Maximizing local violations of the second law with a single-electron transistor driven far from equilibrium

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We experimentally realize protocols that allow to extract work beyond the free energy difference from a single electron transistor at the single thermodynamic trajectory level. With two carefully designed out-of-equilibrium driving cycles featuring kicks of the control parameter, we demonstrate work extraction up to large fractions of k_BT or with probabilities substantially greater than 1/2, despite zero free energy difference over the cycle[1]. Our results are explained in the framework of nonequilibrium fluctuation relations[2]. We thus show that irreversibility can be used as a resource for optimal work extraction even in the absence of feedback from an external operator.

[1]O. Maillet *et al., Optimal probabilistic work extraction beyond the free energy difference with a single-electron device*, arXiv:1810.06274, under review.
[2]C. Jarzynski, *Nonequilibrium equality for free energy differences*, Physical Review Letters **78** (14), 2690.