



Full wwPDB X-ray Structure Validation Report ⓘ

Nov 4, 2023 – 06:16 PM EDT

PDB ID : 1M64
Title : Crystal structure of Q363F mutant flavocytochrome c3
Authors : Mowat, C.G.; Pankhurst, K.L.; Miles, C.S.; Leys, D.; Walkinshaw, M.D.; Reid, G.A.; Chapman, S.K.
Deposited on : 2002-07-12
Resolution : 1.80 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtrriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

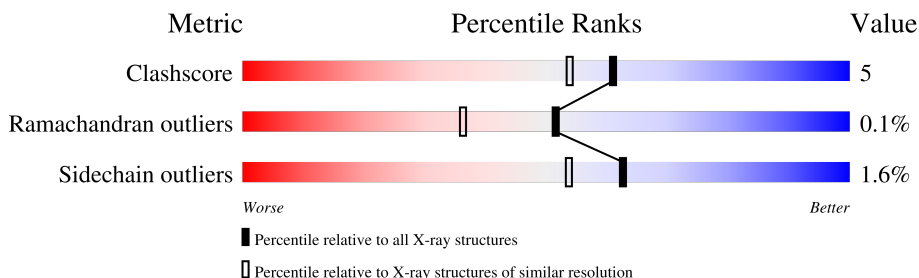
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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))
Clashscore	141614	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	571	
1	B	571	

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
5	FUM	A	3001	-	X	-	-
5	FUM	B	4001	-	X	-	-

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 10932 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 flavocytochrome c3.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	568	4183	2599	733	826	25	0	0	0
1	B	568	4178	2593	732	828	25	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	363	PHE	GLN	engineered mutation	UNP Q02469
B	363	PHE	GLN	engineered mutation	UNP Q02469

- Molecule 2 is SODIUM ION (three-letter code: NA) (formula: Na).

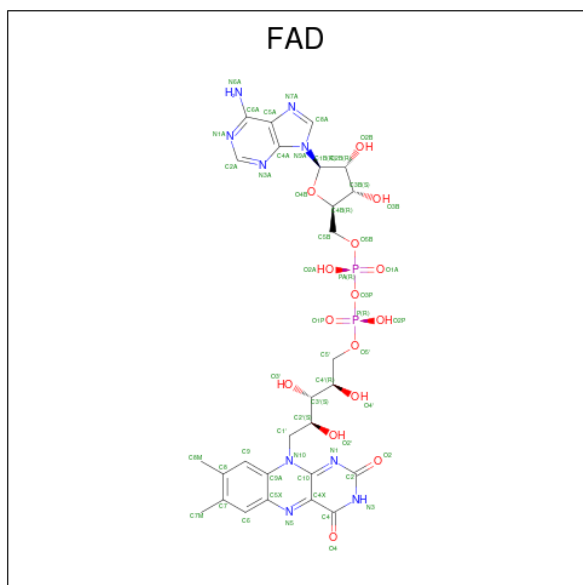
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Na	0	0
			1	1		
2	B	1	Total	Na	0	0
			1	1		

- Molecule 3 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula: C₃₄H₃₂FeN₄O₄).



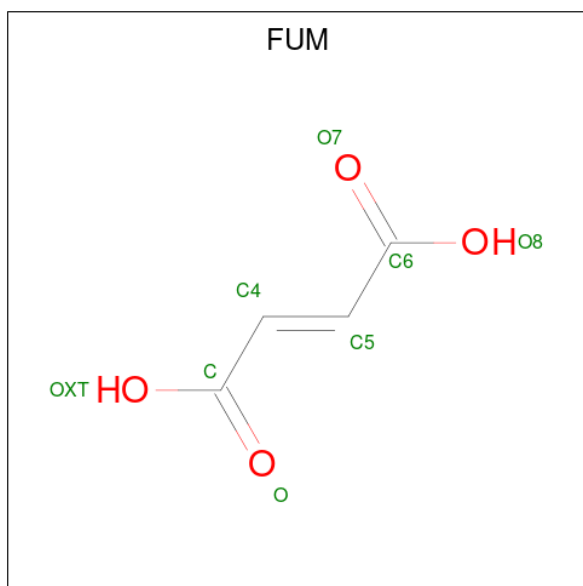
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
3	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
3	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
3	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
3	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
3	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
3	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
3	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

- Molecule 4 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula: $C_{27}H_{33}N_9O_{15}P_2$).



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

- Molecule 5 is FUMARIC ACID (three-letter code: FUM) (formula: C₄H₄O₄).



Mol	Chain	Residues	Atoms		ZeroOcc	AltConf	
5	A	1	Total	C	O	0	0
			8	4	4		
5	B	1	Total	C	O	0	0
			8	4	4		

- Molecule 6 is water.

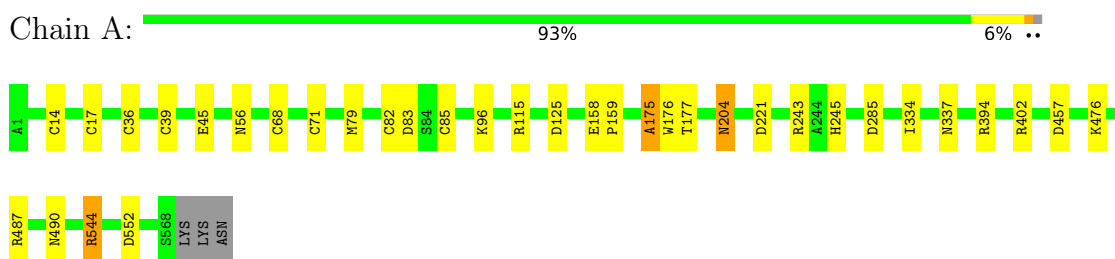
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1072	Total 1072	O 1072	0	0
6	B	1031	Total 1031	O 1031	0	0

3 Residue-property plots [i](#)

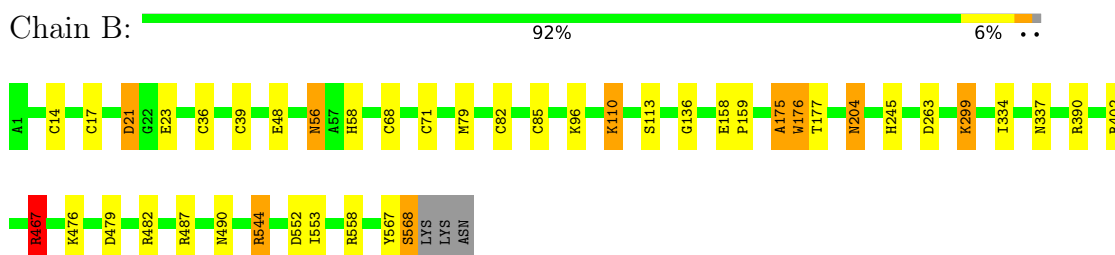
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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.

Note EDS was not executed.

- Molecule 1: flavocytochrome c3



- Molecule 1: flavocytochrome c3



4 Data and refinement statistics

Xtrriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	78.52Å 88.89Å 91.19Å 90.00° 104.42° 90.00°	Depositor
Resolution (Å)	15.00 – 1.80	Depositor
% Data completeness (in resolution range)	(Not available) (15.00-1.80)	Depositor
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC	Depositor
R, R_{free}	0.163 , 0.224	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	10932	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

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: NA, FUM, FAD, HEM

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	0.61	1/4254 (0.0%)	1.18	18/5760 (0.3%)
1	B	0.61	0/4249	1.17	15/5756 (0.3%)
All	All	0.61	1/8503 (0.0%)	1.17	33/11516 (0.3%)

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
1	B	0	1
All	All	0	2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	176	TRP	N-CA	-5.40	1.35	1.46

All (33) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	175	ALA	C-N-CA	22.12	177.00	121.70
1	B	175	ALA	C-N-CA	18.50	167.96	121.70
1	A	176	TRP	N-CA-CB	10.59	129.65	110.60
1	B	402	ARG	NE-CZ-NH2	8.11	124.36	120.30
1	B	558	ARG	NE-CZ-NH1	7.90	124.25	120.30
1	A	552	ASP	CB-CG-OD2	6.79	124.41	118.30
1	A	125	ASP	CB-CG-OD1	6.53	124.18	118.30
1	B	176	TRP	N-CA-CB	6.44	122.19	110.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	402	ARG	NE-CZ-NH1	6.37	123.49	120.30
1	A	544	ARG	NE-CZ-NH1	-6.27	117.17	120.30
1	A	221	ASP	CB-CG-OD1	6.13	123.82	118.30
1	A	457	ASP	CB-CG-OD1	6.01	123.71	118.30
1	A	544	ARG	CD-NE-CZ	5.87	131.81	123.60
1	B	263	ASP	CB-CG-OD2	5.86	123.58	118.30
1	B	487	ARG	NE-CZ-NH2	5.82	123.21	120.30
1	B	482	ARG	NE-CZ-NH2	5.72	123.16	120.30
1	A	175	ALA	N-CA-CB	5.68	118.06	110.10
1	A	45	GLU	OE1-CD-OE2	-5.67	116.50	123.30
1	B	558	ARG	NE-CZ-NH2	-5.65	117.47	120.30
1	B	175	ALA	N-CA-CB	5.58	117.92	110.10
1	A	243	ARG	NE-CZ-NH1	5.58	123.09	120.30
1	B	390	ARG	NE-CZ-NH1	5.55	123.08	120.30
1	B	544	ARG	NE-CZ-NH1	-5.45	117.57	120.30
1	B	467	ARG	CD-NE-CZ	5.43	131.20	123.60
1	B	552	ASP	CB-CG-OD2	5.42	123.18	118.30
1	A	394	ARG	NE-CZ-NH1	-5.35	117.62	120.30
1	B	390	ARG	NE-CZ-NH2	-5.30	117.65	120.30
1	A	487	ARG	NE-CZ-NH2	5.14	122.87	120.30
1	A	402	ARG	NE-CZ-NH2	-5.12	117.74	120.30
1	A	115	ARG	NE-CZ-NH1	5.12	122.86	120.30
1	A	285	ASP	CB-CG-OD2	5.11	122.90	118.30
1	B	568	SER	N-CA-C	5.09	124.73	111.00
1	A	83	ASP	CB-CG-OD2	5.04	122.84	118.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	175	ALA	Peptide
1	B	175	ALA	Peptide

