Full wwPDB X-ray Structure Validation Report (i)

Oct 18, 2023 – 03:16 AM EDT

PDB ID	:	2DFD
Title	:	Crystal Structure of Human Malate Dehydrogenase Type 2
Authors	:	Ugochukwu, E.; Shafqat, N.; Rojkova, A.; Sundstrom, M.; Arrowsmith, C.; Weigelt, J.; Edwards, A.; von Delft, F.; Oppermann, U.; Structural Genomics Consortium (SGC)
Deposited on	:	2006-02-28
Resolution	:	1.90 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 (i) 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 (i)) were used in the production of this report:

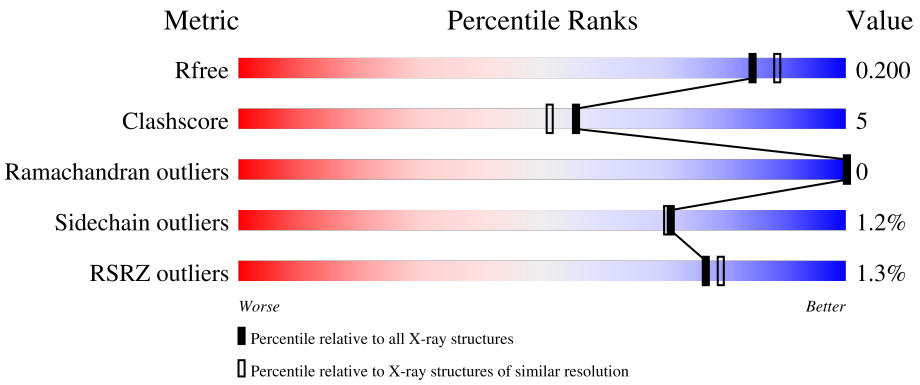
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	6207 (1.90-1.90)
Clashscore	141614	6847 (1.90-1.90)
Ramachandran outliers	138981	6760 (1.90-1.90)
Sidechain outliers	138945	6760 (1.90-1.90)
RSRZ outliers	127900	6082 (1.90-1.90)

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	342	86% 5% 8%
1	B	342	3% 85% 7% 8%
1	C	342	87% 5% 8%
1	D	342	2% 86% 5% • 8%

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	MLT	A	3104	X	-	-	-
2	MLT	B	3102	X	-	-	-
2	MLT	C	3103	X	-	-	-
2	MLT	D	3101	X	-	-	-

2 Entry composition (i)

There are 7 unique types of molecules in this entry. The entry contains 10300 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 Malate dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	314	2320	1481	384	440	15	0	5	0
1	B	314	2294	1464	380	436	14	0	4	0
1	C	314	2320	1476	385	446	13	0	7	0
1	D	314	2313	1475	387	437	14	0	4	0

There are 92 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-21	MET	-	cloning artifact	UNP P40926
A	-20	HIS	-	cloning artifact	UNP P40926
A	-19	HIS	-	cloning artifact	UNP P40926
A	-18	HIS	-	cloning artifact	UNP P40926
A	-17	HIS	-	cloning artifact	UNP P40926
A	-16	HIS	-	cloning artifact	UNP P40926
A	-15	HIS	-	cloning artifact	UNP P40926
A	-14	SER	-	cloning artifact	UNP P40926
A	-13	SER	-	cloning artifact	UNP P40926
A	-12	GLY	-	cloning artifact	UNP P40926
A	-11	VAL	-	cloning artifact	UNP P40926
A	-10	ASP	-	cloning artifact	UNP P40926
A	-9	LEU	-	cloning artifact	UNP P40926
A	-8	GLY	-	cloning artifact	UNP P40926
A	-7	THR	-	cloning artifact	UNP P40926
A	-6	GLU	-	cloning artifact	UNP P40926
A	-5	ASN	-	cloning artifact	UNP P40926
A	-4	LEU	-	cloning artifact	UNP P40926
A	-3	TYR	-	cloning artifact	UNP P40926
A	-2	PHE	-	cloning artifact	UNP P40926
A	-1	GLN	-	cloning artifact	UNP P40926

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Chain	Residue	Modelled	Actual	Comment	Reference
A	0	SER	-	cloning artifact	UNP P40926
A	1	MET	-	cloning artifact	UNP P40926
B	-21	MET	-	cloning artifact	UNP P40926
B	-20	HIS	-	cloning artifact	UNP P40926
B	-19	HIS	-	cloning artifact	UNP P40926
B	-18	HIS	-	cloning artifact	UNP P40926
B	-17	HIS	-	cloning artifact	UNP P40926
B	-16	HIS	-	cloning artifact	UNP P40926
B	-15	HIS	-	cloning artifact	UNP P40926
B	-14	SER	-	cloning artifact	UNP P40926
B	-13	SER	-	cloning artifact	UNP P40926
B	-12	GLY	-	cloning artifact	UNP P40926
B	-11	VAL	-	cloning artifact	UNP P40926
B	-10	ASP	-	cloning artifact	UNP P40926
B	-9	LEU	-	cloning artifact	UNP P40926
B	-8	GLY	-	cloning artifact	UNP P40926
B	-7	THR	-	cloning artifact	UNP P40926
B	-6	GLU	-	cloning artifact	UNP P40926
B	-5	ASN	-	cloning artifact	UNP P40926
B	-4	LEU	-	cloning artifact	UNP P40926
B	-3	TYR	-	cloning artifact	UNP P40926
B	-2	PHE	-	cloning artifact	UNP P40926
B	-1	GLN	-	cloning artifact	UNP P40926
B	0	SER	-	cloning artifact	UNP P40926
B	1	MET	-	cloning artifact	UNP P40926
C	-21	MET	-	cloning artifact	UNP P40926
C	-20	HIS	-	cloning artifact	UNP P40926
C	-19	HIS	-	cloning artifact	UNP P40926
C	-18	HIS	-	cloning artifact	UNP P40926
C	-17	HIS	-	cloning artifact	UNP P40926
C	-16	HIS	-	cloning artifact	UNP P40926
C	-15	HIS	-	cloning artifact	UNP P40926
C	-14	SER	-	cloning artifact	UNP P40926
C	-13	SER	-	cloning artifact	UNP P40926
C	-12	GLY	-	cloning artifact	UNP P40926
C	-11	VAL	-	cloning artifact	UNP P40926
C	-10	ASP	-	cloning artifact	UNP P40926
C	-9	LEU	-	cloning artifact	UNP P40926
C	-8	GLY	-	cloning artifact	UNP P40926
C	-7	THR	-	cloning artifact	UNP P40926
C	-6	GLU	-	cloning artifact	UNP P40926
C	-5	ASN	-	cloning artifact	UNP P40926

