University of Texas at San Antonio

Department of Physics & Astronomy

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Time: 3:00 p.m.-4:00 p.m.

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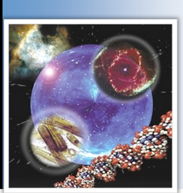
Break-down of Classical Reaction-diffusion Processes in Neurons

Probably, all of you would agree that the nervous system, even a single neuron is complex. In this case, we call complexity to the aggregate effect of multiple structural or metabolic elements at a wide-range of spatial and temporal scales. However, classical physicist and biologist have assumed that it is possible to find a compartment small enough in a cell that can be considered in thermodynamical equilibrium. In such compartments, the concentration of reactants, voltage, and currents are constant. The purpose of this talk is to show you that there are several cases in which classical reaction-diffusion theory is not applicable to study neuronal function. First, I will show experimental evidence in which classical diffusion breaks-down, resulting in anomalous diffusion. Then I will introduce a model of random walk with randomly distributed waiting times to explain the results. Furthermore, this computational model is capable of explaining different reaction-diffusion processes in neurons at different biological and physical scales. I will finish by presenting a theoretical framework which uses a fractional reaction-diffusion equation to study biochemical reactions away from thermodynamical equilibrium .This framework incorporates the structural properties of neurons responsible for anomalous diffusion and their effect on reaction-diffusion processes.



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