



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 09:10 AM UTC

PDB ID : 5BOO / pdb_00005boo
Title : Crystal structure of Plasmodium falciparum dihydroorotate dehydrogenase bound with Inhibitor DSM265
Authors : Phillips, M.; Deng, X.; Tomchick, D.
Deposited on : 2015-05-27
Resolution : 2.80 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

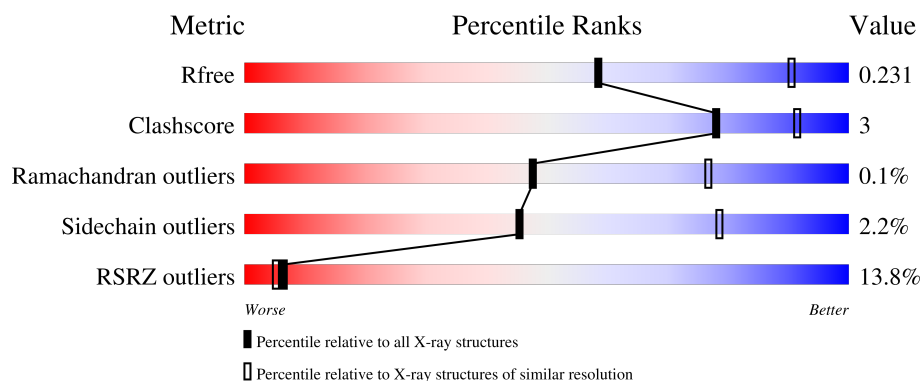
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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	415	9% 80% 9% 10%
1	B	415	16% 83% 7% 10%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	ORO	A	1003	-	X	-	-

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 12128 atoms, of which 6075 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 Dihydroorotate dehydrogenase (quinone), mitochondrial.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	374	Total	C	H	N	O	S	0	0	0
			5972	1893	3010	496	558	15			
1	B	373	Total	C	H	N	O	S	0	0	0
			5950	1887	2997	494	557	15			

There are 126 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	125	MET	-	expression tag	UNP Q08210
A	126	GLY	-	expression tag	UNP Q08210
A	127	SER	-	expression tag	UNP Q08210
A	128	SER	-	expression tag	UNP Q08210
A	129	HIS	-	expression tag	UNP Q08210
A	130	HIS	-	expression tag	UNP Q08210
A	131	HIS	-	expression tag	UNP Q08210
A	132	HIS	-	expression tag	UNP Q08210
A	133	HIS	-	expression tag	UNP Q08210
A	134	HIS	-	expression tag	UNP Q08210
A	135	SER	-	expression tag	UNP Q08210
A	136	SER	-	expression tag	UNP Q08210
A	137	GLY	-	expression tag	UNP Q08210
A	138	LEU	-	expression tag	UNP Q08210
A	139	VAL	-	expression tag	UNP Q08210
A	140	PRO	-	expression tag	UNP Q08210
A	141	ARG	-	expression tag	UNP Q08210
A	142	GLY	-	expression tag	UNP Q08210
A	143	SER	-	expression tag	UNP Q08210
A	144	HIS	-	expression tag	UNP Q08210
A	145	MET	-	expression tag	UNP Q08210
A	146	ALA	-	expression tag	UNP Q08210
A	147	SER	-	expression tag	UNP Q08210
A	148	MET	-	expression tag	UNP Q08210
A	149	THR	-	expression tag	UNP Q08210

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Chain	Residue	Modelled	Actual	Comment	Reference
A	150	GLY	-	expression tag	UNP Q08210
A	151	GLY	-	expression tag	UNP Q08210
A	152	GLN	-	expression tag	UNP Q08210
A	153	GLN	-	expression tag	UNP Q08210
A	154	GLY	-	expression tag	UNP Q08210
A	155	ARG	-	expression tag	UNP Q08210
A	156	ASP	-	expression tag	UNP Q08210
A	157	PRO	-	expression tag	UNP Q08210
A	?	-	SER	deletion	UNP Q08210
A	?	-	THR	deletion	UNP Q08210
A	?	-	TYR	deletion	UNP Q08210
A	?	-	ASN	deletion	UNP Q08210
A	?	-	GLU	deletion	UNP Q08210
A	?	-	ASP	deletion	UNP Q08210
A	?	-	ASN	deletion	UNP Q08210
A	?	-	LYS	deletion	UNP Q08210
A	?	-	ILE	deletion	UNP Q08210
A	?	-	VAL	deletion	UNP Q08210
A	?	-	GLU	deletion	UNP Q08210
A	?	-	LYS	deletion	UNP Q08210
A	?	-	LYS	deletion	UNP Q08210
A	?	-	ASN	deletion	UNP Q08210
A	?	-	ASN	deletion	UNP Q08210
A	?	-	PHE	deletion	UNP Q08210
A	?	-	ASN	deletion	UNP Q08210
A	?	-	LYS	deletion	UNP Q08210
A	?	-	ASN	deletion	UNP Q08210
A	?	-	ASN	deletion	UNP Q08210
A	?	-	SER	deletion	UNP Q08210
A	?	-	HIS	deletion	UNP Q08210
A	?	-	MET	deletion	UNP Q08210
A	?	-	MET	deletion	UNP Q08210
A	?	-	LYS	deletion	UNP Q08210
A	?	-	ASP	deletion	UNP Q08210
A	?	-	ALA	deletion	UNP Q08210
A	?	-	LYS	deletion	UNP Q08210
A	?	-	ASP	deletion	UNP Q08210
A	?	-	ASN	deletion	UNP Q08210
B	125	MET	-	expression tag	UNP Q08210
B	126	GLY	-	expression tag	UNP Q08210
B	127	SER	-	expression tag	UNP Q08210
B	128	SER	-	expression tag	UNP Q08210

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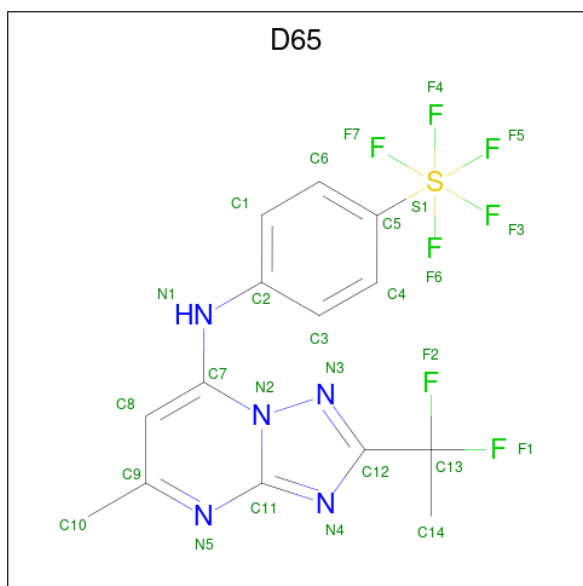
Chain	Residue	Modelled	Actual	Comment	Reference
B	129	HIS	-	expression tag	UNP Q08210
B	130	HIS	-	expression tag	UNP Q08210
B	131	HIS	-	expression tag	UNP Q08210
B	132	HIS	-	expression tag	UNP Q08210
B	133	HIS	-	expression tag	UNP Q08210
B	134	HIS	-	expression tag	UNP Q08210
B	135	SER	-	expression tag	UNP Q08210
B	136	SER	-	expression tag	UNP Q08210
B	137	GLY	-	expression tag	UNP Q08210
B	138	LEU	-	expression tag	UNP Q08210
B	139	VAL	-	expression tag	UNP Q08210
B	140	PRO	-	expression tag	UNP Q08210
B	141	ARG	-	expression tag	UNP Q08210
B	142	GLY	-	expression tag	UNP Q08210
B	143	SER	-	expression tag	UNP Q08210
B	144	HIS	-	expression tag	UNP Q08210
B	145	MET	-	expression tag	UNP Q08210
B	146	ALA	-	expression tag	UNP Q08210
B	147	SER	-	expression tag	UNP Q08210
B	148	MET	-	expression tag	UNP Q08210
B	149	THR	-	expression tag	UNP Q08210
B	150	GLY	-	expression tag	UNP Q08210
B	151	GLY	-	expression tag	UNP Q08210
B	152	GLN	-	expression tag	UNP Q08210
B	153	GLN	-	expression tag	UNP Q08210
B	154	GLY	-	expression tag	UNP Q08210
B	155	ARG	-	expression tag	UNP Q08210
B	156	ASP	-	expression tag	UNP Q08210
B	157	PRO	-	expression tag	UNP Q08210
B	?	-	SER	deletion	UNP Q08210
B	?	-	THR	deletion	UNP Q08210
B	?	-	TYR	deletion	UNP Q08210
B	?	-	ASN	deletion	UNP Q08210
B	?	-	GLU	deletion	UNP Q08210
B	?	-	ASP	deletion	UNP Q08210
B	?	-	ASN	deletion	UNP Q08210
B	?	-	LYS	deletion	UNP Q08210
B	?	-	ILE	deletion	UNP Q08210
B	?	-	VAL	deletion	UNP Q08210
B	?	-	GLU	deletion	UNP Q08210
B	?	-	LYS	deletion	UNP Q08210
B	?	-	LYS	deletion	UNP Q08210

