



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 06:10 PM UTC

PDB ID : 4D1N / pdb_00004d1n
Title : Structure of human nNOS heme domain with L-Arg bound
Authors : Li, H.; Poulos, T.L.
Deposited on : 2014-05-02
Resolution : 2.03 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

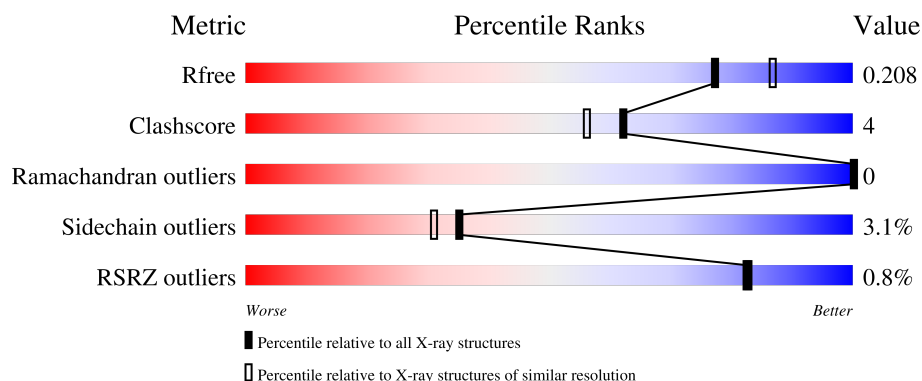
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.03 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	13299 (2.04-2.00)
Clashscore	190562	1022 (2.02-2.02)
Ramachandran outliers	187476	1014 (2.02-2.02)
Sidechain outliers	187428	1014 (2.02-2.02)
RSRZ outliers	180081	13314 (2.04-2.00)

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 $\leq 5\%$. 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	420	% 88% 11% .
1	B	420	86% 11% ..
1	C	420	90% 9% .
1	D	420	% 86% 11% ..

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 14747 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.

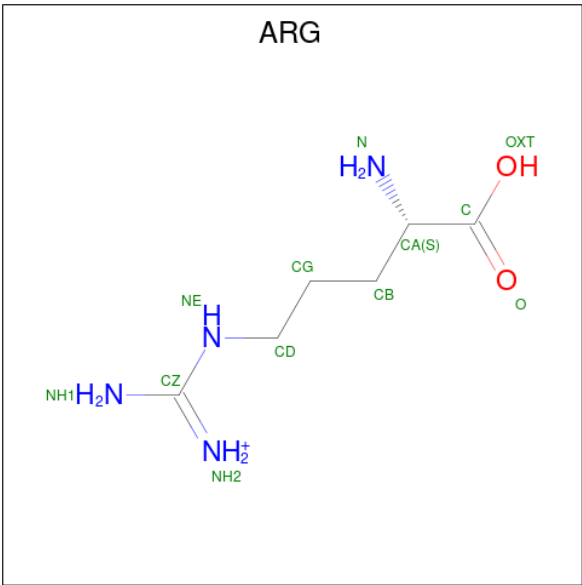
- Molecule 1 is a protein called NITRIC OXIDE SYNTHASE, BRAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	420	Total	C	N	O	S	0	1	0
			3430	2192	590	626	22			
1	B	411	Total	C	N	O	S	0	1	0
			3351	2147	571	611	22			
1	C	420	Total	C	N	O	S	0	1	0
			3430	2192	589	627	22			
1	D	411	Total	C	N	O	S	0	0	0
			3348	2145	571	610	22			

There are 8 discrepancies between the modelled and reference sequences:

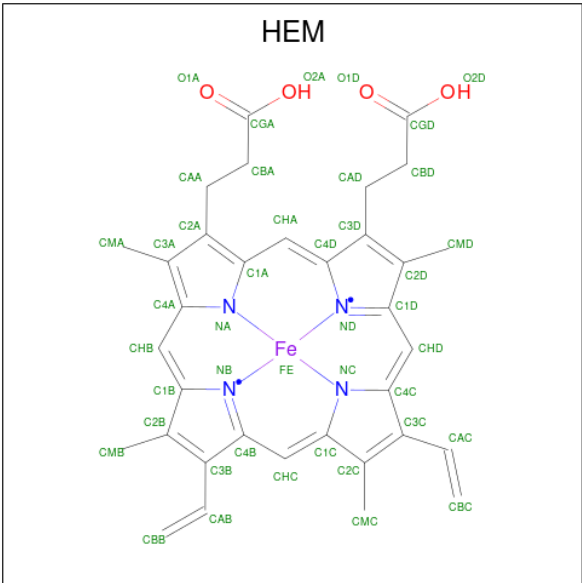
Chain	Residue	Modelled	Actual	Comment	Reference
A	354	ALA	ARG	engineered mutation	UNP P29475
A	357	ASP	GLY	engineered mutation	UNP P29475
B	354	ALA	ARG	engineered mutation	UNP P29475
B	357	ASP	GLY	engineered mutation	UNP P29475
C	354	ALA	ARG	engineered mutation	UNP P29475
C	357	ASP	GLY	engineered mutation	UNP P29475
D	354	ALA	ARG	engineered mutation	UNP P29475
D	357	ASP	GLY	engineered mutation	UNP P29475

- Molecule 2 is ARGININE (CCD ID: ARG) (formula: C₆H₁₅N₄O₂).



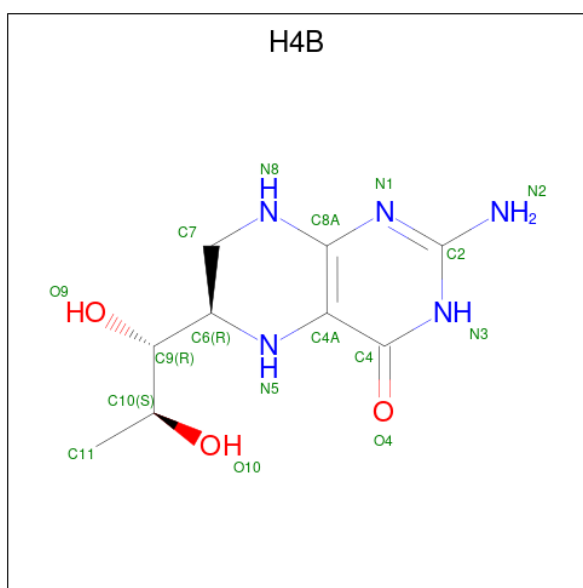
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			12	6	4	2		
2	B	1	Total	C	N	O	0	0
			12	6	4	2		
2	C	1	Total	C	N	O	0	0
			12	6	4	2		
2	D	1	Total	C	N	O	0	0
			12	6	4	2		

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



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

- Molecule 4 is 5,6,7,8-TETRAHYDROBIOPTERIN (CCD ID: H4B) (formula: $C_9H_{15}N_5O_3$).



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

- Molecule 5 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



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

- Molecule 6 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	1	Total Zn 1 1	0	0
6	C	1	Total Zn 1 1	0	0

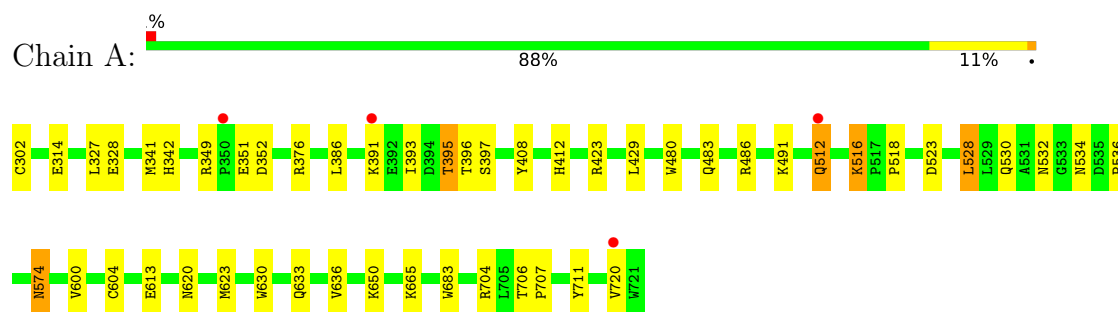
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	214	Total 214	O 214	0	0
7	B	206	Total 206	O 206	0	0
7	C	265	Total 265	O 265	0	0
7	D	171	Total 171	O 171	0	0

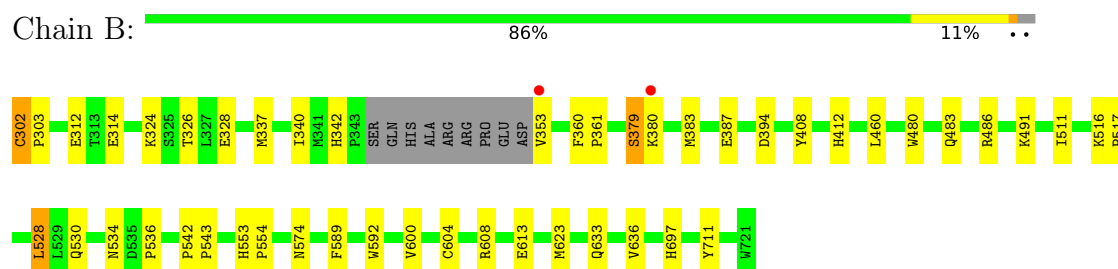
3 Residue-property plots

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 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.

