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Abstract for an Invited Paper
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Brownian Motors from Biology to Quantum Electronics[1]

HEINER LINKE, University of Oregon

Molecular motors in living cells have solved a problem that nanotechnology still chews on: how to generate directed motion with a machine that is so small that thermal fluctuations are of substantial magnitude. From a physics point of view, a possible way of dealing with thermal fluctuations is to use them instead of fighting them – that is, to incorporate thermal fluctuations as an integral part of the operational principle of nanoscale machines. Motors based on this idea are called Brownian motors or thermal ratchets. To function, they require (i) thermal fluctuations, (ii) broken symmetry (a "ratchet"), and (iii) thermal non-equilibrium (a source of free energy). I will introduce the basic concepts of ratchets and Brownian motors in the context of biomolecular motors, and will present three different experimental systems: liquid droplets coaxed by a ratchet to move uphill, a concept for a DNA-based single-molecular motor, and new insights on thermoelectric power generation that are a direct spin-off from research into quantum ratchets.

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