Human-Scale Brownian Ratchet : A Historical Thought Experiment

M. Lagoin, C. Crauste-Thibierge, A. Naert.

Laboratoire de Physique de l'ENS de Lyon,
46 Allée d'Italie, 69364 Lyon Cedex 7, France
antoine.naert@ens-lyon.fr

We present an experimental realization at macroscopic scale of the storied Brownian ratchet, which is an illustration of the Maxwell's demon. In our mechanism, the rotation of a centimeter-scale 1D Brownian object in a granular gas is detected by an electromechanical converter (dynamo), generating a voltage proportional to its angular velocity. The current generated by this random rotation is rectified by an electronic device (demon), such that only positive current passes. Eventually, work can be produced. The advantage of such a macroscopic setup is to allow measurement of all the observables with time : useful power (work), heat taken from the bath, and finally the efficiency of the equivalent heat engine. The feedback allowing the conversion from heat into work expresses as a bias on the Brownian motion.

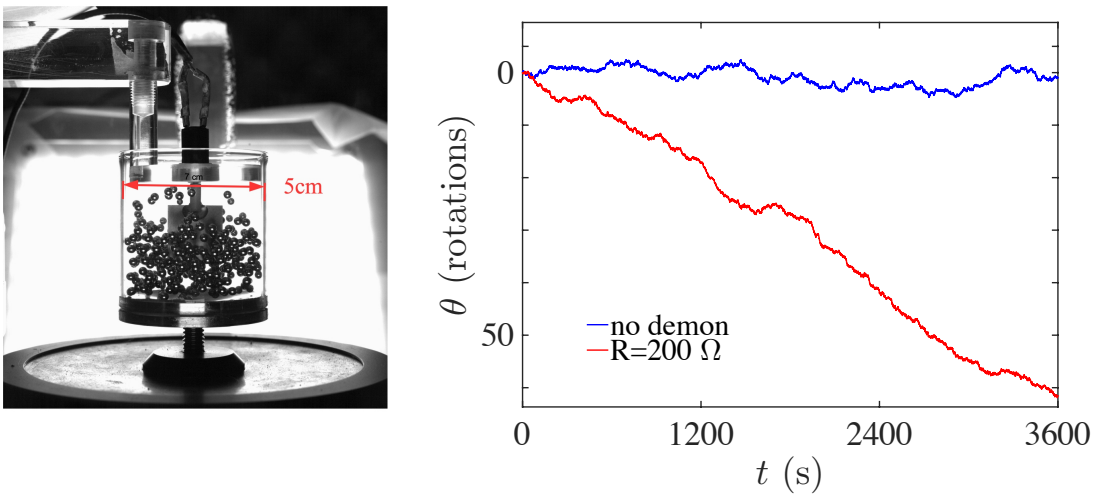

Figure 1. Left : Picture of the experimental system. The beads are vibrated vertically in a vessel by an electromagnetic shaker. A 2cm-diameter rotor is immersed in the grains, fastened on the shaft of a small dc motor. Right : realizations of Brownian trajectories, with and without the demon.

Références

M. Lagoin, C. Crauste-Thibierge , and A. Naert, *PHYS. REV. LETT.*, **129**, page, (2022).