# Stochastic soliton ratchets

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Ratchet-like transport phenomena are identified as the net motion of particles or solitons generated by zero-average forces. Experiments in shaken drops, ferrofluids, optical lattices, and Josephson junctions [1, 2, 3] show the net transport of particles, cold atoms or fluxons under harmonic forces.

Solitons are nonlinear waves, which propagates with a constant velocity defined by the initial conditions. In particular, the so called kinks are exact solutions of the sine-Gordon equation

$$\Phi_{tt} - \Phi_{xx} + \frac{dU}{d\Phi} = 0, \qquad (1)$$

where the field $\Phi(x,t)$ depends both on the space $x$ and on the time, and $U(\Phi) = 1 - \cos\Phi$ represents the sine-Gordon potential. This system describe, for instance, the propagation of magnetic flux along the Josephson junctions [3].

The study of the symmetries of the equations fix the necessary conditions that the external forces must break in order to generate net motion of kinks or particles [4, 5, 6], regardless of the initial conditions.

Recently we have suggested a mechanism, in which no net force is necessary to induce net motion of the sine-Gordon kinks [7]. The motion is consequence of the transitions among different states of the potential. In this contribution we show a novel mechanism of soliton ratchets, in which these transitions occur stochastically. The importance of this mechanism is that huge average velocity can be achieved.

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