Neurotheory Forum

Firing Homeostasis in Neural Circuits: From Basic Principles to Malfunctions

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Neural circuit functions are stabilized by homeostatic mechanisms at long timescales in response to changes in experience and learning. However, we still do not know which specific physiological variables are being stabilized, nor which cellular or neural-network components comprise the homeostatic machinery. At this point, most evidence suggests that the distribution of firing rates amongst neurons in a brain circuit is the key variable that is maintained around a circuit-specific set-point value in a process called firing rate homeostasis. Here, I will discuss our recent findings that implicate mitochondria as a central player in mediating firing rate homeostasis and its impairments. While mitochondria are known to regulate neuronal variables such as synaptic vesicle release or intracellular calcium concentration, we searched for the mitochondrial signaling pathways that are essential for homeostatic regulation of firing rates. We utilize basic concepts of control theory to build a framework for classifying possible components of the homeostatic machinery in neural networks. This framework may facilitate the identification of new homeostatic pathways whose malfunctions drive instability of neural circuits in distinct brain disorders.

Friday, February 19, 2021 03:00pm - 04:00pm
Online

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