



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 19, 2016 – 06:22 PM GMT

PDB ID : 3A3B  
Title : Crystal structure of LumP complexed with flavin mononucleotide  
Authors : Sato, Y.  
Deposited on : 2009-06-11  
Resolution : 2.00 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](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 : 1.7.1 (RC1), CSD as537be (2016)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026982  
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) : rb-20026982

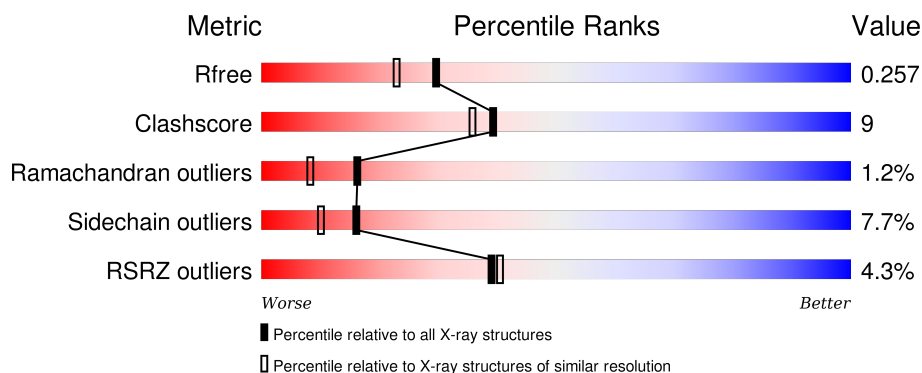
# 1 Overall quality at a glance

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	190	<div> <div>5%</div> <div> <div></div> <div>70%</div> <div>17%</div> <div>• • 8%</div> </div> </div>
1	B	190	<div> <div>3%</div> <div> <div></div> <div>76%</div> <div>16%</div> <div>• 7%</div> </div> </div>

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2946 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 Lumazine protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	177	Total	C	N	O	S	0	1	0
			1375	864	230	278	3			
1	A	175	Total	C	N	O	S	0	0	0
			1345	848	225	269	3			

There are 26 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	1	MET	-	SEE REMARK 999	UNP C4TPG1
B	2	PHE	-	SEE REMARK 999	UNP C4TPG1
B	3	LYS	-	SEE REMARK 999	UNP C4TPG1
B	4	GLY	-	SEE REMARK 999	UNP C4TPG1
B	5	ILE	-	SEE REMARK 999	UNP C4TPG1
B	6	VAL	-	SEE REMARK 999	UNP C4TPG1
B	7	GLN	-	SEE REMARK 999	UNP C4TPG1
B	185	VAL	-	SEE REMARK 999	UNP C4TPG1
B	186	SER	-	SEE REMARK 999	UNP C4TPG1
B	187	ASN	-	SEE REMARK 999	UNP C4TPG1
B	188	GLU	-	SEE REMARK 999	UNP C4TPG1
B	189	TRP	-	SEE REMARK 999	UNP C4TPG1
B	190	ASP	-	SEE REMARK 999	UNP C4TPG1
A	1	MET	-	SEE REMARK 999	UNP C4TPG1
A	2	PHE	-	SEE REMARK 999	UNP C4TPG1
A	3	LYS	-	SEE REMARK 999	UNP C4TPG1
A	4	GLY	-	SEE REMARK 999	UNP C4TPG1
A	5	ILE	-	SEE REMARK 999	UNP C4TPG1
A	6	VAL	-	SEE REMARK 999	UNP C4TPG1
A	7	GLN	-	SEE REMARK 999	UNP C4TPG1
A	185	VAL	-	SEE REMARK 999	UNP C4TPG1
A	186	SER	-	SEE REMARK 999	UNP C4TPG1
A	187	ASN	-	SEE REMARK 999	UNP C4TPG1
A	188	GLU	-	SEE REMARK 999	UNP C4TPG1
A	189	TRP	-	SEE REMARK 999	UNP C4TPG1

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Chain	Residue	Modelled	Actual	Comment	Reference
A	190	ASP	-	SEE REMARK 999	UNP C4TPG1

