



Full wwPDB X-ray Structure Validation Report

Feb 28, 2014 – 03:52 PM GMT

PDB ID : 4IEG
Title : Structure and interactions of the RNA-dependent RNA polymerase from bacteriophage phi12 (P1 crystal form)
Authors : Ren, Z.; Franklin, M.C.; Ghose, R.
Deposited on : 2012-12-13
Resolution : 2.10 Å(reported)

This is a full wwPDB validation report for a publicly released PDB entry.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

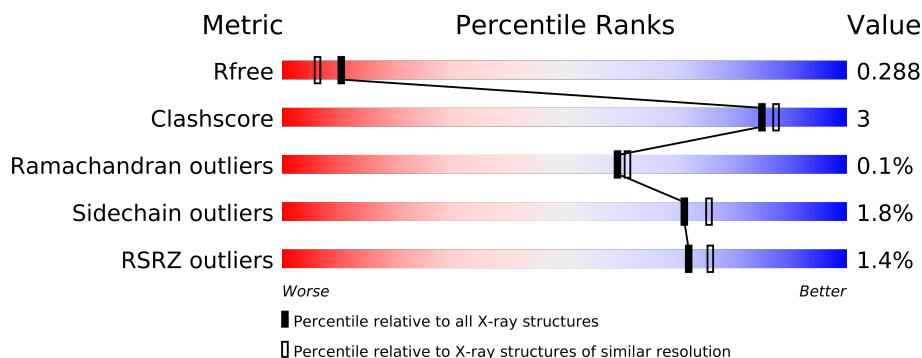
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.15 2013
Xtriage (Phenix) : dev-1323
EDS : stable22639
Percentile statistics : 21963
Refmac : 5.8.0049
CCP4 : 6.3.0 (Settle)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : stable22683

1 Overall quality at a glance

The reported resolution of this entry is 2.10 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}	66092	3012 (2.10-2.10)
Clashscore	79885	3649 (2.10-2.10)
Ramachandran outliers	78287	3610 (2.10-2.10)
Sidechain outliers	78261	3611 (2.10-2.10)
RSRZ outliers	66119	3013 (2.10-2.10)

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 ≥ 3 , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	659	
1	B	659	
1	C	659	
1	D	659	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
2	MG	B	1001	-	X

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 22601 atoms, of which 0 are hydrogen and 0 are deuterium.

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 RNA-dependent RNA polymerase P2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	649	Total	C	N	O	S	0	3	0
			5260	3361	910	967	22			
1	B	634	Total	C	N	O	S	0	6	0
			5166	3305	889	950	22			
1	C	650	Total	C	N	O	S	0	5	0
			5281	3372	915	973	21			
1	D	643	Total	C	N	O	S	0	6	0
			5235	3348	903	962	22			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	2	ALA	MET	ENGINEERED MUTATION	UNP Q94M06
B	2	ALA	MET	ENGINEERED MUTATION	UNP Q94M06
C	2	ALA	MET	ENGINEERED MUTATION	UNP Q94M06
D	2	ALA	MET	ENGINEERED MUTATION	UNP Q94M06

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Mg	0	0
			1	1		
2	A	1	Total	Mg	0	0
			1	1		
2	D	1	Total	Mg	0	0
			1	1		
2	C	1	Total	Mg	0	0
			1	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	416	Total 416	O 416	0	0
3	B	422	Total 422	O 422	0	0
3	C	437	Total 437	O 437	0	0
3	D	380	Total 380	O 380	0	0

4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	87.87Å 94.47Å 96.48Å 75.16° 63.11° 83.79°	Depositor
Resolution (Å)	50.00 – 2.10 31.03 – 2.10	Depositor EDS
% Data completeness (in resolution range)	92.3 (50.00-2.10) 92.3 (31.03-2.10)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.96 (at 2.10Å)	Xtriage
Refinement program	REFMAC 5.5.0072	Depositor
R, R_{free}	0.217 , 0.278 0.225 , 0.288	Depositor DCC
R_{free} test set	7276 reflections (5.29%)	DCC
Wilson B-factor (Å ²)	27.6	Xtriage
Anisotropy	0.027	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 21.0	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Outliers	0 of 144887 reflections	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	22601	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 16.56% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MG

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	0.41	0/5410	0.57	0/7327
1	B	0.42	0/5321	0.58	0/7205
1	C	0.42	0/5438	0.57	0/7367
1	D	0.40	0/5394	0.56	0/7306
All	All	0.41	0/21563	0.57	0/29205

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	5260	0	0	11	0
1	B	5166	0	0	15	0
1	C	5281	0	0	19	0
1	D	5235	0	0	16	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	416	0	0	4	0
3	B	422	0	0	4	0
3	C	437	0	0	9	0
3	D	380	0	0	6	0
All	All	22601	0	0	59	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 3.

