



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 08:32 AM UTC

PDB ID : 4PAB / pdb_00004pab
Title : Crystal structure of the precursor form of rat DMGDH complexed with tetrahydrofolate
Authors : Luka, Z.; Pakhomova, S.; Loukachevitch, L.V.; Newcomer, M.E.; Wagner, C.
Deposited on : 2014-04-07
Resolution : 1.85 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

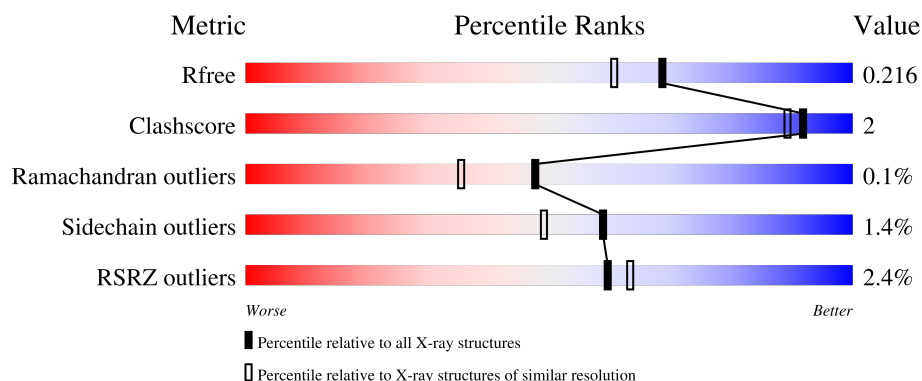
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.85 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	3428 (1.86-1.86)
Clashscore	190562	3579 (1.86-1.86)
Ramachandran outliers	187476	3553 (1.86-1.86)
Sidechain outliers	187428	3553 (1.86-1.86)
RSRZ outliers	180081	3429 (1.86-1.86)

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	869	<div> <div>2%</div> <div> <div></div> <div>91%</div> <div>• 5%</div> </div> </div>
1	B	869	<div> <div>2%</div> <div> <div></div> <div>90%</div> <div>• 5%</div> </div> </div>

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 13995 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 Dimethylglycine dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	823	Total	C	N	O	S	0	2	0
			6540	4184	1126	1211	19			
1	B	824	Total	C	N	O	S	0	1	0
			6540	4184	1126	1211	19			

There are 38 discrepancies between the modelled and reference sequences:

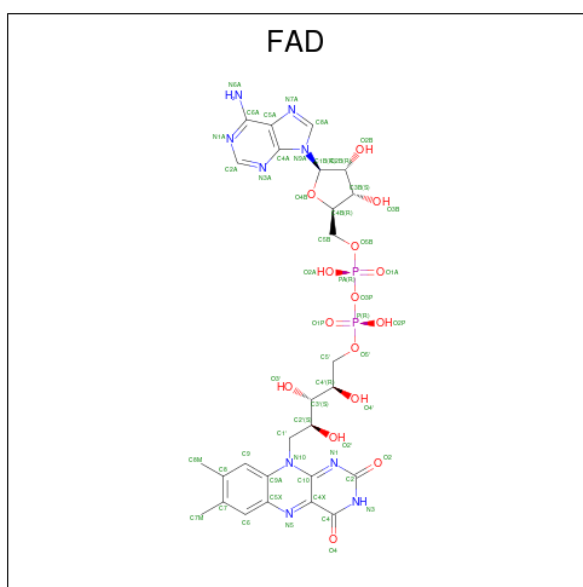
Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	MET	-	expression tag	UNP Q5RKL4
A	0	ALA	-	expression tag	UNP Q5RKL4
A	1	SER	-	expression tag	UNP Q5RKL4
A	204	VAL	ALA	engineered mutation	UNP Q5RKL4
A	267	VAL	ILE	engineered mutation	UNP Q5RKL4
A	402	LYS	THR	engineered mutation	UNP Q5RKL4
A	509	ARG	GLU	engineered mutation	UNP Q5RKL4
A	746	ASP	ASN	engineered mutation	UNP Q5RKL4
A	774	ASP	ASN	engineered mutation	UNP Q5RKL4
A	858	ALA	-	expression tag	UNP Q5RKL4
A	859	ALA	-	expression tag	UNP Q5RKL4
A	860	LEU	-	expression tag	UNP Q5RKL4
A	861	GLU	-	expression tag	UNP Q5RKL4
A	862	HIS	-	expression tag	UNP Q5RKL4
A	863	HIS	-	expression tag	UNP Q5RKL4
A	864	HIS	-	expression tag	UNP Q5RKL4
A	865	HIS	-	expression tag	UNP Q5RKL4
A	866	HIS	-	expression tag	UNP Q5RKL4
A	867	HIS	-	expression tag	UNP Q5RKL4
B	-1	MET	-	expression tag	UNP Q5RKL4
B	0	ALA	-	expression tag	UNP Q5RKL4
B	1	SER	-	expression tag	UNP Q5RKL4
B	204	VAL	ALA	engineered mutation	UNP Q5RKL4
B	267	VAL	ILE	engineered mutation	UNP Q5RKL4
B	402	LYS	THR	engineered mutation	UNP Q5RKL4

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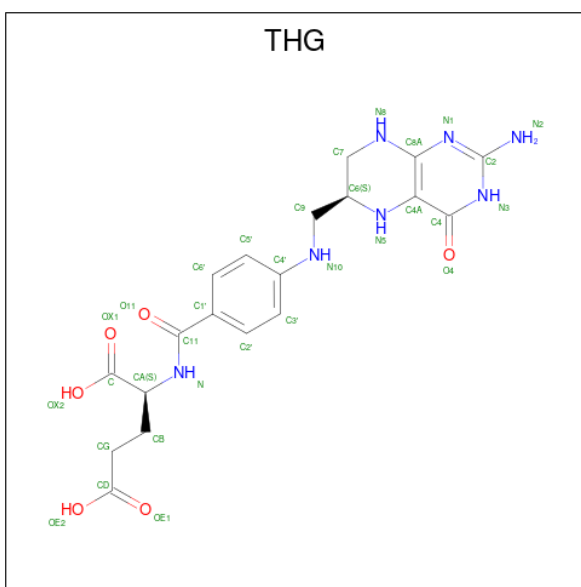
Chain	Residue	Modelled	Actual	Comment	Reference
B	509	ARG	GLU	engineered mutation	UNP Q5RKL4
B	746	ASP	ASN	engineered mutation	UNP Q5RKL4
B	774	ASP	ASN	engineered mutation	UNP Q5RKL4
B	858	ALA	-	expression tag	UNP Q5RKL4
B	859	ALA	-	expression tag	UNP Q5RKL4
B	860	LEU	-	expression tag	UNP Q5RKL4
B	861	GLU	-	expression tag	UNP Q5RKL4
B	862	HIS	-	expression tag	UNP Q5RKL4
B	863	HIS	-	expression tag	UNP Q5RKL4
B	864	HIS	-	expression tag	UNP Q5RKL4
B	865	HIS	-	expression tag	UNP Q5RKL4
B	866	HIS	-	expression tag	UNP Q5RKL4
B	867	HIS	-	expression tag	UNP Q5RKL4

