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EINLADUNG zum IFP-SEMINAR

Metastable phases in photo-doped Mott insulators

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Host: Karsten Held

Termin: Montag, 14. Oktober 2024, 15:30 Uhr

Ort: TU Wien, Freihausgebäude
Wiedner Hauptstraße 8-10, 1040 Wien
Seminarraum DB gelb 05 A (gelber Bereich, 5. OG)

Abstract:

Chemically doped Mott insulators have long been a focal point in condensed matter physics due to their manifestation of intriguing phenomena, including high-temperature superconductivity and metal-insulator transitions. Could photoexcitation across the charge gap exhibit equivalent phenomena, and how do these photodoped states distinguish themselves from their equilibrium counterparts?
In the first part of this seminar, we analyse photo-induced changes in the electronic structure of Mott and charge transfer insulators. Photodoping induces significant bandgap renormalisation and lifetime changes, leaving detectable marks on experimental spectra. The comparison of time-resolved X-ray absorption spectroscopy data on NiO and microscopic simulations based on a combination of Dynamical mean-field theory and GW method unveiled the long-lived renormalisation of the upper Hubbard band [1]. Furthermore, additional photo-induced spectral features appear and are interpreted as many-body (Hund) multiplets activated by photo-doped charge carriers [2].
Beyond the injection of long-lived charge carriers, photoexcitation has the potential to induce phase transitions leading to new metastable phases. We will present a recent example involving Ca_2RuO_4 under epitaxial strain, where optical spectroscopy and X-ray diffraction identified a metastable metallic phase [3]. The driving force behind this transition is a strong coupling between lattice and orbital orders both strongly altered by the photoexcitation. We will analyse the coupled evolution using time-dependent DMFT and Ehrenfest dynamics and contrast it with the equilibrium Landau-Ginzburg landscape. We demonstrate that constraints imposed by Mott physics lead to unconventional trajectories from equilibrium insulating to metastable metallic states.

[1] T. Lojewski, DG, et al., arXiv:2305.10145 (2023).
[2] DG, E. Paprotzki, et al., arXiv:2409.06314 (2024).
[3] A. Verma, DG et al., Nature Physics 20, 807–814 (2024).

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