Committee: Lin Tian, Kevin Xiang and Jie Zheng (UC Davis) Location: Great Bear Winery

Time: noon-9pm Aug 27, 2022

2022 BACLIF Retreat
Aug 27, 2022

Great Bear Vineyard
Davis.

12:30-1:30	Arrival, social in patio	**Host:** Lin Tian
1:30-2:10	Two presentations (15+5 min each)	**Speaker**: Yi Xue and Bo Huang **Moderator**: Jie Zheng
2:15-2:40	Data blitz (5 minutes each)	**Speaker**: Ji Na, Yifan Cheng, Weijian Yang, Bianxiao Cui, Yuanpei Li.
2:45-3:00	Discussion	**Moderator**: Jie Zheng
3:00-3:30	Break and Tour	
3:30-4:10	Two presentations (15 + 5 min each)	**Speaker**: Yang Dan and Billy Li **Moderator**: Kevin Xiang
4:15-4:40	Data blitz (5 minutes each)	**Speaker**: Qili Liu, Min Zhao, Guo Huang, Jiandi Wan
4:45-5:00	Discussion	**Moderator**: Kevin Xiang
5:00-6:00	Business meeting 1. Active in leadership roles: promotion of career development, service and administrative activities. 2. Development of BACLIF group .	**Panel**: Yifan, Yang Hu, Yi Zuo, Ji Na, Jun Ding, and attendees **Moderator**: Lin Tian, Kevin Xiang
6:00-8:00	dinner and social	

BACLIF retreat 2022 speaker introduction

Guo Huang

Research Overview:

Background: The regenerative potential in the animal kingdom displays striking divergence across ontogeny and phylogeny. For example, heart regeneration is remarkably robust in adult zebrafish and newborn mice while very limited in adult mammals. This presents a particular problem for patients with a heart attack who suffer from loss of millions of heart muscle cells and life-threatening functional deterioration of the heart.

Summary: Our current research focuses on cardiac regeneration and repair in adult zebrafish, neonatal and adult mice, with an emphasis on the pathways that regulate resident stem cell activation and cardiac muscle cell proliferation, and with innovative and integrated approaches in engineering, single cell analysis, advanced imaging microscopy and genome manipulation technology.

Major goals: (i) decipher natural regeneration processes (ii) stimulate de novo regenerative responses.

Yangnan Gu

Research Interests

The Gu lab is interested in studying the nuclear envelope, the hallmark of the eukaryote cell. We have emphasized on investigating the composition of plant nuclear membrane proteins and their versatile function in chromatin organization, gene expression, and stress/immune responses. We also explore the specialization of different nuclear transport receptors in mediating nuclear shuttling of signaling cargos under various environmental conditions and its significance in determining specific immune responses in plant cells.

Na Ji

Research Interests

Using concepts in physics, we develop next-generation optical microscopy methods for understanding the brain at higher resolution, greater depth, and faster time scales. Besides inventing methods that make an immediate impact on neuroscience, we also aim to extend the applications of our technologies to other living (and nonliving) systems.

