



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 14, 2026 – 10:26 PM UTC

PDB ID : 7L18 / pdb_00007118
Title : Crystal structure of a tandem deletion mutant of rat NADPH-cytochrome P450 reductase
Authors : Hubbard, P.A.; Xia, C.; Shen, A.L.; Kim, J.J.K.
Deposited on : 2020-12-14
Resolution : 2.54 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

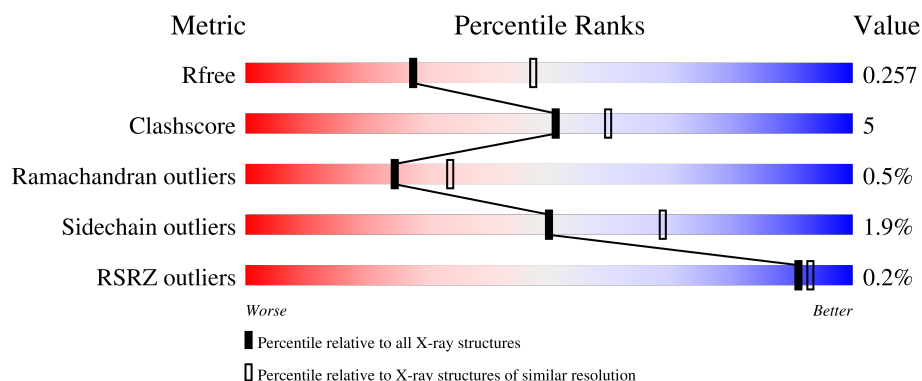
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.54 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	1091 (2.54-2.54)
Clashscore	190562	1120 (2.54-2.54)
Ramachandran outliers	187476	1106 (2.54-2.54)
Sidechain outliers	187428	1106 (2.54-2.54)
RSRZ outliers	180081	1091 (2.54-2.54)

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	AAA	620	
1	BBB	620	

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 10291 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.

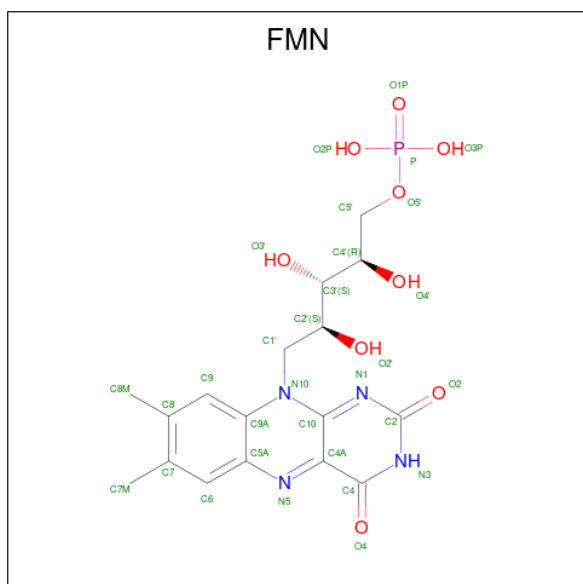
- Molecule 1 is a protein called NADPH–cytochrome P450 reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	AAA	606	Total	C	N	O	S	0	0	0
			4865	3082	838	922	23			
1	BBB	605	Total	C	N	O	S	0	0	0
			4859	3078	837	921	23			

There are 4 discrepancies between the modelled and reference sequences:

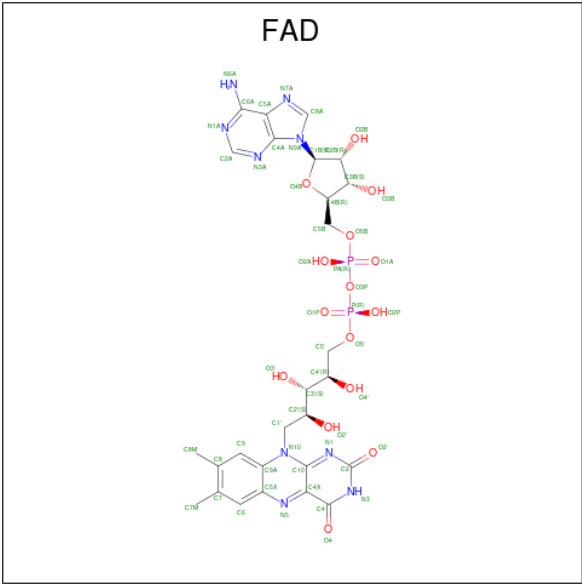
Chain	Residue	Modelled	Actual	Comment	Reference
AAA	?	-	ASP	deletion	UNP P00388
AAA	?	-	VAL	deletion	UNP P00388
BBB	?	-	ASP	deletion	UNP P00388
BBB	?	-	VAL	deletion	UNP P00388

- Molecule 2 is FLAVIN MONONUCLEOTIDE (CCD ID: FMN) (formula: $C_{17}H_{21}N_4O_9P$).



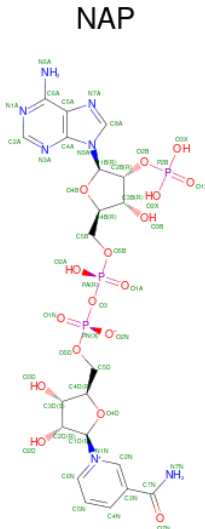
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	AAA	1	Total	C	N	O	P	0	0
			31	17	4	9	1		
2	BBB	1	Total	C	N	O	P	0	0
			31	17	4	9	1		

- Molecule 3 is FLAVIN-ADENINE DINUCLEOTIDE (CCD ID: FAD) (formula: C₂₇H₃₃N₉O₁₅P₂).



