



Full wwPDB X-ray Structure Validation Report

Feb 27, 2014 – 02:29 AM GMT

PDB ID : 3U0K
Title : Crystal Structure of the genetically encoded calcium indicator RCaMP
Authors : Akerboom, J.; Looger, L.L.; Schreiter, E.R.
Deposited on : 2011-09-28
Resolution : 2.10 Å(reported)

This is a full wwPDB validation report for a publicly released PDB entry.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

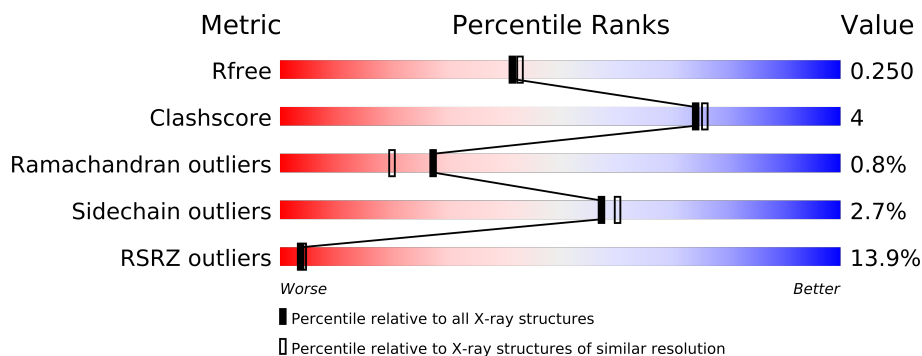
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.15 2013
Xtriage (Phenix) : dev-1323
EDS : stable22639
Percentile statistics : 21963
Refmac : 5.8.0049
CCP4 : 6.3.0 (Settle)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : stable22683

1 Overall quality at a glance

The reported resolution of this entry is 2.10 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}	66092	3012 (2.10-2.10)
Clashscore	79885	3649 (2.10-2.10)
Ramachandran outliers	78287	3610 (2.10-2.10)
Sidechain outliers	78261	3611 (2.10-2.10)
RSRZ outliers	66119	3013 (2.10-2.10)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	440	

2 Entry composition i

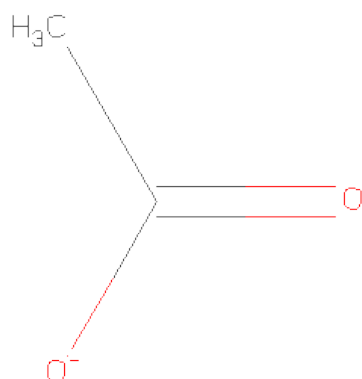
There are 4 unique types of molecules in this entry. The entry contains 3302 atoms, of which 0 are hydrogen and 0 are deuterium.

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 RCaMP.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	398	3156	1974	542	612	28	0	6	0

- Molecule 2 is ACETATE ION (three-letter code: ACT) (formula: C₂H₃O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	A	1	4	2	2	0	0

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

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

- Molecule 4 is water.

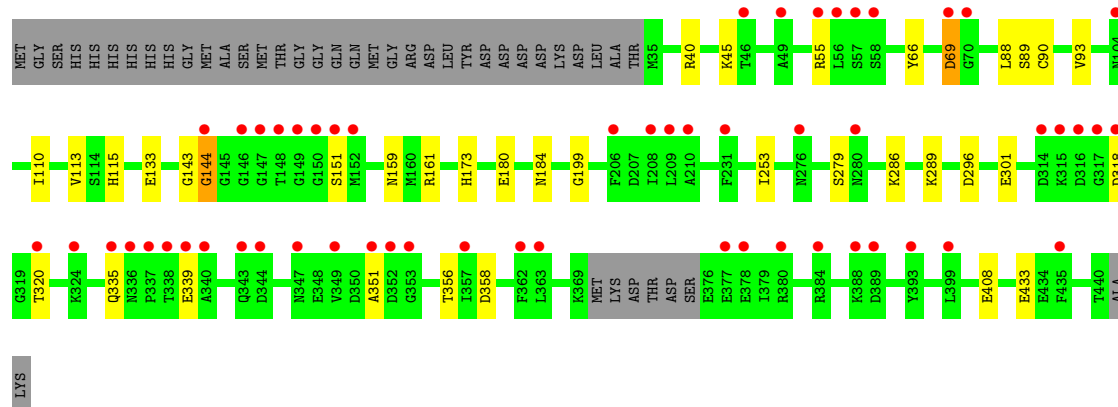
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	138	Total 138	O 138	0	0