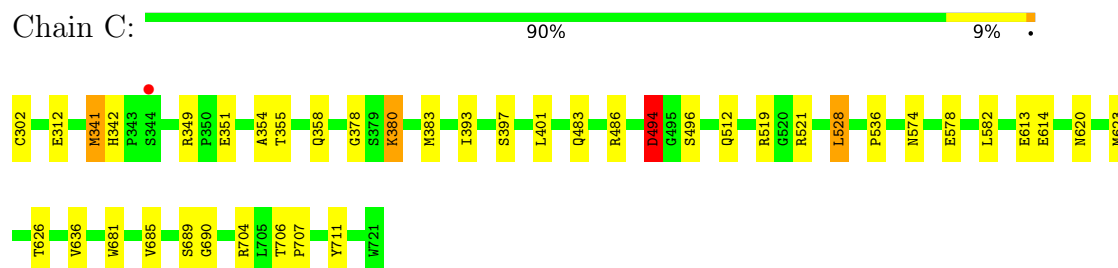
• Molecule 1: NITRIC OXIDE SYNTHASE, BRAIN



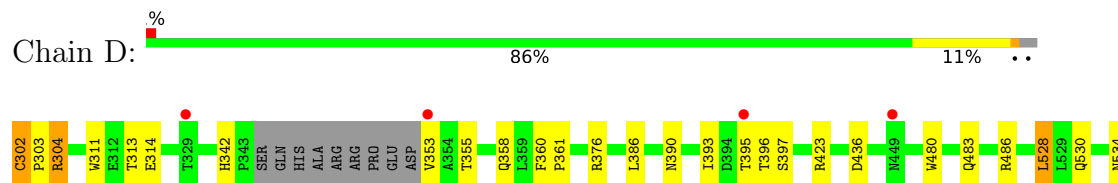
• Molecule 1: NITRIC OXIDE SYNTHASE, BRAIN

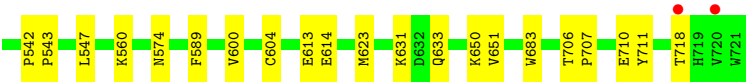


• Molecule 1: NITRIC OXIDE SYNTHASE, BRAIN



• Molecule 1: NITRIC OXIDE SYNTHASE, BRAIN





4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	174.92Å 84.66Å 166.75Å 90.00° 90.94° 90.00°	Depositor
Resolution (Å)	46.60 – 2.03 46.60 – 2.03	Depositor EDS
% Data completeness (in resolution range)	94.5 (46.60-2.03) 94.8 (46.60-2.03)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.62 (at 2.03Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.177 , 0.209 0.176 , 0.208	Depositor DCC
R_{free} test set	7549 reflections (5.05%)	wwPDB-VP
Wilson B-factor (Å ²)	35.9	Xtriage
Anisotropy	0.342	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 44.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.014 for -h,-k,l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	14747	wwPDB-VP
Average B, all atoms (Å ²)	44.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 23.85 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 4.2984e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹Intensities estimated from amplitudes.

²Theoretical 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

5.1 Standard geometry

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

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	0.66	0/3532	0.85	1/4794 (0.0%)
1	B	0.70	1/3450 (0.0%)	0.87	1/4682 (0.0%)
1	C	0.72	0/3532	0.88	1/4794 (0.0%)
1	D	0.70	0/3444	0.89	1/4674 (0.0%)
All	All	0.70	1/13958 (0.0%)	0.87	4/18944 (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 (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	608	ARG	CA-C	5.03	1.56	1.53

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	328	GLU	N-CA-C	6.07	119.06	110.50
1	A	423	ARG	N-CA-C	5.55	119.67	113.01
1	D	423	ARG	N-CA-C	5.28	119.35	113.01
1	C	494	ASP	CB-CA-C	-5.21	100.04	110.42