Yang Hu

Current Research and Scholarly Interests

Regenerative and neuroprotective therapies have long been sought for CNS neurodegenerative diseases but none have been found. That there is no curative neuroprotective or restorative therapy for neurodegeneration is a central challenge for human health. My lab focuses on the mechanisms responsible for neuronal degeneration and axon regeneration after injury or diseases with the goal of building on this understanding to develop effective combined strategies to promote neuroprotection and functional recovery: 1) Through established collaborations with experts in immunology, physiology and cancer, we were the first to demonstrate that axon-injury induced neuronal ER stress is a common mechanism for both RGC soma and axon neurodegeneration. We are currently developing ER stress modulators and AAV-mediated gene therapy strategies for neuroprotection. 2) We are pioneering in the application of AAV-mediated therapies for safer and more effective treatment of glaucoma and related optic neuropathies. We have identified an RGC-specific promoter for CRISPR/Cas9-based gene therapy in RGCs. We are screening mutated AAV capsid libraries to identify AAVs that can specifically infect RGCs but not other retinal cells and make RGC targeting more precise, including in human tissues. 3) We have recently developed novel inducible mouse and NHP glaucoma models that faithfully replicates a secondary post-operative glaucoma following vitreoretinal surgeries; and a genetic mouse glaucoma model to mimic normal tension glaucoma. 4) Through collaboration with experts in adaptive optics, machine deep learning and genetics, we are developing reliable morphological and functional in vivo readouts of RGCs and illustrating genetic causes of RGC degeneration. 5) Previously, we performed molecular dissection of the PTEN/mTOR pathway in mouse RGCs in vivo and illuminated the mechanisms by which AKT interacts with mTORC1 and mTORC2 and their downstream effectors S6K1, 4E-BP and GSK3β to regulate optic nerve regeneration. We currently use a newly developed tracing method to purify regenerating RGCs and survival but non-regeneration RGCs, by which we identified true axon regeneration-associated genes. In summary, our work emphasizes understanding fundamental molecular mechanisms while maintaining a consistent focus on clinically relevant scenarios and therapies that will allow us to translate lab discoveries into effective vision restoration treatments.

Jin Billy Li

Current Research and Scholarly Interests

The Li Lab is primarily interested in RNA editing mediated by ADAR enzymes. We co-discovered that the major function of RNA editing is to label endogenous dsRNAs as "self" to avoid being recognized as "non-self" by MDA5, a host innate immune dsRNA sensor, leading us to pursue therapeutic applications in cancer, autoimmune diseases, and viral infection. The other major direction of the lab is to develop technologies to harness endogenous ADAR enzymes for site-specific transcriptome engineering.

Qili Liu

Motivation, defined as the energizing of behavior in pursuit of a goal, is shared by all animals to fulfill basic needs for survival, including food, water, sleep, and social interaction. The broad goal of the lab is to understand the fundamental principles underlying the organization and modulation of motivated behaviors, with a particular focus on protein feeding.

Given the global obesity epidemic, illuminating the mechanisms underlying protein feeding may also facilitate the development of novel therapeutic treatment for obesity.

We seek to address questions including:

- What are the cellular and molecular substrates mediating the homeostatic negative feedback for protein feeding?
- How does protein specific hunger interact with general hunger and regulate total energy consumption?
- How is the goal (homeostatic setpoint) for motivated behaviors determined and presented in the brain? And how is individual variability in goal values encoded?
- How is compartmentalized signal processing achieved within individual neurons?

To address these questions, we will harness the power of Drosophila model system and employ a multidisciplinary approach including large-scale genetic and behavioral analyses, immunohistochemistry, functional imaging, and patch-clamp electrophysiology.

Biao Wang

Research Overview:

Adipose tissue regulates systemic energy homeostasis by storing lipids as triglycerides and by secreting adipokines. Dysfunctions of adipose tissue in either obesity (too much fat) or lipoatrophy (too little fat) patients cause metabolic syndromes such as insulin resistance and dyslipidemia. Using orthologous genetic systems (Drosophila and mouse), we are interested in 1) identifying genetic hierarchy of adipocyte lineage development, and 2) investigating molecular mechanisms of adipose tissue remodeling in health and disease states.

Dengke Ma

Overview

Our research is focused on understanding the mechanistic (genetic and physiological) basis of cellular and organismic stress resilience. We hope to use the knowledge from such studies to engineer cells and organisms with novel resilience traits that protect against environmental stresses, biological aging and pathological mutations/microbes/toxins.

