



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 02:24 PM UTC

PDB ID : 1BWL / pdb_00001bwl
Title : OLD YELLOW ENZYME (OYE1) DOUBLE MUTANT H191N:N194H
Authors : Brown, B.J.; Deng, Z.; Karplus, P.A.; Massey, V.
Deposited on : 1998-09-24
Resolution : 2.70 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 types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

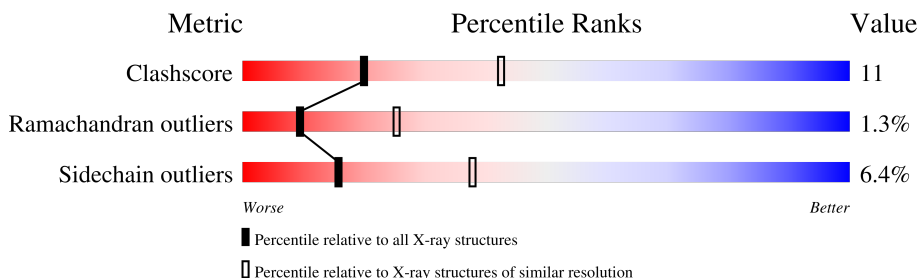
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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))
Clashscore	190562	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)

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 of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. 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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	399	 68% 28% .

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 3333 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.

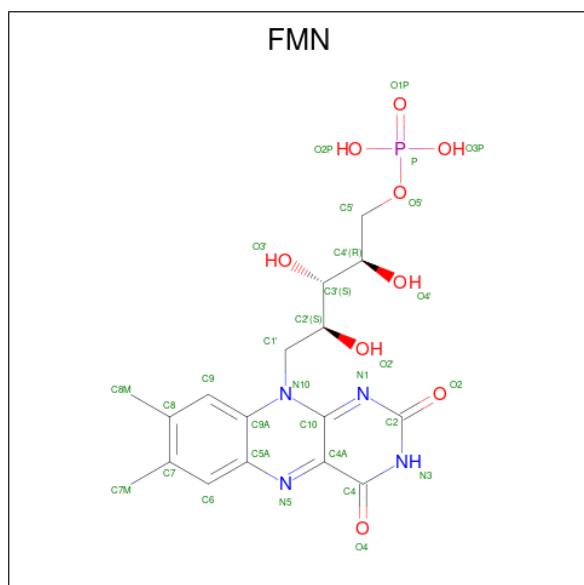
- Molecule 1 is a protein called PROTEIN (NADPH DEHYDROGENASE 1).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	399	Total	C	N	O	S	0	0	0
			3175	2024	550	595	6			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	191	ASN	HIS	engineered mutation	UNP Q02899
A	194	HIS	ASN	engineered mutation	UNP Q02899

- Molecule 2 is FLAVIN MONONUCLEOTIDE (CCD ID: FMN) (formula: $C_{17}H_{21}N_4O_9P$).



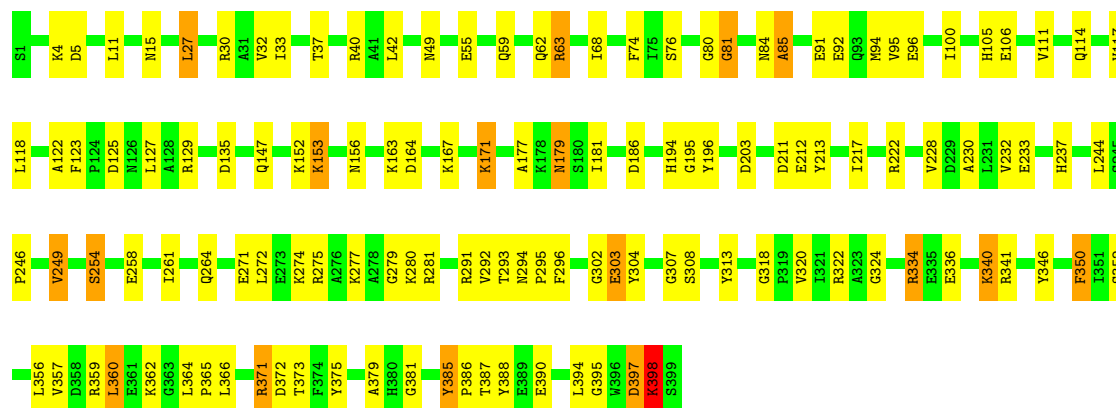
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			31	17	4	9	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	127	Total 127	O 127	0	0

Note EDS was not executed.

