



# Full wwPDB X-ray Structure Validation Report ⓘ

Apr 17, 2021 – 07:17 PM JST

PDB ID : 7CH5  
Title : Crystal structure of the SARS-CoV-2 S RBD in complex with BD-629 Fab  
Authors : Du, S.; Xiao, J.Y.  
Deposited on : 2020-07-05  
Resolution : 2.70 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](mailto: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.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.18  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.18

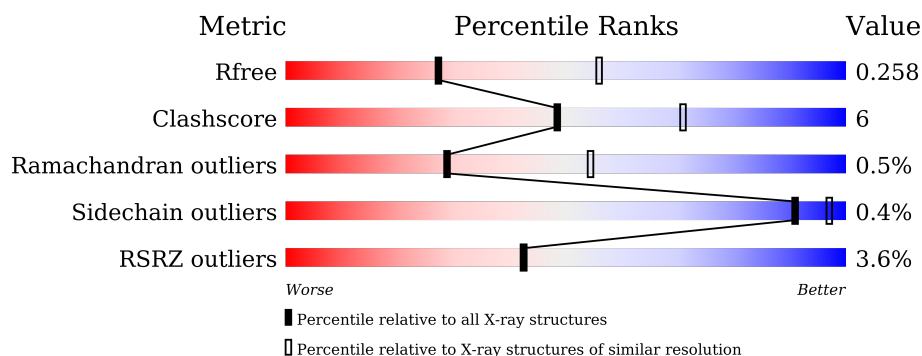
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.70 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))
$R_{free}$	130704	2808 (2.70-2.70)
Clashscore	141614	3122 (2.70-2.70)
Ramachandran outliers	138981	3069 (2.70-2.70)
Sidechain outliers	138945	3069 (2.70-2.70)
RSRZ outliers	127900	2737 (2.70-2.70)

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  $\geq 3$ , 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  $\leq 5\%$ . 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	H	222	<div> <div> <div></div> <div>83%</div> <div>11%</div> <div>5%</div> </div> </div>
2	L	214	<div> <div> <div></div> <div>88%</div> <div>11%</div> <div></div> </div> </div>
3	R	223	<div> <div> <div></div> <div>70%</div> <div>11%</div> <div>18%</div> </div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4687 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 BD-629 Fab H.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	H	211	Total	C	N	O	S	0	0	0
			1595	1009	265	315	6			

- Molecule 2 is a protein called BD-629 Fab L.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	213	Total	C	N	O	S	0	0	0
			1630	1017	281	328	4			

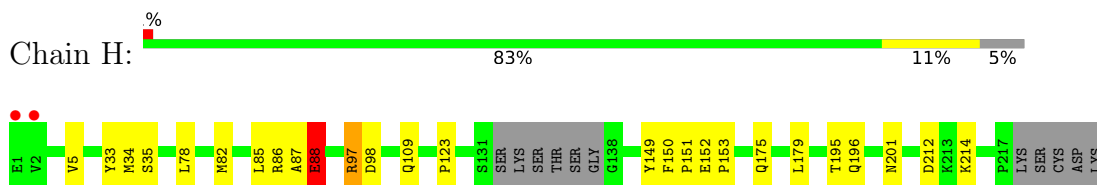
- Molecule 3 is a protein called Spike protein S1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	R	183	Total	C	N	O	S	0	0	0
			1462	937	243	275	7			

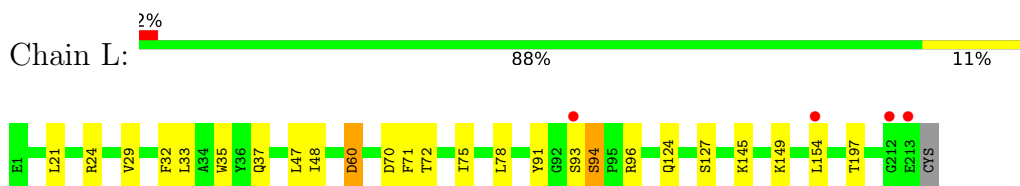
### 3 Residue-property plots [i](#)

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.

