Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2023 – 12:32 AM EST

PDB ID	:	1CBM
Title	:	THE 1.8 ANGSTROM STRUCTURE OF CARBONMONOXY-BETA4 HEMOGLOBIN: ANALYSIS OF A HOMOTETRAMER WITH THE R QUATERNARY STRUCTURE OF LIGANDED ALPHA2BETA2 HEMOGLOBIN
Authors	:	Borgstahl, G.E.O.; Arnone, A.
Deposited on	:	1993-02-18
Resolution	:	1.74 Å(reported)

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

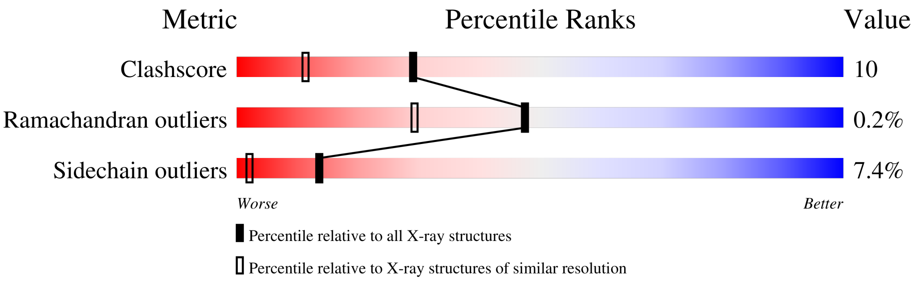
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.32.1

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 1.74 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))
Clashscore	141614	3923 (1.76-1.72)
Ramachandran outliers	138981	3878 (1.76-1.72)
Sidechain outliers	138945	3878 (1.76-1.72)

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%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	146	74% 19% 7%
1	B	146	73% 24% • •
1	C	146	73% 23% 5%
1	D	146	70% 25% 5% •

2 Entry composition (i)

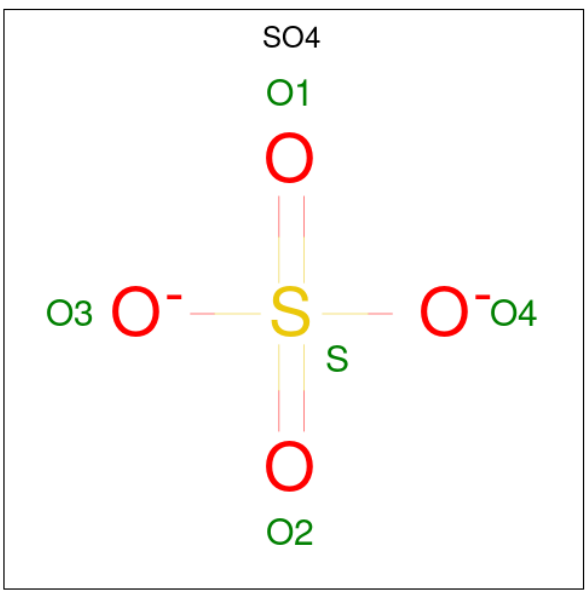
There are 5 unique types of molecules in this entry. The entry contains 4953 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 HEMOGLOBIN BETA 4 (CARBONMONOXY).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	146	Total 1144	C 739	N 198	O 203	S 4	0	6	0
1	B	146	Total 1162	C 750	N 199	O 209	S 4	0	11	0
1	C	146	Total 1153	C 744	N 200	O 205	S 4	0	8	0
1	D	146	Total 1161	C 748	N 200	O 209	S 4	0	10	0

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



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

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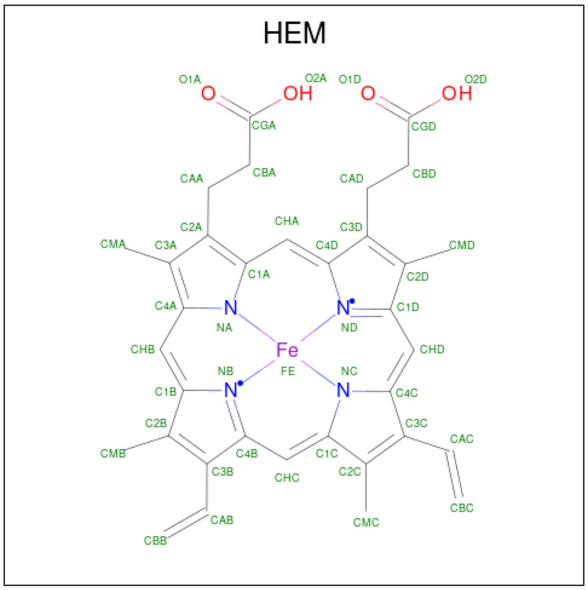
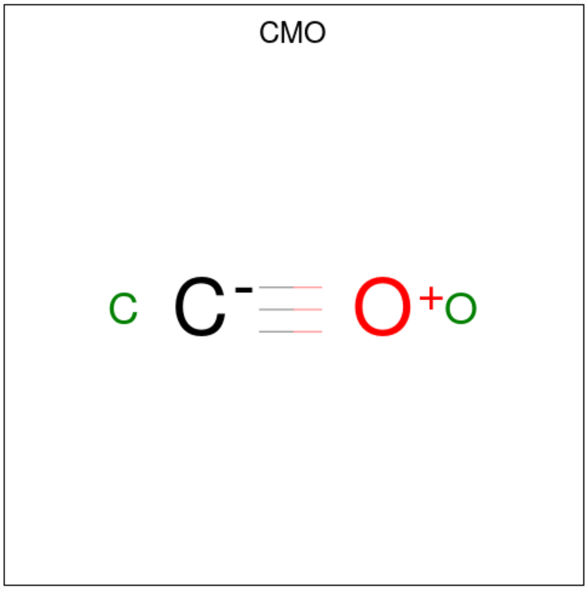
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	C	1	Total 5	O 4	S 1	0	0
2	D	1	Total 5	O 4	S 1	0	0

- 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
3	A	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
3	B	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
3	C	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
3	D	1	Total 43	C 34	Fe 1	N 4	O 4	0	0

- Molecule 4 is CARBON MONOXIDE (three-letter code: CMO) (formula: CO).



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

- Molecule 5 is water.