Many organisms in nature have evolved specialized traits to respond and adapt to severe environmental stresses, including hypothermia (cold) or hypoxia (low oxygen). For example, Arctic ground squirrels can tolerate extreme low levels of oxygen in the brain and heart during hibernation. Most nematodes, including those from the Antarctica and the common model organism C. elegans, can enter "suspended animation" states upon anoxia; they can also be frozen alive and suspend life that can be revived later virtually any long after freezing, unlike many other multicellular organisms. We use both cultured neural stem cells from hibernating Arctic ground squirrels and nematodes with extremophile-like phenotypes recapitulated in the laboratory as discovery tools to understand mechanisms of cellular and physiological resilience. Genes identified from such systems via large-scale experimental screens or computational mining often encode proteins of unusual properties that define novel mechanisms underlying cytoprotection, cellular organelle dynamics and organismic homeostasis in physiology and behaviors. Some were even acquired from extremophile microbes via horizontal gene transfers and functionally co-opted to confer stress resilience. We take advantage of findings from our research and aim to use synthetic physiology approaches to engineer biological systems that may foster new means of cytoprotection, organ transplantation, reversible cryo-preservation and therapeutics to treat ischemic, neurological and age-related disorders.

Bianxiao Cui

Dr. Bianxiao Cui is the Job and Gertrud Tamaki Professor of Chemistry and a fellow of the Wu Tsai Stanford Neuroscience Institute at Stanford University. She holds a Ph.D. degree in Chemistry from the University of Chicago and a BS degree from the University of Science and Technology of China. Dr. Cui develops new tools to study the nano-bio interface, electrophysiology, and signal transduction in cells at normal and disease conditions. As a scientist and a teacher, she enjoys working with young scientists to explore the natural world with scientific innovations. Research in her group spans the disciplines of physical chemistry, material science, nanotechnology, and neurobiology. Her awards and distinctions include Barany Award from Biophysical Society, NIH New Innovator Award, NSF CAREER award, NSF

Inspire award, Packard Fellowships in Science and Engineering, Hellman Scholar, Searle Scholar Award and Dreyfus New Faculty Award.

Bo Huang

Cellular processes are orchestrated by a large number of biomolecules in a spatially and temporally coordinated manner within a tiny volume. To uncover the underlying organizational principles and their functional relevance, we take microscopy visualization as the primary approach to systematically map the spatial localization, temporal dynamics and activity profiles of proteins and nucleic acids.

We are particularly interested in the following problems:

- Subcellular, high-resolution and dynamic mapping of the entire proteome,
- Physical organization and dynamics of the nucleus and the genome,
- Architecture of large protein complexes such as the ciliary transition zone, and
- Subcellular compartmentalization of signaling molecules, particularly in the G-protein coupled receptor (GPCR) and receptor tyrosin kinase (RTK) signaling pathway, and how this spatial distribution defines signaling specificity.

In order to study these systems, we are developing the following microscopy technologies:

- Super-resolution and light-sheet microscopes that can visualize subcellular structures at a higher spatial resolution, record long term cell behavior, and track cells in intact animals, and
- New fluorescent probes and gene editing methods for the labeling of endogenous proteins.

Bianxiao Cui

Dr. Bianxiao Cui is the Job and Gertrud Tamaki Professor of Chemistry and a fellow of the Wu Tsai Stanford Neuroscience Institute at Stanford University. She holds a Ph.D. degree in Chemistry from the University of Chicago and a BS degree from the University of Science and Technology of China. Dr. Cui develops new tools to study the nano-bio interface, electrophysiology, and signal transduction in cells at normal and disease conditions. As a scientist and a teacher, she enjoys working with young scientists to explore the natural world with scientific innovations. Research in her group spans the disciplines of physical chemistry, material science, nanotechnology, and neurobiology. Her awards and distinctions include Barany Award from Biophysical Society, NIH New Innovator Award, NSF CAREER award, NSF Inspire award, Packard Fellowships in Science and Engineering, Hellman Scholar, Searle Scholar Award and Dreyfus New Faculty Award.

