



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 12:43 PM UTC

PDB ID : 5JCM / pdb_00005jcm
Title : Structure and catalytic mechanism of monodehydroascorbate reductase, MD-HAR, from *Oryza sativa* L. japonica
Authors : Park, A.K.; Kim, H.W.
Deposited on : 2016-04-15
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 ⓘ 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

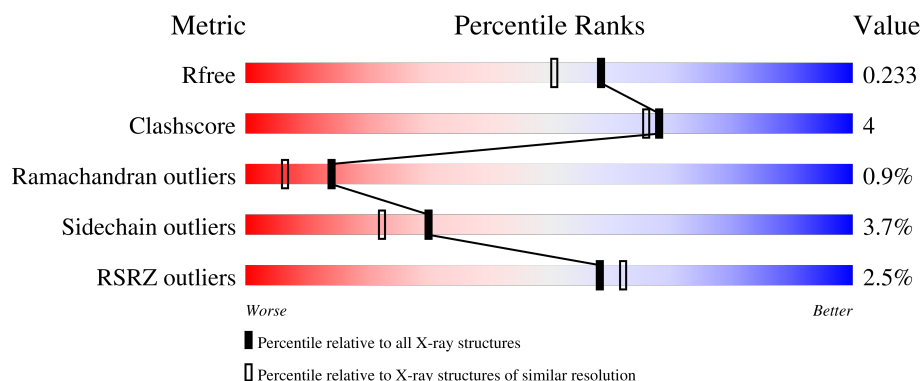
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

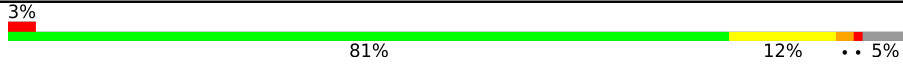
The reported resolution of this entry is 1.90 Å.

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}	180053	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (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 $\leq 5\%$. 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	451	
1	B	451	

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 7283 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 Os09g0567300 protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	429	Total	C	N	O	S	0	0	0
			3256	2099	531	620	6			
1	B	425	Total	C	N	O	S	0	0	0
			3223	2077	526	614	6			

There are 40 discrepancies between the modelled and reference sequences:

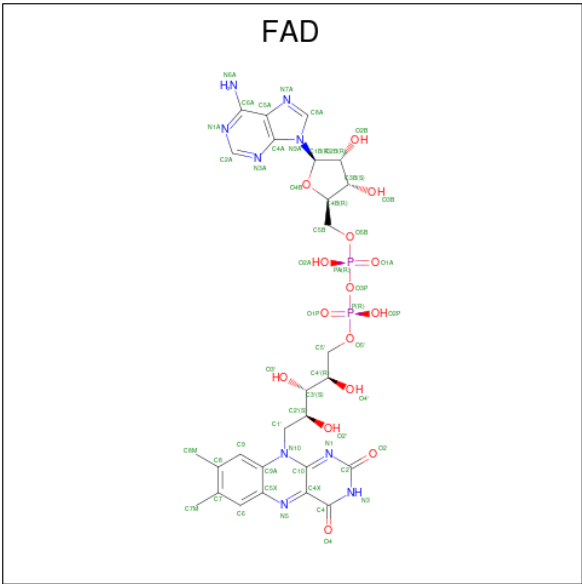
Chain	Residue	Modelled	Actual	Comment	Reference
A	-15	HIS	-	expression tag	UNP Q652L6
A	-14	HIS	-	expression tag	UNP Q652L6
A	-13	HIS	-	expression tag	UNP Q652L6
A	-12	HIS	-	expression tag	UNP Q652L6
A	-11	HIS	-	expression tag	UNP Q652L6
A	-10	HIS	-	expression tag	UNP Q652L6
A	-9	ALA	-	expression tag	UNP Q652L6
A	-8	SER	-	expression tag	UNP Q652L6
A	-7	GLU	-	expression tag	UNP Q652L6
A	-6	ASN	-	expression tag	UNP Q652L6
A	-5	LEU	-	expression tag	UNP Q652L6
A	-4	TYR	-	expression tag	UNP Q652L6
A	-3	PHE	-	expression tag	UNP Q652L6
A	-2	GLN	-	expression tag	UNP Q652L6
A	-1	GLY	-	expression tag	UNP Q652L6
A	0	ALA	-	expression tag	UNP Q652L6
A	1	MET	-	expression tag	UNP Q652L6
A	2	ALA	-	expression tag	UNP Q652L6
A	3	SER	-	expression tag	UNP Q652L6
A	349	PHE	TYR	engineered mutation	UNP Q652L6
B	-15	HIS	-	expression tag	UNP Q652L6
B	-14	HIS	-	expression tag	UNP Q652L6
B	-13	HIS	-	expression tag	UNP Q652L6
B	-12	HIS	-	expression tag	UNP Q652L6
B	-11	HIS	-	expression tag	UNP Q652L6

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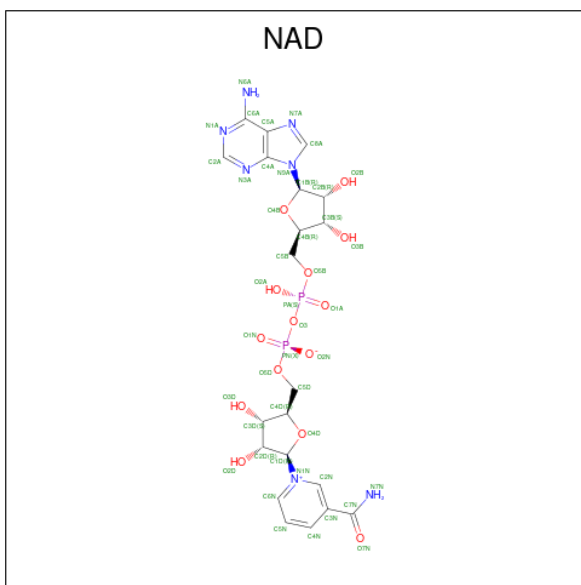
Chain	Residue	Modelled	Actual	Comment	Reference
B	-10	HIS	-	expression tag	UNP Q652L6
B	-9	ALA	-	expression tag	UNP Q652L6
B	-8	SER	-	expression tag	UNP Q652L6
B	-7	GLU	-	expression tag	UNP Q652L6
B	-6	ASN	-	expression tag	UNP Q652L6
B	-5	LEU	-	expression tag	UNP Q652L6
B	-4	TYR	-	expression tag	UNP Q652L6
B	-3	PHE	-	expression tag	UNP Q652L6
B	-2	GLN	-	expression tag	UNP Q652L6
B	-1	GLY	-	expression tag	UNP Q652L6
B	0	ALA	-	expression tag	UNP Q652L6
B	1	MET	-	expression tag	UNP Q652L6
B	2	ALA	-	expression tag	UNP Q652L6
B	3	SER	-	expression tag	UNP Q652L6
B	349	PHE	TYR	engineered mutation	UNP Q652L6

- Molecule 2 is FLAVIN-ADENINE DINUCLEOTIDE (CCD ID: FAD) (formula: C₂₇H₃₃N₉O₁₅P₂).



