



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 06:05 PM UTC

PDB ID : 4YKG / pdb\_00004ykg  
Title : Crystal Structure of the Alkylhydroperoxide Reductase subunit F (AhpF) with NAD<sup>+</sup> from Escherichia coli  
Authors : Kamariah, N.; Manimekalai, M.S.S.; Gruber, G.; Eisenhaber, F.; Eisenhaber, B.  
Deposited on : 2015-03-04  
Resolution : 2.40 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>.

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

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

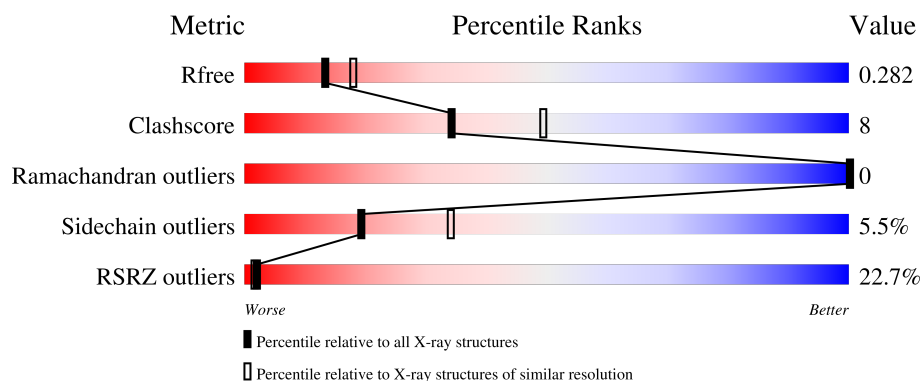
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.40 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	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

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	521	<div> <div>23%</div> <div>80%</div> <div>18%</div> <div>.</div> </div>

## 2 Entry composition [i](#)

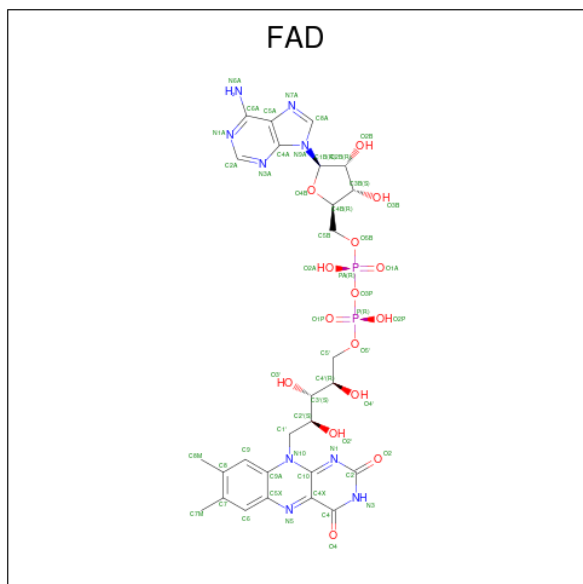
There are 8 unique types of molecules in this entry. The entry contains 4305 atoms, of which 0 are hydrogens and 0 are deuteriums.

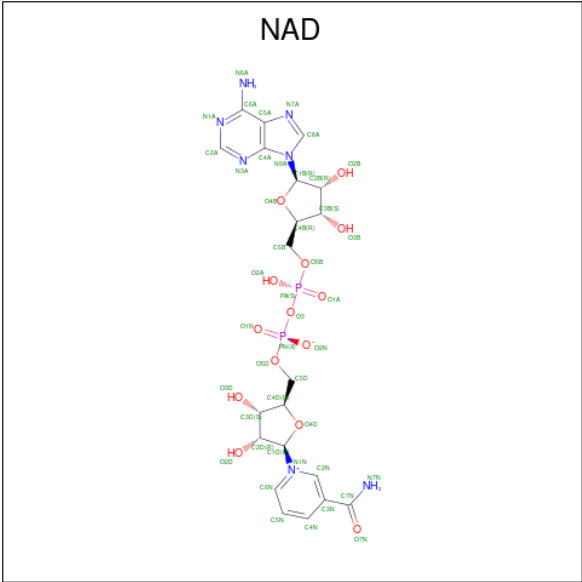
In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Alkyl hydroperoxide reductase subunit F.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	521	Total	C	N	O	S	0	1	0
			3954	2486	681	771	16			

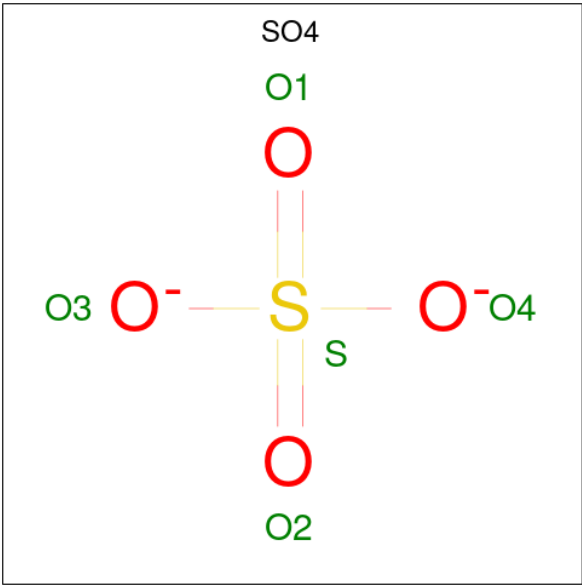
- Molecule 2 is FLAVIN-ADENINE DINUCLEOTIDE (CCD ID: FAD) (formula:  $C_{27}H_{33}N_9O_{15}P_2$ ).





