Full wwPDB X-ray Structure Validation Report ⓘ

Aug 23, 2026 – 05:35 am BST

PDB ID	:	4C3A / pdb_00004c3a
Title	:	Structure of bovine endothelial nitric oxide synthase heme domain in complex with 6-((((3S, 5R)-5-(((6-amino-4-methylpyridin-2-yl)methoxy) methyl)pyrrolidin-3-yl)oxy) methyl)-4-methylpyridin-2-amine
Authors	:	Li, H.; Poulos, T.L.
Deposited on	:	2013-08-22
Resolution	:	2.20 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:

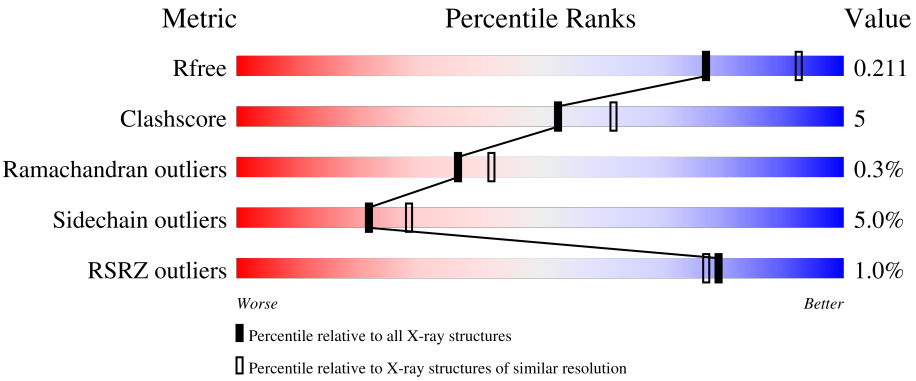
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

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 2.20 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	6164 (2.20-2.20)
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)
RSRZ outliers	180081	6166 (2.20-2.20)

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	443	% 81% 9% · 9%
1	B	443	% 81% 8% · 9%

2 Entry composition (i)

There are 8 unique types of molecules in this entry. The entry contains 6897 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.

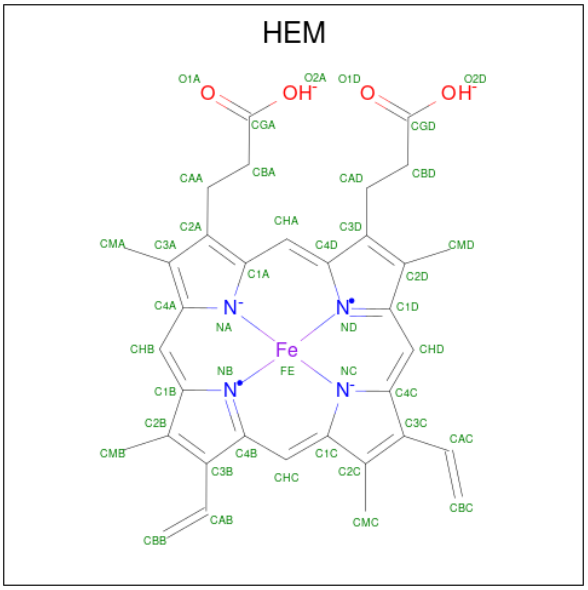
- Molecule 1 is a protein called NITRIC OXIDE SYNTHASE, ENDOTHELIAL.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	405	Total	As	C	N	O	S	0	0	0
			3223	1	2049	568	589	16			
1	B	403	Total	As	C	N	O	S	0	0	0
			3212	1	2042	566	587	16			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	100	ARG	CYS	SEE REMARK 999	UNP P29473
B	100	ARG	CYS	SEE REMARK 999	UNP P29473

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



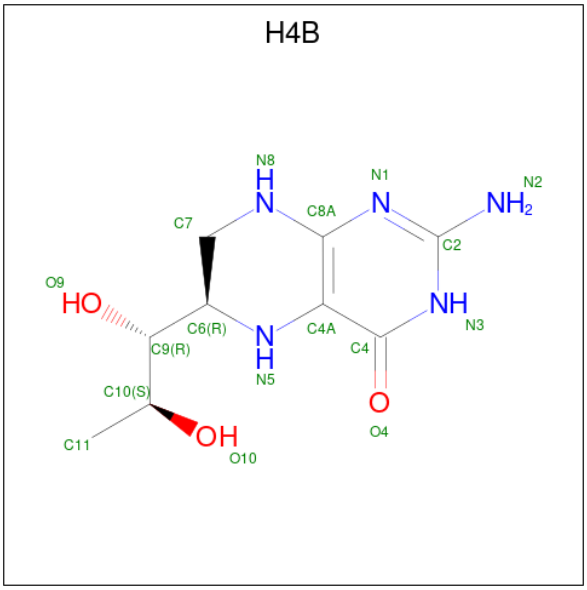
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

Continued on next page...

Continued from previous page...

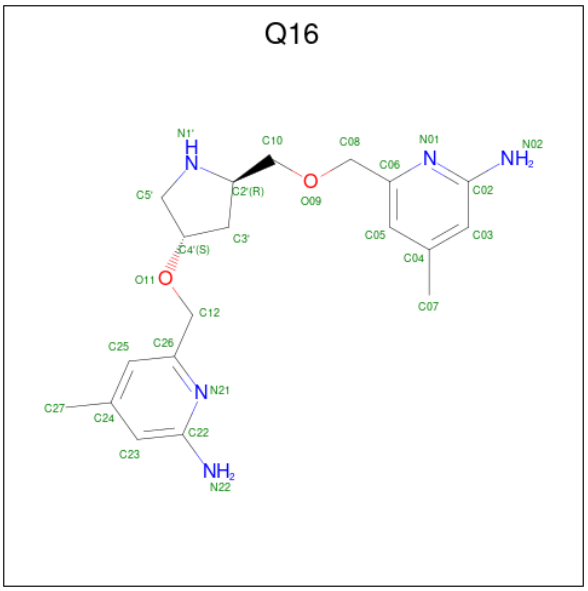
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

- Molecule 3 is 5,6,7,8-TETRAHYDROBIOPTERIN (CCD ID: H4B) (formula: $C_9H_{15}N_5O_3$).



