ANALYTICAL SEMINAR

Watching Molecular Motor Proteins Walk with Minimal Photon Flux Localization (MINFLUX) Microscopy

Alexander Litts

Graduate Student
Purdue University

Obtaining molecular scale resolution remains a major barrier for monitoring subcellular structures, as most spectroscopic methods are limited to roughly half the wavelength of light. The development of super-resolution techniques such as stimulated emission depletion (STED), stochastic optical reconstruction microscopy (STORM) and photoactivated localization microscopy (PALM), have circumvented this limit, achieving resolutions around the order of 10–30 nanometers. However, pushing this boundary even further towards single-molecule detection opens the door to directly visualizing molecular heterogeneity, dynamic interactions, and nanoscale structural organization that underlie complex biological and material systems. Minimal photon flux (MINFLUX) microscopy is a recent breakthrough in this direction. By employing a patterned excitation beam, with areas of minimal intensity serving as a reference point for fluorophore localization, this technique achieves nanometer-scale spatial precision and microsecond temporal resolution, enabling real-time tracking of individual protein movements within biologically relevant environments. As a result of this high spatiotemporal resolution, MINFLUX can directly track fast-moving motor proteins, such as kinesin-1, and observe nanometer-scale conformational changes, providing insight into the mechanistic dynamics that govern intracellular transport and molecular motion.

Tuesday, November 18, 2025 3:30 pm WTHR 172

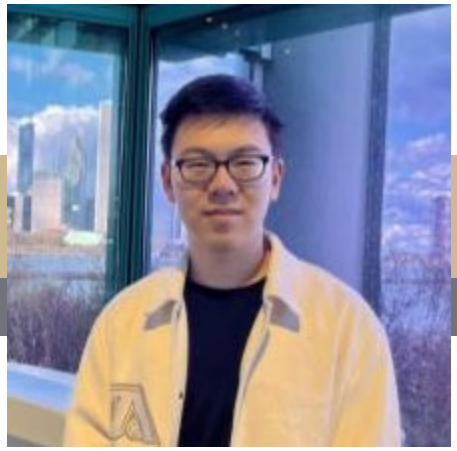
PURDUE UNIVERSITY | James Tarpo Jr. and Margaret Tarpo Department of Chemistry

ANALYTICAL SEMINAR

Nanopore Ping-Pong: Advancing Single-Molecule Sensing through Recapture

Renkai Dong

Graduate Student
Purdue University



Nanopore sensing provides a powerful label-free platform for single-molecule analysis, yet conventional approaches often rely on ensemble averaging due to stochastic variations in molecular translocation events. Molecular ping-pong technology overcomes this limitation by repeatedly detecting the same DNA molecule through rapid voltage reversal, thereby achieving precise motion control and enhanced signal reproducibility. Recent advances in instrumentation have enabled more than 10,000 consecutive recaptures of a single λ-DNA molecule with microsecond temporal precision. In addition, asymmetric nanopore geometries and DNA-carrier-assisted strategies improve molecular confinement and recapture efficiency, offering nearly 100% backward recapture probability. Collectively, these innovations propel nanopore sensing toward genuine single-molecule precision, establishing a foundation for next-generation biosensing, molecular diagnostics, and sequencing applications.

Tuesday, November 18, 2025 | 3:30 pm | WTHR 172

PURDUE UNIVERSITY | James Tarpo Jr. and Margaret Tarpo Department of Chemistry