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	379	SER	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	3430	0	3332	30	0
1	B	3351	0	3260	30	0
1	C	3430	0	3330	24	0
1	D	3348	0	3255	31	0
2	A	12	0	12	0	0
2	B	12	0	12	0	0
2	C	12	0	12	0	0
2	D	12	0	12	0	0
3	A	43	0	30	0	0
3	B	43	0	30	2	0
3	C	43	0	30	1	0
3	D	43	0	30	2	0
4	A	17	0	15	0	0
4	B	17	0	15	0	0
4	C	17	0	15	1	0
4	D	17	0	15	1	0
5	A	6	0	8	1	0
5	B	6	0	8	0	0
5	C	18	0	24	0	0
5	D	12	0	16	0	0
6	A	1	0	0	0	0
6	C	1	0	0	0	0
7	A	214	0	0	1	0
7	B	206	0	0	1	0
7	C	265	0	0	5	0
7	D	171	0	0	2	0
All	All	14747	0	13461	112	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 (112) 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:379:SER:HB2	1:B:380:LYS:HB2	1.31	1.06
1:C:519:ARG:HD2	7:C:2167:HOH:O	1.64	0.97
1:C:613:GLU:HG3	1:C:623:MET:HE1	1.59	0.85
1:D:355:THR:H	1:D:358:GLN:HE21	1.27	0.83
1:B:337:MET:HE2	1:B:340:ILE:HG13	1.59	0.82
1:B:528:LEU:HD22	1:B:536:PRO:HB2	1.64	0.78
1:B:613:GLU:HG3	1:B:623:MET:HE1	1.66	0.76
1:C:494:ASP:HB3	1:C:496:SER:H	1.52	0.74
1:D:395:THR:HG23	1:D:396:THR:HG23	1.70	0.73
1:B:360:PHE:HB2	1:B:361:PRO:HD3	1.71	0.71
1:C:528:LEU:HD22	1:C:536:PRO:HB2	1.74	0.70
7:A:2166:HOH:O	1:B:312:GLU:OE2	2.11	0.69
1:D:360:PHE:HB2	1:D:361:PRO:HD3	1.74	0.69
3:D:750:HEM:HBB2	3:D:750:HEM:HHC	1.73	0.69
1:A:636:VAL:HG11	1:B:633:GLN:HG2	1.78	0.64
1:D:355:THR:H	1:D:358:GLN:NE2	1.94	0.64
1:C:312:GLU:OE2	7:C:2010:HOH:O	2.16	0.61
1:A:342:HIS:HD2	1:A:711:TYR:CD2	2.20	0.60
1:D:342:HIS:HD2	1:D:711:TYR:CD2	2.20	0.59
1:C:342:HIS:HD2	1:C:711:TYR:CD2	2.21	0.59
1:B:324:LYS:HA	1:D:304:ARG:HD3	1.85	0.59
1:B:342:HIS:HD2	1:B:711:TYR:CE2	2.21	0.58
1:C:636:VAL:HG11	1:D:633:GLN:HG2	1.84	0.58
1:D:614:GLU:HG3	7:D:2133:HOH:O	2.03	0.58
1:B:379:SER:O	1:B:383:MET:HG2	2.03	0.58
1:B:312:GLU:HG3	1:B:697:HIS:CG	2.38	0.58
1:A:395:THR:HG23	1:A:396:THR:HG23	1.85	0.57
1:B:613:GLU:CG	1:B:623:MET:HE1	2.35	0.55
1:D:483:GLN:HB2	1:D:486:ARG:HG3	1.89	0.54
1:C:521:ARG:NH1	7:C:2171:HOH:O	2.29	0.54
1:A:528:LEU:HD22	1:A:536:PRO:HB2	1.90	0.54
1:D:342:HIS:HD2	1:D:711:TYR:CE2	2.26	0.53
1:D:530:GLN:HG3	1:D:534:ASN:O	2.08	0.53
1:A:483:GLN:HB2	1:A:486:ARG:HG3	1.90	0.53
1:B:326:THR:HG22	1:D:304:ARG:HB3	1.91	0.53
1:A:633:GLN:HG2	1:B:636:VAL:HG11	1.90	0.53
1:C:378:GLY:HA2	1:C:383:MET:HE3	1.89	0.53
1:C:341:MET:HE3	1:D:311:TRP:CE2	2.45	0.52
1:A:351:GLU:H	1:A:351:GLU:CD	2.17	0.52
1:C:483:GLN:HB2	1:C:486:ARG:HG3	1.90	0.52
1:C:380:LYS:HD2	1:C:380:LYS:N	2.25	0.52
1:D:613:GLU:HG3	1:D:623:MET:HE1	1.92	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:341:MET:HE2	4:C:760:H4B:H9	1.91	0.52
1:A:408:TYR:CE2	1:A:412:HIS:CE1	2.98	0.51
1:B:342:HIS:HD2	1:B:711:TYR:CD2	2.28	0.51
1:A:342:HIS:CD2	1:A:711:TYR:CD2	3.00	0.51
1:B:408:TYR:CE2	1:B:412:HIS:CE1	2.99	0.50
1:C:355:THR:H	1:C:358:GLN:NE2	2.09	0.50
1:A:342:HIS:HD2	1:A:711:TYR:CE2	2.29	0.50
3:C:750:HEM:HHC	3:C:750:HEM:HBB2	1.93	0.50
1:A:341:MET:HE3	1:A:683:TRP:HZ2	1.74	0.50
1:A:480:TRP:HB2	1:A:528:LEU:HB3	1.93	0.50
1:C:393:ILE:O	1:C:397:SER:HA	2.12	0.49
1:D:393:ILE:O	1:D:397:SER:HA	2.12	0.49
1:A:574:ASN:HD22	1:A:574:ASN:H	1.59	0.49
1:D:313:THR:O	1:D:314:GLU:HB2	2.12	0.49
1:B:600:VAL:O	1:B:604:CYS:HB2	2.13	0.49
1:B:460:LEU:HD12	1:B:592:TRP:HB3	1.95	0.49
1:B:530:GLN:HG3	1:B:534:ASN:O	2.13	0.49
1:D:613:GLU:CG	1:D:623:MET:HE1	2.43	0.48
1:A:395:THR:CG2	1:A:396:THR:HG23	2.42	0.48
1:B:379:SER:HB2	1:B:380:LYS:CB	2.22	0.48
1:D:480:TRP:HB2	1:D:528:LEU:HB3	1.96	0.48
1:B:483:GLN:HB2	1:B:486:ARG:HG3	1.96	0.47
1:A:391:LYS:O	1:A:395:THR:HB	2.14	0.47
1:A:393:ILE:O	1:A:397:SER:HA	2.15	0.46
1:B:360:PHE:CB	1:B:361:PRO:HD3	2.43	0.46
1:D:358:GLN:O	1:D:361:PRO:HD2	2.15	0.46
3:B:750:HEM:HHC	3:B:750:HEM:HBB2	1.97	0.46
1:C:349:ARG:HB3	1:C:351:GLU:OE2	2.16	0.46
1:B:511:ILE:HG12	1:B:517:PRO:HG3	1.97	0.46
1:D:631:LYS:NZ	7:D:2137:HOH:O	2.47	0.45
1:A:600:VAL:O	1:A:604:CYS:HB2	2.17	0.45
1:D:547:LEU:HD21	1:D:651:VAL:HG22	1.97	0.45
1:A:349:ARG:HB2	1:A:352:ASP:OD2	2.16	0.45
1:A:349:ARG:HB3	1:A:351:GLU:OE2	2.17	0.45
1:A:706:THR:HA	1:A:707:PRO:C	2.42	0.45
1:D:600:VAL:O	1:D:604:CYS:HB2	2.17	0.45
1:A:530:GLN:HG3	1:A:534:ASN:O	2.16	0.44
1:B:480:TRP:HB2	1:B:528:LEU:HB3	2.00	0.44
1:A:328:GLU:O	1:A:704:ARG:HD3	2.18	0.43
1:A:518:PRO:HG2	1:A:523:ASP:CG	2.43	0.43
1:D:589:PHE:CD1	3:D:750:HEM:CAC	3.02	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:613:GLU:HB2	1:A:623:MET:HE1	2.01	0.43
1:B:589:PHE:CD1	3:B:750:HEM:CAC	3.02	0.43
1:C:354:ALA:HA	1:C:358:GLN:NE2	2.33	0.43
1:D:683:TRP:HA	4:D:760:H4B:N1	2.33	0.43
1:C:401:LEU:HG	1:C:582:LEU:HD12	2.00	0.43
1:A:327:LEU:HD11	1:A:706:THR:CG2	2.48	0.43
1:C:689:SER:O	1:C:690:GLY:C	2.62	0.43
1:C:706:THR:HG23	7:C:2038:HOH:O	2.18	0.42
1:B:542:PRO:HA	1:B:543:PRO:HD3	1.92	0.42
1:D:360:PHE:CB	1:D:361:PRO:HD3	2.46	0.42
1:D:613:GLU:HG3	1:D:623:MET:CE	2.50	0.42
1:A:516:LYS:HD2	1:A:516:LYS:N	2.33	0.42
1:B:337:MET:HE1	7:B:2058:HOH:O	2.20	0.42
1:A:342:HIS:CD2	1:A:711:TYR:CE2	3.08	0.42
1:C:706:THR:HA	1:C:707:PRO:C	2.45	0.42
1:A:512:GLN:HE21	1:A:512:GLN:HB3	1.65	0.42
1:D:542:PRO:HA	1:D:543:PRO:HD3	1.90	0.42
1:B:553:HIS:CG	1:B:554:PRO:HD2	2.54	0.41
1:B:302:CYS:N	1:B:303:PRO:C	2.79	0.41
1:D:302:CYS:N	1:D:303:PRO:C	2.78	0.41
1:D:355:THR:N	1:D:358:GLN:HE21	2.05	0.41
1:A:623:MET:HG2	1:A:630:TRP:CD2	2.56	0.41
1:C:380:LYS:HD2	1:C:380:LYS:H	1.85	0.41
1:C:681:TRP:CE2	1:C:685:VAL:HG21	2.55	0.41
1:D:706:THR:HA	1:D:707:PRO:C	2.46	0.40
1:B:383:MET:O	1:B:387:GLU:HG3	2.21	0.40
1:C:626:THR:HG22	7:C:2163:HOH:O	2.21	0.40
1:A:429:LEU:O	5:A:880:GOL:H32	2.21	0.40
1:D:436:ASP:OD1	1:D:436:ASP:C	2.65	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	419/420 (100%)	411 (98%)	8 (2%)	0	100	100
1	B	408/420 (97%)	396 (97%)	12 (3%)	0	100	100
1	C	419/420 (100%)	411 (98%)	8 (2%)	0	100	100
1	D	407/420 (97%)	396 (97%)	11 (3%)	0	100	100
All	All	1653/1680 (98%)	1614 (98%)	39 (2%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains ⓘ

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	376/375 (100%)	361 (96%)	15 (4%)	28	22
1	B	368/375 (98%)	360 (98%)	8 (2%)	45	45
1	C	376/375 (100%)	365 (97%)	11 (3%)	37	34
1	D	367/375 (98%)	355 (97%)	12 (3%)	33	29
All	All	1487/1500 (99%)	1441 (97%)	46 (3%)	35	31

All (46) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	302	CYS
1	A	314	GLU
1	A	376	ARG
1	A	386	LEU
1	A	395	THR
1	A	491	LYS
1	A	512	GLN
1	A	516	LYS
1	A	528	LEU
1	A	532	ASN
1	A	574	ASN
1	A	620	ASN
1	A	650	LYS

