



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 19, 2016 – 06:30 PM GMT

PDB ID : 3I6R  
Title : Plasmodium falciparum dihydroorotate dehydrogenase bound with triazolopyrimidine-based inhibitor DSM74  
Authors : Deng, X.; Phillips, M.A.  
Deposited on : 2009-07-07  
Resolution : 2.50 Å (reported)

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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

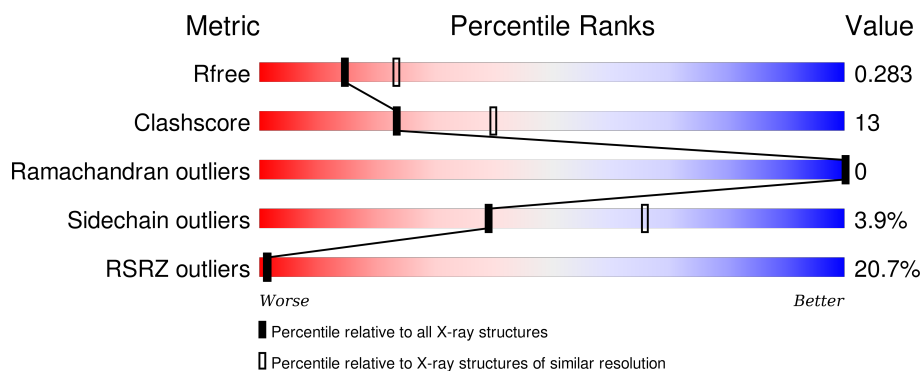
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.50 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	3553 (2.50-2.50)
Clashscore	102246	4242 (2.50-2.50)
Ramachandran outliers	100387	4156 (2.50-2.50)
Sidechain outliers	100360	4158 (2.50-2.50)
RSRZ outliers	91569	3562 (2.50-2.50)

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	415	

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 3086 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 Dihydroorotate dehydrogenase homolog, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	376	2984	1908	500	561	15	0	0	0

There are 63 discrepancies between the modelled and reference sequences:

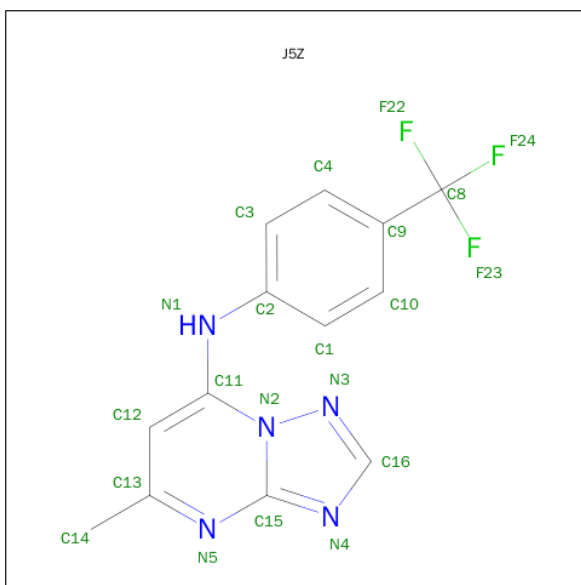
Chain	Residue	Modelled	Actual	Comment	Reference
A	125	MET	-	EXPRESSION TAG	UNP Q08210
A	126	GLY	-	EXPRESSION TAG	UNP Q08210
A	127	SER	-	EXPRESSION TAG	UNP Q08210
A	128	SER	-	EXPRESSION TAG	UNP Q08210
A	129	HIS	-	EXPRESSION TAG	UNP Q08210
A	130	HIS	-	EXPRESSION TAG	UNP Q08210
A	131	HIS	-	EXPRESSION TAG	UNP Q08210
A	132	HIS	-	EXPRESSION TAG	UNP Q08210
A	133	HIS	-	EXPRESSION TAG	UNP Q08210
A	134	HIS	-	EXPRESSION TAG	UNP Q08210
A	135	SER	-	EXPRESSION TAG	UNP Q08210
A	136	SER	-	EXPRESSION TAG	UNP Q08210
A	137	GLY	-	EXPRESSION TAG	UNP Q08210
A	138	LEU	-	EXPRESSION TAG	UNP Q08210
A	139	VAL	-	EXPRESSION TAG	UNP Q08210
A	140	PRO	-	EXPRESSION TAG	UNP Q08210
A	141	ARG	-	EXPRESSION TAG	UNP Q08210
A	142	GLY	-	EXPRESSION TAG	UNP Q08210
A	143	SER	-	EXPRESSION TAG	UNP Q08210
A	144	HIS	-	EXPRESSION TAG	UNP Q08210
A	145	MET	-	EXPRESSION TAG	UNP Q08210
A	146	ALA	-	EXPRESSION TAG	UNP Q08210
A	147	SER	-	EXPRESSION TAG	UNP Q08210
A	148	MET	-	EXPRESSION TAG	UNP Q08210
A	149	THR	-	EXPRESSION TAG	UNP Q08210
A	150	GLY	-	EXPRESSION TAG	UNP Q08210
A	151	GLY	-	EXPRESSION TAG	UNP Q08210

