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**Applications of the ratchet effect at nano- and mesoscopic scales<sup>1</sup>**

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I will discuss the application the ratchet effect in superconducting vortex dynamics and interacting colloidal systems. We have shown theoretically how in superconductors patterned on sub-micron or nanometer scale with various pinning potentials a DC vortex transport and vortex manipulation can be achieved with an external AC drive. I will discuss several applications of the vortex ratchet effect as well as a series of experiments aimed at the detection and investigation of the vortex ratchet transport. For colloidal systems, we have recently shown that a rich variety of dynamic phases can be realized for mono- and bidisperse mixtures of interacting colloids under the influence of a symmetric flashing periodic substrate. With the addition of dc or ac drives, phase locking, jamming, and new types of ratchet effects occur. In some regimes we find that the addition of a non-ratcheting species increases the velocity of the ratcheting particles. We show that these effects occur due to the collective interactions of the colloids.

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