Full wwPDB X-ray Structure Validation Report (i)

Aug 8, 2023 – 06:15 AM EDT

PDB ID	:	1QWM
Title	:	Structure of Helicobacter pylori catalase with formic acid bound
Authors	:	Loewen, P.C.; Carpena, X.; Perez-Luque, R.; Rovira, C.; Haas, R.; Odenbreit, S.; Nicholls, P.; Fita, I.
Deposited on	:	2003-09-02
Resolution	:	1.60 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 (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:

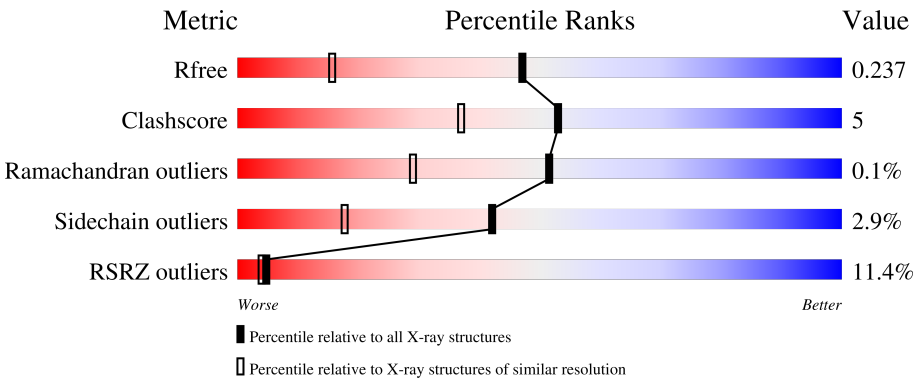
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (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 1.60 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	3398 (1.60-1.60)
Clashscore	141614	3665 (1.60-1.60)
Ramachandran outliers	138981	3564 (1.60-1.60)
Sidechain outliers	138945	3563 (1.60-1.60)
RSRZ outliers	127900	3321 (1.60-1.60)

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	505	13% 85% 11% • •
1	B	505	10% 85% 11% • •

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
4	FMT	A	1714	-	-	X	-
4	FMT	A	1732	-	-	X	-
4	FMT	A	1734	-	-	X	-
4	FMT	A	1735	-	-	X	-
4	FMT	B	1712	-	-	X	-
4	FMT	B	1721	-	-	X	-
4	FMT	B	1729	-	-	X	-
4	FMT	B	1731	-	-	X	-
4	FMT	B	1736	-	-	-	X

2 Entry composition (i)

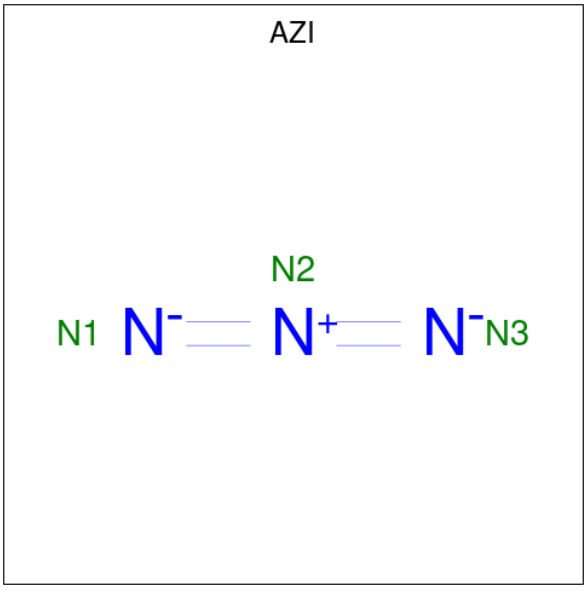
There are 5 unique types of molecules in this entry. The entry contains 9209 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 KatA catalase.

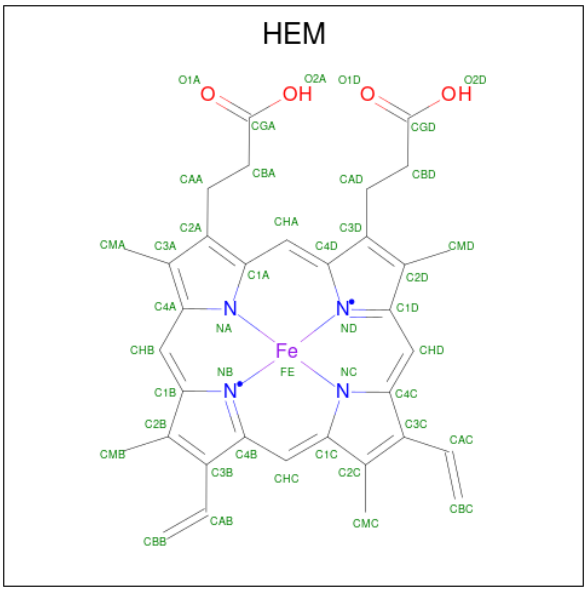
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	490	4041	2580	704	743	14	0	9	0
1	B	490	4038	2578	701	745	14	0	9	0

- Molecule 2 is AZIDE ION (three-letter code: AZI) (formula: N_3).



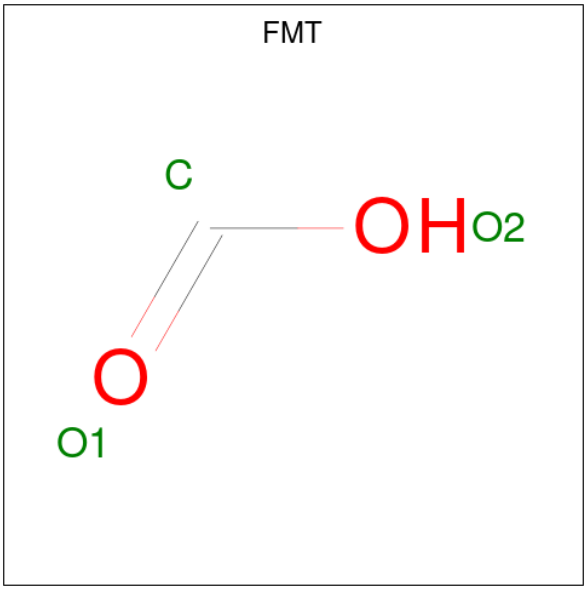
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	N		
2	A	1	3	3	0	0

- Molecule 3 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



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

- Molecule 4 is FORMIC ACID (three-letter code: FMT) (formula: CH_2O_2).



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

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

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

- Molecule 5 is water.

