



# wwPDB X-ray Structure Validation Summary Report i

Feb 28, 2014 – 10:14 PM GMT

PDB ID : 3F2X  
Title : Crystal structure of the FMN riboswitch bound to FMN, Cs<sup>+</sup> soak.  
Authors : Serganov, A.A.; Huang, L.  
Deposited on : 2008-10-30  
Resolution : 3.11 Å(reported)

This is a wwPDB 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/ValidationPDFNotes.html>

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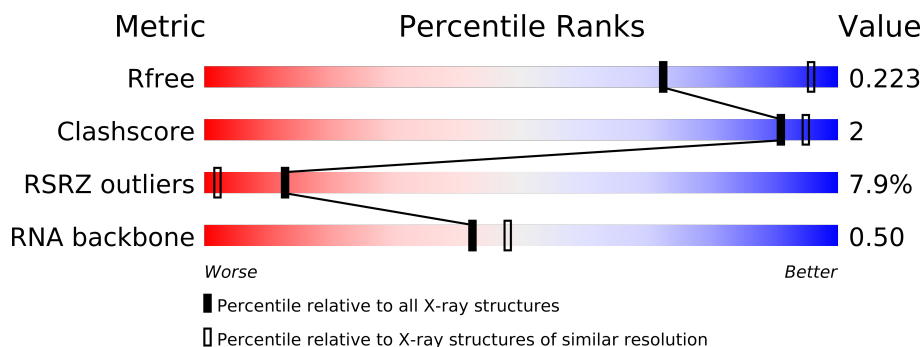
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.15 2013
Xtriage (Phenix)	:	dev-1323
EDS	:	stable22639
Percentile statistics	:	21963
Refmac	:	5.8.0049
CCP4	:	6.3.0 (Settle)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP)	:	stable22683

# 1 Overall quality at a glance

The reported resolution of this entry is 3.11 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))
$R_{free}$	66092	1466 (3.20-3.04)
Clashscore	79885	1067 (3.18-3.06)
RSRZ outliers	66119	1468 (3.20-3.04)
RNA backbone	1838	1054 (3.64-2.60)

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. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	X	112	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
3	MG	X	303	-	X
3	MG	X	304	-	X
3	MG	X	305	-	X
3	MG	X	306	-	X
3	MG	X	307	-	X
3	MG	X	309	-	X
3	MG	X	310	-	X
3	MG	X	311	-	X
3	MG	X	313	-	X

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Mol	Type	Chain	Res	Geometry	Electron density
4	CS	X	401	-	X
4	CS	X	402	-	X
4	CS	X	403	-	X
4	CS	X	404	-	X

## 2 Entry composition i

There are 5 unique types of molecules in this entry. The entry contains 2403 atoms, of which 0 are hydrogen and 0 are deuterium.

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.

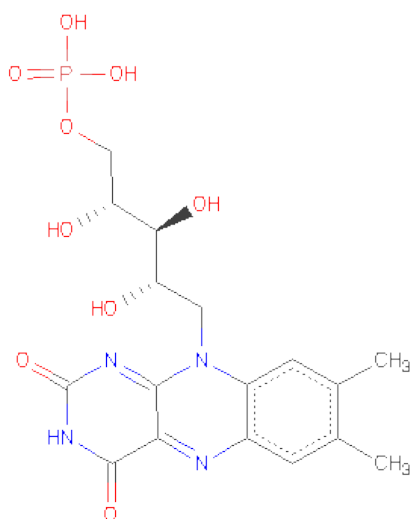
- Molecule 1 is a RNA chain called FMN riboswitch.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
1	X	109	2353	1045	429	767	112	0	0	0

There are 5 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
X	1	GTP	-	INSERTION	GB 20095250
X	2	G	-	INSERTION	GB 20095250
X	110	U	-	INSERTION	GB 20095250
X	111	U	-	INSERTION	GB 20095250
X	112	CCC	-	INSERTION	GB 20095250

- Molecule 2 is FLAVIN MONONUCLEOTIDE (three-letter code: FMN) (formula: C<sub>17</sub>H<sub>21</sub>N<sub>4</sub>O<sub>9</sub>P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	X	1	31	17	4	9	1	0	0

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

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	X	13	Total 13	Mg 13	0	0

- Molecule 4 is CESIUM ION (three-letter code: CS) (formula: Cs).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	X	4	Total 4	Cs 4	0	0

- Molecule 5 is water.

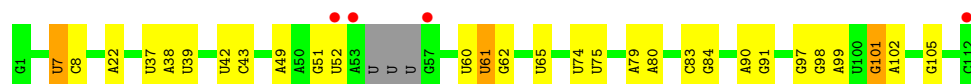
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	X	2	Total 2	O 2	0	0

### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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 ( $\text{RSRZ} > 2$ ). 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: FMN riboswitch

Chain X: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	71.37Å 71.37Å 140.94Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	20.00 – 3.11 19.77 – 3.11	Depositor EDS
% Data completeness (in resolution range)	98.0 (20.00-3.11) 98.0 (19.77-3.11)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.86 (at 3.09Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.192 , 0.215 0.199 , 0.223	Depositor DCC
$R_{free}$ test set	355 reflections (4.84%)	DCC
Wilson B-factor (Å <sup>2</sup> )	100.3	Xtriage
Anisotropy	0.233	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 60.3	EDS
Estimated twinning fraction	0.030 for -h,-k,l	Xtriage
L-test for twinning	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	1 of 7691 reflections (0.013%)	Xtriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	2403	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	98.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.86% of the height of the origin peak. No significant pseudotranslation is detected.*

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

## 5 Model quality

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: FMN, GTP, MG, CS, CCC

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	X	0.53	0/2573	1.08	1/4009 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	X	7	U	O4'-C1'-N1	5.54	112.64	108.20

There are no chirality outliers.