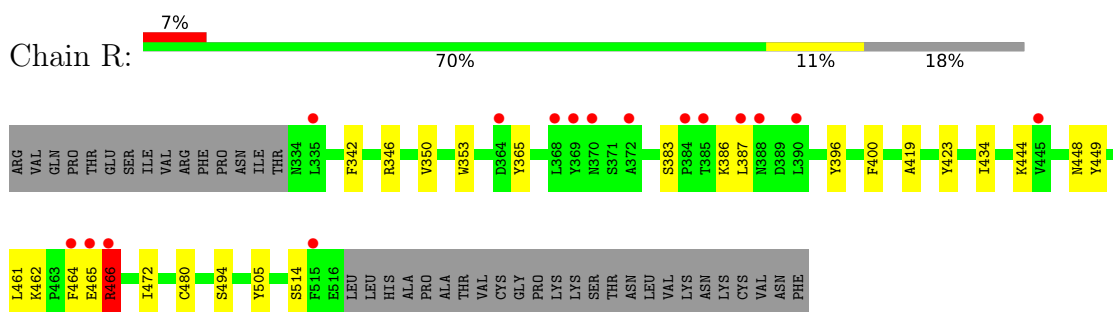
- Molecule 1: BD-629 Fab H



- Molecule 2: BD-629 Fab L



- Molecule 3: Spike protein S1



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	56.05Å 102.35Å 164.82Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.16 – 2.70 49.16 – 2.70	Depositor EDS
% Data completeness (in resolution range)	99.5 (49.16-2.70) 94.6 (49.16-2.70)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.09 (at 2.69Å)	Xtriage
Refinement program	PHENIX 1.18.2_3874	Depositor
R, $R_{free}$	0.227 , 0.260 0.226 , 0.258	Depositor DCC
$R_{free}$ test set	1337 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	35.0	Xtriage
Anisotropy	1.079	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 30.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.91	EDS
Total number of atoms	4687	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	44.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.68% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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

### 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	H	0.40	1/1633 (0.1%)	0.62	1/2225 (0.0%)
2	L	0.33	0/1665	0.57	0/2259
3	R	0.37	0/1503	0.63	1/2043 (0.0%)
All	All	0.36	1/4801 (0.0%)	0.61	2/6527 (0.0%)

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
1	H	0	2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	H	88	GLU	CD-OE2	7.02	1.33	1.25

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	R	466	ARG	NE-CZ-NH1	-10.18	115.21	120.30
1	H	97	ARG	CB-CG-CD	5.51	125.93	111.60

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	H	87	ALA	Peptide
1	H	88	GLU	Sidechain