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

- 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	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		

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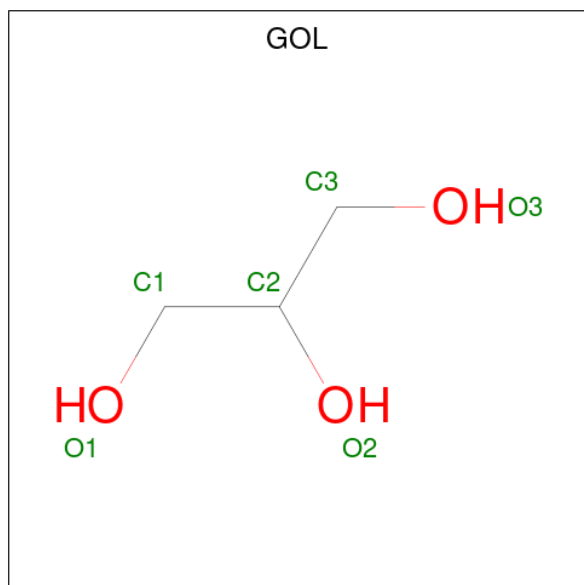
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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	O	S	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 5 is CADMIUM ION (CCD ID: CD) (formula: Cd).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total	Cd	0	0
			1	1		

- Molecule 6 is GLYCEROL (CCD ID: GOL) (formula: C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>).



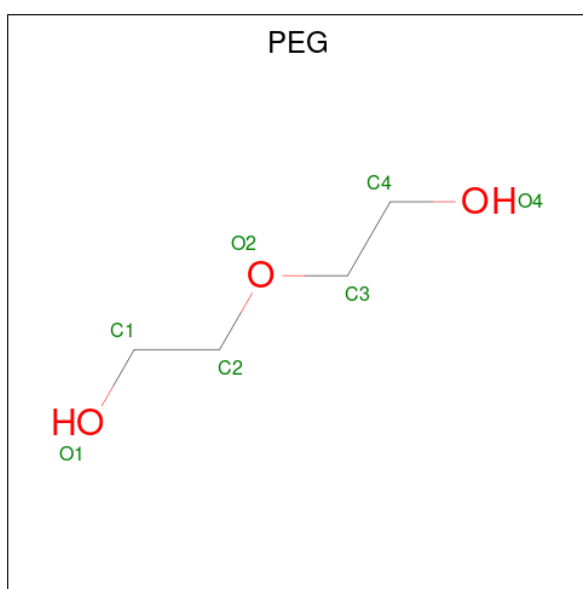
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	C	O	0	0
			6	3	3		
6	A	1	Total	C	O	0	0
			6	3	3		

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

- Molecule 7 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: C<sub>4</sub>H<sub>10</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total	C	O	0	0
			7	4	3		
7	A	1	Total	C	O	0	0
			7	4	3		

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	158	Total	O	0	0
			158	158		

### 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: Alkyl hydroperoxide reductase subunit F



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	106.88Å 59.58Å 121.51Å 90.00° 111.40° 90.00°	Depositor
Resolution (Å)	27.00 – 2.40 27.00 – 2.40	Depositor EDS
% Data completeness (in resolution range)	91.7 (27.00-2.40) 91.7 (27.00-2.40)	Depositor EDS
$R_{merge}$	0.11	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.30 (at 2.39Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, $R_{free}$	0.221 , 0.285 0.225 , 0.282	Depositor DCC
$R_{free}$ test set	1317 reflections (4.69%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	39.2	Xtriage
Anisotropy	0.144	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 49.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.90	EDS
Total number of atoms	4305	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.34% 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: NAD, CD, PEG, GOL, CSD, SO4, FAD

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	0.84	1/4003 (0.0%)	0.97	3/5420 (0.1%)

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	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	472	ILE	C-O	-5.71	1.18	1.24

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	377	ILE	CB-CA-C	-6.43	103.84	111.94
1	A	253	VAL	CB-CA-C	5.47	120.26	111.29
1	A	348	CYS	N-CA-C	5.18	116.62	111.07

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	519	LYS	Peptide

## 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	3954	0	3994	61	0
2	A	53	0	31	2	0
3	A	44	0	26	1	0
4	A	45	0	0	0	0
5	A	1	0	0	0	0
6	A	36	0	48	1	0
7	A	14	0	20	0	0
8	A	158	0	0	3	0
All	All	4305	0	4119	63	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 8.

