



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 1, 2026 – 10:30 AM UTC

PDB ID : 6M40 / pdb_00006m40
Title : Crystal structure of the NS3-like helicase from Alongshan virus
Authors : Gao, X.P.; Zhu, K.X.; Chen, P.; Wojdyla, J.A.; Wang, M.; Cui, S.
Deposited on : 2020-03-05
Resolution : 2.89 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
Mogul : 2022.3.0, CSD as543be (2022)
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

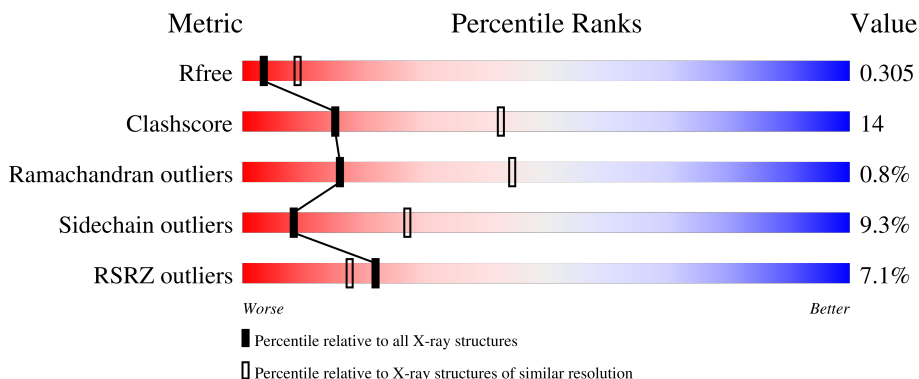
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.89 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	489	5% 51% 24% • 22%

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 5865 atoms, of which 2870 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 NS3-like protein.

Mol	Chain	Residues	Atoms							ZeroOcc	AltConf	Trace
1	A	379	Total	C	H	N	O	S	Se	0	0	0
			5865	1875	2870	549	552	8	11			

- Molecule 1: NS3-like protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	42.88Å 58.67Å 191.47Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.87 – 2.89 47.87 – 2.89	Depositor EDS
% Data completeness (in resolution range)	99.0 (47.87-2.89) 98.9 (47.87-2.89)	Depositor EDS
R_{merge}	0.18	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.10 (at 2.91Å)	Xtriage
Refinement program	PHENIX 1.17.1 _3660	Depositor
R, R_{free}	0.246 , 0.294 0.265 , 0.305	Depositor DCC
R_{free} test set	515 reflections (4.52%)	wwPDB-VP
Wilson B-factor (Å ²)	74.1	Xtriage
Anisotropy	0.683	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 48.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	5865	wwPDB-VP
Average B, all atoms (Å ²)	86.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.92% 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 [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	0.27	0/3036	0.50	0/4094

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	2995	2870	3027	82	0
All	All	2995	2870	3027	82	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 14.

All (82) 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:549:ARG:HH11	1:A:549:ARG:HB2	1.39	0.87
1:A:372:VAL:HB	1:A:411:VAL:HG12	1.64	0.78
1:A:505:ARG:HD3	1:A:539:THR:HG21	1.72	0.71
1:A:417:LEU:HD23	1:A:417:LEU:O	1.92	0.69
1:A:505:ARG:CD	1:A:539:THR:HG21	2.22	0.68

