TT 98: Altermagnets

Time: Friday 9:30–11:45 Location: CHE/0091

TT 98.1 Fri 9:30 CHE/0091

Low-energy magnons in the altermagnet α-MnTe — •Kirill Povarov[1], J. Wosnitza[1,2], Sahana Rössler[3], Marcus Schmidt[4], Alexander Tsirlin[3], and Sergei Zvyagin[1] — [1]Hochfeld-Magnetlabor Dresden (HLD-EMFL) and Würzburg-Dresden Cluster of Excellence ct.qmat, HZDR, Dresden — [2]Institut für Festkörper- und Materialphysik, TU Dresden — [3]Felix Bloch Institute for Solid State Physics, University of Leipzig — [4]Max Planck Institute for Chemical Physics of Solids, Dresden

We report high-field electron spin resonance studies of the altermagnetic material α-MnTe in magnetic fields applied parallel to the triangular Mn^{2+} layers. We observe a single antiferromagnetic resonance (AFMR) mode, displaying isotropic behavior with $g \simeq 2.01$; very close to the free-electron value. At low temperatures the AFMR mode is remarkably sharp, but exhibits a noticeable broadening upon warming indicating the effect of magnon-magnon interactions. Based on this behavior, we estimate the strength of these interactions.

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TT 98.2 Fri 9:45 CHE/0091

Tuning the heavy fermion altermagnet candidate Ce_4Sb_3 by hydrostatic pressure — •Julian Kaiser[1], Bin Shen[1], Franziska Walther[2], Kristin Kliemt[2], Cornelius Krellner[2], Anton Jesche[1], and Philipp Gegenwart[1] — [1]EP VI, EKM, University of Augsburg, Germany — [2]Physikalisches Institut, Goethe-Universität Frankfurt, Frankfurt am Main, Germany

Altermagnets have recently attracted significant attention because they have features of both ferromagnets and antiferromagnets in a novel symmetry framework, giving rise to unconventional electronic and spin-transport phenomena previously believed to be absent in traditional collinear antiferromagnets. The heavy-fermion compound Ce_4Sb_3 has been proposed as an altermagnetic candidate with non-trivial band topology [1], making it an ideal platform for investigating the interplay among magnetism, band topology, and the Kondo effect. To probe this interplay, we performed magnetization measurements under hydrostatic pressure and established a preliminary pressure-temperature phase diagram. Our results reveal that the magnetic order in Ce_4Sb_3 is highly sensitive to pressure and can be gradually suppressed. These findings identify Ce_4Sb_3 as a tunable altermagnetic candidate in which the balance between the Kondo effect and the RKKY interaction, and thus the magnetic order, can be effectively controlled by pressure.

[1] X. He and S. Zhang, Phys. Rev. B **112**, 075138 (2025)

TT 98.3 Fri 10:00 CHE/0091

Effect of pressure on the electronic properties of the Kagome flat band metal $CsCr_3Sb_5$ — •Maria Chatzieleftheriou[1,2], Jonas B. Profe[1], Ying Li[3], and Roser Valentí[1] — [1]Institute for Theoretical Physics, Goethe University Frankfurt, Max-von-Laue-Straße 1, 60438 Frankfurt a.M., Germany — [2]CNRS, CPHT, Ecole polytechnique, Institut Polytechnique de Paris, 91120 Palaiseau, France — [3]MOE Key Laboratory for Nonequilibrium Synthesis and Modulation of Condensed Matter, School of Physics, Xi'an Jiaotong University, Xi'an 710049, China

$CsCr_3Sb_5$ is a novel type of strongly correlated Kagome superconductor. The material shows non-Fermi liquid like behavior at high temperatures, indicating strong correlations and has an intertwined charge and spin density wave ordering below T 54K. Under external pressure, this order is suppressed and a superconducting phase emerges. This phase diagram in combination with a Kagome flat band near the Fermi-level and potential altermagnetic orders has led to a plethora of theoretical and experimental studies. In this work, we perform a systematic analysis of the changes of the electronic properties induced by pressure. To this end we employ DFT+DMFT calculations revealing a complex interplay of the position of the flat bands and the strength of correlations. Our results support the predominant interpretation that pressure effectively reduces the strength of correlations by stronger hybridization between the orbitals. This finding strongly suggests that the superconducting order is emerging due to short range fluctuations present in the system once the ordered state is suppressed sufficiently.

TT 98.4 Fri 10:15 CHE/0091

Alterelectrics: The Electric Counterpart of Altermagnets — •Viktor Könye[1], Amber Visser[1], Oleg Janson[2], Jeroen van den Brink[2], Corentin Coulais[1], and Jasper van Wezel[1] — [1]University of Amsterdam — [2]IFW Dresden

Altermagnets are a new class of materials that mix features of both ferromagnets and antiferromagnets. They have spin-split bands like ferromagnets but still show no net magnetization. Their underlying symmetries also lead to unusual effects, such as a strong piezomagnetic effect and hyperbolic wave dispersion. This raises an important question: which of these behaviors actually come from magnetism, and which are simply a result of symmetry? In this work, we separate these two aspects by proposing a non-magnetic analogue of an altermagnet, built from polarized chains. These "alterelectrics" show anisotropic piezoelectricity and surface states with hyperbolic wave dispersion, demonstrated through a simple model. Instead of spin-split bands, the electronic states localize on opposite surfaces, producing strongly anisotropic, surface-dependent transport.

