DMRG Study of the $S \geq 1$ quantum Heisenberg Antiferromagnet on a Kagome-like lattice without loops

R. Zach Lamberty,[1] Hitesh Changlani,[1] and C. L. Henley[1]

[1] *Cornell University, Ithaca, New York, 14853*

(Dated: November 8, 2012)

The Kagome quantum Heisenberg antiferromagnet (QHA), not only for spin $S = 1/2$ but for $S = 1$ and perhaps $S = 3/2$, is a prime candidate to realize a quantum spin liquid or valence bond crystal state. However, theoretical and computational studies for $S > 1/2$ are difficult and few. We consider instead the QHA for $S \geq 1$ on the Husimi Cactus, a graph of corner sharing triangles whose centers are vertices of a Bethe lattice, using a DMRG procedure tailored for tree graphs [1]. Since both lattices are locally identical, properties of the Kagome antiferromagnet dominated by nearest-neighbor spin correlations should also be exhibited on the Cactus; while loop-dependent effects will be absent on the loopless Cactus. Our study focuses on the possible transition(s) that must occur with increasing S for the Cactus antiferromagnet (It has a disordered valence bond state at $S = 1/2$ but a three-sublattice coplanar ordered state in the large S limit [4]). We also investigate the phase diagram of the $S = 1$ quantum XXZ model with on-site anisotropy, which we expect to have three-sublattice and valence-bond-crystal phases similar to the kagome case [5].

[1] Changlani, Ghosh, Henley, and Lauchli, arXiv:1208.1773 (2012)

[2] Doucot and Simon, J. Phys. A 31, 5855 (1998).

[3] Isakov and Kim, Phys. Rev. B 79, 094408 (2009).