



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 11, 2023 – 05:51 PM EDT

PDB ID : 4M9F  
Title : Dengue virus NS2B-NS3 protease A125C variant at pH 8.5  
Authors : Yildiz, M.; Ghosh, S.; Bell, J.A.; Sherman, W.; Hardy, J.A.  
Deposited on : 2013-08-14  
Resolution : 2.70 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 : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.35.1  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.35.1

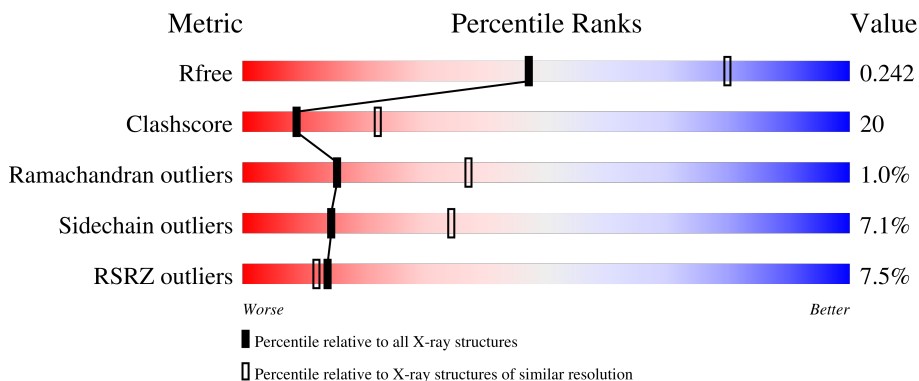
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.70 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))
$R_{free}$	130704	2808 (2.70-2.70)
Clashscore	141614	3122 (2.70-2.70)
Ramachandran outliers	138981	3069 (2.70-2.70)
Sidechain outliers	138945	3069 (2.70-2.70)
RSRZ outliers	127900	2737 (2.70-2.70)

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	247	 6% 65% 12% • 19%

## 2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 1626 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 NS2B-NS3 protease.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	200	1590	1011	274	300	5	0	14	0

There are 17 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	43	GLY	-	expression tag	UNP Q91H74
A	44	SER	-	expression tag	UNP Q91H74
A	45	HIS	-	expression tag	UNP Q91H74
A	46	MET	-	expression tag	UNP Q91H74
A	47	LEU	-	expression tag	UNP Q91H74
A	48	GLU	-	expression tag	UNP Q91H74
A	96	GLY	-	linker	UNP Q91H74
A	993	GLY	-	linker	UNP Q91H74
A	994	GLY	-	linker	UNP Q91H74
A	995	GLY	-	linker	UNP Q91H74
A	996	SER	-	linker	UNP Q91H74
A	997	GLY	-	linker	UNP Q91H74
A	998	GLY	-	linker	UNP Q91H74
A	999	GLY	-	linker	UNP Q91H74
A	1000	GLY	-	linker	UNP Q91H74
A	1125	CYS	ALA	engineered mutation	UNP Q91H74
A	1167	ASN	GLN	conflict	UNP Q91H74

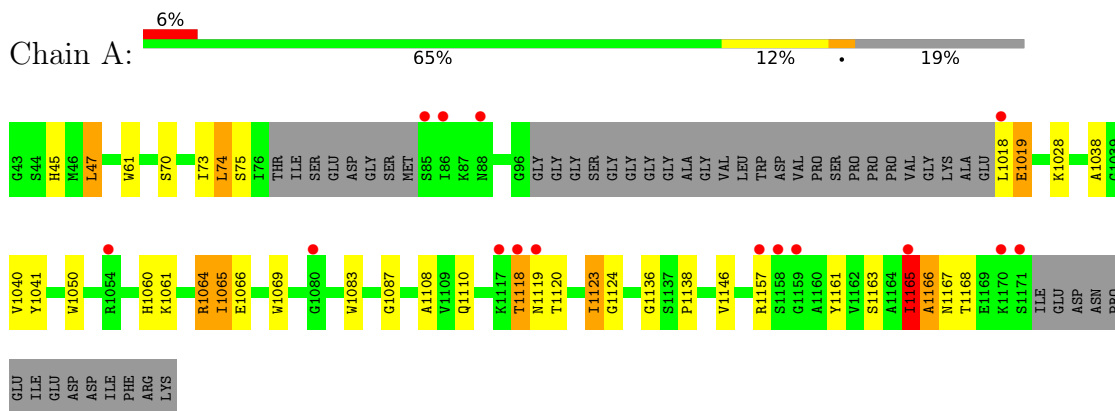
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	36	Total	O	0	0
			36	36		

