



# Full wwPDB X-ray Structure Validation Report ⓘ

May 15, 2020 – 01:06 pm BST

PDB ID : 4BAY  
Title : Phosphomimetic mutant of LSD1-8a splicing variant in complex with CoREST  
Authors : Toffolo, E.; Paganini, L.; Rusconi, F.; Tortorici, M.; Pilotto, S.; Verpelli, C.; Tedeschi, G.; Maffioli, E.; Sala, C.; Mattevi, A.; Battaglioli, E.  
Deposited on : 2012-09-17  
Resolution : 3.10 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.

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

MolProbity : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
buster-report : 1.1.7 (2018)  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.11

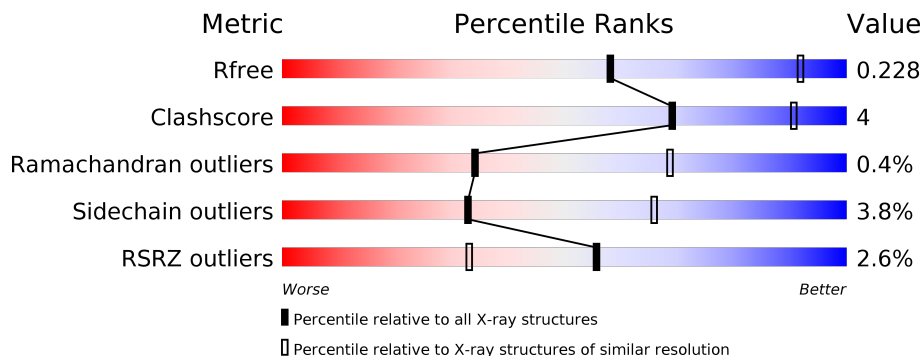
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.10 Å.

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



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	1094 (3.10-3.10)
Clashscore	141614	1184 (3.10-3.10)
Ramachandran outliers	138981	1141 (3.10-3.10)
Sidechain outliers	138945	1141 (3.10-3.10)
RSRZ outliers	127900	1067 (3.10-3.10)

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 on 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	686	 9% 87% 10% ••
2	B	133	 9% 86% 12% •

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 6381 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 LYSINE-SPECIFIC HISTONE DEMETHYLASE 1A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	670	5249	3343	911	975	20	0	0	0

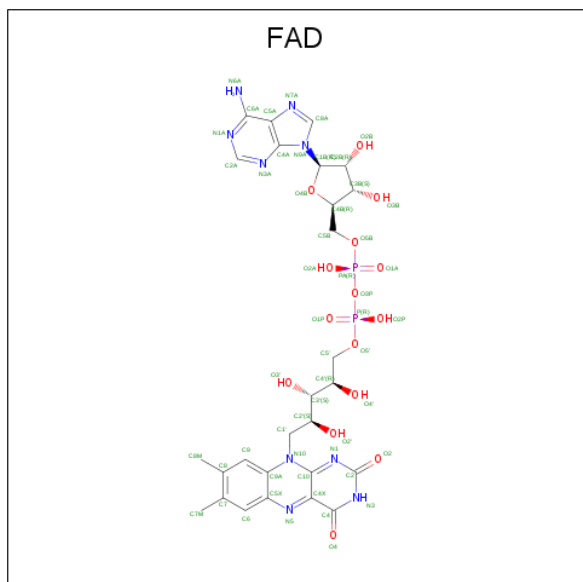
There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	171	PRO	-	expression tag	UNP O60341
A	369B	ASP	THR	engineered mutation	UNP O60341

- Molecule 2 is a protein called REST COREPRESSOR 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	133	1076	676	194	203	3	0	0	0

- Molecule 3 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula:  $C_{27}H_{33}N_9O_{15}P_2$ ).



