



# Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2016 – 11:23 PM EDT

PDB ID : 4YE9  
Title : The crystal structure of the G45V mutant of human GlnRS  
Authors : Ognjenovic, J.; Wu, J.; Ling, J.; Simonovic, M.  
Deposited on : 2015-02-23  
Resolution : 2.70 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 : unknown  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20027257  
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) : rb-20027257

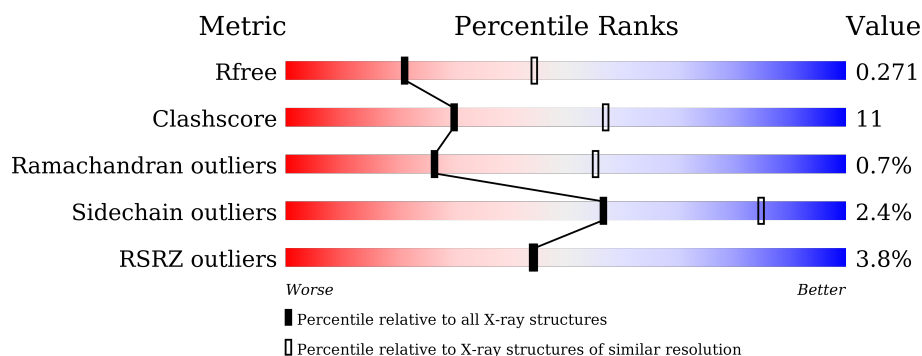
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.70 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	2103 (2.70-2.70)
Clashscore	102246	2422 (2.70-2.70)
Ramachandran outliers	100387	2382 (2.70-2.70)
Sidechain outliers	100360	2382 (2.70-2.70)
RSRZ outliers	91569	2107 (2.70-2.70)

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	776	<div> <div>3%</div> <div>71%</div> <div>19%</div> <div>• 9%</div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5288 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 Glutamine-tRNA ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	709	Total	C	N	O	S	0	5	0
			5201	3307	919	947	28			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	HIS	-	expression tag	UNP P47897
A	45	VAL	GLY	engineered mutation	UNP P47897

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	87	Total	O	0	0
			87	87		



- Molecule 1: Glutamine-tRNA ligase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	336.94Å 58.52Å 86.65Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.50 – 2.70 48.50 – 2.50	Depositor EDS
% Data completeness (in resolution range)	98.8 (48.50-2.70) 86.6 (48.50-2.50)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.29 (at 2.51Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.9_1692)	Depositor
R, $R_{free}$	0.228 , 0.262 0.235 , 0.271	Depositor DCC
$R_{free}$ test set	1443 reflections (3.34%)	DCC
Wilson B-factor (Å <sup>2</sup> )	41.0	Xtriage
Anisotropy	0.122	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.27 , 73.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.85	EDS
Total number of atoms	5288	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	94.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.64% 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 [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	0.51	0/5336	0.76	13/7283 (0.2%)

There are no bond length outliers.

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	A	99	LEU	CB-CA-C	-13.95	83.69	110.20
1	A	623	PRO	N-CA-CB	-12.13	88.74	103.30
1	A	622	GLU	N-CA-C	-8.56	87.88	111.00
1	A	622	GLU	CB-CA-C	-8.46	93.48	110.40
1	A	98	PRO	CB-CA-C	-7.33	93.67	112.00
1	A	78	SER	N-CA-C	-5.98	94.86	111.00
1	A	99	LEU	N-CA-C	5.67	126.30	111.00
1	A	46	SER	N-CA-C	-5.54	96.04	111.00
1	A	540	GLY	N-CA-C	5.37	126.52	113.10
1	A	100	ASP	C-N-CD	5.34	139.62	128.40
1	A	725	ALA	CB-CA-C	5.16	117.84	110.10
1	A	582	PHE	C-N-CD	5.06	139.02	128.40
1	A	77	ALA	CB-CA-C	-5.03	102.56	110.10

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	5201	0	4668	110	0
2	A	87	0	0	3	0
All	All	5288	0	4668	110	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.

