

# IMPRS UFAST Focus Course

## Nonlinear phononics

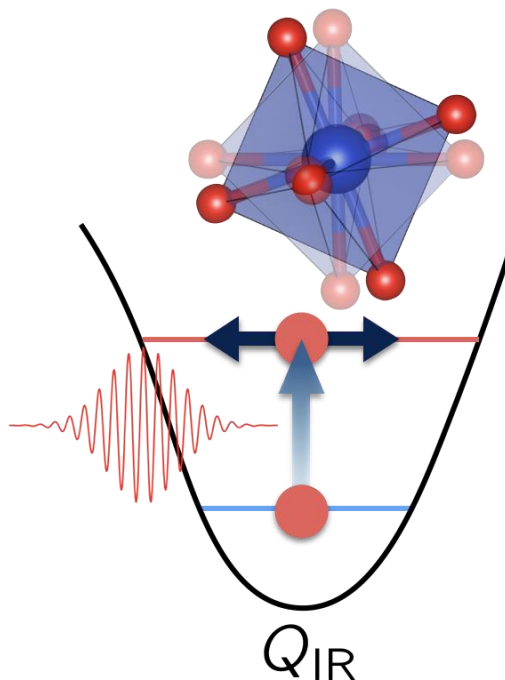
### Michael Först and Michael Fechner

#### Abstract:

Intense terahertz and mid-infrared light fields are nowadays routinely used to control solid-state materials by resonantly exciting crystal lattice vibrations. Connected to the extremely large amplitudes of such phonon oscillations is a nonlinear response resulting from anharmonicities in the lattice potential. It gives rise to phenomena such as rectification, parametric amplification, and harmonic generation of optical phonons, representing analogies to the well-known photonic counterpart of nonlinear optics.

#### Topics include:

- This lecture aims to introduce the concepts of this relatively new field from both theoretical and experimental perspectives.
- We will discuss how effective modeling of the involved Hamiltonian, combined with aspects of group theory, can be used to describe nonlinear phonon dynamics. In addition, we will examine how these large-amplitude atomic motions can couple to electronic and magnetic degrees of freedom of modern complex materials to control their functional properties.
- We will also introduce the experimental techniques necessary to trigger and detect these phononic motions, covering aspects from the generation of intense THz and mid-infrared light pulses to time-resolved optical spectroscopy and x-ray diffraction.



31<sup>st</sup> Aug., 2<sup>nd</sup> Sep., 5<sup>th</sup> Sep. & 7<sup>th</sup> Sep.

9:00 – 12:00

CFEL/building 99

Seminar room O1.060

Register on Geventis I-UF FC2