



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 31, 2026 – 11:10 AM UTC

PDB ID : 3TDK / pdb_00003tdk
Title : Crystal Structure of Human UDP-Glucose Dehydrogenase
Authors : Rajakannan, V.; Han, C.; Robinson, R.
Deposited on : 2011-08-11
Resolution : 2.80 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

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) : 2.0
EDS : 3.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

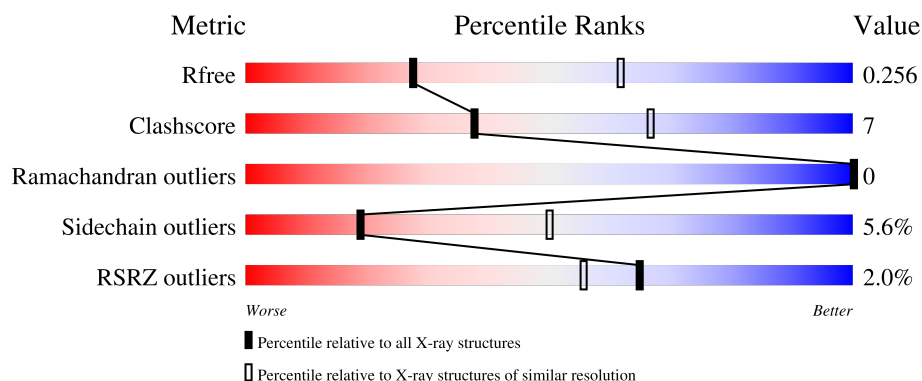
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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}	180053	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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 $\leq 5\%$. 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	487	
1	B	487	
1	C	487	
1	D	487	
1	E	487	

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Mol	Chain	Length	Quality of chain
1	F	487	2% 77% 15% 6%
1	G	487	% 79% 14% 6%
1	H	487	77% 15% 6%
1	I	487	3% 78% 13% 6%
1	J	487	2% 82% 11% 6%
1	K	487	5% 77% 16% 6%
1	L	487	2% 75% 18% 6%

2 Entry composition

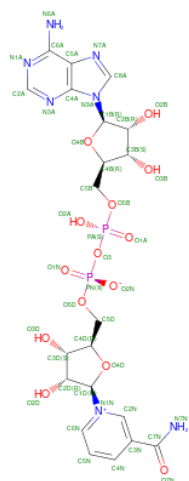
There are 4 unique types of molecules in this entry. The entry contains 44667 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 UDP-glucose 6-dehydrogenase.

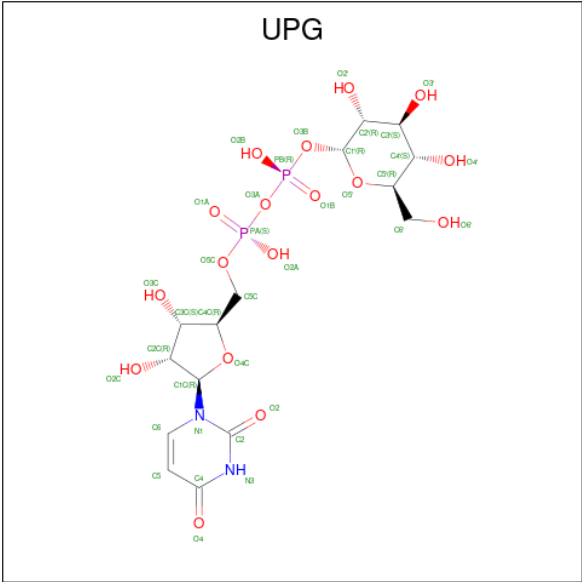
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			
1	B	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			
1	G	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			
1	H	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			
1	L	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			
1	K	458	Total	C	N	O	S	0	0	0
			3588	2272	619	677	20			
1	F	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			
1	E	458	Total	C	N	O	S	0	0	0
			3588	2272	619	677	20			
1	D	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			
1	C	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			
1	J	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			
1	I	460	Total	C	N	O	S	0	0	0
			3606	2282	623	681	20			

- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (CCD ID: NAD) (formula: $C_{21}H_{27}N_7O_{14}P_2$).



Idol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	B	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	G	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	H	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	L	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	K	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	F	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	E	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	D	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	C	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	J	1	Total 35	C 15	N 5	O 13	P 2	0	0
2	I	1	Total 35	C 15	N 5	O 13	P 2	0	0

- Molecule 3 is URIDINE-5'-DIPHOSPHATE-GLUCOSE (CCD ID: UPG) (formula: $\text{C}_{15}\text{H}_{24}\text{N}_2\text{O}_{17}\text{P}_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	B	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	G	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	H	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	L	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	K	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	F	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	E	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	D	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	C	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	J	1	Total	C	N	O	P	0	0
			36	15	2	17	2		
3	I	1	Total	C	N	O	P	0	0
			36	15	2	17	2		

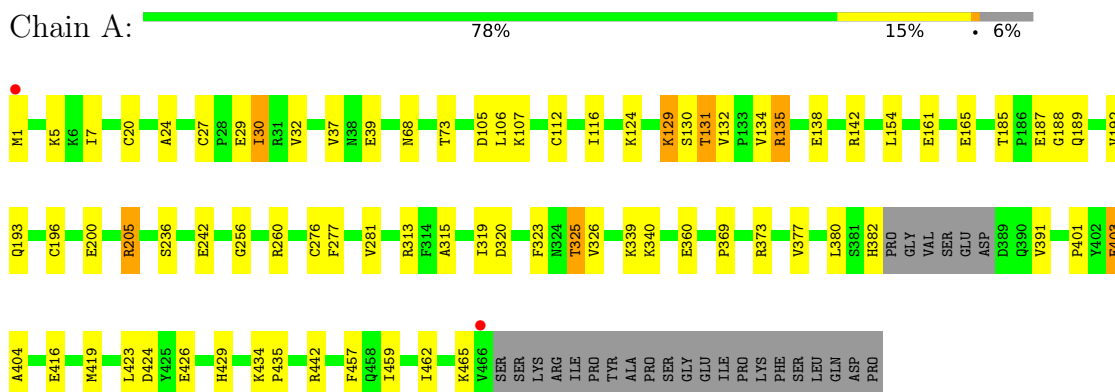
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	77	Total 77	O 77	0	0
4	B	75	Total 75	O 75	0	0
4	G	69	Total 69	O 69	0	0
4	H	85	Total 85	O 85	0	0
4	L	26	Total 26	O 26	0	0
4	K	18	Total 18	O 18	0	0
4	F	33	Total 33	O 33	0	0
4	E	29	Total 29	O 29	0	0
4	D	40	Total 40	O 40	0	0
4	C	38	Total 38	O 38	0	0
4	J	44	Total 44	O 44	0	0
4	I	45	Total 45	O 45	0	0

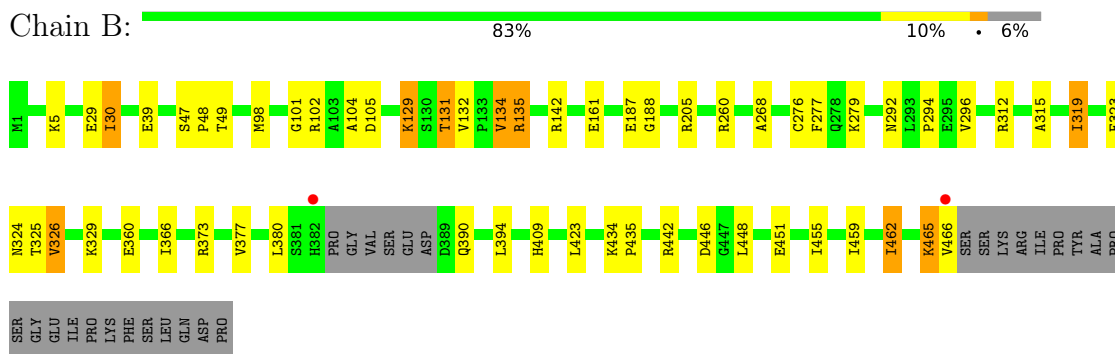
3 Residue-property plots

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 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 ($RSRZ > 2$). 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.

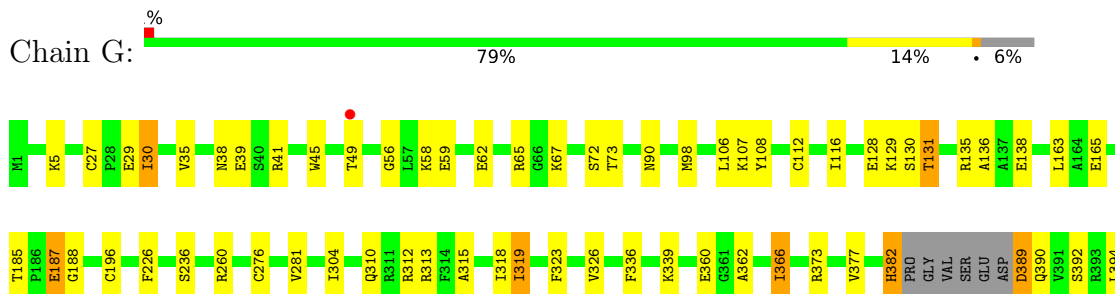
• Molecule 1: UDP-glucose 6-dehydrogenase

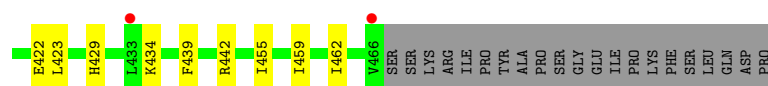


• Molecule 1: UDP-glucose 6-dehydrogenase



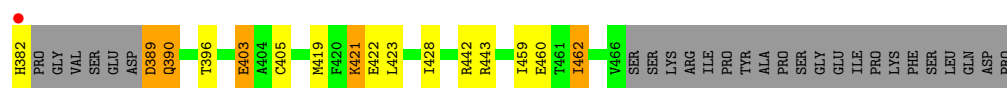
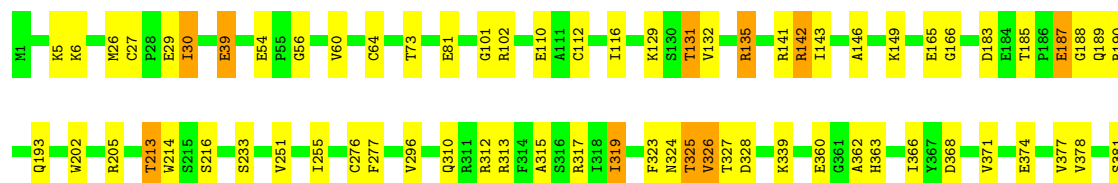
• Molecule 1: UDP-glucose 6-dehydrogenase





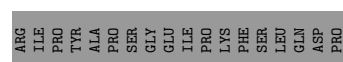
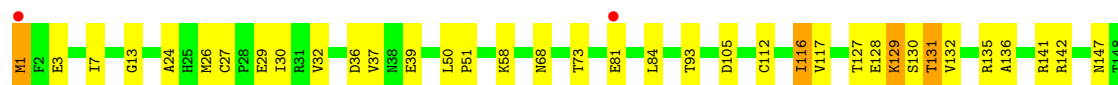
• Molecule 1: UDP-glucose 6-dehydrogenase

Chain H: 77% 15% 6%



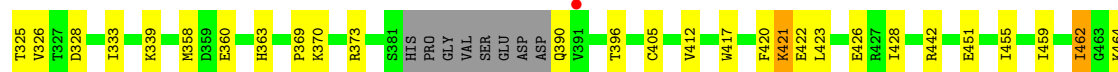
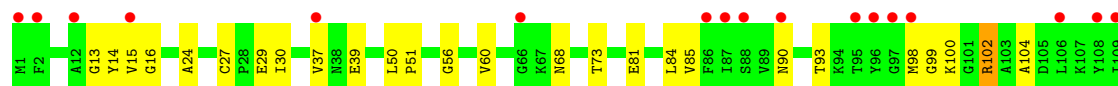
• Molecule 1: UDP-glucose 6-dehydrogenase

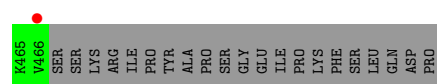
Chain L: 75% 18% 6%



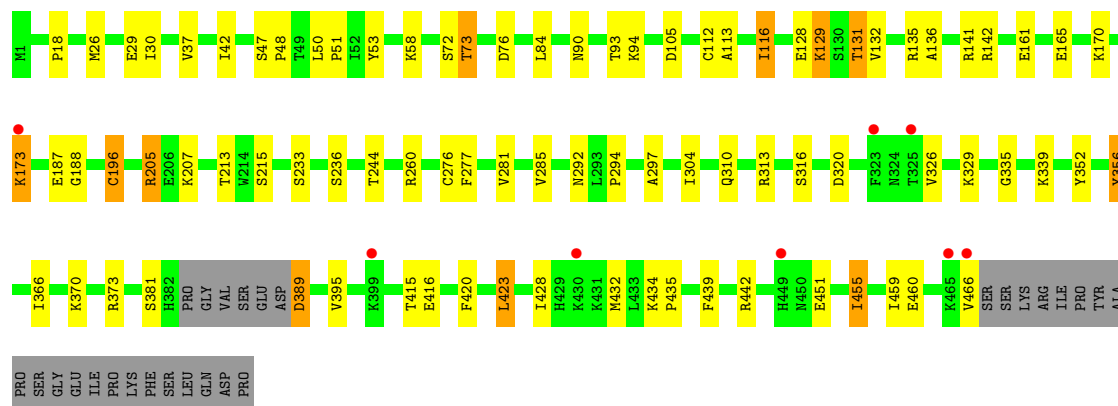
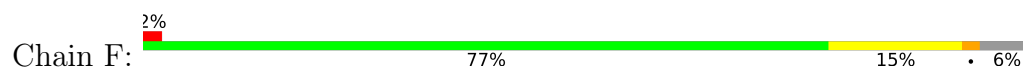
• Molecule 1: UDP-glucose 6-dehydrogenase

Chain K: 77% 16% 6%

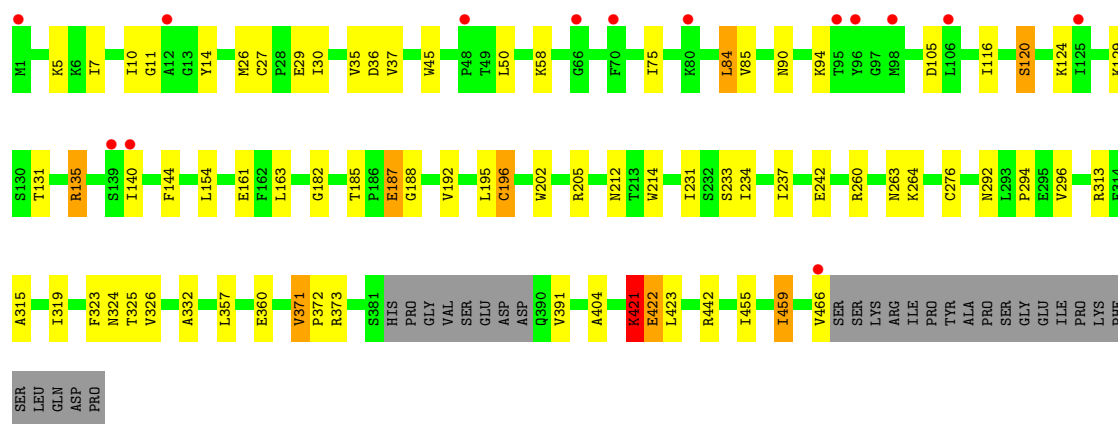
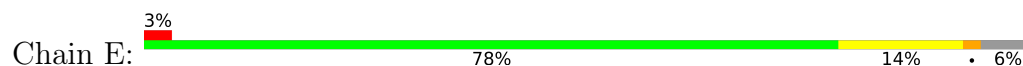




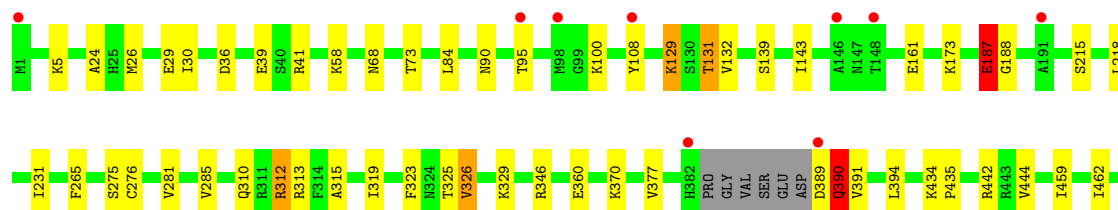
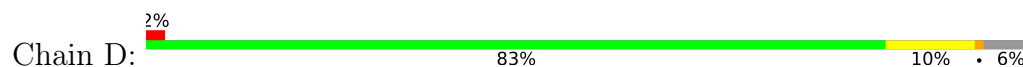
• Molecule 1: UDP-glucose 6-dehydrogenase

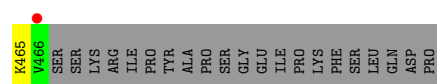


• Molecule 1: UDP-glucose 6-dehydrogenase

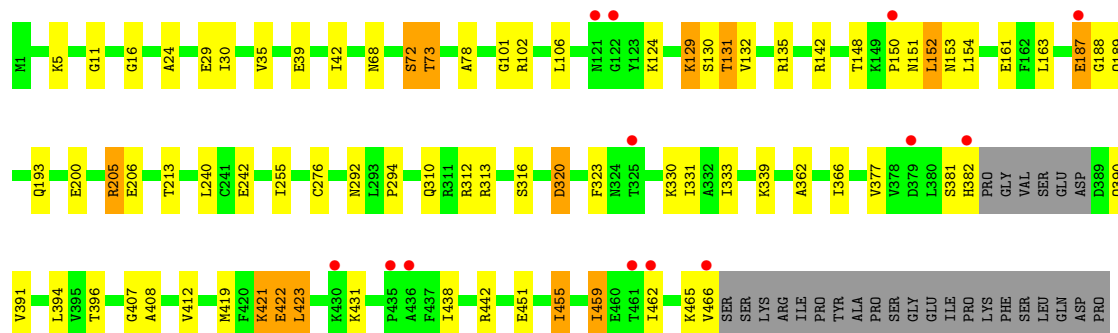
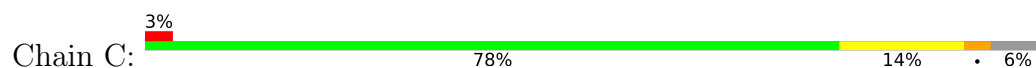


• Molecule 1: UDP-glucose 6-dehydrogenase

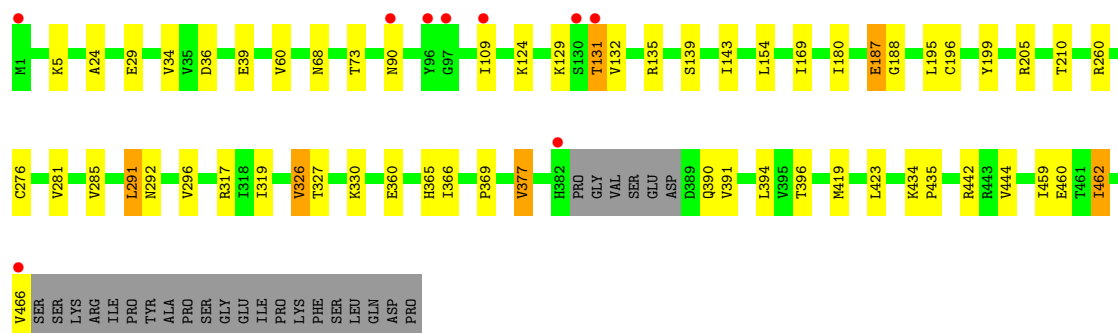
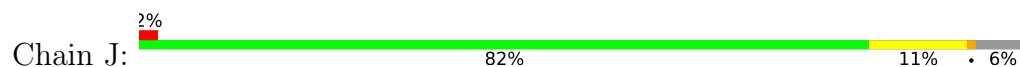




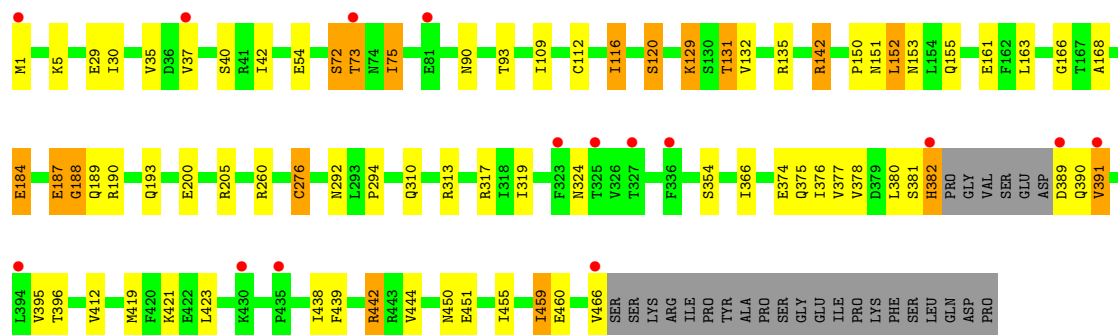
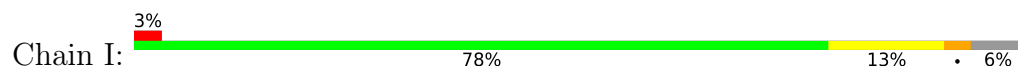
• Molecule 1: UDP-glucose 6-dehydrogenase



