



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 12, 2021 – 09:50 am BST

PDB ID : 6Y87
Title : Crystal Structure of the Homospermidine Synthase (HSS) from *Pseudomonas aeruginosa* in Complex with NAD and PUT
Authors : Helfrich, F.; Scheidig, A.J.
Deposited on : 2020-03-03
Resolution : 2.15 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 : 1.8.5 (274361), CSD as541be (2020)
Xtrriage (Phenix) : 1.13
EDS : 2.23.2
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0267
CCP4 : 7.1.010 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.23.2

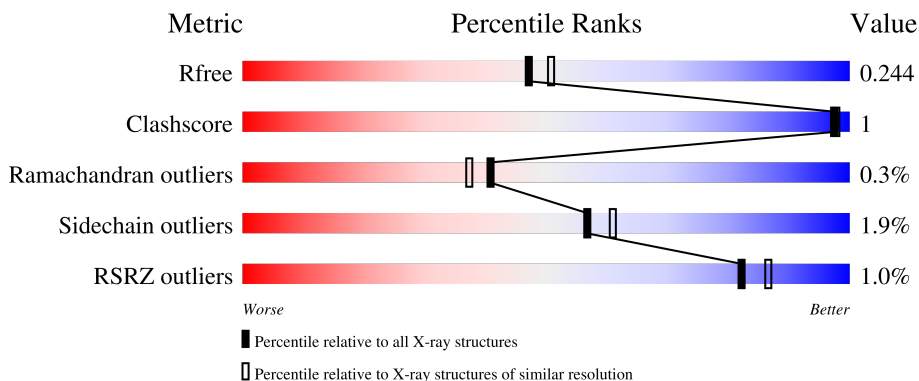
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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}	130704	1479 (2.16-2.16)
Clashscore	141614	1585 (2.16-2.16)
Ramachandran outliers	138981	1560 (2.16-2.16)
Sidechain outliers	138945	1559 (2.16-2.16)
RSRZ outliers	127900	1456 (2.16-2.16)

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	471	<div style="display: flex; align-items: center;"> <div style="width: 2%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 95%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 5%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey; margin-right: 2px;"></div> </div> <p style="text-align: center;">2% 95% 5%</p>
1	B	471	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 96%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: grey; margin-right: 2px;"></div> </div> <p style="text-align: center;">% 96% ..</p>
1	C	471	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 93%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 5%; height: 10px; background-color: grey; margin-right: 2px;"></div> </div> <p style="text-align: center;">% 93% . .</p>
1	D	471	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 93%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 5%; height: 10px; background-color: grey; margin-right: 2px;"></div> </div> <p style="text-align: center;">% 93% . .</p>
1	E	471	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 2px;"></div> <div style="width: 95%; height: 10px; background-color: green; margin-right: 2px;"></div> <div style="width: 2%; height: 10px; background-color: yellow; margin-right: 2px;"></div> <div style="width: 3%; height: 10px; background-color: grey; margin-right: 2px;"></div> </div> <p style="text-align: center;">% 95% . .</p>

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Mol	Chain	Length	Quality of chain
1	F	471	 93%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 44700 atoms, of which 21561 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 Homospermidine synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
1	A	470	7307	2354	3631	614	697	11	0	1	0
1	B	466	7218	2325	3587	606	690	10	0	0	0
1	C	454	7055	2273	3508	593	671	10	0	0	0
1	D	456	7086	2282	3525	595	674	10	0	0	0
1	E	460	7208	2318	3583	608	689	10	0	4	0
1	F	458	7110	2289	3535	598	678	10	0	0	0

There are 12 discrepancies between the modelled and reference sequences:

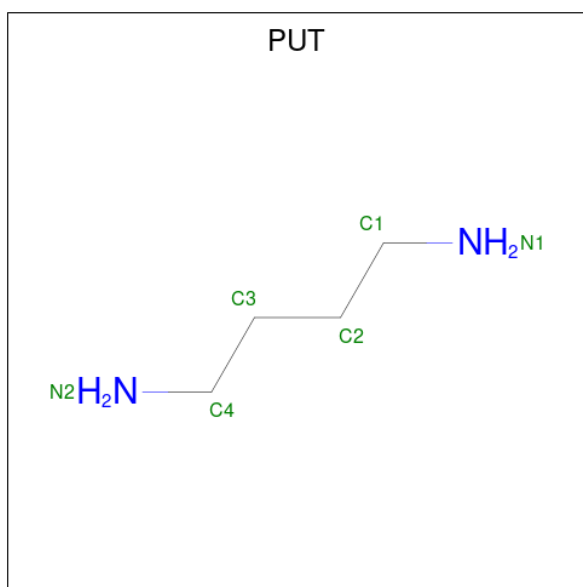
Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	GLY	-	expression tag	UNP Q6X2Y9
A	0	PRO	-	expression tag	UNP Q6X2Y9
B	-1	GLY	-	expression tag	UNP Q6X2Y9
B	0	PRO	-	expression tag	UNP Q6X2Y9
C	-1	GLY	-	expression tag	UNP Q6X2Y9
C	0	PRO	-	expression tag	UNP Q6X2Y9
D	-1	GLY	-	expression tag	UNP Q6X2Y9
D	0	PRO	-	expression tag	UNP Q6X2Y9
E	-1	GLY	-	expression tag	UNP Q6X2Y9
E	0	PRO	-	expression tag	UNP Q6X2Y9
F	-1	GLY	-	expression tag	UNP Q6X2Y9
F	0	PRO	-	expression tag	UNP Q6X2Y9

- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula: C₂₁H₂₇N₇O₁₄P₂).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
			Total	C	H	N	O			P
2	A	1	Total	C	H	N	O	P	0	0
			70	21	26	7	14	2		
2	B	1	Total	C	H	N	O	P	0	0
			70	21	26	7	14	2		
2	C	1	Total	C	H	N	O	P	0	0
			70	21	26	7	14	2		
2	D	1	Total	C	H	N	O	P	0	0
			70	21	26	7	14	2		
2	E	1	Total	C	H	N	O	P	0	0
			70	21	26	7	14	2		
2	F	1	Total	C	H	N	O	P	0	0
			70	21	26	7	14	2		

- Molecule 3 is 1,4-DIAMINOBUTANE (three-letter code: PUT) (formula: C₄H₁₂N₂) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	H	N		
3	A	1	18	4	12	2	0	0
3	C	1	18	4	12	2	0	0
3	E	1	18	4	12	2	0	0

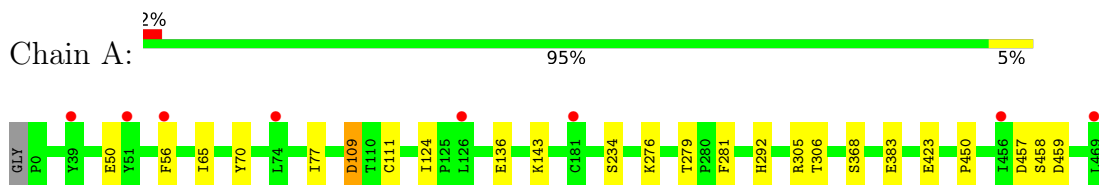
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	168	168	168	0	0
4	B	191	191	191	0	0
4	C	132	132	132	0	0
4	D	184	184	184	0	0
4	E	318	318	318	0	0
4	F	249	249	249	0	0

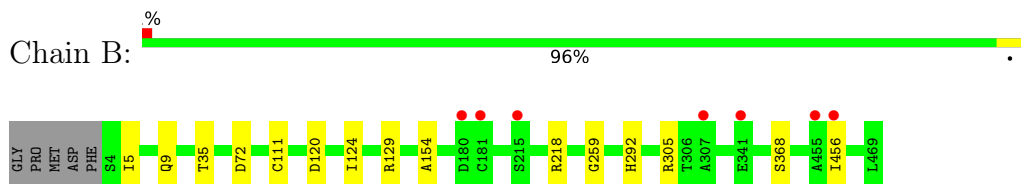
3 Residue-property plots

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.

