MA 15: Poster I

Time: Tuesday 10:00–12:30 Location: P1

MA 15.1 Tue 10:00 P1

Truly Chiral Phonons Arising From Chirality-Selective Magnon-Phonon Coupling — •Philipp Rieger[1], Markus Weissenhofer[1,2], Luca Mikadze[1], M. S. Mrudul[1], Ulrich Nowak[3], and Peter M. Oppeneer[1] — [1]Uppsala University, Uppsala, Sweden — [2]Freie Universität Berlin, Berlin, Germany — [3]Universität Konstanz, Konstanz, Germany

Growing attention has focused on the angular momentum of phonons, particularly in ultrafast magnetization dynamics. This arises from the circular or elliptical motion of atoms around equilibrium positions, forming collective modes known as chiral phonons.

Structural inversion symmetry (P) breaking is well known to give rise to chiral phonons. Here, we present an alternative mechanism for the generation of chiral phonons, stemming from magnon-phonon coupling in P-symmetric crystal lattices with time-reversal symmetry breaking.

We investigate magnon-phonon coupling in bcc Fe using a first-principles framework. Our calculations reveal the hybridization of magnon and phonon modes, giving rise to magnon-polarons and an avoided crossing (energy gap) in the dispersion relations. Along specific high-symmetry lines in reciprocal space, we observe that magnon coupling transforms degenerate transverse phonon modes into chiral phonons, characterized by an energy splitting between left- and right-handed modes. Our findings challenge conventional magneto-elastic interpretations and reveal zero-point phonon angular momentum and anomalous Hall effects linked to finite (spin) Berry curvatures.

MA 15.2 Tue 10:00 P1

Polymer-free stacking and μ-ARPES of multiferroic $CuCrP_2S_6$ — •Niklas Leuth[1], Tim Jacobs[1], Jeff Strasdas[1], Wendong Wang[2], Roman Gorbachev[2], Elena Voloshina[3], Yuriy Dedkov[3], Marcus Liebmann[1], Vitaly Feyer[4], and Markus Morgenstern[1] — [1]II. Institute of Physics B, RWTH-Aachen University, Germany — [2]National Graphene Institute, University of Manchester, UK — [3]Department of Physics, Shanghai University, China — [4]PGI 6, Forschungszentrum Jülich, Germany

Transition-metal (Tm) phosphorus trisulfides are antiferromagnetic van-der-Waals materials with various magnetic orders, providing a platform for detailed studying and tuning of 2D magnetism [1,2]. The binary Tm compound $CuCrP_2S_6$ exhibits additional ferro-/ antiferroelectricity and magnetoelectric coupling enabling gate induced magnetic orders [2]. We present results on stacking of this material by a fully inorganic transfer process in a glovebox developed by the University of Manchester, leading to polymer-free inter- and surfaces [3]. These stacks are analysed by atomic force microscopy and x-ray photoelectron spectroscopy. After transfer in ultra-high vacuum, they are suitable for surface-sensitive angular-resolved photoelectron spectroscopy (ARPES) with micrometre focus. We tracked the band structure from 300 K to 40 K covering several known phase transitions and discuss changes of the band structure in comparison with density functional theory calculations and analyse the relevant photoelectron matrix elements. [1] J. Mater. Chem. A, 2021, 9, 2560-2591. [2] Nat. Comm., 2024, 15, 3029. [3] Nat. Electron., 2023, 6, 981-990.

MA 15.3 Tue 10:00 P1

Towards time-resolved cubic Magneto-optic Kerr effect measurements — •Farell Keiser, Wentao Zhang, Yuhao Meng, Maik Gaerner, Nicolas Beermann, Hassan Hafez, Savio Fabretti, Timo Kuschel, and Dmitry Turchinovich — Bielefeld University, Germany

The magneto-optic Kerr effect (MOKE) represents an alteration in the polarization of light when it is reflected from a magnetized surface. MOKE-based techniques are widely employed to characterize the magnetic properties of thin films. While many experiments focus on first- or second-order MOKE [1,2], a systematic investigation of the third order "cubic MOKE" (CMOKE) was only reported recently [3]. In this study, we present time-resolved MOKE measurements in Ni(111) thin films to investigate the dynamics of CMOKE. Specifically, we measure MOKE-curves for different sample orientations under strong optical pumping to observe the influence of demagnetization on the CMOKE. Time-resolved MOKE measurements were performed for different sample orientations and pump fluences.

