wwPDB X-ray Structure Validation Summary Report (i)

Sep 10, 2023 – 03:43 AM EDT

PDB ID	:	4HBO
Title	:	Crystal Structure of Rubella virus capsid protein (residues 127-277)
Authors	:	Mangala Prasad, V.; Fokine, A.; Rossmann, M.G.
Deposited on	:	2012-09-28
Resolution	:	3.24 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 (i) 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 (1)) were used in the production of this report:

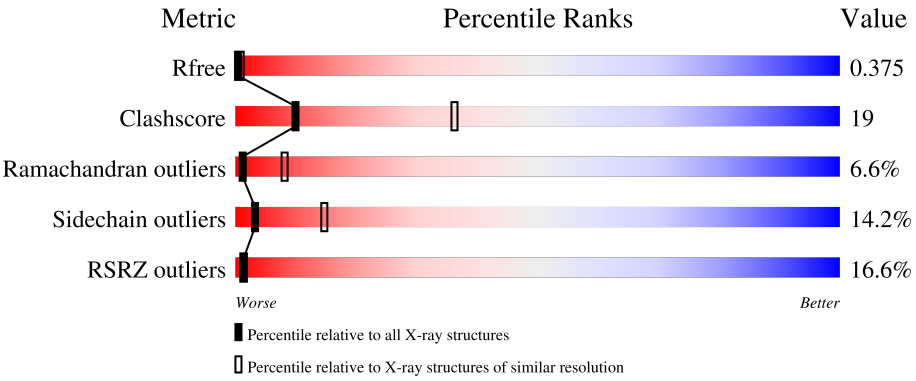
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 3.24 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}	130704	1619 (3.28-3.20)
Clashscore	141614	1755 (3.28-3.20)
Ramachandran outliers	138981	1728 (3.28-3.20)
Sidechain outliers	138945	1727 (3.28-3.20)
RSRZ outliers	127900	1567 (3.28-3.20)

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 <=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	131	17% 24% 24% 9% • 40%
1	B	131	8% 33% 18% 6% • 42%
1	C	131	15% 37% 20% 5% • 37%
1	D	131	5% 44% 15% •• 38%
1	E	131	6% 46% 13% • 38%

2 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 3155 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 Capsid protein.

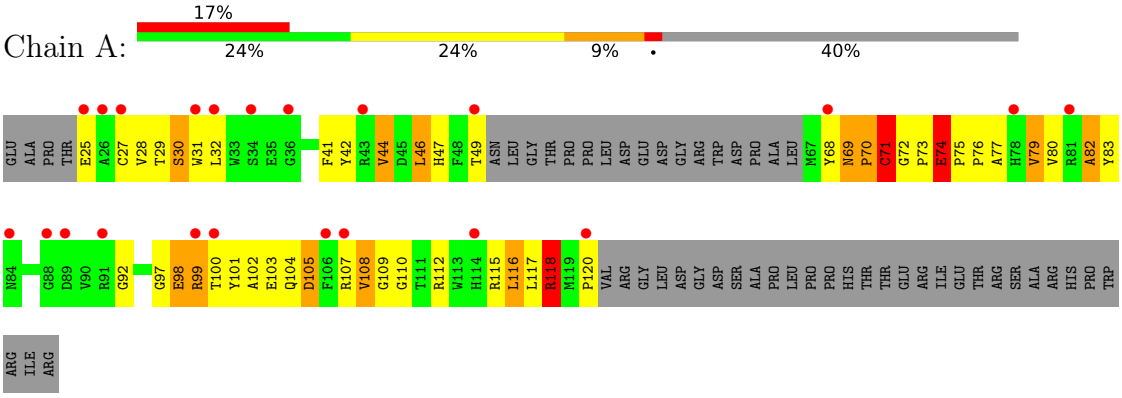
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	79	Total	C	N	O	S	Se	0	0	0
			628	397	117	111	2	1			
1	B	76	Total	C	N	O	S		0	0	0
			602	381	114	105	2				
1	C	82	Total	C	N	O	S	Se	0	0	0
			646	410	118	115	2	1			
1	D	81	Total	C	N	O	S	Se	0	0	0
			641	406	120	112	2	1			
1	E	81	Total	C	N	O	S	Se	0	0	0
			638	404	117	114	2	1			

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.