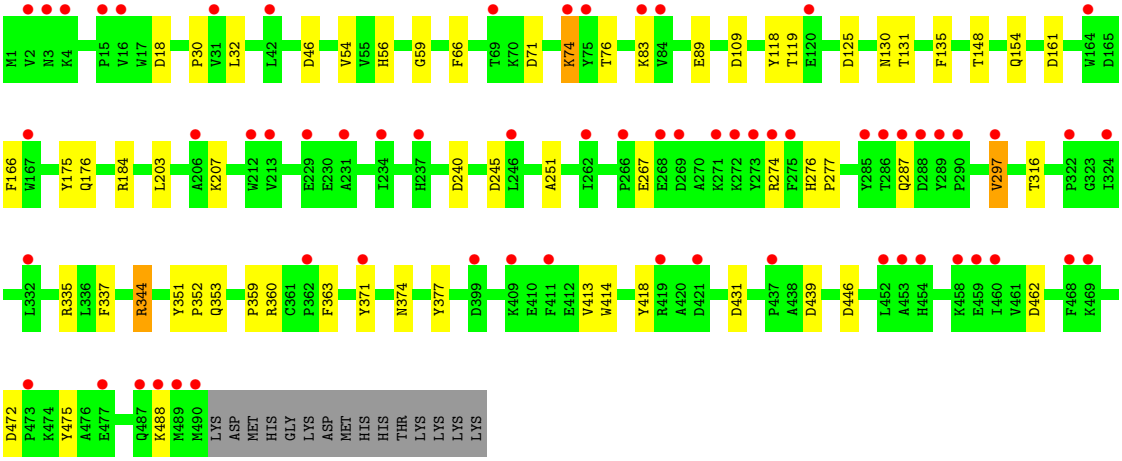
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	442	442	442	0	0
			Total	O		
5	B	491	491	491	0	0

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.

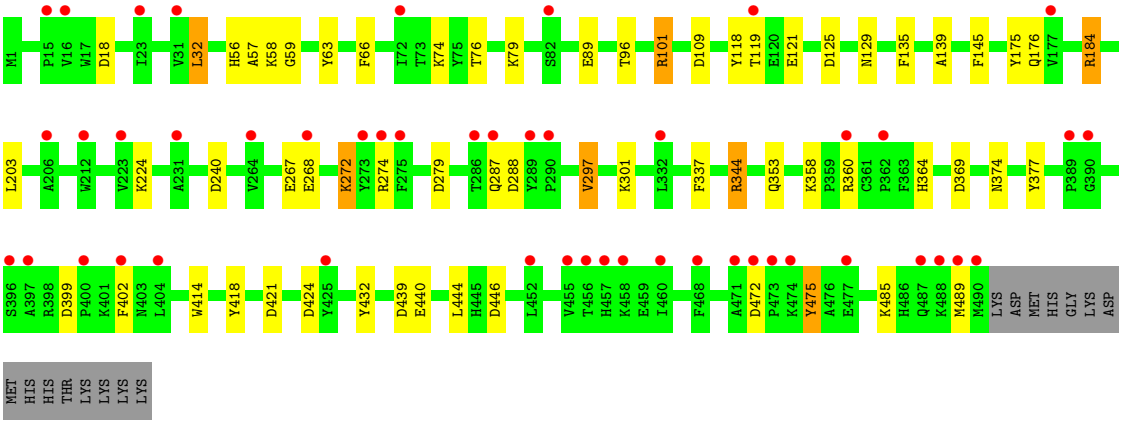
- Molecule 1: KatA catalase

Chain A:



- Molecule 1: KatA catalase

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α, β, γ	64.76Å 154.96Å 96.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.88 – 1.60 29.87 – 1.60	Depositor EDS
% Data completeness (in resolution range)	100.0 (29.88-1.60) 97.4 (29.87-1.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.05	Depositor
$< I/\sigma(I) >$ [1]	3.41 (at 1.60Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.194 , 0.227 0.204 , 0.237	Depositor DCC
R_{free} test set	6282 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	12.6	Xtriage
Anisotropy	0.076	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.52 , 60.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	9209	wwPDB-VP
Average B, all atoms (Å^2)	15.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.59% of the height of the origin peak. No significant pseudotranslation is detected.*

[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 (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: AZI, FMT, HEM

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\#\|Z\|>5$	RMSZ	$\#\|Z\|>5$
1	A	0.79	0/4215	0.89	15/5705 (0.3%)
1	B	0.82	0/4214	0.93	16/5704 (0.3%)
All	All	0.80	0/8429	0.91	31/11409 (0.3%)

There are no bond length outliers.

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	109	ASP	CB-CG-OD2	7.19	124.77	118.30
1	A	32	LEU	CA-CB-CG	-7.04	99.11	115.30
1	B	184	ARG	NE-CZ-NH1	6.38	123.49	120.30
1	B	18	ASP	CB-CG-OD2	6.35	124.01	118.30
1	B	399	ASP	CB-CG-OD2	6.30	123.97	118.30
1	B	109	ASP	CB-CG-OD2	6.29	123.96	118.30
1	A	446	ASP	CB-CG-OD2	6.23	123.91	118.30
1	B	125	ASP	CB-CG-OD2	6.15	123.83	118.30
1	B	279	ASP	CB-CG-OD2	6.04	123.73	118.30
1	A	125	ASP	CB-CG-OD2	5.92	123.63	118.30
1	A	240	ASP	CB-CG-OD2	5.89	123.60	118.30
1	B	439	ASP	CB-CG-OD2	5.80	123.52	118.30
1	B	101[A]	ARG	N-CA-C	5.74	126.50	111.00
1	B	101[B]	ARG	N-CA-C	5.74	126.50	111.00
1	A	161	ASP	CB-CG-OD2	5.69	123.42	118.30
1	A	46	ASP	CB-CG-OD2	5.62	123.36	118.30
1	A	439	ASP	CB-CG-OD2	5.51	123.26	118.30
1	A	245	ASP	CB-CG-OD2	5.46	123.22	118.30
1	A	18	ASP	CB-CG-OD2	5.40	123.16	118.30
1	B	446	ASP	CB-CG-OD2	5.37	123.13	118.30
1	A	344	ARG	NE-CZ-NH2	-5.35	117.63	120.30
1	B	240	ASP	CB-CG-OD2	5.34	123.10	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	431	ASP	CB-CG-OD2	5.29	123.06	118.30
1	B	344	ARG	NE-CZ-NH1	5.24	122.92	120.30
1	A	71	ASP	CB-CG-OD2	5.17	122.95	118.30
1	B	32	LEU	CA-CB-CG	-5.16	103.42	115.30
1	A	462	ASP	CB-CG-OD2	5.08	122.87	118.30
1	A	472	ASP	CB-CG-OD2	5.07	122.87	118.30
1	B	421	ASP	CB-CG-OD2	5.06	122.85	118.30
1	B	472	ASP	CB-CG-OD2	5.06	122.85	118.30
1	B	424	ASP	CB-CG-OD2	5.02	122.82	118.30