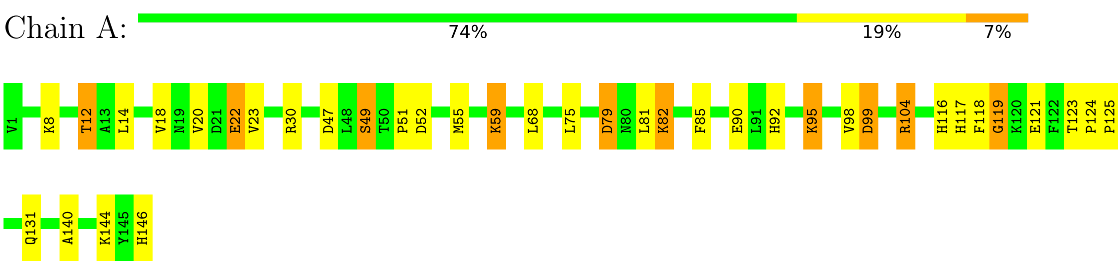
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	31	Total O 31 31	0	0
5	B	34	Total O 34 34	0	0
5	C	46	Total O 46 46	0	0
5	D	22	Total O 22 22	0	0

3 Residue-property plots ⓘ

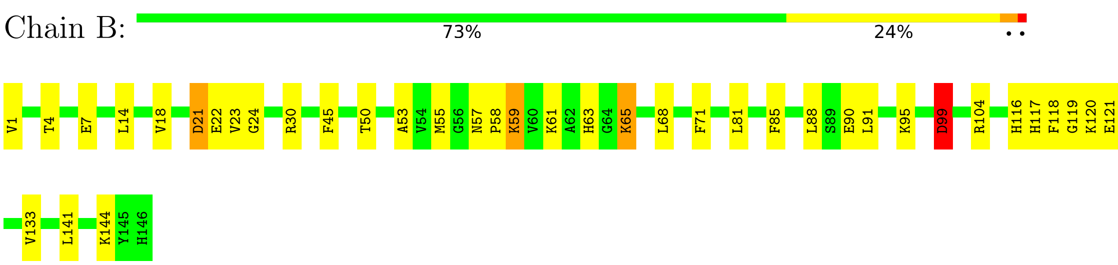
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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.

Note EDS was not executed.

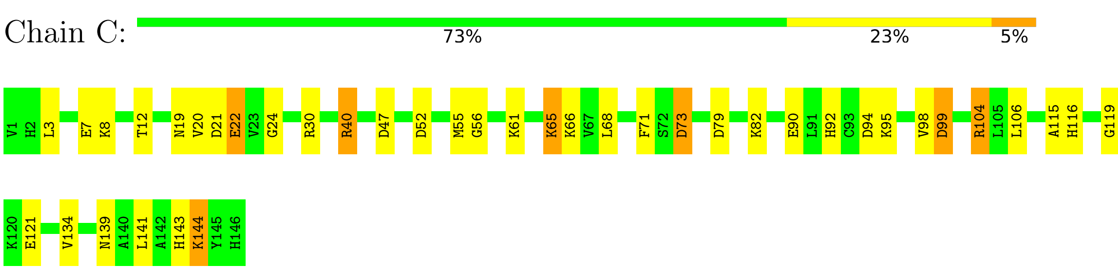
• Molecule 1: HEMOGLOBIN BETA 4 (CARBONMONOXY)



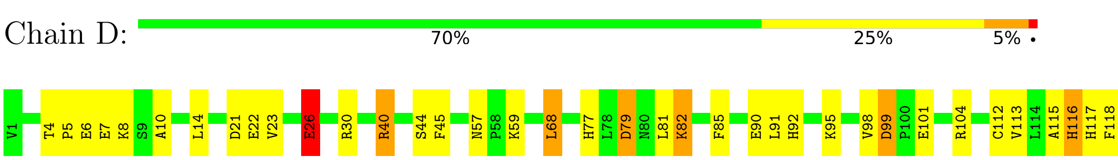
• Molecule 1: HEMOGLOBIN BETA 4 (CARBONMONOXY)

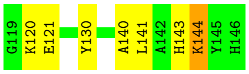


• Molecule 1: HEMOGLOBIN BETA 4 (CARBONMONOXY)



• Molecule 1: HEMOGLOBIN BETA 4 (CARBONMONOXY)




G119
K120
E121
Y130
A140
L141
A142
H143
K144
Y145
H146

4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	63.30Å 82.40Å 53.70Å 90.00° 90.10° 90.00°	Depositor
Resolution (Å)	10.00 – 1.74	Depositor
% Data completeness (in resolution range)	(Not available) (10.00-1.74)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ, TNT	Depositor
R, R_{free}	0.177 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4953	wwPDB-VP
Average B, all atoms ($Å^2$)	30.0	wwPDB-VP

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: CMO, SO4, 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	0.88	0/1205	1.47	13/1637 (0.8%)
1	B	0.89	0/1249	1.42	10/1695 (0.6%)
1	C	0.93	0/1225	1.64	20/1664 (1.2%)
1	D	0.92	2/1243 (0.2%)	1.52	15/1688 (0.9%)
All	All	0.90	2/4922 (0.0%)	1.52	58/6684 (0.9%)

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	C	0	2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	112[A]	CYS	CB-SG	-5.25	1.73	1.81
1	D	112[B]	CYS	CB-SG	-5.25	1.73	1.81

