



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 05:52 AM UTC

PDB ID : 1CH4 / pdb_00001ch4
Title : MODULE-SUBSTITUTED CHIMERA HEMOGLOBIN BETA-ALPHA (F133V)
Authors : Shirai, T.; Fujikake, M.; Yamane, T.; Inaba, K.; Ishimori, K.; Morishima, I.
Deposited on : 1998-06-11
Resolution : 2.50 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) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

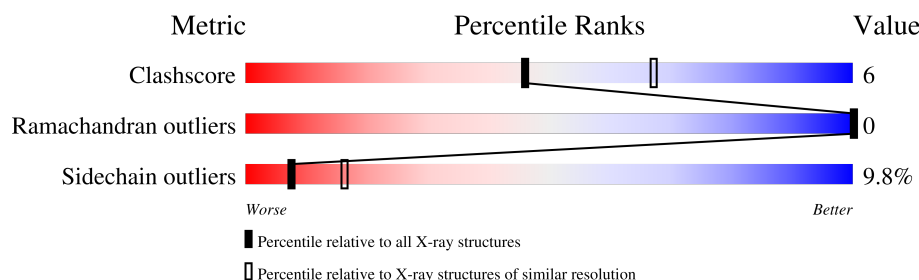
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	146	71% 25% .
1	B	146	70% 25% 5%
1	C	146	68% 25% 7% .
1	D	146	66% 27% 6% .

2 Entry composition [i](#)

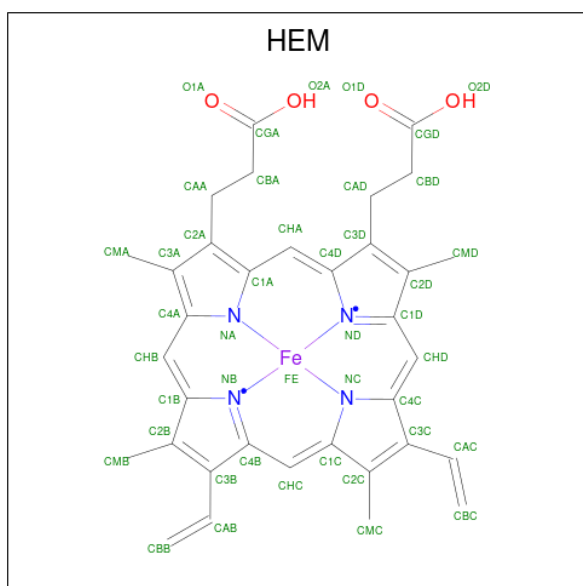
There are 4 unique types of molecules in this entry. The entry contains 4750 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 MODULE-SUBSTITUTED CHIMERA HEMOGLOBIN BETA-ALPHA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	146	Total	C	N	O	S	0	3	0
			1132	727	198	204	3			
1	B	146	Total	C	N	O	S	0	3	0
			1132	727	198	204	3			
1	C	146	Total	C	N	O	S	0	3	0
			1132	727	198	204	3			
1	D	146	Total	C	N	O	S	0	3	0
			1132	727	198	204	3			

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



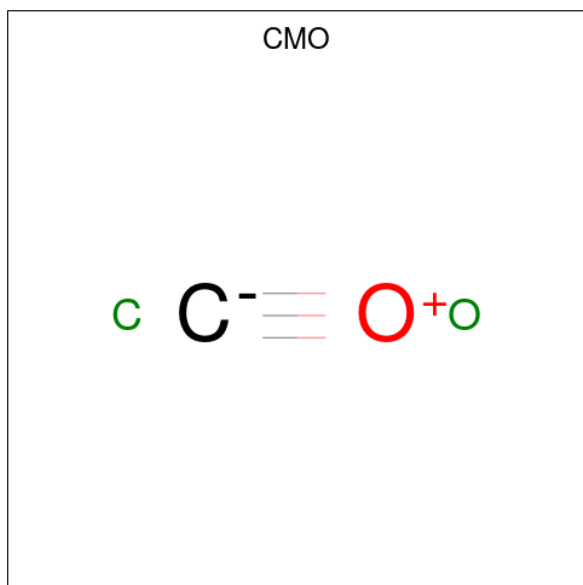
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

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

- Molecule 3 is CARBON MONOXIDE (CCD ID: CMO) (formula: CO).



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

- Molecule 4 is water.

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

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	C	13	Total	O	0	0
			13	13		
4	D	13	Total	O	0	0
			13	13		

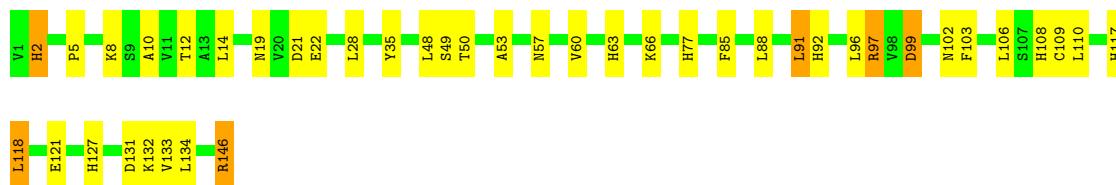
3 Residue-property plots [i](#)

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. 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.