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

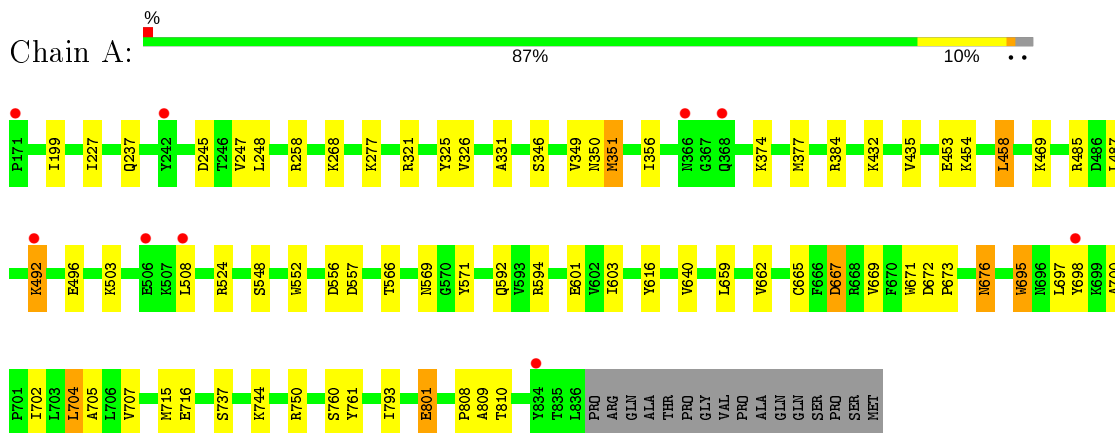
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	2	Total	O	0	0
			2	2		
4	B	1	Total	O	0	0
			1	1		

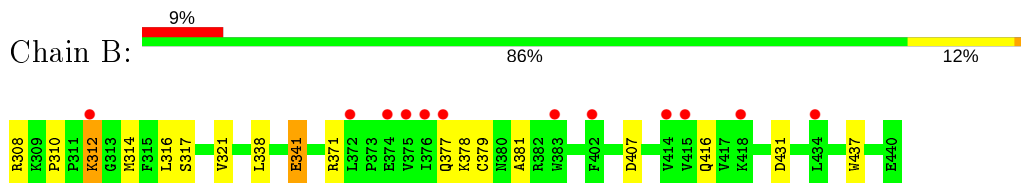
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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: LYSINE-SPECIFIC HISTONE DEMETHYLASE 1A



- Molecule 2: REST COREPRESSOR 1



## 4 Data and refinement statistics

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	117.98Å 179.12Å 233.64Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	59.06 – 3.10 58.99 – 3.10	Depositor EDS
% Data completeness (in resolution range)	99.4 (59.06-3.10) 99.5 (58.99-3.10)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.53 (at 3.13Å)	Xtrriage
Refinement program	REFMAC 5.7.0027	Depositor
R, $R_{free}$	0.209 , 0.226 0.208 , 0.228	Depositor DCC
$R_{free}$ test set	874 reflections (1.94%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	72.6	Xtrriage
Anisotropy	0.067	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 42.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	6381	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	80.0	wwPDB-VP

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

<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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.42	1/5363 (0.0%)	0.49	0/7275
2	B	0.38	1/1091 (0.1%)	0.46	0/1471
All	All	0.42	2/6454 (0.0%)	0.49	0/8746

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	695	TRP	CD2-CE2	5.54	1.48	1.41
2	B	437	TRP	CD2-CE2	5.01	1.47	1.41

There are no bond angle outliers.

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	5249	0	5282	43	0
2	B	1076	0	1091	7	0
3	A	53	0	31	5	0
4	A	2	0	0	0	0
4	B	1	0	0	0	0
All	All	6381	0	6404	47	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 4.

