wwPDB NMR Structure Validation Summary Report (i)

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PDB ID	:	2KZ2
BMRB ID	:	16994
Title	:	Calmodulin, C-terminal domain, F92E mutant
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This is a wwPDB NMR Structure Validation Summary 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:

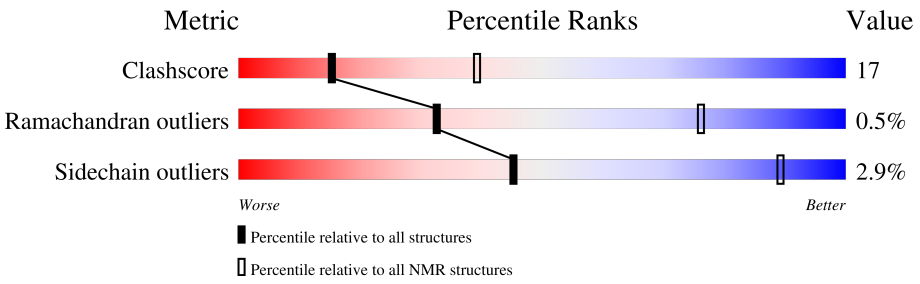
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson 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 was not calculated.

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	94	55% 14% 30% •

2 Ensemble composition and analysis (i)

This entry contains 20 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:82-A:146 (65)	0.60	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 2 clusters and 1 single-model cluster was found.

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

3 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 1418 atoms, of which 671 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	93	1416	450	671	130	160	5	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	55	SER	-	expression tag	UNP P62149
A	56	GLY	-	expression tag	UNP P62149
A	57	SER	-	expression tag	UNP P62149
A	58	HIS	-	expression tag	UNP P62149
A	59	HIS	-	expression tag	UNP P62149
A	60	HIS	-	expression tag	UNP P62149
A	61	HIS	-	expression tag	UNP P62149
A	62	HIS	-	expression tag	UNP P62149
A	63	HIS	-	expression tag	UNP P62149
A	64	GLY	-	expression tag	UNP P62149
A	65	SER	-	expression tag	UNP P62149
A	66	SER	-	expression tag	UNP P62149
A	67	GLY	-	expression tag	UNP P62149
A	68	GLU	-	expression tag	UNP P62149
A	69	ASN	-	expression tag	UNP P62149
A	70	LEU	-	expression tag	UNP P62149
A	71	TYR	-	expression tag	UNP P62149
A	72	PHE	-	expression tag	UNP P62149
A	73	GLN	-	expression tag	UNP P62149
A	74	SER	-	expression tag	UNP P62149
A	75	LEU	-	expression tag	UNP P62149
A	92	GLU	PHE	engineered mutation	UNP P62149

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

Mol	Chain	Residues	Atoms	
			Total	Ca
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: Calmodulin

Chain A: 55% 14% 30%

SER G56 S57 H58 H59 H60 H61 H62 H63 G64 S65 S66 G67 E68 N69 L70 Y71 F72 Q73 S74 L75 M76 K77 D78 T79 D80 S81 R90 D93 K94 D95 G96 N97 G98 L105 R106 M109 I125 R126 D129 D133 Q143 A147 K148

4.2 Residue scores for the representative (medoid) model from the NMR ensemble

The representative model is number 6. Colouring as in section 4.1 above.

- Molecule 1: Calmodulin

Chain A: 49% 19% 30%

SER G56 S57 H58 H59 H60 H61 H62 H63 G64 S65 S66 G67 E68 N69 L70 Y71 F72 Q73 S74 L75 M76 K77 D78 T79 D80 S81 F89 R90 D93 K94 D95 G96 N97 S101 A102 A103 R106 H107 E123 M124 I125 R126 E127 A128 D129 D133 G134 Q135 Q143 M144 A147

K148

5 Refinement protocol and experimental data overview (i)

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

Of the 100 calculated structures, 20 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
AutoStructure	refinement	
CYANA	structure solution	
TALOS	structure solution	
X-PLOR NIH	refinement	

No chemical shift data was provided.

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

There are no covalent bond-length or bond-angle outliers.

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	3.0±0.0
All	All	0	60

There are no bond-length outliers.

There are no bond-angle outliers.

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	90	ARG	Sidechain	20
1	A	106	ARG	Sidechain	20
1	A	126	ARG	Sidechain	20

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	523	480	480	17±4
All	All	10500	9600	9599	332

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 17.

5 of 151 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:97:ASN:HD22	1:A:97:ASN:H	0.65	1.35	9	2
1:A:146:THR:O	1:A:146:THR:HG22	0.65	1.92	17	3
1:A:97:ASN:HD22	1:A:98:GLY:N	0.64	1.91	10	1
1:A:97:ASN:HD22	1:A:97:ASN:N	0.63	1.90	8	3
1:A:146:THR:HG22	1:A:146:THR:O	0.63	1.94	15	3

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	65/94 (69%)	63±1 (98±2%)	1±1 (2±2%)	0±0 (1±1%)	32	76
All	All	1300/1880 (69%)	1269 (98%)	24 (2%)	7 (1%)	32	76

All 2 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	98	GLY	5
1	A	96	GLY	2

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	56/81 (69%)	54±1 (97±2%)	2±1 (3±2%)	45	89
All	All	1120/1620 (69%)	1087 (97%)	33 (3%)	45	89

5 of 13 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	105	LEU	8
1	A	109	MET	6
1	A	97	ASN	4
1	A	124	MET	3
1	A	120	GLU	2

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)

No chemical shift data were provided