On the heat flux and entropy produced by thermal fluctuations

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Abstract

We study both experimentally and theoretically the statistical properties of the energy exchanged between two electrical conductors, kept at different temperature by two different heat reservoirs, and coupled by the electric thermal noise. Such a system is ruled by the same equations as two Brownian particles kept at different temperatures and coupled by an elastic force. We measure the heat flowing between the two reservoirs, the thermodynamic work done by one part of the system on the other, and we show that these quantities exhibit a long time fluctuation theorem. Furthermore, we evaluate the fluctuating entropy, which satisfies a conservation law. These experimental results are fully justified by the theoretically analysis. Our results give more insight into the energy transfer in the famous Feymann ratchet widely studied theoretically but never in an experiment. Starting from this example we also discuss the experimental results of the heat transfer between two Brownian particles kept at different temperatures