Excess noise induced transport

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To demonstrate that the relative stability of non-equilibrium states cannot be found from local criteria, Landauer showed that hot spots in locations of phase space that might be only rarely visited can be decisive. Later, Büttiker [1] and van Kampen [2], investigated the noise induced transport generated by hot spots in systems with overdamped Brownian motion dynamics.

In electrical circuits hot spots occur naturally at places where energy is dissipated. Here we propose a controlled experiment which can demonstrate the appearance of directed current as a consequence of a hot spot. We investigate transport generated in Coulomb coupled electrical conductors from excess electric or thermal fluctuations at the coupling capacitance. Gate effects will be emphasized.

If one of the conductors supports a bias voltage, out of equilibrium charge fluctuations remove detailed balance in the unbiased system manifested in a drag current. Nonlinear fluctuation relations can nevertheless be obtained [3].

Coulomb coupled conductors permit separate directions of the heat and current flux [4]. In our model, one of the conductors is connected via only one lead to a hot reservoir. The other conductor connects to two leads. We investigate the minimal conditions needed to generate directed current flow for a system of two quantum dot conductors in which both energy and charge states are quantized. In quantum dots energy to current conversion can be optimal with one electron transferred for every heat quantum given up by the hot reservoir. We show that at the point of maximum power extraction the efficiency approaches one half of the Carnot efficiency.

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