



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 03:03 AM UTC

PDB ID : 7SR4 / pdb\_00007sr4  
Title : Single chain trimer HLA-A\*02:01 (H98L, Y108C) with HPV.16 E7 peptide  
YMLDLQPETTDLYC  
Authors : Finton, K.A.K.; Rupert, P.B.  
Deposited on : 2021-11-07  
Resolution : 2.59 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

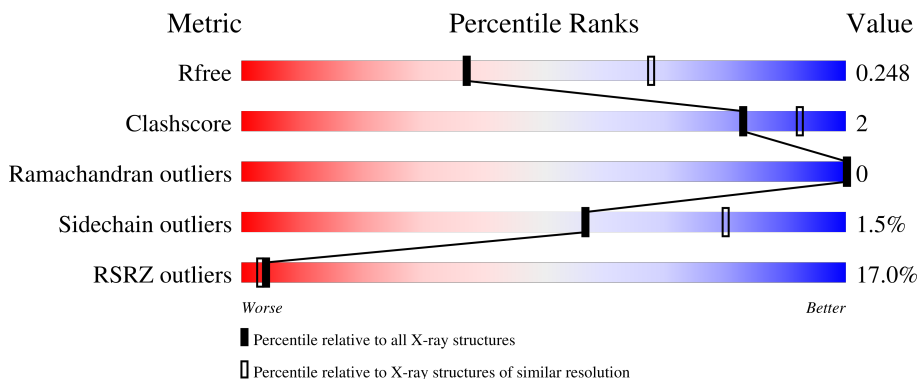
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.59 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	4008 (2.60-2.60)
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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	429	
1	C	429	
2	B	116	
2	D	116	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 7363 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 Protein E7 peptide, Beta-2-microglobulin, MHC class I antigen chimera.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	343	2657	1679	464	502	12	0	0	0
1	C	382	2934	1851	517	553	13	0	0	0

There are 86 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	14A	GLY	-	linker	UNP P03129
A	14B	CYS	-	linker	UNP P03129
A	14C	GLY	-	linker	UNP P03129
A	14D	GLY	-	linker	UNP P03129
A	14E	SER	-	linker	UNP P03129
A	14F	GLY	-	linker	UNP P03129
A	14G	GLY	-	linker	UNP P03129
A	14H	GLY	-	linker	UNP P03129
A	14I	GLY	-	linker	UNP P03129
A	14J	SER	-	linker	UNP P03129
A	14K	GLY	-	linker	UNP P03129
A	14L	GLY	-	linker	UNP P03129
A	14M	GLY	-	linker	UNP P03129
A	14N	GLY	-	linker	UNP P03129
A	14O	SER	-	linker	UNP P03129
A	124	GLY	-	linker	UNP P16213
A	125	GLY	-	linker	UNP P16213
A	126	GLY	-	linker	UNP P16213
A	127	GLY	-	linker	UNP P16213
A	128	SER	-	linker	UNP P16213
A	129	GLY	-	linker	UNP P16213
A	130	GLY	-	linker	UNP P16213
A	131	GLY	-	linker	UNP P16213
A	132	GLY	-	linker	UNP P16213

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Chain	Residue	Modelled	Actual	Comment	Reference
A	133	SER	-	linker	UNP P16213
A	134	GLY	-	linker	UNP P16213
A	135	GLY	-	linker	UNP P16213
A	136	GLY	-	linker	UNP P16213
A	137	GLY	-	linker	UNP P16213
A	138	SER	-	linker	UNP P16213
A	139	GLY	-	linker	UNP P16213
A	140	GLY	-	linker	UNP P16213
A	141	GLY	-	linker	UNP P16213
A	142	GLY	-	linker	UNP P16213
A	143	SER	-	linker	UNP P16213
A	217	LEU	HIS	engineered mutation	UNP A0A678ZGP6
A	227	CYS	TYR	engineered mutation	UNP A0A678ZGP6
A	419	HIS	-	expression tag	UNP A0A678ZGP6
A	420	HIS	-	expression tag	UNP A0A678ZGP6
A	421	HIS	-	expression tag	UNP A0A678ZGP6
A	422	HIS	-	expression tag	UNP A0A678ZGP6
A	423	HIS	-	expression tag	UNP A0A678ZGP6
A	424	HIS	-	expression tag	UNP A0A678ZGP6
C	14A	GLY	-	linker	UNP P03129
C	14B	CYS	-	linker	UNP P03129
C	14C	GLY	-	linker	UNP P03129
C	14D	GLY	-	linker	UNP P03129
C	14E	SER	-	linker	UNP P03129
C	14F	GLY	-	linker	UNP P03129
C	14G	GLY	-	linker	UNP P03129
C	14H	GLY	-	linker	UNP P03129
C	14I	GLY	-	linker	UNP P03129
C	14J	SER	-	linker	UNP P03129
C	14K	GLY	-	linker	UNP P03129
C	14L	GLY	-	linker	UNP P03129
C	14M	GLY	-	linker	UNP P03129
C	14N	GLY	-	linker	UNP P03129
C	14O	SER	-	linker	UNP P03129
C	124	GLY	-	linker	UNP P16213
C	125	GLY	-	linker	UNP P16213
C	126	GLY	-	linker	UNP P16213
C	127	GLY	-	linker	UNP P16213
C	128	SER	-	linker	UNP P16213
C	129	GLY	-	linker	UNP P16213
C	130	GLY	-	linker	UNP P16213
C	131	GLY	-	linker	UNP P16213