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:619:GLY:O	1:A:623:ARG:NH1	2.25	0.68
1:A:396:MSE:HB3	1:A:412:THR:HB	1.75	0.67
1:A:396:MSE:HE1	1:A:420:TYR:CD1	2.34	0.62
1:A:421:ALA:HB2	1:A:426:LEU:HD23	1.84	0.60
1:A:679:LEU:HD11	1:A:728:PHE:CG	2.37	0.60
1:A:696:GLU:N	1:A:696:GLU:OE1	2.32	0.60
1:A:584:ASP:OD1	1:A:625:ARG:NE	2.33	0.59
1:A:485:MSE:O	1:A:618:ARG:NH2	2.35	0.58
1:A:552:TYR:CE1	1:A:556:ILE:HG13	2.37	0.58
1:A:548:SER:HA	1:A:574:ILE:HD11	1.84	0.58
1:A:598:THR:O	1:A:599:ALA:HB3	2.05	0.56
1:A:674:GLN:OE1	1:A:678:ARG:NE	2.38	0.56
1:A:379:VAL:HG12	1:A:383:MSE:HE2	1.86	0.56
1:A:545:ILE:O	1:A:545:ILE:HG22	2.05	0.55
1:A:343:GLN:O	1:A:344:LEU:HD23	2.07	0.55
1:A:421:ALA:CB	1:A:426:LEU:HD23	2.36	0.55
1:A:656:MSE:HE3	1:A:681:PRO:HD3	1.89	0.55
1:A:696:GLU:HG2	1:A:697:THR:HG23	1.88	0.55
1:A:356:ILE:HG13	1:A:357:PRO:HD3	1.90	0.54
1:A:651:LEU:HD21	1:A:667:PRO:O	2.08	0.54
1:A:505:ARG:NE	1:A:539:THR:HG21	2.22	0.54
1:A:553:GLU:O	1:A:557:LYS:NZ	2.36	0.54
1:A:552:TYR:CZ	1:A:556:ILE:HG13	2.42	0.53
1:A:417:LEU:HD23	1:A:417:LEU:C	2.34	0.52
1:A:548:SER:O	1:A:552:TYR:N	2.41	0.52
1:A:583:LEU:HD13	1:A:621:ILE:HG23	1.91	0.52
1:A:549:ARG:HH11	1:A:549:ARG:CB	2.17	0.51
1:A:374:GLY:N	1:A:383:MSE:HE1	2.25	0.51
1:A:454:HIS:NE2	1:A:468:GLU:OE2	2.39	0.51
1:A:357:PRO:O	1:A:360:VAL:HG22	2.12	0.50
1:A:439:THR:HG22	1:A:450:ARG:HE	1.77	0.50
1:A:548:SER:CA	1:A:574:ILE:HD11	2.41	0.50
1:A:558:LEU:HD23	1:A:561:LYS:NZ	2.27	0.49
1:A:607:THR:HG23	1:A:608:PRO:HD2	1.94	0.49
1:A:688:ARG:NH1	1:A:709:GLY:O	2.45	0.48
1:A:394:CYS:SG	1:A:407:ALA:HB2	2.54	0.48
1:A:550:LYS:HG2	1:A:551:THR:HG23	1.96	0.48
1:A:596:LEU:HD23	1:A:648:SER:HA	1.97	0.47
1:A:646:PRO:O	1:A:669:GLY:N	2.48	0.47
1:A:618:ARG:O	1:A:620:ARG:N	2.48	0.46
1:A:375:PRO:HD3	1:A:438:GLU:HB2	1.97	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:350:ALA:C	1:A:352:LYS:H	2.24	0.46
1:A:706:SER:HA	1:A:712:ARG:CZ	2.46	0.46
1:A:397:VAL:O	1:A:397:VAL:HG12	2.14	0.46
1:A:349:GLY:CA	1:A:623:ARG:NH2	2.79	0.46
1:A:417:LEU:C	1:A:417:LEU:CD2	2.89	0.46
1:A:656:MSE:CE	1:A:681:PRO:HD3	2.46	0.45
1:A:520:VAL:HG11	1:A:529:ALA:N	2.32	0.45
1:A:588:ASP:O	1:A:632:PRO:HD3	2.17	0.45
1:A:357:PRO:HG3	1:A:387:LEU:HD23	1.99	0.45
1:A:659:ARG:CZ	1:A:676:MSE:HE2	2.47	0.45
1:A:372:VAL:O	1:A:411:VAL:HA	2.17	0.44
1:A:375:PRO:HB3	1:A:441:VAL:HG21	2.00	0.44
1:A:376:THR:HG23	1:A:378:VAL:HG22	1.99	0.43
1:A:618:ARG:HG3	1:A:629:TYR:CG	2.54	0.43
1:A:574:ILE:H	1:A:574:ILE:HG13	1.47	0.43
1:A:394:CYS:O	1:A:410:VAL:HA	2.19	0.43
1:A:496:TYR:OH	1:A:500:VAL:HG22	2.19	0.43
1:A:434:TYR:CD2	1:A:453:ILE:HD12	2.54	0.42
1:A:545:ILE:HG21	1:A:559:VAL:HG23	2.00	0.42
1:A:697:THR:HG22	1:A:732:ARG:NH1	2.34	0.42
1:A:349:GLY:HA3	1:A:623:ARG:CZ	2.49	0.42
1:A:679:LEU:HD11	1:A:728:PHE:CD2	2.54	0.42
1:A:370:VAL:HG22	1:A:433:SER:HB2	2.01	0.42
1:A:520:VAL:HG13	1:A:527:ASN:O	2.20	0.42
1:A:687:TYR:O	1:A:691:THR:OG1	2.30	0.41
1:A:412:THR:OG1	1:A:413:THR:N	2.53	0.41
1:A:598:THR:O	1:A:599:ALA:CB	2.67	0.41
1:A:702:MSE:O	1:A:712:ARG:NH1	2.53	0.41
1:A:598:THR:HG21	1:A:603:LYS:HG3	2.03	0.41
1:A:682:SER:O	1:A:683:LYS:C	2.64	0.41
1:A:592:GLN:OE1	1:A:613:GLN:NE2	2.53	0.41
1:A:377:ARG:HD3	1:A:397:VAL:HG13	2.03	0.41
1:A:495:VAL:CG1	1:A:633:ALA:HB2	2.51	0.41
1:A:373:ALA:HA	1:A:412:THR:O	2.21	0.40
1:A:515:ARG:HG2	1:A:567:MSE:HE2	2.02	0.40
1:A:618:ARG:C	1:A:620:ARG:H	2.29	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	371/489 (76%)	341 (92%)	27 (7%)	3 (1%)	16	44

