



Full wwPDB Geometry-Only Validation Report ⓘ

Mar 5, 2026 – 07:07 AM UTC

PDB ID : 2XQZ / pdb_00002xqz
Title : Neutron structure of the perdeuterated Toho-1 R274N R276N double mutant beta-lactamase
Authors : Tomanicek, S.J.; Wang, K.K.; Weiss, K.L.; Blakeley, M.P.; Cooper, J.; Chen, Y.; Coates, L.
Deposited on : 2010-09-08
Resolution : 2.10 Å(reported)

This is a Full wwPDB Geometry-Only 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
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

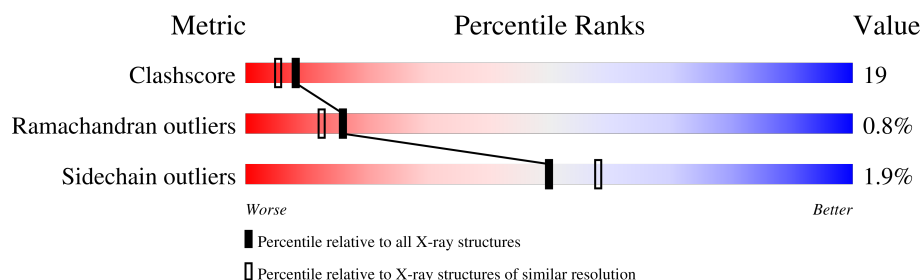
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

NEUTRON DIFFRACTION

The reported resolution of this entry is 2.10 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	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)

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	260	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4151 atoms, of which 0 are hydrogens and 1982 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 BETA-LACTAMSE TOHO-1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	260	Total	C	D	N	O	S	0	0	0
			3946	1223	1982	349	386	6			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	274	ASN	ARG	engineered mutation	UNP Q47066
A	276	ASN	ARG	engineered mutation	UNP Q47066

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	205	Total	O	0	0
			205	205		

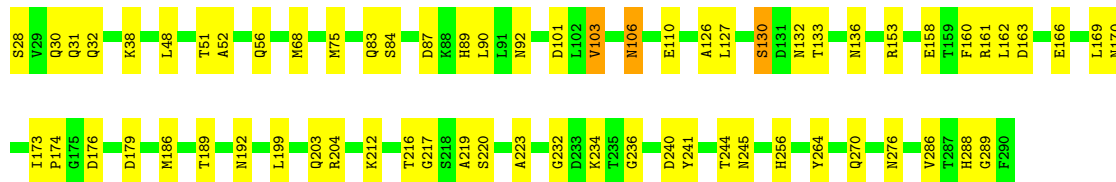
3 Residue-property plots

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: BETA-LACTAMSE TOHO-1

Chain A:  75% 24%



4 Model quality [i](#)

4.1 Standard geometry [i](#)

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

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	0.39	0/1994	0.74	0/2708

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

4.2 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	3946	0	1978	76	0
2	A	205	0	0	62	11
All	All	4151	0	1978	76	11

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 19.

All (76) 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:174:PRO:O	2:A:305:DOD:O	1.57	1.19
1:A:173:ILE:O	2:A:306:DOD:O	1.58	1.18

