Full wwPDB X-ray Structure Validation Report (i)

Aug 23, 2023 – 10:06 AM EDT

PDB ID	:	3EK4
Title	:	Calcium-saturated GCaMP2 Monomer
Authors	:	Akerboom, J.; Velez Rivera, J.D.; Looger, L.L.; Schreiter, E.R.
Deposited on	:	2008-09-18
Resolution	:	2.65 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*
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 (1)) were used in the production of this report:

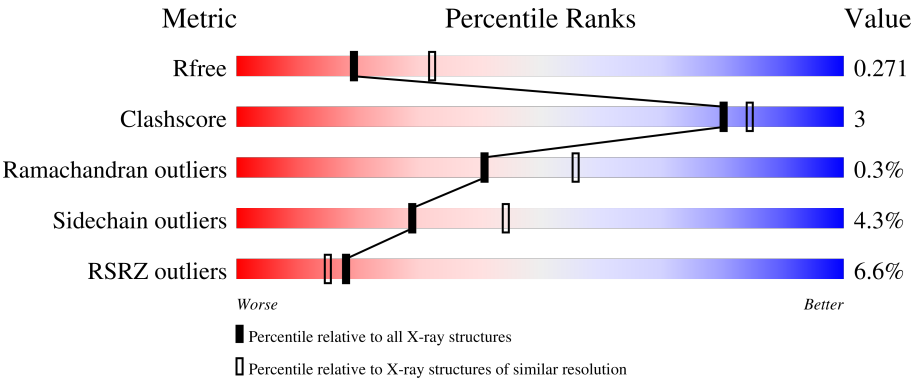
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

1 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 2.65 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	1332 (2.68-2.64)
Clashscore	141614	1374 (2.68-2.64)
Ramachandran outliers	138981	1349 (2.68-2.64)
Sidechain outliers	138945	1349 (2.68-2.64)
RSRZ outliers	127900	1318 (2.68-2.64)

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	449	5%, 70%, 7%, 22%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 2799 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 Myosin light chain kinase, Green fluorescent protein, Calmodulin chimera.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	349	2767	1745	466	544	12	0	0	0

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	76	ALA	VAL	see remark 999	UNP P42212
A	88	GLY	SER	see remark 999	UNP P42212
A	93	TYR	ASP	see remark 999	UNP P42212
A	119	LYS	ALA	see remark 999	UNP P42212
A	144	LEU	HIS	see remark 999	UNP P42212
A	152	GLY	-	linker	UNP P42212
A	153	GLY	-	linker	UNP P42212
A	154	THR	-	linker	UNP P42212
A	155	GLY	-	linker	UNP P42212
A	156	GLY	-	linker	UNP P42212
A	157	SER	-	linker	UNP P42212
A	158	MET	-	linker	UNP P42212
A	159	VAL	-	linker	UNP P42212
A	222	LEU	PHE	see remark 999	UNP P42212
A	224	CRO	SER	chromophore	UNP P42212
A	?	-	TYR	chromophore	UNP P42212
A	?	-	GLY	chromophore	UNP P42212
A	251	ILE	VAL	see remark 999	UNP P42212
A	303	THR	-	linker	UNP P42212
A	304	ARG	-	linker	UNP P42212

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

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Ca		
2	A	3	3	3	0	0

- Molecule 3 is water.

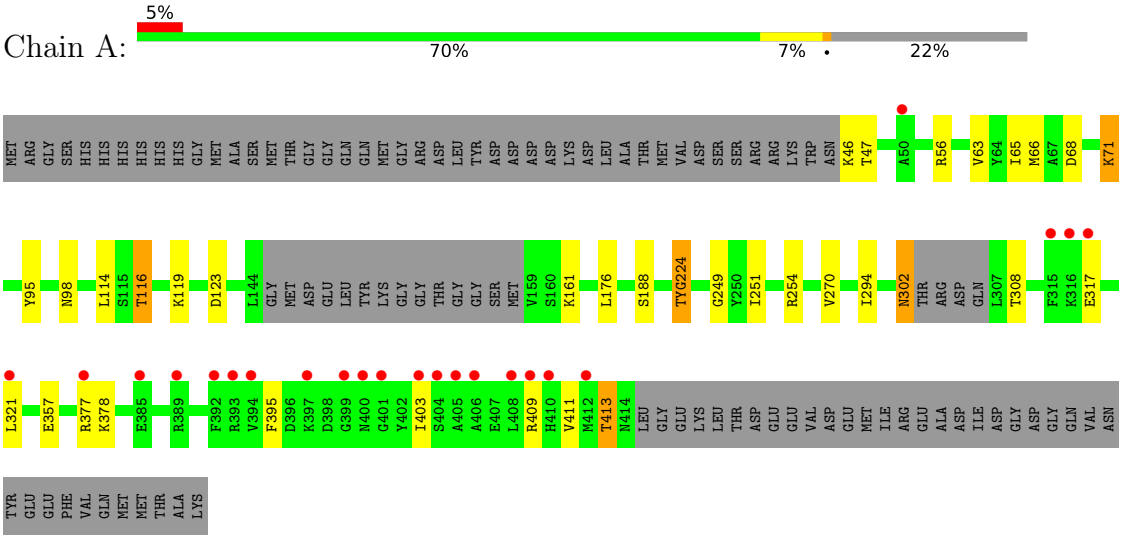
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	29	Total O 29 29	0	0

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: Myosin light chain kinase, Green fluorescent protein, Calmodulin chimera

Chain A:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α, β, γ	60.50Å 117.26Å 68.80Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	45.45 – 2.65 45.43 – 2.65	Depositor EDS
% Data completeness (in resolution range)	98.3 (45.45-2.65) 98.3 (45.43-2.65)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	4.78 (at 2.65Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.222 , 0.280 0.218 , 0.271	Depositor DCC
R_{free} test set	733 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å^2)	36.4	Xtriage
Anisotropy	0.874	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 48.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	2799	wwPDB-VP
Average B, all atoms (Å^2)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.58% 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

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

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	0.57	0/2794	0.61	0/3762

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 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 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	2767	0	2695	15	0
2	A	3	0	0	0	0
3	A	29	0	0	0	0
All	All	2799	0	2695	15	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 3.