Chain A: 68% 28% .



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, α , β , γ	143.60 Å 143.60 Å 42.80 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	8.00 – 2.70	Depositor
% Data completeness (in resolution range)	87.4 (8.00-2.70)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.12	Depositor
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.190 , 0.273	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3333	wwPDB-VP
Average B, all atoms (Å ²)	16.0	wwPDB-VP

5 Model quality ⓘ

5.1 Standard geometry ⓘ

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	0.52	0/3257	1.14	32/4414 (0.7%)

There are no bond length outliers.

All (32) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	118	LEU	N-CA-C	9.88	122.13	111.36
1	A	379	ALA	N-CA-C	-8.64	102.87	113.41
1	A	63	ARG	CA-C-N	7.85	127.91	119.90
1	A	63	ARG	C-N-CA	7.85	127.91	119.90
1	A	398	LYS	N-CA-C	-7.71	94.37	110.80
1	A	85	ALA	N-CA-C	-7.02	100.62	110.31
1	A	135	ASP	N-CA-C	6.95	119.94	110.55
1	A	274	LYS	N-CA-C	-6.55	103.83	110.97
1	A	222	ARG	N-CA-C	6.51	118.04	111.07
1	A	280	LYS	N-CA-C	6.46	120.71	110.70
1	A	62	GLN	N-CA-C	6.42	118.36	111.36
1	A	111	VAL	N-CA-C	6.37	117.27	107.78
1	A	340	LYS	N-CA-C	6.36	120.77	112.89
1	A	254	SER	N-CA-C	6.09	117.61	110.97
1	A	203	ASP	N-CA-C	5.85	118.10	109.50
1	A	195	GLY	N-CA-C	5.57	122.77	115.36
1	A	203	ASP	CA-C-N	5.55	125.38	119.28
1	A	203	ASP	C-N-CA	5.55	125.38	119.28
1	A	42	LEU	N-CA-C	5.50	118.89	110.20
1	A	171	LYS	N-CA-C	-5.50	105.20	111.14
1	A	156	ASN	CA-C-N	5.46	125.40	119.78
1	A	156	ASN	C-N-CA	5.46	125.40	119.78
1	A	372	ASP	N-CA-C	5.39	118.08	111.82
1	A	237	HIS	N-CA-C	5.37	118.62	111.75

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	387	THR	N-CA-C	-5.28	103.72	110.53
1	A	385	TYR	N-CA-C	-5.21	103.22	109.83
1	A	249	VAL	N-CA-C	-5.16	108.25	113.47
1	A	84	ASN	N-CA-C	5.12	118.84	112.59
1	A	336	GLU	N-CA-C	5.10	117.50	111.33
1	A	397	ASP	CA-C-N	5.10	131.28	121.54
1	A	397	ASP	C-N-CA	5.10	131.28	121.54
1	A	129	ARG	N-CA-C	-5.07	105.44	110.97

There are no chirality outliers.

There are no planarity outliers.

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	3175	0	3085	72	0
2	A	31	0	19	1	0
3	A	127	0	0	6	0
All	All	3333	0	3104	72	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 11.

