



# wwPDB X-ray Structure Validation Summary Report ⓘ

Nov 3, 2024 – 04:23 am GMT

PDB ID : 1GZU  
Title : Crystal Structure of Human Nicotinamide Mononucleotide Adenylyltransferase  
in Complex with NMN  
Authors : Werner, E.; Ziegler, M.; Lerner, F.; Schweiger, M.; Heinemann, U.  
Deposited on : 2002-06-06  
Resolution : 2.90 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

<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>.

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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	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.39

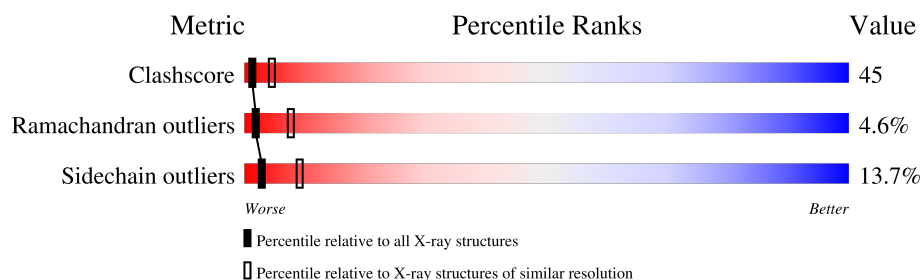
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.90 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	180529	2564 (2.90-2.90)
Ramachandran outliers	177936	2514 (2.90-2.90)
Sidechain outliers	177891	2516 (2.90-2.90)

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  $\geq 3$ , 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	290	
1	B	290	
1	C	290	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	NMN	A	501	X	-	-	-
2	NMN	B	501	X	-	-	-

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	NMN	C	501	X	-	-	-

## 2 Entry composition [i](#)

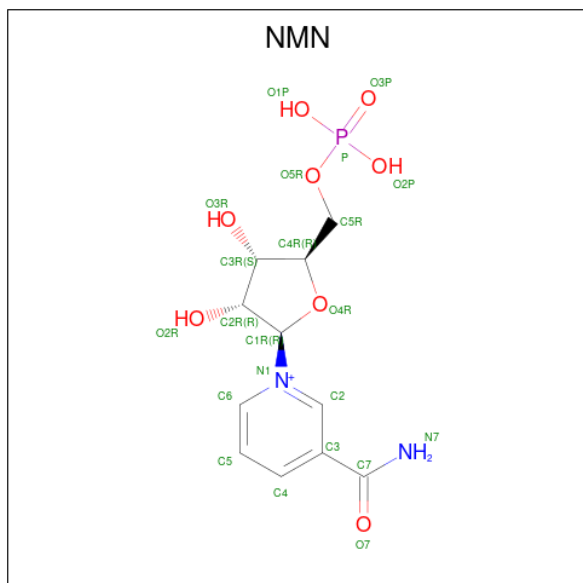
There are 2 unique types of molecules in this entry. The entry contains 5544 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 NICOTINAMIDE MONONUCLEOTIDE ADENYLYL TRANSFERASE.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	228	Total	C	N	O	S	Se	4	0	1
			1826	1168	321	331	3	3			
1	B	228	Total	C	N	O	S	Se	3	0	1
			1826	1168	321	331	3	3			
1	C	228	Total	C	N	O	S	Se	19	0	1
			1826	1168	321	331	3	3			

- Molecule 2 is BETA-NICOTINAMIDE RIBOSE MONOPHOSPHATE (three-letter code: NMN) (formula:  $C_{11}H_{16}N_2O_8P$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			22	11	2	8	1		
2	B	1	Total	C	N	O	P	0	0
			22	11	2	8	1		