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



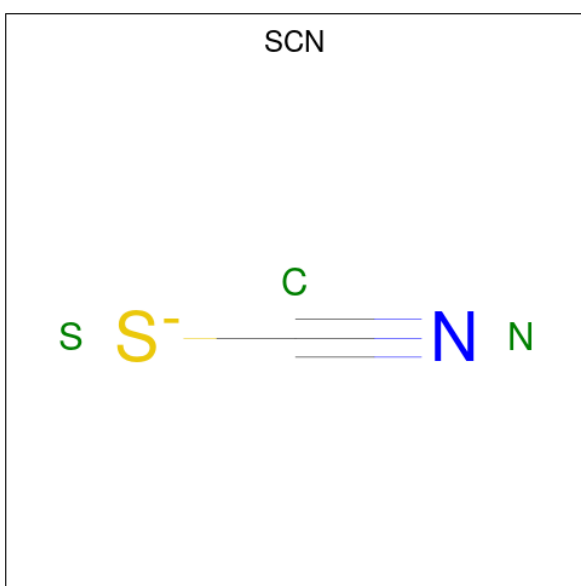
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
2	B	1	Total	C	N	O	P	0	0
			53	27	9	15	2		

- Molecule 3 is (6S)-5,6,7,8-TETRAHYDROFOLATE (CCD ID: THG) (formula: $C_{19}H_{23}N_7O_6$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			32	19	7	6		
3	B	1	Total	C	N	O	0	0
			32	19	7	6		

- Molecule 4 is THIOCYANATE ION (CCD ID: SCN) (formula: CNS).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	S	0	0
			3	1	1	1		
4	A	1	Total	C	N	S	0	0
			3	1	1	1		

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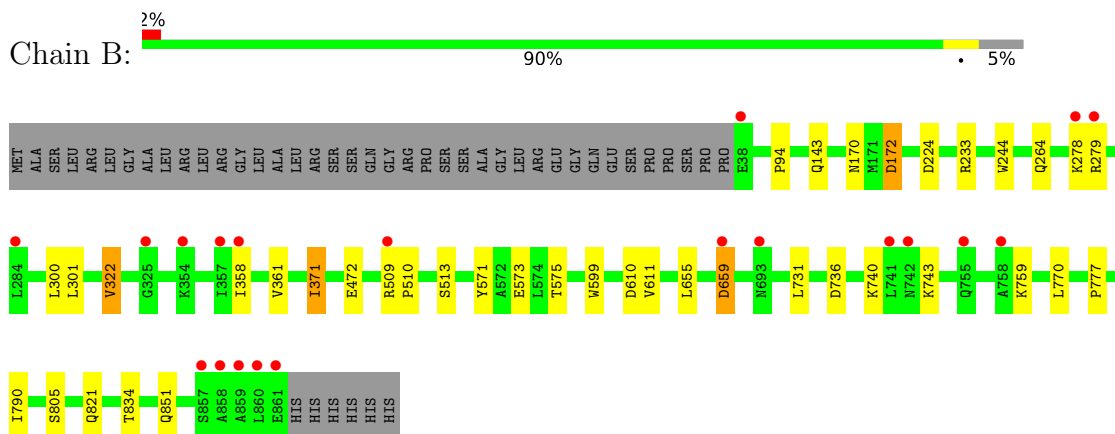
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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total 3	C 1	N 1	S 1	0	0
4	A	1	Total 3	C 1	N 1	S 1	0	0
4	B	1	Total 3	C 1	N 1	S 1	0	0
4	B	1	Total 3	C 1	N 1	S 1	0	0
4	B	1	Total 3	C 1	N 1	S 1	0	0
4	B	1	Total 3	C 1	N 1	S 1	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	360	Total 360	O 360	0	0
5	B	361	Total 361	O 361	0	0

- Molecule 1: Dimethylglycine dehydrogenase



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	84.18Å 107.22Å 114.47Å 90.00° 92.16° 90.00°	Depositor
Resolution (Å)	48.19 – 1.85 48.19 – 1.85	Depositor EDS
% Data completeness (in resolution range)	96.4 (48.19-1.85) 96.4 (48.19-1.85)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.04	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.94 (at 1.86Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.206 , 0.231 (Not available) , 0.216	Depositor DCC
R_{free} test set	3357 reflections (1.90%)	wwPDB-VP
Wilson B-factor (Å ²)	21.3	Xtriage
Anisotropy	0.697	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 32.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.53$, $\langle L^2 \rangle = 0.37$	Xtriage
Estimated twinning fraction	0.000 for h,-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	13995	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 47.64 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 9.6384e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: FAD, SCN, THG

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	0.58	0/6711	0.75	0/9105
1	B	0.60	0/6708	0.75	3/9101 (0.0%)
All	All	0.59	0/13419	0.75	3/18206 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	322	VAL	N-CA-CB	6.09	116.27	109.99
1	B	358	ILE	CB-CA-C	-5.63	104.66	112.04
1	B	322	VAL	CB-CA-C	5.28	116.17	111.00