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- The image displays the chemical structure of Flavin Mononucleotide (FMN). It features an isoalloxazine ring system, which is a tricyclic aromatic heterocycle consisting of a benzene ring fused to two pyrimidine rings. The atoms in the ring are labeled with standard chemical notation: C6, C7, C8, C9, C10, C4A, C2, C4, N1, N3, N5, C5A, C8A, and C1. Substituents on the ring include a carbonyl group at C2 (O2), a carbonyl group at C4 (O4), and a dimethylaminomethyl group at C10 (C8M, C7M, C6). Attached to the C10 position is a ribityl chain, which is a three-carbon chain with hydroxyl groups at C2' (O2'), C3' (O3'), and C4' (O4'). The C3' carbon is also attached to a phosphate group (O1P, O2P, O3P, O5'). The ribityl chain is shown with stereochemistry: the C2' hydroxyl group is on a wedge, the C3' hydroxyl group is on a dash, and the C4' hydroxyl group is on a wedge.

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

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- Chemical structure diagram of a nucleoside derivative, specifically a ribonucleoside, showing the sugar, phosphate, and base components with atom labels.
- The structure includes the following labeled atoms:
- Sugar (Ribose):** C1', C2'(S), C3'(S), C4'(R), C5', O3', O4', O5'.
  - Phosphate Group:** O2'.
  - Nitrogenous Base (Pyrimidine):** N1, N3, N5, N10, C2, C4, C5A, C6, C7, C8, C9, C10, C4A, C8M, C7M.
  - Oxygen Atoms:** O, O2, O4.
- The structure shows the sugar moiety (ribose) attached to the nitrogenous base (pyrimidine) via a glycosidic bond. The sugar is in a cyclic form, and the phosphate group is attached to the 5' carbon (C5'). Stereochemistry is indicated by (R) and (S) labels and wedge/dash bonds.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			27	17	4	6		

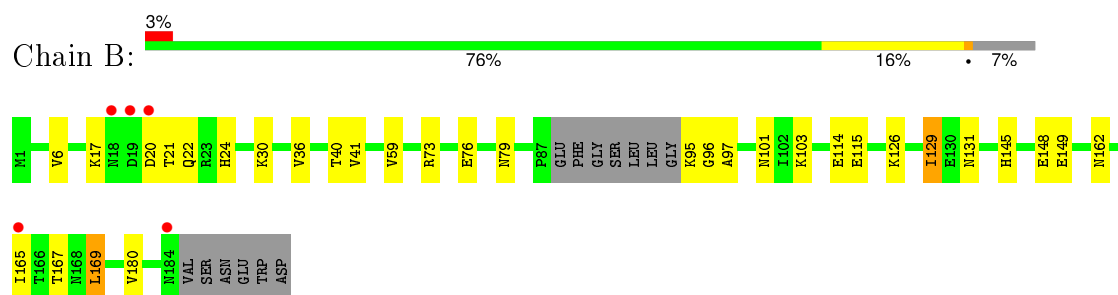
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	97	Total	O	0	0
			97	97		
4	A	71	Total	O	0	0
			71	71		

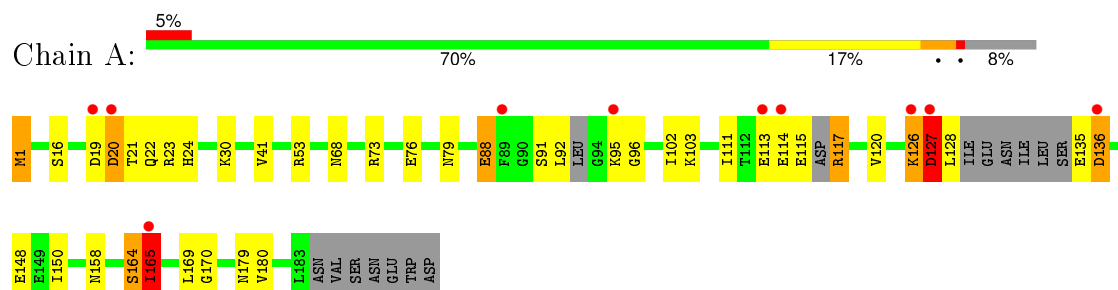
### 3 Residue-property plots [i](#)

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: Lumazine protein



#### • Molecule 1: Lumazine protein



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	46.86Å 47.09Å 160.92Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	33.22 – 2.00 33.21 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.1 (33.22-2.00) 99.1 (33.21-2.00)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.83 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.196 , 0.255 0.197 , 0.257	Depositor DCC
$R_{free}$ test set	2496 reflections (11.25%)	DCC
Wilson B-factor (Å <sup>2</sup> )	24.0	Xtriage
Anisotropy	0.008	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 49.3	EDS
Estimated twinning fraction	0.026 for k,h,-l	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 24679 reflections	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	2946	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.16% 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 [i](#)

