



# Full wwPDB X-ray Structure Validation Report ⓘ

Dec 19, 2023 – 03:32 PM EST

PDB ID : 1J3Y  
Title : Direct observation of photolysis-induced tertiary structural changes in human hemoglobin; Crystal structure of alpha(Fe)-beta(Ni) hemoglobin (laser photolysed)  
Authors : Adachi, S.; Park, S.-Y.; Tame, J.R.H.; Shiro, Y.; Shibayama, N.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)  
Deposited on : 2003-02-21  
Resolution : 1.55 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](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

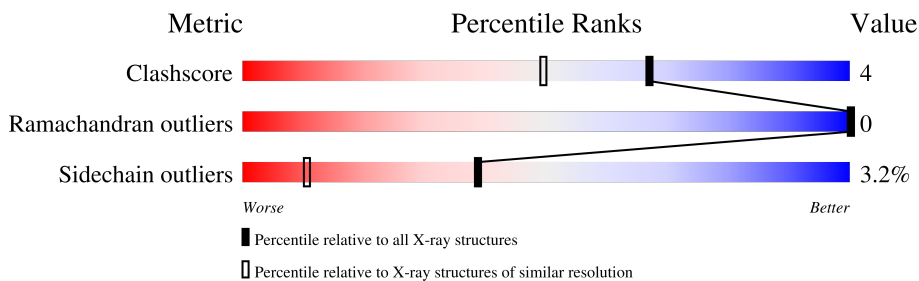
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.55 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	1529 (1.56-1.56)
Ramachandran outliers	138981	1498 (1.56-1.56)
Sidechain outliers	138945	1495 (1.56-1.56)

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	141	93% 7%
1	C	141	96% ..
1	E	141	84% 15% ..
1	G	141	90% 10%
2	B	146	90% 9% .
2	D	146	92% 8% .
2	F	146	88% 10% .
2	H	146	91% 8% .

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:

<b>Mol</b>	<b>Type</b>	<b>Chain</b>	<b>Res</b>	<b>Chirality</b>	<b>Geometry</b>	<b>Clashes</b>	<b>Electron density</b>
5	HNI	B	147	X	-	-	-
5	HNI	D	147	X	-	-	-
5	HNI	F	147	X	-	-	-
5	HNI	H	147	X	-	-	-

## 2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 11404 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Hemoglobin alpha Chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	141	1069	685	187	194	3	0	0	0
1	C	141	1069	685	187	194	3	0	0	0
1	E	141	1069	685	187	194	3	0	0	0
1	G	141	1069	685	187	194	3	0	0	0

- Molecule 2 is a protein called Hemoglobin beta Chain.

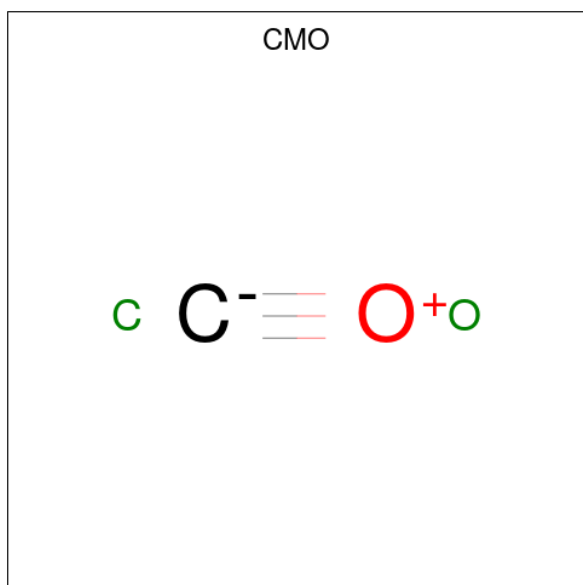
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	146	1123	724	195	201	3	0	0	0
2	D	146	1123	724	195	201	3	0	0	0
2	F	146	1123	724	195	201	3	0	0	0
2	H	146	1123	724	195	201	3	0	0	0

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



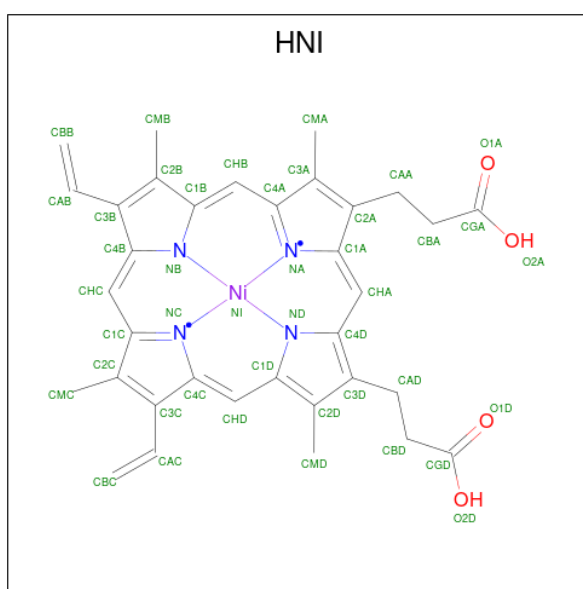
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
			Total	C	Fe	N			O
3	A	1	43	34	1	4	4	0	0
3	C	1	43	34	1	4	4	0	0
3	E	1	43	34	1	4	4	0	0
3	G	1	43	34	1	4	4	0	0

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



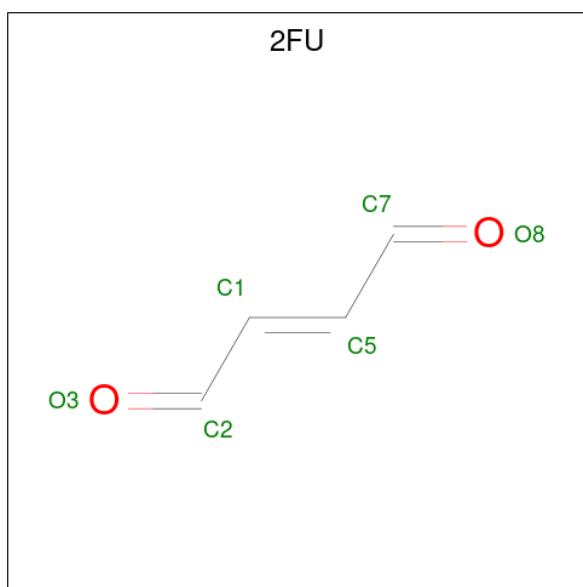
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			2	1	1		
4	C	1	Total	C	O	0	0
			2	1	1		
4	E	1	Total	C	O	0	0
			2	1	1		
4	G	1	Total	C	O	0	0
			2	1	1		

- Molecule 5 is PROTOPORPHYRIN IX CONTAINING NI(II) (three-letter code: HNI) (formula:  $C_{34}H_{32}N_4NiO_4$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
5	B	1	Total	C	N	Ni	O	0	0
			43	34	4	1	4		
5	D	1	Total	C	N	Ni	O	0	0
			43	34	4	1	4		
5	F	1	Total	C	N	Ni	O	0	0
			43	34	4	1	4		
5	H	1	Total	C	N	Ni	O	0	0
			43	34	4	1	4		

- Molecule 6 is BUT-2-ENEDIAL (three-letter code: 2FU) (formula:  $C_4H_4O_2$ ).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	D	1	Total C O 6 4 2	0	0
6	F	1	Total C O 6 4 2	0	0

- Molecule 7 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	A	286	Total O 286 286	0	0
7	B	267	Total O 267 267	0	0
7	C	274	Total O 274 274	0	0
7	D	303	Total O 303 303	0	0
7	E	298	Total O 298 298	0	0
7	F	305	Total O 305 305	0	0
7	G	285	Total O 285 285	0	0
7	H	254	Total O 254 254	0	0

### 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.

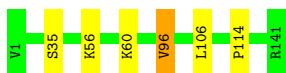
- Molecule 1: Hemoglobin alpha Chain

Chain A:  93% 7%




- Molecule 1: Hemoglobin alpha Chain

Chain C:  96% ..




- Molecule 1: Hemoglobin alpha Chain

Chain E:  84% 15% ..