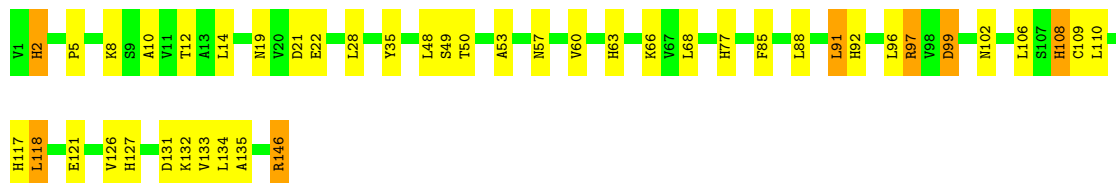
• Molecule 1: MODULE-SUBSTITUTED CHIMERA HEMOGLOBIN BETA-ALPHA

Chain A: 



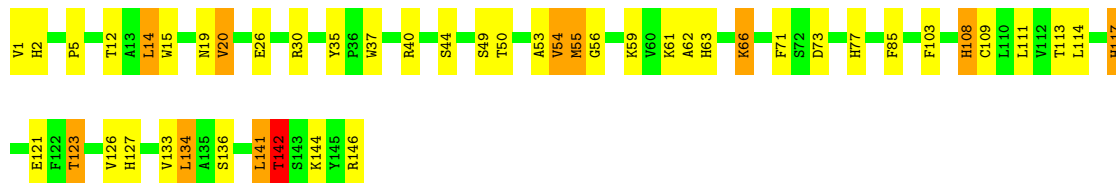
• Molecule 1: MODULE-SUBSTITUTED CHIMERA HEMOGLOBIN BETA-ALPHA

Chain B: 



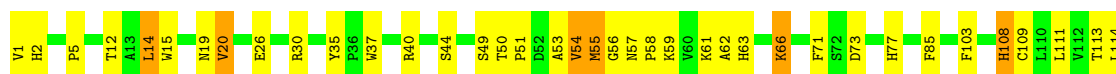
• Molecule 1: MODULE-SUBSTITUTED CHIMERA HEMOGLOBIN BETA-ALPHA

Chain C: 



• Molecule 1: MODULE-SUBSTITUTED CHIMERA HEMOGLOBIN BETA-ALPHA

Chain D: 





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	62.87Å 81.31Å 55.11Å 90.00° 90.96° 90.00°	Depositor
Resolution (Å)	8.00 – 2.50	Depositor
% Data completeness (in resolution range)	81.4 (8.00-2.50)	Depositor
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.188 , 0.244	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4750	wwPDB-VP
Average B, all atoms (Å ²)	29.0	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: HEM, CMO

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	1.09	8/1174 (0.7%)	1.74	26/1594 (1.6%)
1	B	1.09	8/1174 (0.7%)	1.74	26/1594 (1.6%)
1	C	1.12	9/1174 (0.8%)	1.82	22/1594 (1.4%)
1	D	1.12	9/1174 (0.8%)	1.82	20/1594 (1.3%)
All	All	1.11	34/4696 (0.7%)	1.78	94/6376 (1.5%)

All (34) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	117	HIS	CD2-NE2	-7.08	1.30	1.37
1	D	117	HIS	CD2-NE2	-7.07	1.30	1.37
1	C	127	HIS	CD2-NE2	-6.99	1.30	1.37
1	D	127	HIS	CD2-NE2	-6.98	1.30	1.37
1	B	117	HIS	CD2-NE2	-6.97	1.30	1.37
1	A	117	HIS	CD2-NE2	-6.92	1.30	1.37
1	B	63	HIS	CD2-NE2	-6.70	1.30	1.37
1	A	63	HIS	CD2-NE2	-6.70	1.30	1.37
1	C	108[A]	HIS	CD2-NE2	-6.61	1.30	1.37
1	C	108[B]	HIS	CD2-NE2	-6.61	1.30	1.37
1	D	108[A]	HIS	CD2-NE2	-6.59	1.30	1.37
1	D	108[B]	HIS	CD2-NE2	-6.59	1.30	1.37
1	C	77	HIS	CD2-NE2	-6.51	1.30	1.37
1	D	77	HIS	CD2-NE2	-6.46	1.30	1.37
1	A	2	HIS	CD2-NE2	-6.45	1.30	1.37
1	B	2	HIS	CD2-NE2	-6.43	1.30	1.37
1	B	127	HIS	CD2-NE2	-6.30	1.30	1.37
1	A	127	HIS	CD2-NE2	-6.29	1.30	1.37
1	B	108[A]	HIS	CD2-NE2	-6.19	1.31	1.37
1	B	108[B]	HIS	CD2-NE2	-6.19	1.31	1.37
1	A	108[A]	HIS	CD2-NE2	-6.18	1.31	1.37
1	A	108[B]	HIS	CD2-NE2	-6.18	1.31	1.37

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	2	HIS	CG-ND1	-6.11	1.31	1.38
1	D	2	HIS	CG-ND1	-6.01	1.31	1.38
1	B	77	HIS	CD2-NE2	-5.56	1.31	1.37
1	D	54	VAL	CA-CB	5.55	1.61	1.54
1	C	54	VAL	CA-CB	5.54	1.61	1.54
1	A	77	HIS	CD2-NE2	-5.54	1.31	1.37
1	D	63	HIS	CD2-NE2	-5.31	1.32	1.37
1	C	63	HIS	CD2-NE2	-5.31	1.32	1.37
1	A	127	HIS	CG-ND1	-5.26	1.32	1.38
1	D	2	HIS	CD2-NE2	-5.20	1.32	1.37
1	B	127	HIS	CG-ND1	-5.19	1.32	1.38
1	C	2	HIS	CD2-NE2	-5.17	1.32	1.37

