Abstract Submitted
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Quantum many-body scarring: weak ergodicity breaking in an interacting Rydberg atom array simulator[1] WEN WEI HO, Harvard University, SOONWON CHOI, University of California Berkeley, CHRISTOPHER TURNER, University of Leeds, HANNES PICHLER, Harvard University, ALEXIOS MICHAILIDIS, IST Austria, ZLATKO PAPIC, University of Leeds, MAKSYM SERBYN, IST Austra, MIKHAIL LUKIN, Harvard University, DMITRY ABANIN, University of Geneva — A central postulate of statistical mechanics is that of ergodicity – a generic state prepared out of equilibrium is believed to explore its allowed phase phase and eventually thermalize. Recently, quench experiments in an interacting Rydberg atom array [Nature 551, 579 (2017)] demonstrated interesting nonequilibrium dynamics of a new kind: surprising periodic revivals and a lack of thermalization from certain simple initial states, while quick relaxation and equilibriation from others. Here we show that these observations are attributed to the presence of a small number of exceptional, nonthermal many-body eigenstates dubbed "quantum many-body scars" that violate the eigenstate thermalization hypothesis. Furthermore, underlying this behavior is an isolated periodic orbit captured in a suitable "semiclassical" analysis using matrix product states, which suggest a connection to scars in single-particle chaotic systems. Lastly we present work uncovering a nearby parent Hamiltonian that hosts perfect many-body scars, and construct a toy model with similar phenomenology. Quantum many-body scarring represents a new class of quantum dynamics in strongly interacting systems resulting from a weak form of ergodicity breaking, with direct experimental signatures.

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