wwPDB X-ray Structure Validation Summary Report (i)

Sep 19, 2023 – 12:22 AM EDT

PDB ID	:	5DIB
Title	:	2.25 Angstrom resolution crystal structure of betaine aldehyde dehydrogenase (betB) Y450L point mutant from Staphylococcus aureus in complex with NAD+ and BME-modified Cys289
Authors	:	Halavaty, A.S.; Minasov, G.; Chen, C.; Joo, J.C.; Yakunin, A.F.; Anderson, W.F.; Center for Structural Genomics of Infectious Diseases (CSGID)
Deposited on	:	2015-08-31
Resolution	:	2.25 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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:

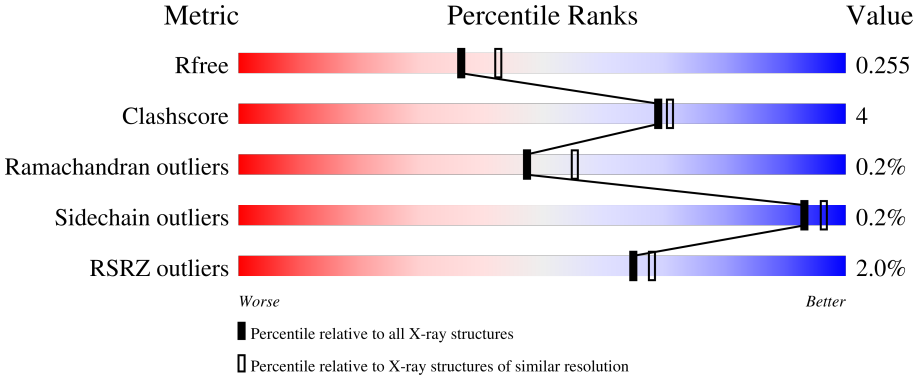
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 2.25 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	1377 (2.26-2.26)
Clashscore	141614	1487 (2.26-2.26)
Ramachandran outliers	138981	1449 (2.26-2.26)
Sidechain outliers	138945	1450 (2.26-2.26)
RSRZ outliers	127900	1356 (2.26-2.26)

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	517	2% 89% 7% •
1	B	517	2% 88% 8% •
1	C	517	2% 88% 8% •
1	D	517	2% 89% 7% •

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
1	CME	D	289	-	-	X	-

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 16596 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 Betaine aldehyde dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	498	3883	2446	660	761	16	0	3	0
1	B	496	3868	2437	656	760	15	0	3	0
1	C	498	3874	2441	657	760	16	0	2	0
1	D	496	3880	2444	659	762	15	0	4	0

There are 88 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-20	MET	-	initiating methionine	UNP Q9L4P8
A	-19	GLY	-	expression tag	UNP Q9L4P8
A	-18	SER	-	expression tag	UNP Q9L4P8
A	-17	SER	-	expression tag	UNP Q9L4P8
A	-16	HIS	-	expression tag	UNP Q9L4P8
A	-15	HIS	-	expression tag	UNP Q9L4P8
A	-14	HIS	-	expression tag	UNP Q9L4P8
A	-13	HIS	-	expression tag	UNP Q9L4P8
A	-12	HIS	-	expression tag	UNP Q9L4P8
A	-11	HIS	-	expression tag	UNP Q9L4P8
A	-10	SER	-	expression tag	UNP Q9L4P8
A	-9	SER	-	expression tag	UNP Q9L4P8
A	-8	GLY	-	expression tag	UNP Q9L4P8
A	-7	ARG	-	expression tag	UNP Q9L4P8
A	-6	GLU	-	expression tag	UNP Q9L4P8
A	-5	ASN	-	expression tag	UNP Q9L4P8
A	-4	LEU	-	expression tag	UNP Q9L4P8
A	-3	TYR	-	expression tag	UNP Q9L4P8
A	-2	PHE	-	expression tag	UNP Q9L4P8
A	-1	GLN	-	expression tag	UNP Q9L4P8
A	0	GLY	-	expression tag	UNP Q9L4P8

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Chain	Residue	Modelled	Actual	Comment	Reference
A	450	LEU	TYR	engineered mutation	UNP Q9L4P8
B	-20	MET	-	initiating methionine	UNP Q9L4P8
B	-19	GLY	-	expression tag	UNP Q9L4P8
B	-18	SER	-	expression tag	UNP Q9L4P8
B	-17	SER	-	expression tag	UNP Q9L4P8
B	-16	HIS	-	expression tag	UNP Q9L4P8
B	-15	HIS	-	expression tag	UNP Q9L4P8
B	-14	HIS	-	expression tag	UNP Q9L4P8
B	-13	HIS	-	expression tag	UNP Q9L4P8
B	-12	HIS	-	expression tag	UNP Q9L4P8
B	-11	HIS	-	expression tag	UNP Q9L4P8
B	-10	SER	-	expression tag	UNP Q9L4P8
B	-9	SER	-	expression tag	UNP Q9L4P8
B	-8	GLY	-	expression tag	UNP Q9L4P8
B	-7	ARG	-	expression tag	UNP Q9L4P8
B	-6	GLU	-	expression tag	UNP Q9L4P8
B	-5	ASN	-	expression tag	UNP Q9L4P8
B	-4	LEU	-	expression tag	UNP Q9L4P8
B	-3	TYR	-	expression tag	UNP Q9L4P8
B	-2	PHE	-	expression tag	UNP Q9L4P8
B	-1	GLN	-	expression tag	UNP Q9L4P8
B	0	GLY	-	expression tag	UNP Q9L4P8
B	450	LEU	TYR	engineered mutation	UNP Q9L4P8
C	-20	MET	-	initiating methionine	UNP Q9L4P8
C	-19	GLY	-	expression tag	UNP Q9L4P8
C	-18	SER	-	expression tag	UNP Q9L4P8
C	-17	SER	-	expression tag	UNP Q9L4P8
C	-16	HIS	-	expression tag	UNP Q9L4P8
C	-15	HIS	-	expression tag	UNP Q9L4P8
C	-14	HIS	-	expression tag	UNP Q9L4P8
C	-13	HIS	-	expression tag	UNP Q9L4P8
C	-12	HIS	-	expression tag	UNP Q9L4P8
C	-11	HIS	-	expression tag	UNP Q9L4P8
C	-10	SER	-	expression tag	UNP Q9L4P8
C	-9	SER	-	expression tag	UNP Q9L4P8
C	-8	GLY	-	expression tag	UNP Q9L4P8
C	-7	ARG	-	expression tag	UNP Q9L4P8
C	-6	GLU	-	expression tag	UNP Q9L4P8
C	-5	ASN	-	expression tag	UNP Q9L4P8
C	-4	LEU	-	expression tag	UNP Q9L4P8
C	-3	TYR	-	expression tag	UNP Q9L4P8
C	-2	PHE	-	expression tag	UNP Q9L4P8

