TT 57: Topology: Poster

Time: Wednesday 15:00–18:00 Location: Poster E

TT 57.1 Wed 15:00 Poster E

Orbital magnetization of Dirac electrons on surfaces with constant curvature — •Maximilian Fürst[1], Denis Kochan[2], and Klaus Richter[1] — [1]University of Regensburg, Germany — [2]Slovak Academy of Sciences, Slovakia

Topological insulator (TI) nanowires exhibit strong spin-orbit coupling with surface states that are well-protected against backscattering [1]. Shaping such nanowires, i.e. varying their cross-section smoothly along the nanowire axis, opens up the possibility to study curvature effects of the TI surface states. This yields significant modifications of the magneto transport features [2] and allows for studying quantum Hall physics in curved 2D space showing peculiar spectra of Landau levels [3]. Complementary to this, here we study the orbital magnetic response of nanowires with curved surfaces. In particular, we consider the magnetic susceptibility for conducting surfaces with constant Gaussian curvature in presence of a coaxial, homogeneous magnetic field.

[1] X.-L. Qi and S.-C. Zhang, Rev. Mod. Phys. 83, 1057 (2011)
[2] R. Kozlovsky, A. Graf, D. Kochan, K. Richter, C. Gorini, Phys. Rev. Lett. 124, 126804 (2020)
[3] M. Fuerst, D. Kochan, C. Gorini, K. Richter, arXive2307.09221 (2023)

TT 57.2 Wed 15:00 Poster E

Quantum coherent transport and Electron-electron interaction in $BiSbTe_3$ single crystals — •Indu Rajput, Sonali Baral, Mukesh Kumar Dasoundhi, Devendra Kumar, and Archana Lakhani — UGC-DAE Consortium for Scientific Research, University Campus, Khandwa Road, Indore-452001, India

The ternary alloy $(Bi_{1-x}Sb_x)_2Te_3$ serves as a promising Topological insulators (TIs), switching between p and n-type semiconductors by fine tuning of E_F by varying the concentration x[1]. While the precise Bi:Sb ratio crucially positions the E_F within the band, the role of defects that occurs during growth process of single crystals remains largely unexplored despite their observations in other TIs [2]. Here we present the effect of defects on the magnetotransport properties of $BiSbTe_3$ single crystals. Two distinct crystals, S1 and S2 sourced from the same boule, exhibit contrasting behaviors: S1 displays metallic traits, while S2 represents a complex multi-transport mechanism involving thermal activation, hopping conduction of localized charge carriers, quantum coherent transport, and electron-electron interaction across varying temperatures. Comprehensive analysis of resistivity and magnetoresistance patterns unveils weak antilocalization behavior, elucidated by the Hikami-Larkin-Nagaoka formula. These observations suggest the presence of multichannel quantum coherent transport, which depends on the thickness of sample.

[1] J. Zhang, et al. Nat. Commun. **2**, 574 (2011)
[2] A. Lakhani et al. Appl. Phys. Lett. **114**, 182101 (2019)

TT 57.3 Wed 15:00 Poster E

Nearly perfectly compensated Topological Insulator $Bi_{1.08}Sn_{0.02}Sb_{0.9}Te_2S$ without charge puddles? — •Rajendra Loke, Rohit Sharma, Mahasweta Bagchi, Yongjian Wang, Yoichi Ando, Thomas Lorenz, and Joachim Hemberger — Physics Institute II, University of Cologne, Zülpicher Straße 77, D-50937 Cologne, Germany.

In topological insulators the bulk conductivity can successfully be suppressed by compensation doping. However, fluctuations of the Coulomb potential usually lead to the formation of mesoscopic charge puddles, which strongly influence the transport properties as magnetic fields may generate a percolating path for conductivity. But even in the non-percolating case, the high DC-resistivity can be overcome at high enough frequencies. The cut-off frequency ν_c, for which AC-conductivity sets in, is related the puddle size and may be located in the microwave regime. The value of ν_c is magnetic field dependent, giving rise to a large positive magnetoconductivity in the gigahertz range [1]. Here we present impedance spectroscopy measurements on various TI systems. While e.g. $BiSbTeSe_2$ (BSTS) shows large positive magneto-conductivity in the GHz range due to the increase of the puddle size in magnetic field, the system $Bi_{1.08}Sn_{0.02}Sb_{0.9}Te_2S$ (Sn-BSTS) only exhibits the Weak Anti-localization effect, a signature of the surface states of Dirac materials, associated with negative magneto-conductivity. Therefore, in Sn-BSTS does not show any signature of puddle formation (in the frequency range measured so far).

