



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 01:56 PM UTC

PDB ID : 7BVJ / pdb_00007bvj
Title : UDP-N-acetylglucosamine 3-dehydrogenase GnnA from Acidithiobacillus ferrooxidans (P21)
Authors : Wangkanont, K.
Deposited on : 2020-04-10
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 types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

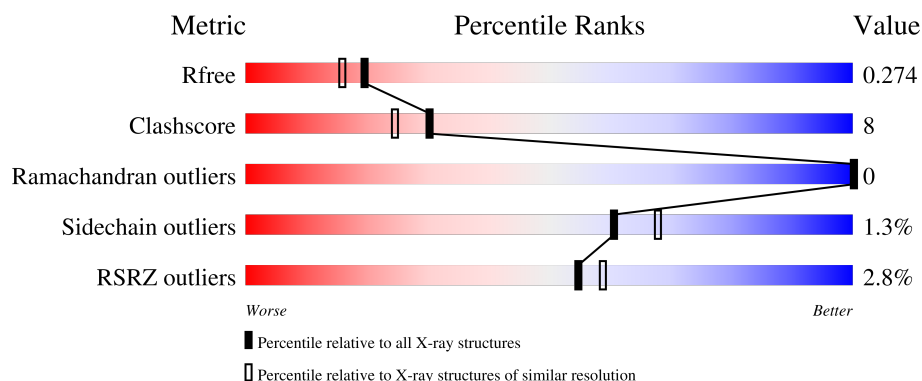
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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}	180053	2057 (2.16-2.16)
Clashscore	190562	2159 (2.16-2.16)
Ramachandran outliers	187476	2134 (2.16-2.16)
Sidechain outliers	187428	2133 (2.16-2.16)
RSRZ outliers	180081	2059 (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	321	2% 83% 14% .
1	B	321	5% 75% 19% 6%
1	C	321	2% 75% 19% 6%
1	D	321	% 76% 17% 6%

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
3	F8U	A	402	-	X	-	-

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 10317 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 Oxidoreductase, NAD-binding.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	313	Total	C	N	O	S	0	1	0
			2404	1518	442	432	12			
1	B	302	Total	C	N	O	S	0	1	0
			2333	1474	428	420	11			
1	C	303	Total	C	N	O	S	0	1	0
			2341	1478	430	421	12			
1	D	301	Total	C	N	O	S	0	0	0
			2319	1465	424	418	12			

There are 32 discrepancies between the modelled and reference sequences:

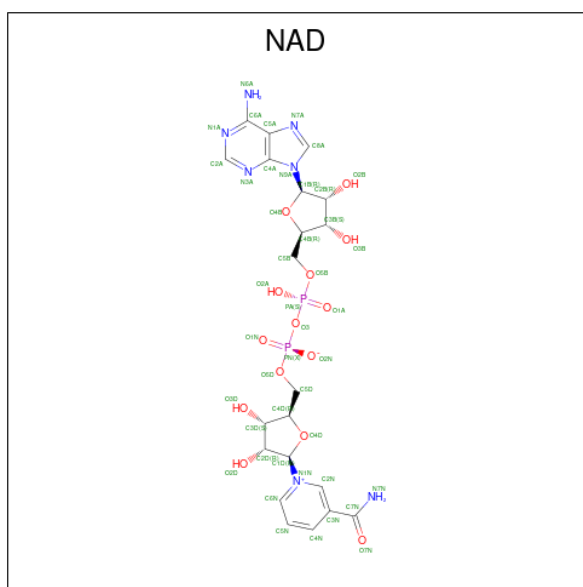
Chain	Residue	Modelled	Actual	Comment	Reference
A	314	LEU	-	expression tag	UNP B7JA34
A	315	GLU	-	expression tag	UNP B7JA34
A	316	HIS	-	expression tag	UNP B7JA34
A	317	HIS	-	expression tag	UNP B7JA34
A	318	HIS	-	expression tag	UNP B7JA34
A	319	HIS	-	expression tag	UNP B7JA34
A	320	HIS	-	expression tag	UNP B7JA34
A	321	HIS	-	expression tag	UNP B7JA34
B	314	LEU	-	expression tag	UNP B7JA34
B	315	GLU	-	expression tag	UNP B7JA34
B	316	HIS	-	expression tag	UNP B7JA34
B	317	HIS	-	expression tag	UNP B7JA34
B	318	HIS	-	expression tag	UNP B7JA34
B	319	HIS	-	expression tag	UNP B7JA34
B	320	HIS	-	expression tag	UNP B7JA34
B	321	HIS	-	expression tag	UNP B7JA34
C	314	LEU	-	expression tag	UNP B7JA34
C	315	GLU	-	expression tag	UNP B7JA34
C	316	HIS	-	expression tag	UNP B7JA34
C	317	HIS	-	expression tag	UNP B7JA34
C	318	HIS	-	expression tag	UNP B7JA34

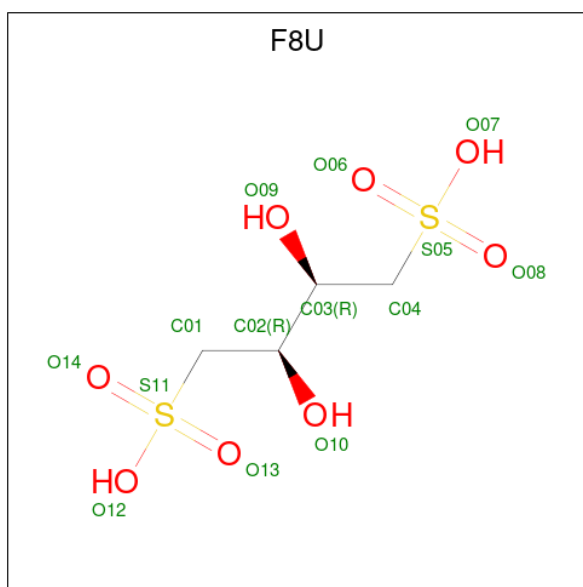
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Chain	Residue	Modelled	Actual	Comment	Reference
C	319	HIS	-	expression tag	UNP B7JA34
C	320	HIS	-	expression tag	UNP B7JA34
C	321	HIS	-	expression tag	UNP B7JA34
D	314	LEU	-	expression tag	UNP B7JA34
D	315	GLU	-	expression tag	UNP B7JA34
D	316	HIS	-	expression tag	UNP B7JA34
D	317	HIS	-	expression tag	UNP B7JA34
D	318	HIS	-	expression tag	UNP B7JA34
D	319	HIS	-	expression tag	UNP B7JA34
D	320	HIS	-	expression tag	UNP B7JA34
D	321	HIS	-	expression tag	UNP B7JA34

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





Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	O	S	0	0
			14	4	8	2		

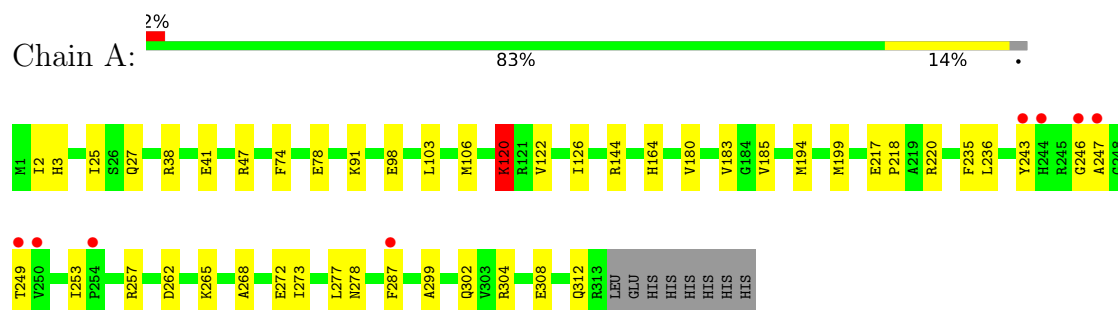
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	221	Total	O	0	0
			221	221		
4	B	193	Total	O	0	0
			193	193		
4	C	194	Total	O	0	0
			194	194		
4	D	190	Total	O	0	0
			190	190		

