SPECIAL LECTURES

THEME A: DEVELOPMENT

Molecular Mechanisms Underlying Activity-Dependent Neural Circuit Development and Plasticity CME

Xiang Yu, PhD

Institute of Neuroscience, Chinese Academy of Sciences

The mammalian brain is highly plastic. Experience, both positive and negative, affects how neural circuits are wired, with long lasting effects on the well-being of the individual. This lecture will discuss the molecular mechanisms through which sensory experience and environmental factors affect neural circuit development and plasticity, focusing on plasticity mechanisms that may be unique to early development. The relevance of these mechanisms to developmental neurological disorders, especially autism spectrum disorders, will also be highlighted.

THEME B: NEURAL EXCITABILITY, SYNAPSES, & GLIA

Neuronal Activity-Dependent Myelination: A Mechanism for Learning and Repair? CME

Ragnhildur T. Karadottir, PhD

University of Cambridge

Myelin is essential for normal brain function, and alterations in myelin are increasingly implicated as a mechanism for learning. The importance of myelin is evident in diseases where damage to myelin leads to physical and cognitive disabilities. Uniquely within the central nervous system, myelin can regenerate; but this often fails, causing sustained clinical deficits. This lecture will cover the progress made in understanding myelination, with a focus on activity-dependent myelination, and explore how the underlying mechanisms of myelin plasticity may underpin myelin regeneration.

THEME C: NEURODEGENERATIVE DISORDERS & INJURY

Aberrant Phase Separation in Neurodegenerative Disease CME

Anthony A. Hyman, PhD

Max Planck Institute of Cell Biology & Genetics

Cells organize many of their biochemical reactions by formation and dissolution of non-membrane-bound compartments. Recent experiments show that a common mechanism for such biochemical organization is phase separation of unstructured proteins to form liquid-like compartments. These liquid-like compartments can be described by principles elucidated from condensed-matter physics and are therefore termed biomolecular condensates. This lecture will cover the relationship between the formation of liquid-like compartments, quality control mechanisms that preserve the liquid-like state, and the onset of aggregated-protein pathology that is commonly observed in neurodegenerative diseases.

SPECIAL LECTURES

THEME C: NEURODEGENERATIVE DISORDERS & INJURY

Leveraging Brain Rhythms as a Therapeutic Intervention for Neurodegenerative Diseases CME

Li-Huei Tsai, PhD
Massachusetts Institute of Technology

Gamma rhythms (30–80 Hz) are modulated during cognition, and impaired gamma rhythms have been associated with Alzheimer's disease (AD). But do they play a causal role? New evidence shows that non-invasive sensory stimulation of 40 Hz rhythm power and synchrony in AD mouse models reduces AD-like pathology and enhances cognitive function. Research is ongoing to understand the mechanisms underlying the beneficial effects of 40 Hz stimulation and to translate this intervention for human patients.

THEME D: SENSORY SYSTEMS

Active Touch, Pain, and Anesthesia CME

Fan Wang, PhD
Duke University Medical Center

This lecture will discuss studies aimed at understanding the neural basis of somatosensory perception. Specifically, three areas of research will be presented including: peripheral and brainstem sensory and motor circuits underlying exploratory touch behaviors; neural circuits processing the sensory-discriminative and the affective aspects of orofacial pain; and neural circuits mediating the analgesic (pain-suppression) functions of general anesthesia, especially the identification of an anesthesia-activated circuit in the amygdala that potently suppresses pain.

THEME E: MOTOR SYSTEMS

Comparative Neurobiology of Vocal Communication CME

Michael A. Long, PhD
New York University School of Medicine

Vocal communication is central to our everyday lives, facilitating social exchange. Despite significant recent discoveries, the neural mechanisms underlying coordinated vocal exchanges remain poorly understood. This lecture will examine the brain processes involved in interactive vocal behaviors, focusing on forebrain circuitry in the songbird and the rodent, and will relate these to emerging human studies that employ a range of methods to manipulate and monitor cortical areas relevant for speech.

THEME E: MOTOR SYSTEMS

Neural Mechanisms of Short-Term Memory and Motor Planning CME

Karel Svoboda, PhD
Howard Hughes Medical Institute, Janelia Research Campus

Motor planning plays key roles in motor control. Movements that are preceded by periods of motor planning are faster and more accurate than in the absence of planning. Motor planning is also a prospective form of short-term memory that links past events and future movements. During motor planning, neurons in the motor cortex show persistent activity related to specific movements, long before movement onset, in the absence of sensory input. This lecture will discuss how multi-regional neural circuits maintain this selective persistent activity and how this activity relates to behavior.