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4183	0	4070	31	0
1	B	4178	0	4053	46	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	172	0	120	24	0
3	B	172	0	120	25	0
4	A	53	0	31	0	0
4	B	53	0	31	0	0
5	A	8	0	1	0	0
5	B	8	0	1	0	0
6	A	1072	0	0	2	0
6	B	1031	0	0	5	0
All	All	10932	0	8427	78	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.

All (78) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:36:CYS:SG	3:B:802:HEM:CAB	2.50	1.00
1:B:82:CYS:SG	3:B:804:HEM:CAB	2.51	0.98
1:A:82:CYS:SG	3:A:804:HEM:CAB	2.52	0.98
1:A:36:CYS:SG	3:A:802:HEM:CAB	2.52	0.97
1:B:68:CYS:SG	3:B:803:HEM:CAB	2.52	0.97
1:B:71:CYS:SG	3:B:803:HEM:CAC	2.54	0.96
1:B:85:CYS:SG	3:B:804:HEM:CAC	2.55	0.94
1:A:14:CYS:SG	3:A:801:HEM:CAB	2.59	0.91
1:B:14:CYS:SG	3:B:801:HEM:CAB	2.59	0.91
1:A:17:CYS:SG	3:A:801:HEM:CAC	2.59	0.90
1:B:17:CYS:SG	3:B:801:HEM:CAC	2.60	0.90
1:A:85:CYS:SG	3:A:804:HEM:CAC	2.60	0.90
1:A:71:CYS:SG	3:A:803:HEM:CAC	2.61	0.89
1:A:68:CYS:SG	3:A:803:HEM:CAB	2.63	0.86
1:A:82:CYS:HG	3:A:804:HEM:CAB	1.89	0.83
1:B:39:CYS:SG	3:B:802:HEM:CAC	2.67	0.83
1:B:204:ASN:H	1:B:204:ASN:HD22	1.26	0.82
1:A:39:CYS:SG	3:A:802:HEM:CAC	2.68	0.82
1:B:82:CYS:HG	3:B:804:HEM:CAB	1.93	0.79
1:B:71:CYS:HG	3:B:803:HEM:CAC	1.99	0.74
1:A:204:ASN:HD22	1:A:204:ASN:H	1.34	0.73
1:A:14:CYS:HG	3:A:801:HEM:CAB	2.01	0.71

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:299:LYS:HB2	6:B:4311:HOH:O	1.90	0.70
1:B:467:ARG:HH11	1:B:467:ARG:HG2	1.60	0.66
1:B:36:CYS:SG	3:B:802:HEM:HAB	2.39	0.62
1:B:82:CYS:SG	3:B:804:HEM:HAB	2.40	0.58
1:B:14:CYS:SG	3:B:801:HEM:HAB	2.41	0.58
1:B:136:GLY:HA3	1:B:553:ILE:HD12	1.85	0.57
1:B:334:ILE:HG12	6:B:4579:HOH:O	2.04	0.57
1:A:36:CYS:SG	3:A:802:HEM:HAB	2.41	0.56
1:B:79:MET:CE	1:B:96:LYS:HE3	2.35	0.56
1:B:68:CYS:SG	3:B:803:HEM:HAB	2.47	0.54
1:B:204:ASN:H	1:B:204:ASN:ND2	2.02	0.53
1:B:79:MET:HE3	1:B:96:LYS:HE3	1.89	0.53
3:A:803:HEM:HMB1	3:A:803:HEM:HBB2	1.90	0.52
1:B:85:CYS:SG	3:B:804:HEM:CBC	2.98	0.52
1:B:71:CYS:SG	3:B:803:HEM:CBC	2.99	0.51
1:B:467:ARG:HH11	1:B:467:ARG:CG	2.24	0.51
1:A:82:CYS:SG	3:A:804:HEM:HAB	2.47	0.50
1:A:204:ASN:H	1:A:204:ASN:ND2	2.06	0.49
1:A:85:CYS:SG	3:A:804:HEM:CBC	3.01	0.49
1:A:36:CYS:SG	3:A:802:HEM:CBB	3.00	0.49
1:A:82:CYS:SG	3:A:804:HEM:CBB	3.00	0.49
1:B:68:CYS:SG	3:B:803:HEM:CBB	2.99	0.48
1:B:17:CYS:SG	3:B:801:HEM:HAC	2.51	0.48
1:B:36:CYS:SG	3:B:802:HEM:CBB	3.00	0.48
1:A:334:ILE:HG12	6:A:3600:HOH:O	2.13	0.47
1:B:567:TYR:O	1:B:568:SER:HB2	2.13	0.47
1:A:177:THR:OG1	1:A:245:HIS:HE1	1.98	0.47
1:B:476:LYS:HE3	6:B:4891:HOH:O	2.15	0.46
1:A:14:CYS:SG	3:A:801:HEM:HAB	2.52	0.46
1:B:71:CYS:HG	3:B:803:HEM:CBC	2.30	0.45
1:B:71:CYS:SG	3:B:803:HEM:C3C	3.10	0.45
1:B:113:SER:HB2	6:B:4567:HOH:O	2.16	0.45
1:B:82:CYS:SG	3:B:804:HEM:CBB	3.04	0.45
1:B:158:GLU:HB3	1:B:159:PRO:HD2	1.99	0.45
1:A:68:CYS:SG	3:A:803:HEM:HAB	2.55	0.44
1:A:14:CYS:SG	3:A:801:HEM:CBB	3.05	0.44
1:B:56:ASN:HD22	1:B:58:HIS:H	1.64	0.44
1:B:21:ASP:OD2	1:B:23:GLU:HG2	2.18	0.43
1:B:39:CYS:SG	3:B:802:HEM:C3C	3.11	0.43
1:B:467:ARG:NH1	1:B:479:ASP:OD2	2.51	0.43
1:A:476:LYS:HD2	6:A:3220:HOH:O	2.17	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:17:CYS:SG	3:A:801:HEM:C3C	3.12	0.43
1:A:68:CYS:SG	3:A:803:HEM:CBB	3.05	0.42
1:B:85:CYS:SG	3:B:804:HEM:C3C	3.12	0.42
1:B:56:ASN:ND2	1:B:58:HIS:H	2.18	0.42
1:A:79:MET:CE	1:A:96:LYS:HE3	2.50	0.42
1:B:110:LYS:O	1:B:110:LYS:HE2	2.19	0.42
1:A:17:CYS:SG	3:A:801:HEM:HAC	2.55	0.41
1:B:177:THR:OG1	1:B:245:HIS:HE1	2.03	0.41
1:A:158:GLU:HB3	1:A:159:PRO:HD2	2.03	0.41
1:B:39:CYS:SG	3:B:802:HEM:CBC	3.09	0.41
1:B:48:GLU:HG3	6:B:4489:HOH:O	2.19	0.41
1:A:71:CYS:SG	3:A:803:HEM:HAC	2.54	0.41
1:B:110:LYS:HE2	1:B:110:LYS:C	2.41	0.41
1:A:17:CYS:SG	3:A:801:HEM:CBC	3.08	0.40
1:A:79:MET:HE3	1:A:96:LYS:HE3	2.03	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	566/571 (99%)	546 (96%)	20 (4%)	0	100	100
1	B	566/571 (99%)	544 (96%)	21 (4%)	1 (0%)	47	33
All	All	1132/1142 (99%)	1090 (96%)	41 (4%)	1 (0%)	51	36

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	176	TRP

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	429/445 (96%)	424 (99%)	5 (1%)	71	65
1	B	429/445 (96%)	420 (98%)	9 (2%)	53	42
All	All	858/890 (96%)	844 (98%)	14 (2%)	62	54

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	56	ASN
1	A	204	ASN
1	A	337	ASN
1	A	490	ASN
1	A	544	ARG
1	B	21	ASP
1	B	56	ASN
1	B	110	LYS
1	B	204	ASN
1	B	299	LYS
1	B	337	ASN
1	B	467	ARG
1	B	490	ASN
1	B	544	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (14) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	56	ASN
1	A	204	ASN
1	A	245	HIS
1	A	490	ASN
1	A	540	HIS
1	A	543	ASN
1	B	10	GLN
1	B	56	ASN

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Mol	Chain	Res	Type
1	B	201	GLN
1	B	204	ASN
1	B	245	HIS
1	B	490	ASN
1	B	540	HIS
1	B	543	ASN

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 14 ligands modelled in this entry, 2 are monoatomic - leaving 12 for Mogul analysis.