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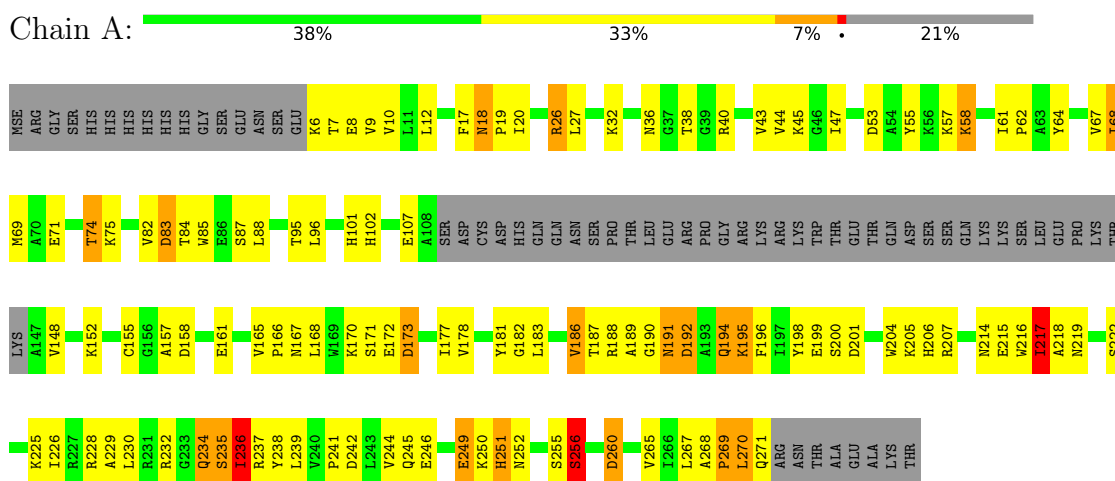
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	C	1	Total	C	N	O	P	0	0
			22	11	2	8	1		

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

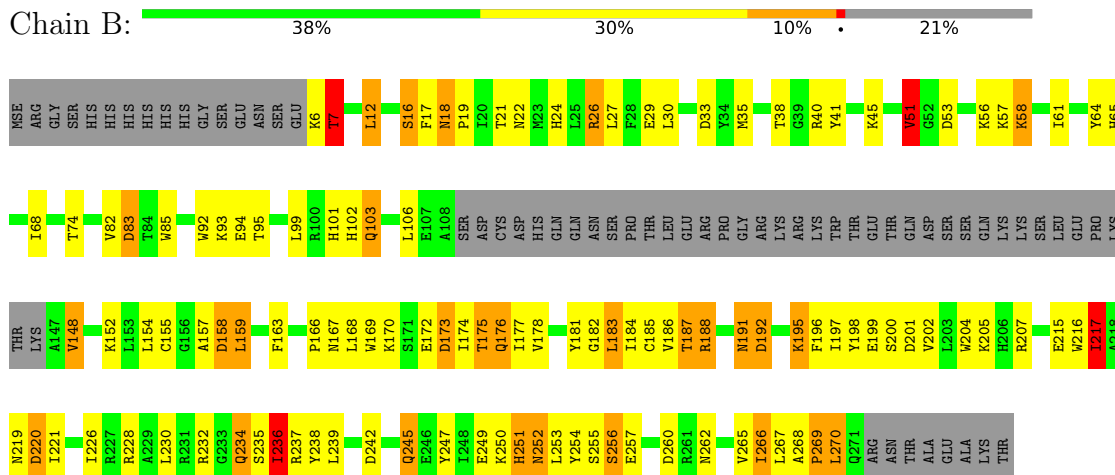
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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.

Note EDS was not executed.