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

- Molecule 4 is NADP NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (CCD ID: NAP) (formula: C₂₁H₂₈N₇O₁₇P₃).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	AAA	1	Total 48	C 21	N 7	O 17	P 3	0	0
4	BBB	1	Total 31	C 10	N 5	O 13	P 3	0	0

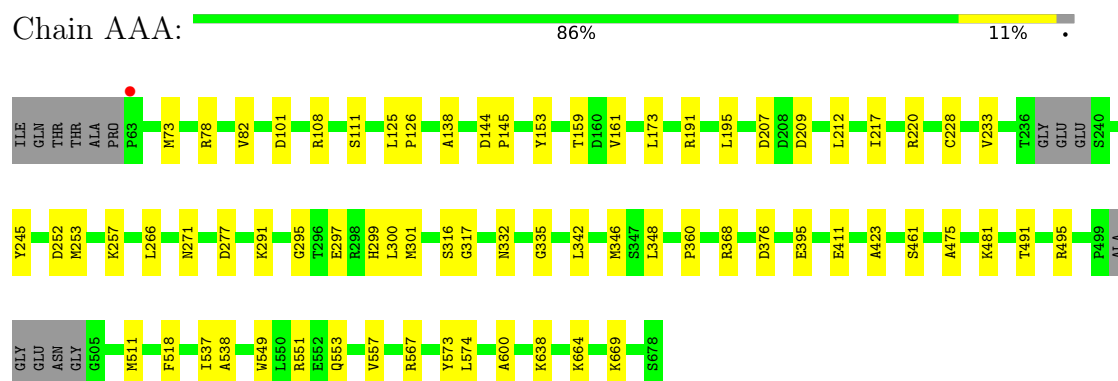
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	AAA	200	Total O 200 200	0	0
5	BBB	120	Total O 120 120	0	0

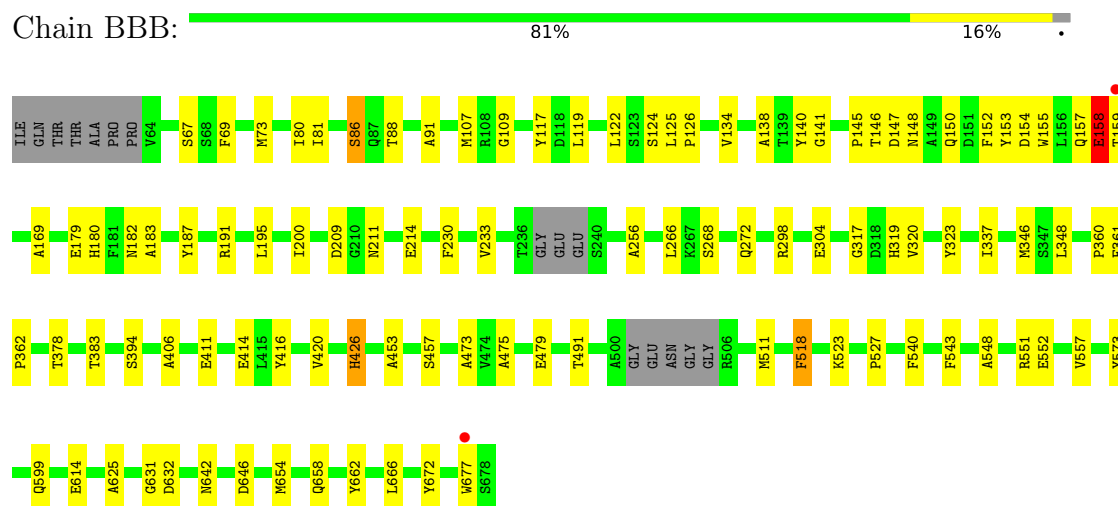
3 Residue-property plots

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

- Molecule 1: NADPH-cytochrome P450 reductase



- Molecule 1: NADPH-cytochrome P450 reductase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	103.06Å 114.82Å 120.28Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.79 – 2.54 29.79 – 2.54	Depositor EDS
% Data completeness (in resolution range)	89.8 (29.79-2.54) 89.8 (29.79-2.54)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.69 (at 2.54Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.181 , 0.254 0.185 , 0.257	Depositor DCC
R_{free} test set	2143 reflections (4.50%)	wwPDB-VP
Wilson B-factor (Å ²)	41.0	Xtriage
Anisotropy	0.364	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 29.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.025 for -h,l,k	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	10291	wwPDB-VP
Average B, all atoms (Å ²)	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 11.52% 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 [i](#)

5.1 Standard geometry [i](#)

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

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	AAA	0.99	0/4981	1.38	1/6737 (0.0%)
1	BBB	1.03	0/4974	1.40	2/6728 (0.0%)
All	All	1.01	0/9955	1.39	3/13465 (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	BBB	518	PHE	CA-CB-CG	6.53	120.33	113.80
1	AAA	376	ASP	CA-CB-CG	5.97	118.57	112.60
1	BBB	631	GLY	CA-C-O	-5.31	117.41	122.13

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	AAA	4865	0	4718	39	0
1	BBB	4859	0	4712	63	0
2	AAA	31	0	19	0	0
2	BBB	31	0	19	2	0
3	AAA	53	0	31	0	0
3	BBB	53	0	31	1	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	AAA	48	0	25	0	0
4	BBB	31	0	11	1	0
5	AAA	200	0	0	4	0
5	BBB	120	0	0	4	0
All	All	10291	0	9566	101	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 5.

The worst 5 of 101 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:BBB:191:ARG:O	1:BBB:195:LEU:HD12	1.73	0.87
1:AAA:301:MET:HE1	1:AAA:495:ARG:HB2	1.74	0.69
1:BBB:107:MET:HE2	1:BBB:233:VAL:HG21	1.76	0.67
1:BBB:614:GLU:HB2	5:BBB:851:HOH:O	1.94	0.67
1:AAA:300:LEU:HD22	1:AAA:574:LEU:HD21	1.77	0.67

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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

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

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	AAA	600/620 (97%)	581 (97%)	19 (3%)	0	100	100
1	BBB	599/620 (97%)	554 (92%)	39 (6%)	6 (1%)	12	17
All	All	1199/1240 (97%)	1135 (95%)	58 (5%)	6 (0%)	24	34

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	BBB	141	GLY
1	BBB	147	ASP
1	BBB	158	GLU
1	BBB	179	GLU
1	BBB	632	ASP

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	AAA	520/529 (98%)	513 (99%)	7 (1%)	61 76
1	BBB	519/529 (98%)	506 (98%)	13 (2%)	42 60
All	All	1039/1058 (98%)	1019 (98%)	20 (2%)	50 69

5 of 20 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	BBB	411	GLU
1	BBB	479	GLU
1	BBB	672	TYR
1	BBB	573	TYR
1	AAA	664	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 ⓘ

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
3	FAD	BBB	702	-	58,58,58	0.56	0	85,89,89	0.73	1 (1%)
2	FMN	BBB	701	-	33,33,33	0.55	0	48,50,50	0.70	1 (2%)
4	NAP	BBB	703	-	32,33,52	0.91	2 (6%)	50,52,80	0.69	0
3	FAD	AAA	702	-	58,58,58	0.64	1 (1%)	85,89,89	0.75	0
2	FMN	AAA	701	-	33,33,33	0.59	0	48,50,50	0.73	1 (2%)
4	NAP	AAA	703	-	50,52,52	0.78	3 (6%)	71,80,80	0.77	2 (2%)