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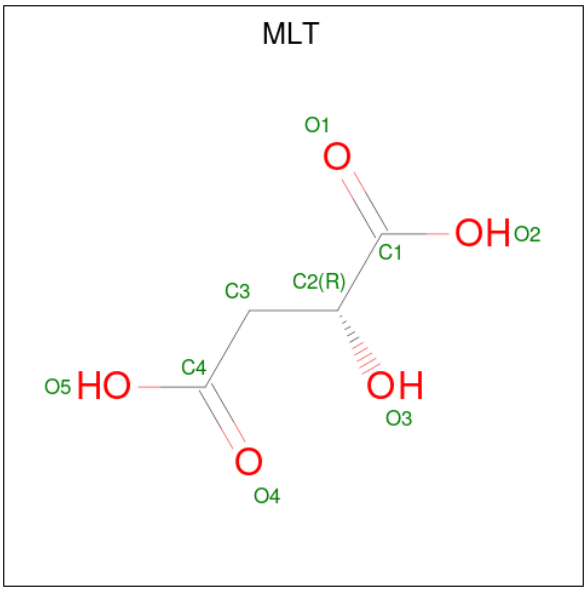
Chain	Residue	Modelled	Actual	Comment	Reference
C	-4	LEU	-	cloning artifact	UNP P40926
C	-3	TYR	-	cloning artifact	UNP P40926
C	-2	PHE	-	cloning artifact	UNP P40926
C	-1	GLN	-	cloning artifact	UNP P40926
C	0	SER	-	cloning artifact	UNP P40926
C	1	MET	-	cloning artifact	UNP P40926
D	-21	MET	-	cloning artifact	UNP P40926
D	-20	HIS	-	cloning artifact	UNP P40926
D	-19	HIS	-	cloning artifact	UNP P40926
D	-18	HIS	-	cloning artifact	UNP P40926
D	-17	HIS	-	cloning artifact	UNP P40926
D	-16	HIS	-	cloning artifact	UNP P40926
D	-15	HIS	-	cloning artifact	UNP P40926
D	-14	SER	-	cloning artifact	UNP P40926
D	-13	SER	-	cloning artifact	UNP P40926
D	-12	GLY	-	cloning artifact	UNP P40926
D	-11	VAL	-	cloning artifact	UNP P40926
D	-10	ASP	-	cloning artifact	UNP P40926
D	-9	LEU	-	cloning artifact	UNP P40926
D	-8	GLY	-	cloning artifact	UNP P40926
D	-7	THR	-	cloning artifact	UNP P40926
D	-6	GLU	-	cloning artifact	UNP P40926
D	-5	ASN	-	cloning artifact	UNP P40926
D	-4	LEU	-	cloning artifact	UNP P40926
D	-3	TYR	-	cloning artifact	UNP P40926
D	-2	PHE	-	cloning artifact	UNP P40926
D	-1	GLN	-	cloning artifact	UNP P40926
D	0	SER	-	cloning artifact	UNP P40926
D	1	MET	-	cloning artifact	UNP P40926

- Molecule 2 is D-MALATE (three-letter code: MLT) (formula: $C_4H_6O_5$).

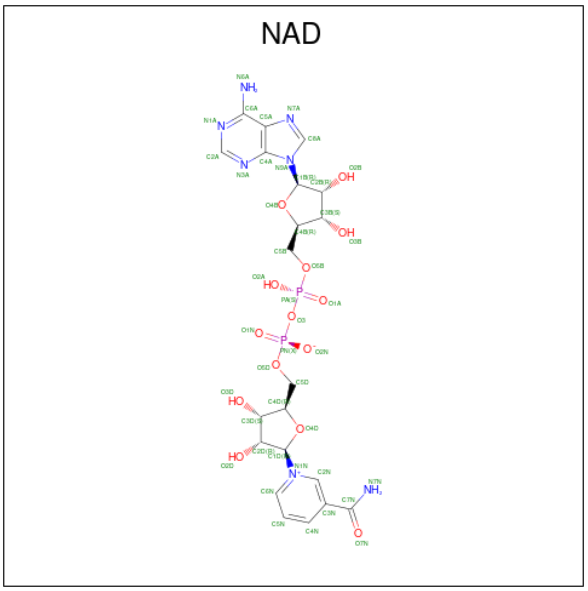


Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 9 4 5	0	0
2	B	1	Total C O 9 4 5	0	0
2	C	1	Total C O 9 4 5	0	0
2	D	1	Total C O 9 4 5	0	0

- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

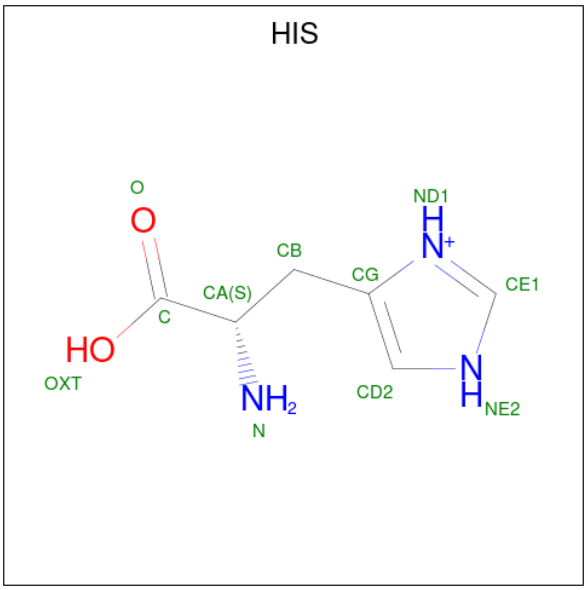
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	2	Total Cl 2 2	0	0
3	B	1	Total Cl 1 1	0	0
3	C	2	Total Cl 2 2	0	0
3	D	2	Total Cl 2 2	0	0

- Molecule 4 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula: $C_{21}H_{27}N_7O_{14}P_2$).



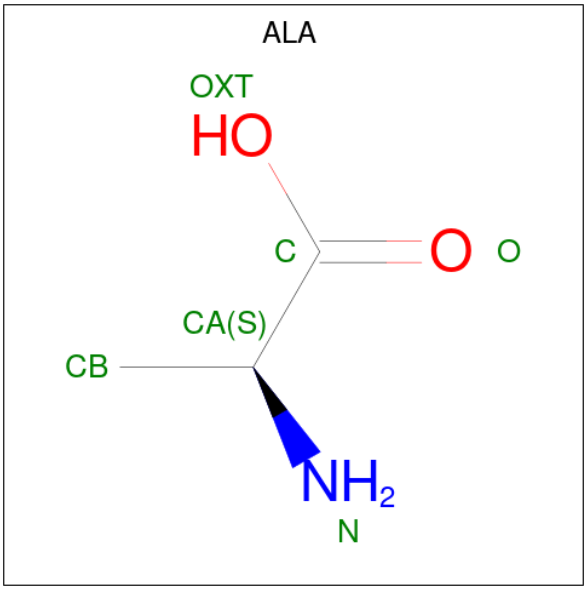
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
4	A	1	44	21	7	14	2	0	0
			Total	C	N	O	P		
4	B	1	44	21	7	14	2	0	0
			Total	C	N	O	P		
4	C	1	44	21	7	14	2	0	0
			Total	C	N	O	P		
4	D	1	44	21	7	14	2	0	0

- Molecule 5 is HISTIDINE (three-letter code: HIS) (formula: $C_6H_{10}N_3O_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
5	A	1	10	6	3	1	0	0
			Total	C	N	O		
5	B	1	10	6	3	1	0	0
			Total	C	N	O		
5	C	1	10	6	3	1	0	0

- Molecule 6 is ALANINE (three-letter code: ALA) (formula: $C_3H_7NO_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
6	A	1	5	3	1	1	0	0

- Molecule 7 is water.

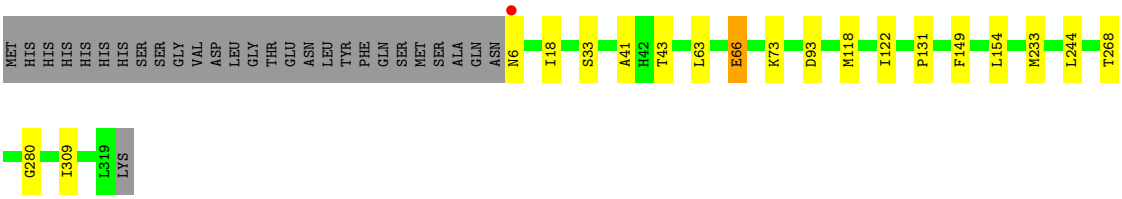
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
7	A	194	194	194	0	0
			Total	O		
7	B	140	140	140	0	0
			Total	O		
7	C	252	252	252	0	0
			Total	O		
7	D	213	213	213	0	0

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.

