WORLDWIDE wwPDB PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report (i)

Jun 11, 2024 – 08:55 PM EDT

PDB ID	:	1DIR
Title	:	CRYSTAL STRUCTURE OF A MONOCLINIC FORM OF DIHY-DROPTERIDINE REDUCTASE FROM RAT LIVER
Authors	:	Varughese, K.I.; Su, Y.; Skinner, M.M.; Matthews, D.A.; Whitely, J.M.; Xuong, N.H.
Deposited on	:	1994-04-18
Resolution	:	2.60 Å(reported)

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

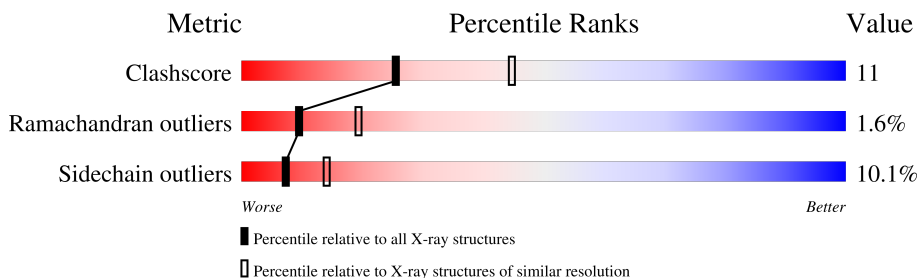|		
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	2.36.2
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

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 2.60 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
Clashscore		11
Ramachandran outliers		1.6%
Sidechain outliers		10.1%

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))
Clashscore	141614	3518 (2.60-2.60)
Ramachandran outliers	138981	3455 (2.60-2.60)
Sidechain outliers	138945	3455 (2.60-2.60)

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%

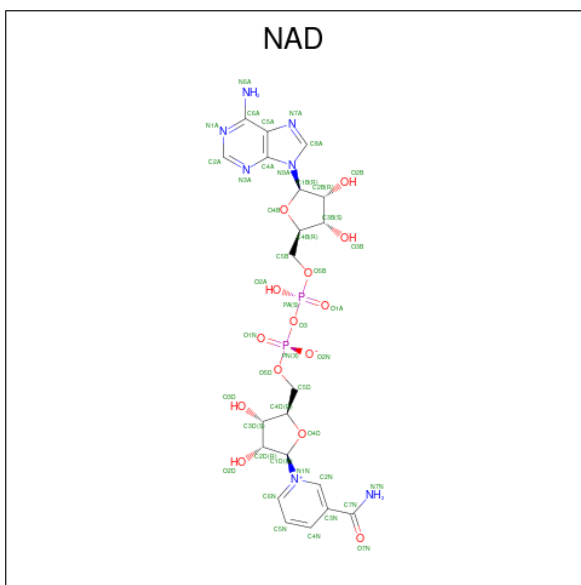| Mol	Chain	Length	Quality of chain
1	A	241	70% 24% · ·
1	B	241	67% 26% 5% ·
1	C	241	61% 27% 9% · ·
1	D	241	63% 27% 6% · ·

2 Entry composition ⓘ

There are 3 unique types of molecules in this entry. The entry contains 9292 atoms, of which 1920 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 DIHYDROPTERIDINE REDUCTASE.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	236	Total	C	H	N	O	S	0	0	0
			2160	1111	398	306	334	11			
1	B	236	Total	C	H	N	O	S	0	0	0
			2160	1111	398	306	334	11			
1	C	236	Total	C	H	N	O	S	0	0	0
			2160	1111	398	306	334	11			
1	D	236	Total	C	H	N	O	S	0	0	0
			2160	1111	398	306	334	11			

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

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	A	1	Total	C	H	N	O	P	0	0
			52	21	8	7	14	2		
2	B	1	Total	C	H	N	O	P	0	0
			52	21	8	7	14	2		

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Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	C	1	Total	C	H	N	O	P	0	0
			52	21	8	7	14	2		
2	D	1	Total	C	H	N	O	P	0	0
			52	21	8	7	14	2		

- Molecule 3 is water.

| Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	38	Total	H	O	0	0
			114	76	38		
3	B	36	Total	H	O	0	0
			108	72	36		
3	C	39	Total	H	O	0	0
			117	78	39		
3	D	35	Total	H	O	0	0
			105	70	35		

