Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 05:22 AM UTC

PDB ID	:	4UH8 / pdb_00004uh8
Title	:	Structure of bovine endothelial nitric oxide synthase heme domain in complex with N1-(5-(2-(6-Amino-4-methylpyridin-2-yl)ethyl)pyridin-3- yl)-N1,N2-dim ethylethane-1,2-diamine
Authors	:	Li, H.; Poulos, T.L.
Deposited on	:	2015-03-23
Resolution	:	2.30 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:

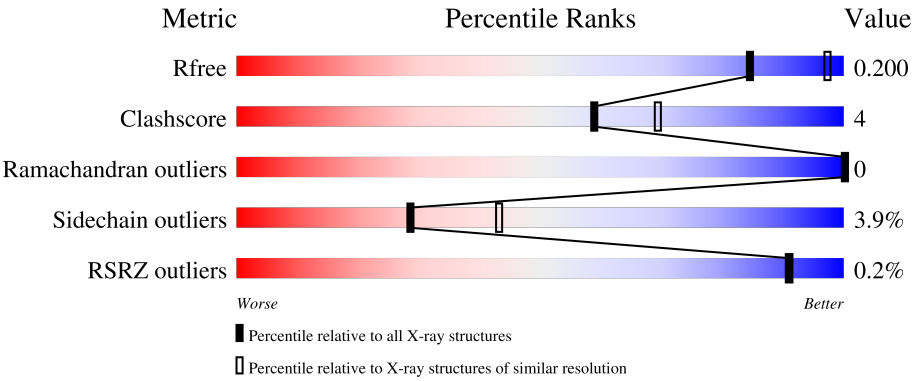
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal 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 (i)

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

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	83% 7% • 9%
1	B	443	79% 11% • 9%

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 6923 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.

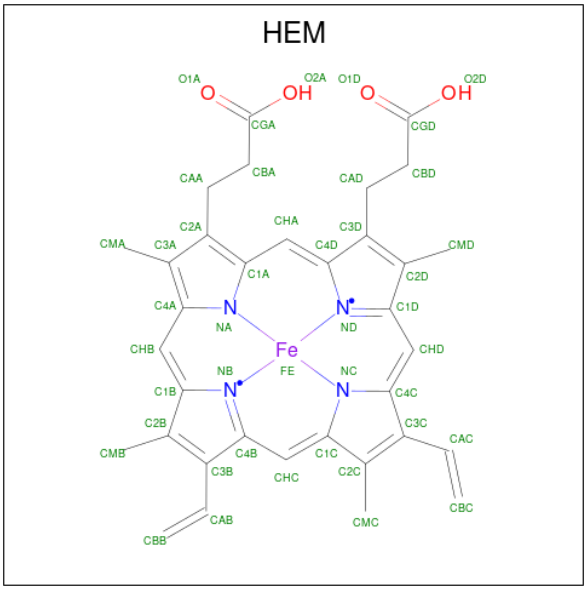
- Molecule 1 is a protein called NITRIC OXIDE SYNTHASE, ENDOTHELIAL.

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	404	Total	As	C	N	O	S	0	0	0
			3221	1	2048	568	588	16			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	100	ARG	CYS	variant	UNP P29473
B	100	ARG	CYS	variant	UNP P29473

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



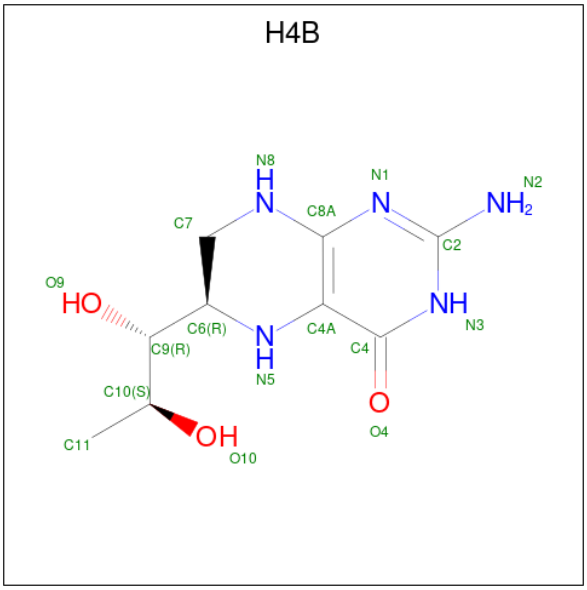
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

Continued on next page...

Continued from previous page...

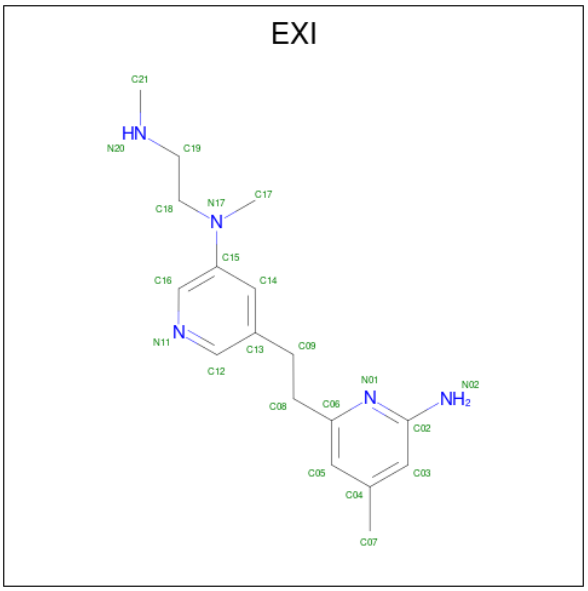
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

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



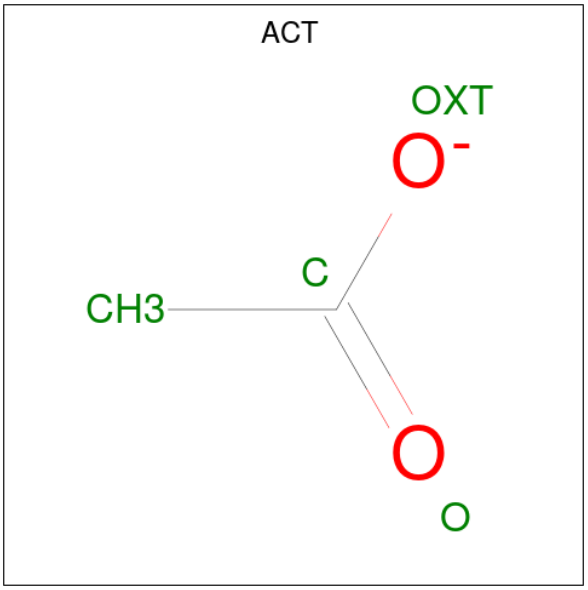
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O		0	0
			17	9	5	3			
3	B	1	Total	C	N	O		0	0
			17	9	5	3			

- Molecule 4 is N1-(5-(2-(6-Amino-4-methylpyridin-2-yl)ethyl)pyridin-3-yl)-N1,N2-dimethylethane-1,2-diamine (CCD ID: EXI) (formula: $C_{17}H_{25}N_5$).



