Magnetism Division
Fachverband Magnetismus (MA)

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Overview of Invited Talks and Sessions

(Lecture halls HSZ/0002, HSZ/0004, POT/0112, POT/0151, POT/351, and POT/361; Poster P2 and P4)

Invited Talks

MA 1.1	Sun	16:00–16:30	TRE/PHYS	**Recent advances and challenges in magnetic structure determination** — •Dmytro Inosov
MA 4.1	Mon	9:30–10:00	POT/0151	**From ML to Kinetics: Modeling the Switching in Ferroelectric Wurtzites** — •Andrew Rappe, Drew Behrendt, Atanu Samanta, Von Braun Nascimento
MA 4.2	Mon	10:00–10:30	POT/0151	**Topological order parameter switching** — •Sergey Artyukhin
MA 4.3	Mon	10:30–11:00	POT/0151	**Optical Control of Ferroaxial Order via Circular Phonon Excitation** — •Zhiyang Zeng, Michael Först, Michael Fechner, Dharmalingam Prabhakaran, Paolo Radaelli, Andrea Cavalleri
MA 10.1	Mon	15:00–15:20	POT/0112	**Multi-field analysis of magnetic materials: Phase-field based simulations of magnetic domains and phase transition** — •Mobina Alaeddini, Jörg Schröder, Maximilian Vorwerk
MA 10.2	Mon	15:20–15:40	POT/0112	**Realistic Modelling of Finite Temperature Electron Transport Properties in Ferromagnets** — •Fabian Engelke, Christian Heiliger
MA 10.3	Mon	15:55–16:20	POT/0112	**Exploring magneto- and multicaloric materials for room and cryogenic temperature applications** — •Benedikt Beckmann
MA 10.4	Mon	16:20–16:45	POT/0112	**Nonlinear magnon dynamics: From the discovery of Floquet magnons to CMOS-compatible magnon computing** — •Christopher Heins
MA 10.5	Mon	16:45–17:10	POT/0112	**The geometric memory of quantum wave functions** — •Niclas Heinsdorf
MA 10.6	Mon	17:10–17:35	POT/0112	**Altermagnets and Odd-parity-wave Magnets** — •Anna Birk Hellenes
MA 14.1	Tue	9:35–10:20	HSZ/0002	**Femtophonomagnetism** — •Sangeeta Sharma, John Dewhurst
MA 14.2	Tue	10:20–10:50	HSZ/0002	**THz-driven dynamical ferroicity in paraelectric and diamagnetic perovskites** — •Martina Basini
MA 14.3	Tue	10:50–11:20	HSZ/0002	**Angular momentum transfer and chiral phonons from first principles** — •Markus Weissenhofer, Philipp Rieger, MS Mrudul, Luca Mikadze, Sergiy Mankovsky, Svitlana Polesya, Hubert Ebert, Ulrich Nowak, Peter M. Oppeneer
MA 14.4	Tue	11:35–12:05	HSZ/0002	**Inertial Spin Dynamics: A Signature of Non-Markovian Interactions in Ferromagnets** — •Vivek Unikandanunni, Felix Hartmann, Matias Bargheer, Eric Fullerton, Stefano Bonetti, Janet Anders
MA 14.5	Tue	12:05–12:35	HSZ/0002	**Atomistic simulations of ultrafast spin-lattice dynamics** — •Richard Evans, Mara Strungaru
MA 18.1	Tue	9:30–10:00	POT/0151	**Magnetic Cooling: From applications at room temperature to hydrogen liquefaction** — •T. Gottschall, E. Bykov, M. Strassheim, T. Platte, C. Fujta, D. Benke, M. Fries, W. Liu, A. Döring, K. Skokov, O. Gutfleisch, J. Wosnitza
MA 25.1	Wed	9:30–10:00	HSZ/0002	**Coherent phononic control of chirality** — •Michael Först

MA 25.2	Wed	10:00–10:30	HSZ/0002	**Towards a modern theory of chiralization (and can chiral phonons help us get there?)** — •Nicola Spaldin
MA 25.5	Wed	11:15–11:45	HSZ/0002	**Observation and control of chiral phonons in non-centrosymmetric materials** — •Hiroki Ueda
MA 27.1	Wed	9:30–10:00	HSZ/0004	**Towards sub-10fs magnetization switching** — Reza Rouzegar, Oliver Franke, Gal Lemut, Oliver Gueckstock, Junwei Tong, Dieter Engel, Xianmin Zhang, Georg Woltersdorf, Piet W. Brouwer, Tobias Kampfrath, •Quentin Remy
MA 29.1	Wed	9:30–10:00	POT/0112	**Exploring the interplay between spin and chirality** — •Angela Wittmann
MA 35.1	Wed	15:00–15:30	POT/0112	**Magneto-optic Kerr effects of higher order in magnetization in thin films of different crystal orientations** — •Timo Kuschel
MA 40.1	Thu	9:30–10:00	HSZ/0002	**Magnetic order induced chiral phonons in a ferromagnetic Weyl semimetal** — •Luyi Yang
MA 40.6	Thu	11:15–11:45	HSZ/0002	**Thermal Hall Effects of Magnons and Phonons** — •Alexander Mook
MA 43.1	Thu	9:30–10:00	POT/0112	**Defect-Induced Phase Transitions in the 2D Magnetic Semiconductor CrSBr** — •Shengqiang Zhou
MA 44.1	Thu	9:30–10:00	POT/0151	**2D and 3D racetracks: Interplay of geometric and magnetic chiralities** — •Stuart Parkin
MA 44.2	Thu	10:00–10:30	POT/0151	**Combined MFM/KPFM at the Ultimate Sensitivity Limit for Probing Curvature-Engineered Micromagnetic States** — •Emily Darwin, Reshma Peremadathil Pradeep, Luca Berchialla, Daniel Rotthardt, Ales Hrabec, Hans Hug
MA 44.3	Thu	10:30–11:00	POT/0151	**Curvilinear magnetism in superconducting spintronics** — •Sol Jacobsen
MA 44.4	Thu	11:15–11:45	POT/0151	**Advanced Control of Magnetic Nanostructures via Metasurface Engineering and Voltage-Driven Functionalities** — •Anna Palau
MA 44.5	Thu	11:45–12:15	POT/0151	**Magnetic tomography of noncollinear spin textures in curvilinear geometries** — •Sandra Ruiz-Gomez

Invited Talks of the joint Symposium SKM Dissertation Prize 2026 (SYSD)

See SYSD for the full program of the symposium.

SYSD 1.1	Mon	9:30–10:00	HSZ/0002	**Stochastic-Calculus Approach to Non-equilibrium Statistical Physics** — •Cai Dieball
SYSD 1.2	Mon	10:00–10:30	HSZ/0002	**Nonuniform magnetic spin textures for sensing, storage and computing applications** — •Sabri Koraltan
SYSD 1.3	Mon	10:30–11:00	HSZ/0002	**Anomalous Quantum Oscillations beyond Onsager's Fermi Surface Paradigm** — •Valentin Leeb
SYSD 1.4	Mon	11:00–11:30	HSZ/0002	**Coherent Control Schemes for Semiconductor Quantum Systems** — •Eva Schöll
SYSD 1.5	Mon	11:30–12:00	HSZ/0002	**On stochastic thermodynamics under incomplete information: Thermodynamic inference from Markovian events** — •Jann van der Meer

Invited Talks of the joint Symposium Fluids with Broken Time-Reversal Symmetry: Odd/Hall Viscosity between Active Matter and Electron Flows (SYBS)

See SYBS for the full program of the symposium.

SYBS 1.1	Tue	9:30–10:00	HSZ/AUDI	**Odd viscosity in three-dimensional fluids: flows, wakes, and eddies** — •Tali Khain
SYBS 1.2	Tue	10:00–10:30	HSZ/AUDI	**Odd viscosity in two-dimensional hydrodynamic electron transport** — •Igor Gornyi, Dmitry Polyakov
SYBS 1.3	Tue	10:30–11:00	HSZ/AUDI	**Odd slip on chiral active surfaces** — •Andrej Vilfan, Yuto Hosaka
SYBS 1.4	Tue	11:15–11:30	HSZ/AUDI	**Parity-odd transport in electron fluids** — •Johanna Erdmenger
SYBS 1.5	Tue	11:30–11:45	HSZ/AUDI	**Curved Odd Elasticity** — Lazaros Tsaloukidis, Yuan Zhou, Jack Binysh, Nikta Fakhri, Corentin Coulais, •Piotr Surówka

Invited Talks of the joint Symposium Beyond Transistors: Material-Based Edge Computing Paradigms (SYBT)

See SYBT for the full program of the symposium.

SYBT 1.1	Wed	9:30–10:00	HSZ/AUDI	**Finding Neuromorphic Advantage with Magnetism** — •Johan Mentink
SYBT 1.2	Wed	10:00–10:30	HSZ/AUDI	**Accelerating Neural Networks Computation with Ferroelectric Oxides** — •Laura Bégon-Lours, Nikhil Garg, Alexandre Baigol, Anwesha Panda, Nathan Savoia, Alexander Flasby
SYBT 1.3	Wed	10:30–11:00	HSZ/AUDI	**a photonic approach to probabilistic computing** — •Wolfram Pernice
SYBT 1.4	Wed	11:15–11:45	HSZ/AUDI	**Tackling Reliability and Scalability in Neuromorphic Computing via Noise-aware Learning** — •Eleni Vasilaki
SYBT 1.5	Wed	11:45–12:15	HSZ/AUDI	**Bayesian nanodevices for trustworthy artificial intelligence** — •Damien Querlioz

Invited Talks of the joint Symposium Interacting Degrees of Freedom in Ultrathin Quantum Films (SYQF)

See SYQF for the full program of the symposium.

SYQF 1.1	Fri	9:30–10:00	HSZ/AUDI	**Exciton dressing by extreme nonlinear magnons in a layered semiconductor** — •Geoffrey M. Diederich
SYQF 1.2	Fri	10:00–10:30	HSZ/AUDI	**A tale of demons and decay in two-dimensional (alter)magnets** — •Alexander Mook
SYQF 1.3	Fri	10:30–11:00	HSZ/AUDI	**Magnetism, light and matter - Role of excitons in two-dimensional magnets** — •Florian Dirnberger
SYQF 1.4	Fri	11:15–11:45	HSZ/AUDI	**Advantages and challanges of resonance Raman scattering with infrared excitation energy** — •Leonetta Baldassarre
SYQF 1.5	Fri	11:45–12:15	HSZ/AUDI	**Shining light on 2D antiferromagnets** — •Dmytro Afanasiev

Sessions

MA 1.1–1.2	Sun	16:00–18:15	TRE/PHYS	**Hands-On Tutorial: Magnetic Structure Determination Using Fullprof and SARAh Representation Analysis (joint session MA/TUT)**
MA 2.1–2.12	Mon	9:30–12:45	HSZ/0004	**Altermagnets I**
MA 3.1–3.12	Mon	9:30–12:45	POT/0112	**Complex Magnetic Oxides**
MA 4.1–4.6	Mon	9:30–12:00	POT/0151	**Focus Session: Novel mechanisms of ferroic switching (joint session MA/FM)**
MA 5.1–5.9	Mon	9:30–12:00	POT/0351	**Surface Magnetism and Topological Insulators (joint session MA/TT)**
MA 6.1–6.12	Mon	9:30–12:45	POT/0361	**Magnetic Imaging Techniques I**
MA 7.1–7.86	Mon	9:30–12:30	P2	**Poster Magnetism I**
MA 8.1–8.13	Mon	15:00–18:30	HSZ/0002	**Altermagnets II**
MA 9.1–9.13	Mon	15:00–18:30	HSZ/0004	**Magnonics I**
MA 10.1–10.6	Mon	15:00–18:05	POT/0112	**INNOMAG e.V. Prizes 2026 (Diplom-/Master and Ph.D. Thesis)**
MA 11.1–11.11	Mon	15:00–18:00	POT/0151	**Electron Theory of Magnetism and Correlations (joint session MA/TT)**
MA 12.1–12.6	Mon	15:00–16:30	POT/0351	**Terahertz Spintronics**
MA 13.1–13.9	Mon	15:00–17:15	POT/0361	**Magnetic Heuslers and Semiconductors**
MA 14.1–14.5	Tue	9:30–12:40	HSZ/0002	**PhD Focus Session: What about the lattice? Lessons from (ultrafast) magnetism**
MA 15.1–15.7	Tue	9:30–12:45	HSZ/0003	**Focus Session: Quantum Sensing with Solid State Spin defects I (joint session TT/MA)**
MA 16.1–16.12	Tue	9:30–12:45	HSZ/0004	**Skyrmions I**
MA 17.1–17.11	Tue	9:30–12:30	POT/0112	**Multiferroics and Magnetoelectric Coupling (joint session MA/FM)**

MA 18.1–18.7	Tue	9:30–11:30	POT/0151	**Caloric Effects in Ferromagnetic Materials (joint session MA/TT)**
MA 19.1–19.11	Tue	9:30–12:30	POT/0361	**Frustrated Magnets I (joint session MA/TT)**
MA 20.1–20.6	Tue	14:00–15:30	HSZ/0002	**Altermagnets III**
MA 21.1–21.6	Tue	14:00–15:30	HSZ/0004	**Skyrmions II**
MA 22.1–22.5	Tue	14:00–15:30	BEY/0138	**Focus Session: Materials Discovery II – High throughput searches for functional magnetic materials (joint session FM/MA)**
MA 23.1–23.6	Tue	14:00–15:30	POT/0151	**Cooperative Phenomena: Spin Structures and Magnetic Phase Transitions (joint session MA/TT)**
MA 24.1–24.6	Tue	14:00–15:30	POT/0361	**Weyl Semimetals (joint session MA/TT)**
MA 25.1–25.9	Wed	9:30–12:45	HSZ/0002	**Focus Session: Chiral phonons and crystals coupled to magnetic order I**
MA 26.1–26.7	Wed	9:30–12:45	HSZ/0003	**Focus Session: Nickelate Superconductivity: Insights into Unconventional Pairing and Correlation Effects I (joint session TT/DS/MA)**
MA 27.1–27.11	Wed	9:30–12:45	HSZ/0004	**Ultrafast Magnetization Effects I**
MA 28.1–28.4	Wed	9:30–10:30	HSZ/0101	**Focus Session: Quantum Sensing with Solid State Spin defects II (joint session TT/HL/MA)**
MA 29.1–29.11	Wed	9:30–12:45	POT/0112	**Spin Transport and Orbitronics, Spin-Hall Effects I (joint session MA/TT)**
MA 30.1–30.12	Wed	9:30–12:45	POT/0151	**Functional Antiferromagnetism**
MA 31.1–31.12	Wed	9:30–12:45	POT/0361	**Frustrated Magnets II (joint session MA/TT)**
MA 32	Wed	14:00–17:30	HZDR	**Excursion: Current and Future High-Field THz User Facilities at HZDR**
MA 33.1–33.13	Wed	15:00–18:30	HSZ/0002	**Altermagnets IV**
MA 34.1–34.13	Wed	15:00–18:30	HSZ/0004	**Computational Magnetism I**
MA 35.1–35.10	Wed	15:00–18:00	POT/0112	**Spintronics (other effects) (joint session MA/TT)**
MA 36.1–36.13	Wed	15:00–18:30	POT/0151	**Molecular Magnetism and Magnetic Particles / Clusters I**
MA 37.1–37.9	Wed	15:00–17:15	POT/0351	**Non-Skyrmionic Magnetic Textures**
MA 38.1–38.14	Wed	15:00–18:45	POT/0361	**Ultrafast Magnetization Effects II**
MA 39.1–39.25	Wed	18:00–21:00	P2	**Poster Magnetism II**
MA 40.1–40.10	Thu	9:30–12:45	HSZ/0002	**Focus Session: Chiral phonons and crystals coupled to magnetic order II**
MA 41.1–41.11	Thu	9:30–12:30	HSZ/0003	**Focus Session: Nickelate Superconductivity: Insights into Unconventional Pairing and Correlation Effects II (joint session TT/DS/MA)**
MA 42.1–42.11	Thu	9:30–12:30	HSZ/0004	**Molecular Magnetism and Magnetic Particles / Clusters II**
MA 43.1–43.6	Thu	9:30–11:15	POT/0112	**Spin-Dependent Phenomena in 2D**
MA 44.1–44.8	Thu	9:30–13:00	POT/0151	**Focus Session: Curvilinear magnetism: Magnetics with nanoscale curved geometries (joint session MA/TT)**
MA 45.1–45.6	Thu	9:30–11:00	POT/0351	**Magnetic Relaxation and Gilbert Damping**
MA 46.1–46.5	Thu	9:30–10:45	POT/0361	**Magnetic Imaging Techniques II**
MA 47.1–47.11	Thu	15:00–18:00	HSZ/0002	**Altermagnets V**
MA 48.1–48.11	Thu	15:00–18:00	HSZ/0004	**Magnonics II**
MA 49.1–49.9	Thu	15:00–17:15	POT/0112	**Magnetic Imaging, Information Technology, and Sensors**
MA 50.1–50.9	Thu	15:00–17:15	POT/0151	**Bulk Materials: Soft and Hard Permanent Magnets**
MA 51.1–51.8	Thu	15:00–17:00	POT/0361	**Spin Transport and Orbitronics, Spin-Hall Effects II (joint session MA/TT)**
MA 52.1–52.40	Thu	15:00–17:00	P4	**Poster Magnetism III**
MA 53	Thu	18:00–19:00	HSZ/0002	**Members' Assembly**
MA 54.1–54.11	Fri	9:30–12:30	HSZ/0002	**Altermagnets VI**
MA 55.1–55.12	Fri	9:30–12:45	HSZ/0004	**Skyrmions III**
MA 56.1–56.6	Fri	9:30–11:30	BEY/0E40	**Focus Session: (Anti)ferroic states – Magnetic and magnetoelectric III (joint session FM/MA)**
MA 57.1–57.6	Fri	9:30–11:00	POT/0112	**Thin Films: Magnetic Coupling Phenomena / Exchange Bias and Magnetic Anisotropy**
MA 58.1–58.12	Fri	9:30–12:45	POT/0151	**Computational Magnetism II**
MA 59.1–59.11	Fri	9:30–12:30	POT/0361	**Magnonics III**

Members' Assembly of the Magnetism Division

Thursday 18:00–19:00 HSZ/0002

- Bericht
- Wahl
- Verschiedenes

MA 1: Hands-On Tutorial: Magnetic Structure Determination Using Fullprof and SARAh Representation Analysis (joint session MA/TUT)

The functionalities of many materials of contemporary interest are related to complex types of magnetic ordering. Accurate magnetic structure determination is thus crucial for understanding and optimizing such materials.

After an introduction into the subject, participants of the tutorial will gain hands-on experience on the methods for magnetic structure determination.

Time: Sunday 16:00–18:15 Location: TRE/PHYS

Invited Talk MA 1.1 Sun 16:00 TRE/PHYS

Recent advances and challenges in magnetic structure determination — •Dmytro Inosov — Institut für Festkörper- und Materialphysik, TU Dresden, Germany

In this introductory tutorial talk, I will provide an overview of magnetic structure determination in the context of recent advances in magnetic materials. I will focus on the limitations and challenges of magnetic structure refinement, and explain why it is important to use the full range of complementary experimental methods alongside conventional diffraction in order to develop a consistent understanding of magnetic structures. This is particularly important when dealing with complex types of magnetic order, such as noncollinear and multi-Q spin textures, altermagnets, and systems with multiple magnetic sublattices or very weak and/or fluctuating magnetic moments.

Tutorial MA 1.2 Sun 16:30 TRE/PHYS

Hands-On Tutorial: Magnetic Structure Determination Using Fullprof and SARAh Representation Analysis — •Matthias Frontzek — Oak Ridge National Laboratory, Neutron Scattering Division, One Bethel Valley Road, 37831 Oak Ridge, TN, USA

The determination of magnetic structures is a crucial aspect of materials science, particularly for understanding the magnetic properties of novel materials. Given the limited availability of neutrons with the closure of smaller sources, competitive access to beam time, and the high hurdles associated with software usage, there is an increasing need for training in the analysis of magnetic structures. This tutorial aims to provide participants with practical skills in magnetic structure determination using SARAh and Fullprof, two powerful tools frequently utilized in this field.

Participants will:

-Gain hands-on experience with the tools and techniques necessary for magnetic structure determination.

-Refine nuclear and magnetic structures using real data sets.

-Understand key concepts in diffraction techniques and steps involved in the magnetic structure determination process.

Important: for Hands-on participation, please bring a laptop with a working installation of Fullprof (https://www.ill.eu/sites/fullprof/).

For links to Fullprof, SARAh stand-alone and tutorial data visit: https://neutrons.ornl.gov/wand/users

MA 2: Altermagnets I

Time: Monday 9:30–12:45 Location: HSZ/0004

MA 2.1 Mon 9:30 HSZ/0004

Electric Control of Spin and Valley Polarization in the XMoTeO6 Family of Two-dimensional Altermagnets — •Avijeet Ray[1], Fatemeh Haddadi[2], Antimo Marrazzo[3], and Marco Gibertini[1,4] — [1]University of Modena and Reggio Emilia, Italy — [2]EPFL, Switzerland — [3]SISSA, Italy — [4]Istituto Nanoscienze-CNR, Italy

Altermagnets are a special class of antiferromagnets with zero net magnetization but spin-split bands, even in the absence of spin-orbit-coupling. In semiconducting altermagnets, this spin-splitting can give rise to spin-valley locking, where valleys located at specific k-points have a well-defined spin. Still, symmetries connecting the spin sublattices impose an overall degeneracy between valleys of opposite spins. An external electric field can break these symmetries, enabling controllable spin (and valley) polarization. This is particularly promising in two-dimensional (2D) materials where it is easy to apply a vertical electric field in a double-gate field-effect setup, provided that 2D altermagnets with suitable crystal symmetries are found. Here, by using first-principles simulations, not only we put forward an interesting family of 2D altermagnets that display the correct symmetries, but we also show that the electric field effect is sizable in these materials and reaches the requirements needed for applications in spin-valleytronics.

MA 2.2 Mon 9:45 HSZ/0004

Zeeman Quantum Geometry as a Probe of Unconventional Magnetism — •Snehasish Nandy[1], Neelanjan Chakraborti[2], and Sudeep Kumar Ghosh[2] — [1]National Institute of Technology Silchar, Silchar, India — [2]Indian Institute of Technology Kanpur, Kanpur, India

Unconventional magnets with momentum-dependent spin-splitting but zero net magnetization form a recently identified class of collinear magnets that are challenging to probe via conventional means. We show that these systems can be distinguished through intrinsic gyrotropic magnetic (IGM) currents, enabled by the Zeeman quantum geometry, which captures the coupled response of electronic states to momentum translation and spin rotation. Examining two prototypical two-dimensional unconventional magnets with Rashba spin-orbit coupling, a time-reversal-broken d-wave altermagnet and a time-reversal-symmetric p-wave magnet, we uncover a direct link between crystalline symmetry, spin-split band structures, and transport signatures. The d-wave altermagnet exhibits both transverse conduction and longitudinal displacement IGM currents, whereas p-wave magnet supports only transverse conduction IGM current. Remarkably, the mixed d-wave altermagnet supports all four types of IGM currents, including a longitudinal conduction current enabled by symmetric (Zeeman) Berry curvature that is forbidden in conventional quantum geometry. These responses, measurable via Hall transport and optical probes, persist even when conventional quantum geometry-driven linear responses vanish, offering unique access to hidden spin-split band structures.

MA 2.3 Mon 10:00 HSZ/0004

Spin demons in d-wave altermagnets — •Pieter Gunnink[1], Jairo Sinova[1], and Alexander Mook[2] — [1]Institute of Physics, Johannes Gutenberg University Mainz, Staudingerweg 7, Mainz 55128, Germany — [2]University of Münster, Institute of Solid State Theory, 48149 Münster, Germany

Demons are a type of plasmons, which consist of out-of-phase oscillations of electrons in different bands. Here, we show that d-wave altermagnets, a recently discovered class of collinear magnetism, naturally realize a spin demon, which consists of out-of-phase movement of the two spin species [1]. The spin demon lives outside of the particle-hole continuum of one of the spin species, and is therefore significantly underdamped, reaching quality factors of > 10. We show that the spin demon carries a magnetic moment, which inherits the d-wave symmetry. Finally, we consider both three and two dimensional d-wave altermagnets, and show that spin demons exists in both.

[1] Gunnink, Sinova, Mook, Phys. Rev. Lett. 135, 126701 (2025)

MA 2.4 Mon 10:15 HSZ/0004

Altermagnetism in magnetic nanoisland arrays — •Rhea Hoyer[1], Lukas Körber[2], Tobias Wagner[3], and Alexander Mook[1] — [1]Institut für Festkörpertheorie, Universität Münster, Münster, Germany — [2]Institute of Molecules and Materials, Radboud

University, Nijmegen, The Netherlands — [3]Department of Physics, Johannes Gutenberg University Mainz, Mainz, Germany

We present a macrospin model for magnetic island arrays engineered with altermagnetic symmetries. The islands interact purely via dipole-dipole coupling, which makes the strict spin-orbit-free limit of altermagnetism inaccessible. Although the magnon dispersion is split by spin-orbit coupling, the magnon bands remain spin-polarized, exhibiting a characteristic d-wave-like pattern of the spin expectation value across the Brillouin zone. This residual altermagnetic character gives rise to direction-dependent spin dynamics and suggests the possibility of anisotropic spin-transport phenomena in mesoscopic artificial magnets.

MA 2.5 Mon 10:30 HSZ/0004

Magnons in Antialtermagnets — •Robin R. Neumann[1,2,3], Rodrigo Jaeschke-Ubiergo[2], Ricardo Zarzuela[2], Jairo Sinova[2,4], and Alexander Mook[1,2] — [1]University of Münster, Münster, Germany — [2]Johannes Gutenberg University Mainz, Mainz, Germany — [3]Martin Luther University Halle-Wittenberg, Halle, Germany — [4]Texas A&M University, College Station, USA

Altermagnets and antialtermagnets are unconventional magnetic phases with compensated magnetization and nonrelativistic spin splitting in their electronic band structures. In altermagnets, this spin splitting has even parity, whereas in antialtermagnets it has odd parity. In this talk we go beyond electrons and demonstrate that magnons, the collective spin excitations of magnetically long-range ordered systems, inherently feature an odd-parity spin polarization in antialtermagnets without spin-orbit or dipolar coupling. We present minimal model spin Hamiltonians free of spin-orbit coupling that stabilize antialtermagnetic ground states, discuss their symmetries, and characterize the spin-polarized magnon band structures.

MA 2.6 Mon 10:45 HSZ/0004

Magnetization processes and spin-lattice coupling in the hexagonal easy-plane altermagnet α-MnTe — •Sahana Rössler[1], Victoria Ginga[1], Ece Uykur[2], Yurii Skourski[3], Jeremy Sourd[3], Sergei Zherlitsyn[3], Marcus Schmidt[4], Yurii Prots[4], Helge Rosner[4], Ulrich Burkhardt[4], Ulrich K. Rössler[5], and Alexander A. Tsirlin[1] — [1]Felix Bloch Institute for Solid State Physics, Leipzig University, Leipzig, Germany — [2]HZDR, IBP and Materials Research, Dresden, Germany — [3]HLD, HZDR, Dresden, Germany — [4]MPI CPfS, Dresden, Germany — [5]Institute for Theoretical Solid-State Physics, Leibniz IFW Dresden, Germany

We investigated the magnetization dynamics associated with domain behavior in α-MnTe using magnetization, magnetostriction, sound velocity, and attenuation measurements. Angle- and field-dependent magnetization data reveal complex magnetic responses with a distinct anomaly around 1 T, reflecting domain-related processes. Magnetostriction and elastic constant measurements indicate strong lattice effects at the field-induced reorientation transition. These features were analysed using a phenomenological micromagnetic model incorporating higher-order anisotropic exchange interactions that couple the weak ferromagnetic component to the antiferromagnetic order parameter. The model successfully reproduces the generic behaviour of the magnetic states and demonstrates that the observed uniaxial and unidirectional anisotropies arise from metastable domain configurations and irreversible magnetization processes [1].

[1] S. Rößler et al., arXiv:2511.01388

15 min break

MA 2.7 Mon 11:15 HSZ/0004

Emergent Altermagnetism in Antiferromagnetic Surfaces — •Colin Lange[1], Rodrigo Jaeschke Ubiergo[1], Alexander Mook[2], and Jairo Sinova[1] — [1]Institut für Physik, Johannes Gutenberg Universität Mainz, Germany — [2]Institut für Festkörpertheorie, Universität Münster, Germany

Three-dimensional altermagnets with collinear compensated order and non-relativistic spin splitting have recently been realized, but experimental access to their 2D counterparts remains limited. We show that surfaces of the most abundant class of collinear magnets – conventional 3D antiferromagnets – provide a general route to 2D altermagnetism through surface-induced symmetry breaking. We implement this in a semi-infinite stack geometry, effectively modeling a thin film to establish a direct connection to experimental systems. This way, the symmetry analysis made here has direct implications for readily available experiments and materials. Using our novel definition of "surface spin groups", which lies between the 3D and 2D cases due to the semi-infinite geometry, we provide a full symmetry classification of all possible cases of altermagnetic surface termination. We scan available databases of magnetic materials, and conclude that almost half of the collinear antiferromagnets can host an altermagnetic surfaces. We present calculations of spin-split surface states in realistic candidates, that can serve for future experimental verification of surface induced altermagnetism. Our work positions the broadly accessible landscape of antiferromagnets as a promising foundation for 2D altermagnetism, whose experimental realization remains limited.

MA 2.8 Mon 11:30 HSZ/0004

Angle-dependent magnetoresistance induced by interface-generated spin current in RuO_2/permalloy heterostructures — Akashdeep Akashdeep[1], Ewiese Mohammad Ababneh[2], Christin Schmitt[1], Edgar Galíndez-Ruales[1], Felix Fuhrmann[1], Timo Kuschel[1], Mathias Kläui[1], Vivek Amin[2], and •Gerhard Jakob[1] — [1]Johannes Gutenberg University, Mainz, Germany — [2]Indiana University, Indianapolis, USA

Ruthenium dioxide (RuO_2) is a promising altermagnetic candidate. In our PLD grown films clear signs of altermagnetism were found by photoemission [1] and optically induced spin polarization with d-wave symmetry [2]. However, recent reports suggest that RuO_2 may be nonmagnetic in its ground state. (100)-oriented RuO_2 films are expected to generate spin currents with transverse spin polarization parallel to the Neel vector. We investigated magnetotransport in epitaxial RuO_2/permalloy (Py) heterostructures to examine spin Hall magnetoresistance and interfacial effects. Our measurements revealed a pronounced negative angular-dependent magnetoresistance that we attribute to interface-generated spin current (IGSC) at the RuO_2/Py interface supported by drift-diffusion calculations. The interface effects predominate over possible altermagnetic contributions [3]. This finding is in accord with recent muon spin resonance on our films [4].

[1] O. Fedchenko et al., Sci. Adv. 10, eadj4883 (2024);
[2] M. Weber et al., arXiv2408.05187 (2024);
[3] A. Akashdeep et al., Phys. Rev. Appl. 24, 054018 (2025);
[4] A. Akashdeep et al., arXiv2510.08064 (2025);

MA 2.9 Mon 11:45 HSZ/0004

X-ray magnetic circular dichroism of altermagnet α-Fe2O3 based on multiplet ligand-field theory using Wannier orbitals — Ruiwen Xie, Hamza Zerdoumi, and •Hongbin Zhang — TU Darmstadt, Darmstadt, Germany

Hematite α-Fe2O3 is a g-wave altermagnet, possessing an easy-axis and easy-plane weak ferromagnetic phase below and above Morin temperature, respectively. The presence of these phases renders it a good candidate to study the characteristic spin splitting in altermagnets under the impacts of relativistic effect and finite temperature. We have calculated the band structure of α-Fe2O3 based on density functional theory (DFT) considering the Coulomb correction and spin-orbit coupling effects. Additionally, the DFT + dynamical mean-field theory calculations have been performed at finite temperatures. It is found that the spin splitting in α-Fe2O3 preserves with either SOC or temperature effect included. Furthermore, we present a numerical simulation of the x-ray magnetic circular dichroism (XMCD) of the L2,3 edge of Fe using a combination of DFT with multiplet ligand-field theory. In terms of the different Néel vectors present in α-Fe2O3, we calculate the x-ray absorption spectroscopy of the L2,3 edge of Fe in the form of conductivity tensor and analyze the XMCD response from a perspective of symmetry. A characteristic XMCD line shape is expected when the Néel vector is along [010] direction and the light propagation vector is perpendicular to the Néel vector, which can be further distinguished from the XMCD response originated from weak ferromagnetism with the light propagation vector parallel to the Néel vector.

MA 2.10 Mon 12:00 HSZ/0004

Magnetic circular dichroism in resonant Auger electron diffraction from altermagnets — •Peter Krüger — Chiba University, Chiba, Japan

Recently we demonstrated that in altermagnets, there exists a large magnetic circular dichroism (MCD) in resonant photoelectron diffraction (RPED) [1]. The MCD-RPED signal is time-reversal odd and characteristic of the altermagnetic state. It is proportional to the local XMCD signal from a single magnetic sublattice and thus provides a direct probe of the sublattice magnetization. Here we show that MCD-RPED occurs in all altermagnets independently of the orientation of the Néel vector. This is a major difference to the weak XMCD observed in some altermagnets [2]. We also extend the theory to resonant Auger electron diffraction, whose MCD gives similar information as that of RPED, while being conceptually simpler. We discuss the symmetry properties of the MCD signal and explain its physical origin with a simple model. [1] P. Krüger, Phys. Rev. Lett. 135, 196703 (2025). [2] A. Hariki et al, Phys. Rev. Lett. 132, 176701 (2024).

MA 2.11 Mon 12:15 HSZ/0004

Heisenberg models of altermagnets — •Volodymyr Kravchuk[1,2], Kostiantyn Yershov[1,2], and Jeroen van den Brink[1] — [1]Leibniz Institute for Solid State and Materials Research, 01069 Dresden, Germany — [2]Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine, 03143 Kyiv, Ukraine

Being collinear-compensated magnets, altermagnets differ from conventional antiferromagnets by a more complex symmetry transformation that connects two sublattices. Due to the specific local nonmagnetic surroundings of the magnetic atoms, the symmetry transformation also involves rotation or mirror reflection, in addition to translation and time reversal. Here we propose Heisenberg models for a number of materials, including d-wave (rutiles), bulk g-wave (CrSb, MnTe), and planar g-wave (FeS2) alternagnets. The models capture the altermagnetic properties due to the additional superexchange interactions whose bonds orientations respect the symmetry of the local nonmagnetic surrounding of the magnetic atoms. Using our models, we reproduce the altermagnetic splitting in the magnon spectra, and predict a number of new effects induced by altermagnetism, namely fluctuation-induced piezomagnetism and thermal spin conductivity for d-wave altermagnets, and emergent magnetization of domain walls for both d- and g-wave altermagnets. For planar g-wave altermagnets, we demonstrate that mechanical stress can induce the effective g-wave – d-wave transition for low-energy magnons. As a result, the stress-induced thermal spin conductivity appears.

MA 2.12 Mon 12:30 HSZ/0004

Multiferroic altermagnet $BiFeO_3$ investigated by DFT+DMFT and XMCD — •Hamza Zerdoumi, Ruiwen Xie, Fu Li, and Hongbin Zhang — Institute of Materials Science, TU Darmstadt, 64287 Darmstadt, Germany

As an emergent magnetic ordering, altermagnets with finite nonrelativistic spin splitting exhibit a wide spectrum of fascinating properties. In this work, combining density functional theory (DFT) and dynamical mean-field theory (DMFT), we investigate how such splitting evolves as a function of temperature in $BiFeO_3$. Moreover, by solving the DFT-derived atomic Hamiltonian, we evaluated x-ray magnetic circular dichoism (XMCD) with detailed symmetry analysis, which can be considered as a characteristic feature for altermagnetic ordering. Furthermore, as $BiFeO_3$ is a well-established multiferroic compound, we evaluate the nonlinear transport properties such as shift current originated from the quantum geometry, and further explore how such altermagnetic properties can be tailored by external electric fields.

MA 3: Complex Magnetic Oxides

Time: Monday 9:30–12:45 Location: POT/0112

MA 3.1 Mon 9:30 POT/0112

Twisted planar freestanding La0.7Sr0.3MnO3 junctions — •Alejandro Martín Merodio, Victor Rouco, Fernando Gallego, David Sanchez-Manzano, Carlos León, and Jacobo Santamaria — GFMC, Dpto. de Física de Materiales, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, 28040 Madrid, Spain

The recent realization of membranes of transition metal oxides has enabled their mechanical assembly in twisted bilayers opening avenues to wards oxide twistronics. The ferroic orders hosted by transition metal oxides, many of which are stable at room temperature, offer exciting opportunities for the search of chiral ferroic properties in twisted ox ide membranes. In this work we present the growth, fabrication and characterization of twisted stacks made of La0.7Sr0.3MnO3 (LSMO), a half-metallic ferromagnetic perovskite with highly tunable properties. We have studied the temperature dependent magnetotransport across the interface of two twisted LSMO membranes for different twisting angles. These samples exhibit a large low temperature magnetoresistance MR up to 32% which switches abruptly at small (10 mT) magnetic fields. These MR values are well above the 0,01% AMR typically observed in single LSMO flakes. This approach allows exploring material combinations which are not possible in epitaxial heterostructures and opens promising avenues towards oxide based CMOS compatible spintronic devices.

MA 3.2 Mon 9:45 POT/0112

Controlling Magnetic Anisotropy in Barium Hexaferrite by Cation Doping — •Jakob Baumsteiger[1,2] and Cesare Franchini[1,2] — [1]Faculty of Physics and Center for Computational Materials Science, University of Vienna, Vienna, Austria — [2]Department of Physics and Astronomy "Augusto Righi", Alma Mater Studiorum - Università di Bologna, Bologna, Italy

Circulators are essential components in many radio-frequency systems, including 5G base stations. Their operating frequency is primarily determined by the magnetic properties of the ferrite core - specifically the anisotropy field and the saturation magnetization. Experimental studies suggest that both quantities can be actively modified in barium hexaferrite - one of the ferrites commonly used in circulators - through cation doping. However, the relationship between doping and the resulting magnetic properties is highly complex and not yet fully understood. We investigate the electronic structure of pristine and cobalt-doped barium hexaferrite using density functional theory. Our calculations show that the additional electron introduced by cobalt plays a key role in modifying the material's magnetocrystalline anisotropy. By occupying a localized orbital at the cobalt site, it locally activates spin-orbit interactions, leading to substantial changes in the magnetocrystalline anisotropy energy even at low doping concentrations. The insights gained from our results support the design of miniaturized circulators capable of operating over broad frequency bands.

MA 3.3 Mon 10:00 POT/0112

Emergent magnetic ordering in high-entropy oxides — •Laura T. Corredor[1,2], Augustè Stanionytė[3], Richard Matyšek[3], Anja U. B. Wolter[4], Carlos F. Eugenio[2,5], Andrea Kirsch[2,5], Giuditta Perversi[6], and Anna Isaeva[1,2,3] — [1]TU Dortmund University, Germany — [2]Research Center Future Energy Materials and Systems, Germany — [3]University of Amsterdam, The Netherlands — [4]Leibniz IFW Dresden, Germany — [5]Ruhr University Bochum, Germany — [6]Maastricht University, The Netherlands

Magnetism in high-entropy oxides (HEOs) has emerged as a compelling topic due to the unique behavior arising from extreme cationic disorder. HEOs offer a rich platform for fundamental studies and are promising for applications like energy-efficient magnetic devices and catalysts. Recently, long-range magnetic order was reported in some HEOs, e.g. the AFM rocksalt $(Co_{0.2}Ni_{0.2}Cu_{0.2}Mg_{0.2}Zn_{0.2})O$[1] and cubic perovskite $La(Cr_{0.2}Mn_{0.2}Fe_{0.2}Co_{0.2}Ni_{0.2})O$[2], demonstrating that HEOs can host long-range magnetic order despite substantial chemical disorder. We present the exploration of magnetism across three HEO families: (1) cubic perovskites $BaIn_{1-x}M_xO_{3-\delta}$[3], (2) spinel M_3O_4 and (3) rocksalt MO. The M site is shared by up to five (post-)transition metals. Some members of the M_3O_4 family exhibit remarkably high T_N up to 618 K, highlighting its potential for stabilizing robust magnetic interactions. In contrast, $BaIn_{1-x}M_xO_{3-\delta}$ display glassy behavior. We examine how chemical complexity shapes magnetic properties across these families. [1] Chem. Mat. 2019 31 (10), 3705-3711. [2] Adv. Sci. 2022, 9, 2200391. [3] Solid State Ionics (2024) 427, 116901.

MA 3.4 Mon 10:15 POT/0112

Exploring the electronic structure of (111)-oriented $La_{0.7}Sr_{0.3}MnO_3$ through soft X-ray ARPES and DFT — •Øyvind Finnseth, Sverre M. Selbach, Hendrik Bentmann, and Ingrid Hallsteinsen — NTNU, Trondheim, Norway

While $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) has been widely studied due to its room-temperature ferromagnetism and half-metallicity, the majority of work has been focused on thin films in the (001)-orientation. The less conventional (111)-orientation has received far less attention despite its distinct intriguing properties, including sixfold in-plane magnetic anisotropy and enhanced interfacial coupling in heterostructures.

As such, a full description of the electronic structure of LSMO in this orientation is lacking. Here, we consider epitaxial thin films of LSMO grown by pulsed laser deposition on (111)-oriented $SrTiO_3$ substrates. We first develop an in-vacuum methodology for surface preparation of the films by annealing in an oxygen atmosphere. The electronic band structure of the films is probed by soft X-ray angle-resolved photoemission spectroscopy (ARPES) using a synchrotron lightsource. The tunability of the photon energy allows for precise control of the probed out-of-plane momentum, yielding a full description of the LSMO electronic band structure. Density functional theory (DFT) calculations are performed to obtain the theoretical band structure of bulk LSMO modeled through the use of the special quasirandom structures approach. By comparing the calculated band structure to the experimental results, we find that the DFT calculations are able to accurately predict the LSMO electronic band structure.

MA 3.5 Mon 10:30 POT/0112

Unveiling the Origins of Strong Magnetostriction in Cobalt Ferrite using neutron scattering. — •Guratinder Kaur — School of Physics and Astronomy, The University of Edinburgh, UK

Cobalt ferrite (CoFe2O4, CFO) stands out among advanced functional materials due to its exceptional magnetostrictive behaviour. This property allows its shape to be influenced by its magnetic state, making it desirable for various technological applications such as electronic devices, ferrofluids, magnetic drug delivery, microwave devices, and high-density information storage1-3. The present study provides a comprehensive investigation using neutron diffraction to explore the interplay between CFO's nuclear and magnetic structures4 across varying temperatures. This study complements our recent inelastic neutron scattering (INS) experiments on single crystal and powder samples. The combined data, along with our INS findings and developed excitonic theory, will provide a deeper understanding of the underlying mechanism responsible for CFO's strong magnetostrictive effect5. This knowledge will be valuable for designing novel materials with precisely controlled magnetostrictive properties for applications in areas like sensors and actuators6. References: 1)*Slonczewski J C, Phys. Rev. 110 1341 (1958). 2)*Zheng H et al., Science 303 661 (2004). 3)*Bhame S D et al., J. Appl. Phys. 100 113911 (2006). 4)*Teillet et al., J. Mag. Magn. Mater. 123, 93 (1993). 5)*Lane et al., Adv. Funct. Mater. 2025, e16830. 6)*Chen Y, et al., IEEE Trans. Magn. 35 3652 (1999).

MA 3.6 Mon 10:45 POT/0112

Polarized Neutron Scattering Studies on SDW Order in $Sr_{1.5}Ca_{0.5}RuO_4$ and $Sr_2Ru_{0.95}Co_{0.05}O_4$ — •Felix Wirth[1], Yvan Sidis[2], Paul Steffens[3], Kevin Jenni[1], Augustinus Agung Nugroho[4], Karin Schmalzl[5], Mechthild Enderle[3], and Markus Braden[1] — [1]II. Physic. Inst., Univ. Cologne, Germany — [2]LLB, CEA Saclay, France — [3]ILL, Grenoble, France — [4]Inst. Teknologi, Bandung, Indonesia — [5]JCNS Outst. ILL, Grenoble, France

Superconductivity in Sr_2RuO_4 emerges close to magnetic instabilities from Fermi-surface nesting at incommensurate $Q^{\alpha\beta} \approx$(0.3,0.3,L) and $Q^{\gamma} \approx$(0.15,0.15,L)[1]. In $Sr_{1.5}Ca_{0.5}RuO_4$ the anisotropic fluctuations at $Q^{\alpha\beta}$ condense into a c-axis polarized spin-density-wave[2]. Polarized inelastic neutron scattering reveals an unusual hierarchy of excitations with enhanced longitudinal modes. In contrast, transverse modes are suppressed, although their energy dependence remains similar to that of the parent compound. Above the SDW transition, longitudinal and transverse contributions show a split response, incompatible with tetragonal symmetry and suggestive of electronic nematicity. Ti^{4+} and Mn^{3+} substitution stabilise the same static order at $Q^{\alpha\beta}$[3]. By contrast, 5% Co doping does not yield the expected ferromagnetic cluster glass but a new magnetic order at Q≈(0.2,0.2,0) with intensity following the Ru^{4+} form factor that cannot be attributed to the known nesting vectors in this system. [1] Jenni, K. et al., Phys. Rev. B 103, 104511 (2021), [2] Kunkemöller, S. et al., Phys. Rev. B 89, 045119 (2014), [3] Braden, M. et al., Phys. Rev. Lett. 88, 197002 (2002)

15 min break

MA 3.7 Mon 11:15 POT/0112

Magnetic structure and magnetic excitations of the triple layer $Sr_4Ru_3O_{10}$ — •Lara Kiefer[1], Zahrasadat Ghazinezhad[1], Felix Wirth[1], Jens Mettler[1], Ursula Bengaard Hansen[2], Paul Steffens[2], Oksana Zaharko[3], Vladimir Pomjakushin[3], Karin Schmalzl[4], Devashibhai Androja[5], Augustinus Agung Nugroho[6], and Markus Braden[1] — [1]Inst. Phys. 2, Cologne, Germany — [2]ILL, Grenoble, France — [3]PSI, Villingen, Switzerland — [4]JCNS Out. ILL, Grenoble, France — [5]ISIS, Didcot, UK — [6]FMIPA ITB, Badung, Indonesia

The triple-layer transition-metal oxide $Sr_4Ru_3O_{10}$ is a member of the Ruddlesden-Popper series with a layered orthorhombic structure. It is a ferromagnetic metal (T_C=105 K) with an additional metamagnetic transition below 60 K. The nature of the intermediate phase is still under debate. Using multiple neutron diffraction techniques, we were able to determine its magnetic structure. Our inelastic neutron experiments revealed a parabolic, isotropic dispersion with a stiffness constant comparable to that of $SrRuO_3$ [1,2]. However, the spin-wave scattering at low constant energy transfer deviates from the expected isotropic ring, and the stiffness increases upon heating, mirroring $SrRuO_3$ [1,2]. Polarized neutron measurements reveal longitudinal spin excitations inside the ferromagnetic phase. These amplitude-type fluctuations are unexpected in a standard Heisenberg ferromagnet, suggesting the emergence of a new class of magnetic excitations beyond conventional transverse magnons. [1] K. Jenni et al., Phys. Rev. B 107, 174429 (2023). [2] K. Jenni et al., Phys. Rev. Lett. 123, 017202 (2019).

MA 3.8 Mon 11:30 POT/0112

Multi-length scale investigation of the Perovskite-Brownmillerite topotactic phase transition in $La_{0.7}Sr_{0.3}MnO_{3-\delta}$ thin films — •C. Yin[1,2], X. Bai[3], Z. Xu[4], V. Lauter[5], S. Zhou[6], F. Gunkel[7], L. Cao[2,8], G. Puebla Hellmann[4], R.E. Dunin-Borkowski[3], and O. Petracic[2,1] — [1]Faculty of Mathematics and Natural Sciences, Heinrich Heine University Düsseldorf — [2]Jülich Centre for Neutron Science (JCNS-2), JARA-FIT, Forschungszentrum Jülich GmbH — [3]Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons (ER-C), JARA-FIT, Forschungszentrum Jülich GmbH — [4]QZabre LLC, Zürich, 8050, Switzerland — [5]Neutron Scattering Division, Neutron Sciences Directorate, Oak Ridge National Laboratory, Oak Ridge, TN, 37831, USA — [6]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [7]Peter Grünberg Institut (PGI-7), JARA-FIT, Forschungszentrum Jülich GmbH — [8]School of Advanced Materials, Peking University, Shenzhen Graduate School, Shenzhen, 518055, China

In $La_{0.7}Sr_{0.3}MnO_{3-\delta}$, the introduction of oxygen vacancies induces a topotactic phase transition from the perovskite phase to an oxygen-vacancy ordered Brownmillerite phase. The influence of oxygen vacancies on near-surface magnetic domains is probed via Nitrogen-Vacancy (NV) magnetometry. Polarized Neutron Reflectometry (PNR) provide depth-resolved magnetization profiles and oxygen stoichiometry. Scanning Transmission Electron Microscopy (STEM) elucidates the atomic structure and depth-dependent oxidation states.

MA 3.9 Mon 11:45 POT/0112

Probing Spin-Waves and Spin-Phonon Coupling in a Double Perovskite Oxide: A Raman Study — •Akriti Singh and Surajit Saha — Indian Institute of Science Education and Research Bhopal, Bhopal, India

Double perovskites have emerged as a promising class of materials to explore the novel magnetic phenomena. This includes high-TC magnetic orderings, spin-reorientation, magnetostriction, and multiferroicity due to the presence of complex spin arrangements, competing exchange pathways or magneto-elastic couplings. Here, we report the evolution of magnetic excitations in Ca2NiWO6 using inelastic light scattering and explore the complex interplay between the lattice and spin degrees of freedom. To get insights into the underlying magnetic dynamics, we performed temperature-dependent magnetization, x-ray diffraction, and Raman spectroscopic measurements. Our results indicate an antiferromagnetic ground state below 50 K along with signatures of magnetostriction and spin-phonon coupling. Additionally, we employ magneto-Raman spectroscopy to probe the low-energy spin-waves (magnons), providing evidence of the nature and origin of magnetism in the system. Taken together, our findings on Ca2NiWO6 highlight its potential as a fertile ground to study the complex magnetic phenomena arising due to its exchange interactions, suggesting that it may be a possible candidate for applications in spintronics, magnonics, and other advanced spin-based technologies.

MA 3.10 Mon 12:00 POT/0112

resonant inelastic x-ray scattering spectra of the dynamic jahn-teller Cu^{2+} center in $CuAl_2O_4$ — •Takumi Gengo[1], Kenta Touge[2], Ara Go[3], and Naoya Iwahara[1] — [1]Graduate School of Engineering, Chiba University, Chiba, Japan — [2]Department of Materials Science, Faculty of Engineering, Chiba University, Chiba, Japan

— [3]Department of Physics, Chonnam National University, Gwangju, South Korea

Cu spinel compounds such as $CuAl_2O_4$ and $CuGa_2O_4$ attract attention as spin-orbit entangled magnets. The density mean-field theory calculations show that the spin-orbit coupling on the Cu site suppresses the Jahn-Teller deformation in the ground state, which is consistent with the x-ray diffraction data. On the contrary, recent resonant inelastic x-ray scattering (RIXS) measurement of $CuAl_2O_4$ suggests the possibility that the Jahn-Teller deformation develops. Such a contradictory situation could occur due to the development of the dynamic Jahn-Teller effect .

This study aims to theoretically elucidate the nature of quantum states on Cu sites induced by the competition between spin-orbit and electron-phonon (vibronic) couplings. We successfully reproduced the Cu L_2- and L_3-edge RIXS spectra based on our model with the quantum mechanical treatment of the lattice degrees of freedom (i.e., dynamic Jahn-Teller effect), which is consistent with the structural data. This study supports the former theoretical prediction that $CuAl_2O_4$ is a 3d spin-orbit coupled magnet.

MA 3.11 Mon 12:15 POT/0112

EMCD analysis of ferrimagnetic moments changes in Ti-doped barium hexaferrite — •Hitoshi Makino[1], Rolf Erni[2], Devendra Singh Negi[3], Ján Rusz[4], Bernd Rellinghaus[1], and Darius Pohl[1] — [1]DCN, TU Dresden, Dresden, Germany — [2]Empa, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland — [3]Indian Institute of Technology Jodhpur, Jodhpur, India — [4]Uppsala University, Uppsala, Sweden

Barium hexaferrite ($BaFe_{12}O_{19}$) is a robust permanent magnet material with good thermal and environmental stability. Small substitutions of Fe by Ti are known to enhance the coercivity at elevated temperatures. Our goal is to reveal changes of the ferrimagnetic arrangement of the moments by the Ti doping using electron energy-loss magnetic chiral dichroism (EMCD), an element- and site-specific probe of magnetic moments via electron energy-loss spectroscopy (EELS). We modified a highly accurate classical EMCD methodology with an improved signal-to-noise ratio, enabling the quantitative deconvolution of the Fe-$L_{2,3}$ edges into oxidation- and site-resolved magnetic contributions. The results suggest that the magnetic structure changes primarily at the tetrahedral site. Using the recently established atomic-resolution electron vortex beam EMCD, we verified these results from an alternative perspective. These measurements reveal a threefold supersymmetry in the magnetic-moments, consistent with the symmetry of the site occupied by Ti substitution identified in the STEM-EELS elemental map. These observations deepen our understanding of magnetic structure changes induced by Ti doping in barium hexaferrite.

MA 3.12 Mon 12:30 POT/0112

Long-range spin density wave order in bilayer nickelates revealed by neutron diffraction — •Igor Plokhikh — TU Dortmund University, Department of Physics, 44227 Dortmund, Germany — Research Center Future Energy Materials and Systems, 44227 Dortmund, Germany

The observation of pressure-induced superconductivity in Ruddlesden Popper nickelates has triggered renewed interest in their magnetic ground states as potential precursors to unconventional superconductivity [1]. Using high-intensity neutron powder diffraction (NPD) complemented by muon-spin rotation/relaxation (μSR), we directly resolve long-range spin-density-wave (SDW) order in bilayer $La_3Ni_2O_7$ and $La_2PrNi_2O_7$ below 150 K [2].

Magnetic Bragg reflections appear at propagation vectors $q_1 = (0, \frac{1}{2}, 0)$ for both compounds and an additional vector $q_2 = (\frac{1}{2}, \frac{1}{2}, 0)$ exclusively in undoped $La_3Ni_2O_7$. Representation analysis reveals amplitude-modulated SDW structures composed of alternating low- ($\approx 0.05\ \mu_B$) and high-moment ($\approx 0.7\ \mu_B$) Ni sites forming antiferromagnetically stacked bilayers along the c-axis. The coexistence of two distinct stacking polymorphs corresponding to q_1 and q_2 reflects quasi-two-dimensional magnetic order intrinsic to this system.

These findings provide the first direct neutron evidence for SDW order in bilayer nickelates and offer crucial insights into their ground state.

[1] Wang et al., Chinese Phys. Lett. 41, 077402 (2024).
[2] Plokhikh et al., arXiv:2503.05287(2025).

MA 4: Focus Session: Novel mechanisms of ferroic switching (joint session MA/FM)

This focus session highlights recent advances in ferroic switching across ferroelectric, multiferroic, ferroaxial and magnetic systems. Topics include topologically protected order-parameter dynamics, ultrafast non-thermal switching, and complex domain-wall phenomena revealed by atomistic modeling, ultrafast optics and advanced imaging. Contributions span machine-learning-based simulations of domain kinetics, optical control of ferroaxial and structural orders, multiferroic multi-cell memory concepts, and theoretically predicted unidirectional domain-wall motion with time-crystal behavior. Together, these works uncover new switching pathways and robust functional mechanisms, offering promising routes toward energy-efficient memory and quantum devices.

Organizer: Andrei Pimenov, andrei.pimenov@tuwien.ac.ac

Time: Monday 9:30–12:00 Location: POT/0151

Invited Talk MA 4.1 Mon 9:30 POT/0151

From ML to Kinetics: Modeling the Switching in Ferroelectric Wurtzites — •Andrew Rappe, Drew Behrendt, Atanu Samanta, and Von Braun Nascimento — Department of Chemistry, University of Pennsylvania, Philadelphia, PA 19104-6323 USA

We present a series of works, from the development of a new force field (MLFF) for multi-scale simulations of bulk AlN, through application of MLFF to understand the atomistic switching mechanism, to the development of a new kinetic model to uncover how switching changes as a function of experimental conditions.

We train our MLFF to 1000s of DFT calculations, so the underlying calculations are as accurate as DFT with the flexibility in simulation size of classical MD. Powered by the MLFF, we can predict the energies, forces, and phonon dispersions of AlN at dramatically lower cost, thus enabling the study of emergent and long-range effects, such as the frequency-dependent dielectric functions and multiple FE domains.

Applying the AlN MLFF, we uncover the atomistic mechanism of domain wall (DW) migration and domain growth in wurtzites. We find that the critical nucleus is a single broken Al-N bond along the polar axis; this creates a cascade of bond breaking in a single column of atoms due to the stability of the 180° DW in wurtzites. We reveal the switching mechanism of 1D atomic columns propagating from a slow-moving 2D fractal-like DW in the basal plane.

Finally, we develop an analytical extension to the KAI model that accounts for fractal FE domains. To do this, we take the traditional model of circles that can nucleate and grow and add a budding term.

Invited Talk MA 4.2 Mon 10:00 POT/0151

Topological order parameter switching — •Sergey Artyukhin — Quantum Materials Theory, Genova, Italy

Ferroic orders are widely used to encode information in data storage devices and may provide a beneficial way to circumvent Boltzmann tyranny affecting conventional MOSFET memory [1]. However, information writing involves order parameter switching, facilitated by domain nucleation and motion of domain walls across a disordered material, which leads to energy dissipation. Recently, an alternative order parameter switching paradigm has been introduced, where the ordered state tracking the free energy minimum continuously rotates the order parameter direction as the free energy surface is deformed by an external driving [2]. The process is analogous to Thouless pumping and is topologically protected. A related mechanism allows pumping of topological spin textures in space [3].

[1] S. Manipatruni, D. E. Nikonov, I. A. Young, Nature Physics 14, 338 (2018)
[2] L. Ponet et al., Nature 607, 81-85 (2022)
[3] L. Maranzana et al., arXiv:2502.13083

Invited Talk MA 4.3 Mon 10:30 POT/0151

Optical Control of Ferroaxial Order via Circular Phonon Excitation — •Zhiyang Zeng[1,2], Michael Först[1], Michael Fechner[1], Dharmalingam Prabhakaran[2], Paolo Radaelli[2], and Andrea Cavalleri[1,2] — [1]Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany — [2]Department of Physics, Clarendon Laboratory, University of Oxford, Oxford, United Kingdom

Ferroaxial order is a distinct ferroic order in crystal systems characterized by a rotational texture of electric dipoles. Its unique symmetry prohibits direct coupling to static fields or stress, making conventional control approaches ineffective.

Based on symmetry analysis, we identify a coupling between the ferroaxial order and circularly driven optical phonons, which can be resonantly excited with circularly polarized mid-infrared light. Exploiting this coupling, we experimentally achieve reversible, deterministic switching of the ferroaxial order in the prototype material RbFe(MoO4)2 using single-shot excitation.

This work establishes a new mechanism for manipulating ferroaxial order via light-driven phonons, enabling dynamic control of ferroic properties in complex materials.

15 min break

MA 4.4 Mon 11:15 POT/0151

Coherent Control of Competing Structural Orders in SrTiO3 — •M. Fechner[1], H. Wang[2], M. Foerst[1], G. Orenstein[2], A. Disa[3], M. Trigo[2], and A. Cavalleri[1] — [1]Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany — [2]Stanford Pulse Institute, SLAC National Accelerator Laboratory, Menlo Park, CA, USA — [3]School of Applied & Engineering Physics, Cornell University, Ithaca, NY USA

The interplay between antiferrodistortive (AFD) rotation and polar instability prevents the formation of ferroelectric order in SrTiO3 yet keeps the paraelectric-to-ferroelectric transition on the verge of emerging. Light excitation has been shown to induce metastable ferroelectricity[1], but the response of the AFD order to such optical driving remains unclear. Here we use time-resolved X-ray scattering to track AFD-order dynamics, launched by mid-infrared excitation of the Ti-O stretching vibration, from 10 K to 135 K above the cubic transition. In the tetragonal phase below 110 K, the AFD order transiently increases before the AFD angle is reduced, whereas in the cubic phase rotational fluctuations initially grow before being strongly suppressed[2]. A unified lattice model, incorporating nonlinear coupling of the excited infrared phonon to the AFD mode and to strain, captures both regimes. With a single set of coupling parameters, we reproduce behaviors for both phases, indicating a common underlying mechanism that also constrains explanations for the light-induced ferroelectric state.

[1] T.F., et al. Nova Science 364, 1075 (2019), [2] M. Fechner, et al. NatMat, 23, 363 (2024)

MA 4.5 Mon 11:30 POT/0151

Multi-cell unit storage based on a multiferroic — •Maksim Ryzhkov[1], Alexey Shuvaev[1], Maxim Mostovoy[2], Andrei Pimenov[1], Anna Pimenov[1], and Sergey Artyukhin[3] — [1]Institute of Solid State Physics, Vienna University of Technology, Vienna, Austria — [2]Zernike Institute for Advanced Materials, University of Groningen, Groningen, The Netherlands — [3]Quantum Materials Theory, Istituto Italiano di Tecnologia, Genova, Italy

Recent advances in multiferroic materials offer promising prospects for next-generation memory and data-processing devices. Previous studies [1,2] have shown that rare-earth manganates RMn_2O_5, particularly with R = Gd, are strong candidates for storage applications due to their topologically protected four-state magnetoelectric switching and the efficient electric-field control of this switching.

In this work, we demonstrate that this system enables the realization of a multi-cell storage unit capable of encoding and decoding at least five bits. We show that only two key ingredients are required:

(i) the four-state magnetoelectric switching observed during magnetic-field sweeps, and

(ii) a ferroelectric domain structure in the bulk together with local inhomogeneities (e.g., internal mechanical stresses) that produce a distribution of the spin-flop critical field H_c across different domains.

Thus, the magnetoelectric domains in $GdMn_2O_5$ are not an unwanted bug but an essential feature enabling multi-cell functionality.

[1] L. Ponet, et al., Nature 607, 81-85 (2022)
[2] H. Wang, et al., PRL 134, 016708 (2025)

MA 4.6 Mon 11:45 POT/0151

E-field induced unidirectional motion of domain wall in a ferromagnet and time crystals — •Margherita Parodi[1,2], Sergey Artyukhin[1], and Maxim Mostovoy[3] — [1]Quantum Materials Theory, Italian Institute of Technology, Genova, Italy — [2]Physics Department, University of Genova, Italy — [3]Theory of Condensed Matter, Zernike Institute for Advanced Materials, Groningen, The Netherlands

Noncollinear spin textures may break inversion symmetry and induce ferroelectric polarization, giving rise to multiferroicity. Here we study the most basic noncollinear spin texture: a domain wall in a collinear (anti)ferromagnet. The spin chirality of the domain wall is analogous to that in spiral multiferroics and likewise leads to ferroelectric polarization. Here we find that oscillating magnetic and electric fields can drive a unidirectional motion of the magnetic texture, similar to how electrons are transported by the Thouless pump. Furthermore, for certain periods of a driving field, the domain wall demonstrates complex behaviour akin to a time crystal, with the period equal to an integer multiple of the driving periods. The phenomenon arises due to a mismatch between the natural timescale of the domain wall motion and the driving field period.

MA 5: Surface Magnetism and Topological Insulators (joint session MA/TT)

Time: Monday 9:30–12:00 Location: POT/0351

MA 5.1 Mon 9:30 POT/0351

Impact of keV He-ion bombardment on the magnetic proximity effect in Pt/Fe bilayers — •Mika Ossenschmidt[1], Arne Vereijken[1], Yahya Shubbak[1], Varun Vanakalapu[1], Maik Gaerner[2], Arno Ehresmann[1], and Timo Kuschel[2] — [1]University of Kassel, Germany — [2]Bielefeld University, Germany

The static magnetic proximity effect (MPE) describes the occurrence of spin polarization at the interface of nominally paramagnetic materials caused by its adjacency to a ferromagnetic material. KeV-He light ion bombardment (IB) of thin-film interfaces offers the opportunity to modify the interface properties of thin-film systems without destroying the thin films, e.g., as shown for exchange-bias systems [1].

Samples of Pt 4 nm/Fe 10 nm//MgO(001) were fabricated by sputter deposition and the subsequent IB was performed with 10 keV He^+ ions with a varying ion dose from 10^{15} to 10^{17} ions/cm^2 in a few steps. To analyze the strength of the MPE in Pt, x-ray resonant magnetic reflectivity measurements were performed at the Pt L_3 absorption edge (11.567 keV) at DESY beamline P09 [2].

The fits of the x-ray reflectivity measurements provide a significant difference for the roughness σ of the Pt-Fe interface due to IB while substrate and surface roughnesses as well as layer thicknesses remained nearly unchanged. The resulting maximum Pt moment at the interface for the sample with IB is higher than without IB, due to the increasing intermixing of Pt and Fe atoms at the Pt-Fe interface.

[1] Ehresmann et al., J. Phys. D: Appl. Phys. 38, 801 (2005)
[2] Kuschel et al., Phys. Rev. Lett. 115, 097401 (2015)

MA 5.2 Mon 9:45 POT/0351

Exchange splitting at surfaces: a new paradigm for spin-polarization in antiferromagnets — •William Schaarman and Sophie Weber — Chalmers University of Technology, Göteborg, Sweden

There has been recent interest in combining the robustness and ultrafast dynamics of antiferromagnets with the transport properties of spin-polarized band structures. While antiferromagnetic bands are typically spin-degenerate, exceptions to this rule such as the altermagnets have demonstrated the possibility to obtain spin polarization in bulk antiferromagnets via selective symmetry lowering. Here, we use symmetry analysis and density functional theory to examine a ferromagnetic-like exchange splitting at certain surfaces. Such spin polarization of the surface-projected band structure can occur for surface orientations with a net two-dimensional magnetization which can emerge via symmetry-lowering at the antiferromagnet's surface. By analyzing the band structure of a slab geometry projected onto a single surface, we confirm surface spin polarization in two representative materials, magnetoelectric Cr2O3 and altermagnetic FeF2. We rationalize the magnitudes of exchange splitting on distance surface orientations in these two materials as a complex interplay between the exchange and crystal field splittings of individual magnetic atoms making up the surface. Notably, our analysis shows the effect of surface exchange splitting can in some cases be of the order of eV which has important implications for spintronic devices.

MA 5.3 Mon 10:00 POT/0351

Image-potential states on a 2D Gr-ferromagnet hybrid: enhancing spin and stacking sensing — Maciej Bazarnik[1,2] and •Anika Schlenhoff[1,2] — [1]Institute of Physics, University of Münster, Germany — [2]Department of Physics, University of Hamburg, Germany

With the increasing research interest in 2D materials, image-potential states (IPSs) have regained attention as sensitive probes, e.g. for a charge transfer at buried graphene(Gr)-metal interfaces. For a Gr-ferromagnet hybrid, the question arises how IPSs sense a respective spin transfer laterally varying within the moiré heterostructure.

Here, we present spin-resolved scanning tunneling microscopy and spectroscopy studies on Fe intercalated Gr/Ir(111), that show the IPSs' sensitivity to the spatial variation of the Gr-Fe distance, and of the interfacial charge and spin transfer within the moiré unit cell [1]. A stacking contrast between fcc and hcp sites, indistinguishable in the direct tunneling mode, is provided by the IPSs. We observe a moiré-site- and energy-dependent spin-polarization of the IPSs that can be mapped across the entire moiré unit cell. Unlike the electronic states around the Fermi energy, the lowest IPSs are found to exhibit a high spin-polarization on the on-top sites attributed to their interfacial character at the respective Gr-Fe distance. Since the physisorbed Gr is only weakly spin-polarized on these sites, our work demonstrates that the lowest order IPSs can be used to locally sense the spin density at magnetic interfaces buried by a nonmagnetic passivation layer.

[1] M. Bazarnik and A. Schlenhoff, ACS Nano 19, 25812 (2025).

MA 5.4 Mon 10:15 POT/0351

Theoretical Investigation of Intrinsically Patterned 2D Transition Metal Halides: Defects, Structure, and Magnetic Phenomena — •Neeta Bisht[1], Andreas Görling[1], Feifei Xiang[2], Binbin Da[2], Mohammad Sajjan[2], Sabine Maier[2], and Christian Neiss[1] — [1]Lehrstuhl für Theoretische Chemie, Friedrich-Alexander-Universität Erlangen-Nürnberg,
Egerlandstraße 3, 91058 Erlangen
— [2]Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, 91058 Erlangen

In the quest for complex structured functional materials, defect engineering and patterning in two-dimensional (2D) systems are critical for tuning material properties and enabling new functionalities. Herein, we report on intrinsically patterned 2D transition metal dihalides (TMDs) on a gold surface, featuring periodic halogen vacancies in the upper and bottom halide layers that result in alternating coordination of the transition metal atoms throughout the film.

We explore the formation pathways leading to periodic halogen vacancies and their role in modifying the electronic and magnetic structure of TMDs. Our calculations also explores the possibility of noncollinear magnetic textures through the magnetic anisotropy calculations. The excellent match between the experimental findings and the DFT calculations, confirms the intrinsic vacancy lattice. By coupling our theoretical results with experimental observations, we provide a comprehensive framework for understanding the structure formation and magnetic properties of 2D materials.

MA 5.5 Mon 10:30 POT/0351

Magnetic domain structure of holmium films at low temperatures — •Patrick Härtl[1], Vijayalaxmi Sankeshwar[2], and Matthias Bode[1] — [1]Physikalisches Institut, Experimentelle Physik II, Universität Würzburg, Am Hubland, D-97074 Würzburg, Germany — [2]Indian Institute of Science Education and Research(IISER), Pune, Maharashtra 411008, India

Rare-earth metals play a central role in modern magnetism, with their behavior largely governed by the element-specific sign and oscillation period of the RKKY interaction. However, real-space investigations of their complex magnetic domain structures remain scarce. Here, we present a systematic study of the structural and magnetic properties of epitaxial holmium (Ho) films grown on W(110), using low-temperature spin-polarized scanning tunneling microscopy (SP-STM).

Bulk Ho crystallizes in a hexagonal close-packed structure and exhibits an exceptionally large magnetic moment of approximately $10\,\mu_B$, forming a helical spin spiral below $T_C = 20\,K$. In our films, we find predominantly ferromagnetic in-plane domains for thicknesses up to about 50 atomic layers (AL), with domain walls strongly pinned to crystalline defects. For coverages above 50 AL, additional out-of-plane stripe domains emerge, which we attribute to the uncompensated c-axis magnetization of the helical cone state. Domain wall analysis reveals Néel-capped Bloch-type walls with characteristic widths of roughly $\approx 1.2\,nm$ (60°), $\approx 3\,nm$ (120°), and $\approx 4\,nm$ (180°). The stripe domains are suppressed by out-of-plane magnetic fields of $\mu_0 H = \pm 300\,mT$.

Published in: P. Härtl et al., Phys. Rev. B **112**, 174402 (2025).

MA 5.6 Mon 10:45 POT/0351

Electronic bounds in magnetic crystals — •Daniel Passos[1] and Ivo Souza[1,2] — [1]Centro de Física de Materiales, Universidad del País Vasco, 20018 San Sebastián, Spain — [2]Ikerbasque Foundation, 48013 Bilbao, Spain

A quantum system in its ground-state must display non-negative optical absorption. This simple statement forms the basis for a string of inequalities between moments of the absorptive conductivity. Through the use of sum rules, these inequalities provide bounds on quantities of physical interest. Recent discoveries include new constraints on the electronic localization length in insulators, and an upper bound on the bandgap of topological insulators. Current research focuses on finding inequalities relating ground-state properties such as the quantum metric to more directly measurable quantities.

We present a systematic study of bound relations between different electronic properties of magnetic crystals: electron density, effective mass, orbital magnetization, localization length, Chern invariant, and electric susceptibility. New results include a lower bound on the electric susceptibility of Chern insulators, and an upper bound on the sum-rule part of the orbital magnetization. In addition, bounds involving the Chern invariant are generalized from two dimensions (Chern number) to three (Chern vector). Bound relations are established for metals as well as insulators, and are illustrated for model systems. The manner in which they approach saturation in a model Chern insulator with tunable flat bands is analyzed in terms of the optical absorption spectrum.

15 min break

MA 5.7 Mon 11:15 POT/0351

Hidden Dirac-Like Crossings in a Prototypical Topological Insulator — •Wei-Sheng Chiu[1,2], Ina Marie Verzola[3], Ying-Jiun Chen[1], Rovi Angelo Beloya Villaos[3], Claus Michael Schneider[1,2], Feng-Chuan Chuang[3], and Christian Tusche[1,2] — [1]Forschungszentrum Jülich, Germany — [2]Universität Duisburg-Essen, Germany — [3]National Sun Yat-sen University, Taiwan

The prototypical topological insulator Bi_2Se_3 has been extensively studied for its topological surface state characterized by a $\mathbb{Z}_2$ topological invariant. By using spin-resolving momentum microscopy with an Au passivated Ir(100) imaging spin filter, we simultaneously recorded the spin-resolved momentum maps (k_x, k_y) over entire surface Brillouin zone of Bi_2Se_3. In addition to the well-known Dirac cone near Fermi energy, we observe a sequence of several Dirac-like spin textures and crossings spanning binding energies down to 4 eV at the $\overline{\Gamma}$ point. Moreover, a Dirac-like crossing is also found at a binding energy 2.3 eV at the $\overline{M}$ point. Our first-principles calculations indicate that those overlooked bands are attributed to surface states. The Dirac-like crossing at the $\overline{M}$ point arises from crystalline-symmetry-enforced degeneracy at the high symmetry point, showing that Bi_2Se_3 has a more complex surface electronic structure than previously expected.

MA 5.8 Mon 11:30 POT/0351

Single domain spectroscopic signatures of a magnetic Kagome metal — •Lukasz Plucinski[1], Gustav Bihlmayer[1], Yuriy Mokrousov[1], Yishui Zhou[2], Yixi Su[2], Jonathan Denlinger[3], Aaron Bostwick[3], Christopher Jozwiak[3], Eli Rotenberg[3], Dmitriy Usachov[4], and Claus M. Schneider[1] — [1]FZ Jülich — [2]JCNS/MLZ Garching — [3]ALS/LBNL Berkeley — [4]DIPC San Sebastian

We investigate the magnetic Kagome metal $DyMn_6Sn_6$ using high-resolution micro-focused circular-dichroic angle-resolved photoemission (μ-CD-ARPES) to probe its magnetic and electronic properties. By tuning the kinetic energy to various features of the Dy $4f$ multiplet, we resolve magnetic domains in samples cryo-cooled down to 20 K. Smaller, but clear signatures are detected in the Mn $3p$ levels. The behavior of both Dy $4f$ and Mn $3p$ features are in remarkable agreement with our modeling based on the Hartree-Fock method, revealing ferrimagnetic alignment of Dy and Mn local moments, and further strengthening our interpretation. Adjusting the energy to the Mn $3d$-dominated valence bands reveals signatures which we relate to the orbital magnetization through a comparison to *ab initio* electronic structure calculations. Our study establishes the spectroscopic access to a single magnetic domain in a Kagome metal, paving the way for further research into imaging magnetic phases of novel magnetic materials using μ-CD-ARPES. Preprint is available at https://arxiv.org/abs/2507.12085.

MA 5.9 Mon 11:45 POT/0351

Topologically non-trivial Kondo insulating state in graphene nanoribbons — •Amogh Kinikar[1,2], Guangze Chen[3], Yanwei Gu[4], David Jacob[5,6], Joaquín Fernández-Rossier[7], Gonçalo Catarina[2], António T. Costa[7], Oliver Gröning[2], Carlo Antonio Pignedoli[2], Klaus Müllen[4], Pascal Ruffieux[2], Jose L. Lado[8], Akimitsu Narita[4], and Roman Fasel[2,9] — [1]KIT, Karlsruhe, Germany — [2]Empa, Dübendorf, Switzerland — [3]Chalmers University of Technology, Gothenburg, Sweden — [4]MPIP, Mainz, Germany — [5]UPV/EHU, San Sebastián, Spain — [6]Basque Foundation for Science,Bilbao, Spain — [7]INL, Braga, Portugal — [8]Aalto University, Espoo, Finland — [9]University of Bern, Bern, Switzerland

Metallic rare-earth alloys display characteristic correlated electron phenomena due to interactions between electrons which give rise to a narrow heavy-fermion band near the Fermi level that hybridizes with the metallic band and opens a hybridization gap. When the Fermi level falls within this gap the system forms a Kondo insulator, which can also acquire a topologically non-trivial character. Here we provide evidence for a topological Kondo insulating state in a specific atomically precise graphene nanoribbon synthesized on Au(111) by on surface methods and characterized by scanning probe microscopy. We observe a sharp resonance near the Fermi level and a pronounced zero-bias peak at the ribbon termini. We show that these spectroscopic signatures are a fingerprint of a topological Kondo insulating state in this graphene nanoribbon.

MA 6: Magnetic Imaging Techniques I

Time: Monday 9:30–12:45 Location: POT/0361

MA 6.1 Mon 9:30 POT/0361

Nanoscale Dipolar Fields in Artificial Spin Ice Probed by Scanning NV Magnetometry — •Ephraim Spindler[1], Vinayak Shantaram Bhat[2], Elke Neu[1], Mathias Weiler[1], and M. Benjamin Jungfleisch[2] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU in Kaiserslautern, Germany — [2]Department of Physics & Astronomy, University of Delaware, Newark, USA

Artificial spin ices (ASI) offer a versatile platform to study frustration and collective spin dynamics in engineered magnetic lattices. We employ scanning probe microscopy based on a single nitrogen-vacancy (NV) center in diamond - a non-invasive, nanoscale quantum sensing technique - to study two square-lattice ASI systems with varied inter-element coupling strengths.

We use NV fluorescence quenching for rapid state determination and continuous-wave optically detected magnetic resonance to quantitatively map magnetic stray fields and extract vectorial dipolar field information. We fit the experimentally determined field components to micromagnetic simulations to infer local magnetic configurations in an iterative procedure.

These micromagnetic modeling results demonstrate that our method successfully quantifies the deviation between the expected and detected dipolar coupling field strengths, which we describe using an effective saturation magnetization. We show that the subtle magnetization tilt induced by small external fields is detectable and quantifiable through its impact on the local dipolar stray fields in the ASI.

MA 6.2 Mon 9:45 POT/0361

Probing nanoscale magnetic phenomena with cryogenic scanning NV magnetometry — •Mirko Bacani[1], Clemens Schäfermeier[1], Ankit Sharma[1], Christopher Kelvin von Grundherr[1], Dieter Andres[1], Khaled Karrai[1], Gabriel Puebla-Hellmann[2], Jan Rhensius[2], Andrea Morales[2], and Florian Otto[1] — [1]attocube systems GmbH , Haar, Germany — [2]QZabre AG, Zurich, Switzerland

Emerging technologies increasingly rely on precise control and understanding of magnetic phenomena at the nanoscale and cryogenic temperatures. NV magnetometry offers a unique approach, combining quantum sensing with scanning probe precision to achieve magnetic field mapping at resolutions and sensitivities beyond conventional limits. We present cw-ODMR imaging of materials hosting emergent quantum and topological magnetic phenomena, including Abrikosov vortices in BSCCO and YBCO, interlayer domain textures in twisted bilayer CrSBr, magnetic domains in skyrmions-hosting Ir/Fe/Co/Pt multilayers, and meronic spin textures in synthetic antiferromagnets.

The imaging was performed by the cryogenic scanning NV magnetometer integrated into a closed-cycle cryostat with turnkey operation from 2-300 K. The system reaches the sensitivity of 3 uT/sqrt(Hz) with automated ODMR for quantitative stray-field mapping. These results exemplify the versatility of cryogenic NV magnetometry as a tool for probing superconductivity, correlated magnetism, and emergent spin textures in quantum materials.

MA 6.3 Mon 10:00 POT/0361

Switchable magnetic nanowire probes for differential magnetic force microscopy — Florian Sandbaumhüter[1,2], •Aniruddha Sathyadharma Prasad[1,2], Rachappa Ravishankar[1,2], Volker Neu[1], Bernd Büchner[1,2], and Thomas Mühl[1] — [1]IFW Dresden — [2]TU Dresden

Recent work on magnetic force microscopy (MFM) has highlighted the need to implement a differential MFM technique to better eliminate interfering electrostatic and topographical crosstalk from MFM images. In addition, the use of specialized MFM probes containing iron-filled carbon nanotubes (FeCNTs) as the sensing element has enabled easy quantitative imaging of magnetic fields and field gradients [1]. In this talk, we demonstrate in-situ differential MFM in a reversed tip-sample arrangement. This is based on our switchable magnetic probes which consist of FeCNTs attached to micron-sized electromagnets, i.e. planar microcoils [2]. The large field gradients of these microcoils make sure that there is only a minimal effect on the sample being measured. Furthermore, the highly inhomogeneous fields produced by our microcoils also provide a new playground for studies of domain wall motion in ferromagnetic nanowires.

[1] Freitag, Norbert H., et al. Communications Physics 6, 11 (2023).

[2] Sathyadharma Prasad, Aniruddha, et al. Communications Materials 6, 164 (2025).

MA 6.4 Mon 10:15 POT/0361

Magnetic Vector Tomography of Thick Chiral Magnets — •Polly Mitchell[1], Claire Donnelly[1,3], Luke Turnbull[2], Jeffrey Neethirajan[1], Rikako Yamamoto[1,3], Marina Raboni Ferreira[1], Burkhard Kaulich[2], and Luke Higgins[2] — [1]MPI CPfS, Dresden, Germany — [2]Diamond Light Source, Harwell Campus, Didcot, UK — [3]SKCM[2] Hiroshima University, Hiroshima, Japan

Complex three-dimensional (3D) textures such as Bloch points, chiral bobbers and hopfions form in chiral magnets through the interplay between Dzyaloshinskii-Moriya and exchange interactions. The 3D nature of such structures provides advantages such as higher degrees of freedom, and the potential for volume-based information encoding. However, the investigation of thick samples presents a number of challenges: first, whether the cancellation of opposing magnetic vectors through the sample will hinder the 3D reconstruction, and second, the high absorption of soft x-ray and electron microscopies. Here we address both challenges, obtaining experimental insight into the 3D configuration of thick chiral magnets. By performing numerical simulations of magnetic vector tomography, we find that increased angular sampling mitigates vector cancellation, allowing accurate high-resolution 3D mapping of samples up to 3μm thick. Following this insight, we harness pre-edge phase soft X-ray ptychography to perform magnetic tomography of a 700nm thick $Co_8Zn_9Mn_3$ sample. In this way, we are able to recover the 3D magnetisation vector field of a thick chiral sample, demonstrating magnetic tomography as a robust technique to recover complex configurations in thick magnetic systems.

MA 6.5 Mon 10:30 POT/0361

Self-Consistent Magnetic Force Microscopy Simulator Framework — •Dominik Schramm[1], Claas Abert[2], Jakub Jurczyk[1], and Amalio Fernández-Pacheco[1] — [1]Tu Wien — [2]Universität Wien

With the advancement in 3D nanofabrication techniques such as Focused Electron Beam Induced Deposition (FEBID), manufacturing of complex magnetic nanostructures emanating more complex stray fields becomes feasible. [1] To quantify these fields, the development of a modified Vector- Magnetic Force Microscope (MFM), resolving all three spatial components of the stray field while still maintaining industrial feasibility, is targeted.

To design an optimized MFM tip, the micromagnetic simulation framework Neuralmag is leveraged to simulate an MFM signal. The simulator allows us to self-consistently study the impact of tip geometry, inclination angle, magnetic state as well as additional oscillatory modes not only on the output, but also on the magnetic states of tip and sample themselves. Furthermore, the simulator is employed to simulate MFM along a topographically non-trivial sample surface.

[1] A. Fernández-Pacheco, et al. Nat Commun 8, (2017) 15756.

MA 6.6 Mon 10:45 POT/0361

Toward 3D magnetic force microscopy: Simultaneous torsional cantilever excitation to access a second, orthogonal stray field component — •Jori F. Schmidt[1], Lukas M. Eng[1,2], and Samuel D. Seddon[1] — [1]TU Dresden, Institute of Applied Physics, Nöthnitzer Strasse 61, 01187 Dresden, Germany — [2]ct.qmat: Dresden-Würzburg Cluster of Excellence EXC 2147, TU Dresden, 01062 Dresden, Germany

Magnetic Force Microscopy (MFM) is a technique for recording maps of the magnetic stray field above a sample, as is for instance well documented for skyrmions. The magnetized tip usually couples to the out-of-plane magnetic sample stray field through cantilever oscillations perpendicular to the sample surface. Nevertheless, the stray field has a 3-dimensional distribution, the reconstruction of which has not been widely performed so far due to the uniaxial sensitivity of standard MFM.

Here, we introduce a novel way towards experimentally mapping the full 3D sample stray field, by simultaneously oscillating the MFM cantilever at its vertical (out-of-plane) and lateral (in-plane) fundamental resonance frequencies, thus making it possible to directly compare and quantify the vertical MFM (V-MFM) and the lateral MFM (L-MFM) signals. We have tested this novel setup for its overall performance and signal-to-noise ratio, using a hard disk with known magnetization, where a good agreement was found between experimental results.[1]

[1] J. Schmidt et al., J. Appl. Phys. 136, 113904 (2024): https://doi.org/10.1063/5.0226570

15 min break

MA 6.7 Mon 11:15 POT/0361

Hamiltonian reverse engineering from magnetic skyrmion images via deep learning surrogates — •Moritz Winterott[1,2] and Samir Lounis[3] — [1]Peter Grünberg Institut, Forschungszentrum Jülich & JARA, Germany — [2]Faculty of Physics, University of Duisburg-Essen, Germany — [3]Institut für Physik and Halle-Berlin-Regensburg Cluster of Excellence CCE, Martin-Luther Universität Halle-Wittenberg, Germany

The extraction of physical parameters from experimental observations is a central inverse problem in condensed matter physics. Complex magnetic textures such as skyrmions are imaged via Scanning Tunneling Microscopy (STM), which probes the local density of states (LDOS). Inferring the underlying interactions by matching theoretical models to experimental LDOS is often computationally expensive. In this work, we introduce a deep-learning framework that serves as a fast and accurate surrogate for this modeling process. Our approach employs a novel neural network architecture that integrates modern Transformers[1,2] with Convolutional Neural Networks (CNNs) to extract spatial features from energy-resolved LDOS images and to learn the highly nonlinear mapping to the parameters of an effective tight-binding Hamiltonian. These parameters encode the skyrmion texture, hopping amplitudes, and spin-orbit coupling strengths. Also, on-the-fly noise augmentation during training enhances robustness, enabling the model to maintain high accuracy even for noisy experimental data.

[1] Vaswani et al. NeurIPS '17; [2] Devlin et al. Proc. NAACL-HLT '19.

MA 6.8 Mon 11:30 POT/0361

Can a Quantum Computer Simulate Nuclear Magnetic Resonance Spectra Better than a Classical One? — •Keith R. Fratus, Nicklas Enenkel, Sebastian Zanker, Jan-Michael Reiner, Michael Marthaler, and Peter Schmitteckert — HQS Quantum Simulations GmbH, Karlsruhe, Germany

The simulation of the spectra measured in nuclear magnetic resonance (NMR) spectroscopy experiments is a computationally non-trivial problem, and as such, it represents a problem for which a quantum computer may provide some practical advantage over traditional computing methods. In order to understand the extent to which such problems may provide examples of useful quantum advantage, it is important to understand the limitations of existing classical simulation methods. In this talk, we present our classical solver designed to solve such problems, and benchmark its performance. We find that it performs well, even outside of the more typical experimental regimes, and discuss what implications this may have for future efforts to demonstrate quantum advantage in the context of NMR.

MA 6.9 Mon 11:45 POT/0361

From imaging static magnetic fields to characterization of GHz magnetic noise - multi-method magnetometer comprising NV, MFM and MOKE — •Nele Harnack, Björn Josteinsson, Andrea Morales, Simon Josephy, and Gabriel Puebla-Hellmann — QZabre Ltd., Zürich (Switzerland)

Nanoscale imaging of static and GHz magnetic fields allows the in-depth study of phenomena like skyrmions, spin-waves and antiferromagnets. Experimental techniques include nitrogen-vacancy (NV) magnetometry, magnetic force microscopy (MFM) and magneto-optic Kerr effect (MOKE) [1,2]. In NV magnetometry, a spin defect in diamond serves as an atomic-scale sensor, delivering quantitative results and high resolution [3]. Here, we show how NV centers yield information complementary to MFM and MOKE - stray field and reconstructed magnetization - in a comparative study of BiYIG using the three techniques. The study is performed on a commercial microscope (QSM), enabling fast localization of the sample region when switching between modes. NV imaging provides insight beyond static field imaging [4]. Here we use scanning relaxometry (T1) to image the GHz magnetic noise present in the sample. The combination of methods enables an in-depth study of magnetic textures in BiYIG, with NV extending the capabilities of well-established techniques by measuring the coupling of the NV spin state to spin fluctuations in the material.
[1] Kazakova et al; J. Appl. Phys., 2019, 125, 060901. [2] Kimel et al; J. Phys. D: Appl. Phys., 2022, 55, 463003. [3] Degen; Appl. Phys. Lett, 2008, 92, 243111. [4] Finco et al.; Nat. Comm., 2021, 12, 767.

MA 6.10 Mon 12:00 POT/0361

Nanoscale mapping of magnetic orientations with complex x-ray magnetic linear dichroism — •Marina Raboni-Ferreira[1,2], Benedikt J. Daurer[3], Jeffrey Neethirajan[1], Andreas Apseros[4,5], Sandra Ruiz-Gómez[1,6], Burkhard Kaulich[3], Majid Kazemian[3], and Claire Donnelly[1,7] — [1]MPI CPfS, Dresden, Germany — [2]UNICAMP, Campinas, Brazil — [3]DLS, Didcot, UK — [4]ETH, Zurich, Switzerland — [5]PSI, Villigen, Switzerland — [6]ALBA, Barcelona, Spain — [7]WPI-SKCM2, Hiroshima, Japan

Compensated magnets are of increasing interest for both fundamental research and applications, as their net-zero magnetization enables ultrafast dynamics and robust order. To understand and control this order, nanoscale mapping of local domain structures is essential. Here, we combine X-ray magnetic linear dichroism (XMLD), a spectroscopic technique sensitive to the local Néel-vector orientation, with ptychography, a coherent X-ray imaging technique, to obtain high-resolution images of in-plane magnetic orientations in a model sample exhibiting a Landau pattern. By combining these techniques with an unsupervised machine learning approach, we retrieve the full complex XMLD spectrum of the sample, and map its magnetic domains with sub-100-nm resolution. Our results show that phase contrast is significantly stronger than the corresponding absorption contrast, offering higher spatial resolution imaging. This establishes phase contrast as a high-resolution mechanism for mapping magnetic orientations and paves the way toward higher-dimensional X-ray imaging, including Néel-vector orientation tomography of antiferromagnets.

MA 6.11 Mon 12:15 POT/0361

Development of in-house high-yield in-situ TEM chip production with magnetic thin-films — •Sindre Vie Jørgensen[1], Patrick R. B. Thomassen[1], Trond Hauklien[1], Marthe Linnerud[1], Asle Sudbø[1], David Barriet[1,2], and Magnus Nord[1] — [1]IFY, NTNU, Norway — [2]NYB Partner DA

Transmission Electron Microscopy (TEM) is a powerful tool for studying materials at the nanoscale. For future device materials, being able to apply a biasing voltage during TEM imaging is highly advantageous for observing magnetic domain responses at the nanoscale. We have developed a 'frontside-then-backside' method to create in-situ biasing TEM chips for as-deposited thin-film samples. This creates 100+ chips from a 4" Si wafer per production batch, which is highly customisable, allowing for multiple designs, TEM window dimensions, and circuit layouts simultaneously, with little variation in production time. This method has been tested with 20 nm thick, 5 um wide permalloy thin films with two narrow sections, 2,5 um wide, for a local increase in current density. Bias has been applied during magnetic Lorentz TEM (LTEM) to verify in-situ capabilities by shifting magnetic domain walls within the film via thermal excitation. This greatly expands the utility of the TEM for studying device-relevant magnetic materials, as simultaneous in-situ studies of the magnetics, structure and composition become possible.

MA 6.12 Mon 12:30 POT/0361

Scanning Magnetometry of van der Waals magnets under in-situ controlled strain — •Yuchen Zhao[1], José Claudio Corsaletti Filho[1], Chenhui Zhang[2], Yejin Lee[1], Young-Gwan Choi[1], Elina Zhakina[1], Hyunsoo Yang[2], Elena Gati[1], Claire Donnelly[1], and Uri Vool[1] — [1]Max Planck Institute for Chemical Physics of Solids, Dresden, Germany — [2]National University of Singapore, Singapore, Singapore

In recent years, van der Waals (vdW) magnets have emerged as one of the promising research directions in the field of condensed matter physics. Due to their thin nature, vdW magnets are mechanically more flexible than their bulk counterparts, allowing them to withstand greater strain. Because strain distorts the lattice, it is expected to modify magnetic properties and may even stabilize new magnetic states. While magnetic imaging of vdW materials has so far been limited to small applied strains, achieving and visualizing magnetic textures under large strain remains a significant challenge. Here, we report a technique that enables large in-situ controlled strain engineering of vdW magnets under scanning probe microscopy at room temperature. We use a piezoelectric actuator-based uniaxial strain cell to strain Fe_3GaTe_2 flakes as a proof-of-principle example of our method. By incorporating this setup into the Magnetic Force Microscope (MFM), we can locally probe the influence of strain on magnetic textures, revealing strain modulation of the magnetic configuration. In the future, this setup will open the investigations of strain-induced magnetic effects in a broad class of vdW systems.

MA 7: Poster Magnetism I

Time: Monday 9:30–12:30 Location: P2

MA 7.1 Mon 9:30 P2

Gapped ground state in a new V(IV) based sawtooth chain — •Ralf Feyerherm[1], Tim Müller[2], and Gündog Yücesan[2] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie, 14109 Berlin — [2]Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf

The sawtooth chain (or delta chain) consists of edge-sharing triangles of magnetic ions carrying Heisenberg spins. Assuming antiferromagnetic interactions between the spins, it is a relatively simple model system for studying the effect of magnetic frustration. Despite extensive theoretical literature, experimental realizations of antiferromagnetic sawtooth chains are very rare. Recently, we (TM and GY) synthesized $[VO(2,2'\text{-bpy})(H_2O)][V(\mu\text{-}O)(C_6H_5PO_3)_2]2H_2O$, a new Vanadyl complex, in which V(IV) ions with $S = 1/2$ form a sawtooth chain. The T dependence of the magnetic susceptibility χ suggests a dimerized state with $J = 18$ K and a gap of 36 K, consistent with heat capacity data. Notably, $\chi(T)$ cannot be well described by the Bleaney-Bowers equation, suggesting that a simple dimer model does not work. The magnetization $M(H)$ at 2 K starts to increase steeply above ≈ 80 kOe and reaches a value of $0.065\mu_B$ per f.u. at 140 kOe. High-field magnetization measurements are under way to search for a possible $M_{sat}/2$ plateau predicted theoretically for a specific range of parameters.

MA 7.2 Mon 9:30 P2

Disorder-driven magnetic duality in ktenasite — •Anton Kulbakov[1], Kaushick Parui[1], Roman Gumeniuk[2], Eduardo Carrillo-Aravena[3,4], María Teresa Fernández-íiaz[5], Stanislav Savvin[5,6], Artem Korshunov[7], Sergey Granovsky[1], Thomas Doert[3], Dmytro Inosov[1], and Darren Peets[1] — [1]IFMP, TUD, Dresden, Germany — [2]Institut für Experimentelle Physik, TU Bergakademie Freiberg, 09596 Freiberg, Germany — [3]Fakultät für Chemie und Lebensmittelchemie, TUD — [4]Würzburg-Dresden ct.qmat, TUD, Dresden, Germany — [5]ILL, 71 avenue des Martyrs, CS 20156, 38042 Grenoble CEDEX 9, France — [6]ICMA, Facultad de Ciencias, CSIC Universidad de Zaragoza, 50009 Zaragoza, Spain — [7]DIPC, Paseo Manuel de Lardizábal, 20018 San Sebastián, Spain

Ktenasite is a rare platform where structural disorder tunes the effective dimensionality and stabilizes coexisting ordered and glassy magnetic phases, offering a unique opportunity to explore the interplay of frustration, disorder, and dimensional crossover in quantum magnets. Neutron diffraction reveals significant Cu/Zn mixing at the Cu2 site, which tunes the Cu^{2+} sublattice from a two-dimensional scalene-distorted triangular lattice into a one-dimensional spin-chain network. Magnetic susceptibility, neutron diffraction, ac susceptibility, and specific heat measurements collectively indicate magnetic duality.

MA 7.3 Mon 9:30 P2

Using applied magnetic fields to induce unconventional magnetic order in the frustrated quantum magnet, clinoatacamite, Cu2Cl(OH)3 — •Juliana Avtarovski[1], Kirrily Rule[1,2], Leonie Heinze[3,4], Stefan Sullow[3], Michael Lerch[1], Moeava Tehei[1], and Siobhan Tobin[2] — [1]School of Physics, University of Wollongong, NSW 2522, Australia — [2]Australian Centre for Neutron Scattering, Australian Nuclear Science and Technology Organisation, Lucas Heights, NSW 2234, Australia — [3]Institut für Physik der Kondensierten Materie, Technische Universität Braunschweig, D-38106 Braunschweig, Germany — [4]Jülich Centre for Neutron Science (JCNS) at Heinz Maier-Leibnitz Zentrum (MLZ), Forschungszentrum Jülich GmbH, 85748 Garching, Germany

The natural mineral clinoatacamite, [Cu2Cl(OH)3], exhibits low-temperature, frustrated magnetic behaviour where competing interactions are responsible for novel magnetic properties. Attempts to establish the magnetic phases in this material have been undertaken and an unconventional applied field (H||b) phase diagram has been revealed. Two critical transition temperatures at zero field have been identified with long range antiferromagnetic (AFM) order for T1 < 6K, and paramagnetic behaviour for T2 >18K. In-field magnetisation data collected between 6-18K reveal three distinct phases for H||b which are not completely understood. Until now, the phase diagram of clinoatacamite has not been probed for H||a* or H||c*. We present neutron scattering of single crystal clinoatacamite in applied fields to map out the phase diagram for H||a*.

MA 7.4 Mon 9:30 P2

Optimization of Neural Quantum States for Frustrated and Chiral Spin Hamiltonians — Andreas Haller, •Stefan Liscak, Vladislav Kuchkin, Andreas Michels, and Thomas Schmidt — University of Luxembourg

Neural quantum states (NQS) offer a versatile variational Ansatz for the study of strongly correlated quantum systems, especially when dimensionality or frustration restricts the use of traditional tensor-network techniques. In order to facilitate effective ground-state searches for such Hamiltonians, we introduce a custom optimization code base. We evaluate the performance of our framework's implementations of the stochastic reconfiguration (SR) and the minimal-step SR (minSR) scheme against well-known NQS optimizers like those available in NetKet. For standard test cases, our results achieve accuracy similar to matrix product state methods (DMRG), demonstrating the competitiveness and robustness of the optimization protocols. Based on these validations, we have investigated an extension of the variational Ansatz that incorporates parameter-dependent local rotations of the computational basis directly into the optimization process. This concept is inspired by earlier findings that, following appropriate local spin rotations, skyrmionic matrix-product states show significant overlap with the simple product states. We studied the effect of adaptive basis rotations in chiral and frustrated systems on sampling requirements and convergence.

MA 7.5 Mon 9:30 P2

Single-crystal growth of intermetallic compounds using the optical floating-zone method — •Moritz Scheffer[1], Florian Kübelbäck[1], Leo Maximov[1], Andreas Bauer[1], and Christian Pfleiderer[1,2,3] — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]Heinz Maier-Leibnitz-Zentrum (MLZ), Technische Universität München,Garching,Germany — [3]Munich Center for Quantum Science and Technology (MCQST), Technical University of Munich, Garching, Germany

High-quality single crystals are an important prerequisite for major advances in experimental solid-state research. To ensure high degree of structural order with a small crystalline mosaicity, low concentrations of defects and impurities, and the absence of parasitic phases, it is crucial to avoid contaminations in every step of the preparation process [1]. The central part of our preparation process is the optical floating zone technique. After moving to a new laboratory, we have re-established our ultra-high vacuum compatible preparation chain for intermetallic compounds and demonstrated its potential by preparing samples from several compound, such as the potentially frustrated paramagnet Fe_2Al_5 [2].

[1] A.Bauer Rev. Sc. 87, 113902 (2016) [2] Ji Chi Ph. Rev. B 82, 174419 (2010)

MA 7.6 Mon 9:30 P2

Rare-earth substitution tuning of a proximate quantum spin-ice pyrochlore — •Yinghao Zhu, Jonathan Gustavo Acosta Ramon, and Yixi Su — JCNS-MLZ, Forschungszentrum Jülich GmbH, Garching, Germany

Pyrochlore-structure frustrated magnets with the general formula R2B2O7 (where R represents magnetic 4f rare-earth ions and B is a non-magnetic cation) consist of a three-dimensional network of corner-sharing tetrahedra. This 3D geometry gives rise to a richer landscape of magnetic interactions and spin configurations compared to their 2D counterparts, such as triangular or kagome latices. The nature of the magnetic anisotropy depends on the specific rare-earth ion: for instance, in Nd2Zr2O7, the Nd3+ ions exhibit local (111) Ising anisotropy, leading to an all-in-all-out antiferromagnetic ground state. In contrast, Yb2Ti2O7 hosts XY-like spins with moments confined to planes perpendicular to the local (111) axes. In this work, we introduce partial substitution of Nd3+ into Yb2Ti2O7, aiming to perturb the pure XY anisotropy of Yb3+ with Ising-like contributions from Nd3+. This allows us to explore the interplay between different types of magnetic anisotropy within the geometrically frustrated pyrochlore framework. Building on the high-quality single crystal obtained, future neutron scattering studies on YbNdTi2O7 are expected to provide valuable insights into the anisotropic spin correlations and potential emergent quantum phenomena arising from the interplay of Ising and XY interactions.

MA 7.7 Mon 9:30 P2

Echo pulses of ultrafast terahertz spintronic emitters — •Krishna Rani Sahoo[1], David Stein[2], Jannis Bensmann[1], Robert Schmidt[1], Steffen Michaelis de Vasconcellos[1], Manfred Albrecht[2], and Rudolf Bratschitsch[1] — [1]University of Münster, Institute of Physics, 48149 Münster, Germany — [2]University of Augsburg, Institute of Physics, 86159 Augsburg, Germany

In its simplest form, an ultrafast terahertz (THz) spintronic emitter consists of a ferromagnetic layer (e.g. Fe) and a nonmagnetic layer (e.g. Pt), grown on an insulating substrate (e.g. sapphire). THz time-domain spectroscopy is a powerful tool for investigating the ultrafast dynamics in THz spintronic emitters. The measured THz waveform provides not only access to the amplitude but also to the phase. Interestingly, additional echo pulses are found in the THz emission of spintronic emitters. We show that these delayed THz pulses are due to reflections of either the optical pump pulse or the THz pulse at different interfaces of the spintronic emitter. Our study provides design strategies for novel spintronic THz emitters with tailored pulse sequences.

MA 7.8 Mon 9:30 P2

Narrow Band THz Emission from micropatterned STEs — •Nikos Kanistras[1], Bikash Das-Mohapatra[1], Seth Kurfman[1], Quentin Remy[2], Reza Rouzegar[2], Tobias Kampfrath[2], and Georg Schmidt[1] — [1]Institut für Physik, Martin-Luther Universität Halle Wittenberg, Von-Danckelmann-Platz 3, 06120 Halle, Germany — [2]Department of Physics, Freie Universität Berlin, 14195 Berlin, Germany

It has recently been demonstrated that Spintronic THz Emitters (STEs) made of metallic multilayers can be used to create ultrashort and broad band THz emission. Such STEs show great potential to complement or even replace conventional semi conducting THz sources due to their straightforward and cost-effective fabrication techniques resulting in seamless on-chip integration with modern device technologies[1, 2]. While quite often the broad band emission is highly desirable, in some cases narrow band or even single frequency emission is preferred, for example for spectroscopy applications.

In this work we present devices for narrow band emission of THz radiation in the range of 1-20THz, based on CoFeB/Pt STE. The samples use a striped emitter on a wedge of a material with an index of refraction >1 (e.g. glass). Our results demonstrate a viable and straightforward method to produce controlled emission in a deterministic THz frequency band, supported by a simple model.

[1] Seifert, T. et al. Nature Photon 10, 483-488 (2016).

[2] Georg Schmidt et al. Phys. Rev. Appl., 19:L041001, Apr 2023.

MA 7.9 Mon 9:30 P2

Switching the magnetization of quantum antiferromagnets: Schwinger boson mean-field approximation gauged with exact diagonalization — Florian Johannesmann, •Asliddin Khudoyberdiev, and Götz S. Uhrig — Condensed Matter Theory, TU Dortmund University, Otto-Hahn-Straße 4, 44227 Dortmund, Germany

For operation on the THz scale, antiferromagnets (AFM) are preferable to commonly used ferromagnets. Also, the lack of stray fields allows for much higher densities of bits. Still, efficient switching of the AFM order and the control of its orientation remain one of the main challenges for applications. Recently, we developed a time-dependent Schwinger boson mean-field theory, to study the sublattice magnetization in anisotropic quantum AFMs [1,2]. To corroborate the obtained results, we compare the short-time dynamics of the mean-field approach to exact numerical calculations for small clusters. We obtained a good agreement: The numerical approach corroborates our mean-field findings, with only about 6 % deviations.

[1] K. Bolsmann, A. Khudoyberdiev, and G. S. Uhrig, PRX Quantum 4, 030332 (2023) [2] A. Khudoyberdiev and G. S. Uhrig, Phys. Rev. B 109, 174419 (2024); Phys. Rev. B 111, 064408 (2025); SciPost Phys. 19, 117 (2025)

MA 7.10 Mon 9:30 P2

Ultrafast Magnetization Dynamics of the self-intercalated vdW ferromagnet Cr_xTe_y — •Maximilian Staabs[1], Tim Titze[1], Pia Henning[2], G.S.Matthijs Jansen[1], Stefan Mathias[1], Jasnamol Palakkal[2], and Daniel Steil[1] — [1]I. Physikalisches Institut, University of Goettingen — [2]Institute for materials physics, University of Goettingen

The groundbreaking discovery of ferromagnetic ordering in layered two-dimensional $CrTe_2$ at ambient temperature [1] has sparked the research interest in chromium-tellurides over the last several years, establishing Cr_xTe_y as a premier platform for next generation spintronics or skyrmionic devices [2].

While the role of intercalation on the magnetic ordering in a static setting is well understood, its impact on ultrafast dynamics remains unclear. Here we use time-resolved MOKE and transient reflectivity measurements to identify the role of intercalation on the ultrafast dynamics in thin films of $CrTe_2$ and Cr_2Te_3 fabricated by hybrid pulsed laser deposition [3]. The pump-probe experiments reveal several significant differences in the ultrafast magnetization dynamics, including the appearance of heavily damped magnon modes at lower temperatures of Cr_2Te_3, as well as significantly stronger coherent phonon modes in $CrTe_2$.

[1] Freitas *et al.*, *J. Phys.: Condens. Matter* **27** 176002 (2015).
[2] Zhang *et al.*, *Adv. Mater.* **35**, 2205967 (2023).
[3] Henning *et al.*, Preprint 10.21203/rs.3.rs-4861088 (2024).

MA 7.11 Mon 9:30 P2

Coupled Magnon-Phonon Dynamics: From Ab Initio Boltzmann Transport to the Three-Temperature Model — •Philipp Rieger, Markus Weissenhofer, and Peter M. Oppeneer — Uppsala University, Uppsala, Sweden

The ultrafast transfer of angular momentum and heat between spin and lattice subsystems is key to spintronics, recently demonstrated to occur on sub-picosecond timescales [1]. While the Three-Temperature Model (3TM) remains a cornerstone for describing this ultrafast demagnetization, its crucial spin-lattice coupling parameter, G_{sl}, typically relies on empirical fitting [2]. To address this, we developed an atomistic framework [3,4] that solves the coupled magnon-phonon Boltzmann transport equation based solely on ab initio inputs. Applied to bcc Fe and fcc Ni, we resolve real-time mode-level dynamics, transport properties, and quasiparticle lifetimes. Crucially, we demonstrate for the first time that the macroscopic 3TM spin-lattice coupling emerges as a valid linear approximation of the underlying non-thermal microscopic dynamics. Consequently, we derive a first-principles G_{sl} that reproduces the seminal results of Beaurepaire et al. [2], unifying the microscopic and phenomenological descriptions of ultrafast spin-lattice dynamics.

[1] S. R. Tauchert et al., Nature **602**, 73–77 (2022)
[2] E. Beaurepaire et al., PRL **76**, 4250 (1996)
[3] S. Mankovsky et al., PRL **129**, 067202 (2022)
[4] M. Weissenhofer, P. Rieger et al., PRL **135**, 216701 (2025)

MA 7.12 Mon 9:30 P2

Fluence dependency of ultrafast-demagnetization in Gadolinium and Terbium — •Timo Dully, Christian Strüber, and Martin Weinelt — Freie Universität Berlin

The magnetic moment in rare-earth metals is primarily determined by the 4f orbitals. Upon optical pumping, the 4f spin polarization decays on markedly different timescales in Gd and Tb of 14 ps and 0.4 ps, respectively. Earlier studies attributed this difference to the stronger magnetocrystalline anisotropy of Tb relative to Gd [1].

Optical excitation of the 5d6s electrons transfers energy to the phonon system; the 4f orbitals are strongly localized and tightly coupled to the lattice. Recent measurements, however, have revealed direct 5d - 4f electron scattering upon optical excitation of Tb, offering an alternative explanation for the differing response times. The first 4f multiplet excitation in Tb requires 0.26 eV, whereas the corresponding excitation energy in Gd is 4.1 eV. Thus hot electrons in the 5d6s valence bands excite 4f electrons via inelastic electron-electron scattering in Tb but not in Gd [2] This should lead to an ultrafast equilibration of 5d and 4f electron temperatures in Tb.

Motivated by these findings, we investigate the fluence dependence of the valence-electron temperature. Using a tr-ARPES setup with 1300 nm pump and XUV probe pulses, we determine the electron-temperature dependence on pump fluence.

[1] B. Frietsch et al., *Sci. Adv.* **6**, eabb1601 (2020)
[2] N. Thielemann-Kühn et al.,*Sci. Adv.* **10**, eadk9522 (2024)

MA 7.13 Mon 9:30 P2

Magnetic properties of Mn_3Sn layer systems — •Paul Marschall[1], Wolfgang Hoppe[1], Prajwal Rigvedi[2], Banabir Pal[2], Georg Woltersdorf[1], and Stuart Parkin[2] — [1]Martin Luther University Halle-Wittenberg, Institute of Physics, Halle (Saale), Germany — [2]Max Planck Institute of Microstructure Physics, Halle (Saale), Germany

Illuminating a nanometer thin metallic bilayer consisting of a ferromagnetic (FM) and a non-magnetic layer (NM) with an intense femtosecond laser pulse launches an ultrafast spin current from the FM into the NM layer where it is subsequently converted into a charge current pulse via the inverse spin Hall effect. This system is established as a so called spintronic terahertz emitter (STE) usable either as a source for THz radiation [1] or for on-chip ultrafast current pulses [2]. The polarity of radiation or current can be fully inverted by switching the magnetization of the FM layer. In this study we focus on the magnetic cluster moment of the non-collinear antiferromagnet Mn_3Sn [3] replacing the FM layer of the canonical STE. The on-chip ultrafast current pulses generated by single Mn_3Sn layers or Mn_3Sn|Pt layer systems are measured with the help of a fast sampling oscilloscope and coplanar microwave probe tip [2]. The conducted experiments allow to analyze the reorietation of the in-plane magnetic cluster moment due to external magnetic fields.

[1] T. Seifert et al., Nat. Photon. 10, 483-488 (2016)
[2] W. Hoppe et al., ACS Appl. Nano Mater. 4, 7454-7460 (2021)
[3] B. Pal et al., Sci. Adv. 8, eabo5930 (2022)

MA 7.14 Mon 9:30 P2

Femtosecond spin dynamics in Ni and Fe probed by transient x-ray magnetic circular dichroism — •L. Endler[1], M. Elhanoty[2], T. Lojewski[3], L. Le Guyader[4], G. Mercurio[4], B. van Kuiken[4], J. Tasto[5], L. Kämmerer[5], A. Delin[6], O. Eriksson[2], O. Granas[2], U. Bovensiepen[5], H. Wende[5], K. Ollefs[1], and A. Eschenlohr[5] — [1]Univ. Heidelberg — [2]Uppsala Univ. — [3]Univ. of Tokyo — [4]European XFEL — [5]Univ. Duisburg-Essen — [6]KTH Sweden

Despite their simple compositions, elemental Fe, Ni and their alloys still spark questions with regard to ultrafast demagnetization dynamics after photoexcitation. By combining ultrafast X-ray absorption, circular dichroism spectroscopy (XMCD) and *ab intio* theory we aim to entangle the underlying processes in elemental Fe and Ni. Electronic correlations have been found to influence the dynamics at ultrafast timescales in elemental Ni [1]. We observed XMCD peak shifts toward lower photon energies at <1 ps timescales, followed by a shift towards higher energies at a few ps. Fe XMCD spectra showed an increase in L_3 and decrease in L_2 edge spectral area at $\approx$ 100 fs.

We acknowledge the financial support through the DFG within the framework of the CRC1242.

[1] T. Lojewski et al., Mater. Res. Lett., **11**, 655 (2023)

MA 7.15 Mon 9:30 P2

Development of a Laboratory Soft X-Ray Reflectometer for Ultrafast Magnetisation Studies — •Pierre Gautier[1], Clemens von Korff Schmising[1], and Stefan Eisebitt[1,2] — [1]Max Born Institut für Nichtlineare Optik und Kurzzeitspektroskopie, Berlin, Germany — [2]Technische Universität Berlin, Institut für Optik und Atomare Physik, Berlin, Germany

Ultrafast spectroscopy in the extreme ultraviolet (XUV) range is a powerful experimental tool for investigating ultrafast magnetisation dynamics, providing element-specific information and access to the non-equilibrium electronic density of states. Using reflection geometry, experimental observables also allow direct access to depth-dependent dynamics. In this study, we present the initial findings from a recently developed experimental setup optimised for broadband reflectometry of magnetic materials. Soft X-ray radiation is generated through high-harmonic generation using 100 kHz, sub-10 femtosecond laser pulses produced by a fibre laser with a two-stage pulse compression scheme. A high-resolution spectrometer optimised for photon energies between 45 eV and 180 eV is mounted on a goniometer arm, allowing access to angles of incidence ranging from $\theta = 0°$ to $80°$. The goal of this research is to resolve the ultrafast dynamics of spatial magnetisation profiles, spin currents, and spin accumulation within functional heterostructures.

