Full wwPDB X-ray Structure Validation Report (i)

Apr 27, 2022 – 04:09 PM EDT

PDB ID : 7N29
Title : Structure of NAD kinase
Authors : Du, J.; Estrella, M.A.; Jeffrey, P.D.; Korennykh, A.V.
Deposited on : 2021-05-28
Resolution : 2.80 Å(reported)

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

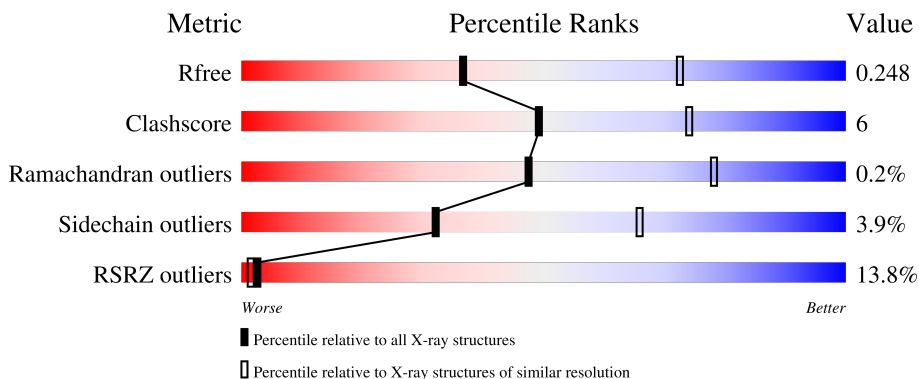|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.28.1
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.28.1

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	Percentile Ranks	Value
Rfree		0.248
Clashscore		6
Ramachandran outliers		0.2%
Sidechain outliers		3.9%
RSRZ outliers		13.8%

Worse *Better*

■ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	3140 (2.80-2.80)
Clashscore	141614	3569 (2.80-2.80)
Ramachandran outliers	138981	3498 (2.80-2.80)
Sidechain outliers	138945	3500 (2.80-2.80)
RSRZ outliers	127900	3078 (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 <=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	398	2% / 70% / 12% · 17%
1	B	398	4% / 76% / 11% · 12%
1	C	398	3% / 75% / 11% · 14%
1	D	398	37% / 60% / 19% · 20%

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	NAD	D	501	-	-	-	X

2 Entry composition ⓘ

There are 3 unique types of molecules in this entry. The entry contains 10868 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 NAD kinase 2, mitochondrial.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	330	Total 2572	C 1611	N 464	O 486	S 7	Se 4	0	0	0
1	B	350	Total 2740	C 1716	N 495	O 518	S 7	Se 4	0	0	0
1	C	342	Total 2679	C 1677	N 486	O 505	S 7	Se 4	0	0	0
1	D	318	Total 2499	C 1568	N 452	O 468	S 7	Se 4	0	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	45	GLY	-	expression tag	UNP Q4G0N4
A	46	PRO	-	expression tag	UNP Q4G0N4
B	45	GLY	-	expression tag	UNP Q4G0N4
B	46	PRO	-	expression tag	UNP Q4G0N4
C	45	GLY	-	expression tag	UNP Q4G0N4
C	46	PRO	-	expression tag	UNP Q4G0N4
D	45	GLY	-	expression tag	UNP Q4G0N4
D	46	PRO	-	expression tag	UNP Q4G0N4

- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula: $C_{21}H_{27}N_7O_{14}P_2$) (labeled as "Ligand of Interest" by depositor).

NAD

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	B	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	C	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	D	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

- Molecule 3 is water.

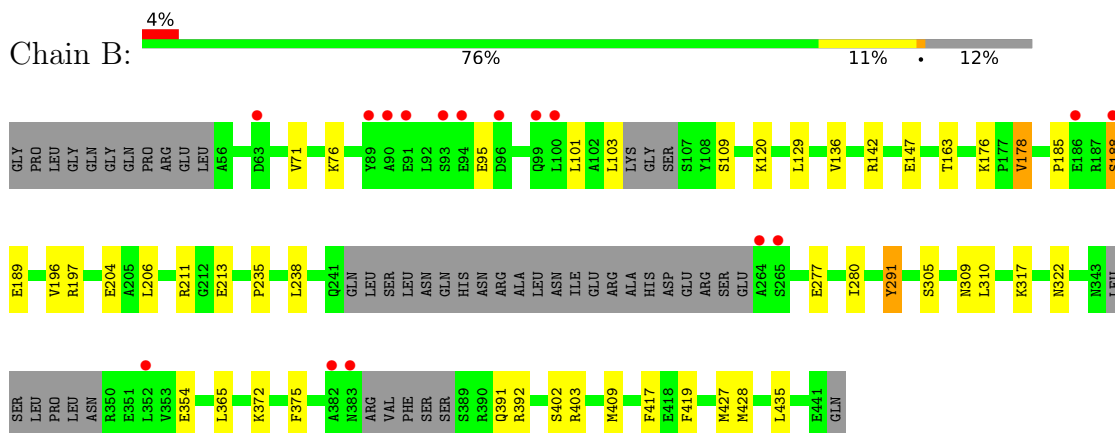| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	63	Total	O	0	0
			63	63		
3	B	71	Total	O	0	0
			71	71		
3	C	68	Total	O	0	0
			68	68		

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.
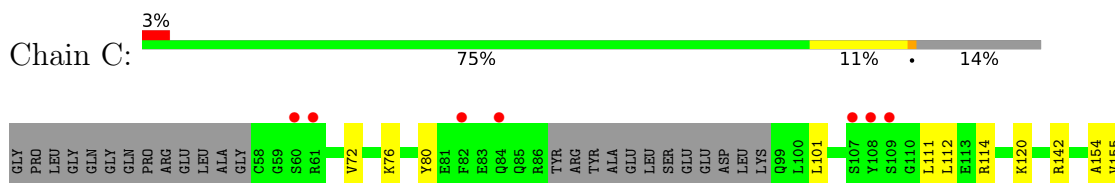
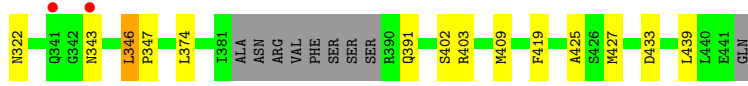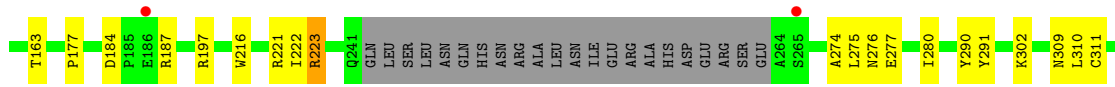- Molecule 1: NAD kinase 2, mitochondrial

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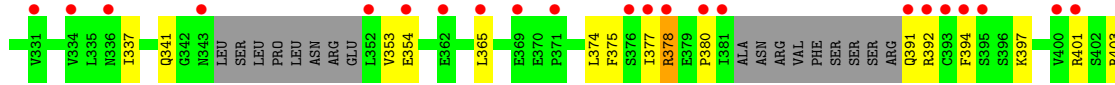T163 P177 D184 P185 E186 R187 R197 W216 R221 I222 R223 Q241 GLN LEU SER LEU ASN GLN HIS ASN ARG ALA LEU ASN ILE GLU GLU ALA HIS ASP GLU ARG SER GLU A264 S265 A274 L275 N276 E277 I280 Y290 Y291 K302 N309 L310 C311

N322 Q341 G342 N343 L346 P347 L374 I381 ALA ASN ARG VAL PHE SER SER R390 Q391 S402 R403 M409 F419 A425 S426 M427 D433 L439 L440 E441 GLN

