wwPDB X-ray Structure Validation Summary Report (i)

Oct 9, 2023 – 05:32 PM EDT

PDB ID	:	7URW
Title	:	Tetradecameric hub domain of CaMKII beta
Authors	:	Ozden, C.; Samkutty, A.; Stratton, M.M.; Garman, S.C.
Deposited on	:	2022-04-22
Resolution	:	3.11 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*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
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:

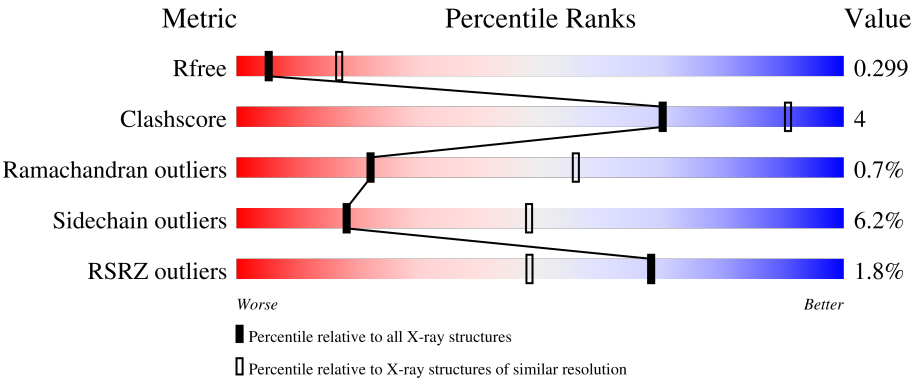
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 3.11 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	1292 (3.14-3.10)
Clashscore	141614	1389 (3.14-3.10)
Ramachandran outliers	138981	1337 (3.14-3.10)
Sidechain outliers	138945	1337 (3.14-3.10)
RSRZ outliers	127900	1260 (3.14-3.10)

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 of the lower bar indicate the fraction of residues that contain outliers for >=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 <=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	137	2% 76% 12% • 11%
1	B	137	% 77% 12% 11%
1	C	137	3% 80% 9% • 9%
1	D	137	3% 80% 11% • 9%
1	E	137	82% 15% ••

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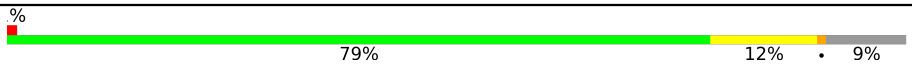
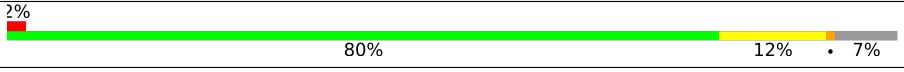
Mol	Chain	Length	Quality of chain
1	F	137	
1	G	137	

2 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 6789 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 beta.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	G	127	Total	C	N	O	S	0	0	0
			963	609	169	180	5			
1	A	122	Total	C	N	O	S	0	0	0
			946	598	165	179	4			
1	B	122	Total	C	N	O	S	0	0	0
			949	599	165	181	4			
1	C	124	Total	C	N	O	S	0	0	0
			943	598	162	179	4			
1	D	125	Total	C	N	O	S	0	0	0
			972	612	170	186	4			
1	E	134	Total	C	N	O	S	0	0	0
			1040	657	183	196	4			
1	F	125	Total	C	N	O	S	0	0	0
			976	616	172	184	4			

There are 28 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
G	530	GLY	-	expression tag	UNP Q13554
G	531	PRO	-	expression tag	UNP Q13554
G	532	HIS	-	expression tag	UNP Q13554
G	533	MET	-	expression tag	UNP Q13554
A	530	GLY	-	expression tag	UNP Q13554
A	531	PRO	-	expression tag	UNP Q13554
A	532	HIS	-	expression tag	UNP Q13554
A	533	MET	-	expression tag	UNP Q13554
B	530	GLY	-	expression tag	UNP Q13554
B	531	PRO	-	expression tag	UNP Q13554
B	532	HIS	-	expression tag	UNP Q13554
B	533	MET	-	expression tag	UNP Q13554
C	530	GLY	-	expression tag	UNP Q13554
C	531	PRO	-	expression tag	UNP Q13554

