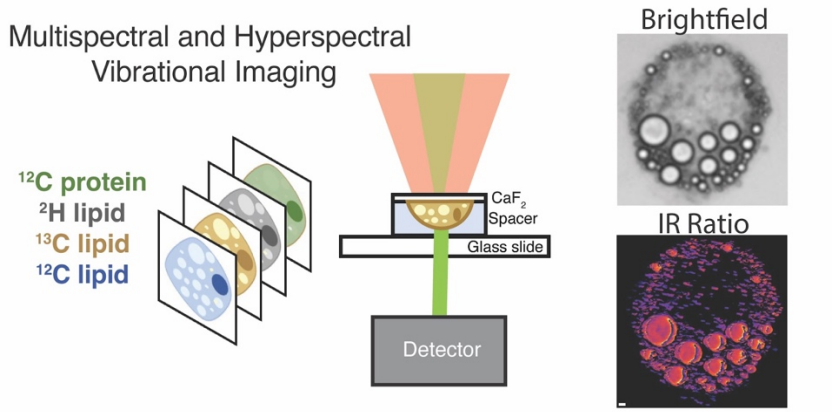
BIOPHYSICAL TRAINING GRANT | RESEARCH IN PROGRESS TALKS

Sydney Shuster



Multispectral vibrational imaging for high resolution tracking of live cell metabolic processes

AND

Gregory Kyro

The Development and Application of Machine Learning and Statistical Methods for Drug Discovery

Friday, December 8, 2023, 11 am
BASS 305
Coffee and snacks will be provided

Sydney Shuster is a third-year Ph.D. student in Chemistry. She works in the lab of Caitlin Davis where she focuses on label-free imaging techniques such as vibrational microscopy. Her research aims to understand how cells adapt their metabolism and proteins to stress and disease. She holds a B.A. in Chemistry from Middlebury College and spent two years as a research fellow at the National Institutes of Health in the Laboratory of Protein Conformation and Dynamics after graduation. Her awards include an NSF GRFP, NIH training grant, and the Yale Kirkwood Fellowship in Chemistry. Outside of academics, she is an avid hiker and U.S. National Park enthusiast, having explored 24 parks so far.

Abstract: Fluorescence microscopy has been a critical tool in understanding cellular processes in real-time with high spatial resolution and biomolecule identification is pivotal to biology, biophysics and our understanding of disease. However, its reliance on fluorescent labels can disrupt cellular processes and be difficult to incorporate. Recently, optical photothermal infrared microspectroscopy (OPTIR), a high resolution vibrational imaging technique, has emerged as a promising alternative for in-cellulo applications. Due to the unique vibrations of each type of biomolecule, OPTIR can track biomolecule localization with sub-500 nm resolution and small, easily incorporated IR tags enables precise labeling of specific proteins or metabolic pathways. Our research with OPTIR has focused on tracing de novo lipogenesis and fatty acid scavenging in cells using isotopic labels. However, the data collection and analysis in these systems presents significant challenges. Data is collected as either hyperspectral images, which contain thousands to tens of thousands of spectra, or multispectral images made up of image snapshots at multiple wavenumbers. Hyperspectral images offer rich information but require extensive processing time and hours for acquisition. In this work, we have demonstrated that, through careful processing and correction, multispectral images tracking rates of DNL and fatty acid scavenging can provide the same accuracy as hyperspectral imaging with a twenty fold reduction in acquisition time. This makes OPTIR multispectral imaging compatible with live cells, opening doors to high-resolution, in situ metabolic tracking without disruptive or hard to incorporate labeling.

Gregory Kyro is a third-year Ph.D. student in Chemistry and works in the Batista lab. Gregory likes to learn new things.

Abstract: Immediately after the AI safety summit hosted by the Institute for Protein Design (Oct 25, 2023), DeepMind announced that it is expanding beyond proteins (Oct 31, 2023), suggesting that AI x Bio innovation will continue to outpace regulation and revolutionize protein engineering, virtual screening in drug discovery, and de novo drug design. In this talk, I will discuss some of my recent work involving each of these three distinct but interconnected areas of research.