



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 26, 2026 – 04:14 PM EDT

PDB ID : 8QBQ / pdb_00008qbq
Title : Crystal structure of the outer membrane decaheme cytochrome MtrC (A430Boc-Lys)
Authors : Nash, B.W.; Lockwood, C.J.; Whiting, K.; Butt, J.N.; Clarke, T.A.; Edwards, M.J.
Deposited on : 2023-08-25
Resolution : 1.81 Å(reported)

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

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

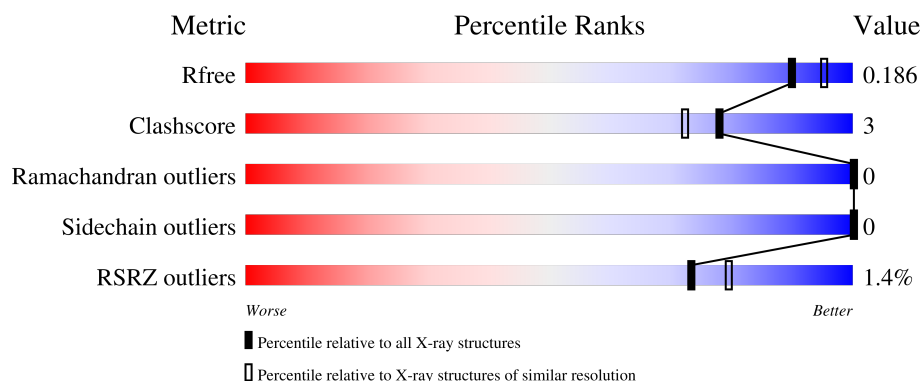
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

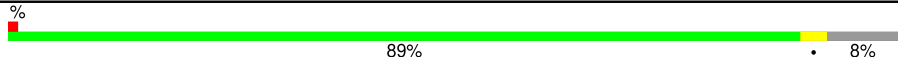
The reported resolution of this entry is 1.81 Å.

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	1112 (1.82-1.82)
Clashscore	190562	1148 (1.82-1.82)
Ramachandran outliers	187476	1140 (1.82-1.82)
Sidechain outliers	187428	1140 (1.82-1.82)
RSRZ outliers	180081	1112 (1.82-1.82)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	679	

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
3	ACT	A	709	-	-	X	-

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 6191 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 Extracellular iron oxide respiratory system surface decaheme cytochrome c component MtrC.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	627	Total	C	N	O	S	0	3	0
			4722	2924	812	954	32			

There are 34 discrepancies between the modelled and reference sequences:

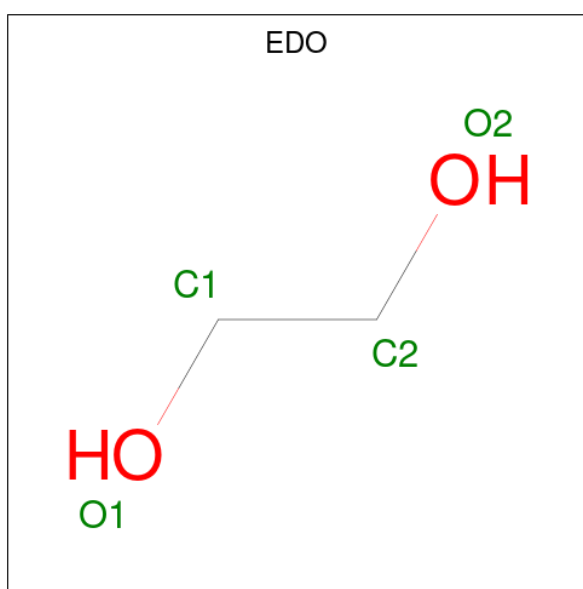
Chain	Residue	Modelled	Actual	Comment	Reference
A	3	MET	-	initiating methionine	UNP Q8EG34
A	4	LYS	-	expression tag	UNP Q8EG34
A	5	PHE	-	expression tag	UNP Q8EG34
A	6	LYS	-	expression tag	UNP Q8EG34
A	7	LEU	-	expression tag	UNP Q8EG34
A	8	ASN	-	expression tag	UNP Q8EG34
A	9	LEU	-	expression tag	UNP Q8EG34
A	10	ILE	-	expression tag	UNP Q8EG34
A	11	THR	-	expression tag	UNP Q8EG34
A	12	LEU	-	expression tag	UNP Q8EG34
A	13	ALA	-	expression tag	UNP Q8EG34
A	14	LEU	-	expression tag	UNP Q8EG34
A	15	LEU	-	expression tag	UNP Q8EG34
A	16	ALA	-	expression tag	UNP Q8EG34
A	17	ASN	-	expression tag	UNP Q8EG34
A	18	THR	-	expression tag	UNP Q8EG34
A	19	GLY	-	expression tag	UNP Q8EG34
A	20	LEU	-	expression tag	UNP Q8EG34
A	21	ALA	-	expression tag	UNP Q8EG34
A	22	VAL	-	expression tag	UNP Q8EG34
A	23	ALA	-	expression tag	UNP Q8EG34
A	24	ALA	-	expression tag	UNP Q8EG34
A	25	ASP	-	expression tag	UNP Q8EG34
A	430	LBV	ALA	engineered mutation	UNP Q8EG34
A	672	SER	-	expression tag	UNP Q8EG34
A	673	ALA	-	expression tag	UNP Q8EG34

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Chain	Residue	Modelled	Actual	Comment	Reference
A	674	TRP	-	expression tag	UNP Q8EG34
A	675	SER	-	expression tag	UNP Q8EG34
A	676	HIS	-	expression tag	UNP Q8EG34
A	677	PRO	-	expression tag	UNP Q8EG34
A	678	GLN	-	expression tag	UNP Q8EG34
A	679	PHE	-	expression tag	UNP Q8EG34
A	680	GLU	-	expression tag	UNP Q8EG34
A	681	LYS	-	expression tag	UNP Q8EG34

- Molecule 2 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



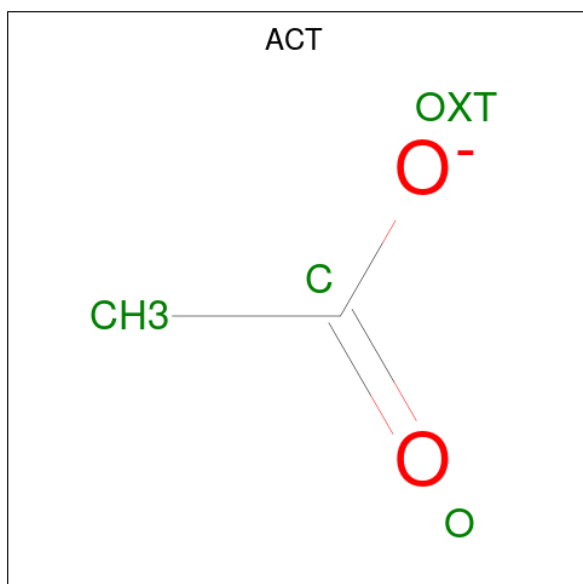
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			4	2	2		
2	A	1	Total	C	O	0	0
			4	2	2		
2	A	1	Total	C	O	0	0
			4	2	2		
2	A	1	Total	C	O	0	0
			4	2	2		
2	A	1	Total	C	O	0	0
			4	2	2		

- Molecule 3 is ACETATE ION (CCD ID: ACT) (formula: $C_2H_3O_2$).



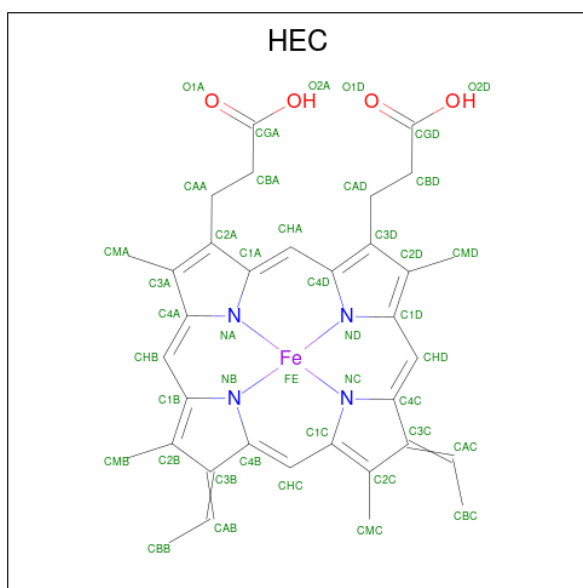
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			4	2	2		

- Molecule 4 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	5	Total	Ca		0	0
			5	5			

- Molecule 5 is HEME C (CCD ID: HEC) (formula: $C_{34}H_{34}FeN_4O_4$) (labeled as "Ligand of

Interest" by depositor).



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

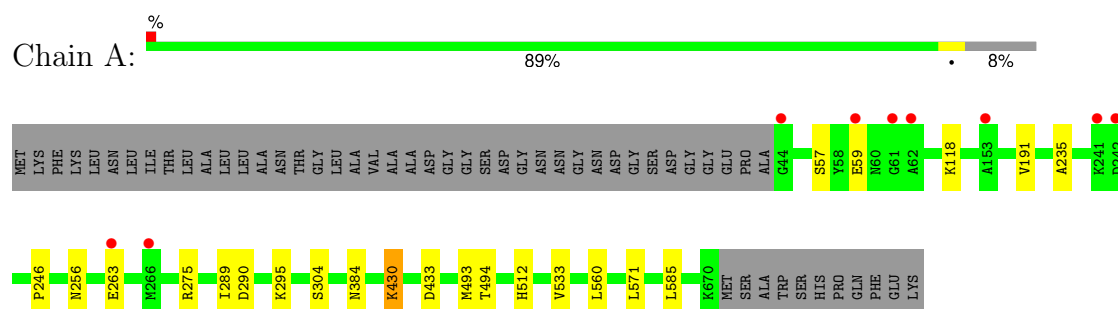
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	978	Total	O		
			978	978	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 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: Extracellular iron oxide respiratory system surface decaheme cytochrome c component MtrC



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	52.90Å 89.61Å 154.03Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	44.80 – 1.81 44.80 – 1.81	Depositor EDS
% Data completeness (in resolution range)	99.9 (44.80-1.81) 99.9 (44.80-1.81)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.79 (at 1.81Å)	Xtriage
Refinement program	PHENIX (1.20.1_4487: ???)	Depositor
R, R_{free}	0.155 , 0.187 0.154 , 0.186	Depositor DCC
R_{free} test set	3389 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	18.1	Xtriage
Anisotropy	0.284	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 42.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	6191	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.85% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

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

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: LBY, ACT, EDO, HEC, CA

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	0.32	0/4803	0.55	0/6521

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	4722	0	4536	24	0
2	A	52	0	78	4	0
3	A	4	0	3	2	0
4	A	5	0	0	0	0
5	A	430	0	300	8	0
6	A	978	0	0	8	0
All	All	6191	0	4917	28	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 3.