#### • Molecule 1: NICOTINAMIDE MONONUCLEOTIDE ADENYLYL TRANSFERASE



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MSE	ARG	GLY	SER	HIS	HIS	HIS	GLY	SER	GLU	ASN	SER	GLU	K6	G52	D53	T7	E8	V9	V10	L11	L12	A13	C14	G15	S16	F17	N18	P19	I20	T21	N22	M23	H24	L25	R26	L27	L30	A31	K32	D33	Y34	M35	T38	G39	R40	Y41	T42	V43	V44	K45	G46	I47	I48	S49	P50	LYS	V51																																																					
														LYS	TRP																																											THR	THR	GLU	GLN	ASP	SER	SER	GLN	LYS	LYS	LEU	GLU	PRO	LYS	THR	LYS	K150	V151	K152	C155	G156	A157	D158	L159	I160	E161	S162	F163	A164	V165	P166	N167	L168	W169	K170	S171	E172	D173	I174	T175	I177	V178	A179	N180	Y181	G182	L183	I184	C185	V186	T187	R188	A189
														G190	N191																																											D192	A193	Q194	K195	F196	S200	D201	W204	H211	E215	W216	I217	A218	N219	D220	I221	I226	R227	R228	A229	L230	R231	R232	G233	Q234	S235	T236	R237	Y238	L239	V240	P241	D242	L243	V244	Q245	E246	Y247	I248	E249	K250	H251	N252	L253	Y254	S255	S256	E257	S258	E259	D260	R261	N262
														V265	I266																																											L267	A268	P269	L270	Q271	ARG	ASN	THR	ALA	GLU	ALA	LYS	THR																																								
														LYS	TRP																																											THR	THR	GLU	GLN	ASP	SER	SER	GLN	LYS	LYS	LEU	GLU	PRO	LYS	THR	LYS	K150	V151	K152	C155	G156	A157	D158	L159	I160	E161	S162	F163	A164	V165	P166	N167	L168	W169	K170	S171	E172	D173	I174	T175	I177	V178	A179	N180	Y181	G182	L183	I184	C185	V186	T187	R188	A189
														G190	N191																																											D192	A193	Q194	K195	F196	S200	D201	W204	H211	E215	W216	I217	A218	N219	D220	I221	I226	R227	R228	A229	L230	R231	R232	G233	Q234	S235	T236	R237	Y238	L239	V240	P241	D242	L243	V244	Q245	E246	Y247	I248	E249	K250	H251	N252	L253	Y254	S255	S256	E257	S258	E259	D260	R261	N262
														V265	I266																																											L267	A268	P269	L270	Q271	ARG	ASN	THR	ALA	GLU	ALA	LYS	THR																																								
														LYS	TRP																																											THR	THR	GLU	GLN	ASP	SER	SER	GLN	LYS	LYS	LEU	GLU	PRO	LYS	THR	LYS	K150	V151	K152	C155	G156	A157	D158	L159	I160	E161	S162	F163	A164	V165	P166	N167	L168	W169	K170	S171	E172	D173	I174	T175	I177	V178	A179	N180	Y181	G182	L183	I184	C185	V186	T187	R188	A189
														G190	N191																																											D192	A193	Q194	K195	F196	S200	D201	W204	H211	E215	W216	I217	A218	N219	D220	I221	I226	R227	R228	A229	L230	R231	R232	G233	Q234	S235	T236	R237	Y238	L239	V240	P241	D242	L243	V244	Q245	E246	Y247	I248	E249	K250	H251	N252	L253	Y254	S255	S256	E257	S258	E259	D260	R261	N262
														V265	I266																																											L267	A268	P269	L270	Q271	ARG	ASN	THR	ALA	GLU	ALA	LYS	THR																																								

## 4 Data and refinement statistics

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

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	140.80Å 235.70Å 89.00Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.90	Depositor
% Data completeness (in resolution range)	86.0 (20.00-2.90)	Depositor
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	REFMAC 5.0	Depositor
R, $R_{free}$	0.246 , 0.286	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	5544	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	53.0	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: NMN

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	0.85	1/1860 (0.1%)	0.84	7/2513 (0.3%)
1	B	0.79	0/1860	0.85	13/2513 (0.5%)
1	C	1.17	5/1860 (0.3%)	1.05	13/2513 (0.5%)
All	All	0.95	6/5580 (0.1%)	0.92	33/7539 (0.4%)