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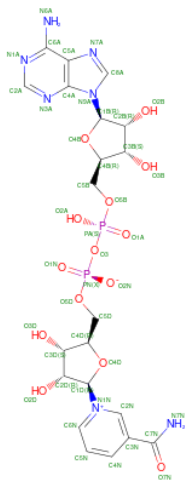
Chain	Residue	Modelled	Actual	Comment	Reference
C	-1	GLN	-	expression tag	UNP Q9L4P8
C	0	GLY	-	expression tag	UNP Q9L4P8
C	450	LEU	TYR	engineered mutation	UNP Q9L4P8
D	-20	MET	-	initiating methionine	UNP Q9L4P8
D	-19	GLY	-	expression tag	UNP Q9L4P8
D	-18	SER	-	expression tag	UNP Q9L4P8
D	-17	SER	-	expression tag	UNP Q9L4P8
D	-16	HIS	-	expression tag	UNP Q9L4P8
D	-15	HIS	-	expression tag	UNP Q9L4P8
D	-14	HIS	-	expression tag	UNP Q9L4P8
D	-13	HIS	-	expression tag	UNP Q9L4P8
D	-12	HIS	-	expression tag	UNP Q9L4P8
D	-11	HIS	-	expression tag	UNP Q9L4P8
D	-10	SER	-	expression tag	UNP Q9L4P8
D	-9	SER	-	expression tag	UNP Q9L4P8
D	-8	GLY	-	expression tag	UNP Q9L4P8
D	-7	ARG	-	expression tag	UNP Q9L4P8
D	-6	GLU	-	expression tag	UNP Q9L4P8
D	-5	ASN	-	expression tag	UNP Q9L4P8
D	-4	LEU	-	expression tag	UNP Q9L4P8
D	-3	TYR	-	expression tag	UNP Q9L4P8
D	-2	PHE	-	expression tag	UNP Q9L4P8
D	-1	GLN	-	expression tag	UNP Q9L4P8
D	0	GLY	-	expression tag	UNP Q9L4P8
D	450	LEU	TYR	engineered mutation	UNP Q9L4P8

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

NAD

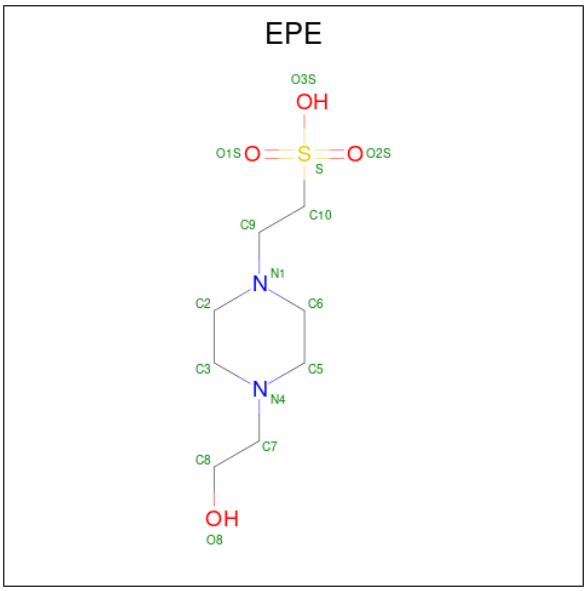


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	44	21	7	14	2	0	0
			Total	C	N	O	P		
2	B	1	44	21	7	14	2	0	0
			Total	C	N	O	P		
2	C	1	44	21	7	14	2	0	0
			Total	C	N	O	P		
2	D	1	44	21	7	14	2	0	0

- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Na		
3	A	2	2	2	0	0
			Total	Na		
3	B	1	1	1	0	0

- Molecule 4 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (three-letter code: EPE) (formula: $C_8H_{18}N_2O_4S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
4	A	1	15	8	2	4	1	0	0
			Total	C	N	O	S		
4	A	1	15	8	2	4	1	0	0

- Molecule 5 is water.

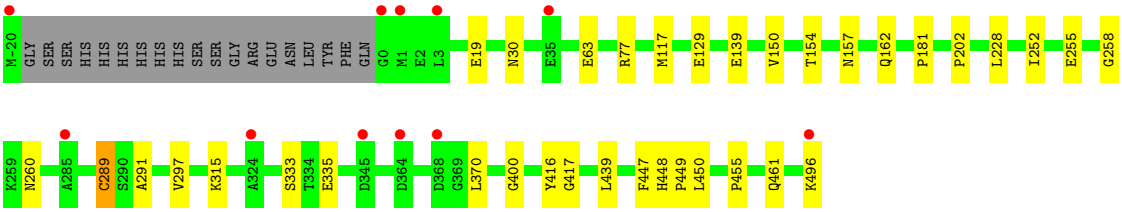
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	222	224	224	0	2
			Total	O		
5	B	225	229	229	0	4
			Total	O		
5	C	210	213	213	0	3
			Total	O		
5	D	210	216	216	0	6

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.

