JST-CREST "Opt Bio" / WPI-IIIS Joint Symposium

Deciphering the Brain through "Opt Bio" Tools

Date : **Friday, March 18, 2022,** 8:30-16:00

Venue : The 99th Annual Meeting of the Physiological Society of Japan
2F Hall, Multimedia Education and Research Complex,
Kawauchi-Kita Campus, Tohoku University

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IIIS INTERNATIONAL INSTITUTE FOR INTEGRATIVE SLEEP MEDICINE

筑波大学 University of Tsukuba

wpi World Premier International Research Center Initiative

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

CREST

OPTOBIO

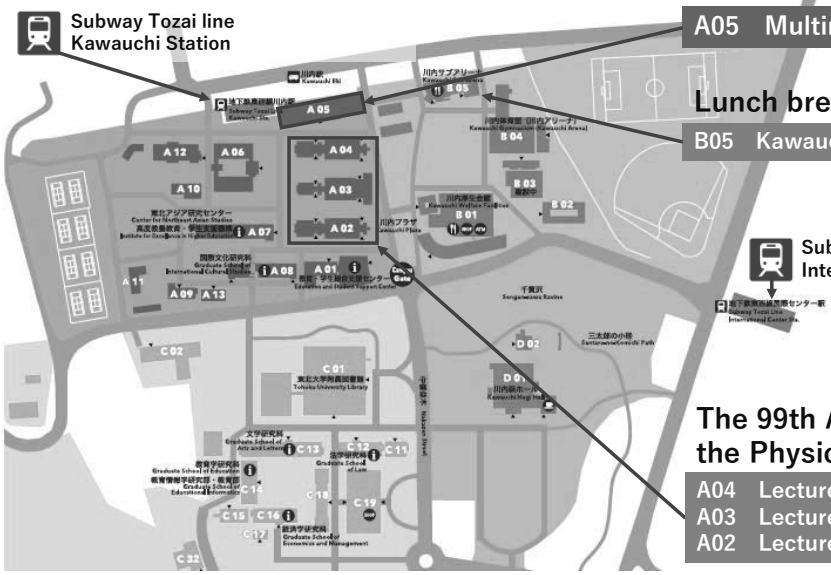
Time Table

Opening | MC: Mayumi Kimura (WPI-IIIS, University of Tsukuba)				
8:30 - 8:45	Welcome	**Masashi Yanagisawa**	Director, WPI-IIIS, University of Tsukuba	
	Opening Address 1	**Akira Ukawa**	WPI Program Director	
	Opening Address 2	**Ryoichiro Kageyama**	Research Supervisor, CREST Optbio Director, Center for Brain Science, RIKEN	
Session 1 | Chair: Arisa Hirano (WPI-IIIS, University of Tsukuba)				
8:45 - 9:15	Computations in neuron-glia circuits for controlling behavioral states	**Misha Ahrens**	HHMI, Janelia Research Campus	Page 4
9:15 - 9:45	Optical tools for studying the brain	**Adam E. Cohen**	Harvard University	Page 5
9:45 - 10:15	Controlling the fate and function of proteins with proximity photopharmacology	**Dirk Trauner**	New York University	Page 6
10:15 - 10:30	Break			
Session 2 | Chair: Masashi Yanagisawa (WPI-IIIS, University of Tsukuba)				
10:30 - 11:15	Inner workings of channelrhodopsins and brains	**Karl Deisseroth**	HHMI / Stanford University	Page 7
11:15 - 11:45	Mechanical interactions of dendritic-spine synapses	**Haruo Kasai**	WPI-IRCN, The University of Tokyo	Page 8
11:45 - 12:15	How synaptic plasticity mediates learning and memory in vivo: an optogenetic approach	**Michisuke Yuzaki**	Keio University School of Medicine	Page 9
12:15 - 12:25	Photo / Break			
12:25 - 13:20	Lunch Break (Bee ARENA Café)			
Poster Session | Chair: Kaspar Vogt (WPI-IIIS, University of Tsukuba)				
13:20 - 13:50	Data Blitz (2F Hall, Multimedia Education and Research Complex)			Page 14-15
13:50 - 14:30	Poster Presentation (1F, Multimedia Education and Research Complex)			Page 14-15
Session 3 | Chair: Sakiko Honjoh (WPI-IIIS, University of Tsukuba)				
14:30 - 15:00	Induction of hypometabolic and hypothermic states in mice	**Takeshi Sakurai**	WPI-IIIS, University of Tsukuba	Page 10
15:00 - 15:30	Spying on neuromodulation by constructing a toolbox of genetically encoded fluorescent sensors	**Yulong Li**	Peking University	Page 11
15:30 - 16:00	Neural circuits underlying sleep structure and functions	**Antoine Adamantidis**	University of Bern	Page 12
16:00	Closing			