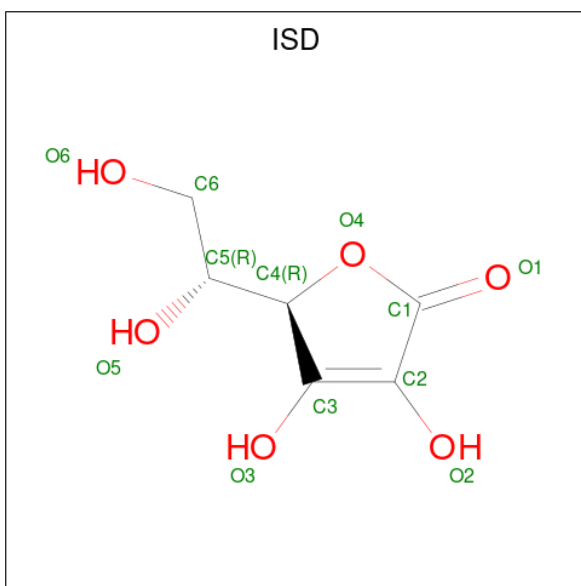
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
2	B	1	Total	C	N	O	P	0	0
			53	27	9	15	2		

- Molecule 3 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (CCD ID: NAD) (formula: C₂₁H₂₇N₇O₁₄P₂).



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

- Molecule 4 is ISOASCORBIC ACID (CCD ID: ISD) (formula: $C_6H_8O_6$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C O 12 6 6	0	0
4	B	1	Total C O 12 6 6	0	0

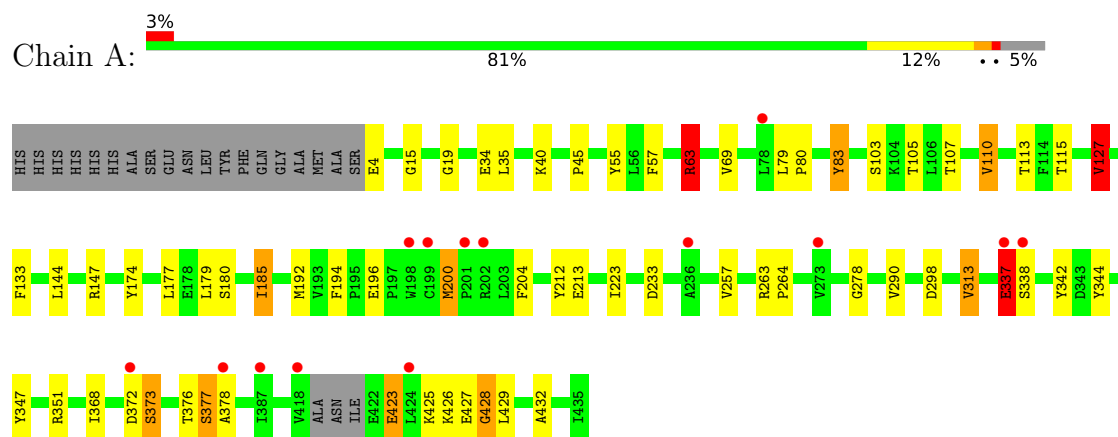
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	290	Total 290	O 290	0	0
5	B	296	Total 296	O 296	0	0

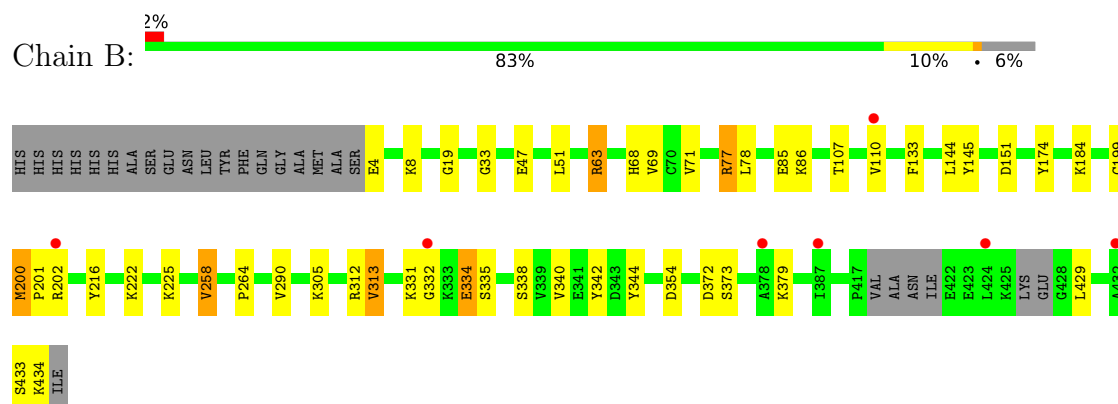
3 Residue-property plots [i](#)

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: Os09g0567300 protein



• Molecule 1: Os09g0567300 protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	78.39Å 85.14Å 131.81Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 1.90 50.00 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.2 (50.00-1.90) 99.3 (50.00-1.90)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.68 (at 1.91Å)	Xtriage
Refinement program	REFMAC 5.8.0103	Depositor
R, R_{free}	0.174 , 0.224 0.186 , 0.233	Depositor DCC
R_{free} test set	3409 reflections (4.87%)	wwPDB-VP
Wilson B-factor (Å ²)	31.9	Xtriage
Anisotropy	0.023	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 51.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7283	wwPDB-VP
Average B, all atoms (Å ²)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.90% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

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

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: FAD, ISD, 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	1.34	10/3325 (0.3%)	1.24	17/4497 (0.4%)
1	B	1.30	7/3291 (0.2%)	1.25	19/4450 (0.4%)
All	All	1.32	17/6616 (0.3%)	1.25	36/8947 (0.4%)

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

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	2
1	B	0	2
All	All	0	4

All (17) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	200	MET	C-O	6.73	1.26	1.23
1	B	151	ASP	N-CA	6.72	1.54	1.46
1	A	45	PRO	C-O	5.91	1.31	1.23
1	B	200	MET	N-CA	5.78	1.51	1.46
1	B	258	VAL	N-CA	-5.65	1.39	1.46
1	B	290	VAL	CA-C	-5.59	1.48	1.53
1	A	347	TYR	C-O	-5.55	1.17	1.24
1	A	298	ASP	CA-C	5.51	1.60	1.52
1	A	432	ALA	C-O	-5.45	1.17	1.24
1	A	200	MET	CA-C	-5.45	1.50	1.53
1	B	51	LEU	C-O	-5.41	1.17	1.24
1	B	354	ASP	N-CA	5.33	1.52	1.46
1	A	35	LEU	N-CA	5.28	1.52	1.46
1	A	83	TYR	CA-C	5.24	1.59	1.52

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	8	LYS	CA-C	5.21	1.59	1.52
1	A	212	TYR	CA-CB	5.21	1.61	1.53
1	A	34	GLU	CA-C	5.13	1.59	1.52