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. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.
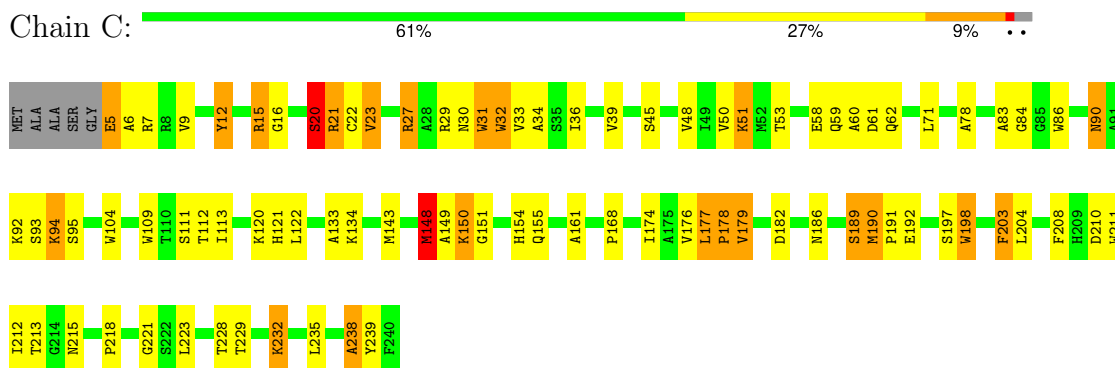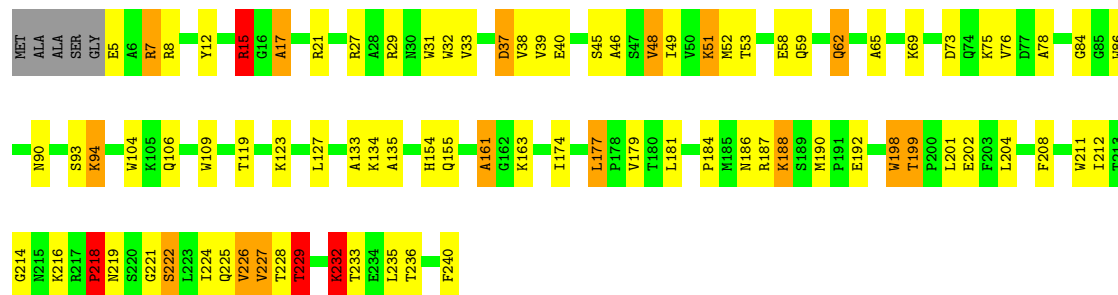
• Molecule 1: DIHYDROPTERIDINE REDUCTASE
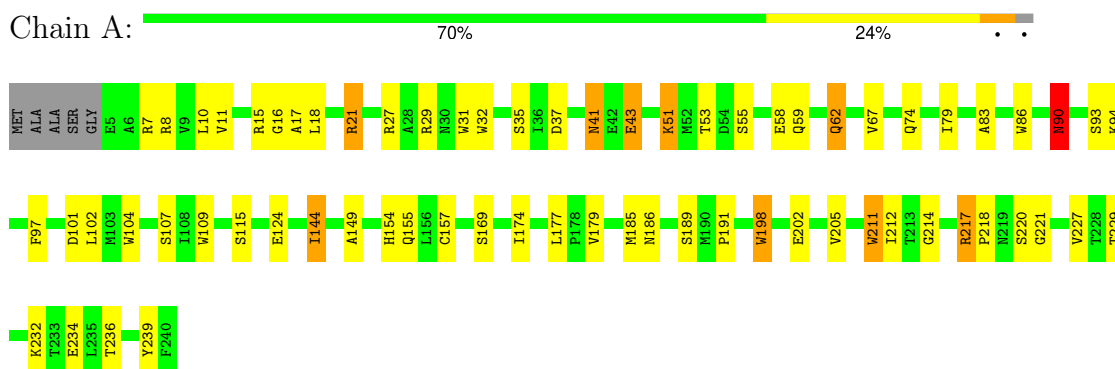
Chain A:

• Molecule 1: DIHYDROPTERIDINE REDUCTASE
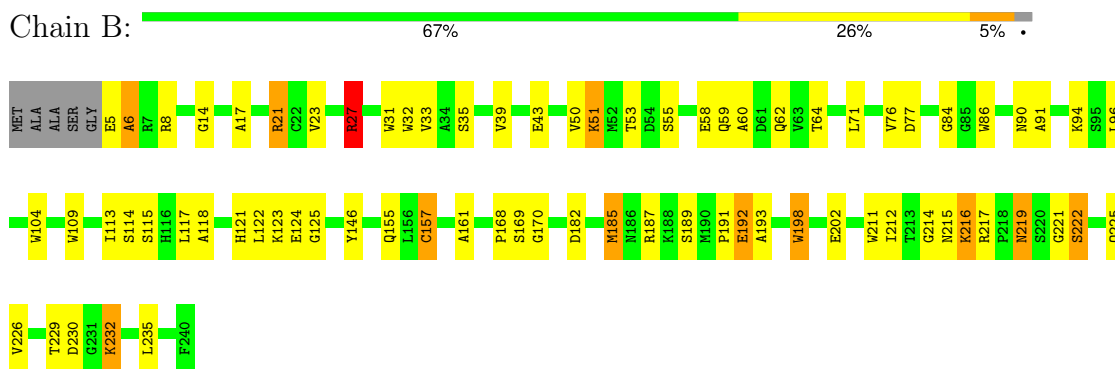
Chain B:

• Molecule 1: DIHYDROPTERIDINE REDUCTASE

Chain C:

• Molecule 1: DIHYDROPTERIDINE REDUCTASE

Chain D:

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	222.20Å 46.50Å 94.30Å 90.00° 101.10° 90.00°	Depositor
Resolution (Å)	8.00 – 2.60 45.48 – 2.54	Depositor EDS
% Data completeness (in resolution range)	(Not available) (8.00-2.60) 90.6 (45.48-2.54)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.26 (at 2.54Å)	Xtriage
Refinement program	X-PLOR	Depositor
R, R_{free}	0.168 , (Not available) 0.288 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å²)	33.1	Xtriage
Anisotropy	0.310	Xtriage
Bulk solvent k_{sol}(e/Å³), B_{sol}(Å²)	0.30 , 62.3	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.84	EDS
Total number of atoms	9292	wwPDB-VP
Average B, all atoms (Å²)	17.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.16% 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	1.01	0/1797	1.84	38/2436 (1.6%)
1	B	1.03	1/1797 (0.1%)	1.90	48/2436 (2.0%)
1	C	1.02	2/1797 (0.1%)	1.82	40/2436 (1.6%)
1	D	0.98	0/1797	1.83	37/2436 (1.5%)
All	All	1.01	3/7188 (0.0%)	1.85	163/9744 (1.7%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1
1	C	0	2
All	All	0	3