All (58) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	30	ARG	NE-CZ-NH1	19.04	129.82	120.30
1	C	30	ARG	NE-CZ-NH2	-12.19	114.20	120.30
1	A	30	ARG	NE-CZ-NH1	11.17	125.88	120.30
1	D	104	ARG	NE-CZ-NH1	11.13	125.86	120.30
1	C	104	ARG	NE-CZ-NH1	10.89	125.74	120.30
1	A	99[A]	ASP	CB-CG-OD1	9.83	127.14	118.30
1	A	99[B]	ASP	CB-CG-OD1	9.83	127.14	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	104	ARG	NE-CZ-NH1	9.83	125.21	120.30
1	B	104	ARG	CD-NE-CZ	9.72	137.21	123.60
1	D	26	GLU	CA-CB-CG	9.08	133.38	113.40
1	C	22	GLU	CA-CB-CG	8.93	133.05	113.40
1	C	99[A]	ASP	CB-CG-OD2	-8.03	111.08	118.30
1	C	99[B]	ASP	CB-CG-OD2	-8.03	111.08	118.30
1	D	99[A]	ASP	CB-CG-OD1	7.91	125.42	118.30
1	D	99[B]	ASP	CB-CG-OD1	7.91	125.42	118.30
1	B	99[A]	ASP	CB-CG-OD1	7.89	125.40	118.30
1	B	99[B]	ASP	CB-CG-OD1	7.89	125.40	118.30
1	C	121	GLU	CA-CB-CG	7.85	130.67	113.40
1	C	21	ASP	CB-CG-OD1	7.61	125.15	118.30
1	A	30	ARG	NE-CZ-NH2	-7.51	116.55	120.30
1	D	30	ARG	NE-CZ-NH1	7.34	123.97	120.30
1	C	99[A]	ASP	CB-CG-OD1	7.07	124.66	118.30
1	C	99[B]	ASP	CB-CG-OD1	7.07	124.66	118.30
1	D	118	PHE	CA-CB-CG	7.06	130.83	113.90
1	A	104	ARG	NE-CZ-NH1	7.01	123.80	120.30
1	D	99[A]	ASP	CB-CG-OD2	-6.98	112.02	118.30
1	D	99[B]	ASP	CB-CG-OD2	-6.98	112.02	118.30
1	C	116	HIS	CA-CB-CG	6.81	125.18	113.60
1	B	99[A]	ASP	CB-CG-OD2	-6.80	112.18	118.30
1	B	99[B]	ASP	CB-CG-OD2	-6.80	112.18	118.30
1	B	21	ASP	CB-CG-OD1	6.69	124.32	118.30
1	D	40[A]	ARG	NE-CZ-NH1	6.49	123.55	120.30
1	D	40[B]	ARG	NE-CZ-NH1	6.49	123.55	120.30
1	C	73	ASP	CB-CG-OD2	-6.15	112.77	118.30
1	D	130	TYR	CB-CG-CD2	-6.08	117.35	121.00
1	C	65	LYS	CB-CA-C	6.05	122.50	110.40
1	C	52	ASP	O-C-N	5.88	132.10	122.70
1	B	30	ARG	NE-CZ-NH1	5.83	123.22	120.30
1	B	104	ARG	NH1-CZ-NH2	-5.77	113.05	119.40
1	D	118	PHE	N-CA-CB	5.74	120.93	110.60
1	C	40[A]	ARG	NE-CZ-NH2	-5.70	117.45	120.30
1	C	40[B]	ARG	NE-CZ-NH2	-5.70	117.45	120.30
1	C	52	ASP	N-CA-CB	5.62	120.72	110.60
1	D	116	HIS	CA-CB-CG	5.56	123.06	113.60
1	D	101	GLU	CG-CD-OE2	-5.46	107.38	118.30
1	A	59	LYS	N-CA-CB	5.45	120.40	110.60
1	A	59	LYS	CA-CB-CG	5.44	125.37	113.40
1	A	121	GLU	CA-CB-CG	5.42	125.33	113.40
1	A	75[A]	LEU	CA-CB-CG	5.41	127.75	115.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	75[B]	LEU	CA-CB-CG	5.41	127.75	115.30
1	B	21	ASP	CB-CG-OD2	-5.36	113.48	118.30
1	A	52	ASP	CB-CG-OD2	-5.31	113.52	118.30
1	C	65	LYS	CA-CB-CG	5.30	125.06	113.40
1	A	79	ASP	CB-CG-OD2	5.19	122.97	118.30
1	D	5	PRO	O-C-N	5.13	130.91	122.70
1	A	18	VAL	CA-CB-CG1	5.10	118.55	110.90
1	C	47	ASP	CB-CG-OD2	-5.08	113.73	118.30
1	C	52	ASP	CA-C-O	-5.02	109.55	120.10

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	40[A]	ARG	Sidechain
1	C	40[B]	ARG	Sidechain

5.2 Too-close contacts (i)

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

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1144	0	1145	18	0
1	B	1162	0	1160	28	0
1	C	1153	0	1150	21	0
1	D	1161	0	1151	27	0
2	A	5	0	0	0	0
2	B	5	0	0	0	0
2	C	5	0	0	0	0
2	D	5	0	0	0	0
3	A	43	0	30	0	0
3	B	43	0	30	4	0
3	C	43	0	30	1	0
3	D	43	0	30	0	0
4	A	2	0	0	0	0
4	B	2	0	0	0	0
4	C	2	0	0	0	0
4	D	2	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	31	0	0	1	0
5	B	34	0	0	1	0
5	C	46	0	0	0	0
5	D	22	0	0	0	0
All	All	4953	0	4726	92	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 10.