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:169:LEU:O	2:A:307:DOD:O	1.63	1.15
1:A:176:ASP:OD2	2:A:308:DOD:O	1.64	1.15
1:A:31:GLN:OE1	2:A:309:DOD:O	1.67	1.12
1:A:240:ASP:OD2	2:A:310:DOD:O	1.70	1.09
1:A:133:THR:HG23	2:A:329:DOD:O	1.47	1.08
1:A:276:ASN:OD1	2:A:312:DOD:O	1.79	0.98
1:A:31:GLN:OE1	2:A:313:DOD:O	1.81	0.98
1:A:286:VAL:O	2:A:315:DOD:O	1.84	0.96
1:A:38:LYS:O	2:A:314:DOD:O	1.83	0.95
1:A:256:HIS:O	2:A:316:DOD:O	1.85	0.93
1:A:56:GLN:O	2:A:318:DOD:O	1.87	0.92
1:A:166:GLU:OE2	2:A:317:DOD:O	1.87	0.91
1:A:223:ALA:O	2:A:319:DOD:O	1.92	0.87
1:A:106:ASN:OD1	2:A:320:DOD:O	1.92	0.86
1:A:136:ASN:HB3	2:A:377:DOD:O	1.71	0.86
1:A:163:ASP:OD1	2:A:322:DOD:O	1.99	0.80
1:A:101:ASP:O	2:A:323:DOD:O	2.00	0.80
1:A:127:LEU:O	2:A:324:DOD:O	2.00	0.79
1:A:101:ASP:O	2:A:325:DOD:O	2.01	0.78
1:A:241:TYR:OH	2:A:326:DOD:O	2.01	0.77
1:A:203:GLN:OE1	2:A:327:DOD:O	2.02	0.77
1:A:217:GLY:O	2:A:328:DOD:O	2.06	0.73
1:A:30:GLN:HB3	2:A:303:DOD:O	1.85	0.72
1:A:101:ASP:O	2:A:329:DOD:O	2.06	0.72
1:A:84:SER:HB2	2:A:336:DOD:O	1.86	0.70
1:A:38:LYS:HB2	2:A:355:DOD:O	1.86	0.69
1:A:153:ARG:HB2	2:A:346:DOD:O	1.89	0.67
1:A:179:ASP:O	2:A:333:DOD:O	2.13	0.67
1:A:87:ASP:OD1	2:A:331:DOD:O	2.12	0.66
1:A:30:GLN:HG2	2:A:423:DOD:O	1.91	0.66
1:A:30:GLN:CB	2:A:303:DOD:O	2.44	0.65
1:A:241:TYR:OH	2:A:330:DOD:O	2.06	0.64
1:A:270:GLN:O	2:A:334:DOD:O	2.14	0.64
1:A:28:SER:N	2:A:345:DOD:O	2.33	0.62
1:A:192:ASN:O	2:A:338:DOD:O	2.18	0.62
1:A:179:ASP:HB3	2:A:333:DOD:O	1.94	0.61
1:A:204:ARG:HG3	2:A:354:DOD:O	1.96	0.60
1:A:288:HIS:ND1	2:A:348:DOD:O	2.35	0.57
1:A:32:GLN:HG2	2:A:479:DOD:O	1.98	0.57
1:A:288:HIS:C	2:A:361:DOD:O	2.45	0.57
1:A:219:ALA:HA	2:A:452:DOD:O	2.00	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:216:THR:OG1	2:A:337:DOD:O	2.17	0.57
1:A:87:ASP:CG	2:A:331:DOD:O	2.47	0.56
1:A:289:GLY:HA3	2:A:361:DOD:O	2.01	0.55
1:A:212:LYS:HA	1:A:232:GLY:HA2	1.79	0.54
1:A:240:ASP:HA	2:A:351:DOD:O	2.02	0.54
1:A:240:ASP:CG	2:A:310:DOD:O	2.38	0.54
1:A:289:GLY:N	2:A:353:DOD:O	2.40	0.54
1:A:199:LEU:HB2	2:A:354:DOD:O	2.02	0.53
1:A:89:HIS:HA	2:A:301:DOD:O	2.04	0.52
1:A:289:GLY:N	2:A:356:DOD:O	2.41	0.49
1:A:75:MET:HE1	1:A:189:THR:HG21	1.85	0.48
1:A:288:HIS:HA	2:A:348:DOD:O	2.07	0.48
1:A:68:MET:SD	1:A:160:PHE:CE2	3.07	0.47
1:A:30:GLN:HB3	2:A:419:DOD:O	2.08	0.47
1:A:92:ASN:ND2	2:A:365:DOD:O	2.48	0.46
1:A:186:MET:HG2	1:A:264:TYR:OH	2.12	0.44
1:A:51:THR:O	1:A:52:ALA:C	2.61	0.44
1:A:101:ASP:C	2:A:329:DOD:O	2.55	0.43
1:A:289:GLY:CA	2:A:361:DOD:O	2.64	0.43
1:A:212:LYS:HA	1:A:232:GLY:CA	2.43	0.42
1:A:83:GLN:OE1	1:A:90:LEU:HD21	2.15	0.42
1:A:126:ALA:O	1:A:130:SER:HA	2.13	0.42
1:A:161:ARG:O	1:A:161:ARG:HG3	2.15	0.42
1:A:170:ASN:OD1	2:A:340:DOD:O	2.26	0.42
1:A:158:GLU:HB2	2:A:417:DOD:O	2.13	0.42
1:A:103:VAL:HG21	1:A:132:ASN:HB3	1.92	0.41
1:A:236:GLY:O	1:A:245:ASN:N	2.53	0.41
1:A:173:ILE:HG22	2:A:305:DOD:O	2.15	0.41
1:A:106:ASN:O	1:A:110:GLU:HG2	2.17	0.41
1:A:126:ALA:O	1:A:234:LYS:HE2	2.16	0.40
1:A:89:HIS:CA	2:A:301:DOD:O	2.65	0.40
1:A:179:ASP:CB	2:A:333:DOD:O	2.63	0.40
1:A:162:LEU:HD12	1:A:179:ASP:OD1	2.16	0.40

All (11) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:A:327:DOD:O	2:A:410:DOD:O[4_565]	0.98	1.22
2:A:362:DOD:O	2:A:373:DOD:O[2_564]	0.98	1.22

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:A:387:DOD:O	2:A:404:DOD:O[3_455]	0.98	1.22
2:A:452:DOD:O	2:A:476:DOD:O[3_455]	0.98	1.22
2:A:467:DOD:O	2:A:483:DOD:O[2_564]	0.98	1.22
2:A:471:DOD:O	2:A:483:DOD:O[2_564]	0.98	1.22
2:A:407:DOD:O	2:A:426:DOD:O[2_564]	1.50	0.70
2:A:346:DOD:O	2:A:387:DOD:O[2_564]	1.57	0.63
2:A:362:DOD:O	2:A:378:DOD:O[2_564]	1.57	0.63
2:A:371:DOD:O	2:A:410:DOD:O[4_565]	1.57	0.63
2:A:427:DOD:O	2:A:452:DOD:O[2_564]	1.57	0.63

4.3 Torsion angles [i](#)

4.3.1 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	258/260 (99%)	246 (95%)	10 (4%)	2 (1%)	16 12

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	103	VAL
1	A	220	SER

4.3.2 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.

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	A	209/209 (100%)	205 (98%)	4 (2%)	50 58

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	48	LEU
1	A	106	ASN
1	A	130	SER
1	A	244	THR

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	30	GLN
1	A	92	ASN
1	A	106	ASN
1	A	114	ASN
1	A	206	GLN
1	A	274	ASN

4.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

There are no non-standard protein/DNA/RNA residues in this entry.

4.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

4.6 Ligand geometry ⓘ

There are no ligands in this entry.

4.7 Other polymers

There are no such residues in this entry.

4.8 Polymer linkage issues

There are no chain breaks in this entry.