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	111	SER	CA-CB	-6.01	1.44	1.52
1	C	109	TRP	CG-CD2	-5.43	1.34	1.43
1	B	31	TRP	CD1-NE1	-5.16	1.29	1.38

The worst 5 of 163 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	27	ARG	NE-CZ-NH1	11.84	126.22	120.30
1	B	217	ARG	NE-CZ-NH2	-11.70	114.45	120.30
1	B	27	ARG	NE-CZ-NH2	-9.93	115.33	120.30
1	B	21	ARG	NE-CZ-NH2	-9.55	115.53	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	D	8	ARG	NE-CZ-NH1	9.36	124.98	120.30

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	239	TYR	Sidechain
1	C	148	MET	Mainchain
1	C	190	MET	Peptide

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	1762	398	1760	27	1
1	B	1762	398	1760	29	13
1	C	1762	398	1760	50	14
1	D	1762	398	1760	48	2
2	A	44	8	26	4	0
2	B	44	8	26	5	0
2	C	44	8	26	2	0
2	D	44	8	26	5	0
3	A	38	76	0	2	0
3	B	36	72	0	3	6
3	C	39	78	0	16	2
3	D	35	70	0	7	2
All	All	7372	1920	7144	152	20

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 11.

The worst 5 of 152 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:186:ASN:HD21	2:A:241:NAD:H72N	1.12	0.93

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:51:LYS:HE3	1:D:58:GLU:HG2	1.62	0.80
1:C:92:LYS:HG2	1:D:119:THR:HB	1.64	0.79
1:C:151:GLY:N	3:C:975:HOH:O	2.16	0.78
1:C:235:LEU:HD21	3:C:992:HOH:O	1.90	0.71

The worst 5 of 20 symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:21:ARG:HH12	3:C:991:HOH:O[4_546]	0.64	0.96
1:C:95:SER:CB	3:B:971:HOH:O[4_546]	1.43	0.77
1:B:230:ASP:OD1	1:C:93:SER:OG[4_556]	1.53	0.67
1:B:21:ARG:NH1	3:C:991:HOH:O[4_546]	1.61	0.59
1:B:230:ASP:OD2	1:C:95:SER:OG[4_556]	1.66	0.54

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	234/241 (97%)	215 (92%)	17 (7%)	2 (1%)	17	35
1	B	234/241 (97%)	224 (96%)	7 (3%)	3 (1%)	12	24
1	C	234/241 (97%)	221 (94%)	10 (4%)	3 (1%)	12	24
1	D	234/241 (97%)	211 (90%)	16 (7%)	7 (3%)	4	7
All	All	936/964 (97%)	871 (93%)	50 (5%)	15 (2%)	9	19

5 of 15 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	17	ALA
1	B	214	GLY

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Mol	Chain	Res	Type
1	B	219	ASN
1	D	93	SER
1	D	214	GLY

5.3.2 Protein sidechains ⓘ

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	185/187 (99%)	166 (90%)	19 (10%)	7	13
1	B	185/187 (99%)	171 (92%)	14 (8%)	13	26
1	C	185/187 (99%)	168 (91%)	17 (9%)	9	17
1	D	185/187 (99%)	160 (86%)	25 (14%)	4	6
All	All	740/748 (99%)	665 (90%)	75 (10%)	7	14

5 of 75 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	51	LYS
1	D	229	THR
1	D	73	ASP
1	D	192	GLU
1	B	94	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 25 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	90	ASN
1	C	155	GLN
1	D	186	ASN
1	C	154	HIS
1	D	30	ASN

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	D	241	-	42,48,48	2.93	11 (26%)	50,73,73	1.91	10 (20%)
2	NAD	C	241	-	42,48,48	2.76	12 (28%)	50,73,73	1.47	6 (12%)
2	NAD	B	241	-	42,48,48	2.97	13 (30%)	50,73,73	1.96	9 (18%)
2	NAD	A	241	-	42,48,48	2.81	13 (30%)	50,73,73	1.47	6 (12%)

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	D	241	-	-	4/26/62/62	0/5/5/5
2	NAD	C	241	-	-	6/26/62/62	0/5/5/5
2	NAD	B	241	-	-	10/26/62/62	0/5/5/5
2	NAD	A	241	-	-	4/26/62/62	0/5/5/5

The worst 5 of 49 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	241	NAD	O7N-C7N	8.24	1.39	1.24
2	B	241	NAD	O7N-C7N	8.23	1.39	1.24
2	C	241	NAD	O7N-C7N	8.23	1.39	1.24
2	D	241	NAD	PN-O3	8.06	1.68	1.59
2	B	241	NAD	PN-O3	8.01	1.68	1.59

The worst 5 of 31 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	241	NAD	C1B-N9A-C4A	-7.16	114.07	126.64
2	B	241	NAD	O4B-C1B-N9A	7.10	118.16	108.75
2	D	241	NAD	N3A-C2A-N1A	-6.02	120.50	128.67
2	A	241	NAD	N3A-C2A-N1A	-5.43	121.31	128.67
2	B	241	NAD	N3A-C2A-N1A	-5.19	121.63	128.67

There are no chirality outliers.