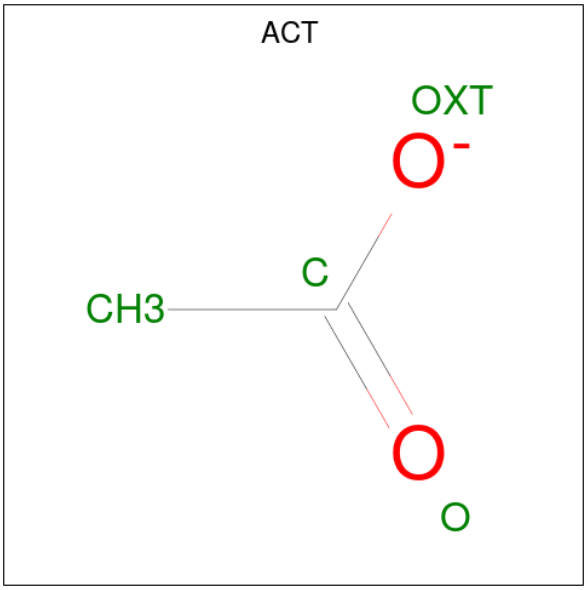
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O		0	0
			17	9	5	3			
3	B	1	Total	C	N	O		0	0
			17	9	5	3			

- Molecule 4 is 6-((((3S, 5R)-5-(((6-amino-4-methylpyridin-2-yl)methoxy)methyl)pyrrolidin-3-yl)oxy)methyl)-4-methylpyridin-2-amine (CCD ID: Q16) (formula: $C_{19}H_{27}N_5O_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			26	19	5	2		
4	B	1	Total	C	N	O	0	0
			26	19	5	2		

- Molecule 5 is ACETATE ION (CCD ID: ACT) (formula: $C_2H_3O_2$).



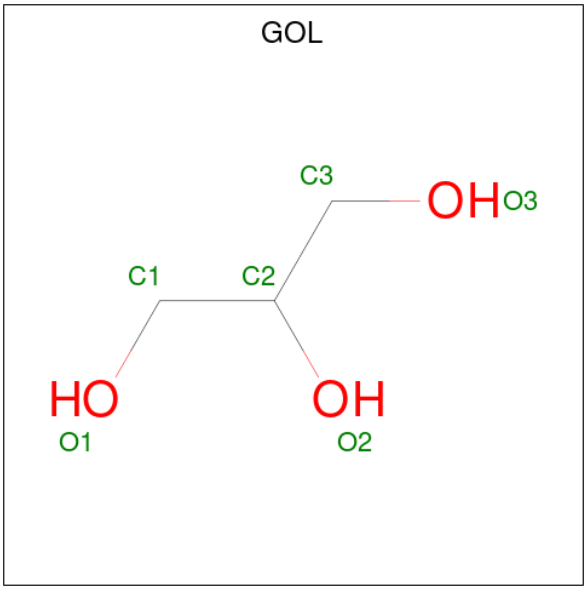
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			4	2	2		
5	A	1	Total	C	O	0	0
			4	2	2		

Continued on next page...

Continued from previous page...

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

- Molecule 6 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	1	Total C O 6 3 3	0	0
6	B	1	Total C O 6 3 3	0	0

- Molecule 7 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	A	1	Total Zn 1 1	0	0

- Molecule 8 is water.

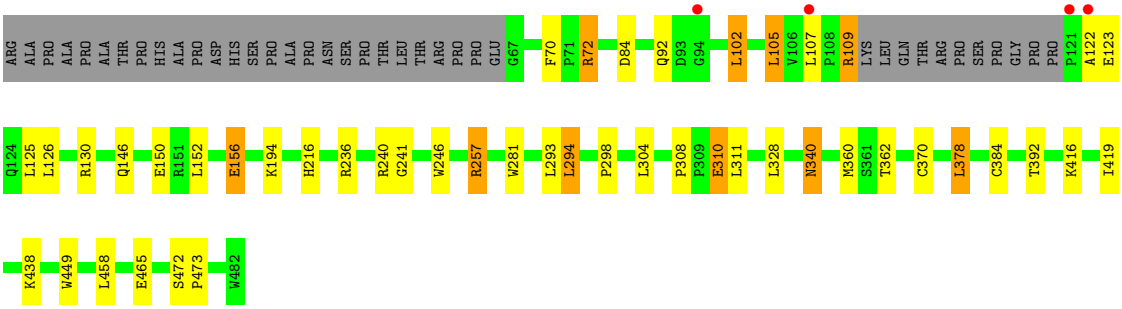
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	143	Total O 143 143	0	0
8	B	118	Total O 118 118	0	0

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.

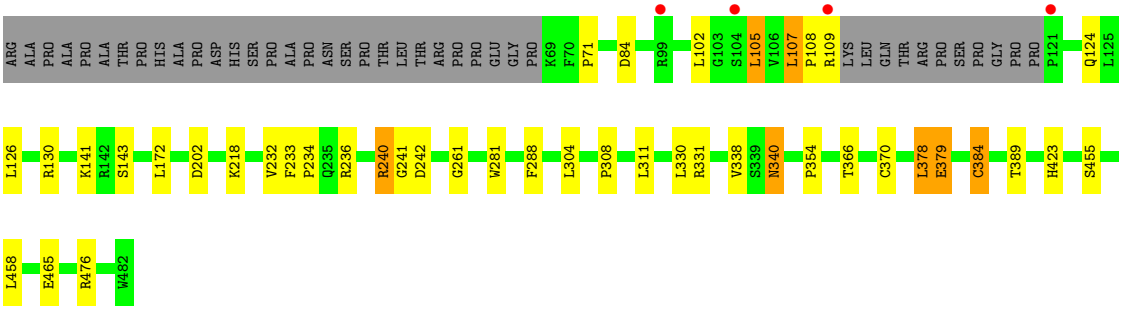
• Molecule 1: NITRIC OXIDE SYNTHASE, ENDOTHELIAL

Chain A:



• Molecule 1: NITRIC OXIDE SYNTHASE, ENDOTHELIAL

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	57.72Å 106.25Å 156.66Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.30 – 2.20 48.30 – 2.20	Depositor EDS
% Data completeness (in resolution range)	98.4 (48.30-2.20) 98.4 (48.30-2.20)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.47 (at 2.20Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.166 , 0.212 0.164 , 0.211	Depositor DCC
R_{free} test set	2450 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å^2)	41.2	Xtriage
Anisotropy	0.467	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 36.9	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	0.97	EDS
Total number of atoms	6897	wwPDB-VP
Average B, all atoms (Å^2)	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.92% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CAS, ZN, H4B, ACT, Q16, GOL, 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	0.77	0/3303	0.91	0/4497
1	B	0.74	0/3291	0.90	1/4480 (0.0%)
All	All	0.75	0/6594	0.90	1/8977 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	240	ARG	N-CA-C	5.36	116.99	108.79

