



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 12:52 AM UTC

PDB ID : 5NQF / pdb_00005nqf
Title : Crystal structure of Plasmodium falciparum AMA1 in complex with a 39 aa PvRON2 peptide
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Deposited on : 2017-04-20
Resolution : 1.90 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

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
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

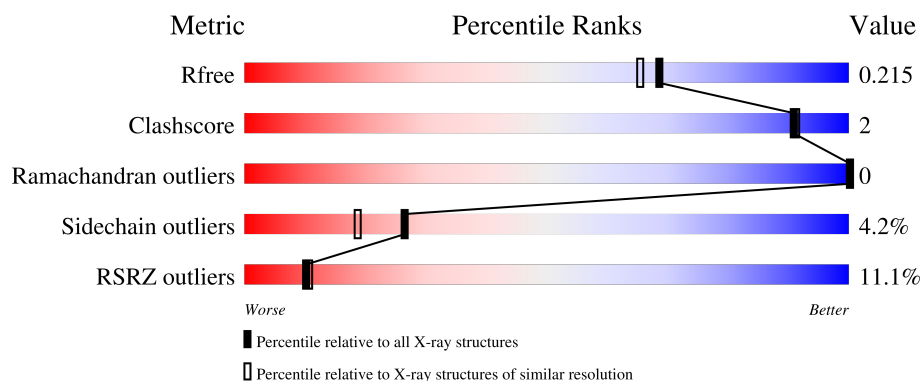
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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}	180053	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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 ≥ 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	371	6% 73% 6% 20%
2	B	39	36% 77% 13% 10%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2970 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 Apical membrane antigen 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	298	2410	1520	410	464	16	0	3	0

There are 30 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	95	GLU	-	expression tag	UNP A0A024UZE1
A	96	PHE	-	expression tag	UNP A0A024UZE1
A	162	LYS	ASN	engineered mutation	UNP A0A024UZE1
A	288	VAL	THR	engineered mutation	UNP A0A024UZE1
A	373	ASP	SER	engineered mutation	UNP A0A024UZE1
A	422	ASP	ASN	engineered mutation	UNP A0A024UZE1
A	423	LYS	SER	engineered mutation	UNP A0A024UZE1
A	443	GLY	-	expression tag	UNP A0A024UZE1
A	444	LEU	-	expression tag	UNP A0A024UZE1
A	445	GLU	-	expression tag	UNP A0A024UZE1
A	446	GLN	-	expression tag	UNP A0A024UZE1
A	447	LYS	-	expression tag	UNP A0A024UZE1
A	448	LEU	-	expression tag	UNP A0A024UZE1
A	449	ILE	-	expression tag	UNP A0A024UZE1
A	450	SER	-	expression tag	UNP A0A024UZE1
A	451	GLU	-	expression tag	UNP A0A024UZE1
A	452	GLU	-	expression tag	UNP A0A024UZE1
A	453	ASP	-	expression tag	UNP A0A024UZE1
A	454	LEU	-	expression tag	UNP A0A024UZE1
A	455	ASN	-	expression tag	UNP A0A024UZE1
A	456	SER	-	expression tag	UNP A0A024UZE1
A	457	ALA	-	expression tag	UNP A0A024UZE1
A	458	VAL	-	expression tag	UNP A0A024UZE1
A	459	ASP	-	expression tag	UNP A0A024UZE1
A	460	HIS	-	expression tag	UNP A0A024UZE1
A	461	HIS	-	expression tag	UNP A0A024UZE1
A	462	HIS	-	expression tag	UNP A0A024UZE1

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Chain	Residue	Modelled	Actual	Comment	Reference
A	463	HIS	-	expression tag	UNP A0A024UZE1
A	464	HIS	-	expression tag	UNP A0A024UZE1
A	465	HIS	-	expression tag	UNP A0A024UZE1

- Molecule 2 is a protein called Rhoptry neck protein 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	35	Total	C	N	O	S	0	1	0
			253	159	43	48	3			