All (92) 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:B:90:GLU:HG3	1:B:144:LYS:HE2	1.63	0.81
1:A:82:LYS:HD2	1:A:140:ALA:HA	1.71	0.72
1:D:23:VAL:HG12	1:D:68:LEU:HD11	1.72	0.71
1:D:14:LEU:HD21	1:D:121[B]:GLU:HG3	1.75	0.68
1:B:55:MET:HE3	5:B:214:HOH:O	1.92	0.68
1:B:58:PRO:HA	1:B:61:LYS:HD2	1.75	0.67
1:B:24:GLY:CA	1:B:68[B]:LEU:HG	2.25	0.67
1:B:91:LEU:CD1	1:B:95:LYS:HE2	2.26	0.65
1:A:8:LYS:O	1:A:12:THR:HG23	1.95	0.65
1:C:92:HIS:HB3	1:C:98[B]:VAL:CG1	2.27	0.63
1:B:24:GLY:HA2	1:B:68[B]:LEU:HG	1.83	0.61
1:B:45:PHE:HA	1:B:59:LYS:HE2	1.83	0.60
1:C:20:VAL:HA	1:C:68[A]:LEU:CD2	2.32	0.59
1:C:71[B]:PHE:CZ	1:C:134:VAL:HG12	2.37	0.59
3:B:147:HEM:HBB2	3:B:147:HEM:HHC	1.85	0.58
1:A:92:HIS:O	1:A:98[B]:VAL:HG12	2.04	0.58
1:C:104:ARG:HH22	1:C:139:ASN:HD22	1.51	0.58
1:D:82:LYS:HE2	1:D:143:HIS:HB2	1.86	0.57
1:D:116:HIS:ND1	1:D:117[A]:HIS:CD2	2.73	0.56
1:B:23:VAL:HG22	1:B:117:HIS:CE1	2.41	0.56
1:D:82:LYS:HD2	1:D:140:ALA:HA	1.86	0.56
1:D:57:ASN:OD1	1:D:59:LYS:HB2	2.06	0.55
1:C:82:LYS:HD2	1:C:143:HIS:ND1	2.20	0.55
1:D:4:THR:OG1	1:D:6[A]:GLU:HG2	2.06	0.55
1:C:8:LYS:O	1:C:12:THR:HG23	2.07	0.55
1:B:116:HIS:HB2	1:C:115:ALA:HB1	1.89	0.54
1:A:47:ASP:OD1	1:A:49:SER:OG	2.25	0.53
1:C:92:HIS:O	1:C:98[B]:VAL:HG12	2.09	0.52
1:A:92:HIS:HB3	1:A:98[B]:VAL:CG1	2.40	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:4:THR:OG1	1:B:7:GLU:HG3	2.10	0.52
1:D:82:LYS:HE3	1:D:140:ALA:HA	1.92	0.52
1:B:57:ASN:OD1	1:B:59:LYS:HB2	2.10	0.51
1:D:92:HIS:O	1:D:98[B]:VAL:HG12	2.10	0.51
1:D:81:LEU:HD22	1:D:85:PHE:HE2	1.75	0.51
1:D:7:GLU:O	1:D:10:ALA:HB3	2.11	0.51
1:C:24:GLY:CA	1:C:68[B]:LEU:HG	2.41	0.50
1:C:56:GLY:HA2	1:C:61:LYS:CE	2.42	0.50
1:B:50:THR:H	1:B:53:ALA:HB3	1.77	0.49
1:C:20:VAL:HA	1:C:68[A]:LEU:HD21	1.93	0.49
1:B:18:VAL:HG13	1:B:23:VAL:HG21	1.93	0.49
1:B:141:LEU:HD12	3:B:147:HEM:CBB	2.43	0.48
1:B:116:HIS:CD2	1:C:119:GLY:O	2.66	0.48
1:A:81:LEU:HD22	1:A:85:PHE:HE2	1.77	0.48
1:C:20:VAL:HA	1:C:68[A]:LEU:HD23	1.96	0.48
1:D:14:LEU:HD21	1:D:121[B]:GLU:CG	2.42	0.48
1:D:113:VAL:O	1:D:116:HIS:HB3	2.15	0.47
1:B:118:PHE:O	1:B:119:GLY:C	2.53	0.46
1:C:19:ASN:ND2	1:C:22:GLU:OE1	2.48	0.46
1:D:22:GLU:O	1:D:26:GLU:HB2	2.16	0.46
1:A:20:VAL:HA	1:A:68:LEU:CD2	2.47	0.45
1:A:116:HIS:HB2	1:D:115:ALA:HB1	1.97	0.45
1:D:90:GLU:HG2	1:D:144:LYS:HE3	1.98	0.45
1:A:123:THR:OG1	1:A:125:PRO:HD2	2.17	0.45
1:B:14[B]:LEU:HD21	1:B:121[B]:GLU:CG	2.46	0.45
1:D:82:LYS:HE2	1:D:143:HIS:CG	2.51	0.45
1:D:144:LYS:HA	1:D:144:LYS:HD2	1.63	0.45
1:D:23:VAL:CG1	1:D:68:LEU:HD11	2.44	0.45
1:D:82:LYS:CE	1:D:140:ALA:HA	2.47	0.45
1:B:91:LEU:HD11	1:B:95:LYS:HE2	1.98	0.44
1:D:23:VAL:HG22	1:D:117[A]:HIS:ND1	2.32	0.44
1:A:95:LYS:HE2	1:A:95:LYS:HB3	1.79	0.44
1:A:22:GLU:HG2	1:A:23:VAL:N	2.33	0.44
1:A:51:PRO:O	1:A:55:MET:HG2	2.17	0.44
1:B:116:HIS:ND1	1:B:117:HIS:HD2	2.16	0.44
1:C:71[B]:PHE:HZ	1:C:134:VAL:HG12	1.81	0.43
1:B:57:ASN:O	1:B:61:LYS:HD2	2.18	0.43
1:C:92:HIS:HB3	1:C:98[B]:VAL:HG11	2.01	0.43
1:D:77:HIS:C	1:D:79:ASP:H	2.23	0.43
3:B:147:HEM:HHC	3:B:147:HEM:CBB	2.49	0.42
1:D:92:HIS:HB3	1:D:98[B]:VAL:CG1	2.49	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:21:ASP:OD1	1:B:65:LYS:HE3	2.18	0.42
1:A:146:HIS:OXT	1:B:1:VAL:HA	2.20	0.42
1:A:124:PRO:N	1:A:125:PRO:CD	2.82	0.42
1:D:45:PHE:HA	1:D:59:LYS:HD3	2.01	0.42
1:B:88:LEU:HD23	1:B:88:LEU:HA	1.91	0.41
1:B:63:HIS:CE1	3:B:147:HEM:HBD2	2.55	0.41
1:B:14[B]:LEU:HD21	1:B:121[B]:GLU:HG2	2.02	0.41
1:C:3:LEU:HA	1:C:7:GLU:OE1	2.20	0.41
1:B:71[B]:PHE:CZ	1:B:133:VAL:HG12	2.56	0.41
1:B:81:LEU:HD22	1:B:85:PHE:HE2	1.85	0.41
1:D:91:LEU:O	1:D:95:LYS:HB3	2.21	0.41
1:A:118:PHE:O	1:A:119:GLY:C	2.58	0.41
1:A:131:GLN:HG3	5:A:276:HOH:O	2.20	0.41
1:C:55:MET:O	1:C:61:LYS:HE2	2.21	0.41
1:A:90:GLU:HA	1:A:144:LYS:HG3	2.03	0.41
1:D:82:LYS:CD	1:D:140:ALA:HA	2.51	0.41
1:C:90:GLU:O	1:C:94:ASP:HB2	2.20	0.41
1:D:82:LYS:HE2	1:D:143:HIS:ND1	2.36	0.40
1:A:116:HIS:ND1	1:A:117:HIS:HD2	2.18	0.40
1:C:144:LYS:HD2	1:C:144:LYS:HA	1.70	0.40
1:C:106:LEU:HD23	3:C:147:HEM:HBB2	2.02	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	150/146 (103%)	146 (97%)	3 (2%)	1 (1%)	22	8
1	B	155/146 (106%)	151 (97%)	4 (3%)	0	100	100
1	C	152/146 (104%)	149 (98%)	3 (2%)	0	100	100
1	D	154/146 (106%)	150 (97%)	4 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	611/584 (105%)	596 (98%)	14 (2%)	1 (0%)	47	29

