



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 12, 2024 – 12:59 AM EDT

PDB ID : 1AVQ  
Title : TOROIDAL STRUCTURE OF LAMBDA EXONUCLEASE DETERMINED  
AT 2.4 ANGSTROMS  
Authors : Kovall, R.A.; Matthews, B.W.  
Deposited on : 1997-09-18  
Resolution : 2.40 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](mailto: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 ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	2.36.2
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)	:	2.36.2

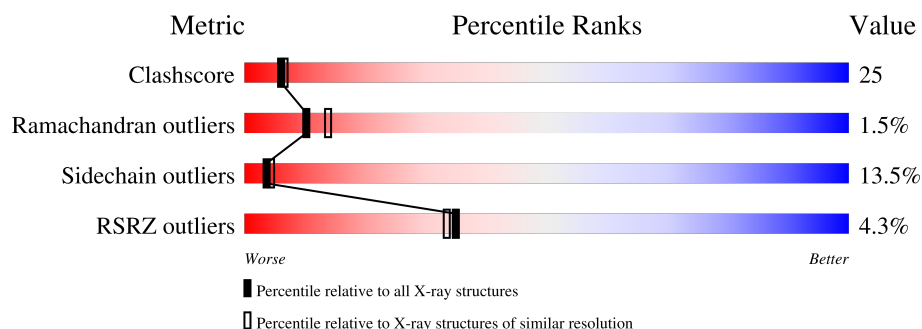
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.40 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	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (2.40-2.40)

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  $\geq 3$ , 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  $\leq 5\%$ . 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	228	<div> <div>3%</div> <div>57%</div> <div>30%</div> <div>10%</div> <div>.</div> </div>
1	B	228	<div> <div>4%</div> <div>55%</div> <div>32%</div> <div>11%</div> <div>.</div> </div>
1	C	228	<div> <div>6%</div> <div>54%</div> <div>32%</div> <div>9%</div> <div>..</div> </div>

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 5933 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 LAMBDA EXONUCLEASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	228	Total	C	N	O	S	0	0	0
			1837	1169	313	341	14			
1	B	228	Total	C	N	O	S	0	0	0
			1837	1169	313	341	14			
1	C	225	Total	C	N	O	S	0	0	0
			1812	1155	308	336	13			

- Molecule 2 is PHOSPHATE ION (three-letter code: PO4) (formula: O<sub>4</sub>P).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	P	0	0
			5	4	1		
2	B	1	Total	O	P	0	0
			5	4	1		
2	C	1	Total	O	P	0	0
			5	4	1		

- Molecule 3 is ACETATE ION (three-letter code: ACT) (formula:  $C_2H_3O_2$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			4	2	2		
3	B	1	Total	C	O	0	0
			4	2	2		
3	C	1	Total	C	O	0	0
			4	2	2		
3	C	1	Total	C	O	0	0
			4	2	2		

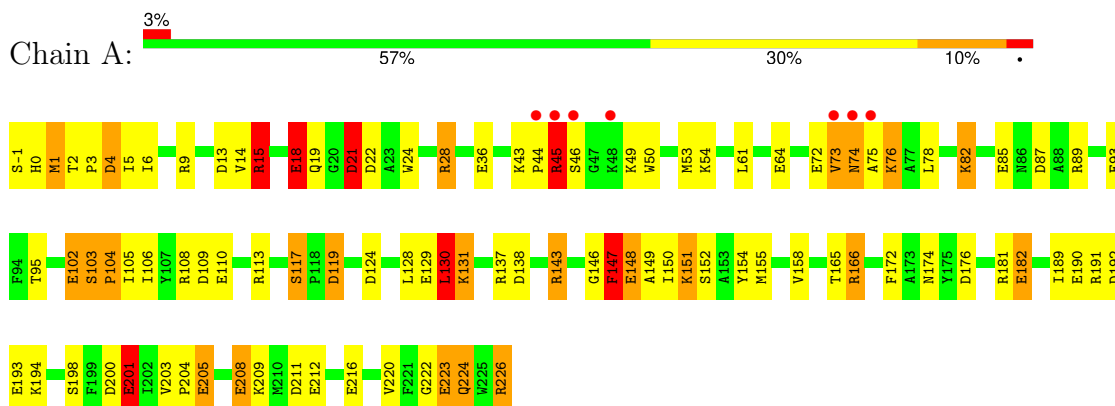
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	169	Total	O	0	0
			169	169		
4	B	131	Total	O	0	0
			131	131		
4	C	116	Total	O	0	0
			116	116		