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	BBB	702	-	-	2/34/50/50	0/6/6/6
2	FMN	BBB	701	-	-	5/18/18/18	0/3/3/3
4	NAP	BBB	703	-	-	2/21/37/67	0/3/3/5
3	FAD	AAA	702	-	-	2/34/50/50	0/6/6/6
2	FMN	AAA	701	-	-	1/18/18/18	0/3/3/3
4	NAP	AAA	703	-	-	15/35/67/67	0/5/5/5

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	BBB	703	NAP	P2B-O2B	3.87	1.66	1.59

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	AAA	703	NAP	C2N-N1N	3.17	1.38	1.35
4	AAA	703	NAP	O4D-C1D	2.18	1.43	1.40
3	AAA	702	FAD	C2-N1	-2.10	1.31	1.36
4	BBB	703	NAP	PN-O5D	2.06	1.62	1.54

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	AAA	703	NAP	C6N-N1N-C2N	-2.93	119.38	121.88
4	AAA	703	NAP	O2B-P2B-O1X	-2.60	100.06	109.33
3	BBB	702	FAD	C4-N3-C2	-2.33	121.51	125.64
2	AAA	701	FMN	C4-N3-C2	-2.11	121.90	125.64
2	BBB	701	FMN	C4-N3-C2	-2.06	121.98	125.64

There are no chirality outliers.

5 of 27 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	BBB	701	FMN	C5'-O5'-P-O1P
2	BBB	701	FMN	C5'-O5'-P-O2P
2	BBB	701	FMN	C5'-O5'-P-O3P
4	AAA	703	NAP	C5B-O5B-PA-O1A
4	BBB	703	NAP	C2B-C1B-N9A-C8A

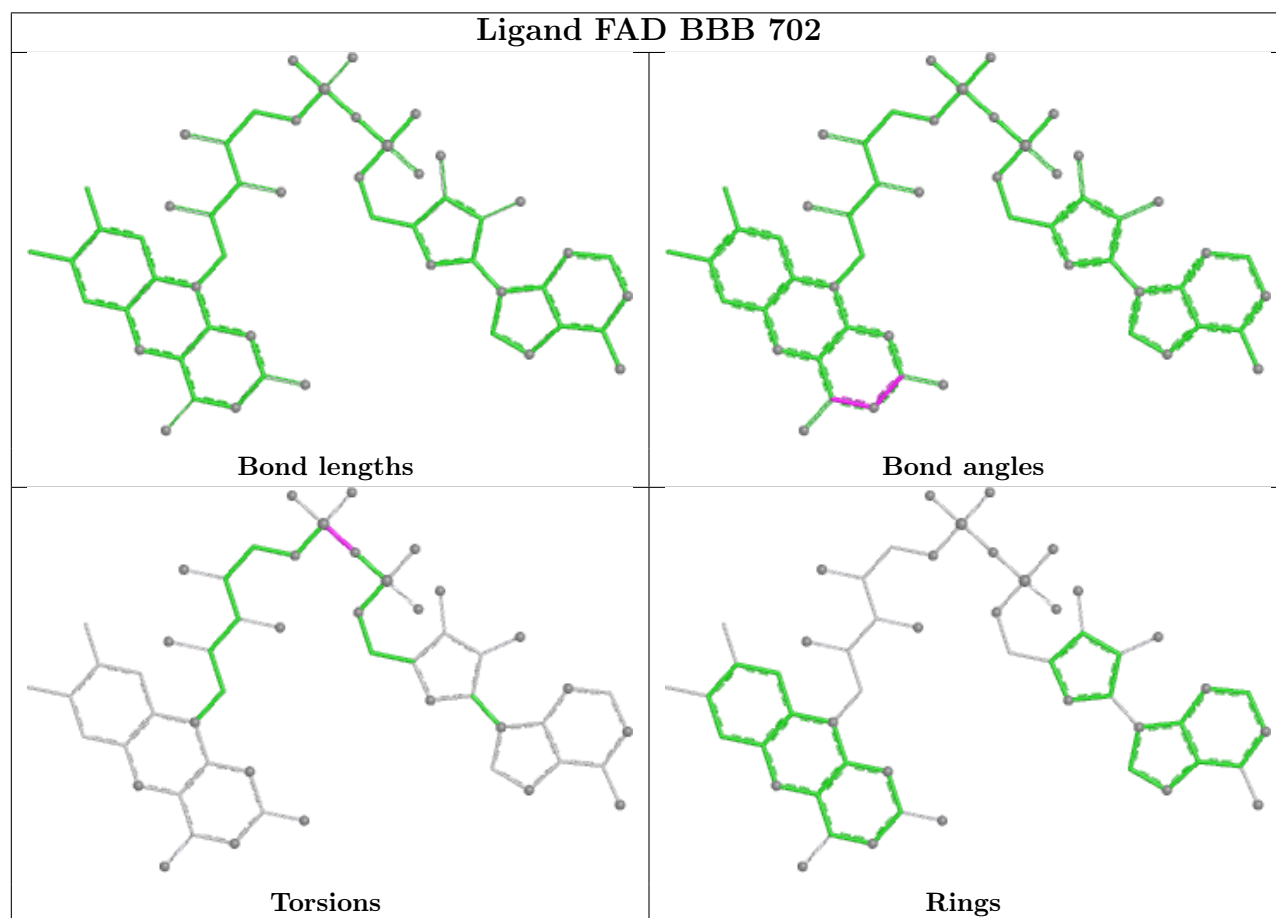
There are no ring outliers.

