

Abstract Submitted
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Effects of Disorder on a Bose-Einstein Condensate with Tunable Interaction: Transition to an Insulator and Loss of Phase Coherence¹

YONG P. CHEN, J. HITCHCOCK, D. DRIES, M. JUNKER, C. WELFORD, R.G. HULET, Department of Physics and Astronomy and Rice Quantum Institute, Rice University, Houston TX 77005 USA — We report our study of the effects of disorder on a Bose-Einstein condensate (BEC) of ^7Li atoms with tunable interaction. A large ^7Li BEC is created in an elongated optical trap after forced evaporation. The strength of the repulsive interaction is tuned using a magnetic Feshbach resonance. A disordered optical potential, whose strength is also tunable, is generated by projecting a laser speckle pattern onto the atoms. We have performed transport studies by measuring the center of mass motion of the trapped BEC in the presence of disorder. Beyond a disorder strength (V_t), the dipole oscillation of the superfluid BEC is completely suppressed, signaling a transition to an insulator. We have also studied the time of flight expansion of the BEC after release from the trap and disordered potentials. With intermediate disorder strengths, striking fringes appear in the cloud after sufficient expansion time. Beyond some disorder strength (V_p), comparable to the chemical potential of the trapped BEC, the fringes are washed out, signaling a loss of phase coherence. Interestingly, V_p is significantly larger than V_t , suggesting that finite phase coherence can still exist in the insulator.

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