



# wwPDB X-ray Structure Validation Summary Report ⓘ

Dec 20, 2023 – 09:31 AM EST

PDB ID : 2NSI  
Title : HUMAN INDUCIBLE NITRIC OXIDE SYNTHASE, ZN-FREE, SEITU COMPLEX  
Authors : Li, H.; Raman, C.S.; Glaser, C.B.; Blasko, E.; Young, T.A.; Parkinson, J.F.; Whitlow, M.; Poulos, T.L.  
Deposited on : 1999-01-11  
Resolution : 3.00 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](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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)  
Xtrriage (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) : 2.36

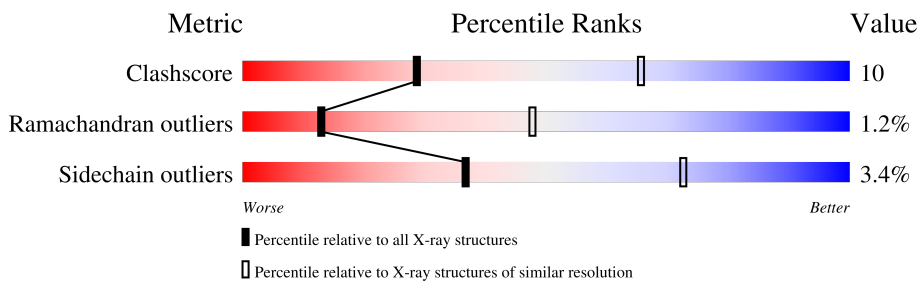
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.00 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	2416 (3.00-3.00)
Ramachandran outliers	138981	2333 (3.00-3.00)
Sidechain outliers	138945	2336 (3.00-3.00)

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  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions  $\leq 5\%$ .

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	431	
1	B	431	
1	C	431	
1	D	431	

## 2 Entry composition [i](#)

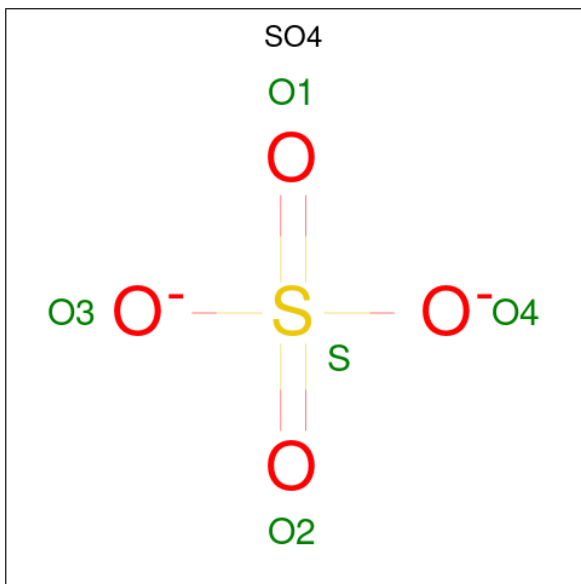
There are 5 unique types of molecules in this entry. The entry contains 13985 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 PROTEIN (NITRIC OXIDE SYNTHASE).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	420	Total 3419	C 2186	N 599	O 612	S 22	0	0	0
1	B	420	Total 3419	C 2186	N 599	O 612	S 22	0	0	0
1	C	420	Total 3419	C 2186	N 599	O 612	S 22	0	0	0
1	D	420	Total 3419	C 2186	N 599	O 612	S 22	0	0	0

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



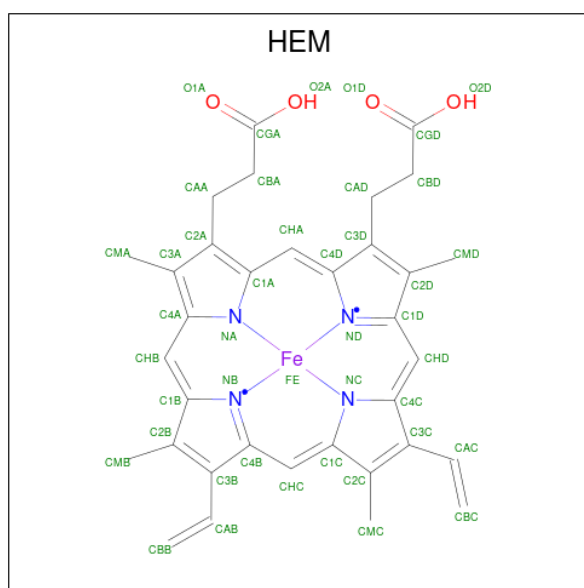
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
2	A	1	Total 5	O 4	S 1	0	0
2	A	1	Total 5	O 4	S 1	0	0

