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Extended slow dynamical regime near the many-body localization transition DAVID J. LUITZ, University of Illinois at Urbana-Champaign, NICOLAS LAFLORENCIE, FABIEN ALET, Laboratoire de Physique Théorique, IRSAMC, Universiteé de Toulouse, CNRS — Many-body localization is characterized by a slow logarithmic growth of entanglement entropy after a global quantum quench while the local memory of an initial spin imbalance remains at infinite time. We address the dynamics in the delocalized ergodic regime, where thermalization is expected. Using an exact Krylov space technique, the out-of-equilibium dynamics of the random-field Heisenberg chain is studied up to L = 28 sites, starting from an initially unantangled high-energy product state. With such a global quench protocol, we study the time evolution of the entanglement entropy, as well as the spin density imbalance in order to make contact with recent cold atom experiments. Within most of the delocalized phase, we unambiguously find a sub-ballistic entanglement growth $S(t) \propto t^{1/z}$ with a disorder-dependent exponent $z \geq 1$, in contrast with the pure ballistic growth $z = 1$ of clean systems. At the same time, anomalous relaxation is also observed for the spin imbalance $I(t) \propto t^{-\zeta}$ with a continuously varying disorder-dependent exponent ζ, vanishing at the transition. This provides a clear experimental signature for detecting this non-conventional metallic state where transport is sub-diffusive.

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