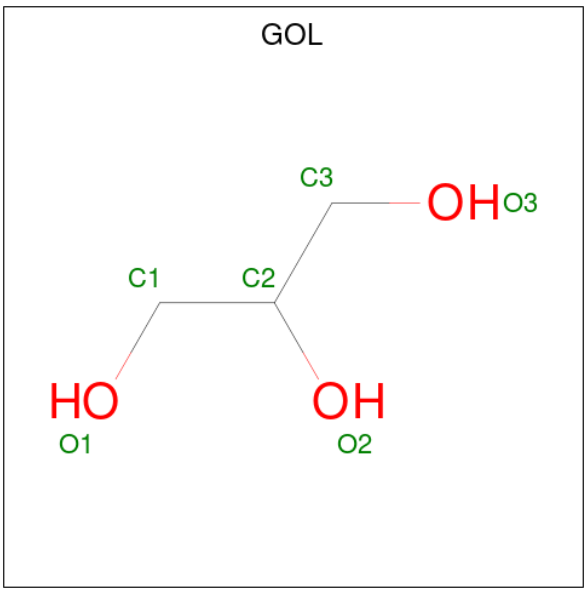
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C N 22 17 5	0	0
4	B	1	Total C N 22 17 5	0	0

- 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 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	B	1	Total Zn 1 1	0	0

- Molecule 8 is water.

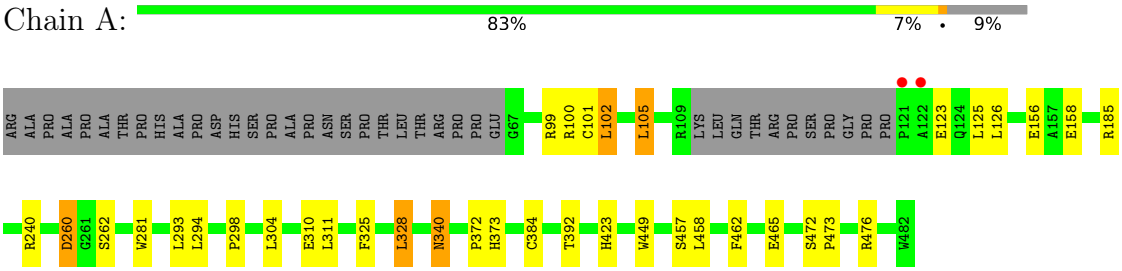
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	172	Total O 172 172	0	0
8	B	122	Total O 122 122	0	0

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.

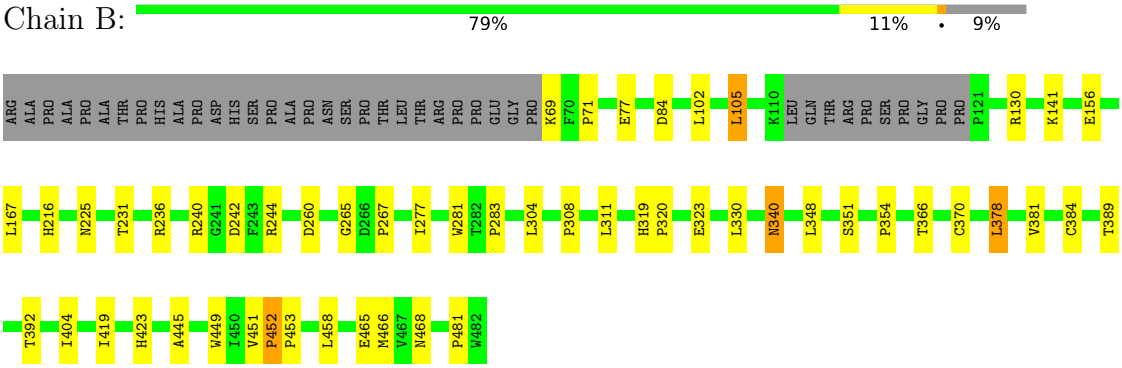
• Molecule 1: NITRIC OXIDE SYNTHASE, ENDOTHELIAL

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	57.94Å 106.32Å 156.85Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.39 – 2.30 48.39 – 2.30	Depositor EDS
% Data completeness (in resolution range)	98.0 (48.39-2.30) 99.6 (48.39-2.30)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.29 (at 2.29Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, R_{free}	0.161 , 0.217 (Not available) , 0.200	Depositor DCC
R_{free} test set	2187 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å^2)	48.6	Xtriage
Anisotropy	0.479	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 45.3	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	6923	wwPDB-VP
Average B, all atoms (Å^2)	44.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.59% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: ACT, HEM, GOL, ZN, EXI, CAS, H4B

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	0.49	0/3303	0.80	0/4497
1	B	0.48	0/3300	0.84	6/4491 (0.1%)
All	All	0.48	0/6603	0.82	6/8988 (0.1%)

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	452	PRO	CA-C-N	7.30	127.46	119.87
1	B	452	PRO	C-N-CA	7.30	127.46	119.87
1	B	240	ARG	N-CA-C	6.74	118.44	108.60
1	B	451	VAL	CA-C-N	6.30	124.26	119.66
1	B	451	VAL	C-N-CA	6.30	124.26	119.66
1	B	452	PRO	O-C-N	5.05	123.63	121.31

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	24	0
1	B	3221	0	3130	31	0
2	A	43	0	30	3	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	43	0	30	3	0
3	A	17	0	15	1	0
3	B	17	0	15	1	0
4	A	22	0	25	2	0
4	B	22	0	25	2	0
5	A	4	0	3	0	0
5	B	4	0	3	0	0
6	A	6	0	8	1	0
6	B	6	0	8	0	0
7	B	1	0	0	0	0
8	A	172	0	0	0	0
8	B	122	0	0	2	0
All	All	6923	0	6419	57	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 4.