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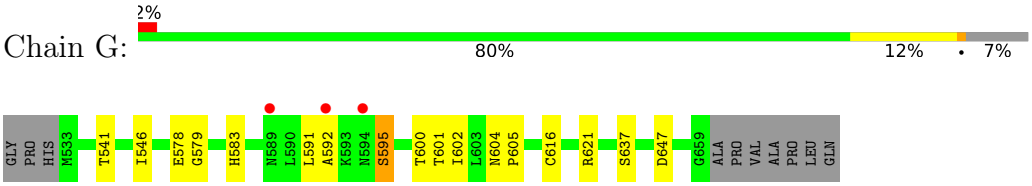
Chain	Residue	Modelled	Actual	Comment	Reference
C	532	HIS	-	expression tag	UNP Q13554
C	533	MET	-	expression tag	UNP Q13554
D	530	GLY	-	expression tag	UNP Q13554
D	531	PRO	-	expression tag	UNP Q13554
D	532	HIS	-	expression tag	UNP Q13554
D	533	MET	-	expression tag	UNP Q13554
E	530	GLY	-	expression tag	UNP Q13554
E	531	PRO	-	expression tag	UNP Q13554
E	532	HIS	-	expression tag	UNP Q13554
E	533	MET	-	expression tag	UNP Q13554
F	530	GLY	-	expression tag	UNP Q13554
F	531	PRO	-	expression tag	UNP Q13554
F	532	HIS	-	expression tag	UNP Q13554
F	533	MET	-	expression tag	UNP Q13554

3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide 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.

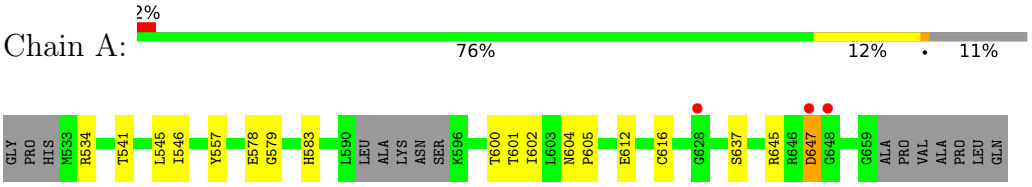
• Molecule 1: Calcium/calmodulin-dependent protein kinase type II subunit beta

Chain G:



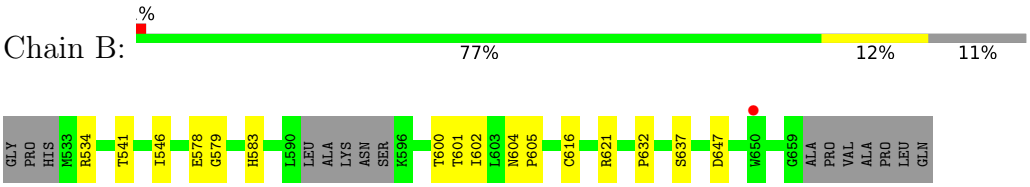
• Molecule 1: Calcium/calmodulin-dependent protein kinase type II subunit beta

Chain A:



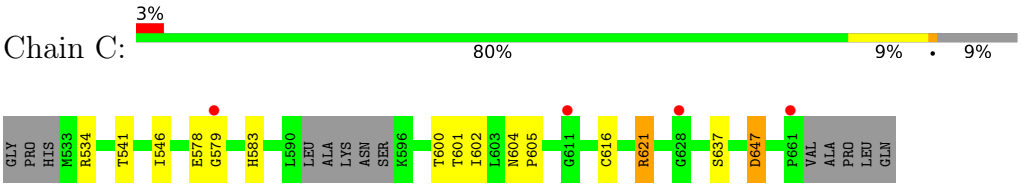
• Molecule 1: Calcium/calmodulin-dependent protein kinase type II subunit beta