All (47) 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:760:SER:HB2	3:A:900:FAD:HM83	1.61	0.83
1:A:325:TYR:HB3	1:A:702:ILE:HD11	1.72	0.71
1:A:384:ARG:HB3	2:B:314:MET:HE1	1.75	0.68
1:A:199:ILE:HD11	1:A:248:LEU:HD11	1.77	0.65
1:A:346:SER:HA	1:A:351:MET:HG3	1.79	0.64
1:A:384:ARG:HB3	2:B:314:MET:CE	2.29	0.63
1:A:331:ALA:HA	3:A:900:FAD:N5	2.17	0.59
1:A:801:GLU:HG2	1:A:809:ALA:H	1.66	0.59
1:A:761:TYR:CD1	1:A:809:ALA:HB1	2.37	0.58
1:A:760:SER:CB	3:A:900:FAD:HM83	2.33	0.58
1:A:349:VAL:HG12	1:A:350:ASN:H	1.68	0.58
1:A:548:SER:O	1:A:552:TRP:HB3	2.03	0.58
1:A:695:TRP:HB2	1:A:704:LEU:HB3	1.85	0.57
1:A:458:LEU:HB3	1:A:487:LEU:HD13	1.88	0.56
1:A:707:VAL:HG11	1:A:715:MET:HG3	1.88	0.56
1:A:321:ARG:HG2	1:A:326:VAL:HG22	1.89	0.54
1:A:349:VAL:HG12	1:A:350:ASN:N	2.24	0.53
1:A:432:LYS:HA	1:A:435:VAL:HG22	1.90	0.52
2:B:381:ALA:HA	2:B:416:GLN:HE22	1.75	0.51
1:A:374:LYS:HG3	1:A:524:ARG:HH12	1.76	0.50
1:A:700:ALA:HB1	1:A:702:ILE:HD12	1.95	0.48
1:A:594:ARG:HG2	1:A:640:VAL:HB	1.96	0.46
1:A:667:ASP:HB3	1:A:744:LYS:HD2	1.96	0.46
1:A:569:ASN:OD1	1:A:569:ASN:N	2.48	0.46
1:A:801:GLU:HG2	1:A:809:ALA:N	2.30	0.46
1:A:676:ASN:HA	1:A:676:ASN:HD22	1.60	0.45
1:A:485:ARG:HG3	2:B:407:ASP:HB2	1.98	0.45
1:A:454:LYS:O	1:A:458:LEU:HB2	2.17	0.45
1:A:698:TYR:C	1:A:700:ALA:H	2.20	0.44
1:A:669:VAL:HG13	1:A:671:TRP:CE2	2.53	0.44
1:A:659:LEU:HD11	3:A:900:FAD:HM73	2.00	0.44
1:A:331:ALA:HA	3:A:900:FAD:C4X	2.48	0.43
1:A:566:THR:HG21	1:A:697:LEU:HD11	2.00	0.43
2:B:310:PRO:HB3	2:B:316:LEU:HD12	2.01	0.42
1:A:808:PRO:O	1:A:810:THR:HG23	2.19	0.42
2:B:338:LEU:HA	2:B:341:GLU:HB2	2.00	0.42
1:A:793:ILE:H	1:A:793:ILE:HD12	1.84	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:356:ILE:HD11	1:A:566:THR:HG23	2.02	0.42
1:A:492:LYS:O	1:A:496:GLU:HG2	2.19	0.42
2:B:317:SER:O	2:B:321:VAL:HG23	2.20	0.41
1:A:716:GLU:HG2	1:A:750:ARG:HG2	2.01	0.41
1:A:662:VAL:HB	1:A:705:ALA:HB3	2.02	0.41
1:A:227:ILE:HG22	1:A:268:LYS:HB3	2.02	0.41
1:A:672:ASP:HA	1:A:673:PRO:HD3	1.89	0.41
1:A:592:GLN:HB3	1:A:603:ILE:HD12	2.03	0.41
1:A:245:ASP:OD1	1:A:247:VAL:HG22	2.20	0.40
1:A:601:GLU:HA	1:A:616:TYR:O	2.20	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	668/686 (97%)	642 (96%)	24 (4%)	2 (0%)	41	73
2	B	131/133 (98%)	124 (95%)	6 (5%)	1 (1%)	19	54
All	All	799/819 (98%)	766 (96%)	30 (4%)	3 (0%)	34	69

