



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 12, 2020 – 11:25 PM BST

PDB ID : 4CUN  
Title : Structure of bovine endothelial nitric oxide synthase heme domain in complex with (9a*S*)-2-amino-9a-methyl-8,9,9a,10-tetrahydrobenzo[*g*]pteridine-4,6(3*H*,7*H*)-dione  
Authors : Chreifi, G.; Li, H.; Poulos, T.L.  
Deposited on : 2014-03-20  
Resolution : 2.48 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](mailto: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 following versions of software and data (see [references ⓘ](#)) 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 : 2.14.4.dev1  
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) : 2.14.4.dev1

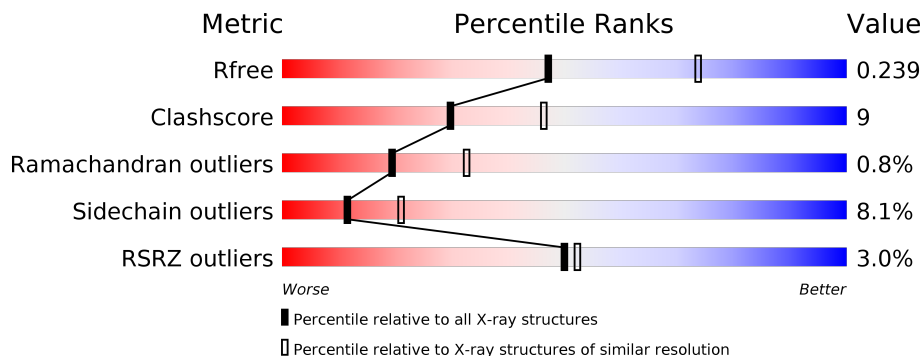
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*



The reported resolution of this entry is 2.48 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	5857 (2.50-2.46)
Clashscore	141614	6594 (2.50-2.46)
Ramachandran outliers	138981	6469 (2.50-2.46)
Sidechain outliers	138945	6471 (2.50-2.46)
RSRZ outliers	127900	5738 (2.50-2.46)

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

Mol	Chain	Length	Quality of chain
1	A	443	 3% 70% 17% • 9%
1	B	443	 2% 68% 21% • 9%

## 2 Entry composition [i](#)

There are 8 unique types of molecules in this entry. The entry contains 6670 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.

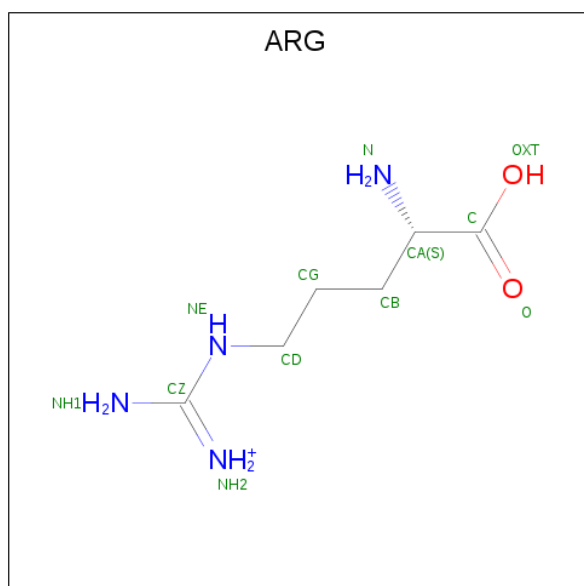
- Molecule 1 is a protein called NITRIC OXIDE SYNTHASE, ENDOTHELIAL.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	As	C	N	O	S			
1	A	405	3223	1	2049	568	589	16	0	0	0
1	B	405	3229	1	2054	569	589	16	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

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

- Molecule 2 is ARGININE (three-letter code: ARG) (formula: C<sub>6</sub>H<sub>15</sub>N<sub>4</sub>O<sub>2</sub>).



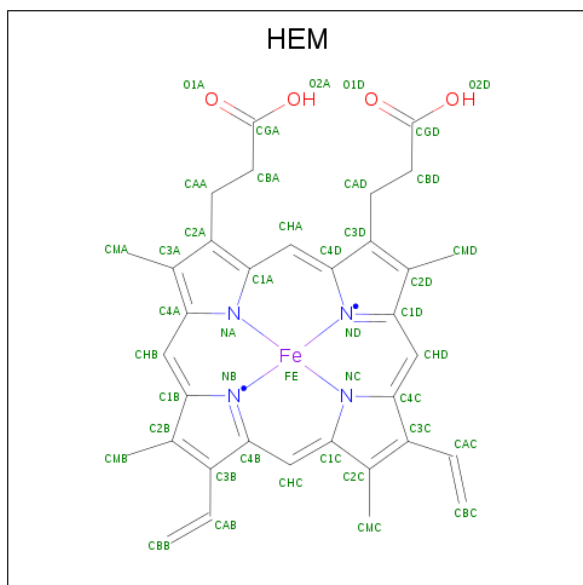
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	12	6	4	2	0	0

*Continued on next page...*

Continued from previous page...

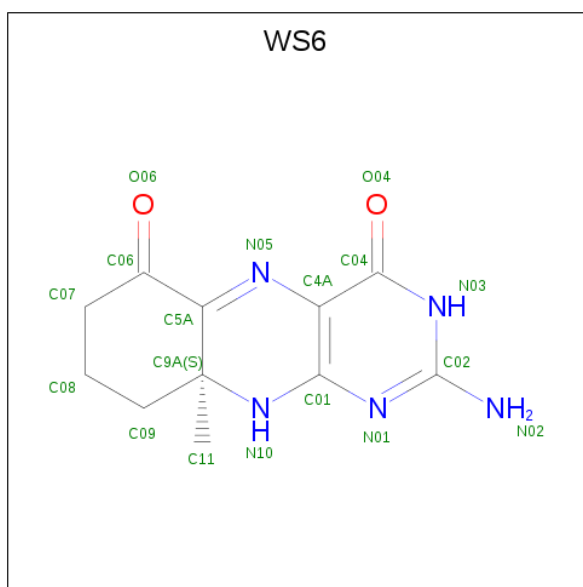
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	B	1	12	6	4	2	0	0

