



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 09:12 AM UTC

PDB ID : 7KFY / pdb_00007kfy
Title : Structural basis for a germline-biased antibody response to SARS-CoV-2 (RBD:C1A-F10 Fab)
Authors : Pan, J.; Abraham, J.; Clark, L.; Clark, S.
Deposited on : 2020-10-15
Resolution : 2.16 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
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
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) : 2.49

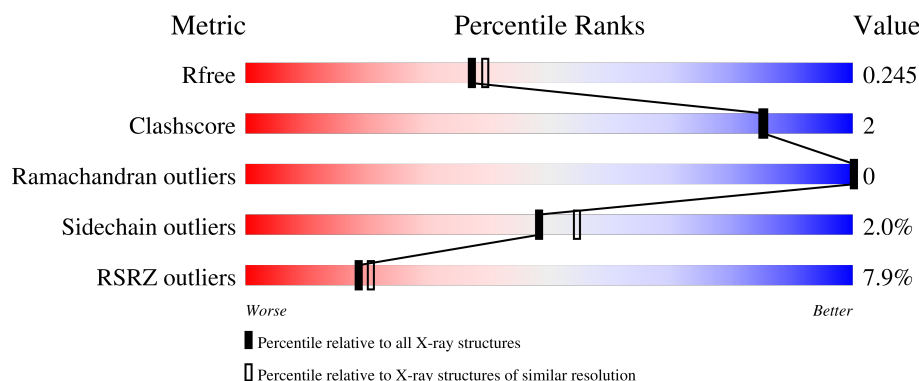
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.16 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}	180053	2057 (2.16-2.16)
Clashscore	190562	2159 (2.16-2.16)
Ramachandran outliers	187476	2134 (2.16-2.16)
Sidechain outliers	187428	2133 (2.16-2.16)
RSRZ outliers	180081	2059 (2.16-2.16)

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 $\leq 5\%$. 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	228	13% 79% 7% 14%
2	H	225	5% 92% 7% .
3	L	214	4% 90% 9%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5411 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 Spike glycoprotein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	195	Total	C	N	O	S	0	0	0
			1545	991	258	288	8			

There are 5 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	314	GLY	-	expression tag	UNP P0DTC2
A	315	SER	-	expression tag	UNP P0DTC2
A	316	GLY	-	expression tag	UNP P0DTC2
A	317	SER	-	expression tag	UNP P0DTC2
A	318	GLY	-	expression tag	UNP P0DTC2

- Molecule 2 is a protein called heavy chain of human antibody C1A-F10 Fab.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	H	223	Total	C	N	O	S	0	2	0
			1669	1047	282	333	7			

- Molecule 3 is a protein called light chain of human antibody C1A-F10 Fab.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	L	214	Total	C	N	O	S	0	2	0
			1651	1031	278	336	6			

- Molecule 4 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: C₈H₁₅NO₆).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			14	8	1	5		

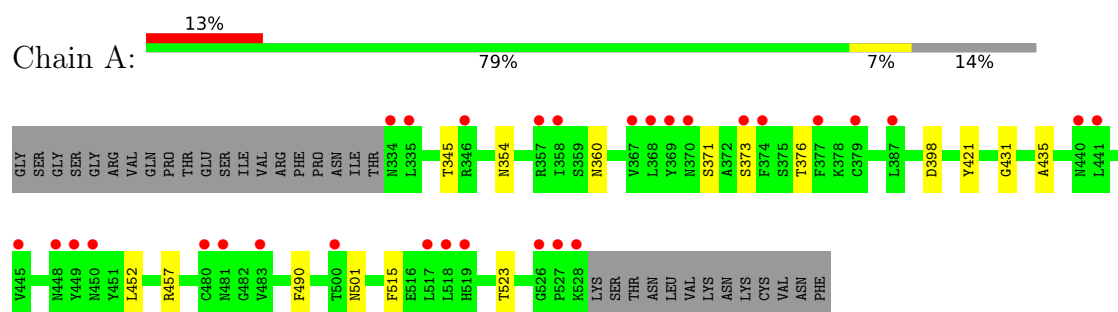
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	115	Total	O	0	0
			115	115		
5	H	228	Total	O	0	0
			228	228		
5	L	189	Total	O	0	0
			189	189		

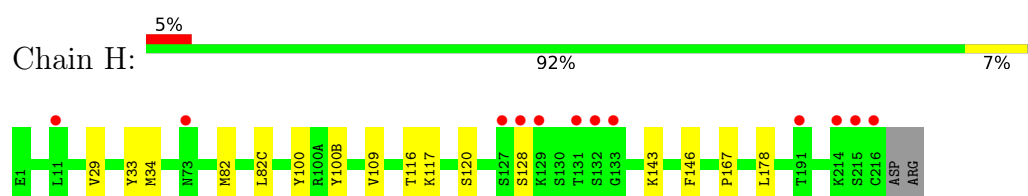
3 Residue-property plots [i](#)

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.

