



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 12, 2026 – 02:32 PM UTC

PDB ID : 7WHC / pdb_00007whc
Title : Crystal structure of SARS-CoV-2 3CLpro catalytic domain
Authors : Shin, D.H.; Jo, S.R.
Deposited on : 2021-12-30
Resolution : 2.27 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 : 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

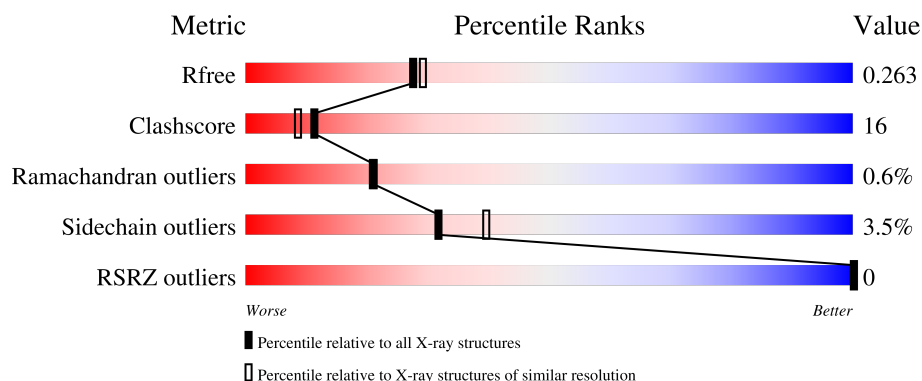
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.27 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	1898 (2.26-2.26)
Clashscore	190562	2005 (2.26-2.26)
Ramachandran outliers	187476	1965 (2.26-2.26)
Sidechain outliers	187428	1966 (2.26-2.26)
RSRZ outliers	180081	1898 (2.26-2.26)

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	196	 76% 16% • 7%
1	B	196	 70% 22% • 7%
1	C	196	 62% 27% • 7%
1	D	196	 60% 30% • 7%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5777 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 3C-like proteinase nsp5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	182	Total	C	N	O	S	0	0	0
			1407	890	241	260	16			
1	B	182	Total	C	N	O	S	0	0	0
			1407	890	241	260	16			
1	C	182	Total	C	N	O	S	0	0	0
			1407	890	241	260	16			
1	D	182	Total	C	N	O	S	0	0	0
			1407	890	241	260	16			

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	53	Total	O	0	0
			53	53		
2	B	47	Total	O	0	0
			47	47		
2	C	23	Total	O	0	0
			23	23		
2	D	26	Total	O	0	0
			26	26		

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.

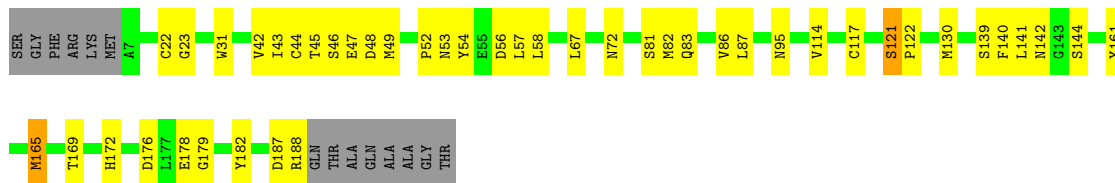
- Molecule 1: 3C-like proteinase nsp5

Chain A: 



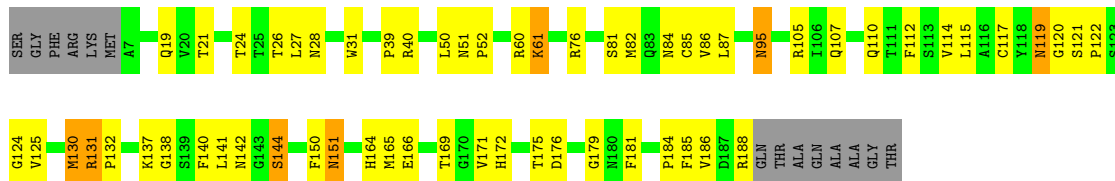
- Molecule 1: 3C-like proteinase nsp5

Chain B: 



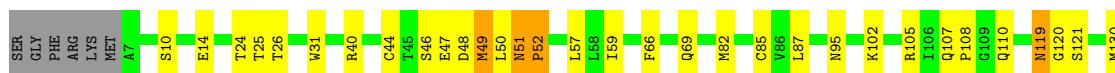
- Molecule 1: 3C-like proteinase nsp5

Chain C: 



- Molecule 1: 3C-like proteinase nsp5

Chain D: 



