MA 10: INNOMAG e.V. Prizes 2026 (Diplom-/Master and Ph.D. Thesis)

Die Arbeitsgemeinschaft Magnetismus der DPG hat einen Dissertationspreis und einen Diplom-/Masterpreis ausgeschrieben, welche auf der Tagung der DPG 2026 in Dresden vergeben werden. Ziel der Preise ist die Anerkennung herausragender Forschung im Rahmen einer Diplom-/Masterarbeit beziehungsweise einer Promotion und deren exzellente Vermittlung in Wort und Schrift. Im Rahmen dieser Sitzung tragen die besten der für ihre an der Hochschule eines Mitgliedslands der European Physical Society durchgeführten Diplom-/Masterarbeit beziehungsweise Dissertation Nominierten vor. Im direkten Anschluss entscheidet das Preiskomitee über den Gewinner bzw. die Gewinnerin des INNOMAG e.V. Diplom/Master-Preises und des Dissertationspreises 2026. Talks will be given in English!

Time: Monday 15:00–18:05 Location: POT/0112

Invited Talk MA 10.1 Mon 15:00 POT/0112

Multi-field analysis of magnetic materials: Phase-field based simulations of magnetic domains and phase transition — •Mobina Alaeddini, Jörg Schröder, and Maximilian Vorwerk — Institut für Mechanik, Universität Duisburg-Essen, Essen, Deutschland

Rising global temperatures have triggered research into novel, efficient, and sustainable alternatives to conventional cooling technologies to tackle the rapidly increasing demand for air conditioning and the resulting strain on energy resources. Among these, novel cooling technologies exploit the magnetocaloric effect, in which the application of magnetic fields induces reversible thermal responses suitable for cooling. Despite its technological relevance, a comprehensive description of the coupled magnetocaloric behavior requires advanced modeling approaches. Current research focuses on understanding and optimizing the magnetocaloric response of materials such as Heusler alloys, which are among the most promising candidates for solid-state cooling. To investigate these effects in a controlled and quantitative manner, a multi-field variational phase-field framework based on finite elements is employed. The formulation relies on the time-dependent Ginzburg-Landau equation and incorporates magnetic, mechanical, and thermal contributions within a unified free-energy description governing the transformation from paramagnetic austenite to ferromagnetic martensite. This approach enables a detailed analysis of the coupled magnetic and structural evolution and provides a predictive framework for magnetocaloric material design.

Invited Talk MA 10.2 Mon 15:20 POT/0112

Realistic Modelling of Finite Temperature Electron Transport Properties in Ferromagnets — •Fabian Engelke and Christian Heiliger — Justus Liebig University Giessen, Germany

The quantitative description of the electrical resistivity of a magnetic material remains challenging to this day. While prior publications reached good agreement with experiment in the so-called supercell or direct approach for non-magnetic materials where the spin-disorder contribution to the resistivity is negligible, an accurate, purely theoretical description of magnetic materials remains elusive. This shortcoming can be attributed to the missing accuracy in the description of the temperature-dependent spin-disorder itself. Considering the example of bcc-Fe, we demonstrate that the inclusion of quantum mechanical effects by semiclassical local quantization of the Heisenberg model significantly improves the description of the spin-disorder component to the electrical resistivity. Compared to previous approaches, this model includes the description of magnetic short-range order effects, enabling us to study temperature effects around and above the Curie temperature, where prior mean-field theory-based approaches inevitably predicted a constant contribution. Furthermore, by analyzing the spin-resolved conductivity tensor, we extend our investigation beyond resistivity to determine the spin-flip diffusion length in bcc-iron.

15 min break

Invited Talk MA 10.3 Mon 15:55 POT/0112

Exploring magneto- and multicaloric materials for room and cryogenic temperature applications — •Benedikt Beckmann — Institute of Materials Science, Technical University of Darmstadt, Darmstadt, Germany

A sustainable future requires energy-efficient and environmentally friendly cooling technologies. This thesis investigates Ni(-Co)-Mn-Ti Heusler alloys [1,2,3], Fe_2AlB_2-type MAB phases [4], $La(Fe,Si)_{13}$-type compounds [5], and $Co_4(OH)_6(SO_4)_2[enH_2]$ [6] for magneto- and multicaloric cooling at room and cryogenic temperatures. At room temperature, optimized Ni(-Co)-Mn-Ti Heusler alloys show large isothermal entropy and adiabatic temperature changes but are limited by hysteresis [1,2], motivating the work on hysteresis-free, low-cost MAB phases [4]. At cryogenic temperatures, universal hysteresis limitations of first-order phase transition materials are revealed for caloric hydrogen liquefaction [3,5], driving follow-up studies [7]. Following these discoveries, the novel second-order material $Co_4(OH)_6(SO_4)_2[enH_2]$ shows record performance among rare-earth-free materials [6], highlighting the potential of transition-metal-based hydrogen liquefaction.

