



## Full wwPDB EM Validation Report ⓘ

Jul 9, 2025 – 01:26 PM JST

PDB ID : 8YZB / pdb\_00008yzb  
EMDB ID : EMD-39688  
Title : BA.2.86 RBD protein in complex with ACE2.  
Authors : Wang, Y.J.; Zhang, X.; Sun, L.  
Deposited on : 2024-04-06  
Resolution : 3.29 Å(reported)

This is a Full wwPDB EM 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/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>.

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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 Phenix2.0rc1  
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) : 2.44

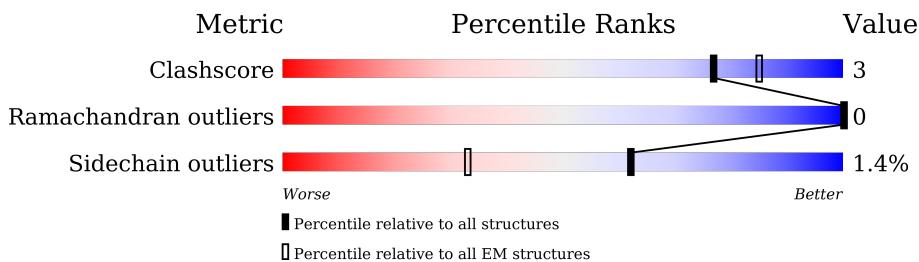
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 3.29 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  $\geq 3$ , 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  $\leq 5\%$ .

Mol	Chain	Length	Quality of chain
1	A	1291	
2	B	742	

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 6448 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 Spike glycoprotein,Fibritin,fusion protein.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	195	Total	C	N	O	S	0	0
			1568	1016	263	281	8		

There are 95 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	MET	-	initiating methionine	UNP P0DTC2
A	-2	PRO	-	expression tag	UNP P0DTC2
A	-1	MET	-	expression tag	UNP P0DTC2
A	0	GLY	-	expression tag	UNP P0DTC2
A	1	SER	-	expression tag	UNP P0DTC2
A	2	LEU	-	expression tag	UNP P0DTC2
A	3	GLN	-	expression tag	UNP P0DTC2
A	4	PRO	-	expression tag	UNP P0DTC2
A	5	LEU	-	expression tag	UNP P0DTC2
A	6	ALA	-	expression tag	UNP P0DTC2
A	7	THR	-	expression tag	UNP P0DTC2
A	8	LEU	-	expression tag	UNP P0DTC2
A	9	TYR	-	expression tag	UNP P0DTC2
A	10	LEU	-	expression tag	UNP P0DTC2
A	11	LEU	-	expression tag	UNP P0DTC2
A	12	GLY	-	expression tag	UNP P0DTC2
A	13	MET	-	expression tag	UNP P0DTC2
A	14	LEU	-	expression tag	UNP P0DTC2
A	15	VAL	-	expression tag	UNP P0DTC2
A	16	ALA	-	expression tag	UNP P0DTC2
A	17	SER	-	expression tag	UNP P0DTC2
A	18	VAL	-	expression tag	UNP P0DTC2
A	19	LEU	-	expression tag	UNP P0DTC2
A	20	ALA	-	expression tag	UNP P0DTC2
A	26	ILE	THR	variant	UNP P0DTC2
A	28	THR	ARG	conflict	UNP P0DTC2
A	?	-	LEU	deletion	UNP P0DTC2
A	?	-	PRO	deletion	UNP P0DTC2

