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Abstract for an Invited Paper
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Quench and Transport Dynamics in Disordered Atomic Hubbard Lattices[1]

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I will give an overview of our experiments using ultracold atom gases trapped in optical lattices to probe transport, dynamics, and relaxation in disordered Hubbard models. By introducing disorder to naturally clean optical lattices using focused optical speckle, we realize variants of the disordered Bose- and Fermi-Hubbard models. In these systems, the distribution of Hubbard parameters is fully known, and the ratio of characteristic energy scales is completely tunable. I will discuss two measurements. In the first, we observe localization via transport measurements in the metallic regime of the Fermi-Hubbard model. We observe three phenomena consistent with many-body localization: localization at non-zero temperature, localization across a range of temperatures, and interaction-induced delocalization. These measurements show agreement with a mean-field theory in a limited parameter regime. In a separate experiment using bosonic atoms, we measure excitations following a quantum quench of disorder. Via comparison to state-of-the-art quantum Monte Carlo calculations that capture all aspects of the experiments—including all the particles—we show that the onset of excitations corresponds to the superfluid–Bose-glass transition. I will discuss how this behavior is reminiscent of the quantum Kibble-Zurek effect.

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