Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

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CFEL Seminar room IV (Bldg. 99)

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Nonequilibrium topological states traced by transient spectroscopies

Chern insulators exhibit fascinating properties which originate from the topologically nontrivial state characterized by the Chern number. How these properties are affected and manifest in the presence time-dependent perturbations is still a sparsely explored field of research. This applies,in particular, to quantum quenches between topologically distinct phases. Identifying robust measures of topology which are applicable in nonequilibrium scenarios — ideally also for correlated materials or dissipative systems — is thus a nontrivial task.

In this talk, we discuss nonlinear spectroscopies with the potential to fill this gap. We focus on the circular dichroism in photoabsorption and angle-resolved photoemission spectroscopy (ARPES) with emphasis on their connection to the Chern number. For the prototypical massive Dirac model,a model system for two-dimension Chern insulators such as HgTe, we show how quenches across the topological phase boundary can be traced transiently by optical absorption. The findings are confirmed to be robust against electron-phonon interactions.

Secondly, we demonstrate how the circular dichroism in ARPES can be employed to map out the band topology. With realistic tight-binding modelling and adequate treatment of photoelectron states — which turns out to be a crucial ingredient — we study photoemission from single-layer graphene. This system can be tuned into a Haldane model by driving with circularly polarized light and hence allows for realizing quantum quenches in practice. We present polarization-resolved ARPES spectra and demonstrate how to nonequilibrium topological state manifests in time-resolved photoemission.

Host: Angel Rubio

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