



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 12:53 PM UTC

PDB ID : 9LPC / pdb\_00009lpc  
Title : Crystal structure of Escherichia coli trptophanyl-tRNA synthetase in complex with tRNA(Trp)  
Authors : Peng, X.; Chen, B.; Zhou, H.  
Deposited on : 2025-01-24  
Resolution : 2.82 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>.

---

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

MolProbity : 4-5-2 with Phenix2.0  
Xtrriage (Phenix) : 2.0  
EDS : 3.0  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
CCP4 : 9.0.010 (Gargrove)  
Density-Fitness : 1.0.12  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.49

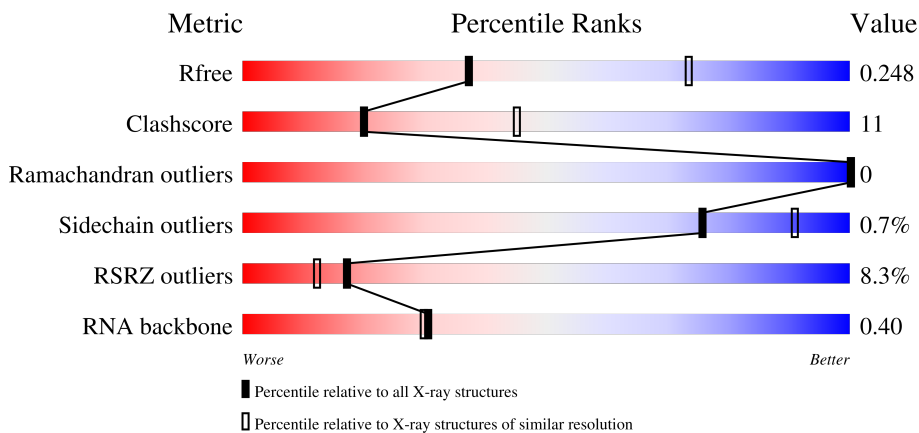
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.82 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))
$R_{free}$	180053	4591 (2.84-2.80)
Clashscore	190562	5010 (2.84-2.80)
Ramachandran outliers	187476	4916 (2.84-2.80)
Sidechain outliers	187428	4918 (2.84-2.80)
RSRZ outliers	180081	4594 (2.84-2.80)
RNA backbone	3983	1142 (3.04-2.60)

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	340	 9% 77% 21%
1	B	340	 10% 70% 21% 9%
2	C	75	 40% 44% 13%
2	D	75	 40% 36% 9% 15%

## 2 Entry composition i

There are 3 unique types of molecules in this entry. The entry contains 7463 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 Tryptophan-tRNA ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	334	Total	C	N	O	S	0	0	0
			2430	1534	419	464	13			
1	B	311	Total	C	N	O	S	0	0	0
			2147	1355	368	412	12			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	334	ARG	-	expression tag	UNP E2QFN4
A	335	HIS	-	expression tag	UNP E2QFN4
A	336	HIS	-	expression tag	UNP E2QFN4
A	337	HIS	-	expression tag	UNP E2QFN4
A	338	HIS	-	expression tag	UNP E2QFN4
A	339	HIS	-	expression tag	UNP E2QFN4
A	340	HIS	-	expression tag	UNP E2QFN4
B	334	ARG	-	expression tag	UNP E2QFN4
B	335	HIS	-	expression tag	UNP E2QFN4
B	336	HIS	-	expression tag	UNP E2QFN4
B	337	HIS	-	expression tag	UNP E2QFN4
B	338	HIS	-	expression tag	UNP E2QFN4
B	339	HIS	-	expression tag	UNP E2QFN4
B	340	HIS	-	expression tag	UNP E2QFN4

- Molecule 2 is a RNA chain called tRNA(Trp).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	C	73	Total	C	N	O	P	0	0	0
			1543	686	272	512	73			
2	D	64	Total	C	N	O	P	0	0	0
			1336	592	237	443	64			