All (94) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	63	HIS	CA-CB-CG	-8.89	104.91	113.80
1	D	63	HIS	CA-CB-CG	-8.86	104.94	113.80
1	A	133	VAL	N-CA-C	-8.66	102.39	110.53
1	B	133	VAL	N-CA-C	-8.61	102.44	110.53
1	D	55	MET	N-CA-C	7.22	119.22	111.36
1	C	55	MET	N-CA-C	7.21	119.22	111.36
1	C	20	VAL	N-CA-C	6.71	118.27	110.62
1	D	20	VAL	N-CA-C	6.70	118.26	110.62
1	B	12	THR	CA-CB-OG1	-6.64	99.65	109.60
1	A	12	THR	CA-CB-OG1	-6.63	99.65	109.60
1	B	2	HIS	CB-CG-CD2	-6.62	122.60	131.20
1	A	2	HIS	CB-CG-CD2	-6.61	122.61	131.20
1	D	19	ASN	OD1-CG-ND2	-6.47	116.13	122.60
1	C	19	ASN	OD1-CG-ND2	-6.46	116.14	122.60
1	D	77	HIS	N-CA-C	-6.44	102.56	110.61
1	C	77	HIS	N-CA-C	-6.44	102.56	110.61
1	A	117	HIS	CB-CG-CD2	-6.24	123.09	131.20
1	B	117	HIS	CB-CG-CD2	-6.23	123.10	131.20
1	C	123	THR	N-CA-CB	-6.20	101.67	110.04
1	A	63	HIS	CB-CG-CD2	-6.20	123.14	131.20
1	B	63	HIS	CB-CG-CD2	-6.19	123.16	131.20
1	D	123	THR	N-CA-CB	-6.17	101.72	110.04
1	A	102	ASN	OD1-CG-ND2	-6.16	116.44	122.60
1	B	102	ASN	OD1-CG-ND2	-6.14	116.46	122.60
1	A	127	HIS	CA-CB-CG	6.08	119.88	113.80
1	B	127	HIS	CA-CB-CG	6.08	119.88	113.80

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	21	ASP	CA-CB-CG	5.98	118.58	112.60
1	B	21	ASP	CA-CB-CG	5.96	118.56	112.60
1	A	2	HIS	CA-CB-CG	5.95	119.75	113.80
1	B	2	HIS	CA-CB-CG	5.91	119.71	113.80
1	B	118	LEU	CA-C-N	5.91	125.60	119.05
1	B	118	LEU	C-N-CA	5.91	125.60	119.05
1	A	118	LEU	CA-C-N	5.90	125.60	119.05
1	A	118	LEU	C-N-CA	5.90	125.60	119.05
1	B	131	ASP	CA-CB-CG	-5.84	106.76	112.60
1	A	131	ASP	CA-CB-CG	-5.84	106.76	112.60
1	A	49	SER	N-CA-C	5.80	119.97	113.01
1	B	49	SER	N-CA-C	5.80	119.97	113.01
1	A	109	CYS	CA-CB-SG	-5.70	101.29	114.40
1	B	109	CYS	CA-CB-SG	-5.70	101.30	114.40
1	D	35	TYR	CA-C-N	5.65	125.18	119.19
1	D	35	TYR	C-N-CA	5.65	125.18	119.19
1	C	35	TYR	CA-C-N	5.63	125.16	119.19
1	C	35	TYR	C-N-CA	5.63	125.16	119.19
1	B	2	HIS	CB-CG-ND1	5.48	130.92	122.70
1	A	2	HIS	CB-CG-ND1	5.46	130.88	122.70
1	A	63	HIS	CA-CB-CG	-5.43	108.36	113.80
1	B	10	ALA	CA-C-O	-5.43	114.79	120.55
1	B	63	HIS	CA-CB-CG	-5.43	108.37	113.80
1	A	10	ALA	CA-C-O	-5.39	114.84	120.55
1	A	48	LEU	N-CA-C	-5.38	104.99	112.30
1	B	48	LEU	N-CA-C	-5.35	105.03	112.30
1	B	35	TYR	CA-C-N	5.33	125.00	119.56
1	B	35	TYR	C-N-CA	5.33	125.00	119.56
1	A	35	TYR	CA-C-N	5.29	124.95	119.56
1	A	35	TYR	C-N-CA	5.29	124.95	119.56
1	D	49	SER	N-CA-C	5.27	119.42	112.89
1	C	49	SER	N-CA-C	5.25	119.39	112.89
1	D	71	PHE	CA-CB-CG	-5.23	108.57	113.80
1	B	92	HIS	CB-CG-CD2	-5.23	124.40	131.20
1	C	15	TRP	CE2-CD2-CG	-5.22	100.94	107.20
1	B	92	HIS	CG-CD2-NE2	-5.21	101.98	107.20
1	D	15	TRP	CE2-CD2-CG	-5.21	100.94	107.20
1	B	99	ASP	CA-C-N	5.21	125.26	119.32
1	B	99	ASP	C-N-CA	5.21	125.26	119.32
1	A	99	ASP	CA-C-N	5.21	125.25	119.32
1	A	99	ASP	C-N-CA	5.21	125.25	119.32
1	C	71	PHE	CA-CB-CG	-5.20	108.60	113.80

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	92	HIS	CB-CG-CD2	-5.20	124.44	131.20
1	A	92	HIS	CG-CD2-NE2	-5.19	102.01	107.20
1	D	126	VAL	N-CA-C	-5.17	104.52	111.44
1	D	73	ASP	CA-CB-CG	5.17	117.77	112.60
1	A	132	LYS	CB-CG-CD	-5.16	99.43	111.30
1	C	73	ASP	CA-CB-CG	5.16	117.76	112.60
1	C	126	VAL	N-CA-C	-5.16	104.53	111.44
1	B	132	LYS	CB-CG-CD	-5.16	99.44	111.30
1	C	12	THR	CA-CB-OG1	-5.12	101.92	109.60
1	D	12	THR	CA-CB-OG1	-5.12	101.92	109.60
1	C	123	THR	CB-CA-C	5.12	116.78	109.11
1	D	123	THR	CB-CA-C	5.11	116.78	109.11
1	C	142	THR	CA-CB-OG1	-5.07	101.99	109.60
1	D	117	HIS	CB-CG-CD2	-5.07	124.61	131.20
1	C	77	HIS	CB-CG-CD2	-5.07	124.61	131.20
1	C	117	HIS	CB-CG-CD2	-5.06	124.62	131.20
1	D	77	HIS	CB-CG-CD2	-5.06	124.62	131.20
1	D	142	THR	CA-CB-OG1	-5.06	102.02	109.60
1	C	142	THR	N-CA-CB	-5.06	102.52	110.46
1	D	142	THR	N-CA-CB	-5.06	102.52	110.46
1	A	121	GLU	CB-CG-CD	5.03	121.14	112.60
1	B	121	GLU	CB-CG-CD	5.02	121.13	112.60
1	C	133	VAL	CB-CA-C	-5.01	105.55	111.97
1	D	133	VAL	CB-CA-C	-5.01	105.56	111.97
1	C	123	THR	CA-C-N	5.00	125.02	119.32
1	C	123	THR	C-N-CA	5.00	125.02	119.32