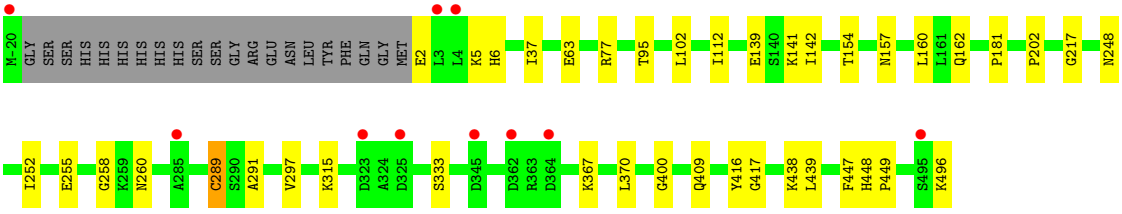
• Molecule 1: Betaine aldehyde dehydrogenase

Chain A:



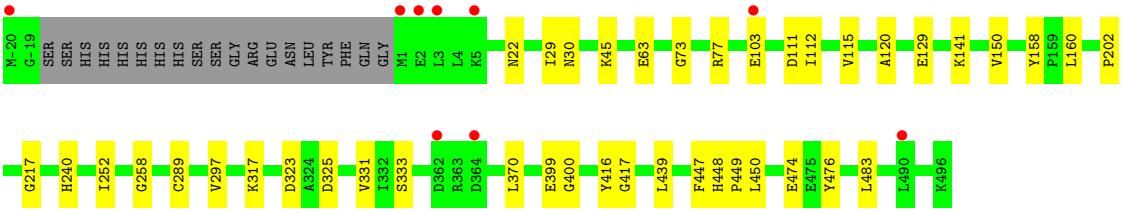
• Molecule 1: Betaine aldehyde dehydrogenase

Chain B:



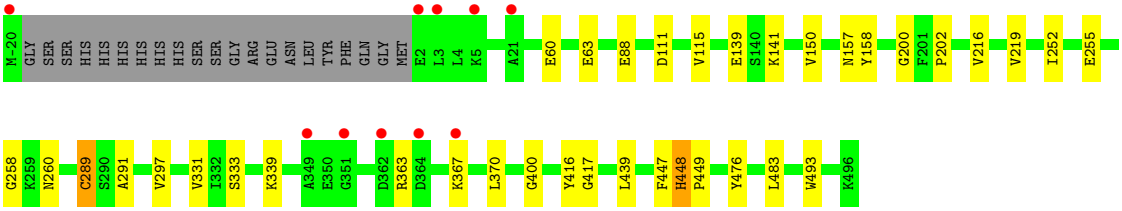
• Molecule 1: Betaine aldehyde dehydrogenase

Chain C:



• Molecule 1: Betaine aldehyde dehydrogenase

Chain D:


M-20
GLY
SER
SER
HIS
HIS
HIS
HIS
HIS
HIS
SER
SER
GLY
ARG
GLU
ASN
LEU
TYR
PHE
GLN
GLY
MET
E2
L3
L4
K5
A21
E60
E63
E88
D111
V115
E139
S140
K141
V150
N157
Y158
G200
F201
P202
V216
V219
I252
E255
G258
K259
N260
C289
S290
A291
V297
V331
I332
S333
K339
A349
E350
G351
D362
R363
D364
K367
L370
G400
Y416
G417
L439
F447
H448
P449
Y476
L483
W493
K496

4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	224.87Å 102.63Å 118.24Å 90.00° 104.83° 90.00°	Depositor
Resolution (Å)	29.72 – 2.25 29.72 – 2.25	Depositor EDS
% Data completeness (in resolution range)	99.5 (29.72-2.25) 99.5 (29.72-2.25)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.26 (at 2.24Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.216 , 0.255 0.217 , 0.255	Depositor DCC
R_{free} test set	6154 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å^2)	25.6	Xtriage
Anisotropy	0.697	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 44.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	16596	wwPDB-VP
Average B, all atoms (Å^2)	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 25.57 % 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 3.0966e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[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: NA, CME, NAD, EPE

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	0.59	0/3941	0.84	0/5323
1	B	0.57	0/3926	0.83	0/5305
1	C	0.58	0/3932	0.84	1/5312 (0.0%)
1	D	0.58	0/3938	0.84	1/5320 (0.0%)
All	All	0.58	0/15737	0.84	2/21260 (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	363	ARG	N-CA-C	-5.79	95.36	111.00
1	C	77	ARG	NE-CZ-NH1	5.14	122.87	120.30

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	3883	0	3842	29	0
1	B	3868	0	3822	34	0
1	C	3874	0	3833	31	0
1	D	3880	0	3833	35	0
2	A	44	0	26	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	44	0	26	1	0
2	C	44	0	26	1	0
2	D	44	0	26	2	0
3	A	2	0	0	0	0
3	B	1	0	0	0	0
4	A	30	0	36	0	0
5	A	224	0	0	4	0
5	B	229	0	0	8	0
5	C	213	0	0	10	0
5	D	216	0	0	5	0
All	All	16596	0	15470	114	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 4.

The worst 5 of 114 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:73:GLY:HA2	5:C:764:HOH:O	1.39	1.21
1:D:339:LYS:HD2	5:D:603:HOH:O	1.80	0.81
1:B:102:LEU:HB2	5:B:751:HOH:O	1.82	0.78
1:A:30:ASN:HB3	5:A:636:HOH:O	1.88	0.73
1:D:289:CME:H	1:D:289:CME:HE3	1.54	0.71

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	497/517 (96%)	481 (97%)	15 (3%)	1 (0%)	47 55
1	B	495/517 (96%)	480 (97%)	14 (3%)	1 (0%)	47 55

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	495/517 (96%)	480 (97%)	14 (3%)	1 (0%)	47	55
1	D	496/517 (96%)	480 (97%)	15 (3%)	1 (0%)	47	55
All	All	1983/2068 (96%)	1921 (97%)	58 (3%)	4 (0%)	47	55

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	448	HIS
1	B	448	HIS
1	C	448	HIS
1	D	448	HIS

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	414/428 (97%)	413 (100%)	1 (0%)	93	96
1	B	413/428 (96%)	412 (100%)	1 (0%)	93	96
1	C	413/428 (96%)	413 (100%)	0	100	100
1	D	414/428 (97%)	413 (100%)	1 (0%)	93	96
All	All	1654/1712 (97%)	1651 (100%)	3 (0%)	93	96

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	255	GLU
1	B	255	GLU
1	D	255	GLU

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

5.3.3 RNA (i)

There are no RNA molecules in this entry.

