



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 02:36 AM UTC

PDB ID : 3Q8B / pdb\_00003q8b  
Title : Crystal structure of WT Protective Antigen (pH 9.0)  
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Deposited on : 2011-01-06  
Resolution : 2.00 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>.

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

MolProbity : 4-5-2 with Phenix2.0  
Xtrriage (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

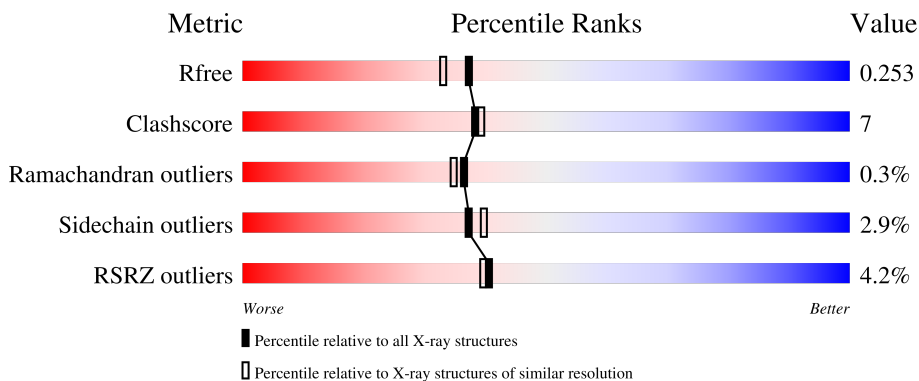
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	735	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5511 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 Protective antigen.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	674	5290	3321	891	1070	8	0	2	0

- Molecule 2 is CALCIUM ION (CCD ID: CA) (formula: Ca).

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

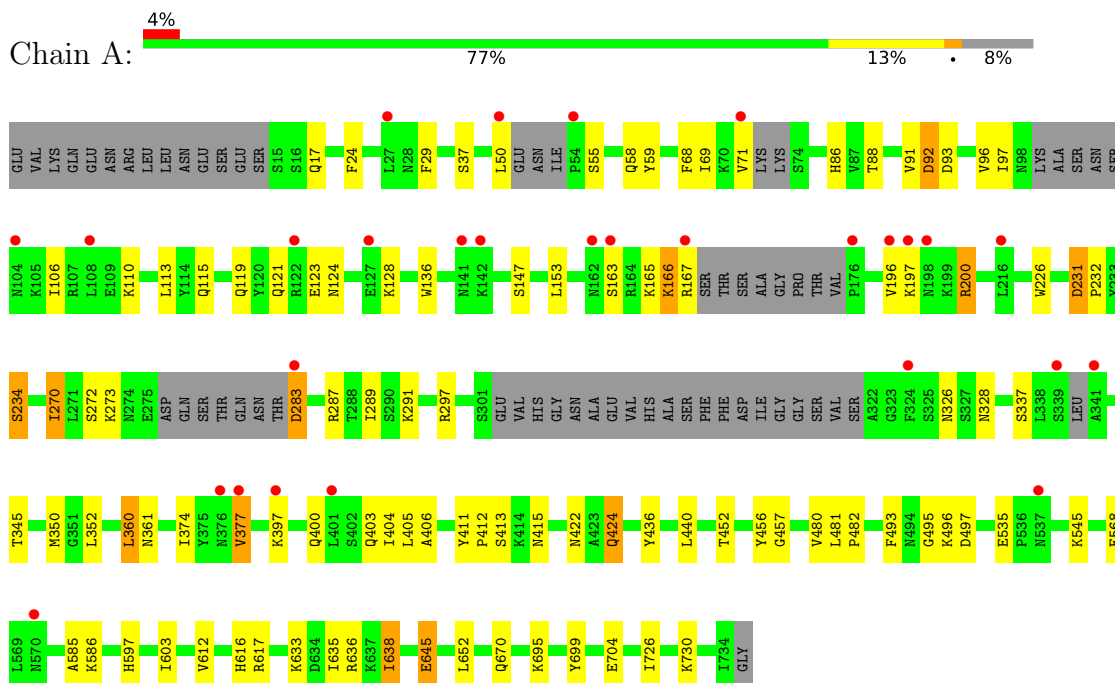
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	219	Total	O	0	0
			219	219		

### 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: Protective antigen



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	71.38Å 93.80Å 115.73Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	39.20 – 2.00 39.20 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.3 (39.20-2.00) 99.2 (39.20-2.00)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.69 (at 2.00Å)	Xtrriage
Refinement program	PHENIX 1.6.4_486	Depositor
R, $R_{free}$	0.207 , 0.258 0.202 , 0.253	Depositor DCC
$R_{free}$ test set	2690 reflections (5.09%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	30.0	Xtrriage
Anisotropy	0.651	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 29.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	5511	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	42.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.97% 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

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	0/5386	0.88	5/7308 (0.1%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	231	ASP	CA-C-N	-7.18	112.67	121.00
1	A	231	ASP	C-N-CA	-7.18	112.67	121.00
1	A	535	GLU	CA-C-N	5.95	125.65	119.64
1	A	535	GLU	C-N-CA	5.95	125.65	119.64
1	A	196	VAL	N-CA-C	5.10	111.67	106.21

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	5290	0	5114	72	0
2	A	2	0	0	0	0
3	A	219	0	0	8	0
All	All	5511	0	5114	72	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 7.