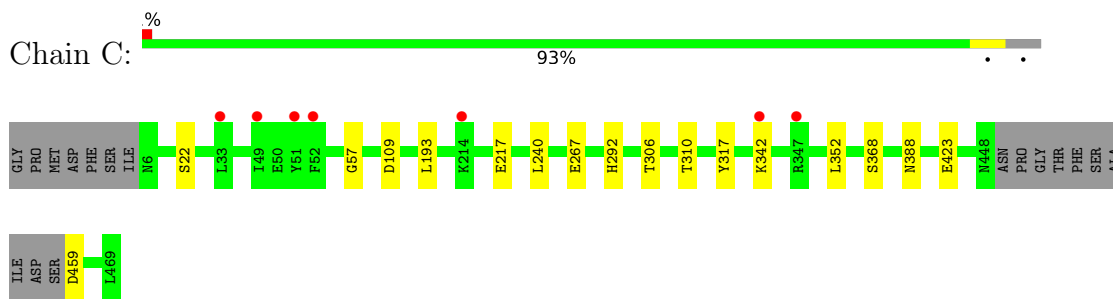
- Molecule 1: Homospermidine synthase



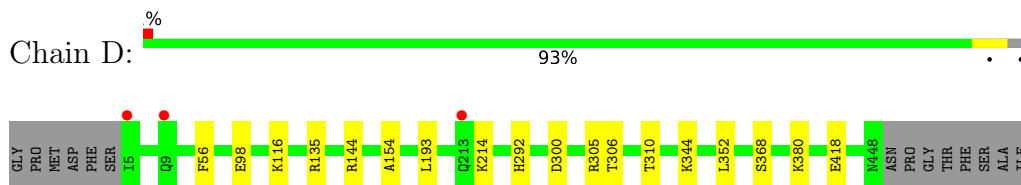
- Molecule 1: Homospermidine synthase



- Molecule 1: Homospermidine synthase



- Molecule 1: Homospermidine synthase



- Molecule 1: Homospermidine synthase





- Molecule 1: Homospermidine synthase

Chain F: 93%



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 1 2	Depositor
Cell constants a, b, c, α , β , γ	103.24Å 103.24Å 548.00Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	80.31 – 2.15 80.31 – 2.15	Depositor EDS
% Data completeness (in resolution range)	98.2 (80.31-2.15) 98.2 (80.31-2.15)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.27 (at 2.14Å)	Xtrriage
Refinement program	PHENIX 1.17.1_3660	Depositor
R, R_{free}	0.203 , 0.244 0.203 , 0.244	Depositor DCC
R_{free} test set	8591 reflections (4.80%)	wwPDB-VP
Wilson B-factor (Å ²)	28.5	Xtrriage
Anisotropy	0.100	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	(Not available) , (Not available)	EDS
L-test for twinning ²	$\langle L \rangle = 0.43$, $\langle L^2 \rangle = 0.26$	Xtrriage
Estimated twinning fraction	0.099 for -h,-k,l	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	44700	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.02% 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: NAD, PUT

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	0.24	0/3771	0.42	0/5134
1	B	0.24	0/3724	0.42	0/5072
1	C	0.24	0/3637	0.41	0/4951
1	D	0.24	0/3651	0.41	0/4970
1	E	0.24	0/3716	0.42	0/5057
1	F	0.24	0/3665	0.42	0/4989
All	All	0.24	0/22164	0.42	0/30173

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

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	3676	3631	3631	8	0
1	B	3631	3587	3587	6	0
1	C	3547	3508	3508	6	0
1	D	3561	3525	3524	11	0
1	E	3625	3583	3579	5	0
1	F	3575	3535	3535	6	0
2	A	44	26	26	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	44	26	26	0	0
2	C	44	26	26	0	0
2	D	44	26	26	0	0
2	E	44	26	26	0	0
2	F	44	26	26	2	0
3	A	6	12	12	0	0
3	C	6	12	12	0	0
3	E	6	12	12	0	0
4	A	168	0	0	0	0
4	B	191	0	0	2	0
4	C	132	0	0	1	0
4	D	184	0	0	5	0
4	E	318	0	0	0	0
4	F	249	0	0	2	0
All	All	23139	21561	21556	36	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 1.

All (36) 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:B:305:ARG:NH2	1:C:306:THR:O	2.21	0.72
1:B:154:ALA:O	4:B:601:HOH:O	2.08	0.70
1:C:22:SER:OG	1:C:388:ASN:OD1	2.09	0.69
1:B:124:ILE:O	1:B:129:ARG:NH1	2.25	0.69
1:C:217:GLU:N	1:C:217:GLU:OE1	2.31	0.62
1:D:344:LYS:NZ	4:D:607:HOH:O	2.31	0.62
1:E:336:ASP:OD1	1:F:276:LYS:NZ	2.32	0.61
1:B:72:ASP:OD2	4:B:602:HOH:O	2.17	0.59
1:A:281:PHE:O	1:B:218:ARG:NH2	2.36	0.57
1:D:154:ALA:O	4:D:601:HOH:O	2.17	0.57
2:F:501:NAD:O4D	4:F:601:HOH:O	2.18	0.56
1:E:368:SER:OG	1:E:441:SER:O	2.24	0.55
1:C:423:GLU:OE1	4:C:601:HOH:O	2.18	0.55
1:A:305:ARG:NH1	1:D:310:THR:OG1	2.39	0.55
1:D:98:GLU:OE1	1:D:144:ARG:NH2	2.40	0.54
2:F:501:NAD:O2N	4:F:602:HOH:O	2.19	0.52
1:D:135:ARG:NH2	1:D:300:ASP:OD2	2.41	0.51
1:D:116:LYS:O	4:D:602:HOH:O	2.19	0.51
1:A:109:ASP:OD1	1:A:111:CYS:N	2.39	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:305:ARG:NH2	1:D:306:THR:O	2.48	0.47
1:D:56:PHE:O	4:D:603:HOH:O	2.20	0.47
1:D:380:LYS:NZ	4:D:614:HOH:O	2.46	0.47
1:D:418:GLU:OE1	1:D:418:GLU:N	2.47	0.46
1:B:259:GLY:O	1:C:310:THR:OG1	2.20	0.46
1:E:457:ASP:OD1	1:E:458:SER:N	2.50	0.44
1:E:368:SER:OG	1:E:369:SER:N	2.50	0.44
1:F:460:SER:N	1:F:461:PRO:HD2	2.33	0.44
1:A:457:ASP:O	1:A:459:ASP:N	2.51	0.42
1:F:254:SER:HB2	1:F:265:TYR:CZ	2.54	0.42
1:A:306:THR:O	1:D:305:ARG:NH2	2.52	0.41
1:F:135:ARG:NH1	1:F:300:ASP:OD2	2.52	0.41
1:F:308:ASP:N	1:F:308:ASP:OD1	2.53	0.41
1:A:450:PRO:O	1:F:71:ARG:NH1	2.54	0.41
1:C:109:ASP:OD1	1:C:109:ASP:C	2.59	0.41
1:A:65:ILE:HG23	1:A:70:TYR:HB2	2.04	0.40
1:E:185:SER:OG	1:E:189:GLN:OE1	2.32	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	469/471 (100%)	448 (96%)	19 (4%)	2 (0%)	34 29
1	B	464/471 (98%)	443 (96%)	20 (4%)	1 (0%)	47 46
1	C	450/471 (96%)	425 (94%)	23 (5%)	2 (0%)	34 29
1	D	452/471 (96%)	429 (95%)	22 (5%)	1 (0%)	47 46
1	E	460/471 (98%)	446 (97%)	14 (3%)	0	100 100
1	F	454/471 (96%)	438 (96%)	15 (3%)	1 (0%)	47 46
All	All	2749/2826 (97%)	2629 (96%)	113 (4%)	7 (0%)	41 37

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	458	SER
1	C	57	GLY
1	A	368	SER
1	B	368	SER
1	C	368	SER
1	D	368	SER
1	F	368	SER

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	403/402 (100%)	390 (97%)	13 (3%)	39	38
1	B	398/402 (99%)	391 (98%)	7 (2%)	59	63
1	C	388/402 (96%)	380 (98%)	8 (2%)	53	57
1	D	390/402 (97%)	386 (99%)	4 (1%)	76	81
1	E	398/402 (99%)	391 (98%)	7 (2%)	59	63
1	F	392/402 (98%)	384 (98%)	8 (2%)	55	59
All	All	2369/2412 (98%)	2322 (98%)	47 (2%)	57	59

All (47) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	50	GLU
1	A	56	PHE
1	A	77	ILE
1	A	109	ASP
1	A	124	ILE
1	A	136	GLU
1	A	143	LYS
1	A	234	SER
1	A	276	LYS
1	A	279	THR

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Mol	Chain	Res	Type
1	A	292	HIS
1	A	383	GLU
1	A	423	GLU
1	B	5	ILE
1	B	9	GLN
1	B	35	THR
1	B	111	CYS
1	B	120	ASP
1	B	292	HIS
1	B	456	ILE
1	C	193	LEU
1	C	240	LEU
1	C	267	GLU
1	C	292	HIS
1	C	317	TYR
1	C	342	LYS
1	C	352	LEU
1	C	459	ASP
1	D	193	LEU
1	D	214	LYS
1	D	292	HIS
1	D	352	LEU
1	E	213	GLN
1	E	274	ARG
1	E	292	HIS
1	E	309[A]	GLU
1	E	309[B]	GLU
1	E	317	TYR
1	E	367	LYS
1	F	49	ILE
1	F	58	LEU
1	F	67	GLN
1	F	143	LYS
1	F	260	CYS
1	F	292	HIS
1	F	352	LEU
1	F	437	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	127	HIS

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Mol	Chain	Res	Type
1	E	137	GLN
1	F	131	ASN
1	F	330	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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

9 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	NAD	F	501	-	42,48,48	1.00	3 (7%)	50,73,73	1.61	10 (20%)
2	NAD	A	501	-	42,48,48	0.98	3 (7%)	50,73,73	1.32	5 (10%)
2	NAD	D	501	-	42,48,48	1.06	5 (11%)	50,73,73	1.76	9 (18%)
2	NAD	C	501	-	42,48,48	0.78	1 (2%)	50,73,73	1.39	9 (18%)
2	NAD	E	501	-	42,48,48	1.07	2 (4%)	50,73,73	1.57	9 (18%)
2	NAD	B	501	-	42,48,48	1.06	2 (4%)	50,73,73	1.70	6 (12%)
3	PUT	C	502	-	5,5,5	0.23	0	4,4,4	0.36	0
3	PUT	E	502	-	5,5,5	0.22	0	4,4,4	0.41	0
3	PUT	A	502	-	5,5,5	0.22	0	4,4,4	0.38	0

