



# Full wwPDB/EMDatabank EM Map/Model Validation Report ⓘ

Feb 20, 2018 – 12:15 am GMT

PDB ID : 5MCX  
EMDB ID: : EMD-3465  
Title : The structure of the mature HIV-1 CA hexamer in intact virus particles  
Authors : Mattei, S.; Glass, B.; Hagen, W.J.H.; Kraeusslich, H.-G.; Briggs, J.A.G.  
Deposited on : 2016-11-10  
Resolution : 6.80 Å(reported)  
Based on PDB ID : 4XFX, 3H4E

This is a Full wwPDB/EMDatabank EM Map/Model Validation Report  
for a publicly released PDB/EMDB 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/EMValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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MolProbity : 4.02b-467  
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk30686

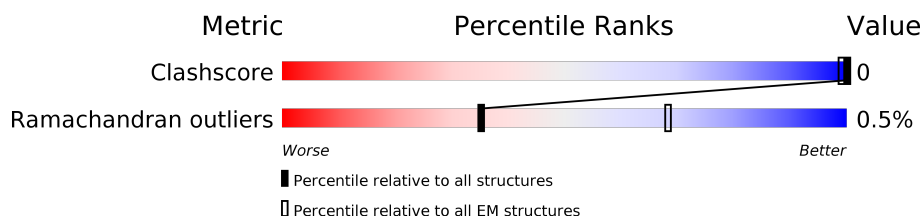
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 6.80 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)	EM structures (#Entries)
Clashscore	136279	1886
Ramachandran outliers	132675	1663

The table below summarises the geometric issues observed across the polymeric chains. The red, orange, yellow and green segments on the bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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  $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	221	 98% .
1	B	221	 98% .
1	C	221	 98% .
1	D	221	 98% .
1	E	221	 98% .
1	F	221	 98% .
1	G	221	 98% .
1	I	221	 98% .
1	J	221	 98% .
1	K	221	 98% .
1	L	221	 98% .

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Mol	Chain	Length	Quality of chain
1	N	221	 98% .
1	O	221	 98% .
1	P	221	 98% .
1	Q	221	 98% .
1	R	221	 98% .
1	S	221	 98% .
1	U	221	 98% .
1	V	221	 98% .
1	W	221	 98% .
1	Y	221	 98% .
1	Z	221	 98% .
1	b	221	 98% .
1	c	221	 98% .

## 2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 21192 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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 Capsid protein p24.

Mol	Chain	Residues	Atoms				AltConf	Trace
1	A	221	Total	C	N	O	0	0
			883	442	221	220		
1	B	221	Total	C	N	O	0	0
			883	442	221	220		
1	C	221	Total	C	N	O	0	0
			883	442	221	220		
1	D	221	Total	C	N	O	0	0
			883	442	221	220		
1	E	221	Total	C	N	O	0	0
			883	442	221	220		
1	F	221	Total	C	N	O	0	0
			883	442	221	220		
1	I	221	Total	C	N	O	0	0
			883	442	221	220		
1	J	221	Total	C	N	O	0	0
			883	442	221	220		
1	K	221	Total	C	N	O	0	0
			883	442	221	220		
1	U	221	Total	C	N	O	0	0
			883	442	221	220		
1	V	221	Total	C	N	O	0	0
			883	442	221	220		
1	W	221	Total	C	N	O	0	0
			883	442	221	220		
1	Z	221	Total	C	N	O	0	0
			883	442	221	220		
1	b	221	Total	C	N	O	0	0
			883	442	221	220		
1	R	221	Total	C	N	O	0	0
			883	442	221	220		
1	c	221	Total	C	N	O	0	0
			883	442	221	220		
1	G	221	Total	C	N	O	0	0
			883	442	221	220		

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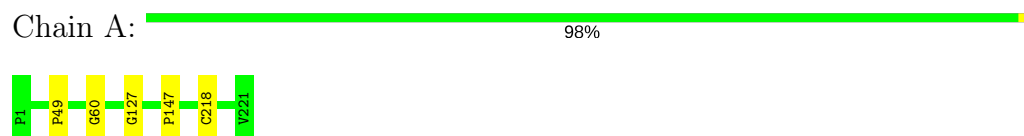
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Mol	Chain	Residues	Atoms				AltConf	Trace
1	S	221	Total 883	C 442	N 221	O 220	0	0
1	L	221	Total 883	C 442	N 221	O 220	0	0
1	N	221	Total 883	C 442	N 221	O 220	0	0
1	P	221	Total 883	C 442	N 221	O 220	0	0
1	O	221	Total 883	C 442	N 221	O 220	0	0
1	Q	221	Total 883	C 442	N 221	O 220	0	0
1	Y	221	Total 883	C 442	N 221	O 220	0	0

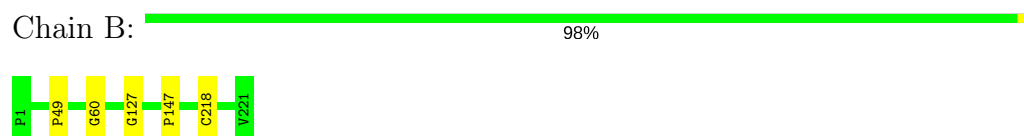
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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. 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. 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.