Yifan Cheng

Cryo-EM technology development

In recent years, the most exciting technological breakthroughs in single particle cryo-EM were brought about by the broad application of direct electron detection cameras. All current commercial direct electron detection cameras have superior detective quantum efficiency (DQE) at all frequencies over traditional scintillator based digital cameras and photograph films. They also have a high output frame rate, typically between 10 to 40 frames per second. Nowadays cryo-EM images of frozen hydrated biological samples are typically recorded as dose-fractionated movie stacks, which enable correction of beam-induced image motion. Together with David Agard's laboratory at UCSF, we developed the programs MotionCorr (Li et al. 2013, Nature Methods) and MotionCor2 (Zheng et al. 2017) for fast and accurate correction of beam-induced image motion.

Membrane protein structure and function

We are interested in developing novel technologies to enable high-resolution structure determination of integral membrane proteins, particularly in lipid bilayer environments. Together with Charles Craik's laboratory at UCSF, we developed a general approach of using conformational specific monoclonal Fabs to facilitate structural studies of small soluble and integral membrane proteins by single particle cryo-EM (Wu et al. 2012, Structure and Kim et al. 2015, Nature). Together with David Julius's laboratory at UCSF, we demonstrated that lipid-nanodiscs can be used for high-resolution structure determination of membrane proteins and visualization of specific lipid protein interactions (Gao et al. 2016, Nature). We are also investigating other methodologies that enable high-resolution structure determination of integral membrane proteins in lipid environments, such as using Saposin as a scaffolding protein to reconstitute lipid-protein complexes for single particle cryo-EM structure determination (Frauenfeld et al., 2016, Nature Methods). (Add native nanodiscs)

Together with David Julius's laboratory at UCSF, we are studying structures of various members of the transient receptor potential (TRP) channel superfamily. We have now determined atomic structures of TRPV1 (Liao, et al. 2016, Nature; Cao et al. 2013 Nature and Gao et al. 2016, Nature), TRPV5 (Dang et al. 2019, PNAS), TRPA1 (Paulsen et al. 2015, Nature, Zhao et al. 2020, Nature), TRPM4 (Autzen et al. 2018, Science), and TRPM8 (Diver et al. 2019, Science). These structures have shed light on how different TRP channels are activated and inhibited by small molecules, toxins, and small proteins such as calmodulin. Shared mechanisms of modulation by calcium ions were also revealed in the TRPM structures.

We are also studying structures of ABC transporters (Kim et al. 2015, Nature). Together with a number of other laboratories at UCSF, including the laboratories of Charles Craik and Robert Stroud, we formed a consortium with the goal to study structures and functions of various ABC transporters.

Protein degradation machinery

In all eukaryotic cells, the 26S proteasome catalyzes most intracellular protein degradation in an ATP-dependent manner. The 26S proteasome is composed of a 20S protease core particle (CP) sandwiched between two 19S regulatory complexes (RP). The atomic structure of the 20S CP has been determined by the x-ray crystallography, and the low-resolution shape of the 19S RP has been determined by the cryo-EM. However, the structures/functions of many subunits in the 19S RP remain to be elucidated at higher resolution. We are interested in studying structure/function of the 19S RP. Among the subunits in the 19S, the proteasomal ATPases

recognize the substrates targeted for degradation, unfold globular substrates, induce gate-opening in the 20S, and facilitate translocation of the unfolded substrate into the 20S CP for degradation. We are using single particle cryo-EM together with other biochemical methods to study the structure/function of the proteasomal ATPases and their mechanisms of inducing gate-opening in the 20S CP.