- Molecule 1: Hemoglobin alpha Chain

Chain G:  90% 10%



- Molecule 2: Hemoglobin beta Chain

Chain B:  90% 9% .




- Molecule 2: Hemoglobin beta Chain



Chain D:  92% 8%




● Molecule 2: Hemoglobin beta Chain

Chain F:  88% 10%



● Molecule 2: Hemoglobin beta Chain

Chain H:  91% 8%



## 4 Data and refinement statistics

Xtrriage (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, $\alpha$ , $\beta$ , $\gamma$	64.49Å 94.01Å 100.11Å 90.00° 101.65° 90.00°	Depositor
Resolution (Å)	19.61 – 1.55	Depositor
% Data completeness (in resolution range)	90.7 (19.61-1.55)	Depositor
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	REFMAC 5.1.19	Depositor
R, $R_{free}$	0.162 , 0.205	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	11404	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	16.0	wwPDB-VP

## 5 Model quality i

### 5.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section: CMO, HNI, 2FU, 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	0.50	0/1097	0.71	1/1491 (0.1%)
1	C	0.55	0/1097	0.74	1/1491 (0.1%)
1	E	0.56	0/1097	0.77	4/1491 (0.3%)
1	G	0.56	0/1097	0.75	1/1491 (0.1%)
2	B	0.58	0/1153	0.76	1/1566 (0.1%)
2	D	0.56	0/1153	0.71	1/1566 (0.1%)
2	F	0.59	0/1153	0.77	3/1566 (0.2%)
2	H	0.57	0/1153	0.78	2/1566 (0.1%)
All	All	0.56	0/9000	0.75	14/12228 (0.1%)

There are no bond length outliers.

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	134	VAL	CG1-CB-CG2	6.70	121.61	110.90
2	F	68	LEU	CB-CG-CD2	6.14	121.44	111.00
1	E	126	ASP	CB-CG-OD2	5.82	123.54	118.30
2	H	134	VAL	CG1-CB-CG2	5.77	120.13	110.90
1	E	94	ASP	CB-CG-OD2	5.72	123.45	118.30
1	A	47	ASP	CB-CG-OD2	5.52	123.26	118.30
1	C	96	VAL	CG1-CB-CG2	5.50	119.70	110.90
2	H	99	ASP	CB-CG-OD1	5.39	123.15	118.30
2	D	94	ASP	CB-CG-OD2	5.37	123.13	118.30
2	F	32	LEU	CB-CG-CD2	5.15	119.76	111.00
1	E	105	LEU	CA-CB-CG	5.07	126.95	115.30
1	E	105	LEU	CB-CG-CD1	5.03	119.55	111.00
2	F	94	ASP	CB-CG-OD2	5.03	122.83	118.30
1	G	85	ASP	CB-CG-OD2	5.00	122.80	118.30

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	1069	0	1073	6	0
1	C	1069	0	1073	6	0
1	E	1069	0	1073	11	0
1	G	1069	0	1073	11	0
2	B	1123	0	1115	11	0
2	D	1123	0	1116	11	0
2	F	1123	0	1116	12	0
2	H	1123	0	1115	8	0
3	A	43	0	30	0	0
3	C	43	0	30	0	0
3	E	43	0	30	0	0
3	G	43	0	30	1	0
4	A	2	0	0	0	0
4	C	2	0	0	0	0
4	E	2	0	0	0	0
4	G	2	0	0	1	0
5	B	43	0	30	2	0
5	D	43	0	30	0	0
5	F	43	0	30	1	0
5	H	43	0	30	0	0
6	D	6	0	2	0	0
6	F	6	0	2	0	0
7	A	286	0	0	4	0
7	B	267	0	0	4	0
7	C	274	0	0	5	0
7	D	303	0	0	4	0
7	E	298	0	0	3	0
7	F	305	0	0	3	0
7	G	285	0	0	6	0
7	H	254	0	0	1	0
All	All	11404	0	8998	71	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 (71) 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:E:113:LEU:HB3	1:E:116:GLU:HG2	1.66	0.78
1:G:78:ASN:HB3	7:G:6416:HOH:O	1.86	0.74
2:F:77:HIS:HE1	7:F:3144:HOH:O	1.75	0.68
2:B:143:HIS:HD2	2:B:144:LYS:NZ	1.93	0.66
2:F:143:HIS:HD2	2:F:144:LYS:NZ	1.94	0.65
2:H:4:THR:HG22	2:H:7:GLU:H	1.63	0.63
2:B:117:HIS:HE1	7:B:205:HOH:O	1.82	0.62
1:C:114:PRO:O	2:D:116:HIS:HE1	1.81	0.62
1:A:49:SER:HB3	7:A:3402:HOH:O	1.99	0.62
2:H:4:THR:CG2	2:H:6:GLU:HG2	2.29	0.62
2:D:4:THR:HG21	7:D:3278:HOH:O	2.00	0.62
2:B:61:LYS:HE3	7:B:244:HOH:O	2.00	0.61
1:C:56:LYS:HD2	7:C:4234:HOH:O	2.00	0.61
2:B:143:HIS:HD2	2:B:144:LYS:HZ2	1.47	0.61
2:H:61:LYS:HE2	7:H:318:HOH:O	2.02	0.59
1:E:60:LYS:HE2	7:E:5295:HOH:O	2.04	0.57
1:A:113:LEU:HB3	1:A:116:GLU:HB2	1.87	0.56
2:D:97:HIS:HD2	7:D:3285:HOH:O	1.89	0.56
2:B:43:GLU:HG2	7:C:4407:HOH:O	2.05	0.56
1:C:56:LYS:HE3	7:C:4390:HOH:O	2.06	0.55
2:H:4:THR:HG23	2:H:6:GLU:HG2	1.89	0.53
1:G:35:SER:HB3	2:H:131:GLN:HG3	1.91	0.53
2:F:21:ASP:OD1	2:F:65:LYS:HG3	2.08	0.52
2:F:143:HIS:HD2	2:F:144:LYS:HZ2	1.56	0.52
2:B:77:HIS:HE1	7:B:257:HOH:O	1.93	0.52
2:D:4:THR:HG22	2:D:7:GLU:H	1.76	0.50
1:G:56:LYS:HE3	7:G:6411:HOH:O	2.12	0.49
1:G:56:LYS:HG3	7:G:6217:HOH:O	2.11	0.48
1:A:80:LEU:HD23	7:A:3401:HOH:O	2.14	0.47
1:A:60:LYS:HD3	7:A:3280:HOH:O	2.14	0.47
1:E:28:ALA:CB	1:E:105:LEU:HD13	2.45	0.47
2:F:53:ALA:O	2:F:57:ASN:HB2	2.14	0.47
1:A:85:ASP:OD1	1:A:139:LYS:HD3	2.14	0.47
1:G:96:VAL:HG22	7:G:6229:HOH:O	2.14	0.47
1:E:14:TRP:O	1:E:17:VAL:HB	2.15	0.47
1:E:76:MET:N	1:E:77:PRO:CD	2.78	0.47
1:A:89:HIS:HE1	7:A:3356:HOH:O	1.97	0.46
2:D:4:THR:CG2	2:D:7:GLU:H	2.28	0.46
1:G:29:LEU:HD21	4:G:6143:CMO:C	2.46	0.46
1:E:35:SER:HB3	2:F:131:GLN:HG3	1.98	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:F:91:LEU:HD21	5:F:147:HNI:HBA2	1.98	0.45
1:C:56:LYS:HG3	7:C:4246:HOH:O	2.16	0.45
1:G:90:LYS:HD2	7:G:6294:HOH:O	2.17	0.45
1:E:54:GLN:NE2	7:E:5361:HOH:O	2.36	0.45
2:F:143:HIS:CD2	2:F:144:LYS:NZ	2.82	0.44
7:C:4158:HOH:O	2:D:120:LYS:HG3	2.16	0.44
1:E:101:LEU:HG	1:E:105:LEU:HD22	1.99	0.43
1:G:14:TRP:O	1:G:17:VAL:HB	2.18	0.43
7:F:3249:HOH:O	2:H:1:VAL:HG21	2.18	0.43
1:C:114:PRO:O	2:D:116:HIS:CE1	2.67	0.43
2:D:4:THR:HG23	2:D:6:GLU:H	1.82	0.43
1:C:35:SER:HB3	2:D:131:GLN:HG3	2.01	0.43
1:G:39:THR:HG22	1:G:97:ASN:HD22	1.84	0.43
1:G:58:HIS:CE1	3:G:142:HEM:HBD2	2.54	0.43
2:F:143:HIS:CD2	2:F:144:LYS:HZ2	2.36	0.43
2:H:4:THR:HG21	2:H:6:GLU:HG2	2.00	0.43
2:F:143:HIS:HD2	2:F:144:LYS:HZ1	1.66	0.42
2:B:143:HIS:CD2	2:B:144:LYS:HZ2	2.31	0.42
2:F:146:HIS:NE2	7:F:3240:HOH:O	2.37	0.42
2:B:53:ALA:O	2:B:57:ASN:HB2	2.20	0.42
2:B:104:ARG:NH2	7:B:316:HOH:O	2.53	0.41
2:B:63:HIS:CE1	5:B:147:HNI:HBD2	2.55	0.41
2:F:104:ARG:HH21	2:F:139:ASN:HD22	1.69	0.41
2:H:4:THR:HG23	2:H:6:GLU:H	1.84	0.41
1:E:68:ASN:O	1:E:72:HIS:HD2	2.04	0.41
1:E:10:VAL:HG21	1:E:128:PHE:HB2	2.02	0.41
2:D:97:HIS:HE1	7:D:3044:HOH:O	2.04	0.41
1:E:56:LYS:HG2	7:E:5268:HOH:O	2.20	0.41
2:B:70:ALA:HB3	5:B:147:HNI:HMB3	2.02	0.40
1:G:74:ASP:HB2	7:G:6322:HOH:O	2.20	0.40
2:D:116:HIS:HD2	7:D:3032:HOH:O	2.05	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	139/141 (99%)	138 (99%)	1 (1%)	0	100	100
1	C	139/141 (99%)	136 (98%)	3 (2%)	0	100	100
1	E	139/141 (99%)	138 (99%)	1 (1%)	0	100	100
1	G	139/141 (99%)	136 (98%)	3 (2%)	0	100	100
2	B	144/146 (99%)	142 (99%)	2 (1%)	0	100	100
2	D	144/146 (99%)	142 (99%)	2 (1%)	0	100	100
2	F	144/146 (99%)	142 (99%)	2 (1%)	0	100	100
2	H	144/146 (99%)	142 (99%)	2 (1%)	0	100	100
All	All	1132/1148 (99%)	1116 (99%)	16 (1%)	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	113/113 (100%)	112 (99%)	1 (1%)	78	61
1	C	113/113 (100%)	110 (97%)	3 (3%)	44	15
1	E	113/113 (100%)	107 (95%)	6 (5%)	22	3
1	G	113/113 (100%)	112 (99%)	1 (1%)	78	61
2	B	118/118 (100%)	115 (98%)	3 (2%)	47	18
2	D	118/118 (100%)	113 (96%)	5 (4%)	30	5
2	F	118/118 (100%)	114 (97%)	4 (3%)	37	9
2	H	118/118 (100%)	111 (94%)	7 (6%)	19	2
All	All	924/924 (100%)	894 (97%)	30 (3%)	39	10

