



# Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 6TV7  
Title : Crystal structure of rsGCaMP in the OFF state (illuminated)  
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Deposited on : 2020-01-09  
Resolution : 2.90 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](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 : 1.8.5 (274361), CSD as541be (2020)  
Xtrriage (Phenix) : 1.13  
EDS : 2.23.2  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0267  
CCP4 : 7.1.010 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.23.2

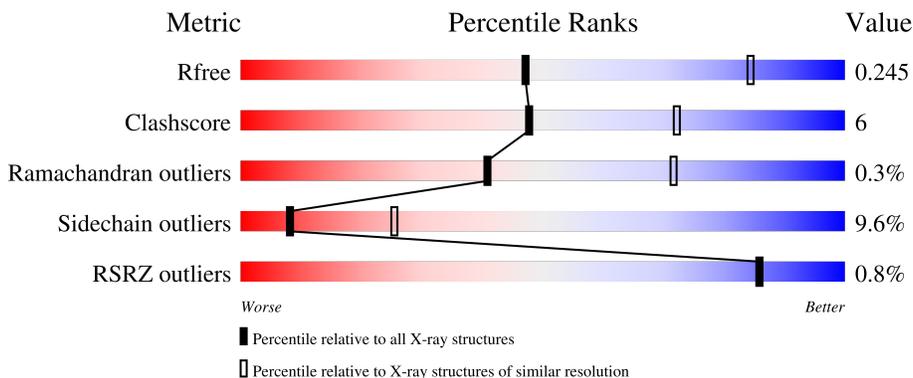
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.90 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	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)

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  $\geq 3$ , 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	422	

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3274 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 rsGCaMP.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	398	3176	1996	536	630	14	0	1	0

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

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

- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	5	Total	Na	0	0
			5	5		

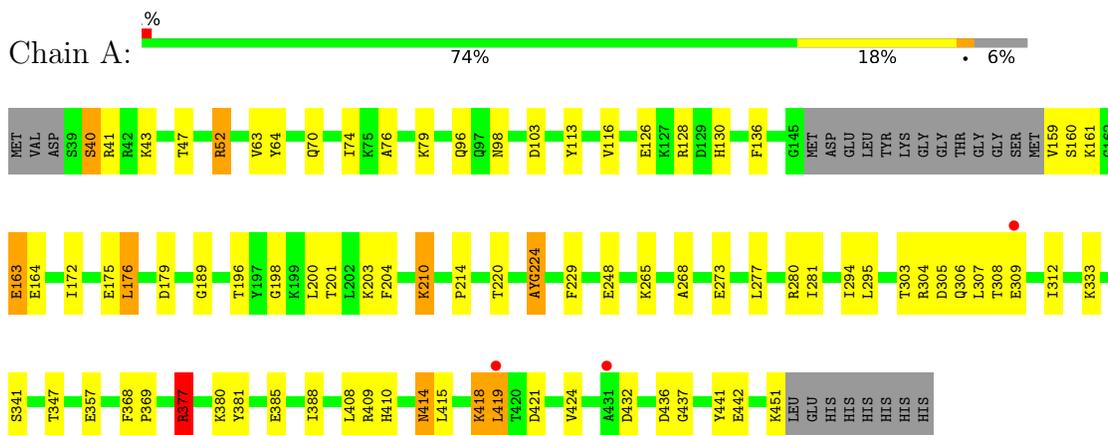
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	88	Total	O	0	1
			89	89		

### 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: rsGCaMP



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	120.67Å 120.67Å 96.02Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.09 – 2.90 47.04 – 2.90	Depositor EDS
% Data completeness (in resolution range)	100.0 (47.09-2.90) 100.0 (47.04-2.90)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.72 (at 2.91Å)	Xtriage
Refinement program	REFMAC 5.8.0238	Depositor
R, $R_{free}$	0.182 , 0.250 0.186 , 0.245	Depositor DCC
$R_{free}$ test set	831 reflections (5.11%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	52.9	Xtriage
Anisotropy	0.011	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	(Not available) , (Not available)	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	3274	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	59.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.16% 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: CA, NA, PIA

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	0.77	0/3211	0.97	2/4322 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	377	ARG	NE-CZ-NH2	6.68	123.64	120.30
1	A	52	ARG	CB-CA-C	5.27	120.95	110.40

There are no chirality outliers.

