

“What are becoming possible by optical imaging and manipulation ”

Tutorial 1

Saturday, 25 April 15:40 – 16:40

Title: Two-photon microscopy for in vivo brain imaging in mammals

Speaker: Doctor Bernd Kuhn, OIST

Abstract:

Since its invention, two-photon microscopy (Denk, Strickler, Webb, 1990) became an indispensable tool in neuroscience and beyond. In my talk I will focus on the principles of two-photon microscopy and explain the methods used for imaging single neurons and populations of neurons in awake mice. I will conclude with a discussion of current limitations and future directions of two-photon microscopy.

Reference:

Theer, P., Kuhn, B., Keusters, D. & Denk, W. “Two-photon microscopy and imaging” in Encyclopedia of Molecular Cell Biology and Molecular Medicine, Vol. 15, page 61-88, (2005).

Reference can be found under “Book Chapters” at

<https://groups.oist.jp/onu/publications>

Tutorial 2

Saturday, 25 April 16:50 – 17:50

Title: Imaging/Optogenetics to elucidate the role of emotion in zebrafish behavior

Speaker: Doctor Makio Torigoe, RIKEN BSI

Abstract:

A fundamental issue in neuroscience is elucidating how emotion affects behavior. Our laboratory is interested in how emotion-based memory affects behavior selection and the underlying circuit mechanisms. We approach the mechanisms by using Ca²⁺ imaging and optogenetic manipulation in zebrafish. In the first part, I will introduce basics of zebrafish focusing on their anatomy and advantages of using. In the following parts, I will talk about real time imaging during behavior selection and optogenetic method to show the causality between neural activities and behavior in the context of our research. These technologies will shed light on dynamic circuit mechanisms among brain parts during emotion-based memory formation and behavior selection.

Suggested Readings:

Aoki, T., Kinoshita, M., Aoki, R., Agetsuma, M., Aizawa, H., Yamazaki, M., Takahoko, M., Amo, R., Atrata, A., Higashijima, S., Tsuboi, T. and Okamoto, H.: "Imaging of neural ensemble for the retrieval of a learned behavioral program" *Neuron*, 78, 881-894 (2013)

Tutorial 3

Saturday, 25 April 18:00-19:00

Title: Optogenetic approaches to analysis of *C. elegans* behaviors: learning, memory and decision

Speaker: Doctor Ichiro Maruyama, OIST

Abstract:

The nematode *Caenorhabditis elegans* is an excellent model organism for the study of behavior at molecular and cellular levels. Wiring diagrams of the entire nervous system, which consists of 302 neurons of 118 classes with ~7,000 chemical synapses and ~600 electrical junctions, has been completely elucidated from serial electron micrographs. Transparency of its body during the entire life from a fertilized egg to an adult makes *C. elegans* suited for optogenetic analysis of behavior while it is moving. In this lecture, I will introduce our approaches to behavior analysis of *C. elegans* through optogenetics, and will describe how the animal perceives environmental changes, how it switches its behavior (decision making), how it learns and forms long-term associative memory at molecular and cellular (networks) levels.

Prior reading requirement: none