Full wwPDB X-ray Structure Validation Report ⓘ

Nov 3, 2025 – 12:19 PM EST

PDB ID	:	9NQ3 / pdb_00009nq3
Title	:	Crystal structure of SARS-CoV-2 S2 directed Fab 1871
Authors	:	Muthuraman, K.; Ivanochko, D.; Julien, J.P.
Deposited on	:	2025-03-11
Resolution	:	2.50 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:

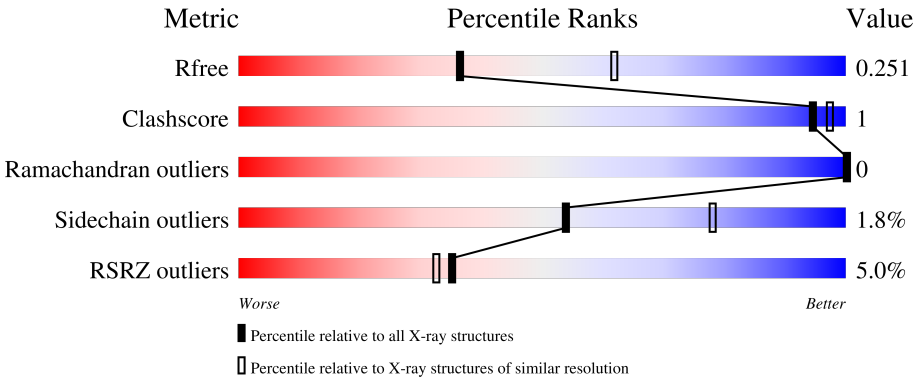
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.46

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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}	164625	5504 (2.50-2.50)
Clashscore	180529	6282 (2.50-2.50)
Ramachandran outliers	177936	6191 (2.50-2.50)
Sidechain outliers	177891	6193 (2.50-2.50)
RSRZ outliers	164620	5504 (2.50-2.50)

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 <=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	227	4% 96% .
1	H	227	8% 93% 7%
2	B	215	3% 95% 5%
2	L	215	4% 96% . .

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 6644 atoms, of which 0 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 1871 Fab heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	H	226	Total	C	N	O	S	0	0	0
			1664	1050	275	331	8			
1	A	226	Total	C	N	O	S	0	0	0
			1660	1049	275	328	8			

- Molecule 2 is a protein called 1871 Fab light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	215	Total	C	N	O	S	0	0	0
			1647	1034	281	327	5			
2	B	215	Total	C	N	O	S	0	0	0
			1651	1037	282	327	5			

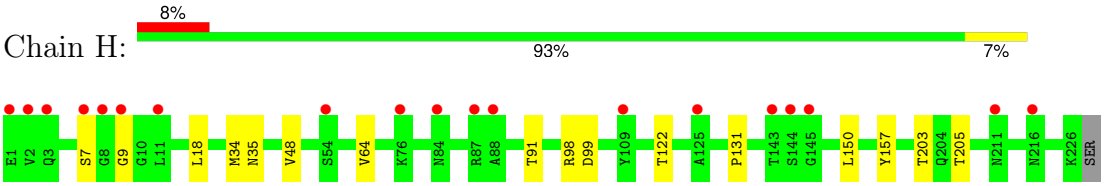
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	H	2	Total	O	0	0
			2	2		
3	L	7	Total	O	0	0
			7	7		
3	A	4	Total	O	0	0
			4	4		
3	B	9	Total	O	0	0
			9	9		

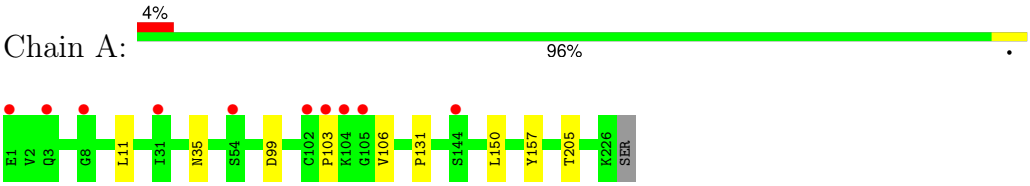
3 Residue-property plots (i)

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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). 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.

