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Tensor RG calculations and quantum simulations near criticality

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We reformulate the Ising model, the O(2) model with a chemical potential and the Abelian Higgs model on a 1+1 space-time lattice using the
Tensor Renormalization Group (TRG) method. The reformulation allows exact blocking and connects smoothly the classical Lagrangian approach to the quantum Hamiltonian approach. We discuss the linearization of the TRG for the Ising model near the critical point.
We calculate the entanglement entropy in the superfluid phase of the O(2) model and show that it obeys the Cardy scaling (c/3)*Ln(L).
We calculate the Polyakov loop in the Abelian Higgs model and discuss the possibility of a deconfinement transition at finite volume.
We propose Bose-Hubbard Hamiltonians with two species implementable on optical lattices as quantum simulators.

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