• Molecule 1: UDP-glucose 6-dehydrogenase



• Molecule 1: UDP-glucose 6-dehydrogenase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	173.13Å 191.18Å 225.81Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	145.91 – 2.80 145.91 – 2.80	Depositor EDS
% Data completeness (in resolution range)	95.8 (145.91-2.80) 95.8 (145.91-2.80)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.13	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.38 (at 2.81Å)	Xtrriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.230 , 0.261 0.229 , 0.256	Depositor DCC
R_{free} test set	8844 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å ²)	41.8	Xtrriage
Anisotropy	0.065	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 49.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	44667	wwPDB-VP
Average B, all atoms (Å ²)	51.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 48.42 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 8.6196e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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 ⓘ

5.1 Standard geometry ⓘ

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

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	0.92	0/3671	1.02	4/4966 (0.1%)
1	B	0.91	1/3671 (0.0%)	0.98	1/4966 (0.0%)
1	C	0.85	0/3671	1.01	5/4966 (0.1%)
1	D	0.87	0/3671	0.98	2/4966 (0.0%)
1	E	0.76	1/3652 (0.0%)	0.95	5/4940 (0.1%)
1	F	0.82	0/3671	0.97	4/4966 (0.1%)
1	G	0.88	1/3671 (0.0%)	0.99	4/4966 (0.1%)
1	H	0.98	0/3671	1.04	7/4966 (0.1%)
1	I	0.83	1/3671 (0.0%)	1.00	6/4966 (0.1%)
1	J	0.88	1/3671 (0.0%)	0.97	1/4966 (0.0%)
1	K	0.73	0/3652	0.93	1/4940 (0.0%)
1	L	0.80	0/3671	0.99	5/4966 (0.1%)
All	All	0.86	5/44014 (0.0%)	0.99	45/59540 (0.1%)

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	459	ILE	CA-CB	5.39	1.60	1.53
1	J	377	VAL	CA-CB	5.30	1.61	1.54
1	I	30	ILE	CA-CB	5.24	1.60	1.54
1	G	49	THR	CA-CB	5.15	1.61	1.53
1	B	30	ILE	CA-CB	5.03	1.60	1.54

The worst 5 of 45 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	L	187	GLU	N-CA-C	9.69	121.92	111.36
1	H	421	LYS	N-CA-C	-8.38	100.10	110.41
1	D	390	GLN	N-CA-C	-7.83	102.81	113.30
1	L	390	GLN	N-CA-C	-7.48	104.15	113.28
1	E	421	LYS	N-CA-C	-6.89	101.44	110.53

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	3606	0	3627	60	0
1	B	3606	0	3627	35	0
1	C	3606	0	3627	54	0
1	D	3606	0	3627	38	0
1	E	3588	0	3616	60	0
1	F	3606	0	3627	53	0
1	G	3606	0	3627	45	0
1	H	3606	0	3627	66	0
1	I	3606	0	3627	57	0
1	J	3606	0	3627	29	0
1	K	3588	0	3616	63	0
1	L	3606	0	3627	64	0
2	A	35	0	19	4	0
2	B	35	0	19	0	0
2	C	35	0	19	2	0
2	D	35	0	19	7	0
2	E	35	0	19	7	0
2	F	35	0	19	3	0
2	G	35	0	19	4	0
2	H	35	0	19	1	0
2	I	35	0	19	1	0
2	J	35	0	19	4	0
2	K	35	0	19	4	0
2	L	35	0	19	5	0
3	A	36	0	21	9	0
3	B	36	0	21	6	0
3	C	36	0	21	7	0
3	D	36	0	22	4	0
3	E	36	0	22	6	0
3	F	36	0	22	5	0
3	G	36	0	21	7	0
3	H	36	0	21	9	0
3	I	36	0	21	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	J	36	0	22	4	0
3	K	36	0	21	13	0
3	L	36	0	22	4	0
4	A	77	0	0	0	0
4	B	75	0	0	2	0
4	C	38	0	0	0	0
4	D	40	0	0	1	0
4	E	29	0	0	0	0
4	F	33	0	0	1	0
4	G	69	0	0	1	0
4	H	85	0	0	0	0
4	I	45	0	0	2	0
4	J	44	0	0	1	0
4	K	18	0	0	0	0
4	L	26	0	0	1	0
All	All	44667	0	43987	614	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 7.

The worst 5 of 614 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:152:LEU:HD12	1:C:153:ASN:N	1.57	1.18
1:B:319:ILE:HD12	1:B:360:GLU:HG3	1.28	1.15
1:I:42:ILE:HG21	1:I:73:THR:HG22	1.30	1.08
1:I:42:ILE:HG21	1:I:73:THR:CG2	1.87	1.05
1:H:135:ARG:HH11	1:H:135:ARG:HG2	1.17	1.04

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	456/487 (94%)	438 (96%)	18 (4%)	0	100	100
1	B	456/487 (94%)	439 (96%)	17 (4%)	0	100	100
1	C	456/487 (94%)	441 (97%)	15 (3%)	0	100	100
1	D	456/487 (94%)	440 (96%)	16 (4%)	0	100	100
1	E	454/487 (93%)	438 (96%)	16 (4%)	0	100	100
1	F	456/487 (94%)	433 (95%)	23 (5%)	0	100	100
1	G	456/487 (94%)	441 (97%)	15 (3%)	0	100	100
1	H	456/487 (94%)	442 (97%)	14 (3%)	0	100	100
1	I	456/487 (94%)	436 (96%)	20 (4%)	0	100	100
1	J	456/487 (94%)	436 (96%)	20 (4%)	0	100	100
1	K	454/487 (93%)	436 (96%)	18 (4%)	0	100	100
1	L	456/487 (94%)	434 (95%)	22 (5%)	0	100	100
All	All	5468/5844 (94%)	5254 (96%)	214 (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	395/419 (94%)	378 (96%)	17 (4%)	26	60
1	B	395/419 (94%)	372 (94%)	23 (6%)	18	49
1	C	395/419 (94%)	371 (94%)	24 (6%)	17	46
1	D	395/419 (94%)	374 (95%)	21 (5%)	20	52
1	E	393/419 (94%)	373 (95%)	20 (5%)	21	54
1	F	395/419 (94%)	368 (93%)	27 (7%)	14	42
1	G	395/419 (94%)	377 (95%)	18 (5%)	24	58
1	H	395/419 (94%)	371 (94%)	24 (6%)	17	46
1	I	395/419 (94%)	369 (93%)	26 (7%)	15	43

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	J	395/419 (94%)	374 (95%)	21 (5%)	20	52
1	K	393/419 (94%)	376 (96%)	17 (4%)	26	60
1	L	395/419 (94%)	370 (94%)	25 (6%)	16	45
All	All	4736/5028 (94%)	4473 (94%)	263 (6%)	19	50

5 of 263 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	J	423	LEU
1	I	29	GLU
1	I	455	ILE
1	L	373	ARG
1	L	205	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 53 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	301	GLN
1	E	212	ASN
1	I	155	GLN
1	F	365	HIS
1	E	118	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 oligosaccharides in this entry.

5.6 Ligand geometry

24 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	UPG	C	501	-	37,38,38	2.55	7 (18%)	55,58,58	2.01	13 (23%)
3	UPG	B	501	-	37,38,38	2.59	7 (18%)	55,58,58	2.37	16 (29%)
2	NAD	C	500	-	38,38,48	1.09	4 (10%)	53,58,73	1.89	13 (24%)
2	NAD	F	500	-	38,38,48	0.96	3 (7%)	53,58,73	1.93	12 (22%)
2	NAD	I	500	-	38,38,48	1.39	4 (10%)	53,58,73	1.77	13 (24%)
3	UPG	F	501	-	37,38,38	1.03	1 (2%)	55,58,58	1.88	12 (21%)
2	NAD	E	500	-	38,38,48	1.40	6 (15%)	53,58,73	1.74	12 (22%)
3	UPG	L	501	-	37,38,38	1.00	2 (5%)	55,58,58	1.74	10 (18%)
3	UPG	J	501	-	37,38,38	1.33	3 (8%)	55,58,58	1.83	12 (21%)
2	NAD	D	500	-	38,38,48	1.29	4 (10%)	53,58,73	1.90	10 (18%)
3	UPG	G	501	-	37,38,38	2.52	8 (21%)	55,58,58	2.55	16 (29%)
2	NAD	B	500	-	38,38,48	1.25	5 (13%)	53,58,73	1.63	10 (18%)
3	UPG	H	501	-	37,38,38	2.55	7 (18%)	55,58,58	2.24	14 (25%)
3	UPG	A	501	-	37,38,38	2.55	9 (24%)	55,58,58	2.47	13 (23%)
2	NAD	H	500	-	38,38,48	1.11	4 (10%)	53,58,73	1.79	12 (22%)
3	UPG	E	501	-	37,38,38	1.06	5 (13%)	55,58,58	1.83	9 (16%)
3	UPG	K	501	-	37,38,38	3.21	10 (27%)	55,58,58	2.41	11 (20%)
2	NAD	A	500	-	38,38,48	1.21	6 (15%)	53,58,73	2.01	14 (26%)
3	UPG	I	501	-	37,38,38	2.61	8 (21%)	55,58,58	2.09	15 (27%)
2	NAD	K	500	-	38,38,48	1.54	7 (18%)	53,58,73	1.80	11 (20%)
2	NAD	G	500	-	38,38,48	1.20	4 (10%)	53,58,73	1.81	9 (16%)
2	NAD	J	500	-	38,38,48	1.22	5 (13%)	53,58,73	1.88	12 (22%)
2	NAD	L	500	-	38,38,48	1.19	3 (7%)	53,58,73	1.68	9 (16%)
3	UPG	D	501	-	37,38,38	0.97	2 (5%)	55,58,58	1.85	11 (20%)

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	UPG	C	501	-	-	6/23/59/59	0/3/3/3
3	UPG	B	501	-	-	7/23/59/59	0/3/3/3
2	NAD	C	500	-	-	3/22/51/62	0/4/4/5
2	NAD	F	500	-	-	6/22/51/62	0/4/4/5
2	NAD	I	500	-	-	2/22/51/62	0/4/4/5
3	UPG	F	501	-	-	3/23/59/59	0/3/3/3
2	NAD	E	500	-	-	7/22/51/62	0/4/4/5
3	UPG	L	501	-	-	10/23/59/59	0/3/3/3
3	UPG	J	501	-	-	4/23/59/59	0/3/3/3
2	NAD	D	500	-	-	13/22/51/62	0/4/4/5
3	UPG	G	501	-	-	5/23/59/59	0/3/3/3
2	NAD	B	500	-	-	1/22/51/62	0/4/4/5
3	UPG	H	501	-	-	6/23/59/59	0/3/3/3
3	UPG	A	501	-	-	5/23/59/59	0/3/3/3
2	NAD	H	500	-	-	6/22/51/62	0/4/4/5
3	UPG	E	501	-	-	4/23/59/59	0/3/3/3
3	UPG	K	501	-	-	6/23/59/59	0/3/3/3
2	NAD	A	500	-	-	5/22/51/62	0/4/4/5
3	UPG	I	501	-	-	6/23/59/59	0/3/3/3
2	NAD	K	500	-	-	4/22/51/62	0/4/4/5
2	NAD	G	500	-	-	1/22/51/62	0/4/4/5
2	NAD	J	500	-	-	13/22/51/62	0/4/4/5
2	NAD	L	500	-	-	6/22/51/62	0/4/4/5
3	UPG	D	501	-	-	4/23/59/59	0/3/3/3

The worst 5 of 124 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	K	501	UPG	O4-C4	13.01	1.49	1.24
3	K	501	UPG	O2-C2	10.37	1.41	1.23
3	I	501	UPG	O2-C2	10.22	1.41	1.23
3	C	501	UPG	O2-C2	10.17	1.41	1.23
3	A	501	UPG	O2-C2	9.99	1.40	1.23

The worst 5 of 289 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	G	501	UPG	O2-C2-N1	-10.31	109.38	122.80
3	K	501	UPG	O2-C2-N1	-9.40	110.56	122.80
3	A	501	UPG	O5'-C1'-O3B	-9.10	99.47	111.36
3	K	501	UPG	O5'-C1'-O3B	-8.49	100.27	111.36
3	A	501	UPG	O2-C2-N1	-7.66	112.83	122.80

There are no chirality outliers.

5 of 133 torsion outliers are listed below:

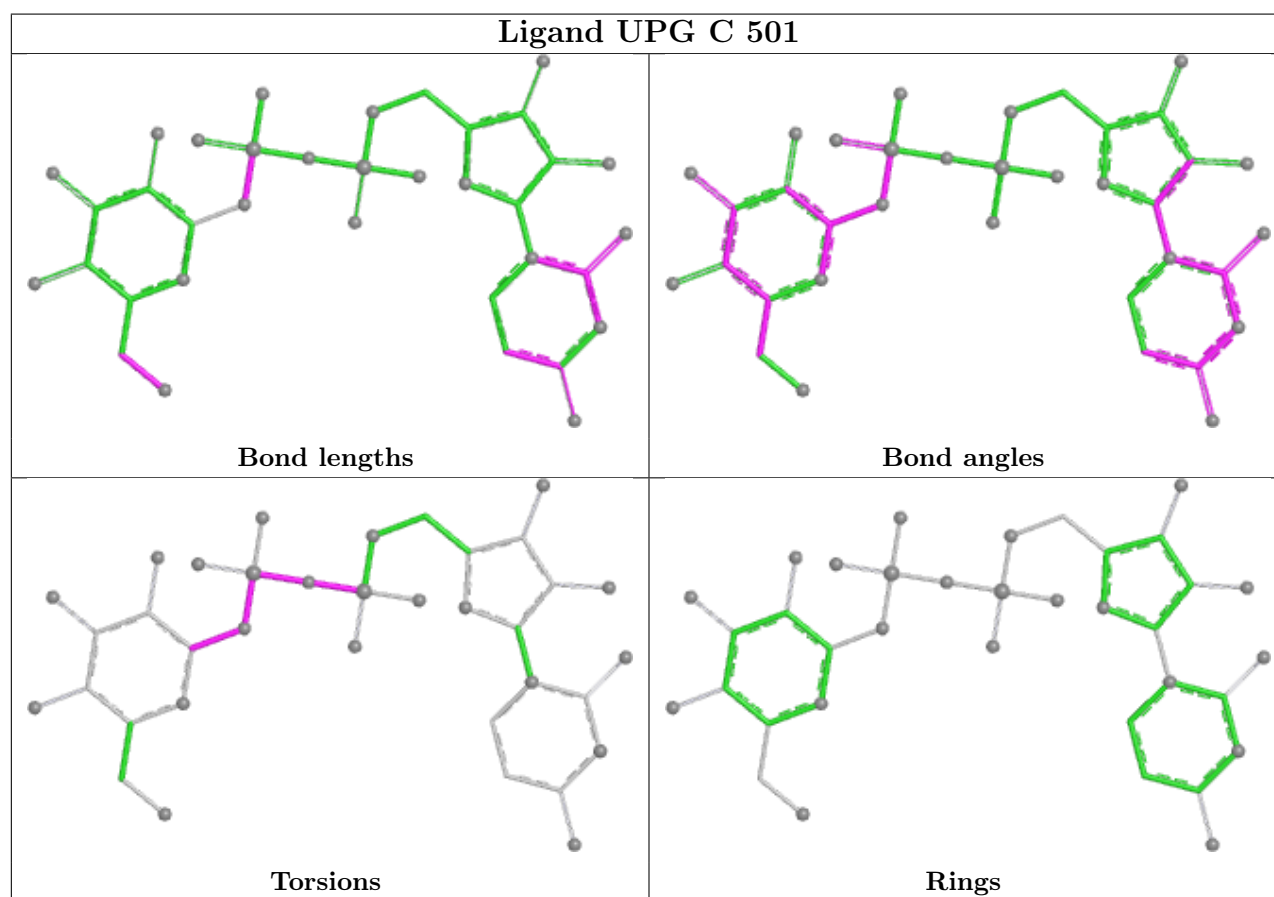
Mol	Chain	Res	Type	Atoms
2	A	500	NAD	C5D-O5D-PN-O3
2	A	500	NAD	O4D-C4D-C5D-O5D
2	A	500	NAD	C3D-C4D-C5D-O5D
2	G	500	NAD	PN-O3-PA-O5B
2	H	500	NAD	C5D-O5D-PN-O3

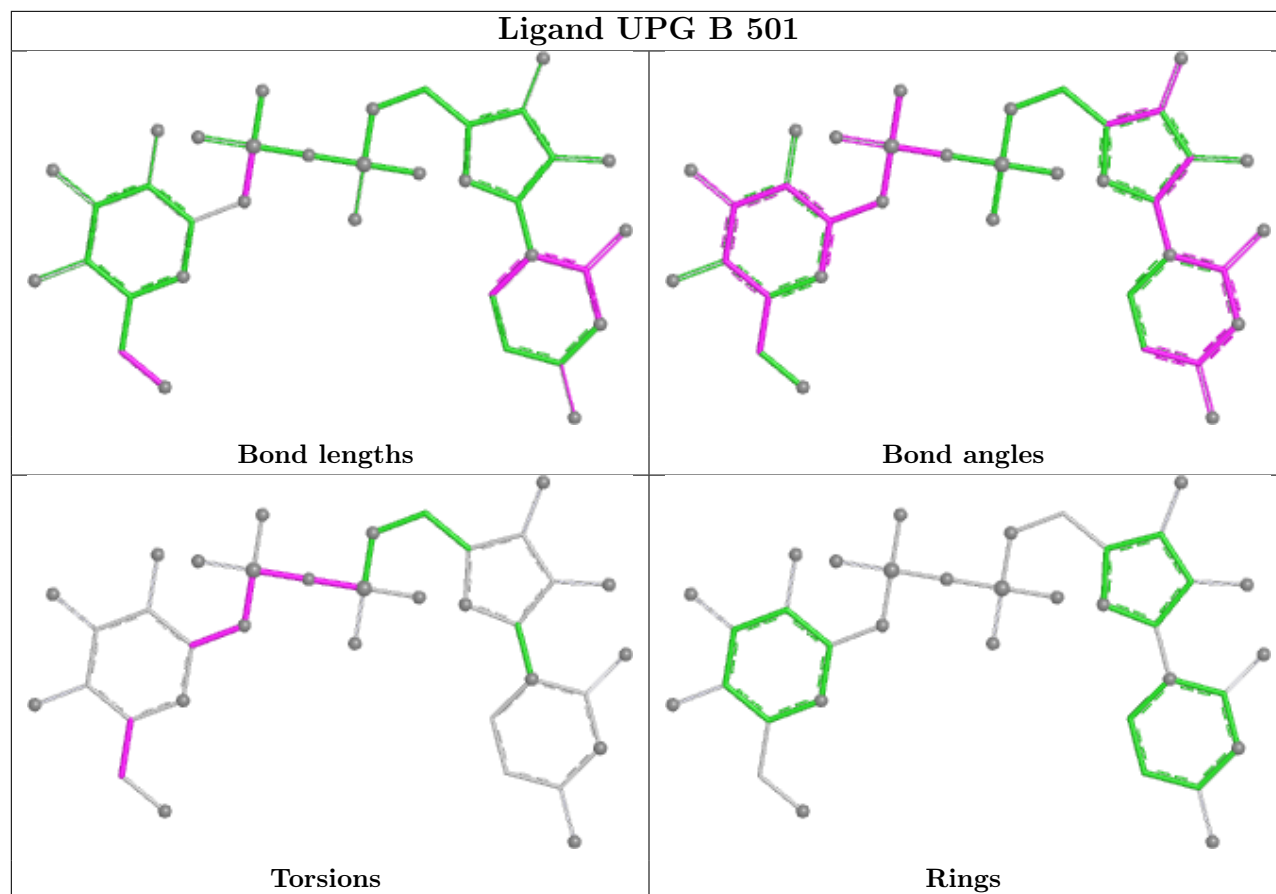
There are no ring outliers.