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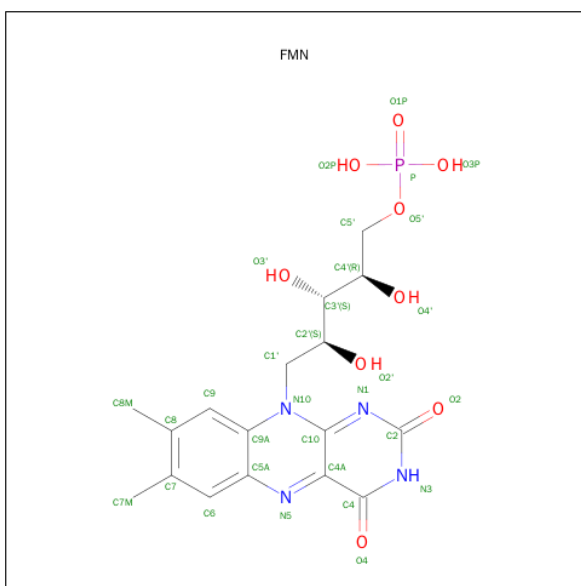
Chain	Residue	Modelled	Actual	Comment	Reference
A	152	GLN	-	EXPRESSION TAG	UNP Q08210
A	153	GLN	-	EXPRESSION TAG	UNP Q08210
A	154	GLY	-	EXPRESSION TAG	UNP Q08210
A	155	ARG	-	EXPRESSION TAG	UNP Q08210
A	156	ASP	-	EXPRESSION TAG	UNP Q08210
A	157	PRO	-	EXPRESSION TAG	UNP Q08210
A	?	-	SER	DELETION	UNP Q08210
A	?	-	THR	DELETION	UNP Q08210
A	?	-	TYR	DELETION	UNP Q08210
A	?	-	ASN	DELETION	UNP Q08210
A	?	-	GLU	DELETION	UNP Q08210
A	?	-	ASP	DELETION	UNP Q08210
A	?	-	ASN	DELETION	UNP Q08210
A	?	-	LYS	DELETION	UNP Q08210
A	?	-	ILE	DELETION	UNP Q08210
A	?	-	VAL	DELETION	UNP Q08210
A	?	-	GLU	DELETION	UNP Q08210
A	?	-	LYS	DELETION	UNP Q08210
A	?	-	LYS	DELETION	UNP Q08210
A	?	-	ASN	DELETION	UNP Q08210
A	?	-	ASN	DELETION	UNP Q08210
A	?	-	PHE	DELETION	UNP Q08210
A	?	-	ASN	DELETION	UNP Q08210
A	?	-	LYS	DELETION	UNP Q08210
A	?	-	ASN	DELETION	UNP Q08210
A	?	-	ASN	DELETION	UNP Q08210
A	?	-	SER	DELETION	UNP Q08210
A	?	-	HIS	DELETION	UNP Q08210
A	?	-	MET	DELETION	UNP Q08210
A	?	-	MET	DELETION	UNP Q08210
A	?	-	LYS	DELETION	UNP Q08210
A	?	-	ASP	DELETION	UNP Q08210
A	?	-	ALA	DELETION	UNP Q08210
A	?	-	LYS	DELETION	UNP Q08210
A	?	-	ASP	DELETION	UNP Q08210
A	?	-	ASN	DELETION	UNP Q08210

- Molecule 2 is 5-METHYL-N-[4-(TRIFLUOROMETHYL)PHENYL][1,2,4]TRIAZOLO[1,5-A]PYRIMIDIN-7-AMINE (three-letter code: J5Z) (formula: C<sub>13</sub>H<sub>10</sub>F<sub>3</sub>N<sub>5</sub>).



