



Full wwPDB EM Validation Report ⓘ

Jul 9, 2025 – 01:19 PM JST

PDB ID : 8ZC1 / pdb_00008zc1
EMDB ID : EMD-39919
Title : SARS-CoV-2 Omicron BA.2 spike trimer (6P) in complex with D1F6 Fab,
focused refinement of RBD region
Authors : Liu, B.; Gao, X.; Li, Z.; Chen, Q.; He, J.; Xiong, X.
Deposited on : 2024-04-28
Resolution : 4.17 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

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 Phenix2.0rc1
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

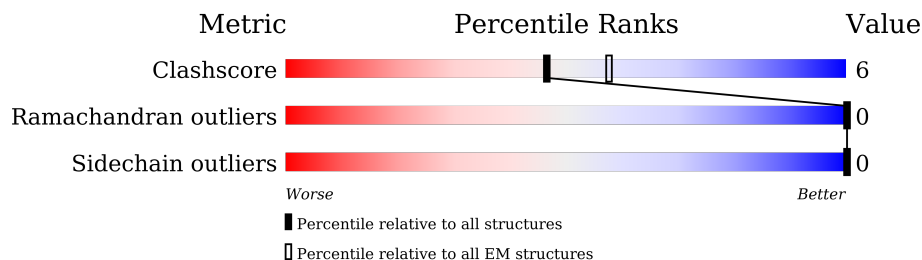
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 4.17 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	B	196	
2	C	223	
3	E	230	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4570 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 protein S1.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	B	163	Total	C	N	O	S	0	0
			1318	856	225	233	4		

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	339	ASP	GLY	variant	UNP P0DTC2
B	371	PHE	SER	variant	UNP P0DTC2
B	373	PRO	SER	variant	UNP P0DTC2
B	375	PHE	SER	variant	UNP P0DTC2
B	376	ALA	THR	variant	UNP P0DTC2
B	405	ASN	ASP	variant	UNP P0DTC2
B	408	SER	ARG	variant	UNP P0DTC2
B	417	ASN	LYS	variant	UNP P0DTC2
B	440	LYS	ASN	variant	UNP P0DTC2
B	477	ASN	SER	variant	UNP P0DTC2
B	478	LYS	THR	variant	UNP P0DTC2
B	484	ALA	GLU	variant	UNP P0DTC2
B	493	ARG	GLN	variant	UNP P0DTC2
B	498	ARG	GLN	variant	UNP P0DTC2
B	501	TYR	ASN	variant	UNP P0DTC2
B	505	HIS	TYR	variant	UNP P0DTC2

- Molecule 2 is a protein called Light chain of D1F6 Fab.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	C	213	Total	C	N	O	S	0	0
			1591	1001	266	320	4		

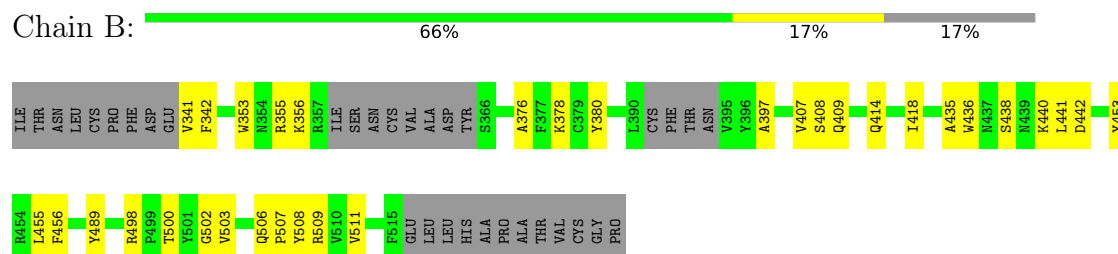
- Molecule 3 is a protein called Heavy chain of D1F6 Fab.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	E	221	Total	C	N	O	S	0	0
			1661	1050	276	325	10		