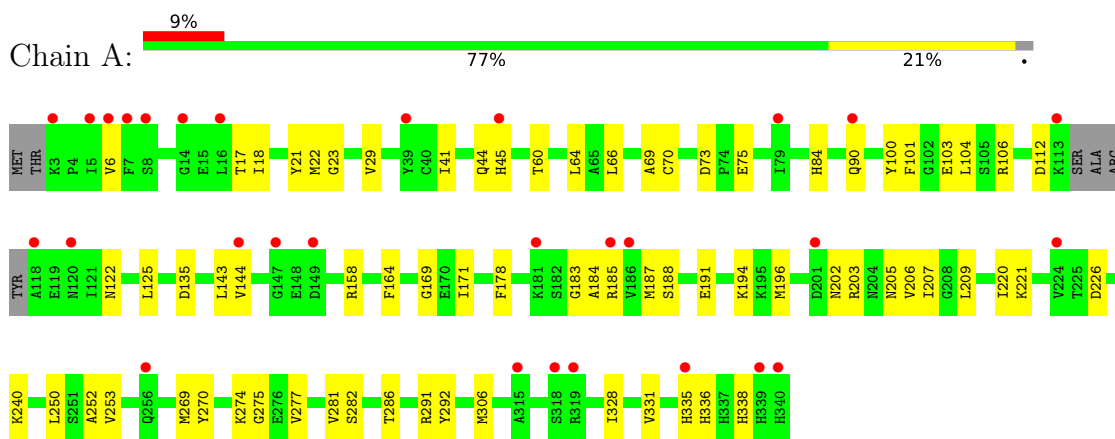
- Molecule 3 is water.

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

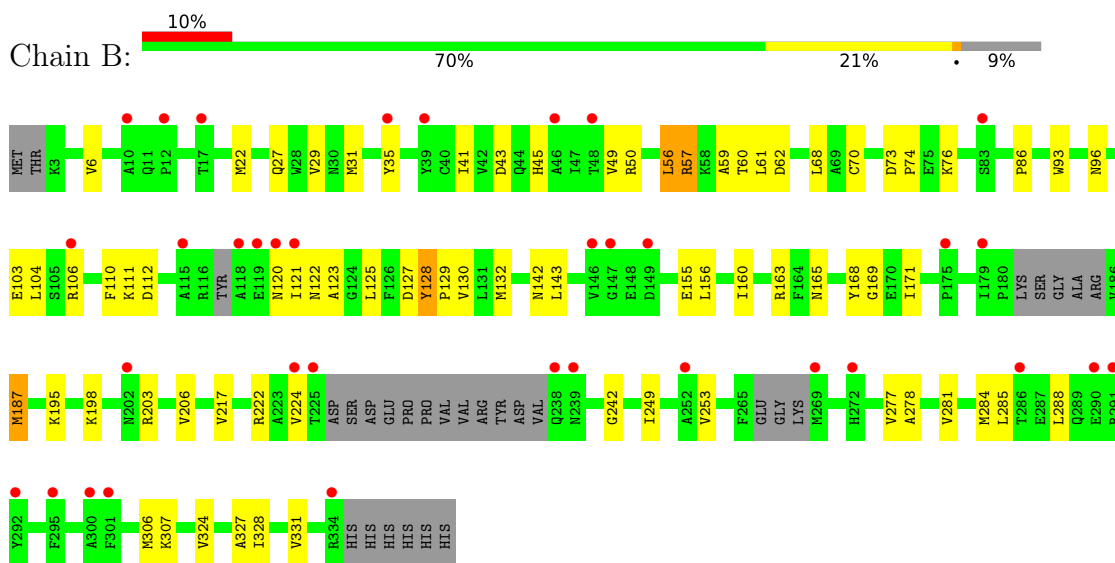
### 3 Residue-property plots [i](#)

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.

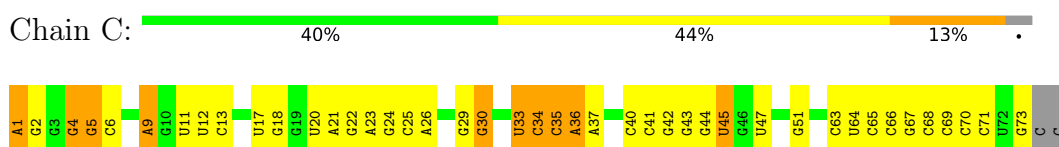
- Molecule 1: Tryptophan-tRNA ligase



- Molecule 1: Tryptophan-tRNA ligase

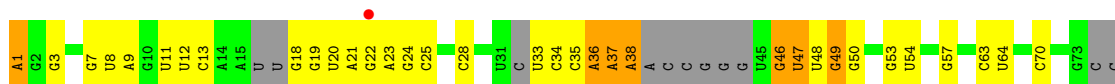


- Molecule 2: tRNA(Trp)