All (30) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	16	LYS
2	B	2	HIS
2	B	78	LEU
2	B	134	VAL
1	C	60	LYS
1	C	96	VAL
1	C	106	LEU
2	D	14	LEU
2	D	68	LEU
2	D	78	LEU
2	D	120	LYS
2	D	139	ASN
1	E	16	LYS
1	E	52	SER
1	E	83	LEU
1	E	99	LYS
1	E	105	LEU
1	E	116	GLU
2	F	68	LEU
2	F	78	LEU
2	F	133	VAL
2	F	146	HIS
1	G	106	LEU
2	H	4	THR
2	H	14	LEU
2	H	78	LEU
2	H	88	LEU
2	H	95	LYS
2	H	134	VAL
2	H	143	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (23) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	9	ASN
1	A	89	HIS
1	A	97	ASN
2	B	77	HIS
2	B	102	ASN
2	B	117	HIS
2	B	143	HIS
1	C	97	ASN
2	D	97	HIS

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Mol	Chain	Res	Type
2	D	102	ASN
2	D	116	HIS
1	E	9	ASN
1	E	68	ASN
1	E	72	HIS
1	E	97	ASN
2	F	77	HIS
2	F	102	ASN
2	F	139	ASN
2	F	143	HIS
1	G	97	ASN
2	H	77	HIS
2	H	102	ASN
2	H	139	ASN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

### 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

14 ligands are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
3	HEM	A	142	1	41,50,50	1.92	9 (21%)	45,82,82	1.93	10 (22%)
4	CMO	G	6143	-	0,1,1	-	-	-	-	-
4	CMO	C	4143	-	0,1,1	-	-	-	-	-
5	HNI	D	147	2	47,50,50	1.38	6 (12%)	56,82,82	1.01	2 (3%)
5	HNI	B	147	2	47,50,50	1.54	8 (17%)	56,82,82	1.06	3 (5%)
4	CMO	E	5143	-	0,1,1	-	-	-	-	-
6	2FU	D	3001	2	5,5,5	0.69	0	4,4,4	1.46	0
5	HNI	H	147	2	47,50,50	1.38	6 (12%)	56,82,82	0.98	1 (1%)
6	2FU	F	3002	2	5,5,5	0.59	0	4,4,4	1.65	1 (25%)
3	HEM	E	142	1	41,50,50	1.82	6 (14%)	45,82,82	1.77	10 (22%)
4	CMO	A	3143	-	0,1,1	-	-	-	-	-
5	HNI	F	147	2	47,50,50	1.49	10 (21%)	56,82,82	1.00	4 (7%)
3	HEM	G	142	1	41,50,50	1.78	6 (14%)	45,82,82	1.67	9 (20%)
3	HEM	C	142	1	41,50,50	1.87	7 (17%)	45,82,82	1.84	11 (24%)

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. '2' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	HEM	A	142	1	-	4/12/54/54	-
5	HNI	D	147	2	1/1/3/9	2/14/54/54	-
5	HNI	B	147	2	1/1/3/9	4/14/54/54	-
6	2FU	D	3001	2	-	2/3/3/3	-
5	HNI	H	147	2	1/1/3/9	4/14/54/54	-
6	2FU	F	3002	2	-	2/3/3/3	-
3	HEM	E	142	1	-	4/12/54/54	-
5	HNI	F	147	2	1/1/3/9	4/14/54/54	-
3	HEM	G	142	1	-	4/12/54/54	-
3	HEM	C	142	1	-	2/12/54/54	-

All (58) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	142	HEM	C3D-C2D	7.15	1.51	1.36
3	C	142	HEM	C3D-C2D	7.12	1.51	1.36
3	G	142	HEM	C3D-C2D	6.80	1.51	1.36

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	E	142	HEM	C3D-C2D	6.71	1.51	1.36
5	B	147	HNI	NI-NC	4.82	2.04	1.91
5	F	147	HNI	NI-NC	4.34	2.03	1.91
5	H	147	HNI	NI-NC	4.27	2.02	1.91
3	A	142	HEM	C3C-CAC	3.98	1.56	1.47
5	D	147	HNI	NI-NC	3.86	2.01	1.91
5	F	147	HNI	NI-NA	3.74	2.01	1.91
5	B	147	HNI	NI-NA	3.70	2.01	1.91
3	C	142	HEM	C3C-C2C	-3.64	1.35	1.40
3	E	142	HEM	C3C-C2C	-3.61	1.35	1.40
3	A	142	HEM	FE-NB	3.38	2.13	1.96
3	A	142	HEM	C3C-C2C	-3.37	1.35	1.40
5	D	147	HNI	NI-NA	3.27	2.00	1.91
3	E	142	HEM	C3C-CAC	3.26	1.54	1.47
5	H	147	HNI	NI-NA	3.23	2.00	1.91
3	C	142	HEM	C3C-CAC	3.22	1.54	1.47
3	E	142	HEM	CAB-C3B	3.17	1.56	1.47
5	B	147	HNI	C1D-ND	3.16	1.42	1.36
3	A	142	HEM	FE-ND	2.98	2.11	1.96
5	B	147	HNI	C1B-NB	2.98	1.43	1.38
3	G	142	HEM	C3C-C2C	-2.92	1.36	1.40
3	G	142	HEM	CAA-C2A	2.84	1.56	1.52
3	G	142	HEM	C3C-CAC	2.83	1.53	1.47
3	C	142	HEM	CAA-C2A	2.82	1.56	1.52
3	C	142	HEM	CAB-C3B	2.72	1.54	1.47
3	E	142	HEM	FE-NB	2.68	2.10	1.96
5	F	147	HNI	CHA-C1A	2.65	1.41	1.35
3	E	142	HEM	FE-ND	2.58	2.09	1.96
5	B	147	HNI	C4D-ND	2.50	1.41	1.36
3	G	142	HEM	FE-ND	2.45	2.09	1.96
5	D	147	HNI	C1D-ND	2.44	1.41	1.36
5	F	147	HNI	C1D-ND	2.40	1.41	1.36
3	A	142	HEM	CAB-C3B	2.40	1.54	1.47
5	B	147	HNI	CHA-C1A	2.35	1.41	1.35
3	C	142	HEM	CMD-C2D	2.34	1.55	1.50
5	D	147	HNI	CAB-C3B	-2.33	1.41	1.47
3	G	142	HEM	CAB-C3B	2.27	1.53	1.47
5	F	147	HNI	C1B-NB	2.26	1.42	1.38
5	D	147	HNI	CBC-CAC	2.25	1.41	1.30
3	A	142	HEM	CMD-C2D	2.21	1.55	1.50
5	B	147	HNI	CAB-C3B	-2.15	1.41	1.47
5	H	147	HNI	CAB-C3B	-2.14	1.41	1.47

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	142	HEM	CMB-C2B	2.14	1.55	1.50
5	D	147	HNI	CHA-C1A	2.12	1.40	1.35
5	H	147	HNI	CBC-CAC	2.11	1.40	1.30
5	F	147	HNI	CBC-CAC	2.11	1.40	1.30
5	H	147	HNI	CAC-C3C	-2.10	1.41	1.47
5	B	147	HNI	CBC-CAC	2.10	1.40	1.30
5	F	147	HNI	CMB-C2B	2.10	1.55	1.50
5	F	147	HNI	CAC-C3C	-2.08	1.41	1.47
3	A	142	HEM	C4A-NA	2.07	1.40	1.36
5	F	147	HNI	CBB-CAB	2.03	1.40	1.30
3	A	142	HEM	CAA-C2A	2.01	1.55	1.52
5	F	147	HNI	CAB-C3B	-2.01	1.42	1.47
5	H	147	HNI	C4D-ND	2.00	1.40	1.36

All (51) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	142	HEM	C4D-ND-C1D	6.18	111.45	105.07
3	C	142	HEM	C4D-ND-C1D	5.48	110.74	105.07
3	E	142	HEM	C4D-ND-C1D	5.28	110.53	105.07
3	G	142	HEM	C4D-ND-C1D	4.74	109.97	105.07
3	E	142	HEM	CAA-CBA-CGA	-4.09	102.30	113.76
3	C	142	HEM	CHD-C1D-ND	3.83	128.59	124.43
3	A	142	HEM	C1B-NB-C4B	3.82	109.02	105.07
3	C	142	HEM	CMA-C3A-C4A	-3.79	122.63	128.46
3	A	142	HEM	CBA-CAA-C2A	-3.78	106.16	112.62
3	G	142	HEM	CMA-C3A-C4A	-3.58	122.96	128.46
3	A	142	HEM	C4B-CHC-C1C	3.57	127.27	122.56
3	G	142	HEM	CHD-C1D-ND	3.41	128.14	124.43
3	C	142	HEM	CBA-CAA-C2A	-3.35	106.91	112.62
3	E	142	HEM	C1B-NB-C4B	3.33	108.51	105.07
5	F	147	HNI	CBD-CAD-C3D	-3.26	107.06	112.62
3	A	142	HEM	C4C-CHD-C1D	3.14	126.70	122.56
3	G	142	HEM	CBD-CAD-C3D	-3.07	104.10	112.63
3	A	142	HEM	CAD-CBD-CGD	-2.99	107.17	113.60
3	E	142	HEM	CMA-C3A-C4A	-2.98	123.88	128.46
5	F	147	HNI	C4B-C3B-C2B	-2.73	104.51	106.75
5	H	147	HNI	CBD-CAD-C3D	-2.73	107.96	112.62
3	E	142	HEM	C4C-CHD-C1D	2.71	126.14	122.56
3	A	142	HEM	CAD-C3D-C4D	2.60	129.21	124.66
5	B	147	HNI	C4B-NB-C1B	-2.58	100.72	105.21
3	E	142	HEM	CHA-C4D-ND	2.53	127.50	124.38

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	F	3002	2FU	O3-C2-C1	-2.45	117.30	125.67
5	D	147	HNI	C4C-C3C-C2C	-2.42	105.19	107.11
3	C	142	HEM	C3B-C2B-C1B	2.42	108.28	106.49
3	G	142	HEM	CAD-C3D-C4D	2.40	128.85	124.66
3	C	142	HEM	CAD-C3D-C4D	2.39	128.83	124.66
3	E	142	HEM	C4B-CHC-C1C	2.36	125.68	122.56
3	A	142	HEM	CHD-C1D-ND	2.35	126.98	124.43
3	C	142	HEM	C1B-NB-C4B	2.35	107.50	105.07
3	C	142	HEM	CMC-C2C-C3C	2.34	129.06	124.68
3	G	142	HEM	C2C-C3C-C4C	2.31	108.51	106.90
5	B	147	HNI	CHC-C4B-NB	-2.30	121.89	124.62
5	F	147	HNI	C4C-C3C-C2C	-2.28	105.31	107.11
5	D	147	HNI	CMC-C2C-C1C	-2.27	121.58	125.04
3	E	142	HEM	CHC-C4B-NB	2.23	126.85	124.43
5	B	147	HNI	C3B-C4B-NB	2.22	114.00	110.36
3	C	142	HEM	CAD-CBD-CGD	-2.20	108.86	113.60
3	A	142	HEM	C3D-C4D-ND	-2.15	107.77	110.17
3	C	142	HEM	C4A-C3A-C2A	2.14	108.49	107.00
3	G	142	HEM	CMA-C3A-C2A	2.13	128.96	124.94
3	E	142	HEM	C1D-C2D-C3D	-2.11	104.73	106.96
3	G	142	HEM	C1B-NB-C4B	2.11	107.25	105.07
3	C	142	HEM	CMA-C3A-C2A	2.09	128.88	124.94
5	F	147	HNI	C3B-C4B-NB	2.06	113.74	110.36
3	E	142	HEM	CBB-CAB-C3B	-2.03	117.51	127.62
3	A	142	HEM	CHA-C4D-ND	2.02	126.88	124.38
3	G	142	HEM	CHC-C4B-NB	2.02	126.62	124.43

All (4) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
5	B	147	HNI	NB
5	D	147	HNI	NB
5	F	147	HNI	NB
5	H	147	HNI	NB

All (32) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	D	3001	2FU	C5-C1-C2-O3
6	D	3001	2FU	C1-C5-C7-O8
6	F	3002	2FU	C5-C1-C2-O3
6	F	3002	2FU	C1-C5-C7-O8

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Mol	Chain	Res	Type	Atoms
3	C	142	HEM	CAD-CBD-CGD-O2D
3	A	142	HEM	CAD-CBD-CGD-O2D
3	E	142	HEM	CAA-CBA-CGA-O1A
5	D	147	HNI	CAA-CBA-CGA-O1A
5	F	147	HNI	CAA-CBA-CGA-O1A
3	A	142	HEM	CAA-CBA-CGA-O1A
3	G	142	HEM	CAD-CBD-CGD-O2D
5	F	147	HNI	CAD-CBD-CGD-O1D
5	H	147	HNI	CAD-CBD-CGD-O1D
3	G	142	HEM	CAD-CBD-CGD-O1D
5	B	147	HNI	CAA-CBA-CGA-O1A
5	F	147	HNI	CAA-CBA-CGA-O2A
5	H	147	HNI	CAA-CBA-CGA-O1A
3	A	142	HEM	CAA-CBA-CGA-O2A
5	D	147	HNI	CAA-CBA-CGA-O2A
5	F	147	HNI	CAD-CBD-CGD-O2D
3	E	142	HEM	CAA-CBA-CGA-O2A
5	B	147	HNI	CAD-CBD-CGD-O1D
5	B	147	HNI	CAD-CBD-CGD-O2D
5	H	147	HNI	CAA-CBA-CGA-O2A
5	H	147	HNI	CAD-CBD-CGD-O2D
3	C	142	HEM	CAD-CBD-CGD-O1D
3	G	142	HEM	CAA-CBA-CGA-O1A
3	G	142	HEM	CAA-CBA-CGA-O2A
3	A	142	HEM	CAD-CBD-CGD-O1D
5	B	147	HNI	CAA-CBA-CGA-O2A
3	E	142	HEM	CAD-CBD-CGD-O2D
3	E	142	HEM	CAD-CBD-CGD-O1D

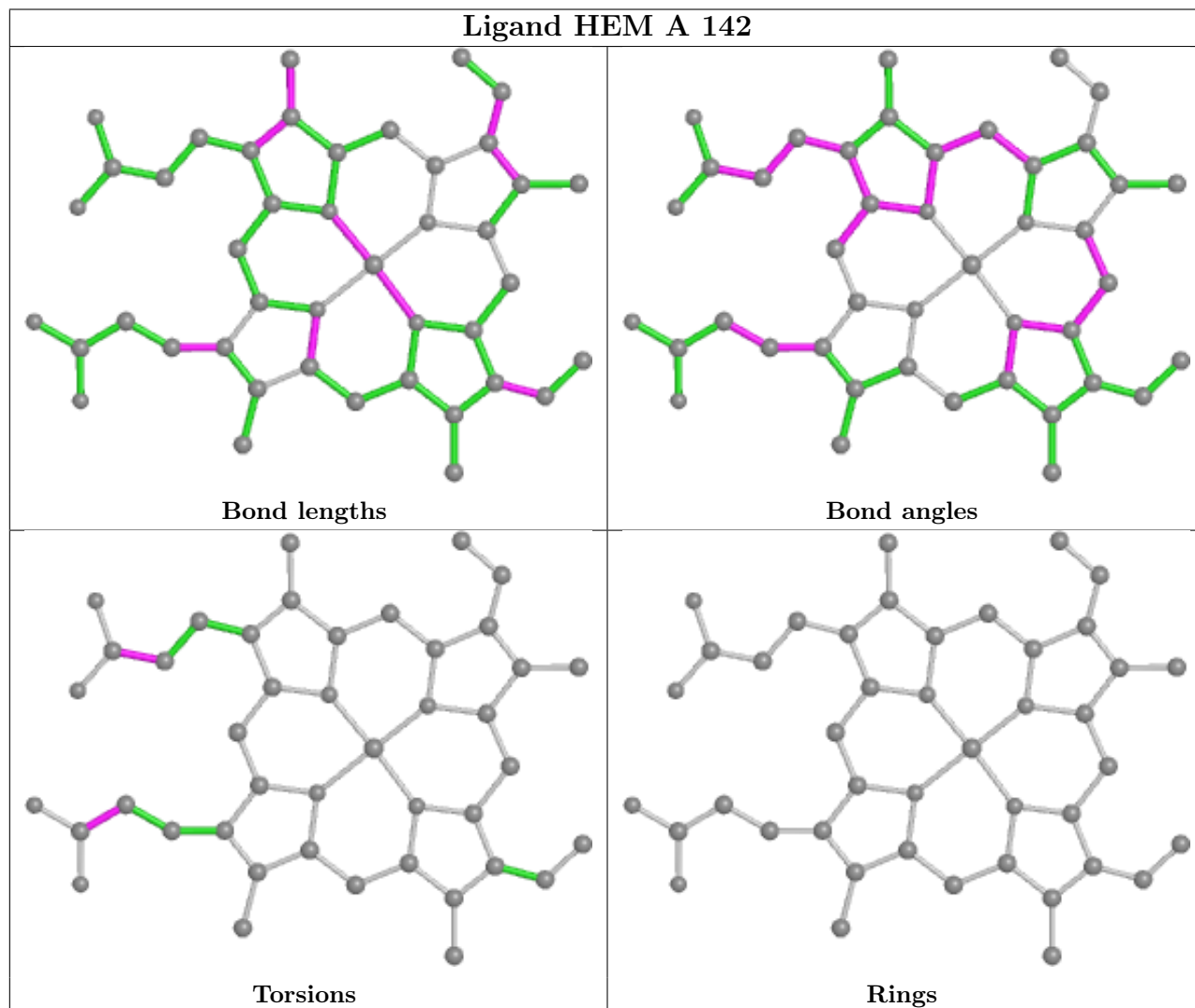
There are no ring outliers.

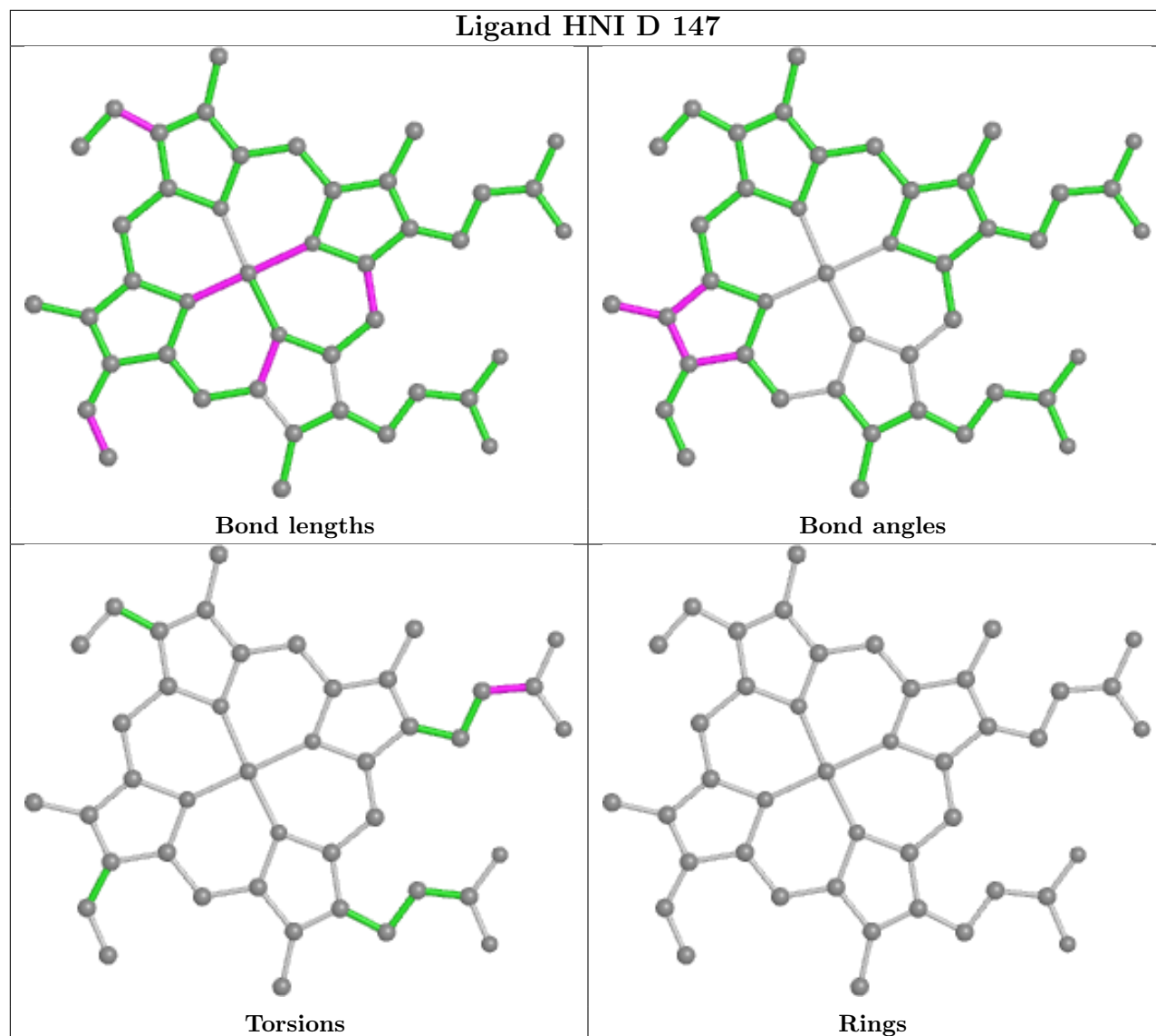
4 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	G	6143	CMO	1	0
5	B	147	HNI	2	0
5	F	147	HNI	1	0
3	G	142	HEM	1	0

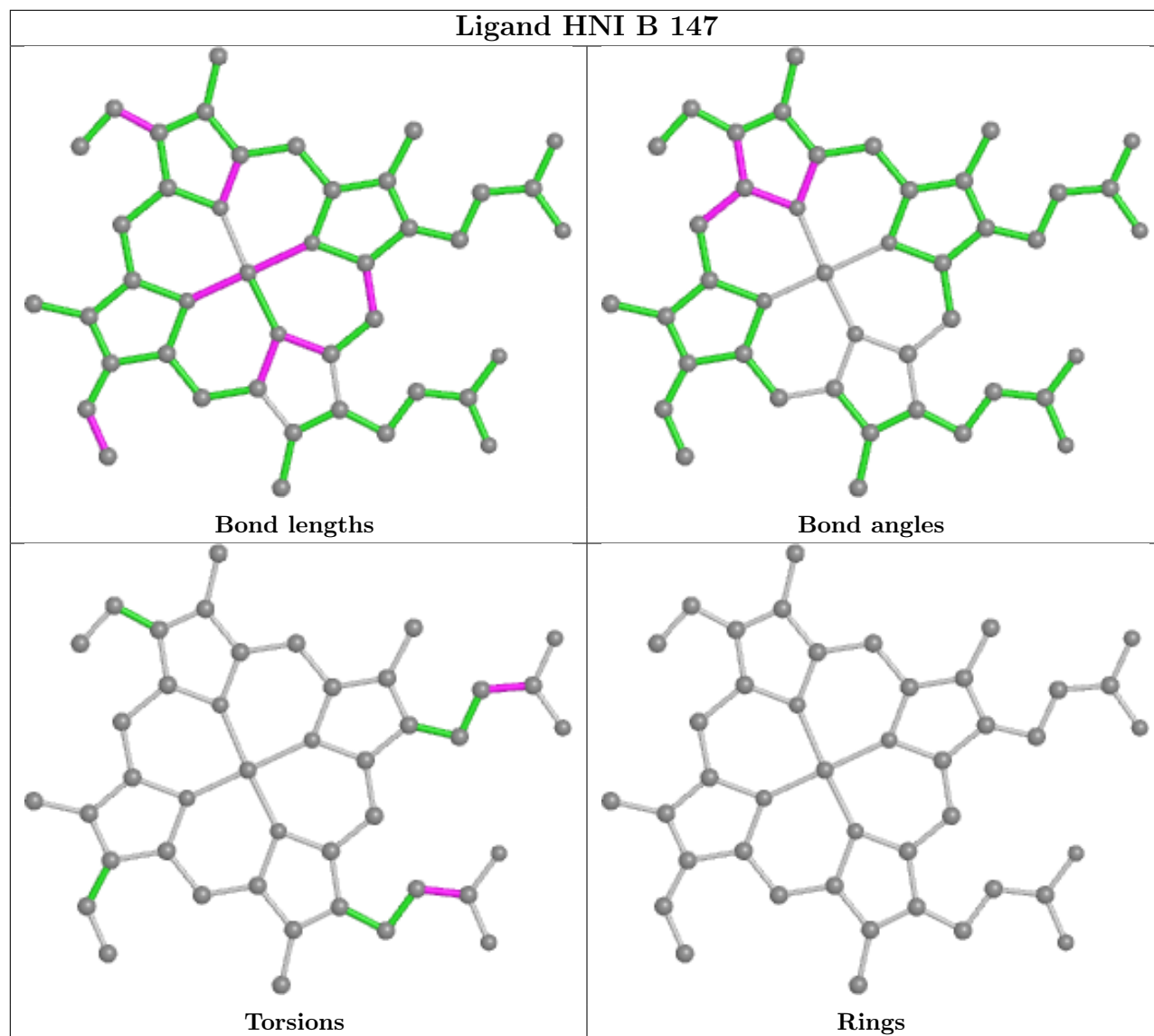
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is

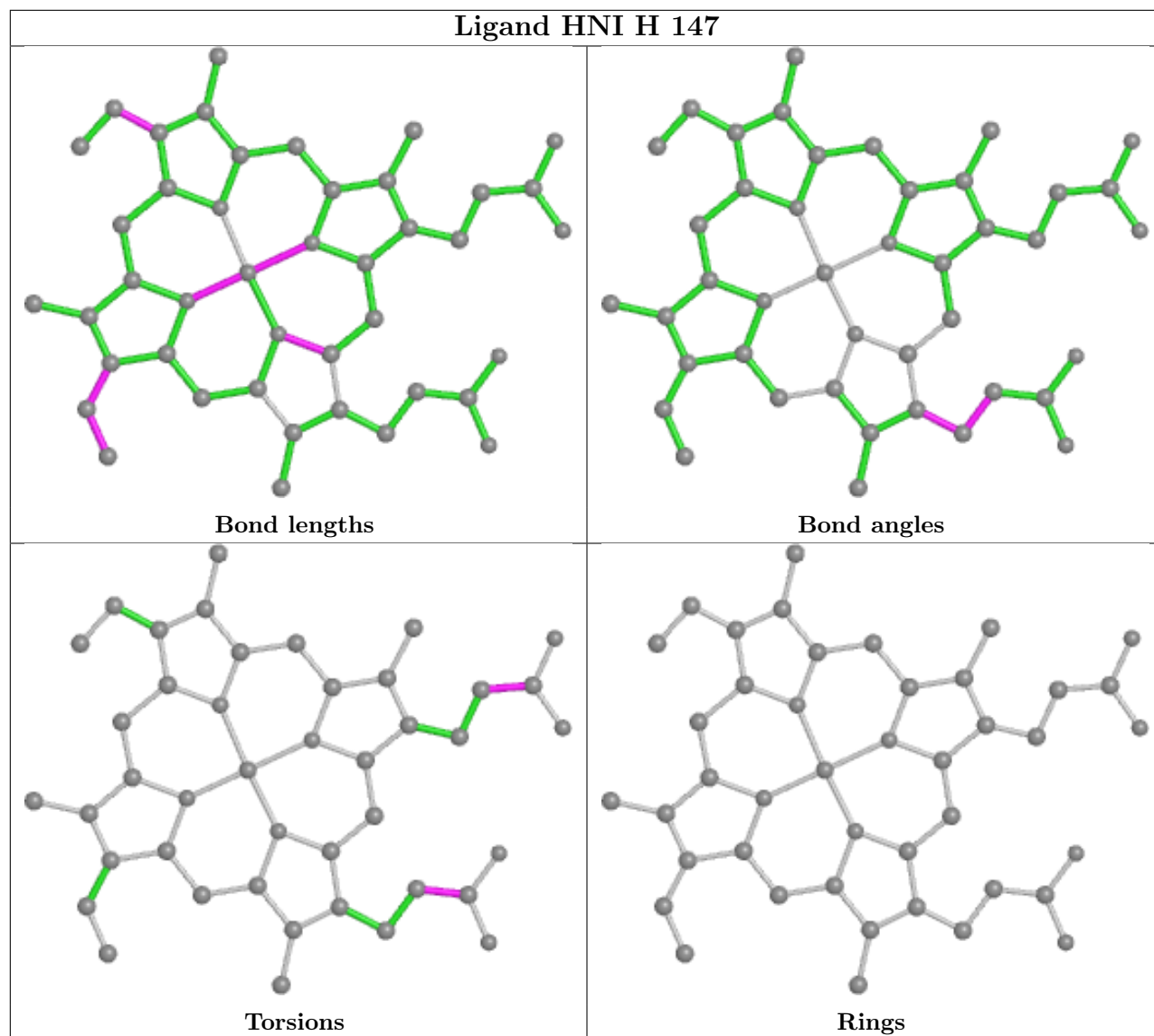
within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question 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.

