Center for Disease Biology and Integrative Medicine
Faculty of Medicine, The University of Tokyo

SEMINAR

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演題： Imaging Neural Circuit Dynamics with a Voltage-Sensitive Fluorescent Protein

要旨：

Protein-based fluorescent probes of neuronal activity are at the core of emerging approaches to study the dynamics of neuronal circuits that are composed of heterologous cell types. The rationale behind our large effort to develop genetically encoded voltage indicators lies in the fact that these probes allow us and others to move beyond the electrophysiological analysis of individual or small numbers of cells without neglecting cellular diversity or compromising temporal resolution. Work in our and other laboratories during the last 15 years resulted in a new generation of voltage-sensitive fluorescent proteins (VSFPs) based on the voltage-sensing domain (VSD) of Ciona intestinalis voltage sensor-containing phosphatase (Ci-VSP). To this end, our laboratory explored different design principle families for these engineered proteins and characterized numerous mutational variants for each facility. We demonstrated that recent versions of VSFPs can report membrane voltage signals in isolated neurons, brain slices and living mice.

Population signals from neuronal ensembles in cortex during behavior are commonly measured with EEG, LFP and voltage-sensitive dyes. A genetically encoded voltage indicator would be useful for detection of such signals in specific cell types. Here, we describe how his goal can be achieved with Butterfly, a voltage-sensitive fluorescent protein (VSFP) with a subthreshold detection range and enhancements designed for the voltage imaging from single neurons to brain in vivo. VSFP-Butterfly showed reliable membrane targeting, maximum response gain around standard neuronal resting membrane potential, fast kinetics for single cell synaptic responses, and a high signal/noise ratio. Butterfly reports EPSPs in cortical neurons, whisker-evoked responses in barrel cortex, 25 Hz gamma oscillations in hippocampal slices, 2-12 Hz slow waves during brain state modulation in vivo.

Along with the ability to target specific genetically-defined cell populations, VSFPs open a new experimental window for the study of the interaction dynamics of neuronal assemblies, facilitate the investigation of information processing mechanisms of the brain, such as the circuit operations involved in sensing our environment and generation of body movements, but will also be applicable to directly visualize cognitive functions and disease states resulting from altered circuit functions.

日時：平成24年8月13日(月) 13:00～14:00

場所：東京大学医学部 1号館 3階講堂 （場所がいつもと異なりますのでご注意ください）

※春日門についてはH24年8月1日～H26年2月（予定）まで通行止めとなりますのでご注意ください

皆様のご来聴を心よりお待ちしております。

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