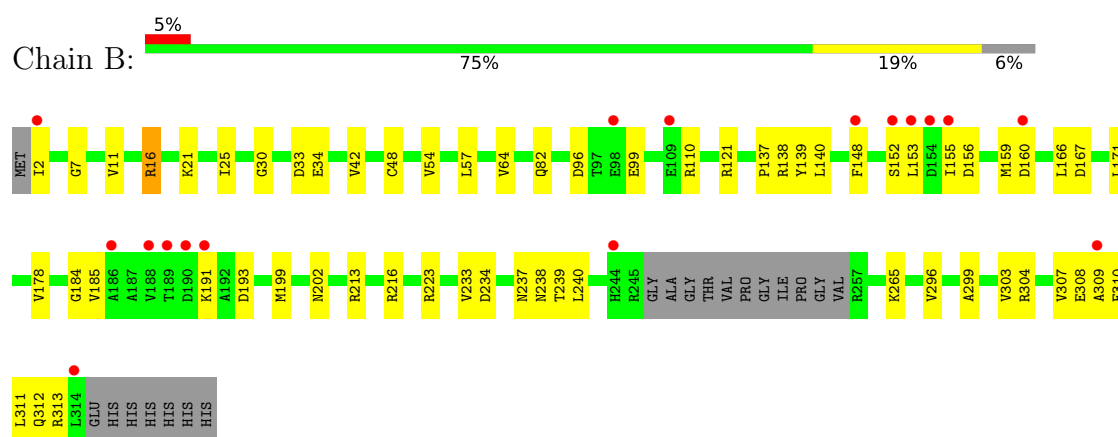
3 Residue-property plots [i](#)

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

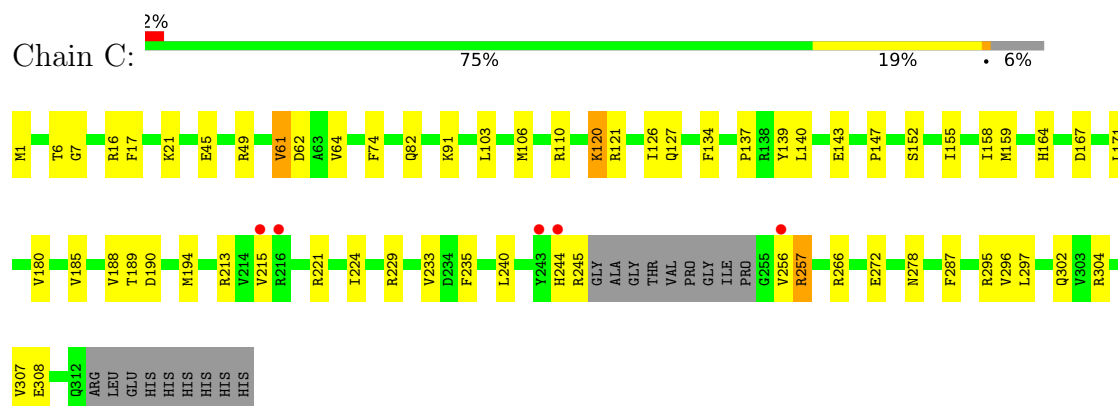
• Molecule 1: Oxidoreductase, NAD-binding



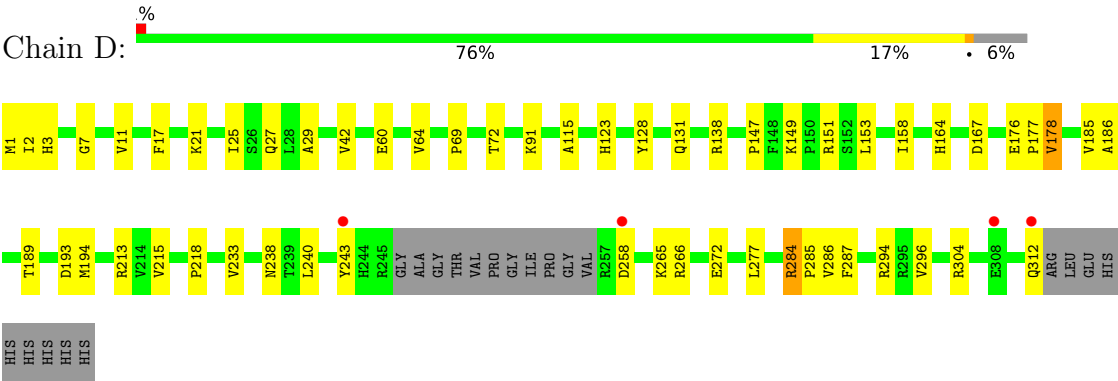
• Molecule 1: Oxidoreductase, NAD-binding



• Molecule 1: Oxidoreductase, NAD-binding



● Molecule 1: Oxidoreductase, NAD-binding



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	72.81Å 80.06Å 107.21Å 90.00° 95.02° 90.00°	Depositor
Resolution (Å)	19.80 – 2.15 19.80 – 2.15	Depositor EDS
% Data completeness (in resolution range)	99.9 (19.80-2.15) 99.8 (19.80-2.15)	Depositor EDS
R_{merge}	0.29	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.51 (at 2.15Å)	Xtrriage
Refinement program	PHENIX 1.17.1	Depositor
R, R_{free}	0.216 , 0.272 0.218 , 0.274	Depositor DCC
R_{free} test set	3276 reflections (4.89%)	wwPDB-VP
Wilson B-factor (Å ²)	25.9	Xtrriage
Anisotropy	0.586	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 47.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	10317	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 47.58 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 9.7206e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: F8U, 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	0.44	1/2449 (0.0%)	0.60	0/3328
1	B	0.49	2/2377 (0.1%)	0.65	0/3227
1	C	0.44	1/2382 (0.0%)	0.61	2/3233 (0.1%)
1	D	0.53	3/2360 (0.1%)	0.64	2/3204 (0.1%)
All	All	0.47	7/9568 (0.1%)	0.62	4/12992 (0.0%)

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	61	VAL	C-O	-7.80	1.14	1.23
1	D	177	PRO	C-O	-7.57	1.15	1.23
1	D	285	PRO	C-O	-6.28	1.16	1.23
1	A	120	LYS	C-O	-5.82	1.16	1.24
1	B	16	ARG	C-O	-5.73	1.17	1.24
1	B	166	LEU	C-O	-5.55	1.17	1.24
1	D	178	VAL	C-O	-5.08	1.18	1.24

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	257	ARG	CB-CG-CD	5.65	124.29	111.30
1	D	284	ARG	CB-CA-C	5.49	117.30	108.91
1	C	62	ASP	N-CA-C	-5.40	106.75	113.55
1	D	178	VAL	N-CA-C	-5.21	108.43	113.53

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2404	0	2423	36	0
1	B	2333	0	2353	47	0
1	C	2341	0	2360	47	0
1	D	2319	0	2336	33	0
2	A	27	0	12	0	0
2	B	27	0	10	1	0
2	C	27	0	12	0	0
2	D	27	0	12	0	0
3	A	14	0	0	0	0
4	A	221	0	0	9	0
4	B	193	0	0	15	0
4	C	194	0	0	8	0
4	D	190	0	0	6	0
All	All	10317	0	9518	160	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 8.

All (160) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:295[B]:ARG:HH11	1:C:295[B]:ARG:HG2	1.36	0.89
1:B:160:ASP:HB3	4:B:642:HOH:O	1.75	0.86
1:D:258:ASP:HB3	4:D:625:HOH:O	1.80	0.82
1:A:262:ASP:HB3	4:A:521:HOH:O	1.81	0.78
1:B:185:VAL:CG2	4:B:651:HOH:O	2.32	0.77
1:B:156:ASP:HB3	1:B:159:MET:HB2	1.68	0.76
1:A:262:ASP:CB	4:A:521:HOH:O	2.33	0.75
1:C:295[B]:ARG:HG2	1:C:295[B]:ARG:NH1	1.97	0.71
1:A:185:VAL:HB	1:A:194:MET:HG3	1.74	0.69
1:B:193:ASP:OD1	1:B:213:ARG:HD2	1.93	0.69
1:C:266:ARG:NH2	4:C:503:HOH:O	2.27	0.68
1:A:78:GLU:HG3	1:A:106:MET:HE1	1.76	0.68
1:A:247:ALA:H	1:A:257:ARG:HG2	1.60	0.66
1:B:199:MET:HE1	1:B:299:ALA:HB1	1.78	0.64