5 of 24 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	241	NAD	O4D-C1D-N1N-C2N
2	A	241	NAD	O4D-C1D-N1N-C6N
2	A	241	NAD	C2D-C1D-N1N-C6N
2	B	241	NAD	C5B-O5B-PA-O1A
2	B	241	NAD	C5B-O5B-PA-O2A

There are no ring outliers.

4 monomers are involved in 16 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	241	NAD	5	0
2	C	241	NAD	2	0
2	B	241	NAD	5	0
2	A	241	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
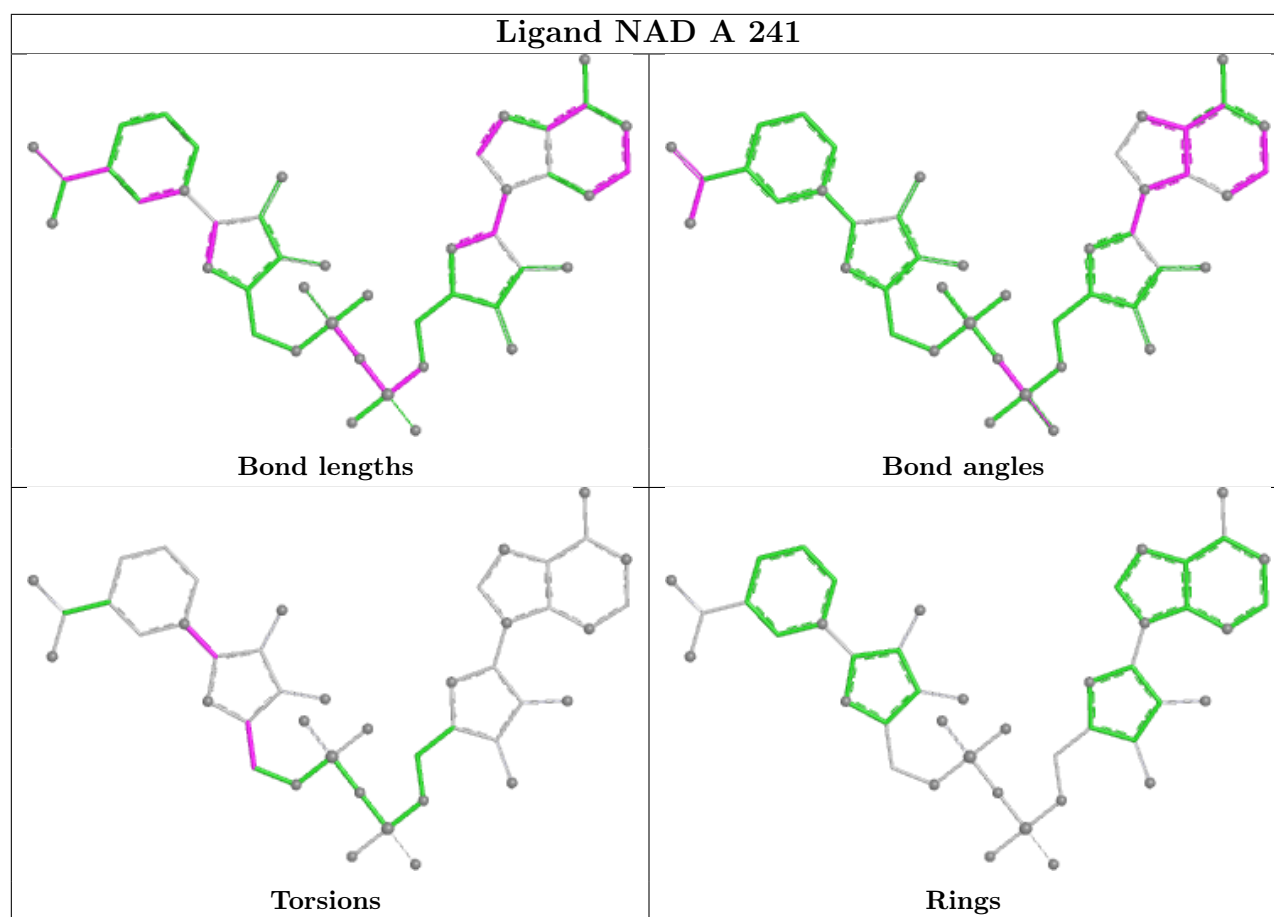
in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