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	351	MET
1	A	737	SER
2	B	312	LYS

### 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	570/583 (98%)	552 (97%)	18 (3%)	39	69
2	B	117/117 (100%)	109 (93%)	8 (7%)	16	45
All	All	687/700 (98%)	661 (96%)	26 (4%)	33	66

All (26) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	237	GLN
1	A	258	ARG
1	A	277	LYS
1	A	377	MET
1	A	453	GLU
1	A	458	LEU
1	A	469	LYS
1	A	492	LYS
1	A	503	LYS
1	A	508	LEU
1	A	556	ASP
1	A	557	ASP
1	A	571	TYR
1	A	665	CYS
1	A	667	ASP
1	A	676	ASN
1	A	704	LEU
1	A	801	GLU
2	B	308	ARG
2	B	312	LYS
2	B	341	GLU
2	B	371	ARG
2	B	377	GLN
2	B	378	LYS
2	B	379	CYS
2	B	431	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	191	GLN
1	A	237	GLN
1	A	402	ASN
1	A	652	GLN
1	A	771	ASN
2	B	348	GLN
2	B	377	GLN

### 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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

1 ligand is 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	FAD	A	900	-	51,58,58	1.92	7 (13%)	60,89,89	1.95	14 (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
3	FAD	A	900	-	-	1/30/50/50	0/6/6/6

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	900	FAD	C4X-C10	9.85	1.48	1.38
3	A	900	FAD	C4-C4X	4.04	1.48	1.41
3	A	900	FAD	C9A-C5X	3.65	1.49	1.42
3	A	900	FAD	C8-C7	3.50	1.49	1.40
3	A	900	FAD	C9A-N10	2.75	1.42	1.38
3	A	900	FAD	C5A-C4A	2.53	1.47	1.40
3	A	900	FAD	C10-N1	2.42	1.36	1.33

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	900	FAD	C4-N3-C2	8.77	122.55	115.14
3	A	900	FAD	C4-C4X-C10	-4.60	116.91	119.95
3	A	900	FAD	C4X-N5-C5X	4.28	121.04	116.77
3	A	900	FAD	C4X-C4-N3	-3.59	118.52	123.43
3	A	900	FAD	N3A-C2A-N1A	-3.46	123.27	128.68
3	A	900	FAD	C1'-N10-C9A	3.01	120.66	118.29
3	A	900	FAD	C5'-C4'-C3'	-2.97	106.46	112.20
3	A	900	FAD	P-O3P-PA	-2.83	123.11	132.83
3	A	900	FAD	C1'-N10-C10	2.44	120.59	118.41
3	A	900	FAD	C9A-N10-C10	-2.43	118.73	121.91
3	A	900	FAD	C4A-C5A-N7A	-2.38	106.92	109.40
3	A	900	FAD	C4-C4X-N5	2.31	121.24	118.60
3	A	900	FAD	C5X-C9A-N10	2.13	119.26	117.72
3	A	900	FAD	C1B-N9A-C4A	-2.00	123.12	126.64

There are no chirality outliers.

All (1) torsion outliers are listed below:

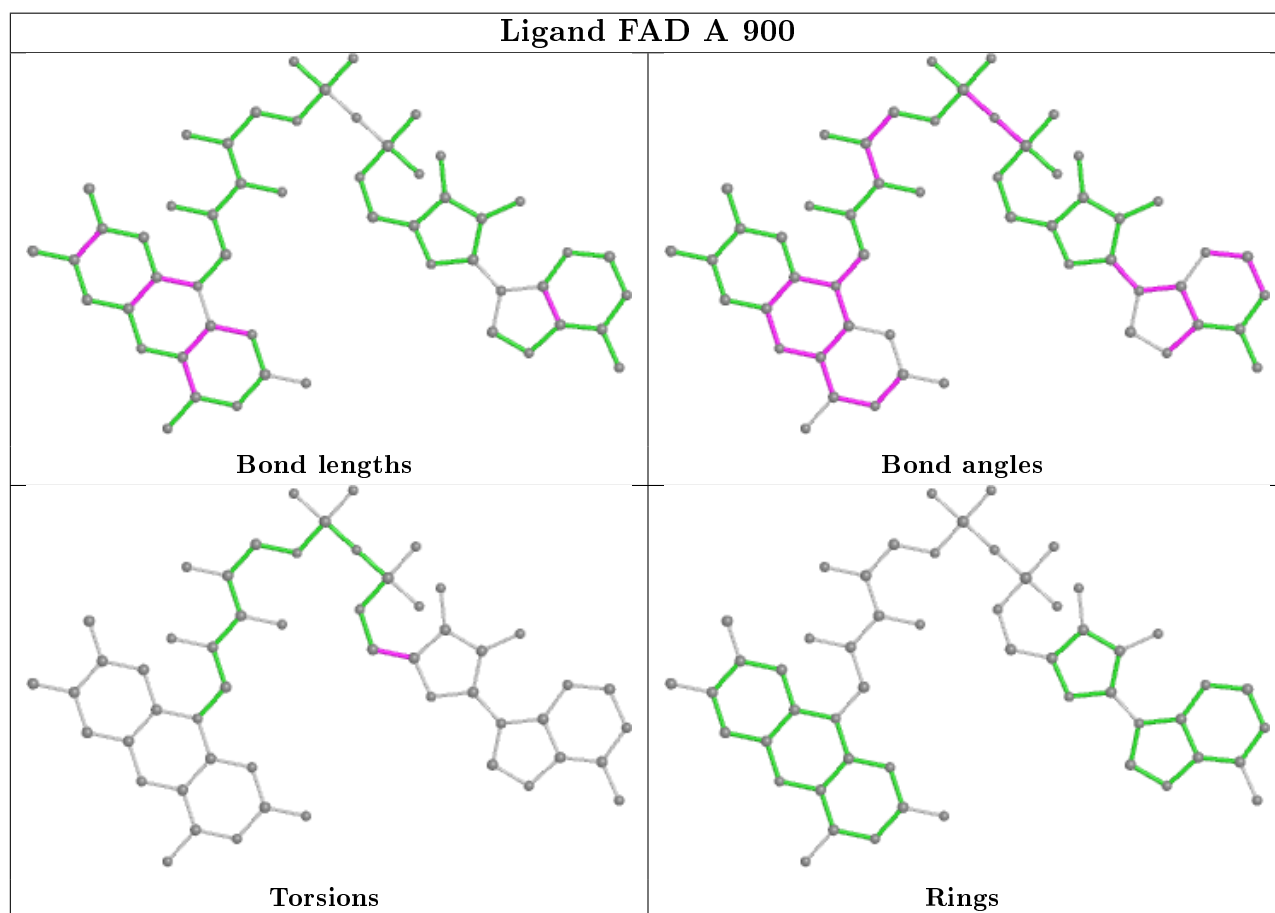
Mol	Chain	Res	Type	Atoms
3	A	900	FAD	O4B-C4B-C5B-O5B

There are no ring outliers.

1 monomer is involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	900	FAD	5	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

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	670/686 (97%)	0.18	9 (1%) 77 59	40, 72, 108, 155	0
2	B	133/133 (100%)	0.60	12 (9%) 9 3	71, 100, 132, 154	0
All	All	803/819 (98%)	0.25	21 (2%) 56 33	40, 78, 118, 155	0

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	374	GLU	3.2
2	B	312	LYS	3.0
1	A	368	GLN	2.8
2	B	383	TRP	2.6
1	A	492	LYS	2.5
1	A	242	TYR	2.4
2	B	375	VAL	2.4
1	A	366	ASN	2.3
1	A	508	LEU	2.3
2	B	376	ILE	2.2
2	B	414	VAL	2.2
1	A	698	TYR	2.2
1	A	834	TYR	2.2
1	A	506	GLU	2.2
2	B	434	LEU	2.1
2	B	415	VAL	2.1
2	B	402	PHE	2.1
1	A	171	PRO	2.1
2	B	377	GLN	2.0
2	B	418	LYS	2.0
2	B	372	LEU	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](#)