### 5.1 Standard geometry [i](#)

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

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	0.86	0/1357	0.92	0/1828
1	B	0.82	1/1388 (0.1%)	0.85	1/1875 (0.1%)
All	All	0.84	1/2745 (0.0%)	0.89	1/3703 (0.0%)

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
1	A	0	2
1	B	0	1
All	All	0	3

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	59	VAL	CB-CG2	5.11	1.63	1.52

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	115	GLU	N-CA-C	-6.83	92.56	111.00

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	164	SER	Peptide

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Mol	Chain	Res	Type	Group
1	A	20	ASP	Peptide
1	B	114	GLU	Peptide

## 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	1345	0	1373	30	0
1	B	1375	0	1403	21	0
2	B	31	0	19	1	0
3	A	27	0	20	1	0
4	A	71	0	0	4	0
4	B	97	0	0	6	0
All	All	2946	0	2815	50	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 9.

The worst 5 of 50 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:135:GLU:HG2	1:A:136:ASP:H	1.32	0.95
1:B:101:ASN:HD22	1:B:103:LYS:NZ	1.73	0.85
1:B:101:ASN:HD22	1:B:103:LYS:HZ3	1.26	0.81
1:A:117:ARG:HG3	1:A:158:ASN:OD1	1.84	0.76
1:B:21:THR:HG22	4:B:226:HOH:O	1.85	0.76

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	167/190 (88%)	156 (93%)	7 (4%)	4 (2%)	7	2
1	B	174/190 (92%)	167 (96%)	7 (4%)	0	100	100
All	All	341/380 (90%)	323 (95%)	14 (4%)	4 (1%)	16	8

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	20	ASP
1	A	127	ASP
1	A	136	ASP
1	A	165	ILE

### 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	
1	A	154/169 (91%)	138 (90%)	16 (10%)	9	4
1	B	159/169 (94%)	151 (95%)	8 (5%)	30	24
All	All	313/338 (93%)	289 (92%)	24 (8%)	16	10

5 of 24 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	30	LYS
1	A	91	SER
1	A	165	ILE
1	A	53	ARG
1	A	88	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	101	ASN
1	A	101	ASN
1	A	24	HIS
1	B	79	ASN
1	A	68	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](#)

2 ligands 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	$\# Z  > 2$
3	RBF	A	191	-	28,29,29	1.58	8 (28%)	30,43,43	2.63	9 (30%)
2	FMN	B	191	-	32,33,33	1.41	5 (15%)	34,50,50	2.63	10 (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
3	RBF	A	191	-	-	0/14/14/14	0/3/3/3
2	FMN	B	191	-	-	0/18/18/18	0/3/3/3

The worst 5 of 13 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	191	FMN	O5'-C5'	-2.22	1.36	1.44
3	A	191	RBF	C2-N3	-2.12	1.33	1.38
3	A	191	RBF	C5A-N5	2.05	1.38	1.35
3	A	191	RBF	C4A-N5	2.34	1.36	1.33
2	B	191	FMN	C4-N3	2.35	1.37	1.33

The worst 5 of 19 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	191	FMN	O4'-C4'-C5'	-8.71	91.10	110.09
3	A	191	RBF	C4-C4A-C10	-7.51	115.14	119.94
2	B	191	FMN	N3-C2-N1	-4.96	119.34	127.69
2	B	191	FMN	O5'-P-O1P	-4.08	96.82	107.08
3	A	191	RBF	N3-C2-N1	-3.80	121.30	127.69

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	191	RBF	1	0
2	B	191	FMN	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	175/190 (92%)	0.13	10 (5%) 27 29	11, 22, 48, 63	0
1	B	177/190 (93%)	-0.02	5 (2%) 56 57	12, 23, 39, 51	0
All	All	352/380 (92%)	0.05	15 (4%) 39 40	11, 23, 43, 63	0

The worst 5 of 15 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	19	ASP	4.1
1	A	95	LYS	4.0
1	A	19	ASP	3.8
1	B	20	ASP	3.7
1	A	126	LYS	3.0

### 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
3	RBF	A	191	27/27	0.98	0.14	0.95	8,12,13,14	0
2	FMN	B	191	31/31	0.94	0.10	-0.80	17,19,35,36	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.