



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 06:12 AM UTC

PDB ID : 4WX9 / pdb_00004wx9
Title : Crystal structure of Mycobacterium tuberculosis OGT in complex with DNA
Authors : Miggiano, R.; Rossi, F.; Garavaglia, S.; Rizzi, M.
Deposited on : 2014-11-13
Resolution : 3.00 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

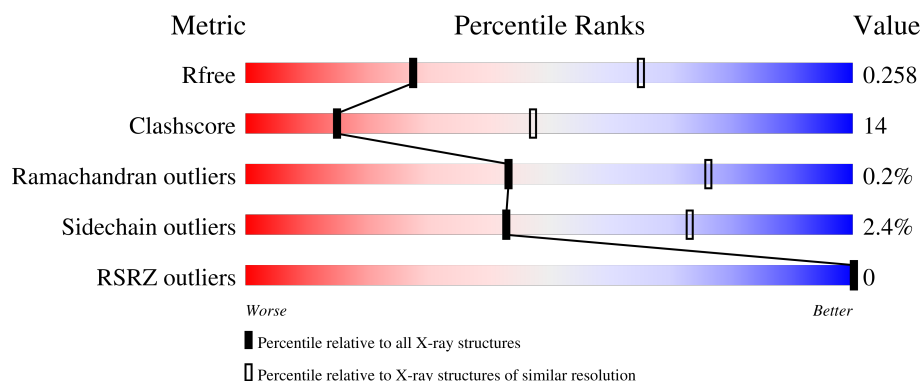
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

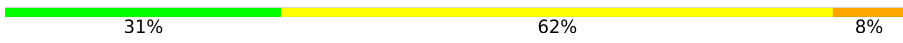
The reported resolution of this entry is 3.00 Å.

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	2672 (3.00-3.00)
Clashscore	190562	2977 (3.00-3.00)
Ramachandran outliers	187476	2877 (3.00-3.00)
Sidechain outliers	187428	2880 (3.00-3.00)
RSRZ outliers	180081	2671 (3.00-3.00)

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	D	13	
2	E	13	
3	A	165	
3	B	165	
3	C	165	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
1	E1X	D	7	-	-	X	-

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 4271 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 DNA chain called DNA (5'-D(*GP*CP*CP*AP*TP*GP*(E1X)P*CP*TP*AP*GP*TP*A)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	D	13	Total	C	N	O	P	0	0	0
			267	129	49	77	12			

- Molecule 2 is a DNA chain called DNA (5'-D(P*TP*AP*CP*TP*AP*GP*CP*CP*AP*TP*GP*GP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	13	Total	C	N	O	P	0	0	0
			265	126	48	78	13			

- Molecule 3 is a protein called Methylated-DNA--protein-cysteine methyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	161	Total	C	N	O	S	0	0	0
			1223	772	220	229	2			
3	B	164	Total	C	N	O	S	0	0	0
			1251	791	223	235	2			
3	C	164	Total	C	N	O	S	0	0	0
			1251	791	223	235	2			

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	2	VAL	ILE	engineered mutation	UNP P9WJW5
B	2	VAL	ILE	engineered mutation	UNP P9WJW5
C	2	VAL	ILE	engineered mutation	UNP P9WJW5

- Molecule 4 is GLYCEROL (CCD ID: GOL) (formula: C₃H₈O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	3	Total	O	0	0
			3	3		
5	B	2	Total	O	0	0
			2	2		
5	C	3	Total	O	0	0
			3	3		

3 Residue-property plots [i](#)

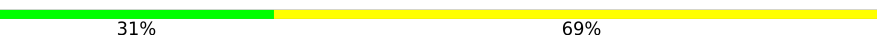
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). 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.