Chain B:



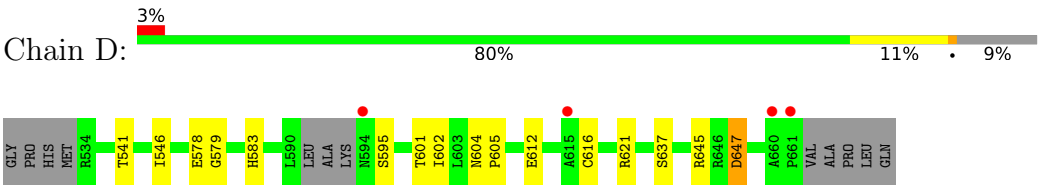
• Molecule 1: Calcium/calmodulin-dependent protein kinase type II subunit beta

Chain C:



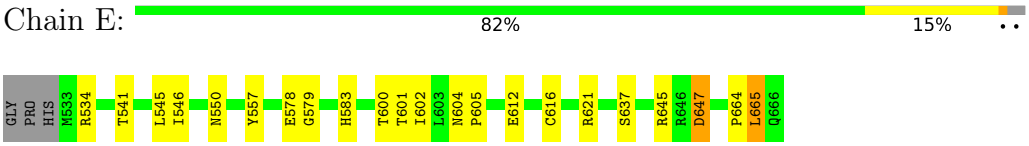
• Molecule 1: Calcium/calmodulin-dependent protein kinase type II subunit beta

Chain D:



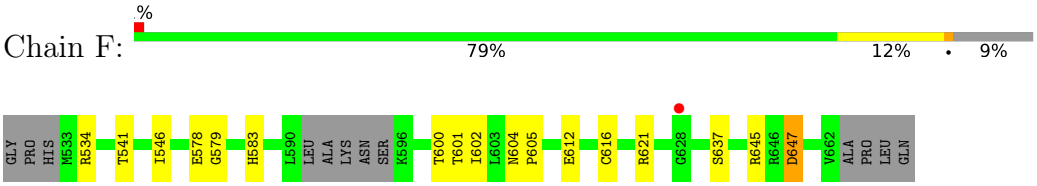
• Molecule 1: Calcium/calmodulin-dependent protein kinase type II subunit beta

Chain E:



• Molecule 1: Calcium/calmodulin-dependent protein kinase type II subunit beta

Chain F:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α, β, γ	104.24Å 183.19Å 108.37Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.80 – 3.11 37.77 – 3.11	Depositor EDS
% Data completeness (in resolution range)	97.7 (37.80-3.11) 97.8 (37.77-3.11)	Depositor EDS
R_{merge}	0.29	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.55 (at 3.12Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.255 , 0.300 0.254 , 0.299	Depositor DCC
R_{free} test set	972 reflections (5.20%)	wwPDB-VP
Wilson B-factor (Å^2)	68.4	Xtriage
Anisotropy	0.082	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.29 , 27.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.55$, $< L^2 > = 0.40$	Xtriage
Estimated twinning fraction	0.000 for 1/2*h-1/2*k,-3/2*h-1/2*k,-l 0.000 for 1/2*h+1/2*k,3/2*h-1/2*k,-l	Xtriage
F_o,F_c correlation	0.90	EDS
Total number of atoms	6789	wwPDB-VP
Average B, all atoms (Å^2)	74.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.25% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

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	0.65	0/970	0.77	0/1320
1	B	0.67	0/973	0.76	0/1325
1	C	0.66	0/968	0.76	0/1321
1	D	0.66	0/997	0.77	0/1357
1	E	0.66	0/1067	0.79	0/1455
1	F	0.67	0/1001	0.76	0/1362
1	G	0.67	0/988	0.77	0/1348
All	All	0.66	0/6964	0.77	0/9488

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	1
1	B	0	1
1	C	0	1
1	D	0	1
1	E	0	1
1	F	0	1
1	G	0	1
All	All	0	7

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 7 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	578	GLU	Peptide
1	B	578	GLU	Peptide

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Mol	Chain	Res	Type	Group
1	C	578	GLU	Peptide
1	D	578	GLU	Peptide
1	G	578	GLU	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	946	0	849	7	0
1	B	949	0	854	7	1
1	C	943	0	836	6	0
1	D	972	0	879	5	0
1	E	1040	0	960	11	0
1	F	976	0	890	6	0
1	G	963	0	863	5	0
All	All	6789	0	6131	46	1

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 4.

