Full wwPDB EM Validation Report ⓘ

Mar 9, 2025 – 12:07 AM JST

PDB ID	:	9IJ2
EMDB ID	:	EMD-60613
Title	:	Cryo-EM Structure of MILI-piRNA-target (22-nt, comma)
Authors	:	Li, Z.Q.; Xu, Q.K.; Wu, J.P.; Shen, E.Z.
Deposited on	:	2024-06-21
Resolution	:	3.90 Å(reported)

The following versions of software and data (see references ⓘ) were used in the production of this report:

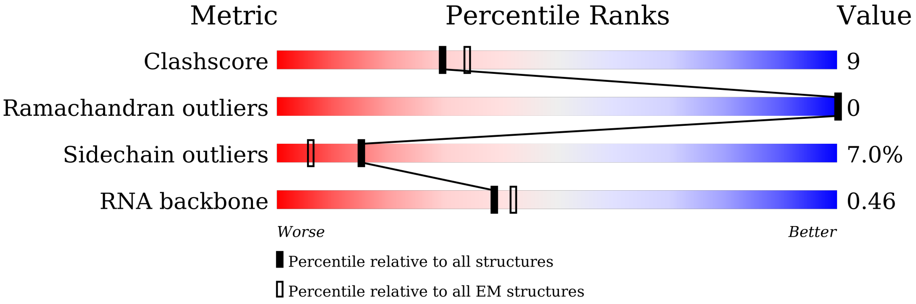
EMDB validation analysis	:	FAILED
MolProbity	:	4.02b-467
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ	:	FAILED
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.41.2

1 Overall quality at a glance

The following experimental techniques were used to determine the structure:
ELECTRON MICROSCOPY

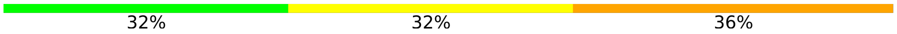
The reported resolution of this entry is 3.90 Å.

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)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415
RNA backbone	6643	2191

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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%

Mol	Chain	Length	Quality of chain
1	A	971	
2	B	22	
3	C	21	

2 Entry composition ⓘ

There are 3 unique types of molecules in this entry. The entry contains 3729 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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 Piwi-like protein 2.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	351	2820	1821	487	487	25	0	0

- Molecule 2 is a RNA chain called RNA (5'-R(P*UP*UP*AP*CP*CP*AP*UP*CP*AP*AP*CP*AP*UP*GP*GP*AP*AP*AP*CP*UP*UP*G)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
2	B	22	466	209	82	153	22	0	0

