



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 02:04 AM GMT

PDB ID : 2FK8  
Title : Crystal structure of Hma (MmaA4) from Mycobacterium tuberculosis complexed with S-adenosylmethionine  
Authors : Boissier, F.; Guillet, V.; Mourey, L.  
Deposited on : 2006-01-04  
Resolution : 2.00 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](mailto:validation@mail.wwpdb.org)  
A user guide is available at  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

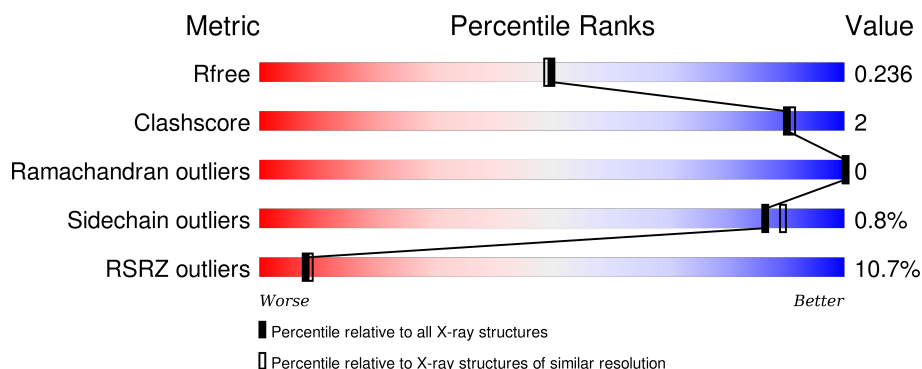
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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))
$R_{free}$	91344	6249 (2.00-2.00)
Clashscore	102246	7340 (2.00-2.00)
Ramachandran outliers	100387	7248 (2.00-2.00)
Sidechain outliers	100360	7247 (2.00-2.00)
RSRZ outliers	91569	6262 (2.00-2.00)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	318	<div> <div>9%</div> <div>83%</div> <div>5%</div> <div>12%</div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2416 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 methoxy mycolic acid synthase 4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	281	2236	1421	377	423	15	0	0	0

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-16	MET	-	EXPRESSION TAG	GB 13880191
A	-15	GLY	-	EXPRESSION TAG	GB 13880191
A	-14	SER	-	EXPRESSION TAG	GB 13880191
A	-13	SER	-	EXPRESSION TAG	GB 13880191
A	-12	HIS	-	EXPRESSION TAG	GB 13880191
A	-11	TYR	-	EXPRESSION TAG	GB 13880191
A	-10	HIS	-	EXPRESSION TAG	GB 13880191
A	-9	HIS	-	EXPRESSION TAG	GB 13880191
A	-8	HIS	-	EXPRESSION TAG	GB 13880191
A	-7	HIS	-	EXPRESSION TAG	GB 13880191
A	-6	SER	-	EXPRESSION TAG	GB 13880191
A	-5	SER	-	EXPRESSION TAG	GB 13880191
A	-4	GLY	-	EXPRESSION TAG	GB 13880191
A	-3	LEU	-	EXPRESSION TAG	GB 13880191
A	-2	VAL	-	EXPRESSION TAG	GB 13880191
A	-1	PRO	-	EXPRESSION TAG	GB 13880191
A	0	ARG	-	EXPRESSION TAG	GB 13880191
A	1	GLY	-	EXPRESSION TAG	GB 13880191
A	2	SER	-	EXPRESSION TAG	GB 13880191
A	3	HIS	-	EXPRESSION TAG	GB 13880191

- Molecule 2 is S-ADENOSYLMETHIONINE (three-letter code: SAM) (formula: C<sub>15</sub>H<sub>22</sub>N<sub>6</sub>O<sub>5</sub>S).



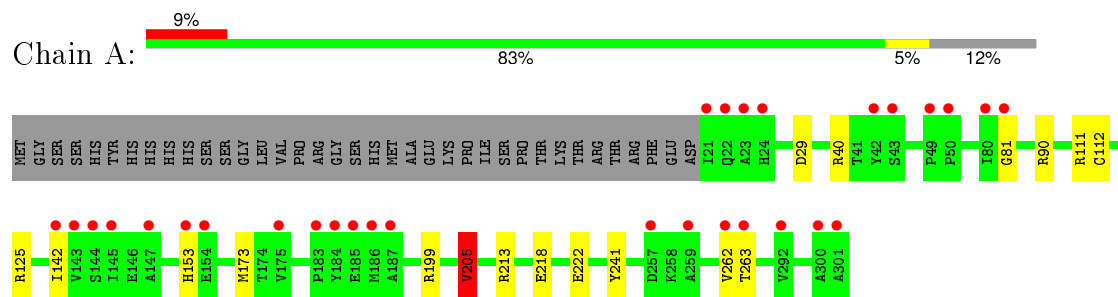
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	S	0	0
			27	15	6	5	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	153	Total	O	0	0
			153	153		



