



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 25, 2026 – 10:53 AM UTC

PDB ID : 2J2M / pdb_00002j2m
Title : Crystal Structure Analysis of Catalase from Exiguobacterium oxidotolerans
Authors : Hara, I.; Ichise, N.; Kojima, K.; Kondo, H.; Ohgiya, S.; Matsuyama, H.; Yumoto, I.
Deposited on : 2006-08-17
Resolution : 2.40 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 : **FAILED**
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

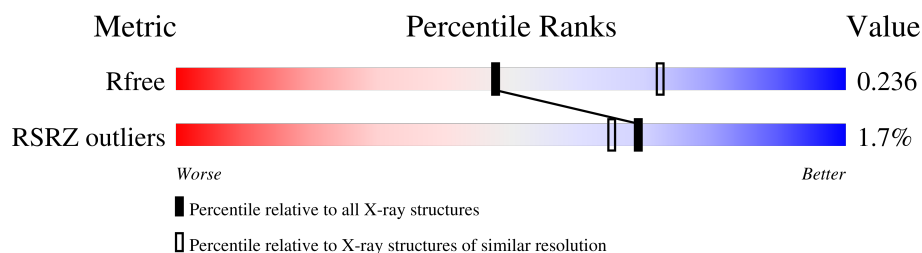
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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	4912 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

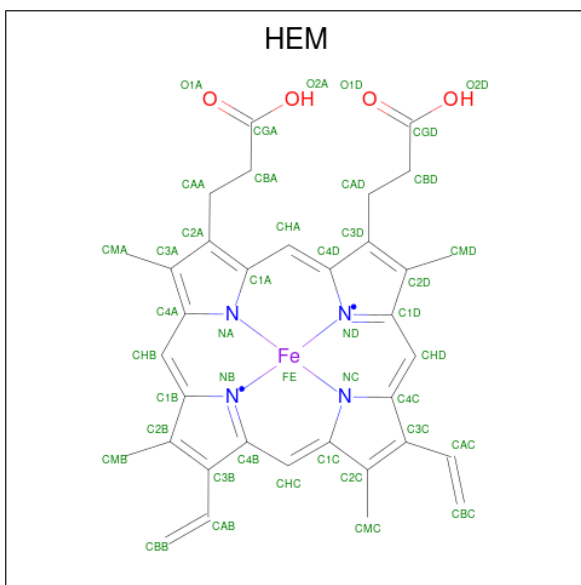
MolProbity failed to run properly - the sequence quality summary graphics cannot be shown.

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 CATALASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	480	Total 3894	C 2456	N 681	O 743	S 14	0	0	0
1	B	480	Total 3894	C 2456	N 681	O 743	S 14	0	0	0
1	C	480	Total 3894	C 2456	N 681	O 743	S 14	0	0	0
1	D	480	Total 3894	C 2456	N 681	O 743	S 14	0	0	0

- Molecule 2 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



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

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	C	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
2	D	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	162	Total	O	0	0
			162	162		
3	B	155	Total	O	0	0
			155	155		
3	C	108	Total	O	0	0
			108	108		
3	D	111	Total	O	0	0
			111	111		

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3 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	94.27Å 131.94Å 110.64Å 90.00° 107.61° 90.00°	Depositor
Resolution (Å)	20.00 – 2.40 20.00 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.1 (20.00-2.40) 98.9 (20.00-2.40)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	13.66 (at 2.41Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.199 , 0.230 0.204 , 0.236	Depositor DCC
R_{free} test set	4994 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	11.9	Xtriage
Anisotropy	0.105	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.41 , 35.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	16284	wwPDB-VP
Average B, all atoms (Å ²)	15.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 17.83% 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.

4 Model quality [i](#)

4.1 Standard geometry [i](#)

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4.2 Too-close contacts [i](#)

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4.3 Torsion angles [i](#)

4.3.1 Protein backbone [i](#)

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4.3.2 Protein sidechains [i](#)

MolProbity failed to run properly - this section is therefore empty.

4.3.3 RNA [i](#)

MolProbity failed to run properly - this section is therefore empty.

4.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

4.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

4.6 Ligand geometry [i](#)

4 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	HEM	D	501	1	50,50,50	2.11	11 (22%)	67,82,82	1.50	11 (16%)
2	HEM	B	501	1	50,50,50	2.05	11 (22%)	67,82,82	1.37	7 (10%)
2	HEM	C	501	1	50,50,50	2.16	10 (20%)	67,82,82	1.46	9 (13%)
2	HEM	A	501	1	50,50,50	2.09	11 (22%)	67,82,82	1.33	5 (7%)

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	HEM	D	501	1	-	4/14/54/54	-
2	HEM	B	501	1	-	4/14/54/54	-
2	HEM	C	501	1	-	2/14/54/54	-
2	HEM	A	501	1	-	4/14/54/54	-

