



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 11:26 PM UTC

PDB ID : 4MJL / pdb\_00004mjL  
Title : Crystal Structure of myo-inositol dehydrogenase from *Lactobacillus casei* in complex with NAD and D-chiro-inositol  
Authors : Bertwistle, D.; Sanders, D.A.R.; Palmer, D.R.J.  
Deposited on : 2013-09-03  
Resolution : 1.60 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](mailto: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

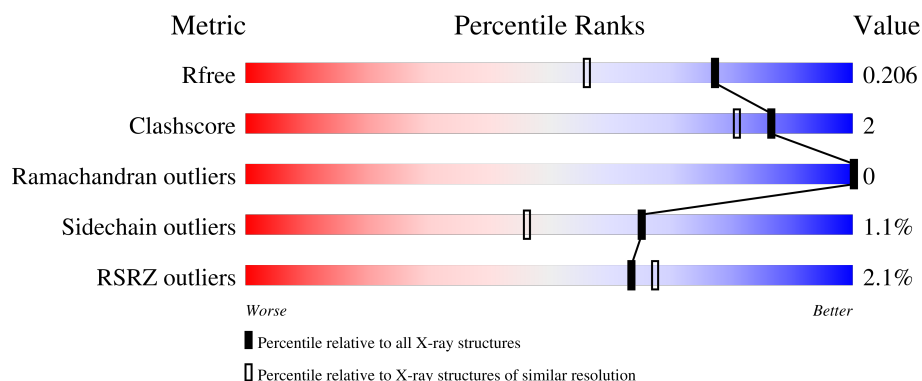
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.60 Å.

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



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	180053	4673 (1.60-1.60)
Clashscore	190562	4931 (1.60-1.60)
Ramachandran outliers	187476	4831 (1.60-1.60)
Sidechain outliers	187428	4830 (1.60-1.60)
RSRZ outliers	180081	4672 (1.60-1.60)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 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	351	<div> <div>5%</div> <div> <div></div> <div>87%</div> <div>9%</div> <div>.</div> </div> </div>
1	B	351	<div> <div>%</div> <div> <div></div> <div>88%</div> <div>8%</div> <div>..</div> </div> </div>
1	C	351	<div> <div>%</div> <div> <div></div> <div>89%</div> <div>7%</div> <div>..</div> </div> </div>
1	D	351	<div> <div>%</div> <div> <div></div> <div>90%</div> <div>7%</div> <div>.</div> </div> </div>

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 11985 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 Inositol 2-dehydrogenase/D-chiro-inositol 3-dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	339	Total	C	N	O	S	1	0	0
			2622	1657	446	513	6			
1	B	339	Total	C	N	O	S	0	1	0
			2630	1662	449	513	6			
1	C	339	Total	C	N	O	S	0	1	0
			2627	1660	447	514	6			
1	D	339	Total	C	N	O	S	0	6	0
			2663	1682	457	518	6			

There are 52 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-11	MET	-	expression tag	UNP B3W8L3
A	-10	ARG	-	expression tag	UNP B3W8L3
A	-9	GLY	-	expression tag	UNP B3W8L3
A	-8	SER	-	expression tag	UNP B3W8L3
A	-7	HIS	-	expression tag	UNP B3W8L3
A	-6	HIS	-	expression tag	UNP B3W8L3
A	-5	HIS	-	expression tag	UNP B3W8L3
A	-4	HIS	-	expression tag	UNP B3W8L3
A	-3	HIS	-	expression tag	UNP B3W8L3
A	-2	HIS	-	expression tag	UNP B3W8L3
A	-1	GLY	-	expression tag	UNP B3W8L3
A	0	SER	-	expression tag	UNP B3W8L3
A	292	GLU	GLN	conflict	UNP B3W8L3
B	-11	MET	-	expression tag	UNP B3W8L3
B	-10	ARG	-	expression tag	UNP B3W8L3
B	-9	GLY	-	expression tag	UNP B3W8L3
B	-8	SER	-	expression tag	UNP B3W8L3
B	-7	HIS	-	expression tag	UNP B3W8L3
B	-6	HIS	-	expression tag	UNP B3W8L3
B	-5	HIS	-	expression tag	UNP B3W8L3
B	-4	HIS	-	expression tag	UNP B3W8L3

*Continued on next page...*

*Continued from previous page...*

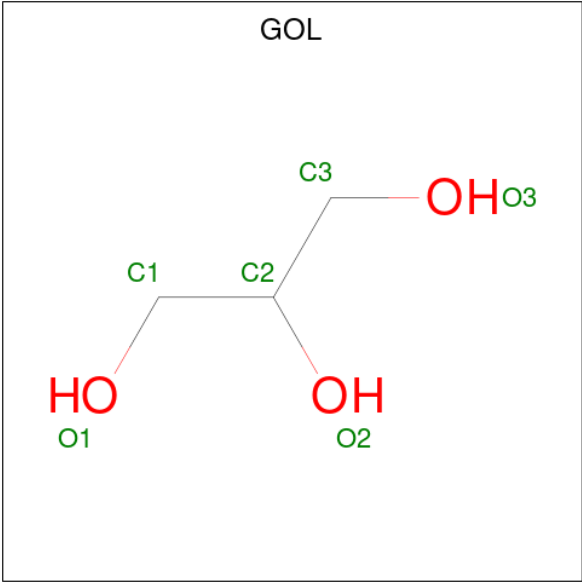
Chain	Residue	Modelled	Actual	Comment	Reference
B	-3	HIS	-	expression tag	UNP B3W8L3
B	-2	HIS	-	expression tag	UNP B3W8L3
B	-1	GLY	-	expression tag	UNP B3W8L3
B	0	SER	-	expression tag	UNP B3W8L3
B	292	GLU	GLN	conflict	UNP B3W8L3
C	-11	MET	-	expression tag	UNP B3W8L3
C	-10	ARG	-	expression tag	UNP B3W8L3
C	-9	GLY	-	expression tag	UNP B3W8L3
C	-8	SER	-	expression tag	UNP B3W8L3
C	-7	HIS	-	expression tag	UNP B3W8L3
C	-6	HIS	-	expression tag	UNP B3W8L3
C	-5	HIS	-	expression tag	UNP B3W8L3
C	-4	HIS	-	expression tag	UNP B3W8L3
C	-3	HIS	-	expression tag	UNP B3W8L3
C	-2	HIS	-	expression tag	UNP B3W8L3
C	-1	GLY	-	expression tag	UNP B3W8L3
C	0	SER	-	expression tag	UNP B3W8L3
C	292	GLU	GLN	conflict	UNP B3W8L3
D	-11	MET	-	expression tag	UNP B3W8L3
D	-10	ARG	-	expression tag	UNP B3W8L3
D	-9	GLY	-	expression tag	UNP B3W8L3
D	-8	SER	-	expression tag	UNP B3W8L3
D	-7	HIS	-	expression tag	UNP B3W8L3
D	-6	HIS	-	expression tag	UNP B3W8L3
D	-5	HIS	-	expression tag	UNP B3W8L3
D	-4	HIS	-	expression tag	UNP B3W8L3
D	-3	HIS	-	expression tag	UNP B3W8L3
D	-2	HIS	-	expression tag	UNP B3W8L3
D	-1	GLY	-	expression tag	UNP B3W8L3
D	0	SER	-	expression tag	UNP B3W8L3
D	292	GLU	GLN	conflict	UNP B3W8L3

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



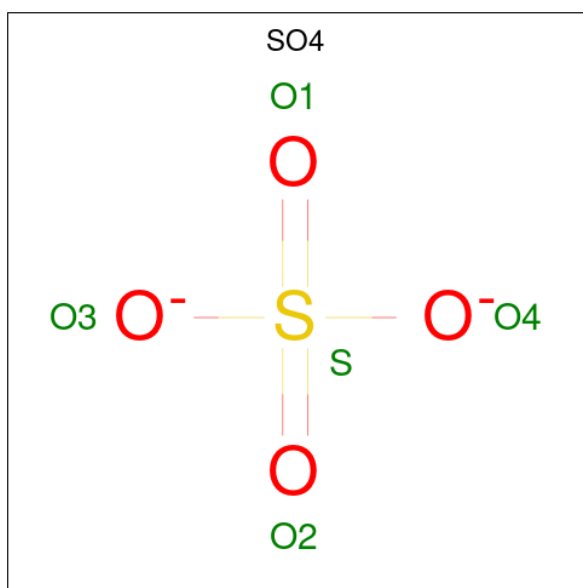
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	B	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	C	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	D	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

- Molecule 3 is GLYCEROL (CCD ID: GOL) (formula: C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O 6 3 3	0	0
3	A	1	Total C O 6 3 3	0	0
3	B	1	Total C O 6 3 3	0	0
3	C	1	Total C O 6 3 3	0	0
3	C	1	Total C O 6 3 3	0	0
3	C	1	Total C O 6 3 3	0	0
3	D	1	Total C O 6 3 3	0	0
3	D	1	Total C O 6 3 3	0	0

- Molecule 4 is SULFATE ION (CCD ID: SO4) (formula: O<sub>4</sub>S).