[1] R. Silber et al., Appl. Phys. Lett. 116, 262401 (2020)
[2] R. Silber et al., Phys. Rev. B 100, 064403 (2019)
[3] M. Gaerner et al., Phys. Rev. Applied 22, 024066 (2024)

MA 15.4 Tue 10:00 P1

Cubic magneto-optic Kerr effect in Ni(111) and Co(111) thin films depending on the angle of incidence — •Malte Schaeffer[1], Maik Gaerner[1], Robin Silber[2], Jaroslav Hamrle[3], Martin Wortmann[4], Andrea Ehrmann[4], and Timo Kuschel[1] — [1]Bielefeld University, Germany — [2]VSB-Technical University of Ostrava, Czechia — [3]Charles University Prague, Czechia — [4]Bielefeld University of Applied Science and Arts, Germany

The magneto-optic Kerr effect (MOKE) describes the change in polarization of linear polarized light when reflected from a magnetized sample. It can be utilized to investigate magnetic properties of thin films and microstructures. In most cases, only the linear dependence on the magnetization M and sometimes the quadratic contribution depending on M^2 (QMOKE) are studied [1,2]. The third-order MOKE, so-called cubic MOKE (CMOKE), has only been studied recently [3,4]. In order to separate the individual MOKE contributions, the eight-directional method is used by applying an external magnetic field in eight different in-plane directions. In this contribution, we measured QMOKE and CMOKE in ferromagnetic Ni(111) and Co(111) thin films for different angles of incidence ranging from 45° to normal. We compared the findings with theoretical predictions based on Yeh's matrix formalism.

[1] R. Silber et al., Phys. Rev. B 100, 064403 (2019)
[2] R. Silber et al., Appl. Phys. Lett. 116, 262401 (2020)
[3] M. Gaerner et al., Phys. Rev. Applied 22, 024066 (2024)
[4] See Focus Session 'Magneto-transport and magneto-optics of higher orders in magnetization' at DPG Meeting 2025 in Regensburg

MA 15.5 Tue 10:00 P1

Dynamical Mean Field Theory for Spin Systems at Finite Temperature — •Przemysław Bieniek, Timo Grässer, and Götz Uhrig — Technische Universität Dortmund, Fakultät Physik

In the recent years, a dynamical mean field theory approach for spin systems at infinite temperature (spinDMFT) was developed. It is an approximate technique in the limit of an infinite coordination number, reducing the full dynamics of a spin system to a problem of a single spin interacting with a dynamical environment field. This allows for very efficient computation of spin correlations, which shows good agreement with other computational techniques and excellently describes nuclear magnetic resonance (NMR) experiments.

However, the current version of spinDMFT applies only to systems at infinite temperature and two-site couplings. We aim at extending the technique. One goal is to address finite temperatures, but still above any ordering temperature. To this end, we modify the approach to dynamical Green's functions instead of spin correlations. The second goal is to deal with three-site couplings as they arise in experiments with magic angle spinning. We benchmark the developed techniques for various spin models by comparing the results with other numerical approaches and discuss possible applications.

MA 15.6 Tue 10:00 P1

Spin Textures and Surface State Sequences of a Prototypical Topological Insulator Revealed by Momentum Microscopy — •Wei-Sheng Chiu[1,2], Ina Marie Verzola[3], Ying-Jiun Chen[1,4], Rovi Angelo Beloya Villaos[3], Claus Michael Schneider[1,2], Feng-Chuan Chuang[3], and Christian Tusche[1,2] — [1]Forschungszentrum Jülich, Peter Grünberg Institut PGI-6, 52425 Jülich, Germany — [2]Fakultät für Physik, Universität Duisburg-Essen, 47057 Duisburg, Germany — [3]National Sun Yat-sen University, Department of Physics, 80424 Kaohsiung, Taiwan — [4]Forschungszentrum Jülich,Ernst Ruska-Centre ER-C-1, 52425 Jülich, Germany

As a hallmark of the prototypical topological insulator of Bi_2Se_3, its intriguing topological surface state (TSS) has been extensively studied. By using spin-resolving momentum microscopy (SPEMM) with an Au passivated Ir(100) imaging spin filter, we directly recorded the spin-resolved momentum maps (k_x, k_y) over entire surface Brillouin zone (SBZ) of Bi_2Se_3. In addition to the well-known Dirac cone at the Fermi level, our measurements reveal a sequence of several Dirac-like spin textures and crossings. Our first-principles calculations indicate that those overlooked bands are attributed to Bi_2Se_3 surface states spanning a wide binding energy up to 4 eV below the Fermi level.

