



## Full wwPDB X-ray Structure Validation Report ⓘ

May 28, 2020 – 08:08 pm BST

PDB ID : 1MXE  
Title : Structure of the Complex of Calmodulin with the Target Sequence of CaMKI  
Authors : Clapperton, J.A.; Martin, S.R.; Smerdon, S.J.; Gamblin, S.J.; Bayley, P.M.  
Deposited on : 2002-10-02  
Resolution : 1.70 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.11

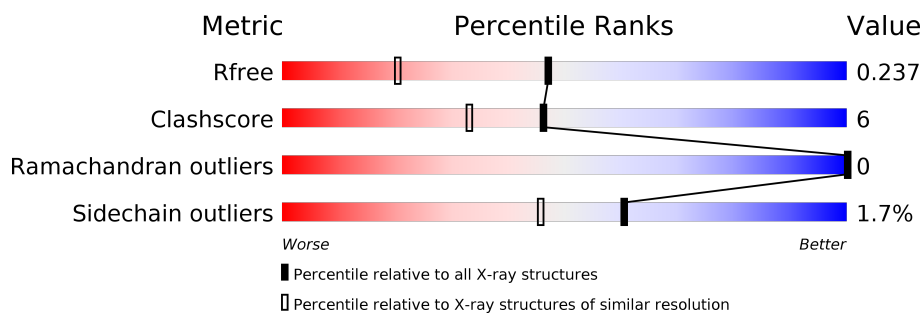
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.70 Å.

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)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	4298 (1.70-1.70)
Clashscore	141614	4695 (1.70-1.70)
Ramachandran outliers	138981	4610 (1.70-1.70)
Sidechain outliers	138945	4610 (1.70-1.70)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. 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	148	80% 17% .
1	B	148	84% 11% . .
2	E	25	84% 12% .
2	F	25	80% 16% .

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 2922 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Calmodulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	144	Total	C	N	O	S	0	0	0
			1132	695	181	247	9			
1	B	144	Total	C	N	O	S	0	0	0
			1126	692	178	247	9			

- Molecule 2 is a protein called Target Sequence of rat Calmodulin-Dependent Protein Kinase I.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	25	Total	C	N	O	S	0	0	0
			211	136	43	31	1			
2	F	25	Total	C	N	O	S	0	0	0
			211	136	43	31	1			

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	4	Total	Ca	0	0
			4	4		
3	A	4	Total	Ca	0	0
			4	4		


- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	121	Total	O	0	0
			121	121		
4	E	18	Total	O	0	0
			18	18		
4	B	81	Total	O	0	0
			81	81		
4	F	14	Total	O	0	0
			14	14		

### 3 Residue-property plots [i](#)


These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-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 outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: Calmodulin

Chain A: 




- Molecule 1: Calmodulin

Chain B: 




- Molecule 2: Target Sequence of rat Calmodulin-Dependent Protein Kinase I

Chain E: 



- Molecule 2: Target Sequence of rat Calmodulin-Dependent Protein Kinase I

Chain F: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	65.71Å 69.58Å 75.34Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.75 – 1.70 29.58 – 1.60	Depositor EDS
% Data completeness (in resolution range)	99.9 (29.75-1.70) 99.9 (29.58-1.60)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.66 (at 1.60Å)	Xtriage
Refinement program	REFMAC 5.0	Depositor
R, $R_{free}$	0.188 , 0.229 0.234 , 0.237	Depositor DCC
$R_{free}$ test set	2326 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	26.9	Xtriage
Anisotropy	0.354	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 52.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	2922	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	18.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.47% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

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

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 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	0.50	0/1144	0.86	5/1536 (0.3%)
1	B	0.42	0/1138	0.82	5/1529 (0.3%)
2	E	0.63	0/215	0.58	0/282
2	F	0.54	0/215	0.60	0/282
All	All	0.48	0/2712	0.81	10/3629 (0.3%)

There are no bond length outliers.

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	80	ASP	CB-CG-OD2	6.56	124.20	118.30
1	A	131	ASP	CB-CG-OD2	6.36	124.02	118.30
1	B	131	ASP	CB-CG-OD2	5.72	123.45	118.30
1	B	56	ASP	CB-CG-OD2	5.68	123.42	118.30
1	B	78	ASP	CB-CG-OD2	5.59	123.33	118.30
1	A	118	ASP	CB-CG-OD2	5.50	123.25	118.30
1	A	56	ASP	CB-CG-OD2	5.43	123.19	118.30
1	B	80	ASP	CB-CG-OD2	5.25	123.02	118.30
1	A	95	ASP	CB-CG-OD2	5.20	122.98	118.30
1	B	93	ASP	CB-CG-OD2	5.01	122.81	118.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 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 the 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 within the asymmetric unit, whereas Symm-Clashes lists symmetry related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1132	0	1062	17	0
1	B	1126	0	1051	12	2
2	E	211	0	228	5	1
2	F	211	0	228	5	0
3	A	4	0	0	0	0
3	B	4	0	0	0	0
4	A	121	0	0	5	2
4	B	81	0	0	1	0
4	E	18	0	0	0	0
4	F	14	0	0	0	0
All	All	2922	0	2569	33	3

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 6.