The worst 5 of 46 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:579:GLY:O	1:A:583:HIS:ND1	2.14	0.80
1:B:579:GLY:O	1:B:583:HIS:ND1	2.14	0.79
1:F:579:GLY:O	1:F:583:HIS:ND1	2.14	0.79
1:G:579:GLY:O	1:G:583:HIS:ND1	2.14	0.79
1:C:579:GLY:O	1:C:583:HIS:ND1	2.14	0.78

All (1) 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:647:ASP:OD1	1:B:647:ASP:OD1[4_555]	1.69	0.51

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	118/137 (86%)	115 (98%)	2 (2%)	1 (1%)	19 53
1	B	118/137 (86%)	116 (98%)	2 (2%)	0	100 100
1	C	120/137 (88%)	118 (98%)	2 (2%)	0	100 100
1	D	121/137 (88%)	118 (98%)	2 (2%)	1 (1%)	19 53
1	E	132/137 (96%)	126 (96%)	4 (3%)	2 (2%)	10 38
1	F	121/137 (88%)	119 (98%)	1 (1%)	1 (1%)	19 53
1	G	125/137 (91%)	122 (98%)	2 (2%)	1 (1%)	19 53
All	All	855/959 (89%)	834 (98%)	15 (2%)	6 (1%)	22 56

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	G	591	LEU
1	E	665	LEU
1	E	647	ASP
1	D	647	ASP
1	F	647	ASP

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	93/117 (80%)	88 (95%)	5 (5%)	22 53
1	B	95/117 (81%)	90 (95%)	5 (5%)	22 53

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	C	91/117 (78%)	84 (92%)	7 (8%)	13	40
1	D	98/117 (84%)	92 (94%)	6 (6%)	18	49
1	E	105/117 (90%)	99 (94%)	6 (6%)	20	51
1	F	98/117 (84%)	92 (94%)	6 (6%)	18	49
1	G	93/117 (80%)	86 (92%)	7 (8%)	13	41
All	All	673/819 (82%)	631 (94%)	42 (6%)	18	48

5 of 42 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	621	ARG
1	E	637	SER
1	D	637	SER
1	E	601	THR
1	F	541	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	651	GLN
1	F	651	GLN
1	B	651	GLN
1	C	651	GLN
1	C	652	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

There are no ligands in this entry.

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

6.1 Protein, DNA and RNA chains

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^{th} 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^2)	Q<0.9
1	A	122/137 (89%)	-0.12	3 (2%) 57 35	47, 67, 109, 137	0
1	B	122/137 (89%)	-0.19	1 (0%) 86 74	48, 71, 98, 115	0
1	C	124/137 (90%)	-0.06	4 (3%) 47 26	47, 75, 114, 132	0
1	D	125/137 (91%)	0.07	4 (3%) 47 26	48, 74, 112, 150	0
1	E	134/137 (97%)	-0.22	0 100 100	46, 68, 100, 140	0
1	F	125/137 (91%)	0.06	1 (0%) 86 74	44, 73, 103, 126	0
1	G	127/137 (92%)	0.11	3 (2%) 59 37	50, 81, 111, 124	0
All	All	879/959 (91%)	-0.05	16 (1%) 68 48	44, 72, 111, 150	0

The worst 5 of 16 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	647	ASP	3.8
1	A	648	GLY	3.4
1	F	628	GLY	3.3
1	G	589	ASN	2.7
1	C	611	GLY	2.6

6.2 Non-standard residues in protein, DNA, RNA chains

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

6.3 Carbohydrates

There are no monosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.