All (28) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:118:LYS:NZ	6:A:801:HOH:O	1.93	1.00
1:A:263:GLU:OE2	6:A:802:HOH:O	2.05	0.74
1:A:493:MET:SD	6:A:1589:HOH:O	2.48	0.71
1:A:289:ILE:HD11	5:A:724:HEC:HBA1	1.75	0.68
1:A:57:SER:OG	1:A:59:GLU:HG2	1.94	0.67
5:A:720:HEC:O2A	6:A:803:HOH:O	2.15	0.64
1:A:430:LBY:HG2	6:A:1300:HOH:O	1.99	0.62
1:A:585:LEU:HB2	2:A:712:EDO:H11	1.82	0.61
1:A:430:LBY:H31	1:A:433:ASP:HB2	1.86	0.57
1:A:512:HIS:CE1	5:A:726:HEC:HBC2	2.40	0.56
1:A:430:LBY:H31	1:A:433:ASP:CB	2.35	0.56
5:A:721:HEC:HMC1	5:A:721:HEC:HBC3	1.88	0.56
1:A:384:ASN:HD22	2:A:713:EDO:H21	1.70	0.55
2:A:706:EDO:H22	5:A:727:HEC:HHC	1.87	0.55
1:A:275:ARG:NH1	6:A:805:HOH:O	2.16	0.52
1:A:560:LEU:HD11	5:A:725:HEC:HMB2	1.92	0.51
1:A:430:LBY:HD3	1:A:430:LBY:H11	1.94	0.50
1:A:290:ASP:HB3	1:A:295:LYS:HG2	1.96	0.47
1:A:256:ASN:HB2	6:A:1486:HOH:O	2.16	0.46
1:A:191:VAL:HG23	1:A:571:LEU:O	2.16	0.46
1:A:533:VAL:HB	3:A:709:ACT:H2	1.98	0.45
1:A:118:LYS:HA	1:A:118:LYS:HD3	1.78	0.44
1:A:275:ARG:HG3	6:A:1308:HOH:O	2.17	0.43
1:A:235:ALA:HA	1:A:246:PRO:HD2	2.01	0.43
1:A:571:LEU:HD11	5:A:720:HEC:HMD3	2.00	0.42
5:A:722:HEC:HBB2	5:A:723:HEC:HBC2	2.02	0.41
1:A:494:THR:N	3:A:709:ACT:H1	2.37	0.40
1:A:304:SER:HB2	2:A:705:EDO:H12	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	627/679 (92%)	612 (98%)	15 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	516/550 (94%)	516 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	60	ASN
1	A	258	GLN
1	A	358	ASN
1	A	384	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](#)

1 non-standard protein/DNA/RNA residue is 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
1	LBY	A	430	1	14,15,16	1.46	1 (7%)	14,19,21	1.22	0

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	LBY	A	430	1	-	7/14/15/17	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	430	LBY	O-C	3.32	1.32	1.20

There are no bond angle outliers.

There are no chirality outliers.

All (7) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	430	LBY	O2-CZ-NZ-CE
1	A	430	LBY	O1-CZ-NZ-CE
1	A	430	LBY	CD-CE-NZ-CZ
1	A	430	LBY	CG-CD-CE-NZ
1	A	430	LBY	CE-CD-CG-CB
1	A	430	LBY	NZ-CZ-O2-CT
1	A	430	LBY	N-CA-CB-CG

There are no ring outliers.

1 monomer is involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	430	LBY	4	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 29 ligands modelled in this entry, 5 are monoatomic - leaving 24 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
2	EDO	A	705	-	3,3,3	0.43	0	2,2,2	0.21	0
5	HEC	A	721	1	46,50,50	1.82	5 (10%)	58,82,82	1.80	6 (10%)
2	EDO	A	706	-	3,3,3	0.36	0	2,2,2	0.48	0
2	EDO	A	708	-	3,3,3	0.42	0	2,2,2	0.63	0
2	EDO	A	703	-	3,3,3	0.51	0	2,2,2	0.33	0
2	EDO	A	704	-	3,3,3	0.49	0	2,2,2	0.38	0
2	EDO	A	707	-	3,3,3	0.50	0	2,2,2	0.21	0
5	HEC	A	726	1	46,50,50	1.85	3 (6%)	58,82,82	1.73	6 (10%)
5	HEC	A	728	1	46,50,50	1.89	6 (13%)	58,82,82	1.87	8 (13%)
2	EDO	A	711	-	3,3,3	0.42	0	2,2,2	0.41	0
3	ACT	A	709	-	3,3,3	1.26	0	3,3,3	1.77	1 (33%)
5	HEC	A	723	1	46,50,50	1.82	5 (10%)	58,82,82	1.79	5 (8%)
2	EDO	A	702	-	3,3,3	0.42	0	2,2,2	1.01	0
2	EDO	A	713	-	3,3,3	0.63	0	2,2,2	0.31	0
5	HEC	A	720	1	46,50,50	1.86	6 (13%)	58,82,82	1.71	5 (8%)
2	EDO	A	714	-	3,3,3	0.49	0	2,2,2	0.05	0
5	HEC	A	729	1	46,50,50	1.90	5 (10%)	58,82,82	1.86	9 (15%)
5	HEC	A	722	1	46,50,50	1.84	5 (10%)	58,82,82	1.60	5 (8%)
5	HEC	A	727	1	46,50,50	1.85	5 (10%)	58,82,82	1.71	6 (10%)
2	EDO	A	701	-	3,3,3	0.48	0	2,2,2	0.33	0
2	EDO	A	710	-	3,3,3	0.49	0	2,2,2	0.27	0
5	HEC	A	725	1	46,50,50	1.85	8 (17%)	58,82,82	1.72	5 (8%)
2	EDO	A	712	-	3,3,3	0.37	0	2,2,2	0.47	0
5	HEC	A	724	1	46,50,50	1.89	6 (13%)	58,82,82	1.77	4 (6%)

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	EDO	A	705	-	-	0/1/1/1	-
5	HEC	A	721	1	-	6/14/54/54	-
2	EDO	A	706	-	-	1/1/1/1	-
2	EDO	A	708	-	-	0/1/1/1	-
2	EDO	A	703	-	-	0/1/1/1	-
2	EDO	A	704	-	-	0/1/1/1	-
2	EDO	A	707	-	-	0/1/1/1	-
5	HEC	A	726	1	-	8/14/54/54	-
5	HEC	A	728	1	-	7/14/54/54	-
2	EDO	A	711	-	-	0/1/1/1	-
5	HEC	A	723	1	-	7/14/54/54	-
2	EDO	A	702	-	-	0/1/1/1	-
2	EDO	A	713	-	-	1/1/1/1	-
5	HEC	A	720	1	-	6/14/54/54	-
2	EDO	A	714	-	-	1/1/1/1	-
5	HEC	A	729	1	-	4/14/54/54	-
5	HEC	A	722	1	-	4/14/54/54	-
5	HEC	A	727	1	-	7/14/54/54	-
2	EDO	A	701	-	-	0/1/1/1	-
2	EDO	A	710	-	-	0/1/1/1	-
5	HEC	A	725	1	-	6/14/54/54	-
2	EDO	A	712	-	-	1/1/1/1	-
5	HEC	A	724	1	-	4/14/54/54	-

All (54) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	728	HEC	CAC-C3C	6.77	1.57	1.35
5	A	724	HEC	CAC-C3C	6.75	1.56	1.35
5	A	726	HEC	CAC-C3C	6.66	1.56	1.35
5	A	725	HEC	CAC-C3C	6.66	1.56	1.35
5	A	727	HEC	CAB-C3B	6.65	1.56	1.35
5	A	727	HEC	CAC-C3C	6.64	1.56	1.35
5	A	720	HEC	CAC-C3C	6.64	1.56	1.35
5	A	729	HEC	CAB-C3B	6.57	1.56	1.35
5	A	723	HEC	CAC-C3C	6.54	1.56	1.35
5	A	729	HEC	CAC-C3C	6.54	1.56	1.35
5	A	721	HEC	CAC-C3C	6.53	1.56	1.35
5	A	722	HEC	CAC-C3C	6.49	1.56	1.35
5	A	728	HEC	CAB-C3B	6.40	1.55	1.35
5	A	720	HEC	CAB-C3B	6.27	1.55	1.35

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	722	HEC	CAB-C3B	6.26	1.55	1.35
5	A	726	HEC	CAB-C3B	6.11	1.54	1.35
5	A	721	HEC	CAB-C3B	5.96	1.54	1.35
5	A	723	HEC	CAB-C3B	5.94	1.54	1.35
5	A	725	HEC	CAB-C3B	5.84	1.54	1.35
5	A	724	HEC	CAB-C3B	5.82	1.53	1.35
5	A	724	HEC	C3D-C2D	5.59	1.53	1.38
5	A	726	HEC	C3D-C2D	5.46	1.53	1.38
5	A	728	HEC	C3D-C2D	5.36	1.52	1.38
5	A	722	HEC	C3D-C2D	5.24	1.52	1.38
5	A	729	HEC	C3D-C2D	5.23	1.52	1.38
5	A	725	HEC	C3D-C2D	5.18	1.52	1.38
5	A	723	HEC	C3D-C2D	5.08	1.52	1.38
5	A	720	HEC	C3D-C2D	4.84	1.51	1.38
5	A	721	HEC	C3D-C2D	4.80	1.51	1.38
5	A	727	HEC	C3D-C2D	4.50	1.50	1.38
5	A	720	HEC	CMA-C3A	2.55	1.56	1.50
5	A	724	HEC	CMC-C2C	2.52	1.55	1.50
5	A	725	HEC	C3B-C2B	-2.47	1.32	1.41
5	A	729	HEC	CMC-C2C	2.45	1.55	1.50
5	A	725	HEC	CMA-C3A	2.45	1.55	1.50
5	A	720	HEC	CMB-C2B	2.41	1.55	1.50
5	A	729	HEC	CMD-C2D	2.39	1.55	1.50
5	A	722	HEC	CMB-C2B	2.33	1.55	1.50
5	A	721	HEC	CMC-C2C	2.31	1.55	1.50
5	A	723	HEC	CMA-C3A	2.30	1.55	1.50
5	A	721	HEC	CMB-C2B	2.30	1.55	1.50
5	A	723	HEC	CMC-C2C	2.27	1.55	1.50
5	A	724	HEC	CMB-C2B	2.26	1.55	1.50
5	A	728	HEC	CMC-C2C	2.22	1.55	1.50
5	A	728	HEC	CMD-C2D	2.16	1.55	1.50
5	A	725	HEC	CMD-C2D	2.15	1.55	1.50
5	A	725	HEC	CMB-C2B	2.14	1.55	1.50
5	A	725	HEC	CMC-C2C	2.13	1.55	1.50
5	A	727	HEC	CMC-C2C	2.11	1.55	1.50
5	A	727	HEC	CMB-C2B	2.10	1.55	1.50
5	A	724	HEC	C3B-C2B	-2.06	1.34	1.41
5	A	722	HEC	CMA-C3A	2.01	1.54	1.50
5	A	728	HEC	CMA-C3A	2.00	1.54	1.50
5	A	720	HEC	CMC-C2C	2.00	1.54	1.50