• Molecule 1: NAD kinase 2, mitochondrial

Chain D:
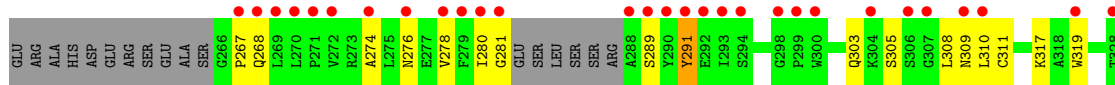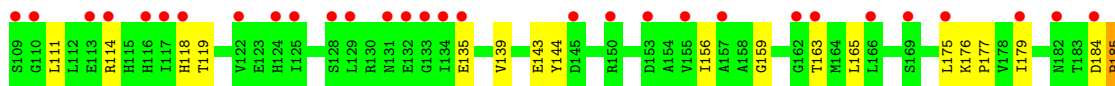

GLY PRO LEU GLY GLN GLY GLN PRO ARG GLU LEU ALA GLY C58 G59 S60 R61 A62 D63 G64 G65 F66 S69 R70 V71 V72 V73 V74 A75 K76 R79 Y80 Q84 Q85 R86 TYR ARG TYR ALA GLU LEU SER GLU GLU ASP LEU LYS GLN LEU LEU ALA LEU LYS GLY SER S107 Y108

S109 G110 L111 L112 E113 R114 H115 H116 I117 H118 T119 V122 E123 H124 I125 S128 L129 R130 N131 E132 G133 I134 E135 V139 E143 Y144 D145 R150 D153 A154 V155 I156 A157 A158 G159 G162 T163 M164 L165 L166 S169 L175 K176 P177 V178 I179 N182 T183 D184 P185

E186 R187 S188 E189 G190 H191 V196 R197 Y198 T199 H200 S201 K208 F209 Y210 R211 G212 E213 F214 W216 L217 W218 R221 I222 R223 L224 Y225 L226 E227 G228 T229 G230 I231 N232 V233 V234 P235 V236 D237 L238 H239 E240 Q241 GLN LEU SER LEU ASN GLN HIS ASN ARG ALA LEU ASN ILE

GLU ARG ALA HIS ASP GLU ARG SER GLU ALA SER Q266 P267 Q268 L269 L270 P271 V272 R273 A274 L275 N276 E277 V278 F279 I280 G281 GLU SER LEU SER ARG A288 S289 Y290 Y291 E292 I293 S294 G298 P299 W300 Q303 K304 S305 S306 G307 L308 N309 L310 C311 K317 A318 W319 T328

V331 V334 L335 N336 I337 Q341 G342 N343 LEU SER LEU PRO LEU ASN ARG GLU L352 V353 E354 E362 L365 E369 E370 P371 L374 F375 S376 I377 R378 E379 P380 I381 ALA ASN ARG VAL PHE SER SER SER ARG Q391 R392 C393 F394 S395 S396 K397 V400 R401 S402 R403

C404 W405 D406 A407 C408 M409 V410 V411 D412 S416 F417 E418 F419 N420 D421 G422 A423 I424 A425 S426 M427 M428 I429 E432 R436 L439 Q442

4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α, β, γ	97.13Å 185.12Å 188.63Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.79 – 2.80 29.79 – 2.80	Depositor EDS
% Data completeness (in resolution range)	100.0 (29.79-2.80) 100.0 (29.79-2.80)	Depositor EDS
R_{merge}	0.19	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.22 (at 2.80Å)	Xtriage
Refinement program	PHENIX 1.17_3644	Depositor
R, R_{free}	0.191 , 0.249 0.191 , 0.248	Depositor DCC
R_{free} test set	2021 reflections (4.79%)	wwPDB-VP
Wilson B-factor (Å^2)	47.7	Xtriage
Anisotropy	0.398	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.28 , 58.8	EDS
L-test for twinning[2]	$< |L| > = 0.50, < L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	10868	wwPDB-VP
Average B, all atoms (Å^2)	55.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.65% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $< |L| >$, $< L^2 >$ 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

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	0.47	0/2613	0.66	0/3525
1	B	0.48	0/2783	0.65	0/3753
1	C	0.45	0/2722	0.66	0/3671
1	D	0.28	0/2539	0.49	0/3423
All	All	0.43	0/10657	0.62	0/14372

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 ⓘ

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	2572	0	2506	24	0
1	B	2740	0	2672	22	0
1	C	2679	0	2637	24	0
1	D	2499	0	2440	52	0
2	A	44	0	26	0	0
2	B	44	0	26	1	0
2	C	44	0	26	1	0
2	D	44	0	24	4	0
3	A	63	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	71	0	0	1	0
3	C	68	0	0	0	0
All	All	10868	0	10357	124	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 6.