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	HEM	A	804	1	41,50,50	1.47	5 (12%)	45,82,82	1.42	8 (17%)
5	FUM	B	4001	-	7,7,7	2.74	4 (57%)	8,8,8	2.00	3 (37%)
3	HEM	B	803	1	41,50,50	1.53	4 (9%)	45,82,82	1.51	4 (8%)
3	HEM	A	803	1	41,50,50	1.64	7 (17%)	45,82,82	1.42	6 (13%)
3	HEM	B	804	1	41,50,50	1.57	6 (14%)	45,82,82	1.40	8 (17%)
5	FUM	A	3001	-	7,7,7	2.51	4 (57%)	8,8,8	1.91	3 (37%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
4	FAD	B	4000	-	53,58,58	1.42	5 (9%)	68,89,89	1.28	7 (10%)
3	HEM	B	801	1	41,50,50	1.66	5 (12%)	45,82,82	1.55	8 (17%)
4	FAD	A	3000	-	53,58,58	1.35	7 (13%)	68,89,89	1.32	5 (7%)
3	HEM	B	802	1	41,50,50	1.53	4 (9%)	45,82,82	1.48	8 (17%)
3	HEM	A	802	1	41,50,50	1.65	9 (21%)	45,82,82	1.65	12 (26%)
3	HEM	A	801	1	41,50,50	1.61	5 (12%)	45,82,82	1.44	5 (11%)

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	HEM	A	804	1	-	5/12/54/54	-
5	FUM	B	4001	-	-	2/5/5/5	-
3	HEM	B	803	1	-	2/12/54/54	-
3	HEM	A	803	1	-	2/12/54/54	-
3	HEM	B	804	1	-	3/12/54/54	-
5	FUM	A	3001	-	-	2/5/5/5	-
4	FAD	B	4000	-	-	10/30/50/50	0/6/6/6
3	HEM	B	801	1	-	3/12/54/54	-
4	FAD	A	3000	-	-	10/30/50/50	0/6/6/6
3	HEM	B	802	1	-	2/12/54/54	-
3	HEM	A	802	1	-	3/12/54/54	-
3	HEM	A	801	1	-	4/12/54/54	-

All (65) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	803	HEM	C3C-C2C	-5.16	1.33	1.40
3	B	803	HEM	C3C-C2C	-5.07	1.33	1.40
3	A	802	HEM	C3C-C2C	-4.85	1.33	1.40
3	B	804	HEM	C3C-C2C	-4.83	1.33	1.40
3	B	801	HEM	C3C-C2C	-4.71	1.33	1.40
3	A	801	HEM	C3C-C2C	-4.56	1.34	1.40
5	B	4001	FUM	O-C	4.25	1.33	1.23
3	B	802	HEM	C3C-C2C	-4.15	1.34	1.40
4	B	4000	FAD	C6-C5X	4.03	1.46	1.40

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	B	4001	FUM	O7-C6	4.00	1.33	1.23
5	A	3001	FUM	O-C	4.00	1.33	1.23
3	A	804	HEM	C3C-C2C	-3.91	1.34	1.40
3	A	802	HEM	C3C-CAC	3.89	1.55	1.47
4	B	4000	FAD	C2'-C3'	3.58	1.60	1.53
3	B	802	HEM	C3C-CAC	3.54	1.55	1.47
4	A	3000	FAD	C2'-C3'	3.52	1.60	1.53
5	A	3001	FUM	O7-C6	3.47	1.31	1.23
3	B	803	HEM	C3C-CAC	3.45	1.54	1.47
3	B	804	HEM	C3C-CAC	3.39	1.54	1.47
3	A	804	HEM	C3C-CAC	3.38	1.54	1.47
3	B	801	HEM	C3C-CAC	3.33	1.54	1.47
3	A	801	HEM	C3C-CAC	3.31	1.54	1.47
3	A	803	HEM	C3C-CAC	3.21	1.54	1.47
4	B	4000	FAD	O4'-C4'	3.16	1.50	1.43
3	B	801	HEM	CAA-C2A	3.09	1.56	1.52
4	A	3000	FAD	C6-C5X	3.07	1.44	1.40
4	B	4000	FAD	C2A-N3A	2.99	1.36	1.32
3	A	801	HEM	CAB-C3B	2.96	1.55	1.47
3	A	803	HEM	CAA-C2A	2.92	1.56	1.52
5	B	4001	FUM	OXT-C	-2.89	1.22	1.30
3	B	801	HEM	CAB-C3B	2.81	1.55	1.47
4	A	3000	FAD	C9-C8	2.81	1.43	1.39
5	A	3001	FUM	OXT-C	-2.79	1.23	1.30
3	A	802	HEM	CAA-C2A	2.78	1.56	1.52
5	B	4001	FUM	O8-C6	-2.74	1.23	1.30
4	B	4000	FAD	C9-C8	2.64	1.43	1.39
3	A	804	HEM	CAB-C3B	2.63	1.54	1.47
3	A	803	HEM	CAB-C3B	2.62	1.54	1.47
4	A	3000	FAD	C2A-N3A	2.61	1.36	1.32
5	A	3001	FUM	O8-C6	-2.61	1.23	1.30
3	B	801	HEM	CMD-C2D	2.60	1.56	1.50
3	A	803	HEM	CMB-C2B	2.58	1.56	1.50
3	B	804	HEM	CAA-C2A	2.58	1.55	1.52
3	A	801	HEM	CAA-C2A	2.57	1.55	1.52
4	A	3000	FAD	O4'-C4'	2.56	1.48	1.43
3	A	801	HEM	CMD-C2D	2.54	1.56	1.50
3	A	802	HEM	CAB-C3B	2.51	1.54	1.47
3	A	804	HEM	CMD-C2D	2.48	1.56	1.50
3	B	803	HEM	CAB-C3B	2.45	1.54	1.47
3	A	802	HEM	CMB-C2B	2.45	1.56	1.50
4	A	3000	FAD	O4-C4	-2.43	1.19	1.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	802	HEM	CAB-C3B	2.41	1.54	1.47
4	A	3000	FAD	C5'-C4'	2.40	1.55	1.51
3	A	803	HEM	CMD-C2D	2.38	1.55	1.50
3	B	803	HEM	C2C-C1C	2.31	1.47	1.42
3	A	802	HEM	CMD-C2D	2.26	1.55	1.50
3	B	804	HEM	CAB-C3B	2.26	1.53	1.47
3	B	804	HEM	CMD-C2D	2.21	1.55	1.50
3	A	802	HEM	CMA-C3A	2.20	1.56	1.51
3	A	802	HEM	C3B-C2B	-2.14	1.33	1.37
3	A	803	HEM	CMA-C3A	2.12	1.56	1.51
3	B	804	HEM	CHA-C4D	2.09	1.40	1.35
3	A	804	HEM	CMB-C2B	2.06	1.55	1.50
3	A	802	HEM	C4A-NA	2.01	1.40	1.36
3	B	802	HEM	CAA-C2A	2.00	1.55	1.52

All (77) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	803	HEM	CAD-CBD-CGD	5.91	126.32	113.60
4	A	3000	FAD	O4B-C1B-C2B	-5.01	99.60	106.93
4	A	3000	FAD	O5'-C5'-C4'	-4.80	96.56	109.36
4	B	4000	FAD	O5'-C5'-C4'	-4.59	97.10	109.36
3	B	803	HEM	CBA-CAA-C2A	4.56	120.40	112.62
3	A	802	HEM	C1B-NB-C4B	4.08	109.29	105.07
3	A	804	HEM	CMA-C3A-C4A	-3.93	122.42	128.46
3	B	802	HEM	C1B-NB-C4B	3.89	109.09	105.07
3	B	801	HEM	CMA-C3A-C4A	-3.69	122.78	128.46
4	B	4000	FAD	O4B-C1B-C2B	-3.43	101.91	106.93
3	A	803	HEM	CMA-C3A-C4A	-3.41	123.22	128.46
4	B	4000	FAD	O2-C2-N3	-3.41	112.02	118.65
3	A	802	HEM	CAA-CBA-CGA	3.33	123.08	113.76
4	B	4000	FAD	O4'-C4'-C3'	-3.29	101.09	109.10
3	B	801	HEM	CAA-CBA-CGA	3.23	122.80	113.76
3	A	803	HEM	CAA-CBA-CGA	3.11	122.48	113.76
3	A	802	HEM	C3B-C2B-C1B	3.11	108.79	106.49
3	A	804	HEM	C1B-NB-C4B	3.08	108.26	105.07
4	A	3000	FAD	O4'-C4'-C3'	-3.06	101.67	109.10
3	B	804	HEM	C1B-NB-C4B	2.96	108.13	105.07
5	B	4001	FUM	C5-C4-C	-2.93	112.19	127.26
3	B	804	HEM	C4C-CHD-C1D	2.89	126.38	122.56
5	A	3001	FUM	C5-C4-C	-2.89	112.41	127.26
3	B	803	HEM	CMA-C3A-C4A	-2.88	124.04	128.46