MA 15.7 Tue 10:00 P1

A single crystal study of the kagome magnets *R*Mn6Sn6 — •Ana Kurtanidze[1,2], Shingo Yamamoto[1], Klara Uhlirova[3], Yurii Skourski[1], Sergei Zherlitsyn[1], Jeremy Sourd[1], and Joachim Wosnitza[1,2] — [1]Hochfeld-Magnetlabor Dresden (HLD-EMFL), HZDR, Dresden, Germany — [2]Institut für Festkörper- und Materialphysik, TU Dresden,Germany — [3]Materials Growth and Measurement Laboratory (MGML), Charles University, Prague, Czech Republic

The kagome magnets *R*Mn6Sn6 (R = Sc, Y, Gd-Lu) with hexagonal structure (P6/mmm) attract attention due to a possible correlation between the observed topological electronic properties and various magnetic phases. We synthesized high-quality single crystals of *R*Mn6Sn6 (R = Er and Tm) by a tin-flux method. We performed scanning electron microscopy, energy-dispersive x-ray spectroscopy, and wavelength dispersive x-ray fluorescence measurements to characterize the phase purity of the samples, which showed a composition close to the nominal stoichiometric ratio. We observed approximately 0.25 at.% aluminum impurity, which originated from the alumina crucibles used. In addition to the chemical characterization, we will discuss the magnetic properties from our preliminary magnetization results under magnetic fields applied along the principal crystallographic axes.

MA 15.8 Tue 10:00 P1

Static and dynamic magnetic properties in the Li-rich antiperovskite (Li_2Fe)ChO (Ch = S, Se) — •F.L. Carstens[1], F. Seewald[2], T. Schulze[2,3], N. Grässler[3], M.A.A. Mohamed[3], S. Hampel[3], L. Singer[1], H.-H. Klauss[2], H.-J. Grafe[3], and R. Klingeler[1] — [1]Kirchhoff Institute for Physics, Heidelberg University, Germany — [2]Institut für Festkörperphysik, TU Dresden, Germany — [3]Leibniz Institute for Solid State and Materials Research IFW Dresden, Germany

The recently discovered class of lithium-rich antiperovskites crystallize in cubic antiperovskite crystal structure such that Li^+ and transition metal ions TM^{2+} are randomly distributed at the same atomic position. They octahedrally coordinate central O^{2-} ions while the chalcogens (S^{2-}/Se^{2-}) are at corners of the cubic crystallographic cell. Despite their compelling properties as high-capacity cathode materials, very little is known about their electronic and magnetic properties. Here, we report static magnetisation, Mössbauer, and NMR studies on Li-rich antiperovskite (Li_2Fe)ChO (Ch = S, Se). Our data show a Pauli paramagnetic-like behaviour, a long-range antiferromagnetically ordered ground state and a regime of short-range magnetic order at least up to 100 K. Our results are consistent with predominantly random Li-Fe distribution on the shared lattice position. In addition, the effect of Li-hopping is observed and discussed. Overall, our data elucidate magnetism in a disordered presumably semimetallic system with thermally induced ionic dynamics.

MA 15.9 Tue 10:00 P1

Manipulation of Surface Domains in an Ultrasoft van-der-Waals Ferromagnet — •Stephan Schmutzler[1], Yichen Jin[1], Guangyao Miao[2,3], Florian Kronast[4], Sergio Valencia[4], Zefang Li[5], Martin Weinelt[1], and Cornelius Gahl[1] — [1]Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany — [2]Beijing National Laboratory for Condensed Matter Physics and Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China — [3]Department of Physics and CSMB, Humboldt-Universität zu Berlin, Berlin 12489, Germany — [4]Helmholtz-Zentrum Berlin, Albert-Einstein-Str. 15, 12489 Berlin, Germany — [5]School of Physics, Nankai University, Tianjin, China

The layered van-der-Waals material $Cr_2Ge_2Te_6$ (CGT) is a very soft ferromagnet at temperatures below 61 K. We show by X-ray magnetic circular dichroism in photoelectron emission microscopy (XMCD-PEEM) that the surface domain structure of a bulk CGT crystal can be reproducibly switched between topologically different phases by ultrashort laser pulse trains in combination with applying small magnetic fields. The effect is attributed to the transient temperature profile normal to the surface established by the interplay of absorption of light and the low interlayer heat conductivity of the material. The laser parameters accordingly allow for tayloring the sample depth of domain manipulation.