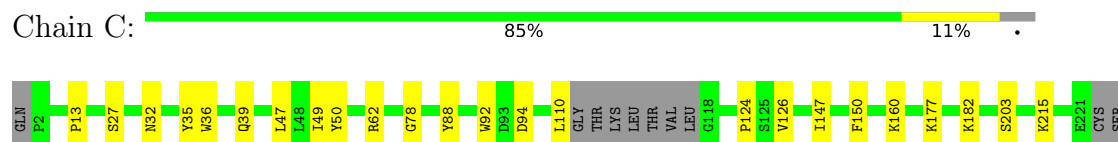
3 Residue-property plots [i](#)

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.

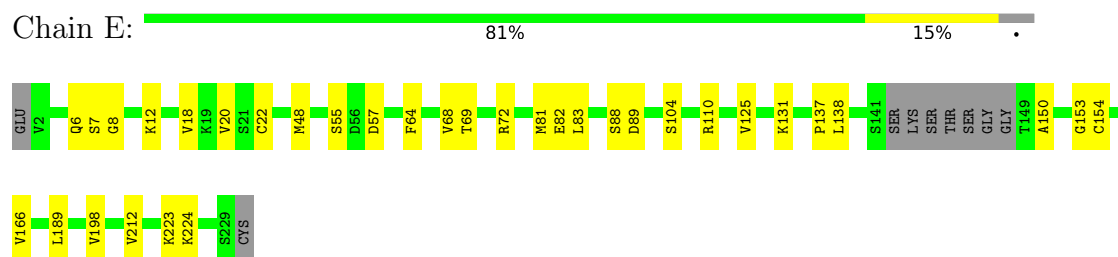
- Molecule 1: Spike protein S1



- Molecule 2: Light chain of D1F6 Fab



- Molecule 3: Heavy chain of D1F6 Fab



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	239007	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TALOS ARCTICA	Depositor
Voltage (kV)	200	Depositor
Electron dose ($e^-/\text{\AA}^2$)	60	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor

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	B	0.17	0/1357	0.40	0/1839
2	C	0.15	0/1633	0.39	0/2229
3	E	0.20	0/1704	0.47	0/2330
All	All	0.18	0/4694	0.43	0/6398

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	B	1318	0	1263	19	0
2	C	1591	0	1539	15	0
3	E	1661	0	1579	21	0
All	All	4570	0	4381	53	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 6.

All (53) 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:B:436:TRP:CZ3	1:B:511:VAL:HG12	2.30	0.66

