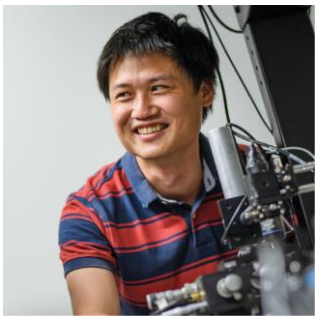
UIC COLLOQUIUM
Department of Physics

Monday, December 10, 2018

"Synthesizing Phase-Separated Membraneless Organelles in Living Cells"



Dr. Ming-Tzo (Steven) Wei

Princeton University

There is currently a growing interest in biopolymer phase transitions, particularly those involving intrinsically disordered proteins/regions (IDPs/IDRs) and RNA. It has been found that intracellular liquid-liquid phase separations underlie the assembly of many membraneless organelles, including RNA/protein assemblies such as P granules, nucleoli, stress granules, and transcription factors. However, little is known about the physics of these organelles, including their internal molecular organization and feedback between their molecular and mesoscale properties. Progress on these questions has been hampered by the lack of detailed phase diagrams, which would elucidate how molecular interactions give rise to emergent droplet properties, particularly condensed-protein concentrations and their physical characteristics.

To answer these questions, we investigate the inter-molecular interaction strengths and the full binodal of a phase-separating disordered protein that induces in-vivo phase transitions, utilizing a novel microscopy, ultrafast-scanning fluorescence correlation spectroscopy. These measurements led to the recent discovery that phase-separated protein droplets have unusually low densities with large void volumes. The data demonstrate how sequence-encoded conformational fluctuations of IDRs give rise to low overlap volume fractions for driving phase separations. Using inter-molecular interactions of native membraneless organelles, we develop an optogenetic platform that permits light activation of IDR-mediated phase transitions in living cells. Inter-molecular interaction strengths are quantified and demonstrate how IDR sequences determine intracellular phase separation. These studies can elucidate not only physiological phase transitions but also for synthetic intracellular biomaterials and cellular organelle engineering applications.

The Department of Physics Colloquium will be held at 1:30 pm in 2214 SES.