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 errors 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: RCaMP

Chain A: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	75.92Å 75.92Å 123.16Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	21.58 – 2.10 21.58 – 2.10	Depositor EDS
% Data completeness (in resolution range)	99.8 (21.58-2.10) 99.9 (21.58-2.10)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.45 (at 2.09Å)	Xtriage
Refinement program	REFMAC 5.6.0111	Depositor
R, R_{free}	0.189 , 0.239 0.202 , 0.250	Depositor DCC
R_{free} test set	1253 reflections (5.38%)	DCC
Wilson B-factor (Å ²)	29.7	Xtriage
Anisotropy	0.633	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 45.1	EDS
Estimated twinning fraction	0.033 for -h,-k,l	Xtriage
L-test for twinning	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 24582 reflections	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	3302	wwPDB-VP
Average B, all atoms (Å ²)	41.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.82% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality

5.1 Standard geometry

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

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	1.07	2/3193 (0.1%)	0.94	5/4286 (0.1%)

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

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	113	VAL	CB-CG2	6.67	1.66	1.52
1	A	433	GLU	CD-OE1	6.15	1.32	1.25

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	40	ARG	NE-CZ-NH2	-10.60	115.00	120.30
1	A	161	ARG	NE-CZ-NH1	5.94	123.27	120.30
1	A	88	LEU	CB-CG-CD1	-5.21	102.15	111.00
1	A	296	ASP	CB-CG-OD2	5.14	122.92	118.30
1	A	253	ILE	CB-CA-C	-5.04	101.51	111.60

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	69	ASP	Peptide

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3156	0	0	13	0
2	A	4	0	3	1	0
3	A	4	0	0	0	0
4	A	138	0	0	3	0
All	All	3302	0	3	13	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 4.

All (13) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:286:LYS:NZ	4:A:575:HOH:O	2.00	0.91
1:A:45:LYS:NZ	4:A:534:HOH:O	2.27	0.66
1:A:318:ASP:OD2	1:A:320:THR:CG2	2.50	0.59
1:A:66:TYR:CE1	1:A:110:ILE:CD1	2.85	0.59
1:A:289:LYS:NZ	4:A:541:HOH:O	2.35	0.58
1:A:93:VAL:CG2	1:A:351:ALA:CB	2.84	0.56
1:A:320:THR:OG1	1:A:356:THR:OG1	2.24	0.55
1:A:358:ASP:C	1:A:358:ASP:OD1	2.48	0.52
1:A:143:GLY:O	1:A:144:GLY:C	2.47	0.51
1:A:115:HIS:CE1	2:A:443:ACT:H2	2.48	0.48
1:A:159:ASN:OD1	1:A:184:ASN:ND2	2.47	0.47
1:A:115:HIS:ND1	1:A:133:GLU:OE2	2.47	0.47
1:A:173:HIS:NE2	1:A:199:GLY:O	2.50	0.43

There are no symmetry-related clashes.

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	397/440 (90%)	382 (96%)	12 (3%)	3 (1%)	27 20

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	69	ASP
1	A	144	GLY
1	A	151	SER

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	337/365 (92%)	328 (97%)	9 (3%)	57 60

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	55	ARG
1	A	89	SER
1	A	90	CYS
1	A	180	GLU
1	A	279	SER
1	A	301	GLU
1	A	335	GLN
1	A	339	GLU
1	A	408	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no

such sidechains identified.

5.3.3 RNA ⓘ

There are no RNA chains in this entry.

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

2 non-standard protein/DNA/RNA residues are 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	NFA	A	213	1	12,12,12	1.04	0	15,15,15	1.09	1 (6%)
1	CRK	A	214	1	24,24,24	3.64	8 (33%)	32,32,32	3.93	11 (34%)

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	NFA	A	213	1	-	0/8/8/8	0/1/1/1
1	CRK	A	214	1	-	0/14/31/31	0/2/2/2

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	214	CRK	CB2-CA2	14.48	1.45	1.35
1	A	214	CRK	CA2-C2	-6.43	1.41	1.48
1	A	214	CRK	C2-N3	-3.89	1.31	1.39
1	A	214	CRK	C1-N2	3.35	1.40	1.33
1	A	214	CRK	CB-CA1	3.14	1.55	1.51
1	A	214	CRK	OH-CZ	2.73	1.40	1.32
1	A	214	CRK	CA2-N2	-2.52	1.32	1.38
1	A	214	CRK	CA3-N3	-2.29	1.43	1.47