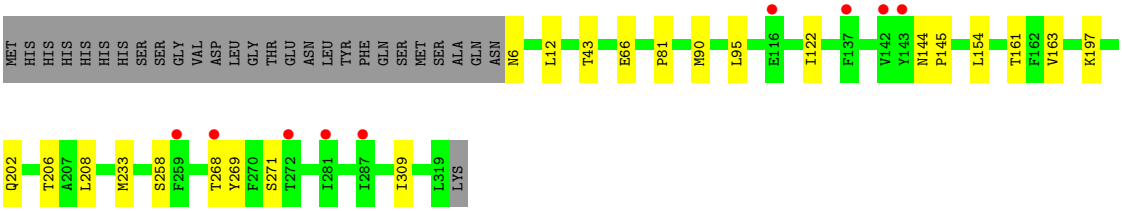
• Molecule 1: Malate dehydrogenase

Chain A:



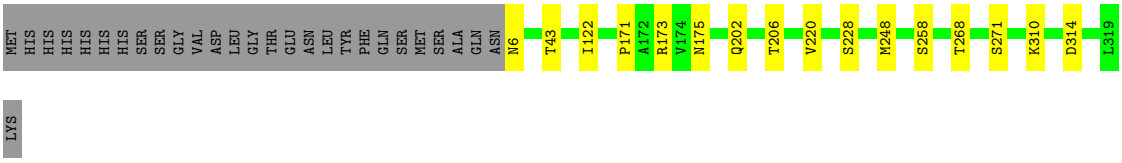
• Molecule 1: Malate dehydrogenase

Chain B:



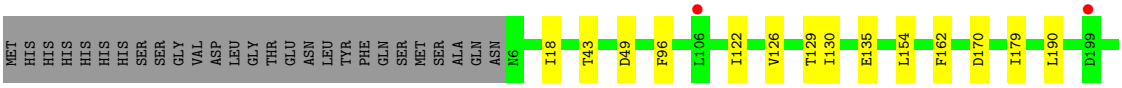
• Molecule 1: Malate dehydrogenase

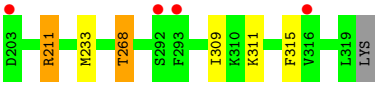
Chain C:



• Molecule 1: Malate dehydrogenase

Chain D:




D203
R211
M233
T268
S292
F293
I309
K310
K311
F315
V316
L319
LYS

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	59.94Å 152.53Å 154.83Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	6.01 – 1.90 68.41 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.8 (6.01-1.90) 99.8 (68.41-1.90)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.73 (at 1.90Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.156 , 0.194 0.163 , 0.200	Depositor DCC
R_{free} test set	5640 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å^2)	28.0	Xtriage
Anisotropy	0.006	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 45.3	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	0.011 for -h,l,k	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	10300	wwPDB-VP
Average B, all atoms (Å^2)	33.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.15% of the height of the origin peak. No significant pseudotranslation is detected.*

[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 (i)

5.1 Standard geometry (i)

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

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	0.73	0/2376	0.68	0/3230
1	B	0.67	0/2348	0.67	0/3196
1	C	0.83	0/2387	0.71	0/3249
1	D	0.78	0/2365	0.73	2/3216 (0.1%)
All	All	0.75	0/9476	0.70	2/12891 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	D	170	ASP	CB-CG-OD2	-5.42	113.42	118.30
1	D	49	ASP	CB-CG-OD1	5.30	123.07	118.30

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts (i)

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2320	0	2389	28	0
1	B	2294	0	2336	26	0
1	C	2320	0	2362	10	0
1	D	2313	0	2374	25	0
2	A	9	0	4	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	9	0	4	1	0
2	C	9	0	4	2	0
2	D	9	0	4	1	0
3	A	2	0	0	0	0
3	B	1	0	0	1	0
3	C	2	0	0	0	0
3	D	2	0	0	1	0
4	A	44	0	26	6	0
4	B	44	0	26	3	0
4	C	44	0	26	3	0
4	D	44	0	26	8	0
5	A	10	0	6	0	0
5	B	10	0	6	0	0
5	C	10	0	6	1	0
6	A	5	0	5	0	0
7	A	194	0	0	3	0
7	B	140	0	0	4	0
7	C	252	0	0	4	0
7	D	213	0	0	5	0
All	All	10300	0	9604	97	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 5.

All (97) 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:D:233[A]:MET:HE3	4:D:3004:NAD:H4N	1.32	1.08
1:D:154:LEU:HD22	1:D:233[A]:MET:HE2	1.34	1.06
1:A:118[B]:MET:CE	1:A:244:LEU:HD11	1.98	0.93
1:B:154:LEU:HB2	1:B:233[A]:MET:HE2	1.51	0.91
1:C:268[B]:THR:HG21	7:C:3569:HOH:O	1.69	0.90
1:D:268[A]:THR:HG22	7:D:3305:HOH:O	1.72	0.90
1:D:233[A]:MET:HE3	4:D:3004:NAD:C4N	2.00	0.90
1:A:118[B]:MET:HE2	1:A:244:LEU:HD11	1.52	0.89
1:D:268[A]:THR:HG21	7:D:3300:HOH:O	1.71	0.89
1:A:154:LEU:HB2	1:A:233[A]:MET:HE2	1.59	0.85
2:A:3104:MLT:H2	4:A:3003:NAD:C4N	2.07	0.85
2:C:3103:MLT:H2	4:C:3002:NAD:C4N	2.08	0.83
1:D:154:LEU:CD2	1:D:233[A]:MET:HE2	2.08	0.83
1:D:154:LEU:HD22	1:D:233[A]:MET:CE	2.08	0.83

