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 $LnRh_2Si_2$ (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 ($\approx$10 MHz), are expensive and technically complex and hence difficult to (retro)fit into EMs. We therefore propose an alternative technique based on easy-to-retrofit, miniaturized (for fast switching) magnetic multipoles chopping the beam to short pulses. They consist of planar copper electrodes with permalloy pole pieces on top ($\approx 50\,\mu$m 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 $\approx$ 1 ps at repetition rates $\gg$ 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.

[1] O. Gutfleisch et al., Adv. Mater., 23, 821-842 (2011).
[2] D. R. Rodriges et al., iScience, 24, 3 (2021).
[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/14006428.

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 $t^1_{2g}e^0_g$ 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 $\pm$ 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$_4^{III}$Co^{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$_3^{III}$Ln^{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$_3^{III}$Ln^{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_{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_{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 3*d*-5*d* 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, $MX_2 : M = Nb, Ti, V...$, $X = S, Se, Te...$) 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.