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	6540	0	6494	21	0
1	B	6540	0	6490	20	0
2	A	53	0	30	2	0
2	B	53	0	30	1	0
3	A	32	0	21	7	0
3	B	32	0	21	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	12	0	0	1	0
4	B	12	0	0	0	0
5	A	360	0	0	3	0
5	B	361	0	0	3	0
All	All	13995	0	13086	42	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 (42) 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:740:LYS:HG3	1:B:743:LYS:HB3	1.84	0.60
1:A:150:HIS:HD2	5:A:1290:HOH:O	1.86	0.59
3:A:902:THG:HC5	5:A:1304:HOH:O	2.04	0.57
1:A:218:ARG:NH2	1:A:233:ARG:NH2	2.54	0.56
1:B:244:TRP:CE3	2:B:901:FAD:H8A	2.45	0.52
1:A:244:TRP:CE3	2:A:901:FAD:H8A	2.44	0.52
1:B:575:THR:HG1	3:B:902:THG:C8A	2.25	0.50
1:B:224:ASP:OD1	1:B:233:ARG:HD2	2.12	0.49
1:B:170:ASN:OD1	1:B:172:ASP:HB2	2.13	0.49
1:A:676:GLU:OE1	3:A:902:THG:N2	2.43	0.49
1:B:851:GLN:NE2	5:B:1001:HOH:O	2.40	0.48
3:B:902:THG:HC5	5:B:1329:HOH:O	2.13	0.48
1:A:509:ARG:HB2	1:A:510:PRO:HD3	1.96	0.48
1:A:170:ASN:OD1	1:A:172:ASP:HB2	2.13	0.47
1:A:264:GLN:HA	1:A:361:VAL:O	2.15	0.47
1:B:264:GLN:HA	1:B:361:VAL:O	2.15	0.47
1:A:233:ARG:NH1	1:B:610:ASP:OD1	2.47	0.46
1:A:575:THR:OG1	3:A:902:THG:C8A	2.65	0.45
1:A:573:GLU:OE1	3:A:902:THG:N10	2.43	0.44
1:A:575:THR:OG1	3:A:902:THG:N1	2.50	0.44
1:A:94:PRO:HA	1:A:143:GLN:NE2	2.33	0.44
1:B:301:LEU:C	1:B:301:LEU:HD23	2.44	0.43
1:A:668:SER:O	4:A:906:SCN:S	2.77	0.43
1:A:571:TYR:CE2	1:A:599:TRP:HB2	2.54	0.43
1:A:301:LEU:C	1:A:301:LEU:HD23	2.44	0.42
1:B:509:ARG:HB2	1:B:510:PRO:HD3	2.01	0.42
1:A:94:PRO:HA	1:A:143:GLN:HE22	1.85	0.42
1:B:821:GLN:NE2	1:B:834:THR:OG1	2.52	0.42
1:B:655:LEU:HD12	1:B:655:LEU:C	2.45	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:659:ASP:C	1:B:659:ASP:OD2	2.62	0.42
1:A:233:ARG:NH2	1:B:611:VAL:O	2.53	0.42
3:A:902:THG:HC92	5:A:1124:HOH:O	2.19	0.42
1:B:94:PRO:HA	1:B:143:GLN:HE22	1.84	0.42
1:A:821:GLN:NE2	1:A:834:THR:OG1	2.52	0.42
1:A:575:THR:OG1	3:A:902:THG:N8	2.54	0.41
1:B:472:GLU:O	5:B:1067:HOH:O	2.22	0.41
1:B:94:PRO:HA	1:B:143:GLN:NE2	2.36	0.41
1:B:571:TYR:CE2	1:B:599:TRP:HB2	2.55	0.41
1:B:777:PRO:HD2	1:B:805:SER:HB3	2.03	0.41
1:A:488:TRP:CE2	1:A:507:TRP:HB3	2.55	0.40
1:A:244:TRP:CD2	2:A:901:FAD:H8A	2.57	0.40
1:B:573:GLU:OE1	3:B:902:THG:N10	2.53	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	823/869 (95%)	798 (97%)	24 (3%)	1 (0%)	48	35
1	B	823/869 (95%)	798 (97%)	24 (3%)	1 (0%)	48	35
All	All	1646/1738 (95%)	1596 (97%)	48 (3%)	2 (0%)	48	35

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	371	ILE
1	B	371	ILE

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	696/731 (95%)	689 (99%)	7 (1%)	68	60
1	B	695/731 (95%)	682 (98%)	13 (2%)	50	38
All	All	1391/1462 (95%)	1371 (99%)	20 (1%)	59	49

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	278	LYS
1	A	309	GLU
1	A	371	ILE
1	A	680	ARG
1	A	731	LEU
1	A	736	ASP
1	A	790	ILE
1	B	172	ASP
1	B	278	LYS
1	B	279	ARG
1	B	300	LEU
1	B	322	VAL
1	B	371	ILE
1	B	513	SER
1	B	659	ASP
1	B	731	LEU
1	B	736	ASP
1	B	759	LYS
1	B	770	LEU
1	B	790	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (17) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	143	GLN
1	A	150	HIS

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Mol	Chain	Res	Type
1	A	359	ASN
1	A	462	GLN
1	A	780	ASN
1	A	820	GLN
1	A	821	GLN
1	A	851	GLN
1	B	143	GLN
1	B	308	GLN
1	B	359	ASN
1	B	383	ASN
1	B	462	GLN
1	B	485	GLN
1	B	780	ASN
1	B	821	GLN
1	B	851	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 ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

12 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	901	1	58,58,58	1.61	10 (17%)	85,89,89	1.67	17 (20%)
4	SCN	A	906	-	1,2,2	0.30	0	0,1,1	-	-
4	SCN	B	903	-	1,2,2	0.59	0	0,1,1	-	-
3	THG	B	902	-	32,34,34	1.52	3 (9%)	39,47,47	1.62	8 (20%)
4	SCN	B	904	-	1,2,2	0.62	0	0,1,1	-	-
4	SCN	A	905	-	1,2,2	0.68	0	0,1,1	-	-
4	SCN	B	905	-	1,2,2	0.52	0	0,1,1	-	-
3	THG	A	902	-	32,34,34	1.49	4 (12%)	39,47,47	1.90	9 (23%)
2	FAD	A	901	1	58,58,58	1.47	11 (18%)	85,89,89	1.68	16 (18%)
4	SCN	A	904	-	1,2,2	0.55	0	0,1,1	-	-
4	SCN	B	906	-	1,2,2	0.28	0	0,1,1	-	-
4	SCN	A	903	-	1,2,2	0.30	0	0,1,1	-	-

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	THG	B	902	-	-	7/22/31/31	0/3/3/3
3	THG	A	902	-	-	9/22/31/31	0/3/3/3
2	FAD	B	901	1	-	0/34/50/50	0/6/6/6
2	FAD	A	901	1	-	1/34/50/50	0/6/6/6

All (28) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	902	THG	C4A-C8A	5.48	1.48	1.38
2	A	901	FAD	C9A-C5X	5.05	1.49	1.41
2	B	901	FAD	C9A-C5X	4.81	1.48	1.41
3	A	902	THG	C4A-C8A	4.56	1.46	1.38
2	B	901	FAD	C5A-C4A	4.08	1.46	1.39
3	A	902	THG	C4-N3	-4.01	1.31	1.38
2	B	901	FAD	C1'-C2'	-3.94	1.47	1.52
2	A	901	FAD	C5A-C4A	3.86	1.46	1.39
3	B	902	THG	C4-N3	-3.69	1.31	1.38
2	B	901	FAD	C8-C7	3.37	1.49	1.40
2	A	901	FAD	C8-C7	3.32	1.49	1.40
2	B	901	FAD	PA-O3P	3.03	1.62	1.59
2	B	901	FAD	C4A-N9A	-2.94	1.31	1.37
2	A	901	FAD	PA-O3P	2.83	1.62	1.59

