

Abstract Submitted
for the DAMOP05 Meeting of
The American Physical Society

Superfluid-insulator transition in a moving system of interacting bosons ANATOLI POLKOVNIKOV, EHUD ALTMAN, EUGENE DEMLER, BERT HALPERIN, MIKHAIL LUKIN, Physics Department, Harvard University — We analyze 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 phase gradient that depends on the interaction strength between atoms. At commensurate filling, 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 current vanishes. We argue that quantum fluctuations smear the transition boundary in low dimensional systems. Finally we discuss the implications to realistic experiments.

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Date submitted: 28 Jan 2005

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