3:30 pm • Friday December 7, 2012 • 2241 Chamberlin Hall • Coffee at 4:30 pm

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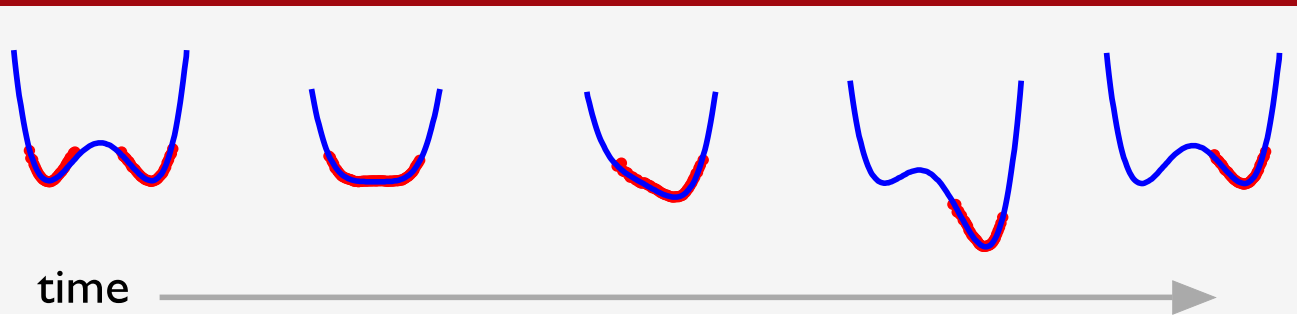
Testing Landauer's Principle in a feedback trap

Department of Physics Colloquium

WISCONSIN



Landauer's principle, formulated in 1961, postulates that irreversible logical or computational operations such as memory erasure require work, no matter how slowly they are performed. For example, to "reset to one" a one-bit memory requires a work of at least kT ln2, which is dissipated as heat. In 1982, Bennett pointed out a link to Maxwell's Demon: Were Landauer's principle to fail, it would be possible to repeatedly extract work from a heat bath.

We report tests of Landauer's principle in an experimental system, where a "virtual" double-well potential is created via a feedback loop. We observe the position of a charged, fluorescent, colloidal particle in water and calculate and then apply the appropriate force using an electric field. In a first experiment, the probability of "erasure" (resetting to one) is unity, and at long cycle times, we observe that the work is compatible with kT ln2. In a second, the probability of erasure is zero; the system may end up in two states; and, at long cycle times, the measured work tends to zero.

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