



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 1, 2026 – 08:33 PM UTC

PDB ID : 2DZS / pdb_00002dzs
Title : Structure of mutant tryptophan synthase alpha-subunit (E103A) from a hyperthermophile, *Pyrococcus furiosus*
Authors : Ogasahara, K.; Yamagata, Y.; Yutani, K.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)
Deposited on : 2006-09-30
Resolution : 2.40 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

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
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

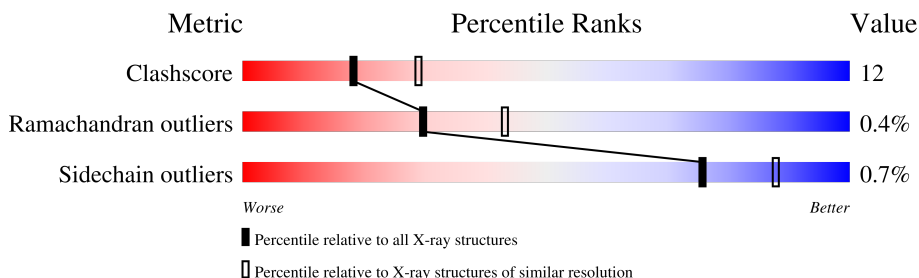
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (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 ≥ 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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	248	
1	B	248	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4197 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 synthase alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	244	Total	C	N	O	S	0	0	0
			1911	1234	324	349	4			
1	B	245	Total	C	N	O	S	0	0	0
			1918	1238	325	351	4			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	103	ALA	GLU	engineered mutation	UNP Q8U094
B	103	ALA	GLU	engineered mutation	UNP Q8U094

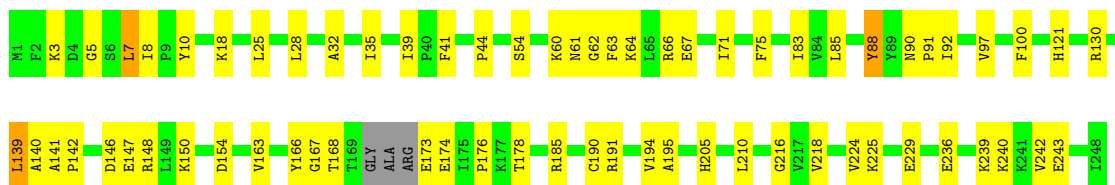
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	191	Total	O	0	0
			191	191		
2	B	177	Total	O	0	0
			177	177		

i

Note EDS was not executed.

- Chain A: 73% 24% •



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	73.28 Å 77.69 Å 166.69 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.70 – 2.40	Depositor
% Data completeness (in resolution range)	97.3 (19.70-2.40)	Depositor
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.215 , 0.260	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4197	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

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	0.44	0/1947	0.92	9/2626 (0.3%)
1	B	0.43	0/1954	0.90	5/2636 (0.2%)
All	All	0.43	0/3901	0.91	14/5262 (0.3%)

There are no bond length outliers.

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	32	ALA	N-CA-C	6.63	120.30	109.76
1	B	32	ALA	N-CA-C	6.28	119.89	109.46
1	A	175	ILE	N-CA-C	-6.12	102.95	108.95
1	A	189	ILE	N-CA-C	6.09	117.24	112.12
1	A	191	ARG	N-CA-C	-5.97	105.07	112.90
1	A	190	CYS	N-CA-C	5.89	119.12	109.76
1	A	67	GLU	N-CA-C	-5.75	105.15	111.82
1	B	191	ARG	N-CA-C	-5.67	105.47	112.90
1	A	166	TYR	N-CA-C	5.50	117.98	111.33
1	A	88	TYR	N-CA-C	-5.40	102.52	110.52
1	B	88	TYR	N-CA-C	-5.39	102.54	110.52
1	B	190	CYS	N-CA-C	5.34	118.19	110.28
1	A	115	VAL	N-CA-C	5.09	115.70	110.36
1	B	7	LEU	N-CA-C	-5.06	100.49	108.73

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	1911	0	1968	45	0
1	B	1918	0	1975	49	0
2	A	191	0	0	12	0
2	B	177	0	0	4	0
All	All	4197	0	3943	94	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 12.

