Recent experiments on autonomous stochastic resonance

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We present a study on the dynamics of two different physical systems: a metal-ferroelectric-semiconductor (MFS) hetero-structure and an electrical discharge double layer (DL) plasma. Autonomous stochastic resonance is observed in both systems. In the first system, a low frequency harmonic oscillation is emerging stimulated by the chaotic signal generated in the physical system itself under high frequency driving. In the second system, a transition from a stationary state to an oscillatory one is induced by injection of Gaussian noise from a separate generator. In both cases, the curves of the signal to noise (signal to chaos) ratio with respect to the noise (chaos) level show the characteristic stochastic resonance behavior with a maximum for a particular value thereof.

The MFS hetero-structure plays the role of nonlinear capacitance in a series RLC circuit driven harmonically at high frequency (close to 100kHz). With decreasing the frequency of the driving at constant amplitude, the system presents a period doubling sequence and chaotic behavior is detected at about 96kHz. The chaotic dynamics persists for a wide range of frequencies below this value and the level of the chaotic spectral component increases with decreasing the frequency of the driving [**?**]. For a value of the frequency slightly below the setting in of the chaotic dynamics, a low frequency harmonic appears. Initially, the amplitude of this spectral component increases faster than the level of chaos. For further decreasing of the frequency, the situation reverses such that the curve of the signal to noise ratio versus the chaos level has a marked maximum. The shape of the curve is very close to that characteristic of stochastic resonance.

The DL plasma is created in the inter-anode space of a discharge system consisting of two independent electrical discharges running in the same glass tube. The dynamics of the plasma is controlled by a dc voltage source connected between the two anodes. For a threshold value of the biasing, the DL dynamics passes from a stationary state to an oscillatory one [**?**]. From the dynamical systems point of view, a Hopf bifurcation takes place on the crossing of this threshold. The experiment is carried out for a value of the biasing below the threshold. The main procedure consists of spectral analysis of time series obtained for different levels of a Gaussian noise from a waveform generator in series with the dc biasing.

We proposed a computational model consisting of a modified van der Pol system which well reproduces the experimentally observed behavior.

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[1] C.P. Cristescu, C. Stan and D. Alexandroaei, *Phys. Rev. E* **70**, 016613 (2004).

[2] B. Mereu, C.P. Cristescu and M. Alexe, *Phys. Rev. E* **71**, 047201 (2005).