Information

TOHOKU UNIVERSITY Kawauchi-Kita Campus

Guide Map



JST-CREST "Opt Bio"/
WPI-IIIS Joint Symposium Venue

A05 Multimedia Education Research Complex

Lunch break @ Bee Arena Café

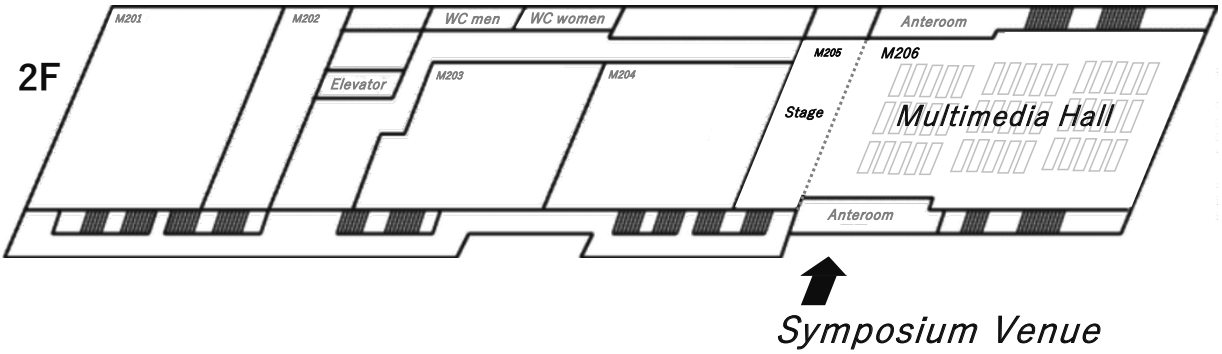
B05 Kawauchi Sub Arena

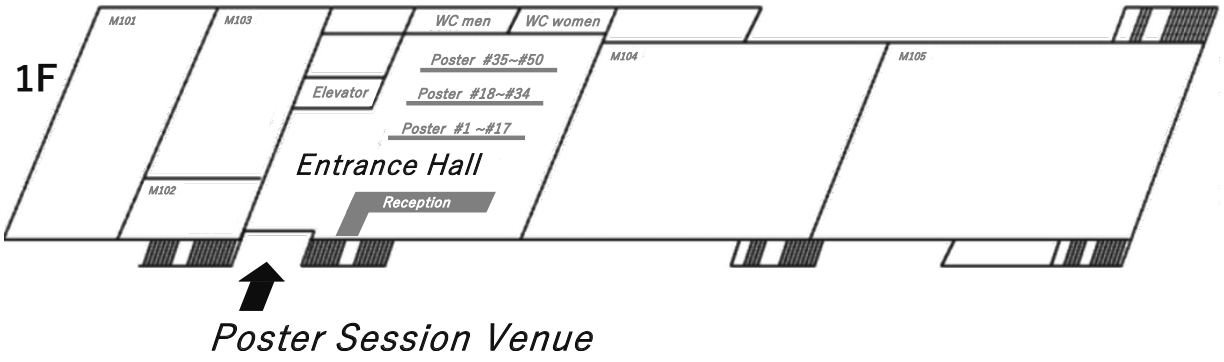
Subway Tozai line
International Center Station

The 99th Annual Meeting of
the Physiological Society of Japan Venue

A04 Lecture Rooms C
A03 Lecture Rooms B
A02 Lecture Rooms A

Floor Map (1F & 2F) | Multimedia Education Research Complex





Computations in neuron-glia circuits for controlling behavioral states

Misha Ahrens

HHMI, Janelia Research Campus, USA

ABSTRACT

No Abstract

Session 1 **9:15 - 9:45**

Optical tools for studying the brain

Adam E. Cohen

Harvard University, USA

ABSTRACT

Optical tools for simultaneous perturbation and measurement of membrane potential enable spatially resolved mapping of neural activity with high resolution in space and time, in behaving animals. I will describe some advances in voltage indicators, microscope systems, and analysis software. With these advanced tools, we are studying the dynamics of microcircuits involved in control of attention and the sub-cellular details of dendritic integration. I will also describe some new approaches to storing brain-wide records of neural activity via intracellular protein "ticker tapes".