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	901	FAD	C5A-N7A	-2.72	1.34	1.39
2	B	901	FAD	C8A-N7A	2.67	1.36	1.31
3	A	902	THG	C4A-N5	-2.65	1.31	1.37
2	B	901	FAD	P-O3P	2.61	1.62	1.59
2	A	901	FAD	C5A-N7A	-2.49	1.34	1.39
2	A	901	FAD	C1'-C2'	-2.35	1.49	1.52
2	A	901	FAD	C4-N3	-2.33	1.34	1.38
2	A	901	FAD	C5A-C6A	2.29	1.47	1.41
3	B	902	THG	C2-N3	-2.26	1.32	1.37
2	A	901	FAD	C4X-N5	2.24	1.35	1.30
2	A	901	FAD	C4A-N9A	-2.19	1.33	1.37
2	B	901	FAD	C4-N3	-2.10	1.34	1.38
2	A	901	FAD	P-O3P	2.09	1.61	1.59
3	A	902	THG	C2-N3	-2.02	1.32	1.37

All (50) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	902	THG	C6-C9-N10	5.67	126.93	110.24
2	A	901	FAD	C5A-C4A-N3A	-5.21	119.55	126.72
2	A	901	FAD	N3A-C4A-N9A	4.96	135.60	127.17
3	A	902	THG	C2-N1-C8A	4.88	121.97	113.36
3	B	902	THG	C2-N1-C8A	4.83	121.89	113.36
3	A	902	THG	C9-C6-N5	-4.60	99.10	108.90
2	B	901	FAD	C5A-C4A-N3A	-4.53	120.47	126.72
2	A	901	FAD	N3A-C2A-N1A	-4.30	122.08	128.58
2	B	901	FAD	N3A-C4A-N9A	4.25	134.39	127.17
2	B	901	FAD	C4A-N9A-C8A	4.21	110.16	105.74
2	B	901	FAD	N3A-C2A-N1A	-3.93	122.63	128.58
2	A	901	FAD	C2A-N3A-C4A	3.86	121.26	111.83
2	A	901	FAD	C4A-N9A-C8A	3.85	109.78	105.74
2	B	901	FAD	C2A-N3A-C4A	3.50	120.37	111.83
2	B	901	FAD	C4'-C3'-C2'	-3.21	108.22	113.57
3	B	902	THG	C7-C6-C9	-3.09	106.62	112.96
2	A	901	FAD	O4-C4-C4X	-2.99	118.65	126.53
2	B	901	FAD	C4-C4X-N5	2.88	122.19	118.21
2	A	901	FAD	C4'-C3'-C2'	-2.83	108.85	113.57
2	A	901	FAD	C4-C4X-N5	2.72	121.96	118.21
2	B	901	FAD	O4-C4-C4X	-2.70	119.41	126.53
3	B	902	THG	C4A-C4-N3	2.68	119.48	112.13
2	B	901	FAD	N9A-C8A-N7A	-2.59	110.27	113.94
2	A	901	FAD	C4A-C5A-N7A	-2.58	107.63	110.58

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	901	FAD	O3P-PA-O1A	-2.53	103.08	110.70
2	A	901	FAD	N9A-C8A-N7A	-2.51	110.37	113.94
2	B	901	FAD	C4X-C10-N1	-2.51	118.45	124.59
2	A	901	FAD	C5A-N7A-C8A	2.49	107.36	103.45
3	B	902	THG	C4-C4A-N5	2.47	123.00	116.27
2	B	901	FAD	C10-N1-C2	2.47	122.19	116.85
3	A	902	THG	C5'-C4'-N10	-2.45	115.43	120.96
3	A	902	THG	C7-C6-C9	2.41	117.90	112.96
3	B	902	THG	C3'-C2'-C1'	-2.39	118.25	120.80
3	B	902	THG	C6'-C1'-C2'	2.37	121.59	118.57
3	A	902	THG	C4A-C4-N3	2.36	118.62	112.13
3	B	902	THG	CB-CA-N	-2.32	106.32	110.91
3	B	902	THG	C6-C9-N10	2.30	117.02	110.24
2	A	901	FAD	C4X-C4-N3	2.30	119.10	113.25
2	A	901	FAD	C6A-C5A-N7A	2.16	136.25	132.09
2	B	901	FAD	C6A-C5A-N7A	2.15	136.23	132.09
3	A	902	THG	C6-C7-N8	2.14	114.50	110.60
2	B	901	FAD	C4X-C4-N3	2.11	118.64	113.25
2	B	901	FAD	C2A-N1A-C6A	2.10	122.19	118.73
2	B	901	FAD	O2P-P-O1P	2.09	122.17	112.44
2	B	901	FAD	C4A-C5A-N7A	-2.09	108.20	110.58
3	A	902	THG	C2-N3-C4	-2.07	121.36	125.11
3	A	902	THG	C9-N10-C4'	2.06	127.24	122.00
2	A	901	FAD	O3'-C3'-C2'	2.06	113.60	108.93
2	B	901	FAD	C5X-N5-C4X	2.02	121.36	118.09
2	A	901	FAD	C9A-C5X-N5	-2.01	120.32	122.45

There are no chirality outliers.

All (17) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	902	THG	C7-C6-C9-N10
3	A	902	THG	N5-C6-C9-N10
3	A	902	THG	C5'-C4'-N10-C9
3	A	902	THG	C-CA-CB-CG
3	B	902	THG	C-CA-CB-CG
3	A	902	THG	C1'-C11-N-CA
3	B	902	THG	C1'-C11-N-CA
3	B	902	THG	CA-CB-CG-CD
3	B	902	THG	OE2-CD-CG-CB
3	A	902	THG	CA-CB-CG-CD
3	B	902	THG	C6-C9-N10-C4'

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Mol	Chain	Res	Type	Atoms
3	A	902	THG	OE2-CD-CG-CB
3	B	902	THG	OE1-CD-CG-CB
3	A	902	THG	OE1-CD-CG-CB
3	B	902	THG	N-CA-CB-CG
3	A	902	THG	C3'-C4'-N10-C9
2	A	901	FAD	P-O3P-PA-O2A