All (36) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	334	GLU	N-CA-C	13.93	126.16	110.97
1	B	63	ARG	NE-CZ-NH2	-13.17	107.35	119.20
1	B	63	ARG	NE-CZ-NH1	10.22	131.72	121.50
1	B	63	ARG	CD-NE-CZ	9.95	138.33	124.40
1	A	63	ARG	NE-CZ-NH2	-8.75	111.32	119.20
1	B	372	ASP	CA-C-N	8.52	137.03	121.70
1	B	372	ASP	C-N-CA	8.52	137.03	121.70
1	A	372	ASP	CA-C-N	8.45	136.90	121.70
1	A	372	ASP	C-N-CA	8.45	136.90	121.70
1	A	127	VAL	CB-CA-C	-8.11	99.86	110.98
1	B	334	GLU	CA-C-N	7.92	135.95	121.70
1	B	334	GLU	C-N-CA	7.92	135.95	121.70
1	A	63	ARG	NE-CZ-NH1	7.11	128.61	121.50
1	B	332	GLY	N-CA-C	-6.42	105.05	112.50
1	B	334	GLU	O-C-N	-6.34	115.44	122.03
1	B	313	VAL	CB-CA-C	6.17	119.76	110.63
1	A	313	VAL	CB-CA-C	6.03	119.78	110.50
1	B	334	GLU	CA-C-O	-5.85	114.85	121.00
1	A	194	PHE	N-CA-C	5.83	113.46	108.22
1	A	351	ARG	NE-CZ-NH2	5.77	124.39	119.20
1	B	372	ASP	O-C-N	-5.70	114.33	122.99
1	A	63	ARG	CD-NE-CZ	5.64	132.30	124.40
1	A	290	VAL	CA-C-N	-5.60	114.19	119.85
1	A	290	VAL	C-N-CA	-5.60	114.19	119.85
1	A	110	VAL	N-CA-CB	-5.60	104.84	112.28
1	B	372	ASP	N-CA-CB	-5.57	101.80	110.87
1	B	33	GLY	N-CA-C	5.42	121.53	115.08
1	A	423	GLU	N-CA-C	5.36	122.21	110.80
1	A	57	PHE	CA-C-N	-5.35	114.16	119.56
1	A	57	PHE	C-N-CA	-5.35	114.16	119.56
1	B	199	CYS	N-CA-C	5.24	117.45	110.53
1	B	216	TYR	N-CA-C	5.23	116.98	111.28
1	A	351	ARG	NE-CZ-NH1	-5.12	116.38	121.50
1	B	107	THR	N-CA-C	5.10	116.72	108.41
1	A	185	ILE	CA-CB-CG2	5.02	119.04	110.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	77	ARG	NE-CZ-NH1	-5.01	116.49	121.50

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	337	GLU	Peptide
1	A	376	THR	Peptide
1	B	334	GLU	Peptide
1	B	63	ARG	Sidechain

5.2 Too-close contacts

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3256	0	3257	31	1
1	B	3223	0	3217	18	1
2	A	53	0	31	0	0
2	B	53	0	31	0	0
3	A	44	0	26	1	0
3	B	44	0	25	0	0
4	A	12	0	0	0	1
4	B	12	0	0	0	1
5	A	290	0	0	5	1
5	B	296	0	0	6	1
All	All	7283	0	6587	48	3

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.

All (48) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:179:LEU:HD23	1:A:257:VAL:HG11	1.60	0.82
1:B:71:VAL:CG1	1:B:77:ARG:HG2	2.13	0.79

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:233:ASP:OD2	5:A:601:HOH:O	2.01	0.78
1:B:71:VAL:HG13	1:B:77:ARG:HG2	1.72	0.72
1:A:174:TYR:CD1	1:A:200:MET:HE1	2.27	0.68
1:A:177:LEU:HD12	1:A:200:MET:HE2	1.76	0.66
1:B:77:ARG:NH1	5:B:603:HOH:O	2.30	0.63
1:B:47:GLU:HG3	5:B:777:HOH:O	1.99	0.63
1:A:105:THR:HG22	1:A:115:THR:HG22	1.82	0.61
1:B:71:VAL:HG23	5:B:777:HOH:O	2.02	0.59
1:A:263:ARG:NE	5:A:608:HOH:O	2.36	0.57
1:A:174:TYR:CE1	1:A:200:MET:HE1	2.38	0.56
1:A:83:TYR:OH	5:A:602:HOH:O	2.05	0.55
1:A:127:VAL:HG22	1:A:147:ARG:HB2	1.87	0.54
1:A:377:SER:HB3	1:A:378:ALA:CA	2.40	0.52
1:A:107:THR:OG1	5:A:603:HOH:O	2.19	0.51
1:B:19:GLY:HA3	1:B:69:VAL:HG21	1.93	0.51
1:A:377:SER:HB3	1:A:378:ALA:HA	1.92	0.51
1:A:337:GLU:HB3	1:A:338:SER:HA	1.93	0.49
1:A:377:SER:HB3	1:A:378:ALA:HB2	1.94	0.49
1:A:200:MET:HB2	1:A:204:PHE:CD2	2.48	0.48
1:A:55:TYR:O	1:A:63:ARG:NH2	2.42	0.48
1:B:4:GLU:N	5:B:609:HOH:O	2.46	0.48
1:B:222:LYS:HE2	5:B:646:HOH:O	2.13	0.48
1:A:342:TYR:CE2	1:A:344:TYR:HB2	2.49	0.48
1:B:264:PRO:HG3	1:B:312:ARG:NH1	2.29	0.47
1:B:331:LYS:NZ	5:B:611:HOH:O	2.48	0.46
1:B:200:MET:N	1:B:201:PRO:CD	2.79	0.46
1:A:264:PRO:HG2	1:A:278:GLY:O	2.17	0.45
1:B:174:TYR:CZ	1:B:200:MET:HE1	2.52	0.45
1:A:179:LEU:CD2	1:A:257:VAL:HG11	2.40	0.45
1:B:342:TYR:CE2	1:B:344:TYR:HB2	2.52	0.45
1:A:19:GLY:HA3	1:A:69:VAL:HG21	1.98	0.44
1:B:110:VAL:HG12	1:B:110:VAL:O	2.18	0.44
1:A:180:SER:OG	1:A:192:MET:HG2	2.18	0.43
1:B:145:TYR:CE1	1:B:258:VAL:HB	2.54	0.43
1:A:213:GLU:OE1	1:B:225:LYS:HB2	2.19	0.43
1:A:377:SER:HB3	1:A:378:ALA:CB	2.49	0.43
1:A:174:TYR:HB3	3:A:501:NAD:C4N	2.48	0.43
1:B:68:HIS:O	1:B:71:VAL:HG22	2.19	0.43
1:B:331:LYS:O	1:B:335:SER:HB3	2.18	0.43
1:A:427:GLU:O	1:A:428:GLY:C	2.62	0.43
1:A:177:LEU:CD1	1:A:200:MET:HE2	2.48	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:4:GLU:CB	1:A:113:THR:HG23	2.50	0.42
1:A:15:GLY:HA2	5:A:814:HOH:O	2.19	0.41
1:A:103:SER:O	1:A:105:THR:HG23	2.21	0.41
1:A:79:LEU:O	1:A:80:PRO:C	2.61	0.41
1:A:213:GLU:HG2	1:A:223:ILE:HD12	2.03	0.41

All (3) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:A:669:HOH:O	5:B:601:HOH:O[3_454]	1.66	0.54
1:B:133:PHE:O	4:A:502:ISD:O6[4_455]	1.99	0.21
1:A:133:PHE:O	4:B:502:ISD:O6[3_454]	2.14	0.06

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	425/451 (94%)	404 (95%)	15 (4%)	6 (1%)	9	3
1	B	419/451 (93%)	404 (96%)	13 (3%)	2 (0%)	24	16
All	All	844/902 (94%)	808 (96%)	28 (3%)	8 (1%)	14	6

All (8) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	428	GLY
1	B	373	SER
1	B	433	SER
1	A	373	SER
1	A	425	LYS
1	A	337	GLU

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Mol	Chain	Res	Type
1	A	426	LYS
1	A	377	SER

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	336/353 (95%)	324 (96%)	12 (4%)	31	23
1	B	332/353 (94%)	319 (96%)	13 (4%)	28	21
All	All	668/706 (95%)	643 (96%)	25 (4%)	30	22

All (25) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	40	LYS
1	A	63	ARG
1	A	110	VAL
1	A	127	VAL
1	A	144	LEU
1	A	185	ILE
1	A	196	GLU
1	A	313	VAL
1	A	368	ILE
1	A	373	SER
1	A	423	GLU
1	A	429	LEU
1	B	78	LEU
1	B	85	GLU
1	B	86	LYS
1	B	144	LEU
1	B	184	LYS
1	B	202	ARG
1	B	305	LYS
1	B	313	VAL
1	B	338	SER