MA 7.16 Mon 9:30 P2

Ultrafast Rearrangement of Antiferromagnetic Spin order Probed with Femtosecond X-ray Diffraction — •Yoav William Windsor[1,2], Sang-Eun Lee[1], Daniela Zahn[1], Kristin Kliemt[3], Christian Schüssler-Langeheine[4], Niko Pontius[4], Denis Vyalikh[5], Urs Staub[6], Cornelius Krellner[3], and Laurenz Rettig[1] — [1]Fritz Haber Institute der MPG, DE — [2]TU Berlin, DE — [3]Goethe-Universität Frankfurt, DE — [4]Helmholtz-Zentrum Berlin, DE — [5]DIPC, San Sebastián, ES — [6]Paul Scherrer Institut, Villigen, CH

Ultrafast spin manipulation carries great potential for future information technology. In particular, antiferromagnets offer the prospect of faster and more efficient spin dynamics, as well as exploitable magnetic properties that are unavailable in ferromagnets. One example is the internal arrangement of spins. Controlling this can alter how the antiferromagnet stores data, interacts with neighboring materials, etc.

Here we demonstrate manipulation of the spin structure in $Ln\mathrm{Rh_2Si_2}$ (Ln = Ho, Dy; see also [1-3]) by means of femtosecond optical excitation. We probe the transient spin arrangement using femtosecond resonant X-ray diffraction tuned to the Ln ions' $M_{4,5}$ edges ("soft X-rays"). By probing the azimuthal dependence of the transient magnetic Bragg intensity, we disentangle the ultrafast rearrangement of the spin order from ultrafast demagnetization.

1. Windsor et al., Communications Physics 3, 139 (2020)
2. Windsor et al., Nature Materials 21, 514-517 (2022)
3. Lee et al., Phys. Rev. Research 6, 043019 (2024)

MA 7.17 Mon 9:30 P2

Miniaturized Multipoles for Ultrafast Electron Microscopy — •Johannes Schultz[1], Max Herzog[1], and Axel Lubk[1,2] — [1]IFF, IFW Dresden, Helmholtzstraße 20, 01069 Dresden — [2]IFMP, TU Dresden, Haeckelstraße 3, 01069 Dresden

Ultrafast Electron Microscopy (UEM) is an emerging technique developed in the last decades. By combining the high spatial resolution of EMs with a temporal resolution down to fs, it provides insights into dynamic processes in the field of nanophotonics, magnetodynamics, and lattice motion among others. Most UEM setups use pumped electron sources, which provide the highest time resolution but suffer from a limited repetition rate (≈10 MHz), are expensive and technically complex and hence difficult to (retro)fit into EMs. We therefore propose an alternative technique based on easy-to-retrofit, miniaturized (for fast switching) magnetic multipoles chopping the beam to short pulses. They consist of planar copper electrodes with permalloy pole pieces on top (≈ 50 μm size), which are structured by lithography on a silicon wafer. The devices are supplied with radio-frequency electrical signals via a custom made holder compatible with standard ports of our EM (FEI Titan[3]), which allows for easy device integration into the central part (C2 aperture plane) of the condenser system. In the lower part of the EM, the beam is chopped by a small aperture (C3 aperture). Considering the magnification of the condenser system, the optical power of the devices (100 μrad deflection at 3 GHz and 300 keV electron energy) and the diameter of the chopping aperture (150 nm), a time resolution of ≈ 1 ps at repetition rates ≫ 10 MHz can be achieved.

MA 7.18 Mon 9:30 P2

Magnetization-dependent electronic structure and ultrafast electron dynamics in CrGeTe3 — •Tulio de Castro[1], Samuel Beaulieu[1], Shuo Dong[1], Maciej Dendzik[1], Tommaso Pincelli[2], Lawson Lloyd Lloyd[2], Ralph Ernstorfer[2], Martin Wolf[1], and Laurenz Rettig[1] — [1]Fritz-Harber-Institut der Max-Planck-Gesellschaft, Berlin — [2]I0AP, Technische Universität Berlin, Berlin.

Magnetic 2D van-der-Waals materials offer novel opportunities for spin-based nanodevices, with advantages over charge-based technologies. One promising material is the semiconductor CrGeTe3 (CGT), which exhibits ferromagnetic order below the Curie temperature(TC=63 K). Here, we investigate bulk CGT using femtosecond time and angle-resolved photoemission spectroscopy(trARPES), to elucidate how magnetic order modifies the electronic structure, and to directly measure the ultrafast dynamics of exchange splitting and demagnetization. We observe a temperature-dependent shift in band energies below TC, associated with magnetic order. Upon femtosecond optical excitation, we observe an ultrafast renormalization of band energies, which we discuss in terms of transiently modified exchange splitting and superexchange pathways. Our results provide a direct ultrafast timescale for electron redistribution in magnetically ordered CGT, and give insight into the pathways of spin-electron interactions in CGT.

MA 7.19 Mon 9:30 P2

Time-resolved resonant magnetic small-angle scattering with a laser-driven soft-X-ray plasma source — •Pascal Wernicke[1], Maximilian Mattern[1], Johannes Tümmler[1], Stefan Eisebitt[1,2], and Daniel Schick[1] — [1]Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie, Berlin, Germany — [2]Institut für Physik & Astronomie, TU Berlin, Germany

Resonant soft-X-ray scattering methods provide unique possibilities to study nanometer-scale magnetization states with element selectivity. Employing ultrashort pulsed X-ray sources accesses the laser-induced dynamics on ultrafast timescales beyond a spatially-averaged insight. Based on a laser-driven plasma X-ray source, we have developed a novel instrument to carry out time-resolved magnetic small-angle X-ray scattering (SAXS) experiments in the soft-X-ray range between 500 and 1500 eV with sub-10 ps temporal resolution. Due to the flexibility of our laboratory-scale setup, we can further vary the sample environment, e.g., by applying external magnetic fields as well as cryogenic temperatures, and hence investigate ground-state-dependent dynamics of emergent textures such as magnetic domains. Specifically, we aim at following laser-driven dynamics of spatially heterogenous phase transitions, e.g. during the prototypical magneto-structural antiferromagnetic (AFM) to ferromagnetic (FM) transition in FeRh. Here, resonant magnetic SAXS can resolve the relevant time and length scales on which FM domains emerge during this first-order transition.

MA 7.20 Mon 9:30 P2

Impact of crystallographic cuts on the magnetoelectric switching of Cr_2O_3. — •Anuvrat Tripathi, Igor Veremchuk, Oleksandr V. Pylypovskyi, Pavlo Makushko, and Denys Makarov — Helmholtz-Zentrum Dresden-Rossendorf e.V., Bautzner Landstrasse 400, 01328 Dresden, Germany

The phenomenon of magnetoelectric (ME) switching in Cr_2O_3 has been demonstrated to facilitate the control of magnetism by an electric field, a property that renders it a subject of considerable interest for applications in low-power spintronics and memory devices [1]. However, the dependence of switching efficiency on crystallographic orientation remains poorly understood [2]. A systematic study of magnetic switching in bulk Cr_2O_3 single crystals with different crystallographic cuts and epitaxial Cr_2O_3 thin films grown on Al_2O_3 substrates with varying orientations has been conducted. By applying fields over a transition from the paramagnetic to the magnetically ordered state, we are able to modify the distribution of the antiferromagnetic (AFM) domains in Cr_2O_3 and identify this change via magnetotransport. A comparison between single crystals and thin films reveal the role of crystal-cut symmetry and epitaxial grown in governing the switching process. The results of this study make it possible to optimize controlled magnetism in spintronic devices based on Cr_2O_3.

[1] P. Rickhaus, O. V. Pylypovskyi et al., Nano Letters 24, 13172 (2024).

[2] O. Pylypovskyi et al., Phys. Rev. Lett. 132, 226702 (2024).

MA 7.21 Mon 9:30 P2

Ferromagnetic Cellulose Nanocomposite for Coating and Filament Production toward Flexible Electronic Materials — •Andrei Chumakov[1], K. Gordeyeva[2], C.J. Brett[1,2], D. Menzel[3], A.V. Riazanova[2], M. Schwartzkopf[1], and D. Soederberg[2] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]KTH Royal Institute of Technology, Stockholm, Sweden — [3]Technische Universität Braunschweig, Braunschweig, Germany

Nanocellulose is a renewable, lightweight, and robust platform for sustainable flexible electronics. Imparting stable ferromagnetism enables thin, patternable, biodegradable components for sensing, tagging, and memory. We report a ferromagnetic nanocomposite via electrostatic co-assembly of negatively charged cellulose nanofibrils (-1360 μmol g^{-1}) with positively charged strontium hexaferrite nanoplatelets. Opposite charges ensure homogeneous dispersion and high coercivity retention of the final composite. Spray-coated films (10-100 nm) on silicon show uniform loading, in-plane nanoplatelet alignment (SEM/SAXS/WAXS), and coercive fields matching hard-magnetic particles. In parallel, we produce magnetic filaments by (i) co-extruding aligned CNFs with ferrites via gelation and (ii) coating CNF yarns with ferrite sheaths. These fibers retain nanocellulose's high specific modulus (60 GPa·cm^3/g) and >1000 MPa strength while gaining magnetic functionality. Together, these coatings and fibers offer a scalable, water-based techniques to magnetically active, biodegradable media.

MA 7.22 Mon 9:30 P2

Copper- and zinc-substituted nanocrystalline ferrites for biomedical applications — •Todor R. Karadimov, Milena T. Georgieva, and Petar A. Georgiev — Faculty of Physics, Sofia University St. Kliment Ohridski, Department of Condensed Matter Physics and Microelectronics, Sofia, 1164, Bulgaria

Worlwide concern of antibiotic resistance has prompted the research of novel, inorganic nanomaterials, effective against pathogens. Nanocrystalline copper- and copper/zinc-substituted ferrites were prepared under solvothermal synthesis conditions at temperatures up to 200°C. The samples' crystalline phases, particle shape and size, and magnetic properties at ambient temperatures, were determined by powder x-ray diffraction, electron microscopies, and vibrating sample magnetometry, respectively. These revealed that the resultant Cu-modified ferrites consisted of agglomerates of nanocrystalline iron ferrite, Fe_3O_4, with metallic copper inclusions. In the zinc-substituted samples the resultant precipitate consisted of agglomerates of a superparamagnetic spinel phase, e.g. $Zn_{0.6}Fe_{0.4}Fe_2O_4$, with nano-crystalline copper particles spread within them. The zinc-substituted samples showed a maximum magnetization of 30 emu/g, which is significant for practical applications. Antimicrobial agar well tests against Gram-positive and Gram-negative bacteria Escherichia coli ATCC 25922 and Staphylococcus aureus ATCC 25923 showed moderate activity of all investigated materials, correlating with the copper content and particle size. However, *Daphnia magna* toxicity tests indicated strong ecotoxicity, suggesting uncontrolled release in the environment should be avoided.

MA 7.23 Mon 9:30 P2

Machine Learning assisted 3D Tracking, Evaluation and Analysis of near-substrate transported Superparamagnetic Microparticles for Intelligent Experimentation and Sensing Applications — •Nikolai Weidt[1,2], Nikita Popkov[2,3], Yahya Shubbak[1,2], Rico Huhnstock[1,2], Kristina Dingel[2,3], Bernhard Sick[2,3], and Arno Ehresmann[1,2] — [1]Institute for Physics and CINSaT, University of Kassel, Heinrich-Plett-Str. 40, 34132 Kassel, Germany — [2]AIM-ED, Joint Lab of Helmholtzzentrum für Materialien und Energie, Berlin (HZB) and University of Kassel, Hahn-Meitner-Platz 1, 14109, Berlin, Germany — [3]Intelligent Embedded Systems, University of Kassel, Wilhelmshöher Allee 71-73, 34121, Kassel, Germany

We present a framework for intelligent control and analysis of superparamagnetic microparticles transported above magnetic domain-patterned samples. Particles are actuated by tailored magnetic stray field landscapes and external field pulse sequences, enabling remote-controlled, near-surface motion. Implementing the open-source TANGO Controls system, the setup supports modular hardware integration, synchronized operation and live data evaluation. Real-time 3D particle trajectory reconstruction can be achieved by combining deep-learning-based tracking with an automated focus-sweep calibration. This closed-loop approach paves the way for rapid evaluation of particle interaction events and supports adaptive experiments, advancing lab-on-a-chip biosensing and machine-learning-assisted diagnostics.

MA 7.24 Mon 9:30 P2

Enhancement of Magnetic and Photocatalytic properties of MnZn/CdZn core/shell structures via lattice matching. — •Ahmed Faramawy, Hesham El-Sayed, Adel Abdel-Sattar, and Romany Nessem — Ain Shams University, Cairo, Egypt

Core/shell nanostructures of ferrite as shell (Mn0.7Zn0.3Fe2O4/CdxZn1-xFe2O4 (x = 0-0.)) were successfully synthesized via a hydrothermal route to explore the role of lattice matching on their structural, magnetic, optical, and photodegradation properties. X-ray diffraction and Rietveld refinement confirmed the formation of single-phase spinel structures with coherent core/shell interfaces. TEM and EDX mapping verified uniform shell growth and compositional gradients, indicating true core/shell formation. Moreover, the saturation magnetization showed a 14% enhancement at x = 0.3 due to optimal lattice coherence and minimal interfacial strain. Optical analysis showed that the direct bandgap decreased. The observed bandgap narrowing and high Urbach energy at moderate Cd2+ levels indicate improved electronic mobility and reduced activation energy for charge transport. Furthermore, Photocatalytic activity studies confirm that the synthesized Mn0.7Zn0.3Fe2O4/CdxZn1-xFe2O4 core-shell nanocomposites have excellent photodegradation behaviour to methylene blue (MB) compared to the bare core.

MA 7.25 Mon 9:30 P2

Magnetic relaxation and structural characterization of single-core FeOx nanoparticle dispersions in solvents of varying viscosity — •Amala Thuruthiyil Jose[1,2], Sascha Ehlert[3], Artem Feoktystov[4], Andreas Stadler[3,2], Martin Dulle[3], and Oleg Petracic[1,5] — [1]Jülich Centre for Neutron Science JCNS-2, Forschungszentrum Jülich GmbH, Germany — [2]RWTH Aachen University, Landoltweg 2, 52056 Aachen, Germany — [3]Jülich Centre for Neutron Science JCNS-1, Forschungszentrum Jülich GmbH, Germany — [4]Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS) at MLZ, Lichtenbergstrasse 1, Garching, Germany — [5]Heinrich Heine University Düsseldorf, Faculty of Mathematics and Natural Sciences, Düsseldorf

We have investigated the structural and magnetic properties of monodisperse single-core iron-oxide nanoparticles dispersed in solvents of systematically varied viscosity. The particles were synthesized via thermal decomposition. Magnetic measurements were performed using SQUID magnetometry, employing zero-field-cooled (ZFC) and field-cooled (FC) curves to probe changes in blocking behavior and relaxation dynamics. To examine the influence of the solvent environment on particle stability, SAXS measurements were carried out. We observe clear viscosity-dependent shifts in the nanoparticle solvent system, reflecting the gradual emergence of Brownian relaxation as solvent mobility increases. The observed viscosity and phase-dependent magnetic signatures demonstrate how solvent dynamics can be used to tune and separate Néel and Brownian relaxation.

MA 7.26 Mon 9:30 P2

Coexistence of ferromagnetism and spin-glass behaviour in CeNiSb3 — •Haribrahma Singh[1], Prabuddha Kant Mishra[1], Gaurav Kumar[2], Aarti Gautam[1], Rie Y. Umetsu[3], Ratnamala Chatterjee[2], and Ashok Kumar Ganguli[1,4] — [1]Department of Chemistry, Indian Institute of Technology Delhi, 110016, India — [2]Department of Physics, Indian Institute of Technology Delhi, New Delhi 110016, India — [3]Institute for Materials Research, Tohoku University, 2-1-1 Katahira, Aoba-ku, Sendai 980-8577, Japan — [4]Department of Chemical Sciences, Indian Institute of Science Education and Research, Berhampur, Odisha 760003, India

We present a comprehensive investigation of the structural and magnetic properties of of CeNiSb3. DC magnetization measurements confirm long-range ferromagnetic ordering below the Curie temperature TC = 7.2 K accompanied by marked magnetic irreversibility. In the ordered phase, CeNiSb3 exhibits strong magnetic anisotropy. Additionally, a field-induced spin-reorientation transition is observed along the b-axis at TC = 6.8 K. Non-equilibrium spin-dynamics measurements reveal a clear memory effect, and thermoremanent magnetization relaxations follow a stretched-exponential form with β=0.30, indicative of spin-glass like behaviour. This is corroborated by AC susceptibility, Power-law analysis yields a characteristic relaxation time of 10^-10s. Under an applied DC magnetic field, the AC susceptibility evolves from a single cusp to a double-peak structure, providing strong evidence for the coexistence of reentrant spin-glass and ferromagnetic ordering below TC in CeNiSb3.

MA 7.27 Mon 9:30 P2

Magnetic phase transitions in Z-type magneto-electric hexaferrites — •Borislava Georgieva[1], Petya Peneva[1], Svetoslav Kolev[1,2], Kiril Krezhov[1], Chavdar Ghelev[1], Lan Maria Tran[3], Michał Babij[3], Benedicte Vertruyen[4], Peter Tzvetkov[5], Daniela Kovacheva[5], and Tatyana Koutzarova[1] — [1]Institute of Electronics, Bulgarian Academy of Sciences, Sofia, Bulgaria — [2]Neofit Rilski South-Western University, Blagoevgrad, Bulgaria — [3]Institute of Low Temperature and Structure Research, Polish Academy of Sciences, Wroclaw, Poland — [4]CESAM, GREENMAT, Chemistry Institute, University of Liège, Liège, Belgium — [5]Institute of General and Inorganic Chemistry, Bulgarian Academy of Sciences, Sofia, Bulgaria

The difference is well known in the occurrence of strong magnetoelectric effects in single magnetoelectric materials (ferrites), depending on their physical state. The single-crystal Z-type hexaferrite Sr3Co2Fe24O41 exhibits a magnetoelectric effect at room temperature. We report studies on the structural and magnetic properties of Sr3Co2Fe24O41 in powder and bulk samples, focusing on the influence of the synthesis conditions. The precursor powders were prepared by sol-gel auto combustion and synthesized at 1200-1250 °C. XRD spectra showed characteristic peaks corresponding to the Z-type hexaferrite structure as a main phase. SEM images of the powder sample showed agglomerated particles forming clusters of different sizes and shapes, while in the bulk sample we observed large regions of hexagonal particles. Magnetic phase transitions between 4.2 and 300 K were observed.

MA 7.28 Mon 9:30 P2

Investigating magnetoelastic effects in multiferroic $CoCr_2O_4$ — •Abdelrahman Elsaid[1], Ryan Morrow[1], Robert Kluge[1], Sabine Wurmehl[1], Bernd Büchner[1,2], and Vilmos Kocsis[1] — [1]IFW-Dresden — [2]TU-Dresden

In a previous study based on optical spectroscopy, chromium-based spinels were found to exhibit significant magnetoelasticity if the magnetic A-site ion was occupied by a Jahn-Teller active ion. While the sentiment of this finding is true, optical spectroscopy is mostly sensitive to symmetry lowerings, and magnetoelasticity - meaning any sort of lattice deformation - may remain unnoticed in optics. Moreover, one of the chromium spinels with orbital singlet ions, $CoCr_2O_4$ is a known multiferroic, where the magnetoelectric interactions are originating from the conical spin order. It is an interesting question whether the polar distortion accompanying the spin order has a noticeable effect on the size of the unit cell, namely: can a piezo-magnetoelectric effect appear in $CoCr_2O_4$?

This motivated us to investigate $CoCr_2O_4$ using high-sensitivity capacitance dilatometry, a method not just sensitive to symmetry lowerings, but also to delicate changes in the size of the unit cell. We have found that, in line with the optical spectroscopy measurements, the unit cell shows zero change in size upon the appearance of the magnetic order. However, the application of magnetic field still reveals a significant magnetostriction in the magnetoelectric conical phase, which suggests the presence of piezo-magnetoelectric interactions.

MA 7.29 Mon 9:30 P2

Equilibrium control of quantum magnets via cavity magnetoelectric coupling — •Nicolas Schmölz[1], Beatriz Pérez González[2], Mónica Benito[2], Marcus Kollar[1], and Francesco Piazza[1] — [1]Theoretische Physik III, University of Augsburg — [2]Quanteninformation und Quantencomputing, University of Augsburg

We investigate the possibility of exploiting a cavity magneto-electric coupling mechanism, whereby spin excitations carry an electric dipole moment, in order to enhance the interactions between photons and correlated (quantum) magnets.

The free-energy of the material is modified by the hybridization between collective spin excitations and cavity photons. We provide estimates for the change in free energy for specific materials which are solely based on experimental input via the measurement of the optical conductivity and the magnetoelectric response.

Our results should guide future experimental realizations by identifying optimal magnetic materials and cavity designs, aiming at a non-invasive equilibrium control of material's phases and functionalities.

MA 7.30 Mon 9:30 P2

Magnetic phase transitions and spin-driven multiferroicity in BaHoFeO4 — •Filip Kadlec[1], Christelle Kadlec[1], Toan Dang[2], Denis Kozlenko[3], T.P. Hoang[2], Sergei Kichanov[3], LTP Thao[4], TL Phan[5], N Tran[2], Tomáš Kmječ[6], Jaroslav Kohout[6], Vojtěch Chlan[6], and Manh-Huong Phan[7] — [1]Institute of Physics CAS, Prague, Czechia — [2]Duy Tan Univ., Danang, Vietnam — [3]Dubna, Russia — [4]Univ. of Danang, Vietnam — [5]VNU Hanoi, Vietnam — [6]Fac.of Mathematics and Physics, Charles Univ., Prague — [7]Univ.of South Florida, Tampa, USA

Magnetic and multiferroic properties of $BaHoFeO_4$ originate in geometrical frustration and in interactions between Fe and Ho sublattices. The magnetic phase transitions remind of the parent compound $BaYFeO_4$ which exhibits an AFM order below the Néel temperature of 48 K. Below 3K, in magnetic field above 1.5 T, specific changes in the magnetic configuration lead to a spin- and H-induced ferroelectric polarization. As magnetic field increases, the ferroelectric polarization peaks, and it disappears above 5 T. Such an unusual ferroelectric behavior is likely related to H-induced metamagnetic phase transitions. We studied polycrystalline BaHoFeO4 using THz time-domain spectroscopy, X-ray diffraction, neutron powder diffraction, Mössbauer spectroscopy and magnetization measurements. Three different AFM structures were observed on cooling, as well as two metamagnetic phase transitions induced by magnetic field of up to 7 T. In view of the proven robustness of the sublattice of Fe spins, these changes of magnetic configurations are attributed to the frustrated Ho-spin sublattice.

MA 7.31 Mon 9:30 P2

Ab initio approaches to the dynamical magnetoelectric effect — •Torsten Geirsson[1], Davide Sangalli[2], and Alejandro Molina-Sánchez[1] — [1]ICMUV, University of Valencia, Spain — [2]ISM-CNR, Rome, Italy

The magnetoelectric (ME) tensor quantifies how an electric field induces magnetization and is key to understanding the coupling between electric and magnetic degrees of freedom. While most studies address the static ME response, its finite-frequency generalization reveals how electric fields drive magnetic excitations on ultrafast timescales. At optical frequencies, the ME effect can be resonantly enhanced by interband or excitonic transitions, giving rise to measurable nonreciprocal magneto-optical signals, as observed for Cr2O3.

We present a first-principles framework to compute the dynamical ME tensor in magnetic insulators, separating spin and orbital contributions and focusing on the electronic response. Approaches based on linear-response theory and real-time simulations are combined to access both equilibrium and transient ME dynamics. Using Cr_2O_3 as a prototypical example, we show how real-time propagation captures non-equilibrium ME effects induced by ultrafast electric-field pulses. Our work establishes a route for connecting ab initio ME response calculations with emerging ultrafast magneto-optical experiments.

MA 7.32 Mon 9:30 P2

High-resolution optical imaging of multiferroic domain topology in $ErMnO_3$ — •Andy Disheng An[1], Andrin Caviezel[1], Erik de Vos[1], Thomas Lottermoser[1], Jan Gerrit Horstmann[1,2], and Manfred Fiebig[1] — [1]Department of Materials, ETH Zürich, Switzerland — [2]Institute of Physical and Theoretical Chemistry, University of Würzburg, Germany

We present a study of the multiferroic domain structure in $ErMnO_3$ using scanning second-harmonic generation (SHG) microscopy. As SHG can couple to both magnetic and ferroelectric orders simultaneously, this confocal technique allows for artefact-free, high-resolution imaging of multiferroic order. In the ferroelectric phase of the type-I multiferroic $ErMnO_3$, topological defects arise as vortices at the meeting point of their six domain states, giving rise to their characteristic six-fold cloverleaf domain pattern. Below the Néel temperature, new topological defects form at the intersection between the cloverleaf domain structure and the antiferromagnetic domain walls. We show for the first time that the SHG intensity is strongly suppressed at the vortex cores. Furthermore, recent theoretical calculations predict attractive interactions between the magnetic domain walls in hexagonal manganites [1], whereby our low-temperature scanning SHG setup is a capable and practical method for the experimental verification of these predictions.

[1] Müller A., et al., arXiv:2510.13020, (2025).

MA 7.33 Mon 9:30 P2

Magnetic Phases in ErFeO3 — •Leo Maximov[1,3], Thomas Reyher[1], Florian Kübelbäck[1,3], Johanna Jochum[2], Andreas Bauer[1,3], and Christian Pfleiderer[1,2,3] — [1]School of Natural Science, Physik-Department, Technical University of Munich, Garching, Germany — [2]Heinz Maier-Leibnitz Zentrum (MLZ), Technical University of Munich, Garching, Germany — [3]Zentrum für QuantumEngineering (ZQE), Technical University of Munich, Garching, Germany

Rare-earth orthoferrites (RFeO3) have been extensively studied for their multiferroic properties [1,2]. Most recently, in ErFeO3, a central motivation has been the observation of Dicke cooperativity in magnetic interactions [3], suggesting that collective coupling between localized moments and excitations can strongly alter spin dynamics. Such cooperative effects may influence magnon dispersion near crystal-field levels. Neutron studies provided Fe3+ spin-wave dispersions [4], and revealed hybrid spin-wave and crystal-field excitations [5]. However, a systematic mapping of the full spin-wave dispersion, as well as possible cooperative effects, remains lacking. We report single-crystal growth of ErFeO3 using the optical floating-zone method. Structural quality was verified by single-crystal Laue and powder X-ray diffraction. Measurements of the magnetization and the heat capacity allow us to establish the anisotropic magnetic phase diagram as a prerequisite for further studies. [1] Y.Ke, et al., Sci. Rep. 6, 19775 (2016). [2] R.L. White, JAP 40, 1061 (1969). [3] Li, Xinwei, et al. Science 361.6404 (2018). [4] Shapiro Physical Review B 10.5 (1974). [5] Zic, et al., J. Appl. Phys. 130, 014102 (2021).

MA 7.34 Mon 9:30 P2

Exploring Quantum Geometry in the Dual Topological Insulator BiTe — •Maksim Povolotskiy[1], Renjith Mathew Roy[1], Ji Eun Lee[1], Yanpeng Qi[2], and Martin Dressel[1] — [1]1. Physikalisches Institut, Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart, Germany — [2]School of Physical Science and Technology, Shanghai Tech University, Shanghai 201210, China

We present an optical spectroscopy study of the dual topological insulator bismuth telluride (BiTe) over a broad infrared range (from 5 meV to 2.5 eV), supported by transport measurements and ab initio calculations. BiTe, a member of the $(Bi_2)_m(Bi_2Te_3)_n$ homologous series, hosts both weak topological insulator (WTI) and topological crystalline insulator (TCI) surface states [1]. High pressure, low temperatures, and directional magnetic fields are applied to access and probe distinct electronic states located on different crystal facets. By systematically varying the measurement geometry and external conditions, the optical response aims to distinguish bulk contributions from surface states protected by different symmetries: time-reversal symmetry in the WTI and crystalline symmetry in the TCI [2]. Additionally, the analysis focuses on signatures of quantum geometric effects on electron-phonon coupling, which are expected to manifest as anomalies in the infrared-active phonon modes and reflect nontrivial Berry curvature in the electronic bands [3]. The results offer perspectives on the interplay between topology, lattice vibrations, and quantum geometry in BiTe. [1] Nat Commun 8, 14976 (2017) [2] Nat. Mater. 19, 610 (2020) [3] arXiv:2410.09677 (2024)

MA 7.35 Mon 9:30 P2

Design and Implementation of Voltage Gating in Weyl Semimetals — •Kamila Szczurek[1], Dola Chakrabartty[1], Lilian Prodan[1], István Kézsmárki[1], Kai Litzius[1], and Felix Büttner[1,2] — [1]Center for Electronic Correlations and Magnetism, University of Augsburg, Augsburg, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany

Weyl semimetals are promising candidates for next generation spintronic devices due to their exotic electronic properties, expected to lead to low power magnetic switching. These promising properties were predicted by theoretical work but have yet to be verified. This research presents the design and implementation of an experimental setup aimed at enabling voltage gating studies of Weyl semimetals using magneto-optical Kerr effect (MOKE) techniques. A polar laser MOKE system in combination with a full-field Kerr microscope was developed and tested, with particular focus on the alignment of the components during operation in a shared setup. A small lamella of the ferromagnetic Weyl semimetal Fe_3Sn_2 was used as the initial sample due to the material's large anomalous Hall response and tunable Berry curvature effect, making it particularly attractive for voltage-control studies using MOKE. However, the limited size and geometry of a lamella introduced challenges in obtaining a clear MOKE signal, highlighting the neccessity for combined full-field and laser MOKE measurements. Despite practical challenges, the setup was successfully commissioned, laying the groundwork for future measurements under applied gate voltages.

MA 7.36 Mon 9:30 P2

Imaging Magnetic Orders in Topological Kagome Ferro- and Antiferromagnets using Single-Spin Magnetometry — •Anusree Vannada Puleri, Yuchen Zhao, Claire Donnelly, Uri Vool, Claudia Felser, and Edouard Lesne — Max-Planck-Institute für Chemische Physik fester Stoffe, Dresden, Germany

Kagome magnets are promising candidates for next-generation memory applications due to their high ordering temperatures and untapped unconventional magnetic ground states and topological properties. These include large anomalous Hall and spin Hall responses arising from sizeable accumulations of Berry curvature in momentum space.

In this study, we focus on the Kagome ferromagnet (FM) Fe_3Sn_2 which exhibits massive Dirac fermions and noncollinear FM order [1], and the Kagome antiferromagnet Mn_3Sn, which displays non-collinear anti-ferromagnetism and Weyl fermions [2]. We present how high-quality epitaxial thin films of Fe_3Sn_2 and Mn_3Sn, can be grown using magnetron sputtering, with controlled tuning of thicknesses and strain. We perform detailed structural characterizations, and resort to a combination of magnetic force microscopy, and nitrogen vacancy (NV)-based magnetometry to image FM and AF domains in these intriguing Kagome magnets.

References:
[1] L. Ye et al., Nature 555, 638-642 (2018).
[2] S. Nakatsuji et al., Nature 527, 212-215 (2015).

MA 7.37 Mon 9:30 P2

Synthesis, characterization and magnetic properties of selected Shandites compounds — •Mervenur Keles, Ahmad Omar, Christian G. F. Blum, Dmitriy Efremov, Bernd Büchner, and Sabine Wurmehl — Leibniz Institute for Solid State and Materials Research, Helmholtzstraße 20, Dresden, 01069, Germany

Shandite-type Co3M2X2 (M: In, Sn, Pb, Tl; X: S, Se), with a unique Kagome lattice structure, serves as a model system for studying the interaction between structure, magnetism, topology, and electronic correlation. Some shandite compounds are magnetic Weyl semimetals that exhibit unconventional transport phenomena. However, the physical properties are strongly dependent on the stoichiometry and sample quality, which are rather difficult to achieve as-desired along with high reproducibility. To address this, we investigate multiple synthesis and crystal-growth routes for selected Co3M2X2 compounds, performing comprehensive structural, chemical, transport, and magnetic characterization. We present correlations between the synthesis route, resulting structure/stoichiometry, and observed physical properties. Through DFT calculations and ARPES measurements done in collaboration, we further investigate the band structure of these potential Co3M2X2 Kagome semimetals, with the aim to establish key parameters for topological band formation and magnetic order, and thus validate a Weyl Type III semimetal.

MA 7.38 Mon 9:30 P2

Investigating Magnetic Material Parameters — •Kübra Kalkan[1], Ross Knapman[1,2], Atreya Majumdar[1], and Karin Everschor-Sitte[1] — [1]Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen, 47057 Duisburg, Germany — [2]Institute of Mechanics, University of Duisburg-Essen, Germany

Ideal magnetic materials would significantly enhance the performance and energy efficiency of modern technological devices [1]. In practice, however, real magnetic samples inevitably contain spatial inhomogeneities that weaken magnetic properties and thus, limit device capabilities. Understanding how these imperfections influence magnetization dynamics is therefore essential for both fundamental insight and material optimization. In this study, we investigate how spatial variations in exchange stiffness and uniaxial anisotropy affect high-temperature magnetization dynamics in thin films. Using physically inspired latent-inference methods [2, 3] applied to micromagnetic simulations, we develop a physics-informed, data-driven framework for quantifying the role of inhomogeneities. This approach enables the inference of material parameters directly from highly fluctuating magnetization behavior, offering a route toward deeper understanding and the design of more energy-efficient magnetic materials.

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[3] I. Horenko et al., Comm. App. Math. And Comp. Sci., 16, 2 (2021).

MA 7.39 Mon 9:30 P2

Atomistic spin dynamics with quantum coloured noise — •Fried-Conrad Weber[1,2], Felix Hartman[2], Matias Bargheer[1,2], Janet Anders[2,3], and Richard Evans[4] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH — [2]University of Potsdam, Institute of Physics and Astronomy — [3]Department of Physics and Astronomy, University of Exeter — [4]School of Physics, Engineering and Technology, University of York

Predicting temperature-dependent magnetisation is a challenge to classical atomistic spin dynamics (ASD) due to the absence of quantum statistics. Here, we present a novel implementation of an open-system Landau-Lifshitz-Gilbert equation within the VAMPIRE package that incorporates quantum coloured noise and non-Markovian memory effects. This approach models the quantum nature of the thermal bath and its self-consistent interaction with magnetic moments. Our results show excellent quantitative agreement with experimental magnetisation curves for nickel and gadolinium across the full temperature range, significantly enhancing the predictive capabilities of ASD beyond standard classical methods.

MA 7.40 Mon 9:30 P2

Differentiable Micromagnetics for Inverse Parameter Extraction — •Moritz Kamm[1,2], Kai Litzius[2], and Felix Büttner[1,2] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany — [2]Center for Electronic Correlations and Magnetism, University of Augsburg

Extracting intrinsic micromagnetic parameters from imaging data usually involves extensive trial-and-error and often remains ambiguous. We address this challenge with a differentiable inversion method that recovers material parameters directly from a single magnetic domain image. Unlike recent neural-network approaches, the method is fully analytical and physics-driven. Because the entire pipeline is differentiable, it integrates naturally with modern optimization and gradient-based design workflows. From an experimentally accessible magnetization image, we perform a deterministic Néel-type reconstruction of the full vector field and infer material constants by enforcing fixed-point consistency under the Landau-Lifshitz-Gilbert relaxation operator. The recovery of the wall-width-determining ratio $\rho = A/K_u$ is enabled by our autograd-compatible micromagnetic solver and consistently achieves relative errors below 1%, providing physically meaningful parameters for downstream micromagnetic modeling or the identification of candidate exotic spin textures. While demonstrated here for Néel walls, the framework is general and extensible to richer energy models, alternative lifting strategies, and other magnetic imaging modalities, establishing a foundation for differentiable inverse micromagnetics.

MA 7.41 Mon 9:30 P2

jaxFMM: Fast and Accurate Stray Field Evaluation for FEM Micromagnetics — •Robert Kraft[1,2], Florian Bruckner[3], Dieter Suess[1,3], and Claas Abert[1,3] — [1]Research Platform MMM Mathematics-Magnetism-Materials, University of Vienna, Vienna, Austria — [2]Vienna Doctoral School in Physics, University of Vienna, Vienna, Austria — [3]Physics of Functional Materials, University of Vienna, Vienna, Austria

Micromagnetic simulations provide invaluable insight for the design of novel magnetic devices and materials. The size and complexity of simulated geometries is ever-increasing, quickly reaching limits in terms of computational cost. Here, the long-ranged stray or demagnetizing field proves to be particularly challenging since its complexity scales quadratically with the system size. Therefore, highly efficient and parallel routines for the evaluation of the stray field are a crucial component in any micromagnetic simulation code. We introduce jaxFMM, an open-source Fast Multipole Method (FMM) implementation written in JAX with a focus on stray field evaluation for Finite-Element simulation codes. Linear complexity scaling, efficient parallel execution on GPUs and precise control over the approximation error enable dynamic simulations of very large and complicated geometries. Additionally, the code is easy to use, extremely concise and ready for machine-learning or inverse-design tasks with automatic differentiation.

MA 7.42 Mon 9:30 P2

Theoretical study of the electronic and magnetic properties of Cd1-xMnxTe quantum wire under the combined effects of the applied magnetic field, spin orbit coupling and exchange effects — •Diana dahliah, Mohammad Elsaid, and Asaad Shandi — physics department, An Najah National University

This poster presents a study for the electronic and magnetic properties of Cd1-xMnxTe quantum wire (QW). The Hamiltonian for an electron confined in a quantum wire, in the presence of an external magnetic field and Rashba spin orbit interaction, had been solved. The obtained energy dispersion relation had been used to calculate the electronic structure and display the Landau levels and density of states for different physical Hamiltonian s parameters. The density of states function shows a significant dependence on spin, Rashba, exchange effect and magnetic field. The dependence of the magnetic properties like magnetization and magnetic susceptibility on the magnetic field strength, quantum wire radius, and exchange and Rashba strength parameters have been examined. The computed results show that the material can display a phase transition between Paramagnetic and Diamagnetic types. In addition, an oscillatory behavior in the magnetic susceptibility as a function of magnetic field has been observed. This oscillating behavior is a result of Landau levels crossing in the quantum wire energy spectra.

MA 7.43 Mon 9:30 P2

Workflow for Robust Code and Data Management exemplified for the numerical calculation of the Hopf index — •Jonas Nothhelfer, Ross Knapman, and Karin Everschor-Sitte — Universität Duisburg-Essen

Structured workflows for code and data management are essential in scientific projects to ensure reproducibility, transparency, and high-quality results. In this work, we examine such workflows from the perspective of a system administrator, focusing on the infrastructure and tools required to support scientific computing. Using a recent project as a case study, we illustrate a workflow designed to make the projects numerical methods for calculating the three-dimensional topological Hopf index accessible to the research community [1]. The workflow not only provides Python scripts but also includes extensions for the established micromagnetic simulation software Mumax3 [2]. Code development and version control are managed via GitLab, ensuring that the most up-to-date source code is available [3], while Zenodo is employed to assign persistent identifiers to released versions, thereby facilitating long-term accessibility and citation [4].

[1] R. Knapman, et al., Phys. Rev. B 111, 134408 (2025).
[2] A. Vansteenkiste, et al., AIP Adv. 4, 107133 (2014).
[3] https://git.uni-due.de/twist-external/numericalhopfindexcalculation.
[4] https://zenodo.org/records/14007386, https://zenodo.org/records/14006

MA 7.44 Mon 9:30 P2

Overcoming quadratic complexity in time for fast-moving textures in micromagnetics: A moving window approach — •Michael Karl Steinbauer[1,2,3], Florian Bruckner[1,2], and Claas Abert[1,2] — [1]University of Vienna — [2]Research Platform MMM — [3]Vienna Doctoral School in Physics

From domain walls and skyrmion race track memory to magnon wave guides: A lot of recent interest in the field of magnetism has focused on fast-moving magnetic textures in otherwise homogeneously magnetized media. Micromagnetic modeling of these phenomena presents a significant computational challenge however, as the displacement of the texture typically requires the simulation volume to increase proportional to time t, leading to an overall simulation complexity of $O(t^2)$.

We introduce a general-purpose simulation methodology that achieves linear scaling $O(t)$ instead. This is accomplished by employing a moving simulation window that encompasses only a small region around the magnetic feature and is continuously re-centered as the feature moves, leveraging that the magnetization ahead of and behind the feature is often highly uniform. To mitigate finite-size effects, we implement a compensation of surface charges. Furthermore, this approach readily accommodates the introduction of location-dependent material parameters, such as material defects or grain structures. The method was implemented for the python library magnum.np [1], where it was successfully used to reduce computational times of a domain wall simulation from multiple weeks to less than a day.

[1] F. Bruckner et al., Sci. Rep. 13, 12054 (2023).

MA 7.45 Mon 9:30 P2

Ferroelectric-controllable spin-orbit torque in two-dimensional magnetic heterostructures — •Weiyi Pan, Gusthavo Brizolla, and Jaroslav Fabian — Institute for Theoretical Physics, University of Regensburg, 93040 Regensburg, Germany

The spin-orbit torque (SOT) in two-dimensional (2D) van der Waals magnets plays a crucial role in next-generation spintronic devices. However, achieving nonvolatile control of SOT in 2D systems remains challenging. In this work, we theoretically demonstrate that placing Fe_3GeTe_2, a promising 2D magnet exhibiting experimentally observable SOT effects, on a ferroelectric In_2Se_3 substrate, enables nonvolatile manipulation of the SOT through ferroelectric polarization reversal. Further analysis reveals that the polarization switching mainly affect the intra-band contribution to the SOT. Our results provide an effective strategy for controlling SOT in realistic 2D heterostructures, paving the way for tunable and energy-efficient spintronic devices in the future. This research has been supported by 2D SPIN-TECH.

MA 7.46 Mon 9:30 P2

Unidirectional Rashba-Edelstein Magnetoresistance in Topological Insulator-based magnetic Heterostructures — •Steffen Kober[1], Ruslan Salikhov[2], Jan Deinert[2], Igor Ilyakov[2], Alexey Ponomaryov[2], Atiqa Arshad[2], Thales Oliveira[2], Kang Jin[2], Gulloo Prajapati[2], Patrik Pilch[1], Anneke Reinold[1], Sergio Valenzuela[3], Carmen Gómez Carbonell[3], Zhe Wang[1], and Sergey Kovalev[1] — [1]TU Dortmund, Department of Physics, Dortmund, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [3]Catalan Institute of Nanoscience and Nanotechnology

Our recent experimental study of transition metal-based heterostructures has demonstrated that the unidirectional spin-Hall magnetoresistance remains active even at picosecond timescales. Here, we report on experimental investigations of the unidirectional Rashba-Edelstein magnetoresistance in topological insulator (TI)-based magnetic heterostructures, in particular, on the nonlinear terahertz (THz) responses in TI/Al/NiFe/Al thin films. The Rashba-Edelstein effect lifts the spin degeneracy due to inversion symmetry breaking at the interface of the TI, enhancing spin-dependency in the momentum space. We use anisotropic THz second harmonic generation to characterize the Rashba-Edelstein magnetoresistance. To separate this from other possible contributions, such as the thermally driven spin-Seebeck effect, we study samples with varying aluminum layer thicknesses between the TI and the ferromagnetic NiFe, which modifies spin propagation and proximity effects between the ferromagnet and the TI's spin texture.

MA 7.47 Mon 9:30 P2

X-ray Absorption Spectroscopy and X-ray Magnetic Circular Dichroism investigation of magnetic properties in monolayer van-der-Waals 3d transition metal diiodides — •Lorenzo Grilli[1], Amina Kimouche[2], Awsaf Chowdhury[1], Jendrik Gördes[1], Chen Luo[3], Florin Radu[3], Sangeeta Thakur[1], Marcel Walter[1], and Wolfgang Kuch[1] — [1]Freie Universität Berlin, Germany — [2]Universität Potsdam, Germany — [3]Helmholtz-Zentrum Berlin for Materials and Energy, Germany

Numerous theoretical works [e.g. A. S. Botana, Phys. Rev. Materials 3, 044001 (2019)] predict that robust magnetic order can persist down to the monolayer limit in 3d transition-metal dihalides. Here we investigate the epitaxial growth and electronic properties of ultrathin MnI_2 and CoI_2 films on heavy-metal and van-der-Waals substrates, using thermal evaporation from stoichiometric sources. Structural properties are characterized in-situ by LEED and XPS. Motivated by STM results [Daniel Rothhardt et al., ACS Nano 19, 2261 (2025)] showing that iodine reacts with Ag before forming MnI_2 islands, we use XPS to quantify stoichiometry and interface chemistry for MnI_2 grown on Ag(111) and on graphene, directly comparing a reactive metal substrate with an inert van-der-Waals one. In parallel, we explore growth of CoI_2 on similar substrates. The magnetic response of these epitaxial films is probed by XAS and XMCD at the VEKMAG end station of BESSY II, providing element-specific sensitivity to spin and orbital moments in the ultrathin limit. We discuss how the substrate influences the magnetic behaviour of MnI_2 and CoI_2 monolayers.

MA 7.48 Mon 9:30 P2

Strong Magnetic Anisotropy in CrSBr Revealed by Magnetotransport Measurements — •Paul Nufer[1,2], Monika Scheufele[1,2], Matthias Grammer[1,2], Julian Herrschmann[2,4], Florian Dirnberger[2,3,4], Matthias Althammer[1,2], and Stephan Geprägs[1] — [1]Walther-Meißner-Institut, BAdW, Garching, Germany — [2]TUM School of Natural Sciences, Physics Department, TUM, Garching, Germany — [3]Munich Center for Quantum Science and Technology, Munich, Germany — [4]Zentrum für Quantum Engineering (ZQE), TUM, Garching, Germany

The antiferromagnetic two-dimensional van-der-Waals material CrSBr exhibits unique electronic properties, as its conductivity is strongly dependent on the direction of the current flow with respect to its orthorhombic crystalline symmetry as well as on the anisotropic magnetic properties. In our work, we investigate the interplay of the magnetic and electronic anisotropies by magnetotransport measurements. Therefore, exfoliated CrSBr multilayers are patterned into Hall-bar structures via lift-off processes using electron-beam lithography and sputter deposition. The magnetotransport measurements are conducted in cryogenic conditions between 10 K and 200 K. By measuring the field- and angle-dependent magnetoresistance in different rotation planes of the magnetic field, we characterize the temperature- and field-dependent magnetic phase transitions of CrSBr and find an anisotropic magnetoresistance of up to 40%. We extract the anisotropy and critical magnetic fields by using free-energy simulations and demonstrate the good agreement between simulation and experimental data.

MA 7.49 Mon 9:30 P2

High-frequency spin eigenstates of an altermagnetic domain wall — •Oksana Peschanska[1] and Volodymyr Kravchuk[1,2] — [1]Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine, 03143 Kyiv, Ukraine — [2]Leibniz-Institut für Festkörper- und Werkstoffforschung, Helmholtzstraße 20, D-01069 Dresden, Germany

We have considered the scattering of spin waves by a domain wall (DW) in an easy-axis d-wave altermagnet (e.g. CoF2, MnF2). Similar to the conventional antiferromagnet, the scattering problem is reduced to the Schröedinger equation with $sech^2$ potential. However, due to altermagnetism, the amplitude of the scattering potential depends on the energy of the magnons. The latter has a number of physical consequences: (i) the scattering process is different for the clockwise and counterclockwise polarized magnons; (ii) the transmission coefficient is a nonmeromorphic function of the complex-valued wave vector, so a modification of Levinson's theorem is required; (iii) new high-frequency bound (localized) eigenstates appear and propagate along DW. The number of new eigenstates, their eigenfrequencies, and eigenfunctions depend on the altermagnetic strength, wave vector q along DW, and orientation of the DW relative to the crystallographic axes. With the increase of q, the size of the localization region of the bound state can increase as well as decrease, depending on the eigenstate polarization, the sign of the altermagnetic parameter, and the DW orientation.

MA 7.50 Mon 9:30 P2

Mössbauer Spectroscopy on the Candidate Altermagnet Material $FeNb_4S_8$ — •Jan Friedrichsen[1], Felix Seewald[1], Lilian Prodan[2], Joachim Deisenhofer[2], István Kézsmárki[2], and Hans-Henning Klauss[1] — [1]Institut für Festkörper- und Materialphysik, TU Dresden, Germany — [2]Experimental Physics V, Institute of Physics, University of Augsburg, Augsburg, Germany

$FeNb_4S_8$ is a proposed altermagnet and a member of the layered intercalated transition metal dichalcogenides. The crystal structure consists of stacked layers of $NbSe_2$, with sandwich layers of intercalated Fe atoms in hexagonal order[1]. Magnetic order is reported below the transition temperature $T_C = 150\,\mathrm{K}$.[2]
Mössbauer spectra at room temperature show the presence of a finite electric field gradient (EFG) of $V_{zz} = -6.50(74)\,\mathrm{V/Å^2}$. At 4.2 K however the absolute value of the electric field gradient is considerably larger with a value of $V_{zz} = -66.45(13)\ \mathrm{V/Å^2}$. Mössbauer data proof predominantly colinear arrangement of the local iron spins along the c-axis and is consistend with the proposed altermagnetic state. First measurements indicate a strong magnetostriction as a likely source of the strong temperature dependence of V_{zz}. The hyperfine field that is reached at 4.2K is 15.52(14) T. We will discuss the implications of the mössbauer results on the electronic and magnetic structure and dynamics.
[1]Regmi, Resham Babu, et al. "Altermagnetism in the layered intercalated transition metal dichalcogenide CoNb4Se8.". [2]Lawrence, Erick A., et al. "Fe site order and magnetic properties of Fe1/4NbS2."

MA 7.51 Mon 9:30 P2

Altermagnetism on hyperbolic lattices — •Eric Petermann[1,2], Kristian Maeland[1,2], Haye Hinrichsen[1,2], and Björn Trauzettel[1,2] — [1]Institute for Theoretical Physics and Astrophysics, University of Würzburg, D-97074 Würzburg, Germany — [2]Würzburg-Dresden Cluster of Excellence ct.qmat, D-97074 Würzburg, Germany

Altermagnets are a novel class of magnetic systems characterized by their momentum-dependent spin splitting without net magnetization. In this work, we extend established Euclidean tight-binding models of altermagnets to hyperbolic lattices defined on a discretized Poincaré disk. Using hyperbolic crystallography and hyperbolic band theory, we derive and analyze the band structure in these lattices. We discover particular properties of altermagnetism in hyperbolic space, for instance, higher angular momentum spin splitting in two-dimensional real space models. We find that orbital ordering or nonmagnetic sites are not essential to see spin-splitting in hyperbolic lattices, unlike Euclidean space.

MA 7.52 Mon 9:30 P2

Magnetic aftereffect and Barkhausen steps in thin Mn_5Si_3 films — •Gregor Skobjin[1], Javier Rial[2], Sebastian Beckert[3,4], Helena Reichlová[3,5], Vincent Baltz[2], Lisa Michez[6], Richard Schlitz[1], Michaela Lammel[1], and Sebastian Goennenwein[1] — [1]Department of Physics, University of Konstanz, Germany — [2]Univ. Grenoble Alpes, CNRS, CEA, Gren. INP, IRIG-SPINTEC, France — [3]IFMP and Würzburg-Dresden Cluster of Excellence ct.qmat, TU Dresden, Germany — [4]DCN, TU Dresden, Germany — [5]Institute of Physics ASCR, Czech Republic — [6]Aix Marseille Université, CNRS, CINAM, AMUTECH, France

Altermagnets are an intriguing novel class of magnetic materials. We exploit the anomalous Hall effect response of micropatterned Mn_5Si_3 thin films to investigate their magnetization relaxation behavior. In experiments at $T < 200\,\mathrm{K}$ i.e., in the altermagnetic phase, and for magnetic fields for which the samples exhibit large magnetic susceptibility, we observe a strong magnetic aftereffect as well as Barkhausen-like steps in the time-dependent Hall voltage evolution. More specifically, we recorded the evolution of the Hall voltage in micropatterned Hall bars with widths of $10\,\mu$m down to $0.1\,\mu$m at a series of different magnetic field magnitudes to gain insights into potential domain effects in the altermagnetic phase of Mn_5Si_3 at micron and submicron length scales. We critically analyze our experimental results and discuss implications for the micromagnetic structures in altermagnetic thin films.

MA 7.53 Mon 9:30 P2

Magnon-Driven Propulsion of Domain Walls in Altermagnets — •Nils Keller, Ricardo Zarzuela, Rodrigo Jaeschke-

Ubiergo, and Jairo Sinova — Institut für Physik, Johannes Gutenberg Universität Mainz, D-55099 Mainz, Germany

Altermagnets form a recently identified class of collinear magnets whose compensated order coexists with time-reversal symmetry breaking and a spin-split electronic band structure with characteristic *d*-, *g*- and *i*-wave symmetry. Domain-wall propulsion by magnons is a central mechanism for spin-based information processing, but in antiferromagnets it relies on angular-momentum transfer because the domain-wall potential itself is reflectionless. In contrast, we show that altermagnetic domain walls can be propelled directly by magnons through linear-momentum transfer, without requiring the wall to acquire internal angular momentum first. This arises from the characteristic symmetry of the altermagnet, which generates a direction-dependent modification of the spin-wave scattering potential. As a result, both redshift and partial reflection of magnons become possible, lowering the energy cost for domain-wall motion and enabling direction-selective propulsion. These anisotropies suggest new strategies for logic and memory concepts based on steering domain walls along symmetry-selected channels. We identify the low-velocity regime and clarify the distinct scattering mechanisms responsible for the propulsion.

MA 7.54 Mon 9:30 P2

Current-induced Spin-Orbit Torque effects in RuO_2 thin films — •Niklas Schmolka, Florian Knossalla, Maik Gärner, Karsten Rott, and Günter Reiss — Bielefeld University, Germany

Current-induced manipulation of the antiferromagnetic order offers a promising route toward ultrafast and energy-efficient spintronic memory devices [1]. Results that are consistent with Néel vector switching could be a hint for antiferromagnetism in RuO_2 [2].
Here, we use eight-terminal devices to investigate Spin-Orbit Torque effects in RuO_2 thin films. We study bilayers consisting of RuO_2|Pt and RuO_2|W where Pt and W act as heavy-metal layers generating Spin-Orbit Torques. We observe signatures of reversible Néel vector reorientation through Hall measurements, with the two sample systems showing opposite responses consistent with the opposite Spin Hall Angles of Pt and W [3].
Additionally we measure pure RuO_2 films and examine the temperature dependence of the switching mechanism to further identify magnetic contributions and disentangle possible non-magnetic effects [4].

[1] T. Jungwirth et al., Nature Nanotechnology 11, 231-241 (2016)
[2] Y. Zhang et al., Nature Communications 16, 5646 (2025)
[3] L. Liu et al., Appl. Phys. Lett. 101 122404 (2012)
[4] T. Matalla-Wagner et al., Phys. Rev. Research 2, 033077 (2020)

MA 7.55 Mon 9:30 P2

Tuning Anomalous Hall Effect in a d-wave Altermagnet — •Sergio Rodríguez Fernández, Rodrigo Jaeschke Ubiergo, and Jairo Sinova — Johannes Gutenberg-Universität Mainz, Deutschland

Altermagnets are a novel class of collinear magnets that, despite being magnetically compensated, break time-reversal symmetry. Their electronic band structure shows spin splitting with characteristic d-, g-, or i-wave symmetry. Owing to their broken time-reversal symmetry, they have been shown, both theoretically and experimentally, to exhibit an Anomalous Hall Effect (AHE) that depends strongly on the orientation of the Néel order.

In this poster, we discuss the AHE in d-wave altermagnets. Using minimal models, symmetry analysis, and the Kubo response formalism, we show how the AHE emerges from different orientations of the Néel vector. We build our minimal models with focus on the tunnability of these responses, and we apply our approach to realistic candidate materials. Our work deepens the understanding of transport properties in altermagnets, contributing to their growing relevance in spintronics research.

MA 7.56 Mon 9:30 P2

Growth of $MnSe_2$ Single Crystals as a Candidate for Supercell Altermagnets — •Mayra Handel, Franziska Walther, Sarah Krebber, Cornelius Krellner, and Kristin Kliemt — Physikalisches Institut, Goethe Universität Frankfurt, 60438 Frankfurt am Main

$MnSe_2$ is predicted to be a supercell altermagnet with d-wave order [1] at a temperature below T_N=49K [2]. $MnSe_2$ crystallizes in a cubic structure and shows a commensurate magnetic structure. Supercell altermagnets are characterized by a magnetic unit cell that is an integer multiple of the crystallographic unit cell. The enlarged magnetic unit cell introduces additional degrees of freedom in supercell altermagnets, enabling control over the spatial orientation of the order parameter. We report on the current progress in the growth of $MnSe_2$ single crystals by means of chemical vapor transport, employing various stoichiometries and transport agents. In addition, we present the chemical and structural characterization of polycrystalline samples of $MnSe_2$.

[1] R. Jaeschke-Ubiergo et al., Phys. Rev. B 109, 094425 (2024)
[2] T. Chattopadhyay et al., Solid State Communications 63, 65 (1987)

MA 7.57 Mon 9:30 P2

Possibility for altermagnetic to antiferromagnetic phase transition in $LaTiO_3$ — •Igor Maznichenko and Samir Lounis — Institute of Physics, Martin Luther University Halle-Wittenberg, D-06099 Halle, Germany

Here we investigate and compare the electronic band structure of altermagnetic and antiferromagnetic phases in Mott insulator $LaTiO_3$ [1]. Using *abinitio* calculations, we have found a stable altermagnetic phase with the *G*-type arrangement. In $LaTiO_3$, triple-degenerated cubic Ti t_{2g} orbitals are occupied by only one electron, the semiconducting band gap separates the occupied Ti $t_{2g}^1 e_g^0$ subband from the unoccupied conduction band edge, while the f states of La appear at much higher energies. The key structural factor of *Pbnm*-$LaTiO_3$, which determines its band gap and zero magnetization, is optimally rotated TiO_6. Using simulations of disorder for these Ti t_{2g} orbitals, we demonstrate the fragility of the altermagnetic phase with multiorbital effects.

[1] I.V.Maznichenko *etal*, Phys. Rev. Materials 8, 064403 (2024).

MA 7.58 Mon 9:30 P2

Electrical control of the exchange bias effect at model ferromagnet-altermagnet junctions — •Gaspar De la Barrera and Alvaro Nunez — Universidad de Chile, Santiago, Chile

This work analyzes the behavior of the interface between a ferromagnetic material and an altermagnet. We use a well-established line of arguments based on electronic mean-field calculations to show that new surface phenomena that lead to altermagnetic materials induce an exchange bias effect on the nearby ferromagnet. We reveal the physical mechanisms behind this phenomenon that lead to quantitative control over its strength. Interestingly, we predict exotic electric-field-induced phenomena. This is an analogy to the relationship between exchange bias and the injection of spin currents in spin-transfer-dominated scenarios, which has been reported earlier in the traditional antiferromagnetic/ferromagnetic junction.

MA 7.59 Mon 9:30 P2

NEGF Quantum Transport Simulations in Altermagnetic Systems — •Tim Kalsberger[1], Erik Schroedter[1], Nicola Lo Gullo[2], Jan-Philip Joost[1], and Michael Bonitz[1] — [1]CAU Kiel, Germany — [2]Università della Calabria, Italy

Altermagnets have the potential to open a broad landscape of new applications. Promising examples include the fields of spintronics and ultrafast photomagnetism, which combine the special properties of altermagnets with ultrafast dynamics and quantum transport. One of these properties is the emergence of spin-polarized currents under an applied bias due to the spin-anisotropic Fermi surface, despite having zero net magnetization [1]. Accurate simulations of spin-resolved dynamics in large, strongly correlated systems are challenging and, with most methods, often impossible for long time scales due to the large basis size and complexity, even for simple lattice models. In this work, we use the quantum fluctuations approach based on non-equilibrium Green functions (NEGF) [2, 3] to simulate correlated, time-resolved, large altermagnetic systems out of equilibrium in scenarios aligned with realistic experimental setups.

[1] Šmejkal *et al.*, Emerging Research Landscape of Altermagnetism. Phys. Rev. X 12, 040501 (2022).
[2] E. Schroedter *et al.*, Quantum fluctuations approach to the nonequilibrium GW approximation, Condens. Matter Phys. 25, 23401 (2022).
[3] E. Schroedter *et al.*, "Nonequilibrium Green Functions Simulations for Large Systems", subm. for publication

MA 7.60 Mon 9:30 P2

Chirality dependent orbital magnetism and anomalous transport in twisted antiferromagnetic bilayers — •Zhiyuan He — Weinberg 2, 06120 Halle (Saale), Germany

Twisted magnetic van der Waals heterostructures have emerged as a fertile ground for exploring the interplay between lattice geometry and magnetism. While the twist angle magnitude governs the moiré potential scale, the physical consequences of the twist angle sign (chirality) remain unexplored due to the inherent mirror symmetry in conventional bilayer systems. In largely this work, we theoretically investigate the electronic structure and orbital transport properties of twisted A-type antiferromagnetic bilayers using a tight-binding model that incorporates lattice anisotropy and interface-induced symmetry breaking. We researched that the interference between the rotating lattice anisotropy and a fixed symmetry-breaking field lifts texture the degeneracy between positive ($+\theta$) and negative ($-\theta$) twist configurations. This symmetry breaking manifests significantly in the momentum-space distribution of the Orbital Magnetic Moment (OMM). on the twist chirality, leading to non-reciprocal Berry curvature distributions. These findings suggest that the twist sign can serve as a switchable degree of freedom to manipulate orbital-driven transport phenomena, such as the topological Hall effect and magneto-optical responses, in altermagnetic moiré systems.

MA 7.61 Mon 9:30 P2

EMCD on Altermagnets — Hitoshi Makino[1], Sebastian Schneider[1], Sebastian Beckert[1], Rikako Yamamoto[2,3], Claire Donnelly[2,3], and •Pohl Darius[1] — [1]DCN, TUD Dresden University of Technology, Dresden, Germany — [2]Max Planck Institute for Chemical Physics of Solids, Dresden, Germany — [3]WPI-SKCM Hiroshima University, Hiroshima, Japan

Altermagnets represent a recently discovered class of magnetic materials featuring unique symmetry properties and compensated magnetic structures, which set them apart from conventional ferromagnets and antiferromagnets. Their novel electronic and magnetic characteristics are interesting for both fundamental research and advanced technological applications, particularly in spintronics. It has recently been shown that X-ray Magnetic Circular Dichroism is sensitive to time-reversal symmetry breaking in altermagnets. A similar behavior is expected for electron energy loss magnetic chiral dichroism (EMCD), the electron wave analogue to XMCD, a method providing element-specific sensitivity and high spatial resolution spectroscopic and imaging capabilities in an electron microscope. We will present first proof-of-principle EMCD experiments on MnTe and Fe_2O_3 and its comparison to structural TEM investigations and XMCD measurements to demonstrate the versatility of our approach and its application to probe altermagnetic materials at the nanoscale.

MA 7.62 Mon 9:30 P2

Growth and properties of altermagnetic MnTe thin films — •Lukas Stroh, Maik Gaerner, Judith Bünte, Karsten Rott, Jan Schmalhorst, Andreas Hütten, and Günter Reiss — Bielefeld University, Germany

In recent years, a new unconventional magnetic phase, named altermagnetism, has emerged [1]. Such altermagnetic materials combine anisotropic time-reversal symmetry breaking with the vanishing net-magnetization of antiferromagnets. One of the materials in which altermagnetism has been observed in is manganese telluride (MnTe) [2,3]. Here, we systematically investigate the growth of MnTe thin films on $SrF_2(111)$ via magnetron co-sputtering. We analyze how the growth-conditions influence structural and electronic properties, including the spontaneous anomalous Hall effect.

[1] Šmejkal et al., Phys. Rev. X, 12:040501 (2022).
[2] Krempaský et al., Nature, 626:517 522 (2024).
[3] Betancourt et al., Phys. Rev. Lett., 130:036702 (2023).

MA 7.63 Mon 9:30 P2

Seed-layer assisted epitaxial growth of Mn_5Si_3 thin films on Al_2O_3 — •Maximilian Koll[1], Maik Gaerner[1], Judith Bünte[1], Finn Peters[1], Andreas Hütten[1], Karsten Rott[1], Jan Schmalhorst[1], Martin Wortmann[2], and Günter Reiss[1] — [1]Bielefeld University, Faculty of Physics, 33615 Bielefeld, Germany — [2]Bielefeld University of Applied Sciences and Arts, Faculty of Engineering and Mathematics, 33619 Bielefeld, Germany

Mn_5Si_3 thin films are a prominent platform in which signatures of altermagnetism, such as the anomalous Hall effect [1] or the anomalous Nernst effect [2,3], have been observed. These responses are consistent with a theoretically predicted d-wave altermagnetic state that breaks time-reversal symmetry while exhibiting zero net magnetization as well as THz spin-current dynamics [4].

Here, we report on the growth of epitaxial $Mn_5Si_3(0001)$ on $Al_2O_3(0001)$ via magnetron sputtering and molecular beam epitaxy. We demonstrate that a high-temperature Mn_5Si_3 seed layer significantly enhances the crystallinity of the thin films while maintaining a smooth surface morphology. Finally, we show that the emergence of a spontaneous anomalous Hall effect in the Mn_5Si_3 thin films is highly sensitive to the Mn content as well as the annealing procedure.

[1] H. Reichlova et al., Nat. Commun. 15, 4961 (2024)
[2] A. Badura et al., Nat. Commun. 16, 7111 (2025)
[3] L. Han et al., Phys. Rev. Applied 23, 044066 (2025)
[4] L. Šmejkal et al., Phys. Rev. X 12, 04051 (2022)

MA 7.64 Mon 9:30 P2

Ab-initio investigation of altermagnetic splitting in the NiAs-type solid solutions (Cr,Mn)-(Sb,Te) — •Karel Knížek and Kyohoon Ahn — Institute of Physics, Czech Academy of Sciences, Prague, Czechia

CrSb is a layered collinear antiferromagnet with perpendicular magnetic anisotropy in the hexagonal structure of NiAs-type, which holds particular interest for AFM spintronics since it belongs to a few compounds which have both high ordering temperature (T_N = 705 K) and substantial altermagnetic spin splitting. Phase diagrams of solid solutions between antiferromagnetic CrSb and ferromagnetic MnSb and CrTe are rich in many various magnetic arrangements [1,2,3]. The observed evolution of the magnetic order as a function of composition for both phase diagrams is consistent with the assumption of the dominance of the M-X-M (M=Cr,Mn, X=Sb,Te) superexchange interaction. The strength of this interaction depends on the M-X-M angle, which is correlated with trigonal distortion of the MX_6 octahedra. Within these phase diagrams, we have performed electronic structure calculation to investigate the evolution of magnetic ordering, with focus on the altermagnetic spin splitting in case of antiferromagnetic ordering, as a function of structural parameters, namely the trigonal distortion and cell volume. In particular we have studied the effect of uniaxial pressure.

[1] F.K.Lotgering et al., J. Phys. Chem. Solids 3, 238 (1957).
[2] W.J.Takei et al., J. Appl. Phys. 37, 973 (1966).
[3] W Reimers et al., J. Phys. C: Solid State Phys. 15 3597 (1982).

MA 7.65 Mon 9:30 P2

Correlation of in-situ Hall measurements with LTEM on Fe/Gd multilayers — •Sebastian Beckert[1], Sebastian Schneider[1], Joe Sunny[2], Manfred Albrecht[2], Bernd Rellinghaus[1], and Darius Pohl[1] — [1]DCN, cfaed, TU Dresden, Dresden, Germany — [2]Institute of Physics, University of Augsburg, Augsburg, Germany

Topologically protected skyrmions are promising information carriers for next generation memory devices, because they can be electrically manipulated and detected, e.g., through their Hall signatures. Sputtered Fe/Gd multilayers host skyrmions at room temperature, making them an ideal model system for exploring the correlation between skyrmion formation and the topological Hall effect (THE) [1].

Building on prior in-situ correlations of Hall responses and Lorentz transmission electron microscopy (LTEM) imaging in antiskyrmion hosting materials [2], we combine simultaneous Hall-voltage measurements with LTEM imaging of the magnetic state of sputtered Fe/Gd multilayers. These experiments aim to disentangle the relationship between skyrmion presence and the Hall signal, which are typically probed independently.

[1] M. Heigl *et al.*, Nat. Commun. **12**, 2611 (2021)
[2] A. Thomas *et al.*, Small Methods **9**, 2401875 (2025)

MA 7.66 Mon 9:30 P2

Effects of chiral polypeptides on skyrmion stability and skyrmion diffusion — Fabian Kammerbauer[1], Yael Kapon[2], •Theo Balland[1], Shira Yochelis[2], Yossi Paltiel[2], and Mathias Kläui[1] — [1]Institut für Physik, Johannes Gutenberg Universität Mainz, 55099 Mainz, Germany — [2]Institute of Applied Physics, Faculty of Sciences, The Hebrew university of Jerusalem, Jerusalem 9190401, Israel

CISS, chirality-induced spin selectivity is a phenomenon that has raised significant interest due to the large spin polarizations generated by organic molecules and other effects such as magnetic switching of ferromagnets impacted by chiral molecules [1]. In hybrid systems, these chiral molecules have been observed to influence magnetic properties such as changes in the magnetization [2]. In this study, we investigate how chiral molecules of α-helix polyalanine interact with chiral spin structures, namely magnetic skyrmions, which are stabilized in ferromagnetic/heavy metal multilayers due to Dzyaloshinskii-Moriya interaction [3]. Using magneto-optic Kerr effect imaging, we show that chiral polypeptides can influence the stability of skyrmions by modifying the ranges of temperature and applied magnetic field in which they are stable. We also show that the chiral molecules affect the skyrmion dynamics, in particular the thermal diffusion of the skyrmions [4].

[1] R. Naaman et al. Nat. Rev. Chem. 3, 250 (2019)
[2] Y. Kapon et al. J. Chem. Phys. 159, 064701 (2023)
[3] K. Everschor-Sitte et al. J. Appl. Phys. 124, 240901 (2018)
[4] Y. Kapon et al. Nano Lett. 25, 306-312 (2025)

MA 7.67 Mon 9:30 P2

Coupled and decoupled topological textures in van der Waals heterostructure — •Sourav Chowdhury[1], Daniel Metternich[2], Simon Gaebel[2], Chithra Sharma[3], Jayjit Dey[1], Victor Deinhart[2], Tim Butcher[2], Michael Schneider[2], Josefin Fuchs[2], Bastian Pfau[2], and Moritz Hoesch[1] — [1]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany — [2]Max-Born-Institut (MBI), Berlin, Germany — [3]University of Hamburg, Hamburg, Germany

Topological nanodomain spin textures in two-dimensional (2D) van der Waals (vdW) magnets are attracting increasing interest for next-generation spintronic technologies, offering pathways to ultradense data storage, energy-efficient operation, and unconventional data processing architectures [1]. Using element-specific X-ray imaging, we visualize a variety of topological spin textures in an Fe3GeTe2/CrGeTe3 heterostructure and directly resolve their interlayer behavior. We find that nanodomains in the two layers are strongly coupled under certain conditions, while within a specific magnetic-field window, the domains become decoupled and evolve independently. This transition from coupled to decoupled topological textures can be understood in terms of distinct magnetic anisotropy contributions in the two layers, arising from interlayer interactions rather than solely from the properties of the individual materials. [1] K. Chang et al., Science 2016, 353, 274.

MA 7.68 Mon 9:30 P2

Anisotropic skyrmion liquid phase — •Daniel Schick[1], Tim Matthies[2], Thomas Mutschler[1], Levente Rózsa[3,4], and Ulrich Nowak[1] — [1]University of Konstanz, Konstanz, Germany — [2]University of Hamburg, Hamburg, Germany — [3]Wigner Research Centre for Physics, Budapest, Hungary — [4]Budapest University of Technology and Economics, Budapest, Hungary

Melting transitions in two-dimensional systems of particles have attracted much attention in research since the development of the Kosterlitz-Thouless-Harperlin-Nelson-Young theory, particularly because of an intermediate phase with long-ranged orientational but short-ranged translational order, called the hexatic phase.

Magnetic skyrmions are topological quasiparticles in thin magnetic films and, due to their two-dimensional nature, are subject to KTHNY theory. Recently, the hexatic phase was identified experimentally in skyrmion lattices [1]. Here, we use a molecular dynamics simulation to study the phase transitions in skyrmion ensembles. Taking into account the anisotropic interaction of skyrmions in the $(Pt_{0.95}Ir_{0.05})/Fe/Pd(111)$ system, we show how this anisotropy influences the phase of the skyrmion system. Instead of an intermediate hexatic phase between solid and liquid phase, one observes a direct solid-liquid transition, with a global orientational order even in the liquid phase.

[1] R.Gruber et. al. Nat. Nanotechnol. **20**, 1405-1411 (2025)

MA 7.69 Mon 9:30 P2

Rotating Skyrmion Lattice by Circularly Polarized Light — •Reza Doostani and Achim Rosch — University of Cologne, Cologne, Germany

Previously, it has been studied that shining a circularly polarized light on a skyrmion crystal (SkX) induces rotation in the lattice. This is due to Inverse Faraday Effect where spins experience local magnetic field. The magnitude of rotation depends on the fluence of light and its polarization. There exist a fluence threahold under which the SkX does not rotate. Further, one can start and stop the rotation by doing double pulse laser experiment and changing the separation time between two pulses. These results has been theoretically described where coherent oscillation of rotation amplitude as a function of pulse separation matches the experimental observation. However the theoretical value for rotation amplitude (for clean system) is orders of magnitude smaller than experimental value. Previously, the only source of rotation was due to Gilbert damping, however this cannot describe the rotation alone. In this work, we investigate other source of rotation in this system, namely we induce disorder and analyze its effect.

MA 7.70 Mon 9:30 P2

Noise measurements on magnetic skyrmions in magnetic multilayers — •Arthur Schmidt[1], Bereket Ghebretinsae[1], Joe Sunny[2], Manfred Albrecht[2], and Jens Müller[1] — [1]Institute of Physics, Goethe University Frankfurt, 60438 Frankfurt am Main, Germany — [2]Institute of Physics, University of Augsburg, Universitätsstraße 1, 86135 Augsburg, Germany

Magnetic skyrmions are topologically protected spin textures which usually appear in materials with broken inversion symmetry and strong spin-orbit coupling due to emergent Dzyaloshinskii-Moriya interaction (DMI). While in bulk materials skyrmions exist mostly at low temperatures, in magnetic multilayers (MM) they can be stabilized at room temperature [1], which, in combination with their small size, stability and fast and energy efficient movement, make them promising for spintronics applications e.g. in unconventional computing and high-density magnetic storage. Here we present first results on low-frequency resistance noise spectroscopy measurements on Pt-Co-Ta-based MM systems which host Néel-type skyrmions at room temperature. The intention is to utilize low-frequency noise as an effective probe for the electrical characterization of fundamental skyrmion properties such as the skyrmion lattice constant or their mean velocity and to investigate their current-induced dynamics [2-4].

[1] Hassan *et al.*, Nat. Phys. **20**, 615 (2024)
[2] Sato *et al.*, Phys. Rev. B **100**, 094410 (2019)
[3] Wang *et al.*, Phys. Rev. B **108**, 094431 (2023)
[4] Diaz *et al.*, Phys. Rev. B **96**, 085106 (2017)

MA 7.71 Mon 9:30 P2

Parameter-Dependent Stability of Magnetic Hopfions — •Niklas Oettgen, Sandra C. Shaju, Maria Azhar, and Karin Everschor-Sitte — Faculty of Physics, University of Duisburg-Essen, Duisburg, Germany

Hopfions are three-dimensional topologically protected magnetic textures that can be considered as closed loops of twisted skyrmion strings. We implement a model of spatially varying Dzyaloshinskii-Moriya interactions in micromagnetic simulations to explore Hopfion stability across a range of external magnetic fields and uniaxial anisotropies. Our simulations identify a clear regime in which the Hopfion remains metastable, and give insight into the conditions required for their formation and robustness.

MA 7.72 Mon 9:30 P2

Stability and Internal Structure of Skyrmioniums — •Finn Feldkamp[1,2], Alessandro Pignedoli[1], Ross Knapman[1], Maria Azhar[1], and Karin Everschor-Sitte[1] — [1]Faculty of Physics and Center for Nanointegration Duisburg-Essen, Duisburg, Germany — [2]Faculty of Physics and Earth System Sciences Leipzig University, Leipzig, Germany

Skyrmioniums are magnetic textures that can emerge in thin-film magnets under suitable conditions, potentially coexisting with other configurations such as domain walls and skyrmions. They can be understood as two nested skyrmions with opposite topological charge, giving rise to a ring-like, non-topological structure rather than the single-core profile characteristic of skyrmions. In this work, we investigate the stability and internal structure of skyrmioniums in thin films, examining the influence of crystalline anisotropy, external magnetic fields, and the demagnetization field. We present a comparative analysis with skyrmions, highlighting key similarities and differences in their stability regimes and structural responses to material and field parameters.

MA 7.73 Mon 9:30 P2

Investigation of the hyperfine coupling constants of the endohedral fullerene N@C$_{60}$ — •Rebecca Löffler, Marco Sommer, and Johann Klare — Inst. of Physics, Univ. Osnabrück, Barbarastr. 7, 49076 Osnabrück, Germany

Endohedral fullerenes such as N@C_{60} are considered promising systems for spin-based quantum bits and quantum sensors on a nanoscale due to their exceptional spin stability and long coherence times, even at room temperature. In this work, the temperature-dependent hyperfine coupling constant of N@C_{60} in various solvents was investigated using EPR spectroscopy. To understand the influence of the chemical environment, crystalline N@C_{60} was introduced into organic solvents (toluene, CS_2) and into an aqueous host*guest complex with two γ-cyclodextrin molecules and then compared. The results show that a vibration model to Waiblinger (PhD thesis, Univ. Konstanz, 2001) reliably describes the behavior of N@C_{60} in crystalline form and in organic solvents, but cannot be applied to the γ-cyclodextrin complex. For crystalline N@C_{60}, a vibrational energy of E = (14,7 ± 0,2) meV was determined. Phase transitions could be detected in toluene and in the γ-cyclodextrin complex by changes in the hyperfine coupling constants. The results show that the hyperfine coupling constant has great potential for use in quantum sensor technology, especially for precise measurements of phase transitions, such as the freezing of water.

MA 7.74 Mon 9:30 P2

Electron paramagnetic resonance and magnetization studies on tetrahedral Co^{II} complexes — •Matthias Heinrich[1], Jan Arneth[1], Amit Gharu[2], Kuduva Vignesh[2], and Rüdiger Klingeler[1] — [1]Kirchhoff Institute for Physics, Heidelberg University, Germany — [2]Department of Chemical Sciences, IISER Mohali, India

We report the static and dynamic magnetic properties of a series of five cobalt complexes of the type $Co^{III}_4Co^{II}$ with four octahedrally coordinated Co^{III} centers in the low-spin $S = 0$ state and a magnetically isolated Co^{II} ion ($S = 3/2$) in distorted tetrahedral coordination. The tetrahedral distortion differs across the series due to variations in bond lengths and bond angles. Our static and dynamic magnetization measurements of all compounds reveal field-induced magnetic relaxation as well as pronounced magnetic anisotropy. For one representative complex, high-field EPR-studies are presented which allow to determine the anisotropic g-factor as well as the easy-plane anisotropy. The effect of tetrahedral distortion on the magnetic anisotropy is quantitatively evaluated and discussed.

MA 7.75 Mon 9:30 P2

Investigating the Magnetic 3d-3d and 3d-4f Interaction in Triangular $Cr^{III}_3Ln^{III}$ Complexes — •Rui Yang[1], Jan Arneth[1], Muthu Thangavel[2], Christopher Anson[2], Annie Powell[2], and Rüdiger Klingeler[1] — [1]Kirchhoff Institute for Physics, Heidelberg University, Germany — [2]Institute for Inorganic Chemistry, Karlsruhe Institute of Technology, Germany

The interplay between the highly localized 4f electrons of the lanthanide ions and the more diffuse transition-metal 3d electrons leads to complex and often weak coupling mechanisms that are difficult to predict and quantify. Here, we report the static and dynamic magnetic properties of a series of isostrucural triangular $Cr^{III}_3Ln^{III}$ (Ln^{III} = Y, Gd, Tb, Dy, Ho, Er, Yb) complexes studied by means of dc/ac magnetization and high-field EPR. In particular, we investigate the bare 3d-magnetism of the Cr^{III}-triangle which is realized for diamagnetic Ln=Y and systematically study the 3d-4f interaction in the series of paramagnetic Ln.

MA 7.76 Mon 9:30 P2

Optimization of metal-doped M0.2Fe2.8O4/PEG nanocomposite for enhanced magnetic and relaxometric performance in MRI applications — •Mennatallah Abouhasswa[1], Ahmed Al Shahawy[2], Samaa El Dek[2], Messaoud Harfouche[3], Nagwa Okasha[1], Giuliana Aquilanti[4], Neama Imam[5], and Jan Ingo Flege[5] — [1]Physics Department, Ain Shams University, Egypt — [2]Faculty of Postgraduate Studies for Advanced Sciences, BeniSuef University, Egypt — [3]SESAME Synchrotron, Jordan — [4]Elettra,Sincrotrone Trieste, Italy — [5]Brandenburg University of Technology Cottbus, Senftenberg, Germany

Magnetic spinel ferrites are promising magnetic resonance imaging (MRI) contrast agents owing to their tunable structure, magnetic anisotropy, and biocompatibility. M0.2Fe2.8O4 nanoparticles (M = Fe2+, Mn2+, Cu2+) coated Polyethylene glycol (30%PEG-6000) were synthesized to correlate cation substitution with structural, magnetic, and relaxometric behavior. XRD, HRTEM, FTIR, XPS, synchrotron-based XAFS spectroscopy, and Vibrating Sample Magnetometer (VSM) confirmed single-phase nanocrystals (8-13 nm) with mixed Fe2+/Fe3+ states and preserved spinel geometry upon PEG coating. Mn-doping enhanced saturation magnetization and transverse relaxivity, providing the strongest T2 weighted MRI contrast. The results demonstrate that combining controlled B-site substitution with hydrophilic PEG capping enables concurrent optimization of magnetic response and colloidal stability, highlighting Mn0.2Fe2.8O4/PEG as a high-performance and biocompatible MRI nanocontrast agent.

MA 7.77 Mon 9:30 P2

Height Calibration of Nitrogen Vacancy Diamond Tips Using Current-Carrying Wires — Robin Abram, •Ricarda Reuter, Alexander Fernández Scarioni, Sibylle Sievers, and Hans Werner Schumacher — Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig, Germany

Scanning Nitrogen Vacancy Microscopy (SNVM) is a measurement technique capable of resolving the spatial distribution of magnetic stray fields with nanometer and microtesla resolution, respectively. It combines optical field detection with a scanning probe-like approach, where the key component is a diamond scanning tip containing a single NV center. While magnetic field measurements are quantum-calibrated with respect to the position of the NV center, precise knowledge of the distance to the sample is required to also consider the height dependence. The latter can currently only be estimated with an uncertainty of up to several nanometers, most commonly by calibration with a known stray field, e.g. using ferromagnetic microstructures. We established an improved height calibration based on SNVM studies of the current-induced Oersted field in Pt wires by Lee et al.. The out of plane field component is extracted from the raw data taken along the NV spin axis, following the approach first introduced by Schendel et al. and later applied to SNVM by Dovzhenko et al., and fitted to an analytical model. Using this approach, we realized a height calibration with an uncertainty of 10 nanometers for both 100 and 111 cut diamond tips. We also found that the nominally expected NV height underestimates the calibration result by about 30 nanometers.

MA 7.78 Mon 9:30 P2

Influence of Reference Sample and Scan Parameters on Magnetic Force Microscopy Calibrations — •Christopher Habenschaden[1], Baha Sakar[2], Sibylle Sievers[1], and Hans Werner Schumacher[1] — [1]Physikalisch-Technische Bundesanstalt (PTB), 38116 Braunschweig, Germany — [2]Felix Bloch Institute for Solid State Physics, University of Leipzig, Linnéstraße 5, 04103 Leipzig

Magnetic force microscopy (MFM) is a technique that enables the precise characterization of magnetic stray field distributions with high sensitivity and spatial resolution. By employing an appropriate calibration procedure, MFM can also provide quantitative values for magnetic fields. This calibration typically involves measuring a reference sample to identify the stray field or stray field gradient of the tip at the sample's surface. This distribution is known as the tip transfer function (TTF), which is obtained through regularized deconvolution in Fourier space. The performance of this process is heavily influenced by the reference sample's properties, scan parameters, and the detection system's noise characteristics, which can restrict its applicability. Our findings indicate that achieving a strong overlap of frequency components between the reference sample and the sample under test is more crucial for accurately reconstructing the stray field than simply obtaining a precise real-space representation of the tip's stray field distribution.

MA 7.79 Mon 9:30 P2

Accessing in-plane stray field components with torsional resonance mode magnetic force microscopy — •Jorge Marqués-Marchán[1], José Claudio Corsaletti Filho[1], Pamela Morales-Fernández[1], and Claire Donnelly[1,2] — [1]MPI CPfS, Dresden, Germany — [2]WPI-SKCM2, Hiroshima, Japan

In recent years, the emergence of 3D nanomagnetism and topological configurations has highlighted the importance of mapping the 3D vector field components in these systems. A lab-based technique that could provide such contrast is torsional resonance mode magnetic force microscopy (TR-MFM), where the MFM probe oscillates laterally with respect to the sample surface. Although MFM is a well-established technique, the use of TR-MFM has only been validated on standard samples [1,2]. Here, we use TR-MFM in combination with standard MFM to map both the in-plane and out-of-plane stray field components of different samples, aiding the understanding of different 3D magnetic configurations.

[1] A. Kaidatzis and J. M. García-Martín, Nanotechnology 24, 165704 (2013)

[2] J. F. Schmidt et al., J. Appl. Phys. 136, 113904 (2024)

MA 7.80 Mon 9:30 P2

Lensless magneto-optical imaging — •Volker Neu[1], Giancarlo Pedrini[2], Ivan Soldatov[1], Stephan Reichelt[2], and Rudolf Schäfer[1] — [1]IFW Dresden, Helmholtzstr. 20, 01069 Dresden — [2]Institut für Technische Optik (ITO), Univ. Stuttgart, Pfaffenwaldring 9, 70569 Stuttgart

Magneto-optical methods, which utilize the interaction of polarized light with the magnetization state of the sample in reflection (magneto-optical Kerr effect) or in transmission (Faraday effect) present the most prominent classical microscopy techniques to investigate magnetic microstructures down to a few hundred nanometers.

In a first proof-of-principle study [1] we verified the feasibility of lensless magnetic imaging in the optical regime and explored the various contrast mechanisms that can be applied in such an approach. We demonstrate that the reconstructed intensity is in full qualitative agreement with the intensity contrast expected from conventional lens-based Faraday microscopy. This holds for the usual application of linearly polarized light with an almost crossed analyzer, but also for the less common combination of linearly polarized light with fully crossed analyzer. The additional phase information, not accessible with conventional microscopy, offers direct access to domain information in the latter case. This initial verification of lensless magneto-optical imaging will enable the various established advantages of lensless microscopy to be utilized for the examination of magnetic materials in the future.

[1] V. Neu, G. Pedrini, I. Soldatov, S. Reichelt, R. Schäfer, "Lensless magneto-optical imaging", Scientific Reports 15, 28277 (2025).

MA 7.81 Mon 9:30 P2

Soft X-ray ptychography with SOPHIE — Tim A Butcher[1,2], Simone Finizio[1], Lars Heller[1], Nicholas W Phillips[1,3], Blagoj Sarafimov[1], Carlos A F Vaz[1], Armin Kleibert[1], Benjamin Watts[1], Mirko Holler[1], and •Jörg Raabe[1] — [1]Paul Scherrer Institut, 5232 Villigen PSI, Switzerland — [2]Max Born Institut, 12489 Berlin, Germany — [3]CSIRO, 3168 Clayton, Australia

Soft X-ray ptychography is rapidly becoming one of the key synchrotron-based magnetic imaging techniques, thanks to the possibility of combining high spatial resolutions over large scan areas with strong contrast mechanisms such as X-ray circular and linear dichroisms. To meet the demands of the user community for ptychography imaging, the SOft X-ray Ptychography Highly Integrated Endstation (SOPHIE) was developed at the Swiss Light Source. In this presentation, we give an overview of the design and performance of the endstation during its commissioning at the SoftiMAX beamline of MaxIV, together with an example of its imaging capabilites, where sub 10nm resolution at the Fe L_3 edge was demonstrated in routine conditions.

MA 7.82 Mon 9:30 P2

High resolution imaging of ultrathin PMA films for racetrack applications — •Anindit Das[1], Sebastian Schneider[1], Jae-Chun Jeon[2], and Bernd Rellinghaus[1] — [1]DCN, cfaed, TU Dresden, Dresden, Germany — [2]Max Planck Institute for Microstructure Physics, D-06120 Halle (Saale), Germany

The realization of domain wall (DW)-based racetrack memory requires Perpendicular Magnetic Anisotropy (PMA) thin films with finely tuned magnetic properties. This work combines direct imaging via Lorentz Transmission Electron Microscopy (LTEM) with micromagnetic simulations to establish design principles for such materials. Our simulations systematically vary key parameters—including saturation magnetization (M_s), uniaxial anisotropy (K_u), exchange stiffness ($A_{\rm ex}$), and the Dzyaloshinskii-Moriya interaction (DMI)—to understand their impact on DW structure and dynamics. We identify that an optimal balance is critical: a high K_u ensures thermal stability, while a moderate M_s and tailored DMI are essential for efficient, fast DW motion. However, significant challenges arise from conflicting requirements; for instance, a high $A_{\rm ex}$ is necessary for robust DWs but can also increase the depinning field, and excessive DMI can compromise DW integrity. This study provides a crucial map of the material parameter space, highlighting the trade-offs between stability, speed, and fabricability to guide the development of viable PMA films for racetrack memory.
Financial support by the DFG through TRR 404, project no. 528378584, is gratefully acknowledged.

MA 7.83 Mon 9:30 P2

Theory of transport properties of coplanar spin spirals — •Ilja Turek — Institute of Physics of Materials, Czech Acad. Sci., Brno, Czech Rep.

Coplanar spin spirals are compensated magnetic systems related closely to the recently introduced *p*-wave magnets [1]. Their special magnetic order leads to the absence of space-inversion symmetry, which is a necessary prerequisite for a nonzero Edelstein effect (change of magnetization due to an external electric field). Here, we consider simple tight-binding models of nonrelativistic coplanar spin spirals and study their transport properties within the Kubo linear response theory and the conserving selfconsistent Born approximation [2]. We reveal that depending on the model details, both the electric conductivity and the coefficient of the Edelstein effect contain not only a coherent (quadratic in the averaged one-particle propagators) term, but also a nonnegligible incoherent term due to the disorder-induced vertex corrections. Consequences for reliable evaluation of the transport properties of real spin-spiral systems are discussed briefly as well.
[1] A. Chakraborty et al., Nat. Commun. 16 (2025) 7270. [2] I. Turek, Phys. Rev. B 93 (2016) 245114.

MA 7.84 Mon 9:30 P2

Emergent non-coplanar magnetism and colossal transverse magnetoresponse in strongly correlated nodal-line half-metal — •Jyotirmoy Sau[1,2], Sourav Chakraborty[1], and Manoranjan Kumar[1] — [1]S. N. Bose National Centre for Basic Sciences, Kolkata 700106, India — [2]Department of Physics and Astronomy, Uppsala University, Uppsala, Sweden

Understanding the interplay of strong correlation and temperature in nodal-line semimetals can unlock new pathways for spin current control. Here, we consider the $3d$-$5d$ double-perovskite Ba_2CoWO_6, which features mirror-symmetry-protected nodal lines, strong Co-site interactions, and spin-orbit coupling at W sites. Our first-principles and exact diagonalization results reveal a half-metallic ground state with high-spin Co and topologically non-trivial bands. Finite spin-orbit coupling gaps out nodal points and induces band inversion. The ensuing non-trivial Berry curvature generates an anomalous Hall response and stabilizes a non-coplanar magnetic order. Our semi-classical Monte Carlo finite-temperature simulation of the five-orbital Hubbard model confirms the non-coplanar magnetic order and uncovers colossal transverse magnetoresponse. We predict the temperature and magnetic field scales for the tunability of the magnetoresponse.

MA 7.85 Mon 9:30 P2

Exploring the tunability of magnetism and charge density waves states in VSe2 — •Javier Corral Sertal[1,2], Adolfo O. Fumega[3], S. Blanco-Canosa[4], and Victor Pardo[2,5] — [1]CiQUS, Centro Singular de Investigacion en Quimica Biolóxica e Materiais Moleculares, Universidade de Santiago de Compostela, Santiago de Compostela, Spain — [2]Departamento de Física Aplicada, Universidade de Santiago de Compostela, Santiago de Compostela, Spain — [3]Department of Applied Physics, Aalto University, 02150 Espoo, Finland — [4]Donostia International Physics Center (DIPC), San Sebastián, Spain — [5]Instituto de Materiais iMATUS, Universidade de Santiago de Compostela, Santiago de Compostela, Spain

Transition metal dichalcogenides (TMDs, $\mathrm{MX_2}: \mathrm{M} = \mathrm{Nb, Ti, V...}$, $\mathrm{X} = \mathrm{S, Se, Te...}$) are a familiy of two-dimensional (2D) layered materials that attract great attention because of their large landscape of collective phenomena that differ from the bulk ones. Among them, magnetism in low dimensions has been argued for decades, being rejected by the Mermin-Wagner theorem but found as Ising-type ferromagnets in purely 2D-materials VSe_2 is a TMDs where ferromagnetism is present in its normal state (NS) bulk phase, but becomes supressed when the charge density wave (CDW) phase $4 \times 4 \times 3$ appears or it is reduced to the monolayer limit. Here, we present a computational study of several heterostructure packaging of VSe_2 with other TMDs materials in order to elucidate if the formation of the CDW can be supressed by different stacking arrangements, and if with these stackings we are able to retain magnetism in the system.

MA 7.86 Mon 9:30 P2

Temperature dependence of the spin-wave dispersion in the spin-polarized homogeneous electron gas — •Michael Neugum, Noah Spiegelberg, and Arno Schindlmayr — Universität Paderborn, Department Physik, 33095 Paderborn, Germany

Spin waves are an important class of elementary excitations in magnetically ordered materials. Due to the absence of an energy gap, they are easily thermally excited and, consequently, influence technological applications like spintronics or magnetic data storage. The impact of temperature is twofold: First, the occupation numbers of the bosonic spin-wave modes increase with the temperature. Second, the dispersion itself changes, leading to lowered spin-wave energies and hence to an accelerated population. The latter effect is largely ignored in current ab initio calculations, which are typically performed at 0 K and often lack proper temperature-dependent functional expressions. Here we calculate the spin-wave dispersion of the spin-polarized homogeneous electron gas at finite temperature within time-dependent density-functional theory, taking only the exchange functional into account. The temperature dependence of the exchange kernel is fully included. Our results demonstrate that the spin-wave energies are indeed systematically lowered as the temperature increases. As an important observation, the spin-wave stiffness also decreases, so that there is a nonnegligible effect on long-wavelength modes and on thermodynamic quantities, such as the specific heat capacity, even at low temperature.

MA 8: Altermagnets II

Time: Monday 15:00–18:30 Location: HSZ/0002

MA 8.1 Mon 15:00 HSZ/0002

Odd-parity spin splitting and anomalous Hall effect in spiral magnets — •Shun Okumura[1,2], Moritz M. Hirschmann[2], and Yukitoshi Motome[3] — [1]Quantum-Phase Electronics Center, The University of Tokyo, Tokyo, Japan — [2]RIKEN Center for Emergent Matter Science, Wako, Japan — [3]Department of Applied Physics, The University of Tokyo, Tokyo, Japan

Altermagnetism with collinear antiferromagnetic order has recently attracted considerable interest for a spontaneous anomalous Hall effect (AHE) mediated by spin-orbit coupling (SOC). In contrast, noncoplanar magnetic textures such as skyrmions exhibit a topological Hall effect by imprinting a Berry phase on itinerant electrons even in the absence of SOC. However, in the case of spiral magnetism, a prototypical example of a non-collinear and coplanar magnetic structure, the conditions required to realize AHE have yet to be thoroughly explored.

In this study, we investigate the AHE in metallic systems coupled to commensurate spiral magnetic textures. The electronic bands exhibit odd-parity spin splitting with spin polarization perpendicular to the helical plane. In the presence of SOC and finite magnetization, the Berry curvature concentrated along the spin-nodal lines leads to a characteristic AHE in the spin spiral state. This spiral-induced AHE depends sensitively on the SOC type, helical plane, and magnetization direction. We also demonstrate that a "p-wave" magnet with a commensurate spin spiral, recently identified in an f-electron material, can host this enormous AHE.

MA 8.2 Mon 15:15 HSZ/0002

Pines' Demons in d-Wave Altermagnets: From Hidden Modes to Fano-Demon States — •Habib Rostami[1] and Johannes Hofmann[2] — [1]Department of Physics, University of Bath, United Kingdom — [2]Department of Physics, Gothenburg University, Sweden

We develop a Fermi-liquid description of d-wave altermagnets and analyze their charge and spin collective excitations [1]. In addition to the conventional undamped plasmon, where both spin components oscillate in phase, we find an acoustic plasmon (demon) mode with out-of-phase spin dynamics. Using the dynamical structure factor, we show that the demon frequency and spectral weight depend sensitively on the Landau parameters and on the propagation direction. As a function of angle, the acoustic mode evolves from a hidden state with vanishing spectral weight in the density response, to a weakly damped propagating demon, and, below a critical interaction parameter, to a Fano-demon mixed state that strongly hybridizes with particle-hole excitations and exhibits an asymmetric line shape. We briefly discuss possible implications for probing and exploiting collective electron spin oscillations in altermagnetic materials.

[1] H. Rostami and J. Hofmann, Fermi liquid theory of d-wave altermagnets: demon modes and Fano-demon states, arXiv:2505.07083, to appear in Physical Review Letters.

MA 8.3 Mon 15:30 HSZ/0002

Studying altermagnetism with muon-spin spectroscopy — •Thomas Hicken[1], Jonas Kreiger[1], Jennifer Graham[1], Zurab Guguchia[1], Franziska Walther[2], Kristin Kliemt[2], Cornelius Krellner[2], Helena Reichlova[3], Klára Uhlířová[4], Juraj Krempaský[1], Nirmal Ghimire[5], and Hubertus Luetkens[1] — [1]PSI, Switzerland — [2]Goethe-Universität Frankfurt, Germany — [3]Czech Academy of Science, Czech Republic — [4]École Polytechnique Fédérale de Lausanne, Switzerland — [5]University of Notre Dame, USA

With properties of both ferro- and antiferro-magnets, altermagnetism is of interest for fundamental physics and spintronic applications. Understanding the magnetic structure, and hence magnetic symmetries, is of utmost importance. Further, it has been suggested that altermagnets may have unique dynamic fluctuations. To answer these questions, muon spin spectroscopy (μSR) measurements provide information that is complementary to, and unique from, other probes. I will discuss how we are using μSR to probe a number of materials, including $Co_{1/4}NbSe_2$ [1], a proposed g-wave altermagnet, Ce_4Sb_3, which shows promise as an altermagnet with $4f$ moments, and MnTe [2], which is perhaps the best studied altermagnet so far. Our measurements, combined with muon stopping site calculations, reveal the sometimes unexpected magnetic structure of candidate altermagnetic materials, and test some of the key predictions of altermagnetism.

[1] J. N. Graham, T. J. Hicken et al., arXiv:2503.09193 (2025).
[2] T. J. Hicken et al., arXiv:2507.14710 (2025).

MA 8.4 Mon 15:45 HSZ/0002

Broadband nonlinear Hall response and multiple wave mixing in a room temperature altermagnet — •Berthold Jaeck — HKUST, Department of Physics, Clear Water Bay, Kowloong, Hong Kong

Altermagnets are characterized by magnetic crystal order that manifests in a non-relativistic spin-splitting of the electronic bands. Their electric material properties should thus be determined by the underlying symmetries. We report the discovery of a broadband third-order nonlinear anomalous Hall effect in altermagnetic CrSb at room temperature that exhibits a distinct spatial anisotropy [1]. The comparison of our experimental observations with symmetry analyses and model calculations shows that this nonlinear Hall response is induced by the nonlinear electric susceptibility of a Berry curvature quadrupole. This quadrupole precisely reflects the magnetic and crystalline symmetries encoded in the altermagnetic g-wave order parameter. We then utilize the nonlinear electric susceptibility of CrSb to realize a multiple wave mixing device with pronounced four wave mixing output. Our study provides a generalized understanding of the impact of magnetic crystal order on the electric material properties of altermagnets and significantly expands their technological scope to include high-frequency applications up to the THz regime.

We acknowledge funding by the Hong Kong RGC (Grant Nos.26304221, 16302422, 16302624, and C6033-22G) and the Croucher Foundation (Grant No.CIA22SC02).

[1] S. Sankar et al., arXiv:2511.10471 [cond-mat.mes-hall] (2025)

MA 8.5 Mon 16:00 HSZ/0002

Ce_4Sb_3: A Kondo metal as candidate for d-wave altermagnetism — •Franziska Walther[1], Thomas J. Hicken[2], Venkata Krishna Bharadwaj[3], Julian Kaiser[4], Bin Shen[4], Jan Priessnitz[5], Rahel Ohlendorf[6], Michelle Ocker[1], Alexander Fedorov[7], Anton Jesche[4], Hubertus Luetkens[2], Philipp Gegenwart[4], Elena Gati[7], Denis Vyalikh[8], Libor Šmejkal[5], Jairo Sinova[3], Cornelius Krellner[1], and Kristin Kliemt[1] — [1]Uni Frankfurt, Germany — [2]PSI, Switzerland — [3]Uni Mainz, Germany — [4]Uni Augsburg, Germany — [5]MPI PKS Dresden, Germany — [6]MPI CPfS Dresden, Germany — [7]HZB Berlin, Germany — [8]DIPC Donostia, Spain

The study of altermagnetic materials has been focused so far on magnetic d-systems. Here, we present Ce_4Sb_3 as a lanthanoid-based altermagnetic candidate to study the altermagnetism arising from local $4f$ moments, where magnetism is mediated indirectly by the RKKY interaction. Below 4 K, the cubic compound Ce_4Sb_3 orders magnetically and d-wave altermagnetism is theoretically predicted. Furthermore, the material shows Kondo behaviour, enabling it to be a promising candidate to study pressure-induced quantum critical phenomena in systems with altermagnetic spin fluctuations. Here, we report on the single crystal growth by the Czochralski method in a quasi-crucible free high pressure setup, the physical characterization of the magnetic ground state and a first study by angle-resolved photoemission and muon spin spectroscopy.

MA 8.6 Mon 16:15 HSZ/0002

Optical Kerr Signatures in d-wave and g-wave Altermagnets

— •Luca Felipe Haag[1], Paul Herrgen[1], Jairo Sinova[2], Benjamin Stadtmüller[3], Martin Aeschlimann[1], and Hans Christian Schneider[1] — [1]Department of Physics and Research Center OPTIMAS, RPTU University Kaiserslautern-Landau, Germany — [2]Institut für Physik, Johannes Gutenberg University, Mainz — [3]Experimentalphysik II, Institute of Physics, University of Augsburg, Germany

The non-relativistic spin splitting in the electronic states of altermagnets makes them promising candidates for next-generation spintronic materials [1,2], but the identification and characterization of these materials is difficult. In a previous study, we demonstrated that altermagnets show intriguing time-dependent magneto-optical properties when probed by ultrashort pulses, which are linked to their particular spin symmetries [3]. In this contribution we analyze the pump-induced Kerr response of different candidate materials in detail. To this end, we theoretically investigate the probe response due to the pump induced birefringence and explain how to distinguish between anisotropic charge carrier distributions and magnetic signatures. Our results suggest that pump-probe Kerr microscopy is a viable tool to image the domain structure of specific altermagnets.

[1] Šmejkal et al., Phys. Rev. X 12, 040501 (2022) [2] Šmejkal et al., Phys. Rev. X 12, 031042 (2022) [3] Weber et al., arXiv:2408.05187 (2024)

MA 8.7 Mon 16:30 HSZ/0002

Ferroelectricity-driven altermagnetism in two-dimensional van der Waals multiferroics

— •Bo Zhao[1], Fu Li[1], Wei Ren[2], Hao Wang[1], and Hongbin Zhang[1] — [1]Theory of Magnetic Materials, Institute of Materials Science, Technical University of Darmstadt, 64287 Darmstadt, Germany — [2]Institute for Quantum Science and Technology, State Key Laboratory of Advanced Refractories, Materials Genome Institute, Physics Department, Shanghai University, Shanghai 200444, China

Altermagnets (AMs) are an unconventional class of collinear compensated antiferromagnets that exhibit momentum-dependent spin splitting despite zero net magnetization. Using spin space group (SSG) symmetry analysis and first-principles calculations, we show that altermagnetism in two-dimensional multiferroics can be efficiently controlled by ferroelectric polarization and interlayer sliding. As a material platform, monolayer and bilayer $FeCuP_2S_6$ display finite spin splitting when ferroelectric sublattices are linked by nonsymmorphic screw-axis operations instead of pure translation or inversion. Interlayer sliding allows reversible switching or suppression of this spin splitting through SSG modifications. We further find that the anomalous Hall response directly probes these spin-split states. These results highlight 2D van der Waals multiferroics as promising systems for electrically tunable altermagnetism and next-generation spintronic applications.

[1] B. Zhao et al. arXiv:2511.00712.

15 min break

MA 8.8 Mon 17:00 HSZ/0002

Elastocaloric probing and tuning of multipolar order in the altermagnet MnF_2

— •Rahel Ohlendorf[1,2], Luca Buiarelli[3], Hilary M. L. Noad[1], Andrew P. Mackenzie[1,4], Rafael M. Fernandes[5], Turan Birol[3], Jörg Schmalian[6], and Elena Gati[1,2,7] — [1]Max Planck Institute for Chemical Physics of Solids, Dresden, Germany — [2]Technische Universität, Dresden, Germany — [3]University of Minnesota, Minneapolis, USA — [4]University of St Andrews, UK — [5]University of Illinois Urbana-Champain, Urbana, USA — [6]Karlsruhe Institute of Technology, Karlsruhe, Germany — [7]Goethe Universität, Frankfurt, Germany

Altermagnets break time-reversal symmetry without net magnetization [1], with the order parameter described by the ferroic ordering of multipoles rather than dipoles. In *d*-wave altermagnets, the predicted ferrooctupolar order couples to magnetic field and strain. In this talk, we demonstrate that elastocaloric experiments under strain and magnetic field are a powerful thermodynamic and symmetry-sensitive probe of the finite-temperature ferrooctupolar critical point. We resolve elastocaloric signatures of altermagnetic crossover lines and entropy accumulation. By combining our experiments with DFT calculations, we provide a microsopic explanation for the size of the observed thermodynamic effects. As a result, we outline the route to stronger thermodynamic responses in insulating and metallic altermagnets (both *d*-wave and *g*-wave), establishing elastocaloric measurements as a key probe of altermagnetic criticality.

[1] L. Šmejkal et al., Phys. Rev. X 12, 031042 (2022)

MA 8.9 Mon 17:15 HSZ/0002

Optical phonons as a testing ground for spin group symmetries

— Felix Schilberth[1], Mark Kondákor[4], Denis Ukulov[2], Lilian Prodan[1], Alexander Tsirlin[3], Peter Lemmens[2], Karlo Penc[4], Istvan Kézsmárki[1], and •Joachim Deisenhofer[1] — [1]Experimental Physics V, Center for Electronic Correlations and Magnetism, Institute for Physics, University of Augsburg, D-86159 Augsburg, Germany — [2]Institute of Condensed Matter Physics, TU Braunschweig, Mendelssohnstr. 3, 38106 Braunschweig, Germany — [3]Felix Bloch Institute for Solid-State Physics, Leipzig University, 04103 Leipzig, Germany — [4]Institute for Solid State Physics and Optics, HUN-REN Wigner Research Centre for Physics, H-1525 Budapest, P.O.B. 49, Hungary

We present a detailed study of the infrared- and Raman-active modes in the collinear antiferromagnet and altermagnet candidate $Co_2Mo_3O_8$. Comparing to *ab initio* calculations accurately capturing the eigenfrequencies, we identify all expected phonon modes at room temperature and deduce their selection rules with the magnetic point group and the spin group. We observe the change of selection rules upon antiferromagnetic ordering, agreeing with the relativistic symmetry approach, while the spin group formalism predicts no changes. Therefore, optical phonons sensing the symmetry of the magnetic order can reveal if relevant magnon-phonon coupling is compatible with the spin-group approach or not.

MA 8.10 Mon 17:30 HSZ/0002

Optical properties of altermagnetic candidate MnTe

— •Ece Uykur[1], Marcus Schmidt[2], Stephan Winnerl[1], and Alexander A. Tsirlin[3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, 01328 Dresden, Germany — [2]Max Planck Institute for Chemical Physics of Solids, 01067 Dresden, Germany — [3]Felix Bloch Institute for Solid-State Physics, University of Leipzig, 04103 Leipzig, Germany

MnTe is one of the promising altermagnetic candidates, where the band splitting, which is a key feature of altermagnetic materials, are confirmed via angle-resolved photoemission spectroscopy (ARPES) [1] and inelastic neutron scattering [2] experiments. In the next step, control of this unique property is desired. Given that in the spin configuration level the compound is antiferromagnetic, light control is a promising route in this regard.

Here, we present optical characterization of MnTe. Broadband infrared spectroscopy (down to the THz regime) and Raman spectroscopy of the compound are reported. Relevant phonon and magnon responses are identified. Results suggest that unusual optical activity is present in MnTe and provide a promising route for light-matter interactions.

[1] J. Krempaský et al., Nature 626, 517 (2024)
[2] Z. Liu et al., Phys. Rev. Lett. 133, 156702 (2024)

MA 8.11 Mon 17:45 HSZ/0002

First-principles study on piezomagnetism in altermagnet CoF_2

— •Hiroshi Katsumoto[1,2], Kunihiko Yamauchi[2], and Tamio Oguchi[2] — [1]Division of Materials and Manufacturing Science, Graduate School of Engineering, The University of Osaka, Suita, Japan — [2]Center for Spintronics Research Network, The University of Osaka, Toyonaka, Japan

Altermagnetic materials have recently attracted considerable interest due to their characteristic spin splitting in the absence of spin–orbit coupling (SOC). Among them, CoF_2 is notable not only for its altermagnetic band structure but also for its longstanding classification as a piezomagnetic material with large piezomagnetic coefficients [1]. Nevertheless, the microscopic link between its electronic structure and mechanical response has not been fully clarified. In this study, we investigate the origin of piezomagnetism in CoF_2 by means of first-principles calculations. We identify two distinct mechanisms: one driven by SOC-induced anisotropic spin–lattice coupling, and the other emerging from the SOC-independent spin splitting inherent to altermagnetism. By examining how strain influences the electronic states through these mechanisms, we gain new microscopic insights into piezomagnetism in CoF_2 and discuss implications for designing functional antiferromagnets with tailored magnetoelastic properties.

This presentation was supported by JSPS KAKENHI Grand Number

JP23H05457.

[1] M. Komuro *et al.*, Phys. Rev. B **111**, 214445 (2025).

MA 8.12 Mon 18:00 HSZ/0002

Influencing altermagnetic transitions by strain and layering

— •Marnin Di Nunzio, Frank Lechermann, and Ilya Eremin — Institut für Theoretische Physik III, Ruhr-Universität Bochum, D-44780 Bochum, Germany

Altermagnets are collinearly ordered magnets, that break time-reversal symmetry, with a zero magnetization, and a spin-split band structure. By employing the minimal tight-binding Hubbard-like model within mean-field and rotationally invariant slave boson (RISB) approximation we explore the effect of uniaxial strain and electronic correlations on altermagnetism in mono- and bilayer systems. We single out two configurations of bilayer stackings and examine the altermagnetic transition and the effect of doping respectively. Following the application of uniaxial strain and doping in the monolayer, we uncover a fully spin-polarized Fermi surface. In the bilayer system doping itself is sufficient to achieve a complete metallic spin-polarization.

MA 8.13 Mon 18:15 HSZ/0002

Relativistically Distinct Altermagnetic States in α-Fe_2O_3 by X-ray Spectromicroscopy

— •Rikako Yamamoto[1,2], Sina Mayr[3,4], Atsushi Hariki[5], Simone Finizio[3], Eugen Weschke[6], Markus Weigand[6], Libor Šmejkal[7], Jan Kuneš[8], Claire Donnelly[1,2], and Sebastian Wintz[6] — [1]MPI-CPfS, Dresden Germany — [2]WPI-SKCM[2] Hiroshima University, Hiroshima, Japan — [3]PSI, Villigen, Switzerland — [4]ETH, Zürich, Switzerland — [5]Osaka Metropolitan University, Osaka, Japan — [6]HZB, Berlin, Germany — [7]MPI-PKS, Dresden, Germany — [8]Masaryk University, Kotlářská, Czech Republic

In this study, we demonstrate the altermagnetic nature of α-Fe_2O_3 using x-ray magnetic linear and circular dichroism (XMLD and XMCD) spectroscopy and imaging. We observed an oscillatory XMCD signal for the x-ray beam along the *c*-axis, perpendicular to the net magnetization due to canting, which originates purely from altermagnetism.

Although the XMCD signal vanishes below the Morin reorientation transition as dictated by symmetry, we show that the x-ray absorption (XAS) alone provides sufficient contrast allowing to distinguish in- and out-of-plane orientations of the Néel vector. By combining the XMCD, XMLD and XAS contrast, we map out the continuous three-dimensional variation of the Néel vector in our samples. This approach can be broadly applied to a wide range of other materials.

MA 9: Magnonics I

Time: Monday 15:00–18:30 Location: HSZ/0004

MA 9.1 Mon 15:00 HSZ/0004

Non-reciprocal phonon propagation along skyrmion strings

— •Riccardo Ciola[1], Naofumi Matsuyama[2], Markus Garst[1], Lars Franke[1], Yoshimitsu Kohama[2], Toshihiro Nomura[3], Sergei Zherlitsyn[4], and Shinichiro Seki[2] — [1]Karlsruhe Institute of Technology (KIT), Germany — [2]University of Tokyo, Japan — [3]Shizuoka University, Japan — [4]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Germany

Non-centrosymmetric cubic chiral magnets host two-dimensional skyrmion textures that extend in the third direction, forming strings. In this work, we investigate the influence of magneto-elastic coupling on the collective excitations of the incommensurate skyrmion lattice phase. Within a microscopic theoretical framework that combines a Ginzburg-Landau description of the chiral magnet with a coupling to the underlying atomic crystal, we predict that magneto-elastic interactions give rise to a pronounced nonreciprocity in the propagation of acoustic phonons along the skyrmion strings. This directional asymmetry stems from the hybridisation between skyrmion lattice magnon modes and acoustic phonons, resulting in hybridized quasiparticles with strongly modified dispersions. Furthermore, our theory predicts the emergence of a phason gap, i.e., a gap of the translational Goldstone mode of the skyrmion lattice induced by a distortion of the atomic crystal. Altogether, our findings establish skyrmion-based topological superlattices as a theoretical platform for engineering chimeric magnon-phonon excitations, opening new directions in quasiparticle design and emergent material functionalities.

MA 9.2 Mon 15:15 HSZ/0004

Magnetically controllable phononic crystals experimentally investigated by combined μSNS-MOKE and μBLS

— •Philipp Knaus, Maximilian Alexander Thiel, and Mathias Weiler — Fachbereich Physik und Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern, Germany

Phononic crystals (PnCs) enable tailored elastic wave propagation and bandgap formation in the GHz range [1]. We present a pillar-type PnC made of gold on a $LiNbO_3$ substrate for controlling Rayleigh surface acoustic waves (SAWs). Using broadband interdigital transducers and nanoscale patterning, we demonstrate a phononic bandgap of 50 MHz at 1.6 GHz. The dispersion relation and spatially resolved SAW fields are measured with a combined micro-focused Super-Nyquist-Sampling Magneto-Optic Kerr Effect (μSNS-MOKE) [2,3] and micro-focused Brillouin Light Scattering (μBLS) setup, providing frequency-, phase-, time-, and space-resolved detection. Measurements reveal clear suppression of SAW propagation within the bandgap and allow direct reconstruction of the dispersion relation. We additionally study the impact of magnetic field on the bandstructrue of PnCs fabricated from CoFe pillars. Paving the way for reconfigurable SAW waveguides, tunable filters, and active phononic devices.

