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Quantum antiferromagnet on a Bethe lattice at percolation I. Low-energy states, DMRG, and diagnostics HITESH CHANGLANI, SHIVAM GHOSH, C.L. HENLEY, Cornell University — We investigate ground and excited state properties of randomly diluted spin-1/2, exchange-coupled Heisenberg antiferromagnets on the Bethe lattice with coordination 3. In the case of square lattice percolation clusters, previous Quantum Monte Carlo (QMC) calculations [1] found that the singlet-triplet gaps scaled "anomalously," being much smaller than the $1/N$ scaling expected from the tower of "quantum rotor" states (due to $E = M^2/2N\chi$). The low energies were attributed to the interaction of distant "dangling spins," forced by the local imbalance of even and odd sites. In the present study we further study this effect on the Bethe lattice, using Exact Diagonalization and density-matrix RG. (DMRG applies naturally since the Bethe lattice lacks loops). We introduce inter-site correlation and susceptibility matrices as diagnostics to identify the spatial locations of the low-energy degrees of freedom, and to understand interactions between them. These matrices have been computed within the harmonic spin-wave theory, in order to highlight the deviations seen in the spin-1/2 system. In addition to the above, we propose a simple effective Hamiltonian which explains the magnitude of the singlet-triplet gap.

[1] L. Wang and A. Sandvik, Phys. Rev. B 81, 054417 (2010).

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