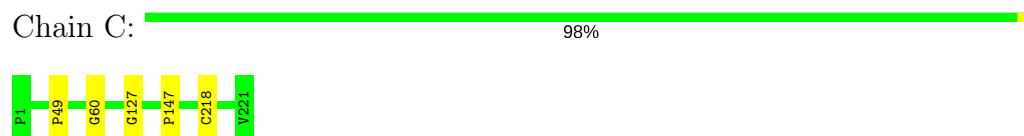
- Molecule 1: Capsid protein p24



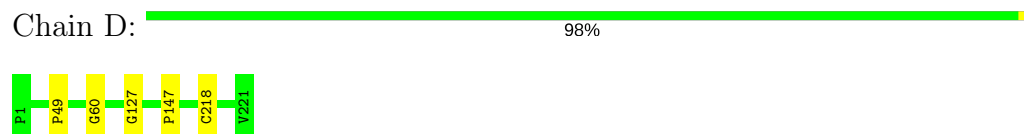
- Molecule 1: Capsid protein p24



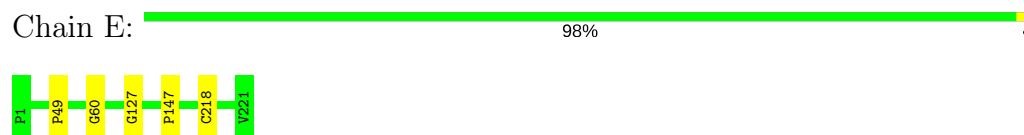
- Molecule 1: Capsid protein p24



- Molecule 1: Capsid protein p24

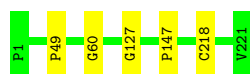


- Molecule 1: Capsid protein p24



- Molecule 1: Capsid protein p24





- Molecule 1: Capsid protein p24

Chain I:  98%



- Molecule 1: Capsid protein p24

Chain J:  98%



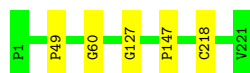
- Molecule 1: Capsid protein p24

Chain K:  98%



- Molecule 1: Capsid protein p24

Chain U:  98%



- Molecule 1: Capsid protein p24

Chain V:  98%



- Molecule 1: Capsid protein p24

Chain W:  98%



- Molecule 1: Capsid protein p24

Chain Z:  98%



- Molecule 1: Capsid protein p24

Chain b:  98%



- Molecule 1: Capsid protein p24

Chain R:  98%



- Molecule 1: Capsid protein p24

Chain c:  98%



- Molecule 1: Capsid protein p24

Chain G:  98%



- Molecule 1: Capsid protein p24

Chain S:  98%



- Molecule 1: Capsid protein p24

Chain L:  98%



- Molecule 1: Capsid protein p24

Chain N:  98%



- Molecule 1: Capsid protein p24



Chain P:  98% .



- Molecule 1: Capsid protein p24

Chain O:  98% .



- Molecule 1: Capsid protein p24

Chain Q:  98% .



- Molecule 1: Capsid protein p24

Chain Y:  98% .



## 4 Experimental information

Property	Value	Source
Reconstruction method	SUBTOMOGRAM AVERAGING	Depositor
Imposed symmetry	POINT, C6	Depositor
Number of subtomograms used	72836	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING ONLY; CTF correction was performed using the ctfphaseflip program in IMOD prior to backprojection.	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ( $e^-/\text{\AA}^2$ )	2.2	Depositor
Minimum defocus (nm)	2000	Depositor
Maximum defocus (nm)	6500	Depositor
Magnification	81000	Depositor
Image detector	GATAN K2 QUANTUM (4k x 4k)	Depositor

## 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  > 2$	RMSZ	# $ Z  > 2$
1	A	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	B	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	C	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	D	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	E	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	F	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	G	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	I	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	J	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	K	1.45	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	L	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	N	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	O	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	P	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	Q	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	R	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	S	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	U	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	V	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	W	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	Y	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	Z	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	b	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
1	c	1.44	3/882 (0.3%)	1.50	1/1101 (0.1%)
All	All	1.44	72/21168 (0.3%)	1.50	24/26424 (0.1%)

