wwPDB X-ray Structure Validation Summary Report (i)

Oct 16, 2021 – 07:55 PM EDT

PDB ID	:	1PQK
Title	:	Repacking of the Core of T4 Lysozyme by Automated Design
Authors	:	Mooers, B.H.; Datta, D.; Baase, W.A.; Zollars, E.S.; Mayo, S.L.; Matthews, B.W.
Deposited on	:	2003-06-18
Resolution	:	2.00 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 following versions of software and data (see references (1)) were used in the production of this report:

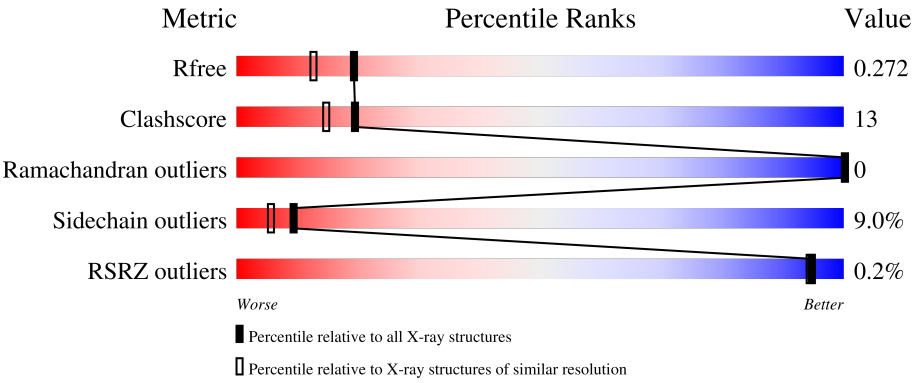
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.23.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.23.2

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 2.00 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))
R_{free}	130704	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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% 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	164	68% 26% 5%
1	B	164	68% 27% 5%
1	C	164	66% 27% 5%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 4308 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 Lysozyme.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	164	Total	C	N	O	S	0	1	0
			1320	835	238	242	5			
1	B	164	Total	C	N	O	S	0	0	0
			1316	832	238	242	4			
1	C	164	Total	C	N	O	S	0	1	0
			1320	834	239	243	4			

There are 27 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	54	THR	CYS	engineered mutation	UNP P00720
A	77	ALA	GLY	engineered mutation	UNP P00720
A	78	VAL	ILE	engineered mutation	UNP P00720
A	97	ALA	CYS	engineered mutation	UNP P00720
A	118	ILE	LEU	engineered mutation	UNP P00720
A	120	TYR	MET	engineered mutation	UNP P00720
A	133	PHE	LEU	engineered mutation	UNP P00720
A	149	ILE	VAL	engineered mutation	UNP P00720
A	152	VAL	THR	engineered mutation	UNP P00720
B	54	THR	CYS	engineered mutation	UNP P00720
B	77	ALA	GLY	engineered mutation	UNP P00720
B	78	VAL	ILE	engineered mutation	UNP P00720
B	97	ALA	CYS	engineered mutation	UNP P00720
B	118	ILE	LEU	engineered mutation	UNP P00720
B	120	TYR	MET	engineered mutation	UNP P00720
B	133	PHE	LEU	engineered mutation	UNP P00720
B	149	ILE	VAL	engineered mutation	UNP P00720
B	152	VAL	THR	engineered mutation	UNP P00720
C	54	THR	CYS	engineered mutation	UNP P00720
C	77	ALA	GLY	engineered mutation	UNP P00720
C	78	VAL	ILE	engineered mutation	UNP P00720
C	97	ALA	CYS	engineered mutation	UNP P00720
C	118	ILE	LEU	engineered mutation	UNP P00720

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Chain	Residue	Modelled	Actual	Comment	Reference
C	120	TYR	MET	engineered mutation	UNP P00720
C	133	PHE	LEU	engineered mutation	UNP P00720
C	149	ILE	VAL	engineered mutation	UNP P00720
C	152	VAL	THR	engineered mutation	UNP P00720

- Molecule 2 is water.

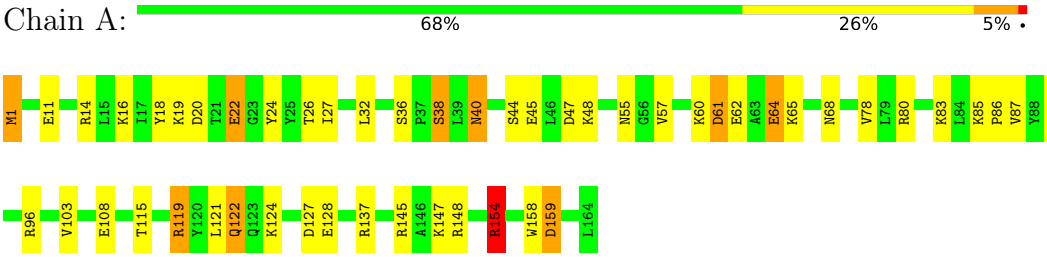
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	131	Total O 131 131	0	0
2	B	134	Total O 134 134	0	0
2	C	87	Total O 87 87	0	0

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 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.

