



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 09:48 AM GMT

PDB ID : 3JSN  
Title : Crystal structure of the adenylation domain of NAD<sup>+</sup>-dependent DNA ligase from *Staphylococcus aureus*  
Authors : Han, S.; Chang, J.S.; Griffor, M.  
Deposited on : 2009-09-10  
Resolution : 1.90 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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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 : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

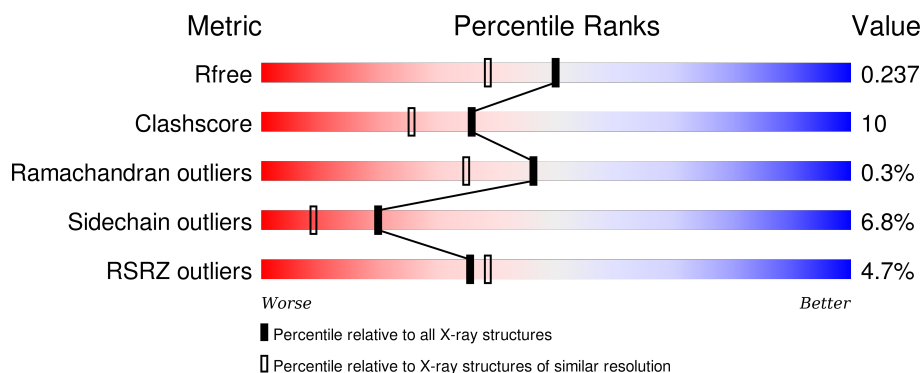
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.90 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))
$R_{free}$	91344	4755 (1.90-1.90)
Clashscore	102246	5398 (1.90-1.90)
Ramachandran outliers	100387	5338 (1.90-1.90)
Sidechain outliers	100360	5339 (1.90-1.90)
RSRZ outliers	91569	4766 (1.90-1.90)

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  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	318	<div> <div>4%</div> <div>74%</div> <div>16%</div> <div>7%</div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2582 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 DNA ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	297	Total	C	N	O	S	0	0	0
			2415	1514	416	479	6			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	313	HIS	-	EXPRESSION TAG	UNP Q9AIU7
A	314	HIS	-	EXPRESSION TAG	UNP Q9AIU7
A	315	HIS	-	EXPRESSION TAG	UNP Q9AIU7
A	316	HIS	-	EXPRESSION TAG	UNP Q9AIU7
A	317	HIS	-	EXPRESSION TAG	UNP Q9AIU7
A	318	HIS	-	EXPRESSION TAG	UNP Q9AIU7

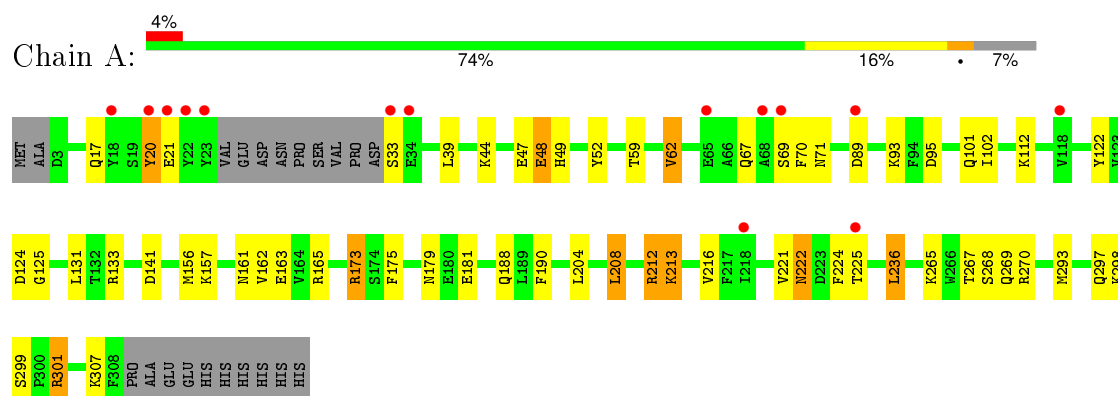
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	167	Total	O	0	0
			167	167		

### 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 errors 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: DNA ligase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	42.88 Å 79.80 Å 101.67 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 1.90 29.21 – 1.90	Depositor EDS
% Data completeness (in resolution range)	92.3 (30.00-1.90) 92.2 (29.21-1.90)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.27 (at 1.91 Å)	Xtriage
Refinement program	REFMAC 5.4.0069	Depositor
R, $R_{free}$	0.193 , 0.235 0.194 , 0.237	Depositor DCC
$R_{free}$ test set	1333 reflections (5.43%)	DCC
Wilson B-factor (Å <sup>2</sup> )	25.2	Xtriage
Anisotropy	0.518	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.40 , 45.8	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtriage
Outliers	0 of 25877 reflections	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	2582	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	31.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.45% 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, 0.375 respectively for untwinned datasets, and 0.333, 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	1.04	0/2457	1.00	5/3313 (0.2%)

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
1	A	0	1

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	A	301	ARG	NE-CZ-NH1	-9.54	115.53	120.30
1	A	212	ARG	NE-CZ-NH1	7.11	123.85	120.30
1	A	173	ARG	NE-CZ-NH2	-6.90	116.85	120.30
1	A	133	ARG	NE-CZ-NH1	-6.46	117.07	120.30
1	A	236	LEU	CA-CB-CG	-5.38	102.93	115.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	33	SER	Peptide

### 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	2415	0	2351	46	0
2	A	167	0	0	4	1
All	All	2582	0	2351	46	1

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 10.