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Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	PRO	deletion	UNP P0DTC2
A	31	SER	ALA	variant	UNP P0DTC2
A	54	LEU	SER	conflict	UNP P0DTC2
A	?	-	HIS	deletion	UNP P0DTC2
A	?	-	VAL	deletion	UNP P0DTC2
A	128	PHE	VAL	conflict	UNP P0DTC2
A	144	ASP	GLY	variant	UNP P0DTC2
A	?	-	TYR	deletion	UNP P0DTC2
A	158	SER	PHE	conflict	UNP P0DTC2
A	159	GLY	ARG	conflict	UNP P0DTC2
A	?	-	ASN	deletion	UNP P0DTC2
A	212	ILE	LEU	conflict	UNP P0DTC2
A	213	GLY	VAL	variant	UNP P0DTC2
A	216	PHE	LEU	conflict	UNP P0DTC2
A	245	ASN	HIS	conflict	UNP P0DTC2
A	264	ASP	ALA	conflict	UNP P0DTC2
A	332	VAL	ILE	conflict	UNP P0DTC2
A	339	HIS	GLY	variant	UNP P0DTC2
A	356	THR	LYS	conflict	UNP P0DTC2
A	371	PHE	SER	variant	UNP P0DTC2
A	373	PRO	SER	variant	UNP P0DTC2
A	375	PHE	SER	variant	UNP P0DTC2
A	376	ALA	THR	variant	UNP P0DTC2
A	403	LYS	ARG	conflict	UNP P0DTC2
A	405	ASN	ASP	variant	UNP P0DTC2
A	408	SER	ARG	variant	UNP P0DTC2
A	417	ASN	LYS	variant	UNP P0DTC2
A	440	LYS	ASN	variant	UNP P0DTC2
A	445	HIS	VAL	conflict	UNP P0DTC2
A	446	SER	GLY	variant	UNP P0DTC2
A	450	ASP	ASN	conflict	UNP P0DTC2
A	452	TRP	LEU	conflict	UNP P0DTC2
A	460	LYS	ASN	variant	UNP P0DTC2
A	477	ASN	SER	variant	UNP P0DTC2
A	478	LYS	THR	variant	UNP P0DTC2
A	481	LYS	ASN	conflict	UNP P0DTC2
A	?	-	VAL	deletion	UNP P0DTC2
A	484	LYS	GLU	variant	UNP P0DTC2
A	486	PRO	PHE	variant	UNP P0DTC2
A	498	ARG	GLN	variant	UNP P0DTC2
A	501	TYR	ASN	variant	UNP P0DTC2
A	505	HIS	TYR	variant	UNP P0DTC2

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Chain	Residue	Modelled	Actual	Comment	Reference
A	554	LYS	GLU	conflict	UNP P0DTC2
A	570	VAL	ALA	conflict	UNP P0DTC2
A	614	GLY	ASP	variant	UNP P0DTC2
A	621	SER	PRO	conflict	UNP P0DTC2
A	655	TYR	HIS	variant	UNP P0DTC2
A	670	VAL	ILE	conflict	UNP P0DTC2
A	679	LYS	ASN	variant	UNP P0DTC2
A	681	ARG	PRO	variant	UNP P0DTC2
A	682	GLY	ARG	conflict	UNP P0DTC2
A	683	SER	ARG	conflict	UNP P0DTC2
A	685	SER	ARG	conflict	UNP P0DTC2
A	764	LYS	ASN	variant	UNP P0DTC2
A	796	TYR	ASP	variant	UNP P0DTC2
A	817	PRO	PHE	conflict	UNP P0DTC2
A	892	PRO	ALA	conflict	UNP P0DTC2
A	899	PRO	ALA	conflict	UNP P0DTC2
A	939	PHE	SER	conflict	UNP P0DTC2
A	942	PRO	ALA	conflict	UNP P0DTC2
A	954	HIS	GLN	variant	UNP P0DTC2
A	969	LYS	ASN	variant	UNP P0DTC2
A	986	PRO	LYS	conflict	UNP P0DTC2
A	987	PRO	VAL	conflict	UNP P0DTC2
A	1143	LEU	PRO	conflict	UNP P0DTC2
A	1209	GLY	-	linker	UNP P0DTC2
A	1210	SER	-	linker	UNP P0DTC2

- Molecule 2 is a protein called Angiotensin-converting enzyme 2.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	597	Total	C	N	O	S	1	0
			4880	3121	809	921	29		

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	733	SER	-	expression tag	UNP Q9BYF1
B	734	GLY	-	expression tag	UNP Q9BYF1
B	735	HIS	-	expression tag	UNP Q9BYF1
B	736	HIS	-	expression tag	UNP Q9BYF1
B	737	HIS	-	expression tag	UNP Q9BYF1
B	738	HIS	-	expression tag	UNP Q9BYF1
B	739	HIS	-	expression tag	UNP Q9BYF1

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Chain	Residue	Modelled	Actual	Comment	Reference
B	740	HIS	-	expression tag	UNP Q9BYF1
B	741	HIS	-	expression tag	UNP Q9BYF1
B	742	HIS	-	expression tag	UNP Q9BYF1





## 4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	67266	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 ( $e^-/\text{\AA}^2$ )	50	Depositor
Minimum defocus (nm)	1200	Depositor
Maximum defocus (nm)	2200	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (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	0.16	0/1620	0.37	0/2204
2	B	0.24	3/5018 (0.1%)	0.33	1/6818 (0.0%)
All	All	0.22	3/6638 (0.0%)	0.34	1/9022 (0.0%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	38	ASP	CA-C	-6.36	1.44	1.52
2	B	40	PHE	C-O	-5.52	1.17	1.24
2	B	39	LEU	C-O	-5.16	1.17	1.24

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	38	ASP	N-CA-C	9.38	121.51	111.28

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	1568	0	1495	7	0
2	B	4880	0	4649	29	0
All	All	6448	0	6144	35	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 3.