All (60) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	725	HEC	CBB-CAB-C3B	-9.10	109.25	127.43
5	A	728	HEC	CBB-CAB-C3B	-8.56	110.32	127.43
5	A	721	HEC	CBB-CAB-C3B	-8.53	110.39	127.43
5	A	720	HEC	CBB-CAB-C3B	-8.41	110.61	127.43
5	A	724	HEC	CBB-CAB-C3B	-8.37	110.70	127.43
5	A	723	HEC	CBB-CAB-C3B	-8.24	110.96	127.43
5	A	729	HEC	CBC-CAC-C3C	-7.65	112.14	127.43
5	A	726	HEC	CBB-CAB-C3B	-7.62	112.21	127.43
5	A	729	HEC	CBB-CAB-C3B	-7.04	113.36	127.43
5	A	723	HEC	CBC-CAC-C3C	-6.91	113.61	127.43
5	A	728	HEC	CBC-CAC-C3C	-6.88	113.68	127.43
5	A	726	HEC	CBC-CAC-C3C	-6.49	114.47	127.43
5	A	722	HEC	CBC-CAC-C3C	-6.45	114.55	127.43
5	A	727	HEC	CBB-CAB-C3B	-6.41	114.63	127.43
5	A	727	HEC	CBC-CAC-C3C	-6.31	114.82	127.43
5	A	722	HEC	CBB-CAB-C3B	-6.24	114.96	127.43
5	A	724	HEC	CBC-CAC-C3C	-6.22	115.01	127.43
5	A	721	HEC	CBC-CAC-C3C	-5.42	116.60	127.43
5	A	720	HEC	CBC-CAC-C3C	-5.15	117.15	127.43
5	A	725	HEC	CBC-CAC-C3C	-4.48	118.49	127.43
5	A	729	HEC	CBA-CAA-C2A	-3.70	102.31	112.53
5	A	721	HEC	CMC-C2C-C1C	-3.54	120.02	125.42
5	A	725	HEC	C4D-ND-C1D	3.54	111.60	105.82
5	A	724	HEC	C4D-ND-C1D	3.35	111.29	105.82
5	A	720	HEC	C4D-ND-C1D	3.22	111.07	105.82
5	A	727	HEC	CMD-C2D-C1D	3.19	130.27	125.42
5	A	727	HEC	CAD-CBD-CGD	-3.13	105.37	113.67
5	A	728	HEC	C4D-ND-C1D	3.10	110.88	105.82
5	A	720	HEC	CMC-C2C-C1C	-3.04	120.80	125.42
5	A	727	HEC	CAD-C3D-C4D	3.02	130.83	124.94
5	A	722	HEC	C4D-ND-C1D	2.91	110.56	105.82
5	A	723	HEC	C4D-ND-C1D	2.90	110.55	105.82
5	A	727	HEC	C4D-ND-C1D	2.90	110.54	105.82
5	A	726	HEC	C4D-ND-C1D	2.89	110.54	105.82
5	A	721	HEC	C4D-ND-C1D	2.86	110.48	105.82
5	A	721	HEC	CBD-CAD-C3D	-2.80	104.79	112.53
5	A	725	HEC	CMC-C2C-C1C	-2.64	121.40	125.42
5	A	729	HEC	C4D-ND-C1D	2.55	109.98	105.82
5	A	726	HEC	C2A-C1A-NA	-2.49	107.92	110.32
5	A	729	HEC	CMC-C2C-C1C	-2.43	121.72	125.42
5	A	728	HEC	CMC-C2C-C1C	-2.38	121.80	125.42
5	A	723	HEC	CBD-CAD-C3D	-2.37	105.98	112.53
5	A	729	HEC	CHB-C4A-NA	2.34	127.00	124.45

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	728	HEC	C2A-C1A-NA	-2.32	108.08	110.32
5	A	721	HEC	CBA-CAA-C2A	-2.32	106.12	112.53
3	A	709	ACT	O-C-CH3	-2.30	113.08	122.53
5	A	729	HEC	CBD-CAD-C3D	-2.29	106.20	112.53
5	A	729	HEC	C2A-C1A-NA	-2.28	108.13	110.32
5	A	720	HEC	CBD-CAD-C3D	-2.27	106.27	112.53
5	A	728	HEC	CHD-C1D-ND	2.20	127.84	123.86
5	A	729	HEC	CAD-CBD-CGD	-2.16	107.94	113.67
5	A	725	HEC	CBD-CAD-C3D	-2.16	106.56	112.53
5	A	728	HEC	CAD-CBD-CGD	-2.11	108.06	113.67
5	A	722	HEC	CHA-C4D-ND	2.09	127.66	123.86
5	A	726	HEC	CMC-C2C-C1C	-2.07	122.27	125.42
5	A	723	HEC	CHC-C4B-NB	2.06	126.70	124.45
5	A	728	HEC	CHB-C4A-NA	2.04	126.67	124.45
5	A	726	HEC	CHC-C4B-NB	2.03	126.67	124.45
5	A	722	HEC	CAA-CBA-CGA	-2.00	108.35	113.67
5	A	724	HEC	CHD-C1D-ND	2.00	127.49	123.86

There are no chirality outliers.

All (63) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	720	HEC	C2B-C3B-CAB-CBB
5	A	720	HEC	C4B-C3B-CAB-CBB
5	A	720	HEC	C2C-C3C-CAC-CBC
5	A	720	HEC	C4C-C3C-CAC-CBC
5	A	721	HEC	C2B-C3B-CAB-CBB
5	A	721	HEC	C4B-C3B-CAB-CBB
5	A	721	HEC	C2C-C3C-CAC-CBC
5	A	721	HEC	C4C-C3C-CAC-CBC
5	A	722	HEC	C2B-C3B-CAB-CBB
5	A	722	HEC	C4B-C3B-CAB-CBB
5	A	722	HEC	C2C-C3C-CAC-CBC
5	A	722	HEC	C4C-C3C-CAC-CBC
5	A	723	HEC	C2B-C3B-CAB-CBB
5	A	723	HEC	C4B-C3B-CAB-CBB
5	A	723	HEC	C2C-C3C-CAC-CBC
5	A	723	HEC	C4C-C3C-CAC-CBC
5	A	724	HEC	C2B-C3B-CAB-CBB
5	A	724	HEC	C4B-C3B-CAB-CBB
5	A	724	HEC	C2C-C3C-CAC-CBC
5	A	724	HEC	C4C-C3C-CAC-CBC

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Mol	Chain	Res	Type	Atoms
5	A	725	HEC	C2B-C3B-CAB-CBB
5	A	725	HEC	C4B-C3B-CAB-CBB
5	A	725	HEC	C2C-C3C-CAC-CBC
5	A	725	HEC	C4C-C3C-CAC-CBC
5	A	726	HEC	C2B-C3B-CAB-CBB
5	A	726	HEC	C4B-C3B-CAB-CBB
5	A	726	HEC	C2C-C3C-CAC-CBC
5	A	726	HEC	C4C-C3C-CAC-CBC
5	A	727	HEC	C2B-C3B-CAB-CBB
5	A	727	HEC	C4B-C3B-CAB-CBB
5	A	727	HEC	C2C-C3C-CAC-CBC
5	A	727	HEC	C4C-C3C-CAC-CBC
5	A	728	HEC	C2B-C3B-CAB-CBB
5	A	728	HEC	C4B-C3B-CAB-CBB
5	A	728	HEC	C2C-C3C-CAC-CBC
5	A	728	HEC	C4C-C3C-CAC-CBC
5	A	729	HEC	C2B-C3B-CAB-CBB
5	A	729	HEC	C4B-C3B-CAB-CBB
5	A	729	HEC	C2C-C3C-CAC-CBC
5	A	729	HEC	C4C-C3C-CAC-CBC
2	A	706	EDO	O1-C1-C2-O2
2	A	713	EDO	O1-C1-C2-O2
2	A	714	EDO	O1-C1-C2-O2
5	A	728	HEC	C2A-CAA-CBA-CGA
2	A	712	EDO	O1-C1-C2-O2
5	A	721	HEC	CAD-CBD-CGD-O2D
5	A	725	HEC	C3A-C2A-CAA-CBA
5	A	723	HEC	C2A-CAA-CBA-CGA
5	A	721	HEC	CAD-CBD-CGD-O1D
5	A	720	HEC	CAA-CBA-CGA-O1A
5	A	726	HEC	CAA-CBA-CGA-O1A
5	A	726	HEC	CAA-CBA-CGA-O2A
5	A	725	HEC	C1A-C2A-CAA-CBA
5	A	726	HEC	CAD-CBD-CGD-O2D
5	A	727	HEC	CAA-CBA-CGA-O2A
5	A	720	HEC	CAA-CBA-CGA-O2A
5	A	726	HEC	CAD-CBD-CGD-O1D
5	A	727	HEC	CAA-CBA-CGA-O1A
5	A	723	HEC	CAD-CBD-CGD-O1D
5	A	723	HEC	CAD-CBD-CGD-O2D
5	A	727	HEC	CAD-CBD-CGD-O1D
5	A	728	HEC	CAD-CBD-CGD-O2D

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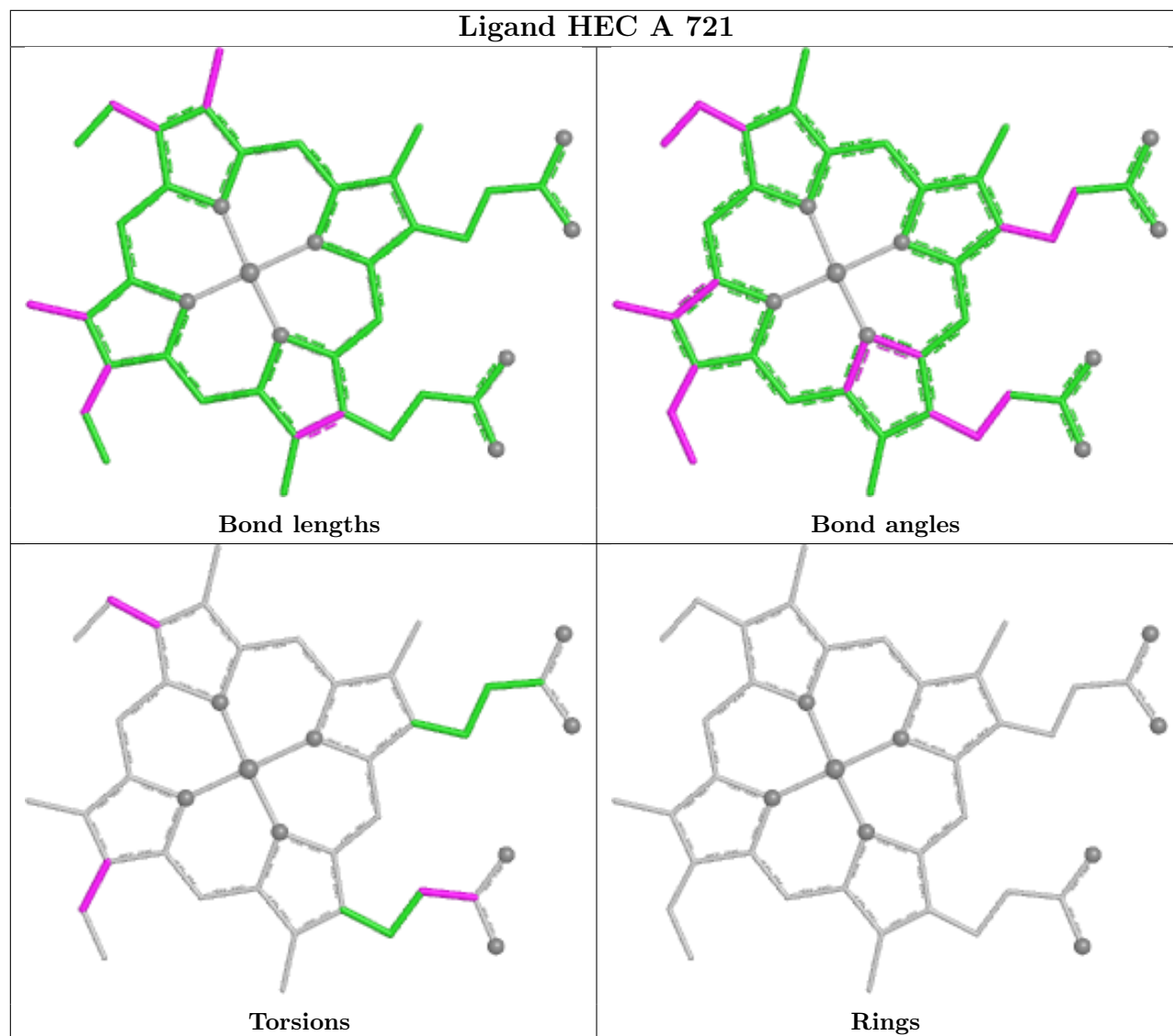
Mol	Chain	Res	Type	Atoms
5	A	728	HEC	CAD-CBD-CGD-O1D

