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Artificial Brownian Ratchets on the Nanoscale Using Ultra-cold Rubidium Atoms ANDREW HACHTEL, MATTHEW GILLETTE, ETHAN CLEMENTS, SAMIR BALI, Miami University — It has been proposed that we may be able to harness, or direct, Brownian motion to create useful energy out of background thermal noise (without violating the laws of Physics) given that the system is being operated outside of equilibrium conditions. Recently, the field of nanotechnology has exploded with scientists trying to fabricate nanomachines that achieve efficiencies similar to that of the molecular motors, but with little success. Ultra-cold Rubidium atoms, which have been arranged into a periodic three-dimensional nanoscale crystalline structure created by the interference of counter-propagating laser beams, have been proposed as a promising testbed for simulating molecular motors. This is because such "designer crystals" are entirely defect-free and important crystal properties (such as lattice spacing and well depth) can be freely varied – this is obviously not the case for crystals found in nature. The ratcheting effect is created by introducing an asymmetry into the wells of the lattice, thus instigating directed transport. This ratcheting phenomenon, which allows for the direct control of atomic dynamics on the nanoscale, is of great interest in fundamental as well as applied science, for example in the new and exciting field of nanolithography.

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