



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 12, 2026 – 03:29 PM UTC

PDB ID : 5HEI / pdb_00005hei
Title : Structure of B. megaterium NfrA2
Authors : Vigouroux, A.; Morera, S.
Deposited on : 2016-01-06
Resolution : 2.84 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

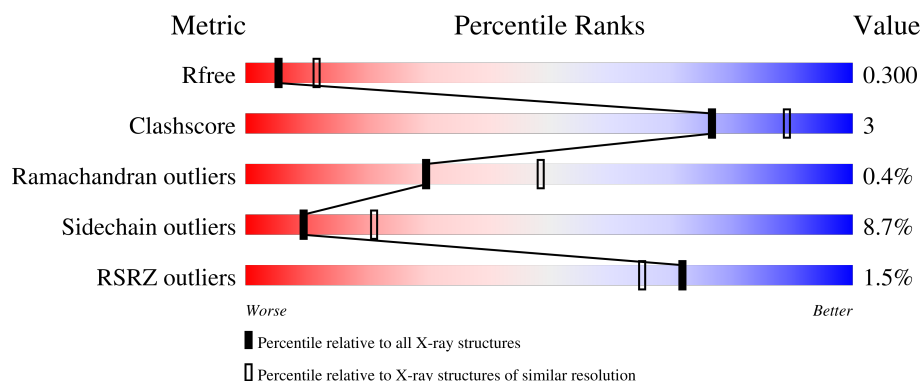
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.84 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	1520 (2.86-2.82)
Clashscore	190562	1559 (2.86-2.82)
Ramachandran outliers	187476	1517 (2.86-2.82)
Sidechain outliers	187428	1518 (2.86-2.82)
RSRZ outliers	180081	1521 (2.86-2.82)

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	253	2% 80% 16% ..
1	B	253	2% 81% 15% ..
1	C	253	83% 12% ..
1	D	253	82% 13% ..
1	E	253	4% 83% 13% ..

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Mol	Chain	Length	Quality of chain
1	F	253	2% 83% 13%
1	G	253	85% 11%
1	H	253	80% 14%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 15833 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 NfrA2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	246	Total	C	N	O	S	0	0	0
			1913	1202	332	374	5			
1	B	246	Total	C	N	O	S	0	0	0
			1913	1202	332	374	5			
1	C	245	Total	C	N	O	S	0	0	0
			1905	1197	331	373	4			
1	D	246	Total	C	N	O	S	0	0	0
			1913	1202	332	374	5			
1	E	246	Total	C	N	O	S	0	0	0
			1913	1202	332	374	5			
1	F	246	Total	C	N	O	S	0	0	0
			1913	1202	332	374	5			
1	G	246	Total	C	N	O	S	0	0	0
			1913	1202	332	374	5			
1	H	246	Total	C	N	O	S	0	0	0
			1913	1202	332	374	5			

There are 64 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	246	LYS	-	expression tag	UNP A0A0K0VJM8
A	247	GLY	-	expression tag	UNP A0A0K0VJM8
A	248	HIS	-	expression tag	UNP A0A0K0VJM8
A	249	HIS	-	expression tag	UNP A0A0K0VJM8
A	250	HIS	-	expression tag	UNP A0A0K0VJM8
A	251	HIS	-	expression tag	UNP A0A0K0VJM8
A	252	HIS	-	expression tag	UNP A0A0K0VJM8
A	253	HIS	-	expression tag	UNP A0A0K0VJM8
B	246	LYS	-	expression tag	UNP A0A0K0VJM8
B	247	GLY	-	expression tag	UNP A0A0K0VJM8
B	248	HIS	-	expression tag	UNP A0A0K0VJM8
B	249	HIS	-	expression tag	UNP A0A0K0VJM8
B	250	HIS	-	expression tag	UNP A0A0K0VJM8

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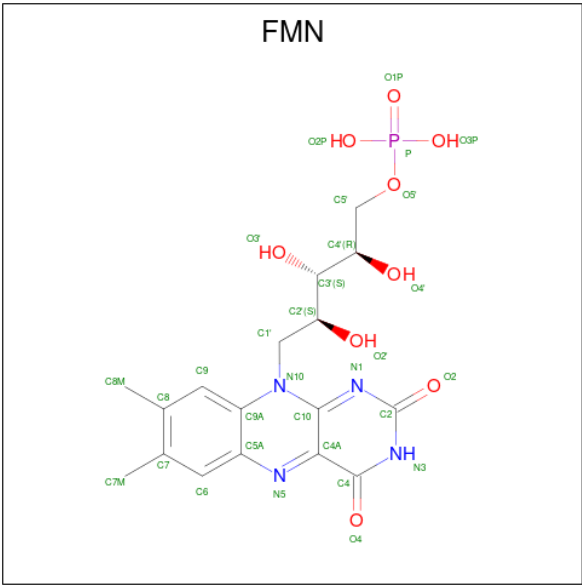
Chain	Residue	Modelled	Actual	Comment	Reference
B	251	HIS	-	expression tag	UNP A0A0K0VJM8
B	252	HIS	-	expression tag	UNP A0A0K0VJM8
B	253	HIS	-	expression tag	UNP A0A0K0VJM8
C	246	LYS	-	expression tag	UNP A0A0K0VJM8
C	247	GLY	-	expression tag	UNP A0A0K0VJM8
C	248	HIS	-	expression tag	UNP A0A0K0VJM8
C	249	HIS	-	expression tag	UNP A0A0K0VJM8
C	250	HIS	-	expression tag	UNP A0A0K0VJM8
C	251	HIS	-	expression tag	UNP A0A0K0VJM8
C	252	HIS	-	expression tag	UNP A0A0K0VJM8
C	253	HIS	-	expression tag	UNP A0A0K0VJM8
D	246	LYS	-	expression tag	UNP A0A0K0VJM8
D	247	GLY	-	expression tag	UNP A0A0K0VJM8
D	248	HIS	-	expression tag	UNP A0A0K0VJM8
D	249	HIS	-	expression tag	UNP A0A0K0VJM8
D	250	HIS	-	expression tag	UNP A0A0K0VJM8
D	251	HIS	-	expression tag	UNP A0A0K0VJM8
D	252	HIS	-	expression tag	UNP A0A0K0VJM8
D	253	HIS	-	expression tag	UNP A0A0K0VJM8
E	246	LYS	-	expression tag	UNP A0A0K0VJM8
E	247	GLY	-	expression tag	UNP A0A0K0VJM8
E	248	HIS	-	expression tag	UNP A0A0K0VJM8
E	249	HIS	-	expression tag	UNP A0A0K0VJM8
E	250	HIS	-	expression tag	UNP A0A0K0VJM8
E	251	HIS	-	expression tag	UNP A0A0K0VJM8
E	252	HIS	-	expression tag	UNP A0A0K0VJM8
E	253	HIS	-	expression tag	UNP A0A0K0VJM8
F	246	LYS	-	expression tag	UNP A0A0K0VJM8
F	247	GLY	-	expression tag	UNP A0A0K0VJM8
F	248	HIS	-	expression tag	UNP A0A0K0VJM8
F	249	HIS	-	expression tag	UNP A0A0K0VJM8
F	250	HIS	-	expression tag	UNP A0A0K0VJM8
F	251	HIS	-	expression tag	UNP A0A0K0VJM8
F	252	HIS	-	expression tag	UNP A0A0K0VJM8
F	253	HIS	-	expression tag	UNP A0A0K0VJM8
G	246	LYS	-	expression tag	UNP A0A0K0VJM8
G	247	GLY	-	expression tag	UNP A0A0K0VJM8
G	248	HIS	-	expression tag	UNP A0A0K0VJM8
G	249	HIS	-	expression tag	UNP A0A0K0VJM8
G	250	HIS	-	expression tag	UNP A0A0K0VJM8
G	251	HIS	-	expression tag	UNP A0A0K0VJM8
G	252	HIS	-	expression tag	UNP A0A0K0VJM8

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Chain	Residue	Modelled	Actual	Comment	Reference
G	253	HIS	-	expression tag	UNP A0A0K0VJM8
H	246	LYS	-	expression tag	UNP A0A0K0VJM8
H	247	GLY	-	expression tag	UNP A0A0K0VJM8
H	248	HIS	-	expression tag	UNP A0A0K0VJM8
H	249	HIS	-	expression tag	UNP A0A0K0VJM8
H	250	HIS	-	expression tag	UNP A0A0K0VJM8
H	251	HIS	-	expression tag	UNP A0A0K0VJM8
H	252	HIS	-	expression tag	UNP A0A0K0VJM8
H	253	HIS	-	expression tag	UNP A0A0K0VJM8

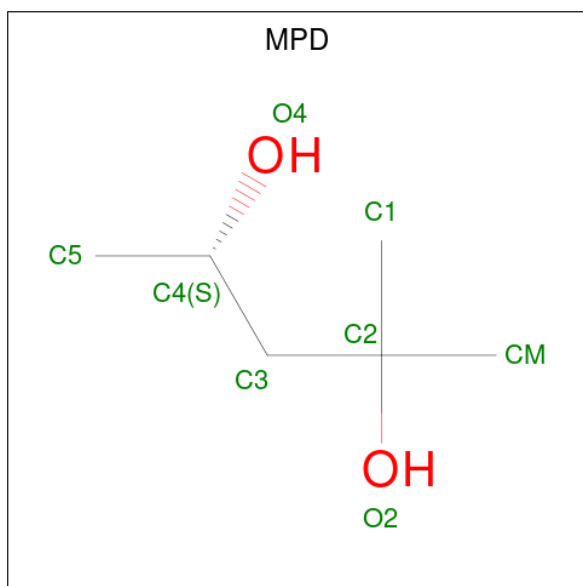
- Molecule 2 is FLAVIN MONONUCLEOTIDE (CCD ID: FMN) (formula: C₁₇H₂₁N₄O₉P).