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	NAD	F	501	-	-	4/26/62/62	0/5/5/5
2	NAD	A	501	-	-	4/26/62/62	0/5/5/5
2	NAD	D	501	-	-	6/26/62/62	0/5/5/5
2	NAD	C	501	-	-	2/26/62/62	0/5/5/5
2	NAD	E	501	-	-	5/26/62/62	0/5/5/5
2	NAD	B	501	-	-	8/26/62/62	0/5/5/5
3	PUT	C	502	-	-	2/3/3/3	-
3	PUT	E	502	-	-	2/3/3/3	-
3	PUT	A	502	-	-	1/3/3/3	-

All (16) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	501	NAD	O4D-C1D	3.78	1.46	1.41
2	B	501	NAD	C3N-C7N	3.16	1.55	1.50
2	A	501	NAD	O4D-C1D	2.89	1.45	1.41
2	D	501	NAD	C2B-C1B	-2.70	1.49	1.53
2	D	501	NAD	C7N-N7N	2.55	1.37	1.33
2	D	501	NAD	C3N-C7N	2.55	1.54	1.50
2	B	501	NAD	O4D-C1D	2.53	1.44	1.41
2	F	501	NAD	C7N-N7N	2.31	1.37	1.33
2	E	501	NAD	C5A-C4A	2.17	1.46	1.40
2	D	501	NAD	O4D-C1D	2.17	1.44	1.41
2	F	501	NAD	O4D-C1D	2.12	1.44	1.41
2	C	501	NAD	C5A-C4A	2.05	1.46	1.40
2	D	501	NAD	C5A-C4A	2.05	1.46	1.40
2	F	501	NAD	C5A-C4A	2.03	1.46	1.40
2	A	501	NAD	C7N-N7N	2.02	1.36	1.33
2	A	501	NAD	C5A-C4A	2.00	1.46	1.40

All (48) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	501	NAD	C3N-C7N-N7N	6.55	125.61	117.75
2	D	501	NAD	C3N-C7N-N7N	5.54	124.40	117.75
2	E	501	NAD	N3A-C2A-N1A	-5.44	120.18	128.68
2	F	501	NAD	C3N-C7N-N7N	5.32	124.13	117.75

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	501	NAD	O7N-C7N-C3N	-4.48	114.27	119.63
2	D	501	NAD	O7N-C7N-C3N	-4.33	114.45	119.63
2	D	501	NAD	N3A-C2A-N1A	-3.99	122.44	128.68
2	D	501	NAD	C1B-N9A-C4A	-3.89	119.81	126.64
2	E	501	NAD	C3N-C7N-N7N	3.76	122.27	117.75
2	C	501	NAD	N3A-C2A-N1A	-3.74	122.84	128.68
2	F	501	NAD	O7N-C7N-C3N	-3.63	115.29	119.63
2	A	501	NAD	N3A-C2A-N1A	-3.54	123.14	128.68
2	F	501	NAD	N3A-C2A-N1A	-3.47	123.26	128.68
2	B	501	NAD	N3A-C2A-N1A	-3.44	123.30	128.68
2	A	501	NAD	C3N-C7N-N7N	3.33	121.75	117.75
2	D	501	NAD	PN-O3-PA	-3.24	121.69	132.83
2	B	501	NAD	C1B-N9A-C4A	-3.21	121.01	126.64
2	E	501	NAD	PN-O3-PA	-3.18	121.92	132.83
2	D	501	NAD	N6A-C6A-N1A	2.82	124.43	118.57
2	C	501	NAD	C3N-C7N-N7N	2.78	121.09	117.75
2	F	501	NAD	O2D-C2D-C3D	2.65	120.39	111.82
2	C	501	NAD	PN-O3-PA	-2.63	123.81	132.83
2	E	501	NAD	O3D-C3D-C2D	2.58	120.17	111.82
2	C	501	NAD	C3D-C2D-C1D	2.57	104.85	100.98
2	F	501	NAD	O2A-PA-O5B	2.52	119.46	107.75
2	C	501	NAD	O7N-C7N-N7N	-2.49	119.05	122.58
2	A	501	NAD	O5D-PN-O1N	2.41	118.50	109.07
2	F	501	NAD	C2A-N1A-C6A	2.41	122.87	118.75
2	C	501	NAD	C6N-N1N-C2N	-2.41	119.78	121.97
2	E	501	NAD	C2A-N1A-C6A	2.40	122.86	118.75
2	E	501	NAD	C1B-N9A-C4A	-2.39	122.44	126.64
2	B	501	NAD	O5D-PN-O1N	2.32	118.12	109.07
2	F	501	NAD	C4A-C5A-N7A	-2.31	106.99	109.40
2	E	501	NAD	O2B-C2B-C3B	2.28	119.20	111.82
2	B	501	NAD	C2A-N1A-C6A	2.25	122.60	118.75
2	D	501	NAD	C2A-N1A-C6A	2.25	122.60	118.75
2	C	501	NAD	O2A-PA-O1A	2.23	123.26	112.24
2	E	501	NAD	O2A-PA-O1A	2.21	123.15	112.24
2	A	501	NAD	C1B-N9A-C4A	-2.19	122.79	126.64
2	A	501	NAD	C3D-C2D-C1D	2.19	104.27	100.98
2	F	501	NAD	O5D-PN-O1N	2.17	117.56	109.07
2	C	501	NAD	O2B-C2B-C3B	2.16	118.80	111.82
2	D	501	NAD	O2N-PN-O5D	2.15	117.73	107.75
2	C	501	NAD	O4B-C1B-C2B	-2.13	103.81	106.93
2	E	501	NAD	O7N-C7N-N7N	-2.10	119.60	122.58
2	F	501	NAD	C1B-N9A-C4A	-2.05	123.04	126.64

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	F	501	NAD	O4B-C1B-C2B	-2.05	103.94	106.93
2	D	501	NAD	O2N-PN-O1N	2.02	122.20	112.24

There are no chirality outliers.

All (34) torsion outliers are listed below:

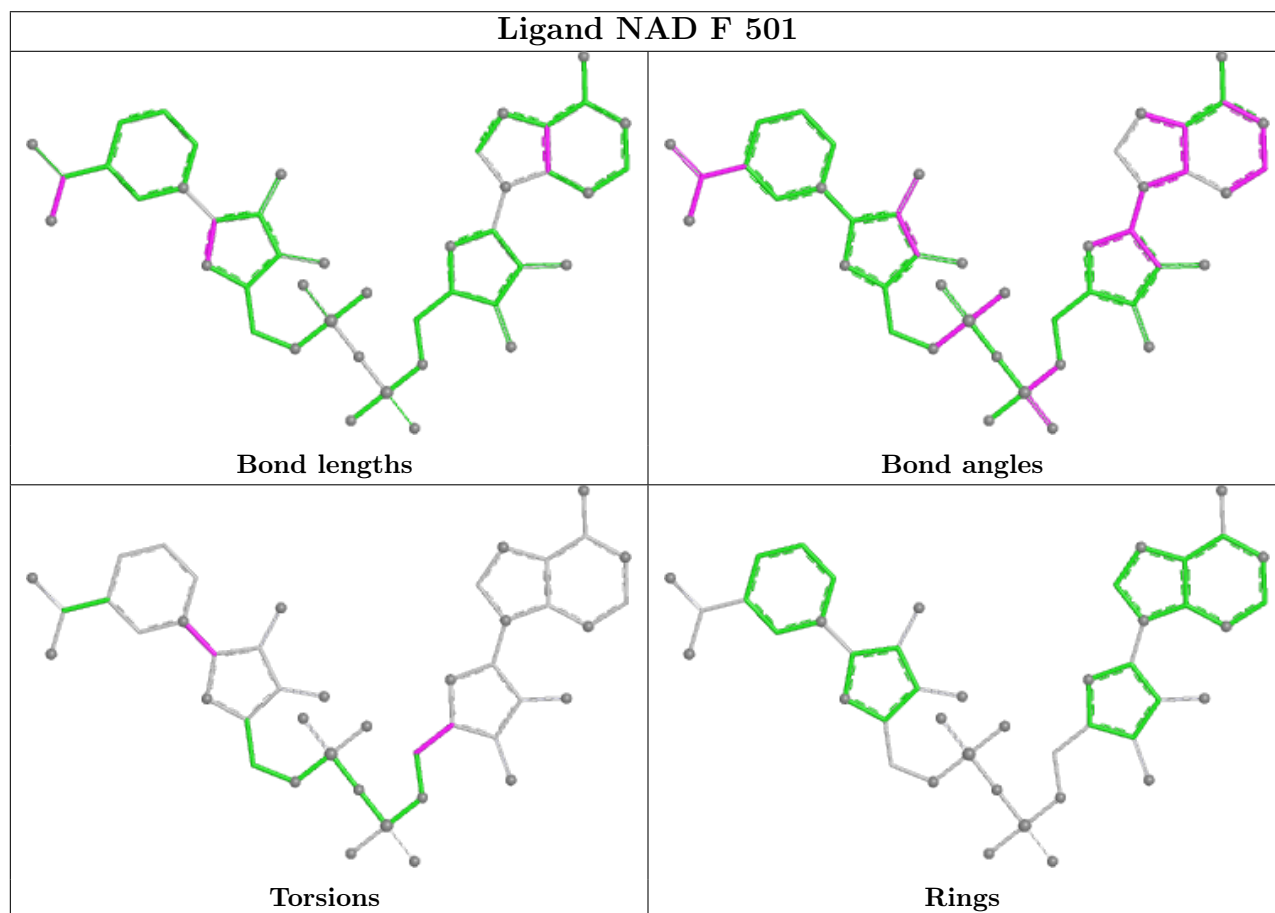
Mol	Chain	Res	Type	Atoms
2	A	501	NAD	O4D-C1D-N1N-C2N
2	A	501	NAD	O4D-C1D-N1N-C6N
2	B	501	NAD	C5D-O5D-PN-O1N
2	B	501	NAD	O4D-C1D-N1N-C2N
2	B	501	NAD	O4D-C1D-N1N-C6N
2	B	501	NAD	C2D-C1D-N1N-C2N
2	C	501	NAD	O4D-C1D-N1N-C6N
2	D	501	NAD	C5D-O5D-PN-O2N
2	D	501	NAD	O4D-C1D-N1N-C2N
2	D	501	NAD	O4D-C1D-N1N-C6N
2	E	501	NAD	O4D-C1D-N1N-C2N
2	E	501	NAD	O4D-C1D-N1N-C6N
2	E	501	NAD	C2D-C1D-N1N-C2N
2	F	501	NAD	O4D-C1D-N1N-C2N
2	F	501	NAD	O4D-C1D-N1N-C6N
2	D	501	NAD	O4B-C4B-C5B-O5B
3	C	502	PUT	C2-C3-C4-N2
2	D	501	NAD	C5D-O5D-PN-O3
2	B	501	NAD	C5D-O5D-PN-O2N
3	C	502	PUT	N1-C1-C2-C3
3	E	502	PUT	N1-C1-C2-C3
2	E	501	NAD	O4B-C4B-C5B-O5B
2	F	501	NAD	O4B-C4B-C5B-O5B
3	A	502	PUT	C2-C3-C4-N2
2	A	501	NAD	C2D-C1D-N1N-C2N
2	B	501	NAD	C5D-O5D-PN-O3
2	B	501	NAD	C2D-C1D-N1N-C6N
2	E	501	NAD	C2D-C1D-N1N-C6N
2	F	501	NAD	C2D-C1D-N1N-C2N
2	A	501	NAD	O4B-C4B-C5B-O5B
2	C	501	NAD	O4B-C4B-C5B-O5B
2	D	501	NAD	C5D-O5D-PN-O1N
2	B	501	NAD	O4B-C4B-C5B-O5B
3	E	502	PUT	C1-C2-C3-C4

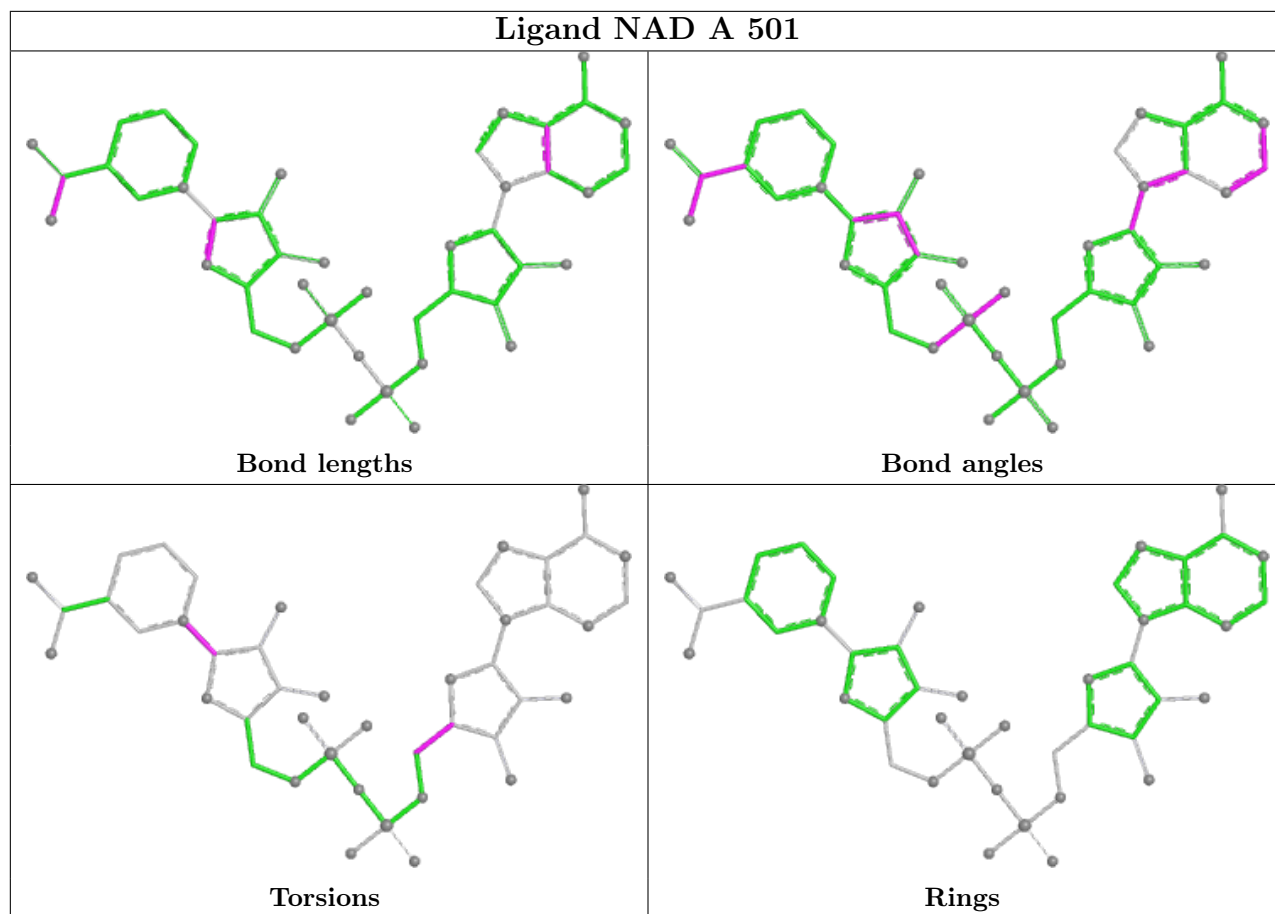
There are no ring outliers.

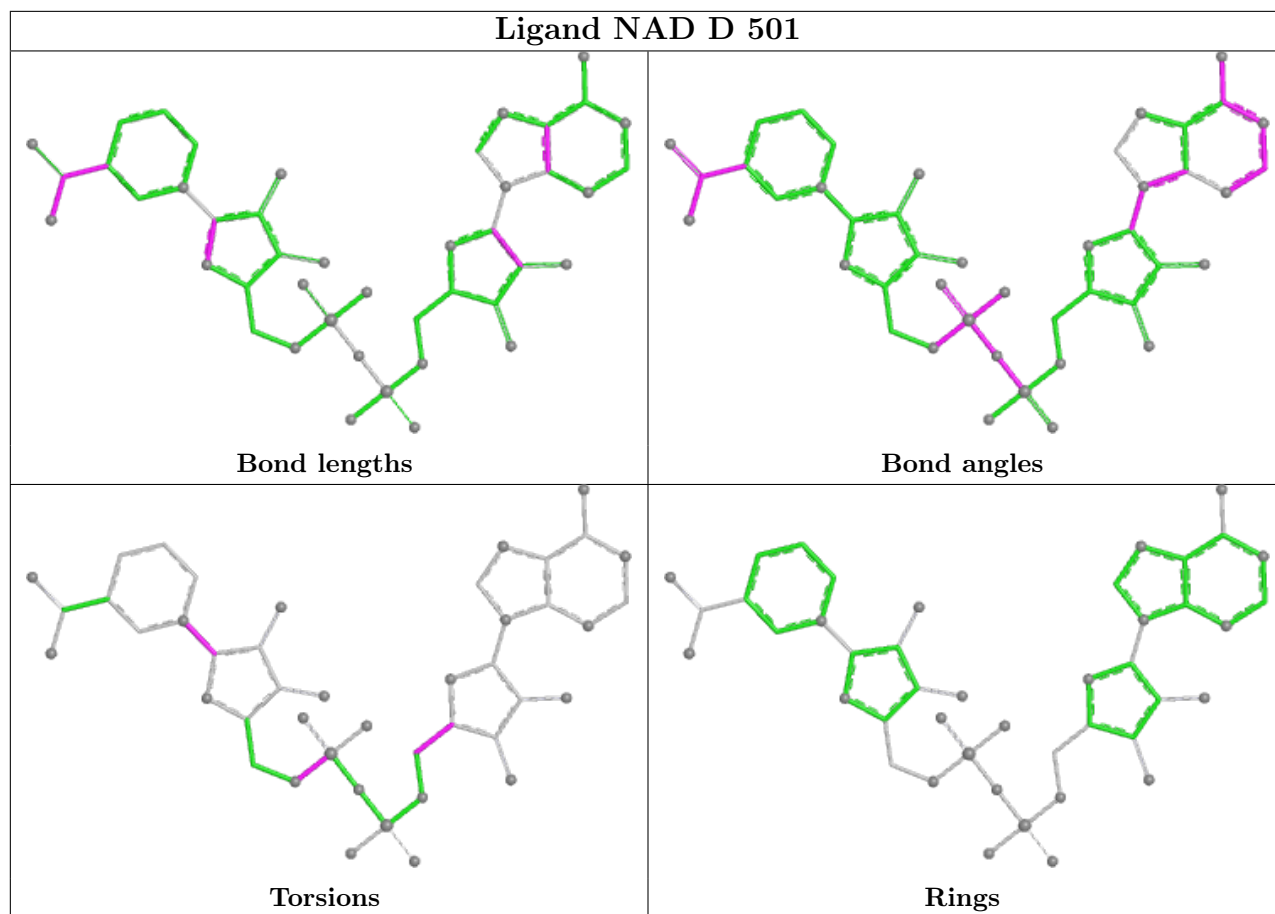
1 monomer is involved in 2 short contacts:

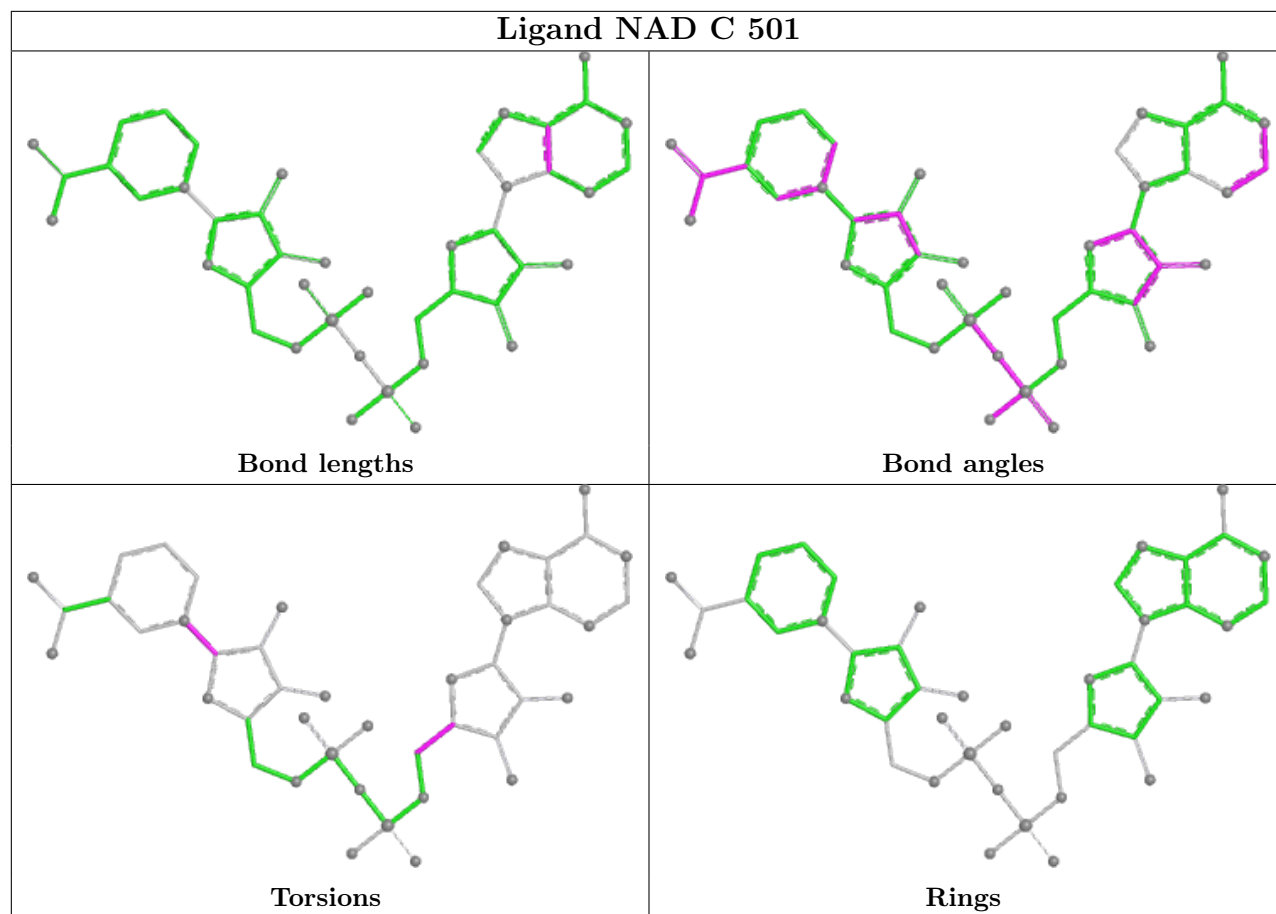
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	F	501	NAD	2	0

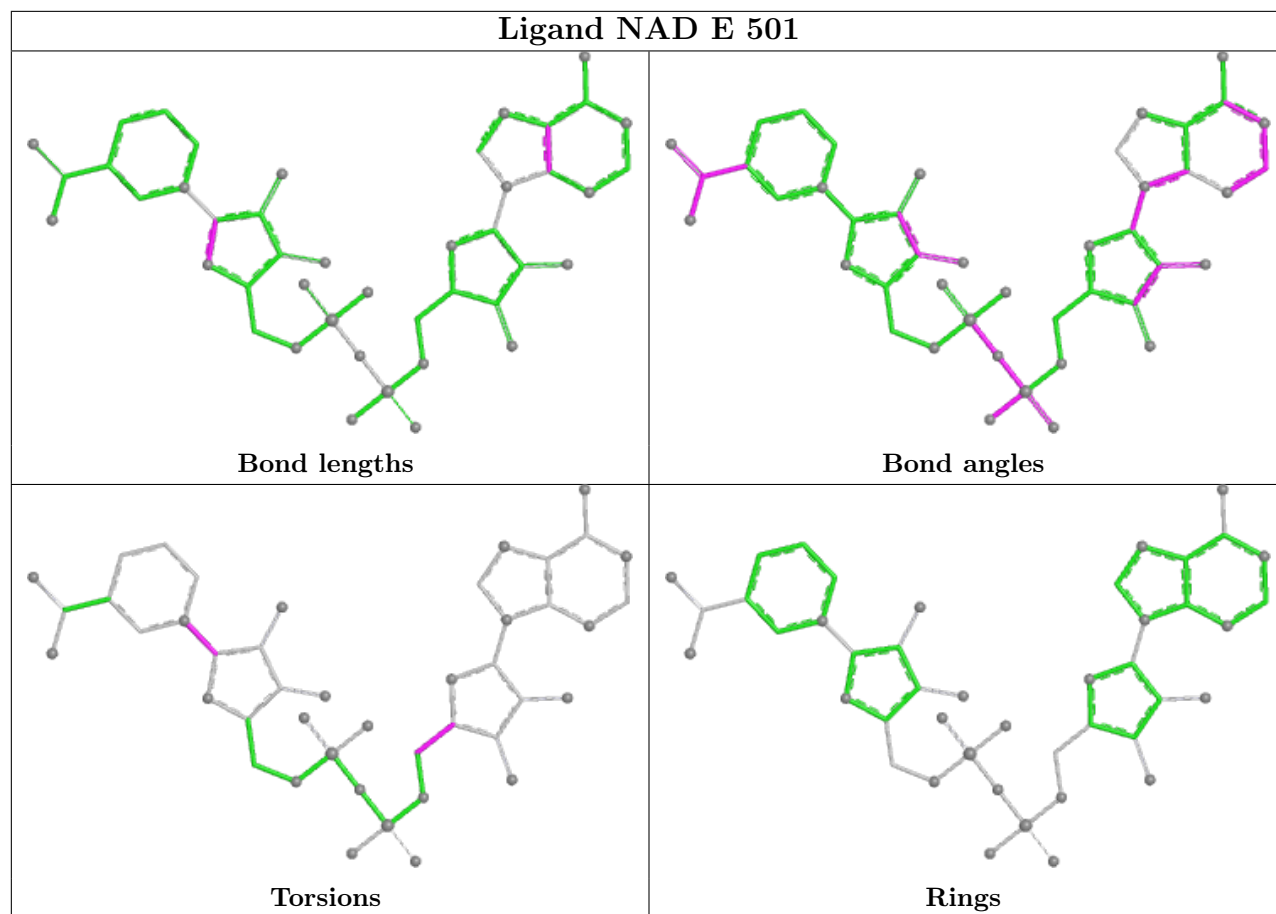
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