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Mol	Chain	Res	Type
1	B	340	VAL
1	B	379	LYS
1	B	429	LEU
1	B	434	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	141	ASN
1	B	186	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

6 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	FAD	B	500	-	58,58,58	1.90	11 (18%)	85,89,89	2.05	25 (29%)
2	FAD	A	500	-	58,58,58	2.22	19 (32%)	85,89,89	2.19	32 (37%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
4	ISD	A	502	-	12,12,12	1.34	2 (16%)	17,17,17	2.56	7 (41%)
4	ISD	B	502	-	12,12,12	1.85	1 (8%)	17,17,17	2.20	6 (35%)
3	NAD	A	501	-	46,48,48	1.97	14 (30%)	64,73,73	2.23	16 (25%)
3	NAD	B	501	-	46,48,48	2.19	14 (30%)	64,73,73	1.94	15 (23%)

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	FAD	B	500	-	-	1/34/50/50	0/6/6/6
2	FAD	A	500	-	-	3/34/50/50	0/6/6/6
4	ISD	A	502	-	-	4/6/22/22	0/1/1/1
4	ISD	B	502	-	-	4/6/22/22	0/1/1/1
3	NAD	A	501	-	-	2/30/62/62	0/5/5/5
3	NAD	B	501	-	-	7/30/62/62	0/5/5/5

All (61) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	500	FAD	C1'-C2'	7.79	1.63	1.52
2	A	500	FAD	C1'-C2'	6.26	1.61	1.52
3	B	501	NAD	PN-O3	-6.08	1.52	1.59
4	B	502	ISD	O4-C1	5.85	1.45	1.36
3	A	501	NAD	C2N-N1N	5.85	1.41	1.35
3	B	501	NAD	C3N-C7N	-5.80	1.42	1.50
2	A	500	FAD	C6-C7	5.73	1.47	1.39
3	A	501	NAD	C3N-C7N	-4.89	1.43	1.50
2	B	500	FAD	C4X-N5	4.67	1.40	1.30
2	B	500	FAD	C2A-N3A	4.62	1.42	1.33
2	A	500	FAD	O4B-C4B	4.49	1.55	1.45
3	A	501	NAD	O2B-C2B	4.39	1.53	1.43
2	A	500	FAD	C2A-N3A	4.30	1.41	1.33
2	A	500	FAD	C8M-C8	-4.28	1.43	1.51
3	B	501	NAD	C4N-C3N	4.26	1.45	1.39
2	A	500	FAD	C4X-N5	4.17	1.39	1.30
3	B	501	NAD	C2A-N1A	4.09	1.41	1.33
3	B	501	NAD	C2A-N3A	3.98	1.41	1.33
2	A	500	FAD	C2A-N1A	3.91	1.40	1.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	500	FAD	C8M-C8	-3.72	1.44	1.51
3	B	501	NAD	O4D-C1D	3.50	1.45	1.40
2	A	500	FAD	O4B-C1B	3.24	1.49	1.42
3	A	501	NAD	O2D-C2D	3.23	1.50	1.43
2	B	500	FAD	C2A-N1A	3.17	1.39	1.33
3	A	501	NAD	C4A-N9A	-3.15	1.31	1.37
2	B	500	FAD	C7M-C7	-3.11	1.45	1.51
2	B	500	FAD	C8A-N7A	3.07	1.37	1.31
2	A	500	FAD	C3B-C4B	-3.07	1.45	1.53
3	B	501	NAD	C1B-N9A	3.06	1.54	1.46
4	A	502	ISD	O4-C1	3.05	1.40	1.36
2	A	500	FAD	C7M-C7	-2.94	1.45	1.51
3	B	501	NAD	O3B-C3B	-2.88	1.35	1.43
2	A	500	FAD	PA-O3P	-2.86	1.56	1.59
3	A	501	NAD	C2A-N3A	2.76	1.38	1.33
2	A	500	FAD	P-O1P	-2.68	1.41	1.50
3	A	501	NAD	PA-O3	-2.59	1.56	1.59
2	A	500	FAD	C2-N3	-2.58	1.33	1.39
3	B	501	NAD	PN-O2N	-2.57	1.43	1.55
2	B	500	FAD	C4X-C10	-2.56	1.36	1.44
3	A	501	NAD	C2A-N1A	2.53	1.38	1.33
2	A	500	FAD	C5A-N7A	-2.48	1.34	1.39
3	B	501	NAD	C5A-C6A	-2.40	1.34	1.41
3	B	501	NAD	C4A-N9A	-2.39	1.32	1.37
2	B	500	FAD	C4X-C4	-2.38	1.35	1.44
3	B	501	NAD	C2N-N1N	2.34	1.37	1.35
3	A	501	NAD	C5A-C4A	-2.33	1.34	1.39
3	B	501	NAD	C2D-C3D	-2.33	1.47	1.53
2	A	500	FAD	C1B-N9A	2.30	1.52	1.46
3	B	501	NAD	C7N-N7N	2.29	1.37	1.33
4	A	502	ISD	O5-C5	2.24	1.48	1.43
3	A	501	NAD	C5A-N7A	-2.22	1.35	1.39
3	A	501	NAD	O3D-C3D	2.17	1.48	1.43
3	A	501	NAD	C8A-N7A	2.16	1.35	1.31
3	A	501	NAD	PN-O2N	-2.16	1.45	1.55
2	A	500	FAD	O2'-C2'	2.16	1.47	1.43
2	B	500	FAD	C2'-C3'	-2.10	1.49	1.53
2	A	500	FAD	C4A-N3A	2.09	1.38	1.34
2	A	500	FAD	C5'-C4'	-2.03	1.49	1.51
3	A	501	NAD	C5A-C6A	-2.02	1.35	1.41
2	B	500	FAD	C5'-C4'	-2.01	1.49	1.51
2	A	500	FAD	C9-C8	-2.00	1.36	1.39

All (101) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	501	NAD	N3A-C2A-N1A	-8.60	115.56	128.58
2	B	500	FAD	N3A-C2A-N1A	-6.76	118.36	128.58
2	B	500	FAD	C9A-C5X-N5	-6.24	115.83	122.45
3	A	501	NAD	C4A-N9A-C1B	-6.21	112.12	126.63
2	A	500	FAD	N3A-C2A-N1A	-6.18	119.23	128.58
3	A	501	NAD	C1B-N9A-C8A	6.01	140.43	127.09
3	B	501	NAD	N3A-C2A-N1A	-5.64	120.04	128.58
4	B	502	ISD	C5-C4-C3	-5.60	104.44	114.71
4	A	502	ISD	C6-C5-C4	-5.31	102.90	111.86
2	A	500	FAD	C1B-N9A-C8A	5.27	138.79	127.09
3	B	501	NAD	N9A-C8A-N7A	-4.95	106.91	113.94
2	A	500	FAD	C4A-N9A-C1B	-4.91	115.15	126.63
2	B	500	FAD	C5A-C4A-N3A	-4.83	120.06	126.72
2	A	500	FAD	O4B-C1B-N9A	-4.77	98.92	108.09
3	B	501	NAD	O4B-C1B-C2B	-4.61	96.75	106.62
2	A	500	FAD	O2P-P-O1P	4.43	133.07	112.44
2	A	500	FAD	C9A-C5X-N5	-4.38	117.81	122.45
2	A	500	FAD	C10-N1-C2	4.27	126.09	116.85
4	A	502	ISD	C5-C4-C3	-4.13	107.14	114.71
2	B	500	FAD	C5A-C4A-N9A	4.06	110.24	105.81
4	A	502	ISD	O6-C6-C5	-4.01	102.74	111.16
3	B	501	NAD	C5A-N7A-C8A	4.00	109.73	103.45
2	B	500	FAD	C1B-N9A-C8A	3.98	135.92	127.09
3	A	501	NAD	N9A-C8A-N7A	-3.96	108.31	113.94
2	A	500	FAD	O2P-P-O3P	-3.91	96.72	107.27
4	B	502	ISD	C4-O4-C1	-3.88	105.02	109.27
2	A	500	FAD	C5X-C9A-N10	3.78	121.38	117.97
3	A	501	NAD	C5A-C4A-N9A	3.68	109.83	105.81
2	A	500	FAD	O3P-P-O1P	-3.67	99.66	110.70
2	A	500	FAD	C4X-C10-N10	3.65	121.71	116.48
2	A	500	FAD	C4X-C10-N1	-3.64	115.68	124.59
3	A	501	NAD	C2A-N3A-C4A	3.58	120.59	111.83
4	A	502	ISD	O5-C5-C6	3.58	117.16	109.03
2	B	500	FAD	C2A-N3A-C4A	3.53	120.46	111.83
4	A	502	ISD	O5-C5-C4	3.51	117.40	110.74
3	A	501	NAD	O3B-C3B-C2B	-3.50	100.59	111.82
3	B	501	NAD	C4A-C5A-N7A	-3.44	106.65	110.58
3	B	501	NAD	C5A-C4A-N3A	-3.42	122.01	126.72
2	B	500	FAD	C4-N3-C2	-3.32	119.74	125.64
3	A	501	NAD	C5A-C4A-N3A	-3.21	122.30	126.72
2	B	500	FAD	O4B-C1B-N9A	-3.20	101.95	108.09
4	B	502	ISD	O5-C5-C4	3.19	116.79	110.74