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts (i)

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4041	0	3865	35	1
1	B	4038	0	3852	44	0
2	A	3	0	0	1	0
3	A	43	0	30	1	0
3	B	43	0	30	5	0
4	A	63	0	21	18	0
4	B	45	0	15	16	1
5	A	442	0	0	9	2
5	B	491	0	0	8	3
All	All	9209	0	7813	85	4

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 5.

All (85) 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)
4:B:1705:FMT:H	5:B:2015:HOH:O	1.54	1.07
4:A:1714:FMT:O1	5:A:2694:HOH:O	1.83	0.94

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:353:GLN:HE22	1:B:374:ASN:H	1.30	0.79
1:A:130:ASN:O	4:A:1714:FMT:H	1.84	0.78
1:B:184:ARG:HG2	4:B:1729:FMT:C	2.15	0.77
1:B:89[B]:GLU:HG3	5:B:1979:HOH:O	1.84	0.75
1:A:335:ARG:HG3	3:A:550:HEM:HBB2	1.69	0.74
1:A:353:GLN:HE22	1:A:374:ASN:H	1.37	0.71
1:A:130:ASN:O	4:A:1714:FMT:C	2.39	0.71
1:A:89:GLU:OE1	5:A:2763:HOH:O	2.10	0.70
1:B:440:GLU:OE2	4:B:1729:FMT:C	2.39	0.70
1:A:74:LYS:HD2	5:A:2937:HOH:O	1.92	0.69
2:A:2600:AZI:N1	4:A:1735:FMT:C	2.57	0.67
1:B:101[A]:ARG:O	4:B:1720:FMT:O2	2.13	0.67
1:B:139:ALA:HB2	3:B:550:HEM:HBB1	1.78	0.66
1:A:207:LYS:HG3	5:A:2894:HOH:O	1.96	0.66
1:A:59:GLY:H	4:A:1734:FMT:H	1.62	0.65
1:A:66:PHE:HD1	1:A:297[A]:VAL:HG13	1.63	0.63
1:A:371:TYR:OH	4:A:1730:FMT:O2	2.17	0.63
1:A:30:PRO:HB2	1:B:32:LEU:HD22	1.83	0.61
1:A:118:TYR:CD1	1:A:360[A]:ARG:HD3	2.36	0.61
1:B:272:LYS:HG3	5:B:2185:HOH:O	2.00	0.60
1:B:66:PHE:HD1	1:B:297[A]:VAL:HG13	1.66	0.59
1:A:184:ARG:HD2	4:A:1714:FMT:C	2.33	0.59
1:B:139:ALA:CB	3:B:550:HEM:HBB1	2.34	0.56
1:B:337:PHE:CD1	4:B:1731:FMT:O2	2.58	0.56
1:B:118:TYR:CD1	1:B:360:ARG:HD3	2.40	0.56
1:B:59:GLY:H	4:B:1712:FMT:H	1.71	0.56
1:B:485:LYS:HE3	1:B:489:MET:HE2	1.90	0.53
1:A:56:HIS:HE2	4:A:1701:FMT:C	2.23	0.52
4:A:1735:FMT:C	5:A:2867:HOH:O	2.58	0.51
1:B:139:ALA:CB	3:B:550:HEM:CBB	2.89	0.51
1:A:66:PHE:CD1	1:A:297[A]:VAL:HG13	2.46	0.50
1:A:251:ALA:HA	4:A:1718:FMT:H	1.93	0.50
1:A:74:LYS:CD	5:A:2937:HOH:O	2.54	0.50
1:A:135:PHE:CZ	1:A:176:GLN:HG3	2.47	0.50
1:A:74:LYS:HB2	1:A:74:LYS:NZ	2.27	0.49
1:A:359:PRO:HG2	1:A:363:PHE:CD2	2.48	0.48
1:B:444[B]:LEU:HD21	1:B:475:TYR:CE2	2.49	0.48
1:B:59:GLY:H	4:B:1712:FMT:C	2.27	0.47
1:A:74:LYS:HB2	1:A:74:LYS:HZ3	1.79	0.47
1:B:56:HIS:NE2	4:B:1702:FMT:C	2.78	0.47
1:B:268:GLU:OE1	5:B:2166:HOH:O	2.20	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:274[B]:ARG:HH22	1:B:287:GLN:NE2	2.13	0.46
1:B:63:TYR:CD1	1:B:301:LYS:HE2	2.51	0.46
1:B:274[B]:ARG:HH21	1:B:288:ASP:CG	2.18	0.46
1:A:59:GLY:H	4:A:1734:FMT:C	2.25	0.46
1:B:358:LYS:HB3	1:B:358:LYS:HE2	1.56	0.46
1:A:337:PHE:HA	4:A:1732:FMT:H	1.98	0.46
1:B:139:ALA:HB2	3:B:550:HEM:CBB	2.45	0.46
4:A:1735:FMT:H	5:A:2727:HOH:O	2.17	0.45
1:B:76:THR:HB	1:B:203:LEU:HB3	1.97	0.45
1:B:63:TYR:HB3	5:B:1979:HOH:O	2.17	0.45
1:B:89[B]:GLU:CG	5:B:1979:HOH:O	2.55	0.45
4:A:1735:FMT:C	5:A:2727:HOH:O	2.64	0.44
1:A:118:TYR:CG	1:A:360[A]:ARG:HD3	2.52	0.44
1:A:54[B]:VAL:HG13	5:A:2629:HOH:O	2.17	0.44
1:A:344:ARG:HH12	4:A:1732:FMT:C	2.30	0.44
1:B:129:ASN:CG	3:B:550:HEM:HAC	2.38	0.44
1:B:59:GLY:N	4:B:1712:FMT:H	2.33	0.44
1:B:79:LYS:HG3	1:B:121:GLU:HG3	1.98	0.44
1:B:56:HIS:HA	1:B:96:THR:O	2.18	0.43
1:A:413:VAL:HB	1:B:402:PHE:HB3	2.01	0.43
1:B:358:LYS:HD2	5:B:2012:HOH:O	2.17	0.43
1:B:364:HIS:HD2	5:B:1948:HOH:O	2.01	0.43
1:B:337:PHE:CD1	4:B:1731:FMT:C	3.02	0.42
1:B:432:TYR:OH	4:B:1729:FMT:O2	2.36	0.42
1:A:351:TYR:N	1:A:352:PRO:CD	2.81	0.42
1:B:485:LYS:O	1:B:489:MET:HG3	2.19	0.42
1:B:58:LYS:HA	4:B:1712:FMT:C	2.50	0.41
1:A:135:PHE:CE2	1:A:176:GLN:HG3	2.55	0.41
1:A:276:HIS:HA	1:A:277:PRO:HD3	1.79	0.41
1:A:148:THR:HG21	1:A:166:PHE:HB2	2.01	0.41
4:A:1710:FMT:C	4:A:1734:FMT:O1	2.68	0.41
1:B:135:PHE:CD1	1:B:145:PHE:CZ	3.08	0.41
1:B:135:PHE:CE2	1:B:176:GLN:HG3	2.55	0.41
1:B:135:PHE:CZ	1:B:176:GLN:HG3	2.55	0.41
1:B:224:LYS:HD3	4:B:1728:FMT:C	2.51	0.41
1:A:76:THR:HB	1:A:203:LEU:HB3	2.02	0.41
1:B:57:ALA:O	4:B:1712:FMT:H	2.21	0.41
1:A:118:TYR:CD1	1:A:360[A]:ARG:CD	3.03	0.40
1:A:337:PHE:HD1	4:A:1732:FMT:H	1.85	0.40
1:B:344:ARG:HH12	4:B:1731:FMT:C	2.34	0.40
1:A:59:GLY:N	4:A:1734:FMT:H	2.31	0.40