All (124) 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:280:ILE:HG12	1:B:409:MSE:HG2	1.74	0.70
1:A:224:LEU:HG	1:A:427:MSE:HE2	1.77	0.67
1:C:76:LYS:HB2	1:C:163:THR:HG21	1.75	0.67
1:C:280:ILE:HG12	1:C:409:MSE:HG2	1.77	0.66
1:D:222:ILE:HB	1:D:274:ALA:HB3	1.78	0.65
1:D:308:LEU:HB3	1:D:375:PHE:HE1	1.61	0.65
1:D:224:LEU:HD21	1:D:278:VAL:HG21	1.78	0.65
1:D:291:TYR:OH	1:D:305:SER:OG	2.16	0.64
1:A:76:LYS:HB2	1:A:163:THR:HG21	1.80	0.63
1:D:319:TRP:HE1	1:D:378:ARG:HH22	1.46	0.63
1:D:289:SER:N	1:D:305:SER:O	2.23	0.63
1:D:74:VAL:HG21	1:D:144:TYR:CD1	2.35	0.61
1:D:76:LYS:HB3	1:D:118:HIS:CE1	2.35	0.61
1:A:70:ARG:NH1	1:A:151:TRP:O	2.33	0.61
1:A:114:ARG:HD2	1:A:187:ARG:HD2	1.81	0.61
1:B:197:ARG:NH2	1:B:204:GLU:OE2	2.33	0.61
1:A:426:SER:O	1:A:427:MSE:HE3	2.02	0.60
1:D:274:ALA:HB2	1:D:278:VAL:HG23	1.83	0.59
1:A:331:VAL:HG11	1:A:356:VAL:HG23	1.85	0.59
1:D:317:LYS:HG3	1:D:365:LEU:HD22	1.82	0.58
1:A:426:SER:C	1:A:427:MSE:HE3	2.24	0.58
1:D:337:ILE:O	1:D:341:GLN:HG2	2.04	0.57
1:A:159:GLY:HA3	1:A:163:THR:HG21	1.87	0.57
1:B:76:LYS:HB2	1:B:163:THR:HG21	1.87	0.56
1:D:408:CYS:HA	1:D:419:PHE:N	2.21	0.55
1:A:203:PRO:O	1:A:207:GLN:HG3	2.06	0.55
1:C:80:TYR:CE1	1:C:112:LEU:HD13	2.41	0.54
1:C:114:ARG:HD2	1:C:187:ARG:HD2	1.89	0.54
1:C:114:ARG:NH1	1:C:184:ASP:OD1	2.40	0.54
1:D:76:LYS:HB2	1:D:163:THR:HG21	1.90	0.54
1:D:404:CYS:O	1:D:421:ASP:HB2	2.08	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:291:TYR:OH	1:A:305:SER:OG	2.26	0.53
1:A:280:ILE:HG12	1:A:409:MSE:HG2	1.90	0.52
1:C:310:LEU:HD22	1:C:427:MSE:HG3	1.90	0.52
1:D:226:LEU:O	1:D:268:GLN:N	2.43	0.52
1:B:310:LEU:HG	1:B:375:PHE:HD1	1.74	0.52
1:D:238:LEU:HD21	1:D:416:SER:HB3	1.90	0.52
1:B:188:SER:O	1:B:188:SER:OG	2.22	0.52
1:A:402:SER:HB2	1:A:419:PHE:CE2	2.46	0.51
1:C:222:ILE:HB	1:C:274:ALA:HB3	1.92	0.51
1:D:308:LEU:HB3	1:D:375:PHE:CE1	2.44	0.51
1:A:114:ARG:NH1	1:A:184:ASP:OD1	2.44	0.51
1:A:222:ILE:HB	1:A:274:ALA:HB3	1.93	0.51
1:A:317:LYS:HG3	1:A:365:LEU:HD22	1.93	0.51
1:D:397:LYS:NZ	1:D:426:SER:HB3	2.25	0.51
1:C:346:LEU:HD12	1:C:347:PRO:HD2	1.94	0.50
1:D:165:LEU:HD11	1:D:276:ASN:ND2	2.27	0.50
1:B:322:ASN:OD1	2:B:501:NAD:N7N	2.44	0.50
1:B:211:ARG:NH2	1:B:213:GLU:OE1	2.43	0.49
1:D:177:PRO:HB3	1:D:216:TRP:CZ3	2.47	0.49
1:A:137:ARG:NH1	1:A:148:THR:HG22	2.28	0.49
1:D:70:ARG:HG2	1:D:135:GLU:HB3	1.94	0.49
1:D:291:TYR:CE1	1:D:303:GLN:HB3	2.49	0.48
1:D:227:GLU:HG3	1:D:424:ILE:HB	1.94	0.48
1:C:177:PRO:HB3	1:C:216:TRP:CZ3	2.48	0.48
1:D:159:GLY:HA3	1:D:163:THR:HG21	1.94	0.48
1:B:317:LYS:HG3	1:B:365:LEU:HD22	1.95	0.48
1:B:392:ARG:NH2	3:B:606:HOH:O	2.46	0.48
1:D:418:GLU:HG2	1:D:420:ASN:HD21	1.77	0.48
1:C:223:ARG:HB3	1:C:433:ASP:OD2	2.13	0.47
1:D:184:ASP:OD1	1:D:187:ARG:NH1	2.46	0.47
1:C:425:ALA:CB	1:C:427:MSE:HE1	2.44	0.47
1:C:154:ALA:HB2	1:C:177:PRO:HG2	1.96	0.47
1:C:277:GLU:HG3	1:C:309:ASN:OD1	2.14	0.47
1:C:120:LYS:HE2	1:C:120:LYS:HB3	1.58	0.47
1:C:177:PRO:HB3	1:C:216:TRP:HZ3	1.80	0.47
1:D:139:VAL:HG13	1:D:143:GLU:HB2	1.98	0.46
1:B:120:LYS:HB3	1:B:120:LYS:HE2	1.66	0.46
1:A:277:GLU:HG3	1:A:309:ASN:OD1	2.15	0.46
1:D:309:ASN:HD21	1:D:311:CYS:HB3	1.81	0.45
1:A:292:GLU:OE2	1:A:403:ARG:NH1	2.49	0.45
1:D:156:ILE:HA	1:D:179:ILE:O	2.16	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:403:ARG:HD3	1:B:403:ARG:HA	1.79	0.45
1:C:221:ARG:HG2	1:C:275:LEU:HA	1.99	0.44
1:C:402:SER:HB2	1:C:419:PHE:CE2	2.52	0.44
1:D:80:TYR:HA	1:D:111:LEU:HD21	1.99	0.44
1:D:227:GLU:HB3	1:D:267:PRO:HA	2.00	0.44
1:D:401:ARG:HD3	1:D:403:ARG:HH21	1.83	0.44
1:B:291:TYR:HH	1:B:305:SER:HG	1.66	0.44
1:D:317:LYS:HE3	1:D:365:LEU:HB3	1.99	0.44
1:B:235:PRO:HB3	1:B:417:PHE:CE1	2.53	0.44
1:D:276:ASN:ND2	2:D:501:NAD:N7A	2.60	0.44
1:D:377:ILE:HG21	1:D:380:PRO:HB3	2.00	0.43
1:B:176:LYS:HB2	1:B:176:LYS:HE3	1.76	0.43
1:C:403:ARG:HA	1:C:403:ARG:HD3	1.88	0.43
1:A:322:ASN:HD22	1:A:325:ARG:HE	1.66	0.43
1:C:311:CYS:SG	1:C:374:LEU:HB3	2.58	0.43
1:B:71:VAL:O	1:B:136:VAL:HA	2.19	0.43
1:C:322:ASN:OD1	2:C:501:NAD:N7N	2.52	0.43
1:B:402:SER:HB2	1:B:419:PHE:CE2	2.53	0.43
1:D:76:LYS:HB2	1:D:159:GLY:HA3	2.01	0.43
2:D:501:NAD:N1N	2:D:501:NAD:H52A	2.33	0.42
1:D:79:ARG:HD3	1:D:114:ARG:NH1	2.35	0.42
1:D:280:ILE:HG12	1:D:409:MSE:HG3	2.02	0.42
1:C:439:LEU:HD23	1:C:439:LEU:HA	1.80	0.42
1:A:310:LEU:HD22	1:A:427:MSE:HG3	2.01	0.42
1:B:129:LEU:HD23	1:B:206:LEU:HD11	2.00	0.42
1:C:276:ASN:HB3	1:C:277:GLU:OE1	2.20	0.42
1:D:175:LEU:O	1:D:436:ARG:NH1	2.47	0.42
1:A:375:PHE:O	1:A:392:ARG:HA	2.19	0.42
1:C:290:TYR:OH	1:C:302:LYS:HD3	2.19	0.42
1:D:176:LYS:HE3	1:D:176:LYS:HB2	1.95	0.41
1:D:280:ILE:HD12	1:D:310:LEU:HD13	2.02	0.41
1:A:428:MSE:HE2	1:A:428:MSE:HB3	2.01	0.41
1:A:129:LEU:HD23	1:A:206:LEU:HD11	2.02	0.41
1:B:178:VAL:HG11	1:B:435:LEU:HD11	2.01	0.41
1:B:277:GLU:HG3	1:B:309:ASN:OD1	2.20	0.41
1:D:409:MSE:N	1:D:417:PHE:O	2.53	0.41
2:D:501:NAD:H52A	2:D:501:NAD:C6N	2.50	0.41
1:D:319:TRP:HB2	2:D:501:NAD:O2D	2.20	0.41
1:D:114:ARG:NE	1:D:187:ARG:HD3	2.36	0.41
1:D:408:CYS:HA	1:D:419:PHE:H	1.84	0.41
1:B:76:LYS:CB	1:B:163:THR:HG21	2.50	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:185:PRO:HB2	1:D:186:GLU:H	1.79	0.41
1:D:375:PHE:O	1:D:392:ARG:HA	2.21	0.41
1:A:326:VAL:HG22	1:A:360:TYR:CD2	2.55	0.41
1:B:185:PRO:HB3	1:B:196:VAL:HG22	2.03	0.41
1:B:238:LEU:HD23	1:B:238:LEU:HA	1.90	0.40
1:C:72:VAL:HG13	1:C:155:VAL:HG13	2.03	0.40
1:D:212:GLY:HA2	1:D:214:PHE:CE1	2.57	0.40
1:D:281:GLY:O	1:D:407:ALA:HB1	2.20	0.40
1:D:74:VAL:HA	1:D:139:VAL:O	2.21	0.40
1:D:291:TYR:CD1	1:D:303:GLN:HB3	2.56	0.40
1:D:374:LEU:HD13	1:D:394:PHE:CZ	2.57	0.40

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	320/398 (80%)	309 (97%)	11 (3%)	0	100	100
1	B	340/398 (85%)	324 (95%)	16 (5%)	0	100	100
1	C	334/398 (84%)	320 (96%)	14 (4%)	0	100	100
1	D	306/398 (77%)	290 (95%)	13 (4%)	3 (1%)	15	44
All	All	1300/1592 (82%)	1243 (96%)	54 (4%)	3 (0%)	47	78

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	185	PRO
1	D	353	VAL
1	D	354	GLU

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	273/341 (80%)	261 (96%)	12 (4%)	28	61
1	B	289/341 (85%)	274 (95%)	15 (5%)	23	55
1	C	288/341 (84%)	279 (97%)	9 (3%)	40	74
1	D	266/341 (78%)	258 (97%)	8 (3%)	41	75
All	All	1116/1364 (82%)	1072 (96%)	44 (4%)	32	66

All (44) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	120	LYS
1	A	142	ARG
1	A	197	ARG
1	A	265	SER
1	A	268	GLN
1	A	291	TYR
1	A	328	THR
1	A	352	LEU
1	A	391	GLN
1	A	404	CYS
1	A	427	MSE
1	A	440	LEU
1	B	95	GLU
1	B	101	LEU
1	B	103	LEU
1	B	109	SER
1	B	142	ARG
1	B	147	GLU
1	B	178	VAL
1	B	188	SER
1	B	189	GLU
1	B	291	TYR
1	B	354	GLU
1	B	372	LYS

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Mol	Chain	Res	Type
1	B	391	GLN
1	B	427	MSE
1	B	428	MSE
1	C	101	LEU
1	C	111	LEU
1	C	142	ARG
1	C	197	ARG
1	C	223	ARG
1	C	291	TYR
1	C	343	ASN
1	C	346	LEU
1	C	391	GLN
1	D	119	THR
1	D	291	TYR
1	D	378	ARG
1	D	391	GLN
1	D	404	CYS
1	D	420	ASN
1	D	427	MSE
1	D	428	MSE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 monosaccharides in this entry.

