



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 28, 2024 – 06:50 PM EDT

PDB ID : 1U0K  
Title : The structure of a Predicted Epimerase PA4716 from *Pseudomonas aeruginosa*  
Authors : Cuff, M.E.; Ginell, S.L.; Rotella, F.J.; Xu, X.; Savchenko, A.; Edwards, A.;  
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Deposited on : 2004-07-13  
Resolution : 1.50 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

<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 : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.003 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.39

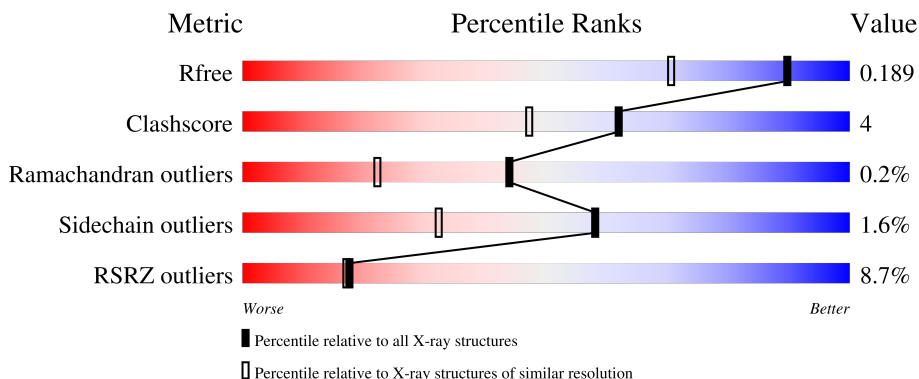
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.50 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))
$R_{free}$	164625	3717 (1.50-1.50)
Clashscore	180529	4048 (1.50-1.50)
Ramachandran outliers	177936	3970 (1.50-1.50)
Sidechain outliers	177891	3967 (1.50-1.50)
RSRZ outliers	164620	3718 (1.50-1.50)

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	288	 13% 91% 7%
1	B	288	 4% 86% 10%

## 2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 5262 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 gene product PA4716.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	284	2181	1377	394	406	1	3	0	0	0
1	B	282	2168	1369	392	404	1	2	0	0	0

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	GLY	-	cloning artifact	UNP Q9HV82
A	0	HIS	-	cloning artifact	UNP Q9HV82
A	1	MSE	MET	modified residue	UNP Q9HV82
A	35	MSE	MET	modified residue	UNP Q9HV82
A	120	MSE	MET	modified residue	UNP Q9HV82
A	285	GLY	-	cloning artifact	UNP Q9HV82
A	286	SER	-	cloning artifact	UNP Q9HV82
B	-1	GLY	-	cloning artifact	UNP Q9HV82
B	0	HIS	-	cloning artifact	UNP Q9HV82
B	1	MSE	MET	modified residue	UNP Q9HV82
B	35	MSE	MET	modified residue	UNP Q9HV82
B	120	MSE	MET	modified residue	UNP Q9HV82
B	285	GLY	-	cloning artifact	UNP Q9HV82
B	286	SER	-	cloning artifact	UNP Q9HV82

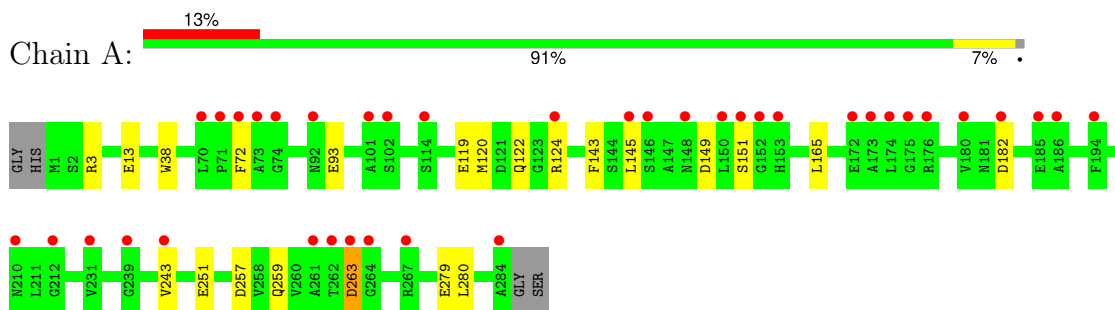
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	399	Total 399	O 399	0	0
2	B	514	Total 514	O 514	0	0