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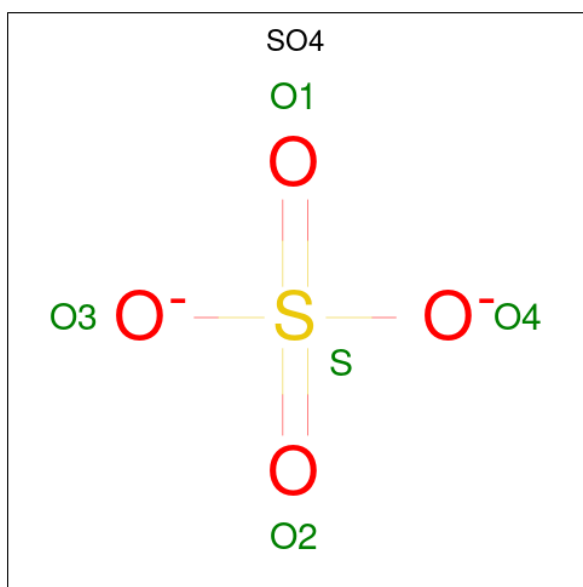
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	H	1	Total	C	N	O	P	0	0
			31	17	4	9	1		

- Molecule 3 is (4S)-2-METHYL-2,4-PENTANEDIOL (CCD ID: MPD) (formula: C₆H₁₄O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	C	1	Total	C	O	0	0
			8	6	2		
3	H	1	Total	C	O	0	0
			8	6	2		

- Molecule 4 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	C	1	Total	O	S	0	0
			5	4	1		
4	D	1	Total	O	S	0	0
			5	4	1		
4	D	1	Total	O	S	0	0
			5	4	1		
4	G	1	Total	O	S	0	0
			5	4	1		
4	H	1	Total	O	S	0	0
			5	4	1		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	23	Total	O	0	0
			23	23		
5	B	26	Total	O	0	0
			26	26		
5	C	41	Total	O	0	0
			41	41		
5	D	40	Total	O	0	0
			40	40		
5	E	19	Total	O	0	0
			19	19		
5	F	16	Total	O	0	0
			16	16		
5	G	36	Total	O	0	0
			36	36		

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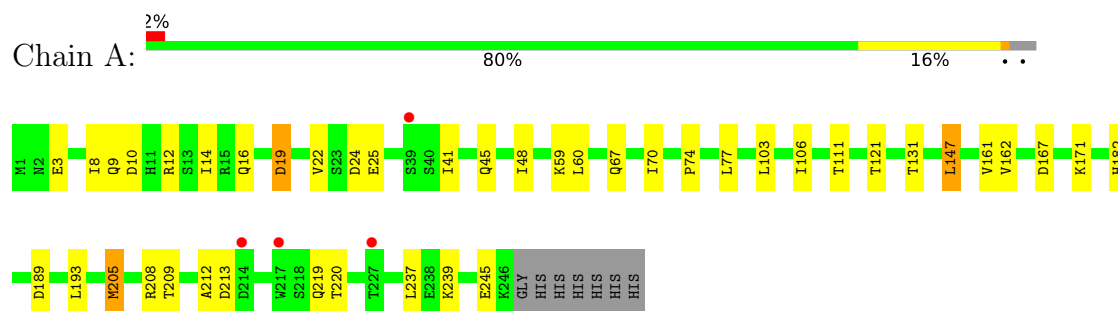
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	H	47	Total	O	0	0
			47	47		

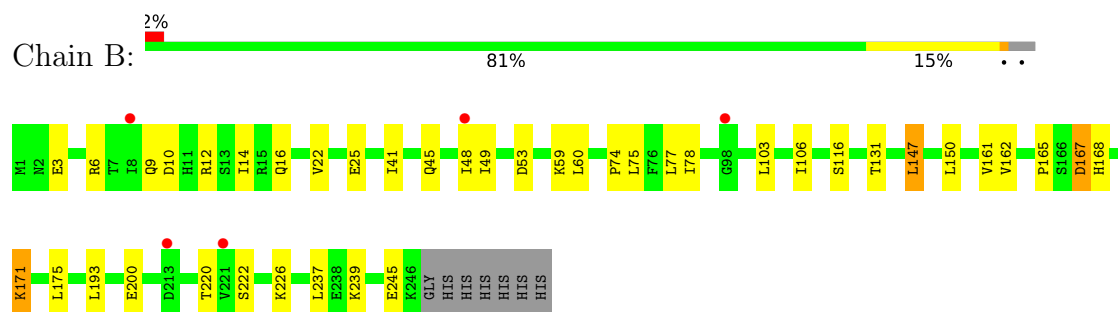
3 Residue-property plots [i](#)

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.

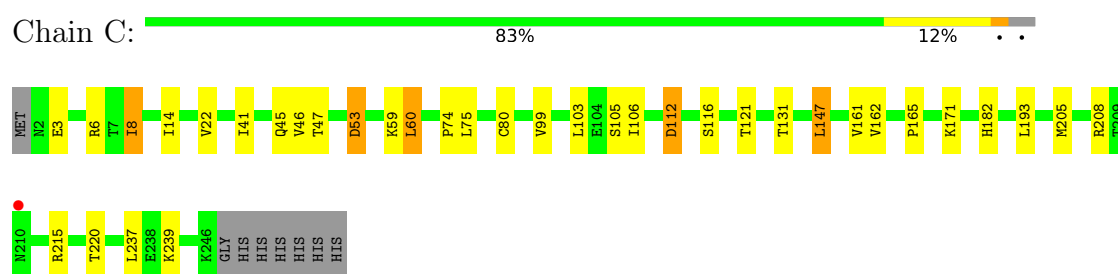
• Molecule 1: NfrA2



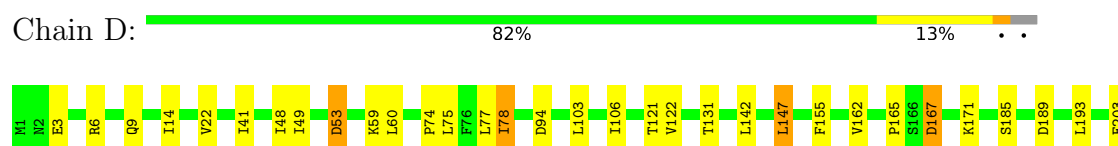
• Molecule 1: NfrA2

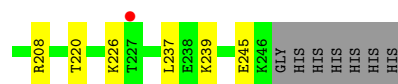


• Molecule 1: NfrA2

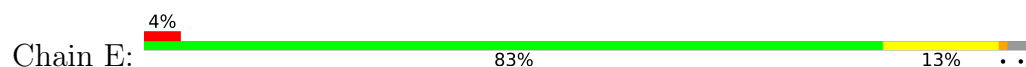


• Molecule 1: NfrA2

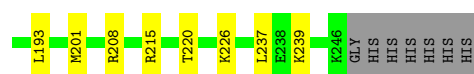
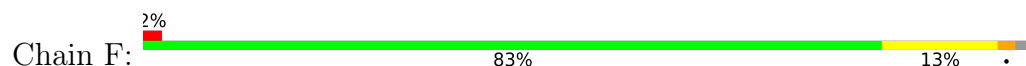




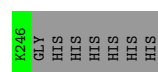
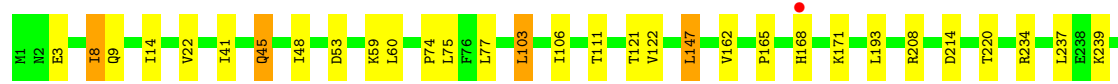
• Molecule 1: NfrA2



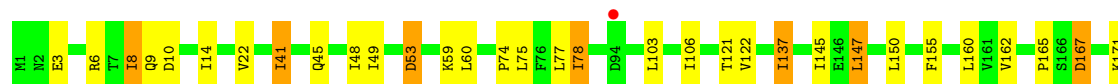
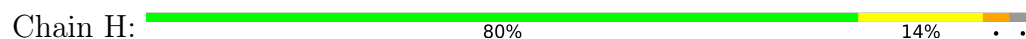
• Molecule 1: NfrA2



• Molecule 1: NfrA2



• Molecule 1: NfrA2



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	61.44Å 158.19Å 103.86Å 90.00° 102.21° 90.00°	Depositor
Resolution (Å)	28.63 – 2.84 28.63 – 2.84	Depositor EDS
% Data completeness (in resolution range)	97.2 (28.63-2.84) 97.3 (28.63-2.84)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.24	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.49 (at 2.86Å)	Xtrriage
Refinement program	BUSTER 2.10.0	Depositor
R, R_{free}	0.203 , 0.247 0.251 , 0.300	Depositor DCC
R_{free} test set	2222 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	39.8	Xtrriage
Anisotropy	0.909	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 65.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.43$, $\langle L^2 \rangle = 0.25$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	15833	wwPDB-VP
Average B, all atoms (Å ²)	59.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 35.91 % 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 5.4182e-04. 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: FMN, MPD, SO4

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	0.77	0/1947	1.38	4/2636 (0.2%)
1	B	0.77	0/1947	1.40	5/2636 (0.2%)
1	C	0.78	0/1939	1.38	5/2626 (0.2%)
1	D	0.76	0/1947	1.39	4/2636 (0.2%)
1	E	0.76	0/1947	1.38	6/2636 (0.2%)
1	F	0.76	0/1947	1.39	7/2636 (0.3%)
1	G	0.77	0/1947	1.37	4/2636 (0.2%)
1	H	0.75	0/1947	1.38	4/2636 (0.2%)
All	All	0.76	0/15568	1.38	39/21078 (0.2%)

There are no bond length outliers.

All (39) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	19	ASP	CA-CB-CG	7.79	120.39	112.60
1	F	189	ASP	CA-CB-CG	6.99	119.59	112.60
1	G	214	ASP	CA-CB-CG	6.74	119.34	112.60
1	E	245	GLU	N-CA-C	5.51	119.62	113.01
1	H	155	PHE	CA-CB-CG	5.41	119.21	113.80
1	A	189	ASP	CA-CB-CG	5.40	118.00	112.60
1	F	56	LYS	CA-C-N	5.36	127.46	120.28
1	F	56	LYS	C-N-CA	5.36	127.46	120.28
1	C	112	ASP	CA-CB-CG	5.32	117.92	112.60
1	F	53	ASP	CA-C-N	5.25	127.63	120.54
1	F	53	ASP	C-N-CA	5.25	127.63	120.54
1	H	167	ASP	CA-CB-CG	5.25	117.85	112.60
1	D	155	PHE	CA-CB-CG	5.21	119.01	113.80
1	D	53	ASP	CA-C-N	5.19	127.55	120.54
1	D	53	ASP	C-N-CA	5.19	127.55	120.54
1	B	222	SER	CA-C-N	5.19	127.55	120.54

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	222	SER	C-N-CA	5.19	127.55	120.54
1	H	53	ASP	CA-C-N	5.19	127.54	120.54
1	H	53	ASP	C-N-CA	5.19	127.54	120.54
1	B	53	ASP	CA-C-N	5.18	127.53	120.54
1	B	53	ASP	C-N-CA	5.18	127.53	120.54
1	C	60	LEU	CA-C-N	5.17	127.16	120.44
1	C	60	LEU	C-N-CA	5.17	127.16	120.44
1	B	167	ASP	CA-CB-CG	5.17	117.77	112.60
1	G	53	ASP	CA-C-N	5.15	127.50	120.54
1	G	53	ASP	C-N-CA	5.15	127.50	120.54
1	E	144	VAL	CA-C-N	5.14	127.50	120.46
1	E	144	VAL	C-N-CA	5.14	127.50	120.46
1	A	167	ASP	CA-C-N	5.12	127.65	120.28
1	A	167	ASP	C-N-CA	5.12	127.65	120.28
1	E	53	ASP	CA-C-N	5.10	127.43	120.54
1	E	53	ASP	C-N-CA	5.10	127.43	120.54
1	C	53	ASP	CA-C-N	5.08	127.40	120.54
1	C	53	ASP	C-N-CA	5.08	127.40	120.54
1	E	78	ILE	CB-CA-C	5.07	116.77	110.73
1	D	167	ASP	CA-CB-CG	5.07	117.67	112.60
1	F	167	ASP	CA-CB-CG	5.03	117.63	112.60
1	F	53	ASP	CA-CB-CG	5.03	117.63	112.60
1	G	53	ASP	CA-CB-CG	5.02	117.62	112.60

There are no chirality outliers.

There are no planarity outliers.