All (59) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:C:245[B]:THR:CG2	1:C:298[B]:LEU:CD1	2.07	1.33
1:B:245[B]:THR:CG2	1:B:298[B]:LEU:CD1	2.44	0.95
1:D:104:ARG:NH2	3:D:1285:HOH:O	2.22	0.72
1:B:65:ALA:O	3:B:1373:HOH:O	2.06	0.72
1:D:190[A]:MET:CE	1:D:190[A]:MET:CA	2.69	0.71
1:C:75:VAL:CG1	1:C:247:VAL:CG2	2.69	0.70
1:D:245[B]:THR:CG2	1:D:298[B]:LEU:CD1	2.72	0.67
1:C:246[A]:ASN:ND2	3:C:1428:HOH:O	2.29	0.64
1:D:486:ARG:NH1	3:D:1354:HOH:O	2.35	0.60
1:C:274:LYS:NZ	3:C:1178:HOH:O	2.35	0.60
1:C:571:ARG:NE	3:C:1165:HOH:O	2.34	0.60
1:A:634:GLN:OE1	1:A:640:LYS:NZ	2.38	0.57
1:B:612:MET:CE	1:B:619:LYS:NZ	2.68	0.56
1:C:252:ASP:N	3:C:1125:HOH:O	2.37	0.56
1:C:190:MET:O	1:C:200:ASN:ND2	2.38	0.56
1:C:415:LYS:NZ	3:C:1487:HOH:O	2.39	0.55
1:C:66:ASN:OD1	1:C:198:ASN:ND2	2.40	0.55
1:A:75:VAL:CG1	1:A:247:VAL:CG2	2.86	0.53
1:C:489:GLU:OE1	1:D:58:ARG:NH1	2.42	0.53
1:C:404:GLY:N	3:C:1392:HOH:O	2.41	0.53
1:B:561:ASN:N	1:B:561:ASN:ND2	2.56	0.53
1:D:408:ARG:O	1:D:413:GLN:NE2	2.43	0.51
1:A:556:ARG:NH2	3:A:1422:HOH:O	2.44	0.50
1:D:200:ASN:ND2	1:D:200:ASN:C	2.64	0.50
1:B:104:ARG:NH1	1:B:575:ASP:OD2	2.46	0.49
1:C:609:LYS:NZ	3:C:1354:HOH:O	2.45	0.49
1:C:561:ASN:ND2	1:C:567:GLU:OE2	2.46	0.48
3:A:1328:HOH:O	1:C:160:ARG:NH1	2.46	0.47
1:A:594:ARG:NH2	3:A:1158:HOH:O	2.48	0.46
1:A:158:GLN:OE1	1:A:361:LYS:NZ	2.48	0.46
1:D:525:GLU:O	1:D:526:ARG:C	2.53	0.46

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:D:104:ARG:NH1	3:D:1196:HOH:O	2.49	0.45
1:B:401:GLN:NE2	3:B:1145:HOH:O	2.49	0.45
1:B:609:LYS:NZ	1:B:628:GLU:OE1	2.50	0.45
1:B:525:GLU:O	1:B:526:ARG:C	2.54	0.45
1:B:219:ASN:OD1	1:B:653:HIS:NE2	2.50	0.43
1:B:311:GLN:N	1:B:312:PRO:CD	2.81	0.43
1:A:245:THR:CG2	1:A:298[B]:LEU:CD1	2.96	0.43
1:A:609:LYS:NZ	1:A:628:GLU:OE1	2.51	0.43
1:A:300:ASN:N	1:A:420:SER:OG	2.53	0.42
1:B:189:LYS:NZ	1:B:635:GLU:O	2.53	0.42
1:B:131:ARG:NH1	3:B:1231:HOH:O	2.53	0.42
1:A:626:ASP:OD1	1:A:640:LYS:NZ	2.52	0.42
1:D:433:LYS:NZ	1:D:471:GLU:OE2	2.53	0.42
1:C:433:LYS:NZ	1:C:471:GLU:OE2	2.52	0.42
1:A:311:GLN:N	1:A:312:PRO:CD	2.82	0.41
1:B:470:ASP:OD2	1:B:509:SER:N	2.53	0.41
1:D:106:ASN:O	1:D:110:GLN:NE2	2.54	0.41
1:D:632:GLN:NE2	3:D:1452:HOH:O	2.53	0.41
1:C:476:LYS:NZ	3:C:1224:HOH:O	2.52	0.41
1:B:440:LYS:NZ	3:B:1388:HOH:O	2.54	0.41
1:C:571:ARG:CZ	3:C:1165:HOH:O	2.68	0.41
1:B:561:ASN:ND2	1:C:273:SER:OG	2.54	0.41
1:C:359:GLU:OE2	1:C:412:LYS:NZ	2.54	0.41
1:D:559:LYS:NZ	3:D:1186:HOH:O	2.54	0.41
1:A:280:LYS:N	3:A:1166:HOH:O	2.54	0.41
1:D:335:LYS:NZ	3:D:1374:HOH:O	2.54	0.41
1:D:55:TYR:OH	1:D:407:ASN:OD1	2.39	0.40
1:D:609:LYS:NZ	1:D:628:GLU:OE1	2.54	0.40

There are no symmetry-related clashes.