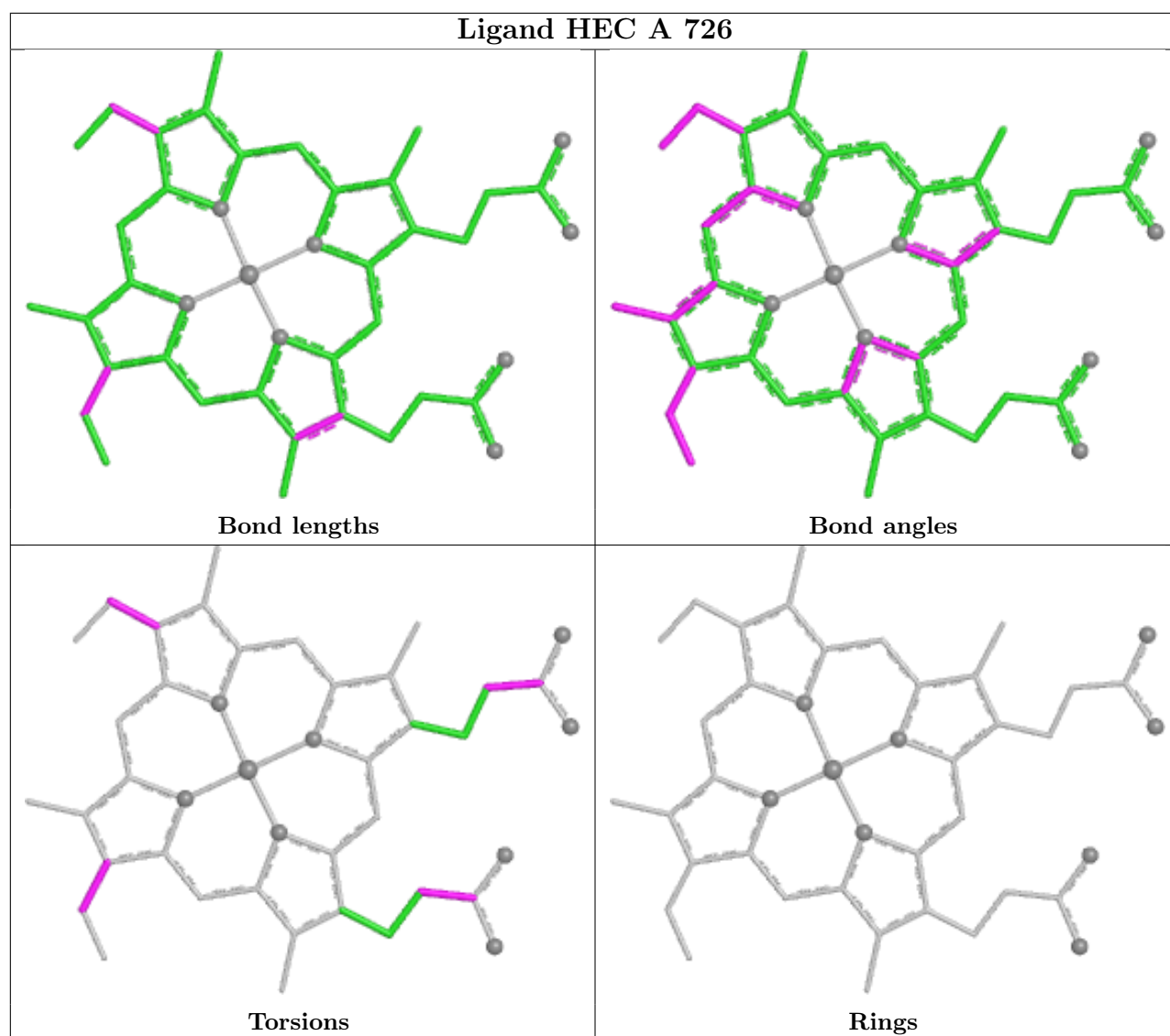
There are no ring outliers.

13 monomers are involved in 13 short contacts:

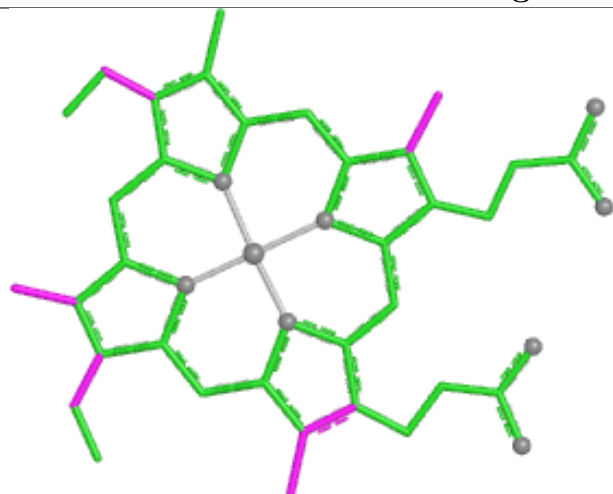
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	705	EDO	1	0
5	A	721	HEC	1	0
2	A	706	EDO	1	0
5	A	726	HEC	1	0
3	A	709	ACT	2	0
5	A	723	HEC	1	0
2	A	713	EDO	1	0
5	A	720	HEC	2	0
5	A	722	HEC	1	0
5	A	727	HEC	1	0
5	A	725	HEC	1	0
2	A	712	EDO	1	0
5	A	724	HEC	1	0

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 than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

