Emergence of h/e-period oscillations in the critical temperature of small superconducting rings and critical velocity in one-dimensional superconductors
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When a large ring of superconductor is threaded by a magnetic flux, the resistance and the critical temperature exhibit oscillations in a flux quantum of $\hbar/2e$. The flux quantum of an electron circling a thread flux on a clean metallic ring is on the contrary $\hbar/e$. When the radius starts to shrink, electrons that compose of Cooper pairs may be able to roam around the ring individually without costing too much energy. An $\hbar/e$ period should thus arise. We discuss the emergence of $\hbar/e$-period oscillations in the critical temperature of small superconducting rings and a few scenarios of superconducting-normal metal transitions. Interestingly, a threading flux is equivalent to a momentum boost in the circumferential direction of the ring. We also discuss a related issue as to how high a flow velocity one-dimensional superconductors can sustain before superconductivity gives way to this instability and the system becomes normal.