



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2018 – 10:48 pm GMT

PDB ID : 3SOA  
Title : Full-length human CaMKII  
Authors : Chao, L.H.; Kuriyan, J.  
Deposited on : 2011-06-30  
Resolution : 3.55 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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  
Mogul : 1.7.3 (157068), CSD as539be (2018)  
Xtriage (Phenix) : 1.13  
EDS : trunk30967  
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)  
Refmac : 5.8.0158  
CCP4 : 7.0 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk30967

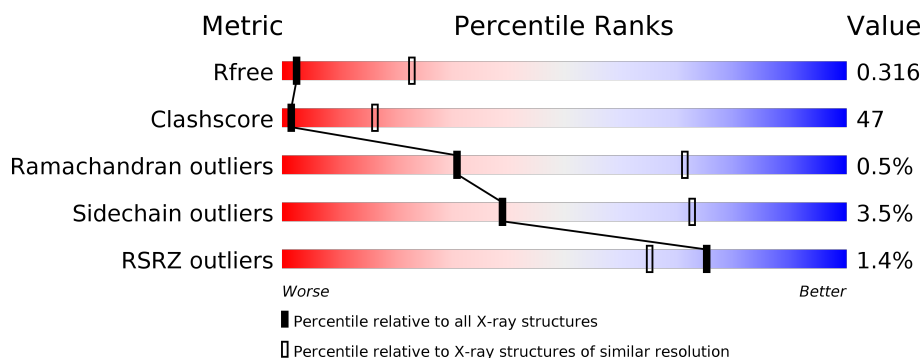
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.55 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))
$R_{free}$	111664	1034 (3.66-3.46)
Clashscore	122126	1117 (3.66-3.46)
Ramachandran outliers	120053	1082 (3.66-3.46)
Sidechain outliers	120020	1082 (3.66-3.46)
RSRZ outliers	108989	1152 (3.70-3.42)

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. 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  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	444	<div> <div></div> <div>44%</div> <div>50%</div> <div>..</div> </div>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	DB8	A	445	-	-	-	X

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3541 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 Calcium/calmodulin-dependent protein kinase type II subunit alpha with a beta 7 linker.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	436	Total	C	N	O	S	0	0	0
			3505	2233	621	634	17			

There are 33 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	42	MET	LYS	ENGINEERED MUTATION	UNP Q9UQM7
A	135	ASN	ASP	ENGINEERED MUTATION	UNP Q9UQM7
A	306	VAL	THR	ENGINEERED MUTATION	UNP Q9UQM7
A	?	-	GLY	DELETION	UNP Q9UQM7
A	?	-	GLY	DELETION	UNP Q9UQM7
A	?	-	LYS	DELETION	UNP Q9UQM7
A	?	-	SER	DELETION	UNP Q9UQM7
A	?	-	GLY	DELETION	UNP Q9UQM7
A	?	-	GLY	DELETION	UNP Q9UQM7
A	?	-	ASN	DELETION	UNP Q9UQM7
A	?	-	LYS	DELETION	UNP Q9UQM7
A	?	-	LYS	DELETION	UNP Q9UQM7
A	?	-	SER	DELETION	UNP Q9UQM7
A	?	-	ASP	DELETION	UNP Q9UQM7
A	?	-	GLY	DELETION	UNP Q9UQM7
A	?	-	VAL	DELETION	UNP Q9UQM7
A	?	-	LYS	DELETION	UNP Q9UQM7
A	?	-	GLU	DELETION	UNP Q9UQM7
A	?	-	SER	DELETION	UNP Q9UQM7
A	?	-	SER	DELETION	UNP Q9UQM7
A	?	-	GLU	DELETION	UNP Q9UQM7
A	?	-	SER	DELETION	UNP Q9UQM7
A	?	-	THR	DELETION	UNP Q9UQM7
A	?	-	ASN	DELETION	UNP Q9UQM7
A	?	-	THR	DELETION	UNP Q9UQM7
A	?	-	THR	DELETION	UNP Q9UQM7

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Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	ILE	DELETION	UNP Q9UQM7
A	?	-	GLU	DELETION	UNP Q9UQM7
A	?	-	ASP	DELETION	UNP Q9UQM7
A	?	-	GLU	DELETION	UNP Q9UQM7
A	?	-	ASP	DELETION	UNP Q9UQM7
A	?	-	THR	DELETION	UNP Q9UQM7
A	?	-	LYS	DELETION	UNP Q9UQM7

