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Emergence of h/e-period oscillations in the critical temperature of small superconducting rings enclosing magnetic flux TZU-CHIEH WEI, Institute for Quantum Computing and Department of Physics and Astronomy, University of Waterloo, 200 University Ave. W., Waterloo, ON N2L 3G1, Canada, PAUL M. GOLDBART, Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801-3080, USA — The Little-Parks critical-temperature oscillations, with magnetic flux, of a large-radius hollow cylindrical superconductor have a period $h/2e$. This oscillation period reflects the binding of electrons into Cooper pairs. On the other hand, the single-electron Aharonov-Bohm oscillations in the resistance or persistent current in a clean metallic ring have period h/e. By using the Gor'kov approach to BCS theory, we investigate oscillations in the critical temperature of a superconducting ring, for radii that are comparable to the superconducting coherence length. In this regime, oscillations in the critical temperature of period h/e emerge, in addition to the usual Little-Parks-period oscillations. We argue that in the clean limit there is a superconductor-normal phase transition at nonzero flux, as the ring radius becomes sufficiently small, and that this transition can be either second- or first-order, depending on the ring radius and the external flux. In the dirty limit, we argue that the transition is rendered second-order, which results in continuous quantum phase transitions tuned by flux and radius.

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