wwPDB X-ray Structure Validation Summary Report (i)

Aug 21, 2023 – 10:51 am BST

PDB ID	:	8BCX
Title	:	Crystal structure of NrfA-1 from Geobacter metallireducens
Authors	:	Denkhaus, L.; Siffert, F.; Einsle, O.
Deposited on	:	2022-10-17
Resolution	:	1.94 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) 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 (i)) were used in the production of this report:

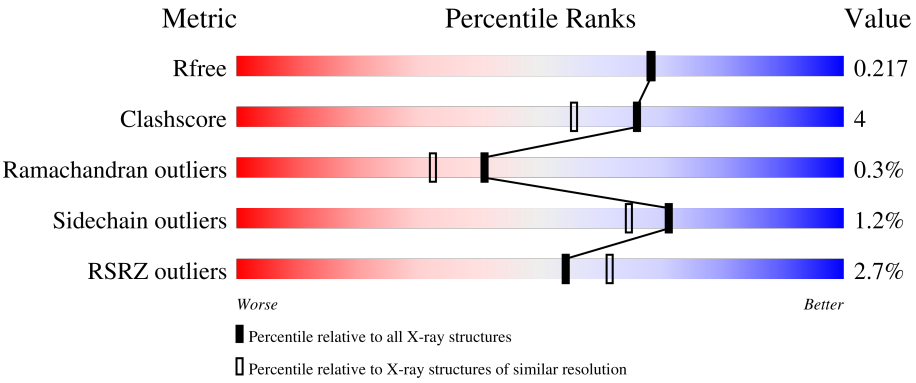
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.94 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}	130704	4310 (1.96-1.92)
Clashscore	141614	1023 (1.94-1.94)
Ramachandran outliers	138981	1007 (1.94-1.94)
Sidechain outliers	138945	1007 (1.94-1.94)
RSRZ outliers	127900	4250 (1.96-1.92)

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 <=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	492	2% 81% 8% 11%
1	B	492	3% 80% 8% 12%
1	C	492	2% 81% 9% 10%
1	D	492	3% 81% 9% • 10%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 15471 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 Nitrite reductase (cytochrome; ammonia-forming).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	437	Total	C	N	O	S	0	0	0
			3433	2185	594	631	23			
1	B	434	Total	C	N	O	S	0	0	0
			3398	2158	586	631	23			
1	C	443	Total	C	N	O	S	0	0	0
			3489	2217	608	641	23			
1	D	444	Total	C	N	O	S	0	0	0
			3493	2222	605	643	23			

There are 132 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	MET	-	initiating methionine	UNP Q39YY5
A	-2	LYS	-	expression tag	UNP Q39YY5
A	-1	LYS	-	expression tag	UNP Q39YY5
A	0	THR	-	expression tag	UNP Q39YY5
A	1	ALA	-	expression tag	UNP Q39YY5
A	2	ILE	-	expression tag	UNP Q39YY5
A	3	ALA	-	expression tag	UNP Q39YY5
A	4	ILE	-	expression tag	UNP Q39YY5
A	5	ALA	-	expression tag	UNP Q39YY5
A	6	VAL	-	expression tag	UNP Q39YY5
A	7	ALA	-	expression tag	UNP Q39YY5
A	8	LEU	-	expression tag	UNP Q39YY5
A	9	ALA	-	expression tag	UNP Q39YY5
A	10	GLY	-	expression tag	UNP Q39YY5
A	11	PHE	-	expression tag	UNP Q39YY5
A	12	ALA	-	expression tag	UNP Q39YY5
A	13	THR	-	expression tag	UNP Q39YY5
A	14	VAL	-	expression tag	UNP Q39YY5
A	15	ALA	-	expression tag	UNP Q39YY5
A	16	GLN	-	expression tag	UNP Q39YY5
A	17	ALA	-	expression tag	UNP Q39YY5

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Chain	Residue	Modelled	Actual	Comment	Reference
A	18	ALA	-	expression tag	UNP Q39YY5
A	19	SER	-	expression tag	UNP Q39YY5
A	20	TRP	-	expression tag	UNP Q39YY5
A	21	SER	-	expression tag	UNP Q39YY5
A	22	HIS	-	expression tag	UNP Q39YY5
A	23	PRO	-	expression tag	UNP Q39YY5
A	24	GLN	-	expression tag	UNP Q39YY5
A	25	PHE	-	expression tag	UNP Q39YY5
A	26	GLU	-	expression tag	UNP Q39YY5
A	27	LYS	-	expression tag	UNP Q39YY5
A	28	GLY	-	expression tag	UNP Q39YY5
A	29	ALA	-	expression tag	UNP Q39YY5
B	-3	MET	-	initiating methionine	UNP Q39YY5
B	-2	LYS	-	expression tag	UNP Q39YY5
B	-1	LYS	-	expression tag	UNP Q39YY5
B	0	THR	-	expression tag	UNP Q39YY5
B	1	ALA	-	expression tag	UNP Q39YY5
B	2	ILE	-	expression tag	UNP Q39YY5
B	3	ALA	-	expression tag	UNP Q39YY5
B	4	ILE	-	expression tag	UNP Q39YY5
B	5	ALA	-	expression tag	UNP Q39YY5
B	6	VAL	-	expression tag	UNP Q39YY5
B	7	ALA	-	expression tag	UNP Q39YY5
B	8	LEU	-	expression tag	UNP Q39YY5
B	9	ALA	-	expression tag	UNP Q39YY5
B	10	GLY	-	expression tag	UNP Q39YY5
B	11	PHE	-	expression tag	UNP Q39YY5
B	12	ALA	-	expression tag	UNP Q39YY5
B	13	THR	-	expression tag	UNP Q39YY5
B	14	VAL	-	expression tag	UNP Q39YY5
B	15	ALA	-	expression tag	UNP Q39YY5
B	16	GLN	-	expression tag	UNP Q39YY5
B	17	ALA	-	expression tag	UNP Q39YY5
B	18	ALA	-	expression tag	UNP Q39YY5
B	19	SER	-	expression tag	UNP Q39YY5
B	20	TRP	-	expression tag	UNP Q39YY5
B	21	SER	-	expression tag	UNP Q39YY5
B	22	HIS	-	expression tag	UNP Q39YY5
B	23	PRO	-	expression tag	UNP Q39YY5
B	24	GLN	-	expression tag	UNP Q39YY5
B	25	PHE	-	expression tag	UNP Q39YY5
B	26	GLU	-	expression tag	UNP Q39YY5

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Chain	Residue	Modelled	Actual	Comment	Reference
B	27	LYS	-	expression tag	UNP Q39YY5
B	28	GLY	-	expression tag	UNP Q39YY5
B	29	ALA	-	expression tag	UNP Q39YY5
C	-3	MET	-	initiating methionine	UNP Q39YY5
C	-2	LYS	-	expression tag	UNP Q39YY5
C	-1	LYS	-	expression tag	UNP Q39YY5
C	0	THR	-	expression tag	UNP Q39YY5
C	1	ALA	-	expression tag	UNP Q39YY5
C	2	ILE	-	expression tag	UNP Q39YY5
C	3	ALA	-	expression tag	UNP Q39YY5
C	4	ILE	-	expression tag	UNP Q39YY5
C	5	ALA	-	expression tag	UNP Q39YY5
C	6	VAL	-	expression tag	UNP Q39YY5
C	7	ALA	-	expression tag	UNP Q39YY5
C	8	LEU	-	expression tag	UNP Q39YY5
C	9	ALA	-	expression tag	UNP Q39YY5
C	10	GLY	-	expression tag	UNP Q39YY5
C	11	PHE	-	expression tag	UNP Q39YY5
C	12	ALA	-	expression tag	UNP Q39YY5
C	13	THR	-	expression tag	UNP Q39YY5
C	14	VAL	-	expression tag	UNP Q39YY5
C	15	ALA	-	expression tag	UNP Q39YY5
C	16	GLN	-	expression tag	UNP Q39YY5
C	17	ALA	-	expression tag	UNP Q39YY5
C	18	ALA	-	expression tag	UNP Q39YY5
C	19	SER	-	expression tag	UNP Q39YY5
C	20	TRP	-	expression tag	UNP Q39YY5
C	21	SER	-	expression tag	UNP Q39YY5
C	22	HIS	-	expression tag	UNP Q39YY5
C	23	PRO	-	expression tag	UNP Q39YY5
C	24	GLN	-	expression tag	UNP Q39YY5
C	25	PHE	-	expression tag	UNP Q39YY5
C	26	GLU	-	expression tag	UNP Q39YY5
C	27	LYS	-	expression tag	UNP Q39YY5
C	28	GLY	-	expression tag	UNP Q39YY5
C	29	ALA	-	expression tag	UNP Q39YY5
D	-3	MET	-	initiating methionine	UNP Q39YY5
D	-2	LYS	-	expression tag	UNP Q39YY5
D	-1	LYS	-	expression tag	UNP Q39YY5
D	0	THR	-	expression tag	UNP Q39YY5
D	1	ALA	-	expression tag	UNP Q39YY5
D	2	ILE	-	expression tag	UNP Q39YY5

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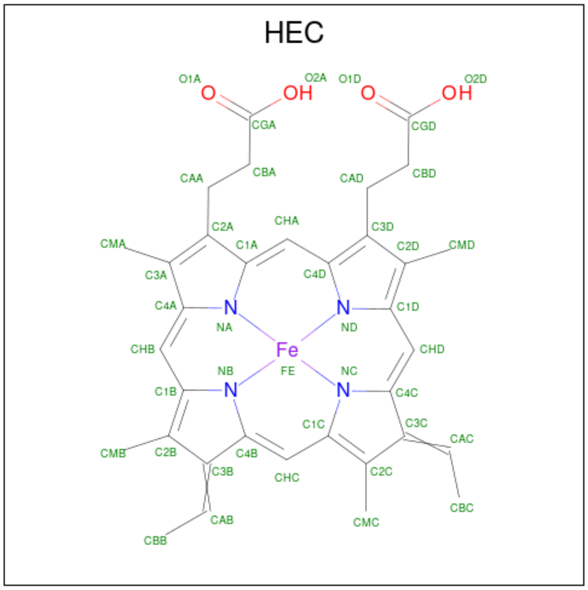
Chain	Residue	Modelled	Actual	Comment	Reference
D	3	ALA	-	expression tag	UNP Q39YY5
D	4	ILE	-	expression tag	UNP Q39YY5
D	5	ALA	-	expression tag	UNP Q39YY5
D	6	VAL	-	expression tag	UNP Q39YY5
D	7	ALA	-	expression tag	UNP Q39YY5
D	8	LEU	-	expression tag	UNP Q39YY5
D	9	ALA	-	expression tag	UNP Q39YY5
D	10	GLY	-	expression tag	UNP Q39YY5
D	11	PHE	-	expression tag	UNP Q39YY5
D	12	ALA	-	expression tag	UNP Q39YY5
D	13	THR	-	expression tag	UNP Q39YY5
D	14	VAL	-	expression tag	UNP Q39YY5
D	15	ALA	-	expression tag	UNP Q39YY5
D	16	GLN	-	expression tag	UNP Q39YY5
D	17	ALA	-	expression tag	UNP Q39YY5
D	18	ALA	-	expression tag	UNP Q39YY5
D	19	SER	-	expression tag	UNP Q39YY5
D	20	TRP	-	expression tag	UNP Q39YY5
D	21	SER	-	expression tag	UNP Q39YY5
D	22	HIS	-	expression tag	UNP Q39YY5
D	23	PRO	-	expression tag	UNP Q39YY5
D	24	GLN	-	expression tag	UNP Q39YY5
D	25	PHE	-	expression tag	UNP Q39YY5
D	26	GLU	-	expression tag	UNP Q39YY5
D	27	LYS	-	expression tag	UNP Q39YY5
D	28	GLY	-	expression tag	UNP Q39YY5
D	29	ALA	-	expression tag	UNP Q39YY5

- Molecule 2 is HEME C (three-letter code: HEC) (formula: $C_{34}H_{34}FeN_4O_4$).



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

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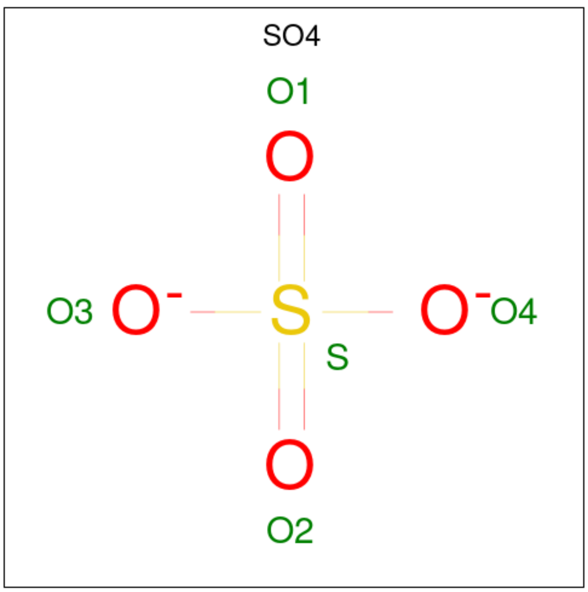
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	C	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
2	D	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
2	D	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
2	D	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
2	D	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
2	D	1	Total 43	C 34	Fe 1	N 4	O 4	0	0

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total 5	O 4	S 1	0	0
3	A	1	Total 5	O 4	S 1	0	0
3	A	1	Total 5	O 4	S 1	0	0
3	B	1	Total 5	O 4	S 1	0	0
3	B	1	Total 5	O 4	S 1	0	0

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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0
3	C	1	Total O S 5 4 1	0	0
3	C	1	Total O S 5 4 1	0	0
3	C	1	Total O S 5 4 1	0	0
3	D	1	Total O S 5 4 1	0	0
3	D	1	Total O S 5 4 1	0	0
3	D	1	Total O S 5 4 1	0	0
3	D	1	Total O S 5 4 1	0	0

- Molecule 4 is water.

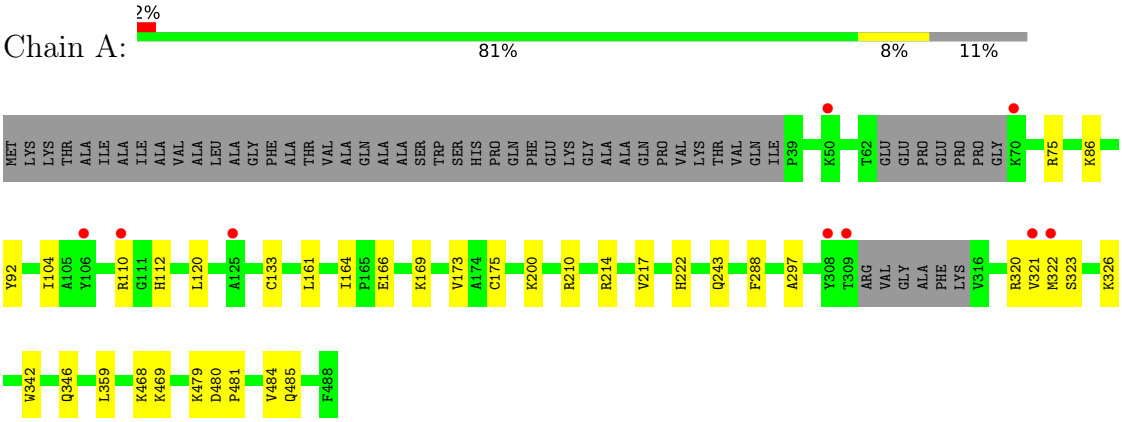
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	186	Total O 187 187	0	1
4	B	154	Total O 154 154	0	0
4	C	188	Total O 189 189	0	1
4	D	197	Total O 198 198	0	1

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.

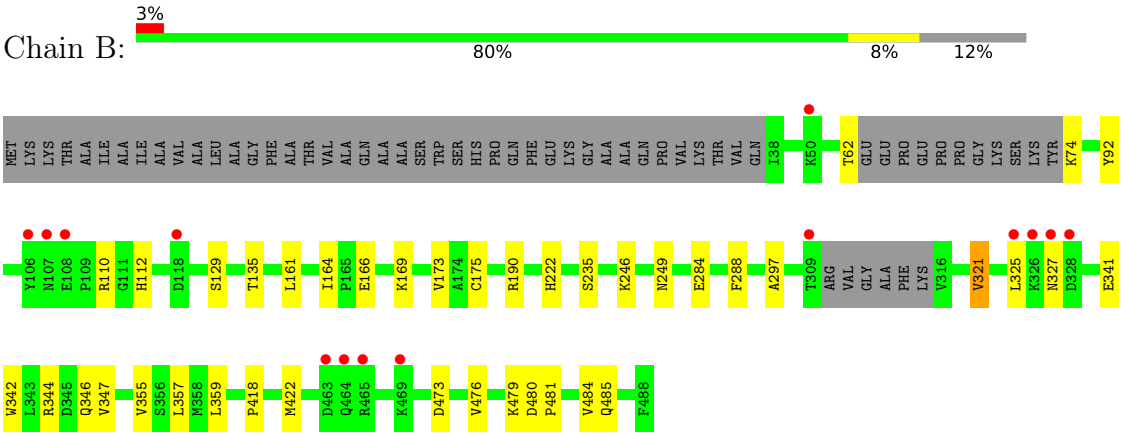
• Molecule 1: Nitrite reductase (cytochrome; ammonia-forming)

Chain A:



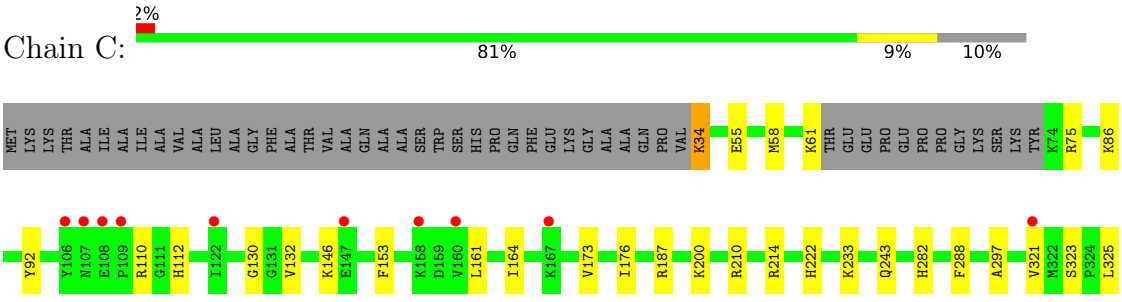
• Molecule 1: Nitrite reductase (cytochrome; ammonia-forming)

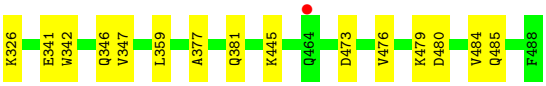
Chain B:



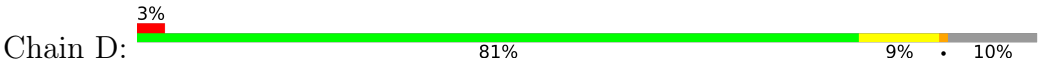
• Molecule 1: Nitrite reductase (cytochrome; ammonia-forming)

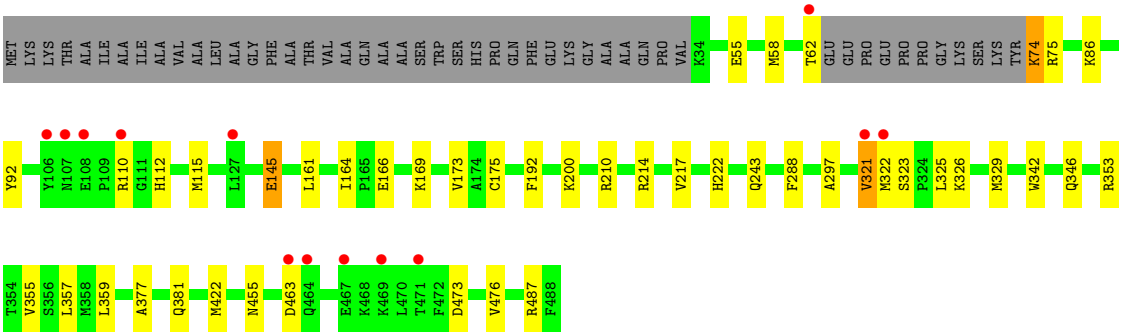
Chain C:





• Molecule 1: Nitrite reductase (cytochrome; ammonia-forming)





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	91.08Å 91.97Å 123.94Å 90.00° 99.06° 90.00°	Depositor
Resolution (Å)	122.39 – 1.94 122.39 – 1.94	Depositor EDS
% Data completeness (in resolution range)	62.1 (122.39-1.94) 62.1 (122.39-1.94)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.55 (at 1.94Å)	Xtriage
Refinement program	BUSTER 2.10.4 (8-JUN-2022)	Depositor
R, R_{free}	0.193 , 0.227 0.187 , 0.217	Depositor DCC
R_{free} test set	4540 reflections (4.90%)	wwPDB-VP
Wilson B-factor (Å^2)	24.8	Xtriage
Anisotropy	0.112	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 49.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.54$, $< L^2 > = 0.38$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	15471	wwPDB-VP
Average B, all atoms (Å^2)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 45.55 % 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 1.2998e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: SO4, HEC

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	0.41	0/3510	0.55	0/4733
1	B	0.40	0/3473	0.55	0/4690
1	C	0.41	0/3567	0.55	0/4814
1	D	0.43	0/3572	0.56	0/4823
All	All	0.42	0/14122	0.55	0/19060

There are no bond length outliers.

There are no bond angle outliers.

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	3433	0	3390	25	0
1	B	3398	0	3339	24	0
1	C	3489	0	3453	28	0
1	D	3493	0	3450	32	0
2	A	215	0	150	8	0
2	B	215	0	150	7	0
2	C	215	0	150	5	0
2	D	215	0	150	7	0
3	A	15	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	20	0	0	0	0
3	C	15	0	0	0	0
3	D	20	0	0	0	0
4	A	187	0	0	0	0
4	B	154	0	0	0	0
4	C	189	0	0	1	0
4	D	198	0	0	1	0
All	All	15471	0	14232	116	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 4.

