BOSTON UNIVERSITY NATIONAL SCIENCE FOUNDATION RESEARCH TRAINEESHIP PROGRAM

UNDERSTANDING THE BRAIN

NEUROPHOTONICS

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http://www.bu.edu/neurophotronics-nrt
NEUROPHOTONICS

The use of light and photo-activated materials to study, control, and image neurons and neural circuits with cellular and sub-cellular resolution.

Quest: Understand how neural activities at the cellular scale drive computation, behavior and psychology

Address brain diseases that involve disruption or deterioration of neural circuitry

• Alzheimer’s
• Traumatic Brain Injury
• Parkinson’s
• Cerebral Palsy
• Multiple Sclerosis

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NRT TRAINEES WILL

• Conduct research with leading neurophotonics faculty members
• Join a community of neurophotonics graduate peers from neuroscience, photonics and biomedical engineering disciplines
• Receive comprehensive mentored training in communications, neuroethics and professional development

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PROGRAM REQUIREMENTS

• Be enrolled in GPN, Biology, Biomedical Engineering, Mechanical Engineering or Biomedical Sciences

• Complete at least one rotation in a NRT faculty member’s laboratory

• Attend NRT Neurophotonics seminars during the academic year

• Select a NRT faculty member’s laboratory for your dissertation research in neurophotonics

• Fill out an application for the NRT Traineeship Program

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WHAT MAKES THIS PROGRAM UNIQUE TO BU?

Prof. Cruz-Martin describes the multidisciplinary nature of the NRT program and how collaborative efforts will to solve research challenges, please click on the photo below to hear his description.

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NRT FACULTY RESEARCH EFFORTS IN NEUROPHOTONICS

• Faculty research in neurophotonics has been active and isolated to individual labs at BU

• With the NRT Traineeship Program, we will create a community of neurophotonics researchers

• The synergy between the Trainees who will become the Practitioners, the Candidates and the faculty members, will grow the neurophotonics community each year at BU

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The Gavornik Lab works from the foundation that all cognitive function is communication between neurons in the brain. In order to get at the big question of “how the brain works”, they are particularly interested in how neural circuits are able to incorporate past experience to predictively represent spatial temporal information.
The Han Lab discovers design principles for novel neuromodulation therapies. They invent and apply various genetic, molecular, pharmacological, optical, electrical and nano tools to build functional connectomes of the brain. Ultimately, the goal is to develop novel neuro-technologies to treat neurological and psychiatric disorders.

An image briefly flashed on the retina introduces a cascade of processes in the brain that unfold in time. Some processing streams focus on texture, others on spatial locations or large scale forms. Through modeling and in-vivo work, song birds are used in the Gardner Lab to understand stable and plastic learning. Preliminary data from optical imaging indicates that individual excitatory neurons in the same region shift their tuning properties over time-scales of days.

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A longstanding goal in neuroscience is to achieve a complete understanding of the central nervous system, from the brain as a whole all the way down to individual neurons and synapses. The Chen lab takes an integrative approach by combining large-scale imaging technology with molecular and genetic tools, utilizing large area two-photon microscopy.

Prof. Eichenbaum’s Laboratory is interested in how the brain mediates a higher form of memory called declarative or explicit memory. Declarative memory involves memory for everyday facts and events that can be brought to conscious recollection. While it would obviously be very useful to understand how the brain mediates this kind of memory, it is difficult to create valid animal models of “episodic memory” and “conscious recall” so that brain processes active during such memory be studied with biological tools. So far they have identified structures of the cerebral cortex and other structures, particularly the hippocampal region, that play key roles in this kind of memory.
FROM THE STUDENT’S PERSPECTIVE

Prof. Chris Gabel’s graduate student, Mehraj Awal was asked, “what made you choose Prof. Gabel’s laboratory?”

CHRIS GABEL

Prof. Gabel’s lab focuses on a common theme of understanding how neuronal activity and cellular calcium signaling modulates neuronal response and regeneration following cellular damage. They use the nematode worm C. elegans as a simple yet powerful model system. Laser surgery and imaging tools are used in this lab’s research endeavors.

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MICHAEL HASSELMO

Research in the Hasselmo Laboratory focuses on the role of oscillatory dynamics and neuromodulatory regulation in cortical mechanisms for memory guided behavior, using a combination of neurophysiological and behavioral experiments along with computational modeling.

IAN DAVISON

Electrophysiological and optical approaches are used in the Davison Lab to measure and manipulate the activity of neural populations. This is complemented by quantitative behavior, reporting the animal’s sensory experience, and precise measures of circuit connectivity with intracellular physiology in vitro. Ultimately the lab hopes to use olfaction to help reveal some of the brain’s general mechanisms for flexible sensory processing, pattern recognition, and neural information storage.

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JOHN WHITE

The White Lab’s research focuses on the mechanism of spatially and temporally coherent electrical activity in the brain and the bases of neuronal information processing. The lab’s approach blends technology development, electrophysiology, computational modeling, and imaging. The goal is to develop new treatments for memory disorders and epilepsy, based on novel applications of electronic technology and methods of analysis from applied mathematics and engineering.

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ALBERTO CRUZ-MARTIN

The Cruz-Martin Lab’s current research aims to define the neural pathways that feed the visual system and understanding how this information is parsed and later combined to create a percept of our world. Optically, genetic labeling is used to understand the contribution of cell types and their connection to visual processing and perception.
WHAT ARE YOUR NEXT STEPS?

If you are interested in Neurophotonics research and would like to be eligible for consideration of a NRT Traineeship

• Fill out the web form, identifying in which faculty member(s) lab(s) you’d like to complete a rotation
• Attend the Neurophotonics Faculty SpotLight on Wednesday, September 28 starting at 4 pm
• Reach out to Helen Fawcett for help connecting with NRT faculty members (nrt@bu.edu)
• Stay tuned and attend NRT hosted/co-hosted seminars
• Watch for the application for the NRT Traineeship in the winter months

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