Full wwPDB X-ray Structure Validation Report ⓘ

Dec 8, 2025 – 08:28 PM JST

PDB ID	:	9KZF / pdb_00009kzf
Title	:	PEDV 3CLpro mutant (C144A) in complex with nsp7/8 peptite substrate
Authors	:	Zhang, Y.; Zhang, D.; Shi, Y.J.; Peng, G.Q.
Deposited on	:	2024-12-10
Resolution	:	1.78 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:

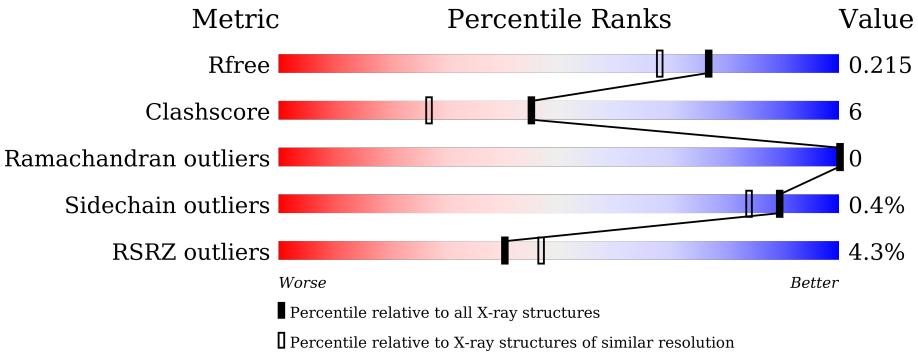
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.47

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.78 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	1191 (1.78-1.78)
Clashscore	180529	1282 (1.78-1.78)
Ramachandran outliers	177936	1270 (1.78-1.78)
Sidechain outliers	177891	1270 (1.78-1.78)
RSRZ outliers	164620	1191 (1.78-1.78)

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	310	5% 81% 15% .
1	B	310	3% 86% 10% .
2	C	6	67% 17% 17%
2	D	6	17% 50% 17% 33%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 4852 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 ORF1ab polyprotein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	298	Total	C	N	O	S	0	0	0
			2267	1433	390	429	15			
1	B	297	Total	C	N	O	S	0	0	0
			2268	1434	391	428	15			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	MET	-	initiating methionine	UNP A0A023J7B5
A	144	ALA	CYS	engineered mutation	UNP A0A023J7B5
A	300	LEU	-	expression tag	UNP A0A023J7B5
A	301	GLU	-	expression tag	UNP A0A023J7B5
A	302	HIS	-	expression tag	UNP A0A023J7B5
A	303	HIS	-	expression tag	UNP A0A023J7B5
A	304	HIS	-	expression tag	UNP A0A023J7B5
A	305	HIS	-	expression tag	UNP A0A023J7B5
A	306	HIS	-	expression tag	UNP A0A023J7B5
A	307	HIS	-	expression tag	UNP A0A023J7B5
A	308	HIS	-	expression tag	UNP A0A023J7B5
A	309	HIS	-	expression tag	UNP A0A023J7B5
B	0	MET	-	initiating methionine	UNP A0A023J7B5
B	144	ALA	CYS	engineered mutation	UNP A0A023J7B5
B	300	LEU	-	expression tag	UNP A0A023J7B5
B	301	GLU	-	expression tag	UNP A0A023J7B5
B	302	HIS	-	expression tag	UNP A0A023J7B5
B	303	HIS	-	expression tag	UNP A0A023J7B5
B	304	HIS	-	expression tag	UNP A0A023J7B5
B	305	HIS	-	expression tag	UNP A0A023J7B5
B	306	HIS	-	expression tag	UNP A0A023J7B5
B	307	HIS	-	expression tag	UNP A0A023J7B5
B	308	HIS	-	expression tag	UNP A0A023J7B5
B	309	HIS	-	expression tag	UNP A0A023J7B5

- Molecule 2 is a protein called Replicase polyprotein 1a.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	5	Total	C	N	O	S	0	0	0
			39	23	7	8	1			
2	D	4	Total	C	N	O	S	0	0	0
			30	18	5	6	1			

- Molecule 3 is water.