Session 1 **9:45 - 10:15**

Controlling the fate and function of proteins with proximity photopharmacology

Dirk Trauner

New York University, USA

ABSTRACT

Photopharmacology endeavors to control biological function with synthetic photoswitches that can be attached covalently or non-covalently to their targets - or nearby. I will discuss potential applications of photopharmacology in biology and medicine, in particular with respect to controlling signal transduction and targeted protein degradation. I will make a case that "Proximity Photopharmacology" is a particularly effective strategy.

Session 2 **10:30 - 11:15**

Inner workings of channelrhodopsins and brains

ABSTRACT

No abstract

Karl Deisseroth

HHMI / Stanford University, USA

Mechanical interactions of dendritic-spine synapses

Haruo Kasai

WPI-IRCN,
The University of Tokyo, Japan

ABSTRACT

The majority of excitatory glutamatergic synapses are made on dendritic spines which enlarge during learning. Since dendritic spines and the presynaptic terminals are tightly connected with the synaptic cleft, the enlargement may have mechanical effects on presynaptic functions. We found that the fine and transient pushing of the boutons by a glass pipette markedly promoted an evoked neurotransmitter release and the assembly of soluble N-ethylmaleimide-sensitive factor attachment protein receptor (SNARE) proteins, whose Furster resonance transfer (FRET) was measured with fluorescence lifetime imaging (FLIM) in rat slice culture preparations. Surprisingly, both effects persisted over 20 min. The increased presynaptic FRET was independent of cytosolic calcium (Ca2+), but dependent on the assembly of SNARE proteins and actin polymerisation in the boutons. Importantly, a low hypertonic sucrose solution (20 mM) caused facilitatory effects on both the FRET and evoked release without inducing spontaneous release, making a striking contrast with a high hypertonic sucrose solution (300 mM) which induced exocytosis by itself. Finally, the spine enlargement, induced by the two-photon glutamate uncaging, enhanced evoked release and FRET only when the spines pushed the boutons by their elongation. Thus, we have found a mechano-sensory and transduction mechanism in the presynaptic boutons.

Session 2 **11:45 - 12:15**

How synaptic plasticity mediates learning and memory in vivo: an optogenetic approach

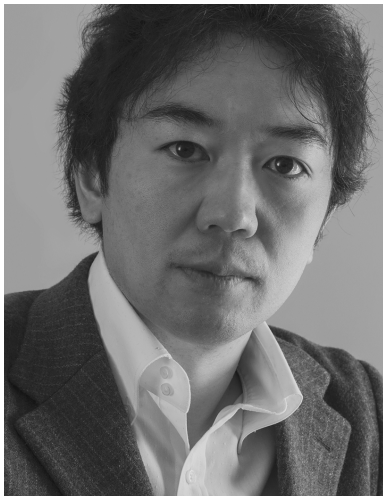
Michisuke Yuzaki

Keio University
School of Medicine, Japan

ABSTRACT

Long-term potentiation (LTP) and long-term depression (LTD) of excitatory neurotransmission has been proposed as a cellular substrate for learning and memory in vivo. Although LTP and LTD are widespread phenomena expressed at every excitatory synapse in the mammalian brain, it is not completely understood whether and how LTP/LTD at specific synapses are causally linked to learning and memory in vivo. This is mainly because it is unknown whether LTP/LTD are induced in vivo in similar stimulus conditions that are used for the induction of LTP/LTD in acute slice preparations. Further, genetic engineering in mice could induce compensatory mechanisms that could modify synaptic plasticity in the remaining circuits. To circumvent these problems, we developed new optogenetic tools, termed PhotonSABER and LysopH-up, which enabled the temporal, spatial, and cell type-specific inhibition of LTD and LTP, respectively, while the basal synaptic properties and other forms of synaptic plasticity were unaffected. Using these tools at parallel fiber-Purkinje cell synapses in the cerebellum, we will show how LTD/LTP at these synapses are causally linked to the cerebellum-dependent oculomotor learning in vivo.