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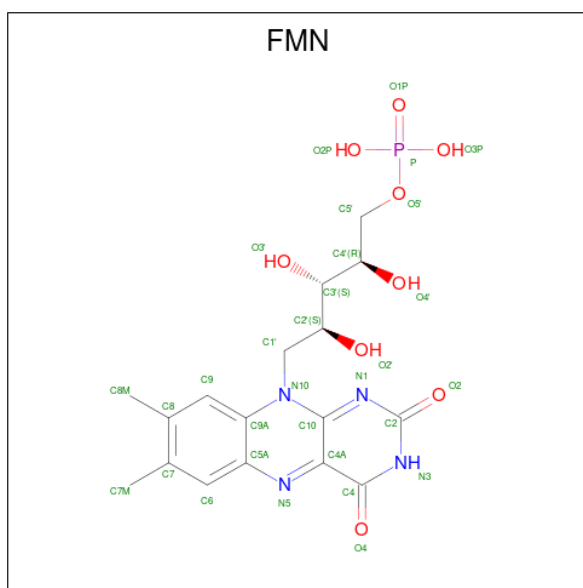
Chain	Residue	Modelled	Actual	Comment	Reference
B	?	-	ASN	deletion	UNP Q08210
B	?	-	ASN	deletion	UNP Q08210
B	?	-	PHE	deletion	UNP Q08210
B	?	-	ASN	deletion	UNP Q08210
B	?	-	LYS	deletion	UNP Q08210
B	?	-	ASN	deletion	UNP Q08210
B	?	-	ASN	deletion	UNP Q08210
B	?	-	SER	deletion	UNP Q08210
B	?	-	HIS	deletion	UNP Q08210
B	?	-	MET	deletion	UNP Q08210
B	?	-	MET	deletion	UNP Q08210
B	?	-	LYS	deletion	UNP Q08210
B	?	-	ASP	deletion	UNP Q08210
B	?	-	ALA	deletion	UNP Q08210
B	?	-	LYS	deletion	UNP Q08210
B	?	-	ASP	deletion	UNP Q08210
B	?	-	ASN	deletion	UNP Q08210

- Molecule 2 is 2-(1,1-difluoroethyl)-5-methyl-N-[4-(pentafluoro-lambda 6 -sulfanyl)phenyl][1,2,4]triazolo[1,5-a]pyrimidin-7-amine (CCD ID: D65) (formula: C₁₄H₁₂F₇N₅S).



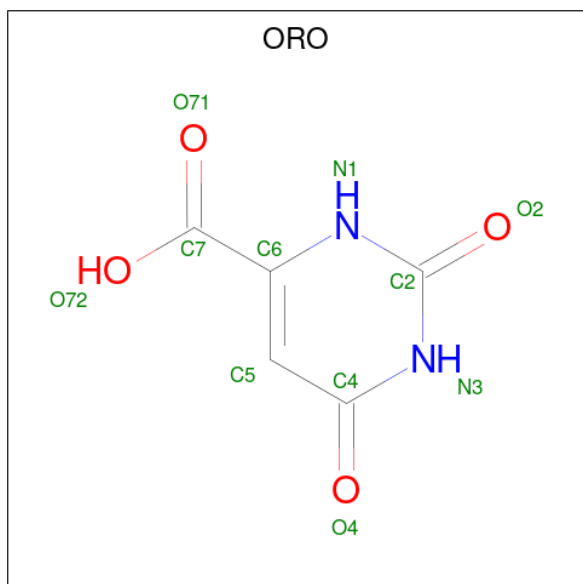
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	A	1	Total	C	F	H	N	S	0	0
			39	14	7	12	5	1		
2	B	1	Total	C	F	H	N	S	0	0
			39	14	7	12	5	1		

- Molecule 3 is FLAVIN MONONUCLEOTIDE (CCD ID: FMN) (formula: $C_{17}H_{21}N_4O_9P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
3	A	1	Total	C	H	N	O	P	0	0
			50	17	19	4	9	1		
3	B	1	Total	C	H	N	O	P	0	0
			50	17	19	4	9	1		

- Molecule 4 is OROTIC ACID (CCD ID: ORO) (formula: $C_5H_4N_2O_4$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	H	N	O	0	0
			14	5	3	2	4		

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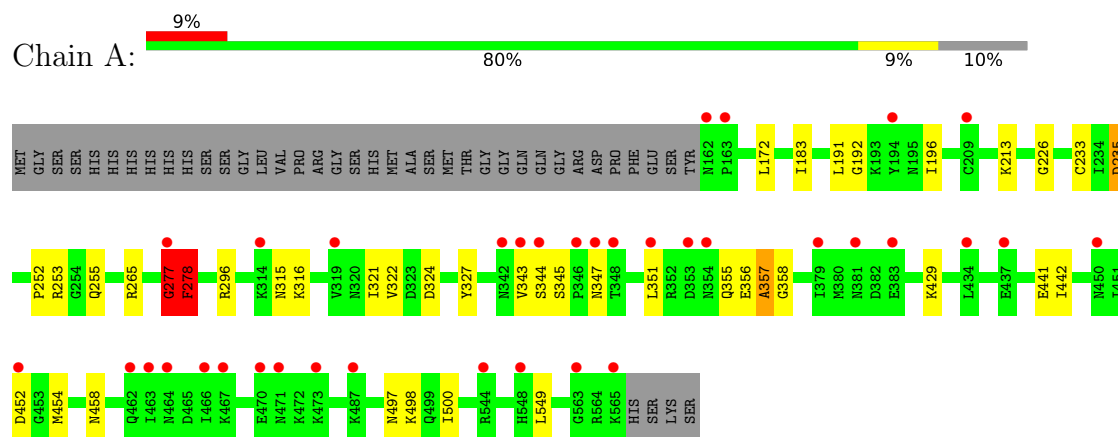
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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	B	1	Total	C	H	N	O	0	0
			14	5	3	2	4		