The worst 5 of 116 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)
2:B:503:HEC:HHA	2:B:503:HEC:HBD1	1.60	0.83
1:D:455:ASN:HB2	1:D:487:ARG:HE	1.42	0.81
1:A:210:ARG:HE	1:A:214:ARG:HH22	1.33	0.74
1:A:480:ASP:OD1	1:A:481:PRO:HD2	1.91	0.70
1:A:210:ARG:HE	1:A:214:ARG:NH2	1.88	0.69

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	431/492 (88%)	414 (96%)	16 (4%)	1 (0%)	47	39
1	B	428/492 (87%)	413 (96%)	14 (3%)	1 (0%)	47	39
1	C	439/492 (89%)	421 (96%)	16 (4%)	2 (0%)	29	17
1	D	440/492 (89%)	422 (96%)	17 (4%)	1 (0%)	47	39

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	1738/1968 (88%)	1670 (96%)	63 (4%)	5 (0%)	41 32

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	130	GLY
1	A	321	VAL
1	B	321	VAL
1	D	321	VAL
1	C	282	HIS

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	360/407 (88%)	357 (99%)	3 (1%)	81 78
1	B	358/407 (88%)	355 (99%)	3 (1%)	81 78
1	C	368/407 (90%)	364 (99%)	4 (1%)	73 67
1	D	368/407 (90%)	361 (98%)	7 (2%)	57 45
All	All	1454/1628 (89%)	1437 (99%)	17 (1%)	71 64

5 of 17 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	321	VAL
1	D	463	ASP
1	C	61	LYS
1	C	146	LYS
1	C	341	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	249	ASN
1	B	327	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)

34 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	HEC	C	505	1	32,50,50	1.32	3 (9%)	24,82,82	1.41	3 (12%)
2	HEC	D	502	1	32,50,50	1.37	4 (12%)	24,82,82	1.58	5 (20%)
3	SO4	C	507	-	4,4,4	0.25	0	6,6,6	0.74	0
2	HEC	C	502	1	32,50,50	1.27	3 (9%)	24,82,82	1.39	3 (12%)
3	SO4	D	508	-	4,4,4	0.26	0	6,6,6	0.32	0
3	SO4	A	507	-	4,4,4	0.20	0	6,6,6	0.23	0
3	SO4	B	509	-	4,4,4	0.26	0	6,6,6	0.21	0
2	HEC	D	503	1	32,50,50	1.18	2 (6%)	24,82,82	1.54	5 (20%)
3	SO4	B	508	-	4,4,4	0.24	0	6,6,6	0.27	0
2	HEC	C	503	1,4	32,50,50	1.31	4 (12%)	24,82,82	1.44	4 (16%)
3	SO4	D	506	-	4,4,4	0.26	0	6,6,6	0.77	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
2	HEC	B	501	1,4	32,50,50	1.31	2 (6%)	24,82,82	1.56	6 (25%)
2	HEC	C	501	1	32,50,50	1.31	3 (9%)	24,82,82	1.52	5 (20%)
3	SO4	D	509	-	4,4,4	0.21	0	6,6,6	0.59	0
3	SO4	B	507	-	4,4,4	0.20	0	6,6,6	0.49	0
2	HEC	A	502	1,4	32,50,50	1.42	4 (12%)	24,82,82	1.38	3 (12%)
2	HEC	D	504	1	32,50,50	1.19	3 (9%)	24,82,82	1.43	3 (12%)
2	HEC	A	503	1	32,50,50	1.35	3 (9%)	24,82,82	1.55	6 (25%)
2	HEC	B	505	1	32,50,50	1.31	3 (9%)	24,82,82	1.34	4 (16%)
2	HEC	D	505	1,4	32,50,50	1.25	2 (6%)	24,82,82	1.45	4 (16%)
3	SO4	C	506	-	4,4,4	0.23	0	6,6,6	1.11	1 (16%)
2	HEC	C	504	1	32,50,50	1.20	3 (9%)	24,82,82	1.48	4 (16%)
2	HEC	B	502	1	32,50,50	1.38	4 (12%)	24,82,82	1.32	2 (8%)
2	HEC	D	501	1	32,50,50	1.26	2 (6%)	24,82,82	1.45	4 (16%)
3	SO4	D	507	-	4,4,4	0.20	0	6,6,6	0.22	0
3	SO4	A	506	-	4,4,4	0.24	0	6,6,6	0.26	0
2	HEC	B	503	1	32,50,50	1.37	3 (9%)	24,82,82	1.42	4 (16%)
2	HEC	B	504	1	32,50,50	1.20	3 (9%)	24,82,82	1.40	4 (16%)
2	HEC	A	504	1	32,50,50	1.26	4 (12%)	24,82,82	1.41	4 (16%)
3	SO4	C	508	-	4,4,4	0.22	0	6,6,6	0.35	0
3	SO4	A	508	-	4,4,4	0.19	0	6,6,6	0.18	0
2	HEC	A	501	1	32,50,50	1.23	2 (6%)	24,82,82	1.31	3 (12%)
3	SO4	B	506	-	4,4,4	0.30	0	6,6,6	0.61	0
2	HEC	A	505	1	32,50,50	1.31	3 (9%)	24,82,82	1.31	4 (16%)

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	HEC	C	505	1	-	4/10/54/54	-
2	HEC	D	502	1	-	8/10/54/54	-
2	HEC	C	502	1	-	1/10/54/54	-
2	HEC	D	503	1	-	4/10/54/54	-
2	HEC	C	503	1,4	-	1/10/54/54	-
2	HEC	B	501	1,4	-	8/10/54/54	-
2	HEC	C	501	1	-	4/10/54/54	-
2	HEC	A	502	1,4	-	6/10/54/54	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	HEC	D	504	1	-	2/10/54/54	-
2	HEC	A	503	1	-	7/10/54/54	-
2	HEC	B	505	1	-	4/10/54/54	-
2	HEC	D	505	1,4	-	2/10/54/54	-
2	HEC	C	504	1	-	2/10/54/54	-
2	HEC	B	502	1	-	3/10/54/54	-
2	HEC	D	501	1	-	4/10/54/54	-
2	HEC	B	503	1	-	3/10/54/54	-
2	HEC	B	504	1	-	4/10/54/54	-
2	HEC	A	504	1	-	4/10/54/54	-
2	HEC	A	501	1	-	3/10/54/54	-
2	HEC	A	505	1	-	7/10/54/54	-

The worst 5 of 60 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	501	HEC	CBB-CAB	-4.80	1.31	1.49
2	C	501	HEC	CBC-CAC	-4.76	1.31	1.49
2	A	502	HEC	CBB-CAB	-4.74	1.31	1.49
2	B	502	HEC	CBC-CAC	-4.72	1.31	1.49
2	D	501	HEC	CBB-CAB	-4.69	1.31	1.49

The worst 5 of 81 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	D	503	HEC	CMB-C2B-C3B	3.70	130.16	125.82
2	D	504	HEC	CMB-C2B-C3B	3.60	130.05	125.82
2	D	501	HEC	CMB-C2B-C3B	3.55	130.00	125.82
2	C	502	HEC	CMB-C2B-C3B	3.51	129.95	125.82
2	C	504	HEC	CMB-C2B-C3B	3.49	129.92	125.82

There are no chirality outliers.

5 of 81 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	503	HEC	C2D-C3D-CAD-CBD
2	A	503	HEC	C4D-C3D-CAD-CBD
2	A	505	HEC	C3A-C2A-CAA-CBA
2	B	501	HEC	C1A-C2A-CAA-CBA

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Mol	Chain	Res	Type	Atoms
2	B	501	HEC	C3A-C2A-CAA-CBA

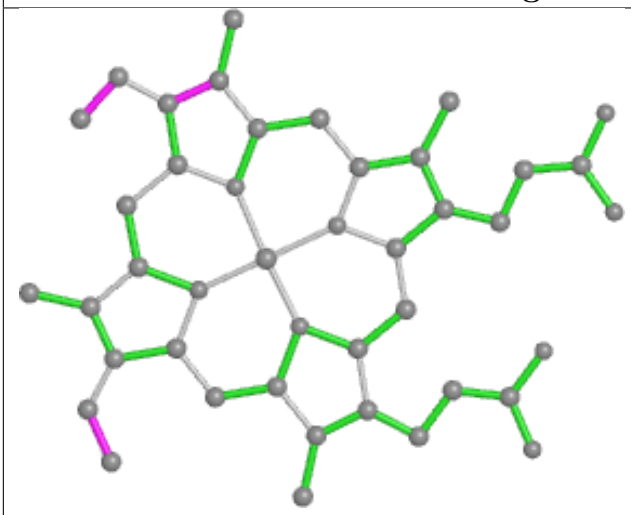
There are no ring outliers.

16 monomers are involved in 27 short contacts:

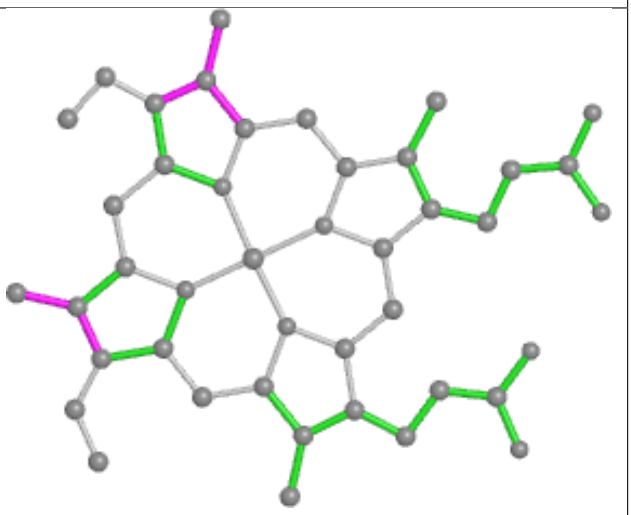
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	502	HEC	1	0
2	C	502	HEC	2	0
2	D	503	HEC	4	0
2	C	503	HEC	1	0
2	B	501	HEC	2	0
2	C	501	HEC	1	0
2	A	502	HEC	1	0
2	A	503	HEC	2	0
2	D	505	HEC	2	0
2	C	504	HEC	2	0
2	B	502	HEC	2	0
2	B	503	HEC	3	0
2	B	504	HEC	1	0
2	A	504	HEC	2	0
2	A	501	HEC	2	0
2	A	505	HEC	1	0

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 then 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.

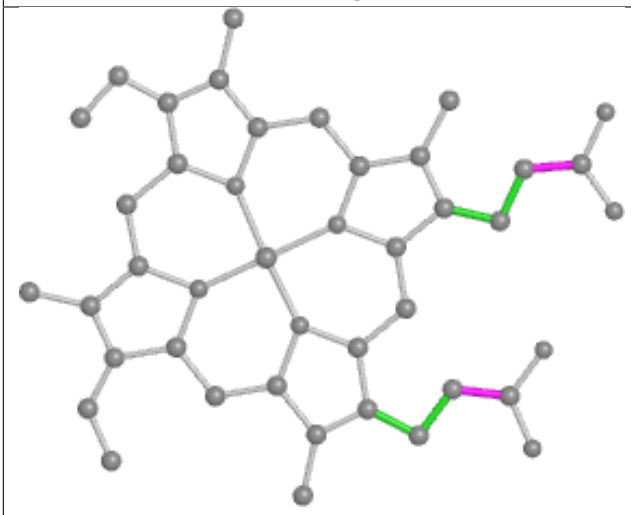
Ligand HEC C 505



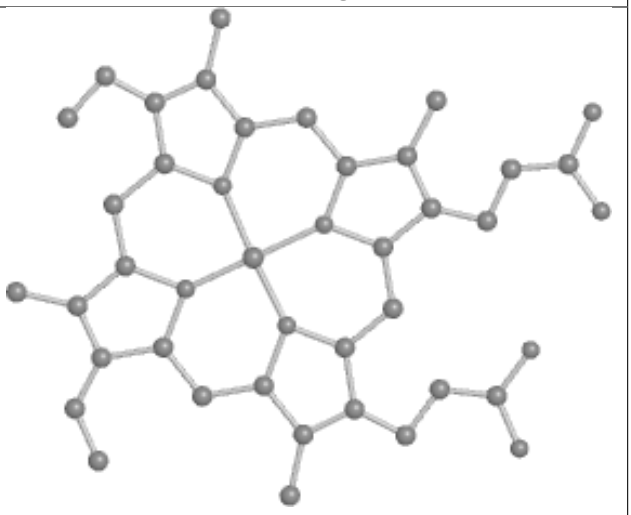
Bond lengths



Bond angles

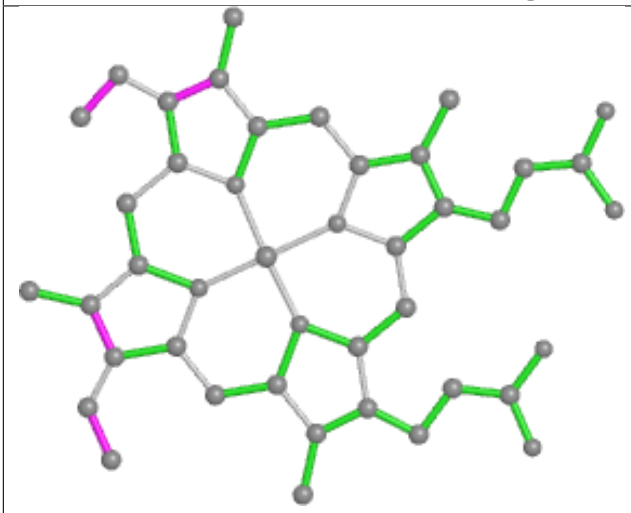


Torsions



Rings

Ligand HEC D 502



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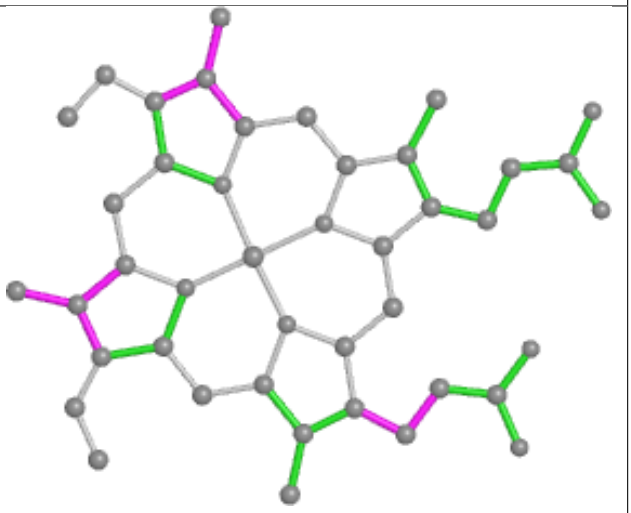

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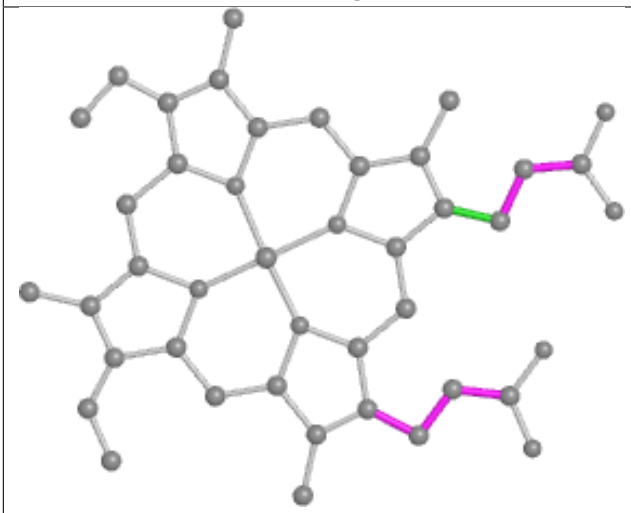

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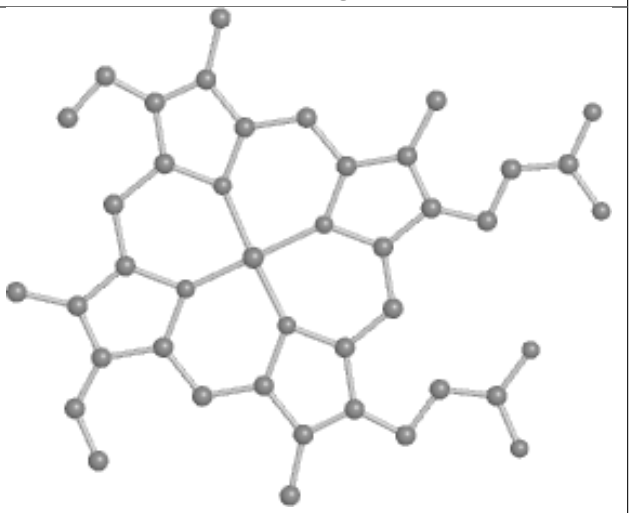

Rings

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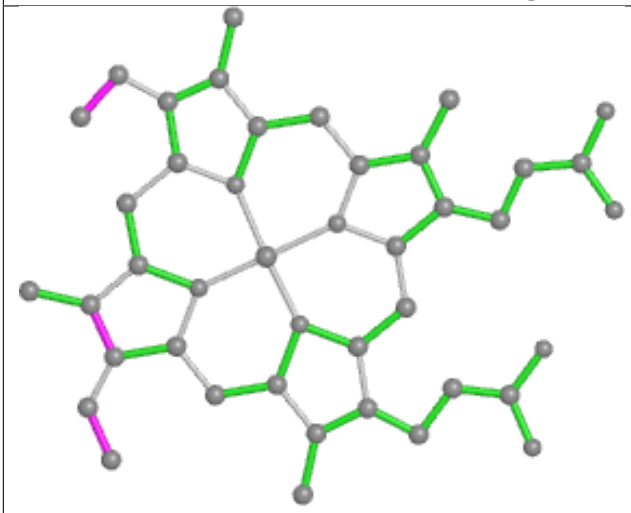

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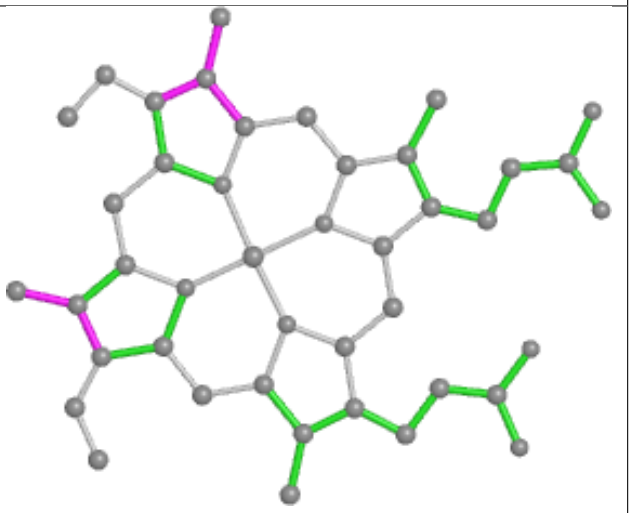
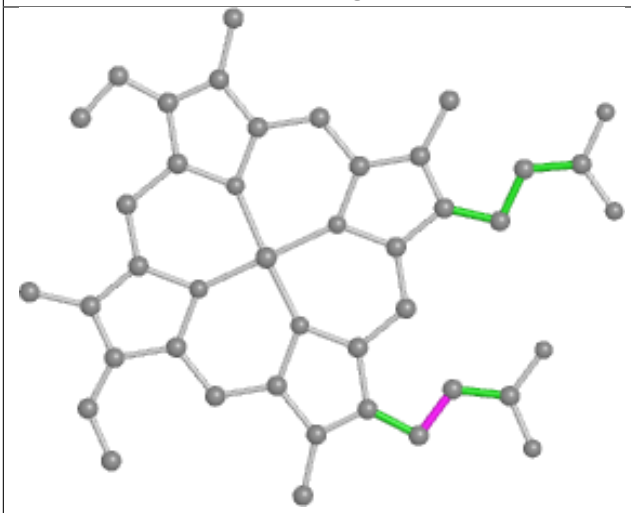


Bond angles



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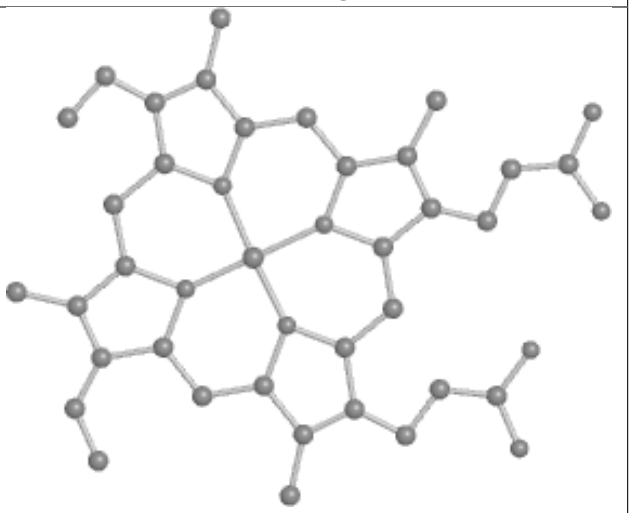

Rings

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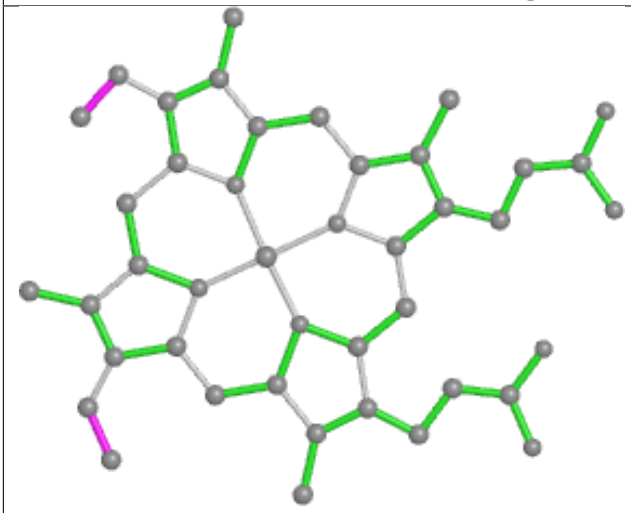