All (63) 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:345[B]:CSD:SG	1:A:348:CYS:SG	2.35	1.23
1:A:345[A]:CSD:SG	1:A:348:CYS:SG	2.87	0.71
3:A:602:NAD:O2A	8:A:701:HOH:O	2.16	0.62
1:A:465:ASN:HB3	1:A:471:ILE:HD11	1.83	0.61
1:A:449:ILE:CG2	1:A:449:ILE:O	2.50	0.58
1:A:244:ARG:HD3	1:A:250:LEU:HD23	1.85	0.57
1:A:142:MET:HE1	1:A:191:ILE:HG21	1.87	0.57
1:A:40:LEU:HB3	1:A:52:PHE:CD1	2.39	0.57
1:A:374:LEU:O	1:A:378:VAL:HG22	2.03	0.57
1:A:471:ILE:HD13	1:A:491:THR:HG21	1.87	0.56
1:A:121:PHE:O	1:A:151:HIS:HA	2.06	0.55
1:A:112:ILE:HD11	1:A:192:VAL:HG12	1.89	0.55
1:A:343:THR:HB	6:A:618:GOL:H11	1.87	0.55
1:A:32:LYS:HD3	1:A:158:THR:HG23	1.89	0.54
1:A:112:ILE:HD11	1:A:192:VAL:CG1	2.38	0.53
1:A:15:GLU:HG3	8:A:853:HOH:O	2.09	0.52
1:A:132:CYS:N	1:A:133:PRO:HD2	2.24	0.52
1:A:327:ARG:HD2	1:A:452:LEU:HD21	1.91	0.51
1:A:314:LYS:NZ	8:A:705:HOH:O	2.43	0.51

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:514:TYR:O	1:A:518:THR:HG23	2.11	0.50
1:A:187:THR:O	1:A:191:ILE:HG12	2.12	0.50
1:A:196:ASP:CG	1:A:199:ALA:HB2	2.36	0.49
1:A:132:CYS:O	1:A:136:VAL:HG23	2.13	0.48
1:A:26:THR:HG22	1:A:62:LYS:HG2	1.97	0.47
1:A:481:LYS:HE3	1:A:481:LYS:HA	1.97	0.47
1:A:253:VAL:O	1:A:265:GLU:HA	2.15	0.47
1:A:328:ASN:OD1	1:A:338:ARG:NH2	2.48	0.47
1:A:143:SER:HA	1:A:149:ILE:O	2.15	0.46
1:A:196:ASP:CB	1:A:199:ALA:HB2	2.46	0.46
1:A:400:LEU:HD11	1:A:406:VAL:HG11	1.98	0.46
1:A:210:ARG:O	1:A:314:LYS:NZ	2.47	0.46
1:A:24:ILE:HD12	1:A:24:ILE:N	2.31	0.45
1:A:413:GLN:OE1	1:A:432:ARG:NH1	2.43	0.45
1:A:122:GLU:HA	1:A:152:THR:O	2.16	0.45
1:A:338:ARG:O	1:A:339:THR:OG1	2.30	0.45
2:A:601:FAD:H9	2:A:601:FAD:H1'1	1.79	0.45
1:A:259:ILE:O	1:A:260:SER:OG	2.33	0.45
1:A:345[B]:CSD:OD1	1:A:348:CYS:SG	2.74	0.45
1:A:176:VAL:HG13	1:A:176:VAL:O	2.17	0.44
1:A:271:GLY:O	1:A:275:VAL:HG23	2.16	0.44
1:A:348:CYS:SG	2:A:601:FAD:C4X	3.06	0.44
1:A:496:GLN:HB2	1:A:499:ILE:HD12	1.99	0.44
1:A:365:ASN:OD1	1:A:392:ALA:HA	2.18	0.43
1:A:449:ILE:O	1:A:449:ILE:HG22	2.16	0.43
1:A:328:ASN:CG	1:A:338:ARG:NH2	2.77	0.43
1:A:339:THR:OG1	1:A:340:LYS:HE2	2.19	0.43
1:A:197:THR:C	1:A:199:ALA:H	2.27	0.42
1:A:426:GLY:HA2	1:A:442:LEU:HD12	2.02	0.42
1:A:491:THR:O	1:A:492:VAL:C	2.62	0.42
1:A:88:THR:O	1:A:92:LEU:HD13	2.19	0.42
1:A:256:GLU:HG2	1:A:263:LYS:HE2	2.02	0.42
1:A:68:THR:OG1	1:A:69:ASN:N	2.53	0.42
1:A:28:ASP:O	1:A:29:ASP:HB2	2.20	0.42
1:A:14:LEU:HD22	1:A:17:LEU:HD11	2.01	0.42
1:A:168:VAL:O	1:A:168:VAL:HG12	2.20	0.42
1:A:473:ASP:OD1	1:A:473:ASP:C	2.62	0.41
1:A:313:LEU:HD22	1:A:313:LEU:N	2.34	0.41
1:A:201:LYS:O	1:A:203:ALA:N	2.53	0.41
1:A:427:LEU:C	1:A:427:LEU:HD23	2.46	0.41
1:A:214:ASP:HB2	1:A:237:ARG:O	2.21	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:345[A]:CSD:CB	1:A:348:CYS:HG	2.28	0.40
1:A:244:ARG:CD	1:A:250:LEU:HD23	2.51	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	518/521 (99%)	484 (93%)	34 (7%)	0	100	100

There are no Ramachandran outliers to report.