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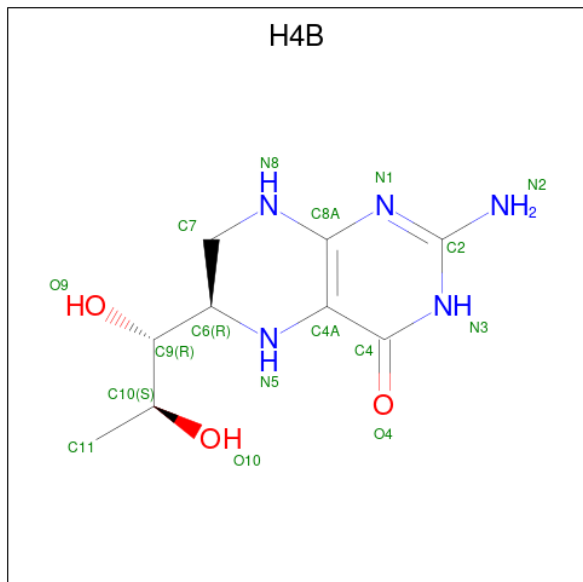
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		
2	C	1	Total	O	S	0	0
			5	4	1		
2	C	1	Total	O	S	0	0
			5	4	1		
2	D	1	Total	O	S	0	0
			5	4	1		
2	D	1	Total	O	S	0	0
			5	4	1		

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



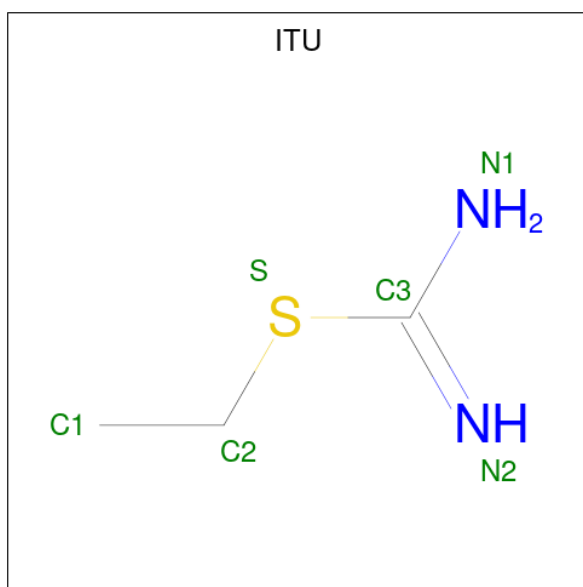
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
3	A	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
3	B	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
3	C	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
3	D	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

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



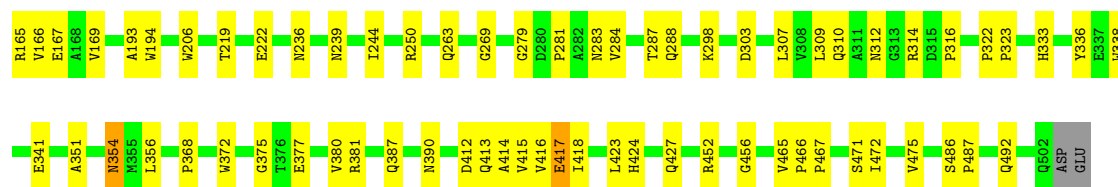
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
4	A	1	Total	C	N	O	0	0
			17	9	5	3		
4	B	1	Total	C	N	O	0	0
			17	9	5	3		
4	C	1	Total	C	N	O	0	0
			17	9	5	3		
4	D	1	Total	C	N	O	0	0
			17	9	5	3		

- Molecule 5 is ETHYLISOTHIOUREA (three-letter code: ITU) (formula:  $C_3H_8N_2S$ ).

