



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 01:27 AM UTC

PDB ID : 3RM5 / pdb_00003rm5
Title : Structure of Trifunctional THI20 from Yeast
Authors : French, J.B.; Begley, T.P.; Ealick, S.E.
Deposited on : 2011-04-20
Resolution : 2.68 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
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

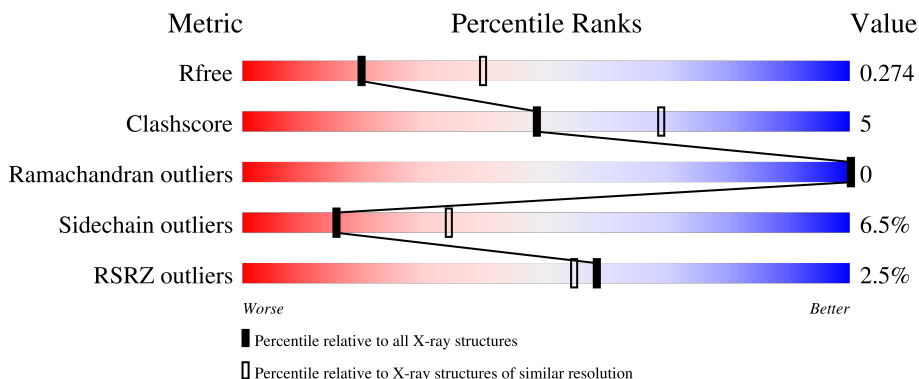
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

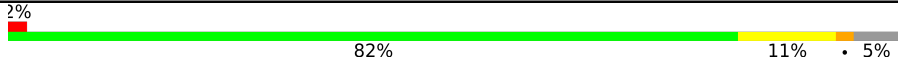
The reported resolution of this entry is 2.68 Å.

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}	180053	5070 (2.70-2.66)
Clashscore	190562	5409 (2.70-2.66)
Ramachandran outliers	187476	5324 (2.70-2.66)
Sidechain outliers	187428	5324 (2.70-2.66)
RSRZ outliers	180081	5070 (2.70-2.66)

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 $\leq 5\%$. 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	550	
1	B	550	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 7866 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 Hydroxymethylpyrimidine/phosphomethylpyrimidine kinase THI20.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	521	Total	C	N	O	S	0	0	0
			3904	2503	647	732	22			
1	B	519	Total	C	N	O	S	0	0	0
			3890	2492	644	731	23			

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	A	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	41	Total 41	O 41	0	0
3	B	16	Total 16	O 16	0	0

- Molecule 1: Hydroxymethylpyrimidine/phosphomethylpyrimidine kinase THI20



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	59.70Å 140.10Å 143.27Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.68 50.00 – 2.68	Depositor EDS
% Data completeness (in resolution range)	91.5 (50.00-2.68) 91.5 (50.00-2.68)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.73 (at 2.69Å)	Xtriage
Refinement program	REFMAC 5.5.0110	Depositor
R, R_{free}	0.238 , 0.279 0.233 , 0.274	Depositor DCC
R_{free} test set	1606 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å ²)	55.3	Xtriage
Anisotropy	0.195	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 28.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.013 for -h,l,k	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	7866	wwPDB-VP
Average B, all atoms (Å ²)	55.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.09% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: SO4

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	0.42	0/3989	0.82	3/5437 (0.1%)
1	B	0.43	0/3973	0.83	0/5412
All	All	0.43	0/7962	0.82	3/10849 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	12	PRO	CA-C-N	5.53	126.75	119.84
1	A	12	PRO	C-N-CA	5.53	126.75	119.84
1	A	526	LEU	N-CA-C	5.13	117.54	111.33

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	3904	0	3717	46	0
1	B	3890	0	3706	50	0
2	A	10	0	0	0	0
2	B	5	0	0	0	0
3	A	41	0	0	0	0
3	B	16	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	7866	0	7423	83	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 5.