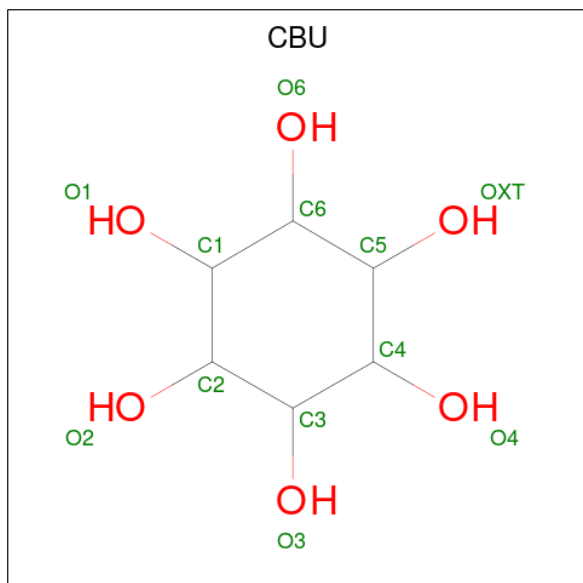
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total O S 5 4 1	0	0
4	A	1	Total O S 5 4 1	0	0
4	B	1	Total O S 5 4 1	0	0
4	B	1	Total O S 5 4 1	0	0

*Continued on next page...*

Continued from previous page...

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	C	1	Total	O	S	0	0
			5	4	1		
4	D	1	Total	O	S	0	0
			5	4	1		

- Molecule 5 is (1R,2R,3S,4S,5S,6S)-CYCLOHEXANE-1,2,3,4,5,6-HEXOL (CCD ID: CBU) (formula: C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	D	1	Total	C	O	0	0
			12	6	6		

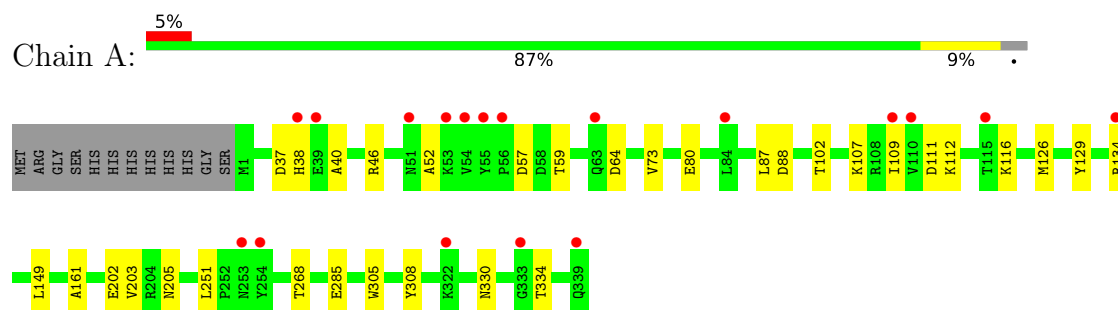
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	231	Total	O	0	0
			231	231		
6	B	291	Total	O	0	0
			291	291		
6	C	319	Total	O	0	0
			319	319		
6	D	336	Total	O	0	0
			336	336		

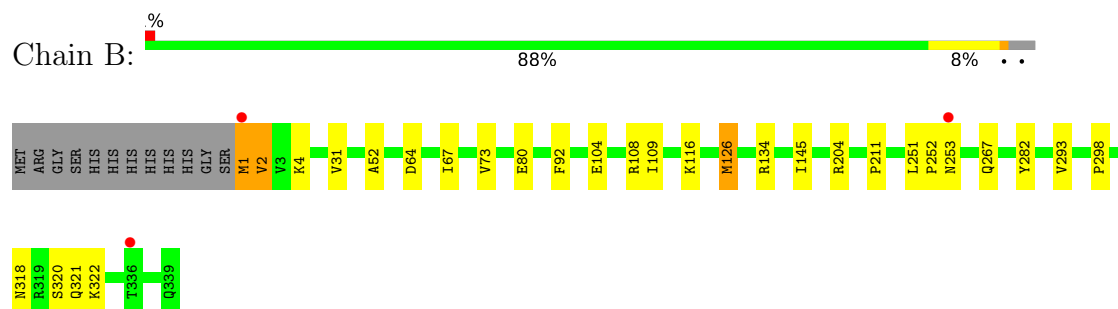
### 3 Residue-property plots

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

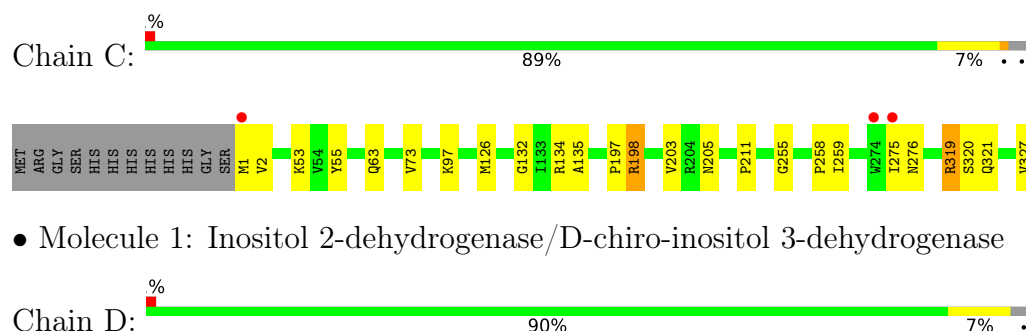
- Molecule 1: Inositol 2-dehydrogenase/D-chiro-inositol 3-dehydrogenase



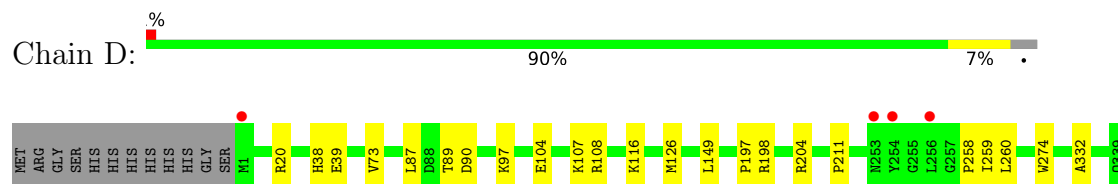
- Molecule 1: Inositol 2-dehydrogenase/D-chiro-inositol 3-dehydrogenase



- Molecule 1: Inositol 2-dehydrogenase/D-chiro-inositol 3-dehydrogenase



- Molecule 1: Inositol 2-dehydrogenase/D-chiro-inositol 3-dehydrogenase





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	106.76Å 110.58Å 127.19Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.07 – 1.60 48.07 – 1.60	Depositor EDS
% Data completeness (in resolution range)	100.0 (48.07-1.60) 100.0 (48.07-1.60)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.07	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.93 (at 1.60Å)	Xtriage
Refinement program	PHENIX 1.8_1069	Depositor
R, $R_{free}$	0.171 , 0.206 0.171 , 0.206	Depositor DCC
$R_{free}$ test set	9958 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	17.9	Xtriage
Anisotropy	0.203	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 39.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.011 for k,h,-l	Xtriage
$F_o, F_c$ correlation	0.97	EDS
Total number of atoms	11985	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.79% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: SO4, GOL, CBU, NAD

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 5$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z  > 5$	RMSZ	$\# Z  > 5$
1	A	1.20	9/2669 (0.3%)	1.06	4/3634 (0.1%)
1	B	1.16	11/2680 (0.4%)	1.00	3/3648 (0.1%)
1	C	1.15	14/2677 (0.5%)	0.98	0/3645
1	D	1.02	5/2726 (0.2%)	0.92	0/3710
All	All	1.13	39/10752 (0.4%)	0.99	7/14637 (0.0%)