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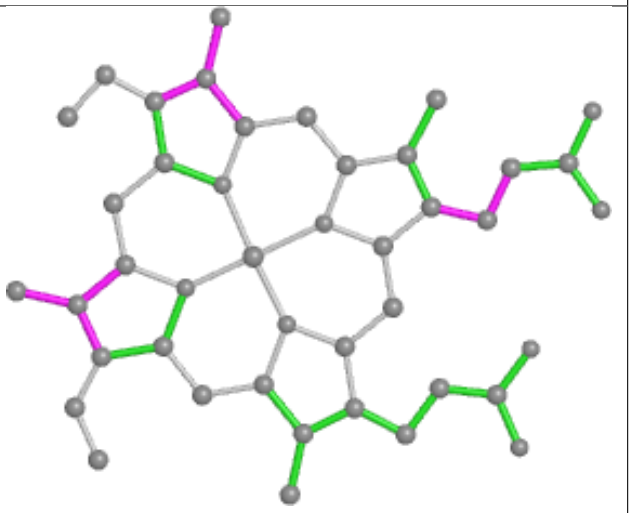

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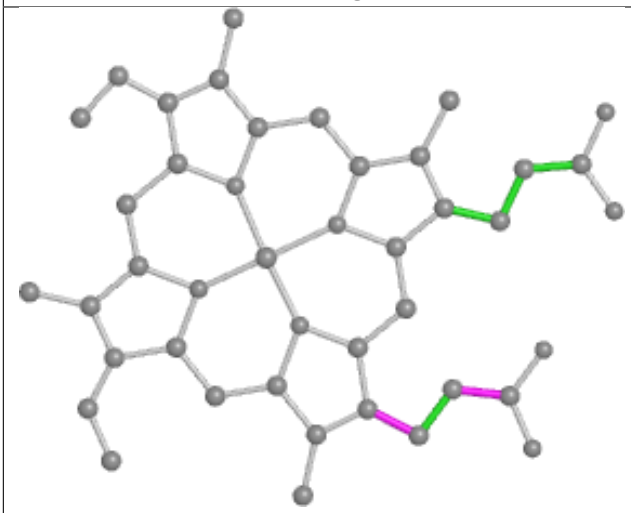

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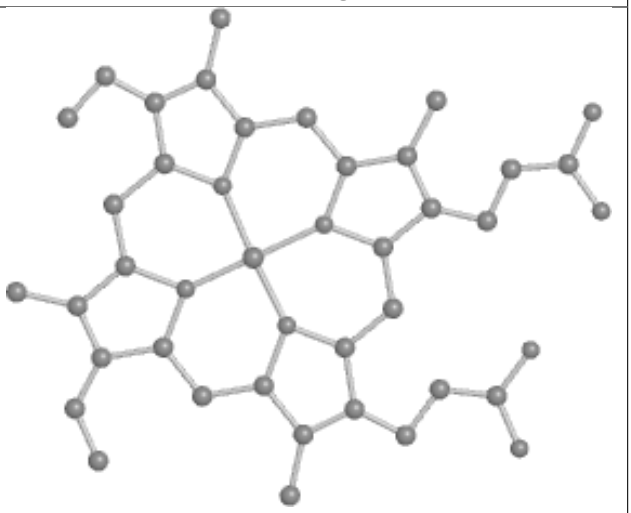

Rings

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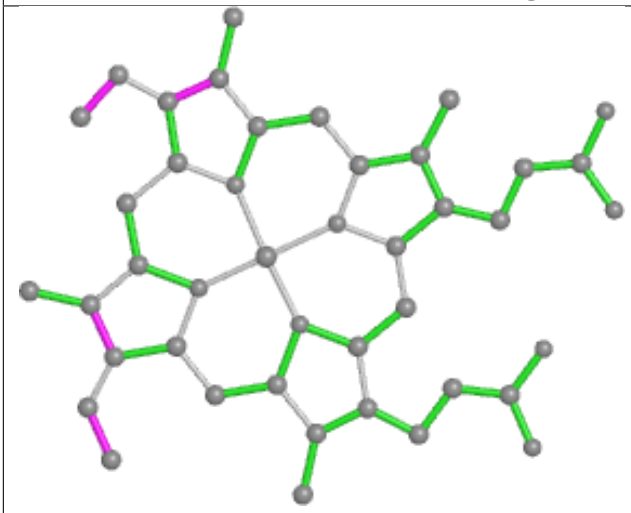

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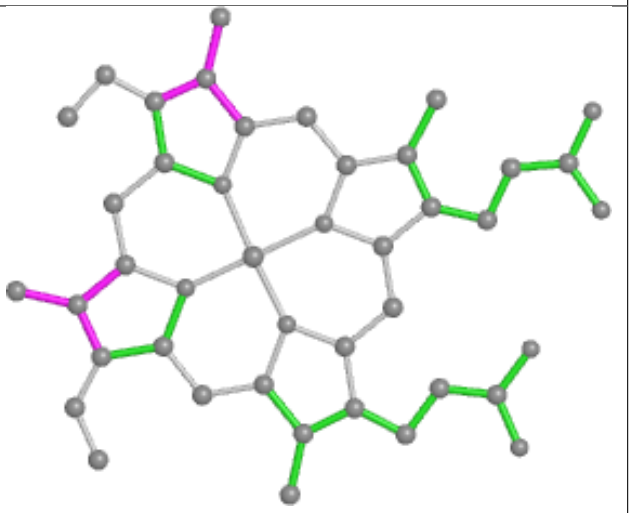
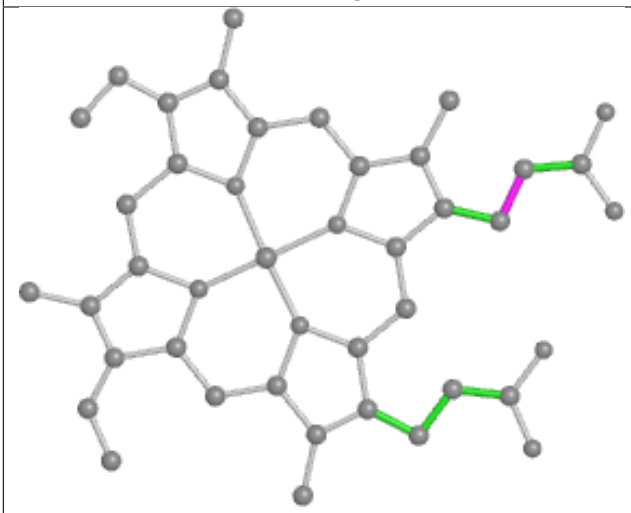


Bond angles



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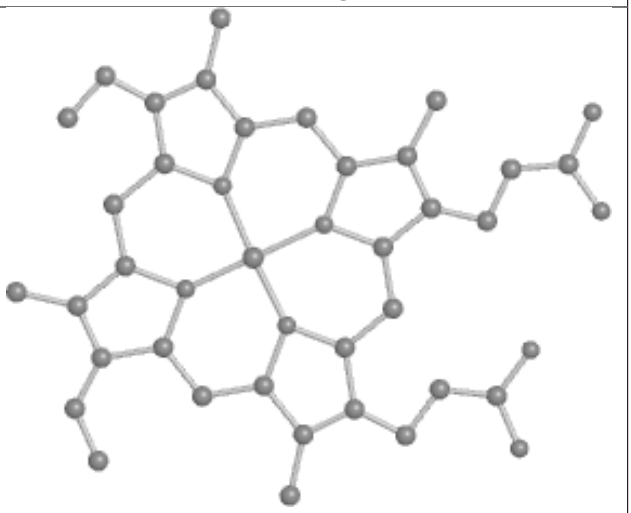

Rings

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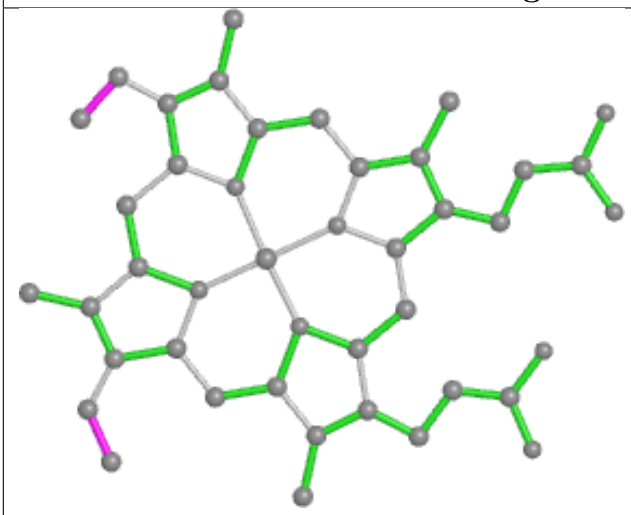
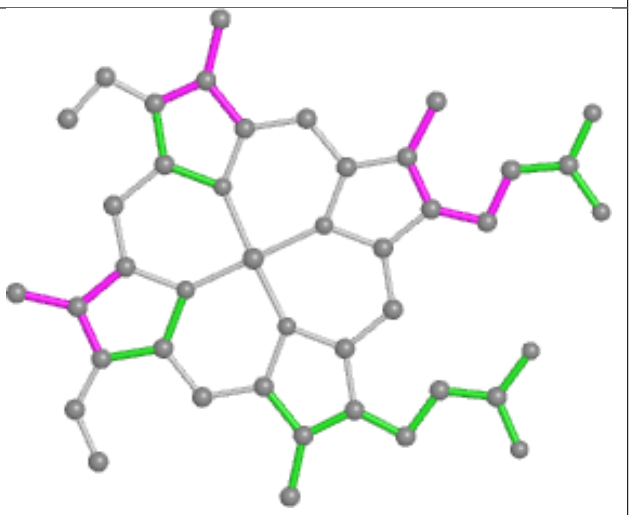
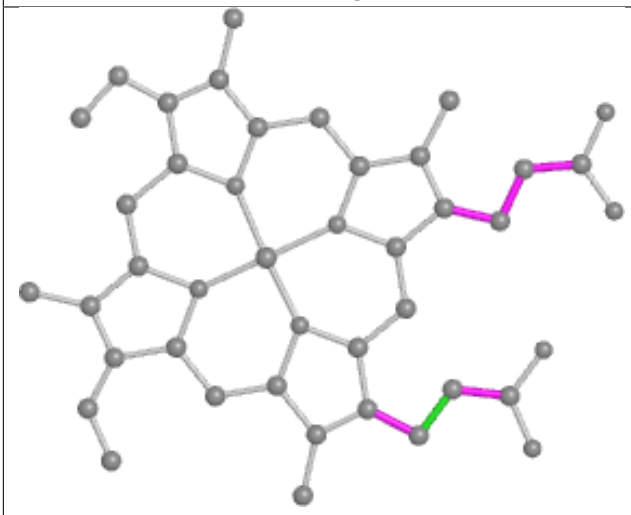


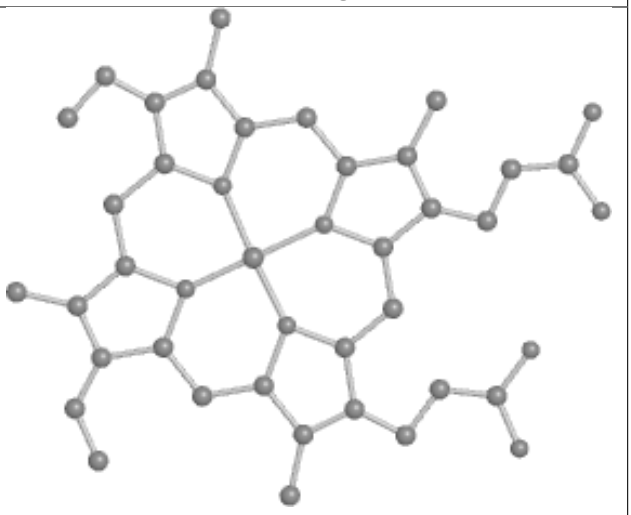
Bond lengths



Bond angles

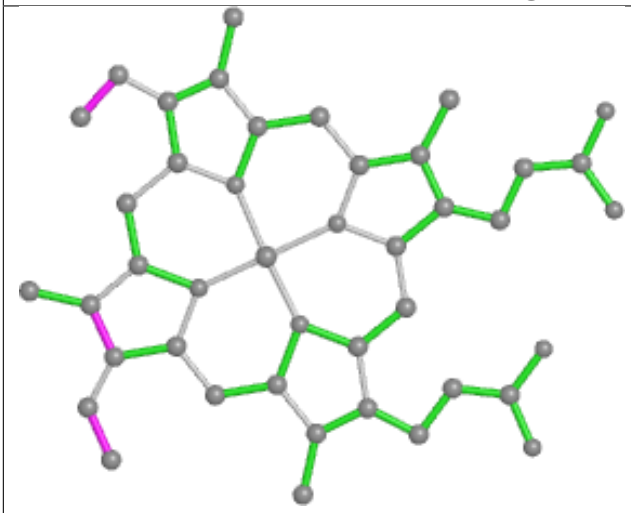


Torsions



Rings

Ligand HEC C 501



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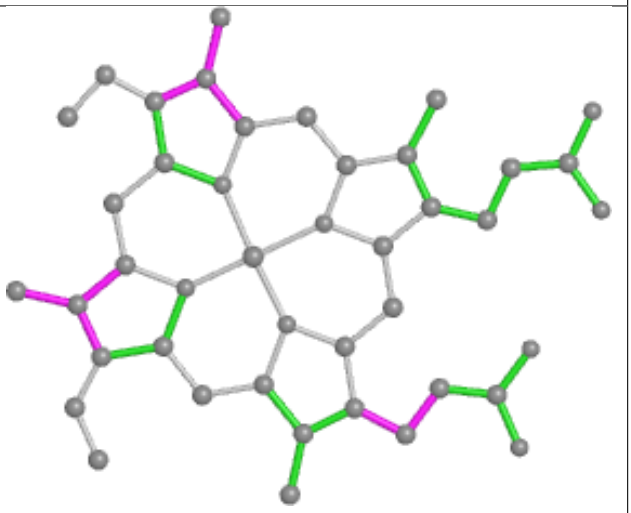

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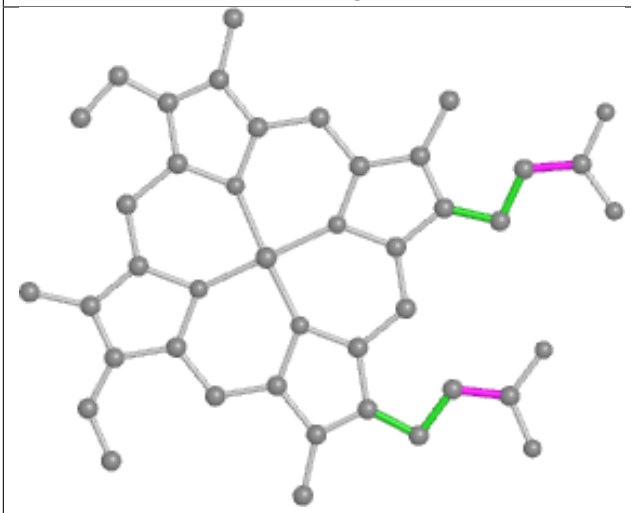
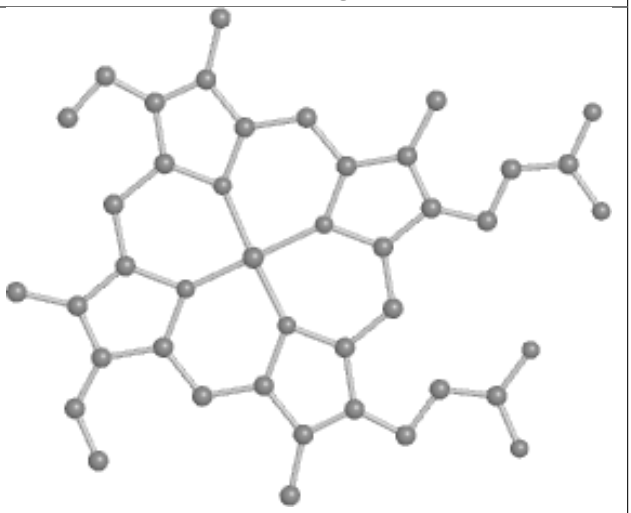
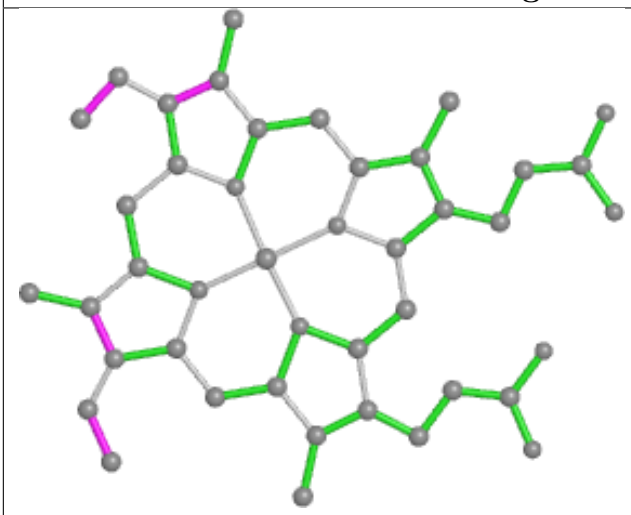


Torsions

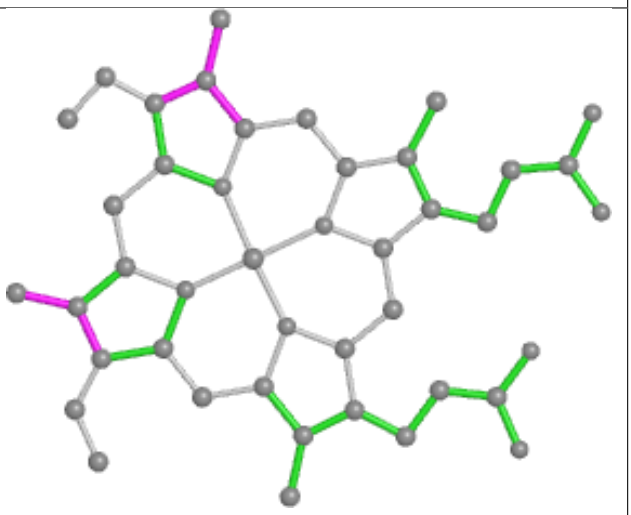


Rings

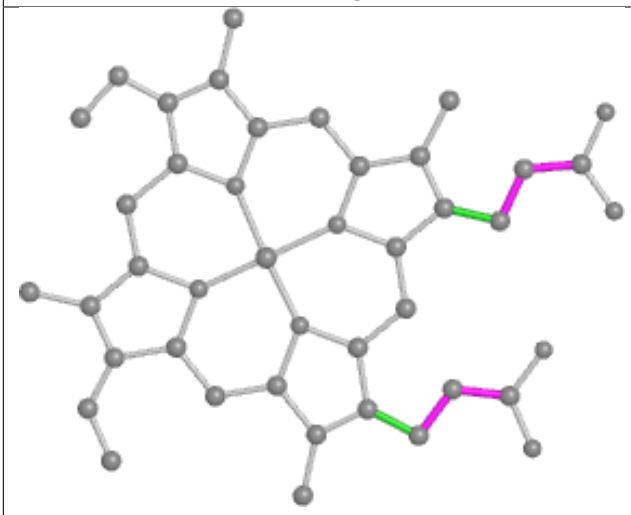
Ligand HEC A 502



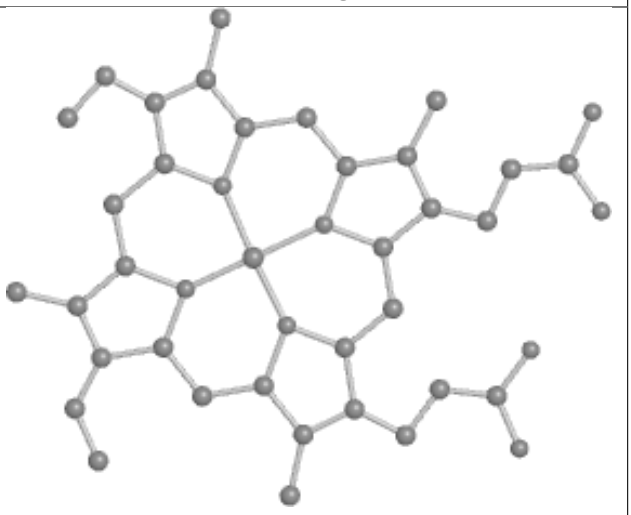
Bond lengths



Bond angles

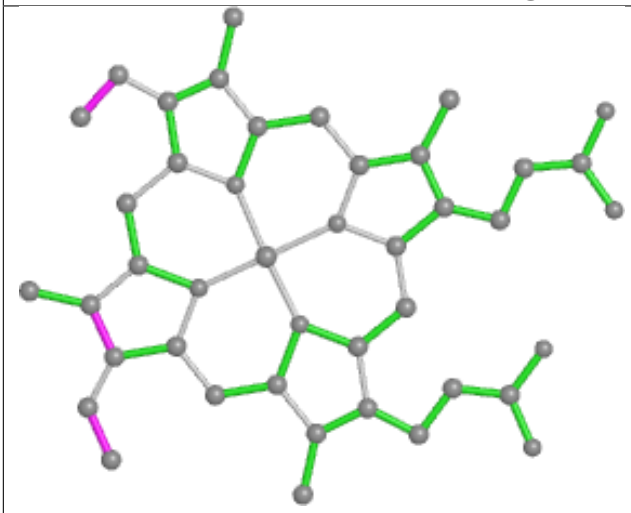


Torsions



Rings

Ligand HEC D 504



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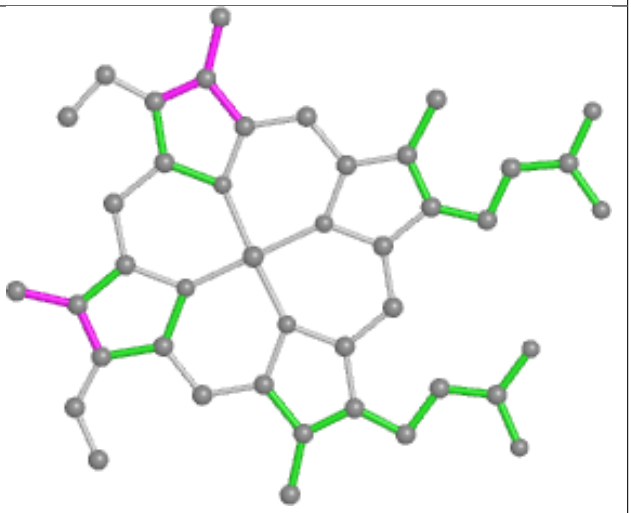
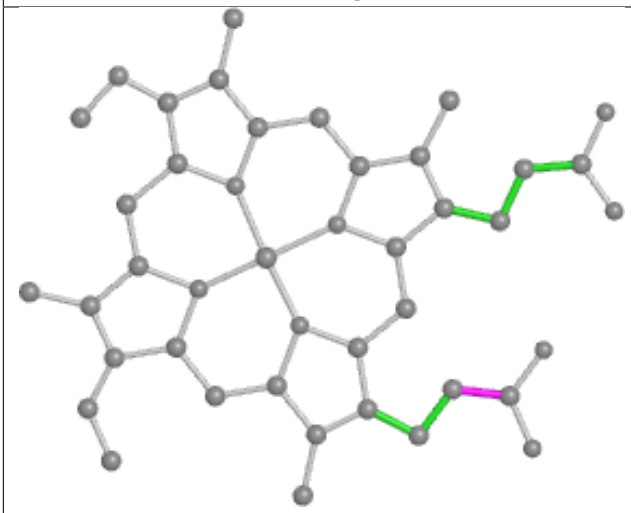