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	1913	0	1906	15	0
1	B	1913	0	1906	13	0
1	C	1905	0	1894	11	0
1	D	1913	0	1906	12	0
1	E	1913	0	1906	9	0
1	F	1913	0	1906	11	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	G	1913	0	1906	13	0
1	H	1913	0	1906	20	0
2	A	31	0	19	0	0
2	B	31	0	19	0	0
2	C	31	0	19	0	0
2	D	31	0	19	0	0
2	E	31	0	19	0	0
2	F	31	0	19	0	0
2	G	31	0	19	0	0
2	H	31	0	19	0	0
3	C	8	0	14	0	0
3	H	8	0	14	1	0
4	C	5	0	0	0	0
4	D	10	0	0	0	0
4	G	5	0	0	0	0
4	H	5	0	0	0	0
5	A	23	0	0	0	0
5	B	26	0	0	0	0
5	C	41	0	0	0	0
5	D	40	0	0	0	0
5	E	19	0	0	0	0
5	F	16	0	0	0	0
5	G	36	0	0	0	0
5	H	47	0	0	0	0
All	All	15833	0	15416	91	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 (91) 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:E:3:GLU:HB3	1:F:3:GLU:HB3	1.63	0.80
1:G:103:LEU:HD11	1:H:244:PHE:CZ	2.19	0.77
1:D:48:ILE:HD11	1:D:77:LEU:HB3	1.66	0.76
1:H:48:ILE:HD11	1:H:77:LEU:HB3	1.67	0.76
1:C:14:ILE:HG21	1:C:165:PRO:HB3	1.68	0.76
1:E:48:ILE:HD11	1:E:77:LEU:HB3	1.67	0.76
1:G:48:ILE:HD11	1:G:77:LEU:HB3	1.67	0.75
1:F:48:ILE:HD11	1:F:77:LEU:HB3	1.68	0.73
1:A:48:ILE:HD11	1:A:77:LEU:HB3	1.68	0.73

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:G:103:LEU:HD11	1:H:244:PHE:HZ	1.52	0.72
1:A:3:GLU:HB3	1:B:3:GLU:HB3	1.72	0.71
1:A:205:MET:O	1:A:209:THR:HG22	1.89	0.71
1:G:3:GLU:HB3	1:H:3:GLU:HB3	1.74	0.68
1:B:48:ILE:HD11	1:B:77:LEU:HB3	1.76	0.67
1:A:209:THR:HG21	1:A:213:ASP:H	1.60	0.66
1:D:106:ILE:HD12	1:D:237:LEU:HD22	1.77	0.65
1:H:106:ILE:HD12	1:H:237:LEU:HD22	1.78	0.64
1:D:49:ILE:HB	1:D:78:ILE:HG23	1.79	0.64
1:F:49:ILE:HB	1:F:78:ILE:HG23	1.80	0.63
1:C:106:ILE:HD12	1:C:237:LEU:HD22	1.80	0.63
1:H:41:ILE:HG22	3:H:302:MPD:H32	1.81	0.63
1:H:49:ILE:HB	1:H:78:ILE:HG23	1.80	0.62
1:F:106:ILE:HD12	1:F:237:LEU:HD22	1.82	0.62
1:G:106:ILE:HD12	1:G:237:LEU:HD22	1.82	0.62
1:A:106:ILE:HD12	1:A:237:LEU:HD22	1.82	0.61
1:B:106:ILE:HD12	1:B:237:LEU:HD22	1.82	0.61
1:E:106:ILE:HD12	1:E:237:LEU:HD22	1.82	0.61
1:A:209:THR:OG1	1:A:212:ALA:HB3	2.01	0.60
1:G:122:VAL:HG23	1:H:8:ILE:HD11	1.84	0.59
1:C:8:ILE:HD11	1:D:122:VAL:HG23	1.84	0.58
1:A:209:THR:CG2	1:A:213:ASP:H	2.17	0.58
1:G:8:ILE:HD11	1:H:122:VAL:HG23	1.86	0.58
1:E:49:ILE:HB	1:E:78:ILE:HG23	1.87	0.57
1:G:75:LEU:HD23	1:G:162:VAL:HB	1.89	0.55
1:B:12:ARG:HD2	1:B:168:HIS:O	2.07	0.54
1:B:49:ILE:HB	1:B:78:ILE:HG23	1.89	0.54
1:C:75:LEU:HD23	1:C:162:VAL:HB	1.90	0.54
1:F:75:LEU:HD23	1:F:162:VAL:HB	1.91	0.53
1:E:75:LEU:HD23	1:E:162:VAL:HB	1.91	0.53
1:D:75:LEU:HD23	1:D:162:VAL:HB	1.91	0.53
1:C:3:GLU:HB3	1:D:3:GLU:HB3	1.91	0.52
1:H:75:LEU:HD23	1:H:162:VAL:HB	1.91	0.52
1:H:78:ILE:HD13	1:H:137:ILE:HG12	1.91	0.52
1:B:75:LEU:HD23	1:B:162:VAL:HB	1.91	0.52
1:H:14:ILE:HG21	1:H:165:PRO:HB3	1.92	0.52
1:E:14:ILE:HG21	1:E:165:PRO:HB3	1.91	0.51
1:B:14:ILE:HG21	1:B:165:PRO:HB3	1.93	0.51
1:D:14:ILE:HG21	1:D:165:PRO:HB3	1.92	0.51
1:G:14:ILE:HG21	1:G:165:PRO:HB3	1.93	0.51
1:F:14:ILE:HG21	1:F:165:PRO:HB3	1.93	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:59:LYS:HB3	1:C:147:LEU:HD11	1.92	0.50
1:A:59:LYS:HB3	1:A:147:LEU:HD11	1.93	0.49
1:F:145:ILE:HG23	1:F:150:LEU:HB2	1.95	0.49
1:A:209:THR:HG21	1:A:213:ASP:N	2.27	0.49
1:D:59:LYS:HB3	1:D:147:LEU:HD11	1.95	0.48
1:B:10:ASP:HA	1:B:171:LYS:HD2	1.96	0.48
1:B:59:LYS:HB3	1:B:147:LEU:HD11	1.95	0.48
1:G:59:LYS:HB3	1:G:147:LEU:HD11	1.94	0.48
1:D:208:ARG:HH12	1:H:10:ASP:CG	2.21	0.48
1:H:77:LEU:HB2	1:H:160:LEU:HB3	1.96	0.48
1:F:59:LYS:HB3	1:F:147:LEU:HD11	1.96	0.47
1:C:99:VAL:HG22	1:C:105:SER:HB3	1.98	0.46
1:A:131:THR:HG22	1:A:162:VAL:HG22	1.97	0.46
1:H:59:LYS:HB3	1:H:147:LEU:HD11	1.97	0.46
1:C:215:ARG:HD2	1:C:220:THR:HG22	1.97	0.46
1:E:59:LYS:HB3	1:E:147:LEU:HD11	1.97	0.45
1:E:215:ARG:HD2	1:E:220:THR:HG22	1.97	0.45
1:A:209:THR:HG23	1:A:212:ALA:H	1.82	0.45
1:A:67:GLN:HB2	1:A:70:ILE:HD12	1.98	0.44
1:H:215:ARG:HD2	1:H:220:THR:HG22	1.99	0.44
1:C:131:THR:HA	1:C:161:VAL:O	2.18	0.44
1:H:22:VAL:HG23	1:H:74:PRO:HG2	2.00	0.43
1:D:22:VAL:HG23	1:D:74:PRO:HG2	2.01	0.43
1:F:215:ARG:HD2	1:F:220:THR:HG22	2.00	0.42
1:G:234:ARG:HH11	1:H:244:PHE:HB3	1.84	0.42
1:E:22:VAL:HG23	1:E:74:PRO:HG2	2.01	0.42
1:C:22:VAL:HG23	1:C:74:PRO:HG2	2.01	0.42
1:F:22:VAL:HG23	1:F:74:PRO:HG2	2.01	0.42
1:G:22:VAL:HG23	1:G:74:PRO:HG2	2.02	0.42
1:B:131:THR:HG22	1:B:162:VAL:HG22	2.02	0.41
1:A:22:VAL:HG23	1:A:74:PRO:HG2	2.02	0.41
1:G:45:GLN:HE21	1:G:45:GLN:HB2	1.72	0.41
1:D:131:THR:HG22	1:D:162:VAL:HG22	2.02	0.41
1:F:131:THR:HG22	1:F:162:VAL:HG22	2.02	0.41
1:H:179:ALA:HA	1:H:190:LEU:HD22	2.02	0.41
1:A:131:THR:HA	1:A:161:VAL:O	2.22	0.40
1:A:182:HIS:O	1:B:49:ILE:HA	2.21	0.40
1:C:182:HIS:O	1:D:49:ILE:HA	2.20	0.40
1:H:145:ILE:HG23	1:H:150:LEU:HB2	2.03	0.40
1:B:131:THR:HA	1:B:161:VAL:O	2.22	0.40
1:B:22:VAL:HG23	1:B:74:PRO:HG2	2.02	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	244/253 (96%)	234 (96%)	9 (4%)	1 (0%)	30	48
1	B	244/253 (96%)	234 (96%)	9 (4%)	1 (0%)	30	48
1	C	243/253 (96%)	234 (96%)	8 (3%)	1 (0%)	30	48
1	D	244/253 (96%)	236 (97%)	7 (3%)	1 (0%)	30	48
1	E	244/253 (96%)	236 (97%)	7 (3%)	1 (0%)	30	48
1	F	244/253 (96%)	236 (97%)	7 (3%)	1 (0%)	30	48
1	G	244/253 (96%)	235 (96%)	8 (3%)	1 (0%)	30	48
1	H	244/253 (96%)	235 (96%)	8 (3%)	1 (0%)	30	48
All	All	1951/2024 (96%)	1880 (96%)	63 (3%)	8 (0%)	30	48

All (8) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	41	ILE
1	B	41	ILE
1	E	41	ILE
1	F	41	ILE
1	H	41	ILE
1	C	41	ILE
1	D	41	ILE
1	G	41	ILE

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	205/211 (97%)	182 (89%)	23 (11%)	6	12
1	B	205/211 (97%)	186 (91%)	19 (9%)	8	19
1	C	204/211 (97%)	186 (91%)	18 (9%)	9	21
1	D	205/211 (97%)	185 (90%)	20 (10%)	7	17
1	E	205/211 (97%)	189 (92%)	16 (8%)	11	25
1	F	205/211 (97%)	190 (93%)	15 (7%)	13	28
1	G	205/211 (97%)	191 (93%)	14 (7%)	14	31
1	H	205/211 (97%)	187 (91%)	18 (9%)	9	21
All	All	1639/1688 (97%)	1496 (91%)	143 (9%)	9	21

All (143) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	8	ILE
1	A	9	GLN
1	A	10	ASP
1	A	12	ARG
1	A	14	ILE
1	A	16	GLN
1	A	19	ASP
1	A	24	ASP
1	A	25	GLU
1	A	45	GLN
1	A	60	LEU
1	A	103	LEU
1	A	111	THR
1	A	121	THR
1	A	147	LEU
1	A	171	LYS
1	A	193	LEU
1	A	205	MET
1	A	208	ARG
1	A	219	GLN
1	A	220	THR
1	A	239	LYS
1	A	245	GLU
1	B	6	ARG