All (72) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	N	60	GLY	CA-C	-6.68	1.41	1.51
1	b	60	GLY	CA-C	-6.67	1.41	1.51
1	G	60	GLY	CA-C	-6.66	1.41	1.51
1	Q	60	GLY	CA-C	-6.65	1.41	1.51

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	V	60	GLY	CA-C	-6.63	1.41	1.51
1	J	60	GLY	CA-C	-6.62	1.41	1.51
1	C	60	GLY	CA-C	-6.61	1.41	1.51
1	E	60	GLY	CA-C	-6.59	1.41	1.51
1	A	60	GLY	CA-C	-6.56	1.41	1.51
1	D	60	GLY	CA-C	-6.53	1.41	1.51
1	F	60	GLY	CA-C	-6.53	1.41	1.51
1	K	60	GLY	CA-C	-6.51	1.41	1.51
1	Y	60	GLY	CA-C	-6.51	1.41	1.51
1	B	60	GLY	CA-C	-6.50	1.41	1.51
1	S	60	GLY	CA-C	-6.49	1.41	1.51
1	W	60	GLY	CA-C	-6.49	1.41	1.51
1	R	60	GLY	CA-C	-6.49	1.41	1.51
1	I	60	GLY	CA-C	-6.48	1.41	1.51
1	U	60	GLY	CA-C	-6.48	1.41	1.51
1	P	60	GLY	CA-C	-6.46	1.41	1.51
1	Z	60	GLY	CA-C	-6.44	1.41	1.51
1	c	60	GLY	CA-C	-6.39	1.41	1.51
1	L	60	GLY	CA-C	-6.39	1.41	1.51
1	O	127	GLY	N-CA	6.37	1.55	1.46
1	O	60	GLY	CA-C	-6.37	1.41	1.51
1	L	127	GLY	N-CA	6.33	1.55	1.46
1	c	127	GLY	N-CA	6.30	1.55	1.46
1	B	127	GLY	N-CA	6.29	1.55	1.46
1	U	127	GLY	N-CA	6.29	1.55	1.46
1	Z	127	GLY	N-CA	6.29	1.55	1.46
1	I	127	GLY	N-CA	6.27	1.55	1.46
1	K	127	GLY	N-CA	6.27	1.55	1.46
1	E	127	GLY	N-CA	6.25	1.55	1.46
1	R	127	GLY	N-CA	6.25	1.55	1.46
1	A	127	GLY	N-CA	6.24	1.55	1.46
1	F	127	GLY	N-CA	6.23	1.55	1.46
1	S	127	GLY	N-CA	6.22	1.55	1.46
1	W	127	GLY	N-CA	6.22	1.55	1.46
1	N	127	GLY	N-CA	6.20	1.55	1.46
1	Y	127	GLY	N-CA	6.20	1.55	1.46
1	P	127	GLY	N-CA	6.20	1.55	1.46
1	Q	127	GLY	N-CA	6.20	1.55	1.46
1	D	127	GLY	N-CA	6.19	1.55	1.46
1	J	127	GLY	N-CA	6.19	1.55	1.46
1	V	127	GLY	N-CA	6.19	1.55	1.46
1	b	127	GLY	N-CA	6.19	1.55	1.46

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	127	GLY	N-CA	6.19	1.55	1.46
1	G	127	GLY	N-CA	6.18	1.55	1.46
1	L	49	PRO	CA-C	-5.59	1.41	1.52
1	c	49	PRO	CA-C	-5.58	1.41	1.52
1	O	49	PRO	CA-C	-5.57	1.41	1.52
1	Z	49	PRO	CA-C	-5.55	1.41	1.52
1	F	49	PRO	CA-C	-5.54	1.41	1.52
1	I	49	PRO	CA-C	-5.53	1.41	1.52
1	E	49	PRO	CA-C	-5.52	1.41	1.52
1	U	49	PRO	CA-C	-5.52	1.41	1.52
1	P	49	PRO	CA-C	-5.52	1.41	1.52
1	R	49	PRO	CA-C	-5.51	1.41	1.52
1	S	49	PRO	CA-C	-5.51	1.41	1.52
1	Y	49	PRO	CA-C	-5.50	1.41	1.52
1	B	49	PRO	CA-C	-5.50	1.41	1.52
1	W	49	PRO	CA-C	-5.49	1.41	1.52
1	K	49	PRO	CA-C	-5.48	1.41	1.52
1	C	49	PRO	CA-C	-5.47	1.42	1.52
1	D	49	PRO	CA-C	-5.46	1.42	1.52
1	A	49	PRO	CA-C	-5.45	1.42	1.52
1	b	49	PRO	CA-C	-5.44	1.42	1.52
1	V	49	PRO	CA-C	-5.44	1.42	1.52
1	J	49	PRO	CA-C	-5.43	1.42	1.52
1	G	49	PRO	CA-C	-5.42	1.42	1.52
1	Q	49	PRO	CA-C	-5.39	1.42	1.52
1	N	49	PRO	CA-C	-5.37	1.42	1.52