All (39) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	318	ASN	C-N	-9.48	1.21	1.33
1	B	298	PRO	CA-C	7.85	1.56	1.51
1	C	259	ILE	C-O	-7.66	1.16	1.24
1	B	320	SER	C-O	-7.51	1.15	1.24
1	A	203	VAL	C-N	-7.22	1.24	1.33
1	C	275	ILE	CA-CB	6.83	1.62	1.54
1	D	259	ILE	C-O	-6.78	1.17	1.24
1	C	255	GLY	C-O	-6.58	1.18	1.23
1	B	252	PRO	C-O	-6.54	1.15	1.23
1	C	205	ASN	C-O	-6.47	1.16	1.24
1	C	258	PRO	C-O	-6.25	1.16	1.23
1	D	20	ARG	C-O	-6.20	1.16	1.24
1	A	52	ALA	C-O	-6.03	1.16	1.23
1	B	1	MET	C-N	-6.02	1.26	1.33
1	C	321	GLN	C-O	-5.81	1.16	1.24
1	B	2	VAL	CA-CB	-5.76	1.48	1.54
1	D	260	LEU	C-O	-5.75	1.17	1.24
1	C	203	VAL	C-O	-5.72	1.18	1.24
1	C	319	ARG	C-O	-5.64	1.17	1.24
1	D	258	PRO	C-O	-5.56	1.17	1.23
1	C	320	SER	C-O	-5.54	1.17	1.24
1	A	202	GLU	C-O	-5.53	1.16	1.24

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	332	ALA	CA-CB	-5.53	1.44	1.53
1	B	251	LEU	C-O	-5.48	1.16	1.24
1	B	2	VAL	C-O	-5.43	1.18	1.24
1	C	132	GLY	C-O	-5.43	1.17	1.23
1	C	276	ASN	N-CA	-5.42	1.39	1.46
1	A	251	LEU	C-O	-5.33	1.17	1.23
1	A	161	ALA	CA-CB	-5.31	1.45	1.53
1	C	198	ARG	CB-CG	-5.29	1.36	1.52
1	A	205	ASN	C-O	-5.25	1.17	1.24
1	A	134	ARG	C-O	-5.22	1.18	1.24
1	A	203	VAL	C-O	-5.21	1.18	1.24
1	C	135	ALA	C-O	-5.20	1.18	1.24
1	C	134	ARG	C-O	-5.13	1.18	1.24
1	B	52	ALA	CA-CB	5.09	1.62	1.53
1	A	102	THR	CA-C	-5.05	1.46	1.52
1	B	321	GLN	C-O	-5.05	1.17	1.24
1	B	145	ILE	CA-CB	5.03	1.60	1.54

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	330	ASN	CA-C-N	-6.79	113.20	122.91
1	A	330	ASN	C-N-CA	-6.79	113.20	122.91
1	B	2	VAL	N-CA-C	6.26	118.46	109.51
1	A	46	ARG	N-CA-C	5.83	117.44	111.14
1	A	40	ALA	N-CA-C	-5.52	105.34	111.36
1	B	2	VAL	N-CA-CB	-5.27	101.65	110.14
1	B	204	ARG	O-C-N	-5.15	116.00	122.24

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	2622	0	2614	13	0

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	2630	0	2627	13	0
1	C	2627	0	2620	8	0
1	D	2663	0	2662	12	0
2	A	44	0	26	0	0
2	B	44	0	26	0	0
2	C	44	0	26	0	0
2	D	44	0	26	2	0
3	A	12	0	16	2	0
3	B	6	0	8	0	0
3	C	18	0	24	0	0
3	D	12	0	16	3	0
4	A	10	0	0	0	0
4	B	10	0	0	0	0
4	C	5	0	0	1	0
4	D	5	0	0	0	0
5	D	12	0	11	2	0
6	A	231	0	0	0	0
6	B	291	0	0	4	0
6	C	319	0	0	1	0
6	D	336	0	0	4	0
All	All	11985	0	10702	46	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 2.

All (46) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:253:ASN:HB3	6:B:790:HOH:O	1.68	0.93
1:A:268:THR:HG23	3:A:402:GOL:H32	1.52	0.90
1:B:322:LYS:HE2	6:B:590:HOH:O	1.79	0.82
1:D:104:GLU:HG2	6:D:573:HOH:O	1.82	0.79
1:B:134:ARG:NH1	6:B:692:HOH:O	2.32	0.63
1:C:53:LYS:HD2	1:C:55:TYR:CZ	2.34	0.61
2:D:401:NAD:C3N	5:D:402:CBU:H4	2.34	0.58
1:B:64:ASP:HB3	1:B:67:ILE:HD12	1.88	0.56
1:C:331:VAL:HG23	6:C:696:HOH:O	2.06	0.54
1:C:319:ARG:HG2	1:C:327:VAL:HG21	1.89	0.54
1:D:38[B]:HIS:CE1	6:D:819:HOH:O	2.61	0.53
1:A:80:GLU:HA	1:A:109:ILE:HD11	1.90	0.53
1:B:4:LYS:HD2	1:B:31:VAL:HG11	1.90	0.51

*Continued on next page...*

*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:401:NAD:C4N	5:D:402:CBU:H4	2.42	0.50
1:A:305:TRP:CD1	1:A:334:THR:HG23	2.47	0.49
1:A:88:ASP:OD1	1:A:112:LYS:NZ	2.40	0.49
1:A:57:ASP:OD2	1:A:59:THR:HB	2.13	0.49
1:B:80:GLU:HA	1:B:109:ILE:HD11	1.95	0.49
1:A:87:LEU:O	1:A:116:LYS:NZ	2.27	0.48
1:A:37:ASP:C	1:A:37:ASP:OD1	2.56	0.48
1:A:107:LYS:HD3	1:A:308:TYR:CZ	2.49	0.48
1:C:63:GLN:HA	1:C:63:GLN:OE1	2.13	0.48
1:D:39:GLU:HG2	6:D:819:HOH:O	2.14	0.47
1:C:197:PRO:O	1:C:198:ARG:C	2.55	0.47
1:C:198:ARG:NH2	4:C:405:SO4:O1	2.44	0.47
1:D:90:ASP:CG	3:D:403:GOL:HO3	2.23	0.47
1:D:87:LEU:O	1:D:116:LYS:HE3	2.15	0.46
1:B:104:GLU:O	1:B:108:ARG:HG3	2.16	0.46
1:D:89:THR:HB	3:D:403:GOL:H32	1.96	0.46
1:A:107:LYS:NZ	1:A:111:ASP:OD1	2.41	0.46
1:A:149:LEU:HD13	1:C:211:PRO:HD3	1.98	0.45
1:A:64:ASP:OD1	1:A:64:ASP:C	2.58	0.44
1:B:1:MET:O	1:B:2:VAL:C	2.58	0.44
1:D:274:TRP:CD1	1:D:274:TRP:H	2.36	0.43
1:D:107:LYS:HE2	6:D:614:HOH:O	2.17	0.43
1:D:197:PRO:O	1:D:198:ARG:C	2.62	0.43
1:B:92:PHE:CG	1:B:293:VAL:HG22	2.55	0.42
1:A:37:ASP:O	1:A:38:HIS:C	2.62	0.42
1:B:116:LYS:HD2	6:B:785:HOH:O	2.20	0.41
1:B:211:PRO:HD3	1:D:149:LEU:HD13	2.02	0.41
1:B:126:MET:HG3	1:B:282:TYR:CE1	2.54	0.41
1:D:197:PRO:HG2	1:D:211:PRO:HG2	2.02	0.41
3:A:402:GOL:H11	1:B:267:GLN:HA	2.02	0.41
1:C:1:MET:HG3	1:C:2:VAL:N	2.36	0.41
1:D:90:ASP:CG	3:D:403:GOL:O3	2.64	0.41
1:A:129:TYR:CD2	1:A:285:GLU:HB2	2.56	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles

### 5.3.1 Protein backbone

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	337/351 (96%)	331 (98%)	6 (2%)	0	100	100
1	B	338/351 (96%)	330 (98%)	8 (2%)	0	100	100
1	C	338/351 (96%)	331 (98%)	7 (2%)	0	100	100
1	D	343/351 (98%)	338 (98%)	5 (2%)	0	100	100
All	All	1356/1404 (97%)	1330 (98%)	26 (2%)	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	282/292 (97%)	280 (99%)	2 (1%)	76	63
1	B	283/292 (97%)	281 (99%)	2 (1%)	76	63
1	C	283/292 (97%)	280 (99%)	3 (1%)	65	46
1	D	288/292 (99%)	281 (98%)	7 (2%)	43	19
All	All	1136/1168 (97%)	1122 (99%)	14 (1%)	65	43

