



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 08:15 PM UTC

PDB ID : 9CR9 / pdb\_00009cr9  
Title : Crystal structure of MA6 Fab in complex with PfCSP repeat region peptide NPNA3  
Authors : Rush, S.A.; McLellan, J.S.  
Deposited on : 2024-07-21  
Resolution : 1.80 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.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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

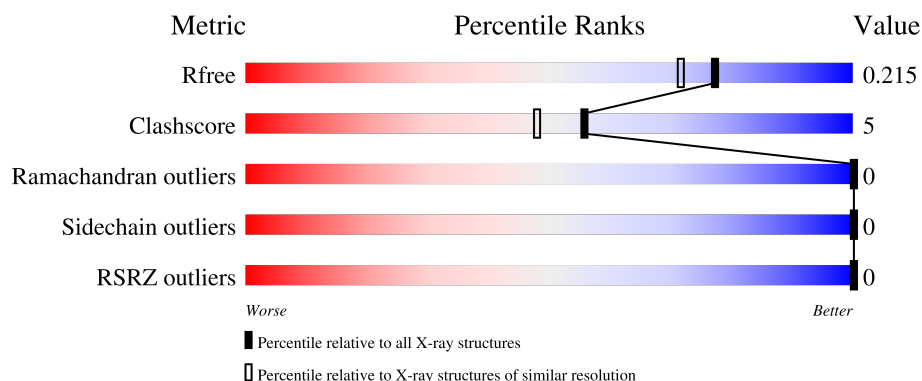
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.80 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	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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	A	235	
1	H	235	
2	B	213	
2	L	213	
3	C	12	

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Mol	Chain	Length	Quality of chain
3	P	12	 75% 25%

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 7814 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 MA6 Fab heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	216	Total	C	N	O	S	0	0	0
			1631	1032	278	315	6			
1	H	218	Total	C	N	O	S	0	0	0
			1641	1037	280	318	6			

- Molecule 2 is a protein called MA6 Fab light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	210	Total	C	N	O	S	0	0	0
			1626	1022	271	329	4			
2	L	210	Total	C	N	O	S	0	0	0
			1626	1022	271	329	4			

- Molecule 3 is a protein called Circumsporozoite protein (NPNA)3 repeat region peptide.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	9	Total	C	N	O	0	0	0
			64	36	14	14			
3	P	9	Total	C	N	O	0	0	0
			64	36	14	14			

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	303	Total	O	0	0
			303	303		
4	B	292	Total	O	0	0
			292	292		
4	C	10	Total	O	0	0
			10	10		
4	H	286	Total	O	0	0
			286	286		

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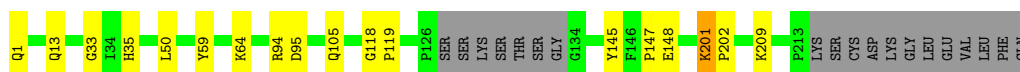
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	L	261	Total 261	O 261	0	0
4	P	10	Total 10	O 10	0	0

### 3 Residue-property plots


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.

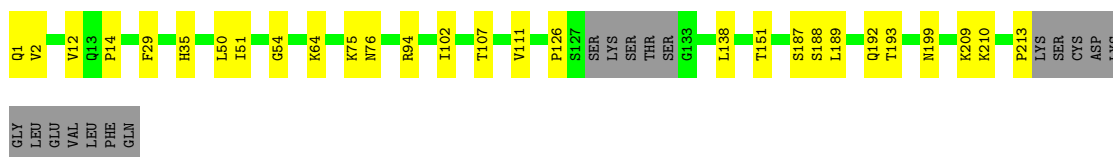
- Molecule 1: MA6 Fab heavy chain

Chain A: 




- Molecule 1: MA6 Fab heavy chain

Chain H: 




- Molecule 2: MA6 Fab light chain

Chain B: 



- Molecule 2: MA6 Fab light chain

Chain L: 



- Molecule 3: Circumsporozoite protein (NPNA)3 repeat region peptide

Chain C: 



- Molecule 3: Circumsporozoite protein (NPNA)3 repeat region peptide



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	46.60Å 61.05Å 153.00Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.72 – 1.80 47.72 – 1.80	Depositor EDS
% Data completeness (in resolution range)	93.3 (47.72-1.80) 93.3 (47.72-1.80)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.09 (at 1.79Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, $R_{free}$	0.185 , 0.215 0.184 , 0.215	Depositor DCC
$R_{free}$ test set	3714 reflections (4.65%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	17.1	Xtriage
Anisotropy	0.747	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 26.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.427 for h,-k,-l	Xtriage
$F_o, F_c$ correlation	0.97	EDS
Total number of atoms	7814	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.12% 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 [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	0.67	3/1673 (0.2%)	0.85	5/2280 (0.2%)
1	H	0.30	0/1683	0.51	0/2293
2	B	0.40	0/1663	0.58	0/2260
2	L	0.43	0/1663	0.60	0/2260
3	C	3.01	2/65 (3.1%)	2.67	3/90 (3.3%)
3	P	0.93	0/65	1.01	0/90
All	All	0.56	5/6812 (0.1%)	0.70	8/9273 (0.1%)

