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Tensor Renormalization of Quantum Many-Body Systems using Projected Entangled Simplex States T. XIANG, Z.Y. XIE, J. CHEN, J.F. YU, X. KONG, Institute of Physics, Chinese Academy of Sciences, Beijing, B. NORMAND, Renmin University, Beijing — We propose a new class of tensor-network states, which we name projected entangled simplex states (PESS), for studying the ground-state properties of quantum lattice models. These states extend the pair-correlation basis of projected entangled pair states (PEPS) to a simplex. PESS are an exact representation of the simplex solid states and provide an efficient trial wave function that satisfies the area law of entanglement entropy. We introduce a simple update method for evaluating the PESS wave function based on imaginary-time evolution and the higher-order singular-value decomposition of tensors. By applying this method to the spin-1/2 antiferromagnetic Heisenberg model on the kagome lattice, we obtain an accurate result for the ground-state energy, $e_0 = -0.4388(1)J$, which sets the lowest upper bound yet achieved for this quantity.

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