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# Energy and temperature fluctuations in the single electron box

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## Abstract

In mesoscopic and nanoscale systems at low temperatures, charge carriers are typically not in thermal equilibrium with the surrounding lattice. The resulting, non-equilibrium dynamics of electrons has only begun to be explored. Experimentally the time-dependence of the electron temperature (deviating from the lattice temperature) has been investigated in small metallic islands. Motivated by these experiments we investigate theoretically the electronic energy and temperature fluctuations in a metallic island in the Coulomb blockade regime, tunnel coupled to an electronic reservoir, i.e. a single electron box. We show that electronic quantum tunnelling between the island and the reservoir, in the absence of any net charge or energy transport, induces fluctuations of the island electron temperature. The full distribution of the energy transfer as well as the island temperature is derived within the framework of full counting statistics. In particular, the low-frequency temperature fluctuations are analysed, fully accounting for charging effects and non-zero reservoir temperature. The experimental requirements for measuring the predicted temperature fluctuations are discussed.

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