TT 57.4 Wed 15:00 Poster E

Band structure and topology of the chiral semimetal CoSi — •B.V. Schwarze[1,2], J. Hornung[1], K. Manna[3], S. Shekhar[3], S. Chattopadhyay[1], C. Felser[3], and J. Wosnitza[1,2] — [1]Hochfeld-Magnetlabor Dresden (HLD-EMFL), HZDR, Dresden, Germany — [2]Institut für Festkörper- und Materialphysik, TU Dresden, Germany — [3]Max-Planck-Institut für Chemische Physik fester Stoffe, Dresden, Germany

CoSi is a chiral semimetal hosting an exceptional topology critically depending on the spin-orbit coupling (SOC). Without SOC, the topology features two band-touching nodes with a Chern number of two and nodal planes. With SOC, the two band-touching nodes have a Chern number of four and there is an additional singular Weyl point. To date, the experimental significance of the SOC in CoSi is controversial.

Here, we present our detailed investigation of the bulk band-structure of CoSi with band-structure calculations and angular-dependent de Haas-van Alphen measurements up to 18 T and down to 40 mK. Our results reveal six clearly spin-split bands crossing the Fermi energy, substantiating the significance of the SOC and verifying the topology. Furthermore, we report on three additional quantum-oscillation frequencies which are predicted by calculations but have never been observed before.

TT 57.5 Wed 15:00 Poster E

Anomalous Hall Effect in $EuSn_2As_2$ Thin Flakes — •Evgenii Maltsev, Louis Veyrat, Joseph Dufouleur, Romain Giraud, Nicolas Perez Rodriguez, and Bernd Büchner — IFW Dresden, Dresden, Germany

$EuSn_2As_2$ is an intrinsic antiferromagnetic topological insulator (TI) with a Néel temperature $T_N = 24$ K and an easy-plane anisotropy. Despite the interest in magnetic TIs, no transport measurements of $EuSn_2As_2$ nanostructures were reported up until now. Here, we present the first magnetotransport study on exfoliated nanostructures of $EuSn_2As_2$ with thicknesses between 60nm to 140nm. In particular, we study the magnetoresistance with respect to magnetic field orientation tilted between out-of-plane and in-plane directions. A small easy-plane magnetic anisotropy is found as previously reported for macrocrystals. Moreover, an anomalous Hall effect (AHE) is observed below T_N. The complex AHE shape does not appear directly compatible with a simple easy-plane anisotropy pointing to a potentially more complex magnetism in $EuSn_2As_2$ nanostructures.

We thank Kirill Pervakov for the help with crystal growth and Dr. Vladimir Pudalov for mentoring.

TT 57.6 Wed 15:00 Poster E

Nonlinear transport in the topological semimetal $ZrTe_5$ — •Yongjian Wang[1], Henry F. Legg[2,3], Thomas Bömerich[2], Jinhong Park[2], Sebastian Biesenkamp[1], Alexey Taskin[1], Markus Braden[1], Achim Rosch[2], and Yoichi Ando[1] — [1]Institute of Physics II, University of Cologne, D-50937 Köln, Germany — [2]Institute for Theoretical Physics, University of Cologne, D-50937 Köln, Germany — [3]Department of Physics, University of Basel, CH-4056 Basel, Switzerland

The topological semimetal $ZrTe_5$ has been a focus of significant interest in recent years. Here we report our discovery that $ZrTe_5$ crystals in proximity to a topological quantum phase transition present gigantic magnetochiral anisotropy (MCA) [1] and non-ohmic behavior [2]. The MCA in $ZrTe_5$ is the largest ever observed to date as a bulk property, which is explained by the combination of very low carrier density, inhomogeneities, and a torus-shaped Fermi surface induced by breaking of inversion symmetry [1]. Besides, in $ZrTe_5$ samples with extremely low carrier density, pronounced nonlinear current-voltage characteristics were observed when the current and magnetic field are both along the crystallographic a-axis. The non-ohmic behavior in the $ZrTe_5$ having torus Fermi surface is likely due to the combined effect of ultra-flat bands and charge puddles, the former shows up as a result of Landau quantization when the magnetic field is applied in the torus plane [2].