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Mol	Chain	Res	Type
1	B	9	GLN
1	B	16	GLN
1	B	25	GLU
1	B	45	GLN
1	B	60	LEU
1	B	103	LEU
1	B	116	SER
1	B	147	LEU
1	B	150	LEU
1	B	167	ASP
1	B	171	LYS
1	B	175	LEU
1	B	193	LEU
1	B	200	GLU
1	B	220	THR
1	B	226	LYS
1	B	239	LYS
1	B	245	GLU
1	C	6	ARG
1	C	8	ILE
1	C	45	GLN
1	C	46	VAL
1	C	47	THR
1	C	53	ASP
1	C	60	LEU
1	C	80	CYS
1	C	103	LEU
1	C	112	ASP
1	C	116	SER
1	C	121	THR
1	C	147	LEU
1	C	171	LYS
1	C	193	LEU
1	C	205	MET
1	C	208	ARG
1	C	239	LYS
1	D	6	ARG
1	D	9	GLN
1	D	53	ASP
1	D	60	LEU
1	D	78	ILE
1	D	94	ASP

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Mol	Chain	Res	Type
1	D	103	LEU
1	D	121	THR
1	D	142	LEU
1	D	147	LEU
1	D	167	ASP
1	D	171	LYS
1	D	185	SER
1	D	189	ASP
1	D	193	LEU
1	D	203	GLU
1	D	220	THR
1	D	226	LYS
1	D	239	LYS
1	D	245	GLU
1	E	9	GLN
1	E	45	GLN
1	E	60	LEU
1	E	103	LEU
1	E	111	THR
1	E	121	THR
1	E	147	LEU
1	E	171	LYS
1	E	185	SER
1	E	190	LEU
1	E	193	LEU
1	E	208	ARG
1	E	226	LYS
1	E	239	LYS
1	E	245	GLU
1	E	246	LYS
1	F	9	GLN
1	F	45	GLN
1	F	60	LEU
1	F	78	ILE
1	F	103	LEU
1	F	111	THR
1	F	147	LEU
1	F	167	ASP
1	F	171	LYS
1	F	189	ASP
1	F	193	LEU
1	F	201	MET

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Mol	Chain	Res	Type
1	F	208	ARG
1	F	226	LYS
1	F	239	LYS
1	G	8	ILE
1	G	9	GLN
1	G	45	GLN
1	G	60	LEU
1	G	103	LEU
1	G	111	THR
1	G	121	THR
1	G	147	LEU
1	G	168	HIS
1	G	171	LYS
1	G	193	LEU
1	G	208	ARG
1	G	220	THR
1	G	239	LYS
1	H	6	ARG
1	H	8	ILE
1	H	9	GLN
1	H	45	GLN
1	H	53	ASP
1	H	60	LEU
1	H	78	ILE
1	H	103	LEU
1	H	121	THR
1	H	137	ILE
1	H	147	LEU
1	H	167	ASP
1	H	171	LYS
1	H	189	ASP
1	H	193	LEU
1	H	208	ARG
1	H	226	LYS
1	H	239	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (26) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	9	GLN
1	A	32	GLN
1	A	168	HIS

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Mol	Chain	Res	Type
1	A	219	GLN
1	B	2	ASN
1	B	9	GLN
1	B	32	GLN
1	B	66	ASN
1	C	9	GLN
1	C	32	GLN
1	D	2	ASN
1	D	9	GLN
1	D	32	GLN
1	D	188	HIS
1	E	2	ASN
1	E	9	GLN
1	F	2	ASN
1	F	9	GLN
1	F	32	GLN
1	G	2	ASN
1	G	9	GLN
1	G	32	GLN
1	H	2	ASN
1	H	9	GLN
1	H	32	GLN
1	H	240	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 ⓘ

15 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	FMN	C	301	-	33,33,33	0.34	0	48,50,50	0.46	0
4	SO4	G	302	-	4,4,4	0.24	0	6,6,6	0.09	0
2	FMN	F	301	-	33,33,33	0.33	0	48,50,50	0.47	0
3	MPD	H	302	-	7,7,7	0.61	0	9,10,10	0.54	0
2	FMN	E	301	-	33,33,33	0.33	0	48,50,50	0.49	0
2	FMN	A	301	-	33,33,33	0.35	0	48,50,50	0.47	0
2	FMN	H	301	-	33,33,33	0.35	0	48,50,50	0.44	0
4	SO4	D	302	-	4,4,4	0.49	0	6,6,6	0.47	0
2	FMN	B	301	-	33,33,33	0.29	0	48,50,50	0.46	0
4	SO4	H	303	-	4,4,4	0.26	0	6,6,6	0.15	0
2	FMN	G	301	-	33,33,33	0.30	0	48,50,50	0.44	0
4	SO4	D	303	-	4,4,4	0.31	0	6,6,6	0.14	0
4	SO4	C	303	-	4,4,4	0.28	0	6,6,6	0.11	0
3	MPD	C	302	-	7,7,7	0.93	1 (14%)	9,10,10	0.45	0
2	FMN	D	301	-	33,33,33	0.33	0	48,50,50	0.46	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	FMN	C	301	-	-	2/18/18/18	0/3/3/3
2	FMN	F	301	-	-	3/18/18/18	0/3/3/3
3	MPD	H	302	-	-	3/5/5/5	-
2	FMN	E	301	-	-	3/18/18/18	0/3/3/3
2	FMN	A	301	-	-	3/18/18/18	0/3/3/3
2	FMN	H	301	-	-	3/18/18/18	0/3/3/3
2	FMN	B	301	-	-	3/18/18/18	0/3/3/3
2	FMN	G	301	-	-	3/18/18/18	0/3/3/3
3	MPD	C	302	-	-	2/5/5/5	-
2	FMN	D	301	-	-	3/18/18/18	0/3/3/3

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	302	MPD	C3-C2	2.15	1.60	1.54

There are no bond angle outliers.

There are no chirality outliers.

All (28) torsion outliers are listed below:

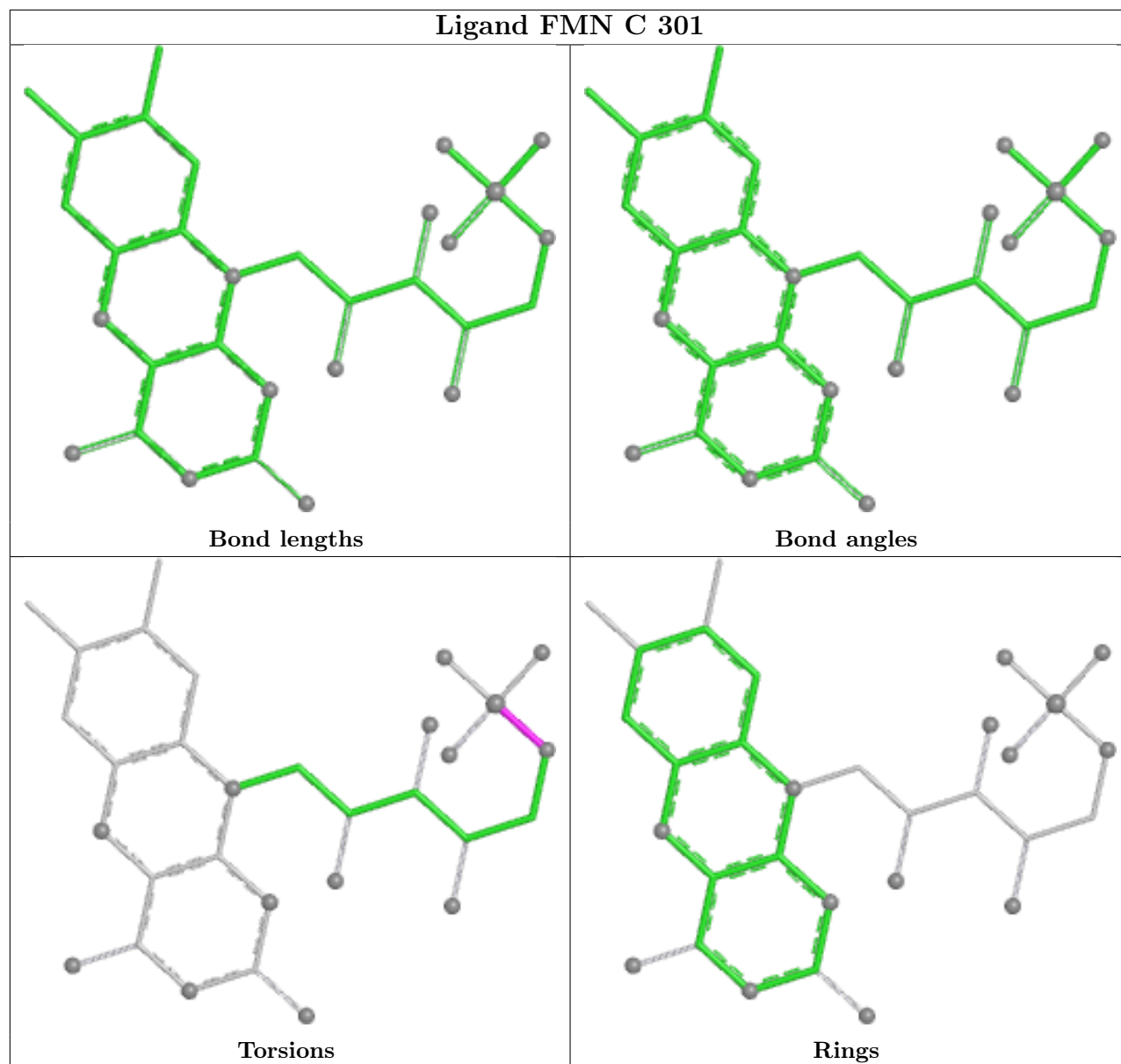
Mol	Chain	Res	Type	Atoms
2	A	301	FMN	C5'-O5'-P-O1P
2	A	301	FMN	C5'-O5'-P-O2P
2	B	301	FMN	C5'-O5'-P-O1P
2	B	301	FMN	C5'-O5'-P-O2P
2	C	301	FMN	C5'-O5'-P-O1P
2	C	301	FMN	C5'-O5'-P-O2P
2	D	301	FMN	C5'-O5'-P-O2P
2	E	301	FMN	C5'-O5'-P-O1P
2	E	301	FMN	C5'-O5'-P-O2P
2	F	301	FMN	C5'-O5'-P-O1P
2	F	301	FMN	C5'-O5'-P-O2P
2	G	301	FMN	C5'-O5'-P-O1P
2	G	301	FMN	C5'-O5'-P-O2P
2	H	301	FMN	C5'-O5'-P-O1P
2	H	301	FMN	C5'-O5'-P-O2P
3	C	302	MPD	C2-C3-C4-O4
3	C	302	MPD	C2-C3-C4-C5
3	H	302	MPD	C1-C2-C3-C4
2	D	301	FMN	C5'-O5'-P-O1P
3	H	302	MPD	O2-C2-C3-C4
3	H	302	MPD	CM-C2-C3-C4
2	A	301	FMN	C5'-O5'-P-O3P
2	B	301	FMN	C5'-O5'-P-O3P
2	D	301	FMN	C5'-O5'-P-O3P
2	E	301	FMN	C5'-O5'-P-O3P
2	F	301	FMN	C5'-O5'-P-O3P
2	G	301	FMN	C5'-O5'-P-O3P
2	H	301	FMN	C5'-O5'-P-O3P

