Characterizing Quantum Many-Body States via Entanglement Hamiltonian Learning

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The experimental characterization and quantification of entanglement properties, and the entanglement spectrum in particular, play a major role in our understanding of modern quantum many body physics in the lab. For most quantum lattice systems of interest, the reduced density matrix ϱ of the lattice is described by a thermal state of a quasi-local Entanglement Hamiltonian $\varrho = \exp(-\beta H)$. As a I will show in this talk, the parametrization of the reduced density matrix in terms of the Entanglement Hamiltonian allows for the determination of entanglement properties like the Schmidt-decomposition with a drastically reduced number of measurements. Furthermore it enables efficient quantum protocols to determine the Entanglement Hamiltonian whose properties can be investigated on the quantum device without any additional classical post-processing steps. Finally, I will provide prospects that learning of local Hamiltonians has the potential of verifying quantum simulators in a regime inaccessible to classical simulations.