Bond angles



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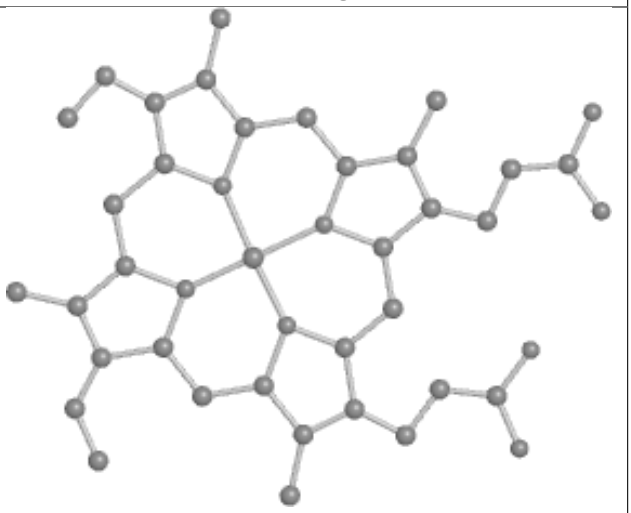

Rings

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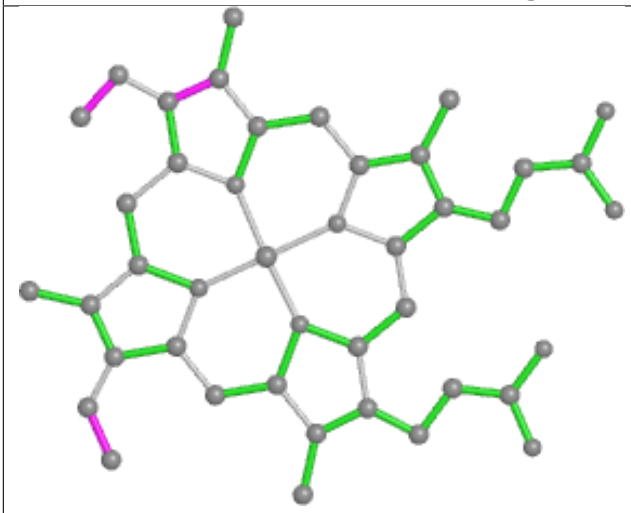

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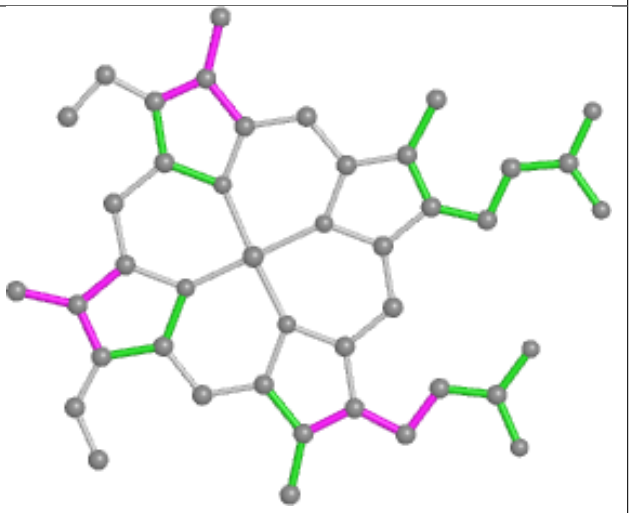
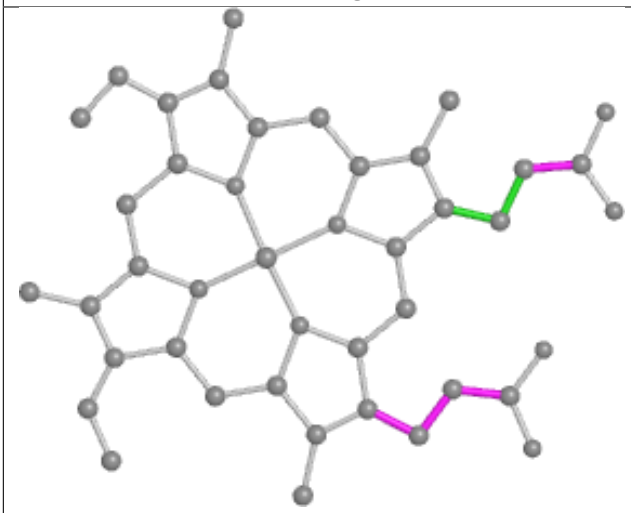


Bond angles



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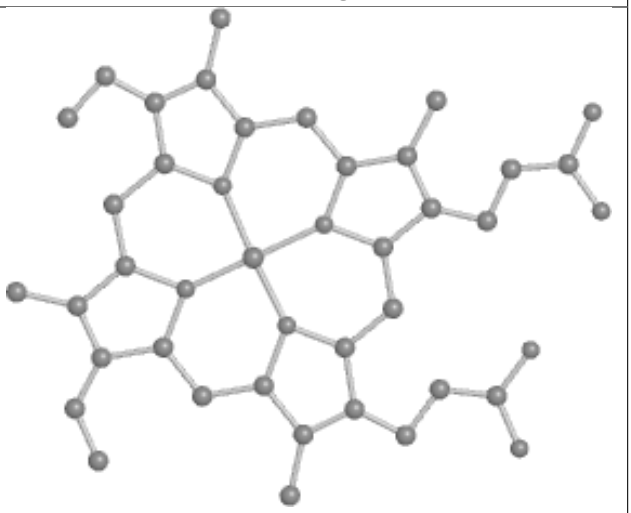

Rings

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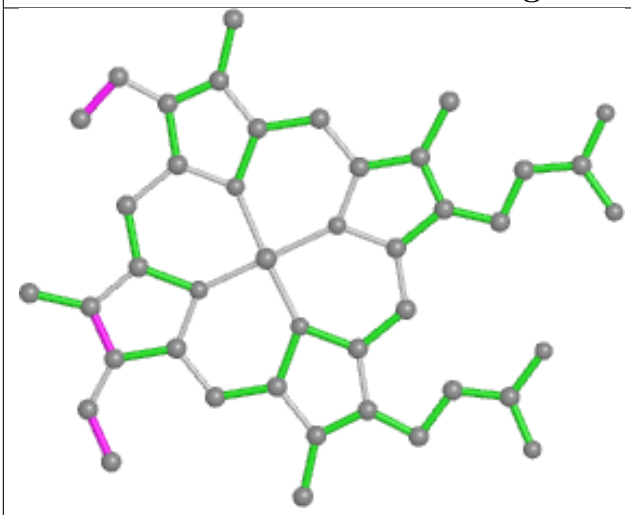

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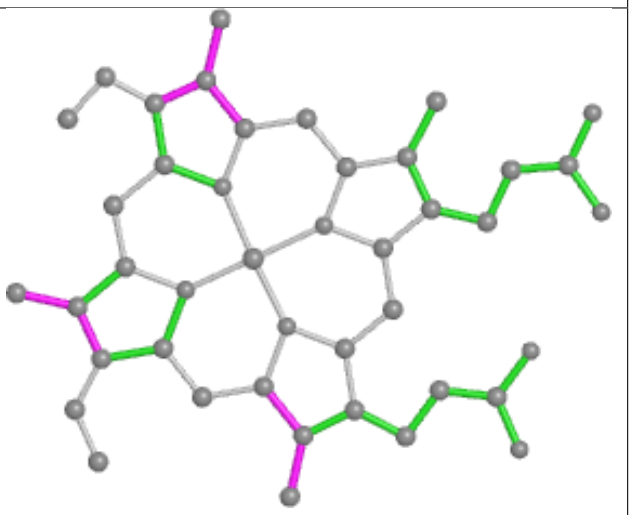
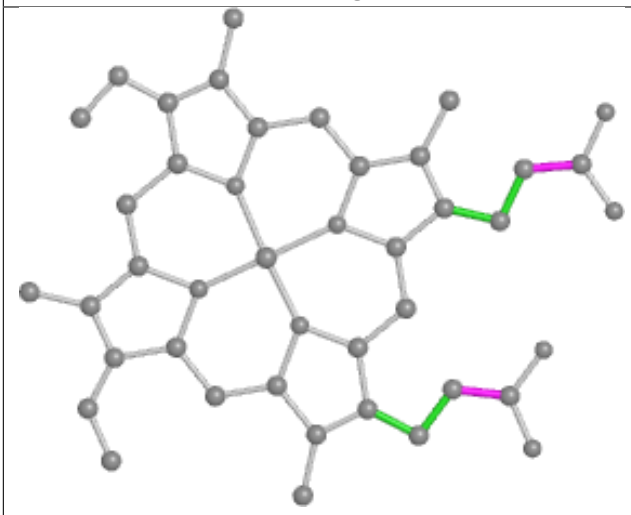


Bond angles



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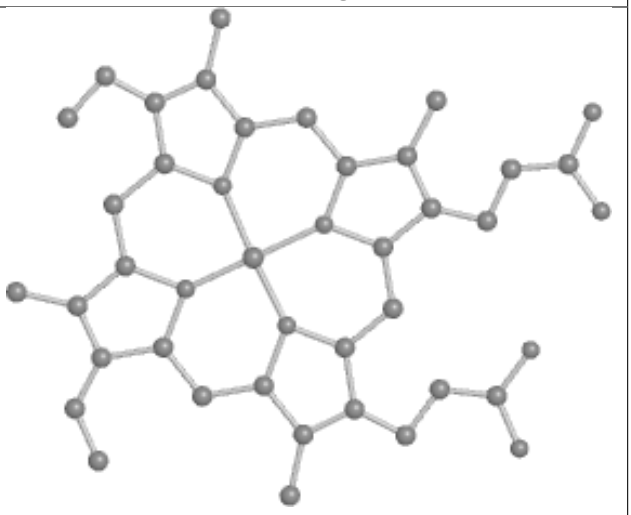
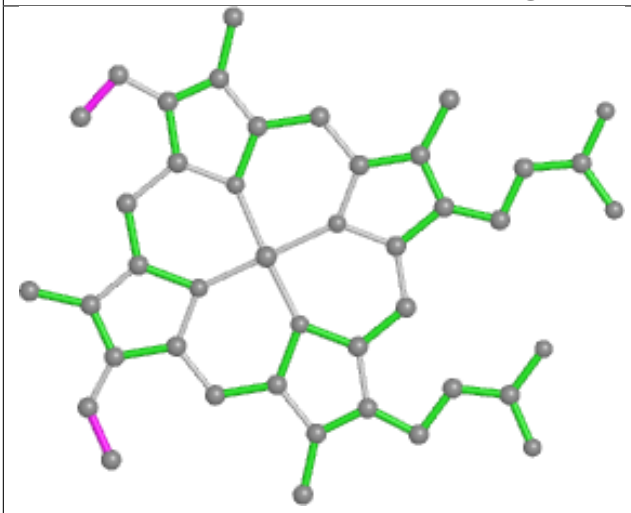


Rings

Ligand HEC D 505



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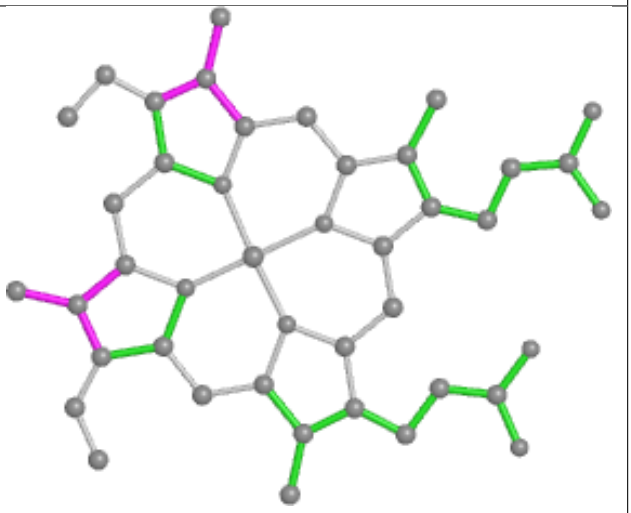
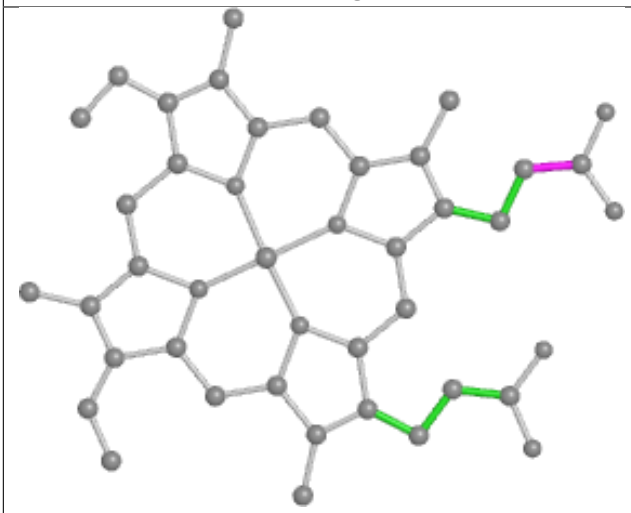


Bond angles



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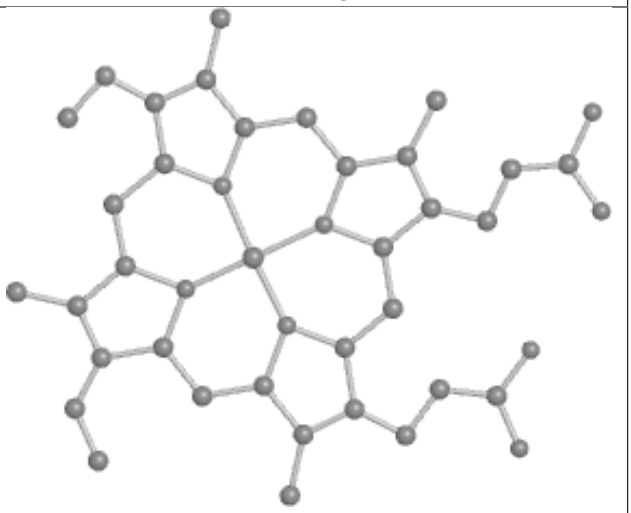
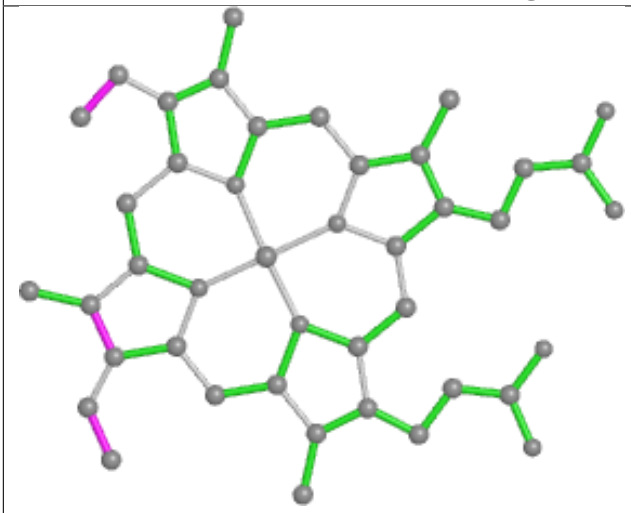
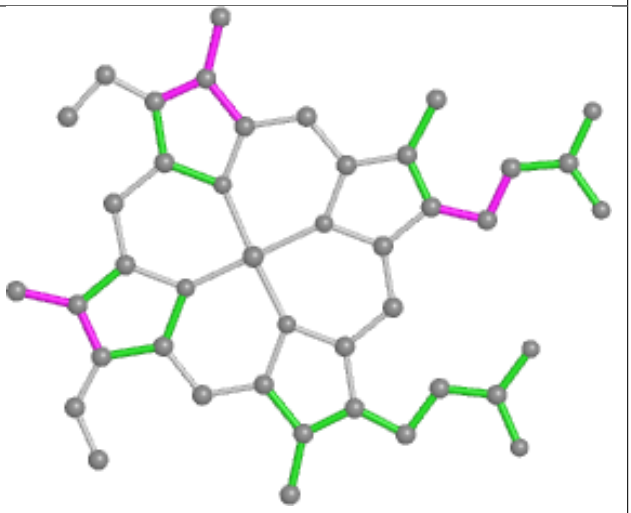


Rings

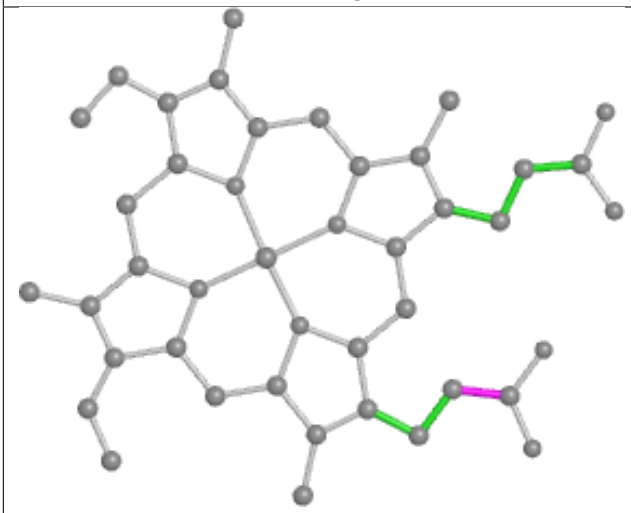
Ligand HEC C 504



Bond lengths



Bond angles



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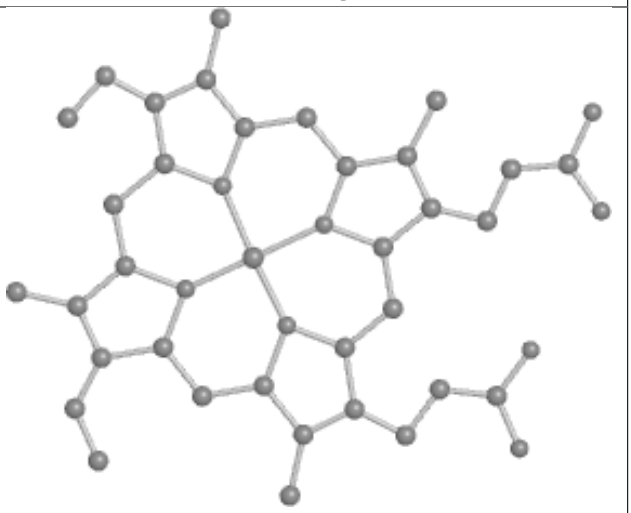

Rings

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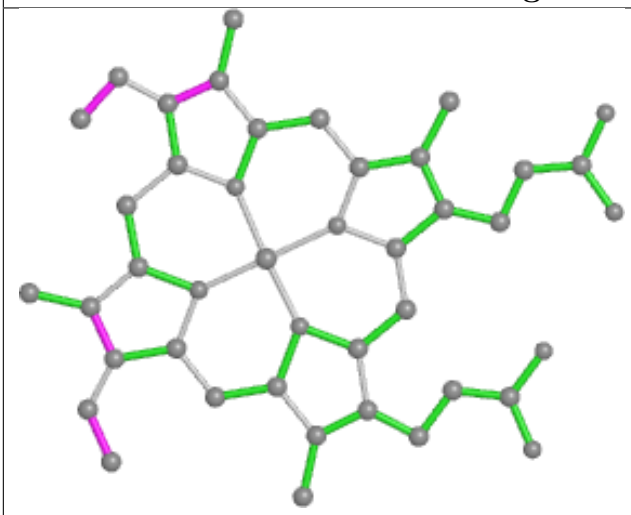

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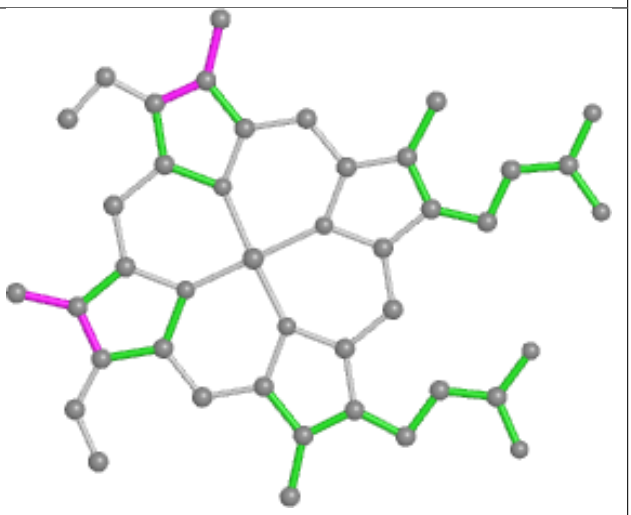
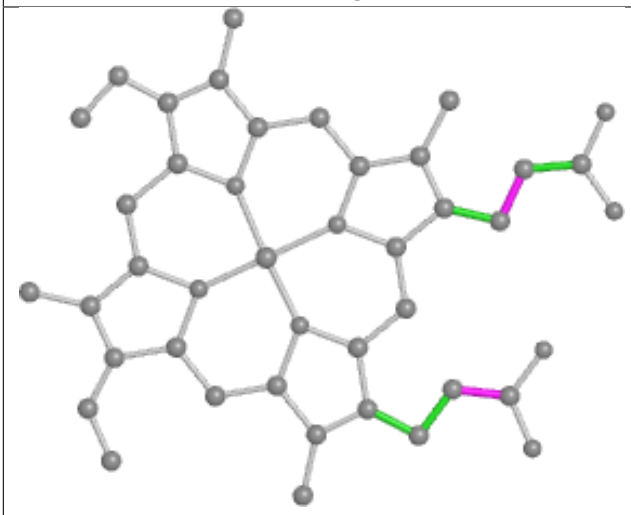