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	801	HEM	C1B-NB-C4B	2.86	108.03	105.07
3	A	803	HEM	CMC-C2C-C3C	2.85	130.01	124.68
3	A	804	HEM	CBD-CAD-C3D	2.85	120.53	112.63
3	A	803	HEM	CAD-CBD-CGD	2.83	119.70	113.60
3	B	801	HEM	CMC-C2C-C3C	2.82	129.95	124.68
3	B	803	HEM	CMC-C2C-C3C	2.79	129.89	124.68
3	A	801	HEM	CMA-C3A-C4A	-2.78	124.19	128.46
4	B	4000	FAD	O3'-C3'-C2'	-2.72	102.24	108.81
3	B	804	HEM	CMC-C2C-C3C	2.69	129.71	124.68
3	B	801	HEM	C4D-ND-C1D	2.65	107.81	105.07
3	A	804	HEM	CHC-C4B-NB	2.60	127.26	124.43
3	B	801	HEM	C1B-NB-C4B	2.57	107.73	105.07
3	A	802	HEM	CAD-CBD-CGD	2.54	119.08	113.60
5	B	4001	FUM	O8-C6-O7	-2.51	117.46	122.67
3	B	802	HEM	CAA-CBA-CGA	2.49	120.74	113.76
3	B	802	HEM	C4D-ND-C1D	2.48	107.63	105.07
3	A	802	HEM	CHC-C4B-NB	2.48	127.12	124.43
3	A	802	HEM	CBA-CAA-C2A	2.46	116.82	112.62
5	B	4001	FUM	O8-C6-C5	2.45	125.40	116.27
3	B	802	HEM	CMA-C3A-C4A	-2.43	124.72	128.46
3	B	801	HEM	CHD-C1D-ND	2.41	127.05	124.43
3	A	804	HEM	CMA-C3A-C2A	2.40	129.47	124.94
3	B	804	HEM	CHC-C4B-NB	2.40	127.03	124.43
3	A	802	HEM	C2B-C1B-NB	-2.38	107.01	109.84
4	A	3000	FAD	O2'-C2'-C3'	-2.36	103.37	109.10
3	B	801	HEM	C3D-C4D-ND	-2.34	107.56	110.17
3	A	801	HEM	CMC-C2C-C3C	2.31	128.99	124.68
3	A	803	HEM	CMA-C3A-C2A	2.27	129.23	124.94
3	A	804	HEM	C4C-CHD-C1D	2.25	125.53	122.56
3	A	801	HEM	C3B-C2B-C1B	2.24	108.15	106.49
4	B	4000	FAD	N3A-C2A-N1A	-2.23	125.19	128.68
3	A	802	HEM	C4A-C3A-C2A	2.21	108.54	107.00
3	A	803	HEM	C3B-C2B-C1B	2.21	108.13	106.49
3	A	802	HEM	CMC-C2C-C3C	2.21	128.81	124.68
3	B	804	HEM	O1D-CGD-CBD	-2.19	116.03	123.08
3	A	802	HEM	C2C-C3C-C4C	2.19	108.43	106.90
3	A	802	HEM	C4D-ND-C1D	2.18	107.33	105.07
3	A	804	HEM	C4B-CHC-C1C	2.18	125.44	122.56
3	A	802	HEM	CBB-CAB-C3B	-2.17	116.83	127.62
5	A	3001	FUM	O8-C6-C5	2.15	124.31	116.27
3	B	802	HEM	C3B-C2B-C1B	2.12	108.06	106.49
3	B	804	HEM	CHA-C4D-ND	2.11	126.99	124.38

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	804	HEM	CMC-C2C-C3C	2.09	128.59	124.68
3	B	801	HEM	CMA-C3A-C2A	2.09	128.87	124.94
4	A	3000	FAD	C5X-C9A-N10	2.08	120.10	117.95
3	B	802	HEM	CMC-C2C-C3C	2.07	128.55	124.68
3	B	804	HEM	CMB-C2B-C1B	-2.06	121.90	125.04
5	A	3001	FUM	C4-C5-C6	-2.06	116.69	127.26
4	B	4000	FAD	N3-C2-N1	2.05	123.40	119.38
3	B	804	HEM	C3B-C2B-C1B	2.04	108.00	106.49
3	B	802	HEM	C2B-C1B-NB	-2.03	107.43	109.84
3	A	801	HEM	C4D-ND-C1D	2.01	107.15	105.07
3	B	802	HEM	C4C-CHD-C1D	2.01	125.21	122.56

There are no chirality outliers.

All (48) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	3000	FAD	C2'-C3'-C4'-O4'
4	B	4000	FAD	N10-C1'-C2'-O2'
4	B	4000	FAD	C2'-C3'-C4'-O4'
4	A	3000	FAD	O3'-C3'-C4'-O4'
5	B	4001	FUM	O-C-C4-C5
5	A	3001	FUM	O-C-C4-C5
5	A	3001	FUM	OXT-C-C4-C5
5	B	4001	FUM	OXT-C-C4-C5
4	A	3000	FAD	O3'-C3'-C4'-C5'
4	A	3000	FAD	C2'-C3'-C4'-C5'
4	B	4000	FAD	C2'-C3'-C4'-C5'
3	A	802	HEM	C3D-CAD-CBD-CGD
4	A	3000	FAD	P-O3P-PA-O1A
3	A	804	HEM	C2A-CAA-CBA-CGA
3	B	804	HEM	C2A-CAA-CBA-CGA
4	A	3000	FAD	PA-O3P-P-O5'
4	B	4000	FAD	PA-O3P-P-O5'
3	B	801	HEM	C3D-CAD-CBD-CGD
4	B	4000	FAD	O3'-C3'-C4'-O4'
4	A	3000	FAD	N10-C1'-C2'-O2'
4	A	3000	FAD	N10-C1'-C2'-C3'
4	B	4000	FAD	O3'-C3'-C4'-C5'
4	B	4000	FAD	P-O3P-PA-O1A
4	B	4000	FAD	P-O3P-PA-O2A
3	A	801	HEM	CAD-CBD-CGD-O1D
3	B	801	HEM	CAD-CBD-CGD-O1D

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Mol	Chain	Res	Type	Atoms
3	A	804	HEM	CAA-CBA-CGA-O2A
3	B	804	HEM	CAA-CBA-CGA-O2A
4	B	4000	FAD	O4B-C4B-C5B-O5B
3	B	804	HEM	CAA-CBA-CGA-O1A
3	A	804	HEM	CAA-CBA-CGA-O1A
3	B	802	HEM	CAD-CBD-CGD-O2D
3	A	801	HEM	CAD-CBD-CGD-O2D
3	B	801	HEM	CAD-CBD-CGD-O2D
3	B	802	HEM	CAD-CBD-CGD-O1D
3	A	803	HEM	CAA-CBA-CGA-O1A
4	A	3000	FAD	O4B-C4B-C5B-O5B
3	A	802	HEM	CAD-CBD-CGD-O2D
3	A	803	HEM	CAA-CBA-CGA-O2A
3	A	802	HEM	CAD-CBD-CGD-O1D
3	B	803	HEM	CAA-CBA-CGA-O2A
3	A	804	HEM	CAD-CBD-CGD-O1D
3	A	804	HEM	CAD-CBD-CGD-O2D
4	A	3000	FAD	P-O3P-PA-O2A
3	B	803	HEM	CAA-CBA-CGA-O1A
3	A	801	HEM	C3D-CAD-CBD-CGD
4	B	4000	FAD	N10-C1'-C2'-C3'
3	A	801	HEM	CAA-CBA-CGA-O1A

