



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 13, 2017 – 08:47 pm GMT

PDB ID : 2YY2  
Title : Crystal structure of the human Phosphodiesterase 9A catalytic domain complexed with IBMX  
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Deposited on : 2007-04-27  
Resolution : 2.80 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](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	:	1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix)	:	1.9-1692
EDS	:	trunk28620
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
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)	:	recalc28949

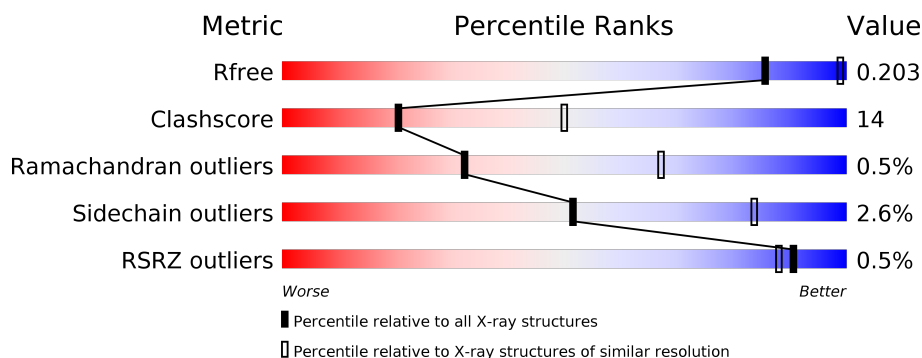
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.80 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))
$R_{free}$	100719	2583 (2.80-2.80)
Clashscore	112137	3033 (2.80-2.80)
Ramachandran outliers	110173	2983 (2.80-2.80)
Sidechain outliers	110143	2985 (2.80-2.80)
RSRZ outliers	101464	2610 (2.80-2.80)

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	333	<div> <div style="width: 100%; height: 10px; position: relative;"> <div style="position: absolute; top: -10px; left: 0;">%</div> <div style="position: absolute; top: 0; left: 0; width: 100%; height: 100%; background: linear-gradient(to right, red 0%, red 1%, orange 1%, orange 23%, yellow 23%, yellow 73%, green 73%, green 100%);"></div> <div style="position: absolute; bottom: -10px; left: 0;">73%23%..</div> </div> </div>
1	B	333	<div> <div style="width: 100%; height: 10px; position: relative;"> <div style="position: absolute; top: 0; left: 0; width: 100%; height: 100%; background: linear-gradient(to right, green 0%, green 61%, yellow 61%, yellow 35%, green 35%, green 100%);"></div> <div style="position: absolute; bottom: -10px; left: 0;">61%35%..</div> </div> </div>

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
3	MG	A	1102	-	-	-	X
3	MG	B	1104	-	-	-	X

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5512 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 High-affinity cGMP-specific 3',5'-cyclic phosphodiesterase 9A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	326	Total	C	N	O	S	0	0	0
			2695	1727	446	492	30			
1	B	324	Total	C	N	O	S	0	0	0
			2676	1715	442	489	30			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	174	GLY	-	EXPRESSION TAG	UNP O76083
A	175	SER	-	EXPRESSION TAG	UNP O76083
A	176	SER	-	EXPRESSION TAG	UNP O76083
A	177	GLY	-	EXPRESSION TAG	UNP O76083
A	178	SER	-	EXPRESSION TAG	UNP O76083
A	179	SER	-	EXPRESSION TAG	UNP O76083
A	180	GLY	-	EXPRESSION TAG	UNP O76083
B	174	GLY	-	EXPRESSION TAG	UNP O76083
B	175	SER	-	EXPRESSION TAG	UNP O76083
B	176	SER	-	EXPRESSION TAG	UNP O76083
B	177	GLY	-	EXPRESSION TAG	UNP O76083
B	178	SER	-	EXPRESSION TAG	UNP O76083
B	179	SER	-	EXPRESSION TAG	UNP O76083
B	180	GLY	-	EXPRESSION TAG	UNP O76083

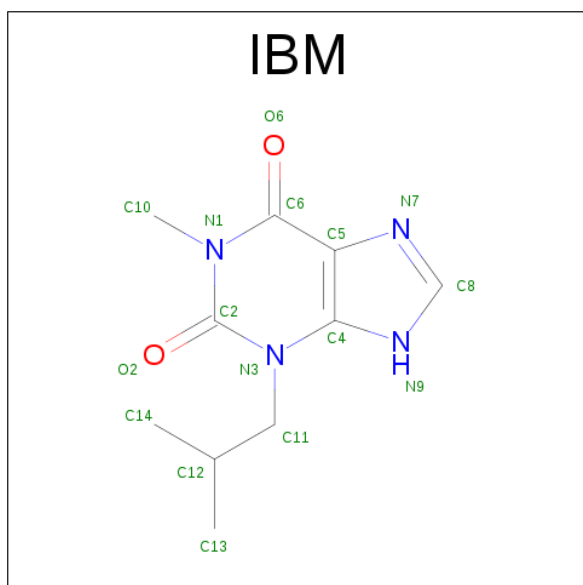
- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Zn	0	0
			1	1		
2	A	1	Total	Zn	0	0
			1	1		