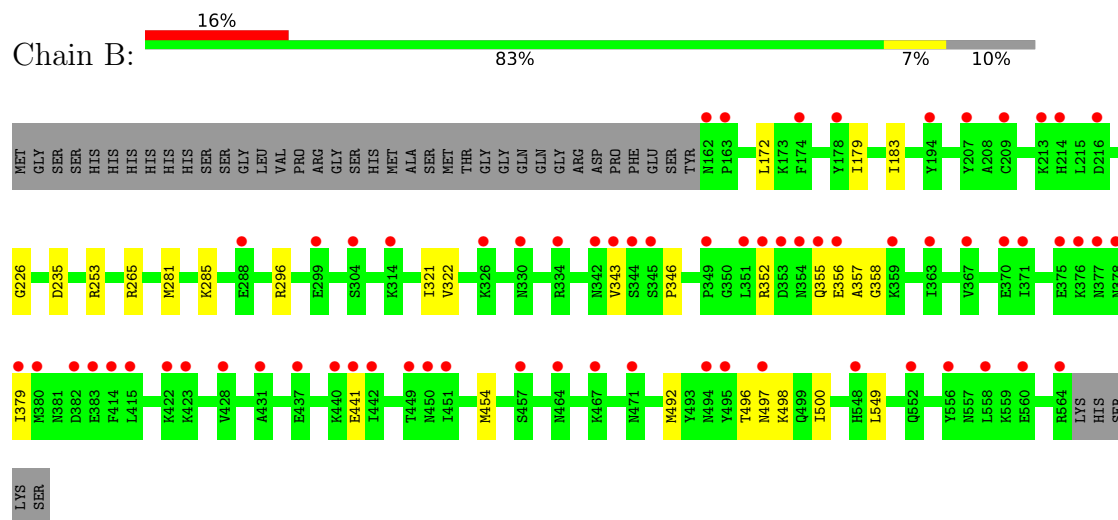
3 Residue-property plots [i](#)

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: Dihydroorotate dehydrogenase (quinone), mitochondrial



- Molecule 1: Dihydroorotate dehydrogenase (quinone), mitochondrial



4 Data and refinement statistics

Property	Value	Source
Space group	P 65	Depositor
Cell constants a, b, c, α , β , γ	89.26Å 89.26Å 275.61Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	44.10 – 2.80 44.10 – 2.80	Depositor EDS
% Data completeness (in resolution range)	88.7 (44.10-2.80) 89.5 (44.10-2.80)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.13 (at 2.77Å)	Xtriage
Refinement program	PHENIX 1.9_1692	Depositor
R, R_{free}	0.234 , 0.254 (Not available) , 0.231	Depositor DCC
R_{free} test set	1988 reflections (6.45%)	wwPDB-VP
Wilson B-factor (Å ²)	44.0	Xtriage
Anisotropy	0.074	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 38.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.063 for h,-h-k,-l	Xtriage
F_o, F_c correlation	0.89	EDS
Total number of atoms	12128	wwPDB-VP
Average B, all atoms (Å ²)	62.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.49% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

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

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: D65, FMN, ORO

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	0.35	0/3011	0.79	4/4054 (0.1%)
1	B	0.34	0/3002	0.76	2/4043 (0.0%)
All	All	0.35	0/6013	0.78	6/8097 (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

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	358	GLY	N-CA-C	6.17	120.67	112.77
1	A	357	ALA	N-CA-C	5.99	117.81	111.28
1	A	356	GLU	N-CA-C	-5.95	102.68	110.53
1	B	358	GLY	N-CA-C	5.80	120.20	112.77
1	B	356	GLU	N-CA-C	-5.64	103.08	110.53
1	A	277	GLY	N-CA-C	5.52	122.70	115.36

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	277	GLY	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	2962	3010	3010	22	0
1	B	2953	2997	2997	12	0
2	A	27	12	12	1	0
2	B	27	12	12	0	0
3	A	31	19	19	1	0
3	B	31	19	19	1	0
4	A	11	3	3	2	0
4	B	11	3	3	0	0
All	All	6053	6075	6075	34	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 3.

All (34) 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:277:GLY:HA2	1:A:347:ASN:HB3	1.81	0.63
1:B:497:ASN:O	1:B:498:LYS:HG2	2.02	0.60
1:A:343:VAL:HG23	1:A:355:GLN:HG2	1.85	0.59
1:A:344:SER:O	1:A:458:ASN:ND2	2.37	0.57
1:A:497:ASN:O	1:A:498:LYS:HG2	2.05	0.55
1:B:281:MET:HE2	1:B:285:LYS:HG2	1.87	0.54
1:A:235:ASP:OD1	1:A:296:ARG:NH1	2.41	0.53
1:B:179:ILE:O	1:B:265:ARG:NH2	2.33	0.50
1:B:454:MET:HE2	1:B:500:ILE:HB	1.96	0.47
1:B:321:ILE:HG23	1:B:322:VAL:N	2.29	0.47
1:B:343:VAL:HG23	1:B:355:GLN:HG2	1.97	0.47
1:A:277:GLY:O	1:A:278:PHE:HB2	2.15	0.46
1:A:345:SER:HB3	1:A:351:LEU:HD23	1.98	0.46
1:B:226:GLY:HA3	3:B:1002:FMN:N5	2.30	0.46
1:A:345:SER:HB3	1:A:351:LEU:CD2	2.46	0.46
1:A:226:GLY:HA3	3:A:1002:FMN:N5	2.32	0.45
1:A:321:ILE:HG23	1:A:322:VAL:N	2.31	0.45
1:A:278:PHE:CE1	4:A:1003:ORO:H5	2.52	0.44
1:B:235:ASP:OD1	1:B:296:ARG:NH1	2.49	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:492:MET:O	1:B:496:THR:OG1	2.28	0.44
1:A:357:ALA:HB2	1:A:441:GLU:HG2	2.00	0.43
1:A:454:MET:HE2	1:A:500:ILE:HB	1.99	0.43
1:A:265:ARG:HD3	2:A:1001:D65:N4	2.34	0.43
1:A:255:GLN:OE1	1:A:316:LYS:N	2.43	0.42
1:B:357:ALA:HB2	1:B:441:GLU:HG2	2.01	0.42
1:A:344:SER:OG	1:A:429:LYS:O	2.37	0.42
1:A:192:GLY:HA3	1:A:233:CYS:SG	2.60	0.42
1:A:278:PHE:HE1	4:A:1003:ORO:H5	1.85	0.42
1:A:252:PRO:HB3	1:A:327:TYR:CD2	2.55	0.41
1:A:315:ASN:N	1:A:324:ASP:OD2	2.47	0.41
1:B:346:PRO:HA	1:B:352:ARG:HD2	2.02	0.41
1:A:213:LYS:HE2	1:A:452:ASP:HA	2.03	0.41
1:A:191:LEU:HD22	1:A:196:ILE:HD11	2.02	0.41
1:B:235:ASP:OD1	1:B:235:ASP:N	2.52	0.40

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	A	372/415 (90%)	358 (96%)	13 (4%)	1 (0%)	36	66
1	B	371/415 (89%)	358 (96%)	13 (4%)	0	100	100
All	All	743/830 (90%)	716 (96%)	26 (4%)	1 (0%)	48	77

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	278	PHE

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	320/365 (88%)	313 (98%)	7 (2%)	45	78
1	B	229/365 (63%)	224 (98%)	5 (2%)	45	78
All	All	549/730 (75%)	537 (98%)	12 (2%)	45	78