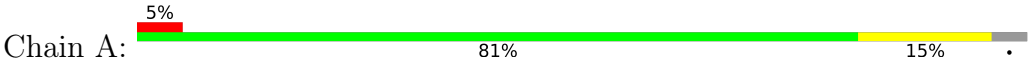
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	117	Total	O	0	0
			117	117		
3	B	128	Total	O	0	0
			128	128		
3	C	3	Total	O	0	0
			3	3		

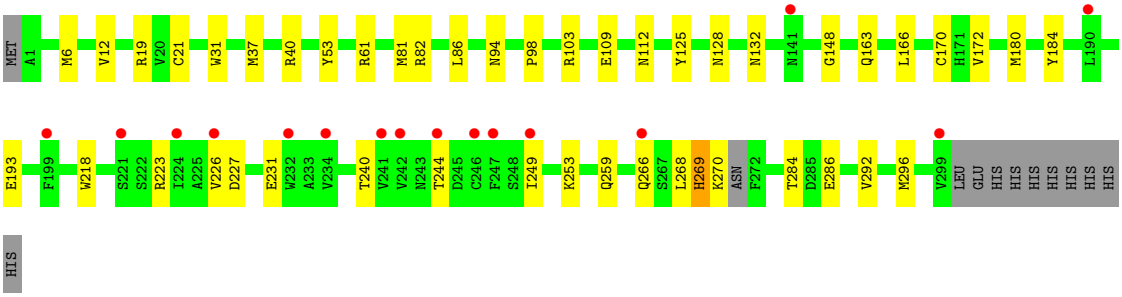
3 Residue-property plots

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: ORF1ab polyprotein

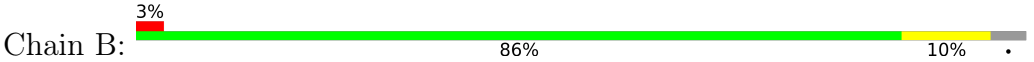
Chain A:

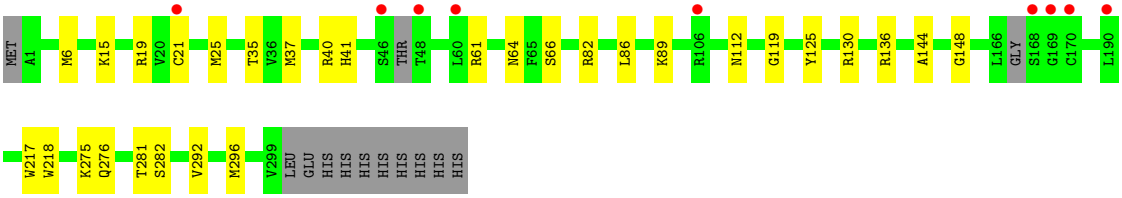




• Molecule 1: ORF1ab polyprotein

Chain B:





• Molecule 2: Replicase polyprotein 1a

Chain C:

• Molecule 2: Replicase polyprotein 1a

Chain D:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	57.01Å 91.41Å 58.10Å 90.00° 100.33° 90.00°	Depositor
Resolution (Å)	28.69 – 1.78 28.69 – 1.78	Depositor EDS
% Data completeness (in resolution range)	97.6 (28.69-1.78) 97.7 (28.69-1.78)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.80 (at 1.77Å)	Xtriage
Refinement program	PHENIX (1.20.1_4487: ???)	Depositor
R, R_{free}	0.203 , 0.216 0.203 , 0.215	Depositor DCC
R_{free} test set	2796 reflections (4.94%)	wwPDB-VP
Wilson B-factor (Å^2)	25.4	Xtriage
Anisotropy	0.422	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 28.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.022 for l,-k,h	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	4852	wwPDB-VP
Average B, all atoms (Å^2)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.94% 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	0.38	0/2313	0.65	2/3141 (0.1%)
1	B	0.39	0/2313	0.63	0/3138
2	C	0.40	0/38	0.70	0/49
2	D	0.64	0/29	1.18	0/37
All	All	0.39	0/4693	0.64	2/6365 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	269	HIS	N-CA-C	-7.93	98.58	110.24
1	A	269	HIS	CB-CA-C	6.73	119.93	109.84

There are no chirality outliers.