All (46) 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:39:LEU:HD21	1:A:62:VAL:HG13	1.31	1.05
1:A:101:GLN:OE1	1:A:301:ARG:NH1	1.97	0.98
1:A:39:LEU:HD21	1:A:62:VAL:CG1	1.94	0.97
1:A:125:GLY:HA2	1:A:156:MET:CE	1.97	0.95
1:A:125:GLY:HA2	1:A:156:MET:HE3	1.51	0.93
1:A:20:TYR:HE2	1:A:157:LYS:HZ1	1.13	0.91
1:A:20:TYR:HE2	1:A:157:LYS:NZ	1.71	0.87
1:A:122:TYR:HB3	1:A:156:MET:HE1	1.64	0.79
1:A:181:GLU:HG2	2:A:430:HOH:O	1.87	0.73
1:A:101:GLN:CD	1:A:301:ARG:HH12	1.95	0.70
1:A:179:ASN:HD21	1:A:190:PHE:H	1.39	0.68
1:A:122:TYR:CB	1:A:156:MET:HE1	2.25	0.65
1:A:20:TYR:CE2	1:A:157:LYS:NZ	2.61	0.64
1:A:125:GLY:HA2	1:A:156:MET:HE2	1.79	0.63
1:A:122:TYR:HB3	1:A:156:MET:CE	2.30	0.60
1:A:112:LYS:NZ	1:A:307:LYS:NZ	2.51	0.58
1:A:267:THR:O	1:A:270:ARG:HG2	2.06	0.54
1:A:89:ASP:OD2	1:A:93:LYS:HE2	2.09	0.53
1:A:59:THR:O	1:A:62:VAL:HG22	2.09	0.52
1:A:112:LYS:NZ	1:A:307:LYS:HZ1	2.10	0.50
1:A:47:GLU:HG3	2:A:381:HOH:O	2.11	0.49
1:A:112:LYS:HZ1	1:A:307:LYS:NZ	2.11	0.49
1:A:39:LEU:CD2	1:A:62:VAL:HG13	2.22	0.49
1:A:181:GLU:CG	2:A:430:HOH:O	2.53	0.49
1:A:208:LEU:HD22	1:A:208:LEU:O	2.12	0.49
1:A:163:GLU:H	1:A:222:ASN:ND2	2.11	0.48
1:A:301:ARG:HD3	1:A:301:ARG:HH11	1.54	0.47
1:A:69:SER:HB2	1:A:71:ASN:ND2	2.29	0.46
1:A:70:PHE:CE2	1:A:204:LEU:HD23	2.50	0.46
1:A:222:ASN:N	1:A:222:ASN:HD22	2.14	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:102:ILE:HD13	1:A:293:MET:HG2	1.98	0.46
1:A:212:ARG:O	2:A:373:HOH:O	2.21	0.45
1:A:307:LYS:HD3	1:A:307:LYS:HA	1.75	0.45
1:A:213:LYS:HD3	1:A:213:LYS:N	2.31	0.45
1:A:224:PHE:O	1:A:225:THR:C	2.56	0.44
1:A:112:LYS:HZ2	1:A:307:LYS:NZ	2.15	0.44
1:A:44:LYS:O	1:A:48:GLU:HG2	2.18	0.43
1:A:131:LEU:HD23	1:A:141:ASP:HA	2.01	0.43
1:A:112:LYS:HZ1	1:A:307:LYS:HZ1	1.66	0.42
1:A:70:PHE:N	1:A:70:PHE:CD2	2.88	0.42
1:A:297:GLN:O	1:A:298:LYS:HB2	2.20	0.41
1:A:39:LEU:HD21	1:A:62:VAL:HG11	1.92	0.41
1:A:221:VAL:HG22	1:A:224:PHE:CE2	2.56	0.41
1:A:265:LYS:O	1:A:269:GLN:HG3	2.21	0.40
1:A:161:ASN:C	1:A:162:VAL:HG13	2.42	0.40
1:A:49:HIS:HB3	1:A:52:TYR:HD2	1.86	0.40

All (1) 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)
2:A:337:HOH:O	2:A:401:HOH:O 3_444]	2.17	0.03

## 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	293/318 (92%)	287 (98%)	5 (2%)	1 (0%)	46 35

All (1) Ramachandran outliers are listed below:



Mol	Chain	Res	Type
1	A	21	GLU

### 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	265/284 (93%)	247 (93%)	18 (7%)	20 9

All (18) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	17	GLN
1	A	20	TYR
1	A	48	GLU
1	A	62	VAL
1	A	67	GLN
1	A	95	ASP
1	A	124	ASP
1	A	165	ARG
1	A	173	ARG
1	A	175	PHE
1	A	188	GLN
1	A	208	LEU
1	A	213	LYS
1	A	216	VAL
1	A	222	ASN
1	A	236	LEU
1	A	268	SER
1	A	299	SER

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

Mol	Chain	Res	Type
1	A	71	ASN
1	A	179	ASN
1	A	222	ASN

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Mol	Chain	Res	Type
1	A	249	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 carbohydrates 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	297/318 (93%)	0.14	14 (4%) 35 38	19, 28, 49, 82	0

All (14) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	22	TYR	7.6
1	A	20	TYR	5.1
1	A	18	TYR	5.1
1	A	65	GLU	5.1
1	A	23	TYR	3.5
1	A	225	THR	3.3
1	A	89	ASP	3.1
1	A	34	GLU	3.0
1	A	21	GLU	3.0
1	A	68	ALA	2.7
1	A	33	SER	2.5
1	A	69	SER	2.4
1	A	218	ILE	2.0
1	A	118	VAL	2.0

### 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](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.