Wave Patterns in Noisy Excitable Media

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Different aspects of the role of the external fluctuations acting on the excitability of extended active media supporting wave propagation will be reviewed. The experimental reference situation consists in the light-sensitive Belousov-Zhabotinsky reaction. Spatio-temporally distributed noise can be thus easily imposed on the system by projecting the desired patterned illumination controlling the excitability of the medium.

The first considered situation refers to the dispersive effects of distributed and time dependent noise acting on 2D spiral waves The wandering motion of the spiral tip is found to display brownian characteristics, with an effective diffusion coefficient which largely depends on the time and length scales of the noise relative to those of the spiral wave. Numerical simulations based on a two-variable reaction-diffusion scheme (Oregonator model) supplement the experimental results. The proposed analytical approach is based on a noise-forced kinematic model whose results are compared favorably with experiments and numerics. As an extension of the previous situation, we numerically and analytically investigate the dynamics of three-dimensional scroll waves. The second addressed scenario corresponds to situations of noise-supported waves under subexcitable averaged conditions (subexcitable-excitable transition) and noise-sustained target patterns under purely excitable conditions (excitable-oscillatory transition). These two striking examples of the positive effect of noise on active extended systems will be presented again with reference to experimental observations, together with analytical and numerical results.

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