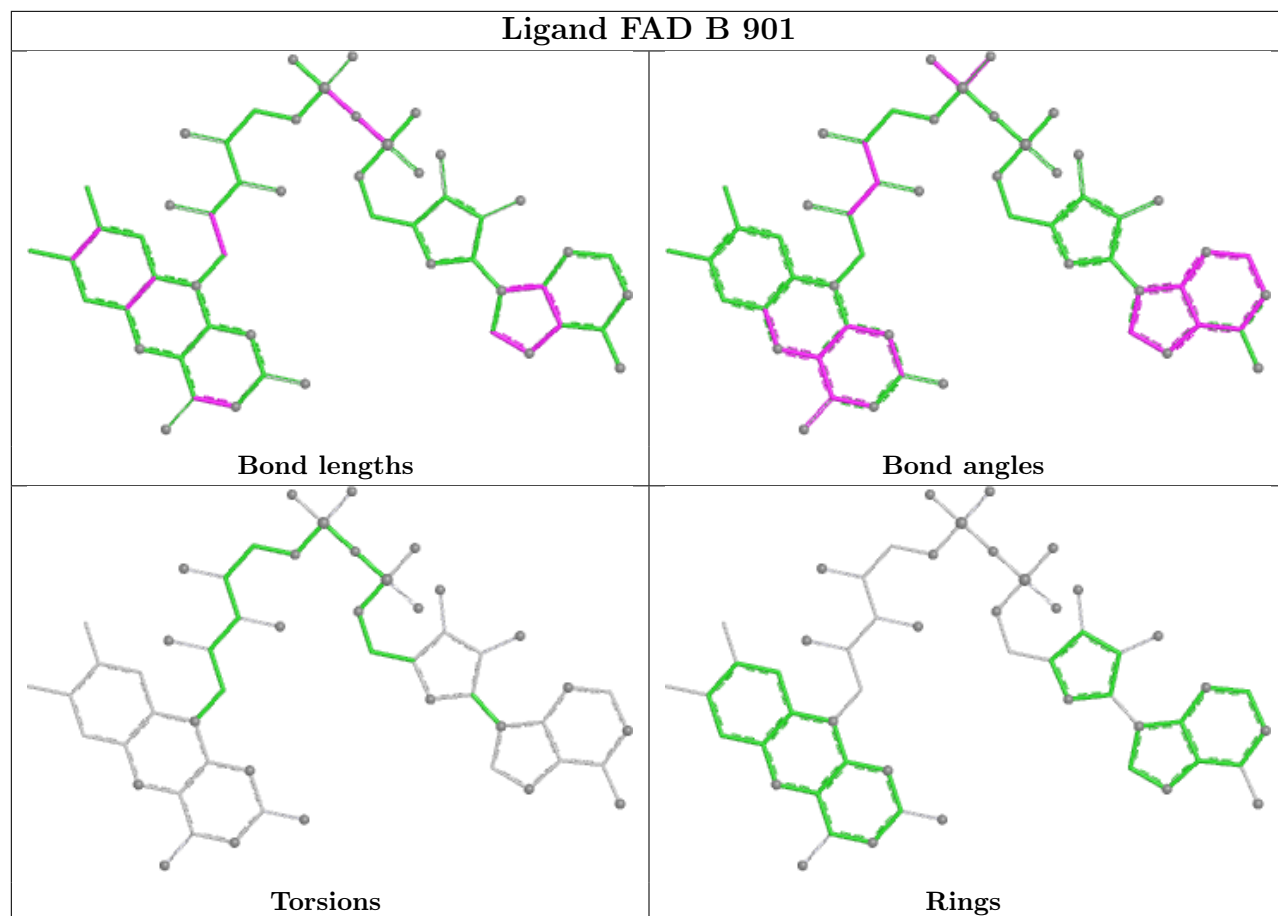
There are no ring outliers.

5 monomers are involved in 14 short contacts:

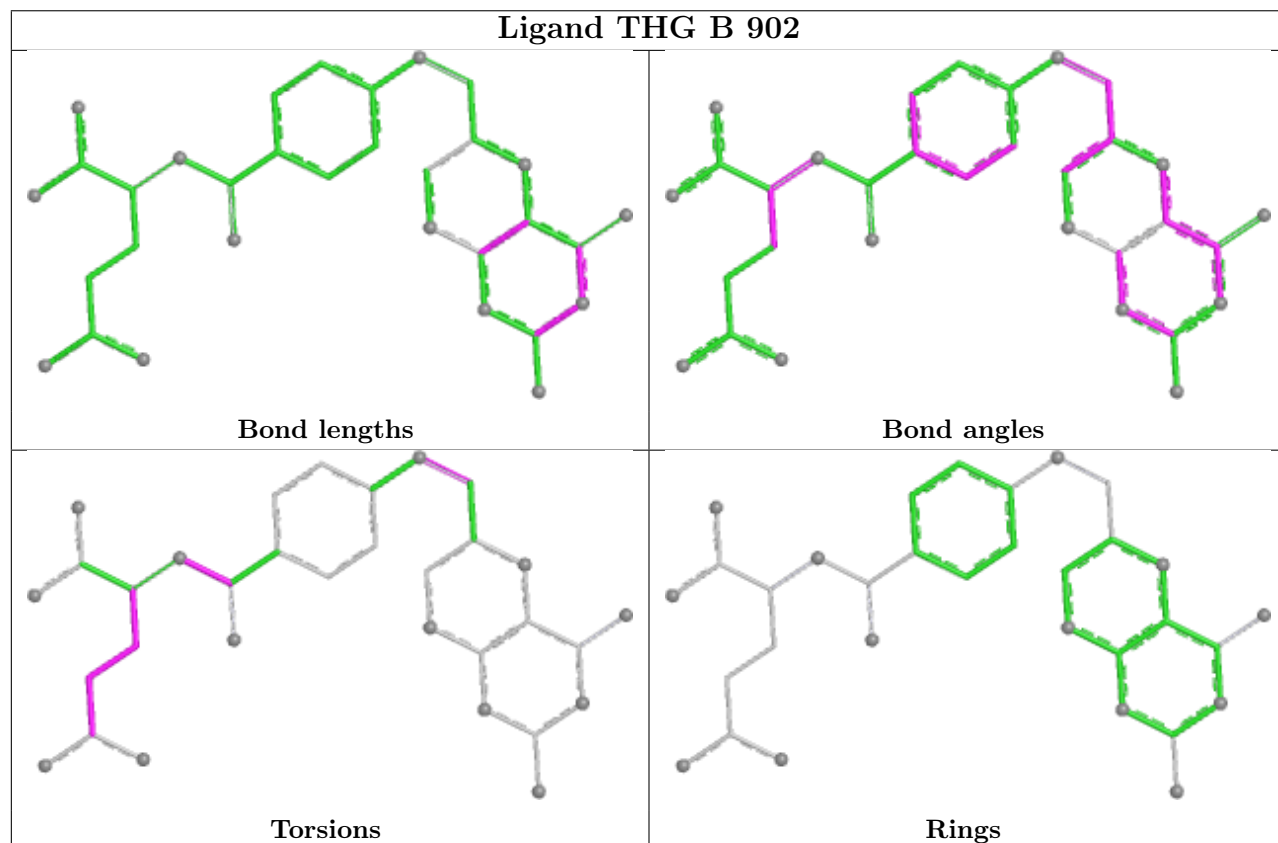
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	901	FAD	1	0
4	A	906	SCN	1	0
3	B	902	THG	3	0
3	A	902	THG	7	0
2	A	901	FAD	2	0

