Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 12:28 AM UTC

PDB ID	:	2DZV / pdb_00002dzv
Title	:	Structure of mutant tryptophan synthase alpha-subunit (D146A) 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:

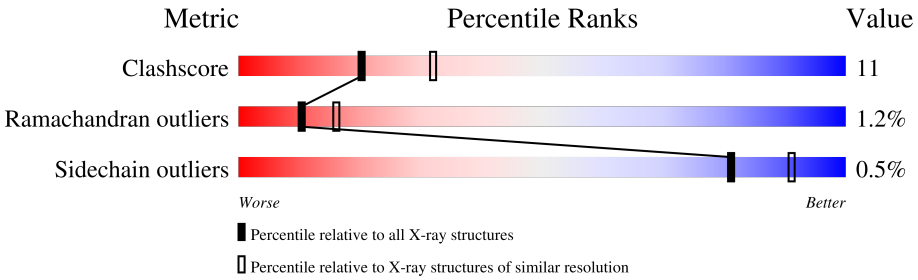
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

1 Overall quality at a glance (i)

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 <=5%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	248	69% 29%
1	B	248	71% 27%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 4096 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
			1912	1235	324	349	4			
1	B	245	Total	C	N	O	S	0	0	0
			1919	1239	325	351	4			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	146	ALA	ASP	engineered mutation	UNP Q8U094
B	146	ALA	ASP	engineered mutation	UNP Q8U094

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	136	Total	O	0	0
			136	136		
2	B	129	Total	O	0	0
			129	129		

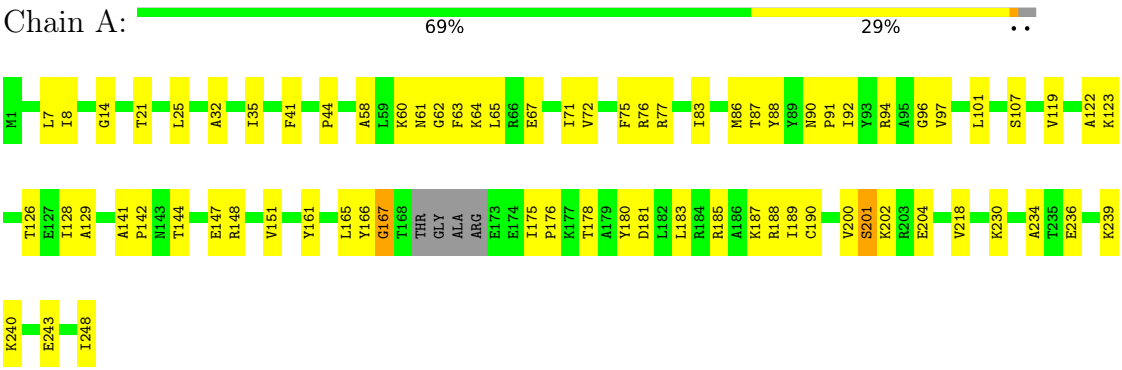
3 Residue-property plots (i)

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. 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. 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.

Note EDS was not executed.

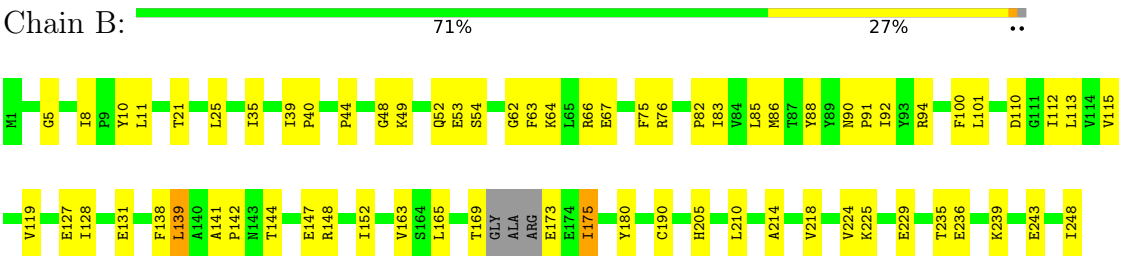
• Molecule 1: Tryptophan synthase alpha chain

Chain A:



• Molecule 1: Tryptophan synthase alpha chain

Chain B:



4 Data and refinement statistics (i)

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	73.38Å 76.50Å 166.90Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.99 – 2.40	Depositor
% Data completeness (in resolution range)	99.7 (19.99-2.40)	Depositor
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.214 , 0.290	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4096	wwPDB-VP
Average B, all atoms (Å^2)	32.0	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	0.41	0/1948	0.91	6/2627 (0.2%)
1	B	0.42	0/1955	0.92	5/2637 (0.2%)
All	All	0.42	0/3903	0.91	11/5264 (0.2%)

There are no bond length outliers.

