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Dissipative Transport of a Bose-Einstein Condensate with Tunable Interactions[1] D. DRIES, S.E. POLLACK, J. HITCHCOCK, R.G. HULET, Department of Physics and Astronomy and Rice Quantum Institute, Rice University, Houston, TX 77005 — We study the superfluid nature of a BEC in an optical dipole trap combined with either a disordered potential or a single Gaussian defect. Through measurement of the damping of the collective dipole mode, we characterize the velocity dependence of the dissipative transport, as well as its dependence on disorder or defect strength. For both a disorder potential and a single Gaussian defect, we observe weak or no damping for a BEC velocity $v \gg c$, maximum damping for $v \sim c$ and weak damping for $v \ll c$ where c is the speed of sound in the BEC. For the case of a single defect, we observe a critical velocity for damping that depends on defect strength. *In situ* images of quasi-1D BECs provide evidence that the damping is driven, in part, by dark soliton formation. Time-of-flight images of condensates in the 3D regime also provide evidence of dark soliton formation. In this regime strong damping is observed, even for weak disorder or defect strength. We also investigate the nature of the damping for different values of the s-wave scattering length a with $0.1\,a_0 < a < 200\,a_0$.

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