CBRAIN Internships 2025

Following is the list of CBR's research projects in which internships are available. In the online application, please indicate up to 3 projects of your choice (i.e., 1st, 2nd, and 3rd preferences). The allotment of internships will depend on availability and the Mentors' recommendations.

Project 1: **Measuring sleep stages**

Sleep plays a crucial role in several brain functions, including memory consolidation and glymphatic clearance. Sleep is broadly classified into NREM and REM sleep. We use neural, video, and muscle recordings to classify stages of sleep. The prospective intern will use MATLAB and work on understanding how sleep is impacted by noninvasive brain stimulation.

Keywords: Neurophysiology, MATLAB, signal processing, mice, time series data

Duration: 3 months

Mentor: Dr. Chinnakkaruppan Adaikkan

Project 2: **Analysis of synaptic plasticity related proteins in neurodegeneration**

Expressions of neuronal and synaptic plasticity-related proteins are severely affected in neurodegenerative diseases. Using brain sections, we can measure the levels of these proteins, compare them between healthy and diseased states, and gain mechanistic insights. The prospective intern will perform immunohistochemical analysis and image processing to understand the mechanisms by which noninvasive neurostimulations impact synaptic plasticity-related proteins.

Keywords: confocal imaging, brain sections, noninvasive brain stimulations, IMARIS

Duration: 3 months

Mentor: Dr. Chinnakkaruppan Adaikkan

Project 3: **Cholinergic dysfunction in pathogenesis of Parkinson's disease**

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by motor impairments and diverse non-motor symptoms (NMS), including depression, anxiety, apathy, and cognitive decline. NMS often precede the onset of motor symptoms, yet their relationship to motor features and underlying mechanisms remains poorly understood. Beyond dopaminergic deficits, dysfunctions in cholinergic signalling, has emerged as critical contributors to PD pathology. The project is focused on understanding such molecular mechanisms contributing to both motor and NMS.

Keywords: Parkinson's disease, Synaptic function, Cholinergic system

Duration: 3 months

Mentor: Dr. Latha Diwakar

Project 4: **Bioenergetics defects in Alzheimer's Disease**

AD is a progressive neurodegenerative disease where synaptic defects precede neuronal death and are primarily responsible for loss of cognition. Synaptic activity is a high-energy demanding process requiring a coordinated regulation of bioenergetic processes. Since mitochondria are one of the organelles affected in ADm, synaptic bioenergetics is severely compromised. In this project, we will investigate how mitochondrial defects may impact synaptic bioenergetics which inturn affect synaptic plasticity.

Keywords: Bioenergetics, mitochondria, synaptic defects, AD neurons

Duration: **3 months**

Mentor: **Prof. Ravi Muddashetty**

Project 5: **The role of FMRP in AD pathology**

Synaptic defects are thought to be primarily responsible for loss of cognition in Alzheimer's Disease. Activity-mediated protein synthesis is an important process involved in synaptic plasticity and this process is shown to be defective by us and several other groups. In this project, we want to explore the role of FMRP, the RNA-binding protein that is characterized as a key regulator of activity-mediated protein synthesis at the synapse.THe project will involve investigating the expression, transport, and function of FMRP in AD neurons and synaptosome preparation from human iPSC and mouse models.

Keywords: Activity mediated protein synthesis, synapse, FMRP, AD neurons, iPSC

Duration: **3 months**

Mentor: **Prof. Ravi Muddashetty**

Project 6: **Spatial and Temporal Progression of Parkinson's Disease in Limbic Circuits: A Immuno histological analysis of astrocytes, along with pre- and postsynaptic protein alterations and a Golgi Cox study.**

Parkinson's disease (PD) is a neurodegenerative disorder characterized by a complex interplay of motor and non-motor symptoms, with significant variability in onset and progression among individuals. While research has primarily focused on the nigrostriatal pathway and its role in motor dysfunction, this study will explore non-motor symptoms—such as cognitive impairment, mood disturbances, and autonomic dysfunction—that often precede motor impairments, capturing the prodromal stage of the disease. To understand the transition from non-motor to motor symptoms, we will map behavioral and phenotypic changes in PD and examine how different brain regions are progressively affected. A key focus will be the limbic pathway, which plays a vital role in emotional and cognitive functions, and its alterations during disease progression may provide critical insights into early pathological mechanisms. By employing histological and immunohistochemical techniques to analyze neuronal and glial changes, as well as pre- and postsynaptic alterations, this study will integrate with ongoing research at Dr. Diwakar's lab to build a comprehensive understanding of PD pathology and track its spatial and temporal progression across disease stages.

Keywords: Nigrostriatal pathway, non-motor symptoms, Golgi Cox staining

Duration: **3 months**

Mentor: **Dr. Shobha Anilkumar**

Project 7: **Molecular basis of tau protein aggregation in Alzheimer's disease.**

Tau degeneration spreads from one brain region to the next in a prion-like fashion, contributing to the onset and progression of dementia in Alzheimer's disease (AD). The incidence of dementia in Alzheimer's disease patients varies, and the molecular basis is unknown. We will aim to understand how tau proteins misfold and cause dementia.

Keywords: Tau

Duration: 3 months

Mentor: **Dr. Sivaprakasam Ramamoorthy**