# Quantum Metastability in Atomtronic Superfluid Circuits

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The hallmark of superfluidity is the appearance of flow-states carrying a quantized metastable circulating current. Considering a unidirectional flow of particles in a ring, at first it appears that any amount of scattering will randomize the velocity, as in the Drude model, and eventually the ergodic steady state will be characterized by a vanishingly small fluctuating current. However, Landau and followers have shown that this is not always the case. If elementary excitations (e.g. phonons) have higher velocity than that of the flow, simple kinematic considerations imply metastability of the vortex state: the energy of the motion cannot dissipate into phonons. On the other hand if this Landau criterion is violated the circulating current can decay. We show [Arwas, Vardi, Cohen, Sci. Rep. 5, 13433 (2015)] that the standard Landau and Bogoliubov superfluidity criteria fail for low-dimensional atomtronic circuits. Proper determination of the flow-stability regime-diagram must account for the crucial role of chaos, Arnold diffusion, and dynamical localization.