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

Mol	Chain	Res	Type
1	A	73	VAL
1	A	126	MET

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type
1	B	73	VAL
1	B	126	MET
1	C	73	VAL
1	C	97	LYS
1	C	126	MET
1	D	73	VAL
1	D	97	LYS
1	D	108[A]	ARG
1	D	108[B]	ARG
1	D	126	MET
1	D	204[A]	ARG
1	D	204[B]	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	38	HIS
1	A	159	ASN
1	A	233	GLN
1	A	265	ASN
1	A	266	GLN
1	B	159	ASN
1	B	233	GLN
1	B	265	ASN
1	C	253	ASN
1	C	318	ASN
1	C	321	GLN
1	D	49	HIS
1	D	131	GLN
1	D	263	ASN
1	D	266	GLN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

## 5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

19 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
3	GOL	A	402	-	5,5,5	0.45	0	5,5,5	1.28	0
4	SO4	D	405	-	4,4,4	0.31	0	6,6,6	0.54	0
3	GOL	D	403	-	5,5,5	0.46	0	5,5,5	2.06	2 (40%)
2	NAD	C	401	-	46,48,48	1.88	13 (28%)	64,73,73	1.62	10 (15%)
4	SO4	C	405	-	4,4,4	0.38	0	6,6,6	0.72	0
2	NAD	A	401	-	46,48,48	1.93	12 (26%)	64,73,73	1.71	13 (20%)
4	SO4	A	405	-	4,4,4	0.47	0	6,6,6	0.64	0
3	GOL	D	404	-	5,5,5	0.34	0	5,5,5	0.76	0
4	SO4	B	403	-	4,4,4	0.28	0	6,6,6	0.28	0
3	GOL	B	402	-	5,5,5	0.42	0	5,5,5	0.96	0
3	GOL	C	404	-	5,5,5	0.50	0	5,5,5	2.14	2 (40%)
2	NAD	D	401	-	46,48,48	1.84	14 (30%)	64,73,73	1.72	14 (21%)
3	GOL	A	403	-	5,5,5	0.60	0	5,5,5	2.16	1 (20%)
3	GOL	C	403	-	5,5,5	0.64	0	5,5,5	1.78	2 (40%)
5	CBU	D	402	-	12,12,12	2.49	8 (66%)	18,18,18	2.71	5 (27%)
2	NAD	B	401	-	46,48,48	1.81	12 (26%)	64,73,73	1.62	12 (18%)
3	GOL	C	402	-	5,5,5	0.65	0	5,5,5	1.51	2 (40%)
4	SO4	B	404	-	4,4,4	0.53	0	6,6,6	1.85	3 (50%)
4	SO4	A	404	-	4,4,4	0.42	0	6,6,6	0.90	0

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
3	GOL	A	403	-	-	2/4/4/4	-
3	GOL	D	404	-	-	0/4/4/4	-
3	GOL	A	402	-	-	2/4/4/4	-
3	GOL	C	402	-	-	2/4/4/4	-
3	GOL	D	403	-	-	0/4/4/4	-
2	NAD	A	401	-	-	3/30/62/62	0/5/5/5
2	NAD	C	401	-	-	1/30/62/62	0/5/5/5
3	GOL	C	403	-	-	2/4/4/4	-
3	GOL	B	402	-	-	0/4/4/4	-
5	CBU	D	402	-	-	-	0/1/1/1
3	GOL	C	404	-	-	3/4/4/4	-
2	NAD	D	401	-	-	2/30/62/62	0/5/5/5
2	NAD	B	401	-	-	1/30/62/62	0/5/5/5

All (59) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	401	NAD	C8A-N9A	-4.62	1.29	1.37
2	B	401	NAD	C2N-N1N	-4.41	1.30	1.35
5	D	402	CBU	C4-C3	4.23	1.63	1.52
2	A	401	NAD	C5A-N7A	-4.11	1.31	1.39
2	A	401	NAD	O7N-C7N	-4.03	1.16	1.24
2	B	401	NAD	O7N-C7N	-3.93	1.16	1.24
2	C	401	NAD	C4A-N9A	-3.82	1.29	1.37
2	C	401	NAD	C5A-N7A	-3.81	1.32	1.39
2	D	401	NAD	C2N-N1N	-3.79	1.30	1.35
2	B	401	NAD	C4A-N9A	-3.78	1.29	1.37
2	C	401	NAD	O7N-C7N	-3.67	1.17	1.24
2	D	401	NAD	C4A-N9A	-3.64	1.30	1.37
2	D	401	NAD	C5A-N7A	-3.61	1.32	1.39
5	D	402	CBU	C3-C2	3.59	1.61	1.52
2	C	401	NAD	PN-O2N	-3.52	1.39	1.55
2	A	401	NAD	C4A-N9A	-3.48	1.30	1.37
2	B	401	NAD	C5A-N7A	-3.44	1.32	1.39
2	A	401	NAD	PN-O2N	-3.39	1.39	1.55
2	A	401	NAD	PA-O2A	-3.33	1.39	1.55
2	D	401	NAD	O4B-C4B	-3.26	1.37	1.45
2	C	401	NAD	C2N-N1N	-3.10	1.31	1.35
2	C	401	NAD	C5A-C4A	3.07	1.44	1.39
2	B	401	NAD	C8A-N9A	-3.04	1.32	1.37
2	B	401	NAD	PA-O2A	-3.04	1.41	1.55
2	C	401	NAD	O4D-C4D	-3.03	1.38	1.45

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	401	NAD	C8A-N9A	-2.98	1.32	1.37
2	B	401	NAD	C5A-C4A	2.84	1.44	1.39
5	D	402	CBU	C5-C4	2.82	1.59	1.52
2	D	401	NAD	PA-O2A	-2.82	1.42	1.55
2	A	401	NAD	C2A-N1A	-2.80	1.29	1.33
2	D	401	NAD	PN-O3	-2.79	1.56	1.59
2	D	401	NAD	C5A-C4A	2.77	1.44	1.39
2	B	401	NAD	PA-O1A	-2.77	1.41	1.50
2	D	401	NAD	PN-O2N	-2.75	1.42	1.55
5	D	402	CBU	C6-C1	2.75	1.59	1.52
2	D	401	NAD	O7N-C7N	-2.70	1.19	1.24
5	D	402	CBU	C2-C1	2.69	1.59	1.52
2	D	401	NAD	PA-O3	-2.67	1.56	1.59
2	A	401	NAD	C2N-N1N	-2.64	1.32	1.35
2	C	401	NAD	C8A-N9A	-2.61	1.33	1.37
2	C	401	NAD	PA-O2A	-2.60	1.43	1.55
2	B	401	NAD	PN-O2N	-2.59	1.43	1.55
2	B	401	NAD	O4B-C4B	-2.58	1.39	1.45
2	C	401	NAD	O4B-C4B	-2.54	1.39	1.45
2	D	401	NAD	PN-O1N	-2.54	1.42	1.50
2	A	401	NAD	O4B-C4B	-2.52	1.39	1.45
2	C	401	NAD	PN-O1N	-2.52	1.42	1.50
2	D	401	NAD	C2A-N1A	-2.46	1.29	1.33
2	D	401	NAD	PA-O1A	-2.32	1.42	1.50
2	C	401	NAD	PA-O1A	-2.24	1.43	1.50
2	B	401	NAD	O4D-C4D	-2.23	1.40	1.45
5	D	402	CBU	OXT-C5	-2.17	1.37	1.43
5	D	402	CBU	O2-C2	-2.15	1.37	1.43
2	B	401	NAD	C2N-C3N	-2.14	1.35	1.39
2	A	401	NAD	C6N-N1N	-2.14	1.30	1.35
2	A	401	NAD	O2D-C2D	-2.13	1.37	1.43
5	D	402	CBU	O4-C4	-2.13	1.37	1.43
2	A	401	NAD	O4D-C4D	-2.10	1.40	1.45
2	C	401	NAD	PN-O3	-2.04	1.57	1.59

All (66) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	D	402	CBU	C5-C6-C1	-6.31	99.76	110.83
5	D	402	CBU	OXT-C5-C4	5.99	124.49	110.38
2	C	401	NAD	C5A-C4A-N3A	-5.54	119.09	126.72
5	D	402	CBU	C5-C4-C3	-5.52	101.13	110.83

