O 2: Electronic structure of surfaces: Spectroscopy, surface states I

Time: Monday 10:30–12:30 Location: HSZ/0201

O 2.1 Mon 10:30 HSZ/0201

Unveiling the spin texture of the topological surface state in Sb(111) — •Xin Liang Tan[1], Arthur Ernst[2], Anders Christian Mathisen[1], Stefanie Suzanne Brinkman[1], Fabian Göhler[1], Chul Hee Min[1], and Hendrik Bentmann[1] — [1]Center for Quantum Spintronics, Department of Physics, Norwegian University of Science and Technology, 7491 Trondheim, Norway — [2]Institut für Theoretische Physik, Johannes Kepler Universität, A 4040 Linz, Austria

Spin-resolved momentum microscopy is a powerful tool for mapping the complete Fermi surface and spin texture of two-dimensional electronic states. Here, we present spin- and momentum-resolved Sb(111) surface state, a benchmark system exhibiting strong spin-orbit coupling and a non-trivial topology. Using a continuous-wave vacuum-ultraviolet laser ($h\nu = 6eV$) for photoexcitation, we achieve efficient k-space mapping of the in-plane spin-polarization components over the full surface Brillouin zone. We will present experimental data obtained for different light polarizations. Our results are compared to first-principles calculations.

[1] X.L. Tan et al., Ultramicroscopy 253, 113820 (2023).
[2] C. Tusche et al., Ultramicroscopy 159, 520 (2015).
[3] D. Hsieh et al., Science 323, 919-922(2009).
[4] H. Ishida. Phys., Rev. B 90, 235422 (2014).

O 2.2 Mon 10:45 HSZ/0201

Surface Electronic Structure of Magnetic Kagome Metal GdV_6Sn_6 — •Robin P. Forster[1], Honey Boban[1], Mohammed Qahosh[1], Xiao Hou[1], Yishui Zhou[2], Yixi Su[2], Gustav Bihlmayer[3], Claus M. Schneider[1], and Lukasz Plucinski[1] — [1]PGI-6 Forschungszentrum-Jülich — [2]JCNS Forschungszentrum-Jülich — [3]PGI-1 Forschungszentrum-Jülich

The magnetic Kagome metal GdV_6Sn_6 combines in a single material phenomena such as van Hove Singularities [1,2,3], local moments of the 4f electrons of Gd, and itinerant V 3d electrons [4], providing a platform to study their complex magentic and electronic interactions. We have performed termination-dependent micro-ARPES measurements of paramagnetic GdV_6Sn_6 with 20 μm real-space resolution at 20 K [5]. A series of scans over a photon energy range between 75 eV and 200 eV enabled the distinction between surface and bulk states. We have chosen $h\nu$ of 80 and 130 eV for detailed ARPES scans. In addition, XPS measurements and DFT-GGA slab calculations were performed, which can be used to investigate surface terminations. Preliminary circular-dirchroic ARPES maps exhibit multiple sign inversions that stem from a combination of initial state orbital angular momenta and photoemission final state scattering [6]. [1] PRL 127, 266401 (2021) [2] RRL 17, 2300083 (2023) [3] Sci. Adv. 8, 38 (2022) [4] JPSJ 90, 124704 (2021) [5] PRB 104, 235139 (2021) [6] arXiv:2410.19652 (2024).

Invited Talk O 2.3 Mon 11:00 HSZ/0201

Superconducting Fermi arcs. — •Andrii Kuibarov, Susmita Changdar, Oleksandr Suvorov, Luminita Harnagea, Bernd Büchner, and Sergey Borisenko — Leibnitz Institute for Solid State and Materials Research, Dresden, Germany

$PtBi_2$ is a trigonal non-centrosymmetric material that has recently drawn attention as a natural platform for topological superconductivity, without the need for engineered heterostructures. Recent STM studies have strengthened this claim by showing a superconducting gap with size up to 20 meV and critical temperature around 45 K.

Using angle-resolved photoemission spectroscopy, we demonstrate that both terminations of $PtBi_2$ expose Fermi arc surface states, which become superconducting at approximately 15 K with a gap size up to 3 meV, while the bulk of the material remains metallic, making $PtBi_2$ a surface-only superconductor. Further momentum-resolved gap measurements have shown that the superconducting gap on the Fermi arcs is anisotropic, with the superconducting node located in the center of six Fermi arcs, making it the first *i-wave* $(l = 6)$ superconductor. This anisotropy implies the formation of Majorana surface cones and predicts robust zero-energy flat-band Majorana states at the hinges of the crystal.

