



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 21, 2025 – 11:57 PM EDT

PDB ID : 5TE8 / pdb_00005te8
Title : Crystal structure of the midazolam-bound human CYP3A4
Authors : Sevrioukova, I.; Poulos, T.
Deposited on : 2016-09-20
Resolution : 2.70 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0rc1
EDS	:	3.0
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.006 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.42

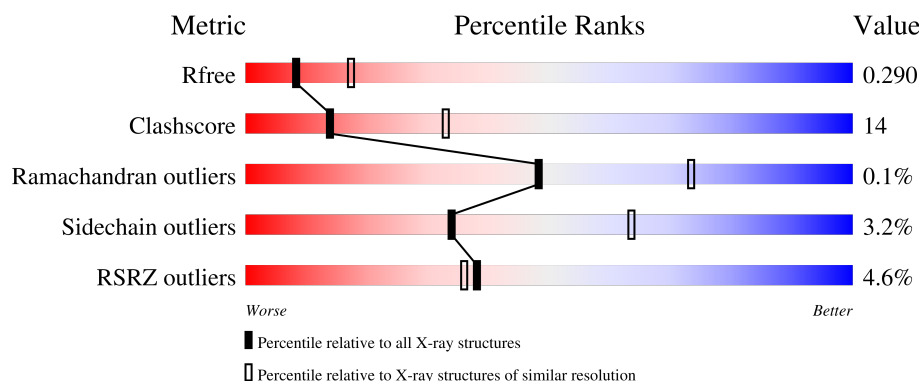
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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}	164625	3333 (2.70-2.70)
Clashscore	180529	3684 (2.70-2.70)
Ramachandran outliers	177936	3633 (2.70-2.70)
Sidechain outliers	177891	3633 (2.70-2.70)
RSRZ outliers	164620	3333 (2.70-2.70)

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	487	<div> <div>2%</div> <div>72%</div> <div>24%</div> <div>..</div> </div>
1	B	487	<div> <div>3%</div> <div>74%</div> <div>22%</div> <div>..</div> </div>
1	C	487	<div> <div>8%</div> <div>60%</div> <div>34%</div> <div>..</div> </div>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	08J	A	602	-	-	X	-
3	08J	C	602	-	-	X	-

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 11681 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.

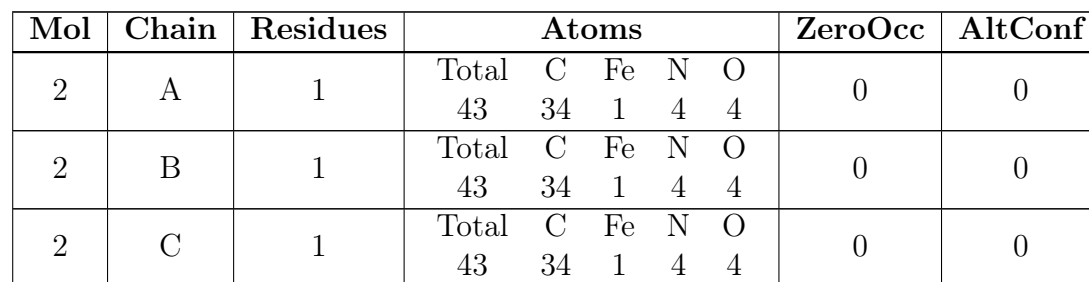
- Molecule 1 is a protein called Cytochrome P450 3A4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	470	Total	C	N	O	S	0	1	0
			3796	2470	626	676	24			
1	B	471	Total	C	N	O	S	0	0	0
			3797	2469	626	678	24			
1	C	469	Total	C	N	O	S	0	0	0
			3779	2459	622	674	24			

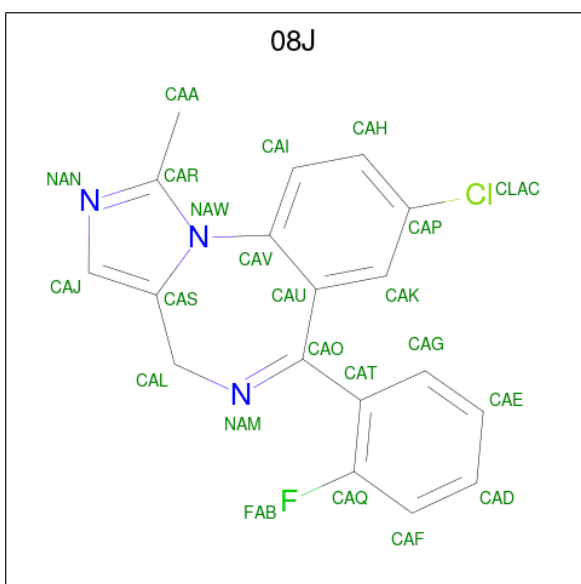
There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	see remark 999	UNP P08684
A	2	ALA	-	see remark 999	UNP P08684
A	504	HIS	-	expression tag	UNP P08684
A	505	HIS	-	expression tag	UNP P08684
A	506	HIS	-	expression tag	UNP P08684
A	507	HIS	-	expression tag	UNP P08684
B	1	MET	-	see remark 999	UNP P08684
B	2	ALA	-	see remark 999	UNP P08684
B	504	HIS	-	expression tag	UNP P08684
B	505	HIS	-	expression tag	UNP P08684
B	506	HIS	-	expression tag	UNP P08684
B	507	HIS	-	expression tag	UNP P08684
C	1	MET	-	see remark 999	UNP P08684
C	2	ALA	-	see remark 999	UNP P08684
C	504	HIS	-	expression tag	UNP P08684
C	505	HIS	-	expression tag	UNP P08684
C	506	HIS	-	expression tag	UNP P08684
C	507	HIS	-	expression tag	UNP P08684

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



- Molecule 3 is 8-chloro-6-(2-fluorophenyl)-1-methyl-4H-imidazo[1,5-a][1,4]benzodiazepine (CCD ID: 08J) (formula: C₁₈H₁₃ClFN₃).