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	7	LEU	N-CA-C	-6.85	98.04	109.07
1	B	190	CYS	N-CA-C	6.26	119.36	109.96
1	A	8	ILE	N-CA-C	6.05	114.14	108.15
1	B	175	ILE	N-CA-C	-5.94	103.52	108.63
1	B	67	GLU	N-CA-C	-5.62	105.30	111.82
1	B	115	VAL	N-CA-C	5.52	116.16	110.36
1	A	32	ALA	N-CA-C	5.43	119.09	109.96
1	A	189	ILE	N-CA-C	5.31	116.58	112.12
1	A	167	GLY	N-CA-C	-5.28	103.03	112.22
1	A	190	CYS	N-CA-C	5.05	117.79	109.76
1	B	21	THR	N-CA-C	-5.04	105.68	111.07

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	1912	0	1970	46	0
1	B	1919	0	1977	42	0
2	A	136	0	0	9	0
2	B	129	0	0	2	0
All	All	4096	0	3947	88	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 (88) 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:90:ASN:OD1	1:A:94:ARG:HD2	1.82	0.79
1:A:90:ASN:HB3	1:A:91:PRO:HD3	1.67	0.77
1:A:188:ARG:HD3	2:A:274:HOH:O	1.85	0.77
1:A:239:LYS:O	1:A:243:GLU:HG3	1.88	0.74
1:B:236:GLU:H	1:B:236:GLU:CD	1.96	0.72
1:B:175:ILE:HB	1:B:180:TYR:CE1	2.29	0.68
1:B:75:PHE:CD2	1:B:83:ILE:HD11	2.34	0.62
1:A:123:LYS:HG2	2:A:326:HOH:O	2.00	0.62
1:B:90:ASN:HB3	1:B:91:PRO:HD3	1.82	0.61
1:A:148:ARG:HH11	1:A:148:ARG:HG3	1.67	0.59
1:A:181:ASP:O	1:A:185:ARG:HG3	2.02	0.59
1:A:175:ILE:HB	1:A:180:TYR:CE1	2.38	0.58
1:A:90:ASN:CG	1:A:94:ARG:HD2	2.27	0.58
1:B:86:MET:HG3	1:B:113:LEU:HD23	1.86	0.58
1:A:101:LEU:HD12	1:A:128:ILE:HG22	1.86	0.57
1:B:11:LEU:HD12	1:B:25:LEU:HD23	1.85	0.57
1:B:54:SER:HB3	1:B:224:VAL:CG1	2.35	0.57
1:B:225:LYS:O	1:B:229:GLU:HG3	2.04	0.57
1:B:44:PRO:HA	1:B:88:TYR:CZ	2.40	0.56
1:B:239:LYS:O	1:B:243:GLU:HG3	2.05	0.56
1:B:243:GLU:HG2	1:B:248:ILE:HD11	1.86	0.55
1:A:176:PRO:HB2	1:A:178:THR:HG22	1.88	0.55
1:B:88:TYR:O	1:B:91:PRO:HD2	2.06	0.55
1:B:48:GLY:O	1:B:52:GLN:HG3	2.07	0.54
1:A:144:THR:HG23	1:A:148:ARG:HD2	1.90	0.54
1:B:11:LEU:HD12	1:B:25:LEU:CD2	2.37	0.54
1:B:144:THR:HG23	1:B:148:ARG:HD2	1.89	0.53
1:B:92:ILE:HG12	1:B:100:PHE:CD2	2.44	0.53
1:A:122:ALA:O	1:A:126:THR:HG23	2.09	0.53
1:B:62:GLY:O	1:B:64:LYS:HE3	2.07	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:39:ILE:HD11	1:B:85:LEU:HD21	1.91	0.52
1:B:54:SER:HB3	1:B:224:VAL:HG13	1.93	0.51
1:A:60:LYS:C	1:A:62:GLY:H	2.18	0.51
1:A:41:PHE:HE1	1:A:90:ASN:HD22	1.59	0.50
1:A:75:PHE:CD2	1:A:83:ILE:HD11	2.47	0.50
1:A:61:ASN:HD22	1:A:61:ASN:N	2.10	0.50
1:A:44:PRO:HA	1:A:88:TYR:CZ	2.46	0.49
1:B:25:LEU:HD22	1:B:35:ILE:HG21	1.95	0.49
1:A:119:VAL:HG12	2:A:299:HOH:O	2.11	0.49
1:B:90:ASN:O	1:B:94:ARG:HG3	2.13	0.49
1:A:151:VAL:HG13	2:A:329:HOH:O	2.12	0.48
1:B:127:GLU:O	1:B:131:GLU:HG3	2.14	0.48
1:A:204:GLU:HG2	2:A:268:HOH:O	2.13	0.48
1:B:5:GLY:HA2	1:B:210:LEU:HD22	1.95	0.48
1:A:183:LEU:O	1:A:187:LYS:HG2	2.13	0.48
1:A:147:GLU:H	1:A:147:GLU:CD	2.21	0.48
1:A:87:THR:HG21	1:A:92:ILE:HD11	1.96	0.48