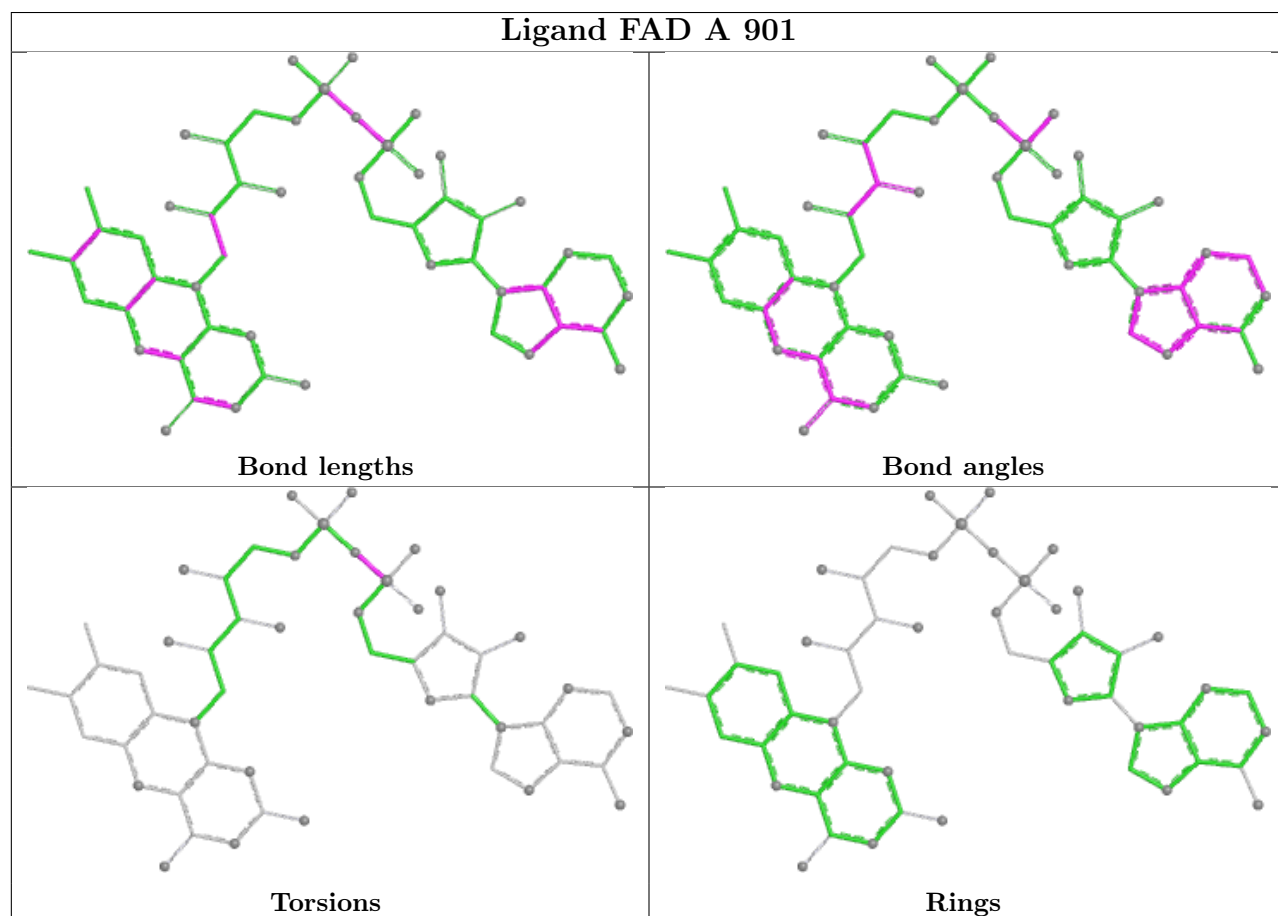
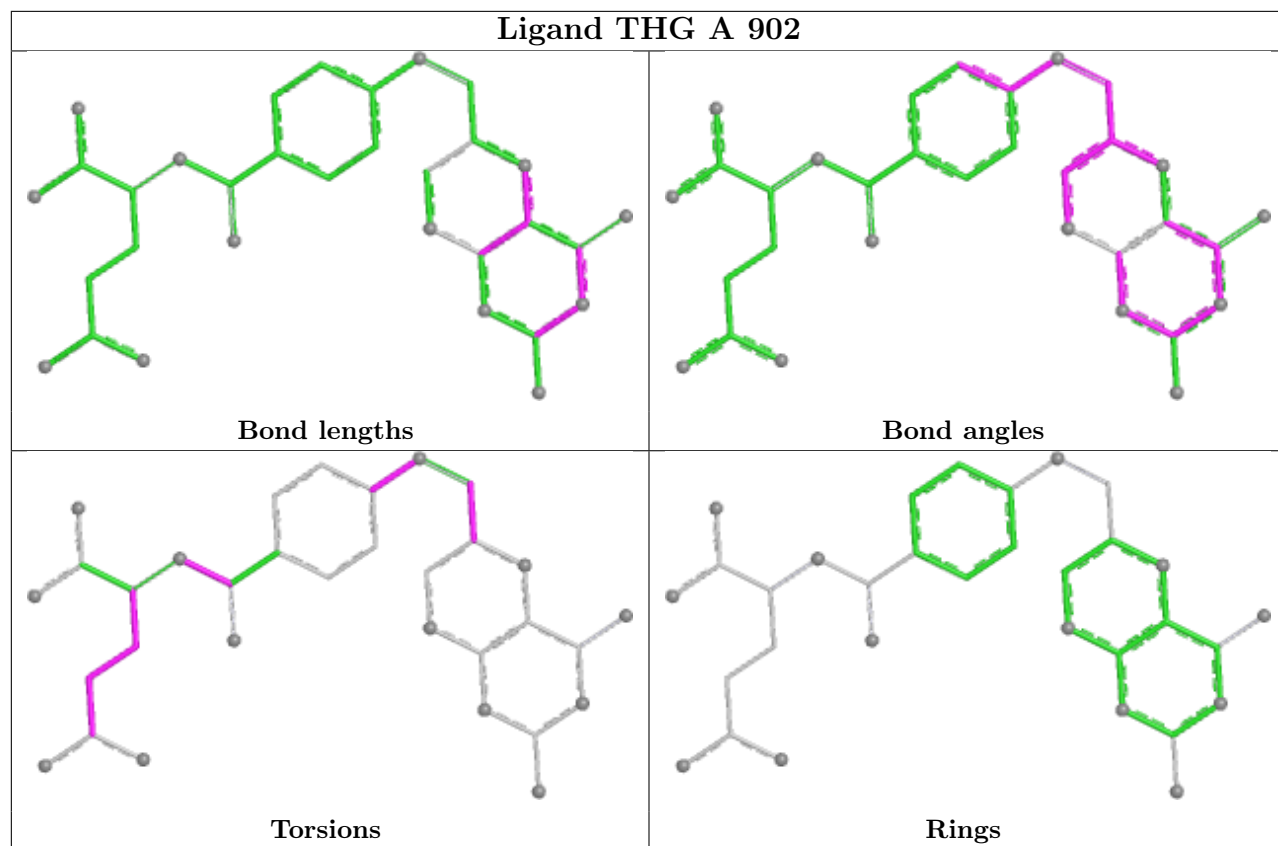
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