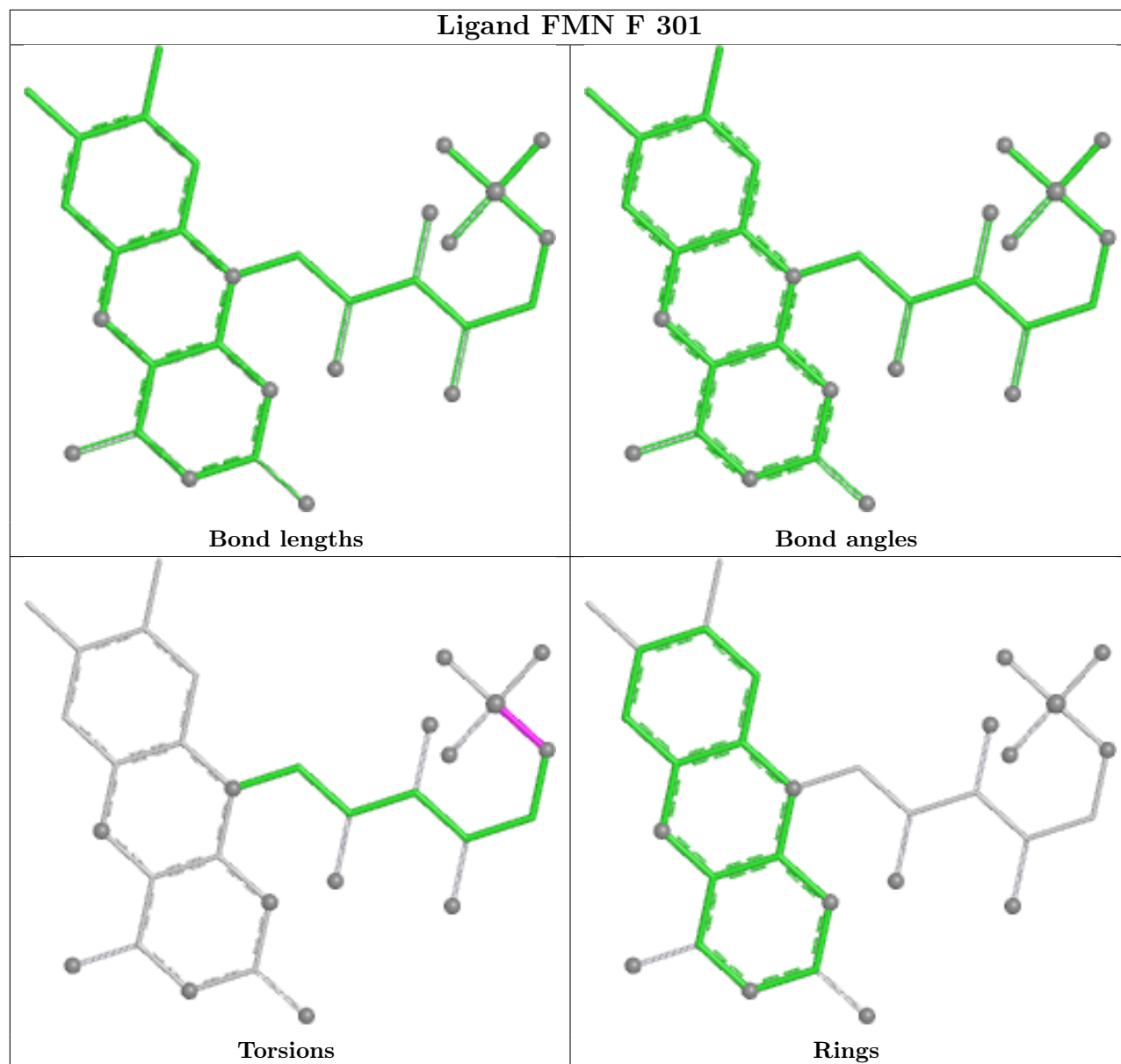
There are no ring outliers.

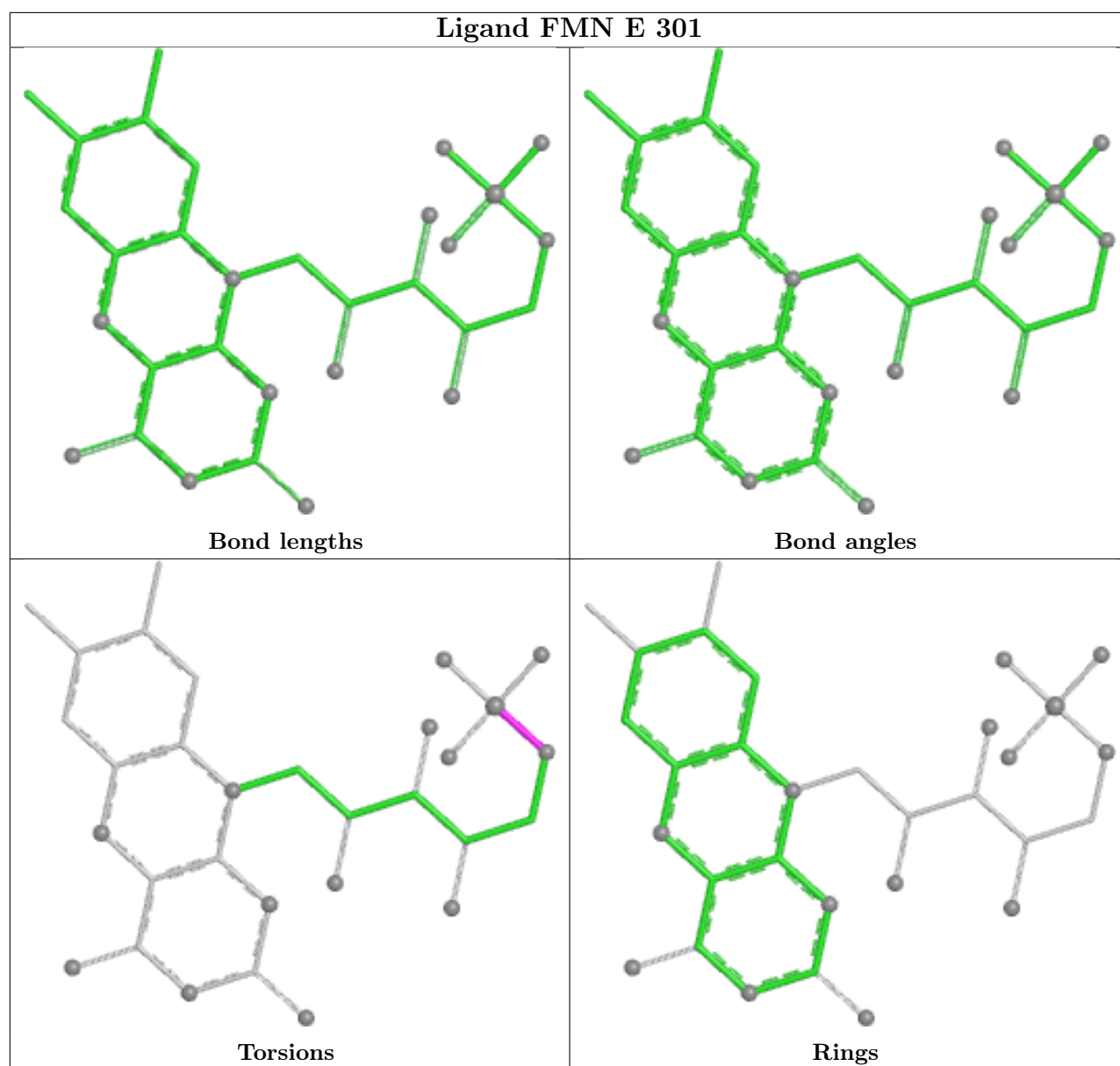
1 monomer is involved in 1 short contact:

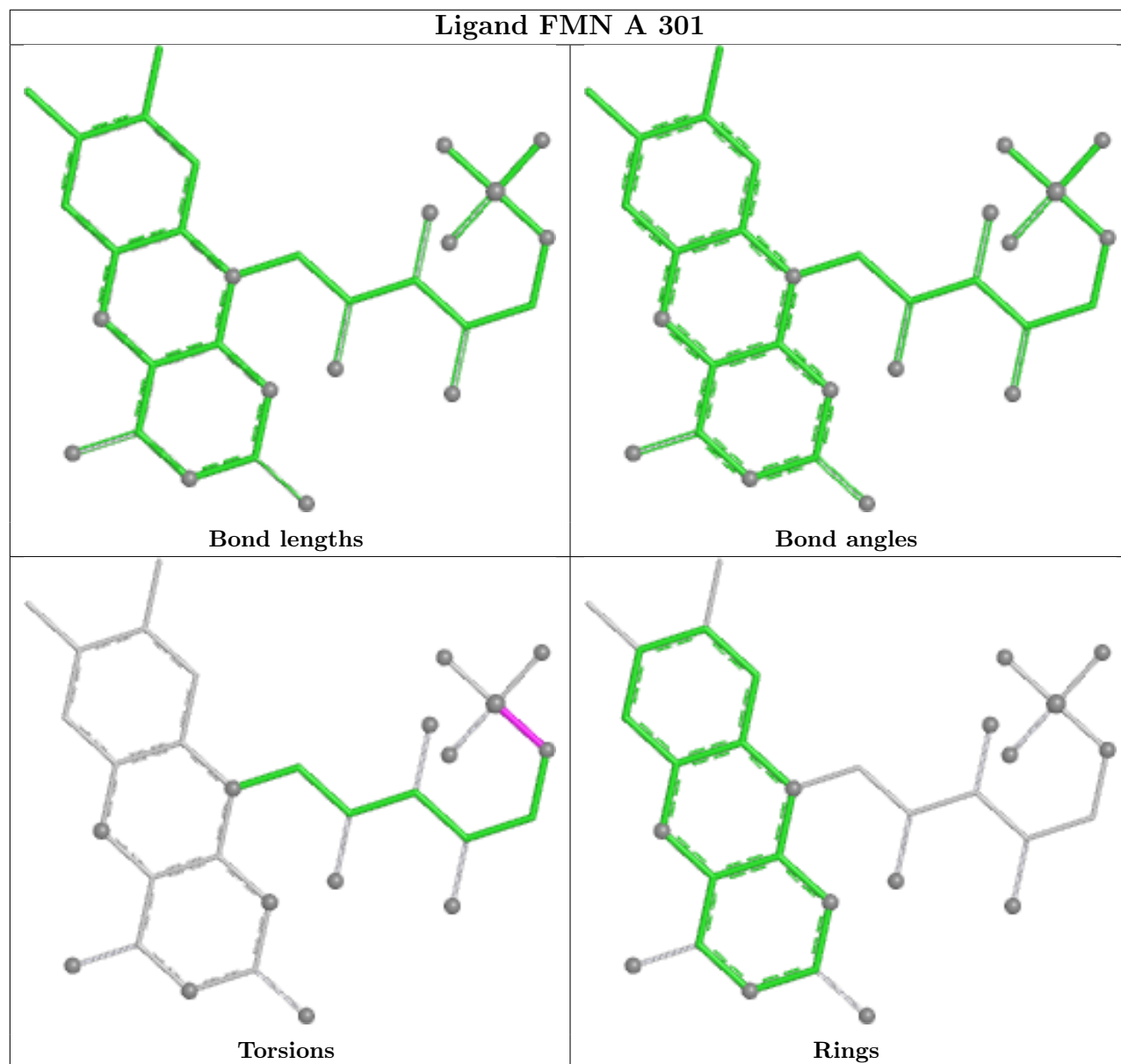
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	H	302	MPD	1	0