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	C	0	1

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	78	LYS	CG-CD	25.39	2.38	1.52
1	C	267	LEU	CB-CG	20.50	2.12	1.52
1	C	220	ASP	CB-CG	-18.46	1.12	1.51
1	A	260	ASP	CA-CB	8.63	1.73	1.53
1	C	150	LYS	CG-CD	-7.64	1.26	1.52

The worst 5 of 33 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	78	LYS	CB-CG-CD	-20.62	57.98	111.60
1	C	78	LYS	CG-CD-CE	11.98	147.85	111.90
1	C	220	ASP	CA-CB-CG	10.68	136.90	113.40
1	C	267	LEU	CB-CG-CD2	10.09	128.16	111.00
1	C	267	LEU	CA-CB-CG	-9.59	93.23	115.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	220	ASP	Sidechain

## 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	1826	0	1858	131	0
1	B	1826	0	1858	145	0
1	C	1826	0	1858	234	0
2	A	22	0	9	2	0
2	B	22	0	8	3	0
2	C	22	0	8	4	0
All	All	5544	0	5599	501	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 45.

The worst 5 of 501 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:C:250:LYS:O	1:C:251:HIS:ND1	1.60	1.33
1:C:18:ASN:HB3	1:C:19:PRO:CD	1.57	1.32
1:C:27:LEU:HD22	1:C:186:VAL:CG2	1.69	1.21
1:C:168:LEU:HD23	1:C:169:TRP:CD1	1.75	1.20
1:B:58:LYS:HE2	1:B:58:LYS:N	1.59	1.17

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	224/290 (77%)	189 (84%)	25 (11%)	10 (4%)	2	8
1	B	224/290 (77%)	188 (84%)	26 (12%)	10 (4%)	2	8
1	C	224/290 (77%)	184 (82%)	29 (13%)	11 (5%)	2	6
All	All	672/870 (77%)	561 (84%)	80 (12%)	31 (5%)	2	8

5 of 31 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	18	ASN
1	A	251	HIS
1	A	265	VAL
1	B	18	ASN
1	B	251	HIS

### 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	199/253 (79%)	178 (89%)	21 (11%)	5	18
1	B	199/253 (79%)	168 (84%)	31 (16%)	2	7
1	C	199/253 (79%)	169 (85%)	30 (15%)	2	7
All	All	597/759 (79%)	515 (86%)	82 (14%)	3	9

5 of 82 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	42	THR
1	C	200	SER
1	C	58	LYS
1	C	168	LEU
1	C	240	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 18 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	245	GLN
1	C	252	ASN
1	C	176	GLN
1	B	103	GLN
1	B	234	GLN

### 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](#)

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	NMN	B	501	-	22,23,23	4.82	7 (31%)	30,34,34	2.33	11 (36%)
2	NMN	C	501	-	22,23,23	4.54	6 (27%)	30,34,34	2.15	9 (30%)
2	NMN	A	501	-	22,23,23	4.42	6 (27%)	30,34,34	2.38	12 (40%)

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	NMN	B	501	-	1/1/6/6	7/14/30/30	0/2/2/2
2	NMN	C	501	-	1/1/6/6	2/14/30/30	0/2/2/2
2	NMN	A	501	-	2/2/6/6	7/14/30/30	0/2/2/2

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	501	NMN	C2R-C1R	-14.06	1.32	1.53
2	C	501	NMN	C2R-C1R	-13.23	1.33	1.53
2	A	501	NMN	C2R-C1R	-11.71	1.36	1.53
2	B	501	NMN	O3R-C3R	-9.46	1.20	1.43
2	A	501	NMN	O3R-C3R	-9.25	1.21	1.43

