Topological Matter Conference

Online
June 28-July 1, 2021

Imaging topological states in photoelectron spectroscopy: from magnetic topological insulators to Weyl semimetals

Hendrik Bentmann[1]
Raphael C. Vidal[1], Philipp Kagerer[1], Celso Fornari[1], Eike Schwier,[1] Sebastian Buchberger[1], Maximilian Ünzelmann[1], Tim Figgemeier[1], Anna Isaeva[2,3], Friedrich Reinert[1]

[1]Experimental Physics VII and Würzburg-Dresden Cluster of Excellence ct.qmat, Universität Würzburg, D-97074 Würzburg, Germany
[2]Van der Waals—Zeeman Institute, Institute of Physics, University of Amsterdam, 1098 XH Amsterdam, The Netherlands
[3]Leibniz Institute for Solid State and Materials Research (IFW) Dresden, Helmholtzstr. 20, D-01069 Dresden, Germany
hendrik.bentmann@physik.uni-wuerzburg.de

Over the past decade, topological states of matter have attracted wide interest in condensed matter physics and material science. In this talk, I will report on recent studies, based on angle-resolved photoelectron spectroscopy (ARPES), of two types of topological materials: intrinsic magnetic topological insulators (IMTI) and Weyl semimetals (WSM).

MTI are materials that combine a topological electronic band structure and magnetic order. The recently discovered van der Waals systems $MnBi_2Te_4(Bi2Te3)_n$ are the first compounds to realize this phenomenology intrinsically. I will present ARPES experiments for the n = 1 and 2 members of this material family, while crystalline and magnetic properties of the same samples will be discussed by Anna Isaeva (same session). Our experiments confirm the existence of topological surface states and show how their properties vary with surface termination [1]. Furthermore, I will briefly describe our present efforts to realize these materials in two dimensions via molecular beam epitaxy [2].

Weyl nodes are topologically protected intersections between non-degenerate electron bands and constitute the defining feature of WSM. At these special points in momentum space the Bloch wave functions show a special behavior: in the bulk the Weyl nodes constitute monopoles of Berry flux and at the surface their projections define the termination points of Fermi-arc surface states. I will discuss how these intricate electronic properties manifest in real materials and how they can be addressed experimentally by use of dichroism in ARPES [3,4].

References

[1] R. C. Vidal, HB, *et al.*, *Phys. Rev. Lett.* **126**, 176403 (2021).
[2] P. Kagerer, C. Fornari,…, A. Isaeva, HB, F. Reinert, *J. Appl. Phys.* **128**, 135303 (2020).
[3] C. H. Min, HB, *et al.*, *Phys. Rev. Lett.* **122**, 116402 (2019).
[4] M. Ünzelmann, HB, *et al., Nat. Comm.* (accepted, 2021), arXiv:2012.06996

SKYTOP Skyrmion-Topological insulator and Weyl semimetal technology
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION HORIZON 2020
TOCHA New Generation of Devices to Harness Topology