All (57) 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	2.91	0.89
1:B:384:CAS:SG	1:B:384:CAS:AS	3.04	0.76
2:A:500:HEM:HMC2	2:A:500:HEM:HBC2	1.76	0.67
2:B:500:HEM:HMC2	2:B:500:HEM:HBC2	1.76	0.66
1:A:240:ARG:HD3	1:A:298:PRO:HB3	1.78	0.66
1:B:236:ARG:HD3	1:B:351:SER:HB3	1.81	0.63
1:B:71:PRO:HG2	1:B:84:ASP:HB3	1.85	0.59
2:B:500:HEM:HBB2	2:B:500:HEM:HHC	1.86	0.57
1:A:310:GLU:H	1:A:310:GLU:CD	2.13	0.55
2:A:500:HEM:HBB2	2:A:500:HEM:HHC	1.88	0.55
1:B:130:ARG:NH1	1:B:156:GLU:OE1	2.37	0.54
1:B:366:THR:HG21	1:B:453:PRO:HB2	1.91	0.53
1:B:277:ILE:HG12	1:B:283:PRO:HG3	1.91	0.52
1:A:465:GLU:HB3	1:B:105:LEU:HD22	1.92	0.52
1:B:236:ARG:HD2	1:B:242:ASP:OD1	2.09	0.52
1:B:281:TRP:HB2	1:B:304:LEU:HD21	1.90	0.52
1:A:105:LEU:HD22	1:B:465:GLU:HB3	1.92	0.51
1:A:281:TRP:HB2	1:A:304:LEU:HD21	1.91	0.51
2:A:500:HEM:HBA1	4:A:800:EXI:H08A	1.91	0.51
1:A:472:SER:HA	1:A:473:PRO:C	2.37	0.49
1:B:308:PRO:HD2	1:B:311:LEU:HD12	1.95	0.49

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:453:PRO:HG3	8:B:2093:HOH:O	2.12	0.48
4:B:800:EXI:H17	4:B:800:EXI:H19A	1.51	0.47
1:A:240:ARG:HD3	1:A:298:PRO:CB	2.42	0.46
2:B:500:HEM:C1C	4:B:800:EXI:H07B	2.50	0.46
1:B:265:GLY:O	1:B:267:PRO:HD3	2.15	0.46
1:A:126:LEU:HD11	1:A:156:GLU:HA	1.96	0.46
1:B:452:PRO:HA	1:B:453:PRO:HD3	1.80	0.46
1:B:378:LEU:HB2	8:B:2095:HOH:O	2.17	0.45
1:B:381:VAL:HG21	1:B:404:ILE:HD11	1.98	0.45
1:A:384:CAS:AS	1:A:384:CAS:CB	3.26	0.44
1:B:319:HIS:CG	1:B:320:PRO:HD2	2.52	0.43
1:A:260:ASP:OD1	1:A:262:SER:OG	2.33	0.43
1:A:449:TRP:HA	3:A:600:H4B:N1	2.34	0.43
1:B:231:THR:O	1:B:354:PRO:HD2	2.17	0.43
1:B:167:LEU:HG	1:B:348:LEU:HD12	2.00	0.43
1:A:340:ASN:H	1:A:340:ASN:HD22	1.65	0.42
1:A:457:SER:HA	1:A:462:PHE:CG	2.54	0.42
1:B:384:CAS:AS	1:B:384:CAS:HB2	2.80	0.42
1:B:445:ALA:HB3	1:B:466:MET:HB3	2.02	0.42
1:A:373:HIS:NE2	6:A:880:GOL:O1	2.45	0.42
4:A:800:EXI:H17	4:A:800:EXI:H19A	1.67	0.42
1:A:423:HIS:HB2	1:B:392:THR:HB	2.01	0.42
1:B:370:CYS:SG	1:B:378:LEU:HD13	2.60	0.42
1:A:185:ARG:HD3	1:A:449:TRP:CD2	2.55	0.41
1:A:100:ARG:HG2	1:A:102:LEU:HD13	2.03	0.41
1:B:449:TRP:HA	3:B:600:H4B:N1	2.34	0.41
1:A:384:CAS:AS	1:A:384:CAS:HB2	2.80	0.41
1:B:244:ARG:NH2	1:B:481:PRO:HD3	2.36	0.41
1:B:340:ASN:HD22	1:B:340:ASN:H	1.66	0.41
1:B:216:HIS:CD2	1:B:216:HIS:C	2.99	0.41
1:A:101:CYS:HB3	1:B:468:ASN:HB3	2.03	0.41
1:A:325:PHE:O	1:A:328:LEU:HB2	2.21	0.41
1:B:366:THR:O	1:B:370:CYS:HB2	2.21	0.41
1:A:126:LEU:HD12	1:A:126:LEU:HA	1.83	0.40
1:A:372:PRO:HG2	1:B:77:GLU:HG3	2.03	0.40
1:A:392:THR:HB	1:B:423:HIS:HB2	2.04	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%)	390 (98%)	10 (2%)	0	100	100
1	B	399/443 (90%)	385 (96%)	14 (4%)	0	100	100
All	All	799/886 (90%)	775 (97%)	24 (3%)	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	343/375 (92%)	329 (96%)	14 (4%)	27	41
1	B	343/375 (92%)	330 (96%)	13 (4%)	29	44
All	All	686/750 (92%)	659 (96%)	27 (4%)	28	43

All (27) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	99	ARG
1	A	102	LEU
1	A	105	LEU
1	A	123	GLU
1	A	125	LEU
1	A	158	GLU
1	A	260	ASP
1	A	293	LEU

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	294	LEU
1	A	311	LEU
1	A	328	LEU
1	A	340	ASN
1	A	458	LEU
1	A	476	ARG
1	B	69	LYS
1	B	102	LEU
1	B	105	LEU
1	B	141	LYS
1	B	225	ASN
1	B	260	ASP
1	B	323	GLU
1	B	330	LEU
1	B	340	ASN
1	B	378	LEU
1	B	389	THR
1	B	419	ILE
1	B	458	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	92	GLN
1	A	124	GLN
1	A	153	GLN
1	A	191	GLN
1	A	340	ASN
1	A	376	ASN
1	A	413	GLN
1	A	468	ASN
1	B	91	GLN
1	B	191	GLN
1	B	278	GLN
1	B	340	ASN
1	B	405	ASN

5.3.3 RNA

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	B	384	1	5,8,9	1.05	0	1,9,11	0.42	0
1	CAS	A	384	1	5,8,9	1.10	0	1,9,11	0.87	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	B	384	1	-	0/0/7/9	-
1	CAS	A	384	1	-	0/0/7/9	-

There are no bond length outliers.