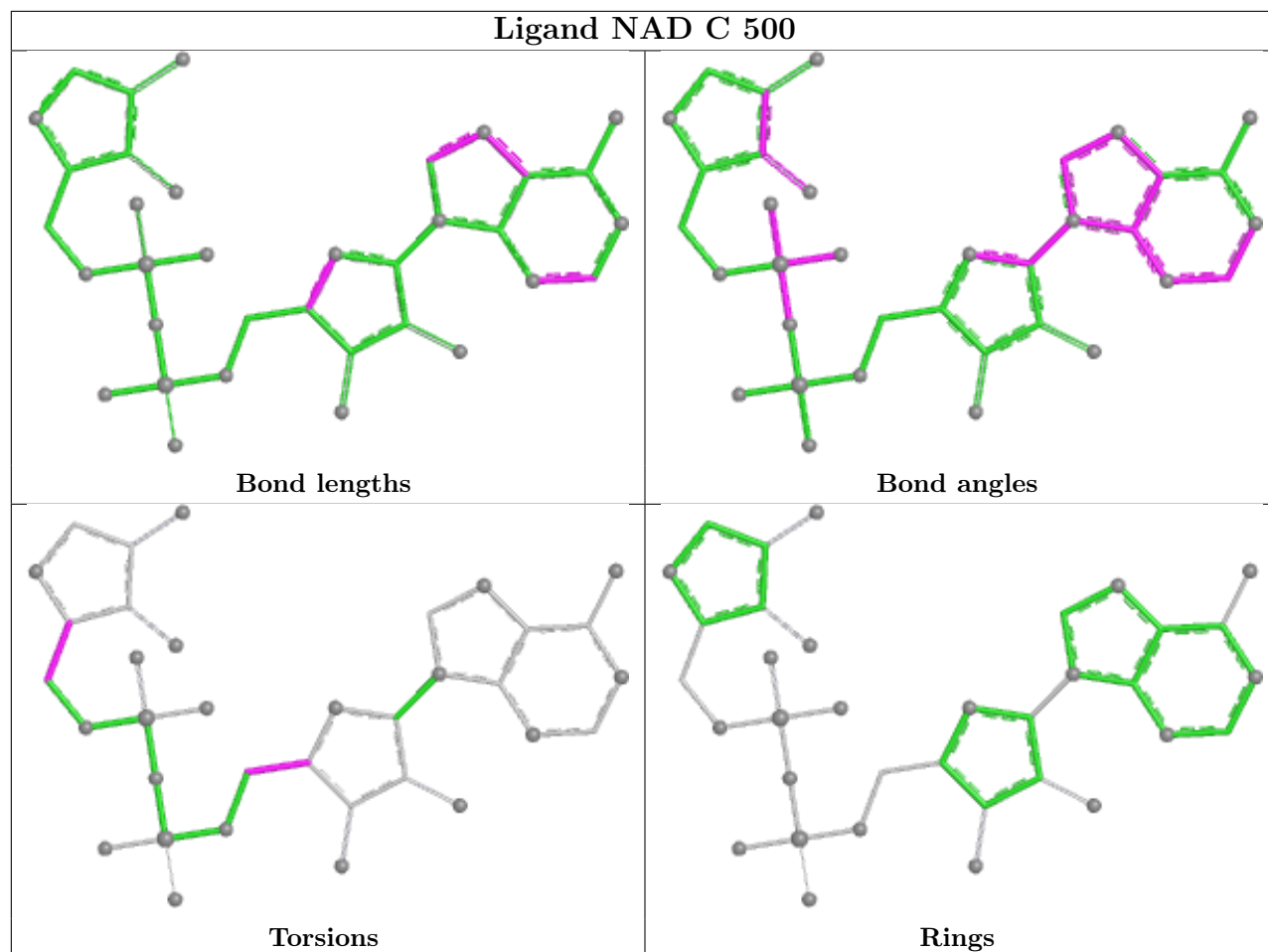
23 monomers are involved in 119 short contacts:

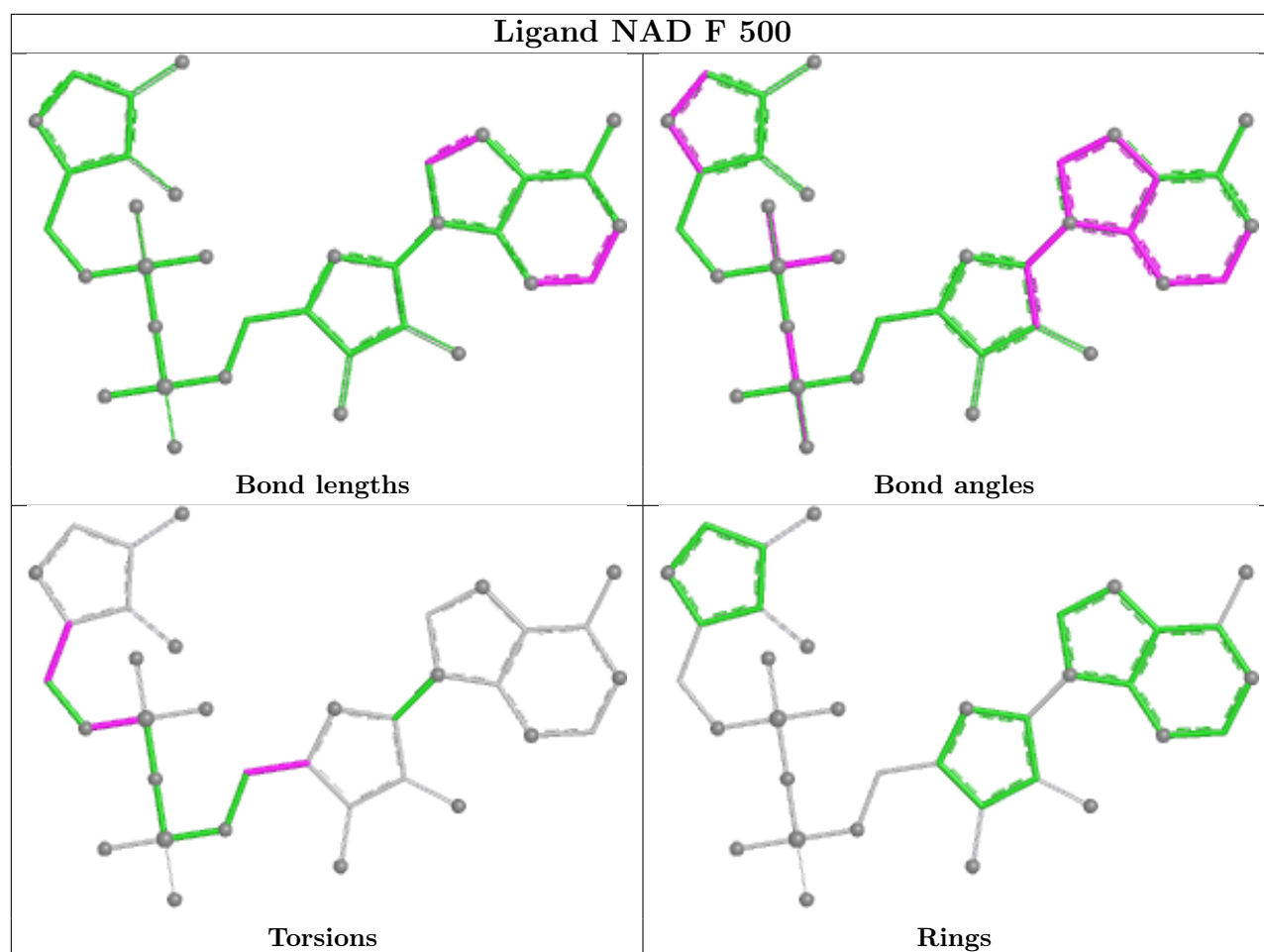
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	501	UPG	7	0
3	B	501	UPG	6	0
2	C	500	NAD	2	0
2	F	500	NAD	3	0
2	I	500	NAD	1	0
3	F	501	UPG	5	0
2	E	500	NAD	7	0
3	L	501	UPG	4	0
3	J	501	UPG	4	0
2	D	500	NAD	7	0
3	G	501	UPG	7	0
3	H	501	UPG	9	0
3	A	501	UPG	9	0
2	H	500	NAD	1	0
3	E	501	UPG	6	0
3	K	501	UPG	13	0
2	A	500	NAD	4	0
3	I	501	UPG	3	0
2	K	500	NAD	4	0
2	G	500	NAD	4	0
2	J	500	NAD	4	0
2	L	500	NAD	5	0
3	D	501	UPG	4	0

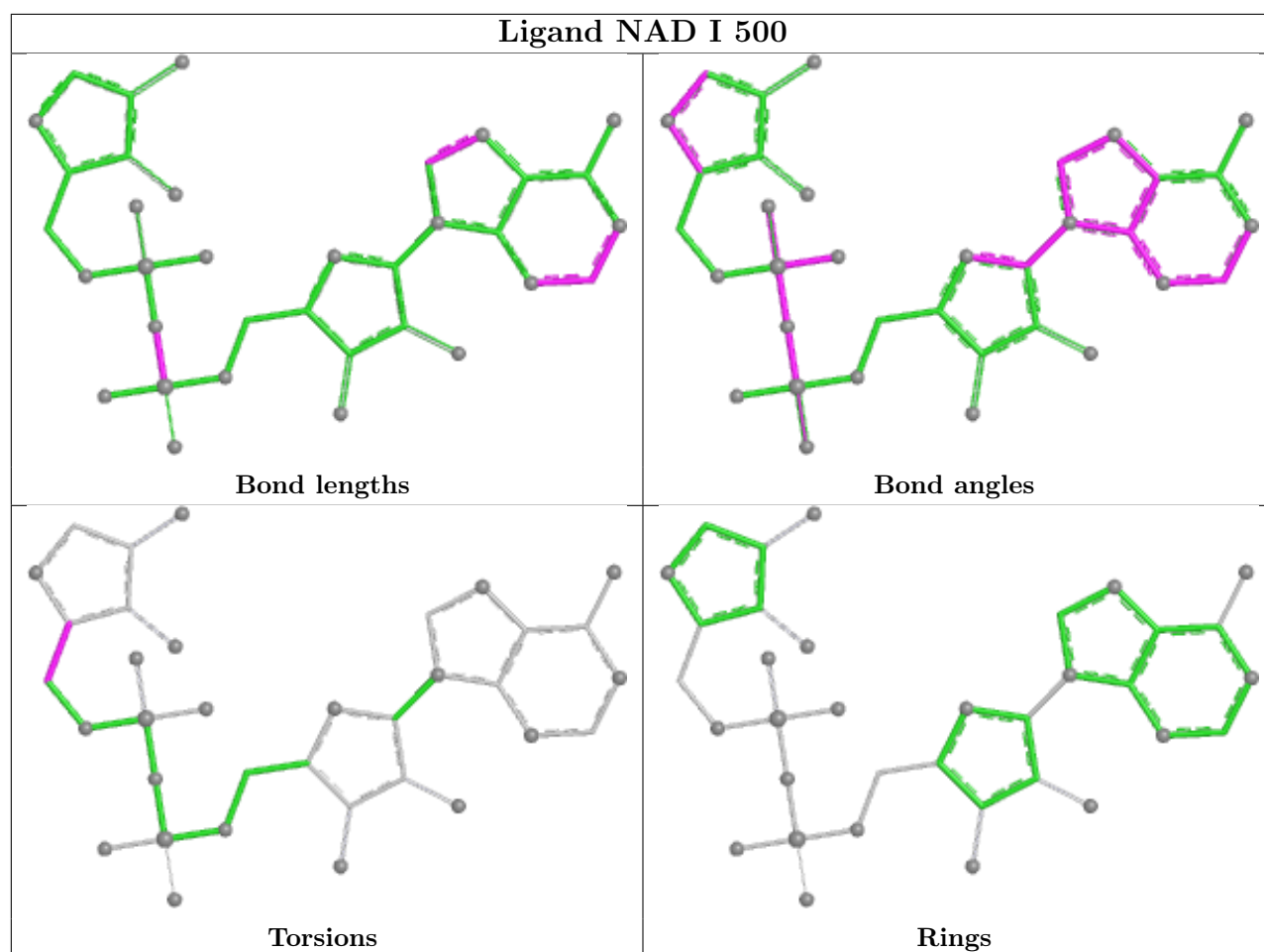
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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.