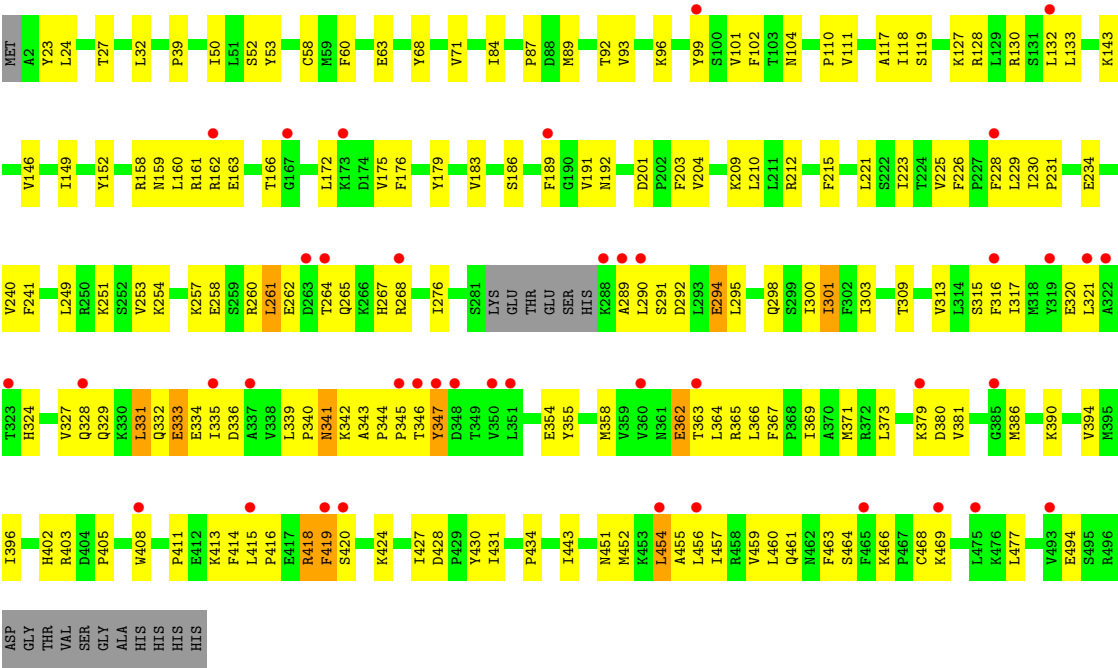
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total 23	C 18	Cl 1	F 1	N 3	0	0
3	B	1	Total 23	C 18	Cl 1	F 1	N 3	0	0
3	C	1	Total 23	C 18	Cl 1	F 1	N 3	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	53	Total 53	O 53	0	0
4	B	42	Total 42	O 42	0	0
4	C	16	Total 16	O 16	0	0

- Molecule 1: Cytochrome P450 3A4





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	64.29Å 117.98Å 205.65Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	102.34 – 2.70 102.34 – 2.70	Depositor EDS
% Data completeness (in resolution range)	98.8 (102.34-2.70) 98.8 (102.34-2.70)	Depositor EDS
R_{merge}	0.17	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.55 (at 2.69Å)	Xtriage
Refinement program	REFMAC 5.8.0049	Depositor
R, R_{free}	0.224 , 0.292 0.235 , 0.290	Depositor DCC
R_{free} test set	2178 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å ²)	50.5	Xtriage
Anisotropy	0.479	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 46.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	11681	wwPDB-VP
Average B, all atoms (Å ²)	73.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.14% of the height of the origin peak. No significant pseudotranslation is detected.*

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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 08J, 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	0.38	0/3889	0.62	2/5260 (0.0%)
1	B	0.38	0/3891	0.61	2/5264 (0.0%)
1	C	0.39	0/3872	0.62	3/5238 (0.1%)
All	All	0.38	0/11652	0.62	7/15762 (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	C	0	2

There are no bond length outliers.

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	243	ARG	CB-CA-C	-7.67	95.07	110.40
1	C	163	GLU	N-CA-CB	6.95	123.11	110.60
1	B	259	SER	N-CA-C	6.50	128.56	111.00
1	C	341	ASN	N-CA-C	-5.94	94.97	111.00
1	B	210	LEU	CA-CB-CG	5.78	128.59	115.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	333	GLU	Peptide
1	C	418	ARG	Sidechain

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	3796	0	3876	100	0
1	B	3797	0	3873	75	0
1	C	3779	0	3862	141	1
2	A	43	0	30	3	0
2	B	43	0	30	3	0
2	C	43	0	30	9	0
3	A	23	0	13	8	0
3	B	23	0	13	2	0
3	C	23	0	13	13	0
4	A	53	0	0	6	0
4	B	42	0	0	2	0
4	C	16	0	0	2	0
All	All	11681	0	11740	331	1

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 14.

The worst 5 of 331 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:C:369:ILE:HD11	3:C:602:08J:CLAC	1.32	1.59
1:C:369:ILE:CD1	3:C:602:08J:CLAC	2.03	1.41
1:C:362:GLU:HG3	1:C:418:ARG:NH2	1.83	0.93
1:C:369:ILE:HD13	3:C:602:08J:CLAC	2.07	0.91
1:C:309:THR:HG21	3:C:602:08J:CLAC	2.10	0.88

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:354:GLU:OE2	1:C:466:LYS:CE[4_545]	2.18	0.02

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	465/487 (96%)	435 (94%)	29 (6%)	1 (0%)	44	68
1	B	467/487 (96%)	424 (91%)	43 (9%)	0	100	100
1	C	465/487 (96%)	402 (86%)	62 (13%)	1 (0%)	44	68
All	All	1397/1461 (96%)	1261 (90%)	134 (10%)	2 (0%)	48	73

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	243	ARG
1	C	347	TYR

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	430/443 (97%)	419 (97%)	11 (3%)	41	70
1	B	430/443 (97%)	417 (97%)	13 (3%)	36	65
1	C	428/443 (97%)	411 (96%)	17 (4%)	27	55
All	All	1288/1329 (97%)	1247 (97%)	41 (3%)	34	63

5 of 41 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	225	VAL

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	C	362	GLU
1	C	261	LEU
1	C	301	ILE
1	C	419	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 11 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	324	HIS
1	C	328	GLN
1	C	461	GLN
1	C	332	GLN
1	C	151	GLN

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](#)

6 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	601	1	42,50,50	1.34	6 (14%)	46,82,82	1.78	11 (23%)
3	08J	C	602	-	22,26,26	1.41	2 (9%)	27,38,38	8.41	12 (44%)
3	08J	A	602	-	22,26,26	0.95	1 (4%)	27,38,38	4.84	10 (37%)
2	HEM	A	601	1	42,50,50	1.31	6 (14%)	46,82,82	1.84	12 (26%)
3	08J	B	602	-	22,26,26	1.08	2 (9%)	27,38,38	3.11	9 (33%)
2	HEM	B	601	1	42,50,50	1.29	6 (14%)	46,82,82	1.73	13 (28%)

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	601	1	-	3/12/54/54	-
3	08J	C	602	-	-	0/2/17/17	0/3/4/4
3	08J	A	602	-	-	0/2/17/17	0/3/4/4
2	HEM	A	601	1	-	2/12/54/54	-
3	08J	B	602	-	-	0/2/17/17	0/3/4/4
2	HEM	B	601	1	-	2/12/54/54	-