1:B:92:ILE:HD11	1:B:112:ILE:HD11	1.96	0.48
1:B:210:LEU:HD23	1:B:214:ALA:O	2.14	0.47
1:A:21:THR:HG21	1:A:71:ILE:HD13	1.95	0.47
1:B:40:PRO:HG2	1:B:63:PHE:CD1	2.49	0.47
1:B:101:LEU:HD12	1:B:128:ILE:HG22	1.95	0.47
1:A:25:LEU:HD22	1:A:35:ILE:HG21	1.97	0.47
1:A:86:MET:HB2	2:A:338:HOH:O	2.15	0.47
1:A:62:GLY:HA2	2:A:368:HOH:O	2.15	0.46
1:A:63:PHE:CD1	1:A:63:PHE:C	2.93	0.46
1:A:243:GLU:HB3	1:A:248:ILE:HG13	1.97	0.46
1:B:119:VAL:HB	2:B:312:HOH:O	2.15	0.46
1:A:77:ARG:HG2	1:A:77:ARG:HH11	1.81	0.46
1:A:41:PHE:O	1:A:44:PRO:HD3	2.17	0.45
1:B:66:ARG:HH11	1:B:66:ARG:HG3	1.81	0.45
1:A:200:VAL:HG13	2:A:346:HOH:O	2.17	0.44
1:B:142:PRO:HD3	1:B:163:VAL:O	2.17	0.44
1:A:72:VAL:HG12	1:A:107:SER:O	2.17	0.44
1:A:230:LYS:HB2	1:A:234:ALA:HB2	2.00	0.44
1:A:240:LYS:HA	1:A:240:LYS:HD3	1.84	0.43
1:B:49:LYS:O	1:B:53:GLU:HG3	2.18	0.43
1:A:165:LEU:HB2	2:A:317:HOH:O	2.17	0.43
1:B:10:TYR:CD2	1:B:10:TYR:C	2.96	0.43
1:B:76:ARG:HD3	1:B:76:ARG:HA	1.85	0.43
1:A:64:LYS:O	1:A:67:GLU:HB2	2.19	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:138:PHE:HB2	1:B:152:ILE:HG23	2.00	0.43
1:A:141:ALA:HB1	1:A:142:PRO:CD	2.49	0.42
1:A:161:TYR:CE1	1:A:218:VAL:HG21	2.54	0.42
1:B:82:PRO:HA	1:B:110:ASP:OD2	2.20	0.42
1:A:165:LEU:O	1:A:167:GLY:N	2.53	0.42
1:B:147:GLU:H	1:B:147:GLU:CD	2.27	0.42
1:A:60:LYS:C	1:A:62:GLY:N	2.77	0.42
1:B:173:GLU:O	1:B:205:HIS:NE2	2.49	0.42
1:B:139:LEU:C	1:B:139:LEU:HD23	2.45	0.41
1:A:76:ARG:HA	1:A:76:ARG:HD3	1.83	0.41
1:A:101:LEU:HD13	1:A:129:ALA:HA	2.03	0.41
1:B:169:THR:C	1:B:173:GLU:HA	2.46	0.41
1:B:141:ALA:HB1	1:B:142:PRO:CD	2.51	0.41
1:A:14:GLY:O	1:A:58:ALA:HA	2.22	0.40
1:B:8:ILE:O	1:B:218:VAL:HA	2.21	0.40
1:B:165:LEU:HB2	2:B:276:HOH:O	2.20	0.40
1:A:201:SER:C	1:A:202:LYS:HG3	2.45	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%)	223 (93%)	12 (5%)	5 (2%)	5 7
1	B	241/248 (97%)	229 (95%)	11 (5%)	1 (0%)	30 43
All	All	481/496 (97%)	452 (94%)	23 (5%)	6 (1%)	10 16

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	166	TYR

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Mol	Chain	Res	Type
1	A	65	LEU
1	A	201	SER
1	B	235	THR
1	A	96	GLY
1	A	97	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	202/204 (99%)	201 (100%)	1 (0%)	81	91
1	B	203/204 (100%)	202 (100%)	1 (0%)	81	91
All	All	405/408 (99%)	403 (100%)	2 (0%)	81	91

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	236	GLU
1	B	139	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) 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	B	19	GLN
1	B	23	ASN
1	B	52	GLN
1	B	61	ASN

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 oligosaccharides 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

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.