



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 04:08 PM UTC

PDB ID : 9F8Y / pdb_00009f8y
Title : Crystal structure of a designed three-motif Respiratory Syncytial Virus immunogen
Authors : Castro, K.M.; Correia, B.E.
Deposited on : 2024-05-07
Resolution : 2.30 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	:	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

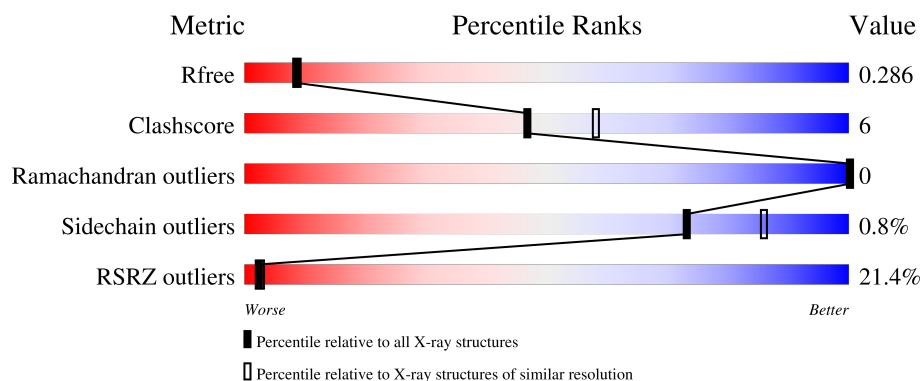
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	146	11% 77% 5% 16%
1	B	146	26% 73% 10% 16%
1	C	146	16% 80% 5% 14%
1	D	146	18% 70% 13% 16%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3747 atoms, of which 0 are hydrogens and 0 are deuteriums.

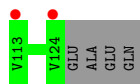
In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called RSVF-multi-3.5 designed scaffold.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	D	122	Total	C	N	O	S	0	0	0
			925	586	157	179	3			
1	A	122	Total	C	N	O	S	0	0	0
			923	590	152	178	3			
1	B	122	Total	C	N	O	S	0	0	0
			904	574	157	170	3			
1	C	125	Total	C	N	O	S	0	0	0
			933	591	159	180	3			

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	D	19	Total	O	0	0
			19	19		
2	A	13	Total	O	0	0
			13	13		
2	B	16	Total	O	0	0
			16	16		
2	C	14	Total	O	0	0
			14	14		



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	46.84Å 106.43Å 113.59Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	77.67 – 2.30 77.67 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.3 (77.67-2.30) 99.4 (77.67-2.30)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.66 (at 2.29Å)	Xtrriage
Refinement program	PHENIX 1.20.1_4487, PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.260 , 0.283 0.260 , 0.286	Depositor DCC
R_{free} test set	1365 reflections (5.23%)	wwPDB-VP
Wilson B-factor (Å ²)	54.6	Xtrriage
Anisotropy	0.149	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 48.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	3747	wwPDB-VP
Average B, all atoms (Å ²)	66.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 52.53 % 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 4.8023e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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	0/933	0.81	1/1262 (0.1%)
1	B	0.72	0/913	0.97	0/1234
1	C	0.56	0/944	0.83	0/1278
1	D	0.69	0/934	0.97	2/1259 (0.2%)
All	All	0.63	0/3724	0.90	3/5033 (0.1%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	106	ILE	N-CA-C	-5.84	107.00	111.62
1	D	111	THR	CA-C-N	-5.01	116.10	122.77
1	D	111	THR	C-N-CA	-5.01	116.10	122.77