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



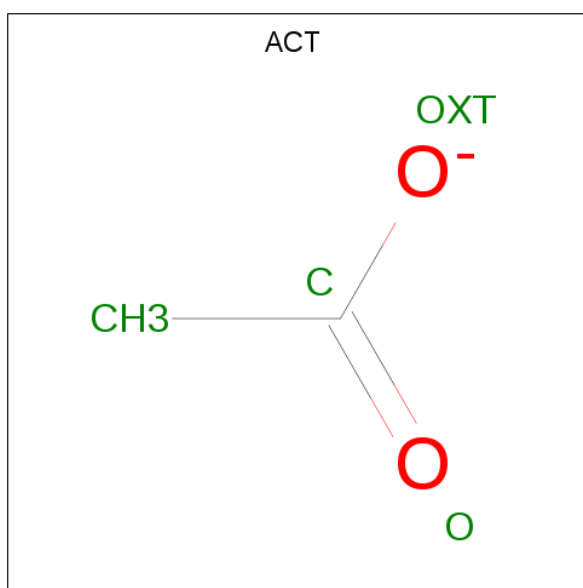
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	Fe	N	O		
3	A	1	43	34	1	4	4	0	0
3	B	1	43	34	1	4	4	0	0

- Molecule 4 is (9aS)-2-amino-9a-methyl-8,9,9a,10-tetrahydrobenzo[g]pteridine-4,6(3H,7H)-dione (three-letter code: WS6) (formula:  $C_{11}H_{13}N_5O_2$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
4	A	1	18	11	5	2	0	0
4	B	1	18	11	5	2	0	0

- Molecule 5 is ACETATE ION (three-letter code: ACT) (formula:  $C_2H_3O_2$ ).



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

- Molecule 6 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



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

- Molecule 7 is ZINC ION (three-letter code: ZN) (formula:  $Zn$ ).

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

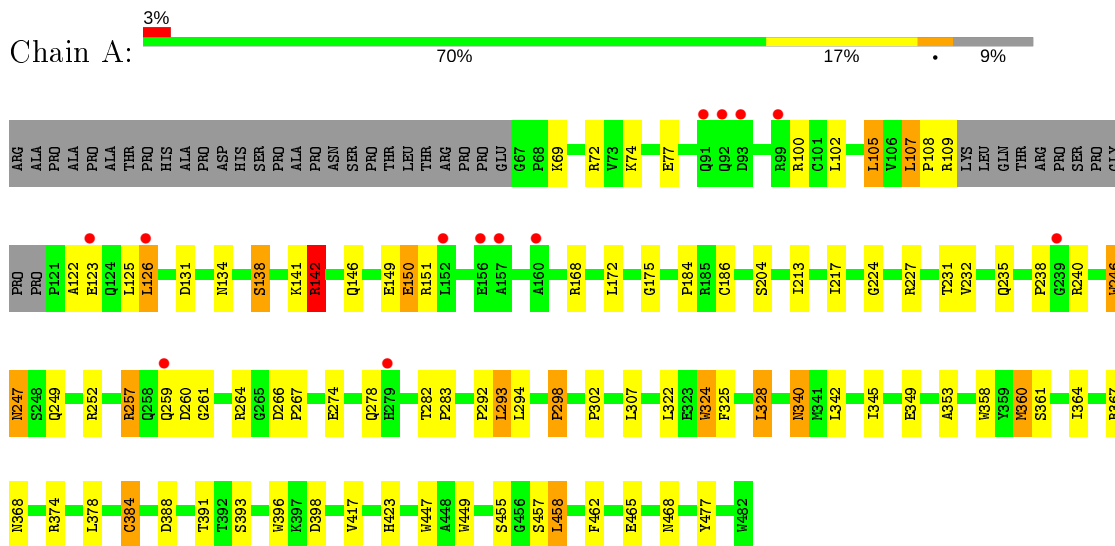
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	36	Total	O	0	0
			36	36		
8	B	15	Total	O	0	0
			15	15		

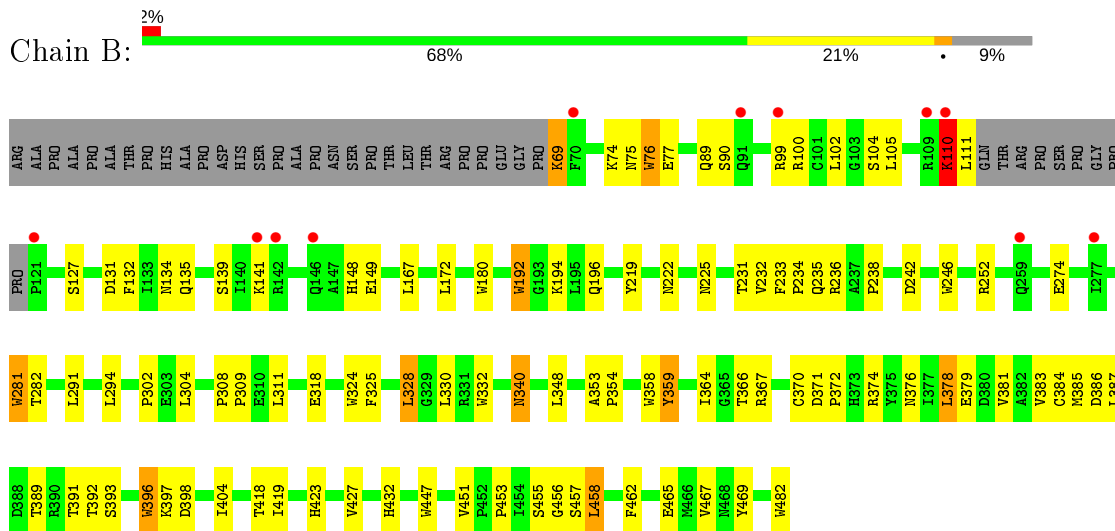
### 3 Residue-property plots

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



- Molecule 1: NITRIC OXIDE SYNTHASE, ENDOTHELIAL



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	58.87Å 106.18Å 156.74Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	87.90 – 2.48 43.03 – 2.48	Depositor EDS
% Data completeness (in resolution range)	99.4 (87.90-2.48) 99.5 (43.03-2.48)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.85 (at 2.48Å)	Xtrriage
Refinement program	REFMAC 5.6.0117	Depositor
R, $R_{free}$	0.184 , 0.242 0.184 , 0.239	Depositor DCC
$R_{free}$ test set	1765 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	56.5	Xtrriage
Anisotropy	0.681	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 42.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	6670	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	68.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.51% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup> Intensities estimated from amplitudes.