Induction of hypometabolic and hypothermic states in mice



Takeshi Sakurai

WPI-IIIS,
University of Tsukuba, Japan

ABSTRACT

We found that chemogenetic/optogenetic excitation of Qrfp-expressing neurons (Q neurons) in a region of the mouse hypothalamus (anterior ventral periventricular nucleus) induces sustained hypothermia and hypometabolism, which we named QIH. The QIH was accompanied by a significant decrease in body temperature and oxygen consumption rate. A battery of behavioral tests was performed on the QIH-experienced and QIH-naïve groups, but no differences were found between the two groups, nor were there any differences in histological observations of the brain, heart, muscles, or other organs. The fact that QIH can be repeated in the same individual suggests that QIH is a reversible and safe hypometabolic state, i.e., a hypometabolic state similar to hibernation. Histological and optogenetic analyses suggested that Q neurons induce QIH mainly through the DMH. QRFP is widely conserved in mammals, suggesting that Q neurons may be involved in a hypometabolism-inducible neural pathway that is widely conserved in mammals. Physiologically, Q neurons may be involved in rapid shifts in body temperature set points and be involved in circadian control of body temperature. Animals in hibernation are in a state of hypothermia, hypometabolism, and low activity, but even under these conditions, they can adapt to changes in the environment and spontaneously return to their original state without any tissue damage. If the oxygen demand of animals could be safely lowered as in hibernating animals, various applications are possible, and I would like to discuss the medical application of QIH.

Session 3 | **15:00 - 15:30**

Spying on neuromodulation by constructing a toolbox of genetically encoded fluorescent sensors

Yulong Li

Peking University, China

ABSTRACT

Diverse neuromodulators in the brain, such as acetylcholine, monoamines, lipids and neuropeptides, play important roles in a plethora of physiological processes including reward, movement, attention, sleep, learning and memory. Dysfunction of the neuromodulatory system is associated with a range of diseases, such as epilepsy, addition, neurodegenerative and psychiatric diseases. A longstanding yet largely unmet goal is to measure the dynamics of different neuromodulators reliably and specifically with high spatiotemporal resolution, particularly in behaving animals. To achieve this goal, we develop a series of genetically encoded GPCR-activation-based (GRAB) sensors for the detection of acetylcholine, dopamine, norepinephrine, adenosine, ATP, serotonin, histamine, endocannabinoids and neuropeptides, and validate the performance of these sensors in multiple preparations in vitro and in vivo. The GRAB sensor toolbox provides new insights into the dynamics and mechanism of neuromodulatory signaling both in health and disease.

Neural circuits underlying sleep structure and functions

Antoine Adamantidis

University of Bern, Switzerland

ABSTRACT

The activity of multiple brain circuits is strongly modulated during sleep states. Some of these are implicated in the temporal control of the sleep-wake cycle, while others support sleep-dependent functions including memory consolidation. In this lecture, I will summarize our recent work investigating a role for REM sleep in modulating cellular dynamics of neural circuits controlling of goal-oriented behaviours and its implication for the maintenance of innate behaviour.

Poster Session

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Deciphering the Brain through “Opt Bio” Tools

Data Blitz by Poster Presenters	**13:10 – 13:40**
Poster Presentation	**13:40 – 14:30**