All (72) 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:114:GLN:HE22	2:A:401:FMN:HN3	1.21	0.85
1:A:33:ILE:HD12	1:A:68:ILE:HG12	1.69	0.73
1:A:296:PHE:HZ	1:A:375:TYR:HH	1.37	0.72
1:A:371:ARG:H	1:A:371:ARG:CD	2.05	0.69
1:A:63:ARG:HG2	1:A:357:VAL:HG11	1.75	0.68
1:A:153:LYS:HB2	1:A:153:LYS:NZ	2.10	0.67
1:A:371:ARG:H	1:A:371:ARG:HD2	1.62	0.65
1:A:96:GLU:O	1:A:100:ILE:HG13	1.97	0.65
1:A:295:PRO:HG3	3:A:661:HOH:O	1.97	0.64

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:395:GLY:C	1:A:397:ASP:H	2.07	0.63
1:A:164:ASP:HA	1:A:167:LYS:HE3	1.81	0.61
1:A:117:VAL:O	1:A:196:TYR:HB3	2.00	0.61
1:A:40:ARG:O	1:A:49:ASN:HB2	2.01	0.59
1:A:167:LYS:O	1:A:171:LYS:HD3	2.05	0.57
1:A:397:ASP:O	1:A:398:LYS:HB2	2.05	0.56
1:A:291:ARG:HA	1:A:303:GLU:HG3	1.88	0.56
1:A:296:PHE:HZ	1:A:375:TYR:OH	1.88	0.56
1:A:33:ILE:HG12	1:A:350:PHE:CE2	2.41	0.55
1:A:153:LYS:HB2	1:A:153:LYS:HZ3	1.72	0.55
1:A:217:ILE:HG23	1:A:264:GLN:HA	1.88	0.55
1:A:365:PRO:HG2	1:A:388:TYR:HE1	1.72	0.55
1:A:365:PRO:HG2	1:A:388:TYR:CE1	2.42	0.54
1:A:74:PHE:CE2	1:A:85:ALA:HB3	2.43	0.54
1:A:249:VAL:HG22	1:A:293:THR:HB	1.88	0.54
1:A:390:GLU:O	1:A:394:LEU:HG	2.06	0.54
1:A:123:PHE:HB3	1:A:125:ASP:OD1	2.08	0.53
1:A:292:VAL:HG13	3:A:508:HOH:O	2.08	0.53
1:A:92:GLU:HB2	3:A:635:HOH:O	2.07	0.53
1:A:271:GLU:HB3	1:A:275:ARG:HH12	1.73	0.53
1:A:33:ILE:HG12	1:A:350:PHE:CD2	2.45	0.52
1:A:163:LYS:NZ	1:A:212:GLU:HB3	2.24	0.52
1:A:395:GLY:C	1:A:397:ASP:N	2.68	0.51
1:A:15:ASN:O	1:A:30:ARG:HD2	2.09	0.51
1:A:230:ALA:O	1:A:233:GLU:HG3	2.10	0.51
1:A:356:LEU:HG	1:A:360:LEU:HD22	1.93	0.51
1:A:81:GLY:HA3	1:A:122:ALA:HB1	1.93	0.51
1:A:37:THR:O	1:A:375:TYR:HE1	1.94	0.51
1:A:281:ARG:NH1	1:A:318:GLY:N	2.60	0.50
1:A:271:GLU:HB3	1:A:275:ARG:NH1	2.26	0.50
1:A:147:GLN:NE2	1:A:147:GLN:HA	2.28	0.49
1:A:398:LYS:HZ2	1:A:398:LYS:HB3	1.76	0.49
1:A:371:ARG:HD2	1:A:371:ARG:N	2.27	0.49
1:A:55:GLU:O	1:A:59:GLN:HG3	2.13	0.48
1:A:63:ARG:HD2	3:A:583:HOH:O	2.12	0.48
1:A:386:PRO:HB2	1:A:390:GLU:HB2	1.94	0.47
1:A:212:GLU:HG2	1:A:212:GLU:O	2.13	0.47
1:A:27:LEU:HD23	1:A:27:LEU:N	2.30	0.47
1:A:228:VAL:O	1:A:232:VAL:HG23	2.15	0.47
1:A:152:LYS:HD2	1:A:152:LYS:HA	1.68	0.46
1:A:318:GLY:O	1:A:341:ARG:HD2	2.16	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:371:ARG:CD	1:A:371:ARG:N	2.77	0.45
1:A:373:THR:OG1	1:A:381:GLY:HA3	2.17	0.44
1:A:91:GLU:O	1:A:95:VAL:HG23	2.17	0.44
1:A:258:GLU:HB3	1:A:261:ILE:HB	1.99	0.44
1:A:94:MET:HE3	1:A:94:MET:HA	1.99	0.44
1:A:362:LYS:HB2	1:A:364:LEU:HG	1.99	0.44
1:A:211:ASP:C	1:A:213:TYR:H	2.27	0.43
1:A:346:TYR:CE2	1:A:360:LEU:HD21	2.54	0.43
1:A:352:SER:HA	1:A:385:TYR:CG	2.52	0.43
1:A:277:LYS:C	1:A:279:GLY:H	2.27	0.43
1:A:105:HIS:HE1	1:A:186:ASP:OD2	2.02	0.42
1:A:179:ASN:N	1:A:179:ASN:ND2	2.66	0.42
1:A:304:TYR:CE2	1:A:307:GLY:N	2.88	0.42
1:A:254:SER:HB3	1:A:258:GLU:HB2	2.01	0.42
1:A:80:GLY:O	1:A:127:LEU:HD21	2.19	0.42
1:A:334:ARG:HG3	3:A:565:HOH:O	2.19	0.42
1:A:302:GLY:HA3	3:A:506:HOH:O	2.20	0.42
1:A:359:ARG:HD3	1:A:365:PRO:O	2.20	0.42
1:A:163:LYS:HZ3	1:A:212:GLU:HB3	1.85	0.41
1:A:177:ALA:O	1:A:181:ILE:HG12	2.21	0.41
1:A:313:TYR:OH	1:A:322:ARG:HD2	2.21	0.41
1:A:294:ASN:HA	1:A:295:PRO:HD2	1.87	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	397/399 (100%)	366 (92%)	26 (6%)	5 (1%)	9 25