Ligand FAD B 901



Ligand THG B 902





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	823/869 (94%)	0.29	19 (2%) 61 64	15, 33, 61, 85	2 (0%)
1	B	824/869 (94%)	0.24	20 (2%) 59 63	14, 33, 59, 84	1 (0%)
All	All	1647/1738 (94%)	0.27	39 (2%) 59 63	14, 33, 61, 85	3 (0%)

All (39) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	860	LEU	6.6
1	B	860	LEU	5.6
1	B	358	ILE	4.2
1	A	38	GLU	3.8
1	B	861	GLU	3.7
1	A	358	ILE	3.6
1	A	278	LYS	3.5
1	B	742	ASN	3.4
1	B	859	ALA	3.3
1	A	858	ALA	3.2
1	B	278	LYS	3.2
1	A	859	ALA	2.9
1	B	858	ALA	2.9
1	B	38	GLU	2.8
1	A	857	SER	2.7
1	A	659	ASP	2.7
1	B	357	ILE	2.6
1	A	689	GLU	2.5
1	B	741	LEU	2.5
1	B	279	ARG	2.5
1	A	267	VAL	2.5
1	A	325	GLY	2.5
1	A	746	ASP	2.5
1	A	762	LYS	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	359	ASN	2.4
1	B	354	LYS	2.4
1	B	659	ASP	2.3
1	A	490	TYR	2.3
1	A	606	ARG	2.3
1	B	758	ALA	2.3
1	B	284	LEU	2.2
1	B	325	GLY	2.2
1	A	326	PHE	2.1
1	B	857	SER	2.1
1	B	509	ARG	2.1
1	B	755	GLN	2.1
1	A	731	LEU	2.1
1	A	297	ARG	2.1
1	B	693	ASN	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(Å ²)	Q<0.9
3	THG	A	902	32/32	0.74	0.20	36,51,60,60	0
3	THG	B	902	32/32	0.76	0.20	37,53,59,61	0
4	SCN	A	906	3/3	0.80	0.26	33,33,42,58	0
4	SCN	A	905	3/3	0.92	0.15	37,37,44,45	0
2	FAD	A	901	53/53	0.96	0.07	22,26,29,30	0
4	SCN	B	904	3/3	0.96	0.10	34,34,36,40	0
4	SCN	B	905	3/3	0.96	0.13	39,39,39,40	0
2	FAD	B	901	53/53	0.97	0.06	18,23,26,28	0

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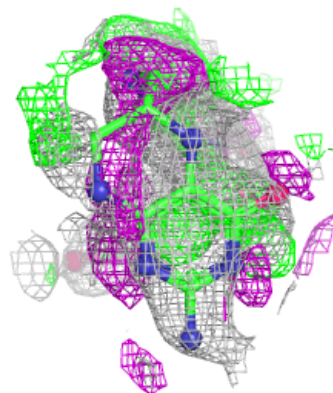
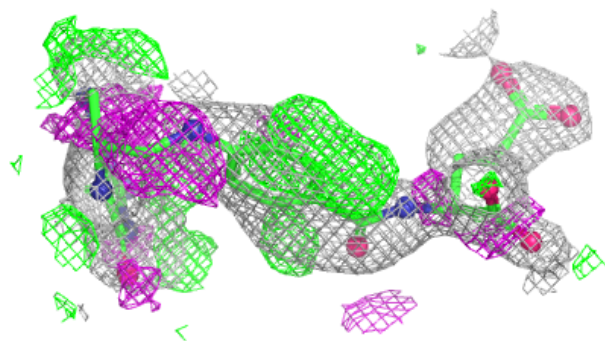
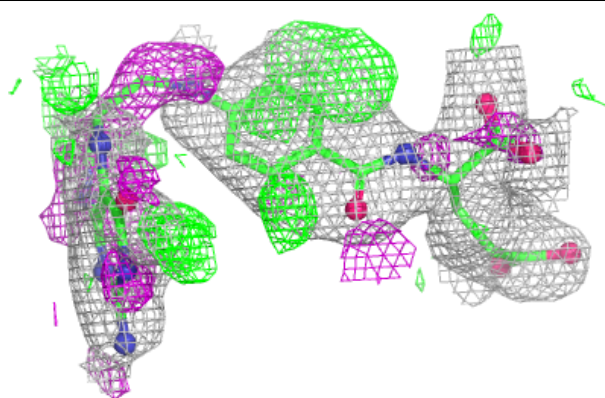
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
4	SCN	A	904	3/3	0.97	0.09	33,33,36,38	0
4	SCN	B	906	3/3	0.97	0.07	34,34,35,38	0
4	SCN	A	903	3/3	0.98	0.10	33,33,34,34	0
4	SCN	B	903	3/3	0.99	0.10	34,34,35,39	0

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.

