Observing Ultrafast Lattice Dynamics and Heat Transfer in Quantum Dots

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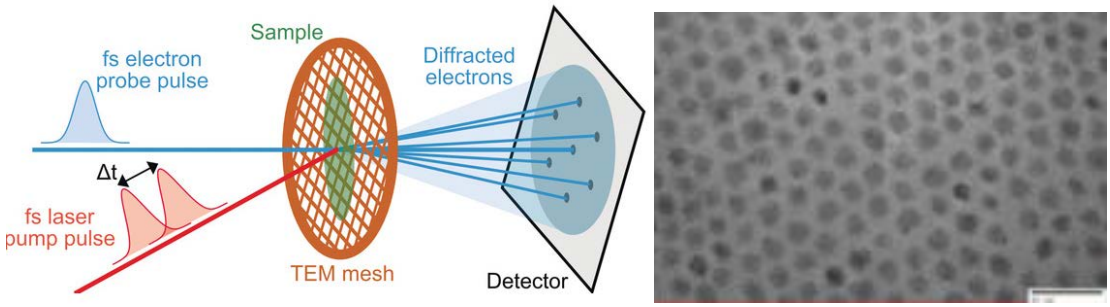
NSERC Undergraduate Research Position – Summer 2020

Ultrafast electron diffraction (UED) is a pump-probe technique that combines the spatial resolution of x-ray crystallography with the time resolution of traditional optical spectroscopies. This powerful tool is capable of capturing atomic motions in real time by observing the change in diffraction patterns over time. From inorganic molecules and their relevant photophysical processes and associated bond length changes, to condensed matter systems undergoing laser excitation near the band gap, UED captures chemistry and physics in action.



(Left) General schematic for UED pump-probe experiment
(Right) Scanning Electron Microscope (SEM) image of quantum dots on a TEM mesh

Currently, quantum dot monolayer systems are being studied with UED, capturing the ultrafast lattice dynamics and additional features when pumped significantly above the band gap. The summer student will assist in data analysis and optimization/parallelization of the code base and image processing routines while he/she is being trained. The student will work closely with graduate students utilizing UED.

The summer student can expect the following research and development tasks:

- General training and use of UED system. The student will require laser safety training as they will be working with a Class 4 laser.
- Assisting in developing new data analysis code base. Ideally, the student has had some exposure to the Python scripting language (other languages are OK).
- General knowledge of crystallography and diffraction. This will be taught more in-depth as the student works with the graduate students, although familiarity with Bragg diffraction is advantageous.

For more information, please contact Kamil Krawczyk at kamilk (at) lphys.chem.utoronto.ca.