5.6 Ligand geometry ⓘ

4 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	A	501	-	42,48,48	0.63	0	50,73,73	0.85	3 (6%)
2	NAD	B	501	-	42,48,48	0.69	1 (2%)	50,73,73	0.91	3 (6%)
2	NAD	C	501	-	42,48,48	0.62	0	50,73,73	0.87	3 (6%)
2	NAD	D	501	-	42,48,48	0.66	1 (2%)	50,73,73	0.97	3 (6%)

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	A	501	-	-	7/26/62/62	0/5/5/5
2	NAD	B	501	-	-	7/26/62/62	0/5/5/5
2	NAD	C	501	-	-	9/26/62/62	0/5/5/5
2	NAD	D	501	-	-	7/26/62/62	0/5/5/5

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	501	NAD	C2N-N1N	2.84	1.38	1.35
2	D	501	NAD	C2N-N1N	2.46	1.38	1.35

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	501	NAD	C3D-C2D-C1D	3.45	106.17	100.98
2	D	501	NAD	C3D-C2D-C1D	3.26	105.89	100.98
2	C	501	NAD	C3D-C2D-C1D	3.05	105.57	100.98
2	A	501	NAD	C3D-C2D-C1D	2.98	105.46	100.98
2	C	501	NAD	C6N-N1N-C2N	-2.61	119.59	121.97
2	A	501	NAD	C6N-N1N-C2N	-2.54	119.66	121.97
2	B	501	NAD	C6N-N1N-C2N	-2.51	119.69	121.97

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	C	501	NAD	C5A-C6A-N6A	2.43	124.04	120.35
2	B	501	NAD	C5A-C6A-N6A	2.25	123.77	120.35
2	D	501	NAD	C6N-N1N-C2N	-2.13	120.03	121.97
2	D	501	NAD	C5A-C6A-N6A	2.09	123.53	120.35
2	A	501	NAD	C5A-C6A-N6A	2.01	123.41	120.35

There are no chirality outliers.

All (30) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	501	NAD	C5B-O5B-PA-O1A
2	A	501	NAD	C5B-O5B-PA-O3
2	A	501	NAD	C5D-O5D-PN-O1N
2	A	501	NAD	O4D-C1D-N1N-C6N
2	B	501	NAD	C5B-O5B-PA-O1A
2	B	501	NAD	O4D-C1D-N1N-C6N
2	C	501	NAD	C5B-O5B-PA-O1A
2	C	501	NAD	C5B-O5B-PA-O3
2	C	501	NAD	C5D-O5D-PN-O1N
2	C	501	NAD	O4D-C1D-N1N-C6N
2	D	501	NAD	O4D-C4D-C5D-O5D
2	D	501	NAD	C3D-C4D-C5D-O5D
2	A	501	NAD	C3B-C4B-C5B-O5B
2	A	501	NAD	O4B-C4B-C5B-O5B
2	D	501	NAD	PA-O3-PN-O1N
2	B	501	NAD	PN-O3-PA-O5B
2	B	501	NAD	O4B-C4B-C5B-O5B
2	B	501	NAD	PA-O3-PN-O2N
2	C	501	NAD	PA-O3-PN-O1N
2	D	501	NAD	PA-O3-PN-O2N
2	A	501	NAD	C4B-C5B-O5B-PA
2	C	501	NAD	C4B-C5B-O5B-PA
2	C	501	NAD	O4B-C4B-C5B-O5B
2	B	501	NAD	PA-O3-PN-O1N
2	C	501	NAD	PA-O3-PN-O2N
2	D	501	NAD	O4B-C4B-C5B-O5B
2	C	501	NAD	C3B-C4B-C5B-O5B
2	B	501	NAD	C5D-O5D-PN-O1N
2	D	501	NAD	C5B-O5B-PA-O1A
2	D	501	NAD	C5D-O5D-PN-O1N

There are no ring outliers.
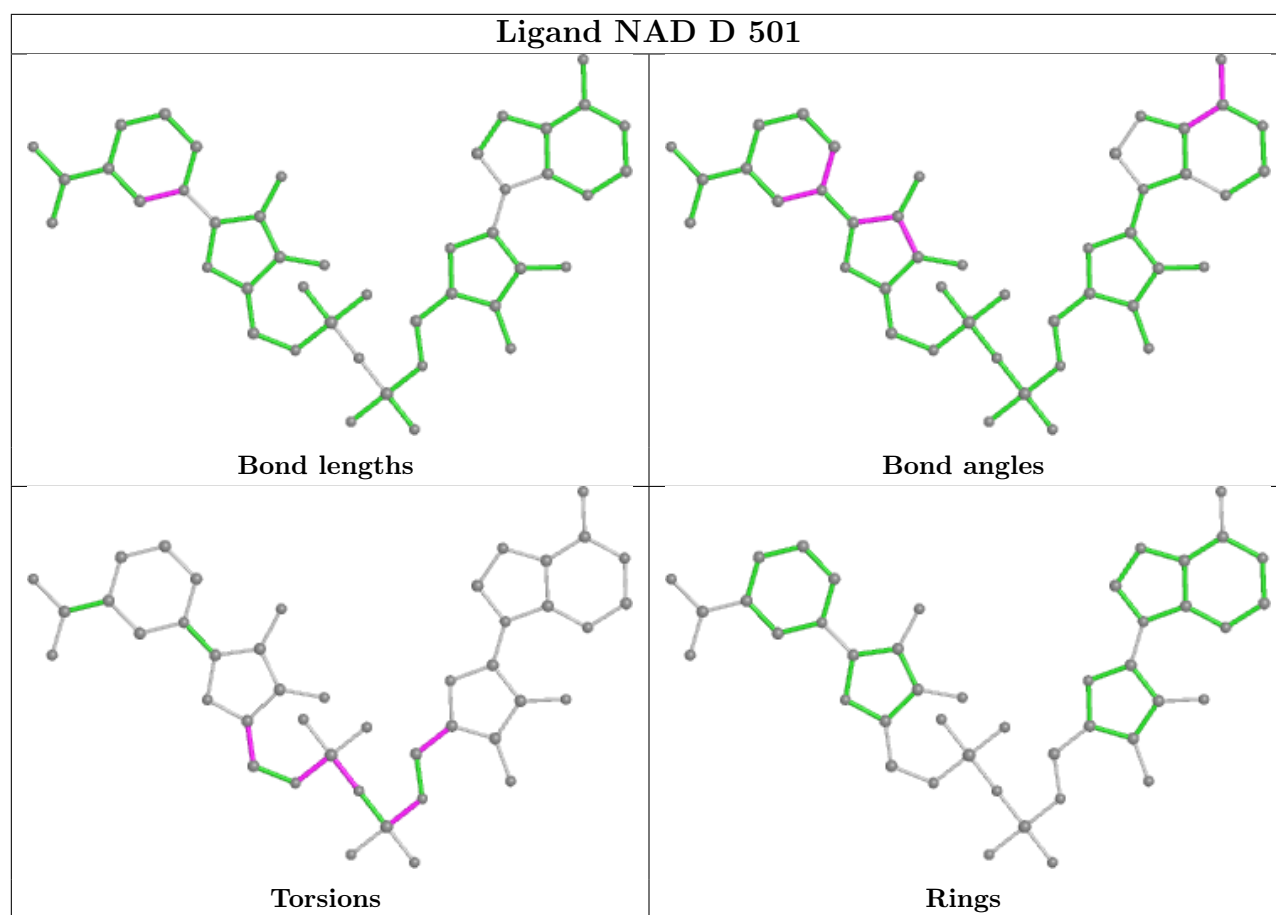
3 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	501	NAD	1	0
2	C	501	NAD	1	0
2	D	501	NAD	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 then 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 NAD A 501