All (94) 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:236:GLU:H	1:B:236:GLU:CD	1.93	0.77
1:B:90:ASN:HB3	1:B:91:PRO:HD3	1.70	0.74
1:A:90:ASN:HB3	1:A:91:PRO:HD3	1.71	0.73
1:A:236:GLU:H	1:A:236:GLU:CD	1.97	0.72
1:A:20:SER:OG	1:A:232:ARG:HG2	1.89	0.71
1:B:121:HIS:HB3	2:B:297:HOH:O	1.97	0.63
1:B:173:GLU:C	1:B:174:GLU:HG3	2.26	0.60
1:A:167:GLY:HA3	2:A:283:HOH:O	2.00	0.60
1:B:5:GLY:HA2	1:B:210:LEU:HD22	1.81	0.60
1:B:75:PHE:CD2	1:B:83:ILE:HD11	2.36	0.60
1:B:41:PHE:O	1:B:44:PRO:HD3	2.03	0.59
1:B:239:LYS:O	1:B:243:GLU:HG3	2.03	0.58
1:B:44:PRO:HA	1:B:88:TYR:CZ	2.38	0.58
1:B:225:LYS:O	1:B:229:GLU:HG3	2.03	0.58
1:A:44:PRO:HA	1:A:88:TYR:CZ	2.39	0.57
1:A:139:LEU:C	1:A:139:LEU:HD23	2.31	0.56
1:A:18:LYS:HG2	2:A:347:HOH:O	2.05	0.55
1:A:75:PHE:CD2	1:A:83:ILE:HD11	2.41	0.55
1:B:28:LEU:HD22	1:B:242:VAL:HG21	1.87	0.55
1:A:5:GLY:HA2	1:A:210:LEU:HD22	1.88	0.55
1:A:167:GLY:HA2	2:A:274:HOH:O	2.06	0.54
1:B:8:ILE:HB	1:B:218:VAL:HG22	1.89	0.54
1:A:166:TYR:CZ	1:A:178:THR:HG21	2.43	0.54
1:A:139:LEU:HD23	1:A:140:ALA:N	2.23	0.54
1:B:139:LEU:HD23	1:B:140:ALA:N	2.22	0.54
1:B:139:LEU:HD23	1:B:139:LEU:C	2.33	0.53
1:A:220:GLY:O	1:A:224:VAL:HG23	2.08	0.53
1:B:147:GLU:H	1:B:147:GLU:CD	2.18	0.52
1:A:41:PHE:O	1:A:44:PRO:HD3	2.08	0.52
1:B:150:LYS:HE3	1:B:154:ASP:OD2	2.10	0.52

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:147:GLU:H	1:A:147:GLU:CD	2.17	0.52
1:A:148:ARG:HH11	1:A:148:ARG:HG3	1.75	0.51
1:B:61:ASN:HD22	1:B:61:ASN:N	2.08	0.51
1:B:142:PRO:HD3	1:B:163:VAL:O	2.11	0.50
1:A:142:PRO:HD3	1:A:163:VAL:O	2.11	0.50
1:A:28:LEU:HD22	1:A:242:VAL:HG21	1.93	0.49
1:B:225:LYS:HD2	2:B:391:HOH:O	2.10	0.49
1:B:54:SER:HB3	1:B:224:VAL:HG13	1.94	0.49
1:A:61:ASN:HD22	1:A:61:ASN:N	2.08	0.49
1:A:92:ILE:HG12	1:A:100:PHE:CD2	2.49	0.48
1:A:25:LEU:HD22	1:A:35:ILE:HD13	1.96	0.48
1:A:165:LEU:HB3	2:A:285:HOH:O	2.13	0.48
1:B:92:ILE:HG12	1:B:100:PHE:CD2	2.49	0.47
1:A:10:TYR:CD2	1:A:10:TYR:C	2.92	0.47
1:B:63:PHE:C	1:B:63:PHE:CD1	2.92	0.47
1:A:39:ILE:HD11	1:A:85:LEU:HD21	1.97	0.47
2:A:332:HOH:O	1:B:3:LYS:HE3	2.14	0.47
1:B:25:LEU:HD22	1:B:35:ILE:HD13	1.97	0.47
1:B:39:ILE:HD11	1:B:85:LEU:HD21	1.96	0.47
1:A:150:LYS:HE3	1:A:154:ASP:OD2	2.15	0.46
1:A:166:TYR:HB2	1:A:176:PRO:HG3	1.97	0.46
1:B:8:ILE:O	1:B:218:VAL:HA	2.15	0.46
1:B:10:TYR:CD2	1:B:10:TYR:C	2.94	0.46
1:A:63:PHE:CD1	1:A:63:PHE:C	2.93	0.46
1:A:19:GLN:NE2	2:A:295:HOH:O	2.40	0.46
1:A:165:LEU:HA	2:A:333:HOH:O	2.15	0.45
1:B:7:LEU:C	1:B:7:LEU:HD23	2.42	0.45
1:A:7:LEU:C	1:A:7:LEU:HD23	2.42	0.45
1:B:236:GLU:CD	1:B:236:GLU:N	2.70	0.44
1:B:61:ASN:N	1:B:61:ASN:ND2	2.66	0.44
1:B:67:GLU:O	1:B:71:ILE:HG13	2.17	0.44
1:B:148:ARG:HH11	1:B:148:ARG:HG3	1.81	0.44
2:A:392:HOH:O	1:B:130:ARG:HD2	2.17	0.43
1:B:141:ALA:HB1	1:B:142:PRO:CD	2.48	0.43
1:B:166:TYR:HB2	1:B:176:PRO:HG3	2.00	0.43
1:A:141:ALA:HB1	1:A:142:PRO:CD	2.49	0.43
1:A:8:ILE:O	1:A:218:VAL:HA	2.19	0.43
1:A:160:VAL:HB	1:A:194:VAL:HG12	2.01	0.43
1:A:45:ILE:HD11	2:A:365:HOH:O	2.17	0.43
1:A:61:ASN:N	1:A:61:ASN:ND2	2.66	0.43
1:B:66:ARG:HH11	1:B:66:ARG:HG3	1.83	0.43