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



## 5 Model quality i

### 5.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, ZN, CAS, WS6, ACT, 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	0.78	4/3303 (0.1%)	0.83	2/4497 (0.0%)
1	B	0.83	9/3308 (0.3%)	0.88	1/4502 (0.0%)
All	All	0.80	13/6611 (0.2%)	0.86	3/8999 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	1

All (13) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	332	TRP	CD2-CE2	7.20	1.50	1.41
1	A	396	TRP	CD2-CE2	6.36	1.49	1.41
1	B	76	TRP	CD2-CE2	6.17	1.48	1.41
1	B	281	TRP	CD2-CE2	5.76	1.48	1.41
1	A	358	TRP	CD2-CE2	5.71	1.48	1.41
1	B	396	TRP	CD2-CE2	5.69	1.48	1.41
1	A	324	TRP	CD2-CE2	5.53	1.48	1.41
1	B	192	TRP	CD2-CE2	5.49	1.48	1.41
1	B	324	TRP	CD2-CE2	5.41	1.47	1.41
1	B	246	TRP	CD2-CE2	5.28	1.47	1.41
1	B	180	TRP	CD2-CE2	5.28	1.47	1.41
1	B	482	TRP	CD2-CE2	5.22	1.47	1.41
1	A	246	TRP	CD2-CE2	5.17	1.47	1.41

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	227	ARG	NE-CZ-NH1	6.29	123.44	120.30
1	B	311	LEU	CA-CB-CG	5.27	127.41	115.30
1	A	142	ARG	NE-CZ-NH1	5.17	122.89	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	359	TYR	Peptide

## 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	65	0
1	B	3229	0	3141	60	0
2	A	12	0	12	0	0
2	B	12	0	12	0	0
3	A	43	0	30	6	0
3	B	43	0	30	4	0
4	A	18	0	13	4	0
4	B	18	0	13	6	0
5	A	4	0	3	0	0
5	B	4	0	3	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	36	0	0	3	0
8	B	15	0	0	0	0
All	All	6670	0	6400	122	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 9.

All (122) 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:142:ARG:HG2	1:A:142:ARG:HH11	1.14	1.08
1:A:384:CAS:AS	1:A:384:CAS:SG	2.78	1.01
1:B:384:CAS:AS	1:B:384:CAS:SG	2.81	0.97
1:B:69:LYS:HZ2	1:B:69:LYS:N	1.75	0.85
1:B:358:TRP:H	3:B:500:HEM:HAB	1.44	0.82
1:B:366:THR:HG21	1:B:453:PRO:HB2	1.61	0.81
3:B:500:HEM:HBC2	3:B:500:HEM:HMC1	1.66	0.78
1:A:447:TRP:CZ2	4:B:800:WS6:H112	2.19	0.78
1:A:257:ARG:HG3	1:A:257:ARG:HH11	1.48	0.77
1:B:281:TRP:HB2	1:B:304:LEU:HD21	1.67	0.76
3:B:500:HEM:HBC2	3:B:500:HEM:CMC	2.17	0.75
1:A:142:ARG:HG2	1:A:142:ARG:NH1	1.92	0.74
1:B:379:GLU:O	1:B:383:VAL:HG23	1.86	0.74
1:A:240:ARG:HD3	1:A:298:PRO:HB3	1.70	0.73
1:A:109:ARG:HH22	1:B:69:LYS:HG3	1.56	0.71
1:B:385:MET:HE2	1:B:387:LEU:HD11	1.73	0.70
1:A:109:ARG:HH12	1:B:69:LYS:HB3	1.59	0.67
1:B:233:PHE:HB3	1:B:234:PRO:CD	2.25	0.67
1:A:109:ARG:HH22	1:B:69:LYS:CG	2.10	0.65
4:A:800:WS6:H113	1:B:462:PHE:CE1	2.32	0.65
1:B:359:TYR:CD2	1:B:364:ILE:HD11	2.36	0.61
1:B:381:VAL:HG21	1:B:404:ILE:HD11	1.83	0.61
1:B:233:PHE:HB3	1:B:234:PRO:HD2	1.81	0.60
4:A:800:WS6:H112	1:B:447:TRP:CZ2	2.37	0.60
3:A:500:HEM:HBB2	3:A:500:HEM:HHC	1.84	0.59
1:B:74:LYS:HD3	1:B:76:TRP:CE2	2.36	0.59
1:B:236:ARG:HD3	1:B:242:ASP:OD2	2.04	0.58
1:A:257:ARG:NH1	1:A:257:ARG:HG3	2.11	0.58
1:B:252:ARG:HB2	1:B:291:LEU:HD12	1.86	0.57
1:A:77:GLU:HG3	1:B:372:PRO:HG2	1.85	0.57
1:B:132:PHE:O	1:B:135:GLN:HB2	2.05	0.56
1:A:292:PRO:HA	8:A:2020:HOH:O	2.06	0.56
1:A:146:GLN:O	1:A:150:GLU:HB2	2.05	0.56
1:B:231:THR:O	1:B:354:PRO:HD2	2.06	0.56
1:A:367:ARG:HH12	4:A:800:WS6:C04	2.19	0.55
1:A:259:GLN:C	1:A:261:GLY:H	2.08	0.55
1:A:213:ILE:O	1:A:217:ILE:HG13	2.07	0.55
1:A:378:LEU:HB2	8:A:2026:HOH:O	2.06	0.55
1:A:184:PRO:HB3	1:A:468:ASN:ND2	2.22	0.54
1:A:184:PRO:CB	1:A:468:ASN:HD21	2.21	0.54
1:B:325:PHE:O	1:B:328:LEU:HB2	2.07	0.54
1:B:423:HIS:O	1:B:427:VAL:HG23	2.08	0.54