[1] Y. Wang et al., PRL 128, 176602 (2022)
[2] Y. Wang et al., PRL 131, 146602 (2023)

TT 57.7 Wed 15:00 Poster E

Evolution of Floquet topological quantum states in driven semiconductors — Andreas Lubatsch[1] and •Regine Frank[2,3] — [1]Physikalisches Institut, Rheinische Friedrich Wilhelms Universität Bonn — [2]College of Biomedical Sciences, Larkin University, Miami, Florida, USA — [3]Donostia International Physics Center, 20018 Donostia-San Sebastian, Spain

Spatially uniform excitations can induce Floquet topological bandstructures within insulators which have equal characteristics to those of topological insulators. We demonstrate the evolution of Floquet topological quantum states for electromagnetically driven semiconductor bulk matter. We show the direct physical impact of the mathematical precision of the Floquet-Keldysh theory when we solve the driven system of a generalized Hubbard model with our framework of dynamical mean field theory (DMFT) in the non-equilibrium with physical consequences for optoelectronic applications.

[1] A. Lubatsch, R. Frank, Eur. Phys. J. B 92 (2019) 215
[2] A. Lubatsch, R. Frank, Symmetry 11 (2019) 1246
[3] P.-C. Chang, J.G. Lu, Appl. Phys. Lett. 92 (2008) 212113

TT 57.8 Wed 15:00 Poster E

Exploring the Effects of a 1D Periodic Potential on a 3D Topological Insulator — •Albert Koop, Alexander Altmann, Dimitriy Kozlov, and Dieter Weiss — Institute of Experimental and Applied Physics, University of Regensburg, Germany

In this work, we have investigated the effect of a weak 1-dimensional periodic potential on the conductivity of 3D high-mobility topological insulator (TI) based on 80nm HgTe film. A stripe gate formed the modulation potential, while a uniform gate additionally covered the whole structure. This makes it possible to change both the position of the Fermi level and the strength of the 1D potential. The classical magnetoresistance ρ_{xx} manifests a pronounced oscillation with minima described by the commensurability condition $2R_c/a = (\lambda - 1/4)$ with $\lambda = 1, 2, 3...$ where R_c is the cyclotron radius and a is the period of the 1D potential. We observed the commensurability features coming from both electrons and holes. On the electron side, the contribution of top-surface electrons (i.e., topological electrons located closer to the gate) dominated in the observed pattern, while all other carriers acted as a background. However, in the valence band, where bulk holes and Dirac electrons coexist, we observed the previously unexplored situation that both electrons and holes can contribute to the commensurability oscillations.

HgTe provided by N. Mikhailov and S. A. Dvoretskii, Novosibirsk.

TT 57.9 Wed 15:00 Poster E

Minimal Model of the Magnetic Weyl Semimetal $EuCd_2As_2$ — •Hannah Price and Carsten Timm — Institute of Theoretical Physics, Technische Universität Dresden, 01062 Dresden, Germany

Weyl semimetals provide an interesting new landscape to study frustrated magnetism due to the mixed charge and spin response. We investigate the interaction and magnetic order of rare-earth magnetic moments mediated by RKKY interactions. In particular, we will examine the proposed Weyl semimetal $EuCd_2As_2$. Using symmetry arguments we determine a minimal tight-binding model of the electronic and magnetic properties of the material. Additionally, we study the magnetic ordering of the rare-earth magnetic moments using classical Monte Carlo simulations.

TT 57.10 Wed 15:00 Poster E

Instabilities driven by electron-electron interactions in Weyl semimetals — •Eva Lopez Rojo, Julia M. Link, and Carsten Timm — TU Dresden, Germany

The consequences of electron-electron interactions in the presence of two Weyl points has been previously studied [1-3]. Inter-valley interactions, meaning interactions between electrons in each of the Weyl cones with opposite chirality, have been found to give rise to an excitonic instability. The resulting exciton condensate spontaneously breaks chiral symmetry, transforming the Weyl semimetal into an axionic insulator. The resulting charge density wave phase and its topological properties have also been examined. In this poster, we introduce a formalism that enables the exploration of how the aforementioned axionic physics extends to a more realistic scenario featuring multiple Weyl points.