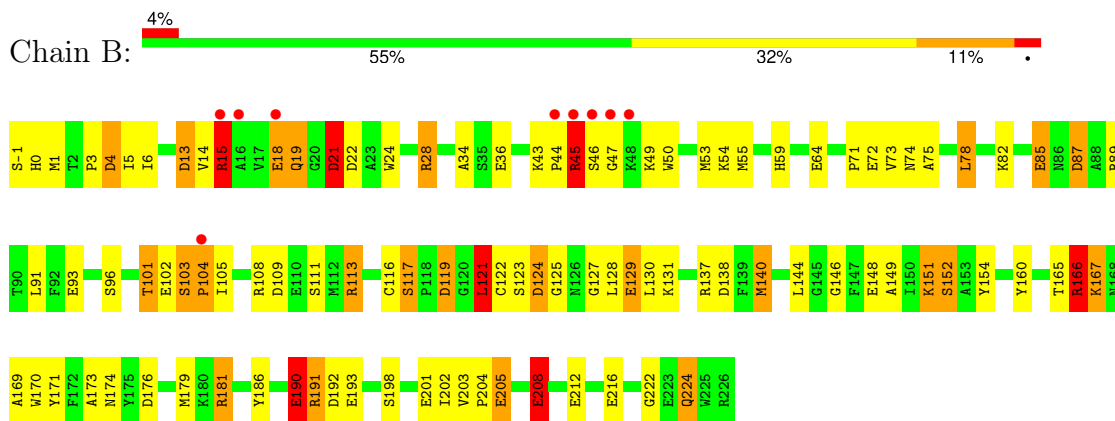
### 3 Residue-property plots

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.

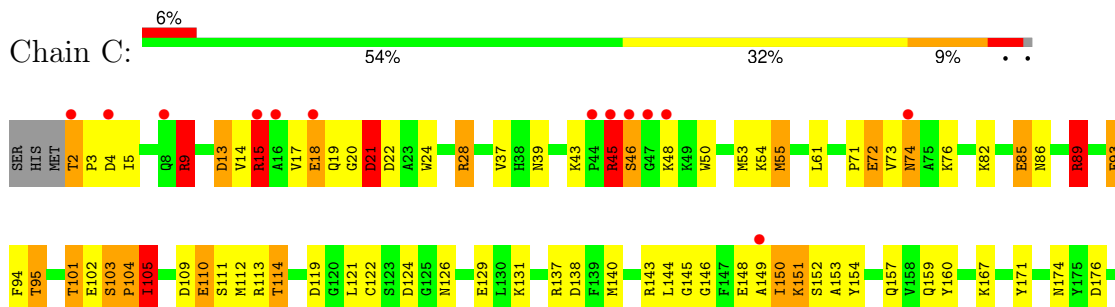
#### • Molecule 1: LAMBDA EXONUCLEASE



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K180	R181	E182		E190	R191	D192	E193	K194	Y195		D200	E201	I202	V203	P204	E205		E208		E212	A213	L214	A215	E216	I217		V220	F221	G222	E223	Q224	W225	R226
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## 4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	156.70Å 156.70Å 131.70Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 2.40 29.93 – 2.40	Depositor EDS
% Data completeness (in resolution range)	97.0 (30.00-2.40) 98.2 (29.93-2.40)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.06	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	6.31 (at 2.42Å)	Xtriage
Refinement program	TNT 5E, XTALVIEW	Depositor
R, $R_{free}$	0.198 , (Not available) 0.193 , (Not available)	Depositor DCC
$R_{free}$ test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	28.7	Xtriage
Anisotropy	0.663	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 102.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	5933	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	40.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.53% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  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: ACT, 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	1.28	19/1883 (1.0%)	1.73	50/2542 (2.0%)
1	B	1.22	16/1883 (0.8%)	1.62	34/2542 (1.3%)
1	C	1.27	14/1857 (0.8%)	1.63	34/2509 (1.4%)
All	All	1.26	49/5623 (0.9%)	1.66	118/7593 (1.6%)

The worst 5 of 49 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	72	GLU	CD-OE1	10.40	1.37	1.25
1	B	208	GLU	CD-OE2	9.18	1.35	1.25
1	A	201	GLU	CD-OE2	8.74	1.35	1.25
1	A	129	GLU	CD-OE1	8.64	1.35	1.25
1	A	216	GLU	CD-OE1	8.55	1.35	1.25

The worst 5 of 118 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	166	ARG	NE-CZ-NH2	-13.52	113.54	120.30
1	B	103	SER	C-N-CD	-12.89	92.23	120.60
1	A	89	ARG	NE-CZ-NH2	-12.89	113.86	120.30
1	B	28	ARG	NE-CZ-NH1	12.67	126.63	120.30
1	C	138	ASP	CB-CG-OD2	-11.96	107.54	118.30

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	1837	0	1784	75	0
1	B	1837	0	1784	102	0
1	C	1812	0	1760	91	0
2	A	5	0	0	0	0
2	B	5	0	0	1	0
2	C	5	0	0	0	0
3	A	4	0	3	0	0
3	B	4	0	3	0	0
3	C	8	0	6	1	0
4	A	169	0	0	5	0
4	B	131	0	0	5	0
4	C	116	0	0	4	0
All	All	5933	0	5340	268	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 25.