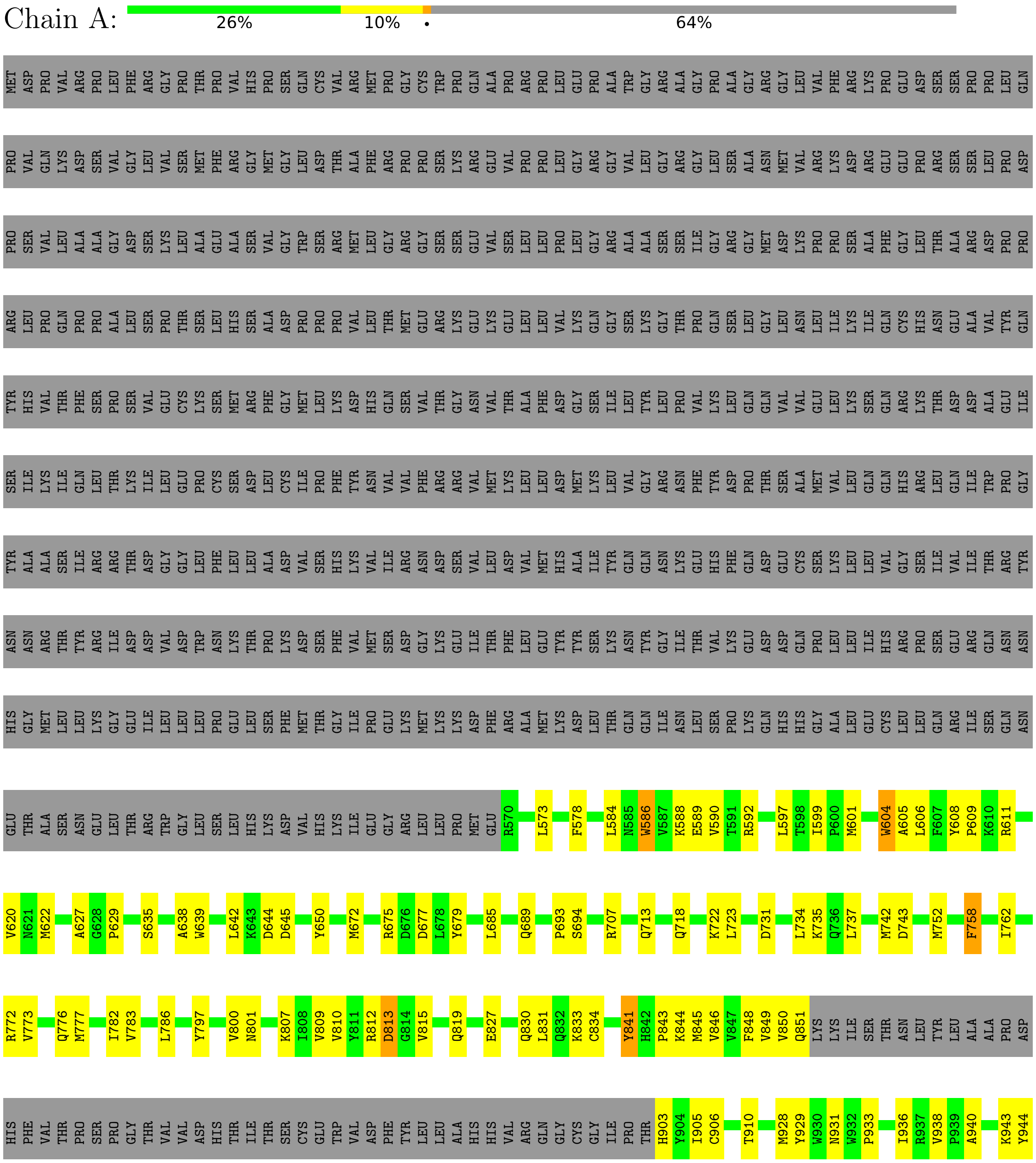
- Molecule 3 is a RNA chain called RNA (5'-R(P*CP*AP*AP*GP*UP*UP*UP*CP*CP*AP*UP*GP*UP*UP*GP*AP*UP*GP*GP*UP*A)-3').

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	P		
3	C	21	443	199	75	148	21	0	0

3 Residue-property plots ⓘ

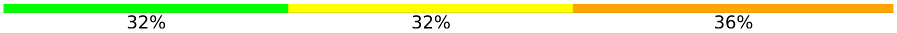
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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: Piwi-like protein 2



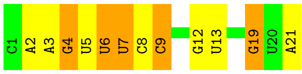
- Molecule 2: RNA (5'-R(P*UP*UP*AP*CP*CP*AP*UP*CP*AP*AP*CP*AP*UP*GP*GP*AP*AP*AP*CP*UP*UP*G)-3')

Chain B:



- Molecule 3: RNA (5'-R(P*CP*AP*AP*GP*UP*UP*UP*CP*CP*AP*UP*GP*UP*UP*GP*AP*UP*GP*GP*UP*A)-3')

Chain C:



4 Experimental information

Property	**Value**	**Source**
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	48385	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose $(e^-/\text{Å}^2)$	50	Depositor
Minimum defocus (nm)	1500	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	TFS FALCON 4i (4k x 4k)	Depositor

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	0.30	0/2887	0.68	4/3914 (0.1%)
2	B	0.65	1/520 (0.2%)	1.38	8/805 (1.0%)
3	C	0.38	0/494	1.30	7/765 (0.9%)
All	All	0.37	1/3901 (0.0%)	0.92	19/5484 (0.3%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1	U	OP3-P	-10.72	1.48	1.61

