Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2025 – 10:12 PM JST

PDB ID	:	9L4A
Title	:	Crystal structure of HLA-C*12:02-MY9
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Deposited on	:	2024-12-20
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:

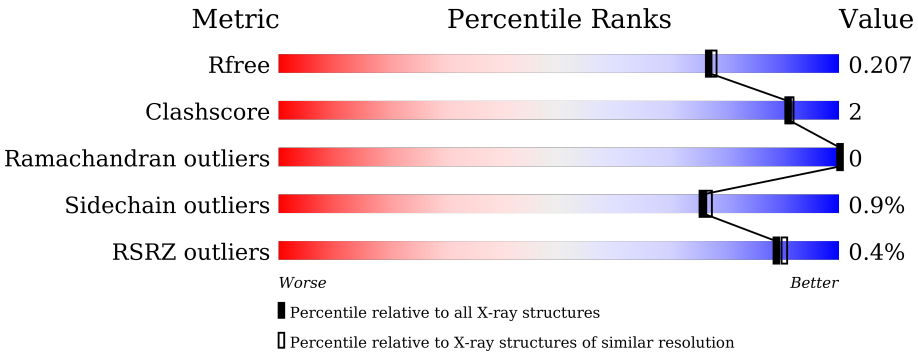
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.21
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.004 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.41.2

1 Overall quality at a glance (i)

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}	164625	7293 (1.90-1.90)
Clashscore	180529	8090 (1.90-1.90)
Ramachandran outliers	177936	8022 (1.90-1.90)
Sidechain outliers	177891	8022 (1.90-1.90)
RSRZ outliers	164620	7292 (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 <=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	273	92% 7%
1	D	273	95% 5%
2	B	99	% 93% 6%
2	E	99	% 95% 5%
3	C	9	89% 11%
3	F	9	89% 11%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 7290 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	273	Total	C	N	O	S	31	2	0
			2253	1400	416	431	6			
1	D	272	Total	C	N	O	S	8	0	0
			2230	1388	410	426	6			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	98	Total	C	N	O	S	4	0	0
			815	518	138	156	3			
2	E	99	Total	C	N	O	S	3	0	0
			823	524	139	157	3			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	58	GLY	LYS	conflict	UNP P61769
E	58	GLY	LYS	conflict	UNP P61769

- Molecule 3 is a protein called MY9.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	9	Total	C	N	O	S	0	0	0
			80	50	14	15	1			
3	F	9	Total	C	N	O	S	0	0	0
			80	50	14	15	1			

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	312	Total	O	0	0
			312	312		

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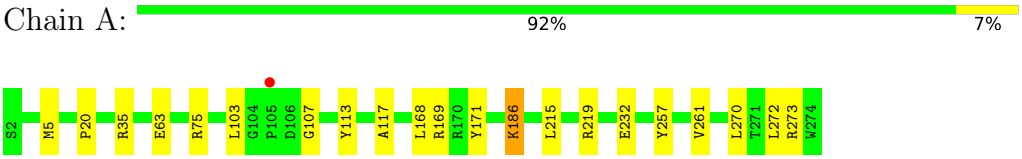
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	B	156	Total O 156 156	0	0
4	C	21	Total O 21 21	0	0
4	D	375	Total O 375 375	0	0
4	E	131	Total O 131 131	0	0
4	F	14	Total O 14 14	0	0

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.

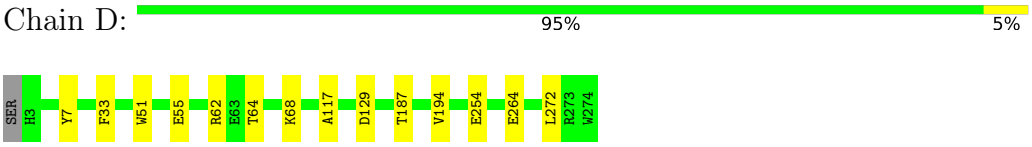
• Molecule 1: MHC class I antigen

Chain A:



