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Emergence of h/e-period oscillations in the critical temperature of small superconducting rings and critical velocity in one-dimensional superconductors

TZU-CHIEH WEI, CN Yang Institute for Theoretical Physics, Stony Brook University

When a large ring of superconductor is thread by a magnetic flux, the resistance and the critical temperature exhibit oscillations in a flux quantum of h/2e. The flux quantum of an electron circling a thread flux on a clean metallic ring is on the contrary h/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 h/e period should thus arise. We discuss the emergence of h/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.