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Modeling Maxwell's demon

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The apparent paradox of Maxwell's demon has inspired many discussions and analyses, ultimately pointing to the conclusion that there are fundamental thermodynamic implications associated with the processing of information. There is now a degree of consensus that a physical device could in principle do what Maxwell's hypothetical creature does – rectify thermal fluctuations to produce a decrease of thermodynamic entropy – provided this device would simultaneously write information to a physical memory register. Far less attention has been paid to the question of precisely *how* an autonomous physical device might accomplish this task. In this talk I will discuss three model systems that we have designed and investigated to address this issue. The first two are stochastic, exactly solvable models in which the demon-like device either converts heat into work [1], or creates a flow of heat against a thermal gradient [2]. The third model is explicitly mechanical, involving a contraption of paddles and axles immersed in a gas of particles; here the device systematically withdraws energy from the gas and delivers it to raise a mass against gravity [3]. These models offer simple paradigms for investigating the thermodynamics of information processing by autonomous physical systems.

[1] D. Mandal and C. Jarzynski, *Proc. Natl. Acad. Sci. (USA)* **109**, 11641 (2012).
[2] D. Mandal, H.T. Quan and C. Jarzynski (submitted).
[3] Z. Lu, D. Mandal and C. Jarzynski (in preparation).