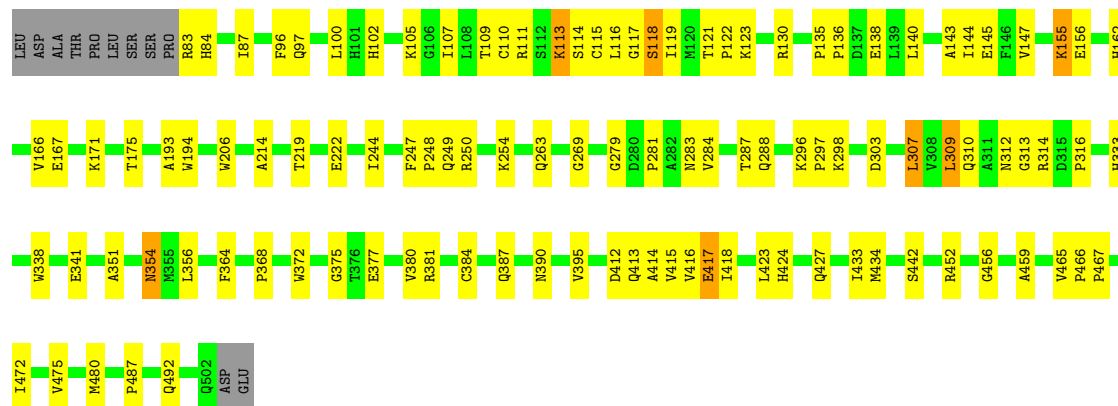


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	N	S	0	0
			6	3	2	1		
5	B	1	Total	C	N	S	0	0
			6	3	2	1		
5	C	1	Total	C	N	S	0	0
			6	3	2	1		
5	D	1	Total	C	N	S	0	0
			6	3	2	1		





● Molecule 1: PROTEIN (NITRIC OXIDE SYNTHASE)





## 4 Data and refinement statistics

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

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	188.37Å 188.37Å 230.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 3.00	Depositor
% Data completeness (in resolution range)	80.8 (30.00-3.00)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.09	Depositor
Refinement program	X-PLOR 3.8	Depositor
R, $R_{free}$	0.214 , 0.238	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	13985	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	58.0	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: ITU, SO4, H4B, 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	0.37	0/3518	0.58	0/4774
1	B	0.37	0/3518	0.59	1/4774 (0.0%)
1	C	0.38	0/3518	0.59	0/4774
1	D	0.37	0/3518	0.58	0/4774
All	All	0.37	0/14072	0.58	1/19096 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	200	CYS	CA-CB-SG	-5.68	103.77	114.00

There are no chirality outliers.

There are no planarity outliers.

### 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	3419	0	3327	71	0
1	B	3419	0	3327	70	0
1	C	3419	0	3327	66	0
1	D	3419	0	3327	73	0
2	A	15	0	0	1	0
2	B	10	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	10	0	0	0	0
2	D	10	0	0	0	0
3	A	43	0	30	1	0
3	B	43	0	30	2	0
3	C	43	0	30	1	0
3	D	43	0	30	1	0
4	A	17	0	15	0	0
4	B	17	0	15	0	0
4	C	17	0	15	0	0
4	D	17	0	15	0	0
5	A	6	0	7	0	0
5	B	6	0	7	0	0
5	C	6	0	7	0	0
5	D	6	0	7	0	0
All	All	13985	0	13516	267	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.

The worst 5 of 267 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:115:CYS:HB2	1:B:110:CYS:SG	2.11	0.91
1:A:110:CYS:SG	1:B:115:CYS:HB2	2.17	0.85
1:B:83:ARG:HB3	1:B:102:HIS:HE1	1.45	0.80
1:D:83:ARG:HB3	1:D:102:HIS:HE1	1.45	0.80
1:C:83:ARG:HB3	1:C:102:HIS:HE1	1.46	0.79

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	418/431 (97%)	392 (94%)	21 (5%)	5 (1%)	13	48
1	B	418/431 (97%)	387 (93%)	26 (6%)	5 (1%)	13	48
1	C	418/431 (97%)	389 (93%)	24 (6%)	5 (1%)	13	48
1	D	418/431 (97%)	390 (93%)	23 (6%)	5 (1%)	13	48
All	All	1672/1724 (97%)	1558 (93%)	94 (6%)	20 (1%)	13	48

