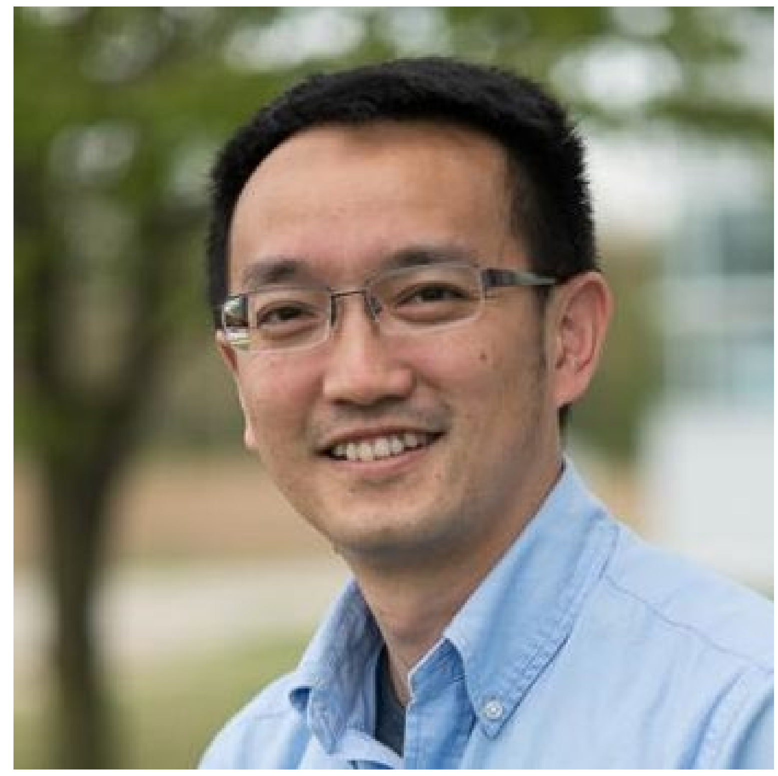
Department of Physics
Arizona State University

COLLOQUIUM

Thursday, November 3rd, 2022

Refreshments at 3:45pm in PSF 186

Colloquium from 4:00 PM – 5:00 PM in PSF 101



Probing ultrafast structural dynamics In quantum materials by x-ray free-electron lasers

Dr. Haidan Wen

Argonne National Lab

Abstract:

The quest for new states of matter in the time domain and the need for ultrafast control of material properties have been fueled by the recent advance of large-scale ultrafast x-ray facilities. These new experimental capabilities enable direct probes of structural dynamics with the unprecedented spatial and temporal resolution, shedding light on the fundamental dynamical processes in materials. In this talk, I will show recent efforts to use ultrafast x-ray diffraction to track emergent dynamical properties of polar nanostructures and 2D materials. In the first example, I will show that polar nanostructures such as polar vortices can possess unique collective modes, featuring dynamical nanoscale vortices upon intense terahertz-field excitation [1]. A unique soft mode dubbed vortexon is identified as a pair of oscillating vortex cores that can be significantly tuned by strain around room temperature. The discovery of tunable vortexons opens a new avenue for high-frequency dielectrics and optoelectronics applications. In the second example, I will show the distinct structural dynamics of monolayer crystals WSe_2 from their bulk counterparts [2]. We found the absorbed optical photon energy is preferably coupled to the in-plane lattice vibrations within one picosecond whereas the out-of-plane lattice vibration amplitude remains unchanged during the first ten picoseconds, marking the distinct structural dynamics of monolayer crystals from their bulk counterparts. Looking into the future, the recent progress of developing multimodal, multiscale x-ray imaging platforms will be discussed to go beyond the ensemble-averaged measurements [3,4].

Biography:

Dr. Haidan Wen is a physicist in the Materials Science Division and X-ray Science Division at Argonne National Laboratory. His research is focused on ultrafast processes in quantum materials and aims at exploring new ways to measure and control how atoms and electrons move, particularly using electromagnetic radiation at terahertz and x-ray frequencies. Prior to his current position, he was a research associate at SLAC National Laboratory and Stanford University. He received his Ph.D. in physics from the University of Michigan, Ann Arbor, in 2006 and B.S. from the University of Science and Technology of China in 2001. He received the US DOE Early Career Award in 2016.

Host: Prof. Robert Kaindl

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