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Talks (continued)

The bistable system: an archetypal model for complex systems

Bernardo Spagnolo[1] (work done with P. Caldara[1], A. La Cognata[1], D. Valenti[1], A. Fiasconaro[2,3]),
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Abstract: Bistable systems often play the role of archetypal models to understand the dynamical behavior of complex systems. Examples range from microphysics to macrophysics, biology, chemistry and also econophysics. Moreover the statistical mechanics is essential to study the physical properties of complex systems and to investigate stochastic systems in which the microscopic degrees of freedom behave collectively over large scales. We investigate the nonlinear relaxation in a bistable system in classical and quantum systems. (i) As a first classical system, the role of the multiplicative and additive noise in the mean life time of the metastable state of an asymmetric bistable system is investigated. This model is useful to describe the dynamical behavior of an out of equilibrium Ising spin system. Nonmonotonic behavior of the average lifetime as a function of both additive and multiplicative noise source intensities is found. (ii) The role of a non-Gaussian Lévy noise on the nonlinear dynamics of: a) a particle moving in a metastable system, b) an ecosystem composed by two competing species interacting with the surrounding environment, and c) a short overdamped Josephson junction is investigated. a) By using the backward fractional Fokker–Planck equation we investigate the barrier crossing event and the nonlinear relaxation time for a metastable system; b) In the ecosystem, the role of two non-Gaussian noise sources in the exclusion and coexistence regimes is analyzed. Quasiperiodic oscillations and stochastic resonance phenomenon in the dynamics of the competing species are found; c) In the short overdamped Josephson, the mean escape time of the junction is investigated considering Gaussian, Cauchy-Lorentz and Lévy-Smirnov probability distributions of the noise signals. In these conditions we find resonant activation and the first evidence of noise enhanced stability in a metastable system in the presence of Lévy noise. For Cauchy-Lorentz noise source, trapping phenomena and power law dependence on the noise intensity are observed. (iii) Finally the dynamics of a quantum particle subject to an asymmetric bistable potential and interacting with a thermal reservoir is investigated. We obtain the time evolution of the population distributions in the position eigenstates of the particle, for different values of the coupling strength with the thermal bath. The calculation is carried out by using the Feynman-Vernon functional under the discrete variable representation.