Jun Ding

Current Research and Scholarly Interests

The interplay between motor cortex, sensory cortex, thalamus and basal ganglia is essential for neural computations involved in generating voluntary movements. Our goal is to dissect the functional organization of motor circuits, particularly cortico-thalamo-basal ganglia networks, using electrophysiology, 2-photon microscopy, optogenetics, and genetic tools. The long-term scientific goal of the lab is to construct functional circuit diagrams and establish causal relationships between activity in specific groups of neurons, circuit function, animal motor behavior and motor learning, and thereby to decipher how the basal ganglia process information and guide motor behavior. We will achieve this by investigating the synaptic organization and function that involve the cortex, thalamus and basal ganglia at the molecular, cellular and circuit level. Currently, we are focusing on several questions:

How are excitatory and inhibitory inputs integrated in the striatum?

How do feed-forward and recurrent local inhibitions balance the excitation in the striatum?

How are functional maps modulated in motor behavior and motor learning?

Our goal is to bridge the gap between molecular or cellular events and the circuit mechanisms that underlie motor behavior. In addition, we aim to further help construct the details of psychomotor disorder circuit diagrams, such as the pathophysiological changes in Parkinson s disease.

Rongze Olivia Lu

I am an Assistant Professor in the Department of Neurological Surgery at University of California, San Francisco (UCSF). Our lab focuses on identifying molecular mechanisms mediating immune suppression and evasion in brain tumors, with the goal of developing novel immunotherapeutics for these diseases. My recent research identified that protein phosphatase 2A negatively regulated T cell and macrophage mediated anti-tumor immunity, and further demonstrated that pharmacological inhibition of PP2A synergized with PD-1 blockade in multiple type of resistant tumors including glioblastoma. Based on those findings, a Phase I/II trial (NCT03027388) of PP2A inhibitor in recurrent glioblastoma is ongoing.

Weijian Yang

Our lab develops advanced optical imaging technology and novel miniaturized devices, and use these new tools to investigate problems in neuroscience and biomedicine. Our research topics include biophotonics, optical imaging, two-photon microscopy, implantable biomedical devices, MEMs/NEMs devices, metastructures, brain imaging and modulation, and neural circuits.

Yi Shen

Research Directions:

1. Functional genomics (the ENCODE project): high-throughput CRISPR/Cas9 screening of functional regulatory elements.

We are using high-throughput CRISPR/Cas9-mediated genetic screening to interrogate the biological significance of a large number of non-coding regulatory sequences in the mammalian genome in both embryonic stem cells and iPSC-derived neural cell types.

2. Charting the regulatory landscape of human brain development and function.

We are utilizing integrative, unbiased, and high-throughput genomic and genetic tools (ATAC-seq, RNA-seq, ChIP-seq, 4C-seq, Hi-C, and CRISPR) to identify and functionally characterize cis-regulatory elements in human brain cells.

3. Investigating the functions of non-coding genetic variation associated with neurological diseases.

Putative regulatory regions harbor a disproportionately large number of sequence variants associated with human traits and diseases, leading to the notion that genetic lesions in the cis-regulatory elements contribute substantially to common human diseases. We are using functional genomics tools to investigate how non-coding variants associated with complex neurological disorders (e.g., autism spectrum disorders (ASD), Alzheimer diseases (AD), and Parkinson disease (PD)) contribute to disease.

Yang K. Xiang

Research/Academic Interests

My current research focuses on aging/stress-related metabolic and inflammatory disorders and diseases like type 2 diabetes, diabetic cardiomyopathy, heart failure, and Alzheimer's disease. We have recently characterized a novel insulin receptor and beta-adrenoceptor network expressed in different tissues. This opens a new field to understand insulin resistance in glucose metabolism and a broad range of cardiovascular and neuronal complications. We drew recent funding from NIH and VA to support these research directions. One of the major goals is to understand the prevalent co-existence of insulin resistance and adrenergic dysregulation in various diseases. We utilize a wide range of tools from single molecular analysis of receptor complex high resolution of living cell imaging to in vivo genetic, surgical, and pharmacological manipulation. By combining novel analytical tools with in vivo and in vitro characterization of receptor signaling and function, my laboratory has developed an integrative approach to systematically analyze insulin and adrenergic signaling in the brain and peripheral tissues.