5 of 20 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	118	SER
1	B	118	SER
1	C	118	SER
1	D	118	SER
1	A	114	SER

### 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	366/376 (97%)	353 (96%)	13 (4%)	35	70
1	B	366/376 (97%)	354 (97%)	12 (3%)	38	73
1	C	366/376 (97%)	355 (97%)	11 (3%)	41	75
1	D	366/376 (97%)	352 (96%)	14 (4%)	33	69
All	All	1464/1504 (97%)	1414 (97%)	50 (3%)	37	72

5 of 50 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	155	LYS
1	C	417	GLU
1	D	442	SER
1	C	156	GLU
1	C	307	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 56 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	502	GLN
1	D	502	GLN
1	C	249	GLN
1	D	482	ASN
1	D	354	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](#)

21 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	$\# Z  > 2$
4	H4B	A	600	-	16,18,18	1.82	3 (18%)	11,26,26	4.27	9 (81%)
3	HEM	B	550	1	41,50,50	1.47	3 (7%)	45,82,82	1.24	3 (6%)
2	SO4	B	911	-	4,4,4	0.73	0	6,6,6	0.41	0
2	SO4	B	921	-	4,4,4	0.67	0	6,6,6	0.46	0
2	SO4	A	920	-	4,4,4	0.69	0	6,6,6	0.40	0
3	HEM	C	550	1	41,50,50	1.34	4 (9%)	45,82,82	1.37	6 (13%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	SO4	A	930	-	4,4,4	0.64	0	6,6,6	0.39	0
2	SO4	C	912	-	4,4,4	0.69	0	6,6,6	0.44	0
5	ITU	C	802	-	4,5,5	0.98	0	4,5,5	2.65	1 (25%)
2	SO4	A	910	-	4,4,4	0.79	0	6,6,6	0.41	0
2	SO4	C	922	-	4,4,4	0.65	0	6,6,6	0.36	0
2	SO4	D	913	-	4,4,4	0.73	0	6,6,6	0.38	0
3	HEM	A	550	1	41,50,50	1.29	3 (7%)	45,82,82	1.24	2 (4%)
5	ITU	A	800	-	4,5,5	0.97	0	4,5,5	2.87	1 (25%)
4	H4B	C	602	-	16,18,18	1.79	3 (18%)	11,26,26	4.26	9 (81%)
5	ITU	D	803	-	4,5,5	0.96	0	4,5,5	2.52	1 (25%)
4	H4B	D	603	-	16,18,18	1.87	4 (25%)	11,26,26	4.30	9 (81%)
2	SO4	D	923	-	4,4,4	0.69	0	6,6,6	0.38	0
3	HEM	D	550	1	41,50,50	1.27	3 (7%)	45,82,82	1.20	4 (8%)
4	H4B	B	601	-	16,18,18	1.90	4 (25%)	11,26,26	4.27	9 (81%)
5	ITU	B	801	-	4,5,5	0.93	0	4,5,5	2.36	1 (25%)

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	A	600	-	-	0/8/17/17	0/2/2/2
3	HEM	C	550	1	-	2/12/54/54	-
3	HEM	A	550	1	-	2/12/54/54	-
3	HEM	D	550	1	-	2/12/54/54	-
5	ITU	A	800	-	-	3/3/3/3	-
4	H4B	C	602	-	-	0/8/17/17	0/2/2/2
3	HEM	B	550	1	-	2/12/54/54	-
5	ITU	D	803	-	-	2/3/3/3	-
5	ITU	B	801	-	-	3/3/3/3	-
4	H4B	B	601	-	-	0/8/17/17	0/2/2/2
5	ITU	C	802	-	-	3/3/3/3	-
4	H4B	D	603	-	-	0/8/17/17	0/2/2/2

The worst 5 of 27 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	D	603	H4B	C4-N3	4.35	1.40	1.33
4	B	601	H4B	C4-N3	4.20	1.40	1.33
3	B	550	HEM	C3C-C2C	-4.19	1.34	1.40
4	D	603	H4B	C4A-N5	4.00	1.46	1.38
3	A	550	HEM	C3C-CAC	-3.97	1.39	1.47

The worst 5 of 55 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	601	H4B	C8A-C4A-C4	9.04	122.60	114.57
4	D	603	H4B	C8A-C4A-C4	8.90	122.47	114.57
4	A	600	H4B	C8A-C4A-C4	8.90	122.47	114.57
4	C	602	H4B	C8A-C4A-C4	8.79	122.38	114.57
4	C	602	H4B	C2-N3-C4	6.06	125.56	115.93

There are no chirality outliers.