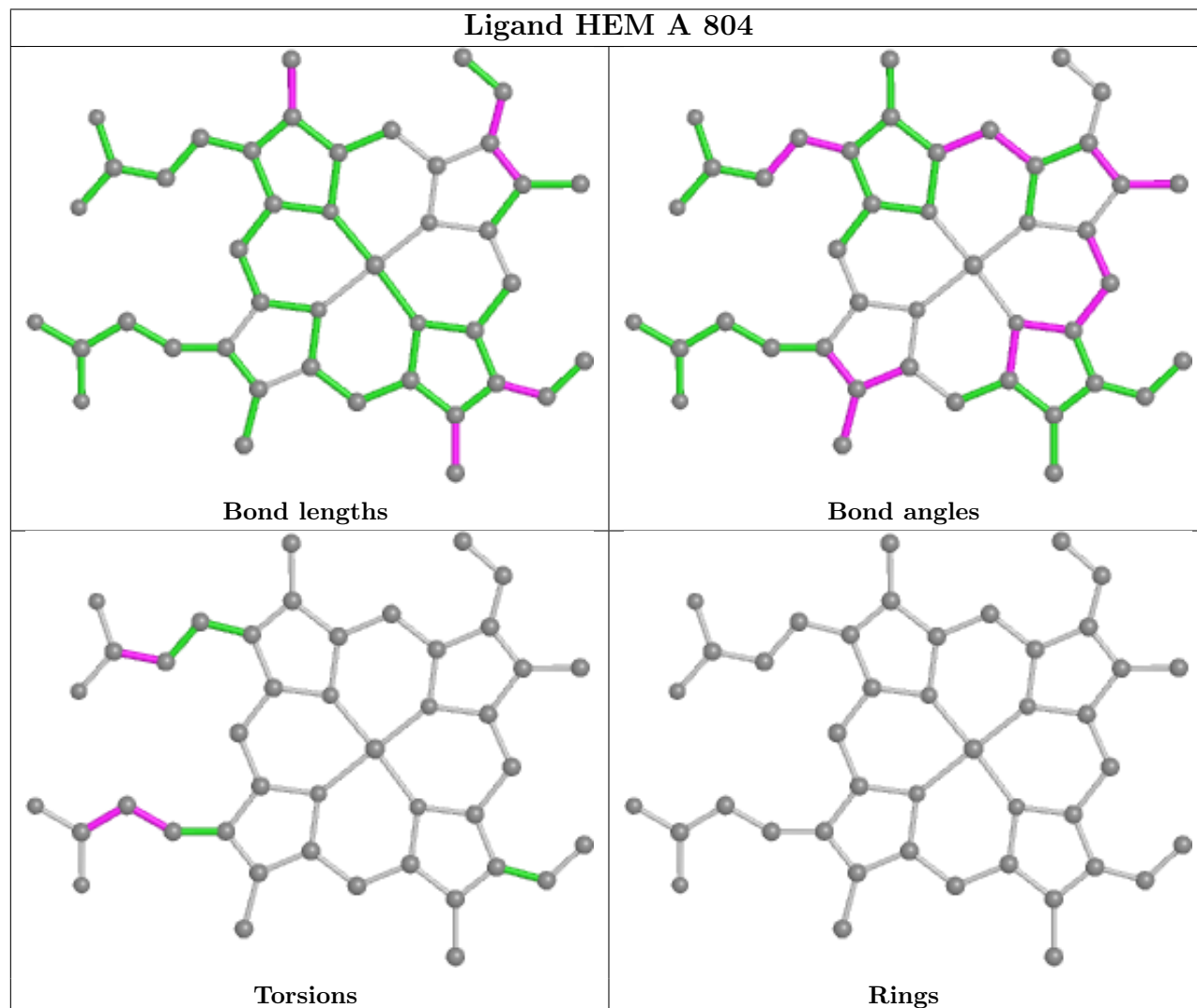
There are no ring outliers.

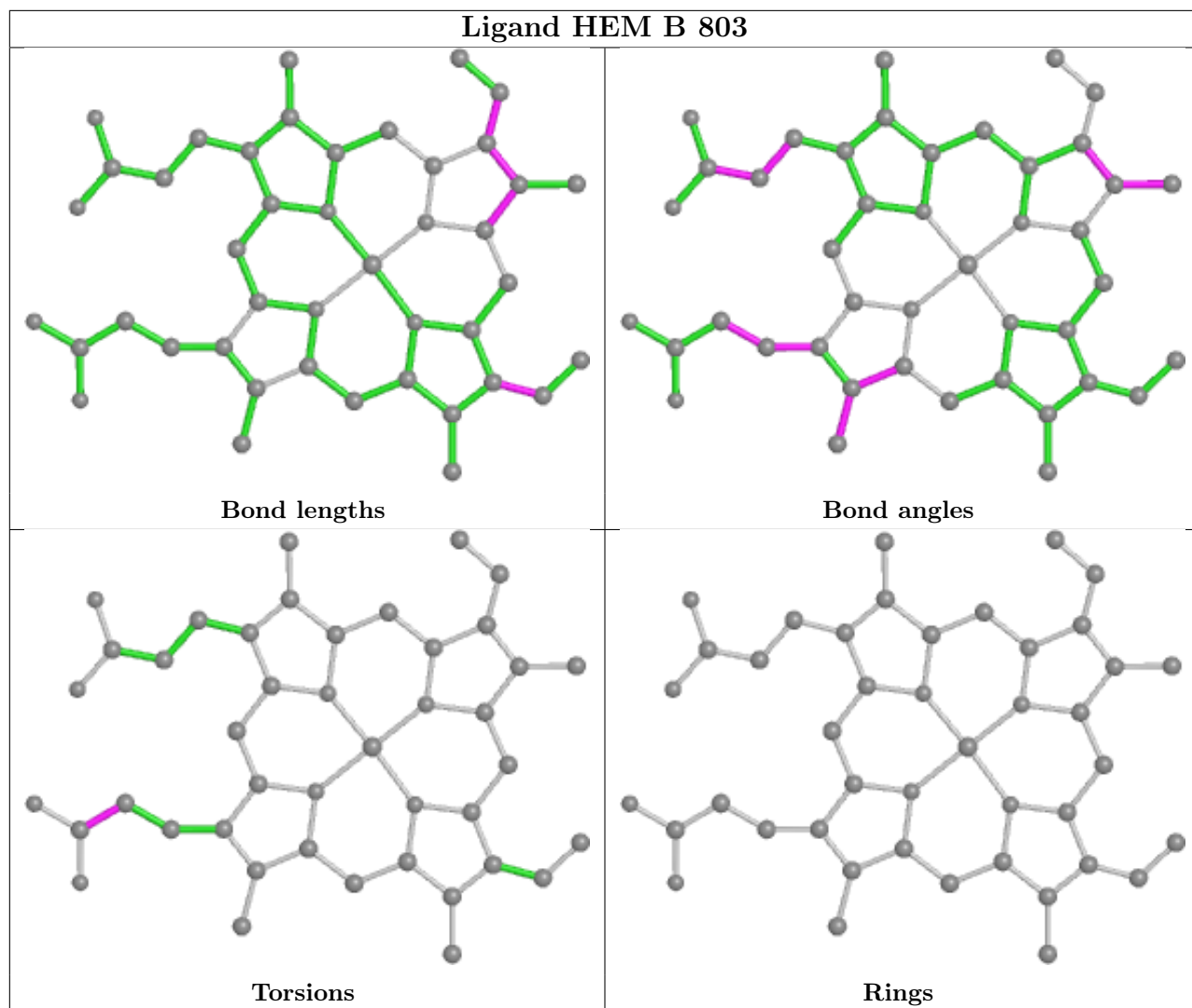
8 monomers are involved in 49 short contacts:

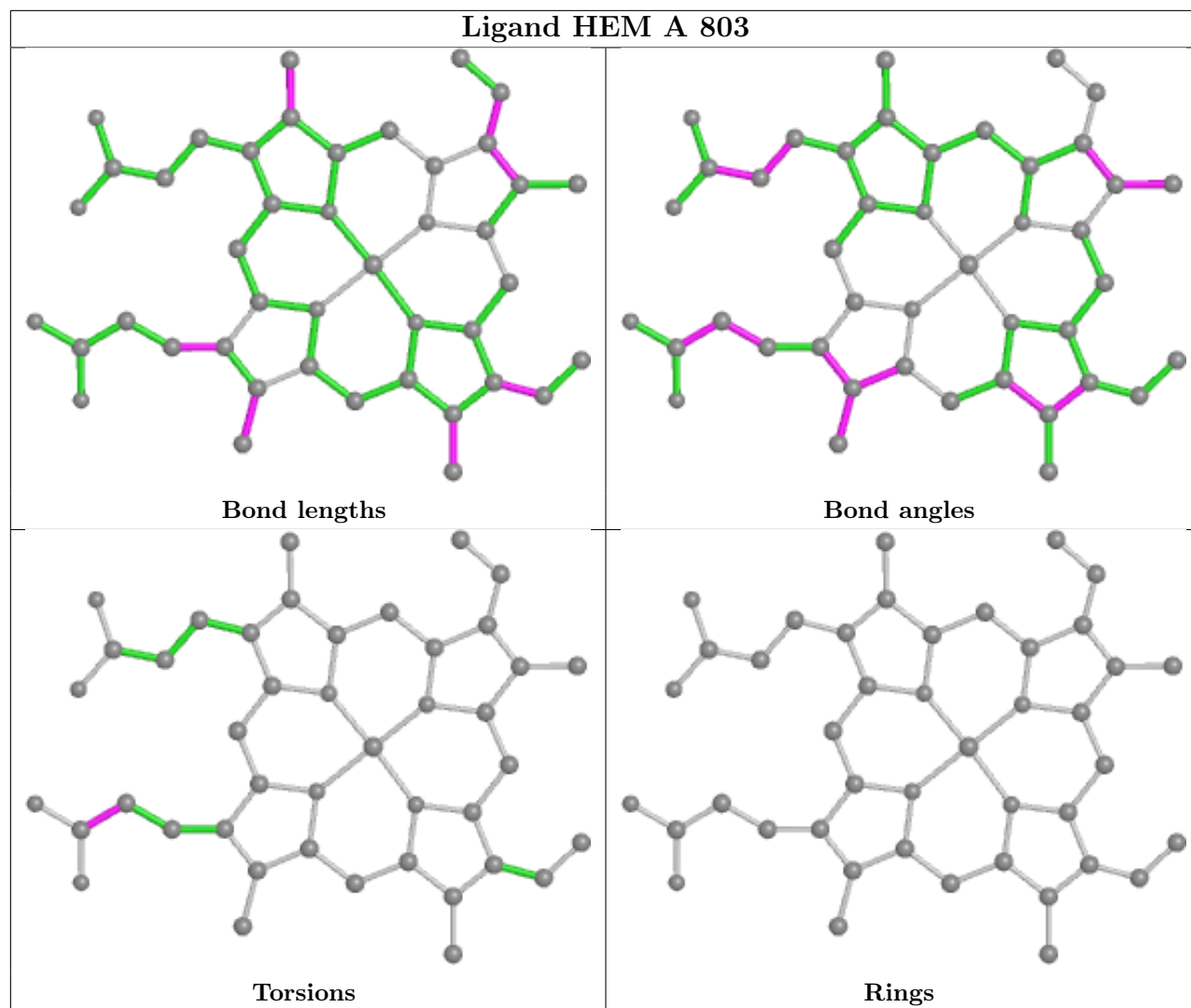
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	804	HEM	6	0
3	B	803	HEM	8	0
3	A	803	HEM	6	0
3	B	804	HEM	7	0
3	B	801	HEM	4	0
3	B	802	HEM	6	0
3	A	802	HEM	4	0
3	A	801	HEM	8	0