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Mol	Chain	Res	Type
1	A	665	LYS
1	A	720	VAL
1	B	302	CYS
1	B	314	GLU
1	B	353	VAL
1	B	394	ASP
1	B	491	LYS
1	B	516	LYS
1	B	528	LEU
1	B	574	ASN
1	C	302	CYS
1	C	341	MET
1	C	380	LYS
1	C	494	ASP
1	C	512	GLN
1	C	528	LEU
1	C	574	ASN
1	C	578	GLU
1	C	614	GLU
1	C	620	ASN
1	C	704	ARG
1	D	302	CYS
1	D	304	ARG
1	D	353	VAL
1	D	376	ARG
1	D	386	LEU
1	D	390	ASN
1	D	528	LEU
1	D	560	LYS
1	D	574	ASN
1	D	650	LYS
1	D	710	GLU
1	D	718	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (44) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	342	HIS
1	A	412	HIS
1	A	445	ASN
1	A	459	ASN
1	A	512	GLN

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Mol	Chain	Res	Type
1	A	513	GLN
1	A	532	ASN
1	A	574	ASN
1	A	702	ASN
1	B	342	HIS
1	B	358	GLN
1	B	412	HIS
1	B	430	GLN
1	B	449	ASN
1	B	459	ASN
1	B	512	GLN
1	B	532	ASN
1	B	574	ASN
1	B	647	GLN
1	B	702	ASN
1	C	342	HIS
1	C	346	HIS
1	C	358	GLN
1	C	412	HIS
1	C	430	GLN
1	C	441	HIS
1	C	445	ASN
1	C	459	ASN
1	C	532	ASN
1	C	574	ASN
1	C	610	ASN
1	C	647	GLN
1	C	702	ASN
1	D	342	HIS
1	D	358	GLN
1	D	412	HIS
1	D	441	HIS
1	D	459	ASN
1	D	512	GLN
1	D	513	GLN
1	D	532	ASN
1	D	574	ASN
1	D	702	ASN
1	D	717	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 21 ligands modelled in this entry, 2 are monoatomic - leaving 19 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$
4	H4B	B	760	-	17,18,18	1.08	1 (5%)	14,26,26	1.78	5 (35%)
5	GOL	C	880	-	5,5,5	0.31	0	5,5,5	0.28	0
4	H4B	A	760	-	17,18,18	1.27	2 (11%)	14,26,26	1.59	4 (28%)
4	H4B	D	760	-	17,18,18	1.04	1 (5%)	14,26,26	1.84	4 (28%)
5	GOL	D	881	-	5,5,5	0.37	0	5,5,5	0.46	0
3	HEM	B	750	1	50,50,50	1.44	5 (10%)	67,82,82	1.56	13 (19%)
2	ARG	D	770	-	10,11,11	0.93	0	9,13,13	0.98	0
5	GOL	A	880	-	5,5,5	0.30	0	5,5,5	0.34	0
5	GOL	D	880	-	5,5,5	0.33	0	5,5,5	0.29	0
4	H4B	C	760	-	17,18,18	1.30	2 (11%)	14,26,26	1.75	5 (35%)
5	GOL	C	882	-	5,5,5	0.29	0	5,5,5	0.49	0
2	ARG	A	770	-	10,11,11	0.72	0	9,13,13	0.72	0
5	GOL	C	881	-	5,5,5	0.24	0	5,5,5	0.38	0
3	HEM	C	750	1	50,50,50	1.42	4 (8%)	67,82,82	1.62	10 (14%)
2	ARG	C	770	-	10,11,11	1.02	1 (10%)	9,13,13	0.83	0
5	GOL	B	880	-	5,5,5	0.51	0	5,5,5	0.61	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	ARG	B	770	-	10,11,11	0.83	0	9,13,13	0.83	0
3	HEM	A	750	1	50,50,50	1.51	4 (8%)	67,82,82	1.58	13 (19%)
3	HEM	D	750	1	50,50,50	1.49	6 (12%)	67,82,82	1.58	15 (22%)

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	H4B	B	760	-	-	0/8/17/17	0/2/2/2
5	GOL	C	880	-	-	0/4/4/4	-
4	H4B	A	760	-	-	0/8/17/17	0/2/2/2
4	H4B	D	760	-	-	0/8/17/17	0/2/2/2
5	GOL	D	881	-	-	4/4/4/4	-
3	HEM	B	750	1	-	0/14/54/54	-
2	ARG	D	770	-	-	0/11/11/11	-
5	GOL	A	880	-	-	4/4/4/4	-
5	GOL	D	880	-	-	2/4/4/4	-
4	H4B	C	760	-	-	0/8/17/17	0/2/2/2
5	GOL	C	882	-	-	2/4/4/4	-
2	ARG	A	770	-	-	0/11/11/11	-
5	GOL	C	881	-	-	2/4/4/4	-
3	HEM	C	750	1	-	0/14/54/54	-
2	ARG	C	770	-	-	0/11/11/11	-
5	GOL	B	880	-	-	4/4/4/4	-
2	ARG	B	770	-	-	0/11/11/11	-
3	HEM	A	750	1	-	4/14/54/54	-
3	HEM	D	750	1	-	2/14/54/54	-

All (26) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	750	HEM	FE-NB	5.33	2.11	1.94
3	D	750	HEM	FE-NB	5.15	2.10	1.94
3	B	750	HEM	FE-NB	4.65	2.09	1.94
3	C	750	HEM	FE-NB	4.42	2.08	1.94
3	B	750	HEM	C1B-NB	-4.23	1.32	1.40
3	A	750	HEM	FE-NC	4.21	2.09	1.95
3	C	750	HEM	FE-NC	3.95	2.08	1.95

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	750	HEM	FE-NC	3.86	2.07	1.95
3	D	750	HEM	FE-NC	3.79	2.07	1.95
4	C	760	H4B	C7-C6	3.67	1.55	1.52
3	C	750	HEM	C1B-NB	-3.41	1.34	1.40
3	D	750	HEM	C1B-NB	-3.13	1.34	1.40
4	A	760	H4B	C7-C6	3.12	1.55	1.52
3	A	750	HEM	C1B-NB	-2.83	1.35	1.40
3	D	750	HEM	C3B-C4B	2.81	1.50	1.44
4	D	760	H4B	C7-C6	2.71	1.54	1.52
3	A	750	HEM	C3B-C4B	2.62	1.50	1.44
4	B	760	H4B	O4-C4	2.40	1.28	1.23
3	D	750	HEM	C4D-ND	-2.29	1.36	1.40
3	D	750	HEM	C3C-C4C	-2.27	1.42	1.46
4	C	760	H4B	C4-N3	-2.23	1.34	1.38
4	A	760	H4B	O4-C4	2.23	1.27	1.23
3	B	750	HEM	C1C-C2C	-2.19	1.41	1.45
2	C	770	ARG	OXT-C	-2.14	1.23	1.30
3	C	750	HEM	C3B-C4B	2.11	1.49	1.44
3	B	750	HEM	C4D-ND	-2.07	1.36	1.40

All (69) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	750	HEM	C3B-C4B-NB	-4.78	106.04	109.47
3	D	750	HEM	CHD-C1D-ND	4.17	128.91	124.42
3	C	750	HEM	C1B-NB-C4B	4.03	109.98	105.21
3	C	750	HEM	CHC-C4B-NB	3.99	128.72	124.42
3	D	750	HEM	CHD-C1D-C2D	-3.98	118.74	125.03
3	B	750	HEM	CHC-C4B-NB	3.90	128.62	124.42
4	C	760	H4B	C2-N1-C8A	3.80	120.07	113.36
3	A	750	HEM	C1B-NB-C4B	3.72	109.62	105.21
3	A	750	HEM	CHC-C4B-NB	3.57	128.27	124.42
4	B	760	H4B	C2-N1-C8A	3.52	119.58	113.36
3	D	750	HEM	C4C-CHD-C1D	-3.50	118.59	126.02
3	B	750	HEM	C1B-NB-C4B	3.32	109.14	105.21
3	A	750	HEM	CHD-C1D-ND	3.27	127.94	124.42
4	D	760	H4B	C2-N1-C8A	3.26	119.12	113.36
4	D	760	H4B	O4-C4-C4A	-3.23	119.48	127.26
3	B	750	HEM	C4C-CHD-C1D	-3.19	119.23	126.02
3	D	750	HEM	CHC-C4B-NB	3.14	127.80	124.42
3	D	750	HEM	C3B-C4B-NB	-3.13	107.22	109.47
3	B	750	HEM	CHA-C4D-ND	3.12	128.23	124.37