There are no planarity outliers.

### 5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	X	2353	0	1173	7	0
2	X	31	0	19	0	0
3	X	13	0	0	0	0
4	X	4	0	0	0	0
5	X	2	0	0	0	0
All	All	2403	0	1192	7	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including



hydrogens) of the entry. The overall clashscore for this entry is 2.

The worst 5 of 7 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:X:60:U:H2'	1:X:61:U:H5'	1.78	0.66
1:X:49:A:H61	1:X:60:U:H3	1.62	0.46
1:X:79:A:H2'	1:X:80:A:C8	2.52	0.45
1:X:83:C:H2'	1:X:84:G:C8	2.54	0.42
1:X:61:U:H2'	1:X:61:U:H6	1.63	0.41

There are no symmetry-related clashes.

## 5.3 Torsion angles

### 5.3.1 Protein backbone ⓘ

There are no protein chains in this entry.

### 5.3.2 Protein sidechains ⓘ

There are no protein chains in this entry.

### 5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	X	106/112 (94%)	16 (15%)	4 (3%)

5 of 16 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	X	7	U
1	X	8	C
1	X	37	U
1	X	38	A
1	X	39	U

All (4) RNA pucker outliers are listed below:

Mol	Chain	Res	Type
1	X	22	A
1	X	42	U

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Mol	Chain	Res	Type
1	X	61	U
1	X	75	U

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

2 non-standard protein/DNA/RNA residues 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$
1	GTP	X	1	1	34,34,34	0.99	1 (2%)	51,54,54	2.17	9 (17%)
1	CCC	X	112	1	23,25,26	3.04	6 (26%)	32,38,41	3.62	9 (28%)

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	GTP	X	1	1	-	0/22/38/38	0/1/3/3
1	CCC	X	112	1	-	0/6/35/36	0/1/3/3

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	X	112	CCC	C6-N1	-8.00	1.22	1.35
1	X	112	CCC	C6-C5	-7.82	1.19	1.38
1	X	112	CCC	C5-C4	-5.97	1.26	1.40
1	X	112	CCC	P-OP1	4.47	1.51	1.46
1	X	1	GTP	C2-N3	4.04	1.38	1.33

The worst 5 of 18 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	X	112	CCC	C6-C5-C4	12.12	122.50	117.47

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	X	112	CCC	O2'-PC-O3'	11.51	106.14	97.06
1	X	1	GTP	C6-C5-N7	-10.83	132.68	134.14
1	X	112	CCC	PC-O2'-C2'	-6.42	102.78	111.48
1	X	112	CCC	PC-O3'-C3'	-6.32	102.92	111.48

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 5.5 Carbohydrates

There are no carbohydrates in this entry.

## 5.6 Ligand geometry

Of 18 ligands modelled in this entry, 17 are monoatomic - leaving 1 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	$\# Z  > 2$
2	FMN	X	200	3	33,33,33	1.01	2 (6%)	46,50,50	1.51	6 (13%)

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	FMN	X	200	3	-	0/18/18/18	0/0/3/3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	X	200	FMN	C1'-N10	2.57	1.51	1.48
2	X	200	FMN	C5A-N5	2.15	1.38	1.35

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	X	200	FMN	C2-N1-C10	5.56	120.58	114.98
2	X	200	FMN	C4A-C10-N1	-3.56	119.17	122.73
2	X	200	FMN	C4A-N5-C5A	3.05	120.11	116.69
2	X	200	FMN	C5A-C9A-N10	3.04	119.79	116.80
2	X	200	FMN	C4-N3-C2	-2.88	119.49	125.39

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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	X	109/112 (97%)	0.31	4 (3%) 39 6	86, 99, 110, 115	0

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	X	112	CCC	3.8
1	X	53	A	3.1
1	X	57	G	2.2
1	X	52	U	2.1

### 6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

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	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
1	CCC	X	112	23/24	0.37	5.00	86,87,89,90	0
1	GTP	X	1	32/32	0.27	1.70	110,113,122,122	0

### 6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 6.4 Ligands ⓘ

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	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
3	MG	X	309	1/1	1.81	38.81	97,97,97,97	0
3	MG	X	306	1/1	1.10	37.74	85,85,85,85	0
3	MG	X	307	1/1	0.68	30.57	80,80,80,80	0
3	MG	X	310	1/1	1.23	21.83	98,98,98,98	0
4	CS	X	404	1/1	0.69	18.23	124,124,124,124	1
3	MG	X	304	1/1	0.96	17.94	69,69,69,69	0
3	MG	X	313	1/1	0.55	17.71	104,104,104,104	0
3	MG	X	311	1/1	0.73	15.78	90,90,90,90	0
3	MG	X	303	1/1	0.93	13.72	88,88,88,88	0
4	CS	X	401	1/1	0.38	13.01	94,94,94,94	1
4	CS	X	403	1/1	0.35	11.91	120,120,120,120	1
4	CS	X	402	1/1	0.57	11.22	114,114,114,114	1
3	MG	X	305	1/1	0.53	6.68	70,70,70,70	0
2	FMN	X	200	31/31	0.26	0.82	73,78,78,78	0
3	MG	X	314	1/1	0.25	0.45	135,135,135,135	0
3	MG	X	302	1/1	0.22	-0.95	118,118,118,118	0
3	MG	X	308	1/1	0.20	-1.62	121,121,121,121	0
3	MG	X	315	1/1	0.28	-	104,104,104,104	0

## 6.5 Other polymers ⓘ

There are no such residues in this entry.