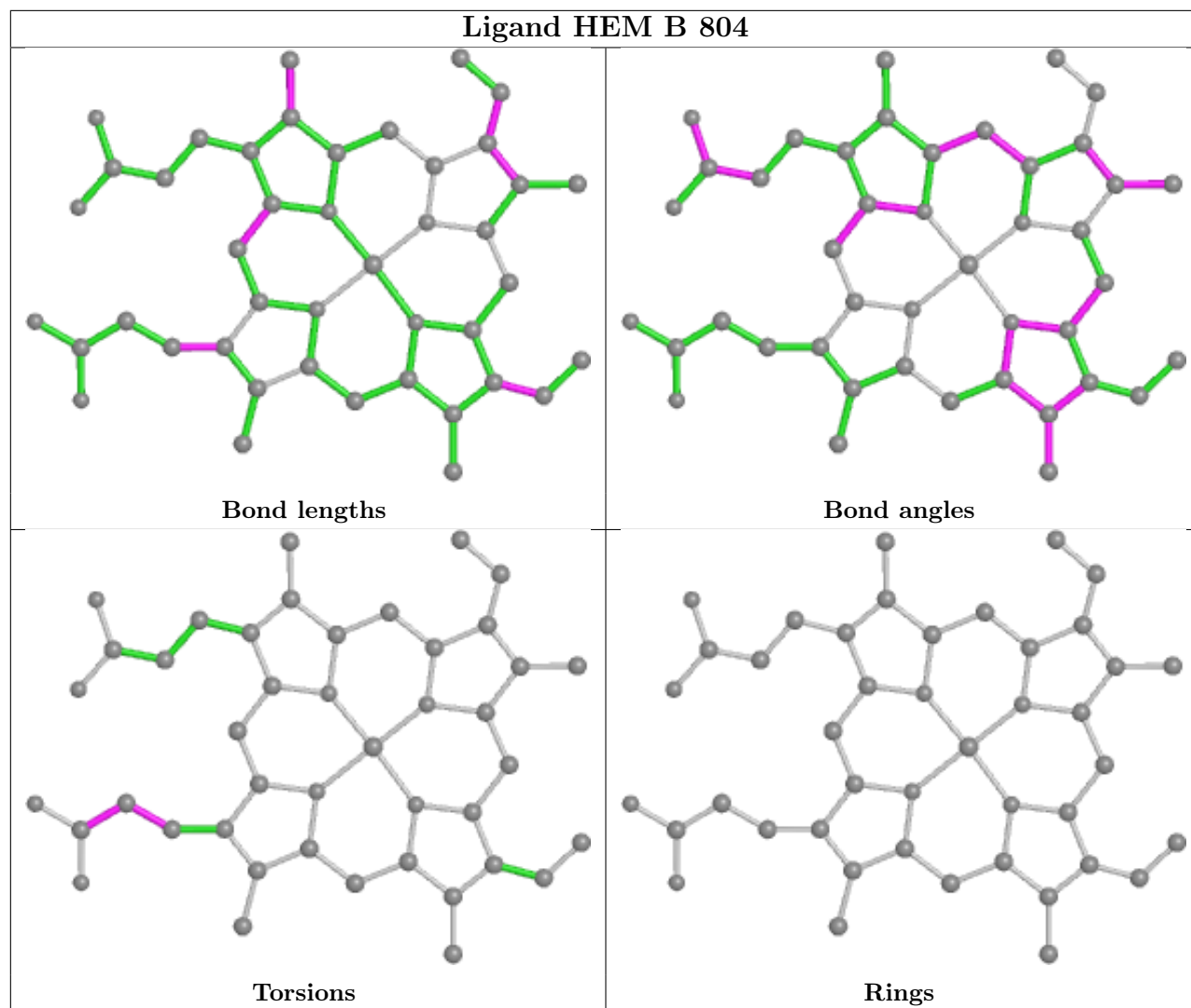
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

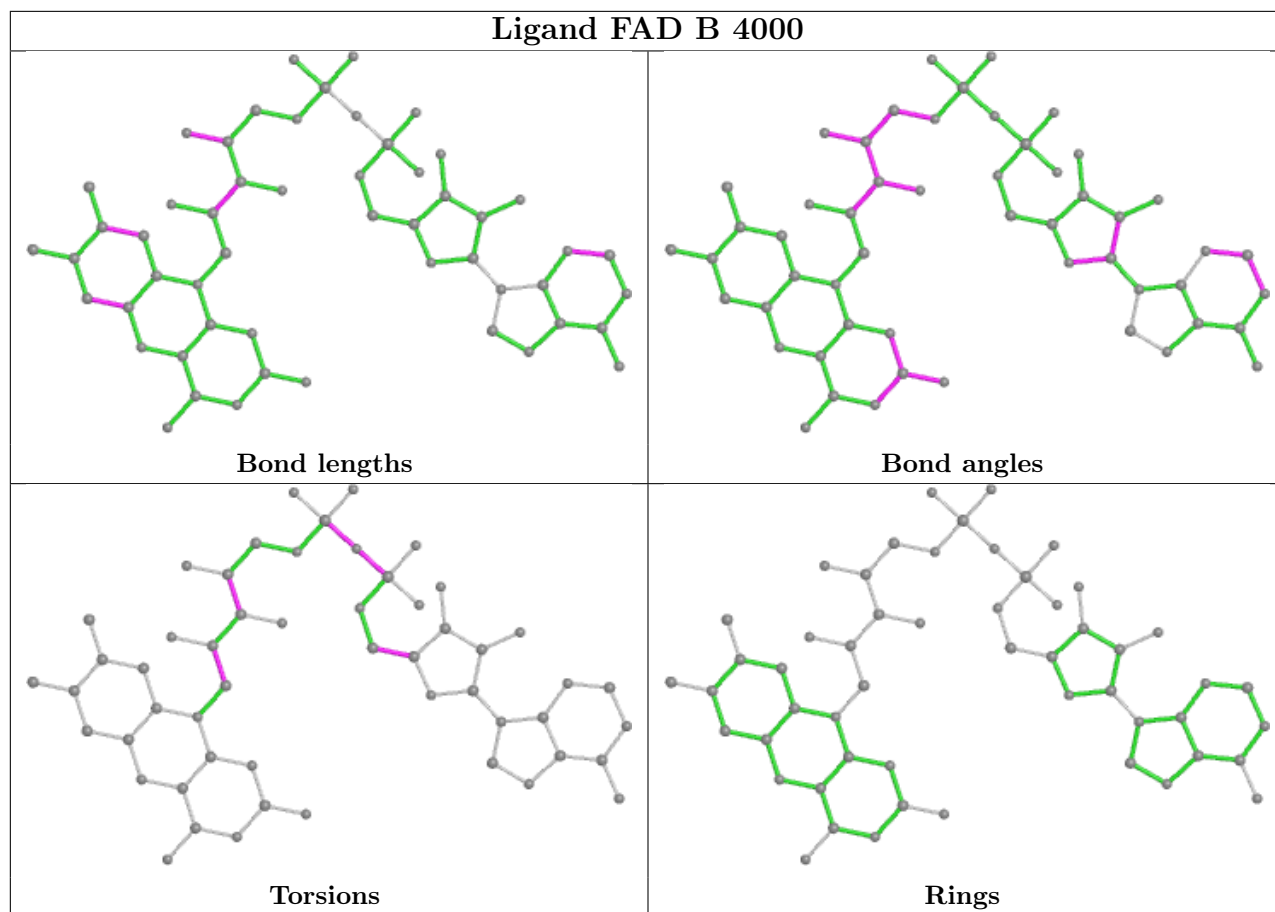
highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified 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.

