UNL Department of Physics and Astronomy &
Nebraska Center for Materials and Nanoscience present:

Tracing Non-Equilibrium Phenomena in Quantum Materials Using Ultrafast Electron Probes

PRESENTED BY

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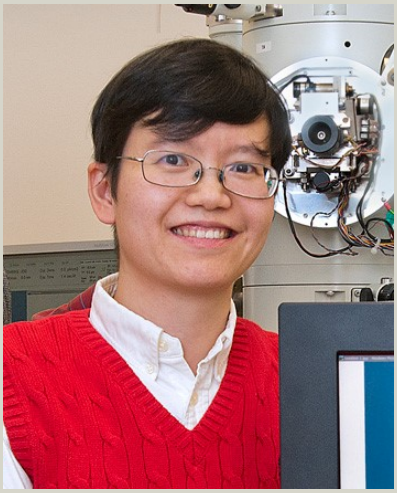

THURSDAY

29 NOVEMBER

4:00 PM

IN JH 136

Refreshments will be served in the JH 1st Floor Vending Area at 3:30

ABSTRACT

Understanding the structural origin of materials' functionality is often challenging to obtain via equilibrium states but promising to unveil through the observation of non-equilibrium processes. The successful development of femtosecond laser systems and pump-probe techniques in the past three decades has enabled us to probe ultrafast dynamics in a variety of materials. Particularly, taking advantages of strong interaction with matter during scattering, ultrafast electron diffraction (UED) technique provides unique opportunities to study the non-equilibrium dynamics. In this talk, we will demonstrate a few UED projects to address the intriguing coupling between electronic degrees of freedom and lattice in quantum materials. One of the projects is the exploration of structural dynamics in superionic Cu_2S nanomaterials. Through a structural phase transition in Cu_2S, we followed the transient states along the transition pathway and identified distinct time scales for crystal symmetry change and lattice expansion. Based on the UED observations, we argue that the mechanism of the structural phase transition in Cu_2S is dominated by electron-phonon coupling [1, 2]. In addition, we will show crystal refinement work using UED results during the pump-probe processes in a 1T-TaSeTe single-crystal sample to understand charge-density-wave (CDW) formation mechanism and charge-lattice interaction in this material.

[1]. J. Tao et al., "Reversible structure manipulation by tuning carrier concentration in metastable Cu_2S", PNAS 114, 9832 (2017).

[2]. J. Li et al., "Probing the pathway of an ultrafast structural phase transition to illuminate the transition mechanism in Cu_2S", Appl. Phys. Lett. 113, 041904 (2018).

Bio

Dr. Tao received her B.S. in Physics at Peking University in 1997, M.S. at Arizona State University in 2000 and Ph.D. at University of Illinois at Urbana-Champaign in 2005. She moved to Oak Ridge National Laboratory and had conducted postdoctoral research from 2005 to 2007. Dr. Tao is now a physicist working in Condensed Matter Physics & Materials Science Division at Brookhaven National Laboratory, sponsored by US Department of Energy. Her research interests are focusing on the structure-property relationship in strongly correlated systems and functional nanomaterials, characterized by transmission electron microscopy and ultrafast electron diffraction techniques. She is a recipient of DOE Early Career Award in 2015.

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