There are no planarity outliers.

### 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	3176	0	3083	38	0
2	A	4	0	0	0	0
3	A	5	0	0	0	0
4	A	89	0	0	2	0
All	All	3274	0	3083	38	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 (38) 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:210:LYS:HE2	4:A:610:HOH:O	1.84	0.75
1:A:418:LYS:HE3	1:A:418:LYS:HA	1.71	0.72
1:A:116:VAL:HG11	1:A:224:PIA:CD1	2.22	0.69
1:A:409:ARG:HG3	1:A:424:VAL:HG21	1.83	0.60
1:A:410:HIS:O	1:A:414:ASN:HB2	2.03	0.59
1:A:380:LYS:HE2	1:A:381:TYR:CZ	2.45	0.52
1:A:136:PHE:HA	1:A:198:GLY:O	2.10	0.51
1:A:160:SER:HB2	4:A:642:HOH:O	2.11	0.50
1:A:307:LEU:HD23	1:A:307:LEU:N	2.26	0.49
1:A:40:SER:HA	1:A:43:LYS:HG3	1.94	0.48
1:A:76:ALA:HB3	1:A:96:GLN:HB3	1.94	0.48
1:A:189:GLY:HA2	1:A:203:LYS:O	2.14	0.48
1:A:268:ALA:HA	1:A:280:ARG:O	2.14	0.48
1:A:368:PHE:HB3	1:A:369:PRO:HD3	1.95	0.47
1:A:172:ILE:HA	1:A:277:LEU:O	2.14	0.47
1:A:116:VAL:O	1:A:377:ARG:NH1	2.48	0.46
1:A:308:THR:O	1:A:309:GLU:C	2.54	0.46
1:A:130:HIS:HA	1:A:204:PHE:O	2.16	0.46
1:A:43:LYS:NZ	1:A:419:LEU:HD21	2.32	0.44
1:A:341:SER:HB2	1:A:414:ASN:O	2.18	0.44
1:A:126:GLU:OE1	1:A:128:ARG:NH2	2.51	0.44
1:A:273:GLU:CD	1:A:280:ARG:HH21	2.21	0.44
1:A:451:LYS:HE3	1:A:451:LYS:HB2	1.82	0.44
1:A:200:LEU:HD21	1:A:229:PHE:HB2	2.00	0.43
1:A:432:ASP:OD2	1:A:437:GLY:N	2.46	0.43
1:A:64:TYR:OH	1:A:357:GLU:OE1	2.30	0.42
1:A:74:ILE:CG1	1:A:98:ASN:HB2	2.49	0.42
1:A:40:SER:O	1:A:43:LYS:HB2	2.19	0.42
1:A:63:VAL:O	1:A:113:TYR:HA	2.20	0.41
1:A:214:PRO:HD3	1:A:294:ILE:O	2.19	0.41
1:A:295:LEU:HD23	1:A:295:LEU:HA	1.89	0.41
1:A:388:ILE:HG22	1:A:441:TYR:CE2	2.55	0.41
1:A:43:LYS:HZ3	1:A:419:LEU:HD21	1.84	0.41
1:A:377:ARG:HH21	1:A:377:ARG:HB2	1.86	0.41
1:A:159:VAL:HG13	1:A:163:GLU:CB	2.51	0.41
1:A:442:GLU:OE2	1:A:442:GLU:N	2.43	0.41
1:A:176:LEU:HA	1:A:281:ILE:O	2.21	0.41
1:A:179:ASP:OD1	1:A:179:ASP:C	2.59	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	392/422 (93%)	362 (92%)	29 (7%)	1 (0%)	41 71

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	421	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	343/362 (95%)	310 (90%)	33 (10%)	8 25