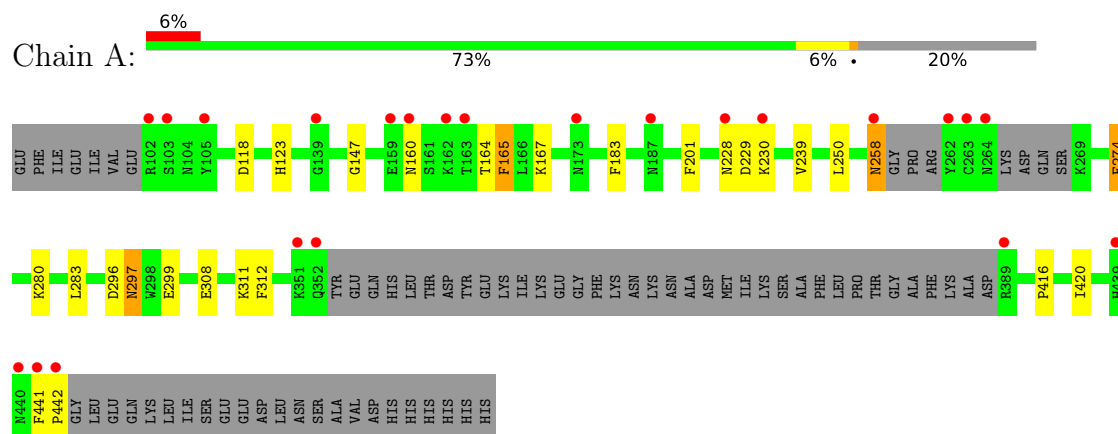
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	290	Total	O	0	0
			290	290		
3	B	17	Total	O	0	0
			17	17		

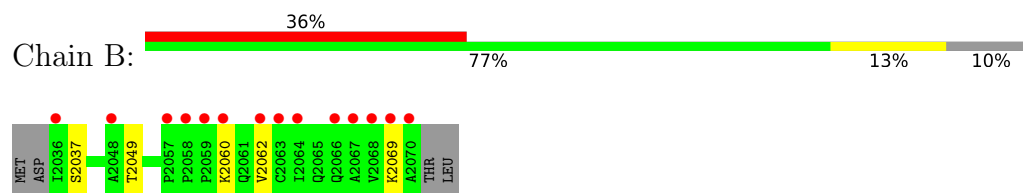
3 Residue-property plots [i](#)

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: Apical membrane antigen 1



- Molecule 2: Rhoptry neck protein 2



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	71.48Å 38.25Å 72.36Å 90.00° 98.55° 90.00°	Depositor
Resolution (Å)	35.78 – 1.90 35.78 – 1.90	Depositor EDS
% Data completeness (in resolution range)	95.9 (35.78-1.90) 95.9 (35.78-1.90)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.62 (at 1.89Å)	Xtriage
Refinement program	BUSTER 2.10.2	Depositor
R, R_{free}	0.169 , 0.205 0.178 , 0.215	Depositor DCC
R_{free} test set	1511 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å ²)	20.4	Xtriage
Anisotropy	0.573	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 49.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.024 for l,-k,h	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	2970	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.65% 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 [i](#)

5.1 Standard geometry [i](#)

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	0.84	0/2473	1.11	8/3348 (0.2%)
2	B	0.89	0/258	1.29	1/352 (0.3%)
All	All	0.84	0/2731	1.13	9/3700 (0.2%)

There are no bond length outliers.

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	274	PHE	CA-CB-CG	7.64	121.44	113.80
1	A	165	PHE	CA-CB-CG	6.57	120.37	113.80
2	B	2037	SER	N-CA-C	-6.32	104.47	111.36
1	A	229	ASP	CA-CB-CG	6.10	118.70	112.60
1	A	258	ASN	CA-CB-CG	5.89	118.49	112.60
1	A	280	LYS	N-CA-C	-5.78	100.28	109.76
1	A	296	ASP	CA-CB-CG	5.38	117.98	112.60
1	A	118	ASP	CA-C-N	5.04	127.36	120.46
1	A	118	ASP	C-N-CA	5.04	127.36	120.46

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	2410	0	2255	9	0
2	B	253	0	253	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	290	0	0	0	0
3	B	17	0	0	0	0
All	All	2970	0	2508	9	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 2.