3 monomers are involved in 4 short contacts:

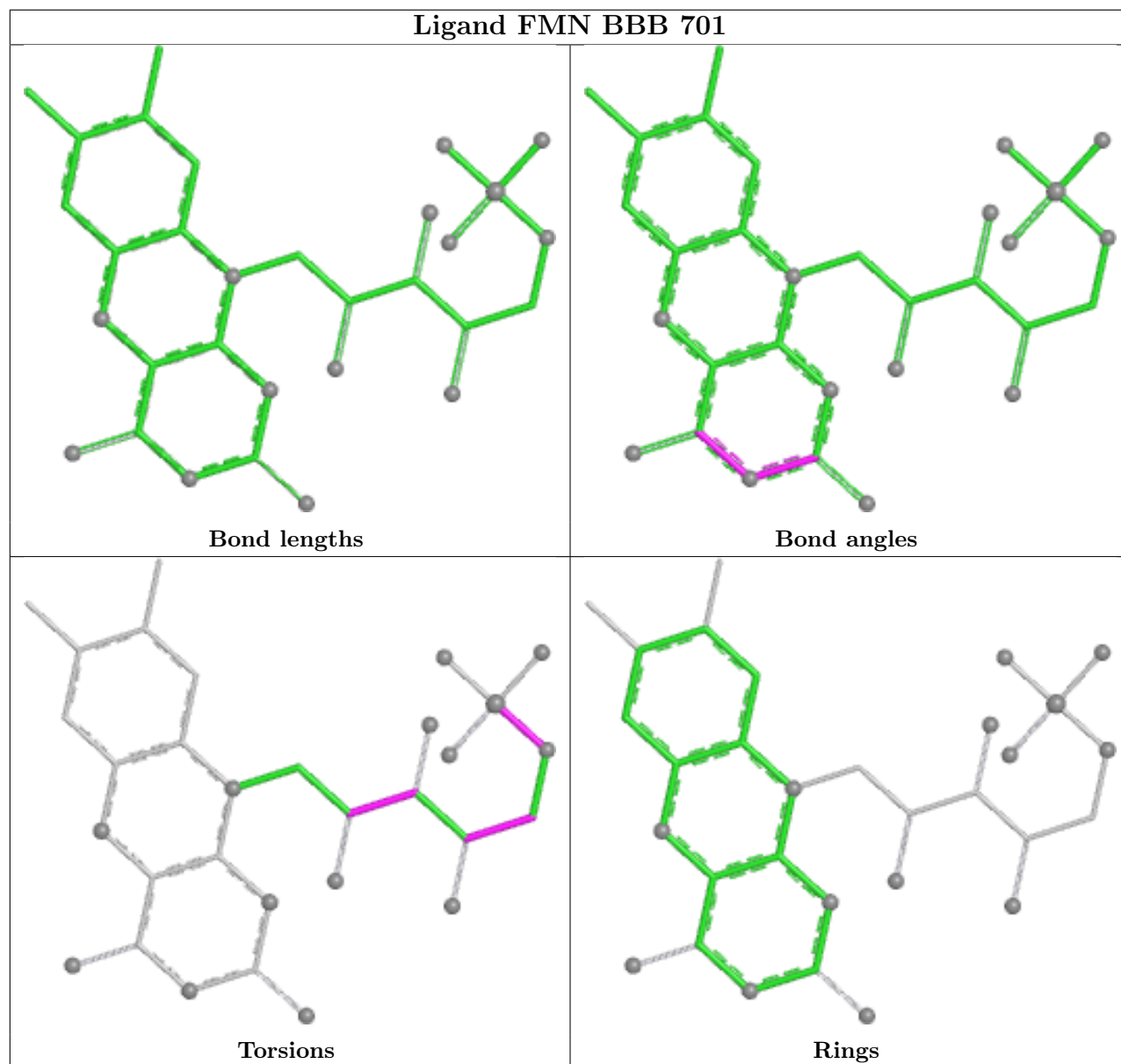
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	BBB	702	FAD	1	0
2	BBB	701	FMN	2	0
4	BBB	703	NAP	1	0

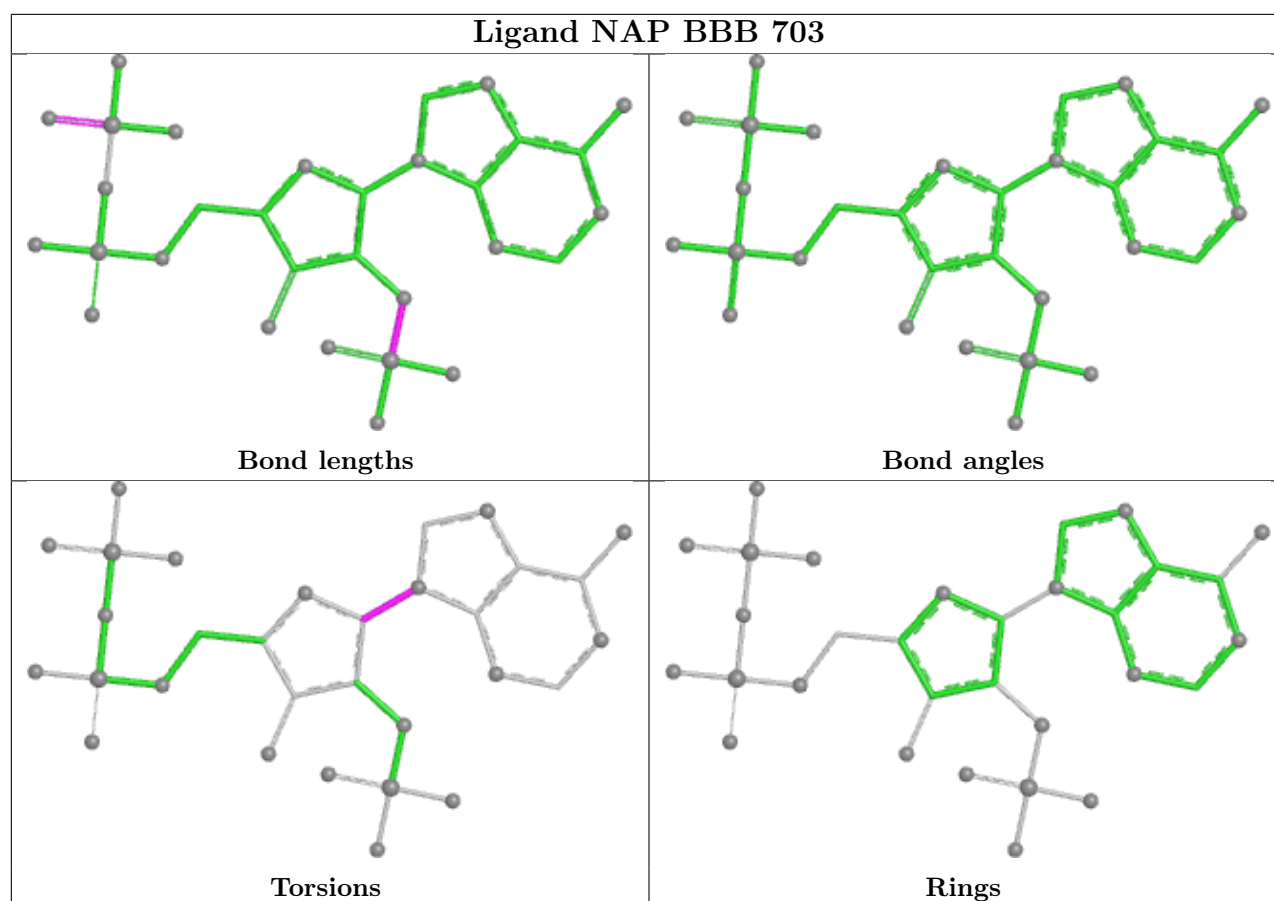
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