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	172	LEU
1	A	183	ILE
1	A	235	ASP
1	A	253	ARG
1	A	278	PHE
1	A	442	ILE
1	A	549	LEU
1	B	172	LEU
1	B	183	ILE
1	B	253	ARG
1	B	379	ILE
1	B	549	LEU

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

Mol	Chain	Res	Type
1	B	355	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

6 ligands are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	FMN	A	1002	-	33,33,33	1.01	2 (6%)	48,50,50	1.25	6 (12%)
3	FMN	B	1002	-	33,33,33	1.01	2 (6%)	48,50,50	1.22	8 (16%)
4	ORO	B	1003	-	11,11,11	1.50	2 (18%)	14,15,15	2.63	7 (50%)
2	D65	A	1001	-	28,29,29	2.96	7 (25%)	42,51,51	1.35	6 (14%)
2	D65	B	1001	-	28,29,29	2.96	6 (21%)	42,51,51	1.32	7 (16%)
4	ORO	A	1003	-	11,11,11	1.50	2 (18%)	14,15,15	2.65	7 (50%)

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	FMN	A	1002	-	-	3/18/18/18	0/3/3/3
3	FMN	B	1002	-	-	3/18/18/18	0/3/3/3
4	ORO	B	1003	-	-	2/4/4/4	0/1/1/1
2	D65	A	1001	-	-	2/18/20/20	0/3/3/3
2	D65	B	1001	-	-	0/18/20/20	0/3/3/3
4	ORO	A	1003	-	-	4/4/4/4	0/1/1/1

All (21) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1001	D65	C5-S1	-13.54	1.64	1.80

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1001	D65	C5-S1	-13.49	1.64	1.80
2	B	1001	D65	C11-N2	-3.84	1.33	1.38
2	A	1001	D65	C11-N2	-3.70	1.33	1.38
3	A	1002	FMN	C4A-N5	3.48	1.38	1.30
3	B	1002	FMN	C4A-N5	3.29	1.37	1.30
2	A	1001	D65	C2-N1	-2.80	1.36	1.41
2	B	1001	D65	C2-N1	-2.79	1.36	1.41
2	A	1001	D65	C7-N2	-2.63	1.35	1.37
2	B	1001	D65	F1-C13	-2.58	1.32	1.37
4	A	1003	ORO	C4-N3	-2.52	1.34	1.38
2	A	1001	D65	F1-C13	-2.50	1.32	1.37
4	B	1003	ORO	C4-N3	-2.48	1.34	1.38
2	A	1001	D65	F2-C13	-2.48	1.32	1.37
2	B	1001	D65	F2-C13	-2.45	1.32	1.37
2	B	1001	D65	C7-N2	-2.43	1.35	1.37
3	A	1002	FMN	C10-N1	2.41	1.38	1.33
3	B	1002	FMN	C10-N1	2.38	1.38	1.33
2	A	1001	D65	C8-C7	2.08	1.41	1.38
4	A	1003	ORO	C5-C4	-2.07	1.38	1.42
4	B	1003	ORO	O4-C4	-2.05	1.20	1.24

All (41) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	1003	ORO	C4-N3-C2	-5.82	119.91	125.55
4	A	1003	ORO	C4-N3-C2	-5.80	119.93	125.55
4	A	1003	ORO	O4-C4-C5	-3.96	119.98	125.46
4	B	1003	ORO	C5-C4-N3	3.93	120.13	115.24
4	B	1003	ORO	O4-C4-C5	-3.74	120.29	125.46
4	A	1003	ORO	C5-C4-N3	3.66	119.79	115.24
3	A	1002	FMN	C4-N3-C2	-3.35	119.69	125.64
2	B	1001	D65	C11-N4-C12	3.27	103.77	102.26
2	A	1001	D65	C11-N2-N3	3.27	112.85	110.41
3	B	1002	FMN	C4-N3-C2	-3.18	120.00	125.64
2	A	1001	D65	C11-N4-C12	3.11	103.69	102.26
2	B	1001	D65	C11-N2-N3	3.06	112.70	110.41
3	A	1002	FMN	C4A-C10-N10	3.04	120.83	116.48
4	A	1003	ORO	N3-C2-N1	2.85	120.22	115.74
2	A	1001	D65	C10-C9-N5	2.81	119.97	116.84
4	B	1003	ORO	N3-C2-N1	2.79	120.12	115.74
3	B	1002	FMN	C4A-C10-N10	2.78	120.46	116.48
4	B	1003	ORO	O72-C7-C6	2.77	120.24	114.27

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	1003	ORO	O72-C7-C6	2.74	120.17	114.27
4	A	1003	ORO	C7-C6-N1	2.68	120.36	115.47
3	A	1002	FMN	C4A-C4-N3	2.61	119.91	113.25
4	B	1003	ORO	C7-C6-N1	2.56	120.14	115.47
3	B	1002	FMN	C4A-C4-N3	2.53	119.69	113.25
2	B	1001	D65	C8-C9-N5	-2.51	120.23	122.71
4	A	1003	ORO	C6-N1-C2	-2.49	119.99	122.65
3	B	1002	FMN	O4-C4-C4A	-2.47	120.01	126.53
3	A	1002	FMN	C10-C4A-N5	-2.45	119.80	124.81
4	B	1003	ORO	C6-N1-C2	-2.43	120.05	122.65
2	A	1001	D65	C8-C9-N5	-2.42	120.32	122.71
3	A	1002	FMN	O4-C4-C4A	-2.38	120.26	126.53
2	B	1001	D65	C10-C9-N5	2.23	119.32	116.84
3	B	1002	FMN	C10-C4A-N5	-2.22	120.28	124.81
3	A	1002	FMN	C4A-C10-N1	-2.21	119.17	124.59
3	B	1002	FMN	C4A-C10-N1	-2.13	119.36	124.59
2	B	1001	D65	F4-S1-F7	2.13	179.97	106.10
2	A	1001	D65	F6-S1-F3	2.13	179.95	106.10
2	A	1001	D65	F4-S1-F7	2.13	179.92	106.10
2	B	1001	D65	F6-S1-F3	2.13	179.92	106.10
3	B	1002	FMN	C5A-C9A-N10	2.03	119.81	117.97
2	B	1001	D65	C6-C5-C4	-2.02	119.01	120.98
3	B	1002	FMN	C9A-C5A-N5	-2.01	120.32	122.45

There are no chirality outliers.

