1-S08-3 Symposium8

Novel optogenetic and chemogenetic tools for understanding of molecular mechanisms which underlie learning and memory.

Wataru Kakegaea, Michisuke Yuzaki

Dept. Physiol., Keio Univ. Sch. of Med.

In our brain, approximately 100 billion neurons connect to each other through "synapses" to make neuronal circuits essential for higher brain functions, such as learning & memory. So, elucidation of molecular mechanisms which underlie synapse formation and functions is one of the important issues in understanding learning & memory (Kakegawa and Yuzaki, *BRAIN & NERVE*, 2018). However, because of a complex environment in the brain, technologies that can selectively intervene at specific synapses are still developing.

Recently, we studied on cerebellar neuronal circuits essential for motor coordination and motor learning, and we developed novel optogenetic and chemogenetic tools to regulate the localization and functions of glutamate receptors, which are key players for synaptic transmission and plasticity (Kiyonaka et al., *Nat Chemistry*, 2016; Kakegawa et al., *Neuron*, 2018). In particular, a novel optogenetic tool, PhotonSABER, controlled not only synaptic plasticity but also cerebellum-dependent motor learning in a light-dependent manner (Kakegawa et al., *Neuron*, 2018). These novel tools are used as a powerful tool that can artificially manipulate the functions of specific synapses in the brain. Using these technologies, we will know the causal relationship between synaptic functions and the behaviors in more detail.