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	194	HIS
1	A	398	LYS
1	A	4	LYS
1	A	81	GLY
1	A	324	GLY

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	328/328 (100%)	307 (94%)	21 (6%)	16	38

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	5	ASP
1	A	11	LEU
1	A	27	LEU
1	A	32	VAL
1	A	76	SER
1	A	106	GLU
1	A	153	LYS
1	A	179	ASN
1	A	244	LEU
1	A	246	PRO
1	A	272	LEU
1	A	303	GLU
1	A	308	SER
1	A	320	VAL
1	A	334	ARG
1	A	340	LYS
1	A	350	PHE
1	A	360	LEU
1	A	366	LEU
1	A	371	ARG
1	A	398	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	24	ASN
1	A	84	ASN
1	A	102	ASN
1	A	105	HIS
1	A	114	GLN
1	A	140	ASN
1	A	147	GLN
1	A	156	ASN
1	A	168	GLN
1	A	175	GLN
1	A	179	ASN
1	A	286	HIS
1	A	380	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 oligosaccharides 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	401	-	33,33,33	2.06	10 (30%)	48,50,50	0.91	1 (2%)

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	401	-	-	2/18/18/18	0/3/3/3

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	401	FMN	C4A-N5	4.89	1.41	1.30
2	A	401	FMN	C1'-C2'	4.71	1.59	1.52
2	A	401	FMN	C7M-C7	-4.38	1.42	1.51
2	A	401	FMN	C5'-C4'	3.54	1.56	1.51
2	A	401	FMN	P-O3P	2.88	1.65	1.54
2	A	401	FMN	C1'-N10	2.75	1.54	1.47
2	A	401	FMN	C5A-N5	-2.38	1.35	1.39
2	A	401	FMN	C6-C7	-2.19	1.36	1.39
2	A	401	FMN	C9A-C5A	2.04	1.44	1.41
2	A	401	FMN	P-O2P	-2.02	1.47	1.54

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	401	FMN	O2P-P-O1P	2.14	119.19	110.83

There are no chirality outliers.