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	750	HEM	CHA-C4D-ND	3.12	128.22	124.37
3	B	750	HEM	CHD-C1D-ND	3.10	127.76	124.42
4	D	760	H4B	C2-N3-C4	-3.10	119.49	125.11
3	D	750	HEM	C1B-NB-C4B	3.04	108.80	105.21
4	A	760	H4B	C2-N1-C8A	3.04	118.72	113.36
3	A	750	HEM	C3B-C4B-NB	-3.00	107.32	109.47
3	A	750	HEM	CHA-C4D-C3D	-2.93	119.82	125.23
3	C	750	HEM	CHA-C4D-C3D	-2.91	119.87	125.23
3	A	750	HEM	C4C-CHD-C1D	-2.91	119.84	126.02
4	D	760	H4B	C4A-C4-N3	2.90	120.11	112.13
3	B	750	HEM	CHA-C4D-C3D	-2.89	119.90	125.23
3	C	750	HEM	CHA-C4D-ND	2.87	127.92	124.37
3	B	750	HEM	CHD-C1D-C2D	-2.85	120.53	125.03
3	C	750	HEM	C4C-CHD-C1D	-2.79	120.09	126.02
3	D	750	HEM	C4A-CHB-C1B	-2.77	119.72	126.25
3	A	750	HEM	CBD-CAD-C3D	-2.76	104.89	112.53
3	A	750	HEM	O2D-CGD-CBD	2.76	122.73	114.00
3	C	750	HEM	C1A-CHA-C4D	-2.76	119.76	126.25
4	C	760	H4B	C4A-C4-N3	2.75	119.69	112.13
4	C	760	H4B	C2-N3-C4	-2.70	120.21	125.11
3	C	750	HEM	CBA-CAA-C2A	-2.69	105.11	112.53
3	A	750	HEM	CHD-C1D-C2D	-2.63	120.88	125.03
3	B	750	HEM	C3B-C4B-NB	-2.63	107.58	109.47
3	B	750	HEM	O2D-CGD-CBD	2.61	122.26	114.00
3	B	750	HEM	C1A-CHA-C4D	-2.59	120.15	126.25
3	C	750	HEM	O2D-CGD-CBD	2.57	122.13	114.00
4	A	760	H4B	O9-C9-C10	-2.53	104.33	109.14
4	B	760	H4B	O9-C9-C10	-2.51	104.36	109.14
4	B	760	H4B	O4-C4-C4A	-2.50	121.24	127.26
3	D	750	HEM	O2D-CGD-CBD	2.47	121.81	114.00
3	A	750	HEM	CAD-C3D-C4D	2.45	128.97	124.70
3	C	750	HEM	CHD-C1D-C2D	-2.39	121.25	125.03
3	A	750	HEM	C1A-CHA-C4D	-2.39	120.62	126.25
3	B	750	HEM	O2A-CGA-O1A	-2.35	117.29	123.33
3	D	750	HEM	CHA-C4D-ND	2.28	127.19	124.37
3	D	750	HEM	C1A-CHA-C4D	-2.26	120.93	126.25
4	B	760	H4B	C4A-C4-N3	2.26	118.33	112.13
4	A	760	H4B	C4A-C4-N3	2.23	118.27	112.13
3	B	750	HEM	C4B-C3B-C2B	-2.23	105.23	107.28
3	D	750	HEM	CHB-C4A-NA	2.22	127.88	123.86
4	A	760	H4B	O4-C4-C4A	-2.19	121.98	127.26
3	D	750	HEM	CHA-C4D-C3D	-2.19	121.20	125.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	C	760	H4B	O4-C4-C4A	-2.13	122.13	127.26
3	D	750	HEM	O2D-CGD-O1D	-2.12	117.87	123.33
3	B	750	HEM	O2D-CGD-O1D	-2.11	117.89	123.33
4	B	760	H4B	C4-C4A-N5	2.10	122.00	116.27
4	C	760	H4B	C4-C4A-N5	2.10	122.00	116.27
3	D	750	HEM	CBD-CAD-C3D	-2.04	106.90	112.53
3	A	750	HEM	O2A-CGA-O1A	-2.03	118.11	123.33
3	D	750	HEM	C2D-C1D-ND	2.01	112.23	109.90

There are no chirality outliers.

All (24) torsion outliers are listed below:

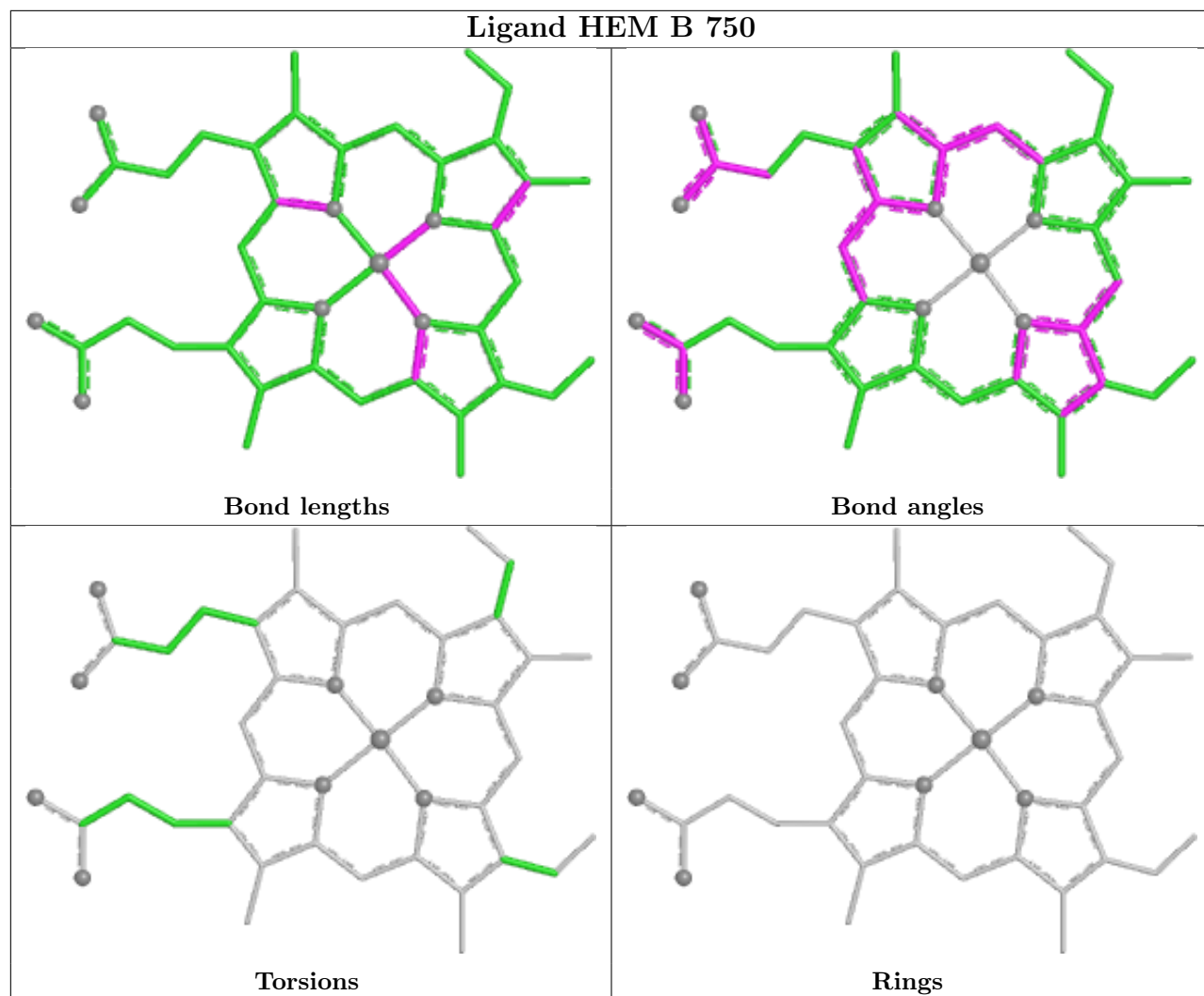
Mol	Chain	Res	Type	Atoms
5	A	880	GOL	C1-C2-C3-O3
5	B	880	GOL	C1-C2-C3-O3
5	C	882	GOL	C1-C2-C3-O3
5	D	881	GOL	O1-C1-C2-C3
5	B	880	GOL	O2-C2-C3-O3
5	D	881	GOL	O2-C2-C3-O3
5	A	880	GOL	O1-C1-C2-C3
5	B	880	GOL	O1-C1-C2-C3
5	D	880	GOL	C1-C2-C3-O3
5	D	881	GOL	C1-C2-C3-O3
5	A	880	GOL	O2-C2-C3-O3
5	D	881	GOL	O1-C1-C2-O2
3	A	750	HEM	C2B-C3B-CAB-CBB
5	C	882	GOL	O2-C2-C3-O3
5	D	880	GOL	O2-C2-C3-O3
5	C	881	GOL	O2-C2-C3-O3
3	D	750	HEM	C4B-C3B-CAB-CBB
3	A	750	HEM	C4B-C3B-CAB-CBB
5	C	881	GOL	C1-C2-C3-O3
5	A	880	GOL	O1-C1-C2-O2
5	B	880	GOL	O1-C1-C2-O2
3	D	750	HEM	CAA-CBA-CGA-O2A
3	A	750	HEM	CAD-CBD-CGD-O2D
3	A	750	HEM	CAD-CBD-CGD-O1D

