

Neuroscience Seminar Series Calendar – Spring 2018

Tuesday, January 30th

CU-Boulder – Interdepartmental Neuroscience Seminar Series

Muenzinger Psychology, Room E214, 4-5 pm

Ilia Karatsoreas, Associate Professor, Department of Integrative Physiology and Neuroscience, Washington State University, Pullman, WA.

Failure to adapt: The neurobehavioral and physiological consequences of disrupted homeostatic systems.

My lab investigates how organisms interact with their environments, and the mechanisms by which the environment shapes physiological and neurobehavioral function to drive adaptation. Maintaining optimal physiologic function requires organisms to accomplish at least two tasks: 1) anticipate recurring changes in the environment, and 2) adapt to unexpected environmental challenges. The circadian (daily) timing system is essential to the former, relying on cues in the environment to anticipate recurring environmental changes. On the other hand, the stress response system is essential for perceiving, responding to, and recovering from unexpected events. These systems are important because their disruption is linked to significant negative impacts on metabolic, immune, and neurobehavioral function. We employ the circadian and stress systems as models to probe how physiological dysregulation leads to long-term negative health consequences, using an integrative approach, from gene expression and neural morphology, to behavior and whole animal physiology.

Tuesday, February 13th

CU-Boulder – Interdepartmental Neuroscience Seminar Series

Muenzinger Psychology, Room E214, 4-5 pm

Cristin Welle, Assistant Professor, Departments of Neurosurgery and Bioengineering, Anschutz Medical Center, Denver, CO

The living interface – Dynamic alterations of neural and vascular morphology during chronic microelectrode implantation in the brain

Brain computer interface (BCI) systems use neural signals to restore movement capabilities to tetraplegic or amputee patients. These systems rely on high-density micro electrode arrays implanted in the motor cortex to record the action potentials of nearby neurons, and then convert those signals into control command for prosthetic or virtual assist devices. Despite the incredible advances in BCI technology over the last several decades, progress is limited by biological changes at the electrode/brain interface that cause a decline in quality of recorded signals. We are exploring the dynamics of the electrode/brain interface in rodent models using in vivo multi photon microscopy and optical coherence tomography to track changes in the neural and vascular morphology. Abrupt 'disorganization' of vascular patterns correlates with local dendrite atrophy, although the timing of these events varies across animals. Glial cells, and their releasable factors, may help to underly some of the neural and vascular alterations.

Tuesday, February 27th

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Muenzinger Psychology, Room E214, 4-5 pm

Christine Denny, Assistant Professor of Clinical Neurobiology, Department of Psychiatry, Columbia University, NY

***Developing novel prophylactics against stress-induced depression:
Ketamine modifies memory traces in the ventral hippocampus***

Stress exposure is a major risk factor for mood disorders, such as major depressive disorder (MDD) and post-traumatic stress disorder (PTSD). However, some individuals can successfully adapt to stress and do not develop mood disorders. This ability is known as stress resilience. We previously reported that a single injection of ketamine prior to stress protects against the development of depressive-like behavior and attenuates learned fear in mice. However, the cellular and molecular pathways underlying ketamine-induced stress resilience are still largely unknown. Here, I will discuss ongoing work to identify the mechanisms mediating prophylactic ketamine-induced stress resilience. We have utilized a combination of behavioral paradigms, drug development, viral strategies, and the ArcCreERT2 mice, a line that allows for the indelible labeling of neural ensembles representing a single behavioral experience. Our data indicate that prophylactic ketamine may induce protective effects by altering aversive memories, specifically in the ventral hippocampus. Understanding how prophylactic ketamine may prevent stress-induced depressive-like behavior can elucidate both the pathophysiology of depression and provide insights into potential new treatment targets.

