Condensed Matter Physics Seminar Series

Quantum Materials in the Time Domain

Andrea Damascelli

Quantum Matter Institute, UBC, Vancouver, Canada; Physics & Astronomy Department, UBC, Vancouver, Canada

With its direct correspondence to the electronic structure, angle-resolved photoemission spectroscopy (ARPES) is a ubiquitous tool for the study of solids. When extended to the temporal domain, time-resolved ARPES offers the potential to move beyond equilibrium properties, exploring both the unoccupied electronic structure as well as its dynamical response under ultrafast perturbation [1]. Historically, ultrafast extreme ultraviolet sources have required compromises that make it challenging to achieve a high energy resolution, while producing sufficiently high photon energies and flux. In this talk I will discuss novel opportunities arising from the development of ultrafast laser-based sources generating ultraviolet photons in the 6-40 eV range, with 190 fs and 20 meV time and energy resolutions, respectively [2]. On the high-temperature superconducting cuprates, we have obtained evidence for the collapse of superconductivity via ultrafast quenching of phase coherence [3], the emergence of the pseudogap from short-range spin-correlations in electron doped cuprates [4], as well as the Fermi-liquid-like suppression of quasiparticle coherence [5]. We have also developed a novel approach for the direct determination of mode-projected electron-phonon coupling in the time-domain, and demonstrated its application to the case of graphite and its Dirac-like dispersion. Measuring the characteristic time scale for quantized energy-loss processes of photo-injected electrons at the K point allows for the direct, quantitative extraction of the electron-phonon matrix elements, for specific modes, with unprecedented sensitivity [6].

Andrea Damascelli is a Full Professor at UBC, a Tier I Canada Research Chair in the Electronic Structure of Quantum Materials, and Director of the Quantum Matter Institute at UBC and Co-Director of the Max Planck – UBC – UTokyo Centre for Quantum Materials. He is internationally recognized for his studies of superconducting cuprates and other correlated oxides by spin and angle-resolved photoemission spectroscopy (Spin+ARPES) and resonant elastic x-ray scattering (REXS). Among different awards and fellowships, he received the NSERC's Steacie Memorial Fellowships, the Bessel Research Award from the Humboldt Foundation, and the Brockhouse Medal from the Canadian Association of Physics. He is also a Fellow of the American Physics Society, Kavli Fellow of the US National Academy of Sciences, Fellow of the Royal Society of Canada, and Senior Fellow of the CIFAR Quantum Materials Program. When not doing research on quantum materials, Andrea enjoys cooking and sailing across the Pacific Ocean.

Wednesday, April 5th, 2023 at 4:00 PM
4-330 PAB