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 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	B	384	CAS	2	0
1	A	384	CAS	3	0

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

Of 11 ligands modelled in this entry, 1 is monoatomic - leaving 10 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	$\#\|Z\| > 2$
5	ACT	B	860	-	3,3,3	0.85	0	3,3,3	0.57	0
4	EXI	A	800	-	23,23,23	0.49	0	28,30,30	1.89	7 (25%)
4	EXI	B	800	-	23,23,23	0.42	0	28,30,30	1.94	9 (32%)
3	H4B	B	600	-	17,18,18	0.86	1 (5%)	14,26,26	1.94	5 (35%)
6	GOL	B	880	-	5,5,5	0.35	0	5,5,5	0.32	0
2	HEM	B	500	1	50,50,50	1.89	10 (20%)	67,82,82	1.36	7 (10%)
2	HEM	A	500	1	50,50,50	1.82	9 (18%)	67,82,82	1.26	6 (8%)
5	ACT	A	860	-	3,3,3	0.75	0	3,3,3	0.84	0
3	H4B	A	600	-	17,18,18	0.85	0	14,26,26	1.90	5 (35%)
6	GOL	A	880	-	5,5,5	0.32	0	5,5,5	0.47	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
4	EXI	A	800	-	-	4/13/13/13	0/2/2/2
4	EXI	B	800	-	-	6/13/13/13	0/2/2/2
3	H4B	B	600	-	-	0/8/17/17	0/2/2/2
6	GOL	B	880	-	-	0/4/4/4	-
2	HEM	B	500	1	-	1/14/54/54	-
2	HEM	A	500	1	-	3/14/54/54	-
3	H4B	A	600	-	-	0/8/17/17	0/2/2/2
6	GOL	A	880	-	-	0/4/4/4	-

All (20) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	500	HEM	C3D-C2D	7.24	1.52	1.36
2	A	500	HEM	C3D-C2D	7.16	1.52	1.36
2	A	500	HEM	FE-ND	4.47	2.08	1.94
2	B	500	HEM	FE-NC	4.45	2.09	1.95
2	A	500	HEM	FE-NA	4.03	2.08	1.95
2	B	500	HEM	FE-NA	4.00	2.08	1.95
2	B	500	HEM	FE-NB	3.81	2.06	1.94
2	B	500	HEM	FE-ND	3.67	2.06	1.94
2	A	500	HEM	FE-NB	3.55	2.05	1.94
2	A	500	HEM	CAB-C3B	3.09	1.55	1.47
2	B	500	HEM	CAB-C3B	3.08	1.55	1.47
2	B	500	HEM	CAC-C3C	2.75	1.54	1.47
2	A	500	HEM	CAC-C3C	2.63	1.54	1.47
2	A	500	HEM	FE-NC	2.55	2.03	1.95
2	A	500	HEM	CMC-C2C	2.23	1.55	1.50
3	B	600	H4B	C4-N3	-2.22	1.34	1.38
2	B	500	HEM	C2A-C3A	-2.17	1.33	1.38
2	B	500	HEM	CMC-C2C	2.10	1.55	1.50
2	A	500	HEM	CMA-C3A	2.08	1.55	1.50
2	B	500	HEM	CMA-C3A	2.05	1.55	1.50

All (39) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	500	HEM	C4D-ND-C1D	4.89	111.00	105.21
2	B	500	HEM	C4D-ND-C1D	4.77	110.85	105.21
4	A	800	EXI	C02-N01-C06	4.71	121.59	118.07
3	A	600	H4B	C2-N1-C8A	4.48	121.27	113.36
4	B	800	EXI	C02-N01-C06	4.43	121.38	118.07
3	B	600	H4B	C2-N1-C8A	4.36	121.06	113.36
4	B	800	EXI	C08-C06-N01	3.59	121.49	116.06
2	B	500	HEM	CBA-CAA-C2A	-3.39	103.15	112.53
4	A	800	EXI	C21-N20-C19	3.27	121.12	112.01
4	A	800	EXI	C14-C13-C12	3.21	119.87	116.90
2	A	500	HEM	C3B-C2B-C1B	3.16	108.78	106.41
4	A	800	EXI	C08-C06-N01	3.11	120.78	116.06
2	B	500	HEM	C3B-C2B-C1B	3.01	108.67	106.41
4	B	800	EXI	C21-N20-C19	2.89	120.06	112.01
4	B	800	EXI	C14-C13-C12	2.83	119.53	116.90
3	B	600	H4B	C4A-C4-N3	2.71	119.57	112.13
4	B	800	EXI	C05-C06-N01	-2.69	119.66	122.73
4	A	800	EXI	C16-N11-C12	2.60	121.04	117.51
4	A	800	EXI	C05-C06-N01	-2.59	119.78	122.73

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	B	800	EXI	N02-C02-N01	2.50	120.61	116.59
2	A	500	HEM	CMD-C2D-C1D	2.49	128.93	125.03
2	B	500	HEM	C3B-C4B-NB	-2.48	107.69	109.47
3	B	600	H4B	O4-C4-C4A	-2.46	121.34	127.26
3	A	600	H4B	O4-C4-C4A	-2.46	121.34	127.26
3	A	600	H4B	C4A-C4-N3	2.39	118.68	112.13
4	A	800	EXI	C07-C04-C05	-2.34	117.75	120.92
4	B	800	EXI	C16-N11-C12	2.32	120.66	117.51
2	B	500	HEM	C2A-C1A-NA	-2.31	107.58	110.15
3	B	600	H4B	C2-N3-C4	-2.31	120.92	125.11
4	B	800	EXI	C16-C15-N17	-2.25	118.44	121.80
2	B	500	HEM	C1B-NB-C4B	2.15	107.75	105.21
4	B	800	EXI	C17-N17-C18	2.09	121.11	115.56
3	A	600	H4B	N3-C2-N1	-2.09	119.50	123.32
3	A	600	H4B	C4-C4A-N5	2.05	121.86	116.27
2	B	500	HEM	CMD-C2D-C1D	2.04	128.23	125.03
3	B	600	H4B	C11-C10-C9	-2.04	109.62	112.11
2	A	500	HEM	CAD-C3D-C4D	2.04	128.25	124.70
2	A	500	HEM	CHB-C1B-NB	2.03	126.88	124.37
2	A	500	HEM	CBD-CAD-C3D	-2.00	106.99	112.53

There are no chirality outliers.

