Harvesting fluctuations at electrical hot spots

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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.

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. Non linear fluctuation relations can nevertheless be obtained [1].

Coulomb coupled conductors permit separate directions of the heat and current flux [2]. In our model, one of the conductors is connected via only one lead to a hot reservoir. The other conductor is connected to two leads. Such a geometry can be used for detection of non linear heat fluctuations [3]. 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. However, the generated power is small.

Larger currents can be generated in a chaotic mesoscopic cavity coupled to two leads. Non linearities due to energy dependent contact transmission to leads are responsible for the rectification of thermal fluctuations in a coupled hot cavity, leading to an electrical current [4]. The maximum power produced by the system will be discussed.

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