All (43) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	501	HEM	C3D-C2D	8.48	1.55	1.36
2	B	501	HEM	C3D-C2D	8.08	1.54	1.36
2	A	501	HEM	C3D-C2D	7.65	1.53	1.36
2	D	501	HEM	FE-ND	7.61	2.18	1.94
2	D	501	HEM	C3D-C2D	7.55	1.53	1.36
2	C	501	HEM	FE-ND	6.22	2.14	1.94
2	C	501	HEM	FE-NB	5.90	2.13	1.94
2	B	501	HEM	FE-ND	5.86	2.13	1.94
2	A	501	HEM	FE-NB	5.84	2.12	1.94
2	A	501	HEM	FE-ND	5.04	2.10	1.94
2	B	501	HEM	FE-NB	4.19	2.07	1.94
2	C	501	HEM	FE-NC	4.05	2.08	1.95
2	D	501	HEM	FE-NB	4.03	2.07	1.94
2	A	501	HEM	FE-NC	3.96	2.08	1.95
2	A	501	HEM	FE-NA	3.71	2.07	1.95
2	D	501	HEM	FE-NA	3.63	2.07	1.95
2	D	501	HEM	FE-NC	3.55	2.06	1.95
2	B	501	HEM	FE-NA	3.29	2.06	1.95

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	501	HEM	FE-NC	3.20	2.05	1.95
2	C	501	HEM	CAB-C3B	3.13	1.55	1.47
2	B	501	HEM	CAC-C3C	3.10	1.55	1.47
2	A	501	HEM	CMD-C2D	3.05	1.57	1.50
2	B	501	HEM	CMD-C2D	2.94	1.56	1.50
2	A	501	HEM	CAC-C3C	2.92	1.55	1.47
2	B	501	HEM	CMB-C2B	2.89	1.56	1.50
2	C	501	HEM	CMB-C2B	2.74	1.56	1.50
2	A	501	HEM	CMC-C2C	2.69	1.56	1.50
2	C	501	HEM	CMD-C2D	2.68	1.56	1.50
2	C	501	HEM	CMC-C2C	2.67	1.56	1.50
2	D	501	HEM	CMD-C2D	2.61	1.56	1.50
2	A	501	HEM	CAB-C3B	2.56	1.54	1.47
2	B	501	HEM	CMC-C2C	2.56	1.56	1.50
2	A	501	HEM	CMB-C2B	2.53	1.56	1.50
2	D	501	HEM	CMB-C2B	2.48	1.55	1.50
2	D	501	HEM	CAB-C3B	2.43	1.53	1.47
2	B	501	HEM	CAB-C3B	2.39	1.53	1.47
2	D	501	HEM	CAC-C3C	2.35	1.53	1.47
2	D	501	HEM	C3C-C2C	-2.34	1.32	1.37
2	C	501	HEM	FE-NA	2.29	2.02	1.95
2	A	501	HEM	CMA-C3A	2.19	1.55	1.50
2	D	501	HEM	CMA-C3A	2.16	1.55	1.50
2	B	501	HEM	O2D-CGD	-2.03	1.24	1.30
2	C	501	HEM	CAC-C3C	2.02	1.52	1.47

All (32) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	501	HEM	C4D-ND-C1D	6.32	112.70	105.21
2	A	501	HEM	C4D-ND-C1D	5.68	111.93	105.21
2	B	501	HEM	C4D-ND-C1D	5.43	111.64	105.21
2	D	501	HEM	C4D-ND-C1D	5.36	111.55	105.21
2	B	501	HEM	C2A-C1A-NA	-3.83	105.90	110.15
2	A	501	HEM	C2A-C1A-NA	-3.31	106.48	110.15
2	C	501	HEM	CHD-C4C-NC	3.14	127.88	124.45
2	C	501	HEM	C4C-C3C-C2C	2.98	109.40	106.81
2	C	501	HEM	C1B-NB-C4B	2.79	108.51	105.21
2	D	501	HEM	C1B-NB-C4B	2.77	108.49	105.21
2	D	501	HEM	CMC-C2C-C1C	2.72	129.52	124.73
2	A	501	HEM	CAA-CBA-CGA	-2.68	106.57	113.67
2	B	501	HEM	CBD-CAD-C3D	-2.53	105.55	112.53

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	501	HEM	CAA-CBA-CGA	-2.52	106.99	113.67
2	C	501	HEM	CBD-CAD-C3D	-2.51	105.58	112.53
2	D	501	HEM	CBD-CAD-C3D	-2.50	105.61	112.53
2	D	501	HEM	CMC-C2C-C3C	-2.47	122.45	128.43
2	A	501	HEM	C1D-C2D-C3D	-2.43	104.42	106.98
2	C	501	HEM	C2A-C1A-NA	-2.42	107.47	110.15
2	D	501	HEM	C2A-C1A-NA	-2.40	107.49	110.15
2	D	501	HEM	CHD-C4C-NC	2.39	127.06	124.45
2	A	501	HEM	C4C-C3C-C2C	2.35	108.85	106.81
2	B	501	HEM	C4A-NA-C1A	2.33	109.62	105.82
2	D	501	HEM	C3B-C4B-NB	-2.27	107.84	109.47
2	D	501	HEM	CAA-CBA-CGA	-2.23	107.76	113.67
2	B	501	HEM	C4C-C3C-C2C	2.22	108.73	106.81
2	D	501	HEM	C1D-C2D-C3D	-2.17	104.70	106.98
2	C	501	HEM	C3D-C4D-ND	-2.14	107.83	110.17
2	C	501	HEM	CAA-CBA-CGA	-2.11	108.08	113.67
2	B	501	HEM	C1D-C2D-C3D	-2.08	104.79	106.98
2	D	501	HEM	C3A-C4A-NA	-2.03	106.89	110.14
2	C	501	HEM	C3B-C4B-NB	-2.03	108.01	109.47