All (4) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:154:GLN:NE2	5:A:2849:HOH:O[2_665]	1.45	0.75
5:A:2930:HOH:O	5:B:2217:HOH:O[1_554]	1.91	0.29
4:B:1721:FMT:O2	5:B:2177:HOH:O[2_665]	1.94	0.26
5:B:2009:HOH:O	5:B:2128:HOH:O[2_665]	2.17	0.03

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	497/505 (98%)	478 (96%)	19 (4%)	0	100	100
1	B	497/505 (98%)	482 (97%)	14 (3%)	1 (0%)	47	26
All	All	994/1010 (98%)	960 (97%)	33 (3%)	1 (0%)	51	29

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	369	ASP

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	436/442 (99%)	419 (96%)	17 (4%)	32	10
1	B	436/442 (99%)	425 (98%)	11 (2%)	47	22

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	872/884 (99%)	844 (97%)	28 (3%)	42 15

All (28) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	74	LYS
1	A	83	LYS
1	A	119	THR
1	A	131	THR
1	A	175	TYR
1	A	267	GLU
1	A	274[A]	ARG
1	A	274[B]	ARG
1	A	287	GLN
1	A	297[A]	VAL
1	A	297[B]	VAL
1	A	316	THR
1	A	377	TYR
1	A	414	TRP
1	A	418	TYR
1	A	475	TYR
1	A	488	LYS
1	B	74	LYS
1	B	119	THR
1	B	175	TYR
1	B	267	GLU
1	B	272	LYS
1	B	297[A]	VAL
1	B	297[B]	VAL
1	B	377	TYR
1	B	414	TRP
1	B	418	TYR
1	B	475	TYR

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	353	GLN
1	A	364	HIS
1	B	287	GLN
1	B	353	GLN

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)

39 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	$\#\|Z\| > 2$
4	FMT	B	1708	-	2,2,2	0.74	0	1,1,1	0.22	0
3	HEM	B	550	1	41,50,50	1.75	6 (14%)	45,82,82	2.15	16 (35%)
4	FMT	A	1733	-	2,2,2	0.61	0	1,1,1	0.22	0
4	FMT	B	1707	-	2,2,2	0.67	0	1,1,1	0.01	0
4	FMT	B	1726	-	2,2,2	0.74	0	1,1,1	0.27	0
4	FMT	B	1720	-	2,2,2	0.77	0	1,1,1	0.23	0
2	AZI	A	2600	4	0,2,2	-	-	0,1,1	-	-
4	FMT	B	1702	-	2,2,2	0.86	0	1,1,1	0.29	0
4	FMT	A	1734	-	2,2,2	0.60	0	1,1,1	0.32	0
4	FMT	A	1723	-	2,2,2	0.70	0	1,1,1	0.18	0
4	FMT	A	1732	-	2,2,2	1.01	0	1,1,1	0.37	0
4	FMT	A	1730	-	2,2,2	0.66	0	1,1,1	0.23	0
3	HEM	A	550	4,1	41,50,50	1.77	8 (19%)	45,82,82	1.88	10 (22%)
4	FMT	A	1706	-	2,2,2	0.66	0	1,1,1	0.17	0
4	FMT	A	1704	-	2,2,2	0.74	0	1,1,1	0.26	0
4	FMT	B	1728	-	2,2,2	0.63	0	1,1,1	0.18	0
4	FMT	A	1701	3	2,2,2	0.53	0	1,1,1	0.21	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
4	FMT	A	1710	1	2,2,2	0.68	0	1,1,1	0.26	0
4	FMT	A	1715	-	2,2,2	0.72	0	1,1,1	0.24	0
4	FMT	A	1724	-	2,2,2	0.71	0	1,1,1	0.14	0
4	FMT	B	1703	-	2,2,2	0.77	0	1,1,1	0.04	0
4	FMT	B	1736	-	2,2,2	0.57	0	1,1,1	0.26	0
4	FMT	A	1718	-	2,2,2	0.72	0	1,1,1	0.07	0
4	FMT	A	1725	-	2,2,2	0.64	0	1,1,1	0.12	0
4	FMT	B	1705	-	2,2,2	0.88	0	1,1,1	0.22	0
4	FMT	B	1717	-	2,2,2	0.55	0	1,1,1	0.01	0
4	FMT	A	1709	-	2,2,2	0.67	0	1,1,1	0.26	0
4	FMT	A	1714	-	2,2,2	1.03	0	1,1,1	0.44	0
4	FMT	A	1711	-	2,2,2	0.89	0	1,1,1	0.54	0
4	FMT	B	1729	-	2,2,2	0.69	0	1,1,1	0.26	0
4	FMT	A	1735	2	2,2,2	0.50	0	1,1,1	0.05	0
4	FMT	B	1712	-	2,2,2	0.56	0	1,1,1	0.13	0
4	FMT	A	1713	-	2,2,2	0.69	0	1,1,1	0.21	0
4	FMT	B	1727	-	2,2,2	0.64	0	1,1,1	0.12	0
4	FMT	A	1716	-	2,2,2	0.49	0	1,1,1	0.09	0
4	FMT	B	1731	-	2,2,2	0.45	0	1,1,1	0.20	0
4	FMT	B	1721	-	2,2,2	0.68	0	1,1,1	0.50	0
4	FMT	A	1722	-	2,2,2	0.63	0	1,1,1	0.19	0
4	FMT	A	1719	-	2,2,2	0.56	0	1,1,1	0.14	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
3	HEM	A	550	4,1	-	4/12/54/54	-
3	HEM	B	550	1	-	4/12/54/54	-

