wwPDB X-ray Structure Validation Summary Report (i)

Feb 6, 2024 – 03:54 PM EST

PDB ID	:	2BPA
Title	:	ATOMIC STRUCTURE OF SINGLE-STRANDED DNA BACTERIOPHAGE PHIX174 AND ITS FUNCTIONAL IMPLICATIONS
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Deposited on	:	1991-12-03
Resolution	:	3.00 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 (i)) were used in the production of this report:

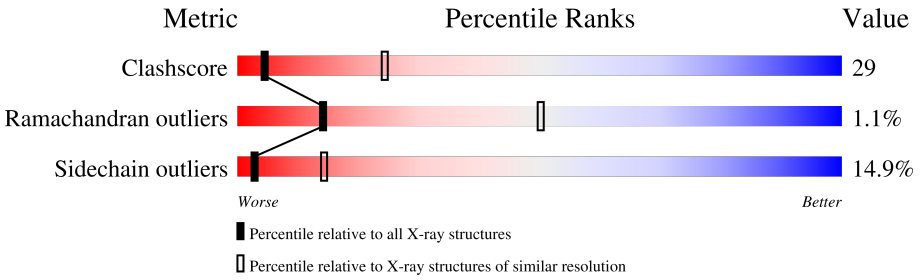
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 3.00 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))
Clashscore	141614	2416 (3.00-3.00)
Ramachandran outliers	138981	2333 (3.00-3.00)
Sidechain outliers	138945	2336 (3.00-3.00)

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%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	5	40% 20% 40%
2	1	426	50% 36% 12% .
3	2	175	47% 38% 10% 6%
4	3	37	24% 30% 19% 24% .

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 5298 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 DNA chain called DNA (5'-D(*AP*AP*AP*AP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	5	Total	C	N	O	P	0	0	1
			83	39	18	22	4			

- Molecule 2 is a protein called PROTEIN (SUBUNIT OF BACTERIOPHAGE PHIX174).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	1	426	Total	C	N	O	S	0	0	0
			3415	2173	590	638	14			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
1	216	ARG	HIS	conflict	UNP P03641

- Molecule 3 is a protein called PROTEIN (SUBUNIT OF BACTERIOPHAGE PHIX174).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	2	175	Total	C	N	O	S	0	0	0
			1339	856	221	254	8			

- Molecule 4 is a protein called PROTEIN (SUBUNIT OF BACTERIOPHAGE PHIX174).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
4	3	36	Total	C	N	O	0	0	0
			283	177	64	42			

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	2	Total	O	0	0
			2	2		

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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	1	129	Total O 129 129	0	0
5	2	41	Total O 41 41	0	0
5	3	6	Total O 6 6	0	0

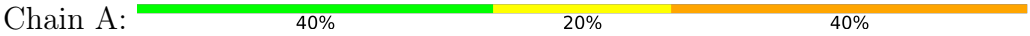
3 Residue-property plots (i)

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. 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.

Note EDS was not executed.

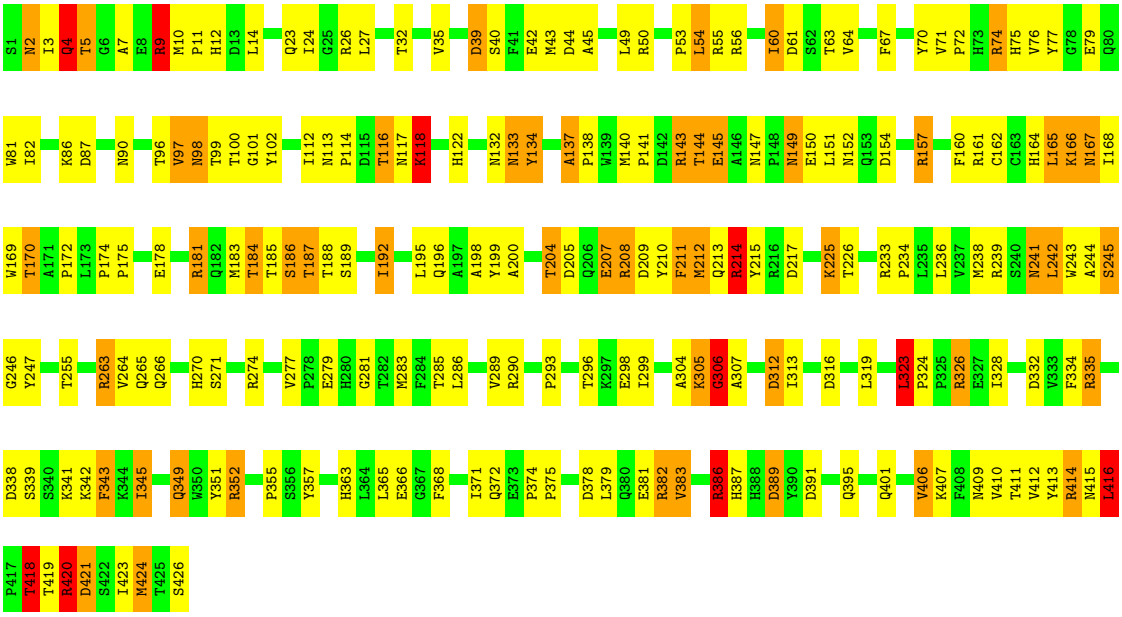
• Molecule 1: DNA (5'-D(*AP*AP*AP*AP*C)-3')