All (110) 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:524:ARG:NH1	1:A:753:PRO:HG2	1.38	1.35
1:A:99:LEU:O	1:A:101:PRO:HD3	1.49	1.11
1:A:311:GLU:OE1	1:A:314:PHE:HE2	1.33	1.08
1:A:311:GLU:OE1	1:A:314:PHE:CE2	2.05	1.07
1:A:99:LEU:O	1:A:101:PRO:CD	2.05	1.05
1:A:752:ASP:OD1	1:A:753:PRO:HD3	1.59	1.03
1:A:524:ARG:NH1	1:A:753:PRO:CG	2.31	0.93
1:A:752:ASP:CG	1:A:753:PRO:CD	2.38	0.92
1:A:524:ARG:HH12	1:A:753:PRO:HG2	1.37	0.88
1:A:524:ARG:HH11	1:A:753:PRO:HG2	1.39	0.87
1:A:752:ASP:OD1	1:A:753:PRO:CD	2.25	0.84
1:A:752:ASP:CG	1:A:753:PRO:HD2	2.00	0.81
1:A:567:ARG:HG3	1:A:596:PRO:HD2	1.71	0.72
1:A:651:VAL:HG12	1:A:652:LYS:H	1.53	0.72
1:A:752:ASP:CG	1:A:753:PRO:HD3	2.05	0.70
1:A:525:ARG:NH2	1:A:554:GLU:OE1	2.26	0.68
1:A:99:LEU:O	1:A:101:PRO:HD2	1.93	0.68
1:A:301:ARG:NH1	1:A:449:GLU:OE1	2.29	0.66
1:A:103:ASP:OD1	1:A:105:VAL:HG12	1.97	0.65
1:A:371:LEU:HG	1:A:372:PRO:HD2	1.79	0.65
1:A:651:VAL:HB	1:A:660:SER:O	1.97	0.64
1:A:691:LEU:HG	1:A:764:ARG:HD2	1.82	0.61
1:A:512:ASP:HB3	1:A:520:THR:HG23	1.85	0.59
1:A:692:TYR:H	1:A:764:ARG:HD3	1.68	0.59
1:A:752:ASP:OD2	1:A:753:PRO:HD2	2.04	0.58
1:A:404:MET:HE3	1:A:470:LEU:HD13	1.86	0.58
1:A:92:GLU:OE2	1:A:96:SER:HB3	2.05	0.57
1:A:665:CYS:SG	1:A:666:ARG:N	2.78	0.57
1:A:83:THR:HG23	1:A:86:GLN:H	1.70	0.57
1:A:225:ARG:NH1	1:A:293:ALA:O	2.38	0.56
1:A:567:ARG:HD3	1:A:742:GLN:HB3	1.87	0.56
1:A:333:THR:HG21	1:A:449:GLU:OE2	2.05	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:218:LEU:HG	1:A:219:SER:H	1.71	0.55
1:A:38:THR:O	1:A:42:GLN:HG2	2.07	0.55
1:A:604:HIS:CD2	1:A:731:SER:HB3	2.41	0.55
1:A:700:ASN:HB3	1:A:701:PRO:HD2	1.88	0.55
1:A:76:ILE:O	1:A:76:ILE:HG22	2.06	0.55
1:A:729:ASP:OD1	1:A:730:CYS:N	2.36	0.54
1:A:704:PRO:HA	1:A:708:PRO:HD2	1.91	0.53
1:A:571:VAL:HG22	1:A:572:LEU:H	1.74	0.53
1:A:75:TYR:CD2	1:A:107:PHE:HE2	2.27	0.53
1:A:148:LEU:O	1:A:152:GLU:HG3	2.10	0.52
1:A:324:TRP:CZ2	1:A:523:ARG:HG3	2.44	0.52
1:A:648:GLN:H	1:A:663:VAL:HA	1.76	0.51
1:A:691:LEU:HA	1:A:764:ARG:HG2	1.92	0.51
1:A:689:VAL:HG22	1:A:762:PHE:HB2	1.92	0.51
1:A:756:HIS:ND1	1:A:756:HIS:N	2.59	0.50
1:A:278:ILE:HA	1:A:519:LEU:HD21	1.94	0.50
1:A:651:VAL:HG12	1:A:652:LYS:N	2.26	0.49
1:A:515:ARG:HE	1:A:692:TYR:HD1	1.60	0.49
1:A:179:PRO:HB2	1:A:181:LEU:HD21	1.93	0.49
1:A:360:GLN:HE21	1:A:371:LEU:HD23	1.77	0.48
1:A:265:ARG:HG2	1:A:297:ILE:HD11	1.94	0.48
1:A:523:ARG:HG2	1:A:738:PHE:CE1	2.48	0.48
1:A:269:PRO:HA	1:A:301:ARG:O	2.14	0.48
1:A:764:ARG:O	1:A:764:ARG:HG3	2.14	0.47
1:A:26:ASN:O	1:A:30:SER:HB3	2.14	0.47
1:A:406:LEU:HD22	1:A:469:TRP:CD2	2.50	0.47
1:A:511:TRP:CZ3	1:A:520:THR:HG21	2.50	0.47
1:A:99:LEU:C	1:A:101:PRO:CD	2.82	0.46
1:A:93:TYR:CD1	1:A:107:PHE:HD1	2.32	0.46
1:A:703:ASP:O	1:A:705:THR:N	2.42	0.46
1:A:514:PRO:HB3	1:A:525:ARG:HB2	1.98	0.46
1:A:55:LEU:HA	1:A:55:LEU:HD23	1.81	0.45
1:A:141:ARG:NH1	2:A:802:HOH:O	2.50	0.45
1:A:219:SER:HB3	1:A:222:GLU:CD	2.36	0.45
1:A:512:ASP:O	1:A:524:ARG:HD3	2.17	0.45
1:A:324:TRP:CE2	1:A:529:PRO:HG3	2.52	0.45
1:A:96:SER:OG	1:A:97:HIS:CD2	2.70	0.45
1:A:83:THR:OG1	1:A:85:PRO:HD2	2.16	0.45
1:A:145:ASN:OD1	1:A:148:LEU:HD12	2.17	0.44
1:A:755:SER:HB2	1:A:761:VAL:H	1.81	0.44
1:A:747:GLY:HA2	1:A:768:LEU:HD11	1.99	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:304:ASP:N	1:A:304:ASP:OD1	2.50	0.44
1:A:359:HIS:HB2	1:A:375:TRP:CH2	2.53	0.44
1:A:485:GLY:HA3	1:A:545:GLN:H	1.82	0.44
1:A:268:PHE:HA	1:A:269:PRO:HD3	1.77	0.43
1:A:360:GLN:NE2	1:A:371:LEU:HD23	2.33	0.43
1:A:646:GLU:O	1:A:664:THR:N	2.50	0.43
1:A:695:LEU:O	1:A:695:LEU:HD23	2.18	0.43
1:A:154:ARG:NH1	1:A:160:ALA:O	2.48	0.43
1:A:176:LEU:HG	1:A:177:LEU:HD23	2.00	0.43
1:A:490:HIS:HB3	1:A:700:ASN:HA	2.00	0.43
1:A:96:SER:O	1:A:98:PRO:HD3	2.19	0.43
1:A:303:ASP:OD1	1:A:442:HIS:NE2	2.44	0.42
1:A:567:ARG:NH1	1:A:596:PRO:HG2	2.34	0.42
1:A:495:SER:HB3	1:A:498:LYS:HB2	2.01	0.42
1:A:154:ARG:HA	1:A:154:ARG:HD3	1.73	0.42
1:A:317:ALA:O	1:A:321:MET:HG2	2.18	0.42
1:A:755:SER:C	1:A:756:HIS:ND1	2.73	0.42
1:A:489:LEU:HD22	1:A:548:MET:HB3	2.00	0.42
1:A:592:VAL:HA	1:A:593:PRO:HD3	1.90	0.42
1:A:67:ARG:HH22	1:A:100:ASP:HA	1.85	0.42
1:A:55:LEU:HD11	1:A:82:HIS:HA	2.01	0.42
1:A:418:TYR:CZ	1:A:436:PRO:HB3	2.55	0.42
1:A:64:ARG:HB2	2:A:865:HOH:O	2.20	0.42
1:A:532:ILE:O	1:A:535:PHE:HB3	2.20	0.42
1:A:267:ARG:HD2	1:A:446:ASP:OD1	2.20	0.42
1:A:489:LEU:CD2	1:A:548:MET:HB3	2.50	0.42
1:A:106:ASP:O	1:A:110:GLU:HG3	2.20	0.41
1:A:373:SER:HA	1:A:374:PRO:HD3	1.82	0.41
1:A:324:TRP:NE1	1:A:529:PRO:HG3	2.35	0.41
1:A:522:LEU:HB3	1:A:527:PHE:CD2	2.56	0.41
1:A:594:ASN:OD1	1:A:594:ASN:N	2.53	0.41
1:A:86:GLN:HG2	1:A:111:CYS:O	2.21	0.41
1:A:134:ARG:HD3	2:A:811:HOH:O	2.20	0.41
1:A:580:THR:H	1:A:664:THR:HA	1.86	0.41
1:A:91:LEU:HA	1:A:91:LEU:HD23	1.81	0.40
1:A:75:TYR:HA	1:A:75:TYR:HD1	1.69	0.40
1:A:692:TYR:HE2	1:A:763:ASN:OD1	2.03	0.40