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:154:LEU:HB2	1:D:233[A]:MET:HE2	1.64	0.79
1:B:90:MET:HE1	1:B:95:LEU:CD2	2.11	0.79
2:D:3101:MLT:H2	4:D:3004:NAD:C4N	2.14	0.78
1:B:202:GLN:HE21	1:B:206:THR:CG2	1.97	0.78
1:B:90:MET:HE1	1:B:95:LEU:HD23	1.67	0.77
1:D:154:LEU:HB2	1:D:233[A]:MET:CE	2.15	0.76
1:B:154:LEU:HB2	1:B:233[A]:MET:CE	2.17	0.74
2:B:3102:MLT:H2	4:B:3001:NAD:C4N	2.18	0.73
1:A:233[A]:MET:HE3	4:A:3003:NAD:H4N	1.68	0.73
3:D:3207:CL:CL	7:D:3416:HOH:O	2.48	0.69
1:A:118[B]:MET:HE3	1:A:244:LEU:HD11	1.77	0.67
1:A:118[B]:MET:CE	1:A:149:PHE:HE2	2.07	0.67
1:A:118[B]:MET:HE1	1:A:149:PHE:CE2	2.30	0.66
1:B:202:GLN:HE21	1:B:206:THR:HG23	1.61	0.65
1:A:118[B]:MET:HE2	1:A:280:GLY:HA2	1.80	0.63
1:D:154:LEU:CB	1:D:233[A]:MET:HE2	2.29	0.61
1:A:154:LEU:HB2	1:A:233[A]:MET:CE	2.28	0.61
1:B:268[A]:THR:HG23	1:B:269:TYR:CD2	2.35	0.61
1:A:154:LEU:HD22	1:A:233[A]:MET:CE	2.31	0.60
1:A:118[B]:MET:HE1	1:A:149:PHE:HE2	1.63	0.59
1:D:233[A]:MET:HE1	4:D:3004:NAD:O7N	2.02	0.59
1:A:118[B]:MET:CE	1:A:149:PHE:CE2	2.85	0.59
1:A:268[B]:THR:HG22	7:A:3326:HOH:O	2.04	0.57
1:B:90:MET:HE1	1:B:95:LEU:HD21	1.85	0.57
1:B:154:LEU:CB	1:B:233[A]:MET:CE	2.85	0.55
1:C:310:LYS:NZ	1:C:314:ASP:OD2	2.40	0.54
1:D:268[A]:THR:HG23	1:D:309:ILE:HG21	1.91	0.53
3:B:3206:CL:CL	7:B:3533:HOH:O	2.56	0.53
1:A:66:GLU:H	1:A:66:GLU:CD	2.12	0.53
1:D:154:LEU:CB	1:D:233[A]:MET:CE	2.85	0.53
1:D:233[A]:MET:CE	4:D:3004:NAD:H4N	2.22	0.53
1:B:268[A]:THR:HG23	1:B:269:TYR:HD2	1.76	0.51
1:A:154:LEU:CB	1:A:233[A]:MET:HE2	2.37	0.51
1:D:154:LEU:CD2	1:D:233[A]:MET:CE	2.79	0.50
1:A:154:LEU:HD22	1:A:233[A]:MET:HE2	1.93	0.50
1:A:18:ILE:HD11	4:A:3003:NAD:C6N	2.42	0.50
1:B:268[A]:THR:CG2	1:B:309:ILE:HG21	2.43	0.49
1:A:233[A]:MET:HE1	4:A:3003:NAD:O7N	2.13	0.48
1:A:118[B]:MET:CE	1:A:280:GLY:HA2	2.42	0.48
1:B:197:LYS:NZ	7:B:3520:HOH:O	2.47	0.48
1:D:211[B]:ARG:NH2	7:D:3297:HOH:O	2.46	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:233[A]:MET:HE3	4:A:3003:NAD:C4N	2.40	0.47
1:C:175[B]:ASN:ND2	7:C:3532:HOH:O	2.24	0.47
1:A:154:LEU:CB	1:A:233[A]:MET:CE	2.93	0.46
7:A:3442:HOH:O	4:D:3004:NAD:H8A	2.16	0.46
1:A:154:LEU:HD22	1:A:233[A]:MET:HE3	1.97	0.46
1:C:248:MET:HE2	7:C:3677:HOH:O	2.15	0.46
1:A:6:ASN:HA	1:A:33:SER:HB3	1.98	0.46
1:B:12:LEU:O	1:B:81:PRO:HD2	2.15	0.45
1:D:96:PHE:CG	1:D:311:LYS:HE3	2.51	0.45
1:A:118[B]:MET:HE3	1:A:149:PHE:HE2	1.80	0.45
1:C:175[B]:ASN:ND2	7:C:3622:HOH:O	2.36	0.45
1:C:202:GLN:O	1:C:206:THR:HG23	2.17	0.45
1:A:154:LEU:CD2	1:A:233[A]:MET:CE	2.95	0.45
1:B:122:ILE:O	4:B:3001:NAD:H2N	2.17	0.44
1:D:315:PHE:CD2	1:D:315:PHE:C	2.90	0.44
1:A:122:ILE:O	4:A:3003:NAD:H2N	2.17	0.44
1:B:154:LEU:CB	1:B:233[A]:MET:HE2	2.35	0.44
1:D:162:PHE:CE2	1:D:211[B]:ARG:HG2	2.53	0.43
1:D:135:GLU:OE1	7:D:3299:HOH:O	2.21	0.43
1:B:144:ASN:HA	1:B:145:PRO:HD2	1.89	0.43
1:B:233[A]:MET:HE1	7:B:3404:HOH:O	2.18	0.43
1:D:18:ILE:HD11	4:D:3004:NAD:C6N	2.49	0.43
1:B:233[A]:MET:HE3	4:B:3001:NAD:H4N	2.00	0.43
1:C:171:PRO:O	5:C:3501:HIS:HE1	2.02	0.42
1:B:163:VAL:HG22	1:B:208:LEU:HD21	2.02	0.42
1:C:122:ILE:O	4:C:3002:NAD:H2N	2.18	0.42
2:C:3103:MLT:H2	4:C:3002:NAD:C3N	2.50	0.42
1:B:268[A]:THR:HG22	7:B:3509:HOH:O	2.20	0.42
1:A:131:PRO:HG2	1:A:309:ILE:HA	2.01	0.42
1:A:41:ALA:HA	1:A:63:LEU:HD11	2.01	0.42
7:A:3375:HOH:O	1:B:161:THR:HG23	2.19	0.42
1:B:202:GLN:O	1:B:206:THR:HG23	2.20	0.41
1:B:90:MET:CE	1:B:95:LEU:CD2	2.90	0.41
1:B:154:LEU:HD22	1:B:233[A]:MET:CE	2.51	0.41
1:C:258:SER:O	1:C:271:SER:HA	2.21	0.41
1:C:220:VAL:HG22	1:C:228:SER:HB3	2.03	0.41
1:D:126:VAL:HA	1:D:129:THR:OG1	2.22	0.40
1:D:122:ILE:O	4:D:3004:NAD:H2N	2.21	0.40
1:D:179:ILE:HD13	1:D:190:LEU:HD11	2.03	0.40
1:B:258:SER:O	1:B:271:SER:HA	2.21	0.40
1:D:130:ILE:HD13	1:D:130:ILE:HA	1.98	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	317/342 (93%)	312 (98%)	5 (2%)	0	100	100
1	B	316/342 (92%)	309 (98%)	7 (2%)	0	100	100
1	C	319/342 (93%)	311 (98%)	8 (2%)	0	100	100
1	D	316/342 (92%)	309 (98%)	7 (2%)	0	100	100
All	All	1268/1368 (93%)	1241 (98%)	27 (2%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains (i)

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	252/278 (91%)	248 (98%)	4 (2%)	62	60
1	B	246/278 (88%)	244 (99%)	2 (1%)	81	82
1	C	253/278 (91%)	250 (99%)	3 (1%)	71	70
1	D	249/278 (90%)	244 (98%)	5 (2%)	55	51
All	All	1000/1112 (90%)	986 (99%)	14 (1%)	71	65

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	43	THR
1	A	66	GLU
1	A	73	LYS
1	A	93	ASP
1	B	6	ASN
1	B	43	THR
1	C	6	ASN
1	C	43	THR
1	C	173	ARG
1	D	43	THR
1	D	211[A]	ARG
1	D	211[B]	ARG
1	D	268[A]	THR
1	D	268[B]	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	146	ASN
1	A	249	ASN
1	B	6	ASN
1	B	202	GLN
1	B	249	ASN
1	C	6	ASN
1	C	249	ASN
1	D	146	ASN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 19 ligands modelled in this entry, 7 are monoatomic - leaving 12 for Mogul analysis.

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	$\#\|Z\| > 2$
6	ALA	A	3302	5	3,4,5	0.75	0	2,4,6	1.12	0
4	NAD	A	3003	-	42,48,48	1.75	5 (11%)	50,73,73	1.39	7 (14%)
5	HIS	A	3301	6	5,10,11	0.76	0	3,12,14	1.44	0
4	NAD	C	3002	-	42,48,48	1.72	5 (11%)	50,73,73	1.70	10 (20%)
4	NAD	D	3004	-	42,48,48	1.61	4 (9%)	50,73,73	1.79	9 (18%)
2	MLT	C	3103	-	8,8,8	1.59	1 (12%)	10,10,10	1.43	2 (20%)
2	MLT	A	3104	-	8,8,8	1.62	1 (12%)	10,10,10	1.57	2 (20%)
5	HIS	B	3401	-	5,10,11	1.03	0	3,12,14	1.21	0
2	MLT	D	3101	-	8,8,8	1.31	0	10,10,10	1.25	1 (10%)
4	NAD	B	3001	-	42,48,48	1.71	4 (9%)	50,73,73	1.43	4 (8%)
5	HIS	C	3501	-	5,10,11	0.82	0	3,12,14	1.35	1 (33%)
2	MLT	B	3102	-	8,8,8	1.57	1 (12%)	10,10,10	1.07	1 (10%)

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
6	ALA	A	3302	5	-	0/0/2/4	-
4	NAD	A	3003	-	-	5/26/62/62	0/5/5/5
5	HIS	A	3301	6	-	2/5/6/8	0/1/1/1
4	NAD	C	3002	-	-	5/26/62/62	0/5/5/5
4	NAD	D	3004	-	-	5/26/62/62	0/5/5/5
2	MLT	C	3103	-	1/1/3/3	0/8/8/8	-
2	MLT	A	3104	-	1/1/3/3	3/8/8/8	-
5	HIS	B	3401	-	-	1/5/6/8	0/1/1/1
2	MLT	D	3101	-	1/1/3/3	0/8/8/8	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	NAD	B	3001	-	-	5/26/62/62	0/5/5/5
5	HIS	C	3501	-	-	2/5/6/8	0/1/1/1
2	MLT	B	3102	-	1/1/3/3	1/8/8/8	-

