



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 05:06 PM GMT

PDB ID : 4H5L  
Title : Crystal Structure of Toscana Virus Nucleocapsid Protein Hexamer  
Authors : Raymond, D.D.; Smith, J.L.  
Deposited on : 2012-09-18  
Resolution : 2.75 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](mailto:validation@mail.wwpdb.org)  
A user guide is available at  
<http://wwpdb.org/validation/2016/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  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

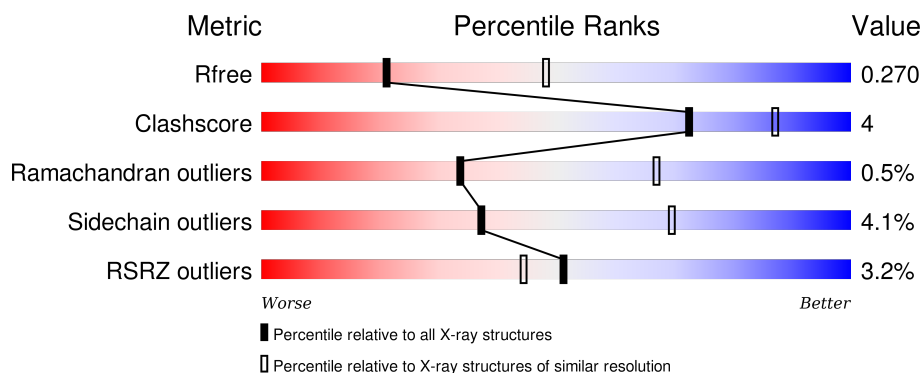
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.75 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))
$R_{free}$	91344	3340 (2.80-2.72)
Clashscore	102246	3829 (2.80-2.72)
Ramachandran outliers	100387	3767 (2.80-2.72)
Sidechain outliers	100360	3770 (2.80-2.72)
RSRZ outliers	91569	3352 (2.80-2.72)

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 on the lower 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  $\leq 5\%$ . 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	253	 3% 81% 14% • •
1	B	253	 2% 83% 13% •
1	C	253	 9% 85% 11% •
1	D	253	 80% 16% •
1	E	253	 2% 82% 14% •

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Mol	Chain	Length	Quality of chain
1	F	253	<div><div></div><div>3%</div><div>85%</div><div>11%</div><div></div></div>

## 2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 11238 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 Nucleoprotein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	243	Total	C	N	O	S	0	0	0
			1869	1186	325	347	11			
1	B	244	Total	C	N	O	S	0	0	0
			1870	1187	325	347	11			
1	C	244	Total	C	N	O	S	0	0	0
			1873	1188	326	348	11			
1	D	244	Total	C	N	O	S	0	0	0
			1873	1188	326	348	11			
1	E	244	Total	C	N	O	S	0	0	0
			1873	1188	326	348	11			
1	F	244	Total	C	N	O	S	0	0	0
			1863	1182	322	348	11			

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	O	0	0
			1	1		
2	B	2	Total	O	0	0
			2	2		
2	C	2	Total	O	0	0
			2	2		
2	D	5	Total	O	0	0
			5	5		
2	E	3	Total	O	0	0
			3	3		
2	F	4	Total	O	0	0
			4	4		

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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 ( $\text{RSRZ} > 2$ ). 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.

Chain A:

Sequence logo for Chain A showing amino acid conservation across 200 positions. The y-axis represents information content in bits (0.00 to 0.10). The x-axis shows positions 1 to 200. A horizontal bar at the top indicates the overall conservation: 81% (green), 14% (yellow), and 3% (red). Specific residues are highlighted with red dots above them: N165, I166, T192, N196, E197, V198, D233, V235, R248, and K79.

Chain B:

Sequence logo for Chain B. The y-axis represents information content in bits (0.00 to 0.04). The x-axis shows positions 1 to 190. The logo is color-coded: green for high conservation (0.03-0.04 bits), yellow for medium (0.01-0.02 bits), and grey for low (0.00-0.01 bits). A green bar at the top indicates 83% conservation, with a yellow bar for 13% and a grey bar for 2%.