[1] M. Sledzinska et. al, Adv. Funct. Mater. 8, 30 (2020)
[2] G. I. Stegeman, J. Appl. Phys. 49, 5624-5637 (1978)
[3] R. Dreyer, PhD Thesis, Uni Halle (2021)

MA 9.3 Mon 15:30 HSZ/0004

Coherent Magnetoelastic Phonon Generation in CMOS-Compatible Ni/Si Microstructures

— •Mohammad Javad Kamali Ashtiani[1], Johan Sebastian Ramirez Amado[2], Abbas Koujok[1], Hanadi Mortada[1,2], Björn Heinz[1], Asma Mouhoub[2], Thibaut Devolder[2], Philipp Pirro[1], and Alexandre Abbass Hamadeh[2] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern-Landau, 67663 Kaiserslautern, Germany — [2]Center de Nanosciences et de Nanotechnologies, CNRS, Universite Paris-Saclay, 91120, Palaiseau, France

We investigate coherent phonon generation in a CMOS-compatible device using Ni micro-striplines fabricated on Si. Due to the coherent precession of the magnetization in Ni and its significant magnetostriction, the free energy oscillates at the drive frequency. Under appropriate conditions, this leads to oscillation of elastic forces on the Si substrate, which launches a propagating surface acoustic wave (SAW). By sweeping the excitation frequency and external magnetic field, we identify resonant conditions for magnon excitation in Ni stripes, which leads to coherent phonon generation.

Under this resonant excitation (e.g., 2.35 GHz, 10 mT), we observe strong phonon emission by micro-focused Brillouin light scattering. These results demonstrate that Ni/Si microstructures provide an efficient platform for studying field-tunable magnon-phonon interactions and magnetoelastic phonon generation in non-piezoelectric media. This research was supported by ANR-25-CE24-6700-01 (SAWSiX) and the DFG through TRR-173/3-268565370 Spin+X (Project-B01).

MA 9.4 Mon 15:45 HSZ/0004

Phase-resolved imaging of coherent phonon-magnon coupling

— •Yannik Kunz[1], Florian Kraft[1], Kevin Künstle[1], Matthias Küss[2], Stephan Glamsch[2], Manfred Albrecht[2], and Mathias Weiler[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU in Kaiserslautern, Germany — [2]Institute of Physics, University of Augsburg, Augsburg, Germany

The interaction between surface acoustic waves (SAWs) and spin waves (SWs) has become a major focus in magnetoacoustic research, as numerous studies have demonstrated the efficiency of SAW-driven SW excitation [1,2]. However, the coherence of the underlying magnetoelastic driving mechanism has so far only been inferred indirectly from microfocused Brillouin light scattering measurements [3].

We employ spatially resolved polarization-modulating optical detection [4] to directly visualize the resonant SAW-to-SW conversion with phase sensitivity. Hereby, $LiTaO_3$ provides a platform to excite shear-horizontal SAW modes in a magnetostrictive $Co_{40}Fe_{40}B_{20}$(5 nm) layer. Our technique enables direct imaging of the coherent driving of spin waves by surface acoustic waves, providing advanced insights into the dynamics of phonon-magnon coupling.

[1] Küß et al., Frontiers in Physics 10, 981257 (2022)
[2] Kunz et al., Phys. Rev. Appl. 24, 014043 (2025)
[3] Kunz et al., Appl. Phys. Lett. 124, 152403 (2024)
[4] Liensberger et al. IEEE Magn. Lett. 10, 5503905 (2019)

MA 9.5 Mon 16:00 HSZ/0004

Magnon-polaron control in a surface magnetoacoustic wave resonator — •Kevin Künstle[1], Yannik Kunz[1], Tarek Moussa[1], Katharina Lasinger[1,2], Kei Yamamoto[3], Philipp Pirro[1], John F. Gregg[2], Akashdeep Kamra[1], and Mathias Weiler[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau, Kaiserslautern, 67663, Germany — [2]Clarendon Laboratory, Department of Physics, University of Oxford, Parks Road, Oxford, OX1 3PU, United Kingdom — [3]Advanced Science Research Center, Japan Atomic Energy Agency, Tokai, 319-1195, Japan

We demonstrate strong coupling between confined phonons and finite-wavelength magnons, forming a magnon-polaron cavity with field-tunable coupling strength [1]. Our platform combines a low-loss YIG film with a ZnO-based surface acoustic wave (SAW) resonator, enabling exceptionally low magnon-polaron dissipation rates below $\kappa/2\pi < 1.5$ MHz. The observed hybridization is accurately captured by a phenomenological model including the spatial mode profiles of SAWs and spin waves. We further observe Rabi-like oscillations in the coupled SAW spin-wave system, revealing time-domain magnon-polaron formation and establishing a platform for engineered hybrid spin-acoustic excitations.

[1] K. Künstle et al., Nat. Commun. 16, 10116 (2025)

MA 9.6 Mon 16:15 HSZ/0004

Understanding change in the sound wave frequency in a ferromagnet under magnetic field influence (Simon effect) in the low-field regime — •Ievgeniia Korniienko[1], Pablo Nieves[2], and Dominik Legut[1] — [1]IT4Innovations, VSB-TU Ostrava, Ostrava, Czech Republic — [2]University of Oviedo, Oviedo, Spain

The Simon effect exhibits itself as the dependence of the ultrasonic wave velocity in a ferromagnetic crystal under applied magnetic field and it was explained using linear theory of magnetoelasticity in 1958. However, the recent research in the interaction of surface acoustic waves with spin waves in ferromagnetic films, as well as widespread use of the pulse echo technique for the study of various materials, has renewed interest in better understanding of the Simon effect. In our work, based on the example of bcc Fe, we propose a refined formula to describe the Simon effect, which contains terms related to dispersion effects associated with the exchange stiffness. We compare our analytical solutions with other alternative computational approaches and show that dispersion effects can be significant and cannot be neglected in the low field regime. As a result, we propose a more accurate analytical formula [1], which, due to its relative simplicity, can become a convenient tool to estimate the magnitude of the magnetic field effect on the sound wave speed propagation in a cubic ferromagnetic crystal, as well as it explains observed deviations from analytically expected results in Simon effect at low magnetic field.

[1] I. Korniienko, et al.: Results in Physics, **73**, 108264 (2025).

MA 9.7 Mon 16:30 HSZ/0004

Magnon-phonon interaction in non-Bravais lattices — •Meritxell Valls Boix[1,2] and Alexander Mook[1,2] — [1]Münster University — [2]Johannes-Gutenberg Universität, Mainz

Non-Bravais lattices with a multi-band magnon spectrum can host a variety of geometrical and topological effects, such as Dirac magnons and nonzero Chern numbers. In this project, we re-examine the magnon-phonon interaction in such systems. In particular, we investigate how the quantum geometry of the magnon bands enters in the theory of magnon-phonon interactions.

15 min break

MA 9.8 Mon 17:00 HSZ/0004

All-YIG based functional magnonic crystals — •Rouven Dreyer, Bikash Das Mohapatra, Seth Kurfman, Georg Schmidt, and Georg Woltersdorf — Martin Luther University Halle-Wittenberg, Institute of Physics, 06120 Halle, Germany

For novel magnon-based applications, such as neuromorphic or reservoir computing, so far metallic ferromagnets with large saturation magnetization and high magnonic damping are the material of choice in order to locally manipulate the amplitude and phase of a propagating spin wave in an Yttrium-Iron-Garnet (YIG) layer underneath. Such YIG-metal heterostructures allow for sufficient control of band gaps in spin-wave dispersion in magnon-based Fabry-Perot-resonators or magnonic crystals [1]. In this work, we demonstrate an all-YIG based heterostructure, which imprints phase shifts and amplitude suppression on propagating waves due to the coupling of the device to the chiral spin wave. Thus, the YIG structure acts as a chiral magnonic resonator (CMR). These CMRs can be combined to realize magnonic crystals and allow for active control of individual gaps. To achieve this, the micron-sized YIG CMRs may be initialized in a different field state with respect to the YIG layer. In particular, an antiparallel magnetization alignment allows for sufficient suppression of a propagating Damon-Eshbach spin wave, as demonstrated by using spatially- and frequency-resolved SNS-MOKE [2].

[1] H. Qin et al., Nat. Commun. 12, 2293 (2021)
[2] R. Dreyer et al., PRM 5, 064411 (2021)

MA 9.9 Mon 17:15 HSZ/0004

Exchange-dominated spin waves in Ga:YIG nanowaveguides — •Andrey Voronov[1], Khrystyna Levchenko[1], Roman Verba[2], Kristyna Davidkova[1,3], Carsten Dubs[4], Michal Urbanek[5], Qi Wang[6], Dieter Suess[1], Claas Abert[1], and Andrii Chumak[1] — [1]Faculty of Physics, University of Vienna, Vienna, Austria — [2]V.G. Baryakhtar Institute of Magnetism of the NAS of Ukraine, Kyiv, Ukraine — [3]Vienna Doctoral School of Physics, University of Vienna, Vienna, Austria — [4]INNOVENT e.V. Technologieentwicklung, Jena, Germany — [5]CEITEC BUT, Brno University of Technology, Brno, Czech Republic — [6]Huazhong University of Science and Technology, Wuhan, China

Spin-wave computing offers a path beyond CMOS scaling, but miniaturization to the 100 nm regime limits long-distance spin-wave transport. Gallium-substituted YIG (Ga:YIG) addresses this challenge through its reduced saturation magnetization, enabling excitation of exchange-dominated spin waves with superior transport properties. We report a combined experimental and theoretical study of spin-wave propagation in Ga:YIG waveguides down to 145 nm width and 73 nm thickness. Using micro-focused Brillouin light scattering, TetraX simulations, and analytical dispersion modeling, we show that Ga:YIG supports spin waves with group velocities up to 600 m/s, largely independent of waveguide width, resulting in enhanced propagation lengths compared to pure YIG. These results demonstrate that gallium substitution enables faster and longer-lived spin waves, establishing Ga:YIG as a promising platform for nanoscale magnonic devices.

MA 9.10 Mon 17:30 HSZ/0004

Spin Hall micro-bars: Near zero effective magnetization for low oscillation-onset thresholds — •Abbas Koujok[1], Hidekazu Kurebayashi[2], kei Yamamoto[3], Björn Heinz[1], Abbass Hamadeh[4], Takeshi Seki[5], and Philipp Pirro[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau, Kaiserslautern, Germany — [2]London Centre for Nanotechnology, University College London, London, United Kingdom — [3]Advanced Science Research Center, Japan Atomic Energy Agency, Tokai, Japan — [4]Centre de Nanosciences et de Nanotechnologies, CNRS, Université Paris-Saclay, Palaiseau, France — [5]Institute for Materials Research, Tohoku University, Sendai, Japan

Spin Hall devices, being promising building blocks in magnonic circuitry, are progressively being researched in the context of lowering required driving charge currents. Here, the impact of near zero effective magnetization on reducing oscillation-onset threshold in magnetic spin Hall micro-bars is studied using micro-focused Brillouin light scattering spectroscopy. We show that a threshold current density reduction of more than two orders of magnitude can be achieved in comparison to the lowest reported values from other studies in this regard. This reduction shows that controlling the effective magnetization can pave the way to employ spin Hall based devices as energy efficient elements in magnonic circuitry.

MA 9.11 Mon 17:45 HSZ/0004

Pinch points in the dynamical spin structure factor of dipolar

ferromagnets — Michal Stekiel[1], Christoph Resch[2], •Konrad Scharff[3], Markus Garst[3], and Christian Pfleiderer[2] — [1]Jülich Center for Neutron Science at MLZ, Jülich, Germany — [2]School of Natural Sciences, Technical University Munich, Garching, Germany — [3]Karlsruhe Institute of Technology, Karlsruhe, Germany

The long-range dipolar interaction gives rise to a pinch-point non-analyticity in the dynamical spin structure factor of a ferromagnet [1]. Its experimental observation is challenging because the strength of the pinch-point singularity at zero magnetic field scales both with the magnetic moment and the size of the easy-plane anisotropy. We demonstrate that suitable materials for its detection are the rare-earth diborides, ErB2 and HoB2, as they possess a large magnetic moment on the order of 10 Bohr magneton and a pronounced easy-plane anisotropy two orders of magnitude larger than their direct exchange. In both materials, we were able to resolve pinch-point singularities in energy-momentum space using inelastic neutron scattering. The experimental signatures are quantitatively reproduced by a Heisenberg model with exchange, anisotropy and dipolar interaction.

[1] Jensen, J. and Mackintosh, A.R. Rare Earth Magnetism. Clarendon Press - Oxford (1991)

MA 9.12 Mon 18:00 HSZ/0004

Spin-wave emission with current-controlled frequency by a PMA-based spin-Hall oscillator — •Moritz Bechberger[1], David Breitbach[1], Abbas Koujok[1], Björn Heinz[1], Carsten Dubs[2], Abbass Hamadeh[3], and Philipp Pirro[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau, D-67663 Kaiserslautern, Germany — [2]INNOVENT e.V. Technologieentwicklung, D-07745 Jena, Germany — [3]Université Paris-Saclay, Centre de Nanosciences et de Nanotechnologies, CNRS, 91120, Palaiseau, France

Spin-Hall oscillators (SHOs) are of particular interest for neuromorphic computing, as they are able to synchronize via spin waves. We demonstrate a SHO based on low-damping gallium-substituted yttrium-iron-garnet (Ga:YIG) with perpendicular magnetic anisotropy (PMA). In-plane magnetized Ga:YIG allows for the operation at a high efficiency level while also enabling resonant spin-wave emission by exploiting the positive nonlinear frequency shift. Via micro-focused Brillouin light scattering spectroscopy, we investigate the properties of auto-oscillation and emission. Multiple modes are excited and compete internally, with two emitted modes detected up to distances larger than 10 μm. Their frequencies combine to an extended bandwidth of approximately 1.6 GHz. The observed two-mode system and its transition to a single mode at higher currents are reproduced via micromagnetic simulations, which account for spatial variation of the PMA arising due to the microstructures on Ga:YIG. Our results propose a promising platform for SHOs with long-range coupling via spin waves.

MA 9.13 Mon 18:15 HSZ/0004

Dispersion-tunable low-loss implanted spin-wave waveguides — •Jannis Bensmann[1], Robert Schmidt[1], Kirill O. Nikolaev[3], Dmitrii Raskhodchikov[1,2], Shraddha Choudhary[1], Richa Bhardwaj[1], Shabnam Teheriniya[1,2,4], Akhil Varri[1,2], Sven Niehues[1], Ahmad El Kadri[1], Johannes Kern[1], Wolfram H. P. Pernice[1,2,4], Sergej O. Demokritov[3], Vladislav E. Demidov[3], Steffen Michaelis de Vasconcellos[1], and Rudolf Bratschitsch[1] — [1]University of Münster, Institute of Physics and Center for Nanotechnology, Münster, Germany — [2]University of Münster, Center for Soft Nanoscience, Münster, Germany — [3]University of Münster, Institute of Applied Physics, Münster, Germany — [4]Heidelberg University, Kirchhoff-Institute for Physics, Heidelberg, Germany

Spin waves offer a promising pathway toward energy-efficient information processing. Here, we present an etchless fabrication method for low-loss spin-wave waveguides in thin yttrium iron garnet (YIG) films using maskless silicon ion implantation. Focused Si-ion irradiation locally amorphizes YIG to create a low-magnetization cladding, effectively confining spin waves while preserving the pristine magnetic properties of the waveguide core. Spin-wave propagation is directly imaged via Faraday rotation microscopy, revealing decay lengths exceeding 100 μm even for submicron waveguides. By tuning the implantation dose and waveguide width, we achieve precise dispersion control. Our approach enables large spin-wave networks, offering a promising route toward magnonic integrated circuits.

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

MA 11: Electron Theory of Magnetism and Correlations (joint session MA/TT)

Time: Monday 15:00–18:00 Location: POT/0151

MA 11.1 Mon 15:00 POT/0151

Origin of pressure-induced anomalies in the nodal-line ferrimagnet $Mn_3Si_2Te_6$ — Varun Venkatasubramanian[1], Makoto Shimizu[2], •Daniel Guterding[3], and Harald O. Jeschke[1] — [1]Research Institute for Interdisciplinary Science, Okayama University, Okayama, Japan — [2]Department of Physics, Graduate School of Science, Kyoto University, Kyoto, Japan — [3]Technische Hochschule Brandenburg, Brandenburg an der Havel, Germany

The nodal-line ferrimagnet $Mn_3Si_2Te_6$ exhibits a pressure-induced insulator-to-metal transition (IMT), which coincides with pronounced anomalies in its magnetic ordering temperature and anomalous Hall conductivity. We employ density functional theory (DFT) in combination with classical Monte Carlo simulations to elucidate the origin of these effects. Pressure-dependent Heisenberg Hamiltonians extracted from DFT reveal a strong evolution of exchange couplings across the structural transition from the trigonal to the monoclinic phase, producing a dome-shaped variation of the ferrimagnetic ordering temperature in quantitative agreement with experiment. While our simulations capture the pressure-driven IMT and magnetic evolution, the anomalous Hall response cannot be fully explained by intrinsic Berry curvature effects, indicating additional extrinsic contributions.

[1] V. Venkatasubramanian, M. Shimizu, D. Guterding, and H. O. Jeschke, *Origin of pressure-induced anomalies in the nodal-line ferrimagnet $Mn_3Si_2Te_6$*, arXiv:2509.18238

MA 11.2 Mon 15:15 POT/0151

Near Room-Temperature Ferromagnetism and Insulator-Metal Transition in van der Waals Material $CrGeTe_3$ — Daniel Guterding[1], Jihaan Ebad-Allah[2], Gili Scharf[3], Han-Xiang Xu[4], Makoto Shimizu[5], Junya Otsuki[6], Alon Ron[3], Christine Kuntscher[2], and •Harald O. Jeschke[6] — [1]Technische Hochschule Brandenburg, Brandenburg an der Havel, Germany — [2]Augsburg University, Augsburg, Germany — [3]Tel Aviv University, Tel Aviv, Israel — [4]Chinese Academy of Sciences, Beijing, China — [5]Kyoto University, Kyoto, Japan — [6]Research Institute for Interdisciplinary Science, Okayama University, Okayama, Japan

We investigate how pressure tunes the electronic and magnetic properties of the van der Waals ferromagnet $CrGeTe_3$, a promising material for near room-temperature applications. Using DFT+DMFT, we trace the transition from semiconducting to metallic ferromagnet [1]. Optical conductivity reveals a mid-infrared feature, signalling orbital-selective correlations, while a double-exchange mechanism stabilizes high-temperature ferromagnetism [2]. The anomalous Hall effect shows extrinsic behaviour beyond pure Berry curvature effects [3]. These results highlight the interplay of magnetism and electronic correlations in achieving tunable ferromagnetism in $CrGeTe_3$, suggesting that pressure and charge carrier doping offer promising routes to control magnetism and transport in layered materials.

[1] H.-X. Xu *et al.*, Phys. Rev. B **108**, 125142 (2023)
[2] J. Ebad-Allah *et al.*, Phys. Rev. B **111**, L140402 (2025)
[3] G. Scharf *et al.*, Phys. Rev. Res. **7**, 013127 (2025)

MA 11.3 Mon 15:30 POT/0151

Ground State of the Topological Insulator Candidate Eu_2AuGe_3 — •Vinicius Estevo Silva Frehse[1], Aleksandr Sukhanov[1], Artem Korshunov[2], Eugen Weschke[3], Aly Abdeldaim[4], Priscila Rosa[5], and Marein Rahn[1] — [1]Universität Augsburg, Augsburg, Germany — [2]Donostia International Physics Center, San Sebastián, Spain — [3]Helmholz Zentrum Berlin, Berlin, Germany — [4]Diamond Light Source, Didcot, UK — [5]Los Alamos National Laboratory, Los Alamos, USA

Eu_2AuGe_3 is an unusual rare earth germanide in which quasi-trigonal europium sheets are interleaved with Au-Ge honeycomb layers, where high-throughput calculations indicate potential for topological band inversions. Bulk and transport data have revealed a series of (re-)ordering transitions upon cooling, as well as metamagnetic transitions at low temperature. Recently, we identified a broad transition around $T_{CDW} = 130$ K as the continuous freezing-out of a buckling mode of the honeycomb layers.

Here, we present preliminary evidence from neutron and resonant elastic X-ray scattering, which hints at helical magnetic order below $T_N = 11$ K. Unexpectedly for the nominally spin-only divalent europium, the magnetic order also appears to be accompanied by a modulated orbital order parameter. This phase is preceded by a transition at 23 K, where we observe a subtle doubling of the *ab*-plane, possibly related to the charge density wave formed during T_{CDW}.

MA 11.4 Mon 15:45 POT/0151

Electronic structure, magnetic and optical properties of antiferromagnetic 3*d*-oxides from a Wannier-localized optimally-tuned screened range-separated hybrid functional — •Alexander Shick[1,2], Guy Ohad[2], Jeffrey Neaton[3,4], and Leeor Kronik[2] — [1]FZU-Institute of Physics, Czech Academy of Sciences, Prague, Czech Republic — [2]Weizmann Institute of Science, Rehovoth, Israel — [3]University of California, Berkeley, USA — [4]Lawrence Berkeley National Laboratory, Berkeley, USA

We apply the recently developed Wannier-localized, optimally tuned, screened range-separated hybrid (WOT-SRSH) functional to prototypical bulk antiferromagnetic insulators — MnO, NiO, and hematite (Fe_2O_3). Comparison to calculations based on well-established functionals, namely PBE0, and HSE06, as well as to self-consistent quasiparticle GW and dynamic mean field theory calculations, and to experiment, shows that the WOT-SRSH functional provides a good quantitative description of band gaps, spin magnetic moments, photoemission, and optical absorption spectra. This establishes WOT-SRSH as a uniform, non-empirical framework for band theory of electronic, magnetic, and optical properties of magnetic insulators.

MA 11.5 Mon 16:00 POT/0151

Spectroscopic evidence of Kondo resonance in 3*d* van der Waals ferromagnets — •Deepali Sharma[1,2], Neeraj Bhatt[1], Asif Ali[1], Rajeswari Roy Chowdhury[1], Chandan Patra[1], Ravi Prakash Singh[1], and Ravi Shankar Singh[1] — [1]IISER Bhopal, Bhopal, India — [2]TU Dortmund, Dortmund, Germany

Two-dimensional van der Waals (vdW) ferromagnets drive the advancement in spintronic applications and enable the exploration of exotic magnetism in low-dimensional systems. The entanglement of the dual−localized and itinerant−nature of electrons lies at the heart of the correlated electron systems giving rise to exotic ground state properties such as complex magnetism, heavy fermionic behavior, Kondo lattice formation, etc. Through temperature-dependent electronic structure of vdW ferromagnets, Co substituted Fe_3GeTe_2, probed using high-resolution photoemission spectroscopy and density functional theory combined with dynamical mean field theory (DFT + DMFT), we provide direct evidence of the emergence of Kondo resonance peak driven by complex interplay between localized and itinerant electrons. Further, in overall agreement with the experimental electronic structure and magnetic properties, DFT + DMFT also reveals non-Stoner magnetism. The findings provide a way forward to the understanding of complex interplay between electronic structure, exotic magnetism, and heavy fermionic behavior leading to the Kondo scenario in 3*d* vdW ferromagnets.

MA 11.6 Mon 16:15 POT/0151

T-linear and quadratic transport across the Cuprate and Nickelate phase diagram : pseudogap, strange-metal and Fermi-liquid — •Dongwook Kim[1], Motoharu Kitatani[2], Juraj Krsnik[3], and Karsten Held[4] — [1]Wiedner Hauptstraße 8-10, 1040 Wien — [2]3-2-1 Koto, Kamigori-cho, Ako-gun, Hyogo 678-1297, Japan — [3]Trg Republike Hrvatske 14. HR-10000 Zagreb Croatia — [4]Wiedner Hauptstraße 8-10, 1040 Wien

We investigate DC resistivity and nodal quasiparticle (QP) scattering in hole-doped cuprates-nickelate type superconductors by ladder dynamical vertex approximation (LDΓA). In the pseudogap regime of doping $\delta = 0.1$-0.175, we observe a crossover from T-linear to T^2 resistivity at low T. For dopings $\delta = 0.2$-0.25, the resistivity remains fully T-linear down to the lowest temperatures, indicating strange-metal behavior associated with a nearby quantum critical point (QCP). At higher doping of $\delta = 0.3$ the T^2 recovery reappears, signaling exit from the quantum-critical regime. The nodal QP scattering rate and the first-Matsubara-frequency rule analysis independently confirm the same FL*NFL crossover, providing consistent support for the T-dependent transport obtained within LDΓA

15 min break

MA 11.7 Mon 16:45 POT/0151

Toward ab-initio simulation for resonant inelastic X-ray scattering in strongly correlated materials — •Yun Yen[1,2], Matthias Krack[2], and Michael Schüler[2,3] — [1]Institute for Theoretical Physics, Bremen Center for Computational Materials Science, University of Bremen, Bremen, Germany — [2]PSI Center for Scientific Computing, Theory and Data, Villigen PSI, Switzerland — [3]Department of Physics, University of Fribourg, Fribourg, Switzerland

X-ray absorption spectroscopy (XAS) and resonant inelastic X-ray scattering (RIXS) can be used to study low-energy excitations in complex materials, which are challenging to interpret due to strong correlations during the photoexcitation processes. We aim to develop ab-initio methods for XAS and RIXS, by constructing Anderson impurity models using Wannier-based tight-binding parameters and constrained random phase approximation. The spectrums are then computed via exact diagonalization and Krylov subspace methods. We will show a benchmark on spin spiral materials, where the d-d excitation intensity dependence can be related to the onset of magnetic order with the support of our methods.

MA 11.8 Mon 17:00 POT/0151

Magnetic Persistence in PrAlGe via RIXS and XAS modeling — •Juan Felipe Pulgarin Mosquera[1,2], Yun Yen[3], Tianlun Yu[4], Yeong-Ah Soh[4], Thorsten Schmitt[4], and Michael Schueler[1,2] — [1]PSI Center for Scientific Computing, Theory and Data, Villigen PSI, Switzerland — [2]University of Fribourg, Department of Physics, University of Fribourg, Fribourg , Switzerland — [3]Institute for Theoretical Physics and Bremen Center for Computational Materials Science, University of Bremen, Bremen, Germany — [4]PSI Center for Photon Sciences, Villigen-PSI, Switzerland

The interplay between topological electronic states and magnetism is in the spotlight of condensed matter for potential applications. PrAlGe is a prime candidate in this context, with several works reporting it as a magnetic Weyl semimetal. However, the microscopic relationship between the magnetic ordering, anomalous Hall effect and local spectroscopic signatures remains an open question. We study this phenomenon based on a combination of X-ray spectroscopy and first-principle calculations. We present our ab-initio approach to computing X-ray absorption spectroscopy and resonant inelastic X-ray scattering based on accurate Anderson Impurity model derived from density-functional theory with Hubbard corrections. This comparison is crucial for understanding the experimental finding that the ferromagnetic transition occurs at $T_c \sim 16$ K, significantly lower than the temperature scale at which the AHE and circular dichroism vanish $T_{AHE} \sim 35$ K). The survival of circular dichroism above T_c serves as a local probe for the persistence of local magnetic moments.

MA 11.9 Mon 17:15 POT/0151

Ab initio spin Hamiltonians and magnetism of Ce and Yb triangular-lattice compounds — Leonid V. Pourovskii[1,2], •Rafael D. Soares[3], and Alexander Wietek[3] — [1]CPHT, CNRS, École polytechnique, Institut Polytechnique de Paris, 91120 Palaiseau, France — [2]Collège de France, Université PSL, 11 place Marcelin Berthelot, 75005 Paris, France — [3]Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Straße 38, 01187 Dresden, Germany

We calculate the crystal-field splitting, ground-state Kramers doublet and intersite exchange interactions within the ground-state doublet manifold for a representative set of Ce and Yb triangular-lattice compounds. These include the putative quantum spin liquids (QSL) $RbCeO_2$ and $YbZn_2GaO_5$ and the antiferromagnets $KCeO_2$ and $KCeS_2$. The calculated nearest-neighbor (NN) couplings are antiferromagnetic and exhibit noticeable anisotropy. The next-nearest-neighbor (NNN) couplings are ferromagnetic in the Ce systems and dominated by classical dipole–dipole interactions in the Yb case. Solving the resulting effective spin-1/2 models by exact diagonalization up to $N = 36$ sites, we predict ordered magnetic ground states for all systems, including the two QSL candidates. We explore the phase space of an anisotropic NN + isotropic NNN triangular-lattice model finding that a significant antiferromagnetic NNN coupling is required to stabilize QSL phases, while the NN exchange anisotropy is detrimental to them. Our findings highlight a possibly important role of deviations from the perfect triangular model in real materials.

MA 11.10 Mon 17:30 POT/0151

Transition metal dihalides: from band structure to magnetic properties — •Alexander Yaresko[1], Sebastien Hadjadj[2], and Maxim Ilyn[2] — [1]Max Planck Institute for Solid State Research, Stuttgart, Germany — [2]Centro de Física de Materiales, Donostia-San Sebastián, Spain

Transition metal dihalides TX_2 (T=Fe, Ni, X=Cl, Br) have recently attracted attention because of successful growth of monolayer-thick TX_2 films on various substrates, such as Au or $NbSe_2$, allowing to study 2D magnetism. We compare results of band structure calculations for bulk and monolayer FeX_2 and NiX_2. By mapping the total energies calculated for helical spin structures with various q to the Heisenberg model we show that the change of magnetic order within a layer from ferro- in $NiCl_2$ to helimagnetic in $NiBr_2$ can be explained by the increased strength of antiferromagnetic (AF) 3-rd neighbor exchange interaction J_3 which competes with FM nearest neighbor J_1. We found that inter-layer coupling J_{2c} stabilizes FM order within a layer. Thus, one can expect stronger tendency to a helimagnetic state in a NiX_2 monolayer.

In contrast to NiX_2, J_1 estimated from LDA+U spin-spiral calculations for FeX_2 is weak but shows substantial dependence on the strength of the Coulomb repulsion U. In agreement with experimental findings, calculations including spin-orbit coupling result in appreciable easy axis anisotropy with Fe magnetic moments normal to layers.

We also discuss various microscopic contributions to intra- and inter-layer exchange interactions.

MA 11.11 Mon 17:45 POT/0151

Coexistence of charge order and antiferromagnetism in three-dimensional Hubbard-Holstein model: A study (exploring phases) at and away from half-filling — •Sandip Halder and Moshe Schechter — Ben-Gurion University of the Negev, Beer-Sheva, Israel

The physics of correlated electron systems has long been explored through the Hubbard model and its extensions, including models with long-range hopping. Likewise, phenomena arising from electron-phonon coupling- such as charge order and superconductivity- have been extensively studied within the Holstein model, though largely in lower dimensions. In transition-metal oxides, however, both electron correlations (U) and electron-phonon coupling (V) coexist intrinsically, motivating a comprehensive study of the Hubbard-Holstein model in three dimensions.

Using an exact diagonalization-based semi-classical Monte Carlo (s-MC) method, we investigate the intriguing properties of this model. At half-filling, the system undergoes a first-order transition between a charge-ordered (CO) phase and an antiferromagnetic (AF) phase as U and V are varied. In the AF regime, near the phase boundary, hole doping drives the system from the AF state (n=1) to a CO state (n=0.5), and eventually to a disordered phase at low densities. Notably, a robust coexistence of AF and CO emerges around x=0.35 (n=0.65), with T_{CO} exceeding T_N, consistent with experiments on $La_{2-x}Sr_xNiO_4$. The study provides new insight into correlated materials and guiding future experimental explorations.

MA 12: Terahertz Spintronics

Time: Monday 15:00–16:30 Location: POT/0351

MA 12.1 Mon 15:00 POT/0351

Interface Modification of Spintronic THz emitters — •David Stein[1], Krishna Rani Sahoo[2], Alexander Heise[1], Stephan Glamsch[1], Jannis Bensmann[2], Robert Schmidt[2], Steffen Michaelis de Vasconcellos[2], Rudolf Bratschitsch[2], and Manfred Albrecht[1] — [1]Universität Augsburg, Augsburg, Germany — [2]Universität Münster, Münster, Germany

The spintronic Terahertz (THz) emission of thin magnetic/heavy metal bilayers with fs laser excitation is an excellent alternative to the well-known bulk nonlinear crystals. Many works have been published about different material combinations of spintronic emitters, but the properties of the bilayer interface and its influence on the THz emission is not well understood. We study Fe/Pt interfaces, which were modified by implantation with foreign atoms to investigate the influence of the interface on the THz emission. THz-Time Domain Spectroscopy and SQUID-VSM Magnetometry, as well as high-resolution Scanning Transmission Electron Microscopy (STEM) with Energy Dispersive X-Ray Spectroscopy (EDS) were performed to understand the effects of the modifications.

MA 12.2 Mon 15:15 POT/0351

Lightwave-driven spintronics by coherent breaking of time-reversal symmetry — •Philipp Weissenberger[1], Josef Riepl[1], Adrian Seith[1], Michael Aschenbrenner[1], Josef Freudenstein[1], Omer Kneller[1], Daniel Riese[1], Manuel Meierhofer[1], Konstantin Kokh[2], Oleg Tereshchenko[2], Jörg Wunderlich[1], Ulrich Höfer[1], Ferdinand Evers[1], Jan Wilhelm[1], and Rupert Huber[1] — [1]University of Regensburg, Germany — [2]Novosibirsk, Russia

Lightwave electronics has the potential to revolutionize high-speed information technology by using the carrier field of light to steer electrons at optical clock rates. Yet, expanding this subcycle control scheme to the spin, one of the most important quantum attributes, has remained a challenge. Additionally, time-reversal symmetry (TRS) prohibits a net spin polarization in non-magnetic solids, limiting ultrafast spintronics to magnetic systems with intrinsically broken TRS. Here, we transcend these boundaries by leveraging intense, phase-stable terahertz (THz) pulses to accelerate Dirac fermions in the topological state of Bi2Te3. Due to spin-momentum locking, the THz field drives ballistic, spin-polarized currents. The nonequilibrium occupation coherently breaks TRS and leads to a net surface magnetization. Our all-optical measurements show that these dynamics follow the driving vector potential, proving their dissipationless nature and our magnetic switching abilities. Astonishingly, the data reveals an anisotropic coupling to higher-lying topological states. Our scheme could be transferred to a host of non-magnetic systems and boost ultrafast magnetic metrology.

MA 12.3 Mon 15:30 POT/0351

Spin Inertia as a Source of Topological Magnons — •Subhadip Ghosh[1], Mikhail Cherkasskii[2], Ritwik Mondal[1], Alexander Mook[3], and Levente Rozsa[4] — [1]IIT (ISM) Dhanbad, India. — [2]RWTH Aachen University, Germany. — [3]University of Munster, Germany — [4]BME, Budapest, Hungary

Ferromagnets exhibit not only the familiar precessional magnon bands, but also high-frequency nutational modes originating from spin inertia [1]. In this work, we show that the hybridization between these nutational and precessional branches opens a magnonic gap whose topology can become nontrivial. In a honeycomb ferromagnet, this topological phase is caused by the pseudodipolar coupling, which not only gaps out the well-known precessional Dirac cones [2,3] but also causes precessional and nutational modes to anticross. By computing the Chern numbers of the full magnon spectrum, we demonstrate that the nutational-precessional gap can host chiral, topologically protected edge states. We highlight the role of spin inertia as a source of topological magnonic phenomena.

[1] R. Mondal *et al.*, Phys. Rev. B 106, 134422 (2022). [2] A. Mook *et al.*, Phys. Rev. B. 90, 024412 (2014). [3] X. S. Wang *et al.*, Phys. Rev. Appl. 9, 024029 (2018).

MA 12.4 Mon 15:45 POT/0351

THz light field driven unidirectional spin Hall magnetoresistance in magnetic heterostructures — •Sergey Kovalev[1], Ruslan Salikhov[2], Igor Ilyakov[2], Anneke Reinold[1], Jan Deinert[2], Thales Oliveira[2], Alexey Ponomaryov[2], Gulloo Prajapati[2], Patrick Pilch[1], Ahmed Ghalgaoui[1], Steffen Kober[1], Jürgen Fassbender[2], Jürgen Lindner[2], and Zhe Wang[1] — [1]Technische Universität Dortmund, Dortmund, Germany — [2]Helmholtz Zentrum Dresden Rossendorf, Dresden, Germany

We demonstrate unidirectional spin Hall magnetoresistance (USMR) in magnetic heterostructures driven by terahertz (THz) light electric fields [1]. To isolate USMR from other spin transport phenomena, we performed anisotropy characterization of spintronic THz second-harmonic generation as a function of sample magnetization and THz pump polarization states. By investigating the temperature dependence of THz-driven USMR, we reveal distinct contributions to USMR dynamics on picosecond time scales. Our approach enables the characterization of ultrafast, field-driven spin-related magnetoresistance in free-standing heterostructures without the need for lithographic processing.

[1] R. Salikhov et al., "Ultrafast unidirectional spin Hall magnetoresistance driven by terahertz light field." Nat Commun 16, 2249 (2025)

MA 12.5 Mon 16:00 POT/0351

Orbital-torque driven excitation of Terahertz perpendicular standing spin wave (PSSW) modes — •Harshita Devda[1], Peter M. Oppeneer[2], and Ulrich Nowak[1] — [1]Fachbereich Physik, Universität Konstanz, Konstanz, Germany — [2]Department of Physics and Astronomy, Uppsala University, Uppsala, Sweden

Layered ferromagnets support interface-sensitive THz spin dynamics, making the controlled excitation of such THz magnon modes relevant for spintronics applications. Recent experiments show that asymmetric NM/FM/NM trilayers couple efficiently to THz fields via interfacial spin-orbit torques (SOTs)[1], emphasizing the importance of interface effects in THz spin dynamics.

Here, we employ atomistic spin-dynamics simulations using ab-initio exchange parameters in thin NM/Co/NM trilayers to investigate ultrafast magnon excitation in presence of asymmetric and symmetric SOT interfaces. SOTs are implemented using the induced spin and orbital moments from first principles calculations. Our simulations show that nanometer thick Co-layers host exchange-dominated PSSWs in 1-3 THz range. Crucially, the efficient excitation of these THz modes is governed by interfacial field-like orbital torques, which follow directly from our recent study on layer-resolved SOTs[2]. This work establishes orbital torques as a robust route to ultrafast magnon generation.

[1]Salikhov et al., Nat. Phys. 19, 529-535 (2023)
[2]Devda et al.,Phys. Rev. B 112, 144438 (2025)

MA 12.6 Mon 16:15 POT/0351

Tuning terahertz emission from spintronic devices via interface engineering — Rahul Gupta[1,2], •Francesco Foggetti[3], Francesco Cosco[3], Venkatesh Mottamchetty[4], Martin Pavelka[3], Kasturie Jatkar[5], Anders Rydberg[3], Rimantas Brucas[3], Peter M. Oppeneer[3], and Peter Svedlindh[3] — [1]University of South Florida, Tampa, Florida, USA — [2]University of Gothenburg, Gothenburg, Sweden — [3]Uppsala University, Uppsala, Sweden — [4]Aarhus University, Aarhus, Denmark — [5]Stockholm University, Stockholm, Sweden

Spintronic terahertz (THz) emitters are emerging as compact and broadband sources. While common optimization approaches consist in the exploration of different materials and stacking geometries, the effects of the external interfaces have been poorly understood. Here we show that THz radiation amplitude from Pt/Fe grown on MgO and MgAl2O4 depends significantly on the interface reflection of spin currents, which is controlled by lattice mismatch and strain of the Fe/substrate interface, providing a powerful lever to tune THz emission. We use the superdiffusive transport theory to simulate the Pt/Fe bilayer, modeling the different interfaces via tunable interface reflection or via simulated substrate layer, resulting in very good agreement with the experimental data. Our results establish interface reflection governed by strain and lattice mismatch as a general design knob for optimizing spintronic THz emitters, opening new routes to engineer material platforms for next-generation THz technologies.

MA 13: Magnetic Heuslers and Semiconductors

Time: Monday 15:00–17:15 Location: POT/0361

MA 13.1 Mon 15:00 POT/0361

Investigation on the interplay of antisite disorder and magnetic ordering in $Co_2FeAl_{1-x}Si_x$ Heusler system — •Ahmad Omar[1], Matthias Frontzek[2], Robin Kramer[1], Bernd Büchner[1], and Sabine Wurmehl[1] — [1]Leibniz Institute for Solid State and Materials Research Dresden, Germany — [2]PSI Villigen, Switzerland

Quaternary Co-based Heusler compounds such as $Co_2FeAl_{1-x}Si_x$ system are predicted to demonstrate half-metallic ferromagnetism for the $L2_1$ ordered structure. However, the observed physical properties, are often in contrast to theory due to antisite disorder commonly present in practical samples. The $L2_1$-B_2 order-disorder transition is further convoluted with the ferromagnetic transition and is not well understood. Therefore, it is pertinent to understand the ordering phenomenon and develop routes to improve the order for practical realization of the desired properties. Herein, we present a systematic study of the impact of synthesis route and annealing parameters on the obtained order fraction in the samples, through detailed structural and magnetic characterization. In-situ neutron diffraction is performed during annealing to directly investigate the order-disorder transition. The interplay of disorder and the magnetic ordering is further studied through magnetic field annealing experiments. We aim to elucidate the structure-property relationships in the quaternary $Co_2FeAl_{1-x}Si_x$ system, developing methodology for tuning of the disorder through synthesis or post-processing routes, thus enabling a practical realization of half metallic ferromagnetism in the Heusler system.

MA 13.2 Mon 15:15 POT/0361

Impact of disorder on magnetic and vibrational properties of Ni-Mn-Sn Heusler alloys — •Olga Miroshkina[1], Benedikt Eggert[1], Benedikt Beckmann[2], Franziska Scheibel[2], Katharina Ollefs[1], Oliver Gutfleisch[2], Heiko Wende[1], and Markus E. Gruner[1] — [1]University of Duisburg-Essen, Duisburg, Germany — [2]Technical University of Darmstadt, Darmstadt, Germany

Ni-Mn-Sn Heusler alloys are attractive candidates for multi-stimuli caloric cooling. They undergo a magneto-structural phase transition at temperature that can be tuned via chemical disorder. In this work, we investigate the austenitic and martensitic phases near the composition $Ni_{50}Mn_{35}Sn_{15}$ by means of density functional theory complemented by magnetometry and nuclear resonant inelastic x-ray scattering (NRIXS). Bain-path calculations reveal strong competition between ferro-(FM) and ferrimagnetic (FiM) states in austenite and a clear FiM configuration in the $L1_0$ martensite. The FiM contribution in the cubic phase is confirmed by comparing the calculated Sn vibrational DOS with that extracted from NRIXS. In martensite, frustrated exchange introduced by Mn excess can prevail in the tetragonal FiM $L1_0$ phases and make nano-twinns competitive. We find that twins constructed according to the continuum theory of martensite are energetically even more favorable than $L1_0$. A striking outcome is that all Mn/Sn-disordered configurations are energetically more favorable than the ordered ones, with the FiM 4O and 10M phases remaining the most competitive structures. Financial support within the DFG Projects MI 3273/1 and CRC/TRR 270 is gratefully acknowledged.

MA 13.3 Mon 15:30 POT/0361

Finite Size-Effects in Martensite Microstructure of Magnetic Shape Memory Films — Satyakam Kar[1,2], Aman Singh[1], Kornelius Nielsch[1], Heiko Reith[1], and •Sebastian Fähler[3] — [1]Leibniz IFW Dresden, 01069 Dresden, Germany — [2]TU Dresden, Institute of Materials Science, 01062 Dresden, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany

Magnetic shape memory alloys, owing to their multifunctional properties, are a promising material system for integration into microsystems. Their multifunctionality arises from the coexistence of ferroelasticity and ferromagnetism. While size-effects in ferromagnetic microstructure are well understood, corresponding experiments on the influence of finite size on the ferroelastic martensite microstructure are sparse. In this study, we use epitaxially grown Ni-Mn-Ga-based films as a model system to investigate the influence of a finite size in the martensite microstructure under constrained and freestanding conditions. Our results show that the microfabricated patterns, in both conditions, retain the characteristics of their continuous film microstructures. Film thickness has a strong influence, as this is the smallest extension investigated in our study. We analyze similarities and differences between ferromagnetic and ferroelastic microstructure, as understanding finite size effects is decisive for using these multifunctional materials in microsystems with reduced size.

MA 13.4 Mon 15:45 POT/0361

Microstructure Design via Additive Manufacturing of Heusler Alloys for Multicaloric Applications — •Nene Narh Teinor[1,2], Adrian Guder[3], Johannes Puy[1], Christian Lauhoff[3], Thomas Niendorf[3], Oliver Gutfleisch[1], and Franziska Scheibel[1,2] — [1]Institute of Materials Science, Technical University of Darmstadt, Germany — [2]Additive Manufacturing Center, Technical University of Darmstadt, Darmstadt, Germany — [3]Institute of Materials Engineering, University of Kassel, Germany

Heusler alloys like NiMnSn and NiCoMnTi show strong potential for solid-state cooling due to their first-order magnetostructural transitions (FOMST). However, their functional performance is highly sensitive to processing conditions. In this work, bulk samples are produced via Laser Powder Bed Fusion (PBF-LB/M) using gas-atomized powders to explore the influence of additive manufacturing parameters on microstructure and caloric properties. By varying laser power, scan speed, and strategy, we achieve controlled tuning of martensitic, austenitic, and Curie temperatures, as well as reduced thermal hysteresis. Structural, compositional, and magnetic analyses reveal how rapid solidification enhances the sharpness and reversibility of FOMST. We demonstrate that additive manufacturing not only preserves the functional properties of these alloys but also enables active enhancement of their tunability of transition behavior compared to conventionally processed samples. We acknowledge Deutsche Forschungsgemeinschaft (DFG) support through the CRC/TRR 270 (Project ID 405553726)

MA 13.5 Mon 16:00 POT/0361

Modelling the martensitic transformation in Ni-Mn-based Heusler compounds with machine-learning force-fields — •Markus E. Gruner, Mike J. Bruckhoff, and Olga Miroshkina — Faculty of Physics and CENIDE, University of Duisburg-Essen, D-47048 Duisburg

Functional properties of Ni-Mn-based Heusler alloys, such as Ni_2MnGa, depend on the presence of hierarchically twinned, modulated structures in the martensite phase. These can be interpreted as an adaptive, self-organized arrangement of [101]-aligned nanotwins consisting of non-modulated tetragonal building blocks. Density functional theory (DFT) suggests that these martensites are connected to cubic austenite via a downhill transformation path. This is owed to a Fermi surface reconstruction, softening the corresponding acoustic phonons of austenite. Modeling free energy surfaces at finite temperatures or the dynamics of the martensitic transition as probed in recent ultrafast laser heating experiments [1] is too expensive for conventional DFT. Machine-learning force fields (ML-FF) trained on DFT data offer a possibility to account for electronic instabilities and allow to explore the impact of adaptive nanotwining on the martensitic transition using ML-FF in classical molecular dynamics simulations. Funding by the DFG via TRR270 (B06), SFB1242 (C02) and MI3273/1 is gratefully acknowledged.

[1] Y. Ge, F. Ganss, D. Schmidt, D. Hensel, M. J. Bruckhoff, S. Sadashivaiah, B. Neumann, M. Brede, M. E. Gruner, P. Gaal, K. Lünser, S. Fähler, arXiv:2509.06513.

MA 13.6 Mon 16:15 POT/0361

Enhanced anomalous Hall response via nodal line tuning in Co2VSn(1-x)Alx topological semimetal — •Sunil Wilfred DSouza[1], Shivani Rastogi[2], Gaurav Shukla[3], Nidhi Shukla[2], Jan Minár[1], and Sanjay Singh[2] — [1]New Technologies Research Centre, University of West Bohemia, 30100 Pilsen, Czech Republic — [2]School of Materials Science and Technology, Indian Institute of Technology (Banaras Hindu University), Varanasi 221005, India — [3]National Institute for Materials Science (NIMS), Tsukuba 305-0047, Japan

Topological semimetals (TSMs) with nodal-line states exhibit strong Berry-curvature driven transport. We Investigate Co2VSn(1-x)Alx (x = 0-0.75) to understand how hole doping tunes the nodal line relative

to the Fermi level. Al substitution shifts the nodal-line states upward, leading to a maximum intrinsic anomalous Hall conductivity (AHC) of 203 S/cm at x = 0.5, representing a significant enhancement over the undoped compound. First-principles calculations corroborate the nodal line in Co2VSn, its gapping under SOC, and its progressive alignment with the Fermi level upon Al doping. The correlation between nodal-line tuning and enhanced AHC highlights an effective strategy for controlling Berry-curvature driven transport in magnetic TSMs.

MA 13.7 Mon 16:30 POT/0361

Manipulating the first-order magnetostructural phase transition in Ni-Mn-Sn Heusler alloy through nano-functionalization — •Johannes Puy[1], Nadine Stratmann[2], Hamed Shokri[3], Bilal Gökce[3], Stephan Barcikowski[2], Oliver Gutfleisch[1], Anna Ziefuss[2], and Franziska Scheibel[1] — [1]TU Darmstadt, Darmstadt, Germany — [2]Universität Duisburg-Essen, Essen, Germany — [3]BU Wuppertal, Wuppertal, Germany

Ni-Mn-based Heusler alloys are considered as a promising candidate for magnetocaloric or multicaloric cooling applications, as they exhibit an inverse magnetocaloric and conventional elastocaloric effect, which arise from a first-order magnetostructural phase transition (FOMST). However, the practical use of these alloys is limited by the thermal hysteresis associated with the FOMST and their intrinsic brittleness. This work demonstrates a novel approach to tailor the FOMST characteritics and the mechanical stability of spark-plasma-sintered (SPS) Ni-Mn-Sn by nano-functionalization. Silver and zirconium diboride nanoparticles (NP) are synthesized by pulsed laser fragmentation of microparticles (MP-LFL) and subsequently used to functionalize Ni-Mn-Sn powder (150 - 75 μm) at varying mass loadings. This enables targeted modification of the sintered particle interfaces, which act as martensite nucleation sites, but also as origin of fracture under compressive stress. We systematically characterize the influence of NP-functionalization on the microstructure, the temperature-induced FOMST and the mechanical stability. This work was supported by the DFG within the CRC/TRR 270 (Project ID No. 405553726).

MA 13.8 Mon 16:45 POT/0361

Fe^{3+}-Centers as Structural Probes in Fe-Doped $Cs_2AgBiBr_6$ Semiconducting Perovskite — •Volodymyr Vasylkovskyi[1], Timur Biktagirov[2], Anastasiia Kultaeva[1], Carlos Canhassi[3], Mykola Slipchenko[4], Yakov Kopelevich[3], and Vladimir Dyakonov[1] — [1]Experimental Physics 6, University of Würzburg, 97074 Würzburg, Germany — [2]Physics Department, Paderborn University, D-33098 Paderborn, Germany — [3]Gleb Wataghin Institute of Physics, University of Campinas, 13083-859 Campinas, Brazil — [4]Institute for Scintillation Materials, Kharkiv, Ukraine

Fe-doping introduces new functionality into halide double perovskites alongside modifying optical properties. We report controlled growth of Fe-doped $Cs_2AgBiBr_6$ single crystals and correlate their structural, optical, and magnetic parameters. ICP analysis confirms Fe incorporation below 0.1% relative to Bi, which induce defect-related sub-gap absorption and photoluminescence shift. EPR measurements reveal an S = 5/2 Fe^{3+} spin center whose anisotropy follows the phase transition below 120 K. DFT calculations, guided by angular-dependent EPR, identify these centers as impurity-vacancy complexes, likely Fe_{Bi}-V_{Br}. SQUID magnetometry shows ferromagnetic-type hysteresis at room temperature, with rising spontaneous magnetization below 20-30 K and magnetization irreversibility under zero-field and field-cooling, confirming ferromagnetism from Fe-related defect complexes. Even small Fe amounts significantly alter optical and magnetic behavior of $Cs_2AgBiBr_6$, emphasizing the role of controlled doping and defect engineering in lead-free double perovskites.

MA 13.9 Mon 17:00 POT/0361

Pressure-dependence of the thermoelectric properties of $MnIn_2Te_4$ — •Shubham Rakesh Singh, Mohammed Ghadiyali, and Udo Schwingenschlögl — Physical Science and Engineering Division (PSE), King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Saudi Arabia

We investigate the thermoelectric properties of $MnIn_2Te_4$ in its two experimentally characterized phases. The tetragonal phase ($I\bar{4}2m$) undergoes a pressure-induced transition to an orthorhombic phase ($Pnma$) at 1.3 GPa. First-principles calculations reveal for both phases a small energy difference between antiferromagnetic and ferromagnetic states. The band gap is 1.04 (0.70) eV in the tetragonal phase and 1.25 (1.10) eV in the orthorhombic phase for the antiferromagnetic (ferromagnetic) state. A higher power factor is achieved by n-type than by p-type carriers. At 700 K, for example, the more densely packed orthorhombic phase exhibits a 56% reduction in the lattice thermal conductivity as compared with the tetragonal phase, yielding high thermoelectric figures of merit of 1.23 for n-type carriers and 0.96 for p-type carriers at optimal carrier concentration.

MA 14: PhD Focus Session: What about the lattice? Lessons from (ultrafast) magnetism

This focus session brings together experimental, theoretical and numerical perspectives to highlight recent discoveries and unresolved questions on ultrafast magnetization effects facilitated by spin-lattice interactions. In recent years, the transfer of magnetic angular momentum during ultrafast demagnetization processes has been observed experimentally. Studies have revealed both the microscopic mechanism through circularly polarized phonons and the macroscopic mechanical response in the form of the ultrafast Einstein-de Haas effect. Further, the complementary ultrafast Barnett effect has been demonstrated, where angular momentum is transferred into the spin system from non-equilibrium angular momentum sources (e.g. lattice vibrations or optical fields) Furthermore, inertial effects in spin dynamics were measured by observing additional nutation frequencies on top of the precessional motion Theoretical work suggests that these frequencies arise due to the spin-lattice coupling, however, the underlying mechanisms are not yet fully understood. In order to predict and explain these different types of phenomena, spin-lattice dynamics simulations have been developed in recent years. These allow energy and angular momentum to be exchanged between the magnetic spin system and the lattice.

Organizers: Felix Hartmann, hartmann3@uni-potsdam.de; Fried-Conrad Weber, fried-conrad.weber@uni-potsdam.de; Finja Tietjen, finja.tietjen@chalmers.se; Daniel Schick, daniel.schick@uni-konstanz.de; Jasmin Jarecki, jasmin.jarecki@mbi-berlin.de

Time: Tuesday 9:30–12:40 Location: HSZ/0002

Introduction and Welcome

Invited Talk MA 14.1 Tue 9:35 HSZ/0002

Femtophononagnetism — •Sangeeta Sharma[1] and John Dewhurst[1,2] — [1]Max Born Institute, Berlin, Germany — [2]Max Planck Inst. Halle, Germany

From the outset of research into femtomagnetism, the field in which spins are manipulated by light on femtosecond or faster time scales, several questions have arisen and remain highly debated: How does the light interact with spin moments? How is the angular momentum conserved between the nuclei, spin, and angular momentum during this interaction? What causes the ultrafast optical switching of magnetic structures? What is the ultimate time limit on the speed of spin manipulation? What is the impact of nuclear dynamics on the light-spin interaction?

In my talk I will advocate a parameter free ab-initio approach to treating ultrafast light-matter interactions, and discuss how this approach has led both to new answers to these old questions but also to the uncovering of novel and hitherto unsuspected early time spin dynamics phenomena [1, 2]. In particular I will show that phonons strongly influence the spin dynamics[3], demonstrating nuclear system can play a profound role in controlling femtosecond magnetization of materials.

[1] Dewhust et al., Nano Lett. 18, 1842 (2018).
[2] Siegrist et al. Nature 571, 240 (2019)
[3] Sharma et al. Sci. Advs. 8, eabq2021 (2022)

Invited Talk MA 14.2 Tue 10:20 HSZ/0002

THz-driven dynamical ferroicity in paraelectric and diamagnetic perovskites — •Martina Basini — ETH Zürich, Department of Phyisics, August-Piccard-Hoff,1, 8049, Zürich, Switzerland

The emergence of collective order in matter is among the most fundamental and intriguing phenomena in physics. In recent years, the dynamical control and creation of novel ordered states of matter not accessible in thermodynamic equilibrium have received much attention. The theoretical concept of dynamical multiferroicity has been introduced to describe the emergence of magnetization due to time-dependent electric polarization in non-ferromagnetic materials. Here, we provide experimental evidence of magnetization in the archetypal paraelectric and diamagnetic perovskites SrTiO3 and KTaO3 due to this mechanism. To induce such a magnetic response, we resonantly drive the infrared-active soft phonon mode with an intense circularly polarized terahertz electric field and detect the time-resolved magneto-optical Kerr effect. Our findings show a new path for the control of magnetism, for example, for ultrafast magnetic switches, by coherently controlling the lattice vibrations with light.

Invited Talk MA 14.3 Tue 10:50 HSZ/0002

Angular momentum transfer and chiral phonons from first principles — •Markus Weissenhofer[1], Philipp Rieger[1], MS Mrudul[1], Luca Mikadze[1], Sergiy Mankovsky[2], Svitlana Polesya[2], Hubert Ebert[2], Ulrich Nowak[3], and Peter M. Oppeneer[1] — [1]Uppsala University, Uppsala, Sweden — [2]Ludwig Maximilian Universität, München, Germany — [3]Universität Konstanz, Konstanz, Germany

Transfer and manipulation of angular momentum is a key aspect in spintronics. Recently, it has been shown that angular momentum transfer between spins and lattice is possible on ultrashort timescales [1]. To contribute to the understanding of this transfer, we have developed a theoretical multiscale framework for spin-lattice coupling, which is linked to ab-initio calculations on the one hand and magnetoelastic continuum theory on the other [2], allowing for the study of a wide range of magnetomechanical phenomena. Here I will demonstrate how this framework can be used to calculate magnon-phonon coupling parameters, emphasizing the importance of a Dzyaloshiskii-Moriya type interaction for angular momentum transfer [2] and revealing the existence of chiral phonons in iron arising from a chirality-selective coupling [3].

[1] Tauchert al., Nature 602, 73 (2022); Luo et al., Science 382, 698 (2023). [2] Mankovsky et al., PRL 129, 067202 (2022); Weißenhofer et al., PRB 108, L060404 (2023). [3] Weißenhofer et al., PRL 135, 216701(2025).

15 min break

Invited Talk MA 14.4 Tue 11:35 HSZ/0002

Inertial Spin Dynamics: A Signature of Non-Markovian Interactions in Ferromagnets — •Vivek Unikandanunni[1,5], Felix Hartmann[2], Matias Bargheer[2], Eric Fullerton[3], Stefano Bonetti[4,5], and Janet Anders[2] — [1]Institute of Applied Physics, University of Bern,Switzerland — [2]Institute of Physics and Astronomy, University of Potsdam, Germany — [3]Center for Memory and Recording Research, University of California San Diego, USA — [4]Department of Molecular Sciences and Nanosystems, Ca Foscari University of Venice, Italy — [5]Department of Physics, Stockholm University, Stockholm, Sweden

We report direct experimental observation of intrinsic inertial spin dynamics in ferromagnetic thin films, manifested as a damped THz frequency oscillation of the magnetization. Using a broadband tabletop THz source, we resonantly drive epitaxial cobalt and directly measure the frequency and relaxation time of the inertial response, which is well described by the inertial Landau-Lifshitz-Gilbert (LLG) equation. We find that the frequency and relaxation time of the inertial dynamics are dependent on the structural symmetry of the sample.

Broadband measurements further reveal a multi-peaked magnetic spectrum that cannot be captured by the inertial LLG alone. An open-quantum-system approach incorporating spin-phonon coupling through a memory kernel yields a non-Markovian LLG equation that reproduces the full experimental spectra demonstrating the fundamental role of non-Markovian memory effects in ultrafast spin dynamics.

Invited Talk MA 14.5 Tue 12:05 HSZ/0002

Atomistic simulations of ultrafast spin-lattice dynamics — •Richard Evans[1] and Mara Strungaru[2] — [1]University of York, York, United Kingdom — [2]University of Manchester, Manchester, United Kingdom

Atomistic spin dynamics (ASD) has become a standard method for studying finite temperature processes in magnetic materials and devices. In some systems, such as magnetic insulators, coupled spin-lattice dynamics can play a dominant role in the thermal and dynamic properties that have so far been neglected in spin-only models. Recent exciting results in ultrafast dynamics have shown that the spin-lattice interaction is a critically important component to the physical properties of a magnetic material. Spin-Lattice Dynamics (SLD) is a relatively recent theoretical development aiming to directly couple an atomistic spin model with a molecular dynamics solver to incorporate the fascinating and complicated dynamics of these coupled systems into a practical numerical framework. In this talk I will introduce the theoretical background and numerical methods for SLD as recently implemented in the VAMPIRE software package, including its parallelisation and scalability on the UK National Supercomputer ARCHER2. I will present recent results on coherent ultrafast THz switching where we found that it is possible to induce magnetic switching through a coherent phonon excitation. I will conclude with a brief perspective on open problems in spin-lattice dynamics, including numerical challenges, quantum thermostats and correlated noise, and how to model electron processes in metallic magnetic systems.

Closing Remarks

MA 15: Focus Session: Quantum Sensing with Solid State Spin defects I (joint session TT/MA)

The electron spins of defects in solid state materials show remarkable quantum coherence, making them excellent sensors. Recent advances in material engineering and measurement techniques lead to continuous improvements in the sensitivity and resolution of established single spin sensors such as the Nitrogen-Vacancy center in diamond, and the development of new defect sensors in materials such as Silicon Carbide and hexagonal Boron Nitride. In condensed matter physics, such sensors are often being used for exploring the structure of magnets, superconductors, topological phases, etc. This focus session will highlight most of the recent experimental and theoretical advances, current challenges, and emerging directions, focusing both on the improvements of the defects themselves, and their use for exploring novel phenomena in condensed matter physics.

Coordinators: Aparajita Singha (TU Dresden), Uri Vool (Max Planck Institute for Chemical Physics of Solids)

Time: Tuesday 9:30–12:45 Location: HSZ/0003

Topical Talk MA 15.1 Tue 9:30 HSZ/0003
Exploring nanoscale van der Waals magnetism using single spin microscopy — •Patrick Maletinsky — Basel University, Departement of Physics, Klingelbergstrasse 82, 4056 Basel

Atomically thin van der Waals (vdW) magnets provide a unique platform to explore magnetism in the ultimate two-dimensional limit [1]. Their weak interlayer coupling, tunable anisotropy, and gate sensitivity enable engineering of magnetic order and spin textures at the atomic scale. However, their small magnetic moments, nanoscale domains, and complex coupling make them difficult to probe experimentally [2].

I will present recent progress in understanding vdW magnetism using single-spin magnetometry based on nitrogen-vacancy centers in diamond. This quantum-sensing technique enables nanoscale imaging of magnetic order, phase transitions in few-layer systems under ambient and cryogenic conditions. I will show how this approach reveals microscopic mechanisms of magnetism in layered materials and uncovers phenomena such as "lateral exchange bias" and spin-reorientation transitions in ultrathin magnets [3,4].

I will conclude with an outlook on how quantum sensors can advance the study of correlated and topological magnetism in vdW materials [5], and how combining them with strain, gating, or optical control may enable designer spintronic and magnonic systems.

[1] Science 363, 706; Nat. Nanotechnol. 14, 408 [2] Science 364, 973 [3] Nat. Commun. 15, 6005 [4] Nat. Commun. 16, 9725 [5] Nat. Rev. Phys. 6, 753

Topical Talk MA 15.2 Tue 10:00 HSZ/0003
Optically addressable spin defects in two-dimensional materials — •Vladimir Dyakonov — Julius-Maximilians-Universität Würzburg, 97074 Würzburg, Germany

Two-dimensional (2D) materials have emerged as the new playground for quantum photonics devices. Among them, hexagonal boron nitride (hBN) is an interesting candidate, mainly because of its crystallographic compatibility with different 2D materials, but also because of its ability to harbour optically active defects generating single photons. The negatively charged boron vacancy was the first intrinsic, optically addressable spin defect in hBN that allows coherent control at room temperature, as reported in 2020. [1] Although other types of spin centers have been found in this material since then, this spin-1 color center remains the only one with a clearly elucidated structure. Practical applications of hBN spin centres as intrinsic magnetic field, temperature, etc. sensors in van der Waals heterostructures are hence envisioned. To further boost the quantum sensing applications of this spin defect in hBN, we investigated the dynamics of the intermediate state, because it is likely to trap electrons for a certain time, which affects the subsequent sensing protocol when the pulsed magnetic resonance experiment is designed.[2] Finally, we found that spin defects exhibit a direct correlation between Raman features and PL intensity, which allowed us to develop an all-optical method for determining the absolute spin defect density in flakes. [3]

[1] A. Gottscholl et al., Nat. Mater. 19, 540 (2020)
[2] P. Konrad et al., arXiv:2503.22815 [quant-ph] (2025)
[3] A. Patra et al., Adv. Funct. Mater. e17851 (2025).

Topical Talk MA 15.3 Tue 10:30 HSZ/0003
Nitrogen vacancy centers in diamond as novel sensing and imaging tool for magnetic nanostructures, in life science and chemistry — Sebastian Westrich[1], Nikhita Khera[1], Emma Resmann[1], Ephraim Spindler[1], Kristin Kühl[1], Alena Erlenbach[1], Mathias Weiler[1], Georg von Freymann[1], Artur Widera[1], Maria Wächtler[2], Stefanie Müller-Schüssele[3], and •Elke Neu-Ruffing[1] — [1]Department of Physics and Research Center Optimas, RPTU Kaiserslautern Landau, Erwin-Schrödinger-Straße 56 67663 Kaiserslautern — [2]Institut für Physikalische Chemie, Christian-Albrechts-Universität zu Kiel — [3]Department of Biology, RPTU Kaiserslautern Landau

Nitrogen vacancy centers (NV centers) locally probe magnetic fields, electric fields and temperature. Advantages of NV sensors include their sensitivity for fluctuating magnetic fields, which can be harnessed e.g. to detect free radicals. Additionally, near field based energy transfer serves as sensing resource to detect optically-active dipoles in close proximity. The talk will summarize our work on using scanning NV-based magnetometry to characterize magnetic nanostructures, including calibrating the scanning NV's position with respect to the sample. We highlight work on imaging frustrated magnetic systems (spin ice) as well as magnetic structures obtained via Direct Laser Writing. As another route towards broadening the field of applicability, we demonstrate for the first time near field energy transfer between NV centers and a naturally occuring fluorophore, namely chlorophyll. We furthermore explore routes to employ NV centers as sensor in photocatalysis.

15 min. break

Topical Talk MA 15.4 Tue 11:15 HSZ/0003
Electron spin, nuclear spin, and optical properties of transition-metal defects in silicon carbide with perspectives for quantum technologies — •Guido Burkard — Department of Physics and IQST, University of Konstanz, 78457 Konstanz, Germany

Transition-metal (TM) defects in silicon carbide (SiC) have emerged as a promising solid-state platform for quantum technologies, particularly because certain species, such as vanadium, provide optical emission in the telecom band and thus enable efficient spin-photon interfaces and quantum memories. In parallel, high-spin nuclei in solids are attracting growing interest for quantum information processing due to their long coherence times and intrinsically large Hilbert spaces, which support advanced protocols in quantum communication, measurement-based quantum computing, and quantum sensing, as well as explorations of fundamental quantum phenomena. A scalable route toward quantum networking relies on modular devices that combine an optically addressable electronic spin with one or more nuclear-spin qudits. We present a theoretical framework for TM defects in SiC. We model the spin and optical structure of a single active 3d electron, revealing how crystal fields and spin-orbit coupling modify selection rules, the g-tensor, and Rabi dynamics. We derive the effective hyperfine interaction within the spin-orbit-induced Kramers doublets and analyze nuclear-electron state transfer. Building on these insights, we propose a driven, dissipative protocol for robust nuclear-spin polarization and investigate how strain engineering can tailor electronic levels, optical Λ systems, and spin initialization pathways.

Topical Talk MA 15.5 Tue 11:45 HSZ/0003
Statics and dynamics of complex magnetic states in mi-

crostructures — •Aurore Finco — Laboratoire Charles Coulomb, CNRS and University of Montpellier, Montpellier, France

Scanning NV center microscopy is a versatile technique allowing both the mapping of static magnetic textures [1] and of microwave fields, which can be generated for example by spin waves. Here I will focus on the investigation of microstructures.

I will first show how we can use magnetoelectric coupling in the antiferromagnetic multiferroic bismuth ferrite to pattern a thin film using electric field and create whirling textures of both electric polarization and magnetization [2].

In a second part, I will discuss ferromagnetic microstructures, in the room-temperature van der Waals magnet Fe_5GeTe_2, demonstrating the stabilization of vortices [3], and in permalloy, which hosts either a S state or a vortex. In this material and when choosing the appropriate dimensions for the microstructures, spin wave modes with frequencies in the vicinity of 2.87 GHz are present and can therefore be probed and imaged. Through the handedness of the stray field that these spin wave mode produce, we can even discriminate between several modes with similar frequencies.

[1] Finco and Jacques, APL Materials 11, 100901 (2023)
[2] Chaudron et al, Nature Materials 23, 905 (2024)
[3] Sfeir et al, Physical Review Materials 9, 114003 (2025)

MA 15.6 Tue 12:15 HSZ/0003

Probing Vortex Dynamics in 2D Superconductors with Scanning Quantum Microscope — •Malik Lenger[1], Sreehari Jayaram[1], Lucas Pupim[2], Ruoming Peng[1], Mathias Scheurer[2], Jurgen Smet[3], and Jörg Wrachtrup[1,3] — [1]3rd Institute of Physics, University Stuttgart, Stuttgart, Germany — [2]Institute for Theoretical Physics III, University Stuttgart, Stuttgart, Germany — [3]Max Planck Institute for Solid State Research, Stuttgart, Germany

Magnetic dynamics at the nanoscale provide crucial insight into the behavior of superconductors. Using single-spin scanning quantum microscopy, we probe vortex dynamics in the two-dimensional superconductor NbSe2. Our measurements reveal a disordered vortex glass phase that melts near the critical temperature and displays cooling-rate-dependent configurations. Surprisingly, magnetic noise persists well below Tc, with a strength that increases at lower temperatures - contrary to expectations. This behavior, detected via spin decoherence, points to an intrinsic origin driven by competition between supercurrent density and thermal fluctuations. Our results establish single-spin microscopy as a powerful platform for investigating fluctuations in 2D superconductors.

MA 15.7 Tue 12:30 HSZ/0003

Quantum sensing of a synthetic 3D spin texture — •R. J. Peña Román[1,2,3], S. Maity[1,2], F. Samad[4,5], S. Josephy[6], A. Morales[6], S. Chattopadhyay[1,3], A. Kákay[4], K. Kern[2,7], O. Hellwig[4,5], and A. Singha[1,2,3] — [1]IFMP, Dresden University of Technology — [2]Max Planck Institute for Solid State Research — [3]Wurzburg-Dresden Cluster of Excellence (ct.qmat) — [4]Institute of Ion Beam Physics and Material Research, Helmholtz-Zentrum Dresden-Rossendorf — [5]Insititute of Physics, Chemnitz University of Technology — [6]QZabre AG, Zurich — [7]Institute de Physique, École Polytechnique Fédérale de Lausanne

Multilayered synthetic antiferromagnets (SAFs) are artificial three-dimensional (3D) architectures engineered to create novel, complex, and stable spin textures. Magnetic imaging of the spin texture is a crucial step for achieving tailored material performance and new functionalities. However, the deterministic detection of the magnetic textures and their quantitative characterization at the nanoscale remains challenging. Here, we use nitrogen-vacancy scanning probe microscopy under ambient conditions to perform quantitative vector-field magnetometry in a multilayered SAF. We demonstrate distinct fingerprints emerging from spin noise and constant stray fields, providing insights into the structure of domains and domain walls, as well as into magnetic noise associated with thermal spin waves. Combined with modern machine learning approaches, this work opens up new possibilities for quantitative magnetometry in materials with tailored and complex 3D spin textures.

MA 16: Skyrmions I

Time: Tuesday 9:30–12:45 Location: HSZ/0004

MA 16.1 Tue 9:30 HSZ/0004

Charge Order, Spin textures, and Electronic Structure of Eu(Ga,Al)4 — Steven Gebel[1], Aleksandr Sukhanov[2], Artem Korshunov[3], Jaime Moya[4], Kevin Allen[5], Emilia Morosan[5], and •Marein Rahn[2] — [1]TU Dresden, Germany — [2]Universität Augsburg, Germany — [3]ESRF, Grenoble, France — [4]Princeton University, USA — [5]Rice University, USA

The tetragonal intermetallic series $Eu(Ga,Al)_4$, is known for a range of interesting phenomena, ranging from the nodal line semimetal EuGa4 to centrosymmetric skyrmion phases in $EuAl_4$. It would be of great interest to design the band topology of these materials and, in particular, to understand how it may couple to electronic correlations. To this end, one must clarify by what mechanisms the multifaceted spin- and charge-ordering instabilities of this series arise from the underlying electronic band structure. For instance, structural modifications and charge density waves exist throughout the series, but show a variable response to hydrostatic pressure – hinting at competing mechanisms. We provide an overview of the ordered phases in $Eu(Ga,Al)_4$ and then show how X-ray crystallography using diamond anvil pressure cells draws a clear line between different structural instabilities. Complementary measurements using inelastic X-ray scattering also provide evidence on the underlying electron-phonon coupling mechanisms. Our results provide a tentative x-P-T phase diagram of $Eu(Ga_{1-x}Al_x)_4$ and highlight interesting questions, e.g. regarding the origin of anomalous Hall effects in $EuGa_4$ and the nature of a new pressure-induced structural phase of $EuAl_4$.

MA 16.2 Tue 9:45 HSZ/0004

Topological pumping of skyrmionic textures in spiral multiferroics — •Luca Maranzana[1,2], Maxim Mostovoy[3], Naoto Nagaosa[4,5], and Sergey Artyukhin[1] — [1]Quantum Materials Theory, Italian Institute of Technology, Via Morego 30, Genoa, Italy — [2]Department of Physics, University of Genoa, Via Dodecaneso 33, Genoa, Italy — [3]Zernike Institute for Advanced Materials, University of Groningen, Nijenborgh 3, 9747 AG Groningen, Netherlands — [4]RIKEN Center for Emergent Matter Science (CEMS), Wako, Saitama 351-0198, Japan — [5]Fundamental Quantum Science Program, TRIP Headquarters, RIKEN, Wako 351-0198, Japan

Precise positioning of topological defects is crucial for racetrack memories, where their positions along a magnetic nanotrack encode information. Conventional approaches rely on engineered pinning landscapes, which increase power consumption. Here, we show that spiral multiferroics serve as a natural ruler for electric-field-driven positioning of skyrmionic textures, extending the concepts introduced in [1]. An oscillating electric field, assisted by anisotropy or a static magnetic field, displaces the topological defect by exactly one spiral period per full oscillation of the field. Such adiabatic pumping, reminiscent of Thouless pumping, is topologically protected and remains robust against small perturbations. Our work proposes a route to electrically driven, topologically protected transport of spin textures and positions spiral multiferroics as a natural platform for skyrmion racetracks.

[1] L. Maranzana, M. Mostovoy, N. Nagaosa, and S. Artyukhin, arXiv:2502.13083 (2025).

MA 16.3 Tue 10:00 HSZ/0004

Statistical Signature of Chirality as a Probe of Skyrmion Topology and Collapse Dynamics — Shiyu Zhou[1], •Kai Litzius[2], Felix Büttner[2,3], and Lucas Caretta[1,4] — [1]Department of Physics, Brown University, Providence, Rhode Island 02912, USA — [2]Center for Electronic Correlations and Magnetism, University of Augsburg, Augsburg, Germany — [3]Helmholtz-Zentrum Berlin für Materialien und Energie, 14109 Berlin, Germany — [4]School of Engineering, Brown University, Providence, Rhode Island 02912, USA

Magnetic skyrmions are topological spin textures whose robustness has driven intense interest for spintronic applications, yet direct experimental evidence linking topology to stability has been limited. We introduce an accessible, material-agnostic method to probe skyrmion topology statistically by measuring annihilation field distributions using Kerr microscopy. By tuning in-plane magnetic fields, we drive transitions from topologically nontrivial to trivial skyrmion states and observe a clear shift in annihilation behavior: skyrmions show broad, thermally activated distributions, while trivial bubbles collapse deterministically with narrow distributions. Micromagnetic simulations corroborate this correlation between topology and collapse statistics. Our approach enables straightforward chirality detection and skyrmion state control without specialized imaging or transport probes. The ability to toggle between deterministic and stochastic collapse suggests new device concepts, including synchronized deletion for memory and topology-tunable randomness for probabilistic applications.

MA 16.4 Tue 10:15 HSZ/0004

observation of a distorted tilted conical spiral at the surface of Cu_2OSeO_3 — •Sina Mehboodi[1], Victor Ukleev[2], Chen Luo[2], Radu Abrudan[2], Florin Radu[2], Christian Back[1], and Aisha Aqeel[3] — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany — [3]Institute of Physics, University of Augsburg, Augsburg, Germany

Chiral magnets such as Cu_2OSeO_3 host a rich variety of noncollinear spin textures [1]. Using resonant elastic X-ray scattering (REXS), where the magnetic satellites are captured as scattered intensity on a CCD detector, we observed a well-ordered surface texture referred to as a distorted tilted conical (dTC) spiral phase. This phase displays strong anharmonicity, evidenced by pronounced higher-order magnetic satellites. Tilting the applied magnetic field causes a continuous reorientation of the dTC propagation vector and increases its modulation wavevector, revealing a high sensitivity of the surface spiral to field direction. Importantly, by combining REXS with rocking-curve analysis, we determine the full scattering vector of dTC, about 0.0718 nm^{-1}. This value is significantly smaller than the reported bulk TC wavevector ($\approx$ 0.095 nm^{-1}) [2], providing direct evidence that the surface spiral is intrinsically distorted and cannot be explained by a simple bulk-like conical modulation [3].

[1] A. Aqeel, et al., Phys. Rev. Lett. 126, 017202 (2021). [2] E. Marchiori et al., Commun. Mater. 5, 202 (2024). [3] S. Mehboodi et al. Sci. Technol. Adv. Mater. 26, 2532366 (2025).

MA 16.5 Tue 10:30 HSZ/0004

Optical manipulation of magnetic skyrmions and antiskyrmions — •Dola Chakrabartty[1], Andreas Wendeln[2,3], Manuel Zahn[1,4], Sascha Schäfer[2,3], and István Kézsmárki[1] — [1]Experimentalphysik V, Center for Electronic Correlations and Magnetism, Institute for Physics, University of Augsburg, Augsburg, D-86135, Germany — [2]Regensburg Center for Ultrafast Nanoscopy, University of Regensburg, Regensburg, 93040, Germany. — [3]Department of Physics, University of Regensburg, Regensburg, 93040, Germany. — [4]NTNU Trondheim, Trondheim, 7034, Norway

Topological magnetic textures like skyrmions and antiskyrmions, have potential applications in next-generation spintronic devices. Notably, skyrmions and antiskyrmions can be viewed as particle- and antiparticle-like entities, respectively, with opposite topological charges and the potential to annihilate each other or be created in pairs. The controlled and fast manipulation of these spin textures are crucial for their practical applications.

In this work, we utilized in-situ femtosecond optical pulses in Lorentz microscopy and investigated the possibility of manipulating skyrmions and antiskyrmions. Our preliminary results show that ultrafast laser excitation can induce a helicity switching of elliptical skyrmions as well as the transformation between different spin textures, such as skyrmions, antiskyrmions, non-topological bubbles and stripes. A statistical analysis of our observations provides insights into the energy landscape of these magnetic patterns. Our findings suggest that laser pulses can control topological magnetic states.

MA 16.6 Tue 10:45 HSZ/0004

Emergent reactance induced by the deformation of a current-drive skyrmion lattice — •Matthew Littlehales[1,2], Max Birch[3], Akiko Kikkawa[3], Yasujiro Taguchi[3], Diego Alba Venero[2], Peter Hatton[1], Naoto Nagaosa[3,4], Yoshinori Tokura[3,5,6], and Tomoyuki Yokouchi[3] — [1]Department of Physics, Durham University, South Road, Durham, DH1 3LE, UK — [2]ISIS Neutron and Muon Source, Rutherford Appleton Laboratory, Didcot, OX11 0QX, UK — [3]RIKEN Center for Emergent Matter Science (CEMS), Wako, Japan — [4]Fundamental Quantum Science Program (FQSP), TRIP Headquarters, RIKEN, Wako, Japan — [5]Department of Applied Physics, University of Tokyo, Tokyo, Japan — [6]Tokyo College, University of Tokyo, Tokyo, Japan

Emergent electromagnetism offers an opportunity to develop novel applications by exploiting quantum mechanics. In condensed matter systems, the Berry phase acquired by conduction electrons acts as an emergent electromagnetic field, facilitating phenomena akin to classical electromagnetism. Magnetic skyrmions, spin vortices with non-trivial topology, offer a unique opportunity to investigate emergent electromagnetism. For example, non-trivial transport responses from magnetic skyrmions arise from the emergent Lorentz force and electromagnetic induction. Here, we present two new examples of emergent electric fields arising simultaneously from skyrmion lattice dynamics in MnSi. We find out-of-phase components in the electrical transport, reminiscent of a reactance, and attribute their existence to inertial, and deformative, current-driven skyrmion lattice dynamics.

15 min break

MA 16.7 Tue 11:15 HSZ/0004

***Ab inito* quantum transport for sub-10 nm skyrmions in 2D magnets** — •Moritz A. Goerzen, Salomé Trillot, and Dongzhe Li — CEMES, Université de Toulouse, CNRS, France

Topological spin textures, such as magnetic skyrmions, play a central role in modern magnetism and have attracted significant interest in both fundamental studies and spintronics applications. *Ab initio* theory can provide a direct connection to experiments, giving access to the material-dependent physics behind the observed effects. However, the high computational cost makes it difficult to model chiral skyrmions, which typically span several nanometers and arise from competing magnetic interactions. Here, we present a novel workflow capable of treating the electronic structure and transport properties of sub-10 nm skyrmions at the full *ab initio* level. We then apply this technique to investigate the electrical detection and chirality-induced orbitronics effects in 2D magnets. In particular, we demonstrate how non-collinear magnetoresistance, chirality-induced orbital moments, and orbital Hall effects evolve with skyrmion size, helicity, and spin-orbit coupling.

MA 16.8 Tue 11:30 HSZ/0004

Magnetic anisotropies resolved in the skyrmion-host GaV_4S_8 by high-field electron spin resonance spectroscopy — •Ignác Fejes[1], Titusz Fehér[1], Norbert Marcell Nemes[1], András Jánossy[2], Dávid Szaller[1,2,3], Sándor Bordács[3,5], Vladirmir Tsurkan[3], and István Kézsmárki[4] — [1]Department of Physics, Institute of Physics, Budapest University of Technology and Economics, Muegyetem rkp. 3., H-1111 Budapest, Hungary — [2]HUN-REN-BME Condensed Matter Physics Research Group, Budapest University of Technology and Economics, Muegyetem rkp. 3., H-1111 Budapest, Hungary — [3]Experimental Physics V, Center for Electronic Correlations and Magnetism, University of Augsburg, D-86135 Augsburg, Germany — [4]GFMC, Departamento de Fisica de Materiales Universidad Complutense de Madrid, 28040 — [5]Institute of Applied Physics, MD 2028, Chisinau, R. Moldova

Appearance of exotic types of magnetic ordering, such as skyrmions, strongly depends on the magnetic anisotropies present in a material, particularly in axially symmetric systems where second-order anisotropy in spin-orbit coupling is allowed. Here, we used high-field electron spin resonance spectroscopy (ESR) to study the field and orientation dependence of the spin excitation in the field-polarized state of GaV_4S_8. Below T_S = 44 K, the material transforms from a cubic phase to a polar rhombohedral phase, giving rise to multiple structural domains at low temperatures. We assigned the observed resonance modes to the corresponding polar domains and identified the relevant anisotropies - magnetocrystalline and g-factor - of GaV_4S_8.

MA 16.9 Tue 11:45 HSZ/0004

Isolated Magnetic Hopfions — Xiaowen Chen[1], •Nikolai S. Kiselev[2], Filipp N. Rybakov[3], Donghai Yang[1], and Fengshan Zheng[1] — [1]South China University of Technology, Guangzhou, China — [2]Forschungszentrum Jülich, Germany — [3]Uppsala University, Sweden

Hopfions are three-dimensional topological solitons formed by closed loops of vortex strings. In magnetic crystals, hopfions have so far been observed only in unusual configurations in which they are linked to skyrmion strings [1]. Although theory predicts the existence of stable, isolated hopfions in frustrated magnets [2] and chiral magnets [3], their experimental realization has remained elusive. Here we report laser-induced nucleation and direct TEM observation of isolated magnetic hopfions in the B20-type FeGe crystal [4]. We map out the nucleation conditions as a function of laser fluence and external magnetic field. Good agreement between experimental data and micromagnetic simulations unambiguously confirms the emergence of isolated hopfions and reveals their detailed structure. We derive the relevant topological invariant for hopfions embedded in helical or conical backgrounds and calculate its integer values for the observed objects. We demonstrate that these hopfions are stable without geometrical confinement and can coexist and interact with other topological spin textures. [1] F. Zheng, et al., Nature **623**, 718 (2023). [2] F. N. Rybakov et al., APL Mater. **10**, 111113 (2022). [3] J.-S. B. Tai & I. I. Smalyukh, Phys. Rev. Lett. **121**, 187201 (2018). [4] X. Chen, et al., preprint on Research Square https://doi.org/10.21203/rs.3.rs-7435743/v1

MA 16.10 Tue 12:00 HSZ/0004

Strain-controlled topological magnetic textures in anti-skyrmion hosting materials — •Somasree Bhattacharjee[1], István Kézsmárki[2], and Jan Masell[1] — [1]Institute of Theoretical Solid State Physics (TFP), Karlsruhe Institute of Technology (KIT), 76049 Karlsruhe, Germany — [2]Experimental Physics V, Center for Electronic Correlations and Magnetism, Institute of Physics, University of Augsburg, 86159 Augsburg, Germany

In non-centrosymmetric crystal structures with D_{2d} or S_4 symmetry, anisotropic Dzyaloshinskii-Moriya interaction (DMI) stabilizes antiskyrmions which was recently confirmed experimentally [1,2]. In these materials, easy-axis anisotropy additionally stabilizes skyrmions and non-topological bubbles in certain ranges of external magnetic fields and lamella thicknesses. The competition between magnetic dipolar interaction and DMI renders skyrmions elliptical depending on their handedness. Also, dipolar interaction stabilizes skyrmion caps on top of antiskyrmions which renders them rectangular [3]. In this work, we investigate how external mechanical strain can be used as an additional tuning parameter for the stability of these topological magnetic textures. We show that strain breaks the degeneracy of distinct types of elongated skyrmions and antiskyrmions, which can be used to controllably switch the helicity of the textures. [1] A. Nayak et al. Nature 548, 561 (2017), [2] K. Karube et al. Nat. Mater. 20, 335 (2021), [3] F. S. Yasin, J. Masell, et al., Adv. Mater. 36 (16), 2311737 (2024)

MA 16.11 Tue 12:15 HSZ/0004

MULTISTABLE SKYRMIONS IN THIN NANODOTS — •Mateusz Zelent[1,2] and Maciej Krawczyk[2] — [1]FACHBEREICH PHYSIK AND LANDESFORSCHUNGSZENTRUM OPTIMAS, RHEINLAND-PFÄLZISCHE TECHNISCHE UNIVERSITÄT KAISERSLAUTERN-LANDAU, 67663 KAISERSLAUTERN, GERMANY — [2]Faculty of Physics and Astronomy, Adam Mickiewicz University, Poznan, ul. Uniwersytetu Poznańskiego 2, Poznan, Poland

We present a new method for controlling and manipulating magnetic skyrmions in ultrathin multilayer structures by employing spatially tailored magnetostatic fields produced by ferromagnetic rings. Through a combination of analytical calculations and micromagnetic simulations, we demonstrate that the stray field generated by a Co/Pd ferromagnetic ring with perpendicular magnetic anisotropy can markedly increase the stability of skyrmions in an Ir/Co/Pt nanodot even when the Dzyaloshinskii Moriya interaction is entirely absent. Our analysis reveals a multistable behaviour, in which skyrmions can exist with two or even three distinct diameters, depending on the magnetization direction of the ring. The associated energy barriers separating these states are substantial, indicating possible applications in binary or multilevel magnetic data storage. We further show that transitions between these states can be triggered in a controlled and robust manner using short magnetic-field pulses. Overall, our approach offers a versatile strategy for engineering the magnetostatic energy landscape and designing skyrmion-based devices with customizable stability characteristics.

MA 16.12 Tue 12:30 HSZ/0004

First-Principles calculation of skyrmion collapse via the geodesic nudged elastic band approach — •Nihad Abuawwad[1], Daniel Wortmann[1], Gregor Michalicek[1], and Stefan Blügel[1,2] — [1]Peter Grünberg Institut, Forschungszentrum Jülich & JARA, 52425 Jülich, Germany — [2]Institute for Theoretical Physics, RWTH Aachen University, 52074 Aachen, Germany

Magnetic skyrmions are often investigated using spin models parameterized from first-principles calculations and achieving a fully *ab initio* description of skyrmion energetics and collapse mechanisms remains a significant challenge. In this work, we present a high-performance computing density functional theory (DFT) framework to compute both the skyrmion structure and its minimum-energy collapse pathway. Using the all-electron FLEUR code [1] within the AiiDA-FLEUR workflow environment [2], we construct an automated geodesic nudged elastic band (GNEB) workflow designed to determine the skyrmion collapse mechanism entirely from first principles. The method generates a sequence of intermediate magnetic states via geodesic interpolation between an initial skyrmion configuration and the final ferromagnetic state, and each image is evaluated under constrained magnetic moments to obtain accurate total energies and true magnetic forces. The resulting energy profile reveals the minimum energy path (MEP) and the associated barrier governing the topological skyrmion collapse. We compared these with the spin-model approach.
[1] D. Wortmann, et al. FLEUR, Zenodo (2023). [2] J. Broeder, et al., Proc. Extreme Data Workshop 40, 43*48 (2019).

MA 17: Multiferroics and Magnetoelectric Coupling (joint session MA/FM)

Time: Tuesday 9:30–12:30 Location: POT/0112

MA 17.1 Tue 9:30 POT/0112

Electric polarization driven by non-collinear spin alignment: first principles calculations — •Sergiy Mankovsky[1,3], Svitlana Polesya[1], Jan Minar[2], Hongbin Zhang[3], and Hubert Ebert[1] — [1]Ludwig Maximilian University of Munich, Munich, DE — [2]University of West Bohemia, Pilsen, CZ — [3]TU Darmstadt, Darmstadt, DE

We present an approach for first principles investigations of the spin driven electric polarization in type II multiferroics. We propose a parametrization of the polarization with the parameters calculated using the multiple scattering Green function (KKR-GF) formalism. On this basis, the induced electric polarization of a unit cell can be represented in terms of three-site parameters. Those antisymmetric with respect to a spin permutation can be seen as an ab-initio based counter-part to the phenomenological parameters used in the inverse-DMI model. Beyond to this, our new approach gives direct access to the element- and site-resolved electric polarization. To demonstrate the capability of the approach, we consider several examples, for which the magneto-electric effect is observed either as a consequence of an applied magnetic field (Cr_2O_3), or as a result of a phase transition to a spin-spiral magnetic state (MnI_2 and $AgCrO_2$).

MA 17.2 Tue 9:45 POT/0112

Competition Between Multiferroic and Magnetic Soliton Lattice States in DyFeO3 — •Nikita Andriushin[1], Stanislav Nikitin[2], Oystein Fjellvag[1,3], Ekaterina Pomjakushina[2], Alexandra Turrini[2], Sergey Artyukhin[4], Christof Schneider[2], and Maxim Mostovoy[5] — [1]TU Dresden, Germany — [2]PSI, Switzerland — [3]IFE, Norway — [4]IIT, Italy — [5]University of Groningen, The Netherlands

Simultaneous breaking of time-reversal and inversion symmetries in multiferroics couples ferroelectricity to magnetism and produces unusual phenomena relevant for next-generation electronics. A notable case is $DyFeO_3$, which under magnetic fields shows a giant linear magnetoelectric response and a large spontaneous polarization arising from coexisting Fe and Dy orders. Using high-resolution neutron diffraction, we demonstrate that at zero field $DyFeO_3$ hosts an incommensurate magnetic soliton lattice formed by spatially ordered Dy domain walls with an average size of 231(8) Å. Long-range interactions between these walls are mediated by magnons in the Fe subsystem, analogous to a Yukawa force. An applied magnetic field destroys the incommensurate order, restores the linear magnetoelectric response, and stabilizes the ferroelectric state. The magnetic domain walls carry electric charge, and the soliton array dimerizes when both electric and magnetic fields are applied. Simulations using experimental parameters indicate that competition between ferroelectric and incommensurate states can be effectively tuned by an electric field.

MA 17.3 Tue 10:00 POT/0112

Magnetoelectric coupling in antiferromagnetic $BiCoO_3$ — •Veronica Goian[1], Fedir Borodavka[1], Petr Proschek[2], Maxim Savinov[1], Christelle Kadlec[1], Hong Dong Nguyen[1], Andrei A. Belik[3], and Stanislav Kamba[1] — [1]Institute of Physics of the Czech Academy of Sciences, Prague, Czech Republic — [2]Department of Condensed Matter Physics, Charles University, Prague Czech Republic — [3]National Institute for Materials Science: Tsukuba, Ibaraki, Japan

$BiCoO_3$ is a potential multiferroic material with a C-type antiferromagnetic phase transition at T_N=470 K and a hypothetical ferroelectric phase transition around 1000 K (the sample decomposes at around 470 °C).[1] First-principles calculations predict an unusually strong antimagnetoelectric coupling in $BiCoO_3$.[2] However, no experimental measurements have been reported in the literature to determine the magnetoelectric coupling or related structural properties. This is mainly because $BiCoO_3$ requires high-pressure and high-temperature sintering. We have measured the dielectric permittivity, ferroelectric hysteresis loops, and Raman, THz, and IR spectra to probe the ferroelectric behavior. In addition, we found that $BiCoO_3$ exhibits well-measurable non-linear magnetoelectric coupling.

[1] Oka et al., J. Am. Chem. Soc., 132, 9438-9443 (2010)

[2] Braun et al., Phys. Rev. B, 110, 144442(2024)

MA 17.4 Tue 10:15 POT/0112

Investigation of the piezomagnetic effect in $CaBaCo_4O_7$ — •Jyotiranjan Rout[1], Yusuke Tokunaga[2], Yasujiro Taguchi[2], Yoshinori Tokura[2], Bernd Büchner[1,3], and Vilmos Kocsis[1] — [1]IFW-Dresden — [2]RIKEN, CEMS, Japan — [3]TU-Dresden

In a magnetoelectric material the electric and magnetic responses are intertwined and cross control via the application of external magnetic and electric field are enabled. Ferroelectric polarization implies a special distortion of the lattice where dipolar moment related to the separation of the positive and negative ions are not compensated within the unit cell. Therefore we immediately can imagine the intricate and complicated connection between the magnetoelectric and magnetoelastic properties of a multiferroic.

The Swedenborgite $CaBaCo_4O_7$ exhibits a polar structure, which is accompanied by a ferrimagnetic order at T_C=62 K and a record large change in the ferroelectric polarization. Correspondingly, former magnetoelastic measurements have indeed confirmed the presence of a giant magnetoelastic distortion close to T_C; However, less is known about the magnetoelastic anisotropies.

Here, we report a detailed study of the magnetoelastic anisotropy, completing the connection between magnetoelasticity and magnetoelectricity in this material family. We also report on an unusual feature of the piezomagnetic effect, which suggests the importance of the orbitals in the piezomagnetoelectric effects.

MA 17.5 Tue 10:30 POT/0112

Multiferroic altermagnetism and magneto-orbital excitations in monolayer VCl3 — •Luigi Camerano[1,2], Adolfo Otero Fumega[3], Alessandro Stroppa[2], Jose Lado[3], and Gianni Profeta[1,2] — [1]University of L'aquila, 67100 L'Aquila, Italy — [2]CNR-SPIN L'Aquila, 67100 L'Aquila, Italy — [3]Aalto University, 02150 Espoo, Finland

Van der Waals monolayers featuring magnetic states provide fundamental building blocks for artificial quantum matter. In this contribution I will present the emergence of a symmetry broken multiferroic ground state featuring magneto-orbital excitations and nematic d-wave altermagnetism in monolayer VCl3 [1-4]. All these physics arises from a pure electronic symmetry breaking ultimately stabilizing an antiferro-orbital order ground state showing the emergence of an electronic polarization. Recent experimental evidence report signatures of symmetry breakings and ferroelectricity combined with 2D magnetism, establishing monolayer VCl3 as a novel 2D multiferroic driven by orbital ordering.

References

1. Mastrippolito D., Camerano L. et al. Phys. Rev. B 108,045126 (2023)
2. Camerano, L. et al. 2D Mater. 11, 025027 (2024)
3. Camerano, L. et al. Nano Lett. 25, 4825,4831 (2025)
4. Camerano, L. et al. npj 2D Mater Appl 9, 75 (2025)

MA 17.6 Tue 10:45 POT/0112

Electric control of antiferromagnetic states in an insulator — •Somnath Ghara[1], Maximilian Winkler[1], Sebastian Schmid[1,2], Lilian Prodan[1], Korbinian Geirhos[1], Vladimir Tsurkan[1,3], Wenbo Ge[4], Weida Wu[4], András Halbritter[2], Stephan Krohns[1], and István Kézsmárki[1] — [1]EP5, Institute of Physics, University of Augsburg, Germany — [2]Department of Physics, Budapest University of Technology and Economics, Hungary — [3]Institute of Applied Physics, Moldova State University, Republic of Moldova — [4]Department of Physics and Astronomy, Rutgers University, USA

Electric control of antiferromagnetic (AFM) order is highly desirable for the development of ultrafast and energy-efficient spintronic devices. In this talk, I will show that the strong linear magnetoelectric coupling in the collinear AFM insulator Co_3O_4 enables full isothermal control of AFM order by electric fields deep within its AFM phase, i.e. the Néel vector can be either reversed instantaneously or rotated smoothly. Importantly, we found that even in macroscopic volumes of Co_3O_4, the non-volatile switching between time-reversed AFM states occurs on timescales as short as a few tens of nanoseconds. These observations suggest that the quasi-cubic AFM insulators, such as Co_3O_4, provide an ideal platform for ultrafast manipulation of microscopic AFM domains and may lead to the realization of antiferromagnet-based spintronic devices.

Ref: S. Ghara et al., Phys. Rev. Lett. 135, 126704 (2025).

15 min break

MA 17.7 Tue 11:15 POT/0112

Optical detection of magnetic order in SmFe3(BO3)4 — •Bálint Beke[1], Bence Szász[1], I. A. Gudim[2], L. N. Bezmaternykh[2], Dávid Szaller[1], and Sándor Bordács[1] — [1]Budapest University of Technology and Economics, Budapest, Hungary — [2]Krasnoyarsk, Russia

The chiral crystal structure of $SmFe_3(BO_3)_4$ hosts an easy-plane antiferromagnetic phase below 32 K. Due to the broken inversion, the magnetic order induces electric polarization in this compound, but this polarization averages out to zero when domains are randomly oriented in the ab plane. We studied the 4f-4f excitations of Sm^{3+} ions using polarization resolved magneto-optical spectroscopy. Low magnetic fields, <2 T give rise to linear dichroism that we associate with the rearrangement of antiferromagnetic domains. In finite fields, we could determine the polarization selection rules in a state where the orientation of the antiferromagnetic domains is well defined. Moreover, we detected non-reciprocal absorption of light, which is a finite frequency fingerprint of the optical magnetoelectric effect.

MA 17.8 Tue 11:30 POT/0112

A high-temperature multiferroic $Tb_2(MoO_4)_3$ — •Shimon Tajima, Hidetoshi Masuda, Yoichi Nii, Shojiro Kimura, and Yoshinori Onose — Institute for Materials Research, Tohoku University, Sendai, Japan

We demonstrated magnetic control of ferroelectric polarization at 432 K in ferroelectric and ferroelastic $Tb_2(MoO_4)_3$, in which the polarity of ferroelectric polarization is coupled to the orthorhombic strain below the transition temperature 432 K.

The paramagnetic but strongly magnetoelastic Tb^{3+} magnetic moments enable the magnetic control of ferroelectric and ferroelastic domains; the ferroelectric polarization is controlled depending on whether the magnetic field is applied along [110] or [1$\bar{1}$0].

MA 17.9 Tue 11:45 POT/0112

Towards topological switching in multiferroics — •Alessandro Granero and Sergey Artyukhin — Italian Institute of Technology (IIT), Genova, Italy

Magnetoelectric switching in GdMn2O5 [1] is the first known example of topological ferroic switching, where magnetic field sweeps across the spin-reorientation transition induce incremental 90° spin rotations described by a topological winding number. While the behavior has been rationalized with a microscopic model, symmetry conditions and minimal model ingredients that enable this behavior are poorly understood. Here we use a symmetry-based Landau theory approach and demonstrate that a toy model with two frustrated antiferromagnetic subsystems and a low-symmetry anisotropy captures the topological switching behavior. The model reveals how sweeps of the driving field move the free-energy minimum continuously in spin-orientation space, in contrast to conventional ferroelectric switching that relies on fixed *P minima and domain-wall nucleation. Multiple switching pathways enabled by the simultaneous presence of E and H fields are summarized by a "switching diagram" [2], linking regions of the H and E field amplitudes to distinct sequences of magnetoelectric transitions. Small parameter variations near diagram boundaries redirect the system along different routes. The results establish a minimal model for topological switching in GdMn2O5 and guide the search for topological switching phenomena in other materials. [1] L. Ponet, et al.: Nature 607, 81-85 (2022) [2] M. Ryzhkov, A. Granero et al.: Communication Materials, in press

MA 17.10 Tue 12:00 POT/0112

Observation of antiferromagnetic domains by low-temperature photoluminescence microscopy — •Bence Szász — Physics Department, Budapest University of Technology and Economics, Budapest, Hungary

The optical oscillator strengths of crystal-field transitions in magnetoelectric antiferromagnets can serve as specific signatures of the underlying magnetic order. In this work, I investigate the feasibility of identifying magnetic domains using a low-temperature optical photoluminescence microscopy system.

MA 17.11 Tue 12:15 POT/0112

Spectroscopy of coupled magnetic and electric resonances — •Dávid Szaller[1,2], Artem M Kuzmenko[3], Alexander A Mukhin[3], Alexey Shuvaev[2], and Andrei Pimenov[2] — [1]HUN-REN-BME Condensed Matter Physics Research Group, and Department of Physics, Institute of Physics, Budapest University of Technology and Economics, Muegyetem rkp. 3., H-1111 Budapest, Hungary — [2]Institute of Solid State Physics, TU Wien, 1040 Vienna, Austria — [3]Moscow, Russia

Controllable non-reciprocal propagation of light is an intensively investigated field of optics, with studies motivated both by fundamental questions and possible telecommunication applications. So far, polarization-independent, switchable one-way transparency has been demonstrated at certain resonances of multiferroic crystals at cryogenic temperatures and in high magnetic fields, limiting the practical implementation. As an alternative approach, we present one-way transparency of an artificial layered structure consisting of split-ring metamaterial and magnetic substrate layers interacting in the dynamic regime [1]. Our quasi-optical experiments in the GHz frequency range show that this unique combination breaks time and space inversion symmetries in external magnetic field. The ease of tuning the dynamic response and the controllable one-way transparency make this approach promising for real-world applications.

[1] A. M. Kuzmenko et al., Phys. Rev. B 112, 134434 (2025).

MA 18: Caloric Effects in Ferromagnetic Materials (joint session MA/TT)

Time: Tuesday 9:30–11:30 Location: POT/0151

Invited Talk MA 18.1 Tue 9:30 POT/0151

Magnetic Cooling: From applications at room temperature to hydrogen liquefaction — •T. Gottschall[1], E. Bykov[1], M. Strassheim[1], T. Platte[2], C. Fujta[2], D. Benke[2], M. Fries[2], W. Liu[3], A. Döring[3], K. Skokov[3], O. Gutfleisch[3], and J. Wosnitza[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]MAGNOTHERM Solutions GmbH, Darmstadt, Germany — [3]Technical University of Darmstadt, Darmstadt, Germany

Magnetic cooling can be utilized to construct environmentally friendly cooling devices, air conditioners, and heat pumps. Recently, low temperatures became the focus of attention as an area of application for magnetocaloric cooling, namely for hydrogen liquefaction. The conventional liquefaction process uses up to 40 % of the lower heating value of the gas we are compressing, just to liquefy it! Magnetocaloric materials enable an alternative and more efficient approach. A large number of compounds are already known that show magnetocaloric effects in the desired temperature range and new candidates are constantly being added. In this work, we would like to discuss our current progress for the creation of a materials library for cryogenic applications. The basis for this is our characterization infrastructure for materials research at TU Darmstadt and the Dresden High Magnetic Field Laboratory in static and pulsed magnetic fields. Furthermore, we also provide an overview of the recent results in the demonstrator development of a magnetic hydrogen liquefier within the framework of the European project HyLICAL.

MA 18.2 Tue 10:00 POT/0151

Hydrogen tunned transition temperature of GdFeSi for magnetocaloric hydrogen liquefaction application — •Allan Döring[1], Wei Liu[1], Marc Strassheim[2], Tino Gottschall[2], Konstantin Skokov[1], and Oliver Gutfleisch[1] — [1]Institute of Materials Science, Functional Materials, Technical University of Darmstadt, Darmstadt, Germany — [2]Hochfeld-Magnetlabor Dresden (HLD-EMFL), HZDR, Dresden, Germany

Hydrogen can play an important role in the future carbon-neutral society. Among several alternatives to store this energy carrier, the liquid H2 (LH2) stands out for its higher volume-to-energy ratio. However, the actual method of H2 liquefaction sums up to 34% of the costs of LH2. The magnetocaloric cooling could be one alternative to improve the efficiency of the process. Thus, it is essential to conduct research on materials exhibiting a strong magnetocaloric effect (MCE) within the temperature range of 20 K to 77 K. The peak of the MCE is at transition temperatures, such as the Curie temperature (TC). The magnetocaloric effect peak of GdFeSi is at 125 K. In this study, the TC of GdFeSi was shifted to lower temperatures by hydrogenation process, achieving a shift of over 90 K. By the anisotropic crystal expansion, GdFeSiH exhibited and higher magnetocaloric effect than the pristine alloy, not only by the isothermal entropy change, but also directly measured adiabatic temperature change. We acknowledge the HyLICAL project for the funding of this research through grant 101101461, and Deutsche Forschungsgemeinschaft (DFG) within the CRC/TRR 270 (Project-ID 405553726).

MA 18.3 Tue 10:15 POT/0151

First-principles investigation of chemical substitution and interstitial doping in La(Fe,Si)$_{13}$ — •Anita Yadav and Markus E. Gruner — University of Duisburg-Essen, 47057 Duisburg, Germany

La(Fe$_x$Si$_{1-x}$)$_{13}$ is a prominent magnetocaloric material, characterized by a sharp first-order phase transition and a large associated entropy change. Its behavior arises from an intricate coupling among the magnetic, electronic, and lattice degrees of freedom, which makes the material highly responsive to external factors and enables targeted tuning of its magnetocaloric response [1,2]. The operating range can be modified through substitution and interstitial loading, which can alter the local atomic environment and reshape the coupling between structural and magnetic subsystems. In this work, we employ first-principles calculations in the framework of density functional theory (DFT) to systematically screen the impact of chemical substitution and loading of light elements on interstitial sites with respect to structural stability, lattice expansion, magnetic interactions, and thermodynamic behavior. Furthermore, we explore the benefits of machine-learning force-fields based on our DFT results for an efficient modeling of the thermodynamic properties of La(Fe$_x$Si$_{1-x}$)$_{13}$-based compounds. Funding by the DFG via TRR270 (B06) is gratefully acknowledged.

[1] M. E. Gruner *et al.*, Phys. Rev. Lett. **114**, 057202 (2015)
[2] K. P. Skokov *et al.*, Appl. Phys. Rev. **10**, 031408 (2023)

MA 18.4 Tue 10:30 POT/0151

Magnetocaloric Laves phases based on light rare earths: Addressing Criticality — •M. Strassheim[1,2], L. Beyer[3,4], J. Wosnitza[1,2], and T. Gottschall[1] — [1]Hochfeld-Magnetlabor Dresden (HLD-EMFL), HZDR, Dresden, Germany — [2]Institut für Festkörper- und Materialphysik, TU Dresden, Germany — [3]Leibniz Institute for Solid State and Materials Research Dresden, Germany — [4]TU Bergakademie Freiberg, Germany

Laves-phase intermetallic compounds based on heavy rare-earth elements have long been recognized for their excellent magnetocaloric performance at low temperatures, making them promising candidates for cryogenic cooling applications. However, the reliance on heavy rare earths poses challenges in terms of cost, availability, and sustainability. In this work, we explore the magnetocaloric properties of the light rare-earth-based Laves phase $CeFe_2$. By the substitution of Al, its unstable ferromagnetism can be disturbed enough to establish an antiferromagnetic phase below 80 K. Using a combination of structural, magnetic, and direct adiabatic temperature change measurements at the Dresden High Field Laboratory, we investigate the potential of this antiferromagnetic state for its potential in magnetocaloric hydrogen liquefaction.

MA 18.5 Tue 10:45 POT/0151

Pressure effect on the magnetocaloric response of RCo$_2$ Laves Phases — •Catalina Salazar-Mejia[1], E. Bykov[1], W. Liu[2], K. Skokov[2], O. Gutfleisch[2], J. Wosnitza[1,3], and T. Gottschall[1] — [1]High Magnetic Field Laboratory (HLD-EMFL), Helmholtz-Zentrum Dresden-Rossendorf, Germany — [2]Institut für Materialwissenschaft, TU Darmstadt, Germany — [3]Institut für Festkörper- und Materialphysik, TU Dresden, Germany

Rare-earth Laves phases are potential candidates for magnetic refrigeration at cryogenic temperatures. They exhibit large magnetocaloric effects and their transition temperatures can be tuned through elemental substitutions. In this work, we investigate the effect of hydrostatic pressure on the magnetism and magnetocaloric effect of RCo$_2$ Laves phases with rare-earth elements R = Tb, Dy, Ho, and Er. In general, we observe that the Curie temperature, T_C, decreases with applied pressure in all alloys. T_C is most sensitive to pressure in TbCo$_2$, with $dT_C/dp \approx -22$ K/GPa, and this value decreases systematically along the series, reaching $dT_C/dp \approx -7.7$ K/GPa in ErCo$_2$. More interestingly, hydrostatic pressure has an almost negligible effect on the magnetocaloric response - specifically on the isothermal entropy change, ΔS_T, with the exception of HoCo$_2$, where ΔS_T increases by about 26% under an applied pressure of approximately 1 GPa and for a magnetic field change of 5 T.

MA 18.6 Tue 11:00 POT/0151

Manipulating Magnetocaloric Properties Through Magnetic Exchange at Mn_{3-x}GaC/Fe Interfaces — •Ivan Tarasov and Ulf Wiedwald — Faculty of Physics and Center for Nanointegration (CENIDE), University of Duisburg-Essen, 47057 Duisburg, Germany

Magnetocaloric materials enable solid-state cooling by exploiting temperature changes under magnetic-field variation. Manganese-based antiperovskites (APVs, Mn_3AX) are promising materials due to their sharp, tunable first-order magnetostructural transition (FOMST). A key challenge is to control the working temperature window and enhance the magnetocaloric response within a given material system. Tailoring magnetic exchange interactions offers a new strategy.

Here, we investigate APV/Fe bilayers, focusing on interface-driven exchange effects. Uncoupled $Mn_2GaC_{1.1}$ films show a sharp FOMST at 189 K with a strong $\partial M/\partial T$ peak. A 5 nm Fe cap lowers the transition to 175 K, broadens hysteresis, and suppresses the $\partial M/\partial T$ peak above 1 T. The bare APV exhibits $\Delta S_m \approx 10$ J kg^{-1} K^{-1} at $B = 6$ T, whereas coupling reduces this to ~ 1 J kg^{-1} K^{-1} at $B = 5$ T. In multi-domain bilayers, $\partial M/\partial T$ increases by 15% (AFM–FM) and 46% (FM–PM) for a Fe film thickness of $t = 2.6$ nm, but disappears for $t = 21$ nm, accompanied by an anomaly near 50 K linked to interfacial AFM ordering.

Funding by the Deutsche Forschungsgemeinschaft (DFG) within CRC/TRR 270, project B02 (Project-ID 405553726) is gratefully acknowledged.

MA 18.7 Tue 11:15 POT/0151

Frustration and Antiferromagnetic Ordering in Low-Temperature Materials for Adiabatic Demagnetization — •Anton Jesche, Tim Treu, Marvin Klinger, Jorginho Villar Guerrero, and Philipp Gegenwart — EP VI, Institute of Physics, University of Augsburg, Germany

The development of improved materials for adiabatic demagnetization refrigeration (ADR) has been driven increasingly by research on magnetically frustrated systems, where competing interactions can suppress magnetic ordering to very low temperatures [1]. Such behavior is particularly attractive for low-temperature cooling and has led to several promising rare-earth-based compounds. Notable examples include $KBaYb(BO_3)_2$, which reaches temperatures near 20 mK [2], and $NaGdP_2O_7$, which demonstrates extended hold times below 2 K in standard cryogenic environments [3].

This contribution will highlight selected Yb- and Gd-based materials and discuss the influence of frustration and antiferromagnetic (AFM) ordering on their cooling performance. Using $NaGdP_2O_7$ as a representative case, we examine how magnetic entropy near AFM transitions affects ADR behavior under varying magnetic fields and temperatures. We further show that high-resolution thermodynamic information, such as heat capacity, can be extracted directly from ADR curves.

[1] M. E. Zhitomirsky, Phys. Rev. B, 2003, 67, 104421, [2] Y. Tokiwa, Commun. Mater. 2021, 2, 42, [3] P. Telang, Phys. Rev. B, 2025, 111, 064434

MA 19: Frustrated Magnets I (joint session MA/TT)

Time: Tuesday 9:30–12:30 Location: POT/0361

MA 19.1 Tue 9:30 POT/0361

Spontaneous symmetry breaking in the Heisenberg antiferromagnet on a triangular lattice — •Bastian Pradenas[1,2], Grigor Adamyan[1,3], and Oleg Tchernyshyov[1] — [1]William H. Miller III Department of Physics and Astronomy, Johns Hopkins University, Baltimore, USA — [2]Leibniz Institute for Solid State and Materials Research, IFW, Dresden, Germany — [3]Department of Physics, Massachusetts Institute of Technology, Cambridge, USA

We present a detailed investigation of an overlooked symmetry structure in non-collinear antiferromagnets that gives rise to an emergent quantum number for magnons. Focusing on the triangular-lattice Heisenberg antiferromagnet, we show that its spin order parameter transforms under an enlarged symmetry group, $\mathrm{SO(3)_L \times SO(2)_R}$, rather than the conventional spin-rotation group SO(3). Although this larger symmetry is spontaneously broken by the ground state, a residual subgroup survives, leading to conserved Noether charges that, upon quantization, endow magnons with an additional quantum number—*isospin*—beyond their energy and momentum. Our results provide a comprehensive framework for understanding symmetry, degeneracy, and quantum numbers in non-collinear magnetic systems, and bridge an unexpected connection between the paradigms of symmetry breaking in non-collinear antiferromagnets and chiral symmetry breaking in particle physics.

