wwPDB EM Validation Summary Report

Apr 5, 2026 – 01:02 AM JST

PDB ID	:	9WAI / pdb_00009wai
EMDB ID	:	EMD-65819
Title	:	Yeast-expressed polio type 1 stablized virus-like particles with 3G10 Fab
Authors	:	Hong, Q.; Cong, Y.
Deposited on	:	2025-08-12
Resolution	:	2.60 Å(reported)

This is a wwPDB EM Validation Summary 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/EMValidationReportHelp
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:

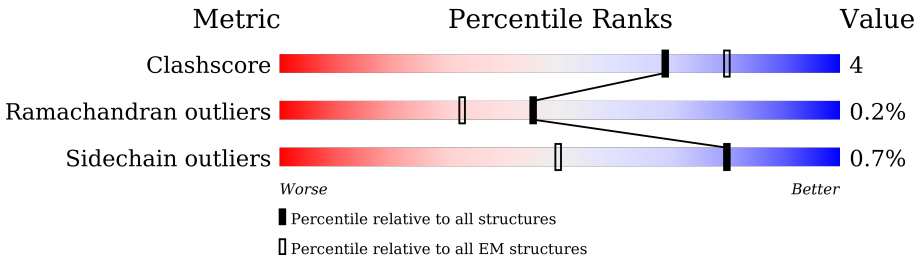
EMDB validation analysis	:	FAILED
MolProbity	:	4-5-2 with Phenix2.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
EM percentile statistics	:	NOT EXECUTED
MapQ	:	FAILED
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.48.1

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 2.60 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

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	D	302	85% 5% • 9%
2	C	238	88% 10% •
3	B	272	87% 8% • •
4	E	224	88% 12%
5	F	214	92% 8%
6	A	69	13% • 83%

2 Entry composition (i)

There are 6 unique types of molecules in this entry. The entry contains 9519 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 Capsid protein VP1.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	D	276	Total	C	N	O	S	0	0
			2172	1388	366	413	5		

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	95	SER	PRO	conflict	UNP P03300
D	196	LEU	VAL	conflict	UNP P03300
D	248	PRO	HIS	conflict	UNP P03300

- Molecule 2 is a protein called Capsid protein VP3.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	C	234	Total	C	N	O	S	0	0
			1828	1166	297	347	18		

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	119	MET	LEU	conflict	UNP P03300
C	123	SER	PHE	conflict	UNP P03300
C	178	LEU	GLN	conflict	UNP P03300

- Molecule 3 is a protein called Capsid protein VP2.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	B	262	Total	C	N	O	S	0	0
			2042	1292	352	385	13		

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	25	ALA	THR	conflict	UNP P03300

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Chain	Residue	Modelled	Actual	Comment	Reference
B	57	GLU	ASP	conflict	UNP P03300

- Molecule 4 is a protein called heavy chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	E	224	Total	C	N	O	S	0	0
			1715	1085	281	341	8		

- Molecule 5 is a protein called light chain.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	F	214	Total	C	N	O	S	0	0
			1668	1036	285	339	8		

- Molecule 6 is a protein called Capsid protein VP4.

Mol	Chain	Residues	Atoms				AltConf	Trace
6	A	12	Total	C	N	O	0	0
			94	57	17	20		

There is a discrepancy between the modelled and reference sequences:

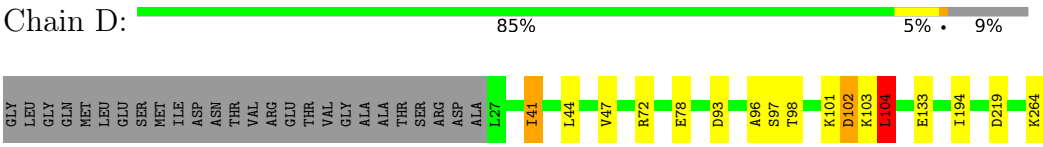
Chain	Residue	Modelled	Actual	Comment	Reference
A	18	GLY	ARG	conflict	UNP B0L5S6

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. 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.

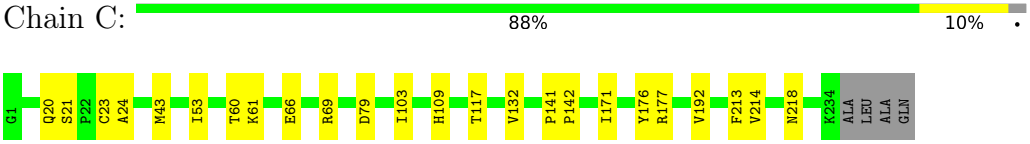
• Molecule 1: Capsid protein VP1

Chain D:



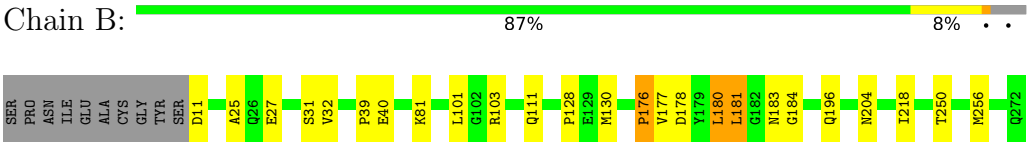
• Molecule 2: Capsid protein VP3

Chain C:



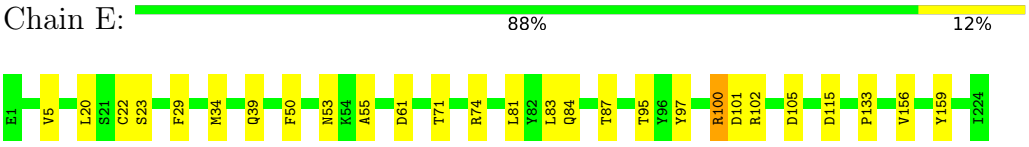
• Molecule 3: Capsid protein VP2

Chain B:



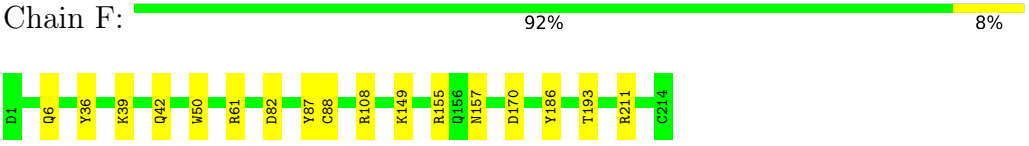
• Molecule 4: heavy chain

Chain E:



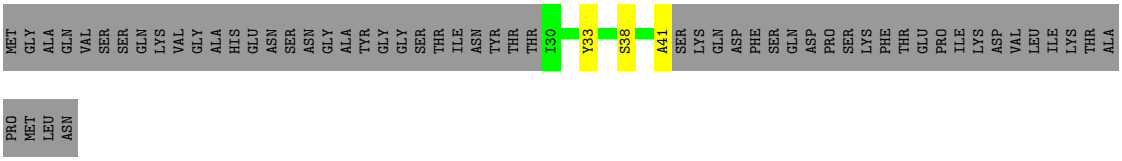
• Molecule 5: light chain

Chain F:



• Molecule 6: Capsid protein VP4

Chain A:


MET GLY ALA GLN VAL SER SER GLN LYS VAL GLY ALA HIS GLU ASN SER ASN GLY ALA TYR GLY GLY SER THR ILE ASN TYR THR THR I30 Y33 S38 A41 SER LYS GLN ASP PHE SER GLN ASP PRO SER LYS PHE THR GLU PRO ILE LYS ASP VAL LEU ILE LYS THR ALA
PRO MET LEU ASN

4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	17984	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TECNAI F30	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/Å^2$)	50	Depositor
Minimum defocus (nm)	8000	Depositor
Maximum defocus (nm)	25000	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k 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	D	0.33	0/2234	0.59	4/3054 (0.1%)
2	C	0.27	0/1875	0.56	0/2553
3	B	0.35	0/2098	0.65	2/2868 (0.1%)
4	E	0.41	0/1759	0.73	5/2401 (0.2%)
5	F	0.30	0/1706	0.63	2/2316 (0.1%)
6	A	0.21	0/95	0.20	0/128
All	All	0.33	0/9767	0.63	13/13320 (0.1%)

There are no bond length outliers.

The worst 5 of 13 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	D	104	LEU	CA-C-N	-7.02	110.71	122.29
1	D	104	LEU	C-N-CA	-7.02	110.71	122.29
4	E	55	ALA	CA-C-N	6.36	133.69	121.54
4	E	55	ALA	C-N-CA	6.36	133.69	121.54
3	B	176	PRO	N-CA-CB	-6.19	96.75	103.25

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	D	2172	0	2129	15	0
2	C	1828	0	1812	15	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	2042	0	1967	17	0
4	E	1715	0	1653	14	0
5	F	1668	0	1596	8	0
6	A	94	0	82	8	0
All	All	9519	0	9239	66	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 4.

The worst 5 of 66 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)
2:C:21:SER:O	6:A:38:SER:HB3	1.88	0.73
3:B:31:SER:HA	3:B:196:GLN:HE22	1.56	0.69
3:B:180:LEU:HD13	3:B:184:GLY:HA2	1.74	0.68
1:D:93:ASP:OD1	1:D:104:LEU:HB3	1.95	0.67
4:E:5:VAL:HB	4:E:23:SER:HB3	1.81	0.63

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 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	D	274/302 (91%)	261 (95%)	12 (4%)	1 (0%)	30 52
2	C	232/238 (98%)	223 (96%)	9 (4%)	0	100 100
3	B	260/272 (96%)	246 (95%)	13 (5%)	1 (0%)	30 52
4	E	222/224 (99%)	212 (96%)	10 (4%)	0	100 100
5	F	212/214 (99%)	206 (97%)	6 (3%)	0	100 100
6	A	10/69 (14%)	10 (100%)	0	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	1210/1319 (92%)	1158 (96%)	50 (4%)	2 (0%)	45 66

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	97	SER
3	B	176	PRO

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 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	D	241/261 (92%)	239 (99%)	2 (1%)	79 91
2	C	210/212 (99%)	210 (100%)	0	100 100
3	B	223/231 (96%)	220 (99%)	3 (1%)	65 84
4	E	194/194 (100%)	192 (99%)	2 (1%)	73 88
5	F	190/190 (100%)	190 (100%)	0	100 100
6	A	9/57 (16%)	9 (100%)	0	100 100
All	All	1067/1145 (93%)	1060 (99%)	7 (1%)	80 93

5 of 7 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	B	180	LEU
3	B	181	LEU
4	E	156	VAL
4	E	100	ARG
3	B	178	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 16 such sidechains are listed below:

Mol	Chain	Res	Type
5	F	166	GLN
5	F	145	ASN
3	B	199	ASN
5	F	93	ASN
3	B	196	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

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.