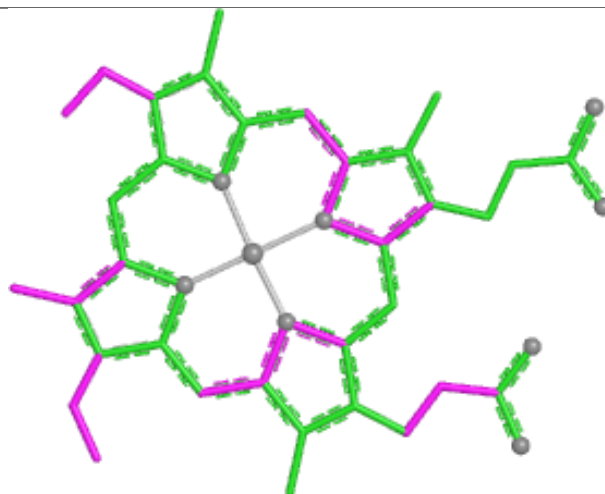




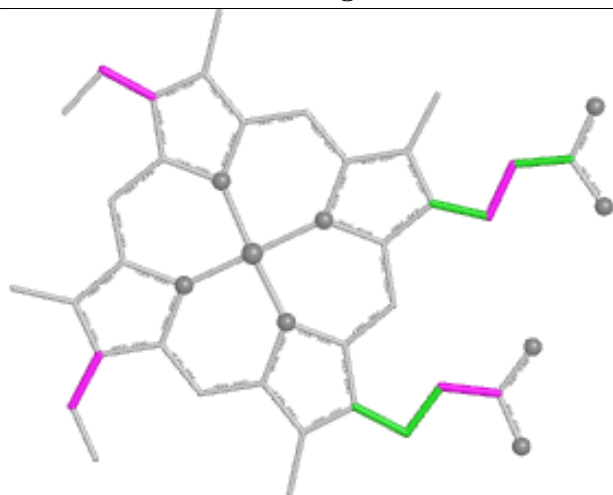
Ligand HEC A 728



Bond lengths



Bond angles

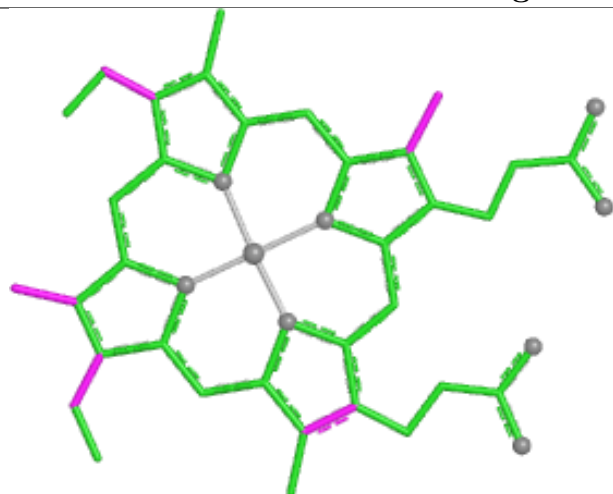


Torsions

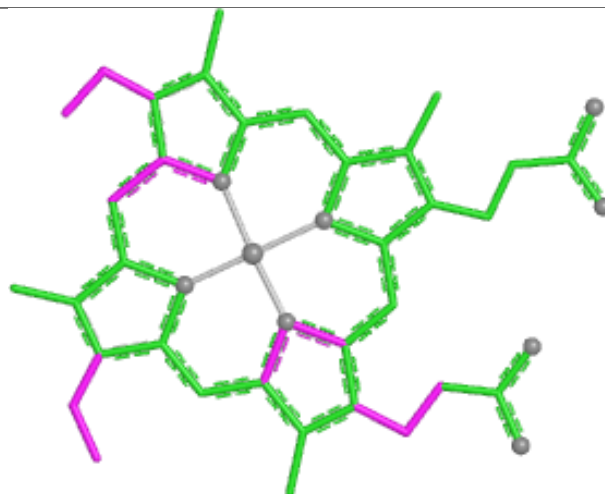


Rings

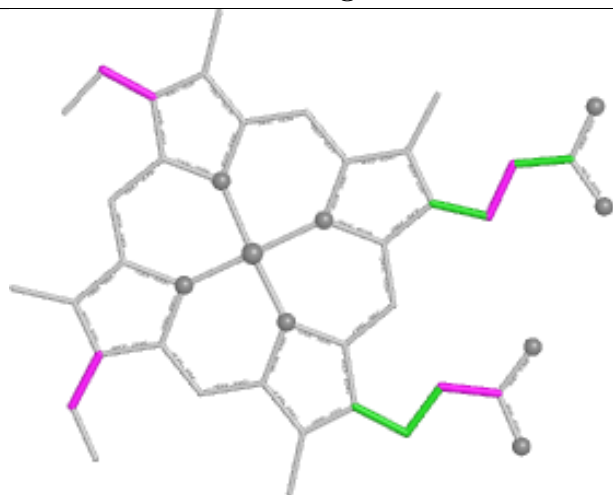
Ligand HEC A 723



Bond lengths



Bond angles

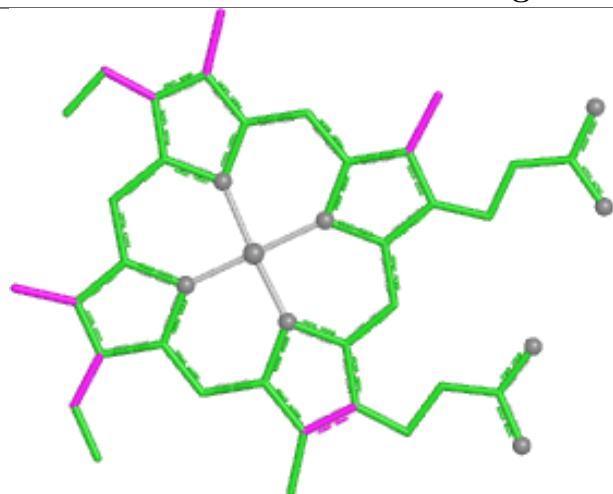


Torsions

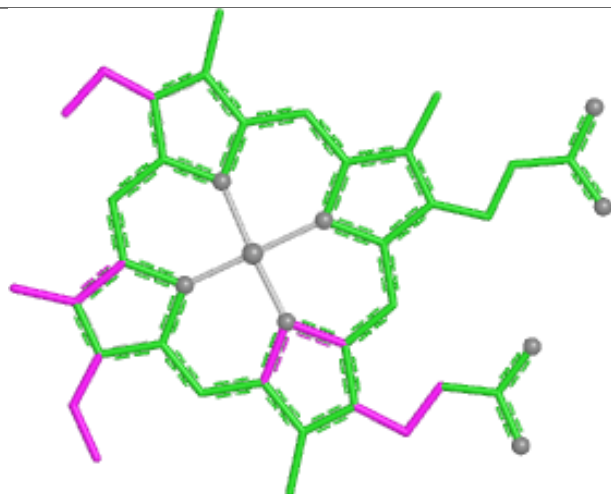


Rings

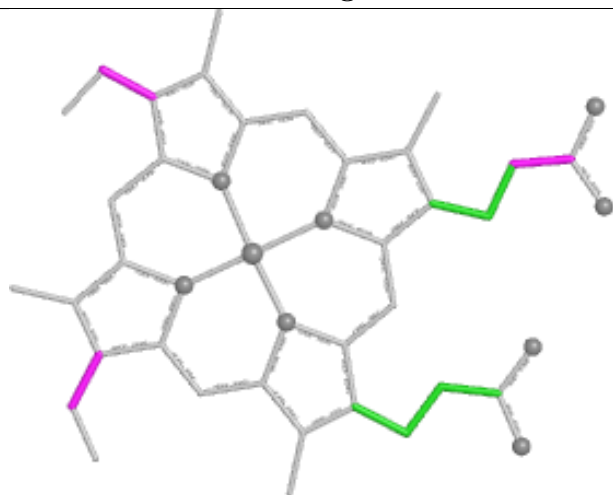
Ligand HEC A 720



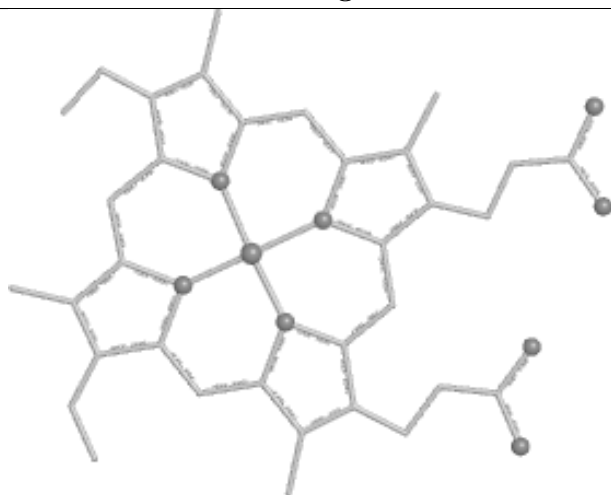
Bond lengths



Bond angles

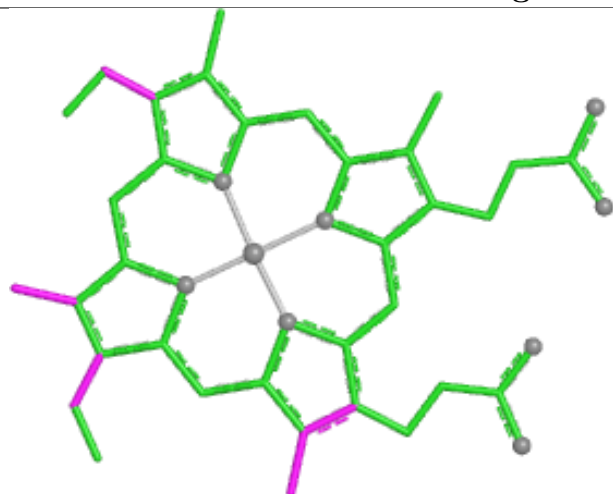


Torsions

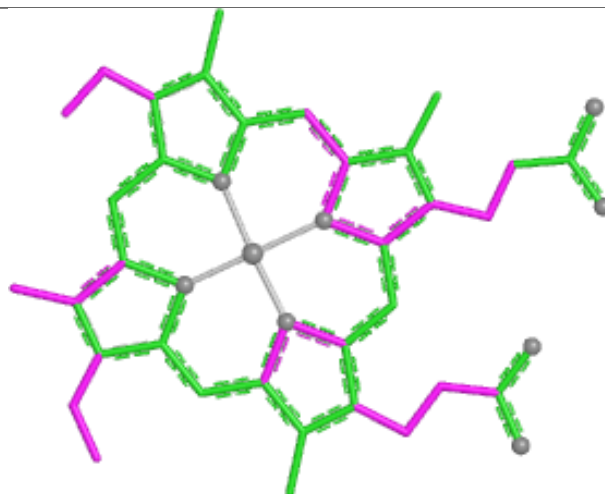


Rings

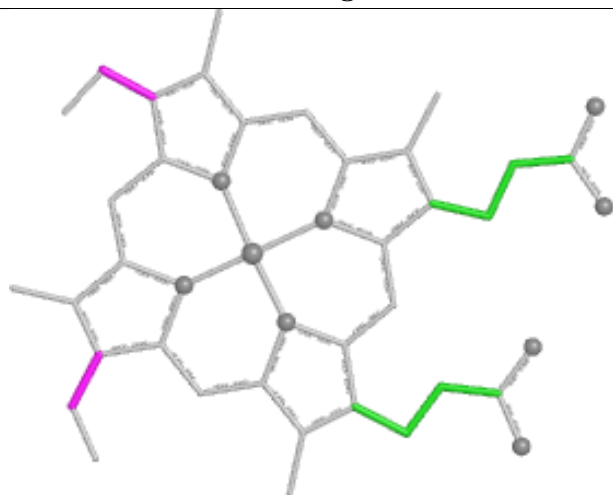
Ligand HEC A 729



Bond lengths



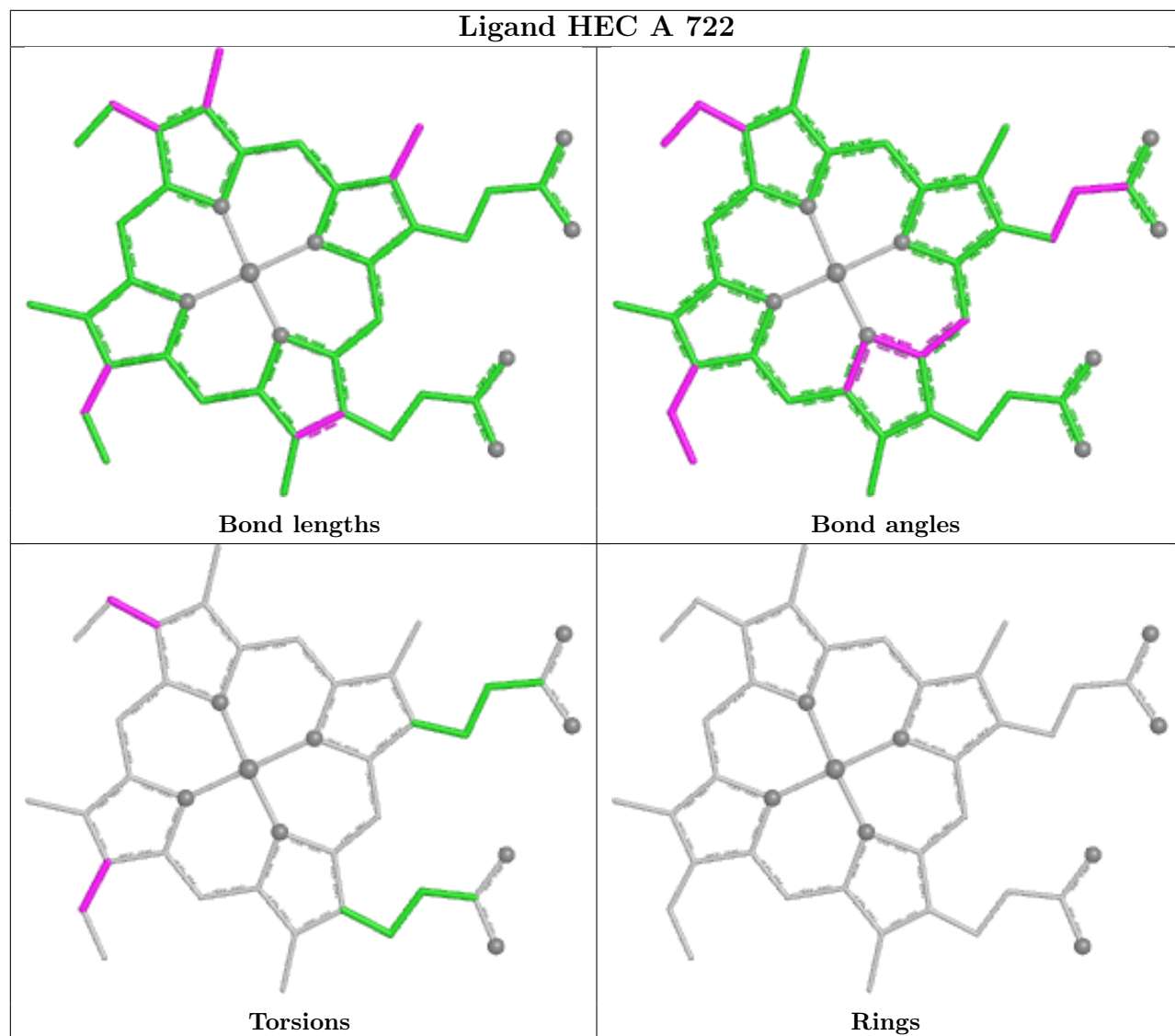
Bond angles



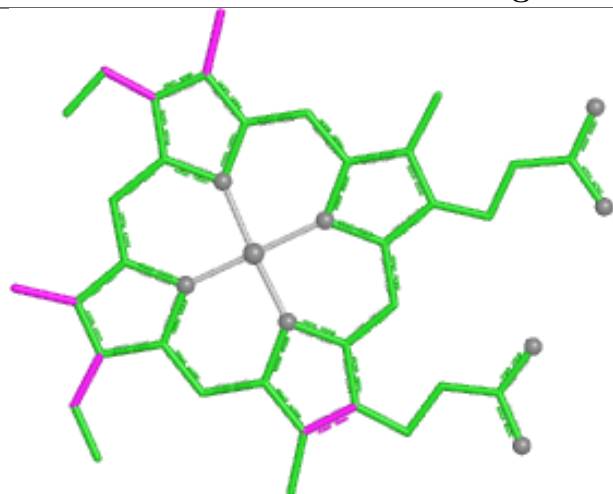
Torsions



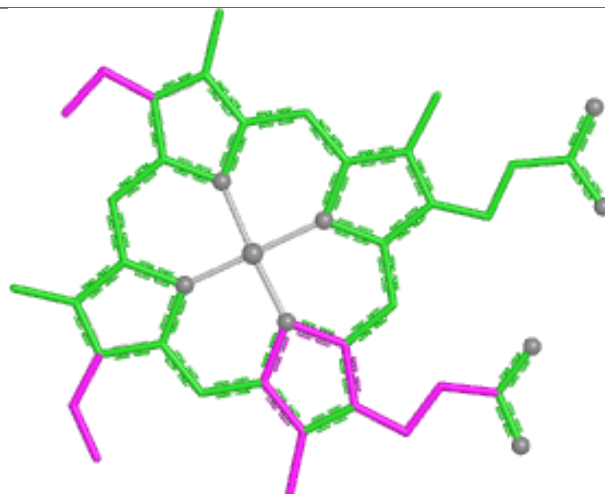
Rings



