

**This Friday, 10<sup>th</sup> Dec, 4 p.m. at the BCCN, Philippstraße 13**

## **Dan Johnston**

**Center of Learning and Memory,  
University of Texas, Austin, USA**

**Will give a talk for the Neuroscience Colloquium, titled**

### **Plasticity of dendritic excitability**

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The dendrites of hippocampal pyramidal neurons express numerous types of voltage-gated ion channels. The properties and/or distributions of these channels in the dendrites are very non-uniform and highly regulated. We have investigated long-term changes in voltage-gated channels in hippocampal CA1 pyramidal neurons following the induction of long-term potentiation (LTP) and long-term depression (LTD). We have found that there are activity-dependent, and bi-directional, changes in the intrinsic excitability of these neurons with LTP and LTD. The changes in ion channels occur in parallel to those at the synapse and affect both the local and overall excitability of the neuron. The change in local excitability can increase the probability that a given synaptic input fires the cell while a change in the overall excitability of the neuron may act to stabilize its firing rate following experience dependent plasticity.

One type of bi-directional change in excitability associated with synaptic plasticity appears to involve the hyperpolarization activated "h" channel, which is comprised of HCN1 and HCN2 subunits in CA1 neurons. There are also bi-directional changes in h channels at different time points following a sustained seizure. These changes in h channels (or  $I_h$ ) can decrease and increase, respectively, the overall excitability of CA1 neurons and represent a form of homeostatic plasticity. In the present work we explored some of the mechanisms involved in the regulation of  $I_h$  in these neurons. We found that the depletion of intracellular calcium stores, or what has been called "ER stress", produced an increase in  $I_h$ . This increase in  $I_h$  required IP3 receptors, store operated calcium channels, and protein kinase A activity. We propose this as a homeostatic mechanism that protects neurons after depletion of calcium stores triggered through altered network activity during pathological conditions. In other work stemming from the changes in  $I_h$  associated with epilepsy, we explored the role of an important auxiliary subunit (TRIP8b) that regulates the trafficking and surface expression of h channels. A mouse in which the gene for TRIP8b was deleted shows profound deficits in  $I_h$  in both soma and dendrites of these neurons. H channels appear to be very "plastic" and highly regulated in CA1 neurons.