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A Matterwave Transistor Oscillator SETH C. CALIGA, CAMERON J.E. STRAATSMA, DANA Z. ANDERSON, Department of Physics and JILA, University of Colorado, and NIST — We perform experiments with an Rb87 Bose-condensed gas in a magnetic trap separated into three regions by a pair of blue-detuned optical barriers, forming a transistor-like structure having large “source” and “drain” regions separated by a narrow “gate” region. A condensate is produced in the source by forced RF evaporative cooling. While atom number and chemical potential of the source atoms are determined by traditional time of flight methods, we observe the flux and energy of the drain atoms emerging from the gate-drain barrier with a high resolution (NA=0.6) in-trap absorption imaging system. Asymmetric cooling of the trap causes a thermo-mechanically induced superfluid current to flow from the source to the gate over the source-gate barrier. Feedback through superfluid coupling between the source and the gate maintains near equality of the source and gate chemical potentials while superfluid flow continues to cause atoms to emerge from the gate into the drain. A resonant “terminator” beam illuminating the drain region effectively couples emerging gate atoms to the vacuum. By turning off the terminator beam shortly before snapping an absorption image we determine both the atom flux and the atom energy. With an appropriate choice of cooling schedule, barrier heights, and separations, the gate emits a monoenergetic beam of atoms. We establish that this system is a superfluid analog of an antenna-coupled transistor- oscillator circuit in which the dual of the electromagnetic wave is a matterwave.

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