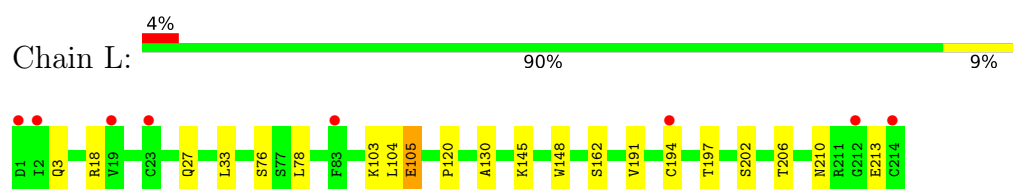
- Molecule 1: Spike glycoprotein



- Molecule 2: heavy chain of human antibody C1A-F10 Fab



- Molecule 3: light chain of human antibody C1A-F10 Fab



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	85.74Å 146.80Å 144.59Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	74.04 – 2.16 74.04 – 2.16	Depositor EDS
% Data completeness (in resolution range)	97.9 (74.04-2.16) 97.9 (74.04-2.16)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.69 (at 2.16Å)	Xtriage
Refinement program	BUSTER 2.10.3	Depositor
R, R_{free}	0.205 , 0.249 0.206 , 0.245	Depositor DCC
R_{free} test set	2585 reflections (5.34%)	wwPDB-VP
Wilson B-factor (Å ²)	43.9	Xtriage
Anisotropy	0.326	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 65.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.015 for 1/2*h-1/2*k,-3/2*h-1/2*k,-l 0.018 for 1/2*h+1/2*k,3/2*h-1/2*k,-l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5411	wwPDB-VP
Average B, all atoms (Å ²)	52.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.70% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: NAG

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	0.68	0/1589	0.97	2/2162 (0.1%)
2	H	0.71	0/1707	0.98	2/2324 (0.1%)
3	L	0.73	0/1685	1.00	0/2287
All	All	0.71	0/4981	0.98	4/6773 (0.1%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	490	PHE	N-CA-C	-5.45	102.78	109.65
2	H	33	TYR	N-CA-C	-5.09	101.67	109.76
2	H	143	LYS	N-CA-C	5.08	117.77	109.59
1	A	501	ASN	CA-CB-CG	5.00	117.61	112.60

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	A	1545	0	1465	6	0
2	H	1669	0	1629	7	0
3	L	1651	0	1606	9	0
4	A	14	0	13	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	115	0	0	0	0
5	H	228	0	0	1	0
5	L	189	0	0	0	0
All	All	5411	0	4713	21	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 2.

All (21) 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:H:82:MET:HB3	2:H:82(C):LEU:HD21	1.85	0.58
2:H:29:VAL:HG13	2:H:34:MET:HG3	1.85	0.58
3:L:78:LEU:HD11	3:L:104:LEU:HD21	1.86	0.57
3:L:148:TRP:CZ3	3:L:194[A]:CYS:HB3	2.42	0.54
2:H:167:PRO:HD2	3:L:162:SER:OG	2.09	0.52
1:A:371:SER:OG	1:A:373:SER:OG	2.30	0.50
1:A:360:ASN:H	1:A:523:THR:HB	1.77	0.50
3:L:103:LYS:HE2	3:L:105:GLU:HB3	1.95	0.48
1:A:431:GLY:HA2	1:A:515:PHE:CD2	2.50	0.46
2:H:117:LYS:NZ	5:H:306:HOH:O	2.48	0.45
1:A:421:TYR:CD1	1:A:457:ARG:HB3	2.52	0.45
1:A:376:THR:HB	1:A:435:ALA:HB3	1.99	0.44
2:H:82:MET:HE1	2:H:109:VAL:HG21	1.99	0.44
1:A:354:ASN:O	1:A:398:ASP:HA	2.18	0.43
2:H:100:TYR:CE2	2:H:100(B):TYR:HB2	2.53	0.43
3:L:18:ARG:HG3	3:L:76:SER:HA	2.01	0.42
3:L:194[B]:CYS:O	3:L:206:THR:HA	2.20	0.41
2:H:116:THR:HA	2:H:146:PHE:O	2.20	0.41
3:L:191:VAL:HG22	3:L:210:ASN:ND2	2.36	0.41
3:L:145:LYS:HB3	3:L:197:THR:HB	2.03	0.41
3:L:120:PRO:HG3	3:L:130:ALA:HB1	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 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	193/228 (85%)	188 (97%)	5 (3%)	0	100	100
2	H	223/225 (99%)	217 (97%)	6 (3%)	0	100	100
3	L	214/214 (100%)	210 (98%)	4 (2%)	0	100	100
All	All	630/667 (94%)	615 (98%)	15 (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 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	168/198 (85%)	166 (99%)	2 (1%)	63	70
2	H	187/187 (100%)	184 (98%)	3 (2%)	55	61
3	L	188/186 (101%)	182 (97%)	6 (3%)	34	36
All	All	543/571 (95%)	532 (98%)	11 (2%)	48	54

