



# Full wwPDB X-ray Structure Validation Report ⓘ

Oct 12, 2024 – 07:42 PM EDT

PDB ID : 2SAS  
Title : STRUCTURE OF A SARCOPLASMIC CALCIUM-BINDING PROTEIN FROM AMPHIOXUS REFINED AT 2.4 ANGSTROMS RESOLUTION  
Authors : Cook, W.J.; Babu, Y.S.; Cox, J.A.  
Deposited on : 1993-07-30  
Resolution : 2.40 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.

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 : 4.02b-467  
Xtriage (Phenix) : 1.20.1  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.003 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.39

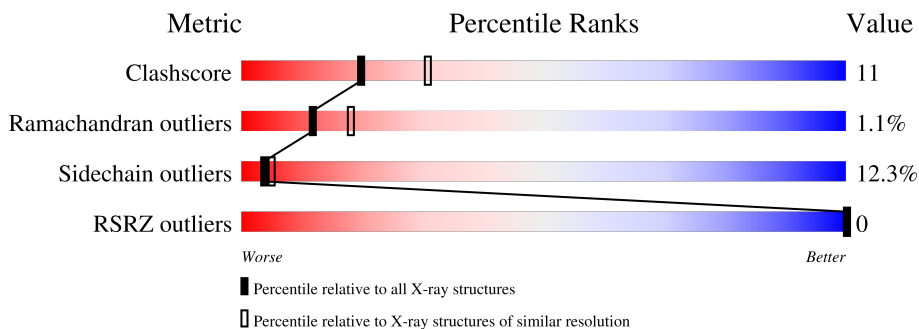
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.40 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))
Clashscore	180529	5218 (2.40-2.40)
Ramachandran outliers	177936	5158 (2.40-2.40)
Sidechain outliers	177891	5159 (2.40-2.40)
RSRZ outliers	164620	4642 (2.40-2.40)

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	185	 58% 32% 6% .

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 1499 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 SARCOPLASMIC CALCIUM-BINDING PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	185	1495	945	244	295	11	0	0	0

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

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

- Molecule 3 is water.

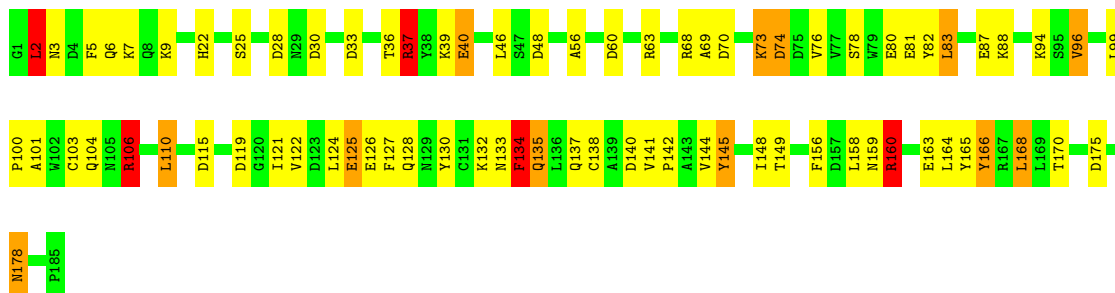
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	O	0	0
			1	1		

### 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: SARCOPLASMIC CALCIUM-BINDING PROTEIN

Chain A: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	59.60Å 81.30Å 82.40Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	5.00 – 2.40 5.00 – 2.40	Depositor EDS
% Data completeness (in resolution range)	(Not available) (5.00-2.40) 81.0 (5.00-2.40)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$	-	Xtrriage
Refinement program	PROLSQ, X-PLOR	Depositor
R, $R_{free}$	0.199 , (Not available) 0.184 , (Not available)	Depositor DCC
$R_{free}$ test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	22.9	Xtrriage
Anisotropy	0.347	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.43 , 72.0	EDS
L-test for twinning <sup>1</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	1499	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	20.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows:

<sup>1</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

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	0.99	0/1527	1.77	33/2059 (1.6%)

There are no bond length outliers.

All (33) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	160	ARG	NE-CZ-NH2	17.83	129.22	120.30
1	A	160	ARG	NE-CZ-NH1	-13.06	113.77	120.30
1	A	145	TYR	CB-CG-CD1	-10.81	114.52	121.00
1	A	40	GLU	CA-CB-CG	10.54	136.59	113.40
1	A	145	TYR	CB-CG-CD2	8.41	126.05	121.00
1	A	70	ASP	CB-CG-OD2	-8.40	110.74	118.30
1	A	119	ASP	CB-CG-OD1	7.77	125.29	118.30
1	A	134	PHE	N-CA-C	-7.18	91.60	111.00
1	A	132	LYS	CA-CB-CG	6.98	128.75	113.40
1	A	88	LYS	CA-CB-CG	6.42	127.53	113.40
1	A	37	ARG	CD-NE-CZ	6.24	132.33	123.60
1	A	128	GLN	CA-CB-CG	6.22	127.08	113.40
1	A	2	LEU	CB-CA-C	5.96	121.53	110.20
1	A	166	TYR	CB-CG-CD2	5.86	124.52	121.00
1	A	28	ASP	CB-CG-OD1	5.81	123.53	118.30
1	A	134	PHE	N-CA-CB	5.57	120.62	110.60
1	A	165	TYR	CB-CG-CD2	5.53	124.32	121.00
1	A	133	ASN	C-N-CA	5.52	135.51	121.70
1	A	170	THR	N-CA-C	5.40	125.58	111.00
1	A	175	ASP	CB-CG-OD1	5.39	123.16	118.30
1	A	134	PHE	O-C-N	5.34	131.25	122.70
1	A	25	SER	CA-CB-OG	5.33	125.58	111.20
1	A	22	HIS	CA-CB-CG	-5.33	104.55	113.60
1	A	106	ARG	CA-CB-CG	5.28	125.01	113.40

