PURDUE UNIVERSITY

## Joint PQSEI-Condensed Matter Physics Seminar

# "Covalent Quantum Defects of Carbon Nanotubes: A New Material for Quantum Information Science"

**Han Htoon, Los Alamos National Laboratory**

**Friday, November 22, 2019 - 3:30 – 4:30 p.m.; PHYS 203**

Color centers in diamond and SiC are now standing as key materials for realization of quantum information technologies ranging from ultrasensitive sensing of electric/magnetic fields to eavesdropping-proof communication and quantum computing. Recent studies have shown that defects capable of mimicking some of the key quantum mechanical properties of these color centers can also be created via covalent bonding of organic functional groups onto the side-wall of single wall carbon nanotube (SWCNT). Here in this talk, I will provide a brief over view on our recent works in understanding and controlling quantum optical properties of these covalent defects, which are often referred to as "organic color centers."[1] Firstly, I will describe our low temperature single defect PL and magneto PL spectroscopies revealing a molecularly tunable electronic structure of these defects[2] and magnetic brightening of spin-sensitive optical transitions. Secondly, Hanbury-Brown-Twiss quantum optic experiment demonstrating the first room temperature single photon generation in O- to C- telecom optical wavelength bands with 99% single photon purity will be presented.[3,4] I will then provide an update on integration of these quantum defects into photonic, plasmonic and electronic nano devices.[5] Finally, I will report our most recent Hong-Ou-Mandel quantum optic experiment performed on quantum defects coupled to plasmonic cavities. We were able to realize indistinguishable single photon generation by exploiting the Purcell enhancement of the radiative decay rate of individual defects.

[1] Nat. Photon 11, 535, 2017; [2] ACS Nano 11, 10785, [3]Nat. Photon. 11, 577 2017; [4]Nat. Mater. 17, 663 2018; [5]Nano Lett. 18, 3873, 2018.

For more information about Dr. Han Htoon, please view his website: lanl.gov/expertise/profiles/view/han-htoon.

PURDUE UNIVERSITY | Quantum Science and Engineering Institute

PURDUE UNIVERSITY Discovery Park