



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 10:41 AM UTC

PDB ID : 1C8I / pdb_00001c8i
Title : BINDING MODE OF HYDROXYLAMINE TO ARTHROMYCES RAMO-
SUS PEROXIDASE
Authors : Wariishi, H.; Nonaka, D.; Johjima, T.; Nakamura, N.; Naruta, Y.; Kubo, K.;
Fukuyama, K.
Deposited on : 2000-05-08
Resolution : 2.00 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

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A user guide is available at

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

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

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

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

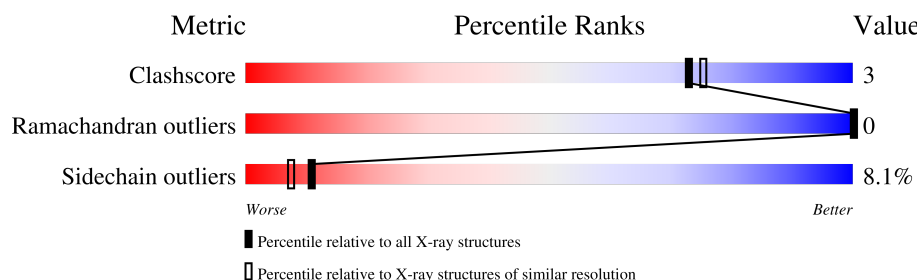
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	344	
2	B	2	

2 Entry composition [i](#)

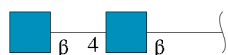
There are 7 unique types of molecules in this entry. The entry contains 2759 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 (PEROXIDASE).

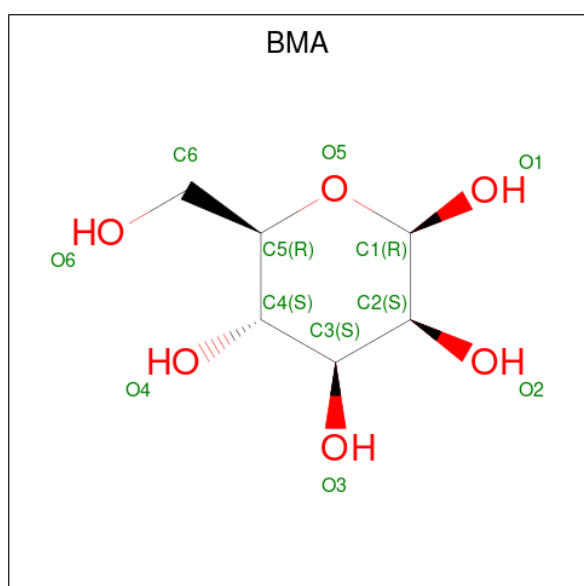
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	336	Total	C	N	O	S	0	0	0
			2465	1537	421	492	15			

- Molecule 2 is an oligosaccharide called 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	2	Total	C	N	O	0	0	0
			28	16	2	10			

- Molecule 3 is beta-D-mannopyranose (CCD ID: BMA) (formula: C₆H₁₂O₆).

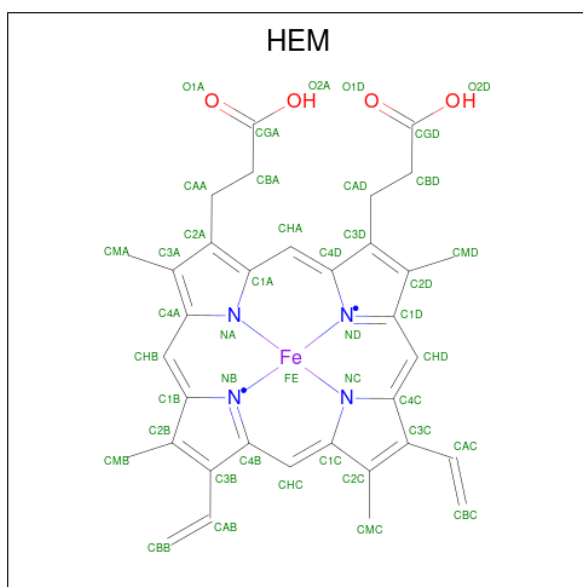


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			11	6	5		

- Molecule 4 is CALCIUM ION (CCD ID: CA) (formula: Ca).

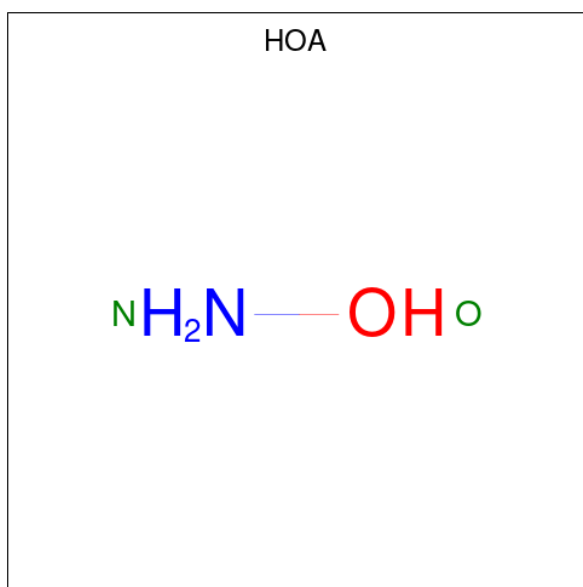
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	2	Total	Ca	0	0
			2	2		

- Molecule 5 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



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

- Molecule 6 is HYDROXYAMINE (CCD ID: HOA) (formula: H_3NO).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	N	O	0	0
			2	1	1		

- Molecule 7 is water.

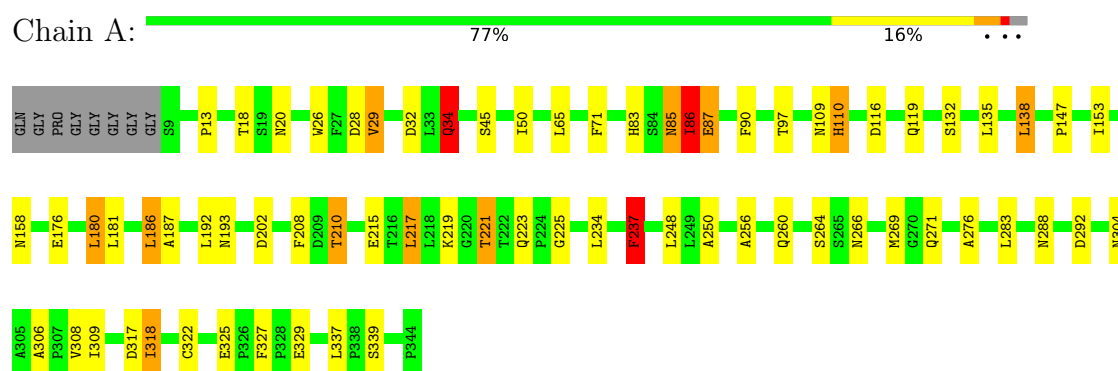
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	208	Total	O	0	0
			208	208		

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. 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: PROTEIN (PEROXIDASE)



- Molecule 2: 2-acetamido-2-deoxy-beta-D-glucopyranose-(1-4)-2-acetamido-2-deoxy-beta-D-glucopyranose



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 42 21 2	Depositor
Cell constants a, b, c, α , β , γ	74.40 Å 74.40 Å 117.50 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	7.00 – 2.00	Depositor
% Data completeness (in resolution range)	94.2 (7.00-2.00)	Depositor
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR	Depositor
R, R_{free}	0.162 , 0.223	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2759	wwPDB-VP
Average B, all atoms (Å ²)	24.0	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: HOA, BMA, NAG, HEM, CA

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	0.87	3/2521 (0.1%)	1.68	54/3436 (1.6%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	318	ILE	CA-CB	7.08	1.63	1.54
1	A	29	VAL	CA-CB	5.85	1.62	1.54
1	A	86	ILE	CA-CB	5.51	1.62	1.54

All (54) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	202	ASP	CA-CB-CG	11.38	123.98	112.60
1	A	309	ILE	N-CA-C	-9.68	97.97	107.55
1	A	221	THR	N-CA-CB	-8.33	98.49	110.81
1	A	34	GLN	OE1-CD-NE2	-7.63	114.97	122.60
1	A	83	HIS	CA-CB-CG	-7.51	106.29	113.80
1	A	193	ASN	OD1-CG-ND2	-6.92	115.68	122.60
1	A	158	ASN	OD1-CG-ND2	-6.83	115.77	122.60
1	A	110	HIS	CG-CD2-NE2	-6.79	100.41	107.20
1	A	288	ASN	CA-CB-CG	6.78	119.38	112.60
1	A	339	SER	N-CA-C	-6.71	97.42	108.76
1	A	339	SER	CA-CB-OG	6.65	124.41	111.10
1	A	110	HIS	ND1-CG-CD2	6.64	112.74	106.10
1	A	85	ASN	CA-CB-CG	6.57	119.17	112.60
1	A	237	PHE	CA-CB-CG	6.48	120.28	113.80
1	A	223	GLN	N-CA-C	-6.40	97.18	108.69
1	A	304	ASN	OD1-CG-ND2	-6.35	116.25	122.60
1	A	210	THR	OG1-CB-CG2	6.29	121.88	109.30
1	A	83	HIS	CB-CG-CD2	-6.25	123.08	131.20

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	28	ASP	CA-CB-CG	6.05	118.65	112.60
1	A	18	THR	CA-CB-OG1	-5.87	100.80	109.60
1	A	85	ASN	OD1-CG-ND2	-5.86	116.74	122.60
1	A	187	ALA	N-CA-C	5.79	118.08	108.99
1	A	26	TRP	CG-CD2-CE3	5.67	139.56	133.90
1	A	83	HIS	CG-CD2-NE2	-5.62	101.58	107.20
1	A	109	ASN	OD1-CG-ND2	-5.60	117.00	122.60
1	A	186	LEU	N-CA-C	-5.60	101.87	109.54
1	A	110	HIS	CB-CG-CD2	-5.55	123.98	131.20
1	A	264	SER	N-CA-C	5.54	120.92	113.72
1	A	306	ALA	CA-C-N	5.50	125.52	119.90
1	A	306	ALA	C-N-CA	5.50	125.52	119.90
1	A	288	ASN	CB-CG-ND2	5.50	124.65	116.40
1	A	215	GLU	N-CA-C	5.48	118.18	111.82
1	A	119	GLN	OE1-CD-NE2	-5.48	117.12	122.60
1	A	237	PHE	N-CA-C	5.42	113.09	108.22
1	A	318	ILE	CB-CG1-CD1	-5.40	102.45	113.80
1	A	45	SER	CA-C-O	-5.37	113.39	118.33
1	A	308	VAL	CB-CA-C	-5.34	101.27	110.30
1	A	87	GLU	N-CA-C	5.20	117.86	111.82
1	A	20	ASN	CA-CB-CG	5.19	117.79	112.60
1	A	71	PHE	N-CA-C	-5.17	101.99	109.59
1	A	90	PHE	CA-C-N	5.16	124.78	119.05
1	A	90	PHE	C-N-CA	5.16	124.78	119.05
1	A	256	ALA	N-CA-C	5.15	116.89	111.28
1	A	97	THR	N-CA-C	5.14	117.28	111.11
1	A	260	GLN	OE1-CD-NE2	-5.14	117.46	122.60
1	A	132	SER	N-CA-C	5.08	116.28	109.83
1	A	158	ASN	CB-CG-ND2	5.06	123.99	116.40
1	A	153	ILE	CA-C-N	5.05	124.96	119.76
1	A	153	ILE	C-N-CA	5.05	124.96	119.76
1	A	327	PHE	CA-C-N	5.05	124.98	119.78
1	A	327	PHE	C-N-CA	5.05	124.98	119.78
1	A	116	ASP	CA-CB-CG	5.04	117.64	112.60
1	A	225	GLY	CA-C-N	5.04	124.64	119.05
1	A	225	GLY	C-N-CA	5.04	124.64	119.05

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	2465	0	2372	16	0
2	B	28	0	25	0	0
3	A	11	0	10	0	0
4	A	2	0	0	0	0
5	A	43	0	30	0	0
6	A	2	0	0	0	0
7	A	208	0	0	0	0
All	All	2759	0	2437	16	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 3.

All (16) 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:217:LEU:HD13	1:A:250:ALA:HB1	1.77	0.66
1:A:34:GLN:HE21	1:A:34:GLN:HA	1.66	0.60
1:A:86:ILE:HG12	1:A:147:PRO:HB3	1.86	0.56
1:A:32:ASP:OD2	1:A:110:HIS:HE1	1.89	0.56
1:A:180:LEU:HD13	1:A:276:ALA:HB1	1.88	0.55
1:A:210:THR:HG23	1:A:266:ASN:OD1	2.05	0.55
1:A:237:PHE:HB3	1:A:337:LEU:HG	1.92	0.51
1:A:219:LYS:HG3	1:A:317:ASP:O	2.13	0.49
1:A:138:LEU:HD12	1:A:292:ASP:HA	1.96	0.48
1:A:86:ILE:HG13	1:A:87:GLU:N	2.29	0.48
1:A:208:PHE:CE2	1:A:269:MET:HE3	2.52	0.45
1:A:322:CYS:SG	1:A:325:GLU:HG2	2.58	0.43
1:A:219:LYS:HE3	1:A:219:LYS:HB2	1.67	0.41
1:A:180:LEU:HD13	1:A:276:ALA:CB	2.50	0.41
1:A:34:GLN:HA	1:A:34:GLN:NE2	2.32	0.41
1:A:176:GLU:O	1:A:180:LEU:HB2	2.21	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	334/344 (97%)	323 (97%)	11 (3%)	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	271/273 (99%)	249 (92%)	22 (8%)	11	7

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	13	PRO
1	A	29	VAL
1	A	34	GLN
1	A	50	ILE
1	A	65	LEU
1	A	85	ASN
1	A	86	ILE
1	A	135	LEU
1	A	138	LEU
1	A	180	LEU
1	A	181	LEU
1	A	186	LEU
1	A	192	LEU

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Mol	Chain	Res	Type
1	A	217	LEU
1	A	221	THR
1	A	234	LEU
1	A	237	PHE
1	A	248	LEU
1	A	271	GLN
1	A	283	LEU
1	A	318	ILE
1	A	329	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	34	GLN
1	A	36	ASN
1	A	85	ASN
1	A	110	HIS
1	A	128	ASN
1	A	193	ASN
1	A	206	GLN
1	A	271	GLN

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 ⓘ

2 monosaccharides 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	NAG	B	1	2,1	14,14,15	0.52	0	17,19,21	1.46	2 (11%)
2	NAG	B	2	2	14,14,15	0.40	0	17,19,21	1.08	1 (5%)

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	NAG	B	1	2,1	-	0/6/23/26	0/1/1/1
2	NAG	B	2	2	-	1/6/23/26	0/1/1/1

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	B	1	NAG	C1-O5-C5	3.19	116.46	112.19
2	B	1	NAG	C1-C2-N2	2.55	114.46	110.43
2	B	2	NAG	C8-C7-N2	2.45	120.17	116.12

There are no chirality outliers.

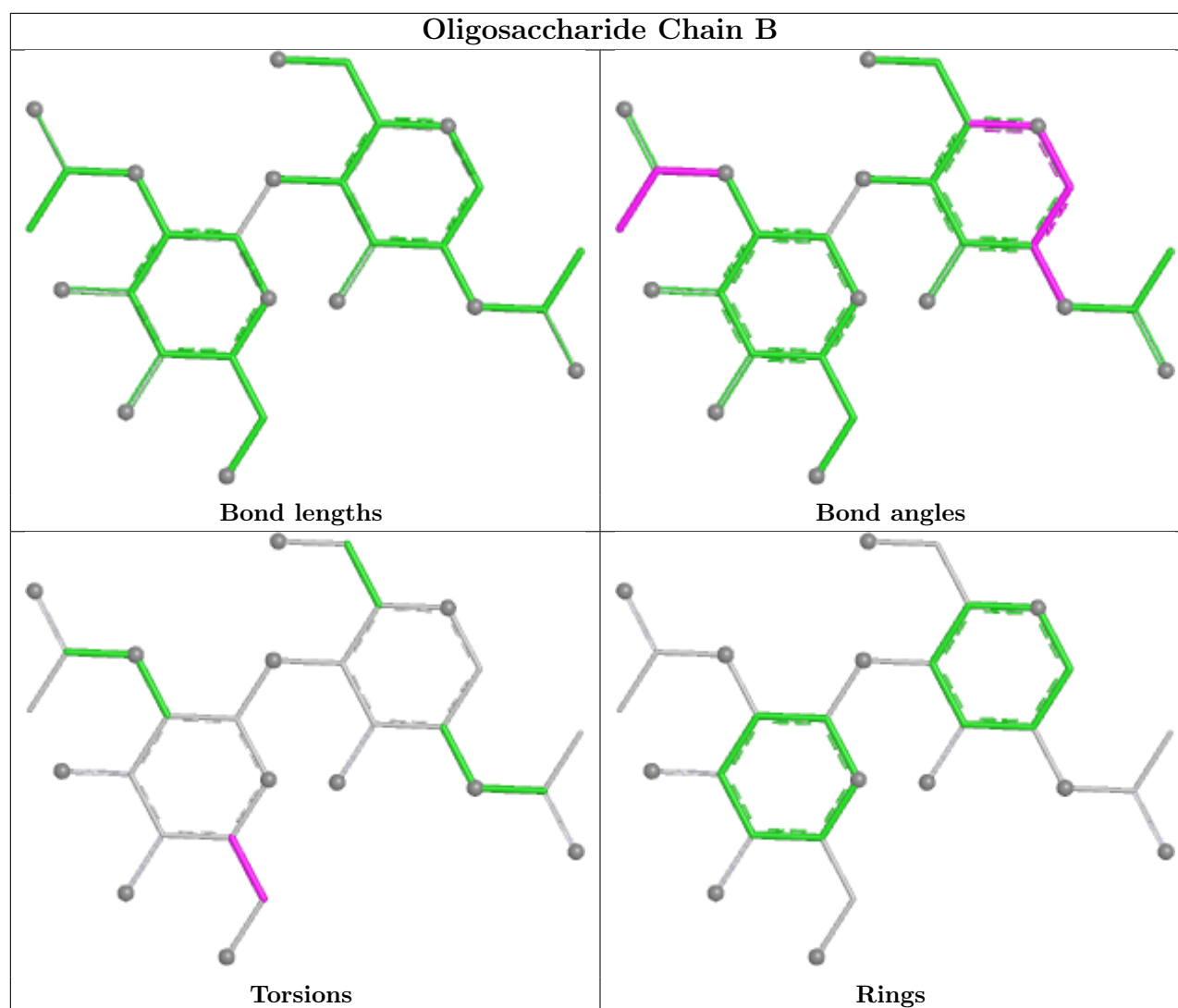
All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	2	NAG	O5-C5-C6-O6

There are no ring outliers.

No monomer is involved in short contacts.

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.



5.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 2 are monoatomic - leaving 3 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	$\# Z > 2$
5	HEM	A	345	6,1	50,50,50	1.11	6 (12%)	67,82,82	0.86	1 (1%)
6	HOA	A	900	5	0,1,1	-	-	-		
3	BMA	A	350	1	11,11,12	0.63	0	15,15,17	1.27	2 (13%)

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
5	HEM	A	345	6,1	-	5/14/54/54	-
3	BMA	A	350	1	-	0/2/19/22	0/1/1/1

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	345	HEM	CBB-CAB	3.01	1.44	1.30
5	A	345	HEM	CBC-CAC	2.98	1.44	1.30
5	A	345	HEM	CAB-C3B	-2.52	1.40	1.47
5	A	345	HEM	O2D-CGD	-2.35	1.23	1.30
5	A	345	HEM	CAC-C3C	-2.31	1.41	1.47
5	A	345	HEM	O2A-CGA	-2.26	1.23	1.30

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	350	BMA	C1-O5-C5	-2.93	108.26	112.19
5	A	345	HEM	C3B-C4B-NB	2.73	111.43	109.47
3	A	350	BMA	C1-C2-C3	-2.07	106.63	109.64

There are no chirality outliers.