*Continued on next page...*

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	121	ILE	CA-C-O	-5.24	109.09	120.10
1	A	115	ASP	CB-CG-OD1	5.23	123.01	118.30
1	A	82	TYR	CB-CG-CD1	5.21	124.12	121.00
1	A	125	GLU	CA-CB-CG	5.13	124.68	113.40
1	A	48	ASP	CB-CG-OD2	5.09	122.88	118.30
1	A	140	ASP	N-CA-C	-5.07	97.30	111.00
1	A	126	GLU	OE1-CD-OE2	-5.07	117.22	123.30
1	A	68	ARG	NE-CZ-NH2	5.05	122.83	120.30
1	A	74	ASP	CB-CG-OD2	5.01	122.81	118.30

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	1495	0	1420	33	0
2	A	3	0	0	0	0
3	A	1	0	0	0	0
All	All	1499	0	1420	33	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 11.

All (33) 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:3:ASN:H	1:A:6:GLN:HE21	1.23	0.86
1:A:130:TYR:O	1:A:134:PHE:HB2	1.76	0.83
1:A:138:CYS:HB3	1:A:141:VAL:HG22	1.66	0.77
1:A:36:THR:O	1:A:40:GLU:HB2	1.91	0.71
1:A:9:LYS:HE3	1:A:168:LEU:O	1.94	0.67
1:A:2:LEU:HD22	1:A:87:GLU:HG2	1.75	0.66
1:A:56:ALA:O	1:A:60:ASP:HB2	2.01	0.61
1:A:100:PRO:O	1:A:103:CYS:HB2	2.02	0.58

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:148:ILE:O	1:A:160:ARG:NH1	2.38	0.57
1:A:78:SER:OG	1:A:81:GLU:HG3	2.08	0.54
1:A:5:PHE:CZ	1:A:9:LYS:HD3	2.44	0.53
1:A:148:ILE:HG23	1:A:164:LEU:HD11	1.91	0.52
1:A:74:ASP:O	1:A:76:VAL:HG23	2.11	0.51
1:A:73:LYS:N	1:A:73:LYS:HD3	2.27	0.50
1:A:3:ASN:H	1:A:6:GLN:NE2	2.03	0.49
1:A:159:ASN:O	1:A:163:GLU:HG3	2.13	0.49
1:A:9:LYS:HB3	1:A:168:LEU:HD22	1.95	0.49
1:A:127:PHE:O	1:A:130:TYR:HB3	2.13	0.48
1:A:101:ALA:HA	1:A:104:GLN:HG2	1.95	0.47
1:A:30:ASP:O	1:A:33:ASP:HB2	2.16	0.46
1:A:148:ILE:HA	1:A:160:ARG:HH12	1.80	0.46
1:A:69:ALA:O	1:A:81:GLU:HB3	2.16	0.46
1:A:141:VAL:N	1:A:142:PRO:CD	2.79	0.46
1:A:96:VAL:HG23	1:A:166:TYR:HB2	1.99	0.45
1:A:145:TYR:CE2	1:A:149:THR:HG21	2.52	0.44
1:A:7:LYS:HG2	1:A:83:LEU:HD21	1.99	0.43
1:A:37:ARG:O	1:A:40:GLU:HB3	2.18	0.43
1:A:106:ARG:HG3	1:A:110:LEU:HD22	2.00	0.43
1:A:144:VAL:O	1:A:148:ILE:HG13	2.19	0.42
1:A:73:LYS:HD3	1:A:73:LYS:H	1.83	0.42
1:A:5:PHE:HZ	1:A:178:ASN:HD21	1.67	0.41
1:A:80:GLU:H	1:A:80:GLU:CD	2.23	0.41
1:A:135:GLN:O	1:A:137:GLN:NE2	2.54	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	183/185 (99%)	171 (93%)	10 (6%)	2 (1%)	<b>12</b> <b>18</b>



All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	134	PHE
1	A	135	GLN

### 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	162/162 (100%)	142 (88%)	20 (12%)	<b>4</b> <b>5</b>

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	LEU
1	A	37	ARG
1	A	39	LYS
1	A	46	LEU
1	A	63	ARG
1	A	73	LYS
1	A	83	LEU
1	A	94	LYS
1	A	96	VAL
1	A	99	LEU
1	A	106	ARG
1	A	110	LEU
1	A	122	VAL
1	A	124	LEU
1	A	125	GLU
1	A	156	PHE
1	A	158	LEU
1	A	160	ARG
1	A	168	LEU
1	A	178	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	6	GLN
1	A	178	ASN
1	A	183	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](#)

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

### 5.5 Carbohydrates [i](#)

There are no oligosaccharides 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 [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	185/185 (100%)	-0.99	0 <b>100</b> <b>100</b>	14, 20, 29, 32	0

There are no RSRZ outliers to report.

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

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

### 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(Å <sup>2</sup> )	Q<0.9
2	CA	A	186	1/1	0.97	0.14	9,9,9,9	0
2	CA	A	187	1/1	0.98	0.14	11,11,11,11	0
2	CA	A	188	1/1	1.00	0.14	12,12,12,12	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.