Full wwPDB NMR Structure Validation Report (i)

Apr 16, 2023 – 07:59 AM EDT

PDB ID	:	8ALQ
BMRB ID	:	34745
Title	:	The Solution Structure of the Triple Mutant Methyl-CpG-Binding Domain from MeCP2 that Binds to Asymmetrically Modified DNA
Authors	:	Singh, H.
Deposited on	:	2022-08-01

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:

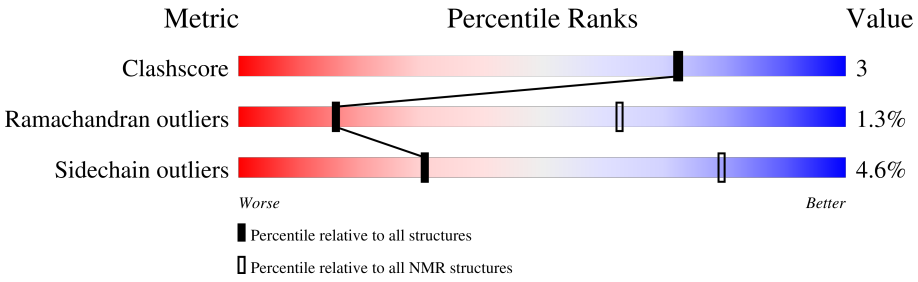
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.32.2

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 55%.

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	104	61% 7% 33%

2 Ensemble composition and analysis (i)

This entry contains 10 models. Model 1 is the overall representative, medoid model (most similar to other models).

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:3-A:5, A:11-A:77 (70)	0.87	1

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 and 1 single-model cluster was found.

Cluster number	Models
1	1, 3, 7, 9, 10
2	2, 4, 5, 6
Single-model clusters	8

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 1664 atoms, of which 823 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Methyl-CpG-binding protein 2.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	104	1664	524	823	160	156	1	0

There are 17 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	SER	-	expression tag	UNP A0A8C5LDB3
A	2	LEU	-	expression tag	UNP A0A8C5LDB3
A	3	GLU	ARG	conflict	UNP A0A8C5LDB3
A	23	THR	LYS	conflict	UNP A0A8C5LDB3
A	36	ALA	VAL	conflict	UNP A0A8C5LDB3
A	48	ASN	SER	conflict	UNP A0A8C5LDB3
A	85	LYS	ARG	conflict	UNP A0A8C5LDB3
A	87	PRO	ALA	conflict	UNP A0A8C5LDB3
A	96	THR	-	expression tag	UNP A0A8C5LDB3
A	97	SER	-	expression tag	UNP A0A8C5LDB3
A	98	HIS	-	expression tag	UNP A0A8C5LDB3
A	99	HIS	-	expression tag	UNP A0A8C5LDB3
A	100	HIS	-	expression tag	UNP A0A8C5LDB3
A	101	HIS	-	expression tag	UNP A0A8C5LDB3
A	102	HIS	-	expression tag	UNP A0A8C5LDB3
A	103	HIS	-	expression tag	UNP A0A8C5LDB3
A	104	HIS	-	expression tag	UNP A0A8C5LDB3

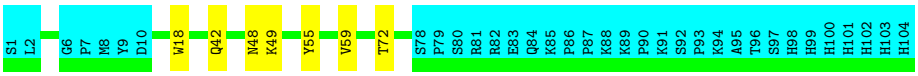
4 Residue-property plots

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: Methyl-CpG-binding protein 2

Chain A:



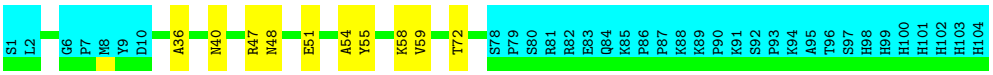
4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1 (medoid)

• Molecule 1: Methyl-CpG-binding protein 2

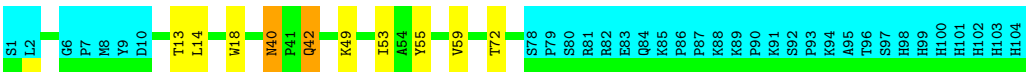
Chain A:



4.2.2 Score per residue for model 2

• Molecule 1: Methyl-CpG-binding protein 2

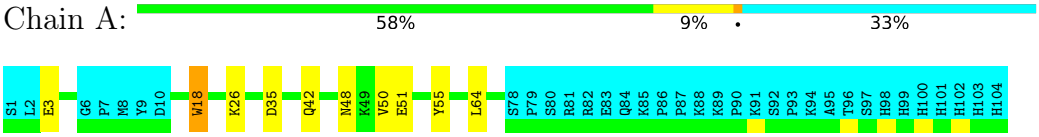
Chain A:



