The Department of Physics presents a Physics Colloquium:

Quantum Materials in the Time Domain

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Host: Adrian Feiguin

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4:00 PM

https://northeastern.zoom.us/s/93298706444

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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, and with unprecedented sensitivity [6].

[1] M. Zonno, F. Boschini, A. Damascelli, JESRP **251**, 147091 (2021).
[2] A.K. Mills et al., Rev. Sci. Instrum. **90**, 083001 (2019).
[3] F. Boschini et al., Nature Materials **17**, 416 (2018).
[4] F. Boschini*, M. Zonno*, et al., npj Quantum Mater. **5**, 6 (2020).
[5] M. Zonno, F. Boschini, et al., Phys. Rev. B **103**, 155109 (2021).
[6] M.X. Na, A.K. Mills, et al., Science **366**, 1231 (2019).

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