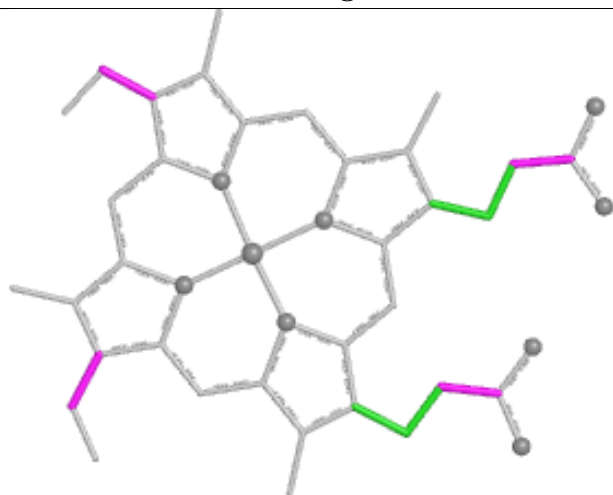
Ligand HEC A 727



Bond lengths



Bond angles

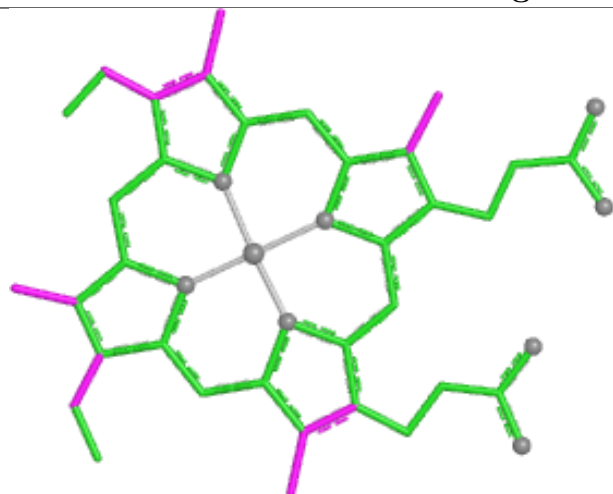


Torsions

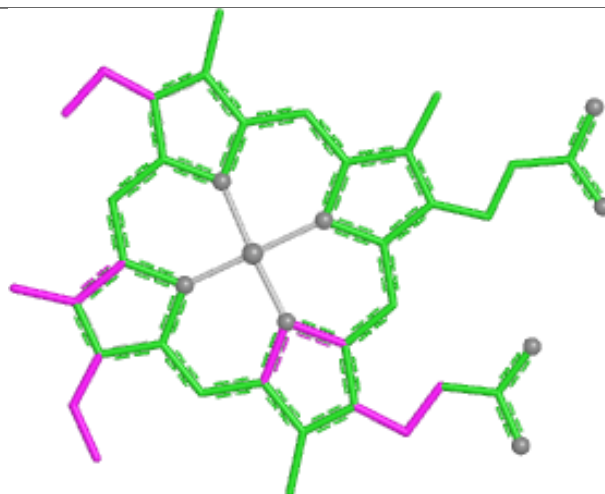


Rings

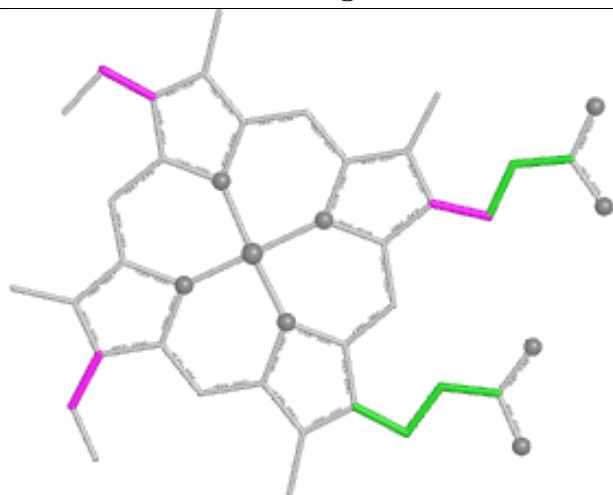
Ligand HEC A 725



Bond lengths



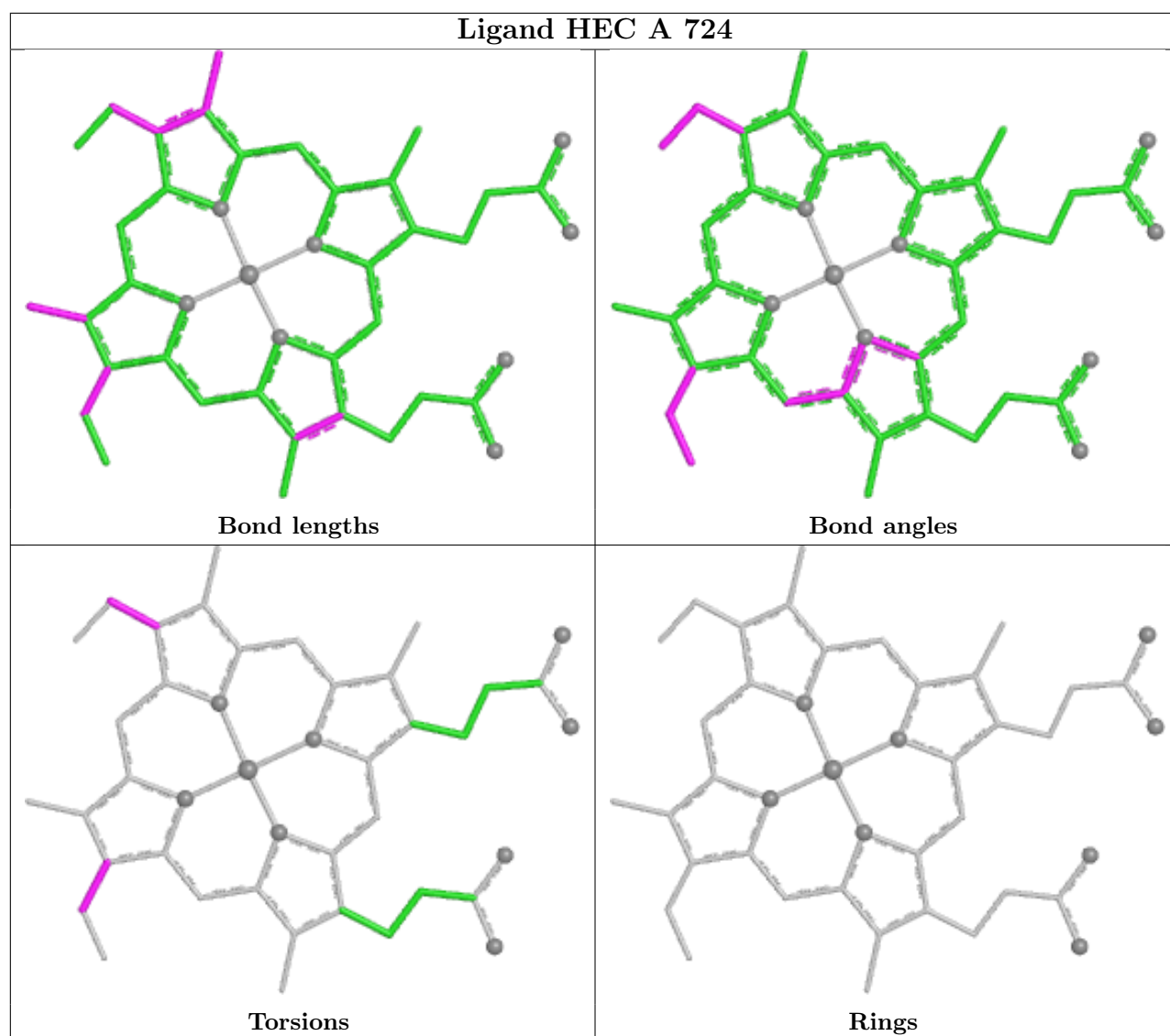
Bond angles



Torsions



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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	626/679 (92%)	-0.40	9 (1%) 73 79	8, 19, 32, 48	3 (0%)

All (9) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	44	GLY	3.7
1	A	59	GLU	2.7
1	A	241	LYS	2.6
1	A	61	GLY	2.5
1	A	153	ALA	2.5
1	A	242	ASP	2.3
1	A	263	GLU	2.3
1	A	266	MET	2.3
1	A	62	ALA	2.2

6.2 Non-standard residues in protein, DNA, RNA chains [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
1	LBY	A	430	16/17	0.89	0.20	18,46,110,120	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