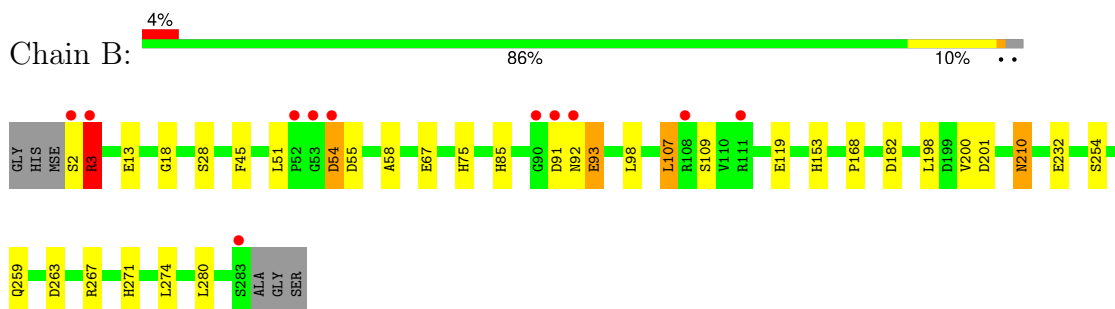
### 3 Residue-property plots [i](#)

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: gene product PA4716



- Molecule 1: gene product PA4716



## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	39.78Å 69.48Å 94.95Å 90.00° 101.10° 90.00°	Depositor
Resolution (Å)	91.29 – 1.50 91.29 – 1.50	Depositor EDS
% Data completeness (in resolution range)	98.2 (91.29-1.50) 98.2 (91.29-1.50)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.91 (at 1.46Å)	Xtrriage
Refinement program	REFMAC 5.1.24, CNS 1.1	Depositor
R, $R_{free}$	0.167 , 0.189 0.169 , 0.189	Depositor DCC
$R_{free}$ test set	4008 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	12.4	Xtrriage
Anisotropy	0.350	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 45.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.024 for h,-k,-h-l	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	5262	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	19.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.85% 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	0.41	1/2229 (0.0%)	0.72	4/3027 (0.1%)
1	B	0.46	1/2216 (0.0%)	0.75	4/3010 (0.1%)
All	All	0.44	2/4445 (0.0%)	0.73	8/6037 (0.1%)

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	B	0	1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	93	GLU	CD-OE2	6.30	1.32	1.25
1	B	93	GLU	CD-OE2	6.26	1.32	1.25

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	263	ASP	CB-CG-OD2	7.28	124.85	118.30
1	A	257	ASP	CB-CG-OD2	5.97	123.68	118.30
1	B	54	ASP	CB-CG-OD2	5.55	123.30	118.30
1	A	182	ASP	CB-CG-OD2	5.49	123.24	118.30
1	B	182	ASP	CB-CG-OD2	5.15	122.94	118.30
1	A	149	ASP	CB-CG-OD2	5.10	122.89	118.30
1	B	201	ASP	CB-CG-OD2	5.05	122.84	118.30
1	B	91	ASP	CB-CG-OD2	5.02	122.82	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	54	ASP	Peptide

## 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	2181	0	2125	11	0
1	B	2168	0	2108	23	0
2	A	399	0	0	7	0
2	B	514	0	0	11	0
All	All	5262	0	4233	34	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 4.