All (21) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	C	3002	NAD	O7N-C7N	8.27	1.40	1.24
4	B	3001	NAD	O7N-C7N	7.99	1.39	1.24
4	A	3003	NAD	O7N-C7N	7.88	1.39	1.24
4	D	3004	NAD	O7N-C7N	6.60	1.36	1.24
4	D	3004	NAD	C2A-N3A	4.41	1.39	1.32
4	A	3003	NAD	C2N-N1N	3.89	1.39	1.35
2	A	3104	MLT	C2-C1	-3.57	1.46	1.52
4	B	3001	NAD	C2A-N3A	3.42	1.37	1.32
4	B	3001	NAD	C2A-N1A	3.42	1.40	1.33
4	A	3003	NAD	C2A-N3A	3.21	1.37	1.32
2	C	3103	MLT	C2-C1	-3.07	1.47	1.52
2	B	3102	MLT	C2-C1	-3.05	1.47	1.52
4	C	3002	NAD	C2A-N3A	3.04	1.37	1.32
4	B	3001	NAD	C2N-N1N	3.01	1.38	1.35
4	A	3003	NAD	C2A-N1A	2.80	1.39	1.33
4	C	3002	NAD	C2A-N1A	2.79	1.39	1.33
4	C	3002	NAD	C4N-C3N	2.63	1.43	1.39
4	C	3002	NAD	O4D-C1D	2.40	1.44	1.41
4	D	3004	NAD	C8A-N7A	2.40	1.39	1.34
4	A	3003	NAD	O4B-C4B	-2.11	1.40	1.45
4	D	3004	NAD	O4D-C4D	-2.06	1.40	1.45

All (37) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	C	3002	NAD	N3A-C2A-N1A	-6.59	118.38	128.68
4	D	3004	NAD	N3A-C2A-N1A	-6.33	118.78	128.68
4	B	3001	NAD	N3A-C2A-N1A	-5.57	119.97	128.68
4	A	3003	NAD	N3A-C2A-N1A	-5.10	120.71	128.68
4	D	3004	NAD	C3N-C7N-N7N	5.02	123.78	117.75
4	D	3004	NAD	O7N-C7N-C3N	-4.01	114.84	119.63
4	B	3001	NAD	O2N-PN-O1N	3.94	131.71	112.24
4	C	3002	NAD	O7N-C7N-C3N	-3.41	115.56	119.63
4	D	3004	NAD	O2N-PN-O1N	3.34	128.78	112.24
2	A	3104	MLT	O2-C1-C2	3.22	119.79	112.72

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	C	3002	NAD	O2N-PN-O1N	3.10	127.56	112.24
4	D	3004	NAD	O4B-C1B-C2B	-3.02	102.51	106.93
4	A	3003	NAD	C4A-C5A-N7A	-2.95	106.33	109.40
4	C	3002	NAD	PN-O3-PA	-2.93	122.78	132.83
4	B	3001	NAD	O7N-C7N-C3N	-2.82	116.26	119.63
4	C	3002	NAD	O4D-C1D-C2D	-2.71	102.97	106.93
2	A	3104	MLT	O1-C1-C2	-2.67	117.32	122.54
4	C	3002	NAD	O5D-PN-O1N	-2.66	98.65	109.07
4	C	3002	NAD	C3N-C7N-N7N	2.64	120.92	117.75
4	A	3003	NAD	C3N-C7N-N7N	2.63	120.91	117.75
4	B	3001	NAD	O4B-C4B-C3B	2.62	110.30	105.11
4	D	3004	NAD	C6N-N1N-C2N	-2.59	119.61	121.97
2	C	3103	MLT	O3-C2-C3	2.55	116.30	110.05
4	D	3004	NAD	O4D-C1D-C2D	-2.46	103.33	106.93
4	A	3003	NAD	O2N-PN-O1N	2.39	124.06	112.24
2	D	3101	MLT	O2-C1-C2	2.34	117.87	112.72
4	C	3002	NAD	O4B-C4B-C3B	2.34	109.74	105.11
4	C	3002	NAD	C2N-C3N-C4N	2.27	120.83	118.26
4	D	3004	NAD	C1B-N9A-C4A	-2.21	122.76	126.64
2	C	3103	MLT	O2-C1-C2	2.20	117.56	112.72
4	D	3004	NAD	PN-O3-PA	-2.17	125.38	132.83
4	A	3003	NAD	O7N-C7N-C3N	-2.16	117.05	119.63
4	C	3002	NAD	C2A-N1A-C6A	2.16	122.44	118.75
2	B	3102	MLT	O2-C1-C2	2.04	117.19	112.72
4	A	3003	NAD	O4B-C4B-C3B	2.02	109.12	105.11
4	A	3003	NAD	C6N-N1N-C2N	-2.01	120.14	121.97
5	C	3501	HIS	CD2-NE2-CE1	2.00	108.90	105.78

All (4) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	A	3104	MLT	C2
2	B	3102	MLT	C2
2	C	3103	MLT	C2
2	D	3101	MLT	C2

All (29) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	3003	NAD	O4D-C1D-N1N-C2N
4	A	3003	NAD	O4D-C1D-N1N-C6N
4	A	3003	NAD	C2D-C1D-N1N-C2N

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Mol	Chain	Res	Type	Atoms
4	A	3003	NAD	C2D-C1D-N1N-C6N
4	B	3001	NAD	O4D-C1D-N1N-C2N
4	B	3001	NAD	O4D-C1D-N1N-C6N
4	B	3001	NAD	C2D-C1D-N1N-C2N
4	B	3001	NAD	C2D-C1D-N1N-C6N
4	C	3002	NAD	O4D-C1D-N1N-C2N
4	C	3002	NAD	O4D-C1D-N1N-C6N
4	C	3002	NAD	C2D-C1D-N1N-C2N
4	C	3002	NAD	C2D-C1D-N1N-C6N
4	D	3004	NAD	O4D-C1D-N1N-C2N
4	D	3004	NAD	O4D-C1D-N1N-C6N
4	D	3004	NAD	C2D-C1D-N1N-C2N
4	D	3004	NAD	C2D-C1D-N1N-C6N
2	A	3104	MLT	O1-C1-C2-C3
2	A	3104	MLT	O2-C1-C2-C3
5	A	3301	HIS	CA-CB-CG-ND1
5	C	3501	HIS	CA-CB-CG-ND1
2	B	3102	MLT	O2-C1-C2-C3
5	B	3401	HIS	N-CA-CB-CG
2	A	3104	MLT	O2-C1-C2-O3
4	A	3003	NAD	O4B-C4B-C5B-O5B
4	C	3002	NAD	O4B-C4B-C5B-O5B
4	D	3004	NAD	O4B-C4B-C5B-O5B
4	B	3001	NAD	O4B-C4B-C5B-O5B
5	A	3301	HIS	CA-CB-CG-CD2
5	C	3501	HIS	CA-CB-CG-CD2

There are no ring outliers.