All (2) torsion outliers are listed below:

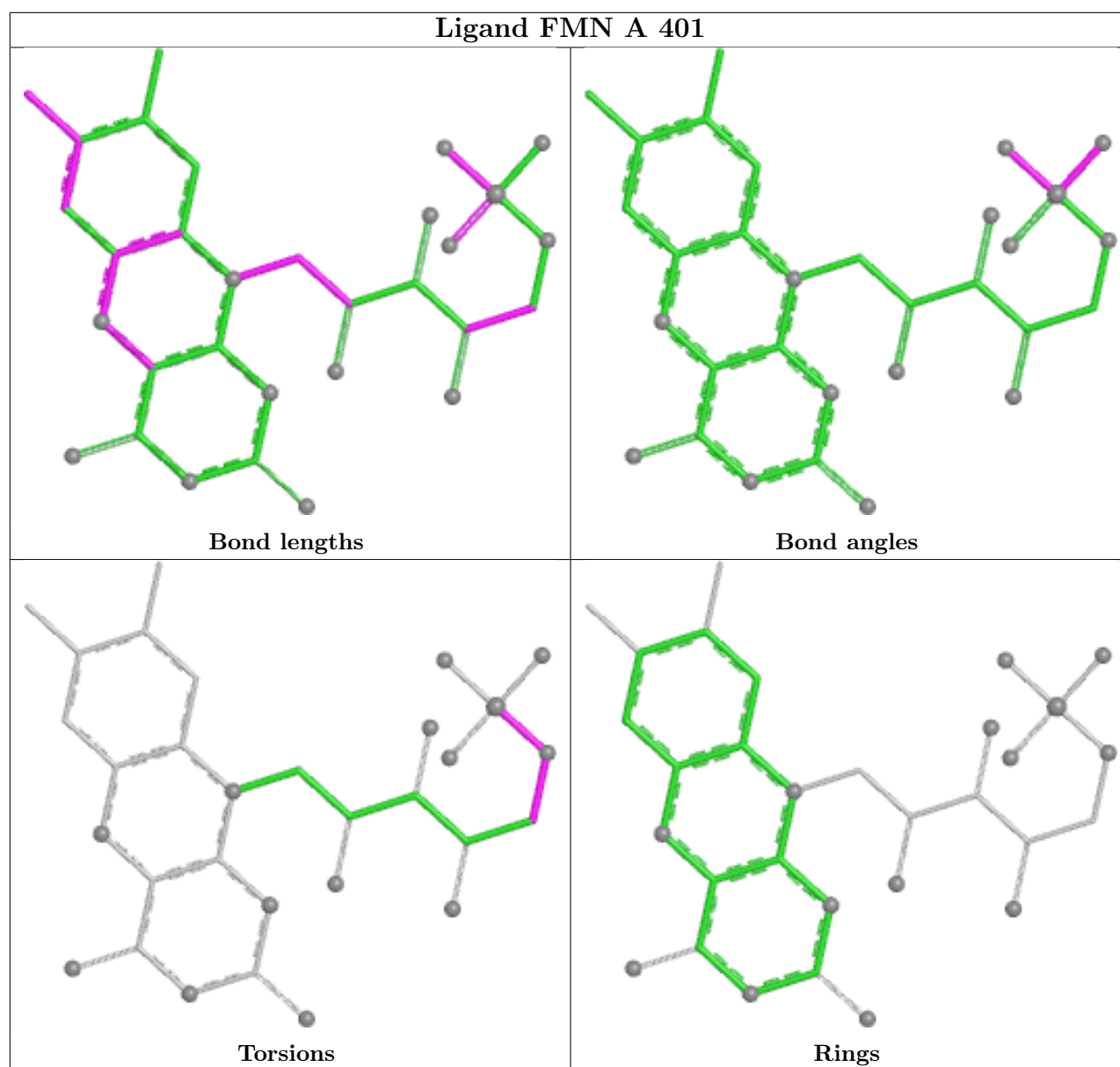
Mol	Chain	Res	Type	Atoms
2	A	401	FMN	C4'-C5'-O5'-P
2	A	401	FMN	C5'-O5'-P-O1P

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	401	FMN	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



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

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.