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Thermalization dynamics in a quenched many-body state ADAM KAUFMAN, PHILIPP PREISS, ERIC TAI, ALEX LUKIN, MATTHEW RISPOLI, ROBERT SCHITTKO, MARKUS GREINER, Harvard Univ — Quantum and classical many-body systems appear to have disparate behavior due to the different mechanisms that govern their evolution. The dynamics of a classical many-body system equilibrate to maximally entropic states and quickly re-thermalize when perturbed. The assumptions of ergodicity and unbiased configurations lead to a successful framework of describing classical systems by a sampling of thermal ensembles that are blind to the system's microscopic details. By contrast, an isolated quantum many-body system is governed by unitary evolution: the system retains memory of past dynamics and constant global entropy. However, even with differing characteristics, the long-term behavior for local observables in quenched, non-integrable quantum systems are often well described by the same thermal framework. We explore the onset of this convergence in a many-body system of bosonic atoms in an optical lattice. Our system's finite size allows us to verify full state purity and measure local observables. We observe rapid growth and saturation of the entanglement entropy with constant global purity. The combination of global purity and thermalized local observables agree with the Eigenstate Thermalization Hypothesis in the presence of a near-volume law in the entanglement entropy.

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