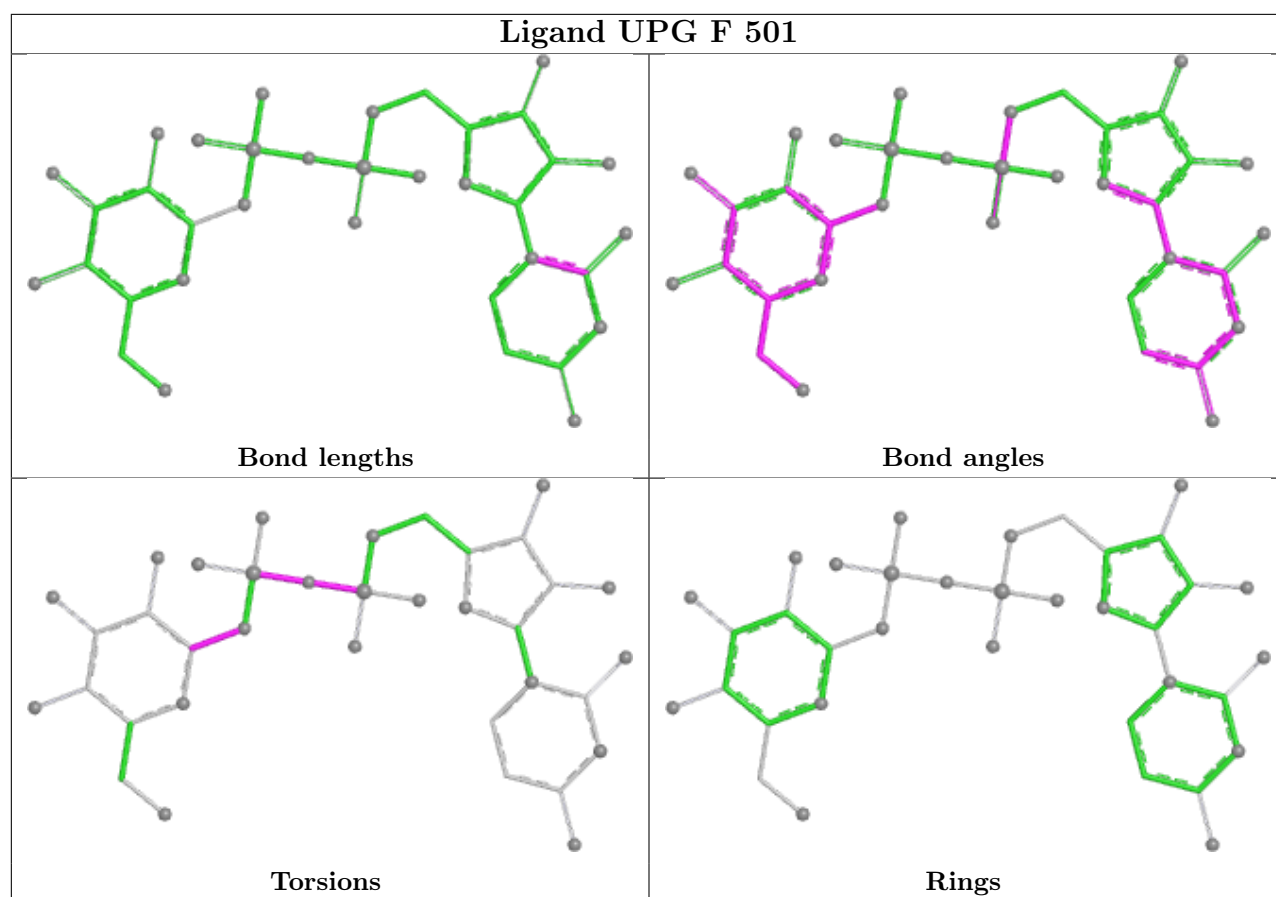


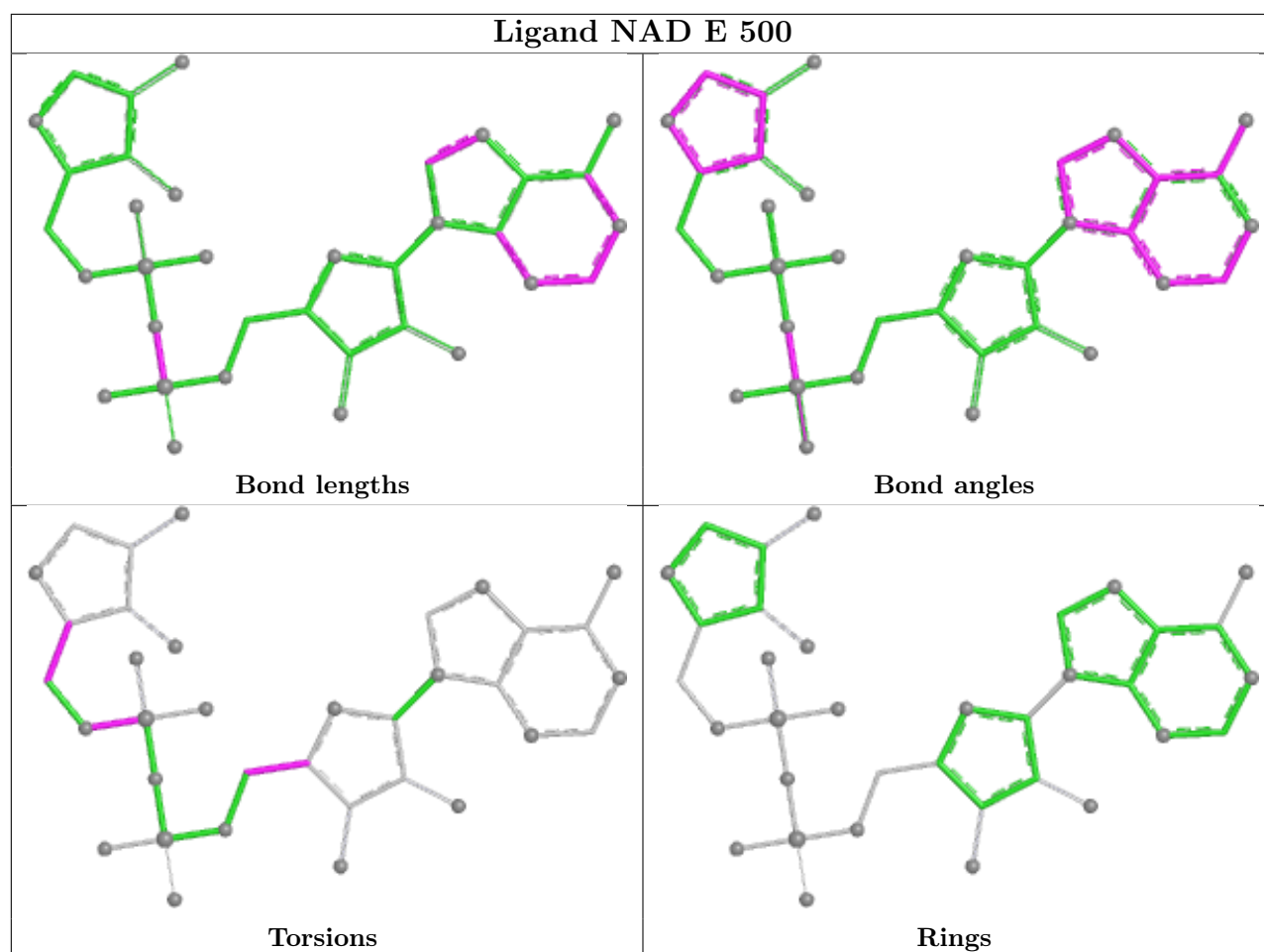




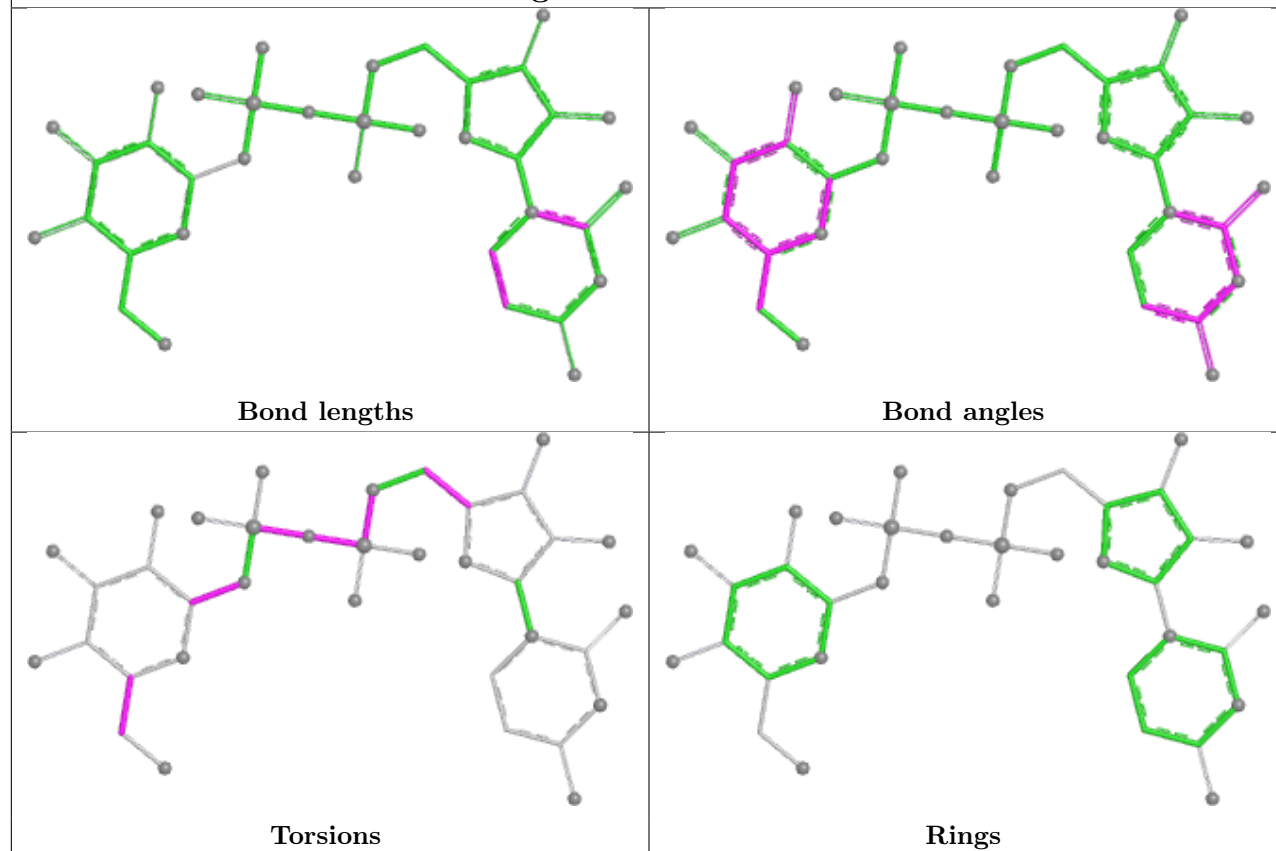




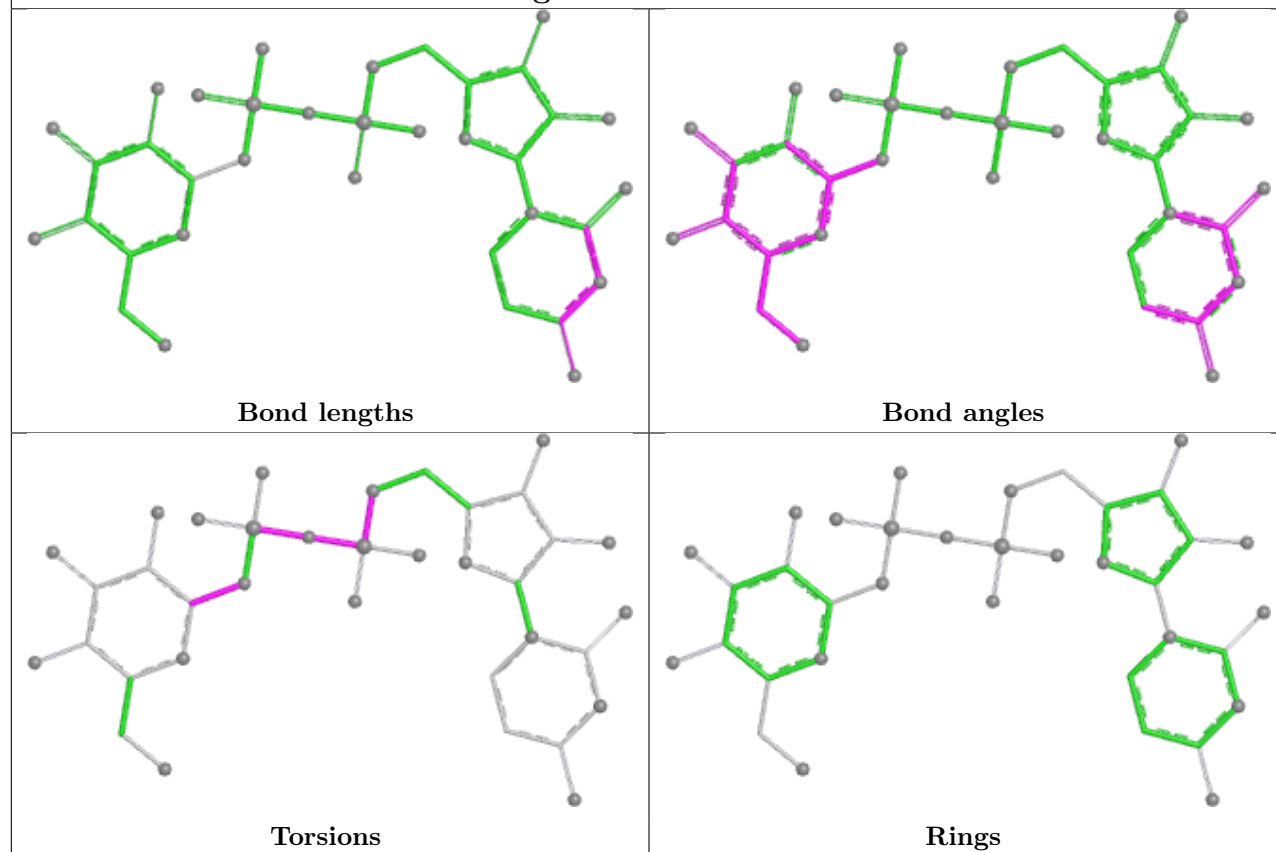


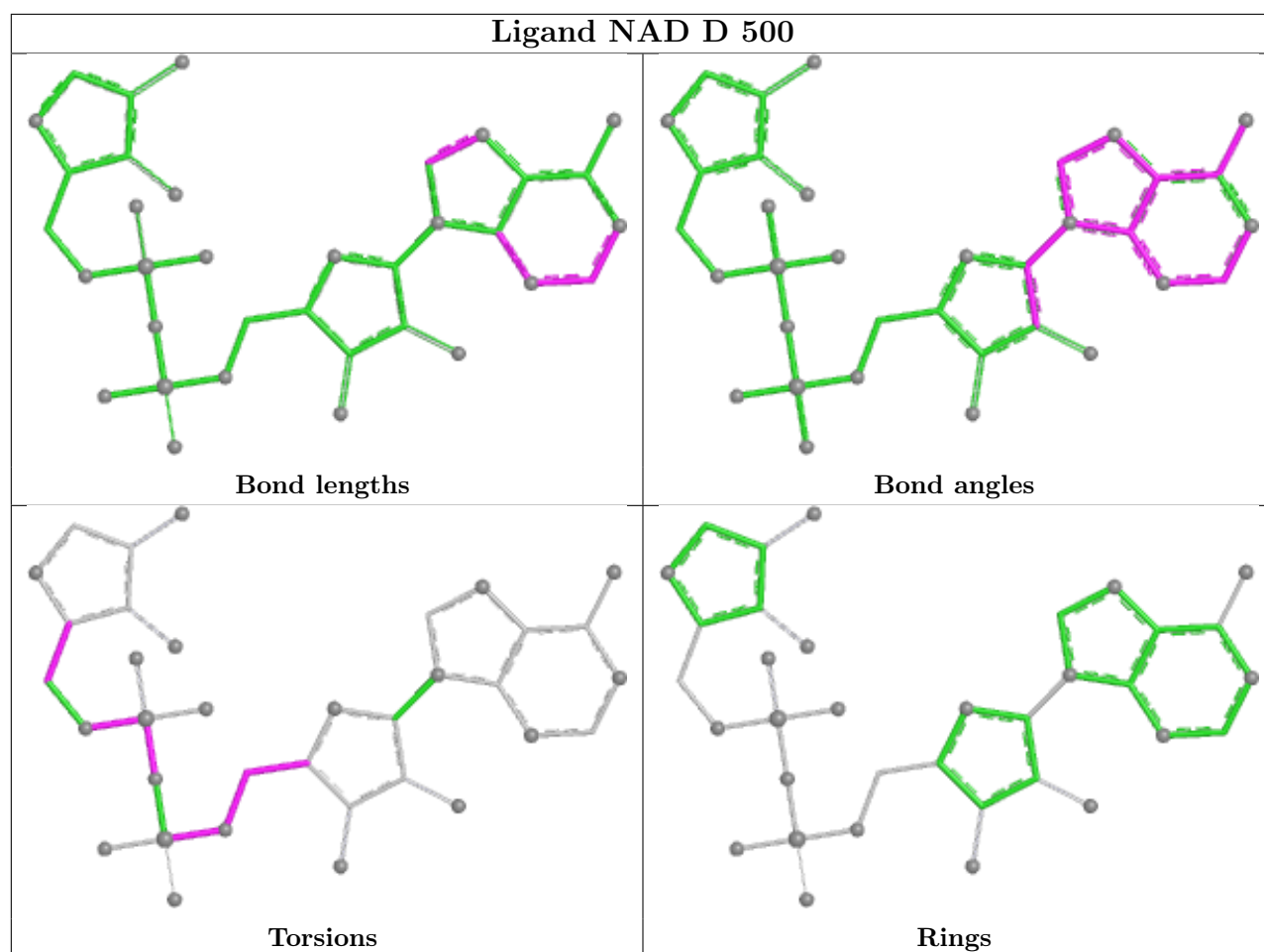


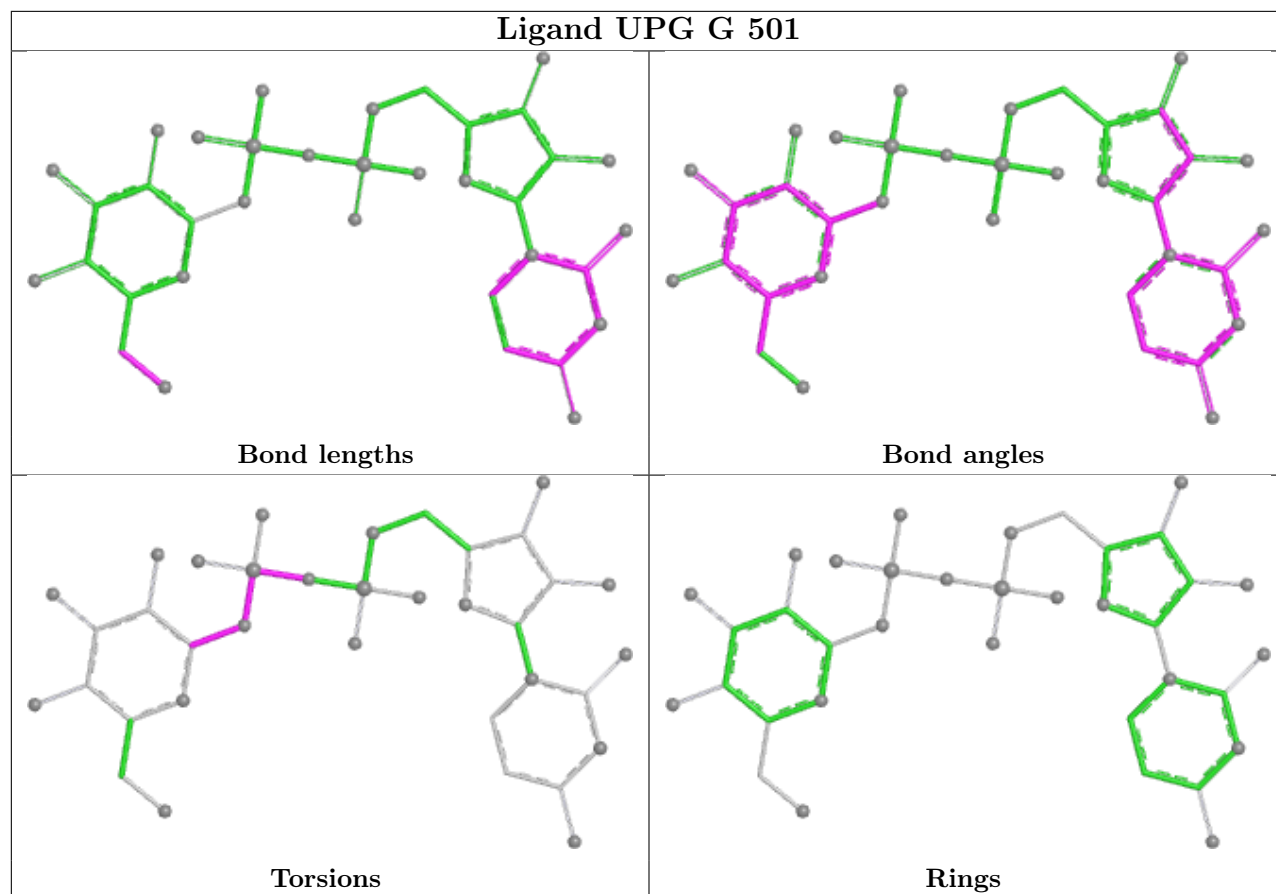
Ligand UPG L 501

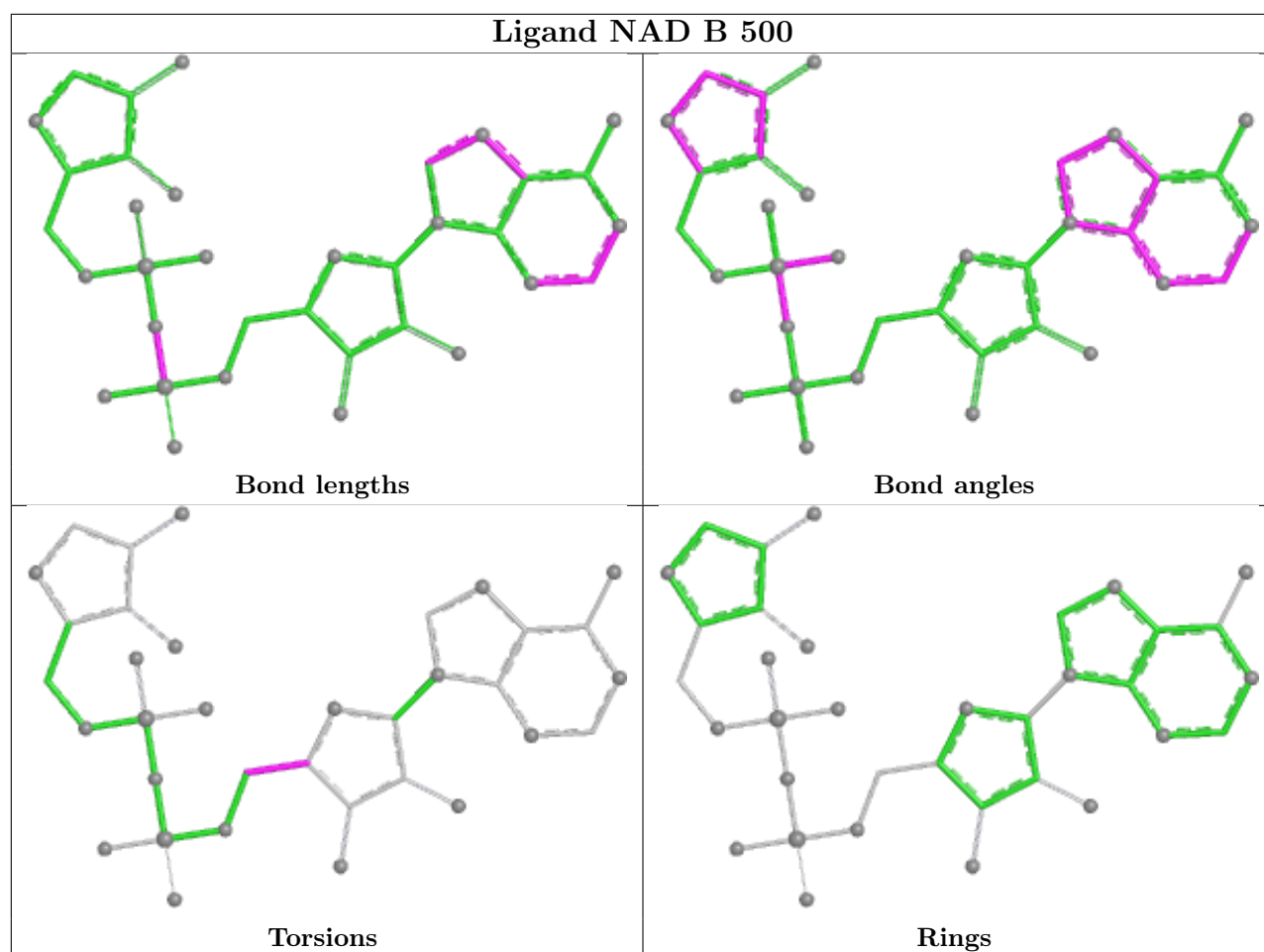


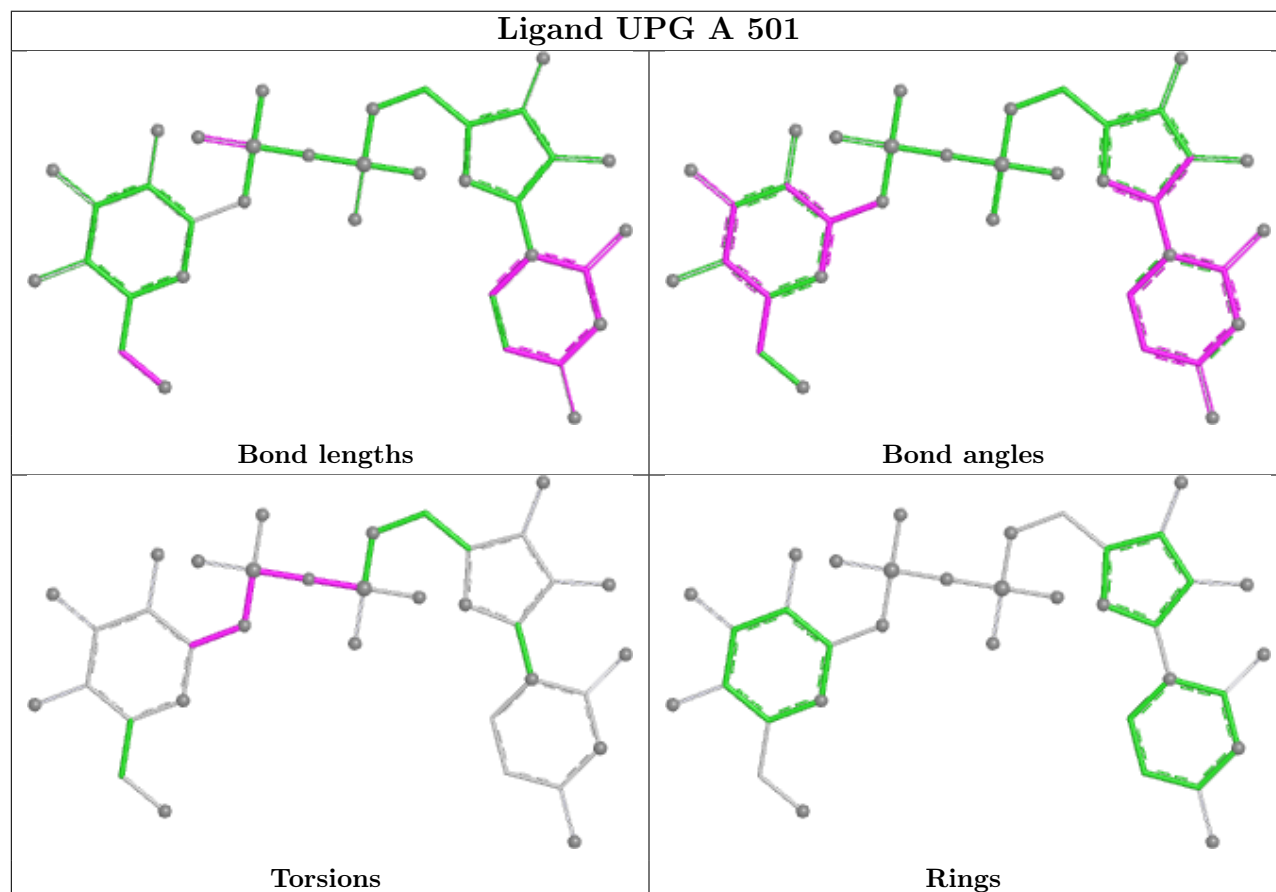
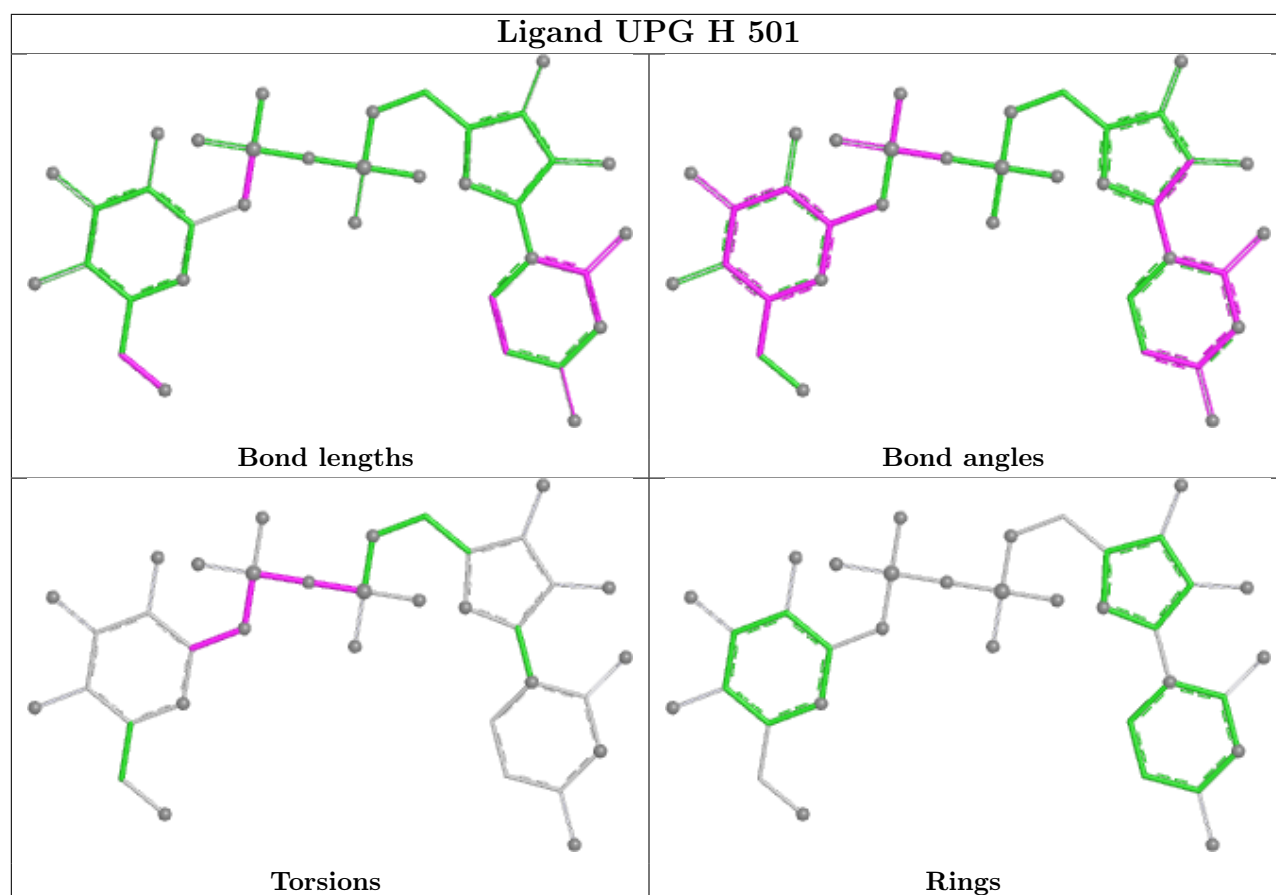
Ligand UPG J 501