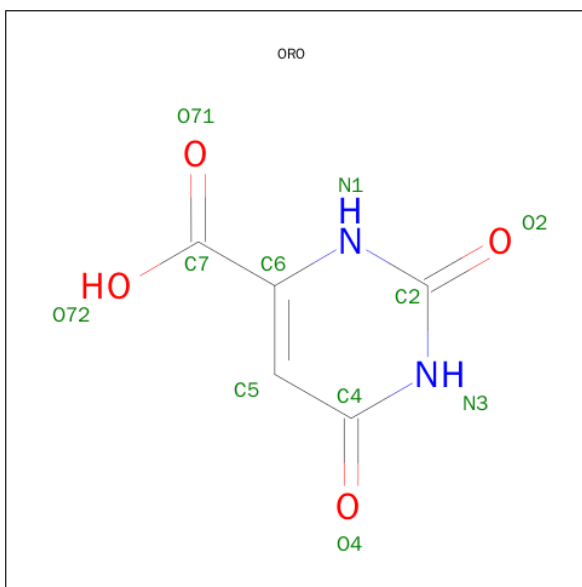
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	F	N	0	0
			21	13	3	5		

- Molecule 3 is FLAVIN MONONUCLEOTIDE (three-letter code: FMN) (formula:  $C_{17}H_{21}N_4O_9P$ ).



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

- Molecule 4 is OROTIC ACID (three-letter code: ORO) (formula:  $C_5H_4N_2O_4$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			11	5	2	4		

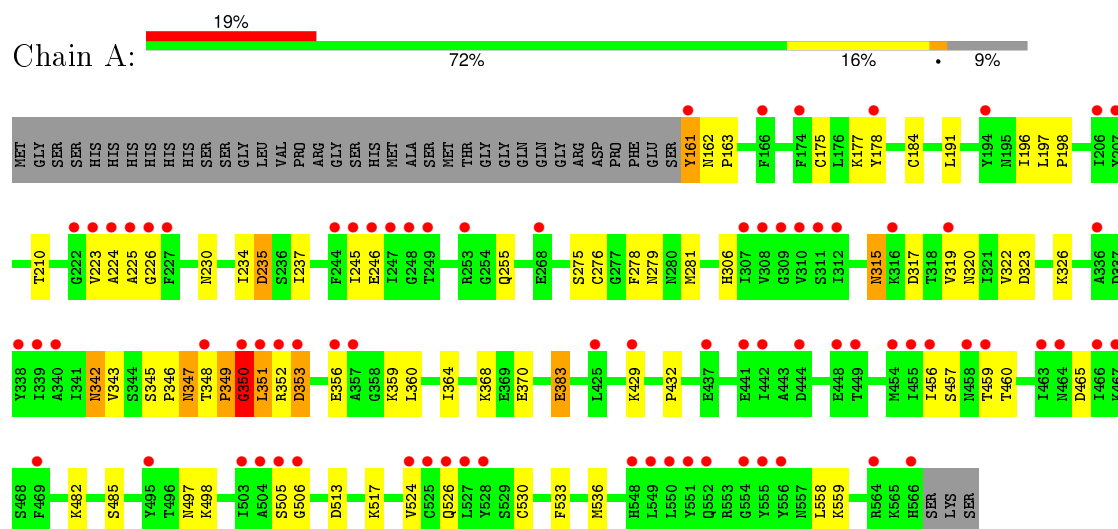
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	39	Total	O	0	0
			39	39		