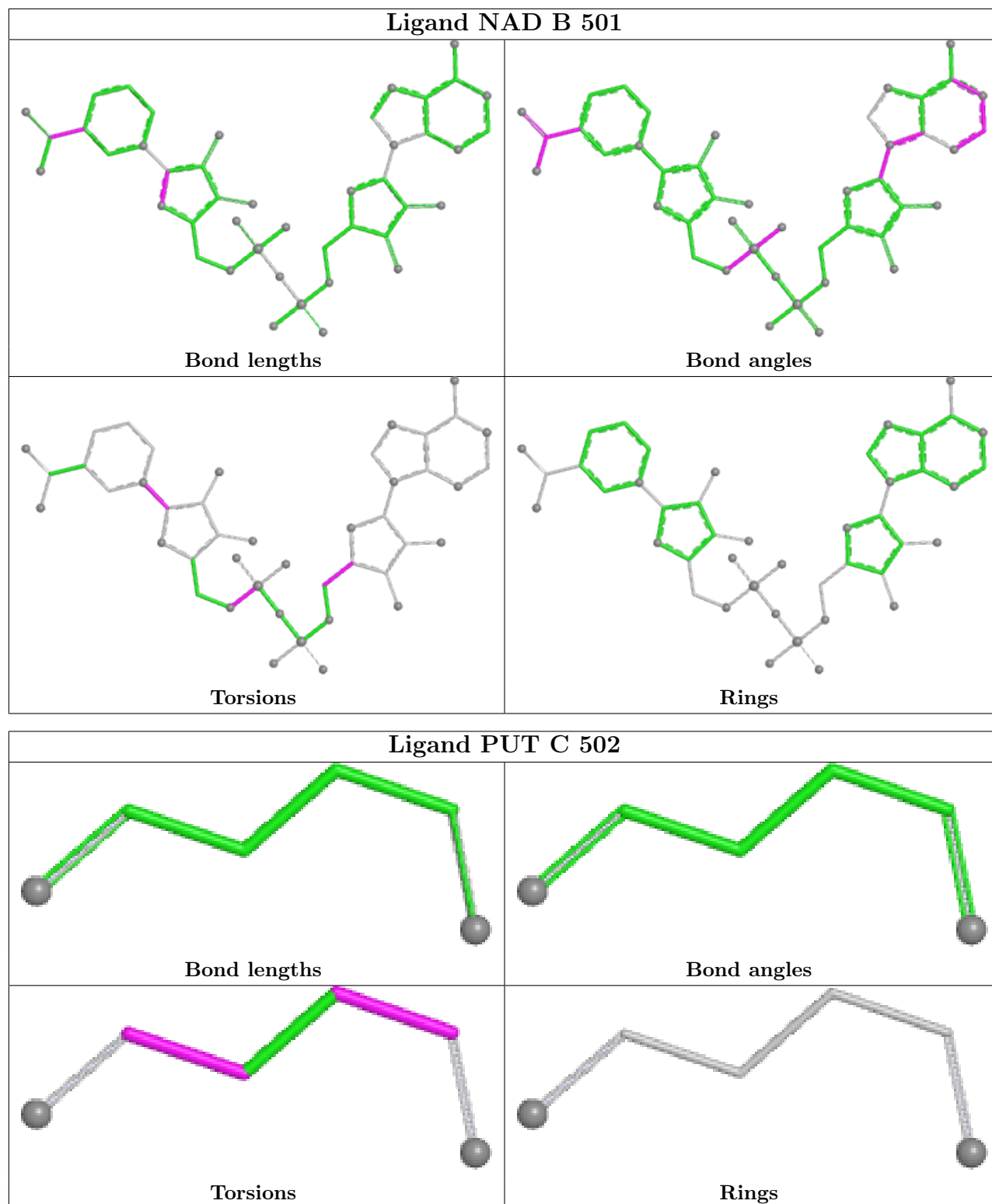


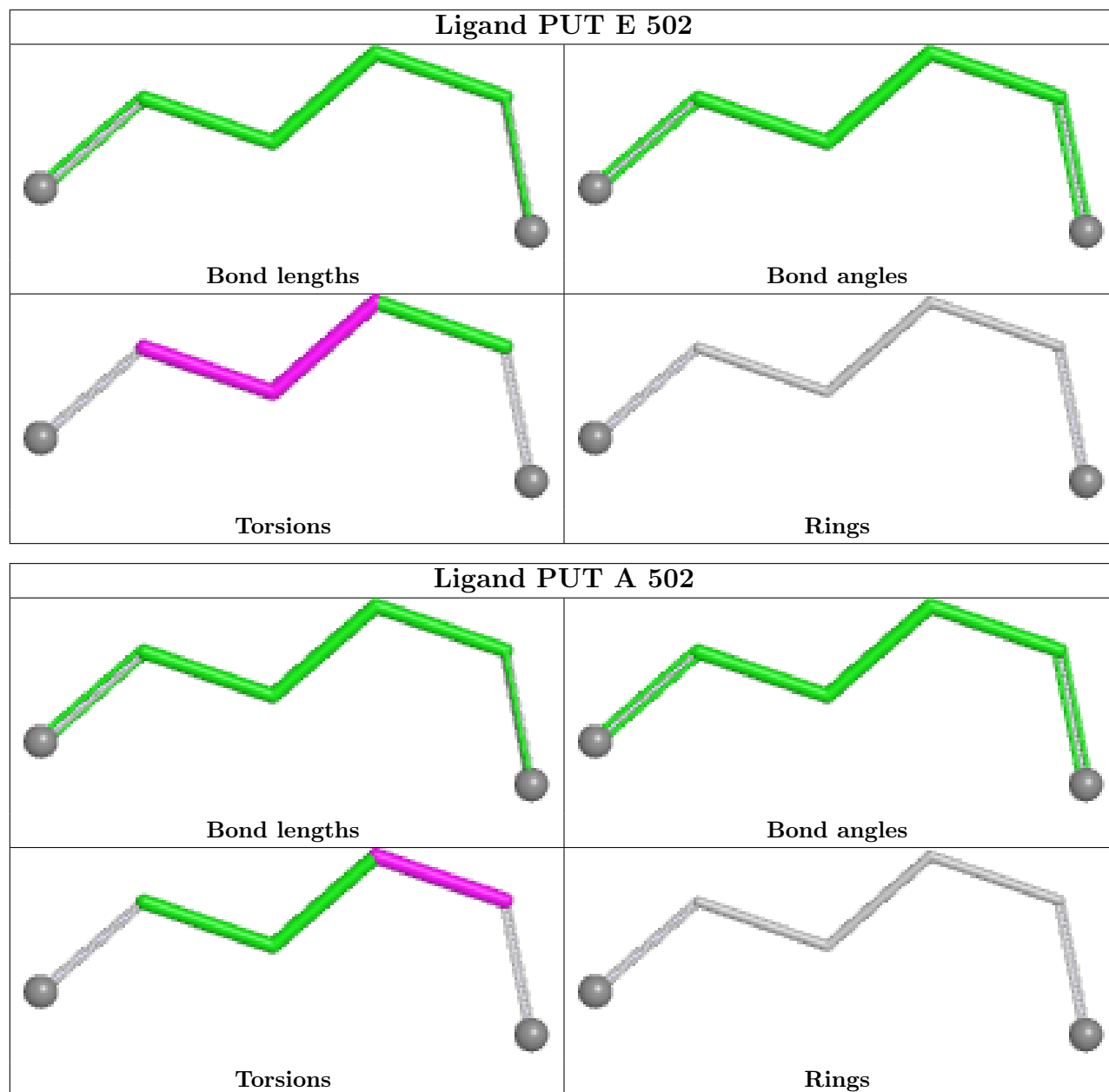












5.7 Other polymers [i](#)

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 [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	470/471 (99%)	0.02	8 (1%) 70 76	19, 35, 58, 69	0
1	B	466/471 (98%)	0.02	7 (1%) 73 79	21, 34, 54, 77	0
1	C	454/471 (96%)	0.12	7 (1%) 73 79	23, 38, 63, 80	0
1	D	456/471 (96%)	-0.02	3 (0%) 87 91	21, 34, 52, 74	0
1	E	460/471 (97%)	-0.21	2 (0%) 92 94	10, 22, 42, 68	0
1	F	458/471 (97%)	-0.13	1 (0%) 95 96	14, 26, 51, 69	0
All	All	2764/2826 (97%)	-0.03	28 (1%) 82 86	10, 32, 56, 80	0

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	181	CYS	4.1
1	A	456	ILE	3.6
1	B	456	ILE	3.4
1	B	180	ASP	3.2
1	C	33	LEU	3.1
1	A	469	LEU	3.0
1	B	455	ALA	3.0
1	E	469	LEU	2.7
1	A	74	LEU	2.7
1	C	52	PHE	2.6
1	A	51	TYR	2.6
1	F	124	ILE	2.6
1	A	126	LEU	2.6
1	E	450	PRO	2.5
1	B	341	GLU	2.5
1	C	214	LYS	2.4
1	A	181	CYS	2.3
1	A	56	PHE	2.2
1	A	39	TYR	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	215	SER	2.2
1	C	49	ILE	2.1
1	D	5	ILE	2.1
1	D	9	GLN	2.1
1	D	213	GLN	2.1
1	C	51	TYR	2.1
1	C	347	ARG	2.0
1	B	307	ALA	2.0
1	C	342	LYS	2.0