### 5.3.2 Protein sidechains [i](#)

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

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

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	421/421 (100%)	398 (94%)	23 (6%)	19	34

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	3	ASP
1	A	40	LEU
1	A	83	LEU
1	A	107	SER

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Mol	Chain	Res	Type
1	A	111	GLN
1	A	122	GLU
1	A	134	ASP
1	A	148	ARG
1	A	163	ILE
1	A	174	VAL
1	A	200	GLU
1	A	205	GLU
1	A	263	LYS
1	A	314	LYS
1	A	325	LYS
1	A	335	ASP
1	A	343	THR
1	A	389	GLU
1	A	395	VAL
1	A	440	ILE
1	A	442	LEU
1	A	462	VAL
1	A	492	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	394	GLN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 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	CSD	A	345[A]	-	4,7,8	1.31	0	1,8,10	0.62	0
1	CSD	A	345[B]	-	4,7,8	1.19	0	1,8,10	2.36	1 (100%)

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	CSD	A	345[A]	-	-	2/2/6/8	-
1	CSD	A	345[B]	-	-	1/2/6/8	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	345[B]	CSD	OD1-SG-CB	2.36	109.94	105.60

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	345[A]	CSD	N-CA-CB-SG
1	A	345[A]	CSD	CA-CB-SG-OD1
1	A	345[B]	CSD	CA-CB-SG-OD1

There are no ring outliers.

2 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	345[A]	CSD	3	0
1	A	345[B]	CSD	2	0

## 5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry

Of 20 ligands modelled in this entry, 1 is monoatomic - leaving 19 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$
7	PEG	A	620	-	6,6,6	0.52	0	5,5,5	0.39	0
2	FAD	A	601	-	58,58,58	0.54	0	85,89,89	0.61	1 (1%)
4	SO4	A	611	-	4,4,4	0.46	0	6,6,6	0.09	0
6	GOL	A	615	-	5,5,5	0.44	0	5,5,5	0.51	0
6	GOL	A	618	-	5,5,5	0.47	0	5,5,5	0.72	0
4	SO4	A	605	-	4,4,4	0.41	0	6,6,6	0.74	0
4	SO4	A	603	-	4,4,4	0.43	0	6,6,6	0.65	0
4	SO4	A	607	-	4,4,4	0.48	0	6,6,6	0.13	0
4	SO4	A	604	-	4,4,4	0.54	0	6,6,6	0.36	0
4	SO4	A	606	-	4,4,4	0.53	0	6,6,6	0.25	0
4	SO4	A	610	-	4,4,4	0.45	0	6,6,6	0.10	0
6	GOL	A	617	-	5,5,5	0.51	0	5,5,5	0.36	0
4	SO4	A	608	-	4,4,4	0.48	0	6,6,6	0.40	0
6	GOL	A	613	-	5,5,5	0.50	0	5,5,5	0.38	0
7	PEG	A	619	-	6,6,6	0.55	0	5,5,5	0.28	0
6	GOL	A	614	-	5,5,5	0.41	0	5,5,5	0.36	0
6	GOL	A	616	-	5,5,5	0.29	0	5,5,5	0.13	0
4	SO4	A	609	-	4,4,4	0.48	0	6,6,6	0.21	0
3	NAD	A	602	-	46,48,48	0.39	0	64,73,73	0.68	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
7	PEG	A	620	-	-	1/4/4/4	-
2	FAD	A	601	-	-	6/34/50/50	0/6/6/6
6	GOL	A	614	-	-	4/4/4/4	-
6	GOL	A	616	-	-	2/4/4/4	-
6	GOL	A	613	-	-	0/4/4/4	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
6	GOL	A	615	-	-	0/4/4/4	-
6	GOL	A	618	-	-	2/4/4/4	-
7	PEG	A	619	-	-	2/4/4/4	-
6	GOL	A	617	-	-	2/4/4/4	-
3	NAD	A	602	-	-	3/30/62/62	0/5/5/5

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	601	FAD	O5'-C5'-C4'	-2.17	103.57	109.36

There are no chirality outliers.