All (15) 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:98:ASN:HA	1:A:251:ILE:O	2.11	0.51

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:63:VAL:HB	1:A:114:LEU:HB2	1.95	0.49
1:A:68:ASP:HB3	1:A:71:LYS:O	2.12	0.48
1:A:395:PHE:HB2	1:A:403:ILE:HD13	1.95	0.48
1:A:123:ASP:OD1	1:A:123:ASP:C	2.52	0.47
1:A:95:TYR:O	1:A:254:ARG:HA	2.17	0.45
1:A:395:PHE:HA	1:A:411:VAL:HG21	1.99	0.44
1:A:116:THR:HG21	1:A:224:CRO:OH	2.18	0.44
1:A:409:ARG:O	1:A:413:THR:OG1	2.35	0.43
1:A:249:GLY:HA3	1:A:270:VAL:O	2.19	0.43
1:A:65:ILE:CD1	1:A:114:LEU:HG	2.48	0.43
1:A:56:ARG:HB2	1:A:378:LYS:HG3	2.01	0.42
1:A:176:LEU:C	1:A:176:LEU:HD23	2.40	0.42
1:A:46:LYS:NZ	1:A:47:THR:HG22	2.35	0.42
1:A:302:ASN:HD22	1:A:302:ASN:HA	1.72	0.40

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	340/449 (76%)	328 (96%)	11 (3%)	1 (0%)	41 56

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	294	ILE

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	299/382 (78%)	286 (96%)	13 (4%)	29 44

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	66	MET
1	A	71	LYS
1	A	116	THR
1	A	119	LYS
1	A	161	LYS
1	A	188	SER
1	A	302	ASN
1	A	308	THR
1	A	317	GLU
1	A	321	LEU
1	A	357	GLU
1	A	377	ARG
1	A	413	THR

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

Mol	Chain	Res	Type
1	A	77	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)

1 non-standard protein/DNA/RNA residue 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	$\#\|Z\| > 2$
1	CRO	A	224	1	23,23,24	3.48	4 (17%)	30,32,34	3.82	9 (30%)

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
1	CRO	A	224	1	-	0/12/31/32	0/2/2/2

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	224	CRO	CB2-CA2	14.40	1.47	1.35
1	A	224	CRO	C1-N2	5.48	1.40	1.32
1	A	224	CRO	CA2-C2	-4.21	1.44	1.48
1	A	224	CRO	C2-N3	-3.27	1.32	1.39

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	224	CRO	CA2-C2-N3	14.64	110.30	103.37
1	A	224	CRO	O2-C2-CA2	-11.98	124.23	130.96
1	A	224	CRO	C2-N3-C1	-4.62	105.63	107.97
1	A	224	CRO	C2-CA2-N2	-3.18	106.70	108.93
1	A	224	CRO	CB2-CA2-C2	3.11	125.99	122.28
1	A	224	CRO	CA1-C1-N3	-2.73	121.47	124.75
1	A	224	CRO	CD2-CG2-CD1	2.35	121.12	117.64
1	A	224	CRO	O3-C3-CA3	-2.34	119.33	126.39
1	A	224	CRO	CA1-C1-N2	2.11	126.84	123.89

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	224	CRO	1	0

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 3 ligands modelled in this entry, 3 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 (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	348/449 (77%)	0.20	23 (6%) 18 15	19, 35, 96, 101	0

All (23) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	406	ALA	5.5
1	A	403	ILE	4.7
1	A	389	ARG	4.6
1	A	408	LEU	4.6
1	A	412	MET	4.2
1	A	321	LEU	4.0
1	A	399	GLY	3.6
1	A	317	GLU	3.5
1	A	401	GLY	3.4
1	A	410	HIS	3.4
1	A	315	PHE	3.3
1	A	392	PHE	3.3
1	A	50	ALA	3.1
1	A	316	LYS	3.0
1	A	400	ASN	2.9
1	A	409	ARG	2.8
1	A	394	VAL	2.7
1	A	404	SER	2.7
1	A	397	LYS	2.7
1	A	385	GLU	2.4
1	A	405	ALA	2.2
1	A	393	ARG	2.2
1	A	377	ARG	2.2

6.2 Non-standard residues in protein, DNA, RNA chains (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^{th} 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^2)	Q<0.9
1	CRO	A	224	22/23	0.98	0.16	21,24,26,27	0

6.3 Carbohydrates (i)

There are no monosaccharides 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^{th} 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^2)	Q<0.9
2	CA	A	454	1/1	0.90	0.04	119,119,119,119	0
2	CA	A	452	1/1	0.92	0.05	55,55,55,55	0
2	CA	A	453	1/1	0.96	0.15	51,51,51,51	0

6.5 Other polymers (i)

There are no such residues in this entry.