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	648/659 (98%)	634 (98%)	13 (2%)	1 (0%)	56 57

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	634/659 (96%)	618 (98%)	16 (2%)	0	100	100
1	C	653/659 (99%)	637 (98%)	15 (2%)	1 (0%)	56	57
1	D	645/659 (98%)	632 (98%)	13 (2%)	0	100	100
All	All	2580/2636 (98%)	2521 (98%)	57 (2%)	2 (0%)	59	61

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	71	GLY
1	C	71	GLY

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	562/568 (99%)	554 (99%)	8 (1%)	78	83
1	B	554/568 (98%)	539 (97%)	15 (3%)	57	60
1	C	565/568 (100%)	559 (99%)	6 (1%)	84	88
1	D	561/568 (99%)	548 (98%)	13 (2%)	63	66
All	All	2242/2272 (99%)	2200 (98%)	42 (2%)	71	73

All (42) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	70	THR
1	A	125	THR
1	A	217	ARG
1	A	257	LYS
1	A	268	ARG
1	A	433	LYS
1	A	571	ARG
1	A	659	VAL
1	B	72	THR
1	B	115	SER

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Mol	Chain	Res	Type
1	B	125	THR
1	B	144	LEU
1	B	217	ARG
1	B	226	LYS
1	B	246[A]	ASN
1	B	246[B]	ASN
1	B	266	ILE
1	B	268	ARG
1	B	433	LYS
1	B	544	ASN
1	B	561	ASN
1	B	589	LEU
1	B	594	ARG
1	C	69	GLN
1	C	199	VAL
1	C	217	ARG
1	C	253	ASN
1	C	257	LYS
1	C	433	LYS
1	D	74	LEU
1	D	115	SER
1	D	190[A]	MET
1	D	190[B]	MET
1	D	200	ASN
1	D	217	ARG
1	D	253[A]	ASN
1	D	253[B]	ASN
1	D	433	LYS
1	D	486	ARG
1	D	504	GLU
1	D	589	LEU
1	D	655	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA ⓘ

There are no RNA chains 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 carbohydrates in this entry.

5.6 Ligand geometry ⓘ

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

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, 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	649/659 (98%)	0.09	6 (0%) 81 85	15, 27, 39, 49	0
1	B	634/659 (96%)	0.13	11 (1%) 67 71	14, 26, 41, 53	0
1	C	650/659 (98%)	0.05	9 (1%) 72 76	17, 26, 37, 45	0
1	D	643/659 (97%)	0.12	11 (1%) 67 71	17, 29, 42, 52	0
All	All	2576/2636 (97%)	0.10	37 (1%) 72 76	14, 27, 40, 53	0

All (37) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	11	ALA	5.1
1	D	10	HIS	4.4
1	C	70	THR	3.5
1	B	545	PHE	3.4
1	D	659	VAL	3.2
1	A	70	THR	3.2
1	B	43	ASP	3.2
1	C	308	VAL	2.9
1	A	479	ARG	2.9
1	C	69	GLN	2.8
1	C	68	ARG	2.7
1	D	59	ASN	2.7
1	C	285	GLY	2.7
1	B	62	THR	2.6
1	B	200	ASN	2.6
1	C	209	ALA	2.6
1	C	659	VAL	2.6
1	B	190[A]	MET	2.3
1	D	65	ALA	2.3
1	B	73	GLN	2.3
1	A	69	GLN	2.2

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Mol	Chain	Res	Type	RSRZ
1	D	11	ALA	2.2
1	D	450	ALA	2.2
1	D	35	VAL	2.2
1	A	67	ALA	2.2
1	C	253	ASN	2.2
1	C	310	LEU	2.1
1	B	544	ASN	2.1
1	A	486	ARG	2.1
1	B	216	ASN	2.1
1	D	310	LEU	2.1
1	D	154[A]	ASP	2.1
1	D	40	GLU	2.0
1	B	153	ARG	2.0
1	A	308	VAL	2.0
1	B	37	HIS	2.0
1	D	27	GLY	2.0

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 carbohydrates in this entry.

6.4 Ligands ⓘ

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q < 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSR	LLDF	B-factors(Å ²)	Q<0.9
2	MG	B	1001	1/1	0.20	4.43	18,18,18,18	0
2	MG	D	1001	1/1	0.10	-0.65	18,18,18,18	0
2	MG	C	1001	1/1	0.05	-1.96	16,16,16,16	0
2	MG	A	1001	1/1	0.10	-2.03	16,16,16,16	0

6.5 Other polymers ⓘ

There are no such residues in this entry.