



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2018 – 08:51 pm GMT

PDB ID : 1WSW
Title : Low Temperature (100K) Crystal Structure Of Flavodoxin Mutant S64C, dimer, semiquinone state
Authors : Artali, R.; Marchini, N.; Meneghetti, F.; Cavazzini, D.; Bombieri, G.; Rossi, G.L.; Gilardi, G.
Deposited on : 2004-11-12
Resolution : 1.69 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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467
Mogul : 1.7.3 (157068), CSD as539be (2018)
Xtriage (Phenix) : 1.13
EDS : trunk30967
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)
Refmac : 5.8.0158
CCP4 : 7.0 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : trunk30967

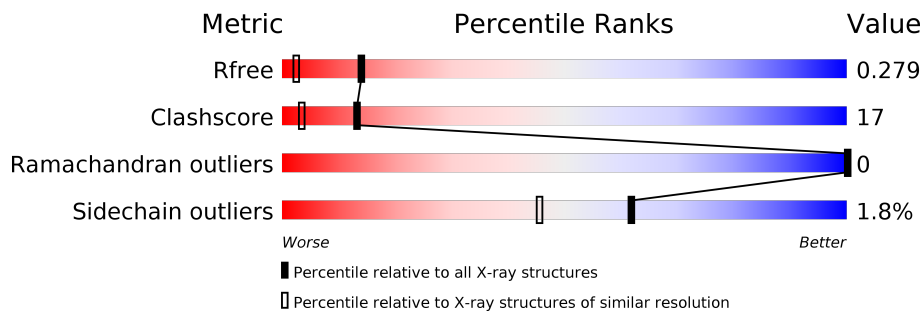
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION


The reported resolution of this entry is 1.69 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}	111664	3793 (1.70-1.70)
Clashscore	122126	4167 (1.70-1.70)
Ramachandran outliers	120053	4100 (1.70-1.70)
Sidechain outliers	120020	4100 (1.70-1.70)

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 ≥ 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 $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	148	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 1346 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.

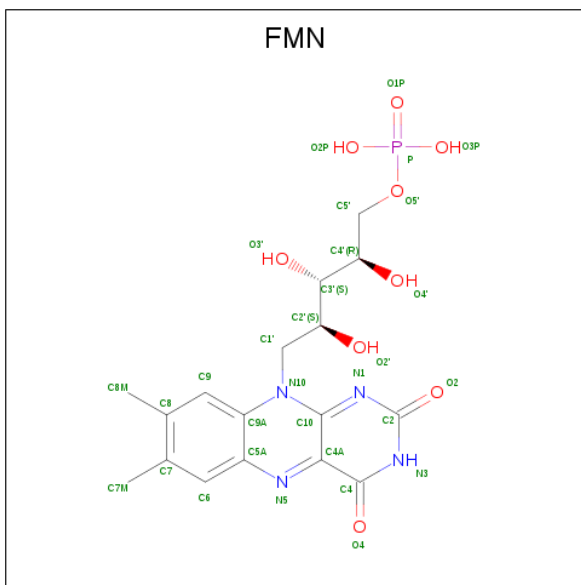
- Molecule 1 is a protein called FLAVODOXIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	147	1102	684	181	232	5	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	2	ALA	PRO	SEE REMARK 999	UNP P00323
A	64	CYS	SER	ENGINEERED	UNP P00323

- Molecule 2 is FLAVIN MONONUCLEOTIDE (three-letter code: FMN) (formula: C₁₇H₂₁N₄O₉P).



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

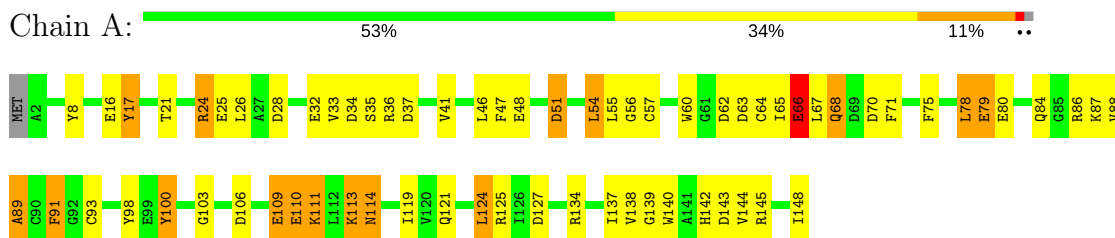
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	213	Total 213	O 213	0	0

