

Experiments in Living Neuronal Networks: Dynamics and Avalanche Phenomena in a Dish

The flexibility and relative simplicity of neuronal cultures make them excellent tools to investigate connectivity and dynamics in living neuronal tissues, and in a control manner. Neuronal cultures are prepared by seeding dissociated neurons onto a substrate. Neurons quickly connect to one another and shape within a week a network with rich spontaneous activity. In this talk I will present different experimental studies, combined with theoretical modelling and simulations, aimed at assessing the connectivity of these in vitro networks and the ingredients that govern the initiation of spontaneous activity. An interesting feature of our observations is the existence of avalanches of neuronal activity, either spontaneous or induced. The analysis of these avalanches provides interesting insight on connectivity and dynamical traits of the living neuronal networks, such as the average connectivity, the importance of metric correlations, or noise-driven activity amplification mechanisms. These studies illustrate the power of Physics to uncover key features of biological systems that would be very difficult to extract otherwise.