The worst 5 of 32 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	501	NMN	C3R-C2R-C1R	5.81	109.72	100.98
2	C	501	NMN	C3R-C2R-C1R	5.34	109.01	100.98
2	B	501	NMN	C3R-C2R-C1R	5.27	108.91	100.98
2	A	501	NMN	O4R-C4R-C5R	4.65	124.68	109.37
2	B	501	NMN	O4R-C4R-C5R	4.27	123.42	109.37

All (4) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	A	501	NMN	C2R
2	A	501	NMN	C4R
2	B	501	NMN	C2R
2	C	501	NMN	C2R

5 of 16 torsion outliers are listed below:

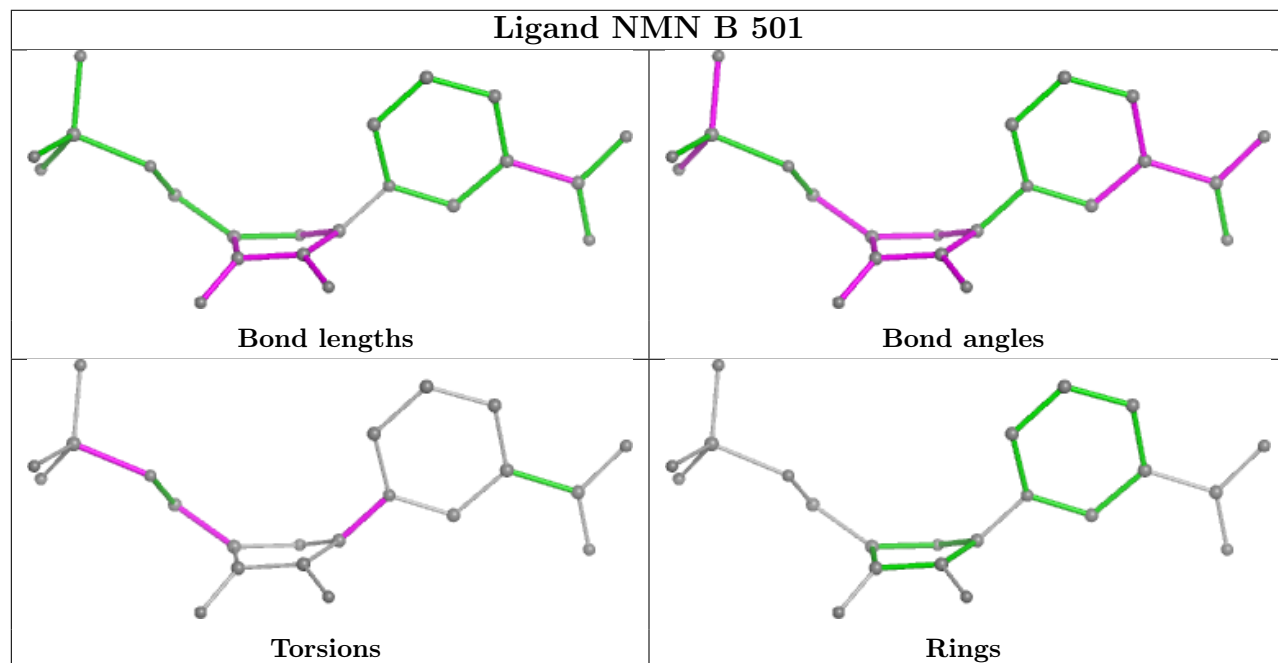
Mol	Chain	Res	Type	Atoms
2	A	501	NMN	C5R-O5R-P-O2P
2	A	501	NMN	O4R-C1R-N1-C2
2	A	501	NMN	O4R-C1R-N1-C6
2	B	501	NMN	C5R-O5R-P-O3P
2	B	501	NMN	C5R-O5R-P-O1P