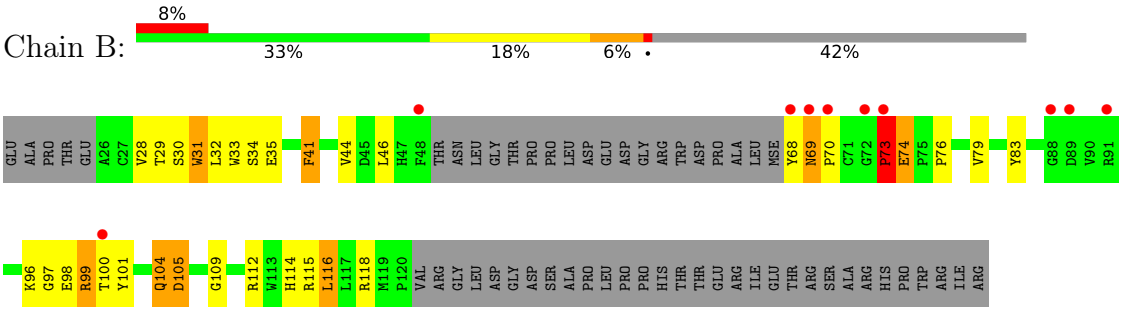
• Molecule 1: Capsid protein

Chain A:



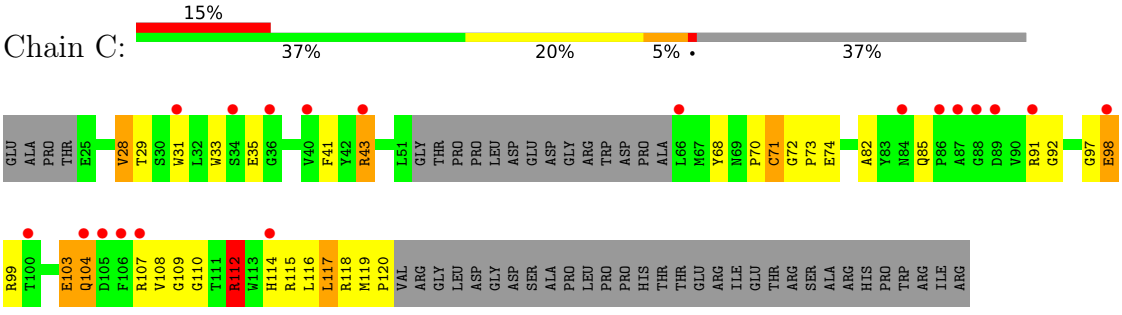
• Molecule 1: Capsid protein

Chain B:



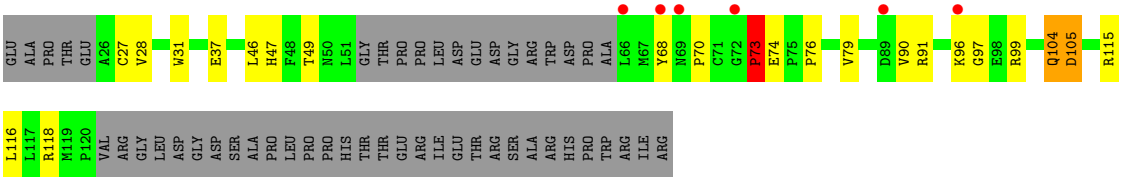
• Molecule 1: Capsid protein

Chain C:

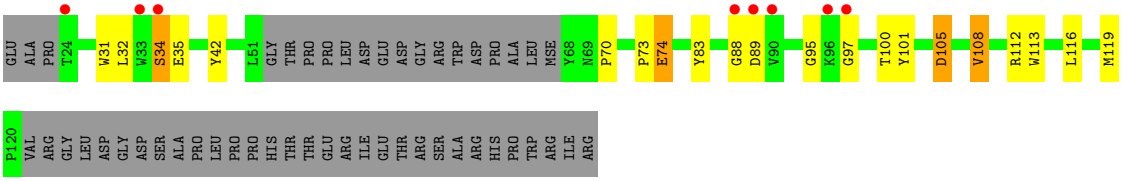


• Molecule 1: Capsid protein

Chain D:



• Molecule 1: Capsid protein



4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α, β, γ	42.79Å 279.70Å 76.72Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.62 – 3.24 46.62 – 3.24	Depositor EDS
% Data completeness (in resolution range)	96.7 (46.62-3.24) 98.4 (46.62-3.24)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.54 (at 3.25Å)	Xtriage
Refinement program	PHENIX 1.8_1069	Depositor
R, R_{free}	0.340 , 0.368 0.349 , 0.375	Depositor DCC
R_{free} test set	760 reflections (9.95%)	wwPDB-VP
Wilson B-factor (Å^2)	54.8	Xtriage
Anisotropy	0.105	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 131.2	EDS
L-test for twinning[2]	$< \|L\| > = 0.44$, $< L^2 > = 0.27$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.83	EDS
Total number of atoms	3155	wwPDB-VP
Average B, all atoms (Å^2)	96.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 78.25 % 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 7.2009e-07. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

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	$\#\|Z\| > 5$	RMSZ	$\#\|Z\| > 5$
1	A	0.46	0/647	1.50	10/878 (1.1%)
1	B	0.47	0/621	0.62	1/843 (0.1%)
1	C	0.36	0/664	0.73	2/901 (0.2%)
1	D	0.28	0/658	0.54	1/891 (0.1%)
1	E	0.29	0/657	0.51	0/893
All	All	0.38	0/3247	0.86	14/4406 (0.3%)

There are no bond length outliers.

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	71	CYS	CB-CA-C	-19.00	72.41	110.40
1	A	118	ARG	NE-CZ-NH1	15.22	127.91	120.30
1	A	74	GLU	N-CA-CB	14.11	135.99	110.60
1	A	73	PRO	N-CA-C	13.04	145.99	112.10
1	A	70	PRO	CB-CA-C	12.44	143.09	112.00

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	628	0	581	45	1
1	B	602	0	552	19	0
1	C	646	0	598	24	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	D	641	0	597	13	0
1	E	638	0	587	16	0
All	All	3155	0	2915	116	1

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 19.

The worst 5 of 116 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:C:118:ARG:HG2	1:C:120:PRO:HD3	1.50	0.93
1:A:99:ARG:HE	1:A:118:ARG:HE	1.09	0.93
1:A:99:ARG:NE	1:A:118:ARG:HE	1.78	0.81
1:A:99:ARG:HE	1:A:118:ARG:NE	1.79	0.80
1:A:105:ASP:N	1:A:105:ASP:OD1	2.20	0.74

All (1) 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)
1:A:74:GLU:OE1	1:A:99:ARG:NH2[3_455]	2.13	0.07

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	75/131 (57%)	57 (76%)	10 (13%)	8 (11%)	0 2
1	B	72/131 (55%)	61 (85%)	6 (8%)	5 (7%)	1 7
1	C	78/131 (60%)	60 (77%)	12 (15%)	6 (8%)	1 6
1	D	77/131 (59%)	62 (80%)	13 (17%)	2 (3%)	5 28

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	E	77/131 (59%)	64 (83%)	9 (12%)	4 (5%)	2 13
All	All	379/655 (58%)	304 (80%)	50 (13%)	25 (7%)	1 8

5 of 25 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	70	PRO
1	A	74	GLU
1	B	70	PRO
1	B	73	PRO
1	D	73	PRO

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	62/106 (58%)	49 (79%)	13 (21%)	1 5
1	B	58/106 (55%)	47 (81%)	11 (19%)	1 7
1	C	64/106 (60%)	54 (84%)	10 (16%)	2 11
1	D	63/106 (59%)	56 (89%)	7 (11%)	6 24
1	E	63/106 (59%)	60 (95%)	3 (5%)	25 59
All	All	310/530 (58%)	266 (86%)	44 (14%)	3 15

5 of 44 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	71	CYS
1	D	47	HIS
1	C	98	GLU
1	C	112	ARG
1	D	68	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	D	78	HIS

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 monosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

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, 95^{th} 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	77/131 (58%)	1.39	22 (28%)	0	0	52, 119, 166, 207	0
1	B	75/131 (57%)	0.81	10 (13%)	3	2	56, 95, 145, 167	0
1	C	80/131 (61%)	1.41	19 (23%)	0	1	46, 110, 172, 216	0
1	D	79/131 (60%)	0.53	6 (7%)	13	9	41, 70, 113, 131	0
1	E	80/131 (61%)	0.80	8 (10%)	7	5	42, 79, 124, 146	0
All	All	391/655 (59%)	0.99	65 (16%)	1	1	41, 96, 149, 216	0

The worst 5 of 65 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	88	GLY	8.4
1	C	114	HIS	8.3
1	C	100	THR	6.4
1	A	106	PHE	6.2
1	E	89	ASP	5.8

6.2 Non-standard residues in protein, DNA, RNA chains

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no monosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.