[1] Z. Wang and S.-C. Zhang, Phys. Rev. B **87**, 161107(R) (2013).
[2] D. Sehayek, M. Thakurathi, and A. A. Burkov, Phys. Rev. B **102**, 115159 (2020).
[3] E. Bobrow, C. Sun, and Y. Li, Phys. Rev. Res. **2**, 012078(R) (2020).

TT 57.11 Wed 15:00 Poster E

Topological flat bands in d-wave superconductors — •Gabriele Domaine[1,2], Yiran Liu[2], Tohru Kurosawa[3], Julia Diana Küspert[4], Pietro Maria Bonetti[2], Shigemi Terakawa[1], Ding Pei[5], Mihir Date[1], Matteo Minola[2], Izabela Biało[4], Timur Kim[6], Matthew D. Watson[6], Jiabao Yang[1], Naoki Momono[3], Migaku Oda[7], Neven Barišić[8], Cephise Cacho[6], Stuart Stephen Papworth Parkin[1], Johan Chang[4], Bernhard Keimer[2], Andreas P Schnyder[2], and Niels B. M. Schröter[1] — [1]Max Planck Institute of Microstructure Physics, Halle (Saale), Germany — [2]Max-Planck-Institut für Festkörperforschung, Stuttgart, Germany — [3]Department of Applied Sciences, Muroran Institute of Technology, Muroran, Japan — [4]Physik-Institut, Universität Zürich, Zürich, Switzerland — [5]Synchrotron-SOLEIL, Université Paris-Saclay, Saint-Aubin, BP48, Gif sur Yvette, Paris F91192, France — [6]Diamond Light Source, Harwell Campus, Didcot, OX11 0DE, United Kingdom — [7]Department of Physics, Hokkaido University, Sapporo, Japan — [8]Department of Physics, Faculty of Science, University of Zagreb, Bijenička cesta 32, 10000 Zagreb

In superconductors with a d(x2-y2)-gap symmetry, the existence of a non-zero winding number leads to the appearance of zero-energy flat-bands on certain edges. These bands are protected by the chiral symmetry and occupy a two-dimensional region of the Brillouin zone bounded by the projections of the superconducting nodes. A recently established approach to cleave crystals by means of micro-notches paves the way for the study of these surface states by ARPES.

TT 57.12 Wed 15:00 Poster E

STM studies on the Weyl-semimetal and superconductor trigonal $PtBi_2$ — •Julia Besproswanny[1], Sebastian Schimmel[1], Sven Hoffmann[1], Gregory Shipunov[2], Saicharan Aswartham[2], Joaquin Puig[3], Yanina Fasano[3], Danny Baumann[2], Jeroen van den Brink[2], Ricardo Vocaturo[2], Jorge I. Facio[3], 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

We report a comprehensive study of the type-I Weyl-semimetal $PtBi_2$, exploring its topological and superconducting properties through low-temperature scanning tunneling microscopy and spectroscopy.

Quasi-particle-interference measurements confirm the topological nature through the presence of Fermi-arcs. Spectroscopic investigations reveal sample dependent electronic structure near the Fermi-level, ranging from metallic characteristics to the presence of particle-hole symmetric energy gaps implying superconductivity. Most notably, the largest observed energy gap suggests a critical temperature T_c in the range of 120 K, two orders of magnitude above the previously reported T_c measured via bulk-sensitive methods. The data provide indications that the superconductivity possibly arises out of topological surface states. This would make trigonal $PtBi_2$ a potential candidate for an intrinsic topological superconductor with a T_c above liquid nitrogen temperatures, highlighting it as a promising material for technological applications in quantum computing.

