



Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 3EK8 / pdb_00003ek8
Title : Calcium-saturated GCaMP2 T116V/G87R mutant monomer
Authors : Akerboom, J.; Velez Rivera, J.D.; Looger, L.L.; Schreiter, E.R.
Deposited on : 2008-09-19
Resolution : 2.80 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 ⓘ 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 ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

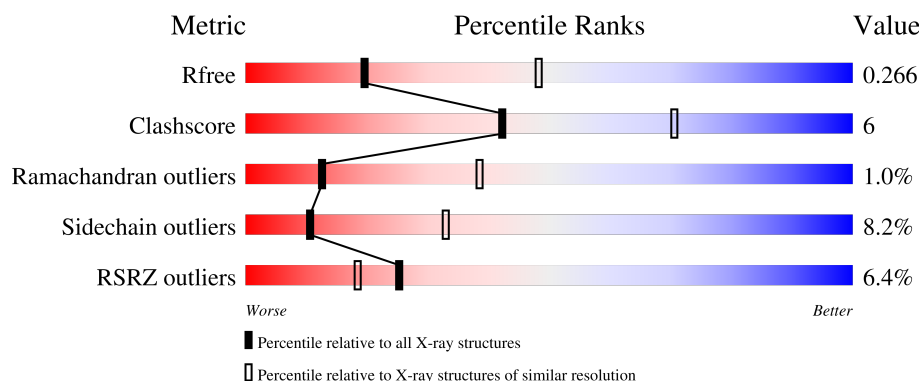
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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}	180053	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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 $\leq 5\%$. 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	449	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3182 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
1	A	394	Total	C	N	O	S	0	1	0
			3154	1979	535	625	15			

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	76	ALA	VAL	see remark 999	UNP P42212
A	87	ARG	GLY	engineered mutation	UNP P42212
A	88	GLY	SER	see remark 999	UNP P42212
A	93	TYR	ASP	see remark 999	UNP P42212
A	116	VAL	THR	engineered mutation	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 (CCD ID: CA) (formula: Ca).

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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	24	Total 24	O 24	0	0

4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	120.80Å 120.80Å 97.35Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.30 – 2.80 29.30 – 2.80	Depositor EDS
% Data completeness (in resolution range)	100.0 (29.30-2.80) 99.8 (29.30-2.80)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.18	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.73 (at 2.80Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.224 , 0.266 0.222 , 0.266	Depositor DCC
R_{free} test set	934 reflections (5.10%)	wwPDB-VP
Wilson B-factor (Å ²)	40.9	Xtriage
Anisotropy	0.167	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 28.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.52$, $\langle L^2 \rangle = 0.35$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	3182	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.10% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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

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	0.70	6/3189 (0.2%)	0.89	4/4293 (0.1%)

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	45	ASN	CG-OD1	5.58	1.34	1.23
1	A	352	GLN	CD-OE1	5.49	1.33	1.23
1	A	410	HIS	ND1-CE1	5.38	1.38	1.32
1	A	440	ASN	CG-OD1	5.30	1.33	1.23
1	A	49	HIS	ND1-CE1	5.27	1.37	1.32
1	A	414	ASN	CG-OD1	5.04	1.33	1.23

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	410	HIS	CB-CG-CD2	-6.54	122.69	131.20
1	A	49	HIS	CB-CG-CD2	-6.50	122.75	131.20
1	A	410	HIS	CB-CG-ND1	5.68	131.22	122.70
1	A	49	HIS	CB-CG-ND1	5.65	131.18	122.70

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	3154	0	3062	39	0
2	A	4	0	0	0	0
3	A	24	0	0	0	0
All	All	3182	0	3062	39	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 6.