All (14) torsion outliers are listed below:

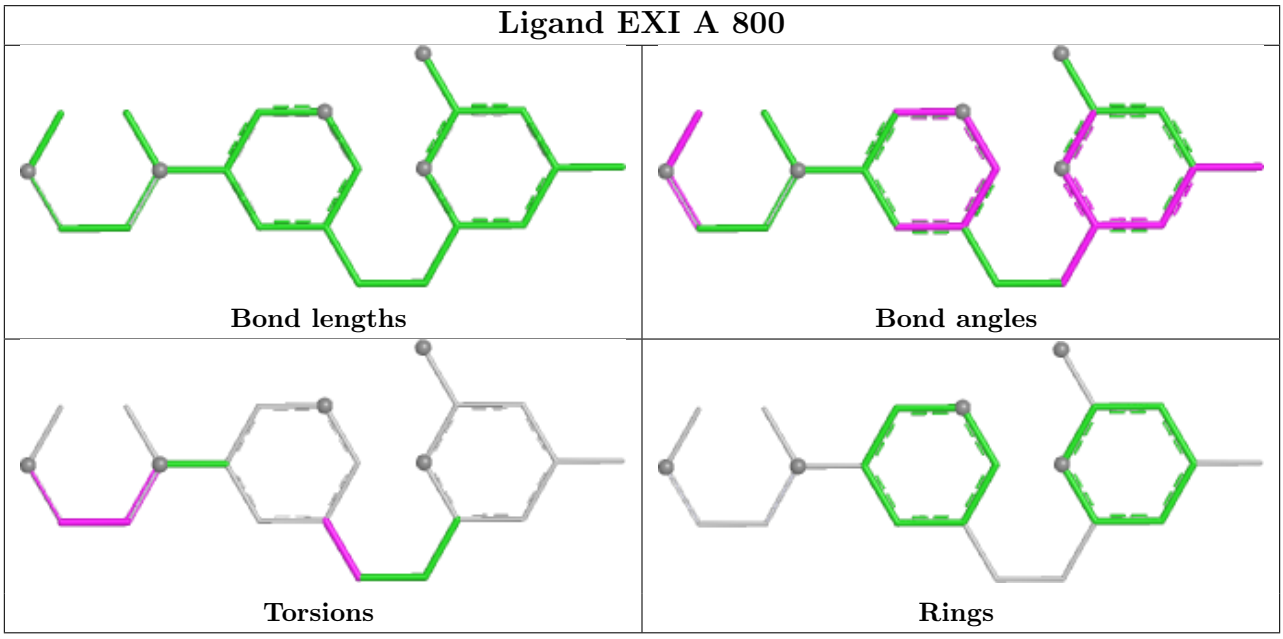
Mol	Chain	Res	Type	Atoms
4	A	800	EXI	C19-C18-N17-C17
4	A	800	EXI	C18-C19-N20-C21
4	B	800	EXI	C19-C18-N17-C17
4	B	800	EXI	C18-C19-N20-C21
4	A	800	EXI	N17-C18-C19-N20
2	A	500	HEM	C1A-C2A-CAA-CBA
4	B	800	EXI	C14-C15-N17-C17
4	B	800	EXI	C16-C15-N17-C17
4	B	800	EXI	C08-C09-C13-C14
4	A	800	EXI	C08-C09-C13-C14
4	B	800	EXI	N17-C18-C19-N20
2	A	500	HEM	CAD-CBD-CGD-O2D
2	A	500	HEM	CAD-CBD-CGD-O1D
2	B	500	HEM	CAD-CBD-CGD-O2D

There are no ring outliers.

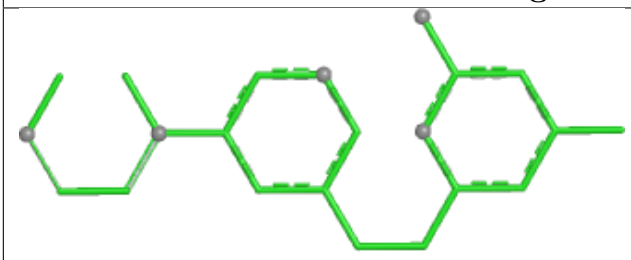
7 monomers are involved in 11 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	800	EXI	2	0
4	B	800	EXI	2	0
3	B	600	H4B	1	0
2	B	500	HEM	3	0
2	A	500	HEM	3	0
3	A	600	H4B	1	0
6	A	880	GOL	1	0

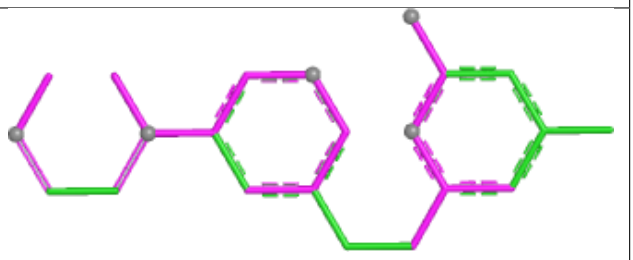
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



