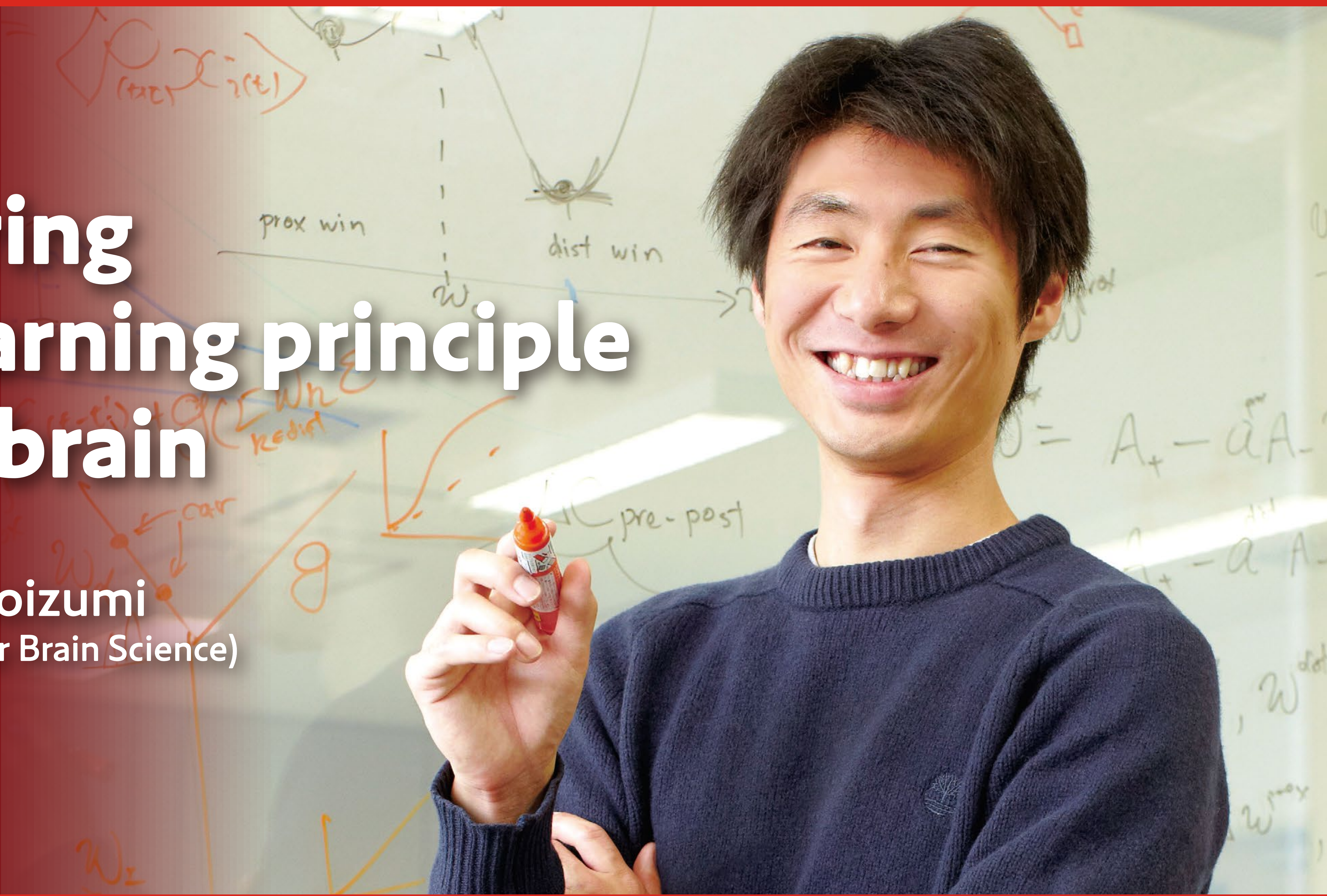
iTHEMS Colloquium

Exploring the learning principle in the brain



Dr. Taro Toyoizumi
(RIKEN Center for Brain Science)

2020 1/16 15:30 - 17:00

Large Meeting Room,
2F Welfare and Conference Building
RIKEN Wako Campus Bldg. C61

R-CCS R311
SUURI-COOL Kyoto
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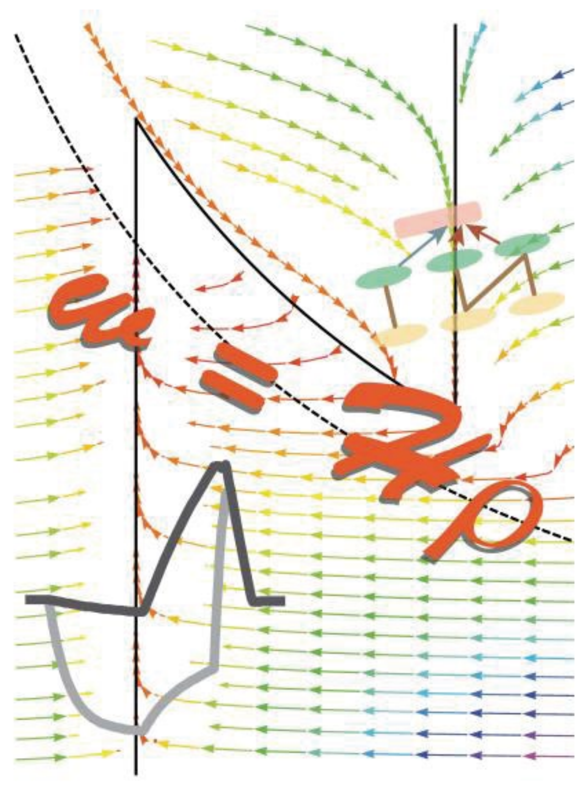
Animals adapt to the environment for survival. Synaptic plasticity is considered a major mechanism underlying this process. However, the best-known form of synaptic plasticity, i.e., Hebbian plasticity that depends on pre- and post-synaptic activity, can surge coincident activity in model neurons beyond a physiological range. Our lab has explored how neural circuits learn about the environment by synaptic plasticity. The instability of Hebbian plasticity could be mitigated by a global factor that modulates its outcome. For example, TNF-alpha that mediates homeostatic synaptic scaling is released by glia, reflecting the activity level of surrounding neurons. I show that a specific interaction of Hebbian plasticity with this global factor accounts for the time course of adaptation to the altered environment (Toyoizumi et al. 2015). At a more theoretical level, I ask what is the optimal synaptic plasticity rule for achieving an efficient representation of the environment. A solution is the error-gated Hebbian rule, whose update is proportional to the product of Hebbian change and a specific global factor. I show that this rule, suitable also in neuromorphic devices, robustly extracts hidden independent sources in the environment (Isomura and Toyoizumi 2016, 2018, 2019).
Finally, I introduce that synapses change by intrinsic spine dynamics, even in the absence of synaptic plasticity. I show that physiological spine-volume distribution and stable cell assemblies are both achieved when intrinsic spine dynamics are augmented in a model (Humble et al.2019).



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