MA 19.2 Tue 9:45 POT/0361

Antiferro octupolar order in the 5d^1 double perovskite Sr_2MgReO_6 and its spectroscopic signatures — •Dario Fiore Mosca[1] and Leonid Pourovskii[2,3] — [1]University of Vienna, Faculty of Physics and Center for Computational Materials Science, Vienna, Austria — [2]CPHT, CNRS, Ecole polytechnique, Institut Polytechnique de Paris, 91120 Palaiseau, France — [3]College de France, Université PSL, 11 place Marcelin Berthelot, 75005 Paris, France

Hidden-order phases governed by high-rank multipolar order parameters have recently been identified in several cubic 5d double perovskites. Because experimental probes often couple weakly to high-rank moments, multipolar orders can remain elusive or be misinterpreted as lower-rank phases. A notable example is the 5d^1 double perovskite Sr_2MgReO_6, originally proposed as a spin glass and later reclassified as a conventional dipolar antiferromagnet.

In this work, we show instead that Sr_2MgReO_6 hosts a hidden antiferroic order of magnetic octupoles. The dominant tetragonal crystal field isolates a doublet carrying octupolar degrees of freedom, while weak dipolar moments arise only through admixture of the excited j = 1/2 spin-orbit multiplet. This octupolar order produces characteristic quasigapless magnetic excitations and superstructural neutron-diffraction intensities that peak at large scattering momenta.

This results highlights the tunability of multipolar interactions in spin-orbit entangled materials and places Sr_2MgReO_6 with unconventional octupolar phases.

MA 19.3 Tue 10:00 POT/0361

Field-dependent CEF excitations in Ce_2Bi — •Nikolai Pavlovskii[1], Alexander Sukhanov[2], Anton Kulbakov[1], Michael Smidman[3], Federico Mazza[4], Darren Peets[1], Kaushick Parui[1], Ross Stewart[5], Ross Piltz[6], and Dmytro Inosov[1] — [1]TU Dresden, Germany — [2]University of Augsburg, Germany — [3]Zhejiang University, China — [4]TU Vienna, Austria — [5]ISIS, UK — [6]ANSTO, Australia

Ce_2Bi is a cerium-based intermetallic compound where crystal-field (CEF) splitting and anisotropic magnetic interactions occur on comparable energy scales. To identify the relevant low-energy degrees of freedom, we investigate the field dependence of CEF-related excitations in single-crystalline Ce_2Bi using neutron-scattering techniques. Single-crystal diffraction establishes the crystallographic symmetry at the Ce site, providing the structural framework required for interpreting the magnetic excitations. The excitation spectrum shows a clear magnetic mode within the $J = 5/2$ manifold whose energy and intensity vary strongly with applied field. Crucially, the mode displays clear dispersion, demonstrating the presence of exchange interactions; as a result, what was previously interpreted as a localized CEF level is revealed to be a dispersive magnetic exciton. The field-induced evolution of this exciton constrains the mixing within the CEF manifold and the anisotropy of the ground-state Kramers doublet.

MA 19.4 Tue 10:15 POT/0361

High-field magnetic excitations in a kagome antiferromagnet — •Yoshihiko Ihara[1], Dmytro Inosov[2], Darren Peets[2], Moyu Kato[1], and Hiroyuki Yoshida[1] — [1]Hokkaido University, Sapporo, Japan — [2]TU Dresden, Dresden, Germany

Magnetic ground states in kagome antiferromagnets have been intensively studied to reveal the quantum mechanically disordered magnetic states. By applying high magnetic fields, further intriguing phenomena have been introduced such as the plateau in magnetization curve at the 1/9 of the full saturation value in $YCu_3(OH)_{6.5}Br_{2.5}$. [S. Jeon et al., Nat. Phys. **20**, 435 (2024), S. Suetsugu et al., PRL **132**, 226701 (2024), G. Zheng et al., PNAS **122**, e2421390112 (2025)]. Although higher magnetic fields induce another magnetization plateau at the 1/3 of the full saturation, the field strength required to access the 1/3 plateau is more than 50 T and is too large to perform most of the microscopic experiments. Thus, we focus on another Cu-based mineral $InCu_3(OH)_6Cl_3$, which shows the 1/3 plateau around 10 T due to smaller energy scale of exchange interactions [M. Kato et al., Commun. Phys. **7**, 424 (2024)]. This allows us to perform NMR experiments in the entire field range reaching the full saturation. The measured nuclear spin-lattice relaxation rate demonstrates that the magnetic excitations are gapped in the 1/3 plateau state and the gap size increases with fields [M. Kato et al., JPSJ **94**, 083704 (2025)]. We will also discuss the magnetic excitations above the 1/3 plateau based on the results obtained in the high-field magnet in Tohoku Univ.

MA 19.5 Tue 10:30 POT/0361

Evidence for a Near-Ideal Jeff = 1/2 Ground State in Triangular-Lattice Na2BaCo(PO4)2 — •Miguel M. F. Carvalho[1,2], Sheng H. Chen[1], Yu C. Ku[3,4], Anagha Jose[5], Ryan Morrow[5], Chang Y. Kuo[3,4], Chun F. Chang[1], Zhiwei Hu[1], Maurits W. Haverkort[6], and Liu H. Tjeng[1] — [1]Max Planck Institute for Chemical Physics of Solids,Dresden — [2]Institute of Physics II, University of Cologne — [3]Department of Electrophysics, National Yang Ming Chiao Tung University, Hsinchu, Taiwan — [4]National Synchrotron Radiation Research Center, Hsinchu, Taiwan — [5]Institut fuer Festkoerperphysik, Leibniz IFW, Dresden — [6]Institute for theoretical physics, Heidelberg University

We investigated the local Co 3d electronic structure of Na2BaCo(PO4)2 using polarization-dependent X-ray absorption spectroscopy (XAS) together with full multiplet cluster calculations. To obtain reliable spectra from this strongly insulating material, we employed the line-fitting inverse partial fluorescence yield (IPFY) method. Our combined experimental and theoretical analysis shows that the CoO6 octahedra exhibit only a very small effective trigonal distortion of about 11 meV, placing the system close to the ideal conditions for a Jeff = 1/2 ground state. Using our cluster model, we are also able to simulate the magnetic susceptibility along different crystallographic directions, . Overall, these results establish Na2BaCo(PO4)2 as a promising platform for investigating exotic magnetic behavior linked to Jeff = 1/2 states on triangular lattices.

MA 19.6 Tue 10:45 POT/0361

Dimensional reduction and fractionalized magnetization plateaus in the scalene-distorted triangular-lattice magnet kobyashevite — •Kaushick Parui[1], Anton Kulbakov[1], Roman Gumeniuk[2], Maria Teresa Fernandez-Diaz[3], Sergey Granovsky[1], Sergei Zvyagin[4], Dmytro Inosov[1], and Darren Peets[1,5] — [1]TU Dresden, Germany — [2]TU Bergakademie Freiberg, Germany — [3]ILL, France — [4]HZDR, Germany — [5]ct.qmat, TU Dresden, Germany

Quantum magnetism intertwined with lattice distortion can give rise to exotic ground states, yet studies on scalene-distorted triangular-lattice antiferromagnets remain scarce. Here, we report the crystal and magnetic structures, as well as magnetic and thermodynamic properties, of kobyashevite, $Cu_5(SO_4)_2(OH)_6{\cdot}4H_2O$. This compound hosts a scalene-distorted triangular lattice and exhibits antiferromagnetic order at 4 K, with a possible second transition at 0.64 K. High-field magnetization and specific-heat measurements reveal a cascade of field-induced states, manifested as magnetization plateaus, suggestive of a rich magnetic phase diagram. Neutron diffraction uncovers a dimensionally-reduced commensurate magnetic structure with propagation vector $\mathbf{k} = (0\,0\,\frac{1}{2})$, consisting of coupled alternating ferromagnetic and antiferromagnetic spin chains, while the Cu4 spins remain idle at 1.5 K. Collectively, these results establish kobyashevite as a promising platform for exploring the interplay of frustration, distortion, and dimensional reduction in quantum magnets.

15 min break

MA 19.7 Tue 11:15 POT/0361

Atomically sharp magnetic solitons for racetrack memory at the spatial limit — K Allen[1], K Du[2], J Bouaziz[3], S Mishra[1], G Bihlmayer[3], Y Zhang[1], Y Hao[4], V Ukleev[5], C Luo[5], F Radu[5], Y Gao[1], Ch Lane[6], J-X Zhu[6], M Yi[1], H Cao[4], S-W Cheong[2], •Stefan Blügel[3], and Emilia Morosan[1] — [1]Dept. of Physics and Astronomy & Rice Center for Quantum Materials, Rice University, Houston, 77005, TX, USA — [2]Dept. of Physics and Astronomy, Rutgers University, Piscataway, 08854, NJ, USA — [3]Peter-Grünberg Institute, Forschungszentrum Jülich, 52425 Jülich, Germany — [4]Neutron Scattering Division, Oak Ridge Natl Lab, Oak Ridge, 37831, TN, USA — [5]Helmholtz-Zentrum Berlin, 14109 Berlin, Germany — [6]Theoretical Division, Los Alamos Nat. Lab., Los Alamos, 87545, NM, USA

We discuss the physics of a metallic square-net lattice rare-earth compound that exhibits RKKY interactions leading to magnetic frustration whose effective exchange interactions competes with the uniaxial anisotropy resulting in a rare ferrimagnetic up-up-down phase. Applying magnetic fields, atomically sharp solitons can be precipitated that have all the foundational credentials for a racetrack memory at the spatial limit. We present DFT calculations relating the RKKY interaction and the magnetic anisotropy to the electronic structure. We performed atomistic spin-dynamics calculations relating the interaction parameters to the soliton formation. A combination of experiments will be presented that provide evidence of the 1D magnetic solitons.

MA 19.8 Tue 11:30 POT/0361

Guest*Controlled Quantum Magnetism in a Flexible Metal-Organic Framework — •Fang Liu[1], Armin Schulz[2], Axel Lubk[4], Alexej Pashkin[3], Sergej Granovski[1], Shuhan Wang[1], Weinel Kristina[4], Herzog Max[4], and Stefan Kaiser[1] — [1]Institute of Solid State and Materials Physic, Dresden University of Technology — [2]Max Planck Institute for Solid State Research, Stuttgart — [3]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Dresden — [4]Leibniz Institute for Solid State and Materials Research, Dresden

Metal-organic frameworks provide an unusual setting where magnetic frustration and structural flexibility coexist. In our system, two distinct states emerge: a guest-stabilized regime with signatures of a potential quantum spin liquid, and a guest-free state exhibiting weak magnetic ordering. Raman and infrared spectroscopy reveal pronounced differences in lattice modes between these phases. Complementary Raman and THz measurements further uncover contrasting magnetic backgrounds. These findings establish a guest-controlled route to tuning magnetic quantum states in MOFs.

MA 19.9 Tue 11:45 POT/0361

Investigation of spin-correlated phases in quasi two-dimensional layered honeycomb oxide — •Aprajita Joshi[1], Anjali Kumari[2,3], Shalini Badola[1], Anup Kumar Bera[2,3], and Surajit Saha[1] — [1]Indian Institute of Science Education and Research Bhopal, 462066, India — [2]Bhabha Atomic Research Centre, Mumbai 400085, India — [3]Homi Bhabha National Institute, Mumbai 400094, India

Honeycomb oxides are an intriguing class of materials characterised by low dimensionality and strong magnetic frustration, which leads to exotic quantum spin correlations. Here, we investigated a quasi-two-dimensional magnetic oxide Na2Co2TeO6, which exhibits several intriguing magnetic phases, including the zigzag antiferromagnetic interaction and Kitaev paramagnetic spin interactions. We explored the intricate relationship between these phases and phonons using temperature-dependent Raman measurements. Our findings reveal the signature of magnetoelastic coupling across the long-range and short-range magnetic ordering temperatures. Furthermore, Na2Co2TeO6, which has a non-centrosymmetric crystal structure, showcases ferroelectric order below 80 K. The evolution of Raman spectra reveals the presence of a ferroelectric order coupled phonon mode in Na2Co2TeO6 below this temperature.

MA 19.10 Tue 12:00 POT/0361

Characterizing entanglement at finite temperature: how does a paramagnet become a quantum spin liquid? — Snigdh Sabharwal[1,2], •Matthias Gohlke[1], Paul Skrzypczyk[2], and Nic Shannon[1] — [1]Okinawa Institute of Science and Technology, Onna, Japan — [2]H. H. Wills Physics Lab., University of Bristol, Bristol, UK

Quantum spin liquids (QSL) are generically many body entangled states of matter that form when quantum fluctuations meet the extensive ground state degeneracy of a classical spin liquid. Entanglement properties have enabled to characterise gapped QSL at zero temperature, however, much less is known about how quantum many body entanglement evolves at finite temperature.

Here, we use entanglement depth and genuine multipartite entanglement (GME) to study how entanglement and its local structure emerge when cooling a frustrated magnet from the high-temperature paramagnet down to the low-temperature QSL state. Within a case study on the Kitaev Honeycomb model, we obtain two characteristic bounds: (1) a lower bound on the upper temperature below which separability breaks and quantum entanglement must be present, while (2) a lower temperature scale is obtained when GME on plaquettes becomes finite signifying the coherent, structured entanglement that is characteristic for QSL ground states [1], i.e. the flux free state of the Kitaev spin liquid. We provide a framework to discuss the relevant temperature scales for QSL in frustrated magnets [2].

[1] L. Lyu, D. Chandorkar, et al., arXiv:2505.18124
[2] S. Sabharwal, M. Gohlke, et al., arXiv:2511.15144

MA 19.11 Tue 12:15 POT/0361

Fate of the Triangular Dirac spin liquid under an external magnetic field — •Sasank Budaraju[1,2], Josef Willsher[3], Federico Becca[4], Johannes Knolle[1,2], and Frank Pollmann[1,2] — [1]Technical University of Munich, TUM School of Natural Sciences, Physics Department, 85748 Garching, Germany — [2]Munich Center for Quantum Science and Technology (MCQST), Schellingstr. 4, 80799 München, Germany — [3]Max-Planck-Institut fur Physik komplexer Systeme, 01187 Dresden, Germany — [4]Dipartimento di Fisica, Universita di Trieste, Strada Costiera 11, I-34151 Trieste, Italy

We investigate the J1-J2 Heisenberg model under an external Zeeman field using the Variational Monte Carlo approach. Simple variational ansatzes are proposed for several candidate ordered states, and their energetics are compared on large clusters to obtain the phase diagram for small/moderate fields. For small J2, we capture a continuous transition from the Y to the "Up-Up-Down" (UUD) states as predicted by spin-wave theory. Additionally, around the highly frustrated region, we demonstrate that the ground state in the presence of a small field is a condensate of monopoles, which are gapless gauge excitations of the U (1) spin liquid. The monopole condensate is shown to be the ground state for a significant region of phase diagram, which we estimate using finite size numerics. Our results imply that the Dirac spin liquid is unstable to a condensation of monopoles in the presence of external fields.

MA 20: Altermagnets III

Time: Tuesday 14:00–15:30 Location: HSZ/0002

MA 20.1 Tue 14:00 HSZ/0002

Curvature-induced magnetization of altermagnetic films — •Kostiantyn Yershov[1,2], Volodymyr Kravchuk[1,2], and Jeroen van den Brink[1] — [1]Leibniz Institute for Solid State and Materials Research, 01069 Dresden, German — [2]Bogolyubov Institute for Theoretical Physics, 03143 Kyiv, Ukraine

Here we generalize the previously developed phenomenology of the d-wave altermagnetic films for the case of a curvilinear film bent in a stretching-free manner. We show that a stretching-free bending of a thin altermangnetic film with nonzero curvature gradients induces local magnetization that is approximately tangential to the film. The origin of curvature-induced magnetization is non-uniformity of the Neel vector distribution generated by the non-zero curvature gradients. The magnitude of the curvature-induced magnetization is determined by the curvature gradient and the direction of bending relative to the crystallographic axes. The maximal effect is achieved when bending is in the direction of maximum altermagnetic splitting in the magnon spectrum. For a periodically bent film of sinusoidal shape possesses a total magnetic moment per period $\propto A^2q^4$ where A and q are the bending amplitude and wave vector, respectively. The total magnetic moment is perpendicular to the plane of the unbent film and its direction (up or down) is determined by the bending direction.

MA 20.2 Tue 14:15 HSZ/0002

Strain controlled g -to d-wave transition in altermagnetic CrSb — Bennet Karetta[1], •Xanthe Verbeek[1], Rodrigo Jaeschke-Ubiergo[1], Libor Šmejkal[2,3,4], and Jairo Sinova[1,5] — [1]Insitut für Physik, Johannes Gutenberg-Universität Mainz, D-55099 Mainz, Germany — [2]Max-Planck-Institut für Physik Komplexer Systeme, Nöthnitzer Str. 38, 01187 Dresden, Germany — [3]Max-Planck-Institut für Chemische Physik Fester Stoffe, Nöthnitzer Str. 40, 01187 Dresden, Germany — [4]Institute of Physics, Academy of Sciences of the Czech Republic, Cukrovarnická 10, Prague 6, Czech Republic — [5]Department of Physics, Texas A&M University, College Station, Texas 77843-4242, USA

We demonstrate a strain-induced transition in the g-wave altermagnet CrSb, revealing how shear strain can tune spin symmetries and enable new responses. Focusing on the spin-splitter effect, which allows for pure spin currents but is forbidden in unstrained CrSb, we identify four shear-strain directions that lower the symmetry and enable spin conductivity. These strains induce three d-wave altermagnetic states and one uncompensated magnetic phase, each with distinct spin symmetries. Using both a minimal model and first-principles calculations, we confirm the emergence of these phases and show that their key features remain robust in the presence of spin-orbit coupling. We predict a spin-splitter effect of up to 5% under just 1% strain, showing that even small deformations can generate sizable spin-splitter currents. Our findings highlight strain as a precise and effective tool for controlling symmetry-driven spin phenomena in altermagnets.

MA 20.3 Tue 14:30 HSZ/0002

Designing non-relativistic spin-splitting in transition metal oxide bulk and heterostructures — •Subhadeep Bandyopadhyay and Rossitza Pentcheva — Department of Physics, University of Duisburg-Essen, Duisburg, Germany

Non-relativistic spin splitting (NRSS) of bands in collinear antiferromagnets is an exotic phenomenon, that has currently shifted in the focus, owing to the great potential for various spintronic applications. Studies showed that the inhomogeneous distribution of the real space magnetization density, originating from the ferroically ordered magnetic octupole moments[1] is the key to this exotic phenomenon, which stems from the global time reversal symmetry (TRS) breaking in antiferromagnets. In perovskite ABO_3 materials, we find an intriguing correlation between the antiferroic distortion patterns and the antiferromagnetic order, that breaks TRS to induce NRSS[2].

Here we explore how structural distortions and antiferromagnetism combine to induce NRSS in perovskites. Building on that insight, we demonstrate the recipe to design and control the NRSS. Beyond the bulk compounds, the discussion is extended to the perovskite heterostructures, where interface-driven structural distortions and modifications of the electronic properties are crucial.

1. S Bhowal and N A Spaldin, Phys. Rev. X 14, 011019 (2024)
2. S. Bandyopadhyay, S Picozzi, S Bhowal, Phys. Rev. B 112, 064405, (2025)

MA 20.4 Tue 14:45 HSZ/0002

hall viscosity of altermagnet — •iksu jang[1], rui aquino[2], rafael fernandes[3,4], and jörg schmalian[1,5] — [1]Institute for Theory of Condensed Matter, Karlsruhe Institute of Technology, Karlsruhe 76131, Germany — [2]ICTP, South American Institute for Fundamental Research Instituto de Física Teórica da UNESP, Universidade Estadual Paulista, Rua Doutor Bento Teobaldo Ferraz 271, 01140-070 São Paulo, Brasil — [3]Department of Physics, The Grainger College of Engineering, University of Illinois Urbana-Champaign, Urbana, Illinois 61801, USA — [4]Anthony J. Leggett Institute for Condensed Matter Theory, The Grainger College of Engineering, University of Illinois Urbana-Champaign, Urbana, Illinois 61801, USA — [5]Institute for Quantum Materials and Technologies, Karlsruhe Institute of Technology, Karlsruhe 76131, Germany

Altermagnets have garnered significant interest due to their ability to exhibit spin splitting without spin orbit coupling and their symmetry-driven phenomena, such as elastic quantum criticality and elasto-Hall responses. In this work, we investigate the Hall viscosity of altermagnets subject to strain. Using group-theoretical analysis and tight-binding calculations, we show that altermagnetic systems with various form factors can host a finite Hall viscosity. We additionally propose that the acoustic Faraday effect offers a viable route for its experimental detection.

MA 20.5 Tue 15:00 HSZ/0002

Dynamical orbital pumping in altermagnets — •Guidobeth Sáez-Toro[1], Mirco Sastges[2], Myunil Choi[3], Dongwook Go[3], and Yuriy Mokrousov[2] — [1]Departamento de Física, Facultad de Ciencias, Universidad de Chile, Santiago 7800024, Chile — [2]Peter Grünberg Institute (PGI-6), Forschungszentrum Jülich, 52425 Jülich, Germany — [3]Department of Physics, Korea University, Seoul 02841, Republic of Korea

Altermagnets constitute a recently recognized class of magnetic materials in which symmetry breaking between sublattices and orbital degrees of freedom gives rise to unconventional magnetic responses. A direct consequence of this symmetry structure is that time-dependent magnetization generates a purely orbital pumping mechanism, $\partial_t \langle \mathbf{L} \rangle_\alpha = \chi^L_{\alpha\beta} (\hat{\mathbf{m}} \times \partial_t \hat{\mathbf{m}})_\beta$, mediated by spin-orbit coupling. We investigate this effect by driving the Néel order in a minimal tight-binding model on a square altermagnetic lattice, based on an antiferromagnetic array of spins with an orbital crystal field breaking both C_4 rotational and sublattice exchange symmetries. Our results reveal a pronounced sublattice dependence of the orbital response, providing a clear microscopic distinction between antiferromagnetic and ferromagnetic configurations. Using the Bastin-Smrcka-Streda Kubo formula, we compute the full response tensor and show that orbital pumping naturally decomposes into two robust contributions, analogous to field-like and damping-like components. These findings establish orbital pumping as a distinctive dynamical signature of altermagnets and highlight its potential for next-generation orbitronic functionalities.

MA 20.6 Tue 15:15 HSZ/0002

Unique responses in odd-parity nodal p-wave magnets — •Atasi Chakraborty[1], Anna Birk Hellenes[1], Rodrigo Jaeschke Ubiergo[1], Tomas Jungwirth[2,3], Libor Šmejkal[2,4], and Jairo Sinova[1,5] — [1]Institut für Physik, Johannes Gutenberg Universität Mainz — [2]Institute of Physics, Academy of Sciences of the Czech Republic — [3]School of Physics and Astronomy, University of Nottingham — [4]Max Planck Institute for the Physics of Complex Systems,Dresden — [5]Department of Physics, Texas A & M University

The recent discovery of Altermagnetism – spin-split even-parity compensated magnets – highlights how spin symmetries can reveal exchange-driven phenomena that has previously been overlooked. Building on this insight, we explore spin symmetry criteria [1,3] to identify the odd-parity magnetic states in noncollinear systems, focusing on effects driven purely by exchange interactions, independent of spin-orbit coupling. In this talk, I will focus on the lowest-order (pwave) nodal odd-parity magnets, and discuss their characteristic responses [1, 2]. We show that these p-wave magnetic phases spontaneously break crystal symmetries, leading to pronounced exchange-mediated resistive anisotropy [1] and exhibit a large, purely non-relativistic, anisotropic out-of-plane charge-to-spin conversion [2], fundamentally distinct from the conventional Rashba-Edelstein effect.

1. Hellenes, Jungwirth, Ubiergo, Chakraborty, Sinova, Šmejkal, arXiv:2309.01607v3 (2020). 2. Chakraborty, Hellenes, Ubiergo, Jungwirth, Šmejkal, Sinova, Nature Communications 16, 7270 (2025). 3. Jungwirth, Fernandes, Sinova, Šmejkal, arXiv:2409.10034v1 (2024)

MA 21: Skyrmions II

Time: Tuesday 14:00–15:30 Location: HSZ/0004

MA 21.1 Tue 14:00 HSZ/0004

Real-Time Modeling of Skyrmion Dynamics in Arbitrary 2D Spatially Dependent Pinning Potential Landscapes — •Simon M. Fröhlich, Tobias Sparmann, Maarten A. Brems, Jan Rothörl, Fabian Kammerbauer, Klaus Raab, Sachin Krishnia, Mathias Kläui, and Peter Virnau — Institute of Physics, Johannes Gutenberg University Mainz

We investigate how non-flat pinning landscapes influence skyrmion dynamics and develop a quantitative framework that links experimental measurements to predictive simulations. Using real-time magneto-optical Kerr microscopy, we track skyrmion hopping and dynamics in a magnetic thin-film system and extract dwell times and transition statistics across pinning sites. This data is used to construct parameters for a coarse-grained Thiele model, for which we introduce a two-stage parameter identification procedure that directly maps experimental observables onto simulation units. This calibration resolves a key barrier to quantitative quasiparticle-level modeling by enabling reconstruction of pinning energies not directly accessible on experimental timescales. We validate the resulting simulation framework by predicting the density dependence of skyrmion diffusion and confirming it through long-time measurements. The approach provides a robust, simulation-ready description of the pinning landscape and establishes a pathway for predictive in-silico exploration of skyrmion dynamics and device concepts on experimentally relevant time and length scales.

MA 21.2 Tue 14:15 HSZ/0004

Theoretical study on excitation in anti-Skyrmion lattice — •László Udvardi, Mátyás Török, and László Szunyogh — Department of Theoretical Physics, Budapest University of Technology and Economic

Magnetic Skyrmions exhibit intriguing and novel phenomena due to their topologically non-trivial spin textures. Their exceptional stability makes them possible candidates for information carriers for future spintronic devices.

We have determined the parameters appearing in a classical spin model from first principle for $Pt_{95}Ir_{05}/Pd(111)$ overlayer. Optimizing the energy of the spin model several local minima have been identified as a Skyrmion with various topological charges. We demonstrate that the frustration of the isotropic exchange interactions is responsible for the creation of these various types of skyrmionic structures. Our study is focused on objects with topological charge of Q=1 anti-Skyrmion. Anti-skyrmions exhibit attractive inter-particle interaction and they have tendency to form clusters or skyrmionic lattice. The excitation spectrum of an anti-skyrmon lattice with various external magnetic field has been calculated. The low energy excitation responsible for the low temperature behavior of the system shows similarities to nematic liquid crystals.

MA 21.3 Tue 14:30 HSZ/0004

Skyrmion topological Hall effect in Ta/CoFeB/MgO at room temperature detected with Kerr microscopy — •Hauke Lars Heyen[1], Michael Vogel[2], Florian Gossing[2], Jakob Walowski[1], Jeffrey McCord[2], and Markus Münzenberg[1] — [1]Institute of Physics, University Greifswald, Germany — [2]Institute of Materials Science, Nanoscale Magnetic Materials and Magnetic Domains, CAU Kiel, Germany

The topological Hall effect is interesting for characterizing materials and their non-trivial spin structures. It arises from spin textures with a finite topological charge, such as skyrmions. In this work, we measured the topological Hall effect originating from topologically protected skyrmions in Ta/CoFeB/MgO single-layer films. Since the small topological Hall contribution appears on top of the dominating anoma-

lous Hall effect, its direct detection in this material system is challenging. Electrical Hall effect measurements contain both effects and to separate these, Kerr-microscopy (MOKE) measurements are carried out simultaneously to Hall effect measurements. We further verify the results with thermal and electrical transport measurements to calculate a topological quantity that contains the topological Nernst and Hall effect respectively. Those measurements are conducted using the experimental scheme introduced in [1].

[1] R. Schlitz et al. All Electrical Access to Topological Transport Features in Mn1.8PtSn Films. Nano Letters, 19(4):2366-2370, March 2019.

MA 21.4 Tue 14:45 HSZ/0004

Optimization of magnetic skyrmion diffusion in thin films — •Alen John[1,2], Maria Andromachi Syskaki[1], Jürgen Langer[1], Gerhard Jakob[2], and Mathias Kläui[2] — [1]Singulus Technologies AG, 63796 Kahl am Main, Germany — [2]Institute of Physics, Johannes Gutenberg University Mainz, 55128 Mainz, Germany

Topological magnetic solitons, particularly skyrmions, have garnered significant interest for their potential in unconventional computing and sensing applications. In this work, we outline an optimized fabrication strategy for generating and stabilizing low-pinning magnetic skyrmions in magnetic thin films using magnetron sputtering. We focus on Ta/CoFeB/MgO heterostructures with perpendicular magnetic anisotropy and systematically vary key deposition parameters including sputter power and Ar pressure to optimize skyrmion formation. Furthermore, we incorporate an ultrathin Ta dusting layer at the CoFeB/MgO interface to precisely tune the interfacial anisotropy. This combined approach enables the realization of ultralow-pinning thin-film systems that reliably host room-temperature, thermally diffusing skyrmions. Such samples represent a promising platform for emerging applications in unconventional computing paradigms, including reservoir computing[1].

[1] J. Zázvorka et al., Nat. Nanotechnol. 14, 658 (2019)

MA 21.5 Tue 15:00 HSZ/0004

Impact of higher-order exchange on the lifetime of skyrmions and antiskyrmions — Hendrik Schrautzer[1], Moritz Goerzen[2,3], •Bjarne Beyer[3], Pavel Bessarab[1,4], Soumyajyoti Haldar[3], and Stefan Heinze[3,5] — [1]Science Institute and Faculty of Physical Sciences, University of Iceland, Reykjavik, Iceland — [2]CEMES, Université de Toulouse, CNRS, Toulouse, France — [3]Institute of Theoretical Physics and Astrophysics, University of Kiel, Germany — [4]Department of Physics and Electrical Engineering, Linnaeus University, Kalmar, Sweden — [5]Kiel Nano, Surface, and Interface Science (KiNSIS), University of Kiel, Germany

Reliable control of skyrmion lifetime is essential for realizing spintronic devices, yet the role of higher-order interactions (HOI) – which can lead to skyrmion stabilization – remains largely unexplored. Here we calculate lifetimes of isolated skyrmions and antiskyrmions at transition-metal interfaces based on an atomistic spin model that includes fourth-order exchange [1]. Within harmonic transition-state theory, we evaluate both energetic and entropic contributions and find substantially enhanced lifetimes when HOI are included. The four-spin four-site interaction raises the energy barrier and lowers the curvature of the energy landscape in the vicinity of the collapse saddle point, increasing the pre-exponential factor of the arrhenius Law. Further HOI allow thermally stable skyrmions and antiskyrmions even in absence of Dzyaloshinskii-Moriya interaction, interesting in the context of 2D van der Waals magnets lacking inversion symmetry.

[1] H. Schrautzer *et al.*, arxiv:2511.05278 (2025).

MA 21.6 Tue 15:15 HSZ/0004

Real-time observation of topological defect dynamics mediating two-dimensional skyrmion lattice melting — Raphael Gruber[1], •Edoardo Mangini[1], Maria-Andromachi Syskaki[1], Elizabeth Jefremovas[1], Sachin Krishnia[1], Asle Sudbø[2], Peter Virnau[2], and Mathias Kläui[1] — [1]Institute of Physics, Johannes Gutenberg University, Staudingerweg 7, Mainz, Germany — [2]Center for Quantum Spintronics, Department of Physics, Norwegian University of Science and Technology, Trondheim, Norway

Magnetic skyrmions, topologically non-trivial chiral magnetic quasiparticles, can be stabilized in magnetic thin-film stacks [1]. By precisely controlling the externally applied in-plane and out-of-plane magnetic fields, two-dimensional dense arrays of skyrmions—so-called skyrmion lattices—can be formed [2]. Through suitable geometrical confinement, both orientational and translational order can be induced in these lattices. Such systems provide experimental insight into the dynamics of phase transitions in two-dimensional particle systems.

In this work, we show a two-step topological lattice-melting experiment, in which phase transitions are triggered in a skyrmion lattice by tuning the skyrmion size. The Kerr microscopy setup, in conjunction with machine learning approaches, enables real-time tracking of skyrmions, allowing us to investigate the emergence and dynamics of topological lattice defects throughout the phase transitions [3].

[1] K. Everschor-Sitte et al., J. Appl. Phys. 124, 24, 2018
[2] J. Zázvorka et al., Adv. Funct. Mater. 30, 46, 2020
[3] R. Gruber et al., Nat. Nanotechnol. 20, 10, 2025

MA 22: Focus Session: Materials Discovery II – High throughput searches for functional magnetic materials (joint session FM/MA)

chairs: Jan Schultheiß (Norwegian University of Science and Technology, NO), Hiroki Taniguchi (Nagoya University, JP)

Discovering new functional materials is crucial to advance today's technologies, ranging from caloric cooling via catalysis to next-generation energy conversion and storage, such as thermoelectric, ferroelectric, and ionic conductor materials. New materials also form the basis for potential applications in quantum information technologies. This session provides a platform to highlight functional materials discoveries and how they come about. Notably, systematic searches with high-throughput synthesis approaches, as well as predictions from materials informatics, have helped to go beyond serendipitous discoveries in recent years. However, intuition guided by general principles remains an important factor. In this session, we particularly welcome contributions that showcase the discovery of new functional materials with original approaches. Diverse material systems - from well-established to emerging and niche classes across condensed-matter and materials physics - will be featured. Bringing together diverse discoveries in a single session will help delineate general principles and inspire future work.

Time: Tuesday 14:00–15:30 Location: BEY/0138

Invited Talk MA 22.1 Tue 14:00 BEY/0138

Thin film combinatorial studies of functional magnetic materials — •Nora Dempsey — Institut NEEL, CNRS/UGA, Grenoble, France

Combinatorial studies based on the preparation and characterisation of compositionally graded thin films are being used for the screening and optimization of a range of functional materials [1]. When combined with Machine Learning (ML), such high-throughput film-based studies hold much potential to guide data driven design of new materials [2,3]. In this talk I will outline our work at Institut Néel on high throughput fabrication and characterisation of functional magnetic materials as well as our recent developments concerning data handling and analysis. I will then show examples from on-going studies of the effect of composition and fabrication conditions on both structural and magnetic properties of hard magnetic and magnetocaloric materials. I will finish up by briefly outlining preliminary results from ML-driven data analysis for the accelerated development of functional magnetic materials with reduced dependence on critical elements, carried out in the framework of various collaborations. [1] ML Green et al., J. Appl. Phys. 113 (2013) 231101 [2] A.G. Kusne et al. Sci. Rep. 4 (2014) 6367 [3] A. Ludwig, npj Comput. Mater. 5 (2019) 70

MA 22.2 Tue 14:30 BEY/0138

Potentially magnetic platinum oxides obtained by computationally guided high-pressure synthesis — •Yasuhito Kobayashi[1], Akitoshi Nakano[2], Shunsuke Kitou[3], Tomasz Klimczuk[4], Hidefumi Takahashi[1,5], and Shintaro Ishiwata[1,5] — [1]Division of Materials Physics, The University of Osaka, Japan — [2]Department of Physics, Nagoya University, Japan — [3]Department of Advanced Materials Science, The University of Tokyo, Japan — [4]Advanced Materials Center, Gdansk University of Technology, Poland — [5]Institute for Open and Transdisciplinary Research Initiatives, The University of Osaka, Japan

The exploration of Pt-based oxides has remained significantly limited, primarily due to the high chemical inertness of platinum and the typically nonmagnetic d^6 or d^8 electronic configurations. Here, we report the discovery of a new layered homologous series of Pt-based ternary oxides, $Na(PtO_2)_{2n+1}$ (n = 1, 2), synthesized through a combination of highly oxidizing high-pressure techniques and density functional theory (DFT) calculations. This series features unprecedented layered structural motifs composed of rutile-based PtO_6 octahedra and one-dimensional PtO_4 square-planar chains, distinct from the perovskite-based Ruddlesden-Popper oxides. We discuss the possibility that this layered homologous series represents the first realization of a magnetic Mott insulator within Pt-based oxides, where $NaPt_3O_6$ (n = 1) exhibits localized spin behavior with an effective spin $S = 1/2$, likely arising from the unusual d^7 electronic configuration of square-planar Pt^{3+} along with one-dimensional antiferromagnetic interactions.

MA 22.3 Tue 14:45 BEY/0138

Magnetism and electrical and thermal transport in the natural $Fe_{1-x}Mn_xWO_4$ (x=0.2) mineral from Potosí, Bolivia — •Skachko Dmytro[1], Bohdan Kundys[2], Volodymyr Levytskyi[1], Esteban Zuñiga-Puelles[1], Andreas Leithe-Jasper[3], and Roman Gumeniuk[1] — [1]Institut für Experimentelle Physik, TU Bergakademie Freiberg, 09596 Freiberg, Germany — [2]Université de Strasbourg, CNRS, Institut de Physique et Chimie des Matériaux de Strasbourg, UMR 7504, Strasbourg F-67000, France — [3]Max-Planck-Institut für Chemische Physik fester Stoffe, 01187 Dresden, Germany

The natural ferberite single crystal of $Fe_{0.8}Mn_{0.2}WO_4$ composition with the monoclinic $NiWO_4$-type structure ($P2/c$) [a = 4.74751(6) Å, b = 5.71335(7) Å, c = 4.96847(5) Å, β = 90.15(1)°] reveals multiple magnetic transitions at T_{N1} = 67(1) K, T_{N2} = 28(3) K, T_{N1}^{cp} = 66(1) K and T_{N2}^{cp} = 8(1) K. The reduced magnetic entropy of ≈ Rln3 observed near T_{N1} indicates the simplified LS-coupling scheme to fail in the description of complex magnetic behavior of the studied ferberite. The temperature dependence of electrical resistivity [$\rho(T)$] shows a semiconducting exponential decay saturating at ≈ 300 K. The activation energy of the decay is found to be ≈310 meV. Temperature dependence of thermal conductivity [$\kappa(T)$] is characterized by a well defined maximum at ≈68 K, which is described by the Debye-Callaway model, pointing to the dominance of phonon scattering on defects and *umklapp* processes. Despite revealing relatively low $\kappa(T)$ and high Seebeck coefficient $Fe_{0.8}Mn_{0.2}WO_4$ is rather poor thermoelectric material because of enhanced $\rho(T)$.

MA 22.4 Tue 15:00 BEY/0138

Ab initio-based phase diagrams for compositionally complex ThMn12-type alloys — •Sourabh Kumar[1], Semih Ener[2], and Tilmann Hickel[1] — [1]Bundesanstalt für Materialforschung und -prüfung, 12489 Berlin — [2]Technische Universität Darmstadt, 64289 Darmstadt

The structural and chemical stability of rare-earth-based transition-metal (such as Nb, Ce, and Sm) alloys is critical in determining the performance of modern hard magnets (HMs), particularly their coercivity and thermal robustness. This study examines the intrinsic phase competition in (Sm/Ce)-(Fe/Co)-Ti systems, focusing on how Ti additions influence the thermodynamic stability of high-temperature HMs. Two compositional pathways were examined: one dominated by Sm/Ce-Fe/Co binary chemistry and the other influenced by (Sm/Ce)-(Fe/Co)-Ti ternary interactions. We employed ab initio calculations to investigate the finite-temperature stability of ordered, disordered, and metastable phases, thereby guiding experiments. Based on the computed energetics, we analyzed how Ti incorporation alters local bonding environments and stabilizes magnetically desirable motifs. Furthermore, we constructed an ab initio phase diagram to reveal the interplay between rare-earth metals and transition metals across a broad temperature range. We have revealed that Ti addition promotes the formation of a more robust Sm-rich phase by strengthening the local Sm-Fe-Ti matrix. This stabilization enhances alloy coercivity and provides insights into the thermodynamic and chemical factors driving phase evolution, enabling the design of better permanent HMs.

MA 22.5 Tue 15:15 BEY/0138

Molecular orbital degeneracy lifting in NbSeI — •Keita Kojima[1], Hayato Takano[1], Youichi Yamakawa[2], Shunsuke Kitou[3], Ryutaro Okuma[1], and Yoshihiko Okamoto[1] — [1]Institute for Solid State Physics, University of Tokyo, Kashiwa 277-8581, Japan — [2]Department of Physics, Nagoya University, Nagoya 464-8602, Japan — [3]Department of Advanced Materials Science, University of Tokyo, Kashiwa 277-8581, Japan

The breathing pyrochlore lattice, composed of alternating small and large tetrahedra, hosts molecular orbitals within the smaller tetrahedra that strongly influences its physical properties. Such molecular-orbital and frustration-driven effects have led to diverse electronic states in related compounds. We investigated NbSeI, a MoSBr-type material with a particularly large breathing distortion whose physical properties remain unexplored despite previous synthesis reports. We synthesized single crystals and conducted x-ray diffraction, physical property measurements, and first-principles calculations. While the calculations predict metallic flat bands originating from Nb 4d orbitals, magnetic and transport measurements reveal a nonmagnetic insulating state below 300 K. NbSeI also undergoes a structural transition at Ts = 106 K. Our structural studies demonstrate local atomic displacements above Ts and a trimer-like molecular transformation below Ts. Our results show that the combination of strong breathing distortion and flat-band*derived electronic structure stabilizes molecular-orbital degrees of freedom, advancing orbital physics beyond single-ion descriptions toward cluster-based electronic phenomena.

MA 23: Cooperative Phenomena: Spin Structures and Magnetic Phase Transitions (joint session MA/TT)

Time: Tuesday 14:00–15:30 Location: POT/0151

MA 23.1 Tue 14:00 POT/0151

Stochastic Simulation of Phase Transitions in the Dissipative 2D XYZ-Model — •Franz Pöschl[1,2,3], Przemyslaw Zielinski[1,2,3], Xin Zhang[1,2,3], and Peter Rabl[1,2,3] — [1]Technical University of Munich, TUM School of Nat- ural Sciences, Physics Department, 85748 Garching, Germany — [2]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany — [3]Munich Center for Quantum Science and Technology (MCQST), 80799 Munich, Germany

The simulation of large, open quantum spin systems is a hard problem and for most cases it is not possible to get exact solutions. Therefore, we use methods in the class of the Truncated Wigner Approximations to tackle this problem. In our work we investigated the hybrid discrete-continuous truncated Wigner approximation and used it to determine the phase diagram of the dissipative 2D XYZ-model. We were able to simulate systems with several thousands of spins due to the linear scaling of the method and numerical optimization of our code. Hence we were able to simulate the phase transitions of the model and also characterize the different phases in the open quantum system.

MA 23.2 Tue 14:15 POT/0151

Large magnetoreflectance and optical anisotropy due to 4f flat bands in the frustrated kagome magnet HoAgGe — •Felix Schilberth[1,2], Luke DeFreitas[3], Khan Zhao[4,5], Florian Le Mardelé[6], Ivan Mohelsky[6], Milan Orlita[6], Philipp Gegenwart[5], Hua Chen[3], István Kézsmárki[1], and Sándor Bordács[2] — [1]Experimentalphysik V, Unversity of Augsburg — [2]Department of Physics, BME Budapest — [3]Department of Physics, Colorado State University — [4]School of Physics, Beihang University — [5]Experimentalphysik VI, Unversity of Augsburg — [6]LNCMI, Université Grenoble Alpes

We report peculiar optical properties of the frustrated itinerant magnet HoAgGe, which exhibits multiple magnetically ordered states obeying the kagome spin-ice rule. The optical conductivity is higher for light polarization perpendicular to the kagome plane both for the free carrier response and the interband transitions. The latter have strong contributions from Ho 4f flat bands located near the Fermi level, as revealed by our *ab initio* calculations, explaining the unusual anisotropy of the optical properties and the pronounced temperature dependence of the interband transitions for out-of-plane light polarization. The key role of Ho 4f states is further supported by the large variation of the magneto-reflectivity, following the field dependence of the magnetization in contrast to that of the magnetotransport data. Such heavy-electron bands near the Fermi level offer an efficient way to control transport and optical properties and we show that their ultrafast magneto-optical response is susceptible to the magnetic order.

MA 23.3 Tue 14:30 POT/0151

Transition between critical antiferromagnetic phases in the J1-J2 spin chain — Adam McRoberts[1], •Chris Hooley[2], and Andrew Green[3] — [1]International Centre for Theoretical Physics, Trieste, Italy — [2]Coventry University, Coventry, United Kingdom — [3]University College London, London, United Kingdom

The J1-J2 spin chain is one of the canonical models of quantum magnetism, and has long been known to host a critical antiferromagnetic phase with power-law decay of spin correlations. We show that there are, in fact, two distinct critical antiferromagnetic phases, where the roles of the local dimer field and its dual field are interchanged: the 'Affleck-Haldane' phase near the Heisenberg point J2 = 0, where the dimer field that parametrises local singlet order is gapless and part of a joint O(4) Neel-singlet order parameter; and the 'Zirnbauer' phase which appears at sufficiently large ferromagnetic J2, where the dimer field is gapped out and its dual field - the instanton density of the O(3) Neel field - is critical instead. The phases are so-named because each realises one of the competing pictures for how the O(3) non-linear sigma model with a topological theta term renormalises to the su(2) level 1 Wess-Zumino-Witten model. We support these predictions with density matrix renormalisation group calculations.

MA 23.4 Tue 14:45 POT/0151

Field-induced transitions in the charge-ordered Kagome metal FeGe — •Lilian Prodan[1], Jeremy Sourd[2], Pavlo Khanenko[2], Yurii Skourski[2], Sergei Zherlitsyn[2], and István Kézsmárki[1] — [1]EPV, Institute of Physics, University of Augsburg - Augsburg, Germany — [2]HLD-EMFL, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

Kagome metals with strong electronic correlations have recently attracted significant interest as fertile platforms for emergent phenomena such as unconventional magnetism, topological transport, and symmetry-breaking instabilities. Among them, FeGe stands out due to its intriguing combination of noncollinear magnetism and charge ordering, making it a prime candidate for studying the coupling between spin, charge, and lattice degrees of freedom [1]. This compound orders antiferromagnetically below $\sim 410\ K$, develops a charge-density-wave state near $\sim 110\ K$, and forms a noncollinear spin structure below $\sim 60\ K$. To explore how these orders interact, we performed magnetization, sound-velocity, and magnetostriction measurements in static and pulsed magnetic fields up to 60 T. Our results reveal previously unreported transitions at high magnetic fields and allow us to construct an extended H-T phase diagram for FeGe. [1] X. Teng, et al., Nature **609**, 490-495 (2022).

MA 23.5 Tue 15:00 POT/0151

Successive field-induced phase transitions in the kagome magnet $ErMn_6Sn_6$ — •A. Kurtanidze[1,2], Sh. Yamamoto[1], K. Uhlirova[3], Y. Skourski[1], S. Zherlitsyn[1], J. Sourd[1], T. Herrmannsdörfer[1], E. Weschke[4], O. Prokhnenko[4], H. Nojiri[5], B. Eggert[6], A. Aubert[7], K. Kummer[8], K. Skokov[7], H. Wende[6], and J. Wosnitza[1,2] — [1]Hochfeld-Magnetlabor Dresden (HLD-EMFL), HZDR, Dresden, Germany — [2]Institut für Festkörper- und Materialphysik, TU Dresden, Germany — [3]Materials Growth and Measurement Laboratory (MGML), Charles University, Prague, Czech Republic — [4]Helmholtz-Zentrum Berlin für Materialien und Energie, BESSY II, Berlin, Germany — [5]Institute for Materials Research, Tohoku University, Sendai, Japan — [6]Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen, Germany — [7]Functional Materials, Material Science, TU Darmstadt, Germany — [8]ESRF, The European Synchrotron, Grenoble, France

The ternary stannides $R\mathrm{Mn_6Sn_6}$ (R = Sc, Y, Gd-Lu) with hexagonal $HfFe_6Ge_6$-type structure ($P6/mmm$) are a key platform for exploring coupled topological electronic and magnetic properties. We focused on single crystals of $ErMn_6Sn_6$ and observed successive field-induced phase transitions. Using element-specific x-ray magnetic circular and linear dichroism (XMCD/XMLD) measurements in pulsed magnetic fields up to 30 T, we revealed the microscopic nature of these transitions, supported by thermodynamic data. We discuss Er and Mn moment reorientations and their link to macroscopic results.

MA 23.6 Tue 15:15 POT/0151

Depinning by shaking of skyrmions by oscillating magnetic fields — •Rajendra Loke[1], Alla Bezvershenko[2], Petra Becker Bohaty[3], Achim Rosch[2], and Joachim Hemberger[1] — [1]II. Physikalisches Institut, University of Cologne, Zülpicher Str. 77, 50937 Cologne, Germany — [2]Institut for Theoretical Physics, University of Cologne , Zülpicher Str. 77, 50937 Cologne, Germany — [3]Institut for Geology und Mineralogy, University of Cologne , Zülpicher St. 49b, 50674 Cologne, Germanyy

Here we present our recent result on shaking the skyrmion lattice by oscillating transvers magnetic field. When a transvers field is applied in addition to the longitudinal external field, skyrmion strings try to align themselves parallel to the effective field. To do so, the tips of the skyrmion strings have to move large distances and thus have to overcome pinning forces before being able to follow the field lines. We employ linear and non-linear AC susceptometry as experimental probe. The signature of this pinning-depinning transition is observable as contribution to the magnetic susceptibility, to the magnetic loss, and as well in the higher harmonic susceptibility. According to theoretical predictions, due to the chiral nature of the material the depinning is connected to translational motion of the skyrmions.

[1] Jan Müller et al. PhysRevLett.119.137201 (2017) [2] Felix Rucker et al. arXiv: 2504.01133v1 [3] Nina del Ser et al. SciPost Phys. 15, 065 (2023).

MA 24: Weyl Semimetals (joint session MA/TT)

Time: Tuesday 14:00–15:30 Location: POT/0361

MA 24.1 Tue 14:00 POT/0361

Ferrimagnetism and the causes of discontinuous magnetic behavior in Kagome Weyl-semimetal Co3Sn2S2 — •Abdul-Vakhab Tcakaev[1], Benjamin Katter[1], Stefan Enzner[2], Eugen Weschke[3], Sebastian Wintz[3], Gohil S. Thakur[4], Michael Ruck[4], Giorgio Sangiovanni[2], and Vladimir Hinkov[1] — [1]Experimentelle Physik IV, Fakultät für Physik und Astronomie, Universität Würzburg, Am Hubland, D-97074 Würzburg, Germany — [2]Computational Quantum Materials, Fakultät für Physik und Astronomie, Universität Würzburg, Am Hubland, D-97074 Würzburg, Germany — [3]Helmholtz-Zentrum Berlin for Materials and Energy, Albert-Einstein-Straße 15, 12489 Berlin, Germany — [4]Technical University of Dresden, Helmholtzstr. 10 01069 Dresden

The Kagome Weyl semimetal Co3Sn2S2 shows puzzling magnetic anomalies that have been interpreted as hidden phase transitions. Combining element-specific XMCD, SQUID magnetometry, STXM, DFT, and inelastic neutron scattering, we establish a ferrimagnetic ground state in which Co moments are partially compensated by antiparallel Sn moments and stabilized by strong uniaxial magnetocrystalline anisotropy. Temperature-dependent XMCD and STXM show that the discontinuous drop of remanent magnetization on zero-field warming arises from abrupt domain nucleation controlled by demagnetization effects, rather than from an intrinsic change of the spin structure. This yields a consistent microscopic picture of the magnetism in Co3Sn2S2 relevant for its Weyl and anomalous Hall properties.

MA 24.2 Tue 14:15 POT/0361

High-field THz Probing of the Crossover between Weyl and Weyl-Kondo Physics in $Mn_{3+x}Sn_{1-x}$ — •Erik W. de Vos[1], Zekai Chen[1], Debankit Priyadarshi[1], Anusree V. Puleri[2], Uri Vool[2], Claudia Felser[2], Edouard Lesne[2], and Manfred Fiebig[1] — [1]Department of Materials, ETH Zurich, Zurich, Switzerland — [2]Max-Planck-Institute for Chemical Physics of Solids, Dresden, Germany

We present temperature-dependent high-field THz spectroscopy measurements on a substitution series of the noncollinear antiferromagnet $Mn_{3+x}Sn_{1-x}$. When the Mn substitution is increased from x=0 to x=0.5, $Mn_{3+x}Sn_{1-x}$ has been found to transition from a pure Weyl semimetal to a Weyl-Kondo insulator. This is accompanied by the emergence of a hybridization gap of 10.2 meV [1]. Our study uses high-field THz radiation to probe and drive the non-linear response of $Mn_{3+x}Sn_{1-x}$ through the onset of Kondo-driven correlations. Via this high-field resonant excitation, we directly probe the dynamic response across the transition from a Weyl semimetal to a Weyl-Kondo insulating state.

[1] Sci. Adv. 6, eabc1977 (2020)

MA 24.3 Tue 14:30 POT/0361

Peierls-induced topological Weyl semimetal in $PtBi_2$ — •Anders C. Mathisen[1], Stefanie S. Brinkman[1], Xin L. Tan[1], Øyvind Finnseth[1], Fabian Göhler[1], Chul-Hee Min[1], Jens Buck[2], Kai Rossnagel[2], Grisha Shipunov[3], Anna Isaeva[3], Jorge I. Facio[4], and Hendrik Bentmann[1] — [1]Center for Quantum Spintronics, Department of Physics, NTNU, Norway — [2]Kiel University & DESY, Germany — [3]Institute of Physics, University of Amsterdam, The Netherlands — [4]Instituto Balseiro, National University of Cuyo, Argentina

$PtBi_2$ is attracting interest because of its exotic electronic properties, including bulk Weyl nodes, Fermi-arc surface states, and unconventional surface superconductivity. The emergence of Weyl nodes in materials is commonly attributed to accidental crossings between nondegenerate valence and conduction bands, while little emphasis has been placed on the physical mechanisms that induce Weyl physics. Recent theory indicates that reduced translational symmetry in the Peierls-distorted crystal structure of $PtBi_2$ constitutes a mechanism for the formation of Weyl nodes [1]. In this talk, we will present an investigation of the bulk electronic structure of $PtBi_2$ using soft X-ray angle-resolved photoelectron spectroscopy. Based on an analysis of the spectral weight across wide regions in momentum space, we show how the Peierls-distortion in $PtBi_2$ promotes the formation of Weyl nodes.

[1] S. Palumbo *et al.*, Interplay between inversion and translation symmetries in trigonal $PtBi_2$. Phys. Rev. B **112**, 205125 (2025)

MA 24.4 Tue 14:45 POT/0361

Phonon-driven axial fields enable terahertz Kerr rotation in WTe2 — •Soma Dutta, Vishal Shokeen, Ruslan Chulkov, David Muradas Belinchón, M. Venkata Kamalakar, Oscar Grånäs, and Hermann Dürr — Department of Physics and Astronomy, Uppsala University, Box 516, 75120 Uppsala, Sweden

Weyl semimetals provide a platform for studying the coupling between lattice dynamics and topological electronic structure through the motion of Weyl nodes and their associated Berry curvature (see Sie et al., Nature 565, 61, 2019). Here we report the observation of terahertz-frequency Kerr rotation in the non-centrosymmetric Weyl semimetal WTe_2, generated in the absence of an external magnetic field. Using ultrafast pump-probe polarimetry, we identify coherent oscillations at 0.24 THz and 2.4 THz that originate from interlayer shear vibrations and optical phonon modes, respectively. The 0.24 THz shear mode exhibits maximum amplitude along the a-axis and is strongly suppressed along b, indicating an odd mirror-symmetry character. By modeling the strain-induced modification of the Weyl-node separation, we show that this shear phonon produces an axial vector potential whose sign depends on the direction of atomic displacement. Spatial gradients of this axial potential generate a pseudo-magnetic field with a sign structure that naturally accounts for the observed phase inversion. Our results provide direct evidence for phonon-driven axial electromagnetic fields in a Weyl semimetal and demonstrate a route for ultrafast control of topological optical responses through coherent lattice motion. *Ab initio* calculations will further clarify the Kerr response mechanism.

MA 24.5 Tue 15:00 POT/0361

Magnetoconductance in Chiral Topological Semimetals — •Ricardo Manuel Sousa Barbosa and Annika Johansson — Max Planck Institute of Microstructure Physics, Weinberg 2, 06120 Halle (Saale), Germany

Chiral topological semimetals [1] are a class of quantum materials whose crystal symmetries enforce multifold band crossings with nonzero topological charge, hosting symmetry-protected chiral fermionic quasiparticles, long surface Fermi arcs, and enhanced optical and transport responses. These Weyl semimetals [2] are three-dimensional materials that exhibit multiple Weyl nodes that act as point-like sources and sinks of Berry curvature in momentum space, and provide a condensed-matter realization of the chiral anomaly [3], a field-induced nonconservation of electrons associated with a given Weyl node, which manifests as a positive longitudinal magnetoconductance.

We investigate the magnetotransport properties of compounds in space group 198 [4], which host four- and six-fold degenerate Weyl nodes at the Γ and R points, respectively, with Chern numbers up to ± 4. Using a semiclassical approach, we compute the resulting magnetoconductance, enabling a detailed analysis of the unconventional electronic responses characteristic of these materials.

[1] N.B.M. Schröter *et al.*, Nature Physics **15**, 759-765 (2019); [2] M. Z. Hasan *et al.*, Annu. Rev. Condens. Matter Phys. **8**, 289-309 (2017); [3] F. Bladuini *et al.*, Nat. Commun. **15**, 6526 (2024) [4] D.A. Pshenay-Severin *et al.*, J. Phys.: Condens. Matter **30**, 135501 (2018)

MA 24.6 Tue 15:15 POT/0361

Giant Anomalous Hall Effect Tuned by Atomic Order in Fe3Pt — •Yibo Wang and Enke Liu — Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China

The Berry curvature induced anomalous Hall effect (AHE) has attracted considerable interest in recent years [1,2]. In Fe3Pt, a nodal line situated near the Fermi level generates a pronounced Berry curvature hotspot [3], giving rise to an intrinsic anomalous Hall conductivity (AHC) of 1250 S/cm according to our measurement. Building on this large intrinsic contribution, we sought to enhance the total AHE by deliberately increasing the extrinsic AHC through control of atomic ordering. By annealing Fe3Pt samples at various temperatures and for different durations, we were able to tune the extrinsic AHC continuously from nearly 0 S/cm up to 550 S/cm. The most striking result was obtained for a specimen that was annealed for ten days; at 2 K this sample exhibited a total AHC of 1892 S/cm. This value is a significant value among magnetic topological materials and represents a 50 % increase over the intrinsic contribution alone. These findings confirm the success of the proposed strategy: leveraging a substantial intrinsic Berry curvature AHC and subsequently amplifying the total AHC through extrinsic AHC through mechanisms such as atomic engineering. The approach provides a practical pathway for achieving exceptionally large anomalous Hall responses in magnetic topological systems. [1]Nat. Phys. 14, 1125-1131 (2018). [2] Nat. Phys. 14, 1119-1124 (2018). [3] Adv. Mater. 35, 2301339 (2023).

MA 25: Focus Session: Chiral phonons and crystals coupled to magnetic order I

Conventional magnetism arises from electron spin and orbital angular momentum, forming the basis of spintronics and orbitronics. Recent advances, however, have revealed that magnetism is also intimately linked to the chirality and angular momentum of the crystal lattice itself, often mediated by circular lattice vibrations known as chiral or axial phonons. These discoveries have uncovered novel mechanisms of spin and phonon transport and enabled direct access to phonon chirality and angular momentum as fundamental physical quantities. These developments prompt a re-examination of angular momentum coupling in solids, including well-established phenomena such as the Einstein-de Haas and Barnett effects, as well as the role of phonon angular momentum in the equilibrium state of magnetic materials. Chiral and axial phonons emerge as a powerful new platform for controlling magnetic order and dynamics, bridging lattice, spin, and angular momentum physics. This focus session aims to highlight recent breakthroughs in phonon angular momentum and magnetism and to connect the rapidly expanding field of chiral phononics with the broader magnetism community, spanning both experimental and theoretical perspectives.

As part of this focus session, we offer an excursion to the high-field THz user facilities at HZDR with an introduction to the planned Dresden Advanced Light Infrastructure (DALI). See MA 32 for details.

Organizers: Dominik Juraschek, d.m.juraschek@tue.nl; Michael Fechner, michael.fechner@mpsd.mpg.de; Sebastian Maehrlein, s.maehrlein@hzdr.de

Time: Wednesday 9:30–12:45 Location: HSZ/0002

Invited Talk MA 25.1 Wed 9:30 HSZ/0002
Coherent phononic control of chirality — •Michael Först — Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany

Chirality is a pervasive property of matter that underpins many important phenomena across physics, chemistry and biology. Given its broad significance, the development of protocols for rational control of chirality in solid state systems is highly desirable, especially if this effect can be tuned continuously and in two directions.

I will show that coherent optical excitation of the crystal lattice at terahertz frequencies can induce chirality in the non-chiral solid BPO_4. By resonantly driving one of two orthogonal, doubly degenerate phonon modes and exploiting their nonlinear coupling to symmetry-lowering lattice distortions, chiral structures of either handedness can be selectively created. These findings offer new prospects for controlling of out-of-equilibrium phenomena in complex materials.

Invited Talk MA 25.2 Wed 10:00 HSZ/0002
Towards a modern theory of chiralization (and can chiral phonons help us get there?) — •Nicola Spaldin — Materials Theory, ETH Zürich, Switzerland

The goal of this talk is to answer the question: Given two chiral crystals, which one is the most chiral? In order to compare the amount of chirality, we propose the concept of "chiralization", representing the amount of chiral moment per unit volume, as a bulk macroscopic thermodynamic quantity, analogous to magnetization or polarization. Such a quantity will allow us to identify the conjugate field for chirality, classify achiral to ferrochiral phase transitions in terms of an appropriate order parameter, determine the multipole(s) associated with chirality, and predict phenomena in chiral materials. We begin by analyzing ferroaxial materials, which are protochiral, in the sense that they have a symmetry-lowering structural phase transition that breaks mirrors but preserves inversion, and are often characterized by rotations of sub-units around an axis yielding domains of opposite handedness. We show that the electric toroidal dipole, calculated as the cross product of the spin and orbital angular momenta, is a suitable order parameter for ferroaxial phase transitions. We outline the difficulties in extending the physics of ferroaxial materials to ferrochiral materials, and indicate how our emerging understanding of chiral phonons might help.

MA 25.3 Wed 10:30 HSZ/0002
Coherent Transfer of Pseudo- and Real Angular Momentum via Lattice Anharmonicity — •Olga Minakova[1], Carolina Paiva[2], Maximilian Frenzel[1], Michael Spencer[1], Joanna Urban[1], Martin Wolf[1], Dominik Juraschek[2,3], and Sebastian Maehrlein[1,4,5] — [1]FHI Berlin — [2]Tel Aviv U. — [3]TU Eindhoven — [4]HZDR — [5]TU Dresden

Rotational symmetry in crystals enforces conservation of phonon pseudo-angular momentum. However, direct evidence for angular momentum transfer between phonon modes has been lacking. We demonstrate coherent angular momentum transfer between doubly degenerate phonons through a resonant three-phonon interaction [1]. Circularly polarized THz pulses drive an IR-active phonon in Bi2Se3, imprinting the helicity of the field and generating ionic loops possessing real angular momentum. Anharmonic coupling then upconverts two such IR phonons into a Raman-active phonon at twice the frequency, transferring energy, linear momentum, and angular momentum. The THz-driven Kerr effect directly resolves the Raman phonon trajectory, revealing a helicity reversal, which perfectly fulfills pseudo-angular momentum conservation in the discrete C3 rotational symmetry of the lattice. Group theory analysis and DFT confirm this helicity flip and simultaneously reveal transfer of real angular momentum as circular ionic motion. These results constitute the first direct experimental evidence of angular momentum conservation in phonon-phonon interactions.

[1] O. Minakova et. al., arXiv:2503.11626 (2025)

MA 25.4 Wed 10:45 HSZ/0002
Rotational Umklapp scattering in chiral nonlinear phononics — •Yu-Chi Huang[1], Carolina Paiva[2], and Dominik Juraschek[1] — [1]Eindhoven University of Technology, Eindhoven, Netherlands — [2]Tel Aviv University, Tel Aviv, Israel

Chiral phonons, circularly polarized lattice vibrations propagating perpendicular to their rotational plane, commonly arise in chiral materials and have attracted considerable attention in condensed matter physics lately. Due to n-fold rotational crystal symmetry, they enable rotational phonon-phonon Umklapp scattering through nonlinear phonon coupling. This process is the angular-momentum analog of the conventional Umklapp scattering conserving linear crystal momentum. Recent pump-probe experiments have measured the effect in Bi_2Se_3, and we here develop a general theory using α-quartz (α-SiO_2) as an example. Our results offer insight into the fundamentals of angular momentum conservation in solids.

15 min break

Invited Talk MA 25.5 Wed 11:15 HSZ/0002

Observation and control of chiral phonons in non-centrosymmetric materials — •Hiroki Ueda — Paul Scherrer Institute, Villigen, Switzerland

The field of chiral phonons has rapidly grown with the emergence of various intriguing phenomena, including magnetism, transport, and light-matter interactions. Chiral phonons are rotational phonon modes propagating out of the rotational plane, breaking improper rotational symmetry. I will present direct demonstrations of chiral phonons in chiral crystal α-SiO2 and polar crystals LiNbO3 and BaTiO3 using resonant inelastic X-ray scattering (RIXS) with circularly polarized X-rays. Angular momentum transfer between circularly polarized photons and chiral phonons imposes the selection rule in the RIXS process, enabling observation of chiral phonons through circular dichroism in phonon excitation peaks. Furthermore, in BaTiO3, we demonstrate in situ electrical switching of phonon chirality, opening pathways for dynamic control of chiral phononic properties.

MA 25.6 Wed 11:45 HSZ/0002

Associated magnetism of circular ionic motion probed with ultrafast x-ray pulses — •Clifford Allington[1], Matthew Lutz[2], E. Ho[2], F. Graf[3], M. Basini[3], H. Ueda[2], A. Elliot[2], M. Biggs[2], R. Finn[2], S-W Huang[1], M. Grimes[1], M. Henstridge[4], M. Hoffmann[4], R. Alonso-Mori[4], D. Zhu[4], Q. Nguyen[4], V. Esposito[4], T. Sato[4], E. Skoropota[1], E. Paris[1], A. Camps[1], E. Razzoli[1], R. Mankowsky[1], F. Capotondi[5], N. Jaouen[6], M. Radovic[1], M. Savoini[1,3], E. Abreu[3], S. Johnson[1,3], Jeremy Johnson[2], and Urs Staub[1] — [1]Paul Scherrer Institute — [2]Brigham Young University — [3]ETH Zurich — [4]SLAC National Accelerator Laboratory — [5]Elettra Sincrotrone Trieste — [6]Synchrotron SOLEIL

It has been proposed that the coherent circular motion of ions creates a magnetic field. This effect, termed dynamical multiferroicity (DM), has been evidenced experimentally in diamagnetic materials such as SrTiO3 using circular terahertz (THz)-pump optical-probe methodologies. However, the fields reported are much larger than predicted, raising questions on the exact nature of the transient state. Thus, we performed a suite of circular THz-pump experiments on the paramagnetic EuTiO3, a material directly analogous to SrTiO3 but with a $S = 7/2$ spin on the Eu2+ ion. We have measured the circular motion of ions by femtosecond x-ray diffraction as well as an optical-probe signal which changes sign upon changing the helicity of the THz-pump, consistent with DM. However, no induced Eu2+ moment was found within the resolution of time-resolved x-ray magnetic circular dichroism, providing a quantitative upper limit on the resulting field.

MA 25.7 Wed 12:00 HSZ/0002

Real-time laser-driven (chiral) phonon dynamics from atomistic simulations — •Mike Pols and Nicola A. Spaldin — Materials Theory, ETH Zürich, Zürich, CH-8093, Switzerland

I will present an approach to simulate the real-time dynamics of excited phonons in materials. Using machine-learning interatomic potentials (MLIPs) together with laser-driven molecular dynamics simulations, we can capture the response of materials to driven (chiral) phonon excitations and directly capture their nonlinear vibrational dynamics. Driving phonon modes into the nonlinear regime can induce a wide range of material properties, such as strain and magnetism [1]. While first-principles modeling has provided valuable insights into these dynamics, the commonly used coupled-oscillator method requires the computation of numerous higher-order coupling coefficients [2], limiting its scalability.

Our MLIP-based approach enables the direct simulation of the full anharmonic lattice response. It effectively models both IR- and Raman-active modes, with finite-temperature effects, and the nonlinear couplings to high orders. Using this method, we explore the vibrational dynamics of linear and chiral phonons in oxide perovskites, enabling predictive simulations of the behavior and coupling of phonons in functional materials.

[1] A. Disa et al., Nat. Phys. 17, 1087 (2021).
[2] A. Subedi et al., Phys. Rev. B 89, 220301 (2014).

MA 25.8 Wed 12:15 HSZ/0002

THz field-induced magnetic-like response in the quantum paraelectric diamagnet $KTaO_3$ — •Christelle Kadlec[1], Filip Kadlec[1], Dalibor Repček[1], Martina Basini[2], Petr Kužel[1], Jan-Christoph Deinert[3], Sergey Kovalev[3], Mattia Udina[4], Igor Ilyakov[3], Alexey Ponomaryov[3], and Stanislav Kamba[1] — [1]Institute of Physics, Prague, Czechia — [2]ETH Zurich, Switzerland — [3]HZDR, Dresden, Germany — [4]CESQ-ISIS, Strasbourg, France

The current efforts on developing new ways of data manipulation are aimed at ultrafast control of magnetization in magnetic materials, as well as at inducing magnetic moments in diamagnetics. We demonstrate that in the diamagnetic quantum paraelectric $KTaO_3$, the electric field of circularly polarized THz pulses with an amplitude of 300 kV/cm induces a transient magnetic-like response by resonantly pumping its degenerate soft phonon. The transient phonon-mediated magnetic-like response was measured via the rotation of the polarisation of a probe light. However, such response usually contains contributions from both the magneto-optic THz-field-induced Faraday effect and the electro-optic THz-field-induced Kerr effect (TKE). In order to distinguish between them, we separately measured the TKE by applying a linearly polarized THz pump beam. Moreover, we present a theoretical analysis of the TKE, showing that its contribution can be suppressed by subtracting the experimental data generated by opposite elliptically polarized THz radiation. Thus, we are able to unambiguously identify a magnetic-like behavior of the $KTaO_3$ crystal manifested by the extracted Faraday rotation.

MA 25.9 Wed 12:30 HSZ/0002

Phonon-induced chirality — •Dominik Juraschek — Eindhoven University of Technology, Eindhoven, Netherlands

Controlling and utilizing solid-state chirality is a central challenge in condensed matter physics, because it does not couple to applied magnetic or electric fields, in contrast to magnetism and ferroelectricity. In this talk I show that geometric chiral phonons, lattice vibrations whose instantaneous atomic displacements break inversion and mirror symmetries, can transiently drive an achiral crystal into a chiral state. Using group-theoretical analysis, we identified selection rules for phonon-induced geometric chirality across all 32 point groups and demonstrate that ultrashort mid-infrared and terahertz pulses can excite pairs of IR-active phonons whose nonlinear coupling rectifies a geometric chiral phonon. I further demonstrate that chiral order exhibits fundamental excitations which we term “chiralons,” similar to the recently discovered ferrons in ferroelectric order. Our results highlight an emerging functionality of chiral phononics beyond phonon angular momentum.

MA 26: Focus Session: Nickelate Superconductivity: Insights into Unconventional Pairing and Correlation Effects I (joint session TT/DS/MA)

Nickel, a direct neighbor of copper in the periodic table, has been considered a promising candidate for high-temperature superconductivity since the early 1990s. After more than three decades of research, this prediction was confirmed with the discovery of superconductivity in nickelates, marking the beginning of the "nickel age" of superconductivity. Recent advances include Sm-based infinite-layer nickelates with transition temperatures approaching 40 K, as well as bilayer nickelates exhibiting superconductivity above 90 K under pressure and up to 60 K under compressive epitaxial strain. These results highlight the crucial roles of structural engineering, epitaxial strain, and precise synthesis control, and they open new frontiers for both fundamental understanding and materials design. This focus session aims to define key scientific challenges ahead, strengthen collaboration within Germany and Europe, and accelerate progress toward higher superconducting transition temperatures.

Coordinators: Marta Gibert (TU Wien), Mattias Hepting (MPI FKF Stuttgart), Ilya M. Eremin (Ruhr-University Bochum)

Time: Wednesday 9:30–12:45 Location: HSZ/0003

Topical Talk MA 26.1 Wed 9:30 HSZ/0003

Unconventional Superconductivity in Infinite-layer Samarium Nickelates — •Danfeng Li — City University of Hong Kong, Kowloon, Hong Kong SAR, China

Infinite-layer nickelates have emerged as a frontier platform for studying unconventional superconductivity beyond the cuprates. In this talk, I will present our recent advances on samarium-based infinite-layer nickelate thin films, which exhibit enhanced superconductivity and a mixed two- and three-dimensional superconducting character arising from strong coupling between rare-earth $5d$ and Ni $3d$ orbitals. I will further highlight our discovery of robust field-induced re-entrant superconductivity in heavily Eu-doped $Sm_{0.95-x}Ca_{0.05}Eu_xNiO_2$, where superconductivity suppressed at low fields re-emerges above 6 T and persists to 45 T. This exotic high-field state results from the interplay between NiO-plane superconductivity and Eu^{2+}-sublattice ferromagnetism, revealing a unique coexistence of magnetism and superconductivity within a single material system. These findings demonstrate how rare-earth-site engineering and magnetic-field tuning provide powerful routes for realising and manipulating high-temperature ferromagnetic superconductivity.

[1] M. Yang, H. Wang, J. Tang, J. Luo et al., arXiv:2503.18346 (2025).
[2] M. Yang, J. Tang, X. Wu, H. Wang et al., arXiv:2508.14666 (2025).

Topical Talk MA 26.2 Wed 10:00 HSZ/0003

Recent insights into infinite-layer nickelate heterostructures from x-ray spectroscopy — •Eva Benckiser — Max Planck Institute for Solid State Research, Stuttgart, Germany

Nickelates have emerged as an important class of materials for studying unconventional superconductivity. However, the exact cation concentrations and oxygen stoichiometry in infinite-layer nickelates are difficult to determine due to the complex synthesis process. This has so far prevented the clear experimental identification of the nickel valence electron configuration in the superconducting phase.

In my talk, I will discuss our recent x-ray spectroscopy studies on $NdNiO_x$-$SrTiO_3$ heterostructures [1] and $PrNiO_x$ thin films [2] at various intermediate stages of topotactic reduction with $x = 2 - 3$. We find that even the most reduced films do not exhibit a pure Ni^{1+}-$3d^9$ configuration. The quantitative analysis shows that there is an average of 1.35 holes in the nickel $3d$ states and superconducting samples have even higher values [2]. These results challenge previous findings regarding the doping range in which superconductivity occurs in infinite-layer nickelates. Variations between samples are attributed to a complex interplay of ordered, self-doped regions, interfacial reconstructions, and disorder occurring on different length scales in both the cation and anion sublattices.

[1] R. A. Ortiz et al., Phys. Rev. Materials 9, 054801 (2025).
[2] R. Pons et al., submitted (2025).

Topical Talk MA 26.3 Wed 10:30 HSZ/0003

Theory of infinite-layer nickelate superconductors — •Karsten Held — TU Wien, Austria

The discovery of superconductivity in infinite-layer nickelates [1] marked a new age of superconductivity: the nickel age. Using density functional theory, dynamical mean-field theory and dynamical vertex approximation (DΓA [2]), we successfully predicted [3] the phase diagram T_c vs. Sr-doping of $Nd_{1-x}Sr_xNiO_2$ with –for an unconventional superconductor– unprecedented accuracy with defect free films synthesized only 3 years later [4]. Also, the normal state spin spectrum well agrees with resonant inelastic x-ray spectroscopy (RIXS) [5] and the one-particle spectrum with angular-resolved photoemission spectroscopy (ARPES) [6], which both enter into the calculation of T_c. With this excellent agreement to later experiments, we can now with some confidence calculate the phase diagram of finite-layer nickelates [7] and predict that infinite-layer nickelates have a much higher T_c under 100GPa of pressure even without any chemical doping [8].

This work has been supported by the ERC project 101201037 and the FWF project I5398.

[1] D. Li et al., Nature 572, 624 (2019).
[2] G. Rohringer et al., Rev. Mod. Phys. 90, 25003 (2018).
[3] M. Kitatani et al., npj Quantum Materials 5, 59 (2020).
[4] K. Lee et al., Nature 619, 288 (2023).
[5] L. Si et al., Phys. Rev. Res. 6, 043104(2024).
[6] P. Worm et al., Phys. Rev. B 109, 235126 (2024).
[7] A. Hausoel et al., npj Quantum Mater. 10, 69 (2025).
[8] S. Di Cataldo et al., Nature Comm. 15, 3952 (2024).

15 min. break

Topical Talk MA 26.4 Wed 11:15 HSZ/0003

Disorder and distortions: what electrons tell us about nickelate superconductivity — •Berit H. Goodge — MPI-CPfS, Dresden, Germany

Recent realizations of superconductivity in both square-planar and bilayer Ruddlesden-Popper nickelates have opened a host of opportunities to explore fundamental questions of high-temperature superconductivity, while simultaneously posing unique synthetic challenges. Despite recent breakthroughs in sample synthesis, however, the highest quality thin films still pose immense challenges for investigation of fundamental characteristics, such as the pairing symmetry of the superconducting order parameter. Systematically introducing point-like disorder with high-energy electron irradiation consistently suppresses the superconducting transition, pointing towards a sign-changing order parameter in square-planar nickelates [1]. In parallel, epitaxial stabilization of superconductivity in bilayer nickelate thin films has opened the door to investigate local atomic structure and bonding environments. Leveraging the highest accessible spatial resolution and light-element sensitivity enabled by state-of-the-art multislice electron ptychography, we survey a series of bilayer nickelate thin films spanning a full series of tensile and compressive strain. We combine these experimental with strain-decomposed DFT calculations to investigate correlations between the observed atomic structure and superconductivity [2].

[1] Ranna et al., *PRL* 135, 126501 (2025).
[2] Bhatt et al., arXiv:2501.08204 (2025).

Topical Talk MA 26.5 Wed 11:45 HSZ/0003

Superconducting gap structure and bosonic mode in $La_2PrNi_2O_7$ thin films at ambient pressure — •Hai-Hu Wen — Hankou Rd. 22, Gulou, Nanjing, China

The recent discovery of high temperature superconductivity in nickelate systems has generated tremendous interests in the community. The core issue to understand the pairing mechanism is about the superconducting gap and its symmetry. We have successfully synthesized the superconducting thin films of $La_2PrNi_2O_7$ with $T_c^{\ onset} = 41.5$ K, and measured the superconducting tunneling spectra after we expose the superconducting layer by using the tip-excavation technique. The spectrum shows a two-gap structure with $\Delta_1 = 9$ meV, $\Delta_2 =$ 6-8 meV, and fittings based on the Dynes model indicate that the dominant gap should have an s-wave structure with low anisotropy, this allows us to select the s^{+-}-pairing symmetry among the two possibilities s^{+-} and d-wave. Furthermore, a clear bosonic mode with energy $\Omega = 30 \pm 2$ meV is observed, which further supports a sign reversal gap[1]. Our results shed new light in understanding the mystery of superconductivity in bilayer nickelate superconductors.

Collaborators: Huan Yang, Ilya M. Eremin, Shengtai Fan, Mengjun Ou, Marius Scholten, Qing Li, Zhiyuan Shang, Yi Wang, Jiasen Xu

[1] S. Fan et al., arXiv: 2506.01788

MA 26.6 Wed 12:15 HSZ/0003

Investigation of Ruddlesden-Popper nickelates and the monolayer-trilayer polymorph using Raman spectroscopy — •Vignesh Sundaramurthy[1], Abhi Suthar[1], Pascal Puphal[1,2], Hasan Yilmaz[3], Masahiko Isobe[1], Matteo Minola[1], Bernhard Keimer[1], and Matthias Hepting[1] — [1]Max-Planck-Institute for Solid State Research, Heisenbergstraße 1, 70569 Stuttgart, Germany — [2]2^{nd} Physics Institute, University of Stuttgart, 70569 Stuttgart, Germany — [3]University of Stuttgart, Institute for Materials Science, Materials Synthesis Group, Heisenbergstraße 3, 70569 Stuttgart, Germany

Ruddlesden-Popper nickelates have attracted intense interest following the discovery of superconductivity in several members of the series, including bilayer $La_3Ni_2O_7$, trilayer $La_4Ni_3O_{10}$, and structural polymorphs composed of monolayer-bilayer or monolayer-trilayer (ML-TL) units. In this talk, we explore the phononic and electronic Raman responses of high-quality ML-TL single crystals and contrast them with those of the other nickelate phases, using samples with optimized oxygen content.

MA 26.7 Wed 12:30 HSZ/0003

Multiorbital density wave in the trilayer nickelate $La_4Ni_3O_{10}$ — Abhi Suthar[1], Vignesh Sundaramurthy[1], Matias Bejas[2], Congcong Le[3], Pascal Puphal[1], Pablo Sosa-Lizama[1], Masahiko Isobe[1], Peter A. van Aken[1], Y. Eren Suyolcu[1], Matteo Minola[1], Andreas P. Schnyder[1], Xianxin Wu[4], Bernhard Keimer[1], Giniyat Khaliullin[1], Andres Greco[2], and •Matthias Hepting[1] — [1]Max-Planck-Institute for Solid State Research, Stuttgart, Germany — [2]UNR-CONICET, Rosario, Argentina — [3]RIKEN, Saitama, Japan — [4]Institute of Theoretical Physics, Beijing, China

Ruddlesden–Popper nickelates exhibit high-temperature superconductivity closely intertwined with charge and spin density wave order. However, fundamental questions persist regarding the orbital character and symmetry underlying the density wave instabilities. Using polarized Raman scattering on trilayer $La_4Ni_3O_{10}$, we resolve characteristic phonon anomalies and a redistribution of electronic spectral weight across the density wave transitions. Momentum-selective electronic Raman responses, combined with multiorbital model calculations, reveal a density-wave–induced gap with incoherent, non-mean-field opening and contributions from both Ni-$d_{x^2-y^2}$ and d_{z^2} states [1]. These results reconcile conflicting experimental reports of the density wave gap and underscore its multiorbital character.

[1] A. Suthar *et al.*, arXiv:2508.06440 (2025).

MA 27: Ultrafast Magnetization Effects I

Time: Wednesday 9:30–12:45 Location: HSZ/0004

Invited Talk MA 27.1 Wed 9:30 HSZ/0004

Towards sub-10fs magnetization switching — Reza Rouzegar[1], Oliver Franke[1], Gal Lemut[1], Oliver Gueckstock[1], Junwei Tong[1], Dieter Engel[2], Xianmin Zhang[3], Georg Woltersdorf[4], Piet W. Brouwer[1], Tobias Kampfrath[1], and •Quentin Remy[1] — [1]Department of Physics, Freie Universität Berlin, 14195 Berlin, Germany — [2]Max-Born-Institut für nichtlineare Optik und Kurzzeitspektroskopie, 12489 Berlin, Germany — [3]Key Laboratory for Anisotropy and Texture of Materials (Ministry of Education), School of Material Science and Engineering, Northeastern University, Shenyang 110819, China — [4]Institut für Physik, Martin-Luther-Universität Halle, 06120 Halle, Germany

Femtosecond laser pulses can induce sub-picosecond demagnetization, enabling ultrafast magnetic writing, spin transport, and broadband THz generation. Yet the microscopic processes in the first ~ 10 fs remain poorly understood. Three-temperature models describe energy flow among electrons, spins, and the lattice but neglect angular-momentum transfer, essential for spin dissipation.

Using ultrabroadband THz emission spectroscopy with ~ 10 fs resolution, we find that electron-magnon (em) scattering drives the nonequilibrium spin dynamics, generating both spin flips and magnons in under 10 fs, well before ~ 100 fs demagnetization. Angular momentum is then dissipated primarily through magnon-lattice interactions. Having established em scattering as the dominant sub-10-fs mechanism, we show that THz pulses can harness this coupling to reverse magnetization, pointing to sub-10-fs spin control.

MA 27.2 Wed 10:00 HSZ/0004

Ultrafast Control of Spin Periodicity in a Helical Heisenberg Antiferromagnet — •Hyein Jung[1,2], Abeer Arora[2], Deeksha Gupta[3], Franziska Walther[4], Kristin Kliemt[4], Victoria C. A. Taylor[2], Túlio de Castro[2], Hanqian Lu[1,2], Christian Schüssler-Langeheine[3], Niko Pontius[3], Urs Staub[5], Cornelius Krellner[4], Laurenz Rettig[2], Ralph Ernstorfer[1,2], and Yoav W. Windsor[1,2] — [1]Technische Universität Berlin, Berlin, Germany — [2]Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin, Germany — [3]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany — [4]Goethe-Universität Frankfurt, Frankfurt, Germany — [5]Paul Scherrer Institut, Villigen, Switzerland

The ultrafast manipulation of spin structures is a promising route toward the next generation spintronic devices. In this work, we study the helical Heisenberg antiferromagnet $EuCo_2P_2$ using resonant soft X-ray diffraction (RXD). By probing the magnetic Bragg reflections, we are experimentally sensitive both to the antiferromagnetic (AF) order parameter and to the 4f spin periodicity. We measure their response under three distinct perturbations: (a) femtosecond laser excitation (ultrafast RXD), (b) external magnetic fields, and (c) temperature variation. Employing a Heisenberg model, we directly reveal how the observables respond to each of the perturbations we apply. We further probe the response of the crystal lattice under the same conditions as the spin order and draw a relation between the dynamics of the two. These results offer insight into different routes to control AF spin order and its couplings.

MA 27.3 Wed 10:15 HSZ/0004

Time-resolved coherent small-angle EUV scattering of magnetic thin film structures — •Konstanze Korell[1], Sergey Zayko[1], Hung-Tzu Chang[1], Timo Schmidt[2], Murat Sivis[1,3], Manfred Albrecht[2], and Claus Ropers[1,3] — [1]Max Planck Institute for Multidisciplinary Sciences, Göttingen, Germany — [2]Experimental Physics IV, University of Augsburg, Germany — [3]4th Physical Institute - Solids and Nanostructures, University of Göttingen, Germany

Laser excitation yields control over magnetic structures on the femtosecond timescale, yet the corresponding nanoscale response remains difficult to access. Ultrafast coherent diffractive imaging has recently provided real-space insights [1], limited, however, to reversible dynamics. Here, by carrying out coherent speckle diffraction, we combine the strengths of diffraction with the coherence of a source capable of coherent imaging. Through this, we get insights to reversible and irreversible processes. Using a femtosecond high harmonic generation source, we measure pump-probe scattering from magnetic thin films in a laboratory-based setup. We discuss both the opportunities and limitations of this approach providing a basis for the interpretation of nanoscale magnetic dynamics in future ultrafast experiments.

[1] H.-T. Chang et. al, arXiv:2504.17917 (2025)

MA 27.4 Wed 10:30 HSZ/0004

Exploitation of Spin Wave Resonances in Miniaturized Magnetic Electron Optics for Ultrafast Electron Beam Manipulation — •Max Herzog[1], Johannes Schultz[1], and Axel Lubk[1,2] — [1]IFF, IFW Dresden, Helmholtzstraße 20, 01069 Dresden — [2]IFMP, TU Dresden, Haeckelstraße 3, 01069 Dresden

Magnetic electron optics that can be switched on sub-nanosecond time scales are useful for the setup of stroboscopic measurements in scanning and transmission electron microscopes. Scaling laws indicate that devices become permeable for alternating magnetic fields with GHz frequency by miniaturizing them to micrometer length scales, therefore decreasing their induction. On these length scales, spin waves can be excited in the magnetic pole pieces which can drastically increase the micro optics effectivity when their resonance condition is met. We fabricate such magnetic multipole optics using lithographic techniques with pole piece sizes in the tens of μm, a thickness of up to 800 nm, a pole piece distance of 25 μm as well as variable geometries in order to optimize the resonant behavior. Due to those resonances, the characterized micro optics show an especially strong deflection of the TEMs 300 keV electron beam of more than 100 μrad at 3 GHz excitation frequency. Conducted electron spin resonance measurements confirm the possibility to excite spin waves in the magnetic pole pieces in the same frequency range. This allows for the application of models of the dispersion relation to determine favorable values for parameters like thickness, exchange interaction, and saturation magnetization in order to achieve the desired resonance frequency.

MA 27.5 Wed 10:45 HSZ/0004

Terahertz Spectroscopy of non-collinear magnetic state in ferrimagnetic iron garnet — •Tushar Baruah[1], Andrzej Stupakiewicz[2], Paul H. M. van Loosdrecht[1], and Evgeny A. Mashkovich[1] — [1]II. Physikalisches Institut, Universität zu Köln, 50937 Köln, Germany. — [2]Faculty of Physics, University of Bialystok, Ciolkowskiego 1L, 15-245 Bialystok, Poland.

Data storage technologies and magnetic control research, in general, focuses primarily on magnets with anti-ferromagnetic exchange interactions for their ultrafast picosecond-scale dynamics. Among them, ferrimagnets are particularly appealing, as they combine high Terahertz (THz)-scale eigenfrequencies with the feasibility of ground state control. Non-collinear magnetic states in ferrimagnets exhibit complex spin dynamics, whose ultrafast behaviour remains partly understood. Using a table-top high-power broadband THz pump-optical probe setup integrated with a 10T superconducting magnet, we directly probe the field and temperature dependent spin dynamics in Bi-substituted Gadolinium iron garnet, which is a ferrimagnet with non-collinear magnetic state and a magnetic moment compensation point temperature. Our results show magnetisation dynamics in non-collinear state driven by overlap of exchange modes and THz cavity modes formed by multiple reflections inside the sample.

15 min break

MA 27.6 Wed 11:15 HSZ/0004

Spin-lattice coupling control of ultrafast order melting in antiferromagnetic insulators — Aleksandr Buzdakov[1], •Ravi Kaushik[1], Nikolai Khokhlov[2], Johan Mentink[2], Sergey Artyukhin[1], and Aleksei Kimel[2] — [1]Istituto Italiano di Tecnologia, Via Morego 30, 16163 Genova, Italy — [2]Radboud University Nijmegen, Institute for Molecules and Materials, 6525 AJ Nijmegen, The Netherlands

Ultrafast order melting in magnetic insulators is governed by two processes: intrinsic intra-spin relaxation and spin-lattice energy transfer. Antiferromagnets, which lack net magnetization, can in principle evade angular-momentum constraints and display markedly faster order-parameter dynamics than ferromagnets, but experimental rates vary widely across materials. Here we combine first-principles magnetostriction calculations, phonon and magnon spectral analysis, atomistic spin-dynamics simulations and time-resolved second-harmonic generation to disentangle these pathways and explain material-dependent disparities. Focusing on two structurally similar antiferromagnets, Cr_2O_3 and $FeBO_3$, we show that the strength of spin-phonon coupling - revealed by magnetostrictive response and phonon-magnon spectral overlap - dictates the dramatic difference in order-melting rates. We also achieved accelerated dynamics in Cr_2O_3 and show sub-2-ps order melting in both experiment and simulation. Our results identify spin-phonon coupling as the decisive control parameter for ultrafast antiferromagnetic dynamics and provide a practical framework to design faster switching in antiferromagnetic spintronic devices.

MA 27.7 Wed 11:30 HSZ/0004

Nonlinear optical probing of a strongly correlated phase transition in epitaxial $NdNiO_3$ thin films — •Christian Tzschaschel[1,2], Felix Utsch[1], Qi Song[2], Spencer Doyle[3], Grace A. Pan[3], Julia A. Mundy[3], and Stefan Eisebitt[2,4] — [1]Department of Physics, University of Zurich, Switzerland — [2]Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany — [3]Department of Physics, Harvard University, USA — [4]IOAP, TU Berlin, Germany

The family of rare-earth nickelates is a prime example of strongly correlated oxide materials displaying a wealth of physical phenomena from antiferromagnetism to superconductivity. $NdNiO_3$ specifically exhibits a metal-to-insulator phase transition upon cooling that is concomitant with the emergence of antiferromagnetic order.
Here, we use nonlinear optical second harmonic generation (SHG) in the near-infrared regime to gain insight into the symmetry and ultrafast dynamics of this correlated electronic and magnetic phase transition. In static measurements, we observe a symmetry reduction from orthorhombic in the paramagnetic phase to monoclinic in the antiferromagnetically ordered phase. Upon optical excitation, we observe a quench of the SHG signal and a restoration of the orthorhombic state within 125 fs. Our study highlights the capabilities of nonlinear optics and advances the understanding of strongly correlated quantum materials.

MA 27.8 Wed 11:45 HSZ/0004

Ultrafast angular momentum transfer in RKKY-coupled 4f antiferromagnets — S.-E. Lee[1], Y.W. Windsor[1,2], D. Zahn[1], A. Kraiker[3], K. Kummer[3], K. Kliemt[4], C. Krellner[4], C. Schüssler-Langeheine[5], N. Pontius[5], U. Staub[6], D.V. Vyalikh[7], A. Ernst[8], and •L. Rettig[1,9] — [1]Fritz-Haber-Institut der MPG, DE — [2]TU Berlin, DE — [3]ESRF, Grenoble, FR — [4]Goethe-Universität Frankfurt, DE — [5]Helmholtz-Zentrum Berlin, DE — [6]PSI, Villigen, CH — [7]DIPC, San Sebastian, ES — [8]Johannes Kepler University, Linz, AU — [9]RPTU Kaiserslautern-Landau, DE

Antiferromagnets allow for direct angular momentum (AM) transfer between opposing spins, thereby avoiding AM transfer to the lattice, which limits ultrafast magnetization dynamics in ferromagnets. Here, we study the ultrafast magnetization dynamics in 4f antiferromagnetic intermetallics of type $LnRh_2Si_2$ (Ln=Pr, Nd, Sm, Gd, Tb, Dy, Ho) where we modify the magnitude of the on-site RKKY coupling strength via substitution of Ln ions. By combining time-resolved soft X-ray diffraction with ab-initio calculations, we find that the rate of AM transfer between opposing moments is directly determined by this coupling [1]. Moreover, the influence of itinerant conduction electrons has been explored in the Series GdT_2Si_2 by varying the transition metal T (T=Co, Rh, Ir). Here, we find a more than twofold increase in ultrafast AM transfer rate between the materials, which we associate with modifications in the conduction electron susceptibility due to differences in their density of states [2].

[1] Nat. Mater. 21, 514 (2022) [2] PRR 6, 043019 (2024)

MA 27.9 Wed 12:00 HSZ/0004

Time-resolved wide-field SHG imaging of ferroic materials — •Andrin Caviezel, Jan Gerrit Horstmann, Thomas Lottermoser, and Manfred Fiebig — Department of Materials, ETH Zurich, Zurich, Switzerland

We investigate the ultrafast dynamics of van der Waals ferroics using time-resolved second harmonic generation (SHG) wide-field imaging. Controlling antiferromagnetic order on ultrafast timescales is of central relevance for spintronic applications, and van der Waals ferroics constitute highly promising material platforms. However, achieving such control requires an experimental technique that is simultaneously sensitive to ferroic order and combines micrometer spatial with femtosecond temporal resolution. Here, we present a setup for direct wide-field visualization of ferroic domain structures by exploiting SHG generated from high-energy pulses of an amplified laser system. The adjustable wavelength and polarization of pump and probe pulses, together with tailored pulse sequences for excitation, enable sensitive detection and selective manipulation of magnetic order. Our approach provides access to ultrafast processes in bulk ferroics with microscopic domain patterns as well as in micrometer-sized flakes of van der Waals ferroics under cryogenic conditions, opening new pathways for understanding and steering their nonequilibrium dynamics.

MA 27.10 Wed 12:15 HSZ/0004

Photoinduced demagnetization and carrier dynamics in $SrRuO_3$ thin films probed by time resolved THz spectroscopy — •Ankhijur Islam Sekh[1], Harun Mert Iyiisler[1], Phillip Leiprecht[2], Mathias Beck[2], Paul Leiderer[2], Gad Koren[3], Ionela Lindfors-Vrejoiu[4], Paul H.M. van Loosdrecht[4], and Jure Demsar[1] — [1]JGU Mainz — [2]University of Konstanz — [3]Technion, Haifa — [4]University of Cologne

$SrRuO_3$ is an itinerant ferromagnet (Tc ≈ 150 K) whose T^2 resistivity below 30K signals a ferromagnetic Fermi-liquid ground state. We present the temperature (T) and excitation fluence (F) dependent photoinduced conductivity dynamics of thin films grown by MBE and PLD, following excitation with fs near-infrared pulses. We show that photoinduced changes in THz conductivity are governed by the changes in the scattering rate of the intraband Drude response. The T- and F-dependent photoconductivity dynamics suggest that rapid carrier thermalization is accompanied by magnon generation, consistent with a high spin-flip scattering rate due to strong spin-orbit coupling. Accordingly, over a broad T and F-range, the photoconductivity transients track the evolution of the magnon population. At temperatures below 20K and at lowest F, we observe a delayed rise in photoconductivity, which reflects the reduced e-e thermalization rate with its characteristic Fermi-liquid T^2 dependence.

MA 27.11 Wed 12:30 HSZ/0004

Element-specific magnetization dynamics of epitaxial ultrathin Co/Pt heterostructures — •Puloma Singh[1], Corentin Aulagnet[2], Thomas Jauk[3], Sangeeta Sharma[1,4], Martin Schultze[3], Stéphane Mangin[2], Clemens von Korff Schmising[1], and Stefan Eisebitt[1,5] — [1]Max Born Institut für Nichtlineare Optik und Kurzzeitspektroskopie, Berlin, Germany — [2]Université de Lorraine, CNRS, Institut Jean Lamour, Nancy, France — [3]Institut für Experimentalphysik, Technische Universität Graz, Graz, EU, Austria — [4]Institute for Theoretical Solid-state Physics, Freie Universität Berlin, Berlin, Germany — [5]Technische Universität Berlin, Institut für Optik und Atomare Physik, Berlin, Germany

Magnetic systems comprising 3d ferromagnetic transition metals and 4d/5d heavy metals are of interest because of their potential application in future energy storage technology. The microscopic process involved after femtosecond laser excitation is complex and is still controversially discussed in the existing literature. We present a systematic and element specific study of epitaxial, ultrathin Co films (0.8 and 1.0 nm) sandwiched by Pt layers. We compare the ultrafast response for the different Co thicknesses as well as for out-of-plane and in-plane magnetic anisotropy by a combination of pump-probe spectroscopy in the optical and extreme ultraviolet spectral range. Exploiting the Pt $O_{2,3}$ and N_7 and Co $M_{2,3}$ resonances, we accurately disentangle the intrinsic and proximity induced magnetic moments of Co and Pt. We find consistently larger demagnetization amplitudes of the Pt magnetization compared to Co and a very pronounced thickness dependence.

MA 28: Focus Session: Quantum Sensing with Solid State Spin defects II (joint session TT/HL/MA)

Time: Wednesday 9:30–10:30 Location: HSZ/0101

MA 28.1 Wed 9:30 HSZ/0101

Locally Imaging the Insulator to Metal Transition of Ca_2RuO_4 with Single Spin Magnetometry — •Hayden Binger[1], Cissy Suen[2], Young-Gwan Choi[1], Yejin Lee[1], Haolin Jin[1], Max Krautloher[2], Yuchen Zhao[1], Luke Turnbull[1], Elina Zhakina[1], Jeffrey Neethirajan[1], Lotte Boer[1], Berit Goodge[1], Piotr Surówka[3], Roderich Moessner[4], Bernhard Keimer[2], Claire Donnelly[1], and Uri Vool[1] — [1]MPI CPfS, Dresden, Germany — [2]MPI FKF, Stuttgart, Germany — [3]Wrocław University of Science and Technology, Wrocław, Poland — [4]MPI PKS, Dresden, Germany

The current-driven insulator to metal transition (IMT) in Ca_2RuO_4 is a fascinating phenomenon where increasing current driven across a sample causes a smaller voltage difference to develop. We have created devices of size 10-20 um by 10-20 um and 100 nm thick using Focused Ion Beam (FIB) milling. Through the utilization of Nitrogen Vacancies (NV), optically addressable spin-1 defects acting as a qubit at room temperature, we probe the local magnetic field at the defect via the Zeeman interaction. We are thusly able to image the local character of the insulator to metal transition in Ca_2RuO_4. At low currents we image the formation of a singular conducting channel at the edge of the device, which gradually grows throughout the entire device as more current is applied until eventually current flows evenly across the device. We explore reasons why local current channels nucleate at the edge, such as strain, defects, and crystalline lattice orientation.

MA 28.2 Wed 9:45 HSZ/0101

Topological Ambiguity in Stray Field Magnetometry — •Shirsopratim Chattopadhyay[1,2] and Aparajita Singha[1,2] — [1]IFMP, TU Dresden, Germany — [2]Würzburg-Dresden Cluster of Excellence (ct.qmat)

Inferring magnetic topology from stray field measurements is central to characterizing skyrmions, vortices, and other topological textures. Yet, the uniqueness of such reconstructions remains poorly characterized. We present a computational framework to systematically generate pairs of magnetization configurations with distinct topological charges ($|\Delta Q| = q$, where q can be set by the user) that produce nearly identical stray fields (Normalized Root Mean Square Error ~ 0.8-4 percent). Our approach uses constrained optimization with a physics informed loss to jointly evolve magnetization pairs towards field degeneracy while preserving topological distinction. Across 200 randomized trials with varied initializations, we demonstrate rapid and reliable generation of adversarial pairs spanning skyrmions, merons, fractional defects and uniform domain textures. We theoretically analyse the relation between topological charge and stray field and construct an explicit example of near identical stray field from distinct topologies. Our adversarial dataset enables rigorous assessment of magnetization reconstruction algorithms and guides the design of measurement strategies capable of resolving topological ambiguity.

MA 28.3 Wed 10:00 HSZ/0101

Towards Cryogenic Scanning Nitrogen Vacancy Magnetometry — •Lotte Boer[1], Kilian Srowik[1], Hayden Binger[1], Young-Gwan Choi[1], Ahmet Ünal[1], Edouard Lesne[1], Matheus Barbosa[2], Bernd Büchner[2], Alexey Popov[2], and Uri Vool[1] — [1]MPI CPfS, Dresden, Germany — [2]IFW Dresden, Germany

In scanning nitrogen vacancy (NV) magnetometry, an atomic force microscopy tip is replaced with a diamond pillar containing a single NV center, which acts as a highly sensitive magnetic field sensor. Scanning over a sample then allows to map the magnetic stray field. This method has been widely used at room temperature to investigate, for example, magnetic textures in thin films or local current flow patterns. However, a wide range of interesting material properties, such as emergent magnetic phases and superconductivity only occur at lower temperatures. As the NV center retains its ability to sense magnetic fields at low temperatures, we are developing a variable temperature cryogenic scanning NV system. This will not only allow for the imaging of materials at low temperatures, but also allow for the unique opportunity of mapping magnetic phase transitions in quantum materials.

Building a cryogenic NV setup presents several challenges, as the NV requires optical access for readout and microwave pulses for control, all within tight spatial confines and while preventing sample heating. In this talk, we will discuss our setup, which is in its final stages of development, and show preliminary measurement results at few Kelvin temperatures.

MA 28.4 Wed 10:15 HSZ/0101

CISS from Vibrationally Assisted Tunneling in Chiral Molecules — •Fedor Baranov, Virginia Gali, and Maxim Breitkreiz — Dahlem Center for Complex Quantum Systems, Freie Universitat Berlin, Arnimallee 14, 14195 Berlin, Germany

Chiral-induced spin selectivity (CISS) remains a puzzling phenomenon, despite extensive experimental evidence. A possible explanation emerges when recognizing that charge transport through chiral insulating molecules occurs in the tunneling regime, where even small spin-orbit coupling becomes crucial inside the barrier. This enhancement leads to a spin-dependent potential that gives different tunneling probabilities for different spin orientations. Because this tunneling alone produces extremely small currents, one has to take into account the vibrational degrees of freedom of the system that in the static limit increases the current while preserving the spin splitting nature. Together, these ingredients offer a transparent physical mechanism underlying the CISS effect.

MA 29: Spin Transport and Orbitronics, Spin-Hall Effects I (joint session MA/TT)

Time: Wednesday 9:30–12:45 Location: POT/0112

Invited Talk MA 29.1 Wed 9:30 POT/0112
Exploring the interplay between spin and chirality — •Angela Wittmann — Johannes Gutenberg University Mainz, Germany

Chirality is omnipresent in nature, bridging magnetic and molecular spin phenomena. At the core of this connection lies the chiral-induced spin selectivity (CISS) effect, describing the highly efficient generation of spin polarized currents in chiral molecules. Despite extensive experimental evidence, the underlying mechanisms of CISS remain debated. Here, we explore how chirality is directly linked to the intrinsic magnetic moments in molecules and how molecular design can be harnessed to control spin phenomena at hybrid chiral molecule magnetic interfaces [1]. Our findings pave a pathway towards functional "chiralitronic" devices - turning a fundamental puzzle into a technological opportunity.

[1] A. Moharana, AW et al., Sci. Adv.11, eado4285 (2025)

MA 29.2 Wed 10:00 POT/0112
Chiral Molecule-Induced Magnetic Anisotropies — •Simon Sochiera[1], Ashish Moharana[1], Yael Kapon[2], Fabian Kammerbauer[1], Shira Yochelis[2], Mathias Kläui[1], Yossi Paltiel[2], and Angela Wittmann[1] — [1]Johannes Gutenberg University, Mainz, Germany — [2]Hebrew University of Jerusalem, Jerusalem, Israel

The chiral-induced spin selectivity effect promises novel spintronic devices. Despite numerous interdisciplinary experiments revealing its implications and trends, this phenomenon challenges our theoretical understanding of the interplay between spin and chirality, particularly regarding apparent time-reversal symmetry breaking. This symmetry breaking can be observed by measuring a magnetic thin film's anisotropy upon chiral-molecule adsorption. We quantify this phenomenon by measuring the magnetic anisotropy through electrical magnetotransport measurements. Upon chiral-molecule adsorption, we observe a 35% change in out-of-plane hard-axis anisotropy. This approach enables sensitive probing of magnetic property changes induced by different chiral molecular systems on various conductive or insulating magnetic thin films. Correlating molecular properties, such as spin-orbit coupling, with their impact on magnetic anisotropy will be crucial for understanding the fundamental mechanisms of chiral-induced spin selectivity and for facilitating the design of spintronic devices that require a precisely tuned anisotropy.

MA 29.3 Wed 10:15 POT/0112
Generation, Transmission, and Conversion of Orbital Torque by an Antiferromagnetic Insulator — •Shilei Ding[1,2], Paul Noël[2], Gunasheel Kauwtilyaa Krishnaswamy[2], Niccolò Davitti[2], Giacomo Sala[2], Marzia Fantauzzi[3], Antonella Rossi[2,3], and Pietro Gambardella[2] — [1]School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore 637371, Singapore — [2]Department of Materials, ETH Zürich, 8093 Zürich, Switzerland — [3]Dipartimento di Scienze Chimiche e Geologiche, Università degli Studi di Cagliari, Campus di Monserrato S.S. 554, Italy

Orbital currents and orbital torques have recently emerged as powerful tools for controlling magnetization, yet their transport has been studied almost exclusively in metals. We report the first demonstration of orbital generation, transport, and conversion through an insulating antiferromagnet CoO. By inserting CoO between Cu* and Co, we show that orbital transport is preserved and the orbital-torque efficiency is strongly enhanced. Temperature-dependent measurements indicate that orbital transport above the Néel temperature is mediated by thermal fluctuations, while antiferromagnetic order and exchange bias provide additional transport channels at low temperature. These results identify insulating antiferromagnets as effective mediators of orbital angular momentum and highlight transition-metal oxides with unquenched orbital moments as promising materials for efficient spin-orbitronic technologies.

MA 29.4 Wed 10:30 POT/0112
Modern theory of the Orbital Hall effect from Wannier Representation — •Mirco Sastges[1,2], Insu Baek[3], Hojun Lee[3], Hyun-Woo Lee[3], Yuriy Mokrousov[1,2], and Dongwook Go[4] — [1]Peter Grüunberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich and JARA, 52425 Jülich, Germany — [2]Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany — [3]Department of Physics, Pohang University of Science and Technology, Pohang, Kyungbuk 37673, South Korea — [4]Department of Physics, Korea University, Seoul 02841, South Korea

In the field of orbital dynamics and orbital transport a particularly important quantity is the so-called orbital Hall conductivity (OHC), which is expressed in terms of operators of velocity and orbital angular momentum (OAM). To overcome the difficulties in treating the unbounded position operator, very often the so-called atom-centered approximation (ACA) is used. However, while being very practical, this approach captures only some local contributions to the OAM operator. Here, we will report on developing a new approach to quantify the OAM operator in the basis of Wannier functions, which is based on the modern theory of orbital magnetization. This method allows us to capture both local and itinerant contributions to the OHC. By performing first principles calculations for selected transition metals we show that a significant correction to the OHC due to non-local contributions arises, while the local effects are captured in accordance to the ACA. Our approach is very promising since it improves our understanding of OAM and allows for a precise estimation of the OHC.

MA 29.5 Wed 10:45 POT/0112
Chirality-induced orbital Edelstein effect in an analytically solvable model — •Lennart Schimpf, Börge Göbel, and Ingrid Mertig — Institut für Physik, Martin-Luther-Universität Halle-Wittenberg

Chirality-induced spin selectivity (CISS), a phenomenon wherein chiral structures selectively determine the spin polarization of electron currents flowing through the material, has garnered significant attention due to its potential applications in areas such as spintronics, enantioseparation, and catalysis. The underlying physical effect is the Edelstein effect that converts charge to angular momentum. Besides a spin contribution, there exists a contribution based on the orbital angular momentum but the precise mechanism for its generation remains yet to be understood. Here, we introduce the minimal model for explaining the phenomenon based on the orbital Edelstein effect [1]. We consider nonlocal intersite contributions to the current-induced orbital angular momentum and reveal the underlying mechanism by analytically calculating the Edelstein susceptibilities in a tight-binding and Boltzmann approach. While the orbital angular momentum is directly generated by the chirality of the crystal, the spin contribution of each spin-split band pair relies on spin-orbit coupling. Using tellurium as an example, we show that the orbital contribution surpasses the spin contribution by orders of magnitude.

[1] B.Göbel, L. Schimpf, I. Mertig, Phys. Rev. Res. 7, 033180 (2025)

15 min break

MA 29.6 Wed 11:15 POT/0112
Spin-charge and Orbital-charge Interconversion on SrTiO3-based Two-dimensional Electron Gases: A Semiclassical Approach — •Le Viet Duc Pham and Annika Johansson — Max Planck Institute of Microstructure Physics, Weinberg 2, 06120 Halle (Saale), Germany

Two-dimensional electron gases (2DEGs) at SrTiO3-based oxide interfaces display large, gate-tunable Rashba-like spin-orbit coupling (SOC) that enables spin-charge interconversion via the spin Edelstein effect [1, 2]. It has also been demonstrated that the orbital Edelstein effect, i.e, current-induced orbital magnetization, is larger than the spin Edelstein effect by more than one order of magnitude [3]. Yet, most transport studies assume a constant relaxation time [1, 3], potentially underestimating the role of anisotropic relaxation times and scattering-in contributions. Here, we systematically study charge-spin and charge-orbital conversion in SrTiO3-based 2DEGs, combining the Boltzmann semiclassical transport theory and various ansatzes for the scattering terms, such as constant relaxation time, momentum relaxation time, as well as scattering on various impurity potentials. Comparing different scattering approaches, we gain insights into the influence of impurity scattering on charge-spin and charge-orbital interconversion phenomena.

[1] Vaz, Diogo C., et al. Nature Materials 18.11 (2019): 1187-1193. [2] Caviglia, A. D., et al. Physical Review Letters 104.12 (2010): 126803. [3] Johansson, Annika, et al. Physical Review Research 3.1 (2021): 013275.

MA 29.7 Wed 11:30 POT/0112

Quantum geometry for orbital magnetization and spintronics from parallel transport of Bloch states — •Johannes Mitscherling, Jan Priessnitz, and Libor Šmejkal — Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany

Quantum geometry emerges as a unifying, quantitative guiding principle for the linear and nonlinear response functions of quantum matter. Going beyond current-current responses [1,2], we identify the generator of parallel transport of Bloch states, given by the commutator of the band projector and its momentum derivative, as a further essential building block of quantum geometry [3]. I will show that orbital magnetism arises from the non-commutativity of adiabatic transport in orthogonal directions. We will see that the spin Berry curvature and the spin quantum metric, which control the linear spin conductivity, are not fundamentally geometric but yield three geometric contributions of distinct physical origin. Our theory enables efficient numerical and analytical evaluations for general Bloch Hamiltonians with an arbitrary number of potentially degenerate bands. I will exemplify the results in application to altermagnets [4] and p-wave magnets [5].

[1] Avdoshkin*, Mitscherling*, and Moore, PRL 135, 066901 (2025). [2] Mitscherling*, Avdoshkin*, and Moore, PRB 112, 085104 (2025). [3] Mitscherling and Šmejkal, to be submitted. [4] Šmejkal, Sinova, and T. Jungwirth, PRX 12, 031042 (2022). [5] Birk Hellenes, Jungwirth, Jaeschke-Ubiergo, Chakraborty, Sinova, and Šmejkal, arXiv:2309.01607v3.

MA 29.8 Wed 11:45 POT/0112

Signatures of magnon dispersion in spin transport — •Sebastian Sailler, Denise Reustlen, Michaela Lammel, Sebastian T. B. Goennenwein, and Richard Schlitz — Department of Physics, University of Konstanz, 78457 Konstanz, Germany

The spin Hall magnetoresistance (SMR) provides electrical access to the magnetization of a magnetically ordered material. It recently became clear that changes in the net magnetization due to magnon creation and annihilation can be observed in the SMR. However, the number of magnons - and thus the magnetization - can also be modified by changing the energy of the system. In this work, we experimentally demonstrate that the changes of magnon occupation due to magnetic fields and crystal orientation sensitively modify the SMR response. Higher magnetic fields reduce the magnon population by pushing the magnon manifold to higher energies, leading to an increase of magnetization and thus the SMR. In turn, the influence of the anisotropic magnon gap in yttrium iron garnet films leads to a crystal orientation dependence of the SMR. The magnetic field and orientation dependence can be rationalized in terms of the changing magnon occupation. Our results showcase that magnetoresistive effects not only probe the properties of the static magnetization, but also reveal information about the dynamics, i.e., the magnons.