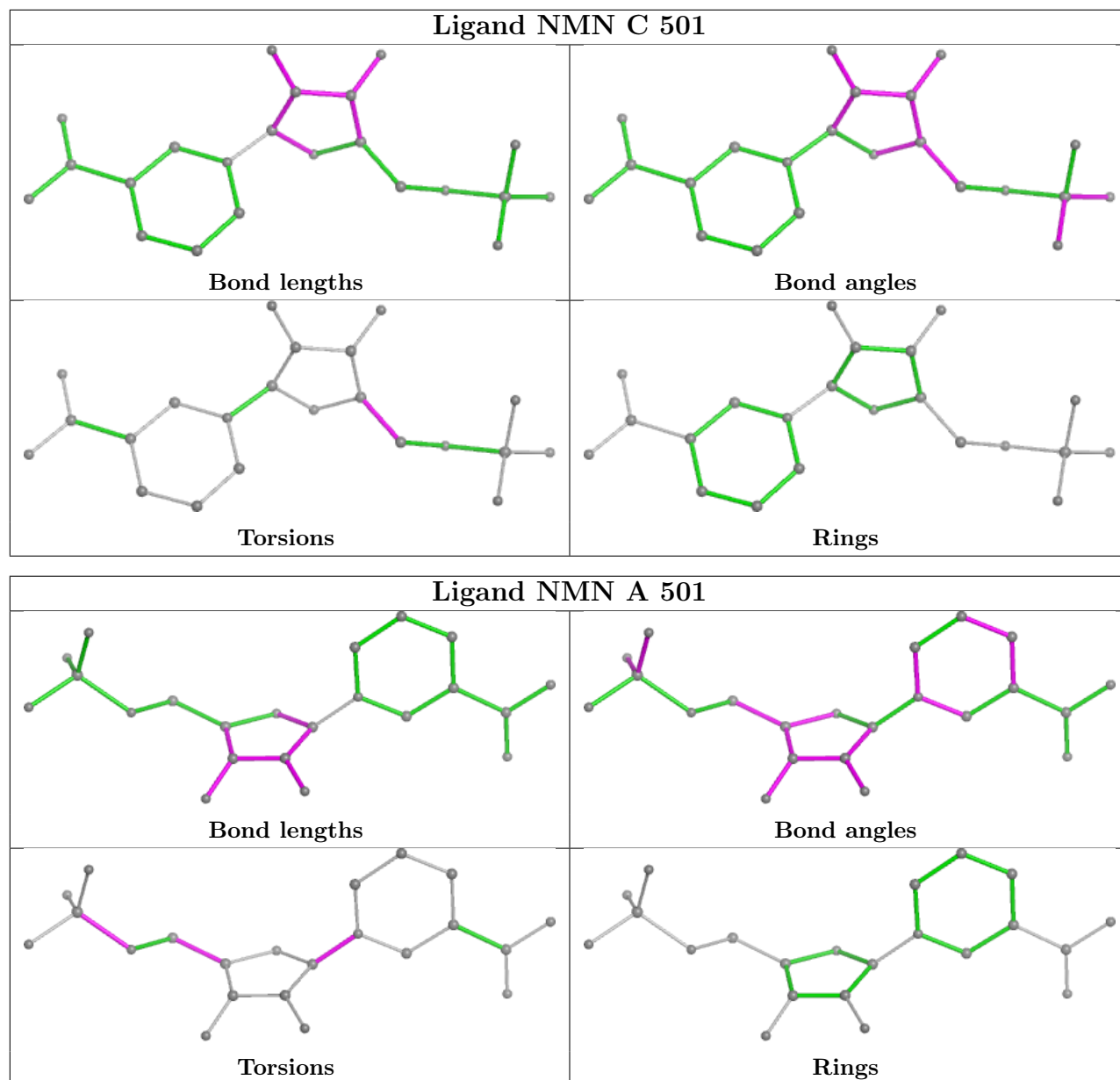
There are no ring outliers.

3 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	501	NMN	3	0
2	C	501	NMN	4	0
2	A	501	NMN	2	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.