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Capacitance, entanglement energetics and persistent currents of mesoscopic rings[1]

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Small rings are a quintessential mesoscopic system. As a consequence of quantum coherence small normal metal rings support a persistent current. Novel experimental techniques will permit to investigate rings with geometries which highlight the effects of interactions. We discuss rings with in-line and side quantum dots. In the Coulomb blockade regime we derive an effective two-state Hamiltonian and discuss the flux dependence of the Coulomb blockade peaks in the capacitance and the persistent current [1]. Different nearly degenerate charge configurations of the ring-dot system become entangled with an electrical environment. With an environment consisting of an external resistor capacitively coupled to the ring and dot the entire system maps on a spin boson problem. Analysis shows that the visibility of the persistent current decreases with increasing coupling to the environment [2]. The system-bath entanglement which is at the origin of this phenomenon can be detected by projective measurements of the energy of the ring-dot subsystem or the persistent current: even in the ground state of the total system the ring can be found with some probability in the energetically higher lying state [3]. The distribution of energy or of the persistent currents is a direct measure of the system bath entanglement.

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