

Current and Future Trends in Stochastic Thermodynamics

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Experiments on thermodynamics, information, and control using a feedback trap

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We report experiments that test aspects of the interplay among thermodynamics, information theory, and control. Our goal is to explore the issues raised historically by Maxwell, Szilard, Landauer, Bennett, which have found renewed interest after the development of stochastic thermodynamics. Our setup consists of a time-dependent, "virtual" double-well potential created by a feedback loop that is much faster than the relaxation time of the particle. Focusing on tests of Landauer's principle of erasure, we extend Landauer's original scenario to cases where less than a full bit of information is erased. We show experimentally that the appropriate thermodynamic definition of a nonequilibrium system connected to a heat bath is given by the Gibbs-Shannon entropy function, evaluated over nonequilibrium probabilities. We also present preliminary results showing how our setup can be modified to model a combined system for work extraction and measurement.

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