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:60:LYS:C	1:A:62:GLY:H	2.27	0.42
1:A:230:LYS:HE3	1:A:237:PHE:CZ	2.54	0.42
1:A:166:TYR:CB	1:A:176:PRO:HG3	2.48	0.42
1:B:88:TYR:O	1:B:91:PRO:HD2	2.20	0.42
1:B:64:LYS:O	1:B:67:GLU:HB2	2.19	0.42
1:B:195:ALA:HA	1:B:216:GLY:O	2.20	0.41
1:B:240:LYS:HD3	1:B:240:LYS:HA	1.93	0.41
1:B:54:SER:HB3	1:B:224:VAL:CG1	2.51	0.41
1:B:167:GLY:HA3	2:B:403:HOH:O	2.20	0.41
1:B:166:TYR:CZ	1:B:178:THR:HG21	2.56	0.41
1:A:64:LYS:O	1:A:67:GLU:HB2	2.20	0.41
1:A:167:GLY:CA	2:A:274:HOH:O	2.68	0.41
1:A:219:VAL:HG12	1:A:223:LEU:HG	2.03	0.41
1:B:60:LYS:C	1:B:62:GLY:H	2.29	0.41
1:B:66:ARG:HG3	1:B:66:ARG:NH1	2.36	0.41
1:A:67:GLU:O	1:A:71:ILE:HG13	2.21	0.40
1:B:147:GLU:CD	1:B:147:GLU:N	2.79	0.40
1:B:168:THR:HG21	1:B:205:HIS:CE1	2.56	0.40
1:B:18:LYS:HG2	2:B:336:HOH:O	2.20	0.40
1:A:64:LYS:NZ	2:A:350:HOH:O	2.54	0.40
1:A:88:TYR:O	1:A:91:PRO:HD2	2.21	0.40
1:B:146:ASP:OD1	1:B:185:ARG:HD2	2.21	0.40
1:A:178:THR:HG23	2:A:364:HOH:O	2.22	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	240/248 (97%)	224 (93%)	15 (6%)	1 (0%)	30	43
1	B	241/248 (97%)	229 (95%)	11 (5%)	1 (0%)	30	43

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	481/496 (97%)	453 (94%)	26 (5%)	2 (0%)	30	43

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	97	VAL
1	B	97	VAL

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	202/204 (99%)	201 (100%)	1 (0%)	81	91
1	B	203/204 (100%)	201 (99%)	2 (1%)	68	84
All	All	405/408 (99%)	402 (99%)	3 (1%)	76	88

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

Mol	Chain	Res	Type
1	A	139	LEU
1	B	139	LEU
1	B	194	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	19	GLN
1	A	23	ASN
1	A	52	GLN
1	A	61	ASN
1	A	192	ASN
1	B	19	GLN
1	B	23	ASN
1	B	52	GLN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	B	61	ASN
1	B	192	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 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 ⓘ

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.