MA 15.10 Tue 10:00 P1

Sensing the Spin States of Individual Lanthanide Atoms on a surface — •Kyungju Noh[1,2,3], Gregory Czap[3], Jairo Velasco Jr.[3,4], Roger M. Macfarlane[3], Harald Brune[3,5], and Christopher P. Lutz[3] — [1]Center for Quantum 467 Nanoscience (QNS), Institute of Basic Science (IBS), Seoul 468 03760, Republic of Korea — [2]Department of Physics, Ewha 469 Womans University, Seoul 03760, Republic of Korea — [3]IBM Almaden Research Center, San Jose, 466 California 95120, United States — [4]Department of Physics, 472 University of California, Santa Cruz, California 95064, 473 United States — [5]Institute of Physics, Ecole 458 Polytechnique Fédérale de Lausanne (EPFL), Lausanne CH- 459 1015, Switzerland

Research on single atoms and molecules of lanthanide elements has become a focal point in materials science due to their exceptional magnetic and electronic properties arising from the 4f shell electrons.

Here, we introduce the magnetic property of individual Samarium (Sm) and Europium (Eu) atoms, which has nearly half-filled and half-filled 4f shell each, adsorbed on various binding sites of a MgO thin film. Using electron spin resonance scanning tunneling microscopy (ESR-STM), we analyze the spin structures of Sm and Eu on different binding sites. Titanium (Ti), a well-established atom, serves as a spin sensor to detect interactions with the lanthanide atoms. Our comparison across binding sites reveals distinct spin characteristics of the lanthanides on a surface, which further opens a way to implement lanthanide atoms to quantum devices.

MA 15.11 Tue 10:00 P1

Applications of 3D Nano-Lithography in Magnetism — •Jana Kredl[1], Christian Denker[1], Cornelius Fendler[2], Julia Bethune[1], Nina Meyer[1], Theresa Brinker[1], Finn-F. Stiewe[1], Hauke Heyen[1], Chris Badenhorst[1], Alena Rong[1], Jakob Walowski[1], Robin Silber[3], Mark Doerr[1], Raghvendra Palankar[1], Uwe T. Bornscheuer[1], Marcel Kohlmann[1], Toni Hache[6], Michaela Lammel[4], Alexander Paarmann[5], Andy Thomas[4], Robert Blick[2], Mihaela Delcea[1], and Markus Münzenberg[1] — [1]University of Greifswald, Germany — [2]University of Hamburg, Germany — [3]VSB-Technical University of Ostrava, Czech Republic — [4]IFW Dresden, Germany — [5]Fritz Haber Institute of Max Planck Society, Berlin, Germany — [6]Helmholtz-Zentrum Dresden-Rossendorf, Germany

3D 2-Photon-Lithography, originally developed for 3D photonic crystals, opens a wide range of new possible applications in many fields, e.g. life sciences, micro-optics and mechanics. We will present our recent applications of 3D 2-Photon-lithography and show 3D evaporation masks for in-situ device fabrication using different deposition angles, infra-red laser light focusing lenses directly fabricated on optical fibers, tunnel structures for guiding growth of neurons [1], pillars for investigation of cell mechanics and master-mold fabrication for Polydimethylsiloxane (PDMS) micro-fluidic channels. Based on our experience we will discuss possible applications in magnetism. [1] C. Fendler et al., Adv. Biosys. 5 (2019) doi: 10.1002/adbi.201970054

MA 15.12 Tue 10:00 P1

Straining three-dimensional magnetic nanostructures — •José Claudio Corsaletti Filho, Mohammad Sedghi, Elina Zhakina, Markus König, Elena Gati, and Claire Donnelly — Max Planck Institute for Chemical Physics of Solids, Dresden, Germany