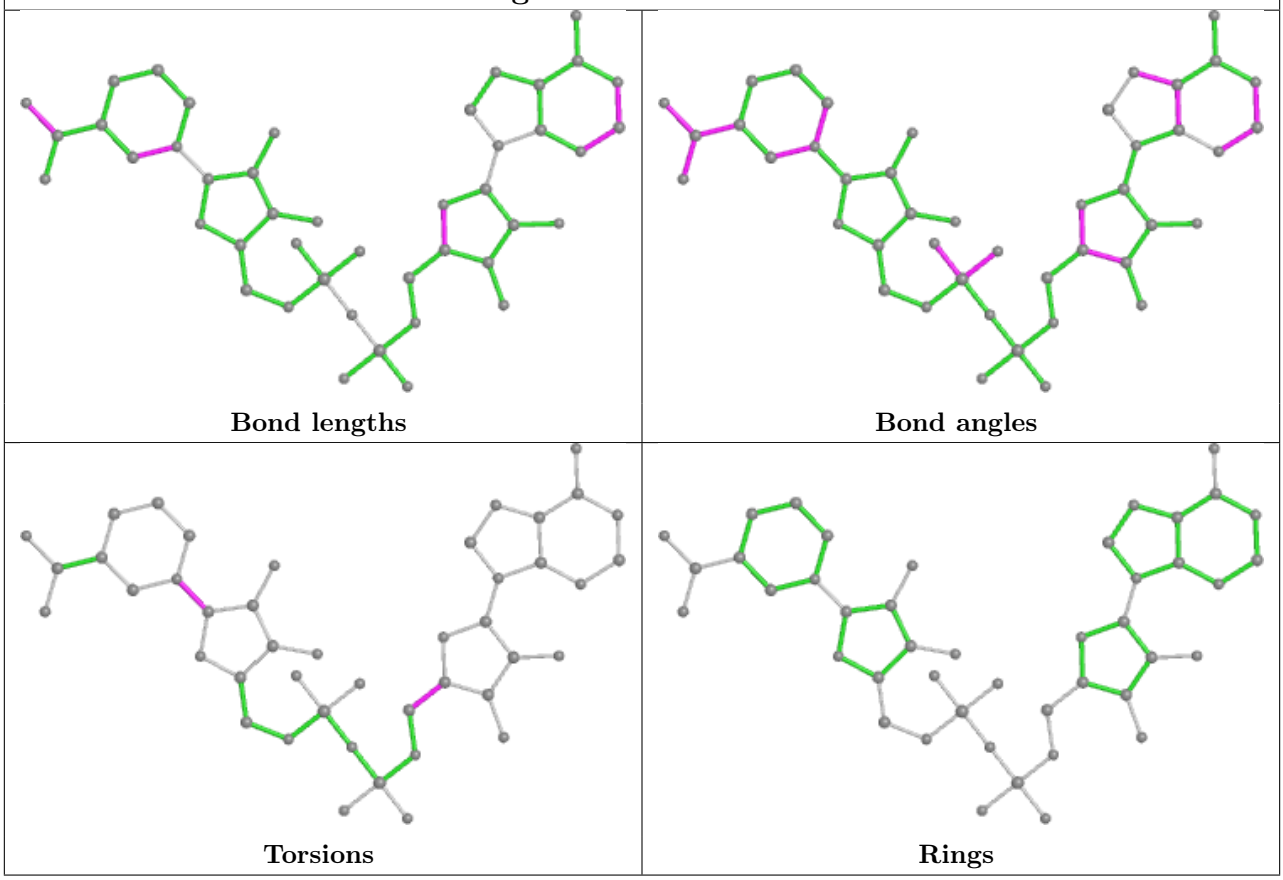
9 monomers are involved in 21 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	3003	NAD	6	0
4	C	3002	NAD	3	0
4	D	3004	NAD	8	0
2	C	3103	MLT	2	0
2	A	3104	MLT	1	0
2	D	3101	MLT	1	0
4	B	3001	NAD	3	0
5	C	3501	HIS	1	0
2	B	3102	MLT	1	0

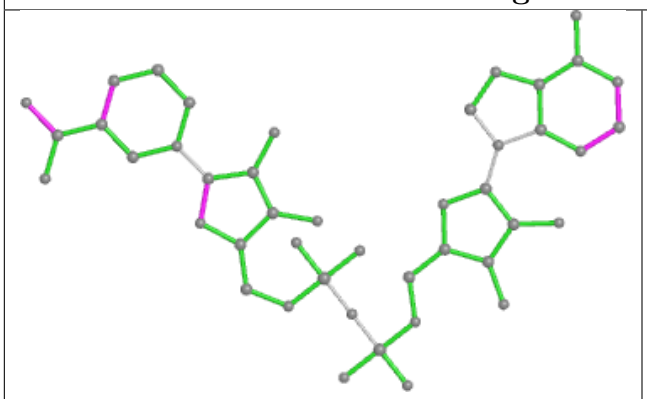
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths,

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 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.