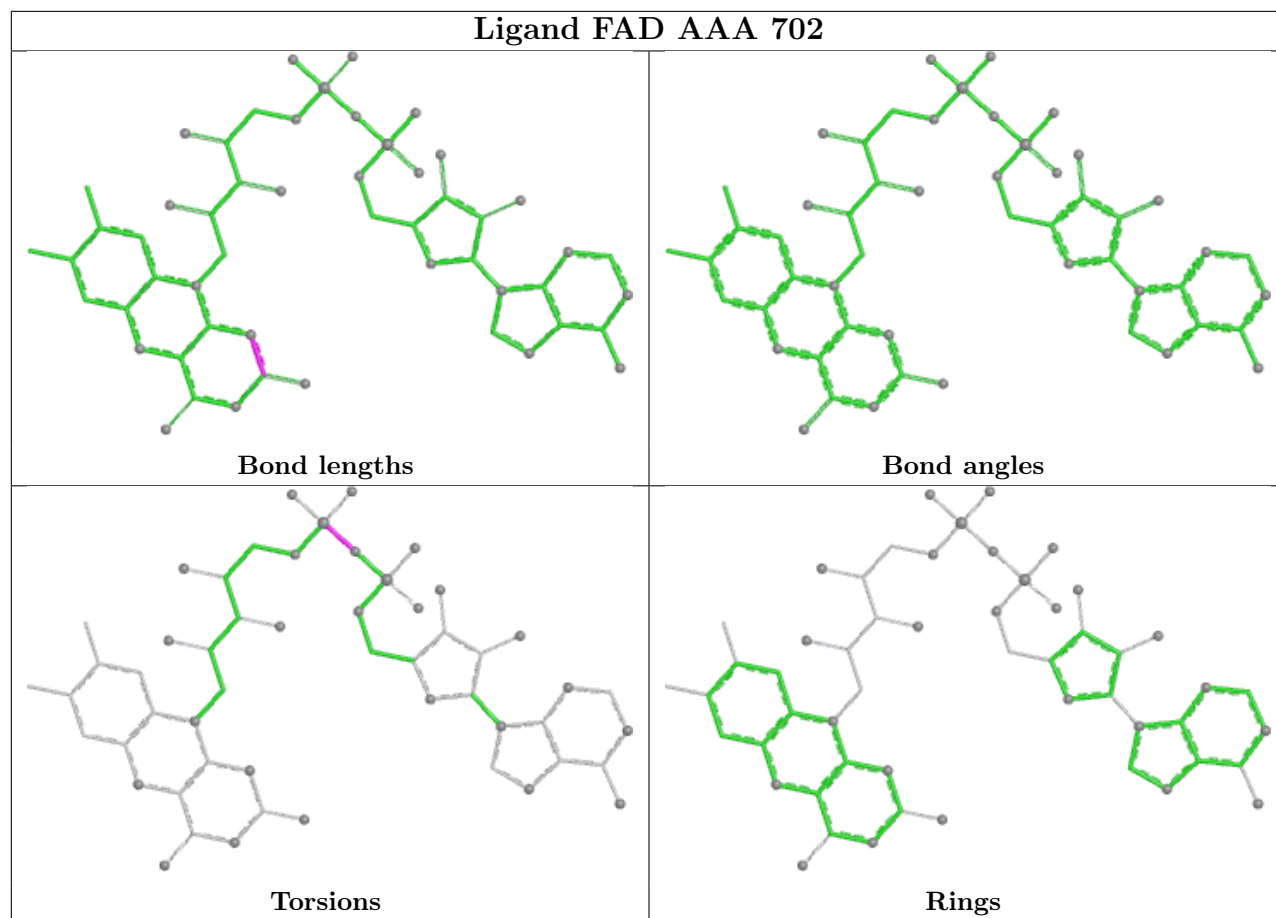
The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