All (39) 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:56:ARG:NH2	1:A:357:GLU:OE2	2.19	0.76
1:A:76:ALA:HB3	1:A:96:GLN:HB3	1.77	0.66
1:A:408:LEU:HD21	1:A:427:MET:HE2	1.78	0.65
1:A:408:LEU:O	1:A:412:MET:HG2	2.04	0.56
1:A:44:TRP:CG	1:A:447:MET:HE1	2.42	0.54
1:A:41:ARG:C	1:A:43:LYS:H	2.18	0.52
1:A:368:PHE:HB3	1:A:369:PRO:HD3	1.91	0.52
1:A:419:LEU:HB3	1:A:423:GLU:HG2	1.92	0.51
1:A:341:SER:O	1:A:414:ASN:HB3	2.12	0.49
1:A:221:THR:CG2	1:A:281:ILE:HG21	2.43	0.49
1:A:321:LEU:HD12	1:A:321:LEU:HA	1.69	0.48
1:A:354:MET:O	1:A:357:GLU:HB2	2.14	0.48
1:A:79:LYS:HD2	1:A:91:LEU:HD22	1.97	0.47
1:A:283:LEU:C	1:A:283:LEU:HD23	2.40	0.47
1:A:279:ASN:ND2	1:A:281:ILE:HD11	2.30	0.47
1:A:436:ASP:OD2	1:A:438:GLN:HB2	2.14	0.47
1:A:273:GLU:CD	1:A:280:ARG:HH21	2.23	0.46
1:A:132:VAL:HG22	1:A:203:LYS:HG3	1.97	0.45
1:A:56:ARG:HG3	1:A:378:LYS:HB2	1.97	0.45
1:A:41:ARG:O	1:A:41:ARG:HG2	2.17	0.45
1:A:211:LEU:HA	1:A:212:PRO:HD3	1.79	0.45
1:A:418:LYS:HD2	1:A:418:LYS:HA	1.77	0.44
1:A:447:MET:HB3	1:A:447:MET:HE3	1.54	0.44
1:A:418:LYS:O	1:A:419:LEU:HD23	2.18	0.44
1:A:44:TRP:CD2	1:A:447:MET:HE1	2.53	0.43
1:A:224:CRO:N2	1:A:224:CRO:HD1	2.34	0.43
1:A:422:GLU:O	1:A:426:GLU:HB2	2.18	0.43
1:A:420:THR:O	1:A:424:VAL:HG23	2.19	0.43
1:A:273:GLU:OE1	1:A:280:ARG:NH2	2.52	0.43
1:A:63:VAL:O	1:A:113:TYR:HA	2.19	0.42
1:A:98:ASN:HA	1:A:251:ILE:O	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:268:ALA:HA	1:A:280:ARG:O	2.19	0.42
1:A:215:TRP:N	1:A:216:PRO:CD	2.83	0.41
1:A:308:THR:HB	1:A:311:GLN:H	1.85	0.41
1:A:211:LEU:HD22	1:A:215:TRP:CE2	2.55	0.41
1:A:81:ARG:HD2	1:A:381:ASP:HB3	2.03	0.41
1:A:74:ILE:HG13	1:A:98:ASN:HB2	2.03	0.41
1:A:56:ARG:HD3	1:A:374:MET:HG3	2.03	0.40
1:A:95:TYR:O	1:A:254:ARG:HA	2.22	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	388/449 (86%)	366 (94%)	18 (5%)	4 (1%)	12	38

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	42	ARG
1	A	304	ARG
1	A	305	ASP
1	A	396	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	342/383 (89%)	314 (92%)	28 (8%)	10	33

All (28) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	42	ARG
1	A	43	LYS
1	A	52	ARG
1	A	56	ARG
1	A	59	SER
1	A	74	ILE
1	A	75	LYS
1	A	144	LEU
1	A	164	GLU
1	A	173	LEU
1	A	184	LYS
1	A	188	SER
1	A	230	SER
1	A	281	ILE
1	A	308	THR
1	A	309	GLU
1	A	310	GLU
1	A	321	LEU
1	A	352	GLN
1	A	377	ARG
1	A	390	GLU
1	A	418	LYS
1	A	422	GLU
1	A	423	GLU
1	A	429	ARG
1	A	430	GLU
1	A	442	GLU
1	A	447	MET

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

Mol	Chain	Res	Type
1	A	77	ASN
1	A	410	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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	22,23,24	3.29	5 (22%)	30,32,34	2.76	7 (23%)

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	-	1/12/31/32	0/2/2/2

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	224	CRO	CB2-CA2	13.78	1.48	1.35
1	A	224	CRO	C1-N2	4.42	1.38	1.32
1	A	224	CRO	O2-C2	3.27	1.29	1.23
1	A	224	CRO	C2-N3	-2.76	1.33	1.40
1	A	224	CRO	CA2-C2	-2.29	1.46	1.48

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	224	CRO	O2-C2-CA2	-10.20	124.51	131.02
1	A	224	CRO	CA2-C2-N3	6.68	109.11	103.50
1	A	224	CRO	C2-N3-C1	-4.36	106.05	108.07
1	A	224	CRO	CB2-CA2-C2	4.28	127.55	122.36

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	224	CRO	C2-CA2-N2	-3.64	106.35	108.95
1	A	224	CRO	CG2-CB2-CA2	-2.65	126.72	129.87
1	A	224	CRO	CA1-C1-N3	-2.08	122.23	124.69

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	224	CRO	C3-CA3-N3-C2

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 4 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 ⓘ

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	393/449 (87%)	0.05	25 (6%)	25 18	14, 31, 78, 93	1 (0%)

All (25) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	40	SER	5.0
1	A	418	LYS	4.8
1	A	303	THR	3.8
1	A	44	TRP	3.7
1	A	449	THR	3.7
1	A	159	VAL	3.3
1	A	416	GLY	3.2
1	A	419	LEU	3.1
1	A	422	GLU	3.1
1	A	433	ILE	3.0
1	A	420	THR	3.0
1	A	435	GLY	2.9
1	A	446	GLN	2.9
1	A	306	GLN	2.8
1	A	87	ARG	2.5
1	A	41	ARG	2.5
1	A	429	ARG	2.3
1	A	427	MET	2.3
1	A	442	GLU	2.3
1	A	413	THR	2.3
1	A	415	LEU	2.2
1	A	305	ASP	2.2
1	A	309	GLU	2.1
1	A	406	ALA	2.1
1	A	424	VAL	2.0

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, 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	RSCC	RSR	B-factors(Å ²)	Q<0.9
1	CRO	A	224	22/23	0.96	0.08	23,25,27,27	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides 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, 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	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	CA	A	455	1/1	0.95	0.05	59,59,59,59	0
2	CA	A	454	1/1	0.98	0.04	47,47,47,47	0
2	CA	A	452	1/1	0.98	0.04	28,28,28,28	0
2	CA	A	453	1/1	0.99	0.03	29,29,29,29	0

6.5 Other polymers [i](#)

There are no such residues in this entry.