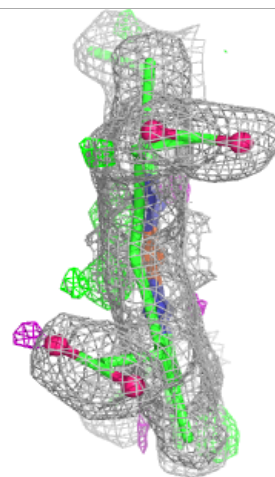
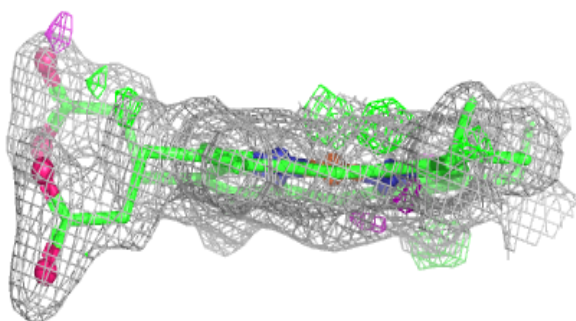
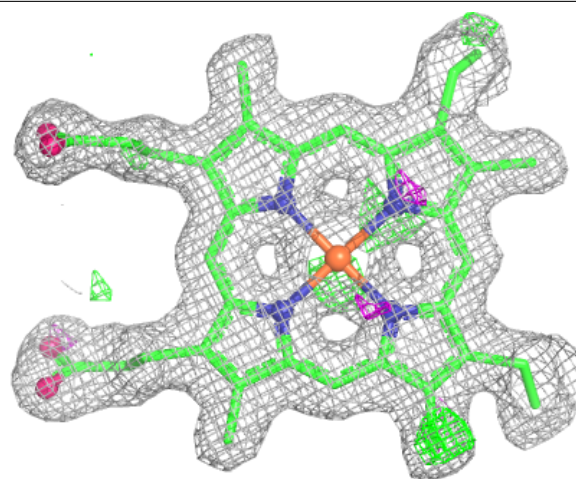
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	ACT	A	709	4/4	0.81	0.20	25,28,37,46	0
2	EDO	A	713	4/4	0.83	0.18	26,33,38,45	0
2	EDO	A	706	4/4	0.84	0.26	24,29,32,33	0
2	EDO	A	712	4/4	0.90	0.20	26,31,32,33	0
2	EDO	A	705	4/4	0.90	0.12	25,31,35,42	0
2	EDO	A	702	4/4	0.90	0.10	17,20,20,24	0
2	EDO	A	710	4/4	0.91	0.11	30,31,34,39	0
2	EDO	A	714	4/4	0.92	0.14	23,24,27,35	0
2	EDO	A	704	4/4	0.92	0.08	24,25,28,29	0
2	EDO	A	701	4/4	0.93	0.08	29,30,31,34	0
2	EDO	A	711	4/4	0.93	0.10	31,32,32,34	0
2	EDO	A	707	4/4	0.95	0.08	22,26,26,31	0
2	EDO	A	708	4/4	0.95	0.07	26,27,29,30	0
2	EDO	A	703	4/4	0.96	0.09	17,22,24,26	0
4	CA	A	718	1/1	0.96	0.11	39,39,39,39	0
5	HEC	A	724	43/43	0.97	0.07	14,18,32,34	0
5	HEC	A	725	43/43	0.97	0.07	12,14,28,44	0
5	HEC	A	720	43/43	0.98	0.06	10,13,29,33	0
5	HEC	A	723	43/43	0.98	0.06	11,14,30,38	0
5	HEC	A	728	43/43	0.98	0.06	11,14,24,38	0
5	HEC	A	729	43/43	0.98	0.06	12,15,20,27	0
4	CA	A	716	1/1	0.99	0.18	26,26,26,26	0
4	CA	A	719	1/1	0.99	0.10	25,25,25,25	0
4	CA	A	717	1/1	0.99	0.04	18,18,18,18	0
5	HEC	A	726	43/43	0.99	0.05	13,16,21,32	0
5	HEC	A	727	43/43	0.99	0.04	9,13,14,14	0
5	HEC	A	721	43/43	0.99	0.05	8,12,20,24	0
5	HEC	A	722	43/43	0.99	0.04	9,11,14,15	0
4	CA	A	715	1/1	1.00	0.02	12,12,12,12	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.

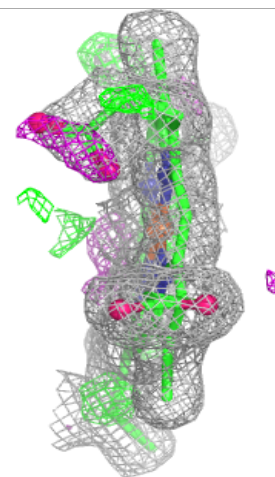
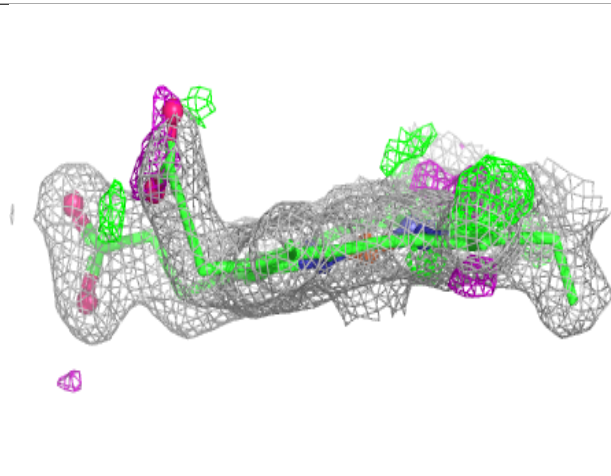
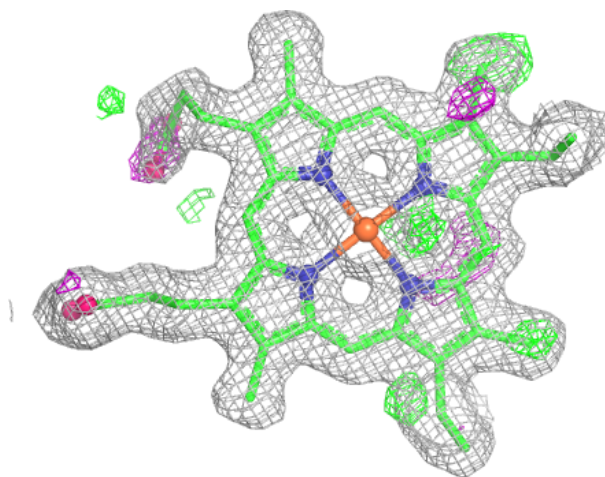
Electron density around HEC A 724:

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



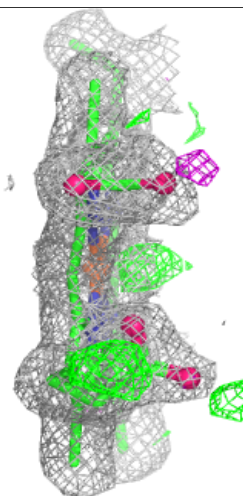
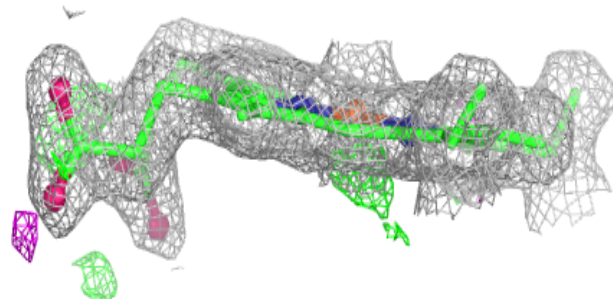
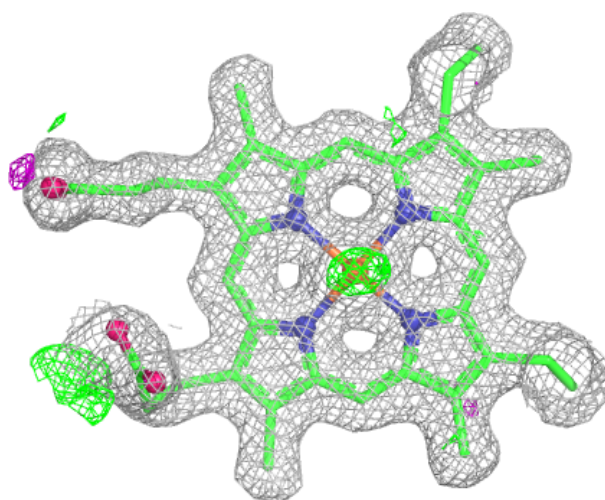
Electron density around HEC A 725:

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



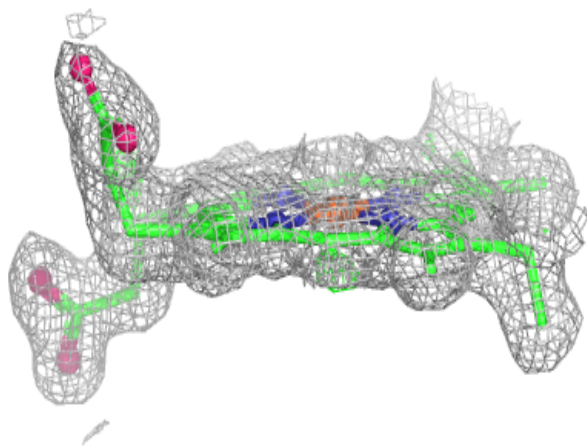
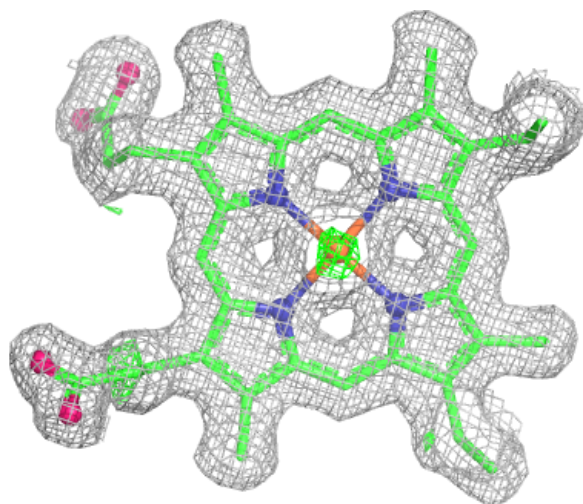
Electron density around HEC A 720:

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



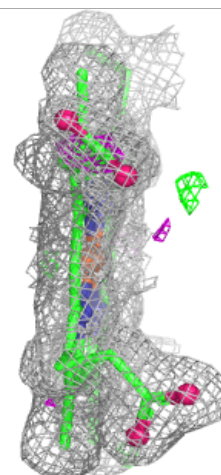
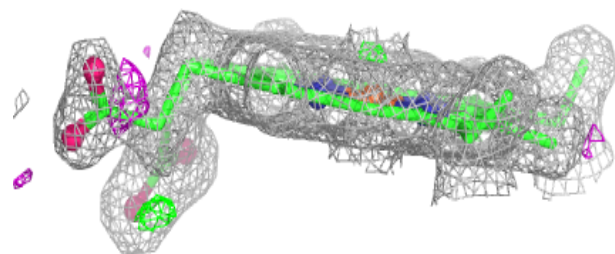
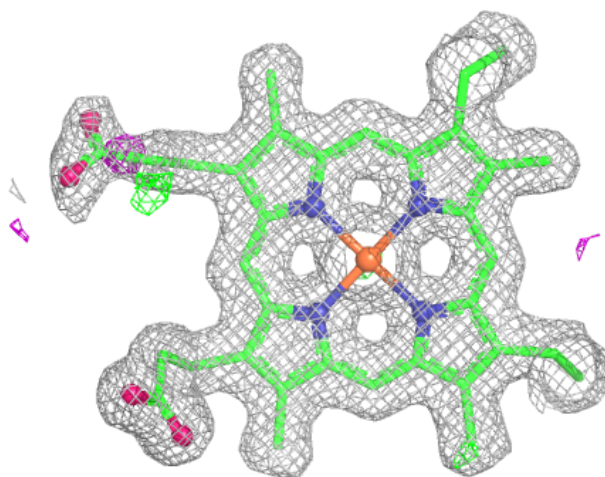
Electron density around HEC A 723:

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and green (positive)



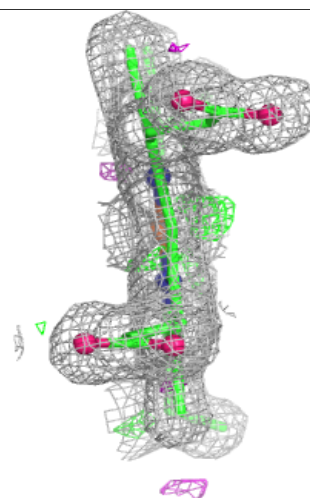
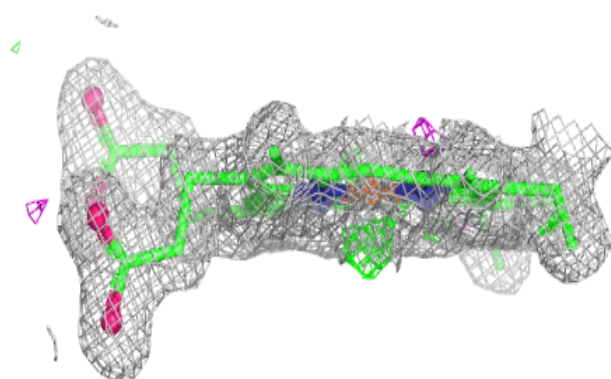
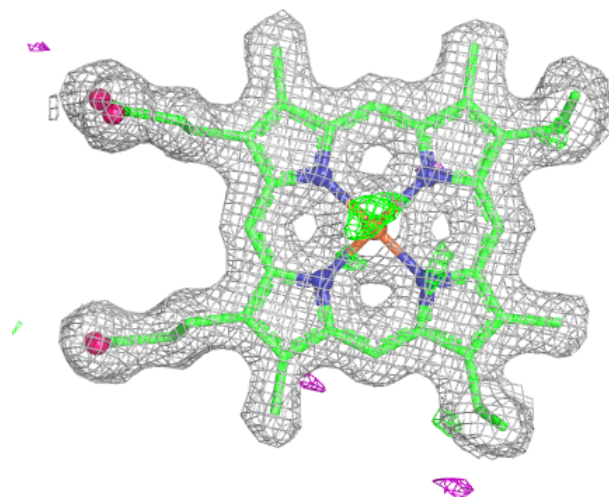
Electron density around HEC A 728:

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



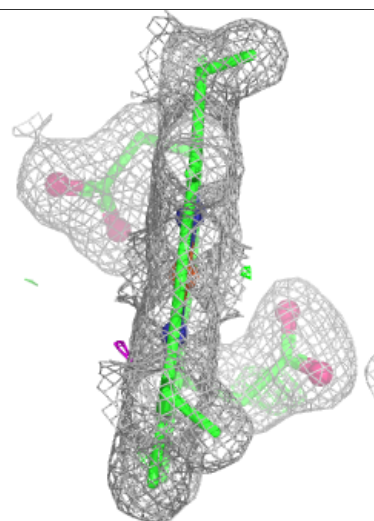
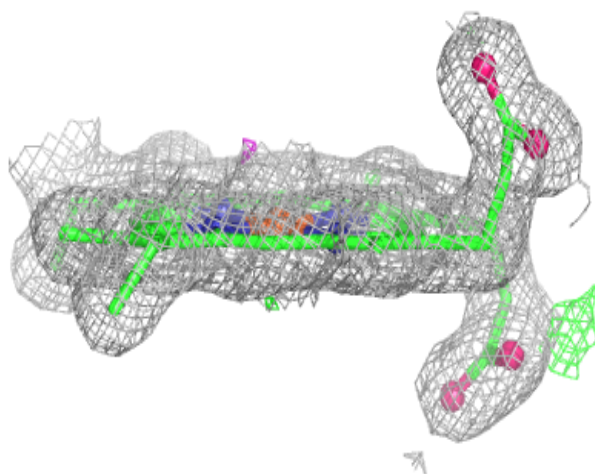
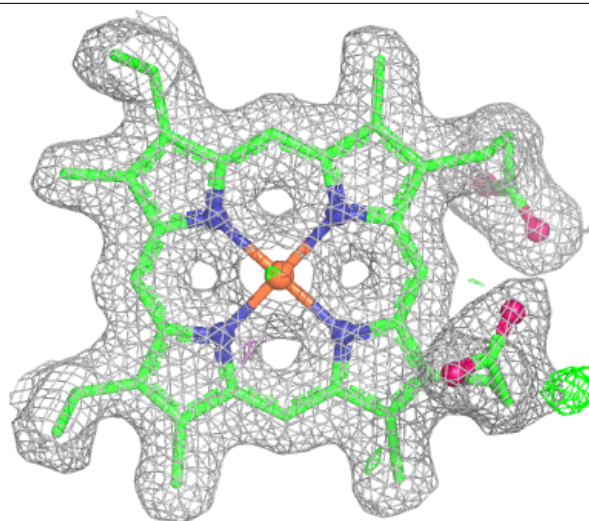
Electron density around HEC A 729:

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



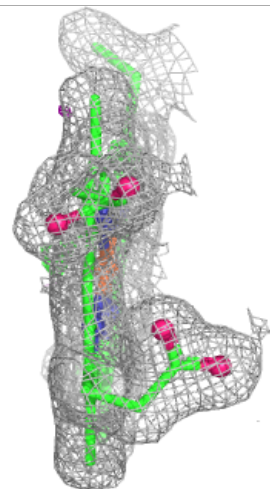
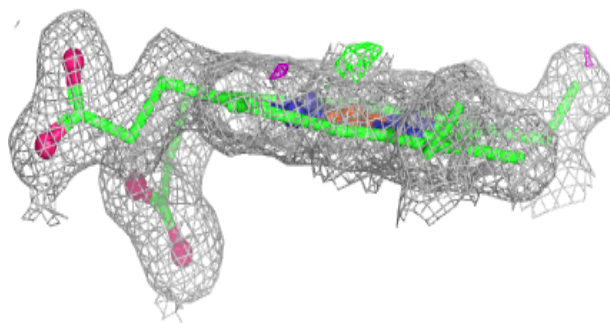
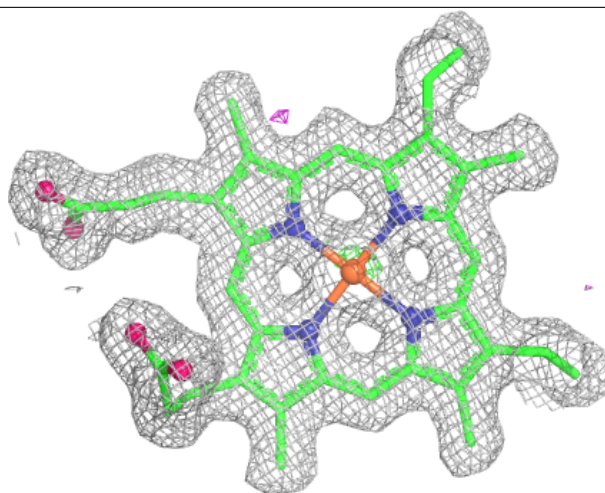
Electron density around HEC A 726:

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and green (positive)



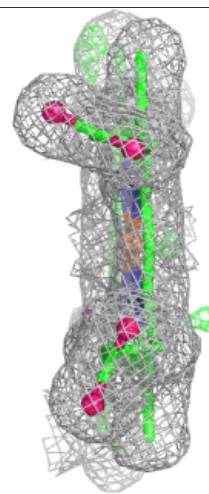
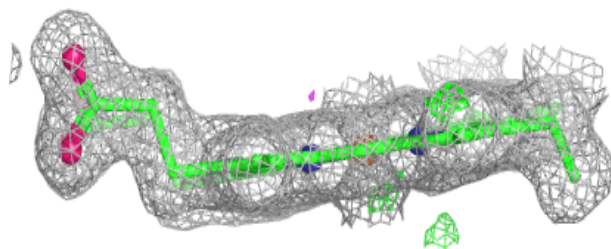
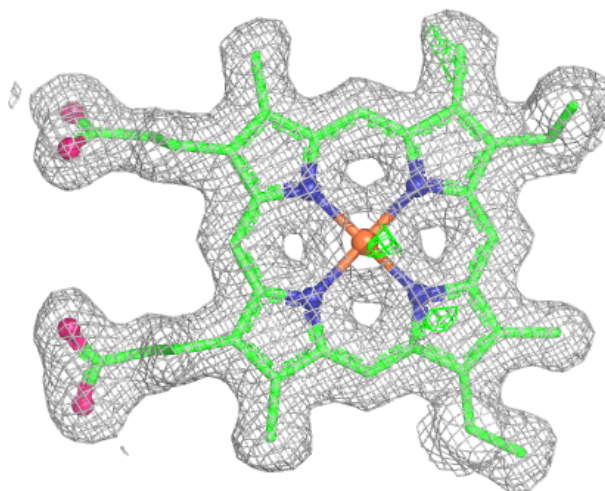
Electron density around HEC A 727:

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and green (positive)



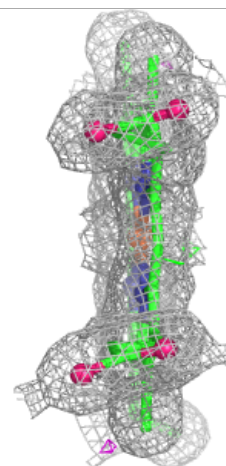
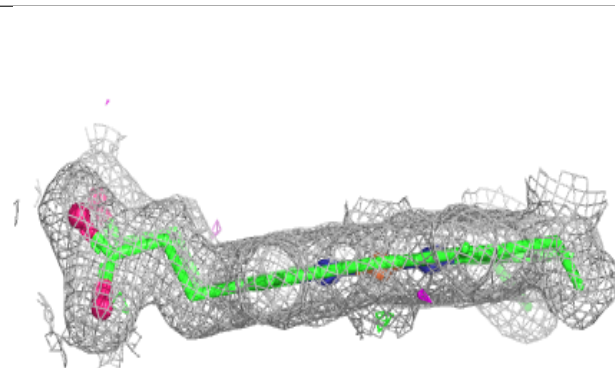
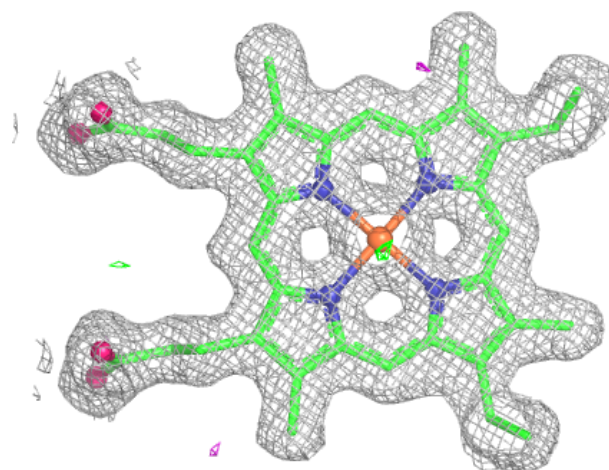
Electron density around HEC A 721:

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



Electron density around HEC A 722:

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



6.5 Other polymers [i](#)

There are no such residues in this entry.