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	O	218	CYS	O-C-N	-5.81	113.41	122.70
1	A	218	CYS	O-C-N	-5.77	113.46	122.70
1	Z	218	CYS	O-C-N	-5.77	113.47	122.70
1	L	218	CYS	O-C-N	-5.77	113.47	122.70
1	c	218	CYS	O-C-N	-5.77	113.47	122.70
1	B	218	CYS	O-C-N	-5.76	113.48	122.70
1	P	218	CYS	O-C-N	-5.75	113.50	122.70
1	Y	218	CYS	O-C-N	-5.75	113.50	122.70
1	E	218	CYS	O-C-N	-5.74	113.51	122.70
1	U	218	CYS	O-C-N	-5.74	113.51	122.70
1	I	218	CYS	O-C-N	-5.74	113.51	122.70
1	J	218	CYS	O-C-N	-5.74	113.52	122.70

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	S	218	CYS	O-C-N	-5.73	113.53	122.70
1	b	218	CYS	O-C-N	-5.73	113.53	122.70
1	C	218	CYS	O-C-N	-5.72	113.54	122.70
1	V	218	CYS	O-C-N	-5.72	113.54	122.70
1	G	218	CYS	O-C-N	-5.72	113.55	122.70
1	D	218	CYS	O-C-N	-5.72	113.55	122.70
1	W	218	CYS	O-C-N	-5.71	113.56	122.70
1	F	218	CYS	O-C-N	-5.70	113.58	122.70
1	N	218	CYS	O-C-N	-5.70	113.58	122.70
1	R	218	CYS	O-C-N	-5.69	113.60	122.70
1	Q	218	CYS	O-C-N	-5.69	113.60	122.70
1	K	218	CYS	O-C-N	-5.66	113.64	122.70

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	883	0	234	0	0
1	B	883	0	234	0	0
1	C	883	0	234	0	0
1	D	883	0	234	0	0
1	E	883	0	234	0	0
1	F	883	0	234	0	0
1	G	883	0	234	0	0
1	I	883	0	234	0	0
1	J	883	0	234	0	0
1	K	883	0	234	0	0
1	L	883	0	234	0	0
1	N	883	0	234	0	0
1	O	883	0	234	0	0
1	P	883	0	234	0	0
1	Q	883	0	234	0	0
1	R	883	0	234	0	0
1	S	883	0	234	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	U	883	0	234	0	0
1	V	883	0	234	0	0
1	W	883	0	234	0	0
1	Y	883	0	234	0	0
1	Z	883	0	234	0	0
1	b	883	0	234	0	0
1	c	883	0	234	0	0
All	All	21192	0	5616	0	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 0.

There are no clashes within the asymmetric unit.

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 PDB entries followed by that with respect to all EM entries.

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	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31 74
1	B	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31 74
1	C	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31 74
1	D	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31 74
1	E	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31 74
1	F	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31 74
1	G	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31 74
1	I	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31 74
1	J	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31 74
1	K	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31 74
1	L	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31 74

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	N	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31	74
1	O	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31	74
1	P	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31	74
1	Q	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31	74
1	R	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31	74
1	S	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31	74
1	U	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31	74
1	V	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31	74
1	W	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31	74
1	Y	219/221 (99%)	212 (97%)	6 (3%)	1 (0%)	31	74
1	Z	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31	74
1	b	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31	74
1	c	219/221 (99%)	213 (97%)	5 (2%)	1 (0%)	31	74
All	All	5256/5304 (99%)	5102 (97%)	130 (2%)	24 (0%)	35	74

All (24) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	147	PRO
1	B	147	PRO
1	C	147	PRO
1	D	147	PRO
1	E	147	PRO
1	F	147	PRO
1	I	147	PRO
1	J	147	PRO
1	K	147	PRO
1	U	147	PRO
1	V	147	PRO
1	W	147	PRO
1	Z	147	PRO
1	b	147	PRO
1	R	147	PRO
1	c	147	PRO
1	G	147	PRO
1	S	147	PRO
1	L	147	PRO

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Mol	Chain	Res	Type
1	N	147	PRO
1	P	147	PRO
1	O	147	PRO
1	Q	147	PRO
1	Y	147	PRO

### 5.3.2 Protein sidechains [i](#)

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

### 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 carbohydrates 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.