Abstract Submitted
for the DAMOP12 Meeting of
The American Physical Society

Fundamental Atomtronic Circuit Elements JEFFREY LEE, BRIAN MCILVAIN, CHRISTOPHER LOBB, WENDELL T. HILL III, Joint Quantum Institute, University of Maryland, College Park, MD 20742 USA — Recent experiments with neutral superfluid gases have shown that it is possible to create atomtronic circuits analogous to existing superconducting circuits. The goals of these experiments are to create complex systems such as Josephson junctions. In addition, there are theoretical models for active atomtronic components analogous to diodes, transistors and oscillators. In order for any of these devices to function, an understanding of the more fundamental atomtronic elements is needed. Here we describe the first experimental realization of these more fundamental elements. We have created an atomtronic capacitor that is discharged through a resistance and inductance. We will discuss a theoretical description of the system that allows us to determine values for the capacitance, resistance and inductance. The resistance is shown to be analogous to the Sharvin resistance, and the inductance analogous to kinetic inductance in electronics. This atomtronic circuit is implemented with a thermal sample of laser cooled rubidium atoms. The atoms are confined using what we call free-space atom chips, a novel optical dipole trap produced using a generalized phase-contrast imaging technique. We will also discuss progress toward implementing this atomtronic system in a degenerate Bose gas.

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Date submitted: 27 Jan 2012 Electronic form version 1.4