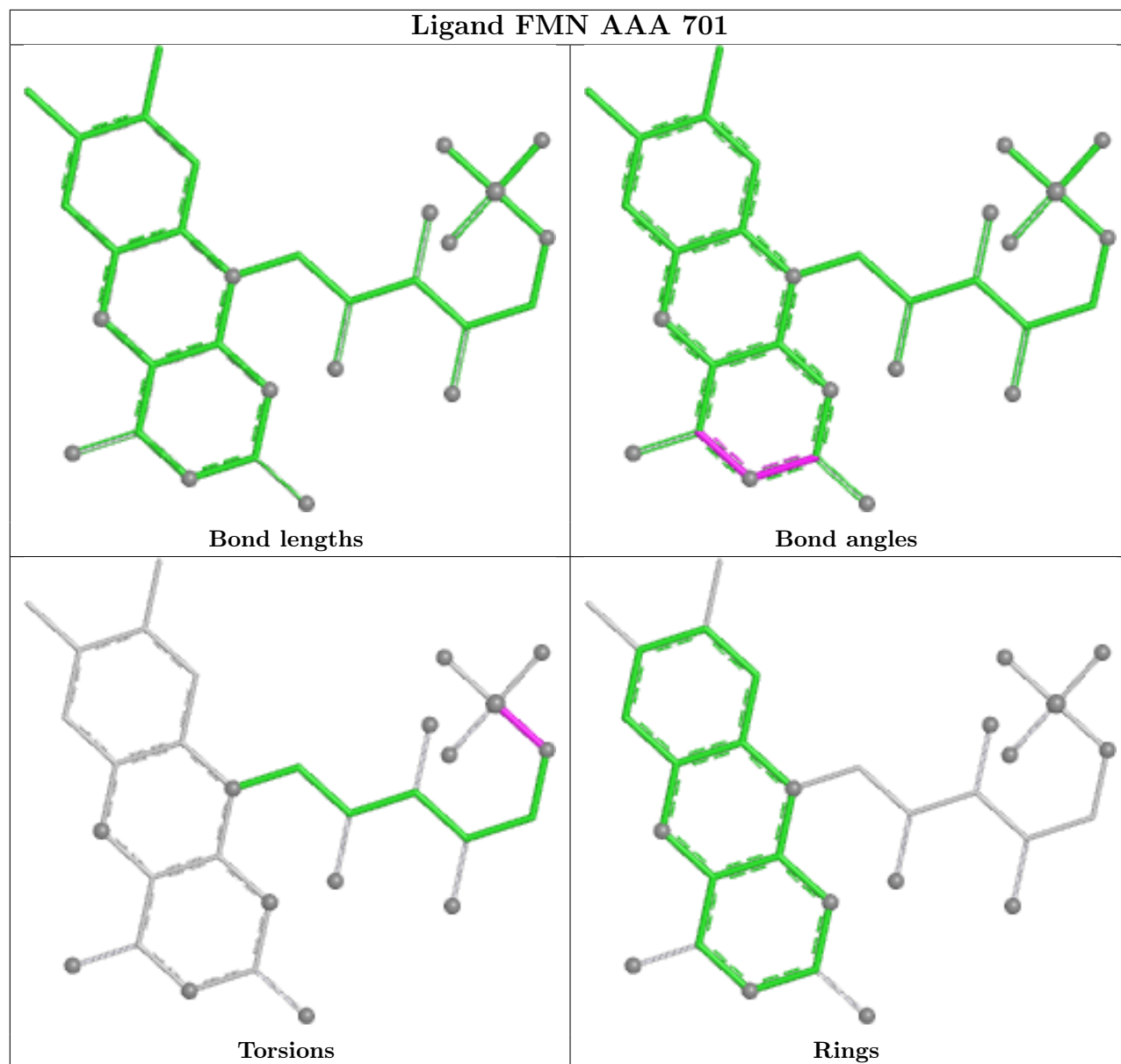
Ligand FMN BBB 701

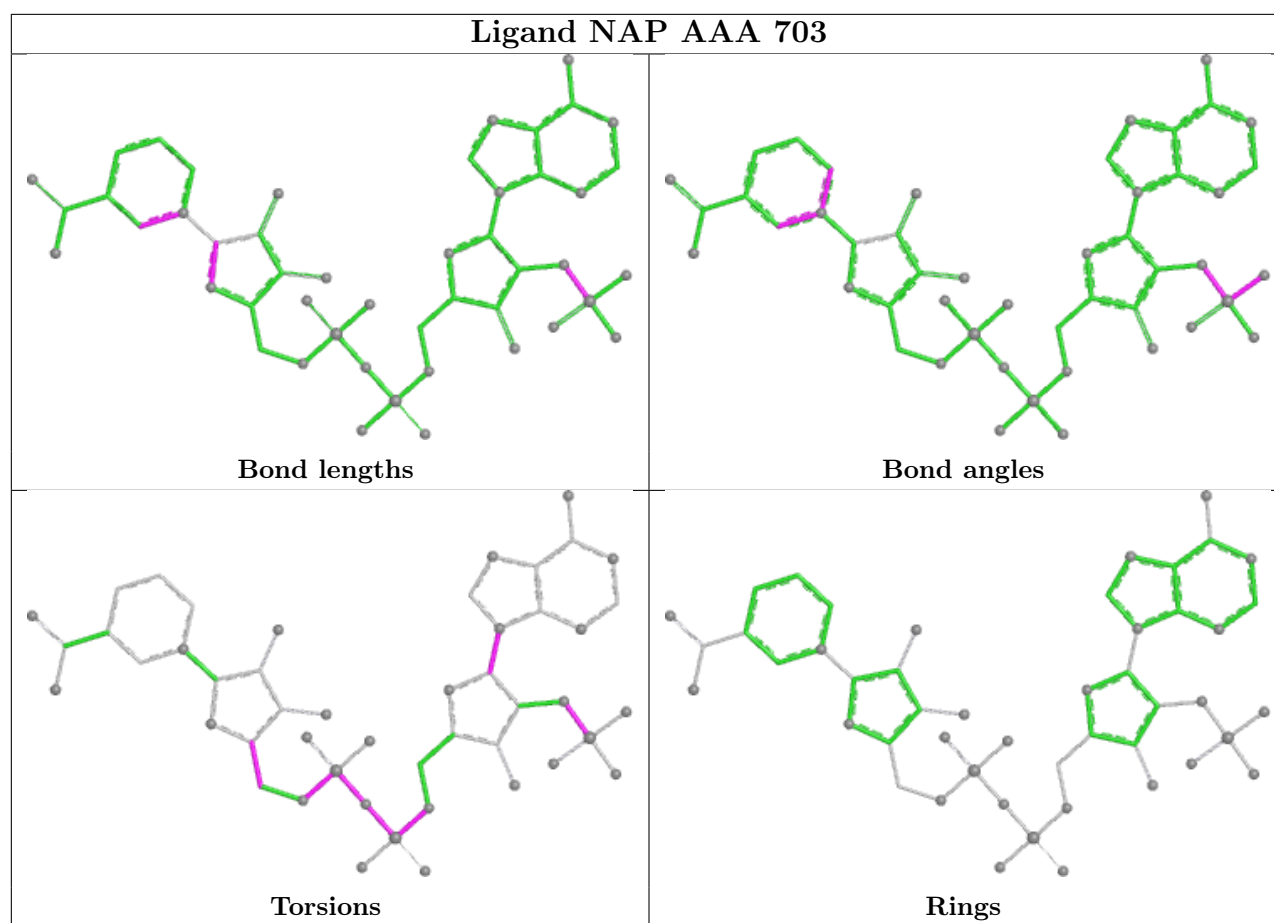






Ligand FMN AAA 701





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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	AAA	606/620 (97%)	-0.41	1 (0%) 91 93	28, 42, 65, 96	0
1	BBB	605/620 (97%)	-0.05	2 (0%) 90 92	29, 54, 94, 133	0
All	All	1211/1240 (97%)	-0.23	3 (0%) 91 93	28, 46, 88, 133	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	BBB	677	TRP	2.7
1	AAA	63	PRO	2.1
1	BBB	159	THR	2.1

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
2	FMN	BBB	701	31/31	0.90	0.10	63,84,91,91	0
4	NAP	AAA	703	48/48	0.95	0.10	30,48,125,128	0

Continued on next page...

