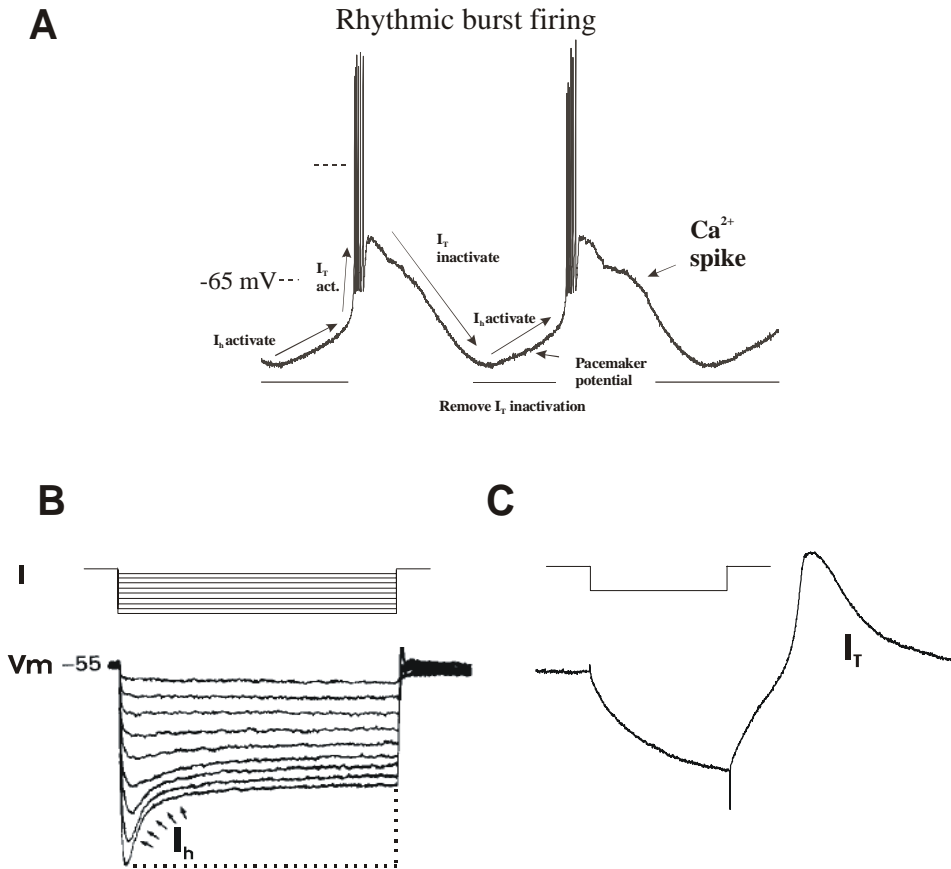


4. Active properties of neurons part II: Interacting voltage-gated channels can give rise dynamic states (Room #757, Monckton)



Rhythmic oscillations are of great importance in many biological processes such as the pacing of the heart, generation of sleep spindles in the brain, and coordinated movement of flagella in sperm. These oscillations arise through the delicate interplay between different voltage sensitive ion channels. Two such channels are I_h , hyperpolarization-activated mixed cationic channel (B), and I_T , a low-threshold calcium current (C). To demonstrate the fundamental properties of these channels, whole cell patch clamp recordings will be used in a thalamic brain slice preparation. (A) Rhythmic burst firing of a thalamic neuron may be observed while in current clamp when the neuron's membrane potential is relatively hyperpolarized. The regions in the cycle where each channel contributes to the oscillation are indicated.

The behavior of I_h and I_T can be observed separately using pharmacological and electrophysiological manipulations. I_h is a voltage sensitive cyclic nucleotide gated channel which opens in response to hyperpolarizing membrane potential shifts and acts to depolarize the cell. I_T is a low-threshold channel that opens in response to depolarizing shifts in membrane potential and allows Ca^{+2} into the cell resulting in a rapid depolarization. One fundamental difference between these two channel is that I_T has an inactivation gate whereas I_h does not. We will explore many of these properties during the lab demonstration.