*Continued on next page...*

*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:340:ASN:HD22	1:B:340:ASN:C	2.12	0.53
1:B:456:GLY:O	1:B:462:PHE:HB2	2.09	0.53
1:A:134:ASN:O	1:A:138:SER:HB2	2.09	0.53
1:A:105:LEU:HD22	1:B:465:GLU:HB3	1.90	0.52
1:A:342:LEU:HD11	1:A:349:GLU:HB3	1.89	0.52
1:A:184:PRO:HB3	1:A:468:ASN:HD21	1.75	0.52
1:B:74:LYS:HD3	1:B:76:TRP:CZ2	2.46	0.51
1:A:151:ARG:HD3	1:A:168:ARG:NH1	2.25	0.51
3:A:500:HEM:CBB	3:A:500:HEM:HHC	2.41	0.51
1:A:465:GLU:OE1	1:B:105:LEU:HD13	2.11	0.51
1:B:131:ASP:O	1:B:135:GLN:HG3	2.12	0.50
1:B:370:CYS:SG	1:B:378:LEU:HD13	2.52	0.50
1:B:447:TRP:CZ2	1:B:451:VAL:HG21	2.47	0.50
1:B:366:THR:O	1:B:370:CYS:HB2	2.12	0.50
1:A:74:LYS:O	1:A:465:GLU:HG3	2.13	0.49
1:B:167:LEU:HG	1:B:348:LEU:HD12	1.94	0.49
1:B:359:TYR:CG	1:B:364:ILE:HD11	2.48	0.49
1:A:266:ASP:OD1	1:A:266:ASP:C	2.52	0.48
1:B:134:ASN:HA	1:B:148:HIS:HE2	1.78	0.48
1:A:325:PHE:HA	1:A:328:LEU:HD22	1.97	0.47
1:A:267:PRO:HD2	1:A:374:ARG:HA	1.96	0.47
1:A:109:ARG:NH1	1:B:69:LYS:HB3	2.28	0.47
1:A:186:CYS:HB2	3:A:500:HEM:ND	2.28	0.47
1:B:236:ARG:HD2	1:B:242:ASP:OD1	2.14	0.47
1:B:467:VAL:HG12	1:B:469:TYR:CD1	2.50	0.47
3:B:500:HEM:HMC1	3:B:500:HEM:CBC	2.42	0.47
1:A:264:ARG:HD3	8:A:2017:HOH:O	2.14	0.47
1:B:110:LYS:HD3	1:B:111:LEU:N	2.30	0.47
1:A:259:GLN:C	1:A:261:GLY:N	2.68	0.47
1:A:340:ASN:HD22	1:A:340:ASN:H	1.63	0.47
1:A:224:GLY:O	1:A:417:VAL:HA	2.15	0.46
1:B:457:SER:HA	1:B:462:PHE:CG	2.50	0.46
1:A:138:SER:O	1:A:141:LYS:HE3	2.16	0.46
1:B:104:SER:O	4:B:800:WS6:H081	2.16	0.46
1:A:175:GLY:HA3	1:A:345:ILE:HD13	1.97	0.46
1:B:172:LEU:HD11	1:B:232:VAL:HG11	1.97	0.46
1:A:462:PHE:CE1	4:B:800:WS6:H113	2.51	0.46
1:B:236:ARG:CD	1:B:242:ASP:OD2	2.63	0.46
1:A:246:TRP:CZ2	1:A:302:PRO:HG3	2.51	0.45
1:A:423:HIS:HB2	1:B:392:THR:HB	1.98	0.45
1:B:455:SER:O	1:B:458:LEU:HB2	2.16	0.45

*Continued on next page...*

*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:396:TRP:CZ2	1:B:397:LYS:HE2	2.52	0.45
1:A:105:LEU:HD23	1:A:105:LEU:N	2.31	0.45
1:A:447:TRP:CZ2	4:B:800:WS6:C11	2.96	0.45
1:A:126:LEU:HA	1:A:126:LEU:HD12	1.72	0.45
1:A:172:LEU:HD11	1:A:232:VAL:HG11	1.98	0.45
1:B:294:LEU:HD22	1:B:302:PRO:HB2	1.98	0.45
1:A:360:MET:HB3	1:A:360:MET:HE3	1.91	0.45
1:A:231:THR:O	1:A:353:ALA:HA	2.16	0.44
1:A:282:THR:HA	1:A:283:PRO:HD2	1.78	0.44
1:A:259:GLN:O	1:A:261:GLY:N	2.51	0.43
1:B:231:THR:O	1:B:353:ALA:HA	2.19	0.43
1:A:457:SER:HB3	1:B:453:PRO:HB3	2.00	0.43
1:A:447:TRP:CH2	4:B:800:WS6:H112	2.54	0.43
1:B:308:PRO:HA	1:B:309:PRO:HD2	1.87	0.43
1:A:246:TRP:HB2	1:A:294:LEU:HB3	1.99	0.43
1:A:384:CAS:SG	1:A:384:CAS:CE1	3.07	0.43
1:A:364:ILE:HA	1:A:368:ASN:HD22	1.84	0.42
1:B:367:ARG:HH12	4:B:800:WS6:C04	2.32	0.42
1:A:388:ASP:OD2	1:A:391:THR:HG22	2.18	0.42
1:A:477:TYR:OH	3:A:500:HEM:O1D	2.20	0.42
1:A:449:TRP:CE3	4:A:800:WS6:C02	3.02	0.42
1:A:360:MET:HE2	3:A:500:HEM:HMA1	2.02	0.42
1:B:371:ASP:HB2	1:B:374:ARG:CG	2.50	0.42
1:B:75:ASN:OD1	1:B:77:GLU:N	2.53	0.42
1:A:249:GLN:HB2	1:A:252:ARG:HG2	2.02	0.42
1:A:322:LEU:HD13	1:A:324:TRP:CZ2	2.55	0.42
1:B:222:ASN:HB3	1:B:225:ASN:O	2.20	0.41
1:B:467:VAL:HG12	1:B:469:TYR:HD1	1.85	0.41
1:A:107:LEU:HA	1:A:108:PRO:HD2	1.74	0.41
1:B:372:PRO:HA	1:B:376:ASN:ND2	2.35	0.41
1:A:247:ASN:OD1	1:A:247:ASN:N	2.54	0.41
3:A:500:HEM:HBB2	3:A:500:HEM:CHC	2.45	0.41
1:A:455:SER:O	1:A:458:LEU:HB2	2.20	0.41
1:A:257:ARG:CG	1:A:257:ARG:HH11	2.24	0.41
1:B:192:TRP:CD1	1:B:432:HIS:HE1	2.39	0.41
1:A:293:LEU:HD21	1:A:307:LEU:HD21	2.03	0.40
1:B:196:GLN:HG2	1:B:219:TYR:CZ	2.56	0.40
1:A:151:ARG:HD3	1:A:168:ARG:HH12	1.87	0.40
1:B:366:THR:CG2	1:B:453:PRO:HB2	2.41	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%)	381 (95%)	16 (4%)	3 (1%)	19	33
1	B	400/443 (90%)	374 (94%)	23 (6%)	3 (1%)	19	33
All	All	800/886 (90%)	755 (94%)	39 (5%)	6 (1%)	19	33