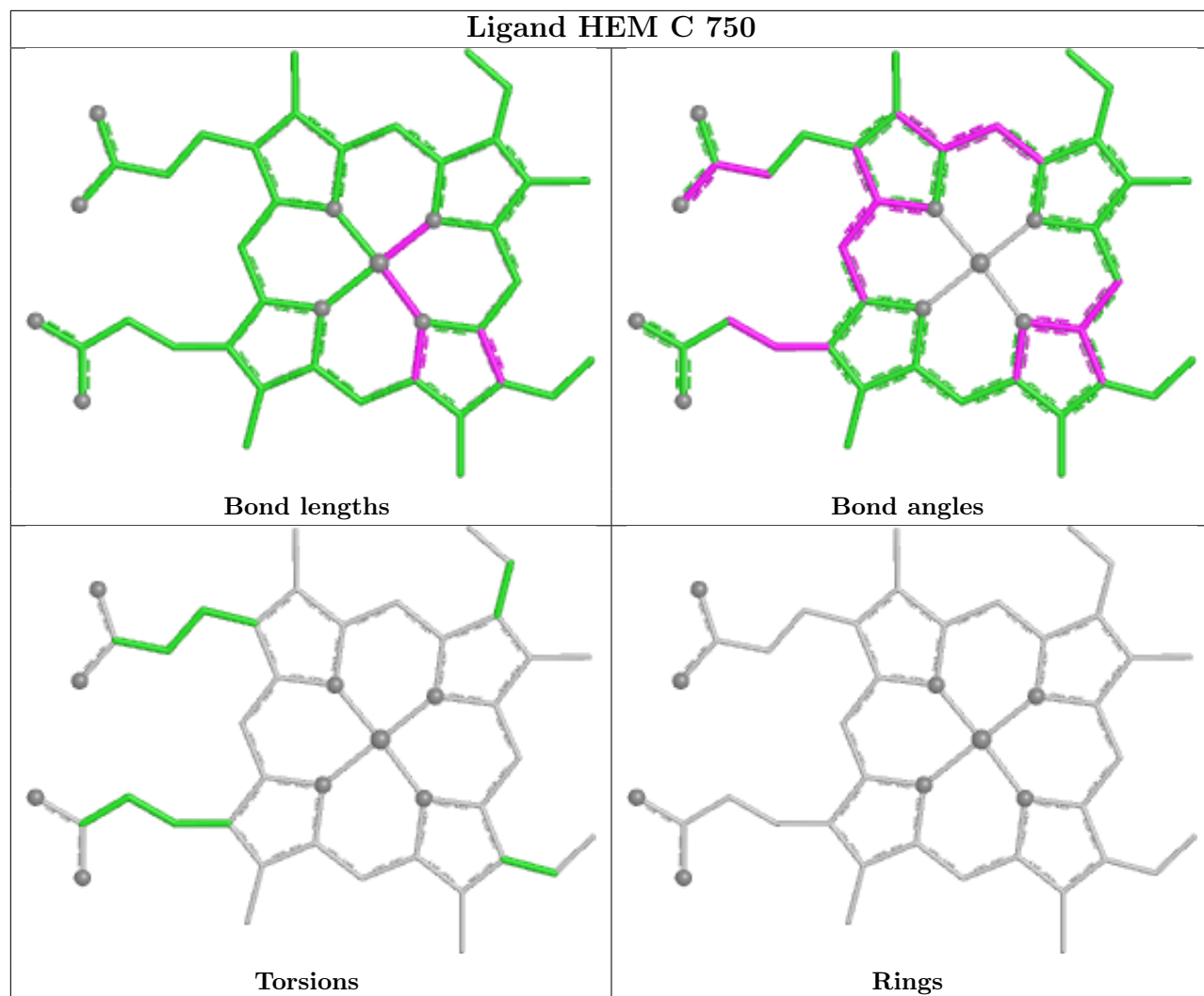
There are no ring outliers.

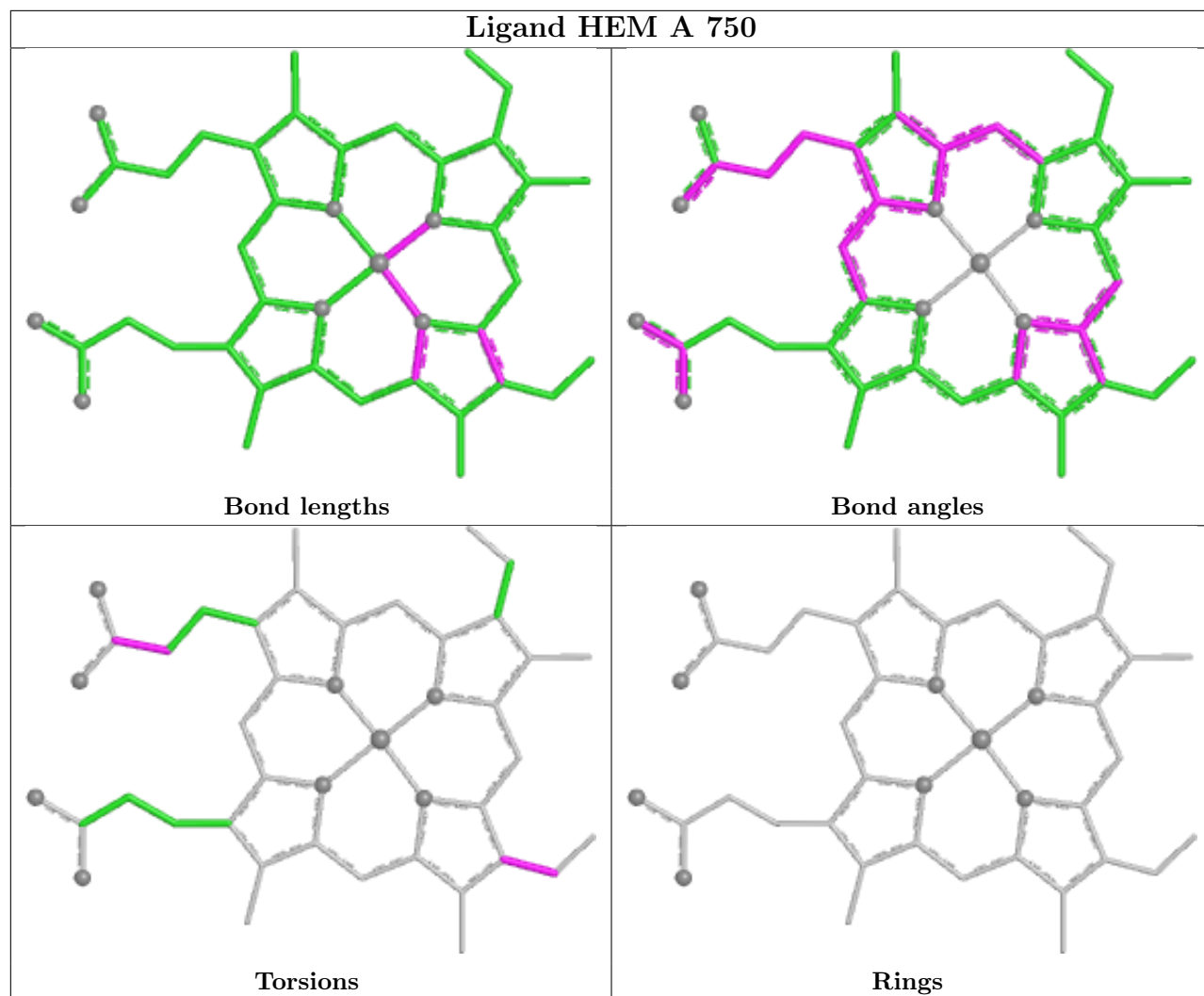
6 monomers are involved in 8 short contacts:

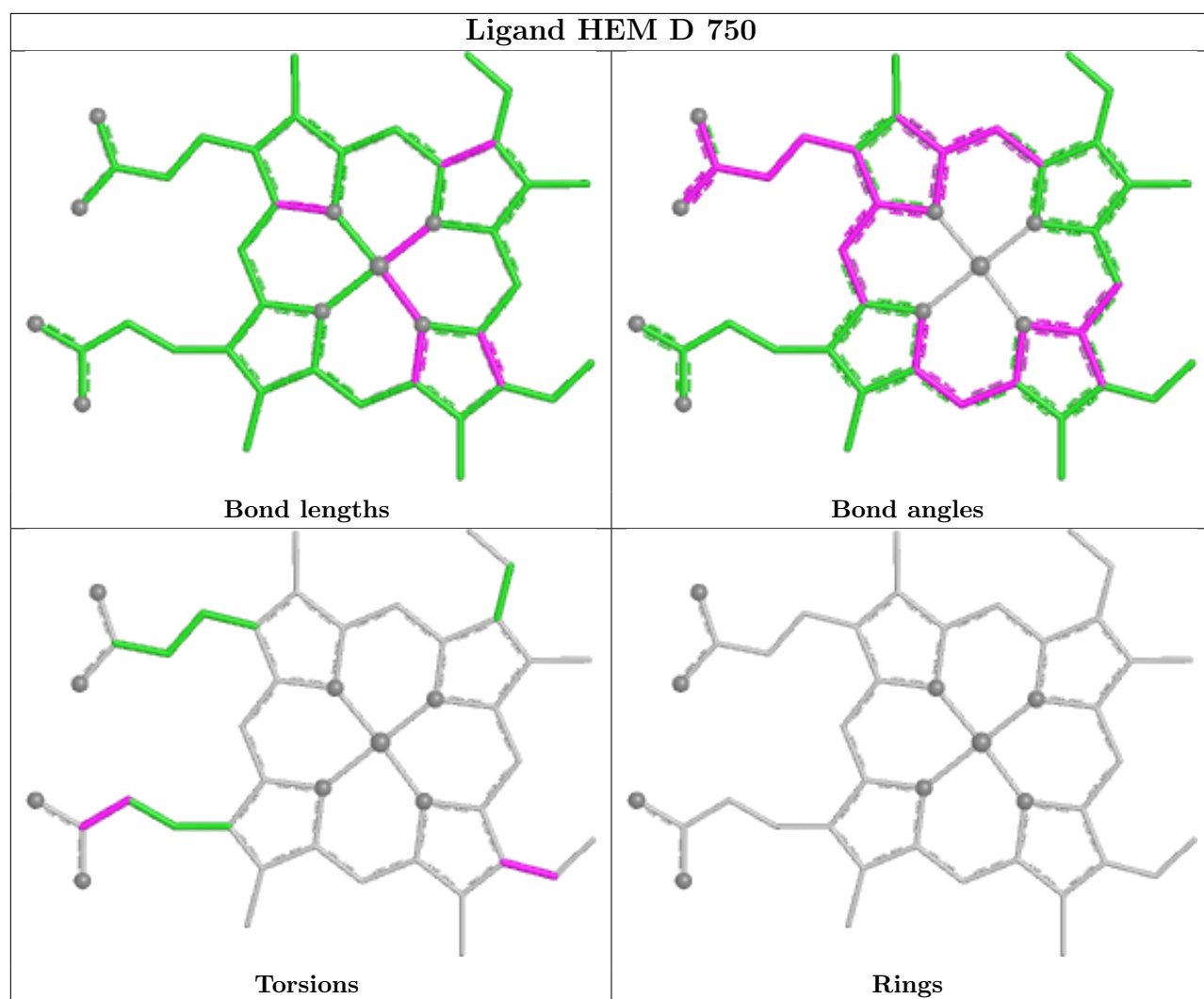
Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	D	760	H4B	1	0
3	B	750	HEM	2	0
5	A	880	GOL	1	0
4	C	760	H4B	1	0
3	C	750	HEM	1	0
3	D	750	HEM	2	0

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, 95th 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	420/420 (100%)	0.07	4 (0%) 79 80	27, 45, 66, 83	1 (0%)
1	B	411/420 (97%)	0.02	2 (0%) 87 87	22, 42, 68, 87	1 (0%)
1	C	420/420 (100%)	-0.10	1 (0%) 91 91	21, 39, 61, 78	1 (0%)
1	D	411/420 (97%)	0.07	6 (1%) 72 72	24, 43, 71, 96	0
All	All	1662/1680 (98%)	0.01	13 (0%) 82 83	21, 42, 67, 96	3 (0%)

All (13) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	353	VAL	3.7
1	D	720	VAL	3.2
1	D	395	THR	2.9
1	B	353	VAL	2.6
1	D	329	THR	2.3
1	D	449	ASN	2.2
1	A	720	VAL	2.2
1	B	380	LYS	2.2
1	A	350	PRO	2.1
1	A	512	GLN	2.1
1	D	718	THR	2.1
1	A	391	LYS	2.1
1	C	344	SER	2.1

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

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

6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

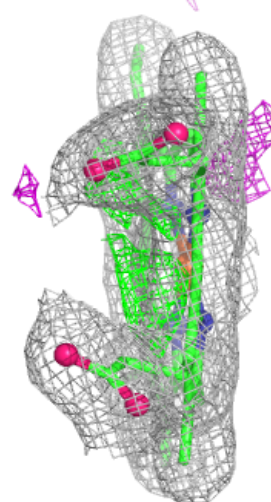
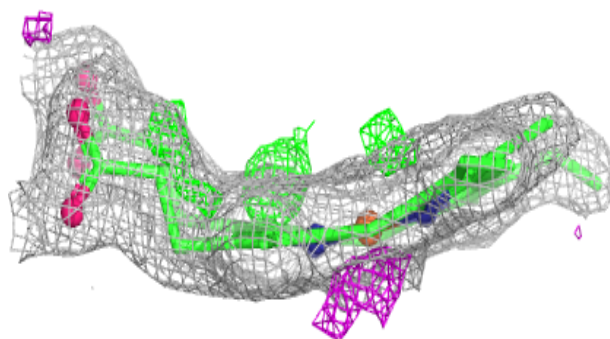
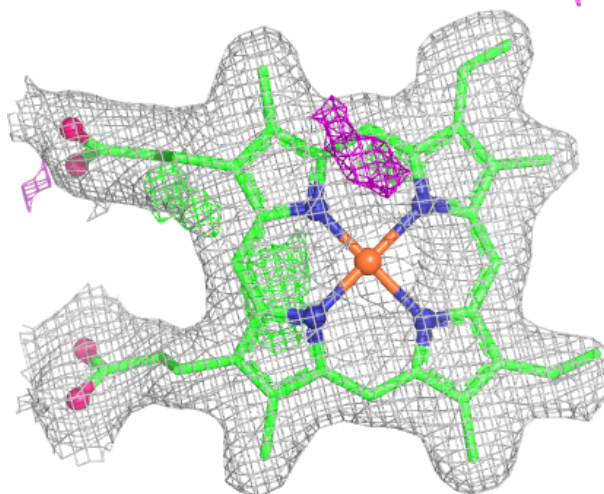
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
5	GOL	D	881	6/6	0.80	0.18	66,74,74,74	0
5	GOL	C	881	6/6	0.83	0.16	67,71,73,73	0
5	GOL	C	882	6/6	0.89	0.12	43,53,55,57	0
5	GOL	B	880	6/6	0.90	0.12	53,58,61,62	0
2	ARG	A	770	12/12	0.91	0.10	42,45,48,48	0
2	ARG	C	770	12/12	0.92	0.09	35,39,42,42	0
2	ARG	D	770	12/12	0.92	0.09	40,43,45,46	0
5	GOL	D	880	6/6	0.92	0.08	48,55,58,58	0
2	ARG	B	770	12/12	0.92	0.09	39,43,48,49	0
5	GOL	A	880	6/6	0.93	0.09	51,57,60,63	0
5	GOL	C	880	6/6	0.94	0.10	43,51,54,54	0
4	H4B	D	760	17/17	0.96	0.06	27,29,31,32	0
3	HEM	A	750	43/43	0.97	0.09	33,37,42,46	0
3	HEM	B	750	43/43	0.97	0.07	32,35,39,44	0
3	HEM	D	750	43/43	0.97	0.08	31,34,42,45	0
4	H4B	A	760	17/17	0.97	0.06	28,31,32,32	0
4	H4B	C	760	17/17	0.98	0.04	23,26,30,30	0
3	HEM	C	750	43/43	0.98	0.07	27,32,36,38	0
4	H4B	B	760	17/17	0.98	0.04	29,31,32,33	0
6	ZN	C	900	1/1	0.99	0.02	27,27,27,27	0
6	ZN	A	900	1/1	1.00	0.02	28,28,28,28	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.

