

Arcsine law and multistable Brownian dynamics in a tilted periodic potential

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Multistability is one of the most important phenomena in dynamical systems, e.g., bistability enables the implementation of logic gates and therefore computation. Recently multistability has attracted a greatly renewed interest related to memristors and graphene structures, to name only a few. We investigate tristability in velocity dynamics of a Brownian particle subjected to a tilted periodic potential. It is demonstrated that the origin of this effect is attributed to the arcsine law for the velocity dynamics at the zero temperature limit. We analyze the impact of thermal fluctuations and construct the phase diagram for the stability of the velocity dynamics. It suggests an efficient strategy to control the multistability by changing solely the force acting on the particle or temperature of the system. Our findings for the paradigmatic model of nonequilibrium statistical physics apply to, inter alia, Brownian motors, Josephson junctions, cold atoms dwelling in optical lattices, and colloidal systems.

[1] J. Spiechowicz and J. Łuczka, Phys. Rev. E 104 (2021) 024132