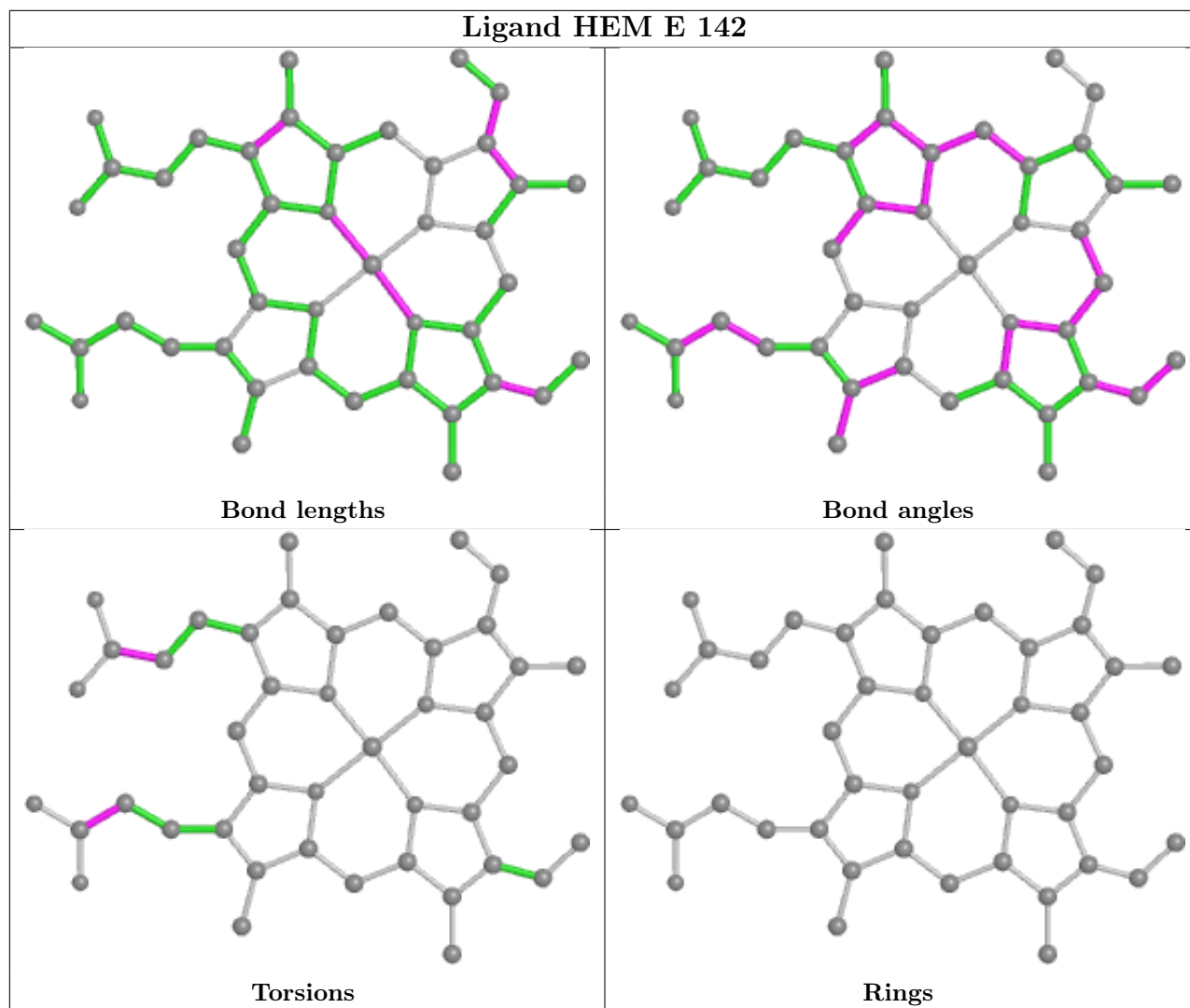


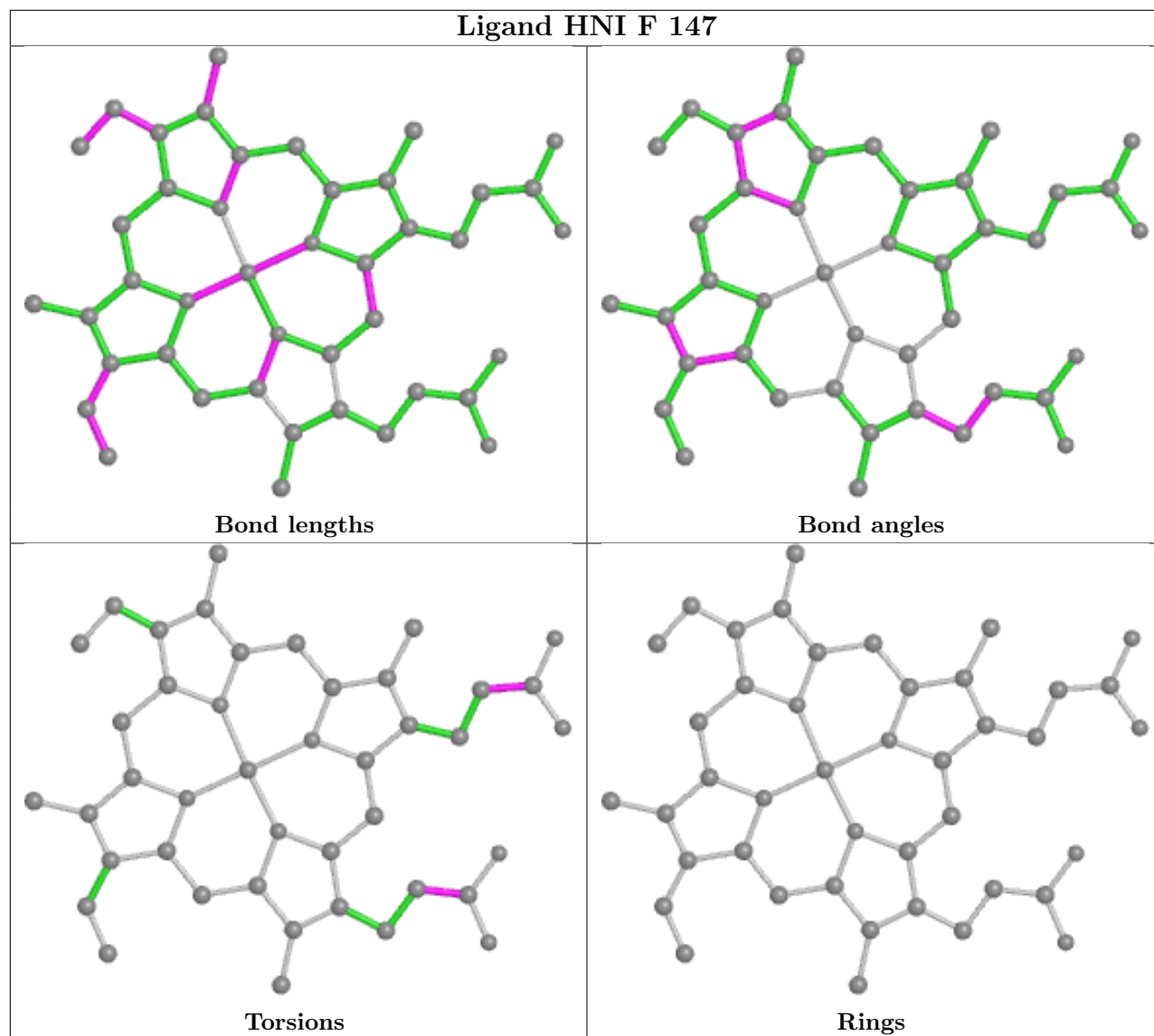


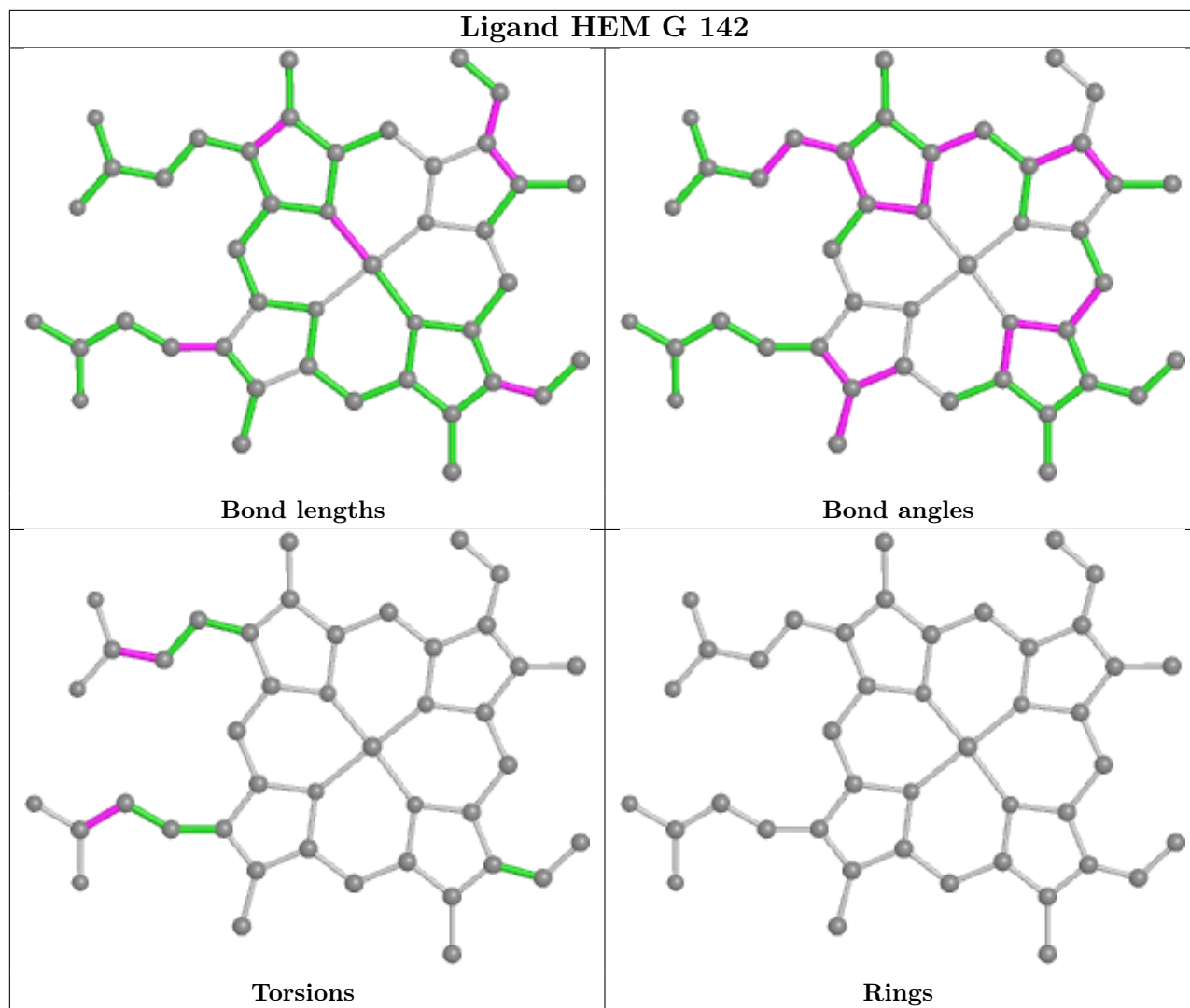


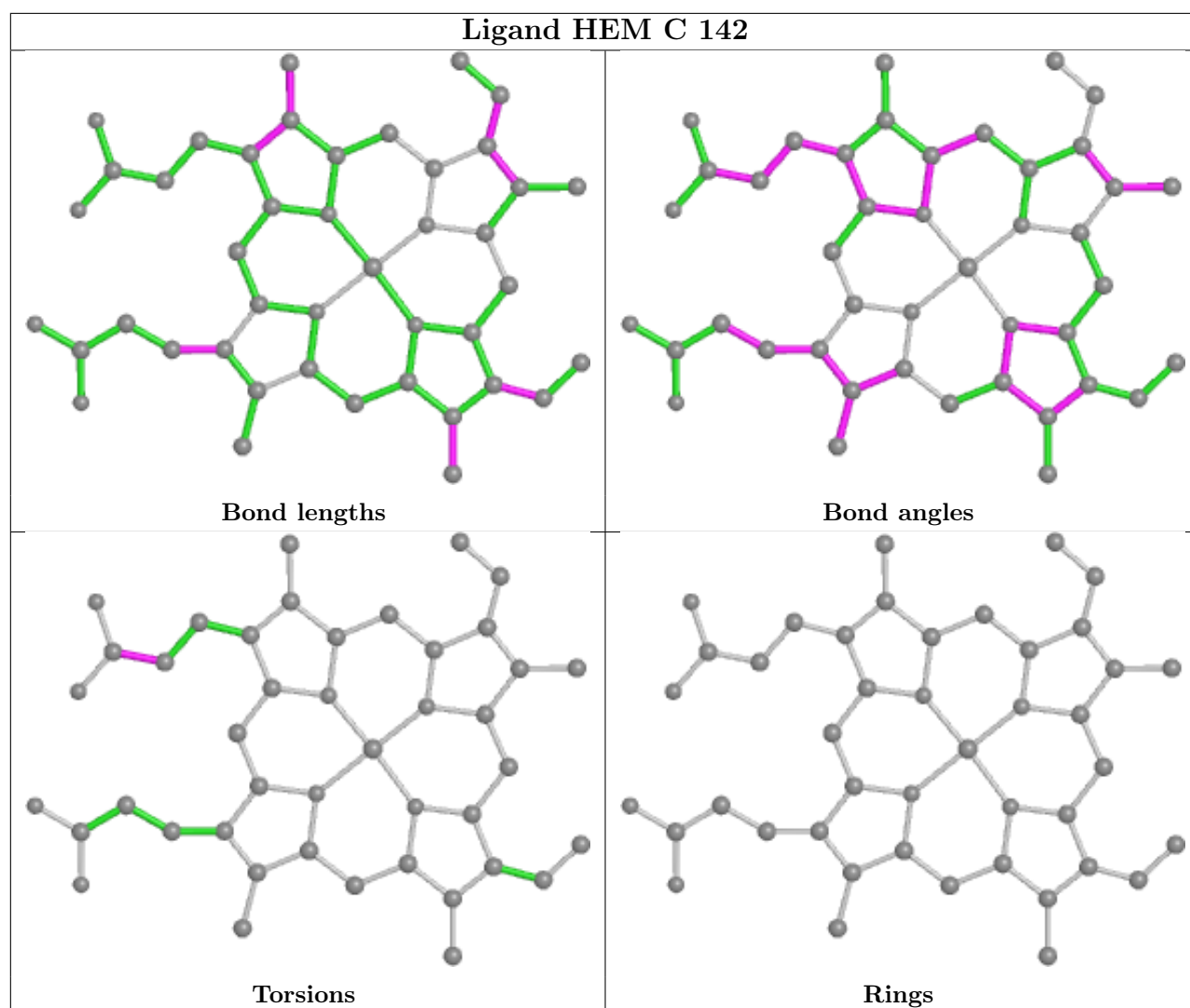












## 5.7 Other polymers [i](#)

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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

### 6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

### 6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

### 6.5 Other polymers [i](#)

EDS was not executed - this section is therefore empty.