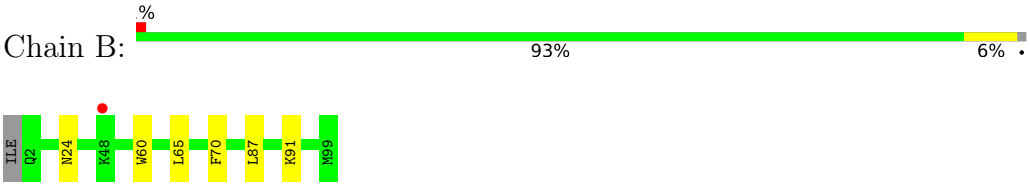
• Molecule 1: MHC class I antigen

Chain D:



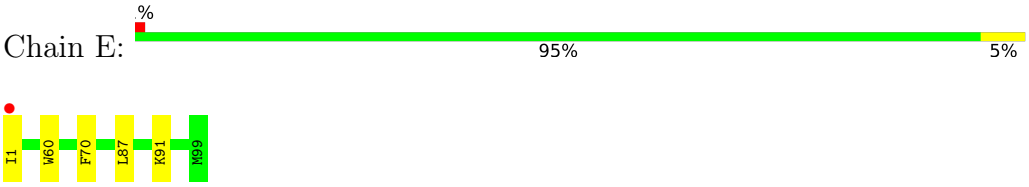
• Molecule 2: Beta-2-microglobulin

Chain B:



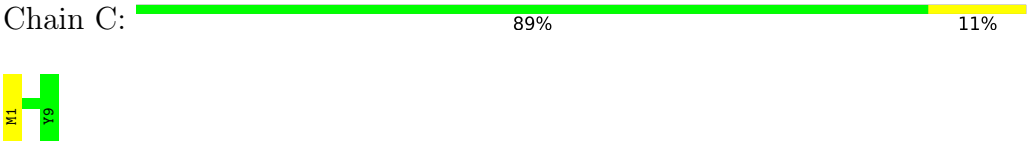
• Molecule 2: Beta-2-microglobulin

Chain E:



• Molecule 3: MY9

Chain C:



• Molecule 3: MY9

Chain F:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	79.52Å 96.40Å 121.10Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.22 – 1.90 41.22 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.5 (41.22-1.90) 99.5 (41.22-1.90)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.59 (at 1.89Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487, PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.164 , 0.207 0.165 , 0.207	Depositor DCC
R_{free} test set	71967 reflections (2.72%)	wwPDB-VP
Wilson B-factor (Å^2)	17.2	Xtriage
Anisotropy	0.361	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 37.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	7290	wwPDB-VP
Average B, all atoms (Å^2)	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.58% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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	0.93	4/2316 (0.2%)	0.93	5/3147 (0.2%)
1	D	1.02	5/2293 (0.2%)	0.91	1/3117 (0.0%)
2	B	0.95	0/838	0.87	0/1135
2	E	0.88	0/846	0.84	1/1146 (0.1%)
3	C	1.06	0/82	1.11	1/108 (0.9%)
3	F	1.26	0/82	1.23	1/108 (0.9%)
All	All	0.97	9/6457 (0.1%)	0.91	9/8761 (0.1%)

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	232	GLU	CB-CG	-11.17	1.30	1.52
1	D	55	GLU	CD-OE2	-8.40	1.16	1.25
1	D	264	GLU	CB-CG	-5.57	1.41	1.52
1	D	254	GLU	CG-CD	5.53	1.60	1.51
1	A	63	GLU	CD-OE2	-5.52	1.19	1.25
1	A	63	GLU	CD-OE1	-5.34	1.19	1.25
1	D	7	TYR	CD2-CE2	5.20	1.47	1.39
1	A	171	TYR	CD1-CE1	5.10	1.47	1.39
1	D	194	VAL	CB-CG2	-5.01	1.42	1.52

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	232	GLU	OE1-CD-OE2	-10.07	111.22	123.30
3	F	1	MET	CG-SD-CE	-7.64	87.98	100.20
1	A	5	MET	CG-SD-CE	-5.96	90.66	100.20
1	A	270	LEU	CA-CB-CG	5.96	129.02	115.30
1	A	272	LEU	CA-CB-CG	5.78	128.59	115.30
1	A	272	LEU	CB-CG-CD2	-5.52	101.62	111.00
2	E	1	ILE	CG1-CB-CG2	5.17	122.77	111.40
3	C	1	MET	CG-SD-CE	5.11	108.37	100.20
1	D	129	ASP	CB-CG-OD1	5.06	122.85	118.30