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	6	PRO	N-CA	19.72	1.70	1.47
1	A	201	LYS	C-N	14.04	1.50	1.33
1	A	118	GLY	C-N	13.35	1.50	1.33
3	C	5	ASN	C-N	11.95	1.45	1.33
1	A	148	GLU	C-N	8.23	1.49	1.34

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	5	ASN	CA-C-N	15.16	137.28	120.45
3	C	5	ASN	C-N-CA	15.16	137.28	120.45
1	A	201	LYS	CA-C-N	13.52	133.35	119.56
1	A	201	LYS	C-N-CA	13.52	133.35	119.56
1	A	118	GLY	CA-C-N	12.02	132.88	120.14
1	A	118	GLY	C-N-CA	12.02	132.88	120.14
3	C	6	PRO	CA-N-CD	-7.06	102.12	112.00
1	A	118	GLY	O-C-N	-5.33	116.44	121.77

There are no chirality outliers.

There are no planarity outliers.

## 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	1631	0	1583	11	0
1	H	1641	0	1591	23	0
2	B	1626	0	1581	13	0
2	L	1626	0	1581	15	0
3	C	64	0	56	2	0
3	P	64	0	56	0	0
4	A	303	0	0	4	4
4	B	292	0	0	4	3
4	C	10	0	0	0	0
4	H	286	0	0	11	3
4	L	261	0	0	8	3
4	P	10	0	0	0	1
All	All	7814	0	6448	62	7

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 5.

All (62) 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:C:6:PRO:CA	3:C:6:PRO:N	1.70	1.41
1:A:1:GLN:N	4:A:301:HOH:O	1.92	1.02
1:H:187:SER:OG	4:H:301:HOH:O	1.95	0.83
2:B:185:ASP:OD1	4:B:301:HOH:O	1.96	0.83
1:A:13:GLN:OE1	4:A:302:HOH:O	1.95	0.83
1:H:189:LEU:O	4:H:302:HOH:O	1.98	0.80
2:L:10:THR:OG1	4:L:301:HOH:O	2.05	0.72
1:H:213:PRO:O	4:H:303:HOH:O	2.08	0.72
2:B:24:ARG:NH1	2:B:70:GLU:OE2	2.24	0.71
1:H:75:LYS:NZ	4:H:308:HOH:O	2.27	0.68
2:L:186:GLU:OE1	4:L:302:HOH:O	2.11	0.67
2:L:187:LYS:NZ	4:L:309:HOH:O	2.28	0.66
1:H:193:THR:HG23	1:H:210:LYS:HE3	1.79	0.62
1:A:33:GLY:HA3	3:C:6:PRO:HB2	1.84	0.60
2:B:21:ILE:HD11	2:B:73:LEU:HD23	1.86	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:H:51:ILE:HG12	1:H:54:GLY:HA2	1.86	0.57
1:H:2:VAL:HG11	1:H:102:ILE:HD13	1.86	0.56
2:B:145:LYS:HB3	2:B:197:THR:OG1	2.06	0.56
2:L:37:GLN:HB2	2:L:47:LEU:HD11	1.89	0.55
1:A:105:GLN:NE2	4:A:303:HOH:O	2.14	0.54
1:H:126:PRO:HG3	1:H:138:LEU:HB3	1.92	0.52
1:H:188:SER:OG	4:H:304:HOH:O	2.18	0.52
1:A:119:PRO:HB3	1:A:145:TYR:HB3	1.92	0.51
2:B:168:SER:OG	4:B:304:HOH:O	2.19	0.51
1:H:1:GLN:O	4:H:305:HOH:O	2.18	0.51
1:H:64:LYS:NZ	4:H:317:HOH:O	2.41	0.50
2:L:122:GLU:OE1	4:L:303:HOH:O	2.19	0.50
1:A:59:TYR:HB2	1:A:64:LYS:HG3	1.93	0.50
2:L:168:LYS:HB2	4:L:307:HOH:O	2.10	0.50
1:H:94:ARG:CZ	1:H:102:ILE:HD12	2.42	0.50
1:H:1:GLN:NE2	4:H:311:HOH:O	2.33	0.49
2:B:197:THR:HG23	4:B:426:HOH:O	2.13	0.48
1:H:35:HIS:CE1	1:H:50:LEU:HD13	2.49	0.47
1:A:201:LYS:HB2	4:A:356:HOH:O	2.14	0.47
1:H:107:THR:OG1	4:H:306:HOH:O	2.20	0.47
2:L:22:THR:HG22	2:L:72:THR:HG22	1.97	0.47
2:L:167:SER:HB3	4:L:447:HOH:O	2.14	0.47
2:L:165:GLN:HG3	2:L:172:TYR:CZ	2.49	0.46
2:L:2:ILE:HD12	2:L:93:SER:HB3	1.98	0.46
1:H:151:THR:OG1	1:H:199:ASN:HB3	2.15	0.46
2:B:33:LEU:HD22	2:B:71:PHE:CG	2.52	0.45
1:A:94:ARG:HG2	1:A:95:ASP:O	2.17	0.45
2:L:142:GLU:H	2:L:142:GLU:CD	2.25	0.45
1:H:51:ILE:CG1	1:H:54:GLY:HA2	2.47	0.45
1:H:192:GLN:HG3	4:H:492:HOH:O	2.17	0.44
1:H:209:LYS:NZ	4:H:324:HOH:O	2.50	0.44
2:B:105:GLU:HG2	2:B:106:ILE:N	2.32	0.44
1:A:35:HIS:CE1	1:A:50:LEU:HD13	2.53	0.44
2:L:184:ASP:OD1	4:L:304:HOH:O	2.21	0.44
2:L:187:LYS:HE2	4:L:304:HOH:O	2.16	0.43
2:L:33:LEU:HD22	2:L:71:PHE:CG	2.54	0.43
1:H:189:LEU:HD23	1:H:189:LEU:HA	1.87	0.43
1:A:209:LYS:HD2	1:A:209:LYS:HA	1.83	0.43
2:B:199:GLN:NE2	4:B:302:HOH:O	2.09	0.43
2:L:124:LEU:O	2:L:182:LYS:HD3	2.19	0.42
2:B:153:ALA:HA	1:H:14:PRO:HB2	2.01	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:75:ILE:HG21	2:B:78:LEU:HD23	2.01	0.41
2:B:37:GLN:HB2	2:B:47:LEU:HD11	2.01	0.41
1:A:147:PRO:HD2	1:A:202:PRO:HB2	2.03	0.41
1:H:29:PHE:CD2	1:H:76:ASN:HA	2.56	0.41
1:H:12:VAL:O	1:H:111:VAL:HA	2.21	0.40
2:B:22:THR:HG22	2:B:72:THR:HG22	2.04	0.40

