Joint DANDRITE-Biomedicine/Neuroscience Seminar

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Space and time: Internal dynamics of the brain's entorhinal cortex

In mammals, space is mapped by specialized position-coding cell types in entorhinal cortex and hippocampus, including entorhinal grid cells, which are active only when animals are at locations that tile environments in a periodic hexagonal pattern. I will show how space-coding neurons in the medial entorhinal cortex (MEC) collectively form a low-dimensional network representation that persists across behavioral tasks and activity states. The nature of this representation provides important clues about underlying mechanisms of the grid pattern. I will further ask how entorhinal networks are organized in time. To determine how activity is self-organized in the MEC network, we have tested mice in a spontaneous locomotion task under sensory-deprived conditions, when activity is determined primarily by the intrinsic structure of the network. Using 2-photon calcium imaging, we monitored the activity of several hundreds of MEC layer-2 neurons. We find a striking presence of stereotyped sequence elements in the network activity. These may be recruited during encoding of space, and more widely experience, in the entorhinal-hippocampal network. Deficiencies in these mechanisms may be at the core of neurological diseases characterized by early entorhinal cell death, spatial disorientation and memory dysfunction, such as Alzheimer´s disease.

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