MA 29.9 Wed 12:00 POT/0112

Non-reciprocal spin-orbital-charge interconversion via magnon transport in nonlocal devices — •Jose Omar Ledesma-Martin[1], Sachin Krishnia[1], Edgar Galindez-Ruales[1], Duc Tran[1], Marcel Gasser[1], Dongwook Go[1,2], Gerhard Jakob[1], Yuriy Mokrousov[1,2], and Mathias Kläui[1] — [1]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich and JARA, Jülich, Germany

In magnetic systems, angular momentum is carried by electrons' spin and orbital angular momentum. We use devices based on Pt nanowires on insulating magnets to study angular-momentum transport mediated by magnons, enabling angular-momentum information to propagate without charge flow. In these systems, magnons are generated by spin accumulation from the Spin Hall Effect (SHE) and detected via the inverse Spin Hall Effect (iSHE). In conventional Pt-YIG nonlocal geometries, this spin-charge interconversion is fully reciprocal: interchanging the injector and detector yields equal efficiencies. We further confirm that this power-to-power efficiency remains reciprocal when the thickness of one Pt wire is varied. However, when Ru is used as a source and detector of orbital currents via the orbital Hall effect (OHE) and inverse OHE, the reciprocity is broken. In our devices, the combined SHE + OHE-driven magnon generation, followed by detection through the iSHE, becomes ~35% more efficient than the reverse process, demonstrating nonreciprocity in the system. (1)

(1) J.O. Ledesma-Martin, Nano Lett. 2025, 25, 8, 3247-3252

MA 29.10 Wed 12:15 POT/0112

Giant orbital magnetoresistance in orbital magnets — •Sachin Krishnia[1], Christin Schmitt[1], Edgar Galindez Ruales[1], Takashi Kikkawa[2], Timo Kuschel[1], Eiji Saitoh[2], Olena Gomonay[1], Yuriy Mokrousov[1], and Mathias Kläui[1] — [1]Institute of Physics, Johannes Gutenberg-University Mainz, Mainz, Germany — [2]Department of Applied Physics, The University of Tokyo, Tokyo, Japan

Generation and transport of large orbital angular momentum (OAM) currents have recently emerged as a key research area in the field of orbitronics. In contrast to spin currents, whose generation depends on weak spin-orbit coupling, OAM currents arise directly from the coupling between crystal momentum and electronic OAM even in light and environmentally friendly materials (Cu, Al, Cr)[1]. A major challenge has been to exploit these giant orbital currents in magnetic systems, where static magnetization is dominated by spin. We show that this limitation can be overcome by employing magnetic materials in which OAM contributes significantly to the static magnetization. Using these orbital magnets, we demonstrate two orders of enhancement of orbital Hall magnetoresistance, compared to the spin counterpart. This enhancement originates from the interaction of the dynamic OAM generated in light metals with the static orbital moments of the orbital magnet. Our results establish a pathway to harness giant OAM currents for device functionalities that cannot be achieved with conventional spin-dominated magnets[2]. [1] S. Ding et al, PRL 125, 177201 (2020). [2] C. Schmitt, S. Krishnia et al. (under review).

MA 29.11 Wed 12:30 POT/0112

Spin-Current Sensitivity in $CuSeO_3$ Across the Antiferromagnetic Transition — •Ankita Nayak[1], Mathew James[1], Maxim Mostovoy[2], and Aisha Aqeel[1] — [1]University of Augsburg, 86135Augsburg, Germany — [2]Zernike Institute for Advanced Materials, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands

Antiferromagnets are promising materials for next-generation spintronics due to their robustness against magnetic fields and ultrafast dynamics. Spin Hall magnetoresistance (SMR) provides a sensitive method to probe spin transport at normal-metal–antiferromagnetic-insulator interfaces. In antiferromagnets, SMR can detect Néel-vector reorientation, spin-flop behaviour, and short-range correlations above the ordering temperature, as shown in systems such as NiO and α-Fe_2O_3.

Here, we use SMR in a Pt/$CuSeO_3$ bilayer to investigate spin transport in the unconventional antiferromagnet $CuSeO_3$. An AC current in the Pt Hall bar generates a transverse spin accumulation, whose interface reflection modulates the Pt resistance and enables electrical detection of the magnetic state.

$CuSeO_3$ consists of Cu(1) spin dimers and Cu(2) spins that order antiferromagnetically below 8 K. SMR measurements between 5 and 100 K with magnetic-field rotation in three planes reveal clear SMR signals, including a finite response above the Néel temperature, indicating persistent spin correlations. The plane-dependent SMR amplitude also reflects the intrinsic magnetic anisotropy of $CuSeO_3$.

MA 30: Functional Antiferromagnetism

Time: Wednesday 9:30–12:45 Location: POT/0151

MA 30.1 Wed 9:30 POT/0151

Electric Current Control of Helimagnetic Chirality from a Multidomain State — •Yuta Kimoto[1], Hidetoshi Masuda[1], Jun-ichiro Ohe[2], Shoya Sakamoto[1], Takeshi Seki[1,3], and Yoshinori Onose[1,3] — [1]Institute for Materials Research, Tohoku University, Sendai 980-8577, Japan — [2]Department of Physics, Toho University, Funabashi 274-8510, Japan — [3]Center for Science and Innovation in Spintronics (CSIS), Core Research Cluster, Tohoku University, Sendai 980-8577, Japan

In helimagnets, magnetic moments form a helical spin order possessing chirality. In centrosymmetric crystals, two helical states with opposite handedness are degenerate; thus, chiral domains can coexist and form domain walls. Here, we study the domain wall dynamics under electric current in the helimagnet $MnAu_2$. We found that the threshold current required for the transition from the multidomain state to a single-chiral domain state in a magnetic field is much lower than that for chirality reversal from a single-chiral domain within certain ranges of temperature and magnetic field. The chirality after the transition depends on whether the magnetic field and electric current were parallel or antiparallel. Numerical calculations based on the Landau-Lifshitz-Gilbert equation reproduce our observations. These results indicate that the domain walls are highly mobile in the helimagnet, reflecting a pinning potential much smaller than the domain-nucleation energy. They also suggest that helimagnetic domain walls could serve as efficient information carriers, opening new avenues for spintronic applications, such as racetrack-type memory devices.

MA 30.2 Wed 9:45 POT/0151

Multistate probabilistic computing in the chiral kagome antiferromagnet Mn3Sn — •Prajwal Rigvedi[1], Jae-Chun Jeon[1], Kevin Callahan-Coray[2], Kerem Y. Camsari[2], and Stuart S.P Parkin[1] — [1]Max-Planck Institute of Microstructure Physics, Halle (Saale), Germany — [2]Department of Electrical and Computer Engineering, University of California, Santa Barbara, CA, USA

Chiral kagome antiferromagnets such as Mn3Sn are promising candidates for spintronic applications due to their ultrafast spin dynamics and negligible stray fields. Their magnetic ground state exhibits six-fold degeneracy, which naturally supports multistate information processing. In this work, we investigate ultra-thin W/Mn3Sn bilayers and demonstrate spin-orbit torque-driven multistate probabilistic switching. Above a critical current density, stochastic fluctuations in the anomalous Hall resistance (Rxy) emerge, and their probability distribution can be continuously tuned with nanosecond electrical pulses. This tunability results in a sigmoidal response of Rxy to the applied current, enabling electrically controlled antiferromagnetic probabilistic bits with multiple accessible states. Leveraging experimentally obtained state statistics, we implement a graph coloring task, an NP-hard optimization problem. These results constitute the first experimental realization of multistate probabilistic switching in an antiferromagnet and demonstrate its applicability to non-deterministic computing tasks. Our findings position non-collinear antiferromagnets as a promising material platform for multibit spintronics, highlighting their potential for unconventional computing architectures.

MA 30.3 Wed 10:00 POT/0151

Antiferromagnetic Writing by Magneto-electric Field in Cr_2O_3 — Nikolai Khokhlov[1], •Aleksandr Buzdakov[2], Timur Gareev[1], Anatoly Zvezdin[3], Sergey Artyukhin[2], and Aleksei Kimel[1] — [1]Radboud University Nijmegen, Institute for Molecules and Materials, Nijmegen 6525 AJ, The Netherlands — [2]Istituto Italiano di Tecnologia, Via Morego 30, Genova 16163, Italy — [3]Moscow, Russia

Antiferromagnetic (AFM) spintronics is a promising platform for next-generation storage, offering high domain wall velocities and immunity to stray fields. However, a bottleneck remains: the lack of a low-power method to write arbitrary domains without high-density currents and Joule heating. Here, we demonstrate full, non-volatile control of AFM domains in magnetoelectric Cr_2O_3 at room temperature. Utilizing an electrically charged needle to "draw" domains under a magnetic bias, we find that approaching the Néel temperature is critical. In this regime, domain walls lose their elastic "rubber band" behavior, allowing complex shapes to stabilize. We rationalize this via the Larkin length, establishing that reliable storage requires a Larkin length smaller than the bit size. Our findings provide a model for domain writability in insulating antiferromagnets, paving the way for low-energy, electrically controlled AFM memory.

MA 30.4 Wed 10:15 POT/0151

Magnetic-phase-entangled orbital anisotropy in the van der Waals antiferromagnet $CrPS_4$ revealed by resonant inelastic X-ray scattering — •Zhijia Zhang[1], Yuan Wei[1], Carlos William Galdino[1], Cedomir Petrovic[2], and Thorsten Schmitt[1] — [1]Centre for Photon Science, Paul Scherrer Institut, Villigen PSI 5225, Switzerland — [2]Shanghai Advanced Research in Physical Sciences, Shanghai 201203, P.R. China

The emergence of exfoliable magnetic van der Waals (vdW) materials with weak inter-layer correlations enables physicists to study magnetism directly in two dimensions (2D). Their sustained magnetic order and other novel magnetic properties down to the 2D limit make them promising candidates for spintronic applications. $CrPS_4$ is an A-type antiferromagnetic vdW material with strong correlations between spin, orbital, and structural degrees of freedom, and its highly unusual magnetic properties has been the subject of considerable scientific and practical interests. In this talk, I will present our temperature-dependent X-ray absorption spectroscopy (XAS) and resonant inelastic X-ray scattering (RIXS) measurements on bulk $CrPS_4$ crystals. Both the XAS and RIXS spectra display significant linear dichroism. In particular, the linear-dichroic RIXS intensity of one of the orbital excitations shows an order-parameter-like temperature dependence below the Néel temperature; and the dichroism entirely disappears in the paramagnetic phase. This evidence strongly supports the role of the orbital anisotropy as the shaping agent of the magnetic states in $CrPS_4$.

MA 30.5 Wed 10:30 POT/0151

Impact of deposition parameters on magnonic properties of α-Fe_2O_3 thin films. — •Katharina Müller[1,2], Tobias Herrlich[1,2], Monika Scheufele[1,2], Matthias Opel[1], Hans Huebl[1,2,3], Rudolf Gross[1,2,3], Akashdeep Kamra[4], Matthias Althammer[1,2], and Stephan Geprägs[1] — [1]Walther-Meißner-Institut, BAdW, Garching, Germany — [2]TUM School of Natural Sciences, Munich, Germany — [3]Munich Center for Quantum Science and Technology, Munich, Germany — [4]Department of Physics and Research Center OPTIMAS, RPTU Kaiserslautern-Landau, Kaiserslautern, Germany

Magnons in magnetic insulators are promising spin information carriers in future spintronic devices. For such applications, investigating and understanding the magnonic properties of thin films is crucial. Among the antiferromagnetic insulators, α-Fe_2O_3 is a prime example to study. Upon cooling, it features a Morin transition at 263 K from an antiferromagnetic easy-plane to an easy-axis phase below the Néel temperature. We obtain the magnetic anisotropy, the Dzyaloshinskii-Moriya interaction, as well as the magnon decay length from the magnon Hanle effect in all-electrical magnon transport experiments [1]. We study the dependence of these properties on the deposition parameters of α-Fe_2O_3 thin films grown on differently oriented Al_2O_3-substrates. Starting from a multi-domain state and driving the system with an external magnetic field, we use spin Hall magnetoresistance measurements to assess how the monodomainization field is influenced by the deposition parameters. [1] M.Scheufele *et al.*, APL Mater. **11**, 091115 (2023).

MA 30.6 Wed 10:45 POT/0151

Investigation of magnetic symmetries and domain imaging in antiferromagnetic Mn_2As via methods of electron microscopy — •Oleksandr Zaiets[1,2], Kamil Olejník[3], Filip Křížek[3], Jose Angel Castellanos-Reyes[4], Jan Rusz[4], Darius Pohl[2], and Axel Lubk[1,2] — [1]IFW Dresden, Germany — [2]TU Dresden, Germany — [3]Institute of Physics of the Czech — [4]Uppsala University, Sweden

Antiferromagnets are promising candidates for spintronic applications due to their ultrafast dynamics, low magnetic susceptibility, and lack of stray fields. Their switching behaviour is determined by the undisturbed antiferromagnetic ordering, the distribution of magnetic defects (notably domain walls) and their pinning to structural defects of the underlying crystal structure.

In this work we investigate antiferromagnetic Mn_2As thin films epitaxially grown on GaAs via methods of transmission electron microscopy, in particular high resolution imaging and electron diffraction. The antiferromagnetic ordering of Mn_2As entails a doubled magnetic unit cell compared to the structural one. This allows us to study purely magnetic Bragg reflections. The analysis of these reflections suggests the presence of a previously unknown antiferromagnetic phase. We furthermore reveal the presence of an antiferromagnetic domain structure by mapping the intensity of these reflections. We discuss stabilization mechanisms of this new AF ordering with the help of ab-initio methods. The strength of the antiferromagnetic signal is sufficient for domain mapping with sub-nanometer scale.

15 min break

MA 30.7 Wed 11:15 POT/0151

Creation of antiferromagnetic skyrmions by edge manipulation — •Aleksey Berg, Tim Matthies, and Elena Vedmedenko — University of Hamburg

Novel magnetic storage technologies rely on ferromagnetic topological objects to represent information. These objects can be created, propelled and annihilated by electric currents in racetracks. We have recently demonstrated theoretically that arbitrary sequences of coexisting ferromagnetic skyrmions and antiskyrmions can be processed via local rotations of magnetic moments at the edge of a rectangular slab, eliminating the need for global charge or spin currents [1]. This local manipulation can be achieved experimentally using rotating local magnetic fields or currents. Here, we demonstrate that edge rotation can be effectively applied to antiferromagnetic skyrmions, too. Furthermore, antiferromagnetic quasiparticles can be created and propelled without rotating the edge magnetisation, but rather by switching the local magnetisation at the racetrack edge. This low-energy manipulation of stable antiferromagnetic topological quasiparticles via local excitation would be highly advantageous in the field of antiferromagnetic spintronics. 1. P. Siegl et al., Phys. Rev. B 106, 014421 (2022)

MA 30.8 Wed 11:30 POT/0151

Field-induced spin-reorientation transitions in collinear antiferromagnet Cr_2O_3 — •Paulina J. Prusik[1,2], Igor Veremchuk[1], Florin Radu[3], Pavlo Makushko[1], Jürgen Fassbender[1,2], Kirill D. Belashchenko[4], Denys Makarov[1], and Oleksandr V. Pylypovskyi[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf e.V., 01328 Dresden, Germany — [2]Dresden University of Technology, Dresden 01062, Germany — [3]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin 12489, Germany — [4]University of Nebraska-Lincoln, Lincoln, NE 68588, USA

We classify collinear antiferromagnets (AMFs) by presence in their σ-model of a term of exchange origin that couples the external magnetic field and gradients of the Néel vector. One representative material is the magnetoelectric, room-temperature, collinear AFM Cr_2O_3, which is promising for spintronics applications [1,2] as well as for fundamental research [3,4]. In Cr_2O_3 this term leads to a texture-induced magnetization with a finite component along the crystallographic c axis. By analyzing the field-induced spin-reorientation transitions, we find the appearance of a phase in which a field-induced domain wall lies in the basal plane at fields below the spin-flop field. The theoretical predictions are supported by X-ray magnetic linear dichroism measurements, which show that the transition field in thin films is reduced by nearly half compared to the single crystal. [1] Hedrich et al., Nat. Phys. 17, 574 (2021) [2] Rickhaus, Prusik et al., Nano Letters 24, 13172 (2024) [3] Makushko et al., Nat. Comm. 13, 6745 (2022) [4] Pylypovskyi et al., Phys. Rev. Lett. 132, 226702 (2024)

MA 30.9 Wed 11:45 POT/0151

Direct Observation of Hidden Excitonic States via Exciton-Magnon Coupling in CrSBr — Sophie Bork[1], •Richard Leven[1], Vincent Wirsdörfer[1], Alessandro Ferretti[2], Rafael Rojas Lopez[1], Mattia Benini[1], David Maximilian Janas[1], Umut Parlak[3], Alberto Brambilla[2], Alexey Scherbakov[1], and Mirko Cinchetti[1] — [1]Department of Physics, TU Dortmund University, 44227 Dortmund, Germany — [2]CNR-IFN Dipartimento di Fisica, Politecnico di Milano, 20133 Milan, Italy — [3]Fachbereich Physik, Universität Konstanz, 78457 Konstanz, Germany

Two-dimensional van der Waals magnets exhibit strong exciton binding and intrinsic magnetic order, enabling exciton-magnon coupling that links collective spin excitations with excitonic states. However, detecting dark excitons and their coupling remains challenging. Here we employ broadband transient reflectivity on CrSBr, a quasi-two-dimensional antiferromagnetic semiconductor, to probe excitonic structures across 1.25 - 1.65 eV under varying magnetic fields. We identify two excitonic resonances: a bright 1s exciton at 1.36 eV and a dark exciton near 1.46 eV, the latter revealed solely through exciton-magnon interactions. The detected GHz magnon mode exhibits magnetic-field-dependent frequency shifts and coupling signatures with both excitons. High-energy excitation modifies magnon dispersion and enhances exciton-magnon hybridization. These findings provide direct insight into exciton-magnon coupling in CrSBr and demonstrate that ultrafast optical probes can uncover hidden excitonic states, advancing understanding of hybrid quasiparticles in van der Waals magnets.

MA 30.10 Wed 12:00 POT/0151

Rocket-like dynamics of ferrimagnetic domain walls in graded magnets — •Pietro Diona[1,2], Sergey Artyukhin[2], and Luca Maranzana[2,3] — [1]Scuola Normale Superiore di Pisa, Pisa, Italia — [2]Istituto Italiano di Tecnologia, Genova, Italia — [3]Università di Genova, Genova, Italia

The domain wall motion underpins emerging spintronic technologies, such as high-speed racetrack devices and THz logic. Spatially nonuniform magnetic exchange and anisotropy in ferromagnets can pin or accelerate domain walls [1,2]. In ferrimagnets, where Walker breakdown is suppressed, domain walls can therefore approach the magnon speed [3]. Here we show that in non-uniform ferrimagnets such gradients not only exert a net force on the ferrimagnetic domain walls, but also modify the effective mass of the wall, enabling an entirely new acceleration mechanism. As a domain wall travels through regions of varying exchange or anisotropy, it can shed or gain effective mass leading to a "rocket effect" as in variable-mass systems. This phenomenon becomes increasingly pronounced as the wall approaches the magnon velocity [3], providing a natural route to ultrafast domain-wall propulsion. Our analytical theory, supported by micromagnetic simulations, suggests strategies for mass control in racetrack devices. These results establish variable-mass domain walls as a new paradigm for efficient, high-velocity spintronics and THz-frequency magnetic technologies.

[1] F. N. Tan et al., Scient. Rep., 9, 7369 (2019).
[2] P. Diona et al., IEEE Trans. on Elec. Dev., 69(7), 3675 (2022).
[3] P. Diona et al., Adv. Func. Mat., e22549 (2025).

MA 30.11 Wed 12:15 POT/0151

Revealing Magnetic Chirality in Non-Collinear Kagome Antiferromagnets through Spin-Seebeck Measurements — •Feodor Svetlanov Konomaev, Mithuss Tharmalingam, and Kjetil Magne Dørheim Hals — Department of Engineering Sciences, University of Agder, 4879 Grimstad, Norway

Non-collinear antiferromagnets (NCAFMs) are appealing for antiferromagnetic spintronics, as they combine the advantages of collinear antiferromagnets with novel emergent phenomena stemming from their complex spin structures. These phenomena are often associated with the intrinsic spin chirality, which characterizes the handedness of the ground-state spin configuration. Here, we investigate a kagome NCAFM interfaced with a normal metal and demonstrate that the groundstate vector spin chirality can be probed through measurements of the spin Seebeck effect (SSE). Starting from a microscopic spin Hamiltonian, we derive the corresponding bosonic Bogoliubov-de-Gennes Hamiltonians for the two chiral configurations. Using linear response theory, we obtain a general expression for the spin current thermally pumped into the normal metal by the SSE. We show that a sizable in-plane spin current emerges exclusively in the negative-chiral state, providing a direct signature for real-time detection of chirality switching in kagome NCAFMs. In addition, we find a field-dependent out-of-plane spin current whose magnitude differs between the two chiralities, reflecting their distinct magnon band structures

MA 30.12 Wed 12:30 POT/0151

Strain engineering of antiferromagnetic $LaFeO_3$ films for magneto-optical investigations — •Antonia Rieche, Wolfgang Hoppe, Chis Körner, Aurora Diana Rata, Andreas Herklotz, and Kathrin Dörr — Martin-Luther-Universität Halle-Wittenberg

$LaFeO_3$ is a representative member of the orthoferrites. This antiferromagnet exhibits a high Néel temperature of 740 K. A weak net magnetization is created due to a small tilting of the magnetic moments. $LaFeO_3$ is considered to be a promising candidate for antiferromagnetic spintronics.

While the magneto-optical Kerr effect (MOKE) has been used to investigate bulk crystals, only a single study has reported MOKE data for $LaFeO_3$. [1]

Our work demonstrates the magnetic switching behavior of coherently strained $LaFeO_3$ films. The strain states were generated using different substrates and helium implantation. [2] The films were grown using pulsed laser deposition (KrF 248 nm), and their strain state was analyzed by X-ray diffraction.

Longitudinal MOKE hysteresis and microscopy measurements revealed a strain-dependent orientation of the magnetization axis, which is consistent with predictions from density functional theory. [3] Further single-domain remanence has been confirmed.

[1] J. Alaria et al., Chem. Sci. 5, 1599 (2014)
[2] A. Herklotz et al., Adv. Science, 5, 1800356 (2018)
[3] A. J. Mao et al., RSC Adv. 6, 100526 (2016)

MA 31: Frustrated Magnets II (joint session MA/TT)

Time: Wednesday 9:30–12:45 Location: POT/0361

MA 31.1 Wed 9:30 POT/0361

Finite-size spectral signatures of order by quantum disorder: A perspective from Anderson's tower of states — •Subhankar Khatua[1], Griffin C. Howson[2], Michel J. P. Gingras[2], and Jeffrey G. Rau[3] — [1]IFW Dresden, Germany — [2]University of Waterloo, Canada — [3]University of Windsor, Canada

In frustrated magnetic systems with a subextensive number of classical ground states, quantum zero-point fluctuations can select a unique long-range ordered state, a celebrated phenomenon referred to as order by quantum disorder (ObQD). While ObQD is well understood in the semiclassical, large spin length limit, its behavior in quantum spin-1/2 systems is less clear. As exact analytical solutions are scarce for frustrated systems, numerical approaches are essential. We show that ObQD can be identified from exact diagonalization (ED) calculations through an analysis akin to the Anderson tower of states associated with spontaneous symmetry breaking. By defining an effective quantum rotor model, we describe the competition between ObQD-induced localization of the rotor and its tunneling between symmetry-related ground states, identifying the crossover lengthscale from the finite-size regime where the rotor is delocalized, to the infinite system-size limit where it becomes localized. This rotor model relates the characteristic splittings in the ED energy spectrum to the ObQD selection energy scale, providing an estimate that can be compared to spin wave calculations. We demonstrate the general applicability of this approach in one-, two- and three-dimensional frustrated spin models that exhibit ObQD.

MA 31.2 Wed 9:45 POT/0361

Magnetic resonance experiments on the quantum spin liquid candidate $YbCuSe_2$ — Madhurima Biswas[1], •Marlis Schuller[3], Khokan Bhattacharya[1], Yoshifumi Tokiwa[2], Mamoun Hemmida[3], Hans-Albrecht Krug von Nidda[3], Norbert Büttgen[3], István Kézsmárki[3], and Mayukh Majumder[1] — [1]Department of Physics, Shiv Nadar Institution of Eminence, IN — [2]Advanced Science Research Center, Japan Atomic Energy Agency, JPN — [3]EPV, Institut of Physics, University of Augsburg, DE

Frustrated magnetism in triangular-lattice delafossites offers a fertile route to realising quantum spin liquids (QSL) beyond conventional ordered phases. Among these materials a new candidate, $YbCuSe_2$, stands out as a QSL candidate from the present study. Magnetisation and ESR measurements on high-quality single crystals of $YbCuSe_2$ reveal easy-plane anisotropy. Furthermore, heat-capacity measurements down to 400 mK and μSR measurements down to 30 mK show no signatures of long-range magnetic ordering, establishing this compound as a promising QSL candidate. To probe the low-energy spin dynamics, we performed ^{63}Cu ($I = 3/2$) NMR measurements down to 20 mK. We document in-plane and out-of-plane spin-lattice relaxation T_1 as a function of temperature in an applied field of approximately 4 T. A dynamical phase separation was observed below 0.7 K, where one phase corresponds to the disorder-induced state, whereas the temperature evolution of the relaxation rate of the other phase exhibits a power-law divergence indicative of some quantum-critical spin fluctuations due to the proximity to a field-induced ordered state.

MA 31.3 Wed 10:00 POT/0361

Fluctuation driven phases in the triangular lattice — •P. Peter Stavropoulos[1], Roser Valentí[1], and Johannes Knolle[2] — [1]Goethe University, Frankfurt, Germany — [2]Technical University of Munich, Garching, Germany

The triangular lattice has proven to be a model platform of frustrated magnetism, with a rich landscape of emergent phases. It is also an experimentally accessible platform, with many family of materials showing quasi-2D triangular arrangements of magnetic ions. Motivated by this, we revisit magnetic exchange models on the triangular lattice. We discuss phases that are stabilized by order by disorder mechanisms, and comment on their observable signatures.

MA 31.4 Wed 10:15 POT/0361

Frustrated spin-1/2 chains in a correlated metal Ti4MnBi2 — •Xiyang Li and Meng Lyu — No.8, 3rd South Street, Zhongguancun, Haidian District, Beijing, China, 100190

Electronic correlations lead to heavy quasiparticles in three-dimensional(3D) metals, and their collapse can destabilize magnetic moments. It is an open question whether there is an analogous instability in one-dimensional (1D) systems, unanswered due to the lack of metallic spin chain materials. We report neutron scattering measurements and density matrix renormalization group calculations establishing spinons in the correlated metal Ti4MnBi2, confirming that its magnetism is 1D. Ti4MnBi2 is inherently frustrated, forming near a quantum critical point that separates different phases at temperature T = 0. One-dimensional magnetism dominates at the lowest T, and is barely affected by weak interchain coupling. Ti4MnBi2 is a previously unrecognized metallic spin chain in which 3D conduction electrons become strongly correlated due to their coupling to 1D magnetic moments.

MA 31.5 Wed 10:30 POT/0361

Low-temperature spin-freezing in frustrated zirconates $Tb_2Zr_{2-x}Ti_xO_7$ — •Frederik Leon Carstens[1], Sujata Singh[2], C. S. Yadav[2], and Rüdiger Klingeler[1] — [1]Kirchhoff Institute for Physics, Heidelberg University, Germany — [2]School of Physical Sciences, IIT Mandi, India

We report on magnetic studies of polycrystalline $Tb_2Zr_{1-x}Ti_xO_7$ ($x = 0, 0.5$). The zironates possess significant cationic disorder due to similar radii of the cations which introduces magnetic frustration. The materials are investigated by means of low-temperature ac and dc magnetization measurements in magnetic fields up to 7 T and down to 400 mK. Long-range magnetic order is not found down to $T = 400$ mK. However, in small magnetic fields, we observe a low-temperature spin-frozen state below $T = 1.4$ K and a slow spin relaxation regime which is significantly enhanced in static magnetic fields, e.g. to 15 K at $B = 2$ T. A similar behavior has been previously reported for the related rare-earth zirconate $Ho_2Zr_2O_7$ and in the hafnate $Tb_2Hf_2O_7$ [1,2].

[1] A. Elghandour et al., Phys. Rev. B **110**, 064408 (2024)
[2] V. K. Anand et al., Phys. Rev. B **97**, 094402 (2018)

MA 31.6 Wed 10:45 POT/0361

Magnetization plateaus, spin-canted orders and field-induced transitions in a spin-1/2 Heisenberg antiferromagnet on a distorted diamond-decorated honeycomb lattice — •Katarina Karlova and Jozef Strecka — Pavol Jozef Safarik University in Kosice, Slovakia

We investigate the spin-1/2 Heisenberg antiferromagnet on a distorted diamond-decorated honeycomb lattice in an external magnetic field. Using density-matrix renormalization group, sign-problem-free quantum Monte Carlo, exact diagonalization, and an effective lattice-gas approach based on localized-magnon physics, we determine the ground-state phase diagram and analyze the finite-temperature magnetization process.

The model hosts a rich variety of frustration-induced quantum phases, including Lieb-Mattis ferrimagnetic states, spin-canted regimes, monomer-dimer and dimer-tetramer phases, and dimensional-crossover states with 0D or 1D character. Depending on the lattice distortion, we identify robust magnetization plateaus at 0, 1/4, 1/2, and

3/4 of the saturation value, originating from competing local singlet clusters, composite spins, and flat-band localized magnons. Finite-temperature QMC data show how thermal fluctuations progressively smear the plateau structure, while the effective lattice-gas description reliably captures the corresponding low-temperature trends.

Funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V04-00403.

15 min break

MA 31.7 Wed 11:15 POT/0361

Effect of Ca-doping on the exotic quantum spin liquid states of Y3Cu2Sb3O14 — •Muhammad Usama Akbar[1], Hans-Albrecht Krug von Nidda[1], Mamoun Hemmida[1], Avinash Mahajan[2], and Saikat Nandi[2] — [1]Experimental Physics V, Center for Electronic Correlations and Magnetism, University of Augsburg, D-86135 Augsburg, Germany — [2]Department of Physics, Indian Institute of Technology, Mumbai, 400076, India

The three-dimensional spin S = 1/2 compound Y3Cu2Sb3O14 was recently identified as a promising candidate for novel quantum spin liquid (QSL) behavior, with two inequivalent Cu2+ sites in edge-sharing triangles and no long-range order observed in multiple experiments [1]. NMR detects a transition near 120 K, associated with partial singlet formation, while muSR and DFT indicate frustrated antiferromagnetic interactions around both Cu+2 sites. ESR shows a Lorentzian line (g = 2.16) above 120 K that splits into two components on cooling, with only a part of spins being ESR-active. In the current work, we extend this investigation to Ca-doped Y3-xCaxCu2Sb3O14 (x = 0.05, 0.10, 0.25), to examine how chemical substitution at the Y site influences the spin dynamics of the compound.

[1] S. Nandi et al. (2025), arXiv:2509.15835 [cond- mat.str-el]

MA 31.8 Wed 11:30 POT/0361

Synthesis and *H*-*T* phase diagram of $Cu_2(OH)_3HCOO$ — •Issei Niwata[1,2], Kaushick K. Parui[1], Maxim Avdeev[3], Anton A. Kulbakov[1], Dmytro S. Inosov[1], and Darren C. Peets[1] — [1]TU Dresden, Dresden, Germany — [2]Hokkaido University, Sapporo, Japan — [3]ANSTO, Sydney, Australia

$Cu_2(OH)_3X$ (X = monovalent anion) consists of quasi one-dimensional (1D) ferromagnetic (FM) and antiferromagnetic (AFM) chains which alternate to form two-dimensional triangular layers, which are stacked along the c axis. As the interchain interactions are frustrated and interlayer interactions are weak, the system can be regarded as weakly coupled 1D FM and AFM chains. In bulk measurements, these compounds typically show AFM behavior with a Néel temperature (T_N) below 10 K. Because of the coexistence of FM and AFM chains, exotic magnetic excitations are expected. As a matter of fact, for $X = Br^-$, inelastic neutron scattering revealed magnon excitations and a gapped spinon continuum in the same energy range. In addition, for $X = NO_3^-$, the realization of a Tomonaga-Luttinger-liquid state in the AFM chain was suggested in magnetic fields around 20 T, where the magnetization shows a half saturation indicating full polarization of the FM chains. Recently, we grew single crystals of the $X = HCOO^-$ compound. Magnetization measurements showed $T_N = 5.4$ K and a half saturation below 5 T, much lower than $X = NO_3^-$. This suggests that we can explore the excitation structure in relatively low magnetic fields. I will discuss the phase diagram obtained by physical properties measurements.

MA 31.9 Wed 11:45 POT/0361

***H*–*T* Phase Diagram of the Frustrated Quantum Magnet Antlerite, $Cu_3SO_4(OH)_4$** — •Darren C. Peets[1], Nikolai S. Pavlovskii[1], Roman Gumeniuk[2], Sergey Granovsky[1], and Dmytro S. Inosov[1] — [1]IFMP, TU Dresden, Germany — [2]IEP, TU Bergakademie Freiberg, Germany

The magnetic copper sites in antlerite, $Cu_3SO_4(OH)_4$, are arranged in three-leg triangular-lattice ladders, a unique magnetic lattice. In the ground state, the outer legs are ferromagnetic and antialigned, while the central leg is antiferromagnetic. This material has four distinct magnetic states in zero field alone, and we show that the phase diagram in applied fields is also remarkably rich.

MA 31.10 Wed 12:00 POT/0361

Magnetic structure of a geometrically frustrated Mn3V2Ge3O12 garnet oxide — •Sagar Mal Kumawat[1], Tsai-Ling Liu[1], Chin-Wei Wang[2], Jia-Xiang Hsu[1,3], En-Pei Liu[3], Wei-Tin Chen[3,4,5], and Chien-Lung Huang[1] — [1]Department of Physics and Center for Quantum Frontiers of Research & Technology (QFort), National Cheng Kung University, Tainan 701, Taiwan — [2]National Synchrotron Radiation Research Center, Hsinchu 30076, Taiwan — [3]Center for Condensed Matter Sciences, National Taiwan University, Taipei 10617, Taiwan — [4]Center of Atomic Initiative for New Materials, National Taiwan University, Taipei 10617, Taiwan — [5]Taiwan Consortium of Emergent Crystalline Materials, National Science and Technology Council, Taipei 10622, Taiwan

We investigated the low-temperature magnetic structure and thermodynamic properties of Mn3V2Ge3O12 (MVGO) using neutron diffraction, magnetic, and heat capacity measurements. MVGO crystallizes in a cubic Ia-3d structure with a minor MnV2O4 impurity. Two successive transitions at TN1 = 4 K and TN2 = 2.4 K indicate noncollinear antiferromagnetic ordering of the frustrated V3+ and Mn2+ sublattices. Field-dependent heat capacity shows suppression of the TN1 anomaly and a shift of TN2, consistent with magnetic frustration and spin reorientation. The total magnetic entropy reaches approximately 51 J/mol K above 20 K, accounting for ~81% of the theoretical entropy for the full spin system. Temperature-dependent measurements reveal noncollinear antiferromagnetic order below TN2, with peak broadening up to TN1 indicating strong spin frustration.

MA 31.11 Wed 12:15 POT/0361

Crystallographic and magnetic structure of Pr_2PdSi_3: a single crystal neutron diffraction study — •Matthias Frontzek — Neutron Scattering Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA

The intermetallic compound series R_2PdSi_3 (R = rare earth metal) exhibits intriguing magnetic properties, including giant magnetoresistance, pronounced anisotropy in its electronic behavior, and a generic field-induced phase. The magnetic structures are complex, with large magnetic unit cells arising from the delicate interplay between competing crystal electric-field effects, magnetic exchange interactions, and geometric frustration. Recently, the discovery of a Skyrmion lattice in Gd_2PdSi_3 has renewed interest in the magnetic properties of this series.

In our contribution, we present a detailed neutron single crystal diffraction study using the $WAND^2$ diffractometer at the High-Flux Isotope Reactor (HFIR) at ORNL. In heavy rare earth members, Pd/Si ordering lowers the symmetry from hexagonal to monoclinic; in contrast, the Pr_2PdSi_3 compound adopts an orthorhombic structure with a $2*a, 2*b, 4*c$ unit cell relative to the primitive hexagonal cell. Magnetic order setting in at $T_N = 2.1$K is preceded by broad diffuse scattering around the nuclear reflections, and below T_N a long-wavelength spin-density wave is observed coinciding with the short-range order evidenced by the diffuse scattering.

MA 31.12 Wed 12:30 POT/0361

Dynamical heterogeneity and fractal subdiffusive transport in spin-ice — •Malte Bieringer[1], Gianluca Teza[1,2], Claudio Castelnovo[3], and Roderich Moessner[1] — [1]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Straße 38, 01187 Dresden, Germany — [2]Department of Physics, University of Trieste, Strada Costiera 11, 34136 Trieste, Italy — [3]TCM Group, Cavendish Laboratory, University of Cambridge, Cambridge CB3 0HE, UK

Spin ice is a paradigmatic model that, despite its simplicity, enables the exploration of rich and robust emergent phenomena in topological magnets. Here we uncover a novel set of spin-ice phenomenology typically associated with vitrification processes in disordered systems.

We identify a pronounced peak in dynamical heterogeneity in a classical spin-ice model on the three-dimensional pyrochlore lattice, in the complete absence of disorder and - remarkably - in thermal equilibrium. At low temperatures, additional dynamical constraints emerge that confine the motion of magnetic monopole excitations to three-dimensional percolation clusters. This gives rise to ergodic subdiffusion, opposing conventional emergent hydrodynamics. The observed dynamical heterogeneity arises without disorder or ergodicity breaking, distinguishing it from conventional glasses and systems with Hilbert space fragmentation, suggesting a generic feature of topological magnets hosting deconfined quasiparticles.

Our results motivate the search for materials and artificial spin-ice realizations of this physics and propose higher-order dynamical correlations as a distinctive experimental signature of topological magnetism.

MA 32: Excursion: Current and Future High-Field THz User Facilities at HZDR

As part of the Focus Session "Chiral phonons and crystals coupled to magnetic order" and open to all interested potential users, we offer a tour of the high-field THz user facilities at Helmholtz-Zentrum Dresden-Rossendorf (HZDR) and an introduction to the planned Dresden Advanced Light Infrastructure (DALI). The superconducting accelerator-based THz beam lines TELBE and FELBE currently provide extreme THz and mid-infrared pulse energies at high repetition rates for international users from around the globe. In 2025, DALI was announced as one of the 9 shortlisted priority research infrastructures in Germany. It has been selected as a world-leading THz facility by the Federal Ministry for Research, Technology, and Space (BMFTR) to secure and enhance Germany's long-term research capabilities for the next decades. The guided tour includes a bus transfer to the Rossendorf site, lab visits at the current ELBE facilities and an introduction to DALI.

As the number of participants is limited, registration is required latest by 6 March 2026, using the following link https://events.hifis.net/e/DPG-2026_HZDR-excursion. The meeting point will be provided after registration.

Contact: Sebastian F. Maehrlein, s.maehrlein@hzdr.de

Time: Wednesday 14:00–17:30 Location: HZDR

Excursion

MA 33: Altermagnets IV

Time: Wednesday 15:00–18:30 Location: HSZ/0002

MA 33.1 Wed 15:00 HSZ/0002

Magnon transport and surface effects in an altermagnetic toy model — •Moumita Kundu[1], Rabea Schmidhuber[2], Marian Duelli[1], and Ulrich Nowak[1] — [1]Fachbereich Physik, Universität Konstanz, Konstanz, Germany — [2]Ludwig-Maximilians-Universität München, Geschwister-Scholl-Platz 1, 80539 München, Germany

Altermagnets are a recently discovered class of magnetic materials that show non-relativistic spin-splitting of the magnon bands and on exposure to a thermal gradient can carry a net magnetization unlike conventional antiferromagnets. Here, we present a simplistic toy model of an altermagnet having asymmetric exchange interactions in a checkered antiferromagnetic lattice. Using atomistic spin dynamic simulations based on the stochastic-LLG equation we obtain the spin dynamics. The altermagnetic phase is confirmed from magnon dispersions under a steady thermal excitation revealing chiral spin splitting as expected along one of the high-symmetry directions [110] and directions orthogonal to it. Surface effects are a direct outcome from these calculations, showing an orientation dependent surface magnetization detected for each cut of the sample. The spin Seebeck and spin Nernst effects are investigated both showing unique orientation dependent net magnetization and magnon accumulations following the lattice symmetries. Owing to the nondegenerate magnons branches, the group velocities of the corresponding magnons vary leading to distinct propagation lengths of the RH- and LH- modes predominant along different directions. The robustness to external magnetic fields is explored revealing preferential band liftings with an additional gap at the Γ point.

MA 33.2 Wed 15:15 HSZ/0002

Skyrmion dynamics in altermagnets — •Nicolai Timon Bechler and Jan Masell — Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

Altermagnetism is a new type of magnetic order that combines the time-reversal symmetry breaking nature of ferromagnetism with the stray-field free nature of antiferromagnetism. [1] Altermagnets can host skyrmions - whirling magnetic textures that are characterized by an integer real-space topological winding number. In d-wave altermagnets, the skyrmions in both sublattices are elliptical, related by lattice symmetries, and the total winding number vanishes as the contributions of each sublattice cancel each other. In this talk, we explore the motion of skyrmions in d-wave altermagnets, driven by either spin transfer torque (STT) or a magnon current. We combine an analytical collective-coordinate approach with high-precision micromagnetic simulations. Our findings predict that the anisotropic skyrmion profile yields a genuine Hall response beyond conventional Zhang-Li STT. In turn, standard Zhang-Li STT yields no Hall-signal but large artifacts in simulations which were previously misinterpreted as a physical Hall effect. [2] Furthermore, we show that for a system driven by a magnon current, the anisotropic scattering cross-sections immediately lead to a skyrmion Hall effect.

[1] L. Šmejkal et al., Emerging Research Landscape of Altermagnetism. Phys. Rev. X 12, 040501 (2022). [2] Z. Jin et al., Skyrmion hall effect in altermagnets. Phys. Rev. Lett. 133, 196701 (2024).

MA 33.3 Wed 15:30 HSZ/0002

Unconventional Magnetism in Fe-Based Materials — Reuel Dsouza[1], Andreas Kreisel[1], Brian M. Andersen[1], Daniel Agterberg[2], and •Morten H. Christensen[1] — [1]Niels Bohr Institute, University of Copenhagen, 2200 Copenhagen, Denmark — [2]Department of Physics, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201, USA

Odd-parity magnetism constitutes an intriguing phase of matter which breaks inversion symmetry while preserving time-reversal symmetry. Here we demonstrate that the Fe-based superconductors exhibiting coplanar magnetic order realize an odd-parity magnetic state by combining low-energy modeling with density-functional theory. In the absence of spin-orbit coupling, the electronic spins are polarized along the k_z-direction and the splitting of the up and down states exhibits an h- wave form-factor. The magnitude of the splitting depends sensitively on specific parameters of the low-energy model, including specific out-of-plane hopping parameters and the Fermi energies of the hole- and electron-pockets. Interestingly, despite this state breaking inversion symmetry and exhibiting a finite out-of-plane Berry curvature and non-linear anomalous Hall effect, the Edelstein effect vanishes. Incorporating spin-orbit coupling tilts the momentum-space electronic spins into the (k_x, k_y)-plane and imparts finite in-plane components to the Edelstein response. Our findings highlight the Fe-based superconductors as platforms for exploring odd-parity magnetism both on its own and coexisting with unconventional superconductivity.

MA 33.4 Wed 15:45 HSZ/0002

Optical investigations of electron-doped $FeSb_2$ — Renjith Mathew Roy[1], •Maxim Wenzel[1], Maksim Povolotskiy[1], Christian Prange[1], Artem Pronin[1], Yujie Xie[2], Tiantian Zhang[2], Vignesh Sundaramurthy[3], Maximilian van de Loo[4], Jule Kirschke[4], Andreas Kreyssig[4], Anna Böhmer[4], and Martin Dressel[1] — [1]1. Physikalisches Institut, Universität Stuttgart — [2]Institute of Theoretical Physics, Chinese Academy of Science, 100190 Beijing, China — [3]Max-Planck-Institute for Solid State Research, 70569 Stuttgart — [4]Experimental Physics IV, Ruhr Universität Bochum

While the marcasite-structured semiconductor $FeSb_2$ is nonmagnetic, theoretical predictions suggest that hole or electron doping can stabilize an altermagnetic order with a substantial non-relativistic spin splitting of approximately 0.2 eV [1].

Here, we investigate a series of Co-doped $FeSb_2$ samples using optical spectroscopic techniques including broadband infrared spectroscopy, Müller-matrix ellipsometry, and Raman scattering. Combined with density-functional theory calculations, we discuss the effects of electron doping and the consequent magnetic ordering on the electronic structure and optical phonon modes. In particular, we address the possibility of an emerging altermagnetic state for dopings above $x = 0.12$. [1] I. I. Mazin, K. Koepernik, M. D. Johannes, R. González-Hernández, L. Šmejkal, PNAS **118**, e2108924118 (2021)

MA 33.5 Wed 16:00 HSZ/0002

Realization of epitaxial thin films of CrSb altermagnetic candidate material — •Edouard Lesne and Claudia Felser — Max-Planck-Institute für Chemische Physik fester Stoffe

CrSb belongs to a newly identified class of antiferromagnetically ordered materials coined altermagnets, whose spin-sublattices arrangement breaks time-reversal symmetry, giving rise to alternating spin-split bands with lifted Kramers degeneracy throughout the Brillouin zone. CrSb crystallizes in the hexagonal NiAs-type structure ($P6_3/mmc$) and exhibits a high antiferromagnetic ordering temperature (700-710 K), making it an ideal altermagnetic candidate material for room-temperature studies and prospective technological use in antiferromagnetic spintronic architectures.

We resort to a combination of X-ray diffraction, SQUID magnetometry and electrical magnetotransport techniques to investigate the intertwined structural, magnetic, and electronic transport properties of CrSb epitaxial thin films. We explore the growth of CrSb crystalline films by magnetron sputtering on a variety of crystalline seed layers and underlying single-crystalline substrates with hexagonal or cubic symmetry, which allows the stabilization of different crystallographic orientations of CrSb, while also tuning epitaxial strain. This work, while providing a testbed for the fundamental study of altermagnets and their structure-properties relationship, also opens avenues for the use of altermagnetic CrSb for antiferromagnetic devices with new functionalities relying on the manipulation of charge, orbital and spin degrees of freedom.

MA 33.6 Wed 16:15 HSZ/0002

Emergent d-Wave Order from Altermagnetic Symmetry in Cuprate and Nickelate Superconductors — •Tom G. Saunderson[1], James F. Annett[2], and Samir Lounis[1] — [1]Institute of Physics and Halle-Berlin-Regensburg Cluster of Excellence CCE, Martin-Luther-University Halle-Wittenberg, Halle(Saale) 06120, Germany — [2]H. H. Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol BS8-1TL, United Kingdom

Since the discovery of cuprate high-T_c superconductivity, numerous theoretical frameworks have been proposed to explain its mechanism. Anderson's RVB picture [1] and U(1) gauge theory [2], for example, motivate a minimal one-band description that largely integrates out the role of oxygen. By contrast, 'altermagnetism' [3] produces a d-wave like k-space magnetic texture originating from alternatingly rotated *nonmagnetic* cages. In this talk, we take the central ideas of altermagnetism and apply them to both cuprate and nickelate families of superconductors. We show that the in-plane oxygen sublattice of CuO_2/NiO_2 layers, ubiquitous in these materials, intrinsically realizes the same symmetry. By imposing an *oxygen-centered*, staggered s-wave pairing, one obtains a d-wave gap with perfect C_4 symmetry, demonstrated self-consistently in $NdNiO_2$ from first principles. This description of superconductivity enables a direct mapping between a real-space order parameter and a lattice-based picture, opening the possibility of treating superconductivity and Hubbard-model physics on the same footing. [1] Science **235**, 1196 (1987); [2] Phys. Rev. Lett. **76**, 503 (1996); [3] Phys. Rev. X **12**, 031042 (2022).

15 min break

MA 33.7 Wed 16:45 HSZ/0002

Medium-Throughput Evaluation of Topological Transports for Altermagnets — •Fu Li[1], Bo Zhao[1], Shengqiao Wang[2], Chen Shen[1], Hao Wang[1], and Hongbin Zhang[1] — [1]Institute of Materials Science,Technical University of Darmstadt, 64287 Darmstadt, Germany — [2]School of Materials Science and Engineering, Jilin University, Changchun, 130012, China

The recent surge of interest in altermagnetism, distinct from both ferromagnetism and antiferromagnetism, highlights its potential for a wide range of technological applications. Quantifying their topological transport properties can provide essential guidance on the characterization of such materials while assessing their suitability for spintronic and optical applications. In this work, we collect around 200 known altermagnets (including also those with odd parity) based on symmetry arguments and perform medium-throughput density functional theory calculations to evaluate their topological transport properties such as anomalous Hall conductivity, magneto-optical Kerr effect, and shift current. Focusing on cases with broken inversion symmetry (i.e., polar altermagnets and odd-parity magnets), it is observed that the shift current can be large, making them promising for bulk photovoltaic applications. Furthermore, taking ferroelectric Fe2Mo3O8 as an example, it is demonstrated that its shift current can be controlled by external electric fields. Our results provide significant features characterizing altermagnets, and the obtained electronic structure can be starting point to investigate other intriguing physical properties.

MA 33.8 Wed 17:00 HSZ/0002

Electronic Raman spectroscopy in altermagnet MnTe — •Garima Garima[1,2,3], Thomas Böhm[1,3], Rudi Hackl[3], Bernd Büchner[1,3], and Jochen Geck[1,2] — [1]Institut für Festkörper- und Materialphysik, Technische Universität Dresden, 01062 Dresden, Germany — [2]Würzburg-Dresden Cluster of Excellence ct.qmat, Technische Universität Dresden, 01062 Dresden, Germany — [3]Leibniz Institute for Solid Sate and Materials Research Dresden, Helmholtzstrasse 20, D-01069 Dresden, Germany

Altermagnets, the new class of magnets, are promising candidates to realize spintronic and spin-information processing devices. The new magnetic state is characterized by broken time-reversal symmetry, resulting in spin-split bands in momentum space and hence provides a basis to foster chiral magnetic excitations. Here, we utilize electronic Raman scattering to investigate chirality in the hexagonal altermagnet MnTe. In consistency with RIXS experiments [1], our polarization-resolved results reveal optical signatures of 2-magnon excitations, appearing below the magnetic transition temperature of 310 K in the chiral A_{2g} channel. [1] Jost, D., et al. Chiral altermagnon in MnTe. arXiv preprint arXiv:2501.17380.

MA 33.9 Wed 17:15 HSZ/0002

Optically tunable spin transport in bilayer altermagnetic Mott insulators — Niklas Sicheler[1], Roberto Raimondi[2], Giorgio Sangiovanni[1], and •Lorenzo Del Re[1] — [1]Würzburg University — [2]Roma Tre

Altermagnets are a class of materials in which antiferromagnetic order coexists with non-relativistic spin splitting (NRSS), offering a promising route to spintronic functionalities without relying on strong spin*orbit coupling. In this work, we study a two-dimensional bilayer Mott insulator that realizes an altermagnetic phase shaped by the interplay between spin and layer degrees of freedom. This coupling produces a rich symmetry-breaking structure in which magnetic order is intertwined with inter-layer excitonic correlations. The layer polarization*tunable through an external gate voltage*acts as a key control parameter for this excitonic altermagnetic state. We demonstrate that an in-plane electric field applied with opposite signs across the layers generates a polarization current, which in turn drives a spin current within each layer. While the polarization current itself is isotropic, the induced spin current is highly anisotropic and can be reversed by tuning the photon energy. These results identify a mechanism for electrically and optically manipulating spin transport in correlated altermagnets, and highlight the central role of excitons in enabling controllable spin responses.

MA 33.10 Wed 17:30 HSZ/0002

Microscopic origin of the magnetic interactions and their experimental signatures in altermagnetic La2O3Mn2Se2 — •Laura Garcia-Gassull[1], Aleksandar Razpopov[1], Panagiotis P. Stavropoulos[1], Igor I. Mazin[2], and Roser Valentí[1] — [1]Goethe-Universität Frankfurt, Germany — [2]George Mason University, Fairfax, USA

Our analysis on the altermagnetic candidate La2O3Mn2Se2, realized on an inverse Lieb lattice, combines ab initio calculations, analytical modeling and spin-wave theory. We resolve a contradiction within the existing literature, where the GKA rules for half-filled orbitals have been applied, instead of the high-spin configuration ones. By studying the exchange pathways we show that the antiferromagnetic nearest-neighbor dominates over the next-nearest-neighbor coupling, since both direct exchange and superexchange cooperatively stabilize the magnetic ground state.

Going beyond static interactions, we compute the magnon spectrum within linear spin-wave theory and identify experimental signatures of the altermagnetic exchange, a characteristic chiral splitting of magnon bands driven the inequivalent second-neighbor exchanges.

Our work not only clarifies the microscopic origin of altermagnetism, but also offers concrete predictions for its experimental verification, reinforcing La2O3Mn2Se2 as a model system for studying altermagnetic physics. You can find more details at: https://arxiv.org/pdf/2506.21661.

We thank the (DFG) through the TRR 288 (project B05).

MA 33.11 Wed 17:45 HSZ/0002

Altermagnetic Magnons in MnTe Probed by CD-RIXS — Daniel Jost[1,2], Resham B. Regmi[3,4], Eder G. Lomeli[5,1], Samuel Sahel-Schackis[6,2,7], •Monika Scheufele[8,9], Marcel Neuhaus[2], Rachel Nickel[10], Flora Yakhou[10], Kurt Kummer[10], Nicholas B. Brookes[10], Lingjia Shen[2], Georgi L. Dakovski[2], Nirmal J. Ghimire[3,4], Stephan Geprägs[8], and Matthias F. Kling[6,2,11] — [1]Stanford Inst. for Material and Energy Science, SLAC, USA — [2]Linac Coherent Light Source, SLAC, USA — [3]Dept. of Physics and Astronomy, Univ. of Notre Dame, USA — [4]Stravropoulos Center for Complex Quantum Matter, Univ. of Notre Dame, USA — [5]Dept. of Materials Science and Engineering, Stanford Univ., USA — [6]Stanford PULSE Inst., SLAC, USA — [7]Dept. of Physics, Stanford Univ., USA — [8]Walther-Meißner-Inst., BAdW, Germany — [9]TUM School of Natural Sciences, Physics Dept., TUM, Germany — [10]ESRF, France — [11]Dept. of Applied Physics, Stanford Univ., USA

Altermagnetism has emerged as a novel magnetic order combining features of both ferro- and antiferromagnetism. Despite their compensated spin structure, altermagnets exhibit symmetry-induced momentum-dependent splitting of magnon bands with well-defined chirality. This splitting must reflect the material's point-group symmetry. Here, we demonstrate the chiral character of these magnons by circular-dichroism resonant inelastic X-ray scattering (CD-RIXS) on altermagnetic α-MnTe [1]. We reveal momentum-dependent dichroism, indicating the polarization-dependent magnon splitting consistent with a g-wave symmetry. [1] D. Jost *et al.*, arXiv:2501.17380v2 (2025).

MA 33.12 Wed 18:00 HSZ/0002

Robust spin splitting and optical control in a layered altermagnet — •Alessandro De Vita[1,2], Chiara Bigi[3], Davide Romanin[4], Ralph Ernstorfer[1,2], Ilija Zeljkovic[5], Younghun Hwang[6], Matteo Calandra[7], Jill A. Miwa[8], and Federico Mazzola[9] — [1]Institut für Physik und Astronomie, Technische Universität Berlin — [2]Fritz Haber Institut der Max Planck Gesellshaft — [3]Synchrotron SOLEIL — [4]Université Paris-Saclay, CNRS — [5]Department of Physics, Boston College — [6]Electricity and Electronics and Semiconductor Applications Ulsan College — [7]Department of Physics, University of Trento — [8]Department of Physics and Astronomy, Interdisciplinary Nanoscience Center, Aarhus University — [9]Dipartimento di Fisica e Astronomia Galileo Galilei, Padova

Altermagnetism defies conventional classifications of collinear magnetic phases, with its unique combination of spin-dependent symmetries, net-zero magnetization, and anomalous Hall transport. Although altermagnetic states have been realized experimentally, their integration into functional devices has been hindered by the structural rigidity and poor tunability of existing materials. First, through cobalt intercalation of the superconducting 2H-NbSe2 polymorph, we induce and stabilize a robust altermagnetic phase and, via angle- and spin-resolved photoemission spectroscopy (spin-ARPES), we directly observe the lifting of Kramers degeneracy. Then, using ultrafast laser pulses, we demonstrate how a low-temperature phase can be quenched. Our findings open pathways to spin-based technologies and lay a foundation for advancing the emerging field of altertronics.

MA 33.13 Wed 18:15 HSZ/0002

Odd-parity-wave spin-polarized multiferroics — •Jan Priessnitz, Johannes Mitscherling, and Libor Šmejkal — Max Planck Institute for Physics of Complex Systems, Dresden, Germany

Combining ferroelectricity with spin polarization in ferromagnets is difficult due to the poor compatibility of insulating band structures and ferromagnetism. Recently, an alternative strategy based on combining time-reversal-broken spin polarization in altermagnetic insulators and ferroelectricity into type-I multiferroics was suggested [1]. Here we propose a different strategy based on time-reversal-symmetric odd-parity-wave spin polarization, which we demonstrate in type-II multiferroics induced by noncollinear magnetism [2,3]. Via state-of-the-art spin group theory and first-principle calculations, we demonstrate the spin polarization in $GdMn_2O_5$, a type-II multiferroic material combining coplanar p-wave magnetic order with ferroelectric order. Furthermore, we propose the antialtermagnetoelectric effect – cross-coupling between ferroelectric and odd-parity-wave time-reversal-symmetric spin polarization. The calculated switching path, influenced by exchange fields and spin-orbit coupling, and consistent with previous studies of ferroelectricity in this material, connects two distinct magnetic states with opposite signs of both electric and spin polarization.

[1] L. Šmejkal, arXiv:2411.19928.
[2] A. Birk Hellenes et al., arXiv:2309.01607v3.
[3] A. Chakraborty et al., Nat Commun 16, 7270 (2025).

MA 34: Computational Magnetism I

Time: Wednesday 15:00–18:30 Location: HSZ/0004

MA 34.1 Wed 15:00 HSZ/0004

GPU acceleration of atomistic spin dynamics simulations — Mariia Mohylna[1], Anders Bergman[2], Arkadijs Slobodkins[2], Olle Eriksson[2], Anna Delin[1], and •Johan Hellsvik[1] — [1]KTH Royal Institute of Technology, Stockholm, Sweden — [2]Uppsala University, Uppsala, Sweden

The Uppsala Atomistic Spin Dynamics (UppASD) [1,2] code implements algorithms for modelling magnetic materials on microscopic and mesoscopic length scales. In our recent implementation, kernels for magnetic field calculation for bilinear spin-spin pair interaction and one numerical integrator have been implemented with the CUDA programming model for use on NVIDIA GPUs, and the HIP programming model for AMD GPUs. Benchmarks for the simulation of bulk bcc Fe and the spin glass CuMn establish firmly the proposition of high speed-up for magnetization dynamics simulation on GPU hardware. The superior performance of the GPU implementations highlights the compatibility of spin-related problems with GPU architecture.

[1] The UppASD code https://github.com/UppASD/UppASD [2] Atomistic spin-dynamics; foundations and applications, O. Eriksson, et al. (Oxford University Press, 2017).

MA 34.2 Wed 15:15 HSZ/0004

Spin waves in double-layered antiferromagnets: insights from chain models and application to CrN — Seo-Jin Kim[1], Zdeněk Jirák[2], Jiří Hejtmánek[2], Karel Knížek[2], Helge Rosner[1], and •Kyo-Hoon Ahn[2] — [1]Max Planck Institute for Chemical Physics of Solids, D-01187 Dresden, Germany — [2]Institute of Physics, Czech Academy of Sciences, Cukrovarnická 10, 162 00 Praha 6, Czechia

The stability and magnonic properties of double-layered antiferromagnets are examined using two model systems, the linear chain (LC) and the railroad trestle (RT) geometry, and compared with the behavior of the real solid CrN. In the LC, the spin-paired order $(\cdots{+}{+}{-}{-}\cdots)$ requires alternating ferromagnetic and antiferromagnetic (AFM) exchanges, whereas in the RT geometry an analogous order remains stable even with purely AFM interactions under specific analytical conditions. In CrN, the rock-salt structure causes strong magnetic frustration because each Cr atom has twelve symmetry-equivalent AFM nearest neighbors. Below $T_N = 287$ K, however, a magnetostructural transition to an orthorhombically distorted phase generates four distinct Cr-Cr distances and, consequently, a broad distribution of exchange strengths. This diversification suppresses frustration and stabilizes the double-layered AFM order. We trace this behavior to the competition between Cr–Cr direct exchange and 90° Cr–N–Cr superexchange, both exhibiting characteristic power-law dependencies on the interatomic distances. Finally, using *ab initio* exchange parameters, we derive the magnon spectrum and the temperature evolution of the ordered moments.

MA 34.3 Wed 15:30 HSZ/0004

Magnetoelastic behavior calculations in tetragonal systems —

•Jakub Sebesta and Dominik Legut — IT4Innovations, VSB-TU Ostrava, 17.listopadu 2172/15, 708 00 Ostrava-Poruba, Czech Republic

In modern devices, various energy conversion effects are used for efficient operation. One of these effects represents magnetoelasticity – the conversion between the magnetic and mechanical energy. It is widely used in sensors or actuators *e.g.* force or torque sensors, fuel injectors, micro-pump, etc. So far, high symmetry systems, such as ferromagnetic 3d elements or rare-earth-based Laves phases, have been studied especially. In contrast ,here we provide a theoretical investigation of magnetoelastic behavior in tetragonal systems, focusing on the determination of the magnetoelastic properties influenced by the magnetic structure, and investigating the source of the observed modification. Eventually, we discussed a simple theoretical model for the magnetoelasticity in the considered systems.

[1] J. Sebesta et al. Magnetoelasticity - magnetic structure interrelation - tetragonal MnPt system study, Arxiv 2503.14693

MA 34.4 Wed 15:45 HSZ/0004

Ontology-driven Metadata for Multiscale Magnetism: The mammos-entity tool — •Andrea Petrocchi[1], Swapneel Amit Pathak[1], Martin Lang[1], Samuel J. R. Holt[1], Wilfried Hortschitz[2], Santa Pile[2], Martin Dobiasch[2], Thomas Schrefl[2], and Hans Fangohr[1] — [1]MPSD, Hamburg, Germany — [2]UWK, Krems, Austria

In science numerical values are interpretable only when their units and semantic meanings are known. Ontologies are able to identify physical quantities (i.e. using unique labels) and the provenance of data (i.e. the source and process creating it). The magnetic materials ontology is developed within the MaMMoS project and defines magnetic material properties and their interrelationships across various length scales.

In this talk, we present the core capabilities and limitations of mammos-entity, a Python package focused on one essential subset of information (called entity) needed for reliable data exchange: value, unit, and ontology label. This package facilitates working with entities programmatically, streamlines reading and writing data enriched with units and ontology identifiers as metadata and improves FAIRness of data. The aim is to make semantic annotation of data simple enough for everyday use. The mammos-entity package emerges from the magnetism community but supports all quantities defined in the EMMO (https://emmc.eu/emmo/).

Acknowledgements: Supported by the EU Horizon Europe programme under grant agreement No. 101135546 (MaMMoS).

MA 34.5 Wed 16:00 HSZ/0004

Prediction of Iron Atom Magnetic Moments in Fe-Al Alloys via SOAP-based Neural Network Models — •Vojtěch Ráliš[1,2], Martin Friák[1], Jan Fikar[1], and Aleš Horák[2] — [1]Institute of Physics of Materials, v.v.i., Czech Academy of Sciences, Brno, Czech Republic — [2]Faculty of Informatics, Masaryk University, Brno, Czech Republic

We investigate neural network approaches for predicting local magnetic moments of iron atoms in Fe-Al disordered alloys using a dataset of 227 unit cells (27–216 atoms) with Al concentrations of 0–60%, totaling 6880 Fe atoms (mean: $2.013\,\mu_B$, std: $0.424\,\mu_B$) from DFT calculations.

Local environments are encoded using SOAP descriptors with a cutoff capturing the first three coordination shells, yielding rotation- and translation-invariant features. Our feedforward neural network achieves MAE = $0.0436\,\mu_B$ on the test set, significantly outperforming a first-neighbor baseline (MAE = $0.121\,\mu_B$) and CHGNet (MAE = $0.215\,\mu_B$), while requiring far less memory and compute time.

These results demonstrate the effectiveness of SOAP-based neural networks for fast, accurate prediction of electronic properties in metallic alloys, with implications for large-scale computational screening and local magnetic phenomena studies.

MA 34.6 Wed 16:15 HSZ/0004

Material Parameter Determination with Deep Learning — •Jack Smith[1,2], Dieter Suess[1], and Florian Slanovc[2] — [1]University of Vienna, Vienna, Austria — [2]Silicon Austria Labs, Villach, Austria

Measuring a set of material parameters from stray field measurements presents a challenging inverse problem. In this work, we introduce a data-driven approach for this task using a probabilistic neural network.

A standard regression approach can fail to capture the non-uniqueness of this task, leading to unphysical predictions. To mitigate this, we model the conditional probability distribution of the material parameters and measured stray field. We use a mixture density network (MDN)[1], which combines a neural network with a mixture density model, to model this conditional probability distributions. To capture spatial correlations, we employ a convolutional neural network feature extractor that projects the stray field map into a high-dimensional latent space before probabilistic decoding with the MDN.

We demonstrate that this method can extract ground-truth parameters with high accuracy, even for visually indistinguishable stray fields. It also provides a quantifiable uncertainty, identifying regimes where the stray field solution is non-unique and traditional inversion methods would fail.

[1] C. M. Bishop, Mixture density networks (1994).

MA 34.7 Wed 16:30 HSZ/0004

Automated Magnetism Analysis via Tensorial Interacting Spins — •Haichang Lu[1,2] and Stefan Blügel[3,4] — [1]Fert Beijing Institute, MIIT Key Laboratory of Spintronics, School of Integrated Circuit Science and Engineering, Beihang University, Beijing, 100191, China — [2]Engineering Department, Cambridge University, Cambridge CB2 1PZ, UK — [3]Peter Grünberg Institut, Forschungszentrum Jülich and JARA, 52425 Jülich, Germany — [4]Institute for Theoretical Physics, RWTH Aachen University, 52062 Aachen, Germany

Analyzing and describing magnetism in materials with localized moments requires accurate and generalizable spin models that go beyond conventional scalar or vector exchange interactions. Here we present *AMATIS*: an automated computational workflow that systematically incorporates tensorial spin interactions (non-relativistic and relativistic) into the effective Hamiltonian. Grounded in quantum spin properties and group theoretical analysis, tensorial components are extracted from the constrained least-squares fitting, ensuring fidelity to *ab initio* data. An integrated Monte Carlo module allows for the simulation of finite-temperature magnetic thermal equilibrium properties. We demonstrate the utility of this workflow on a series of two-dimensional magnetic materials and a van der Waals heterostructure, revealing the full spectrum of relevant tensorial interactions and their impact on magnetic properties. This approach offers a robust, high-throughput pathway from atomic structure to magnetic behavior, advancing the predictive design of novel magnetic materials.

15 min break

MA 34.8 Wed 17:00 HSZ/0004

Forestalled phase separation as the precursor to stripe order and superconductivity — •Aritra Sinha and Alexander Wietek — Max Planck Institute for the Physics of Complex Systems

Stripe order is a key feature of the cuprate phase diagram and appears as the ground state of the two-dimensional Fermi-Hubbard and t-J models in relevant regimes. With increasing temperature, stripe and superconducting orders give way to the strange metal and pseudogap phases, whose microscopic origins remain unclear. Using advanced tensor-network simulations, we try to identify the real-space mechanisms behind this evolution. iPEPS reveals a strong peak in the uniform charge susceptibility above the stripe phase near hole doping p=0.1, sharpening on cooling. METTS simulations on finite cylinders trace this peak to fluctuating charge clusters, resembling incipient phase separation into hole-rich and hole-poor regions-ultimately prevented by stripe order at low temperature. In the doped Mott regime of the t-t'-J model, we find that fluctuating domain walls of doped holes act as precursors to superconductivity. At low T, transient mergers of hole-rich regions create larger clusters containing superconducting condensates, which gradually phase-lock upon cooling into a coherent, stripe-aligned d-wave superconductor. Together, these results suggest a unified picture where charge and pairing fluctuations evolve into stripe order and superconductivity, clarifying their intertwined roles in strongly correlated systems.

MA 34.9 Wed 17:15 HSZ/0004

Anisotropic Ligand-Mediated Magnetic Interactions in Strongly Correlated Layered Antiferromagnet $GdTe_3$ — •Sergii Grytsiuk[1], Patrik Thunström[2], Mikhail I. Katsnelson[1], and Malte Rösner[1] — [1]Radboud University, Institute for Molecules and Materials, Nijmegen, The Netherlands — [2]Department of Physics and Astronomy, Uppsala University, Uppsala, Sweden

In this study, we investigate the magnetic properties of $GdTe_3$ through first-principles calculations and spin-dynamics simulations. We reveal that its complex phase diagram arises from the interplay between the antiferromagnetic isotropic exchange of Gd localized f- and delocalized d-states and the substantial anisotropic exchange with Te ligand-conducting p-states. Despite the half-filled nature of Gd-f states suggesting a lack of magnetocrystalline anisotropy (MCA), we identify that the anisotropic coupling of it with ligand states serves as the primary source of MCA. This coupling is significantly influenced by the magnetic ordering of neighboring localized spins and is sensitive to charge density waves (CDW). It can also be tuned via magnetic field, temperature, and pressure. By linking the ligand spin-orbit coupling and induced magnetic moments to the effective interactions among localized spins, we successfully reproduce the experimental magnetic susceptibility across varying temperatures, magnetic fields, and pressures.

MA 34.10 Wed 17:30 HSZ/0004

operator Lanczos approach enabling neural quantum states as real frequency impurity solvers — •Jonas Rigo[1] and Markus Schmitt[1,2] — [1]Forschungszentrum Jülich GmbH, Peter Grünberg Institute, Quantum Control, 52425 Jülich, Germany — [2]University of Regensburg

To understand the intricate exchange between electrons of different bands in strongly correlated materials, it is essential to treat multi-orbital models accurately. For this purpose, dynamical mean-field theory (DMFT) provides an established framework, whose scope crucially hinges on the availability of efficient quantum impurity solvers. Here we present a real-frequency impurity solver based on neural quantum states (NQS) combined with an operator-space Lanczos construction. NQS are an asymptotically unbiased variational ground-state ansatz that employs neural networks to capture long-range correlations on complicated graph structures. We leverage this ability to solve complex multi-orbital impurity problems using a systematically improvable segmented commutator operator Lanczos (SCOL) construction. Our benchmarks on both the single-orbital Anderson model and the multi-orbital Hubbard–Kanamori impurity Hamiltonian reveal excellent ground state precision and the capacity to resolve key features of zero temperature spectral functions and self-energies. These promising results open avenues for extending DMFT to more challenging problems.

MA 34.11 Wed 17:45 HSZ/0004

Theoretical study of doping and pressure effects in organic magnets — Rohit Pathak[1,2], Isabella Rudengren[1,2], Torbjörn Wigren[1], Anna Delin[2,3], Olle Eriksson[1,2], Niklas Wahlström[1,2], and •Vladislav Borisov[1,2] — [1]Uppsala University, Sweden — [2]Wallenberg Initiative Materials Science for Sustainability, Sweden — [3]KTH Royal Institute of Technology, Stockholm, Sweden

Technologically important permanent magnets used nowadays rely on rare-earth elements and are associated with negative environmental impact and high energy costs, when produced. On the other hand, organic magnets are known, which can solve these problems, but their applications are limited due to low ordering temperature and coercivity. In this work, we aim to explore further the class of organic magnets to find ways of improving their magnetic properties, which would allow their applications and potentially even partial replacement of inorganic magnets. Also, fundamental aspects of organic magnets are studied in terms of delocalized nature of magnetism. Using first-principles electronic structure theory and atomistic spin dynamics (UppASD code [1]), we model magnetic properties of different compounds including the effects of chemical doping and mechanical pressure to understand the structural and chemistry-related trends. Machine-learning models for property prediction and structure reverse engineering will be applied to make the search for new magnets feasible.

1. B. Skubic, J. Hellsvik, L. Nordström, and O. Eriksson, A method for atomistic spin dynamics simulations: implementation and examples, J. Phys.: Condens. Matter. 20, 315203 (2008).

MA 34.12 Wed 18:00 HSZ/0004

Ground-state phases and excitation spectra of dipole conserving spin-half chain — •Prabhakar Prabhakar[1], Soumya Bera[1], and Giuseppe De Tomasi[2] — [1]Department of Physics, Indian Institute of Technology Bombay, Mumbai 400076, India — [2]CeFEMA-LaPMET, Departamento de Fisica, Instituto Superior Tecnico, Universidade de Lisboa, Portugal

We explore the ground state phase diagram of a translationally invariant, non-integrable one-dimensional spin chain with dipole conservation. The model is typically realized in quantum simulators, such as cold-atom setups, in the presence of a large, tilted electric field. Despite the strong kinetic constraints imposed by dipole conservation, which prevent the propagation of isolated spin excitations and suppress single-spin order, the system stabilizes an antiferromagnetic dipole-ordered ground state. However, at a large Ising interaction strength, the model shows a phase transition to a spin-ordered phase. Using exact diagonalization along with density matrix renormalization group simulations, we examine the associated phases with different antiferromagnetic order parameters, the entanglement spectrum, and the dynamical spectral function.

MA 34.13 Wed 18:15 HSZ/0004

Implementation of spin-current density functionals in VASP — •Fabien Tran, Marie-Therese Huebsch, and Martijn Marsman — VASP Software GmbH, A-1090, Vienna, Austria

The implementation of spin-current density functionals (SCDF) in VASP is reported. SCDFs, which depend on the spin kinetic-energy density and spin current density, are intended for non-collinear calculations and can capture a non-zero local exchange-correlation spin torque. Results obtained with various SCDFs, namely TDRU [Tancogne-Dejean *et al.*, Phys. Rev. B **107**, 165111 (2023)], nc-mSCAN [Desmarais *et al.*, Phys. Rev. Lett. **134**, 106402 (2025)] and HTM [Huebsch *et al.*, arXiv:2501.04124 (2025)] will be presented.

MA 35: Spintronics (other effects) (joint session MA/TT)

Time: Wednesday 15:00–18:00 Location: POT/0112

Invited Talk MA 35.1 Wed 15:00 POT/0112

Magneto-optic Kerr effects of higher order in magnetization in thin films of different crystal orientations — •Timo Kuschel — Johannes Gutenberg University Mainz, Germany

The magneto-optic Kerr effect (MOKE) is an important tool to study magnetic properties of thin films. While the MOKE contribution linear in magnetization (LinMOKE) is mainly used for Kerr imaging, Kerr spectroscopy, time-resolved MOKE, and vectorial magnetometry of ferromagnetic thin films [1], the MOKE contributions quadratic in magnetization (QMOKE) [2] have been used for investigations of antiferromagnetic materials, spin-orbit torques, and structural order of Heusler compounds [3]. Recently, we have identified MOKE contributions of third order in magnetization (cubic MOKE, CMOKE) [4] and studied its dependence on the structural domain twinning of Ni(111) thin films.

In this talk, I will introduce these MOKE effects of higher order and describe their angular dependencies with respect to the crystal orientations of the thin films. While it is quite simple to find CMOKE in (111)-oriented films, it is not straightforward to identify it in (001)-oriented samples. I will discuss the reasons. Furthermore, I will report on the material systems that have shown CMOKE so far and mention potential applications.

[1] T. Kuschel et al., J. Phys. D: Appl. Phys. 44, 265003 (2011)
[2] R. Silber, TK et al., Phys. Rev. B 100, 064403 (2019)
[3] R. Silber, TK et al., Appl. Phys. Lett. 116, 262401 (2020)
[4] M. Gaerner, TK et al., Phys. Rev. Applied 22, 024066 (2024)

MA 35.2 Wed 15:30 POT/0112

Ignition of spin-triplet supercurrent in a ballistic S/F/S Josephson junction with precessing magnetization — •Elizaveta Andriyakhina, Miad Mansouri, Maxim Breitkreiz, and Piet Brouwer — Freie Universität Berlin, Germany

We develop a theory for a ballistic Josephson junction with a ferromagnetic (including half-metallic) interlayer whose uniformly precessing magnetization generates a controllable equal-spin (triplet) supercurrent. In a co-rotating frame, the driven junction maps to an effective static problem that can be treated with a scattering-matrix approach to obtain Andreev bound states and the dc Josephson current.

A key result is that steady precession produces a spin-dependent non-equilibrium occupation in the rotating frame, yielding a finite dc supercurrent. In the half-metal limit the junction is “off” without precession, but becomes “on” when a finite precession angle induces phase-sensitive Andreev levels and a triplet current.

For small precession angles, the induced current is approximately sinusoidal in phase and the critical current scales quadratically with the precession angle (and with drive parameters), enabling microwave-controlled switching via ferromagnetic resonance.

MA 35.3 Wed 15:45 POT/0112

Magnetic Domain Wall Motion under Microwave Excitation — •Lukas Fischer[1], Rouven Dreyer[2], Jae-Chun Jeon[1], Georg Woltersdorf[2], and Stuart Parkin[1] — [1]Max-Planck Institute of Microstructure Physics, Halle (Saale), Germany — [2]Martin-Luther-University Halle-Wittenberg, Halle (Saale), Germany

Chiral domain walls (DWs) and their synchronous motion via current pulses in magnetic conduits (so-called magnetic racetracks) are of enormous interest due to their fast speed, non-volatility, and capability of creating high bit-density for advanced memory and logic technologies. Most experimental and numerical studies have focused on the motion of the DWs by spin-orbit torque using nanosecond-long current pulses which are not efficient in coupling to magnetization precessions of the magnetic material, typically occurring in the GHz regime.

Here we present that the microwave excitation of chiral Néel DWs in a magnetic microwire with perpendicular magnetic anisotropy significantly impacts the DW motion. We use either magnetic fields or electrical currents at RF-frequencies to explore the pronounced impact on the DW motion. Firstly, we directly visualize the high-frequency response of the DW by using the Super-Nyquist sampling magneto-optical Kerr effect. We then determine the effect of this excitation on the DW motion. When the DW is excited in the presence of a static, transverse magnetic field, it exhibits unidirectional self-propulsion. Moreover, the resonant excitation in a static, longitudinal field leads to a current-triggered, sustained DW motion over micrometer distances, which dramatically increases the effective DW displacement.

MA 35.4 Wed 16:00 POT/0112

Assembly of Magnetic Heterostructures with Chiral Nanographenes — •Chi Fang, Wenhui Niu, Jitul Deka, and Stuart Parkin — Max Planck Institute of Microstructure Physics, Halle(Saale) 06120, Germany

Chirality-induced spin selectivity (CISS) is an emergent phenomenon whereby chiral molecules act as efficient spin filters, selectively transmitting electrons of a particular spin orientation. A central challenge in advancing CISS-based spintronics lies in experimentally verifying spin filtering in structurally defined, laterally extended molecular systems, using standard solid-state device techniques that yield reproducible and robust spin-dependent transport signals. Here, we present direct experimental evidence of the CISS effect in helical nanographenes (NGs), using magnetoresistance (MR) measurements in magnetic heterostructures. The device architecture included a bottom electrode ferromagnetic contact, orthogonally patterned and electrically isolated by an AlOx layer to confine current to the junctions. NG, a synthetically tailored chiral molecule, was spin-coated to form a thin, uniform layer serving as a spin-filter interface. Different from previous works, the ferromagnet layer grown directly on the substrate offers a better performance of the magnetic properties. Both enantiomeric devices showed MR values around 1 % at room temperature, with minimal variation over the 10*400 K temperature range, indicating robust and reproducible spin selectivity. [1] B. Bloom et al. Chem. Rev. 124(4), 2014;[2] S. Ham et al. Micromachines 15(4), 528, 2024;[3] S. Yang et al., Nat. Rev. Phys. 3, 328, 2021.

MA 35.5 Wed 16:15 POT/0112

Alloying-Driven Modifications of the Magnetic Properties in Transition-Metal Iodides — •Paulina Jureczko[1,2] and Martin Gmitra[1,3] — [1]Institute of Experimental Physics, Slovak Academy of Sciences, 04001 Košice, Slovakia — [2]Institute of Physics, University of Silesia in Katowice, 41-500 Chorzów, Poland — [3]Institute of Physics, Pavol Jozef Šafárik University in Košice, 04001 Košice, Slovakia

Single-layer transition-metal dihalides have recently emerged as a platform for exploring two-dimensional magnetism and topology. Using density-functional theory, we investigate the electronic and magnetic properties of MI_2 monolayers and alloyed $M_{1-x}N_xI_2$ systems, where M and N represent Mn, Fe, Co, Ni. We analyze how chemical substitution modifies exchange interactions and spin-orbit-driven topological features by computing the Berry curvature and Chern numbers. The results reveal that alloying provides an efficient route for tuning magnetic anisotropy and topological phases in transition-metal iodides, underscoring their potential relevance for 2D spintronics.

This work has been funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I05-03-V02-00071.

15 min break

MA 35.6 Wed 16:45 POT/0112

Spintronic THz Frequency Conversion Mediated by Ferromagnetic/Oxide Interfaces — •Kang Jin[1], Ruslan Salikhov[1], Stefan Kober[2], Igor Ilyakov[1], Jan-Christoph Deinert[1], Aleksandra Lindner[1], Jürgen Fassbender[1,3], Sebastian F. Maehrlein[1,3], Zhe Wang[2], and Jürgen Lindner[1] — [1]HZDR — [2]TU Dortmund — [3]TU Dresden

Frequency conversion is a key nonlinear phenomenon for communication and data processing technologies. Exploring this phenomenon at terahertz (THz) frequencies is of particular interest, as the high carrier frequency enables faster data transfer and higher operational speeds. Previous experiments have revealed that THz frequency conversion could serve as a distinctive probe for THz-light-induced ultrafast spin-transfer currents (STCs) at Ferromagnetic (FM)/Non-Magnetic (NM) interfaces. Building on these findings, we report THz frequency conversion using cost-effective NM materials (such as SiO2 and Al2O3 films) and demonstrate their origin from the interfacial inverse Rashba-Edelstein effect. We compare conversion efficiencies and characteristics of different samples, revealing that FM interfaces, featuring off-stoichiometric SixOy and AlxOy, achieve conversion efficiencies comparable to heavy metal capping layers (i.e. Ta). The deposition sequence and the oxidation level of the samples were found to critically influence the sign of the spin-charge conversion. The observed THz second harmonic generation represents a spintronic foundation for developing THz frequency mixers and rectifying components.

MA 35.7 Wed 17:00 POT/0112

Magnetic hyperfine fields in solids without inversion symmetry induced by an external electric field — •Alberto Marmodoro[1,2,3,4], Hubert Ebert[1], Sergiy Mankovsky[1], and Jan Minar[3] — [1]LMU Munich, Munich, DE — [2]Inst. of Physics of the Czech Acad. of Sci., Prague, CZ — [3]University of West Bohemia, Pilsen, CZ — [4]Czech Technical University., Prague, CZ

An electric field induces in a solid without inversion symmetry spin and orbital magnetization - a phenomenon called Edelstein effect. This induced magnetization has to have its counterpart in an induced magnetic hyperfine field seen by nuclear magnetic moments. Corresponding NMR experiments have been performed recently on Te with success [1]. Using Kubo's linear response formalism implemented on the basis of the relativistic Korringa-Kohn-Rostoker Green function technique a description for the field induced hyperfine field (EFI-HFF) has been developed in analogy to that for the spin and orbital Edelstein effect [2]. The EFI-HFF drastically differs from that induced by an external magnetic field as the later one does not need missing inversion symmetry. Making use of a Gordon decomposition of the electronic current a splitting of the EFI-HFF into its spin and orbital parts is achieved [3]. This allows to discuss them in relation to their counterparts concerning the magnetization as well as the role of the spin-orbit coupling for them. Corresponding numerical results are presented for Te.

[1] T. Furukawa et al., Phys. Rev. Res., **3**, 023111 (2021). [2] S. Wimmer et al. Phys. Rev B, **103**, 024437 (2021). [3] M. Battocletti and H. Ebert, Phys. Rev. B, **64**, 094417 (2001).

MA 35.8 Wed 17:15 POT/0112

Theoretical description of the optical activity and directional dichroism of chiral solids — •Hubert Ebert and Sergiy Mankovsky — Ludwig Maximilian University of Munich, Munich, DE

A scheme to deal with the optical activity and directional dichroism of solids on the basis of Kubo's linear response formalism is presented. Accounting for the $\vec{q}$-dependence of the radiation field implies that the corresponding optical transitions described in $\vec{k}$-space are no more vertical. More important, one is led to corrections to the electric dipole matrix element due to the electric quadrupole and magnetic dipole interaction. The scheme is implemented making use of the relativistic

Korringa-Kohn-Rostoker Green function (KKR-GF) formalism. Corresponding applications to chiral Te that has time reversal ($\mathcal{T}$) but no inversion ($\mathcal{I}$) symmetry led to a $\vec{q}$-dependent optical conductivity tensor with off-diagonal elements caused by the interference of the electric dipole and its correction terms giving rise to optical activity. In the case of anti-ferromagnetic Cr_2O_3 without $\mathcal{T}$-symmetry the correction terms lead to directional dichroism that strongly depends on whether a magnetic configuration with or without $\mathcal{I}$- but with combined $\mathcal{IT}$-symmmetry is considered.

MA 35.9 Wed 17:30 POT/0112

Intrinsic and Proximity-Enhanced Spin-Orbit Torques in Fe_3(Ge,Ga)Te_2 and WTe_2 Heterostructures — •Gusthavo Brizolla[1], Stepan Tsirkin[2], Yaroslav Zhumagulov[2], and Jaroslav Fabian[1] — [1]Institute for Theoretical Physics, University of Regensburg, 93040 Regensburg, Germany — [2]EPFL, Lausanne, Switzerland

Spin-orbit torques (SOTs) in 2D magnets and their heterostructures offer a route to ultra-thin, energy-efficient memories where currents can switch magnetization without external magnetic fields. Materials such as Fe_3GeTe_2 (FGT) and Fe_3GaTe_2 (FGaT), and their interfaces with low-symmetry WTe_2, are especially promising, but the angular dependence and microscopic origin of their SOTs are still not fully understood. Here we compute SOTs in FGT, FGaT and WTe_2-proximitized heterostructures using first-principles (DFT) calculations and compare two protocols for mapping the angular dependence: self-consistent magnetization rotation and rigid rotation of a fixed exchange field. They agree when spin-orbit mixing is weak, but differ strongly near in-plane alignment, where interband hot spots and evolving spin-orbit hybridization amplify the torkances. In WTe_2 heterostructures, broken symmetry and Te-Te interfacial hybridization further boost torques with out-of-plane spin polarization. These results provide design rules for field-free current control in 2D magnets and show that the angle dependence of spin-orbit coupling must be treated explicitly to obtain reliable SOT angular maps.

MA 35.10 Wed 17:45 POT/0112

Spin vacuum switching — •Eddie Harris-Lee[1,2], John Kay Dewhurst[2], Samuel Shallcross[1], and Sangeeta Sharma[1,3] — [1]Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie, Berlin, Germany. — [2]Max-Planck-Institut für Mikrostrukturphysik, Halle, Germany. — [3]Institut für Theoretische Physik, Freie Universität Berlin, Berlin, Germany.

While physical mechanisms underpinning spin switching are established for nano- to pico-second time scales, here we present a physical route to magnetization toggle control at < 100 femtoseconds. A minority spin current injected into a ferromagnet is shown to create a minority "spin vacuum" that then drives rapid charge redistribution from the majority channel and spin switching. We demonstrate this mechanism reproduces many of the features of recent sub-picosecond switching of ferromagnetic Co/Pt multilayers, and provide simple practical rules for the design of materials to optimize "spin vacuum" control over magnetic order.

Harris-Lee *et al.*, Sci. Adv. **10**, eado6390 (2024). DOI:10.1126/sciadv.ado6390

MA 36: Molecular Magnetism and Magnetic Particles / Clusters I

Time: Wednesday 15:00–18:30 Location: POT/0151

MA 36.1 Wed 15:00 POT/0151

A Combined Theoretical and Experimental Study of Oxygen Vacancies in Co_3O_4 for Liquid-Phase Oxidation Catalysis — Amir Omranpour[1], •Lea Kämmerer[2], Catalina Leiva–Leroy[1], Anna Rabe[2], Takuma Sato[3], Soma Salamon[2], Joachim Landers[2], Benedikt Eggert[2], Eugen Weschke[4], Jean Pascal Fandré[5], Ashwani Kumar[5], Harun Tüysüz[5,6], Martin Muhler[1], Heiko Wende[2], and Jörg Behler[1] — [1]University of Duisburg-Essen and CENIDE — [2]Ruhr-University Bochum — [3]Max Planck Institute for Chemical Energy Conversion — [4]Helmholtz-Zentrum Berlin für Materialien und Energie — [5]Max-Planck-Institut für Kohlenforschung — [6]IMDEA Materials Institute, Spain

We combined Density Functional Theory (DFT) and experimental techniques to investigate oxygen vacancies (V_O) in bulk Co_3O_4 and during liquid-phase ethylene glycol oxidation. DFT calculations show that a V_O reduces two adjacent Co^{3+} ions to stable, high-spin Co^{2+} in distorted octahedral sites, simultaneously narrowing the band gap. Comparison of experimental O K-edge X-ray absorption spectra with DFT calculated spectra reveal that the fresh catalyst resembles the vacancy-containing calculation, but the post-reaction catalyst shifts toward the ideal Co^{3+} state, strongly suggesting that Co_3O_4 becomes more oxidized under liquid-phase ethylene glycol oxidation by refilling preexisting oxygen vacancies, a finding supported by increased conversion at higher O_2 pressures and the catalyst's stability and activity over multiple cycles. We gratefully acknowledge the DFG funding by CRC/TRR 247 (Project ID: 388390466) projects A01, A10, and B02.

MA 36.2 Wed 15:15 POT/0151

KNB mechanism in convex polygon molecular magnets: bipartite entanglement transfer with the aid of electric field. — •Zhirayr Adamyan[1,2], Vadim Ohanyan[1,2], Ani Chobanyan[1], Hamid Arian Zad[3], Jozef Strecka[3], Azadeh Ghannadan[4], and Saeed Haddadi[4,5] — [1]Laboratory of Theoretical Physics, Yerevan State University, 1 Alex Manoogian, 0025 Yerevan, Armenia — [2]CANDLE, Synchrotron Research Institute, 31 Acharyan Str., 0040 Yerevan, Armenia — [3]Department of Theoretical Physics and Astrophysics, Faculty of Science, P. J. Safarik University, Park Angelinum 9, 041 54 Kosice, Slovak Republic — [4]Saeeds Quantum Information Group, P.O. Box 19395-0560, Tehran, Iran — [5]Faculty of Physics, Semnan University, P.O. Box 35195-363, Semnan, Iran

The unique properties exhibited by single molecular magnets (SMMs) have led to their integration into hybrid devices, emphasizing their quantum nature. We examine models of 1/2-spin molecular magnets arranged in a convex polygon configuration, utilizing a Katsura-Nagaosa-Balatsky (KNB) mechanism to couple the spin degrees of freedom to an external electric field. This KNB mechanism enables extensive control over quantum entanglement through both the magnitude and direction of the electric field. By employing a rotating configuration of the KNB-coupled electric field, where the field's magnitude remains constant while its direction changes, we demonstrate the controllable transfer of bipartite entanglement between different pairs of spins in the model.

MA 36.3 Wed 15:30 POT/0151

Magneto-optical properties of ferromagnetic liquid crystals — •Tom Rehfeldt[1], A. Jarosik[1], D. Lisjak[2], A. Eremin[1], and H. Nádasi[1] — [1]Institute of Physics, Otto von Guericke University, Universitätsplatz 2, 39106 Magdeburg, Germany — [2]Jožef Stefan Institute, Jamova cesta 39, Ljubljana SL-1000, Slovenia

Ferromagnetic nematic liquid crystals (FNLCs) combine the orientational order of nematic liquid crystals with the spontaneous magnetization of ferrimagnetic nanoplatelets.

In this work, the dynamic magneto-optical behavior of FNLCs is investigated by changing the parameters of the external dynamic magnetic field.

MA 36.4 Wed 15:45 POT/0151

Making molecular changes visible using near-surface transport of micron-sized magnetic particles — •Yahya Shubbak, Nikolai Weidt, Arne Vereijken, Rico Huhnstock, and Arno Ehresmann — Institute of Physics and Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), University of Kassel, Heinrich-Plett-Strasse 40, 34132 Kassel, Germany

Transport of magnetic particles (MPs) in liquid close to the surface of a flat substrate containing a periodic magnetic domain pattern is a promising lab-on-a-chip (LOC) technology for detecting MP-bound analytes, even when their size is negligible compared to the MP size. As proof of principle, we show that simple observation of MP motion via optical microscopy is sufficient to distinguish MPs of the same nominal size, but surface-functionalized with two different functional groups. The different surface chemistry changes the liquid-mediated MP-to-substrate forces acting during close-to-surface transport, resulting in significant variations in the experimentally observable MP velocity. More specifically, superparamagnetic MPs measuring 2 micrometre in diameter with a polymer coating of solely carboxyl (COOH) end groups, or a mixture of carboxyl and amino (NH2) groups, respectively, have been studied. Transport of these MPs above a magnetic stripe domain pattern in double-distilled water showed a remarkable difference in their average velocities, rendering the COOH-functionalized MPs almost twice as fast as the NH2 counterparts for otherwise identical experimental parameters. This result enables the magnetophoretic separation of MPs based on their surface properties.

MA 36.5 Wed 16:00 POT/0151

Magnetic cuboidal particles as field sensors for microscaled magnetic stray field landscapes — •Jonas Bugase, Christian Janzen, Arne Vereijken, Yahya Shubbak, Nikolai Weidt, Rico Huhnstock, and Arno Ehresmann — Institute of Physics , University of Kassel, 34132 Kassel

Recently, magnetic domain patterns engineered in thin-film systems have been widely used in data storage, spintronics, and magnetic imaging. Characterizing the micron-scale magnetic stray fields emerging from these patterns remains a topical but challenging task [1]. We present a non-mechanical, optically trackable method to visualize effective magnetic field directions using anisotropically shaped magnetic particles. These particles are fabricated via 2-photon polymerization lithography and magnetic exchange-biased layer deposition to achieve custom shapes and anisotropies. When positioned in the field landscape of a periodically patterned substrate [2] within a quiescent liquid, the particles spontaneously orient and reorient in response to local micron-scale stray fields. This enables efficient characterization of complex magnetic domain patterns. We further explore probing local field variations with superimposed external fields facilitating diagnostic and biomedical microfluidic applications [3].

[1] Nistico *et al.* (2020), Inorganics, 8(1):6.
[2] Holzinger *et al.* (2013), J. Appl. Phys, (114): 013908.
[3] Ehresmann *et al.* (2015), Sensors, (15): 28854.

MA 36.6 Wed 16:15 POT/0151

Metal-free magnetism and organic 2D crystals — •Hongde Yu and Thomas Heine — TU Dresden, Dresden, Germany

Organic 2D crystals with metal-free magnetism have attracted considerable research interest owing to their promising applications in organic spintronics and quantum information technologies. However, achieving stable spin-polarization and controlling magnetic interactions in these systems remains challenging due to strong electronic coupling and the closed-shell nature of most organic monomers. In this talk, I will present a strategy to induce spin-polarization and tailor magnetic interactions in organic 2D crystals. By assembling triangulene monomers into dimers and extended 2D polymers, we theoretically explore strategies to control magnetic interactions and electronic structures. We showed substantial magnetic coupling (J) up to -198 meV through rational chemical design of triangulene dimers. Furthermore, triangulene-based 2D crystals exhibit unique electronic features, including a Dirac point flanked by twin flat bands. By tuning the Fermi level, we predict metal-free ferromagnetism with Curie temperatures of ~260 K and half-metallic behavior. Furthermore, we proposed a mixed-topology design strategy enabling purely organic 2D FM semiconductors with J values up to 127 meV and Curie temperatures exceeding 500 K. Beyond conventional FM and AFM, I will also present a simple approach to achieve metal-free altermagnetism.

MA 36.7 Wed 16:30 POT/0151

Modelling the Spin States of Frustrated Nanographenes and Their Dimers: Challenges & Insights — •Helen Preiss, Hongde Yu, and Thomas Heine — Dresden University of Technology, Germany

Metal-free magnetism is an emerging field with promising applications especially in quantum computing. Fundamentally, metal atoms are replaced by organic radicals as spin-carriers, which can be extended to 1D or 2D networks via suitable coupling reactions while possibly maintaining a long-range magnetic order. One class of such radical building blocks are the topologically frustrated nanographenes. For these, it is impossible to pair all π-electrons into alternating single and double bonds, resulting in an open-shell system. A prominent example is the recently synthesised Clar's goblet, a biradical with a singlet ground-state according to Lieb's theorem. We will show that BS-DFT fails to quantitatively predict the magnetic coupling in this molecule, and to describe its dimer even qualitatively, owing to the delocalised nature of the spin centres and their inherent multi-reference character, while higher level ab initio methods struggle with the sheer size of the systems. Alternatively, Clar's goblet may be thought of as two olympicenyl radicals fused together by a six-membered ring. Sublattice-balanced and C-C-linked olympicenyl dimers thus offer themselves as a comparable yet simpler system to study. By comparing both types of nanographene, we gain insights into the limitations of modelling the magnetic states and both inter- and intramolecular coupling of organic molecules with BS-DFT.

15 min break

MA 36.8 Wed 17:00 POT/0151

Tuning chiral-induced unidirectional spin-charge conversion via molecular organization — •Ashish Moharana[1], Zhitian Ling[2], Hao Wu[2], Tomasz Marszalek[2], and Angela Wittmann[1] — [1]Institut für Physik, Johannes-Gutenberg-Universität Mainz, 55099 Mainz, Germany — [2]Max Planck Institute for Polymer Research, Ackermannweg 10, 55128, Mainz, Germany

The observation of spin-dependent transmission of electrons through chiral molecules has led to the discovery of chiral-induced spin selectivity (CISS). The high efficiency of the spin filtering effect in chiral molecules has recently gained significant interest due to the high potential for novel hybrid molecule magnetic spintronics applications. However, the fundamental mechanisms underlying the CISS effect at the molecule-metal interface remain an open challenge. In our work, we explore spin-to-charge conversion at hybrid chiral helical nanographene and heavy metal interfaces. We demonstrate that spin-to-charge conversion in hybrid chiral heterostructures can be tuned by controlling the ordering, and crystallinity of helical nanographene molecules at the interface. We show a more than two-fold increase in interfacial CISS efficiency with increasing molecular crystallinity. Quantifying the impact of spin to charge as a function of the molecular structure reveals the role of the molecular design and organization in the spin filtering effect, paving the path toward the three-dimensional engineering of hybrid interfaces.

MA 36.9 Wed 17:15 POT/0151

Revealing molecular alignment in thin films of DyCu5 single-molecule magnets via XMCD — •David Anthofer, Ashish Moharana, Alexander Hagenow, Dominik Laible, Tristan Fischer, Eva Rentschler, Hans-Joachim Elmers, and Angela Wittmann — Johannes-Gutenberg Universität Mainz, Deutschland

Single-molecule magnets (SMMs) have recently gained significant interest due to their ability to retain magnetic information at the molecular level, offering potential applications in ultra-compact and high-density data storage devices. A crucial challenge hindering their application in technology is the integration with thin-film devices. To tackle this, we probe the magnetic properties of DyCu5 SMMs deposited by dip-coating on a gold surface, where layer thickness is controlled by rinsing or not rinsing the sample. Using X-ray magnetic circular dichroism combined with sum-rule analysis for 4f elements, we extract the spin and orbital moments of the central Dy3+ ion. Rotating the sample relative to the incident beam reveals magnetic anisotropy in the thin layer, indicating preferential molecular alignment at the interface. In thicker films, this anisotropy vanishes, suggesting that the molecules are ordered on top of the gold surface, but have a random orientation with increasing coverage. While engineering ordered molecular assemblies on surfaces is generally challenging, our results demonstrate that a readily accessible dip-coating protocol can induce ordered alignment in the low-coverage regime, providing a practical route toward incorporating SMMs into thin-film devices.

MA 36.10 Wed 17:30 POT/0151

Probing the magnetic behavior of the metastable high-spin state achieved by light-induced excited spin-state trapping in Fe (II) spin-crossover complexes — •Sangeeta Thakur[1], Marcel Walter[1], Tarek Al Said[2], Eike F. Kuhlemann[3], Clara W. A. Trommer[3], Torben Adam[3], Karsten Holldack[2], Felix Tuczek[3], and Wolfgang Kuch[1] — [1]Institut für Experimentalphysik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie, Hahn-Meitner-Platz 1, 14109 Berlin, Germany — [3]Institut für Anorganische Chemie, Christian-Albrechts Universität zu Kiel, 24098 Kiel, Germany

The magnetic behavior of the metastable high-spin (HS) state of the Fe (II) complexes mononuclear [Fe(bpz)$_2$(bipy)]; (bpz = dihydrobis(pyrazolyl)borate) and dinuclear [(Fe(bpz)$_2$)$_2$$\mu$-(ac(bipy)$_2$)]

($ac(bipy)_2$ = bridging ligand) was investigated at 5 K by frequency-domain Fourier transform electron paramagnetic resonance (EPR) spectroscopy in a magnetic field of 1-10 T. The magnetic field map of the EPR measurements indicates a large value (70-90 cm^{-1}) of zero-field splitting (ZFS) for the dinuclear and mononuclear complexes. Comparatively, the HS-locked complexes [$Fe(H_2B(pz)_2)_2$(4,7-Me_2-phen)] and [Fe(tris(3-Methylpyrazolyl)borate)$_2$] exhibit values of ZFS around around 10-17 cm^{-1}. The large ZFS obtained for the dinuclear and mononuclear complexes could be due to the contribution of spin-orbit coupling (SOC). To the best of our knowledge, this is the first time the spin Hamiltonian parameters for Fe (II) SCO complexes were investigated in the metastable HS state.

MA 36.11 Wed 17:45 POT/0151

Insights into magnetic and magnetocaloric features of 3d-4f nonanuclear Gd3Cu6 complex from a mixed spin-(7/2, 1/2) Heisenberg diamond cluster — •Jozef Strecka and Katarina Karlova — Pavol Jozef Safarik University, Kosice, Slovakia

Low-temperature magnetization curves and magnetocaloric features of 3d-4f molecular complex [Gd3Cu6L6(OH)6(CH3OH)6(H2O)6]Cl3.5H2O (LH2 = 1,1,1-trifluoro-7-hydroxy-4-methyl-5-aza-hept-3-en-2-one) to be further abbreviated as Gd3Cu6 are examined within the framework of exact diagonalization method as well as the cluster-based mean-field theory. The magnetic compound Gd3Cu6 reveals in low-temperature magnetization curves an intermediate magnetization plateau at 21.27 Bohr magnetons, which is far below the saturated magnetization value of 27 Bohr magnetons expected for three spin-7/2 Gd3+ and six spin-1/2 Cu2+ magnetic ions per magnetic molecule. The crystal structure of the Gd3Cu6 complex is built from three condensed cubane-like moeties Gd2Cu2, which are from the magnetic point of view equivalent with three corner-sharing diamond motifs. The nonanuclear coordination compound Gd3Cu6 thus affords an intriguing experimental realization of the mixed spin-(7/2, 1/2) Heisenberg diamond chain composed from three unit cell. The magnetic compound Gd3Cu6 displays at sufficiently low temperatures an enhanced magnetocaloric effect, which is due to a geometric spin frustration quite superior with respect to that one of paramagnetic salts built from Gd3+ magnetic ions.

This work was supported by the grant APVV-24-0091.

MA 36.12 Wed 18:00 POT/0151

Suppressing geometric frustration in triangular dysprosium cluster encapsulated in fullerenes — •Matheus Barbosa, Wei Yang, Noel Israel, Fupin Liu, Bernd Büchner, Stanislav Avdoshenko, and Alexey Popov — Leibniz Institute for Solid State and Materials Research, Dresden/Germany

Nitride clusterfullerenes are compounds in which a metallic cluster is encapsulated within a fullerene cage, exhibiting diverse magnetic properties that depend on the composition and geometry of the endohedral cluster. For the case of $Dy_3N@C_{80}$, the presence of the central nitrogen ion induces a strong uniaxial Ligand Field contribution, locking the magnetic moments of dysprosium centers in a triangular arrangement. Such geometry avoids simultaneous ferromagnetic alignment of the moments between the dysprosium ions, leading to ground state frustration and exhibiting rather efficient spin reorientation through the Quantum Tunneling channel. Their magnetic and geometric frustration is harmful for the Single Molecule Magnetism, resulting in closed hysteresis loops in zero-field and at 2 K. We here report the suppression of this frustration by functionalization of the fullerene cage. The photochemical reaction of $Dy_3N@C_{80}$ with adamantane aziridine produced the monoadduct $Dy_3N@C_{80}$-Ad. This additional space inside the fullerene has direct influence on the cluster, elongating the atomic distance in the Dy-N bond towards the modified fragment (breaking the spatial symmetry) and substantially increasing the Dy*Dy coupling constants. As a result, the monoadduct $Dy_3N@C_{80}$-Ad exhibits suppression of the geometric frustration and enhanced Single Molecule Magnetism.

MA 36.13 Wed 18:15 POT/0151

Orientation of Magnetic Anisotropy Axes in Single Molecule Magnets by Inelastic Neutron Scattering: A Case Study on Mn_2Y_2 — •Yifan Wang[1], Christoper E. Anson[2], Zayan A. Ali[1], Annie K. Powell[2], and Oliver Waldmann[1] — [1]Physikalisches Institut, Universität Freiburg, Germany — [2]Institut of Inorganic Chemistry, Karlsruhe Institute of Technology (KIT), Germany

Single molecule magnets (SMMs) are molecular systems that exhibit slow magnetic relaxation and well-defined spin states arising from strong magnetic anisotropy. These features give them potential for future information storage and have attracted much research interest. However, determining the magnetic parameters experimentally, especially the anisotropy orientations, remains challenging. In this work, we demonstrate, with regard to this point, the capability of inelastic neutron scattering (INS) on powder samples through a case study on the dimeric molecular spin cluster Mn_2Y_2. This complex belongs to a family of SMMs and consists of two magnetic spin-2 Mn^{III} ions coupled by antiferromagnetic exchange. The recorded INS spectrum on Mn_2Y_2 displays three cold transitions corresponding to singlet-triplet excitations. The transition energies enable a precise determination of the exchange coupling and the anisotropy magnitudes of the Mn^{III} centers. Most interestingly, a detailed analysis of the peak intensities is shown to yield, in addition, information on the orientation of the Mn^{III} magnetic anisotropy axes. The approach can be generally extended to related SMM families and provides a valuable addition to the range of experimental techniques.

MA 37: Non-Skyrmionic Magnetic Textures

Time: Wednesday 15:00–17:15 Location: POT/0351

MA 37.1 Wed 15:00 POT/0351

Regularized micromagnetic theory for Bloch points — •Vladyslav M. Kuchkin[1], Andreas Haller[1], Andreas Michels[1], Thomas L. Schmidt[1], and Nikolai S. Kiselev[2] — [1]Department of Physics and Materials Science, University of Luxembourg — [2]Peter Grünberg Institute, Forschungszentrum Jülich and JARA, 52425 Jülich, Germany

Magnetic singularities, known as Bloch points, pose a significant challenge for the micromagnetic theory due to the divergence of the effective field at these points. In this talk, we present a recently developed regularized micromagnetic model that does not assume a fixed magnetization length, but treats magnetization as an order parameter on the $\mathbb{S}^3$ sphere, thus allowing it to vary in length from zero up to a threshold value. Such an extension of micromagnetics respects the fundamental properties of local spin expectation values in quantum systems. Relying on the $\mathbb{S}^3$ order parameter, we derive Landau-Lifshitz-Gilbert and Thiele equations and apply them to the dynamics of several spin textures: domain walls in nanowires, chiral bobbers, and magnetic dipole strings. The results demonstrate how the extended formalism accounts for the dynamics of Bloch points observed experimentally and open up prospects for modeling complex spin structures, including the nucleation and annihilation of topological states such as skyrmions and hopfions.

MA 37.2 Wed 15:15 POT/0351

Magnetoelastic Fingerprints in Dysprosium Iron Garnet Thin Films: Inversion of Effective Local Anisotropy within Domain Walls — •Lukas D. Ćavar[1], Julian Skolaut[2], Olena Gomonay[1], Miela J. Gross[3], Khang Vi Becker[1], Simon J. Sochiera[1], Dirk Backes[4], Caroline A. Ross[3], and Angela Wittmann[1] — [1]Johannes Gutenberg Universität, Mainz, DE — [2]Christian-Albrechts-Universität zu Kiel, DE — [3]Massachusetts Institute of Technology, Cambridge, MA, USA — [4]Diamond Light Source, Oxfordshire, UK

A promising direction for future computing devices is to embed topological spin textures in compensated collinear magnetic systems. Yet in the absence of significant stray fields, these textures must be stabilized unconventionally. While we observe a wide variety of topological textures in magnetoelastic systems, including the altermagnet α-Fe2O3 ('hematite') and the ferrimagnet dysprosium iron garnet (DyIG), their specific origin is not clear. Here, we compare Néel vector mapping via x-ray magnetic linear dichroism photoemission electron microscopy and stray-field imaging by scanning nitrogen vacancy center magnetometry to show that the DyIG 360° domain wall profile exhibits significant deviations from the classical domain wall profile. These are consistent with an inversion of the effective local anisotropy, i.e.

the easy and hard axes trading places within the domain wall body. Thereby we obtain quantitative insight into the mechanism, scale, and energetics of the magnetoelastic stabilization of topological textures in thin films with strong magneto-elastic coupling and uncover a new degree of straintronic freedom for next-generation spin devices.

MA 37.3 Wed 15:30 POT/0351

Hopfions in Symmetry-Transformed Magnetic Models — •Sandra Chulliparambil Shaju, Maria Azhar, and Karin Everschor-Sitte — Faculty of Physics and CENIDE, University of Duisburg-Essen

Three-dimensional (3D) topological spin structures continue to attract significant interest due to their rich physics and potential for future information technologies. We present a systematic framework of continuously transformed models that enables the stabilisation of topologically non-trivial 3D spin configurations. By applying this approach, we construct an effective model that hosts Hopfions embedded in a ferromagnetic background, with distinct energetic and dynamical characteristics. Our results provide new routes for investigating the formation, stability, and dynamics of three-dimensional topologically non-trivial textures.

MA 37.4 Wed 15:45 POT/0351

Fractional Hopfions in Composite Magnets — •Sanjay Ashok and Jan Masell — Karlsruhe Institute of Technology (KIT), Karlsruhe

Hopfions are three dimensional magnetization textures studied due to their unique physical-, topological properties and their functionalization prospects [1]. These textures are usually doughnut shaped and classified by their integer topological winding number called Hopf index. In our work, we demonstrate that hopfions with fractional Hopf index, called fractional hopfions [2, 3], can be stabilized in composite magnets. We identify a two-slab composite magnet with slab-dependent Dzyaloshinskii-Moriya interaction (DMI) as a suitable material platform for stabilizing fractional Hopfions. We further distinguish the role of Bloch-, Neel- and Antiskyrmion-type DMI in composite magnets and their effect on the winding of fractional hopfions [4]. By studying the phase diagram of fractional hopfions we predict the range of external magnetic field and uniaxial anisotropy where these textures can be found.

[1] Zheng et al., Nature 623, 7988 (2023); [2] Knapman et al., Comm. Phys. 7, 1 (2024); [3] Yu et al., Adv. Mat. 35, 20 (2023); [4] Ashok and Masell, *in preparation*

MA 37.5 Wed 16:00 POT/0351

Acoustically-driven manipulation of magnetic textures in epitaxial ferromagnetic thin-films — •João Pedro Leite Gomes, Jens Herfort, and Alberto Hernández-Mínguez — Paul-Drude-Institut für Festkörperelektronik - Leibniz-Institut im Forschungsverbund Berlin e.V., Hausvogteiplatz 5-7, 10117 Berlin, Germany

Recent advances in information technology have driven the research towards more reliable storage devices, while striving for ever higher memory densities. One drawback of current spintronic technologies for information recording is the need for large spin-polarized currents to access/write information in magnetic materials, leading to less energy-efficient devices. An alternative proposal to achieve controlled magnetization switching is to make use of the magnetoelastic (ME) interaction, for example, through the excitation of surface acoustic waves (SAW) in piezoelectric substrates.

In this contribution, we report SAW-driven manipulation of domain walls (DWs) in epitaxial ferromagnetic thin-films with both cubic and uniaxial magnetic anisotropies along well-defined crystalline directions. Micromagnetic simulations model the physical mechanism by which the tickling magnetic field generated by the strain modulation, via the ME interaction, can result in the local switching of the DWs. We discuss how much SAWs are a feasible approach to achieve magnetization switching and/or promote DW pinning in single crystal ferromagnetic thin-films.

MA 37.6 Wed 16:15 POT/0351

Control of helix orientation in chiral magnets via lateral confinement — •Maurice Colling[1], Mariia Stepanova[1], Mario Hentschel[2], Erik Lysne[1], Kasper Hunnestad[1], Naoya Kanazawa[3], Yoshinori Tokura[3,4], Jan Masell[4,5], and Dennis Meier[1] — [1]Department of Materials Science and Engineering, NTNU Norwegian University of Science and Technology, Trondheim, Norway — [2]Physics Institute and Research Center SCoPE, University of Stuttgart, Stuttgart, Germany — [3]Department of Applied Physics, University of Tokyo, Tokyo, Japan — [4]RIKEN Center for Emergent Matter Science (CEMS), Wako, Japan — [5]Institute of Theoretical Solid State Physics, Karlsruhe Institute of Technology, Karlsruhe, Germany

Helimagnetic materials offer a versatile platform for spin-based device concepts due to their long-range, tunable spiral order. This talk demonstrates control of the helimagnetic propagation vector q via geometrical confinement, using FeGe as a model DMI-driven chiral magnet. Micromagnetic simulations based on the nonlinear sigma model show that open boundaries generate a chiral surface twist that acts as an effective surface anisotropy selecting the helix orientation. This behavior is captured well by an analytical model derived from the DMI boundary condition. Magnetic force microscopy on focused ion beam structured FeGe confirms the predicted orientation and establishes geometry-controlled helimagnetic order as a robust mechanism for steering DMI-stabilized spin-spiral states. The concept provides a route to device-level control of chiral magnetic textures.

MA 37.7 Wed 16:30 POT/0351

Magnetization dynamics of twists in (anti-)ferromagnetic insulators — Patricia Oehrl[1,2], Mathew James[3], Luca Maranzana[4], Andreas Bauer[2], Denis Mettus[2], Christian Pfleiderer[2], Christian Back[2], Sergey Artyukhin[4], Hans Huebl[1,2], and •Aisha Aqeel[3] — [1]Walther-Meißner-Institut, 85748 Garching, Germany — [2]Technical University of Munich, 85748 Garching, Germany — [3]University of Augsburg, 86159 Augsburg, Germany — [4]Quantum Materials Theory, Italian Institute of Technology, Via Morego 30, Genoa, Italy

Magnetic insulators hosting noncollinear spin textures display a remarkable variety of static and dynamic phenomena. In chiral systems such as Cu2OSeO3, the lack of inversion symmetry gives rise to helices and skyrmions stabilized by Dzyaloshinskii-Moriya interactions [1]. By contrast, in centrosymmetric compounds like CuSeO3, complex antiferromagnetic spiral states can emerge purely from competing symmetric exchange interactions, providing an intriguing platform to explore magnetism without intrinsic chirality. In this talk, I will present our preliminary results on dynamic excitation of these textures in chiral Cu2OSeO3 and centrosymmetric CuSeO3 magnets using magnetic resonance spectroscopy [2].