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	923	0	909	8	0
1	B	904	0	888	20	0
1	C	933	0	910	5	0
1	D	925	0	921	12	0
2	A	13	0	0	0	0
2	B	16	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	14	0	0	0	0
2	D	19	0	0	1	0
All	All	3747	0	3628	42	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 (42) 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:71:ALA:HB2	1:B:113:VAL:HG22	1.58	0.86
1:B:96:CYS:SG	1:B:109:PHE:HB2	2.29	0.72
1:B:71:ALA:HA	1:B:113:VAL:HG21	1.71	0.71
1:B:20:ASP:CB	1:B:38:ILE:HD13	2.20	0.71
1:B:111:THR:HG23	1:B:111:THR:O	1.97	0.65
1:B:71:ALA:HB2	1:B:113:VAL:CG2	2.28	0.62
1:A:40:ASP:O	1:A:41:GLU:C	2.44	0.60
1:A:100:ASP:HB2	1:A:106:ILE:HD11	1.85	0.58
1:D:108:THR:HB	1:A:108:THR:HB	1.85	0.57
1:A:1:MET:SD	1:A:83:LEU:HD22	2.45	0.57
1:A:55:LEU:HD21	1:C:55:LEU:HD21	1.86	0.57
1:B:113:VAL:HG22	1:B:113:VAL:O	2.07	0.55
1:B:20:ASP:CB	1:B:38:ILE:CD1	2.84	0.54
1:D:40:ASP:OD1	1:D:44:GLU:N	2.40	0.54
1:A:1:MET:HG2	1:A:83:LEU:HD22	1.92	0.52
1:B:71:ALA:CA	1:B:113:VAL:CG2	2.89	0.50
1:A:6:ALA:HB3	1:A:120:PHE:HB2	1.94	0.50
1:B:71:ALA:CA	1:B:113:VAL:HG21	2.41	0.49
1:B:111:THR:O	1:B:111:THR:CG2	2.61	0.48
1:B:38:ILE:HG13	1:B:39:LYS:H	1.78	0.48
1:D:97:GLU:OE2	1:D:99:ARG:NE	2.47	0.47
1:B:17:SER:O	1:B:20:ASP:N	2.48	0.46
1:B:71:ALA:HA	1:B:113:VAL:CG2	2.43	0.46
1:B:71:ALA:CB	1:B:113:VAL:CG2	2.94	0.46
1:D:55:LEU:HD21	1:B:55:LEU:HD21	1.97	0.46
1:D:81:LYS:NZ	2:D:202:HOH:O	2.46	0.45
1:C:111:THR:O	1:C:111:THR:HG23	2.17	0.45
1:B:40:ASP:C	1:B:42:ASN:H	2.24	0.44
1:D:15:ARG:HG3	1:D:99:ARG:NH1	2.32	0.44
1:D:100:ASP:O	1:D:101:LYS:C	2.60	0.44
1:D:107:LYS:HB2	1:D:107:LYS:HE3	1.87	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:24:ILE:HG12	1:D:50:VAL:HG11	2.00	0.43
1:A:1:MET:CG	1:A:83:LEU:HD22	2.49	0.43
1:B:96:CYS:HG	1:B:109:PHE:HB2	1.83	0.42
1:D:3:LEU:HD23	1:D:123:ARG:HA	2.02	0.42
1:C:2:LYS:HG2	1:C:54:THR:HG22	2.03	0.41
1:C:81:LYS:O	1:C:87:ARG:HD2	2.21	0.41
1:B:12:LYS:O	1:B:13:VAL:C	2.64	0.41
1:D:113:VAL:HG23	1:D:115:LEU:HG	2.02	0.41
1:B:38:ILE:HG13	1:B:39:LYS:N	2.35	0.41
1:C:97:GLU:CD	1:C:99:ARG:HE	2.29	0.40
1:D:5:ILE:HG21	1:D:61:TYR:CE2	2.55	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 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	118/146 (81%)	116 (98%)	2 (2%)	0	100	100
1	B	118/146 (81%)	109 (92%)	9 (8%)	0	100	100
1	C	123/146 (84%)	120 (98%)	3 (2%)	0	100	100
1	D	118/146 (81%)	116 (98%)	2 (2%)	0	100	100
All	All	477/584 (82%)	461 (97%)	16 (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	95/131 (72%)	94 (99%)	1 (1%)	65	81
1	B	89/131 (68%)	88 (99%)	1 (1%)	65	81
1	C	95/131 (72%)	95 (100%)	0	100	100
1	D	96/131 (73%)	95 (99%)	1 (1%)	68	82
All	All	375/524 (72%)	372 (99%)	3 (1%)	73	86

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	101	LYS
1	A	108	THR
1	B	106	ILE