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	238	PRO
1	A	122	ALA
1	A	260	ASP
1	B	110	LYS
1	B	328	LEU
1	A	238	PRO

### 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%)	314 (92%)	29 (8%)	10	19
1	B	344/375 (92%)	317 (92%)	27 (8%)	12	22
All	All	687/750 (92%)	631 (92%)	56 (8%)	11	20

All (56) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	69	LYS
1	A	72	ARG
1	A	100	ARG
1	A	102	LEU
1	A	105	LEU
1	A	107	LEU
1	A	123	GLU
1	A	125	LEU
1	A	126	LEU
1	A	131	ASP
1	A	138	SER
1	A	142	ARG
1	A	149	GLU
1	A	150	GLU
1	A	204	SER
1	A	235	GLN
1	A	247	ASN
1	A	257	ARG
1	A	274	GLU
1	A	278	GLN
1	A	293	LEU
1	A	298	PRO
1	A	328	LEU
1	A	340	ASN
1	A	360	MET
1	A	361	SER
1	A	393	SER
1	A	398	ASP
1	A	458	LEU
1	B	69	LYS
1	B	89	GLN
1	B	90	SER
1	B	99	ARG
1	B	100	ARG
1	B	102	LEU
1	B	110	LYS
1	B	127	SER
1	B	139	SER
1	B	141	LYS
1	B	149	GLU
1	B	194	LYS
1	B	235	GLN
1	B	274	GLU

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type
1	B	282	THR
1	B	318	GLU
1	B	330	LEU
1	B	340	ASN
1	B	378	LEU
1	B	386	ASP
1	B	389	THR
1	B	391	THR
1	B	393	SER
1	B	398	ASP
1	B	418	THR
1	B	419	ILE
1	B	458	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	191	GLN
1	A	340	ASN
1	A	376	ASN
1	A	413	GLN
1	A	468	ASN
1	B	124	GLN
1	B	191	GLN
1	B	222	ASN
1	B	340	ASN
1	B	376	ASN
1	B	405	ASN
1	B	432	HIS

### 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	B	384	1	5,8,9	1.35	0	1,9,11	0.13	0
1	CAS	A	384	1	5,8,9	1.37	1 (20%)	1,9,11	0.61	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	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	384	CAS	AS-CE2	2.12	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 3 short contacts:

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

## 5.5 Carbohydrates [i](#)

There are no monosaccharides 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
3	HEM	B	500	1	27,50,50	2.09	9 (33%)	17,82,82	3.83	8 (47%)
2	ARG	A	700	-	7,11,11	0.56	0	6,13,13	1.51	2 (33%)
3	HEM	A	500	1	27,50,50	2.31	10 (37%)	17,82,82	3.46	7 (41%)
2	ARG	B	700	-	7,11,11	0.43	0	6,13,13	1.44	1 (16%)
6	GOL	B	880	-	5,5,5	0.47	0	5,5,5	0.57	0
4	WS6	B	800	-	18,20,20	1.50	3 (16%)	18,31,31	2.52	9 (50%)
5	ACT	A	860	-	1,3,3	0.66	0	0,3,3	0.00	-
5	ACT	B	860	-	1,3,3	1.53	0	0,3,3	0.00	-
4	WS6	A	800	-	18,20,20	1.44	3 (16%)	18,31,31	2.49	7 (38%)
6	GOL	A	880	-	5,5,5	0.31	0	5,5,5	1.23	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	B	500	1	-	0/6/54/54	-
2	ARG	A	700	-	-	1/7/11/11	-
3	HEM	A	500	1	-	0/6/54/54	-
2	ARG	B	700	-	-	0/7/11/11	-
6	GOL	B	880	-	-	3/4/4/4	-
4	WS6	B	800	-	-	-	0/3/3/3
4	WS6	A	800	-	-	-	0/3/3/3
6	GOL	A	880	-	-	2/4/4/4	-

All (25) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	500	HEM	C3C-C2C	5.71	1.48	1.40
3	A	500	HEM	C4A-NA	5.42	1.47	1.36
3	B	500	HEM	C1A-NA	4.42	1.45	1.36
3	B	500	HEM	C3C-C2C	4.29	1.46	1.40

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	500	HEM	C1A-NA	3.77	1.43	1.36
3	B	500	HEM	C4A-NA	3.72	1.43	1.36
4	A	800	WS6	C5A-N05	3.56	1.34	1.29
4	B	800	WS6	C5A-N05	3.43	1.34	1.29
3	B	500	HEM	C4D-C3D	3.39	1.50	1.42
3	A	500	HEM	C2A-C3A	3.37	1.47	1.37
3	B	500	HEM	C2A-C3A	3.17	1.47	1.37
3	A	500	HEM	C3B-C2B	3.17	1.44	1.40
3	B	500	HEM	C1B-C2B	3.03	1.49	1.42
3	A	500	HEM	C1C-C2C	2.88	1.49	1.42
4	B	800	WS6	C9A-C5A	-2.81	1.47	1.51
3	B	500	HEM	C1C-C2C	2.79	1.48	1.42
3	A	500	HEM	C1D-ND	-2.74	1.30	1.36
3	B	500	HEM	C3B-C2B	2.66	1.44	1.40
3	A	500	HEM	C3D-C2D	2.62	1.45	1.37
3	B	500	HEM	C3D-C2D	2.53	1.45	1.37
3	A	500	HEM	C1B-C2B	2.43	1.48	1.42
3	A	500	HEM	C4D-C3D	2.16	1.47	1.42
4	A	800	WS6	C9A-C5A	-2.13	1.48	1.51
4	B	800	WS6	C4A-C01	2.07	1.47	1.41
4	A	800	WS6	C4A-N05	-2.07	1.34	1.38