R131	F132	M133	F134	T135	I136	K137	G138	S139	F140	L141	N142	G143	S144	C145	I152	D155	C156	H163	H164	M165	E166	L167	P168	T169	G170	V171	H172	T175	G179	N180	F181	Y182	G183	P184	F185	V186	D187	R188	GLN	THR	ALA	ALA	GLN	ALA	ALA	GLY	THR
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4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	52.47Å 121.09Å 62.70Å 90.00° 90.01° 90.00°	Depositor
Resolution (Å)	31.99 – 2.27 31.99 – 2.27	Depositor EDS
% Data completeness (in resolution range)	84.5 (31.99-2.27) 84.4 (31.99-2.27)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.55 (at 2.26Å)	Xtriage
Refinement program	PHENIX 1.9_1692	Depositor
R, R_{free}	0.197 , 0.264 0.207 , 0.263	Depositor DCC
R_{free} test set	2007 reflections (5.55%)	wwPDB-VP
Wilson B-factor (Å ²)	39.8	Xtriage
Anisotropy	0.388	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 32.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.487 for h,-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5777	wwPDB-VP
Average B, all atoms (Å ²)	48.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.42% 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](#)

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	0.55	0/1442	0.94	2/1957 (0.1%)
1	B	0.61	0/1442	0.98	3/1957 (0.2%)
1	C	0.55	0/1442	1.03	10/1957 (0.5%)
1	D	0.56	1/1442 (0.1%)	1.07	12/1957 (0.6%)
All	All	0.57	1/5768 (0.0%)	1.00	27/7828 (0.3%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	119	ASN	C-N	-5.91	1.25	1.33

The worst 5 of 27 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	155	ASP	N-CA-C	-11.18	99.89	114.31
1	D	120	GLY	N-CA-C	-9.79	101.05	115.63
1	B	139	SER	N-CA-C	7.64	119.96	109.11
1	C	144	SER	N-CA-C	-7.57	103.93	113.01
1	C	119	ASN	N-CA-C	7.26	121.94	111.56

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	1407	0	1364	33	0
1	B	1407	0	1364	42	0
1	C	1407	0	1364	59	0
1	D	1407	0	1364	56	0
2	A	53	0	0	2	0
2	B	47	0	0	1	0
2	C	23	0	0	0	0
2	D	26	0	0	1	0
All	All	5777	0	5456	180	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 16.

The worst 5 of 180 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:116:ALA:HB2	1:A:140:PHE:CE1	1.85	1.11
1:B:44:CYS:SG	1:B:57:LEU:HD13	1.90	1.10
1:A:116:ALA:HB2	1:A:140:PHE:HE1	0.96	1.08
1:D:140:PHE:HB2	1:D:172:HIS:NE2	1.78	0.98
1:C:140:PHE:O	1:C:141:LEU:HG	1.68	0.92

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 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	180/196 (92%)	174 (97%)	6 (3%)	0	100	100
1	B	180/196 (92%)	167 (93%)	12 (7%)	1 (1%)	21	21
1	C	180/196 (92%)	170 (94%)	10 (6%)	0	100	100
1	D	180/196 (92%)	160 (89%)	17 (9%)	3 (2%)	7	3

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	720/784 (92%)	671 (93%)	45 (6%)	4 (1%)	21	21

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	46	SER
1	D	139	SER
1	D	51	ASN
1	D	52	PRO

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	159/168 (95%)	157 (99%)	2 (1%)	61	72
1	B	159/168 (95%)	156 (98%)	3 (2%)	50	61
1	C	159/168 (95%)	152 (96%)	7 (4%)	25	29
1	D	159/168 (95%)	149 (94%)	10 (6%)	16	16
All	All	636/672 (95%)	614 (96%)	22 (4%)	32	39

5 of 22 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	47	GLU
1	D	59	ILE
1	D	57	LEU
1	D	69	GLN
1	C	50	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 7 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	151	ASN

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Mol	Chain	Res	Type
1	C	172	HIS
1	D	172	HIS
1	D	119	ASN
1	C	142	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 [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	182/196 (92%)	-1.38	0 100 100	26, 38, 68, 87	0
1	B	182/196 (92%)	-1.38	0 100 100	25, 39, 70, 85	0
1	C	182/196 (92%)	-1.21	0 100 100	32, 52, 83, 92	0
1	D	182/196 (92%)	-1.21	0 100 100	31, 52, 81, 89	0
All	All	728/784 (92%)	-1.30	0 100 100	25, 45, 79, 92	0

There are no RSRZ outliers to report.

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.