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Quantum Control by Imaging: The Zeno Effect in an Ultracold Lattice Gas[1] YOGESH SHARAD PATIL, SRIVATSAN CHAKRAM, MUKUND VENGALATTORE, Cornell University — We demonstrate the control of quantum tunneling in an ultracold lattice gas by the measurement backaction imposed by an imaging process. A *in situ* imaging technique is used to acquire repeated images of an ultracold gas confined in a shallow optical lattice. The backaction induced by these position measurements modifies the coherent quantum tunneling of atoms within the lattice. By varying the rate at which atoms are imaged, we observe the crossover from the weak measurement regime, where the measurement has a negligible effect on coherent dynamics, to the strong measurement regime, where measurement-induced localization leads to a dramatic suppression of tunneling. The latter effect is a manifestation of the Quantum Zeno effect [1]. We thereby demonstrate the paradigmatic Heisenberg microscope in a lattice gas, and shed light on the implications of quantum measurement on the coherent evolution of a mesoscopic quantum system. Our technique demonstrates a powerful tool for the control of an interacting many-body quantum system via spatially resolved measurement backaction.

[1] Y. S. Patil *et al.* arXiv:1411.2678

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Yogesh Sharad Patil
Cornell University

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