O 2.4 Mon 11:30 HSZ/0201

From low- to high-energy photoelectron diffraction: Novel theoretical approaches and Kikuchi diffraction analysis — •Trung-Phuc Vo[1], Olena Tkach[2], Didier Sébilleau[3], Olena Fedchenko[2], Hans-Joachim Elmers[2], Gerd Schönhense[2], and Ján Minár[1] — [1]Univ. of West Bohemia in Pilsen, Czech Republic — [2]Univ. of Mainz, Germany — [3]Univ. of Rennes, France

Time-of-flight momentum microscopy (ToF-MM) enables simultaneous energy- and momentum-resolved mapping of the full photoelectron distribution. Its sensitivity to the strong energy dependence of Kikuchi patterns [1,2] requires advanced theoretical modeling, especially across the broad energy range accessible with modern large-k-field setups [3]. We present a fully relativistic multiple-scattering study of fine diffraction features in core-level photoemission from Ge(100) and Si(100) over kinetic energies from 106 to 4174 eV [4]. Our one-step calculations avoid cluster-size convergence issues and include inelastic scattering to describe pattern broadening. For the first time, we reproduce circular dichroism in the angular distribution of Si(100) 1s with asymmetries up to 31%, and capture both bulk- and surface-sensitive diffraction features. The simulations show good agreement with experimental data obtained using circularly polarized light, demonstrating the robustness of our approach for high-energy photoemission and PED analysis.

[1] O. Tkach et al., Ultramicroscopy 250, 113750 (2023); [2] T.-P. Vo et al., AIP Conf. Proc. 3251, 020005 (2024); [3] T.-P. Vo et al., arXiv:2504.14758 (2025); [4] T.-P. Vo et al., npj Comput. Mater. 11, 159 (2025).

O 2.5 Mon 11:45 HSZ/0201

Fermiology and spin polarization of the topological surface states in $PtBi_2$ — •Stefanie Suzanne Brinkman[1], Anders Christian Mathisen[1], Xin Liang Tan[1], Kristian Maeland[2], Øyvind Finnseth[1], Fabian Göhler[1], Chul Hee Min[1], Grisha Shipunov[3], Anna Isaeva[2], Jorge Ismael Facio[4], and Hendrik Bentmann[1] — [1]Center for Quantum Spintronics, Department of Physics, NTNU, Norway — [2]Institute for Theoretical Physics and Astrophysics, University of Würzburg, Germany — [3]Institute of Physics, University of Amsterdam, The Netherlands — [4]Instituto Balseiro, National University of Cuyo, Argentina

Weyl semimetals host topologically protected Weyl nodes in the bulk, that are connected by Fermi arcs on the surface. In $PtBi_2$, recent reports indicate superconductivity in the surface Fermi arcs at elevated temperatures [1]. In this talk, we will present results from spin- and angle-resolved VUV photoemission experiments for both inequivalent surface terminations of $PtBi_2$. Our measurements, combined with first-principles calculations, establish vastly different low-energy dispersion relations of the Fermi arcs depending on surface termination. Furthermore, we provide evidence for spin polarization of the Fermi arcs. We will discuss the implications of our results for the emergence of unconventional superconductivity on the surface of $PtBi_2$.

[1] Andrii Kuibarov et al., Evidence of superconducting Fermi arcs. Nature **626**, 294-299 (2024)

O 2.6 Mon 12:00 HSZ/0201

Multi-technique research ecosystem structured around electronic band structure analysis — Takahiro Hashimoto[1], Andreas Janzen[2], •Hrag Karakachian[2], Eleni Anargirou[2], Timo Wätjen[1], and Martin Schmid[1] — [1]Scienta Omicron AB, Danmarksgatan 22, 75323 Uppsala, Sweden — [2]Scienta Omicron GmbH, Limburger Strasse 75, 65232 Taunusstein, Germany

The discovery and control of novel quantum materials are essential to the progress of modern technology. These materials frequently show complex behaviours that demand multiple, complementary techniques to fully understand their properties. For example, the electronic band structure, which is central to understanding emerging quantum materials, is typically investigated using angle-resolved photoemission spectroscopy (ARPES) or momentum microscopy.

Here, we describe how a surface-science research ecosystem centred on ARPES can be established by integrating state-of-the-art capabilities such as molecular beam epitaxy (MBE) for thin-film growth, X-ray photoemission spectroscopy (XPS) for chemical-state analysis, and scanning probe microscopy (SPM) for real-space imaging. Materials innovation is accelerated by combining these complementary techniques, leveraging both laboratory-based and user-facility instrumentation, and developing new tools to extend commercial systems.

We will present several research scenarios focused on electronic band-structure analysis and highlight application examples involving 2D materials and topological materials.

O 2.7 Mon 12:15 HSZ/0201

The TXPES Beamline at SESAME * A New Facility for Advanced Soft X-ray Photoelectron Spectroscopy — •ZEYNEP REYHAN OZTURK — SESAME

The Turkish X-ray Photoelectron Spectroscopy (TXPES) beamline, newly installed at the SESAME synchrotron, is dedicated to advanced soft X-ray photoelectron spectroscopy (XPS/UPS) for surface and interface analysis. Designed for high-resolution measurements across a broad photon energy range, TXPES enables detailed investigation of electronic structure, chemical composition, and oxidation states in complex materials.

The end station features interconnected UHV chambers for sample preparation, analysis, and in situ or near-ambient pressure experiments. Equipped with a hemispherical analyzer, ion gun, LEED, and LEIS, it allows comprehensive surface characterization with variable depth sensitivity.

TXPES provides a powerful platform for studying surface oxidation, adsorption, catalysis, and band alignment under controlled environments, including realistic gas conditions via its high-pressure cell. Currently in commissioning, the beamline will support diverse research on functional oxides, thin films, catalysts, and magnetic materials, highlighting the collaborative effort between Turkish institutions and SESAME toward full user operation.