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Quantum quenches in the many-body localized phase ZLATKO PAPIC, Perimeter Institute, MAKSYM SERBYN, University of California, Berkeley, DMITRY ABANIN, Perimeter Institute — Many-body localized (MBL) systems provide an example of ergodicity-breaking systems that cannot be described by conventional statistical mechanics. We show that the behaviour of local observables following a quantum quench is a direct probe of the MBL phase, which distinguishes it from both the Anderson insulator and the ergodic phase. For a global quench, we find that local observables reach stationary, highly non-thermal values at long times, which retain the local memory of the initial state due to the existence of local integrals of motion in the MBL phase. The temporal fluctuations around stationary values exhibit a universal power-law decay in time, with an exponent set by the localization length and the diagonal entropy of the initial state. Such a power-law decay holds for any local observable and is related to the logarithmic in time growth of entanglement in the MBL phase. For the case of a local quench, we also find a power-law approach of local observables to their stationary values when the system is prepared in a mixed state. Quench protocols considered here can be naturally implemented in systems of ultra cold atoms in disordered optical lattices, and the behaviour of local observables provides a direct experimental signature of many-body localization.

Zlatko Papic
Perimeter Institute

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