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	401	NAD	C5A-C4A-N3A	-5.46	119.20	126.72
2	B	401	NAD	C5A-C4A-N3A	-5.46	119.20	126.72
2	C	401	NAD	N3A-C4A-N9A	5.10	135.84	127.17
2	D	401	NAD	C5A-C4A-N3A	-4.91	119.96	126.72
2	D	401	NAD	C4D-O4D-C1D	4.70	114.23	109.92
2	B	401	NAD	O7N-C7N-C3N	-4.58	114.00	119.60
2	D	401	NAD	N3A-C4A-N9A	4.30	134.48	127.17
2	A	401	NAD	N3A-C4A-N9A	4.29	134.46	127.17
2	B	401	NAD	N3A-C4A-N9A	4.20	134.32	127.17
2	A	401	NAD	N3A-C2A-N1A	-4.16	122.28	128.58
3	A	403	GOL	O3-C3-C2	-4.08	92.00	110.38
2	D	401	NAD	O7N-C7N-N7N	3.82	128.14	122.62
3	C	404	GOL	O1-C1-C2	-3.73	93.57	110.38
2	A	401	NAD	C2A-N3A-C4A	3.71	120.90	111.83
5	D	402	CBU	C6-C5-C4	3.68	117.29	110.83
2	C	401	NAD	C2A-N3A-C4A	3.62	120.66	111.83
2	A	401	NAD	O2A-PA-O3	3.57	116.92	107.27
2	C	401	NAD	N3A-C2A-N1A	-3.44	123.37	128.58
3	D	403	GOL	O3-C3-C2	-3.42	94.96	110.38
2	C	401	NAD	C4A-N9A-C8A	3.34	109.25	105.74
2	A	401	NAD	C4A-C5A-N7A	-3.25	106.86	110.58
2	D	401	NAD	N6A-C6A-N1A	3.21	125.54	118.38
2	B	401	NAD	C2A-N3A-C4A	3.02	119.22	111.83
2	A	401	NAD	C2A-N1A-C6A	2.98	123.63	118.73
2	B	401	NAD	O4B-C1B-C2B	-2.97	100.26	106.62
2	D	401	NAD	O7N-C7N-C3N	-2.92	116.03	119.60
3	C	403	GOL	C3-C2-C1	-2.81	101.50	111.80
4	B	404	SO4	O3-S-O2	-2.81	94.89	109.56
2	A	401	NAD	O4B-C1B-C2B	-2.76	100.71	106.62
2	D	401	NAD	C2A-N1A-C6A	2.76	123.26	118.73
2	C	401	NAD	C2A-N1A-C6A	2.75	123.25	118.73
3	D	403	GOL	C3-C2-C1	-2.73	101.77	111.80
2	B	401	NAD	C4D-O4D-C1D	2.71	112.41	109.92
2	B	401	NAD	C4A-C5A-N7A	-2.70	107.50	110.58
2	D	401	NAD	C2A-N3A-C4A	2.65	118.30	111.83
2	A	401	NAD	C4D-O4D-C1D	2.60	112.31	109.92
2	C	401	NAD	O4B-C1B-C2B	-2.55	101.16	106.62
2	C	401	NAD	N6A-C6A-N1A	2.49	123.93	118.38
2	B	401	NAD	N3A-C2A-N1A	-2.38	124.98	128.58
2	D	401	NAD	C5N-C6N-N1N	2.34	123.58	120.38
2	D	401	NAD	C4A-N9A-C8A	2.32	108.17	105.74
2	C	401	NAD	C4A-C5A-N7A	-2.30	107.95	110.58

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	401	NAD	C4A-N9A-C8A	2.29	108.14	105.74
2	A	401	NAD	C6A-C5A-N7A	2.27	136.47	132.09
2	A	401	NAD	O2N-PN-O5D	2.25	117.78	107.57
2	B	401	NAD	O2A-PA-O3	2.25	113.36	107.27
3	C	402	GOL	O3-C3-C2	-2.25	100.26	110.38
4	B	404	SO4	O3-S-O1	2.24	121.28	109.56
2	B	401	NAD	N6A-C6A-N1A	2.20	123.28	118.38
2	C	401	NAD	O3-PA-O1A	-2.20	104.09	110.70
3	C	403	GOL	O1-C1-C2	-2.16	100.67	110.38
2	D	401	NAD	N3A-C2A-N1A	-2.13	125.36	128.58
4	B	404	SO4	O2-S-O1	-2.13	94.05	109.06
2	B	401	NAD	O7N-C7N-N7N	2.09	125.64	122.62
2	D	401	NAD	O2N-PN-O3	2.09	112.93	107.27
2	B	401	NAD	C3N-C7N-N7N	2.08	120.30	117.74
3	C	402	GOL	O1-C1-C2	-2.07	101.05	110.38
5	D	402	CBU	O2-C2-C3	-2.05	105.55	110.38
2	D	401	NAD	C6N-C5N-C4N	-2.04	116.51	119.45
2	D	401	NAD	O4B-C1B-C2B	-2.02	102.28	106.62
3	C	404	GOL	O3-C3-C2	-2.02	101.29	110.38
2	A	401	NAD	C5A-N7A-C8A	2.01	106.61	103.45

There are no chirality outliers.

All (18) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401	NAD	O4D-C1D-N1N-C6N
3	A	403	GOL	C1-C2-C3-O3
3	C	402	GOL	C1-C2-C3-O3
3	C	403	GOL	C1-C2-C3-O3
3	C	404	GOL	O1-C1-C2-C3
3	C	404	GOL	O1-C1-C2-O2
3	A	403	GOL	O2-C2-C3-O3
3	C	403	GOL	O2-C2-C3-O3
3	C	404	GOL	O2-C2-C3-O3
3	A	402	GOL	O1-C1-C2-O2
3	A	402	GOL	O1-C1-C2-C3
2	A	401	NAD	O4D-C1D-N1N-C2N
2	B	401	NAD	O4D-C1D-N1N-C6N
2	C	401	NAD	O4D-C1D-N1N-C2N
2	D	401	NAD	O4D-C1D-N1N-C2N
3	C	402	GOL	O2-C2-C3-O3
2	A	401	NAD	PA-O3-PN-O1N

*Continued on next page...*

*Continued from previous page...*

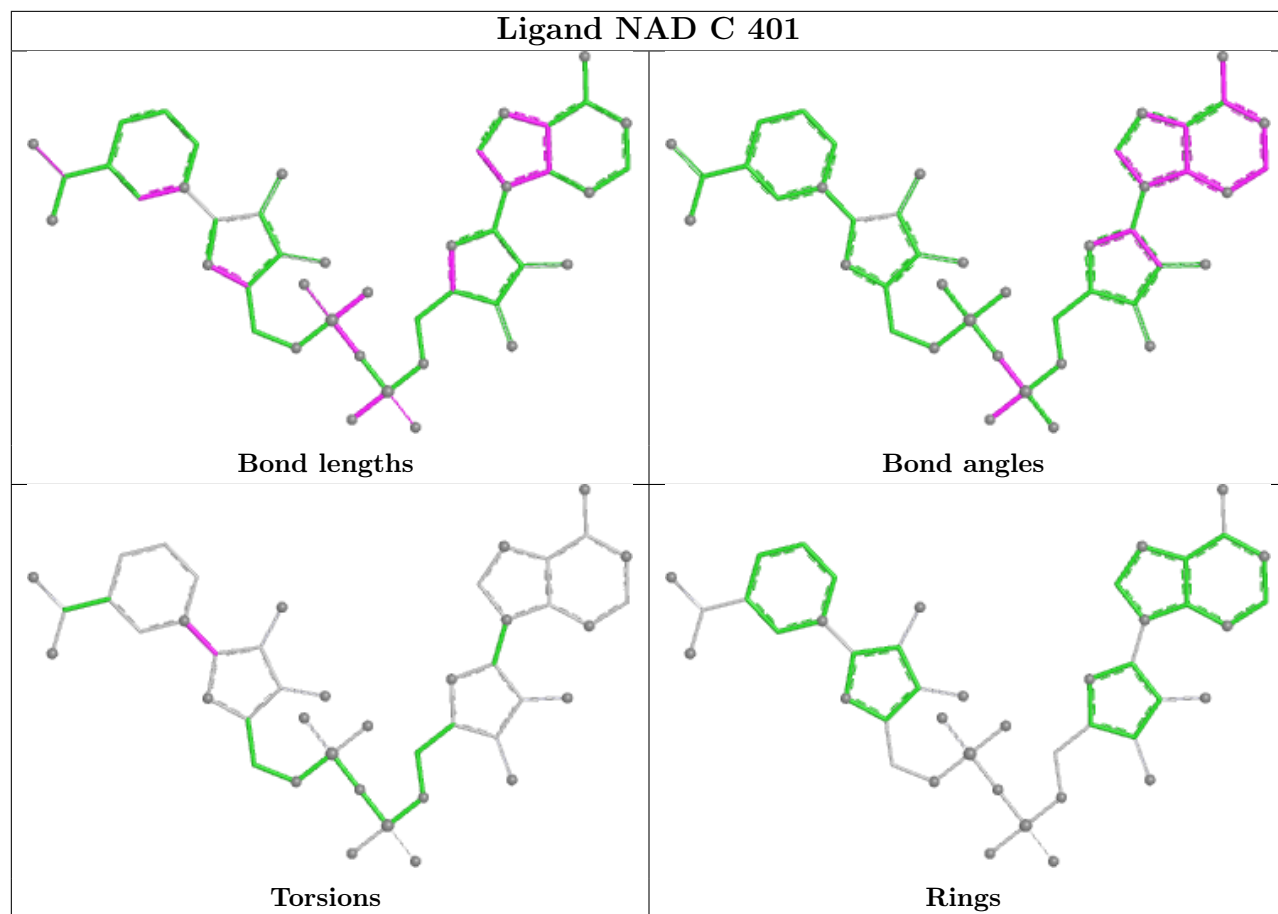
Mol	Chain	Res	Type	Atoms
2	D	401	NAD	PA-O3-PN-O1N