5 of 19 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	550	HEM	C2B-C3B-CAB-CBB
3	A	550	HEM	C4B-C3B-CAB-CBB
3	B	550	HEM	C2B-C3B-CAB-CBB
3	B	550	HEM	C4B-C3B-CAB-CBB
3	C	550	HEM	C2B-C3B-CAB-CBB

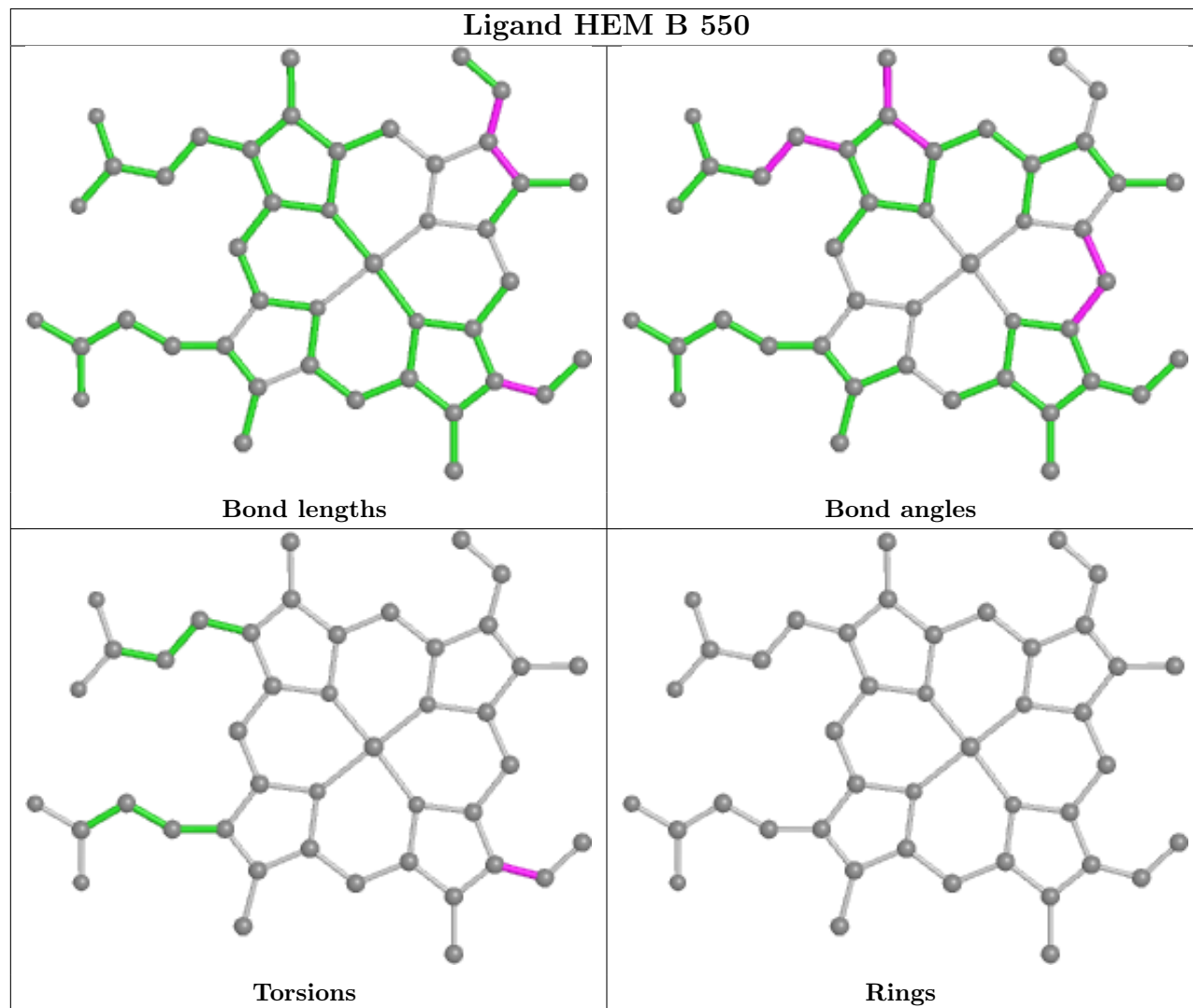
There are no ring outliers.