TT 57.13 Wed 15:00 Poster E

Majorana Chains using 2π Domain Walls — •Daniel Hauck[1], Stefan Rex[2,3], and Markus Garst[1] — [1]Karlsruhe Institute of Technology, Institute for Theoretical Solid State Physics, Wolfgang-Gaede-Str. 1, 76131 Karlsruhe — [2]Institute for Quantum Materials and Technologies, Karlsruhe Institute of Technology, 76021 Karlsruhe, Germany — [3]Institute for Theoretical Condensed Matter Physics, Karlsruhe Institute of Technology, 76131 Karlsruhe

Superconductor-magnet hybrid structures provide a platform for investigating topological phases with localized Majorana states. Such states have previously been predicted in the presence of elongated Skyrmions in the magnetic layer. Here, we consider 2π domain walls that can be easily controlled experimentally. We show that Majorana states can occur in these systems and discuss the possibility of building Majorana chains using a sequence of 2π domain walls.

TT 57.14 Wed 15:00 Poster E

Majorana bound state signatures on the magnetic flux-dependent zero bias conductance — •Cajetan Heinz[1], Patrik Recher[1,2], and Fernando Dominguez[1] — [1]Institute of Mathematical Physics, Technical University of Braunschweig, D-38106

Braunschweig, Germany — [2]Laboratory for Emerging Nanometrology Braunschweig, D-38106 Braunschweig, Germany

We propose a theoretical framework designed to unravel the p-wave character of the Majorana bound state (MBS) through an analysis of the periodicity in the flux-dependent zero-bias conductance. Our goal is to obtain an experimentally detectable signal that cannot be mimicked by zero energy Andreev bound states. We use a tight-binding model that describes a quantum spin Hall insulator (QSHI) - topological superconductor junction, where a MBS is expected to form at the NS boundary. By applying a magnetic flux, we explore the scattering processes of the QSHI edge states with the MBS. This configuration manifests distinct indicators of a topological non-trivial phase even in the presence of non-zero temperatures and weak coupling between the superconductor and the normal part. Additionally, we employ a scattering network to gain insight into the underlying physics governing the junction.

TT 57.15 Wed 15:00 Poster E

Chiral Majorana network in the BHZ model — Lena Bittermann[1], Patrik Recher[1,2], and •Fernando Dominguez[1] — [1]Institut für Mathematische Physik, Technische Universität Braunschweig, D-38106 Braunschweig, Germany — [2]Laboratory for Emerging Nanometrology Braunschweig, D-38106 Braunschweig, Germany

We investigate the energy spectrum and conductance properties of a 2 dimensional topological superconductor, which varies its Chern number spatially with a chessboard pattern. This can be achieved, for example, in topological superconductors described by the BHZ model, where the presence of a spatial dependent electric field can modulate the relative strength of the Rashba and the Dresselhaus spin-orbit coupling [1]. In this scenario, a pair of copropagating chiral Majorana modes appears at the interfaces with a Chern number difference of 2, resulting into a chiral Majorana network that extends over the whole system. To this aim, we develop a Chalker-Coddington scattering model [2], that captures the basic scattering processes that occur at the vortices between four different boundaries. We investigate further, the impact of defects and disorder in the conductance properties.

[1] L. Weithofer and P. Recher, New J. Phys. 15, 085008 (2013)
[2] J. T. Chalker and P. D. Coddington, J. Phys. C: Solid State Phys. 21, 2665 (1988)

TT 57.16 Wed 15:00 Poster E

Photonic noise spectroscopy of Majorana bound states — •Lena Bittermann[1], Fernando Dominguez[1], and Patrik Recher[1,2] — [1]Institut für Mathematische Physik, Technische Universität Braunschweig, D-38106 Braunschweig, Germany — [2]Laboratory for Emerging Nanometrology Braunschweig, D-38106 Braunschweig, Germany

We propose a route to detect Majorana bound states (MBSs) by coupling a topological superconductor to quantum dots (QDs) in a pnp junction. Here, two MBSs are coherently coupled to the electron levels of the two QDs, and via electron-hole recombination, photons are emitted. We focus on the cross-correlated shot noise and the polarization of the emitted photons, and discuss the processes of crossed Andreev reflection, elastic cotunneling and local tunneling processes [1]. Our detection scheme allows us to probe the existence of non-local triplet superconducting correlations and that two MBSs comprise a single fermion [2]. We compare our results to the ones obtained from quasi-Majorana bound states [3], giving rise to signatures that deviate from the MBSs scenario.

