total	Zn
2	A	2	2	2

4 Residue-property plots (i)

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA, DNA and oligosaccharide 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: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 71% 6% 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 R40 R43 C58 R59 N78 K100 T101

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: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 71% • • 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 R40 R43 P51 V88 F99 K100 T101

4.2.2 Score per residue for model 2

• Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 69% 7% • 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 R40 R43 H54 C58 R59 G60 S61 N78 K100 T101

4.2.3 Score per residue for model 3

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 70% 7% 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 R40 R43 C58 R59 I79 K89 K100 T101

4.2.4 Score per residue for model 4

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 69% 8% 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 G36 A37 R40 R43 F53 C58 R59 N78 K100 T101

4.2.5 Score per residue for model 5

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 61% 16% 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 C39 R40 I41 C42 R43 N50 P55 C56 K57 C58 R59 N78 I79 D80 I81 K89 I97 K100 T101

4.2.6 Score per residue for model 6 (medoid)

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 72% 5% 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 G36 R40 I79 H94 K100 T101

4.2.7 Score per residue for model 7

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

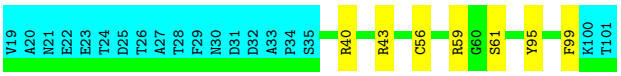
Chain A: 67% 10% 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 R40 A46 C56 K57 C58 N78 I79 D80 I81 V88 K100 T101

4.2.8 Score per residue for model 8

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

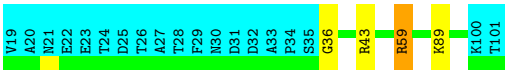
Chain A: 69% 8% 23%



4.2.9 Score per residue for model 9

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 72% 23%



4.2.10 Score per residue for model 10

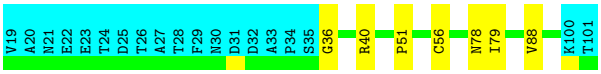
- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 76% 23%

4.2.11 Score per residue for model 11

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

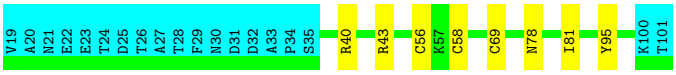
Chain A: 69% 8% 23%



4.2.12 Score per residue for model 12

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 67% 10% 23%



4.2.13 Score per residue for model 13

• Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 72% • • 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 R40 R43 Y64 I97 K100 T101

4.2.14 Score per residue for model 14

• Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 70% 5% • 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 R40 P51 K57 C58 R59 Y95 K100 T101

4.2.15 Score per residue for model 15

• Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 63% 14% 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 G36 R40 R43 C56 K57 C58 R59 G60 S61 N78 V88 C93 H94 Y95 F99 K100 T101

4.2.16 Score per residue for model 16

• Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A: 67% 10% 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 R40 R43 P51 K57 C58 N78 I81 Y95 K100 T101

4.2.17 Score per residue for model 17

• Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

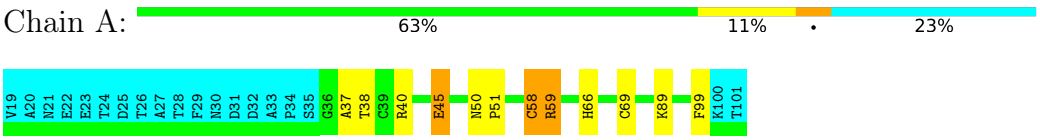
Chain A: 67% 8% • 23%

V19 A20 N21 E22 E23 T24 D25 T26 A27 T28 F29 N30 D31 D32 A33 P34 S35 R40 R43 P51 K57 C58 R59 G60 N78 I79 K100 T101

4.2.18 Score per residue for model 18

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

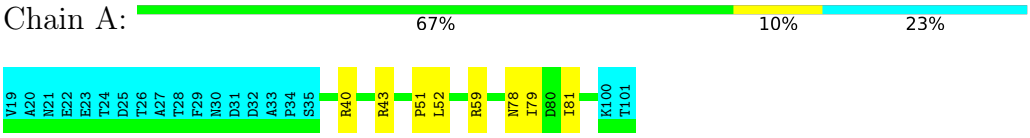
Chain A:



4.2.19 Score per residue for model 19

- Molecule 1: ERAD-associated E3 ubiquitin-protein ligase DOA10

Chain A:



5 Refinement protocol and experimental data overview (i)

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

Of the 1000 calculated structures, 19 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
CYANA	structure solution	
Amber	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)	working_cs.cif
Number of chemical shift lists	1
Total number of shifts	974
Number of shifts mapped to atoms	974
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	92%

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: ZN

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	0.70±0.01	0±0/512 (0.0± 0.0%)	1.18±0.04	2±1/692 (0.2± 0.2%)
All	All	0.70	0/9728 (0.0%)	1.18	29/13148 (0.2%)

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(^{o})	Ideal(^{o})	Models	
								Worst	Total
1	A	58	CYS	C-N-CA	8.04	141.81	121.70	14	2
1	A	45	GLU	C-N-CA	8.00	141.69	121.70	18	1
1	A	43	ARG	NE-CZ-NH1	7.72	124.16	120.30	17	12
1	A	58	CYS	O-C-N	-6.26	112.69	122.70	14	1
1	A	51	PRO	C-N-CA	5.96	136.60	121.70	19	1
1	A	89	LYS	N-CA-CB	-5.72	100.31	110.60	9	1
1	A	59	ARG	NE-CZ-NH1	5.67	123.13	120.30	9	5
1	A	57	LYS	N-CA-CB	-5.48	100.73	110.60	17	1
1	A	58	CYS	CA-C-N	5.39	129.05	117.20	14	1
1	A	64	TYR	CB-CG-CD2	-5.33	117.80	121.00	13	1
1	A	37	ALA	CB-CA-C	5.26	118.00	110.10	4	1
1	A	40	ARG	NE-CZ-NH1	5.21	122.91	120.30	14	2

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	499	479	479	1±1
All	All	9519	9101	9101	10

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 1.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:38:THR:HG22	1:A:45:GLU:HA	0.69	1.64	18	1
1:A:56:CYS:SG	1:A:95:TYR:HB2	0.42	2.54	12	3
1:A:55:PRO:HG2	1:A:56:CYS:H	0.41	1.74	5	1
1:A:57:LYS:HB2	1:A:95:TYR:CG	0.41	2.50	16	1
1:A:39:CYS:SG	1:A:41:ILE:HB	0.41	2.56	5	1
1:A:57:LYS:HB2	1:A:95:TYR:CD1	0.41	2.51	14	1
1:A:50:ASN:HD21	1:A:66:HIS:HB3	0.40	1.76	18	1
1:A:66:HIS:HB2	1:A:69:CYS:SG	0.40	2.57	18	1

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	64/83 (77%)	53±2 (83±4%)	9±2 (13±3%)	2±1 (3±2%)	7	38
All	All	1216/1577 (77%)	1014 (83%)	163 (13%)	39 (3%)	7	38

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	59	ARG	9
1	A	58	CYS	7
1	A	51	PRO	6
1	A	88	VAL	4

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Mol	Chain	Res	Type	Models (Total)
1	A	36	GLY	4
1	A	61	SER	3
1	A	43	ARG	1
1	A	46	ALA	1
1	A	99	PHE	1
1	A	60	GLY	1
1	A	37	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	56/72 (78%)	53±1 (94±2%)	3±1 (6±2%)	24 73
All	All	1064/1368 (78%)	1002 (94%)	62 (6%)	24 73

All 18 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	40	ARG	17
1	A	78	ASN	10
1	A	79	ILE	7
1	A	81	ILE	5
1	A	58	CYS	4
1	A	99	PHE	3
1	A	89	LYS	3
1	A	97	ILE	2
1	A	56	CYS	2
1	A	54	HIS	1
1	A	53	PHE	1
1	A	50	ASN	1
1	A	94	HIS	1
1	A	43	ARG	1
1	A	69	CYS	1
1	A	64	TYR	1
1	A	59	ARG	1

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Mol	Chain	Res	Type	Models (Total)
1	A	93	CYS	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 monosaccharides in this entry.

6.6 Ligand geometry (i)

Of 2 ligands modelled in this entry, 2 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 92% for the well-defined parts and 92% for the entire structure.