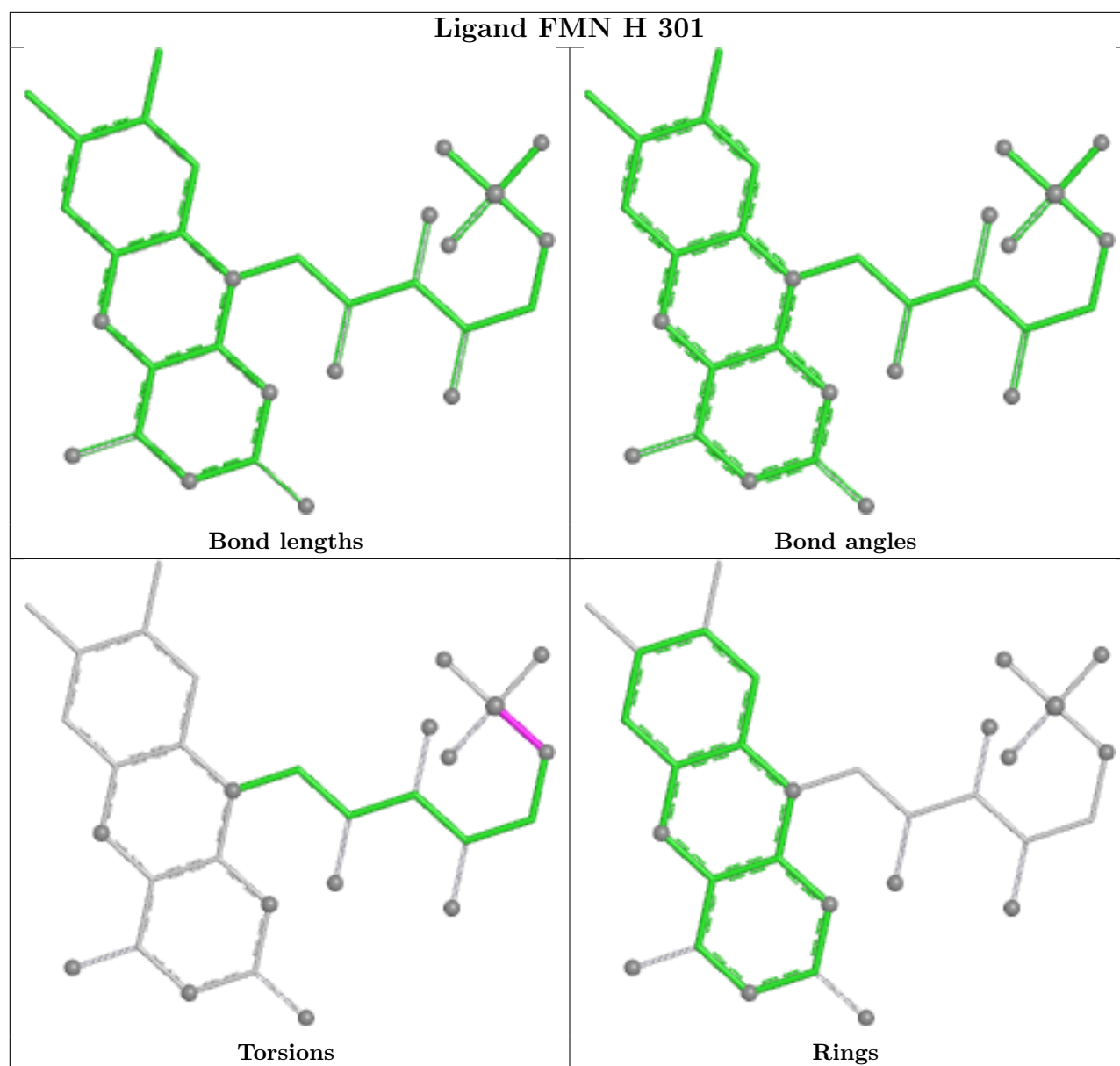
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