The worst 5 of 268 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:45:ARG:NH1	1:A:45:ARG:H	1.45	1.14
1:B:1:MET:HE3	1:B:5:ILE:HB	1.27	1.13
1:A:45:ARG:HH11	1:A:45:ARG:N	1.47	1.12
1:C:45:ARG:HH11	1:C:45:ARG:HB3	1.18	1.08
1:B:75:ALA:HA	1:B:78:LEU:HD12	1.35	1.06

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	226/228 (99%)	220 (97%)	3 (1%)	3 (1%)	12	17
1	B	226/228 (99%)	218 (96%)	5 (2%)	3 (1%)	12	17
1	C	223/228 (98%)	210 (94%)	9 (4%)	4 (2%)	8	10
All	All	675/684 (99%)	648 (96%)	17 (2%)	10 (2%)	10	14

5 of 10 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	21	ASP
1	A	104	PRO
1	B	104	PRO
1	B	45	ARG
1	C	105	ILE

### 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	194/194 (100%)	168 (87%)	26 (13%)	4	4
1	B	194/194 (100%)	172 (89%)	22 (11%)	6	8
1	C	191/194 (98%)	161 (84%)	30 (16%)	2	3
All	All	579/582 (100%)	501 (86%)	78 (14%)	4	4

5 of 78 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	46	SER
1	C	180	LYS
1	C	53	MET
1	C	82	LYS
1	C	217	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	224	GLN
1	C	224	GLN
1	A	224	GLN
1	B	19	GLN
1	B	74	ASN

### 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 ⓘ

7 ligands are modelled in this entry.

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	$\# Z  > 2$
2	PO4	C	227	-	4,4,4	1.80	1 (25%)	6,6,6	1.10	1 (16%)
2	PO4	A	227	-	4,4,4	2.29	3 (75%)	6,6,6	0.92	0
2	PO4	B	227	-	4,4,4	2.28	2 (50%)	6,6,6	0.82	0
3	ACT	B	228	-	3,3,3	0.99	0	3,3,3	1.02	0
3	ACT	A	228	-	3,3,3	0.77	0	3,3,3	1.38	0
3	ACT	C	229	-	3,3,3	0.87	0	3,3,3	0.94	0
3	ACT	C	228	-	3,3,3	0.72	0	3,3,3	1.35	0

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	227	PO4	P-O4	-2.95	1.46	1.54
2	A	227	PO4	P-O1	-2.75	1.44	1.50
2	B	227	PO4	P-O2	-2.55	1.47	1.54
2	C	227	PO4	P-O3	-2.47	1.47	1.54
2	A	227	PO4	P-O2	-2.32	1.47	1.54

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	227	PO4	O3-P-O2	2.01	114.16	107.91

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	227	PO4	1	0
3	C	228	ACT	1	0

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q < 0.9
1	A	228/228 (100%)	-0.26	7 (3%)	49	47	19, 30, 71, 100	0
1	B	228/228 (100%)	-0.07	9 (3%)	39	38	23, 38, 73, 100	0
1	C	225/228 (98%)	-0.06	13 (5%)	23	22	16, 35, 77, 98	0
All	All	681/684 (99%)	-0.13	29 (4%)	35	33	16, 34, 75, 100	0

The worst 5 of 29 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	46	SER	5.1
1	C	46	SER	5.0
1	A	45	ARG	3.9
1	C	4	ASP	3.9
1	B	45	ARG	3.7

### 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 monosaccharides 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, 95<sup>th</sup> 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( $\text{\AA}^2$ )	Q<0.9
3	ACT	C	228	4/4	0.74	0.22	73,73,73,73	0
3	ACT	B	228	4/4	0.77	0.24	70,70,70,70	4
3	ACT	A	228	4/4	0.92	0.20	40,40,40,40	4
3	ACT	C	229	4/4	0.95	0.14	42,42,42,42	0
2	PO4	C	227	5/5	0.99	0.14	27,35,47,55	0
2	PO4	B	227	5/5	1.00	0.15	25,30,46,62	0
2	PO4	A	227	5/5	1.00	0.15	27,42,44,47	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.