All (83) 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:46:THR:HG21	1:A:244:THR:HB	1.52	0.92
1:A:459:GLN:HG3	1:A:521:TYR:HD2	1.37	0.90
1:B:481:GLY:HA2	1:B:482:LYS:HB2	1.63	0.81
1:A:42:ALA:O	1:A:46:THR:HG23	1.79	0.81
1:A:350:TYR:CE1	1:A:540:GLU:HG2	2.17	0.78
1:B:481:GLY:CA	1:B:482:LYS:HB2	2.17	0.74
1:A:459:GLN:HG3	1:A:521:TYR:CD2	2.22	0.73
1:B:42:ALA:O	1:B:46:THR:HG23	1.90	0.71
1:A:240:GLY:O	1:A:244:THR:HG23	1.93	0.68
1:B:481:GLY:HA2	1:B:482:LYS:CB	2.23	0.67
1:B:542:ASN:HA	1:B:545:THR:HG22	1.78	0.66
1:B:65:THR:HG22	1:B:67:VAL:H	1.61	0.64
1:A:521:TYR:CE1	1:A:525:GLN:HB3	2.35	0.61
1:B:343:VAL:HG12	1:B:534:ALA:HB2	1.82	0.61
1:B:379:TYR:HB2	1:B:442:LEU:HD11	1.83	0.61
1:B:375:GLN:HG3	1:B:442:LEU:HD22	1.82	0.60
1:B:240:GLY:O	1:B:244:THR:HG23	2.02	0.60
1:B:459:GLN:HG3	1:B:521:TYR:CD1	2.38	0.58
1:B:252:ASN:HB2	1:B:262:SER:HB2	1.86	0.58
1:A:244:THR:HG21	1:A:293:HIS:NE2	2.20	0.57
1:A:46:THR:HG21	1:A:244:THR:CB	2.33	0.56
1:B:370:GLN:O	1:B:374:GLU:HB2	2.06	0.56
1:B:373:ILE:HD11	1:B:421:LEU:HG	1.89	0.55
1:A:382:ASP:OD2	1:A:438:ARG:NH1	2.40	0.54
1:A:476:LEU:HD22	1:A:495:CYS:HA	1.89	0.54
1:A:95:VAL:HG22	1:A:122:LYS:HB2	1.89	0.53
1:A:332:ASN:HD22	1:A:332:ASN:H	1.56	0.53
1:A:8:ILE:HD11	1:B:228:PHE:HB3	1.90	0.52
1:B:127:PRO:HG2	1:B:159:PRO:HB3	1.92	0.52
1:A:84:LEU:HD12	1:A:108:VAL:HG12	1.93	0.51
1:A:84:LEU:HD22	1:A:88:LEU:HD22	1.93	0.51
1:B:334:TYR:CE2	1:B:338:ILE:HD11	2.46	0.50
1:A:91:MET:HE1	1:B:281:THR:HG22	1.94	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:201:GLY:HA2	1:B:213:ILE:HA	1.94	0.49
1:A:513:LEU:HD22	1:A:517:ILE:HD12	1.94	0.49
1:B:334:TYR:CZ	1:B:338:ILE:HD11	2.47	0.49
1:A:294:VAL:HG13	1:B:51:ARG:CG	2.43	0.48
1:A:480:LYS:HA	1:A:481:GLY:HA2	1.61	0.48
1:A:27:LEU:HD23	1:A:96:ILE:HG12	1.95	0.48
1:A:294:VAL:HG13	1:B:51:ARG:HG3	1.95	0.48
1:A:8:ILE:CD1	1:B:228:PHE:HB3	2.44	0.47
1:A:19:CYS:HA	1:B:276:ILE:HG23	1.96	0.47
1:B:125:VAL:HB	1:B:157:LEU:HD23	1.97	0.47
1:B:466:THR:HG21	1:B:514:LEU:HD11	1.97	0.47
1:A:344:LYS:HB3	1:A:345:PRO:HD3	1.97	0.47
1:A:228:PHE:HB3	1:B:8:ILE:CD1	2.45	0.46
1:A:161:ILE:HD11	1:A:201:GLY:H	1.80	0.46
1:A:393:LYS:HG2	1:B:454:ARG:HH21	1.80	0.46
1:A:504:ARG:HA	1:A:507:MET:HE3	1.98	0.46
1:A:350:TYR:CZ	1:A:540:GLU:HG2	2.50	0.46
1:A:46:THR:CG2	1:A:244:THR:HB	2.36	0.46
1:B:244:THR:HG21	1:B:293:HIS:NE2	2.31	0.46
1:A:404:LEU:HD22	1:B:404:LEU:HD22	1.97	0.46
1:B:78:GLU:H	1:B:78:GLU:HG3	1.44	0.46
1:B:12:PRO:HA	1:B:13:PRO:HD3	1.84	0.45
1:A:116:LEU:HB3	1:A:120:ARG:HB3	1.99	0.45
1:A:381:VAL:O	1:A:385:ARG:HG3	2.17	0.45
1:A:51:ARG:HA	1:B:294:VAL:HG21	1.99	0.45
1:B:330:GLY:HA2	1:B:331:GLY:HA2	1.57	0.45
1:A:459:GLN:HB3	1:A:517:ILE:HG12	1.99	0.44
1:A:120:ARG:HD2	1:A:121:PRO:O	2.17	0.44
1:B:350:TYR:HA	1:B:541:THR:HG22	1.99	0.44
1:A:372:PHE:CD1	1:A:373:ILE:HD12	2.53	0.44
1:A:388:CYS:HB2	1:B:392:SER:HB3	1.99	0.44
1:A:51:ARG:HA	1:B:294:VAL:CG2	2.48	0.43
1:B:365:GLU:HB2	1:B:368:LYS:HG2	2.00	0.43
1:A:476:LEU:HD13	1:A:498:TYR:HB2	2.00	0.43
1:B:156:ILE:HD12	1:B:259:LEU:HD21	2.01	0.42
1:A:537:CYS:O	1:A:541:THR:HG23	2.19	0.42
1:A:393:LYS:HB3	1:A:458:TRP:HB2	2.01	0.42
1:B:120:ARG:HD2	1:B:121:PRO:O	2.19	0.42
1:B:316:ILE:HA	1:B:317:PRO:C	2.45	0.42
1:B:350:TYR:CE2	1:B:471:GLY:HA3	2.54	0.42
1:A:350:TYR:CE2	1:A:471:GLY:HA3	2.55	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:228:PHE:HB3	1:B:8:ILE:HD11	2.01	0.42
1:B:382:ASP:OD2	1:B:438:ARG:NH2	2.51	0.41
1:B:158:THR:HG22	1:B:197:LEU:HB3	2.02	0.41
1:A:294:VAL:HG13	1:A:294:VAL:O	2.21	0.41
1:B:365:GLU:HB2	1:B:368:LYS:CG	2.51	0.41
1:B:401:GLU:O	1:B:405:VAL:HG23	2.20	0.41
1:B:311:THR:HA	1:B:312:ALA:HA	1.70	0.41
1:B:123:LEU:HB3	1:B:154:ALA:HA	2.03	0.40
1:B:65:THR:HG23	1:B:66:PRO:HD2	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	513/550 (93%)	501 (98%)	12 (2%)	0	100	100
1	B	509/550 (92%)	490 (96%)	19 (4%)	0	100	100
All	All	1022/1100 (93%)	991 (97%)	31 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	391/471 (83%)	361 (92%)	30 (8%)	12	27
1	B	390/471 (83%)	369 (95%)	21 (5%)	20	42
All	All	781/942 (83%)	730 (94%)	51 (6%)	15	34

