Universität Regensburg

FAKULTÄT FÜR PHYSIK
Lehrstuhl für Experimentelle und Angewandte Physik

**Prof. Dr. Rupert Huber**

# Seminar

**Thursday, December 8, 2022, 10:00 am**

**Link to Zoom Meeting FU**

## Dr. Jianhui FU

## Nanyang Technological University (NTU), Singapore

## *Ultrafast electron-phonon interactions in 2D halide perovskites*

Electron-phonon interaction is one of the fundamental topics in solid-state physics and plays a significant role in the optoelectronic properties of the organic-inorganic halide perovskites, which have emerged as a class of game-changing semiconducting materials for a variety of optoelectronic device applications. Representative examples include photoluminescence linewidth, carrier transport, thermal properties, hot carrier cooling and to name a few. Although experimental observations of coupling of lattice vibrations to the carriers are well reported, how these lattice vibrations modulate the optical properties of the halide perovskites is still an open question.

In this talk, I will present ultrafast electron coupling to coherent optical phonons in 2D halide perovskites (PEA)2PbI4 films at 77 K using transient absorption (TA) spectroscopy. I will first present in the low-temperature absorption spectrum the presence of an exciton fine structure with two peaks which are coupled distinctly with optical phonons (with wavenumber < 50 cm−1) arising from vibrational motion of PbI6 octahedra. Via systematic pump- and probe-energy dependent studies and theoretical modeling, we validate that these pump- and probe-energy dependence is due to the intrinsic processes of coherent phonon generation and detection in the TA measurement. The former stems from resonant impulsive stimulated Raman scattering with the driving force governed by the imaginary part of the refractive index; while the latter is determined by the derivative of the imaginary part of the refractive index with respect to energy. Furthermore, we found that the organic cation has a significant influence on the phonon frequency, the lattice displacement as well as the deformation potential constant. Our study injects fresh insights into the exciton–phonon coupling of 2D perovskites relevant for emergent optoelectronics development.

Host: Rupert Huber