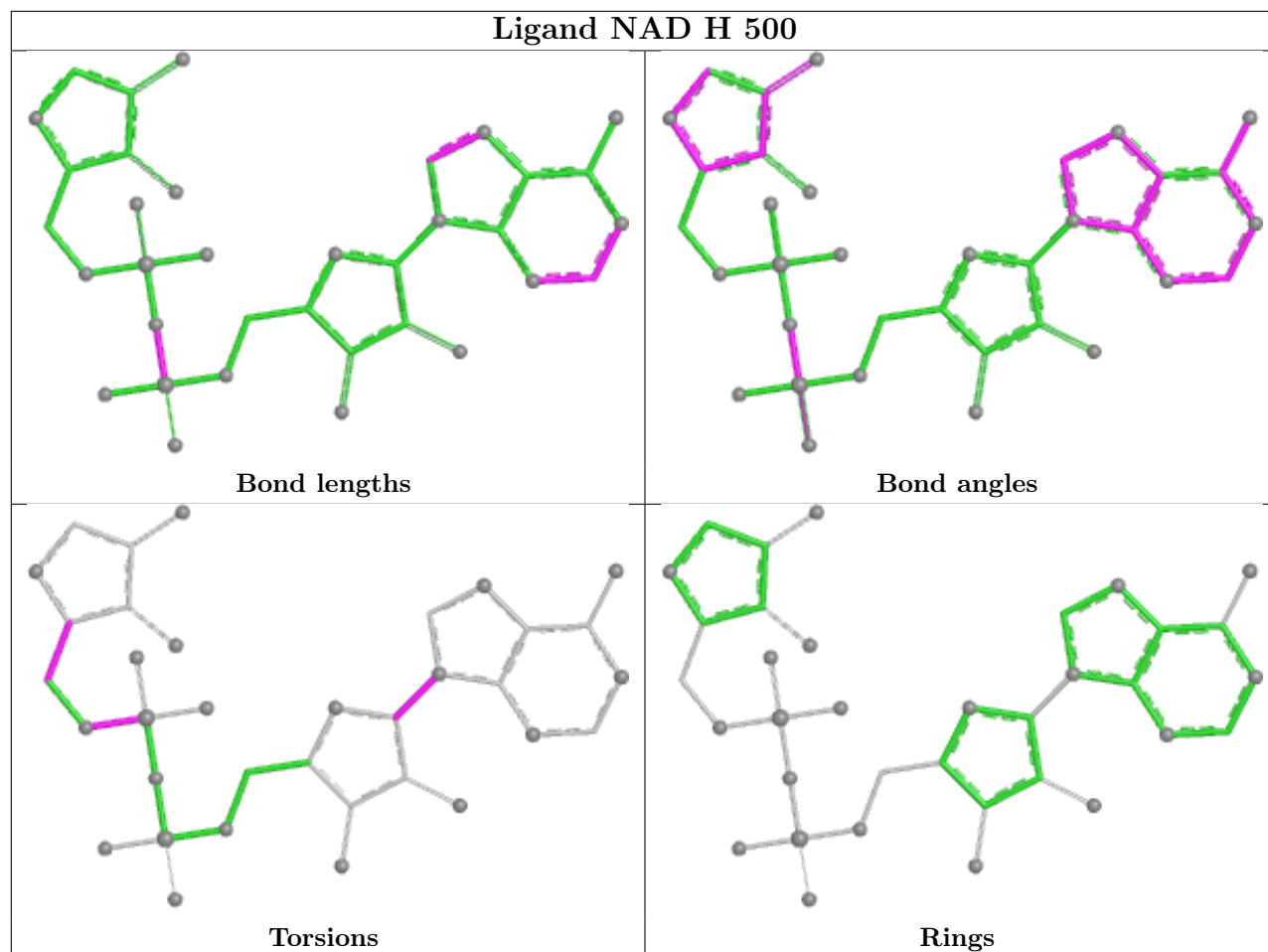


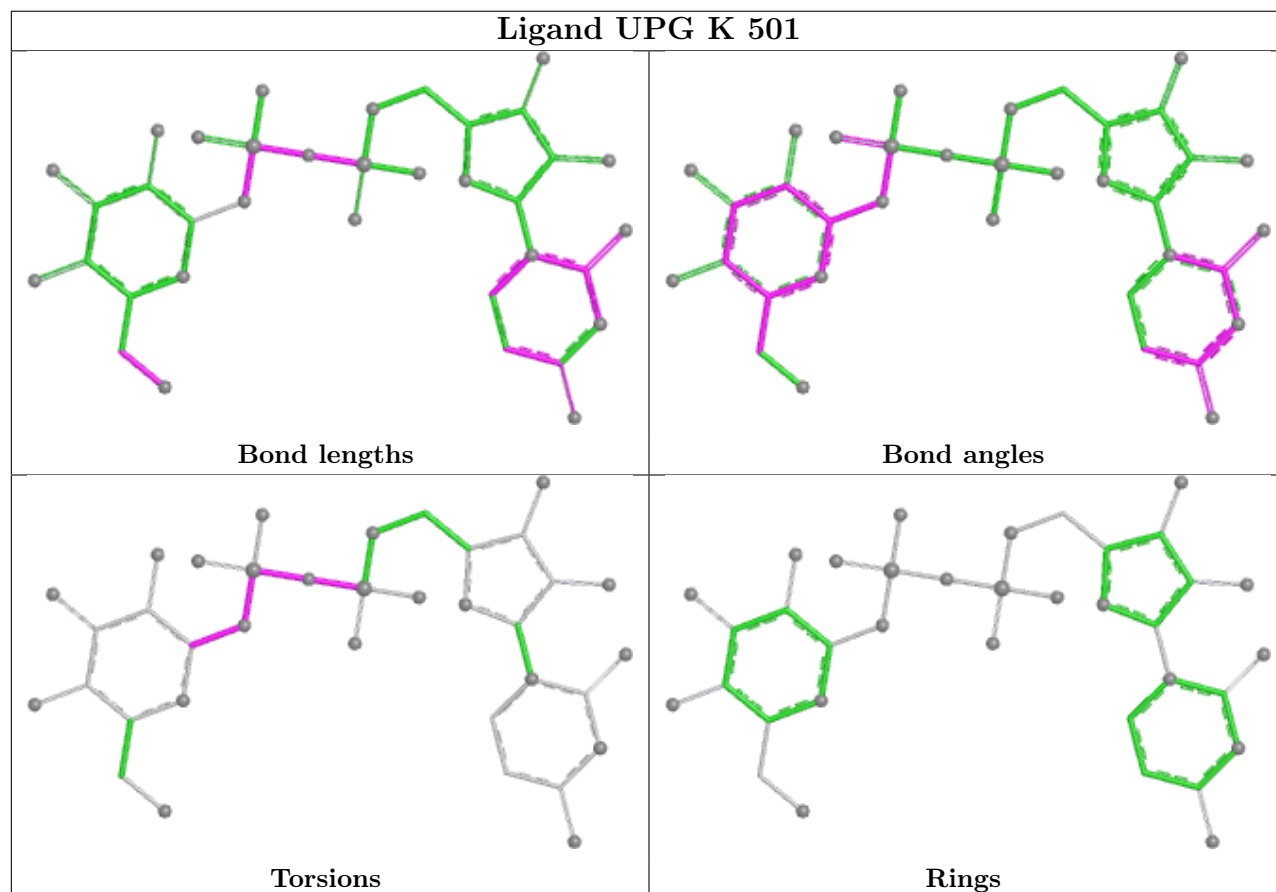
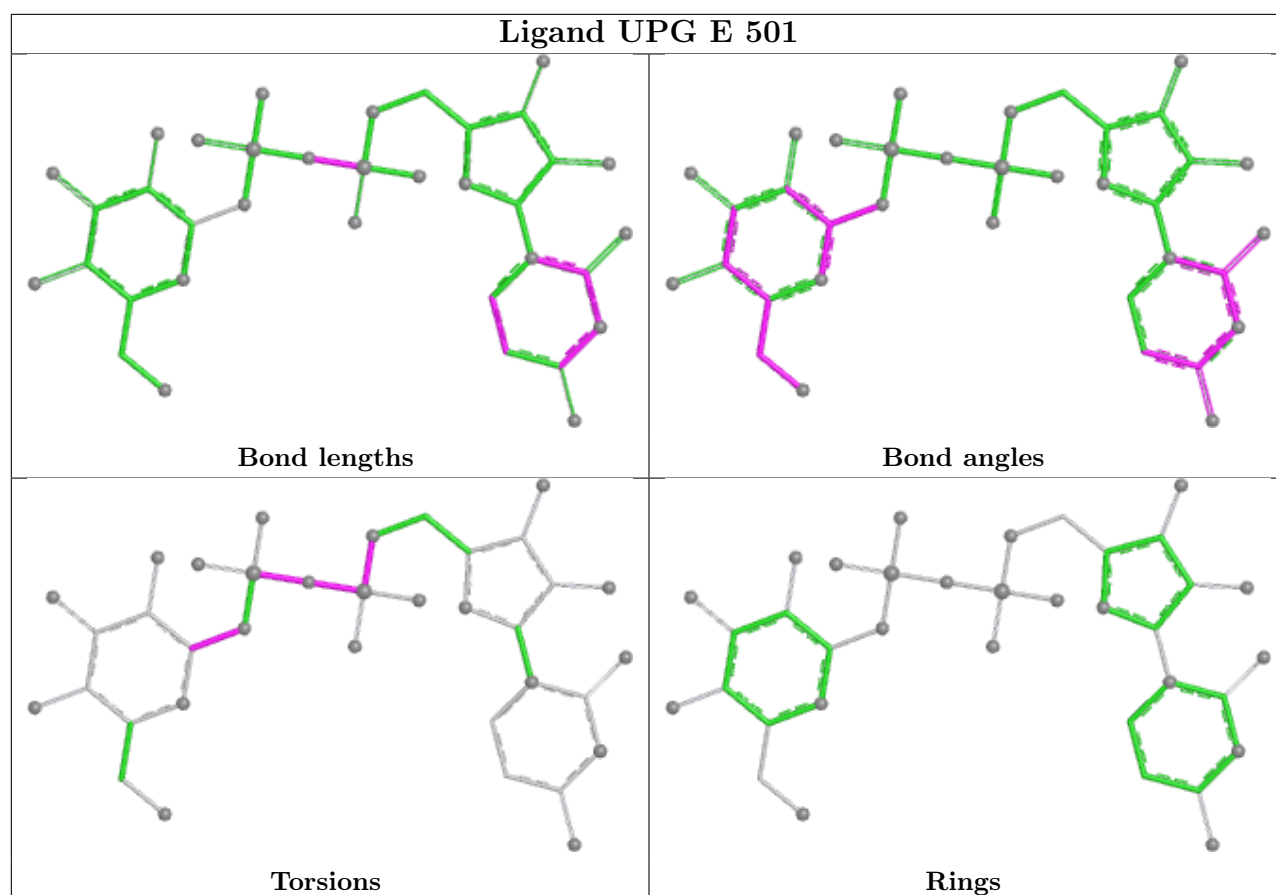


