Yale Institute for Nanoscience and Quantum Engineering

Friday- April 11, 2014

12:00 to 1:00 p.m.

Becton Seminar Room

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

Professor Charles Sindelar

Department of Molecular Biophysics and Biochemistry, Yale University

“How Do Cytoskeletal Motor Proteins Work? A New Look Under The Hood of the Kinesin Molecular Machine"

Kinesin molecular motors use energy derived from ATP to step along microtubules, driving many essential processes in eukaryotic cells including mitosis, vesicle transport and cytoskeletal remodeling. However, kinesin’s functional cycle, which occurs while the motor is attached to the microtubule, has not been characterized at atomic resolution. Thus, the detailed basis of motility has remained unclear. We used recent improvements in cryo-electron microscopy methodology and instrumentation to obtain 5-6Å resolution maps that capture the detailed conformation of a single kinesin motor domain at key points in the force-generation process. I will discuss how these results have allowed us to generate atomic-level models that can explain many key functional features of this beautiful molecular machine. I will also describe a recent breakthrough in our lab that allows us for the first time to study the detailed structure of kinesin "walkers", in which pairs of co-assembled kinesin motor domains flip each other forward in a coordinated fashion to achieve continuous movement along the microtubule.

Professor Joerg Bewersdorf

Departments of Cell Biology and Biomedical Engineering, Yale University

"Observing Nanoscale Dynamics in Living Cells by Breaking the Diffraction Barrier of Light "

The diffraction limit of light has constrained the resolution of light microscopes in the far field since its discovery more than a century ago. Structures smaller than about half the wavelength of light could therefore not be resolved by (far field) light microscopes. The realization that this limit can be broken has triggered a revolution in imaging, especially in biological applications which heavily depend on light microscopy. By optically switching fluorescent molecules on and off, 25 nm spatial resolution or better, more than 10-fold better than in conventional microscopy, is now achievable! In my presentation, I will provide an overview of the different approaches that are currently developed and applied. I will focus on the physical basis of the techniques which allows identifying striking similarities of seemingly very different methods. I will present our latest achievements in the development and application of these techniques to provide examples of the current state of this exciting new field in physics.