



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 19, 2026 – 05:53 AM UTC

PDB ID : 7F4W / pdb_00007f4w
Title : Complex structure of HLA2402 with recognizing SARS-CoV-2 epitope pep4
Authors : Deng, S.; Jin, T.
Deposited on : 2021-06-21
Resolution : 2.90 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

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

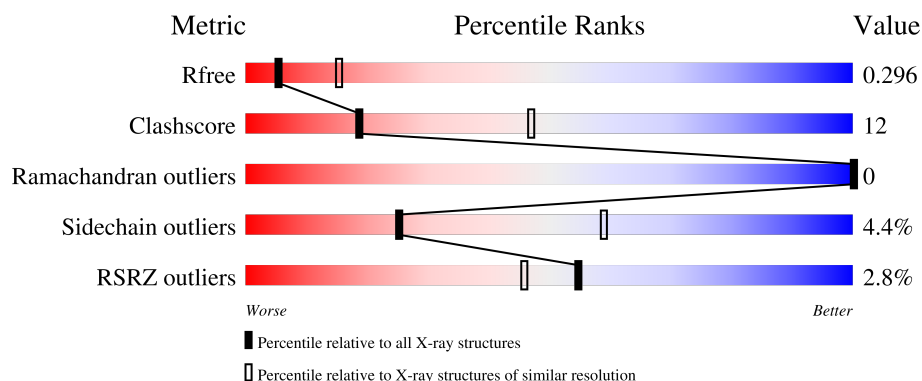
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.90 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	2481 (2.90-2.90)
Clashscore	190562	2690 (2.90-2.90)
Ramachandran outliers	187476	2623 (2.90-2.90)
Sidechain outliers	187428	2625 (2.90-2.90)
RSRZ outliers	180081	2481 (2.90-2.90)

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	308	5% 62% 28% 9%
1	C	308	5% 59% 30% 9%
2	B	102	79% 19% .
2	D	102	2% 72% 25% ..
3	E	9	11% 78% 22%

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Mol	Chain	Length	Quality of chain
3	F	9	 A horizontal bar chart showing the quality of chain F. The bar is divided into three segments: green (56%), yellow (33%), and orange (11%).

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 6388 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	280	Total	C	N	O	S	0	0	0
			2267	1408	410	438	11			
1	C	280	Total	C	N	O	S	0	0	0
			2267	1408	410	438	11			

There are 64 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-4	MET	-	initiating methionine	UNP D9UAY1
A	-3	ASN	-	expression tag	UNP D9UAY1
A	-2	SER	-	expression tag	UNP D9UAY1
A	-1	VAL	-	expression tag	UNP D9UAY1
A	0	ASP	-	expression tag	UNP D9UAY1
A	277	GLY	-	expression tag	UNP D9UAY1
A	278	SER	-	expression tag	UNP D9UAY1
A	279	GLY	-	expression tag	UNP D9UAY1
A	280	LEU	-	expression tag	UNP D9UAY1
A	281	ASN	-	expression tag	UNP D9UAY1
A	282	ASP	-	expression tag	UNP D9UAY1
A	283	ILE	-	expression tag	UNP D9UAY1
A	284	PHE	-	expression tag	UNP D9UAY1
A	285	GLU	-	expression tag	UNP D9UAY1
A	286	ALA	-	expression tag	UNP D9UAY1
A	287	GLN	-	expression tag	UNP D9UAY1
A	288	LYS	-	expression tag	UNP D9UAY1
A	289	ILE	-	expression tag	UNP D9UAY1
A	290	GLU	-	expression tag	UNP D9UAY1
A	291	TRP	-	expression tag	UNP D9UAY1
A	292	HIS	-	expression tag	UNP D9UAY1
A	293	ALA	-	expression tag	UNP D9UAY1
A	294	ALA	-	expression tag	UNP D9UAY1
A	295	ALA	-	expression tag	UNP D9UAY1
A	296	LEU	-	expression tag	UNP D9UAY1