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:312:GLN:HG3	4:A:619:HOH:O	1.98	0.64
1:C:110:ARG:HG2	4:C:654:HOH:O	1.97	0.64
1:A:120:LYS:HE2	4:A:570:HOH:O	1.98	0.64
1:A:25:ILE:HD11	1:A:273:ILE:HG22	1.81	0.63
1:B:152:SER:O	1:B:153:LEU:HD12	1.98	0.62
1:B:82:GLN:OE1	1:B:110:ARG:NH1	2.33	0.62
1:B:156:ASP:OD2	1:B:304:ARG:NH1	2.30	0.61
1:A:262:ASP:CG	4:A:521:HOH:O	2.44	0.59
1:C:185:VAL:HB	1:C:194:MET:HG3	1.87	0.57
1:C:147:PRO:HA	1:C:215:VAL:O	2.04	0.56
1:C:49:ARG:NH2	4:C:501:HOH:O	2.24	0.56
1:D:266:ARG:NH2	4:D:503:HOH:O	2.33	0.56
1:A:249:THR:HB	1:A:257:ARG:NH1	2.21	0.55
1:D:2:ILE:HD13	1:D:277:LEU:CB	2.36	0.55
1:A:246:GLY:HA3	1:A:257:ARG:HG2	1.89	0.55
1:B:185:VAL:HG22	4:B:651:HOH:O	2.02	0.54
1:C:295[B]:ARG:HH11	1:C:295[B]:ARG:CG	2.12	0.54
1:D:2:ILE:HD13	1:D:277:LEU:HB2	1.89	0.54
1:C:159:MET:HE2	4:C:572:HOH:O	2.06	0.54
1:D:193:ASP:OD2	1:D:213:ARG:NH2	2.40	0.54
1:A:253:ILE:CD1	1:B:216:ARG:HG2	2.38	0.54
1:A:272:GLU:HG3	1:A:287:PHE:CZ	2.43	0.54
1:B:11:VAL:HB	1:B:42:VAL:HG21	1.90	0.54
1:B:309:ALA:HA	1:B:312:GLN:HG2	1.89	0.54
1:C:185:VAL:HB	1:C:194:MET:CG	2.38	0.54
1:C:143:GLU:OE2	1:C:221:ARG:NH2	2.41	0.53
1:B:30:GLY:HA2	1:B:48:CYS:SG	2.48	0.53
1:C:158:ILE:HD11	1:C:307:VAL:HG21	1.89	0.53
1:C:180:VAL:HG11	1:C:302:GLN:HB3	1.91	0.53
1:A:47:ARG:NH1	4:A:501:HOH:O	2.26	0.53
1:C:127:GLN:OE1	1:C:266:ARG:NH1	2.37	0.53
1:D:186:ALA:HB1	1:D:189:THR:O	2.09	0.53
1:B:313:ARG:NH2	4:B:516:HOH:O	2.42	0.52
1:A:199:MET:HE1	1:A:299:ALA:HB1	1.91	0.52
1:C:244:HIS:O	1:C:256:VAL:HB	2.09	0.52
1:C:139:TYR:C	1:C:140:LEU:HD23	2.35	0.52
1:B:184:GLY:HA3	1:B:307:VAL:HG13	1.91	0.52
1:C:159:MET:HE1	1:C:297:LEU:HD12	1.92	0.51
1:A:180:VAL:HG11	1:A:302:GLN:HB3	1.93	0.51
1:B:308:GLU:HB3	4:B:504:HOH:O	2.10	0.51
1:C:140:LEU:CD2	1:C:224:ILE:HG23	2.41	0.51

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:237:ASN:OD1	1:D:178:VAL:HG11	2.10	0.51
1:D:91:LYS:HD3	1:D:164:HIS:CE1	2.46	0.50
1:D:115:ALA:HB2	1:D:286:VAL:HG21	1.93	0.50
1:C:272:GLU:HG3	1:C:287:PHE:CZ	2.47	0.49
1:B:155:ILE:HG13	1:B:213:ARG:NH2	2.27	0.49
1:D:138:ARG:NH1	4:D:513:HOH:O	2.45	0.49
1:A:122:VAL:HG12	4:A:667:HOH:O	2.11	0.49
1:D:294:ARG:HD3	4:D:553:HOH:O	2.12	0.49
1:B:138:ARG:HG2	4:B:640:HOH:O	2.11	0.49
1:B:148:PHE:CZ	1:B:152:SER:HB2	2.48	0.49
1:A:218:PRO:HB2	1:A:236:LEU:HD21	1.95	0.49
1:C:82:GLN:OE1	1:C:110:ARG:NH1	2.46	0.48
1:C:74:PHE:HA	1:C:103:LEU:HD11	1.94	0.48
1:D:11:VAL:HB	1:D:42:VAL:HG21	1.95	0.48
1:D:185:VAL:HB	1:D:194:MET:HG3	1.94	0.48
1:A:38:ARG:O	1:A:41:GLU:HG2	2.13	0.48
1:A:91:LYS:HE2	1:A:164:HIS:CE1	2.49	0.48
1:C:188:VAL:HG12	1:C:189:THR:HG23	1.96	0.48
1:D:147:PRO:HA	1:D:215:VAL:O	2.13	0.48
1:B:304:ARG:NH2	4:B:514:HOH:O	2.38	0.48
1:D:21:LYS:O	1:D:25:ILE:HG13	2.15	0.47
1:D:243:TYR:HD2	1:D:258:ASP:OD2	1.97	0.47
1:C:257:ARG:N	1:C:257:ARG:HD3	2.30	0.47
1:A:126:ILE:HD13	1:A:235:PHE:HE2	1.79	0.47
1:A:257:ARG:HH11	1:A:257:ARG:HA	1.78	0.47
1:B:185:VAL:HG23	4:B:651:HOH:O	2.08	0.47
1:C:137:PRO:CG	1:C:140:LEU:HD21	2.45	0.47
1:D:158:ILE:HD13	1:D:304:ARG:HA	1.97	0.47
1:C:152:SER:HA	1:C:155:ILE:HD12	1.97	0.47
1:C:278:ASN:ND2	4:C:507:HOH:O	2.35	0.47
1:B:21:LYS:O	1:B:25:ILE:HG13	2.15	0.47
1:D:147:PRO:HD3	1:D:218:PRO:HB3	1.97	0.47
1:B:155:ILE:HD12	1:B:160:ASP:OD1	2.15	0.46
1:D:149:LYS:HB3	1:D:151:ARG:HH11	1.80	0.46
1:D:233:VAL:HG22	1:D:240:LEU:HD13	1.97	0.46
1:B:57:LEU:C	1:B:57:LEU:HD23	2.41	0.46
1:B:121:ARG:HG2	1:B:171:LEU:HD22	1.96	0.46
1:B:155:ILE:HB	4:B:642:HOH:O	2.15	0.46
1:B:191:LYS:HE3	1:B:191:LYS:HB3	1.80	0.46
1:B:54:VAL:HG12	4:B:597:HOH:O	2.16	0.46
1:C:7:GLY:O	1:C:64:VAL:HA	2.16	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:140:LEU:HD22	1:C:224:ILE:HG23	1.98	0.46
1:B:137:PRO:HG2	1:B:140:LEU:HD11	1.98	0.46
1:C:304:ARG:O	1:C:308:GLU:HG3	2.15	0.46
1:B:7:GLY:O	1:B:64:VAL:HA	2.14	0.46
1:B:265:LYS:NZ	4:B:511:HOH:O	2.34	0.45
1:D:69:PRO:O	1:D:72:THR:OG1	2.30	0.45
1:D:128:TYR:O	1:D:131:GLN:HG3	2.16	0.45
1:C:134:PHE:CE1	1:C:229:ARG:HD3	2.51	0.45
1:D:149:LYS:HB3	1:D:151:ARG:NH1	2.30	0.45
1:D:258:ASP:CB	4:D:625:HOH:O	2.53	0.45
1:A:2:ILE:HD13	1:A:277:LEU:HB2	1.99	0.45
1:C:233:VAL:HG22	1:C:240:LEU:HD13	1.99	0.45
1:A:3:HIS:HA	1:A:27:GLN:OE1	2.17	0.45
1:C:266:ARG:NH1	4:C:522:HOH:O	2.50	0.45
1:A:247:ALA:H	1:A:257:ARG:CG	2.29	0.45
1:A:272:GLU:HG3	1:A:287:PHE:CE1	2.52	0.45
1:C:16:ARG:HE	1:C:45:GLU:CD	2.25	0.45
1:B:34:GLU:HG2	2:B:401:NAD:C5A	2.47	0.44
1:A:217:GLU:OE2	1:A:217:GLU:N	2.48	0.44
1:C:17:PHE:O	1:C:21:LYS:HG2	2.17	0.44
1:B:239:THR:HG22	4:B:519:HOH:O	2.17	0.44
1:C:155:ILE:O	1:C:213:ARG:NH1	2.49	0.44
1:B:178:VAL:CG1	1:B:202:ASN:HB3	2.47	0.44
1:D:3:HIS:HA	1:D:27:GLN:OE1	2.18	0.44
1:C:139:TYR:O	1:C:140:LEU:HD23	2.17	0.43
1:C:106:MET:HE2	1:C:106:MET:HB3	1.89	0.43
1:C:190:ASP:OD1	1:C:190:ASP:N	2.49	0.43
1:B:223:ARG:NH1	4:B:518:HOH:O	2.44	0.43
1:D:138:ARG:NH2	4:D:517:HOH:O	2.49	0.43
1:D:17:PHE:O	1:D:21:LYS:HG2	2.19	0.43
1:A:183:VAL:HG21	1:B:139:TYR:CE1	2.54	0.43
1:D:2:ILE:HD13	1:D:277:LEU:HB3	2.01	0.43
1:A:74:PHE:HA	1:A:103:LEU:HD11	2.01	0.43
1:C:120:LYS:HE2	4:C:605:HOH:O	2.19	0.43
1:C:121:ARG:NH1	1:C:171:LEU:HD13	2.34	0.43
1:B:167:ASP:HB2	1:B:296:VAL:HG21	2.01	0.42
1:B:238:ASN:ND2	4:B:528:HOH:O	2.51	0.42
1:B:234:ASP:HB3	1:B:239:THR:HB	2.01	0.42
1:C:245:ARG:C	1:C:257:ARG:NH1	2.78	0.42
1:A:257:ARG:HA	1:A:257:ARG:HD2	1.63	0.42
1:A:278:ASN:ND2	4:A:523:HOH:O	2.52	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:123:HIS:CE1	1:D:238:ASN:HD22	2.37	0.42
1:D:29:ALA:HB1	1:D:60:GLU:HG2	2.01	0.42
1:D:167:ASP:HB2	1:D:296:VAL:HG21	2.02	0.42
1:A:304:ARG:O	1:A:308:GLU:HG3	2.20	0.41
1:C:1:MET:HE2	1:C:1:MET:HB2	1.91	0.41
1:C:126:ILE:HD13	1:C:235:PHE:HE2	1.85	0.41
1:A:220:ARG:HB3	1:A:235:PHE:HB2	2.00	0.41
1:B:138:ARG:HG3	4:B:641:HOH:O	2.20	0.41
1:B:11:VAL:HG22	1:B:33:ASP:HB2	2.02	0.41
1:A:144:ARG:NH1	1:A:220:ARG:HD3	2.35	0.41
1:B:311:LEU:HD23	1:B:311:LEU:HA	1.88	0.41
1:C:6:THR:C	1:C:61:VAL:HG12	2.46	0.41
1:C:167:ASP:HB2	1:C:296:VAL:HG21	2.02	0.41
1:B:233:VAL:HG22	1:B:240:LEU:HD13	2.01	0.41
1:B:310:PHE:HA	1:B:313:ARG:NH2	2.35	0.41
1:A:243:TYR:HA	1:A:257:ARG:O	2.21	0.41
1:B:96:ASP:OD1	1:B:99:GLU:HG3	2.21	0.41
1:C:91:LYS:HE2	1:C:164:HIS:CE1	2.56	0.41
1:D:272:GLU:HG3	1:D:287:PHE:CZ	2.56	0.41
1:B:303:VAL:O	1:B:307:VAL:HG23	2.21	0.40
1:A:268:ALA:HB2	4:A:697:HOH:O	2.20	0.40
1:C:229:ARG:NH1	4:C:519:HOH:O	2.55	0.40
1:D:7:GLY:O	1:D:64:VAL:HA	2.21	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	312/321 (97%)	301 (96%)	11 (4%)	0	100	100
1	B	299/321 (93%)	289 (97%)	10 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	300/321 (94%)	293 (98%)	7 (2%)	0	100	100
1	D	297/321 (92%)	291 (98%)	6 (2%)	0	100	100
All	All	1208/1284 (94%)	1174 (97%)	34 (3%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains ⓘ