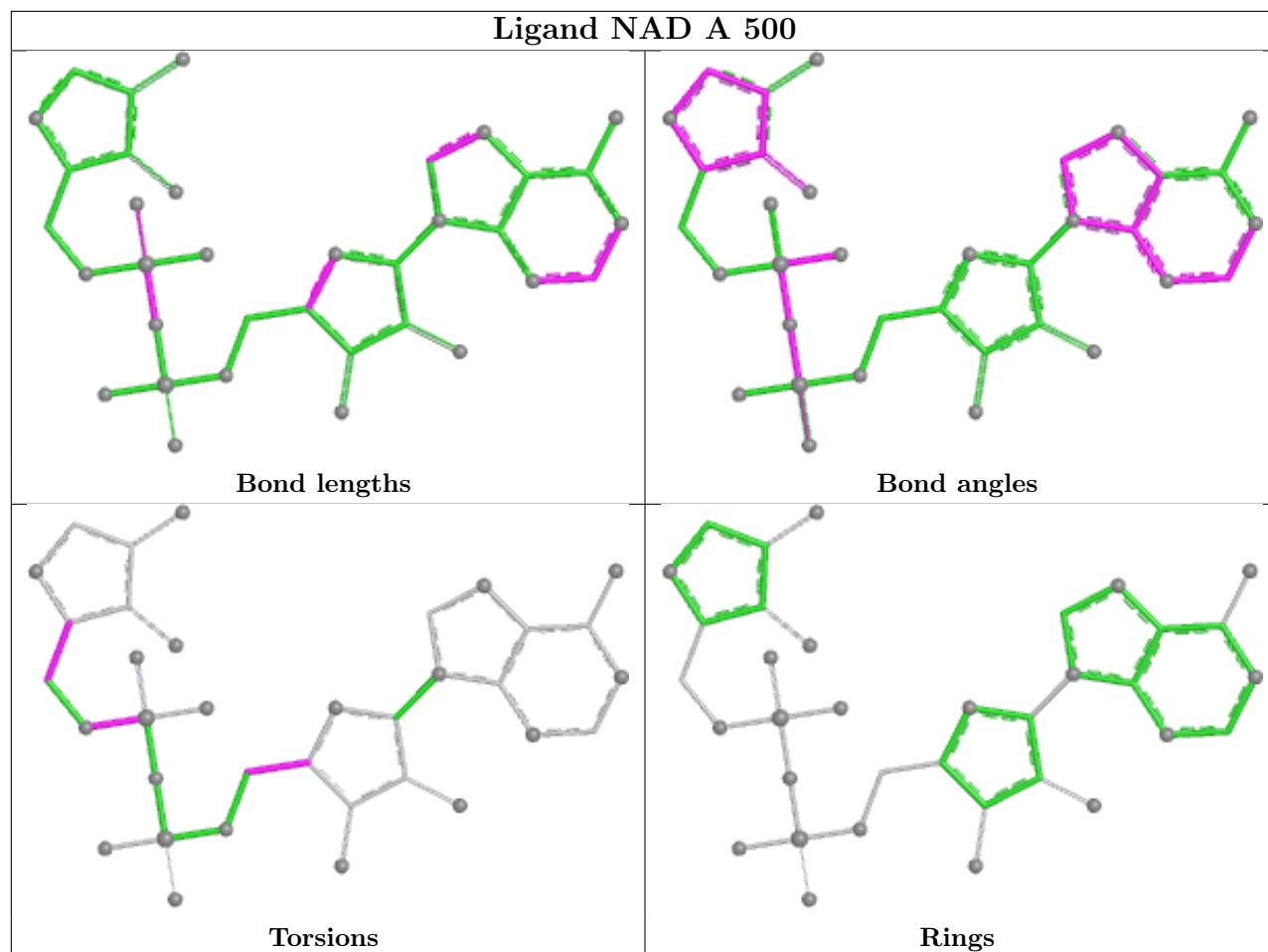


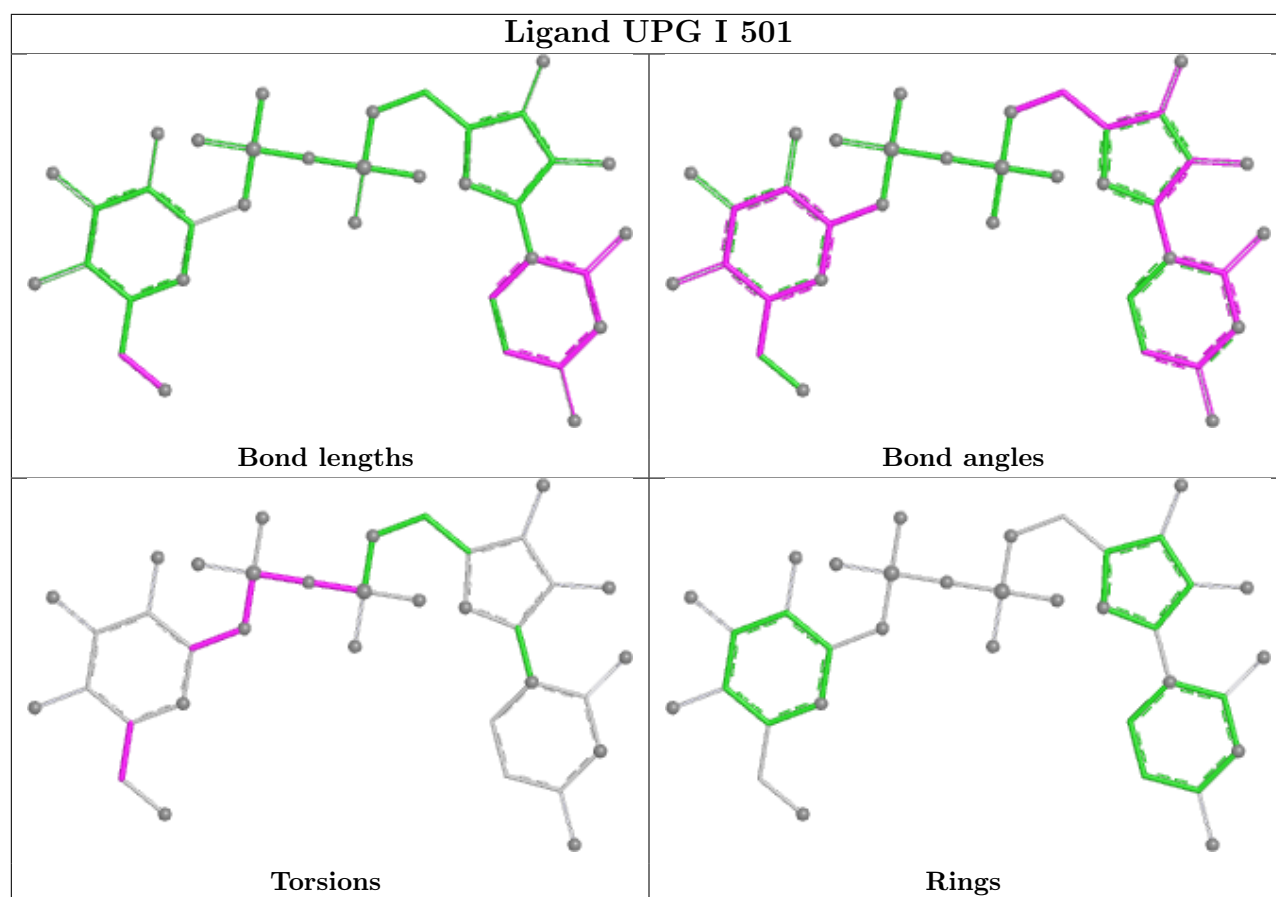


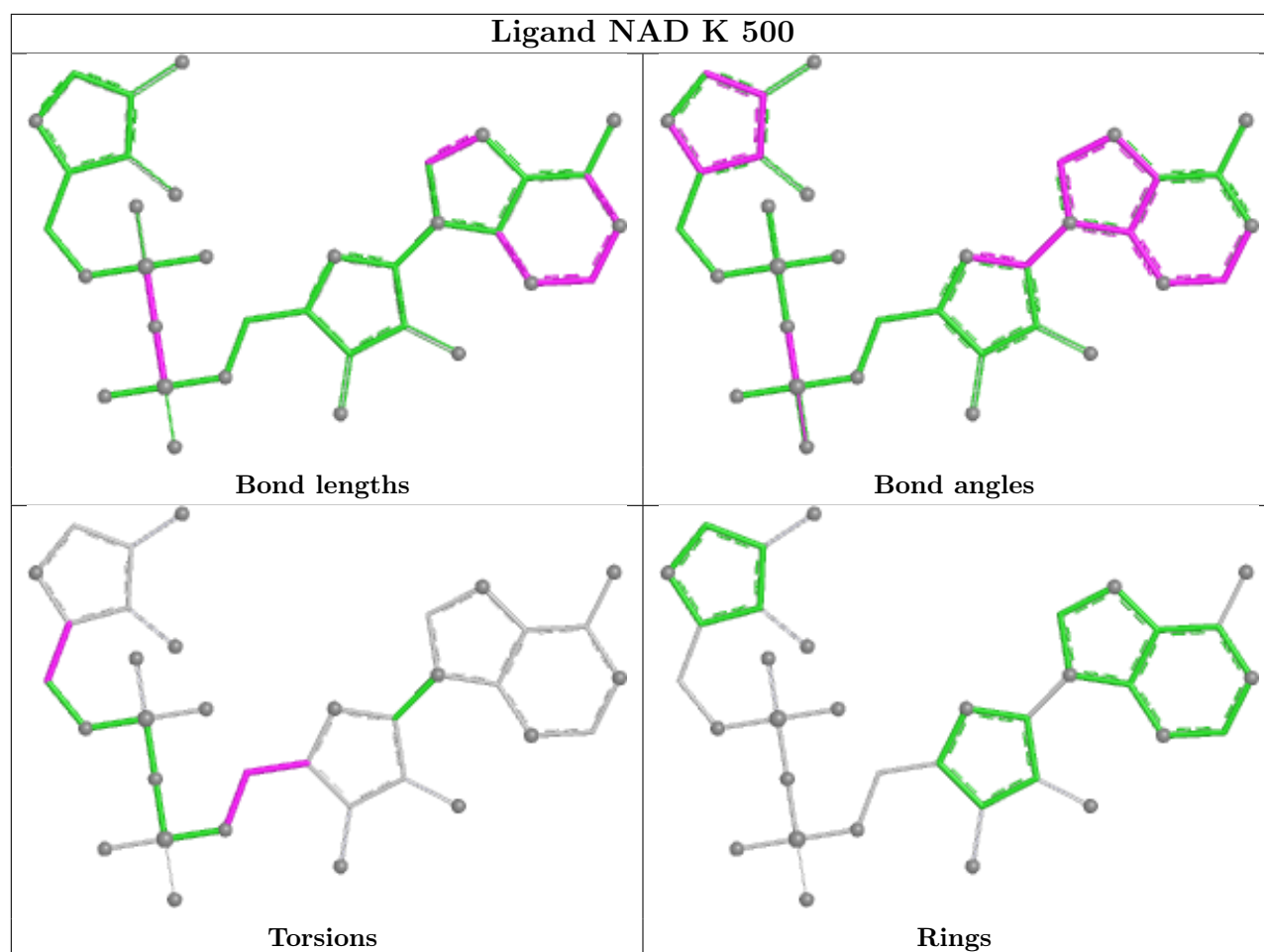


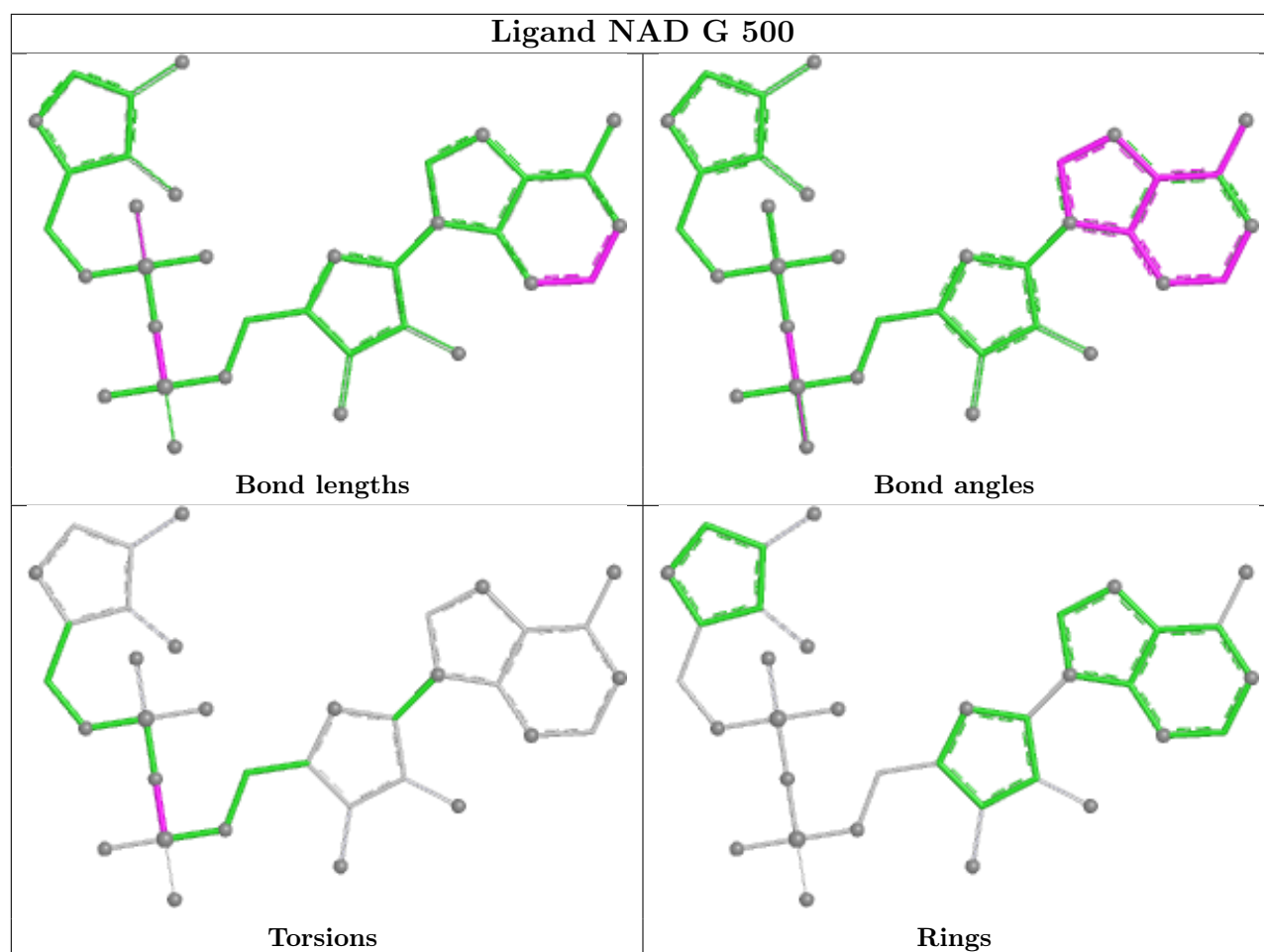


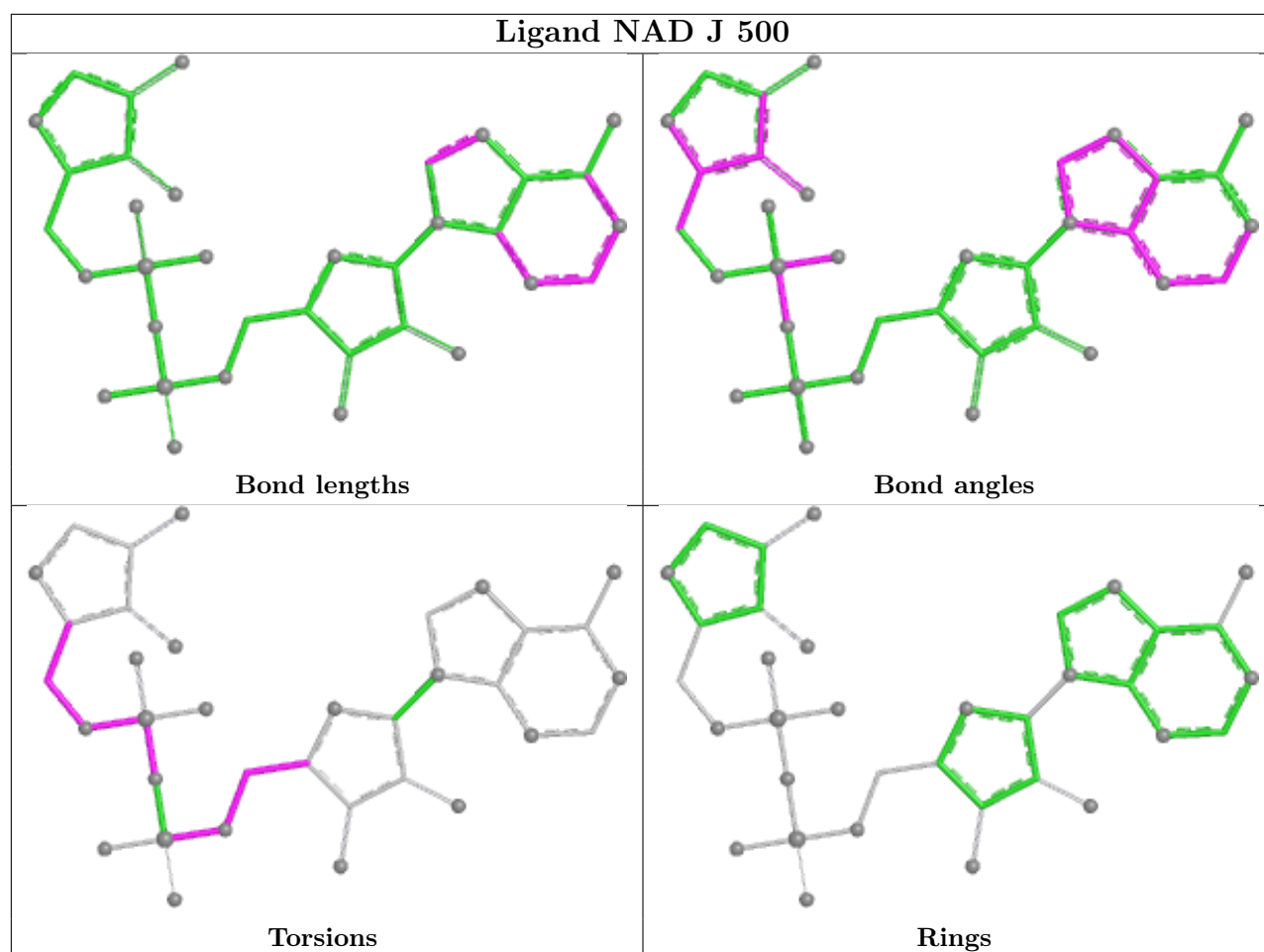


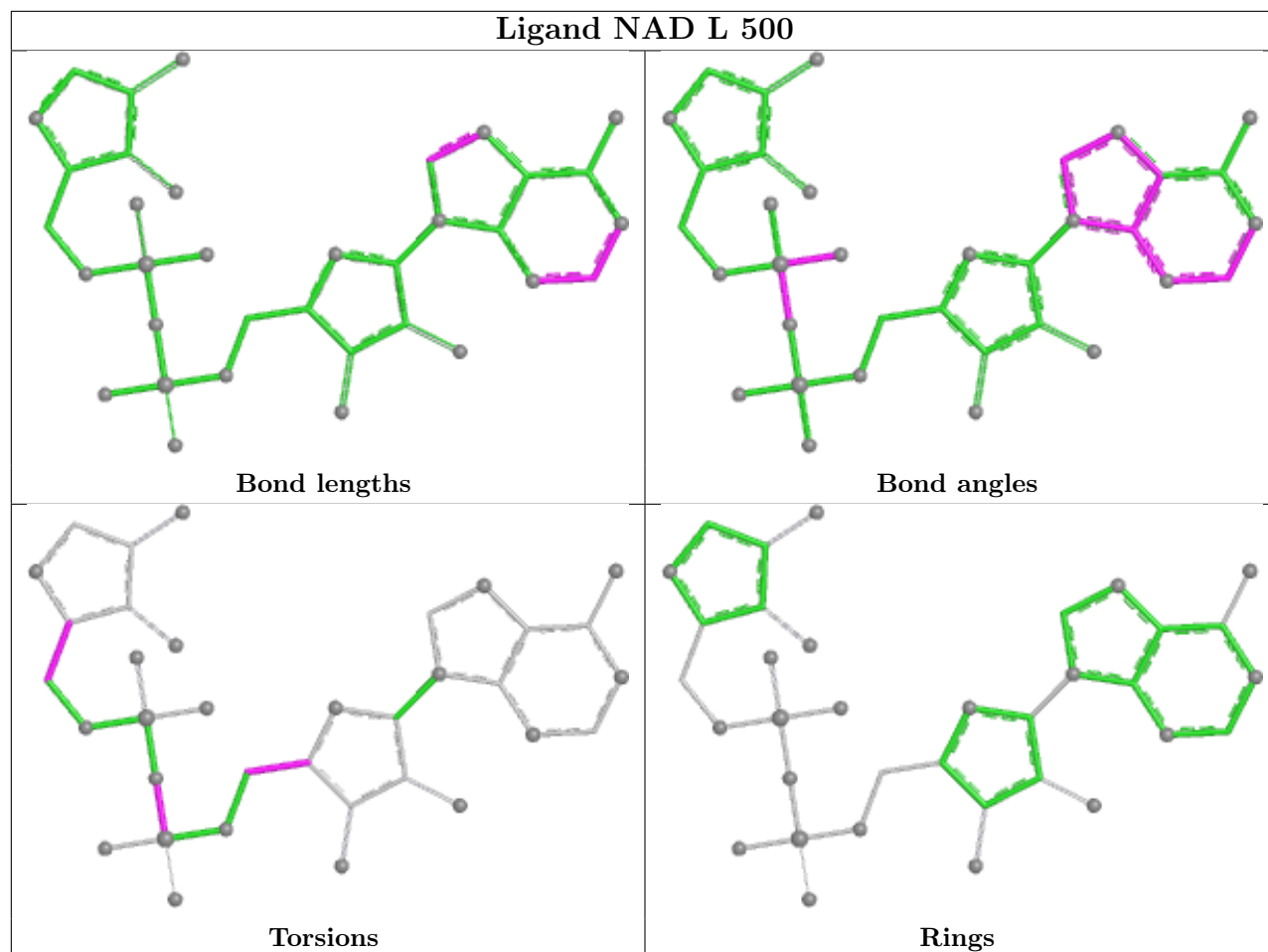


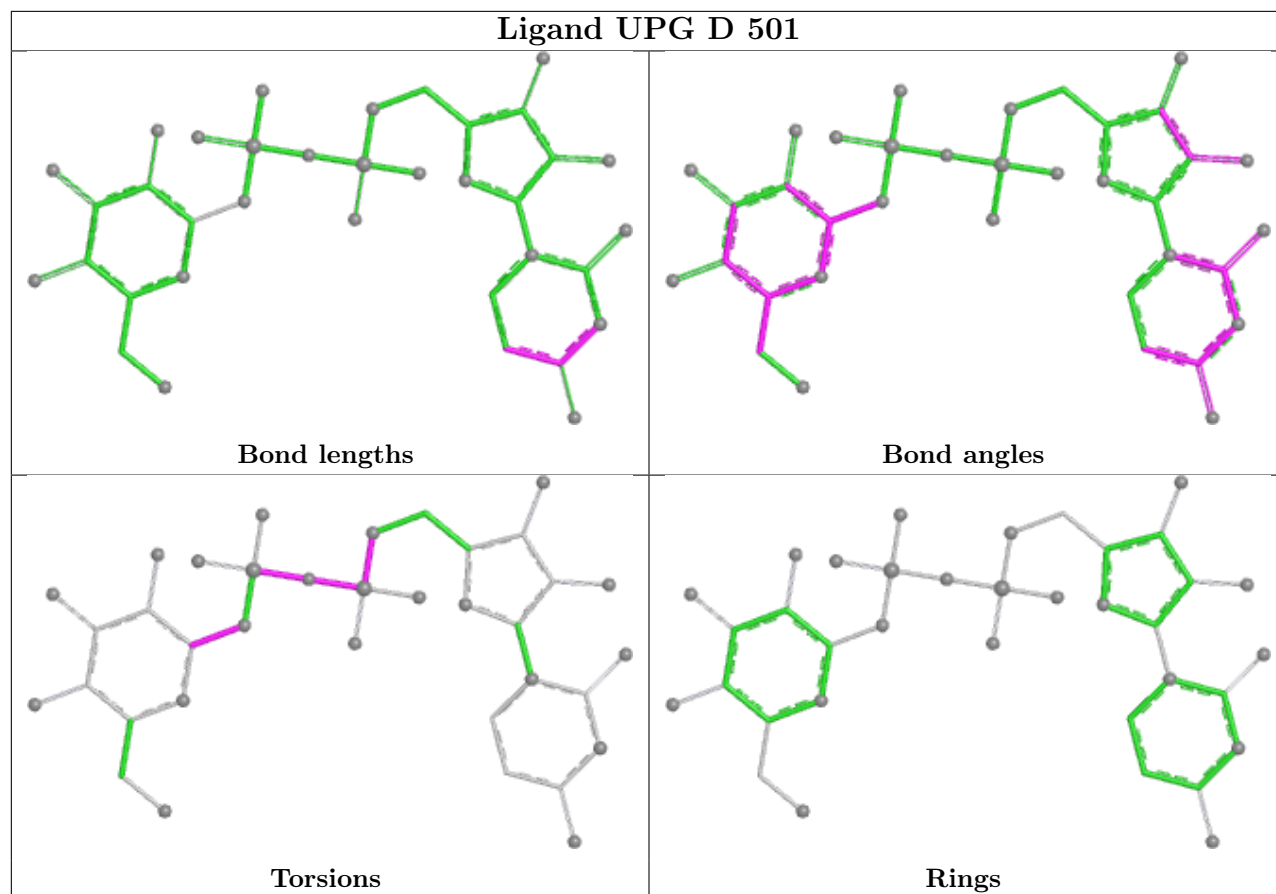












5.7 Other polymers [i](#)

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, 95th 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 ²)	Q < 0.9
1	A	460/487 (94%)	-0.35	2 (0%) 88 84	23, 34, 55, 71	0
1	B	460/487 (94%)	-0.27	2 (0%) 88 84	22, 37, 54, 70	0
1	C	460/487 (94%)	0.16	13 (2%) 55 45	29, 48, 88, 103	0
1	D	460/487 (94%)	0.01	10 (2%) 62 52	26, 45, 73, 99	0
1	E	458/487 (94%)	0.43	14 (3%) 51 41	37, 62, 99, 113	0
1	F	460/487 (94%)	0.16	8 (1%) 69 60	35, 52, 85, 110	0
1	G	460/487 (94%)	0.01	3 (0%) 84 77	23, 47, 73, 88	0
1	H	460/487 (94%)	-0.35	1 (0%) 91 88	20, 33, 50, 70	0
1	I	460/487 (94%)	0.31	15 (3%) 49 39	27, 54, 95, 110	0
1	J	460/487 (94%)	0.04	9 (1%) 65 56	23, 45, 79, 105	0
1	K	458/487 (94%)	0.69	25 (5%) 30 23	42, 75, 106, 117	0
1	L	460/487 (94%)	0.17	8 (1%) 69 60	33, 54, 84, 106	0
All	All	5516/5844 (94%)	0.08	110 (1%) 65 56	20, 47, 89, 117	0

The worst 5 of 110 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	F	466	VAL	5.1
1	E	95	THR	4.6
1	L	466	VAL	4.5
1	C	466	VAL	4.3
1	I	466	VAL	4.0

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 ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

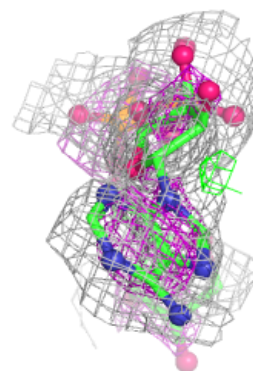
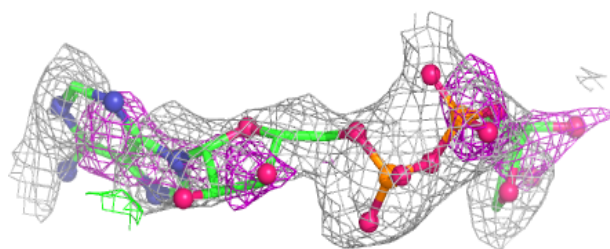
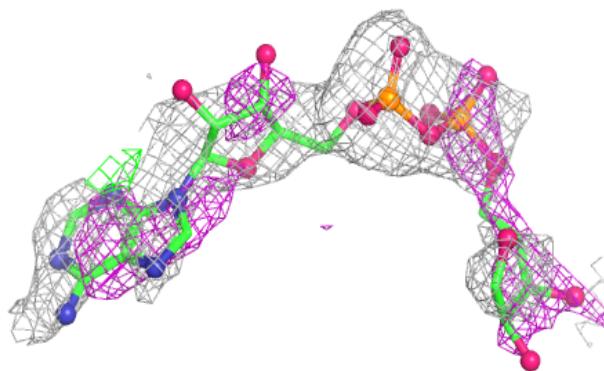
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	NAD	K	500	35/44	0.73	0.17	58,66,71,71	0
2	NAD	E	500	35/44	0.74	0.17	55,65,70,71	0
2	NAD	J	500	35/44	0.80	0.17	49,61,64,66	0
2	NAD	D	500	35/44	0.84	0.15	52,60,65,66	0
2	NAD	I	500	35/44	0.88	0.13	44,55,57,59	0
2	NAD	F	500	35/44	0.91	0.11	44,52,56,57	0
2	NAD	G	500	35/44	0.92	0.12	43,50,59,60	0
2	NAD	C	500	35/44	0.93	0.11	42,47,57,59	0
2	NAD	B	500	35/44	0.93	0.11	40,46,53,54	0
2	NAD	L	500	35/44	0.93	0.11	44,48,57,57	0
3	UPG	K	501	36/36	0.93	0.10	40,52,62,69	0
3	UPG	F	501	36/36	0.93	0.10	43,47,51,53	0
3	UPG	E	501	36/36	0.94	0.10	41,47,53,57	0
2	NAD	H	500	35/44	0.95	0.10	39,45,49,52	0
2	NAD	A	500	35/44	0.95	0.10	37,45,55,59	0
3	UPG	I	501	36/36	0.95	0.09	35,44,59,67	0
3	UPG	H	501	36/36	0.96	0.08	27,35,45,56	0
3	UPG	L	501	36/36	0.96	0.08	43,47,52,56	0
3	UPG	D	501	36/36	0.96	0.09	34,38,47,51	0
3	UPG	C	501	36/36	0.96	0.09	34,41,52,64	0
3	UPG	G	501	36/36	0.96	0.09	36,41,47,57	0
3	UPG	B	501	36/36	0.97	0.09	26,33,49,63	0
3	UPG	J	501	36/36	0.97	0.08	35,40,47,50	0
3	UPG	A	501	36/36	0.97	0.09	34,37,48,56	0