5 monomers are involved in 6 short contacts:

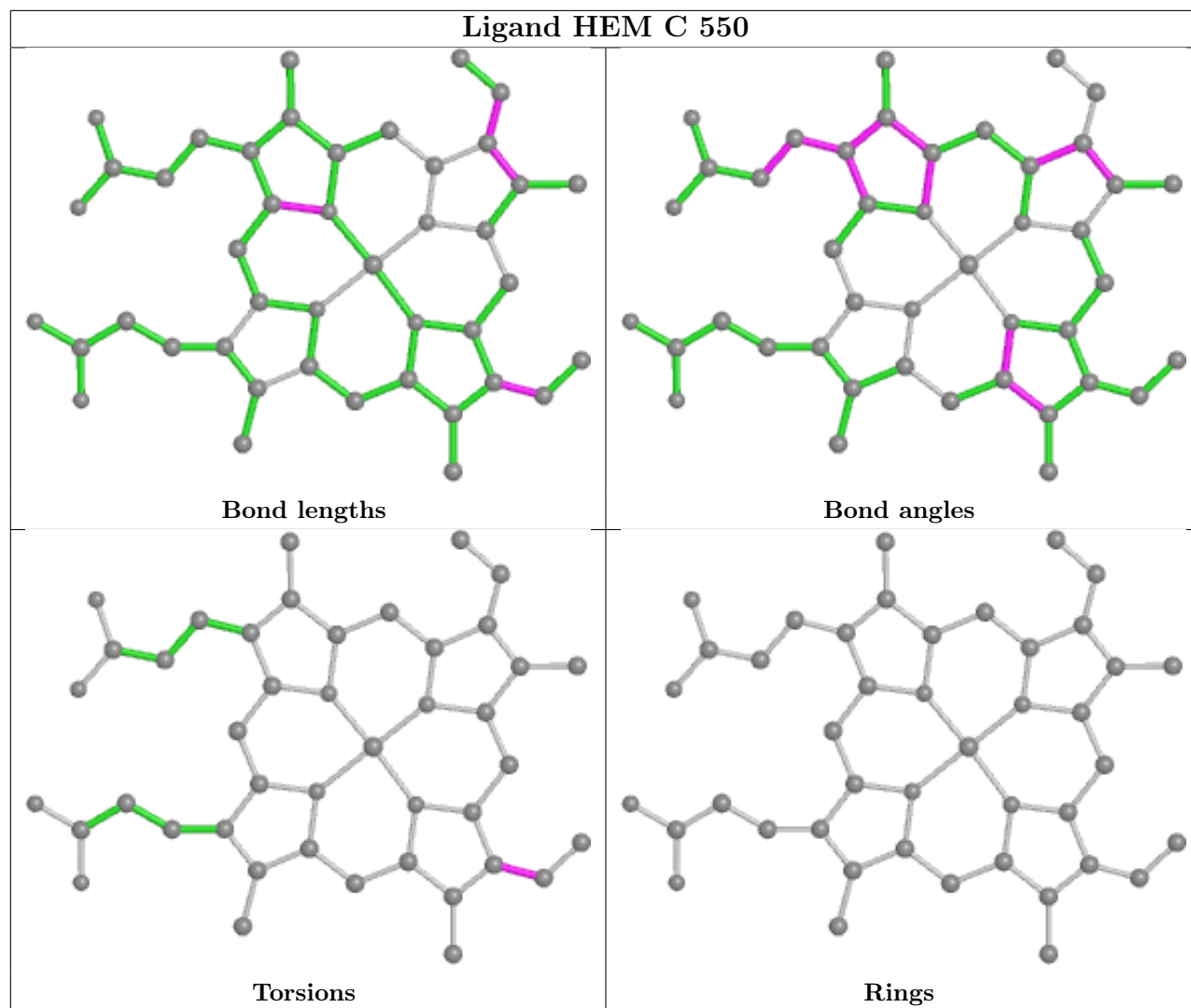
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	550	HEM	2	0
3	C	550	HEM	1	0
2	A	930	SO4	1	0
3	A	550	HEM	1	0
3	D	550	HEM	1	0

