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Dynamical Entanglement Growth and Measurement with Cold Atoms or Ions JOHANNES SCHACHENMAYER, University of Pittsburgh, University of Innsbruck, and Institute for Quantum Optics and Quantum Information, Innsbruck, HANNES PICHLER, PETER ZOLLER, BEN LANYON, University of Innsbruck, and Institute for Quantum Optics and Quantum Information, Innsbruck, ANDREW J. DALEY, University of Pittsburgh — Systems of cold atoms in optical lattices or a string of ions in a linear trap offer the possibility to experimentally study non-equilibrium dynamics of 1D many-body quantum systems with interactions of varying range in a controlled environment. Entanglement is a basic feature of these systems, and the increase of the entanglement entropy between different blocks of a many-body state as a function of time determines whether the long-time evolution of the system can be efficiently simulated on a classical computer. Correspondingly, states with large-scale entanglement offer regimes where quantum simulators could be used to outperform classical simulation. Thus, there is a great interest to produce large-scale entanglement in these types of experiments. Here we present analytical and numerical results on the entanglement entropy growth behavior in 1D lattice systems after a sudden quench of a model parameter, and the dependence of this growth on the range of the interactions. Furthermore, we present how bipartite Rényi entropies can be measured solely by using tunnel couplings and local measurements, tools which are both available in recent experiments with bosons in optical lattices.

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