Position	Amino Acid	Information Content (bits)
1	MET	0.00
2	SER	0.00
3	ASP	0.00
4	GLU	0.00
5	ASN	0.00
6	Y6	0.01
7	R7	0.01
8	L14	0.00
9	D19	0.00
10	G34	0.00
11	I40	0.00
12	V44	0.00
13	T49	0.00
14	V59	0.00
15	M66	0.00
16	L67	0.00
17	V68	0.00
18	R69	0.00
19	G70	0.00
20	N71	0.00
21	K72	0.00
22	P73	0.00
23	K79	0.00
24	I92	0.01
25	L97	0.01
26	P102	0.00
27	T108	0.00
28	L109	0.00
29	A114	0.00
30	V117	0.00
31	P118	0.00
32	W119	0.00
33	T120	0.00
34	V121	0.00
35	L127	0.00
36	A149	0.00
37	S154	0.00
38	I158	0.00
39	L190	0.00
40	K193	0.00
41	E197	0.01
42	F202	0.01
43	L223	0.00
44	I225	0.00
45	L230	0.00
46	D231	0.00
47	E232	0.00
48	V235	0.00
49	A249	0.00
50	LYS	0.00
51	VAL	0.00
52	GLY	0.00
53	LYS	0.00

Chain C:

9% 85% 11%

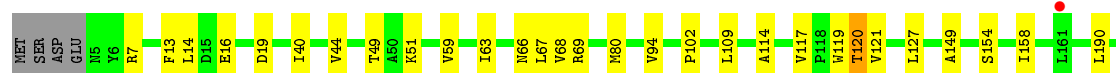
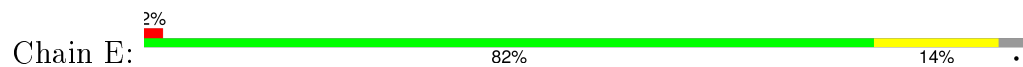
Sequence logo for Chain C showing amino acid conservation across 200 positions. The y-axis represents information content in bits (0.00 to 0.10). The x-axis shows positions 1 to 200. A bar chart at the top indicates the percentage of conserved residues: 9% (red), 85% (green), and 11% (yellow). Amino acid labels are shown below the plot, with red dots indicating conserved residues. The labels are: K193, N196, A199, N206, L224, V227, G228, L229, D230, D231, E232, L236, A237, S238, A239, V240, V241, R242, K246, R248, A248, LYS, VAL, GLY, LYS, A114, A115, F116, V117, P118, W119, T120, R125, V126, L127, A142, S154, H165, G166, A167, T170, I171, L190.

Chain D:

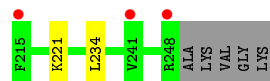
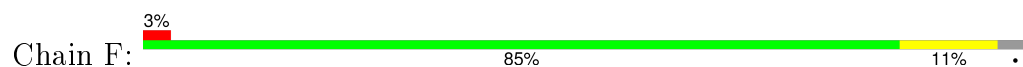
Metric	Value (%)
MET	~95
SER	~95
ASP	~95
GLU	~95
US	~95
Y6	~95
R7	~95
F13	~95
L14	~95
D19	~95
N28	~95
I40	~95
V44	~95
T49	~95
A50	~95
K51	~95
V59	~95
X60	~95
N66	~95
L67	~95
V68	~95
V68	~95
G70	~95
V94	~95
P102	~95
G103	~95
R104	~95
L109	~95
S113	~95
A114	~95
V117	~95
P118	~95
V119	~95
T120	~95
V121	~95
L127	~95
M138	~95
A149	~95
S154	~95
I168	~95
D172	~95