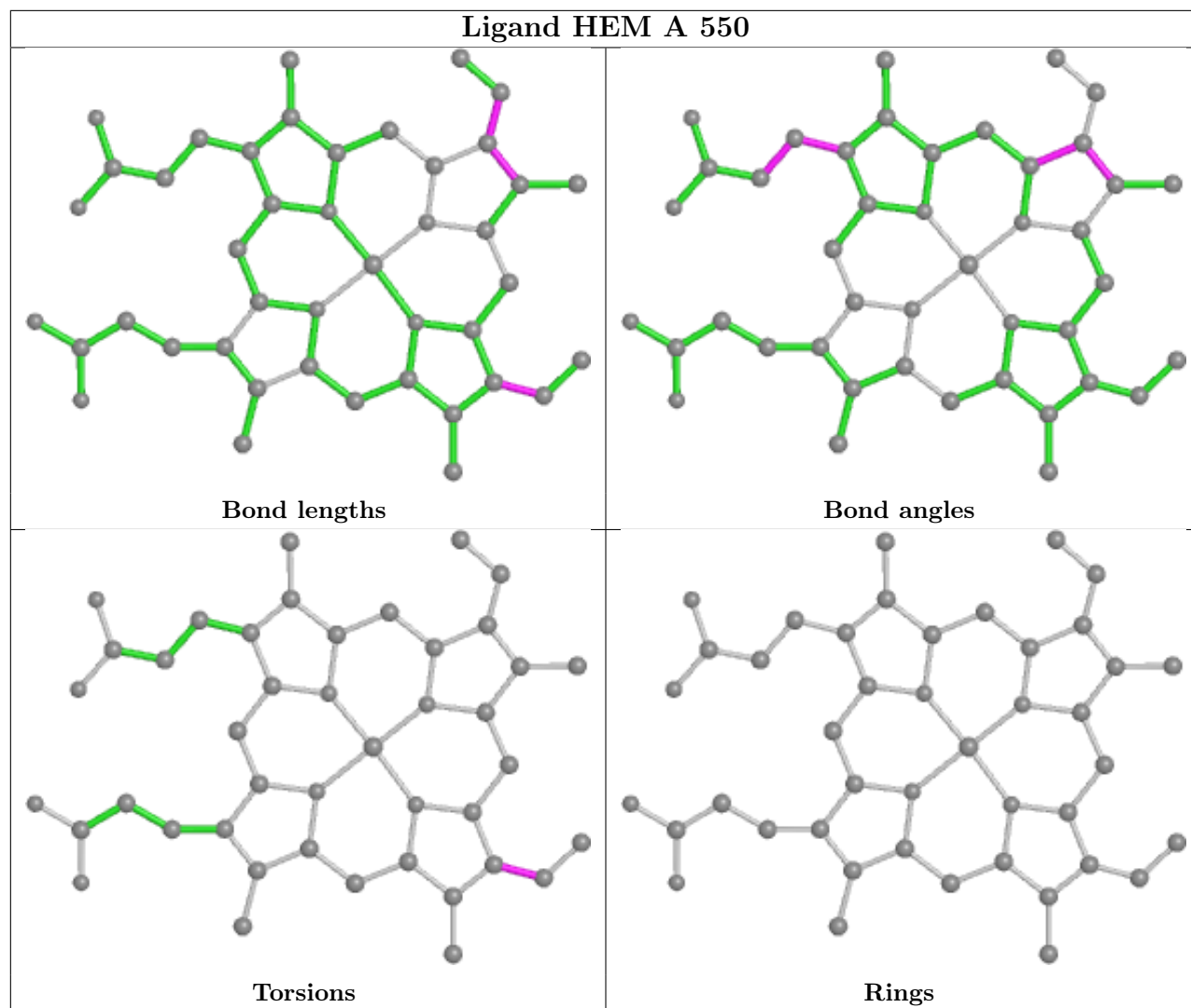
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