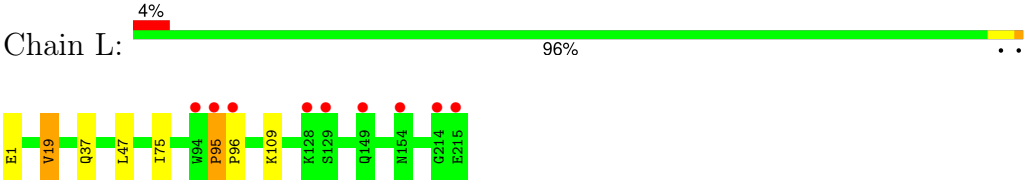
• Molecule 1: 1871 Fab heavy chain



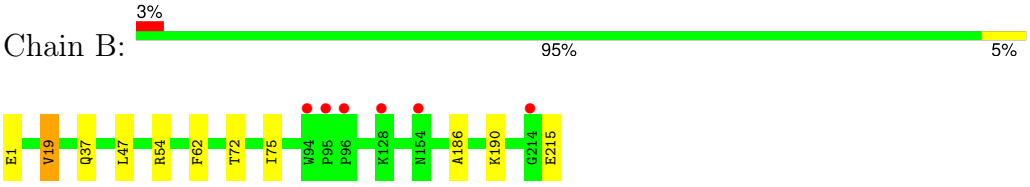
• Molecule 1: 1871 Fab heavy chain



• Molecule 2: 1871 Fab light chain



• Molecule 2: 1871 Fab light chain



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 2 21	Depositor
Cell constants a, b, c, α, β, γ	82.19Å 101.33Å 134.98Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	70.20 – 2.50 70.20 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.8 (70.20-2.50) 97.8 (70.20-2.50)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.55 (at 2.51Å)	Xtriage
Refinement program	PHENIX 1.21rc1_5127	Depositor
R, R_{free}	0.216 , 0.251 0.217 , 0.251	Depositor DCC
R_{free} test set	1998 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	32.6	Xtriage
Anisotropy	0.477	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 35.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	6644	wwPDB-VP
Average B, all atoms (Å^2)	40.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 51.37 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 5.6602e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

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	0.19	0/1701	0.48	0/2321
1	H	0.20	0/1705	0.49	0/2327
2	B	0.22	0/1688	0.52	0/2296
2	L	0.22	0/1684	0.53	0/2292
All	All	0.21	0/6778	0.50	0/9236

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
2	L	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	L	95	PRO	Peptide

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	1660	0	1597	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	H	1664	0	1596	6	1
2	B	1651	0	1599	4	0
2	L	1647	0	1588	3	0
3	A	4	0	0	0	0
3	B	9	0	0	0	0
3	H	2	0	0	0	0
3	L	7	0	0	0	0
All	All	6644	0	6380	16	1

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 1.

All (16) 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:35:ASN:ND2	1:A:99:ASP:OD1	2.40	0.55
2:B:54:ARG:NH1	2:B:62:PHE:O	2.37	0.54
1:H:35:ASN:ND2	1:H:99:ASP:OD1	2.41	0.54
2:L:19:VAL:HG22	2:L:75:ILE:HB	1.93	0.50
1:H:131:PRO:HB3	1:H:157:TYR:HB3	1.94	0.49
2:B:19:VAL:HG22	2:B:75:ILE:HB	1.95	0.49
1:A:131:PRO:HB3	1:A:157:TYR:HB3	1.96	0.47
2:B:186:ALA:O	2:B:190:LYS:HG2	2.16	0.46
1:H:34:MET:HE1	1:H:98:ARG:HG3	2.00	0.44
1:H:9:GLY:HA2	1:H:18:LEU:HD21	2.01	0.43
2:B:37:GLN:HB2	2:B:47:LEU:HD11	2.00	0.43
1:H:48:VAL:HG13	1:H:64:VAL:HG21	2.00	0.43
2:L:37:GLN:HB2	2:L:47:LEU:HD11	2.00	0.43
1:H:91:THR:HG23	1:H:122:THR:HA	2.03	0.40
2:L:95:PRO:HA	2:L:96:PRO:HD3	1.90	0.40
1:A:103:PRO:HD2	1:A:106:VAL:O	2.22	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:H:7:SER:OG	1:H:7:SER:OG[2_555]	2.05	0.15