All (9) 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:201:PHE:HZ	2:B:2060[B]:LYS:HE2	1.61	0.65
1:A:297:ASN:HD22	1:A:297:ASN:H	1.47	0.62
1:A:311:LYS:HG2	1:A:420:ILE:HB	1.97	0.47
1:A:441:PHE:HA	1:A:442:PRO:C	2.40	0.47
1:A:164:THR:HG23	1:A:167:LYS:HE2	1.98	0.46
1:A:228:ASN:HD22	2:B:2049:THR:HG22	1.81	0.45
1:A:123:HIS:CE1	1:A:147:GLY:HA3	2.51	0.45
1:A:239:VAL:HG23	1:A:250:LEU:HD11	1.98	0.45
1:A:312:PHE:HB3	1:A:416:PRO:HB3	2.03	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	293/371 (79%)	281 (96%)	12 (4%)	0	100	100
2	B	34/39 (87%)	34 (100%)	0	0	100	100
All	All	327/410 (80%)	315 (96%)	12 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	263/329 (80%)	252 (96%)	11 (4%)	26	19
2	B	28/33 (85%)	26 (93%)	2 (7%)	13	7
All	All	291/362 (80%)	278 (96%)	13 (4%)	26	17

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

Mol	Chain	Res	Type
1	A	160	ASN
1	A	165	PHE
1	A	183	PHE
1	A	230	LYS
1	A	258	ASN
1	A	274	PHE
1	A	283	LEU
1	A	297	ASN
1	A	299[A]	GLU
1	A	299[B]	GLU
1	A	308	GLU
2	B	2062	VAL
2	B	2069	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	187	ASN
1	A	210	ASN
1	A	228	ASN
1	A	231	ASN
1	A	297	ASN
1	A	421	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](#)

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](#)

There are no ligands in this entry.

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, 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	298/371 (80%)	-0.03	23 (7%) 19 21	10, 20, 53, 88	3 (1%)
2	B	35/39 (89%)	1.71	14 (40%) 1 0	26, 42, 68, 79	1 (2%)
All	All	333/410 (81%)	0.15	37 (11%) 10 11	10, 21, 57, 88	4 (1%)

All (37) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	2070	ALA	6.1
2	B	2060[A]	LYS	6.0
1	A	102	ARG	5.5
1	A	442	PRO	4.7
1	A	352	GLN	4.4
2	B	2036	ILE	4.1
2	B	2067	ALA	4.0
1	A	160	ASN	3.7
1	A	163	THR	3.5
1	A	258	ASN	3.4
2	B	2064	ILE	3.4
1	A	263	CYS	3.3
1	A	228	ASN	3.2
1	A	264	ASN	3.2
1	A	389	ARG	3.1
1	A	105	TYR	3.0
1	A	439	HIS	3.0
1	A	159	GLU	3.0
1	A	103	SER	2.9
2	B	2066	GLN	2.8
1	A	162	LYS	2.7
2	B	2069	LYS	2.7
1	A	262	TYR	2.6
2	B	2068	VAL	2.6

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Mol	Chain	Res	Type	RSRZ
1	A	230	LYS	2.5
1	A	351	LYS	2.5
2	B	2063	CYS	2.4
1	A	441	PHE	2.4
2	B	2059	PRO	2.4
1	A	139	GLY	2.2
2	B	2048	ALA	2.2
1	A	173	ASN	2.2
2	B	2057	PRO	2.1
2	B	2062	VAL	2.1
2	B	2058	PRO	2.1
1	A	440	ASN	2.0
1	A	187	ASN	2.0

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 oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.