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	119	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	124/118 (105%)	113 (91%)	11 (9%)	9	1
1	B	129/118 (109%)	123 (95%)	6 (5%)	26	7
1	C	126/118 (107%)	117 (93%)	9 (7%)	14	2
1	D	128/118 (108%)	114 (89%)	14 (11%)	6	1
All	All	507/472 (107%)	467 (92%)	40 (8%)	13	1

All (40) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	12	THR
1	A	14	LEU
1	A	22	GLU
1	A	49	SER
1	A	59	LYS
1	A	79	ASP
1	A	82	LYS
1	A	95	LYS
1	A	99[A]	ASP
1	A	99[B]	ASP
1	A	104	ARG
1	B	22	GLU
1	B	59	LYS
1	B	65	LYS

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Mol	Chain	Res	Type
1	B	99[A]	ASP
1	B	99[B]	ASP
1	B	120	LYS
1	C	65	LYS
1	C	66	LYS
1	C	73	ASP
1	C	79	ASP
1	C	95	LYS
1	C	99[A]	ASP
1	C	99[B]	ASP
1	C	141	LEU
1	C	144	LYS
1	D	8	LYS
1	D	21	ASP
1	D	26	GLU
1	D	40[A]	ARG
1	D	40[B]	ARG
1	D	44	SER
1	D	68	LEU
1	D	79	ASP
1	D	82	LYS
1	D	99[A]	ASP
1	D	99[B]	ASP
1	D	120	LYS
1	D	141	LEU
1	D	144	LYS

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

Mol	Chain	Res	Type
1	A	117	HIS
1	B	131	GLN
1	C	131	GLN
1	C	139	ASN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

12 ligands are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
3	HEM	A	147	4,1	41,50,50	1.48	6 (14%)	45,82,82	1.43	6 (13%)
2	SO4	A	150	-	4,4,4	0.65	0	6,6,6	0.23	0
4	CMO	C	148	3	0,1,1	-	-	-		
4	CMO	A	148	3	0,1,1	-	-	-		
4	CMO	D	148	3	0,1,1	-	-	-		
2	SO4	D	152	-	4,4,4	0.66	0	6,6,6	0.07	0
3	HEM	B	147	4,1	41,50,50	1.55	5 (12%)	45,82,82	1.81	11 (24%)
3	HEM	C	147	4,1	41,50,50	1.56	5 (12%)	45,82,82	1.66	14 (31%)
3	HEM	D	147	4,1	41,50,50	1.59	6 (14%)	45,82,82	1.59	9 (20%)
2	SO4	B	151	-	4,4,4	0.68	0	6,6,6	0.33	0
4	CMO	B	148	3	0,1,1	-	-	-		
2	SO4	C	153	-	4,4,4	0.65	0	6,6,6	0.10	0

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	HEM	A	147	4,1	-	3/12/54/54	-
3	HEM	D	147	4,1	-	6/12/54/54	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	HEM	B	147	4,1	-	4/12/54/54	-
3	HEM	C	147	4,1	-	6/12/54/54	-

All (22) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	D	147	HEM	C3C-C2C	-5.21	1.33	1.40
3	C	147	HEM	C3C-C2C	-4.82	1.33	1.40
3	B	147	HEM	C3C-C2C	-4.20	1.34	1.40
3	A	147	HEM	C3C-C2C	-4.01	1.34	1.40
3	B	147	HEM	C3C-CAC	3.90	1.55	1.47
3	A	147	HEM	CAA-C2A	3.51	1.57	1.52
3	D	147	HEM	C3C-CAC	3.36	1.54	1.47
3	C	147	HEM	CMB-C2B	3.27	1.57	1.50
3	D	147	HEM	CAB-C3B	3.22	1.56	1.47
3	C	147	HEM	C3C-CAC	2.98	1.53	1.47
3	A	147	HEM	C3C-CAC	2.80	1.53	1.47
3	C	147	HEM	CAA-C2A	2.80	1.56	1.52
3	B	147	HEM	CAB-C3B	2.71	1.54	1.47
3	A	147	HEM	CAB-C3B	2.70	1.54	1.47
3	A	147	HEM	CMB-C2B	2.69	1.56	1.50
3	D	147	HEM	CAA-C2A	2.54	1.55	1.52
3	D	147	HEM	CMD-C2D	2.25	1.55	1.50
3	C	147	HEM	CHA-C4D	2.21	1.40	1.35
3	B	147	HEM	CMD-C2D	2.11	1.55	1.50
3	D	147	HEM	CAD-C3D	2.09	1.56	1.51
3	A	147	HEM	C3D-C2D	-2.01	1.32	1.36
3	B	147	HEM	CAA-C2A	2.01	1.55	1.52

All (40) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	D	147	HEM	CMA-C3A-C4A	-5.36	120.22	128.46
3	B	147	HEM	O2A-CGA-O1A	4.25	133.89	123.30
3	B	147	HEM	CMA-C3A-C4A	-4.15	122.09	128.46
3	D	147	HEM	CMA-C3A-C2A	4.07	132.61	124.94
3	C	147	HEM	O2A-CGA-O1A	3.79	132.75	123.30
3	B	147	HEM	CMA-C3A-C2A	3.77	132.04	124.94
3	B	147	HEM	O1D-CGD-CBD	-3.63	111.42	123.08
3	A	147	HEM	CMA-C3A-C4A	-3.54	123.02	128.46
3	A	147	HEM	C4B-CHC-C1C	3.47	127.13	122.56
3	B	147	HEM	O1A-CGA-CBA	-3.19	112.84	123.08