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	2	U	N1-C2-O2	8.64	128.85	122.80
2	B	2	U	N3-C2-O2	-8.22	116.45	122.20
2	B	2	U	C2-N1-C1'	8.15	127.48	117.70
1	A	950	PHE	CB-CG-CD1	6.10	125.07	120.80
3	C	6	U	N3-C2-O2	-6.02	117.99	122.20
1	A	584	LEU	CA-CB-CG	5.90	128.88	115.30
3	C	8	C	N1-C2-O2	5.88	122.43	118.90
3	C	6	U	N1-C2-O2	5.70	126.79	122.80
2	B	8	C	C5-C6-N1	5.62	123.81	121.00
2	B	8	C	C2-N1-C1'	5.56	124.91	118.80
3	C	4	G	N3-C4-N9	5.48	129.29	126.00
2	B	2	U	C6-N1-C1'	-5.47	113.54	121.20
3	C	6	U	C2-N1-C1'	5.42	124.20	117.70
2	B	8	C	C6-N1-C2	-5.36	118.16	120.30
1	A	950	PHE	CB-CG-CD2	-5.34	117.06	120.80
2	B	1	U	P-O3'-C3'	5.14	125.86	119.70
1	A	948	LEU	CA-CB-CG	5.12	127.08	115.30
3	C	9	C	N1-C2-O2	5.10	121.96	118.90
3	C	19	G	C5-C6-O6	-5.04	125.57	128.60

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	2820	0	2889	54	0
2	B	466	0	237	10	0
3	C	443	0	224	4	0
All	All	3729	0	3350	64	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 9.

All (64) 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:943:LYS:HA	1:A:946:HIS:HB3	1.73	0.70
1:A:609:PRO:HA	1:A:642:LEU:HB2	1.74	0.70
1:A:586:TRP:HB2	1:A:590:VAL:HG11	1.73	0.69
1:A:762:ILE:HG23	1:A:800:VAL:HG21	1.73	0.69
1:A:783:VAL:HG11	1:A:830:GLN:HG2	1.78	0.66
1:A:813:ASP:HB2	1:A:850:VAL:HB	1.81	0.62
1:A:830:GLN:HA	1:A:833:LYS:HB2	1.82	0.61
1:A:936:ILE:HD12	1:A:943:LYS:HE3	1.81	0.61
1:A:815:VAL:HG13	1:A:819:GLN:HB3	1.83	0.60
2:B:14:G:H2’	2:B:15:G:H8	1.66	0.60
1:A:786:LEU:HD23	1:A:831:LEU:HD13	1.87	0.57
1:A:599:ILE:HD11	1:A:723:LEU:HD12	1.88	0.56
1:A:848:PHE:HA	1:A:906:CYS:HA	1.87	0.56
1:A:734:LEU:HB2	1:A:737:LEU:HD12	1.89	0.55
2:B:8:C:H2’	2:B:9:A:H8	1.71	0.55
1:A:645:ASP:O	1:A:675:ARG:NH2	2.40	0.55
1:A:783:VAL:HG21	1:A:830:GLN:HE21	1.71	0.54
1:A:845:MET:H	1:A:910:THR:HB	1.73	0.53
2:B:8:C:H2’	2:B:9:A:C8	2.43	0.53
1:A:707:ARG:HH21	3:C:21:A:H3’	1.74	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:677:ASP:N	1:A:677:ASP:OD1	2.41	0.52
1:A:644:ASP:OD1	1:A:644:ASP:N	2.41	0.52
1:A:928:MET:O	1:A:944:TYR:OH	2.27	0.51
1:A:851:GLN:O	1:A:903:HIS:N	2.44	0.51
1:A:694:SER:O	1:A:722:LYS:NZ	2.44	0.51
1:A:685:LEU:HA	1:A:689:GLN:HB2	1.93	0.50
1:A:758:PHE:HD2	1:A:772:ARG:HB2	1.77	0.50
1:A:718:GLN:O	1:A:722:LYS:HB2	2.11	0.50
1:A:597:LEU:HD21	1:A:599:ILE:HG23	1.95	0.49
3:C:2:A:H2'	3:C:3:A:H8	1.76	0.49
1:A:940:ALA:O	1:A:943:LYS:N	2.46	0.49
1:A:952:SER:HA	1:A:956:LEU:HB2	1.95	0.48
1:A:588:LYS:HD2	3:C:21:A:H5"	1.93	0.48
1:A:776:GLN:HB3	1:A:782:ILE:HG12	1.95	0.48
1:A:589:GLU:HG2	1:A:592:ARG:HH12	1.78	0.47
1:A:586:TRP:O	1:A:588:LYS:N	2.44	0.47
1:A:841:TYR:HD1	1:A:843:PRO:HD3	1.80	0.47
1:A:782:ILE:HG22	1:A:786:LEU:HD13	1.97	0.46
1:A:849:VAL:N	1:A:905:ILE:O	2.47	0.46
1:A:627:ALA:O	1:A:713:GLN:NE2	2.41	0.46
1:A:592:ARG:HG3	1:A:629:PRO:HD2	1.98	0.45
2:B:16:A:H2	3:C:7:U:H3	1.65	0.44
1:A:606:LEU:HD23	1:A:639:TRP:HD1	1.81	0.44
1:A:827:GLU:HA	1:A:830:GLN:HE22	1.82	0.44
1:A:693:PRO:HB2	1:A:722:LYS:HG3	2.00	0.44
1:A:810:VAL:N	1:A:846:VAL:O	2.40	0.43
1:A:601:MET:HG3	1:A:604:TRP:CD1	2.54	0.43
1:A:773:VAL:HG22	1:A:948:LEU:HD21	2.01	0.43
1:A:931:ASN:ND2	2:B:3:A:OP1	2.52	0.42
1:A:573:LEU:HD12	1:A:573:LEU:HA	1.81	0.42
2:B:5:C:H2'	2:B:6:A:H8	1.84	0.42
1:A:605:ALA:HA	1:A:638:ALA:HB3	2.02	0.41
1:A:731:ASP:OD1	1:A:731:ASP:N	2.53	0.41
1:A:807:LYS:HD2	1:A:844:LYS:HG3	2.01	0.41
2:B:11:C:H2'	2:B:12:A:C8	2.56	0.41
1:A:809:VAL:HA	1:A:846:VAL:HB	2.01	0.41
1:A:586:TRP:HE1	1:A:933:PRO:HB2	1.85	0.41
1:A:844:LYS:H	1:A:844:LYS:HG2	1.57	0.41
2:B:14:G:H2'	2:B:15:G:C8	2.51	0.41
1:A:601:MET:O	1:A:635:SER:OG	2.38	0.41
1:A:620:VAL:HG21	1:A:639:TRP:HE1	1.87	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:11:C:H2'	2:B:12:A:H8	1.86	0.40
1:A:938:VAL:HG22	1:A:943:LYS:HE2	2.03	0.40
2:B:13:U:H2'	2:B:14:G:C8	2.57	0.40