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Chain	Residue	Modelled	Actual	Comment	Reference
A	297	GLU	-	expression tag	UNP D9UAY1
A	298	HIS	-	expression tag	UNP D9UAY1
A	299	HIS	-	expression tag	UNP D9UAY1
A	300	HIS	-	expression tag	UNP D9UAY1
A	301	HIS	-	expression tag	UNP D9UAY1
A	302	HIS	-	expression tag	UNP D9UAY1
A	303	HIS	-	expression tag	UNP D9UAY1
C	-4	MET	-	initiating methionine	UNP D9UAY1
C	-3	ASN	-	expression tag	UNP D9UAY1
C	-2	SER	-	expression tag	UNP D9UAY1
C	-1	VAL	-	expression tag	UNP D9UAY1
C	0	ASP	-	expression tag	UNP D9UAY1
C	277	GLY	-	expression tag	UNP D9UAY1
C	278	SER	-	expression tag	UNP D9UAY1
C	279	GLY	-	expression tag	UNP D9UAY1
C	280	LEU	-	expression tag	UNP D9UAY1
C	281	ASN	-	expression tag	UNP D9UAY1
C	282	ASP	-	expression tag	UNP D9UAY1
C	283	ILE	-	expression tag	UNP D9UAY1
C	284	PHE	-	expression tag	UNP D9UAY1
C	285	GLU	-	expression tag	UNP D9UAY1
C	286	ALA	-	expression tag	UNP D9UAY1
C	287	GLN	-	expression tag	UNP D9UAY1
C	288	LYS	-	expression tag	UNP D9UAY1
C	289	ILE	-	expression tag	UNP D9UAY1
C	290	GLU	-	expression tag	UNP D9UAY1
C	291	TRP	-	expression tag	UNP D9UAY1
C	292	HIS	-	expression tag	UNP D9UAY1
C	293	ALA	-	expression tag	UNP D9UAY1
C	294	ALA	-	expression tag	UNP D9UAY1
C	295	ALA	-	expression tag	UNP D9UAY1
C	296	LEU	-	expression tag	UNP D9UAY1
C	297	GLU	-	expression tag	UNP D9UAY1
C	298	HIS	-	expression tag	UNP D9UAY1
C	299	HIS	-	expression tag	UNP D9UAY1
C	300	HIS	-	expression tag	UNP D9UAY1
C	301	HIS	-	expression tag	UNP D9UAY1
C	302	HIS	-	expression tag	UNP D9UAY1
C	303	HIS	-	expression tag	UNP D9UAY1

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	100	Total	C	N	O	S	0	0	0
			837	533	141	159	4			
2	D	100	Total	C	N	O	S	0	0	0
			837	533	141	159	4			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-2	VAL	-	expression tag	UNP P61769
B	-1	ASP	-	expression tag	UNP P61769
B	0	MET	-	expression tag	UNP P61769
D	-2	VAL	-	expression tag	UNP P61769
D	-1	ASP	-	expression tag	UNP P61769
D	0	MET	-	expression tag	UNP P61769

- Molecule 3 is a protein called SARS-CoV-2 T-cell Epitope pep4.

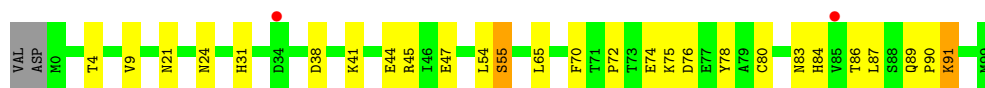
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	E	9	Total	C	N	O	0	0	0
			90	62	14	14			
3	F	9	Total	C	N	O	0	0	0
			90	62	14	14			

- Molecule 1: MHC class I antigen



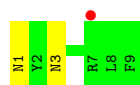
• Molecule 2: Beta-2-microglobulin

Chain D:  2% 72% 25% ..