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	3223	0	3127	37	0
1	B	3212	0	3117	27	0
2	A	43	0	30	2	0
2	B	43	0	30	4	0
3	A	17	0	15	1	0
3	B	17	0	15	0	0
4	A	26	0	27	2	0
4	B	26	0	27	0	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	8	0	6	0	0
5	B	8	0	6	0	0
6	A	6	0	8	0	0
6	B	6	0	8	0	0
7	A	1	0	0	0	0
8	A	143	0	0	2	0
8	B	118	0	0	3	0
All	All	6897	0	6416	65	0

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

All (65) 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:384:CAS:SG	1:A:384:CAS:AS	2.52	1.28
1:B:384:CAS:SG	1:B:384:CAS:AS	2.59	1.20
2:B:500:HEM:HMC2	2:B:500:HEM:HBC2	1.48	0.96
1:A:257:ARG:HG3	1:A:257:ARG:HH11	1.27	0.96
2:A:500:HEM:HBA2	4:A:800:Q16:H082	1.54	0.86
1:A:240:ARG:HD3	1:A:298:PRO:HB3	1.57	0.86
1:A:257:ARG:HG3	1:A:257:ARG:NH1	1.96	0.77
1:A:310:GLU:H	1:A:310:GLU:CD	1.98	0.71
1:B:236:ARG:HD2	1:B:242:ASP:OD1	1.95	0.67
1:A:240:ARG:HD3	1:A:298:PRO:CB	2.26	0.66
1:B:107:LEU:HD23	1:B:108:PRO:HD2	1.83	0.60
1:A:384:CAS:SG	1:A:384:CAS:CE1	2.91	0.59
1:A:384:CAS:AS	1:A:384:CAS:CB	3.10	0.59
1:B:233:PHE:HB3	1:B:234:PRO:CD	2.33	0.58
1:B:476:ARG:NH1	8:B:2114:HOH:O	2.24	0.57
1:B:233:PHE:HB3	1:B:234:PRO:HD2	1.86	0.57
1:A:126:LEU:HD23	1:A:130:ARG:NH2	2.20	0.57
1:B:71:PRO:HG2	1:B:84:ASP:HB3	1.87	0.57
1:A:246:TRP:HB2	1:A:294:LEU:HB3	1.87	0.55
2:B:500:HEM:HMC2	2:B:500:HEM:CBC	2.32	0.53
1:A:472:SER:HA	1:A:473:PRO:C	2.33	0.52
1:B:281:TRP:HB2	1:B:304:LEU:HD21	1.92	0.52
1:A:240:ARG:HD2	1:A:241:GLY:O	2.11	0.51
1:B:366:THR:O	1:B:370:CYS:HB2	2.11	0.51
1:B:126:LEU:O	1:B:130:ARG:HG3	2.11	0.51
1:A:236:ARG:HB2	1:A:236:ARG:NH1	2.26	0.50

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:126:LEU:HD11	1:A:156:GLU:HA	1.94	0.49
1:A:449:TRP:HA	3:A:600:H4B:N1	2.27	0.49
1:A:146:GLN:HG2	1:A:150:GLU:OE2	2.14	0.48
1:A:378:LEU:HB2	8:A:2102:HOH:O	2.14	0.47
1:A:340:ASN:H	1:A:340:ASN:HD22	1.60	0.47
1:A:281:TRP:HB2	1:A:304:LEU:HD21	1.96	0.47
1:A:109:ARG:HB2	1:A:109:ARG:HH11	1.80	0.47
2:B:500:HEM:HBB2	2:B:500:HEM:HHC	1.98	0.46
1:A:392:THR:HB	1:B:423:HIS:HB2	1.97	0.46
1:A:308:PRO:CB	1:A:310:GLU:OE2	2.64	0.46
2:A:500:HEM:CBA	4:A:800:Q16:H082	2.35	0.46
1:A:105:LEU:HD22	1:B:465:GLU:HB3	1.99	0.45
1:B:172:LEU:HD11	1:B:232:VAL:HG11	1.99	0.45
1:B:370:CYS:SG	1:B:378:LEU:HD13	2.57	0.45
1:B:378:LEU:HB2	8:B:2090:HOH:O	2.17	0.45
1:B:455:SER:O	1:B:458:LEU:HB2	2.17	0.44
1:B:384:CAS:SG	1:B:384:CAS:CE1	3.05	0.44
1:A:72:ARG:H	1:B:109:ARG:NE	2.16	0.43
1:B:288:PHE:CB	1:B:331:ARG:HD3	2.48	0.43
1:A:105:LEU:HD23	1:A:105:LEU:N	2.33	0.43
1:A:310:GLU:CD	1:A:310:GLU:N	2.73	0.43
1:B:340:ASN:HD22	1:B:340:ASN:H	1.67	0.43
1:A:236:ARG:HB2	1:A:236:ARG:HH11	1.83	0.43
1:A:370:CYS:SG	1:A:378:LEU:HD13	2.58	0.42
1:B:384:CAS:AS	1:B:384:CAS:CB	3.26	0.42
1:A:70:PHE:HB3	1:A:84:ASP:O	2.19	0.42
2:B:500:HEM:HBC2	2:B:500:HEM:CMC	2.30	0.42
1:A:360:MET:HE3	1:A:362:THR:OG1	2.19	0.42
1:A:216:HIS:CD2	1:A:216:HIS:C	2.97	0.42
1:A:152:LEU:O	1:A:156:GLU:HG2	2.20	0.41
1:A:308:PRO:HB2	1:A:310:GLU:OE2	2.20	0.41
1:A:438:LYS:NZ	8:A:2124:HOH:O	2.54	0.41
1:B:240:ARG:HD2	1:B:241:GLY:O	2.21	0.41
1:B:308:PRO:HD2	1:B:311:LEU:HD12	2.01	0.41
1:A:102:LEU:HD11	1:B:71:PRO:HB3	2.03	0.41
1:A:384:CAS:AS	1:A:384:CAS:HB2	2.81	0.40
1:A:465:GLU:HB3	1:B:105:LEU:HD22	2.04	0.40
1:B:338:VAL:O	1:B:354:PRO:HA	2.21	0.40
1:B:379:GLU:HB2	8:B:2092:HOH:O	2.21	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	400/443 (90%)	391 (98%)	8 (2%)	1 (0%)	36	42
1	B	398/443 (90%)	388 (98%)	9 (2%)	1 (0%)	36	42
All	All	798/886 (90%)	779 (98%)	17 (2%)	2 (0%)	36	42