All (22) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	601	FAD	PA-O3P-P-O5'
6	A	614	GOL	O1-C1-C2-C3
6	A	614	GOL	C1-C2-C3-O3
6	A	617	GOL	O1-C1-C2-O2
6	A	617	GOL	O1-C1-C2-C3
6	A	618	GOL	C1-C2-C3-O3
6	A	614	GOL	O1-C1-C2-O2
3	A	602	NAD	O4D-C4D-C5D-O5D
3	A	602	NAD	C3D-C4D-C5D-O5D
7	A	619	PEG	O2-C3-C4-O4
6	A	616	GOL	C1-C2-C3-O3
6	A	618	GOL	O2-C2-C3-O3
7	A	619	PEG	O1-C1-C2-O2
6	A	614	GOL	O2-C2-C3-O3
6	A	616	GOL	O2-C2-C3-O3
2	A	601	FAD	C2B-C1B-N9A-C8A
7	A	620	PEG	O1-C1-C2-O2
2	A	601	FAD	O4B-C1B-N9A-C8A
2	A	601	FAD	P-O3P-PA-O1A
2	A	601	FAD	C2B-C1B-N9A-C4A
3	A	602	NAD	O4B-C4B-C5B-O5B
2	A	601	FAD	O4B-C4B-C5B-O5B

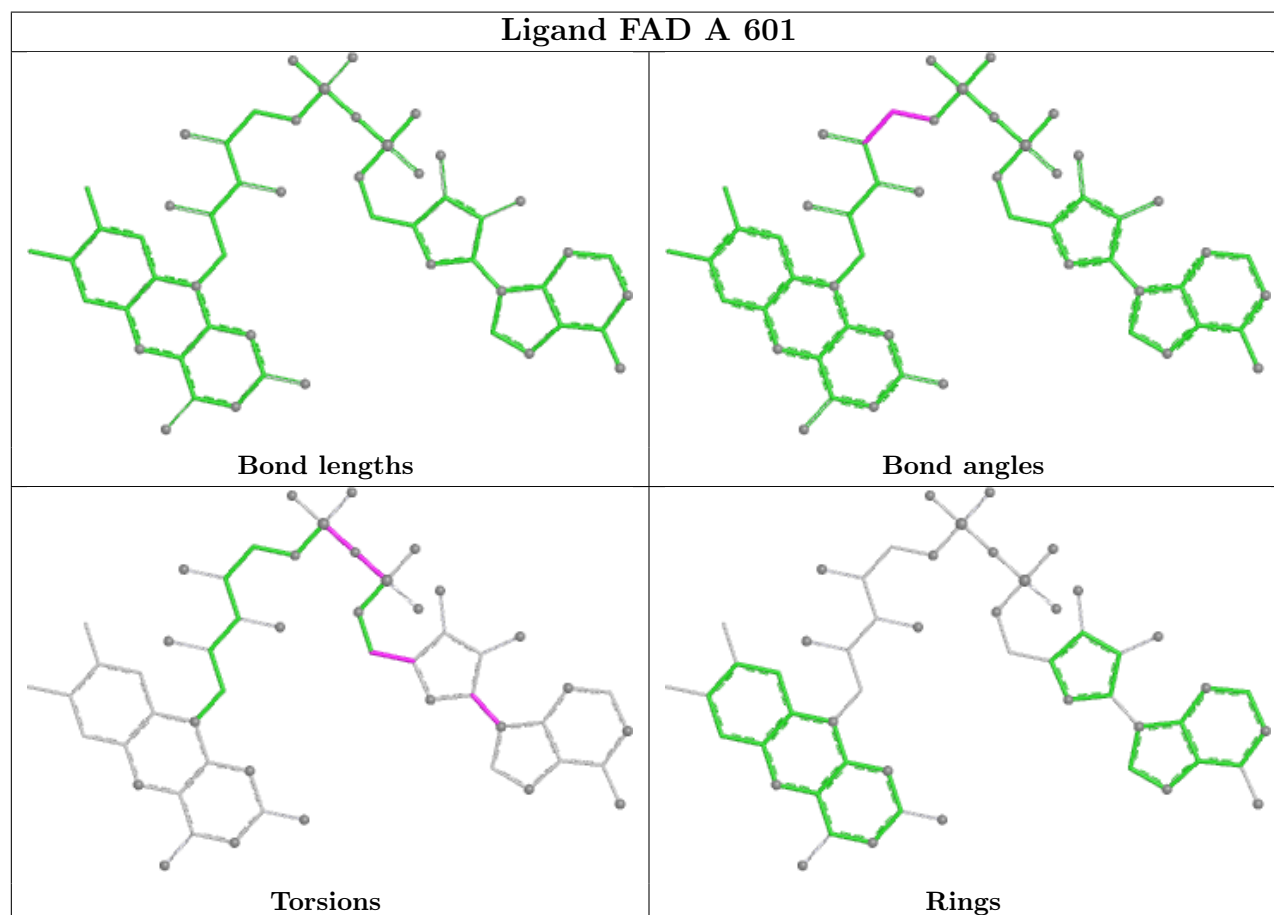
There are no ring outliers.