- Molecule 1: methoxy mycolic acid synthase 4



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	56.78Å 56.78Å 199.03Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.00 28.39 – 2.00	Depositor EDS
% Data completeness (in resolution range)	97.5 (30.00-2.00) 97.5 (28.39-2.00)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.09	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.44 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, $R_{free}$	0.179 , 0.239 0.181 , 0.236	Depositor DCC
$R_{free}$ test set	1303 reflections (5.39%)	DCC
Wilson B-factor (Å <sup>2</sup> )	31.2	Xtriage
Anisotropy	0.175	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 47.2	EDS
Estimated twinning fraction	0.067 for -h,-k,l	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.45$ , $\langle L^2 \rangle = 0.27$	Xtriage
Outliers	0 of 25488 reflections	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	2416	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.54% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 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: SAM

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	0.77	1/2290 (0.0%)	0.85	8/3104 (0.3%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	112	CYS	CB-SG	-5.07	1.73	1.81

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	199	ARG	NE-CZ-NH2	-14.02	113.29	120.30
1	A	199	ARG	NE-CZ-NH1	10.35	125.47	120.30
1	A	125	ARG	NE-CZ-NH1	9.59	125.09	120.30
1	A	125	ARG	NE-CZ-NH2	-8.09	116.25	120.30
1	A	90	ARG	NE-CZ-NH1	7.97	124.28	120.30
1	A	90	ARG	NE-CZ-NH2	-6.44	117.08	120.30
1	A	205	VAL	CG1-CB-CG2	5.54	119.76	110.90
1	A	199	ARG	CG-CD-NE	-5.46	100.33	111.80

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	2236	0	2136	10	0
2	A	27	0	22	1	0
3	A	153	0	0	3	0
All	All	2416	0	2158	10	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 2.

All (10) 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:218:GLU:O	1:A:222:GLU:HG3	1.95	0.66
1:A:111:ARG:NH1	3:A:323:HOH:O	2.29	0.65
1:A:205:VAL:HG13	3:A:395:HOH:O	1.98	0.62
1:A:153:HIS:CD2	1:A:213:ARG:HG2	2.40	0.57
1:A:262:VAL:HG12	1:A:263:THR:HG23	1.87	0.56
1:A:81:GLY:HA2	2:A:302:SAM:H1'	1.98	0.46
1:A:111:ARG:NH1	3:A:422:HOH:O	2.44	0.45
1:A:29:ASP:HB3	1:A:40:ARG:HH21	1.83	0.43
1:A:142:ILE:O	1:A:173:MET:HA	2.20	0.42
1:A:29:ASP:HB3	1:A:40:ARG:NH2	2.36	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles ⓘ

### 5.3.1 Protein backbone ⓘ

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	279/318 (88%)	275 (99%)	4 (1%)	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	238 / 279 (85%)	236 (99%)	2 (1%)	<a href="#">86</a> <a href="#">89</a>

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

Mol	Chain	Res	Type
1	A	205	VAL
1	A	241	TYR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	36	GLN
1	A	108	GLN
1	A	122	ASN
1	A	269	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 carbohydrates 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	$\# Z  > 2$
2	SAM	A	302	-	21,29,29	1.17	2 (9%)	17,42,42	2.97	5 (29%)

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
2	SAM	A	302	-	-	0/8/33/33	0/3/3/3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	302	SAM	C2-N1	2.47	1.38	1.33
2	A	302	SAM	C2-N3	3.70	1.38	1.32

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	302	SAM	N3-C2-N1	-10.96	120.50	128.89
2	A	302	SAM	C1'-N9-C4	-2.41	123.30	126.94
2	A	302	SAM	C4-C5-N7	-2.30	107.37	109.48
2	A	302	SAM	O4'-C1'-N9	2.06	112.41	108.10
2	A	302	SAM	C2'-C1'-N9	2.50	118.11	114.29

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	302	SAM	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

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	281/318 (88%)	0.25	30 (10%) <b>8</b> <b>8</b>	27, 35, 52, 72	0

All (30) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	21	ILE	7.8
1	A	23	ALA	7.4
1	A	184	TYR	5.4
1	A	187	ALA	4.7
1	A	145	ILE	4.1
1	A	262	VAL	4.1
1	A	24	HIS	3.6
1	A	259	ALA	3.6
1	A	186	MET	3.3
1	A	80	ILE	3.2
1	A	301	ALA	3.1
1	A	175	VAL	2.9
1	A	143	VAL	2.9
1	A	257	ASP	2.9
1	A	144	SER	2.8
1	A	22	GLN	2.6
1	A	142	ILE	2.6
1	A	183	PRO	2.5
1	A	292	VAL	2.4
1	A	49	PRO	2.4
1	A	263	THR	2.3
1	A	300	ALA	2.3
1	A	153	HIS	2.3
1	A	147	ALA	2.2
1	A	42	TYR	2.2
1	A	50	PRO	2.2
1	A	81	GLY	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	43	SER	2.0
1	A	185	GLU	2.0
1	A	154	GLU	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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
2	SAM	A	302	27/27	0.95	0.08	-1.17	31,35,39,42	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.