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	500	FAD	C10-N1-C2	3.18	123.74	116.85
2	B	500	FAD	C4A-C5A-N7A	-3.18	106.95	110.58
2	A	500	FAD	O2-C2-N3	3.16	124.64	118.58
2	B	500	FAD	C4A-N9A-C1B	-3.15	119.25	126.63
3	B	501	NAD	O2B-C2B-C1B	3.09	120.73	110.10
2	A	500	FAD	C10-C4X-N5	-3.02	118.65	124.81
2	A	500	FAD	O2A-PA-O3P	2.97	115.30	107.27
3	B	501	NAD	O3B-C3B-C2B	2.93	121.21	111.82
3	B	501	NAD	C6A-C5A-C4A	2.93	121.18	117.18
3	B	501	NAD	C4A-N9A-C8A	2.88	108.76	105.74
2	B	500	FAD	C10-C4X-N5	-2.84	119.00	124.81
2	B	500	FAD	C5X-N5-C4X	2.84	122.68	118.09
2	A	500	FAD	O3P-PA-O1A	2.81	119.16	110.70
3	B	501	NAD	C4D-O4D-C1D	-2.81	107.35	109.92
2	B	500	FAD	C5X-C9A-N10	2.81	120.50	117.97
2	B	500	FAD	C9-C9A-C5X	-2.77	115.13	120.03
3	A	501	NAD	C2N-N1N-C1D	-2.76	113.05	119.13
3	A	501	NAD	C2N-C3N-C4N	-2.73	115.08	118.26
3	A	501	NAD	C6N-N1N-C1D	2.73	125.08	119.73
4	A	502	ISD	O4-C4-C3	2.71	106.47	103.76
2	A	500	FAD	O2A-PA-O5B	-2.70	95.32	107.57
2	B	500	FAD	C6-C5X-C9A	2.65	122.69	119.05
2	A	500	FAD	C9A-C9-C8	2.63	124.50	119.22
4	B	502	ISD	O4-C1-O1	2.62	124.72	121.27
2	A	500	FAD	C5A-C4A-N3A	-2.60	123.14	126.72
4	B	502	ISD	O1-C1-C2	-2.59	125.45	129.33
3	A	501	NAD	C4A-C5A-N7A	-2.55	107.66	110.58
4	A	502	ISD	O4-C1-C2	-2.54	107.61	109.86
2	B	500	FAD	C4X-C4-N3	2.51	119.65	113.25
3	B	501	NAD	O4B-C1B-N9A	-2.46	103.36	108.09
3	A	501	NAD	C2B-C1B-N9A	2.42	119.31	113.30
2	B	500	FAD	O2-C2-N3	2.41	123.20	118.58
2	A	500	FAD	C9-C9A-C5X	-2.40	115.78	120.03
2	A	500	FAD	C6-C5X-C9A	2.38	122.32	119.05
2	B	500	FAD	C5A-N7A-C8A	2.38	107.19	103.45
2	B	500	FAD	O4B-C1B-C2B	-2.38	101.53	106.62
2	A	500	FAD	C2A-N3A-C4A	2.37	117.62	111.83
2	A	500	FAD	C5X-N5-C4X	2.35	121.89	118.09
2	A	500	FAD	N9A-C8A-N7A	-2.33	110.63	113.94
2	A	500	FAD	C4-C4X-N5	2.32	121.41	118.21
3	B	501	NAD	O7N-C7N-C3N	2.31	122.43	119.60
3	A	501	NAD	C5A-C6A-N1A	2.31	123.38	117.51

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	500	FAD	C4B-O4B-C1B	-2.30	104.38	109.47
2	B	500	FAD	C4X-C10-N1	-2.29	118.97	124.59
2	B	500	FAD	O4-C4-C4X	-2.24	120.62	126.53
3	A	501	NAD	C4D-O4D-C1D	-2.24	107.88	109.92
3	B	501	NAD	C2B-C3B-C4B	-2.22	98.31	102.61
2	A	500	FAD	C5A-C4A-N9A	2.17	108.17	105.81
2	B	500	FAD	N9A-C8A-N7A	-2.15	110.88	113.94
3	A	501	NAD	C5A-N7A-C8A	2.15	106.83	103.45
2	A	500	FAD	C5A-N7A-C8A	2.14	106.82	103.45
4	B	502	ISD	O4-C4-C3	2.14	105.90	103.76
2	B	500	FAD	C4X-C10-N10	2.14	119.54	116.48
2	A	500	FAD	C4X-C4-N3	2.12	118.65	113.25
3	B	501	NAD	C2N-C3N-C4N	-2.11	115.80	118.26
2	A	500	FAD	O2-C2-N1	-2.10	118.32	121.80
2	A	500	FAD	O4-C4-C4X	-2.05	121.13	126.53
2	A	500	FAD	O4B-C1B-C2B	-2.04	102.25	106.62
2	B	500	FAD	C3B-C2B-C1B	-2.02	97.64	101.46

There are no chirality outliers.