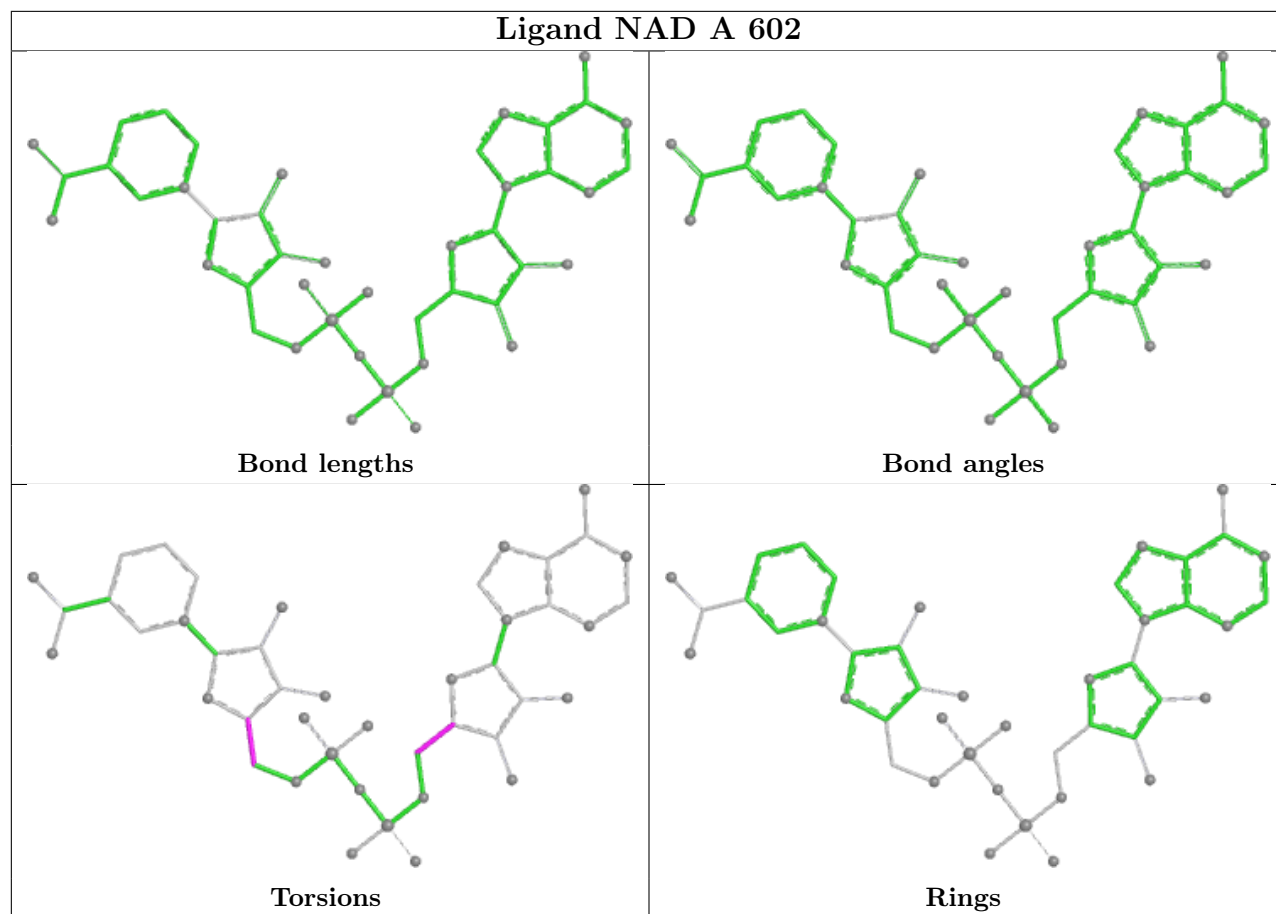


3 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	601	FAD	2	0
6	A	618	GOL	1	0
3	A	602	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, 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	520/521 (99%)	1.16	118 (22%) 2 2	18, 40, 93, 126	0

All (118) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	195	ILE	4.9
1	A	131	ASN	4.8
1	A	27	LEU	4.7
1	A	108	LEU	4.6
1	A	163	ILE	4.6
1	A	198	GLY	4.5
1	A	114	HIS	4.3
1	A	197	THR	4.0
1	A	168	VAL	3.9
1	A	204	ALA	3.9
1	A	184	GLY	3.9
1	A	149	ILE	3.7
1	A	170	GLY	3.7
1	A	119	PHE	3.7
1	A	192	VAL	3.6
1	A	191	ILE	3.6
1	A	121	PHE	3.6
1	A	115	ILE	3.6
1	A	117	GLY	3.6
1	A	139	LEU	3.6
1	A	112	ILE	3.5
1	A	199	ALA	3.5
1	A	99	GLY	3.5
1	A	154	ILE	3.5
1	A	84	GLY	3.4
1	A	187	THR	3.4
1	A	185	ARG	3.3