All (14) torsion outliers are listed below:

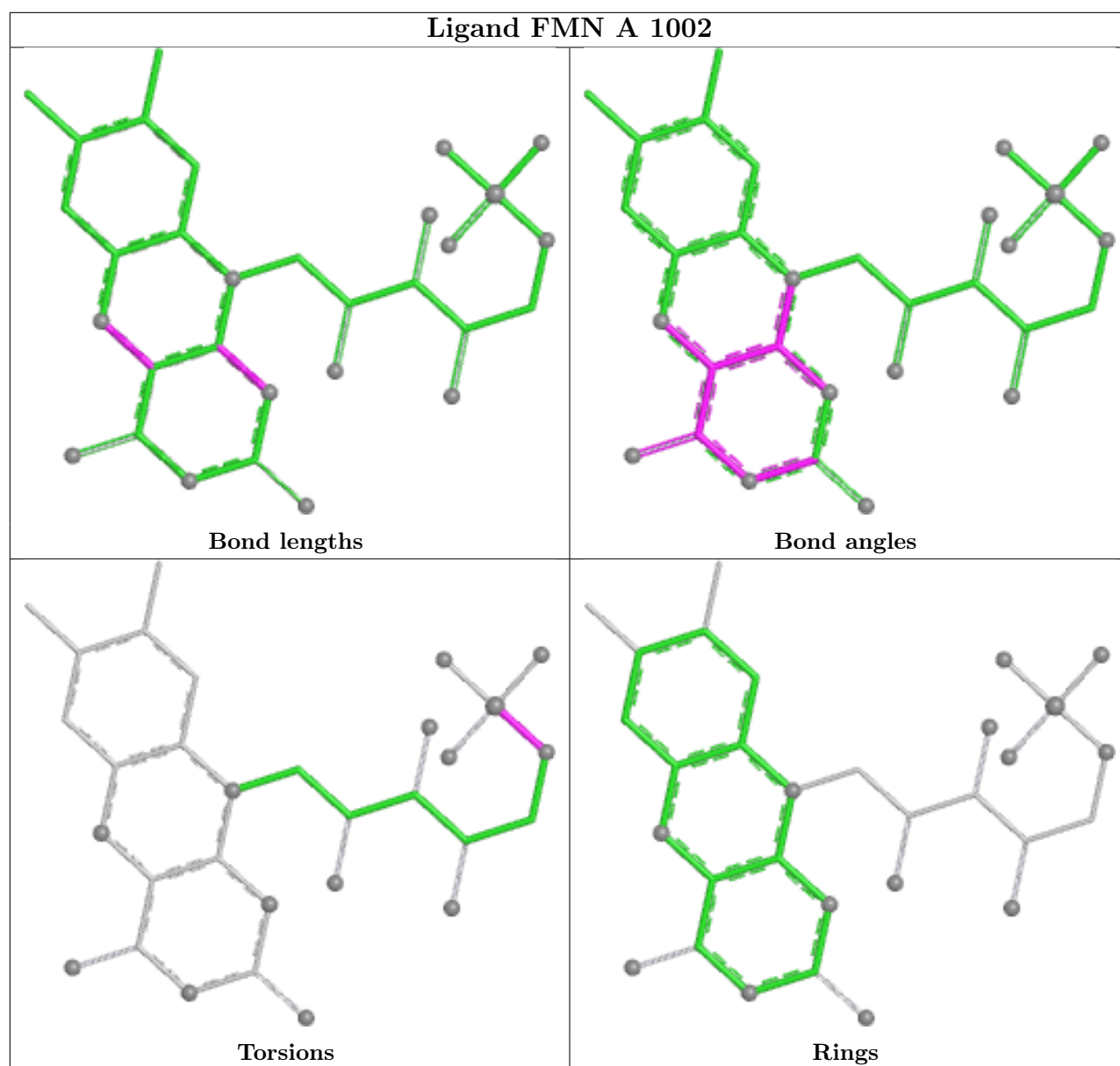
Mol	Chain	Res	Type	Atoms
2	A	1001	D65	C4-C5-S1-F5
2	A	1001	D65	C6-C5-S1-F5
3	A	1002	FMN	C5'-O5'-P-O1P
3	A	1002	FMN	C5'-O5'-P-O2P
3	B	1002	FMN	C5'-O5'-P-O2P
3	B	1002	FMN	C5'-O5'-P-O3P
4	A	1003	ORO	N1-C6-C7-O71
4	A	1003	ORO	N1-C6-C7-O72
4	A	1003	ORO	C5-C6-C7-O71
4	A	1003	ORO	C5-C6-C7-O72
4	B	1003	ORO	N1-C6-C7-O71
4	B	1003	ORO	N1-C6-C7-O72
3	B	1002	FMN	C5'-O5'-P-O1P
3	A	1002	FMN	C5'-O5'-P-O3P

There are no ring outliers.

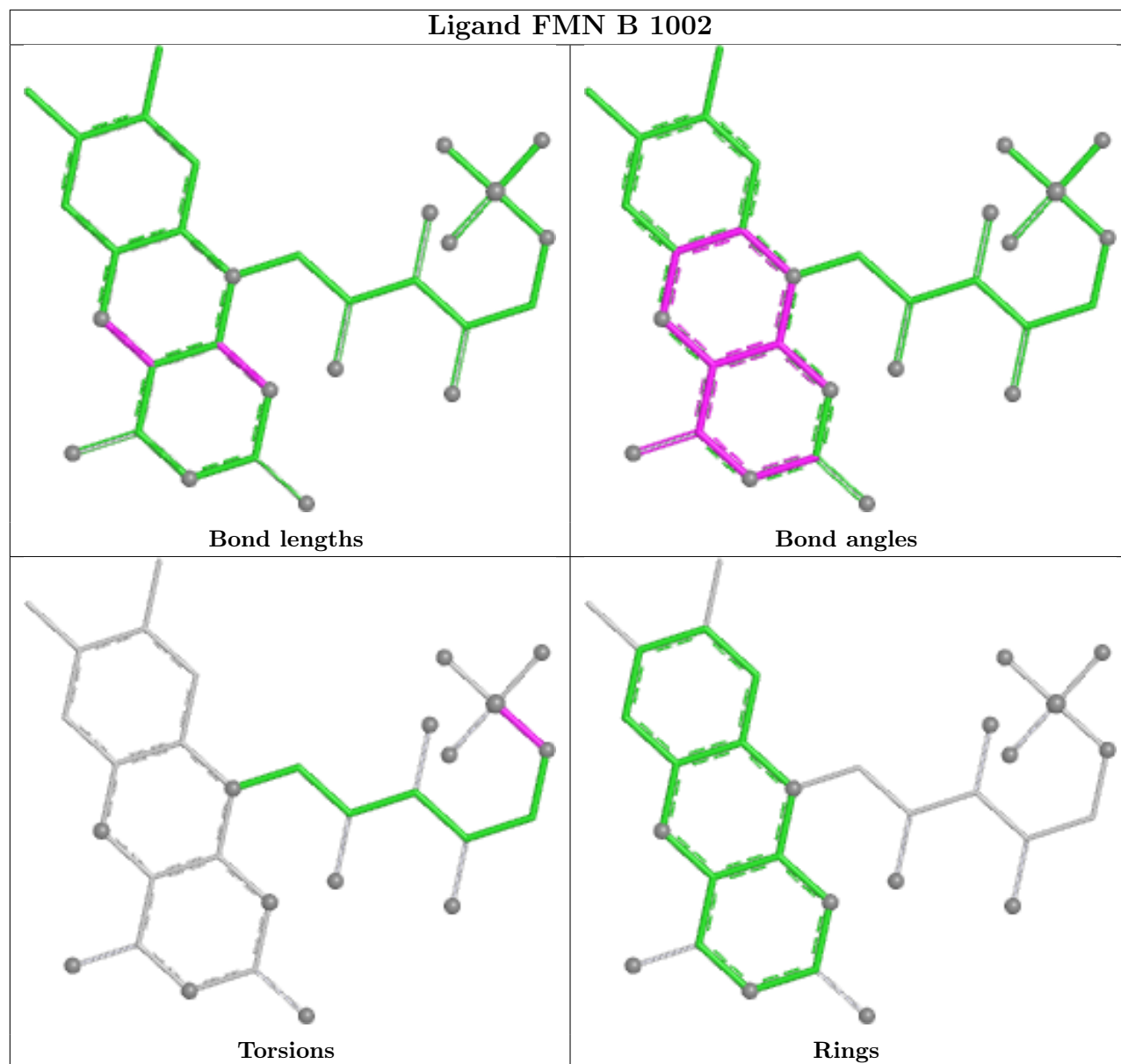
4 monomers are involved in 5 short contacts:

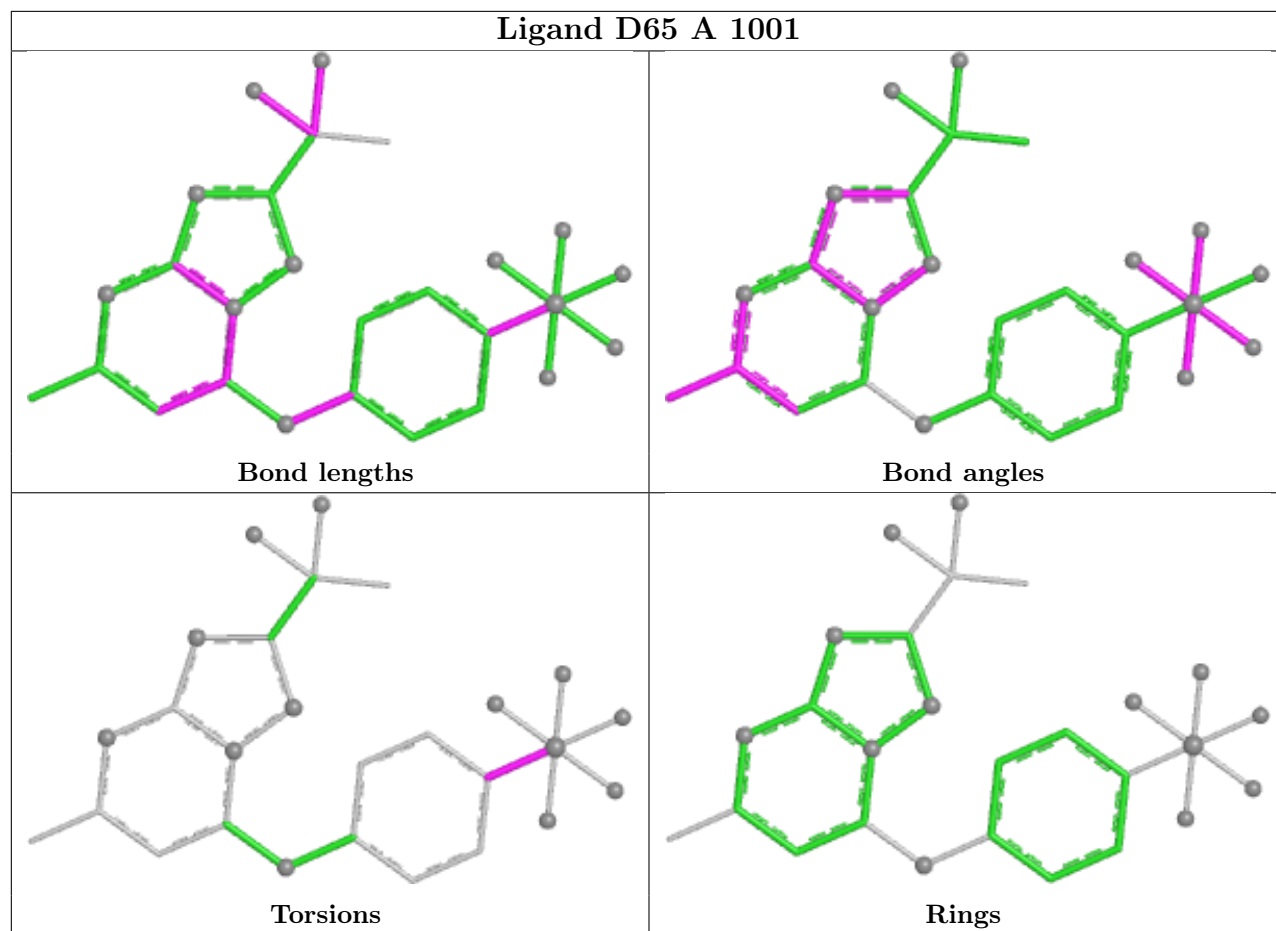
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	1002	FMN	1	0
3	B	1002	FMN	1	0
2	A	1001	D65	1	0
4	A	1003	ORO	2	0

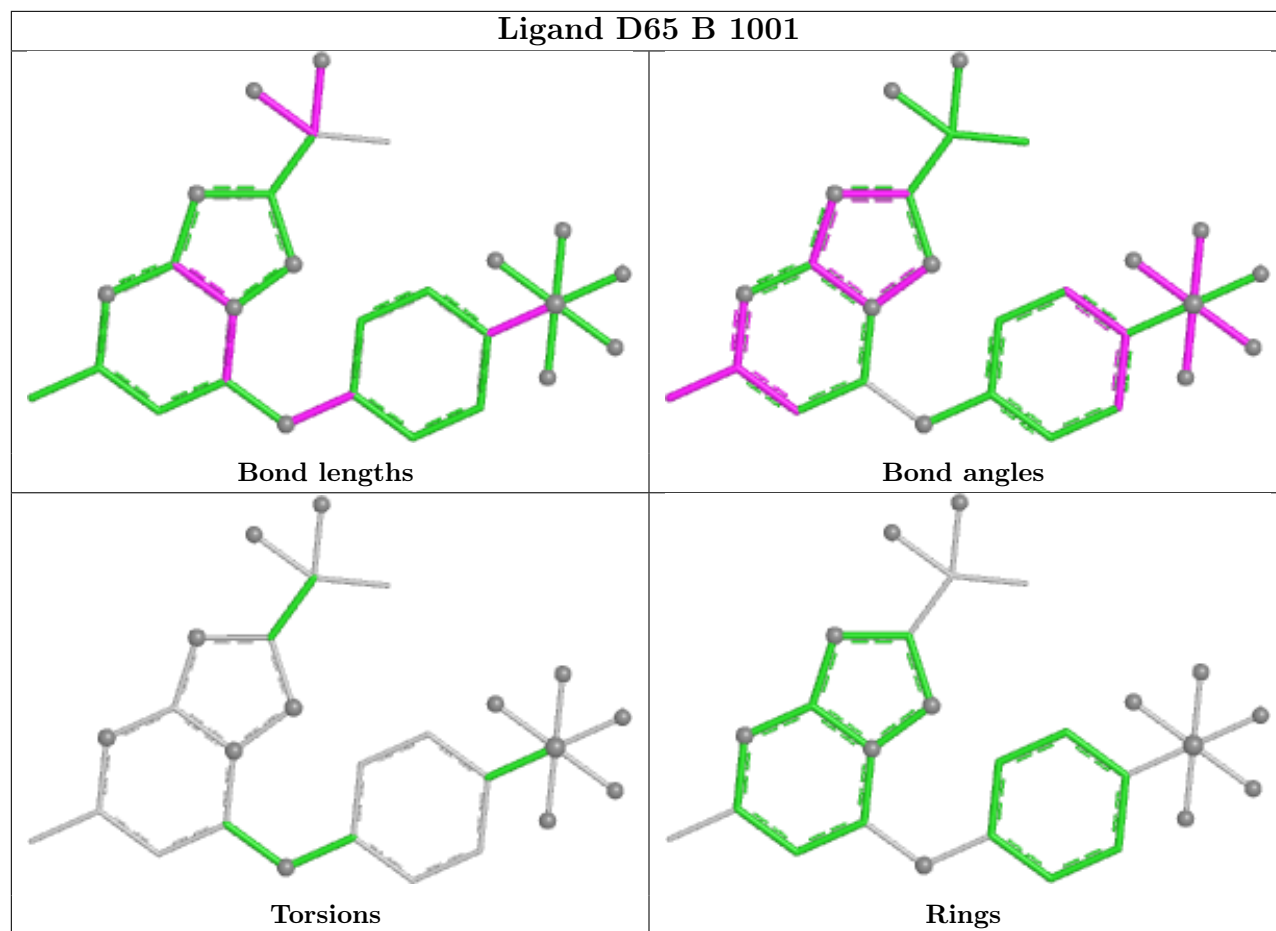
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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 FMN B 1002