The worst 5 of 23 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	602	08J	CAO-NAM	-4.97	1.22	1.28
2	C	601	HEM	C1B-NB	-3.13	1.34	1.40
2	A	601	HEM	C1B-NB	-3.13	1.34	1.40
2	B	601	HEM	C1B-NB	-3.10	1.34	1.40
2	C	601	HEM	C4B-NB	-2.93	1.33	1.38

The worst 5 of 67 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	602	08J	CAL-NAM-CAO	32.26	153.83	117.47
3	A	602	08J	CAL-NAM-CAO	19.87	139.87	117.47
3	C	602	08J	CAU-CAO-NAM	-17.31	96.73	125.06
3	C	602	08J	CAT-CAO-NAM	12.89	134.26	116.84
3	C	602	08J	CAI-CAV-CAU	-11.00	112.43	122.95

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

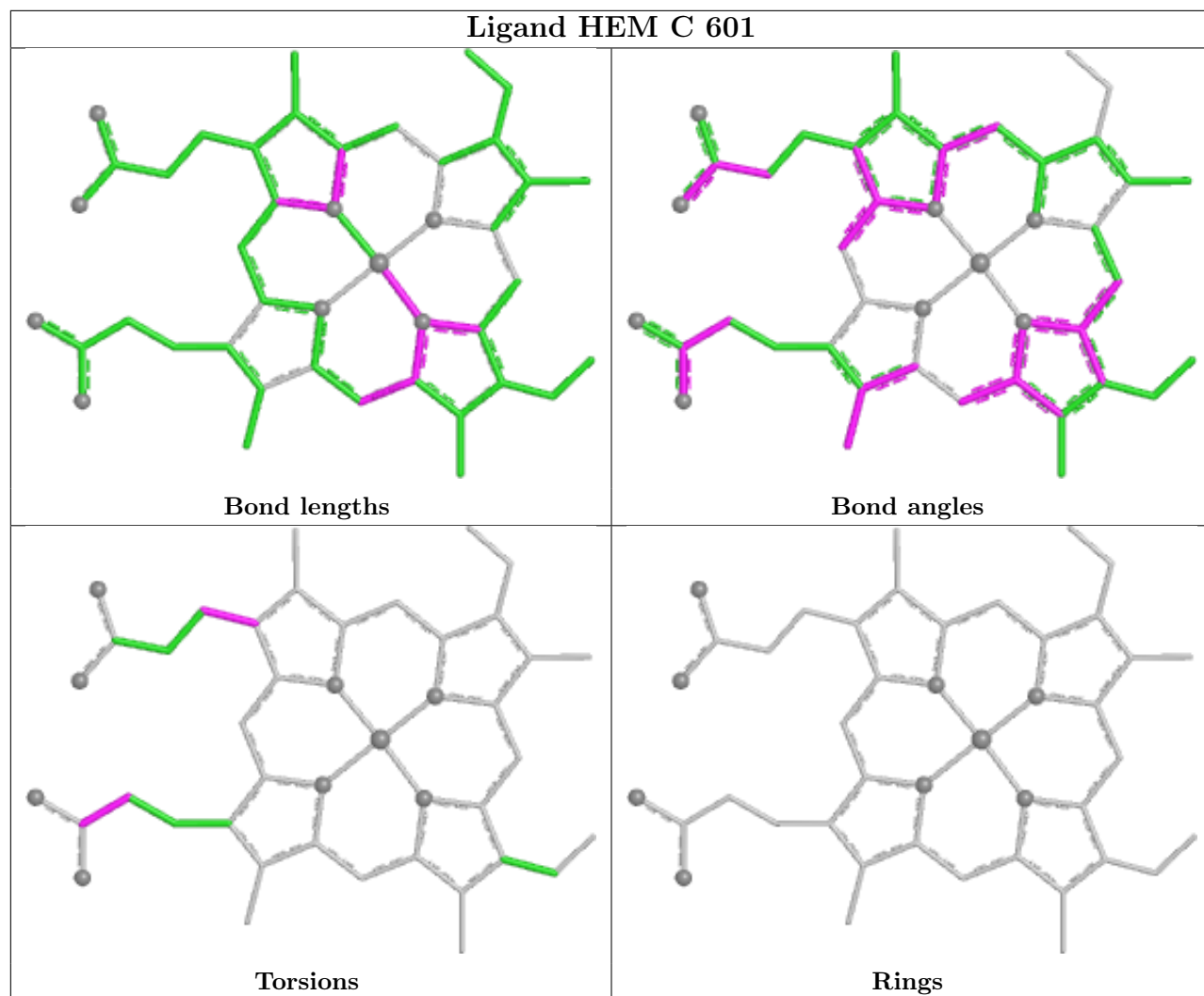
Mol	Chain	Res	Type	Atoms
2	C	601	HEM	C2D-C3D-CAD-CBD
2	C	601	HEM	C4D-C3D-CAD-CBD
2	B	601	HEM	CAD-CBD-CGD-O1D
2	B	601	HEM	CAD-CBD-CGD-O2D
2	A	601	HEM	C2B-C3B-CAB-CBB