Eventually, we hope to provide information/strategies on clinical therapies for different metabolic and cardiovascular conditions.

Yi Xue

Computational optics, optical imaging, biophotonics, brain-computer interfaces, neurotechnology

Dr. Xue's group develops computational optical systems by jointly designing optical hardware and computational algorithms to achieve extremely high throughput, high resolution, and high signal-to-noise ratio. Her group builds optical microscopy tailored to physics-based computational models to exceed the performance of traditional optical microscopy. Such techniques will open new avenues in all-optical interrogation of neural circuits in the mouse brain and form the basis for non-invasive brain-computer interfaces to treat mental disease and motor dysfunction.

Lin Tian

Finding an effective treatment for neurological disorders is our ultimate goal in neuroscience. To achieve this goal, we must understand the brain mechanisms that govern physiological processes.

Addressing this problem requires a thorough understanding of neural activity pattern, and the ability to relate this to physiological processes, behavior and disease states. We are combining computational protein design, chemical biology, electrophysiology, optical imaging techniques, and inducible pluripotent stem cell (iPSC) technology to describe the logic of the neural circuitry, how this logic relates to behavior and disease states.

One of the major focuses in the lab is to develop optical tools for multiplex, large-scale recording of neural activity and employ these tools to study the brain mechanisms over the control of behaviors in health and disease. We develop novel genetically encoded indicators based on fluorescence and bioluminescence proteins or small molecules, to enable optical dissection of neural activity, with a special focus on direct and specific measurement of myriad chemical input signals with needed spatial and temporal resolutions.

We use a variety of techniques (computational modeling, machine learning, rational design, directed evolution, chemical synthesis) to develop these imaging probes. We characterize, validate and apply these probes in vitro and in vivo in multiple biological systems using electrophysiological, pharmacological, genetic, microscopic, and behavioral approaches. In combination with calcium imaging and optogenetics, these sensors are well poised to permit direct functional analysis of how the spatiotemporal coding of neural input signaling mediates the plasticity and function of target circuits.

We also integrate our imaging probes to induced pluripotent stem cells (iPSCs)-derived neurons and glias, tap into microfluidic device, to create a platform for studying molecular and cellular mechanisms of neurodevelopment disorders (such as Down syndrome) and psychiatric diseases (depression, addiction and schizophrenia). Such cultured human neuronal networks will enable us to visualize how the precise, guided communication in neurons develops, and how it breaks down in diseases.

This platform also enables real-time, on spot optical measurement and discovery of pharmacological profiles and mechanistic action of therapeutic drugs in a patient-specific manner to realize personalized medicine to treat neurological disorders.

Jie Zheng

Ion channels are membrane proteins found in all cell types. Under precise regulation of cellular and environmental inputs, ion channels support rapid ion translation into or out of cell, which generates electrical signaling of the nervous system, triggers muscle contraction, initiates fertilization and immune response, etc. Ion channels are the target of many drugs currently on the market or under development. Mechanisms underlying the activation and inactivation of an ion channel, termed gating, thus hold the key to understand numerous physiological phenomena.

Our current research focuses on the capsaicin receptor TRPV1 ion channels and its homologs. Gating of these ion channels is “polymodal”, meaning that multiple physical and chemical stimuli can be simultaneously detected. Activation of TRPV1 by pungent compounds in chili peppers (capsaicin) and gingers (shogaol, gingerol, zingerone) produces the spicy sensation; its activation by heat supports temperature sensing and body thermo-regulation; its activation by extracellular H+ plays an important role in inflammation response. Activation of TRPV1 in nociceptive neurons by these and additional stimuli (e.g., toxins produced by venomous animals) initiates pain signaling. Multiple clinical trials are testing analgesic drug candidates that manipulate TRPV1 activity.