4.2.3 Score per residue for model 3

• Molecule 1: Methyl-CpG-binding protein 2

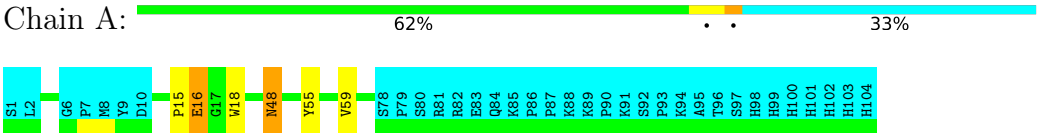
Chain A:



4.2.4 Score per residue for model 4

• Molecule 1: Methyl-CpG-binding protein 2

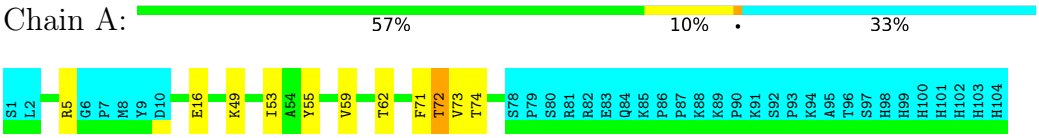
Chain A:



4.2.5 Score per residue for model 5

• Molecule 1: Methyl-CpG-binding protein 2

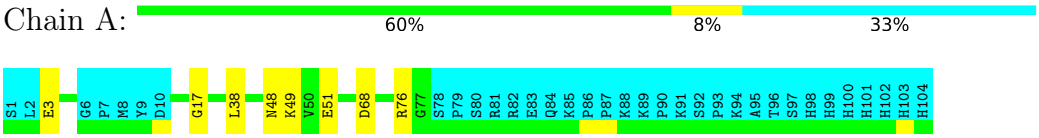
Chain A:



4.2.6 Score per residue for model 6

• Molecule 1: Methyl-CpG-binding protein 2

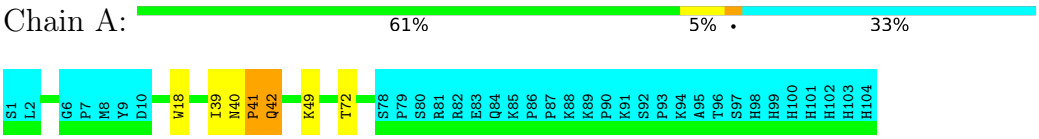
Chain A:



4.2.7 Score per residue for model 7

• Molecule 1: Methyl-CpG-binding protein 2

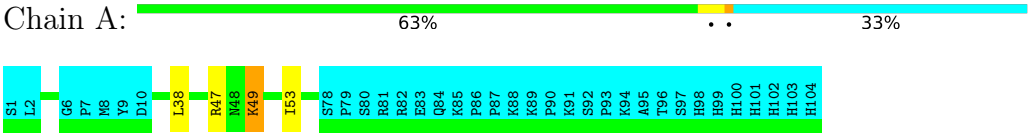
Chain A:



4.2.8 Score per residue for model 8

• Molecule 1: Methyl-CpG-binding protein 2

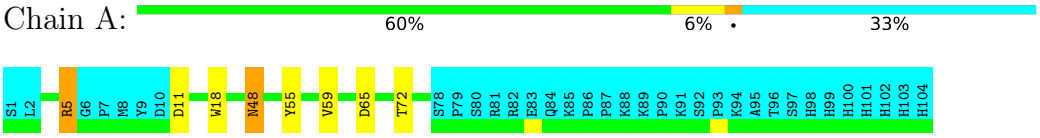
Chain A:



4.2.9 Score per residue for model 9

• Molecule 1: Methyl-CpG-binding protein 2

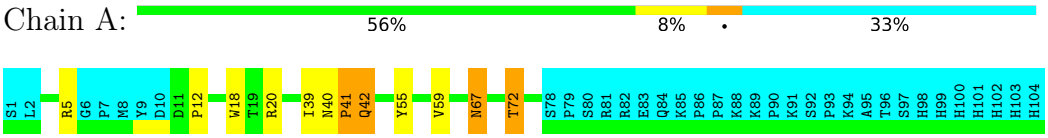
Chain A:



4.2.10 Score per residue for model 10

• Molecule 1: Methyl-CpG-binding protein 2

Chain A:



5 Refinement protocol and experimental data overview

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

Of the 200 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
CNS	refinement	
CYANA	structure calculation	

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	608
Number of shifts mapped to atoms	608
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	55%

6 Model quality

6.1 Standard geometry

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

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	561	545	545	4±1
All	All	5610	5450	5450	38

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:5:ARG:HA	1:A:5:ARG:NE	0.55	2.17	5	2
1:A:55:TYR:O	1:A:59:VAL:HG12	0.55	2.02	5	3
1:A:40:ASN:HB3	1:A:42:GLN:NE2	0.52	2.19	2	1
1:A:54:ALA:O	1:A:58:LYS:HG2	0.51	2.05	1	1
1:A:48:ASN:OD1	1:A:51:GLU:HG3	0.51	2.06	1	1
1:A:42:GLN:NE2	1:A:42:GLN:H	0.51	2.03	2	1
1:A:36:ALA:O	1:A:47:ARG:HA	0.48	2.08	1	1
1:A:15:PRO:HG2	1:A:18:TRP:O	0.48	2.08	4	1
1:A:49:LYS:O	1:A:53:ILE:HG12	0.47	2.10	8	3
1:A:72:THR:HG23	1:A:73:VAL:H	0.47	1.68	5	1
1:A:18:TRP:HB2	1:A:39:ILE:O	0.46	2.10	10	2
1:A:48:ASN:OD1	1:A:51:GLU:HG2	0.45	2.10	6	2
1:A:40:ASN:CG	1:A:41:PRO:HD2	0.45	2.32	7	2
1:A:67:ASN:HD22	1:A:67:ASN:C	0.44	2.16	10	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:55:TYR:O	1:A:59:VAL:HG22	0.44	2.13	1	3
1:A:18:TRP:CZ3	1:A:64:LEU:HG	0.43	2.48	3	1
1:A:38:LEU:HD12	1:A:38:LEU:N	0.43	2.29	8	1
1:A:38:LEU:HD11	1:A:49:LYS:HZ1	0.42	1.74	6	1
1:A:48:ASN:OD1	1:A:50:VAL:HG12	0.41	2.15	3	1
1:A:47:ARG:HD2	1:A:47:ARG:C	0.41	2.36	8	1
1:A:55:TYR:CD2	1:A:64:LEU:HD22	0.41	2.51	3	1
1:A:42:GLN:H	1:A:42:GLN:NE2	0.41	2.13	10	2
1:A:48:ASN:HD22	1:A:48:ASN:N	0.41	2.14	9	2
1:A:3:GLU:O	1:A:17:GLY:HA3	0.41	2.16	6	1
1:A:13:THR:HG23	1:A:14:LEU:HD12	0.41	1.91	2	1
1:A:71:PHE:HA	1:A:74:THR:O	0.40	2.17	5	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	70/104 (67%)	66±2 (94±2%)	4±2 (5±2%)	1±1 (1±1%)	16	63
All	All	700/1040 (67%)	656 (94%)	35 (5%)	9 (1%)	16	63

All 3 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	72	THR	6
1	A	41	PRO	2
1	A	5	ARG	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	59/91 (65%)	56±1 (95±2%)	3±1 (5±2%)	31 79
All	All	590/910 (65%)	563 (95%)	27 (5%)	31 79

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	42	GLN	4
1	A	18	TRP	3
1	A	40	ASN	2
1	A	16	GLU	2
1	A	48	ASN	2
1	A	49	LYS	2
1	A	3	GLU	1
1	A	26	LYS	1
1	A	35	ASP	1
1	A	62	THR	1
1	A	68	ASP	1
1	A	76	ARG	1
1	A	5	ARG	1
1	A	11	ASP	1
1	A	65	ASP	1
1	A	20	ARG	1
1	A	67	ASN	1
1	A	72	THR	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

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 55% for the well-defined parts and 39% for the entire structure.

7.1 Chemical shift list 1

File name: working_cs.cif

Chemical shift list name: *starch_ output*

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	608
Number of shifts mapped to atoms	608
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

The following errors were found when reading this chemical shift list.

- Chemical shift has been reported more than once. All 54 occurrences are reported below.