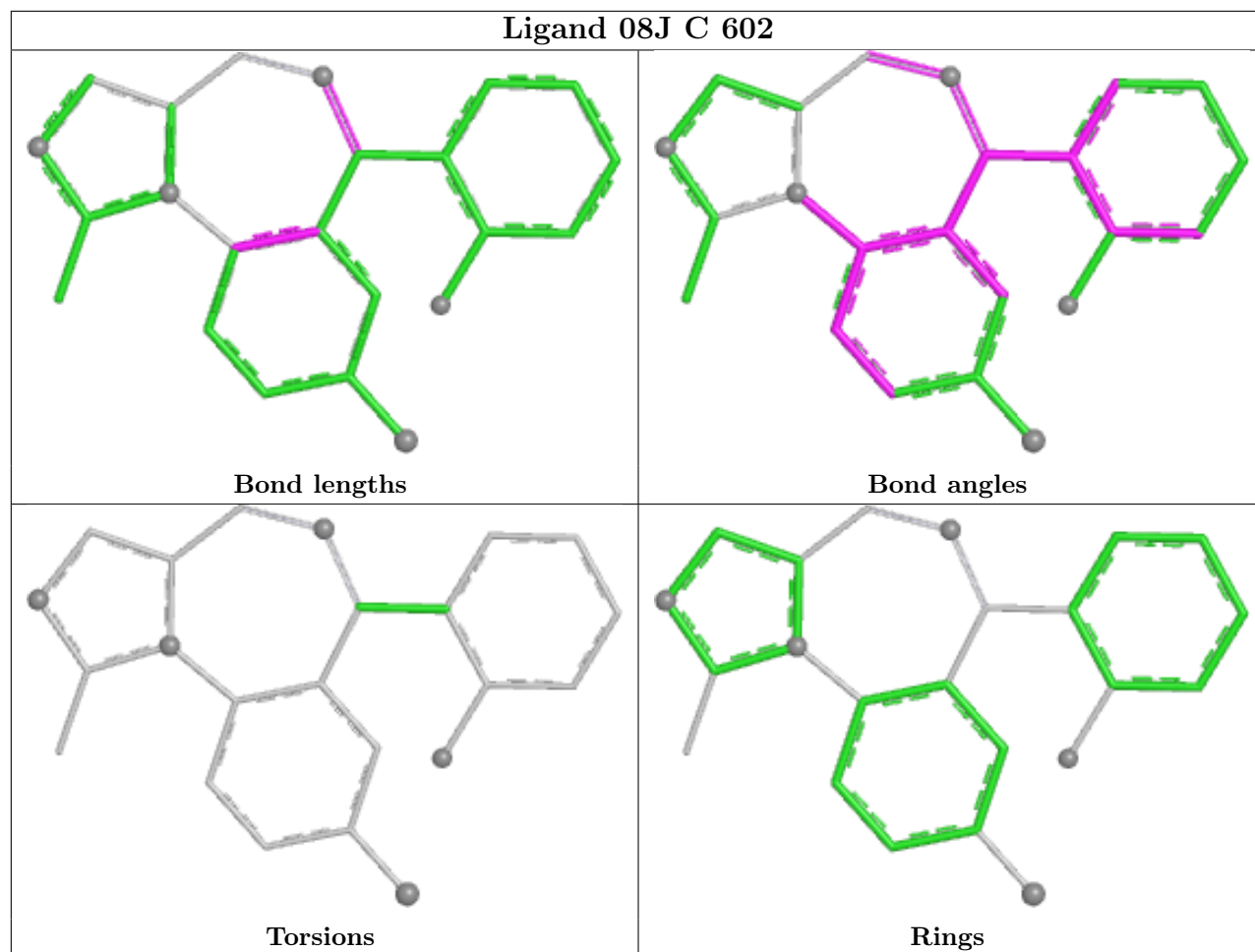
There are no ring outliers.

6 monomers are involved in 36 short contacts:

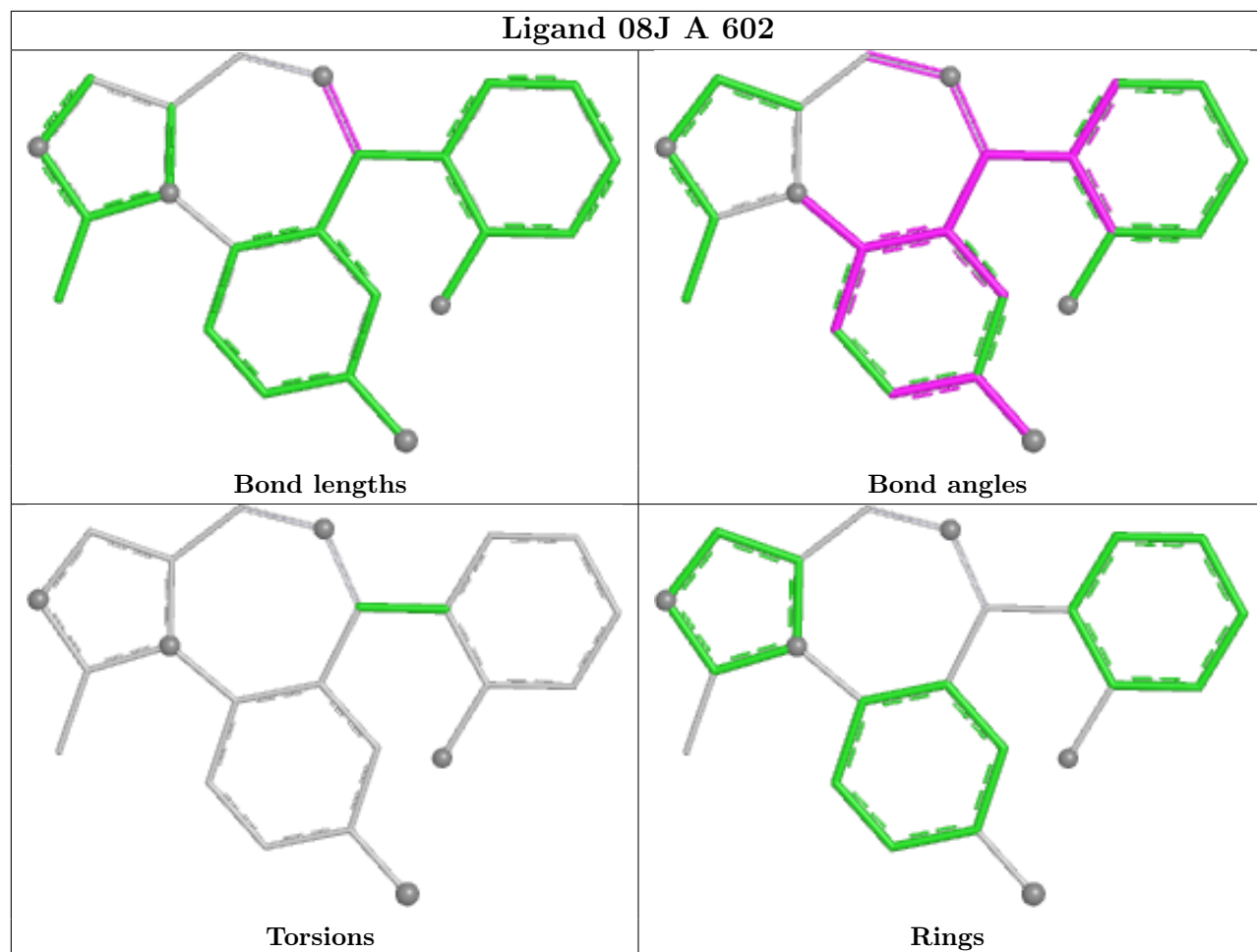
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	601	HEM	9	0
3	C	602	08J	13	0
3	A	602	08J	8	0
2	A	601	HEM	3	0
3	B	602	08J	2	0
2	B	601	HEM	3	0