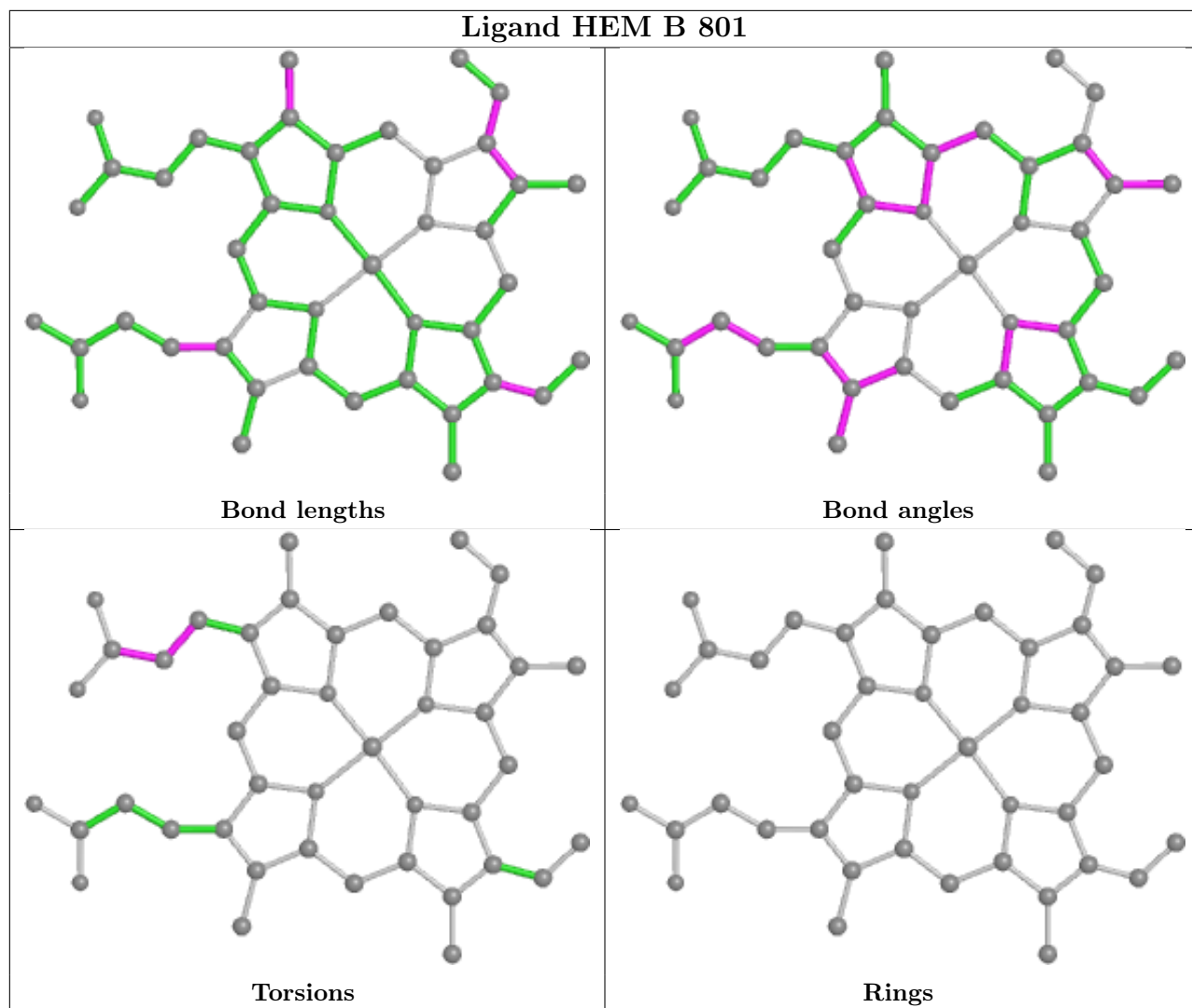


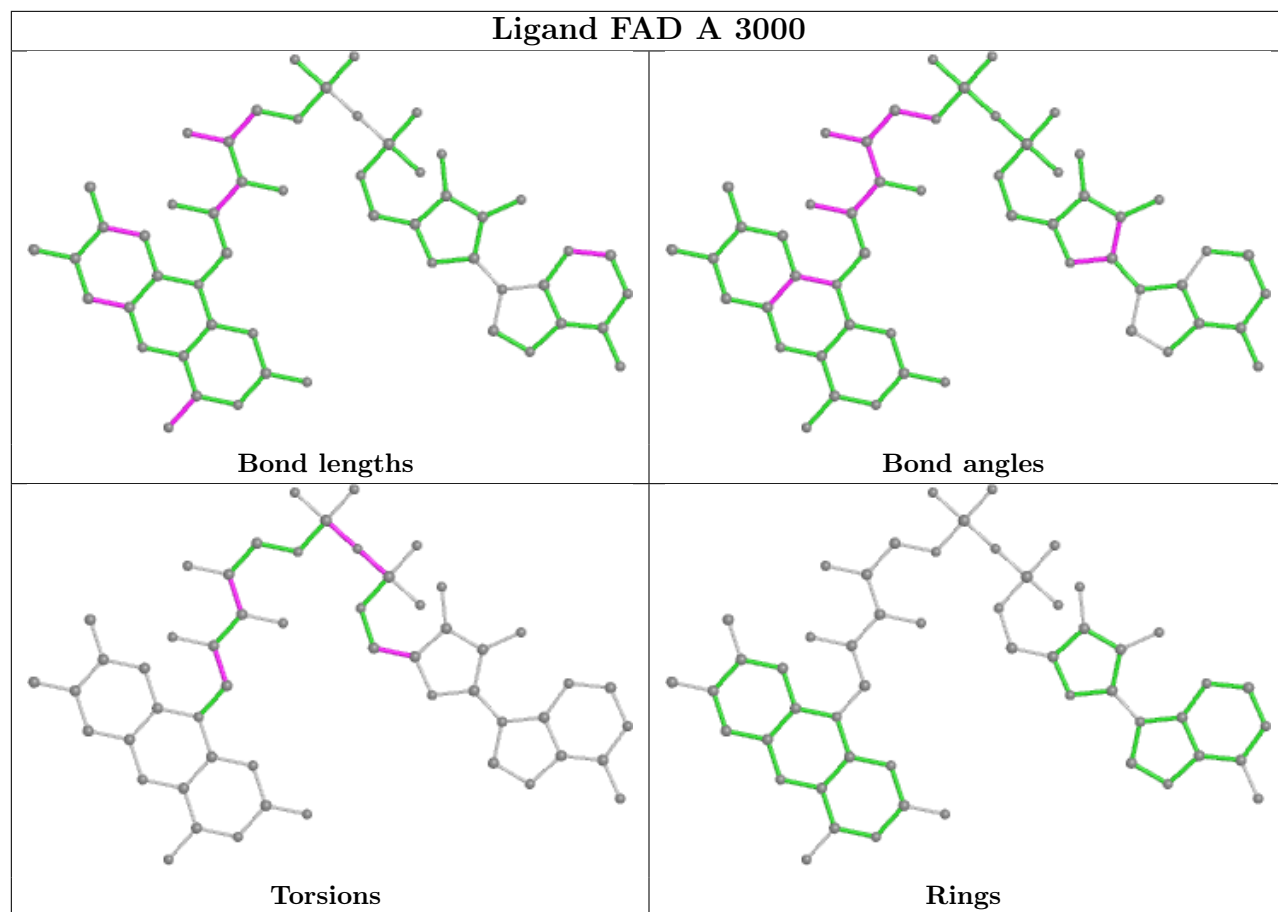


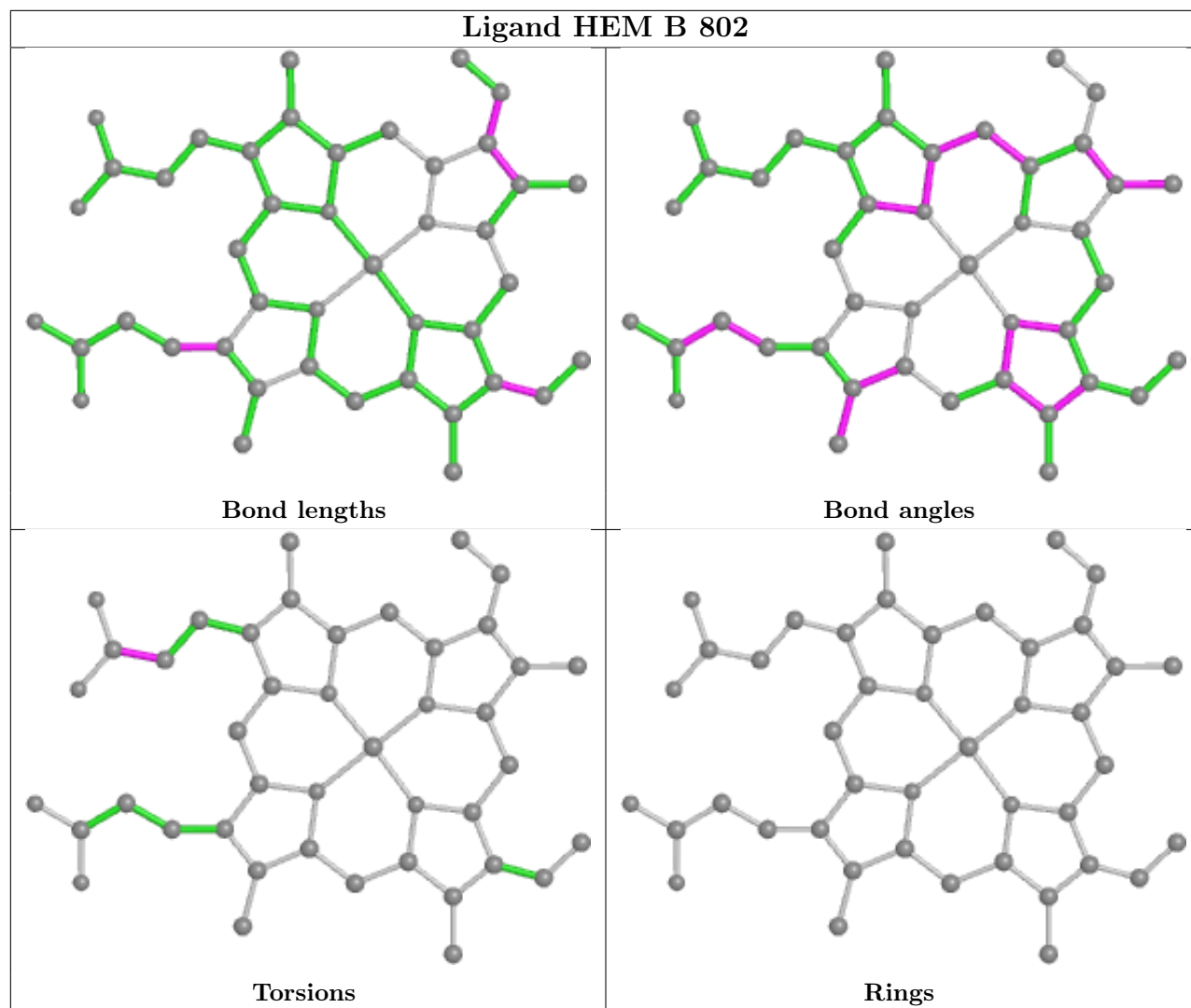


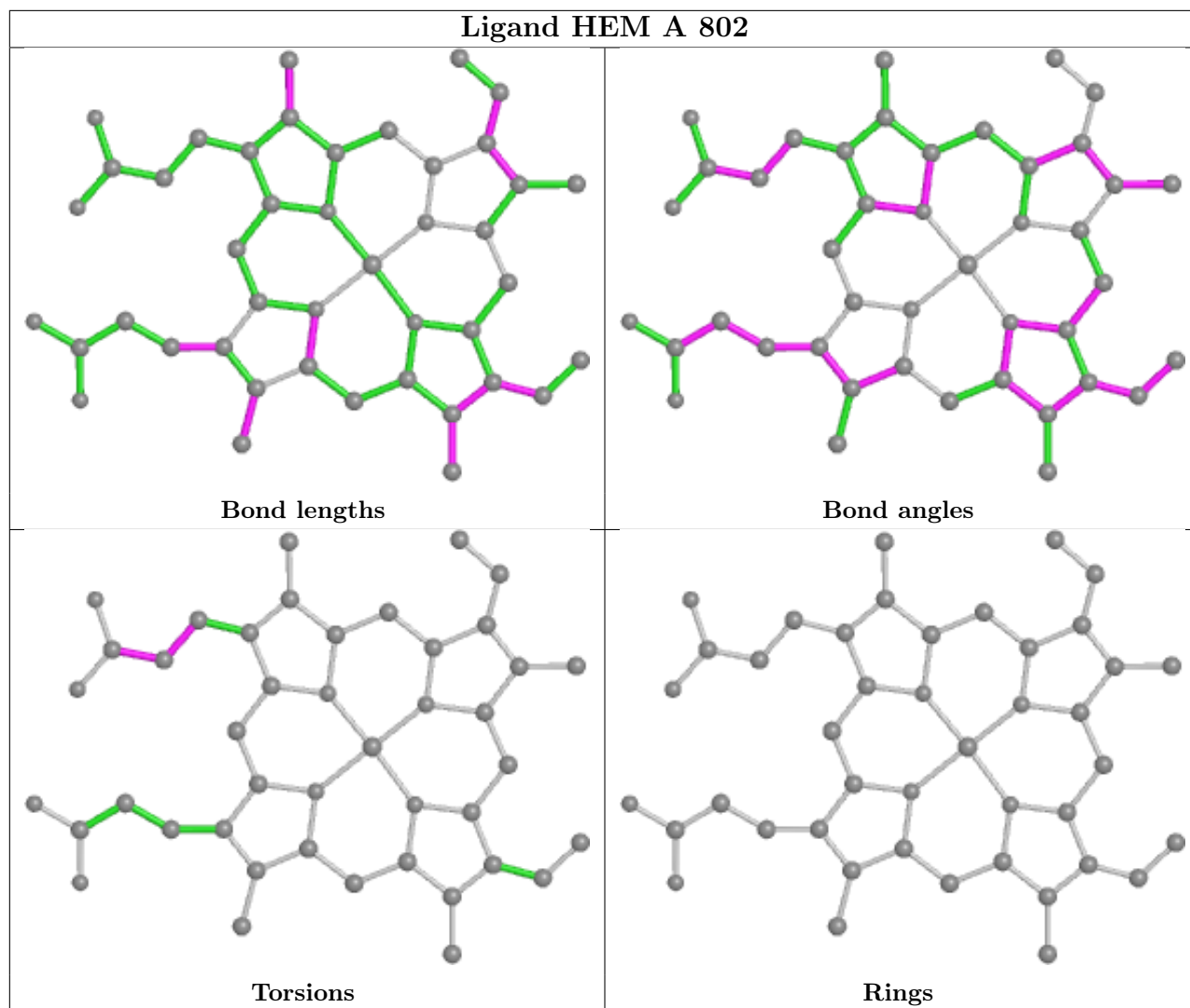