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	2253	0	2095	11	0
1	D	2230	0	2074	5	0
2	B	815	0	770	3	0
2	E	823	0	784	2	0
3	C	80	0	75	0	0
3	F	80	0	75	0	0
4	A	312	0	0	0	0
4	B	156	0	0	0	0
4	C	21	0	0	0	0
4	D	375	0	0	0	0
4	E	131	0	0	0	0
4	F	14	0	0	0	0
All	All	7290	0	5873	19	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 (19) 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:219:ARG:HD3	1:A:257:TYR:CZ	2.28	0.69
1:A:273:ARG:HH11	1:A:273:ARG:HG3	1.63	0.63
1:A:219:ARG:HG2	1:A:219:ARG:HH11	1.69	0.56
1:A:273:ARG:HG3	1:A:273:ARG:NH1	2.22	0.55
1:D:187:THR:HB	1:D:272:LEU:HD21	1.89	0.54
1:A:107:GLY:O	1:A:169:ARG:NH1	2.37	0.52
1:A:117:ALA:HB2	2:B:60:TRP:CE2	2.48	0.48
2:B:87:LEU:HD22	2:B:91:LYS:HE3	1.96	0.47
2:B:24:ASN:HB3	2:B:65:LEU:HD11	1.96	0.47
1:D:272:LEU:HD12	1:D:272:LEU:N	2.29	0.47
1:A:219:ARG:HG2	1:A:219:ARG:NH1	2.31	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:186:LYS:HD3	1:A:186:LYS:N	2.30	0.45
1:A:103:LEU:HG	1:A:168:LEU:HD23	2.00	0.44
1:A:215:LEU:HD23	1:A:261:VAL:HG22	2.00	0.44
1:D:33:PHE:HB3	1:D:51:TRP:CH2	2.53	0.44
1:D:117:ALA:HB2	2:E:60:TRP:CE2	2.53	0.44
2:E:87:LEU:CD2	2:E:91:LYS:HE3	2.48	0.43
1:A:20:PRO:HD2	1:A:75:ARG:HG2	2.03	0.41
1:D:64:THR:O	1:D:68:LYS:HG3	2.20	0.41

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	273/273 (100%)	272 (100%)	1 (0%)	0	100	100
1	D	270/273 (99%)	269 (100%)	1 (0%)	0	100	100
2	B	96/99 (97%)	94 (98%)	2 (2%)	0	100	100
2	E	97/99 (98%)	97 (100%)	0	0	100	100
3	C	7/9 (78%)	7 (100%)	0	0	100	100
3	F	7/9 (78%)	5 (71%)	2 (29%)	0	100	100
All	All	750/762 (98%)	744 (99%)	6 (1%)	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	230/228 (101%)	227 (99%)	3 (1%)	65	65
1	D	227/228 (100%)	226 (100%)	1 (0%)	89	90
2	B	92/93 (99%)	91 (99%)	1 (1%)	70	71
2	E	93/93 (100%)	92 (99%)	1 (1%)	70	71
3	C	8/8 (100%)	8 (100%)	0	100	100
3	F	8/8 (100%)	8 (100%)	0	100	100
All	All	658/658 (100%)	652 (99%)	6 (1%)	75	77

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	35	ARG
1	A	113	TYR
1	A	186	LYS
2	B	70	PHE
1	D	62	ARG
2	E	70	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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

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^{th} 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	273/273 (100%)	-0.36	1 (0%) 89 90	8, 19, 38, 48	9 (3%)
1	D	272/273 (99%)	-0.66	0 100 100	9, 16, 30, 46	3 (1%)
2	B	98/99 (98%)	-0.69	1 (1%) 79 81	11, 17, 31, 39	1 (1%)
2	E	99/99 (100%)	-0.43	1 (1%) 79 81	10, 19, 34, 41	1 (1%)
3	C	9/9 (100%)	-0.79	0 100 100	13, 17, 19, 21	0
3	F	9/9 (100%)	-0.81	0 100 100	12, 16, 17, 28	0
All	All	760/762 (99%)	-0.53	3 (0%) 89 90	8, 17, 34, 48	14 (1%)

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	E	1	ILE	3.4
2	B	48	LYS	2.9
1	A	105	PRO	2.9

6.2 Non-standard residues in protein, DNA, RNA chains

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no monosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.