Tuesday, March 13th

CU-Boulder – Interdepartmental Neuroscience Seminar Series

Muenzinger Psychology, Room E214, 4-5 pm

Chris Link, Associate Professor, Department of Integrative Physiology, CU
Boulder

Underlying causes of neuroinflammation in ALS and Alzheimer's disease

Tuesday, April 10th

CU-Boulder – Interdepartmental Neuroscience Seminar Series

Muenzinger Psychology, Room E214, 4-5 pm

Yavin Shaham, Senior Investigator and Branch Chief, Behavioral Neuroscience Branch, National Institute on Drug Abuse, Baltimore, MD

Incubation of drug craving after voluntary abstinence: Behavior and circuit mechanisms

In previous studies, we and others have used a rat model of drug relapse and craving to demonstrate time-dependent increases in drug seeking after experimenter-imposed (forced) abstinence from several drugs of abuse (heroin, cocaine, methamphetamine, nicotine), a phenomenon we termed incubation of drug craving (Grimm et al. *Nature*, 2001; Pickens et al. *TINS*, 2011). In these studies, the rats were removed from their drug self-administration environment during extended periods of forced abstinence. More recently, we have established a rat model in which we observe incubation of drug craving after extended periods of voluntary abstinence in the drug environment. Voluntary abstinence is achieved using a mutually exclusive discrete choice procedure in which food-sated male and female rats with prior extended history of intravenous methamphetamine or heroin self-administration can choose every day (20 trials per day) between the palatable food and the drug. In this lecture, I will present our initial behavioral, pharmacological, and brain circuit characterization of incubation of drug craving after voluntary abstinence. I will also introduce a novel relapse model in which voluntary abstinence is achieved by providing the rats an alternative social reward.

Tuesday, April 24th

CU-Boulder – Interdepartmental Neuroscience Seminar Series

Muenzinger Psychology, Room E214, 4-5 pm

Joel Krajl, Assistant Professor, Department of Molecular, Cellular and Developmental Biology, University of Colorado Boulder

Voltage imaging in cells and organisms

Every living cell maintains an internal voltage difference relative to the outside world, and nature exploits these electrical fields in many ways. Electrical activity in neurons form our every thought and emotion. Exquisitely tuned voltage transients trigger and sculpt each heartbeat. Bacteria and mitochondria convert electrical gradients into chemical energy by making ATP. Moreover, voltage misregulation is coupled to diseases as varied as cancer, heart failure, and autoimmunity. The scope of voltage dynamics in nature highlights the crucial role it plays in maintaining life.

Despite the importance of membrane potential, traditional measurement techniques prohibit investigations across vast regions of biology, leaving voltage nearly unexplored outside of neuroscience and cardiology. Patch clamp measurements, in which cells are impaled with a micron sized glass electrode, are the gold standard in electrophysiology, but suffer from serious limitations: the technique (i) is technically difficult and demands serial, time consuming experiments, (ii) is restricted to specific cell types and geometries, and (iii) cannot measure for longer than 4 hours, precluding long-term studies of voltage, such as during development or differentiation. These conditions exclude numerous cell types such as immune cells (too prickly), sperm cells (too motile), bacteria (too small), and fungi (too stiff).

Optical voltage sensing overcomes many limitations of patch clamp. Measurements on a microscope can be taken automatically with little operator training, while removing restrictions on cell size or structure. Furthermore, optical measurements eliminate the need for mechanical contact allowing voltage recordings of moving cells, and experiments over the course of many days. Cells can also be measured in parallel, enabling rapid electrophysiological tests across many conditions including chemical and genetic perturbations. To take advantage of optical voltage imaging, a probe is needed to convert electrical changes into optical changes.

During my postdoc, I discovered that microbial rhodopsins represent a fundamentally new class of fluorescent protein with no homology to GFP, and that the fluorescence of these proteins is exquisitely sensitive to membrane voltage in a cell. My colleagues and I used rhodopsins to optically record individual action potentials in neurons and cardiomyocytes with high signal-to-noise ratio. Combinations of our probes with channelrhodopsin yielded “optopatch”, an all-optical platform for voltage actuation and sensing. Experiments that were previously technically challenging, such as measuring synaptic conduction in neurons, are straightforward using an optical platform. We also used rhodopsins to record the first voltage transients in *E. coli* (Fig 1), launching the field of bacterial electrophysiology. We found that, unlike neurons and cardiomyocytes, individual bacteria have several different types of depolarizations, which may

correspond to different physiological outputs. Armed with rhodopsins, new fields in biology await electrophysiological exploration.