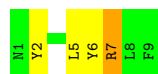
• Molecule 3: SARS-CoV-2 T-cell Epitope pep4

Chain E:  11% 78% 22%



• Molecule 3: SARS-CoV-2 T-cell Epitope pep4

Chain F:  56% 33% 11%



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	47.44Å 135.60Å 153.33Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.83 – 2.90 47.83 – 2.90	Depositor EDS
% Data completeness (in resolution range)	99.4 (47.83-2.90) 90.1 (47.83-2.90)	Depositor EDS
R_{merge}	0.34	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.20 (at 2.91Å)	Xtriage
Refinement program	PHENIX 1.19.2_4158	Depositor
R, R_{free}	0.244 , 0.298 0.243 , 0.296	Depositor DCC
R_{free} test set	1132 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å ²)	53.0	Xtriage
Anisotropy	0.414	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 22.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	6388	wwPDB-VP
Average B, all atoms (Å ²)	62.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.63% 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

5.1 Standard geometry

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	0.44	0/2327	0.62	0/3154
1	C	0.44	0/2327	0.64	1/3154 (0.0%)
2	B	0.44	0/860	0.60	0/1162
2	D	0.43	0/860	0.62	0/1162
3	E	0.37	0/93	0.73	0/125
3	F	0.38	0/93	0.59	0/125
All	All	0.44	0/6560	0.63	1/8882 (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	C	0	2

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	-4	MET	CG-SD-CE	-8.26	82.74	100.90

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	106	ASP	Peptide
1	C	195	SER	Peptide

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	2267	0	2121	61	0
1	C	2267	0	2121	63	1
2	B	837	0	803	10	0
2	D	837	0	803	17	0
3	E	90	0	85	4	0
3	F	90	0	85	5	0
All	All	6388	0	6018	148	1

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 12.

The worst 5 of 148 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:C:261:VAL:HG22	1:C:270:LEU:HB2	1.53	0.89
2:B:24:ASN:HB3	2:B:65:LEU:HD11	1.60	0.82
1:C:106:ASP:HB2	1:C:108:ARG:H	1.47	0.80
1:A:189:MET:HE1	1:A:217:TRP:HH2	1.48	0.77
1:C:102:ASP:HB2	1:C:111:ARG:HG3	1.67	0.76

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:17:ARG:NH2	1:C:174:ASN:OD1[1_455]	2.16	0.04

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	278/308 (90%)	266 (96%)	12 (4%)	0	100	100
1	C	278/308 (90%)	265 (95%)	13 (5%)	0	100	100
2	B	98/102 (96%)	96 (98%)	2 (2%)	0	100	100
2	D	98/102 (96%)	93 (95%)	5 (5%)	0	100	100
3	E	7/9 (78%)	7 (100%)	0	0	100	100
3	F	7/9 (78%)	6 (86%)	1 (14%)	0	100	100
All	All	766/838 (91%)	733 (96%)	33 (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	236/258 (92%)	225 (95%)	11 (5%)	23	56
1	C	236/258 (92%)	222 (94%)	14 (6%)	18	48
2	B	95/97 (98%)	94 (99%)	1 (1%)	65	88
2	D	95/97 (98%)	92 (97%)	3 (3%)	34	68
3	E	9/9 (100%)	9 (100%)	0	100	100
3	F	9/9 (100%)	8 (89%)	1 (11%)	6	20
All	All	680/728 (93%)	650 (96%)	30 (4%)	25	59

5 of 30 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	11	SER
2	D	55	SER
1	C	78	LEU
3	F	7	ARG
1	C	249	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
2	D	17	ASN
2	D	83	ASN
1	C	96	GLN
1	C	180	GLN
1	C	226	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](#)

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	280/308 (90%)	0.55	4 (1%) 73 65	45, 62, 96, 111	0
1	C	280/308 (90%)	0.58	14 (5%) 34 27	46, 59, 99, 143	0
2	B	100/102 (98%)	0.26	1 (1%) 79 73	48, 56, 79, 102	0
2	D	100/102 (98%)	0.45	2 (2%) 65 56	47, 60, 85, 96	0
3	E	9/9 (100%)	0.64	1 (11%) 10 9	53, 59, 64, 73	0
3	F	9/9 (100%)	0.51	0 100 100	52, 56, 60, 61	0
All	All	778/838 (92%)	0.51	22 (2%) 55 46	45, 60, 90, 143	0

The worst 5 of 22 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	199	ALA	4.6
1	A	200	THR	3.6
1	C	249	VAL	3.1
1	C	194	ILE	2.9
1	C	193	PRO	2.9

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.