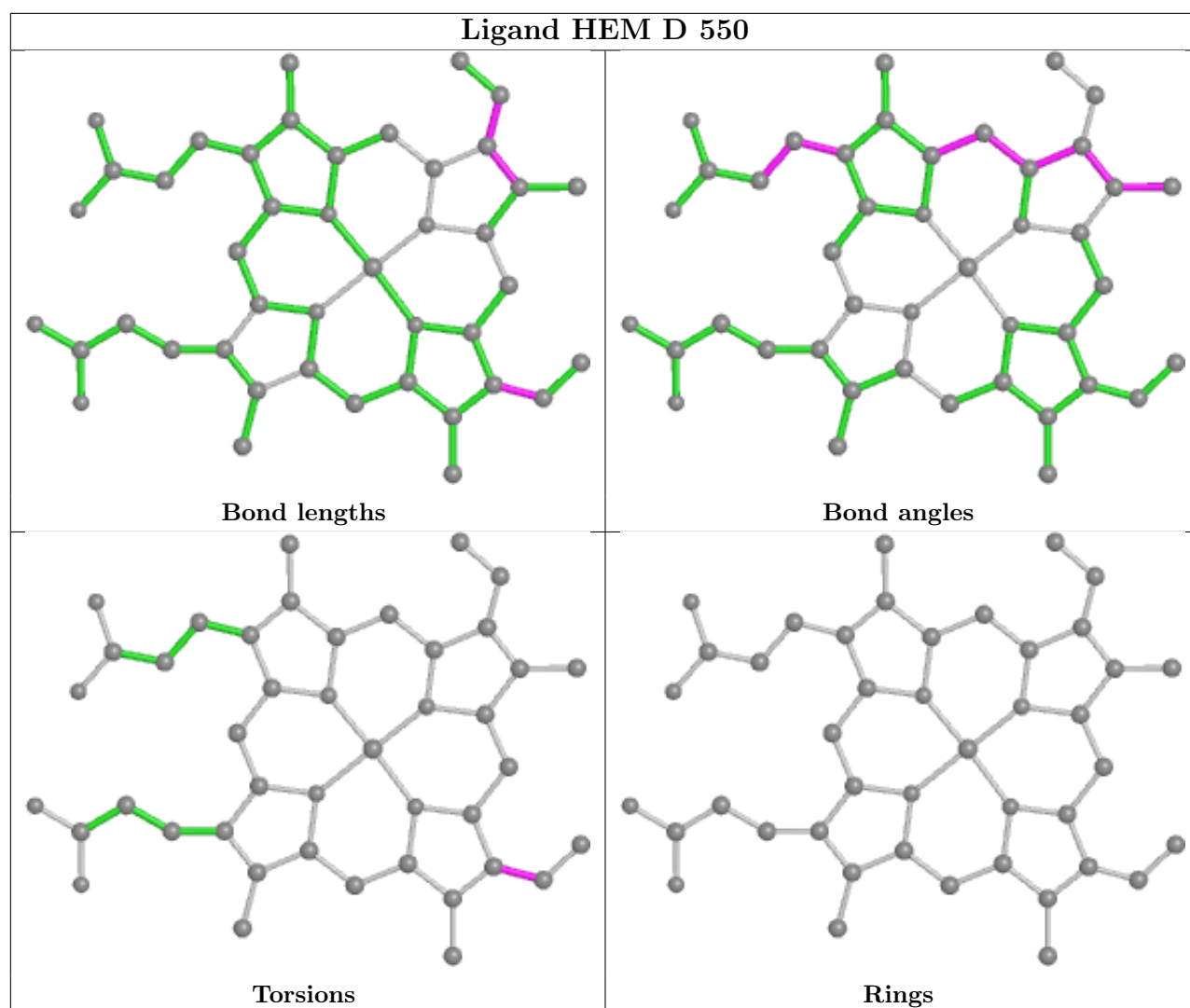
in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers 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.