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P R O T E I N   D A T A   B A N K

wwPDB X-ray Structure Validation Summary Report (i)

May 15, 2020 – 05:53 am BST

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PDB ID	:	1K28
Title	:	The Structure of the Bacteriophage T4 Cell-Puncturing Device
Authors	:	Kanamaru, S.; Leiman, P.G.; Kostyuchenko, V.A.; Chipman, P.R.; Mesyanzhinov, V.V.; Arisaka, F.; Rossmann, M.G.
Deposited on	:	2001-09-26
Resolution	:	2.90 Å(reported)

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 2.90 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.
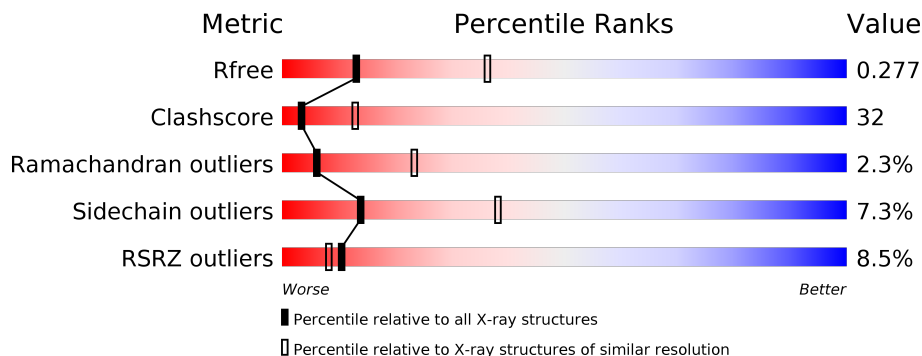
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)

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 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	584	
2	D	391	

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 7614 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 TAIL-ASSOCIATED LYSOZYME.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	557	4309	2672	763	853	21	0	0	0

There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	576	SER	-	EXPRESSION TAG	UNP P16009
A	577	VAL	-	EXPRESSION TAG	UNP P16009
A	578	ASP	-	EXPRESSION TAG	UNP P16009
A	579	HIS	-	EXPRESSION TAG	UNP P16009
A	580	HIS	-	EXPRESSION TAG	UNP P16009
A	581	HIS	-	EXPRESSION TAG	UNP P16009
A	582	HIS	-	EXPRESSION TAG	UNP P16009
A	583	HIS	-	EXPRESSION TAG	UNP P16009
A	584	HIS	-	EXPRESSION TAG	UNP P16009

- Molecule 2 is a protein called BASEPLATE STRUCTURAL PROTEIN GP27.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
2	D	364	2912	1858	478	559	2	15	0	0	0

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	1	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	3	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	40	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	51	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	64	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	135	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	168	ASN	THR	SEE REMARK 999	UNP P17172

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Chain	Residue	Modelled	Actual	Comment	Reference
D	193	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	197	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	198	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	202	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	203	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	211	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	248	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	262	SER	GLU	SEE REMARK 999	UNP P17172
D	265	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	286	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	301	MSE	MET	MODIFIED RESIDUE	UNP P17172
D	308	ALA	LEU	SEE REMARK 999	UNP P17172
D	357	MSE	MET	MODIFIED RESIDUE	UNP P17172

- Molecule 3 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	K	0	0
			1	1		

- Molecule 4 is PHOSPHATE ION (three-letter code: PO4) (formula: O_4P).
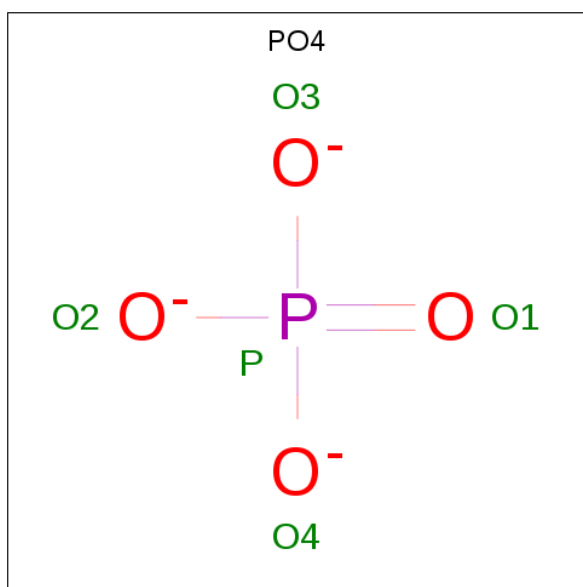
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	O	P	0	0
			3	2	1		

• Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	307	Total 307	O 307	0	0
5	D	82	Total 82	O 82	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 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: TAIL-ASSOCIATED LYSOZYME

- Molecule 2: BASEPLATE STRUCTURAL PROTEIN GP27

4 Data and refinement statistics (i)

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, α, β, γ	139.26Å 139.26Å 382.00Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 2.90 49.72 – 2.90	Depositor EDS
% Data completeness (in resolution range)	5.1 (50.00-2.90) 98.9 (49.72-2.90)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	0.08	Depositor
$<I/\sigma(I)>$ [1]	7.57 (at 2.91Å)	Xtriage
Refinement program	CNS 1.0	Depositor
R, R_{free}	0.211 , 0.280 0.212 , 0.277	Depositor DCC
R_{free} test set	1602 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å^2)	52.2	Xtriage
Anisotropy	0.794	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 76.0	EDS
L-test for twinning[2]	$<|L|> = 0.49, <L^2> = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	7614	wwPDB-VP
Average B, all atoms (Å^2)	63.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.73% of the height of the origin peak. No significant pseudotranslation is detected.*

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[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 (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: K, PO4

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	0.39	0/4391	0.65	1/5950 (0.0%)
2	D	0.33	0/2965	0.59	0/3997
All	All	0.36	0/7356	0.63	1/9947 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	575	GLY	N-CA-C	5.25	126.21	113.10

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	4309	0	4202	237	1
2	D	2912	0	2835	227	0
3	A	1	0	0	0	0
4	A	3	0	0	0	1
5	A	307	0	0	6	0
5	D	82	0	0	5	0
All	All	7614	0	7037	460	2

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 32.

The worst 5 of 460 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:89:LYS:HE2	1:A:89:LYS:H	1.16	1.10
1:A:184:GLU:HG2	1:A:203:GLY:HA3	1.36	1.03
1:A:89:LYS:CE	1:A:89:LYS:H	1.72	1.03
1:A:221:LEU:HD11	1:A:236:ILE:HD11	1.40	1.01
1:A:416:HIS:CD2	1:A:418:THR:HB	1.95	1.01

All (2) 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)
4:A:586:PO4:P	4:A:586:PO4:O2[2_555]	1.48	0.72
1:A:584:HIS:OXT	1:A:584:HIS:OXT[4_555]	1.87	0.33

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	551/584 (94%)	512 (93%)	31 (6%)	8 (2%)	10	34
2	D	360/391 (92%)	295 (82%)	52 (14%)	13 (4%)	3	14
All	All	911/975 (93%)	807 (89%)	83 (9%)	21 (2%)	6	23

5 of 21 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	575	GLY
2	D	77	ALA
2	D	213	VAL

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Mol	Chain	Res	Type
1	A	232	ASN
2	D	98	ASP

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	472/494 (96%)	435 (92%)	37 (8%)	12	34
2	D	324/333 (97%)	303 (94%)	21 (6%)	17	45
All	All	796/827 (96%)	738 (93%)	58 (7%)	14	38

5 of 58 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	418	THR
1	A	519	THR
2	D	333	PHE
1	A	429	ARG
1	A	457	ASN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 37 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	443	ASN
2	D	11	ASN
2	D	354	HIS
1	A	457	ASN
1	A	526	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 carbohydrates in this entry.

5.6 Ligand geometry (i)

Of 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#|Z| > 2$	Counts	RMSZ	$\#|Z| > 2$
4	PO4	A	586	-	0,2,4	0.00	-	0,1,6	0.00	-

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.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	586	PO4	0	1

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, 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	557/584 (95%)	0.11	6 (1%)	80	80	22, 45, 71, 103	0
2	D	349/391 (89%)	1.02	71 (20%)	1	0	49, 85, 120, 138	0
All	All	906/975 (92%)	0.46	77 (8%)	10	8	22, 59, 111, 138	0

The worst 5 of 77 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	D	216	PRO	5.5
2	D	367	ILE	5.1
2	D	99	SER	4.9
2	D	355	LEU	4.7
2	D	346	LEU	4.6

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)

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. 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	RSCC	RSR	B-factors(Å²)	Q<0.9
3	K	A	585	1/1	0.91	0.15	48,48,48,48	1
4	PO4	A	586	3/5	0.99	0.30	24,24,25,95	2

6.5 Other polymers ⓘ

There are no such residues in this entry.