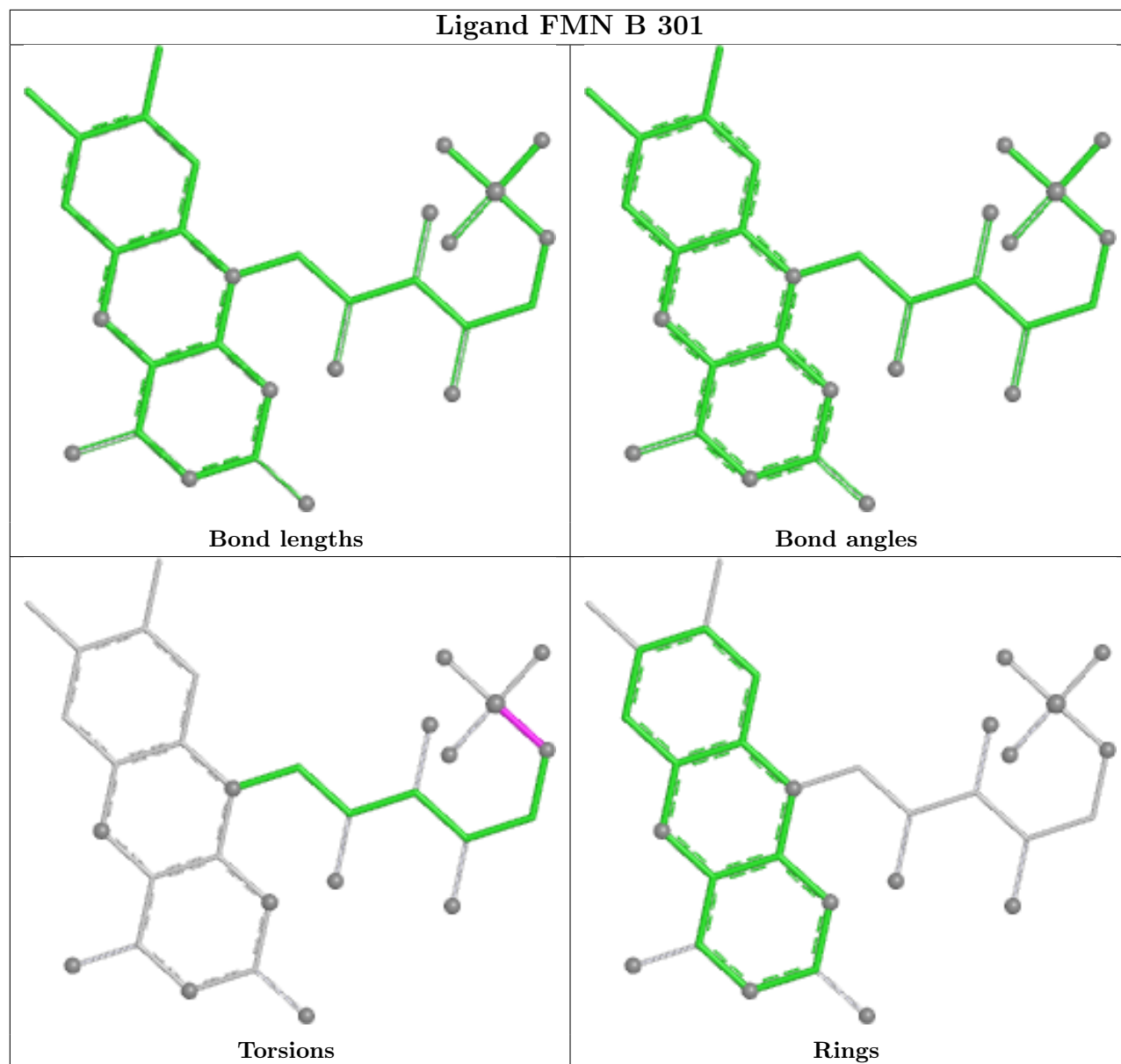


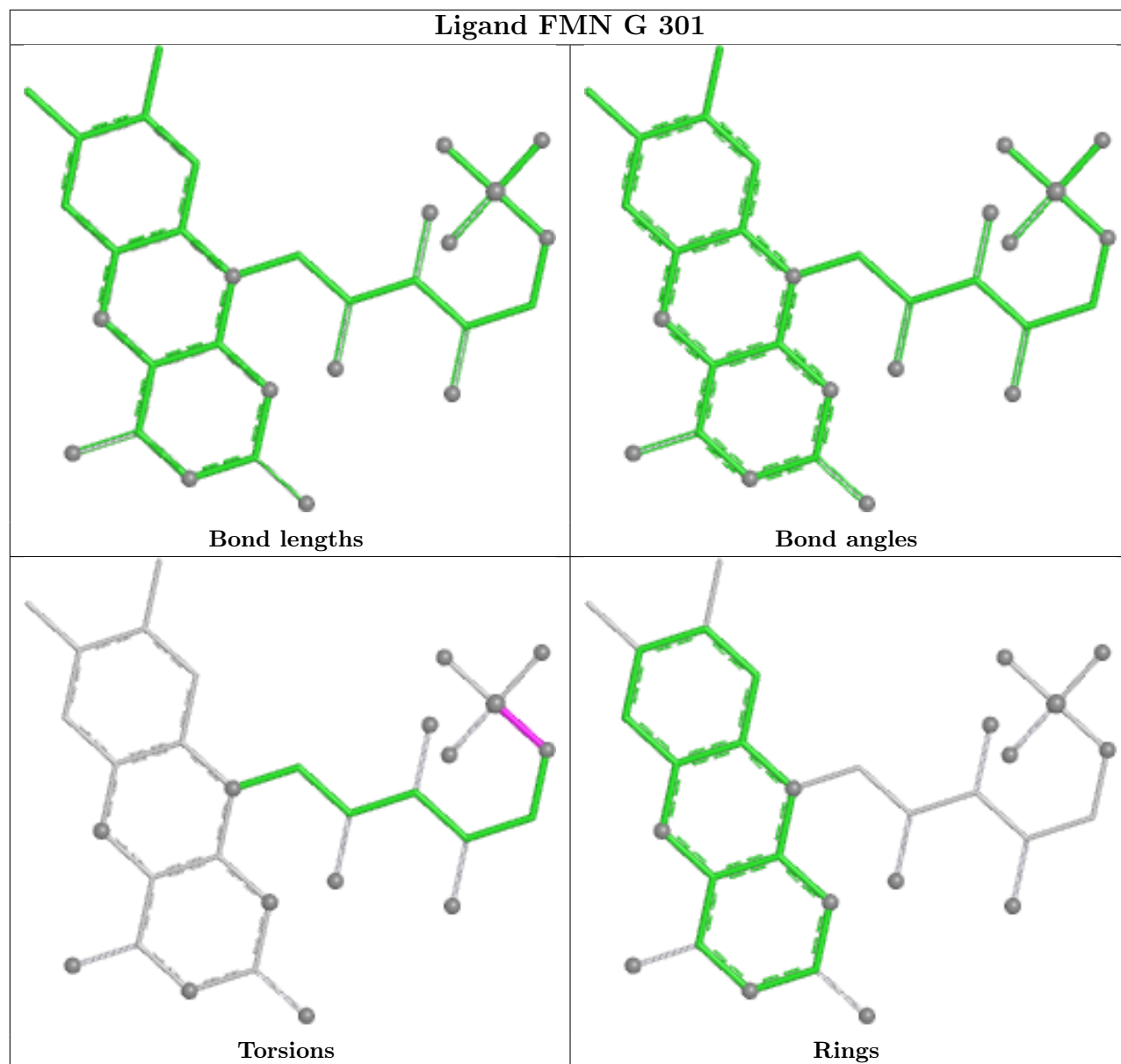


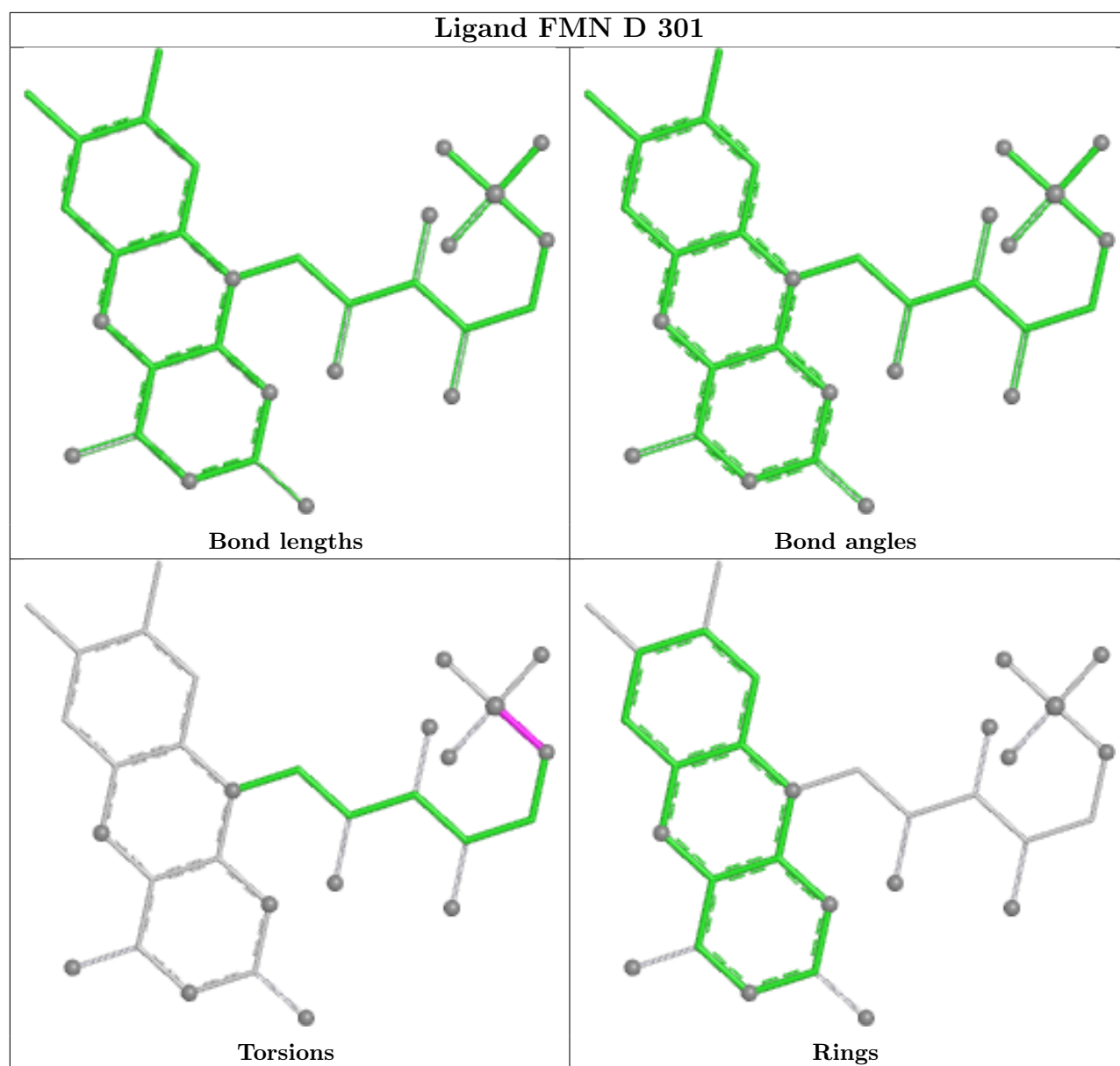












5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 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	246/253 (97%)	0.60	4 (1%) 70 64	50, 70, 91, 105	0
1	B	246/253 (97%)	0.66	5 (2%) 65 57	49, 67, 89, 114	0
1	C	245/253 (96%)	0.14	1 (0%) 88 87	27, 47, 75, 105	0
1	D	246/253 (97%)	0.14	1 (0%) 88 87	30, 44, 69, 85	0
1	E	246/253 (97%)	0.73	10 (4%) 41 33	52, 74, 100, 116	0
1	F	246/253 (97%)	0.71	6 (2%) 59 50	51, 70, 90, 109	0
1	G	246/253 (97%)	0.15	1 (0%) 88 87	28, 47, 76, 93	0
1	H	246/253 (97%)	0.22	1 (0%) 88 87	26, 43, 69, 85	0
All	All	1967/2024 (97%)	0.42	29 (1%) 72 65	26, 61, 89, 116	0

All (29) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	189	ASP	3.3
1	E	8	ILE	3.2
1	E	134	ILE	3.1
1	A	227	THR	3.1
1	B	48	ILE	3.0
1	B	213	ASP	2.8
1	F	8	ILE	2.8
1	H	94	ASP	2.7
1	B	98	GLY	2.7
1	F	153	TYR	2.5
1	A	39	SER	2.5
1	B	8	ILE	2.5
1	E	135	GLY	2.4
1	E	217	TRP	2.3
1	A	214	ASP	2.2
1	A	217	TRP	2.2

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Mol	Chain	Res	Type	RSRZ
1	C	210	ASN	2.2
1	F	2	ASN	2.2
1	G	168	HIS	2.2
1	E	246	LYS	2.1
1	E	206	LYS	2.1
1	F	110	ALA	2.1
1	D	227	THR	2.1
1	F	94	ASP	2.1
1	E	4	ALA	2.1
1	B	221	VAL	2.1
1	F	188	HIS	2.0
1	E	227	THR	2.0
1	E	49	ILE	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($\text{\AA}^2$)	Q<0.9
3	MPD	C	302	8/8	0.64	0.22	43,47,50,52	0
3	MPD	H	302	8/8	0.65	0.25	38,46,49,50	0
4	SO4	G	302	5/5	0.73	0.18	82,83,83,84	0
4	SO4	C	303	5/5	0.75	0.16	86,86,87,87	0
4	SO4	H	303	5/5	0.84	0.13	70,71,72,72	0
4	SO4	D	303	5/5	0.85	0.13	74,74,75,75	0
4	SO4	D	302	5/5	0.88	0.16	11,16,18,19	0
2	FMN	B	301	31/31	0.88	0.14	68,73,78,79	0
2	FMN	E	301	31/31	0.89	0.10	47,61,80,82	0
2	FMN	F	301	31/31	0.90	0.12	61,68,71,72	0

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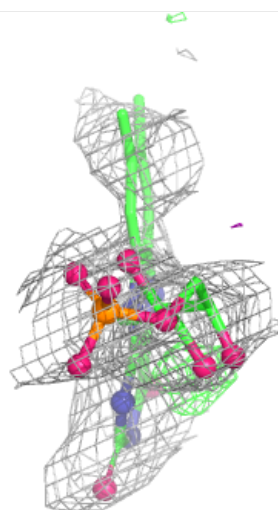
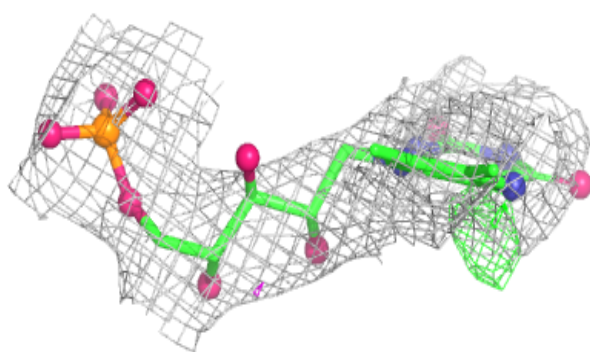
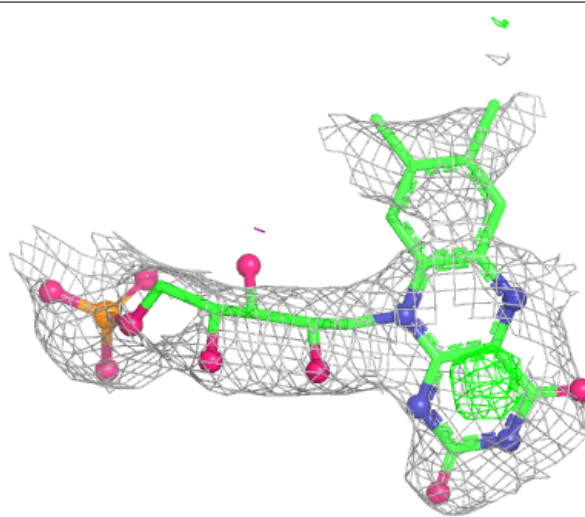
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	FMN	A	301	31/31	0.90	0.12	58,68,78,80	0
2	FMN	G	301	31/31	0.92	0.10	32,44,67,68	0
2	FMN	C	301	31/31	0.94	0.10	26,35,49,51	0
2	FMN	H	301	31/31	0.94	0.10	31,39,41,42	0
2	FMN	D	301	31/31	0.94	0.10	35,38,44,47	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.

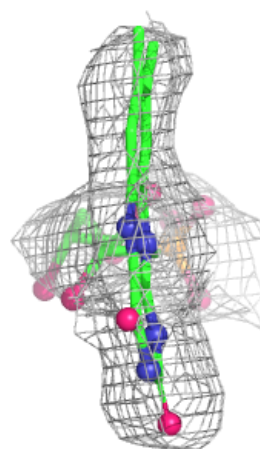
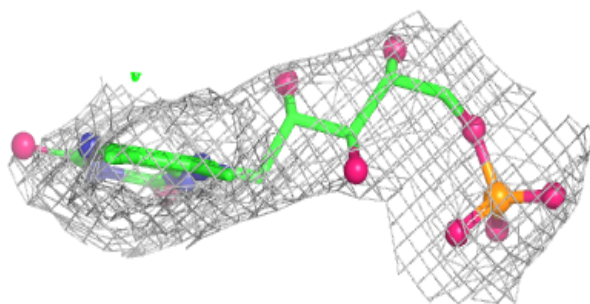
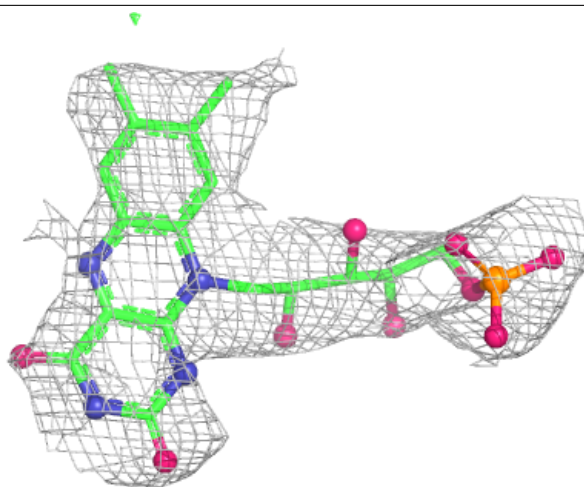
Electron density around FMN B 301:

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



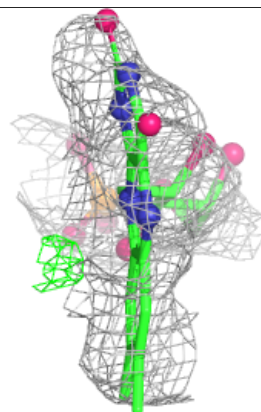
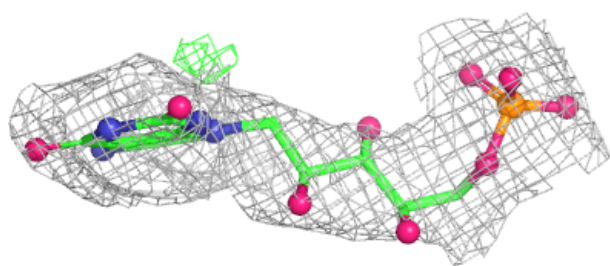
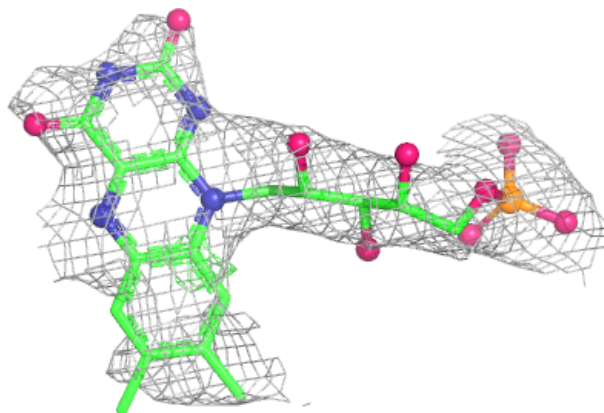
Electron density around FMN E 301:

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

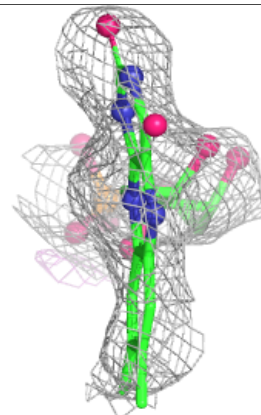
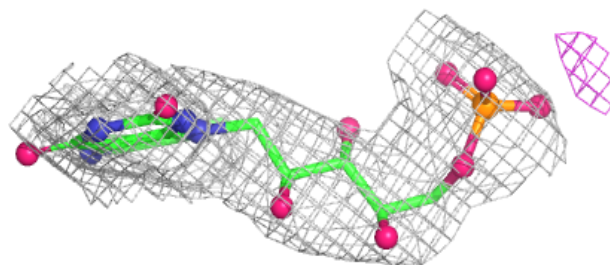
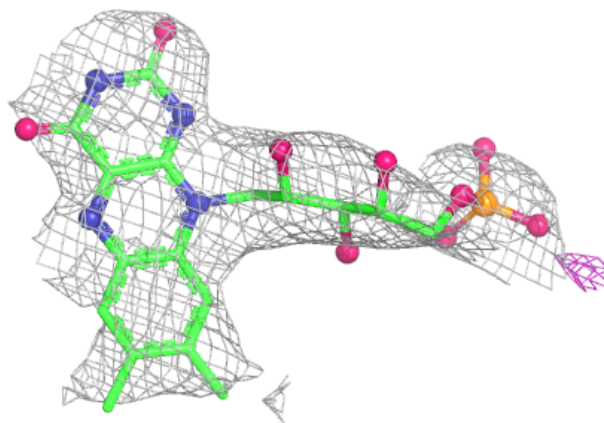


Electron density around FMN F 301:

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

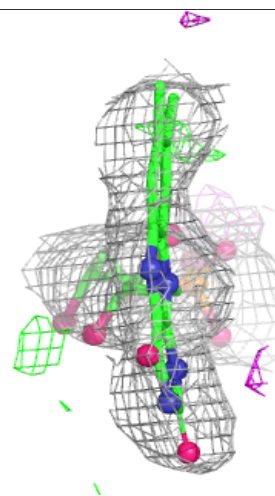
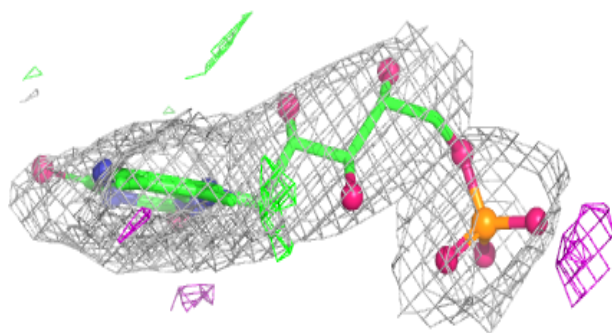
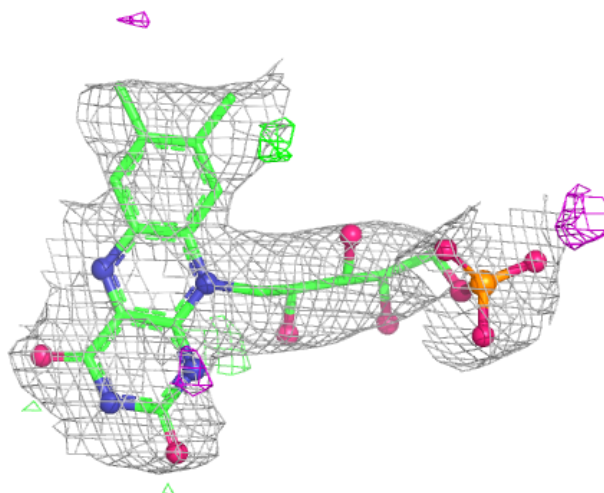
**Electron density around FMN A 301:**

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



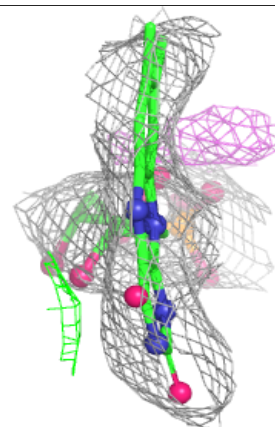
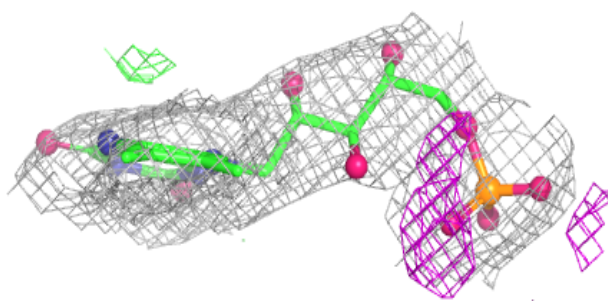
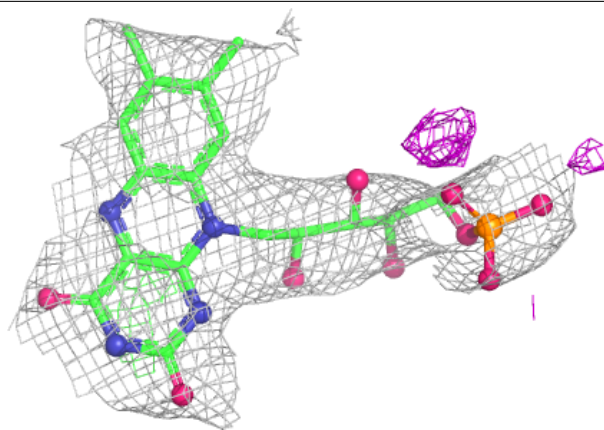
Electron density around FMN G 301:

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



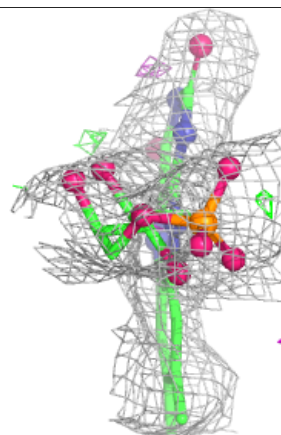
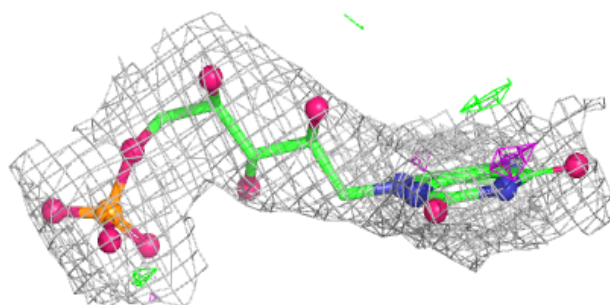
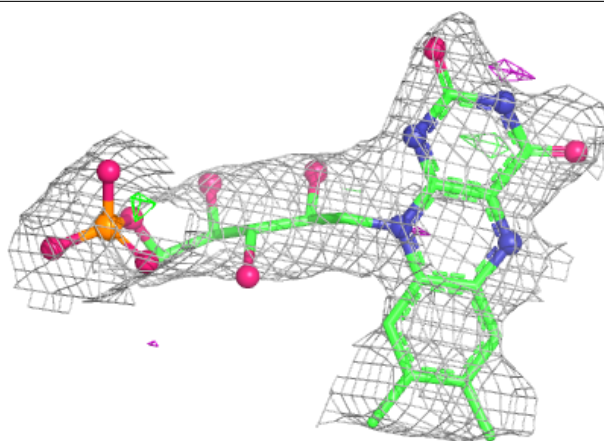
Electron density around FMN C 301:

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



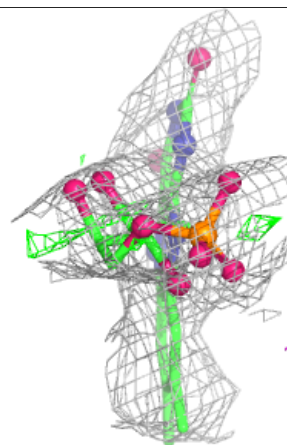
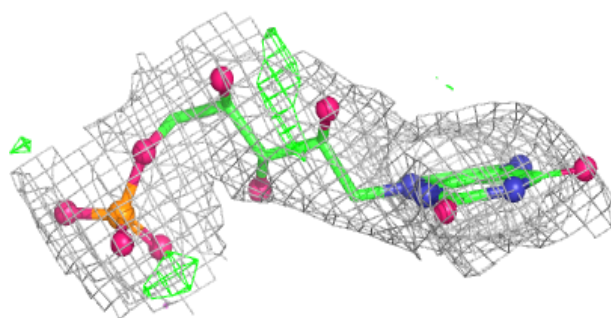
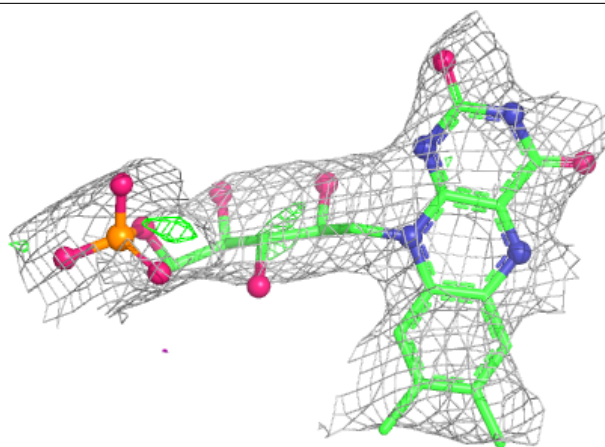
Electron density around FMN H 301:

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



Electron density around FMN D 301:

$2mF_o - DF_c$ (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.