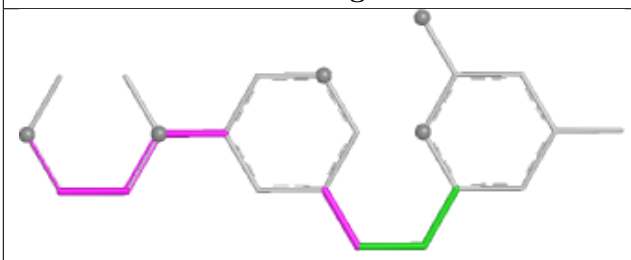
Ligand EXI B 800



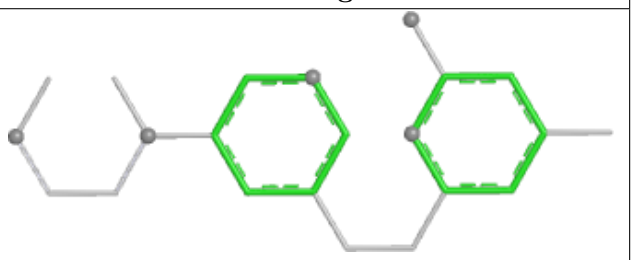
Bond lengths



Bond angles

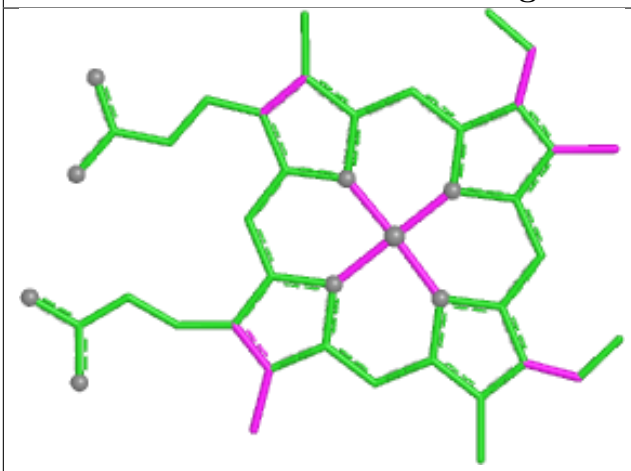


Torsions

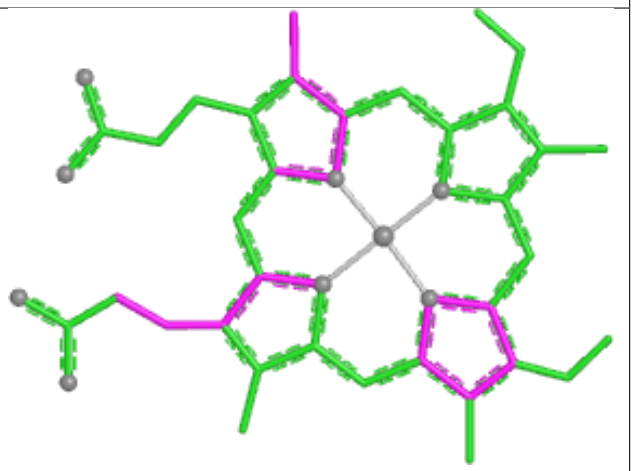


Rings

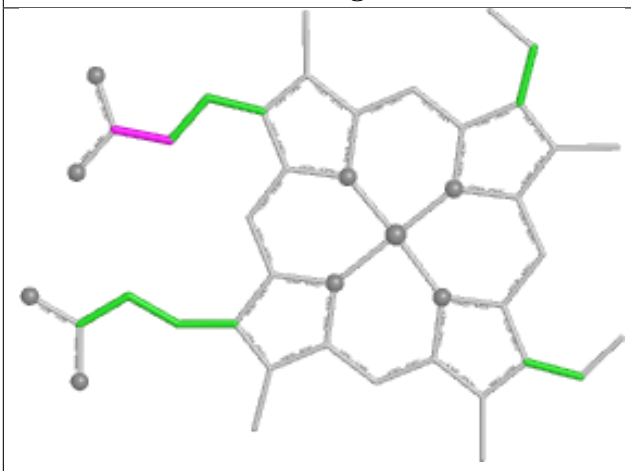
Ligand HEM B 500



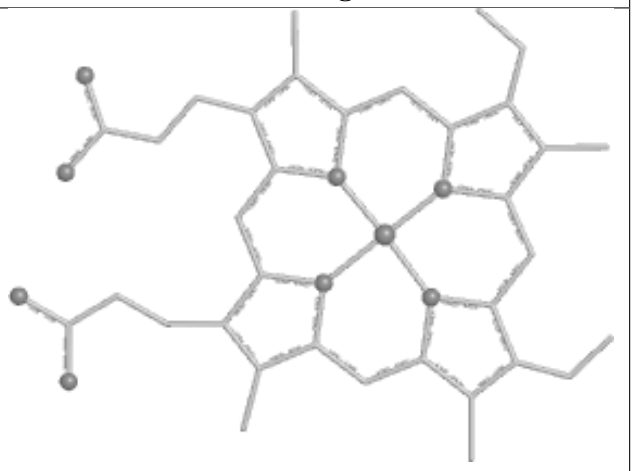
Bond lengths



Bond angles

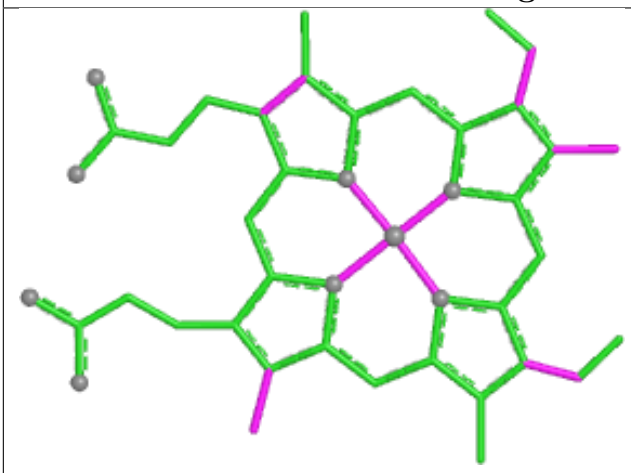


Torsions

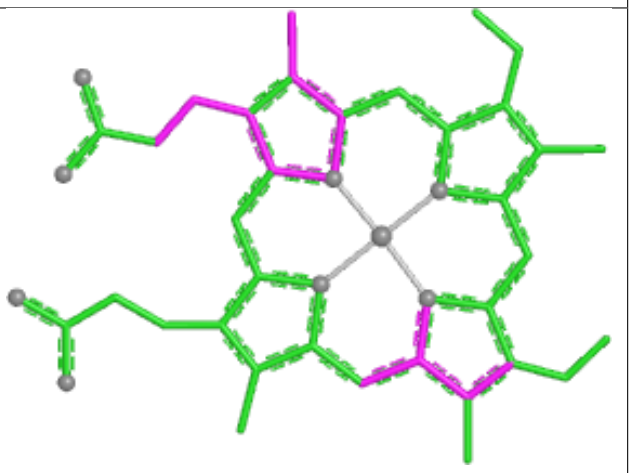


Rings

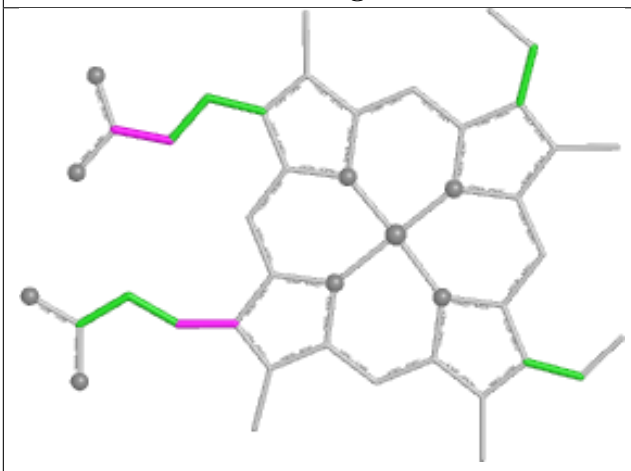
Ligand HEM A 500



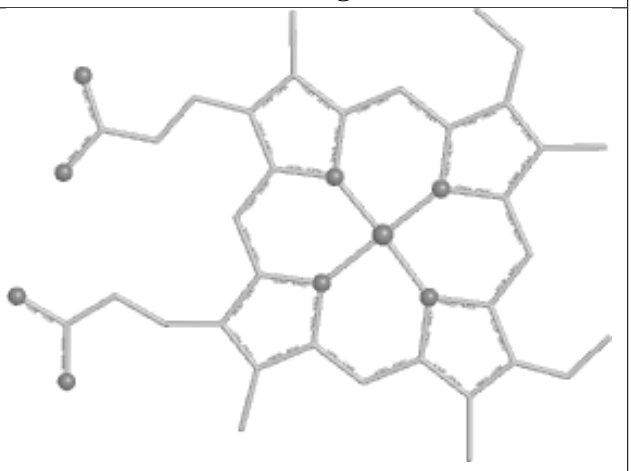
Bond lengths



Bond angles



Torsions



Rings

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

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%)	-0.62	2 (0%) 87 87	24, 39, 71, 96	0
1	B	403/443 (90%)	-0.55	0 100 100	26, 41, 75, 110	0
All	All	807/886 (91%)	-0.58	2 (0%) 91 91	24, 41, 74, 110	0