Ligand NAD D 241

Bond lengths

Bond angles

Torsions

Rings

Ligand NAD C 241

Bond lengths

Bond angles

Torsions

Rings

Ligand NAD B 241

Bond lengths

Bond angles

Torsions

Rings

Ligand NAD A 241

Bond lengths

Bond angles

Torsions

Rings
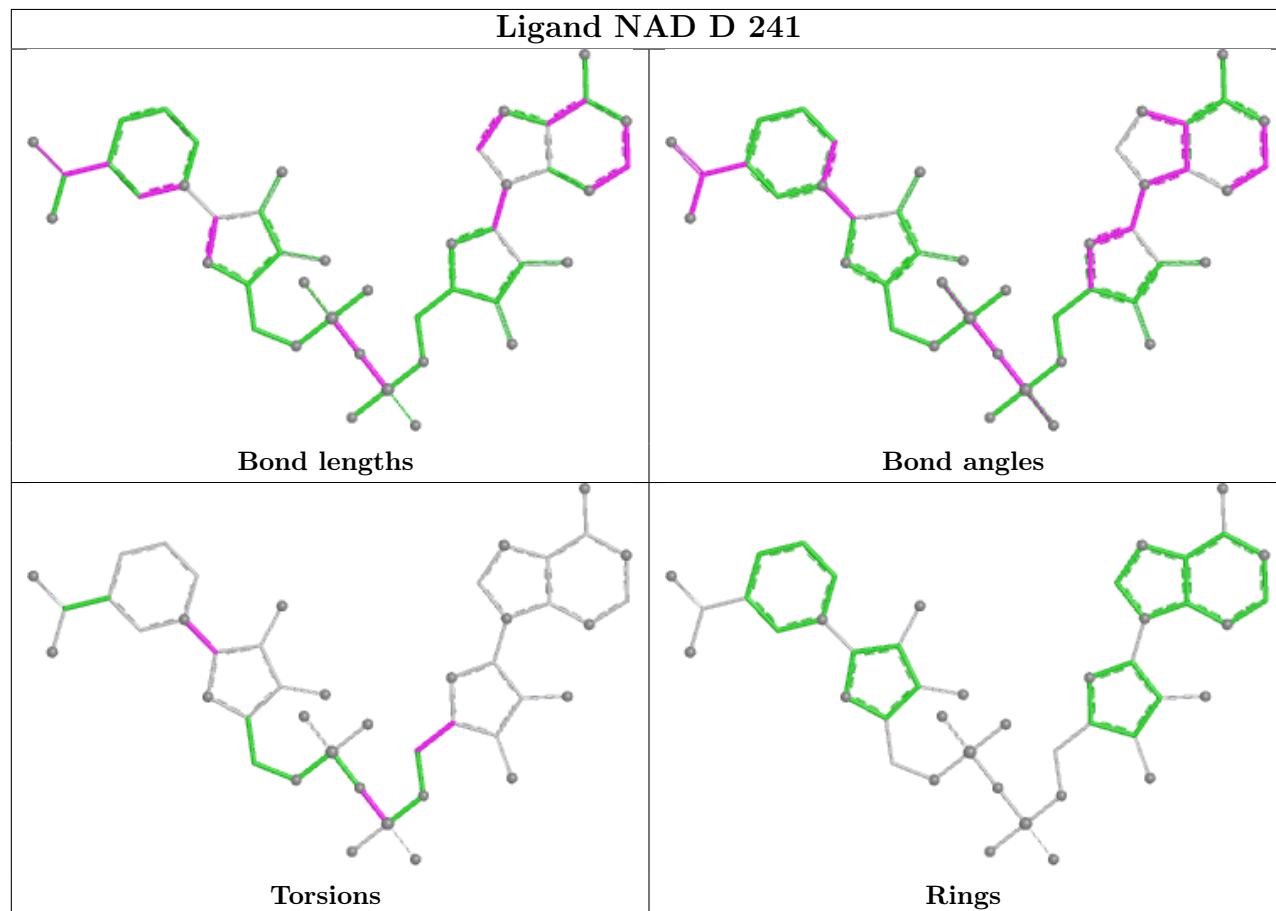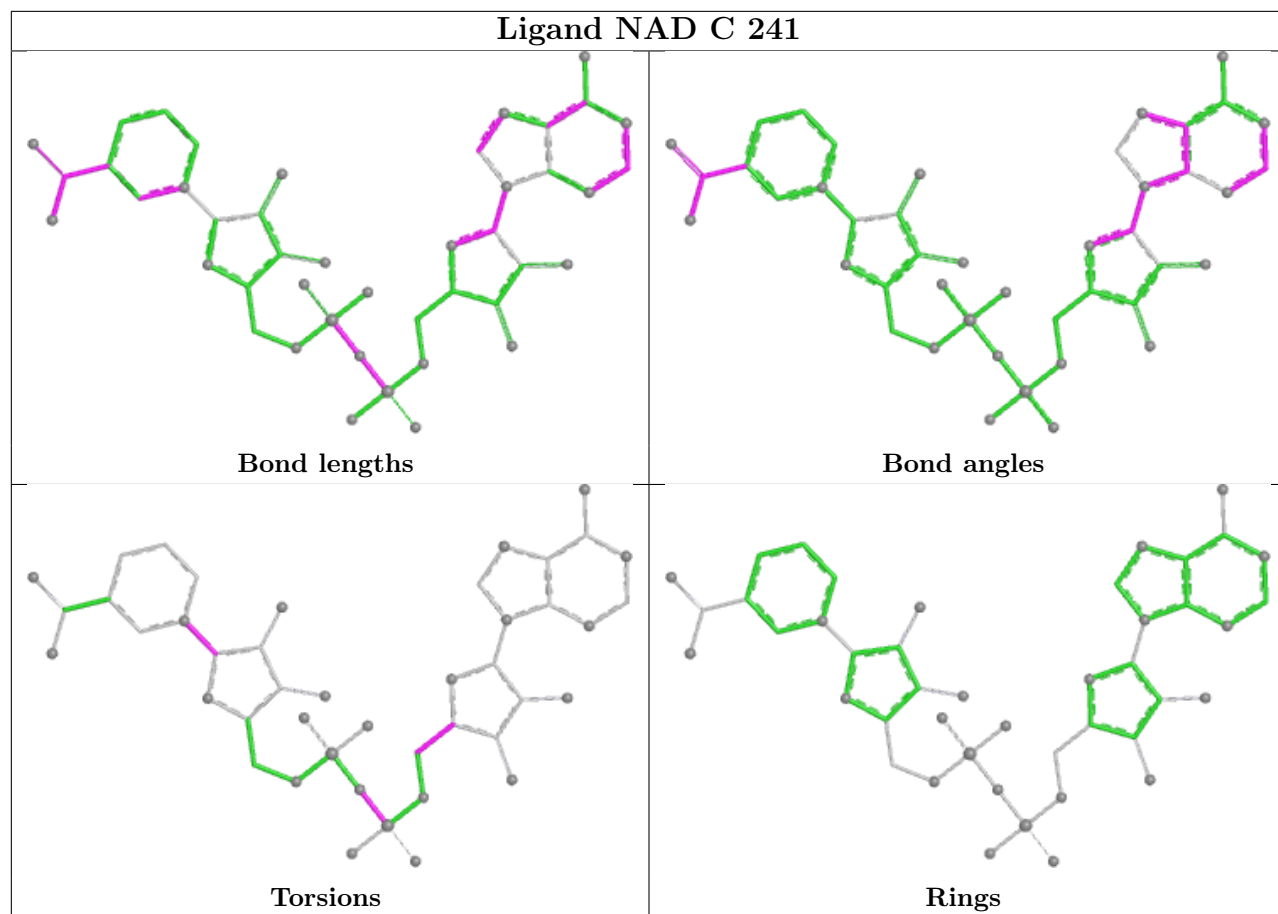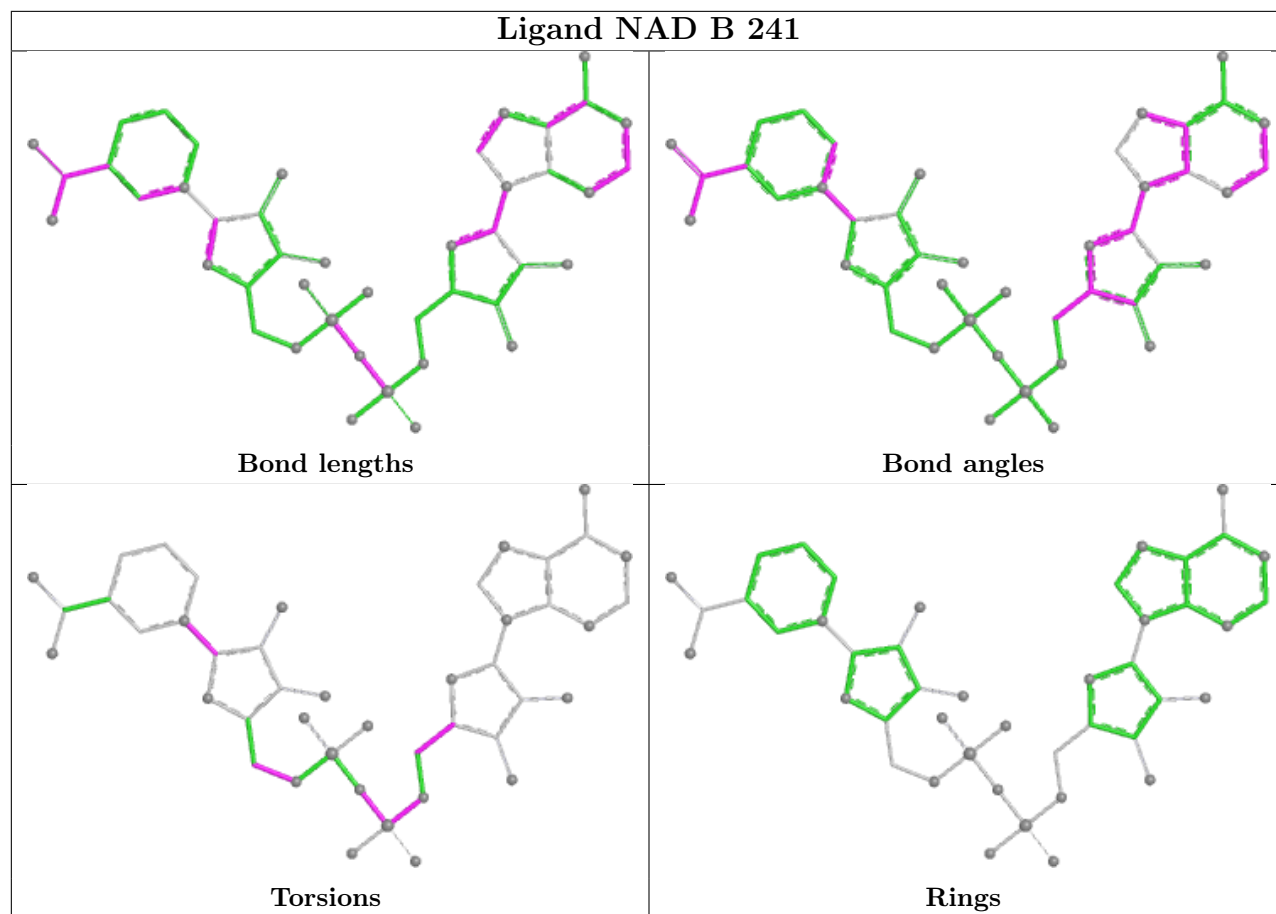
5.7 Other polymers ⓘ