All (51) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	8	ILE
1	A	40	ILE
1	A	41	GLU
1	A	78	GLU
1	A	84	LEU
1	A	88	LEU
1	A	97	LYS
1	A	148	GLU
1	A	149	LYS
1	A	168	LEU
1	A	199	LYS
1	A	217	LEU
1	A	231	ASN
1	A	244	THR
1	A	245	LEU
1	A	259	LEU
1	A	276	ILE
1	A	294	VAL
1	A	332	ASN
1	A	364	LEU
1	A	423	GLU
1	A	459	GLN
1	A	490	VAL
1	A	504	ARG
1	A	513	LEU
1	A	517	ILE
1	A	520	THR
1	A	525	GLN
1	A	526	LEU
1	A	541	THR
1	B	40	ILE
1	B	41	GLU
1	B	78	GLU
1	B	84	LEU
1	B	97	LYS

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Mol	Chain	Res	Type
1	B	148	GLU
1	B	149	LYS
1	B	217	LEU
1	B	245	LEU
1	B	259	LEU
1	B	276	ILE
1	B	280	VAL
1	B	294	VAL
1	B	343	VAL
1	B	373	ILE
1	B	375	GLN
1	B	459	GLN
1	B	461	LEU
1	B	513	LEU
1	B	520	THR
1	B	526	LEU

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	115	GLN
1	A	237	HIS
1	A	332	ASN
1	A	352	ASN
1	B	73	ASN
1	B	271	GLN
1	B	339	ASN
1	B	346	HIS
1	B	352	ASN
1	B	450	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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

3 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	SO4	A	1	-	4,4,4	0.22	0	6,6,6	0.11	0
2	SO4	B	552	-	4,4,4	0.22	0	6,6,6	0.15	0
2	SO4	A	552	-	4,4,4	0.23	0	6,6,6	0.10	0

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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, 95th 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 ²)	Q<0.9
1	A	521/550 (94%)	0.19	12 (2%) 61 57	32, 54, 71, 81	1 (0%)
1	B	519/550 (94%)	0.31	14 (2%) 56 52	31, 56, 74, 85	1 (0%)
All	All	1040/1100 (94%)	0.25	26 (2%) 58 54	31, 55, 73, 85	2 (0%)

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	130	VAL	4.2
1	A	461	LEU	3.7
1	B	461	LEU	3.7
1	B	312	ALA	3.2
1	A	314	ASP	2.9
1	A	430	PRO	2.9
1	B	338	ILE	2.9
1	B	284	THR	2.9
1	B	316	ILE	2.8
1	A	311	THR	2.7
1	A	520	THR	2.4
1	B	2	THR	2.4
1	B	483	VAL	2.4
1	A	288	ASN	2.3
1	A	202	HIS	2.2
1	A	210	GLU	2.2
1	B	547	ALA	2.2
1	A	306	SER	2.2
1	A	361	ASP	2.2
1	B	317	PRO	2.1
1	A	201	GLY	2.1
1	B	330	GLY	2.1
1	B	200	GLY	2.1
1	B	532	ILE	2.1

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Mol	Chain	Res	Type	RSRZ
1	B	551	GLU	2.0
1	A	363	THR	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 oligosaccharides in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	SO4	A	552	5/5	0.77	0.09	110,110,110,110	0
2	SO4	A	1	5/5	0.84	0.14	95,95,95,96	0
2	SO4	B	552	5/5	0.88	0.30	76,76,76,76	0

6.5 Other polymers [i](#)

There are no such residues in this entry.