List ID	Chain	Res	Type	Atom	Shift Data		
					Value	Uncertainty	Ambiguity
1	A	4	ASP	HB3	3.099	0.020	1
1	A	5	ARG	HB3	1.378	0.020	1
1	A	6	GLY	HA3	4.233	0.020	1
1	A	7	PRO	HB3	2.086	0.020	2
1	A	7	PRO	HG3	1.888	0.020	2
1	A	7	PRO	HD3	3.594	0.020	2
1	A	12	PRO	HB3	2.077	0.020	2
1	A	12	PRO	HG3	2.034	0.020	2
1	A	14	LEU	HB3	1.645	0.020	1
1	A	15	PRO	HB3	1.812	0.020	2
1	A	15	PRO	HG3	1.105	0.020	2
1	A	15	PRO	HD3	2.520	0.020	2
1	A	16	GLU	HB3	2.077	0.020	1
1	A	17	GLY	HA3	3.742	0.020	2
1	A	18	TRP	HB3	3.257	0.020	1

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List ID	Chain	Res	Type	Atom	Shift Data		
					Value	Uncertainty	Ambiguity
1	A	22	LEU	HB3	1.765	0.020	2
1	A	24	GLN	HB3	1.559	0.020	1
1	A	25	ARG	HB3	1.378	0.020	1
1	A	25	ARG	HG3	1.756	0.020	1
1	A	25	ARG	HD3	2.834	0.020	1
1	A	26	LYS	HB3	1.870	0.020	1
1	A	27	SER	HB3	3.847	0.020	1
1	A	28	GLY	HA3	4.404	0.020	2
1	A	29	ARG	HB3	1.888	0.020	1
1	A	32	GLY	HA3	4.379	0.020	1
1	A	34	TYR	HB3	2.564	0.020	1
1	A	35	ASP	HB3	1.781	0.020	1
1	A	37	TYR	HB3	2.834	0.020	1
1	A	40	ASN	HB3	2.176	0.020	2
1	A	41	PRO	HB3	1.733	0.020	2
1	A	42	GLN	HB3	1.991	0.020	1
1	A	43	GLY	HA3	4.103	0.020	2
1	A	44	LYS	HB3	1.255	0.020	2
1	A	46	PHE	HB3	3.161	0.020	1
1	A	47	ARG	HB3	1.760	0.020	1
1	A	48	ASN	HB3	2.948	0.020	1
1	A	49	LYS	HB3	1.961	0.020	1
1	A	51	GLU	HB3	2.396	0.020	1
1	A	52	LEU	HB3	1.383	0.020	2
1	A	55	TYR	HB3	3.088	0.020	1
1	A	56	PHE	HB3	3.303	0.020	2
1	A	57	GLU	HB3	2.097	0.020	1
1	A	58	LYS	HB3	2.041	0.020	1
1	A	60	GLY	HA3	3.856	0.020	2
1	A	61	ASP	HB3	2.501	0.020	1
1	A	63	SER	HB3	3.853	0.020	1
1	A	64	LEU	HB3	1.042	0.020	2
1	A	65	ASP	HB3	2.437	0.020	1
1	A	67	ASN	HB3	2.777	0.020	1
1	A	68	ASP	HB3	2.653	0.020	1
1	A	69	PHE	HB3	2.752	0.020	1
1	A	70	ASP	HB3	3.161	0.020	1
1	A	75	GLY	HA3	3.903	0.020	2
1	A	94	LYS	HB3	1.739	0.020	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
$^{13}C_{\alpha}$	74	0.14 ± 0.19	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	62	0.16 ± 0.17	None needed (< 0.5 ppm)
$^{13}C'$	61	-0.37 ± 0.29	None needed (< 0.5 ppm)
^{15}N	63	-0.28 ± 0.49	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 55%, i.e. 520 atoms were assigned a chemical shift out of a possible 953. 0 out of 8 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	310/349 (89%)	125/143 (87%)	126/140 (90%)	59/66 (89%)
Sidechain	206/525 (39%)	121/334 (36%)	79/162 (49%)	6/29 (21%)
Aromatic	4/79 (5%)	3/38 (8%)	0/40 (0%)	1/1 (100%)
Overall	520/953 (55%)	249/515 (48%)	205/342 (60%)	66/96 (69%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 39%, i.e. 554 atoms were assigned a chemical shift out of a possible 1425. 0 out of 9 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	331/508 (65%)	133/206 (65%)	135/208 (65%)	63/94 (67%)
Sidechain	219/773 (28%)	128/493 (26%)	85/239 (36%)	6/41 (15%)
Aromatic	4/144 (3%)	3/70 (4%)	0/59 (0%)	1/15 (7%)
Overall	554/1425 (39%)	264/769 (34%)	220/506 (43%)	70/150 (47%)

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	33	LYS	HD3	2.67	0.54 – 2.65	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.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: