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**Spin dynamics and entanglement growth with trapped ions, atoms & molecules** JOHANNES SCHACHENMAYER, JILA/CU-Boulder, BEN LANYON, CHRISTIAN ROOS, University of Innsbruck, IQOQI, ANDREW DALEY, University of Pittsburgh/University of Strathclyde, Glasgow, BIHUI ZHU, ANA MARIA REY, JILA/CU-Boulder — Trapped ions and systems of cold atoms or molecules in optical lattices offer controlled environments to experimentally study non-equilibrium dynamics of many-body quantum spin-models with interactions of varying range. Theoretically calculating dynamics of observables for these experiments is a major challenge both analytically and numerically. In 1D, the growth behavior of the entanglement entropy between different blocks of a many-body state determines whether the evolution of the system can be efficiently simulated on a classical computer or not. In return, the study of entanglement growth can guide experiments to regimes where a quantum simulator can outperform a numerical simulation. Here we present results on the entanglement growth behavior in 1D strings of ions after a quench, and show how the growth depends on the range of the interactions. Furthermore we report on progress on methods for higher dimensional systems. These can be used to model Ramsey-dynamics for current experiments with alkaline earth atoms or polar molecules in optical lattices, or for systems with Rydberg atoms.

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