All (34) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	500	HEM	C1D-C2D-C3D	-9.30	100.53	107.00
3	A	500	HEM	C1D-C2D-C3D	-8.34	101.19	107.00
3	B	500	HEM	CBA-CAA-C2A	-7.90	97.92	112.49
3	A	500	HEM	CBA-CAA-C2A	-7.00	99.57	112.49
3	B	500	HEM	C3B-C4B-NB	5.68	116.55	109.21
3	A	500	HEM	C4A-C3A-C2A	-5.56	103.13	107.00
3	A	500	HEM	C3B-C4B-NB	4.58	115.13	109.21
4	A	800	WS6	C04-C4A-C01	4.38	117.40	114.53
3	B	500	HEM	CBD-CAD-C3D	-4.32	104.52	112.48
4	B	800	WS6	C04-N03-C02	4.28	122.72	115.93
4	A	800	WS6	O06-C06-C5A	-4.26	117.58	121.86
4	B	800	WS6	C11-C9A-C5A	-4.24	101.48	111.44
4	A	800	WS6	C04-N03-C02	4.04	122.34	115.93
4	A	800	WS6	C4A-C04-N03	-3.89	118.11	123.43
4	B	800	WS6	C04-C4A-C01	3.84	117.04	114.53
4	B	800	WS6	C4A-C04-N03	-3.66	118.42	123.43
4	B	800	WS6	C02-N01-C01	3.61	122.63	114.54

*Continued on next page...*

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	500	HEM	CAA-CBA-CGA	3.60	118.71	112.67
4	A	800	WS6	C11-C9A-C5A	-3.56	103.08	111.44
4	A	800	WS6	C02-N01-C01	3.50	122.38	114.54
2	B	700	ARG	CG-CD-NE	-3.49	102.24	112.21
3	B	500	HEM	C4A-C3A-C2A	-3.43	104.61	107.00
4	B	800	WS6	C11-C9A-C09	3.18	114.23	109.97
3	A	500	HEM	CMB-C2B-C3B	3.13	130.53	124.68
4	B	800	WS6	N03-C02-N01	-2.83	120.97	125.42
3	A	500	HEM	CMD-C2D-C3D	2.72	130.06	124.94
4	B	800	WS6	O06-C06-C5A	-2.52	119.33	121.86
3	A	500	HEM	CMA-C3A-C4A	2.50	132.30	128.46
3	B	500	HEM	CMD-C2D-C3D	2.30	129.28	124.94
4	A	800	WS6	N03-C02-N01	-2.28	121.85	125.42
3	B	500	HEM	CMB-C2B-C3B	2.22	128.83	124.68
4	B	800	WS6	N02-C02-N03	2.15	120.60	117.25
2	A	700	ARG	NE-CZ-NH2	-2.14	116.94	120.70
2	A	700	ARG	CG-CD-NE	-2.13	106.13	112.21

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	B	880	GOL	C1-C2-C3-O3
6	A	880	GOL	O1-C1-C2-C3
6	A	880	GOL	O1-C1-C2-O2
6	B	880	GOL	O2-C2-C3-O3
6	B	880	GOL	O1-C1-C2-C3
2	A	700	ARG	N-CA-CB-CG

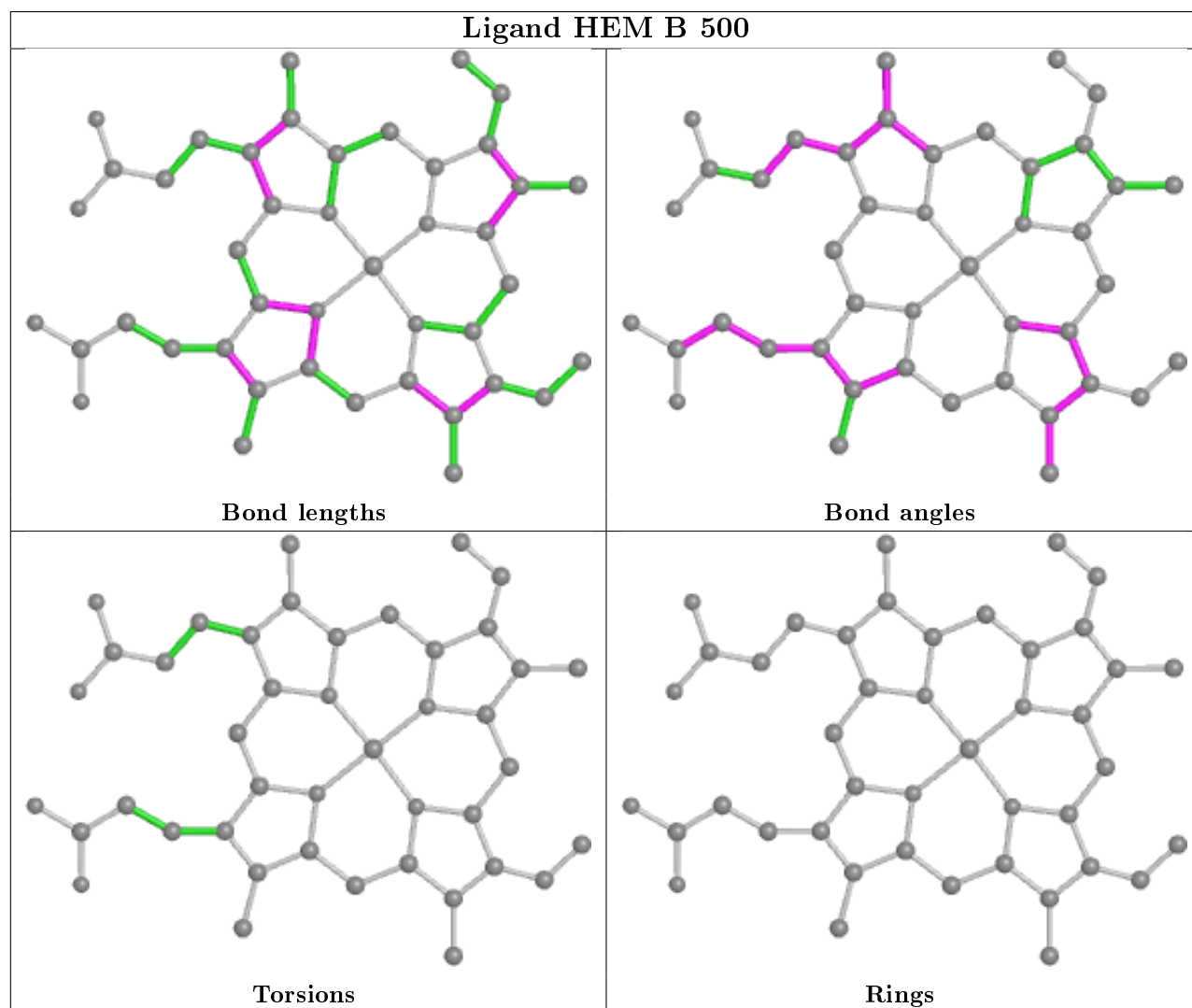
There are no ring outliers.