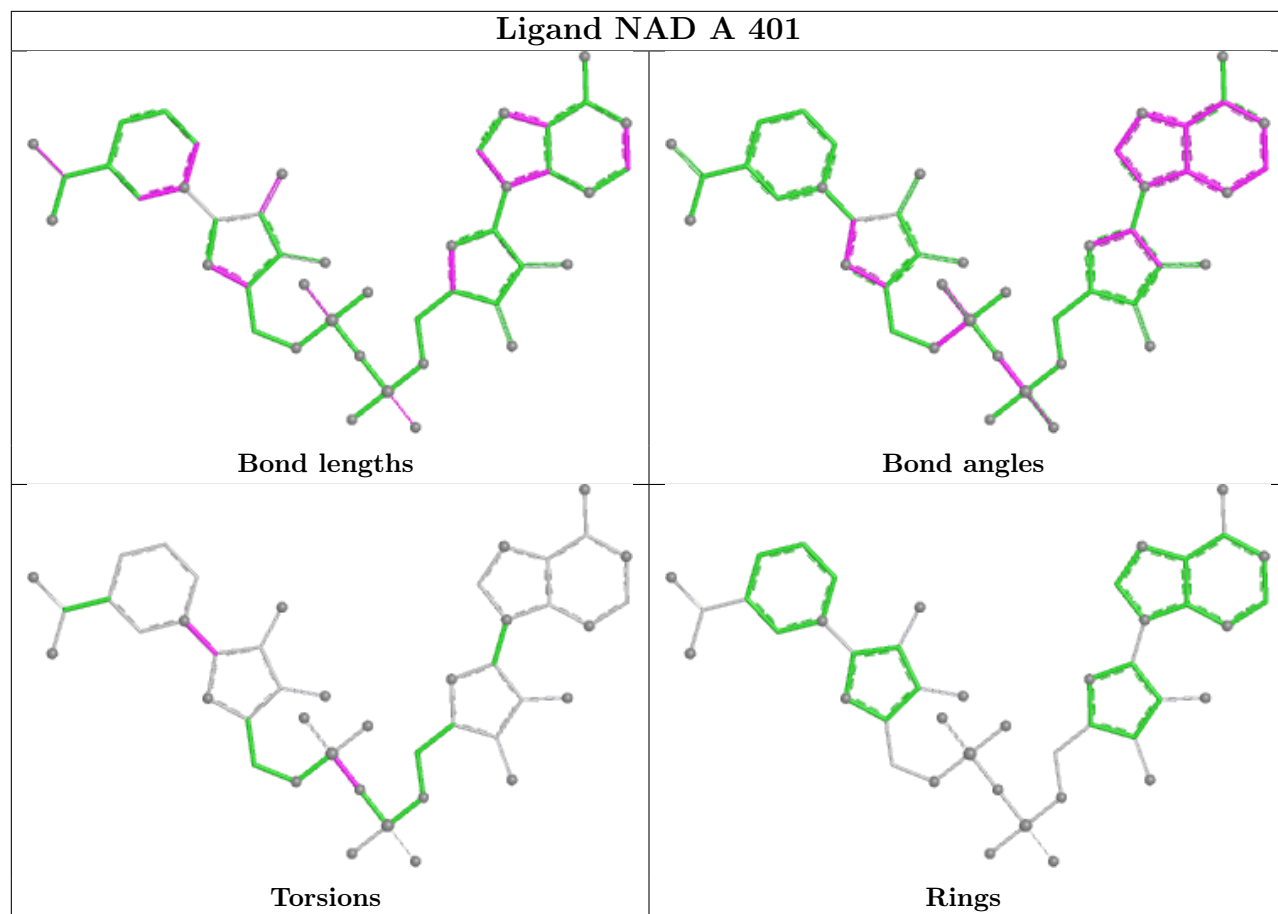
There are no ring outliers.

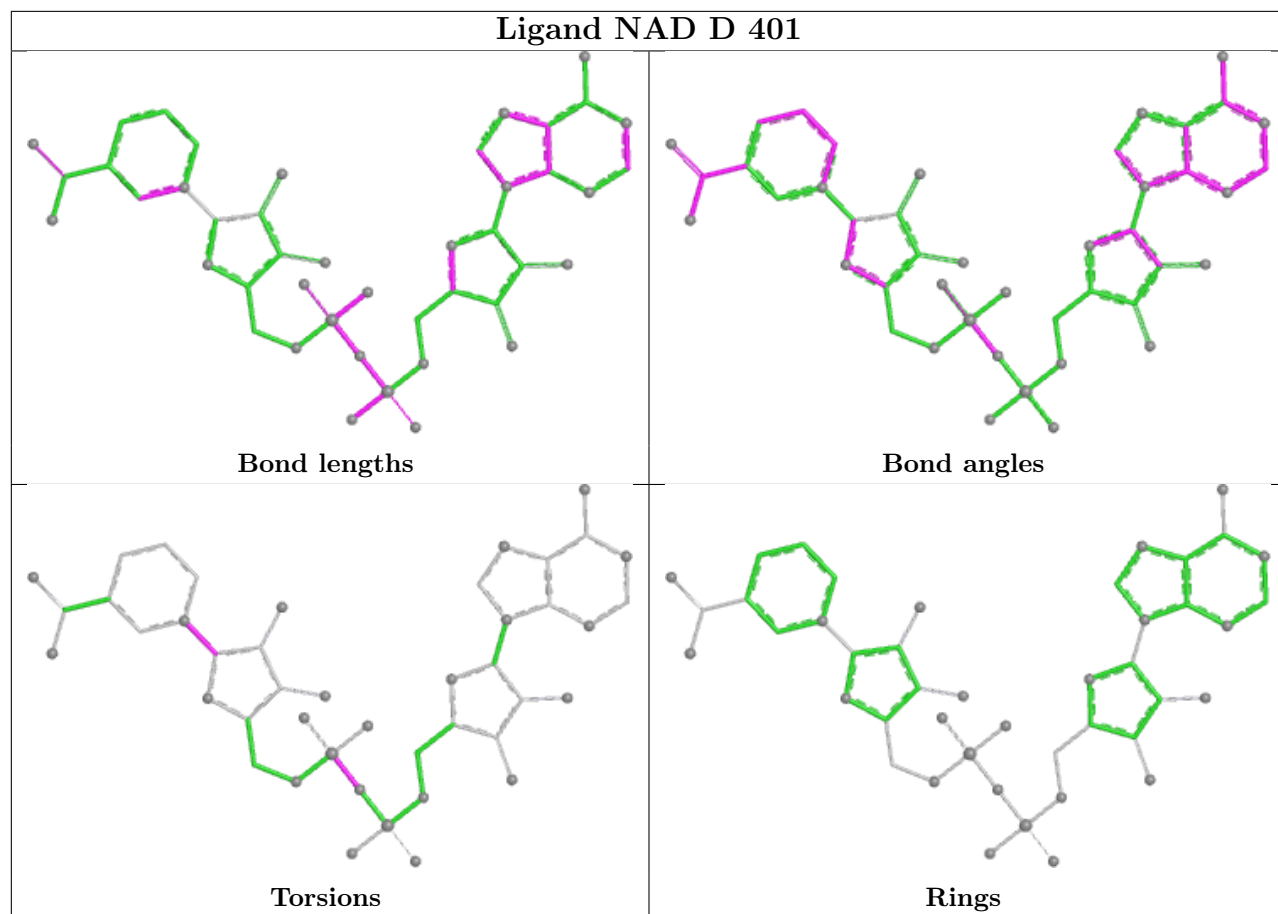
5 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	402	GOL	2	0
3	D	403	GOL	3	0
4	C	405	SO4	1	0
2	D	401	NAD	2	0
5	D	402	CBU	2	0