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	550	HEM	C3D-C2D	6.33	1.50	1.36
3	B	550	HEM	C3D-C2D	6.17	1.49	1.36
3	B	550	HEM	C3C-C2C	-4.27	1.34	1.40
3	A	550	HEM	C3C-C2C	-3.54	1.35	1.40
3	A	550	HEM	C3C-CAC	3.30	1.54	1.47
3	B	550	HEM	C3C-CAC	3.02	1.54	1.47
3	A	550	HEM	CMA-C3A	2.96	1.57	1.51

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	550	HEM	CAA-C2A	2.67	1.56	1.52
3	B	550	HEM	CAB-C3B	2.59	1.54	1.47
3	A	550	HEM	O2A-CGA	-2.23	1.23	1.30
3	A	550	HEM	CMC-C2C	2.09	1.56	1.51
3	B	550	HEM	FE-NB	2.09	2.07	1.96
3	A	550	HEM	CMB-C2B	2.08	1.55	1.50
3	B	550	HEM	CMA-C3A	2.07	1.55	1.51

All (26) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	B	550	HEM	C4D-ND-C1D	6.97	112.27	105.07
3	A	550	HEM	C4D-ND-C1D	5.92	111.19	105.07
3	B	550	HEM	CHA-C4D-ND	4.61	130.07	124.38
3	A	550	HEM	CAD-CBD-CGD	-3.93	105.15	113.60
3	A	550	HEM	CHD-C1D-ND	3.91	128.68	124.43
3	B	550	HEM	CBA-CAA-C2A	-3.72	106.28	112.62
3	B	550	HEM	CAD-CBD-CGD	-3.45	106.17	113.60
3	B	550	HEM	C3D-C4D-ND	-3.43	106.34	110.17
3	A	550	HEM	C4B-C3B-C2B	3.34	109.77	107.11
3	A	550	HEM	C2C-C3C-C4C	3.15	109.10	106.90
3	A	550	HEM	CMD-C2D-C1D	2.94	129.51	125.04
3	A	550	HEM	CHA-C4D-ND	2.94	128.01	124.38
3	B	550	HEM	CHD-C1D-ND	2.92	127.60	124.43
3	B	550	HEM	C1B-NB-C4B	2.89	108.06	105.07
3	A	550	HEM	CBA-CAA-C2A	-2.62	108.14	112.62
3	B	550	HEM	CMD-C2D-C1D	2.46	128.78	125.04
3	A	550	HEM	CHB-C1B-NB	2.43	127.39	124.38
3	B	550	HEM	C4B-C3B-C2B	2.43	109.04	107.11
3	B	550	HEM	C2C-C3C-C4C	2.42	108.59	106.90
3	B	550	HEM	O1D-CGD-CBD	-2.35	115.55	123.08
3	B	550	HEM	CMA-C3A-C4A	-2.22	125.05	128.46
3	B	550	HEM	C4C-CHD-C1D	2.18	125.44	122.56
3	B	550	HEM	CHB-C1B-NB	2.12	127.01	124.38
3	B	550	HEM	O2A-CGA-CBA	2.12	120.84	114.03
3	A	550	HEM	C4C-CHD-C1D	2.05	125.26	122.56
3	B	550	HEM	CAD-C3D-C2D	-2.00	124.15	127.88

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	550	HEM	C2B-C3B-CAB-CBB
3	A	550	HEM	C4B-C3B-CAB-CBB
3	B	550	HEM	C2B-C3B-CAB-CBB
3	A	550	HEM	CAD-CBD-CGD-O2D
3	B	550	HEM	CAD-CBD-CGD-O2D
3	B	550	HEM	CAD-CBD-CGD-O1D
3	B	550	HEM	C4B-C3B-CAB-CBB
3	A	550	HEM	CAD-CBD-CGD-O1D

There are no ring outliers.