Bond lengths

Bond angles

Torsions

Rings

Ligand NAD B 501

Bond lengths

Bond angles

Torsions

Rings

Ligand NAD C 501

Bond lengths

Bond angles

Torsions

Rings

Ligand NAD D 501

Bond lengths

Bond angles

Torsions

Rings
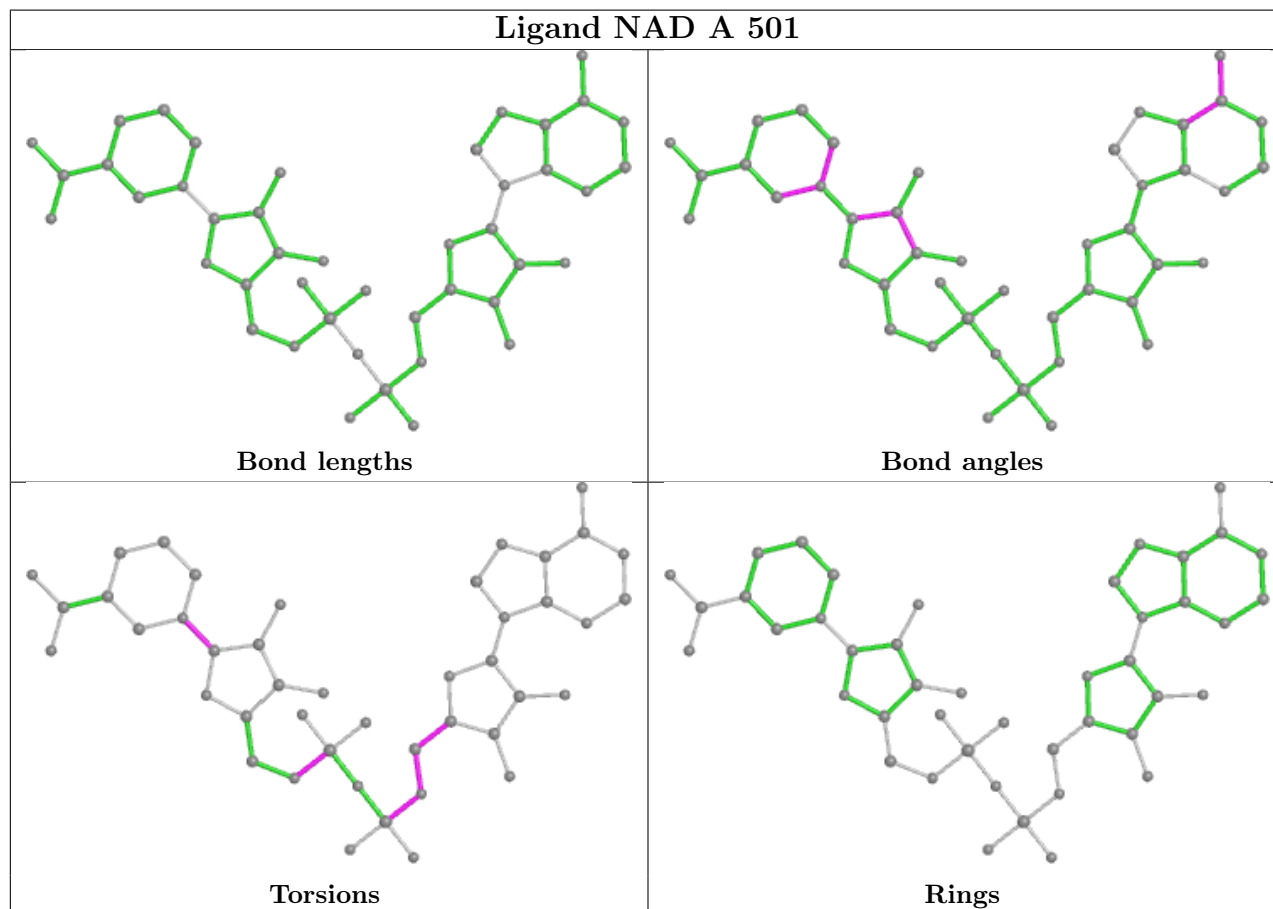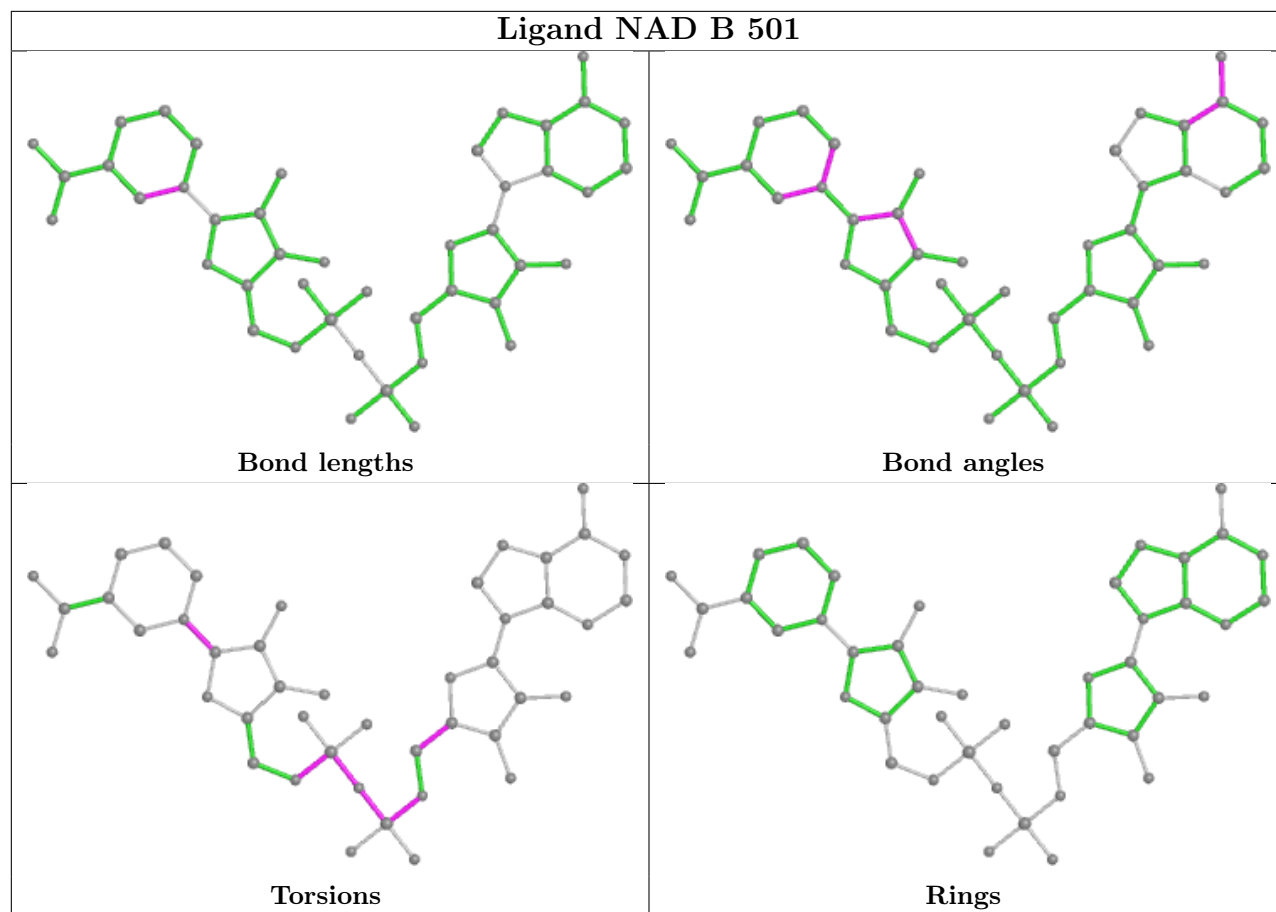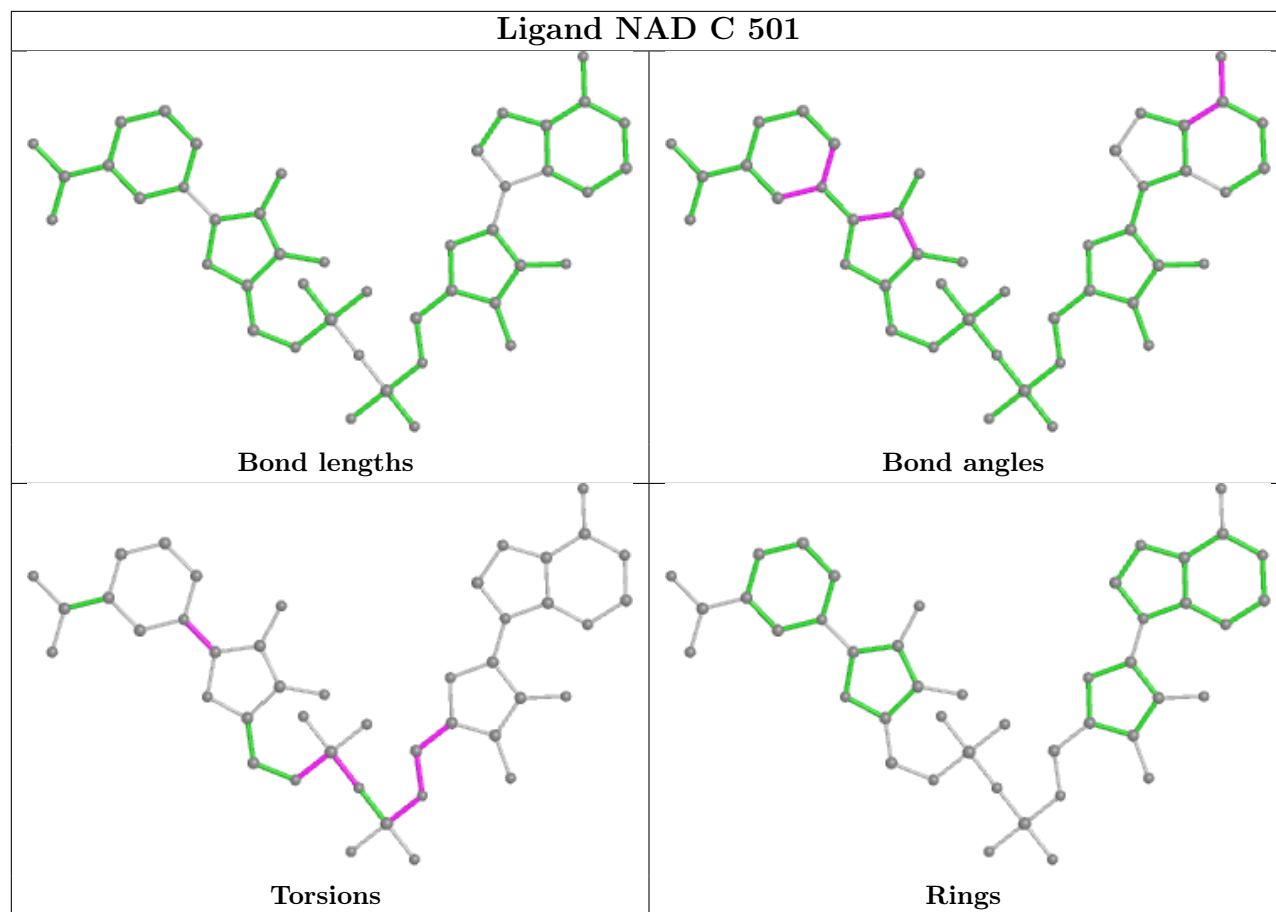
5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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(Å²)	Q<0.9
1	A	326/398 (81%)	-0.29	8 (2%)	57	47	17, 45, 99, 190	0
1	B	346/398 (86%)	-0.27	16 (4%)	32	22	18, 40, 99, 203	0
1	C	338/398 (84%)	-0.11	11 (3%)	46	36	25, 47, 112, 152	0
1	D	314/398 (78%)	2.31	148 (47%)	0	0	27, 65, 99, 135	314 (100%)
All	All	1324/1592 (83%)	0.38	183 (13%)	2	1	17, 50, 105, 203	314 (23%)