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:C:124:PRO:HB2	2:C:147:ILE:HD11	1.82	0.62
3:E:48:MET:HE1	3:E:64:PHE:HD2	1.64	0.62
1:B:409:GLN:HE22	1:B:418:ILE:H	1.48	0.62
3:E:6:GLN:HG2	3:E:22:CYS:HB3	1.83	0.60
3:E:166:VAL:HG12	3:E:212:VAL:HG12	1.83	0.60
1:B:436:TRP:HZ3	1:B:511:VAL:HG12	1.67	0.60
3:E:12:LYS:HG2	3:E:18:VAL:HG12	1.84	0.58
1:B:356:LYS:HB3	1:B:397:ALA:HB3	1.87	0.56
2:C:92:TRP:NE1	2:C:94:ASP:OD1	2.38	0.55
2:C:62:ARG:NH1	2:C:78:GLY:O	2.41	0.53
2:C:124:PRO:HB3	2:C:150:PHE:HB3	1.91	0.52
2:C:39:GLN:HE21	2:C:88:TYR:HE2	1.58	0.51
2:C:126:VAL:O	2:C:215:LYS:NZ	2.43	0.51
1:B:408:SER:O	1:B:414:GLN:NE2	2.44	0.51
3:E:150:ALA:HB3	3:E:198:VAL:HG23	1.93	0.50
1:B:442:ASP:OD1	1:B:509:ARG:NH1	2.43	0.50
3:E:69:THR:HB	3:E:82:GLU:HB2	1.94	0.50
1:B:407:VAL:HG21	1:B:508:TYR:HD2	1.77	0.49
3:E:138:LEU:HB2	3:E:153:GLY:O	2.13	0.48
1:B:438:SER:OG	1:B:507:PRO:O	2.31	0.48
3:E:57:ASP:OD2	3:E:104:SER:OG	2.32	0.48
2:C:160:LYS:HB2	2:C:203:SER:HB3	1.96	0.47
3:E:150:ALA:N	3:E:198:VAL:O	2.41	0.47
2:C:35:TYR:OH	3:E:110:ARG:O	2.31	0.47
1:B:502:GLY:O	1:B:506:GLN:NE2	2.47	0.47
3:E:20:VAL:HG13	3:E:81:MET:HB3	1.97	0.47
1:B:436:TRP:CH2	1:B:511:VAL:HG12	2.50	0.46
2:C:36:TRP:HB2	2:C:49:ILE:HB	1.97	0.46
1:B:440:LYS:HG3	1:B:441:LEU:HD12	1.96	0.46
1:B:353:TRP:HZ3	1:B:355:ARG:HB2	1.81	0.46
1:B:456:PHE:HE2	1:B:489:TYR:HD2	1.62	0.46
2:C:47:LEU:HD11	2:C:50:TYR:HB3	1.99	0.45
3:E:138:LEU:HD13	3:E:154:CYS:HA	1.98	0.45
1:B:453:TYR:HE2	1:B:455:LEU:HD13	1.83	0.43
3:E:223:LYS:NZ	3:E:224:LYS:O	2.50	0.43
3:E:55:SER:O	3:E:72:ARG:NH1	2.50	0.43
1:B:503:VAL:HA	1:B:506:GLN:HE22	1.83	0.43
3:E:131:LYS:HD2	3:E:189:LEU:HD11	2.00	0.43
3:E:89:ASP:OD1	3:E:89:ASP:N	2.51	0.43
3:E:68:VAL:HG12	3:E:83:LEU:HD11	2.00	0.43
1:B:498:ARG:HB2	1:B:500:THR:HG22	2.00	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:C:27:SER:O	2:C:27:SER:OG	2.37	0.42
3:E:7:SER:OG	3:E:8:GLY:N	2.52	0.42
1:B:376:ALA:HB3	1:B:435:ALA:HB3	2.01	0.42
1:B:378:LYS:HE2	1:B:380:TYR:HE1	1.84	0.42
3:E:137:PRO:C	3:E:138:LEU:HD12	2.44	0.42
2:C:177:LYS:HA	2:C:177:LYS:HD2	1.88	0.42
2:C:182:LYS:HD3	2:C:182:LYS:HA	1.88	0.41
3:E:88:SER:HA	3:E:125:VAL:HG21	2.02	0.41
2:C:32:ASN:OD1	3:E:110:ARG:NE	2.51	0.41
2:C:13:PRO:HA	2:C:110:LEU:HB2	2.02	0.41
1:B:341:VAL:HG13	1:B:342:PHE:HD1	1.86	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 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	B	157/196 (80%)	150 (96%)	7 (4%)	0	100	100
2	C	209/223 (94%)	200 (96%)	9 (4%)	0	100	100
3	E	217/230 (94%)	208 (96%)	9 (4%)	0	100	100
All	All	583/649 (90%)	558 (96%)	25 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	B	139/168 (83%)	139 (100%)	0	100	100
2	C	178/187 (95%)	178 (100%)	0	100	100
3	E	185/198 (93%)	185 (100%)	0	100	100
All	All	502/553 (91%)	502 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

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

Mol	Chain	Res	Type
1	B	414	GLN
1	B	448	ASN
1	B	505	HIS
1	B	506	GLN
2	C	39	GLN
3	E	3	GLN
3	E	39	GLN
3	E	59	ASN
3	E	106	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

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.