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	1132	0	1155	12	0
1	B	1132	0	1155	15	0
1	C	1132	0	1156	17	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	D	1132	0	1156	17	0
2	A	43	0	30	1	0
2	B	43	0	30	0	0
2	C	43	0	30	0	0
2	D	43	0	30	0	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
3	C	2	0	0	0	0
3	D	2	0	0	0	0
4	A	8	0	0	1	0
4	B	8	0	0	1	0
4	C	13	0	0	0	0
4	D	13	0	0	0	0
All	All	4750	0	4742	55	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 6.

All (55) 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:D:26:GLU:HA	1:D:55:MET:HE1	1.73	0.69
1:C:26:GLU:HA	1:C:55:MET:HE1	1.73	0.69
1:A:14:LEU:HD22	1:A:118:LEU:HD23	1.80	0.63
1:B:14:LEU:HD22	1:B:118:LEU:HD23	1.80	0.63
1:B:97[B]:ARG:HG3	1:D:37:TRP:HA	1.86	0.57
1:C:1:VAL:HG13	1:C:136:SER:OG	2.04	0.57
1:A:97[B]:ARG:HG3	1:C:37:TRP:HA	1.86	0.57
1:D:1:VAL:HG13	1:D:136:SER:OG	2.04	0.57
1:D:113:THR:O	1:D:117:HIS:HD2	1.89	0.56
1:C:113:THR:O	1:C:117:HIS:HD2	1.89	0.56
1:B:85:PHE:HD1	1:B:88:LEU:HD12	1.75	0.52
1:D:14:LEU:HD12	1:D:121:GLU:HB3	1.92	0.51
1:C:14:LEU:HD12	1:C:121:GLU:HB3	1.92	0.51
1:C:62:ALA:O	1:C:66:LYS:HD2	2.11	0.51
1:A:85:PHE:HD1	1:A:88:LEU:HD12	1.75	0.50
1:D:62:ALA:O	1:D:66:LYS:HD2	2.11	0.50
1:B:97[B]:ARG:HB3	1:D:40[B]:ARG:HD3	1.93	0.50
1:A:97[B]:ARG:HB3	1:C:40[B]:ARG:HD3	1.93	0.49
1:D:109:CYS:O	1:D:113:THR:HG23	2.13	0.49
1:C:109:CYS:O	1:C:113:THR:HG23	2.13	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:85:PHE:HB3	1:C:141:LEU:CD1	2.44	0.47
1:C:142:THR:HG22	1:C:146:ARG:HH12	1.78	0.47
1:D:85:PHE:HB3	1:D:141:LEU:CD1	2.44	0.47
1:D:142:THR:HG22	1:D:146:ARG:HH12	1.78	0.47
1:B:5:PRO:HA	1:B:8:LYS:HE3	1.97	0.45
1:A:5:PRO:HA	1:A:8:LYS:HE3	1.98	0.45
1:A:91:LEU:HD22	1:A:96:LEU:HG	1.98	0.45
1:B:91:LEU:HD22	1:B:96:LEU:HG	1.99	0.45
1:C:50:THR:H	1:C:53:ALA:HB3	1.83	0.43
1:B:19:ASN:HB3	1:B:22:GLU:HG2	2.00	0.43
1:D:50:THR:H	1:D:53:ALA:HB3	1.83	0.43
1:A:57:ASN:O	1:A:60:VAL:HB	2.19	0.43
1:D:57:ASN:HA	1:D:58:PRO:HD3	1.78	0.43
1:A:50:THR:H	1:A:53:ALA:HB3	1.84	0.43
1:B:108[B]:HIS:ND1	1:C:108[B]:HIS:CD2	2.87	0.42
1:C:103:PHE:CE1	1:C:141:LEU:HD23	2.54	0.42
1:B:50:THR:H	1:B:53:ALA:HB3	1.84	0.42
1:B:57:ASN:O	1:B:60:VAL:HB	2.19	0.42
1:D:30:ARG:HD2	1:D:113:THR:HG22	2.02	0.42
1:D:103:PHE:CE1	1:D:141:LEU:HD23	2.54	0.42
1:A:19:ASN:HB3	1:A:22:GLU:HG2	2.00	0.41
1:B:68:LEU:HD23	1:B:68:LEU:HA	1.88	0.41
1:B:146:ARG:HA	1:B:146:ARG:HE	1.86	0.41
1:C:56:GLY:HA2	1:C:61:LYS:NZ	2.36	0.41
1:C:30:ARG:HD2	1:C:113:THR:HG22	2.02	0.41
1:D:51:PRO:O	1:D:55:MET:HG2	2.21	0.41
1:D:56:GLY:HA2	1:D:61:LYS:NZ	2.36	0.41
1:A:103:PHE:HD1	2:A:147:HEM:HBB2	1.85	0.41
1:A:146:ARG:HD3	1:B:135:ALA:HB3	2.03	0.41
4:A:241:HOH:O	1:D:108[B]:HIS:CE1	2.73	0.41
4:B:220:HOH:O	1:C:108[B]:HIS:CE1	2.73	0.40
1:B:14:LEU:HG	1:B:126:VAL:HG11	2.03	0.40
1:C:134:LEU:HD12	1:C:134:LEU:HA	1.93	0.40
1:B:97[A]:ARG:HH11	1:B:97[A]:ARG:HD3	1.78	0.40
1:A:146:ARG:HE	1:A:146:ARG:HA	1.86	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	147/146 (101%)	143 (97%)	4 (3%)	0	100	100
1	B	147/146 (101%)	143 (97%)	4 (3%)	0	100	100
1	C	147/146 (101%)	140 (95%)	7 (5%)	0	100	100
1	D	147/146 (101%)	141 (96%)	6 (4%)	0	100	100
All	All	588/584 (101%)	567 (96%)	21 (4%)	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	125/122 (102%)	114 (91%)	11 (9%)	9	20
1	B	125/122 (102%)	114 (91%)	11 (9%)	9	20
1	C	125/122 (102%)	111 (89%)	14 (11%)	6	12
1	D	125/122 (102%)	111 (89%)	14 (11%)	6	12
All	All	500/488 (102%)	450 (90%)	50 (10%)	7	15