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	121	PRO	3.7
1	A	122	ALA	2.3

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	0.93	0.13	49,56,100,119	0
1	CAS	A	384	9/10	0.96	0.08	35,38,52,70	0

6.3 Carbohydrates

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,

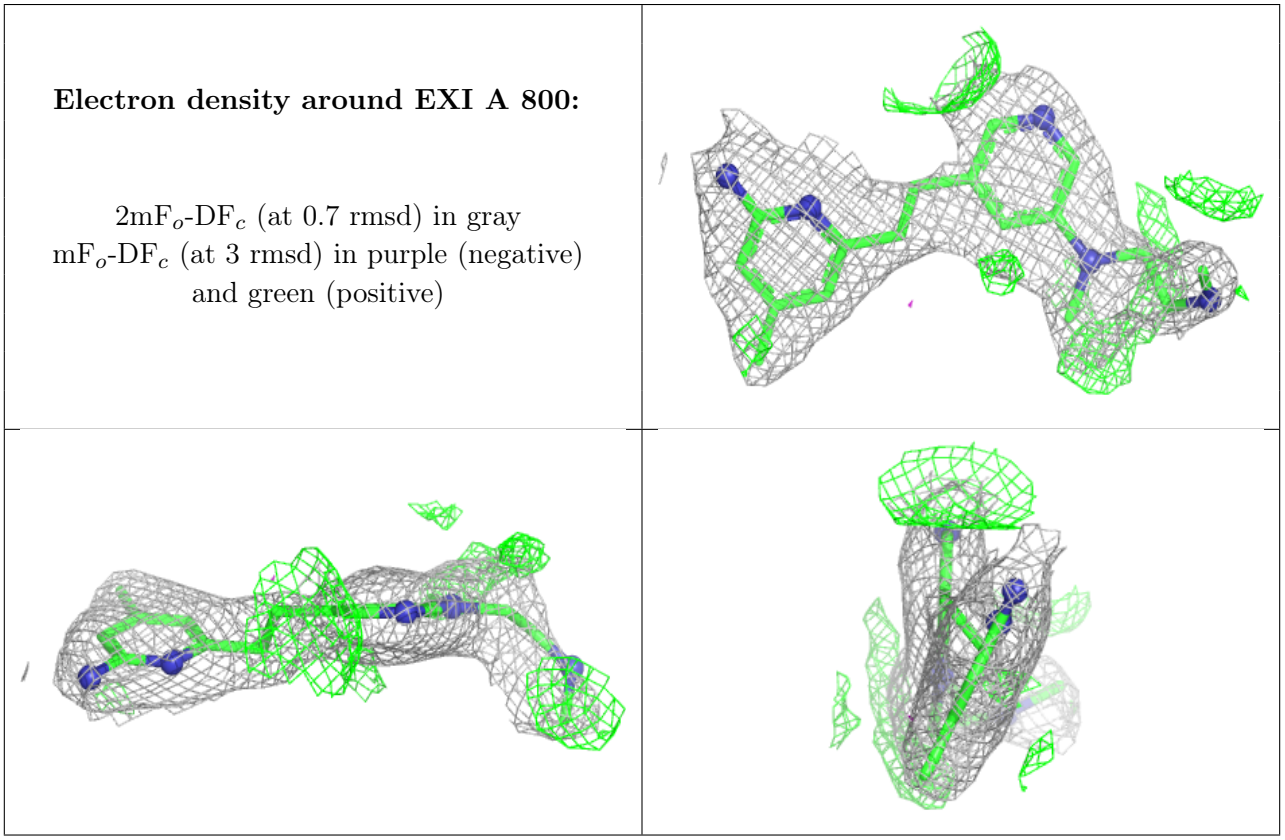
median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
6	GOL	A	880	6/6	0.84	0.15	65,67,69,70	0
6	GOL	B	880	6/6	0.88	0.13	59,62,68,69	0
4	EXI	A	800	22/22	0.89	0.12	22,71,81,82	0
4	EXI	B	800	22/22	0.89	0.13	27,63,78,80	0
5	ACT	B	860	4/4	0.94	0.13	49,51,53,60	0
3	H4B	A	600	17/17	0.96	0.05	27,36,44,44	0
5	ACT	A	860	4/4	0.97	0.05	42,44,45,47	0
3	H4B	B	600	17/17	0.97	0.05	29,35,41,42	0
2	HEM	B	500	43/43	0.98	0.06	19,27,49,53	0
2	HEM	A	500	43/43	0.99	0.06	17,25,54,62	0
7	ZN	B	1483	1/1	0.99	0.06	45,45,45,45	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.

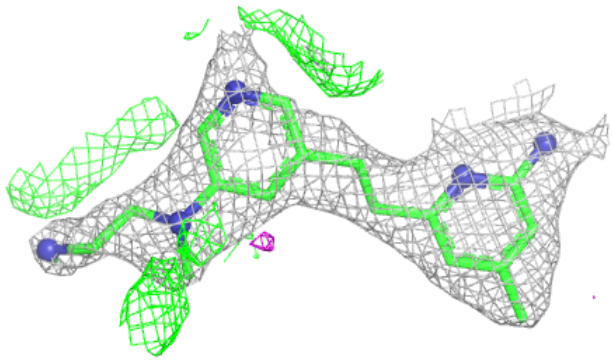
Electron density around EXI A 800:

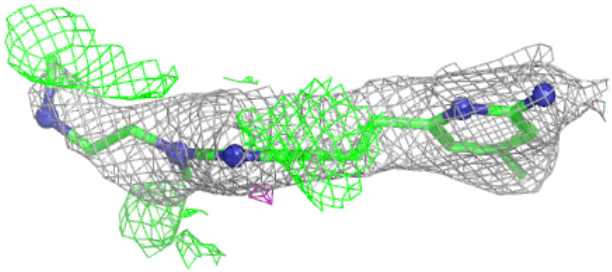
$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