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	242/249 (97%)	239 (99%)	3 (1%)	63	70
1	B	236/249 (95%)	234 (99%)	2 (1%)	73	79
1	C	236/249 (95%)	235 (100%)	1 (0%)	84	89
1	D	234/249 (94%)	228 (97%)	6 (3%)	40	43
All	All	948/996 (95%)	936 (99%)	12 (1%)	61	68

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	98	GLU
1	A	120	LYS
1	A	265	LYS
1	B	2	ILE
1	B	16	ARG
1	C	120	LYS
1	D	1	MET
1	D	153	LEU
1	D	176	GLU
1	D	265	LYS
1	D	284	ARG
1	D	312	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	13	HIS
1	B	227	GLN
1	C	312	GLN
1	D	13	HIS
1	D	227	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

5 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	401	-	28,29,48	1.89	5 (17%)	43,45,73	1.76	10 (23%)
2	NAD	B	401	-	28,29,48	3.54	20 (71%)	43,45,73	1.80	11 (25%)
2	NAD	C	401	-	28,29,48	1.94	5 (17%)	43,45,73	1.73	8 (18%)
3	F8U	A	402	-	9,13,13	1.47	2 (22%)	16,20,20	3.36	8 (50%)
2	NAD	D	401	-	28,29,48	1.96	4 (14%)	43,45,73	1.91	11 (25%)

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	401	-	-	7/16/32/62	0/3/3/5
2	NAD	B	401	-	-	0/16/32/62	0/3/3/5
2	NAD	C	401	-	-	6/16/32/62	0/3/3/5
3	F8U	A	402	-	-	11/14/14/14	-
2	NAD	D	401	-	-	9/16/32/62	0/3/3/5

All (36) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	401	NAD	C5A-N7A	-7.37	1.25	1.39
2	D	401	NAD	PN-O5D	7.26	1.81	1.54
2	A	401	NAD	PN-O5D	6.77	1.80	1.54
2	C	401	NAD	PN-O5D	6.51	1.79	1.54
2	B	401	NAD	O4B-C4B	-5.78	1.32	1.45
2	B	401	NAD	PA-O3	-5.60	1.53	1.59
2	B	401	NAD	O3B-C3B	-5.19	1.30	1.43
2	B	401	NAD	C8A-N9A	-5.06	1.28	1.37
2	B	401	NAD	C2A-N3A	-4.71	1.25	1.33
2	B	401	NAD	PN-O5D	4.68	1.72	1.54
2	C	401	NAD	PA-O5B	4.32	1.76	1.59
2	B	401	NAD	C4A-N9A	-4.25	1.28	1.37
2	B	401	NAD	O2B-C2B	-4.18	1.32	1.43
2	D	401	NAD	PA-O5B	4.16	1.75	1.59
2	A	401	NAD	PA-O5B	4.07	1.75	1.59
2	B	401	NAD	C8A-N7A	-3.65	1.24	1.31
2	C	401	NAD	PA-O3	3.33	1.63	1.59
2	B	401	NAD	C5A-C4A	-3.29	1.33	1.39
2	B	401	NAD	PA-O2A	-3.09	1.41	1.55
2	B	401	NAD	PA-O5B	2.99	1.71	1.59
2	B	401	NAD	PN-O2N	-2.93	1.43	1.54
2	B	401	NAD	C2A-N1A	-2.91	1.28	1.33
2	B	401	NAD	O4B-C1B	-2.80	1.35	1.42
2	A	401	NAD	PA-O3	2.74	1.62	1.59
2	B	401	NAD	PA-O1A	-2.68	1.41	1.50
2	B	401	NAD	C5B-C4B	2.38	1.58	1.51
2	A	401	NAD	C2A-N1A	2.35	1.38	1.33
3	A	402	F8U	O09-C03	-2.34	1.38	1.43
2	B	401	NAD	C6A-N6A	-2.23	1.28	1.34
2	C	401	NAD	C3B-C4B	2.18	1.58	1.53
2	B	401	NAD	C4A-N3A	-2.16	1.30	1.34

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	401	NAD	C5A-C4A	2.16	1.42	1.39
2	D	401	NAD	PA-O3	2.11	1.61	1.59
2	D	401	NAD	C8A-N9A	2.05	1.41	1.37
2	C	401	NAD	C5A-C4A	2.00	1.42	1.39
3	A	402	F8U	O13-S11	2.00	1.50	1.45

