Experimental confirmation of Landauer’s principle\textsuperscript{1} JOHN BECHHOEFER, YONGGUN JUN\textsuperscript{2}, Simon Fraser University — Landauer’s principle, formulated in 1961, postulates that irreversible logical or computational operation such as memory erasure must dissipate heat, no matter how slowly they are performed. For example, to “reset to one” a memory that can be in state 0 or 1 requires at least $kT \ln 2$ of work, 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 the first confirmation 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 a force $= -\nabla U(x,t)$ via 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 $kT \ln 2$. 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.

\textsuperscript{1}Supported by NSERC, Canada
\textsuperscript{2}Present address: Department of Developmental and Cell Biology, School of Biological Sciences, Univ. of Calif., Irvine