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 the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. 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. 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: FLAVODOXIN



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	55.05Å 55.05Å 121.62Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.97 – 1.69 19.46 – 1.60	Depositor EDS
% Data completeness (in resolution range)	53.7 (19.97-1.69) 99.4 (19.46-1.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.08	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.53 (at 1.60Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.172 , 0.245 0.217 , 0.279	Depositor DCC
R_{free} test set	2508 reflections (9.90%)	wwPDB-VP
Wilson B-factor (Å ²)	18.5	Xtrriage
Anisotropy	0.433	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 43.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	1346	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.92% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: FMN

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	2.36	46/1119 (4.1%)	2.02	39/1514 (2.6%)

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

All (46) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	66	GLU	CB-CG	12.21	1.75	1.52
1	A	64	CYS	CB-SG	-11.90	1.62	1.82
1	A	41	VAL	CB-CG1	-10.55	1.30	1.52
1	A	114	ASN	CG-OD1	10.04	1.46	1.24
1	A	89	ALA	CA-CB	-9.68	1.32	1.52
1	A	121	GLN	CB-CG	-8.49	1.29	1.52
1	A	100	TYR	CD2-CE2	8.45	1.52	1.39
1	A	66	GLU	CD-OE2	8.41	1.34	1.25
1	A	110	GLU	CD-OE2	8.15	1.34	1.25
1	A	47	PHE	CD1-CE1	8.14	1.55	1.39
1	A	140	TRP	CG-CD1	7.92	1.47	1.36
1	A	71	PHE	CD2-CE2	7.68	1.54	1.39
1	A	57	CYS	CB-SG	-7.55	1.69	1.82
1	A	75	PHE	CG-CD2	-7.09	1.28	1.38
1	A	79	GLU	CD-OE2	7.08	1.33	1.25
1	A	60	TRP	CZ3-CH2	6.90	1.51	1.40
1	A	114	ASN	CB-CG	6.87	1.66	1.51
1	A	17	TYR	CG-CD2	6.84	1.48	1.39

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	91	PHE	CD1-CE1	6.60	1.52	1.39
1	A	35	SER	CA-CB	6.49	1.62	1.52
1	A	71	PHE	CD1-CE1	6.28	1.51	1.39
1	A	79	GLU	CG-CD	6.07	1.61	1.51
1	A	24	ARG	CG-CD	-6.00	1.36	1.51
1	A	98	TYR	CE2-CZ	-5.82	1.30	1.38
1	A	16	GLU	CD-OE2	-5.75	1.19	1.25
1	A	36	ARG	CD-NE	5.72	1.56	1.46
1	A	34	ASP	CG-OD1	5.69	1.38	1.25
1	A	98	TYR	CE1-CZ	5.68	1.46	1.38
1	A	32	GLU	CG-CD	5.67	1.60	1.51
1	A	139	GLY	C-O	5.62	1.32	1.23
1	A	106	ASP	CG-OD1	5.59	1.38	1.25
1	A	86	ARG	C-O	-5.53	1.12	1.23
1	A	138	VAL	C-O	5.52	1.33	1.23
1	A	33	VAL	CB-CG1	5.48	1.64	1.52
1	A	134	ARG	CZ-NH2	5.46	1.40	1.33
1	A	113	LYS	CE-NZ	5.45	1.62	1.49
1	A	144	VAL	CB-CG2	5.40	1.64	1.52
1	A	41	VAL	CB-CG2	5.38	1.64	1.52
1	A	32	GLU	CD-OE2	5.35	1.31	1.25
1	A	75	PHE	CE2-CZ	5.32	1.47	1.37
1	A	86	ARG	CZ-NH2	-5.30	1.26	1.33
1	A	109	GLU	CG-CD	5.29	1.59	1.51
1	A	34	ASP	CA-CB	-5.29	1.42	1.53
1	A	110	GLU	CB-CG	5.12	1.61	1.52
1	A	48	GLU	CD-OE2	-5.08	1.20	1.25
1	A	137	ILE	CA-CB	-5.01	1.43	1.54