SPECIAL LECTURES

THEME F: INTEGRATIVE PHYSIOLOGY AND BEHAVIOR

Flies and Alcohol:
An Interplay of Nature and Nurture CME

Ulrike Heberlein, PhD
Howard Hughes Medical Institute, Janelia Research Campus

Alcoholism is a major problem in medicine and society, yet few effective therapies are available for its treatment. This lecture will discuss the development and use of the fruit fly *Drosophila melanogaster* as a model system to identify genes, molecular pathways, and neural circuits that mediate the highly conserved behavioral responses to alcohol.

THEME G: MOTIVATION AND EMOTION

The Neurobiology of Long-Term Memory: Key Molecules, Diverse Cell Types, Temporal Dynamics, and Critical Periods CME

Cristina M. Alberini, PhD
New York University

Long-term memory formation and storage are complex and dynamic processes. What types of molecular and cellular mechanisms underlie this complexity? This lecture will describe key biological mechanisms regulated in response to learning, their expression in diverse cell types, their temporal dynamics, and their roles in long-term memory formation, storage, as well as changes induced by memory recall. It will also discuss how the biological mechanisms engaged in long-term memory formation and storage change over development.

THEME G: MOTIVATION AND EMOTION

CLINICAL NEUROSCIENCE LECTURE:
From Pecking Order to Ketamine: Neural Mechanisms of Social and Emotional Behaviors CME

Hailan Hu, PhD
Zhejiang University School of Medicine

Emotions and social interactions color our lives and shape our behaviors. Using animal models and engineered manipulations, we aim to understand how social and emotional behaviors are encoded, focusing on the neural circuits underlying dominance hierarchy and depression. This lecture will highlight recent discoveries on the interplay between winning history and prefrontal circuit activities; the impact of social status loss on depression; and how ketamine tames depression by blocking bursts in the brain's anti-reward center, involving a surprising role of glia.

THEME H: COGNITION

The Brain From Inside Out CME

Gyorgy Buzsaki, MD, PhD
New York University

Is there a right way to study the brain? The current "outside-in" approach examines neural reactions to external stimuli. It has fueled a generation of extraordinary brain research but now it must confront its limits and hidden assumptions. The brain is a foretelling device that interacts with its environment through action and the examination of action's consequence. It is not an information-absorbing coding device but a venture-seeking explorer constantly controlling the body to test its hypotheses. Our brain does not process information: it creates it.

SPECIAL LECTURES

THEME H: COGNITION

Evolution and Dissolution of Memories Over Time CME

Eleanor A. Maguire, PhD
University College London

Autobiographical memories are the ghosts of our past. Through them we visit places long departed, see faces once familiar, and hear voices now silent. These often decades-old personal experiences can be recalled on a whim or come unbidden into our everyday consciousness. This lecture will focus on examining not only how autobiographical memories evolve in the brain over time, but also how our understanding of this process has developed through the 50 years of the Society for Neuroscience.

THEME H: COGNITION

Neural Codes for Natural Behaviors in Flying Bats CME

Nachum Ulanovsky, PhD
Weizmann Institute of Science

"Natural Neuroscience" aims to decipher the neural mechanisms of natural behaviors in freely-moving animals. This lecture will focus on studies of neural codes for space, time, and social behaviors in flying bats using wireless neurophysiology methods. It will highlight new neuronal representations discovered in animals navigating through complex, 3D, or large-scale environments, or engaged in social interactions. The lecture will posit that neuroscience experiments — in bats, rodents, or humans — should be conducted under evermore naturalistic settings.

THEME I: TECHNIQUES

Theoretical Neuroscience: Decision Making and Its Discontents CME

Peter Dayan, PhD
Max Planck Institute for Biological Cybernetics

Theoretical neuroscience comes in three intertwined strands: data analysis, which is of ever greater importance in the present age of burgeoning big neural data; mathematical neuroscience, offering quantitative accounts spanning levels of description; and computational neuroscience, predicated on the fact that brains solve complex information processing problems. This lecture will review elements of each of these, focusing on the ever richer understanding of normal and dysfunctional affectively-charged decision-making.

THEME I: TECHNIQUES

Extracting Function from Structure: Lessons from the Fly Connectome CME

Gerald M. Rubin, PhD
Howard Hughes Medical Institute, Janelia Research Campus

A connectome of the *Drosophila* central nervous system will soon be available, providing the first glimpse of synaptic-level connectivity of the brain of an animal with sophisticated behavior. The challenge now is to use this information — together with genetically targeted physiology and perturbation during behavior — to understand the neural basis of perception, sleep, associative learning, navigation, and more.