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

4 non-standard protein/DNA/RNA residues 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	$\#\|Z\| > 2$
1	CME	D	289	1	8,9,10	0.81	0	5,9,11	1.67	1 (20%)
1	CME	A	289	1	8,9,10	0.88	0	5,9,11	1.93	2 (40%)
1	CME	C	289	1	8,9,10	0.65	0	5,9,11	1.18	0
1	CME	B	289	1	8,9,10	0.90	0	5,9,11	2.00	2 (40%)

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
1	CME	D	289	1	-	3/5/8/10	-
1	CME	A	289	1	-	2/5/8/10	-
1	CME	C	289	1	-	3/5/8/10	-
1	CME	B	289	1	-	2/5/8/10	-

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	289	CME	CB-SG-SD	3.54	113.00	103.82
1	A	289	CME	CB-SG-SD	3.45	112.76	103.82
1	D	289	CME	CE-SD-SG	-3.18	88.79	103.45
1	B	289	CME	CZ-CE-SD	-2.56	104.49	113.37

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	289	CME	CZ-CE-SD	-2.40	105.04	113.37

There are no chirality outliers.

5 of 10 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	D	289	CME	SD-CE-CZ-OH
1	D	289	CME	CE-SD-SG-CB
1	C	289	CME	SD-CE-CZ-OH
1	C	289	CME	CZ-CE-SD-SG
1	A	289	CME	SD-CE-CZ-OH

There are no ring outliers.

4 monomers are involved in 12 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	D	289	CME	9	0
1	A	289	CME	1	0
1	C	289	CME	1	0
1	B	289	CME	1	0

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 9 ligands modelled in this entry, 3 are monoatomic - leaving 6 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	$\#\|Z\| > 2$
2	NAD	D	501	-	42,48,48	1.23	5 (11%)	50,73,73	1.68	9 (18%)
4	EPE	A	504	-	15,15,15	1.79	1 (6%)	18,20,20	1.44	1 (5%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	NAD	C	501	-	42,48,48	1.07	1 (2%)	50,73,73	1.42	7 (14%)
2	NAD	A	501	-	42,48,48	1.06	2 (4%)	50,73,73	1.40	6 (12%)
2	NAD	B	501	-	42,48,48	1.02	2 (4%)	50,73,73	1.42	6 (12%)
4	EPE	A	503	-	15,15,15	2.01	1 (6%)	18,20,20	1.21	1 (5%)

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	501	-	-	2/26/62/62	0/5/5/5
4	EPE	A	504	-	-	4/9/19/19	0/1/1/1
2	NAD	C	501	-	-	5/26/62/62	0/5/5/5
2	NAD	A	501	-	-	6/26/62/62	0/5/5/5
2	NAD	B	501	-	-	9/26/62/62	0/5/5/5
4	EPE	A	503	-	-	4/9/19/19	0/1/1/1

The worst 5 of 12 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	503	EPE	C10-S	-7.35	1.67	1.77
4	A	504	EPE	C10-S	-6.65	1.68	1.77
2	D	501	NAD	O7N-C7N	5.60	1.34	1.24
2	A	501	NAD	O7N-C7N	5.15	1.34	1.24
2	C	501	NAD	O7N-C7N	5.09	1.33	1.24

The worst 5 of 30 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	A	504	EPE	O3S-S-C10	5.17	114.13	105.77
2	A	501	NAD	N3A-C2A-N1A	-4.77	121.23	128.68
2	B	501	NAD	N3A-C2A-N1A	-4.69	121.35	128.68
2	C	501	NAD	N3A-C2A-N1A	-4.53	121.60	128.68
2	D	501	NAD	C3D-C2D-C1D	4.52	107.78	100.98

There are no chirality outliers.

5 of 30 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	501	NAD	C5B-O5B-PA-O1A
2	A	501	NAD	C5B-O5B-PA-O2A
2	A	501	NAD	C5D-O5D-PN-O1N
2	B	501	NAD	C3B-C4B-C5B-O5B
2	B	501	NAD	C5D-O5D-PN-O1N

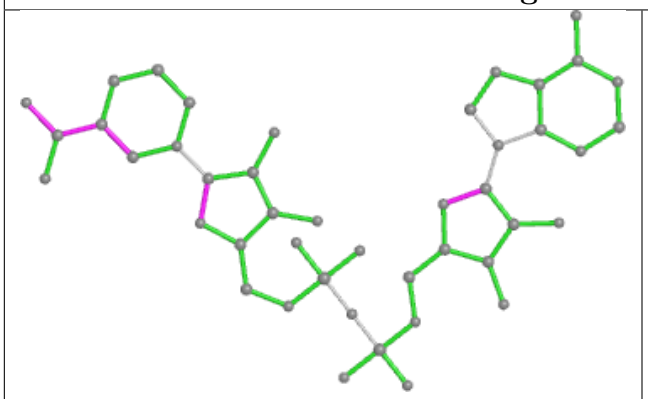
There are no ring outliers.

3 monomers are involved in 4 short contacts:

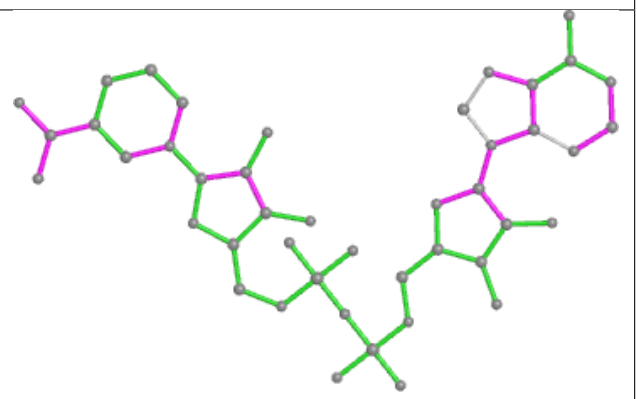
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	501	NAD	2	0
2	C	501	NAD	1	0
2	B	501	NAD	1	0

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 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.