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 [i](#)

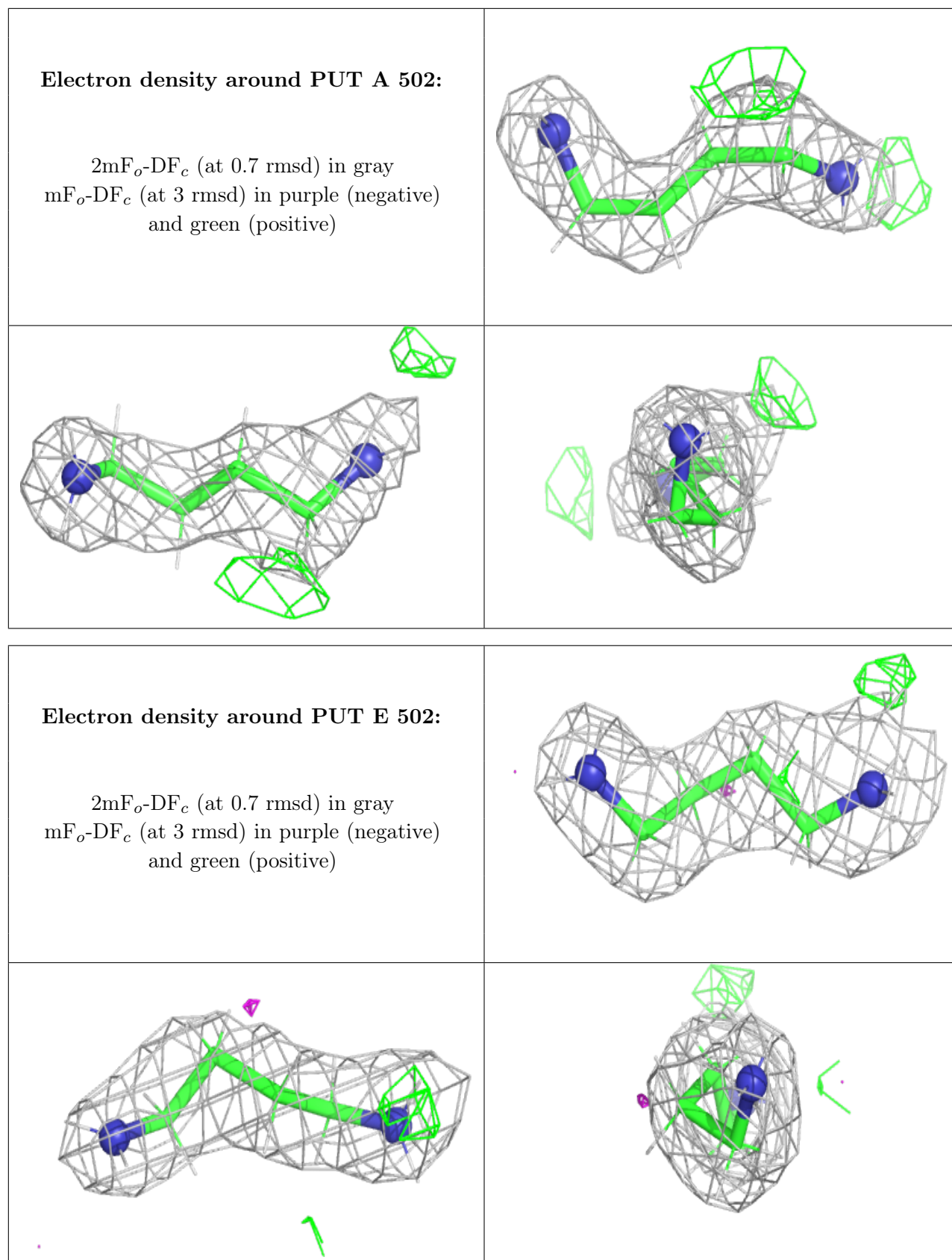
There are no monosaccharides in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. 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.

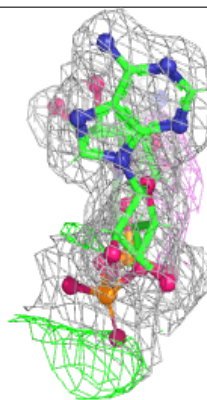
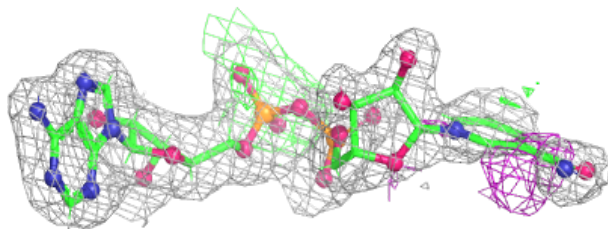
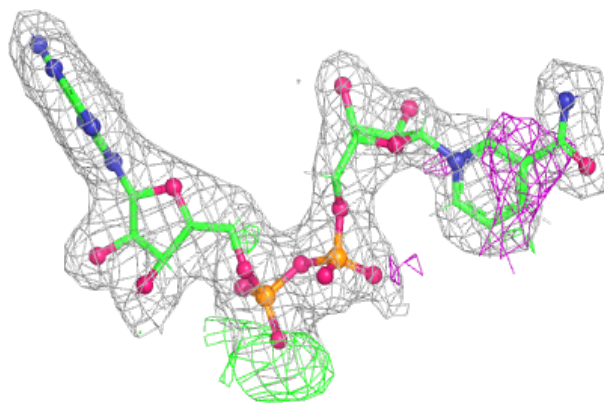
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	PUT	A	502	6/6	0.82	0.18	35,45,51,51	0
3	PUT	E	502	6/6	0.86	0.14	26,32,38,38	0
2	NAD	B	501	44/44	0.88	0.14	24,39,55,58	0
3	PUT	C	502	6/6	0.91	0.15	41,50,55,55	0
2	NAD	F	501	44/44	0.92	0.11	20,37,47,54	0
2	NAD	A	501	44/44	0.94	0.11	31,47,58,61	0
2	NAD	D	501	44/44	0.94	0.11	22,40,49,53	0
2	NAD	C	501	44/44	0.95	0.11	33,41,50,54	0
2	NAD	E	501	44/44	0.97	0.09	15,23,30,33	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.

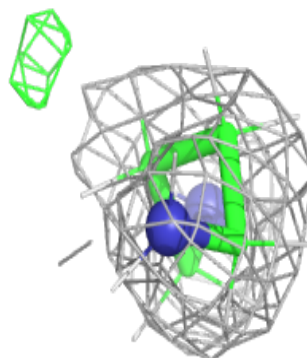
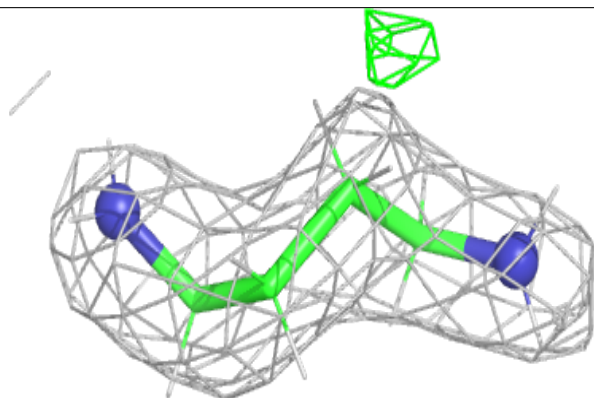
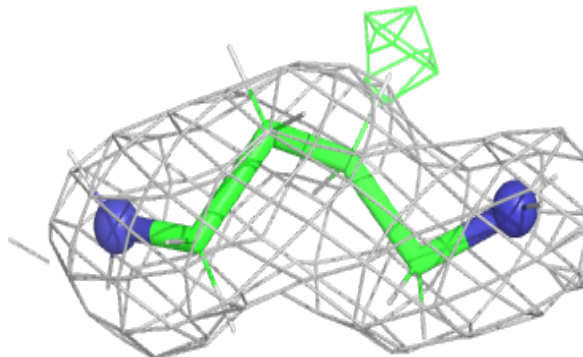


Electron density around NAD B 501:

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

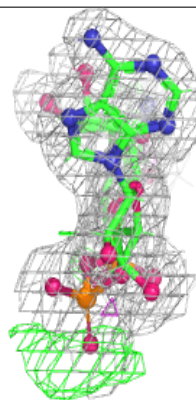
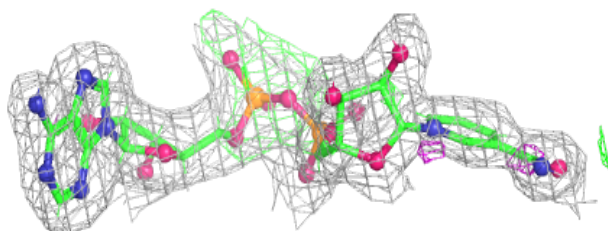
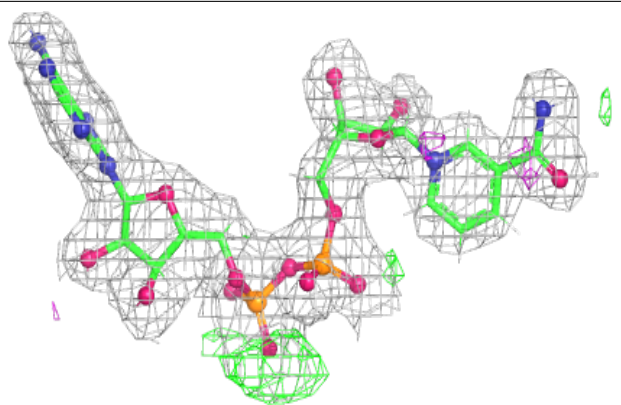
**Electron density around PUT C 502:**