References: [1] S. Mehboodi, V. Ukleev, C. Luo, R. Abrudan, F. Radu, C. H. Back, A. Aqeel, Sci. Technol. Adv. Mater 26(1) 2532366 (2025) [2] Aisha Aqeel, Jan Sahliger,... Christian H Back, Phys. Rev. Lett. 126, 017202 (2021)

MA 37.8 Wed 16:45 POT/0351

Extraordinary return point memory in ferrimagnetic materials — •Tamer Karaman[1], Kai Litzius[1], Aladin Ullrich[1], Riccardo Battistelli[1], Manas Patra[1,2], Raluca Boltje[1], Miela Gross[2], Steffen Wittrock[2], Krishnanjana Joy[1], Daniel Metternich[2], Sebastian Hoffman[1], Timo Schmidt[1], Daniel Perez[3], Manuel Valvidares[3], Sebastain Wintz[2], Manfred Albrecht[1], and Felix Büttner[1,2] — [1]University of Augsburg, Germany — [2]Helmholtz-Zentrum Berlin, Germany — [3]ALBA Synchrotron Light Source, Spain

Magnetic domains and domain walls are promising information carriers, widely explored for racetrack memory [1] and other mobility applications [2]. In this study, we demonstrate deterministic magnetic-domain nucleation in rare-earth transition-metal (RE-TM) ferrimagnetic systems. Remarkably, the as-grown domain configuration serves as an intrinsic template that reappears with 100% return-point memory after repeated out-of-plane magnetic-field cycling. Even more surprisingly, the full domain pattern can be toggle switched using extremely small in-plane fields near 0 mT, while the overall domain morphology remains unchanged. These findings point to new opportunities in cryptography and other technologies requiring deterministic pattern reproducibility, and they highlight the importance of further exploring properties of RE-TM ferrimagnets. References: 1.Parkin, S. et al. Nat. Nano. 10, 195-198 (2015) 2.Venkat, G. et al. J. Phys. Appl. Phys. 57, 063001 (2024).

MA 37.9 Wed 17:00 POT/0351

Microscale coexistence of magnetic phases compatible with the Kagome spin-ice rule in HoAgGe — •Manuel Zahn[1,2], Kan Zhao[3], Philipp Gegenwart[1], Sándor Bordács[4], and István Kézsmárki[1] — [1]Center for Electronic Correlation and Magnetism, University of Augsburg, Augsburg, Germany — [2]Norwegian University of Science and Technology, Trondheim, Norway — [3]School of Physics, Beihang University, Beijing, China — [4]Department of Physics, Budapest University of Technology and Economics, Budapest, Hungary

HoAgGe realizes kagome spin-ice with a series of fractionalized magnetization plateau states for applied in-plane magnetic fields [1]. Corresponding magnetoresistance and Hall effect reveal a hysteresis at the plateau states, indicating field-history dependent occupation of magnetic domains with opposite chirality and Berry curvature [2].

In the presented study, we investigate the microscale magnetic patterns, using low-temperature atomic force microscopy to visualize possible phase coexistence. By studying different crystal cuts and varying magnetic fields using a vector magnet, we reconstruct the full 3D magnetic texture of phase coexistence. Our results provide insights into the interplay of geometrical, topological and frustrated properties of spin ice materials and demonstrate pathways for external manipulation of magnetic textures in highly-frustrated systems.

[1] K. Zhao *et al.*, Science **367**, 1218 (2020). [2] K. Zhao *et al.*, Nat. Phys. **20**, 442 (2024).

MA 38: Ultrafast Magnetization Effects II

Time: Wednesday 15:00–18:45 Location: POT/0361

MA 38.1 Wed 15:00 POT/0361

Ultrafast light-induced spin and orbital moment in nonmagnetic band insulators from RT-TDDFT — •Andri Darmawan, Markus E. Gruner, and Rossitza Pentcheva — Department of Physics, University of Duisburg-Essen

Recently dynamical multiferroicity was predicted in $SrTiO_3$ as well as $KTaO_3$ [1-2] and subsequently observed experimentally in $SrTiO_3$ [3], employing THz circularly polarized pulse. This is particularly intriguing as $SrTiO_3$ and $KTaO_3$ are nonmagnetic band insulators with d^0 occupation at Ti and Ta. Here, using real-time time-dependent density functional theory (RT-TDDFT) as implemented in the Elk code we employ optical circularly polarized laser pulses to investigate laser-induced spin and orbital moment in $SrTiO_3$ and $KTaO_3$. We study systematically the dependence on the laser parameters and find that duration and frequency of the pulse strongly influence the behavior of the light-induced spin and orbital magnetic moment in both $SrTiO_3$ and $KTaO_3$. While in $SrTiO_3$ the induced orbital momentum predominates, at certain frequencies $KTaO_3$ exhibits both substantial light-induced spin moment and orbital moment.

Funding by DFG within CRC1242 (project C02) and computational time at magnitUDE, amplitUDE are gratefully acknowledged.

[1] D. Juraschek et al., Phys. Rev. Mater. **1**, 014401 (2017)
[2] R. M. Geilhufe et al., Phys. Rev. Research **3**, L022011 (2021)
[3] M. Basini et al., Nature **628**, 534 (2024)

MA 38.2 Wed 15:15 POT/0361

Interfacial magnon generation drives ultrafast spin dynamics in Gd — •Corvin Krohn[1], Ekaterina Bobrova[1], Tim Amrhein[1], Dominic Lawrenz[1], Niko Pontius[2], Christian Schüssler-Langeheine[2], Martin Weinelt[1], and Nele Thielemann-Kühn[1,2] — [1]Freie Universität Berlin, Berlin, Germany — [2]Helmholtz-Zentrum Berlin, Berlin, Germany

Previous time-resolved photoemission [1] and x-ray magnetic circular dichroism (XMCD) [2] experiments investigating $4f$ magnetization dynamics in Gadolinium (Gd) showed conflicting results, with demagnetization timescales of 14 ps [1] and 0.7 ps [2], respectively.

Within an XMCD study at the FemtoSlicing facility, we could now show that intrinsic dynamics in Gd is slow. For a thin Gd film, however, where the pump laser directly excites the non-magnetic substrate as well, generation of magnons at the metal-substrate interface drives the ultrafast demagnetization.

In the next step we aim to identify magnons as m_s state excitations within the Gd $4f$ electronic ground level, using time-resolved x-ray absorption spectroscopy.

Revealing signatures of magnetic dynamics in the electronic structure will provide insights into the correlated electronic and magnetic structure of $4f$ metals.

[1] B. Frietsch *et al.*, Nat. Commun. **6**, 8262 (2015).
[2] K. Bobowski *et al.*, J. Phys.: Condens. Matter **29**, 234003 (2017).

MA 38.3 Wed 15:30 POT/0361

Probing ultrafast dynamics of artificial antiferromagnets by soft-x-ray diffraction — •Jasmin Jarecki[1], Martin Borchert[1], Stefan Eisebitt[1,2], and Daniel Schick[1] — [1]Max-Born-Institut für Nichtlineare Optik & Kurzzeitspektroskopie, Berlin, Germany — [2]Institut für Optik & Atomare Physik, TU Berlin, Germany

Ordering phenomena in solids encode key information about microscopic interactions and subsystem coupling. In magnetic materials, magnetic and structural order can be strongly coupled, yet the corresponding periodicities may exhibit different characteristic lengths. This calls for methods capable of simultaneously probing lattice and spin degrees of freedom to disentangle phonon and spin dynamics.

Using on- and off-resonant ultrafast x-ray diffraction (UXRD) in the soft-x-ray regime, we investigate the coupled structural and magnetic dynamics of a Fe/Cr superlattice (SL), an artificial antiferromagnet in which adjacent Fe layers adopt alternating magnetization directions for the chosen Cr spacer thickness. By tracking the structural and magnetic SL Bragg peaks, we study photon-energy- and fluence-dependent dynamics via their transient peak positions and intensities. While the structural peak shift and the magnetic peak intensity follow the expected behavior, the magnetic peak shift deviates markedly from the structural response and, in particular, does not exhibit the anticipated linear fluence dependence. These findings highlight the strong intercoupling between depth-dependent sample dynamics and depth-dependent probing, underscoring the need for careful analysis and modeling to reliably extract microscopic dynamics from UXRD.

MA 38.4 Wed 15:45 POT/0361

Double-pulse all-optical magnetization re-switching of GdFe — Rahil Hosseinifar[1], Felix Steinbach[2], Ivar Kumberg[1], José Miguel Lendínez[3], Sangeeta Thakur[1], Sebastien E. Hadjadj[1], Jendrik Gördes[1], Chowdhury S. Awsaf[1], Mario Fix[4], Manfred Albrecht[4], Florian Kronast[5], Unai Atxitia[3], Clemens von Korff Schmising[2], and •Wolfgang Kuch[1] — [1]Freie Universität Berlin, Berlin, Germany — [2]Max-Born-Institut, Berlin, Germany — [3]ICMM-CSIC, Madrid, Spain — [4]Universität Augsburg, Augsburg, Germany — [5]Helmholtz-Zentrum Berlin, Berlin, Germany

The reversible helicity-independent switching of the magnetization direction of ferrimagnetic materials like GdFe by individual sub-ps optical laser pulses bears the potential to accelerate magnetic data storage. We present a systematic Kerr-microscopy domain-imaging study of a 10 nm $Gd_{26}Fe_{74}$ film after excitation with two laser pulses with a certain time delay in between. Our results show that when the fluence of the first pulse is adjusted just above the threshold of single-pulse switching, a second pulse with about 60% of the fluence of the first pulse, arriving only 4 ps later, can already switch the magnetization back [1]. Atomistic spin dynamics simulations reproduce the experimental results and show that under these conditions the magnetizations of the Fe and Gd sublattices have already moved sufficiently away from zero when the second pulse hits the sample, a prerequisite for fast re-switching.

[1] R. Hosseinifar *et al.*, Phys. Rev. B **112**, 174406 (2025).

MA 38.5 Wed 16:00 POT/0361

Light-induced ultrafast magnetization dynamics driven by chiral phonons — •Shiqi Hu and Sangeeta Sharma — Max-Born Institute for Nonlinear Optics and Short Pulse Spectroscopy,Berlin,Germany

The pursuit of high-speed, low-power information processing is driving advanced research into ultrafast laser control of magnetic order. Going beyond conventional approaches that rely on heterojunctions for spin-current injection, this work demonstrates direct manipulation of magnetism in bulk materials through intrinsic interactions. Using circularly polarized laser excitation, we generate THz chiral phonons in the non-collinear antiferromagnet Mn3Sn with a Kagome lattice. The angular momentum of these phonons produces an effective magnetic field, inducing coupled in-plane and out-of-plane spin precession that reorients the magnetic octupole. This reorientation, in turn, modulates the topological properties of Weyl points. Spin*orbit coupling and the rotational motion of chiral phonons are shown to be essential to this mechanism. We attribute the observed spin dynamics to a competition between the phonon-induced effective field*favoring ferromagnetic alignment*and the intrinsic antiferromagnetic spin interactions in the Kagome lattice. These findings open a new pathway for controlling magnetic topology.

MA 38.6 Wed 16:15 POT/0361

Exploring the ultrafast change of antiferromagnetic and ferromagnetic order in a Mn_2Au/Py bilayer — •Jendrik Gördes[1], Markus Weissenhofer[1,2], Sangeeta Thakur[1], Chowdhury S. Awsaf[1], Marcel Walter[1], Lorenzo Grilli[1], Deeksha Gupta[3], Niko Pontius[3], Christian Schüssler-Langeheine[3], Peter M. Oppeneer[2], Martin Jourdan[4], and Wolfgang Kuch[1] — [1]Freie Universität Berlin, Berlin, Germany — [2]Uppsala University, Uppsala, Sweden — [3]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany — [4]Johannes Gutenberg-Universität Mainz, Mainz, Germany

Antiferromagnetic (AFM) materials are promising candidates for future data storage devices. One noteworthy material is Mn_2Au, a metallic collinear AFM that can be electrically switched [1]. We report on the time-resolved change of AFM and ferromagnetic (FM) order of a Mn_2Au/permalloy (Py) bilayer after excitation with 800 nm fs laser pulses by X-ray magnetic linear and circular dichroism (XMLD and XMCD) in resonant soft X-ray reflectivity at the Mn and Fe L_3 edges. We observe an ultrafast loss and an exceptionally fast recovery of the AFM order within a few ps, much faster than the recovery of the adjacent FM order. Local and non-local mechanisms are considered in simulations using an atomistic spin model. The presented research highlights the fast dynamics of AFM layers for spintronic applications. [1] J. Železný, H. Gao, K. Výborný et al., PRL 113, 157201 (2014)

MA 38.7 Wed 16:30 POT/0361

Intrinsic timescales of ferro- and antiferromagnets in ultrafast demagnetisation — •Tobias Dannegger[1], Stephan Wust[2], Paul Herrgen[2], Martin Aeschlimann[2], Benjamin Stadtmüller[3], and Ulrich Nowak[1] — [1]Fachbereich Physik, Universität Konstanz, Konstanz, Germany — [2]Department of Physics and Research Center OPTIMAS, RPTU University Kaiserslautern-Landau, Kaiserslautern, Germany — [3]Experimentalphysik II, Institute of Physics, University of Augsburg, Germany

For small deviations from the ground state, the spin dynamics of a magnetically ordered material can be described within linear spin-wave theory. There is a well known difference between the intrinsic timescales, given by the eigenfrequencies, of ferro- and antiferromagnets, the latter being approximately two orders of magnitude faster. Here, we present a systematic investigation, based on atomistic spin dynamics simulations, of how ferro- and antiferromagnetic ordering affects the intrinsic timescales of the magnetic order parameter far away from equilibrium, such as in ultrafast light-induced quenching experiments. We find that the speed advantage of antiferromagnets persists in the strongly non-equilibrium regime, but with some striking qualitative differences for very large excitations, where antiferromagnets slow down while the ferromagnetic quenching efficiency increases again.

15 min break

MA 38.8 Wed 17:00 POT/0361

Field-tuning of ultrafast magnetization fluctuations in $Sm_{0.7}Er_{0.3}FeO_3$ — •Julius Schlegel[1], Marvin Alexander Weiss[1], Daniel Anić[1], Emil Steiner[1], Franz Stefan Herbst[1], Makoto Nakajima[2], Takayuki Kurihara[3], Alfred Leitenstorfer[1], Sebastian T.B. Goennenwein[1], and Ulrich Nowak[1] — [1]Department of Physics, University of Konstanz, Germany — [2]Institute of Laser Engineering, Osaka University, Japan — [3]Department of Basic Science, The University of Tokyo, Japan

The missing stray field and the vanishing net magnetization make it challenging to investigate antiferromagnetic dynamics experimentally. Nevertheless, thermal magnetization fluctuations persist in antiferromagnets and can be exploited to gain insights into their dynamics [1].

In this work, we investigate these fluctuations in the canted antiferromagnet $Sm_{0.7}Er_{0.3}FeO_3$ under the influence of an external magnetic field [2]. Using femtosecond noise-correlation spectroscopy combined with atomistic spin-dynamics simulations, we examine the spin noise in the vicinity of the magnetic reorientation transition.

We demonstrate that the external magnetic field suppresses characteristic features of critical fluctuations, such as a diverging noise amplitude. Moreover, it enhances the quasi-ferromagnetic magnon frequency near the reorientation transition. Our results offer a means to tune ultrafast spin fluctuations via experimentally accessible external parameters.

[1] M. A. Weiss et al., Nat. Commun. 14, 7651 (2023).
[2] M. A. Weiss et al., arXiv:2509.26084 (2025)

MA 38.9 Wed 17:15 POT/0361

Large strain contribution to the laser-driven magnetization response of magnetostrictive $TbFe_2$ — •Constantin Walz[1], Fried-C. Weber[1,2], Steffen-P. Zeuschner[1], Karine Dumesnil[3], Alexander von Reppert[1], and Matias Bargheer[1,2] — [1]Institut für Physik und Astronomie, Universität Potsdam, Potsdam, Germany — [2]Helmholtz-Zentrum Berlin, Berlin, Germany — [3]Institut Jean Lamour, Université de Lorraine, Nancy, France

Rare Earth-Iron compounds ($RE\mathrm{Fe}_2$ with $RE = \mathrm{Tb, Dy, Tb_{0.3}Dy_{0.7}}$) are well known for their giant (inverse) magnetostriction, exhibiting lattice-constant changes exceeding 10^{-3} at saturation. While they are widely used as ultrasonic transducers in the MHz regime, their ultrafast magnetization dynamics remain less explored.

We investigate the strain-driven magnetization dynamics in $TbFe_2$ using time-resolved magneto-optical Kerr effect (trMOKE) and optical reflectivity measurements. The delayed strain response in the trMOKE signal indicates a true magnetic origin of these features, ruling out instantaneous changes of the optical constants. In addition, we show that glass-capped sample structures efficiently transduce unipolar strain pulses, which we use to calibrate the contribution of quasi-static-strain-induced magnetization dynamics to the total signal. Modeling with a Landau-Lifshitz-Gilbert equation including a time-dependent magneto-elastic field reproduces the observations and demonstrates that strain can even provide the dominant contribution to the laser-driven magnetization dynamics.

MA 38.10 Wed 17:30 POT/0361

All-optical stochastic switching of magnetisation textures in Fe3Sn2 — •Andras Kovacs[1], Jonathan Weber[2], Michalis Charilaou[3], Rafal Dunin-Borkowski[1], and Sascha Schaefer[2] — [1]Ernst Ruska-Centre, Forschungszentrum Jülich, Germany — [2]Regensburg Center for Ultrafast Nanoscopy, University of Regensburg, Regensburg, Germany — [3]Department of Physics, University of Louisiana at Lafayette, USA

We utilize femtosecond optical pulses to alter the helicity of the magnetic spin configuration in dipolar skyrmions formed in the kagome magnet Fe3Sn2 in the absence of an external magnetic field and at room temperature. In situ Lorentz transmission electron microscopy is used to visualise the light-induced stochastic switching process of chiral Néel caps, while the internal Bloch component of the dipolar skyrmions remains unchanged. To corroborate the spin states and the light-induced magnetisation dynamics, micromagnetic modelling and simulations of the resulting electron phase shift maps are conducted to elucidate the spin rearrangement induced by individual femtosecond optical pulses [1]. We acknowledge the scientific support to D. Kong, L. Prodan, V. Tsurkan, A. Schroder, N. Kiselev, I Kezsmarki, A. Tavabi and the financial support to EU grant No. 856538. [1] A. Kovacs etal, Comm. Mater. 6, 223 (2025)

MA 38.11 Wed 17:45 POT/0361

Nonlinear spin and orbital Rashba–Edelstein effects induced by a femtosecond laser pulse: Simulations for Au(001) — Oliver Busch, •Franziska Ziolkowski, Börge Göbel, Ingrid Mertig, and Jürgen Henk — Martin-Luther-Universität Halle-Wittenberg, 06099 Halle, Germany

Rashba-type spin-orbit coupling gives rise to distinctive surface and interface phenomena, such as spin-momentum locking and spin splitting. In nonequilibrium conditions, it manifests e.g., as the Rashba–Edelstein effect, where an electric current generates a net spin or orbital polarization perpendicular to the current direction. While the steady-state behavior of these effects is well studied, their dynamics on ultrafast timescales remain largely unexplored.

We theoretically investigate the ultrafast spin and orbital Edelstein effects on an Au(001) surface, induced by femtosecond laser excitation [1]. These effects are intrinsic and inherently nonlinear. We simulate the ultrafast electron dynamics in response to the laser pulse by using a real-space tight-binding model combined with unitary time evolution of the density matrix.

Our results reveal pronounced differences between the spin and orbital responses and quantify the resulting charge, spin, and orbital currents, including laser-induced spin and orbital Hall effects. These findings provide insights into ultrafast angular momentum transfer mediated by the light-matter interaction and offer guidance for the design of next-generation spintronic and orbitronic devices.

[1] Busch *et al* PRR **7**, 043023 (2025)

MA 38.12 Wed 18:00 POT/0361

Impact of Structural Imperfections on the Ultrafast Orbital Hall Effect in Metallic Nanoribbons — •Theresa Albrecht, Franziska Ziolkowski, Börge Göbel, Ingrid Mertig, Jürgen Henk, and Samir Lounis — Institut für Physik, Martin-Luther-Universität, D-06099 Halle

The ultrafast orbital Hall effect (UOHE) arises when a femtosecond laser pulse drives a transient orbital current. We investigate how structural defects affect the UOHE in a Cu nanoribbon [1]. Using Evolve, a real-space tight-binding framework for finite systems [2], we simulate the laser-induced electron dynamics and compute the orbital angular momentum (OAM) and its associated currents with atomic resolution. Defects significantly alter the OAM landscape: while defect-free ribbons exhibit pronounced edge accumulation, imperfections redistribute OAM toward defect sites and progressively suppress edge signatures as their number increases. Furthermore, we analyze the phase relation between the p- and d-orbital contributions to the OAM in interface geometries. Our results reveal the pivotal influence of defects on ultrafast orbital transport and dynamics.

[1] O. Busch *et al.*, Physical Review Research **6**, 013208 (2024)
[2] F. Töpler *et al.*, New Journal of Physics **23**, 033042 (2021)

MA 38.13 Wed 18:15 POT/0361

Pump-induced out-of-equilibrium magnetism in the Mott insulator CuO — •Katja Sophia Moos[1,2], Yun Yen[2], Gian Parusa[1,2], Arnau C. Romaguera[3], Elia Razzoli[3], Hiroki Ueda[3], and Michael Schüler[1,2] — [1]Department of Physics, University of Fribourg, 1700 Fribourg, Switzerland — [2]Center for Scientific Computing, Theory and Data, Paul Scherrer Institute, 5232 Villigen PSI, Switzerland — [3]Center for Photon Science, Paul Scherrer Institute, 5232 Villigen PSI, Switzerland

Understanding ultrafast magnetism requires tracking energy flow among coupled electronic, spin, and lattice subsystems. Using time-resolved resonant diffuse scattering combined with complementary X-ray techniques and quantum-kinetic simulations, we reveal microscopic pathways of pump-induced demagnetization in the antiferromagnetic Mott insulator CuO. Above-bandgap photoexcitation creates non-thermal magnons across the Brillouin zone within tens of femtoseconds, followed by magnon-magnon scattering driving quasi-thermalization within picoseconds. Magnetic recovery occurs via magnon-phonon coupling on nanoseconds, constrained by dispersion mismatches imposing intrinsic bottlenecks. Our momentum-resolved quantum Boltzmann simulations establish a hierarchical energy-transfer framework beyond phenomenological multi-temperature models, reproducing key features of the experiments. This approach provides design principles for controlling non-equilibrium magnetic states and highlights time-resolved resonant diffuse scattering as a power tool for ultrafast quantum materials research.

MA 38.14 Wed 18:30 POT/0361

Ultrafast spin and pure spin currents — •Deepika Gill, Sam Shallcross, and Sangeeta Sharma — Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie, Max-Born-Strasse 2A, 12489, Berlin, Germany

Pure spin currents, the flow of spin in the absence of charge flow, represent a promising route toward energy efficient next-generation electronics [1]. Creating such currents often involves designed nanostructures, which can be challenging to create in experiment. Here, relying only on intrinsic material properties, we shift the design to the light pulse via two schemes: (1) via anti-symmetric laser pulses [2] and (2) via composite light pulses that generate pure spin current by tailoring spin density occupation in momentum space [3]. We provide realistic material examples including WSe2 and calculate the ultra-fast spin current response both via state-of-the-art time density function theory as well as Wannier parameterized tight-binding calculations.

[1] S Sharma et al. Nature Communications 15 (1), 7579 (2024)
[2] D Gill et al. Nanoletters 25 (25), 9913-9917 (2025)
[3] D Gill et al. npj 2D Materials and Applications 9 (1), 49 (2025)

MA 39: Poster Magnetism II

Time: Wednesday 18:00–21:00 Location: P2

MA 39.1 Wed 18:00 P2

Observation of negative orbital torque from Vanadium — •Jose Omar Ledesma Martin[1], Nikhil Vijayan[1], Durgesh Kumar[1], Ao Du[1], Lei Gao[2], Zijie Xiao[2], Hai I. Wang[2], Rahul Gupta[1], Gerhard Jakob[1], Sachin Krishnia[1], Yuriy Mokrousov[1,3], and Mathias Kläui[1] — [1]Institute of Physics, Johannes Gutenberg University Mainz, Germany — [2]Max Planck Institute for Polymer Research, Germany — [3]Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich and JARA, Germany

Vanadium is predicted to exhibit a large orbital Hall effect. This effect is measured using ST-FMR, second-harmonic Hall, and THz emission, and all techniques reveal a negative orbital torque, in contrast to previous predictions and measurements that report a positive sign. The consistency in the results suggests the intrinsic origin of the OHE in our V samples. The torque magnitude depends strongly on the choice of ferromagnet: FeCoB/V, sensitive mainly to SHE-driven currents, shows only a weak response, whereas Ni/V, which efficiently converts OHE-driven currents, exhibits a torque nearly seven times larger. The torque increases with V thickness while remaining negative, and the extracted parameters indicate a large negative orbital Hall conductivity and long orbital diffusion length. Our results show that V generates strong orbital Hall currents with minimal spin Hall contribution and that itinerant interfacial orbital currents play a decisive role in determining both the efficiency and the sign of the torque (1).

(1) Vijayan, N. et al., arXiv:2508.16339 (2025).

MA 39.2 Wed 18:00 P2

Transport and spin torque in van der Waals heterostructures — •Nils Stüber[1], Sadeed Hameed[1], Aditya Kumar[1], Xinran Wang[1], Durgesh Kumar[1], Aravind Puthirath Balan[1], and Mathias Kläui[1,2] — [1]Institute of Physics, Johannes Gutenberg-Universität, Mainz, Germany — [2]Center for Quantum Spintronics, Department of Physics, Norwegian University of Science and Technology, Trondheim, Norway

Graphene serves as an ideal spin-transport channel due to its long spin relaxation times and possible near-ballistic transport. In Ni/Gr heterostructures, the strength of the Spin Hall effect can be tuned via gate voltage, enabled by the Dirac-cone band structure.

In this work, we investigate spin-current generation in graphene induced by proximity-driven spin-orbit coupling (SOC) from epitaxially grown Ni(111). The SOC arises from hybridization between the graphene*s π-electrons and the Ni 3d orbitals.

We perform spin-torque ferromagnetic resonance (ST-FMR) to study the dependence of the spin-current signal on the Ni thickness and to identify the origin of the generated spin current. Additionally, THz emission experiments were carried out to detect the inverse Spin Hall effect in graphene, revealing a significantly different signal compared to CoFe/Gr heterostructures.

MA 39.3 Wed 18:00 P2

Tuning Spin-Charge Conversion at the hybrid heavy-metal/organic semiconductor interface via Doping — Parul Devi[1], •Devamrutha I S[1], Zhitian Ling[2], Ashish Moharana[1], David Anthofer[1], Tomasz Marszalek[2], and Angela Wittmann[1] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz, Deutschland — [2]Max-Planck-Institut für Polymerforschung, Mainz, Deutschland

Spintronics, the way forward to device miniaturization, leverages electron spin rather than charge. Though inorganic materials were predominantly given more attention in spin transport studies, organic semiconductor (OSC)/magnetic hybrid interfaces are quickly gaining interest, owing to the flexibility, scalability, and structural tunability of organic materials. Here, we probe the role of the charge carrier concentration of the OSC on the spin injection and spin-charge conversion efficiency in hybrid heterostructures via spin pumping. For this, we probe the inverse spin Hall effect (ISHE) in a ferrimagnetic insulator/ heavy-metal/ OSC heterostructure and systematically dope the conjugated polymer PBTTT with F4-TCNQ. We observed that the ISHE amplitude in the heavy metal increases by a factor of 4 upon adsorption of the PBTTT layer while doping reduces the signal. These results open the door to charge doping as an effective tool to control spin injection across hybrid interfaces.

MA 39.4 Wed 18:00 P2

Chirality controlled quantum transport in kagome AV3Sb5 — •Li Cheng and Qun Yang — Max Planck Institute of Microstructure Physics

Kagome metals AV3Sb5 exhibit a rich interplay among charge-density waves (CDWs), structural chirality, unconventional superconductivity, and anomalous Hall transport. Recent theoretical progress shows that layer-dependent phase shifts between CDW wave vectors can generate helical stacking and chiral electronic structures, while experiments reveal strong correlations between chirality and anomalous charge transport. In parallel, distorted kagome compounds display intertwined CDW and magnetic orders with enhanced tunability under external stimuli.

Motivated by these developments, this project aims to establish a predictive first-principles framework that connects CDW chirality with spin/orbital polarization as well as anomalous transport, and to uncover the microscopic mechanisms driving anomalous Hall responses in kagome systems. We further propose to explore pressure, strain, and temperature as external knobs for switching chirality and controlling emergent electronic and magnetic functionalities.

MA 39.5 Wed 18:00 P2

Tunable Topological Spin Pump in the XXZ Chain via Incommensurate Boundary Drives. — •Anshuman Tripathi[1], Mircea Trif[2], and Thore Posske[1] — [1]I. Institute for Theoretical Physics, University of Hamburg, Hamburg, Germany — [2]International Research Centre MagTop, Institute of Physics, Polish Academy of Sciences, Warsaw, Poland

We investigate an interacting XXZ spin-1/2 chain driven quasiadiabatically at its boundaries by two incommensurate phase drives. The independently evolving phases result in a quasi-periodic trajectory on a two-dimensional torus, which generates a robust topological spin pump in the ground state. We show that the pumped spin is determined by an effective Chern number defined over the drive-phase torus, whose value is set by the number of degeneracy points enclosed by the trajectory. These degeneracy points increase systematically with the chain length and can be tuned through the exchange anisotropy, providing direct control of the topological pumping strength. Our results demonstrate that incommensurate multi-tone driving enables a versatile and robust realization of topological pumps in interacting quantum spin chains.

MA 39.6 Wed 18:00 P2

Ab-initio calculated linear, quadratic and cubic magneto-optic Kerr effect spectra — •Martin Zeman[1], Maik Gaerner[2], Robin Silber[3], Martin Veis[1], Timo Kuschel[2,4], and Jaroslav Hamrle[1,5] — [1]Charles University Prague, Czech Republic — [2]Bielefeld University, Germany — [3]VSB - Technical University of Ostrava, Czech Republic — [4]Johannes Gutenberg University Mainz, Germany — [5]Czech Technical University, Prague, Czech Republic

The cubic magneto-optic Kerr effect originates from higher-order symmetry terms in cubic crystals. Using density-functional theory within WIEN2k, we calculate the linear, quadratic, and cubic MOKE contributions. First, the permittivity tensor is calculated for different magnetization orientations using the Kubo formula (linear response theory). Then, the individual contributions are separated using expected dependence on the magnetization direction, as predicted by the symmetry. Here we limit to ferromagnetic materials of cubic symmetry, bcc Fe, fcc Co, fcc Ni, and Heusler compounds Co_2FeSi and AuMnSb, whose magneto-optic response is described by principal spectra K, G_s, $2G_{44}$, and ΔH. Surprisingly, the strength of the cubic contribution ΔH is of similar order as the quadratic ones G_s, $2G_{44}$, which has also been confirmed by experimentally [1,2].

[1] M. Gaerner et al., Phys. Rev. Appl. **22**, 024066 (2024)
[2] R. Silber et al, Phys. Rev. B **100**, 064403 (2019)

MA 39.7 Wed 18:00 P2

Application of 3D Nano-Lithography in Magnetism — •Jana Kredl[1], Christian Denker[1], Cornelius Fendler[2], Julia Bethune[1], Nina Meyer[1], Theresa Brinker[1], Finn-F. Stiewe[1], Tobias Kleinke[1], Chris Badenhorst[1], Alena Rong[1], Robin Silber[3], Mark Doerr[1], Raghvendra Palanakar[1], Toni Hache[6], Neha Jah[1], Uwe T. Bornscheuer[1], Marcel Kohlmann[1], Hauke Lars Heyen[1], Michaela Lammel[4], Alexander Paarmann[5], Andy Thomas[4], Robert Blick[2], Jakob Walowski[1], Michaela Dalcea[1], and Markus Muenzenberg[1] — [1]University of Greifswald, Germany — [2]University of Hamburg — [3]VSB-Technical University of Ostrava, Czech Republic — [4]IFW Dresden, Gemany — [5]Fritz Haber Institute of the Max Planck Society, Berlin, Germany — [6]Helmholtz-Zentrum Dresden-Rossendorf, Germany

3D 2-Photon-Lithography, originally developed for 3D photonic crystals, opens a wide range of new possible applications in many fields, e.g. life sciences, micro-optics and mechanics. We will present our recent applications of 3D 2-Photon-lithography and show 3D evaporation masks for in-situ device fabrication using different deposition angles, infra-red laser light focusing lenses directly fabricated on optical fibers, tunnel structures for guiding growth of neurons [1], pillars for investigation of cell mechanics and master-mold fabrication for Polydimethylsiloxane (PDMS) micro-fluidic channels. Based on our experience we will discuss possible applications in magnetism. [1] C. Fendler et al., Adv. Biosys. 5 (2019) doi: 10.1002/adbi.201970054

MA 39.8 Wed 18:00 P2

Mapping the Interaction Field in Artificial Spin Ices — •Brindaban Ojha, Matías P. Grassi, and Vassilios Kapaklis — Department of Physics and Astronomy, Uppsala University, Uppsala, Sweden

Artificial spin ice (ASI) consists of lithographically patterned nanomagnet arrays that interact through dipolar coupling. Although these interactions can be tuned by adjusting nanomagnet dimensions, periodicity, and thickness, their detailed distribution and influence on magnetization reversal remain incompletely understood. We study square ASI structures with nanomagnet widths corresponding to aspect ratios (length/width) of 3 and 4.5, while keeping the length fixed at ~450 nm, and probe their interaction fields using First-Order Reversal Curve (FORC) analysis. ASI with an aspect ratio of 4.5 shows a single central peak in the FORC distribution, whereas the aspect-ratio-3 system displays both a central peak and an asymmetric 'boomerang'-shaped feature. To understand these signatures, we perform micromagnetic simulations using MuMax. After relaxation from a random state, lower-aspect ratio ASI develops multidomain or vortex-like states, while higher-aspect-ratio ASI stabilizes in single-domain configurations due to enhanced shape anisotropy. The simulations confirm that the central FORC peak corresponds to single-domain switching in the higher-aspect ratio ASI, whereas the 'boomerang' feature arises from an intermediate S-shaped reversal mode in the lower-aspect ratio system. These results demonstrate how geometry governs interaction-field distributions and reversal mechanisms in ASI.

MA 39.9 Wed 18:00 P2

Element- and Depth-Selective Magnetometry of Buried Magnetic Layers by MCD-HAXPES at PETRA III — •Andrei Gloskovskii[1], Christoph Schlueter[1], and Gerhard Fecher[2] — [1]Photon Science / DESY, Hamburg — [2]Max Planck Institute for Chemical Physics of Solids, Dresden

Magnetic circular dichroism (MCD) in hard X-ray photoelectron spectroscopy (HAXPES) provides direct element-specific access to magnetization in deeply buried layers. The MCD signal follows a simple $\cos(\theta)$ dependence on the angle between the X-ray polarization vector and the sample magnetization. Depth-selective magnetic sensitivity is achieved by exploiting near-total-reflection and waveguide excitation geometries, where the depth resolution is controlled by shaping the spatial intensity profile of the incident hard X-ray field inside the multilayer structure. In both cases, the probing depth is tuned by redistributing the X-ray excitation field inside the sample rather than by changing the emission angle or the kinetic energy of the photoelectrons. Using Co-based alloys as model systems, we show that MCD-HAXPES provides element- and depth-resolved magnetic contrast in complex multilayer stacks. The method is particularly powerful for disentangling interface and bulk magnetization in buried heterostructures. In addition to the methodological aspects, this contribution also presents an overview of recent user activities at beamline P22 (PETRA III), where an increasing number of external user groups have successfully applied MCD-HAXPES for depth-resolved magnetic studies and have already published a broad range of high-impact results.

MA 39.10 Wed 18:00 P2

Interferometric measurements of Yttrium-Iron-Garnet cantilevers — Sumiya Saleem[1], •Richard Boucher[1], Seth Kaufman[1], and Georg Schmidt[1,2] — [1]Martin-Luther-Universität Halle-Wittenberg Insitut für Physik, Halle, Germany. — [2]Interdisziplinäres Zentrum für Materialwissenschaften, Martin-Luther-Universität Halle-Wittenberg, Halle, Germany.

Interferometric effects provide a sensitive detection of displacement, including those related to the resonance oscillations of cantilevers. We fabricate Yttrium-Iron-Garnet (YIG) cantilevers using a room-temperature pulsed laser deposition of amorphous YIG, lift-off method, followed by an anneal in oxygen yielding single-crystal structures [1]. By combining these in an interferometer built on the basis of the work of Pernpeitner [2] and Jörg [3] we have looked at the resonance frequency dependence on YIG cantilever length in the micrometre range, which will be compared with the work of Seo [4], various theoretical models, and COMSOL simulations, showing excellent agreement with theoretical results. We further show that these cantilevers can be driven to a non-linear regime, indicated via a characteristic Duffing non-linearity at high driving powers.

[1] P. Trempler et al, APL, 117, 232401 (2019) [2] M. Pernpeitner PhD thesis, TUM. [3] P. Jörg Bachelor's thesis, TUM [4] Y-J. Seo, APL., 110, 132409 (2017)

MA 39.11 Wed 18:00 P2

Spin-lattice coupling as a source of chiral phonons in cubic magnets — •Yelyzaveta A. Borysenko, Daniel Schick, and Ulrich Nowak — Department of Physics, University of Konstanz, 78457 Konstanz, Germany

Hybrid spintronic device concepts can be implemented based on angular momentum, as this can be transferred over significant distances and effectively exchanged between different quasiparticles. The understanding, control, and effective generation of angular momentum is crucial for such applications.

The creation and manipulation of chiral phonons introduces an additional degree of freedom, as they can couple to other quasiparticles in a chirality-selective manner as well as transfer angular momentum obtained from magnons. Chiral phonons mainly occur in materials with inversion-symmetry breaking, although recent works proved that they can be also generated in materials preserving this symmetry due to spin-lattice coupling [1], which was also experimentally demonstrated with ultrafast demagnetization in a nickel thin film [2].

In this work, we linearize the coupled equations of motion for the spin and lattice degrees of freedom assuming a coupling term of anisotropy type. We describe the appearance of chiral phonons induced by spin-lattice coupling comparing cubic ferromagnets and antiferromagnets, calculate angular momentum of the modes and discuss the chirality selective coupling of magnon and phonon bands.

[1] M. Weißenhofer et al., Phys. Rev. Lett. 135, 216701 (2025);
[2] S. R. Tauchert et al., Nature 602, 73 (2022);

MA 39.12 Wed 18:00 P2

Optical manipulation of spin based AC-nanooscillators — •Niklas Dornquast[1], Kevin Jäckel[1], Jakob Walowski[1], Tim Böhnert[2], and Markus Münzenberg[1] — [1]University of Greifswald, Germany — [2]The International Iberian Nanotechnology Laboratory (INL), Portugal

With the steady rise of artificial intelligence and the end of Moore's law, a novel approach for computational capabilities arises to fulfill the ever-increasing demand, while keeping energy consumption low. The research field of spintronics provides new possibilities for such energy-efficient technology by also utilizing the transport of electron spin in addition to charge transport, opening up operation processing in a higher Gigahertz frequency range. Devices that realize such utilization of electron spin are, for example, spintronic AC-nanooscillators such as Spin-Torque-nanooscillators (STNOs) and Spin-Hall-nanooscillators (SHNOs). Additionally, these types of nanooscillators have the prospect of being used in a whole new computer architecture based on the human brain, called "neuromorphic computing". We investigate the effects of femtosecond laser pulses (<100 fs) of different polarities on such nanooscillators by optimizing the lasers' parameters to increase oscillation efficiency as well as manipulate the oscillation frequency optically.

MA 39.13 Wed 18:00 P2

Cubic magneto-optic Kerr effect in (001)-oriented thin films at grazing incidence of light — •Marius Krause[1], Maik Gaerner[1], Robin Silber[2], Jaroslav Hamrle[3], and Timo Kuschel[1,4] — [1]Bielefeld University, Germany — [2]VSB - Technical University of Ostrava, Czech Republic — [3]Charles University Prague, Czech Republic — [4]Johannes Gutenberg University Mainz, Germany

We investigate the cubic magneto-optic Kerr effect (CMOKE) in thin films of cubic crystal structures. CMOKE is proportional to third order in magnetization ($\propto M^3$) and was recently observed in Ni(111) thin films with 45° incidence of light [1]. At this angle of incidence, no CMOKE could be observed for (001)-oriented Ni thin films so far. However, we could observe a distinct CMOKE signal in Ni(001) at grazing incidence. Similar behaviour is found in other materials with (001)-oriented cubic crystal structure, indicating that grazing-incidence CMOKE is a more general feature of this crystal orientation. In this contribution, we present first experimental results of grazing-incidence CMOKE and discuss the incidence-angle dependence of CMOKE for different materials and crystal orientations. Our findings open new possibilities for CMOKE-based characterization of materials with (001)-oriented crystal structures.

[1] M. Gaerner et al., Phys. Rev. Appl. 22, 024066 (2024)

MA 39.14 Wed 18:00 P2

Generation of Floquet-like sidebands in spin-wave systems induced by surface accustic waves — •Tim Vogel, Matthias Wagner, Björn Heinz, and Philipp Pirro — Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern-Landau

The interaction between spin waves (SWs) and surface accoustic waves (SAWs) offers promising opportunities for advanced magnonic and spintronic applications. In this work, we investigate the generation of Floquet-like frequency combs in the GHz spin-wave spectrum with low-frequency SAWs in the MHz range as the Floquet-drive. We study the excitation of these states by coupling SAWs of different frequencies and incidence angles to SWs in both Damon-Eshbach and backward-volume geometry. We further explore these effects in multiple material systems to validate an analytical model describing the modified spin-wave dispersion under SAW driving. Our results contribute to a deeper understanding of magnon-phonon interactions and the conditions under which Floquet-like states emerge.

We acknowledge funding by the European Union via Horizon Europe project MandMEMS, Grant No. 101070536.

MA 39.15 Wed 18:00 P2

Growth and magnetic characterization of freestanding single-crystalline SrRuO3 /La0.7Sr0.3MnO3 oxide bilayers — •Diana Rata, Lilly Patschinsky, Elin Vocks, Alexander Much, Oleksandr Dolynchuk, Antonia Rieche, and Kathrin Dörr — Institute of Physics, Martin Luther University Halle*Wittenberg, 06099 Halle, Germany

We report the successful fabrication of freestanding epitaxial SrRuO3 /La0.7Sr0.3MnO3 (SRO/LSMO) heterostructures. LSMO and SRO layers were first prepared by PLD on a water-soluble sacrificial oxide Sr3Al2O6 (SAO), which was epitaxially grown on a SrTiO3 (100) substrate, followed by selective release and transfer of the membranes onto SiO2 wafers. The structure was characterized by X-ray diffraction. Our findings reveal that the epitaxial growth and strain of SAO layer is strongly affected by the subsequent growth condition (e.g., oxygen partial pressure) of upper oxide layers and influences strongly the quality and integrity of the oxide membranes. Magnetic characterization show that the freestanding SRO/LSMO membranes retain the key magnetic signatures of their corresponding bilayers. Notably, in the case of freestanding single-layer SrRuO3, we observe an enhancement of the magnetic response compared to its epitaxial single layer, suggesting strain relaxation and reduced substrate clamping as important factors. These results highlight the potential of freestanding oxide membranes for flexible integration and for exploring strain-decoupled magnetic phenomena in functional single-crystalline freestanding oxide bilayers.

MA 39.16 Wed 18:00 P2

Magnetic Anisotropy in Ordered and Disordered CoPd Alloys: A First-Principles Study — •Christian Maas, Michael Czerner, and Christian Heiliger — Institute for Theoretical Physics, Justus Liebig University Giessen

Understanding the magnetic anisotropy in magnetic materials is crucial for designing devices like sensors or data storage. In this work, we present ab initio density functional theory calculations of the magnetocrystalline anisotropy of $Co_xPd_{(1-x)}$ alloys with varying concentrations as well as $L1_0$ like $[CoPd]_x[PdCo]_{(1-x)}$ structures. We also show results for ordered layer structures with different thicknesses of Co and Pd layers. For our calculations, we employ the relativistic screened Korringa-Kohn-Rostoker Green's function method. The alloys are treated within the coherent potential approximation. Additionally, we explore the magnetic anisotropy of thin $Co_xPd_{(1-x)}$ films, considering both the magnetocrystalline and shape anisotropy.

MA 39.17 Wed 18:00 P2

Tailoring magnetic textures and investigation of magnetization processes in 3D via geometrical transformation — •Aman Singh[1], Timo Schmidt[2], Ivan Soldatov[1], Manfred Albrecht[2], Rudolf Schäfer[1], and Volker Neu[1] — [1]Leibniz IFW Dresden, D-01069 Dresden, Germany — [2]Institute of Physics, University of Augsburg, D-86159 Augsburg, Germany

Control over magnetic domains and domain walls is crucial for developing magnetic systems and devices. Here, we use a simple technique that uses a self-assembled reversible geometrical transformation from a flat 2D state to a rolled-up 3D state and back to the 2D state to create periodic up-down magnetization patterns in TbFe by applying a homogeneous magnetic field in the 3D state. We present how the magnetization patterns can be deterministically tailored simply by selecting the magnitude and direction of the applied magnetic field in the 3D state, which would otherwise require much more elaborate processes. This approach further provides a unique pathway to access and visualize magnetization processes in 3D by investigating the imprinted domains in the unrolled state of material magnetized at various fields in the 3D state. We further show that the overall 3D magnetization evolution can be reconstructed from recoil measurements in the 2D state when combined with the intrinsic anisotropy of the material. Finally, we discuss how this platform can be extended to investigate anisotropy changes in magnetostrictive materials, opening new possibilities for studying and engineering 3D magnetic states through reversible shape transformation.

MA 39.18 Wed 18:00 P2

Exploring spin reorientation and structural stability in distorted kagome metal — •Jayjit Kumar Dey[1], Tomke Glier[2], Sourav Chowdhury[1], Mouli Roy-Chowdhury[3], Subhajit Nandy[1], Amir-Abbas Haghighirad[4], Dmitry Reznik[2], and Moritz Hoesch[1] — [1]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany — [2]University of Colorado Boulder, Boulder, CO, USA — [3]Université Grenoble Alpes, CEA, CNRS, Grenoble INP, SPINTEC, Grenoble, France — [4]Karlsruhe Institute of Technology, Karlsruhe, Germany

Distorted kagome metals have emerged as fertile platforms for investigating the interplay between geometrical frustration, magnetoelastic coupling, and exotic electronic states. In this work, we investigate the magnetic anisotropy and spin-reorientation behavior of TbAgGe and DyAgGe using X-ray magnetic circular dichroism (XMCD) and X-ray magnetic linear dichroism (XMLD) at the rare-earth M4,5-edges. XMCD reveals strong magnetocrystalline anisotropy and highlights the gradual evolution of 4f-moment orientation under applied magnetic field. Complementary XMLD measurements provide direct evidence of exchange-driven spin arrangement and local crystal field anisotropy. The robustness of the hexagonal crystal framework is evidenced by Extended X-ray absorption fine structure (EXAFS) and Raman spectroscopy, with no evidence of symmetry breaking despite noticeable shifts in bond angles and interlayer spacing. These results establish spin dynamics and structural stability in distorted kagome systems.

MA 39.19 Wed 18:00 P2

More is not always better: the case of $Mn_{0.56}Ge_{0.09}Sb_{0.23}Te$ — Tijmen Groot[1], Marie Tardieux[1], Laura T. Corredor[2,3], Manaswini Sahoo[4], Anja U.B. Wolter[4], and •Anna Isaeva[1,2,3] — [1]University of Amsterdam, The Netherlands — [2]TU Dortmund University, Germany — [3]Research Center Future Energy Materials and Systems, Germany — [4]Leibniz IFW Dresden, Germany

In the quest to optimize magnetic topological materials within the $(MnX_2Te_4)(X_2Te_3)_n$ family [1], Mn enrichment appears to be a viable strategy that enhances the ferrimagnetic ground state and the Curie temperature. We recently reported the most Mn-rich phases derived from $MnSb_2Te_4$, achieving T_C = 58-73 K [2-3], nearly satisfying one key requirement for potential applications.

Our further attempts to tune T_C show that not only Mn richness but also lattice symmetry plays a key role. Here we present the cubic, Mn-rich compound $Mn_{0.56}Ge_{0.09}Sb_{0.23}Te$ ($Fm\bar{3}m$, $a = 5.9320(2)$ Å), as identified by powder and single-crystal XRD, SEM/EDX, and DC susceptibility. Due to the statistical disorder of Mn, Ge, and Sb over the cationic sites, it loses ferrimagnetic order in favor of an A-type antiferromagnetic arrangement with a low T_N = 25 K. This ground state is also supported by DFT+U calculations across a wide range of plausible compositions.

References: [1] National Science Review 11 (2024), nwad282; [2] Mater. Today Phys. 38 (2023), 101265; [3] Chem. Mater. 37 (2025), 1446-1456.

MA 39.20 Wed 18:00 P2

Magnetic Domain Structure of Erbium thin films — •Ujjval Mishra, Patrick Härtl, and Matthias Bode — University of Würzburg, Experimental Physics 2, Am Hubland, D-97074 Würzburg, Germany

Rare-earth metal (REM) films exhibit diverse magnetic behaviors governed by the indirect RKKY coupling of localized $4f$ moments, leading to complex long-range order. Building on prior studies of REM surface magnetism [1-5], we investigate the magnetic properties of epitaxial Erbium (Er) thin films. Er, a heavy rare-earth element with two unpaired $4f$ electrons, crystallizes in a hexagonal close-packed structure and remains paramagnetic above T_N = 85 K. Below T_C = 20 K, it adopts a conical ferromagnetic phase with the cone axis parallel to the c direction and a semi-cone angle of 29.6° at 6 K [6].

Spin-polarized scanning tunneling microscopy (SP-STM) reveals a complex domain structure in Er(0001) films epitaxially grown on W(110). At 4.5 K, domain walls are predominantly pinned to structural defects, while external magnetic fields around 2 T induce a maze-like contrast, confirming their magnetic origin. These findings highlight the intricate coupling between structural defects and magnetic domain evolution in Er(0001) thin films.

[1] P. Härtl et al., Phys. Rev. B **105**, 174431 (2022). [2] P. Härtl et al., Phys. Rev. Lett. **133**, 186701 (2024). [3] P. Härtl et al., Phys. Rev. B **110**, 184405 (2024). [4] P. Härtl et al., Phys. Rev. B **112**, 024416 (2025). [5] P. Härtl et al., Phys. Rev. B **112**, 174402 (2025). [6] W. C. Koehler et al., J. Appl. Phys. **36**, 1078 (1965).

MA 39.21 Wed 18:00 P2

First-principles study of Mn mono- and bilayers on the Ta(001) surface — •Leo Kollwitz, Tim Drevelow, and Stefan Heinze — Institute of Theoretical Physics and Astrophysics, Kiel University, Leibnizstraße 15, 24098 Kiel, Germany

The magnetic order in ultrathin $3d$ transition-metal films on surfaces can be strongly influenced by the substrate. A prominent example is a Mn monolayer on W(001), in which the prototypical antiferromagnetic Mn exhibits strong ferromagnetic exchange coupling [1]. Deposition of an additional Mn layer, however, leads to a checkerboard antiferromagnetic order in the surface layer, while the magnetic moment of the Mn interface layer is quenched moment [2]. Here, we study the magnetism in Mn mono- and bilayers on the Ta(001) surface by density functional theory (DFT) via the Fleur code [3]. Surprisingly, the Ta substrate leads to a very similar behavior of magnetic order in the Mn mono- and bilayer as on the W(001) surface, contrary to the trend observed for Fe monolayers [4]. Our DFT calculations show a strong dependence of the magnetic moments of the lower Mn layer on the interlayer distance as well as the magnetic configuration. Based on the DFT results we parameterize an atomistic spin Hamiltonian.

[1] P. Ferriani *et al.*, Phys. Rev. B **72**, 024452 (2005)
[2] S. Meyer *et al.*, Phys. Rev. Res. **2**, 012075(R) (2020)
[3] The Fleur project, www.flapw.de
[4] P. Ferriani *et al.*, Phys. Rev. Lett. **99**, 187203 (2007)

MA 39.22 Wed 18:00 P2

prospects of studying circularly polarised phonons in 2D magnetic materials — •Hanna Shirin Pulikkal Hamza[1], Lukas Nöding[1], Helya Alaei[1], Ahmed Hassanien[1], Mashood Tariq Mir[1], Zdeněk Sofer[2], Jochen Mikosch[1], Thomas Baumert[1], and Arne Senftleben[1] — [1]Institute of Physics,University of Kassel, 34132 Kassel, Germany — [2]UCT Prague

It has been proposed that circularly polarised phonons can induce transient magnetisation in materials when driven by ultrafast laser pulses via the atomistic scale Barnett effect. In this ongoing study, we want to directly link the observation of circular atomic motion with magnetisation in 2D Van der Waals room temperature ferromagnetic materials. We have recently induced circularly polarised coherent phonons by a pair of femto-second laser pulses in a non-magnetic material namely graphite and detected the resulting lattice dynamics using Ultrafast Electron Diffraction (UED). In this contribution, we will review the results on graphite and show our recent progress in exfoliating ferromagnetic 2D materials. Furthermore, we will explore magnetisation measurements of our microscopic samples using Kerr microscopy and vibrating sample magnetometry.

MA 39.23 Wed 18:00 P2

D-wave Chiral Phonons from Electron-Phonon Coupling — •Dimos Chatzichrysafis[1] and Alexander Mook[1,2] — [1]Johannes Gutenberg Universität, Mainz — [2]University of Münster

Chiral phononics, the field of study of phonons carrying finite orbital angular momentum has recently attracted wide interest due to its rich, versatile physics and potential applications.

In search of mechanisms to generate unconventional phonon orbital angular momentum textures, we demonstrate theoretically that d-wave chiral phonons can emerge even in the absence of electronic spin order. We show that by considering an electronic system hosting a d-wave orbital angular momentum texture, non-relativistic electron-phonon coupling leads to the formation of d-wave chiral phonons.

In this way we expand the potential platforms of chiral phononics and offer application routes unique to d-wave textures, such as orbital phonon splitters.

MA 39.24 Wed 18:00 P2

Phonon Pumping Experiments — •Jeremias Mütschele, Luise Holder, Michaela Lammel, Richard Schlitz, and Sebastian T. B. Goennenwein — Department of Physics, University of Konstanz, Konstanz, Germany

Phonons carrying angular momentum have recently attracted significant attention in the field of spintronics, as they are considered promising candidates for information carriers that do not require electrical currents. The coupling of phonons to spin-wave excitations (magnons) opens up opportunities to manipulate them, and consequently the transmitted information, via magnon-phonon interactions. However, engineering such hybrid quasiparticles, known as magnon-phonon-polaritons, remains a major experimental challenge. To gain deeper insight into the properties of magnon-phonon-polaritons, we investigate phonon pumping from a ferromagnetic thin film into a paramagnetic bulk crystal under various geometrical configurations. We find that our approach enables the selective excitation and analysis of distinct magnon-phonon-polariton modes. This could open a pathway to tailor phonon-based information transport.

MA 39.25 Wed 18:00 P2

Thorium-229 as a Chiral Phonon Detector — •Martin Pimon[1], Kjeld Beeks[2], Thorsten Schumm[2], and Andreas Grüneis[1] — [1]Institute of Theoretical Physics, TU Wien, Vienna, Austria — [2]Institute of Atomic and Subatomic Physics, TU Wien, Vienna, Austria

The thorium-229 isotope features an exceptionally low-energy nuclear metastable excited state 8.4 eV above the ground state. This property makes it a viable candidate for probing level splitting in nuclear sub-levels using modern high-precision laser spectroscopy methods.

Magnetic interactions play a significant role in this level splitting, highlighting the potential of thorium-229 as a novel atomic-sized detector for the magnetic moment of chiral phonons. Moreover, the electric field gradient from the surrounding crystal lattice introduces additional level splitting, providing insights into structural properties.

By incorporating thorium atoms into an ionic crystal, our proposed technique enables the direct observation of both magnetic and electric interactions from within the crystal itself. This approach leverages high sensitivity to phonon-related phenomena, presenting a promising avenue for detecting chiral phonons.

In this poster, we will review the contributions to nuclear level splitting and explore the challenges and benefits of utilizing the thorium-229 nucleus as a detector for chiral phonons.

MA 40: Focus Session: Chiral phonons and crystals coupled to magnetic order II

Conventional magnetism arises from electron spin and orbital angular momentum, forming the basis of spintronics and orbitronics. Recent advances, however, have revealed that magnetism is also intimately linked to the chirality and angular momentum of the crystal lattice itself, often mediated by circular lattice vibrations known as chiral or axial phonons. These discoveries have uncovered novel mechanisms of spin and phonon transport and enabled direct access to phonon chirality and angular momentum as fundamental physical quantities. These developments prompt a re-examination of angular momentum coupling in solids, including well-established phenomena such as the Einstein-de Haas and Barnett effects, as well as the role of phonon angular momentum in the equilibrium state of magnetic materials. Chiral and axial phonons emerge as a powerful new platform for controlling magnetic order and dynamics, bridging lattice, spin, and angular momentum physics. This focus session aims to highlight recent breakthroughs in phonon angular momentum and magnetism and to connect the rapidly expanding field of chiral phononics with the broader magnetism community, spanning both experimental and theoretical perspectives.

As part of this focus session, we offer an excursion to the high-field THz user facilities at HZDR with an introduction to the planned Dresden Advanced Light Infrastructure (DALI). See MA 32 for details.

Organizers: Dominik Juraschek, d.m.juraschek@tue.nl; Michael Fechner, michael.fechner@mpsd.mpg.de; Sebastian Maehrlein, s.maehrlein@hzdr.de

Time: Thursday 9:30–12:45 Location: HSZ/0002

Invited Talk MA 40.1 Thu 9:30 HSZ/0002

Magnetic order induced chiral phonons in a ferromagnetic Weyl semimetal — •Luyi Yang — Tsinghua University, Beijing, China

Chiral phonons are vibrational modes in a crystal that possess a well-defined handedness or chirality, typically found in materials that lack inversion symmetry. Here we report the discovery of chiral phonon modes in the kagome ferromagnetic Weyl semimetal $Co_3Sn_2S_2$, a material that preserves inversion symmetry but breaks time-reversal symmetry. Using helicity-resolved magneto-Raman spectroscopy, we observe the spontaneous splitting of the doubly degenerate in-plane E_g modes into two distinct chiral phonon modes of opposite helicity when the sample is zero-field cooled below the Curie temperature, in the absence of an external magnetic field. As we sweep the out-of-plane magnetic field, this E_g phonon splitting exhibits a well-defined hysteresis loop directly correlated with the material's magnetization. The observed spontaneous splitting reaches up to 1.27 cm^{-1} at low temperatures, progressively diminishes with increasing temperature, and completely vanishes near the Curie temperature. Our findings highlight the role of the magnetic order in inducing chiral phonons, paving the way for novel methods to manipulate chiral phonons through magnetization and vice versa. Additionally, our work introduces new possibilities for controlling chiral Weyl fermions using chiral phonons.

Ref: [1] M. Che et al., Magnetic order induced chiral phonons in a ferromagnetic Weyl semimetal, Physical Review Letters 134, 196906 (2025).

MA 40.2 Thu 10:00 HSZ/0002

The effect of lattice vibrations on the Curie temperature — •Thorben Pürling[1,2,3] and Stefan Blügel[1,2] — [1]Peter Grünberg Institut, Forschungszentrum Jülich and JARA, 52425 Jülich, Germany — [2]Institute for Theoretical Physics, RWTH Aachen University, 52074 Aachen, Germany — [3]Science Institute and Faculty of Physical Sciences, University of Iceland, 107 Reykjavík, Iceland

Lattice vibrations, or phonons, are important degrees of freedom that are excited in every magnet operating at finite temperatures. This is particularly true for magnets used in practical applications, which typically operate above room temperature. When predicting critical temperatures – a key property of magnets – from *ab initio* calculations lattice vibrations are typically neglected in favor of fluctuations only in the magnetic degrees of freedom. Conversely, in experiments at room temperature the lattice does contribute to the thermal properties of the system. We aim to close the gap between theory and experiment at room temperature by taking lattice vibrations into account explicitly. We present a numerical method based on the atomistic spin model and showcase how the lattice vibrations can be integrated out to an effective spin Hamiltonian that inherently depends on lattice fluctuations.

We acknowledge funding from the ERC grant 856538 (project "3D MAGIC") and DFG through SFB-1238 (project C1).

MA 40.3 Thu 10:15 HSZ/0002

Universal phonon angular momentum Hall effect — •Daniel Bustamante Lopez[1,2], Verena Brehm[2], and Dominik Juraschek[2] — [1]Boston University, Boston, MA, USA — [2]Eindhoven University of Technology, Eindhoven, Netherlands

The phonon angular momentum Hall effect was recently proposed as a phononic analogue of the spin and orbital Hall effects. Here, we demonstrate that a temperature gradient universally drives a transverse flow of phonon angular momentum in harmonic lattices. Using an exact Green's function method together with nonequilibrium molecular dynamics, we obtain closed-form expressions for the local phonon angular momentum density, bond-resolved current, and a corresponding conductivity kernel that ties them to spatial temperature variations. The Hall response originates from bath-induced mode mixing encoded in off-diagonal phonon correlations and does not require lattice chirality, Berry curvature, or inversion-symmetry breaking. It persists in the most simple centrosymmetric geometries, including square and honeycomb lattices. We predict robust edge accumulation and a tunable Hall angle for phonon angular momentum in various materials with quantitative agreement between analytic theory and simulations. Our results establish the phonon angular momentum Hall effect as a universal channel for transverse angular-momentum transport in crystalline solids.

MA 40.4 Thu 10:30 HSZ/0002

Phonon Angular Momentum Transfer Torque — •Verena Brehm[1], Daniel Bustamante Lopez[2], Shu Zhang[3], and Dominik Juraschek[1] — [1]Department of Applied Physics and Science Education, Eindhoven University of Technology, Eindhoven, Netherlands — [2]Department of Physics, Boston University, Boston, USA — [3]Okinawa Institute of Science and Technology, Okinawa, Japan

Angular momentum can be carried by a variety of (quasi)particles, including magnons, photons, and phonons, whose interplay has recently opened new directions in spintronics and optoelectronics. In this talk, we demonstrate the transfer of angular momentum from a phononic system to a magnetic system via an interfacial transfer torque, which we call the Phonon Angular Momentum Transfer Torque (PAMTT). We estimate the magnitude of phonon angular momentum originating from different mechanisms, among them the recently discovered phonon angular momentum Hall effect, and explore the possible magnetization dynamics that can be induced by the resulting PAMTT. Our analysis shows that both the precessional and relaxation components of the PAMTT can be detected as shifts in frequency and broadening of the linewidth in ferromagnetic resonance (FMR) experiments.

MA 40.5 Thu 10:45 HSZ/0002

The phonomagnet: Spontaneous order of phonon angular momentum — •Maike Fahrensohn and Matthias Geilhufe — Condensed Matter and Materials Theory Division, Department of Physics, Chalmers University of Technology, 41258 Göteborg, Sweden

Magnetism arises from the collective order of electron spin and orbital angular momentum. Here, we introduce a new type of magnetism, which appears due to spontaneous order of the phonon angular momentum. We consider a Hamiltonian containing an interaction term that couples the phonon angular momentum to the electronic spin density. Using an imaginary-time Dyson expansion, we evaluate the spin partition function and obtain an effective phonon Hamiltonian.

To first order in the coupling strength, this approach yields a Zeeman-like term, which couples the electronic magnetization to the phonon angular momentum and leads to a spin-induced bias of phonon chirality.

To second order, we obtain a bilinear interaction between ionic angular momentum modes on different sites, mediated by the Matsubara spin susceptibility. Decomposing the tensor into isotropic and anisotropic parts, we identify emergent phononic analogues of the Heisenberg (isotropic), Γ-model (symmetric, anisotropic), and Dzyaloshinskii-Moriya (antisymmetric, anisotropic) interactions.

Similarly to the conventional Heisenberg model for electronic spins, our model exhibits a phase transition in which ions spontaneously develop angular momentum at elevated temperatures.

15 min break

Invited Talk MA 40.6 Thu 11:15 HSZ/0002

Thermal Hall Effects of Magnons and Phonons — •Alexander Mook — Universität Münster

Thermal Hall transport in insulating magnets provides a powerful probe of topology, interactions, and spin-lattice coupling in charge-neutral quantum matter. I will discuss the magnon thermal Hall effect arising from Berry curvature in altermagnets, and show how symmetry and band geometry control transverse heat currents carried by spin waves [1]. Going beyond single-particle pictures, I highlight recent theoretical results demonstrating that magnon-magnon interactions can generate intrinsic thermal Hall responses even in topologically trivial magnon bands [2]. I then turn to magnetoelastic systems, where magnon-phonon coupling produces hybrid excitations whose combined Berry curvature and scattering processes can strongly enhance or even invert the thermal Hall signal [3,4]. Together, these results establish thermal Hall transport as a genuinely many-body phenomenon governed by topology, interactions, and spin-lattice hybridisation.

[1] Hoyer et al., PRB 111 (2), L020412 (2025) [2] Chatzichrysafis, Mook, PRB 111 (13), 134405 (2025) [3] Li et al., PRB 108 (14), L140402 (2023) [4] Nawwar et al., Reports on Progress in Physics 88 (8), 080503 (2025)

MA 40.7 Thu 11:45 HSZ/0002

Electrical conductivity from the axial phono-magnetic effect — •Natalia Shabala and Matthias Geilhufe — Department of Physics, Chalmers University of Technology, 412 96 Gothenburg, Sweden

Axial, or circularly polarized phonons, are characterized by the collective vibrations of atoms in circular patterns. These phonons have been shown to induce large magnetization in a phenomenon referred to as the phono-magnetic effect [1,2]. The mechanism behind this effect is believed to be the electron-phonon interaction. In combination with circular polarization of phonons this interaction leads to the time-reversal symmetry breaking and causes splitting of electronic energy levels. In this work, we aim to study the effect of this splitting on other physical phenomena. In particular, we are interested in the electrical conductivity, which can be studied through the Hubbard model. Additionally, we investigate whether the time-reversal symmetry breaking leads to the emergence of the anomalous Hall effect, as can be expected in 2D materials.

[1] N. Shabala, and R. M. Geilhufe, Phys. Rev. Lett. 133.26 (2024): 266702

[2] N. Shabala, F. Tietjen, R. M. Geilhufe, arXiv:2511.03329 (2025)

MA 40.8 Thu 12:00 HSZ/0002

Magnetic field induced pseudo angular momenta, chiral phonons, and anomalous EP interactions in some Weyl semimetals — Vladimir Gnezdilov[1], Florian Büscher[2], •Peter Lemmens[2], Angela Möller[3], Dirk Wulferding[4], Claudia Felser[5], and Chandra Shekar[5] — [1]ILTPE, Kharkiv, Ukraine — [2]IPKM, TU-BS, Braunschweig — [3]Dept. Chemistry, JGU, Mainz —

[4]Dept. Physics and Astr., Sejong Univ., Korea — [5]MPI-CPfS, Dresden

Applying magnetic fields excite phonon chirality and induce angular momenta due to the time-reversal breaking [1]. This allows to study effects usually restricted to the boundary of the Brillouin zone. We show such results for several Weyl semimetals [2] with uncommon spin-phonon interactions and discuss novel possibilities for the transfer and interaction between the angular momenta of photons and phonons [3].

[1] T. Wang, H. Sun, X. Li, L. Zhang, Chiral Phonons: Prediction, Verification, and Application, Nano Lett. 24, 15, 4311 (2024).

[2] P. Sessi, et al., Handedness-dependent quasiparticle interference in the two enantiomers of the topological chiral semimetal *PdGa*, Nature Comm. 11, 3507 (2020).

[3] R. Rao, et al., Anomalous Raman scattering in layered $AgCrP_2Se_6$: Helical modes and excitation energy-dependent intensities, https://arxiv.org/abs/2501.17565 (2025).

MA 40.9 Thu 12:15 HSZ/0002

Phonon Polariton Hall Effect — •Omer Yaniv[1] and Dominik Juarschek[1,2] — [1]Tel Aviv University, Tel Aviv, Israel — [2]Eindhoven University of Technology, Eindhoven, Netherlands

The phonon Hall effect conventionally describes the generation of a transverse heat current in an applied magnetic field. In this work, we extend the effect to hybrid light matter excitations and demonstrate theoretically that phonon polaritons, formed by coupling optical phonons with terahertz radiation, support transverse energy flow when coherently driven in an applied magnetic field. Using the example of PbTe, which exhibits strongly coupled phonon polaritons, we show that the magnetic field splits the phonon-polariton branches into left and right-handed circular polarization, obtaining unequal group velocities. We derive the energy current operators for propagating phonon polaritons and show how their mixed phononic-photonic nature enables controllable transverse phonon-polariton transport in the terahertz regime. Our results demonstrate bending of light through a phonon polariton Hall effect, which provides a route towards terahertz polaritonic devices.

MA 40.10 Thu 12:30 HSZ/0002

Phonon angular momentum in ultrafast demagnetization and hybrid quasiparticles — •Markus Weissenhofer[1], MS Mrudul[1], Philipp Rieger[1], Luca Mikadze[1], Ulrich Nowak[2], and Peter M. Oppeneer[1] — [1]Uppsala University, Uppsala, Sweden — [2]Universität Konstanz, Konstanz, Germany

Transfer and manipulation of angular momentum is a key aspect in spintronics. Recently, it has been shown that angular momentum transfer between spins and phonons is possible even on ultrashort timescales [1]. To contribute to the understanding of this transfer, we investigate spin-phonon coupling using two different fully ab-initio based methods [2,4]. Using Ehrenfest nuclear dynamics simulations combined with time-dependent density functional theory, we demonstrate that after ultrafast demagnetization of FePt optical phonons carrying finite angular momentum are created [2]. In addition, we show how a novel framework [3] can be used to calculate magnon-phonon coupling parameters and hybridization from first principles, revealing the existence of chiral phonons in Fe arising from a chirality-selective magnon-phonon coupling [4].

[1] Tauchert al., Nature 602, 73 (2022); Luo et al., Science 382, 698 (2023). [2] Mrudul et al., PRB 112, L180407 (2025). [3] Mankovsky et al., PRL 129, 067202 (2022). [4] Weißenhofer et al., PRL 135, 216701 (2025).

MA 41: Focus Session: Nickelate Superconductivity: Insights into Unconventional Pairing and Correlation Effects II (joint session TT/DS/MA)

Time: Thursday 9:30–12:30 Location: HSZ/0003

MA 41.1 Thu 9:30 HSZ/0003

Bulk High-Temperature Superconductivity and Density Waves in Layered Nickelates — •Jun Luo[1,2], Jie Dou[1,2], Shuo Li[1], Qin Xin Shen[1,2], Xu Yang Feng[1,2], De Min Chai[1,2], Ran Sheng Jia[1,2], Jie Yang[1,2], and Rui Zhou[1,2] — [1]Institute of Physics, Chinese Academy of Sciences, and Beijing National Laboratory for Condensed Matter Physics, Beijing 100190, China — [2]School of Physical Sciences, University of Chinese Academy of Sciences, Beijing 100190, China

The recent advances in bilayer nickelates $La_3Ni_2O_7$ have revealed fascinating high-temperature superconductivity (HTSC) under high-pressure conditions, offering a promising platform to explore unconventional superconducting mechanisms. In this talk, I will first discuss the discovery of bulk HTSC in Pr-doped $La_2PrNi_2O_7$, where Pr substitution effectively suppresses intergrowth phases, resulting in nearly pure bilayer structures. Superconducting onset temperature reaches 82.5 K at 16 GPa. Clear diamagnetic signals confirm the bulk nature of HTSC. I will also present microscopic evidence of charge and spin density wave (CDW/SDW) orders in $La_3Ni_2O_7$, revealed through 139La nuclear quadrupole resonance (NQR). Below the density wave transition temperature, we observe distinct line splitting and magnetic broadening, indicating unidirectional CDW order coupled with SDW order. By integrating insights from high-pressure and NQR studies, this work provides a comprehensive understanding of the structural and electronic mechanisms underlying HTSC in bilayer nickelates, paving the way for future experimental and theoretical investigations.

MA 41.2 Thu 9:45 HSZ/0003

ARPES spectra and the role of interstitial-*s* orbital in infinite-layer nickelates calculated by DFT+DMFT — •Leonard Verhoff[1], Liang Si[1,2], and Karsten Held[1] — [1]Institut für Festkörperphysik, Technische Universität Wien, Wien, Austria — [2]School of Physics, Northwest University, Xi'an, China

Infinite-layer nickelates, such as $NdNiO_2$, are a compelling platform to explore the microscopic origin of unconventional high-temperature superconductivity, from both theoretical and experimental perspectives.

Experimentally, infinite-layer nickelates are reduced from the stable perovskite phase, leaving an empty apical oxygen site. *Density functional theory* (DFT) calculations show that the resulting interstitial vacancy hosts localized, *s*-like states about 2 eV above the fermi level, while recent *angle-resolved photoemission spectroscopy* (ARPES) measurements of superconducting $NdNiO_2$ thin films conjectured Fermi surfaces with major *s*-like orbital character, highlighting a possible role of interstitial-*s* states in superconductivity.

We present DFT and *dynamical mean field theory* calculations of Fermi surfaces and band structures for both bulk and slab geometries, directly comparable to ARPES spectra. Our ARPES simulations explicitly include first-principles photoemission matrix elements, capturing the impact of orbital shapes on the measured intensity. We show how the correlated band structure reproduces low-energy ARPES spectra and identify the features dominated by interstitial-*s* character.

We acknowledge support through a joint German and Austrian Science Funds (DFG and FWF) project; FWF project ID I5398.

MA 41.3 Thu 10:00 HSZ/0003

A photoinduced two-dimensional electron gas (2DEG) at infinite-layer nickelate/strontium titanate interfaces — •D. Sanchez-Manzano[1], G. Krieger[2], A. Raji[3], B. Geisler[4], V. Humbert[1], H. Jaffres[1], J. Santamaria[5], R. Pentcheva[4], A. Glotter[3], D. Preziosi[2], and Javier E. Villegas[1] — [1]Laboratoire Albert Fert, CNRS, Thales, Université Paris-Saclay, France. — [2]Institute of Physics and Chemistry of Materials of Strasbourg, CNRS, University of Strasbourg, France. — [3]Laboratoire de Physique de Solides, CNRS, Université Paris-Saclay, France. — [4]Department of Physics and Center for Nanointegration (CENIDE), University of Duisburg-Essen, Germany — [5]6Departamento de Física de Materiales, Universidad Complutense de Madrid, Spain

We demonstrate, through experiments (transport, electron microscopy & spectroscopy) and density functional theory (DFT), that a high-mobility 2DEG can be optically switched on and off at an oxide interface where such a state does not naturally exist [1]. We show that near-ultraviolet light instantly creates a volatile 2DEG at the interface between $SrTiO_3$ (a band insulator) and infinite-layer $NdNiO_2$ (a poor metal), resulting in a conductivity increase of up to five orders of magnitude. This stems from structural and electronic reconstructions that, along with a built-in interfacial electric field, facilitate the Ti-3d band occupation by photogenerated carriers. These findings open venues for engineering photoconductance in strongly correlated systems.

[1] Sanchez-Manzano et al., Nat. Mater. (2025).
https://doi.org/10.1038/s41563-025-02363-y

MA 41.4 Thu 10:15 HSZ/0003

Democratizing nickelates superconductors: Topotactic reduction induced by aluminum sputter deposition — •Lucía Iglesias[1], Dongxin Zhang[1], Aravind Raji[2,3], Luis M. Vicente-Arche[1], Alexandre Gloter[2], and Manuel Bibes[1] — [1]Laboratoire Albert Fert, CNRS, Thales, Université Paris-Saclay — [2]Laboratoire de Physique des Solides, CNRS, Université Paris-Saclay — [3]Synchrotron SOLEIL

Superconductivity in infinite-layer (IL) nickelates (ABO_2) was discovery in 2019, opening a new research frontier. However, progress remains limited by the challenging topotactic reduction needed to remove all apical oxygens from the perovskite precursor, typically achieved through a complex ex situ CaH_2 method. Although recent in situ approaches, such as metal overlayer deposition via molecular beam epitaxy and atomic hydrogen bombardment, have improved control and reproducibility, their restricted accessibility highlights the need for simpler synthesis routes. Here, we demonstrate a broadly accessible method to fabricate superconducting IL $Pr_{0.8}Sr_{0.2}NiO_2$ films via aluminum deposition using direct-current magnetron sputtering. The sputtered Al drives the reduction through a redox reaction, converting the precursor perovskite into the superconducting IL phase. Systematic optimization of Al-induced reduction yields high-quality films with a maximum transition temperatures of 17 K, consistent with the best reported values. This accessible and highly reproducible approach provides an effective alternative to existing techniques and lowers barriers to the exploration of nickelate superconductors.

MA 41.5 Thu 10:30 HSZ/0003

Two-dimensional vortex matter in infinite-layer nickelates — •David Sanchez-Manzano[1], Vincent Humbert[1], Araceli Gutiérrez-Llorente[1,2], Dongxin Zhang[1], Jacobo Santamaría[3], Manuel Bibes[1], Lucia Iglesias[1], and Javier E. Villegas[1] — [1]Laboratoire Albert Fert, CNRS, Thales, Univerisité Paris-Saclay, 91767 Palaiseau, France — [2]Escuela Superior de Ciencias Experimentales y Tecnología, Universidad Rey Juan Carlos, 28933 Madrid, Spain — [3]GFMC, Dpto. de Física de Materiales, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, 28040 Madrid, Spain

Characterizing the dimensionality of the superconducting state in the infinite-layer (IL) nickelates is crucial to understanding its nature. Most studies have addressed the problem by studying the anisotropy of the upper critical fields. Yet, the dominance of Pauli-paramagnetism effects over orbital ones makes it challenging to interpret the experiments in terms of dimensionality. Here we address the question from a different perspective, by investigating the vortex phase diagram in the mixed-state. We demonstrate that superconducting $Pr_{0.8}Sr_{0.2}NiO_2$ thin films present a vortex liquid-to-glass transition of a two-dimensional nature. The obtained results suggest that bidimensionality is an intrinsic property, and that superconductivity resides in fully-decoupled NiO_2 planes. In this scenario, the coherence length along the c-axis must be shorter than the distance between those planes, while Josephson and magnetostatic coupling between them must be negligible. We believe that these conclusions are relevant for theories on the origin of superconductivity in the IL-nickelates.

MA 41.6 Thu 10:45 HSZ/0003

Systematically Controlled Disorder to Probe Pairing Symmetry in Infinite-Layer Nickelates — •A. Ranna[1], R. Grasset[2], M. Gonzalez[3], K. Lee[3], B. Y. Wang[3], D. Zhang[4], W. Sun[5], C. Parzyck[6], Y. Wu[6], M. Konczykowski[2], M. Bibes[4], K. M. Shen[6], Y. F. Nie[5], L. Iglesias[4], H. Y. Hwang[3], A. P. Mackenzie[1], and B. H. Goodge[1] — [1]MPI CPfS, Germany — [2]LSI, Ecole Polytechnique, France — [3]Stanford University, USA — [4]CNRS Thales, France — [5]Nanjing University, China — [6]Cornell University, USA

Superconductivity in infinite-layer nickelates has expanded rapidly with advances in thin-film synthesis and reduction techniques. A central question is the symmetry of the superconducting gap in these materials. Because superconducting samples can only be stabilized as thin films and suffer surface degradation during the post-growth reduction process, some conventional probes to determine the gap symmetry remain challenging to perform and interpret. Here, we leverage high-energy electron irradiation to controllably introduce point-like defects without altering film stoichiometry or crystallinity. Tracking superconductivity with systematically increasing disorder shows a steady suppression of transition temperature and rising normal state resistivity, indicative of an unconventional, sign-changing gap [1] . Additionally, this method offers a unique way to study the effect of point defects on superconducting and electronic properties in nickelates across rare-earth compositions, doping, and strain to disentangle intrinsic behavior from synthesis-related variability.

[1] Ranna et al., *PRL* **135**, 126501 (2025).

15 min. break

MA 41.7 Thu 11:15 HSZ/0003

Correlated electronic structure of $La_3Ni_2O_6$ and $La_3Ni_2O_{6.5}$ — •Frank Lechermann, Steffen Bötzel, and Ilya M. Eremin — Theoretische Physik III, Fakultät für Physik und Astronomie, Ruhr-Universität Bochum, Bochum, Germany

There are two known superconducting nickelate families, i.e. low-valence $Ni(3d^{9-\delta})$ compounds and Ruddelsden-Popper (RP) compounds with $Ni(3d^{8\pm\delta})$ valence. While both families host NiO_2 square planes, key difference is given by the missing apical oxygen atoms in the low-valence nickelates. A possible route to connect both nickelate families might be given by the reduction of the $La_3Ni_2O_7$ RP bilayer compound, i.e. by removing it's apical oxygens. Complete removal results in the $La_3Ni_2O_6$ compound, while taking out only half of the apical oxygens results in the $La_3Ni_2O_{6.5}$ compound. Both reduced materials are so far only scarcely characterized experimentally, but display quite intriguing correlation physics from theory. We will discuss the results of advanced first-principles many body calculations for these two nickelates, highlighting different mechanisms of Mott criticality as well as challenging low-temperature physics.

MA 41.8 Thu 11:30 HSZ/0003

Superconductivity governed by Janus-faced fermiology in strained bilayer nickelates — •Siheon Ryee[1], Niklas Witt[2], Giorgio Sangiovanni[2], and Tim Wehling[1] — [1]University of Hamburg, Hamburg, Germany — [2]University of Würzburg, Würzburg, Germany

High-temperature superconductivity in pressurized and strained bilayer nickelates has emerged as a new frontier. One of the key unresolved issues concerns the fermiology that underlies superconductivity. On both theoretical and experimental sides, no general consensus has been reached, and conflicting results exist regarding whether the relevant Fermi surface involves a γ pocket—a hole pocket with d_{z^2}-orbital character centered at the Brillouin zone corner. Here, we address this issue by unveiling a Janus-faced role of the γ pocket in spin-fluctuation-mediated superconductivity. We show that this pocket simultaneously induces dominant pair-breaking and pair-forming channels for the leading $s_{\pm}$-wave pairing. Consequently, an optimal superconducting transition temperature T_c is achieved when the γ pocket surfaces at the Fermi level, placing the system near a Lifshitz transition. This suggests that superconductivity can emerge, provided the maximum energy level of the γ pocket lies sufficiently close to the Fermi level, either from below or above. Our finding not only reconciles two opposing viewpoints on the fermiology, but also naturally explains recent experiments on $(La,Pr)_3Ni_2O_7$ thin films, including the superconductivity under compressive strain, two conflicting measurements on the Fermi surface, and the dome shape of T_c as a function of hole doping.

MA 41.9 Thu 11:45 HSZ/0003

Bonding-antibonding $s_{\pm}$ superconductivity in bilayer nickelates: potential experimental signatures — •Steffen Bötzel, Frank Lechermann, and Ilya Eremin — Ruhr-Universität Bochum, Bochum, Germnay

The discovery of high-T_c superconductivity in Ruddelsden-Popper bilayer nickelates under applied high pressure and/or compressive strain provides a promising platform to study the interplay of multiorbital intralayer and interlayer Cooper-pairing in bilayer systems. In particular, dominant interlayer pairing may naturally lead to a bonding-antibonding $s_{\pm}$-gap structure, which directly reflects the bilayer geometry. Such a scenario would produce characteristic experimental signatures that differ from d-wave type gap symmetries. In this contribution, we theoretically address the possible gap structures in bilayer nickelates and discuss how a interlayer-dominated bonding-antibonding $s_{\pm}$-gap structure can be potentially distinguished from a d-wave type pairing using experimentally observables.

MA 41.10 Thu 12:00 HSZ/0003

Interlayer interaction-driven $s^{\pm}$-to-d_{xy}-wave superconductivity in $La_3Ni_2O_7$ under pressure — •Lauro B. Braz[1], George B. Martins[2], and Luis G. G. de V. D. Da Silva[1] — [1]Instituto de Física, Universidade de São Paulo, Rua do Matão 1371, São Paulo, São Paulo 05508-090, Brazil — [2]Instituto de Física, Universidade Federal de Uberlândia, Uberlândia, Minas Gerais 38400-902, Brazil

Experimental and theoretical progress on the normal-state properties of the high-temperature superconductor $La_3Ni_2O_7$ has provided evidence of strong interlayer interactions. To better understand the effects of interlayer interactions in $La_3Ni_2O_7$ under high pressure, we investigate a two-layer, two-orbital electron model that includes both intra- and interlayer Coulomb interaction terms within the framework of the matrix random-phase approximation. Our analysis reveals that interlayer interactions play a crucial role in determining the preferred superconducting pairing symmetry. Specifically, when interlayer interactions are included, a d_{xy}-wave pairing symmetry is favored over the $s^{\pm}$-wave symmetry, which was previously found to dominate in their absence. Furthermore, we find that interlayer interactions enhance interorbital pairing by incorporating contributions from all three electron pockets, which originate from both $d_{3z^2-r^2}$ and $d_{x^2-y^2}$ orbital characters. This results in the emergence of nodes in the superconducting gap function - features absent in the $s^{\pm}$-wave state - ultimately stabilizing the d_{xy}-wave pairing symmetry.

MA 41.11 Thu 12:15 HSZ/0003

Incommensurate spin-fluctuations and competing pairing symmetries in $La_3Ni_2O_7$ — •Han-Xiang Xu[1] and Daniel Guterding[2] — [1]Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, Beijing, China — [2]Technische Hochschule Brandenburg, Brandenburg an der Havel, Germany

The discovery of superconductivity in the bilayer nickelate $La_3Ni_2O_7$ under high pressure raises key questions about the pairing symmetry and microscopic mechanism. Using a three-dimensional multi-orbital Hubbard model including all Ni 3d and O 2p states, we analyze the superconducting instability within the random phase approximation. Spin fluctuations with incommensurate wave vectors $(\pi/2, \pi/2)$ and $(7\pi/10, 7\pi/10)$ coexist and compete, leading to nearly degenerate sign-changing $s_{\pm}$- and $d_{x^2-y^2}$-wave pairing channels. The leading symmetry depends sensitively on pressure and the ratio of Hund's rule to Coulomb interactions. Cooperative incommensurate fluctuations stabilize a $d_{x^2-y^2}$-wave state for realistic parameters, while their competition may explain the absence of magnetic order. These findings reconcile previous contradictory results and highlight the importance of careful model construction for bilayer nickelates.

[1] H.-X. Xu and D. Guterding, arXiv:2501.05254

MA 42: Molecular Magnetism and Magnetic Particles / Clusters II

Time: Thursday 9:30–12:30 Location: HSZ/0004

MA 42.1 Thu 9:30 HSZ/0004

Towards a Physics-Informed Deep Learning Model for Parameterizing the Magnetism in 4f based Single-Molecule Magnets — •Zayan Ahsan Ali and Oliver Waldmann — Physikalisches Institut, Universität Freiburg, Germany

Single-molecule magnets (SMMs) have attracted interest in recent decades for their intriguing magnetic behavior and potential applications in quantum computing and spintronics. 4f based SMMs stand out because lanthanide ions can provide large magnetic anisotropies. However, the ligand environments that govern their magnetic properties involve up to 27 ligand-field parameters, while common experimental data such as temperature dependent magnetic susceptibility measured on powdered samples are comparatively featureless. Inferring ligand field parameters from such data is therefore a highly over-parameterized inverse problem. Machine learning approaches have shown promise in addressing this challenge [1]. Two central difficulties are identification of physically relevant regions of the ligand field parameter space and learning of a highly complex one-to-many mapping. This work presents a machine learning framework tailored to overcome both obstacles. It is shown that an informative training data set can be constructed via active learning with uncertainty sampling, and that incorporating the energy spectrum as an intermediate representation significantly improves the learnability of the high dimensional inverse mapping. The resulting architecture is found to be capable of predicting multiple possible ligand field parameter sets.

[1] Z. A. Ali *et al.*, PRB 112, 064403 (2025).

MA 42.2 Thu 9:45 HSZ/0004

Graphene-based quantum heterospin graphs — Gabriel Martínez-Carracedo[1], Amador García-Fuente[1], László Oroszlány[2], •László Szunyogh[3], and Jaime Ferrer[1] — [1]Universidad Oviedo, Spain — [2]Eötvös Loránd University, Budapest, Hungary — [3]Budapest University of Technology and Economics, Hungary

Harnessing quantum-regime functionalities without relying on rare-earth elements represents an important step toward developing globally accessible quantum technologies. In this contribution, we investigate a range of low-dimensional open quantum spin systems constructed from magnetic nanographene structures containing spin-1/2 and spin-1 triangulenes and/or olympicenes. These graphene nanostructures act as localized spins and can be effectively modeled using a quantum bilinear*biquadratic Heisenberg Hamiltonian. We compute the energy spectrum and the quantum numbers associated with the low-energy eigenstates. We identify a double degeneracy in the total spin quantum number S of the first excited state in three-leg spin graphs (3-LSGs) and in other heterospin nanostructures. This degeneracy depends on both the number of sites and the spin species, and arises from a swapping-transformation symmetry of the Hamiltonian. Numerical simulations further show that this degeneracy remains largely robust in $N = 7$ spin-1 3-LSGs under realistic perturbations relevant to experimental conditions. [1]

[1] G. Martínez-Carracedo *et al.*, DOI: 10.1103/v3fm-lvsh (2025)

MA 42.3 Thu 10:00 HSZ/0004

Femtosecond spin-state switching dynamics of Fe(II) complexes condensed in thin films — •Manuel Gruber[1], Lea Kämmerer[1], Gérald Kämmerer[1], Laurent Mercadier[2], Andreas Scherz[2], Felix Tuczek[3], Peter Kratzer[1], Uwe Bovensiepen[1], and Heiko Wende[1] — [1]Faculty of Physics and CENIDE, University of Duisburg-Essen, Germany — [2]European XFEL, Schenefeld, Germany — [3]Institute for Inorganic Chemistry, Kiel University, Germany

Significant progress has been made in tailoring spin-crossover films, driven by their potential for technological applications. However, studies of ultrafast switching in such films remain limited compared to their solution-phase counterparts. Here, we investigated photoinduced spin-state switching in a molecular film at room temperature, using the new capabilities offered by X-ray free-electron lasers. The sub-picosecond transition from the $S = 0$ low-spin state to the $S = 2$ high-spin state is tracked via transient changes in the Fe L_3 X-ray absorption edge. Our results reveal the involvement of an intermediate state in the switching dynamics [Kämmerer et al., ACS Nano 18, 34596 (2024)].

Financial support from CRC 1242 is gratefully acknowledged.

MA 42.4 Thu 10:15 HSZ/0004

Chirality-induced spin selectivity without intrinsic spin-orbit coupling: Role of non-equilibrium molecular orbital moment — •Sumit Ghosh[1] and Daniel E. Bürgler[2] — [1]The Institute of Physics of the Czech Academy of Sciences, 16200 Prague, Czech Republic — [2]Peter Grünberg Institut (PGI-6), Forschungszentrum Jülich GmbH, 52428 Jülich, Germany

We present an alternative theory of chirality induced spin selectivity (CISS) that does not require any intrinsic spin orbit coupling (SOC). The proposed mechanism is based on the formation of circulating currents in the molecular rings. In each ring, this current generates a non-equilibrium molecular orbital moment (MOM) which interacts with the spin of an injected electron, giving rise to CISS. The direction of the MOM is governed by the gauge field that arises from the chirality-induced structural distortion of the molecule. Being non-relativistic in nature, the gauge field induced MOM can be stronger than the effect generated by SOC. The presence of such a gauge field also overcomes the hurdle posed by Onsager's reciprocity. Finally we demonstrate that a non-equilibrium MOM can also form in the absence of the gauge field. However only the presence of the gauge field can produce the experimentally observed crossing I-V curve which is a characteristics of the CISS effect.

MA 42.5 Thu 10:30 HSZ/0004

Magnetocaloric effect of the centered-square, centered-hexagon, and double-pyramidal spin models — •Hamza Meel and Jürgen Schnack — Bielefeld University, Faculty of Physics, Bielefeld, Germany

Molecular magnetocalorics have been proposed as a replacement to ^{3}He for cryogenic applications, however the search for the best compound for such an application is still ongoing. Specifically, magnetic molecules exhibiting a high adiabatic entropy change in the kelvin and sub-kelvin range are sought after. Such an entropy change could for instance be achieved by a molecule whose ground state is highly degenerate. We investigate three frustrated systems, the centered square, the centered-hexagon, and the double-pyramidal spin models. Their figures of merits and their magnetocaloric effect are discussed.

MA 42.6 Thu 10:45 HSZ/0004

Exchange-biased toroidal moments in a family of homochiral Cu_6Ln_3 complexes studied by high-field EPR — •Jan Arneth[1], Deepanshu Chauhan[2], Sagar Paul[3], Bapan Jana[2], Wolfgang Wernsdorfer[3], Maheswaran Shanmugam[2], Gopalan Rajaraman[2], and Rüdiger Klingeler[1] — [1]Kirchhoff Institute for Physics, Heidelberg University, Germany — [2]Department of Chemistry, Indian Institute of Technology Bombay, India — [3]Physikalisches Institut, Karlsruhe Institute of Technology, Germany

The vortex-like arrangement of the individual magnetic moments renders single-molecule toroics (SMT) promising candidates for application in quantum computing, molecular spintronics and the development of magneto-electric coupling in multiferroic devices. Here, we report the magnetic investigation of a family of heterobimetallic nonanuclear Cu_6Ln_3 (Ln = Y,Gd,Dy) clusters, featuring a homochiral Cu_3-Ln_3-Cu_3 triangular core, using combined theoretical *ab-initio*, ac and dc susceptibility, μ-SQUID and high-field EPR studies. Numerical analysis of our experimental data allow for the determination of the microscopic spin Hamiltonian parameters, which reveal an antiferromagnetic inter-triangular coupling between the two spin-frustrated Cu_3 units. In particular, Cu_6Dy_3 exhibits both single-molecule magnet (SMM) and SMT behaviour with a non-magnetic ground state persisting up to magnetic fields as high as $B \simeq 1.3$ T. The large excitation gap is found to result from the ferromagnetic Cu-Dy exchange interaction coupling the toroidal Dy_3 unit with the adjacent Cu_3 triangles.

15 min break

MA 42.7 Thu 11:15 HSZ/0004

Fully Quantum-Mechanical Simulations of Spin Crossover Behaviour in an Iron(II) Complex — •Ethan Crawford, Solveig Felton, and David Wilkins — Queen's University Belfast, Belfast, Northern Ireland

Spin-crossover (SCO) complexes change spin state when exposed to external stimuli such as light, temperature or pressure, allowing them to be used as sensors or magnetic memory devices. Predicting with precision when a crossover occurs would bring the technology closer to fruition, but it remains a significant challenge. Single-point energy calculations using Density Functional Theory (DFT) have been employed with limited accuracy, because they neglect the vibrational and other entropic contributions present at finite temperatures. Furthermore, a given calculation setup is not necessarily transferable to another complex. We trained a committee neural network potential (c-NNP) using data generated via Ab Initio Molecular Dynamics for an Iron (II) SCO complex. Two c-NNPs were trained, to model both the highest and lowest spin states respectively, encompassing all intramolecular interactions. The models were systematically improved using the query by committee approach. These systems were extended from a single complex to a bulk system combining the c-NNPs with a classical forcefield to account for the intermolecular interactions. The spin state for each complex is individually assigned to simulate experimental transitions. During the transition window, neither model can accurately predict the behaviour of the complex, but combining the three forcefields should replicate experimental behaviour.

MA 42.8 Thu 11:30 HSZ/0004

Symmetric finite-temperature Lanczos method for anisotropic magnetic molecules — •Jürgen Schnack — Bielefeld University, Faculty of Physics, Bielefeld, Germany

The finite-temperature Lanczos method (FTLM) constitutes a valuable approximation scheme for Hilbert space problems that exceed the dimension tractable by complete numerical diagonalization [1,2]. Several large magnetic molecules have been successfully modeled using FTLM [3]. It has been noted earlier that the method converges best for problems where the z-component of total spin commutes with the Hamiltonian. For anisotropic Hamiltonians the convergence is much poorer [4]. Here, we discuss conceptional improvements [5] as well as realizations on nowadays supercomputing architectures that employ CPUs as well as GPUs.

[1] J. Jaklic, P. Prelovsek, Phys. Rev. B 49, 5065 (1994). [2] J. Schnack, J. Richter, R. Steinigeweg, Phys. Rev. Research 2, 013186 (2020). [3] T. Tziotzi, D. Gracia, S. Dalgarno, J. Schnack, M. Evangelisti, E. Brechin, C.J. Milios, JACS 145, 7743 (2023). [4] O. Hanebaum, J. Schnack, Eur. Phys. J. B 87, 194 (2014). [5] M. Aichhorn, M. Daghofer, H. G. Evertz, W. von der Linden, Phys. Rev. B 67, 161103(R) (2003).

MA 42.9 Thu 11:45 HSZ/0004

Investigation of Magnetic Properties of Ce-Doped Ni-Based Composites as Near Infrared Absorbers Based on Soft-XAS and XMCD Measurements — •Timuçin Emre Tabaru[1], Ali Karatutlu[2], Iremnur Duru[1], and M. Fatih Kilicaslan[3] — [1]Department of Electrical Electronics Engineering, Sivas University of Science and Technology, 58000 Sivas, Turkey — [2]National Nanotechnology Research Center (UNAM), Bilkent University, Ankara 06800, Türkiye — [3]Department of Engineering Fundamental Sciences, Sivas University of Science and Technology, 58000 Sivas, Turkey

In this study, the X-ray Magnetism Circular Dichroism (XMCD) spectra of Ni-based composites produced by melt spinning and rapid solidification with ~75% Ni, ~10% Cr, ~8% Si, ~5% Fe, ~2% B, and 1% Ce doping were determined according to different Fe and Cerium (Ce) contents using soft X-ray absorption spectroscopy (XAS) at the HESEB beamline at the Synchrotron-Light For Experimental Science And Applications In The Middle East (SESAME). The L2 and L3 edges of Ni, Fe, and Ce were investigated for both Ce-doped and undoped samples. The areas under the XAS and XMCD spectra obtained from these measurements were determined, and the spin and orbital magnetic momenta of each sample were calculated. The results confirmed that the materials mentioned exhibit paramagnetic properties, in agreement with the literature. Ni-based composite doped with Ce demonstrated enhanced broadband infrared (IR) absorption, reaching a maximum efficiency of 93% in the 3-5 μm mid-IR window and maintaining over 80% absorption across the entire 3-15 μm spectral range.

MA 42.10 Thu 12:00 HSZ/0004

Magnetic Hexagonal Nanoferrite-Based Electrode: Structural Characterization and Electrochemical Detection of Caffeine in Drinks — •Sajjad Hussain — The Begum Nusrat Bhutto Women University, Sukkur, Sindh, Pakistan

Caffeine is a pharmacologically active alkaloid that is frequently incorporated into a wide range of food and beverage formulations. V-type hexagonal ferrite nanoparticles (SrSnFe*O**-NPs) were prepared through a sol*gel-based green auto-combustion route and analyzed using a range of advanced characterization techniques, including X-ray diffraction (XRD), X-ray absorption fine structure (XAFS), scanning electron microscopy (SEM), atomic force microscopy (AFM), Brunauer*Emmett*Teller (BET) surface area analysis, and vibrating sample magnetometry (VSM). The V-type hexaferrite exhibits a single-phase crystalline structure with an average crystallite size exceeding 30 nm. The local atomic structure was confirmed using XAFS analysis, while the surface morphology and particle size were examined through SEM and AFM. BET was used to confirm the surface area 209.6 m*/g. The magnetic studies revealed soft magnetic behavior. Furthermore, the synthesized V-type hexagonal ferrites were employed to modify a glassy carbon electrode (GCE), developing SrSnFe*O**-NPs/GCE for the electrochemical sensing of caffeine. Cyclic voltammetry studies revealed conductive and diffusion-controlled behavior, with the SrSnFe*O**-NPs/GCE demonstrating high sensitivity and selectivity for caffeine detection (linear ranges: 0.5 to 80 *M; detection limits: 0.025 *M, while the LOQ was 0.078 *M.

MA 42.11 Thu 12:15 HSZ/0004

Strain control of three-dimensional magnetic nanostructures — •José Claudio Corsaletti Filho, Mohammad Sedghi, Elina Zhakina, Markus König, Elena Gati, and Claire Donnelly — Max Planck Institute for Chemical Physics of Solids, Dresden, Germany

The study of nanoscale objects in three-dimensions has led to new discoveries and opportunities for technological development. Recent studies have shown that the magnetic landscape of 3D nanostructures can be controlled by geometrical effects, enabling innovations in design and magneto-mechanical devices. Consequently, a method to reversibly tune the properties of a three-dimensional nanostructure is highly desirable. Strain represents a particularly promising approach, as it directly influences the geometry. Indeed, while strain has been extensively applied to magnetic thin films for the tuning of global material properties, there the substrate restricts global strains to 0.7-1%. In this work, we describe how we strained 3D magnetic nanostructures and map out their geometrical changes through in situ electron microscopy. We are able to achieve ultimate strains of up to 20%, but we also identify regimes associated with the elastic and plastic deformations of 3D nanostructures with different geometries. By determining the mechanical properties of the nanowires, we obtain the fundamental insight to achieving reversible tuning of the geometry - and therefore the magnetic properties - of 3D nanostructures. Such reversible tuning will be of key interest for future technological applications.

MA 43: Spin-Dependent Phenomena in 2D

Time: Thursday 9:30–11:15 Location: POT/0112

Invited Talk MA 43.1 Thu 9:30 POT/0112
Defect-Induced Phase Transitions in the 2D Magnetic Semiconductor CrSBr — •Shengqiang Zhou — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

As an air-stable van der Waals magnetic semiconductor, CrSBr has attracted great research interest due to its exceptional optical, electronic, and magnetic properties [1]. Below its Néel temperature of 132 K, CrSBr exhibits a typical A-type antiferromagnetic order consisting of antiferromagnetically coupled ferromagnetic monolayers [1, 2]. In this talk, I will present the magnetic phase transition from antiferromagnetic to ferromagnetic order in CrSBr induced by ion irradiation [3, 4]. We observe the emergence and subsequent suppression of the ferromagnetic phase in CrSBr as the irradiation fluence increases. Structural analysis combined with first-principles calculations suggests that the formation of interstitials promotes ferromagnetic coupling between the layers. At moderate irradiation fluences, the Curie temperature gradually decreases, reflecting the impact of crystalline degradation. Surprisingly, at even higher irradiation fluences, CrSBr does not amorphize but instead transforms into a new crystalline phase. These findings indicate that, by precisely tuning irradiation parameters and employing lithography techniques, one can selectively modulate the induced ferromagnetism in CrSBr in terms of magnetization strength, critical temperature, and spatial distribution. [1] E.J. Telford, et al. Adv. Mater., 32, 2003240 (2020). [2] F. Long, et al. Appl. Phys. Lett. 123, 222401 (2023). [3] F. Long, et al. Nano Lett. 23, 8468 (2023). [4] F. Long, et al. Adv. Phys. Res., 3, 2400053 (2024)

MA 43.2 Thu 10:00 POT/0112
Electric-field tunable valley excitons in proximity coupled WSe_2/CrI_3 heterostructures — Felix Hellenkamp[1], •Yiheng Li[1], Marc Schütte[1], Kenji Watanabe[2], Takashi Taniguchi[3], Lutz Waldecker[1], Christoph Stampfer[1,4], and Bernd Beschoten[1] — [1]2nd Institute of Physics and JARA-FIT, RWTH Aachen University, Germany — [2]National Institute for Materials Science, Tsukuba, Japan — [3]International Center for Materials Nanoarchitectonics, NIMS — [4]PGI-9, Forschungszentrum Jülich, Jülich, Germany

Two-dimensional (2D) transition metal dichalcogenides have attracted significant interest due to their unique optical properties. The possibility to address the K and K' valley selectively via σ^+ and σ^- polarized light enables optical initialization and readout of the valley degree of freedom. The valley degeneracy can be lifted via magnetic proximity coupling to a 2D magnet such as CrI_3. However, in the heterostructures the resulting exciton splitting lacks tunability, limiting its applicability in device architectures that demand adjustable valley splitting. Our work shows a large tunability of the exciton splitting in a WSe_2/CrI_3 heterostructure via external displacement fields. Reflection contrast measurements show a displacement field induced change in the exciton resonance energy which is asymmetric with respect to the excitons at the K and K' valleys, leading to a 35% increase in exciton splitting at a displacement field of -0.4V/nm. We attribute the change in resonance energy to a reduction in the optical bandgap, caused by a displacement-field-induced modification in the band alignment.

MA 43.3 Thu 10:15 POT/0112
Atomic-scale visualization of quasi-one-dimensional structure and magnetic-field-tunable electronic statesin CrSBr — •Keda Jin[1,2], Tobias Wichmann[1,3], F. Stefan Tautz[1,3], Felix Lüpke[1,4], Jose Martinez-Castro[1,2], and Markus Ternes[1,2] — [1]Peter Grünberg Institut (PGI-3), Forschungszentrum Jülich, 52425 Jülich — [2]Institut für Experimentalphysik II B, RWTH Aachen, 52074 Aachen — [3]Institut für Experimentalphysik IV A, RWTH Aachen, 52074 Aachen — [4]Institute of Physics II, Universität zu Köln, 50937 Köln

The anisotropic two-dimensional (2D) van der Waals magnet CrSBr is famous for hosting a quasi-one-dimensional (1D) electronic structure, but its direct visualisation has remained elusive.

Using low-temperature scanning tunnelling microscopy and spectroscopy, we present the atomic-scale characterisation of this quasi-1D conduction bands in monolayer CrSBr on $NbSe_2$. Our measurements reveal a spatial anisotropy in the local density of states, confirming the existence of conduction bands that are flat along one crystallographic direction but dispersive along the perpendicular direction. Moreover, we demonstrate that an applied magnetic field reconstructs its electronic structure, showcasing strong magneto-electronic coupling. Our work provides the real-space visualisation of the long-predicted electronic anisotropy and establishes its potential for developing magnetically-tunable low-dimensional electronic devices.

MA 43.4 Thu 10:30 POT/0112
Origin of Exchange Bias in Compensated and Orthogonal Spin Interfaces in vdW Heterostructures — •Aditya Kumar[1], Aravind Balan[1], Patrick Reiser[2], Sadeed Hameed[1], Thibaud Denneulin[3], Rafal E. Dunin-Borkowski[3], Patrick Maletinsky[2], and Mathias Kläui[1] — [1]Institute of Physics, Johannes Gutenberg University Mainz, Staudinger Weg 7, 55128 Mainz, Germany — [2]Department of Physics, University of Basel, Klingelbergstrasse 82, 4056 Basel, Switzerland — [3]Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons and Peter Grünberg Institute, Forschungszentrum Jülich, 52425 Jülich, Germany

Van der Waals heterostructures formed by mechanical stacking can create atomically flat, defect-free interfaces, yet exhibit exchange bias in expected compensated and orthogonal spin configurations. This work investigates the underlying spin-pinning mechanisms in heterostructures of out-of-plane ferromagnet Fe_3GeTe_2 interfaced with c-type out-of-plane antiferromagnet $MnPS_3$ and in-plane a-type antiferromagnet CrSBr. Using NV magnetometry and STEM holography imaging, we reveal distinct exchange bias origins: the spin reorientation transition in $MnPS_3$ induces large, robust exchange bias, while orthogonal coupling at the Fe_3GeTe_2/CrSBr interface generates circular flux closure domains that produce switchable exchange bias. [1] A. P. Balan et al., Advanced Materials 36, 2403685 (2024). [2] A. Kumar et al., Small 21, e06284 (2025).

MA 43.5 Thu 10:45 POT/0112
Spin-polarized scanning tunneling microscopy of antiferromagnetic spin ordering in a topological Hall material — Alexina Ollier[1,2], Valeria Sheina[1,2], Seik Pak[4], Corina Urdaniz[1,2], Muskan Sande[1,3], Soonhyung Lee[1,2], Lei Fang[1,2], Christoph Wolf[1,2], Woonghee Cho[6], Pyeongjae Park[7], Andreas Heinrich[1,3], Je-Geun Park[6], Moon jip Park[4,5], and •Won-Jun Jang[1,2] — [1]Center for Quantum Nanoscience (QNS), Institute for Basic Science (IBS), Seoul, Korea — [2]Ewha Womans University, Seoul, Korea — [3]Department of Physics, Ewha Womans

University, Seoul, Korea — [4]Department of Physics, Hanyang University, Seoul, Korea — [5]Research Institute for Natural Science and High Pressure, Hanyang University, Seoul, Korea — [6]Department of Physics and Astronomy, Seoul National University, Seoul, Korea — [7]Materials Science and Technology Division, Oak Ridge National Laboratory, Tennessee, USA

We report spin-polarized scanning tunneling microscopy measurements on Co1/3TaS2. STM images acquired with a conventional tip reveal the triangular atomic lattice of the surface, whereas SP-STM uncovers additional symmetry features directly linked to the spin-polarized electronic structure of TaS2 arising from the triple-Q magnetic order. The spin-dependent contrast observed with the SP tip confirms the presence of spin-polarized van Hove singularities, a hallmark of the non-coplanar magnetic state. These results demonstrate that SP-STM can directly probe the modified electronic structure arising from chiral magnetic textures in non-coplanar magnets.

MA 43.6 Thu 11:00 POT/0112

Super-Moiré Spin Textures in Twisted 2D Antiferromagnets — •King Cho Wong[1], Ruoming Peng[1], Eric Anderson[2], Jackson Ross[3], Adam Wei Tsen[4], Elton Santos[3], Xiaodong Xu[2], and Joerg Wrachtrup[1] — [1]3rd Physics Institute, University of Stuttgart, Stuttgart, Germany — [2]University of Washington, Seattle, USA — [3]University of Edinburgh, Edinburgh, UK — [4]University of Waterloo, Canada

Stacking two-dimensional (2D) layered materials offers a platform to engineer electronic and magnetic states. In general, the resulting states - such as Moiré magnetism - have a periodicity at the length scale of the Moiré unit cell. Here, we study magnetic order in twisted double bilayer chromium triiodide (tDB CrI3) by means of scanning nitrogen-vacancy microscopy. We observe long-range magnetic textures extending beyond the single Moiré unit cell, which we dub a super-Moiré magnetic state. At small twist angles, the size of the spontaneous magnetic texture increases with twist angle, opposite to the underlying Moiré wavelength. The spin-texture size reaches a maximum of about 300 nm in 1.1° twisted devices, an order of magnitude larger than the underlying Moiré wavelength. The vector field maps suggest the formation of antiferromagnetic Neel-type skyrmions spanning multiple Moiré cells. The twist angle dependent study combined with atomistic simulations suggests that magnetic competition between the Dzyaloshinskii-Moriya interaction, magnetic anisotropy, and exchange interactions produces the super-Moiré spin orders.

MA 44: Focus Session: Curvilinear magnetism: Magnetics with nanoscale curved geometries (joint session MA/TT)

The behaviour of any physical system is determined by the order parameter whose distribution is governed by the geometry and topology of the physical space of the object, in particular its dimensionality and curvature. Specifically, spin textures, static and dynamic magnetic responses become sensitive to bends and twists in physical space. In this respect, curvature effects emerged as a novel tool to tailor magnetic properties and responses relying on geometric deformations. In magnetism, coupling between geometry of a magnet and magnetic order parameter brings about novel responses of curved thin films, nanowires and nanoparticles and enforces topological constraints on the number and type of magnetic solitons living in a curved space. Curvatures can force a geometry-driven local interactions like Dzyaloshinskii-Moriya interaction (DMI) and anisotropy as well as novel non-local chiral symmetry breaking effects, which were confirmed experimentally using electron holography studies of magnetic cap-shaped structures. Advances in experimental techniques (fabrication and tomographic characterization) allow validating theoretically predicted effects and apply them for functional devices as was demonstrated with geometrically twisted 3D racetracks. Recent highlights of the community include experimental proof of curvature stabilised skyrmions, explorations of curvilinear altermagnets, tailoring magnetic solitons in curvilinear 2D magnets, curvilinear magnetoelectrics, use of curvilinear magnetic architectures to tune superconducting transport, and magnetoionic manipulation of magnetic states in nanostructures to name just a few representative topics, which will be covered at the focused symposium.

Organizers: Denys Makarov, d.makarov@hzdr.de; Paola Gentile, paola.gentile@spin.cnr.it

Time: Thursday 9:30–13:00 Location: POT/0151

Invited Talk MA 44.1 Thu 9:30 POT/0151

2D and 3D racetracks: Interplay of geometric and magnetic chiralities — •Stuart Parkin — Max Planck Institute for Microstructure Physics, Halle (Saale), Germany — Martin Luther University Halle-Wittenberg

Magnetic Racetrack Memory (RTM) is a unique memory-storage device that relies on the current driven motion of multiple domain walls along magnetic conduits that can be arranged either horizontally (2D) or vertically (3D). It has great potential as a high performance, non-volatile memory that has enormous data storage capacity compared to today*s memory technologies. Atomically engineered 2D magnetic racetracks in the form of synthetic antiferromagnets allow for very high current induced motion of nanoscopic chiral domain walls[1]. Recently we have shown that 2D RTM can be scaled to dimensions that are technologically relevant with widths of just ~50 nm[2]. 3D racetracks would allow for the highest density memories. Using a state-of-the-art multi-photon super-resolution lithography system we form 3D scaffolds of arbitrary shapes on which the racetracks can be subsequently deposited. We discuss 3D racetracks that are formed with clockwise and anticlockwise chiral twists and curved cross-sections. The interplay between the geometrical chirality and the spin chirality of the individual domain walls allows for domain wall diode devices [3]. [1] S. S. P. Parkin, S.-H. Yang, Nat. Nanotechnol. 2015, 10, 195. [2] J.-C. Jeon, A. Migliorini, J. Yoon, J. Jeong, S. S. P. Parkin, Science 2024, 386, 315. [3] A. M. A. Farinha, S.-H. Yang, J. Yoon, B. Pal, S. S. P. Parkin, Nature 2025, 639, 67.

Invited Talk MA 44.2 Thu 10:00 POT/0151

Combined MFM/KPFM at the Ultimate Sensitivity Limit for Probing Curvature-Engineered Micromagnetic States — •Emily Darwin[1], Reshma Peremadathil Pradeep[1,2], Luca Berchialla[3], Daniel Rotthardt[1,2], Ales Hrabec[3], and Hans Hug[1,2] — [1]Empa, Swiss Federal Laboratories for Materials Science and Technology, 8600 Dübendorf, Switzerland — [2]Department of Physics, University of Basel, 4056 Basel, Switzerland — [3]aul Scherrer Institut PSI, 5232 Villigen, Switzerland

Curved substrates offer a promising route for tailoring the magnetic properties of multilayer systems, potentially stabilizing topologically non-trivial spin textures such as skyrmions. However, local variations in surface inclination can significantly affect growth conditions, altering crystallographic orientation or even disrupting the multilayer architecture.

In this study, we investigate a Pt/Co/Ru multilayer deposited on a polymer substrate patterned with nanoscale semispherical bumps using a combined single-pass Magnetic Force Microscopy (MFM) and Frequency-Modulated Kelvin Probe Force Microscopy (FM-KPFM) technique. Our system achieves unprecedented sensitivity to both magnetic and electrostatic interactions. We find that steep, near-vertical walls at the perimeter of hemispherical features locally disorder the multilayer stack, resulting in distinct changes in the contact potential difference. This disruption facilitates magnetic flux return and enables the formation of circular magnetic domains aligned with the external magnetic field on the dome tops.

