TT 11: $PtBi_2$

Time: Monday 11:15–12:30 Location: CHE/0091

TT 11.1 Mon 11:15 CHE/0091

Surface-confined fluctuating superconductivity in the topological semimetal γ-$PtBi_2$ — •Manaswini Sahoo, Luminita Harnagea, Mahdi Behnami, Michele Ceccardi, Sebastian Gass, Sabine Wurmehl, Anja UB Wolter, and Bernd Büchner — Leibniz Institute for Solid State and Materials Research Dresden, Helmholtzstrasse 20, D-01069 Dresden, Germany

$PtBi_2$ has recently emerged as a promising candidate for hosting superconducting topological surface states. While surface-sensitive probes have observed this unique superconductivity, it remains elusive in bulk thermodynamic measurements. Here, we present evidence of superconducting fluctuations at elevated temperatures through AC susceptibility measurements. The real component of the susceptibility exhibits a diamagnetic response below 20 K, accompanied by a finite imaginary component, both indicative of surface-confined superconducting fluctuations. The small superconducting volume fraction supports a surface rather than bulk origin. Complementary magnetoresistance measurements reveal anomalies below this characteristic temperature. These findings establish $PtBi_2$ as a robust platform for exploring topological superconductivity and provide strong motivation for future studies aimed at elucidating the superconducting bulk-surface interplay.

TT 11.2 Mon 11:30 CHE/0091

Engineering Weyl nodes in the nodal-line semimetal $PtBi_2$ — •Ankit Kumar[1,2], Joseph Dufouleur[1], and Bernd Büchner[1,2] — [1]Leibniz Institute for Solid State and Materials Research(IFW) Dresden — [2]Department of Physics, TU Dresden

The nonmagnetic Weyl and nodal-line semimetal $PtBi_2$ has recently been shown an anomalous planar Hall effect (APHE), a phenomenon generated purely by Berry curvature surrounding Zeeman-induced Weyl points. The location of Zeeman-split Weyl nodes along the nodal line can be tuned.

In this work, we investigate the tunability of Weyl physics in $PtBi_2$ through systematic APHE measurements performed under three-dimensional rotations of the magnetic field. By tilting the magnetic field out of plane, we are able to tune the amplitude of the anomalous Hall effect, obtaining a signal stronger or weaker than that measured in-plane. This behaviour provides evidence that the location of Zeeman-induced Weyl nodes can be manipulated by controlling the field orientation.

Our results establish a new pathway to engineer Zeeman-induced Weyl nodes in nodal line semimetals by a magnetic field.

TT 11.3 Mon 11:45 CHE/0091

Low-temperature scanning tunneling spectroscopy on the superconducting Weyl semimetal t-$PtBi_2$ — •Sebastian Schimmel[1], Julia Besproswanny[1], Xiaochun Huang[2], Yanina Fasano[3], Grigory Shipunov[4], Victor Felix Correa[3], José Zabala[3], Luminita Harnagea[5], Sven Hoffmann[1], Bernd Büchner[5], Matthias Bode[2], and Christian Hess[1] — [1]Universität Wuppertal, 42119, Wuppertal, Germany — [2]Universität Würzburg, 97074 Würzburg, Germany — [3]Centro Atómico Bariloche and Instituto Balseiro,8400, Bariloche, Argentina — [4]University of Amsterdam, 1098 XH Amsterdam, The Netherlands — [5]IFW Dresden, 01069, Dresden, Germany

Combining a topologically non-trivial Weyl semimetal nature and surface superconductivity with $T_c > 5$ K, trigonal $PtBi_2$ (t-$PtBi_2$) is a fascinating representative of quantum materials. Intriguingly, large superconducting gaps, comparable to those known from high-T_c superconductors, suggest elevated transition temperatures, and ARPES revealed that the surface superconductivity is confined to Weyl Fermi arcs exhibiting unconventional i-wave symmetry [1,2]. Via low-temperature scanning tunneling spectroscopy, we experimentally address the local electronic properties of the surface of t-$PtBi_2$. Here we report on the temperature dependence of the surface superconductivity and peculiar spectroscopic signatures of its spacially varying electronic structures. The presented results corroborate the unconventional non-trivial electronic properties of t-$PtBi_2$.

[1] A. Kuibarov et al., Nature(2024)
[2] S. Changdar et al., Nature(2025)

TT 11.4 Mon 12:00 CHE/0091

t-$PtBi_2$: Topological Fermi Arcs and Surface Superconductivity from Quasiparticle Interference — •Julia Besproswanny[1], Sebastian Schimmel[1], Sven Hoffmann[1], Gregory Shipunov[2], Saicharan Aswartham[2], Joaquin Puig[3], Yanina Fasano[3], Danny Baumann[2], Riccardo Vocaturo[2], Jorge I. Facio[3], Oleg Janson[2], Jeroen van den Brink[2], Bernd Büchner[2], and Christian Hess[1] — [1]University of Wuppertal, 42119 Wuppertal, Germany — [2]IFW Dresden, 01069 Dresden, Germany — [3]Centro Atómico Bariloche, Instituto Balseiro, 8400 Bariloche, Argentina

Non-centrosymmetric trigonal $PtBi_2$ hosts a rich electronic structure that gives rise to several quantum phenomena. In particular, the coexistence of topological surface states and surface superconductivity suggests that it may be an intrinsic, possibly high-T_c, topological superconductor. ARPES [1] shows that superconductivity in t-$PtBi_2$ is both intertwined with and confined to its topological surface states.

By means of low-temperature scanning tunneling spectroscopy and quasi-particle interference investigations, we probe the local topological and superconducting properties and their interplay on the surface of t-PtBi2. The revealed scattering channels originate from the topological Fermi arcs. These QPI signatures are suppressed in the superconducting state, while re-emerging above B_c – highlighting the close connection between superconductivity and topology.

[1] A. Kuibarov et. al., Nature 626, 294 (2024).

TT 11.5 Mon 12:15 CHE/0091

Phonon and Coulomb mechanism for nodal topological superconductivity on $PtBi_2$ surface — •Kristian Maeland, Giorgio Sangiovanni, and Björn Trauzettel — Institute for Theoretical Physics and Astrophysics, University of Würzburg and Würzburg-Dresden Cluster of Excellence ct.qmat, D-97074 Würzburg, Germany

Experiments show that the Weyl semimetal $PtBi_2$ hosts unconventional superconductivity in its topological surface states. Hence, the material is a candidate for intrinsic topological superconductivity. Measurements indicate nodal gaps in the center of the Fermi arcs. We show that unusually anisotropic electron-phonon coupling on Weyl semimetal surfaces combined with statically screened Coulomb repulsion is a microscopic mechanism for the i-wave pairing. We solve the linearized gap equation close to the critical temperature and find nodal gaps when the surface state bandwidth is comparable to the maximum phonon energy, as is the case in $PtBi_2$.