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Colloidal Bandpass and Bandgap Filters[1] BENJAMIN YELLEN, 1) Duke University, 2) University of Michigan - Shanghai Jiao Tong University, Joint Institute, MUKARRAM TAHIR, Duke University, YUYU OUYANG, University of Michigan - Shanghai Jiao Tong University, Joint Institute, FRANCO NORI, Riken Institute, Japan — Thermally or deterministically-driven transport of objects through asymmetric potential energy landscapes (ratchet-based motion) is of considerable interest as models for biological transport and as methods for controlling the flow of information, material, and energy. Here, we provide a general framework for implementing a colloidal bandpass filter, in which particles of a specific size range can be selectively transported through a periodic lattice, whereas larger or smaller particles are dynamically trapped in closed-orbits. Our approach is based on quasi-static (adiabatic) transition in a tunable potential energy landscape composed of a multi-frequency magnetic field input signal with the static field of a spatially-periodic magnetization. By tuning the phase shifts between the input signal and the relative forcing coefficients, large-sized particles may experience no local energy barriers, medium-sized particles experience only one local energy barrier, and small-sized particles experience two local energy barriers. The odd symmetry present in this system can be used to nudge the medium-sized particles along an open pathway, whereas the large or small beads remain trapped in a closed-orbit, leading to a bandpass filter, and vice versa for a bandgap filter.

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Benjamin Yellen
1) Duke University, 2) University of Michigan -
Shanghai Jiao Tong University, Joint Institute

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