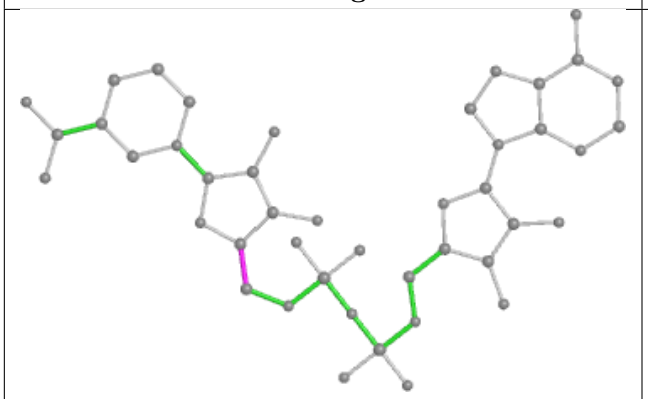
Ligand NAD D 501



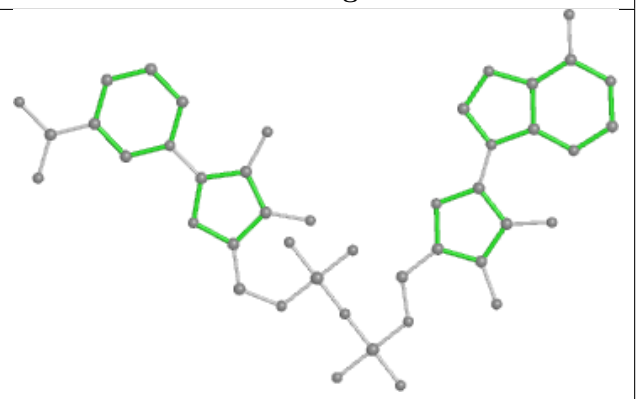
Bond lengths



Bond angles

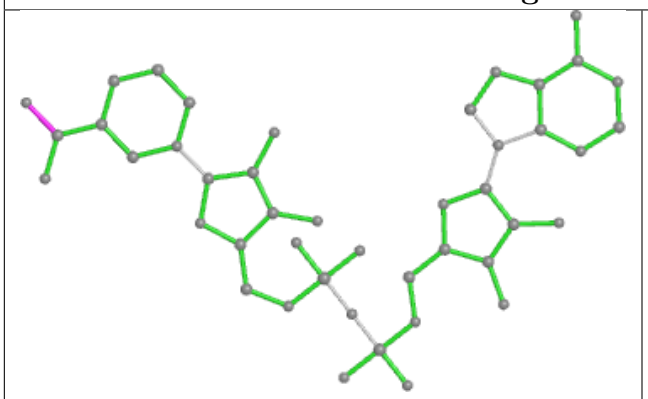


Torsions

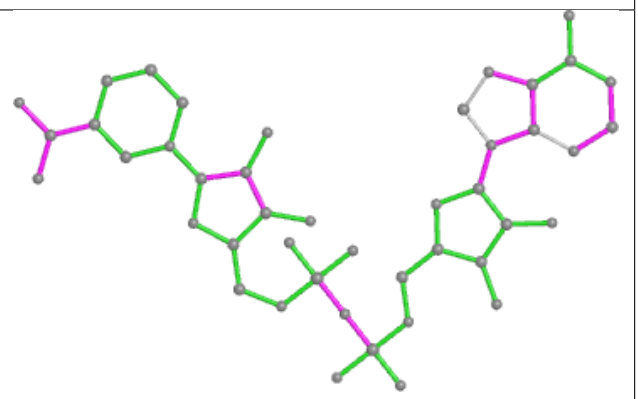


Rings

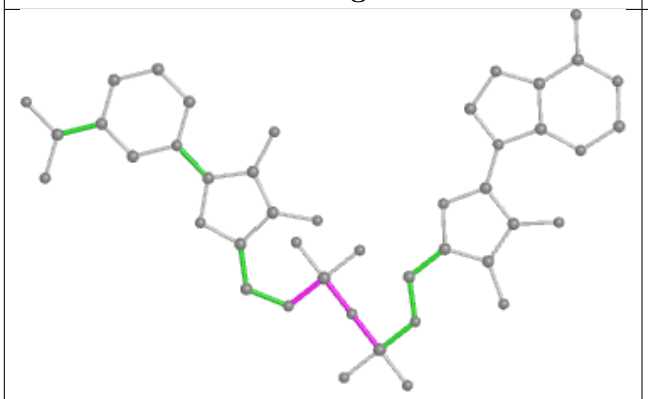
Ligand NAD C 501



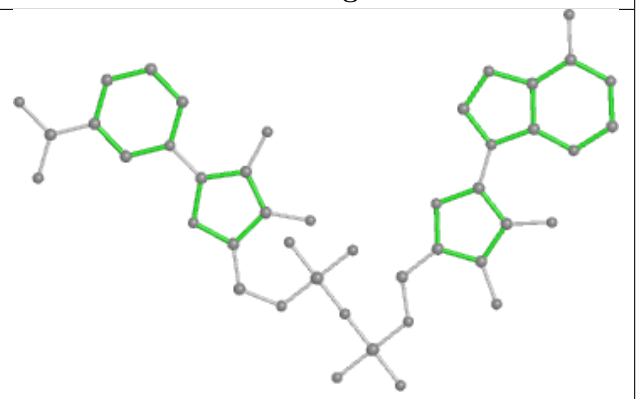
Bond lengths



Bond angles

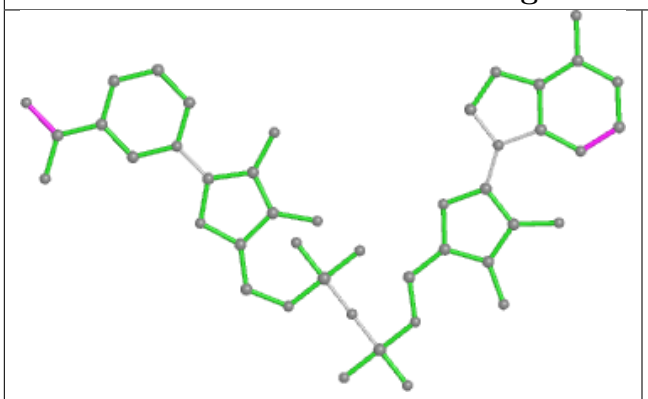


Torsions

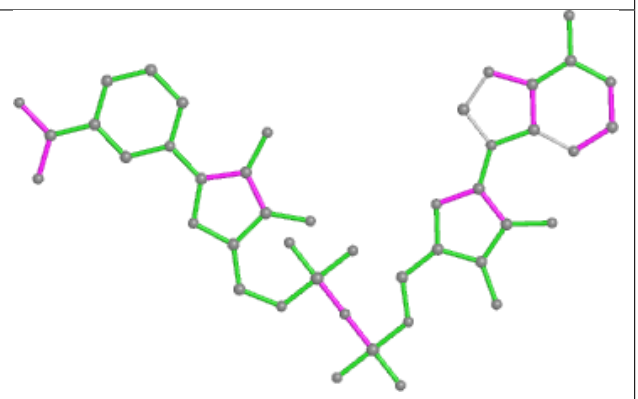


Rings

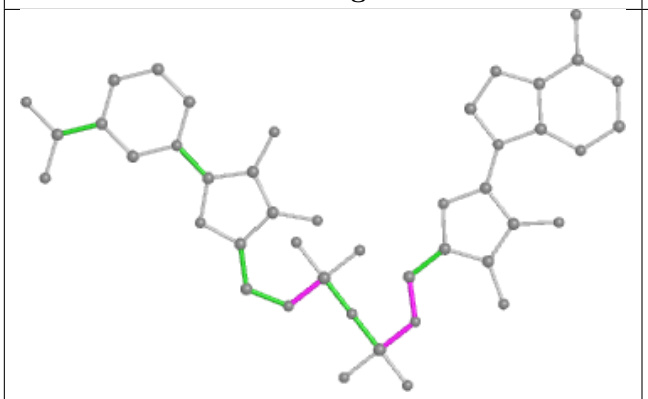
Ligand NAD A 501



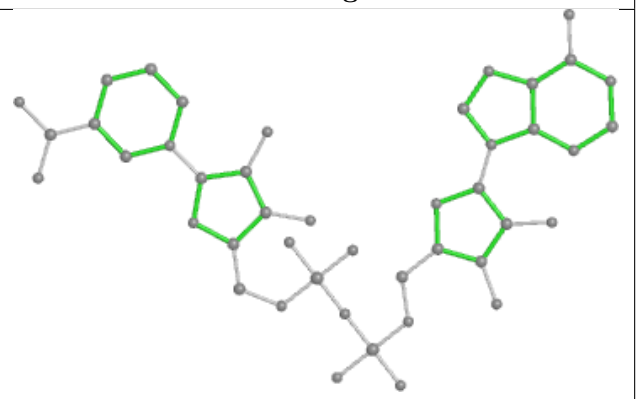
Bond lengths



Bond angles

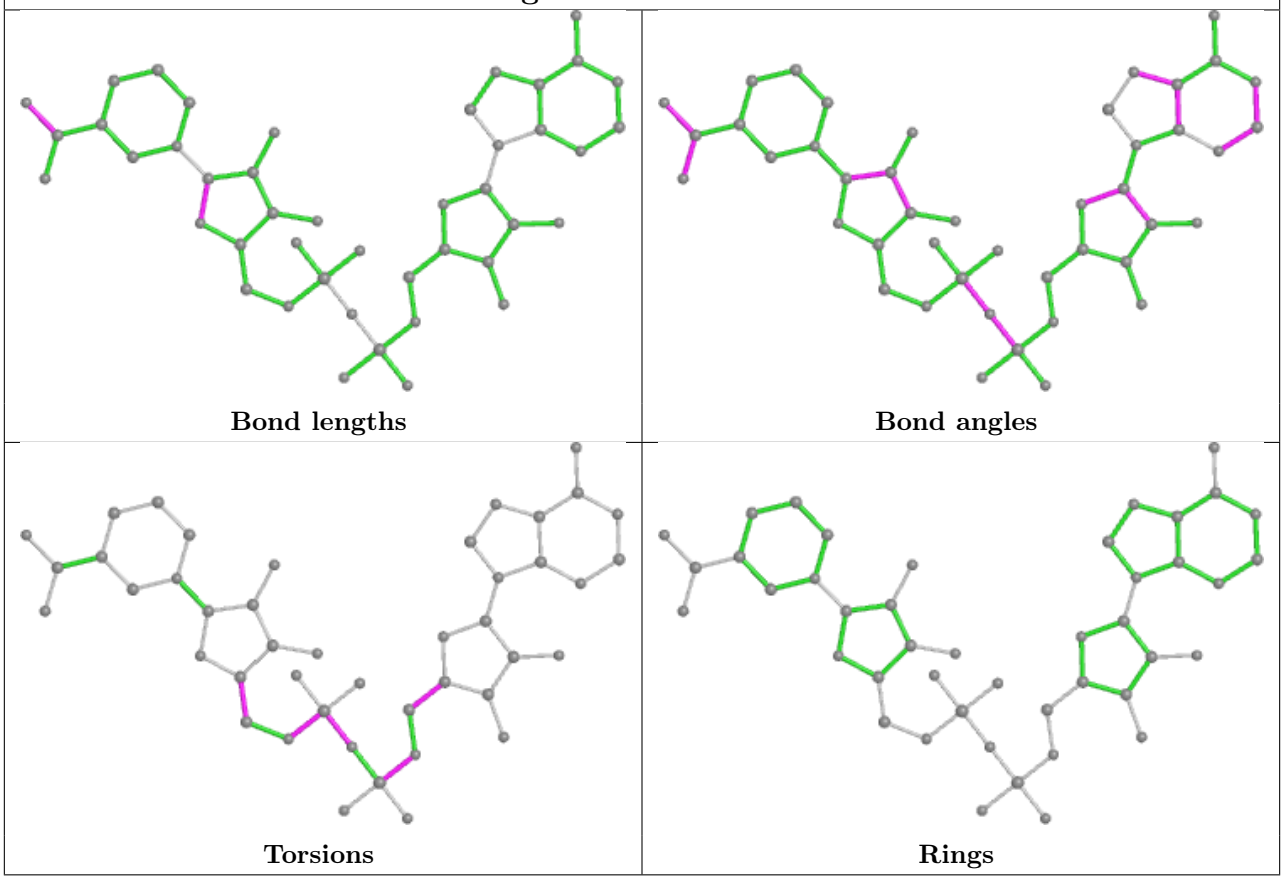


Torsions



Rings

Ligand NAD B 501



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	497/517 (96%)	-0.12	11 (2%)	62	65	14, 26, 48, 82	0
1	B	495/517 (95%)	-0.06	10 (2%)	65	68	15, 27, 49, 79	0
1	C	497/517 (96%)	-0.10	9 (1%)	68	71	16, 27, 47, 108	0
1	D	495/517 (95%)	-0.11	10 (2%)	65	68	15, 27, 46, 87	0
All	All	1984/2068 (95%)	-0.10	40 (2%)	65	68	14, 27, 48, 108	0

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	364	ASP	4.8
1	C	3	LEU	4.5
1	D	5	LYS	4.4
1	D	2	GLU	4.2
1	C	1	MET	4.0

6.2 Non-standard residues in protein, DNA, RNA chains (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
1	CME	C	289	10/11	0.88	0.16	30,36,57,64	0
1	CME	D	289	10/11	0.88	0.16	27,36,60,63	0
1	CME	B	289	10/11	0.92	0.16	28,39,64,65	0
1	CME	A	289	10/11	0.93	0.16	24,36,73,77	0

6.3 Carbohydrates (i)

There are no monosaccharides in this entry.