[1] L. Bittermann, C. De Beule, D. Frombach, P. Recher, PRB 106, 075305 (2022).
[2] A. Y. Kitaev, Phys.-Usp. 44, 131 (2001).
[3] G. Kells, D. Meidan, P. W. Brouwer, PRB 86, 100503(R) (2012).

TT 57.17 Wed 15:00 Poster E

Long Range Interactions in Synthetic Dimensions — •Patrick Geraghty[1] and Matteo Rizzi[2] — [1]University of Cologne, Cologne, Germany — [2]University of Cologne, Cologne, Germany

In recent cold atom experiments, the utilization of internal degrees of freedom as synthetic dimensions has enabled the simulation of higher-dimensional systems. Specifically, magnetic quantum numbers have been employed to transform a 1D chain of atoms into a synthetic 2D lattice, resulting in the realization of an integer quantum Hall state. However, this configuration introduces highly anisotropic and long-range particle interactions. To facilitate theoretical analysis, we develop a 1D effective model in the limit of infinite interaction anisotropy. This model serves as a simplified representation, allowing us to explore the impact of long-range interactions on the phases realized in the system. Our investigation delves into the emergence of new phases, the study of phase transitions, and the stability of configurations under the influence of extreme long-range interactions. This research contributes to a deeper understanding of the intricate interplay between synthetic dimensions and particle interactions in cold atom systems.

TT 57.18 Wed 15:00 Poster E

Topology of open spin chains — •Alexander Sattler and Maria Daghofer — Institut für Funktionelle Materie und Quantentechnologien, Universität Stuttgart, 70550 Stuttgart, Germany

Some spin chains, for example the Haldane chain or a topological dimerized chain, feature topologically protected edge states that are robust against some kind of noise. Despite their great appeal such spin states have not yet been created in a controlled manner in solid states environments, as spin chains on surfaces, where such a robustness can be quantified. We are here interested in the robustness of edge states against the coupling with surface.

Beyond that, since no physical system is perfectly isolated, it is of general interest to study whether the topological robustness is still given if there is a coupling with an environment.

The theoretical investigation is based on an alternating Heisenberg spin chain with spin-1/2, which is investigated by means of exact diagonalization. The coupling with the environment is modeled with the Lindblad-Master equation, whereby the jump operators are chosen in such a way that decoherence and spin flips occur.

We find, that the analyzed topological spin chain is susceptible to coupling with an environment just like topologically trivial spin chains. This can be seen in the time evolution of e.g. the topological energy gap, entropy, fidelity and edge state magnetization.

TT 57.19 Wed 15:00 Poster E

Non-Hermitian topological ohmmeter — Viktor Könye[1,2], Kyrylo Ochkan[1,2], •Anastasiia Chyzhykova[1,3], Jan Carl Budich[4,2], Jeroen van den Brink[1,2,4], Ion Cosma Fulga[1,2], and Joseph Dufouleur[1,2] — [1]Leibniz Institute for Solid State and Materials Research, IFW Dresden, Helmholtzstrasse 20, 01069 Dresden, Germany — [2]Würzburg-Dresden Cluster of Excellence ct.qmat, 01062 Dresden, Germany — [3]Taras Shevchenko National University of Kyiv, Volodymyrska Street 60, 01033 Kyiv, Ukraine — [4]Department of Physics, TU Dresden, 01062 Dresden, Germany

We introduce and experimentally implement a groundbreaking electronic ohmmeter that capitalizes on the unique properties of non-Hermitian matrices, specifically their spectral sensitivity. Notably, the precision of our multi-terminal device, characterized by a non-Hermitian conductance matrix, increases exponentially with the number of terminals. We demonstrate its superiority over a standard measurement, achieving precision levels exceeding an order of magnitude. Our findings not only represent a significant advancement in addressing the critical challenge of accurately measuring large resistances but also establish a broader framework for leveraging the timely and interdisciplinary field of non-Hermitian topology in the domain of high-precision sensing.