There are no chirality outliers.

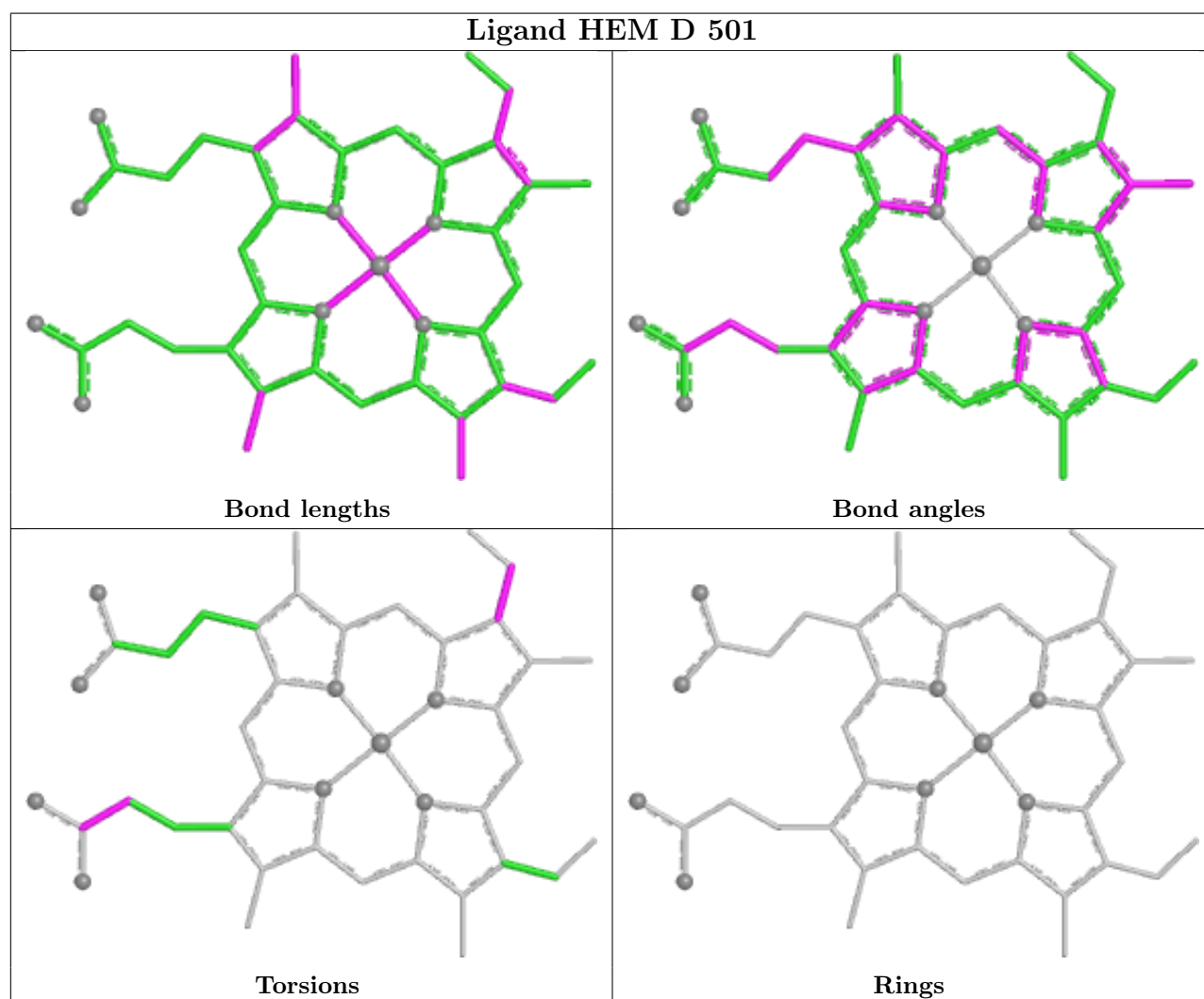
All (14) torsion outliers are listed below:

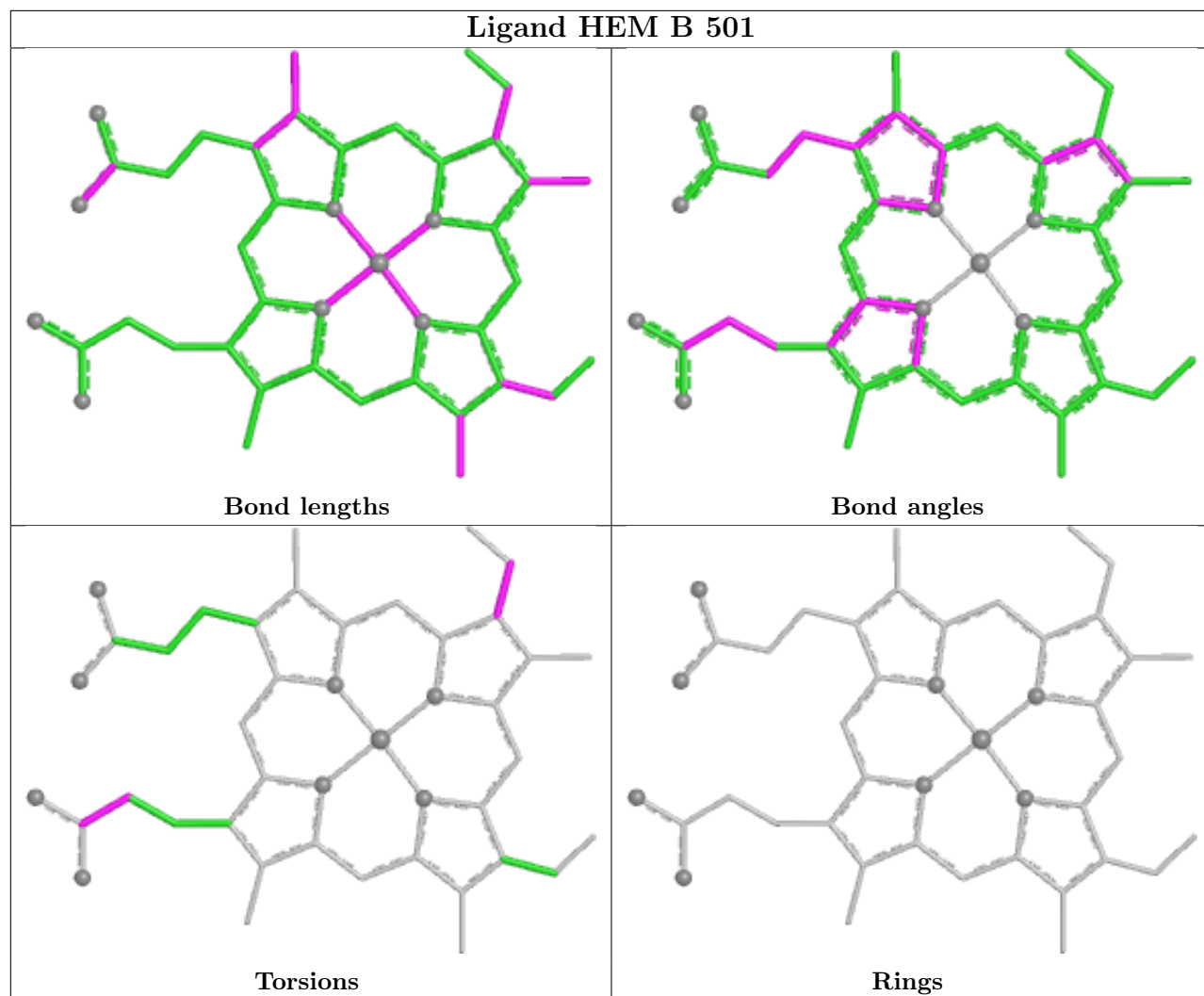
Mol	Chain	Res	Type	Atoms
2	A	501	HEM	C2C-C3C-CAC-CBC
2	A	501	HEM	C4C-C3C-CAC-CBC
2	B	501	HEM	C2C-C3C-CAC-CBC
2	B	501	HEM	C4C-C3C-CAC-CBC
2	D	501	HEM	C2C-C3C-CAC-CBC
2	A	501	HEM	CAA-CBA-CGA-O1A
2	C	501	HEM	CAA-CBA-CGA-O2A
2	C	501	HEM	CAA-CBA-CGA-O1A
2	D	501	HEM	CAA-CBA-CGA-O1A
2	A	501	HEM	CAA-CBA-CGA-O2A
2	D	501	HEM	CAA-CBA-CGA-O2A
2	B	501	HEM	CAA-CBA-CGA-O2A
2	B	501	HEM	CAA-CBA-CGA-O1A
2	D	501	HEM	C4C-C3C-CAC-CBC