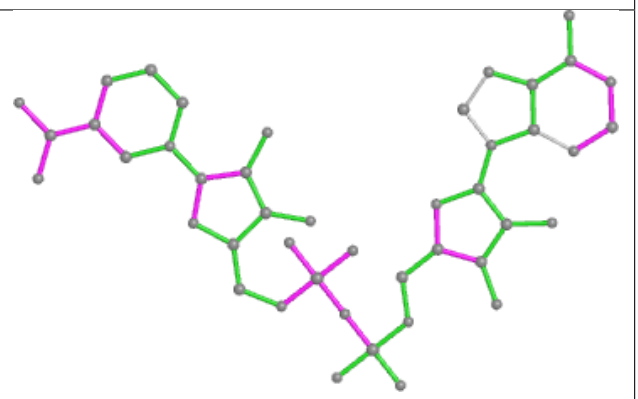
Ligand NAD A 3003



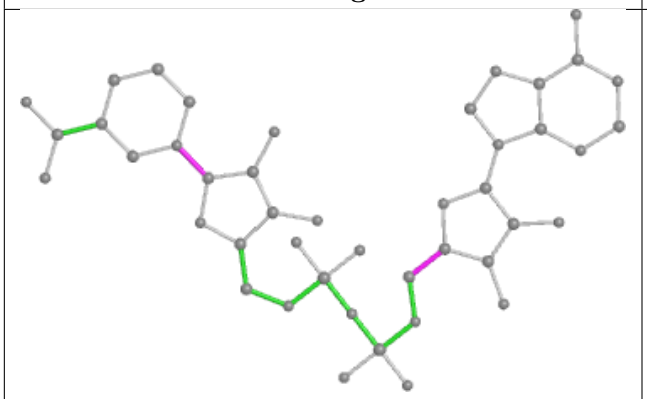
Ligand NAD C 3002



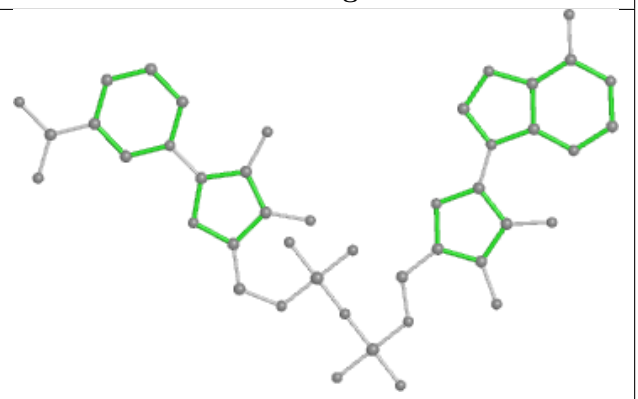
Bond lengths



Bond angles

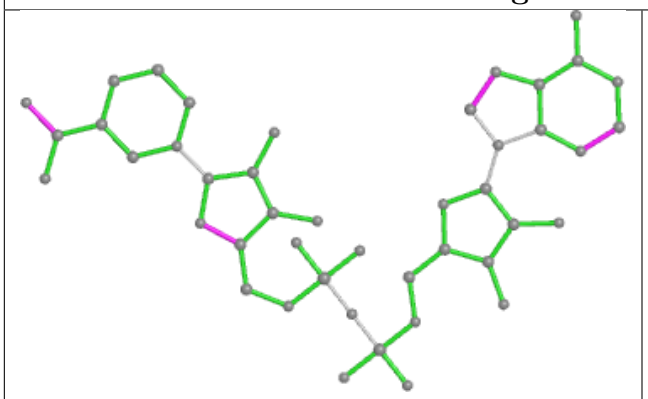


Torsions

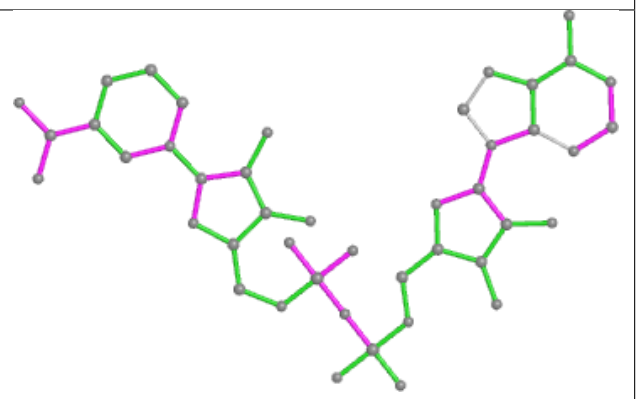


Rings

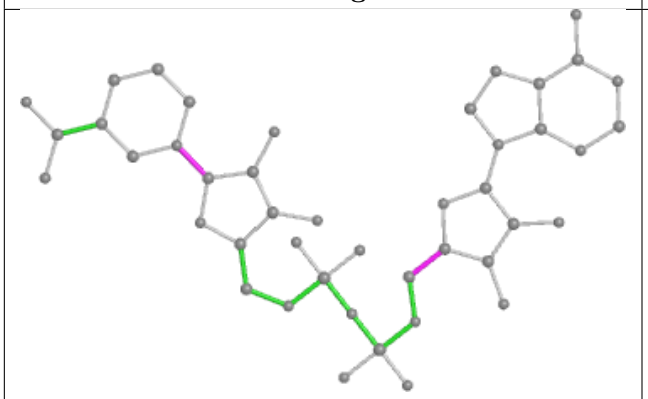
Ligand NAD D 3004



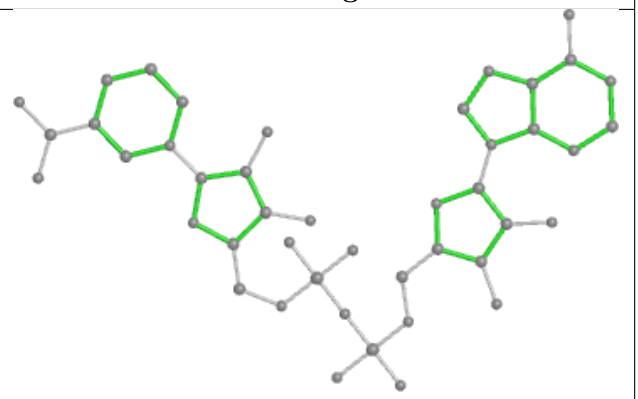
Bond lengths



Bond angles

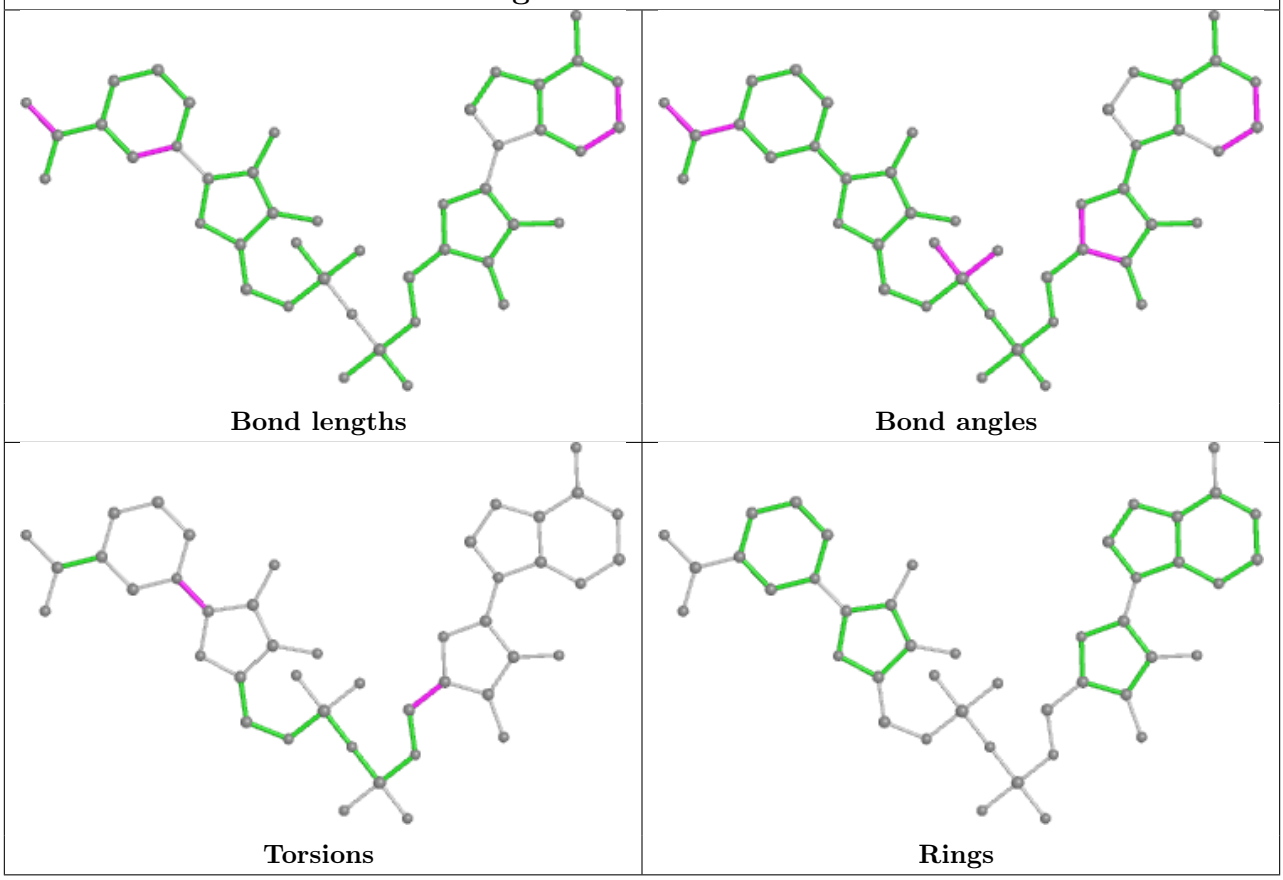


Torsions



Rings

Ligand NAD B 3001



5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data (i)

6.1 Protein, DNA and RNA chains (i)

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å^2)	Q<0.9
1	A	314/342 (91%)	0.20	1 (0%) 94 94	28, 32, 38, 49	0
1	B	314/342 (91%)	0.44	9 (2%) 51 54	28, 33, 37, 46	0
1	C	314/342 (91%)	0.29	0 100 100	29, 32, 38, 49	0
1	D	314/342 (91%)	0.53	6 (1%) 66 69	28, 32, 38, 49	0
All	All	1256/1368 (91%)	0.37	16 (1%) 77 79	28, 32, 38, 49	0

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	143	TYR	3.5
1	D	292	SER	3.0
1	D	316	VAL	2.8
1	D	203	ASP	2.6
1	B	116	GLU	2.6
1	B	272	THR	2.5
1	D	106	LEU	2.5
1	B	281	ILE	2.4
1	B	142	VAL	2.3
1	B	137	PHE	2.2
1	D	199	ASP	2.1
1	B	259	PHE	2.1
1	D	293	PHE	2.1
1	B	287	ILE	2.1
1	B	268[A]	THR	2.0
1	A	6	ASN	2.0

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

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

6.3 Carbohydrates (i)

There are no monosaccharides in this entry.