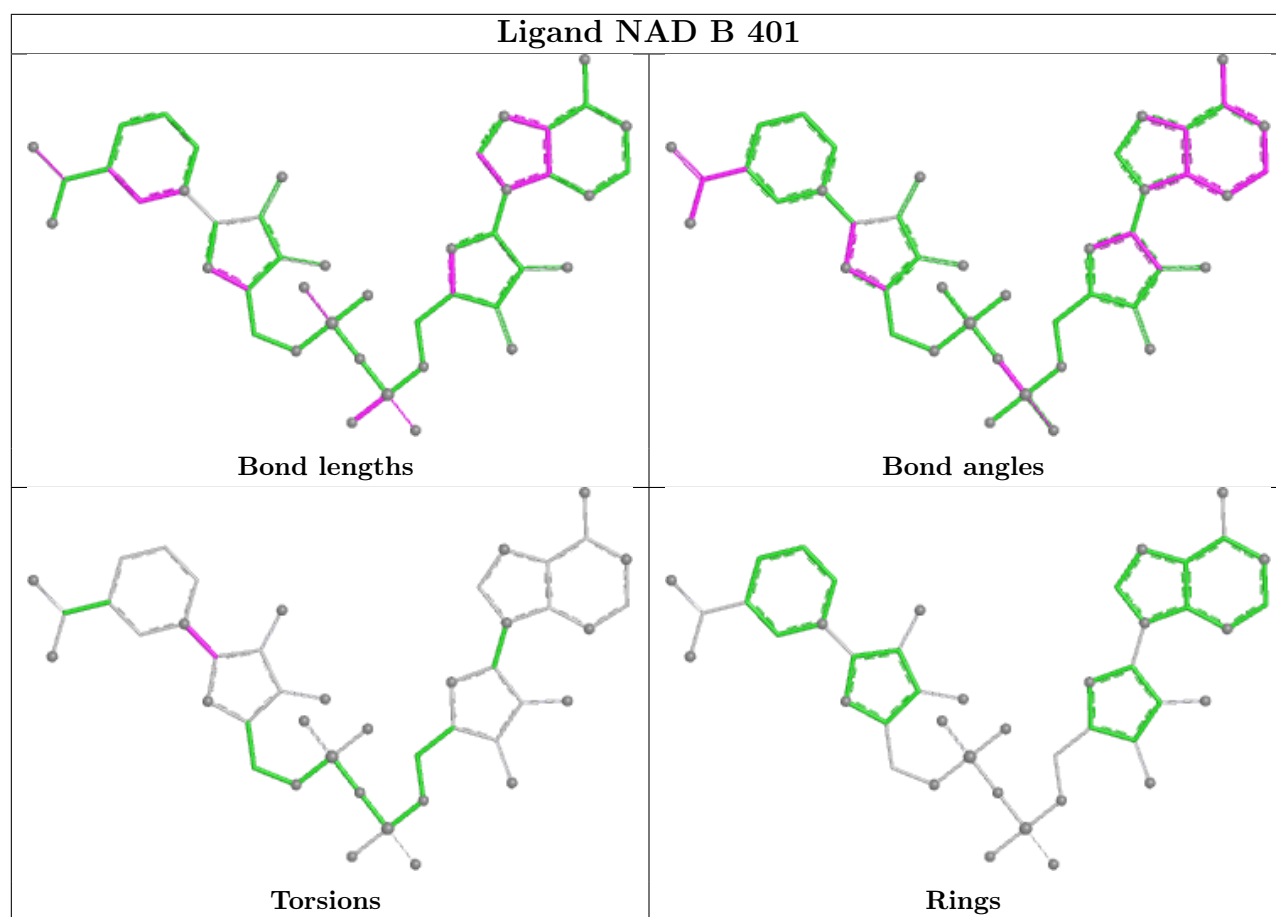
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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.











## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	339/351 (96%)	0.20	18 (5%) 32 33	13, 21, 37, 52	16 (4%)
1	B	339/351 (96%)	-0.06	3 (0%) 81 84	6, 19, 32, 41	13 (3%)
1	C	339/351 (96%)	-0.21	3 (0%) 81 84	7, 18, 30, 38	15 (4%)
1	D	339/351 (96%)	-0.42	4 (1%) 76 80	8, 16, 27, 36	17 (5%)
All	All	1356/1404 (96%)	-0.12	28 (2%) 63 67	6, 19, 32, 52	61 (4%)

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	1	MET	13.5
1	C	1	MET	12.0
1	D	256	LEU	5.5
1	A	253	ASN	5.3
1	A	39	GLU	4.3
1	B	253	ASN	4.1
1	A	51	ASN	3.8
1	A	134	ARG	2.9
1	A	38	HIS	2.9
1	D	1	MET	2.8
1	A	333	GLY	2.7
1	D	254	TYR	2.5
1	A	254	TYR	2.5
1	C	275	ILE	2.4
1	A	63	GLN	2.3
1	A	56	PRO	2.3
1	A	110	VAL	2.3
1	A	55	TYR	2.2
1	A	53	LYS	2.2
1	A	322	LYS	2.2
1	B	336	THR	2.2

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	RSRZ
1	A	339	GLN	2.1
1	C	274	TRP	2.1
1	D	253	ASN	2.1
1	A	84	LEU	2.1
1	A	115	THR	2.1
1	A	54	VAL	2.0
1	A	109	ILE	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, 95<sup>th</sup> 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.

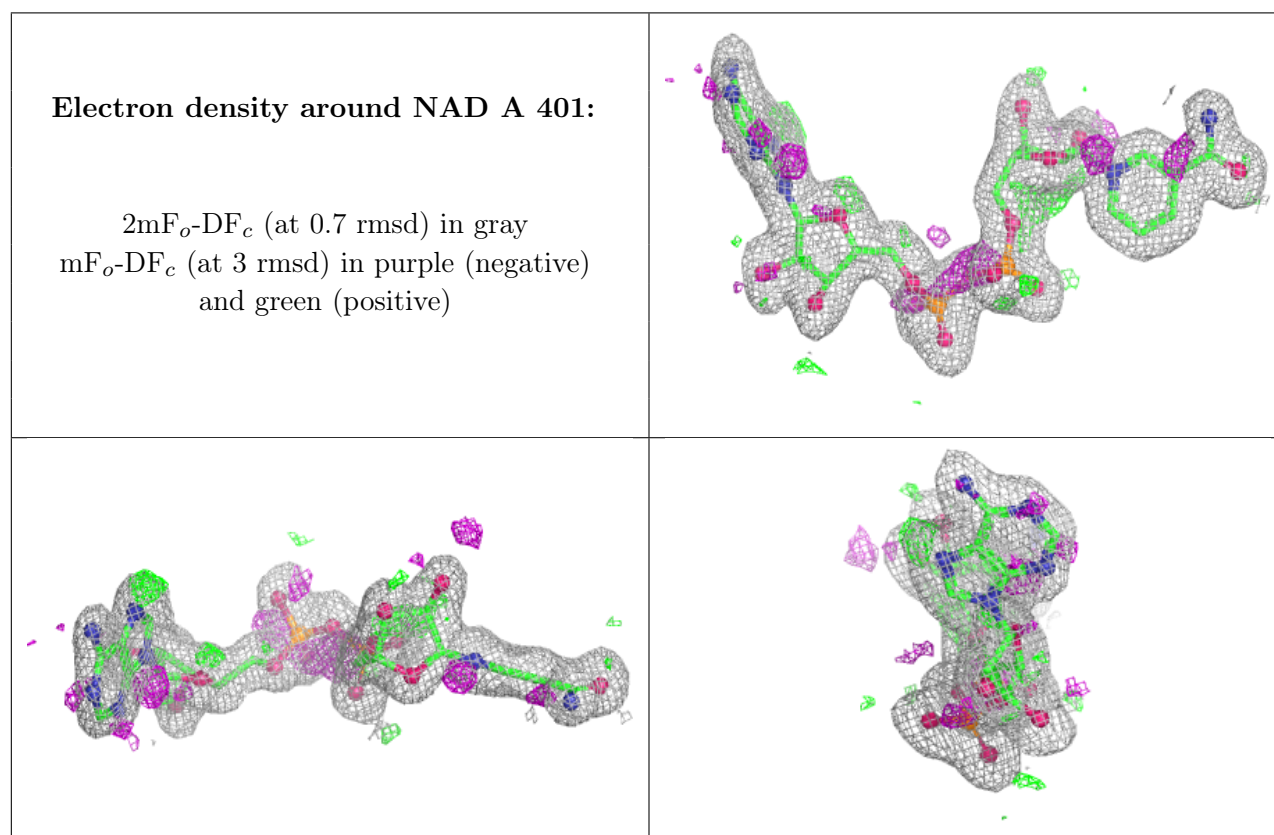
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
3	GOL	C	403	6/6	0.76	0.14	33,34,40,42	0
3	GOL	D	403	6/6	0.78	0.16	24,29,31,42	0
3	GOL	A	402	6/6	0.80	0.12	29,30,37,41	0
3	GOL	B	402	6/6	0.80	0.14	26,29,31,36	0
3	GOL	C	404	6/6	0.83	0.13	27,29,32,33	0
4	SO4	B	404	5/5	0.84	0.17	22,24,29,31	5
3	GOL	A	403	6/6	0.85	0.11	26,27,28,28	0
3	GOL	C	402	6/6	0.88	0.11	27,31,33,33	0
2	NAD	A	401	44/44	0.92	0.10	19,25,29,32	0
5	CBU	D	402	12/12	0.93	0.08	16,20,23,24	0
4	SO4	A	404	5/5	0.94	0.11	23,24,29,30	5
4	SO4	A	405	5/5	0.94	0.09	23,24,26,28	5
4	SO4	B	403	5/5	0.94	0.09	23,30,32,37	5
2	NAD	B	401	44/44	0.94	0.08	14,19,22,26	0
3	GOL	D	404	6/6	0.94	0.07	26,28,29,30	0
4	SO4	C	405	5/5	0.95	0.08	22,26,30,31	5