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	374/415 (90%)	0.64	36 (9%) 13 10	19, 54, 101, 158	0
1	B	373/415 (89%)	0.98	67 (17%) 3 3	23, 67, 114, 144	0
All	All	747/830 (90%)	0.81	103 (13%) 6 5	19, 61, 109, 158	0

All (103) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	382	ASP	5.3
1	B	414	PHE	4.9
1	B	378	ASN	4.9
1	A	565	LYS	4.7
1	B	415	LEU	4.7
1	A	471	ASN	4.7
1	B	353	ASP	4.6
1	A	470	GLU	4.6
1	B	383	GLU	4.5
1	B	162	ASN	4.4
1	B	376	LYS	4.4
1	A	346	PRO	4.4
1	B	342	ASN	4.3
1	A	437	GLU	4.2
1	A	342	ASN	4.2
1	A	473	LYS	4.1
1	A	162	ASN	4.1
1	B	377	ASN	4.1
1	A	379	ILE	4.1
1	B	356	GLU	4.1
1	B	379	ILE	3.7
1	B	209	CYS	3.5
1	B	352	ARG	3.5
1	B	564	ARG	3.5

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Mol	Chain	Res	Type	RSRZ
1	A	163	PRO	3.5
1	B	343	VAL	3.5
1	B	494	ASN	3.5
1	B	548	HIS	3.5
1	B	330	ASN	3.4
1	A	548	HIS	3.4
1	A	348	THR	3.3
1	B	440	LYS	3.3
1	B	326	LYS	3.2
1	B	355	GLN	3.2
1	A	383	GLU	3.2
1	A	319	VAL	3.1
1	B	371	ILE	3.0
1	B	299	GLU	3.0
1	A	452	ASP	2.9
1	B	380	MET	2.9
1	B	314	LYS	2.9
1	B	422	LYS	2.8
1	A	464	ASN	2.8
1	B	464	ASN	2.8
1	B	471	ASN	2.8
1	B	437	GLU	2.8
1	A	463	ILE	2.8
1	B	334	ARG	2.7
1	B	354	ASN	2.7
1	A	351	LEU	2.7
1	B	556	TYR	2.7
1	A	347	ASN	2.7
1	A	209	CYS	2.7
1	A	343	VAL	2.7
1	B	423	LYS	2.6
1	A	381	ASN	2.6
1	B	214	HIS	2.6
1	A	314	LYS	2.5
1	B	451	ILE	2.5
1	B	178	TYR	2.5
1	B	304	SER	2.4
1	B	450	ASN	2.4
1	B	213	LYS	2.4
1	B	367	VAL	2.4
1	B	375	GLU	2.4
1	B	560	GLU	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	431	ALA	2.4
1	A	462	GLN	2.3
1	B	558	LEU	2.3
1	B	163	PRO	2.3
1	B	370	GLU	2.3
1	B	467	LYS	2.3
1	B	174	PHE	2.3
1	A	487	LYS	2.3
1	A	277	GLY	2.3
1	B	359	LYS	2.3
1	B	344	SER	2.3
1	B	495	TYR	2.3
1	B	428	VAL	2.3
1	A	434	LEU	2.2
1	A	353	ASP	2.2
1	B	449	THR	2.2
1	B	207	TYR	2.2
1	B	497	ASN	2.2
1	B	552	GLN	2.2
1	B	194	TYR	2.2
1	A	354	ASN	2.2
1	A	563	GLY	2.2
1	B	363	ILE	2.1
1	B	457	SER	2.1
1	B	441	GLU	2.1
1	B	442	ILE	2.1
1	A	467	LYS	2.1
1	A	544	ARG	2.1
1	A	466	ILE	2.1
1	B	349	PRO	2.1
1	A	344	SER	2.1
1	B	351	LEU	2.1
1	A	450	ASN	2.0
1	B	216	ASP	2.0
1	B	345	SER	2.0
1	B	288	GLU	2.0
1	A	194	TYR	2.0

6.2 Non-standard residues in protein, DNA, RNA chains

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

6.3 Carbohydrates [i](#)

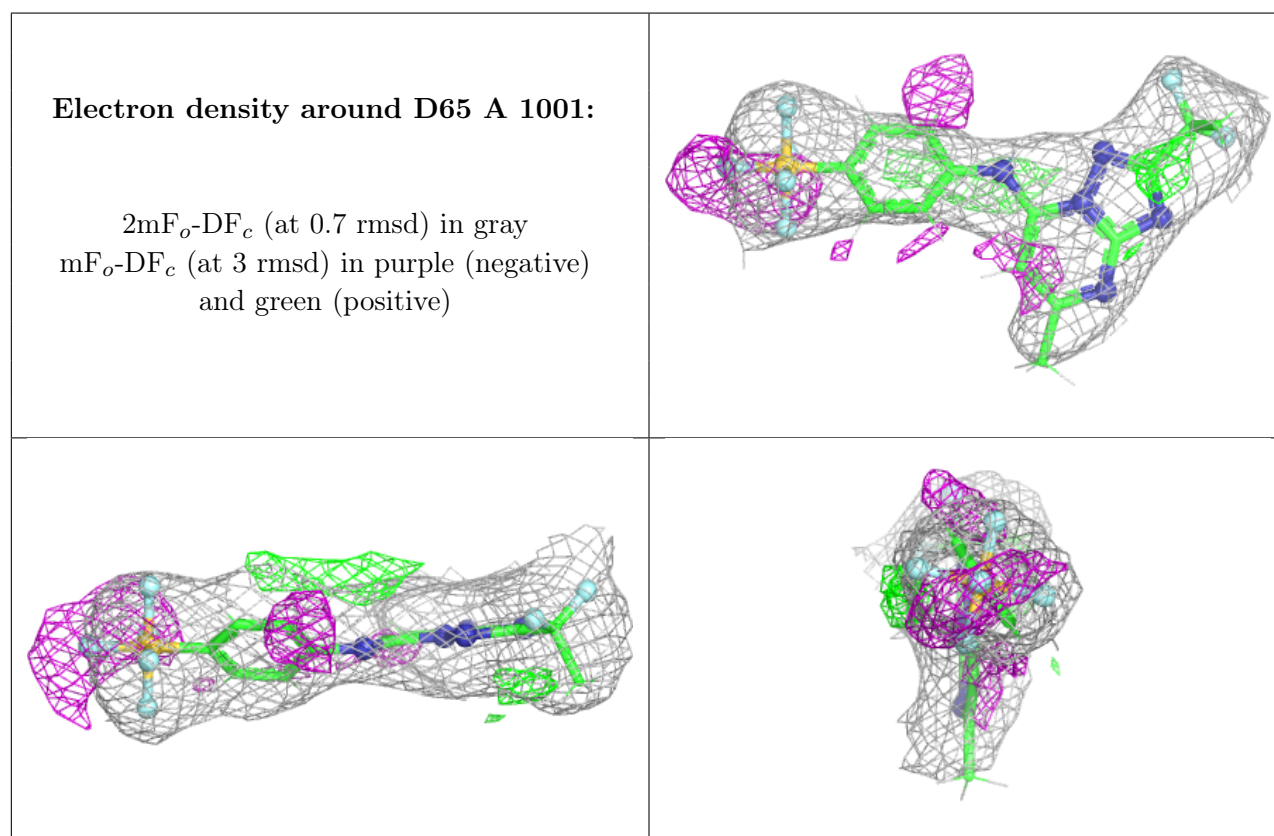
There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