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Mol	Chain	Res	Type	RSRZ
1	A	142	MET	3.3
1	A	18	THR	3.3
1	A	140	ASN	3.3
1	A	145	LEU	3.3
1	A	188	LEU	3.3
1	A	521	ALA	3.1
1	A	1	MET	3.1
1	A	134	ASP	3.1
1	A	59	PRO	3.1
1	A	113	ARG	3.1
1	A	176	VAL	3.1
1	A	103	LYS	3.0
1	A	169	MET	3.0
1	A	203	ALA	2.9
1	A	202	ARG	2.9
1	A	196	ASP	2.9
1	A	178	GLY	2.9
1	A	143	SER	2.9
1	A	66	LEU	2.9
1	A	179	LYS	2.8
1	A	144	VAL	2.8
1	A	116	ASP	2.8
1	A	155	ASP	2.8
1	A	86	GLU	2.8
1	A	75	GLY	2.8
1	A	128	SER	2.7
1	A	158	THR	2.7
1	A	13	TYR	2.7
1	A	85	HIS	2.7
1	A	61	ARG	2.6
1	A	186	MET	2.6
1	A	58	LEU	2.6
1	A	74	GLN	2.6
1	A	72	SER	2.6
1	A	51	THR	2.6
1	A	76	PRO	2.6
1	A	265	GLU	2.6
1	A	124	TYR	2.6
1	A	19	LYS	2.6
1	A	102	SER	2.5
1	A	520	THR	2.5
1	A	180	GLU	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	173	ALA	2.5
1	A	73	ASN	2.5
1	A	105	ALA	2.5
1	A	26	THR	2.5
1	A	29	ASP	2.4
1	A	137	GLN	2.4
1	A	56	ASN	2.4
1	A	200	GLU	2.4
1	A	136	VAL	2.4
1	A	45	GLU	2.4
1	A	83	LEU	2.3
1	A	109	LEU	2.3
1	A	392	ALA	2.3
1	A	503	GLU	2.3
1	A	157	GLY	2.3
1	A	46	LEU	2.3
1	A	201	LYS	2.3
1	A	132	CYS	2.3
1	A	171	VAL	2.3
1	A	253	VAL	2.3
1	A	160	GLN	2.3
1	A	22	GLU	2.3
1	A	53	LYS	2.2
1	A	92	LEU	2.2
1	A	150	LYS	2.2
1	A	15	GLU	2.2
1	A	54	GLU	2.2
1	A	20	PRO	2.2
1	A	77	ARG	2.2
1	A	344	TYR	2.2
1	A	127	LEU	2.2
1	A	206	GLU	2.2
1	A	107	SER	2.2
1	A	175	PHE	2.2
1	A	189	THR	2.1
1	A	183	GLN	2.1
1	A	64	SER	2.1
1	A	118	ASP	2.1
1	A	34	ALA	2.1
1	A	308	ALA	2.1
1	A	167	ASN	2.1
1	A	156	GLY	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	104	GLU	2.1
1	A	87	PHE	2.0
1	A	141	LEU	2.0
1	A	62	LYS	2.0
1	A	63	PRO	2.0
1	A	125	TYR	2.0
1	A	17	LEU	2.0

## 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, 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
1	CSD	A	345[A]	8/9	0.85	0.15	21,26,30,33	5
1	CSD	A	345[B]	8/9	0.85	0.15	22,25,30,33	5

## 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
4	SO4	A	611	5/5	0.28	0.18	114,118,121,122	0
4	SO4	A	606	5/5	0.65	0.19	84,87,89,95	0
6	GOL	A	614	6/6	0.65	0.18	57,60,62,66	0
7	PEG	A	620	7/7	0.68	0.21	59,68,74,75	0
6	GOL	A	615	6/6	0.69	0.21	64,69,73,75	0
4	SO4	A	610	5/5	0.69	0.23	131,135,136,139	0
7	PEG	A	619	7/7	0.71	0.21	65,71,74,76	0
6	GOL	A	613	6/6	0.74	0.18	51,57,58,58	0
6	GOL	A	616	6/6	0.76	0.16	61,66,70,73	0

