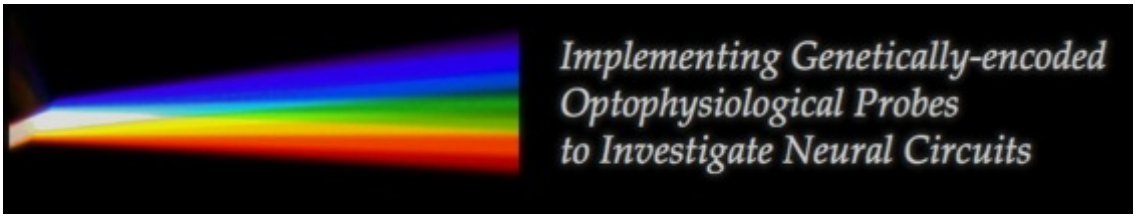
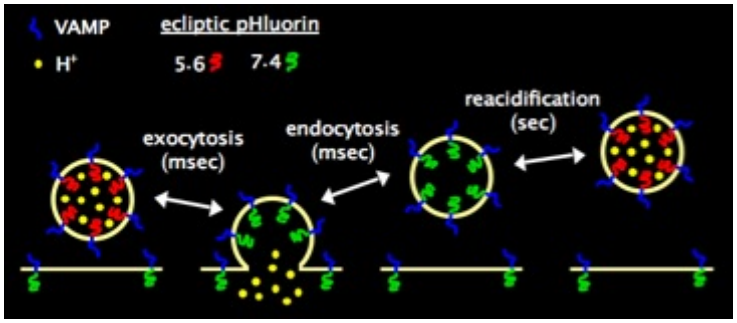
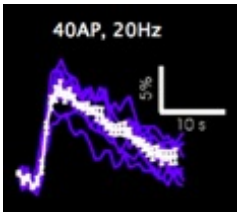
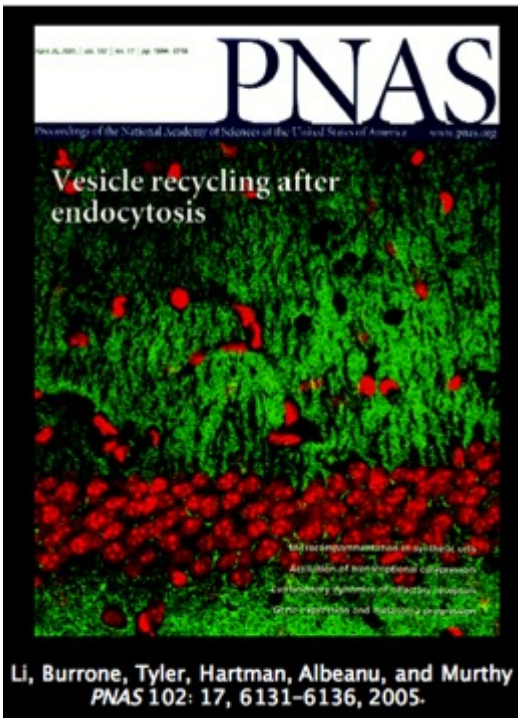


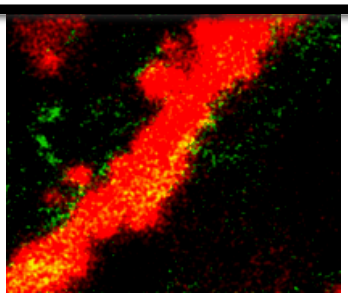
We are taking advantage of several recent technical breakthroughs, which combine genetics and optical imaging. By inducing the expression of specific proteins, which respond to light activation in different manners (genetically-encoded optophysiological probes) we can monitor synaptic activity and/or control neuronal activity using light in a relatively non-invasive manner. We are also exploring new methods and uses for these tools. In the coming decade(s), there is little doubt the use of optogenetic tools will change the face of biology.

One probe synaptopHluorin (spH) permits the study of synaptic vesicle exo/endocytosis at individual synapses by reporting changes in pH.



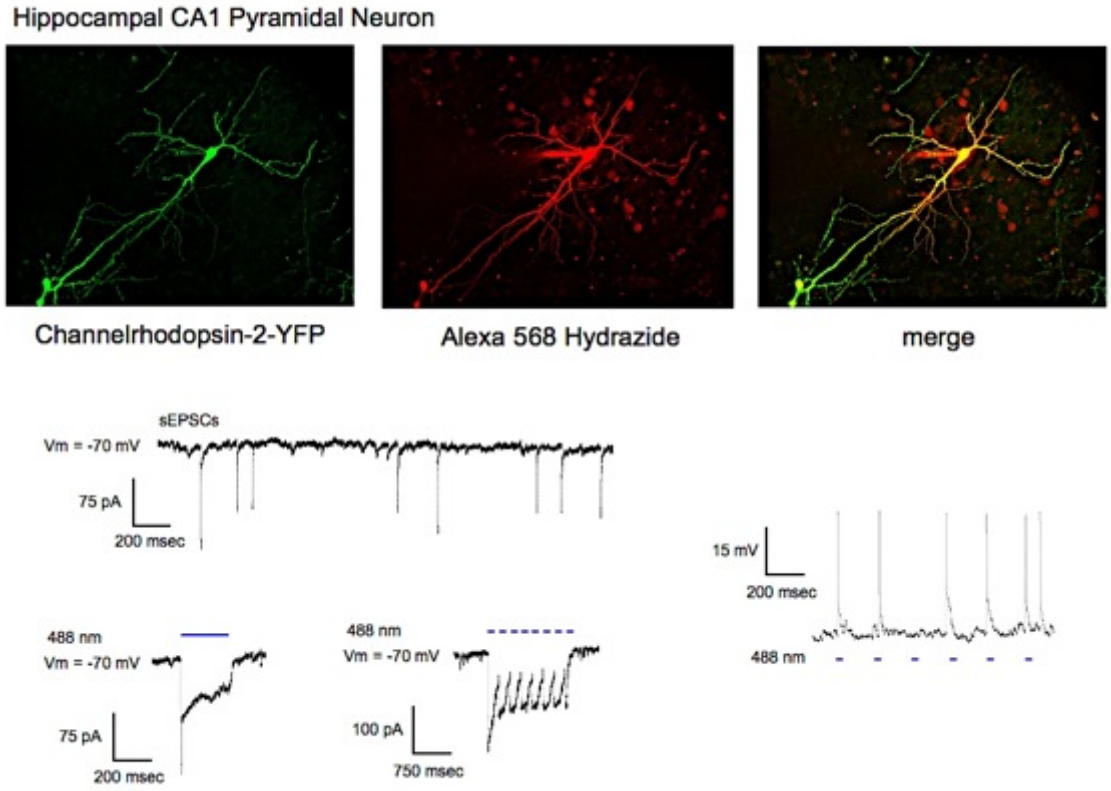






expresses spH under control of a *thy-1* promoter. The *green* channel corresponds to spH signals in response to Schaffer collateral stimulation while the *red* channel corresponds to a length of CA1 apical dendrite from a cell whole-cell voltage clamped and filled with Alexa-594.

Channelrhodopsin-2 and millisecond control of an individual hippocampal CA1 neuron's activity using pulses of blue light in a hippocampal slice culture.



Neuronal activity (calcium) monitored using a genetically-encoded calcium probe G-CaMP 1.6