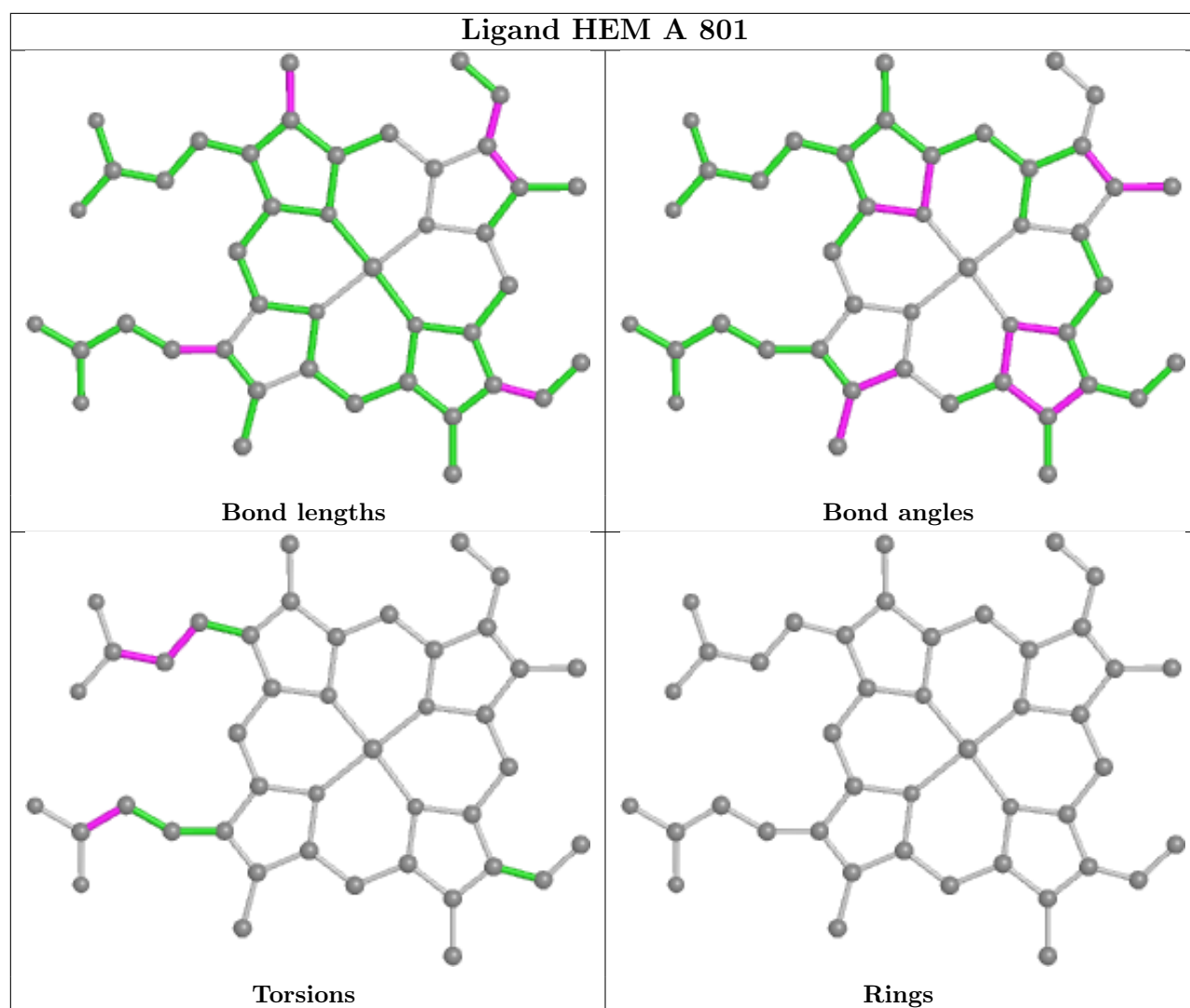












5.7 Other polymers [i](#)

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

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.