There are no planarity outliers.

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	2212	30	0
1	B	2268	0	2218	24	0
2	C	39	0	38	1	0
2	D	30	0	30	3	0
3	A	117	0	0	1	0
3	B	128	0	0	1	0
3	C	3	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	4852	0	4498	53	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 6.

All (53) 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:19:ARG:NH1	1:A:21:CYS:SG	2.56	0.79
1:B:25:MET:HE1	2:D:142:LEU:HD11	1.66	0.78
1:B:19:ARG:NH1	1:B:21:CYS:SG	2.59	0.75
1:B:37:MET:HE1	1:B:82:ARG:NE	2.09	0.68
1:B:217:TRP:CE2	1:B:275:LYS:HD3	2.29	0.67
1:B:35:THR:HG22	1:B:89:LYS:HE2	1.79	0.65
1:B:61:ARG:HB2	1:B:64:ASN:ND2	2.12	0.64
1:A:269:HIS:O	1:A:270:LYS:C	2.41	0.63
2:C:141:ASN:N	3:C:201:HOH:O	2.31	0.63
1:A:284:THR:OG1	1:A:286:GLU:HG2	1.98	0.63
1:A:40:ARG:HA	1:A:86:LEU:HG	1.85	0.58
1:B:281:THR:HG22	1:B:282:SER:O	2.03	0.58
1:B:276:GLN:NE2	3:B:404:HOH:O	2.38	0.55
1:A:180:MET:HG2	1:A:184:TYR:O	2.07	0.55
1:B:112:ASN:O	1:B:148:GLY:HA2	2.09	0.53
1:B:41:HIS:NE2	2:D:142:LEU:HG	2.25	0.52
1:A:132:ASN:ND2	1:A:193:GLU:HG3	2.25	0.51
1:B:292:VAL:O	1:B:296:MET:HG2	2.09	0.51
1:A:112:ASN:O	1:A:148:GLY:HA2	2.11	0.51
1:A:172:VAL:HG12	1:A:180:MET:HE3	1.92	0.51
1:A:53:TYR:HB3	1:A:81:MET:HE1	1.93	0.50
1:A:226:VAL:HG21	1:A:244:THR:HG21	1.93	0.49
1:A:61:ARG:NE	1:A:61:ARG:HA	2.27	0.49
1:A:249:ILE:CD1	1:A:253:LYS:HE2	2.43	0.48
1:A:268:LEU:O	1:A:269:HIS:C	2.55	0.47
1:A:37:MET:HE1	1:A:82:ARG:CD	2.44	0.47
1:A:6:MET:HG2	1:B:125:TYR:CD1	2.49	0.46
1:A:125:TYR:CD1	1:B:6:MET:HG2	2.50	0.46
1:B:19:ARG:HH12	1:B:21:CYS:HG	1.63	0.46
1:B:218:TRP:CD1	1:B:218:TRP:H	2.33	0.46
1:A:12:VAL:CG2	1:A:98:PRO:HB3	2.46	0.45
1:A:218:TRP:CD1	1:A:218:TRP:H	2.35	0.45
1:A:31:TRP:CE2	1:A:94:ASN:HB2	2.52	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:37:MET:HE1	1:A:82:ARG:NE	2.32	0.44
1:B:217:TRP:CD2	1:B:275:LYS:HD3	2.51	0.44
1:B:130:ARG:HD3	1:B:136:ARG:HE	1.83	0.44
1:B:35:THR:CG2	1:B:89:LYS:HE2	2.47	0.43
1:B:19:ARG:HB2	1:B:119:GLY:HA3	2.01	0.43
1:A:128:ASN:ND2	3:A:401:HOH:O	2.32	0.43
1:A:223:ARG:HG3	1:A:259:GLN:CB	2.49	0.43
1:A:166:LEU:HD12	1:A:170:CYS:HB2	2.01	0.42
1:A:249:ILE:O	1:A:253:LYS:HG2	2.19	0.42
1:B:40:ARG:HA	1:B:86:LEU:HG	2.01	0.42
1:B:15:LYS:HD2	1:B:15:LYS:HA	1.55	0.42
1:B:37:MET:HE1	1:B:82:ARG:CZ	2.49	0.41
1:A:227:ASP:O	1:A:231:GLU:HG3	2.20	0.41
1:B:19:ARG:NH1	1:B:21:CYS:CB	2.82	0.41
1:A:163:GLN:CB	1:A:180:MET:HE1	2.50	0.41
1:A:223:ARG:HG3	1:A:259:GLN:HB3	2.02	0.40
1:A:103:ARG:NH2	1:A:109:GLU:OE1	2.54	0.40
1:A:266:GLN:HE21	1:A:266:GLN:HB3	1.68	0.40
1:A:292:VAL:O	1:A:296:MET:HG2	2.21	0.40
1:B:144:ALA:HB2	2:D:142:LEU:HA	2.02	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	294/310 (95%)	289 (98%)	5 (2%)	0	100	100
1	B	291/310 (94%)	284 (98%)	7 (2%)	0	100	100
2	C	3/6 (50%)	3 (100%)	0	0	100	100
2	D	2/6 (33%)	2 (100%)	0	0	100	100
All	All	590/632 (93%)	578 (98%)	12 (2%)	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	243/256 (95%)	242 (100%)	1 (0%)	89 84
1	B	244/256 (95%)	243 (100%)	1 (0%)	89 84
2	C	5/6 (83%)	5 (100%)	0	100 100
2	D	4/6 (67%)	4 (100%)	0	100 100
All	All	496/524 (95%)	494 (100%)	2 (0%)	89 84