All (33) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:79:THR:HB	4:B:532:HOH:O	1.57	1.05
1:A:94:LYS:HG2	4:A:613:HOH:O	1.62	0.97
1:B:114:GLU:OE1	2:F:302:LYS:NZ	2.04	0.91
1:B:78:ASP:O	1:B:79:THR:OG1	1.93	0.86
2:E:317:ARG:O	2:E:318:LYS:HB2	1.80	0.82
1:A:147:SER:O	2:E:300:LYS:HE2	1.82	0.80
1:A:11:GLU:OE2	2:E:304:LYS:HE3	1.87	0.75
1:A:38:SER:HB2	1:A:111:ASN:HB3	1.72	0.70
1:A:94:LYS:CG	4:A:613:HOH:O	2.31	0.67
1:B:79:THR:HG22	1:B:80:ASP:N	2.10	0.66
1:A:30:LYS:HG2	4:A:578:HOH:O	1.99	0.62
1:B:79:THR:HG22	1:B:80:ASP:H	1.64	0.62
1:B:79:THR:HG21	2:F:314:ARG:HH12	1.65	0.60
1:B:5:THR:H	1:B:8:GLN:HE21	1.51	0.59
1:A:72:MET:O	1:A:76:MET:HG3	2.03	0.58
2:E:317:ARG:O	2:E:318:LYS:CB	2.52	0.57
2:F:300:LYS:HE2	2:F:304:LYS:HE3	1.85	0.57
1:B:79:THR:CG2	1:B:80:ASP:H	2.20	0.55
2:F:300:LYS:CE	2:F:304:LYS:HE3	2.37	0.54
1:A:108:VAL:HG23	4:A:613:HOH:O	2.08	0.54
1:A:94:LYS:HE2	1:A:108:VAL:HG22	1.91	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:79:THR:CG2	1:B:80:ASP:N	2.73	0.50
1:B:119:GLU:HG2	2:F:294:ILE:CD1	2.43	0.48
1:A:144:MET:O	2:E:300:LYS:HE3	2.15	0.46
1:A:74:ARG:NH2	1:A:77:LYS:HD3	2.31	0.46
1:A:8:GLN:NE2	1:A:76:MET:SD	2.89	0.45
1:A:94:LYS:HE2	4:A:613:HOH:O	2.16	0.45
1:A:52:ILE:HD13	1:A:63:ILE:CD1	2.47	0.44
1:B:143:THR:O	1:B:147:SER:O	2.36	0.44
1:A:18:LEU:HD21	1:A:112:LEU:HD22	1.99	0.43
1:A:94:LYS:HE2	1:A:108:VAL:CG2	2.49	0.42
1:A:105:LEU:O	1:A:109:MET:HG2	2.21	0.41
1:B:94:LYS:HE2	1:B:108:VAL:HG22	2.02	0.41

All (3) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:86:ARG:NH2	4:A:574:HOH:O[2_665]	1.72	0.48
1:B:83:GLU:OE2	1:B:118:ASP:OD2[3_755]	1.76	0.44
2:E:318:LYS:NZ	4:A:553:HOH:O[4_555]	2.04	0.16

## 5.3 Torsion angles ⓘ

### 5.3.1 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 X-ray entries followed by that with respect to entries of similar resolution.

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	142/148 (96%)	142 (100%)	0	0	100	100
1	B	142/148 (96%)	141 (99%)	1 (1%)	0	100	100
2	E	23/25 (92%)	23 (100%)	0	0	100	100
2	F	23/25 (92%)	23 (100%)	0	0	100	100
All	All	330/346 (95%)	329 (100%)	1 (0%)	0	100	100



There are no Ramachandran outliers to report.

### 5.3.2 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 X-ray entries followed by that with respect to entries of similar resolution.

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	124/127 (98%)	123 (99%)	1 (1%)	81	74
1	B	123/127 (97%)	121 (98%)	2 (2%)	62	48
2	E	21/21 (100%)	20 (95%)	1 (5%)	25	9
2	F	21/21 (100%)	20 (95%)	1 (5%)	25	9
All	All	289/296 (98%)	284 (98%)	5 (2%)	60	46

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	79	THR
2	E	300	LYS
1	B	54	GLU
1	B	135	GLN
2	F	300	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	8	GLN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

## 5.5 Carbohydrates

There are no carbohydrates in this entry.

## 5.6 Ligand geometry

Of 8 ligands modelled in this entry, 8 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 5.7 Other polymers

There are no such residues in this entry.

## 5.8 Polymer linkage issues

There are no chain breaks in this entry.

## 6 Fit of model and data [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.3 Carbohydrates [i](#)

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.4 Ligands [i](#)

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.5 Other polymers [i](#)

Unable to reproduce the depositors R factor - this section is therefore empty.