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Breakdown of superfluid flow in a moving lattice JONGCHUL MUN, PATRICK M. MEDLEY, DAVID A. HUCUL, DAVID M. WELD, DAVID E. PRITCHARD, WOLFGANG KETTERLE, MIT-Harvard Center for Ultracold Atoms, Research Laboratory of Electronics, Massachusetts Institute of Technology
— The stability of superfluid currents in strongly interacting ultracold bosons was studied using a moving optical lattice. The critical momentum for a stable current was found to vary continuously from 0.5 recoil momentum in a weakly interacting superfluid (SF) to zero in the Mott insulator (MI) phase. This critical momentum was measured at various lattice depths, and the phase diagram was obtained. This measurement also enabled us to precisely determine the critical lattice depth for the SF-MI phase transition. The critical lattice depth was measured to be 13.5 recoil energy for a three- dimensional gas. When a one-dimensional gas was loaded into a moving optical lattice, a broadening of the transition between stable and unstable phases was observed.

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