Bond angles



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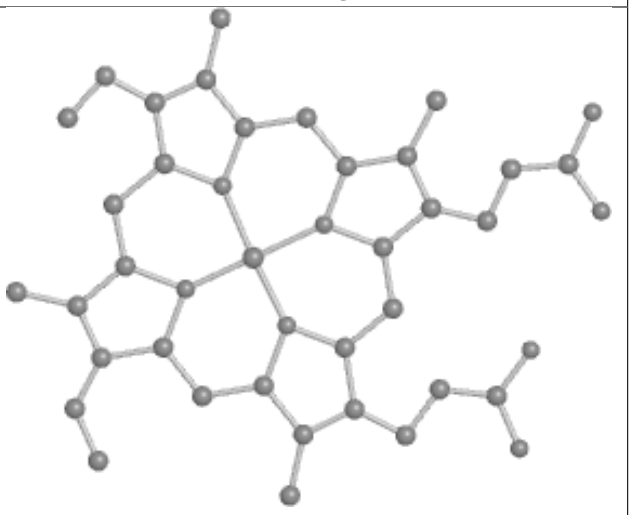
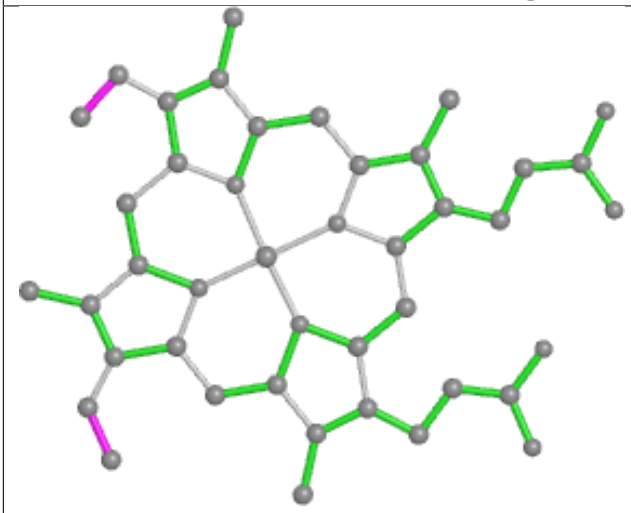


Rings

Ligand HEC D 501



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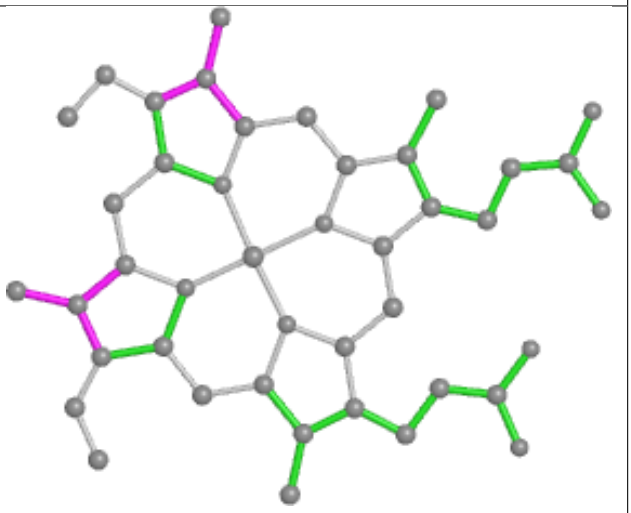
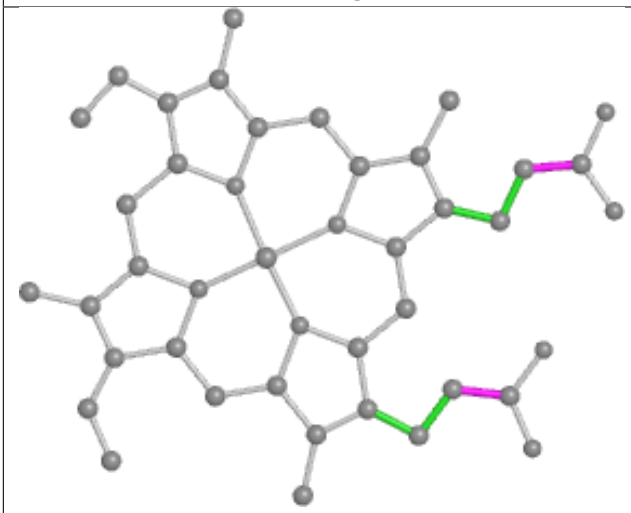
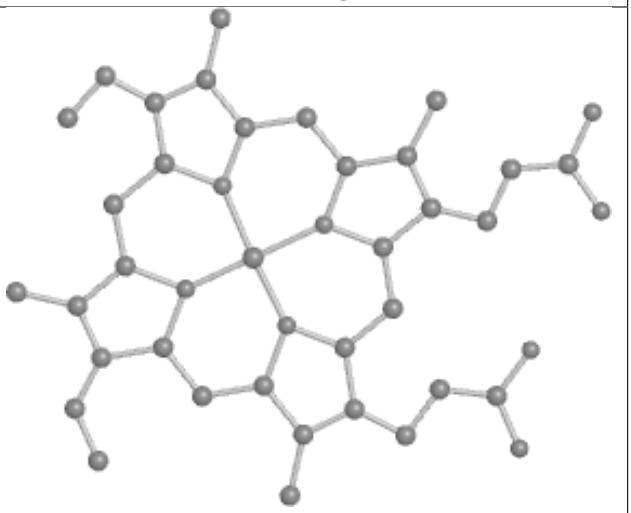


Bond angles

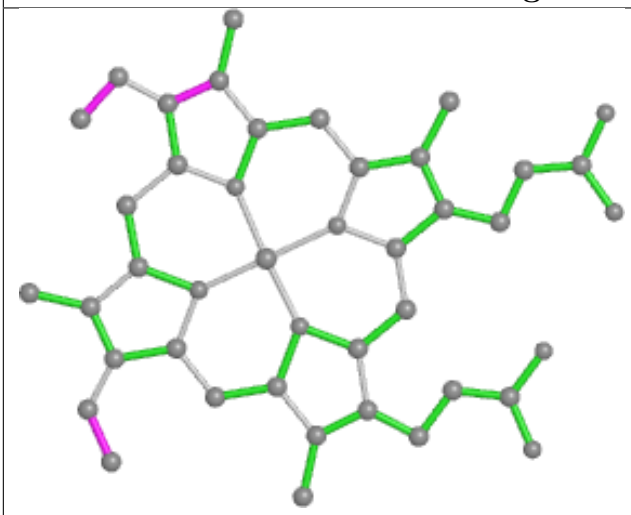


Torsions



Rings

Ligand HEC B 503



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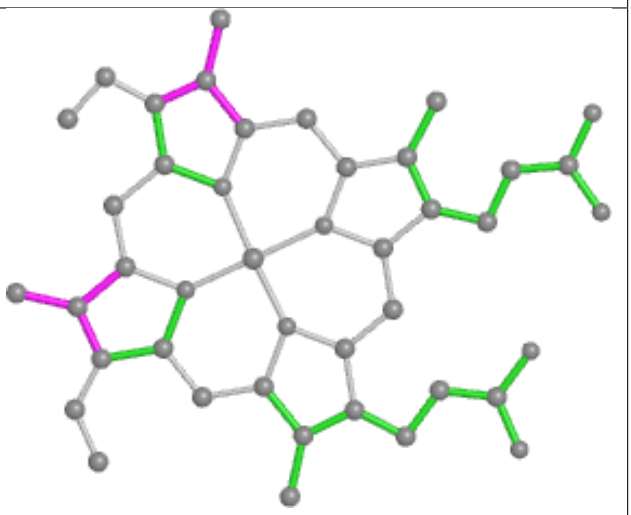
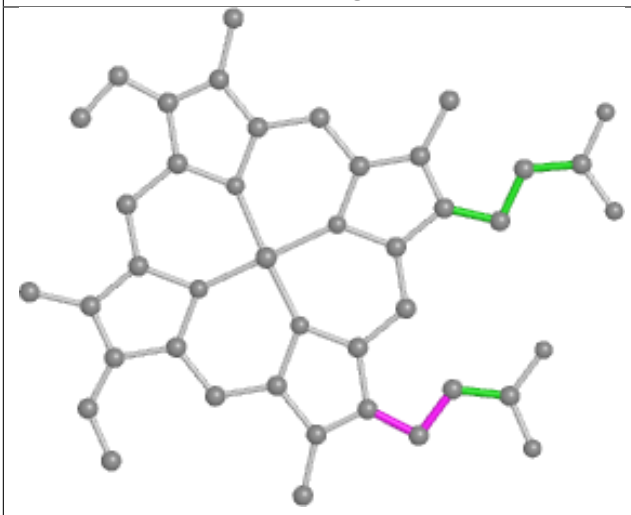


Bond angles



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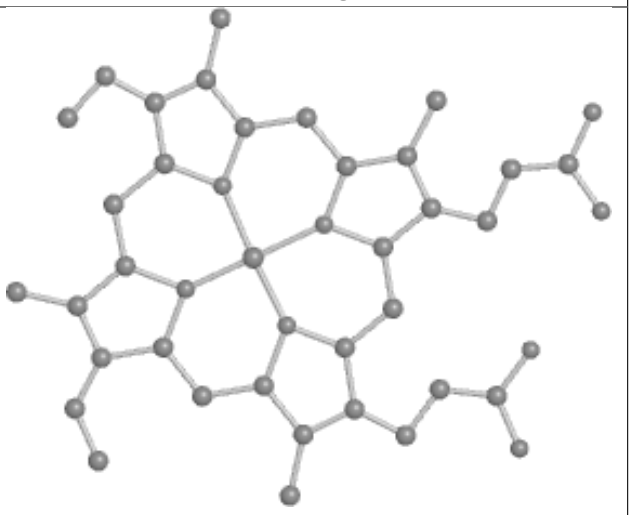

Rings

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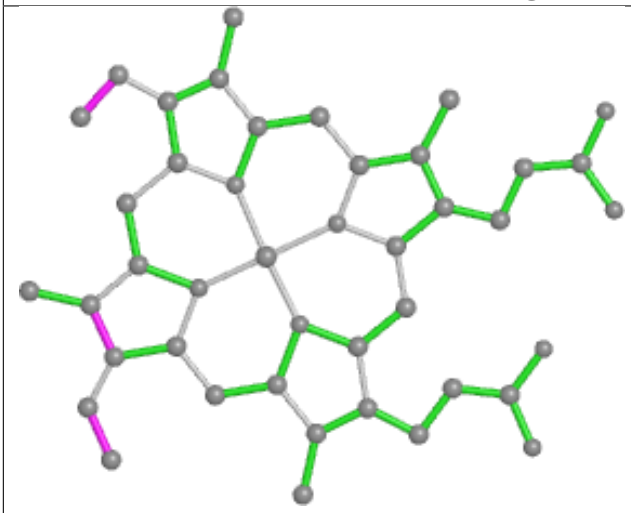

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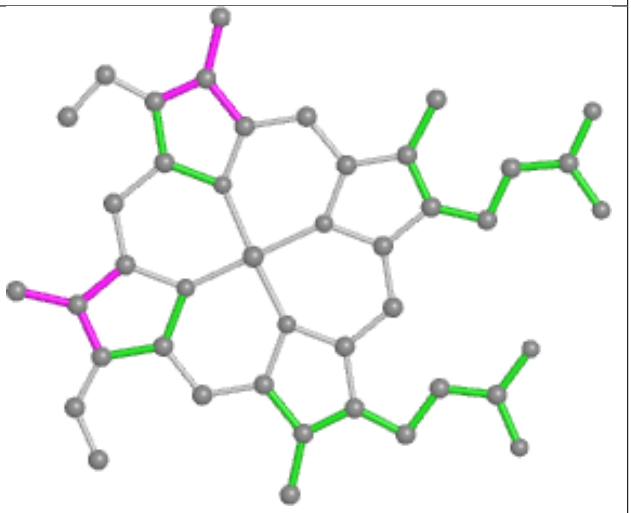
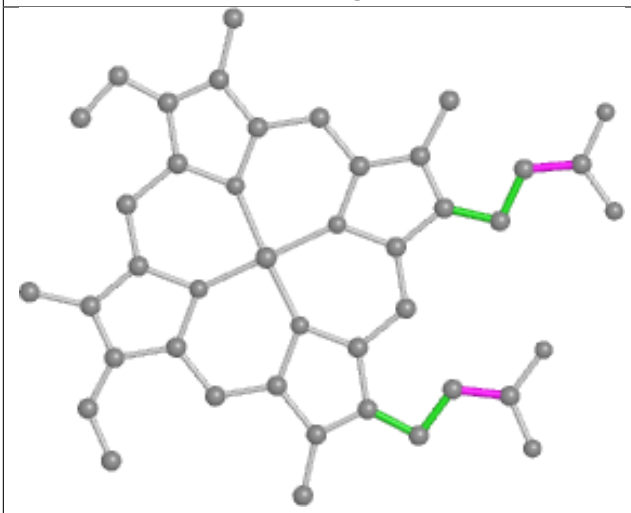


Bond angles



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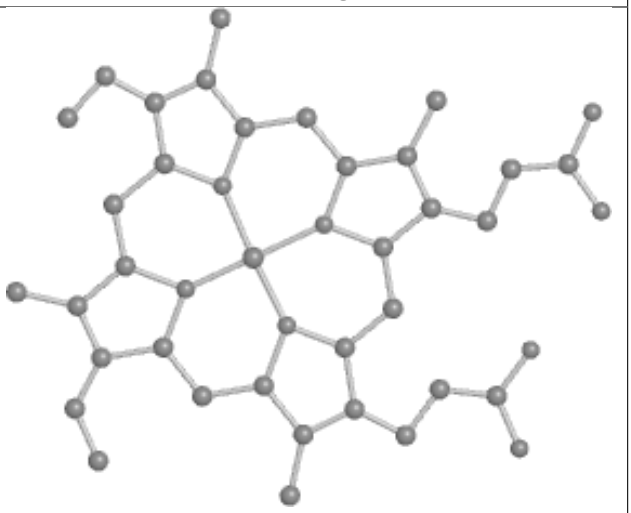
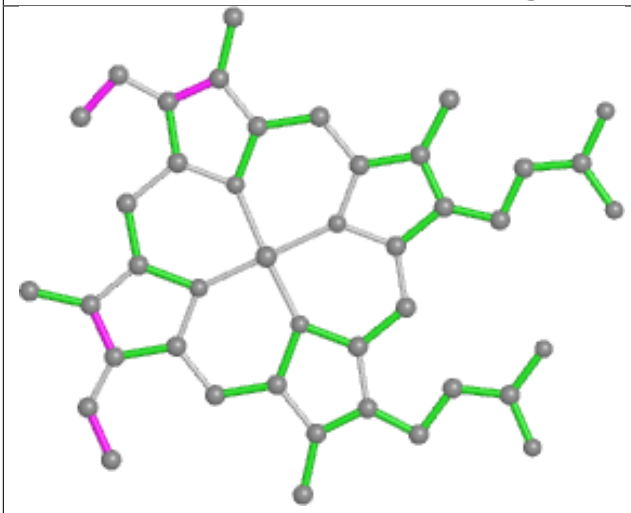


Rings

Ligand HEC A 504



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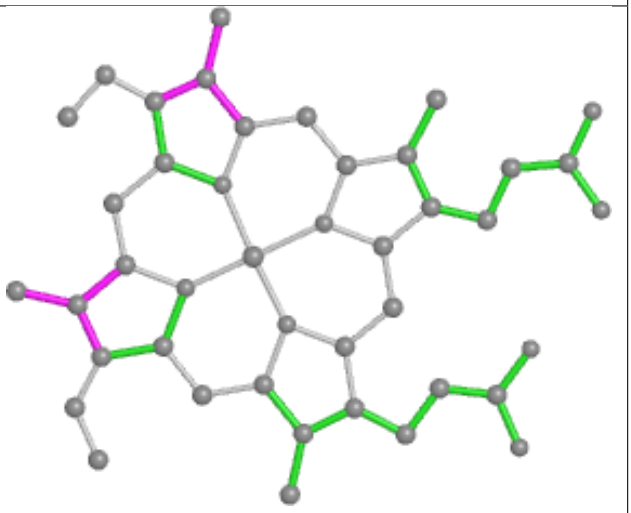
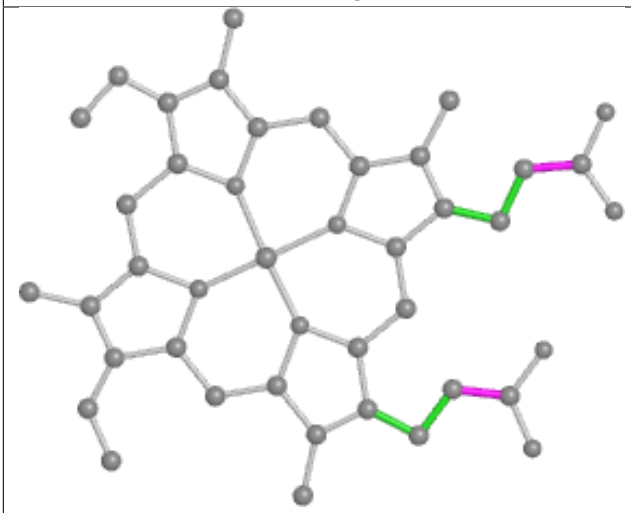


Bond angles



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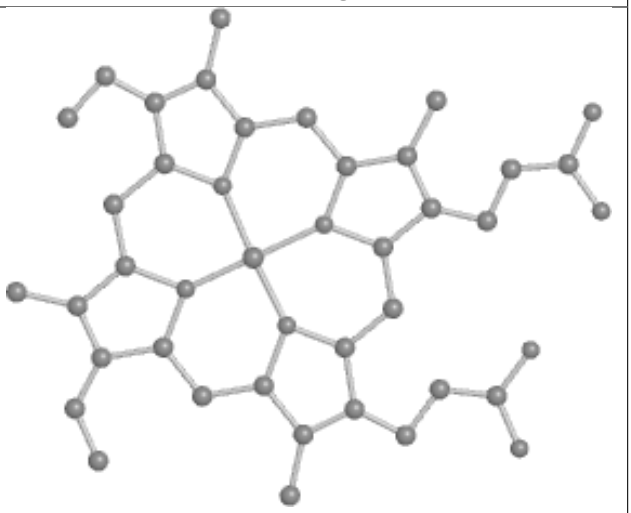
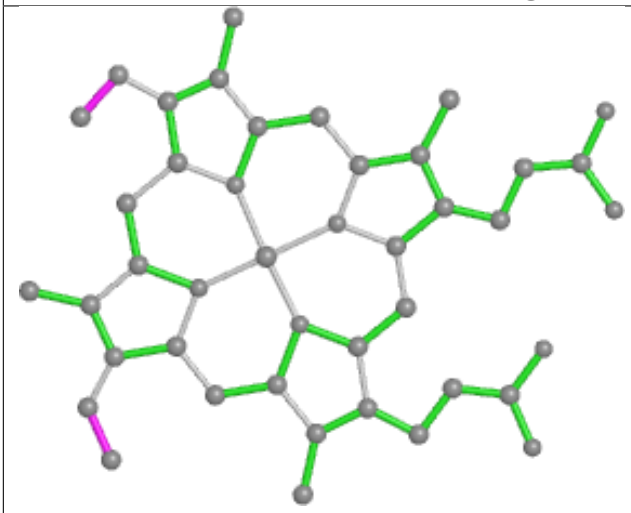


Rings

Ligand HEC A 501



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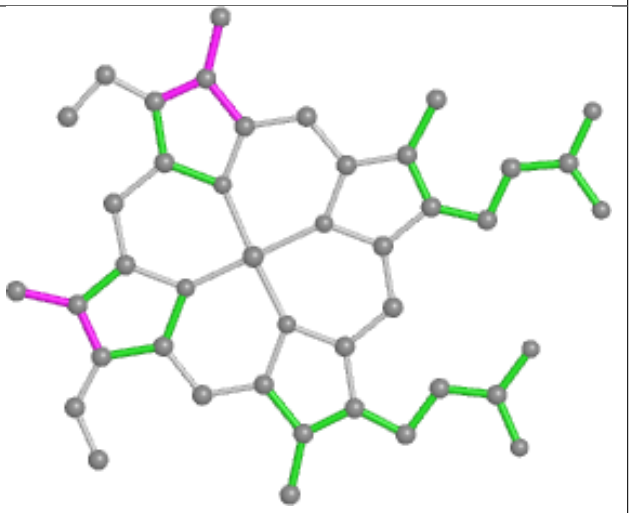
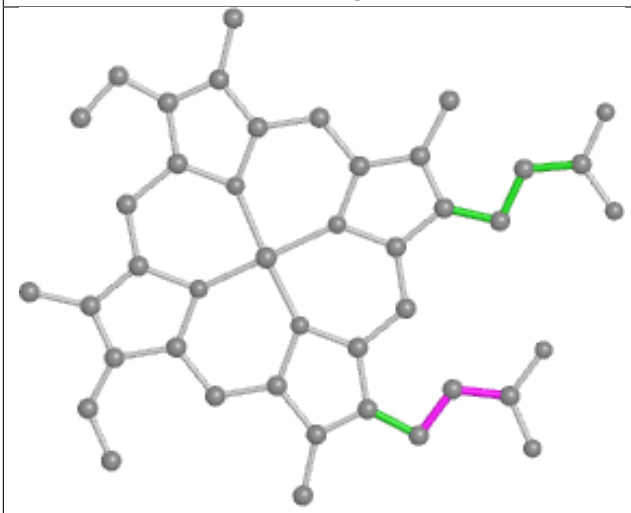


