

Chez Pierre

Presents ...

Monday, December 11, 2023

12:00 pm - 1:00 pm

Duboc Room - 4-331



Chez Pierre Seminar

Mengkun Liu, Stony Brook University

“Why 10 nm is an interesting length scale? - A magneto nano-optics perspective”

In contemporary condensed matter physics and photonics, four length scales are fundamentally interesting and intertwined: **1)** Polaritonic wavelength λ in infrared (IR) and terahertz (THz) frequencies ω (e.g. plasmon, phonon, exciton, or magnon polaritons), which defines the scale of the light confinement and interaction; **2)** Magnetic lengths $l_B = \sqrt{\hbar/eB} = 257\text{\AA}/\sqrt{B[\text{T}]}$, (with B the magnetic field), which defines the restricted electron motion in a B field; **3)** Diffusion length D of the hot carriers at interfaces and the edges, which defines the scale of energy relaxation, and **4)** Periodicities of superlattices induced by moiré engineering, which defines the energy scale of emerging phases. For instance, the commensurability of the magnetic lengths (e.g. ~ 10 nm for graphene at 7T) and superlattice constant (e.g. ~ 10 nm for twisted bilayer graphene at ‘magic angle’) could lead to exotic fractal states that have not been optically probed yet. In this talk, I report 1) A novel optical nanoscopy technique to tackle all four above-mentioned ‘lengths’ simultaneously in one experiment; 2) A direct visualization of the infrared plasmon polaritons due to quantized Landau transitions in near-charge neutral graphene; 3) The magnetic field dependent cooling length of hot carriers; 4) A strong coupling of modes among two-dimensional heterostructures with minimum thickness. Our approach establishes magneto nano-optics as a versatile platform for exploring magneto-optical effects at the nanoscale. Our preliminary research also sets the stage for future spectroscopic investigations of the topological and chiral photonic phenomena in complex quantum materials using low-energy photons.

Mengkun Liu (Ph.D. 2012 Boston University) is an associate professor at the Department of Physics and Astronomy of Stony Brook University (since Jan. 2015). His postdoc research was at UC San Diego from 2012-2014. His research interests include the physics of correlated electron systems, low-dimensional quantum materials, infrared and terahertz nano-optics, and ultrafast time-domain spectroscopy. Prizes include the Moore EPI award (2023), NSF career award (2021), and Seaborg Institute Research Fellowships at Los Alamos National Lab (2009, 2010).