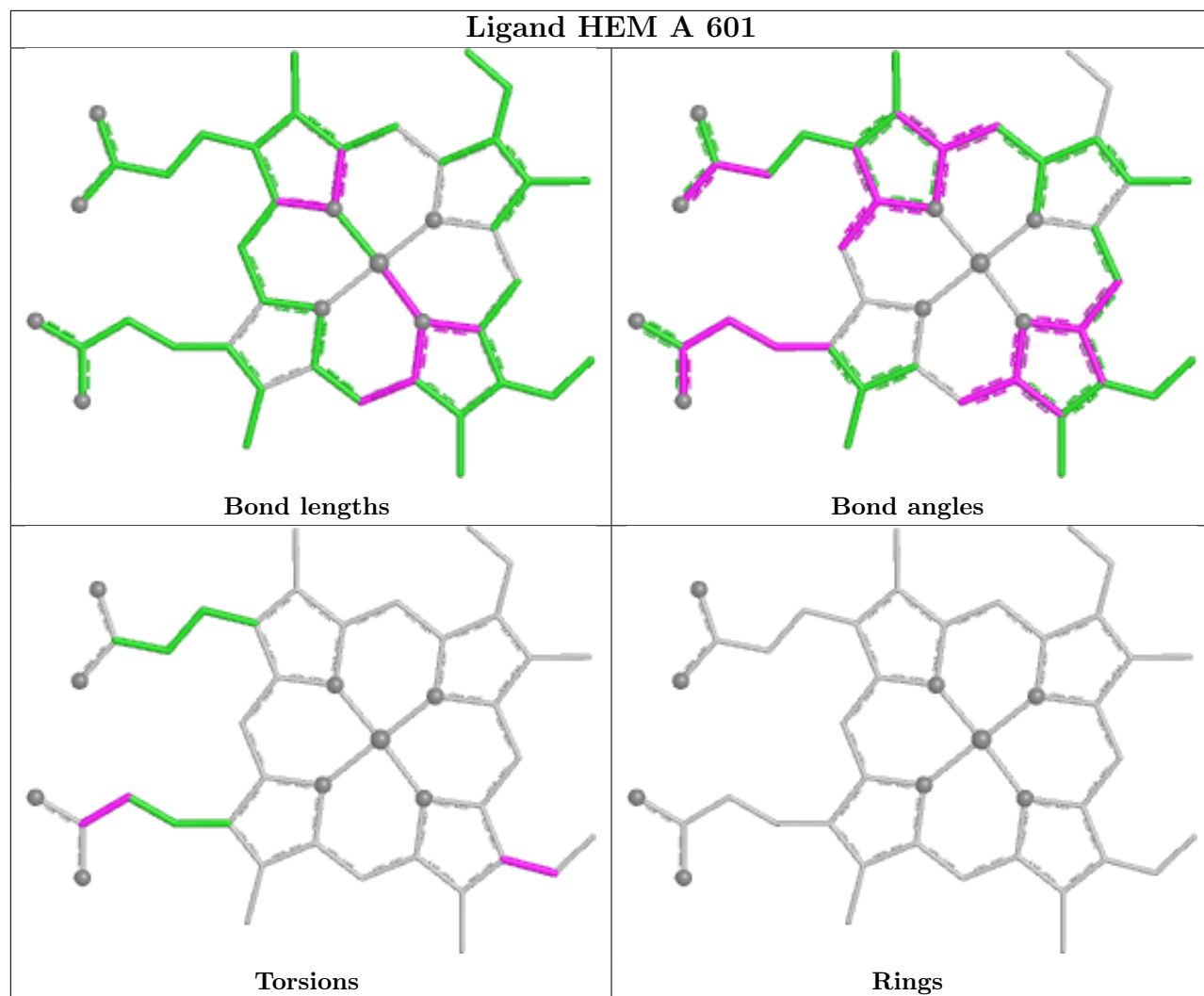
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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.