The study of nanoscale magnetic objects has led to fascinating discoveries over the past few decades. Three-dimensional magnetism offers new opportunities to develop compact energy storage devices and explore spin textures and novel domain walls, which could be crucial for energy-efficient computation. To improve our fundamental understanding and enable the development of new devices, it is important to be able to tune the magnetic properties of materials. One way to achieve the controlled manipulation of magnetic properties is through the application of strain. While the straining of materials is well established for both bulk, and thin film samples, applying strain to 3D magnetic nanostructures remains an open challenge. In this project we develop a protocol to strain three-dimensional cobalt nanostructures grown with focused electron beam induced deposition. By performing in-situ measurements as a function of applied strain, we explore first the mechanical properties of the 3D nanostructures under an electron microscope, and secondly, the evolution of the magnetic properties of the nanostructure with strain. The straining of magnetic nanostructures opens the door to control of magnetic textures in complex geometries, of key importance both to our fundamental understanding, and the development of new devices.

MA 15.13 Tue 10:00 P1

Micromagnetic Simulations of Domain Wall Dynamics in Chiral Nanostructures — •Iason-Konstantinos Douveas[1], Pamela Morales Fernandez[1,8], Sandra Ruiz- Gómez[3], Elina Zhakina[2], Sebastian Wintz[4], Markus König[2], Aurelio Hierro Rodríguez[5], Simone Finizio[6], Luke Turnbull[2], Naëmi Leo[7], Dieter Suess[1], Amalio Fernández-Pacheco[8], Claire Donnelly[2,9], and Claas Abert[1] — [1]Faculty of Physics, University of Vienna, Austria — [2]Max Planck Institute for Chemical Physics of Solids, Dresden, Germany — [3]ALBALBA Synchrotron Light Source, CELLS, Spain — [4]Helmholtz Zentrum Berlin BESSY II, Germany — [5]CINN CSIC, University of Oviedo, Spain — [6]Paul Scherrer Institut, Swiss Light Source, Switzerland — [7]Loughborough University, United Kingdom — [8]Institute of Applied Physics, University of Vienna, Austria — [9]International Institute for Sustainability with Knotted Matter, Japan

We investigate domain wall (DW) eigenmodes in three-dimensional chiral magnetic nanostructures through micromagnetic simulations using the finite-element method. Our study focuses on double helices under external magnetic fields, examining the relationship between DW behavior and structural parameters. We employ two computational approaches: a small-scale model for extensive parameter space exploration and a larger structure matching experimental specimens. By implementing X-ray magnetic circular dichroism simulations, we provide direct comparison with experimental data, offering insights into DW mechanics in curved geometries.

MA 15.14 Tue 10:00 P1

Developing a two sublattice model for spin inertia and nutation — •Tarek Moussa[1], Ritwik Mondal[2], and Akashdeep Kamra[1] — [1]Department of Physics, RPTU Kaiserlautern-Landau, Kaiserslautern, Germany — [2]Department of Physics, Indian Institute of Technology (ISM) Dhanbad, India

Recent theoretical and experimental works on ultrafast magnetization dynamics suggest the existence of a finite spin inertia resulting in a nutation mode. Using the Landau-Lifshitz-Gilbert equation, we develop a two sublattice model for the description of spin inertia on the basis of an effective spin-orbit-coupling description and results for two sublattice ferrimagnets. We examine the conditions under which the two-sublattice model leads us to the magnetization dynamics description including spin inertia.

MA 15.15 Tue 10:00 P1

Flip-flop transport of magnetic cuboidal particles in dynamic potential energy landscapes for Lab-on-Chip applications — •Jonas Bugase, Christian Janzen, Arne Vereijken, Yahya Shubbak, Nikolai Weidt, Rico Huhnstock, and Arno Ehresmann — Institute of Physics , University of Kassel, 34132 Kassel

The unique possibility to transport magnetic particles using controlled magnetic forces have resulted in their increased use in bio-applications. We, therefore, present the remotely controlled transport mechanism for cubiodal particles, fabricated using two-photon polymerization (2PP) lithography above a magnetically patterned flat substrate. By sputtering a magnetic exchange bias thin film system on the surface of the polymeric particles, we fix the magnetic moment of the particles along the elongated axis. We characterized the magnetic properties of the custom-made particles and studied their exotic transport within a periodic magnetic stray field landscape, artificially created by parallel stripe domains fabricated via ion bombardment induced magnetic patterning [1]. The shape anisotropy contributions and the rotation dynamics of the particles in a quiescent liquid environment leading to the lateral walking and flipping modes of the particle transport are characterized using optical microscopy. This transport mechanism is promising for the detection of biomolecules in Lab-on-Chip devices [2] and for probing the effective field direction of dynamically transformed magnetic stray field landscapes.