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	698/776 (90%)	610 (87%)	83 (12%)	5 (1%)	26	55

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	100	ASP
1	A	269	PRO
1	A	543	VAL
1	A	101	PRO
1	A	732	VAL

### 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	472/667 (71%)	461 (98%)	11 (2%)	58	85

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	137	LEU
1	A	267	ARG
1	A	286	PHE
1	A	311	GLU
1	A	349	LEU
1	A	383	SER

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Mol	Chain	Res	Type
1	A	401	THR
1	A	520	THR
1	A	571	VAL
1	A	755	SER
1	A	756	HIS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	97	HIS

### 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 carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

There are no ligands in this entry.

## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues ⓘ

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	709/776 (91%)	0.16	27 (3%) 44 44	37, 92, 164, 186	0

All (27) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	684	PRO	6.6
1	A	607	PRO	4.0
1	A	576	ARG	3.7
1	A	517	PHE	3.5
1	A	574	SER	3.2
1	A	575	LEU	3.2
1	A	747	GLY	3.0
1	A	624	GLU	2.9
1	A	741	PHE	2.7
1	A	612	VAL	2.7
1	A	87	LEU	2.7
1	A	618	ASP	2.6
1	A	516	LEU	2.6
1	A	743	PHE	2.6
1	A	748	TYR	2.5
1	A	606	VAL	2.4
1	A	1	MET	2.3
1	A	613	PHE	2.3
1	A	489	LEU	2.3
1	A	94	VAL	2.3
1	A	526	GLY	2.2
1	A	683	GLN	2.2
1	A	543	VAL	2.2
1	A	643	TYR	2.2
1	A	621	GLU	2.1
1	A	560	VAL	2.0
1	A	749	PHE	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.