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	240	THR
1	B	66	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	87	GLN
1	A	93	ASN
1	B	92	GLN
1	B	128	ASN
1	B	235	HIS
1	B	266	GLN
2	C	141	ASN

5.3.3 RNA

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates

There are no oligosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

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	298/310 (96%)	0.40	16 (5%) 32 38	18, 31, 53, 65	0
1	B	297/310 (95%)	0.18	9 (3%) 52 59	18, 28, 44, 63	0
2	C	5/6 (83%)	0.43	0 100 100	26, 28, 39, 47	0
2	D	4/6 (66%)	1.97	1 (25%) 2 2	40, 42, 43, 54	0
All	All	604/632 (95%)	0.30	26 (4%) 40 47	18, 30, 52, 65	0

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	299	VAL	4.9
2	D	142	LEU	3.9
1	A	226	VAL	3.7
1	A	234	VAL	3.4
1	A	141	ASN	3.1
1	A	199	PHE	3.1
1	B	21	CYS	3.1
1	A	242	VAL	3.0
1	A	244	THR	2.9
1	B	169	GLY	2.6
1	B	190	LEU	2.5
1	A	224	ILE	2.4
1	B	106	ARG	2.4
1	A	190	LEU	2.3
1	A	249	ILE	2.3
1	B	48	THR	2.3
1	A	246	CYS	2.2
1	A	232	TRP	2.2
1	B	168	SER	2.2
1	B	46	SER	2.1
1	A	247	PHE	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	241	VAL	2.1
1	A	266	GLN	2.1
1	B	60	LEU	2.1
1	A	221	SER	2.1
1	B	170	CYS	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)

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.