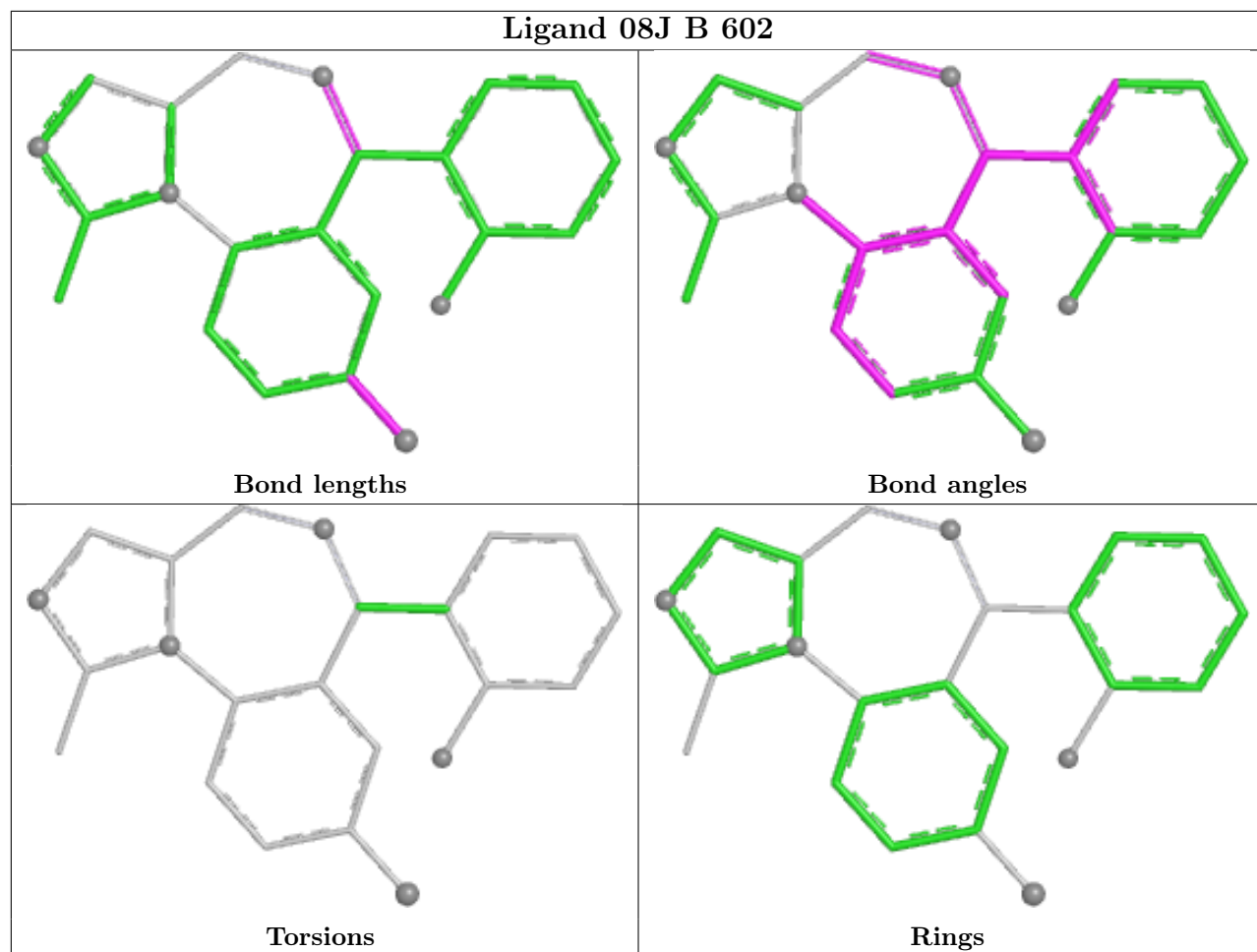


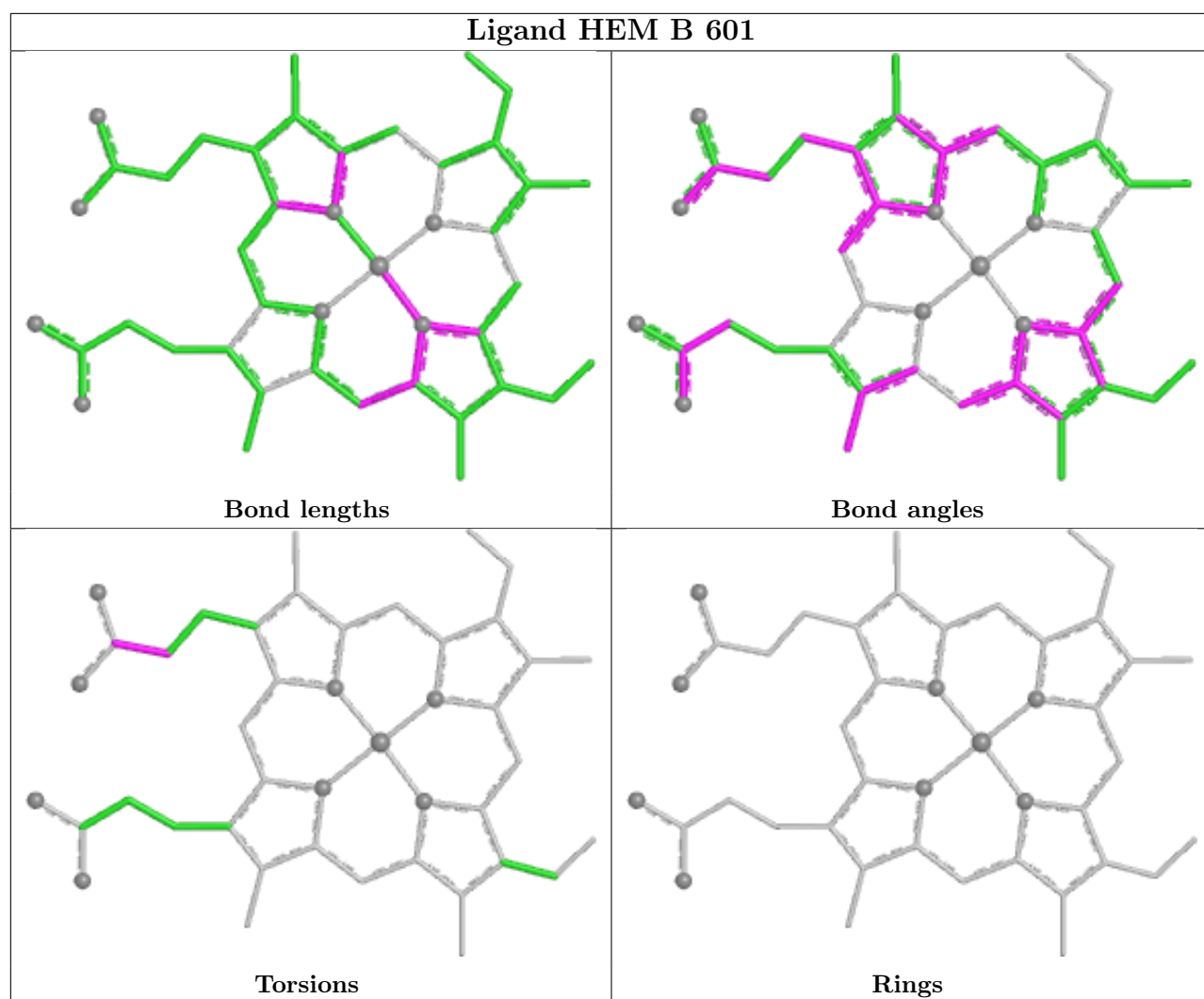
Ligand 08J A 602





Ligand 08J B 602





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](#)

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	470/487 (96%)	-0.08	8 (1%) 69 68	25, 48, 90, 163	1 (0%)
1	B	471/487 (96%)	0.23	16 (3%) 48 46	25, 63, 121, 167	0
1	C	469/487 (96%)	0.78	41 (8%) 17 16	38, 96, 163, 186	0
All	All	1410/1461 (96%)	0.31	65 (4%) 38 36	25, 65, 145, 186	1 (0%)

The worst 5 of 65 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	350	VAL	3.5
1	B	287	HIS	3.3
1	C	454	LEU	3.1
1	B	497	ASP	3.1
1	C	162	ARG	3.0

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

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

6.3 Carbohydrates [i](#)

There are no monosaccharides in this entry.

