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Measurement of the entropy production rate in a macroscopic replica of the Brownian ratchet

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A two-states device such as the Brownian ratchet can be regarded as both a “heat engine” and an “information engine”. From this dual perspective, long time series recorded in our centimeter-scale experimental setup [1] allow for a precise investigation of all the observables of interest. These are the heat flux supplied by the athermal hot bath at $kT_{\text{eff.}}$, the work produced per time unit, and, remarkably, the heat given to the surroundings at $k_{\text{B}}T_{\text{room}}$ (cold sink) [2]. This last heat flux is distinct from the various losses. Our experiment being at macroscopic scale, all the observables are time resolved. Processing realizations of the heat flux released to the cold sink thanks to a novel time-frequency filtering protocol, we inferred the “rate of entropy production” in the Boltzmann sense. We present a comprehensive characterization of the rate of entropy production. Our findings are compatible with a simple Poisson point process [2]. An interpretation of these results is proposed, some remaining questions are discussed. Possible generalization to other contexts is also proposed.
[1] M. Lagoin, C. Crauste-Thibierge, and A. Naert, Phys. Rev. Lett., 129, 120606 (2022).
[2] A. Meynard, M. Lagoin, C. Crauste-Thibierge, and A. Naert, unpublished.

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