All (50) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	HIS
1	A	28	LEU

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Mol	Chain	Res	Type
1	A	66	LYS
1	A	91	LEU
1	A	97[A]	ARG
1	A	97[B]	ARG
1	A	99	ASP
1	A	106	LEU
1	A	110	LEU
1	A	134	LEU
1	A	146	ARG
1	B	2	HIS
1	B	28	LEU
1	B	66	LYS
1	B	91	LEU
1	B	97[A]	ARG
1	B	97[B]	ARG
1	B	99	ASP
1	B	106	LEU
1	B	110	LEU
1	B	134	LEU
1	B	146	ARG
1	C	5	PRO
1	C	14	LEU
1	C	20	VAL
1	C	44	SER
1	C	54	VAL
1	C	59	LYS
1	C	66	LYS
1	C	111	LEU
1	C	114	LEU
1	C	123	THR
1	C	134	LEU
1	C	141	LEU
1	C	142	THR
1	C	144	LYS
1	D	5	PRO
1	D	14	LEU
1	D	20	VAL
1	D	44	SER
1	D	54	VAL
1	D	59	LYS
1	D	66	LYS
1	D	111	LEU

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Mol	Chain	Res	Type
1	D	114	LEU
1	D	123	THR
1	D	134	LEU
1	D	141	LEU
1	D	142	THR
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	C	80	ASN
1	C	117	HIS
1	D	80	ASN
1	D	117	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](#)

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

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

8 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
2	HEM	C	147	3,1	50,50,50	1.14	6 (12%)	67,82,82	1.01	2 (2%)
3	CMO	C	148	2	0,1,1	-	-	-		
3	CMO	D	148	2	0,1,1	-	-	-		
2	HEM	D	147	3,1	50,50,50	1.14	6 (12%)	67,82,82	1.01	2 (2%)
2	HEM	B	147	3,1	50,50,50	1.18	6 (12%)	67,82,82	1.05	3 (4%)
3	CMO	A	148	2	0,1,1	-	-	-		
3	CMO	B	148	2	0,1,1	-	-	-		
2	HEM	A	147	3,1	50,50,50	1.18	6 (12%)	67,82,82	1.05	3 (4%)

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

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	HEM	C	147	3,1	-	11/14/54/54	-
2	HEM	D	147	3,1	-	11/14/54/54	-
2	HEM	A	147	3,1	-	4/14/54/54	-
2	HEM	B	147	3,1	-	4/14/54/54	-

All (24) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	147	HEM	CBC-CAC	3.23	1.45	1.30
2	B	147	HEM	CBC-CAC	3.22	1.45	1.30
2	D	147	HEM	CBB-CAB	3.18	1.45	1.30
2	A	147	HEM	CBB-CAB	3.17	1.45	1.30
2	B	147	HEM	CBB-CAB	3.17	1.45	1.30
2	C	147	HEM	CBB-CAB	3.17	1.45	1.30
2	C	147	HEM	CBC-CAC	3.02	1.44	1.30
2	D	147	HEM	CBC-CAC	3.01	1.44	1.30
2	A	147	HEM	CAC-C3C	-2.93	1.39	1.47
2	B	147	HEM	CAC-C3C	-2.91	1.39	1.47
2	D	147	HEM	CAB-C3B	-2.90	1.39	1.47
2	C	147	HEM	CAB-C3B	-2.89	1.39	1.47
2	D	147	HEM	CAC-C3C	-2.88	1.39	1.47
2	C	147	HEM	CAC-C3C	-2.88	1.39	1.47
2	B	147	HEM	CAB-C3B	-2.60	1.40	1.47
2	A	147	HEM	CAB-C3B	-2.59	1.40	1.47
2	B	147	HEM	O2A-CGA	-2.39	1.22	1.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	147	HEM	O2A-CGA	-2.37	1.23	1.30
2	D	147	HEM	O2A-CGA	-2.34	1.23	1.30
2	C	147	HEM	O2A-CGA	-2.33	1.23	1.30
2	B	147	HEM	O2D-CGD	-2.28	1.23	1.30
2	A	147	HEM	O2D-CGD	-2.28	1.23	1.30
2	C	147	HEM	O2D-CGD	-2.04	1.24	1.30
2	D	147	HEM	O2D-CGD	-2.04	1.24	1.30

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	147	HEM	C3B-C4B-NB	3.26	111.81	109.47
2	D	147	HEM	C3B-C4B-NB	3.25	111.80	109.47
2	A	147	HEM	C3B-C4B-NB	3.04	111.65	109.47
2	B	147	HEM	C3B-C4B-NB	3.04	111.65	109.47
2	B	147	HEM	C4B-C3B-C2B	-2.91	104.61	107.28
2	A	147	HEM	C4B-C3B-C2B	-2.89	104.62	107.28
2	C	147	HEM	CBA-CAA-C2A	2.42	119.24	112.53
2	D	147	HEM	CBA-CAA-C2A	2.41	119.19	112.53
2	B	147	HEM	C3B-C2B-C1B	2.28	108.13	106.41
2	A	147	HEM	C3B-C2B-C1B	2.25	108.10	106.41

There are no chirality outliers.

