Training Awards: Call for Proposals

For CCBM Affiliates

Begins January 2019

As part of the awarded NSF-CREST Supplement, we are pleased to call for applications for Training Awards. CCBM affiliates (graduate students, project scientists and faculty) are eligible for training awards related to their research efforts. Grants will be awarded on an ongoing and competitive basis.

A Selection of Summer Schools and Workshops

Boulder School

The Boulder School in Condensed Matter and Materials Physics provides education for advanced graduate students and postdoctoral fellows working in condensed matter physics, materials science and related fields. The goal is to enable students to work at the frontiers of science and technology by providing expert training not easily available within the traditional system of graduate education and postdoctoral apprenticeship. The School, which is supported by the National Science Foundation and the University of Colorado, meets annually during July in Boulder Colorado. Lectures are given by leading scientists in the field. The topic changes from year to year, and biophysics and soft matter topics occur every few years. Here is a short list of previous courses that align with the CCBM thrust: Soft Matter In and Out of Equilibrium, Polymers in Soft and Biological Matter, Nonequilibrium Statistical Mechanics and Biophysics (see references).

While it is difficult to quantify exact technical skills gained at a student level, the knowledge gained is significant. Boulder School offers a very broad and thorough lecture series on advanced topics that are usually not covered in most graduate programs. Intensive classes every day (~6 hrs) for five days a week for 3-4 weeks is an intensive experience for attendees. During breaks, students are encouraged by faculty to form groups that further explore new concepts learned during the day's course. Students are encouraged to reach out to visiting faculty to further discuss topics taught and advanced research. These interactions foster very important networks of contacts that will further support graduate students as they progress in their academic careers. Finally, all students are encouraged to present a research poster while at Boulder School. Overall, Boulder School is a valuable experience that will allow our CCBM students to receive structured feedback on their current and future research goals and prospects.

KITP Advanced School

While the subject of the Advanced School changes from year to year, here is a summary of the 2016 Advanced School for Mechanics and Mechanisms of Morphogenesis which aligns very well with CCBM's Thrust 3 research. The Advanced School also incorporates laboratory projects as well serving both theory and experimental driven graduate needs.

"This course aims at bringing together the Biology and Physics perspectives on Morphogenesis - the process through which animals and plants acquire their physical form and biological function. Morphogenesis is a developmental program encoded in DNA and kick-started by "maternal factors" in the egg. Developmental Biology has made enormous progress in identifying the genes that specify developmental axes and the general body-plan as well as the numerous genes and biochemical signals that control growth and cell differentiation. Yet, even as we know the expression of what gene would cause a fruit-fly to grow a leg on its head instead of an antennae, we have little understanding of how controlled growth and cell differentiation actually generates the distinct shape and structure that make a leg rather than an antennae. A century ago, before the advent of developmental genetics, D'Arcy Thompson viewed Morphogenesis as an essentially physical process of controlled growth. Revisiting Thomson's agenda, the challenge is to connect the macroscopic dynamics of morphogenesis to the underlying molecular genetic and cell-biological processes. Physics perspective in particular focuses on the *dynamical* aspect of morphogenesis. To use a metaphor, what are the "laws of motion" that define the developmental trajectory from maternal factors as "initial conditions" to embryonic structures and beyond? Physics perspective also brings to fore the role of intercellular interactions in coordinating development and, in particular, the role of mechanics alongside with biochemical signals governing collective and individual behavior of cells in tissues."

"The course will be anchored by laboratory projects involving different morphogenetic processes in model organisms such as the fruit fly *Drosophila melanogaster*, the nematode *Caenorhabditis elegans*, zebra fish (*D. rerio*), a sea squirt (Ciona) and a crustacean (*Parhyale hawaiensis*). Experimental projects will aim to introduce quantitative approaches to the study of the dynamics of morphogenesis."

KITP Advanced School offers instruction to both theoretical and experimental graduate students. The emphasis is carefully chosen each year. In 2016, the emphasis was focused on experimental students. Below is a short description of a five-week boot camp course on advanced experimental techniques in measuring and quantifying morphogenesis in model systems such as Drosophila and Zebra Fish. As with all advanced summer schools, KITP offers an environment that fosters networking and collaboration.

This five-week course will consist of a "bootcamp" week to be followed by two 2-week research project sessions. Each session will consist of three or four experimental projects led by instructors and TAs who will closely work with groups of 4-5 students. Each day will consist of a morning lecture and discussions followed by lab work late into the evening.

The bootcamp week will be aimed at introducing all students to a basic set of microscopy, quantitative image analysis and theoretical modeling tools that will be necessary for the later research projects. Bootcamp will also introduce students to different laboratory model systems of development.

Advanced Technical and Research Workshops

COMSOL Workshop: 2 day
This workshop is an intensive introduction to using COMSOL Multiphysics. During the COMSOL Multiphysics Intensive Training course, students "will develop a strong foundation for your future multiphysics modeling work. We start at an introductory level, leading students through the essential steps needed in all analyses (geometry creation, interactive meshing techniques, model setup, postprocessing, etc.) Then, we move into more advanced topics, such as solution techniques and multiphysics modeling."

"To teach this course, we use a combination of guided hands-on training, theoretical and practical lecture, and self-guided hands-on training. The goal is to immerse you in all the main aspects of using COMSOL Multiphysics, so that you feel comfortable working with the software. You will leave the course feeling confident that you are correctly solving your simulation problems with COMSOL Multiphysics."

