



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 2, 2026 – 12:16 PM JST

PDB ID : 9LUD / pdb\_00009lud  
Title : Crystal structure of 9-mer peptide from H5N1 avian influenza virus in complex with B4 DUCK MHC I (UAA\*76)  
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Deposited on : 2025-02-08  
Resolution : 2.50 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  
Xtriage (Phenix) : 2.0  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
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) : 2.47

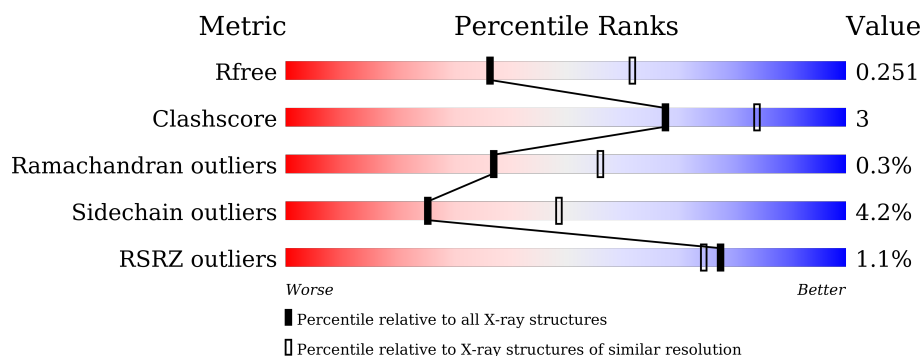
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.50 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))
$R_{free}$	164625	5504 (2.50-2.50)
Clashscore	180529	6282 (2.50-2.50)
Ramachandran outliers	177936	6191 (2.50-2.50)
Sidechain outliers	177891	6193 (2.50-2.50)
RSRZ outliers	164620	5504 (2.50-2.50)

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	271	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red 1%, orange 1%, yellow 12%, green 88%);"></div> <div style="display: flex; justify-content: space-between; width: 100%;"> <span>%</span> <span>88%</span> <span>12%</span> </div> </div>
2	B	101	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red 1%, orange 1%, yellow 7%, green 91%, grey 2%);"></div> <div style="display: flex; justify-content: space-between; width: 100%;"> <span>%</span> <span>91%</span> <span>7%</span> <span>•</span> </div> </div>
3	C	9	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, green 44%, yellow 44%, orange 11%);"></div> <div style="display: flex; justify-content: space-between; width: 100%;"> <span>44%</span> <span>44%</span> <span>11%</span> </div> </div>

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3223 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 MHC class I antigen.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	271	Total	C	N	O	S	0	0	0
			2220	1389	394	430	7			

- Molecule 2 is a protein called Beta-2-microglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	99	Total	C	N	O	S	0	0	0
			798	511	134	149	4			

- Molecule 3 is a protein called ILE-ARG-ASN-LEU-HIS-ILE-PRO-GLU-VAL.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	9	Total	C	N	O	0	0	0
			76	49	15	12			

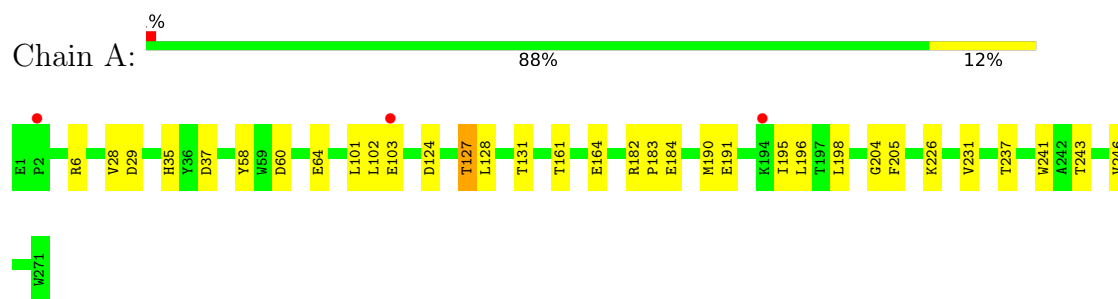
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	91	Total	O	0	0
			91	91		
4	B	36	Total	O	0	0
			36	36		
4	C	2	Total	O	0	0
			2	2		

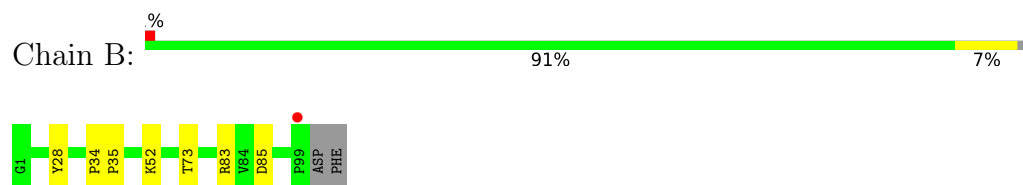
### 3 Residue-property plots

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.