All (183) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	281	GLY	14.4
1	D	241	GLN	12.2
1	D	85	GLN	10.1
1	D	304	LYS	8.2
1	D	404	CYS	7.4
1	D	267	PRO	7.0
1	D	395	SER	7.0
1	D	288	ALA	7.0
1	D	393	CYS	6.9
1	D	60	SER	6.8
1	D	442	GLN	6.8
1	D	110	GLY	6.7
1	D	116	HIS	6.7
1	D	210	TYR	6.6
1	D	132	GLU	6.6
1	D	113	GLU	6.6
1	D	186	GLU	6.5
1	D	84	GLN	6.3
1	D	240	GLU	6.0
1	D	300	TRP	5.9
1	D	422	GLY	5.9

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Mol	Chain	Res	Type	RSRZ
1	D	58	CYS	5.8
1	D	128	SER	5.7
1	D	407	ALA	5.6
1	D	229	THR	5.5
1	D	299	PRO	5.3
1	D	352	LEU	5.2
1	D	400	VAL	5.0
1	D	406	ASP	5.0
1	D	376	SER	5.0
1	D	232	ASN	4.9
1	D	211	ARG	4.9
1	D	405	TRP	4.7
1	B	91	GLU	4.7
1	D	129	LEU	4.6
1	D	421	ASP	4.6
1	D	371	PRO	4.6
1	D	290	TYR	4.5
1	D	86	ARG	4.4
1	B	96	ASP	4.4
1	D	59	GLY	4.3
1	D	439	LEU	4.3
1	D	306	SER	4.2
1	B	93	SER	4.1
1	D	289	SER	4.1
1	D	124	HIS	4.1
1	D	293	ILE	4.1
1	D	394	PHE	4.0
1	B	265	SER	4.0
1	B	99	GLN	4.0
1	B	63	ASP	3.9
1	D	381	ILE	3.9
1	D	189	GLU	3.9
1	D	280	ILE	3.8
1	D	209	PHE	3.8
1	D	233	PRO	3.8
1	D	198	TYR	3.8
1	D	271	PRO	3.8
1	D	187	ARG	3.7
1	D	197	ARG	3.7
1	D	268	GLN	3.7
1	D	191	HIS	3.7
1	D	423	ALA	3.7