Students will gain experience with multi-physics simulation with COMSOL. This is software that we will be implementing in our CCBM shared computational resource beginning in March 2018. As such it will be invaluable to have project scientists, faculty and students that are trained in the basic features and core modelling concepts that are necessary skills to use and implement custom simulation needs. This software can be used in both theory and experimental groups. In the theory aspect, COMSOL can be used to simulated very difficult, analytically intractable elasticity and fluid dynamics simulations. The codes contained within the COMSOL would near impossible to code by a student or post-doc within the time frame of their tenure.

For experimental labs, COMSOL is an essential tool for designing robust laboratory tools, such as micro-fluidic devices and custom ICs (integrated circuits). In COMOL, students and post-docs will have the ability to test their device design prior to the manufacturing step to address design issues at an earlier stage.

Mass Spectrometry Course: Q Exactive Biotech Operations
"This course will help users gain a complete understanding of the operation and maintenance of the Thermo Scientific Q-Exactive mass spectrometer. The course introduces new operators to the use of high-resolution accurate mass (HRAM) for qualitative and quantitative sample analysis with an emphasis on peptide and protein applications. Experience in FTMS is not required. Course topics include lectures along with laboratory experiments to familiarize participants with Orbitrap theory, tuning and calibration, hands-on ESI and NSI MS, instrument method development for LC/FTMS, data dependent method design, Xcalibur software, Proteome Discoverer software and basic Q-Exactive maintenance. Course Content: Q-Exactive Introduction, Ion Generation, Ion Optics and Ion Detection Q-Exactive Tuning and Calibration Xcalibur

Instrument Method Setup for Qualitative and Quantitative Analysis Xcalibur Sequence Setup Qualitative and Quantitative Analysis Xcalibur Qual Browser Proteome Discoverer Introduction Q-Exactive Maintenance" (see reference).

"This course is designed for users that have previous LC-MS experience and are interested in protein and peptide analysis. It is specific to the Thermo Scientific™ Q Exactive™ mass spectrometer and will include instruction for electrospray ionization (ESI) of proteins and peptides, instruction for setting up dynamic and static nanospray (NSI), calibration and basic maintenance, setup and optimization of the various data dependent acquisition methods. In addition, there will be an in depth discussion of qualitative analysis and processing of accurate mass methods with Thermo Scientific Xcalibur, Proteome Discoverer, and SIEVE software programs." Training takes place twice a year, in February and May, for 4 days from 9am to 5pm.

Mass Spectrometry has become invaluable across a broad range of fields and applications, including proteomics. The development of high-throughput and quantitative MS proteomics workflows within the last two decades has expanded the scope of what we know about protein structure, function, modification and global protein dynamics.

Through this course, participants will learn:
• Overview of Theory and Practical Operation of the Thermo Scientific Orbitrap Mass Analyser
• System Tuning and Calibration Procedures
• Nano-flow LC Method Development
• Method and Sequence Setup
• Xcalibur Set Up and Processing
• Proteome Discoverer Software
• Processing of Post Translation Modification Methods
• Preventative Maintenance and Troubleshooting Procedures

Cold Spring Harbor Laboratory Courses
Cold Spring Harbor Laboratory (CSHL) is a private, non-profit research institution aimed at advancing the frontiers of biology. CSHL courses provide immersive and in-depth training across a diverse range of topics in the biological sciences that are fundamental to research at the NSF-CREST CCBM center at UC Merced.

Here we propose two course opportunities that are likely beneficial for our graduate students, project scientists and faculty members. Each course is led by world-class researchers who are active in their respective fields of expertise. Both courses are appropriate for scientists across a wide career stage, ranging from junior-level (graduate students, postdoctoral scientists, assistant professors) to mid-career investigators (associate professor). The admission of each course is merit-based. Each course offers the successful applicant the opportunity to become rapidly immersed in a new set of concepts and techniques.

a. Express, Purification & Analysis of Proteins and Protein Complexes (April each year)
This two-week course is for scientists who seek a rigorous introduction into the expression and the purification of proteins, as well as the analysis of protein structure and function. The course includes both hands-on experiments in the lab and extensive investigator-led lecture and discussion.
Through this course, participants will learn:

- Strategies for choosing and optimizing bacterial or eukaryotic expression of particular protein and the advantage/pitfalls of various affinity and solubility tags.
- Strategies for solubilization, bulk fractionation and liquid chromatography
- Approaches in protein characterizations, including the use of mass spectroscopy to identify protein interaction partners and post-translational modifications.

b. Quantitative Imaging: From Acquisition to Analysis (April each year)
This two-week course is designed for quantitative cell and molecular biologists, biophysics and bioengineers. It combines careful image acquisition with rigorous computational analysis to quantify fluorescence-based light microscopy images.
Through this course, participants will gain:

- A thorough understanding on the complete process of quantitative imaging, disentangling physics considerations (photon counts) from the underlying biology measurements.
- Open-source image analysis tools.

Gordon Research Conference Travel Award

Gordon research conferences (GRC) are a group of prestigious and intensive conferences that brings together world-class researchers at the top of their fields. Each conference is typically 1 week in duration and approximately 100 researchers in attendance. Because the small size of the GRC promotes the networking opportunity among its attendees, its attendance is particularly valuable for young early-career scientists (graduate students, project scientists, assistant professors). Because GRC encourages its attendee to present unpublished data, its attendance is important for scientists across all career stages (including mid-career and senior principle investigators) to keep abreast the frontiers of scientific research.

References

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