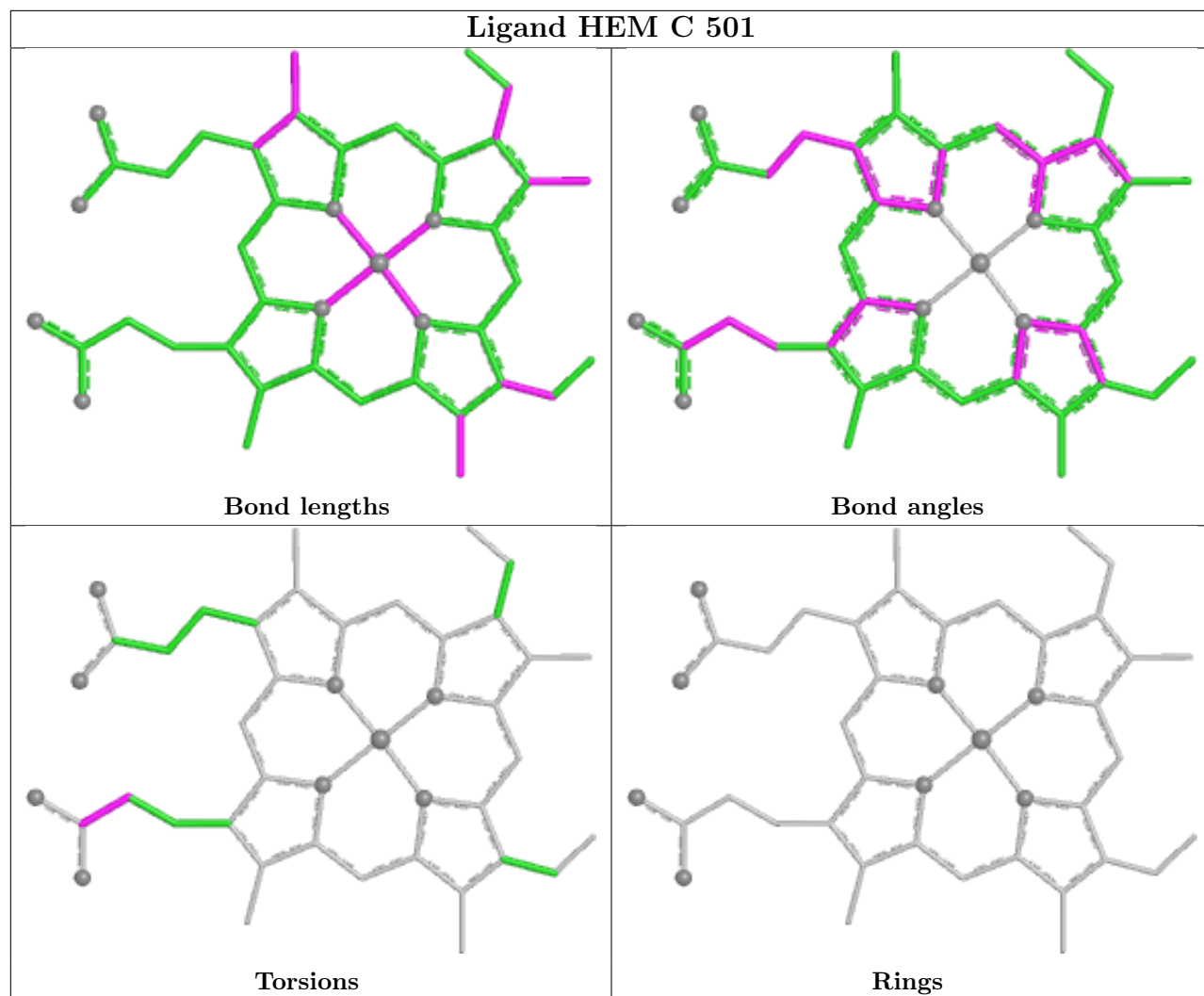
There are no ring outliers.