All (21) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	501	NAD	C5B-O5B-PA-O1A
3	A	501	NAD	C5B-O5B-PA-O3
3	B	501	NAD	O4D-C1D-N1N-C6N
4	A	502	ISD	C3-C4-C5-O5
4	A	502	ISD	O4-C4-C5-C6
4	B	502	ISD	C3-C4-C5-O5
4	B	502	ISD	C3-C4-C5-C6
4	B	502	ISD	O4-C4-C5-O5
4	B	502	ISD	O4-C4-C5-C6
3	B	501	NAD	C2B-C1B-N9A-C8A
3	B	501	NAD	C2B-C1B-N9A-C4A
4	A	502	ISD	O4-C4-C5-O5
4	A	502	ISD	C3-C4-C5-C6
3	B	501	NAD	C5B-O5B-PA-O1A
2	A	500	FAD	O4B-C4B-C5B-O5B
3	B	501	NAD	O4B-C1B-N9A-C8A
3	B	501	NAD	O4B-C4B-C5B-O5B
2	A	500	FAD	P-O3P-PA-O2A
2	A	500	FAD	C3B-C4B-C5B-O5B
2	B	500	FAD	O4B-C4B-C5B-O5B

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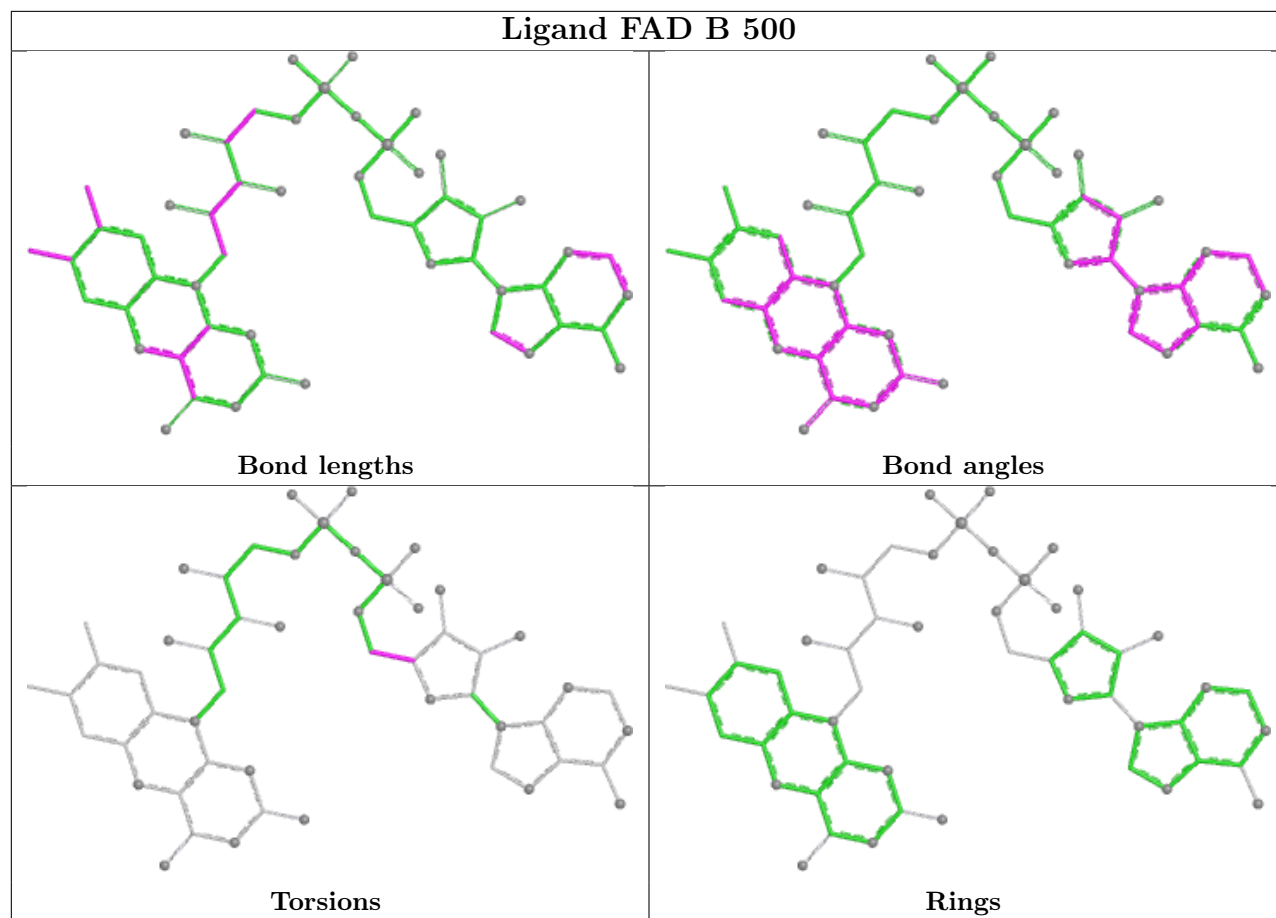
Mol	Chain	Res	Type	Atoms
3	B	501	NAD	PA-O3-PN-O2N

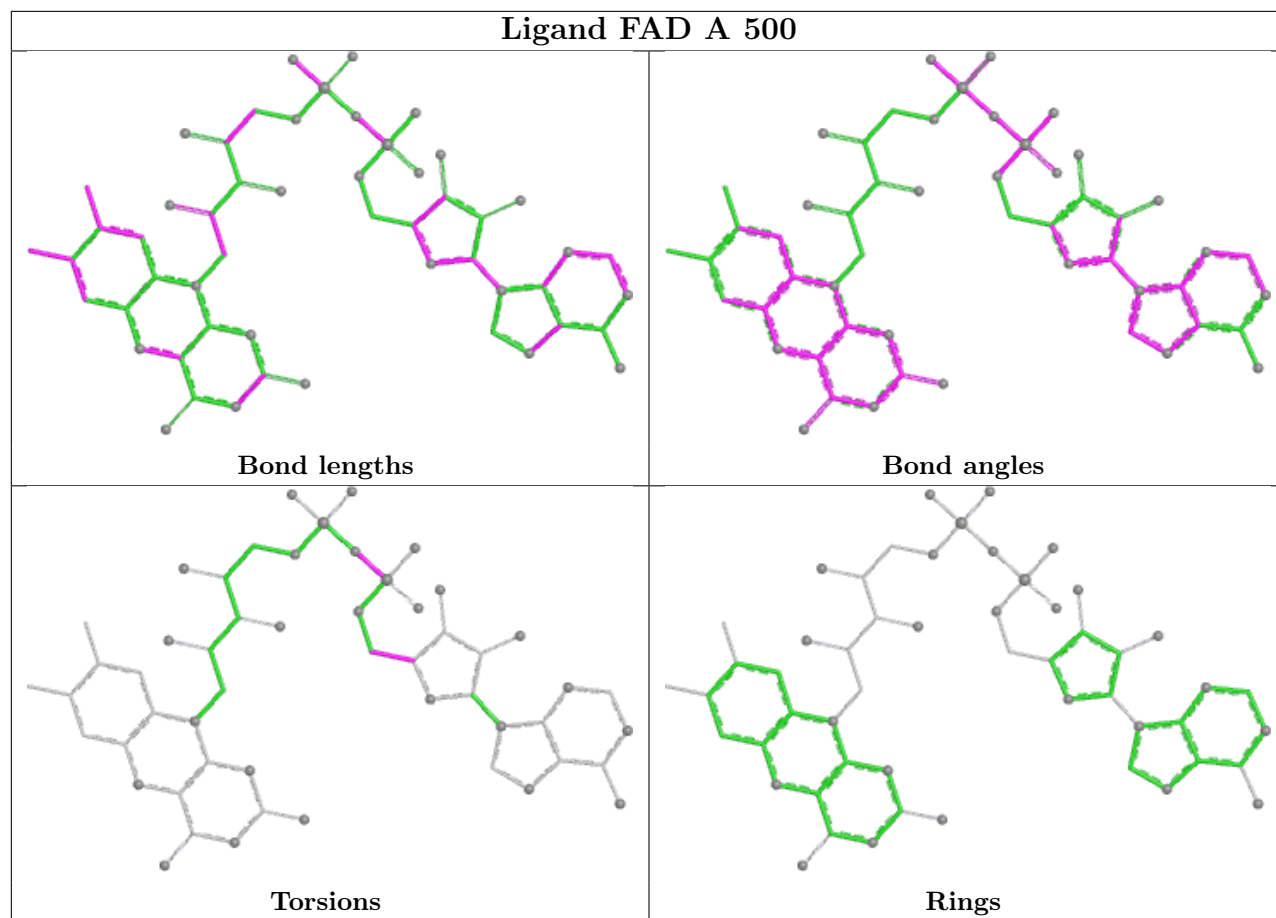
There are no ring outliers.

