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Low-Temperature Gibbs States with Tensor Networks

We introduce a tensor network method for approximating thermal equilibrium states of quantum many-body systems at low temperatures. Whereas the usual approach starts from infinite temperature and evolves the state in imaginary time (towards lower temperature), our ansatz is constructed from the zero-temperature limit, the ground state, which can be found with a standard tensor network approach. Motivated by properties of the ground state for conformal field theories, our ansatz is especially well-suited near criticality. Moreover, it allows an efficient computation of thermodynamic quantities and entanglement properties. We demonstrate the performance of our approach with a tree tensor network ansatz, although it can be extended to other tensor networks, and present results illustrating its effectiveness in capturing the finite-temperature properties in one- and two-dimensional scenarios. In particular, in the critical 1D case we show how the ansatz reproduces the finite temperature scaling of entanglement in a CFT.

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