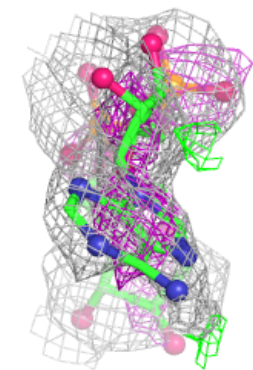
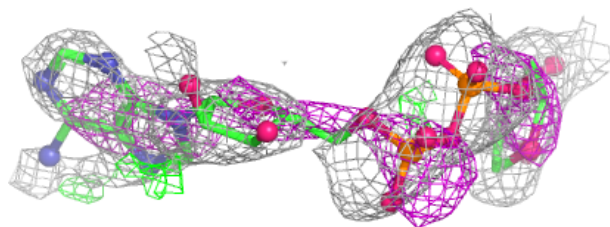
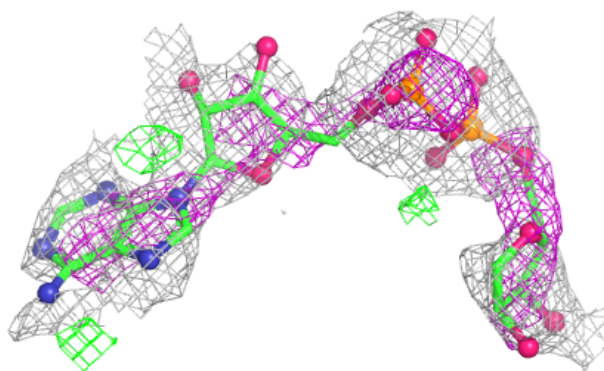
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around NAD K 500:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

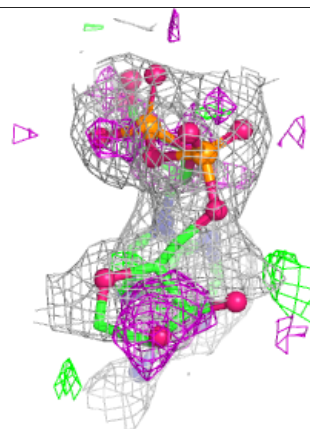
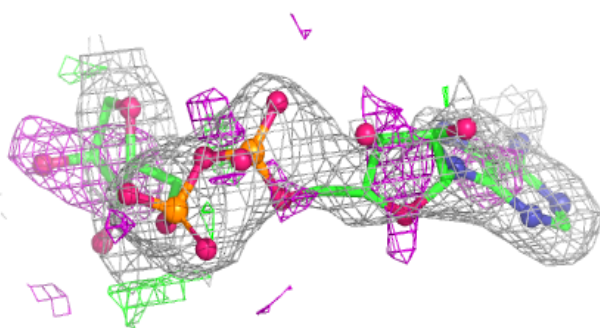
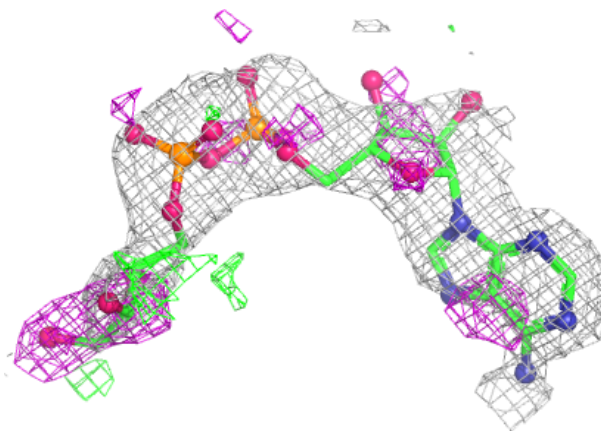
**Electron density around NAD E 500:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



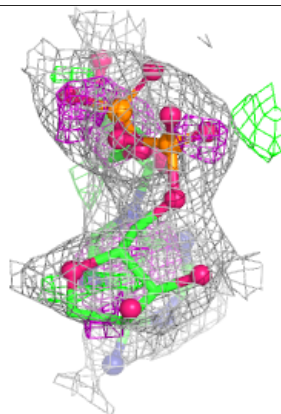
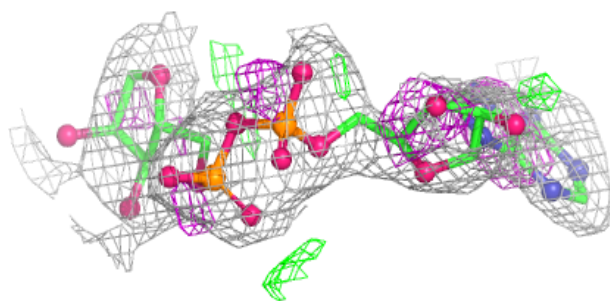
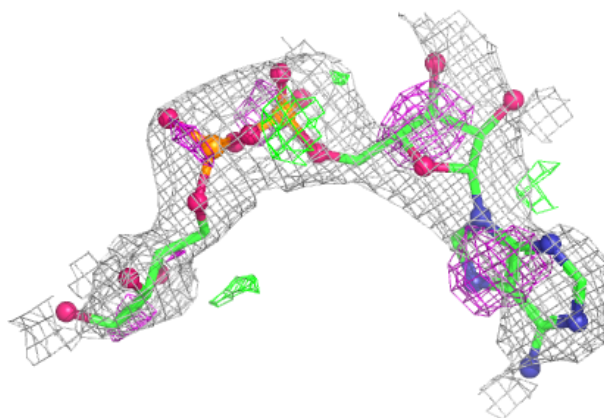
Electron density around NAD J 500:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



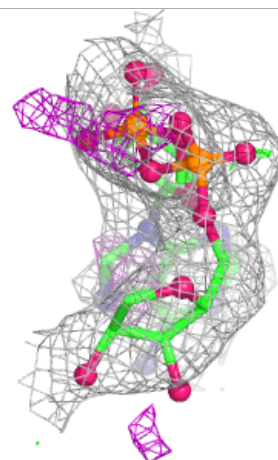
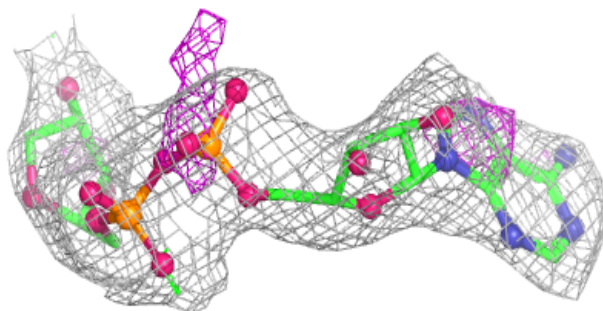
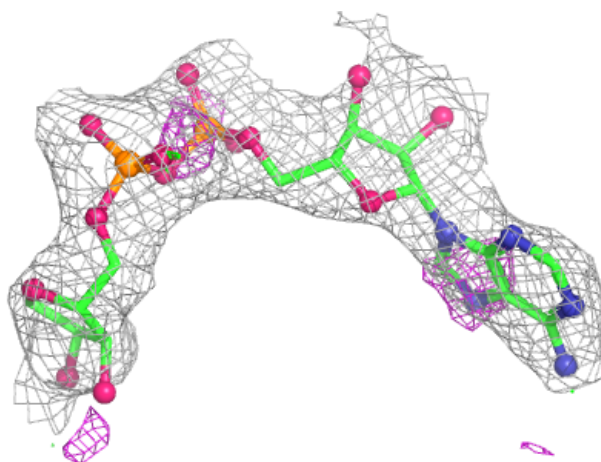
Electron density around NAD D 500:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



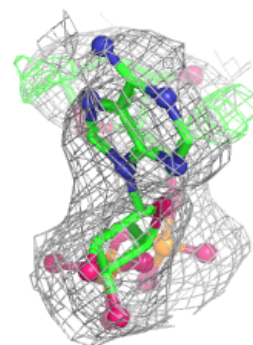
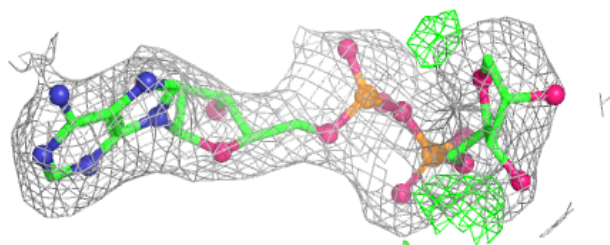
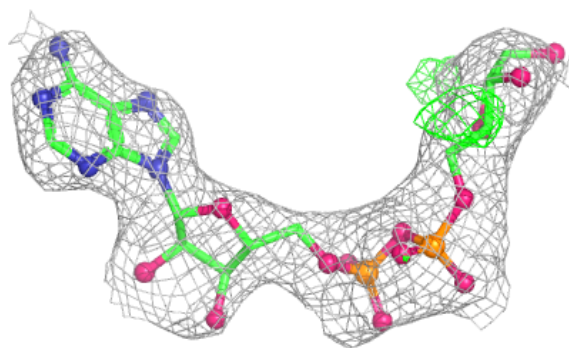
Electron density around NAD I 500:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

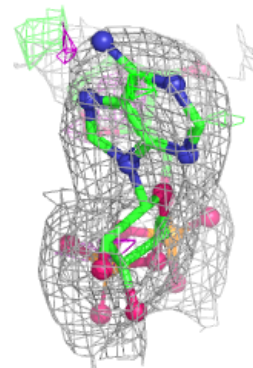
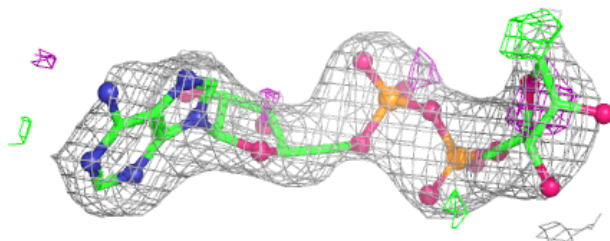
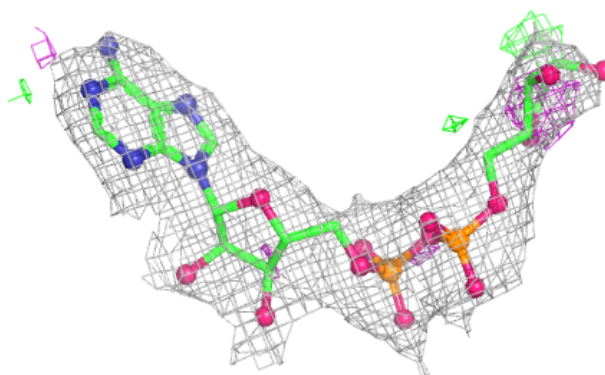


Electron density around NAD F 500:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

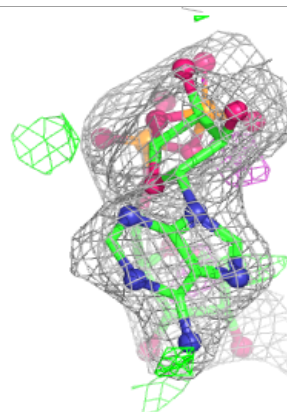
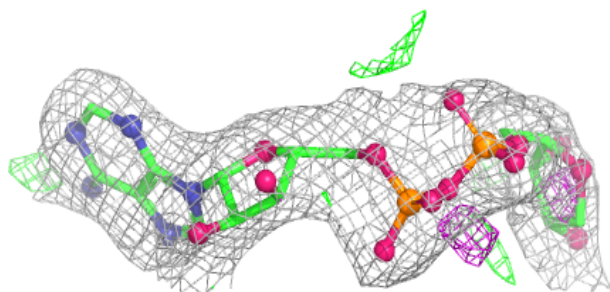
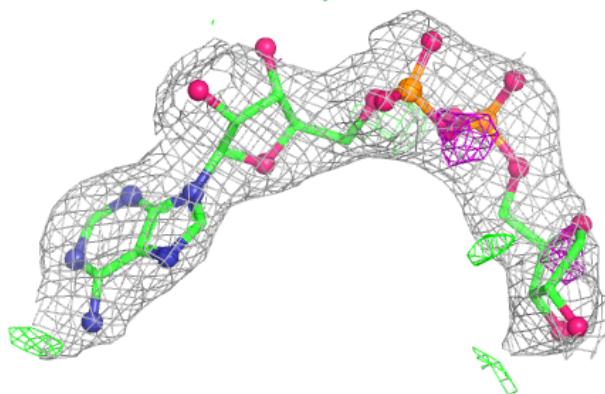
**Electron density around NAD G 500:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

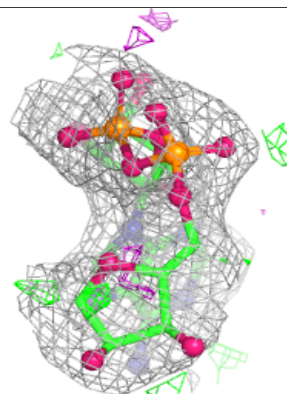
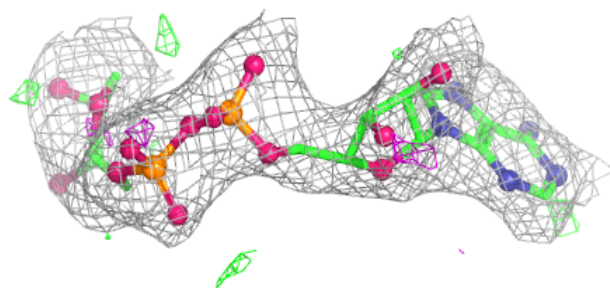
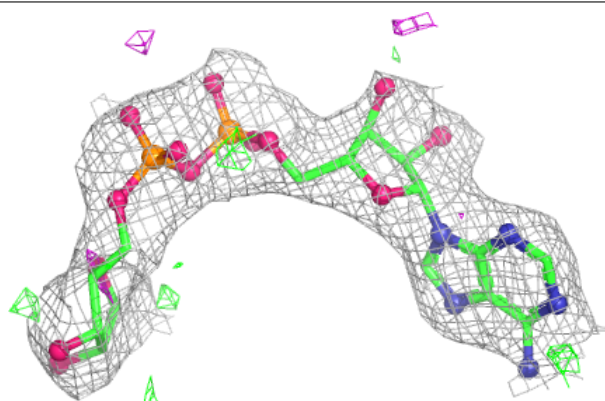


Electron density around NAD C 500:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

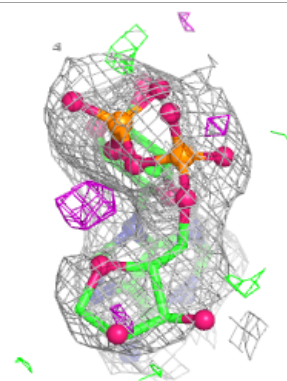
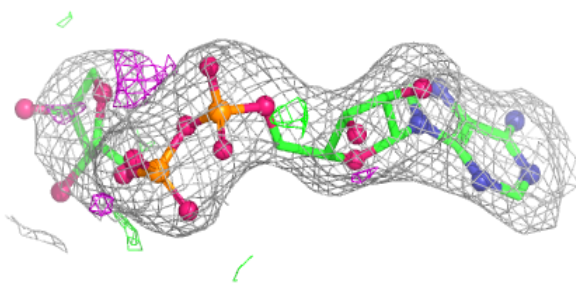
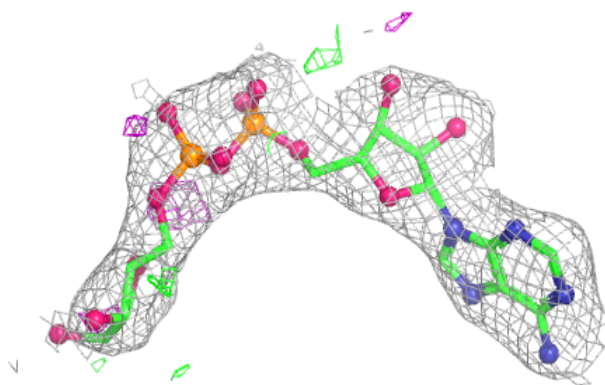
**Electron density around NAD B 500:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

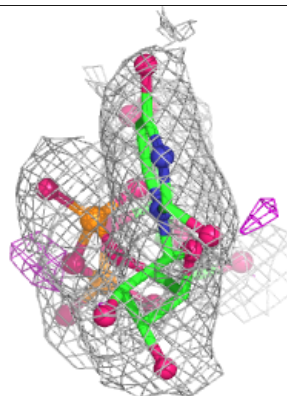
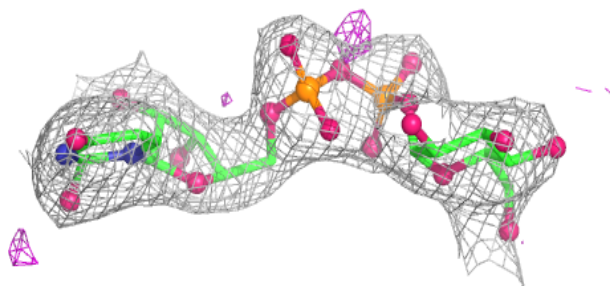
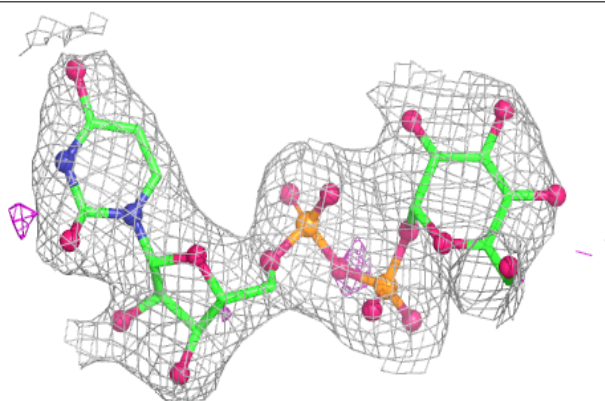


Electron density around NAD L 500:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

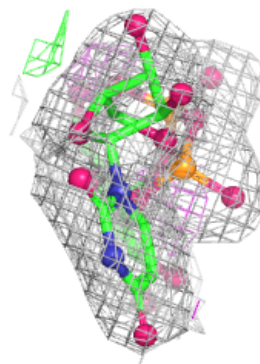
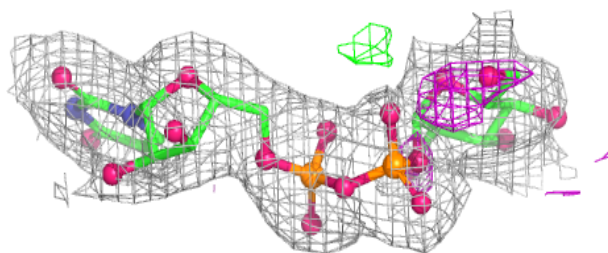
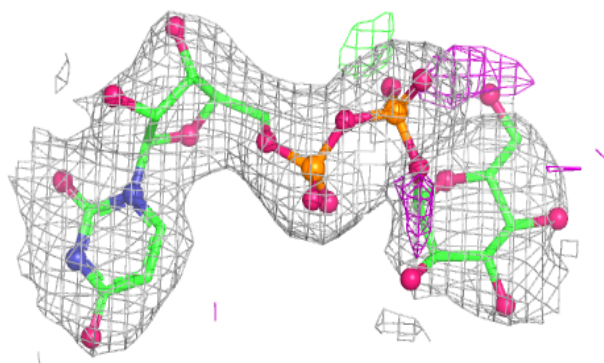
**Electron density around UPG K 501:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

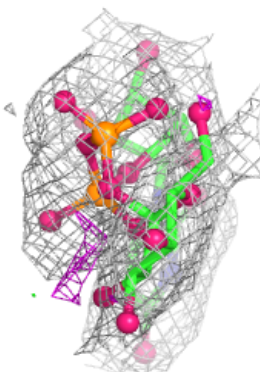
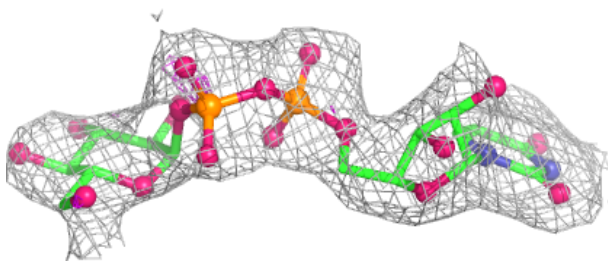
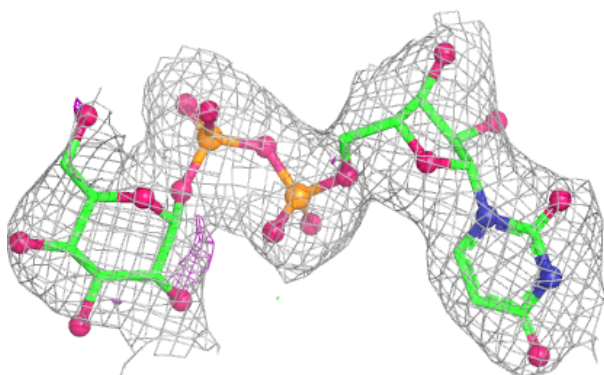


Electron density around UPG F 501:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

