Yale Institute for Nanoscience and Quantum Engineering

Friday- September 19, 2014

12:00 to 1:00 p.m.

BECTON SEMINAR ROOM

Light lunch will be served at 11:45 a.m.

Peter Koo

Department of Physics, Yale University

"New Analysis Tools to Characterize the Diffusive Behavior of Single Protein Trajectories in Live Cells"

Recent advances in live cell imaging have now made it possible to non-invasively monitor the motions of individual proteins inside live cells. Therefore, over the past few years, interest in improving the quality of the diffusion analysis for single particle trajectories has grown rapidly. However, the photoinstability of the fluorescent probes used in these approaches results in a premature truncation of the observed protein trajectories. Due to the limited statistics provided by these short trajectories, traditional mean squared displacement analysis is unreliable, because these approaches generally fail to properly handle noise sources in a statistically accurate manner, inevitably yielding sub-optimal results. Here, we introduce new analysis tools to characterize different aspects of the underlying protein dynamics: the number of distinct diffusive states (perturbation expectation-maximization for *short-time* diffusive states and variational Bayes expectation-maximization for *macroscopic* diffusive states); the diffusive properties of each state (maximum likelihood estimator for non-normal modes of diffusion); and classification of individual particle trajectories to a respective diffusive state (likelihood Bayes). We test the performance of these new analysis tools on various sets of simulated particle tracks subject to static and dynamic localization noise. We then demonstrate the applicability of these analysis tools on single protein trajectories of Rho GTPase, an integral regulator of cytoskeletal dynamics and cellular homeostasis, in live cells acquired via single particle tracking photo-activated localization microscopy.

Sung Hyun Park

Department of Electrical Engineering, Yale University

" III-Nitride Nanomembranes for Photonic and Electronic Applications"

III-nitride nanomembranes (NMs) represent a new embodiment of the nitride compound semiconductors having identical crystalline perfection and optoelectronic efficacy. The III-nitride NMs are naturally compatible with flexible hosts due to the reduced flexural rigidity and can be incorporated into layered stacks with other two-dimensional materials. A major reason to hinder the nitride NM from realizing devices is the ceramic-like chemical inertness of nitride compound semiconductor, making it difficult to etch or to undercut which resulted in the formation of freestanding NM. Based on a recent discovery of conductivity selective electrochemical etching of GaN, we demonstrated large area GaN NMs with a freestanding thickness less than 150 nm produced from state-of-the-art epitaxial structures. Bright blue light emission from NM light emitting diode (LED) validates the concept of NM-based optoelectronics and points to potentials in flexible applications and heterogeneous integration. In addition to the photonic application, enhancement-mode field effect transistors (FETs) have been fabricated on a SiO_2/Si wafer, suggesting that GaN NMs can be a new candidate for flexible electronics requiring high power and high-frequency.

HOST: Paul Fleury