• Molecule 1: Nucleoprotein



• Molecule 1: Nucleoprotein



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	50.35Å 93.75Å 95.52Å 67.92° 85.94° 87.95°	Depositor
Resolution (Å)	50.22 – 2.75 50.22 – 2.75	Depositor EDS
% Data completeness (in resolution range)	95.2 (50.22-2.75) 84.0 (50.22-2.75)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.09	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.89 (at 2.77Å)	Xtriage
Refinement program	BUSTER 2.10	Depositor
R, $R_{free}$	0.219 , 0.238 0.251 , 0.270	Depositor DCC
$R_{free}$ test set	2022 reflections (5.33%)	DCC
Wilson B-factor (Å <sup>2</sup> )	52.5	Xtriage
Anisotropy	0.413	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 41.2	EDS
Estimated twinning fraction	0.020 for -h,-l,-k	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.28$	Xtriage
Outliers	0 of 39945 reflections	Xtriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	11238	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	82.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.99% 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, 0.375 respectively for untwinned datasets, and 0.333, 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	0.45	0/1900	0.60	0/2565
1	B	0.45	0/1902	0.61	0/2569
1	C	0.45	0/1905	0.59	0/2573
1	D	0.45	0/1905	0.60	0/2573
1	E	0.45	0/1905	0.58	0/2573
1	F	0.45	0/1895	0.59	0/2562
All	All	0.45	0/11412	0.60	0/15415

There are no bond length outliers.

There are no bond angle outliers.

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	1869	0	1908	16	0
1	B	1870	0	1911	19	0
1	C	1873	0	1912	16	0
1	D	1873	0	1912	20	0
1	E	1873	0	1912	19	0
1	F	1863	0	1890	15	0
2	A	1	0	0	0	0
2	B	2	0	0	0	0
2	C	2	0	0	0	0
2	D	5	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	E	3	0	0	0	0
2	F	4	0	0	0	0
All	All	11238	0	11445	94	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 4.

The worst 5 of 94 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:117:VAL:HA	1:A:120:THR:HG22	1.51	0.92
1:B:117:VAL:HA	1:B:120:THR:HG22	1.51	0.92
1:F:117:VAL:HA	1:F:120:THR:HG22	1.53	0.88
1:D:117:VAL:HA	1:D:120:THR:CG2	2.07	0.84
1:D:117:VAL:HA	1:D:120:THR:HG22	1.63	0.77

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	239/253 (94%)	226 (95%)	11 (5%)	2 (1%)	24	55
1	B	242/253 (96%)	231 (96%)	10 (4%)	1 (0%)	39	72
1	C	242/253 (96%)	230 (95%)	11 (4%)	1 (0%)	39	72
1	D	242/253 (96%)	231 (96%)	10 (4%)	1 (0%)	39	72
1	E	242/253 (96%)	234 (97%)	7 (3%)	1 (0%)	39	72
1	F	242/253 (96%)	233 (96%)	8 (3%)	1 (0%)	39	72
All	All	1449/1518 (96%)	1385 (96%)	57 (4%)	7 (0%)	34	67

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	232	GLU
1	A	102	PRO
1	B	102	PRO
1	C	102	PRO
1	D	102	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	198/206 (96%)	188 (95%)	10 (5%)	29	61
1	B	197/206 (96%)	189 (96%)	8 (4%)	37	69
1	C	198/206 (96%)	192 (97%)	6 (3%)	48	80
1	D	198/206 (96%)	188 (95%)	10 (5%)	29	61
1	E	198/206 (96%)	189 (96%)	9 (4%)	34	66
1	F	196/206 (95%)	190 (97%)	6 (3%)	47	79
All	All	1185/1236 (96%)	1136 (96%)	49 (4%)	37	69

5 of 49 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	206	ASN
1	D	40	ILE
1	F	19	ASP
1	D	7	ARG
1	D	49	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	66	ASN
1	A	71	ASN

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Mol	Chain	Res	Type
1	B	71	ASN
1	C	66	ASN
1	D	66	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 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.

## 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	243/253 (96%)	0.25	7 (2%) 55 48	40, 80, 145, 240	0
1	B	244/253 (96%)	0.13	4 (1%) 74 70	34, 78, 131, 205	0
1	C	244/253 (96%)	0.53	23 (9%) 11 7	42, 86, 179, 229	0
1	D	244/253 (96%)	0.00	1 (0%) 93 92	32, 65, 108, 142	0
1	E	244/253 (96%)	0.10	4 (1%) 74 70	30, 76, 138, 178	0
1	F	244/253 (96%)	0.16	8 (3%) 50 43	28, 70, 152, 233	0
All	All	1463/1518 (96%)	0.19	47 (3%) 51 44	28, 76, 150, 240	0

The worst 5 of 47 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	196	ASN	7.2
1	C	142	ALA	4.7
1	E	248	ARG	3.8
1	C	230	ILE	3.7
1	C	232	GLU	3.6

### 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 carbohydrates 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.