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   ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

6.3   Carbohydrates   ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

6.4   Ligands   ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

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.
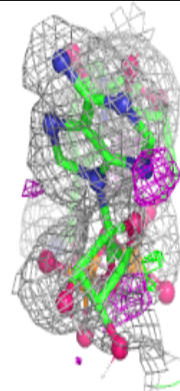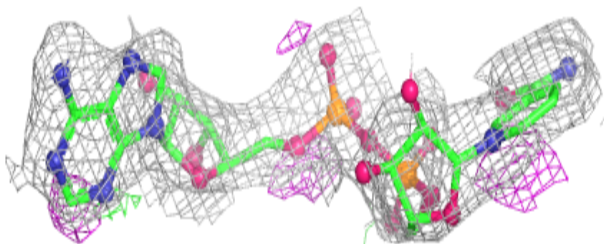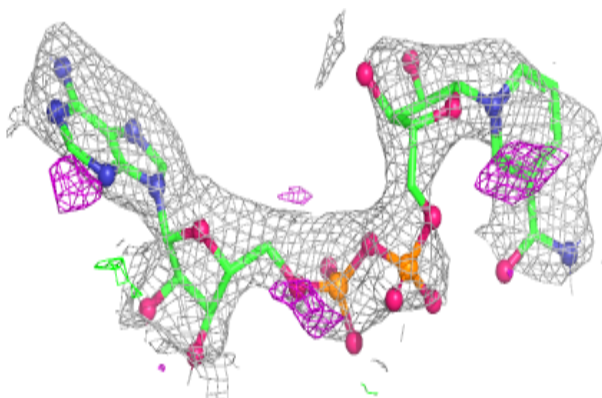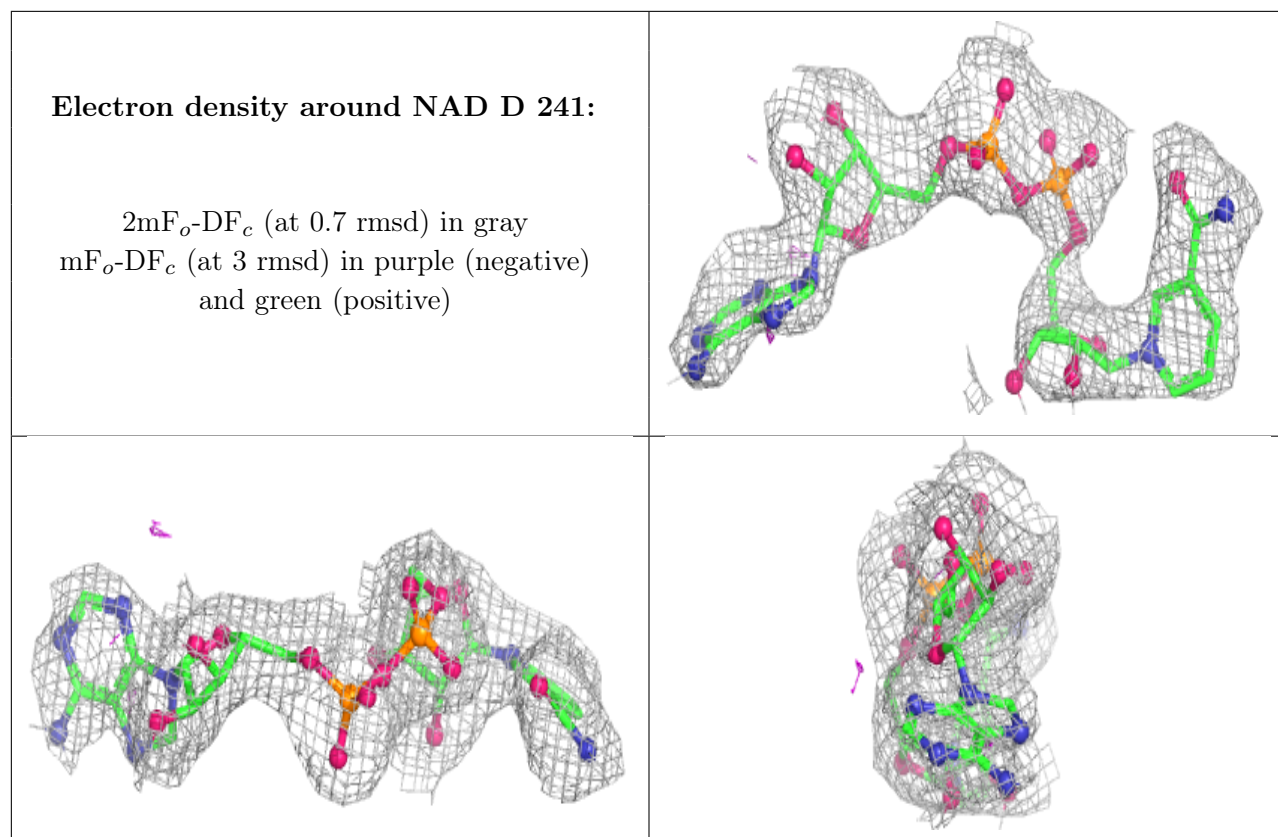