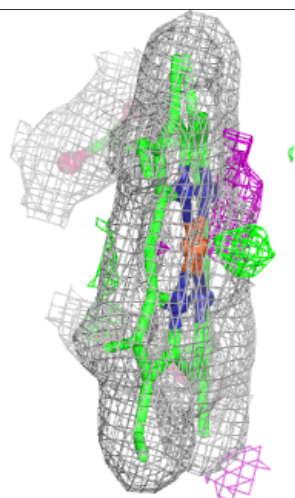
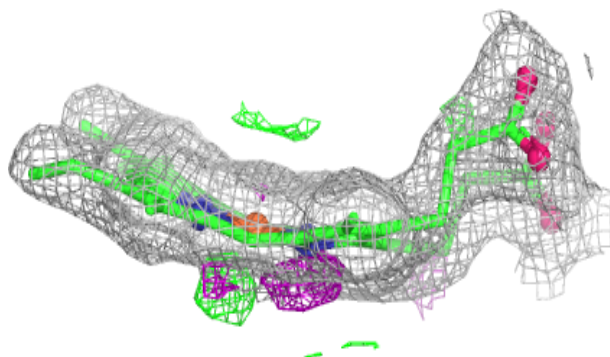
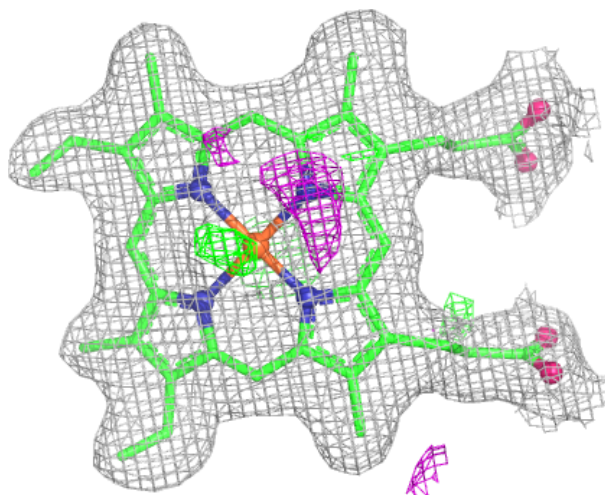
Electron density around HEM A 750:

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



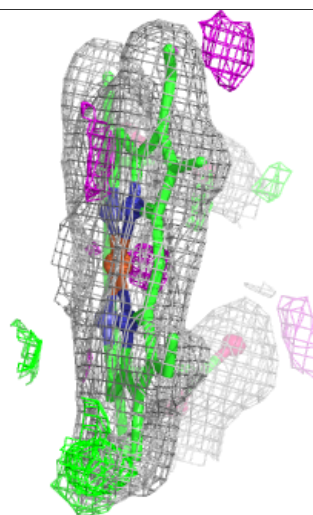
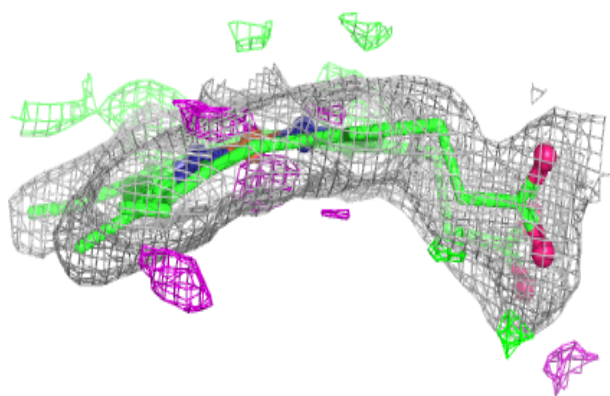
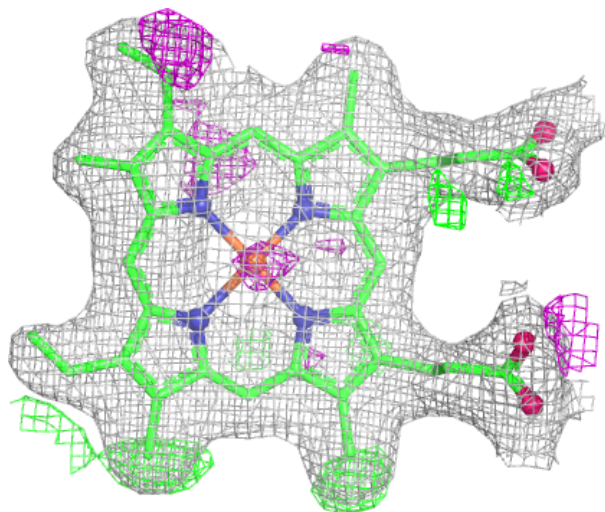
Electron density around HEM B 750:

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



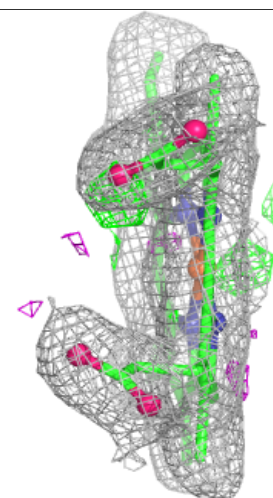
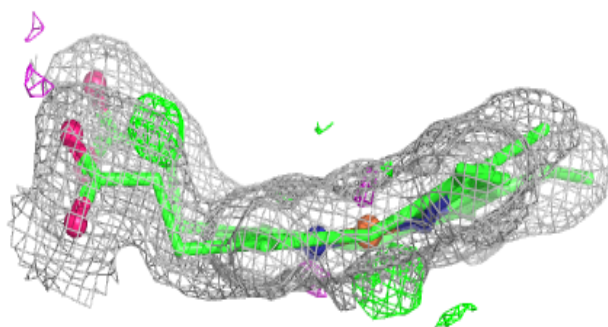
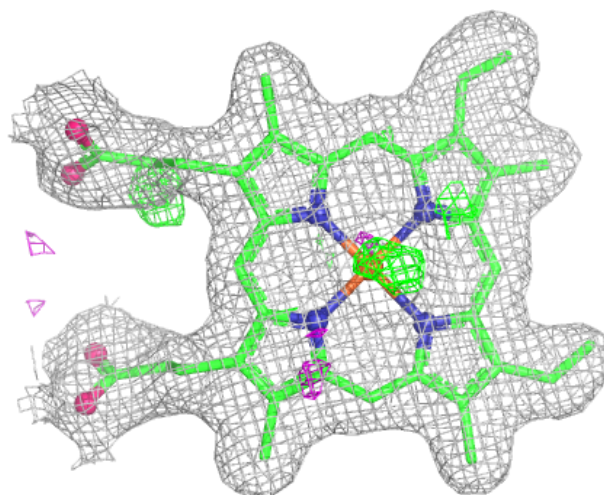
Electron density around HEM D 750:

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



Electron density around HEM C 750:

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



6.5 Other polymers ⓘ

There are no such residues in this entry.