7.1 Chemical shift list 1

File name: working_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	974
Number of shifts mapped to atoms	974
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
$^{13}C_{\alpha}$	83	-0.01 ± 0.13	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	79	0.20 ± 0.20	None needed (< 0.5 ppm)
$^{13}C'$	80	0.03 ± 0.11	None needed (< 0.5 ppm)
^{15}N	76	-0.36 ± 0.32	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 92%, i.e. 777 atoms were assigned a chemical shift out of a possible 842. 0 out of 5 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	311/316 (98%)	127/128 (99%)	125/128 (98%)	59/60 (98%)
Sidechain	412/455 (91%)	280/295 (95%)	129/143 (90%)	3/17 (18%)

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	Total	^{1}H	^{13}C	^{15}N
Aromatic	54/71 (76%)	27/36 (75%)	25/31 (81%)	2/4 (50%)
Overall	777/842 (92%)	434/459 (95%)	279/302 (92%)	64/81 (79%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 92%, i.e. 974 atoms were assigned a chemical shift out of a possible 1059. 0 out of 6 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	402/409 (98%)	163/165 (99%)	163/166 (98%)	76/78 (97%)
Sidechain	518/569 (91%)	352/367 (96%)	161/182 (88%)	5/20 (25%)
Aromatic	54/81 (67%)	27/41 (66%)	25/36 (69%)	2/4 (50%)
Overall	974/1059 (92%)	542/573 (95%)	349/384 (91%)	83/102 (81%)

7.1.4 Statistically unusual chemical shifts (i)

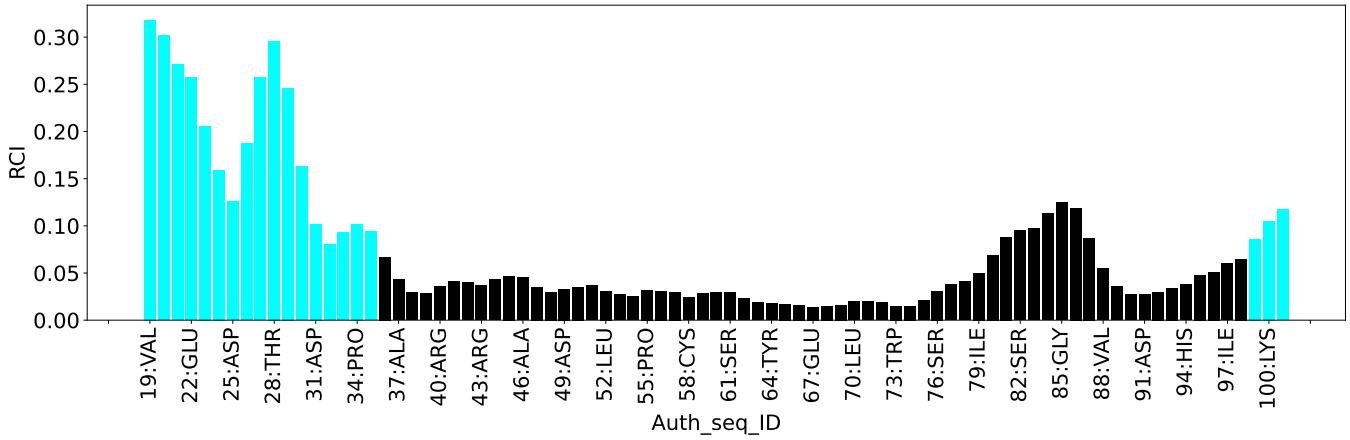
The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

List Id	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	63	LYS	HG2	-0.08	0.13 – 2.61	-5.8

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.If well-defined core and ill-defined regions are not identified then it is shown as gray bars.

Random coil index (RCI) for chain A:


RCI
0.00
0.05
0.10
0.15
0.20
0.25
0.30
19:VAL
22:GLU
25:ASP
28:THR
31:ASP
34:PRO
37:ALA
40:ARG
43:ARG
46:ALA
49:ASP
52:LEU
55:PRO
58:CYS
61:SER
64:TYR
67:GLU
70:LEU
73:TRP
76:SER
79:ILE
82:SER
85:GLY
88:VAL
91:ASP
94:HIS
97:ILE
100:LYS
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