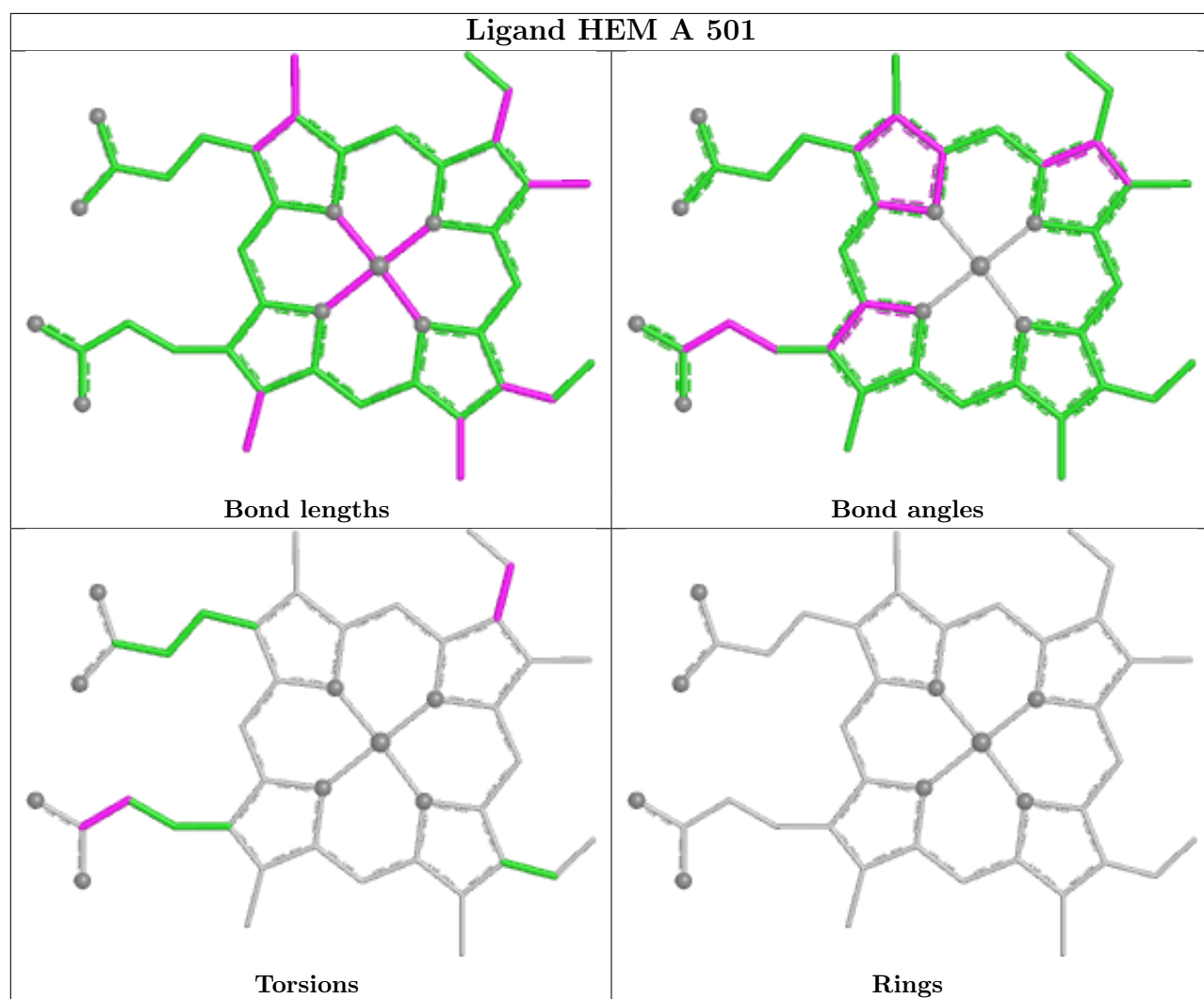
No monomer is involved in short contacts.

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.









4.7 Other polymers [i](#)

There are no such residues in this entry.

4.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

5 Fit of model and data ⓘ

5.1 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	480/491 (97%)	-0.30	3 (0%) 85 83	4, 12, 23, 34	0
1	B	480/491 (97%)	-0.33	3 (0%) 85 83	3, 12, 23, 34	0
1	C	480/491 (97%)	-0.03	13 (2%) 56 52	4, 17, 33, 59	0
1	D	480/491 (97%)	0.11	13 (2%) 56 52	6, 18, 33, 60	0
All	All	1920/1964 (97%)	-0.14	32 (1%) 69 65	3, 14, 30, 60	0

All (32) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	485	PHE	8.6
1	D	485	PHE	8.1
1	C	484	PRO	4.6
1	C	482	ILE	4.0
1	C	401	ASP	3.5
1	D	484	PRO	3.3
1	C	477	ALA	3.2
1	A	287	ASP	3.2
1	D	437	MET	3.1
1	D	482	ILE	3.0
1	D	483	LYS	3.0
1	C	480	VAL	2.9
1	D	101	THR	2.8
1	D	477	ALA	2.8
1	D	103	SER	2.7
1	D	478	LEU	2.6
1	D	207	HIS	2.6
1	C	481	ASP	2.5
1	C	479	ASN	2.5
1	B	478	LEU	2.5
1	A	390	ASP	2.4

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Mol	Chain	Res	Type	RSRZ
1	C	478	LEU	2.3
1	D	434	GLU	2.2
1	C	437	MET	2.1
1	C	457	LEU	2.1
1	A	207	HIS	2.1
1	B	479	ASN	2.1
1	D	454	ASN	2.1
1	C	471	GLY	2.1
1	B	437	MET	2.1
1	D	406	HIS	2.1
1	C	231	ALA	2.0

5.2 Non-standard residues in protein, DNA, RNA chains [i](#)

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

5.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.4 Ligands [i](#)

