

Chez Pierre

Presents ...

Monday, March 4, 2013

10:00am

MIT Room 4-331



SPECIAL CHEZ PIERRE SEMINAR

Jan Bruges
Harvard University

“Physical principles of self-organization in metaphase spindles”

The spindle is a complex assembly of microtubules, motors, and other associated proteins, which segregates chromosomes during cell division. In metaphase, the spindle exists in a nonequilibrium steady-state with a constant flux of molecules and energy continuously modifying and maintaining its architecture. Understanding self-organizing structures such as the spindle is not only crucial for cell biology, but also poses a fundamental challenge for physics, since these systems are materials that behave drastically differently from those that have been traditionally studied in condensed matter physics. While the self-organization of systems of microtubules and motors have been investigated using theory and experiments, there have been few attempts to test if the proposed theories can be used to quantitatively explain the dynamics and structure of complex biological systems *in vivo*. I will first present a novel method based on laser ablation capable of measuring the detailed architecture of spindles. This method reveals a complex microtubule organization in *Xenopus laevis* egg extracts. With the aid of theory and biochemical perturbations I will present a new mechanism of microtubule organization based on nucleation and transport. During the second part of the talk I will show that, despite its molecular complexity, the large scale behaviors of the spindle—shape, dynamics and microtubule organization—can be quantitatively described in terms of a phenomenological description containing just a few physically meaningful parameters. More generally, this work supports the validity of using simple physical theories to understand complex self-organizing structures *in vivo*.