[1] Ehresmann *et al.* (2015), Sensors, (15): 28854.
[2] Lowensohn *et al.* (2020), Langmuir, (36): 7100.

MA 15.16 Tue 10:00 P1

Current status and outlooks in time-resolved scanning transmission X-ray microscopy imaging — Simone Finizio[1], Bart Olsthoorn[2], Joe Bailey[1], Claire Donnelly[3], Sina Mayr[1,4], Ales Hrabec[1,4], and •Jörg Raabe[1] — [1]Paul Scherrer Institut, Villigen PSI, Switzerland — [2]Nordita (KTH), Stockholm, Sweden — [3]MPI-CPFS, Dresden, Germany — [4]DMATL, ETH Zurich, Zurich, Switzerland

Time-resolved X-ray microscopy is a powerful imaging technique that has been extensively employed for the study of dynamical processes in condensed matter systems. In particular, time-resolved scanning transmission X-ray microscopy (TR-STXM) has been the workhorse in the experimental study of magneto-dynamical processes such as magnonics, switching, domain wall motion, and the dynamics of topological magnetic objects.

In this contribution, we will present the current status and outlooks of TR-STXM imaging at soft X-ray energies. The TR-STXM setup of the Swiss Light Source (SLS) will be presented, together with examples of 3D TR-STXM imaging, of periodogram-based imaging, and of how to overcome the limitations given by the X-ray pulse width.

In addition, we will present the planned future developments of the technique in view of the significant increase of coherent photon flux that will be offered by the upgrade of the SLS to a diffraction limited storage ring.

MA 15.17 Tue 10:00 P1

Micro-Hall magnetometry on magnetic grains and nanostructures — •Bereket Ghebretinsae and Jens Müller — Institute of Physics, Goethe University Frankfurt, 60438 Frankfurt (M), Germany

Micro-Hall magnetometry is a highly versatile and extremely sensitive magnetic measurement technique which allows for stray field measurements on micro- to nanosized samples with nanotesla sensitivity. The magnetometer is a Hall sensor based upon an AlGaAs/GaAs heterostructure which hosts a 2DEG whose unparalleled electron mobility in measurements directly translates into an ultrahigh stray-field resolution. Micro-Hall sensors have previously been used for diverse purposes such as resolving the discrete lattice potential inside a YIG thin film [1], pinpointing the onset of the formation of magnetic polarons inside ferromagnetic EuB_6 [2] as well as investigating the magnetostatics and the magnetization dynamics of two- and three-dimensional artificial spin ice systems [3]. Here we outline a (PhD) thesis project which intends to exploit the capabilities and the versatility of micro-Hall magnetometry to investigate a variety of magnetic systems of current scientific interest. We explain how micro-Hall measurements on specially prepared micron-sized YIG flakes, exchange-biased ferromagnetic bricks, and most of all, three-dimensional Co_3Fe nanotetrapod lattices serve to elucidate their characteristic properties and add upon our current understanding of the magnetism in these systems.

[1] K. Novoselov *et al.* Nature **426**, 812–816 (2003)
[2] M. Pohlit *et al.* Phys. Rev. Lett. **120**, 257201 (2018)
[3] L. Keller *et al.* Sci Rep. **8**, 6160 (2018)

MA 15.18 Tue 10:00 P1

Impact of sample dimensions on the anomalous Hall effect response — •Dominik Vogel, Denise Reustlen, Sebastian Sailler, Gregor Skobjin, Michaela Lammel, Richard Schlitz, and Sebastian T. B. Goennenwein — Fachbereich Physik, Universität Konstanz, Konstanz, Germany

The anomalous Hall effect (AHE) enables an electrical detection of the magnetization in ferromagnetic conductors. In typical AHE measurements, the voltage transverse to both the applied charge current and magnetic field is detected. Recording this voltage as a function of magnetic field strength and polarity allows one to infer the magnetic hysteresis loop of a given magnetic microstructure. However, the absolute magnitude of the AHE voltage characteristically scales with the sample dimensions. In particular, the smaller the width w of the respective studied Hall bar microstructure, the smaller the Hall voltage signal for constant current density. In order to establish the minimal sample dimensions required for a detectable AHE signal, we have systematically varied the dimensions of Hall bar microstructures patterned into thin Co/Pt multilayers with perpendicular magnetic anisotropy and measured their Hall response as a function of field magnitude and current density. We critically discuss the scaling of the Hall voltage with sample dimensions observed and its implications for Hall effect-based experiments in magnetic nanostructures.