### 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: Dihydroorotate dehydrogenase homolog, mitochondrial



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 64	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	85.44Å 85.44Å 138.55Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 2.50 39.18 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.9 (50.00-2.50) 99.9 (39.18-2.50)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.16 (at 2.51Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.236 , 0.276 0.245 , 0.283	Depositor DCC
$R_{free}$ test set	1013 reflections (5.39%)	DCC
Wilson B-factor (Å <sup>2</sup> )	64.4	Xtriage
Anisotropy	0.340	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 55.7	EDS
Estimated twinning fraction	0.063 for h,-h-k,-l	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.34$	Xtriage
Outliers	0 of 19791 reflections	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	3086	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	72.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.71% 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, J5Z, ORO

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	0.69	1/3035 (0.0%)	0.68	2/4087 (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	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	530	CYS	CB-SG	-6.38	1.71	1.82

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	533	PHE	N-CA-C	5.24	125.14	111.00
1	A	350	GLY	C-N-CA	5.07	134.38	121.70

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	350	GLY	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	2984	0	3026	81	0
2	A	21	0	10	0	0
3	A	31	0	19	1	0
4	A	11	0	3	3	0
5	A	39	0	0	2	0
All	All	3086	0	3058	81	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 13.

The worst 5 of 81 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:351:LEU:HD11	1:A:352:ARG:CD	1.25	1.56
1:A:351:LEU:CD1	1:A:352:ARG:HD2	1.33	1.52
1:A:351:LEU:HD12	1:A:351:LEU:C	1.49	1.21
1:A:482:LYS:HE3	1:A:513:ASP:OD1	1.58	1.03
1:A:191:LEU:HD22	1:A:196:ILE:HD11	1.40	0.99

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	374/415 (90%)	360 (96%)	14 (4%)	0	100 100

There are no Ramachandran outliers to report.

### 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	333/365 (91%)	320 (96%)	13 (4%)	39 66

5 of 13 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	343	VAL
1	A	347	ASN
1	A	383	GLU
1	A	342	ASN
1	A	353	ASP

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	195	ASN
1	A	306	HIS
1	A	330	ASN
1	A	541	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

3 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	$\# Z  > 2$
2	J5Z	A	1001	-	17,23,23	1.24	3 (17%)	24,34,34	1.98	3 (12%)
3	FMN	A	1002	-	32,33,33	1.24	3 (9%)	34,50,50	1.80	7 (20%)
4	ORO	A	1003	-	6,11,11	1.04	0	6,15,15	3.86	6 (100%)

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	J5Z	A	1001	-	-	0/10/10/10	0/3/3/3
3	FMN	A	1002	-	-	0/18/18/18	0/3/3/3
4	ORO	A	1003	-	-	0/0/4/4	0/1/1/1

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1001	J5Z	C15-N4	-2.45	1.32	1.35
2	A	1001	J5Z	C2-N1	-2.33	1.35	1.40
2	A	1001	J5Z	C11-N1	-2.23	1.35	1.39
3	A	1002	FMN	C5A-N5	2.26	1.38	1.35
3	A	1002	FMN	C4-N3	3.41	1.39	1.33

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1002	FMN	N3-C2-N1	-4.57	119.99	127.69
4	A	1003	ORO	C5-C4-N3	-4.13	119.65	124.02
4	A	1003	ORO	N3-C2-N1	-3.74	121.39	127.69
3	A	1002	FMN	C4A-C4-N3	-3.04	119.55	123.52
2	A	1001	J5Z	C12-C13-N5	-2.72	120.23	122.76

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	1002	FMN	1	0
4	A	1003	ORO	3	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	376/415 (90%)	0.97	78 (20%) <b>1</b> <b>1</b>	44, 72, 91, 102	1 (0%)

The worst 5 of 78 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	556	TYR	6.3
1	A	161	TYR	6.0
1	A	551	TYR	5.6
1	A	224	ALA	5.2
1	A	467	LYS	4.8

### 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(Å <sup>2</sup> )	Q<0.9
3	FMN	A	1002	31/31	0.95	0.32	0.30	53,55,58,59	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
4	ORO	A	1003	11/11	0.94	0.19	-0.08	60,61,61,62	0
2	J5Z	A	1001	21/21	0.98	0.13	-1.19	58,60,61,61	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.