All (5) torsion outliers are listed below:

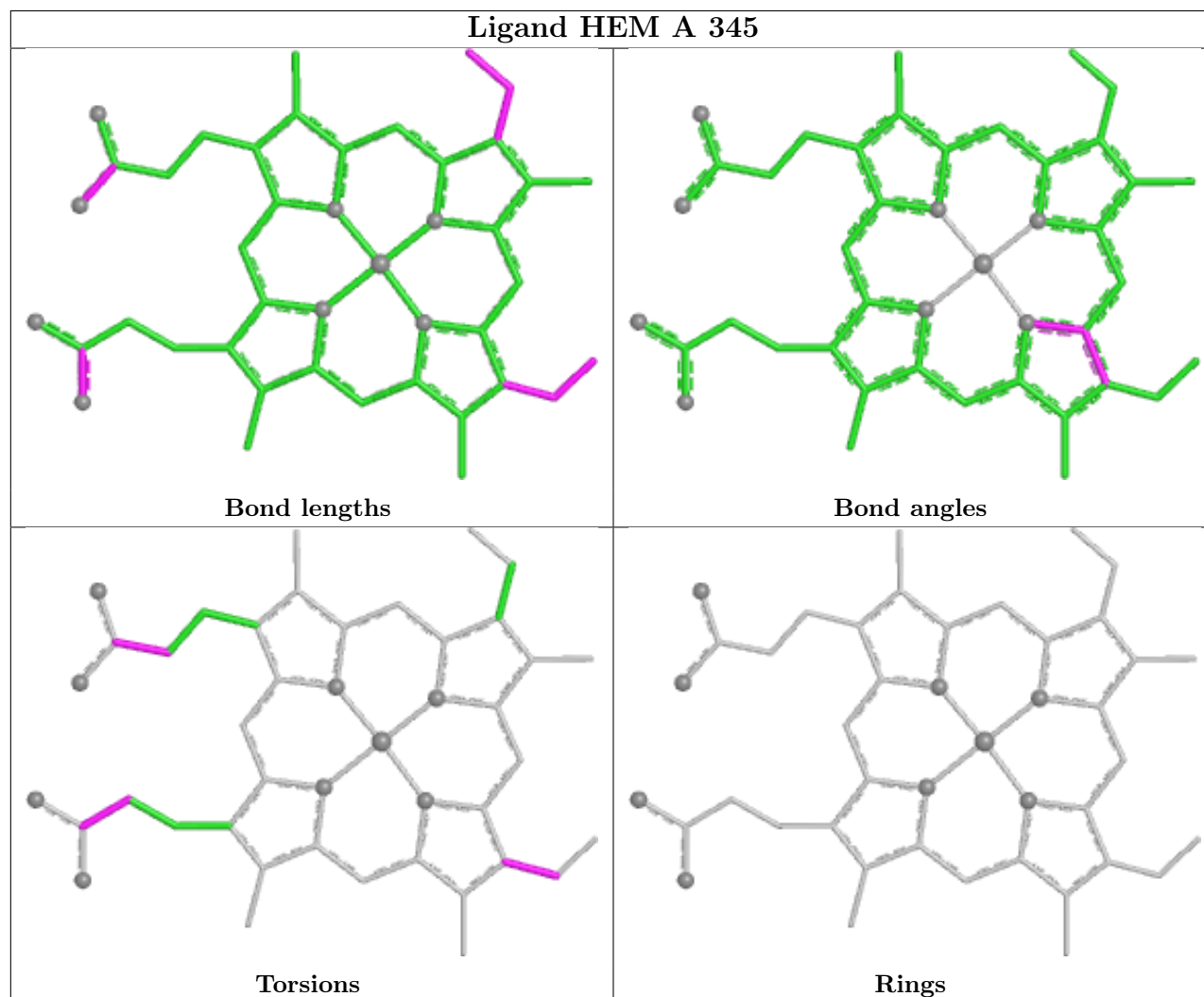
Mol	Chain	Res	Type	Atoms
5	A	345	HEM	C2B-C3B-CAB-CBB
5	A	345	HEM	C4B-C3B-CAB-CBB
5	A	345	HEM	CAA-CBA-CGA-O2A
5	A	345	HEM	CAA-CBA-CGA-O1A
5	A	345	HEM	CAD-CBD-CGD-O2D

There are no ring outliers.

No monomer is involved in short contacts.

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.