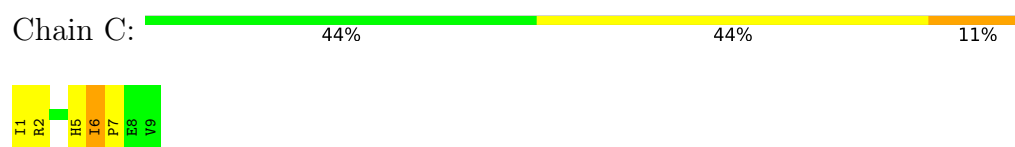
- Molecule 1: MHC class I antigen



- Molecule 2: Beta-2-microglobulin



- Molecule 3: ILE-ARG-ASN-LEU-HIS-ILE-PRO-GLU-VAL



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 62	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	82.09Å 82.09Å 111.37Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	43.84 – 2.50 43.84 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.3 (43.84-2.50) 99.3 (43.84-2.50)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	5.14 (at 2.51Å)	Xtriage
Refinement program	REFMAC 5.8.0415	Depositor
R, $R_{free}$	0.176 , 0.247 0.183 , 0.251	Depositor DCC
$R_{free}$ test set	734 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	28.5	Xtriage
Anisotropy	0.196	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 22.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.053 for h,-h-k,-l	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	3223	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.63% 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](#)

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	0.62	0/2279	1.03	0/3086
2	B	0.59	0/824	1.02	2/1122 (0.2%)
3	C	0.57	0/77	1.04	0/104
All	All	0.61	0/3180	1.03	2/4312 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	85	ASP	CA-CB-CG	5.53	118.12	112.60
2	B	73	THR	CB-CA-C	5.31	115.74	110.33

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	182	ARG	Sidechain

### 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	2220	0	2082	15	0
2	B	798	0	758	3	0
3	C	76	0	83	6	0
4	A	91	0	0	2	0
4	B	36	0	0	0	0
4	C	2	0	0	0	0
All	All	3223	0	2923	21	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 3.

All (21) 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:64:GLU:HG2	4:A:389:HOH:O	1.83	0.77
1:A:191:GLU:HG2	1:A:196:LEU:HD13	1.86	0.58
1:A:124:ASP:OD2	1:A:127:THR:CG2	2.53	0.56
1:A:58:TYR:CE2	3:C:1:ILE:HG22	2.45	0.52
1:A:241:TRP:CE3	1:A:243:THR:HG23	2.47	0.50
1:A:58:TYR:HE2	3:C:1:ILE:HG22	1.78	0.49
3:C:6:ILE:HB	3:C:7:PRO:CD	2.44	0.48
1:A:198:LEU:O	1:A:243:THR:HA	2.14	0.47
1:A:183:PRO:HB3	1:A:205:PHE:HB3	1.97	0.47
1:A:231:VAL:HG12	2:B:28:TYR:CD2	2.50	0.46
1:A:60:ASP:O	1:A:64:GLU:HG3	2.16	0.46
3:C:6:ILE:HB	3:C:7:PRO:HD3	1.97	0.46
2:B:52:LYS:HD3	2:B:52:LYS:HA	1.74	0.45
4:A:307:HOH:O	3:C:7:PRO:HD2	2.16	0.45
3:C:1:ILE:HG13	3:C:2:ARG:O	2.18	0.44
1:A:28:VAL:O	1:A:29:ASP:C	2.61	0.43
1:A:37:ASP:OD1	1:A:37:ASP:C	2.61	0.43
1:A:161:THR:O	1:A:164:GLU:HG2	2.19	0.43
2:B:34:PRO:HB2	2:B:35:PRO:HD2	2.02	0.42
1:A:204:GLY:HA2	1:A:237:THR:OG1	2.21	0.41
1:A:35:HIS:CD2	1:A:35:HIS:C	2.99	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles

### 5.3.1 Protein backbone

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	269/271 (99%)	259 (96%)	10 (4%)	0	100	100
2	B	97/101 (96%)	94 (97%)	3 (3%)	0	100	100
3	C	7/9 (78%)	6 (86%)	0	1 (14%)	0	0
All	All	373/381 (98%)	359 (96%)	13 (4%)	1 (0%)	37	56

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	C	6	ILE

### 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	235/235 (100%)	223 (95%)	12 (5%)	20	40
2	B	86/88 (98%)	85 (99%)	1 (1%)	67	86
3	C	9/9 (100%)	8 (89%)	1 (11%)	5	10
All	All	330/332 (99%)	316 (96%)	14 (4%)	25	49

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	6	ARG
1	A	101	LEU

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Mol	Chain	Res	Type
1	A	102	LEU
1	A	103	GLU
1	A	127	THR
1	A	128	LEU
1	A	131	THR
1	A	184	GLU
1	A	190	MET
1	A	195	ILE
1	A	226	LYS
1	A	246	VAL
2	B	83	ARG
3	C	5	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	35	HIS
1	A	86	GLN
1	A	203	HIS
1	A	221	GLN
2	B	15	HIS

### 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, 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	271/271 (100%)	-0.39	3 (1%) 77 74	18, 28, 51, 77	0
2	B	99/101 (98%)	-0.42	1 (1%) 79 76	18, 25, 45, 60	0
3	C	9/9 (100%)	-0.30	0 100 100	25, 34, 42, 49	0
All	All	379/381 (99%)	-0.40	4 (1%) 77 74	18, 28, 49, 77	0

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	194	LYS	3.6
2	B	99	PRO	2.8
1	A	103	GLU	2.7
1	A	2	PRO	2.5

### 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.