

Lecture 4: Tuesday, July 2

Watching the brain in action: creating tools for functional analysis of neural circuitry

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Abstract

To study the neural circuitry, the action of one cells under the context of others, one would precisely measure and perturb specific neuronal populations and molecules in behaving animals who are specifically engaged in performing the computation or function of interest. The dataset of millions of neurons firing together underlying a behavior are required to develop and refine theories (hypotheses) explaining animal behavior in terms of brain physiology. The focus of our lab is to develop novel genetically encoded indicators based on fluorescence proteins, especially focusing on direct and specific measurement of myriad input signals with needed spatial and temporal resolutions. In this talk, I will discuss most recent progress in the field about developing and applying a new suite of genetically encoded indicators, calcium, voltage and neurotransmitter/modulators. In combination with calcium imaging and optogenetics, these sensors are well poised to permit direct functional analysis of how the spatiotemporal coding of neural input signaling mediates the plasticity and function of target circuits. Together with advanced microscopy methods for multiplex measurement and manipulation of cellular function in behaving animals, a full integration of these sensors with opsin-based optogenetic tools and calcium/voltage imaging will elucidate the input/output

interactions within neural circuits in health and disease at depths that are inaccessible via currently existing approaches.

BIOGRAPHICAL SKETCH

Dr. Tian holds a Ph.D. in biochemistry, molecular and cell biology from Northwestern University. She completed postdoctoral training at the Howard Hughes Medical Institute's Janelia Farm Research Campus, where she developed a toolbox of ultrasensitive neural activity sensors that have been widely utilized. She established her own lab at UC Davis in 2012. Her current work is a combination of neural activity sensor development and applications. Recently, Dr. Tian's lab developed a suite of fluorescence sensors for dopamine and other monoamines to enable ultrafast neuronal imaging of neuromodulator dynamics in vivo, which opened new doors for imaging beyond spikes. Tian has received the National Institutes of Health Director's New Innovator Award, Human Frontier Science Program Young Investigator Grant, Hartwell Foundation Individual Biomedical Research Award and NIH BRAIN Initiative grants.