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	345	THR
1	A	452	LEU
2	H	120	SER
2	H	128	SER
2	H	178	LEU

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Mol	Chain	Res	Type
3	L	3	GLN
3	L	27	GLN
3	L	33	LEU
3	L	105	GLU
3	L	202	SER
3	L	213	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	334	ASN
1	A	360	ASN
1	A	450	ASN
1	A	498	GLN
1	A	501	ASN
2	H	39	GLN
2	H	81	GLN
2	H	199	ASN
3	L	38	GLN
3	L	92	ASN
3	L	147	GLN
3	L	160	GLN
3	L	210	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](#)

1 ligand is modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
4	NAG	A	601	1	14,14,15	0.32	0	17,19,21	0.76	1 (5%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	NAG	A	601	1	-	0/6/23/26	0/1/1/1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	601	NAG	C1-O5-C5	2.37	115.37	112.19

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.7 Other polymers [i](#)

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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, 95th 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	195/228 (85%)	0.98	30 (15%) 5 5	21, 58, 93, 117	0
2	H	223/225 (99%)	0.47	12 (5%) 31 35	18, 44, 73, 127	2 (0%)
3	L	214/214 (100%)	0.48	8 (3%) 45 49	6, 49, 67, 86	2 (0%)
All	All	632/667 (94%)	0.63	50 (7%) 18 20	6, 49, 85, 127	4 (0%)

All (50) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	528	LYS	4.5
2	H	133	GLY	4.2
1	A	370	ASN	4.2
2	H	132	SER	4.1
3	L	214	CYS	3.9
1	A	369	TYR	3.7
2	H	191	THR	3.7
1	A	450	ASN	3.3
1	A	518	LEU	3.3
2	H	129	LYS	3.3
2	H	73	ASN	3.1
3	L	23	CYS	3.1
3	L	194[A]	CYS	3.1
1	A	387	LEU	3.1
1	A	445	VAL	3.0
2	H	216	CYS	2.9
1	A	517	LEU	2.9
1	A	346	ARG	2.8
1	A	519	HIS	2.7
2	H	215	SER	2.7
1	A	334	ASN	2.7
1	A	449	TYR	2.6
2	H	128	SER	2.6

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Mol	Chain	Res	Type	RSRZ
1	A	335	LEU	2.6
1	A	368	LEU	2.6
2	H	131	THR	2.6
3	L	212	GLY	2.6
1	A	374	PHE	2.5
3	L	2	ILE	2.5
1	A	441	LEU	2.5
1	A	500	THR	2.5
1	A	367	VAL	2.5
3	L	19	VAL	2.4
1	A	373	SER	2.4
1	A	357	ARG	2.4
2	H	11	LEU	2.4
1	A	440	ASN	2.4
1	A	448	ASN	2.3
1	A	377	PHE	2.3
1	A	526	GLY	2.3
1	A	481	ASN	2.2
1	A	358	ILE	2.2
3	L	1	ASP	2.2
1	A	527	PRO	2.1
3	L	83	PHE	2.1
1	A	379	CYS	2.1
2	H	127	SER	2.1
1	A	480	CYS	2.0
1	A	483	VAL	2.0
2	H	214	LYS	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](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum,

median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	NAG	A	601	14/15	0.78	0.16	100,101,101,102	0

6.5 Other polymers [i](#)

There are no such residues in this entry.