MAX PLANCK INSTITUTE
FOR THE STRUCTURE AND DYNAMICS OF MATTER

ANNOUNCEMENT - TALK

Title: **Terahertz spectroscopy and polarimetry of unconventional superconductors**

Abstract:
Superconductors are naturally well suited for spectroscopic studies in the terahertz (THz) range, as their gap energies are of comparable order to THz photon energies, meV. In this talk I will present work on two unconventional superconductors, FeTe1-xSex (FTS) and a BiNi bilayer. Firstly, using time-domain terahertz spectroscopy I elucidate the low temperature conducting behavior of two FTS samples. Constrained with DC resistivity, I find two conduction channels that add in parallel, one which has a scattering rate that goes as the Planckian limited rate, ~kT/h. Through analysis of its spectral weight, I show the superconducting condensate is mainly drawn from this channel that undergoes Planckian scattering. Secondly, implementing a novel design for high-precision THz polarimeter, I find a finite Kerr rotation, the smallest rotation measured in THz frequencies to date, in the superconducting state of BiNi at zero magnetic field. This is indicative of a possible time reversal symmetry breaking (TRSB) order parameter. Using general Kramers-Kronig relations one can relate the Kerr rotation at high frequencies, i.e. optical probes, to rotations at low frequency, i.e. THz. With this relation I propose a possible scenario in which this TRSB is able to manifest.

References
1. FTS, https://arxiv.org/abs/2505.00623
2. High precision polarimeter, Zhenisbek Tagay, Ralph Romero III, and N. P. Armitage, "High-precision measurements of terahertz polarization states with a fiber coupled time-domain THz spectrometer," Opt. Express 32, 15946-15954 (2024)

Date/Time: **WEDNESDAY, JULY 2, 2025 at 11:00**
Location: **MPSD 900.EG.136**

Speaker: **Ralph Romero**
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