All (34) 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:B:67:GLU:OE1	2:B:743:HOH:O	1.88	0.90
1:A:259:GLN:NE2	2:A:650:HOH:O	2.14	0.81
1:A:13:GLU:HG3	2:A:622:HOH:O	1.93	0.68
1:A:151:SER:HA	2:A:649:HOH:O	1.95	0.67
1:B:75:HIS:HE1	2:B:780:HOH:O	1.77	0.66
1:B:3:ARG:HB3	1:B:3:ARG:CZ	2.26	0.65
1:B:92:ASN:HB2	2:B:744:HOH:O	1.97	0.63
1:B:263:ASP:CG	2:B:634:HOH:O	2.38	0.62
1:A:119:GLU:CD	2:A:650:HOH:O	2.43	0.56
1:B:92:ASN:CG	1:B:93:GLU:H	2.09	0.56
1:B:92:ASN:ND2	2:B:503:HOH:O	2.38	0.56
1:B:119:GLU:CD	2:B:797:HOH:O	2.45	0.54
1:B:55:ASP:HB3	1:B:58:ALA:HB3	1.90	0.54
1:B:75:HIS:CE1	2:B:780:HOH:O	2.54	0.53
1:A:124:ARG:HB3	2:A:666:HOH:O	2.09	0.53
1:B:45:PHE:HB3	2:B:780:HOH:O	2.10	0.49
1:B:28:SER:HA	1:B:51:LEU:HD23	1.96	0.47
1:B:210:ASN:N	1:B:210:ASN:HD22	2.12	0.47
1:B:153:HIS:CD2	1:B:200:VAL:HG21	2.50	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:38:TRP:CH2	1:A:280:LEU:HD22	2.51	0.46
1:B:232:GLU:OE1	2:B:573:HOH:O	2.21	0.46
1:A:251:GLU:HG2	2:B:757:HOH:O	2.16	0.45
1:B:98:LEU:HD12	1:B:107:LEU:HD13	2.00	0.44
1:B:168:PRO:HA	1:B:198:LEU:O	2.19	0.43
1:B:18:GLY:HA2	1:B:254:SER:OG	2.19	0.42
1:A:279:GLU:HG2	2:A:536:HOH:O	2.19	0.42
1:B:85:HIS:HD2	1:B:109:SER:OG	2.01	0.42
1:B:2:SER:HA	1:B:280:LEU:HB2	2.01	0.42
1:B:259:GLN:OE1	1:B:267:ARG:HD3	2.20	0.42
1:B:274:LEU:HB2	2:B:782:HOH:O	2.20	0.41
1:A:120:MSE:HE2	1:A:122:GLN:HG2	2.02	0.41
1:A:72:PHE:HB2	2:A:623:HOH:O	2.19	0.41
1:B:13:GLU:OE2	1:B:271:HIS:HD2	2.04	0.41
1:A:143:PHE:O	1:A:145:LEU:HD13	2.21	0.41

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	282/288 (98%)	277 (98%)	5 (2%)	0	100	100
1	B	280/288 (97%)	274 (98%)	5 (2%)	1 (0%)	30	12
All	All	562/576 (98%)	551 (98%)	10 (2%)	1 (0%)	44	22

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	3	ARG



### 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	217/216 (100%)	213 (98%)	4 (2%)	54	27
1	B	216/216 (100%)	213 (99%)	3 (1%)	62	38
All	All	433/432 (100%)	426 (98%)	7 (2%)	58	32

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	3	ARG
1	A	165	LEU
1	A	243	VAL
1	A	263	ASP
1	B	3	ARG
1	B	107	LEU
1	B	210	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	85	HIS
1	A	271	HIS
1	B	85	HIS
1	B	92	ASN
1	B	210	ASN
1	B	271	HIS

### 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 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

### 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<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	281/288 (97%)	0.76	38 (13%) 8 7	8, 21, 35, 42	0
1	B	280/288 (97%)	-0.17	11 (3%) 44 47	6, 10, 24, 34	0
All	All	561/576 (97%)	0.30	49 (8%) 17 17	6, 14, 32, 42	0

All (49) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	2	SER	5.8
1	B	91	ASP	4.3
1	B	283	SER	4.2
1	B	92	ASN	4.1
1	A	102	SER	4.1
1	A	148	ASN	3.9
1	A	284	ALA	3.6
1	A	180	VAL	3.6
1	A	73	ALA	3.5
1	A	146	SER	3.0
1	A	92	ASN	3.0
1	A	263	ASP	2.9
1	A	74	GLY	2.8
1	A	145	LEU	2.8
1	A	72	PHE	2.8
1	A	175	GLY	2.7
1	A	71	PRO	2.7
1	B	53	GLY	2.7
1	A	210	ASN	2.6
1	A	172	GLU	2.6
1	A	151	SER	2.5
1	B	3	ARG	2.4
1	A	262	THR	2.4
1	B	108	ARG	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	185	GLU	2.4
1	A	212	GLY	2.3
1	A	264	GLY	2.3
1	B	111	ARG	2.3
1	A	152	GLY	2.3
1	A	194	PHE	2.3
1	A	124	ARG	2.3
1	B	90	GLY	2.2
1	A	176	ARG	2.2
1	A	70	LEU	2.2
1	A	174	LEU	2.2
1	A	153	HIS	2.2
1	A	243	VAL	2.1
1	A	239	GLY	2.1
1	A	150	LEU	2.1
1	A	182	ASP	2.1
1	A	231	VAL	2.1
1	A	114	SER	2.1
1	A	101	ALA	2.1
1	A	261	ALA	2.1
1	B	54	ASP	2.1
1	A	267	ARG	2.0
1	B	52	PRO	2.0
1	A	173	ALA	2.0
1	A	186	ALA	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 monosaccharides 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.