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Chain	Residue	Modelled	Actual	Comment	Reference
C	132	GLY	-	linker	UNP P16213
C	133	SER	-	linker	UNP P16213
C	134	GLY	-	linker	UNP P16213
C	135	GLY	-	linker	UNP P16213
C	136	GLY	-	linker	UNP P16213
C	137	GLY	-	linker	UNP P16213
C	138	SER	-	linker	UNP P16213
C	139	GLY	-	linker	UNP P16213
C	140	GLY	-	linker	UNP P16213
C	141	GLY	-	linker	UNP P16213
C	142	GLY	-	linker	UNP P16213
C	143	SER	-	linker	UNP P16213
C	217	LEU	HIS	engineered mutation	UNP A0A678ZGP6
C	227	CYS	TYR	engineered mutation	UNP A0A678ZGP6
C	419	HIS	-	expression tag	UNP A0A678ZGP6
C	420	HIS	-	expression tag	UNP A0A678ZGP6
C	421	HIS	-	expression tag	UNP A0A678ZGP6
C	422	HIS	-	expression tag	UNP A0A678ZGP6
C	423	HIS	-	expression tag	UNP A0A678ZGP6
C	424	HIS	-	expression tag	UNP A0A678ZGP6

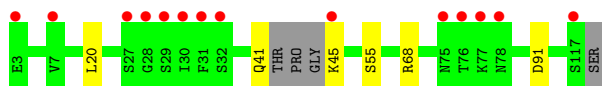
- Molecule 2 is a protein called VHH.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace	
2	B	112	Total	C	N	O	S	0	0	0
			818	506	140	168	4			
2	D	111	Total	C	N	O	S	0	0	0
			812	502	139	167	4			

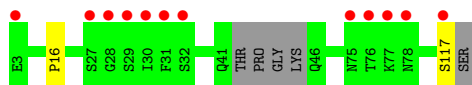
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	40	Total	O	0	0
			40	40		
3	B	22	Total	O	0	0
			22	22		
3	C	50	Total	O	0	0
			50	50		
3	D	30	Total	O	0	0
			30	30		





- Molecule 2: VHH



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	117.88Å 117.88Å 262.29Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.91 – 2.59 48.91 – 2.59	Depositor EDS
% Data completeness (in resolution range)	99.8 (48.91-2.59) 99.8 (48.91-2.59)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.74 (at 2.58Å)	Xtrriage
Refinement program	PHENIX 1.19.1_4122	Depositor
R, $R_{free}$	0.218 , 0.247 0.220 , 0.248	Depositor DCC
$R_{free}$ test set	2962 reflections (5.09%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	46.5	Xtrriage
Anisotropy	0.043	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 41.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	7363	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	55.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 23.23 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 4.8612e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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	0.11	0/2728	0.29	0/3714
1	C	0.13	0/3016	0.30	0/4116
2	B	0.11	0/831	0.32	0/1126
2	D	0.11	0/825	0.30	0/1119
All	All	0.12	0/7400	0.30	0/10075

There are no bond length outliers.

There are no bond angle outliers.

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	2657	0	2382	15	0
1	C	2934	0	2600	15	0
2	B	818	0	749	2	0
2	D	812	0	739	1	0
3	A	40	0	0	0	0
3	B	22	0	0	0	0
3	C	50	0	0	0	0
3	D	30	0	0	0	0
All	All	7363	0	6470	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 2.

The worst 5 of 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)
2:B:68:ARG:NH2	2:B:91:ASP:OD2	2.24	0.69
1:A:276:TRP:HB2	1:A:287:LYS:HG3	1.85	0.58
1:C:300:ARG:NH1	1:C:304:GLU:OE2	2.37	0.58
1:A:2:MET:HE1	1:A:210:VAL:HB	1.85	0.57
1:C:149:ARG:NH2	1:C:245:ASP:OD1	2.38	0.57

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	331/429 (77%)	323 (98%)	8 (2%)	0	100	100
1	C	374/429 (87%)	365 (98%)	9 (2%)	0	100	100
2	B	108/116 (93%)	106 (98%)	2 (2%)	0	100	100
2	D	107/116 (92%)	106 (99%)	1 (1%)	0	100	100
All	All	920/1090 (84%)	900 (98%)	20 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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	261/353 (74%)	253 (97%)	8 (3%)	35	63
1	C	282/353 (80%)	281 (100%)	1 (0%)	84	93
2	B	84/97 (87%)	82 (98%)	2 (2%)	43	70
2	D	83/97 (86%)	83 (100%)	0	100	100
All	All	710/900 (79%)	699 (98%)	11 (2%)	57	80

5 of 11 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	402	CYS
2	B	20	LEU
1	C	402	CYS
2	B	55	SER
1	A	308	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 7 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	175	GLN
1	C	197	GLN
1	C	331	HIS
1	C	230	GLN
1	C	37	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	343/429 (79%)	0.90	63 (18%) 3 3	34, 52, 101, 127	0
1	C	382/429 (89%)	1.09	72 (18%) 3 2	34, 54, 104, 134	0
2	B	112/116 (96%)	0.51	14 (12%) 8 6	32, 41, 86, 102	0
2	D	111/116 (95%)	0.50	12 (10%) 11 8	33, 41, 84, 100	0
All	All	948/1090 (86%)	0.88	161 (16%) 4 3	32, 49, 100, 134	0

The worst 5 of 161 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	340	HIS	9.6
2	B	75	ASN	9.1
2	D	75	ASN	7.4
1	C	14	CYS	7.1
1	C	417	TRP	7.1

### 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.