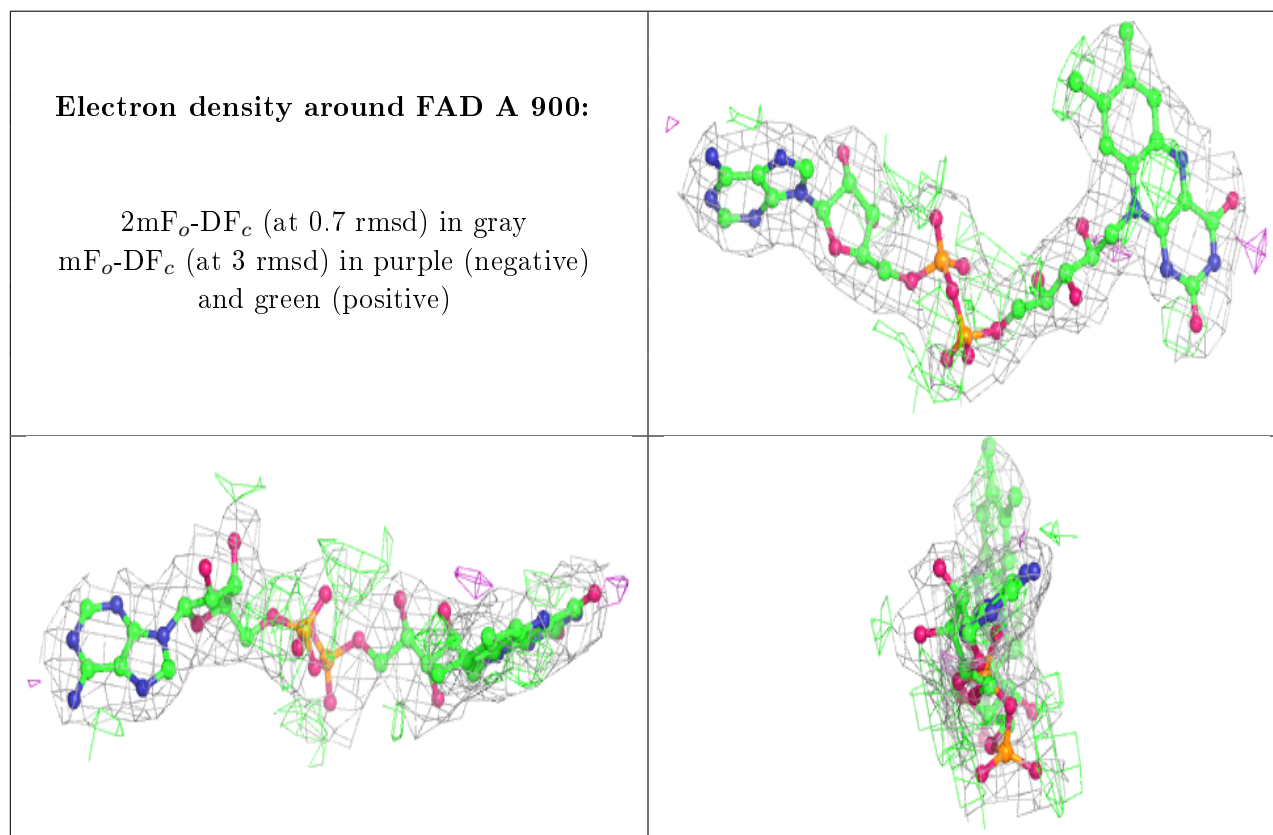
There are no carbohydrates in this entry.

## 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	FAD	A	900	53/53	0.98	0.23	42,54,65,68	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.





## 6.5 Other polymers

There are no such residues in this entry.