All (35) 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:368:LEU:HB3	1:A:375:PHE:HE2	1.51	0.74
2:B:177:ARG:NH2	2:B:495:GLU:O	2.24	0.70
2:B:394:ASN:OD1	2:B:395:GLY:N	2.32	0.63
2:B:528:ALA:HB2	2:B:574:VAL:HG12	1.83	0.60
1:A:354:ASN:OD1	1:A:355:ARG:N	2.36	0.57
2:B:312:GLU:O	2:B:316:VAL:HG23	2.05	0.56
2:B:139:GLN:N	2:B:139:GLN:OE1	2.38	0.56
2:B:290:ASN:OD1	2:B:291:ILE:N	2.39	0.55
2:B:569:ALA:O	2:B:573:VAL:HG23	2.06	0.55
2:B:181:GLU:O	2:B:185:VAL:HG23	2.07	0.54
2:B:161:ARG:NH1	2:B:265:HIS:O	2.41	0.53
2:B:459:TRP:O	2:B:463:VAL:HG23	2.12	0.50
1:A:493:GLN:NE2	2:B:34[B]:HIS:CD2	2.80	0.50
2:B:79:LEU:HD23	2:B:79:LEU:O	2.13	0.49
2:B:180:TYR:O	2:B:184:VAL:HG23	2.14	0.48
1:A:455:LEU:HD23	1:A:455:LEU:H	1.79	0.47
2:B:364:VAL:O	2:B:365:THR:OG1	2.24	0.47
2:B:201:ASP:OD1	2:B:219:ARG:NE	2.41	0.47
2:B:294:THR:O	2:B:298:VAL:HG23	2.15	0.47
2:B:151:ILE:O	2:B:155:SER:OG	2.31	0.46
2:B:222:LEU:O	2:B:226:VAL:HG23	2.15	0.46
2:B:549:GLU:OE1	2:B:549:GLU:N	2.44	0.46
2:B:129:THR:HG22	2:B:129:THR:O	2.15	0.46
1:A:470:THR:HG22	1:A:470:THR:O	2.14	0.46
2:B:169:ARG:NH2	2:B:270:MET:SD	2.87	0.46
2:B:351:LEU:HD12	2:B:351:LEU:N	2.33	0.43
2:B:400:PHE:O	2:B:404:VAL:HG23	2.20	0.42
1:A:368:LEU:HB3	1:A:375:PHE:CE2	2.42	0.42
1:A:375:PHE:HD1	1:A:375:PHE:HA	1.73	0.42
2:B:240:LEU:O	2:B:244:VAL:HG23	2.19	0.42
2:B:581:VAL:O	2:B:581:VAL:HG22	2.20	0.41
2:B:516:TYR:CE2	2:B:520:LEU:HD11	2.56	0.40
2:B:198:ASP:OD1	2:B:200:GLY:N	2.55	0.40
2:B:47:SER:O	2:B:51:ASN:ND2	2.47	0.40
2:B:145:GLU:HB3	2:B:146:PRO:HD3	2.04	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	193/1291 (15%)	184 (95%)	9 (5%)	0	100	100
2	B	596/742 (80%)	588 (99%)	8 (1%)	0	100	100
All	All	789/2033 (39%)	772 (98%)	17 (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 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	169/1115 (15%)	164 (97%)	5 (3%)	36	62
2	B	528/656 (80%)	523 (99%)	5 (1%)	75	85
All	All	697/1771 (39%)	687 (99%)	10 (1%)	62	78

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	374	PHE
1	A	375	PHE
1	A	386	LYS
1	A	462	LYS
1	A	498	ARG
2	B	38	ASP
2	B	39	LEU
2	B	45	LEU

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Mol	Chain	Res	Type
2	B	283	VAL
2	B	363	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	339	HIS
1	A	437	ASN
1	A	474	GLN
1	A	493	GLN
1	A	505	HIS
2	B	58	ASN
2	B	340	GLN
2	B	373	HIS
2	B	508	ASN

### 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 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 ⓘ

There are no chain breaks in this entry.