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	147	HEM	CMA-C3A-C2A	3.05	130.70	124.94
3	D	147	HEM	C4B-CHC-C1C	3.04	126.58	122.56
3	C	147	HEM	O1D-CGD-CBD	-2.89	113.78	123.08
3	C	147	HEM	O2D-CGD-O1D	2.87	130.46	123.30
3	C	147	HEM	CMA-C3A-C4A	-2.87	124.05	128.46
3	B	147	HEM	CBA-CAA-C2A	-2.87	107.73	112.62
3	C	147	HEM	O1A-CGA-CBA	-2.86	113.89	123.08
3	B	147	HEM	O2D-CGD-O1D	2.72	130.09	123.30
3	D	147	HEM	O1D-CGD-CBD	-2.72	114.34	123.08
3	C	147	HEM	CMC-C2C-C3C	2.71	129.75	124.68
3	B	147	HEM	C4B-CHC-C1C	2.69	126.11	122.56
3	D	147	HEM	CMC-C2C-C3C	2.59	129.52	124.68
3	D	147	HEM	O2D-CGD-O1D	2.56	129.68	123.30
3	C	147	HEM	CBA-CAA-C2A	-2.53	108.31	112.62
3	C	147	HEM	CMA-C3A-C2A	2.49	129.64	124.94
3	B	147	HEM	CMC-C2C-C3C	2.47	129.31	124.68
3	C	147	HEM	CAD-C3D-C4D	-2.34	120.57	124.66
3	A	147	HEM	O2D-CGD-O1D	2.34	129.13	123.30
3	B	147	HEM	C4B-C3B-C2B	2.33	108.96	107.11
3	A	147	HEM	O2A-CGA-O1A	2.28	128.98	123.30
3	B	147	HEM	C3D-C4D-ND	-2.24	107.67	110.17
3	C	147	HEM	C4D-C3D-C2D	2.23	110.15	106.90
3	C	147	HEM	CMD-C2D-C1D	-2.21	121.68	125.04
3	C	147	HEM	CMD-C2D-C3D	2.14	131.93	126.12
3	C	147	HEM	CAA-CBA-CGA	-2.13	107.79	113.76
3	D	147	HEM	O2A-CGA-O1A	2.11	128.55	123.30
3	D	147	HEM	CBA-CAA-C2A	2.06	116.13	112.62
3	D	147	HEM	O1A-CGA-CBA	-2.05	116.49	123.08
3	C	147	HEM	C4B-CHC-C1C	2.04	125.25	122.56
3	A	147	HEM	O1A-CGA-CBA	-2.02	116.59	123.08

There are no chirality outliers.

All (19) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	C	147	HEM	C4B-C3B-CAB-CBB
3	D	147	HEM	C2B-C3B-CAB-CBB
3	C	147	HEM	C2B-C3B-CAB-CBB
3	D	147	HEM	C4B-C3B-CAB-CBB
3	A	147	HEM	C2B-C3B-CAB-CBB
3	B	147	HEM	CAA-CBA-CGA-O2A
3	D	147	HEM	CAA-CBA-CGA-O1A

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Mol	Chain	Res	Type	Atoms
3	C	147	HEM	CAA-CBA-CGA-O2A
3	B	147	HEM	CAD-CBD-CGD-O1D
3	D	147	HEM	CAA-CBA-CGA-O2A
3	B	147	HEM	CAA-CBA-CGA-O1A
3	B	147	HEM	CAD-CBD-CGD-O2D
3	C	147	HEM	CAA-CBA-CGA-O1A
3	A	147	HEM	CAD-CBD-CGD-O2D
3	D	147	HEM	CAD-CBD-CGD-O1D
3	C	147	HEM	CAD-CBD-CGD-O2D
3	D	147	HEM	CAD-CBD-CGD-O2D
3	C	147	HEM	CAD-CBD-CGD-O1D
3	A	147	HEM	CAD-CBD-CGD-O1D

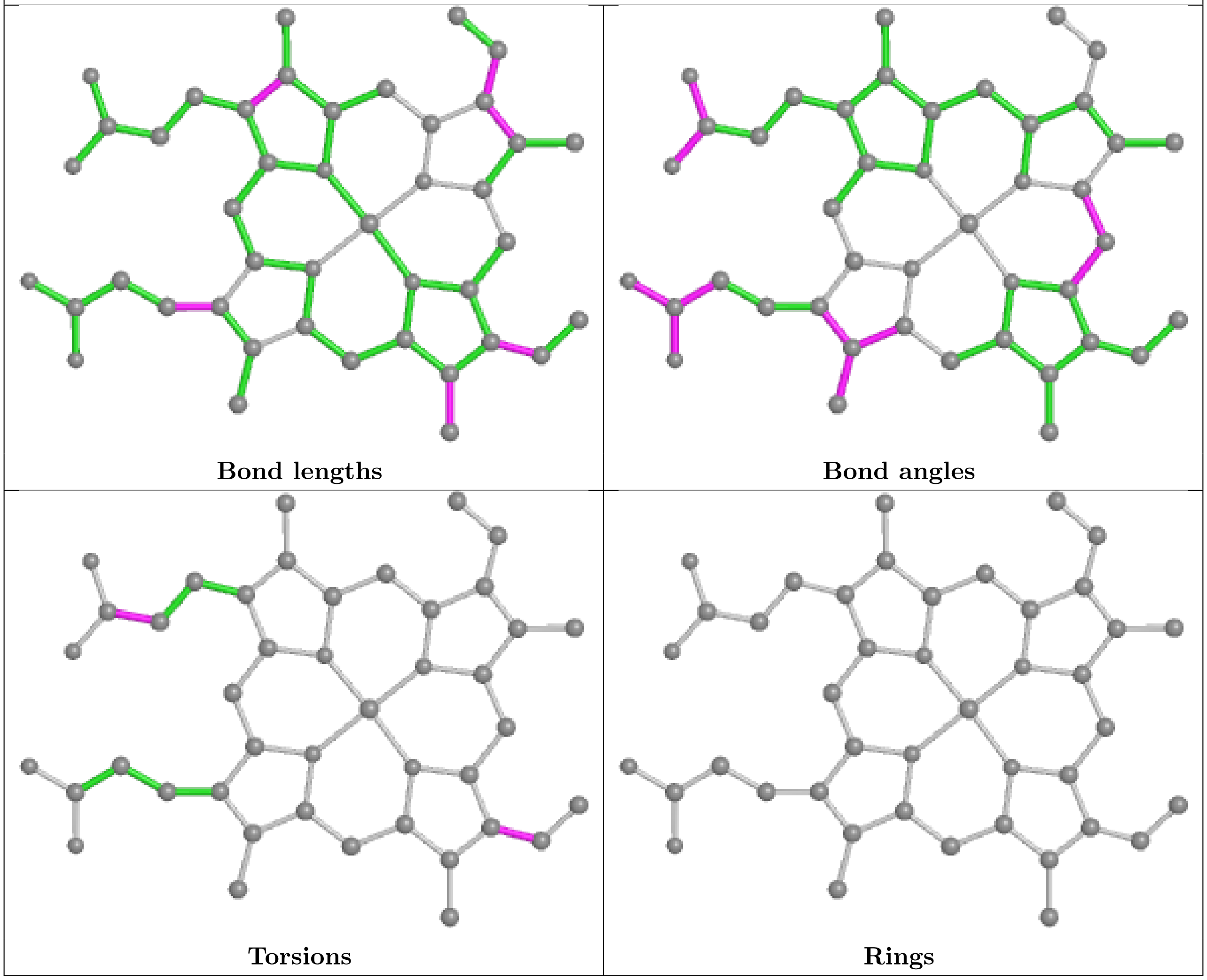
There are no ring outliers.