6.4 Ligands (i)

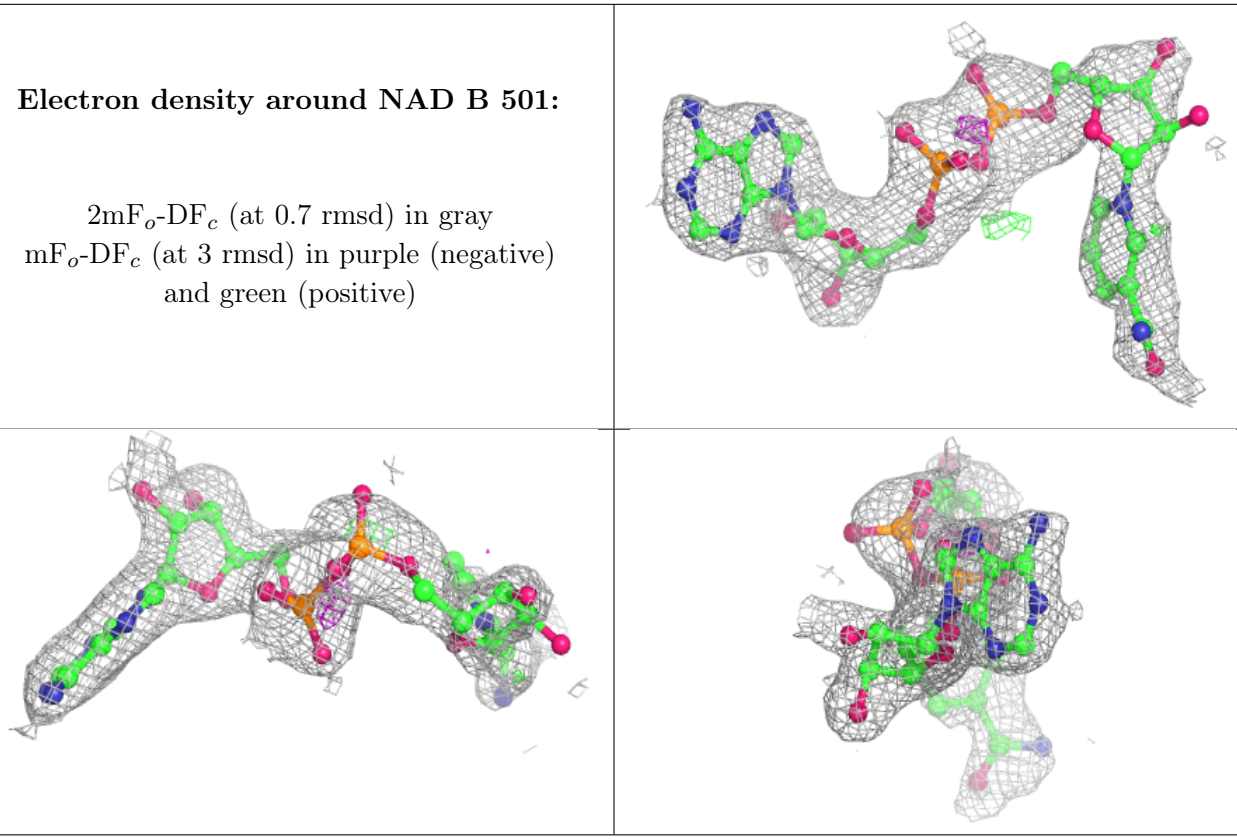
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
4	EPE	A	504	15/15	0.83	0.18	41,49,67,75	0
3	NA	B	502	1/1	0.87	0.14	39,39,39,39	0
4	EPE	A	503	15/15	0.88	0.14	42,48,80,80	0
2	NAD	B	501	44/44	0.91	0.17	31,59,91,107	0
2	NAD	A	501	44/44	0.91	0.17	33,54,88,100	0
2	NAD	D	501	44/44	0.92	0.15	32,54,92,116	0
2	NAD	C	501	44/44	0.92	0.15	33,54,78,83	0
3	NA	A	502	1/1	0.95	0.11	45,45,45,45	0
3	NA	A	505	1/1	0.98	0.09	29,29,29,29	0

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

Electron density around NAD B 501:

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



Electron density around NAD A 501:

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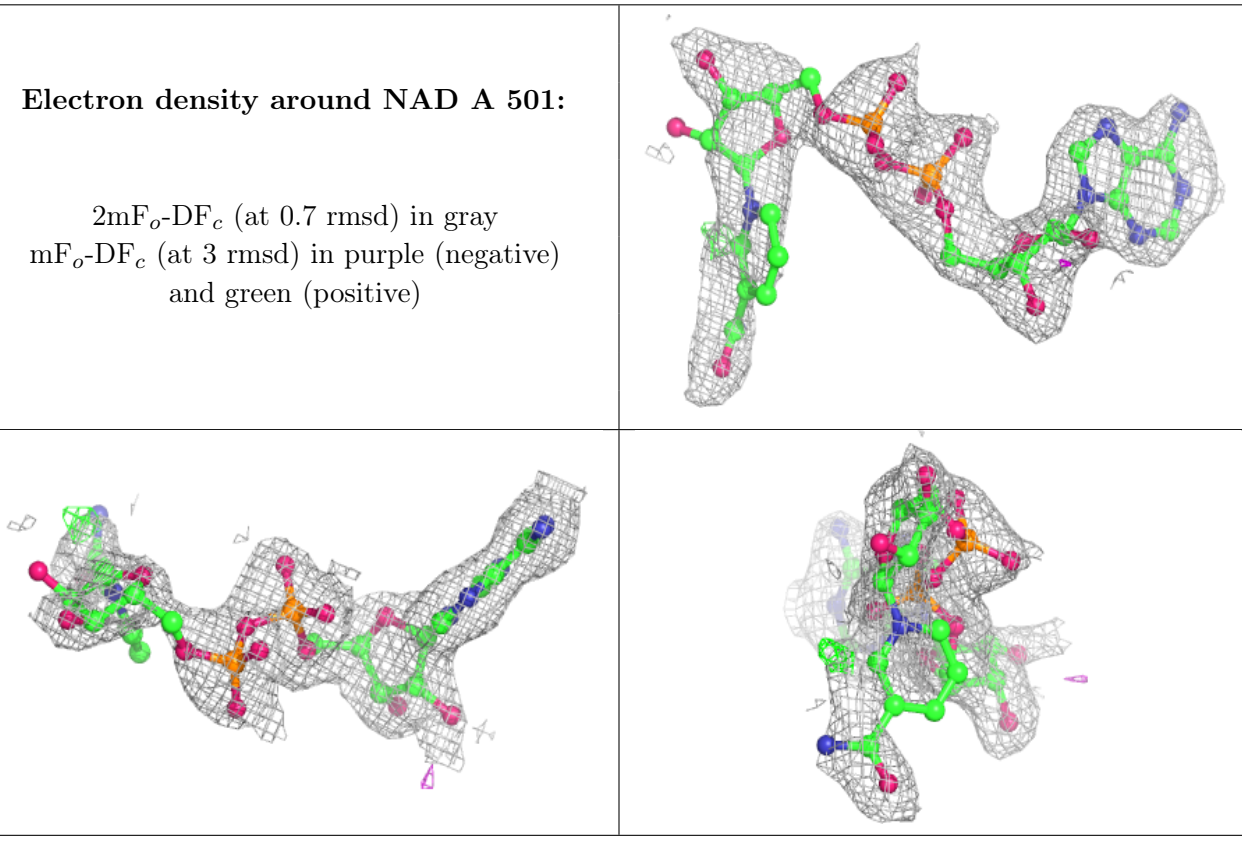
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around NAD D 501:

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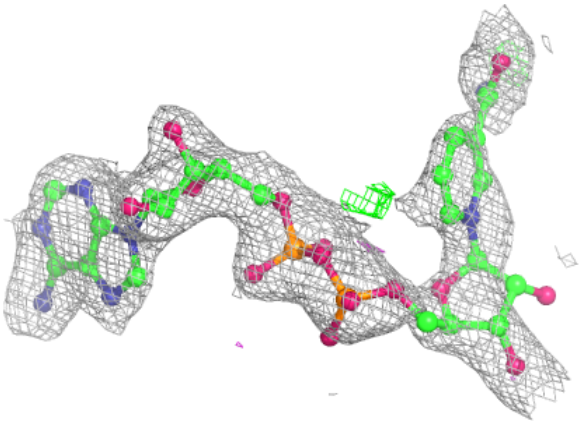
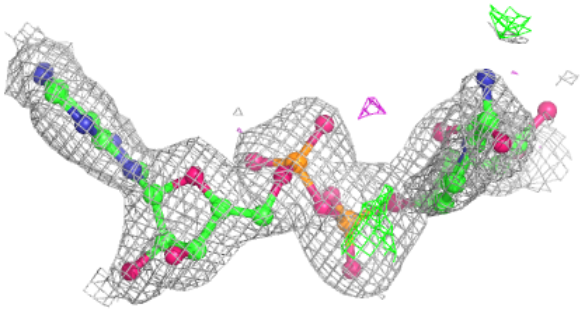
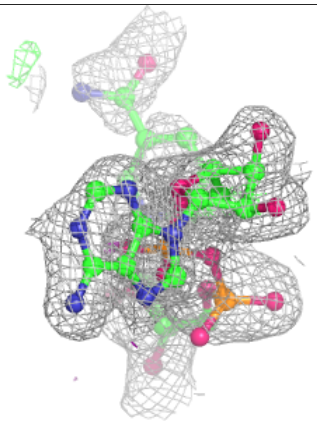
and green (positive)

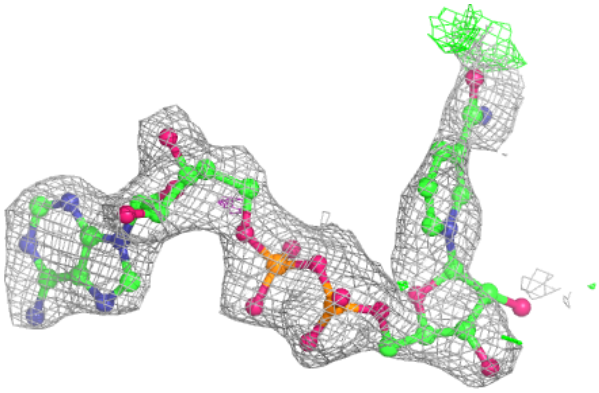


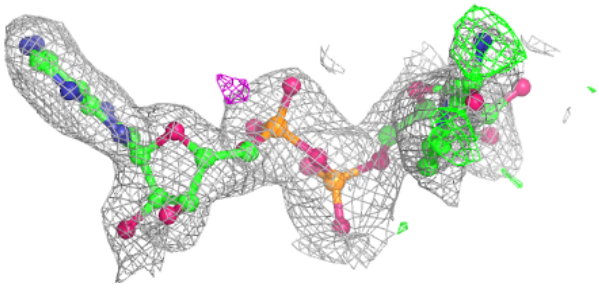


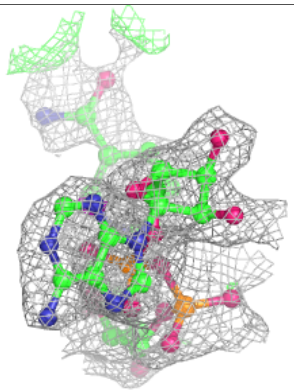


Electron density around NAD C 501:

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







6.5 Other polymers (i)

There are no such residues in this entry.