Bond angles



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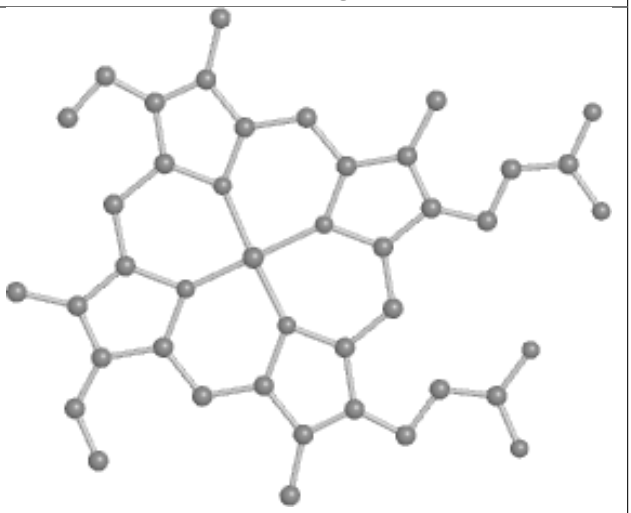
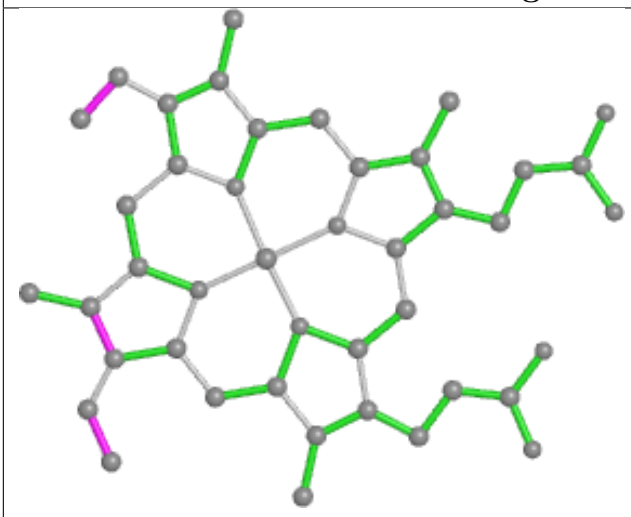
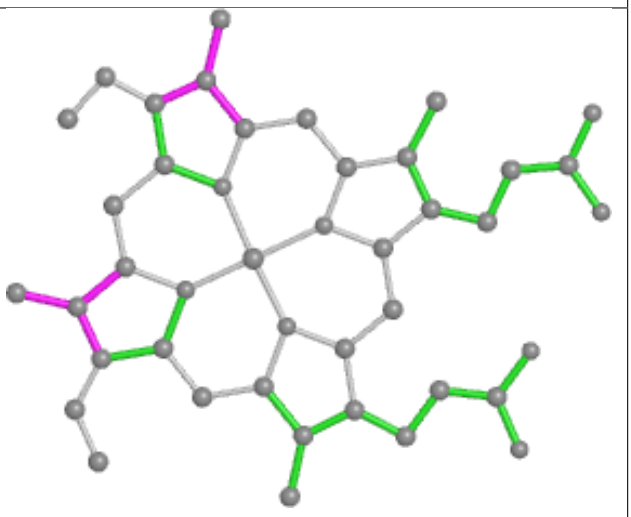


Rings

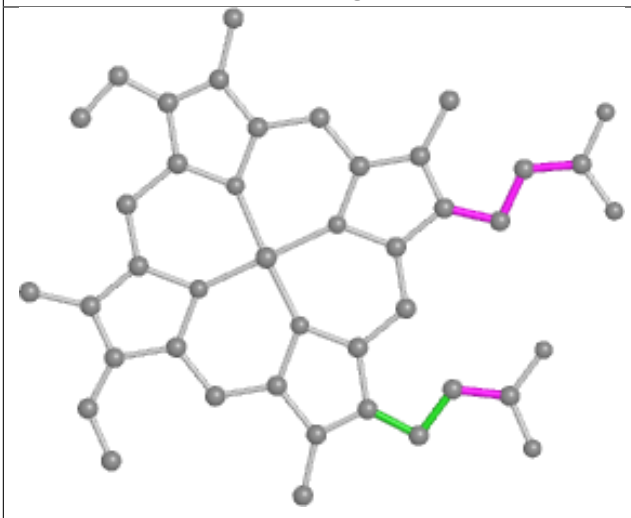
Ligand HEC A 505



Bond lengths



Bond angles



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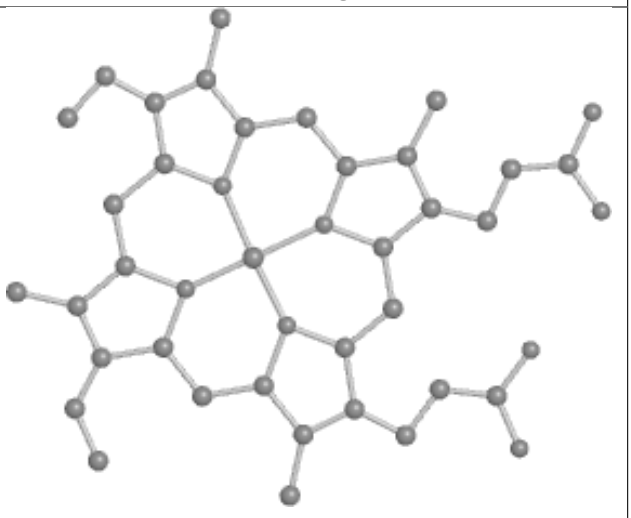


Rings

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, 95^{th} 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	437/492 (88%)	-0.15	9 (2%)	63	70	15, 33, 59, 77	0
1	B	434/492 (88%)	-0.08	14 (3%)	47	55	13, 34, 69, 87	0
1	C	443/492 (90%)	-0.05	11 (2%)	57	64	13, 33, 75, 86	0
1	D	444/492 (90%)	-0.14	13 (2%)	51	59	11, 29, 61, 82	0
All	All	1758/1968 (89%)	-0.10	47 (2%)	54	61	11, 32, 67, 87	0

The worst 5 of 47 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	464	GLN	5.9
1	C	106	TYR	5.7
1	A	106	TYR	5.0
1	D	469	LYS	3.8
1	B	106	TYR	3.7

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

There are no monosaccharides in this entry.

6.4 Ligands

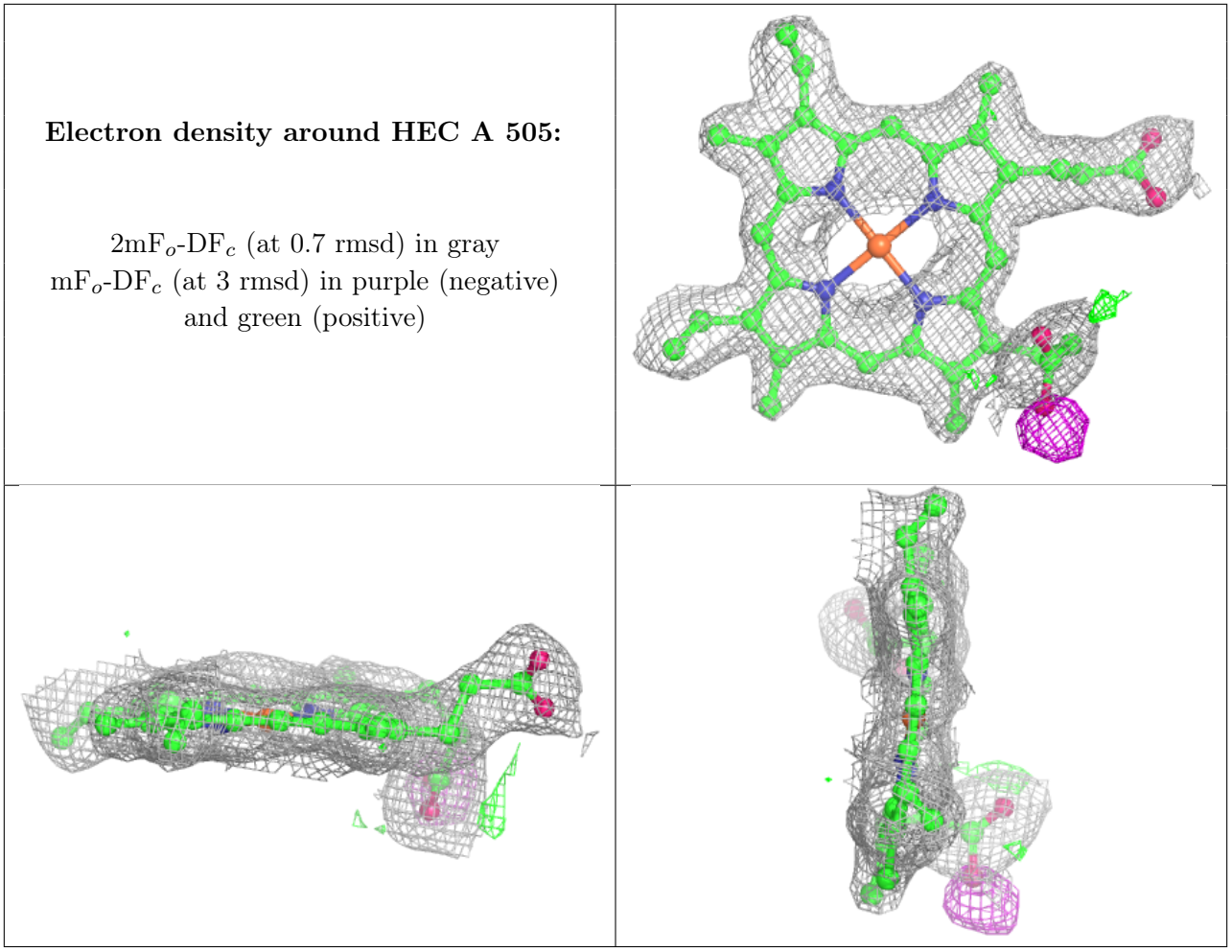
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' 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
3	SO4	B	508	5/5	0.72	0.28	115,115,115,115	0
3	SO4	D	509	5/5	0.81	0.27	98,98,98,98	0
3	SO4	A	507	5/5	0.83	0.15	98,98,98,98	0
3	SO4	B	509	5/5	0.84	0.20	111,111,111,111	0
3	SO4	A	508	5/5	0.84	0.18	113,113,113,113	0
3	SO4	D	507	5/5	0.86	0.14	98,98,98,99	0
3	SO4	C	507	5/5	0.87	0.17	91,92,92,92	0
3	SO4	C	508	5/5	0.88	0.19	79,80,80,80	0
3	SO4	D	508	5/5	0.90	0.17	85,85,85,85	0
3	SO4	B	507	5/5	0.91	0.12	83,83,83,84	0
2	HEC	A	505	43/43	0.94	0.11	41,45,51,52	0
2	HEC	B	503	43/43	0.95	0.12	45,47,56,56	0
2	HEC	D	505	43/43	0.95	0.10	20,24,34,39	0
3	SO4	A	506	5/5	0.95	0.16	80,80,80,80	0
2	HEC	A	503	43/43	0.95	0.11	26,29,41,42	0
2	HEC	A	501	43/43	0.95	0.11	34,36,43,44	0
3	SO4	B	506	5/5	0.95	0.11	68,68,68,68	0
2	HEC	B	502	43/43	0.95	0.11	27,32,43,45	0
2	HEC	C	501	43/43	0.96	0.11	20,23,35,42	0
2	HEC	C	503	43/43	0.96	0.11	27,33,41,45	0
2	HEC	D	504	43/43	0.96	0.12	17,21,35,38	0
3	SO4	C	506	5/5	0.96	0.10	56,56,56,57	0
2	HEC	B	501	43/43	0.96	0.10	23,28,39,43	0
2	HEC	A	504	43/43	0.96	0.10	27,30,40,44	0
2	HEC	A	502	43/43	0.96	0.10	23,26,36,38	0
2	HEC	B	504	43/43	0.96	0.09	25,30,41,43	0
2	HEC	B	505	43/43	0.96	0.10	34,41,45,48	0
2	HEC	C	502	43/43	0.97	0.11	16,22,39,41	0
2	HEC	C	504	43/43	0.97	0.10	22,29,38,39	0
2	HEC	C	505	43/43	0.97	0.09	30,32,36,39	0
2	HEC	D	502	43/43	0.97	0.10	18,23,36,39	0
2	HEC	D	503	43/43	0.97	0.10	12,17,33,35	0
2	HEC	D	501	43/43	0.98	0.09	21,23,28,32	0
3	SO4	D	506	5/5	0.99	0.11	42,42,42,42	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.

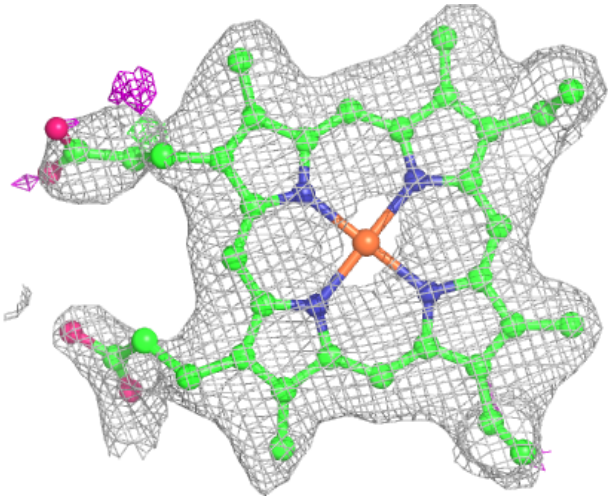
Electron density around HEC A 505:

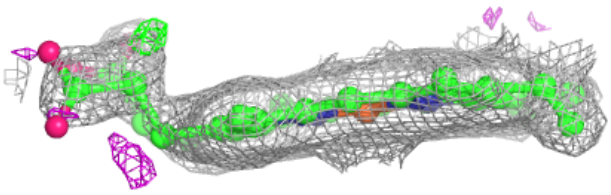
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

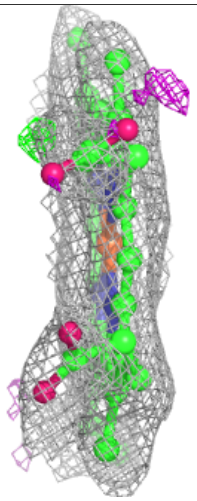


Electron density around HEC B 503:

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

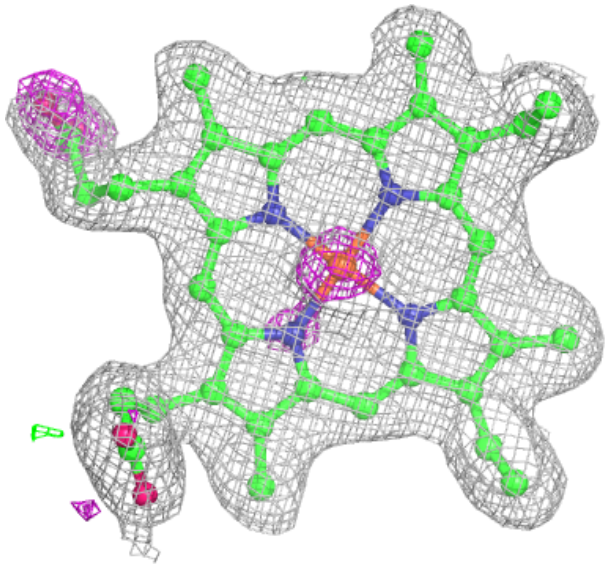


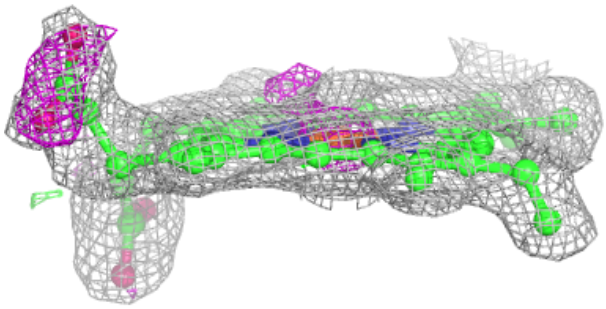


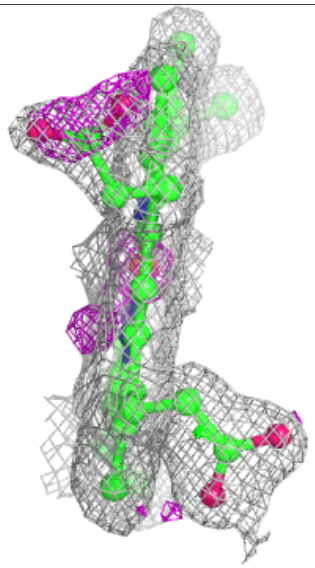


Electron density around HEC D 505:

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

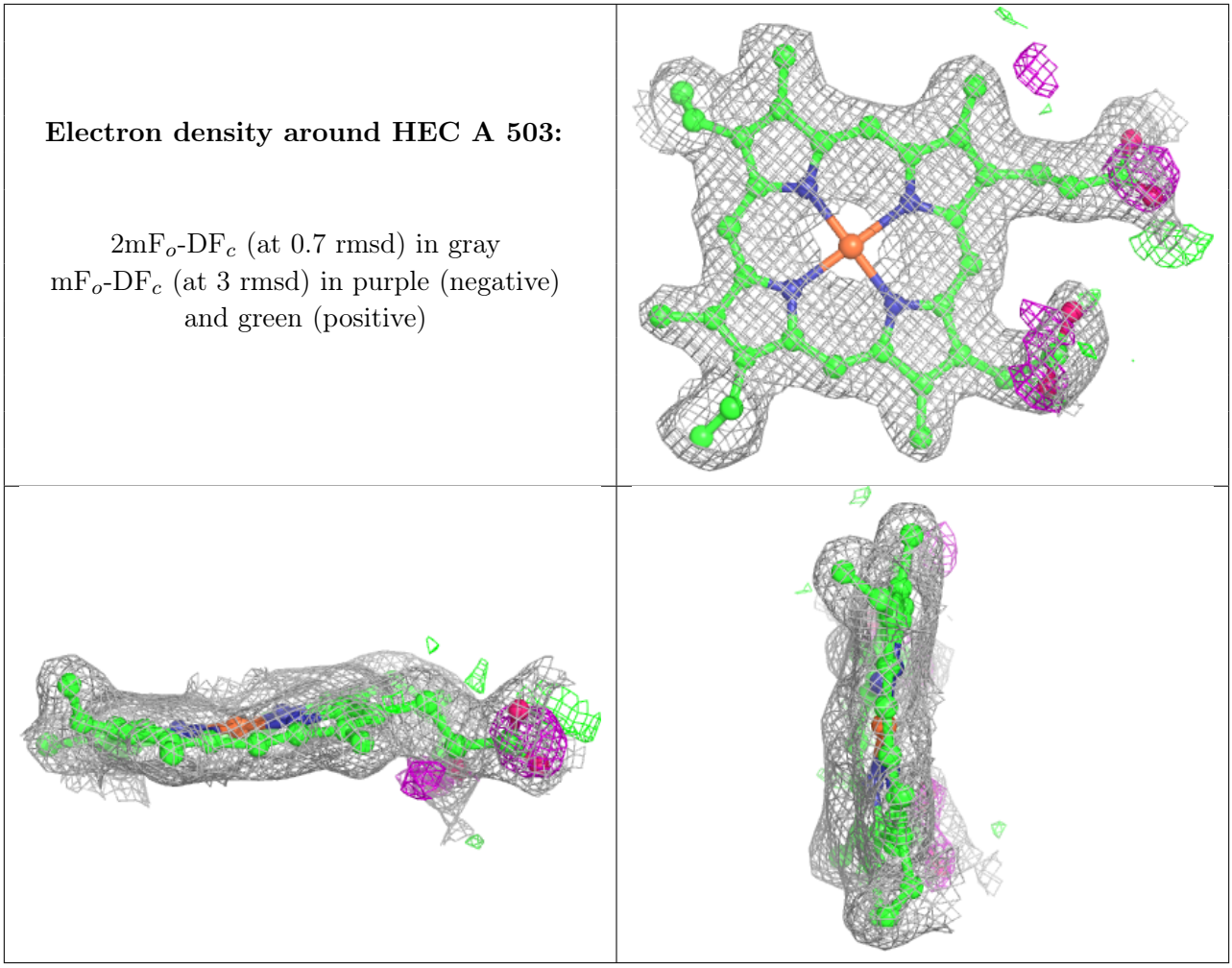






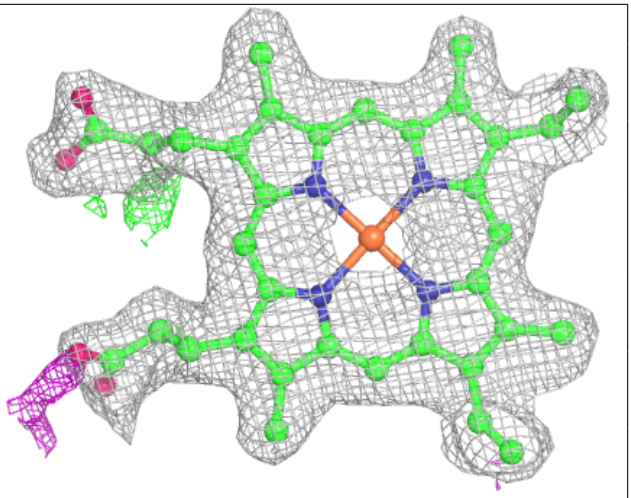
Electron density around HEC A 503:

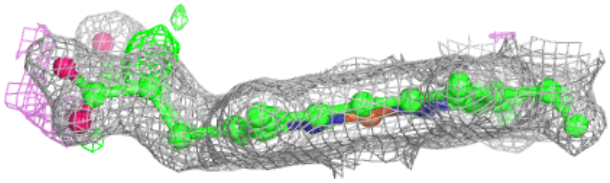
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

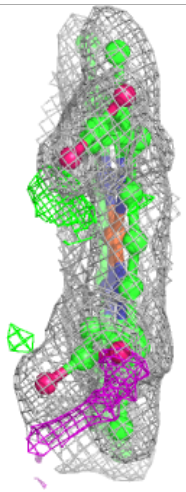


Electron density around HEC A 501:

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

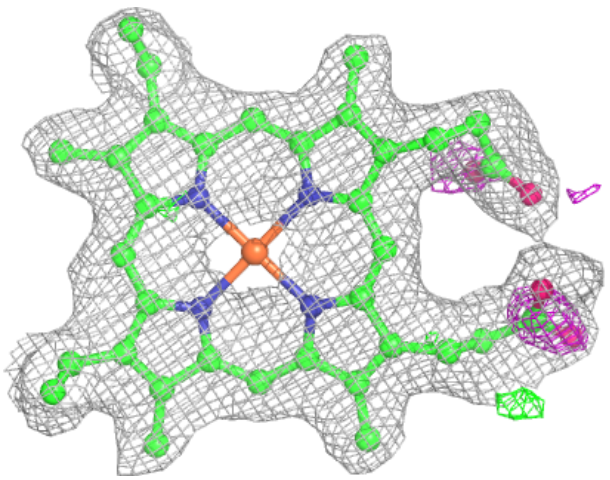


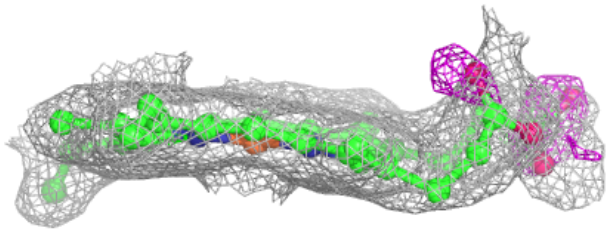


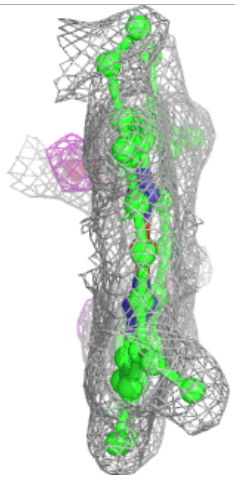


Electron density around HEC B 502:

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

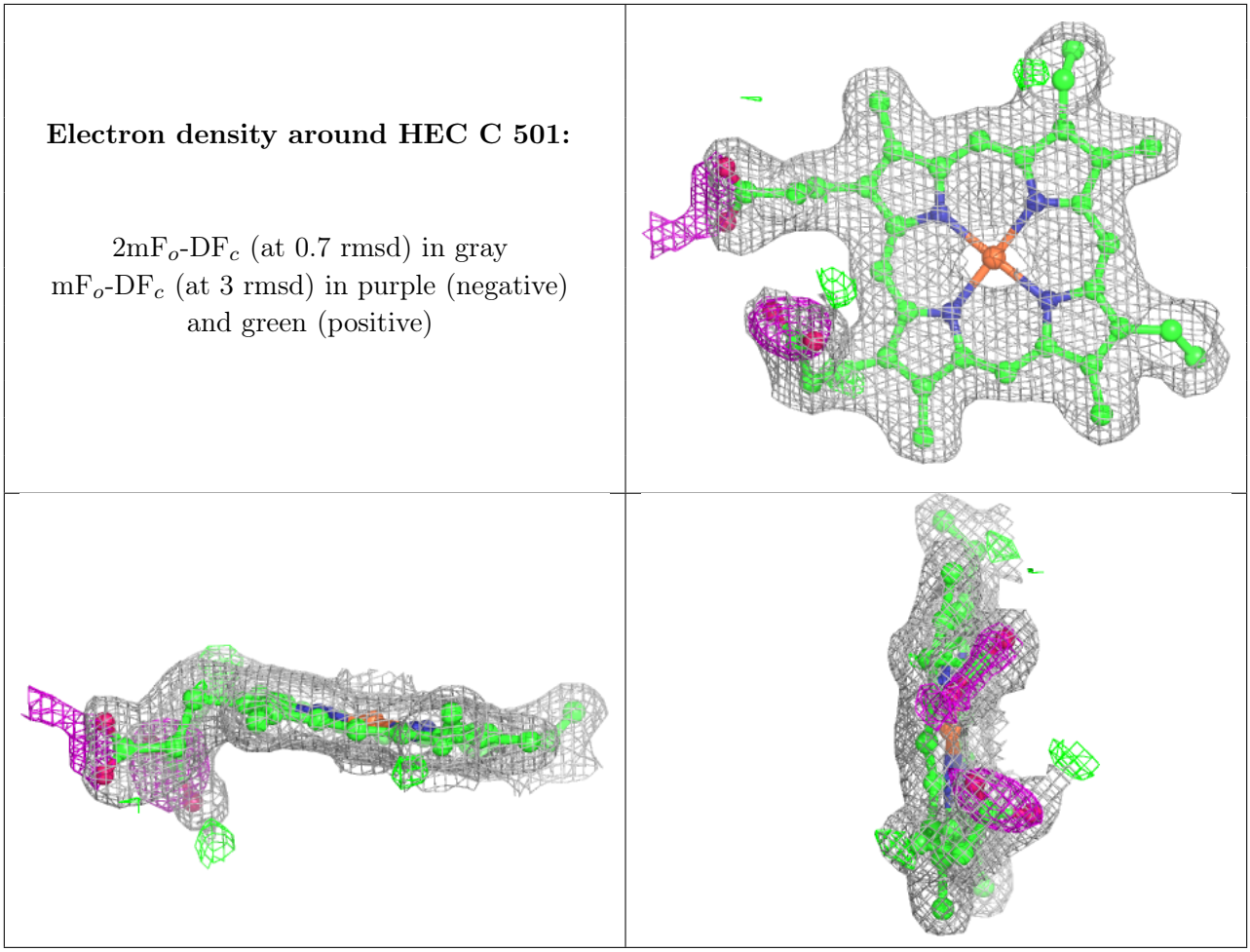






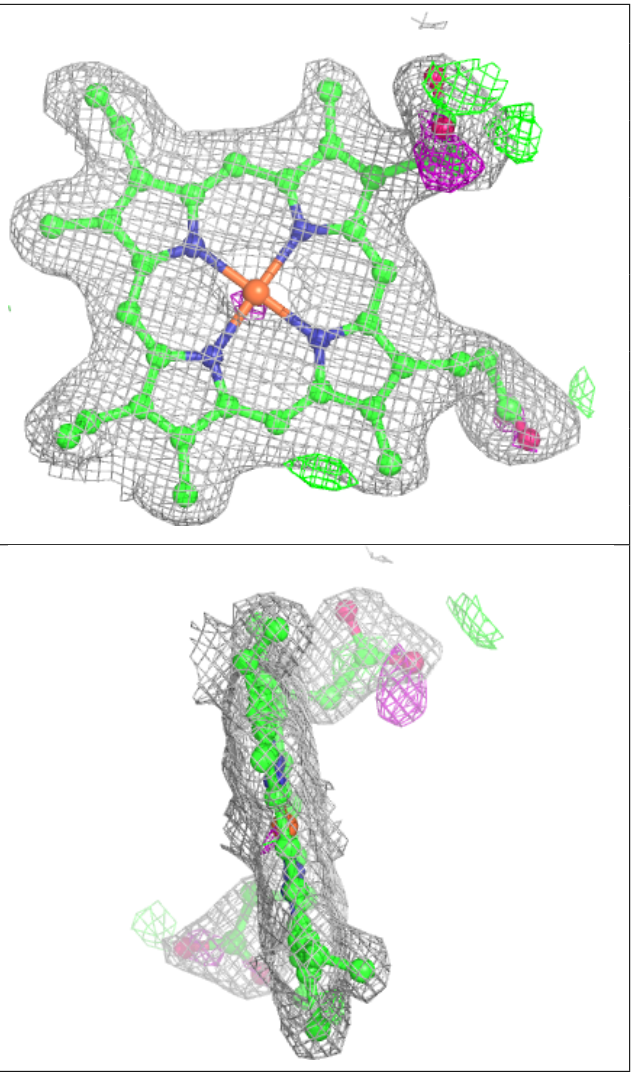
Electron density around HEC C 501:

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



Electron density around HEC C 503:

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



Electron density around HEC D 504:

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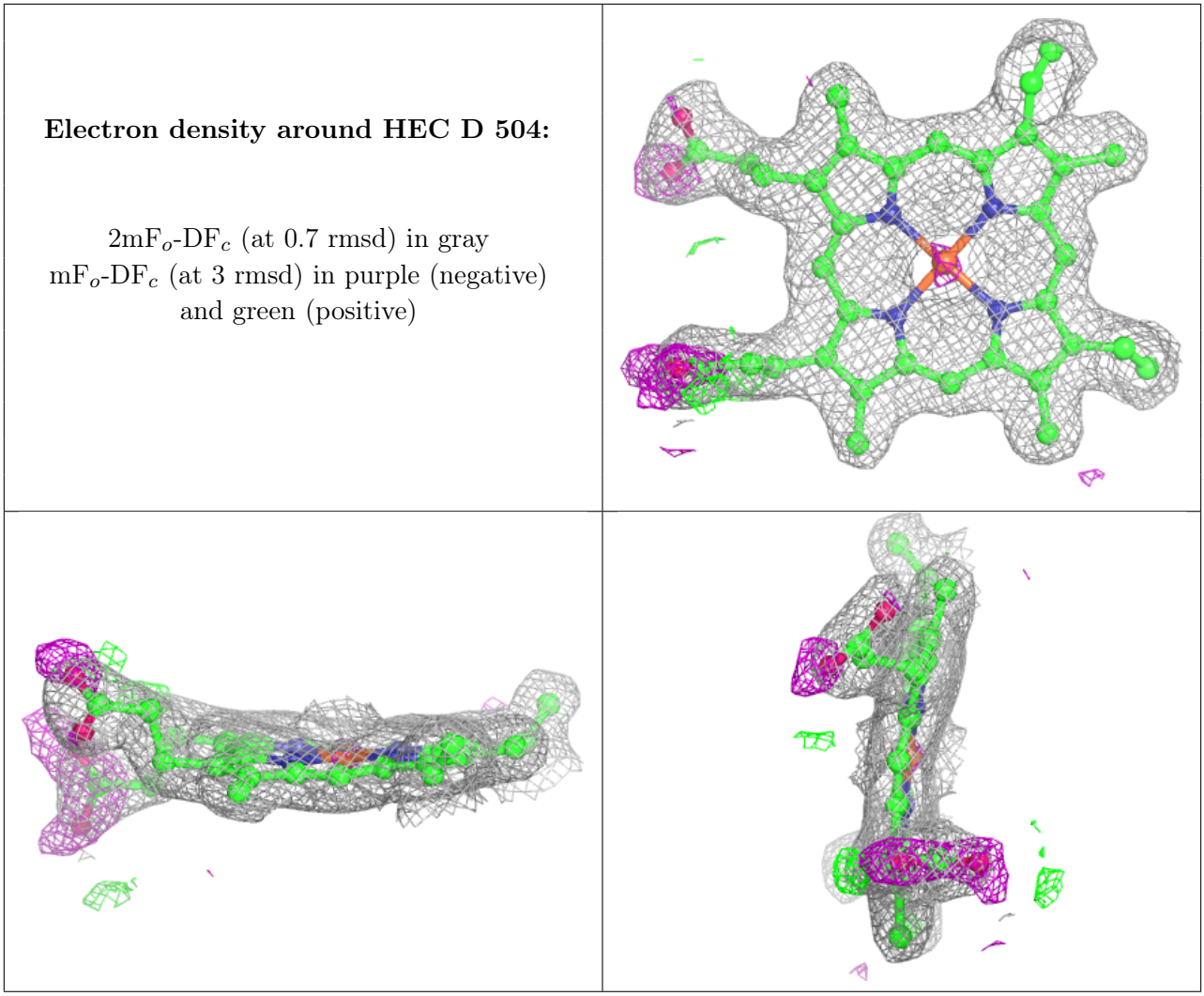
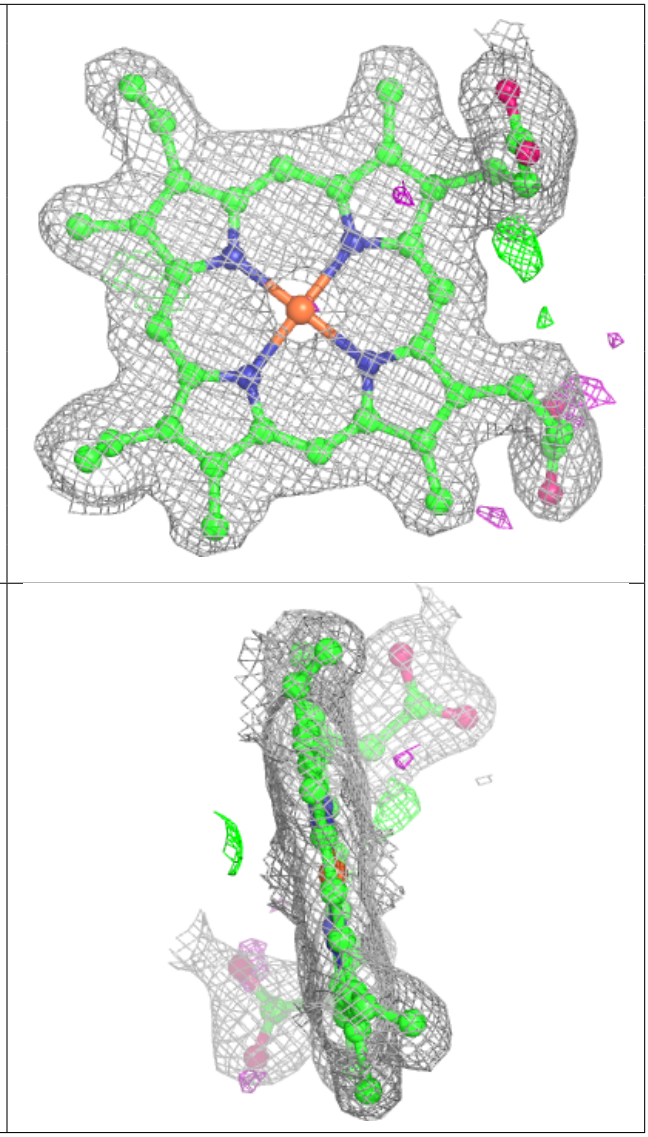
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)



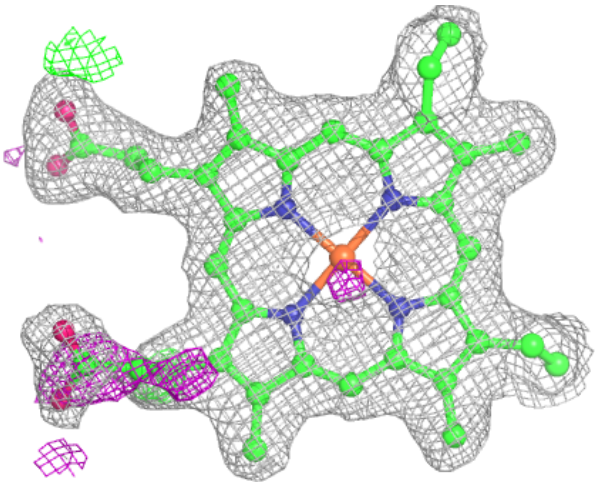
Electron density around HEC B 501:

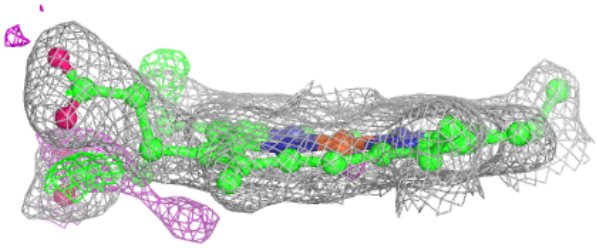
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

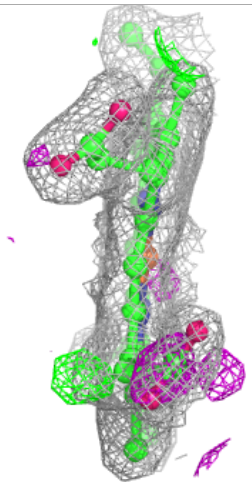


Electron density around HEC A 504:

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

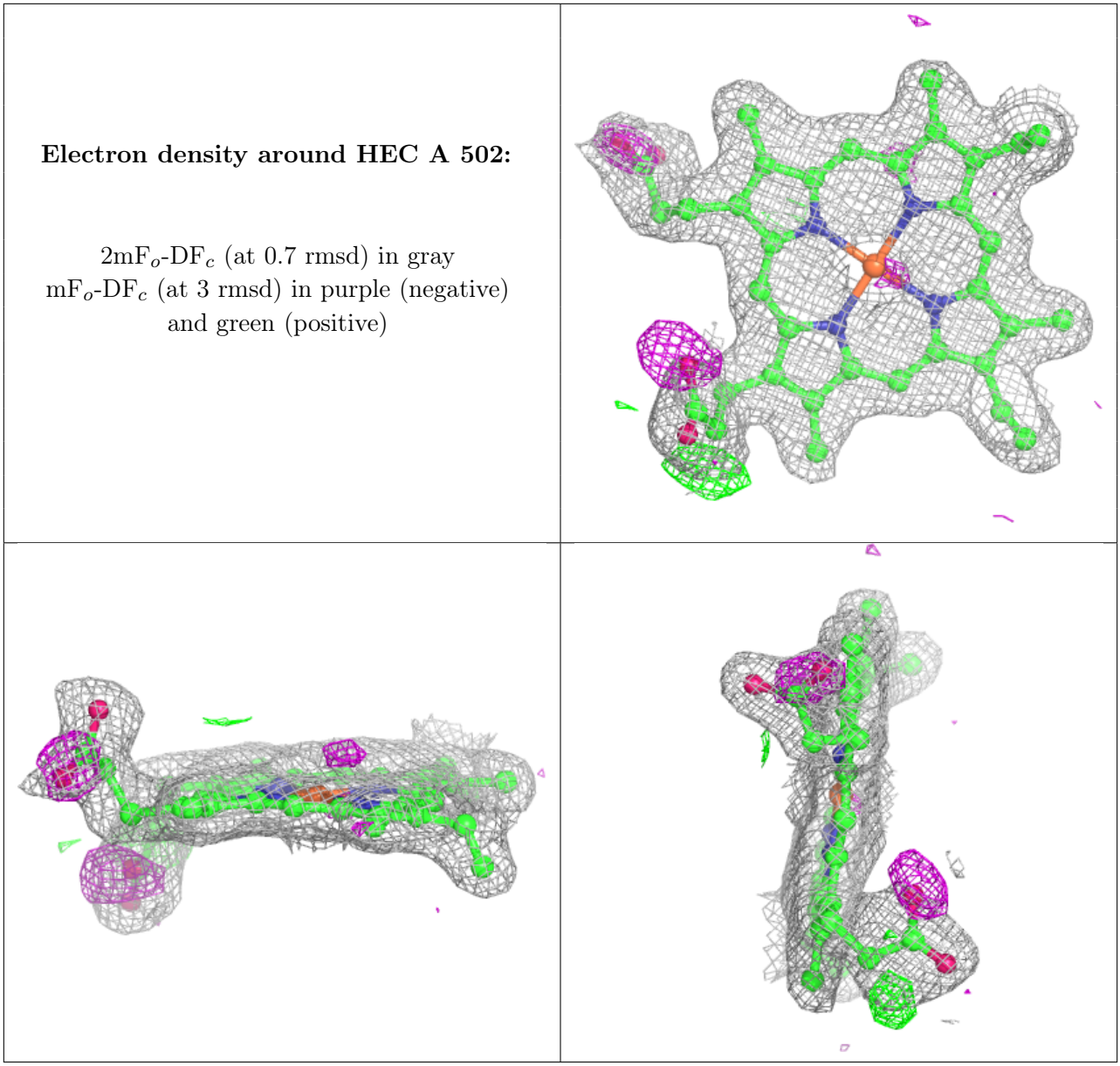






Electron density around HEC A 502:

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



Electron density around HEC B 504:

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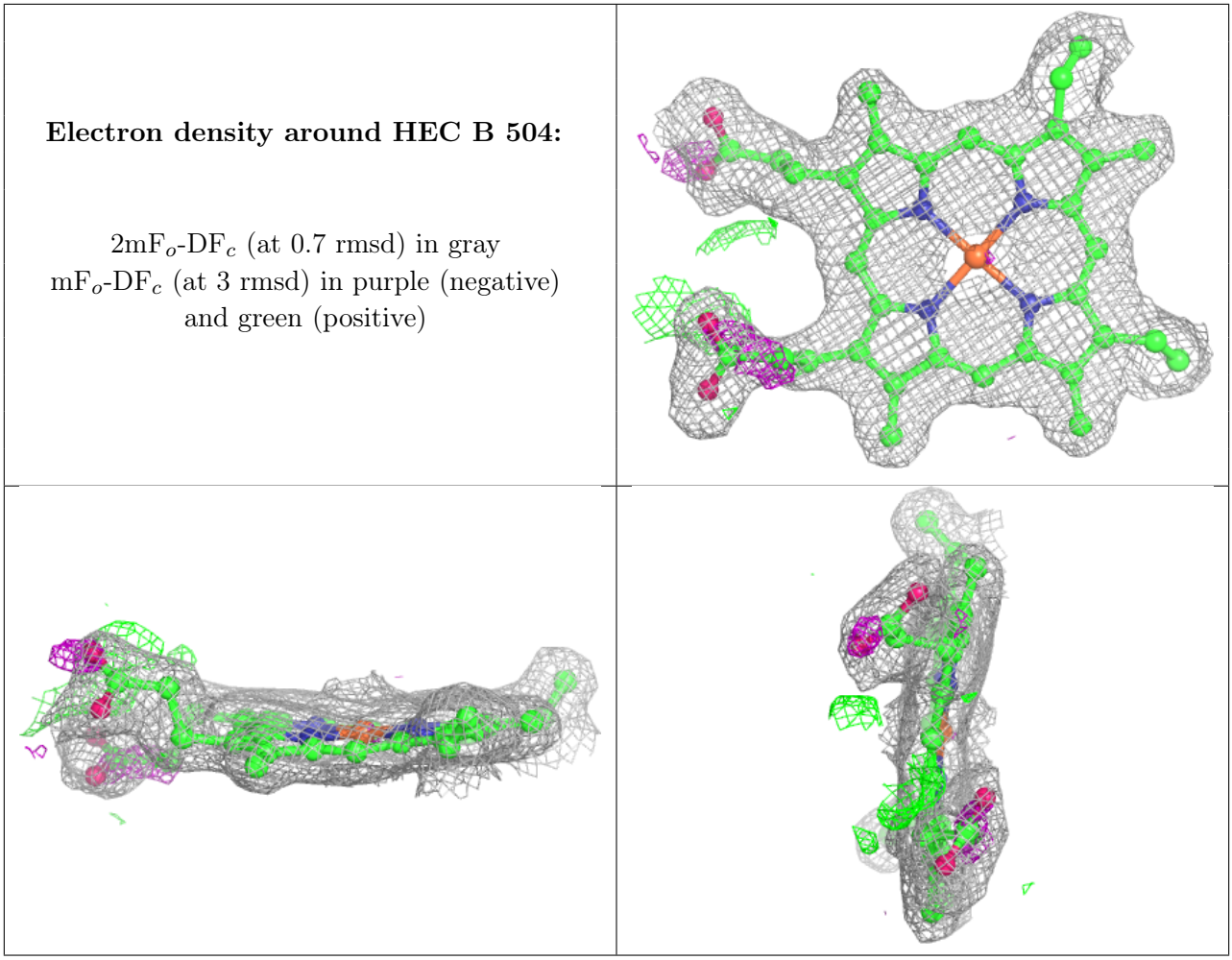
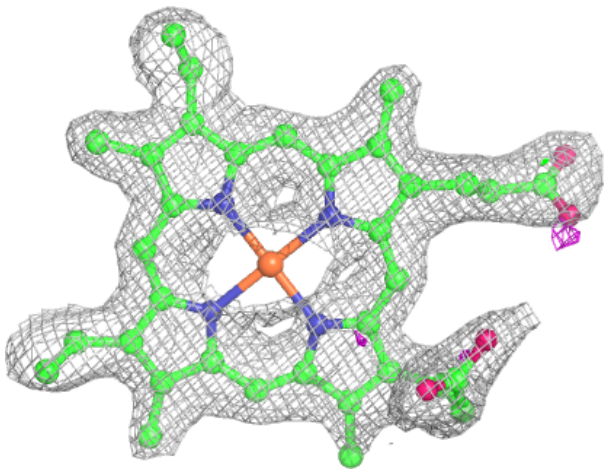
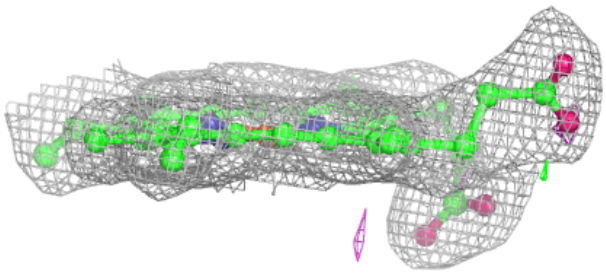
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

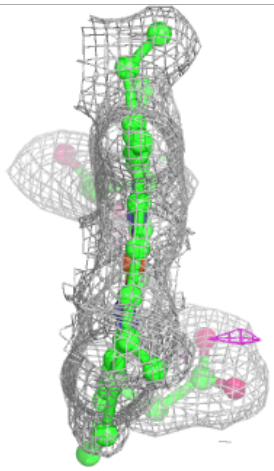


Electron density around HEC B 505:

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

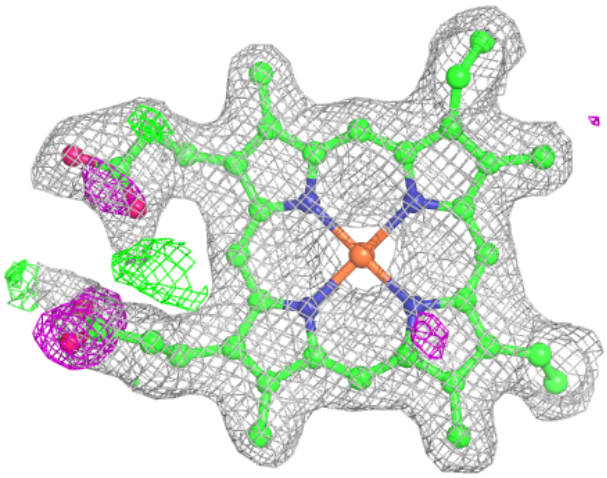


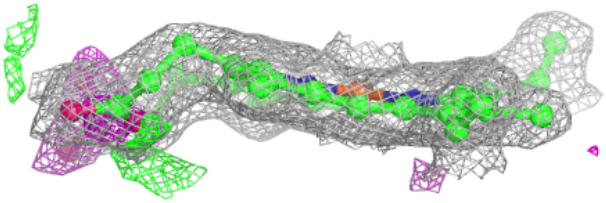


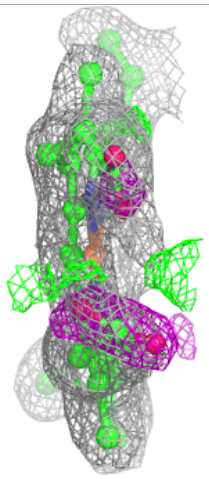


Electron density around HEC C 502:

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

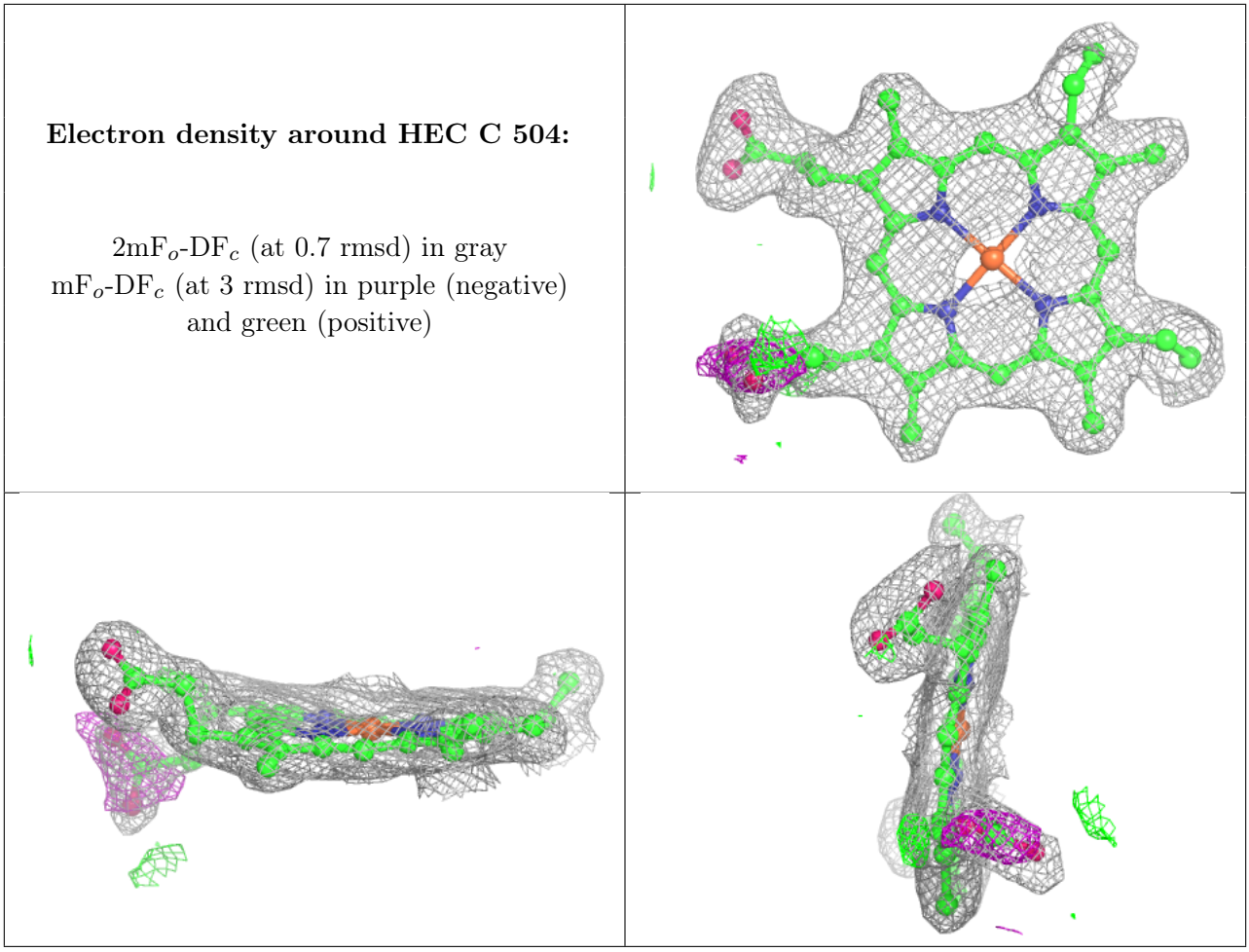






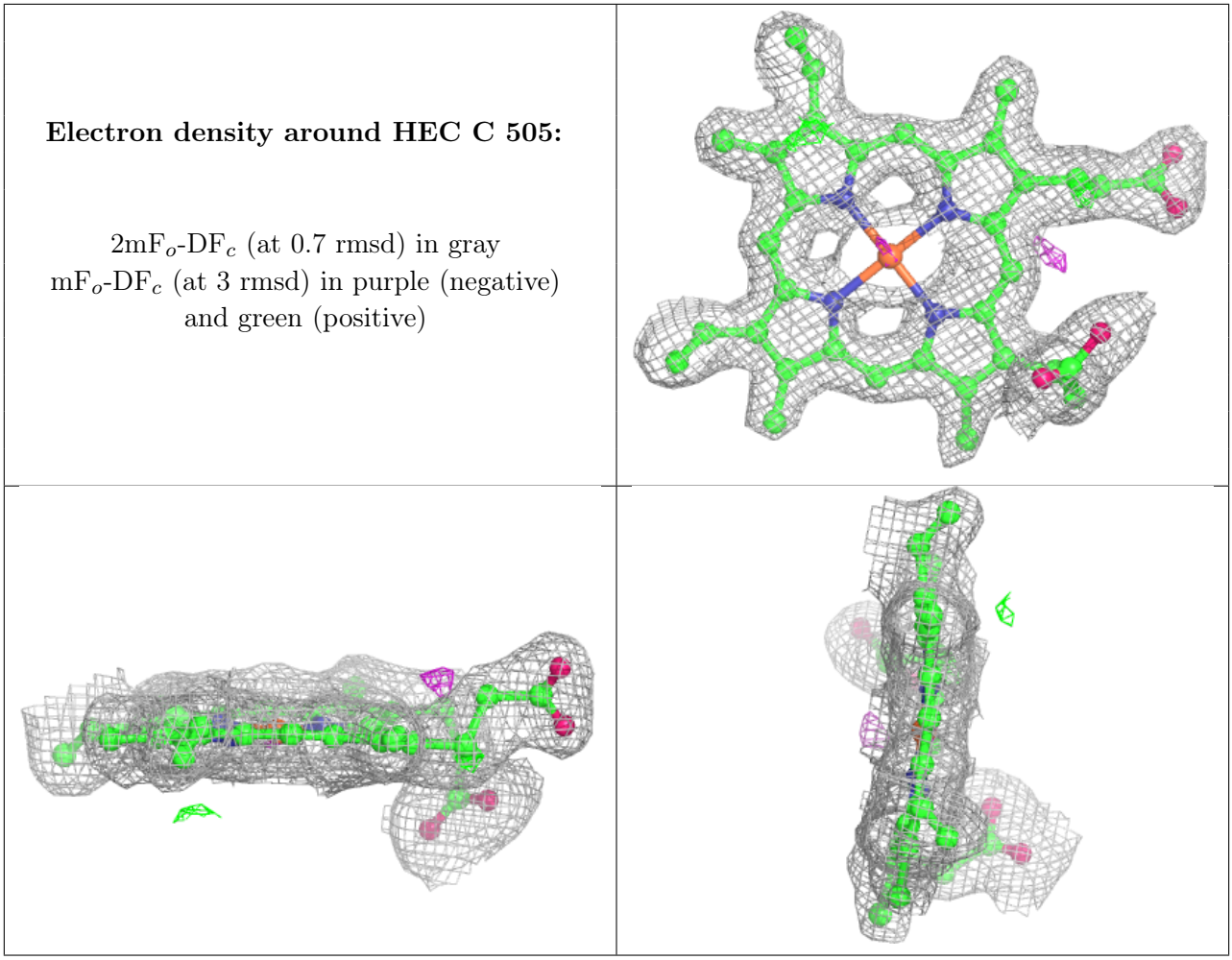
Electron density around HEC C 504:

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



Electron density around HEC C 505:

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



Electron density around HEC D 502:

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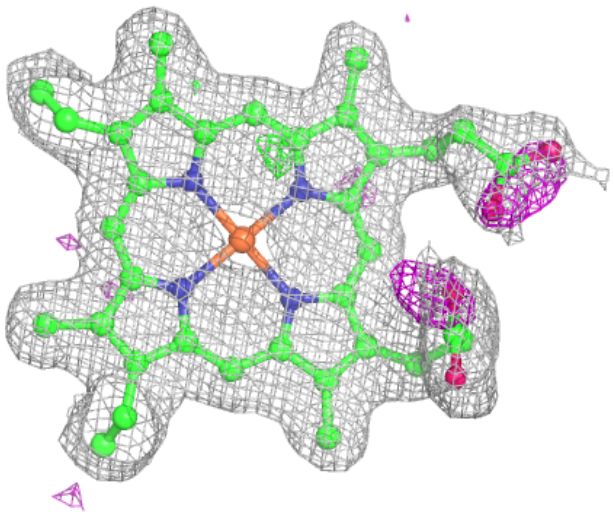
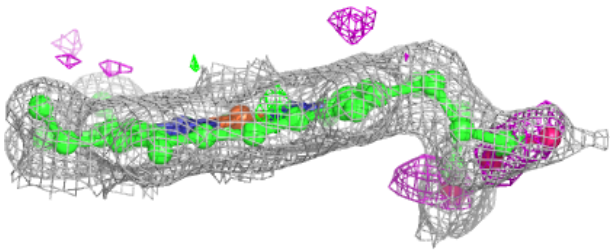
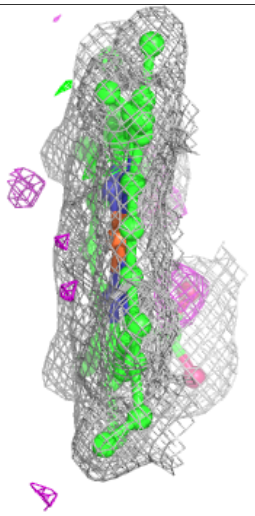
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

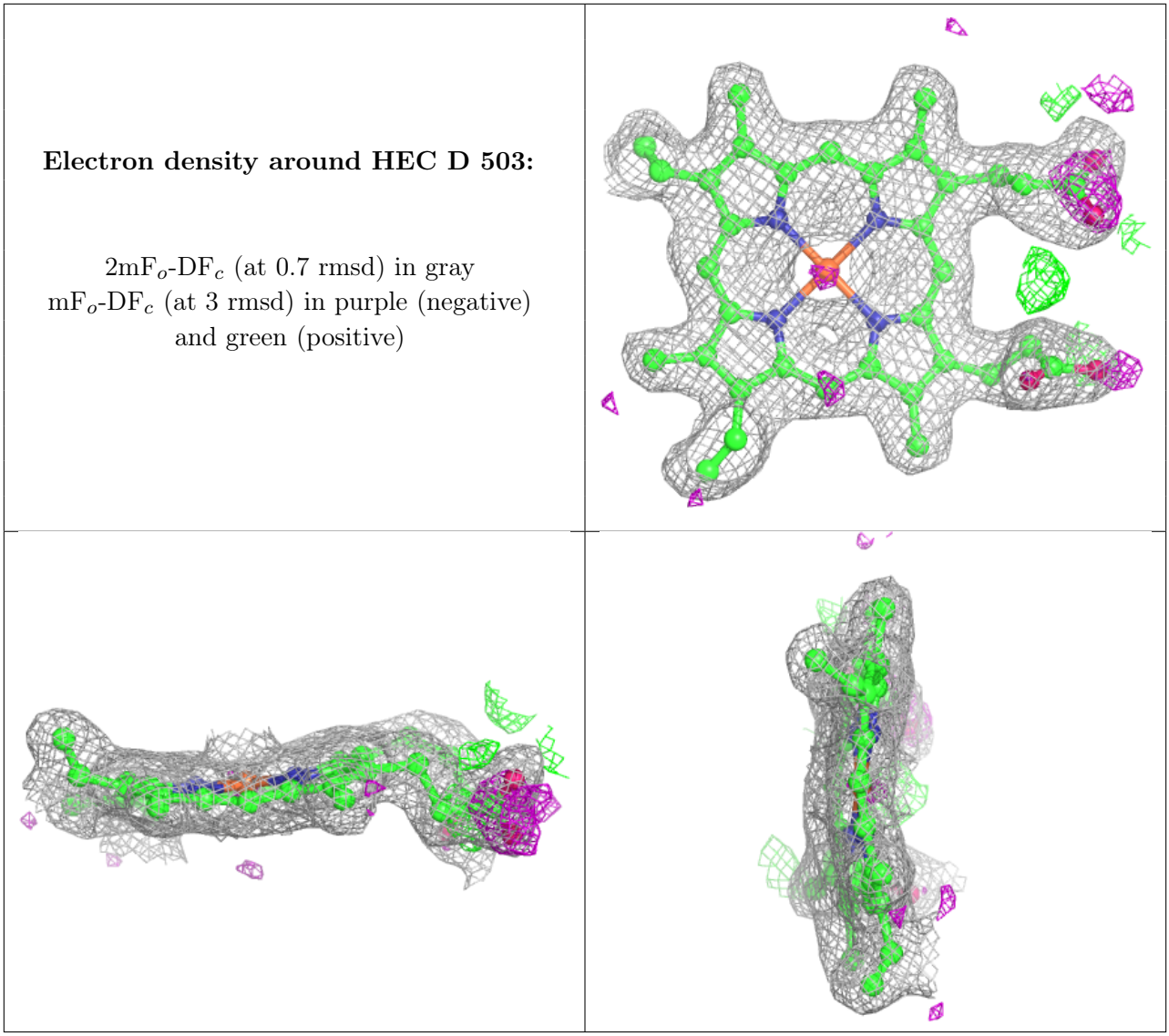






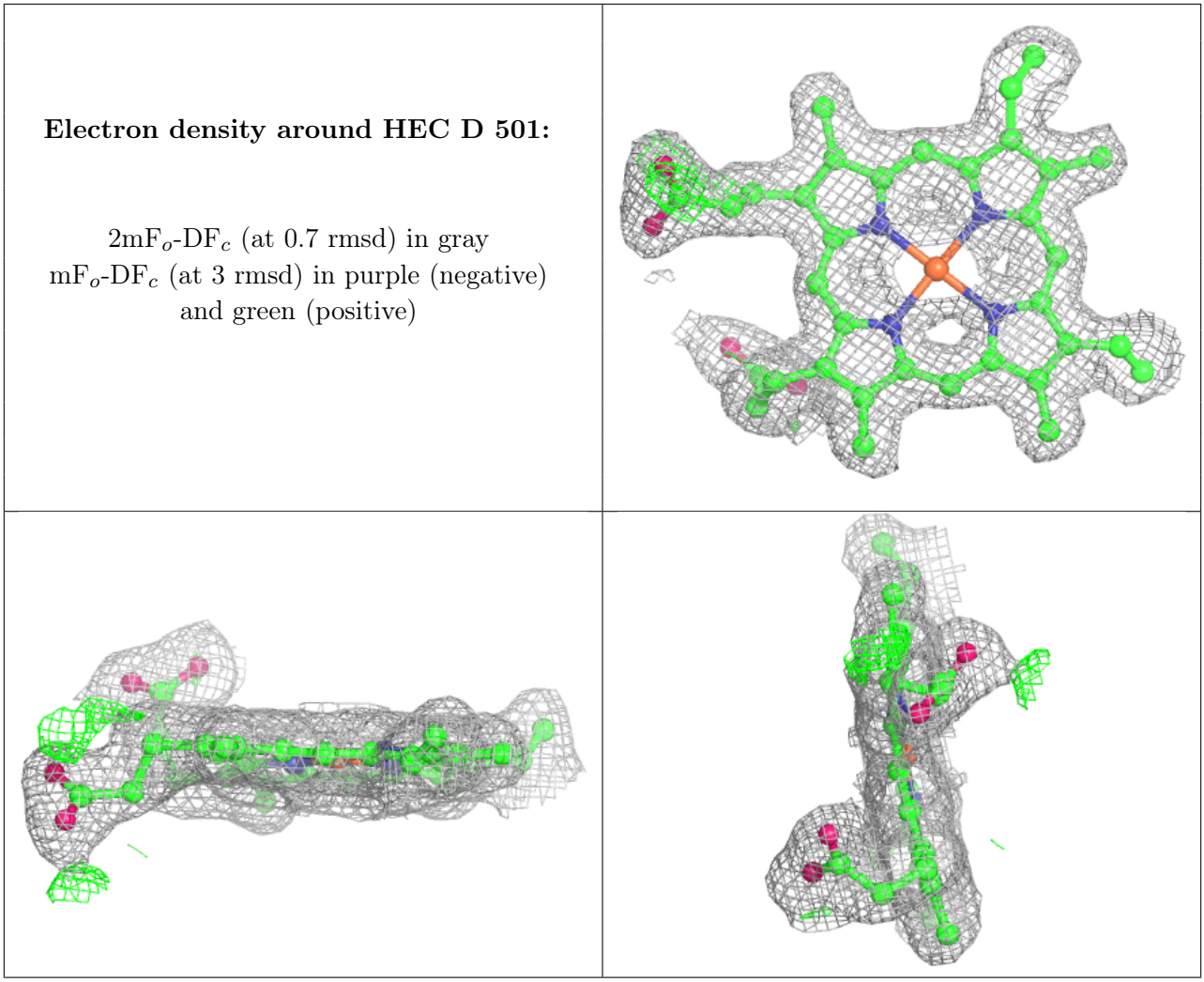
Electron density around HEC D 503:

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



Electron density around HEC 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)



6.5 Other polymers

There are no such residues in this entry.