All (39) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	34	ASP	CB-CG-OD2	-15.30	104.53	118.30
1	A	106	ASP	CB-CG-OD2	-12.04	107.46	118.30
1	A	34	ASP	CB-CG-OD1	10.26	127.53	118.30
1	A	28	ASP	CB-CG-OD1	9.57	126.91	118.30
1	A	24	ARG	NE-CZ-NH2	9.50	125.05	120.30
1	A	66	GLU	CG-CD-OE1	-9.15	100.00	118.30
1	A	51	ASP	CB-CG-OD1	-9.07	110.14	118.30
1	A	8	TYR	CD1-CE1-CZ	-8.84	111.85	119.80
1	A	24	ARG	NE-CZ-NH1	-8.75	115.92	120.30
1	A	63	ASP	CB-CG-OD1	-8.41	110.73	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	66	GLU	CG-CD-OE2	8.21	134.72	118.30
1	A	51	ASP	CB-CG-OD2	7.89	125.40	118.30
1	A	109	GLU	OE1-CD-OE2	-7.73	114.02	123.30
1	A	78	LEU	CB-CG-CD1	-7.59	98.09	111.00
1	A	26	LEU	CB-CG-CD1	-7.55	98.17	111.00
1	A	127	ASP	CB-CG-OD2	-7.49	111.56	118.30
1	A	93	CYS	CA-CB-SG	-7.39	100.70	114.00
1	A	125	ARG	NE-CZ-NH2	7.38	123.99	120.30
1	A	66	GLU	CA-CB-CG	7.35	129.57	113.40
1	A	28	ASP	CB-CG-OD2	-6.77	112.21	118.30
1	A	67	LEU	CB-CG-CD2	-6.57	99.83	111.00
1	A	54	LEU	CA-CB-CG	-6.57	100.19	115.30
1	A	24	ARG	CD-NE-CZ	-6.56	114.42	123.60
1	A	106	ASP	CB-CG-OD1	6.53	124.18	118.30
1	A	25	GLU	OE1-CD-OE2	-6.33	115.71	123.30
1	A	145	ARG	NE-CZ-NH2	6.19	123.40	120.30
1	A	124	LEU	CB-CG-CD2	-6.14	100.56	111.00
1	A	88	VAL	CG1-CB-CG2	-5.59	101.96	110.90
1	A	36	ARG	CG-CD-NE	-5.53	100.19	111.80
1	A	46	LEU	CB-CG-CD2	-5.42	101.79	111.00
1	A	110	GLU	CG-CD-OE1	-5.32	107.67	118.30
1	A	91	PHE	N-CA-C	-5.28	96.76	111.00
1	A	125	ARG	N-CA-C	-5.27	96.76	111.00
1	A	111	LYS	CG-CD-CE	-5.27	96.08	111.90
1	A	26	LEU	CB-CG-CD2	5.26	119.94	111.00
1	A	36	ARG	CB-CG-CD	-5.25	97.94	111.60
1	A	110	GLU	CG-CD-OE2	5.14	128.57	118.30
1	A	114	ASN	CB-CA-C	-5.09	100.23	110.40
1	A	91	PHE	CB-CG-CD2	-5.07	117.25	120.80

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	100	TYR	Sidechain
1	A	37	ASP	Mainchain

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	1102	0	1029	38	0
2	A	31	0	19	0	0
3	A	213	0	0	11	0
All	All	1346	0	1048	38	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 17.