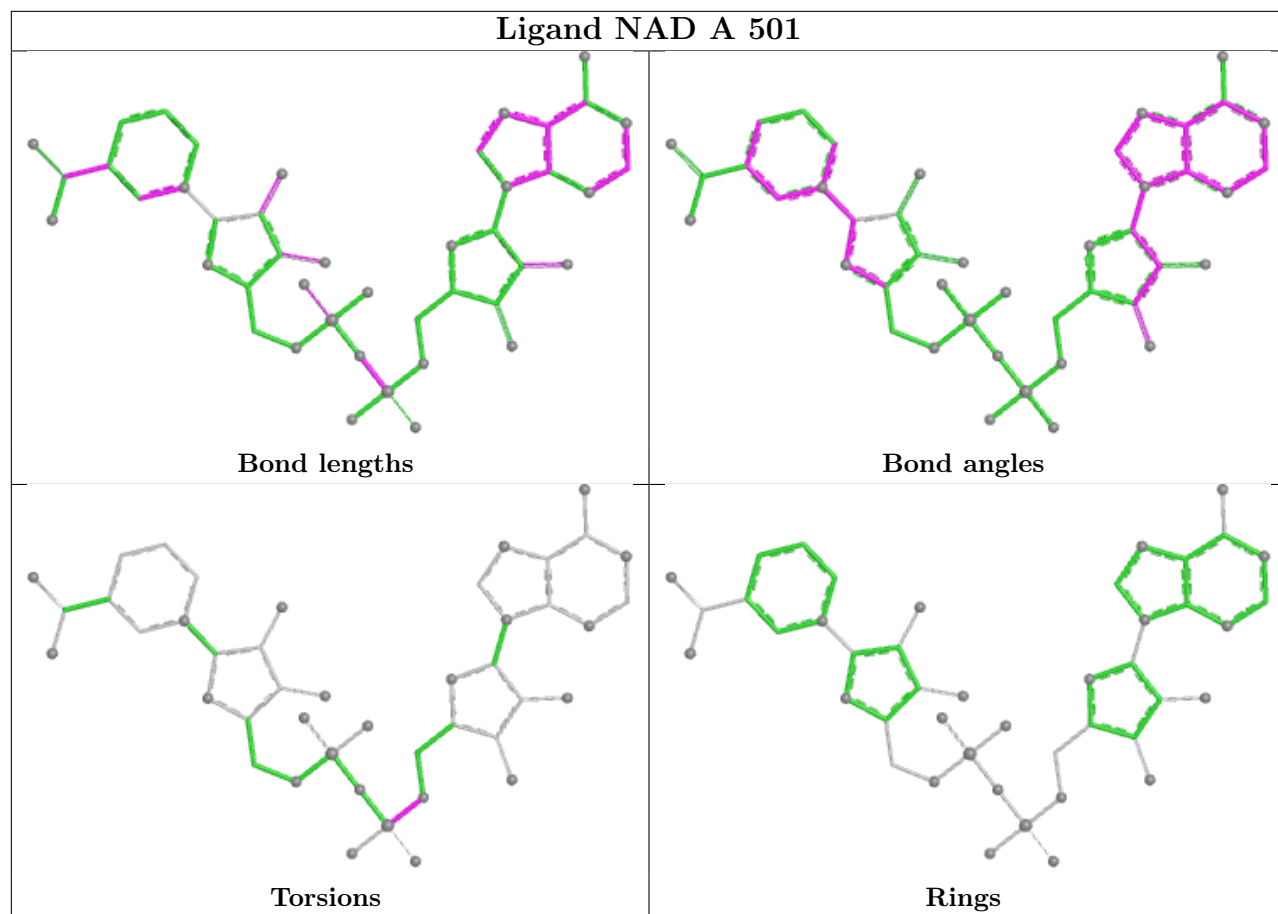
3 monomers are involved in 3 short contacts:

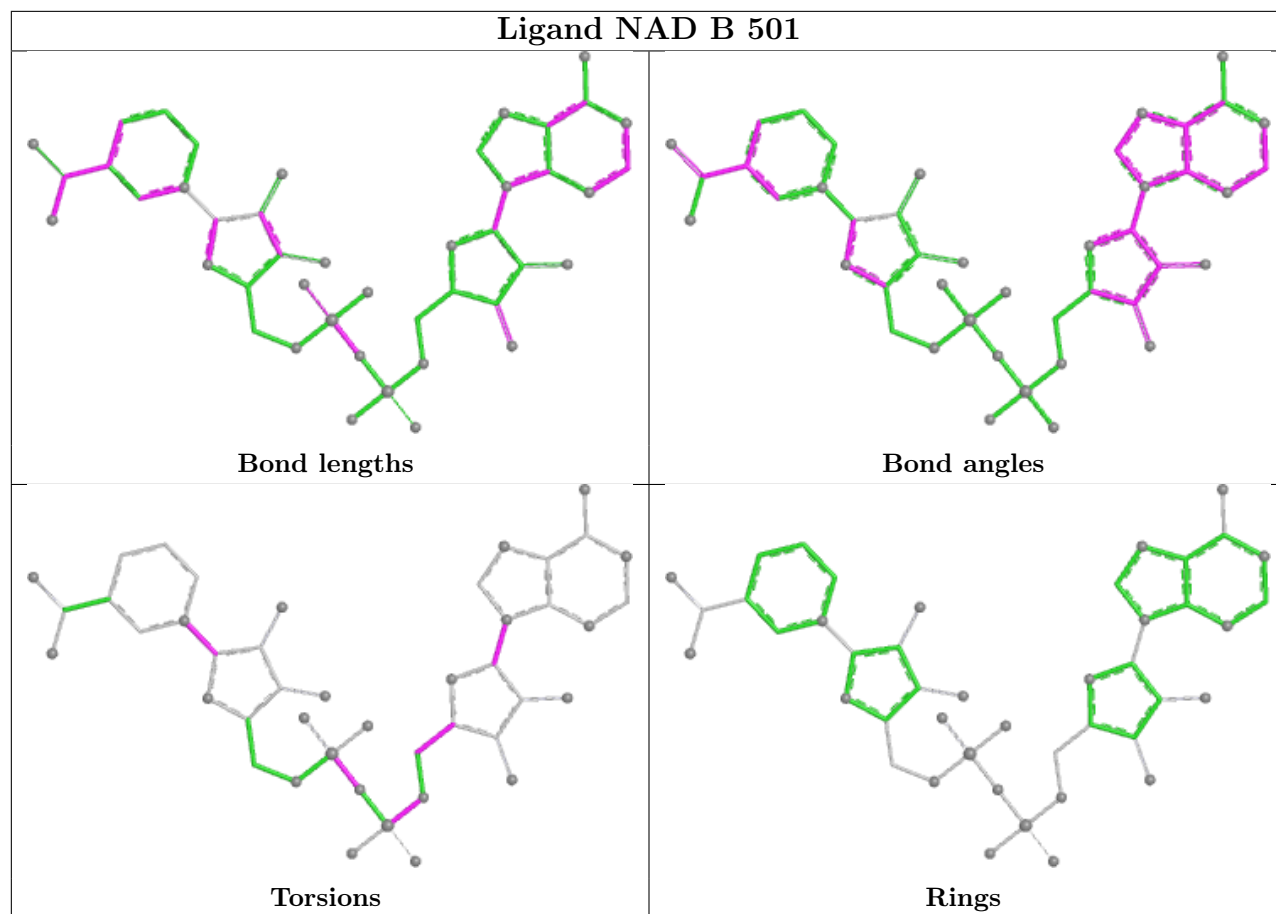
Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	502	ISD	0	1
4	B	502	ISD	0	1
3	A	501	NAD	1	0

