MAX PLANCK INSTITUTE
FOR THE STRUCTURE AND DYNAMICS OF MATTER

ANNOUNCEMENT - TALK

Title: **Magnetophononics: Breaking Time Reversal Symmetry with Non-Maxwellian Magnetic-esque Fields**

Abstract:
Optical rectification of intense, circularly polarized light penetrating a material generates a static magnetization through the inverse Faraday effect and, therefore, a magnetic field aligned with the light's direction of propagation. Recent ultrafast experiments have unveiled a substantial, orders-of-magnitude gap between the observed effective field and theoretical predictions. In this study, we show that the discrepancy arises due to a missing factor on the order of 24210−α≈×, where α is the fine structure constant.
We demonstrate that, alongside the Maxwellian magnetization, circular polarization creates large non-Maxwellian fields that disrupt time-reversal symmetry, effectively mimicking authentic magnetic fields within the material while eluding detection externally. These unconventional fields, reaching effective magnitudes as high as 100 T, lead to phenomena akin to Faraday rotation and robustly interact with magnons in magnetically ordered materials.
The connection between the non-Maxwellian fields and the AC Stark effect of atomic physics will be discussed, and an exact perturbative solution to the interaction of an arbitrary material with a monochromatic electromagnetic field will be presented, using various formalisms.
These considerations are particularly relevant to the direct, resonant excitation of polar phonons. Contrary to common perception, the origin of phonon-induced magnetic activity does not stem from the motion of ions themselves; instead, it arises from the effect their motion exerts on the electron subsystem via the electron-phonon interaction. Because the light-induced non-reciprocal fields depend on the square of the phonon displacements, the chirality the photons transfer to the ions plays no role in magnetophononics.

Date/Time: **FRIDAY, SEPT. 6 at 14:00**
Location: **MPSD 900.EG.136**

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