

## PHYSICAL CHEMISTRY SEMINAR

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# Imaging, Learning, and Engineering of Soft Matter Systems at the Nanoscale



The motion and dynamics of nanoparticles and macromolecules in bulk and at interfaces is of fundamental importance in physics, chemistry, and biology. Liquid phase transmission electron microscopy (LPTEM) is an emerging technique which enables nanoscale visualization of the motion and dynamics of single nanoparticles in liquid environment with an unprecedented spatial and temporal resolution. However, in order to develop LPTEM as a tool for in situ single nanoparticle and macromolecule tracking, we first need to understand how the electron beam of a transmission electron microscope affects the particle motion in the liquid environment and near surfaces. In this talk, I will present my recent work on studying the anomalous diffusive motion of a model system of gold nanorods dispersed in water and moving near the silicon nitride membrane of a commercial liquid cell in a broad range of electron beam dose rates. By leveraging the power of convolutional deep neural networks inspired by canonical statistical tests, I show that there is a crossover in diffusive behavior of nanoparticles in LPTEM from fractional Brownian motion at low dose rates, resembling diffusion in a viscoelastic medium, to continuous time random walk at high dose rates, resembling diffusion on an energy landscape with trapping sites. I will then discuss how this work forms the foundation to study equilibrium and nonequilibrium dynamic processes for a broad range of nanoparticles, interfaces, and fluids in chemical and biological systems.