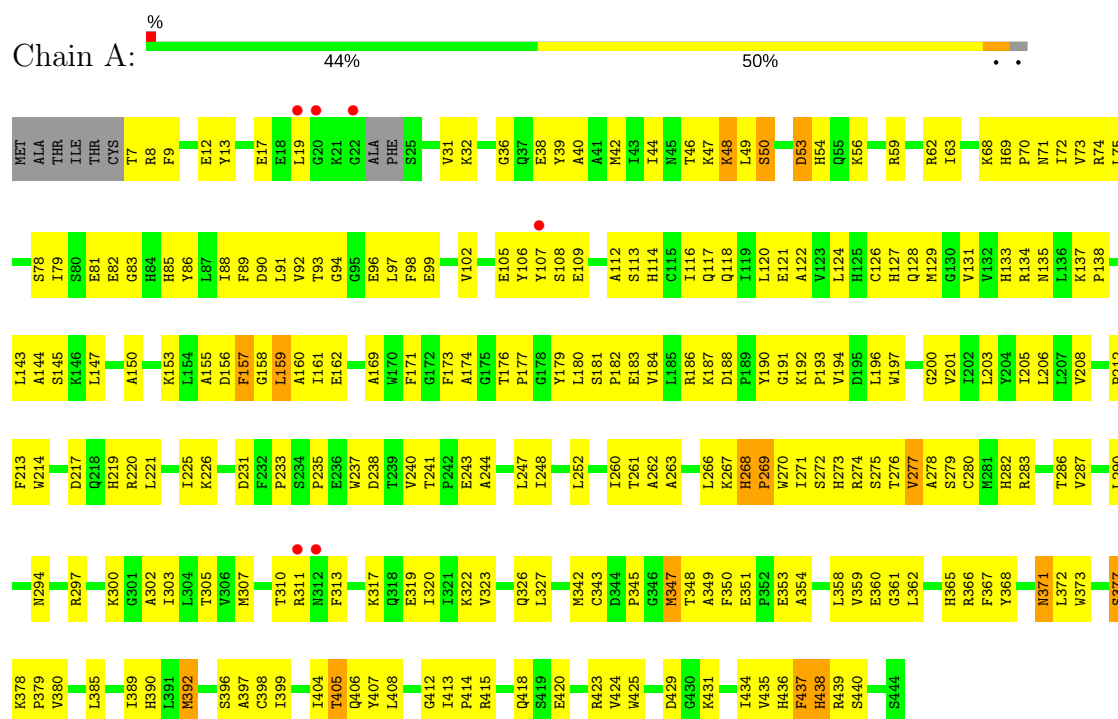
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- The chemical structure of DB8 is a complex molecule. It features a piperazine ring substituted with a carboxylate group (COO-) and a 2,6-dichlorophenyl group. The piperazine ring is connected to a pyridine ring, which is further substituted with a carboxylate group (COO-) and a 2,6-dichlorophenyl group. The pyridine ring is also connected to a benzimidazole ring system, which is substituted with a carboxylate group (COO-) and a 2,6-dichlorophenyl group. The structure is highly symmetrical and contains several functional groups, including amine, amide, and carboxylate groups.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	Cl	N	O	0	0
			36	26	2	5	3		

### 3 Residue-property plots

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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). 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: Calcium/calmodulin-dependent protein kinase type II subunit alpha with a beta 7 linker



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 6 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	155.72Å 155.72Å 106.16Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	45.95 – 3.55 45.95 – 3.55	Depositor EDS
% Data completeness (in resolution range)	88.8 (45.95-3.55) 88.7 (45.95-3.55)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.94 (at 3.57Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.7.1_743)	Depositor
R, $R_{free}$	0.273 , 0.327 0.264 , 0.316	Depositor DCC
$R_{free}$ test set	856 reflections (10.01%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	102.0	Xtriage
Anisotropy	0.028	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 161.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.45$ , $\langle L^2 \rangle = 0.27$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.89	EDS
Total number of atoms	3541	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	168.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.06% 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: DB8

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	0.40	0/3590	0.66	2/4858 (0.0%)

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 outliers	#Planarity outliers
1	A	0	3

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	A	277	VAL	N-CA-C	5.69	126.37	111.00
1	A	159	LEU	N-CA-C	-5.12	97.18	111.00

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	157	PHE	Peptide
1	A	158	GLY	Peptide
1	A	48	LYS	Peptide

### 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	3505	0	3477	330	0
2	A	36	0	29	14	0
All	All	3541	0	3506	334	0

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 47.

The worst 5 of 334 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:A:368:TYR:CD2	1:A:373:TRP:HZ3	1.64	1.14
1:A:367:PHE:O	1:A:372:LEU:HD23	1.53	1.08
1:A:107:TYR:OH	1:A:206:LEU:O	1.69	1.08
1:A:49:LEU:HD23	1:A:379:PRO:HG2	1.24	1.07
1:A:274:ARG:HB3	1:A:278:ALA:HB2	1.30	1.07

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 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 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	432/444 (97%)	402 (93%)	28 (6%)	2 (0%)	31 71

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	50	SER
1	A	269	PRO



### 5.3.2 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 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	374/380 (98%)	361 (96%)	13 (4%)	39 72

5 of 13 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	350	PHE
1	A	360	GLU
1	A	405	THR
1	A	347	MET
1	A	392	MET

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	294	ASN
1	A	371	ASN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

## 5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

## 5.6 Ligand geometry

1 ligand is modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	DB8	A	445	-	38,39,39	2.65	13 (34%)	51,54,54	2.52	20 (39%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	DB8	A	445	-	-	0/17/27/27	0/4/4/4

The worst 5 of 13 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	445	DB8	CAG-NAD	-3.68	1.05	1.14
2	A	445	DB8	CAL-CBC	2.00	1.40	1.36
2	A	445	DB8	CAL-CBG	2.12	1.46	1.42
2	A	445	DB8	CBB-NAU	2.91	1.47	1.39
2	A	445	DB8	CAK-CBF	3.12	1.46	1.41

The worst 5 of 20 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	445	DB8	OAV-CBC-CAL	-8.75	114.92	125.25
2	A	445	DB8	CBG-CBF-NAT	-4.77	117.80	122.88
2	A	445	DB8	CAL-CBG-CBF	-3.78	114.08	118.93
2	A	445	DB8	CAM-CAC-NBH	-2.70	107.18	113.88
2	A	445	DB8	OAW-CBD-CAK	-2.55	120.98	125.22

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 14 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	445	DB8	14	0

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

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

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

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	436/444 (98%)	-0.17	6 (1%) 75 65	52, 163, 279, 492	0

The worst 5 of 6 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	22	GLY	3.9
1	A	19	LEU	3.7
1	A	312	ASN	2.9
1	A	20	GLY	2.7
1	A	311	ARG	2.1

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

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

### 6.3 Carbohydrates [i](#)

There are no carbohydrates in this entry.

### 6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q < 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	DB8	A	445	36/36	0.69	0.46	7,173,181,297	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.