212th WPI-IIIS Seminar

Neuromodulator Control of Memory Processing During Sleep

Neuromodulators play a significant role in brain functions, including memory formation. Most previous research on neuromodulators has concentrated on their functions during wakefulness. However, recent recordings of neuromodulator dynamics using GRAB sensors have shown that they also exhibit intricate dynamics during NREM sleep. Research in my lab has aimed to explore how the neuromodulator dynamics contribute to memory processing during sleep. In my presentation, I will share two unpublished findings to highlight the essential roles of acetylcholine and norepinephrine in facilitating hippocampal-dependent memory consolidation during NREM sleep.

Dr. Min Xu

Institute of Neuroscience,

Chinese Academy of Sciences, Shanghai

Date: **Tuesday, November 26, 2024**

Time: **10:00 – 10:50**

Venue: **1F Auditorium, IIIS Building**

✻On-site participation only

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213th WPI-IIIS Seminar

Neural mechanisms for emotional memory processing during sleep

The gradual reinforcement of memories, called “consolidation”, is a process occurring partially during sleep and mediated by various patterns of coordinated neural activity (Girardeau & Lopes dos Santos, *Science*, 2021). The formation of contextualized emotional memories involves a large network of structures, among which the hippocampus and the baso-lateral amygdala (BLA) are central. In the dorsal hippocampus, fast oscillations (sharp-wave ripples) during non-REM sleep mediate the consolidation of spatial memories through the reactivation of place cell activity. On the other hand, emotional information is processed primarily in the ventral hippocampus and amygdala, which are reciprocally connected. Using large-scale electrophysiology in freely-moving rats, we investigate how the association of contextual and aversive information involves changes in neural synchronization at the level of local field potential and neuronal assemblies along the dorso-ventral hippocampus-BLA axis during sleep (Morici et al., *BioRxiV*, 2024).

Dr. Gabrielle Girardeau

Institut du Fer à Moulin UMR-S 1270 Inserm
Sorbonne University, Paris

Date: **Tuesday, November 26, 2024**
Time: **10:50 – 11:40**
Venue: **1F Auditorium, IIIS Building**

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MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

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214th WPI-IIIS Seminar

Dancing Proteins: Choreographing Circadian Rhythms

Terrestrial life has evolved circadian rhythms to align with Earth's 24-hour rotation. Aligning cellular processes with this cycle is crucial. Our study reveals ATXN2 and ATXN2L as key regulators of rhythmic translation in mammals, orchestrating phase separation in the suprachiasmatic nucleus. This oscillating mechanism ensures the timely progression of mRNA processing to protein synthesis for key genes. Moreover, we are exploring more aspects of phase separation in regulating circadian rhythm, investigating how compartmentalized protein translation is influenced by the properties of protein phase separation. Our discovery underscores the cellular condensates' role in tuning circadian clocks and opens avenues to explore their broader impact on rhythmic regulation.

Dr. Yi Lin

Tsinghua-Peking Center for Life Sciences,
State Key Laboratory of Membrane Biology,
Tsinghua University

Date: **Tuesday, November 26, 2024**
Time: **11:40 – 12:30**
Venue: **1F Auditorium, IIIS Building**

*On-site participation only

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WPI-IIIS Seminar

Special Student Seminar

Effects of daily torpor on sleep-wake states and brain activity in Djungarian hamsters (*Phodopus sungorus*)

Torpor is ubiquitous, yet a highly specialized state of hypometabolism during which organisms display bouts of sustained hypothermia. Djungarian hamsters (*Phodopus sungorus*) seasonally display spontaneous daily torpor.

Sleep and torpor are closely linked and may share a common neurophysiological substrate. This raises questions like - What triggers the onset of torpor from sleep?

This talk will discuss some key methodology and data demonstrating how sleep and torpor are linked. This research may potentially inform efforts to enable human hibernation for long-duration space flight and hypothermic medical treatment.