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

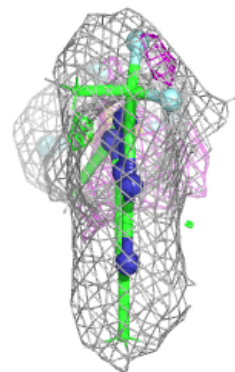
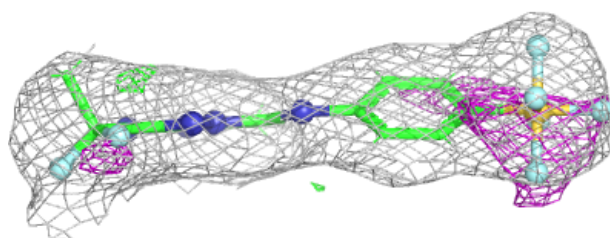
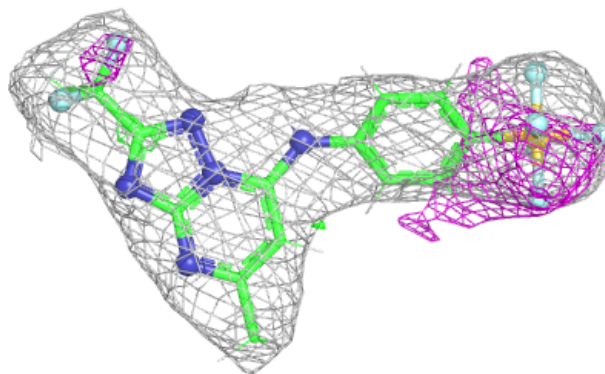
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	D65	A	1001	27/27	0.90	0.14	25,40,56,82	0
2	D65	B	1001	27/27	0.93	0.12	11,22,63,78	0
3	FMN	B	1002	31/31	0.93	0.10	5,16,30,37	0
4	ORO	A	1003	11/11	0.94	0.10	24,30,34,38	0
3	FMN	A	1002	31/31	0.95	0.08	9,18,27,35	0
4	ORO	B	1003	11/11	0.97	0.09	10,16,19,22	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.



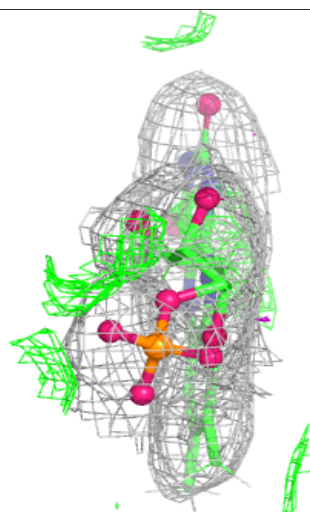
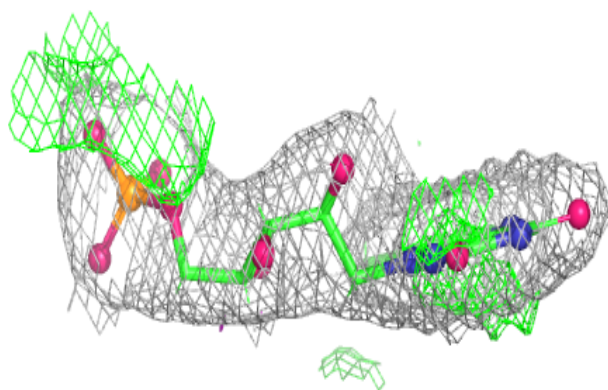
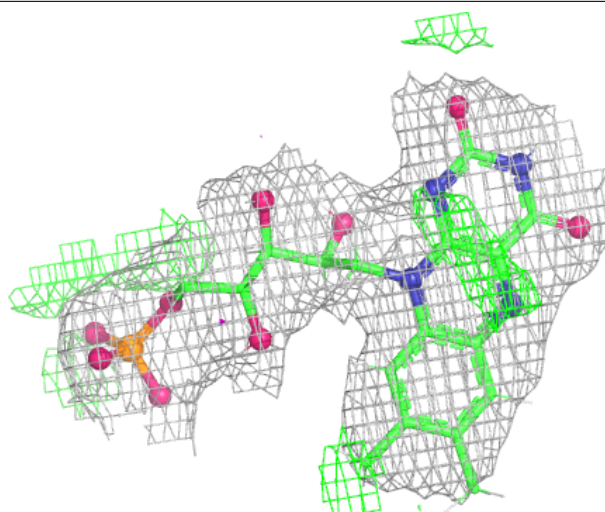
Electron density around D65 B 1001:

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



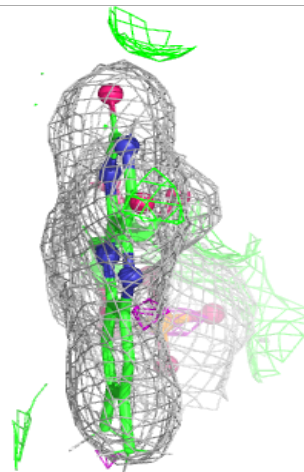
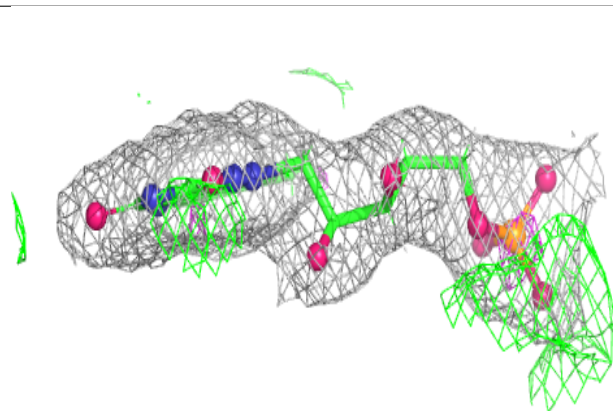
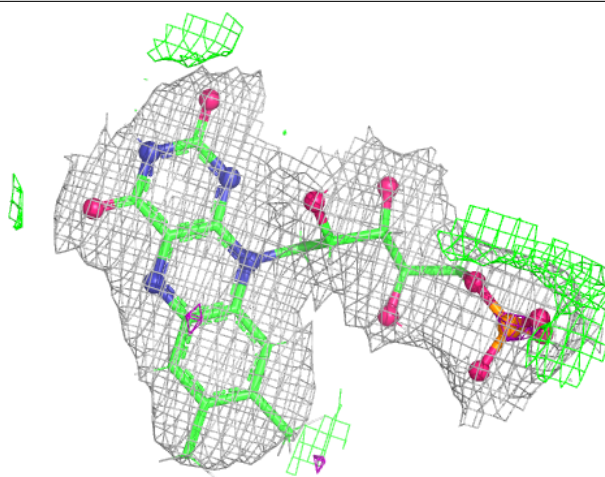
Electron density around FMN B 1002:

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



Electron density around FMN A 1002:

$2mF_o-DF_c$ (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.