UNIVERSITÄT DUISBURG ESSEN

PHYSIK

Physikalisches Kolloquium

Mittwoch, 10.11.2021
13:00 Uhr
Hörsaal MC 122

https://uni-due.zoom.us/j/63663010311?pwd=elk0L1gxcXZTbkhWTFMrdnFTYTZDUT09
Meeting ID: 636 6301 0311, Passcode: 505938

New Fermions with Large Topological Charges in Chiral Crystals

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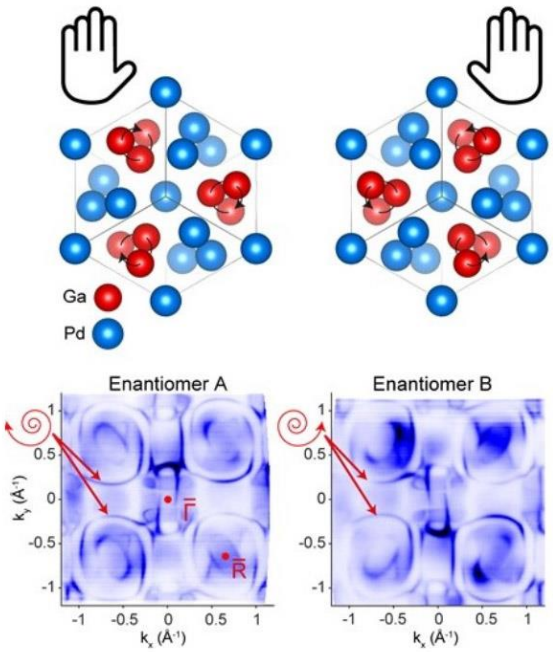

Since the discovery of Dirac-fermions in graphene, condensed matter physicists have become fascinated with electronic quasiparticles in crystals that mimic the behavior of elusive elementary particles predicted in high-energy physics, such as Weyl- or Majorana-fermions. However, unlike elementary particles, quasiparticles do not have to obey Poincaré symmetry, which means that crystals could host new fermionic quasiparticles described by effective models that go beyond the models known from particle physics [1]. Whilst there have been many theoretical predictions of new phenomena related to these “new fermions” in recent years, they have not been detected in experiments until now.

In this talk, I will present our experimental results from angle-resolved photoelectron spectroscopy that directly visualized such new fermionic quasiparticles as band crossings in the bulk band structure of a chiral crystal [2]. By resolving a band splitting in the fermi-arc surface states that are connecting the projections of these crossings in the surface Brillouin zone, we showed that these quasiparticles carry the largest topological charge possible for quasiparticles in metals. We were also able to show experimentally that there is a direct relationship between the handedness of the crystal structure and the electronic chirality (i.e., the Chern number sign) of these new fermions, which indicates that structural chirality can be used as a control parameter to manipulate phenomena that are sensitive to the electronic chirality, such as the direction of topological photocurrents [3]. If there is time in the end, I will also comment on the latest developments in this new field of topological matter science.

[1] Bradlyn et al., Science 353, 6299 (2016)
[2] Schröter et al., Nature Physics 15, 759–765 (2019)
[3] Schröter et al., Science 369, 179–183 (2020)