2 monomers are involved in 5 short contacts:

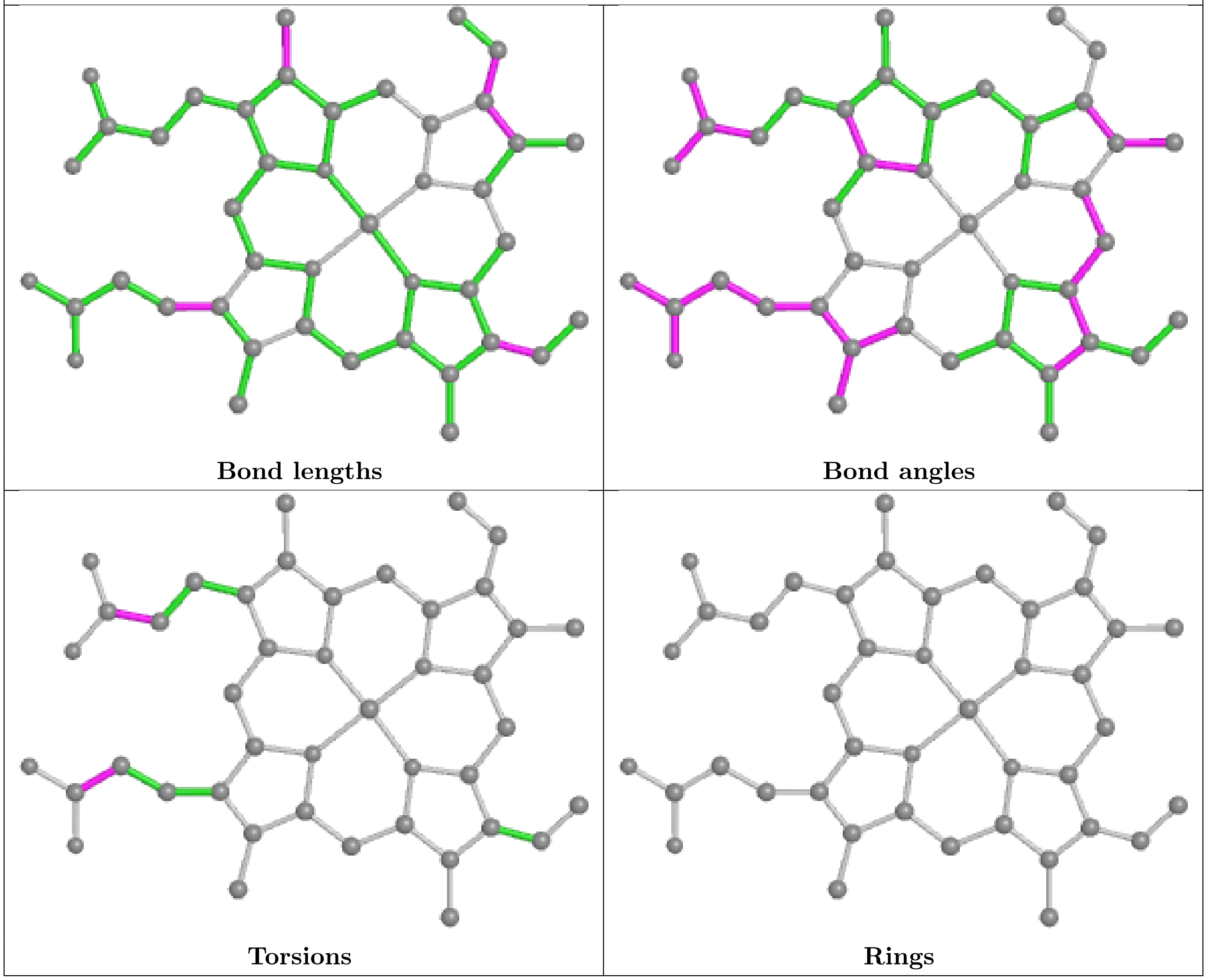
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	147	HEM	4	0
3	C	147	HEM	1	0

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.