All (38) 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:65:ILE:CG1	1:A:65:ILE:CD1	1.79	1.60
1:A:66:GLU:CG	1:A:66:GLU:CB	1.75	1.59
1:A:114:ASN:HB3	3:A:268:HOH:O	1.17	1.26
1:A:66:GLU:OE1	1:A:66:GLU:CB	2.22	0.86
1:A:87:LYS:NZ	1:A:148:ILE:O	2.10	0.85
1:A:66:GLU:OE1	1:A:66:GLU:CA	2.31	0.79
1:A:66:GLU:OE1	1:A:66:GLU:HA	1.88	0.72
1:A:66:GLU:CD	1:A:66:GLU:CB	2.58	0.71
1:A:65:ILE:HD13	1:A:103:GLY:HA3	1.77	0.67
1:A:109:GLU:O	1:A:113:LYS:HG3	2.02	0.60
1:A:51:ASP:OD1	3:A:258:HOH:O	2.15	0.59
1:A:68:GLN:HE22	1:A:70:ASP:HB2	1.68	0.59
1:A:114:ASN:ND2	3:A:251:HOH:O	2.37	0.56
1:A:110:GLU:HB2	3:A:267:HOH:O	2.09	0.53
1:A:91:PHE:HA	1:A:124:LEU:O	2.10	0.52
1:A:113:LYS:HG2	1:A:119:ILE:CD1	2.40	0.51
1:A:56:GLY:HA2	1:A:91:PHE:O	2.13	0.49
1:A:113:LYS:CG	1:A:119:ILE:HD11	2.43	0.48
1:A:113:LYS:HE2	1:A:119:ILE:HD12	1.95	0.47
1:A:142:HIS:HD2	1:A:143:ASP:OD1	1.98	0.46
1:A:79:GLU:HG2	1:A:80:GLU:HG3	1.98	0.46
1:A:24:ARG:NH1	3:A:360:HOH:O	2.49	0.46
1:A:54:LEU:CD2	1:A:89:ALA:HB3	2.46	0.46
1:A:21:THR:OG1	3:A:270:HOH:O	2.21	0.45
1:A:113:LYS:HG2	1:A:119:ILE:HD11	1.97	0.45
1:A:114:ASN:CB	3:A:268:HOH:O	2.04	0.44
1:A:17:TYR:CD1	1:A:17:TYR:C	2.91	0.43
1:A:78:LEU:HB2	1:A:111:LYS:HE2	1.99	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:62:ASP:HB3	3:A:259:HOH:O	2.18	0.43
1:A:113:LYS:NZ	1:A:113:LYS:HB3	2.34	0.42
1:A:84:GLN:HG2	3:A:228:HOH:O	2.18	0.42
1:A:62:ASP:CB	3:A:259:HOH:O	2.68	0.42
1:A:113:LYS:CG	1:A:119:ILE:CD1	2.98	0.42
1:A:84:GLN:CG	3:A:228:HOH:O	2.69	0.41
1:A:55:LEU:HA	1:A:55:LEU:HD23	1.83	0.41
1:A:65:ILE:CB	1:A:65:ILE:CD1	2.87	0.41
1:A:54:LEU:HD22	1:A:89:ALA:HB3	2.03	0.41
1:A:24:ARG:HD2	1:A:24:ARG:HH11	1.53	0.40

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	145/148 (98%)	142 (98%)	3 (2%)	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	111/112 (99%)	109 (98%)	2 (2%)	62 45

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

Mol	Chain	Res	Type
1	A	66	GLU
1	A	68	GLN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	68	GLN
1	A	114	ASN
1	A	142	HIS

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	FMN	A	149	-	31,33,33	2.31	9 (29%)	39,50,50	2.63	14 (35%)

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	A	149	-	-	0/16/18/18	0/3/3/3

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	149	FMN	C4A-N5	-5.19	1.25	1.33
2	A	149	FMN	C9A-N10	-3.83	1.34	1.38
2	A	149	FMN	C2'-C3'	-3.60	1.46	1.53
2	A	149	FMN	C5'-C4'	-2.53	1.48	1.51
2	A	149	FMN	C4-C4A	-2.15	1.37	1.41
2	A	149	FMN	C4-N3	2.20	1.37	1.33
2	A	149	FMN	O4'-C4'	4.05	1.52	1.43
2	A	149	FMN	O2'-C2'	4.43	1.53	1.43
2	A	149	FMN	C7M-C7	5.50	1.61	1.51

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	149	FMN	C5A-C9A-N10	-4.37	114.38	117.71
2	A	149	FMN	C4A-C4-N3	-4.32	117.33	123.47
2	A	149	FMN	C4A-C10-N10	-3.74	116.93	120.40
2	A	149	FMN	C1'-N10-C10	-3.58	114.88	118.46
2	A	149	FMN	C4-C4A-C10	-3.00	117.71	119.95
2	A	149	FMN	O2'-C2'-C1'	-2.91	102.43	109.61
2	A	149	FMN	C1'-C2'-C3'	-2.02	104.05	109.82
2	A	149	FMN	O2P-P-O1P	-2.01	102.77	110.60
2	A	149	FMN	C4A-N5-C5A	2.17	119.03	116.76
2	A	149	FMN	O5'-P-O1P	2.42	113.27	106.47
2	A	149	FMN	C10-C4A-N5	2.85	123.87	120.59
2	A	149	FMN	C1'-N10-C9A	4.78	122.56	118.31
2	A	149	FMN	O2P-P-O5'	5.05	120.18	106.73
2	A	149	FMN	C4-N3-C2	10.11	123.75	115.14

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

6.3 Carbohydrates

Unable to reproduce the depositors R factor - this section is therefore empty.

6.4 Ligands

Unable to reproduce the depositors R factor - this section is therefore empty.

6.5 Other polymers

Unable to reproduce the depositors R factor - this section is therefore empty.