[1] A. Taubel, **B. Beckmann** *et al.*, Acta Mater. 201 (2021), [2] **B. Beckmann** *et al.*, Acta Mater. 282 (2025), [3] **B. Beckmann** *et al.*, Acta Mater. 246 (2023), [4] **B. Beckmann** *et al.*, J. Appl. Phys. 133 (2023), [5] **B. Beckmann** *et al.*, ACS Appl. Mater. Interfaces 16, (2024), [6] J.J.B. Levinsky, **B. Beckmann** *et al.*, Nat. Commun. 15 (2024), [7] T. Niehoff, **B. Beckmann** *et al.*, Adv. Funct. Mater. 2505704 (2025)

Invited Talk MA 10.4 Mon 16:20 POT/0112

Nonlinear magnon dynamics: From the discovery of Floquet magnons to CMOS-compatible magnon computing — •Christopher Heins — Helmholtz-Zentrum Dresden-Rossendorf, Institute for Ion Beam Physics and Materials Research, Dresden, Germany

Magnetic vortices are prominent examples for topology in magnetism with a rich set of dynamic properties. They exhibit an intricate magnon spectrum and show a special eigen-resonance of the vortex texture itself, the gyroscopic motion of the vortex core. While there has been studies about magnon assisted reversal of the vortex core polarity, the impact of the vortex core motion on the magnon spectrum wasn't addressed so far. Both excitation types are clearly separated by one order of magnitude in their resonance frequencies, where magnons are in the lower GHz range and the vortex typically gyrates at a few hundred MHz. This clear separation allows for experiments studying the temporal evolution of the magnon spectrum when the motion of the vortex core is driven by an external stimulus. We present experimental and numerical studies on how the magnon eigenstates are transformed into Floquet bands, when the vortex ground state is periodically modulated in time by the gyroscopic motion of the vortex core [1]. The existence of the Floquet bands is evidenced by the appearance of magnon frequency combs, where the comb spacing is determined by the frequency of the gyroscopic motion. References: [1] C. Heins, et al., arXiv:2409.02583, accepted with Science

Invited Talk MA 10.5 Mon 16:45 POT/0112

The geometric memory of quantum wave functions — •Niclas Heinsdorf — Max Planck Institut für Festkörperforschung

Altermagnets are a newly identified type of collinear antiferromagnetism with vanishing net magnetic moment, characterized by lifted Kramers degeneracy in parts of the Brillouin zone. Their time-reversal symmetry-broken band structure has been observed experimentally and is theoretically well understood. On the contrary, altermagnetic fluctuations and the formation of the corresponding instabilities remain largely unexplored. We establish a correspondence between the quantum metric of normal and the altermagnetic spin-splitting of ordered phases. We analytically derive a criterion for the formation of instabilities and show that the quantum metric favors altermagnetism. We recover the expression for conventional q=0 instabilities where the spin-splitting terms of the normal-state model are locally absent. As an example, we construct an effective model of MnTe and illustrate the relationship between quantum geometry and altermagnetic fluctuations by explicitly computing the quantum metric and the generalized magnetic susceptibility.

Invited Talk MA 10.6 Mon 17:10 POT/0112

Altermagnets and Odd-parity-wave Magnets — •Anna Birk Hellenes — Institute of Physics of the Czech Academy of Sciences

The discovery of altermagnets was enabled by an unorthodox symmetry framework, spin groups, allowing to classify all collinear magnetic orders [1]. This raises the questions of whether (i) altermagnetism can be verified experimentally, (ii) new magnets with unknown symmetries can be realized, and (iii) whether they can be useful for spintronics.

In my thesis, I have contributed to answering these questions affirmatively. In this talk, I will review altermagnetic symmetries [1], present our theory-experiment verification of altermagnetism [2-4], and show that it enables spintronics phenomena such as giant magnetoresistance effects [5]. I will then discuss our theoretical prediction that odd-parity-wave magnetism arises in noncentrosymmetric, noncollinear magnets with a combined translation and time-reversal symmetry [6]. Contrary to common assumptions, they host non-relativistic spin-split electronic bands while preserving time-reversal symmetry: unlike ferromagnets and altermagnets, which break it. Our work opens broad opportunities for exploring altermagnets and odd-parity-wave magnets with potential applications including giant magnetoresistance [5], transport anisotropy [6], and Edelstein [7] effects.

[1] Šmejkal et al. PRX 12, 031042 (2022), [2] Nature 626, 517-522 (2024), [3] Nat. Comm. 15, 2116 (2024), [4] arXiv:2511.01690, [5] Šmejkal, ABH & Jungwirth et al. PRX 12, 011028 (2022), [6] ABH & Šmejkal et al. arXiv:2309.01607, [7] Chakraborty, ABH & Sinova et al. arXiv:2411.16378.

30 min. discussion break and bestowal of INNOMAG e.V. Diplom-/Master Prize and Ph.D. Thesis Prize