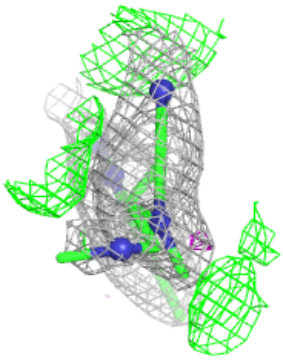


Electron density around EXI B 800:

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

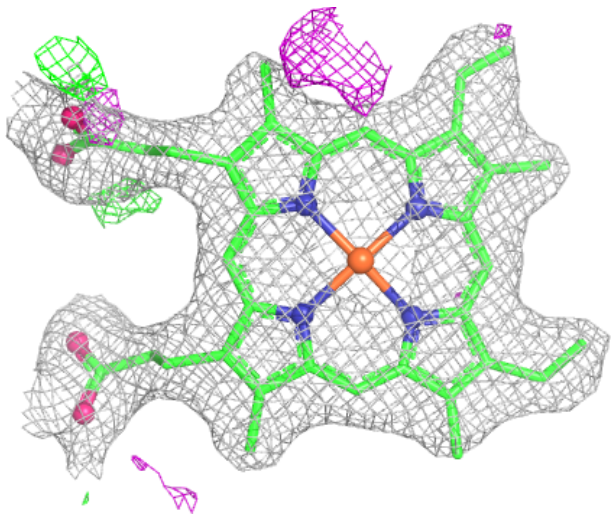


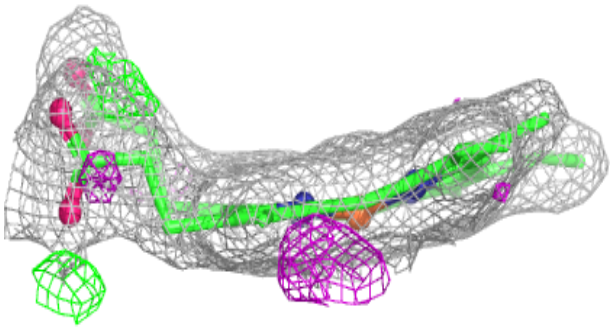


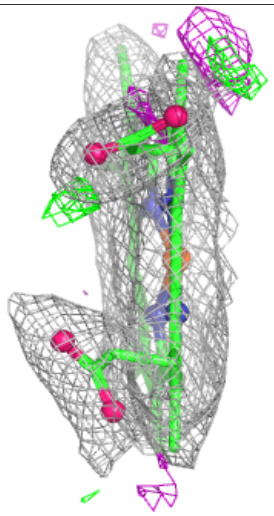


Electron density around HEM B 500:

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

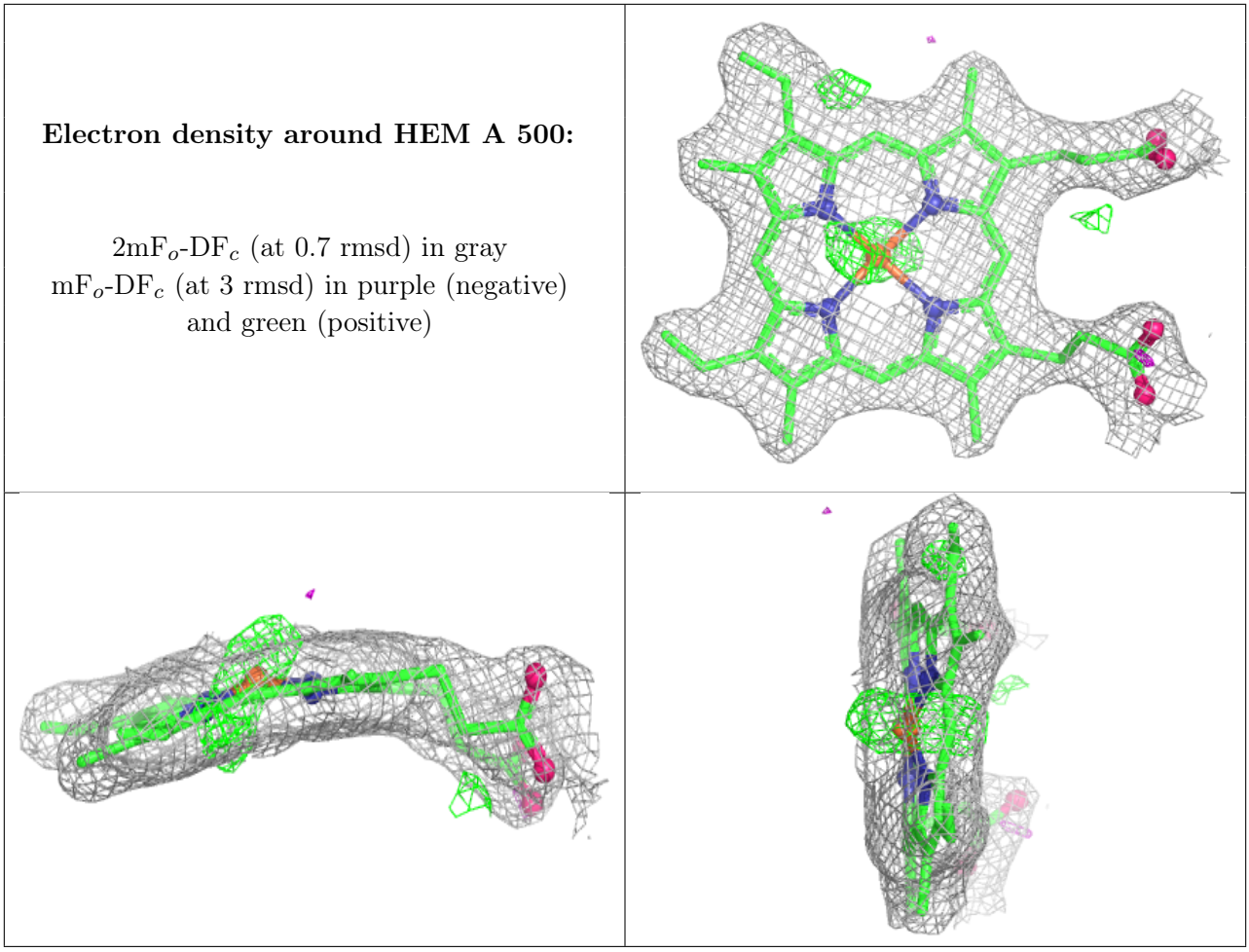






Electron density around HEM A 500:

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



6.5 Other polymers (i)

There are no such residues in this entry.