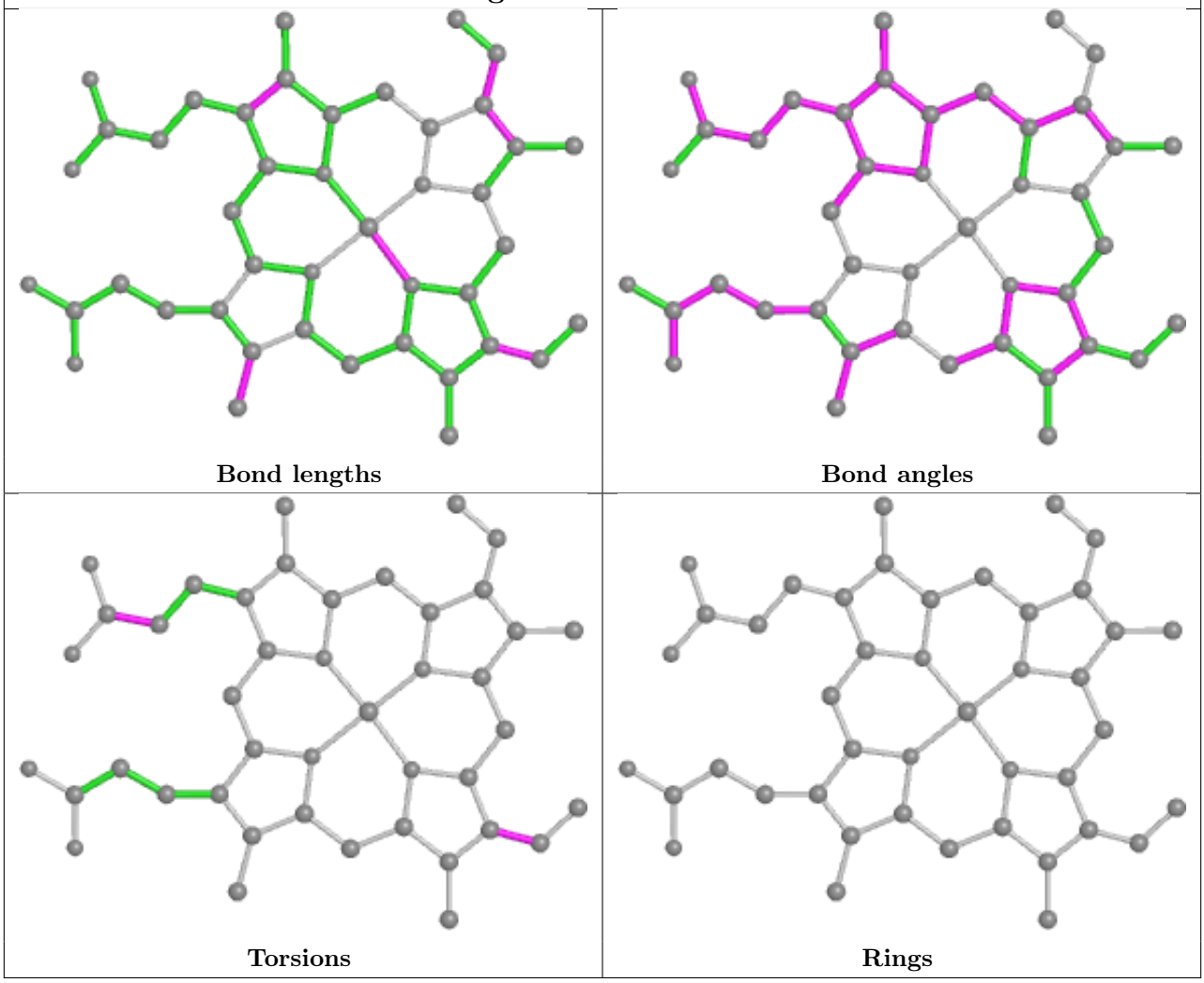
19 monomers are involved in 41 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	550	HEM	5	0
4	B	1720	FMT	1	0
2	A	2600	AZI	1	0
4	B	1702	FMT	1	0
4	A	1734	FMT	4	0
4	A	1732	FMT	3	0
4	A	1730	FMT	1	0
3	A	550	HEM	1	0
4	B	1728	FMT	1	0
4	A	1701	FMT	1	0
4	A	1710	FMT	1	0
4	A	1718	FMT	1	0
4	B	1705	FMT	1	0
4	A	1714	FMT	4	0
4	B	1729	FMT	3	0
4	A	1735	FMT	4	0
4	B	1712	FMT	5	0
4	B	1731	FMT	3	0
4	B	1721	FMT	1	1

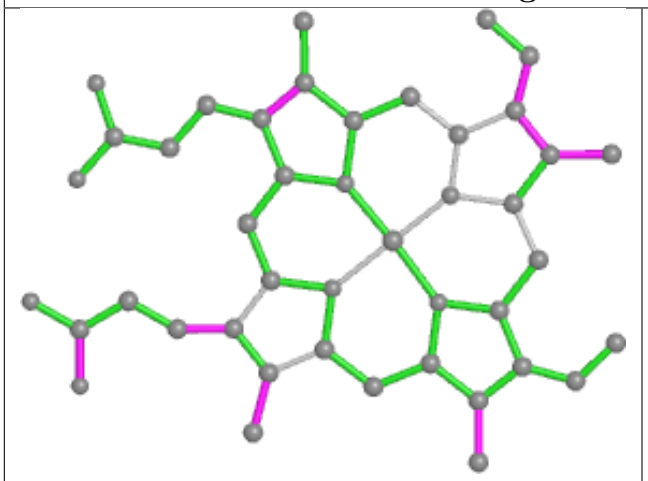
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