## ● Molecule 2: tRNA(Trp)

Chain D:  %



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	60.79Å 63.21Å 91.63Å 98.50° 97.25° 100.04°	Depositor
Resolution (Å)	59.12 – 2.82 59.12 – 2.82	Depositor EDS
% Data completeness (in resolution range)	97.2 (59.12-2.82) 97.3 (59.12-2.82)	Depositor EDS
$R_{merge}$	0.04	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.68 (at 2.82Å)	Xtrriage
Refinement program	PHENIX (1.18.2_3874: ???)	Depositor
R, $R_{free}$	0.236 , 0.271 (Not available) , 0.248	Depositor DCC
$R_{free}$ test set	1476 reflections (4.79%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	72.5	Xtrriage
Anisotropy	0.433	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.27 , 68.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	0.000 for -k,-h,-l	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	7463	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	94.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.54% 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](#)

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	0.74	0/2479	0.84	2/3381 (0.1%)
1	B	0.76	1/2188 (0.0%)	0.81	3/2996 (0.1%)
2	C	0.40	1/1723 (0.1%)	0.59	0/2683
2	D	0.39	1/1489 (0.1%)	0.59	0/2312
All	All	0.63	3/7879 (0.0%)	0.73	5/11372 (0.0%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	1	A	OP3-P	6.60	1.61	1.48
2	D	1	A	OP3-P	6.16	1.60	1.48
1	B	56	LEU	CA-C	-5.19	1.46	1.52

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	128	TYR	CA-C-N	-8.82	110.70	119.87
1	B	128	TYR	C-N-CA	-8.82	110.70	119.87
1	B	130	VAL	N-CA-C	-6.60	104.58	111.58
1	A	112	ASP	CB-CA-C	-5.42	101.69	110.79
1	A	44	GLN	N-CA-C	-5.01	106.67	112.89

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	2430	0	2191	57	0
1	B	2147	0	1805	55	0
2	C	1543	0	779	32	0
2	D	1336	0	674	17	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
3	C	2	0	0	0	0
3	D	1	0	0	0	0
All	All	7463	0	5449	146	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 11.

The worst 5 of 146 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:17:THR:HB	1:A:196:MET:HE2	1.50	0.93
1:A:331:VAL:HG22	1:B:57:ARG:HG3	1.60	0.82
2:D:37:A:H3'	2:D:38:A:H8	1.53	0.74
2:D:11:U:H3	2:D:24:G:H1	1.33	0.73
2:D:37:A:H3'	2:D:38:A:C8	2.25	0.71

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	330/340 (97%)	303 (92%)	27 (8%)	0	100	100
1	B	301/340 (88%)	283 (94%)	18 (6%)	0	100	100
All	All	631/680 (93%)	586 (93%)	45 (7%)	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	226/290 (78%)	226 (100%)	0	100	100
1	B	178/290 (61%)	175 (98%)	3 (2%)	53	81
All	All	404/580 (70%)	401 (99%)	3 (1%)	76	91

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	57	ARG
1	B	171	ILE
1	B	187	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	45	HIS
1	A	239	ASN
1	A	339	HIS
1	B	45	HIS

### 5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	C	72/75 (96%)	21 (29%)	2 (2%)
2	D	59/75 (78%)	21 (35%)	2 (3%)
All	All	131/150 (87%)	42 (32%)	4 (3%)

5 of 42 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	C	4	G
2	C	5	G
2	C	9	A

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type
2	C	13	C
2	C	17	U

All (4) RNA pucker outliers are listed below:

Mol	Chain	Res	Type
2	C	17	U
2	C	33	U
2	D	7	G
2	D	46	G

#### 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 oligosaccharides 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 [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	334/340 (98%)	0.61	29 (8%) 16 11	30, 73, 92, 102	0
1	B	311/340 (91%)	0.77	35 (11%) 10 7	46, 84, 140, 167	0
2	C	73/75 (97%)	0.23	0 100 100	75, 109, 145, 164	0
2	D	64/75 (85%)	0.34	1 (1%) 70 61	72, 106, 201, 227	0
All	All	782/830 (94%)	0.62	65 (8%) 17 12	30, 80, 144, 227	0

The worst 5 of 65 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	225	THR	4.3
1	A	340	HIS	3.7
1	B	292	TYR	3.7
1	B	238	GLN	3.6
1	A	5	ILE	3.6

### 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 oligosaccharides in this entry.

### 6.4 Ligands [i](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.