All (30) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	147	HEM	C2B-C3B-CAB-CBB
2	C	147	HEM	C4B-C3B-CAB-CBB
2	D	147	HEM	C2B-C3B-CAB-CBB
2	D	147	HEM	C4B-C3B-CAB-CBB
2	C	147	HEM	C3D-CAD-CBD-CGD
2	D	147	HEM	C3D-CAD-CBD-CGD
2	C	147	HEM	C2D-C3D-CAD-CBD
2	D	147	HEM	C2D-C3D-CAD-CBD
2	C	147	HEM	C4D-C3D-CAD-CBD
2	D	147	HEM	C4D-C3D-CAD-CBD
2	A	147	HEM	C2C-C3C-CAC-CBC
2	B	147	HEM	C2C-C3C-CAC-CBC
2	C	147	HEM	C2C-C3C-CAC-CBC
2	D	147	HEM	C2C-C3C-CAC-CBC
2	C	147	HEM	CAA-CBA-CGA-O2A
2	D	147	HEM	CAA-CBA-CGA-O2A

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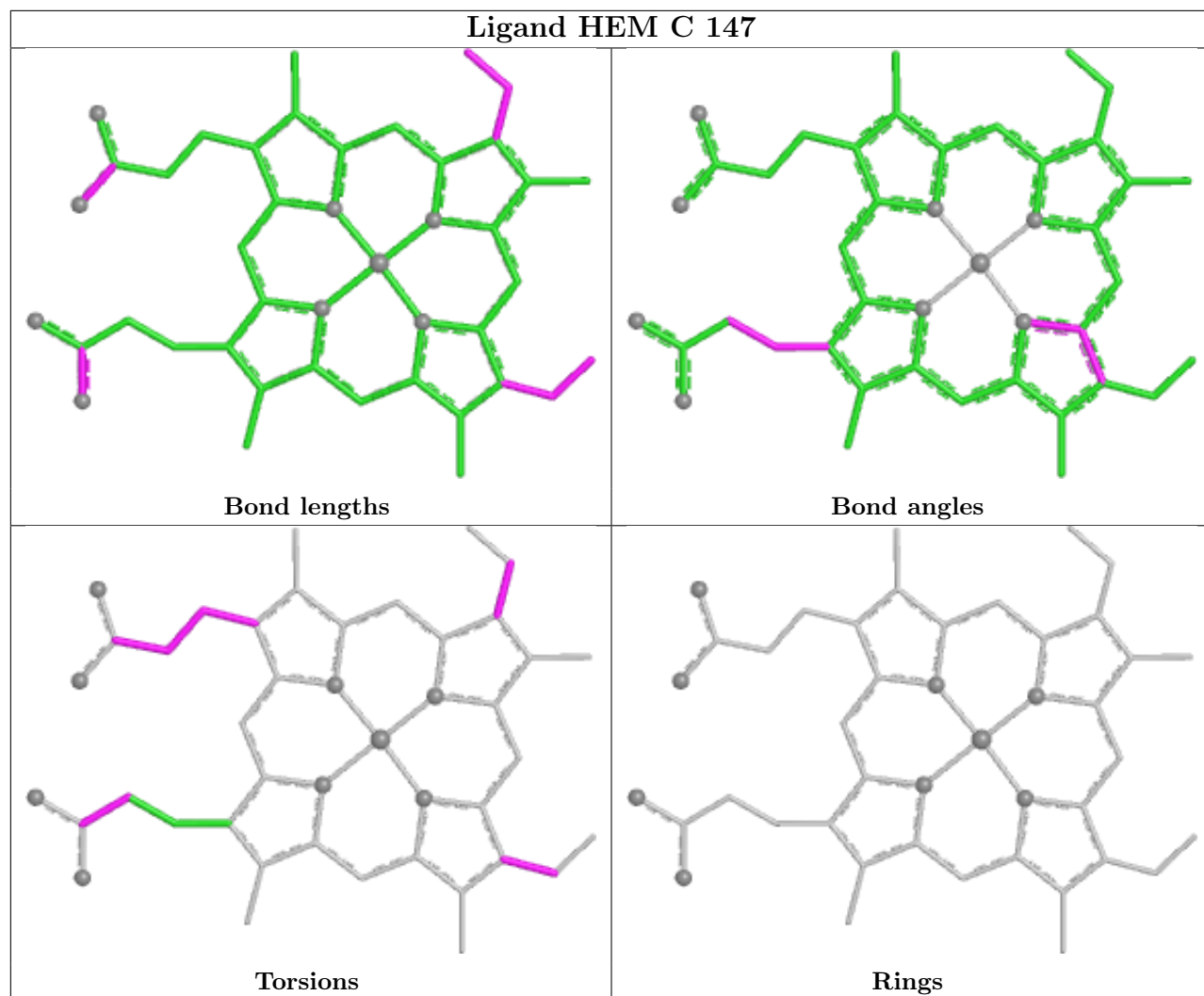
Mol	Chain	Res	Type	Atoms
2	A	147	HEM	CAA-CBA-CGA-O1A
2	B	147	HEM	CAA-CBA-CGA-O1A
2	D	147	HEM	CAA-CBA-CGA-O1A
2	C	147	HEM	CAA-CBA-CGA-O1A
2	D	147	HEM	CAD-CBD-CGD-O1D
2	C	147	HEM	CAD-CBD-CGD-O1D
2	D	147	HEM	CAD-CBD-CGD-O2D
2	A	147	HEM	CAA-CBA-CGA-O2A
2	C	147	HEM	CAD-CBD-CGD-O2D
2	B	147	HEM	CAA-CBA-CGA-O2A
2	A	147	HEM	C4C-C3C-CAC-CBC
2	B	147	HEM	C4C-C3C-CAC-CBC
2	C	147	HEM	C4C-C3C-CAC-CBC
2	D	147	HEM	C4C-C3C-CAC-CBC