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	1	Total Mg 1 1	0	0
3	A	1	Total Mg 1 1	0	0

- Molecule 4 is 3-ISOBUTYL-1-METHYLNANTHINE (three-letter code: IBM) (formula:  $C_{10}H_{14}N_4O_2$ ).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C N O 16 10 4 2	0	0
4	B	1	Total C N O 16 10 4 2	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	35	Total O 35 35	0	0
5	B	70	Total O 70 70	0	0



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	104.27Å 104.27Å 269.61Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	45.95 – 2.80 45.95 – 2.80	Depositor EDS
% Data completeness (in resolution range)	98.9 (45.95-2.80) 99.0 (45.95-2.80)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.11	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.42 (at 2.81Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.206 , 0.240 0.207 , 0.203	Depositor DCC
$R_{free}$ test set	1857 reflections (5.01%)	DCC
Wilson B-factor (Å <sup>2</sup> )	43.3	Xtriage
Anisotropy	0.368	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 32.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.43$ , $\langle L^2 \rangle = 0.26$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	5512	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	41.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.55% 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, 0.333 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: MG, ZN, IBM

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	0.37	0/2765	0.58	0/3743
1	B	0.36	0/2746	0.58	0/3721
All	All	0.36	0/5511	0.58	0/7464

There are no bond length outliers.

There are no bond angle outliers.

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	2695	0	2640	60	0
1	B	2676	0	2614	91	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	16	0	14	1	0
4	B	16	0	14	0	0
5	A	35	0	0	0	0
5	B	70	0	0	3	0
All	All	5512	0	5282	149	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 149 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:184:PRO:HG2	1:A:187:LEU:HD23	1.55	0.89
1:B:386:ASN:HD22	1:B:387:GLU:N	1.72	0.87
1:B:417:VAL:HG11	1:B:449:LYS:HG3	1.65	0.77
1:B:268:VAL:HA	1:B:273:LEU:HD12	1.70	0.74
1:A:432:LYS:HG3	1:A:438:VAL:HG21	1.72	0.72

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	324/333 (97%)	297 (92%)	26 (8%)	1 (0%)	44	77
1	B	322/333 (97%)	297 (92%)	23 (7%)	2 (1%)	28	62
All	All	646/666 (97%)	594 (92%)	49 (8%)	3 (0%)	32	67

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	505	LYS
1	B	186	TYR
1	B	381	ASN

### 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	303/307 (99%)	295 (97%)	8 (3%)	51	83
1	B	301/307 (98%)	293 (97%)	8 (3%)	50	83
All	All	604/614 (98%)	588 (97%)	16 (3%)	51	83

5 of 16 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	497	ASP
1	B	186	TYR
1	B	422	GLU
1	A	474	MET
1	B	467	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	389	HIS
1	A	453	GLN
1	B	381	ASN
1	A	386	ASN
1	B	351	GLN

### 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 carbohydrates in this entry.

## 5.6 Ligand geometry

Of 6 ligands modelled in this entry, 4 are monoatomic - leaving 2 for Mogul analysis.

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	IBM	A	1103	-	14,17,17	1.69	3 (21%)	19,25,25	2.84	7 (36%)
4	IBM	B	1105	-	14,17,17	1.58	1 (7%)	19,25,25	2.53	7 (36%)

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	IBM	A	1103	-	-	0/4/4/4	0/2/2/2
4	IBM	B	1105	-	-	0/4/4/4	0/2/2/2

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	1105	IBM	C4-N3	-4.90	1.40	1.45
4	A	1103	IBM	C4-N3	-4.45	1.41	1.45
4	A	1103	IBM	C11-N3	2.21	1.51	1.47
4	A	1103	IBM	C2-N3	2.65	1.40	1.37

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	1105	IBM	C6-N1-C2	-4.12	120.81	124.23
4	A	1103	IBM	C6-N1-C2	-3.99	120.92	124.23
4	A	1103	IBM	C4-N3-C2	-3.42	119.77	122.32
4	B	1105	IBM	C4-N3-C2	-2.35	120.57	122.32
4	B	1105	IBM	O2-C2-N3	-2.14	119.48	122.12

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
4	A	1103	IBM	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, 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	326/333 (97%)	-0.44	2 (0%) 89 86	21, 39, 60, 99	0
1	B	324/333 (97%)	-0.43	1 (0%) 93 92	21, 41, 61, 98	0
All	All	650/666 (97%)	-0.44	3 (0%) 90 88	21, 40, 61, 99	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	181	PRO	3.2
1	A	182	THR	2.2
1	B	181	PRO	2.2

### 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
3	MG	A	1102	1/1	0.95	0.35	16.11	30,30,30,30	0
3	MG	B	1104	1/1	0.98	0.42	15.35	26,26,26,26	0
4	IBM	A	1103	16/16	0.94	0.21	1.93	51,53,58,58	0
4	IBM	B	1105	16/16	0.98	0.15	-0.66	32,33,35,37	0
2	ZN	A	101	1/1	0.99	0.12	-	55,55,55,55	0
2	ZN	B	103	1/1	0.98	0.15	-	59,59,59,59	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.