## 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	H	1595	0	1549	17	0
2	L	1630	0	1588	17	0
3	R	1462	0	1378	23	0
All	All	4687	0	4515	55	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 (55) 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)
3:R:464:PHE:HA	3:R:466:ARG:HH12	1.18	1.03
3:R:464:PHE:HA	3:R:466:ARG:NH1	1.83	0.93
3:R:342:PHE:HE2	3:R:434:ILE:HD11	1.38	0.86
3:R:353:TRP:HZ2	3:R:466:ARG:NE	1.76	0.84
1:H:201:ASN:ND2	1:H:212:ASP:OD2	2.10	0.83
3:R:353:TRP:HE1	3:R:466:ARG:HG2	1.45	0.81
2:L:24:ARG:NH1	2:L:70:ASP:OD1	2.20	0.75
3:R:472:ILE:HD11	3:R:480:CYS:HB3	1.69	0.72
2:L:149:LYS:HE2	2:L:154:LEU:HD22	1.73	0.69
3:R:342:PHE:CE2	3:R:434:ILE:HD11	2.26	0.69
3:R:353:TRP:HZ2	3:R:466:ARG:CZ	2.10	0.65
1:H:175:GLN:HG2	1:H:179:LEU:O	1.97	0.64
3:R:350:VAL:O	3:R:353:TRP:HD1	1.81	0.64
2:L:35:TRP:HD1	2:L:48:ILE:HD11	1.63	0.63
2:L:149:LYS:HE2	2:L:154:LEU:CD2	2.28	0.63
1:H:82:MET:HB3	1:H:85:LEU:HD21	1.80	0.62
3:R:353:TRP:CZ2	3:R:466:ARG:CZ	2.85	0.60
2:L:60:ASP:N	2:L:60:ASP:OD1	2.35	0.57
1:H:33:TYR:HB2	1:H:98:ASP:O	2.07	0.55
1:H:34:MET:HB3	1:H:78:LEU:HD22	1.88	0.55
3:R:353:TRP:CZ2	3:R:466:ARG:NE	2.67	0.54
1:H:97:ARG:HG2	1:H:98:ASP:N	2.24	0.53
3:R:462:LYS:HB2	3:R:465:GLU:HB3	1.91	0.52
1:H:195:THR:OG1	1:H:196:GLN:N	2.43	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:L:37:GLN:HB2	2:L:47:LEU:HD11	1.91	0.52
1:H:5:VAL:HA	1:H:109:GLN:HE22	1.75	0.51
2:L:35:TRP:CD1	2:L:48:ILE:HD11	2.46	0.50
2:L:33:LEU:HD22	2:L:71:PHE:CG	2.47	0.49
2:L:93:SER:OG	2:L:94:SER:N	2.46	0.49
1:H:35:SER:OG	1:H:98:ASP:OD2	2.33	0.47
2:L:145:LYS:HD2	2:L:145:LYS:C	2.35	0.47
3:R:449:TYR:HA	3:R:494:SER:OG	2.13	0.47
1:H:123:PRO:HB3	1:H:149:TYR:HB3	1.97	0.47
3:R:461:LEU:HD13	3:R:466:ARG:HG3	1.96	0.47
2:L:124:GLN:O	2:L:127:SER:OG	2.33	0.46
1:H:152:GLU:HB3	1:H:153:PRO:HA	1.98	0.46
3:R:353:TRP:HB3	3:R:400:PHE:HB3	1.98	0.45
3:R:365:TYR:CD2	3:R:387:LEU:HB3	2.53	0.44
3:R:396:TYR:HB2	3:R:514:SER:HB2	1.99	0.43
3:R:464:PHE:CA	3:R:466:ARG:NH1	2.67	0.43
3:R:383:SER:HB3	3:R:386:LYS:HB2	2.00	0.42
2:L:32:PHE:HB3	2:L:91:TYR:CD1	2.54	0.42
3:R:444:LYS:HG2	3:R:448:ASN:HB2	2.01	0.42
1:H:214:LYS:HE2	1:H:214:LYS:HB3	1.83	0.42
3:R:419:ALA:HA	3:R:423:TYR:O	2.20	0.42
3:R:466:ARG:HE	3:R:466:ARG:HB2	1.29	0.42
1:H:86:ARG:HD3	1:H:88:GLU:OE1	2.20	0.41
2:L:29:VAL:HA	3:R:505:TYR:OH	2.20	0.41
2:L:21:LEU:O	2:L:72:THR:HA	2.20	0.41
2:L:145:LYS:HE3	2:L:197:THR:HB	2.02	0.41
1:H:98:ASP:CG	2:L:96:ARG:HH12	2.24	0.41
1:H:150:PHE:HA	1:H:151:PRO:HA	1.84	0.41
1:H:33:TYR:HB2	1:H:98:ASP:HB3	2.04	0.40
1:H:33:TYR:CB	1:H:98:ASP:HB3	2.52	0.40
2:L:75:ILE:HG21	2:L:78:LEU:HD23	2.03	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	H	207/222 (93%)	201 (97%)	5 (2%)	1 (0%)	29	54
2	L	211/214 (99%)	198 (94%)	11 (5%)	2 (1%)	17	40
3	R	181/223 (81%)	172 (95%)	9 (5%)	0	100	100
All	All	599/659 (91%)	571 (95%)	25 (4%)	3 (0%)	29	54

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	H	88	GLU
2	L	94	SER
2	L	60	ASP

### 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	H	178/188 (95%)	178 (100%)	0	100	100
2	L	183/184 (100%)	183 (100%)	0	100	100
3	R	159/196 (81%)	157 (99%)	2 (1%)	69	87
All	All	520/568 (92%)	518 (100%)	2 (0%)	91	97

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	R	346	ARG
3	R	466	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	H	109	GLN
1	H	175	GLN

### 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 monosaccharides 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 [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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	H	211/222 (95%)	0.12	2 (0%) 84 85	26, 42, 61, 87	0
2	L	213/214 (99%)	0.15	4 (1%) 66 69	28, 41, 57, 75	0
3	R	183/223 (82%)	0.47	16 (8%) 10 8	27, 45, 80, 91	0
All	All	607/659 (92%)	0.23	22 (3%) 42 42	26, 42, 67, 91	0

All (22) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	H	1	GLU	6.0
2	L	212	GLY	5.1
3	R	384	PRO	4.2
3	R	466	ARG	3.9
3	R	388	ASN	3.8
3	R	387	LEU	3.4
2	L	213	GLU	3.4
3	R	364	ASP	3.1
2	L	154	LEU	3.0
1	H	2	VAL	2.8
3	R	465	GLU	2.7
3	R	369	TYR	2.6
3	R	464	PHE	2.5
3	R	515	PHE	2.5
3	R	335	LEU	2.4
3	R	370	ASN	2.3
3	R	368	LEU	2.3
3	R	390	LEU	2.2
3	R	445	VAL	2.1
3	R	372	ALA	2.1
2	L	93	SER	2.1
3	R	385	THR	2.1

## 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 monosaccharides 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.