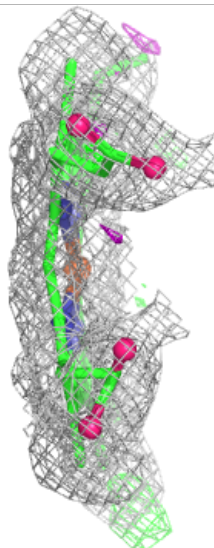
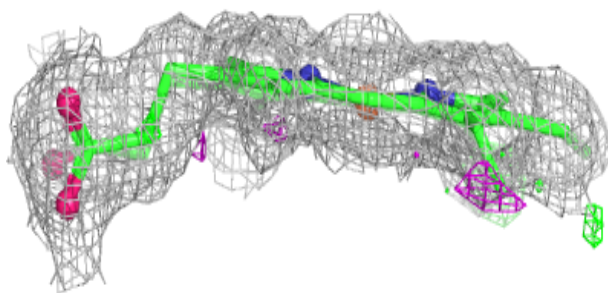
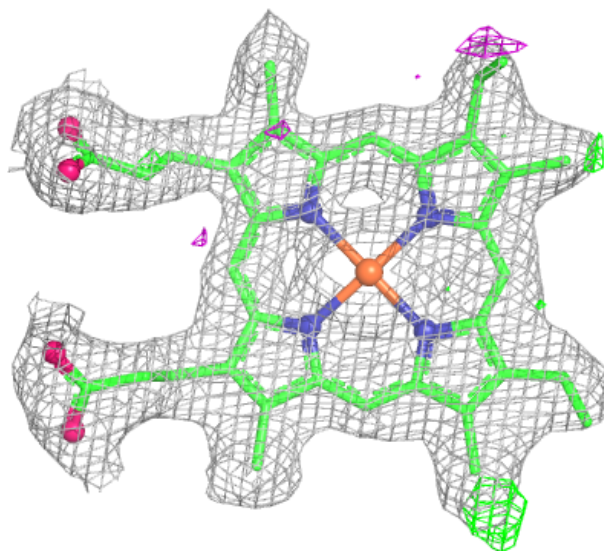
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q<0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	HEM	D	501	43/43	0.96	0.09	4,10,13,16	0
2	HEM	B	501	43/43	0.97	0.07	2,5,8,15	0
2	HEM	C	501	43/43	0.97	0.08	5,9,12,17	0
2	HEM	A	501	43/43	0.97	0.07	2,5,7,15	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.

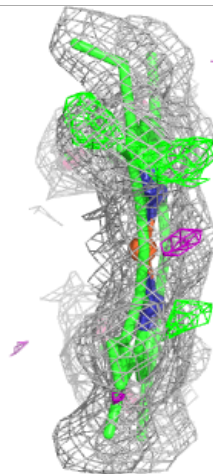
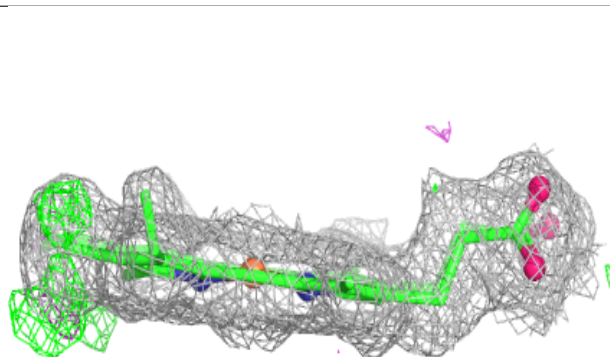
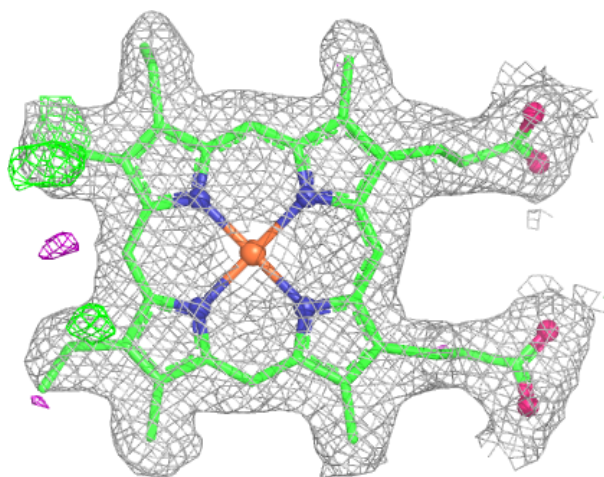
Electron density around HEM D 501:

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



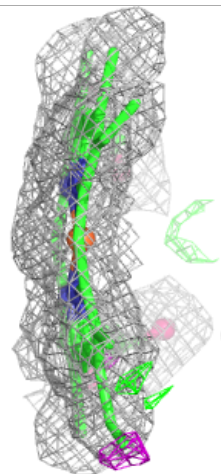
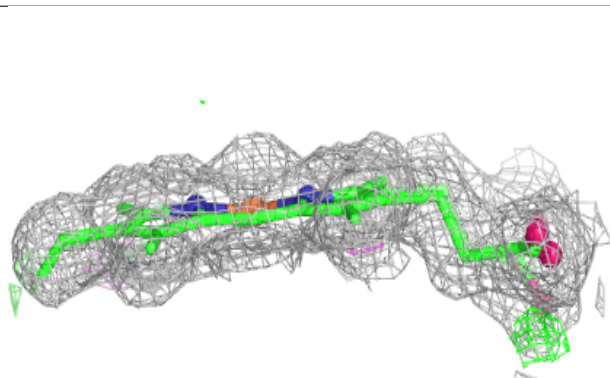
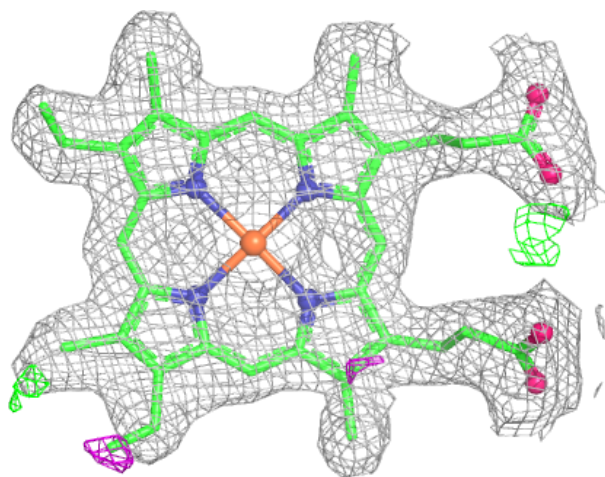
Electron density around HEM B 501:

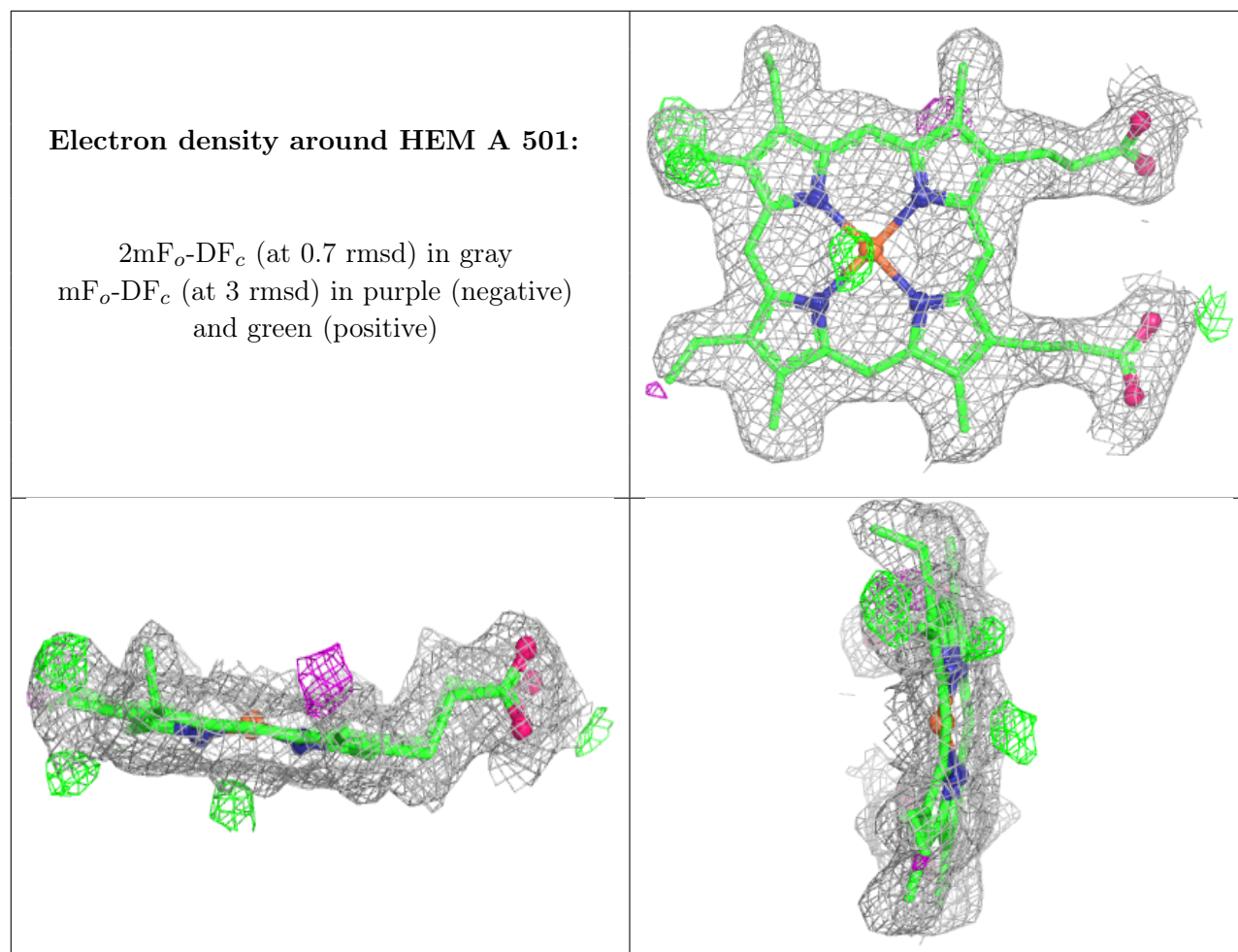
$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around HEM C 501:

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





5.5 Other polymers [i](#)

There are no such residues in this entry.