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**Experimental Study of a Bose Superfluid "Battery" for Atomtronics** DANA Z. ANDERSON, SETH C. CALIGA, CAMERON J.E. STRAATSMA, Department of Physics and JILA, University of Colorado, and NIST — The two component model of superfluids describes a thermo-mechanical force in which a thermal gradient across the fluid causes a counter-propagating flow of the normal and superfluid components, with the superfluid current propagating toward the "hot" portion of the container and the normal component towards the "cold." We observe the energy and flux of a Bose-condensed gas flowing over a barrier in a hybrid magnetic and optical trap using a high-resolution atom chip projection and in-trap imaging system. We introduce a thermal gradient using asymmetric cooling of the condensed gas and the resulting thermo-mechanical force induces a supercurrent flow over the barrier. We observe, as expected, that the energy of the atoms emerging from the barrier is determined by the barrier height. We show that, like the "fountain effect" seen in liquid helium-4, the energy of the emerging atoms can be many times higher than the chemical potential as well as the thermal energy of the condensate. Through these experiments we establish that a reservoir of Bose-condensed atoms combined with a cooling mechanism can serve as a "battery" to drive the current in an atomtronic circuit.

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