Investigating the polymodal activation mechanisms of TRPV1 and related channels calls for a multidisciplinary approach. Patch-clamp recordings at macroscopic and single-channel levels yield high temporal resolution information on its gating kinetics and equilibrium properties. Pharmacological analyses using native or novel synthesized compounds and peptide toxins hold the key to unlock the mystery of ligand-host interactions. Computational modeling based on available high-resolution cryo-EM structures guides ligand docking, precise structural perturbations by mutagenesis and chemical modification, as well as de novo design of peptide modulators. Spectroscopic imaging coupled with site-specific fluorescent unnatural amino acid incorporation allows real-time monitoring of conformational changes, whose functional output can be monitored simultaneously by patch-clamp recording. We combine these methods with additional biophysical and biochemical approaches and various cell and animal models to address specific needs for solving each scientific question.

Yuanpei Li

Research Interests

1. Development of novel nano-medicine platforms, biomaterials and microfluidic devices

The Nanomedicine and Biomaterials Laboratory aims to 1) develop next generation nano-medicine platforms, biomaterials and microfluidic devices by learning from nature and clinical practice, 2) obtain fundamental knowledge on how these subjects interact with biological systems, and 3) apply them to solve complex medical problems that are associated with cancer and other diseases. Our research projects integrate recent advances in interdisciplinary fields, such as nanotechnology, material sciences, chemistry, engineering and biology, to create innovative technologies and therapeutics. Significant efforts have also been devoted to the rapid “bench to bed side” translation of these innovative technologies and therapeutics that can tremendously benefit the health of human and companion animals. We are particularly interested in the following research area:

1. Targeting and programmable drug/gene delivery
2. Theranostics
3. New biomaterials/bio-inspired materials
4. Enabling technology for immunoengineering
5. Integration of nanotechnology/biomaterials in microfluidics

2. Exosomes/oncosomes and stem cells

We are interested in new isolation, drug discovery & development, targeting delivery and engineering technologies that are related to stem cells and exosomes/oncosomes from clinical patients.

Yang Dan

Research Description

Yang Dan is a Professor of Neurobiology. Her research lab aims to elucidate (1) what circuits in the mammalian brain control sleep, and (2) mechanisms by which the frontal cortex exerts top-down executive control. They use a variety of techniques, including optogenetics, electrophysiology, imaging, and virus-mediated circuit tracing.

Current Projects

Neural circuits controlling sleep. Using optogenetic manipulation, optrode recording, and cell-type-specific calcium imaging, they identify neuronal types that play critical roles in the generation of rapid-eye-movement (REM) sleep and non-REM sleep. Local synaptic interactions between cell types are measured by recordings in brain slices, and long-range connections are mapped using a variety of viral tools.

Function of the prefrontal cortex (PFC). Combining electrophysiological recording, calcium imaging, and optogenetic manipulation in mice performing PFC-dependent tasks, they aim to understand how the PFC generate task-related activity, and how the activity regulates the downstream targets for optimal behavioral control.

Yi Zuo

Decipher the dynamic neural circuit in the living brain

The ability to learn new skills and to adapt to an ever-changing environment is vital for the animal. To understand the neural circuit basis of such abilities, we combine live imaging, molecular genetics, opto- and chemo-genetics, and mouse behavioral analysis to study synapse plasticity under both physiological and pathological conditions.

Synaptic mechanisms of learning and memory.

Memory leaves physical traces in the brain. It is generally believed that a memory trace is stored by a specific population of neurons together with their synaptic connections. Using motor learning as a paradigm, we ask how memories of new motor skills are allocated at the level of synapses and how neurons integrate synaptic inputs to generate behavioral outputs. Furthermore, we try to understand how the synaptic machinery deteriorates with aging and in neurological disorders.

Neuronal circuits for cognitive flexibility.

Cognitive flexibility refers to the brain's ability to extract rules from experience and to apply them adaptively in a complex, changing environment. Loss of cognitive flexibility is frequently encountered in stress-associated psychiatric disorders. We focus on the frontal cortex, a region critically involved in working memory and decision-making, to understand its organizational principles and functional roles in cognitive flexibility.

