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Superfluid Atomtronic Circuits STEPHEN ECKEL, FRED JENDRZEJEWSKI, AVINASH KUMAR, Joint Quantum Institute, NIST/UMD, MARK EDWARDS, Georgia Southern University, GRETCHEN CAMPBELL, Joint Quantum Institute, NIST/UMD — We present studies of superfluid atom circuit using a toroidal Bose-Einstein Condensate (BEC). Just as a current in a superconducting circuit will flow forever, if a current is created in our superfluid circuit, the flow will not decay as long as the current is below a critical value. A repulsive optical barrier across one side of the torus creates a tunable weak link in the condensate circuit and can be used to control the current around the loop. Using a second BEC as a phase reference, we have developed techniques to read out the phase around the ring and current flowing in the ring. These techniques allow us to measure the current-phase relationship of our weak link, a single function characterizes the superfluid properties of the weak link. We can also insert two weak links that move through the ring in opposite directions. In this case, we observe resistive flow when the current exceeds the critical current, and can measure the current-voltage relationship of our weak link. Lastly, we have studied the dynamics of persistent current decay in the system and temperature. These studies allow us to characterize the primary circuit component in our system, our weak link.

Stephen Eckel
Joint Quantum Institute, NIST/UMD

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