All (33) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	40	SER
1	A	41	ARG
1	A	47	THR
1	A	52	ARG
1	A	70	GLN
1	A	79	LYS
1	A	103	ASP
1	A	161	LYS
1	A	163	GLU
1	A	164	GLU

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Mol	Chain	Res	Type
1	A	175	GLU
1	A	176	LEU
1	A	196	THR
1	A	201	THR
1	A	210	LYS
1	A	220	THR
1	A	248	GLU
1	A	265	LYS
1	A	303	THR
1	A	304	ARG
1	A	305	ASP
1	A	306	GLN
1	A	312	ILE
1	A	333	LYS
1	A	347	THR
1	A	377	ARG
1	A	385	GLU
1	A	408	LEU
1	A	414	ASN
1	A	415	LEU
1	A	418	LYS
1	A	419	LEU
1	A	436	ASP

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	306	GLN

### 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	PIA	A	224	1	21,21,22	3.86	5 (23%)	27,29,31	6.95	16 (59%)

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	PIA	A	224	1	-	2/8/27/28	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	PIA	CB2-CA2	15.27	1.47	1.35
1	A	224	PIA	CA1-C1	-5.60	1.43	1.51
1	A	224	PIA	CA2-N2	-3.99	1.30	1.38
1	A	224	PIA	C2-N3	-3.66	1.31	1.39
1	A	224	PIA	CA2-C2	-2.23	1.46	1.48

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	224	PIA	CB2-CA2-C2	19.35	145.38	122.28
1	A	224	PIA	CA2-C2-N3	17.55	111.67	103.37
1	A	224	PIA	C2-N3-C1	-14.36	100.70	107.97
1	A	224	PIA	CB2-CA2-N2	-13.75	109.76	128.83
1	A	224	PIA	N3-C1-N2	7.48	116.63	111.45
1	A	224	PIA	CA1-C1-N2	-6.24	116.07	124.05
1	A	224	PIA	C2-CA2-N2	-5.90	104.80	108.93
1	A	224	PIA	C1-CA1-N1	-4.42	96.37	109.24
1	A	224	PIA	CD1-CE1-CZ	-3.81	115.70	119.88
1	A	224	PIA	O2-C2-CA2	-3.71	128.88	130.96
1	A	224	PIA	CD2-CG2-CD1	3.01	122.10	117.64
1	A	224	PIA	CE2-CD2-CG2	-2.88	117.49	121.25
1	A	224	PIA	O2-C2-N3	-2.46	119.45	124.35
1	A	224	PIA	CA3-N3-C2	2.34	129.15	123.80
1	A	224	PIA	CE2-CZ-CE1	2.27	123.59	119.77
1	A	224	PIA	CA3-N3-C1	2.26	129.87	127.16

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	224	PIA	C2-CA2-CB2-CG2
1	A	224	PIA	N2-CA2-CB2-CG2

There are no ring outliers.

1 monomer is involved in 1 short contact:

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

## 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 9 ligands modelled in this entry, 9 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 [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	397/422 (94%)	-0.31	3 (0%) 86 86	35, 53, 110, 160	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	419	LEU	3.3
1	A	309	GLU	2.3
1	A	431	ALA	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<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
1	PIA	A	224	20/21	0.97	0.15	40,49,66,67	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<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( $\text{\AA}^2$ )	Q<0.9
3	NA	A	506	1/1	0.79	0.25	37,37,37,37	0
3	NA	A	507	1/1	0.88	0.36	52,52,52,52	0
3	NA	A	508	1/1	0.94	0.10	43,43,43,43	0
3	NA	A	509	1/1	0.94	0.28	37,37,37,37	0
3	NA	A	505	1/1	0.95	0.26	38,38,38,38	0
2	CA	A	501	1/1	0.96	0.04	66,66,66,66	0
2	CA	A	504	1/1	0.98	0.04	56,56,56,56	0
2	CA	A	502	1/1	0.98	0.14	41,41,41,41	0
2	CA	A	503	1/1	0.99	0.17	45,45,45,45	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.