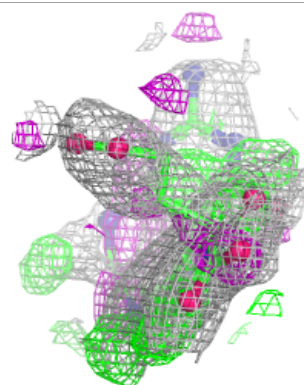
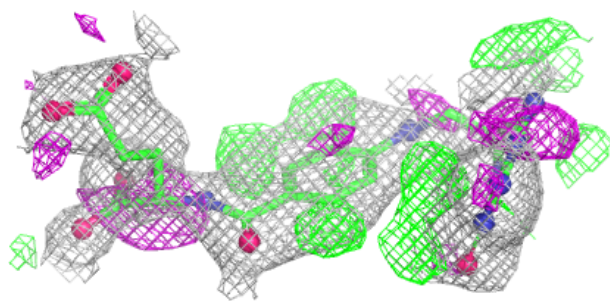
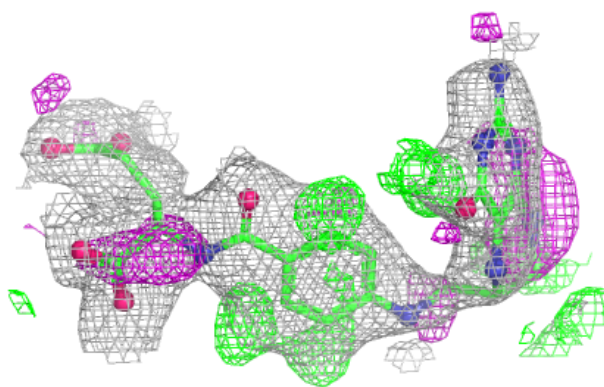
Electron density around THG A 902:

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

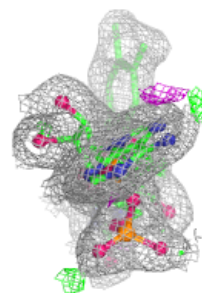
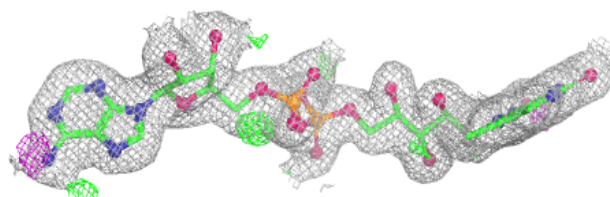
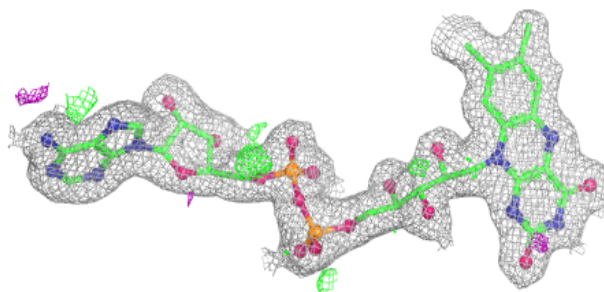


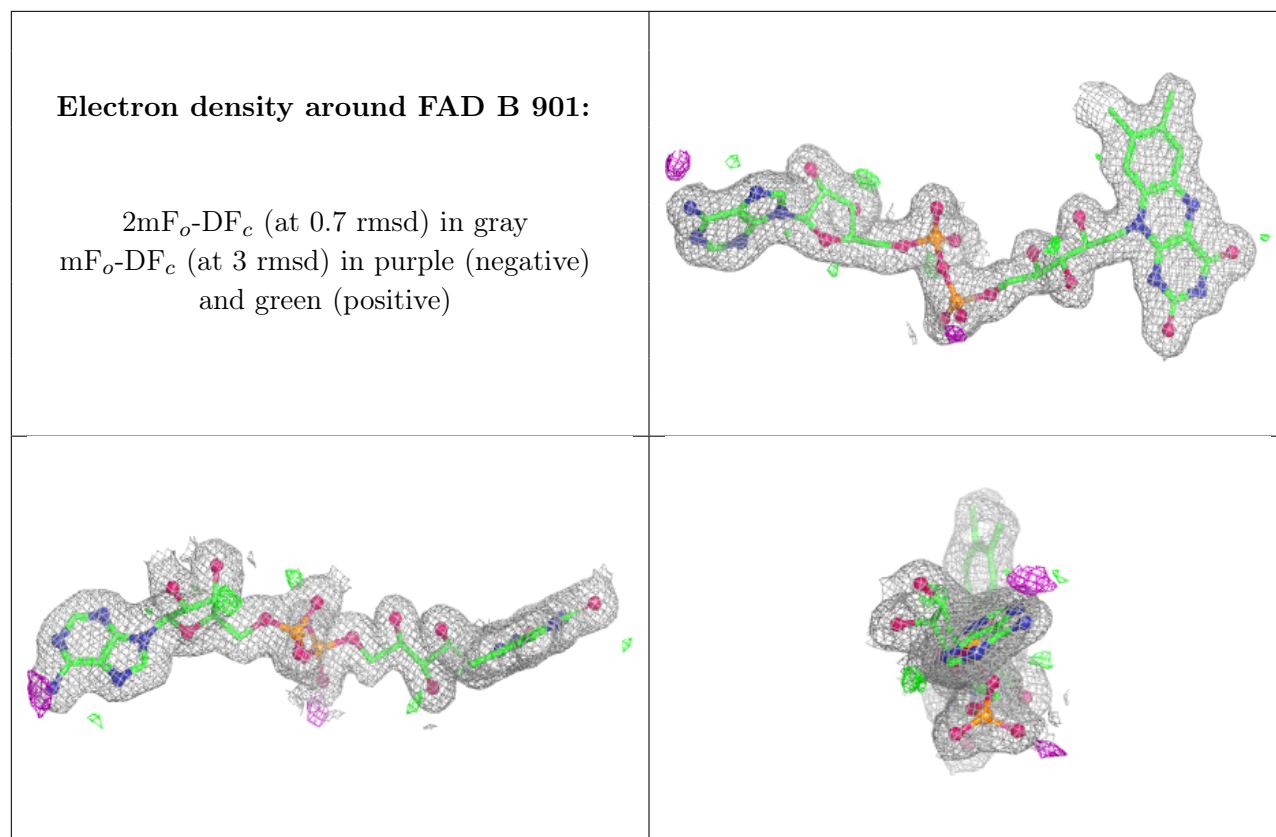
Electron density around THG B 902:

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

**Electron density around FAD A 901:**

$2mF_o-DF_c$ (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.