DMRG Study of the $S > 1/2$ quantum Heisenberg Antiferromagnet on a Kagome-like lattice without loops

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The Kagome quantum Heisenberg antiferromagnet is a prime candidate for the realization of a quantum spin liquid. Though many of the experimental realizations of this model have $S > 1/2$, theoretical and computational studies for these spin values have proven difficult. To study this larger spin regime, we consider the quantum Heisenberg antiferromagnet for $S \geq 1/2$ on the Husimi cactus, a graph of corner sharing triangles each of whose centers is a vertex of a Bethe lattice. Our method is a DMRG procedure tailored for tree graphs [1] and is thus well suited to our models; by contrast, such $S > 1/2$ models are virtually intractable by exact diagonalization on the kagome lattice.

Our focus is the possible transition(s) as S is increased from a spin liquid at $S = 1/2$ to the coplanar ordered state known to be stable in the large S limit [2]. Since the geometry is like the Kagome lattice locally, properties dominated by nearest-neighbor spin correlations should be captured by the same interactions on the Husimi cactus; on the other hand, the cactus lacks loops, so properties dependent on them cannot be captured. As a proof of principle we also investigate the quantum XXZ model with on-site anisotropy for $S = 1$, and compare it to previous work [3].

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[1] H. J. Changlani, S. Ghosh, C. L. Henley, A. M. Läuchli, arXiv:1208.1773v1 (2012).
[2] B. Doucot and P. Simon, J. Phys. A **31**, 5855 (1998).
[3] S. V. Isakov and Y. B. Kim, Phys. Rev. B **79**, 094408 (2009).