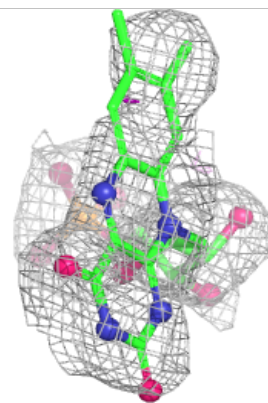
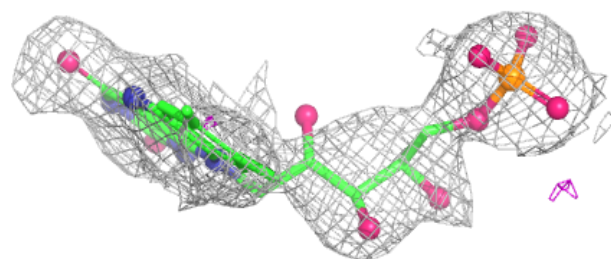
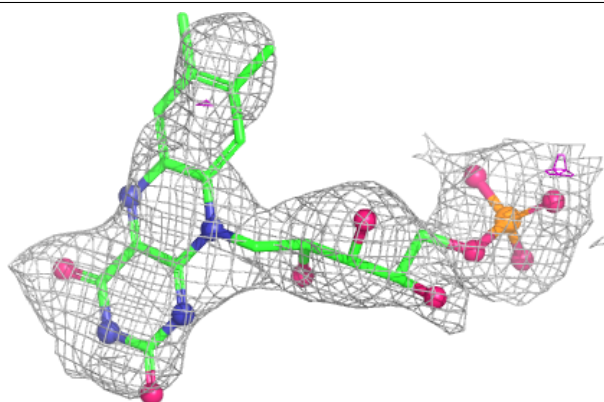
Continued from previous page...

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	FMN	AAA	701	31/31	0.96	0.06	31,43,50,56	0
3	FAD	BBB	702	53/53	0.97	0.05	29,34,40,43	0
3	FAD	AAA	702	53/53	0.97	0.05	24,33,44,48	0
4	NAP	BBB	703	31/48	0.97	0.05	28,33,51,54	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.

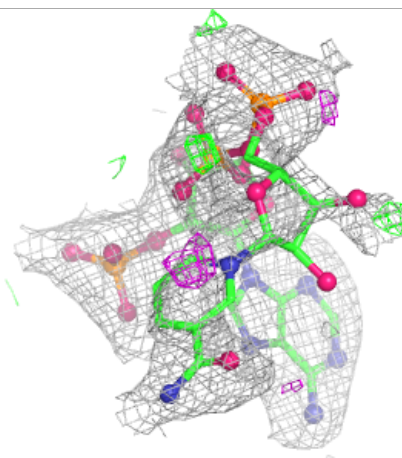
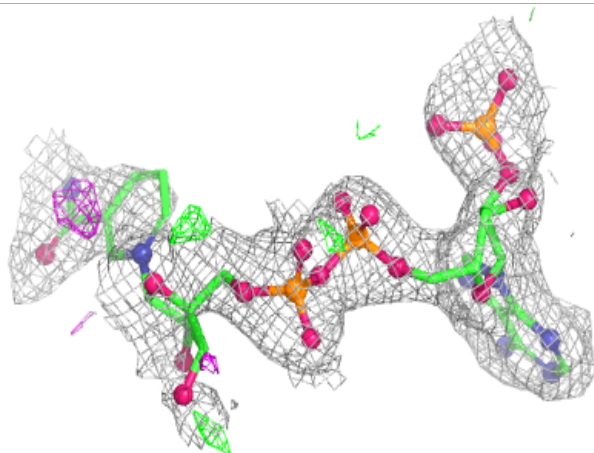
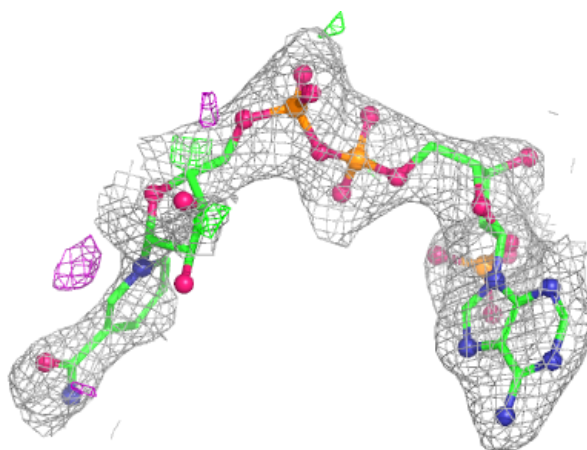
Electron density around FMN BBB 701:

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



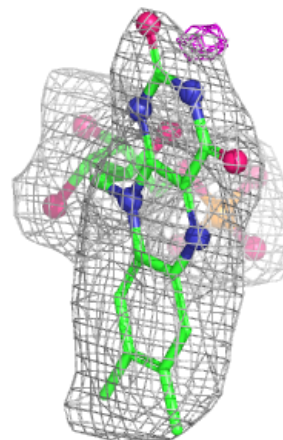
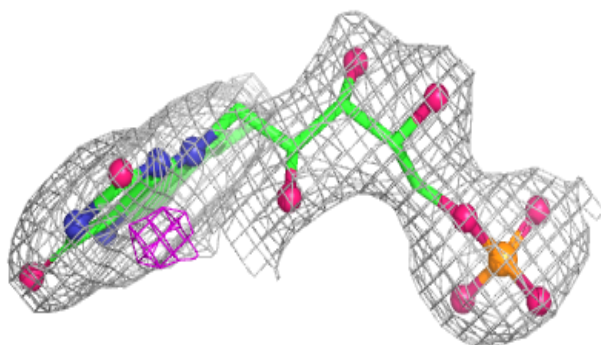
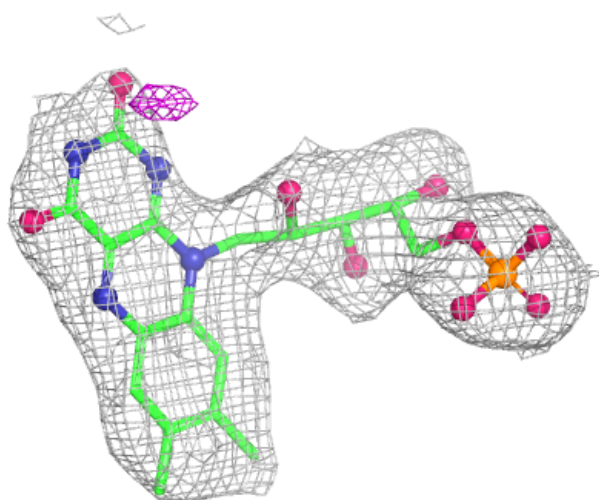
Electron density around NAP AAA 703:

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



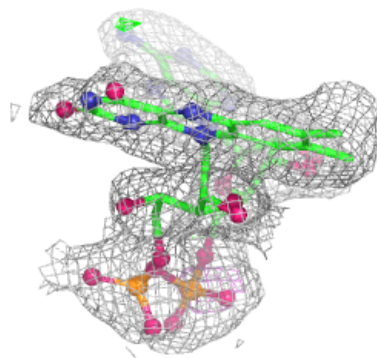
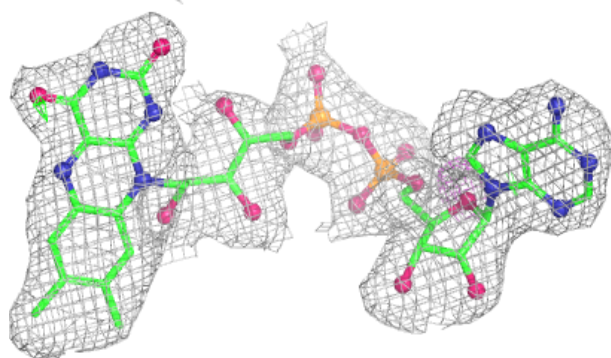
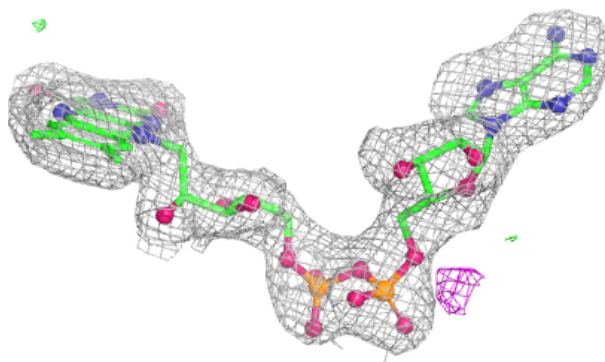
Electron density around FMN AAA 701:

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

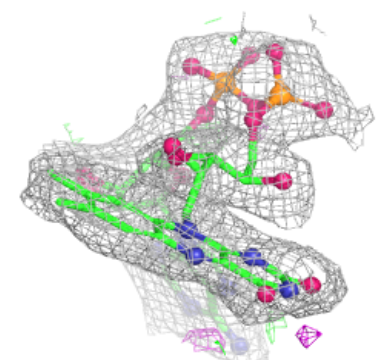
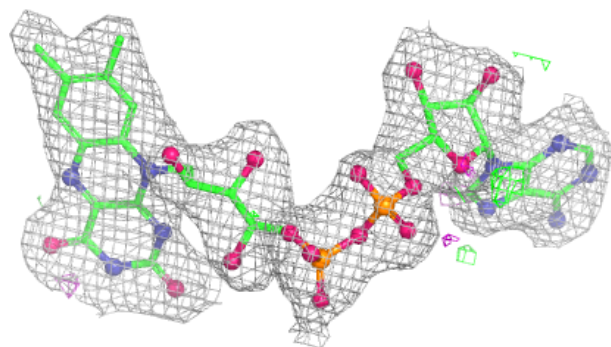
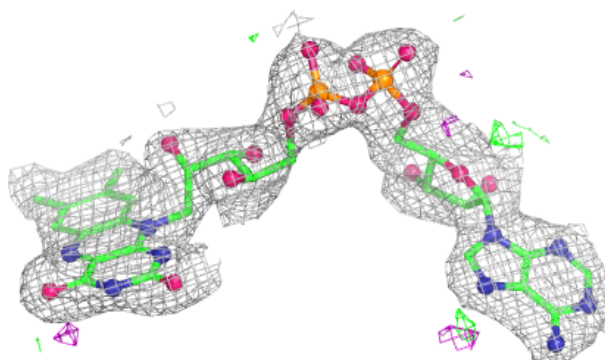


Electron density around FAD BBB 702:

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

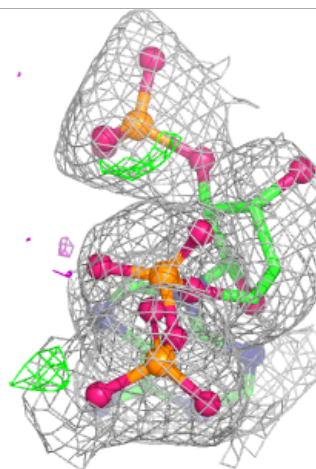
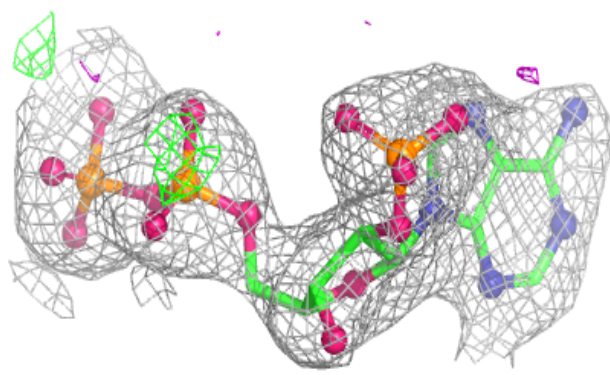
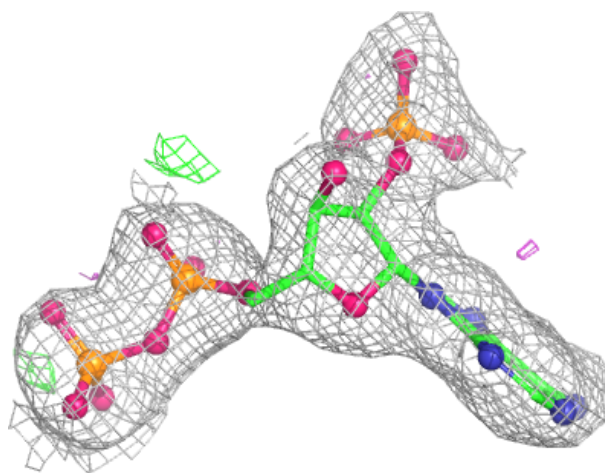
**Electron density around FAD AAA 702:**

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



Electron density around NAP BBB 703:

$2mF_o-DF_c$ (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.