### 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: NS2B-NS3 protease



## 4 Data and refinement statistics i

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	59.63Å 62.16Å 115.43Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 2.70 21.52 – 2.70	Depositor EDS
% Data completeness (in resolution range)	98.2 (30.00-2.70) 98.6 (21.52-2.70)	Depositor EDS
$R_{merge}$	0.17	Depositor
$R_{sym}$	0.17	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	7.38 (at 2.71Å)	Xtrriage
Refinement program	REFMAC 5.6.0117	Depositor
R, $R_{free}$	0.227 , 0.244 0.224 , 0.242	Depositor DCC
$R_{free}$ test set	301 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	35.4	Xtrriage
Anisotropy	0.156	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 32.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	0.059 for -k,-h,-l	Xtrriage
$F_o, F_c$ correlation	0.91	EDS
Total number of atoms	1626	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	30.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.89% 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	0.75	4/1658 (0.2%)	0.81	1/2234 (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	2

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1083	TRP	CD2-CE2	5.50	1.48	1.41
1	A	1069	TRP	CD2-CE2	5.40	1.47	1.41
1	A	61	TRP	CD2-CE2	5.26	1.47	1.41
1	A	1050	TRP	CD2-CE2	5.11	1.47	1.41

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1165	ILE	CG1-CB-CG2	-5.48	99.34	111.40

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	1118	THR	Peptide
1	A	1166	ALA	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	1590	0	1614	65	0
2	A	36	0	0	19	0
All	All	1626	0	1614	65	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 20.

All (65) 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:1018[A]:LEU:HB2	1:A:1041[A]:TYR:CE2	1.81	1.15
1:A:1118:THR:HB	1:A:1119:ASN:HB3	1.19	1.15
1:A:1018[B]:LEU:HD22	2:A:1233:HOH:O	1.54	1.04
1:A:1018[B]:LEU:CD2	2:A:1233:HOH:O	2.04	1.02
1:A:1018[A]:LEU:O	1:A:1041[A]:TYR:CZ	2.16	0.99
1:A:1166:ALA:CB	2:A:1228:HOH:O	2.11	0.98
1:A:1166:ALA:C	1:A:1168:THR:H	1.66	0.97
1:A:1018[A]:LEU:CB	1:A:1041[A]:TYR:CE2	2.46	0.97
1:A:74:LEU:HB2	2:A:1231:HOH:O	1.63	0.96
1:A:1118:THR:CB	1:A:1119:ASN:HB3	1.97	0.93
1:A:1166:ALA:HB1	2:A:1228:HOH:O	1.67	0.92
1:A:1166:ALA:H	1:A:1168:THR:HG22	1.35	0.89
1:A:47:LEU:CD1	2:A:1229:HOH:O	2.21	0.89
1:A:1157[B]:ARG:HG2	2:A:1230:HOH:O	1.71	0.89
1:A:1166:ALA:N	1:A:1168:THR:HG22	1.93	0.82
1:A:1028:LYS:HD3	2:A:1225:HOH:O	1.81	0.79
1:A:1157[B]:ARG:H	1:A:1157[B]:ARG:HD2	1.47	0.78
1:A:1018[A]:LEU:HB2	1:A:1041[A]:TYR:HE2	1.49	0.76
1:A:1018[A]:LEU:HG	1:A:1060:HIS:ND1	1.99	0.76
1:A:1018[A]:LEU:O	1:A:1041[A]:TYR:OH	2.08	0.72
1:A:1040:VAL:HG21	1:A:1138:PRO:HB3	1.70	0.72
1:A:1166:ALA:HB2	2:A:1218:HOH:O	1.88	0.72
1:A:1166:ALA:CB	2:A:1218:HOH:O	2.40	0.70
1:A:1166:ALA:C	1:A:1168:THR:N	2.38	0.69
1:A:47:LEU:HD11	2:A:1229:HOH:O	1.90	0.66