*Continued on next page...*

*Continued from previous page...*

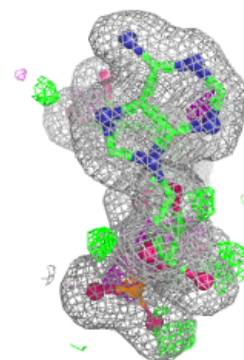
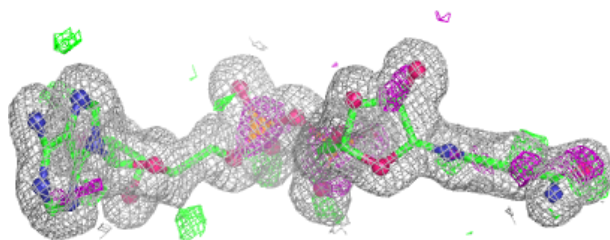
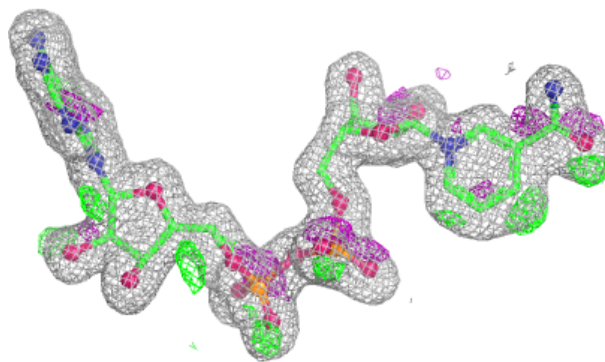
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	NAD	C	401	44/44	0.95	0.08	14,17,19,21	0
4	SO4	D	405	5/5	0.96	0.07	25,29,33,36	5
2	NAD	D	401	44/44	0.97	0.06	12,15,18,20	0

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.

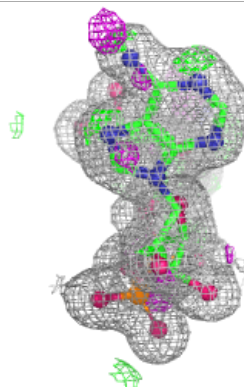
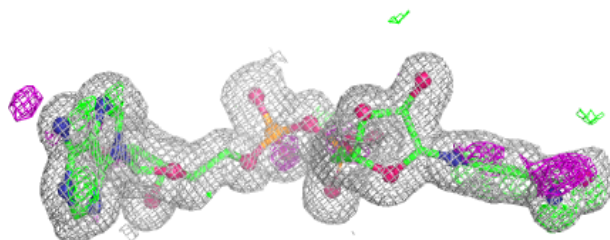
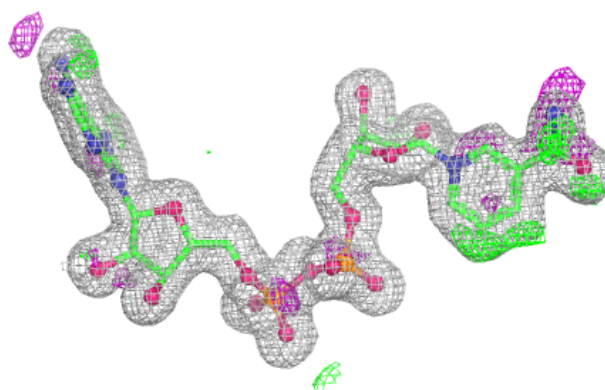


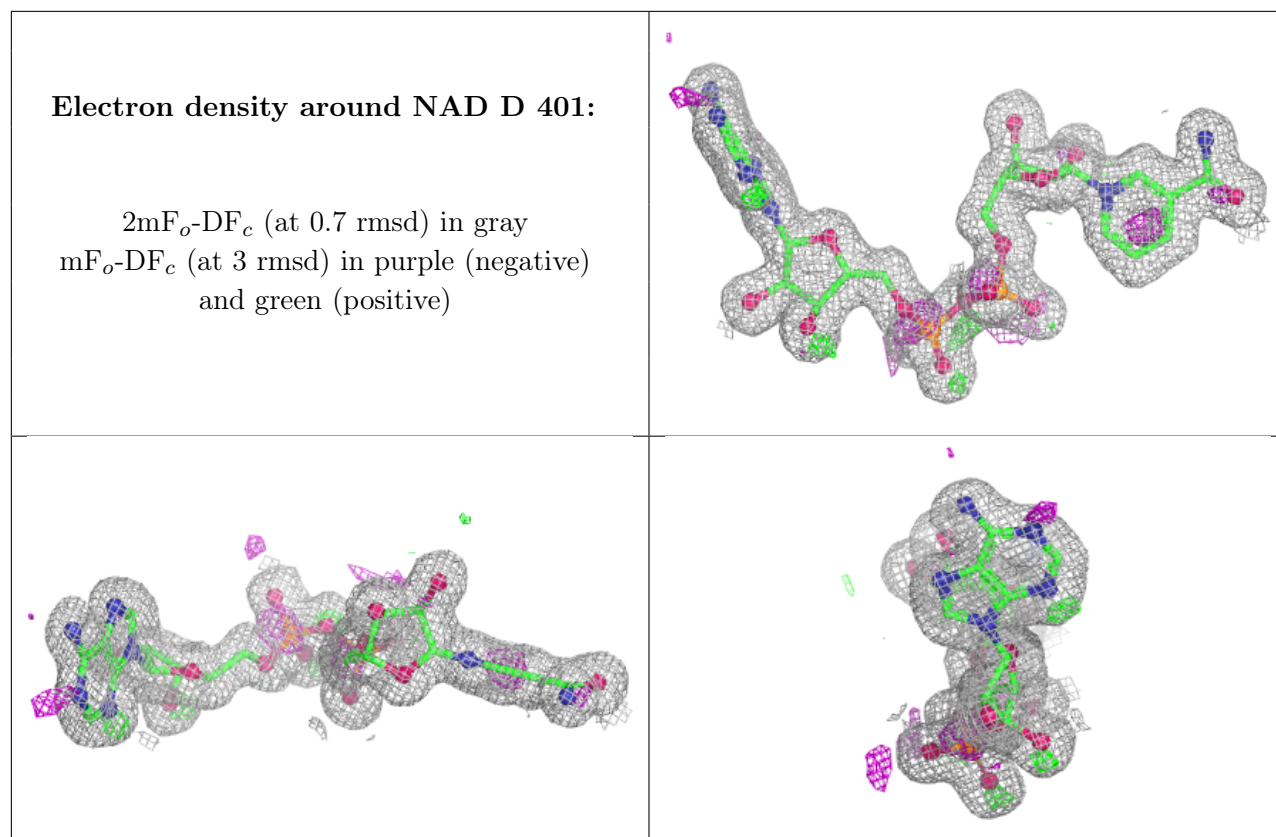
**Electron density around NAD B 401:**

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

**Electron density around NAD 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)





## 6.5 Other polymers [i](#)

There are no such residues in this entry.