All (72) 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:404:ILE:HD11	1:A:406:ALA:HB2	1.65	0.78
1:A:69:ILE:HD11	1:A:136:TRP:CZ3	2.24	0.71
1:A:71:VAL:HG23	1:A:110:LYS:HA	1.72	0.70
1:A:166:LYS:O	1:A:167:ARG:CB	2.42	0.67
1:A:612:VAL:O	1:A:616:HIS:HD2	1.79	0.66
1:A:68:PHE:CE1	1:A:115:GLN:HG2	2.33	0.63
1:A:422:ASN:HB3	3:A:792:HOH:O	1.97	0.62
1:A:360:LEU:C	1:A:360:LEU:HD23	2.27	0.60
1:A:436:TYR:CE2	1:A:440:LEU:HD11	2.37	0.59
1:A:326:ASN:CG	3:A:890:HOH:O	2.45	0.59
1:A:404:ILE:HD12	1:A:406:ALA:N	2.22	0.55
1:A:635:ILE:O	1:A:638:ILE:HG13	2.07	0.55
1:A:272:SER:C	1:A:350:MET:HE3	2.33	0.54
1:A:165:LYS:HG2	3:A:871:HOH:O	2.08	0.54
1:A:289:ILE:HD12	1:A:350:MET:SD	2.49	0.53
1:A:633:LYS:CD	3:A:905:HOH:O	2.57	0.52
1:A:695:LYS:HG2	1:A:730:LYS:HD3	1.91	0.52
1:A:374:ILE:HD11	1:A:456:TYR:CD1	2.44	0.52
1:A:113:LEU:HD12	1:A:163:SER:OG	2.09	0.52
1:A:37:SER:O	1:A:200:ARG:HD3	2.10	0.52
1:A:88:THR:HB	1:A:119:GLN:HG2	1.92	0.52
1:A:287:ARG:O	1:A:350:MET:HG2	2.10	0.52
1:A:404:ILE:CD1	1:A:406:ALA:HB2	2.37	0.51
1:A:411:TYR:C	1:A:411:TYR:CD1	2.89	0.50
1:A:226:TRP:CZ2	1:A:234:SER:HB3	2.47	0.50
1:A:328:ASN:HB2	1:A:452:THR:O	2.13	0.48
1:A:403:GLN:HE22	1:A:413:SER:H	1.62	0.48
1:A:96:VAL:HG12	1:A:96:VAL:O	2.13	0.48
1:A:597:HIS:HD2	1:A:704:GLU:OE2	1.97	0.48
1:A:493:PHE:CZ	1:A:495:GLY:HA3	2.50	0.47
1:A:377:VAL:HG13	1:A:457:GLY:HA3	1.97	0.47
1:A:270:ILE:HG23	1:A:361:ASN:HB3	1.97	0.46
1:A:68:PHE:CE1	1:A:115:GLN:CG	2.99	0.46
1:A:496:LYS:O	1:A:497:ASP:OD1	2.34	0.46
1:A:652:LEU:HD12	1:A:652:LEU:N	2.31	0.45
1:A:413:SER:HB2	1:A:415:ASN:OD1	2.16	0.45
1:A:283:ASP:N	1:A:283:ASP:OD1	2.48	0.45
1:A:297:ARG:HD3	3:A:825:HOH:O	2.16	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:273:LYS:N	1:A:350:MET:HE3	2.32	0.45
1:A:123:GLU:O	1:A:124:ASN:CG	2.60	0.45
1:A:585:ALA:O	1:A:586:LYS:HB2	2.17	0.45
1:A:645:GLU:OE2	1:A:699:TYR:OH	2.32	0.45
1:A:404:ILE:HD12	1:A:405:LEU:C	2.43	0.44
1:A:92:ASP:O	1:A:93:ASP:HB2	2.17	0.43
1:A:603:ILE:HD12	3:A:830:HOH:O	2.18	0.43
1:A:197:LYS:HB2	1:A:200:ARG:O	2.18	0.43
1:A:403:GLN:HG3	1:A:411:TYR:CD2	2.53	0.43
1:A:17:GLN:OE1	1:A:153:LEU:HD23	2.18	0.43
1:A:119:GLN:O	1:A:119:GLN:HG3	2.16	0.43
1:A:481:LEU:HB2	1:A:482:PRO:HD3	2.01	0.43
1:A:545:LYS:HB3	1:A:545:LYS:HE3	1.78	0.43
1:A:345:THR:HB	3:A:881:HOH:O	2.19	0.43
1:A:231:ASP:HB2	1:A:232:PRO:CD	2.49	0.42
1:A:273:LYS:HG3	1:A:352:LEU:HD12	2.01	0.42
1:A:617:ARG:HG2	1:A:617:ARG:HH11	1.84	0.42
1:A:403:GLN:CG	1:A:411:TYR:CD2	3.02	0.42
1:A:123:GLU:O	1:A:124:ASN:ND2	2.52	0.42
1:A:726:ILE:C	1:A:726:ILE:HD12	2.44	0.42
1:A:59:TYR:CZ	1:A:128:LYS:HG2	2.54	0.42
1:A:403:GLN:HG2	1:A:411:TYR:CE2	2.55	0.42
1:A:17:GLN:HA	1:A:153:LEU:CD2	2.50	0.42
1:A:88:THR:HA	1:A:97:ILE:O	2.20	0.41
1:A:91:VAL:O	1:A:92:ASP:C	2.63	0.41
1:A:50:LEU:HD12	1:A:58:GLN:HB3	2.03	0.41
1:A:297:ARG:NE	3:A:825:HOH:O	2.51	0.41
1:A:24:PHE:CG	1:A:29:PHE:HA	2.55	0.41
1:A:291:LYS:NZ	1:A:337:SER:O	2.54	0.41
1:A:360:LEU:C	1:A:360:LEU:CD2	2.92	0.41
1:A:397:LYS:HB2	1:A:400:GLN:HB2	2.02	0.41
1:A:86:HIS:HB3	1:A:121:GLN:O	2.21	0.40
1:A:403:GLN:HG3	1:A:411:TYR:HD2	1.85	0.40
1:A:411:TYR:HA	1:A:412:PRO:C	2.46	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	660/735 (90%)	632 (96%)	26 (4%)	2 (0%)	36 35