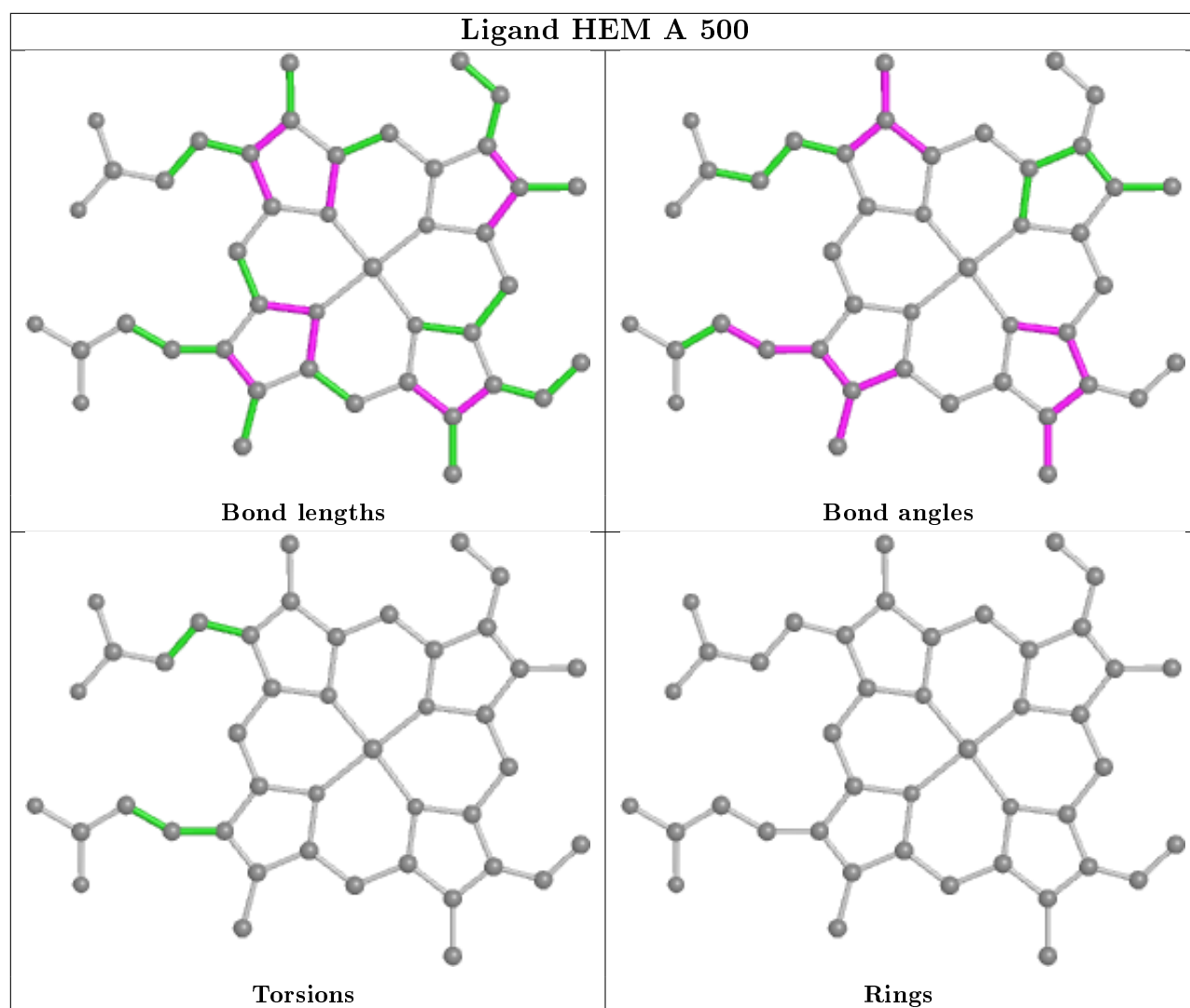
4 monomers are involved in 20 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	500	HEM	4	0
3	A	500	HEM	6	0
4	B	800	WS6	6	0
4	A	800	WS6	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 than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





## 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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	404/443 (91%)	-0.06	13 (3%) 47 50	44, 65, 100, 129	0
1	B	404/443 (91%)	-0.07	11 (2%) 54 56	40, 66, 99, 124	0
All	All	808/886 (91%)	-0.06	24 (2%) 50 52	40, 66, 100, 129	0

All (24) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	259	GLN	4.4
1	B	146	GLN	3.5
1	A	160	ALA	3.5
1	A	239	GLY	3.3
1	B	142	ARG	3.1
1	A	123	GLU	3.1
1	B	141	LYS	3.0
1	A	156	GLU	3.0
1	A	93	ASP	2.8
1	A	91	GLN	2.7
1	B	110	LYS	2.7
1	B	121	PRO	2.7
1	A	92	GLN	2.7
1	B	91	GLN	2.7
1	A	259	GLN	2.7
1	B	99	ARG	2.6
1	A	152	LEU	2.6
1	B	70	PHE	2.5
1	A	99	ARG	2.4
1	A	126	LEU	2.4
1	B	277	ILE	2.1
1	A	279	HIS	2.1
1	A	157	ALA	2.1
1	B	109	ARG	2.0

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

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	CAS	B	384	9/10	0.95	0.15	84,91,140,163	0
1	CAS	A	384	9/10	0.95	0.08	67,70,90,113	0

## 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, 95<sup>th</sup> 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.