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	214	CRK	CA2-C2-N3	14.61	111.76	103.44
1	A	214	CRK	O2-C2-CA2	-13.48	123.16	130.96
1	A	214	CRK	C3-CA3-N3	4.14	116.87	112.00
1	A	214	CRK	CE-SD-CG	-3.33	87.84	100.27
1	A	214	CRK	C2-N3-C1	-3.22	103.53	109.01
1	A	213	NFA	CB-CA-C	3.02	115.62	108.77
1	A	214	CRK	CD1-CE1-CZ	2.90	124.20	121.28
1	A	214	CRK	CA3-N3-C2	2.62	127.48	123.67
1	A	214	CRK	CB-CA1-C1	-2.54	114.25	118.39
1	A	214	CRK	N3-C1-N2	-2.42	111.35	113.24
1	A	214	CRK	CE1-CD1-CG2	-2.34	118.35	121.30
1	A	214	CRK	CG2-CB2-CA2	2.18	132.61	130.10

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

5.6 Ligand geometry ⓘ

Of 5 ligands modelled in this entry, 4 are monoatomic - leaving 1 for Mogul analysis.

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	ACT	A	443	-	1,3,3	1.88	0	0,3,3	0.00	-

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	ACT	A	443	-	-	0/0/0/0	0/0/0/0

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.

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 ⓘ

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, 95th 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	398/440 (90%)	0.55	56 (14%) 3 4	18, 37, 88, 121	0

All (56) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	146	GLY	10.8
1	A	336	ASN	10.4
1	A	340	ALA	7.8
1	A	150	GLY	6.4
1	A	56	LEU	6.2
1	A	149	GLY	5.6
1	A	347	ASN	5.5
1	A	353	GLY	4.6
1	A	104	ASN	3.7
1	A	209	LEU	3.7
1	A	388	LYS	3.6
1	A	338	THR	3.4
1	A	151	SER	3.4
1	A	57	SER	3.3
1	A	344	ASP	3.3
1	A	343	GLN	3.2
1	A	55	ARG	3.2
1	A	70	GLY	3.2
1	A	152	MET	3.2
1	A	147	GLY	3.1
1	A	389	ASP	3.0
1	A	377	GLU	3.0
1	A	314	ASP	3.0
1	A	316	ASP	3.0
1	A	352	ASP	2.9
1	A	58	SER	2.9
1	A	324	LYS	2.9

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	337	PRO	2.9
1	A	144	GLY	2.8
1	A	318	ASP	2.8
1	A	315	LYS	2.8
1	A	231	PHE	2.7
1	A	208	ILE	2.7
1	A	393	TYR	2.6
1	A	206	PHE	2.5
1	A	317	GLY	2.5
1	A	210	ALA	2.5
1	A	69	ASP	2.5
1	A	280	ASN	2.4
1	A	148	THR	2.4
1	A	384	ARG	2.4
1	A	335	GLN	2.4
1	A	351	ALA	2.4
1	A	357	ILE	2.4
1	A	378	GLU	2.4
1	A	435	PHE	2.3
1	A	320	THR	2.3
1	A	276[A]	ASN	2.2
1	A	363	LEU	2.2
1	A	399	LEU	2.2
1	A	46	THR	2.2
1	A	49	ALA	2.1
1	A	380	ARG	2.1
1	A	339	GLU	2.0
1	A	362	PHE	2.0
1	A	349	VAL	2.0

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

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th 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	RSR	LLDF	B-factors(Å ²)	Q<0.9
1	NFA	A	213	12/12	0.22	0.97	27,28,32,33	0
1	CRK	A	214	23/23	0.15	0.57	18,19,27,33	0

6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

6.4 Ligands ⓘ

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th 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	RSR	LLDF	B-factors(Å ²)	Q<0.9
2	ACT	A	443	4/4	0.17	0.65	26,32,34,42	0
3	CA	A	444	1/1	0.07	-1.01	26,26,26,26	0
3	CA	A	445	1/1	0.05	-1.59	33,33,33,33	0
3	CA	A	447	1/1	0.12	-1.76	73,73,73,73	0
3	CA	A	446	1/1	0.09	-1.87	59,59,59,59	0

6.5 Other polymers ⓘ

There are no such residues in this entry.