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	424	GLN
1	A	92	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	585/661 (88%)	568 (97%)	17 (3%)	37 40

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	55	SER
1	A	106	ILE
1	A	147	SER
1	A	166	LYS
1	A	200	ARG
1	A	234	SER
1	A	270	ILE
1	A	283	ASP
1	A	360	LEU

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Mol	Chain	Res	Type
1	A	377	VAL
1	A	424	GLN
1	A	480	VAL
1	A	568	GLU
1	A	636	ARG
1	A	638	ILE
1	A	645	GLU
1	A	670	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (23) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	58	GLN
1	A	86	HIS
1	A	124	ASN
1	A	140	GLN
1	A	150	ASN
1	A	158	GLN
1	A	180	ASN
1	A	400	GLN
1	A	403	GLN
1	A	408	ASN
1	A	422	ASN
1	A	437	ASN
1	A	539	ASN
1	A	541	GLN
1	A	553	ASN
1	A	556	GLN
1	A	597	HIS
1	A	601	ASN
1	A	616	HIS
1	A	670	GLN
1	A	697	ASN
1	A	705	ASN
1	A	709	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](#)

Of 2 ligands modelled in this entry, 2 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

### 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, 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	674/735 (91%)	0.27	28 (4%) 40 39	17, 39, 73, 90	2 (0%)

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	104	ASN	4.9
1	A	54	PRO	4.8
1	A	341	ALA	4.6
1	A	324	PHE	3.8
1	A	196	VAL	3.6
1	A	283	ASP	3.3
1	A	198	ASN	3.2
1	A	537	ASN	2.9
1	A	216	LEU	2.8
1	A	71	VAL	2.8
1	A	127	GLU	2.6
1	A	339	SER	2.5
1	A	397	LYS	2.4
1	A	122	ARG	2.4
1	A	141	ASN	2.4
1	A	176	PRO	2.3
1	A	167	ARG	2.3
1	A	401	LEU	2.3
1	A	142	LYS	2.2
1	A	162	ASN	2.2
1	A	376	ASN	2.2
1	A	377	VAL	2.1
1	A	108	LEU	2.1
1	A	197	LYS	2.1
1	A	163	SER	2.1
1	A	27	LEU	2.0
1	A	570	ASN	2.0

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Mol	Chain	Res	Type	RSRZ
1	A	50	LEU	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](#)

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	736	1/1	0.99	0.02	26,26,26,26	0
2	CA	A	737	1/1	0.99	0.03	28,28,28,28	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.