Stochastic resonance, synchronization and transport in systems driven by Lévy noises

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A standard approach to analysis of noise-induced effects in stochastic dynamics assumes a Gaussian character of the noise term describing interaction of the analyzed system with its complex surroundings. An additional assumption about the existence of timescale separation between the dynamics of the measured observable and the typical timescale of the noise allows external fluctuations to be modeled as temporally uncorrelated and therefore white. However, in many natural phenomena the assumptions concerning the abovementioned properties of "Gaussianity" and "whiteness" of the noise can be violated. In this context, so called Lévy flights correspond to the class of Markov processes which still can be interpreted as white, but distributed according to a more general, infinitely divisible, stable and non-Gaussian law. Lévy noise-driven non-equilibrium systems are known to manifest interesting physical properties and have been addressed in various scenarios of physical transport exhibiting a superdiffusive behavior.

In order to document and discuss the widespread presence in nature of the stochastic resonance phenomenon, we investigate the generic double-well potential model perturbed by the α-stable Lévy type noises. Our research focuses on the analysis of the influence of noise parameters on a shape of SR measures, revealing presence and robustness of the SR in the system at hand. In addition to the discussion of the SR, a brief summary of stochastic dynamics under the influence of Lévy white noise perturbations will be given. In particular, problems of synchroznization and directed transport (ratcheting effect) will be covered.

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