- Molecule 1: DNA (5'-D(*GP*CP*CP*AP*TP*GP*(E1X)P*CP*TP*AP*GP*TP*A)-3')

Chain D: 



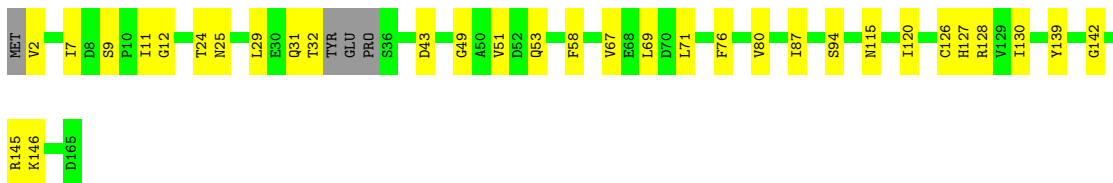
- Molecule 2: DNA (5'-D(P*TP*AP*CP*TP*AP*GP*CP*CP*AP*TP*GP*GP*C)-3')

Chain E: 



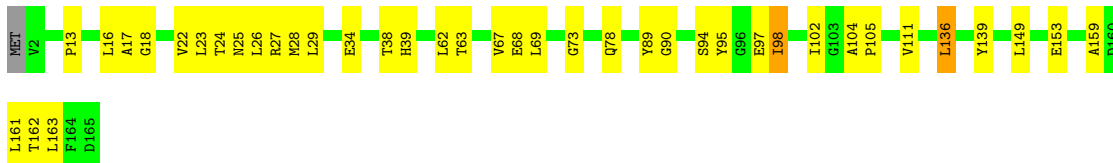
- Molecule 3: Methylated-DNA--protein-cysteine methyltransferase

Chain A: 



- Molecule 3: Methylated-DNA--protein-cysteine methyltransferase

Chain B: 



- Molecule 3: Methylated-DNA--protein-cysteine methyltransferase

Chain C: 



MET	V2	L26	T32	T38	A46	F47	T63	V67	T74	D75	F76	R79	P88	Y89	G90	E91	T92	R93	S94	I102	N115	G116	I120	I130	G131	A132	S133	G134	K135	L136	T137	G138	Y139	G140	G141	G142	I143	N144	R145	K146	R147	F164	D165
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4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	43.48Å 102.91Å 137.09Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	82.30 – 3.00 82.30 – 3.00	Depositor EDS
% Data completeness (in resolution range)	99.7 (82.30-3.00) 99.7 (82.30-3.00)	Depositor EDS
R_{merge}	0.15	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.07 (at 3.01Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.194 , 0.265 0.199 , 0.258	Depositor DCC
R_{free} test set	628 reflections (4.85%)	wwPDB-VP
Wilson B-factor (Å ²)	61.3	Xtriage
Anisotropy	0.537	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 39.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4271	wwPDB-VP
Average B, all atoms (Å ²)	61.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 24.44 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 3.8348e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: E1X, GOL

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	D	0.41	0/271	0.65	0/414
2	E	0.42	0/296	0.75	0/454
3	A	0.74	0/1249	1.00	2/1697 (0.1%)
3	B	0.61	0/1280	0.97	1/1742 (0.1%)
3	C	0.73	0/1280	1.00	2/1742 (0.1%)
All	All	0.67	0/4376	0.95	5/6049 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
3	C	0	1

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	12	GLY	CA-C-N	6.14	127.52	119.84
3	A	12	GLY	C-N-CA	6.14	127.52	119.84
3	C	67	VAL	N-CA-C	5.72	115.91	108.35
3	C	76	PHE	N-CA-C	5.32	116.89	111.14
3	B	136	LEU	N-CA-C	-5.19	102.23	109.96

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
3	C	120	ILE	Peptide

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	D	267	0	151	22	0
2	E	265	0	147	19	0
3	A	1223	0	1210	33	0
3	B	1251	0	1233	23	0
3	C	1251	0	1233	30	0
4	A	6	0	8	1	0
5	A	3	0	0	0	0
5	B	2	0	0	0	0
5	C	3	0	0	0	0
All	All	4271	0	3982	109	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 14.