TT 98.5 Fri 10:30 CHE/0091

Crossed surface flat bands in three-dimensional superconducting altermagnets — Yuri Fukaya[1], Bo Lu[2], Keiji Yada[3], Yukio Tanaka[3], and •Jorge Cayao[4] — [1]Faculty of Environmental Life, Natural Science and Technology, Okayama University, 700-8530 Okayama, Japan — [2]Department of Physics, Tianjin University, 300354 Tianjin, China — [3]Department of Applied Physics, Nagoya University, 464-8603 Nagoya, Japan — [4]Department of Physics and Astronomy, Uppsala University, Box 516, S-751 20 Uppsala, Sweden

Superconducting altermagnets have proven to be a promising ground for emergent phenomena but their study has involved two dimensional systems. Here, we investigate three-dimensional d- and g-wave altermagnets with chiral d-wave superconductivity and show the formation of crossed surface flat bands due to the underlying symmetries. We find that these crossed flat bands appear at zero energy in the surface along z due to the superconducting nodal lines in the xy-plane, while the number of corners is determined by the crystal symmetry of altermagnets. We also show that the superconducting nodal lines give rise to Bogoliubov-Fermi surfaces, which then affect the appearance of zero-energy arcs in the surface along x. Moreover, we demonstrate that the crossed surface flat bands, surface arcs, and Bogoliubov-Fermi surfaces give rise to distinct signals in charge conductance, hence offering a solid way for their detection and paving the way for realizing higher dimensional topological phases using altermagnets.

15 min. break

TT 98.6 Fri 11:00 CHE/0091

Strongly disordered superconductor-altermagnet heterostructures — •Christian Wiedemann[1], Danilo Nikolić[2], Matthias Eschrig[2], and Wolfgang Belzig[1] — [1]Universität Konstanz, Konstanz, Germany — [2]Universität Greifswald, Greifswald, Germany

Similarly to ferromagnets and antiferromagnets previously [1,2], proximity systems involving superconductors (S) and a recently found class of d-wave magnetic materials known as altermagnets (AM) [3] represent promising platforms for both understanding and applications in superconducting spintronics [4]. Introducing nonmagnetic impurities to systems where superconductivity and altermagnetism coexist can reduce the effect of the altermagnetic exchange field on the critical temperature of the superconductor [5]. We investigate the interplay between the anisotropic altermagnetic influence and the isotropization caused by impurity scattering and its effect on superconductivity in an S/AM bilayer. In particular, we compute the order parameter and the free energy using the quasiclassical Green's function formalism to find stable superconducting states with a special focus on the regime of high impurity concentrations and strong altermagnetic exchange fields.

[1] A. I. Buzidn, Rev. Mod. Phys. **77**, 935 (2005)
[2] M. Eschrig, Rep. Prog. Phys. **78**, 104501 (2015)
[3] L. Šmejkal *et al*, Phys. Rev. X **12**, 040501 (2022)

[4] S. Chourasia *et al*, Phys. Rev. B **111**, 224503 (2025)
[5] M.M. Vasiakin & A.S. Mel'nikov, PRB, **111**, L100502 (2025)

TT 98.7 Fri 11:15 CHE/0091

Nonlinear Sigma Model of an Insulating Altermagnet — •Parasar Thulasiram[1,2], Chris Hooley[3], and Roderich Moessner[1] — [1]Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — [2]Max Planck Institute for Chemical Physics of Solids, Dresden, Germany — [3]Centre for Fluid and Complex Systems, Coventry University, Coventry, United Kingdom

We applied the Haldane map to derive an O(3) x O(3) nonlinear sigma model of an insulating altermagnet from a transition-metal-dichalcogenide-inspired 3D spin model. The model displays nonrelativistic spin splitting of the magnon bands and anisotropic couplings. We studied the energetics of its preferred topological defects (skyrmions and hopfions), their viability in being generated, as well as the model's behaviour under lightly frustrated couplings. We performed a renormalization analysis of the model and studied its (in)stabilities.

TT 98.8 Fri 11:30 CHE/0091

Projectively implemented altermagnetism in an exactly solvable quantum spin liquid — •Avedis Neehus[1,2], Achim Rosch[3], Johannes Knolle[1,2,4], and Urban Seifert[3] — [1]Technical University of Munich, TUM School of Natural Sciences, Physics Department, 85748 Garching, Germany — [2]Institute for Theoretical Physics, University of Cologne, 50937 Cologne, Germany — [3]Blackett Laboratory, Imperial College London, London SW7 2AZ, United Kingdom — [4]Munich Center for Quantum Science and Technology (MCQST), Schellingstr. 4, 80799 München, Germany

Altermagnets are a new class of symmetry-compensated magnets with large spin splittings. Here, we show that the notion of altermagnetism extends beyond the realm of Landau-type order: we study exactly solvable $\mathbb{Z}_2$ quantum spin(-orbital) liquids (QSL), which simultaneously support magnetic long-range order as well as fractionalization and $\mathbb{Z}_2$ topological order. Our symmetry analysis reveals that in this model three distinct types of "fractionalized altermagnets (AM*)" may emerge, which can be distinguished by their residual symmetries. Importantly, the fractionalized excitations of these states carry an emergent $\mathbb{Z}_2$ gauge charge, which implies that they transform *projectively* under symmetry operations. Consequently, we show that "altermagnetic spin splittings" are now encoded in a momentum-dependent particle-hole asymmetry of the fermionic parton bands. We discuss consequences for experimental observables such as dynamical spin structure factors and (nonlinear) thermal and spin transport.