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Superfluid-insulator transition in moving boson lattice systems EHUD ALTMAN, ANATOLI POLKOVNIKOV, EUGENE DEMLER, BERTRAND HALPERIN, MIKHAIL LUKIN, Department of Physics, Harvard University — We analyze the stability of superfluid currents in a system of strongly interacting ultra-cold atoms in an optical lattice. We show that such a system undergoes a dynamic, irreversible phase transition at a critical momentum that depends upon the interaction strength between atoms. At integer filling of the lattice, the phase boundary continuously interpolates between the classical modulation instability of a weakly interacting condensate and the equilibrium quantum phase transition into a Mott insulator state at which the critical momentum vanishes. For fractional filling, the critical momentum dips to a minimum at intermediate interaction strength, but saturates to the same limiting value at both strong and weak interactions.

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