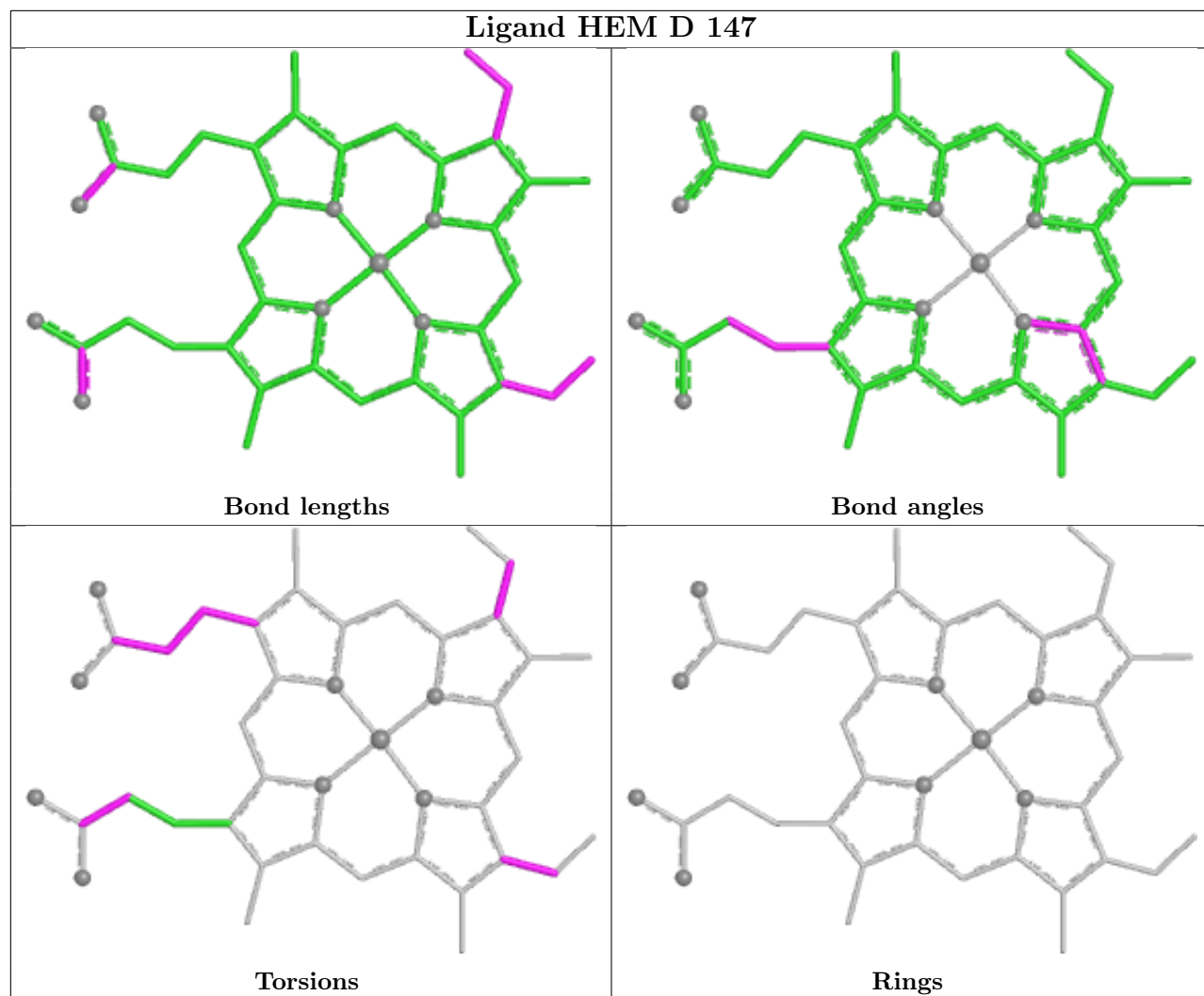
There are no ring outliers.

