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Quantum revivals and many-body localization JOEL MOORE, ROMAIN VASSEUR, UC Berkeley and LBNL, SIDDHARTH PARAMESWARAN, UC Irvine — We show that the interaction-induced dephasing that distinguishes many-body localized phases from Anderson insulators has a striking consequence for quantum revivals in the time evolution of local observables. We examine the magnetization dynamics of a single "qubit" spin weakly coupled to an otherwise isolated disordered spin chain and first demonstrate that in the localized regime the spin chain is unable to act as a source of dissipation for the qubit, which therefore retains an imprint of its initial magnetization at infinite time. For Anderson localization, the magnetization exhibits periodic revivals, whose rate is strongly suppressed upon adding interactions after a time scale corresponding to the onset of dephasing. In contrast, the ergodic phase acts as a bath for the qubit, with no revivals visible on the time scales studied. The suppression of quantum revivals provides a quantitative, experimentally observable alternative to entanglement growth as a measure of the "non-ergodic but dephasing" nature of many-body localized systems.

Joel Moore
UC Berkeley and LBNL

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