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	619	GLY
1	A	375	PRO
1	A	642	VAL

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	323/400 (81%)	293 (91%)	30 (9%)	8	27

All (30) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	342	LEU
1	A	356	ILE
1	A	384	LEU
1	A	430	LYS
1	A	439	THR
1	A	461	LYS
1	A	487	SER
1	A	516	VAL

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Mol	Chain	Res	Type
1	A	526	LYS
1	A	535	HIS
1	A	543	THR
1	A	545	ILE
1	A	549	ARG
1	A	553	GLU
1	A	556	ILE
1	A	559	VAL
1	A	562	GLN
1	A	574	ILE
1	A	582	ASP
1	A	583	LEU
1	A	600	VAL
1	A	605	VAL
1	A	621	ILE
1	A	637	ILE
1	A	638	THR
1	A	639	GLN
1	A	644	ASP
1	A	684	ASP
1	A	686	VAL
1	A	693	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	347	HIS
1	A	535	HIS
1	A	613	GLN
1	A	616	GLN

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 [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, 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	368/489 (75%)	0.57	26 (7%) 22 17	48, 84, 120, 170	0

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	576	GLU	5.4
1	A	406	LEU	4.0
1	A	582	ASP	3.4
1	A	338	ALA	3.3
1	A	351	GLY	3.2
1	A	551	THR	3.2
1	A	501	VAL	3.1
1	A	394	CYS	2.7
1	A	529	ALA	2.7
1	A	384	LEU	2.7
1	A	552	TYR	2.6
1	A	573	SER	2.5
1	A	393	VAL	2.4
1	A	533	ALA	2.4
1	A	549	ARG	2.4
1	A	556	ILE	2.3
1	A	397	VAL	2.3
1	A	504	VAL	2.2
1	A	480	GLU	2.2
1	A	545	ILE	2.1
1	A	704	ILE	2.1
1	A	599	ALA	2.1
1	A	687	TYR	2.1
1	A	583	LEU	2.0
1	A	636	ASP	2.0
1	A	550	LYS	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.