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	224/227 (99%)	221 (99%)	3 (1%)	0	100	100
1	H	224/227 (99%)	214 (96%)	10 (4%)	0	100	100
2	B	213/215 (99%)	206 (97%)	7 (3%)	0	100	100
2	L	213/215 (99%)	203 (95%)	10 (5%)	0	100	100
All	All	874/884 (99%)	844 (97%)	30 (3%)	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 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	183/190 (96%)	180 (98%)	3 (2%)	58	80
1	H	184/190 (97%)	181 (98%)	3 (2%)	58	80
2	B	183/187 (98%)	179 (98%)	4 (2%)	47	73
2	L	182/187 (97%)	179 (98%)	3 (2%)	58	80
All	All	732/754 (97%)	719 (98%)	13 (2%)	54	78

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	150	LEU
1	H	203	THR

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Mol	Chain	Res	Type
1	H	205	THR
2	L	1	GLU
2	L	19	VAL
2	L	109	LYS
1	A	11	LEU
1	A	150	LEU
1	A	205	THR
2	B	1	GLU
2	B	19	VAL
2	B	72	THR
2	B	215	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	H	176	HIS
1	A	204	GLN
2	B	42	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 (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, 95^{th} 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	226/227 (99%)	0.38	10 (4%)	39	36	27, 44, 64, 81	0
1	H	226/227 (99%)	0.48	19 (8%)	18	17	23, 43, 72, 100	0
2	B	215/215 (100%)	0.04	6 (2%)	55	51	22, 34, 54, 84	0
2	L	215/215 (100%)	0.06	9 (4%)	41	38	22, 32, 53, 70	0
All	All	882/884 (99%)	0.25	44 (4%)	35	32	22, 39, 64, 100	0

All (44) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	L	94	TRP	5.4
2	B	94	TRP	5.1
1	H	144	SER	4.6
2	L	96	PRO	4.5
1	A	54	SER	4.3
2	L	95	PRO	4.2
2	B	95	PRO	3.9
1	H	2	VAL	3.6
2	B	214	GLY	3.5
1	A	104	LYS	3.5
1	H	54	SER	3.5
2	L	214	GLY	3.4
1	A	144	SER	3.2
1	H	145	GLY	3.1
2	L	215	GLU	3.1
1	H	9	GLY	3.1
1	H	3	GLN	2.9
1	H	1	GLU	2.9
2	L	128	LYS	2.8
1	A	8	GLY	2.8
2	L	129	SER	2.8

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Mol	Chain	Res	Type	RSRZ
2	B	154	ASN	2.7
1	H	7	SER	2.7
1	H	8	GLY	2.7
1	H	84	ASN	2.6
1	H	125	ALA	2.6
1	A	105	GLY	2.6
1	H	109	TYR	2.5
1	H	11	LEU	2.5
1	A	102	CYS	2.4
1	H	143	THR	2.4
1	A	31	ILE	2.3
1	A	1	GLU	2.3
1	A	103	PRO	2.3
1	H	88	ALA	2.3
1	H	76	LYS	2.2
2	B	128	LYS	2.2
2	B	96	PRO	2.2
1	A	3	GLN	2.1
1	H	87	ARG	2.0
2	L	149	GLN	2.0
2	L	154	ASN	2.0
1	H	211	ASN	2.0
1	H	216	ASN	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.