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Mol	Chain	Res	Type	RSRZ
1	D	224	LEU	3.7
1	D	401	ARG	3.7
1	D	274	ALA	3.6
1	D	107	SER	3.6
1	D	125	ILE	3.6
1	D	163	THR	3.5
1	D	378	ARG	3.5
1	D	228	GLY	3.5
1	D	63	ASP	3.5
1	D	408	CYS	3.4
1	D	343	ASN	3.4
1	D	69	SER	3.3
1	C	186	GLU	3.3
1	D	276	ASN	3.3
1	D	131	ASN	3.3
1	D	272	VAL	3.3
1	D	188	SER	3.2
1	C	61	ARG	3.2
1	C	60	SER	3.2
1	D	66	PHE	3.2
1	D	213	GLU	3.2
1	D	298	GLY	3.1
1	D	175	LEU	3.1
1	D	416	SER	3.1
1	C	343	ASN	3.1
1	A	341	GLN	3.1
1	D	133	GLY	3.1
1	D	216	TRP	3.1
1	D	292	GLU	3.1
1	C	109	SER	3.1
1	D	184	ASP	3.0
1	D	214	PHE	3.0
1	B	100	LEU	3.0
1	B	352	LEU	3.0
1	B	186	GLU	3.0
1	D	217	LEU	3.0
1	D	309	ASN	2.9
1	D	392	ARG	2.9
1	D	153	ASP	2.9
1	D	122	VAL	2.9
1	D	196	VAL	2.9
1	B	188	SER	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	186	GLU	2.9
1	D	234	VAL	2.9
1	D	269	LEU	2.9
1	D	294	SER	2.8
1	D	182	ASN	2.8
1	D	420	ASN	2.8
1	C	108	TYR	2.8
1	D	319	TRP	2.8
1	D	169	SER	2.8
1	A	80	TYR	2.7
1	D	310	LEU	2.7
1	D	419	PHE	2.7
1	A	85	GLN	2.7
1	D	412	ASP	2.7
1	B	383	ASN	2.7
1	D	238	LEU	2.6
1	D	377	ILE	2.5
1	D	118	HIS	2.5
1	D	278	VAL	2.5
1	D	270	LEU	2.5
1	D	425	ALA	2.5
1	C	84	GLN	2.5
1	D	218	TRP	2.5
1	D	429	ILE	2.5
1	D	279	PHE	2.5
1	D	200	HIS	2.5
1	D	369	GLU	2.5
1	D	432	GLU	2.5
1	D	117	ILE	2.5
1	B	264	ALA	2.4
1	D	208	LYS	2.4
1	D	155	VAL	2.4
1	D	80	TYR	2.4
1	D	391	GLN	2.4
1	B	90	ALA	2.4
1	D	61	ARG	2.4
1	D	410	VAL	2.3
1	D	79	ARG	2.3
1	D	354	GLU	2.3
1	D	65	GLY	2.3
1	D	72	VAL	2.3
1	A	120	LYS	2.3

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Mol	Chain	Res	Type	RSRZ
1	D	145	ASP	2.3
1	D	157	ALA	2.3
1	B	89	TYR	2.3
1	C	341	GLN	2.3
1	D	380	PRO	2.2
1	C	82	PHE	2.2
1	D	150	ARG	2.2
1	D	328	THR	2.2
1	D	114	ARG	2.2
1	D	331	VAL	2.2
1	C	265	SER	2.2
1	D	291	TYR	2.2
1	D	70	ARG	2.2
1	D	336	ASN	2.2
1	B	382	ALA	2.2
1	D	307	GLY	2.2
1	D	334	VAL	2.2
1	D	134	ILE	2.1
1	D	179	ILE	2.1
1	B	94	GLU	2.1
1	D	230	GLY	2.1
1	D	362	GLU	2.1
1	D	162	GLY	2.1
1	D	365	LEU	2.1
1	D	236	VAL	2.1
1	D	135	GLU	2.1
1	D	75	ALA	2.1
1	D	221	ARG	2.1
1	A	61	ARG	2.0
1	A	116	HIS	2.0
1	D	109	SER	2.0
1	D	201	SER	2.0
1	D	237	ASP	2.0
1	A	84	GLN	2.0
1	C	107	SER	2.0
1	D	166	LEU	2.0