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

Mol	Chain	Res	Type
1	A	78	ASN
1	C	32	ASN

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 [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, 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	122/146 (83%)	1.06	16 (13%) 7 8	35, 64, 94, 128	0
1	B	122/146 (83%)	1.55	38 (31%) 1 1	36, 71, 112, 128	0
1	C	125/146 (85%)	1.17	24 (19%) 3 3	35, 65, 95, 117	0
1	D	122/146 (83%)	1.29	27 (22%) 2 2	33, 65, 102, 124	0
All	All	491/584 (84%)	1.27	105 (21%) 2 3	33, 68, 105, 128	0

All (105) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	105	ILE	6.1
1	D	106	ILE	5.5
1	B	38	ILE	4.5
1	D	42	ASN	4.4
1	A	44	GLU	4.2
1	B	124	VAL	4.2
1	C	113	VAL	4.0
1	B	96	CYS	4.0
1	B	16	LEU	3.8
1	B	113	VAL	3.8
1	D	104	GLY	3.7
1	B	43	GLY	3.7
1	B	36	VAL	3.7
1	C	124	VAL	3.7
1	B	105	ILE	3.7
1	B	48	VAL	3.6
1	B	104	GLY	3.5
1	B	46	ILE	3.5
1	D	16	LEU	3.5
1	C	41	GLU	3.4
1	B	102	ASN	3.4

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Mol	Chain	Res	Type	RSRZ
1	D	101	LYS	3.4
1	C	96	CYS	3.4
1	C	42	ASN	3.4
1	D	110	SER	3.3
1	A	102	ASN	3.3
1	D	1	MET	3.3
1	A	1	MET	3.3
1	B	42	ASN	3.1
1	D	100	ASP	3.0
1	C	3	LEU	3.0
1	A	41	GLU	3.0
1	B	111	THR	3.0
1	B	121	PHE	2.9
1	B	109	PHE	2.9
1	D	96	CYS	2.8
1	C	43	GLY	2.8
1	B	40	ASP	2.8
1	B	116	ASP	2.8
1	D	124	VAL	2.8
1	D	46	ILE	2.8
1	A	109	PHE	2.7
1	C	109	PHE	2.7
1	D	86	GLY	2.7
1	D	41	GLU	2.7
1	A	111	THR	2.7
1	B	18	GLU	2.7
1	B	39	LYS	2.7
1	D	99	ARG	2.7
1	D	29	LYS	2.7
1	C	28	LEU	2.7
1	D	21	ILE	2.6
1	B	3	LEU	2.6
1	C	14	LYS	2.6
1	D	109	PHE	2.5
1	B	74	LEU	2.5
1	A	124	VAL	2.5
1	B	13	VAL	2.5
1	A	32	ASN	2.5
1	B	34	ALA	2.5
1	D	26	SER	2.5
1	C	111	THR	2.4
1	C	37	THR	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	110	SER	2.4
1	B	120	PHE	2.4
1	C	13	VAL	2.4
1	B	99	ARG	2.4
1	B	52	LEU	2.4
1	C	108	THR	2.4
1	B	8	VAL	2.4
1	B	21	ILE	2.3
1	B	35	VAL	2.3
1	A	103	ARG	2.3
1	A	38	ILE	2.3
1	B	24	ILE	2.3
1	B	106	ILE	2.3
1	D	45	GLU	2.3
1	D	43	GLY	2.3
1	B	27	ALA	2.3
1	C	36	VAL	2.3
1	B	14	LYS	2.3
1	D	108	THR	2.3
1	A	101	LYS	2.3
1	D	3	LEU	2.2
1	B	112	ASP	2.2
1	C	112	ASP	2.2
1	C	0	SER	2.2
1	B	15	ARG	2.2
1	C	18	GLU	2.2
1	A	14	LYS	2.2
1	C	26	SER	2.2
1	A	15	ARG	2.2
1	C	15	ARG	2.2
1	D	120	PHE	2.2
1	B	11	PRO	2.2
1	D	111	THR	2.2
1	C	1	MET	2.1
1	B	47	GLU	2.1
1	D	82	ALA	2.1
1	A	45	GLU	2.1
1	C	47	GLU	2.1
1	D	15	ARG	2.1
1	A	105	ILE	2.0
1	C	38	ILE	2.0
1	C	46	ILE	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.