Neural coding of space and time in entorhinal cortex

Prof. Michael Hasselmo
Director, Center for Systems Neuroscience
Boston University

Neurophysiological recordings from brain regions in behaving rodents demonstrate neuron response properties that may code space and time for memory guided behavior. These responses include the coding of spatial dimensions of animal behavior by grid cells (Moser and Moser, 2008), place cells (O'Keefe and Burgess, 2005), and boundary cells (Lever et al., 2009), and the coding of temporal dimensions of behavior by time cells (Kraus et al., 2013; 2015). Manipulations of input to the cortex from the medial septum influences network oscillatory dynamics such as theta rhythm as well as the cortical coding of space (Brandon et al., 2011) and time (Wang et al., 2014). These effects on the coding of space and time may involve modulation of cellular neural mechanisms of resonance and rebound spiking (Giocomo et al., 2007; Shay et al., 2015) and persistent spiking (Yoshida et al., 2013; Tiganj et al., 2015). Models demonstrate how intrinsic properties may contribute to coding of space and time, while addressing data on spiking activity showing theta phase precession and theta cycle skipping (Climer et al., 2013; Brandon et al., 2013). Modeling has also addressed the potential mechanism of influence of visual stimuli on grid cells (Raudies and Hasselmo, 2015) and the role of grid cells in goal-directed spatial navigation (Erdem and Hasselmo, 2014).