There are no symmetry-related clashes.

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 PDB entries followed by that with respect to all EM entries.

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	347/971 (36%)	313 (90%)	34 (10%)	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 PDB entries followed by that with respect to all EM entries.

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	316/863 (37%)	294 (93%)	22 (7%)	12 36

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	578	PHE
1	A	586	TRP
1	A	604	TRP

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Mol	Chain	Res	Type
1	A	608	TYR
1	A	611	ARG
1	A	622	MET
1	A	650	TYR
1	A	672	MET
1	A	679	TYR
1	A	735	LYS
1	A	742	MET
1	A	743	ASP
1	A	752	MET
1	A	758	PHE
1	A	777	MET
1	A	797	TYR
1	A	801	ASN
1	A	812	ARG
1	A	813	ASP
1	A	834	CYS
1	A	841	TYR
1	A	929	TYR

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

5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	B	22/22 (100%)	8 (36%)	1 (4%)
3	C	20/21 (95%)	8 (40%)	1 (5%)
All	All	42/43 (97%)	16 (38%)	2 (4%)

All (16) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	B	2	U
2	B	3	A
2	B	4	C
2	B	5	C
2	B	11	C
2	B	13	U
2	B	16	A
2	B	18	A

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Mol	Chain	Res	Type
3	C	4	G
3	C	5	U
3	C	6	U
3	C	7	U
3	C	9	C
3	C	12	G
3	C	13	U
3	C	19	G

All (2) RNA pucker outliers are listed below:

Mol	Chain	Res	Type
2	B	1	U
3	C	12	G

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.