264th WPI-IIIS Seminar

Torpor and the brain: How hypometabolic states challenge our understanding of behaviour, vigilance and sleep

Torpor is a naturally occurring state of hypometabolism with promising translational potential, from emergency medicine and neuroprotection to organ preservation and space exploration. While our knowledge of the brain circuits responsible for torpor is growing rapidly, remarkably little is known about the effects of hypometabolism on the brain. In this seminar, I will present our recent work combining electrophysiology, behavioural analysis, circuit neuroscience and molecular approaches in mice and Djungarian hamsters to characterise brain activity during hypometabolic states. I will discuss how spontaneous and induced torpor reshape neuronal activity, sensory processing and synaptic plasticity, and how these findings challenge our current understanding of brain states and the regulation of sleep.

Dr. Vladyslav Vyazovskiy

Department of Physiology, Anatomy and Genetics

University of Oxford

Date: **Wednesday, September 30, 2026**

Time: **9:00 – 10:00**

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

*On-site participation only

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INTERNATIONAL INSTITUTE FOR INTEGRATIVE SLEEP MEDICINE

筑波大学 高等研究院
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265th WPI-IIIS Seminar

Synapse homeostasis: the cellular basis of sleep need

Sleep is conserved across all animal species, suggesting that sleep emerged in the last common ancestor and serves a fundamental function. “Sleep-need”, which accumulates with time awake, can be inferred through subjective experience, or measurable changes in physiology and behavior. However, the nature of the conserved “need to sleep” remains mysterious. Broad conservation in biology exists at the cellular and molecular level, supporting a cellular basis of sleep-need. Accordingly, recent advances show that “sleep-need” is not a physiological abstract, but is biochemically encoded within the cells of the brain, specifically localized to the neuronal synapse. In this seminar, I will discuss advances in understanding the synaptic mechanisms that mediate the accumulation and discharge of sleep need, informed from the convergent discoveries of unbiased proteomics and genetics analysis. Our work supports a model in which neuronal synapses are at least one major cellular site for the cellular basis of sleep need.

Dr. Graham Diering

University of North Carolina

Date: **Thursday, October 1, 2026**

Time: **11:30 – 12:30**

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

*On-site participation only

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266th WPI-IIIS Seminar

How the Central Clock and Hypothalamic Nuclei Compute Light Signals for Circadian Photoentrainment and Avoidance

To survive in nature, animals evaluate ambient light intensity and the specific time of day of light exposure to occupy appropriate temporal niches. For example, the endogenous circadian clock entrains the sleep-wake cycle to environmental cycles, while light intensity regulates transitions between exploration and avoidance. Although visual afferents are traditionally viewed as parallel labeled-line pathways, we found that hypothalamic structures—including the suprachiasmatic nucleus (SCN) and supraoptic nucleus (SON)—utilize probabilistic population coding to control physiological functions. Thus, deep brain nuclei perform sensory computations through dynamic, flexible population circuitry rather than simple on-off switches.

Dr. ShihKuo Chen

Department of Life Science,

National Taiwan University

Date: **Friday, October 1, 2026**

Time: **10:30 – 11:30**

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

✻On-site participation only

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