All (7) 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)
4:H:576:HOH:O	4:L:481:HOH:O[1_455]	1.80	0.40
4:A:481:HOH:O	4:L:517:HOH:O[1_455]	1.84	0.36
4:A:428:HOH:O	4:B:305:HOH:O[1_455]	1.89	0.31
4:H:563:HOH:O	4:P:109:HOH:O[2_646]	1.91	0.29
4:B:547:HOH:O	4:H:468:HOH:O[1_465]	2.02	0.18
4:A:458:HOH:O	4:L:483:HOH:O[1_455]	2.17	0.03
4:A:414:HOH:O	4:B:489:HOH:O[1_565]	2.19	0.01

## 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	212/235 (90%)	209 (99%)	3 (1%)	0	100	100
1	H	214/235 (91%)	212 (99%)	2 (1%)	0	100	100
2	B	208/213 (98%)	203 (98%)	5 (2%)	0	100	100
2	L	208/213 (98%)	205 (99%)	3 (1%)	0	100	100
3	C	7/12 (58%)	7 (100%)	0	0	100	100
3	P	7/12 (58%)	6 (86%)	1 (14%)	0	100	100
All	All	856/920 (93%)	842 (98%)	14 (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	180/197 (91%)	180 (100%)	0	100	100
1	H	181/197 (92%)	181 (100%)	0	100	100
2	B	186/188 (99%)	186 (100%)	0	100	100
2	L	186/188 (99%)	186 (100%)	0	100	100
3	C	7/9 (78%)	7 (100%)	0	100	100
3	P	7/9 (78%)	7 (100%)	0	100	100
All	All	747/788 (95%)	747 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
2	B	152	ASN
1	H	13	GLN
2	L	188	HIS
2	L	209	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 [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, 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	A	216/235 (91%)	-1.48	0 100 100	9, 19, 41, 59	0
1	H	218/235 (92%)	-1.46	0 100 100	10, 20, 43, 65	0
2	B	210/213 (98%)	-1.48	0 100 100	11, 21, 36, 47	0
2	L	210/213 (98%)	-1.50	0 100 100	11, 21, 34, 47	0
3	C	9/12 (75%)	-1.31	0 100 100	17, 19, 26, 48	0
3	P	9/12 (75%)	-1.42	0 100 100	15, 19, 24, 57	0
All	All	872/920 (94%)	-1.48	0 100 100	9, 20, 39, 65	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.