6.4 Ligands [i](#)

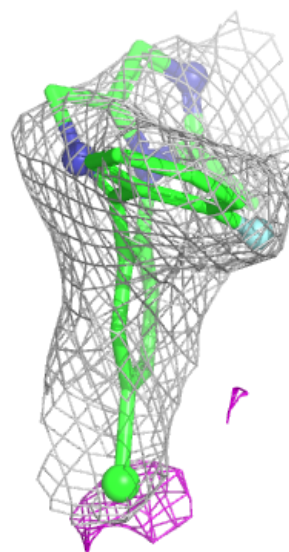
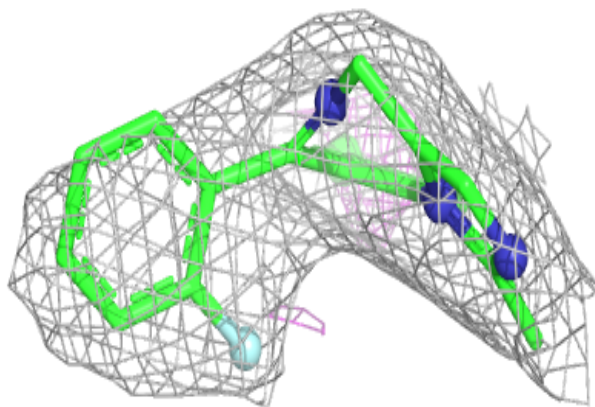
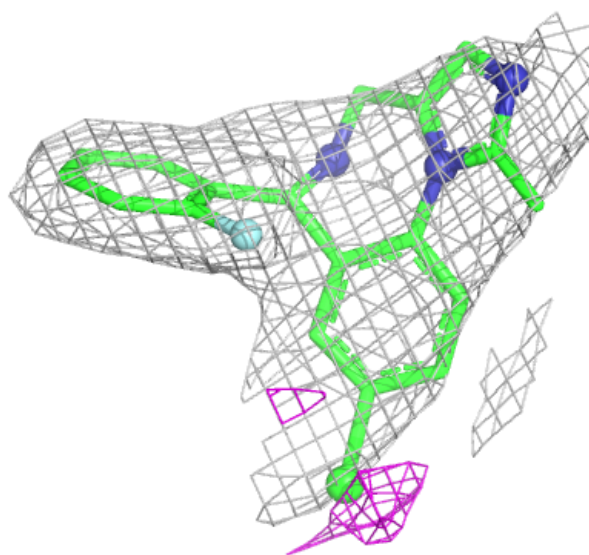
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q < 0.9’ lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
3	08J	C	602	23/23	0.85	0.14	73,87,95,115	0
3	08J	A	602	23/23	0.93	0.09	32,34,37,37	0
3	08J	B	602	23/23	0.95	0.07	39,40,42,44	0
2	HEM	C	601	43/43	0.95	0.11	58,62,67,70	0
2	HEM	B	601	43/43	0.97	0.07	29,37,41,45	0
2	HEM	A	601	43/43	0.98	0.06	22,25,30,31	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.

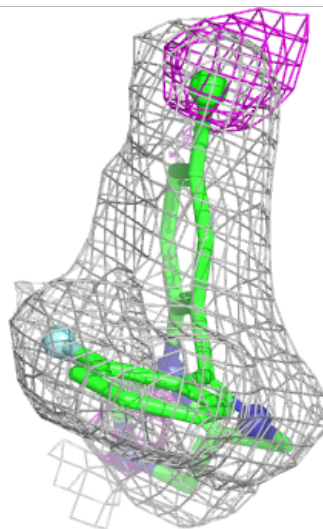
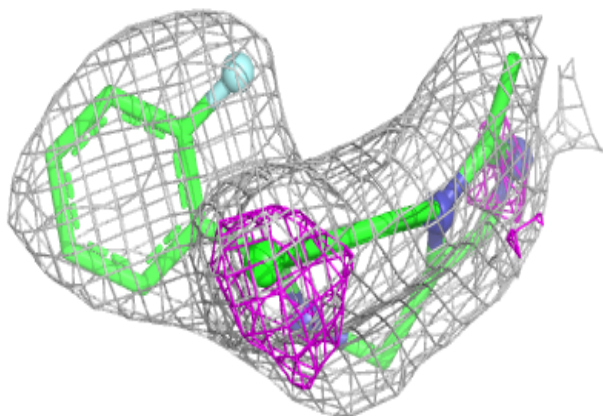
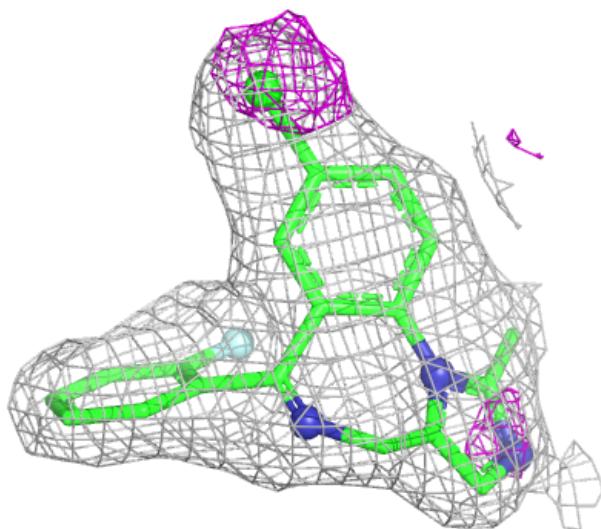
Electron density around 08J C 602:

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



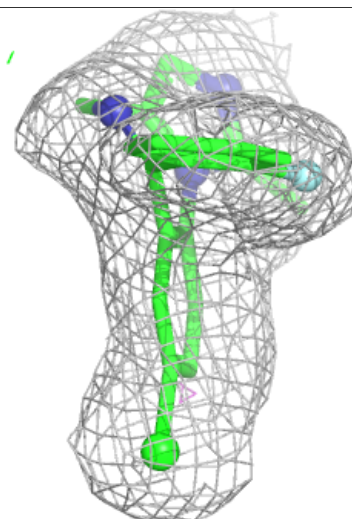
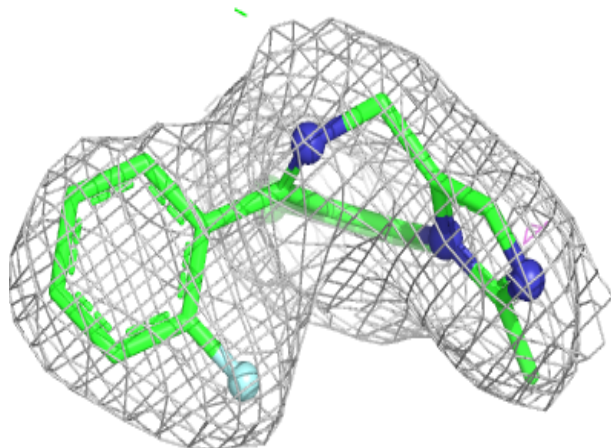
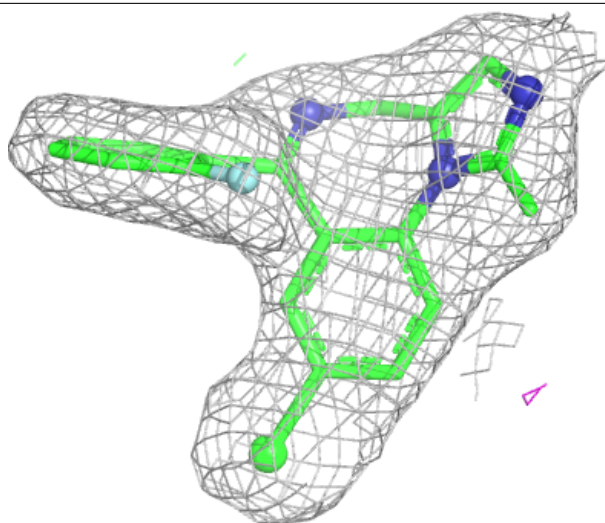
Electron density around 08J A 602:

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



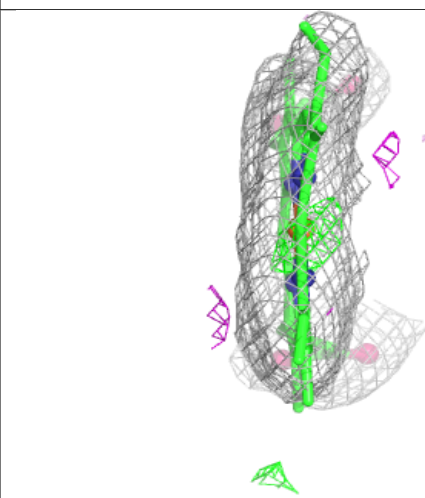
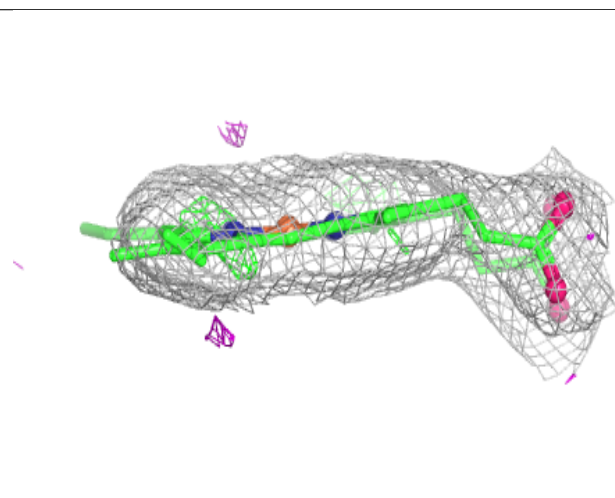
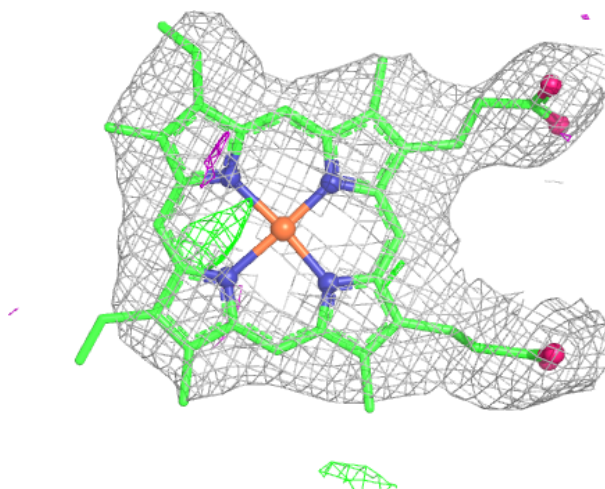
Electron density around 08J B 602:

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



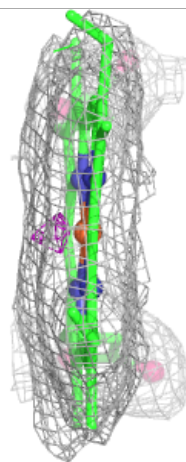
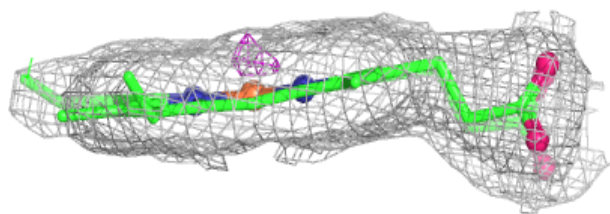
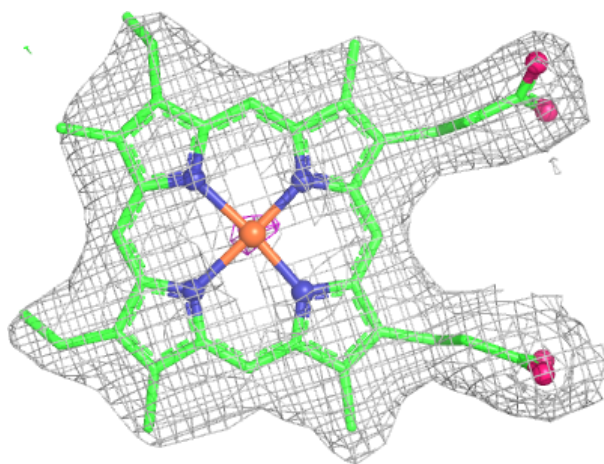
Electron density around HEM C 601:

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



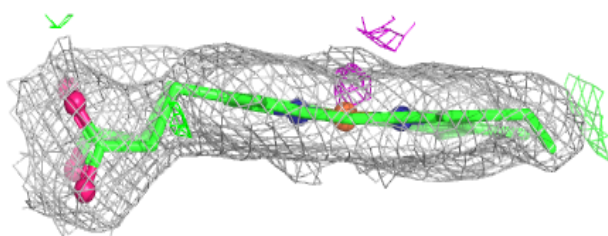
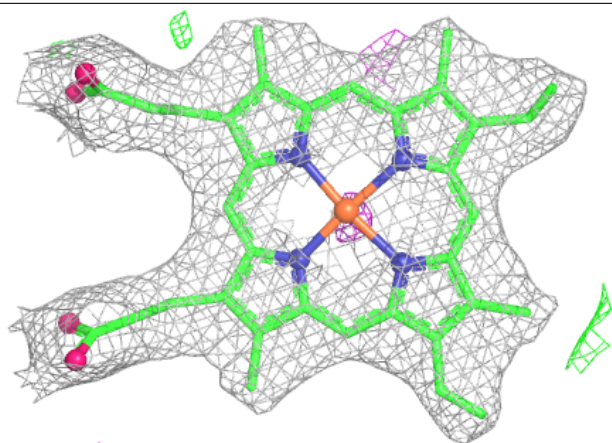
Electron density around HEM B 601:

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



Electron density around HEM A 601:

$2mF_o-DF_c$ (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.