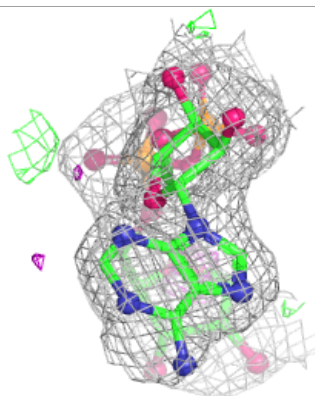
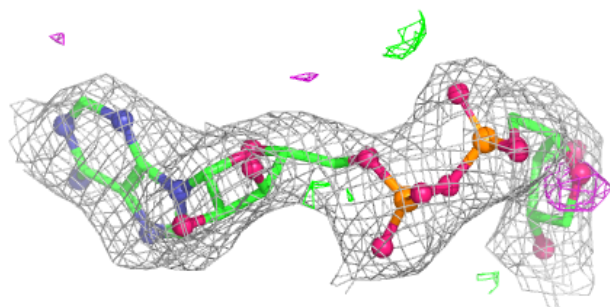
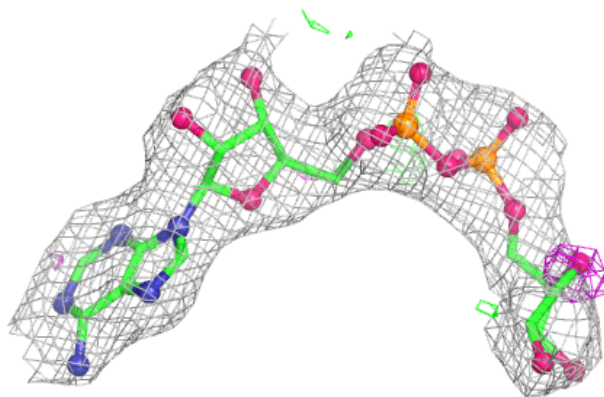
**Electron density around UPG E 501:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

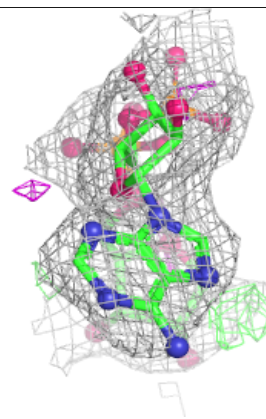
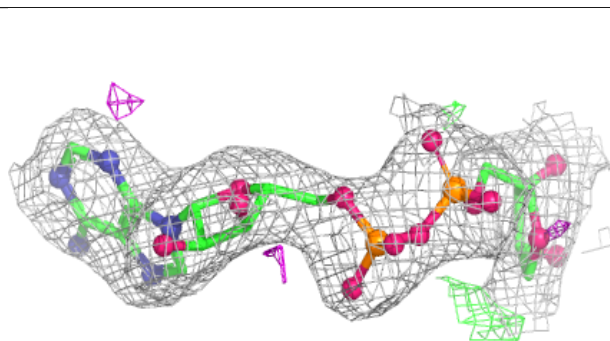
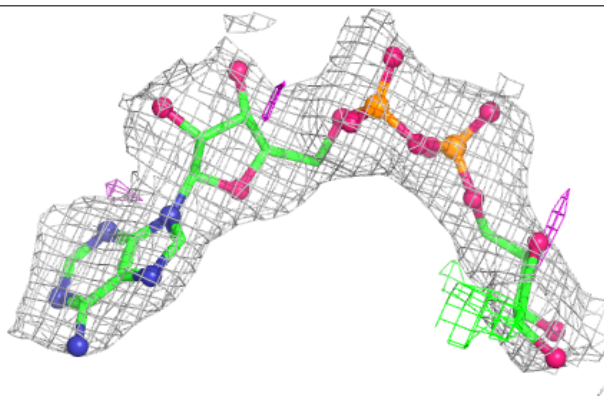


Electron density around NAD H 500:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

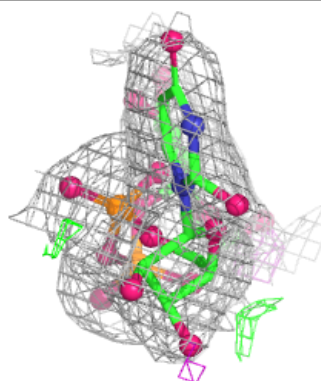
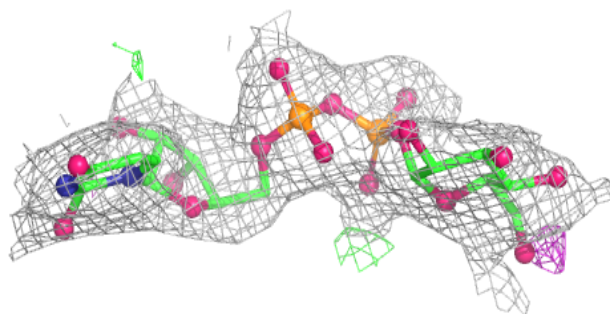
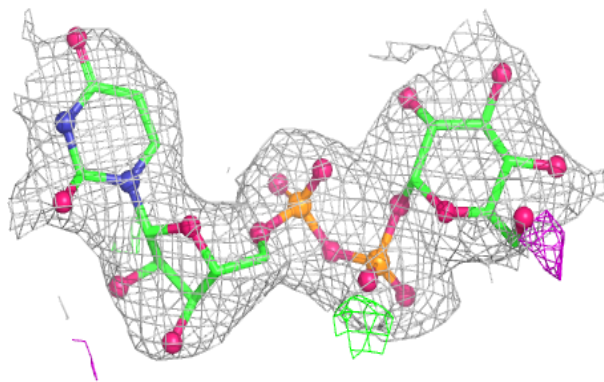
**Electron density around NAD A 500:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

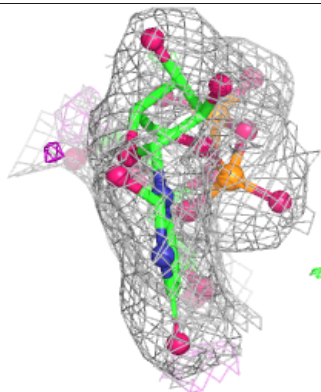
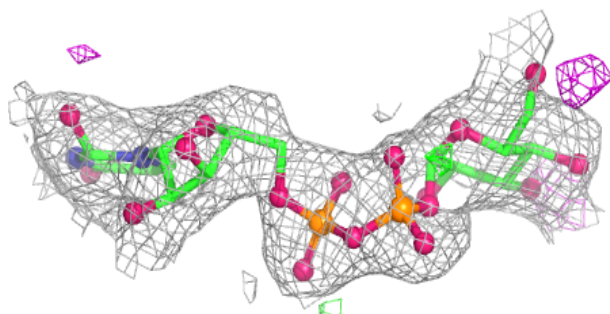
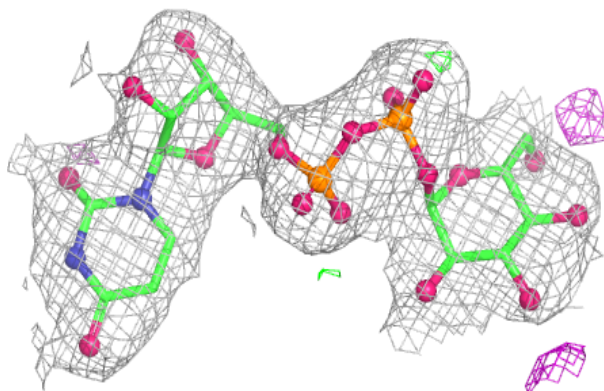


Electron density around UPG I 501:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

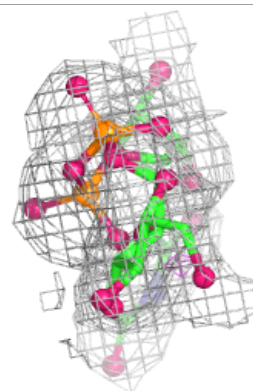
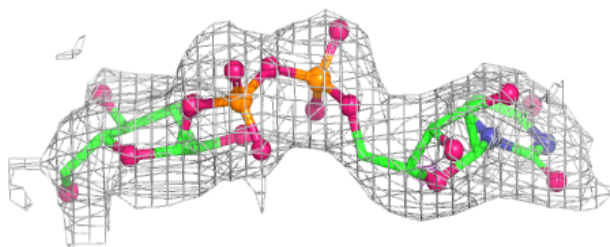
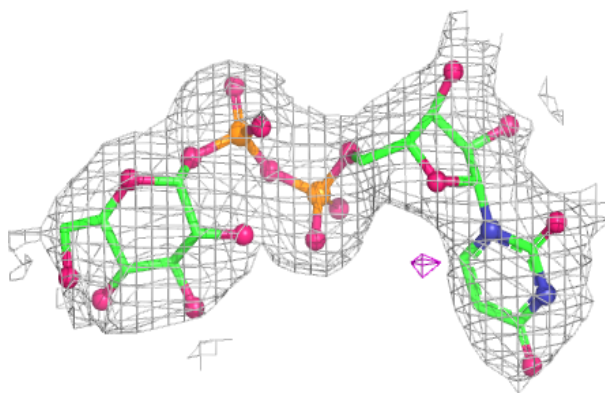
**Electron density around UPG H 501:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

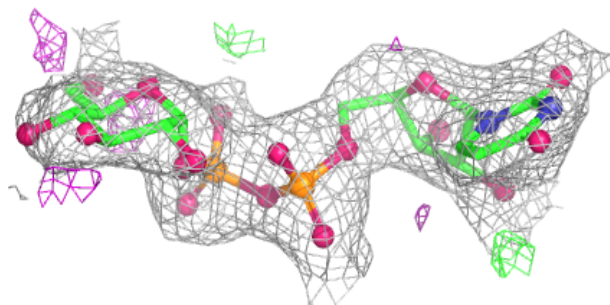
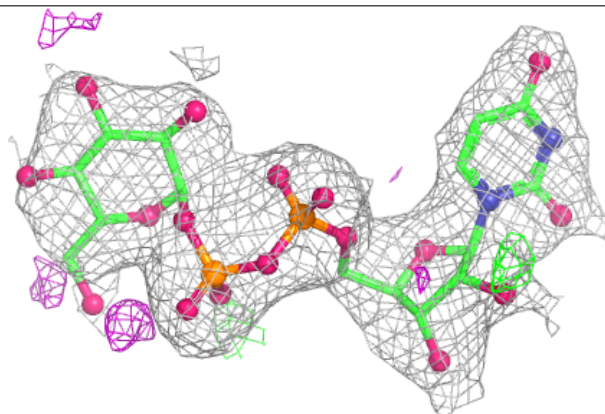


Electron density around UPG L 501:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

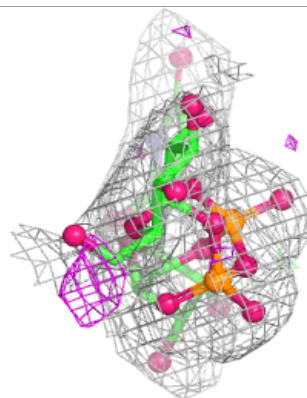
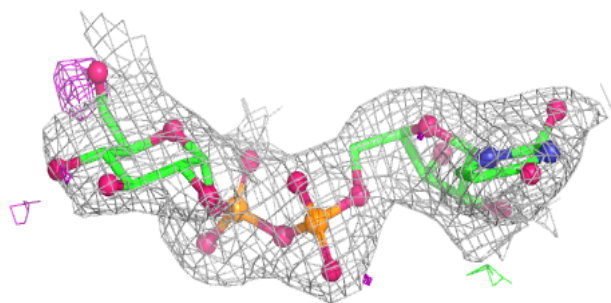
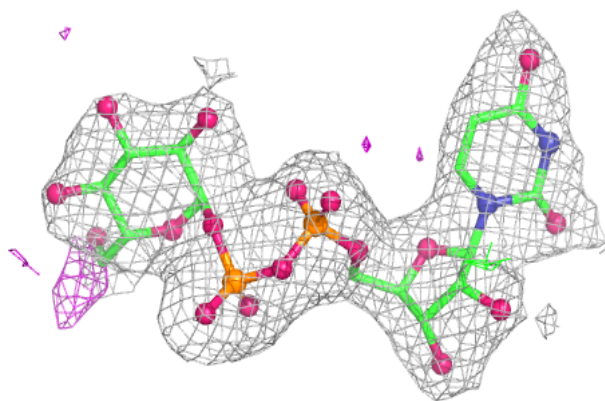
**Electron density around UPG D 501:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

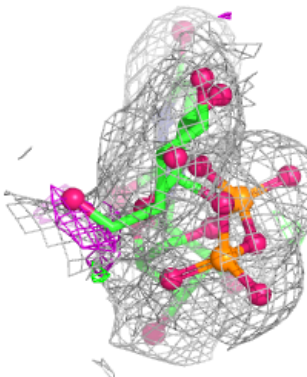
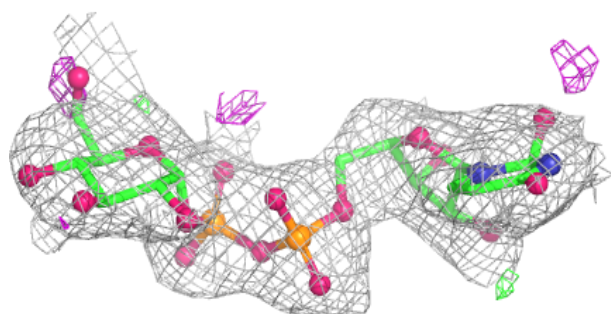
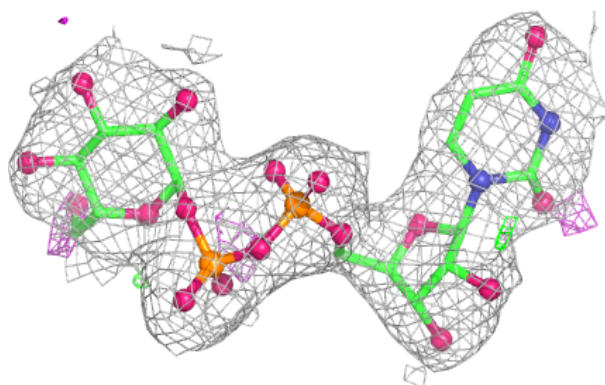


Electron density around UPG C 501:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

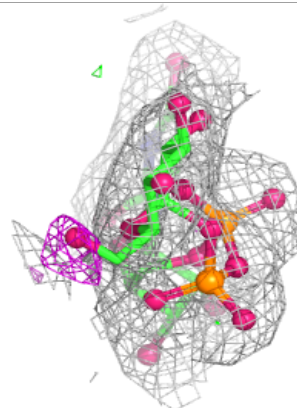
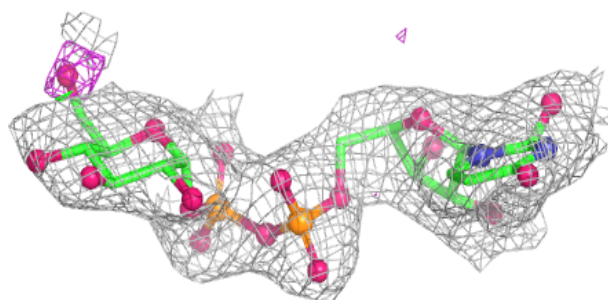
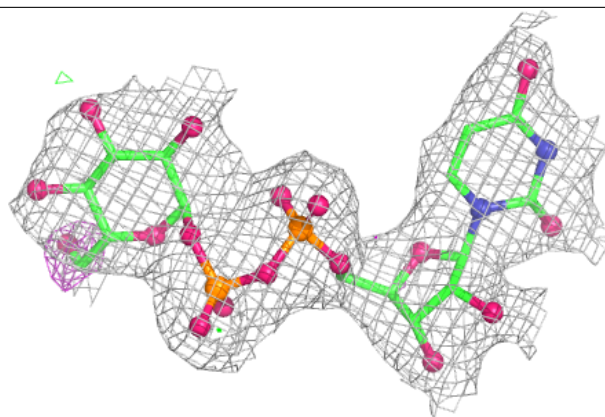
**Electron density around UPG G 501:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

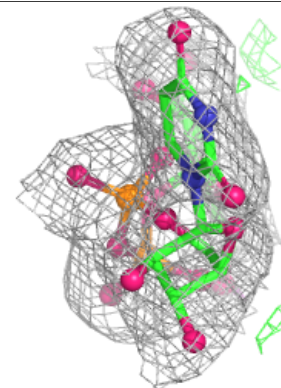
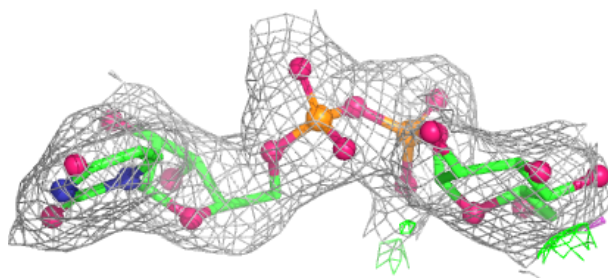
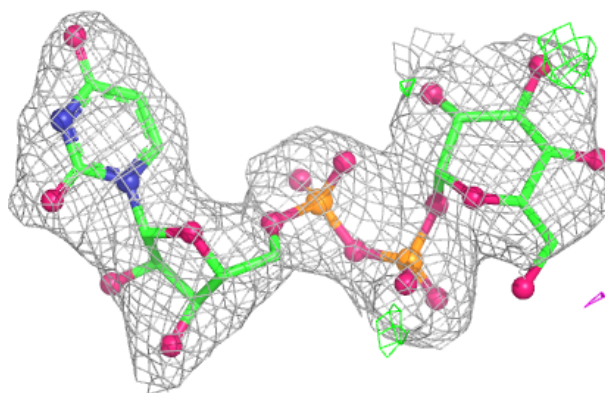


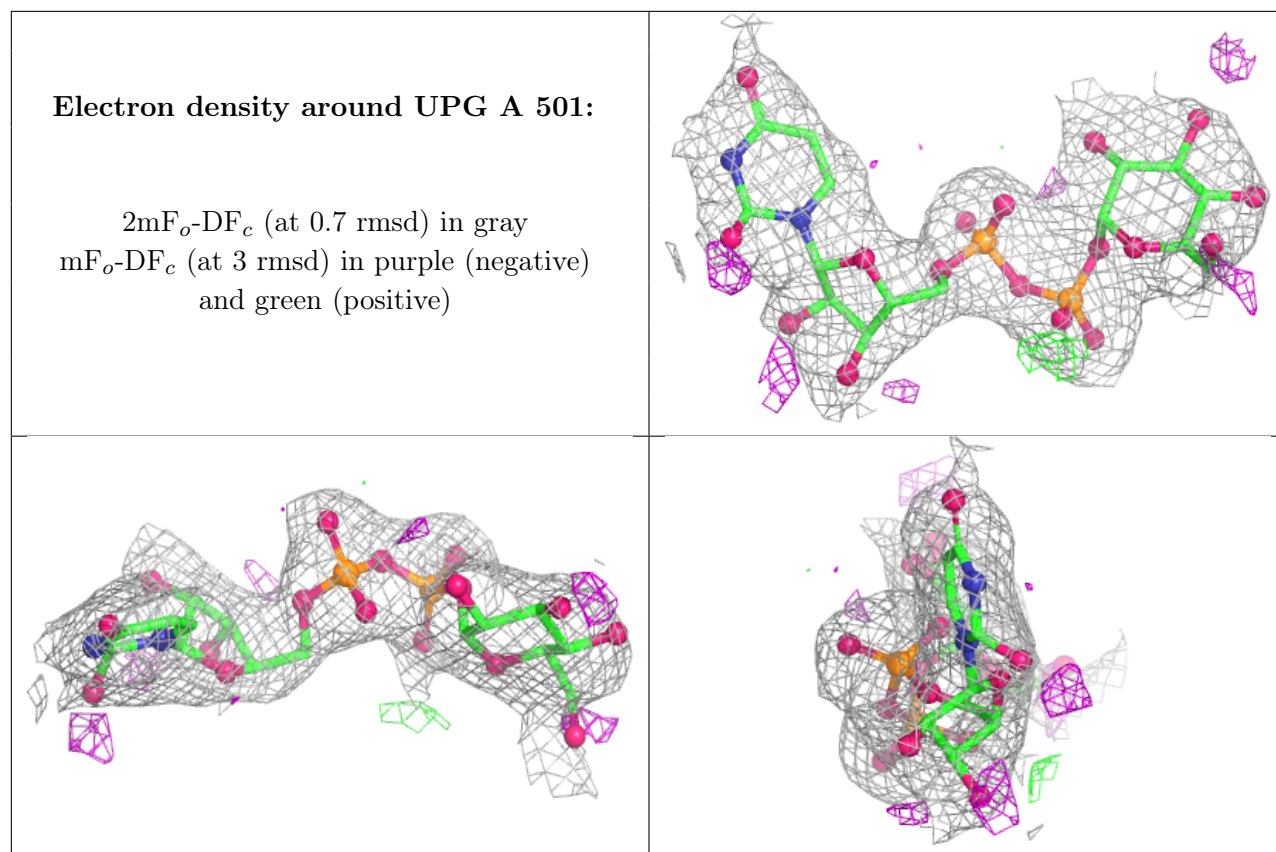
Electron density around UPG B 501:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

**Electron density around UPG J 501:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)





6.5 Other polymers [i](#)

There are no such residues in this entry.