Workshop: MULTIPLE TIME SCALES IN THE DYNAMICS OF THE NERVOUS SYSTEM June 18-20

Requested oral presentation by Paul Miller.

Title: **Stochastic transitions in neuronal systems: taste, decisions and timing.**

Abstract:
Stochastic transitions, or barrier-hoppings, between discrete states is a means whereby fast noise at a small scale can get amplified into slower, larger scale random fluctuations. Whereas such fluctuations can be detrimental for information storage in memory, they can provide a useful means for computations such as timing and decision-making. Here we describe how stochastic transitions between discrete attractor states can produce mechanisms for timing and in some cases more reliable decision-making than deterministic integration.

Experimental observation of such stochastic behavior is limited by the ubiquitous across-trial averaging, which renders any randomly timed sharp transition into a smoothed, gradual change. However, Hidden Markov (HM) modeling is an approach that utilizes the variability across trials to produce a model of stochastic state transitions. We present such an HM analysis of extracellular electrode recordings from the gustatory cortex of awake rats during taste processing. The HM analysis suggests a dynamics consisting of transitions with variable timing, through taste-specific sequences of discrete states. We reproduce these coarse-grained results with two distinct types of cortical model, one based on stochastic transitions between deterministically stable states, the other based on a deterministically chaotic network. We discuss how a finer analysis of the experimental data can differentiate the two model networks, with the aim of clarifying the dynamical basis of cortical processing.