

*Electrical Sciences and Computer Engineering (ESCE) Seminar***Multi-THz spectroscopy of ultrafast charge transport processes in materials****Dr. David Cooke***Dept. of Physics, McGill University*

Our lab performs ultrafast spectroscopy on a variety of materials in the low energy portion of the electromagnetic spectrum between 0.3 - 30 THz or about 1-125 meV in energy. This region is a “sweet spot” for signatures of charge motion in materials, both free and bound. Using femtosecond lasers and nonlinear optics, we generate phase-locked, few-cycle pulses of THz frequency light that enables time-resolved tracking of these low energy excitations on sub-100 fs time scales. In this talk, I will describe how we generate THz pulses so short they cover more than 6 optical octaves, the entire THz range in a single pulse, and use them to interrogate materials. We discuss recent multi-THz measurements observing charge transport, exciton and lattice screening dynamics in a new class of solar cell materials called hybrid metal halide perovskites that has taken the photovoltaic community by storm. I also discuss our recent work on generating extremely intense THz pulses with field strengths approaching MV/cm, allowing one to not only probe charge (and spin) excitations but also coherently drive them on sub-cycle time scales corresponding to the realm of "extreme nonlinear optics". I will discuss some examples of applications, including our recent work on high field transport in graphene and future directions including multi-dimensional THz spectroscopy and THz field-controlled electron emission.



Dave Cooke received his B. Sc. Honours in Physics at St. Francis Xavier University, Antigonish, NS, Canada in 2001, and Ph. D. in Physics in 2006 from University of Alberta, Edmonton, AB, Canada in the group of Frank A. Hegmann. He went on to do a postdoc in the group of Peter Uhd Jepsen at the Technical University of Denmark in 2007, working on terahertz waveguides and time-resolved terahertz spectroscopy. He became Assistant professor at DTU in 2008 and Associate professor in 2009. In 2011, he moved to Montreal to become an Assistant professor in the Physics Department at McGill University. His research interests are in ultrafast terahertz spectroscopy of semiconductors and their nanostructures and the development of new measurement techniques and devices at THz frequencies.

Thursday, December 10, 2015**12:00 PM****Barus & Holley 190***Refreshments start at 11:30 AM*