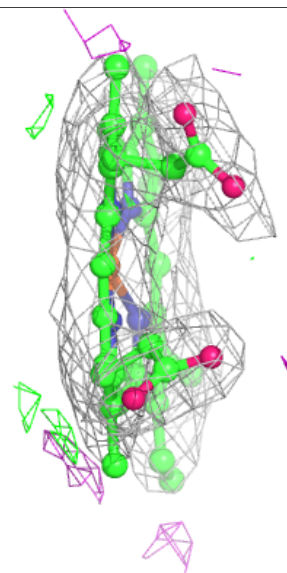
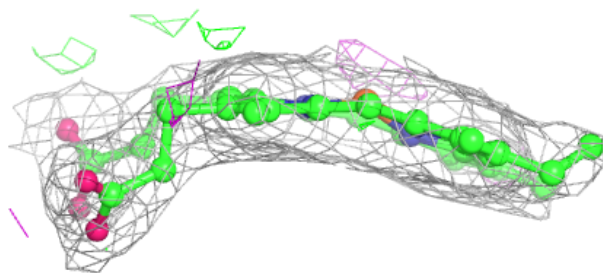
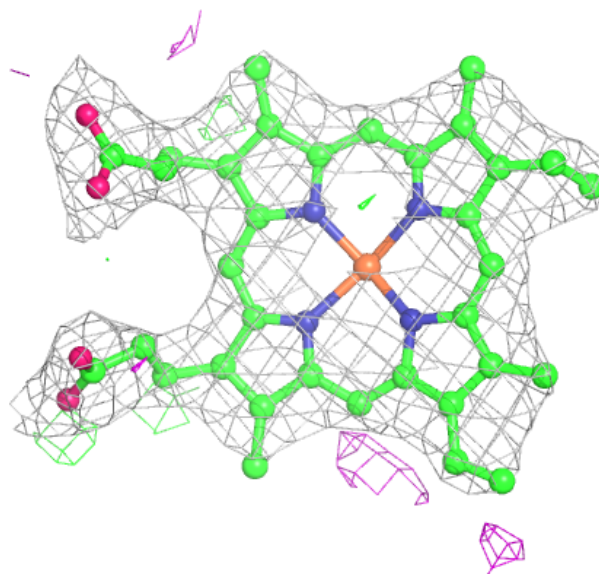
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
6	GOL	A	880	6/6	0.86	0.40	87,93,104,139	0
6	GOL	B	880	6/6	0.93	0.31	60,68,79,80	0
4	WS6	B	800	18/18	0.94	0.24	80,90,102,117	0
4	WS6	A	800	18/18	0.95	0.16	74,79,89,91	0
2	ARG	A	700	12/12	0.96	0.23	47,51,65,66	0
2	ARG	B	700	12/12	0.96	0.16	41,48,63,63	0
5	ACT	B	860	4/4	0.97	0.15	66,71,75,78	0
3	HEM	B	500	43/43	0.98	0.19	43,51,58,64	0
3	HEM	A	500	43/43	0.98	0.18	37,43,64,71	0
5	ACT	A	860	4/4	0.99	0.17	54,56,56,57	0
7	ZN	A	1483	1/1	1.00	0.08	61,61,61,61	0

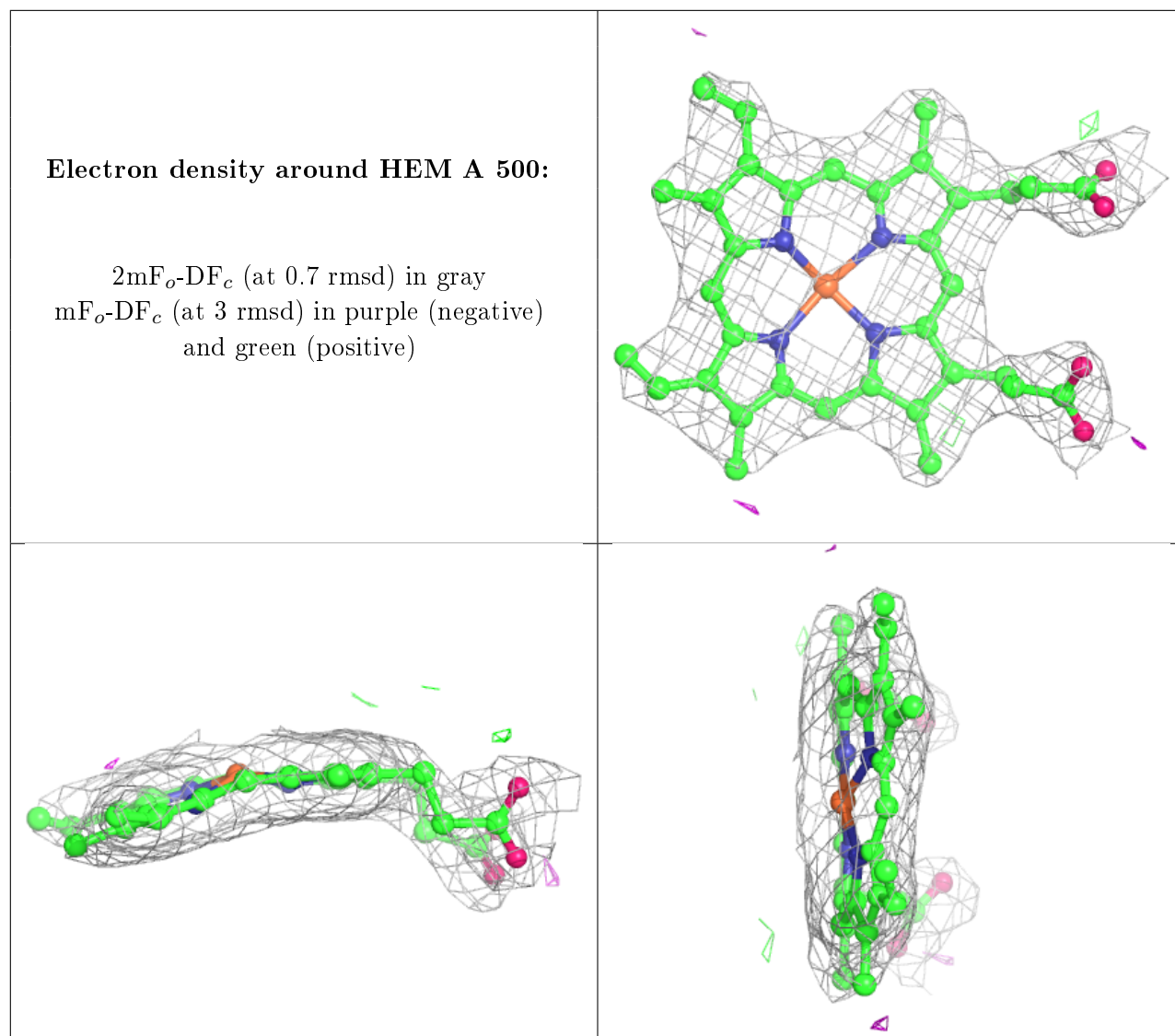
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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



**Electron density around HEM 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 [i](#)

There are no such residues in this entry.