All (48) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	402	F8U	O06-S05-C04	7.05	117.28	106.76
3	A	402	F8U	O12-S11-O13	-5.03	98.81	111.40
3	A	402	F8U	O12-S11-C01	5.02	115.67	105.97
2	C	401	NAD	O2N-PN-O1N	4.95	130.12	110.83
2	D	401	NAD	O2N-PN-O3	4.90	121.07	104.64
3	A	402	F8U	O13-S11-C01	4.90	114.07	106.76
2	A	401	NAD	O2N-PN-O1N	4.89	129.88	110.83
2	D	401	NAD	O2N-PN-O1N	4.77	129.43	110.83
3	A	402	F8U	O07-S05-O06	-4.16	101.00	111.40
2	C	401	NAD	O2A-PA-O1A	4.06	131.35	112.44
2	B	401	NAD	O2N-PN-O1N	4.01	126.47	110.83
2	D	401	NAD	O2A-PA-O1A	3.93	130.74	112.44
2	A	401	NAD	O2A-PA-O1A	3.78	130.02	112.44
2	B	401	NAD	O5D-PN-O1N	-3.69	96.47	110.83
2	D	401	NAD	O5D-PN-O1N	-3.68	96.48	110.83
2	B	401	NAD	O2A-PA-O1A	3.57	129.05	112.44
2	C	401	NAD	O5D-PN-O1N	-3.34	97.81	110.83
3	A	402	F8U	O08-S05-O06	-3.34	102.97	113.82
2	B	401	NAD	O2A-PA-O3	-3.31	98.33	107.27
2	A	401	NAD	O5D-PN-O1N	-3.20	98.35	110.83
2	A	401	NAD	O5D-PN-O2N	-3.12	96.09	107.80
2	C	401	NAD	O2A-PA-O3	-3.10	98.91	107.27
2	B	401	NAD	O4B-C1B-N9A	-3.00	102.33	108.09
3	A	402	F8U	O07-S05-C04	2.97	111.70	105.97
2	D	401	NAD	O2A-PA-O3	-2.95	99.31	107.27
2	B	401	NAD	C6A-C5A-C4A	-2.91	113.20	117.18
3	A	402	F8U	O10-C02-C03	-2.90	103.49	109.57
2	C	401	NAD	O5D-PN-O2N	-2.87	97.04	107.80
2	A	401	NAD	O2A-PA-O3	-2.67	100.06	107.27
2	D	401	NAD	C5B-C4B-C3B	-2.65	105.67	115.21
2	A	401	NAD	O3B-C3B-C4B	-2.65	103.48	111.08
2	C	401	NAD	C5B-C4B-C3B	-2.59	105.88	115.21
2	D	401	NAD	O5D-PN-O2N	-2.58	98.13	107.80

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	401	NAD	C5B-C4B-C3B	-2.52	106.14	115.21
2	A	401	NAD	O5B-PA-O1A	-2.52	98.95	108.94
2	C	401	NAD	O2A-PA-O5B	-2.48	96.34	107.57
2	A	401	NAD	PA-O5B-C5B	-2.47	107.18	121.35
2	B	401	NAD	O5D-PN-O2N	-2.33	99.08	107.80
2	B	401	NAD	C1B-N9A-C8A	2.30	132.20	127.09
2	D	401	NAD	O3B-C3B-C4B	-2.28	104.53	111.08
2	A	401	NAD	O3-PN-O1N	2.22	122.73	111.04
2	D	401	NAD	C4A-N9A-C1B	-2.22	121.45	126.63
2	C	401	NAD	PA-O5B-C5B	-2.20	108.77	121.35
2	B	401	NAD	C4A-N9A-C1B	-2.20	121.50	126.63
2	D	401	NAD	O4B-C1B-N9A	-2.17	103.93	108.09
2	B	401	NAD	O3-PA-O1A	2.09	116.99	110.70
2	B	401	NAD	O5B-PA-O1A	-2.07	100.73	108.94
2	D	401	NAD	PA-O5B-C5B	-2.07	109.51	121.35

There are no chirality outliers.

All (33) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401	NAD	C5B-O5B-PA-O1A
2	A	401	NAD	PN-O3-PA-O5B
2	A	401	NAD	PA-O3-PN-O5D
2	C	401	NAD	C5B-O5B-PA-O2A
2	D	401	NAD	C5B-O5B-PA-O1A
2	D	401	NAD	C5B-O5B-PA-O2A
2	D	401	NAD	C5B-O5B-PA-O3
2	D	401	NAD	PA-O3-PN-O5D
3	A	402	F8U	S11-C01-C02-O10
3	A	402	F8U	C02-C01-S11-O12
3	A	402	F8U	C02-C01-S11-O13
3	A	402	F8U	C02-C01-S11-O14
3	A	402	F8U	C01-C02-C03-C04
3	A	402	F8U	C01-C02-C03-O09
3	A	402	F8U	O10-C02-C03-C04
3	A	402	F8U	O10-C02-C03-O09
3	A	402	F8U	C03-C04-S05-O06
3	A	402	F8U	C03-C04-S05-O07
3	A	402	F8U	C03-C04-S05-O08
2	D	401	NAD	O4B-C4B-C5B-O5B
2	D	401	NAD	C3B-C4B-C5B-O5B
2	A	401	NAD	C3B-C4B-C5B-O5B