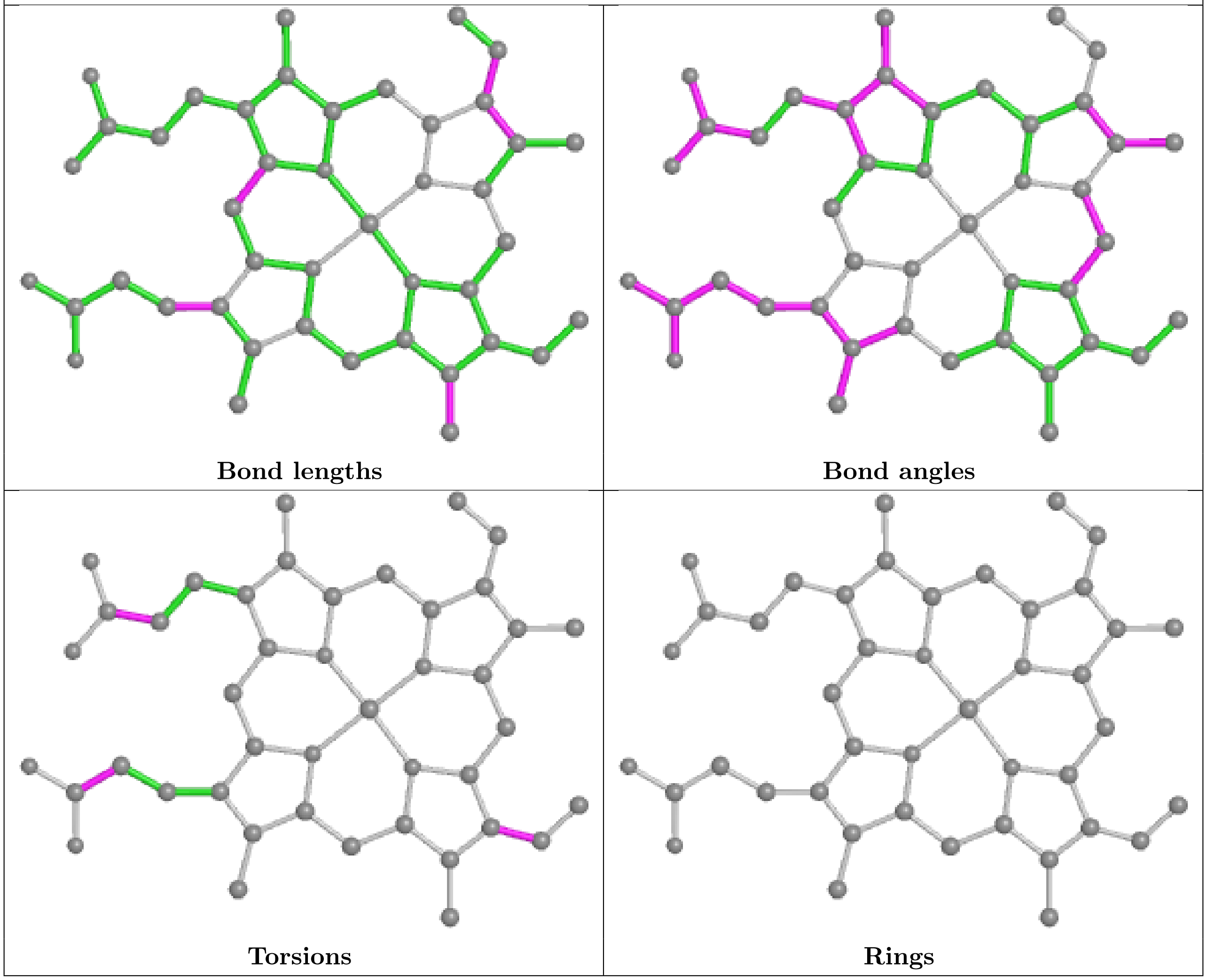
Ligand HEM A 147



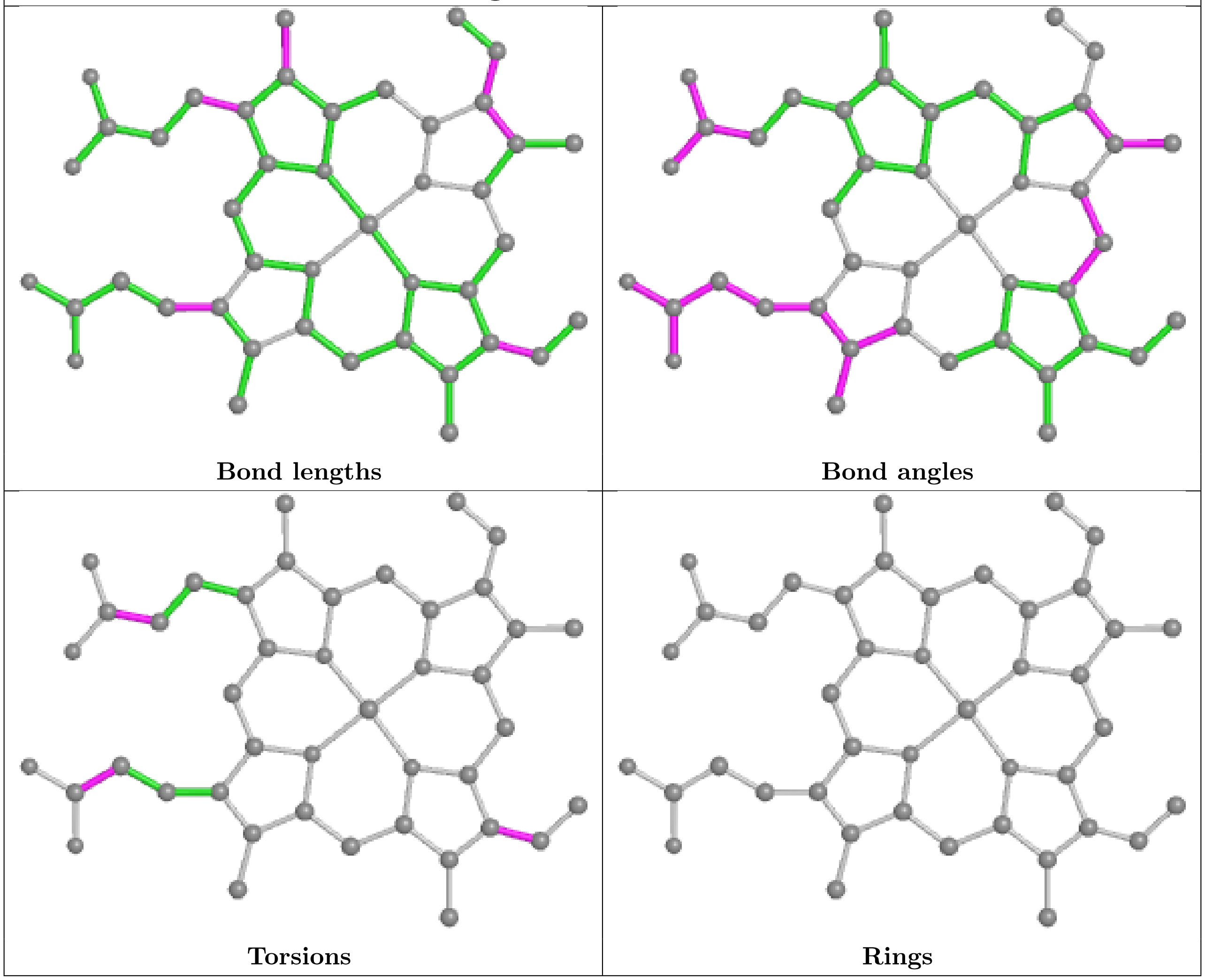
Ligand HEM B 147



Ligand HEM C 147



Ligand HEM D 147



5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data (i)

6.1 Protein, DNA and RNA chains (i)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates (i)

EDS was not executed - this section is therefore empty.

6.4 Ligands (i)

EDS was not executed - this section is therefore empty.

6.5 Other polymers (i)

EDS was not executed - this section is therefore empty.