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	122	ALA
1	B	261	GLY

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	343/375 (92%)	322 (94%)	21 (6%)	17	20
1	B	342/375 (91%)	329 (96%)	13 (4%)	29	40
All	All	685/750 (91%)	651 (95%)	34 (5%)	22	28

All (34) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	72	ARG
1	A	92	GLN
1	A	102	LEU
1	A	105	LEU

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	107	LEU
1	A	109	ARG
1	A	123	GLU
1	A	125	LEU
1	A	156	GLU
1	A	194	LYS
1	A	257	ARG
1	A	293	LEU
1	A	294	LEU
1	A	310	GLU
1	A	311	LEU
1	A	328	LEU
1	A	340	ASN
1	A	378	LEU
1	A	416	LYS
1	A	419	ILE
1	A	458	LEU
1	B	102	LEU
1	B	105	LEU
1	B	107	LEU
1	B	124	GLN
1	B	141	LYS
1	B	143	SER
1	B	202	ASP
1	B	218	LYS
1	B	330	LEU
1	B	340	ASN
1	B	378	LEU
1	B	379	GLU
1	B	389	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (17) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	91	GLN
1	A	128	GLN
1	A	153	GLN
1	A	166	HIS
1	A	191	GLN
1	A	340	ASN
1	A	376	ASN
1	A	413	GLN

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	468	ASN
1	A	478	GLN
1	B	178	GLN
1	B	225	ASN
1	B	278	GLN
1	B	340	ASN
1	B	376	ASN
1	B	410	HIS
1	B	478	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)

2 non-standard protein/DNA/RNA residues 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	$\#\|Z\| > 2$
1	CAS	A	384	1	5,8,9	1.04	0	1,9,11	0.11	0
1	CAS	B	384	1	5,8,9	1.34	1 (20%)	1,9,11	0.01	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	CAS	A	384	1	-	0/0/7/9	-
1	CAS	B	384	1	-	0/0/7/9	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	384	CAS	AS-CE1	2.03	2.01	1.96

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	384	CAS	4	0
1	B	384	CAS	3	0

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

Of 13 ligands modelled in this entry, 1 is monoatomic - leaving 12 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	HEM	A	500	1	50,50,50	1.48	7 (14%)	66,82,82	1.81	17 (25%)
6	GOL	B	880	-	5,5,5	0.33	0	5,5,5	0.53	0
6	GOL	A	880	-	5,5,5	0.31	0	5,5,5	0.63	0
4	Q16	A	800	-	26,28,28	0.84	0	33,38,38	1.37	5 (15%)
5	ACT	B	860	-	3,3,3	0.73	0	3,3,3	0.91	0
3	H4B	A	600	-	15,18,18	0.98	1 (6%)	11,26,26	1.97	4 (36%)
5	ACT	A	860	-	3,3,3	0.76	0	3,3,3	0.75	0
5	ACT	B	861	-	3,3,3	0.88	0	3,3,3	0.40	0
2	HEM	B	500	1	50,50,50	1.50	6 (12%)	66,82,82	1.79	13 (19%)
3	H4B	B	600	-	15,18,18	0.81	0	11,26,26	2.40	7 (63%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
4	Q16	B	800	-	26,28,28	0.68	0	33,38,38	1.79	6 (18%)
5	ACT	A	861	-	3,3,3	0.89	0	3,3,3	0.56	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
2	HEM	A	500	1	-	2/14/54/54	-
6	GOL	B	880	-	-	0/4/4/4	-
4	Q16	A	800	-	-	2/11/20/20	0/3/3/3
3	H4B	A	600	-	-	0/8/17/17	0/2/2/2
2	HEM	B	500	1	-	2/14/54/54	-
3	H4B	B	600	-	-	1/8/17/17	0/2/2/2
4	Q16	B	800	-	-	2/11/20/20	0/3/3/3
6	GOL	A	880	-	-	0/4/4/4	-

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	500	HEM	C1B-NB	-4.55	1.32	1.40
2	B	500	HEM	FE-NB	4.42	2.08	1.94
2	B	500	HEM	FE-NC	3.90	2.08	1.95
2	B	500	HEM	C1B-NB	-3.69	1.33	1.40
2	A	500	HEM	FE-NB	3.62	2.06	1.94
2	A	500	HEM	FE-NC	3.31	2.06	1.95
2	A	500	HEM	C3B-C4B	2.68	1.50	1.44
2	B	500	HEM	C3B-C4B	2.43	1.49	1.44
2	A	500	HEM	C1C-C2C	-2.37	1.40	1.45
2	A	500	HEM	C4D-C3D	2.37	1.49	1.45
2	B	500	HEM	C3C-C4C	-2.35	1.41	1.46
2	B	500	HEM	C4C-NC	-2.16	1.35	1.39
3	A	600	H4B	C4-N3	-2.05	1.35	1.38
2	A	500	HEM	C4B-NB	-2.00	1.34	1.38

All (52) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	B	800	Q16	C02-N01-C06	5.05	121.93	118.10
2	A	500	HEM	C1B-NB-C4B	5.01	110.25	105.07