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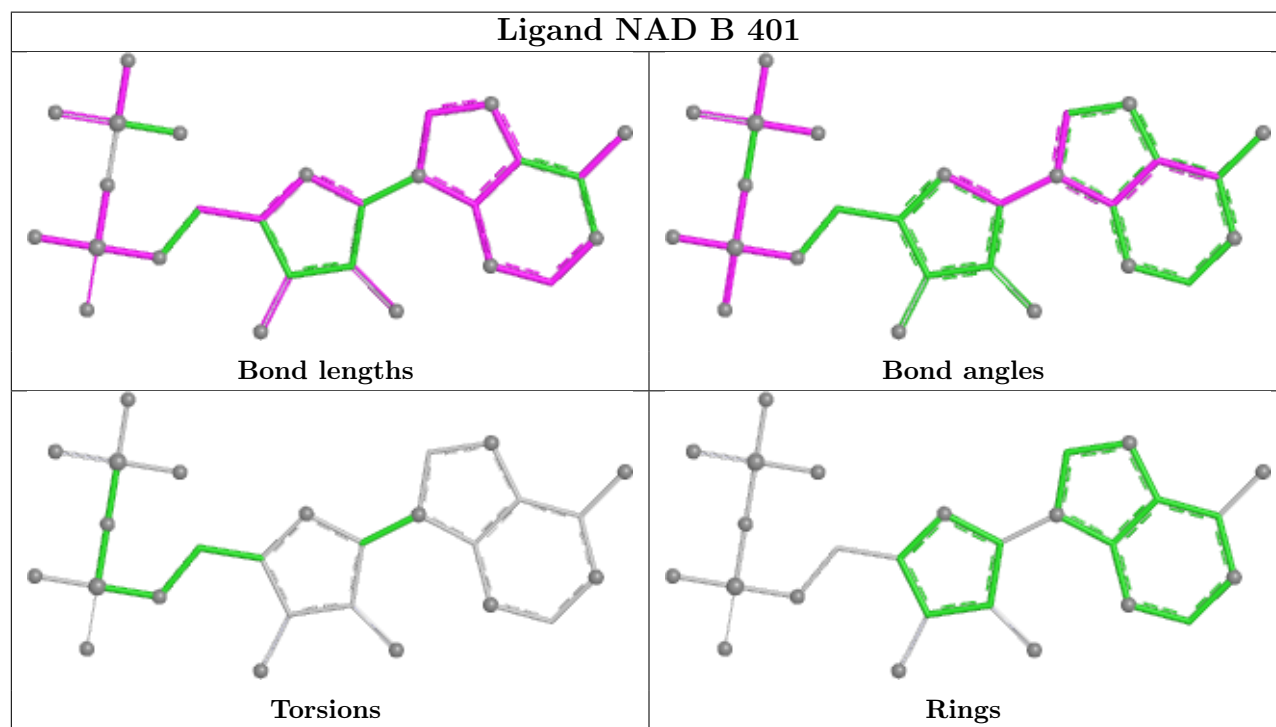
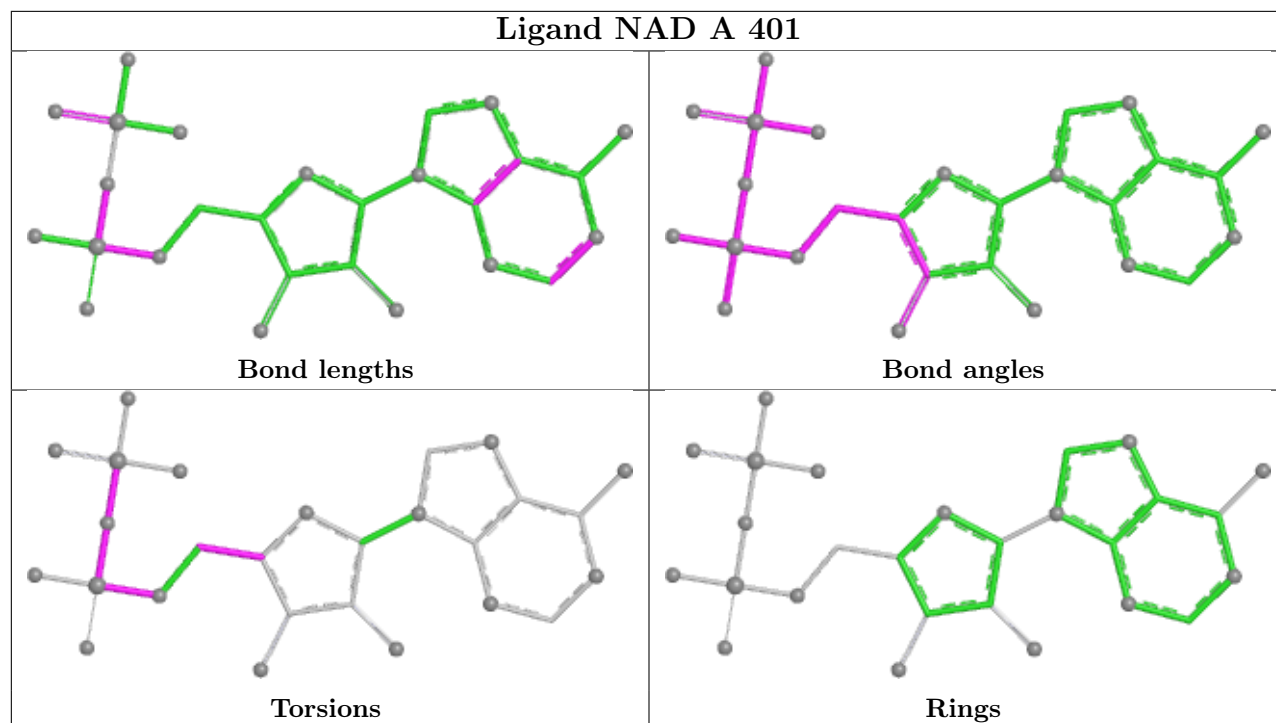
Mol	Chain	Res	Type	Atoms
2	C	401	NAD	C3B-C4B-C5B-O5B
2	A	401	NAD	O4B-C4B-C5B-O5B
2	C	401	NAD	O4B-C4B-C5B-O5B
2	C	401	NAD	PN-O3-PA-O5B
2	D	401	NAD	PN-O3-PA-O5B
2	A	401	NAD	C5B-O5B-PA-O3
2	C	401	NAD	C5B-O5B-PA-O1A
2	D	401	NAD	PA-O3-PN-O1N
2	A	401	NAD	PA-O3-PN-O2N
2	C	401	NAD	PA-O3-PN-O2N
2	D	401	NAD	C2B-C1B-N9A-C8A

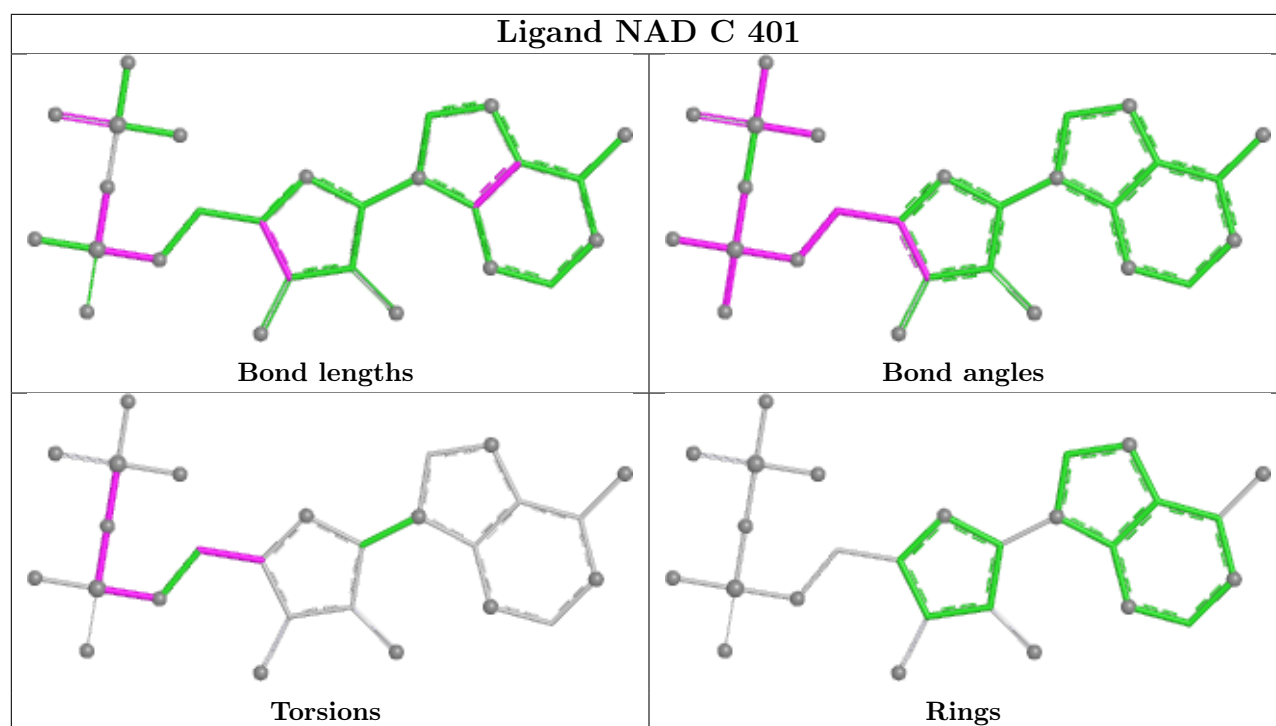
There are no ring outliers.

1 monomer is involved in 1 short contact:

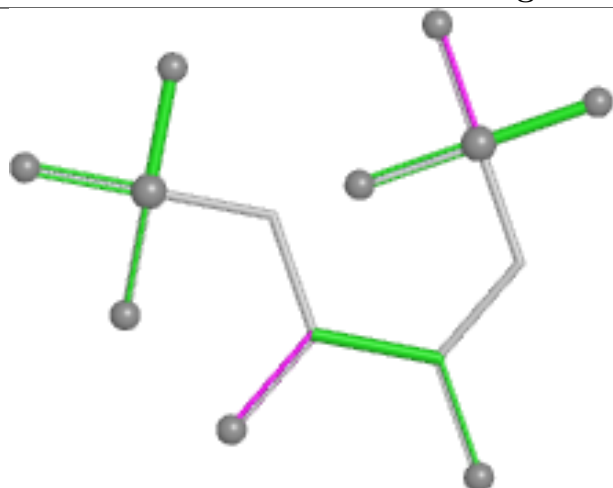
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	401	NAD	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