Electron density around NAD A 241:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
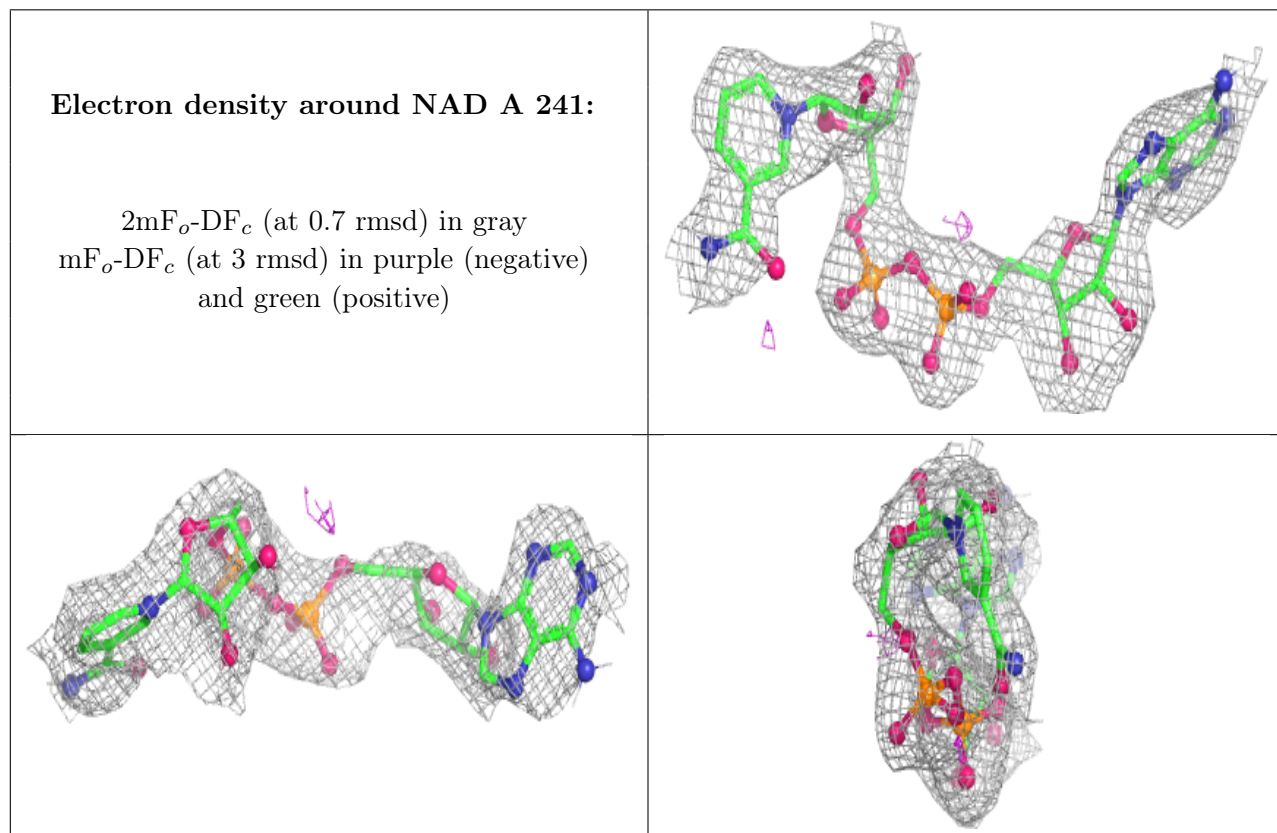
Electron density around NAD B 241:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)
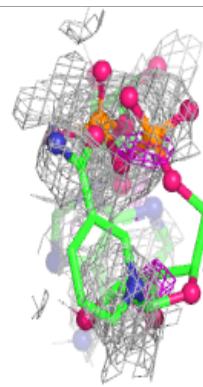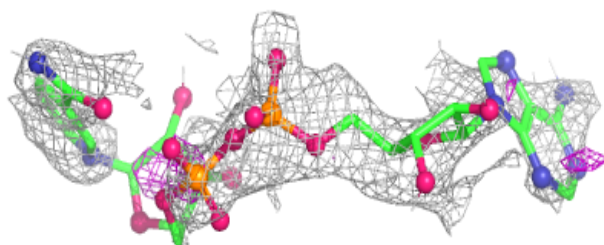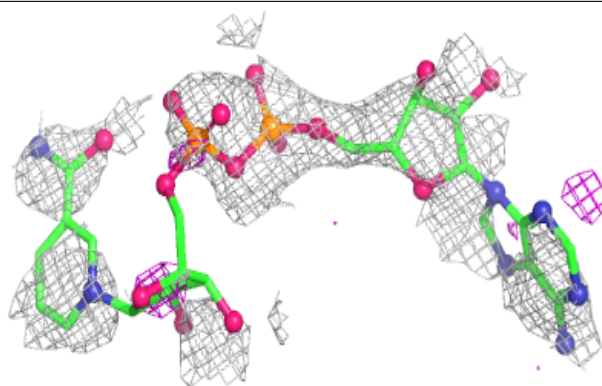
Electron density around NAD C 241:

$2mF_o$-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 241:

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

6.5   Other polymers ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.