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	B	800	Q16	C3'-C4'-C5'	4.59	107.77	103.65
3	B	600	H4B	C2-N1-C8A	4.55	121.64	113.43
2	A	500	HEM	CHC-C4B-NB	4.35	129.14	124.42
2	B	500	HEM	C1B-NB-C4B	4.23	109.45	105.07
2	A	500	HEM	CHD-C1D-ND	4.12	128.89	124.42
2	B	500	HEM	CBA-CAA-C2A	-4.04	101.40	112.63
2	B	500	HEM	CHD-C1D-C2D	-4.03	118.68	124.98
2	B	500	HEM	CHD-C1D-ND	4.03	128.79	124.42
3	A	600	H4B	C2-N1-C8A	3.95	120.56	113.43
2	A	500	HEM	CHD-C1D-C2D	-3.91	118.86	124.98
3	B	600	H4B	O4-C4-C4A	-3.74	118.66	127.24
2	B	500	HEM	CHC-C4B-NB	3.67	128.41	124.42
2	B	500	HEM	C1A-CHA-C4D	-3.57	117.87	126.34
2	B	500	HEM	CHA-C4D-ND	3.55	128.76	124.37
4	A	800	Q16	C3'-C2'-C10	-3.50	107.10	113.26
2	A	500	HEM	C4C-CHD-C1D	-3.47	118.58	126.06
2	B	500	HEM	C4C-NC-C1C	3.46	108.74	105.35
4	B	800	Q16	C22-N21-C26	3.24	120.56	118.10
2	A	500	HEM	C1A-CHA-C4D	-3.24	118.66	126.34
2	A	500	HEM	CHB-C1B-NB	3.21	128.34	124.37
4	B	800	Q16	C04-C05-C06	-3.18	118.24	120.32
2	B	500	HEM	CHA-C4D-C3D	-3.14	119.43	125.33
2	A	500	HEM	CHA-C4D-C3D	-3.11	119.49	125.33
2	A	500	HEM	CBA-CAA-C2A	-3.11	104.00	112.63
2	A	500	HEM	O2D-CGD-O1D	-2.92	116.03	123.30
2	A	500	HEM	CHA-C4D-ND	2.88	127.93	124.37
3	B	600	H4B	C4A-C4-N3	2.76	120.54	112.31
2	A	500	HEM	O2D-CGD-CBD	2.72	122.77	114.03
2	B	500	HEM	C4C-CHD-C1D	-2.64	120.36	126.06
4	A	800	Q16	C02-N01-C06	2.63	120.09	118.10
3	B	600	H4B	C2-N3-C4	-2.62	120.32	125.10
2	A	500	HEM	C4B-C3B-C2B	-2.61	105.04	107.11
2	A	500	HEM	C4A-CHB-C1B	-2.56	120.28	126.34
2	B	500	HEM	CHD-C4C-NC	2.54	127.19	124.44
4	A	800	Q16	C22-N21-C26	2.53	120.02	118.10
2	B	500	HEM	C4B-C3B-C2B	-2.47	105.15	107.11
2	A	500	HEM	CHA-C1A-NA	2.38	128.23	123.85
2	A	500	HEM	C4C-NC-C1C	2.36	107.66	105.35
4	A	800	Q16	N22-C22-N21	2.36	120.22	116.49
3	A	600	H4B	C4-C4A-N5	2.34	123.04	116.76
4	B	800	Q16	C05-C06-N01	-2.26	120.51	122.90
3	A	600	H4B	C4A-C4-N3	2.25	119.01	112.31

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	A	800	Q16	C10-C2'-N1'	-2.21	107.68	111.58
3	A	600	H4B	O4-C4-C4A	-2.21	122.18	127.24
3	B	600	H4B	C4-C4A-N5	2.18	122.61	116.76
3	B	600	H4B	N2-C2-N3	2.16	121.31	116.71
2	B	500	HEM	C2D-C1D-ND	2.10	112.40	109.88
4	B	800	Q16	C08-C06-C05	2.08	123.98	121.08
3	B	600	H4B	N3-C2-N1	-2.05	119.50	123.32
2	A	500	HEM	C3D-C4D-ND	2.04	112.44	110.17

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	800	Q16	C5'-C4'-O11-C12
4	B	800	Q16	C5'-C4'-O11-C12
4	A	800	Q16	C06-C08-O09-C10
4	B	800	Q16	O09-C10-C2'-N1'
3	B	600	H4B	O10-C10-C9-O9
2	A	500	HEM	CAA-CBA-CGA-O2A
2	B	500	HEM	CAD-CBD-CGD-O2D
2	A	500	HEM	CAA-CBA-CGA-O1A
2	B	500	HEM	CAD-CBD-CGD-O1D

There are no ring outliers.

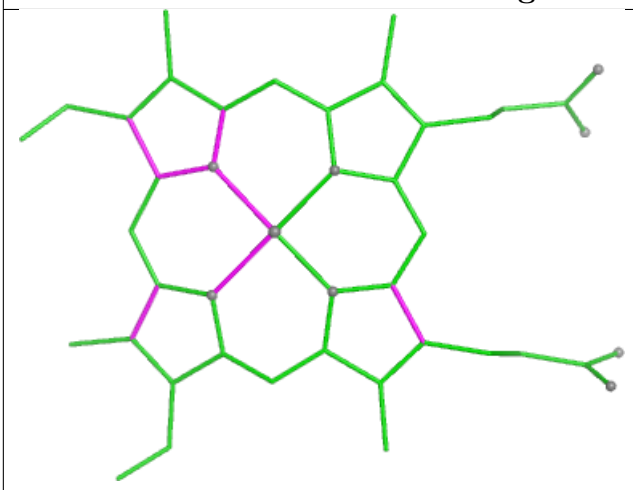
4 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	500	HEM	2	0
4	A	800	Q16	2	0
3	A	600	H4B	1	0
2	B	500	HEM	4	0

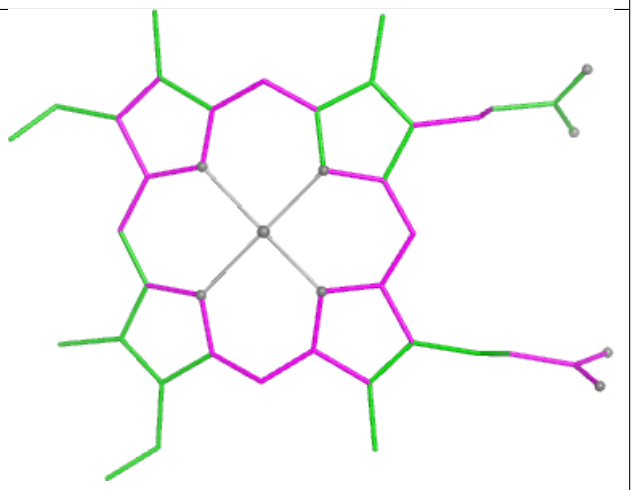
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