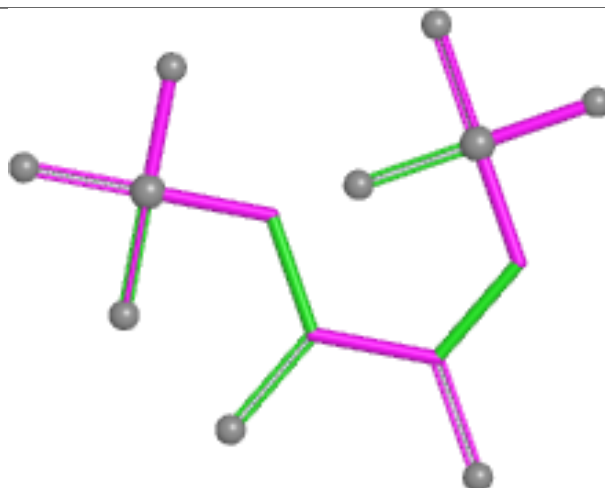




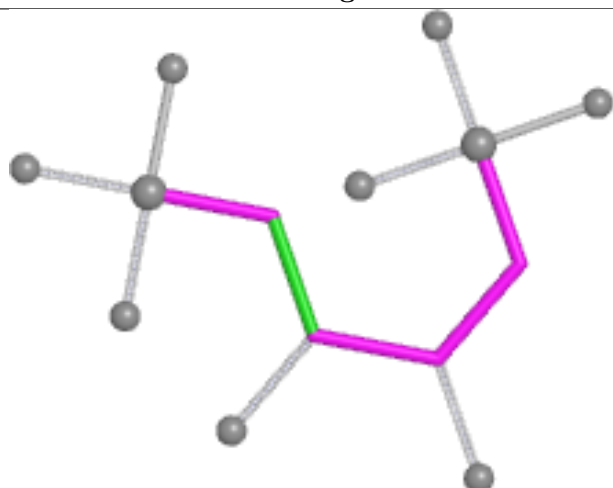
Ligand F8U A 402



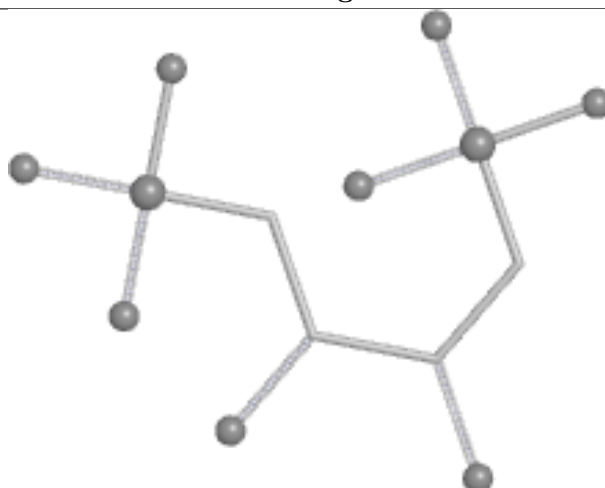
Bond lengths



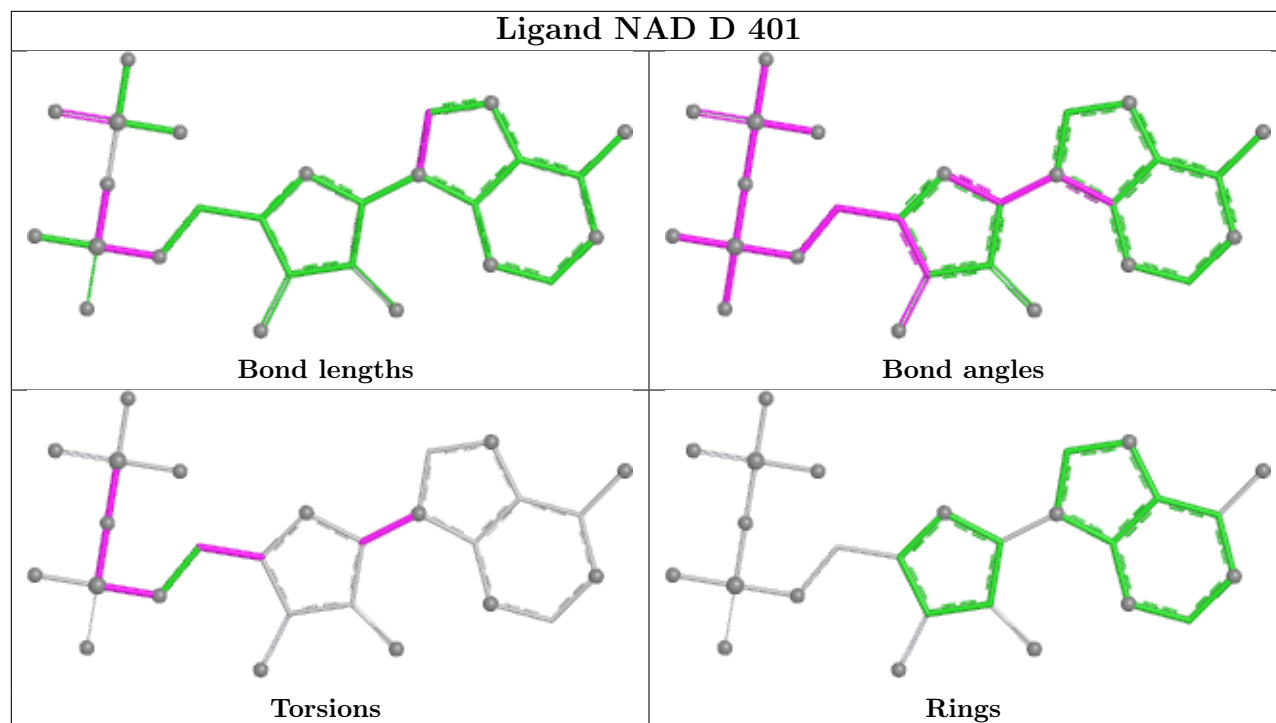
Bond angles



Torsions



Rings



5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

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	313/321 (97%)	0.22	8 (2%) 57 61	18, 27, 45, 65	1 (0%)
1	B	302/321 (94%)	0.50	17 (5%) 30 34	15, 28, 49, 72	1 (0%)
1	C	303/321 (94%)	0.33	5 (1%) 69 73	13, 28, 44, 63	1 (0%)
1	D	301/321 (93%)	0.28	4 (1%) 75 78	15, 27, 43, 61	0
All	All	1219/1284 (94%)	0.33	34 (2%) 55 59	13, 27, 46, 72	3 (0%)

All (34) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	153	LEU	5.1
1	C	256	VAL	4.8
1	B	152	SER	4.6
1	B	155	ILE	4.4
1	A	247	ALA	3.5
1	D	308	GLU	3.2
1	B	314	LEU	3.1
1	A	254	PRO	3.1
1	C	216	ARG	3.1
1	D	258	ASP	3.1
1	A	249	THR	3.0
1	C	215	VAL	2.8
1	B	109	GLU	2.8
1	B	154	ASP	2.7
1	A	250	VAL	2.6
1	A	246	GLY	2.6
1	B	189	THR	2.6
1	B	2	ILE	2.5
1	D	243	TYR	2.5
1	B	160	ASP	2.5
1	B	186	ALA	2.4

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Mol	Chain	Res	Type	RSRZ
1	D	312	GLN	2.4
1	A	243	TYR	2.4
1	B	191	LYS	2.4
1	B	309	ALA	2.4
1	B	148	PHE	2.4
1	C	243	TYR	2.3
1	B	188	VAL	2.3
1	A	287	PHE	2.3
1	B	98	GLU	2.3
1	B	244	HIS	2.2
1	C	244	HIS	2.1
1	B	190	ASP	2.1
1	A	244[A]	HIS	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 oligosaccharides in this entry.

