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Dynamical Entanglement Creation and Measurement with Cold Atoms or Ions JOHANNES SCHACHENMAYER, University of Pittsburgh, JILA, CU-Boulder, HANNES PICHLER, PETER ZOLLER, BEN LANYON, University of Innsbruck, and Institute for Quantum Optics and Quantum Information, Innsbruck, ANDREW DALEY, University of Pittsburgh — Systems of cold atoms in optical lattices or a string of ions in a linear trap offer a controlled environment to experimentally study non-equilibrium dynamics of 1D many-body quantum systems with interactions of varying range. In these systems, the question of how the entanglement entropy between different blocks of a many-body state evolves as a function of time is an important one, since it determines whether the evolution of the system can be efficiently simulated on a classical computer. States with large-scale entanglement offer regimes where quantum simulators could be used to outperform classical simulation, and 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 change of a model parameter, and the dependence of this growth on the range of the interactions. Furthermore we show, how entanglement entropies can be directly measured in realistic experiments.

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