Poster List

#	Presenter	Title
1	**Tsuyoshi Saito**	Development of photocaged adenosine 2A receptor activator
2	**Koustav Roy**	Opto-chemical control of sleep in the nucleus accumbens using a photocaged adenosine A2A receptor allosteric modulator
3	**Hikari Yashiki**	Chemogenetic suppression of histamine receptor cells produces slow-waves in mice
4	**Iyo Koyanagi**	Mechanisms of hippocampal adult-born neurons for memory consolidation during sleep
5	**Jiahui Yu**	Adult-born neuron activity in the establishment of fear generalization
6	**Yuteng Wang**	Synchronous young and matured neuron activity for memory consolidation
7	**Pablo Vergara**	CaliAli: A tool for inter-session alignment of 1-photon calcium imaging data allowing tracking neurons in the non-rigidly moving brain
8	**Sakthivel Srinivasan**	Transient recruitment of an adult-born neuron ensemble for fear memory consolidation in REM sleep
9	**Shingo Soya**	Whole brain mapping and manipulation of activated neuronal populations by exhausted exercise
10	**Saki Yamada**	Capturing and manipulating neurons activated by exhausted exercise
11	**Emi Hasegawa**	Rapid eye movement sleep is initiated by dopamine signaling in the basolateral amygdala in mice
12	**Jeong Sol**	GABAergic neurons around ventrolateral periaqueductal gray regulate cataplexy in narcolepsy model mice
13	**Yuki Saito**	Visualizing input-output architecture of orexin neurons with double-color projection-selective retrograde tracin
14	**Kseniia Prokofeva**	Delineation of neural circuits of galaninergic neurons in the VLPO implicated in regulation of sleep
15	**Zhongwen Zhang**	Mechanism by which the BNST→DpMe pathway induces arousal
16	**Ruth Li**	Gastrin-releasing peptide neurons in the suprachiasmatic nucleus play an essential role in regulating circadian rhythm
17	**Toru Takahashi**	Induction of mouse hibernation-like state using high sensitive optogenetics
18	**Yoan Cherasse**	Roles of monoamines and their regulatory systems in motivation and arousal
19	**Katsuyasu Sakurai**	The anatomical and functional understanding of neural dynamics of VTA dopaminergic neurons in female sexual behavior
20	**Ai Miyasaka**	Dopamine dynamics in NAc-vs control male sexual behaviors in mice
21	**Hibiki Okamura**	Analyses of the effect of prior social stress on brain activity during social interaction in mice using a novel semi-automated c-Fos mapping program
22	**Shinnosuke Yasugaki**	Is increased REM sleep an adaptive response or an exacerbating factor in stress resilience?
23	**Yoshifumi Arai**	Characterization of the neuronal activity of a newly identified REM sleep-regulating neuron using glass pipette extracellular unit recording combined with optogenetics
24	**Ami Kaneko**	Analysis of the mechanism of REM sleep behavior disorder with focus on Parkinson’s disease
25	**Ayako Imamura**	Effects of chronic cell ablation in the preoptic area on sleep-wake cycles
26	**Yusuke Murakami**	Toward label-free molecular imaging of whole brain and brain cells using ultra-broadband multiplex CARS microspectroscopy
27	**Olga Malyshevskaya**	The role of hypothalamic supraoptic nucleus in maintaining wakefulness
28	**Javier Diaz Cisternas**	Recovering EEG generators from their collective stochastic interference
29	**GoEun (Abby) Han**	Dihydropyridine calcium blockers do not interefere with slow wave sleep
30	**Satomi Okabe**	The effects of olfactory stimulation during REM sleep on dream emotionality: a study focusing on individual difference in olfactory perception

#	Presenter	Title
31	**Tsuyoshi Nemoto**	Recovery from systemic-inflammation-induced altered sleep is potentiated by sevoflurane preconditioning
32	**Shigeru Chiba**	Validation experiment using in-home sleep electroencephalography and its clinical application
33	**Juan Carlos Neira Almanza**	Automatic assessment of sleep recordings from a portable IoT EEG device.
34	**Haruka Suzuki**	Metabolomic and pharmacologic analyses of brain substances associated with sleep pressure in mice
35	**Tomohiro Kitazono**	The novel intracellular signaling pathways for the regulation of homeostatic sleep need
36	**Liqin Cao**	Natural history study of sleep disturbances in CDKL5 deficiency disorder mice
37	**Hikari Yamamoto**	OX2R-selective orexin agonism is sufficient to suppress narcoleptic symptoms, cataplexy and wake fragmentation, without inducing drug-seeking behavior in mouse models
38	**Mahesh Kaushik Kumar**	Pre-narcoleptics are more prone to suvorexant-induced cataplexy
39	**Mari Hondo**	Orexin receptor antagonists ameliorate the symptoms of REM sleep behavior disorder in a novel mouse model and in human patients
40	**Deependra Kumar**	Learning and memory deficit in adult dreamless mice
41	**Tomoyuki Fujiyama**	NALCN in the forebrain and pons-medulla regions have distinct roles in REM sleep regulation
42	**Asmaa Elhosainy Mohamed Mahmoud**	Sleepy mouse as a model of idiopathic hypersomnia
43	**Yuki Taira**	Electrophysiological analysis of ion channel mutations in mice with REM sleep abnormalities
44	**Noriko Hotta**	Sleep/wakefulness and body weight growth from infancy to adulthood in a hypersomnia model, *Sleepy* mutant mouse.
45	**Patricia Seoane Collazo**	SIK3 in different hypothalamic areas mediates whole-body energy balance
46	**Kanako Iwasaki**	Where does *Sleepy* mutation of SIK3 cause sleep phenotypes?
47	**Fuyuki Asano**	Sik3 regulates sleep need via glutamatergic neurons in cerebral cortex
48	**Shinya Nakata**	Molecular mechanisms for SIK3(*Sleepy*)-mediated sleep/wake regulation
49	**Minjeong Park**	Sleep/wake behavior of mice lacking PKA phosphorylation site in SIK3
50	**Kim Staci Jakyong**	Loss of canonical Hdac4 signaling leads to disregulated NREMS

MEMO

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