6.4 Ligands [i](#)

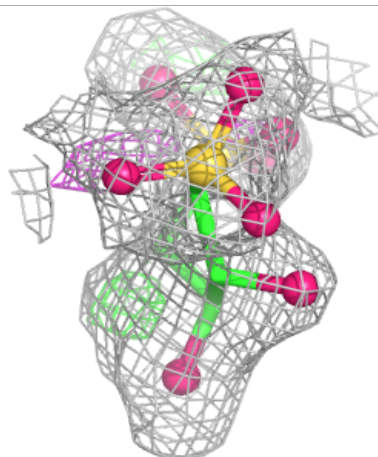
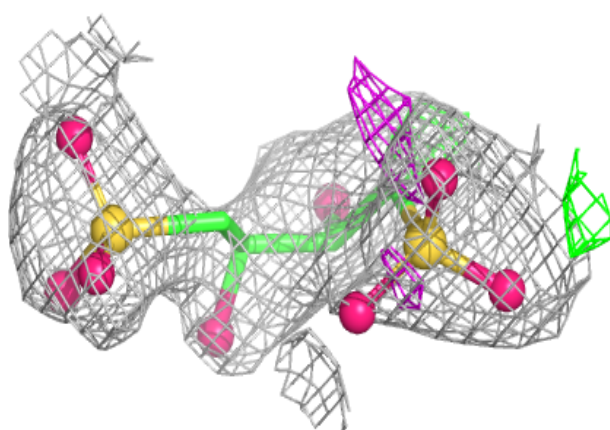
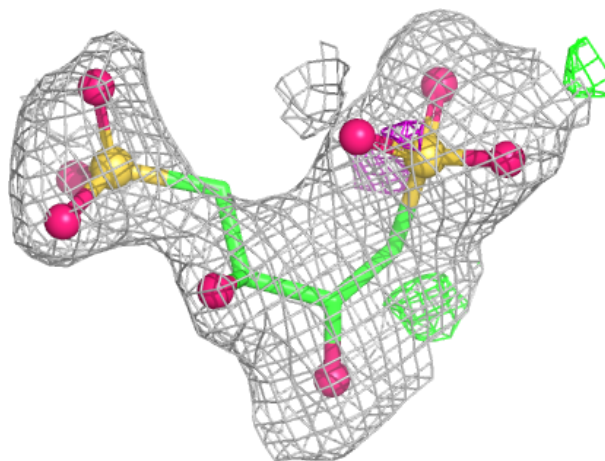
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
3	F8U	A	402	14/14	0.77	0.15	31,37,49,53	14
2	NAD	C	401	27/44	0.91	0.08	23,26,40,42	0
2	NAD	A	401	27/44	0.94	0.07	22,27,39,43	0
2	NAD	D	401	27/44	0.94	0.07	18,27,41,45	0
2	NAD	B	401	27/44	0.94	0.07	21,29,35,38	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.

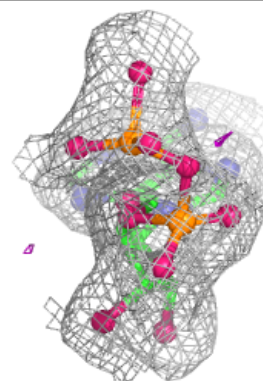
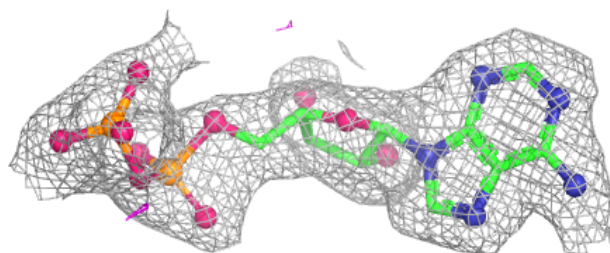
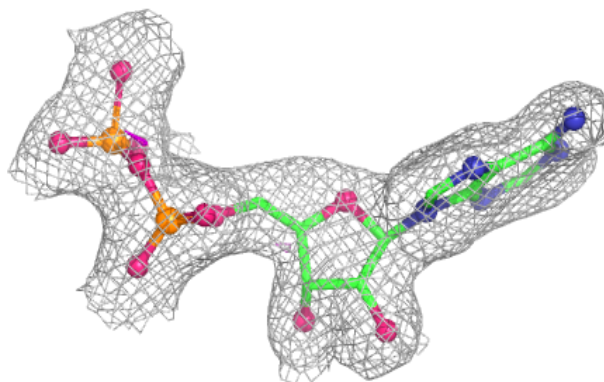
Electron density around F8U A 402:

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

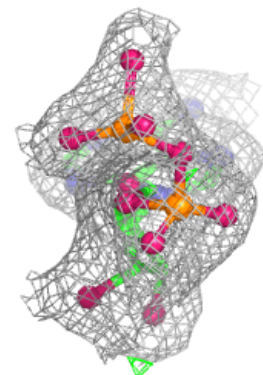
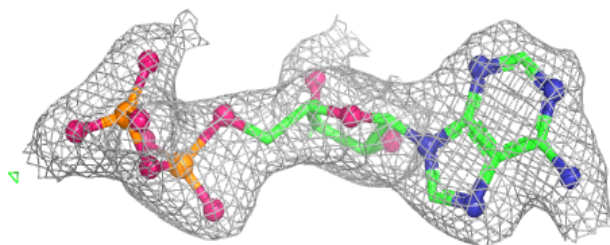
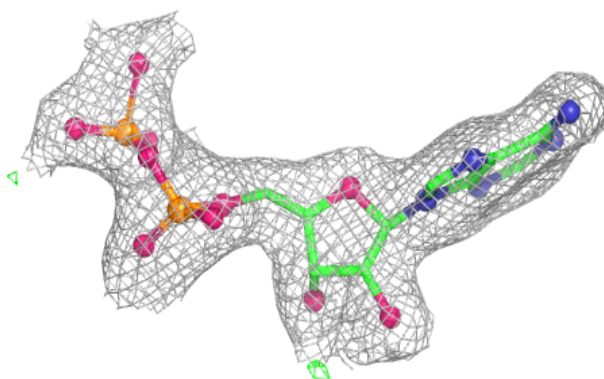


Electron density around NAD C 401:

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

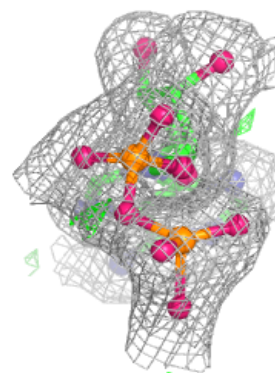
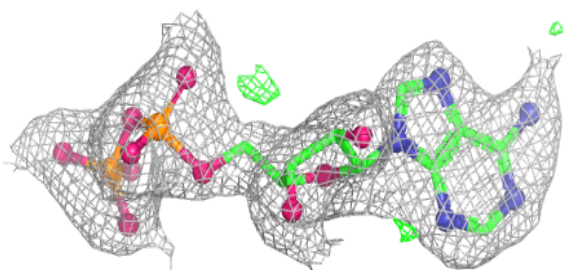
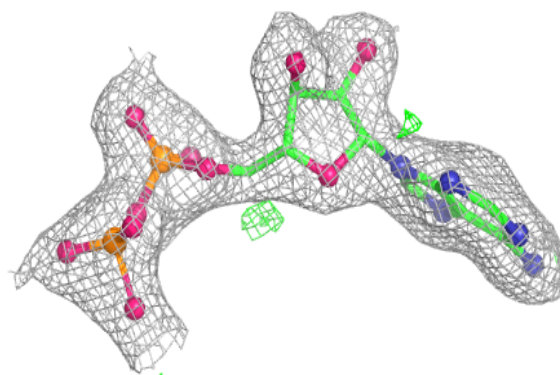
**Electron density around NAD A 401:**

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

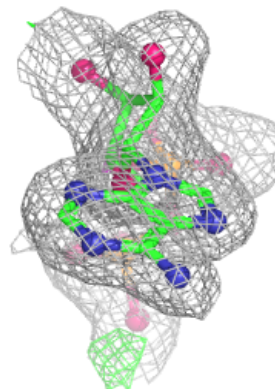
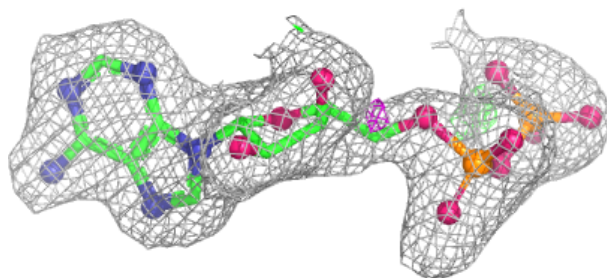
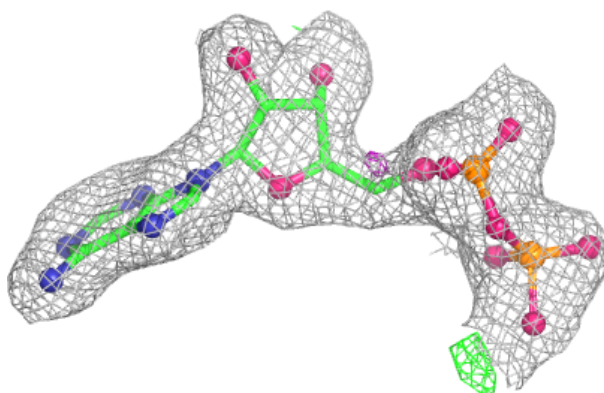


Electron density around NAD D 401:

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

**Electron density around NAD B 401:**

$2mF_o-DF_c$ (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.