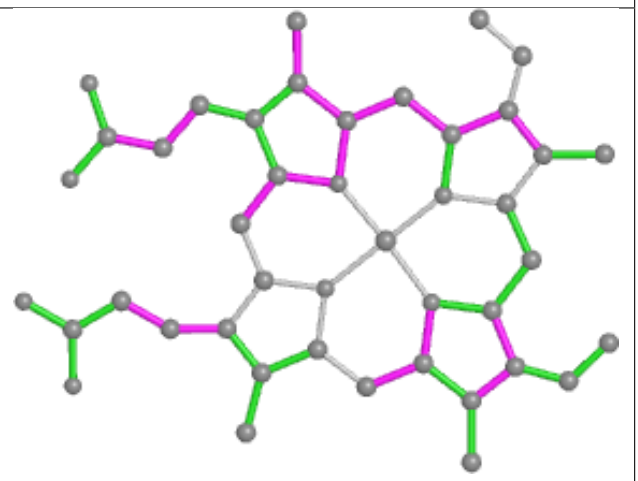
Ligand HEM B 550



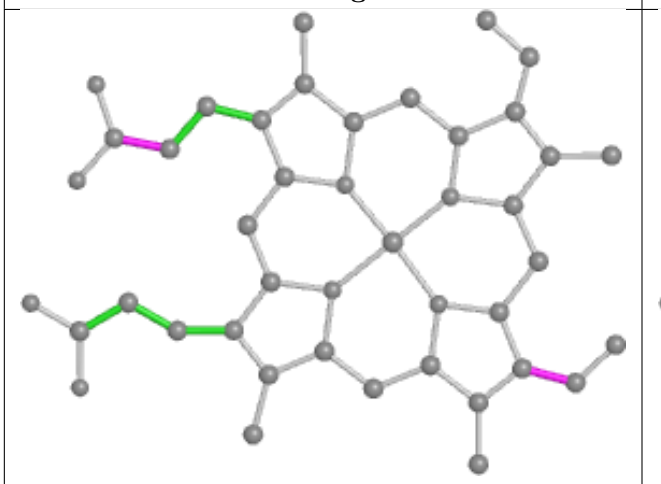
Ligand HEM A 550



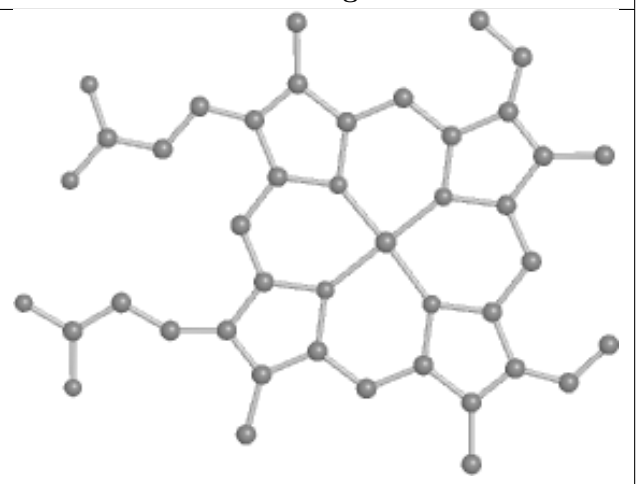
Bond lengths



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	490/505 (97%)	0.98	64 (13%)	3	2	5, 14, 25, 48	2 (0%)
1	B	490/505 (97%)	0.85	48 (9%)	7	6	5, 12, 23, 47	1 (0%)
All	All	980/1010 (97%)	0.91	112 (11%)	5	4	5, 13, 24, 48	3 (0%)

All (112) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	489	MET	9.1
1	B	489	MET	8.9
1	A	488	LYS	6.8
1	A	266	PRO	5.7
1	B	268	GLU	5.6
1	A	490	MET	5.5
1	A	272	LYS	5.2
1	A	287	GLN	5.2
1	A	290	PRO	4.7
1	B	490	MET	4.6
1	A	268	GLU	4.4
1	A	2	VAL	4.0
1	B	15	PRO	3.9
1	A	271	LYS	3.8
1	A	459	GLU	3.8
1	B	273	TYR	3.7
1	A	269	ASP	3.7
1	A	274[A]	ARG	3.7
1	A	289	TYR	3.6
1	A	84	VAL	3.6
1	B	456	THR	3.5
1	A	246	LEU	3.4
1	B	264	VAL	3.4
1	A	458	LYS	3.4

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Mol	Chain	Res	Type	RSRZ
1	A	3	ASN	3.2
1	B	396	SER	3.2
1	B	23	ILE	3.2
1	B	458	LYS	3.1
1	A	460	ILE	3.1
1	A	477	GLU	3.1
1	B	390	GLY	3.1
1	A	31	VAL	3.1
1	A	409	LYS	3.0
1	B	402	PHE	3.0
1	A	83	LYS	3.0
1	B	488	LYS	3.0
1	B	212	TRP	3.0
1	B	286	THR	3.0
1	A	212	TRP	2.9
1	A	69	THR	2.9
1	B	16	VAL	2.9
1	B	455	VAL	2.8
1	A	454	HIS	2.8
1	A	206	ALA	2.8
1	B	452	LEU	2.8
1	A	332	LEU	2.8
1	B	472	ASP	2.8
1	A	213	VAL	2.7
1	B	289	TYR	2.7
1	B	31	VAL	2.7
1	A	286	THR	2.7
1	B	397	ALA	2.7
1	A	15	PRO	2.7
1	A	437	PRO	2.7
1	A	362	PRO	2.6
1	B	487	GLN	2.6
1	A	262	ILE	2.6
1	B	177	VAL	2.6
1	A	74	LYS	2.6
1	B	460	ILE	2.6
1	A	4	LYS	2.6
1	B	82	SER	2.6
1	A	297[A]	VAL	2.5
1	B	404	LEU	2.5
1	A	273	TYR	2.5
1	A	487	GLN	2.5

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Mol	Chain	Res	Type	RSRZ
1	B	477	GLU	2.5
1	B	290	PRO	2.5
1	B	468	PHE	2.5
1	A	16	VAL	2.5
1	A	234	ILE	2.5
1	A	469	LYS	2.4
1	A	419	ARG	2.4
1	A	275	PHE	2.4
1	A	453	ALA	2.4
1	B	332	LEU	2.4
1	A	411	PHE	2.3
1	A	42	LEU	2.3
1	A	120	GLU	2.3
1	B	223	VAL	2.3
1	A	473	PRO	2.2
1	B	473	PRO	2.2
1	A	164	TRP	2.2
1	A	324	ILE	2.2
1	B	206	ALA	2.2
1	B	275	PHE	2.2
1	B	362	PRO	2.2
1	A	285	TYR	2.2
1	B	72	ILE	2.2
1	B	474	LYS	2.2
1	A	237	HIS	2.2
1	B	457	HIS	2.1
1	B	471	ALA	2.1
1	B	400	PRO	2.1
1	A	371	TYR	2.1
1	A	468	PHE	2.1
1	A	322	PRO	2.1
1	A	288	ASP	2.1
1	A	421	ASP	2.1
1	B	287	GLN	2.1
1	A	231	ALA	2.1
1	B	231	ALA	2.1
1	A	399	ASP	2.1
1	B	274[A]	ARG	2.0
1	B	360	ARG	2.0
1	B	389	PRO	2.0
1	A	229	GLU	2.0
1	A	75	TYR	2.0

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Mol	Chain	Res	Type	RSRZ
1	B	425	TYR	2.0
1	A	452	LEU	2.0
1	B	119	THR	2.0
1	A	167	TRP	2.0

6.2 Non-standard residues in protein, DNA, RNA chains (i)

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

6.3 Carbohydrates (i)

There are no monosaccharides in this entry.

6.4 Ligands (i)

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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
4	FMT	A	1724	3/3	0.53	0.20	48,48,48,48	0
4	FMT	A	1725	3/3	0.61	0.12	41,41,41,42	0
4	FMT	B	1736	3/3	0.62	0.41	29,29,31,31	0
4	FMT	B	1728	3/3	0.63	0.16	49,49,50,50	0
4	FMT	A	1730	3/3	0.63	0.16	38,38,39,39	0
4	FMT	B	1703	3/3	0.64	0.22	27,27,30,32	0
4	FMT	B	1707	3/3	0.67	0.18	38,38,39,39	0
4	FMT	B	1717	3/3	0.70	0.18	34,34,36,36	0
4	FMT	A	1715	3/3	0.70	0.25	49,49,49,49	0
4	FMT	A	1701	3/3	0.70	0.24	26,26,28,29	0
4	FMT	B	1702	3/3	0.71	0.27	38,38,39,41	0
4	FMT	A	1734	3/3	0.72	0.29	26,26,28,29	0
4	FMT	B	1721	3/3	0.76	0.20	38,38,39,40	0
4	FMT	B	1729	3/3	0.79	0.17	45,45,45,45	0
4	FMT	B	1727	3/3	0.79	0.17	36,36,37,38	0
4	FMT	A	1723	3/3	0.80	0.17	54,54,54,54	0
4	FMT	B	1720	3/3	0.82	0.19	30,30,31,31	0
4	FMT	A	1735	3/3	0.82	0.11	22,22,25,28	0
4	FMT	A	1719	3/3	0.83	0.19	27,27,28,28	0