Ms. Ritika Mukherji

MSc + DPhil Candidate in Neuroscience,
University of Oxford

Date: **Tuesday, November 26, 2024**
Time: **14:00 – 14:15**
Venue: **1F Auditorium, IIIS Building**

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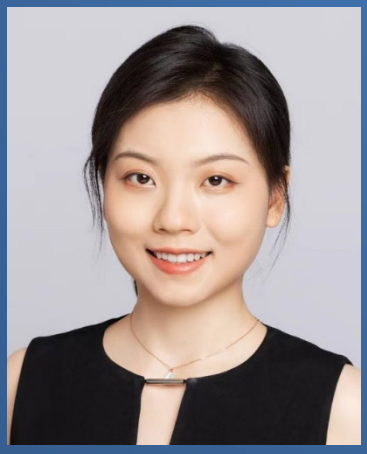
WPI-IIIS Seminar

Special Student Seminar

Investigating the relationship between torpor, sleep, and neural plasticity in Djungarian hamsters (*Phodopus sungorus*)

Torpor is a controlled and reversible state characterized by decreased body temperature, metabolic rate, and physical activity, typically initiated through non-rapid eye movement (NREM) sleep. Djungarian hamsters (*Phodopus sungorus*) exhibit spontaneous daily torpor as a winter adaptation, during which their metabolic rate decreases to 30% of the basal metabolic rate. To explore the relationship between spontaneous daily torpor, sleep, and neural plasticity, we examined the ultrastructural, molecular, and behavioural alterations during daily torpor and subsequent sleep in Djungarian hamsters. This study provides crucial evidence for understanding how short-term torpor bouts may impact the brain.



Ms. Xiao Zhou

DPhil Candidate

Department of Physiology, Anatomy and Genetics, University of Oxford

Date: **Tuesday, November 26, 2024**

Time: **14:15 – 14:30**

Venue: **1F Auditorium, IIIS Building**

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215th WPI-IIIS Seminar

Cross-species comparison linking form and function of neural circuits in teleost fish

Animals have evolved stimulus sensitivities that are matched to their respective habitat. Environmental cues are then transformed by the brain into appropriate behavioral responses, but the way in which evolution has shaped these sensorimotor transformations and their underlying circuit implementations remain largely unknown. We can leverage cross-species comparison to uncover not only the fundamental mechanisms that are common between species, but also the divergent mechanisms that are optimized to allow each species to survive in its specific environmental niche. By using both zebrafish and medaka that evolved in different environmental conditions and show divergent behavioral responses, I will elucidate the precise behavioral algorithms and the neural circuits that realize these sensorimotor transforms.

Dr. Yasuko Isoe

Dept. of Molecular and Cellular Biology,

Harvard Brain Science Initiative,

Harvard University

Date: **Tuesday, November 26, 2024**

Time: **14:40 – 15:30**

Venue: **1F Auditorium, IIIS Building**

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216th WPI-IIIS Seminar

Modulation of neural circuit organization by synaptic suppressors

Synapses are fundamental information units of the brain that function by establishing and regulating innumerable overlapping and interdigitating neural circuits between neurons. Synaptic cell-adhesion molecules (CAMs) are central synapse organizers that structurally align pre- and postsynaptic membranes and functionally coordinate assembly of pre- and postsynaptic machineries that are essential for instructing cell-type specificity, neuronal specification, and the diversity of individual synapse functions. My laboratory has spent recent years identifying key synaptic CAMs and studying their mechanisms in shaping distinct synaptic signaling pathways. Our hypothesis is that the number, location, and properties of diverse synapses are determined by interactions between pre- and postsynaptic CAMs and their associated signaling molecules, and we refer to the rules by which the network of these proteins build neural circuits as the molecular logic of neural circuit architecture. In this talk, I will discuss our recent studies on modulation of *trans*-synaptic mechanisms tuned by a specific class of membrane-anchored proteins and touch on potential implications not only for understanding how neural circuits are designed, but also how brain disorders might be driven, at least in part, by synaptic impairments.

Dr. Jaewon Ko

Department of Brain Sciences,
Daegu Gyeongbuk Institute of Science and Technology (DGIST)

Date: **Tuesday, November 26, 2024**

Time: **15:30 – 16:20**

Venue: **1F Auditorium, IIIS Building**

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