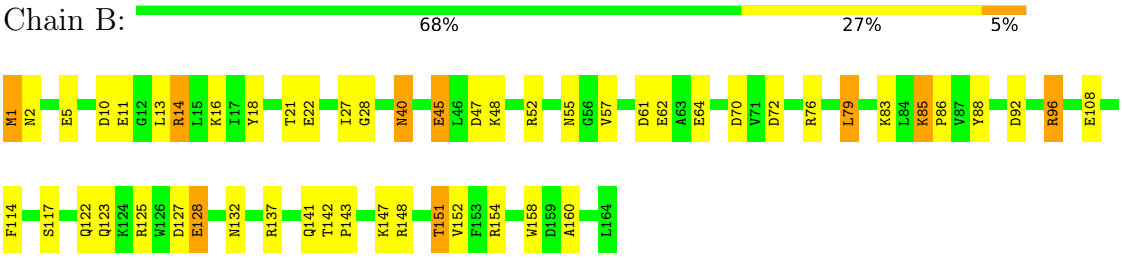
• Molecule 1: Lysozyme

Chain A:



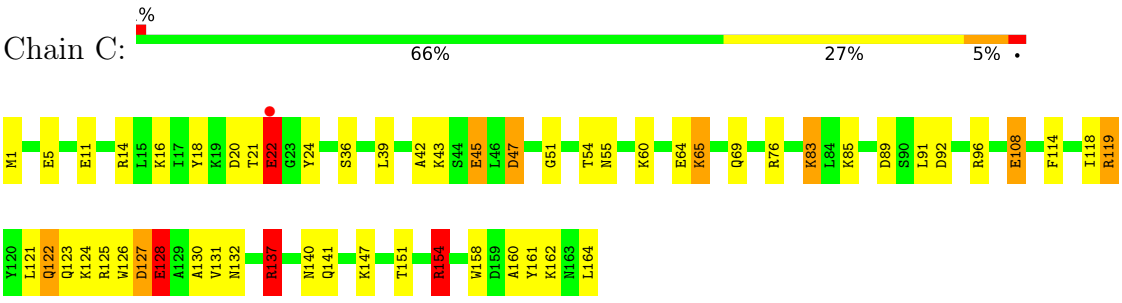
• Molecule 1: Lysozyme

Chain B:



• Molecule 1: Lysozyme

Chain C:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	156.23Å 67.28Å 61.65Å 90.00° 112.43° 90.00°	Depositor
Resolution (Å)	72.50 – 2.00 22.73 – 1.99	Depositor EDS
% Data completeness (in resolution range)	(Not available) (72.50-2.00) 96.0 (22.73-1.99)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	0.05	Depositor
$< I/\sigma(I) >$ [1]	3.95 (at 1.99Å)	Xtriage
Refinement program	TNT	Depositor
R, R_{free}	0.177 , 0.277 0.173 , 0.272	Depositor DCC
R_{free} test set	989 reflections (2.55%)	wwPDB-VP
Wilson B-factor (Å^2)	19.1	Xtriage
Anisotropy	0.506	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.39 , 128.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.020 for -h-2*l,-k,l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	4308	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 5.36% of the height of the origin peak. No significant pseudotranslation is detected.*

[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	0.94	7/1346 (0.5%)	1.35	15/1812 (0.8%)
1	B	0.95	8/1338 (0.6%)	1.37	17/1802 (0.9%)
1	C	0.94	7/1346 (0.5%)	1.38	13/1813 (0.7%)
All	All	0.94	22/4030 (0.5%)	1.36	45/5427 (0.8%)

The worst 5 of 22 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	22	GLU	CD-OE2	7.16	1.33	1.25
1	C	108	GLU	CD-OE2	7.11	1.33	1.25
1	B	62	GLU	CD-OE2	6.97	1.33	1.25
1	A	22	GLU	CD-OE2	6.87	1.33	1.25
1	A	128	GLU	CD-OE2	6.79	1.33	1.25

The worst 5 of 45 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	137	ARG	NE-CZ-NH1	10.28	125.44	120.30
1	C	92	ASP	CB-CG-OD2	-9.36	109.88	118.30
1	B	61	ASP	CB-CG-OD2	-9.34	109.89	118.30
1	B	70	ASP	CB-CG-OD2	-8.64	110.52	118.30
1	C	76	ARG	NE-CZ-NH2	-8.46	116.07	120.30

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	1320	0	1337	36	0
1	B	1316	0	1334	31	0
1	C	1320	0	1336	41	0
2	A	131	0	0	4	0
2	B	134	0	0	1	0
2	C	87	0	0	0	0
All	All	4308	0	4007	102	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 13.

The worst 5 of 102 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:137:ARG:HH11	1:C:137:ARG:HB3	1.21	1.00
1:C:119:ARG:O	1:C:122:GLN:HG3	1.83	0.79
1:A:1[A]:MET:HG3	1:A:158:TRP:CE3	2.18	0.77
1:A:60:LYS:HE3	1:A:64:GLU:OE2	1.89	0.72
1:B:147:LYS:O	1:B:151:THR:HG23	1.91	0.70

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	162/164 (99%)	158 (98%)	4 (2%)	0	100	100
1	B	162/164 (99%)	157 (97%)	5 (3%)	0	100	100
1	C	163/164 (99%)	155 (95%)	8 (5%)	0	100	100
All	All	487/492 (99%)	470 (96%)	17 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	138/137 (101%)	123 (89%)	15 (11%)	6 3
1	B	137/137 (100%)	127 (93%)	10 (7%)	14 9
1	C	138/137 (101%)	125 (91%)	13 (9%)	8 5
All	All	413/411 (100%)	375 (91%)	38 (9%)	9 5

5 of 38 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	36	SER
1	C	137	ARG
1	C	65	LYS
1	C	119	ARG
1	C	154	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	123	GLN
1	C	53	ASN
1	C	132	ASN
1	B	53	ASN
1	B	55	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 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

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	164/164 (100%)	-0.73	0	100	100	13, 22, 49, 59	0
1	B	164/164 (100%)	-0.67	0	100	100	13, 21, 47, 60	0
1	C	164/164 (100%)	-0.43	1 (0%)	89	88	14, 25, 54, 65	0
All	All	492/492 (100%)	-0.61	1 (0%)	95	94	13, 23, 50, 65	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	22	GLU	2.1

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

There are no such residues in this entry.