6.4 Ligands (i)

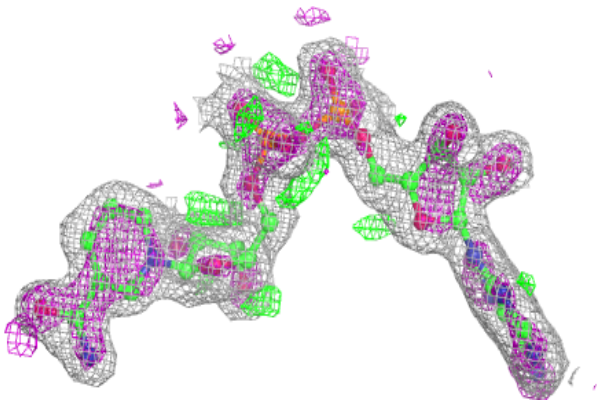
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

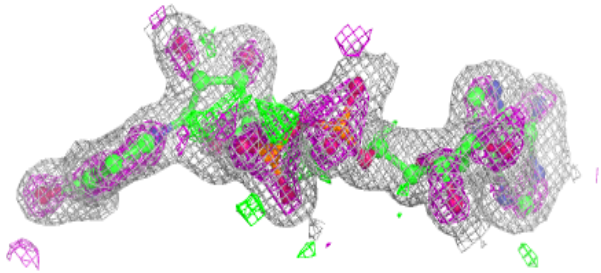
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
3	CL	A	3205	1/1	0.59	0.10	86,86,86,86	0
6	ALA	A	3302	5/6	0.74	0.21	53,53,54,55	0
5	HIS	C	3501	10/11	0.77	0.32	40,47,51,52	0
5	HIS	B	3401	10/11	0.79	0.17	49,52,57,58	0
5	HIS	A	3301	10/11	0.83	0.22	45,49,53,53	0
3	CL	C	3204	1/1	0.83	0.30	69,69,69,69	0
3	CL	D	3207	1/1	0.88	0.13	77,77,77,77	0
2	MLT	B	3102	9/9	0.93	0.17	32,36,38,38	0
2	MLT	D	3101	9/9	0.94	0.12	25,29,32,33	0
3	CL	B	3206	1/1	0.94	0.12	76,76,76,76	0
2	MLT	C	3103	9/9	0.97	0.09	20,24,26,27	0
2	MLT	A	3104	9/9	0.97	0.12	28,31,32,33	0
4	NAD	A	3003	44/44	0.97	0.09	20,26,29,29	0
4	NAD	B	3001	44/44	0.97	0.11	23,28,30,32	0
3	CL	D	3202	1/1	0.98	0.11	38,38,38,38	0
3	CL	A	3203	1/1	0.98	0.10	36,36,36,36	0
4	NAD	C	3002	44/44	0.98	0.08	17,22,24,26	0
4	NAD	D	3004	44/44	0.98	0.08	21,24,30,31	0
3	CL	C	3201	1/1	0.99	0.06	28,28,28,28	0

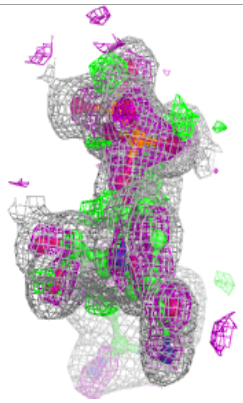
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around NAD A 3003:

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

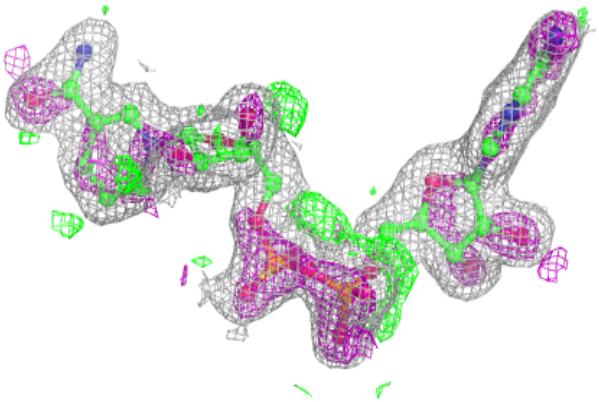


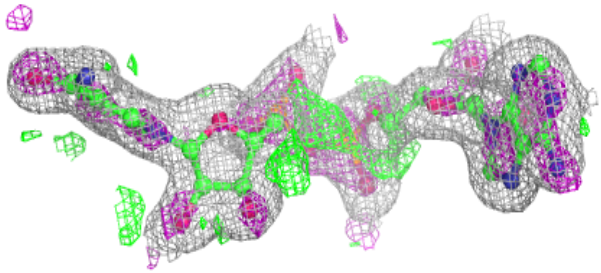


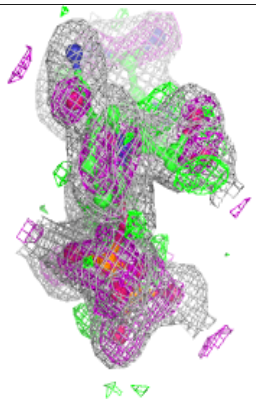


Electron density around NAD B 3001:

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

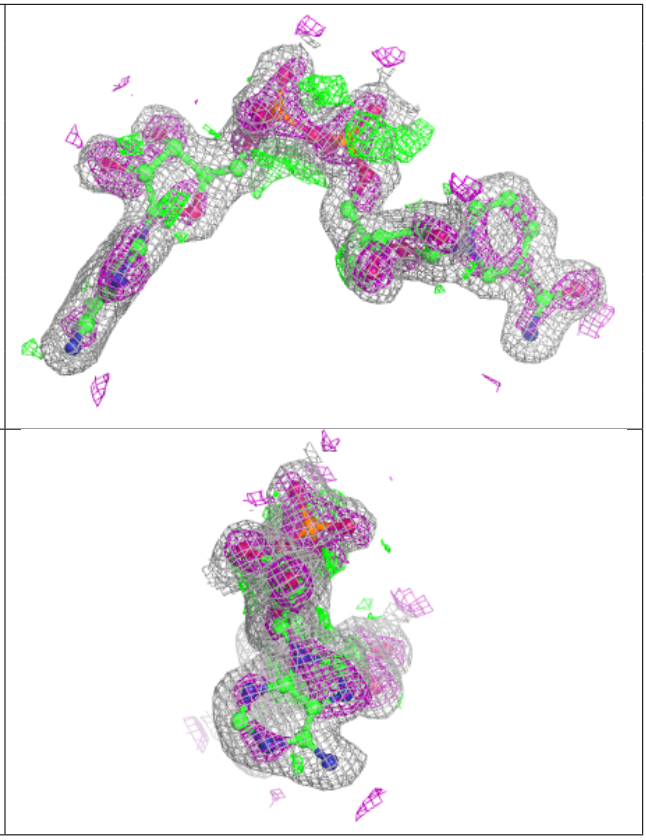






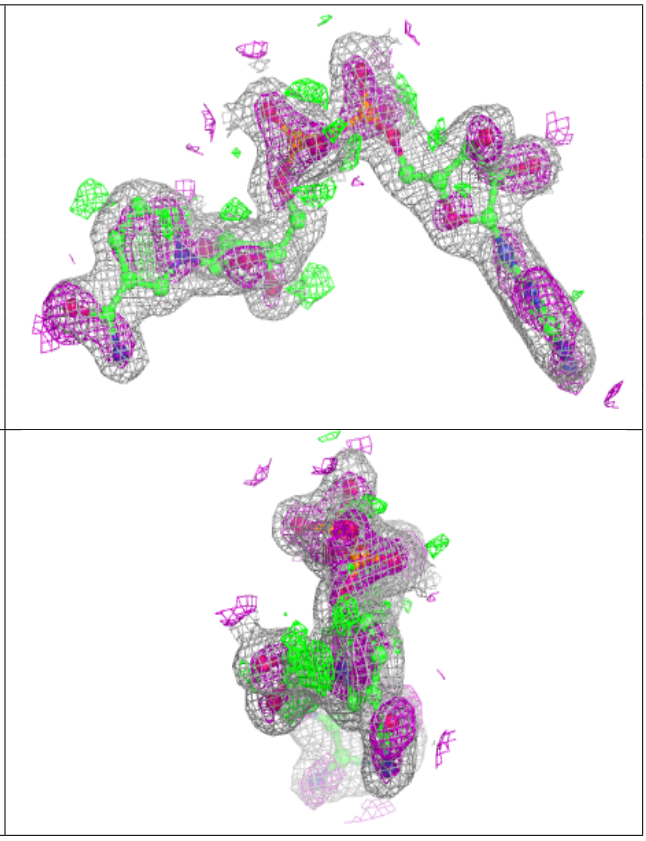
Electron density around NAD C 3002:

$2mF_o$-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 3004:

$2mF_o$-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.