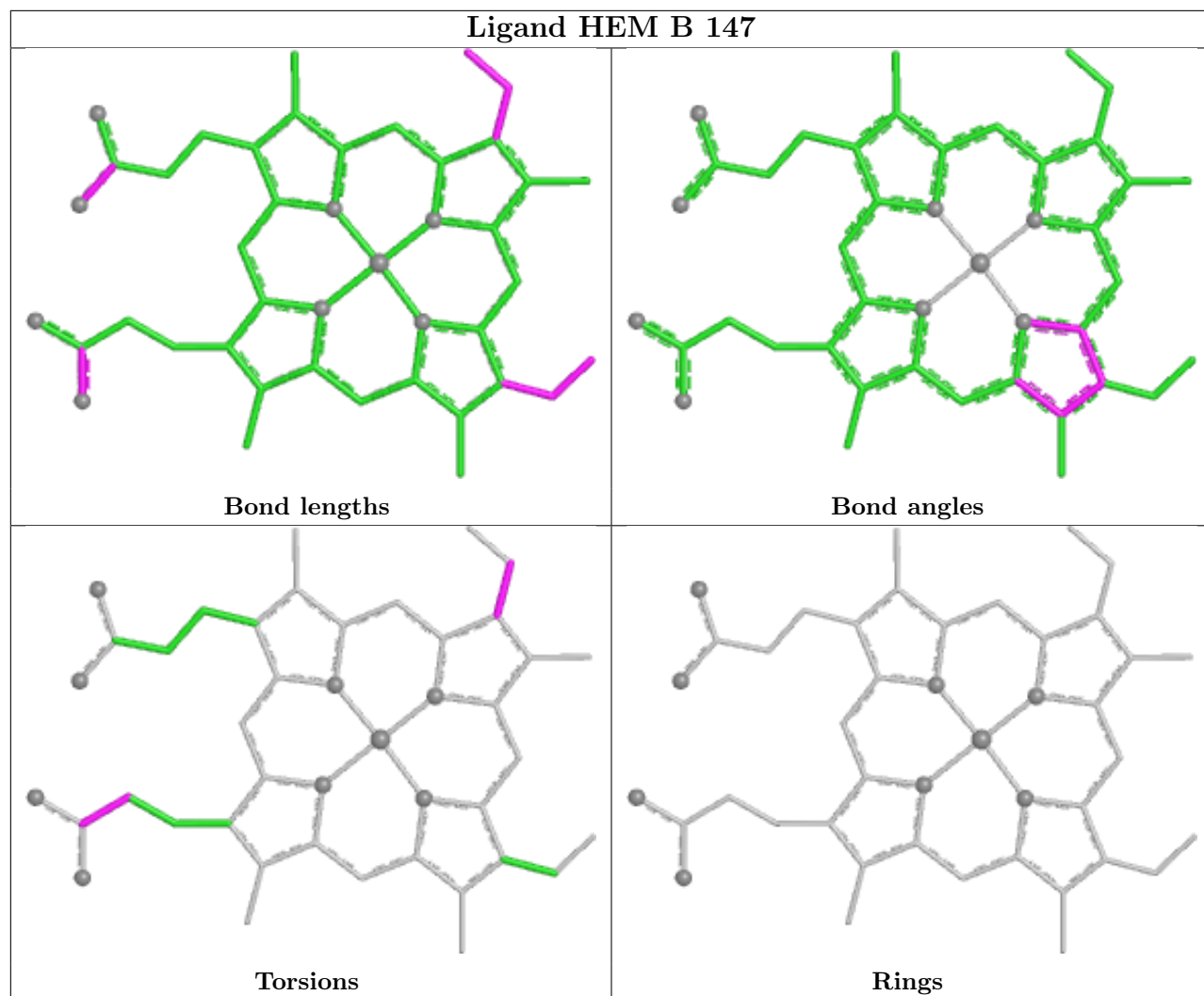
1 monomer is involved in 1 short contact:

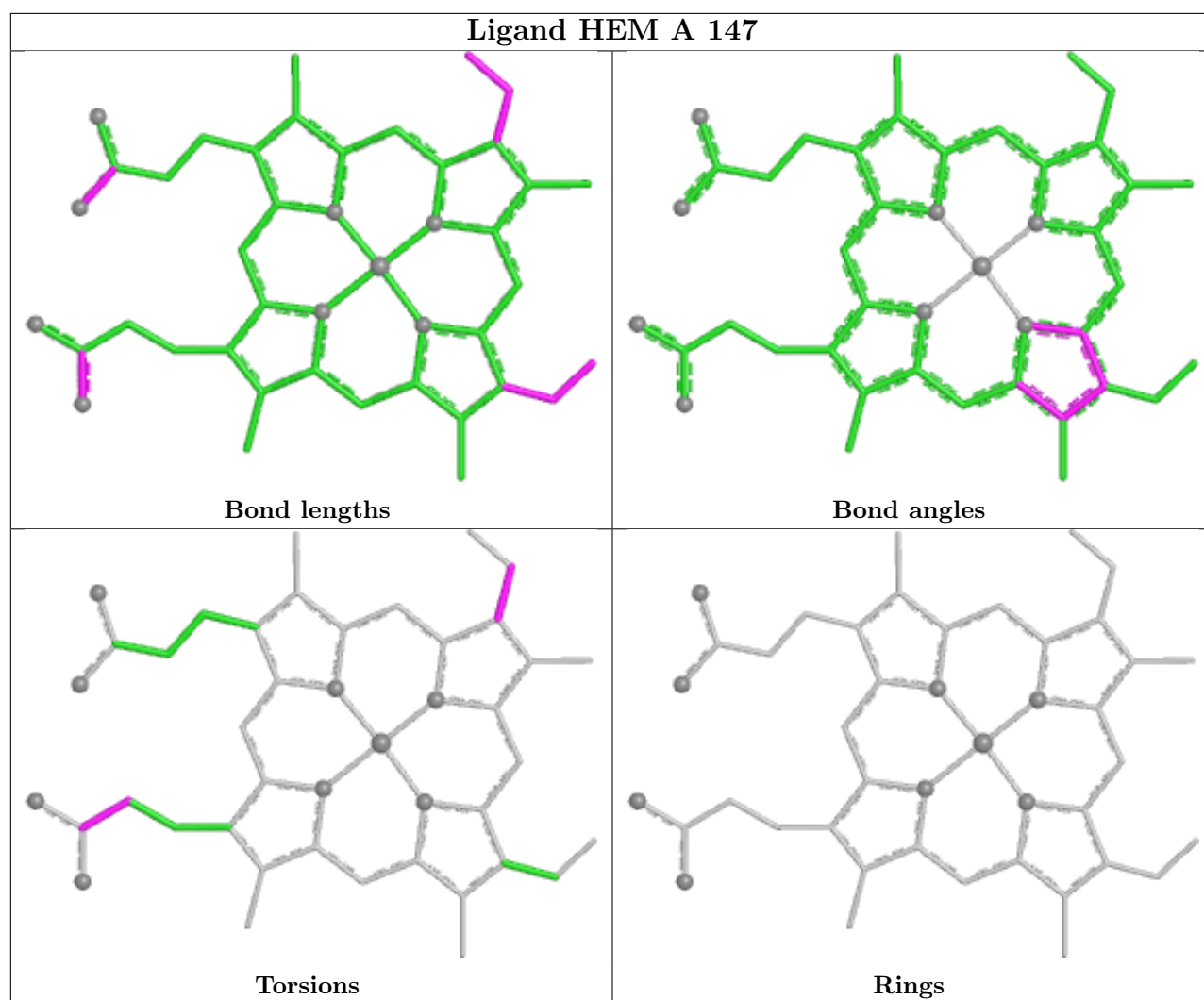
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	147	HEM	1	0

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 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

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.