**LABORATORY OF COMPUTATIONAL NEUROSCIENCE (LCN)**

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# Thursday, May 10th, 2012

# Swiss Computational Neuroscience Series in ETHZ, Zurich

## 15h00 - Dr. Arnd ROTH

### London Centre for Nanotechnology

## *The power of the single neuron*

This talk will focus on the role of dendritic morphology in shaping the input-output relation of a single neuron, and the influence of the single neuron on network dynamics in the neocortex.

How does dendritic morphology shape the functional architecture of different types of neurons? Using compartmental models of reconstructed neurons endowed with the same distribution of active conductances we isolate morphology as the only variable. We show that the spread of subthreshold synaptic potentials, the forward- and backpropagation of action potentials in dendrites, the conditions for initiation of local dendritic spikes as well as the interaction of somatic and dendritic action potential initiation sites depend on the dendritic branching pattern of the neuron.

Although it is well known that neural activity in the neocortex is highly variable, it has been difficult to determine whether this variability is noise or whether it carries important information. We address this issue from the bottom up, by asking whether small perturbations to neural activity in vivo are amplified. We find that, in rat barrel cortex, a perturbation consisting of a single extra spike in one neuron produces approximately 28 additional spikes in its postsynaptic targets. Theoretical analysis shows that this amplification leads to intrinsic, stimulus-independent variations in membrane potential on the order of ±2.2-4.5 mV. These variations are purely noise, and do not carry any information. Therefore, for the brain to perform reliable computations, it must use a code that is robust to this variability, such as a rate code.