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:1018[A]:LEU:HB3	1:A:1041[A]:TYR:CE2	2.30	0.65
1:A:74:LEU:CB	2:A:1231:HOH:O	2.32	0.65
1:A:1018[A]:LEU:HB3	1:A:1041[A]:TYR:CD2	2.34	0.63
1:A:1124:GLY:H	1:A:1168:THR:CG2	2.12	0.62
1:A:1018[A]:LEU:O	1:A:1041[A]:TYR:CE1	2.53	0.61
1:A:1064:ARG:HH11	1:A:1064:ARG:HG2	1.65	0.61
1:A:1064:ARG:HG2	1:A:1064:ARG:NH1	2.15	0.61
1:A:1118:THR:HB	1:A:1119:ASN:CB	2.13	0.61
1:A:1118:THR:CA	1:A:1119:ASN:HB3	2.30	0.60
1:A:1118:THR:HG23	1:A:1123:ILE:HD12	1.83	0.60
1:A:1064:ARG:HD2	2:A:1213:HOH:O	2.02	0.58
1:A:1165:ILE:O	1:A:1166:ALA:HB3	2.05	0.56
1:A:1124:GLY:H	1:A:1168:THR:HG23	1.70	0.55
1:A:45:HIS:HD2	2:A:1219:HOH:O	1.89	0.54
1:A:1018[B]:LEU:O	1:A:1019:GLU:HB3	2.07	0.54
1:A:1064:ARG:CD	2:A:1213:HOH:O	2.55	0.54
1:A:1038:ALA:O	1:A:1136:GLY:HA3	2.07	0.54
1:A:47:LEU:HD13	2:A:1229:HOH:O	1.98	0.54
1:A:1166:ALA:HA	2:A:1228:HOH:O	2.08	0.53
1:A:1040:VAL:CG2	1:A:1138:PRO:HB3	2.40	0.52
1:A:1166:ALA:H	1:A:1168:THR:CG2	2.17	0.49
1:A:1064:ARG:HH11	1:A:1064:ARG:CG	2.26	0.49
1:A:45:HIS:CD2	2:A:1219:HOH:O	2.64	0.48
1:A:1166:ALA:CA	2:A:1228:HOH:O	2.54	0.48
1:A:1087:GLY:HA3	1:A:1146:VAL:C	2.34	0.47
1:A:1018[A]:LEU:HD12	1:A:1018[A]:LEU:N	2.30	0.47
1:A:1166:ALA:O	1:A:1168:THR:N	2.40	0.46
1:A:1018[A]:LEU:HD21	1:A:1065:ILE:HD11	1.98	0.45
1:A:1124:GLY:O	1:A:1165:ILE:HG12	2.17	0.45
1:A:1019:GLU:HA	1:A:1041[A]:TYR:CE1	2.52	0.45
1:A:73:ILE:HD11	1:A:1108:ALA:HB2	1.99	0.45
1:A:1157[B]:ARG:H	1:A:1157[B]:ARG:CD	2.25	0.44
1:A:1018[B]:LEU:HD23	1:A:1018[B]:LEU:N	2.33	0.43
1:A:1018[A]:LEU:HB2	1:A:1041[A]:TYR:CZ	2.43	0.43
1:A:70:SER:HA	1:A:1108:ALA:O	2.19	0.43
1:A:1060:HIS:NE2	1:A:1061:LYS:HE2	2.33	0.43
1:A:1118:THR:CG2	1:A:1123:ILE:HD12	2.47	0.43
1:A:1165:ILE:O	1:A:1166:ALA:CB	2.68	0.42
1:A:1123:ILE:H	1:A:1123:ILE:HD13	1.86	0.41
1:A:1064:ARG:NH2	1:A:1066:GLU:OE2	2.54	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	208/247 (84%)	200 (96%)	6 (3%)	2 (1%)	15 37

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	1167	ASN
1	A	1019	GLU

### 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	170/195 (87%)	158 (93%)	12 (7%)	14 34

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	47	LEU
1	A	74	LEU
1	A	75[A]	SER
1	A	75[B]	SER
1	A	1064	ARG
1	A	1065	ILE
1	A	1110	GLN
1	A	1120	THR
1	A	1123	ILE

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Mol	Chain	Res	Type
1	A	1161	TYR
1	A	1163	SER
1	A	1165	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	45	HIS
1	A	64	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 monosaccharides 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	200/247 (80%)	0.24	15 (7%) <b>14</b> <b>12</b>	14, 27, 53, 72	0

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1157[A]	ARG	4.0
1	A	1018[A]	LEU	3.8
1	A	1171	SER	3.7
1	A	86	ILE	3.4
1	A	1119	ASN	3.3
1	A	1080[A]	GLY	2.9
1	A	1117	LYS	2.6
1	A	85	SER	2.6
1	A	1054[A]	ARG	2.6
1	A	1170	LYS	2.3
1	A	1159	GLY	2.3
1	A	1165	ILE	2.3
1	A	1118	THR	2.2
1	A	88	ASN	2.1
1	A	1158	SER	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 monosaccharides in this entry.

## 6.4 Ligands

There are no ligands in this entry.

## 6.5 Other polymers

There are no such residues in this entry.