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

There are no monosaccharides 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(Å²)	Q<0.9
2	NAD	D	501	44/44	0.34	0.63	63,93,108,118	44
2	NAD	B	501	44/44	0.96	0.13	17,30,82,104	0
2	NAD	C	501	44/44	0.96	0.13	25,40,91,118	0
2	NAD	A	501	44/44	0.96	0.14	24,42,86,111	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.
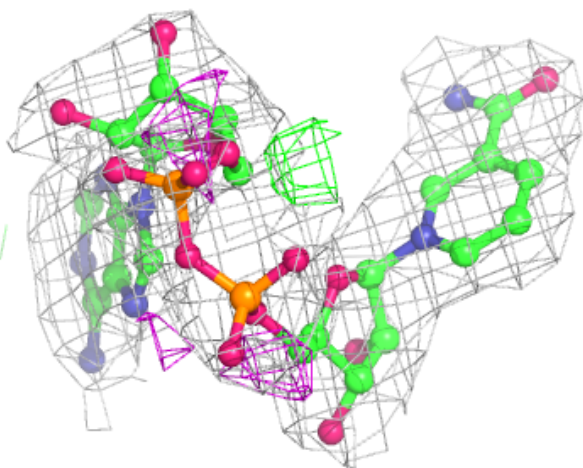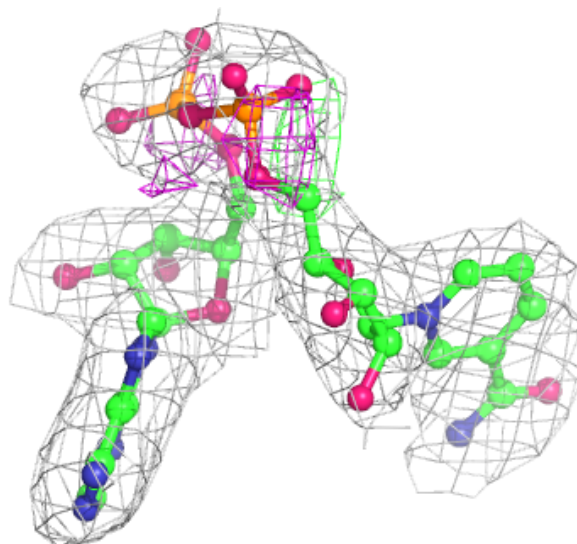
Electron density around NAD D 501:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
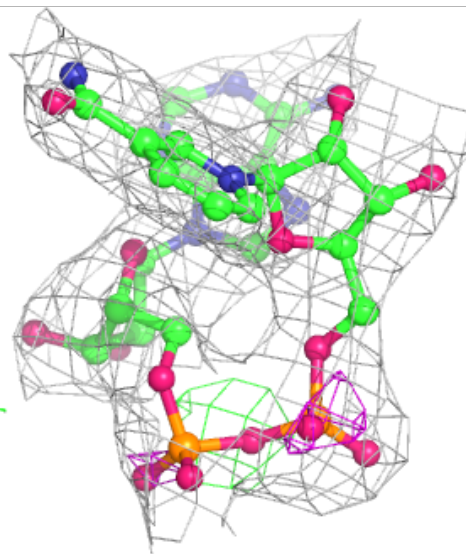mF_o-DF_c (at 3 rmsd) in purple (negative)
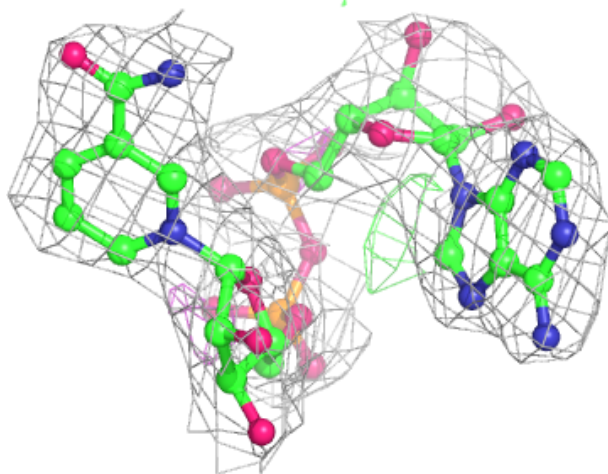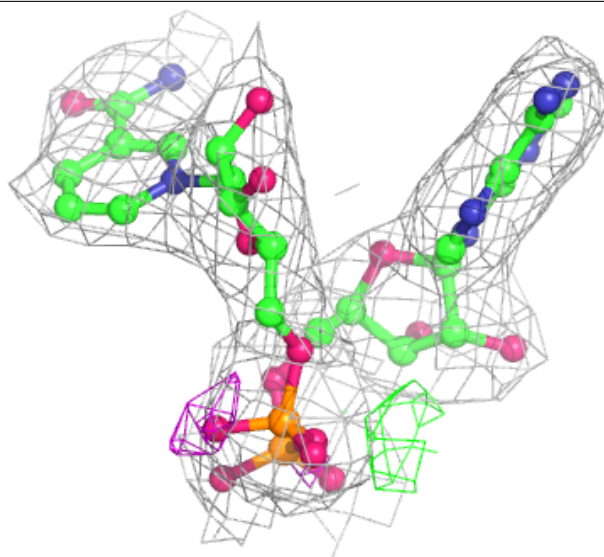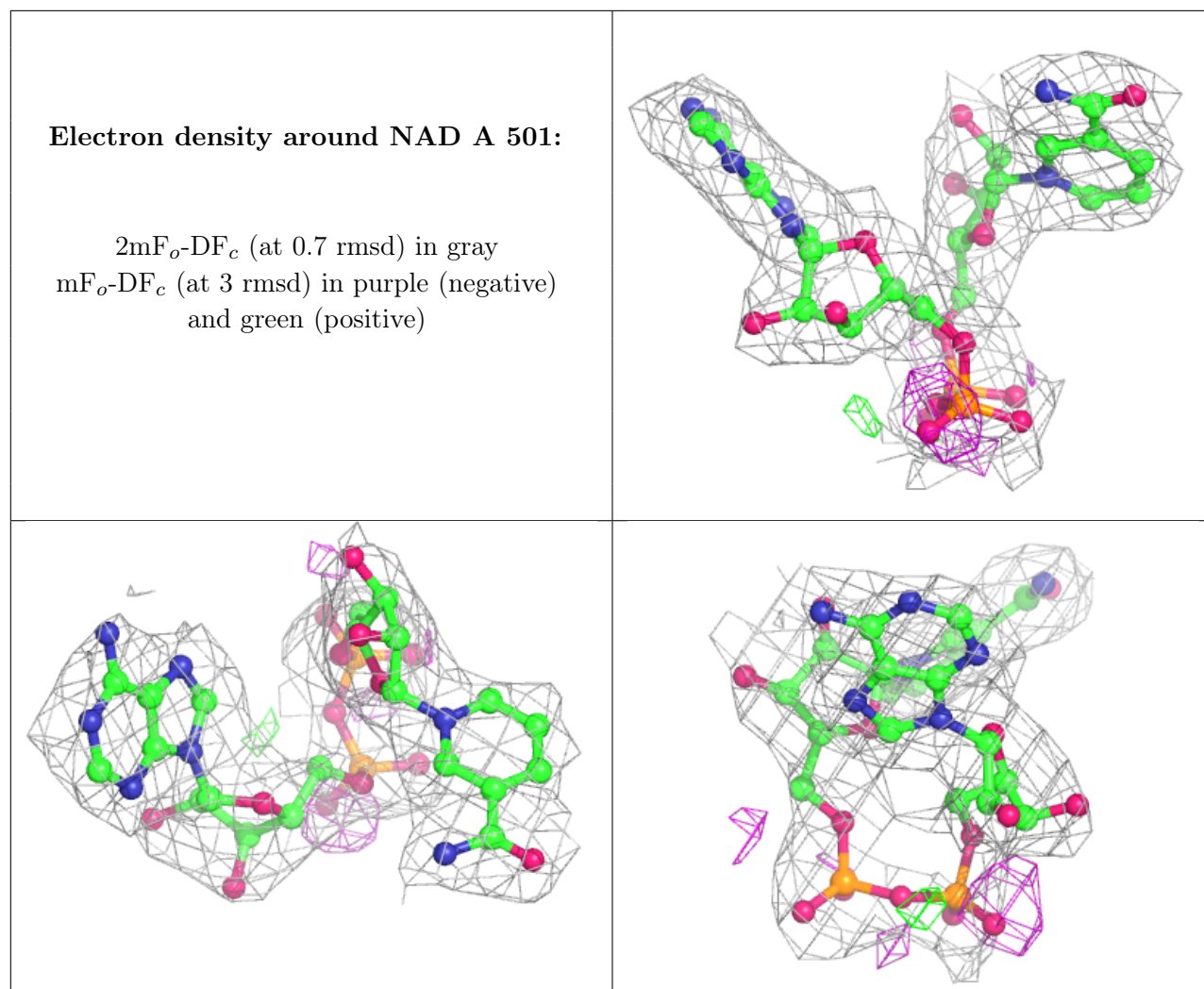and green (positive)
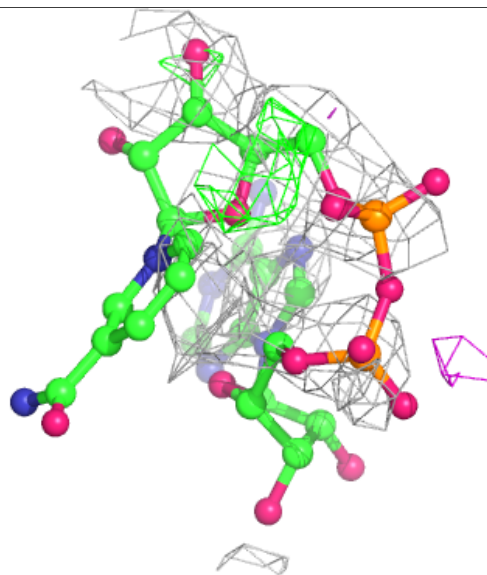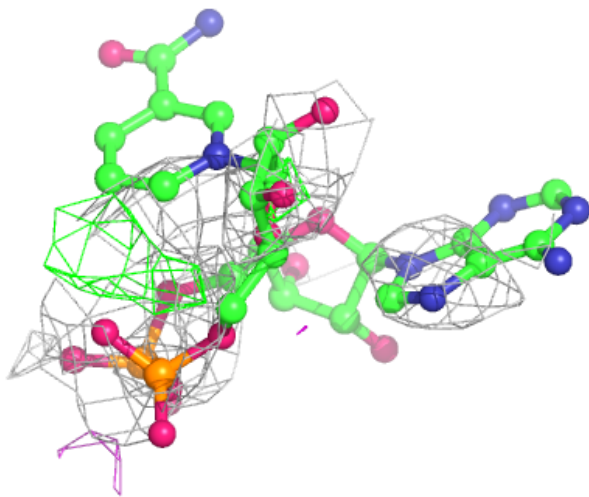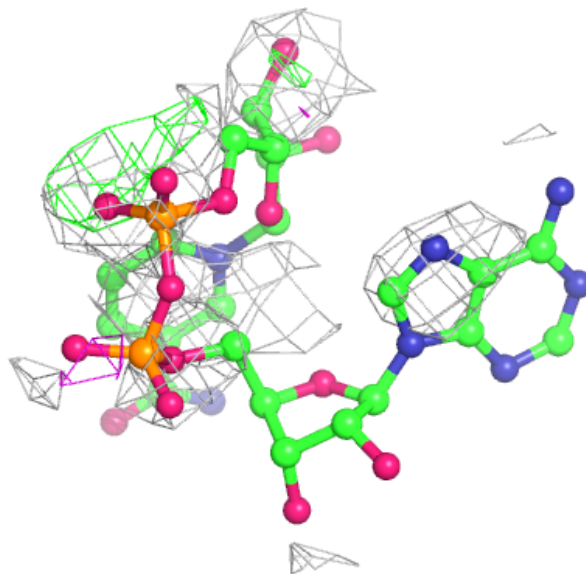
Electron density around NAD B 501:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
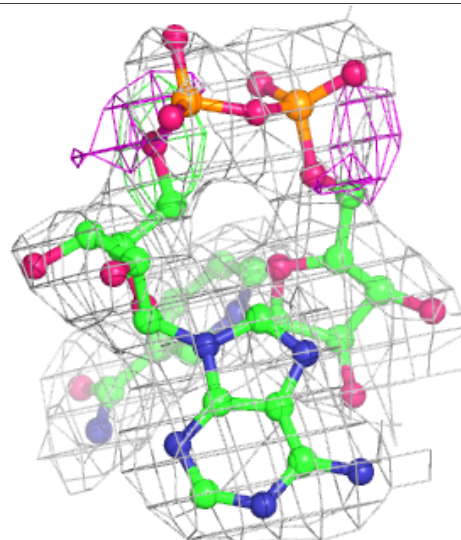
Electron density around NAD C 501:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (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)

6.5 Other polymers ⓘ

There are no such residues in this entry.