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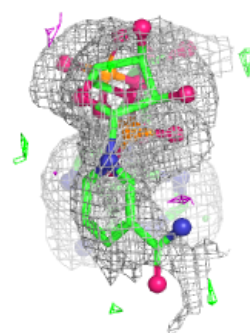
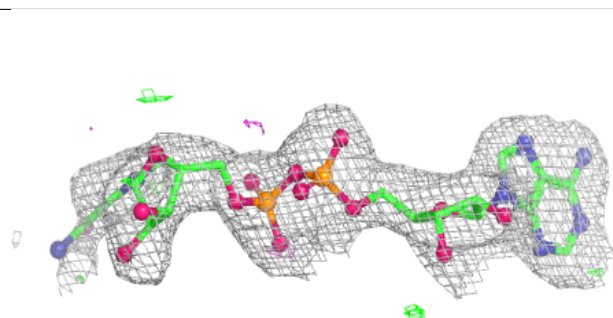
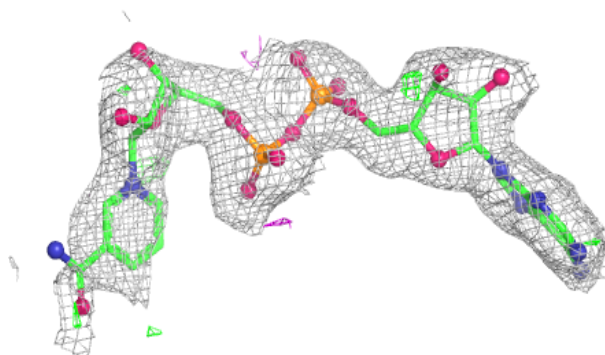
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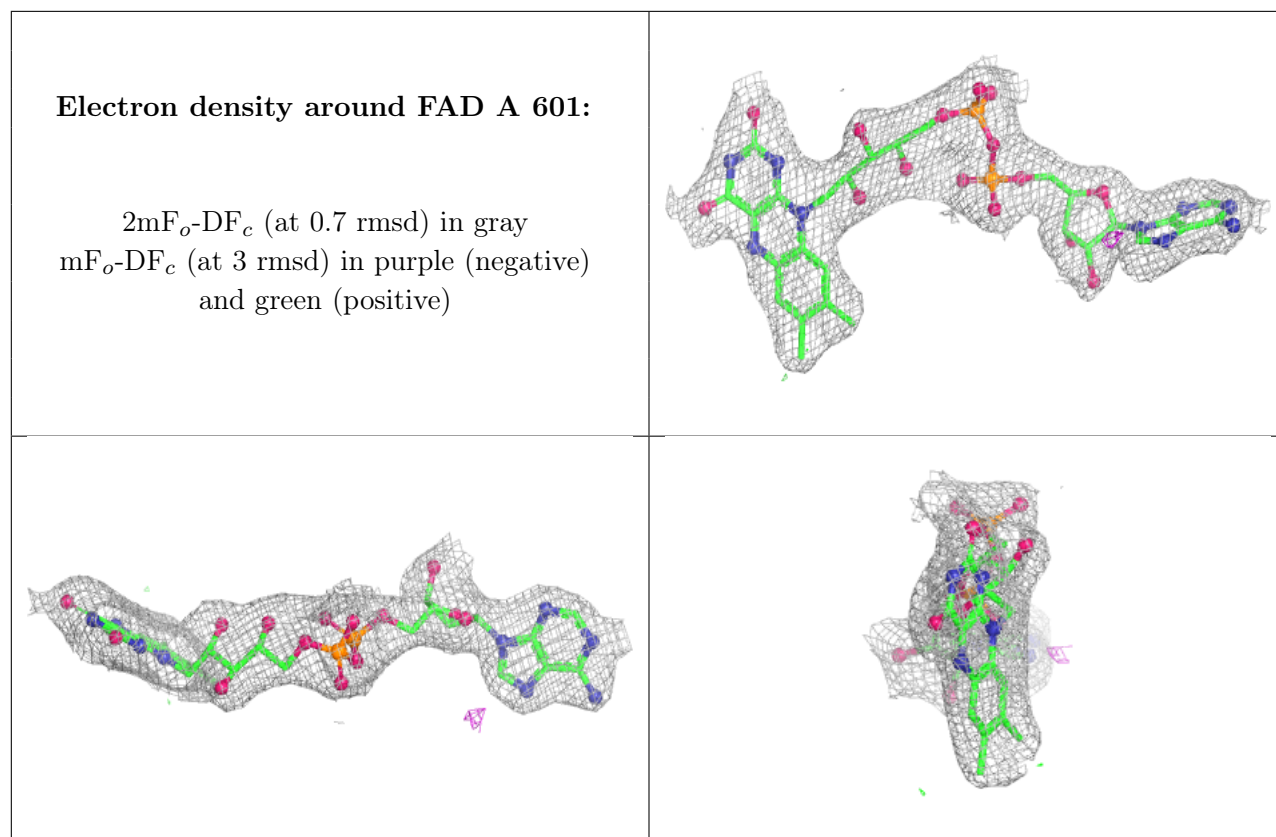
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
6	GOL	A	618	6/6	0.77	0.27	46,58,61,65	0
4	SO4	A	608	5/5	0.78	0.21	64,72,74,80	0
6	GOL	A	617	6/6	0.79	0.16	53,65,69,72	0
4	SO4	A	607	5/5	0.80	0.13	90,90,92,94	0
4	SO4	A	609	5/5	0.82	0.19	78,79,87,88	0
4	SO4	A	604	5/5	0.88	0.10	62,63,67,69	0
3	NAD	A	602	44/44	0.93	0.11	23,35,77,96	0
4	SO4	A	605	5/5	0.93	0.11	33,34,39,40	0
2	FAD	A	601	53/53	0.95	0.08	18,25,39,40	0
4	SO4	A	603	5/5	0.96	0.08	27,29,29,33	0
5	CD	A	612	1/1	0.96	0.04	91,91,91,91	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 602:

2mF<sub>o</sub>-DF<sub>c</sub> (at 0.7 rmsd) in gray  
mF<sub>o</sub>-DF<sub>c</sub> (at 3 rmsd) in purple (negative)  
and green (positive)





## 6.5 Other polymers [i](#)

There are no such residues in this entry.