Invited Talk MA 44.3 Thu 10:30 POT/0151
Curvilinear magnetism in superconducting spintronics — •Sol Jacobsen — Center for Quantum Spintronics, Norwegian University of Science and Technology NTNU, Trondheim, Norway

Replacing semiconductor-based computational components with superconducting elements can give an energy saving of two orders of magnitude. To harness this, we need precise control of the interaction between superconducting and magnetic components. Geometric curvature controls the superconducting transition by affecting spin relaxation and precession in superconductor-magnet heterostructures [1]. To functionalize this in devices, we can dynamically alter the curvature by inducing bending-strain. This can for example lead to electrically controlled superconducting spin-valves, current-reversal, and chirality-dependent ground states in triplet-SQUIDs [1-3]. In this presentation, I will discuss how real-space geometric curvature provides new pathways for manufacturing and controlling the interaction between superconductivity and magnetism in wires and thin films, and anticipate future developments in the field.

[1] Salamone et al, Phys. Rev. B 104 (2021) L060505; 105, (2022) 134511. [2] Salamone et al, Appl. Phys. Lett. 125 (2024) 062602. [3] Skarpeid et al, J.Phys.:Condens.Matter, 36 (2024) 235302.

15 min break

Invited Talk MA 44.4 Thu 11:15 POT/0151
Advanced Control of Magnetic Nanostructures via Metasurface Engineering and Voltage-Driven Functionalities — •Anna Palau — Institut de Ciència de Materials de Barcelona (ICMAB-CSIC)

Understanding and manipulating magnetic micro- and nanostructures are fundamental to advancing technologies in data storage, spintronics, and magnetic sensing. Magnetic metasurfaces have recently attracted significant interest for their ability to locally configure magnetic field distributions and overcome limitations of traditional magnetic imaging techniques. In this work, we demonstrate how metasurfaces enable precise control of vortex motion, coercive fields, and saturation behaviour in magnetic nanostructures without altering their intrinsic anisotropy [1]. We show that metasurfaces can overcome magnetic field constraints in X-ray Photoemission Electron Microscopy (XPEEM), enabling high-resolution imaging of magnetisation states under conditions previously inaccessible. Additionally, we explore electric-field-driven ionic migration as a complementary route for voltage-controlled, non-volatile modulation of magnetic and superconducting properties [2], highlighting new opportunities for energy-efficient control and advanced characterisation. [1] Barrera et al. ACS Nano 19, 10461 (2025), [2] Günkel et al. Small 2411908 (2025), Spasojević et al. Nat. Commun. 16, 1990 (2025)

Invited Talk MA 44.5 Thu 11:45 POT/0151
Magnetic tomography of noncollinear spin textures in curvilinear geometries — •Sandra Ruiz-Gomez — ALBA Synchrotron, Barcelona, Spain

Three-dimensional nanomagnetic systems offer a unique platform for discovering and controlling complex spin textures. Recent advances in 3D nanofabrication, magnetic characterization techniques, and micromagnetic modeling are now enabling precise control of curvature, torsion, and geometry at the nanoscale, opening new routes for engineering spin textures in three-dimensional architectures.

In this talk, I will present our latest results on how geometrical design and 3D architecture can be exploited to tailor the energy landscape of domain walls, manipulate their topological properties, and guide their motion from straight nanowires to more complex curved cylindrical and tubular geometries. By combining state-of-the-art fabrication techniques with high-resolution imaging and theoretical analysis, we identify how curvature can be harnessed to stabilize complex spin textures, enabling deterministic control over their dynamics.

Overall, this work highlights how 3D nanomagnetism can be leveraged to access new regimes of topological control, with implications for next-generation spintronic devices, robust information carriers, and reconfigurable magnetic architectures.

MA 44.6 Thu 12:15 POT/0151
Transferred magnetic nanomembranes for curvilinear magnetism and spintronics — •Olha Bezsmertna[1], Oleksandr Pylypovskyi[1], Rui Xu[1], Mykola Vinnichenko[2], Andrea Sorrentino[3], Daniel Wolf[4], Axel Lubk[4], Peter Fischer[5,6], and Denys Makarov[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany — [2]Institute for Ceramic Technologies and Systems IKTS, 01277 Dresden, Germany — [3]Alba Light Source, MISTRAL beamline, Cerdanyola del Vallès 08290, Spain — [4]Leibniz Institute for Solid State and Materials Research, 01069 Dresden, Germany — [5]University of California, Santa Cruz, United States — [6]Lawrence Berkeley National Laboratory, Berkeley, United States

The functionality of the magnetic nanomembranes can be extended through controlled transfer processes and geometric design. We show that advanced giant magnetoresistive thin films can be reliably transferred onto various substrates using green chemistry, preserving their structural integrity and magnetic performance, thus enabling mechanically conformal devices for applications where low weight, flexibility, and durability are essential [1]. With the developed technique, we demonstrate fabrication of curvilinear hierarchical magnetic nanotemplates and their subsequent transfer to an appropriate handling support enabling high-resolution transmission microscopy investigations (electron- and x-ray-based) of the impact of geometric curvature on complex magnetic states [2].

References: [1] Bezsmertna et al. Adv. Funct. Mater. 35, 2502947 (2025). [2] Bezsmertna et al. Nano Lett. 24, 15774 (2024).

MA 44.7 Thu 12:30 POT/0151
Magnetic solitons in spherical maghemite nanoshells — •Oleksandr V. Pylypovskyi[1], Gaspare Varvaro[2], Davide Peddis[2,3], Priyanka Mishra[4], Carmine Autieri[4], Filipp N. Rybakov[5], Denis D. Sheka[6], and Denys Makarov[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf e.V., 01328 Dresden, Germany — [2]CNR-Istituto di Struttura della Materia, 00015 Roma, Italy — [3]Universitá degli Studi di Genova, 1-16146 Genova, Italy — [4]International Research Centre Magtop, Institute of Physics, Polish Academy of Sciences, 02668 Warsaw, Poland — [5]Uppsala University, Uppsala SE-751 20, Sweden — [6]Taras Shevchenko National University of Kyiv, 01601 Kyiv, Ukraine

Topology of the shape of magnetic nanoarchitecture makes a major impact on global properties of its magnetic textures [1,2]. Here, we present a fabrication of maghemite spherical shells and a theoretical analysis of magnetic solitons they host in equilibrium. The ferrimagnetic shells with a radius and shell thickness of about 4 nm and 1.4 nm have a radial easy axis that favors skyrmionic textures. Their ground state corresponds to a 3D onion state with the change of the radial component of magnetization at the equator. In this presentation, we will also report on the localization of magnetic solitons on spherical shells.

[1] V. P. Kravchuk et al., PRB **94**, 144402 (2016); [2] O. M. Volkov, O. V. Pylypovskyi et al., Nat. Commun., **15**, 2193 (2024).

MA 44.8 Thu 12:45 POT/0151
Coherent Spin Waves in Curved Ferromagnetic Nanocaps of a 3D-printed Magnonic Crystal — •Kilian Lenz[1], Huixin Guo[2], Mateusz Golebiewski[3], Ryszard Narkowicz[1], Jürgen Lindner[1], Maciej Krawczyk[3], and Dirk Grundler[2] — [1]Inst. of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Germany — [2]School of Engineering, Institute of Materials,Laboratory of Nanoscale Magnetic Materials and Magnonics, École Polytechnique Fédérale de Lausanne, Switzerland — [3]Institute of Spintronics and Quantum Information, Adam Mickiewicz University, Poznań, Poland

In this work we present ferromagnetic resonance measurements and simulations of a 3D magnonic crystals embedded in an on-chip microresonator. It was realized by two-photon lithography of a 3D woodpile structure and atomic layer deposition of a 30-nm-thin Ni film. Operated near 14 and 24 GHz, the microresonator output revealed numerous coherent magnons with distinct angular dependencies reflecting the underlying face-centered cubic lattice. The micromagnetic simulations show that some of the edge modes are localized at the curved nanocaps and that they remain robust against changes of the field orientation. These cap modes exhibit an unexpected phase evolution. The findings advance the development of functional microwave circuits with 3D magnonic crystals and strengthen their visionary prospects for edge-dominated magnon modes.

MA 45: Magnetic Relaxation and Gilbert Damping

Time: Thursday 9:30–11:00 Location: POT/0351

MA 45.1 Thu 9:30 POT/0351

Nonlinear magnon-magnon coupling in a ferrimagetic YIG sphere at cryogenic temperatures — •Johannes Weber[1,2], Richard Schlitz[3], Sebastian T. B. Goennenwein[3], Matthias Althammer[1,2], and Hans Huebl[1,2,4] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany — [2]TUM School of Natural Sciences, Technische Universität München, Garching, Germany — [3]Department of Physics, University of Konstanz, Konstanz, Germany — [4]Munich Center for Quantum Science and Technology (MCQST), Munich, Germany

Yttrium ion garnet (YIG) is known for its low magnetic damping properties, which are optimized in single crystalline YIG spheres, making it a potent candidate for nonlinear magnonics. The magnetic spectrum shows numerous so called Walker modes. Here, we present two-tone pump and probe microwave spectroscopy measurements of the magnetization dynamics of a 250 μm YIG sphere. The data shows signatures of three-magnon scattering, when the drive exceeds the first order Suhl instability threshold. We quantitatively analyze the underlying non-linearity for different Walker modes. These experiments enable a pathway for probing quantum signatures in magnetic systems.

MA 45.2 Thu 9:45 POT/0351

Evidence of relativistic field-derivative torque in nonlinear THz response of magnetization dynamics — •Arpita Dutta[1], Pratyay Mukherjee[6], Swosti P. Sarangi[1], Somasree Bhattacharjee[6], Christian Tzschaschel[2,3], Debankit Priyadarshi[3], Kouki Mikuni[4], Takuya Satoh[4,5], and Ritwik Mondal[6] — [1]NISER Bhubaneswar, HBNI, Jatni, India — [2]Max-Born Institute, Berlin, Germany — [3]ETH Zurich, Switzerland — [4]Institute of Science Tokyo, Japan — [5]Quantum Research Center for Chirality, Okazaki, Japan — [6]IIT (ISM) Dhanbad, India

The selective addressing of spins by THz electromagnetic fields via Zeeman torque is one of the most successful means of controlling magnetic excitations. Here, we show that the conventional Zeeman torque on the spin is not sufficient, rather an additional relativistic field derivative torque is essential to realize the observed magnetization dynamics. We accomplish this by exploring the ultrafast nonlinear magnetization dynamics of a ferrimagnetic garnet when excited by two co-propagating THz pulses. Having identified the Kaplan-Kittel mode at 0.48 THz, resulting from the exchange interaction, we drive this to a nonlinear regime. We find that the observed nonlinear trace of the magnetic response cannot be mapped to the magnetization precession induced by the Zeeman torque, while the Zeeman torque supplemented by an additional FDT follows the experimental evidences.

MA 45.3 Thu 10:00 POT/0351

Quantum Landau-Lifshitz-Gilbert equation — •Yuefei Liu — Nordita, Stockholm University and KTH Royal Institute of Technology, SE-10691 Stockholm, Sweden — Center for Quantum Spintronics, Department of Physics, NTNU, Norwegian University of Science and Technology, NO-7491 Trondheim, Norway

The classical Landau-Lifshitz-Gilbert (LLG) equations describe magnetization dynamics. Extending them to quantum systems is difficult, but we introduce an effective equation that is considered as a quantum analog of LLG equation [PRL 133, 266704 (2024)]. It reproduces classical features for ferromagnetically coupled spin-1/2 dimers, yet deviates strongly in antiferromagnetic and entangled cases, suggesting a new paradigm beyond Lindblad-type master equations.

MA 45.4 Thu 10:15 POT/0351

Temperature dependence of volume and interface contributions to the magnetic damping of Permalloy thin films — Verena Ney[1], Kilian Lenz[2], Fabian Ganss[2], René Hübner[2], Jürgen Lindner[2], and •Andreas Ney[1] — [1]Johannes Kepler Universität, Linz, Österreich — [2]Helmholtz-Zentrum Dresden-Rossendorf, Deutschland

The magnetic damping of $Ni_{80}Fe_{20}$ (Permalloy, Py) thin films has been reported to be lowest when sandwiched in Al cap and spacer layers [1]. Here we study the Gilbert damping parameter α as a function of Py layer thickness via temperature- and frequency-dependent ferromagnetic resonance (FMR) experiments. The full FMR dataset allows to separate the Gilbert-like contributions to the FMR linewidth from non-Gilbert-like ones like two magnon scattering processes. In addition, the Py thickness series allows to deconvolute α into its respective bulk and interfacial contributions and their respective temperature dependencies. While the bulk contribution monotonously decreases with temperature from 0.0061(1) down to 0.0054(1), the interfacial contribution shows a subsequent increase at low temperature. The remaining bulk contribution, which is only of resistivity-like character, can be considered to reflect the intrinsic magnetic damping properties of Py thin films, while the interface contribution contains both resistivity- and conductivity-like contributions [2].

[1] V. Ney et al. Phys. Rev. Materials **8**, 124410 (2024)
[2] V. Ney et al. Phys. Rev. Materials (submitted, 2025)

MA 45.5 Thu 10:30 POT/0351

Thickness-dependent modulation of magnetization dynamics in ultralow-damping Co_2MnSi Heusler alloys measured by ultrafast TR-MOKE — •Levi Geier[1], Anulekha De[1], Anna Maria Friedel[1,2], Philipp Pirro[1], Martin Aeschlimann[1], and Georg von Freymann[1,3] — [1]RPTU University Kaiserslautern-Landau — [2]Institut Jean Lamour, UMR CNRS 7198, Université de Lorraine, 54000 Nancy, France — [3]Fraunhofer Institute for Industrial Mathematics ITWM, Kaiserslautern

We measure the laser-induced ultrafast demagnetization and subsequent damped precession of the magnetization dynamics in Co_2MnSi Heusler alloys of varying thicknesses (4 nm - 18 nm). The study is performed by a time-resolved magneto-optical Kerr effect (TR-MOKE) setup based on an all-optical pump-probe approach. An ultralow effective damping down to an effective Gilbert damping constant $\alpha = 0.004$ is measured for the 18-nm-thick sample, which increases with decreasing applied magnetic field and increasing pump fluence. We attribute this trend to the generation of incoherent magnons in addition to the coherent magnons after excitation by the laser pulse. Moreover, we observe a strong dependence of the effective damping parameter on the film thickness. The effective damping decreases significantly with increasing film thickness, presumably due to two-magnon scattering. Interestingly the quenching of the magnetization during the demagnetization does not change significantly with pump fluence.

MA 45.6 Thu 10:45 POT/0351

Systematic Theory of Real-Time Atomistic Spin Dynamics — •Sarah Damerow and Michael Potthoff — I. Institute of Theoretical Physics, University of Hamburg

We present a systematic response-theoretical approach for deriving indirect interactions and novel couplings in the effective dynamics of classical spins coupled to generic lattice-fermion models. Via a systematic twofold expansion of the exact time evolution operator, namely in the coupling strength and in the retardation time, one identifies a rich variety of spin-, orbital-, and site-dependent contributions to the equations of motion. These include the familiar Ruderman–Kittel–Kasuya–Yosida and the Dzyaloshinskii–Moriya interactions. Additional anisotropic terms, different types of Gilbert damping and of geometrical spin torques, as well as various spin-inertia terms emerge. While the order of expansion suggests the order of magnitude of the effects, symmetry analysis allows for their classification. The practical feasibility of the approach is demonstrated with numerical results obtained for a Chern insulator.

MA 46: Magnetic Imaging Techniques II

Time: Thursday 9:30–10:45 Location: POT/0361

MA 46.1 Thu 9:30 POT/0361

Spin-Disorder-Induced Angular Anisotropy in Polarized Magnetic Neutron Scattering — Ivan Titov, •Venus Rai, and Andreas Michels — Department of Physics and Materials Science, University of Luxembourg, 162A Avenue de la Faiencerie, 1511 Luxembourg

We experimentally report a hitherto unseen angular anisotropy in the polarized small-angle neutron scattering (SANS) cross section of a magnetically strongly inhomogeneous material [1]. Based on an analytical prediction using micromagnetic theory, the difference between the spin-up and spin-down SANS cross sections is expected to show a spin-disorder-induced anisotropy. The effect is particularly pronounced in inhomogeneous magnetic materials, such as nanoporous ferromagnets, magnetic nanocomposites, or steels, which exhibit large nanoscale jumps in the saturation magnetization at internal pore-matrix or particle-matrix interfaces. Analysis of the experimental neutron data constitutes a method for determining the exchange-stiffness constant. Our results for the nuclear-magnetic interference terms contained in the polarized magnetic neutron scattering cross section might also be of relevance to other neutron techniques.

[1] I. Titov, M. Bersweiler, M. P. Adams, E. P. Sinaga, V. Rai, Š. Liščák, M. Lahr, T. L. Schmidt, V. M. Kuchkin, A. Haller, K. Suzuki, N.-J. Steinke, D. A. Venero, D. Honecker, J. Kohlbrecher, L. F. Barquín, and A. Michels, Phys. Rev. Lett. **135**, 196706 (2025)

MA 46.2 Thu 9:45 POT/0361

Beam focusing with nested mirror optics(NMO) at RESEDA — •Florian Schönleitner[1,2], Denis Mettus[2], Johanna Jochum[2], and Christian Pfleiderer[1,2] — [1]Physik-Department, Technische Universität München, Germany — [2]Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität München, Garching, Germany

The RESEDA(REsonance Spin Echo for Diverse Applications) instrument is a spectrometer that can use the MIEZE(Modulated IntEnsity with Zero Effort) method, a variant of neutron spin echo(NSE) that uses radio frequency(RF) spin flippers instead of static magnetic fields and that can measure samples that depolarise the beam. As a next step for improving the experimental setup it was proposed that nested mirror optics should be integrated to focus the beam at varios components of the instrument. Focusing the beam at the sample might allow measurements of samples with smaller sizes, such as samples in a diamond anvil cell. It also might allow for measurements at higher scattering angles, as it could reduce phase aberrations for the MIEZE method. Focusing the beam at the RF-flippers allows to build smaller AC-coils, leading to higher accessible frequencies, and consequently might lead to a better energy resolution of the spectrometer. In order to create an efficient setup that does not introduce additional artifacts, careful consideration of all effects caused by inserting NMO is necessary. Here we will present preliminary results of the simulations of NMO integration and discuss their potential.

MA 46.3 Thu 10:00 POT/0361

Towards Halbach spheres - Icosahedral symmetry is not just cool anymore — •Ingo Rehberg[1] and Peter Blümler[2] — [1]Experimental Physics, University of Bayreuth, Germany — [2]Institute of Physics, University of Mainz, Germany

Halbach spheres [e.g.1] are an ideal theoretical solution for generating homogeneous magnetic fields. Experimentally, a continuous magnetisation profile is difficult to realise, and the inaccessibility of the sphere's interior favours the use of Halbach rings [2,3]. An alternative is to arrange discrete magnets on the surface of a sphere. Regular polyhedra with a high degree of symmetry are well suited to approximate spherical Halbach configurations [3,4]. Icosahedral symmetry is especially effective at producing uniform magnetic fields (4th order saddle points).

[1] Peter Blümler and Helmut Soltner, Practical Concepts for Design, Construction and Application of Halbach Magnets in Magnetic Resonance. Appl. Magn. Reson. 54, 1701 (2023).

[2] Ingo Rehberg and Peter Blümler, Analytic approach to creating homogeneous fields with finite-size magnets, Phys. Rev. Appl. 23, 064029 (2025).

[3] Ingo Rehberg and Peter Blümler, Halbach two point oh: Optimize uniform fields with clusters and rings of permanent magnets. https://doi.org/10.5281/zenodo. 15006677 (2025).

[4] Ingo Rehberg, Dipole Cluster Inspector - A Duty-Free Python GUI for Exploring 569 Magnetic Configurations. https://doi.org/10.5281/zenodo. 10084573 (2025).

MA 46.4 Thu 10:15 POT/0361

Shaken, not stirred: Using vibrations for sub-10nm resolution scanning X-ray microscopy imaging — •Simone Finizio, Benjamin Watts, Benedikt Rösner, and Jörg Raabe — Paul Scherrer Institut, Villigen PSI, Switzerland

In order to fully exploit the significantly higher coherent photon flux offered by the novel diffraction-limited light sources for high-resolution imaging, scanning microscopy techniques need to tackle imaging overheads and the unavoidable vibrations at the nanometric scales, both hindering the achievement of sub-10nm resolutions in routine conditions.

In most scanning microscopy endstations, significant effort and expense is dedicated to fight these unavoidable vibrations. In this work, we propose to stop fighting vibrations, and instead harness their potential to provide a uniform sampling at the nanoscale. This is achieved by relaxing the positioning precision requirements and sampling the position of the sample with a fast (10 kHz) clock, significantly above the mechanical eigenfrequencies of the sample assembly. An image is then created by binning the recorded positions and photon counts according to a user-defined pixel size. With this method, the routine imaging of sub-10nm features could be demonstrated.

MA 46.5 Thu 10:30 POT/0361

Magnetic interactions and magnetic field distributions in van der Waals heterostructures with Fe_3GeTe_2 — •Joachim Dahl Thomsen[1], Qianqian Lan[1], Eva Duft[1], Zdeněk Sofer[2], Nikolai Kiselev[3], and Rafal Dunin-Borkowski[1] — [1]Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons, Forschungszentrum Jülich, Jülich, Germany — [2]Department of Inorganic Chemistry, University of Chemistry and Technology Prague, Prague, Czech Republic — [3]Peter Grünberg Institute and Institute for Advanced Simulations, Forschungszentrum Jülich, Jülich, Germany

Magnetic van der Waals (vdW) materials are promising for memory and logic applications because their properties are highly tunable and they integrate readily into heterostructures that exploit proximity and interlayer effects. However, depth-resolved imaging of interlayer coupling is challenging in plan-view, where contrast is integrated through the sample. Here we use cross-sectional Fe_3GeTe_2 (FGT)/graphite/FGT heterostructures to probe coupling between vertically stacked FGT layers across separations of 0-110 nm. We use Lorentz TEM and off-axis electron holography to visualize the domain structure and map the magnetic field inside and outside the vdW heterostructures, resolving how the interaction evolves with spacer (graphite) thickness. We find that domain alignment between FGT flakes is set by their separation, and that a weak interaction persists even at a separation of 110 nm. These measurements provide design guidance for vdW heterostructure devices that rely on controlled interlayer interactions between magnetic textures.

MA 47: Altermagnets V

Time: Thursday 15:00–18:00 Location: HSZ/0002

MA 47.1 Thu 15:00 HSZ/0002

Electronic correlations and non-colinear spins driving chirality-induced spin selectivity — Jacek Herbrych[1], Nicole Naber[2], and •Maria Daghofer[2] — [1]Wroclaw University of Science and Technology, Wroclaw, Poland — [2]FMQ, Universität Stuttgart, Stuttgart, Germany

Starting from a non-interacting *p*-orbital model for helical organic molecules, we look at the impact of onsite Hubbard and Hund's-rule interactions. We find that they can induce an orbital-selective Mott transition as well as a block spiral with non-colinear helical magnetic order. We then investigate the resulting chiral bands and find them to be partially spin polarized, a manifestation of *p*-wave magnetism. Using density-matrix renormalization group, cluster perturbation theory and Monte-Carlo methods, we find that small spin-orbit coupling together with strong correlations robustly leads to spin-polarized bands, even at moderately high temperature and for short correlation lengths. We thus propose this combination as an explanation of chirality-induces spin selectivity and also discuss the interplay of such non-colinear spin patterns with magnetised leads.

MA 47.2 Thu 15:15 HSZ/0002

Chiral phonon-electron interaction in altermagnets — •Armando Consiglio[1], Giancarlo Panaccione[1], and Domenico Di Sante[1,2] — [1]CNR-Istituto Officina dei Materiali (IOM), Unità di Trieste, Strada Statale 14, km 163.5, 34149 Basovizza (TS), Italy — [2]Department of Physics and Astronomy, University of Bologna, 40127 Bologna, Italy

The recent discovery of altermagnetism has opened new frontiers in condensed matter physics, bridging the behaviour of collinear antiferromagnets and ferromagnets. Altermagnetic materials exhibit zero net magnetization while hosting spin-split electronic bands, suggesting novel couplings between lattice and electronic degrees of freedom with potential implications for chiral phonon formation and magnetophononic effects. In this study, we focus on MnTe and CrSb and present two main results. First, we identify signatures of chiral phonons in the presence of altermagnetic order. Second, we analyze the coupling between these chiral phonon modes and the low-energy electronic states of the compounds, revealing new magneto-phononic interactions. The work provides insight into the interplay between spin order and lattice dynamics in altermagnetic materials, highlighting their potential for novel spintronic and phononic functionalities.

MA 47.3 Thu 15:30 HSZ/0002

Spin polarized optical excitation in altermagnetic RuO_2 — •Paul Herrgen[1], Luca Haag[1], Stephan Wust[1], Marius Weber[1], Akashdeep Akashdeep[2], Mathias Kläui[2], Gerhard Jakob[2], Hans Christian Schneider[1], Benjamin Stadtmüller[3], and Martin Aeschlimann[1] — [1]Department of Physics and Research Center OPTIMAS, RPTU University Kaiserslautern-Landau, 67663 Kaiserslautern, Germany — [2]Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany — [3]Institute of Physics, University of Augsburg, 86159 Augsburg, Germany

Altermagnetic materials open new avenues for spintronic applications in compensated magnets due to the spin-split band structure. This unconventional electronic configuration enables access to spin-polarized, all-optical excitation despite the absence of a net magnetization.

In this work, we experimentally probe optically induced spin polarization in the altermagnetic material candidate RuO_2 [1]. The out-of-plane Néel vector of the system allows for the detection of the induced spin polarization via polar magneto-optical Kerr effect (MOKE) measurements. In light of the ongoing debate surrounding the altermagnetic nature of RuO_2, we conducted a systematic study across a range of film thicknesses. Our results show that altermagnetic behavior is observable only in the thinnest films, while increasing thickness leads to a progressive suppression of the characteristic altermagnetic response.

[1]: Weber et al., arXiv:2408.05187 (2024)

MA 47.4 Thu 15:45 HSZ/0002

Non-collinear achiral altermagnetic semiconductor — •Mengli Hu[1], Mikel Iraola[1], Paul McClarty[2], Jeroen van den Brink[1,3], and Maia G. Vergniory[4,5] — [1]Leibniz Institute for Solid State and Materials Research, IFW Dresden, Helmholtzstraße 20, 01069 Dresden, Germany — [2]Laboratoire Léon Brillouin, CEA, CNRS, Université Paris-Saclay, CEA-Saclay, 91191 Gif-sur-Yvette, France — [3]Würzburg-Dresden Cluster of Excellence Ct.qmat, Technische Universitat Dresden, 01062, Dresden, Germany — [4]Département de Physique et Institut Quantique, Université de Sherbrooke, Sherbrooke, J1K 2R1 Québec, Canada. — [5]Donostia International Physics Center, 20018 Donostia-San Sebastian, Spain

Altermangnets (AMs) constitute a novel family of magnetic materials characterized by the absence of net magnetization and the presence of spin-polarized band structures. Whereas AM phases were initially proposed in collinear structures, the recently discovered noncollinear chiral AMs stand out for their distinct hedgehog spin texture and multifunctionality in spintronics. In this work, we deepen the characterization of these systems by constructing a Landau theory for noncollinear achiral AMs. Furthermore, we demonstrate that the achiral symmetry of the crystal is reflected in the spin texture in reciprocal space, which presents only spatial-even multipoles. These multipoles, distinguished from those in collinear AMs via the high-order secondary order parameters, can couple to many phenomena. Our results suggest non-collinear achiral AMs as a promising platform for spintronics applications due to the potential to achieve various spin textures.

MA 47.5 Thu 16:00 HSZ/0002

Circular Dichroism in Resonant Photoelectron Diffraction on Altermagnetic MnTe Films — •Lena Hirnet, Marco Dittmar, Maximilian Ünzelmann, and Friedrich Reinert — Exp. Physik VII and Würzburg-Dresden Cluster of Excellence ctd.qmat, Universität Würzburg, Germany

Altermagnets have lately attracted great attention combining antiferromagnetic spin alignment in real space with a momentum-dependent spin polarization of the electronic states in the band structure. One of the proposed altermagnet work horse materials is MnTe [1,2]. Recently, it has been theoretical predicted that the circular dichroism observed in resonant photoelectron diffraction patterns serves as a direct probe of the altermagnetic sublattice texture [3]. Here, we present resonant photoemission experiments conducted at soft x-ray photon energies corresponding to the Mn $L_{2,3}$ absorption edge. In the corresponding photoelectron diffraction pattern, we can identify the scattering processes of electrons — photoexcited from the Mn-3d states — with the surrounding sublattice atoms. In particular, we find Mn-Mn and Mn-Te forward-scattering peaks and will discuss their dichroic texture which compares very well with the theoretical calculations [3].

[1] L. Šmejkal *et al.*, Phys. Rev. X **12**, 031042 (2022)
[2] J. Krempaský *et al.*, *Nature* **626**, 517-522 (2024)
[3] P. Krüger, Phys. Rev. Let **135**, 196703 (2025)

MA 47.6 Thu 16:15 HSZ/0002

Atomic altermagnetism — •Rodrigo Jaeschke-Uiergo[1], Venkata K. Bharadwaj[1], Warlley Campos[2], Ricardo Zarzuela[1], Nikolaos Biniskos[3], Rafael M. Fernandes[4], Tomáš Jungwirt[5], Jairo Sinova[1], and Libor Šmejkal[2,6,1,5] — [1]Johannes Gutenberg Universität, Mainz, Germany — [2]Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — [3]Charles University, Prague, Czech Republic — [4]University of Illinois Urbana-Champaign, Urbana, USA — [5]Czech Academy of Sciences, Prague, Czech Republic — [6]Max Planck Institute for Chemical Physics of Solids, Dresden Germany

Altermagnetism has recently been verified experimentally in MnTe and CrSb, which feature two sublattices with antiparallel magnetic dipole moments. In this talk, I will introduce the concept of atomic altermagnetism, a form of ferroic higher-order partial waves of the atomic spin density. Using spin-symmetry analysis and a partial-wave decomposition of first-principles spin densities, we demonstrate such non-dipolar spin order in MnTe, CrSb and KV_2Se_2O, where it coexists with the Néel order. In the Mott insulator Ba_2CaOsO_6, we uncover a striking case of pure atomic altermagnetism, which is entirely absent of dipolar sublattice order. These results show that altermagnetism can occur without Néel order. Finally, I will show that KV_2Se_2O and Ba_2CaOsO_6 are predicted to host giant spin-splitter angles of up to

42° and 26°, respectively demonstrating that strong altermagnetic responses can emerge without requiring the staggered Néel order of local dipole moments.

15 min break

MA 47.7 Thu 16:45 HSZ/0002

High-field magnetotransport and quantum oscillations in altermagnetic CrSb — •Sajal Naduvile Thadathil[1,2], B. V. Schwarze[1], T. Kotte[1], M. Uhlarz[1], C. Muller[3,4], P. Ritzinger[3,4], K. Vyborny[3], T. Speliotis[5], J. Pospisil[4], R. G. Hernandez[6], H. Reichlova[3], D. Kriegner[3], J. Wosnitza[1,2], and T. Helm[1] — [1]Dresden High Magnetic Field Laboratory (HLD-EMFL), HZDR, Germany — [2]Institute of Solid-State and Materials Physics, TU Dresden, Germany — [3]Institute of Physics ASCR, Czech Republic — [4]Charles University, Czech Republic — [5]Institute of Nanoscience and Nanotechnology, Greece — [6]Universidad del Norte, Colombia

Within the family of altermagnets, CrSb is a metallic, collinearly ordered material that exhibits particularly strong symmetry-induced spin splitting in its band structure. In this study, we combine electrical magnetotransport measurements up to 70 T on microfabricated single-crystalline CrSb with first-principles calculations to investigate its Fermi surface. Our experiments reveal a non-saturating magnetoresistance and nonlinear Hall resistivity consistent with multiband charge transport. Notably, we report the observation of Shubnikov-de Haas quantum oscillations in CrSb. Band-structure calculations, when compared with our measurements, accurately reproduce the expected Fermi-surface geometry. These results confirm the predicted electronic band structure of CrSb, establish robust multi-charge-carrier transport at high fields, and highlight the importance of high-field experiments for mapping electronic band structures of altermagnets.

MA 47.8 Thu 17:00 HSZ/0002

Altermagnetism in RuO_2? An experimental study on strain and stoichiometry in heterostructures — •Maik Gaerner[1], Niklas Schmolka[1], Alexander Weissbach[2], Joachim Wollschläger[2], Karsten Rott[1], Jan Schmalhorst[1], Martin Wortmann[3], and Günter Reiss[1] — [1]Bielefeld University, Germany — [2]Osnabrück University, Germany — [3]Bielefeld University of Applied Sciences and Arts, Germany

RuO_2 is a widely studied altermagnetic candidate material, but its magnetic ground state remains actively debated. While some studies find little to no evidence of altermagnetic order in RuO_2 thin films [1,2], others report on clear signatures of altermagnetism [3]. Strain and stoichiometry are widely regarded as key parameters for electronic and magnetic properties of RuO_2 [4,5].

Here, we analyze the impact of strain as well as stoichiometry on the appearance of altermagnetic order in RuO_2. Therefore, we investigate RuO_2 heterostructures, probing e.g. spin-torques and tunnel magnetoresistance. Through an accompanying, systematic X-ray photoelectron spectroscopy study, we analyze the thermal instability of oxidation states in the near surface region to elucidate the role of process temperature in the production of heterostructures.

[1] Akashdeep et al., arXiV:2510.08064 (2025)
[2] Jechumtál et al., arXiV:2508.11481 (2025)
[3] Noh et al. Phys., Rev. Lett. 134, 246703 (2025)
[4] Brahimi et al., J. Phys. Condens. Matter 37 395801(2025)
[5] Smolyanyuk et al., Phys. Rev. B 109, 134424 (2024)

MA 47.9 Thu 17:15 HSZ/0002

Altermagnetic non-reciprocal magnon transport in insulating d-wave orthoferrites — •Jonas Köhler[1], Edgar Galindez-Ruales[1], Shixun Cao[2], Ulrich Nowak[3], Gerhard Jakob[1], and Mathias Kläui[1] — [1]Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany. — [2]Materials Genome Institute, Institute of Quantum Science and Technology, International Center for Quantum and Molecular Structures, Shanghai University, 99 Shangda Road, Shanghai, 200444, China. — [3]Fachbereich Physik, Universität Konstanz, Universitätsstr. 10, Konstanz, 78457, Germany.

Altermagnetic materials have recently been predicted to host unique magnonic phenomena, including chiral magnon modes, anisotropic magnon lifetimes, and spin transport without additional symmetry breaking by magnetic fields [1].

We present non-local transport in the insulating rare-earth orthoferrites $LuFeO_3$ and $YFeO_3$. We observe a non-zero magnon spin-transport signal for the Spin-Hall-injected magnons, indicating a field-free spin-biased magnon transport. Using thermal excitation via the Spin-Seebeck effect, we observe a strong directional dependence. The signal in the $\Gamma - U$ direction has the opposite sign from the one in the $\Gamma - U'$ direction, while it vanishes along and perpendicular to the easy axis, suggesting a suppression along those crystallographic directions. This shows the altermagnetic spin split magnons, and we can reproduce the observation with an atomistic spin dynamics model.

[1] L. Šmejkal, Phys. Rev. Lett., 2023, 131, 256703.

MA 47.10 Thu 17:30 HSZ/0002

Magnetic structure and the detwinning effect under applied magnetic field in the altermagnet α-MnTe — •Feihao Pan[1], Yishui Zhou[1], Sabreen Hammouda[1], Yinghao Zhu[1], Soohyeon Shin[1], Karin Schmalzl[2], Wolfgang Schmidt[2], Eric Ressouche[3], Oscar Ramon Fabelo Rosa[4], and Yixi Su[1] — [1]Jülich Centre for Neutron Science (JCNS) at the Heinz Maier-Leibnitz Zentrum (MLZ), Forschungszentrum Jülich, Lichtenbergstrasse 1, D-85747 Garching, Germany — [2]Jülich Centre for Neutron Science (JCNS) at ILL, Forschungszentrum Jülich, F-38000 Grenoble, France — [3]IRIG, CEA and Université Grenoble Alpes, CEA Grenoble, F-38054 Grenoble, France — [4]Institut Laue-Langevin, 71 avenue des Martyrs, 38042 Grenoble Cedex 9, France

Altermagnetism has garnered significant interest due to spin splitting without relativistic spin-orbit coupling and its promising applications in spintronics. We have recently carried out a detailed single-crystal neutron diffraction study of α-MnTe under applied in-plane magnetic field. We found that a moderate field can generate a strong detwinning effect of magnetic domains. The determination of the magnetic structure of α-MnTe, carried out under both the twined and detwinned conditions, allows us to conclude that the magnetic moment of Mn is indeed colinearly ordered and is uniquely aligned along the crystallographic [1,1,0] direction. This important finding can pave the way for future investigations of altermagnetic phenomena, such as chiral magnon splitting and unconventional spin transport, in α-MnTe under almost detwinned conditions via a wide range of experimental probes.

MA 47.11 Thu 17:45 HSZ/0002

Altermagnetism from the point of view of Mössbauer spectroscopy and other local probes — •Felix Seewald[1], Tillmann Weinhold[1], Cornelius Herrmann[1], Jan Friedrichsen[1], Domenic Nowak[2], Rowena Wachtel[2], Rajib Sarkar[1], Sabine Wurmehl[2], and Hans-Henning Klauss[1] — [1]IFMP, TUD Dresden University of Technology — [2]Leibniz Institute for Solid State and Materials Research, IFW, Dresden

Altermagnetism has emerged as a hot topic of interest in solid state magnetism during recent years. Altermagnets combine a compensated antiferromagnetic structure with spin-split electronic bands. [1, 2]

We want to discuss what one can learn about altermagnetism from (nuclear) local probe spectroscopy, focusing mainly on Mössbauer spectroscopy (MBS) and NMR/NQR.

Depending on the type of altermagnet and the easy axis of the antiferrromagnetic order, local probes can prove or disprove the altermagnetic order. For d-wave altermagnets in Mössbauer spectroscopy and NMR/NQR studies the interplay between the local electric field gradient and the local magnetic hyperfine field may directly differentiate the altermagnetic sites.

We wull discuss Mössbauer spectroscpy as well as NMR/NQR studies on candidates FeF_2, FeF_3, $La_2O_2FeMnOSe_2$ and furthermore highlight the challenges and restrictions they are connected with.

[1] L. Smejkal et al., Phys. Rev. X 12, 031042 (2022)
[2] Fender et al., J. Am. Chem. Soc., 147, 2257-2274 (2025)

MA 48: Magnonics II

Time: Thursday 15:00–18:00 Location: HSZ/0004

MA 48.1 Thu 15:00 HSZ/0004

Linear and nonlinear zero-field spin waves in transversally magnetised low-damping, half-metallic Co_2MnSi waveguides — •Anna Maria Friedel[1,2], Moritz Bechberger[1], Björn Heinz[1], Sébastien Petit-Watelot[2], Stéphane Andrieu[2], and Philipp Pirro[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern-Landau, 67663 Kaiserslautern, Germany — [2]Institut Jean Lamour, UMR CNRS 7198, Université de Lorraine, 54000 Nancy, France

We report on zero-field spin waves in the linear and nonlinear regime propagating over tens of micrometers in transversally magnetised Co_2MnSi waveguides. The remanent configuration is stabilised by the intrinsic cubic magnetocrystalline anisotropy of the $L2_1$-ordered Heusler compound, which enables an operation in the favourable Damon-Eshbach geometry, yielding large spin wave group velocities and propagation lengths associated with the large saturation magnetisation $M_s \approx 1000\,kA/m$ and the low Gilbert damping $\alpha \leq 10^{-3}$ in the half-metallic, $L2_1$-ordered Co_2MnSi. The cubic anisotropy not only allows for a reconfigurable remanent geometry and stable remanent operation, but also impacts the nonlinear magnetisation dynamics, yielding for instance a first order instability suppression range over several GHz. Investigating the linear and nonlinear dynamics in microstructured waveguides in remanence by Brillouin light scattering, this study consolidates the great interest in the half-metallic Co_2MnSi particularly for hybrid magnonic-spintronic applications at zero external bias fields.

MA 48.2 Thu 15:15 HSZ/0004

Long-range propagating paramagnon-polaritons in organic free radicals — •Sebastian Knauer[1], Roman Verba[2], Rostyslav O. Serha[1,3], Denys Slobodianiuk[2], David Schmoll[1,3], Andreas Ney[4], Sergej O. Demokritov[5], and Andrii V. Chumak[1] — [1]Faculty of Physics, University of Vienna, 1090 Vienna, Austria. — [2]V. G. Baryakhtar Institute of Magnetism of the NAS of Ukraine, 03142 Kyiv, Ukraine. — [3]Vienna Doctoral School in Physics, University of Vienna, 1090 Vienna, Austria. — [4]Institut für Halbleiter- und Festkörperphysik, Johannes Kepler Universität, 4040, Linz, Austria. — [5]Institute for Applied Physics, University of Münster, 48149 Münster, Germany.

Magnetic materials can host magnons below their Curie or Néel temperature, whereas in their paramagnetic phase, only short-range paramagnons are observed. We show that the organic free radical TEMPO supports long-range coherent spin dynamics well above its Néel temperature. Using all-electrical propagating spin-wave spectroscopy with on-chip microwave lines and external fields, we observe coherent excitations up to 23 GHz with group velocities above 100 km s^{-1} over 8 mm, exceeding calculated paramagnon velocities. Dispersion and pulse-propagation modelling identify these modes as paramagnon-polaritons, hybrid spin-photon excitations guided by the TEMPO column. This establishes organic free radicals as tunable paramagnetic magnonic media for microwave circuitry, spintronics, and high-frequency classical and quantum information processing [1].

[1] S. Knauer et al., RS, 2025 DOI: 10.21203/rs.3.rs-7990671/v1

MA 48.3 Thu 15:30 HSZ/0004

Nonlinear frequency mixing in spin-wave transducers — •Matthias Wagner, Felix Kohl, Björn Heinz, and Philipp Pirro — Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern- Landau, D-67663 Kaiserslautern, Germany

The demand for higher data transmission rates and high level of miniaturization has drawn attention to spin waves as a potential platform for building future radio frequency devices. So far, a lot of research has been carried out in optimizing prototype devices solely relying on continuous single-frequency operation. Nevertheless, the question how spin-wave transducers perform when real, multi-frequency signals are applied still is an open research subject that is especially relevant in the high-power regime where nonlinear spin-wave scattering leads to intermixing of frequency components within the passband. In this study, we quantify the nonlinear distortions caused by two-tone signals in spin-wave transducers by measuring relevant parameters, such as the 1-dB compression point and the third-order intercept point. Our results enable direct comparison between spin-wave based devices and conventional RF technology at the application level.

MA 48.4 Thu 15:45 HSZ/0004

Temperature-dependent characterization of spin-wave transducers — •Julien Schäfer, Björn Heinz, and Philipp Pirro — Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern- Landau, D-67663 Kaiserslautern, Germany

In radiofrequency technology, spin-wave-based (SW) communication building blocks, such as limiters and isolators, offer a low-energy alternative to traditional electronic devices. These magnonic communication devices consist of micrometer-sized antenna pairs that allow for tuning of the bandwidth and the frequency range through antenna shaping and adjustment of the applied magnetic field. Especially their compact size makes magnonic circuits attractive for on-chip integration, aiming to replace bulky electronic counterparts in crowded surroundings, such as cryostats and satellites. Following the objective to expand the SW transducer applicability to low-temperature environments, we study the propagation of SWs at various temperatures ranging from room temperature to 2 K. Understanding the impact of temperature-dependent variations in magnetic material parameters, including saturation magnetization and SW lifetime, on dispersive propagation characteristics is essential for engineering suitable devices. Our research provides insight into temperature-dependent insertion loss and isolation, consequently validating the applicability of SW transducers beyond room temperature conditions.

MA 48.5 Thu 16:00 HSZ/0004

Uniaxial strain response of antiferromagnetic magnons — •Manuel Knauft, Arthur von U.-S. Schwark, Matteo Minola, and Bernhard Keimer — Max Planck Institute for Solid State Research, Stuttgart, Germany

With the suggested paradigm shift away from conventional transistors towards lower loss devices, magnonics has attracted considerable attention in recent years. Generation, manipulation and detection of magnons are prerequisites for successful integration into microstructured chips. One potential phase space parameter to control magnon behavior is strain. In particular, in antiferromagnetic iridates with perovskite structure, it has recently been shown that the magnon energy can be varied by as much as 40% with small uniaxial strain of about 0.1% [1]. These ideas can also be extended to spatially inhomogeneous strain environments. We will demonstrate ideas of guiding magnons through bending single crystals and show results of finite element simulations and confocal Raman scattering.

[1] Kim *et al.*, Nat. Commun. **13**, 6674 (2022)

MA 48.6 Thu 16:15 HSZ/0004

Antiferromagnetic magnon condensation — •David Angster[1], Tobias Dannegger[1], Ulrich Nowak[1], and Verena Brehm[2] — [1]University of Konstanz, Germany — [2]Eindhoven University of Technology, Netherlands

The Bose-Einstein condensation (BEC) is a phase transition of a boson gas in which the ground state becomes macroscopically occupied below a critical temperature. BEC of bosonic quasiparticles, such as magnons, has been realised experimentally through active pumping of their density above a threshold value, since their number is not conserved in thermal equilibrium. This non-equilibrium magnon BEC was first demonstrated by Demokritov et al. [1]. Here, we present atomistic spin dynamics (ASD) simulations of antiferromagnetic hematite. The pumping of high-energy magnon modes triggers magnon redistribution via scattering processes that ultimately lead to condensation in the ground state, visible as an overproportional and non-thermal occupation of the low-frequency modes. Exploiting the non-linearity of ASD, we explore the key characteristics of BEC formation [2]: 1. a pumping threshold, 2. the spontaneous emergence of coherence, and 3. the shift of the magnon chemical potential.

[1] Demokritov et al., Nature 443, 430-433 (2006)
[2] Schneider et al., Nat. Nanotechnol. 15, 457-461 (2020)

MA 48.7 Thu 16:30 HSZ/0004

High-Resolution Field Mapping of Parametric-Instability Thresholds in YIG Films: Fine Structure and Magnon-

Phonon Hybridization — •Tamara Azevedo[1], Rostyslav O. Serha[2], Yannik Kunz[1], Matthias R. Schweizer[1], Vitaliy I. Vasyuchka[1], Mikhail Kostylev[3], Burkard Hillebrands[1], and Alexander A. Serga[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern-Landau, 67663 Kaiserslautern, Germany — [2]Faculty of Physics, University of Vienna, 1090 Vienna, Austria — [3]Faculty of Physics, University of Western Australia, 6009 Perth, Australia

Parametric electromagnetic pumping of magnons is a central technique for exciting and amplifying spin waves. Determining the parametric-instability threshold where the supplied energy compensates intrinsic magnon damping is essential for understanding and controlling this process. Using a highly sensitive automated measurement scheme based on quasi-continuous-wave excitation from a vector network analyzer and a microstrip resonator, we determined the instability threshold in tangentially magnetized yttrium-iron-garnet (YIG) films as a function of the external field $\mathbf{H}_0$ with unprecedented magnetic-field resolution. For parallel pumping, the threshold power exhibits distinct features originating from magnon hybridization with transverse and longitudinal phonons, as well as fine structure caused by the competitive excitation of thickness modes. These results highlight the dynamics specific to parallel parametric pumping that govern the onset of instability and provide crucial insight for efficient magnonic devices.

15 min break

MA 48.8 Thu 17:00 HSZ/0004

Stability of a magnon Bose-Einstein condensate under two-tone pumping — •Franziska Kühn[1], Lars Schiesser[1], Matthias R. Schweizer[1], Vitaliy I. Vasyuchka[1], Georg von Freymann[1,2], Mathias Weiler[1], Burkard Hillebrands[1], and Alexander A. Serga[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern-Landau, 67663 Kaiserslautern, Germany — [2]Fraunhofer Institute for Industrial Mathematics ITWM, Fraunhofer Platz 1, 67663 Kaiserslautern, Germany

In our work we investigate the stability of magnon Bose-Einstein condensates (BEC) in yttrium-iron-garnet films under two-tone pumping. First, to create a magnon BEC, the magnon gas is populated above the thermal level by external injection of magnons through parametric pumping. For flexible control of the excitation conditions, we employ a broadband microstrip antenna, allowing continuous tuning of the pumping frequencies. Second, after the magnon BEC is formed, its stability is tested by disturbing it with a second pumping pulse at a lower frequency. By shaking the magnon system without generating additional magnons, we aim to properly identify stability conditions of the magnon BEC in a time-varying environment. The measurements are performed using wave vector resolved Brillouin light scattering spectroscopy as an optical detection method for magnons. This research was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation)-TRR 173/3-268565370 Spin+X (Project B04 and B13).

MA 48.9 Thu 17:15 HSZ/0004

Modelling spin-wave interference with electromagnetic leakage in micron-scaled spin-wave transducers — •Felix Kohl[1], Björn Heinz[1], Matthias Wagner[1], Christoph Adelmann[2], Florin Ciubotaru[2], and Philipp Pirro[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern-Landau, D-67663 Kaiserslautern, Germany — [2]imec, Kapeldreef 75, 3001 Heverlee, Belgium

Utilization of spin-wave transducers for radio-frequency signal processing provides significant potential due to intrinsic tunability, scalability and nonlinearity. However, such components can exhibit passband ripples, distortions in their transmission band, diminishing their operation and functionality. In this work, we experimentally identify the interference with the electromagnetic crosstalk (EM) as a major source of passband ripples and provide a simple analytic model to predict its impact on device operation. The results are in good agreement with the experimental observation. In addition, we test multiple transducer geometries to identify operational regimes and minimize the EM impact. Finally, the effect of nonlinear device operation on the interference with the EM is addressed, which is of relevance for the exploitation of the spin-waves intrinsic nonlinear traits.

MA 48.10 Thu 17:30 HSZ/0004

Avoided Crossings of Magnon Modes and Superconducting Lumped Element Resonator in YIG Microplatelet — •Seth W. Kurfman[1], Anoop Kamalasanan[1], Karl Heimrich[1], Philipp Geyer[1], Frank Heyroth[2], Kwangyul Hu[3], Tharnier Puel[3], Michael Flatté[3,4], and Georg Schmidt[1,2] — [1]Martin Luther Universität Halle-Wittenberg Institut für Physik, Halle, Germany — [2]Interdisziplinäres Zentrum für Materialwissenschaften, Halle, Germany — [3]University of Iowa Department of Physics and Astronomy, Iowa City, Iowa (USA) — [4]Eindhoven University of Technology Department of Applied Physics, Eindhoven, The Netherlands

Yttrium iron garnet (YIG) has been considered for decades as a gold standard material for magnonics due to its low-loss magnonic properties, and has successfully been used to demonstrate strong-coupling in macroscopic device geometries [1-4]. However, strong coupling of magnons in truly sub-10 micron YIG structures to date has not yet been realized. Here, we demonstrate the use of a YIG microplatelet placed on superconducting lumped element LC resonator to achieve strong coupling between numerous magnon modes and the LC resonator photons. These experimental findings are qualitatively backed by micromagnetic simulations and analytical calculations to identify the magnon modes corresponding to the experimentally observed anticrossings in the microwave transmission signal.

[1] Lachance-Quirion, et al., Appl. Phys. Express 12, 070101 (2019). [2] Zhang, et al. Phys. Rev. Lett. 113, 156401 (2014). [3] Tabuchi et al. PRL 113, 083602 (2014). [4] Huebl, et al., PRL 111, 127003 (2013).

MA 48.11 Thu 17:45 HSZ/0004

Auto-oscillations and directional magnonemission induced by spin current injection into large magnetic volumes — •R. Schlitz[1,2], V. E. Demidov[3], M. Lammel[1], S. O. Demokritov[3], and P. Gambardella[2] — [1]Department of Physics, University of Konstanz, Konstanz, Germany — [2]Department of Materials, ETH Zurich, Zurich, Switzerland — [3]Institute of Applied Physics, University of Muenster, Muenster, Germany

Magnons are quantized excitations of the magnetization texture in ordered magnets, which can be used to transport spin information. In magnetic insulator/heavy metal bilayers angular momentum conversion from the electrical to the magnonic domain allows to electrically generate and detect magnon spin currents in the magnetic layer [1]. Recent studies showed, that in the nonlinear regime the changes of the nonlocal transport allow to also obtain information on the transported magnon manifold [2,3]. We show that local modifications of the magnon dispersion in the nonlinear regime can sensitively affect nonlocal magnon transport, giving rise to a strong enhancement of the number of specific low energy magnons. Considering the role of nonlinear relaxation processes, the nonlocal transport can be understood in terms of the nonequilibrium modification of the magnon dispersion. Our results showcase that nonlocal transport measurements are a sensitive probe to unravel changes to the magnon manifold [4].

[1] L. J. Cornelssien et al., Nature Physics **11**, 1022-1026 (2015)
[2, 3] R. Kohno et al., Physical Review B **108**, 14410 and 14411 (2023)
[4] R. Schlitz et al., Nature Communications **16**, 8472 (2025)

MA 49: Magnetic Imaging, Information Technology, and Sensors

Time: Thursday 15:00–17:15 Location: POT/0112

MA 49.1 Thu 15:00 POT/0112

Scalable magnetoreceptive e-skin for high-resolution interaction towards undisturbed extended reality — •Pavlo Makushko[1], Jin Ge[1], Gilbert Santiago Cañón Bermúdez[1], Oleksii Volkov[1,5], Yevhen Zabila[1], Stanislav Avdoshenko[2], Rico Illing[1], Leonid Ionov[3], Martin Kaltenbrunner[4], Jürgen Fassbender[1], Rui Xu[1], and Denys Makarov[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf e.V., Dresden, Germany — [2]Leibniz Institute for Solid State and Materials Research Dresden, Dresden,Germany — [3]University of Bayreuth, Bayreuth, Germany — [4]Johannes Kepler University, Linz, Austria — [5]Goethe-Universität Frankfurt, Frankfurt am Main, Germany

Electronic skins seek to go beyond the natural human perception, e.g., by providing magnetoperception to detect magnetic fields. However, realizing magnetoreceptive e-skin with spatially continuous sensing over extended areas is challenging due to escalating circuit complexity and power consumption with increasing sensing resolution or interactive area. Here, by incorporating the GMR effect and electrical resistance tomography, we achieve continuous sensing of magnetic trigger across an area up to $120 \times 120\,\text{mm}^2$ with a sensing resolution of better than 1 mm [1]. A simplified circuit design enables optically transparent, mechanically compliant, and vapor/liquid permeable devices, that can be conveniently applied onto any surface including human skin. These achievements pave the way to numerous applications, including undisturbed recognition of fine-grained gesture touchless interaction. [1] P. Makushko et al., Nat Commun 16, 1647 (2025).

MA 49.2 Thu 15:15 POT/0112

Probing the magnetic order in a ferromagnetic monolayer — •Paritosh Karnatak[1], Andriani Vervelaki[1], Katharina Kress[1], Boris Gross[1], Daniel Jetter[1], Menghan Liao[2,3], Ritadip Bharati[2,3], Fengrui Yao[2,3], Ignacio Gutierrez[2,3], Kenji Watanabe[4], Takashi Taniguchi[5], Alberto Morpurgo[2,3], and Martino Poggio[1,6] — [1]Department of Physics, University of Basel, Basel, Switzerland — [2]Department of Quantum Matter Physics, University of Geneva, Geneva, Switzerland — [3]Group of Applied Physics, University of Geneva, Geneva, Switzerland — [4]Research Center for Functional Materials, National Institute for Material Science, 1-1 Namiki, Tsukuba 305-0044, Japan — [5]International Center for Materials Nanoarchitectonics, National Institute for Materials Science, 1-1 Namiki, Tsukuba 305-0044, Japan — [6]Swiss Nanoscience Institute, University of Basel, Basel, Switzerland

Understanding magnetism in two-dimensional (2D) van der Waals (vdW) magnets requires nanoscale local probes. Scanning SQUID microscopy (SSM), with ∼100 nm resolution, enables direct imaging of magnetic structures in mono- and few-layer materials. Using SSM, we investigate the magnetic behavior of $CrPS_4$, a weakly anisotropic vdW interlayer antiferromagnet. Monolayer $CrPS_4$ shows no remanence and a zero coercive field, unlike thicker odd layers that exhibit 20-50 mT coercivity and nearly 100% remanence.

These layer-dependent studies reveal the role of interlayer coupling and dimensionality on magnetic responses. Our findings provide insights into mechanisms driving long-range magnetic order in 2D.

MA 49.3 Thu 15:30 POT/0112

SQUID-on-lever scanning probe for magnetic imaging with sub-100-nm spatial resolution — Timur Weber[2], •Daniel Jetter[1], Martino Pogio[1], and Dieter Kölle[2] — [1]Department of Physics, University of Basel, 4056 Basel, CH — [2]Physikalisches Institut, University of Tübingen, 72076 Tübingen, Germany

Scanning superconducting quantum interference device (SQUID) microscopy is a magnetic imaging technique combining high field sensitivity with nanometer-scale spatial resolution. We demonstrate a scanning probe that combines the magnetic and thermal imaging with the tip-sample distance control and topographic contrast of a non-contact atomic force microscope. We pattern the nanometer-scale SQUID, including its weak-link Josephson junctions, via neon or helium focused ion beam milling on a niobium coated cantilever. These SQUID-on-lever probes overcome many of the limitations of existing devices, achieving spatial resolution better than 100 nm, magnetic flux sensitivity of 0.3 $\mu\Phi_0/\sqrt{\text{Hz}}$, operation in magnetic fields up to about 0.5 T and the incorporation of a third Josephson junction for shifting its phase. Its advanced functionality, high spatial resolution, and the ease of use of a cantilever-based scanning probe, extends the applicability of scanning SQUID microscopy to a wide range of magnetic, superconducting, and quantum Hall systems. We demonstrate magnetic imaging of skyrmions at the surface of bulk Cu2OSeO3. Analysis of the SQUID's point spread function yields a full-width-half-maximum of 71 nm that allows to image modulated magnetization patterns with a period of 65 nm.

MA 49.4 Thu 15:45 POT/0112

Magneto-Mechanical Resonator with Stimulus-Responsive Hydrogel for pH Sensing — •Nora Timm[1], Jonas Faltinath[2,3], Bruno Kluwe[1], Jonas Schumacher[1], Pascal Stagge[1], and Tobias Knopp[1,2,3] — [1]Fraunhofer Research Institution for Individualized and Cell-based Medical Engineering IMTE, Lübeck, Germany — [2]Section for Biomedical Imaging, University Medical Center Hamburg-Eppendorf, Hamburg, Germany — [3]Institute for Biomedical Imaging, Hamburg University of Technology, Hamburg, Germany

Magneto-mechanical resonators (MMRs) offer a promising platform for passive and wireless sensing. We present a novel chemical sensor by integrating a miniaturized MMR (2 mm × 2 mm × 7 mm) with a pH-responsive poly(2-hydroxyethyl methacrylate) (pHEMA) hydrogel functionalized with acrylic acid. In our implementation, the stimulus-responsive hydrogel modulates the distance between two permanent magnets through reversible volumetric changes in response to pH variations. One magnet serves as the stator and the other as the rotor of the MMR that is excited into torsional oscillations by external magnetic fields. Since the resonance frequency depends on magnet separation, frequency analysis of the inductively detected signal enables pH sensing. We demonstrate the sensor's response to pH variations in the range of pH 5-7 with observable shifts in resonance frequency of more than 40 Hz, which corresponds to a relative shift of more than 12 %. This proof-of-concept establishes hydrogel-integrated MMR sensors as a viable approach for wireless chemical sensing.

MA 49.5 Thu 16:00 POT/0112

Deep learning enabled wearable magnetoelectronics — •Guannan Mu, Rui Xu, Proloy T. Das, Jan Schmidtpeter, Lin Guo, Oleksandr Pylypovskyi, Andreas Knüpfer, Rico Illing, Olha Bezsmertna, and Denys Makarov — Helmholtz-Zentrum Dresden-Rossendorf e.V., 01328 Dresden, Germany

A wide variety of magnetic field sensors is already integrated into human-machine interfaces in wearable electronics [1,2]. However, the currently available interfaces are limited in the number of recognizable gestures and operation distance. To overcome these limitations, we integrate deep learning into two magnetic interaction platforms. First, we employ a flexible magnetoresistive sensor for user-definable temporal multipattern classification. Furthermore, we realize a compact LSTM-enabled wearable magnetic-interaction system integrated into a wrist-worn platform that incorporates a planar Hall magnetoresistive sensor, enabling a single sensor to recognize multiple predefined gestures and achieving a high classification accuracy of 99.4 % at a long range interaction distance of 12 cm, highlighting the potential of deep learning-enhanced magnetic sensing to expand functionality and enable long-range magnetic interaction recognition in smart wearable interfaces. [1] R. Xu et al., ACS Nano 19, 21891 (2025) [2] O. Bezsmertna et al., Adv. Funct. Mater. 2502947 (2025)

MA 49.6 Thu 16:15 POT/0112

Eco-sustainable printed magnetoresistive sensors — •Lin Guo, Xiaotao Wang, Proloy Taran Das, Yevhen Zabila, Ihor Veremchuk, Rui Xu, and Denys Makarov — Helmholtz-Zentrum Dresden-Rossendorf e.V., 01328 Dresden, Germany

Magnetoresistive sensors (MR), capable of non-contact detection of magnetic fields and consequently relative motion, have been extensively used across a broad spectrum of applications[1].Meanwhile, the massive deployment of magnetoresistive sensor arise the sustainability concerns from two aspects: 1. Carbon footprint in fabrication. 2. Electronics waste issue at the end of their lifetime.

Here, we propose the printed eco-sustainable magnetoresistance sensors. First, the recyclable printed MR sensors is developed based on a polyepichlorohydrin binder[2]. The hazardous MR ([Co/Cu]50) fillers are realized a close loop recycle once after the sensor lifetime. Further, we develop a healable and recyclable printed MR sensor via a full biomaterial gelatin-choline-citric acid ionogel. The additional healable capability extends the service time of the printed MR sensors and the full biomaterial binder decreased the carbon footprint. Finally, we developed a fully green printed magnetoresistance with Fe@Fe3O4 core-shell particles as functional filler, carboxymethyl cellulose as matrix binder, and water as solvents. Given that the skill-fully engineered magnetic structure and spin dependent transport, the printed sensors exhibit the remarkable low field magnetoresistance and sensitivity.

[1]Guo, L. et al., Chin. J. Struct. Chem. 44, 100428 (2025).
[2]Wang, X., Guo L. et al., J. Mater. Chem. A. 12, 24906 (2024).

MA 49.7 Thu 16:30 POT/0112

Mechanically Flexible High-Resolution Planar-Hall Effect Sensors — •Proloy Taran Das, Jan Schmidtpeter, Pavlo Makushko, Yevhen Zabila, Conrad Schubert, and Denys Makarov — Helmholtz-Zentrum Dresden-Rossendorf e.V., Institute of Ion Beam Physics and Materials Research, Bautzner Landstrasse 400, 01328 Dresden, Germany

Planar Hall effect (PHE) magnetic field sensors are attractive for applications requiring sub-nanoTesla resolution and vector field sensing [1,2]. In this presentation, we will discuss a comparative investigation of rigid and flexible PHE devices, linking their thin-film design and substrate mechanics to performance in sensitivity, linearity, and low-frequency noise. We show that flexible PHE sensors [3], fabricated as bi- and tri-layer elements on polymer substrates, maintain linear response under bending and achieve a magnetic field resolution to a few nT/*Hz at 10 Hz. The performance, rivalling that of rigid silicon-based references, is attained through careful tuning of unidirectional and uniaxial anisotropy through exchange bias, shape and growth effects and a synchronous demodulation readout. The results underscore the potential of PHE sensors for high-resolution biomagnetic sensing and robotics.

References: 1.Proloy T. Das et al. IEEE Trans. Magn. 60(9), 1-4 (2024) 2.*J. Schmidtpeter, Proloy T. Das et al. IEEE Magn. Lett. 15, 4100205 (2024) 3.*H. Nhalil et al. Appl. Phys. Lett. 123, 024102(2023)

MA 49.8 Thu 16:45 POT/0112

Probing nuclear spin dynamics in a single-atom magnet using Landau-Zener transitions — •Seunghyeok Jang[1,4], Valeria Sheina[1,3], Luciano Collazo[1,3], Georg A. Traeger[5], Denis Jankovic[1,3], Alexina Ollier[1,3], Muskan Sande[2,3], Sejong Kahng[4], Andreas Heinrich[2,3], and Won-jun Jang[1,3] — [1]Center for Quantum Nanoscience, Institute for Basic Science (IBS) — [2]Departure of Physics, Ewha Woman University — [3]Ewha Woman University — [4]Departure of Physics, Korea University — [5]Physik, Georg-August-Universitat Gottingen

Single-atom magnets provide a unique platform to probe quantum dynamics driven by hyperfine interactions. Holmium atoms on MgO thin films constitute a model system with exceptionally long-lived electronic states and well-resolved avoided level crossings, enabling electron-spin inversion via Landau-Zener (LZ) tunneling. Here, using spin-polarized scanning tunneling microscopy, we perform single-shot measurements of LZ tunneling events on 2-monolayer (ML) MgO at millikelvin temperatures, observing nuclear-spin polarization and resolving a ~10 peV gap at the avoided level crossing. We further measure the nuclear-spin lifetimes on both 2 ML and 3 ML MgO by applying LZ transitions twice in a pump-probe scheme. On 3 ML MgO, the lifetime reaches several hundred seconds, representing an enhancement of roughly two orders of magnitude compared with 2 ML. The exceptionally long nuclear-spin lifetime highlights single Ho atoms on MgO as a promising platform for quantum information processing based on coupled electron-nuclear spin states.

MA 49.9 Thu 17:00 POT/0112

Sensing Electric Currents in an a-IGZO TFT-Based Circuit Using a Quantum Diamond Microscope — •Pralekh Dubey[1], Mayana Yousuf Ali Khan[2], Lakshmi Madhuri P[3], Ashutosh Kumar Tripathi[3], Phani Kumar Peddibhotla[1], and Pydi Ganga Bahubalindruni[2] — [1]Department of Physics, Indian Institute of Science Education and Research, Bhopal — [2]Department of Electrical Engineering and Computer Science, Indian Institute of Science Education and Research, Bhopal — [3]National Centre for Flexible Electronics, Indian Institute of Technology, Kanpur

Quantum diamond microscopy (QDM), based on nitrogen-vacancy centers in diamond, provides a new approach for non-invasive magnetic imaging and diagnostics of electronic circuits under ambient conditions. By detecting magnetic fields generated by on-chip currents, QDM can probe device regions inaccessible to conventional electrical methods. It enables reconstruction of current density maps with sub-micron spatial resolution and sensitivity down to sub-microampere currents. Here, we employ a home-built QDM to map current flow in amorphous indium-gallium-zinc oxide (a-IGZO) thin-film transistor (TFT) circuits, a key technology for flexible and transparent electronics. As a demonstration, we map magnetic fields produced by current flowing through an a-IGZO TFT-based current mirror circuit. The corresponding current density was reconstructed, enabling direct visualization of current pathways. This study establishes QDM as a novel and powerful diagnostic tool for evaluating oxide-semiconductor circuits and emerging technologies.

MA 50: Bulk Materials: Soft and Hard Permanent Magnets

Time: Thursday 15:00–17:15 Location: POT/0151

MA 50.1 Thu 15:00 POT/0151

Ag-induced hardening and enhanced magnetic performance in SPS-consolidated CoCrFeMnNi high-entropy alloys — •Emmanouil Kasotakis[1], Ivan Tarasov[1], Tatiana Smoliarova[1], Hamed Shokri[2], Bilal Gökce[2], Michael Farle[1], and Natalia Shkodich[1] — [1]Faculty of Physics and Center of Nanointegration (CENIDE), University of Duisburg-Essen, Duisburg, 47057 Germany — [2]Chair of Materials Science and Additive Manufacturing, School of Mechanical Engineering and Safety Engineering, University of Wuppertal, Wuppertal, 42119 Germany

Nanocrystalline CoCrFeMnNi-Agx (x = 0; 1; 2.5; 5.5 at. %) high-entropy alloy (HEA) powders, produced via rapid two-step high-energy ball milling (HEBM) in Ar [1], were consolidated into ferromagnetic (Tc ~ 80 K) bulk samples by spark plasma sintering (SPS) at 700 K and 1000 K. Ag-free CoCrFeMnNi sintered at 1000 K formed a single-phase fcc alloy with uniform elemental distribution and a Vickers microhardness (HV0.2) of 2.4 GPa. Ag addition created distinct powder microstructures, from Ag-segregated regions (1 and 2.5 at. %) to uniform Ag distribution (5.5 at. %), increasing HV0.2 by 12% (to 2.7 GPa) in SPS-consolidated HEAs. In-field annealing (up to 700 K, 9 T) enhanced magnetization (M), coercivity (Hc), and remanence (Mr). CoCrFeMnNi-Agx (x = 5.5 at. %, 700 K) showed a tenfold rise in M (9 T, 310 K) to 40.2 Am2/kg, Hc = 46 kA/m, and Mr = 12.1 Am2/kg. We acknowledge DFG support (project ID: FA209/27-1).

[1] E. Kasotakis, et al. Acta Mater. 303, 121717 (2026).

MA 50.2 Thu 15:15 POT/0151

Transition-Metal-Induced Uniaxial Anisotropy in Fe_3Y — •M. Nur Hasan[1], Santa Pile[2], Rafael M. Vieira[1,3], Alexander Kovacs[2], Samuel RJ Holt[4], Martin Lang[4], Swapneel Pathak[4], Andrea Petrocchi[4], Hans Fangohr[4], Thomas Schrefl[2], and Heike C. Herper[1] — [1]Uppsala University, Sweden — [2]University for Continuing Education Krems, Austria — [3]Luleå University of Technology, Sweden — [4]MPSD, Hamburg, Germany

The rising demand for sustainable energy increases the need for rare-earth-free high-performance permanent magnets. The intermetallic compound Fe_3Y is a promising candidate due to its high saturation magnetization and Curie temperature. However, its intrinsic easy-plane magnetocrystalline anisotropy (MCA) hinders its use as a permanent-magnet material. Here, we combine first-principles density functional theory, spin-dynamics and micromagnetic simulations to explore mechanisms for reorienting the MCA toward a desired uniaxial direction through selective transition-metal doping. Our results show that Fe-site substitution, particularly with V, Zn, Nb, and Ta reverses the MCA to a uniaxial, reaching values up to 2 MJ/m^3, while the Curie temperature remains unaffected by these dopants. Micromagnetic simulations reveal dopant-specific hysteresis trends and indicate that the systems maintain stability in low-temperature regimes.

Acknowledgment: This work is supported by the European Union's Horizon Europe research and innovation programme under grant agreement No. 101135546 (MaMMoS).

MA 50.3 Thu 15:30 POT/0151

Magnetic imaging of interaction domains in nanocrystalline Nd-Fe-B by X-rays — P. Klassen[1], D. Günzing[2], A. Aubert[3], B. Eggert[1], T. Feggeler[2,4], •L. Kämmerer[1], G. Kämmerer[1], F. Maccari[3], J. Neethijaran[5], A. Ditter[2], D. Shapiro[2], H. Wende[1], K. Skokov[3], O. Gutfleisch[3], C. Donnelly[5], and K. Ollefs[6] — [1]Uni. Duisburg-Essen and CENIDE, GER — [2]LBNL, ALS, CA US — [3]Mat. Sc., TU Darmstadt, GER — [4]BNL, NSLS-II, NY US — [5]MPI-CPfS, Dresden, GER — [6]KIP, Uni. Heidelberg, GER

Nd-Fe-B magnets play a key role in sustainable energy conversion due to their high energy density. We provide insights into the magnetic domain structure of nanocrystalline Nd-Fe-B magnets obtained by X-ray ptychographic coherent diffractive imaging. The magnetic interaction domains of nanocrystalline Nd-Fe-B magnets with different compositions and grain structures ($Nd_2Fe_{14}B$ and $Nd_{15}Fe_{78}B_7$ melt spun ribbons and hot-deformed Nd-Fe-B from MQU-F) are shown and correlated to its microstructure. The soft X-ray imaging at the Fe L_3 edge provides detailed insights into the complex magnetic structure within the magnets, down to individual grains in the nanometer regime (10 nm). With 3D X-ray ptycho-tomography imaging we investigate the nature and local character of the domain wall in the hot-deformed Nd-Fe-B and correlate it to the microstructure in the material. Misalignment in magnetization of individueal grains from the interaction domain direction can be seen. We gratefully acknowledge funding from the DFG via the CRC/TRR 270 and used resources of the Advanced Light Source (contract no. DE-AC02-05CH11231).

MA 50.4 Thu 15:45 POT/0151

Nanoscale origins of coercivity in Cu-modified Sm(Co,Zr)6.7 alloys with globular 1:5/2:17 nanostructure — •Burcak Ekitli[1], Alex Aubert[1], Xinren Chen[2], Konstantin Skokov[1], Fernando Maccari[1], Esmaeil Adabifiroozjaei[3], Leopoldo Molina-Luna[3], Baptiste Gault[2], and Oliver Gutfleisch[1] — [1]Functional Materials, TU Darmstadt, 64287 Darmstadt, Germany — [2]Max-Planck-Institut for Sustainable Materials, 40237 Düsseldorf, Germany — [3]Advanced Electron Microscopy, TU Darmstadt, 64287 Darmstat, Germany

Sm-Co permanent magnets are commercially available in two main forms: the SmCo5 nucleation type and the more complex Sm(Co,Fe,Cu,Zr)7-7.5 (2:17-type), where coercivity is controlled by domain-wall pinning linked to a Cu concentration gradient within a cellular nanostructure. In this work, we investigate the Sm(CobalCuyZr0.023)6.7 composition to examine how Cu content affects microstructure and magnetic performance. HRSEM, TEM, and atom probe tomography reveal a previously unreported globular nanostructure, consisting of nanoscale 2:17 regions embedded in a continuous 1:5 matrix. Coercivity increases with Cu concentration and reaches up to 2 T when the Cu gradient is sufficiently strong. This underscores the superior efficiency of the cellular structure, which achieves comparable coercivity with less Cu. However the globular structure provides more stable coercivity at elevated temperatures (>700 K). These results connect microstructure and thermal stability, guiding new designs for high-temperature Sm-Co magnets.

MA 50.5 Thu 16:00 POT/0151

Unraveling the Magnetic Interactions of Nanocrystalline Rare-Earth-Lean Nd-Fe-B Powder and the Influence of Additive Manufacturing on the Magnetic Properties — •Priyatosh Sahoo[1], Lukas Schäfer[1], Kilian Schäfer[1], Franziska Scheibel[1], Esmaeil Adabifiroozjaei[1], Rebekka Hlawaty[1], Enrico Bruder[1], Philipp Gabriel[2], Anna Ziefuss[2], Stephan Barcikowski[2], Leopoldo Molina-Luna[1], Karsten Durst[1], Oliver Gutfleisch[1], and Konstantin Skokov[1] — [1]TU Darmstadt, Germany — [2]Universität Duisburg-Essen, Germany

MQP-S powder is a promising material for Laser Powder Bed Fusion (PBF-LB/M) thanks to its excellent flowability and hard magnetic properties. It shows enhanced remanence despite an isotropic microstructure, indicating exchange-spring-like behavior. However, PBF-LB/M processing fully melts the powder, erasing its initial microstructure and possibly affecting magnetic interactions. This study explores how PBF-LB/M parameters influence both density and magnetic performance in MQP-S magnets. Selected samples were characterized using Henkel and Thamm-Hesse plots, First-Order Reversal Curves (FORC) and magnetic domain imaging give insides about the global and local magnetic properties and interaction. A comparative analysis between the initial powder and the additively manufactured samples shows distinct magnetic coupling behaviors linked to the changing microstructure, providing new insights into the relationships among processing, microstructure, and properties in these magnets.

MA 50.6 Thu 16:15 POT/0151

Accelerating Sm-Fe-V Phase-Diagram Mapping via an Active-Learning Pipeline — •Aaron Dextre, Alex Aubert, Konstantin Skokov, Oliver Gutfleisch, and Pelin Tozman — Technische Universität Darmstadt

Sm1Fe12-based compounds are promising candidates to replace Nd-Fe-B, yet realizing their potential requires specific microstructures where grains are isolated by a low-melting-point phase. To locate the specific phase equilibria required for this coexistence, we developed an active-learning framework to accelerate the mapping of the Sm-Fe-V phase diagram. Integrating Neural Networks and Random Forests, our ensemble model iteratively directed the synthesis and annealing of target alloys to refine phase boundaries efficiently. After six cycles, we determined that the 1:12 phase is stable over a broader V range, while the target two-phase field is more confined than previously reported. These findings revise the Sm-Fe-V equilibria and demonstrate active learning*s utility in magnetic materials discovery.

MA 50.7 Thu 16:30 POT/0151

A new look at the magnetic properties of $DyCo_5$ — Alena Vishina[1], Konstantin Skokov[2], Hiroki Tsuchiura[3], Patrik Thunström[1], Alex Aubert[2], Oliver Gutfleisch[2], Olle Eriksson[1,4], and •Heike C. Herper[1] — [1]Uppsala University, Uppsala, Sweden — [2]Technische Universität Darmstadt, Germany — [3]Tohoku University, Sendai, Japan — [4]WISE-Wallenberg Initiative Materials Science, Uppsala University

Rare earth (RE) intermetallics such as $RECo_5$ impress with a huge variety of magnetic properties arising from the interplay of RE 4f and transition metal 3d orbitals. Our recent study provides new insights in $DyCo_5$.[1] Measurements were carried our on single crystals in applied fields up to 14T. We employed a multiscale modelling theory combining dynamical mean field theory (as implemented in the LMTO code RSPt) and atomistic spin-dynamics (UppASD) simulations with the effective spin model for RE compounds to understand the origin of the experimental findings.

Our multiscale method allows to explain the experimentally observed magnetisation anisotropy as well as the behaviour around the magnetic compensation point. For $DyCo_5$, both experiment and theory, show that the compensation is incomplete and field dependent. Furthermore, key experimental features - such as the saturation behaviour at high fields and the evolution of the magnetic moment at different temperatures - are successfully reproduced.

[1] http://arxiv.org/abs/2511.17087

MA 50.8 Thu 16:45 POT/0151

Orbital magnetic moment and magnetocrystalline anisotropy of Fe_2AlB_2 — •Nicolas Josten[1], Benedikt Eggert[1], Benedikt Beckmann[2], Anna Semisalova[1], Ralf Meckenstock[1], Konstantin Skokov[2], Hanna Pazniak[3], Thierry Ouisse[3], Katharina Ollefs[1], Heiko Wende[1], Oliver Gutfleisch[2], Michael Farle[1], and Ulf Wiedwald[1] — [1]Faculty of Physics and Center for Nanointegration (CENIDE), University Duisburg Essen, Germany — [2]Functional Materials, Institute of Materials Science, Technical University of Darmstadt, Germany — [3]LMGP, Grenoble INP, CNRS, Université Grenoble Alpes, France

Fe_2AlB_2 is a ferromagnet known for its considerably high magnetocrystalline anisotropy (1 MJ·m^{-3} at 10 K [1]), tunable Curie-temperature around ambient temperature (stoichiometric $T_C = 291$ K [1]) and magnetocaloric effect of moderate size ($\Delta T_{ad}(2\ T) = 2.2$ K [2]). It can be easily synthesized out of earth-abundant and low-cost elements. Here we combine X-ray magnetic circular dichroism (XMCD) and ferromagnetic resonance (FMR) measurements on single crystals to determine the orbital moment and correlate it with the high magnetocrystalline anisotropy. Additional magnetometry measurements along the principal crystallographic directions show the development of anisotropy across the ferromagnetic to paramagnetic phase transition.

Funded by the Deutsche Forschungsgemeinschaft (DFG, German

Research Foundation) – Project-ID 405553726 – SFB/TRR 270.

[1] N. Josten et al. Phys. Rev. Materials 9, 054405 (2025)
[2] B. Beckmann et al. J. Appl. Phys. 133, 173903 (2023)

MA 50.9 Thu 17:00 POT/0151

Enabling Ce Substitution in Nd-Fe-B Magnets for Wind Turbines via the 2-Powder Method — •Chi-Chia Lin[1,2], Konrad Opelt[1], Abdullatif Durgun[2], Imants Dirba[2], and Oliver Gutfleisch[2] — [1]Fraunhofer IWKS, Hanau, Germany — [2]TU Darmstadt, Darmstadt, Germany

Wind turbines contain Nd-Fe-B magnets weighing up to several tonnes. As deployment accelerates, demand for Nd rises, increasing supply risk and cost. Ce substitution can reduce critical-RE usage but degrades performance due to inferior intrinsic properties of $Ce_2Fe_{14}B$, formation of detrimental phases, and microstructural degradation.

We present a 2-powder method (2PM) enabling substantial Ce substitution without geometry constraints. A coarser (Ce,Nd)-Fe-B main powder is blended with a finer Nd-Fe-B powder and conventionally sintered, producing a uniform core-shell structure in which Nd-enriched shells magnetically harden $RE_2Fe_{14}B$ grain surfaces. Relative to single-powder processing at identical overall composition, 2PM boosts coercivity, remanence, and energy product by increasing local anisotropy fields at grain surfaces and optimizing grain-boundary chemistry. In addition, we introduce a hybrid segmented magnet that positions the 2PM Ce-substituted segment between Nd-Fe-B segments, extending local magnetic hardening to a bulk macroscopic effect and enhancing demagnetization resistance while concentrating Nd only where peak coercivity is required.

Together, 2PM and hybrid segmentation offer a scalable route to thrift Nd with abundant Ce toward wind-turbine performance targets.

MA 51: Spin Transport and Orbitronics, Spin-Hall Effects II (joint session MA/TT)

Time: Thursday 15:00–17:00 Location: POT/0361

MA 51.1 Thu 15:00 POT/0361

Spin-pumping and induced magnetic polarization in permalloy/platinum heterostructures — •Verena Ney[1], Kilian Lenz[2], Fabrice Wilhelm[3], René Hübner[2], Fabian Ganss[2], Andrei Rogalev[3], Jürgen Lindner[2], and Andreas Ney[1] — [1]Johannes Kepler Universität Linz, Österreich — [2]Helmholtz Zentrum Dresden-Rossendorf, Deutschland — [3]ESRF, Grenoble, Frankreich

Spin pumping is the transfer of angular momentum across interfaces into a non-ferromagnetic material driven by the precessing magnetization of an adjacent ferromagnet. Using ferromagnetic resonance (FMR) the presence of spin pumping can be evidenced by an increase of the Gilbert damping parameter α [1]. Here we study platinum-permalloy (Pt/Py) heterostructures using temperature-dependent broadband FMR. A clear increase of α is seen in a temperature range from 10 to 300 K when Pt and Py are in direct contact. The temperature dependence of the spin-pumping contribution can be derived by comparing with an Al-sandwiched Py reference film from [2]. Surprisingly, upon insertion of a thin Al spacer layer between Pt and Py the increase in α is suppressed. X-ray magnetic circular dichroism at the Pt L_3-edge reveals a clear magnetic polarization in Pt/Py whereas it is absent when a spacer layer of only 2 nm of Al is inserted. The induced polarization of Pt can thus be associated with spin pumping, while non-polarized Pt in proximity to Py shows an almost identical $\alpha(T)$ behavior as the Py reference sample in [2].

[1] Y. Tserkovnyak Phys. Rev. Lett. **88**, 117601 (2002)
[2] V. Ney et al. Phys. Rev. Materials **7**, 124403 (2023)

MA 51.2 Thu 15:15 POT/0361

Single and double spin Hall anomalous Hall and Hanle effects in Pt/YIG and Ta/YIG bilayers — •Akashdeep Akashdeep, Duc Minh Tran, Mathias Kläui, Gerhard Jakob, and Timo Kuschel — Johannes Gutenberg University Mainz, Germany

Anomalous Hall effect data of heavy metal / magnetic insulator bilayers, such as Pt/$Y_3Fe_5O_{12}$ (YIG), are commonly explained by magnetoresistance effects that are quadratically depending on the spin Hall angle (SHA) [1-4]. This is because they usually consist of two spin Hall processes as for example valid for spin Hall magnetoresistance [1,2]. In addition, S. Zhang et al. predicted theoretically a single spin Hall process combined with interfacial spin-dependent scattering which results in a linear SHA dependence [5] not reported experimentally so far.
In this contribution, we present anomalous Hall effect results for Pt/YIG and Ta/YIG with opposite sign in SHA of Pt and Ta. Thus, we can probe even and odd SHA dependencies. For thin Pt and Ta thicknesses, we observe results that are even in the SHA which is consistent with experimental literature. However, we found an odd SHA dependence for thicker heavy metal layers which is only partially mentioned in theory. We will present the separation of the effects and discuss the impact of the SHA on the individual effect contributions.

[1] H. Nakayama et al., Phys. Rev. Lett. 110, 206601 (2013)
[2] S. Meyer et al., Appl. Phys. Lett. 106, 132402 (2015)
[3] S. Vélez et al., Phys. Rev. Lett. 116, 016603 (2016)
[4] J. Li et al., Phys. Rev. B 106, 184420 (2022)
[5] S. S.-L. Zhang, G. Vignale, Phys. Rev. Lett. 116, 136601 (2016)

MA 51.3 Thu 15:30 POT/0361

Current-induced spin and orbital polarization in the ferroelectric Rashba semiconductor GeTe — •Sergio Leiva-Montecinos[1], Libor Vojácek[2], Jing Li[2], Mairbek Chshiev[2], Laurent Vila[2], Ingrid Mertig[1], and Annika Johansson[3] — [1]Martin-Luther-Universität Halle-Wittenberg, Germany — [2]Univ. Grenoble Alpes, CEA, CNRS, Grenoble, France — [3]Max Planck Institute of Microstructure Physics, Halle (Saale), Germany

The Edelstein effect is a promising mechanism for generating spin and orbital polarization from charge currents in systems without inversion symmetry. In ferroelectric materials, such as Germanium Telluride (GeTe), the combination of bulk Rashba splitting and voltage-controlled ferroelectric polarization provides a pathway for electrical control of the sign of the charge-spin conversion [1, 2].

In this work [3], we investigate current-induced spin and orbital magnetization in bulk GeTe using Wannier-based tight-binding models derived from *ab initio* calculations and semiclassical Boltzmann theory. Employing the modern theory of orbital magnetization, we demonstrate that the orbital Edelstein effect surpases its spin counterpart by one order of magnitude. Moreover, the orbital Edelstein effect remains largely unaffected in the absence of spin-orbit coupling, highlighting its distinct physical origin compared to the spin Edelstein effect.

[1] D. Di Sante *et al.*, Adv. Mater. **25**, 509 (2012).
[2] C. Rinaldi *et al.*, Nano Lett. **18**, 2751 (2018).
[3] S. Leiva-Montecinos *et al.*, arXiv:2505.21340 (2025).

MA 51.4 Thu 15:45 POT/0361

Orbital contribution to g-tensor from first-principles modern theory — •Garima Ahuja[1], Mirco Sastges[2,3], Dongwook Go[4], Shobhana Narasimhan[1], Yuriy Mokrousov[2,3], and Stefan Blügel[2,5] — [1]Theoretical Sciences Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India — [2]Peter Grünberg Institut, Forschungszentrum Jülich and JARA, Jülich, Germany — [3]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [4]Department of Physics, Korea University, Seoul, South Korea — [5]Institute for Theoretical Physics, RWTH Aachen University, Aachen, Germany

The electronic g-factor, which measures how angular momentum couples to magnetic fields, is a key descriptor of magnetic behavior in solids. In crystalline materials, the orbital contribution to the g-factor can significantly modify its value. In this talk, we present a first-principles framework for computing g-factors, based on multiband perturbation theory with the DFT-Wannier approach, to reveal microscopic origins of the orbital contribution, highlighting the roles of local and non-local orbital currents. We resolve both orbital and spin responses, determine the full g-tensor, and show how interband couplings and band geometry shape the g-tensor across the Brillouin zone. g-tensor plays a key role in quantum technologies, where qubit coherence and control depend on accurate knowledge of magnetic response. We present our findings for some interesting bulk and 2D systems, offering a predictive route for engineering magnetic responses in materials relevant to quantum computing, spin-orbitronics, and spectroscopy.

MA 51.5 Thu 16:00 POT/0361

Inherent Electro-Optic Kerr Rotation — •Erlend Syljuåsen[1], Alireza Qaiumzadeh[1], Rembert Duine[2,3], and Arne Brataas[1]

— [1]Center for Quantum Spintronics,Trondheim, Norway — [2]Institute for Theoretical Physics, Utrecht University, The Netherlands — [3]Department of Applied Physics, Eindhoven University of Technology, The Netherlands

Static electric-field–induced Kerr rotation of reflected light is used to probe symmetry breaking, electronic properties, and transport phenomena as the spin and orbital Hall effects. In this talk, we uncover a previously overlooked contribution to the electric-field–induced Kerr rotation, arising from the interplay of matter, the static electric field, and the magnetic component of light. This contribution remains nonzero even in isotropic nonmagnetic homogeneous materials, making this effect inherent to any such Kerr measurement. We present analytical expressions for both two-dimensional layers and semi-infinite bulk metals, and find within the relaxation-time approximation signal magnitudes directly relevant for experiments.

MA 51.6 Thu 16:15 POT/0361

Thermally Activated Spin Transport in a Multiferroic $LiCu_2O_2$/Pt Heterostructure — •Mathew James, Ankita Nayak, István Kézsmárki, and Aisha Aqeel — University of Augsburg, 86159 Augsburg, Germany

Multiferroics, in which electric and magnetic orders are coupled, are potential materials for low-power spintronic devices. $LiCu_2O_2$ is a Type II multiferroic material known to exhibit spiral (noncollinear) spin ordering below its antiferromagnetic transition temperature, $T_N \approx 23$ K [1]. In this material, the magnetic Cu^{2+} ions form double chains along the crystallographic b-axis, resulting in a double-leg spin-ladder configuration.

In this study, we use the Spin Seebeck Effect (SSE) as an electric probe to investigate the thermally activated magnetic response of $LiCu_2O_2$ across different magnetic configurations. In the SSE, a temperature gradient across a magnetic insulator generates non-equilibrium magnons that carry a spin current. This spin current is converted into a measurable voltage in a heavy-metal layer deposited on top of the insulator, via the Inverse Spin Hall Effect [2]. Our preliminary results indicate that the SSE voltage is sensitive to the spiral ordering in $LiCu_2O_2$. References: [1]S. Park, et al., Phys. Rev. Lett., 98, 5 (2007). [2]K. Uchida et al., Nature, vol. 455, no. 7214, (2008).

MA 51.7 Thu 16:30 POT/0361

Current-induced orbital dynamics in magnetic oxides — •Mahmoud Zeer[1], Marjana Ležaic[1], Dongwook Go[1,2], Leonid Pourovskii[3], Stefan Blügel[1,4], Mathias Kläui[2], Olena Gomonay[2], and Yuriy Mokrousov[1,2] — [1]Peter Grünberg Institute, Forschungszentrum Jülich, 52425 Jülich, Germany — [2]Institute of Physics, Johannes Gutenberg-University Mainz, 55099 Mainz, Germany — [3]CPHT, CNRS, École polytechnique, Institut Polytechnique de Paris, 91120 Palaiseau, France — [4]Institute of Theoretical Physics, RWTH Aachen University, 52074 Aachen, Germany

Magnetic oxides provide an ideal platform for exploring orbital degrees of freedom emerging from strong orbital angular momentum and spin-orbit coupling. The resulting unquenched orbital moments enable rich orbital-transport phenomena, particularly in antiferromagnetic systems. In this work, we investigate current-induced orbital dynamics in representative transition-metal oxides using first-principles calculations in both bulk and thin-film geometries. We identify sizable orbital response and highly efficient orbital-to-spin conversion mechanisms, which give rise to substantial torque components on the magnetic sublattices [1]. In addition, we analyze the contributions of dipole, quadrupole, and octupole magnetic moments to the overall orbital response. Our findings establish magnetic oxides as a promising and realistic platform for harnessing orbital degrees of freedom for next-generation spin-orbital technologies. [1] S. Krishnia, C. Schmitt, M. Zeer et al., under review.

MA 51.8 Thu 16:45 POT/0361

Disentangling angular momentum transport in ferromagnet-diamagnet structures via suspended systems — •Fiona Sosa Barth[1,2], Matthias Grammer[1,2], Richard Schlitz[3], Tobias Wimmer[1,2], Janine Gückelhorn[1,2], Luis Flacke[1,2], Sebastian T.B. Goennenwein[3], Rudolf Gross[1,2,4], Hans Huebl[1,2,4], Akashdeep Kamra[5], and Matthias Althammer[1,2] — [1]Walther-Meißner-Institut, BAdW, Garching, Germany — [2]School of Natural Sciences, TUM, Garching, Germany — [3]Department of Physics, University of Konstanz, Konstanz, Germany — [4]Munich Center for Quantum Science and Technology, München, Germany — [5]RPTU Kaiserslautern-Landau, Kaiserslautern, Germany

Spintronics relies on the transfer of angular momentum between electrons and solid state excitations such as magnons and phonons. In our recent work, we demonstrate angular momentum transfer between two ferromagnetic strips on diamagnetic substrates [1]. A DC current on one of the strips is converted into a non-equilibrium magnon accumulation, which transfers angular momentum to the magnonic system of the second FM strip, detected electrically by the inverse processes. In this work, we investigate how the nature of this angular momentum transport is affected by the substrate. We first examine how SiOx, SiN and SiN/SiOx layers on Si substrates impact the transport response, and then study the effect in freestanding ferromagnetic strips fully decoupled from the substrate. This allows us to separate potential dipolar from phononic contributions to the coupling between the FM strips. [1] R. Schlitz et al., Phys. Rev. Lett. 132, 256701 (2024)

MA 52: Poster Magnetism III

Time: Thursday 15:00–17:00 Location: P4

MA 52.1 Thu 15:00 P4

Coupling between spin waves and excitons in CrSBr bilayers — •Luis Rolf Gieselmann, Thorsten Deilmann, and Michael Rohlfing — Institute of Solid State Theory, University of Münster, Germany

CrSBr is a layered van der Waals semiconductor characterized by its peculiar magnetic structure, possessing ferromagnetic ordering within and antiferromagnetic ordering between its layers.

The antiparallel alignment of spins in neighboring layers directly affects the excitonic properties of the material, as interlayer transitions of electrons and holes are thus optically forbidden in the magnetic ground state. External manipulation of the spins, however, produces partially parallel alignments between layers and thus enables excitations of interlayer excitons.

Such excitonic effects have previously been studied for canting by an external magnetic field. In our work, we have considered an alternative, namely canting of the spins induced by spin waves within CrSBr bilayers. The spin wave behavior of the material is studied using coherent states and then employed in a simple model Hamiltonian to calculate the change of excitonic energies.

MA 52.2 Thu 15:00 P4

Holstein-Primakoff Expansions and the Goldstone Theorem for Ferromagnetic Spin Chains — •Hendrik Wächter, Fred Hucht, and Jürgen König — University of Duisburg-Essen, Faculty of Physics, Duisburg, Germany

A common approach to investigate collective magnetic excitations is to represent spins as bosons. A popular representation that achieves this is the Holstein-Primakoff transformation, which comes at the cost of introducing square roots containing the occupation number operator to the spin ladder operators. For many applications, it is preferable to expand these square roots in power series. Typically, this is done by a Taylor series expansion in powers of $1/S$, sacrificing essential virtues of the Holstein-Primakoff transformation by coupling to an unphysical Hilbert space. We consider Newton series expansions as an alternative [1]. Ferromagnetic spin chains are used to compare the efficacy of both expansions, focusing on ground-state and low-energy excitation properties, notably including Goldstone modes. Matrix product states and the density-matrix renormalization group method are used to obtain highly accurate numerical results. We find that the Newton series expansion up to a finite order respects the existence of gapless spin excitations within the relevant Hilbert space.

[1] J. König and A. Hucht, SciPost Phys. **10**, 007 (2021)

MA 52.3 Thu 15:00 P4

Local Spin Seebeck Effect in Hematite — •Florian Kraft[1], Maximilian Thiel[1], Katharina Lasinger[1,2], Matthias R.

Schweizer[1], and Mathias Weiler[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern-Landau, Germany — [2]Clarendon Laboratory, Department of Physics, University of Oxford, United Kingdom

Antiferromagnets such as hematite (α-Fe_2O_3) are key candidates for spintronic and magnonic devices due to their ultra-low magnetic damping and vanishing stray fields. However, the inherent compensation of magnetic moments makes probing the magnetic order challenging.
We employ the Local Spin Seebeck Effect (LSSE), generated by focused laser heating of an α-Fe_2O_3/Pt bilayer, to spatially resolve thermal spin currents. Our measurements are performed at room temperature, where hematite orders in a weak ferromagnetic state, characterized by an intrinsic net magnetization (**m**). In our r-cut single crystal, the crystallographic c-axis is obliquely aligned relative to the surface plane, thus enabling us to vary the in-plane and oblique components of **m** and the Néel vector **n** by rotating the external magnetic field.
The local heat-to-spin conversion mechanism is analyzed through the field and field-angle dependence of the LSSE signal. We place particular emphasis on alignments close to the in-plane projection of the c-axis, as this direction maximizes the competition between the magnetic field and intrinsic anisotropies. Resolving the contributions of the in-plane and oblique components of **m** and **n** is critical for understanding magnon transport in complex antiferromagnetic systems.

MA 52.4 Thu 15:00 P4

Entanglement and Dissipation in Quantum Spin Systems — •Jakob Wagner, Daniel K. J. Boness, and Wolfgang Belzig — Department of Physics, University of Konstanz, D-78457 Konstanz, Germany

Squeezing in quantum systems allows the reduction of quantum fluctuations in one observable of interest at the cost of enhanced uncertainty in its conjugate. Spin systems common in magnonics naturally exhibit squeezing [1, 2]. Generally, dissipation changes the amount of squeezing, possibly also amplifying it [3, 4]. Here, we relate the effects of dissipation in spin systems to linearized bosonic systems. We extend previous considerations by assuming a general linear system-bath coupling. Associating the position coordinate of the bosonic system with spin fluctuations in one direction, as well as the momentum coordinate with the orthogonal direction we demonstrate the equivalence of the Landau-Lifschitz-Gilbert equation to an unconventionally damped harmonic oscillator. We demonstrate several coupling dependent effects like control of the squeezing direction and modified entanglement properties. Our results thus give new controls over decoherence in magnonic systems via engineered dissipation.

[1] A. Kamra et al, Phys. Rev. B 100, 174407 (2019)
[2] D. Wuhrer et al, Appl. Phys. Lett. 125, 022404 (2024)
[3] G. Rastelli, New. J. Phys. 18, 053033 (2016)
[4] H. Y. Yuan et al, Phys. Rev. B 106, 224422 (2022)

MA 52.5 Thu 15:00 P4

Silicon ion implantation of YIG thin films for magnonics — •Richa Bhardwaj[1], Jannis Bensmann[1], Robert Schmidt[1], Kirill O. Nikolaev[2], Dimitri Raskhodchikov[1], Shraddha Choudhary[1], Shabnam Taheriniya[3,4], Sven Niehues[1], Akhil Varri[1,3], Ahmad El Kadri[1], Johannes Kern[1], Wolfram H. P. Pernice[1,3,4], Sergej O. Demokritov[2], Vladislav E. Demidov[2], Steffen Michaelis de Vasconcellos[1], and Rudolf Bratschitsch[1] — [1]Institute of Physics and Center for Nanotechnology(CeNTech), UniversityofMünster — [2]InstituteofAp- plied Physics, University of Münster — [3]Center for Soft Nanoscience, University of Münster — [4]Kirchhoff-Institute for Physics, Heidelberg University

Magnons hold the promise for novel computing architectures due to their low power consumption. Recently, magnonic YG waveguides have been demonstrated using a maskless silicon ion-implantation technique [1]. Here, we examine how silicon ion implantation modifies the structural, optical, and magneto-optical properties of YIG thin films. Our findings establish design guidelines for YIG improved spin-wave manipulation for magnonic integrated circuits. Reference: [1] J. Bensmann, et al., Nat. Mater. 24, 1920-1926 (2025).

MA 52.6 Thu 15:00 P4

Linear Spin Wave Theory for Resonant Inelastic X-ray Scattering — •Paul Hille and Maurits W. Haverkort — Institute for Theoretical Physics, Heidelberg University, 69120 Heidelberg

Magnon excitations provide a key window into the collective magnetic behavior of correlated materials. While inelastic neutron scattering (INS) has long been the standard technique to map magnon dispersion relations and intensities, in recent years, resonant inelastic X-ray scattering (RIXS) has grown into a complementary technique to measure dispersing magnetic excitations. Within the RIXS process one can not only excite single magnons but also multiple magnetic excitations with a single photon.

The central goal of this work is to extend existing linear spin wave theory (LSWT) routines for INS to handle multi-magnon excitations characteristic of RIXS spectra. This is combined with an effective RIXS scattering operator incorporating the resonant energy and light polarisation dependence. We obtain a general and extensible computational framework that enables RIXS modeling for realistic magnetic materials within LSWT. Furthermore, quantitative comparison with experimental RIXS data enables assessment of the validity of treating magnons as non-interacting quasiparticles.

MA 52.7 Thu 15:00 P4

Electric Control of Magnon Phase via the Aharonov–Casher Effect — •Gabriel Schwöbel[1], Rostyslav O. Serha[2], Matthias R. Schweitzer[1], Vitaliy I. Vasyuchka[1], Mathias Weiler[1], Burkard Hillebrands[1], and Aleksander A. Serga[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern-Landau, Kaiserslautern, Germany — [2]Faculty of Physics, University of Vienna, Vienna, Austria

A promising approach toward nonreciprocal magnon phase manipulation is offered by the Aharonov–Casher effect—a mechanism whereby particles or quasiparticles with a magnetic moment acquire an additional phase when traveling through an electric field. While this effect has been theoretically predicted for magnons, direct experimental confirmation is still lacking. Additionally, electric fields also influence magnetic systems through the magnetoelectric effect by modifying the magnetization.

Our experiments demonstrate that the Aharonov–Casher effect and magnetoelectric contributions can be independently quantified and unambiguously distinguished. By applying an in-plane electric field to a perpendicularly magnetized YIG film, we achieve controlled manipulation of the phase of the forward-volume magnetostatic spin waves. The resulting phase shifts depend on both the propagation direction and the polarity of the applied electric field, demonstrating electric-field tunability of magnon transport and offering a pathway toward nonreciprocal phase control in magnonic systems.

MA 52.8 Thu 15:00 P4

Femtosecond noise correlation spectroscopy of magnon fluctuations in bismuth doped yttrium iron garnet — •C. Runge[1], F. S. Herbst[1], M. A. Weiss[1], N. Beaulieu[2], J. B. Youssef[2], A. Leitenstorfer[1], M. Lammel[1], R. Schlitz[1], and S. T. B. Goennenwein[1] — [1]Department of Physics, University of Konstanz, Germany — [2]LabSTICC, CNRS, Université de Bretagne Occidentale, France

Magnetic systems exhibit a rich variety of dynamic phenomena on ultrafast timescales, which are of both fundamental and technological interest. For example, magnons, the quanta of spin waves, are discussed as promising candidates for information carriers due to their ability to propagate without charge transport. Femtosecond noise correlation spectroscopy (FemNoC) has been established [1] as a time-resolved optical technique that directly probes the local magnetization correlation function of a spin system. Thus, FemNoC is sensitive to incoherent magnetization dynamics like thermal magnons or random telegraph switching in the anisotropy landscape and allows to distinguish them by their respective correlation characteristics [1]. Here, we apply FemNoC to bismuth doped yttrium iron garnet. We investigate the magnon population of the sample both in thermal equilibrium and excited by ferromagnetic resonance. Introducing a quantitative model we can fit both regimes and determine the number of magnons induced by the resonant drive.

[1] M. A. Weiss et al., Nat. Commun. **14**, 7651 (2023).

MA 52.9 Thu 15:00 P4

Active noise spectroscopy of magnon-photon polaritons — •Lars Nikolas Hess, Philipp Schwenke, Vitaliy Vasyuchka, Kevin Künstle, and Mathias Weiler — Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau, 67663 Kaiserslautern, Germany

Microwave (MW) cavities offer a wide range of applications for exciting ferromagnetic resonance (FMR) in solid-state magnets [1]. Due to the interaction of resonant MW photons with the magnonic excitations of a magnetic sample, their coupling behaviour can be studied in detail [2]. In this study, we use a MW cavity designed to operate in the frequency range from 500 MHz to 600 MHz to investigate the thermally excited MW photons and their coupling to magnons in the ferrimagnetic insulator $Y_3Fe_5O_{12}$ (YIG). To this end, a 2 *m thick YIG film is positioned inside the cavity. The resonant coupling between the MW photons and the YIG FMR is realised. An active feedback loop inspired by a similar setup for surface acoustic wave resonators [3] is implemented to specifically amplify the thermal photons in the MW cavity, that couple to the magnetic excitations in YIG. The resonator used in combination with the active amplification process makes it possible to determine characteristic parameters of the coupled systems without the use of an external MW source.

[1] H.Huebl *et. al*, Phys. Rev. Lett. **111**, 127003 (2013)
[2] L.Liensberger *et. al*, Phys. Rev. B **104**, L100415 (2021)
[3] Z.Xi *et. al*, Phys. Rev. App. **23**, 024054 (2025)

MA 52.10 Thu 15:00 P4

Low-temperature-compatible iron garnet films grown by liquid phase epitaxy — Jamal Ben Youssef[1], Nathan Beaulieu[1], Richard Schlitz[2], Davit Petrosyan[3], •Michaela Lammel[2], and William Legrand[4] — [1]LabSTICC-CNRS, Université Bretagne Occidentale, Brest — [2]Department of Physics, University of Konstanz, Konstanz — [3]Department of Materials, ETH Zurich, Zurich — [4]CNRS, Institute Néel, Université Grenoble Alps, Grenoble

Integrating thin epitaxial yttrium iron garnet (YIG) - one of the prototypical material systems in the field of magnonics, owing to its record-low damping of the magnetization dynamics - into hybrid (quantum) systems promises a platform to study the interaction of magnons with other (quasi)particles. However, up to now the usability of YIG in such devices is limited due to the losses occurring at low temperatures due to the paramagnetic gadolinium gallium garnet (GGG) substrate, and eventually Gd intermixing in the first layers. To circumvent this problem, we use liquid phase epitaxy (LPE) to grow ultrathin films of strained YIG on a commercial diamagnetic substrate, yttrium scandium gallium garnet (YSGG) [arXiv:2509.06242]. We investigate their magnetization dynamics between 3 K and 300 K, and compare them to films grown on paramagnetic GGG. We demonstrate that our LPE YIG on YSGG substrates features a ferromagnetic resonance linewidth below 1 mT at 3 K, together with a very weak temperature and frequency dependence of the losses. Therewith, the growth of YIG/YSGG by LPE provides a straightforward approach for the fabrication of YIG thin films for low-temperature investigations.

MA 52.11 Thu 15:00 P4

Magnetoacoustic interaction in Yttrium-Iron-Garnet / Aluminium-Scandium-Nitride heterostructures — •Kaya Gauch[1], Kevin Künstle[1], Yannik Kunz[1], Agne Žukauskaite[2,3], Stephan Barth[2], and Mathias Weiler[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzisch Tech nische Universität Kaiserslautern-Landau, 67663 Kaiserslautern, Germany — [2]Fraunhoferr Institute for Electron Beam und Plasma Technology FEP, 01277 Dresden, Germany — [3]Institute of Solid State Electronics, Technische Universität Dresden, 01062 Dresden, Germany

The magnetoelastic interaction between surface acoustic waves (SAWs) and spin waves (SWs) has attracted considerable attention in recent years. Magnetoelastic excitation of SWs is particularly promising in low-damping ferrimagnets such as yttrium iron garnet (YIG). Electri cal excitation of SAWs necessitates a piezoelectric layer, such as ZnO [1]. Here, we investigate magnetoelastic interactions in a heterostruc ture consisting of a YIG/GGG bilayer coated with a piezoelectric AlScN thin film. The coupling between SAWs and SWs is characterized using micro-focused Brillouin light scattering (BLS) spectroscopy and vector network analyzer (VNA) measurements. In addition, the ob served magnetoelastic interaction is benchmarked against the coupling in the more established ZnO/YIG/GGG heterostructure. [1] Ryburn et al., Phys. Rev. Appl. 23, 034062 (2025)

MA 52.12 Thu 15:00 P4

Distinctive Propagation of Phonon-mediated Magnons in YIG/GGG — •Youngseon Soon[1], Moojune Song[1], Phuoc Cao Van[2], Jinhyun Baek[1], Byong-Guk Park[3], Jong-Ryul Jeong[2], Albert Min Gyu Park[1], and Kab-Jin Kim[1] — [1]Department of Physics, Korea Advanced Institute of Science and Technology, Daejeon 34141, Republic of Korea — [2]Department of Materials Science and Engineering, Chungnam National University, Daejeon 34134, Republic of Korea — [3]Department of Materials Science and Engineering, Korea Advanced Institute of Science and Technology, Daejeon 34141, Republic of Korea

Magnonic systems enable information processing via collective spin excitations and couple efficiently to other quasiparticles. We study magnetostatic surface spin waves (MSSWs) coupled to standing acoustic waves in a 200-nm YIG film on GGG. Using two microwave antennas and VNA measurement, we observe 3.5 MHz periodic modulation in transmission spectra arising from magnetoelastic interaction. As the magnon wave vector k increases, these phononic signatures weaken and eventually vanish, reflecting both the k-dependence of the coupling and the momentum selectivity of antennas. Phonon-mediated magnon modes emerge at lower frequencies than directly excited MSSWs and propagate much farther, providing a low-k channel for long-distance spin-wave transport without acoustic resonators. These distinctive features highlight the wavevector-dependent magnon-phonon hybridization and demonstrate that both coupling strength and propagation behavior can be engineered through excitation geometry.

MA 52.13 Thu 15:00 P4

Broadband Floating-Electrode SAW Transducers for Magnetoelastic Spin-Wave Excitation in CoFeB thin films — •Kawa Noman[1], Ryusuke Hisatomi[2], Kotaro Taga[2], Teruo Ono[2], Vitaliy Vasyuchka[1], and Mathias Weiler[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau, 67663 Kaiserslautern, Germany — [2]Kyoto University, Institute for Chemical Research,Kyoto,Japan

Microwave filters based on surface acoustic wave (SAW) devices exhibit low insertion loss and enable wideband operation in the GHz range. In this study, we microfabricate custom-designed floating-electrode in terdigital transducers (FE-IDTs) on piezoelectric LiNbO3 substrates, whose unique geometry with additional electrically floating metal fin gers enhances electromechanical coupling and broadband SAW exci tation [1]. We then deposit a 10 nm CoFeB thin film by DC mag netron sputtering within the SAW propagation path. We investigate the magnetic-field dependence of the SAW-driven magnetoelastic spin-wave resonance using vector network analysis. Systematic variation of the electrode material, aperture, and duty cycle reveals a rich spec trum of high-amplitude Rayleigh modes at odd and even harmonics of FE-IDT excitation. Moreover, we observe clear signatures of SAW-driven magnetoelastic excitation of spin-waves in CoFeB. High-amplitude SAWs enable non linear magnon generation [2].

[1] K. Yamanouchi et al., IEEE Ultrasonics Symposium (2013)
[2] M. Geilen et al., Applied Physics Letters 120, 242404 (2022)

MA 52.14 Thu 15:00 P4

Backward volume spin waves in ion-implanted magnonic YIG waveguides — •Sven Niehues[1], Jannis Bensmann[1], Robert Schmidt[1], Kirill O. Nikolaev[2], Dimitri Raskhodchikov[1], Shraddha Choudhary[1], Richa Bhardwaj[1], Shabnam Taheriniya[1,3,4], Akhil Varri[1,3], Ahmad El Kadri[1], Johannes Kern[1], Wolfram H. P. Pernice[1,3,4], Sergej O. Demokritov[2], Vladislav E. Demidov[2], Steffen Michaelis de Vasconcellos[1], and Rudolf Bratschitsch[1] — [1]Institute of Physics and Center for Nanotechnology (CeNTech), University of Münster — [2]Institute of Applied Physics, University of Münster — [3]Center for Soft Nanoscience, University of Münster — [4]Kirchhoff-Institute for Physics, Heidelberg University

Magnonics offers a promising alternative approach to conventional information processing due to the low-energy nature of spin waves and distinctive features such as nm-scale wavelengths. Recently, the fabrication of dispersion-tunable magnonic waveguides and a large-scale spin-wave network with 198 crossings have been demonstrated using a newly developed maskless silicon ion implantation technique [1]. Here, we show that backward volume spin waves (BVSW) propagate in silicon-ion implanted waveguides written into YIG thin films. Using time-resolved Faraday rotation spectroscopy, we extract the dispersion relation, the mode profile and damping of the BVSWs. Our results demonstrate the versatility of silicon-ion implanted magnonic waveguides, offering a promising route toward magnonic integrated circuits. Reference: [1] J. Bensmann, et al. Nat. Mat. 24, 1920-1926 (2025).

MA 52.15 Thu 15:00 P4

Quantum Geometry of Magnons — •Sidhartha Chatterjee[1], Andreas Haller[1], Peter P. Orth[2], and Thomas L. Schmidt[1] — [1]University of Luxembourg — [2]Saarland University

We develop a theoretical framework for magnon dynamics in a one-dimensional antiferromagnetic Heisenberg chain that includes next-nearest-neighbour Dzyaloshinskii-Moriya interaction (DMI) and a position-dependent magnetic field applied along the easy axis. This combination leads to a spin spiral ground state. The collective excitations above the ground state are magnons, spin-1 bosonic modes. We perform the Holstein-Primakoff transformation to obtain the magnon Hamiltonian, which is quadratic in nature. For the diagonalisation, we use the Bogoliubov transformation, and we show that the quantum geometric tensor of magnons naturally exhibits symplectic structure. This geometric structure yields corrections to the semiclassical equations of motion for magnon wave packets, resulting in anomalous velocity terms and metric-driven contributions. Overall, the framework provides a systematic route for incorporating geometric effects and symplectic structure into magnon dynamics, where no particle number conserving framework exists, and offers a pathway for engineering transport phenomena in magnetic materials through the direct manipulation of the quantum geometry of their collective excitations.

MA 52.16 Thu 15:00 P4

Impact of Magnetic Ground State on the Generation of an All-Magnonic Frequency Comb — •Alexandra Schrader, Chris Körner, Rouven Dreyer, and Georg Woltersdorf — Martin Luther University Halle-Wittenberg

We have observed the emergence of a magnonic frequency comb in extended Permalloy films as well as in microstructures of Permalloy and CoFeB. Since the frequency comb generation appears to be a unique feature of softmagnetic materials at very low bias fields (below 2 mT), we anticipate a strong correlation between the static ground state and the emerging dynamics. In the case of microstructures, the higher harmonic generation is indeed connected to the non-uniform domain structure at the edges.

However, the presence of these edge effects reduces the frequency multiplication efficiency. In this work, stripes of different aspect ratios are investigated to bridge the gap between extended layers and microstructures. This allows to explore the correlation between the static magnetization pattern obtained in Kerr microscopy and the generation of the frequency comb revealed via SNS-MOKE and NV-center microscopy. Both static and dynamic features are complemented by micromagnetic simulations.