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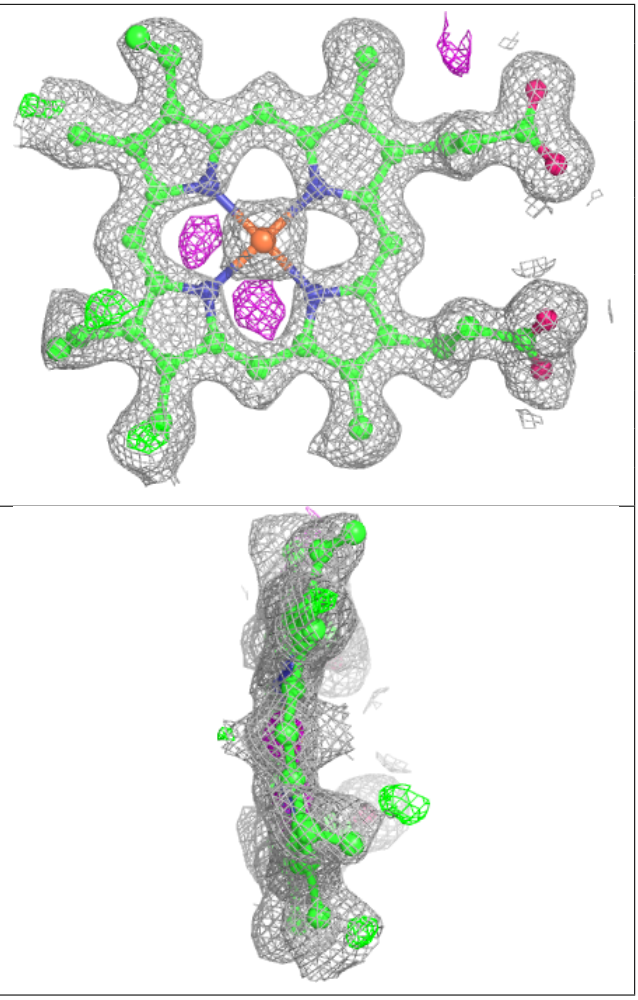
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
4	FMT	A	1706	3/3	0.84	0.13	42,42,42,42	0
4	FMT	A	1722	3/3	0.84	0.14	39,39,39,40	0
4	FMT	B	1731	3/3	0.85	0.21	13,13,21,27	0
4	FMT	A	1713	3/3	0.87	0.16	24,24,26,29	0
2	AZI	A	2600	3/3	0.87	0.16	11,11,18,22	0
4	FMT	A	1733	3/3	0.87	0.15	27,27,27,28	0
4	FMT	A	1709	3/3	0.87	0.10	39,39,39,39	0
4	FMT	B	1712	3/3	0.88	0.17	24,24,24,26	0
4	FMT	A	1704	3/3	0.88	0.20	42,42,43,44	0
4	FMT	B	1705	3/3	0.88	0.19	32,32,34,36	0
4	FMT	A	1716	3/3	0.88	0.12	18,18,20,23	0
4	FMT	B	1726	3/3	0.88	0.11	54,54,55,55	0
4	FMT	A	1718	3/3	0.91	0.09	28,28,30,30	0
4	FMT	A	1711	3/3	0.91	0.13	32,32,33,33	0
4	FMT	A	1710	3/3	0.92	0.09	32,32,32,32	0
4	FMT	A	1732	3/3	0.93	0.14	15,15,23,29	0
3	HEM	A	550	43/43	0.93	0.15	7,10,14,20	0
3	HEM	B	550	43/43	0.94	0.13	5,9,15,21	0
4	FMT	A	1714	3/3	0.95	0.12	17,17,22,27	0
4	FMT	B	1708	3/3	0.96	0.13	32,32,33,33	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

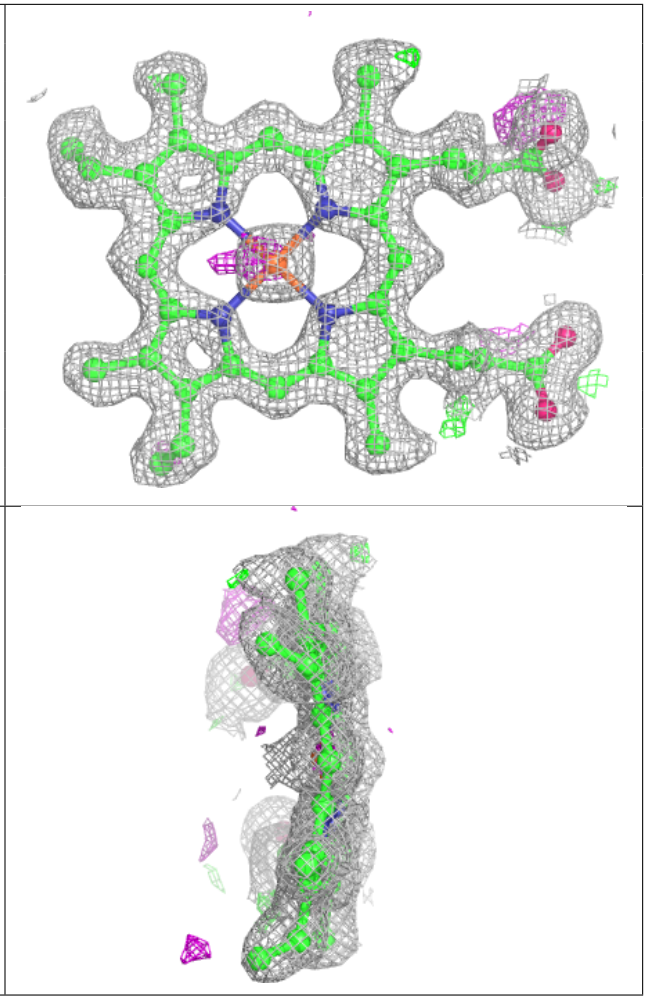
Electron density around HEM A 550:

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



Electron density around HEM B 550:

$2mF_o$-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.