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

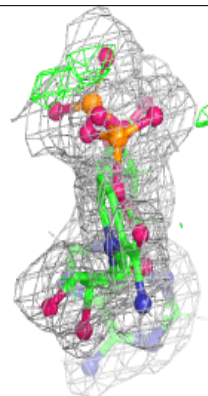
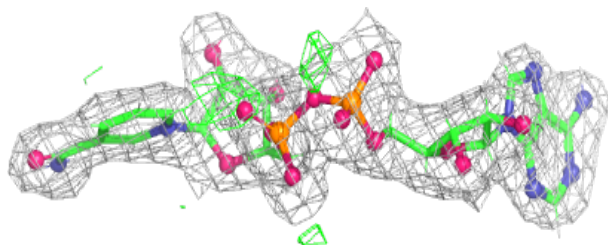
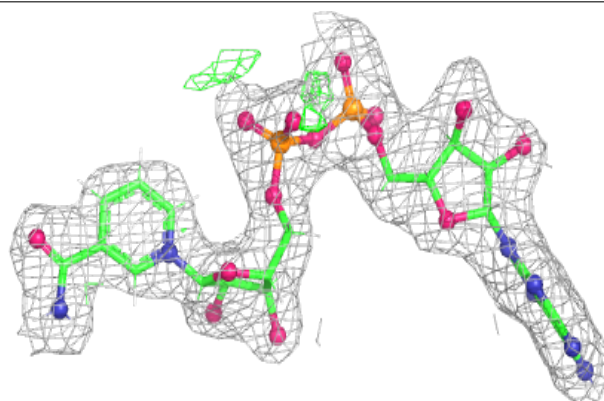


Electron density around NAD F 501:

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

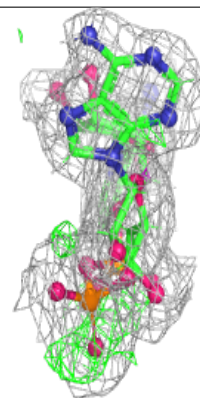
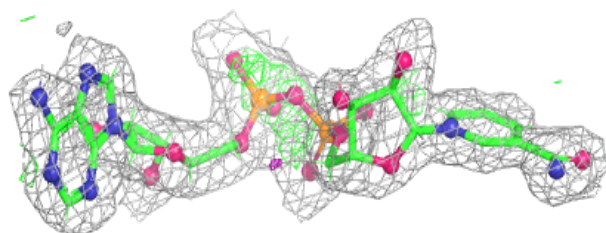
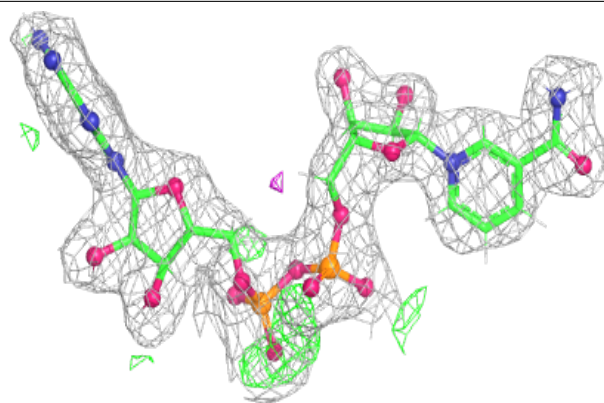
**Electron density around NAD A 501:**

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

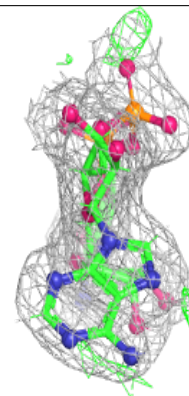
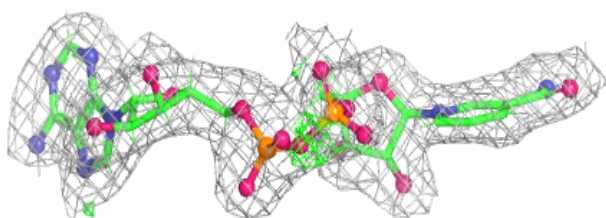
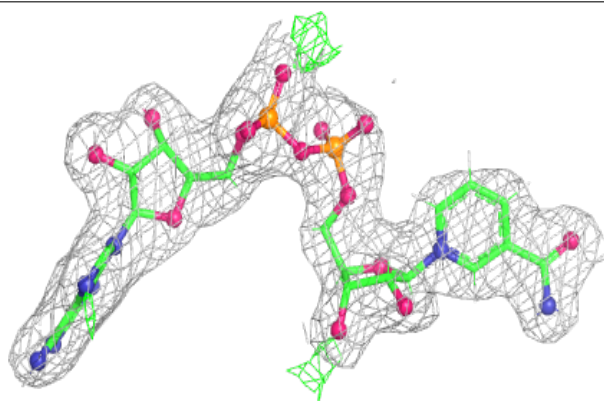


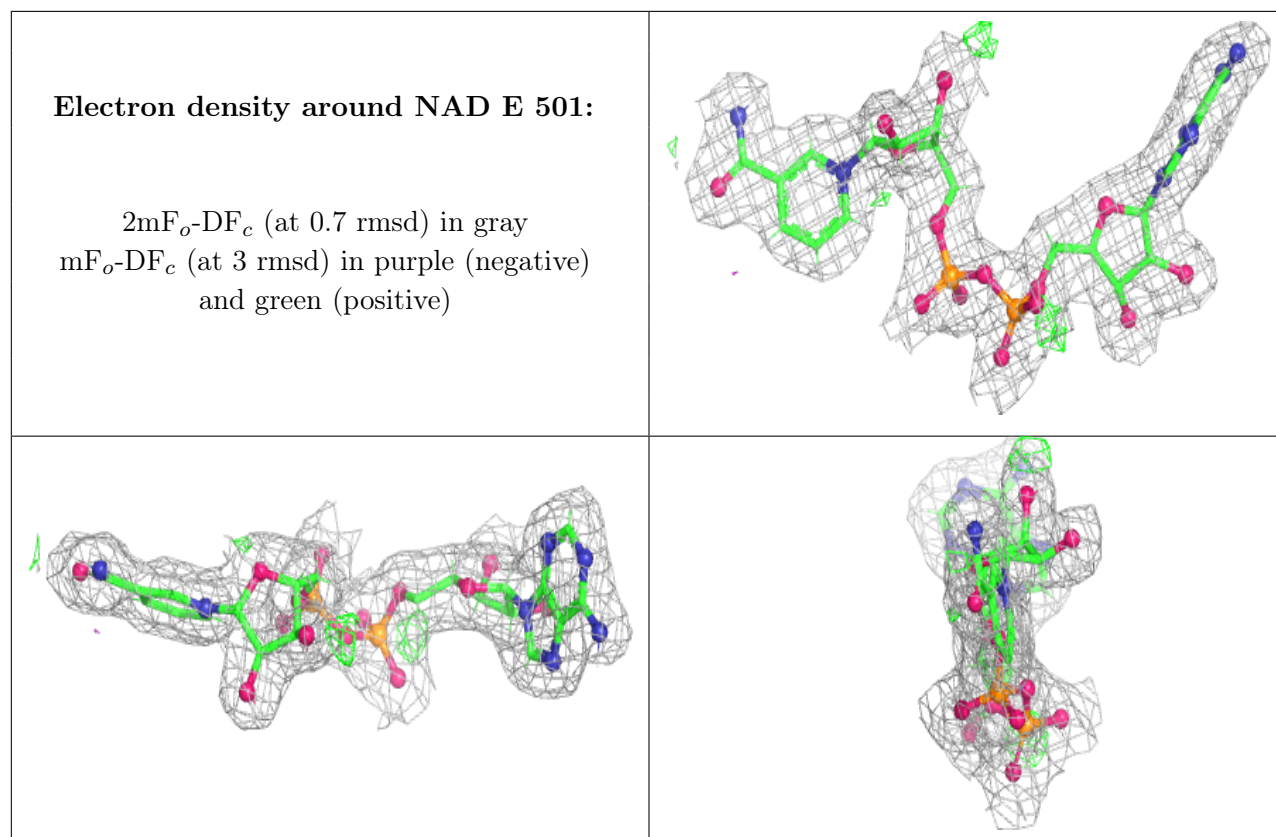
Electron density around NAD D 501:

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

**Electron density around NAD 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)





6.5 Other polymers [i](#)

There are no such residues in this entry.