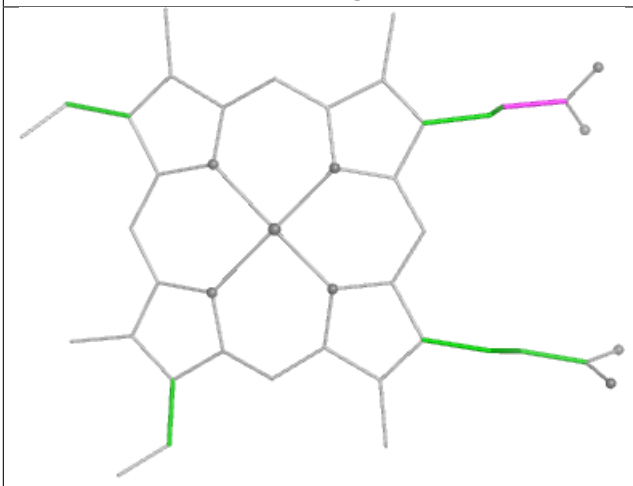
Ligand HEM A 500



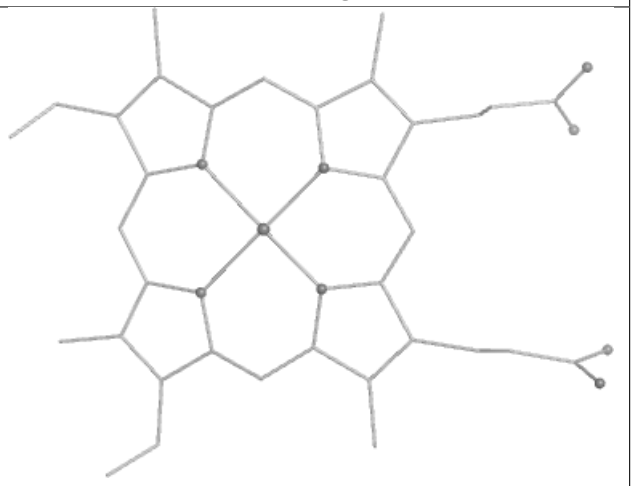
Bond lengths



Bond angles

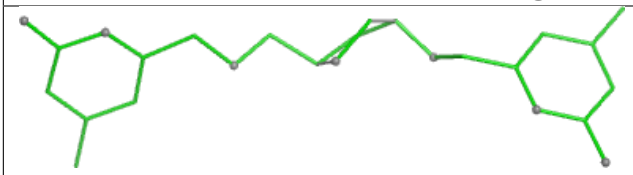


Torsions

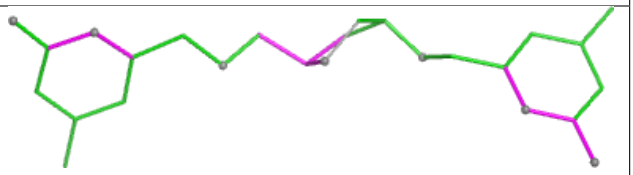


Rings

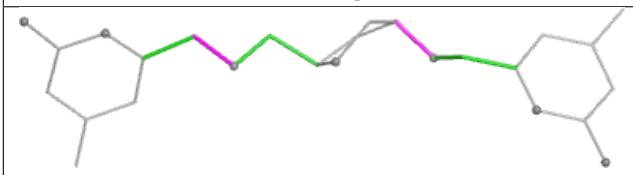
Ligand Q16 A 800



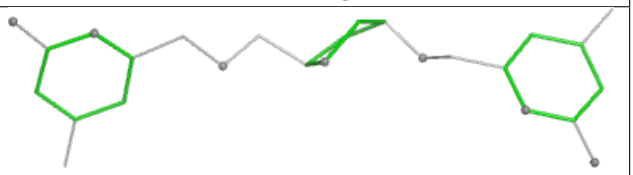
Bond lengths



Bond angles

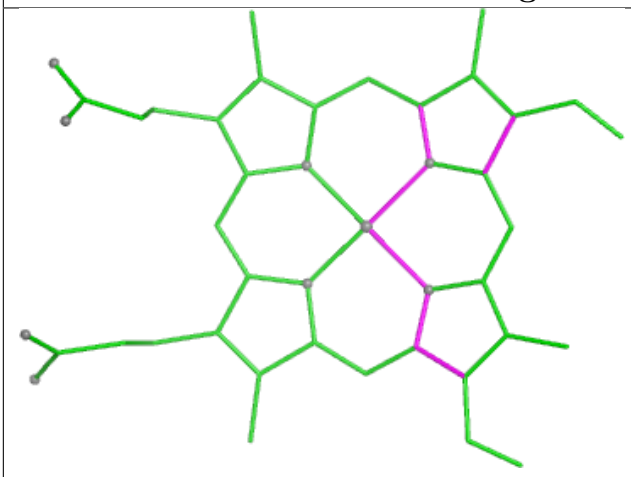


Torsions

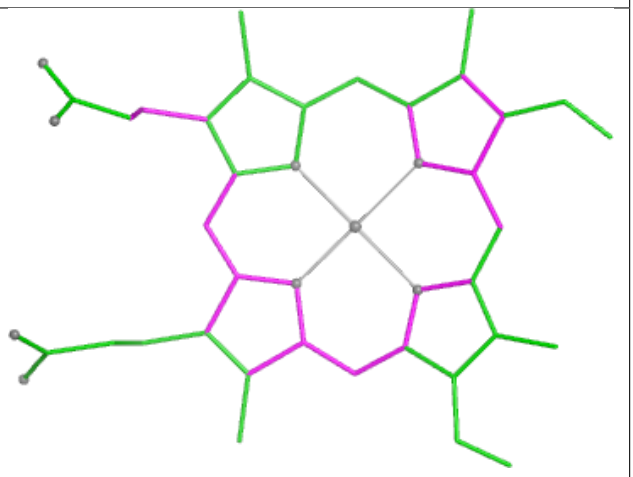


Rings

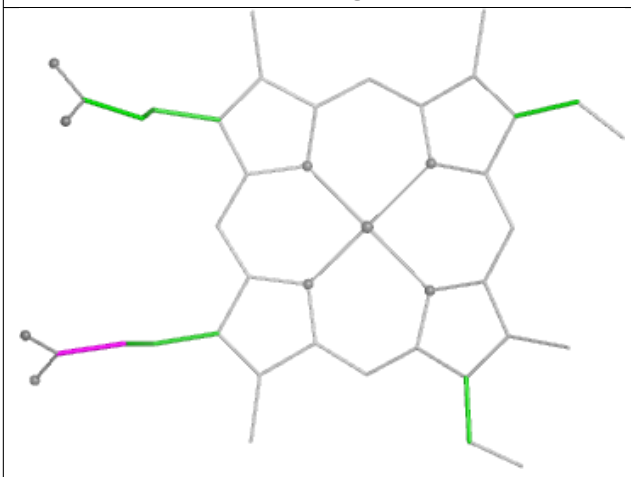
Ligand HEM B 500



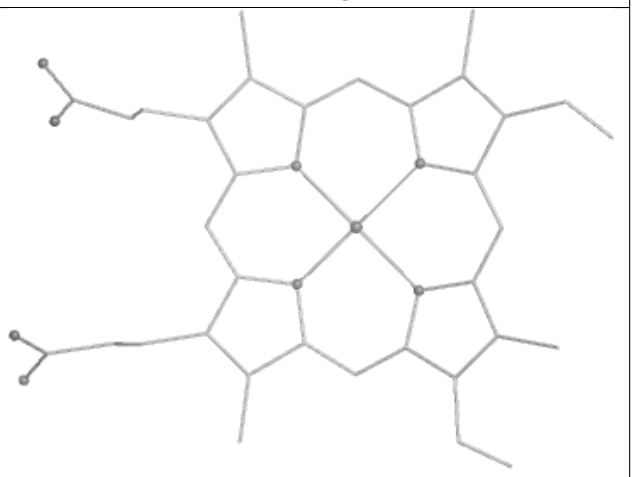
Bond lengths



Bond angles

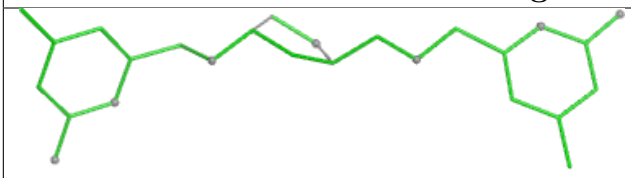


Torsions

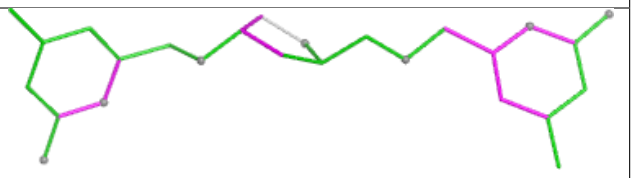


Rings

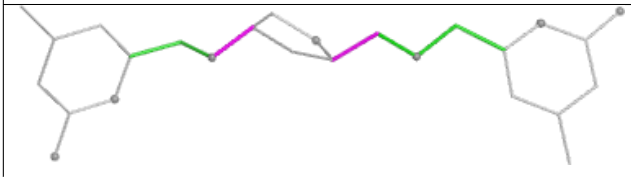
Ligand Q16 B 800



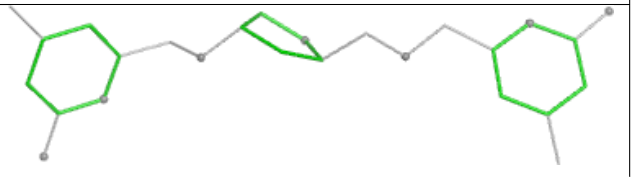
Bond lengths



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

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	404/443 (91%)	-0.42	4 (0%)	79	77	31, 44, 77, 126	0
1	B	402/443 (90%)	-0.35	4 (0%)	79	77	32, 47, 83, 120	0
All	All	806/886 (90%)	-0.39	8 (0%)	79	77	31, 45, 80, 126	0

All (8) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	121	PRO	2.7
1	A	107	LEU	2.7
1	A	94	GLY	2.4
1	B	109	ARG	2.3
1	B	121	PRO	2.3
