O 65: Poster: Topology and Symmetry-Protected Materials

Time: Wednesday 18:00–20:00 Location: P2/EG

O 65.1 Wed 18:00 P2/EG

Topological insulator Bi2Se3: the effect of doping with Fe, Ru, Os, and Mo — •Frantisek Maca[1], Stanislav Cichon[1], Vaclav Drchal[1], Katerina Horakova[1], Irena Kratochvilova[1], Jan Lancok[1], Vladimir Chab[1], Patrik Cermak[2], Cestmír Drasar[2], and Jiri Navratil[2] — [1]Institute of Physics CAS, Praha, Czech Republic — [2]University of Pardubice, Pardubice, Czech Republic

Doping is one of the most suitable ways of tuning the electronic properties of topological insulators (TI) and a promising means of a band gap opening. We report a reliable method for preparation of high-quality single crystal substrates Bi2Se3 containing anti-site defects and vacancies and doped with VIIIB and VIB columns elements.

We combine experimental (XPS, ARPES) and theoretical (ab initio) methods to analyze the electronic properties and chemical states of atoms and defects in the substitutional position in TI that can be achieved using the free melt crystallization method of the sample growth. Doping introduced change in the position of Dirac cone is shown and discussed.

O 65.2 Wed 18:00 P2/EG

Green's functions formulation of Floquet topological invariants — •Marcus Meschede, Helena Drüeke, and Dieter Bauer — University of Rostock

Floquet topological insulators (FTIs) allow for topological protection through their time evolution as opposed to static topological insulators, which are only protected by their band topology. FTIs have become ubiquitous in the pursuit of realizing new phases of matter. In general, the momentum-dependent quasi-energy spectrum of single-particle time evolution operators or, equivalently, Floquet Hamiltonians is used to classify the band topology. In the presence of many-particle interactions, this single-particle picture breaks down. In order to overcome this issue, topological invariants of static systems have been formulated through their single-particle Green's functions. [1,2] We expand on this work by calculating Floquet topological invariants through their Floquet Green's function. As there is much experimental work on realizing FTIs, we hope to provide another tool to determine the topological properties of these systems through their bulk spectral function.

[1] Gurarie, V. "Single-Particle Green's Functions and Interacting Topological Insulators." Physical Review B 83, 085426 (2011).

[2] He, Yuan-Yao, Han-Qing Wu, Zi Yang Meng, and Zhong-Yi Lu. "Topological Invariants for Interacting Topological Insulators. I. Efficient Numerical Evaluation Scheme and Implementations." Physical Review B 93, 195163 (2016).

O 65.3 Wed 18:00 P2/EG

Interaction-Induced Directional Transport on Driven Coupled Chains — •Helena Drüeke and Dieter Bauer — Universität Rostock

We examine whether interaction between particles may introduce (topologically protected) directional transport in a driven two-particle quantum system. As a simple example, we consider two one-dimensional chains of equal length, each with one particle. The two particles interact but stay on their respective chain. The particles move alternatingly and without a preferred direction.

Without interaction between the particles, they each diffuse along their chains. Interaction between them suppresses this diffusion. With the proper timing of their alternating movement, the particles form a bound doublon state. Depending on their starting positions, this doublon either remains stationary or moves along the chain. The motion of the doublon consists of alternating, leapfrogging motion of the two particles.

O 65.4 Wed 18:00 P2/EG

Near-field investigation of topologically protected edge states in plasmonic waveguide arrays — •Hans-Joachim Schill, Anna Sidorenko, and Stefan Linden — Department of Physics, University of Bonn, Germany

Light propagation along evanescently coupled waveguide arrays resembles mathematically the dynamics of a lattice Schrödinger equation and is, therefore, ideally suited for simulating condensed matter lattice systems. Here, we report on near-field measurements with scattering-type scanning near-field optical microscopy (s-SNOM) in transmission mode combined with leakage radiation microscopy to investigate topological effects in coupled arrays of dielectric loaded surface plasmon polariton waveguides (DLSPPWs). Specifically, we implement the Su-Schrieffer-Heeger (SSH) model by fabricating arrays of DLLSPPWs with alternating weak and strong couplings. The interface between two topologically distinct domains of the SSH model is known to host a topologically protected edge state. The combination of far- and near-field imaging allows us to investigate the global intensity evolution of the lattice as well as the local amplitude and phase distribution of the edge state.

O 65.5 Wed 18:00 P2/EG

Orbital Protection of a Weyl Nodal line — •Tim Figgemeier[1,3], Maximilian Ünzelmann[1,3], Philipp Eck[2,3], Jakub Schusser[1,3], Jennifer Neu[4,5], Theo Siegrist[4,6], Domenico Di Sante[7], Giorgio Sangiovanni[2,3], Hendrik Bentmann[1,3,8], and Friedrich Reinert[1,3] — [1]EP VII, Universität Würzburg, Germany — [2]ITPA, Universität Würzburg, Germany — [3]Würzburg-Dresden Cluster of Excellence, ct.qmat — [4]NHMFL, Tallahassee, FL, US — [5]Nuclear Nonproliferation Division, ORNL, Oak Ridge, Tennessee, US — [6]FAMU-FSU, Tallahassee, FL, US — [7]Center for Computational Quantum Physics, Flatiron Institute, New York, US — [8]NTNU, Trondheim, Norway

We present a combined soft X-ray angle-resolved photoelectron spectroscopy (SX-ARPES) and density functional theory study on TaAs and NbP. The two compounds are usually known as paradigmatic nonmagnetic Weyl semimetals. Here, however, we show that they further host twofold spin-degenerate nodal lines located at the center of a one-dimensional vortex line of Orbital Angular Momentum (OAM). These momentum space vortices can be tracked experimentally by using k_z-resolved dichroic SX-ARPES. The OAM vortex line protects the spin degeneracy against spin-orbit coupling and imparts high topological robustness to the nodal line. In order to investigate the impact of SOC on the degeneracy experimentally, we compare TaAs with NbP, which differ from each other by having a different magnitude of atomic SOC strength.

O 65.6 Wed 18:00 P2/EG

Towards *higher−order* topological corner states in quantum spin Hall insulating heterostructures — •Markus Feld[1,2], Philipp Eck[1,2], and Giorgio Sangiovanni[1,2] — [1]ITPA, Universität Würzburg, Germany — [2]Würzburg-Dresden Cluster of Excellence, ct.qmat

Real-space obstruction in $\mathbb{Z}_2$ trivial systems is under current investigation as it promotes quantized electronic bulk multipoles. In two dimensions it can stabilize a *higher−order* topological insulator (HOTI) with insulating edges and zero energy in-gap corner states. However the recent analysis for the triangular quantum spin Hall insulator (QSHI) indenene has extended the concept of real-space obstruction to $\nu = 1$ phases [1].

We show that this is in contrast to the well established large-gap QSHI bismuthene [2], where the Wannier functions center on the atomic lattice sites. Here we present an *ab initio* based study, where we address the edges and corners of obstructed and non-obstructed interfaces by considering heterostructures of indenene and bismuthene.

[1] P. Eck et al., Phys. Rev. B **106**, 195143 (2022)

[2] F. Reis et al., Science **357**, 287 (2017),