Min Zhao

Research Interests

Dr. Zhao's group is interested in the control of directed cell motility and directed cell division. One particular interest is in the role played by small physiological electrical fields in wound healing, the development and regeneration of many tissues. He has been leading the group that attracted research funding of £2.7m (~ US $4.9 million) in the last eight years. He leads international collaborations to unravel the electrical control of cell migration and growth with Colin McCaig, John Forrester, Bing Song (University of Aberdeen), Josef Penninger (Austrian Academy of Sciences), Peter Devreotes (Johns Hopkins University Medical School), Henry Bourne (UCSF), Eammon Gaffney, Philip Manni (Oxford University), Robert Insall (Glasgow, Scotland), Kees Weijer (Dundee, Scotland), Yuesheng Huang and Jianxin Jiang (China).

Steady extracellular electrical fields are present at a wound. Our group has used multiple approaches to study electric field-directed migration and growth of nerve, blood vessels, epithelial cells, and immune cells. Dr. Zhao proposed and initiated the work using the social amoeba Dictyostelium discoideum and transgenic animals to study the genetic basis of the effects and mechanisms of physiological electrical field. We use at molecule, cellular, tissue and whole animal level. Our recent publications that provide

Chengji Zhou

The Zhou Lab Conducts Biomedical Dynamics Research (BDR) on Birth Defects and Regeneration (BDR)

The developmentally dynamic organogenesis is regulated by several inductive factors, such as Wnts. It is also regulated by epigenetics. Incorrect activity and timing of these signaling pathways or epigenetic regulations during early development may result in embryonic death or severe birth defects. We are investigating the mechanism and prevention of birth defects mainly using Wnt signaling and epigenetic mutant mice as the research models. We are also investigating the roles of Wnt signaling and epigenetics in stem cell/progenitor renewal and regeneration processes in order to enhance their therapeutic potential.

- From the aspect of congenital disease, we are investigating the mechanism and prevention of several major birth defects related to tissue closure and patterning in Wnt signaling mutant animal models, such as:

o Orofacial cleft (OFC), defective tissue closure in the upper lip, palate, and related orofacial structures, including cleft lip with or without cleft palate (CLP) and isolated cleft palate;

o Neural tube defect (NTD), defective closure of the neural tube (the precursor of brain and spinal cord), including spina bifida (open spine) and exencephaly (open skull/brain);

o and related congenital disorders in several major organs, including the brain, heart, limb, kidney and the urogenital system.

- From the aspect of stem cell biology, we are addressing the roles of Wnt signaling and epigenetics in tissue/organ-specific stem cells and progenitors, including neural crest stem cells, mesenchymal stem cells, neural stem cells and glia during development and regeneration.

Guo Huang	UCSF	plus 3
Yangnan Gu	UCB	
Na Ji	UCB	
Yang Hu	UCB	
Jin Billy Li	Stanford	
Qili Liu	UCSF	
Biao Wang	UCSF	
Dengke Ma	UCSF	
Bo Huang	UCSF	
Yifan Cheng	UCSF, HHMI	plus 2
Bianxiao Cui	Stanford	
Jun Ding	Stanford	plus 3
Rongze Olivia Lu	UCSF	
Yi Shen	UCSF	
Weijian Yang	UC Davis	
Kevin Xiang	UC Davis	
Lin Tian	UC Davis	
Jie Zheng	UC Davis	
Yi Xue	UC Davis	
Min Zhao	UC Davis	
Yuanpei Li	UC Davis	
Yang Dan	UC berkeley, HHMI	
Yi Zuo	UCSC	
jiandi wan	UC Davis	
Jian He	UC berkeley	

2022 BACLIF Retreat

Lin Tian

CHEN INSTITUTE TIANQIAO & CHRISSY

UCDAVIS SCHOOL OF MEDICINE

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