MA 52.17 Thu 15:00 P4

Surface Acoustic Wave Generation and Detection in AlScN/GGG Heterostructures — •Karl Heimrich[1], Seth Kurfman[1], Frank Heyroth[2], Katrin Lehmann[2], Fabian Lofink[3], and Georg Schmidt[1,2] — [1]Martin Luther Universität Halle-Wittenberg Institut für Physik, Halle, Germany — [2]Interdisziplinäres Zentrum für Materialwissenschaften, Halle, Germany — [3]Frauenhofer ISIT, Itzehoe, Germany

Surface acoustic waves (SAWs) can be excited and detected in piezoelectric materials using interdigitated transducers (IDTs). In magnetostrictive materials, particularly with low-loss magnetic properties (e.g. Yttrium-Iron-Garnet, YIG), the coupling between SAWs and magnons provides unique opportunities for device applications. Different groups have already successfully demonstrated the coupling of ferromagnetic resonance with acoustic surface waves [1, 2, 3, 4]. Even the coupling to the low loss material YIG has been shown[3, 5]. Here we demonstrate the use of an Aluminium-Scandium-Nitride (AlScN)/Gallium-Gadolinium-Garnet (GGG) heterostructure to excite and detect SAWs that propagate in a pure GGG surface, offering the possibility to couple into micropatterned or even suspended YIG structures [6].

[1] Weiler et al., PRL: 106.11 (2011): 117601. [2] Dreher et al., PRB: 86.13 (2012): 134415. [3] Kunz et al., arXiv preprint: 2503.11203 (2025). [4] Rayburn et al., PRA: 23.3 (2025): 034062. [5] Wong et al., APL 349.6246 (2024): 125.5 [6] Heyroth, Schmidt et al., PRA: 12.5 (2019): 054031

MA 52.18 Thu 15:00 P4

Magnon-phonon coupling in suspended nanostructure — •Giovanni Del Bufalo[1,2], Matthias Grammer[1,2], Johannes Weber[1,2], and Hans Huebl[1,2,3] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany — [2]TUM School of Natural Sciences, Technische Universität München, Garching, Germany — [3]Munich Center for Quantum Science and Technology (MCQST), Munich, Germany

High-overtone bulk acoustic wave resonators were among the first mechanical systems explored in the quantum regime, enabling studies of vacuum fluctuations and non-classical states. Integrating magnetic thin films with these resonators creates hybrid magneto-phononic excitations through magnetoelastic coupling, allowing energy exchange between phonons and magnons. Beyond energy transfer, these hybrid modes can inherit angular momentum from their constituent excitations, raising a fundamental question: how is angular momentum transferred and shared between phonons and magnons in such systems? We address this by implementing a suspended silicon membrane as a bulk acoustic wave resonator, coupled to a 40nm $Co_{25}Fe_{75}$ metallic film. Using broadband ferromagnetic resonance spectroscopy at cryogenic temperatures, we quantify the magnon-phonon coupling strength and assess its implications for angular momentum transfer and magnetization damping. Our results highlight the potential of this device architecture for probing spin-mechanical interactions and advancing hybrid quantum systems that combine magnetic and mechanical degrees of freedom.

MA 52.19 Thu 15:00 P4

Characterization of spin-Hall nano-oscillators — •Christine Strickler, Moritz Bechberger, Julien Schäfer, Björn Heinz, and Philipp Pirro — Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau, D-67663 Kaiserslautern, Germany

Within the research field of spintronics, spin-Hall nano-oscillators (SHNOs) have emerged as promising candidates for building blocks in neuromorphic computing. These devices typically consist of a bi layer comprising a ferromagnetic (FM) and a heavy metal (HM) layer. Typically, a direct charge current is applied to the HM, which injects a spin current into the FM via the spin Hall effect, exerting spin orbit torques that can counteract the natural damping of the FM and thereby excite coherent auto-oscillations. We perform ferromagnetic resonance spectroscopy on fabricated full-film bilayer systems to opti mize the material stack in terms of FM-layer thickness and FM/HM interface quality. The materials selected for this study are CoFeB and NiFe as FM and Pt and W as HM, which leads to four potential ma terial stacks. The optimized stacks are fabricated in several SHNO geometries and sizes to investigate their properties concerning mode spectrum and threshold current for auto-oscillation via Brillouin light scattering spectroscopy. This study of SHNO fabrication paves the way for further investigation into such structures and their potential coupling phenomena.

MA 52.20 Thu 15:00 P4

Frequency-dependent parametric injection of magnons in yttrium iron garnet — •Lars Schiesser, Franziska Kühn, Matthias R. Schweizer, Vitaliy Vasyuchka, Alexander A. Serga, and Mathias Weiler — Fachbereich Physik and Landesforschungszentrum OPTIMAS, RPTU Kaiserslautern-Landau, 67663 Kaiserslautern, Germany

Parametric generation of magnons in low-damping yttrium iron garnet (YIG) films offers a flexible approach to excite magnons across a broad range of wavenumbers, enabling the creation of high magnon densities, which are essential for the preparation of magnon gases preceding condensation phenomena. Using parallel parametric pumping driven by a broadband stripline antenna, we investigate the frequency dependence of pumping thresholds and the ensuing nonlinear scattering processes. By tuning both the external magnetic field and the pumping frequency, we selectively control the initial position of parametrically injected magnons in momentum space and thus define the starting conditions for subsequent multi-magnon scattering dynamics. Time-resolved Brillouin light scattering (BLS) spectroscopy is employed for the direct observation of the temporal and spectral evolution of the magnon population.

These frequency characteristics provide the basis for the implementation of pumping schemes with arbitrary waveforms, which will enable the realization of complex, tailored excitation signals, opening new pathways for the precise control of nonlinear magnon dynamics.

MA 52.21 Thu 15:00 P4

Spatially-Localized Second Harmonic Generation via Spin Wave Concentration in Patterned YIG Structures — •Marc Eger[1], Stephanie Lake[1], Philipp Geyer[1], Seth Kurfman[1], Rouven Dreyer[1], and Georg Schmidt[1,2] — [1]Martin-Luther-Universität Halle-Wittenberg Insitut für Physik, Halle, Germany — [2]Interdisziplinäres Zentrum für Materialwissenschaften, Martin-Luther-Universität Halle-Wittenberg, Halle, Germany

The anisotropic dispersion and inherent non-linearity of (magnetostatic) spin waves in thin films and confined structures provide unique opportunities for implementation in next-generation radio-frequency devices [1]. A particular challenge remains in establishing effective and useful means to locally generate and subsequently exploit higher harmonics without extraneous non-linear losses [2]. In order to compensate these losses, one method to achieve this is to focus low-intensity spin waves in a low-loss magnetic material to a localised region far from the exciting antenna. This can be done, for example, with deterministically tuning the dispersion relation by modifying film thickness along with a geometric confinement through standard patterning processes. Here we compare micromagnetic simulations and experimental results obtained by frequency- and spatially-resolved SNS MOKE [3] within passive, lithographically-patterned YIG funnel structures, wherein we demonstrate second harmonic generation of magnons.

[1] Ustinov et. al, IEEE Magnetics Letters 10, 1-4, 2019
[2] T. Hula et. al, Appl. Phys. Lett. 117, 042404, 2020
[3] Rouven Dreyer et. al., Phys. Rev. Materials 5, 064411, 2021

MA 52.22 Thu 15:00 P4

Enhancing Mechanical Stability of Heusler Alloys via the Powder-in-Tube Method — •T. Niehoff[1,2], L Beyer[3,4], J. Puy[5], J. Freudenberger[3,4], O. Gutfleisch[5], J. Wosnitza[1,2], F. Scheibel[5], and T. Gottschall[1] — [1]Dresden High Magnetic Field Laboratory (HLD-EMFL), Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Institut für Festkörper- und Materialphysik, TU Dresden, Dresden, Germany — [3]Leibniz-Institut für Festkörper- und Werkstoffforschung IFW, Dresden, Germany — [4]TU Bergakademie Freiberg, Freiberg, Germany — [5]Institute of Materials Science, Technical University of Darmstadt Darmstadt, Germany

We address the long-standing problem of mechanical fatigue in Heusler-based elastocaloric and multicaloric materials by applying the Powder-in-Tube (PIT) method to stabilize the material inside a steel shell. This significantly enhances mechanical robustness. Under cyclic loading up to 100,000 cycles and high-load tests, PIT samples retain their structural integrity, showing only minor, non-critical end cracks while the core remains thermally connected to the shell. Even after plastic deformation, the Heusler core stays intact. Magnetization before and after cycling exhibits only minimal changes, confirming durability, and magnetocaloric measurements demonstrate excellent thermal coupling between core and metal shell. Overall, the PIT method extends the operational lifetime of Heusler alloys by orders of magnitude and allows independent optimization of mechanical stability and caloric performance.

MA 52.23 Thu 15:00 P4

Significant Enhancement of Magnetocaloric Performance of LaFe12B6 via Microstructure Optimization — •Protyasha Prachurja, Wei Liu, Alex Aubert, Benedikt Beckmann, Konstantin Skokov, and Oliver Gutfleisch — Institute of Materials Science, Technische Universität Darmstadt, Darmstadt, Germany

Light rare-earth magnetocaloric (MC) materials are appealing because of their abundance and reduced criticality risks [1]. Within this group of materials, LaFe12B6 - a first-order MC compound - undergoes a phase transition around 36 K, making it a potential candidate for hydrogen liquefaction applications [2]. However, its pronounced MC effect emerges only under relatively high magnetic fields (>5 T), which restricts its performance at lower fields [3]. This limitation is linked to its antiferromagnetic ground state and the presence of secondary phases in the microstructure. We carried out a systematic optimization of the synthesis conditions to improve phase purity and magnetocaloric properties. We found that annealing at 1383 K for 24 hours with a 3% La excess reduced the secondary phase content from 13.2 to 7.7 wt.% and sharpened the first-order transition. Consequently, the peak magnetic entropy change increased significantly from -1 to -10 J/kgK under a 5 T field. References: [1] Wei Liu et al. J. Phys. Energy, 2023, 5.3, 034001; [2] L.V.B. Diop; O. Isnard; J. Rodríguez-Carvajal Phys. Rev. B, 2016, 93.1, 80; [3] L.V.B. Diop; O. Isnard J. App. Phys., 2016, 119.21, 213904. Acknowledgement: We acknowledge financial support by the DFG within the CRC/TRR 270 (Project-ID 405553726).

MA 52.24 Thu 15:00 P4

Superconducting magnetic system for magnetocaloric hydrogen liquefaction — •C. Estillac Leal Silva[1,2], T. Platte[4], M. Strassheim[1,3], T. Niehoff[1,3], C. Salazar-Meija[1], J. Wosnitza[1,3], and T. Gottschall[1] — [1]Dresden High Magnetic Field Laboratory (HLD-EMFL), Helmholtz-Zentrum Dresden-Rossendorf Dresden, Germany — [2]TU Bergakademie Freiberg, Freiberg, Germany — [3]Institüt für Festkörper und Materialphysik, TU Dresden, Dresden, Germany — [4]Magnotherm Solutions GmbH, Darmstadt, Germany

As hydrogen's importance in the clean-energy sector continues to expand, improving its liquefaction efficiency becomes crucial, since the liquid form provides high volumetric energy density for storage and transport. Traditional compression systems, however, remain both costly and energy-intensive, prompting interest in magnetic refrigeration as an alternative process. This approach employs the adiabatic temperature variation of magnetocaloric materials in an Active Magnetocaloric Regenerator (AMR) to reach the final cooling stage required for hydrogen liquefaction. Achieving large temperature spans requires large variations in the magnetic field. In addition, higher operating frequencies are needed to reach greater cooling powers. Therefore, a magnetic system capable of sustaining high fields while supporting rapid cycling, whether through linear or rotary motion of the magnetocaloric material, is necessary. This presentation discusses the development of a superconducting magnetic system meeting these requirements, targeting a concentrated 5-7 T field which enables a sharp field change.

MA 52.25 Thu 15:00 P4

MnCrNiGeSi high-entropy alloy: structural, magnetic and magnetocaloric properties — •Atakan Tekgül[1] and Kağan Şarlar[2] — [1]Uludag University, Bursa, Turkey — [2]Karamanoglu Mehmetbey University, Bursa, Turkey

This study investigates the structural, magnetic, and magnetocaloric properties of two rare-earth-free high-entropy alloys, $Mn_{20}Cr_{14}Ni_{33}Ge_{25}Si_5$ and $Mn_{24}Cr_{10}Ni_{33}Ge_{25}Si_8$, produced by arc melting. Rietveld refinement of X-ray diffraction data confirms that both alloys crystallize in an orthorhombic Pnma structure. Increasing the Mn content from 20% to 24% strengthens the ferromagnetic exchange interactions, resulting in an enhancement of the saturation magnetization (43.8->56.7 $Am^{-1}kg^{-1}$) and an upward shift of the Curie temperature (361->387 K). Isothermal magnetization measurements and Arrott plot analyses reveal a second-order magnetic phase transition. The magnetocaloric effect, calculated via the Maxwell relation, yields a magnetic entropy change of 2.1 $Jkg^{-1}K^{-1}$ for the alloy with 20% Mn and 3.6 $Jkg^{-1}K^{-1}$ for the Mn-rich alloy under a magnetic field of 2 T. The combination of low hysteresis, high Curie temperature, and enhanced entropy change demonstrates that Mn-enriched Mn-Cr-Ni-Ge-Si HEAs offer promising performance for environmentally friendly, high-temperature magnetic refrigeration. These results confirm that compositional tuning, particularly Mn substitution, is an effective route for optimizing the magnetocaloric response in rare-earth-free HEAs.

MA 52.26 Thu 15:00 P4

Spin structure analysis on Fe_2AlB_2 powder and single-crystals — •Joachim Landers[1], Niels Kubitza[2], Soma Salamon[1], Ulf Wiedwald[1], Christina Birkel[2,3], and Heiko Wende[1] — [1]Faculty of Physics and CENIDE, University of Duisburg-Essen — [2]Department of Chemistry and Biochemistry, TU Darmstadt — [3]School of Molecular Sciences, Arizona State University

The MAB phase Fe_2AlB_2 exhibits ferromagnetic ordering below the Curie temperature $T_C \approx 290$ K, showing a strong magnetocaloric effect close to room temperature, which makes it a promising candidate for magnetic cooling applications. We utilize Mössbauer spectroscopy under high magnetic fields to analyze the spin structure and ferro- to paramagnetic phase transition of Fe_2AlB_2 microparticle powders. Field- and temperature-dependent measurements on an Fe_2AlB_2 single-crystal sanded down to appropriate thickness for transmission experiments are used as reference and allow for specific characterization along easy and hard magnetic directions with regards to magnetic alignment. Funding by the DFG via CRC/TRR 270 (project number 405553726, subprojects B02, B03, and B05) is gratefully acknowledged. We thank T. Ouisse and H. Pazniak (LMGP, Grenoble) for providing single crystals.

MA 52.27 Thu 15:00 P4

Combining X-ray absorption spectroscopy with a multifunctional probe to decipher first-order phase transitions — •Benedikt Eggert[1], Alex Aubert[2], Shingo Yamamoto[3], Ana Kurtanidze[3,4], Thomas Herrmannsdörfer[3], Oliver Gutfleisch[2], Kurt Kummer[5], Nick Brookes[5], Jochen Wosnitza[3,4], Katharina Ollefs[6], Konstantin Skokov[2], and Heiko Wende[1] — [1]University Duisburg-Essen — [2]TU Darmstadt — [3]HZDR, HLD-EMFL — [4]TU Dresden — [5]ESRF — [6]KIP, University

Heidelberg

Here, we present a new instrumental setup designed for the investigation of magnetostructural phase transition, installed within the high field magnet at beamline ID32 of the European Synchrotron Radiation Facility in Grenoble, France. With these newly established setups, we can perform dichroic X-ray absorption spectroscopy, while accessing other subsystems via bulk probes (e.g., lattice expansion or change in electrical resistivity) within a temperature range from 4 K to 650 K in the soft X-ray regime.

Here, we will show first experimental results from La(Fe,Si)13 during the field and temperature-induced magnetostructural phase transition showcasing some of the possibilities.

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MA 52.28 Thu 15:00 P4

Magnetic and transport properties of compensated ferrimagnetic Heusler alloys at finite-temperature predicted by *ab inito* spin fluctuation theory — •Shogo Yamashita[1], Esita Pandey[1], Gerhard Fecher[1], Claudia Felser[1], and Atsufumi Hirohata[1,2] — [1]Max-Planck-Institute for Chemical Physics of Solids, Dresden, Germany. — [2]Center for Science and Innovation in Spintronics, Tohoku University, Sendai, Japan

Fully compensated ferrimagnets have been attractive for spintronics because their net zero magnetization suppresses stray fields, enabling high-density memory integration. Among them, Heusler alloys which have 24 valence electrons are of particular interest since they can exhibit both half-metallicity with 100 % spin polarization at the Fermi level and fully compensated ferrimagnetism. However, a fully compensated half metallic Heusler alloy $Mn_{1.5}V_{0.5}FeAl$ reported previously has a Curie temperature below room temperature, limiting its device applications. To find alternatives, we investigated $Mn_2Co_{0.5}V_{0.5}Al(Ga)$, which is regarded as a mixture of half-metallic $Mn_2VAl(Ga)$ and $Mn_2CoAl(Ga)$ exhibiting high Curie temperature, with 24 valence electrons. Using an *ab inito* spin-fluctuation theory based on the coherent potential approximation and disordered local moments, we examined its electronic structure, magnetic properties, and spin conductivities at finite-temperature. In this presentation, we will also discuss possible future control in the properties.

MA 52.29 Thu 15:00 P4

Broadly tunable compensation in ferrimagnetic MnFeVAl Heusler alloy — •Esita Pandey[1], Shogo Yamashita[1], Edouard Lesne[1], Gerhard Fecher[1], Claudia Felser[1], and Atsufumi Hirohata[1,2] — [1]Max-Planck-Institute for Chemical Physics of Solids, Dresden, Germany — [2]Tohoku University, Sendai, Japan

Zero-moment spintronic systems are highly desirable, as they minimize stray fields while maintaining stability against external magnetic perturbations. Unlike antiferromagnets, compensated ferrimagnets offer an ideal solution, combining a net-zero magnetic moment with spin-polarized conduction [1-3]. In this study, we demonstrate the realization of a near-zero-moment state in Mn1.5V0.5FeAl Heusler alloy thin films with a wide tunable compensation range. Films of varying thickness were fabricated on thermally oxidized Si substrates with a W buffer layer using simultaneous triple-target sputtering in an ultra-high-vacuum system. Structural analysis via X-ray diffraction shows that the W underlayer is stabilized in the body-centered cubic (bcc) α-phase with (110) orientation, while the Heusler films exhibit pronounced [110] texture and a lattice parameter close to bulk values. Magnetometry measurements reveal that the samples are magnetically isotropic and exhibit an exceptionally low saturation magnetization at RT. These results position MnFeVAl films as promising candidates for thermally stable, stray-field-free spintronic devices with robust spin-polarized transport. Reference: [1] V. Baltz et al., Rev. Mod. Phys. Vol. 90, No. 1 (2018); [2] A. Hirohata, Magnetochemistry 8, 37 (2022); [3] R. Stinshoff et al., Phys. Rev. B 95, 060410(R) (2017).

MA 52.30 Thu 15:00 P4

Halbach 2.0 - Creating homogenous fields with finite size magnets — •Peter Blümler[1] and Ingo Rehberg[2] — [1]Institute of Physics, University of Mainz, 55128 Mainz, Germany — [2]Institute of Physics, University of Bayreuth, 95440 Bayreuth, Germany

Homogeneous magnetic fields can be generated with permanent magnet arrangements, most notably Halbach rings made of idealized, infinitely long magnetic rods. However, this classical concept is limited when using real, finite magnets. To address this, three-dimensional configurations have been investigated. Optimal single and stacked rings of point dipoles are identified, offering greater field strength and homogeneity than traditional Halbach designs and earlier numerical estimates.

A central innovation is the "focused configuration" (I.R. & P.B., Phys. Rev. Appl. 23 (2025) 064029), where dipoles are tilted out of the ring plane, producing highly homogeneous fields shifted away from the magnet plane. Rotating multiple tilted rings relative to each other further improves homogeneity, though at the cost of a fixed field direction (still confined to the transverse plane).

Experiments with cuboid magnets confirm the theoretical predictions, showing that these configurations overcome finite-magnet limitations and provide enhanced field strength and homogeneity. All configurations can be explored and exported for 3D printing using a dedicated Python GUI (https://zenodo.org/records/15064360).

MA 52.31 Thu 15:00 P4

Towards Sustainable NdFeB Magnets Using Advanced Recycling — •Aybike Paksoy[1], Amrita Khan[1], Abdullatif Durgun[1], Mario Schönfeldt[2], Hasan Mahmudul[2], Iliya Radulov[2], Imants Dirba[1], and Oliver Gutfleisch[1] — [1]Functional Materials, Technical University of Darmstadt, Darmstadt, Germany — [2]Fraunhofer IWKS, Fraunhofer Research Institution for Materials Recycling and Resource Strategies, Hanau, Germany

NdFeB permanent magnets exhibit the highest maximum energy product (BH)max at room temperature, making them important for many technologies essential to the clean energy transition. However, their reliance on critical rare earth elements raises significant environmental, economic, and geopolitical challenges [1]. Consequently, increasing attention has been directed toward the recycling of end-of-life NdFeB permanent magnets. Enhancing the sustainability of rare earth permanent magnets and reducing their criticality are key requirements for environmentally responsible products. The magnetic properties of NdFeB magnets are strongly governed by their microstructure. Recycling routes can alter grain size, crystallographic texture, and defect density, which in turn influence magnetic performance. In this work, advanced recycling strategies are explored with the aim of producing sustainable NdFeB magnets while preserving their functional properties. [1] M. Schönfeldt et al., J. Alloys and Compounds (2023) https://doi.org/10.1016/j.jallcom.2023.168709

MA 52.32 Thu 15:00 P4

Resource efficient recycling and additive manufacturing of Nd-Fe-B magnets — •Amrita Khan[1], Lukas Schäfer[1], Priyatosh Sahoo[1], Iliya Radulov[2], Mahmudul Hasan[2], Konstantin Skokov[1], Igor Lubomirsky[3], and Oliver Gutfleisch[1] — [1]TU Darmstadt, Darmstadt, Germany — [2]Fraunhofer IWKS, Hanau, Germany — [3]Weizmann Institute of Science, Rehovot, Israel

Recycling Nd-Fe-B magnets is crucial for maintaining a sustainable supply of rare-earth elements for clean energy applications while significantly reducing the environmental impact and energy footprint. Additive manufacturing (AM) is a promising production route for functional magnetic materials, especially for achieving high geometric complexity, energy-efficient processing, and waste minimization. In this work, the PBF-LB/M process is used to directly produce permanent magnets, which are not yet optimized with regard to magnetic performance. The recycling of Nd-Fe-B scrap magnets and powder production is a critical step for successful processing via PBF-LB/M. In this study, different recycling processes are investigated: (i) hydrogen decrepitation, (ii) electrolytic decrepitation, and (iii) ultrasonic atomization, which are characterized regarding their particle size distribution, morphology, and flowability. The goal is to identify the influence of the powder properties on the PBF process and the resulting magnetic performance of additively manufactured magnets. This work was supported by the Volkswagen-Stiftung through the project MagCycleAM (9D878 Project No. 0071952-00).

MA 52.33 Thu 15:00 P4

Inverse garnet/Pt heterostructures by lateral crystallization — •Christian Holzmann[1], Stephan Glamsch[1], David Stein[1], Maximilian Mihm[1], Aladin Ullrich[1], Richard Schlitz[2], Michaela Lammel[2], Johannes Boneberg[2], and Manfred Albrecht[1] — [1]Institute of Physics, University of Augsburg, 86159 Augsburg, Germany — [2]Department of Physics, University of Konstanz, 78457 Konstanz, Germany

Rare-earth iron garnet thin films are known for their low Gilbert damping, insulating nature, and tunable magnetic properties. These favorable properties are mostly limited to single-crystalline films grown on specific substrates like GGG, which limits their applications [1]. To expand the functionallity of garnet thin films, we grow a thulium iron garnet film on a thin Pt layer by means of lateral crystallization. The Pt layer is sputter-deposited on a GSGG substrate, followed by garnet deposition by PLD. Hereby, a hole pattern in the Pt layer - either created naturally by thermal dewetting or artifically patterned - acts as crystallization seed. While the as-grown film is amorphous, post-deposition annealing at 700°C results in a lateral garnet crystallization rate of about 1 um/min and a single-crystalline garnet film on top of the Pt layer. This garnet film exhibits similar properties to an epitaxially grown film, including Gilbert damping as low as 0.008 [2]. Therefore, the lateral crystallization of garnet films opens up new possibilities to combine garnet and metal films for spintronic devices.

[1] Sailler, S. et al., Phys. Rev. Mater. 8, L020402 (2024).
[2] Holzmann, C. et al., Phys. Rev. Mater. 9, 114416 (2025).

MA 52.34 Thu 15:00 P4

FMR in chiral Mn_2TiO_4 — •Amruthavarshini Anand[1], Rajendra Loke[1], Ahmed Rasheed[1], Agustinus Agung Nugroho[2], and Joachim Hemberger[1] — [1]Institute of Physics II, University of Cologne, 50937 Cologne, Germany — [2]Institut Teknologi Bandung, Bandung 40116, Indonesia.

Ferromagnetic resonance (FMR) is a powerful technique for probing the dynamic magnetic properties of materials. In this study, we investigate FMR in Mn_2TiO_4, an inverse spinel tetragonal oxide. When Mn occupy full of tetrahedrally coordinated A site and half of B site, the space group $P4_322$, posses a chiral axis along c. Which via spin orbit coupling influences the magnetic resonance.

FMR measurements performed across different frequencies and magnetic field orientations allow us to extract resonance fields, linewidths, damping parameters, and magnetic anisotropy constants. Analysis of the FMR data using Kittel fitting enables determination of the frequency-field relationship, effective magnetization, and g-factors, while linewidth fitting provides quantitative values of the Gilbert damping parameter. And we also performed a FMR configuration with circularly polarized microwave excitation to enhance sensitivity to chiral magnetic effects and enable a more comprehensive investigation of the system's frequency- and field-dependent behaviour.

MA 52.35 Thu 15:00 P4

Magnetic interactions in compositionally complex and high entropy perovskites BaIn1-xMxO3-δ (M = Fe, Co, Sn, Ti) — •Auguste Stanionyte[1], Laura T. Corredor[2], Richard Matyšek[2,3], Anja U. B. Wolter[4], Giuditta Perversi[3], and Anna Isaeva[1,2] — [1]University of Amsterdam, The Netherlands — [2]TU Dortmund University and Research Center Future Energy Materials and Systems, Germany — [3]Maastricht University, The Netherlands — [4]Leibniz IFW Dresden, Germany

High configurational entropy exerts unprecedented effects on a material's phase stability and functional properties and raises questions about possible interrelationships between the two.[1] In our recent work, the BaIn1-xMxO3-δ series were obtained as phase-pure cubic perovskites where Co, Fe, Sn, Ti and In share the B-site in increasing configurational entropy.[2] The present study investigates the magnetic behavior of these compounds. We observe antiferromagnetic-like behavior in the M(T) curves below 20 K, and varying levels of hysteresis in the M(H) experiments at 2K. Specific heat measurements show a field-dependent magnetic entropy release at low temperatures, but neutron diffraction rules out long-range order. With AC susceptibility measurements showing a shift in transition temperatures for higher frequencies, the study so far indicates a glassy magnetic structure with clusters. Altogether, our experimental results give an intriguing look into the emergent properties of such complex and disordered structures, but the exact microscopic mechanism remains to be uncovered.
[1] Adv. Sci. (2022) 9, 2200391; [2] Solid State Ion. (2024) 427, 116901.

MA 52.36 Thu 15:00 P4

FMR in chiral Mn_2TiO_4 — •Amruthavsarshini Anand[1], Rajendra Loke[1], Ahmed Rasheed[1], Agustinus Agung Nugroho[2], and Joachim Hemberger[1] — [1]Institute of Physics II, University of Cologne, 50937 Cologne, Germany — [2]Institut Teknologi Bandung, Bandung 40116, Indonesia.

Ferromagnetic resonance (FMR) is a powerful technique for probing the dynamic magnetic properties of materials. In this study, we investigate FMR in Mn_2TiO_4, an inverse spinel oxide. The magnetic Mn^{2+} ions occupy tetrahedrally coordinated (A) sites and half of octahedrally coordinated (B) sites. The space group $P4_322$ possesses a chiral axis along c, which via spin orbit coupling influences the magnetic resonance.

FMR measurements performed across different frequencies allow us to extract resonance fields and linewidths for different crystal orientations. The data can be analysed using Kittel's formula revealing magnetic anisotropy constants and g-factor, while linewidth fitting provides quantitative values of the Gilbert damping parameter. We also utilise circularly polarized microwave excitation to directly address chirality and the resulting non-reciprocity of the magnetic response.

MA 52.37 Thu 15:00 P4

Emergent electromagnetic inductance of nontrivial magnetic textures in $SrRuO_3/SrIrO_3$ bilyers — •Ludwig Scheuchenpflug[1], Sebastian Esser[2], Robert Gruhl[1], Max Hirschberger[2,3], and Philipp Gegenwart[1] — [1]Universität Augsburg, Lehrstuhl für Experimentalphysik VI — [2]Department of Applied Physics, University of Tokyo, Japan — [3]RIKEN Center for Emergent Matter Science, Japan

Emergent electromagnetic induction (EEMI) by current-driven spin dynamics was proposed and observed in the spin helix magnet $Gd_3Ru_4Al_{12}$ [1], where the (current-nonlinear) imaginary impedance at kHz frequency was associated with the motion of helical spin structures.

To explore the possibility of EEMI arising from current-driven dynamics of nontrivial magnetic structures, we fabricated and microstructured epitaxial thin film bilayers of ferromagnetic $SrRuO_3$ and paramagnetic $SrIrO_3$ on STO. This bilayer system is suspected to host DMI-stabilized Néel-skyrmions, indicated by the topological Hall-effect (THE) [2]. We observe in AC-measurements a large and current-linear imaginary impedance at low temperatures over broad current density and frequency ranges, signaling the EEMI of nontrivial textures.
[1] Naoto Nagaosa, Jpn. J. Appl. Phys. (2019) 58 120909, Yokouchi et al., Nature 586, 232 (2020).
[2] J. Matsuno et al., Science Adv. 2 (2016) e1600304, S. Esser et al., Phys. Rev. B 103 (2021) 214430.

MA 52.38 Thu 15:00 P4

SQUID magnetometry of weakly diamagnetic samples using custom 3D-printed sample holders — •Thomas Kerschenbauer, Luca Bischof, and Rüdiger Klingeler — Kirchhoff Institut for Physics, Heidelberg, Germany

Magnetization studies of weakly diamagnetic samples by means of SQUID magnetometers using conventional sample holders often produce background signals comparable to the sample signal. Therefore, accurate background measurement and subtraction processes are necessary, which are challenging with conventional sample holders. Here, we present high-resolution magnetization data on representative diamagnetic samples, including the aromatic compounds naphthalene and anthracene. We obtained these results through SQUID measurements using custom sample holders designed for the Quantum Design MPMS 3 with SLA 3D printing technology. This offers a versatile and cost-effective solution for manufacturing improved sample holders. These sample holders allow us, e.g., to improve the positioning of the sample, which requires high precision for background subtraction. It also allows for flexibility in sample shape, size, and orientation. These improvements can be used to study weakly magnetic materials and enable measurements that are limited by background signals of conventional sample holders.

MA 52.39 Thu 15:00 P4

Quantitative Distance Calibration and Magnetic Noise Imaging with Scanning NV Magnetometry — •Nikhita Khera, Ephraim Spindler, Kristin Kuehl, and Elke Neu Ruffing — RPTU in Kaiserslautern, Rheinland Pfalz, Germany

Nitrogen-vacancy (NV) enters in diamond are widely used as quantum sensors for nanoscale magnetometry and the study of spin dynamics. As part of ongoing work using a Scanning NV Magnetometer, we report progress towards quantitatively calibrated scanning NV measurements and applications to low-magnetisation systems. A central part of this work is the calibration if the sensor sample distance for scanning NV tips, which is essential for reliable spatial resolution. Using perpendicular magnetic anisotropy (PMA) reference sample, we perform distance calibration and aim to determine the NV orientation in the tip. When combined with complementary approaches such as

reverse AFM to determine the NV position within the tip, this enables access to the full three-dimensional localisation of the quantum sensor. Beyond calibration, we explore magnetic fluctuations in antiferromagnetic insulators by measuring the NV spin relaxation times T1, giving insight into their local magnetic noise and spin dynamics. We also use scanning NV magnetometers to map stray fields - from exfoliated 2D- hematite flakes revealing nanoscale field structures associated with antiferromagnetic domain structures, and from 3-D printed nickel microstructures. Altogether, this work pushes forward scanning NV magnetometry and showcases its use across a variety of magnetic materials.

MA 52.40 Thu 15:00 P4

User-Interactive Magnetic Field Characterization Employing a 3D Printer as a Three-Axis Motor Stage — •Daniel Feser[1,2], Nikolai Weidt[1,2], Nikita Popkov[2,3], Rico Huhnstock[1,2], and Arno Ehresmann[1,2] — [1]Institute for Physics and CINSaT, University of Kassel, Heinrich-Plett-Str. 40, 34132 Kassel, Germany — [2]AIM-ED, Joint Lab of Helmholtzzentrum für Materialien und Energie, Berlin (HZB) and University of Kassel, Hahn-Meitner-Platz 1, 14109, Berlin, Germany — [3]Intelligent Embedded Systems, University of Kassel, Wilhelmshöher Allee 71-73, 34121, Kassel, Germany

This project presents a flexible, user-interactive system for three-dimensional magnetic field mapping that repurposes a consumer-grade 3D printer as a precise three-axis positioning platform. A teslameter probe is mounted in a custom-designed and 3D-printed printhead, ensuring stable and accurate field measurements. The printer is controlled through Python-generated G-code, with device coordination handled via the Tango server framework. This system allows users to manually configure scan volumes, adjust measurement parameters, and safely map magnetic fields around sensitive samples while avoiding collisions. The acquired magnetic field data are processed and displayed as heatmaps, enabling intuitive analysis of spatial field variations. Overall, the platform demonstrates a low-cost, adaptable approach to magnetic field characterization using accessible hardware and open-source software.

MA 53: Members' Assembly

Time: Thursday 18:00–19:00 Location: HSZ/0002

All members of the Magnetism Division are invited to participate.

MA 54: Altermagnets VI

Time: Friday 9:30–12:30 Location: HSZ/0002

MA 54.1 Fri 9:30 HSZ/0002

A metallic p-wave magnet with commensurate spin helix — Rinsuke Yamada[1], •Jan Masell[2,3], Moritz M. Hirschmann[3], and Max Hirschberger[1,3] — [1]The University of Tokyo, Tokyo, Japan — [2]Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany — [3]RIKEN Center for Emergent Matter Science (CEMS), Wako, Japan

Antiferromagnetic states with a spin-split electronic structure give rise to spintronic, magnonic and electronic phenomena despite (near-)zero net magnetization. Even-parity spin-split magnets (d, g-wave) can be collinear and are known as altermagnets. Odd-parity magnets (p, f-wave) may be termed antialtermagnets and need co-planar magnetic order.[1] In this talk, we present our recent experimental realization of a metallic p-wave magnet, the simplest odd-parity spin-split magnet. [2] The magnetic texture is a coplanar spin helix whose magnetic period is an even multiple of the chemical unit cell, as revealed by X-ray scattering experiments. This texture breaks space-inversion symmetry but approximately preserves time-reversal symmetry up to a half-unit-cell translation, thereby fulfilling the symmetry conditions for p-wave magnetism. Consistent with theoretical predictions, our p-wave magnet shows a characteristic anisotropy in the electronic conductivity. Spin-orbit coupling and a tiny spontaneous net magnetization further break time-reversal symmetry, resulting in a giant anomalous Hall effect.

[1] A. B. Hellenes et al. arXiv2309.01607 (2024). [2] R. Yamada et al. Nature 646, 837 (2025).

MA 54.2 Fri 9:45 HSZ/0002

Giant Faraday Effect of magnon-polarons in the magnetoelectric altermagnet Fe2Mo3O8 — •Kirill Vasin[1], Sandor Bordács[2], Lilian Prodan[1], Vladimir Tsurkan[3], Istvan Kézsmárki[1], and Joachim Deisenhofer[1] — [1]University of Augsburg, Augsburg, Germany — [2]Budapest University of Technology and Economics, Budapest, Hungary — [3]Moldova State University, Chisinau, Republic of Moldova

We investigate magnetic circular dichroism of magnon-polarons in the polar altermagnet candidate $Fe_2Mo_3O_8$ using time-domain terahertz magnetospectroscopy. From linearly polarized measurements in Faraday geometry we reconstruct right- and left-circular transmission, revealing hybrid magnon-phonon branches which are fully circularly polarized below the Néel temperature. These magnon-polarons are both electric- and magnetic-dipole active and produce exceptionally large Faraday rotations in the terahertz range, with Verdet constant up to $\sim 4100°/T/cm$. A suggested minimal circular-birefringent dielectric model captures both the magnitude and field dependence of the response.

MA 54.3 Fri 10:00 HSZ/0002

Mn4As3: a structure-search prediction of altermagnetism in a tetragonal Mn-As compound — •Bo Tai[1], Yu Zhu[1], Weikang Wu[2], and Xiaolong Feng[1] — [1]Max Planck Institute for Chemical Physics of Solids, Nöthnitzer Straße 40, 01187 Dresden, Germany — [2]Key Laboratory for Liquid-Solid Structural Evolution and Processing of Materials, Ministry of Education, Shandong University, Jinan 250061, China

We predict that 2D Mn4As3 is a dynamically stable altermagnetic Mn-As compound obtained from an ab initio structure search. The search identifies a tetragonal P4/mmm structure as the lowest-energy configuration, and confirming its dynamical stability. Using first-principle calculation, we find 2D Mn4As3 (P4'/mm'm) breaks PT symmetry while preserving zero net magnetization, realizing an altermagnetic state. Spin-resolved band structures reveal characteristic momentum-dependent spin splitting: spin-up and spin-down bands are split along Γ-X and Γ-Y but remain degenerate along Γ-M, leading to a Fermi-surface spin texture with a d-wave-like pattern of spin splitting. Berry-curvature and transport calculations further show that rotating the magnetic moment (Néel vector) direction provides effective control over both the anomalous Hall conductivity and the positions of band crossings near the Fermi level. These results establish structure-searched Mn4As3 as a dynamically stable altermagnet and a promising platform for magnetization-direction control of Berry-phase transport in Mn-pnictides.

MA 54.4 Fri 10:15 HSZ/0002

Antichiral surface states in altermagnets — •Sopheak Sorn — Institute for quantum materials and technology, Karlsruhe Institute of Technology, Karlsruhe, Germany — Institute of theoretical solid state physics, Karlsruhe Institute of Technology, Karlsruhe, Germany

Altermagnets host symmetry-protected nodal lines and nodal planes in their band structures. In this talk, I will show how nodal lines in d-wave altermagnets give rise to unusual surface states that are antichiral. Antichiral surface states on two opposite surfaces of a slab geometry propagate parallel to one another, in contrast to the antiparallel propagation direction of chiral surface states. I demonstrate the presence of antichiral surface states using a tight-binding model. The antichiral character and many important features of the antichiral surface states are explained using a mapping from the altermagnetic model to Su-Schrieffer-Heeger chains: the topological index and the bulk-boundary correspondence of the latter explain the antichiral surface states. This work indicates that altermagnets are one of the few quantum materials that can support such antichiral surface states.

Reference [1] Sopheak Sorn, Antichiral surface states and Su-Schrieffer-Heeger physics in rutile altermagnets, Phys. Rev. B 111, L161109 (2025).

MA 54.5 Fri 10:30 HSZ/0002

Quantum Entanglement Signatures of Altermagnetism — •mahsa seyed heydari, wolfgang belzig, and sebastián a. díaz — Universität Konstanz

In two-sublattice magnets in an antiferromagnetic configuration, the notion of two-mode squeezing is equivalent to quantum entanglement between the sublattice spins[1]. It has been shown that the logarithmic negativity is linearily related to the squeezing parameter. Altermagnets are a particular class of magnets which have a vanishing total magnetisation but a peculiar spin-polarization texture in momentum space. Using a simple model an altermagnet [2], we determine the magnon spectrum of an altermagnet and show that particular entanglement features witness the altermagnetic nature. Hence, we show that quantum magnonics offers a route towards distinguishing altermagnets from simple antiferromagnets, which is a difficult experimental task to date.

[1] Kamra, A.; Belzig, W. Phys. Rev. Lett. 2016, 116, 146601.

[2] Brekke, B.; Brataas, A.; Sudbø, A. Phys. Rev. B 2023, 108, 224421.

MA 54.6 Fri 10:45 HSZ/0002

Persistent altermagnetic spin polarisation — •Warlley H. Campos[1], Florette C. F. Mbognou[1], Anna B. Hellenes[2,3], Jan Priessnitz[1], and Libor Šmejkal[1,3] — [1]Max Planck Institute for the Physics of Complex Systems, 01187 Dresden, Germany — [2]Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany — [3]Institute of Physics, Czech Academy of Sciences, 162 00 Praha 6, Czech Republic.

Altermagnets exhibit d-, g-, or i-wave collinear spin polarisation of nonrelativistic exchange origin [1]. Relativistic spin-orbit coupling (SOC) is commonly considered to generate noncollinear spin textures in reciprocal space. Here, we demonstrate that collinear, persistent altermagnetic spin polarisation (PASP) in the full Brillouin zone is possible even in the presence of strong SOC. By combining spin and magnetic layer group analysis, we identify two distinct classes of PASP: one materialising on top of strong exchange spin splitting, and the other accompanying a typically weaker [2], relativistic spin splitting. We then perform *ab initio* calculations to realise the strong and weak types in Lieb-lattice [3-5] and cuprate altermagnets [1], respectively. Finally, we discuss experimental indication of weak PASP in MnTe [2]. PASP could enable strong spintronics currents with long spin lifetimes and efficient spin accumulation [5].

[1] L. Šmejkal *et al.*, Phys. Rev. X **12**, 031042 (2022). [2] Krempasky *et al.*, Nature (2024); A. Dal Din *et al.*, arXiv:2511.01690. [3] R. Jaeschke-Ubiergo *et al.*, arXiv:2503.10797. [4] N. Parthenios *et al.*, arXiv:2502.19270. [5] L.E. Golub *et al.*, arXiv:2503.12203.

15 min. break

MA 54.7 Fri 11:15 HSZ/0002

Spin Orbit Coupling Affecting the Presence of Altermagnetism in $La_2O_2\mathit{TM}_2OSe_2$, TM={Fe, Mn, $Fe_{0.5}Mn_{0.5}$} — •Tillmann Weinhold[1], Cornelius Herrmann[1], Domenic Nowak[2], Rowena Wachtel[2], Felix Seewald[1], Rajib Sarkar[1], Sabine Wurmehl[2], and Hans-Henning Klauss[1] — [1]Institute of Solid State and Materials Physics, IFMP, TUD Dresden University of Technology — [2]Leibniz Institute for Solid State and Materials Research, IFW, Dresden

Altermagnets are a recently discovered type of solid with magnetic order leading to zero net magnetization while providing spin-splitting effects of electron bands of up to multiple eV.

While hundreds of possible candidates have been found by analyzing proposed crystal and magentic structures, only few of them could be experimentally proven to be altermagnets by now.

By the use of local probe techniques we were able to precisely determine the magnetic structure of $La_2O_2Fe_2OSe_2$, a compound isostructural to two proposed altermagnets, namely $La_2O_2FeMnOSe_2$ and $La_2O_2Mn_2OSe_2$.

A comparison of these conclusions with upcoming results of the other two compounds can give strong indications or possibly even experimental verification of whether the magnetic phase of these materials is altermagnetic.

MA 54.8 Fri 11:30 HSZ/0002

Ultrafast carrier dynamics in the g-wave altermagnet $CoNb_4Se_8$ — •Alexander Schmid[1], Gregor Zinke[1,2], Resham B. Regmi[3], Luca Haag[2], Tobias Eul[1], Hans C. Schneider[2], Nirmal J. Ghimire[3], Martin Aeschlimann[2], and Benjamin Stadtmüller[1] — [1]University of Augsburg — [2]RPTU University Kaiserslautern-Landau — [3]University of Notre Dame, USA

Altermagnets have sparked considerable interest as a new type of compensated magnet with an unconventional spin splitting in momentum space that is rooted in the crystal and spin group symmetries of these materials.

In the manifold of altermagnetic candidates, intercalated transition metal dichalcogenides such as $CoNb_4Se_8$ have been identified as altermagnetic materials with characteristic g-wave spin splitting below 168 K. [1]

In our work, we used time- and momentum-resolved photoemission to gain insight into the ultrafast dynamics of the layered altermagnetic $CoNb_4Se_8$. Specifically, we focus on the ultrafast carrier dynamics near the characteristic spin-split bands at the M-point of the band structure, both in the altermagnetic and paramagnetic phases. This direct comparison allows us to uncover the impact of the spin and nodal plane structure of altermagnets on the ultrafast charge and spin carrier scattering. Our findings will be a vital first step toward understanding the optical response of altermagnets on ultrafast timescales.

[1] R. B. Regmi et al., Nat. Commun. 16, 4399 (2025)

MA 54.9 Fri 11:45 HSZ/0002

Emergent *d*-wave surface altermagnetism in G-type Heusler antiferromagnets V_3Al and V_2TiSi — •Ersoy Sasioglu, Ingrid Mertig, and Samir Lounis — Institute of Physics, Martin Luther University Halle-Wittenberg, 06120 Halle (Saale), Germany

Antiferromagnets that preserve combined inversion and time-reversal symmetry (PT) necessarily exhibit spin-degenerate electronic bands in the absence of spin-orbit coupling. Using density-functional theory, we show that asymmetric surface terminations of centrosymmetric G-type Heusler antiferromagnets lift the PT symmetry and give rise to an exchange-driven, nonrelativistic d-wave spin splitting, a mechanism we term *surface altermagnetism*. In the antiferromagnetic semimetal V_3Al, an experimentally established compound with $T_N \approx 700$ K, and in the antiferromagnetic semiconductor V_2TiSi, the interior layers of the slab retain the conventional compensated G-type order and spin-degenerate electronic structure, whereas inequivalent surface terminations induce pronounced d-wave spin splittings and metallic surface states localized on the outer transition-metal layers that decay exponentially toward the bulk. These results demonstrate that surface altermagnetism arises purely from lattice-symmetry breaking at asymmetric terminations, providing a robust, exchange-driven route to engineer spin-polarized metallic surface states in high-temperature G-type antiferromagnets without invoking spin-orbit coupling.

MA 54.10 Fri 12:00 HSZ/0002

P-wave magnetism with helical order — •Jaafar Ansari[1] and Libor Šmejkal[1,2,3] — [1]Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — [2]Max Planck Institute for Chemical Physics of Solids, Dresden, Germany — [3]Institute of Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic

The emergent class of magnetic materials exhibiting p-wave [1] spin polarization represents a critical frontier in condensed matter physics for holding considerable promise for advanced spintronic architectures. Examples have been studied in commensurate and incommensurate p-wave structures with asymmetric spin polarizations [2-4]. This work presents a systematic theoretical classification of systems capable of realizing this unique band-structure symmetry, which is rooted in spin group theory. Our study focuses on helimagnets that do and do not generate p-wave order. By ab initio calculations we investigate the role played by broken inversion symmetry, noncollinearity of the spins, and the robustness of the p-wave polarisation against spin-orbit interaction. Our analysis characterizes the conditions under which the nominal p-wave symmetry is maintained, partially suppressed or entirely lost, and identifies material candidates. [1] Hellenes, A. B., et. al, arXiv.2309.01607 (2023), [2] Chakraborty, A., et al., Nat Commun 16, 7270 (2025), [3] Kim, S.-J, et. al., Adv. Sci. 11, 2307306 (2024),

[4] Alvarez, N., Phys. Rev. B 112, 024404 (2025)

MA 54.11 Fri 12:15 HSZ/0002

Evidence for spin split bands in RuO_2 investigated by ultrafast magnetization dynamics — •Kevin Jäckel[1], Holger Grisk[1], Niklas Dornquast[1], Jakob Walowski[1], Markus Münzenberg[1], Maik Gaerner[2], Günter Reiss[2], and Timo Kuschel[2,3] — [1]University of Greifswald, Germany — [2]Bielefeld University, Germany — [3]Johannes Gutenberg University Mainz, Germany

In the search for new materials suitable for spintronic applications, the recently discovered altermagnets open up novel paths of research. In our work we focus on the proposed d-wave altermagnetic material RuO_2 by measuring its magnetic response to circularly polarized ultrashort laser pulses. Hereby we propose a way to link its ultrafast demagnetization dynamics, which are accessed by employing time-resolved magneto-optical Kerr effect measurements, to other, well established material systems such as semiconducting GaAs or topological insulators [1]. Therefore, we measure both the real and imaginary parts of the Kerr rotation, which are the Kerr angle and the Kerr ellipticity related to magnetic circular birefringence and dichroism. We see a strong, transient response, which scatters on a femtosecond timescale and can be described by the Raman coherence time.

[1] https://doi.org/10.1038/srep15304

MA 55: Skyrmions III

Time: Friday 9:30–12:45 Location: HSZ/0004

MA 55.1 Fri 9:30 HSZ/0004

RC circuit based on magnetic skyrmions — •Ismael Ribeiro de Assis, Ingrid Mertig, and Börge Göbel — Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale), Germany

Skyrmions are nanosized magnetic whirls attractive for spintronic applications due to their innate stability. They can emulate the characteristic behavior of various spintronic and electronic devices such as spin-torque nano-oscillators, artificial neurons and synapses, logic devices, diodes, and ratchets. Here, we show that skyrmions can emulate the physics of an RC circuit-the fundamental electric circuit composed of a resistor and a capacitor-on the nanosecond time scale. The equation of motion of a current-driven skyrmion in a quadratic energy landscape is mathematically equivalent to the differential equation characterizing an RC circuit: the applied current resembles the applied input voltage and the skyrmion position resembles the output voltage at the capacitor. These predictions are confirmed via micromagnetic simulations. We show that such a skyrmion system reproduces the characteristic exponential voltage decay upon charging and discharging the capacitor under constant input. Furthermore, it mimics the low-pass filter behavior of RC circuits by filtering high frequencies in periodic input signals. Since RC circuits are mathematically equivalent to the leaky-integrate-fire (LIF) model widely used to describe biological neurons, our device concept can also be regarded as a perfect artificial LIF neuron.

MA 55.2 Fri 9:45 HSZ/0004

Accelerating Skyrmion-Based Computing via Oscillating Magnetic Fields — •Yuean Zhou[1], Thomas B. Winkler[2], Grischa Beneke[1], Fabian Kammerbauer[1], Robert Frömter[1], Giovanni Finocchio[3], Johan H. Mentink[2], Davi R. Rodrigues[4], and Mathias Kläui[1] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz, Germany — [2]Radboud University, Institute for Molecules and Materials, Netherlands — [3]Department of Mathematical and Computer Sciences, Physical Sciences and Earth Sciences, University of Messina, Italy — [4]Department of Electrical and Information Engineering, Politecnico di Bari, Italy

Skyrmion-based unconventional computing architectures, including stochastic, reservoir, and probabilistic computing [1], rely on stochasticity and dynamical transitions. However, pinning effects restrict mobility in realistic device geometries. To stably enhance the dynamics, we apply an additional oscillating out-of-plane magnetic field [2], and quantify the skyrmion motion in confined geometries using Markov State Models constructed from skyrmion trajectories recorded by Kerr microscopy. The diffusion enhancement shows a distinct maximum around 25 Hz and tapers off on either side, suggesting a stochastic-resonance-driven mechanism. Micromagnetic simulations qualitatively reproduce the resonance peak, supporting this interpretation. Controlled periodic driving thus provides an effective route to boost skyrmion dynamics for unconventional computing. [1] T.B. Winkler et al., arXiv:2508.19623 (2025) [2] R. Gruber et al., Adv. Mater. 2208922 (2023)

MA 55.3 Fri 10:00 HSZ/0004

Dipolar Skyrmion Continuum Mechanics — •Kilian Leutner[1], Klaus Raab[1], Grischa Beneke[1], Duc M. Tran[1], Sachin Krishnia[1], Robert Frömter[1], and Mathias Kläui[1,2] — [1]Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany — [2]Center for Quantum Spintronics, Norwegian University of Science and Technology, 7491 Trondheim, Norway

Magnetic skyrmions–topological quasiparticle spin textures–offer a platform for both fundamental physics and applications [1]. In multilayer films, micrometer-scale skyrmions can emerge from dipolar interactions, and describing the long-timescale behavior of an ensemble requires multiscale modeling. We extend the Thiele equation by treating the skyrmion radius as a dynamic variable and derive the forces governing changes in both position and size from micromagnetic theory. As a novel approach to describe ensemble dynamics, we develop a continuum-mechanics framework in which individual skyrmions are replaced by macroscopic fields such as density, velocity, and radius. The equation of state required for this description–relating pressure and density in the basic case–is calculated using dipolar-lattice theory [2]. We validate these two theoretical frameworks by examining how a spin-orbit torque compresses a skyrmion lattice in a Ta/CoFeB/MgO wire in an experiment. The continuum-mechanics model provides deeper insight into dipolar skyrmion ensembles as a hyperelastic medium composed of interacting particles of variable size.

[1] C. Back et al. J. Phys. D: Appl. Phys., 53, 363001 (2020).
[2] E. M. Jefremovas, K. Leutner et al. Newton, 1, 100036 (2025).

MA 55.4 Fri 10:15 HSZ/0004

Magnetoresistance and Planar Hall Effect in Noncollinear Magnets — •Juba Bouaziz[1,2], Hiroshi Ishida[3], Hiroshi Katsumoto[1], and Stefan Blügel[1,4] — [1]Peter Grünberg Institut, Forschungszentrum Jülich, 52425 Jülich — [2]Faculty of Physics, University of Duisburg-Essen, 47057 Duisburg — [3]College of Humanities and Sciences, Nihon University, Tokyo — [4]Institute for Theoretical Physics, RWTH Aachen University, 52062 Aachen

Magnetotransport measurements are widely used to probe magnetic structures. We study how noncollinear magnetism modifies magnetoresistance (MR) and the planar Hall effect (PHE). In the weak-coupling limit, and using a multiple-scattering expansion of the electron current for Rashba-mediated conduction electrons [1], we show that noncollinearity introduces additional contributions to both MR and PHE. These arise from tilted magnetic moments and include a chiral MR term determined by the chirality of the magnetic structure. We also identify a noncollinear magnetoresistance (NCMR) contribution that persists even without Rashba spin-orbit interaction. Finally, we analyze the form and magnitude of these effects for different nanostructures, including magnetic trimers and topological spin textures such as skyrmions.

[1] J. Bouaziz et al., Phys. Rev. Lett. 126, 147203 (2021).

MA 55.5 Fri 10:30 HSZ/0004

Reorientation of skyrmion lattice with local magnetic field gradients — •Duc Tran[1], Edoardo Mangini[1], Elizabeth Jefremovas[1], Dennis Meier[2,3], Robert Frömter[1], and Mathias Kläui[1,2] — [1]Institute of Physics, Johannes Gutenberg University Mainz, 55128 Mainz, Germany — [2]Centre for Quantum Spintronics, NTNU, 7491 Trondheim, Norway — [3]Faculty of Physics, University of Duisburg-Essen, 45057 Duisburg, Germany

We present a minimally invasive approach for nucleating and manipulating skyrmion lattices in soft CoFeB multilayers using single-pass MFM. By matching the scan-line spacing to the domain periodicity, we drive reversible transitions from stripe domains to isolated skyrmions and locally ordered lattices using the field gradient generated by the magnetic tip. Skyrmion positions are used to calculate the local orientational order parameter ψ_6, allowing quantitative assessment of lattice order[1]. Repeated scanning leads to a systematic increase in $\langle|\psi_6|\rangle$, revealing a progression from a disordered configuration toward a well-ordered hexagonal lattice. We show that the lattice orientation can be directly controlled by altering the scanning direction, as verified through both real-space analysis and fast Fourier transforms. This technique enables on-demand creation, rearrangement, and deletion of metastable skyrmions, offering unprecedented control over lattice symmetry, ordering, and orientation[2].

[1] R. Gruber et al., Nat. Nanotechnol. 20, 1405–1411 (2025).
[2] D. Tran et al., Appl. Phys. Lett. (in press 2025), arXiv:2508.14771.

MA 55.6 Fri 10:45 HSZ/0004

Static and dynamic spin texture manipulation in Fe/Gd multilayers — Tim Titze[1], Sabri Koraltan[2,4], Timo Schmidt[3], Mailin Matthies[1], Florian Bruckner[2], Claas Abert[2], Amalio Fernández-Pacheco[4], Dieter Suess[2], Claus Ropers[5], Manfred Albrecht[3], Stefan Mathias[1], and •Daniel Steil[1] — [1]Georg-August-Universität Göttingen — [2]University of Vienna — [3]University of Augsburg — [4]Technical University of Vienna — [5]Max-Planck Institute for Multidisciplinary Sciences, Göttingen

Topological spin textures can be created, annihilated and manipulated in Fe/Gd multilayers using adiabatic and non-adiabatic external stimuli like temperature, magnetic fields and ultrashort light pulses. In this talk, I will show various ways to control magnetic spin textures statically and dynamically in $[\mathrm{Fe(0.35\ nm)/Gd(0.40\ nm)}]_{160}$ multilayers, combining time-resolved magneto-optical Kerr spectroscopy with micromagnetic simulations and static magnetic imaging techniques. In particular, I will discuss different pathways for skyrmion creation [1,3], the use of in-plane fields as an additional control knob [4], as well as tailoring the skyrmion breathing mode using a two pulse excitation sequence [2].

[1] Adv. Funct. Mater. **34**, 2313619 (2024)
[2] Phys. Rev. Lett. **133**, 156701 (2024)
[3] Phys. Rev. B **112**, 064413 (2025)
[4] arXiv:2510.21320 (2025)

15 min break

MA 55.7 Fri 11:15 HSZ/0004

Effects of interlayer Dzyaloshinskii-Moriya interaction on the shape and dynamics of magnetic twin-skyrmions — •Tim Matthies[1], Levente Rózsa[2,3], Roland Wiesendanger[1], and Elena Vedmedenko[1] — [1]University of Hamburg, Hamburg, Germany — [2]Wigner Research Centre for Physics, Budapest, Hungary — [3]Budapest University of Technology and Economics, Budapest, Hungary

Magnetic skyrmions have been proposed as promising candidates for storing information due to their high stability and easy manipulation by spin-polarized currents. Here, we study how these properties are influenced by the interlayer Dzyaloshinskii-Moriya interaction (IL-DMI), which stabilizes twin-skyrmions in magnetic bilayers. We find that the spin configuration of the twin-skyrmion adapts to the direction of the IL-DMI by elongating or changing the helicities in the two layers. Driving the skyrmions by spin-polarized currents in the current-perpendicular-to-plane configuration, we observe significant changes either in the skyrmion velocity or in the skyrmion Hall angle depending on the current polarization. These findings unravel further prospects for skyrmion manipulation enabled by the IL-DMI.

MA 55.8 Fri 11:30 HSZ/0004

Current-Induced Skyrmion Dynamics and Diffusion — •Leonie-Charlotte Dany, Maarten Brems, Simon Fröhlich, Tobias Sparmann, Fabian Kammerbauer, Sachin Krishnia, Peter Virnau, and Mathias Kläui — Institute of Physics, Johannes Gutenberg University Mainz, 55128 Mainz, Germany

Magnetic skyrmions, nanoscale chiral spin textures with particle-like behavior, are promising candidates for information storage and unconventional computing due to their robustness and efficient current-driven motion [1-3]. In Ta/CoFeB/MgO multilayers, we investigate the transition of current-driven skyrmion motion from creep, through depinning, to the viscous flow regime driven by a unipolar, pulsed current. By varying current density, pulse width, and frequency, we demonstrate how external stimulation overcomes pinning potentials and enables skyrmions to enter into a regime characterized by linear velocity-current relations, i.e., the viscous flow regime. Additional studies with an alternating, net-zero current drive reveal an exponential increase of the diffusion coefficient with current density, while higher frequencies suppress diffusion following a power-law dependence. These findings provide quantitative insight into controlling skyrmion mobility and diffusion, essential for spintronic device design [4].

[1] G. Beneke *et al.*, *Nat. Commun.*, **15**, 8103 (2024).
[2] K. Raab *et al.*, *Nat. Commun.*, **13**, 6982 (2022).
[3] K. Everschor-Sitte *et al.*, *J. Appl. Phys.*, **124**, 24, 240901 (2018).
[4] L. Dany *et al.*, under preparation.

MA 55.9 Fri 11:45 HSZ/0004

Correlating on-the-fly Electrical and Optical Skyrmion Readout — •Grischa Beneke[1], Kilian Leutner[1], Nikhil Vijayan[1,2], Fabian Kammerbauer[1], Duc Minh Tran[1], Sachin Krishnia[1], Johannes Güttinger[2], Armin Satz[2], Robert Frömter[1], and Mathias Kläui[1] — [1]Institute of Physics, Johannes Gutenberg University Mainz, Germany — [2]Infineon Technologies Austria AG, Austria

Magnetic skyrmions, topologically stabilized spin textures, are promising candidates for memory devices and non-conventional computing due to their stability, non-linear interactions, and low-power manipulation. However, reliable electrical readout of individual skyrmions remains a fundamental challenge, as current magnetic tunnel junction and anomalous Hall effect techniques fail to reliably detect single moving skyrmions. Our approach leverages thermally activated skyrmions, where a low constant drive current simultaneously drives skyrmion motion and the Hall voltage necessary for detection. We demonstrate reliability through real-time correlation between Hall voltage signals and direct Kerr microscopy imaging. Two consecutive Hall crosses enable skyrmion velocity determination in accordance with Kerr microscopy videos [1]. We present an analytical formula for the skyrmion AHE readout signal, demonstrating scalability from micrometer to nanometer dimensions. These advances establish a robust platform for skyrmion-based sensors, counters, and unconventional computing systems requiring precise individual skyrmion control and detection.
[1] G. Beneke et al., Accepted for publication in Appl. Phys. Lett., arXiv:2508.15519 (2025).

MA 55.10 Fri 12:00 HSZ/0004

CNN-Based Classifier for Automated Identification of Magnetic States in Spin Dynamics Simulations — •Amal Aldarawsheh[1], Ahmed alia[2], and Stefan Blügel[1] — [1]Peter Grünberg Institute Forschungszentrum Jülich and JARA, D-52425 Jülich, Germany — [2]Institute for Advanced Simulation (IAS-7), Forschungszentrum Jülich, 52425 Jülich, Germany

The identification and classification of different magnetic states are essential for understanding the complex behavior of magnetic systems. Traditional approaches that rely on handcrafted features or manual inspection often fall short, particularly when dealing with subtle or topologically complex spin textures. In this study, we present an automated deep learning model that employs an EfficientNetV1B0 Convolutional Neural Network to classify nine distinct magnetic states, including both FM and, for the first time, AFM spin textures such as AFM skyrmions and AFM stripe domains. The spin configurations are generated through atomistic spin dynamics simulations using the *Spirit* code, then visualized with VFRendering to produce RGB images, which serve as inputs to the classification model. To train and evaluate the model, we created a new dataset of manually labeled RGB images. Experimental results show that the proposed model achieves an accuracy and F1-score of 99%, significantly outperforming established deep learning baselines.

MA 55.11 Fri 12:15 HSZ/0004

Exchange striction model calculations for the skyrmion-containing compound $Gd_3Ru_4Al_{12}$ — •Justus Grumbach[1], Martin Rotter[2], and Mathias Doerr[1] — [1]Institut für Festkörper- und Materialphysik, Technische Universität Dresden, 01062 Dresden, Germany — [2]McPhase Project, Sestiere Cannaregio 2904, 30121 Venezia, Italy

For the compound $Gd_3Ru_4Al_{12}$, we measured the complete dilatometric tensor, enabling a refinement of the phase diagrams in all crystallographic directions (see also the talk by M. Doerr). The most prominent feature is a lattice effect indicating a coupling of skyrmions to the crystal lattice, as previously evidenced by a docking of the propagation vector onto the crystal lattice. In the simulations, an approach for calculating the exchange striction was implemented that takes volume-

influences into account and is particularly suitable for Gd-based compounds. Major aspects supporting our experimental results could be reproduced. The presentation will outline the full simulation process - from modeling, through the calculation of general magnetostrictive effects, to the influence of skyrmions - and conclude with a discussion of the volume effect in the skyrmion phase.

MA 55.12 Fri 12:30 HSZ/0004

Volume effect in Gd-containing skyrmion compounds — •Mathias Doerr[1], Justus Grumbach[1], and Maximilian Hirschberger[2] — [1]Technische Universität Dresden, Germany. — [2]University of Tokyo and RIKEN Center for Emergent Matter Science, Japan.

Skyrmions with a smaller characteristic wavelength are currently investigated in centrosymmetric compounds. The interplay between skyrmion lattices (SkL) and underlying crystallographic structures offers the possibility to determine the stability region of skyrmions by dilatometric measurements (thermal expansion and forced magnetostriction). Magnetostriction measurements on the two hexagonal metallic compounds $Gd_3Ru_4Al_{12}$ with a planar breathing kagome lattice and the triangular lattice magnet Gd_2PdSi_3 show a volume change (plateau phase) in the stability region of the skyrmion lattice, indicating the need for an unstrengthened crystal lattice for the formation of skyrmions. Another important result of our investigations was the refinement of the *H*-*T* phase diagrams for both investigated materials. The key results of the measurements were verified using a mean field calculation (see talk by J. Grumbach).

MA 56: Focus Session: (Anti)ferroic states – Magnetic and magnetoelectric III (joint session FM/MA)

chair: Morgan Trassin (ETH Zurich, CH)

This focus session explores recent advances in understanding and control of (anti)ferroic states. Emphasis will be placed on theoretical modelling, advanced characterization techniques, and the engineering of emergent properties for use in nano-electronic devices. The session aims to bridge fundamental research with emerging device-relevant functionalities, bringing together experimental, and theoretical perspectives on ferroic materials.

Time: Friday 9:30–11:30 Location: BEY/0E40

Invited Talk MA 56.1 Fri 9:30 BEY/0E40

Mapping topological textures in compensated magnets with X-rays — •Claire Donnelly — Max Planck Institute for Chemical Physics of Solids, Dresden, Germany

Extending spin systems to three dimensions promise significant opportunities for applications, for example providing higher density devices and new functionalities associated with complex topology and greater degrees of freedom. Until now, however, insight into three dimensional spin systems has mainly been limited to ferromagnetic and ferrimagnetic systems through X-ray magnetic tomography [1], where a variety of topological textures [1,2], as well as 3D dynamics [3,4], have been observed. In this talk I will describe our recent work mapping topological textures in compensated systems. I will first describe the development of X-ray linear orientation tomography [5], which we have harnessed to map three-dimensional orientation fields - both crystallographic [5], and antiferromagnetic - at the nanoscale. Second, I will present our recent mapping of topological textures in altermagnets [6], harnessing both X-ray circular and linear magnetic dichroism. These insights into the formation of topological textures in compensated magnets not only paves the way for enhanced understanding of these systems, but also towards the next generation of technological devices.

[1] C. Donnelly et al., Nature 547, 328 (2017). [2] C. Donnelly et al., Nat. Phys. 17, 316 (2021) [3] C. Donnelly et al., Nature Nanotechnology 15, 356 (2020). [4] S. Finizio et al., Nano Letters (2022) [5] A. Apseros et al., Nature 636, 354 (2024) [6] R. Yamamoto et al., Phys. Rev. Appl. 24, 034037 (2025)

MA 56.2 Fri 10:00 BEY/0E40

Exploring Magnetoelectric Effects in 1T-$FeCl_2$/bilayer-GaSe Multiferroic Heterostructures — •Fahmida Fakhera[1], Oliver J. Conquest[1], Carla Verdi[1,2], and Catherine Stampfl[1] — [1]School of Physics, The University of Sydney, NSW 2006, Australia — [2]School of Mathematics and Physics, The University of Queensland, QLD 4072, Australia.

Multiferroic materials exhibit multiple ferroic orders simultaneously, including ferromagnetism and ferroelectricity [1]. A recent study [2] on sliding ferroelectricity in bilayer GaSe adds a novel dimension, making it useful as a ferroelectric (FE) sublayer in multiferroic heterostructures. We employ first-principles density functional theory (DFT) to investigate the interlayer and intralayer sliding mechanisms of FE GaSe. Moreover, this study investigates the structural and electronic properties, energy band alignments, magnetic anisotropy, binding energies, electric dipole moments, and interfacial charge transfer of different stackings of 1T-$FeCl_2$/bilayer GaSe. For all stackings, the magnetic anisotropy energies indicate an in-plane easy axis of magnetization in both upward and downward polarization directions. The contact interfaces form Ohmic contacts, enabling sufficient charge transfer between the layers. As the first study on sliding-induced FE and ferromagnetic interfaces, this work offers new insights into the design and understanding of multiferroic materials for the future.

[1] X. Feng, J. Liu, X. Ma, and M. Zhao, Physical Chemistry Chemical Physics 22, 7489 (2020). [2] F. Fakhera, O.J. Conquest, C. Verdi, and C. Stampfl, Physical Review Materials 9, 054402 (2025).

MA 56.3 Fri 10:15 BEY/0E40

Nonlinear phononic slidetronics — •Pooja Rani and Dominik Juraschek — Eindhoven University of Technology, Eindhoven, Netherlands

We investigate ultrafast switching of ferroelectricity in bilayer hexagonal boron nitride using nonlinearly driven phonons. Conventional coherent phonon excitation mechanisms such as infrared absorption, Raman-based techniques, and terahertz sum-frequency excitation produce too small a shear-mode amplitude to overcome the barrier between stacking orders. Using first-principles calculations and phenomenological modeling, we demonstrate instead that strong excitation of high-frequency intralayer phonons dynamically tilts the interlayer potential, enabling efficient and deterministic switching at experimentally accessible pulse strengths. Our results establish nonlinear phononic slidetronics as a powerful method for ultrafast, energy-efficient control of stacking order and related electronic phases in van der Waals materials, with potential for future all-optical ferroelectric memory devices.

Coffee break

MA 56.4 Fri 10:45 BEY/0E40

Resolving the chemical depth profile of ultrathin EuO films by grazing incidence HAXPES measurements — •Katharina Wehrstein[1], Umut Parlak[1], Pia Düring[1], Oliver Rehm[1], Andrei Gloskovskii[2], Christoph Schlueter[2], and Martina Müller[1] — [1]FB Physik, Uni Konstanz — [2]DESY, Hamburg

Magnetic proximity effects enable control of magnetic order in ferromagnetic insulators without altering their intrinsic properties. Europium oxide (EuO) thin films coupled with heavy metals (HM) are promising systems for spintronic applications, in which spin-polarized states are induced, altered or converted via interface coupling. These systems require a sharp interface between the metal and the EuO layer, as well as stoichiometric EuO. As ferromagnetic Eu(II)O is metastable and tends to oxidize to paramagnetic $Eu(III)_2O_3$, investigating the depth-resolved chemical and thus magnetic nature of an EuO layer is mandatory to observe and eventually tune magnetic proximity effects.

Ultrathin EuO films (2-15 nm) were prepared by molecular beam epitaxy on $Pt/SrTiO_3$ and $W/SrTiO_3$ substrates. Grazing incidence hard X-ray photoelectron spectroscopy (GIXPES) enables high X-ray intensity at the sample surface due to reflection of the X-ray beam on the heavy metal layer, leading to the formation of X-ray standing waves. By changing the incidence angle of the X-ray beam, spectra with modulated depth-sensitivity were recorded, revealing variations in the Eu^{3+} content at different depths of the ultrathin EuO layer. This yields a chemical depth profile and thus a magnetic profile that provides insight into the magnetic behavior of the EuO/HM system.

MA 56.5 Fri 11:00 BEY/0E40

Optical manipulation of multiferroic phases in $BiFeO_3$ thin films — •Bixin Yan[1], Lauren J. Riddiford[1,2], Ales Hrabec[1,2], Annika Mechnich[3], Christian L. Degen[3], Manfred Fiebig[1], and Morgan Trassin[1] — [1]Department of Materials, ETH Zurich, Switzerland — [2]PSI Center for Neutron and Muon Sciences, Paul Scherrer Institute PSI, Switzerland — [3]Department of Physics, ETH Zurich, Switzerland

Employing light as a means of actively tuning material properties unlocks the potential for non-invasive, remote, and macroscopic control over technology-relevant functionalities. In our work, we demonstrate optical control over multiferroic phases in prototypical magnetoelectric $BiFeO_3$ (BFO) thin films, utilizing above-bandgap UV light illumination. Taking advantage of the enhanced response at the strain-driven morphotropic phase boundary, we show that by modifying the electrostatic boundary conditions with photoinduced charge carriers, the rhombohedral-like (R-like) phase of BFO can be selectively suppressed within the tetragonal-like (T-like) phase BFO matrix. Furthermore, the electronic origin of such an optical response permits a pronounced polarization-dependent R-to-T-phase conversion. Finally, using scanning nitrogen-vacancy magnetometry, we correlate optically induced ferroelectric phase conversion with a change from uncompensated magnetic ordering to G-type antiferromagnetic ordering. Our work thus presents a novel approach to writing multiferroic states, which is key to magnetoelectric oxide electronics.

MA 56.6 Fri 11:15 BEY/0E40

Time resolved X-ray diffraction study of polarization reversal in uniaxial ferroelectric $BaMgF_4$ single crystals — •Nathan Leubner[1,4], Sara Polo-Filisan[2], Gaetano Bonetti[2], Hiroki Tanaka[2], Matthias Zschornak[3], Dirk C. Meyer[1], Carsten Richter[2], and Semën Gorfman[4] — [1]Institut für Experimentelle Physik, TU Bergakademie Freiberg — [2]Leibniz-Institut für Kristallzüchtung, Berlin — [3]Fakultät Maschinenbau, HTW Dresden — [4]Department of Materials Science and Engineering, Tel Aviv University, Israel

$BaMgF_4$ (BMF) is a uniaxial ferroelectric material crystallizing in the orthorhombic space group $Cmc2_1$ and being a compelling candidate for frequency conversion in far ultraviolet regime. In this work, we present time-resolved X-ray diffraction (XRD) studies of single-crystalline BMF under applied electric fields, enabling direct observation of atomic-scale structural changes during domain switching. Complementary dielectric measurements provide insights into the kinetics of domain wall motion. The XRD data reveal the electric-field dependence of strain, allowing for the determination of the components of the piezoelectric tensor of BMF. Furthermore, by exploiting the resonant Friedel pair contrast between oppositely polarized domains, we achieve a direct determination of the crystal structure of each domain. This approach eliminates the need for conventional correction factors (e.g., absorption, extinction), offering a robust and accurate alternative to traditional structure refinement methods. Our findings advance the fundamental understanding of ferroelectric switching in BMF.

MA 57: Thin Films: Magnetic Coupling Phenomena / Exchange Bias and Magnetic Anisotropy

Time: Friday 9:30–11:00 Location: POT/0112

MA 57.1 Fri 9:30 POT/0112

Angle-dependent magnetization reversal in perpendicular-anisotropy garnet films — •Senyin Zhu, Hanxu Zhang, Xianjie Wang, and Bo Song — Harbin Institute of Technology, Harbin 150001, China

Rare-earth-doped iron garnet (RIG) films with perpendicular magnetic anisotropy (PMA) offer a useful platform for studying angle-dependent magnetization reversal. The hysteresis behavior of Bi/La-doped thin RIG films was measured for magnetic-field orientations ranging from the in-plane direction, defined as 0°, to the out-of-plane direction at 90° and further up to 140°, enabling the identification of two distinct reversal regimes. For field orientations close to the film plane (0-50°), the reversal is governed by a continuous rotation of the magnetization, consistent with a uniform-state instability leading to a second-order phase transition. For field orientations close to the film normal (50-140°), the reversal is driven by domain nucleation with irreversible jumps, which is the characteristic signature of a first-order phase transition. The reversal mechanisms are consistent with the rotation- and nucleation-dominated processes known from metallic films.[1,2] In garnet film systems, however, the angular ranges at which these processes occur are shifted with respect to metallic films, most likely due to their stress-controlled perpendicular anisotropy and the larger exchange lengths.[1] O. Hovorka, A. Berger, and L. Fallarino, Phys. Rev. B 94, 064408 (2016). [2] R. Salikhov, F. Samad, L. Fallarino et al., Phys. Rev. B 110, 024417 (2024).

MA 57.2 Fri 9:45 POT/0112

Tailoring Magnetic Anisotropy Energy (MAE) with ion irradiation on Fe (110) — •Gabriel Gray[1], Kilian Lenz[1], Aleksandra Lindner[1], Fabian Ganss[1], Jürgen Fassbender[1], René Hübner[1], Rodolfo Gallardo[2], Pedro Landeros[2], and Jürgen Lindner[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, Dresden, Germany — [2]Universidad Técnica Federico Santa María, Department of Physics, Valparaíso, Chile

Our research focuses on the changes in Magnetic Anisotropy Energies (MAE) in epitaxially grown Fe (110) thin films. We aim to create spatially defined regions with tunable magnetic anisotropies, modified through local ion implantation, in order to engineer spin textures and establish controllable spin-wave channels within the ferromagnetic thin film.

The Fe films were irradiated with Cr ions at varying kinetic energies and fluences. Subsequent magnetic characterization was performed using ferromagnetic resonance, while structural characterization was done by x-ray diffractometry, transmission electron microscopy and energy-dispersive x-ray spectroscopy.

Our results reveal a clear correlation between ion fluence and modifications in uniaxial magneto-crystalline anisotropy, while cubic anisotropy and the effective magnetization remain largely unaffected.

MA 57.3 Fri 10:00 POT/0112

Perpendicular magnetic anisotropy in Pt/Co/Cu heterostructures — •Anastasios Markou[1] and Ioannis Panagiotopoulos[2] — [1]Physics Department, University of Ioannina, 45110 Ioannina, Greece — [2]Department of Materials Science and Engineering, University of Ioannina, 45110 Ioannina,Greece

Magnetic multilayers with perpendicular magnetic anisotropy (PMA) formed by interfacing ferromagnetic layers with heavy-metal spin-orbit-coupled layers have received significant attention due to their tunable magnetic interactions and potential for stabilizing room-temperature topological magnetic textures. Inserting a 3d metal, such as Cu, at the interface between the ferromagnet and the heavy metal can break the symmetry of the adjacent interfaces and give rise to non-compensated asymmetric interactions, enhancing the chiral character of the system [1].

Here, we report on the magnetic properties of magnetron sputtered $[Pt/Co/Cu]_7$ multilayers with optimized deposition parameters to achieve high-quality interfaces and tunable PMA. We show that the magnetic properties can be tuned by varying the thickness of the 3d elements. PMA is observed over a broad range of Co and Cu thicknesses, demonstrating the crucial role of the Pt/Co interface, while the adjacent Cu layer provides an additional degree of freedom to tailor the effective interfacial anisotropy and magnetic coupling. These interfacial contributions are found to govern key properties such as coercivity, loop squareness, and the overall magnetization reversal behavior.

[1] H. Jia et al, Phys. Rev. Mater. 4, 024405 (2020).

MA 57.4 Fri 10:15 POT/0112

Large Microstructure-Dependent Magneto-Ionic Effects in Nanocrystalline Fe-Ni alloys — •Anna Ullrich[1], Florin Leo Hambeck[1], Raphael Kohlstedt[2,3], Sandra Schiemenz[4], Daniel Wolf[4], and Karin Leistner[1,3,4] — [1]Institute of Chemistry, Chemnitz University of Technology, Germany — [2]Institute of Physics, Chemnitz University of Technology, Germany — [3]Research Center MAIN, Chemnitz University of Technology, Germany — [4]Leibniz IFW Dresden, Germany

Magneto-ionic effects offer voltage-driven, energy-efficient control of magnetic properties via electrochemical reactions or ion migration.[1] Most studies focus on Co- or Fe-based systems,[2] recent research has reported similar effects in Ni,[3] prompting exploration in industrial relevant Fe-Ni alloys. We investigated magneto-ionic control in electrodeposited Fe-Ni thin films across the full compositional range using in situ MOKE microscopy.[4] Near-equiatomic films with mixed fcc/bcc phase and ultrafine grains show up to -90 % coercivity reduction at ~ 1 V. In situ Raman spectroscopy and structural characterization attribute the effect to dense grain boundaries and heterogeneous surface oxides, facilitating voltage-induced surface oxide reduction and magnetic softening. Our findings highlight the importance of microstructure in enhancing magneto-ionic functionality, providing guidelines for designing materials for sensing, actuation, and neuromorphic computing. [1] Leighton, Nat. Mater. 2019, 18, 13-18., [2] Nichterwitz et al., APL Mater. 2021, 9, 030903., [3] Kutuzau et al., Phys. Rev. Mater. 2025, 9, 114408., [4] Ullrich et al., Adv. Electron. Mater. 2025, e00654.

MA 57.5 Fri 10:30 POT/0112

Two-component anomalous Hall and Nernst effects in anisotropic $Fe_{4-x}Ge_xN$ thin films — •Jakub Vít[1], Petr Levinský[1], Robin K. Paul[2], Imants Dirba[2], and Karel Knížek[1] — [1]Institute of Physics, Prague, Czechia — [2]TU Darmstadt

50-500 nm thin films of $Fe_{4-x}Ge_xN$ (x=0–1) were fabricated onto MgO substrates by magnetron sputtering. The Hall and Nernst effects were measured, complemented with structural and magnetic characterizations, electron microscopy and DFT calculations. Fe_4N is cubic, whereas a small tetragonal distortion is found in $Fe_{4-x}Ge_xN$ films for $x>0.35$. The tetragonal samples with x=0.8 and 1 show two-component behavior in the Hall and Nernst effect hysteresis loops, which can be analyzed as a sum of positive and negative loops with different saturation fields. This unusual behavior is due to a combination of several factors: (1) Co-existence of two different crystallographic orientations in the tetragonal thin films. (2) Opposite sign of the anomalous Hall&Nernst effects (AHE&ANE) for the direction of magnetization along the a and c-axis. (3) Strong easy-plane magnetic anisotropy, responsible for different saturation fields for a and c-axis.

The maximum ANE was determined to be 0.9 V/K for x=0 at room temperature, and -0.85 V/K for x=1 at T=50 K. The rapid increase of ANE for Fe_3GeN from low temperatures indicates that, were it not for its low T_C (≈100 K), it could surpass ANE of Fe_4N. This observation is consistent with our theoretical assumptions and motivates further research of doped Fe_4N for which ANE enhancement is predicted by DFT calculations. (Preprint of this research: [arXiv 2511.14305])

MA 57.6 Fri 10:45 POT/0112

Voltage control of exchange bias in coupled spin-valve heterostructures — •Markus Gössler[1], Jonas Zehner[1,2], Rico Huhnstock[3], Falk Röder[2,4], Rico Ehrler[1], Olav Hellwig[1,5], Arno Ehresmann[3], and Karin Leistner[1] — [1]TU Chemnitz, Germany — [2]IFW Dresden, Germany — [3]University of Kassel, Germany — [4]IPF Dresden, Germany — [5]HZDR Dresden, Germany

Exchange bias can be described as a unidirectional magnetic anisotropy that arises at the interface of a ferromagnet and an antiferromagnet, which is commonly used to pin magnetization in magnetic devices. Typically, exchange bias is initiated only once via a field cooling procedure and cannot be easily modified thereafter. Here, we demonstrate the voltage control of exchange bias in a coupled spin-valve heterostructure via a magneto-ionic (i.e. electrochemical) approach. This is accomplished in a sputtered IrMn/Fe/Au/Fe/FeOx layer structure by modifying the Fe/FeOx top layer thicknesses via voltage-triggered electrochemical reduction/oxidation in an alkaline electrolyte.[1] Magnetic interlayer coupling between the exchange-biased (untreated) Fe layer and the top Fe layer through the Au spacer allows controlling exchange bias in this system by a top layer modification only. The reversibility in our heterostructures is significantly improved compared to the direct magneto-ionic treatment of exchange-biased Fe layers. Furthermore, by tailoring the layer structure we also demonstrate a reversible switching between single-step and double-step hysteresis loops,[1] which could pave the way for magnetic field sensors with adjustable sensitivity.

[1] M. Gößler et al., ACS Appl. Mater. Interfaces 17, 49671 (2025)

MA 58: Computational Magnetism II

Time: Friday 9:30–12:45 Location: POT/0151

MA 58.1 Fri 9:30 POT/0151

Prototype for Magnetic Multiscale Modelling Suite (MaMMoS) — •Hans Fangohr[1], Samuel RJ Holt[1], Martin Lang[1], Swapneel Pathak[1], Andrea Petrocchi[1], Wilfried Hortschitz[2], Santa Pile[2], Alena Vishina[3], M Nur Hasan[3], Georgia A Marchant[3], Timoteo Colnaghi[4], Christina Winkler[4], Jonas Winkler[5], Nora Dempsey[6], Thomas G Woodcock[5], Andreas Marek[4], Heike C Herper[3], and Thomas Schrefl[2] — [1]MPSD, Hamburg, Germany — [2]UWK, Krems, Austria — [3]Uppsala University, Sweden — [4]MPCDF, Garching, Germany — [5]IFW, Dresden, Germany — [6]Institute Neel, Grenoble, France

Magnetic materials require multiscale modelling across electronic, atomistic, micromagnetic and device levels. MaMMoS provides a unified Python framework that links these steps and avoids manual data translation. Based on ground-state magnetic parameters from DFT databases, it computes their temperature dependence using atomistic spin-dynamics, and passes them directly to micromagnetic solvers for modelling hysteresis and switching. Common analysis tools (e.g., coercivity, remanence) are included, and benchmarking and optimisation are possible. Planned extensions include machine-learning based modules to replace simulations with faster, approximate estimates. We present the current prototype to attract early adopters and invite community feedback.

Acknowledgements: This work is supported by the European Union's Horizon Europe research and innovation programme under grant agreement No. 101135546 (MaMMoS).

MA 58.2 Fri 9:45 POT/0151

A Fourier-Space Approach to Physics-Informed Magnetization Reconstruction from Nitrogen-Vacancy Measurements — •Alexander Setescak[1], Florian Bruckner[1], Dieter Suess[1], Young-Gwan Choi[2,3], Hayden Binger[2], Lotte Boer[2], Claire Donnelly[2], Uri Vool[2], and Claas Abert[1] — [1]University of Vienna, Vienna, Austria — [2]Max Planck Institute for the Chemical Physics of Solids, Dresden, Germany — [3]University of Ulsan, Ulsan, Republic of Korea

Reconstructing complex magnetization textures from nitrogen-vacancy (NV) magnetometry stray-field measurements presents a challenging inverse problem. In this work, we introduce a physics-informed method that addresses this by incorporating the full micromagnetic energy directly into the variational formulation.

Built on a PyTorch backend, our forward model integrates an auto-differentiable micromagnetic framework with FFT-based stray-field calculations and Fourier-space upward continuation. This enables efficient gradient-based optimization via the adjoint method and allows the sensor-sample distance to be treated as an optimization parameter. By doing so, we eliminate the experimental uncertainty arising from unknown NV implantation depths and surface oxidation layers.

Validation on synthetic data demonstrates high-fidelity reconstruction of spin textures and precise sensor height estimation. Furthermore, when applied to experimental NV measurements of the van der Waals magnet $Fe_{3-x}GaTe_2$, the framework reconstructs skyrmion bubbles that are consistent with theoretical micromagnetic behavior.

MA 58.3 Fri 10:00 POT/0151

First principals calculation of current-induced spin-transfer and spin-orbit torques — •Tamás Véber[1], László

Oroszlány[1,2], Zoltán Tajkov[1,3], Marcell Sipos[1], and Branislav K. Nikolic[4] — [1]Eötvös Loránd University, Budapest, Hungary — [2]Wigner Research Centre for Physics, Budapest, Hungary — [3]HUN-REN Centre for Energy Research, Budapest, Hungary — [4]University of Delaware, USA

The study of two dimensional magnetic materials - especially those possessing strong spin-orbit coupling - has great promise both in terms of providing new theoretical discoveries, as well as practical applications like smaller and more energy efficient magnetoresistive RAM (MRAM) technologies. The theoretical study of such systems has been well-established in recent decades. However, no single ecosystem exists in which all the simulation and post-processing steps can be performed in a cohesive way. We aim to fill this gap by providing a chain of cross-compatible software for this purpose - and where it is possible, do this in the form of open-source libraries. In this work we lay out such an implementation for obtaining current-induced spin torques - like spin-transfer torque (STT) and spin-orbit torque (SOT) - in the linear response regime from ab initio results. We demonstrate this method on a set of magnetic two dimensional few-layer materials, comparing our results with the literature.

MA 58.4 Fri 10:15 POT/0151

Multi-spin Hamiltonians from symmetry considerations — •Levente Rózsa — HUN-REN Wigner Research Centre for Physics, Budapest, Hungary — Budapest University of Technology and Economics, Budapest, Hungary

Spin Hamiltonians are central to modeling magnetic materials. These Hamiltonians must reflect the symmetry of the underlying crystal [1]. Going beyond the most extensively studied two-spin interaction terms, for example the introduction of the isotropic biquadratic exchange interaction, has proven successful in describing special types of magnetic ordering in classical and quantum magnets. Four-spin generalizations of the anisotropic Dzyaloshinsky-Moriya interaction have also been proposed [2,3].

Here, we present a general formalism for deriving symmetry-adapted multi-spin interactions up to arbitrary order in the spin Hamiltonian. This method provides an alternative to perturbative expansions [2] which become difficult to tract as the number of spins and the complexity of the interactions increases. We identify all possible interaction terms containing four spins, and describe their transformation properties under rotations. We propose procedures for deriving these interactions from first-principles calculations, and for calculating the magnetic ground states stabilized by them.

[1] J. Bouaziz et al., Phys. Rev. B 112, 014406 (2025). [2] S. Brinker et al., New J. Phys. 21, 083015 (2019). [3] A. Lászlóffy, L. Rózsa et al., Phys. Rev. B 99, 184430 (2019).

MA 58.5 Fri 10:30 POT/0151

Above-Room-Temperature Magnetism in the Fe3GeTe2 and Fe3GaTe2 monolayer — •Anjali Jyothi Bhasu[1], Bendegúz Nyári[1], László Oroszlány[2], László Udvardi[1], and László Szunyogh[1] — [1]Department of Theoretical Physics, Budapest University of Technology and Economics, Budafoki ut 8., HU-1111 Budapest, Hungary — [2]Department of Physics of Complex Systems, Eötvös Loránd University, 1117 Budapest, Hungary

Room-temperature ferromagnetism that remains robust at the nanoscale is a key requirement for next-generation spintronic and information storage technologies. Using density-functional methods, we investigate monolayers of the van der Waals magnets Fe3GeTe2 and Fe3GaTe2, both of which exhibit magnetic ordering under ambient conditions. We compute the magnetic interaction parameters using the LKAG torque formalism as well as the spin-cluster expansion combined with the relativistic disordered local moment formalism. Special emphasis is placed on how these interactions vary with the Hubbard parameter U, which controls electron-electron correlations within the DFT+U framework. We then estimate the energetically favored magnetic structure by evaluating the Fourier transform of the tensorial coupling matrices. The order-disorder transition temperatures are obtained from large-scale Monte Carlo simulations, and we find that the simulated transition temperatures depend sensitively on the value of U.

MA 58.6 Fri 10:45 POT/0151

Micro and macroscopic quantum details of complex spin-textures — •Wenhan Chen[1,2], Sangeeta Sharma[1,3], and John Kay Dewhurst[2] — [1]Max-Born-Institut (MBI) im Forschungsverbund Berlin e.V,Max-Born-Str 2A, Berlin — [2]Max-Planck-Institut für Mikrostrukturphysik, Halle (saale) — [3]Freie Universität Berlin, Berlin

Studying large-scale systems from first principles remains challenging because conventional DFT becomes prohibitively expensive. The recently proposed ultra-long-range DFT (ULR-DFT) aims to address this systematically while retaining full quantum-mechanical detail.

In our preliminary work, ULR-DFT successfully reproduces micrometre-scale ferromagnetic domains and domain walls, while also providing quantum-level information such as band structures and response functions. Applied to B20 chiral magnets, it captures helical states and skyrmion textures in agreement with experiments. Overall, ULR-DFT is promising for both fundamental research and device modelling, including band-structure engineering for spintronic applications.

15 min break

MA 58.7 Fri 11:15 POT/0151

Automated Defect Detection in Magnetic Imaging Data Using Latent Measures and U-Net Segmentation — •Ross Knapman[1,2], Nasim Bazazzadeh[1,3], Kübra Kalkan[1], Atreya Majumdar[1], and Karin Everschor-Sitte[1] — [1]Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen, 47057 Duisburg, Germany — [2]Institute of Mechanics, Faculty of Engineering, University of Duisburg-Essen, 45141 Essen, Germany — [3]Radiology Department, Massachusetts General Hospital, 175 Cambridge St., Boston, MA 02114, USA

Detecting and characterising local inhomogeneities is essential for understanding and optimising magnetic materials. We present an automated framework that combines physics-based latent measures with deep convolutional segmentation for robust defect identification in magnetic imaging data. Time-resolved micromagnetic simulations with randomly distributed defects are used to compute three per-pixel descriptors: temporal mean, temporal standard deviation, and a latent-entropy measure that quantifies local dynamical complexity [1,2]. Each measure serves as input to a U-Net architecture trained for pixel-level segmentation of defect regions. Performance is evaluated under additive and multiplicative noise to test robustness. This approach demonstrates how integrating physics-motivated feature construction with deep learning enables reliable automated analysis of magnetic textures and defect landscapes in simulation and experiment.

[1] Horenko, I. et al., Comm. App. Math. and Comp. Sci 16, 267 (2021). [2] Rodrigues, D. R. et al., iScience 24, 102171 (2021).

MA 58.8 Fri 11:30 POT/0151

Dynamical mean-field theory for spin systems at finite temperature: cluster extension — •Przemyslaw Bieniek[1], Timo Grässer[2], and Götz Uhrig[1] — [1]Condensed Matter Theory, TU Dortmund University, Otto-Hahn-Str. 4, 44227 Dortmund, Germany — [2]Institute of Molecular Physical Science, ETH Zürich, Vladimir-Prelog-Weg 1-5/10, 8093 Zürich, Switzerland

Dynamical mean-field theory (DMFT) is an established numerical technique for approximately solving fermionic many-body problems. It maps the full quantum system to an impurity problem and uses a self-consistency condition to connect back to expectation values of the original model. In recent years, a method inspired by DMFT applicable to spin systems (spinDMFT) was developed. It is in agreement with numerical techniques and has already proven successful in explaining nuclear magnetic resonance experiments. However, it was derived only in the case of infinite temperature.

Based on spinDMFT, we develop a dynamical mean-field theory for spin systems at finite temperatures. The algorithm computes spin correlations in imaginary time. It maps the spin system to a single-site problem with a time-dependent mean field and uses a self-consistency condition to connect the values of the mean-field to quantum expectation values. The single-site approach is extended to a cluster algorithm, allowing for the computation of nonlocal expectation values. We benchmark the algorithm by comparing the resulting correlations with numerical approaches. We discuss the potential applications of the method and possible extensions.

MA 58.9 Fri 11:45 POT/0151

A Computational Framework for Bare and Interacting Longitudinal Susceptibility in Magnetic Materials — •Rohit Pathak[1], Vladislav Borisov[1,2], Mikhail I. Katsnelson[2,3], Anna Delin[4,5], and Olle Eriksson[1,2] — [1]Uppsala University, Sweden — [2]Wallenberg Initiative Materials Science for Sustainability, Uppsala, Sweden — [3]Radboud University, Netherlands — [4]KTH Royal Institute of Technology, Sweden — [5]Wallenberg Initiative Materials Science for Sustainability, Stockholm, Sweden

We present a computational framework for calculating the non-interacting and interacting spin susceptibilities in magnetic materials using the Relativistic Spin-Polarized Toolkit (RSPt) [1]. The ground-state electronic structure is obtained from self-consistent DFT calculations, followed by the computation of site-resolved Matsubara Green's functions, whose convolution yields the bare susceptibility. The interacting χ^{zz} is evaluated by solving the ADA–TDDFT Dyson equation $K = (1 - XU)^{-1}X$, based on previously developed theory [2]. Applications to bcc Cr, $BaFe_2As_2$, and FeSe show that the calculated $\chi(\mathbf{q})$ peaks reproduce the known magnetic ordering vectors. This framework enables systematic exploration of spin-density-wave phenomena in correlated electron systems.

[1] J. M. Wills, M. Alouani, P. Andersson, A. Delin, O. Eriksson, and O. Grechnyev, Full-Potential Electronic Structure Method (Springer, 2010).

[2] M. I. Katsnelson and A. I. Lichtenstein, J. Phys.: Condens. Matter 16, 7439 (2004).

MA 58.10 Fri 12:00 POT/0151

Proximity-Induced Magnetic Phases in CrI3 Monolayers Coupled to Transition-Metal Dichalcogenide Monolayer — •Zoltan Tajkov[1], Laszlo Oroszlany[1], Amador Garcia Fuente[2], Jaime Ferrer[2], Jaroslav Fabian[3], and Daniel Pozsar[1] — [1]Eotvos Lorand University, Budapest, Hungary — [2]University of Oviedo, Oviedo, Spain — [3]University of Regensburg, Regensburg, Germany

We investigate the emergence of altered magnetic phases in a CrI3 monolayer induced by proximity effects with WTe2. Using density functional theory (DFT) calculations within the SIESTA framework, we analyze the magnetic properties via a novel approach for extracting the magnetic exchange interaction and onsite anisotropy tensors in extended Heisenberg spin models, explicitly incorporating relativistic effects. This method, based on the Liechtenstein-Katsnelson-AntropovGubanov torque formalism, evaluates energy variations upon infinitesimal spin rotations. Our results provide insight into how a 2D magnet is influenced when coupled to a material with strong spin-orbit coupling. Additionally, we explore the impact of varying twist angles, considering the incommensurability of the CrI3 and WTe2 unit cells.

MA 58.11 Fri 12:15 POT/0151

Acoustic Wave Group Velocity under Magnetic Field — •Dominik Legut[1,2], Ievgeniia Korniienko[1], and Pablo Nieves[3] — [1]IT4Innovations, VSB-TU Ostrava, Ostrava, Czechia — [2]Charles University, Prague, Czechia — [3]University of Oviedo, Oviedo, Spain

Recently, we derived a spin-lattice model for ferromagnetic cubic crystals[1]. Then we analyzed the effect of the magneto-elasticity on the group velocities for high symmetry directions[2]. Here we present a different approach to determine the group velocity of the acoustic waves in any crystals and under the effects an external magnetic field for cubic and hexagonal symmetry. The group velocity is obtained by calculating Christoffel matrix elements and their partial derivative with respect to the phase velocity direction, and inserting them in an analytical expression for the group velocity. The effect of that external magnetic field is computed through the induced effective corrections to the elastic tensor which depend on the magnetic susceptibility tensor and the magnetoelastic constants. We present examples of dry sandstone, cubic CoPt and hcp Co to show complex landscapes of fractional change in group velocity as a function of ray direction, as well as a field dependence consistent with the Simon effect[3]. We have developed web-based applications where these effects can be analyzed and visualized in 3D[4].

[1] P. Nieves et al.: Phys. Rev. B **103**, 094437 (2021)

[2] P. Nieves et al.: Phys. Rev. B **105**, 134430 (2022)

[3] I. Korniienko, et al.: Results in Physics, **73**, 108264 (2025)

[4] P. Nieves et al.:, SoftwareX **33**, 102472 (2026)

MA 58.12 Fri 12:30 POT/0151

machine learning prediction of magnetic ordering in chiral induced multiferroic hybrid MOFs — •Gayathri Palanichamy, Biplab Sanyal, and Jonas Fransson — Materials Theory Division, Angstrom Laborartory, Uppsala Univesity, Sweden

Chiral hybrid metal organic frameworks with Ruddlesden Popper type halide layers provide a versatile platform for engineering multiferroicity by combining molecular chirality with transition metal magnetism. In this work, we develop a machine learning framework to identify multiferroic candidates in systems where chiral A-site organic molecules break inversion symmetry to induce ferroelectricity, while B-site transition metal centers govern magnetic ordering. First principles calculations confirm that the chiral distortion stabilizes a spontaneous polarization, and selected compositions exhibit coexisting ferroelectricity and ferromagnetism. To efficiently explore this large chemical and structural space, we construct feature descriptors capturing molecular chirality, distortion modes, metal ligand coordination metrics, and octahedral connectivity. Random Forest and Deep Neural Network models are trained to classify magnetic ground states (FM, AFM A, AFM C, AFM G) and achieve an R* score of 0.94, enabling reliable prediction of magnetic ordering across diverse chiral MOFs. Our approach also identifies previously unexplored chiral Ruddlesden Popper candidates with potential multiferroic behavior. This work establishes a data driven strategy toward building a chiral magnetic MOF repository, providing design principles for future spintronic and multifunctional materials.

MA 59: Magnonics III

Time: Friday 9:30–12:30 Location: POT/0361

MA 59.1 Fri 9:30 POT/0361

Magnetization dynamics in RMn_6Sn_6 crystals investigated by broadband ferromagnetic resonance spectroscopy — •Philipp Schwenke[1], David Weffling[1,3], Kyle Fruhling[2], Vitaliy Vasyuchka[1], Fazel Tafti[2], and Mathias Weiler[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau, 67663 Kaiserslautern, Germany — [2]Department of Physics, Boston College, Chestnut Hill, MA 02467, USA — [3]Present address: Department of Physics and Materials Science, University of Luxembourg, L-4362 Esch-sur-Alzette, Luxembourg

The RMn_6Sn_6-material family is known for hosting complex magnetic orders [1]. Their Kagome and triangular lattices give rise to an unconventional band structure forming flat bands and Dirac cones leading to significant anomalous Hall- and Nernst-effects [2,3]. In this study, we investigate the magnetization dynamics of $ErMn_6Sn_6$ and $YbMn_6Sn_6$. We track characteristic phase transitions of the materials and the accompanying signatures in the magnetization dynamics over temperature. We find that the phase transitions are in agreement with previous results, while the spin dynamical signatures have not been discussed before. This study highlights the potential of using broadband ferromagnetic resonance spectroscopy to investigate the magnetic properties in RMn_6Sn_6

[1] L. Nil, *et. al*, Phys. Rev. B **111**, 054410 (2025)

[2] A. Bolens and N. Nagaosa, Phys. Rev. B **99**, 165141 (2019)

[3] K. Fruhling, *et. al*, Phys. Rev. Mat. **8**, 094411 (2021)

MA 59.2 Fri 9:45 POT/0361

Anisotropic magnon transports in van der Waals altermagnetic and ferromagnetic insulators — •Qirui Cui — Department of Applied Physics, School of Engineering Sciences, KTH Royal Institute of Technology, AlbaNova University Center, SE-10691 Stockholm, Sweden

Based on state-of-the-art first-principles calculations and model analysis [Nat. Rev. Phys. 5, 43-61 (2023)], we report the spin Seebeck effect (SSE) and spin Nernst effect (SNE) in vdW altermagnetic and ferromagnetic insulators, which are entirely independent of magnetic fields and spin-orbit coupling [Phys. Rev. B 108, L180401 (2023)]. In altermagnetic monolayers Cr2Te2O and Cr2Se2O, the breaking of combined symmetries of space inversion P, time reversal T, and translation τ, while preserving the combined symmetry of mirror M and τ, renders magnons with anisotropic spin-momentum locking, i.e., altermagnetic magnons. Interestingly, this spin-momentum locking gives rise to the SSE and SNE, with very efficient generation of longitudinal and transverse spin currents when the thermal gradient is aligned with and deviates from the main crystal axes, respectively. Moreover, anisotropic magnon dispersions are also realized in synthesized ferromagnetic monolayers CrPS4 and CrSBr, arising from C4 symmetry breaking-induced anisotropic exchange couplings [Adv. Funct. Mater. 35, 2407469 (2025)]. Consequently, without the magnetic field, the anisotropic SSE and the SNE emerge. These nontrivial magnonic transports can be further manipulated by the temperature and gate current.

MA 59.3 Fri 10:00 POT/0361

Magnon Shake-Up Enabling Quantum Features and Devices — •Vahid Azimi Mousolou — Department of physics and astronomy, Uppsala University

Shake-up effects, based on the sudden approximation and many-body quantum dynamics, reveal fundamental aspects of quantum systems and have broad applications in molecular spectroscopy and electronic structure analysis. Here, we present magnon shake-up patterns within magnetic systems [1], highlighting their significance in generating and detecting magnon entanglement and squeezing. This study offers new insights into shake-up phenomena in quantum magnonics and paves the way for novel developments in quantum technology.

[1] V. Azimi-Mousolou, A. Delin, E. Sjöqvist, O. Eriksson, Magnon Shake-up: Entanglement Generation and Sensing, arXiv:2503.20063 (2025).

MA 59.4 Fri 10:15 POT/0361

Optical vortex generation by magnons with spin-orbit-coupled light — •Ryusuke Hisatomi[1,2], Alto Osada[3], Kotaro Taga[1], Haruka Komiyama[1], Takuya Takahashi[1], Shutaro Karube[1,2], Yoichi Shiota[1,2], and Teruo Ono[1,2] — [1]Institute for Chemical Research, Kyoto University, Uji, Japan — [2]Center for Spintronics Research Network, Institute for Chemical Research, Kyoto University, Uji, Japan — [3]Center for Quantum Information and Quantum Biology (QIQB), Osaka University, Toyonaka, Osaka, Japan

Magneto-optic effects are generally described as the interaction between spin systems and collimated light (paraxial light). However, in many real-world systems studied in magneto-optics research, light focused by an objective lens (non-paraxial light) is utilized, which inherently exhibits optical spin-orbit coupling. Such spin-orbit-coupled light possesses a longitudinal electric-field component. Recently, we found that the interaction between spin-orbit-coupled light and collective spin dynamics (i.e., magnons) leads to optical vortex scattering, and we developed a theoretical framework to reproduce this phenomenon. The result provides the first step toward a comprehensive magneto-optics study incorporating optical vortices.

MA 59.5 Fri 10:30 POT/0361

Magnetization dynamics in YIG optomechanical crystals — •Matthias Grammer[1,2], Jonny Qiu[3], Sebastian Sailler[4], Sebastian T.B. Goennenwein[4], Matthias Althammer[1,2], Stephan Geprägs[1], Michaela Lammel[4], Eva Weig[3], and Hans Huebl[1,2] — [1]Walther-Meißner-Institut, BAdW, Garching, Germany — [2]School of Natural Sciences, TUM, Garching, Germany — [3]School of Computation, Information and Technology, TUM, Garching, Germany — [4]Department of Physics, University of Konstanz, Konstanz, Germany

Efficient transduction between microwave and optical photons is a key requirement for future quantum network applications. Recent studies have focused on freestanding magnetic nanostructures such as optomechanical crystals (OMC) based on yttrium iron garnet (YIG). These devices allow for co-localizing magnonic, elastic and photonic excitations in a single nanostructure. While the optical properties of a YIG OMC have already been experimentally shown [1], its magnonic and phononic modes have so far only been explored through simulations. In this talk, we present an experimental investigation of the magnetic modes in a YIG OMC. For our proof of principle study, we fabricated a non-suspended YIG OMC on a GGG substrate using sputtering and lift-off techniques. We investigate the collective magnon modes using spacially resoved micro-focused magneto-optical Kerr effect measurements and categorize the observed modes using micromagnetic simulations.

[1] A. Rashedi et al., Phys. Rev. Applied 24, 054017(2025).

MA 59.6 Fri 10:45 POT/0361

Direct observation of magnetic vortex resonances on curvilinear surfaces — •Sabri Koraltan[1], Takeaki Gokita[1], Michal Krupinski[2], Sebastian Wintz[3], and Amalio Fernández-Pacheco[1] — [1]Insitute of Applied Physics, TU Wien, Vienna, Austria — [2]Institute of Nuclear Physics, Polish Academy of Sciences, Krakow, Poland — [3]Institute for Nanospectroscopy, Helmholtz-Zentrum Berlin, Berlin, Germany

Spin waves in magnonic systems offer energy-efficient alternatives to conventional electronics [1], with low-frequency magnetic vortex resonances being particularly relevant for microwave applications [2]. While planar magnetic vortices have been extensively studied [2], their dynamics in three-dimensional curvilinear architectures remain largely unexplored. Here, we present the direct experimental observation of vortex core gyration on a 3D curvilinear surface [3]. Using a stripline antenna on a SiN membrane, we excite self-assembled polystyrene spheres coated with NiFe, which host a vortex lattice state at remanence. Time-resolved scanning transmission X-ray microscopy (TR-STXM) at BESSY II [4] captures real-space, time-resolved dynamics, revealing complex spin-wave modes due to curvature-induced field gradients. Our results highlight the potential of curvilinear magnetic architectures for next-generation magnonic devices.

[1] Chumak, Andrii V., et al. Nature physics 11.6 (2015): 453-461. [2] Yu, Haiming, et al. Physics Reports 905 (2021): 1-59. [3] Koraltan, Sabri, et al. In Preparation (2026). [4] Koraltan, Sabri, et al. Science Advances 10.39 (2024): eado8635.

15 min break

MA 59.7 Fri 11:15 POT/0361

Direction Selective Spin Waves Imaging in Microstructures — •Roméo Beignon[1], Chris Köerner[2], Rouven Dreyer[2], Zeling Xiong[3], Katrin Schultheiss[3], Helmut Schultheiss[3], Vincent Jacques[1], Georg Woltersdorf[2], and Aurore Finco[1] — [1]Laboratoire Charles Coulomb, Université de Montpellier, CNRS, Montpellier, France — [2]Martin Luther University Halle-Wittenberg, Halle, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, Institut für Ionenstrahlphysik und Materialforschung, Dresden, Germany

Spin waves can be generated and manipulated at the nanoscale using patterned microstructures and magnetization features. Harnessing these effects is key to the development of magnonic devices. With scanning NV microscopy, we are able to image spin waves with a spatial resolution of about 50 nm. Simultaneously, we probe the stray field produced by non-uniform static magnetic textures hosted in the microstructures and explore their interactions with spin wave modes.

Here, we apply this technique to observe spin waves in Permalloy microstructures. We first investigate spin waves generated via scattering and measure their dispersion relation. Then, we show that the NV center is sensitive to the handedness of the circularly polarized field emitted by spin waves. We can thus selectively image spin waves propagating in different directions and study how they interact with the edges of the Py structure. Finally, we observe discrete magnon modes with high azimuthal indices in disks featuring a vortex state. These measurements open the way to understanding complex nonlinear dynamic phenomena in magnetic microstructures.

MA 59.8 Fri 11:30 POT/0361

Time domain correlation spectroscopy of thermal and nonequilibrium magnons — •F. S. Herbst[1], M. A. Weiss[1], C. Runge[1], N. Beaulieu[2], J. B. Youssef[2], A. Leitenstorfer[1], M. Lammel[1], R. Schlitz[1], and S. T. B. Goennenwein[1] — [1]Department of Physics, University of Konstanz, Germany — [2]LabSTICC, CNRS, Université de Bretagne Occidentale, France

Yttrium iron garnet (YIG) is a prototypical material for spintronics and magnonics due to its low magnetic damping and high spin wave propagation velocities. The properties of coherently excited, standing spin waves are well understood. However, much less is known about the interplay between coherently excited magnons and incoherent fluctuations, as schemes simultaneously resolving both coherent and incoherent contributions in a single measurement are scarce. In this work, we probe bismuth doped YIG with femtosecond noise correlation spectroscopy (FemNoC), an optical technique probing magnetization dynamics in the time domain. This method enables us to simultaneously investigate both the thermal magnon noise background and the coherent magnon response induced by microwave excitation. Using a phenomenological model, we can fit both the waveform and amplitude of the experimental data. This step allows us to quantify and disentangle the respective contributions by their correlation signature. Consequently, FemNoC gives access to the absolute magnon number of a magnetic system in the time domain.

MA 59.9 Fri 11:45 POT/0361

Nonlinearly controllable magnonic mode-converter in a synthetic antiferromagnet — •Mujin You[1,2], Moojune Song[2], Jun Seok Seo[2], Sanghoon Kim[3], Yoichi Shiota[4], Teruo Ono[4], Se Kwon Kim[1], Albert M. Park[2], Kab-Jin Kim[2], Mathias Weiler[1], and Philipp Pirro[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzische Technische Universität Kaiserlautern-Landau, Germany — [2]Department of Physics, Korea Advanced Institute of Science and Technology (KAIST), Korea — [3]Department of Nano-semiconductor Engineering, University of Ulsan, Korea — [4]Institute for Chemical Research, Kyoto University, Uji, Japan

Exploring and controlling nonlinear regimes enables new functionalities in hybrid magnonic systems, including phenomena such as nonlinear anticrossing gap closure and bistability in magnon dispersion. In this work, we observe mode hopping between acoustic and optic modes in a SAF, occurring at the magnetic field where the optic frequency becomes twice the acoustic frequency-consistent with a three-magnon interaction process. Based on this nonlinear mode-hopping behavior, we demonstrate an electrically tunable, nanoscale GHz-range mode-converter. These findings reveal a promising application via nonlinear coupling between acoustic and optic magnons in SAFs, paving the way for energy-efficient, reconfigurable magnonic devices.

MA 59.10 Fri 12:00 POT/0361

$\mathbb{Z}$ **Topological Index for 3D Hamiltonians based on Lattice Gauge Theory** — Nastaran Salehi and •Manuel Pereiro — Department of Physics and Astronomy, Uppsala University, Box 516, SE-751 20 Uppsala, Sweden

The characterization of topological phases in three-dimensional (3D) systems often requires extending concepts well-established in two dimensions (2D). We propose a robust method for calculating an integer topological invariant, akin to the Chern number, for 3D Hamiltonians with periodic boundary conditions. This approach utilizes conceptual elements derived from lattice gauge theory, defining the invariant over a discretized Brillouin zone (a 3-torus, T^3). By constructing U(1) link variables from the Bloch wavefunctions, we define a gauge-invariant quantity from Wilson loops over elementary 3D plaquettes (cubes) in k-space. The resulting topological index is an integer, reflecting the classification of principal fiber bundles $T^3 \times U(1)$ and related to the homotopy group $\pi_3(\mathbb{P}^2(\mathbb{R})) \cong \mathbb{Z}$. This method is general and computationally efficient, avoids issues with band degeneracies, and provides a unique integer invariant for each band. We adapt the method for magnetic Hamiltonians and showcase its effectiveness with two examples: firstly, a 3D Kagome lattice model, and secondly, a realistic material, Mn_3Se, for which the magnon spectra is obtained by employing electronic structure first-principles calculations.

MA 59.11 Fri 12:15 POT/0361

Second-Chern Topology of 3D Magnon Bands via a Field-Angle Pump — •Nastaran Salehi and Manuel Pereiro — Department of Physics and Astronomy, Uppsala University, Box 516, SE-751 20 Uppsala, Sweden

We present a general framework to realize second-Chern topology in three-dimensional (3D) bosonic Bogoliubov-de Gennes (BdG) bands by augmenting the Brillouin zone with a slow, cyclic control parameter, yielding a 4D manifold $\mathbf{T}^3 \times S^1$. Using the bosonic metric Σ_3 and paraunitary gauge, we define the non-Abelian Berry connection/curvature for isolated positive-norm band bundles and an integer invariant $C_2 \in \mathbf{Z}$. We prove that C_2 quantizes an adiabatic transport: across a slab, the pumped conserved quantity (spin for magnons) per 2π cycle is an *integer* set by C_2, and the corresponding current is proportional to $\dot{\phi}$. We introduce a stable lattice algorithm, based on Σ_3-polar link variables, that is gauge covariant and robust in the presence of degeneracies. For the sake of concreteness and pedagogical clarity, we carry out the full derivation in a kagome-based 3D magnet, where a field-angle cycle drives a topological spin flow detectable via inverse spin Hall voltages in Pt contacts on opposing faces. Although illustrated for magnons, the construction applies broadly to quadratic bosonic BdG systems, including phononic and photonic analogues.