1	B	99	ARG	2.3
1	A	122	ALA	2.2
1	B	104	SER	2.1

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

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
1	CAS	B	384	9/10	0.95	0.11	56,57,66,79	0
1	CAS	A	384	9/10	0.98	0.07	42,43,67,71	0

6.3 Carbohydrates

There are no oligosaccharides in this entry.

6.4 Ligands (i)

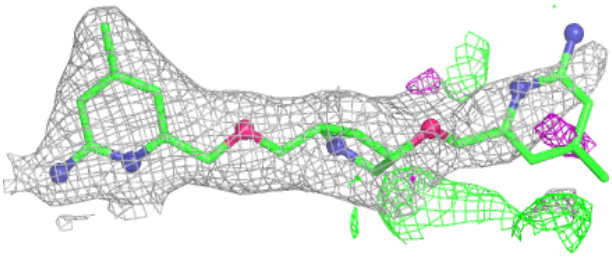
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9'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

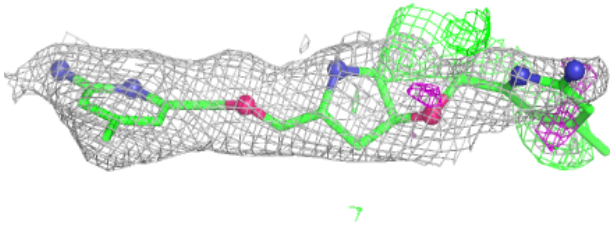
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
6	GOL	A	880	6/6	0.87	0.15	68,76,79,82	0
6	GOL	B	880	6/6	0.88	0.12	49,66,72,73	0
4	Q16	B	800	26/26	0.90	0.14	35,56,108,114	0
4	Q16	A	800	26/26	0.91	0.13	31,49,113,122	0
5	ACT	B	861	4/4	0.92	0.12	41,41,44,45	0
5	ACT	B	860	4/4	0.94	0.17	54,61,63,65	0
5	ACT	A	860	4/4	0.94	0.10	53,54,57,60	0
3	H4B	A	600	17/17	0.96	0.06	39,43,46,53	0
5	ACT	A	861	4/4	0.96	0.09	39,41,42,44	0
3	H4B	B	600	17/17	0.96	0.06	38,43,46,50	0
2	HEM	A	500	43/43	0.98	0.06	28,32,42,47	0
2	HEM	B	500	43/43	0.99	0.05	32,35,45,52	0
7	ZN	A	1483	1/1	0.99	0.10	57,57,57,57	0

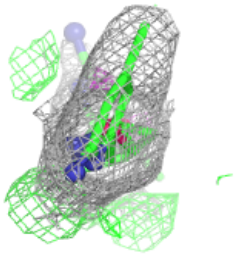
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around Q16 B 800:

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

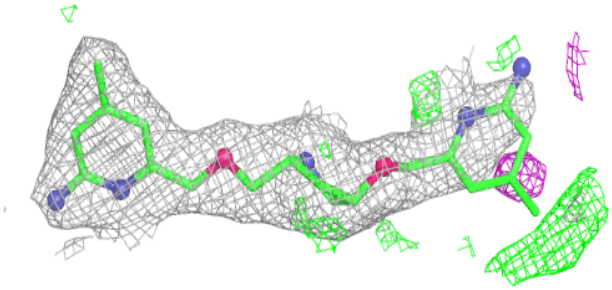


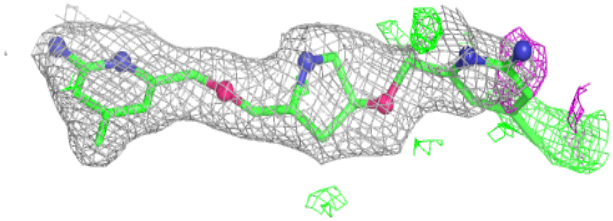


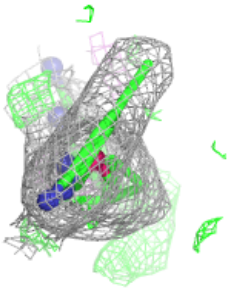


Electron density around Q16 A 800:

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

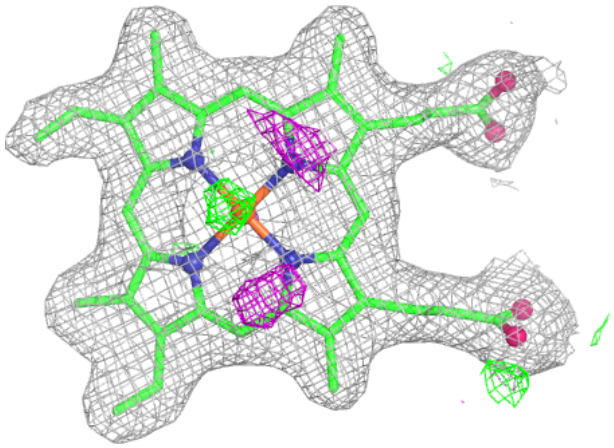


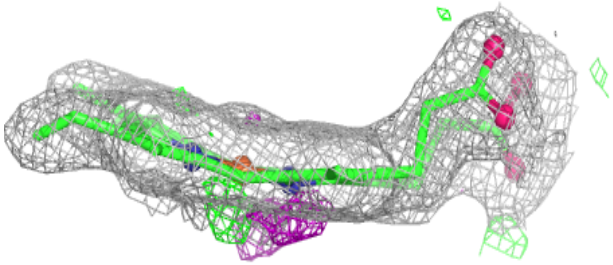


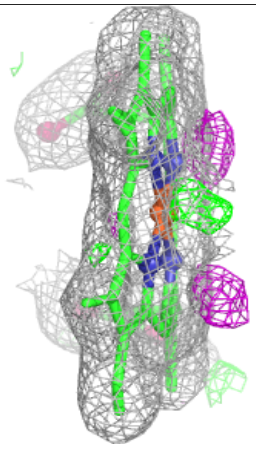


Electron density around HEM A 500:

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

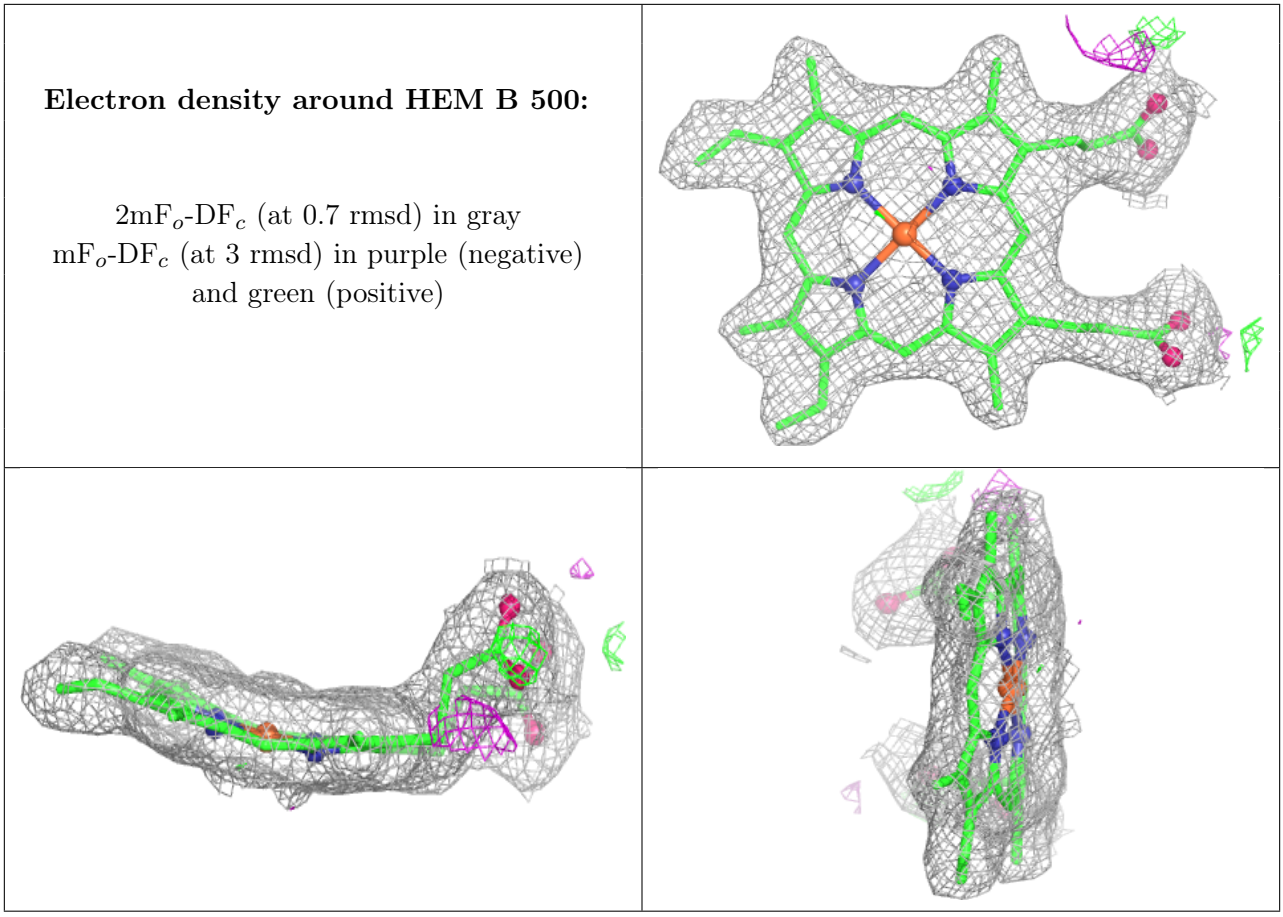






Electron density around HEM B 500:

$2mF_o$-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.