Chain A:



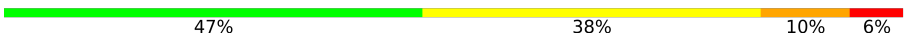
• Molecule 2: PROTEIN (SUBUNIT OF BACTERIOPHAGE PHIX174)

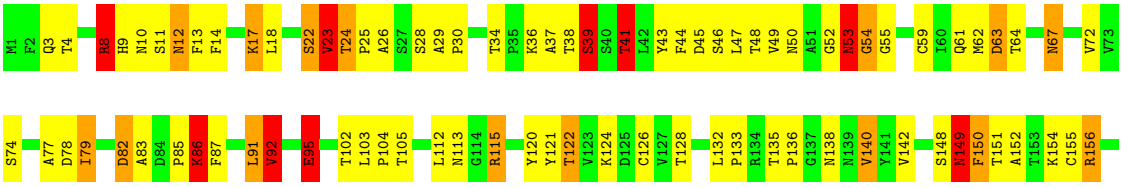
Chain 1:

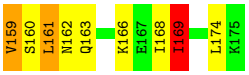


• Molecule 3: PROTEIN (SUBUNIT OF BACTERIOPHAGE PHIX174)

Chain 2:

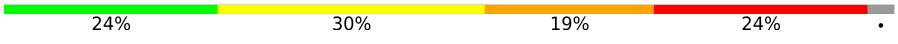






• Molecule 4: PROTEIN (SUBUNIT OF BACTERIOPHAGE PHIX174)

Chain 3:



4 Data and refinement statistics (i)

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	305.58Å 360.78Å 299.46Å 90.00° 92.89° 90.00°	Depositor
Resolution (Å)	6.00 – 3.00	Depositor
% Data completeness (in resolution range)	(Not available) (6.00-3.00)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.209 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	5298	wwPDB-VP
Average B, all atoms (Å^2)	15.0	wwPDB-VP

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	1.74	0/93	1.80	2/142 (1.4%)
2	1	1.39	3/3511 (0.1%)	2.17	125/4779 (2.6%)
3	2	1.38	3/1371 (0.2%)	1.95	31/1872 (1.7%)
4	3	2.24	11/289 (3.8%)	2.57	24/380 (6.3%)
All	All	1.45	17/5264 (0.3%)	2.13	182/7173 (2.5%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
2	1	0	1

The worst 5 of 17 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	3	19	GLY	N-CA	7.39	1.57	1.46
4	3	8	GLY	N-CA	7.07	1.56	1.46
2	1	178	GLU	CD-OE2	-6.82	1.18	1.25
4	3	13	ARG	CZ-NH2	6.68	1.41	1.33
4	3	18	ARG	C-O	6.49	1.35	1.23

The worst 5 of 182 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	1	214	ARG	NE-CZ-NH2	27.10	133.85	120.30
2	1	208	ARG	NE-CZ-NH2	24.34	132.47	120.30
2	1	56	ARG	NE-CZ-NH2	-24.21	108.20	120.30
2	1	352	ARG	NE-CZ-NH1	22.71	131.65	120.30
2	1	9	ARG	NE-CZ-NH2	-21.64	109.48	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	1	386	ARG	Sidechain

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	83	0	45	13	0
2	1	3415	0	3305	186	0
3	2	1339	0	1322	72	0
4	3	283	0	305	35	0
5	1	129	0	0	12	0
5	2	41	0	0	1	0
5	3	6	0	0	1	0
5	A	2	0	0	2	0
All	All	5298	0	4977	289	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 29.

The worst 5 of 289 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)
3:2:41:THR:HG21	5:2:199:HOH:O	1.40	1.22
2:1:167:ASN:HB2	2:1:170:THR:HB	1.15	1.14
4:3:9:ALA:O	4:3:11:PRO:HD3	1.51	1.11
2:1:363:HIS:O	2:1:372:GLN:OE1	1.71	1.06
3:2:39:SER:HB2	3:2:162:ASN:HD22	1.13	1.05

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
2	1	424/426 (100%)	406 (96%)	16 (4%)	2 (0%)	29 68
3	2	173/175 (99%)	165 (95%)	8 (5%)	0	100 100
4	3	34/37 (92%)	24 (71%)	5 (15%)	5 (15%)	0 1
All	All	631/638 (99%)	595 (94%)	29 (5%)	7 (1%)	14 50

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	1	306	GLY
4	3	3	GLY
4	3	4	LYS
4	3	22	GLY
2	1	101	GLY

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
2	1	372/372 (100%)	329 (88%)	43 (12%)	5 23
3	2	153/153 (100%)	123 (80%)	30 (20%)	1 7
4	3	26/27 (96%)	17 (65%)	9 (35%)	0 1
All	All	551/552 (100%)	469 (85%)	82 (15%)	3 14

5 of 82 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	2	79	ILE
3	2	169	ILE
3	2	91	LEU
3	2	128	THR
4	3	6	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 36 such sidechains are listed below:

Mol	Chain	Res	Type
3	2	53	ASN
4	3	15	GLN
3	2	67	ASN
3	2	149	ASN
2	1	153	GLN

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 monosaccharides 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

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.