TT 57.20 Wed 15:00 Poster E

Phonon topology and winding of spectral weight in graphite — •Stanislav E. Nikitin[1], N. D. Andriushin[2], A. S. Sukhanov[2], A. N. Korshunov[3], M. S. Pavlovskii[4], and M. C. Rahn[2] — [1]Paul Scherrer Institut, Switzerland — [2]TU Dresden, Germany — [3]ESRF, France — [4]Krasnoyarsk

The topology of electronic and phonon band structures of graphene is well studied and known to exhibit a Dirac cone at the K point of the Brillouin zone. In the talk I will discuss our recent results on phonon topology in graphite, the 3D analogue of graphene. We found a pair of modes that exhibit a weak anticrossing at the K point and can be viewed as a Dirac cone approximant. The spectral weight exhibit harmonic modulation above and below the Dirac energy in agreement with predictions for the Dirac point. We illustrate how such intensity modulation can be understood in terms of atomic displacements. Our results demonstrate how inelastic x-ray scattering can be used to experimentally investigate topological properties of the phonon band structure.

TT 57.21 Wed 15:00 Poster E

Symmetry-enforced topological band degeneracies in non-Hermitian periodic systems — •Reuel Dsouza[1,2] and Andreas

Schnyder[1] — [1]Max-Planck-Institute for Solid State Physics, D-70569 Stuttgart, Germany — [2]Department of Physics, University of Stuttgart, Germany

Non-Hermitian Hamiltonians are effective descriptions of non-equilibrium systems, in which quantities such as energy or particle number are not conserved. Similar to Hermitian systems, periodic non-Hermitian Hamiltonians can exhibit non-trivial band topologies, depending on the on-site and lattice symmetries. An important class of symmetries that gives rise to topological band degeneracies are the non-symmorphic symmetries, such as screw rotation or glide mirror. Here, we apply these symmetries to non-Hermitian Bloch Hamiltonians. We show that these symmetries give rise to interesting complex energy eigenvalue spectra with symmetry-enforced exceptional points as well as regular band degeneracies. We characterize these degeneracies with discriminant and vorticity numbers and develop a general classification of symmetry-enforced band degeneracies.

TT 57.22 Wed 15:00 Poster E

Topological phase diagram of the s-d–Hubbard model on finite clusters — •Christian Jöns — Max-Planck-Institut für Struktur und Dynamik der Materie, Hamburg, Germany

Topological concepts in solid-state physics are widely used and applied, e.g., to classify topological insulators. Furthermore, these concepts allow to better understand the famous quantum-Hall effect. The state of quantum-Hall systems with broken time-reversal symmetry is described by the quantized Chern number, a topological invariant. A nonzero Chern number also implies the existence of protected edge states which are observable experimentally.

Here, we consider topological classification starting from an intrinsic parameter manifold different from the reciprocal space. We study interacting electron systems with local spin exchange coupled to the S^2 and products of S^2. These manifolds represent the configuration spaces of a single or several impurity spins assumed as classical vectors. Topological classification of the s-d–Hubbard model on finite clusters in different geometries is achieved by means of the Nth spin-Chern number. Phase diagrams in the Hubbard-U – exchange-coupling-J plane are computed and discussed. With an analytical relation between the linear response and the spin-Chern number we can look for new insights of $\langle \hat{s} \rangle (\vec{S})$, with $\vec{S} \in S^2$.

TT 57.23 Wed 15:00 Poster E

Fractonic excitations in the U(1)-enriched toric code? — •Maximilian Vieweg and Kai Phillip Schmidt — Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, D-91058 Erlangen, Germany

We study the properties of different symmetry sectors in the U(1)-enriched toric code[1]. Only distinct symmetry sectors posses states which exhibit maximal connectivity in the Hilbert space. We argue that these symmetry sectors have a ground state energy that lies bellow other symmetry sectors without such states. This claim is consistent with our ED calculation and previous QMC calculations done by Kai-Hsin Wu et al.[1]. This leads to energy barriers which restrict the mobility of plaquette excitations under small magnetic perturbations in complete analogy to fracton excitations. Furthermore we use perturbation theory on a finite system to study the kinetic hopping processes of these excitations.

[1] K.-H. Wu, A. Khudorozhkov, G. Delfino, D. Green, C. Chamon, Phys. Rev. B 108 (2023) 115159