The worst 5 of 109 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:D:7:E1X:H111	3:A:126:CYS:SG	1.34	1.62
1:D:7:E1X:C11	3:A:126:CYS:SG	2.11	1.38
3:C:136:LEU:HD11	3:C:143:ILE:CG2	1.74	1.17
3:C:136:LEU:HD11	3:C:143:ILE:HG23	1.35	1.05
1:D:7:E1X:H112	3:A:115:ASN:OD1	1.57	1.04

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	
3	A	157/165 (95%)	146 (93%)	11 (7%)	0	100	100
3	B	162/165 (98%)	141 (87%)	21 (13%)	0	100	100
3	C	162/165 (98%)	150 (93%)	11 (7%)	1 (1%)	21	56
All	All	481/495 (97%)	437 (91%)	43 (9%)	1 (0%)	43	76

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	C	133	SER

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	
3	A	125/129 (97%)	123 (98%)	2 (2%)	55	79
3	B	128/129 (99%)	123 (96%)	5 (4%)	28	62
3	C	128/129 (99%)	126 (98%)	2 (2%)	55	79
All	All	381/387 (98%)	372 (98%)	9 (2%)	43	73

5 of 9 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	C	26	LEU
3	C	38	THR
3	B	98	ILE
3	B	102	ILE
3	B	136	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
3	C	55	ASN
3	B	117	HIS
3	B	77	GLN
3	B	39	HIS
3	B	115	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

1 non-standard protein/DNA/RNA residue is 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	$\# Z > 2$
1	E1X	D	7	1	23,26,27	1.84	5 (21%)	28,38,41	1.68	9 (32%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	E1X	D	7	1	-	2/9/23/24	0/3/3/3

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	7	E1X	C5-C4	5.93	1.48	1.38
1	D	7	E1X	C4-N9	-3.13	1.34	1.37
1	D	7	E1X	C1'-N9	-2.62	1.41	1.48
1	D	7	E1X	C2-N1	2.23	1.42	1.39
1	D	7	E1X	C5-N7	-2.00	1.35	1.39

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	7	E1X	N3-C2-N1	3.82	122.31	115.45
1	D	7	E1X	C6-C5-N7	2.75	135.47	129.36
1	D	7	E1X	O2-C2-N1	-2.65	118.86	122.32
1	D	7	E1X	C8-N9-C4	2.43	108.72	106.67
1	D	7	E1X	C10-N1-C2	2.39	119.90	116.67

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	D	7	E1X	O4'-C4'-C5'-O5'
1	D	7	E1X	C3'-C4'-C5'-O5'

There are no ring outliers.

1 monomer is involved in 13 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	D	7	E1X	13	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

1 ligand is 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	$\# Z > 2$
4	GOL	A	201	-	5,5,5	0.60	0	5,5,5	0.59	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral

centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	GOL	A	201	-	-	4/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	201	GOL	O1-C1-C2-C3
4	A	201	GOL	C1-C2-C3-O3
4	A	201	GOL	O2-C2-C3-O3
4	A	201	GOL	O1-C1-C2-O2

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	201	GOL	1	0

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	D	12/13 (92%)	0.06	0 100 100	55, 75, 123, 140	0
2	E	13/13 (100%)	0.08	0 100 100	62, 72, 126, 146	0
3	A	161/165 (97%)	-0.60	0 100 100	38, 51, 72, 102	0
3	B	164/165 (99%)	-0.39	0 100 100	41, 67, 92, 101	0
3	C	164/165 (99%)	-0.52	0 100 100	35, 51, 75, 95	0
All	All	514/521 (98%)	-0.47	0 100 100	35, 56, 90, 146	0

There are no RSRZ outliers to report.

6.2 Non-standard residues in protein, DNA, RNA chains [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(Å ²)	Q<0.9
1	E1X	D	7	24/25	0.93	0.11	60,70,88,90	0

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
4	GOL	A	201	6/6	0.88	0.10	58,63,67,69	0

6.5 Other polymers [i](#)

There are no such residues in this entry.