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 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, 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	429/451 (95%)	0.28	14 (3%) 49 52	22, 36, 63, 100	0
1	B	425/451 (94%)	0.18	7 (1%) 70 74	22, 35, 61, 99	0
All	All	854/902 (94%)	0.23	21 (2%) 58 62	22, 36, 63, 100	0

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	378	ALA	4.0
1	A	236	ALA	3.1
1	B	424	LEU	2.9
1	B	110	VAL	2.6
1	B	378	ALA	2.4
1	A	418	VAL	2.4
1	B	387	ILE	2.3
1	B	332	GLY	2.3
1	A	198	TRP	2.3
1	A	78	LEU	2.3
1	A	201	PRO	2.3
1	A	338	SER	2.3
1	B	432	ALA	2.2
1	A	337	GLU	2.2
1	A	372	ASP	2.2
1	A	202	ARG	2.2
1	A	387	ILE	2.0
1	A	273	VAL	2.0
1	A	199	CYS	2.0
1	A	424	LEU	2.0
1	B	202	ARG	2.0

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

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

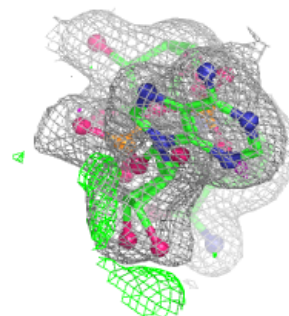
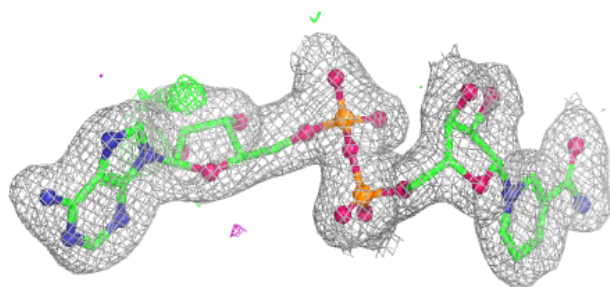
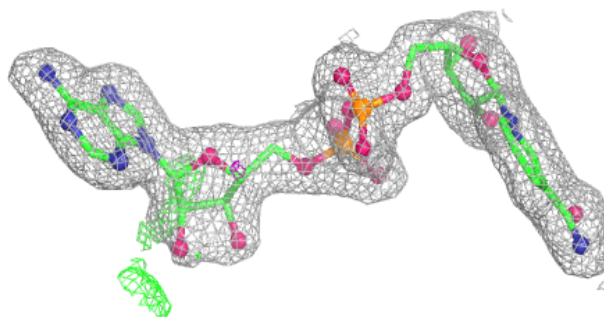
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	ISD	A	502	12/12	0.88	0.11	31,38,66,76	0
4	ISD	B	502	12/12	0.89	0.12	35,46,80,94	0
3	NAD	A	501	44/44	0.97	0.05	21,28,38,60	0
3	NAD	B	501	44/44	0.97	0.06	21,28,36,45	0
2	FAD	A	500	53/53	0.97	0.05	19,24,35,38	0
2	FAD	B	500	53/53	0.97	0.06	19,25,34,38	0

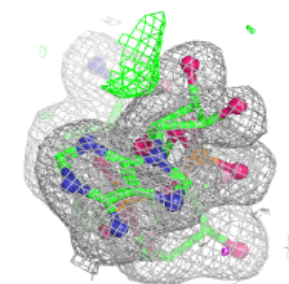
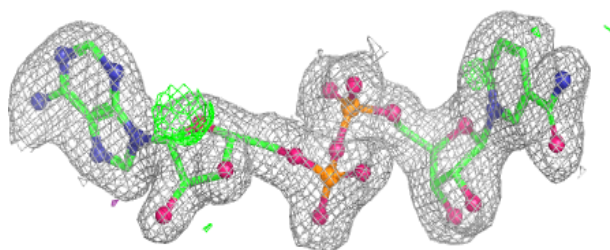
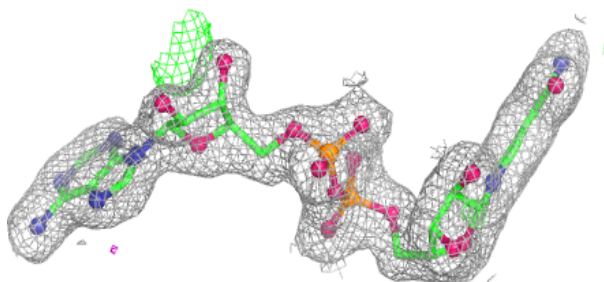
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around NAD A 501:

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

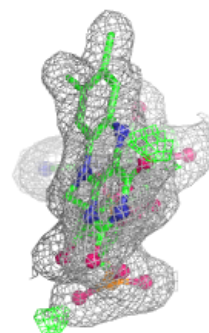
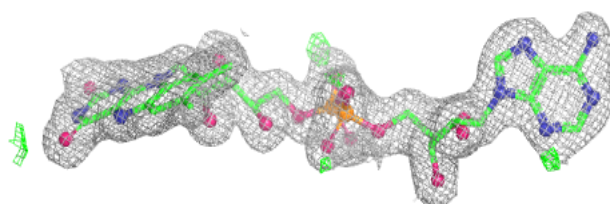
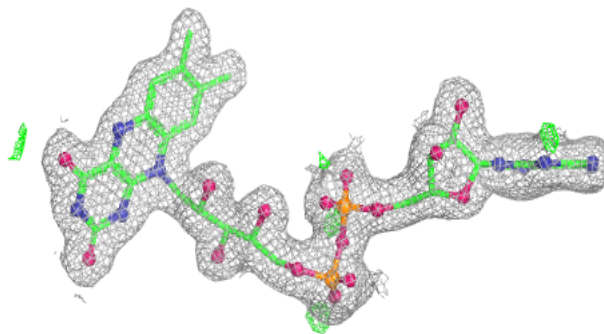
**Electron density around NAD B 501:**

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

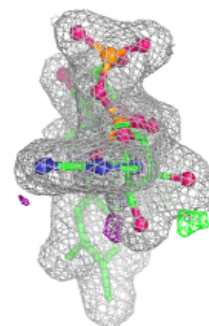
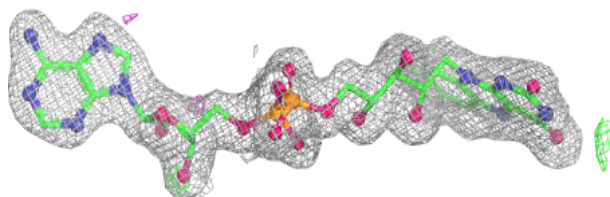
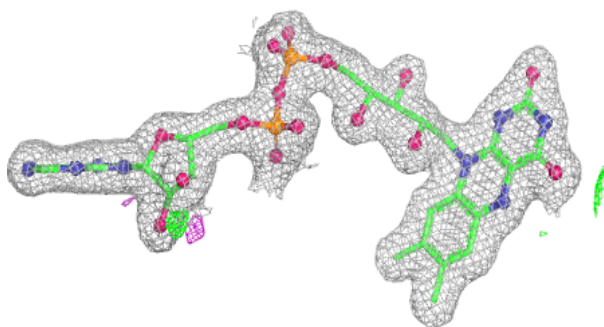


Electron density around FAD A 500:

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

**Electron density around FAD B 500:**

$2mF_o-DF_c$ (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.