MA 15.19 Tue 10:00 P1

Bright days ahead - Soft X-ray scanning microscopy at 4th generation lightsources — •Simone Finizio[1], Tim Butcher[1,2], Lars Heller[1], Benjamin Watts[1], Blagoj Sarafimov[1], Mirko Holler[1], and Jörg Raabe[1] — [1]Paul Scherrer Institut, Villigen PSI, Switzerland — [2]Max-Born-Institut, Berlin, Germany

Diffraction limited synchrotron (DLSR), or 4th generation, light sources are now delivering an increase in the coherent photon flux of several orders of magnitude compared to the current 3rd generation storage ring design, revolutionizing synchtrotron-based experiments.

For scanning transmission X-ray microscopy (STXM), the increase in coherent photon flux will allow us to routinely perform high-resolution imaging, as it will tackle all the issues occurring for high-resolution X-ray optics. In addition, the combined increase in coherent photon flux, in the available (GPU) computational power, and in the performances of 2D soft X-ray detectors will also enable for the routine performing of high-resolution soft X-ray ptychographic imaging.

In this presentation, we will show the current status of the commissioning of a new combined STXM and soft X-ray ptychography endstation at the SoftiMAX beamline of the MaxIV DLSR, and the first results in the ptychographic imaging of the magneto-electric coupling between ferroelectric domains and spin cycloid in freestanding BiFeO3 thin films, which fully exploit the sub-5nm spatial resolutions achievable with the technique.

MA 15.20 Tue 10:00 P1

Theory of Magnetization Dynamics Control by Phonons — •Meritxell Valls Boix and Alexander Mook — Johannes Gutenberg University, Mainz

Spin-lattice coupling plays a crucial role in facilitating angular momentum exchange between the lattice and magnetic subsystems. In this work, we explore how this coupling can be harnessed to enhance the lifetime of magnons in ferromagnetic materials. Specifically, we focus on the interaction between propagating surface acoustic waves and a proximate magnetic system, where these waves generate a torque on the spins. Using perturbation theory, we derive the effective field arising from magneto-rotational coupling and subsequently define the resulting torque. In particular, we investigate whether a damping-like component of the torque can emerge, which could act as an anti-damping mechanism to counteract the intrinsic magnon damping.

MA 15.21 Tue 10:00 P1

Prospects of spin dynamic mean-field theory for nuclear magnetic resonance — •Timo Grässer and Götz S. Uhrig — Condensed Matter Physics, TU Dortmund University, Germany

The recently developed dynamic mean-field theory for spins at infinite temperature (spinDMFT) [1] is perfectly tailored to simulate NMR experiments. The underlying idea of spinDMFT is to couple a spin to a dynamic Gaussian mean-field with second moments that are self-consistently linked to the spin's autocorrelations. The approach can be straight-forwardly improved by considering clusters of spins quantum-mechanically in a mean-field background [2,3]. As such, the extension to a non-local spinDMFT (nl-spinDMFT) has been successfully benchmarked for calcium fluoride (CaF_2) and adamantane ($C_{10}H_{16}$) [3]. Due to the low computational requirements and the high flexibility of the method, it can be applied to various scenarios in NMR such as magic angle spinning (MAS) or spin diffusion.

[1] T. Gräßer et al., Phys. Rev. Research 3, 043168 (2021).
[2] T. Gräßer et al., Phys. Rev. Research 5, 043191 (2023).
[3] T. Gräßer et al., Solid State NMR 132, 101936 (2024).

MA 15.22 Tue 10:00 P1

Micromagnetic simulation of an X-shaped crossing controlled by the orientation of an external bias magnetic field — •Sven Niehues, Robert Schmidt, Jannis Bensmann, Steffen Michaelis de Vasconcellos, and Rudolf Bratschitsch — Institute of Physics, University of Münster, Germany

Magnonics is a well-known research field in solid-state physics, which studies magnetic phenomena and the propagation of spin waves and their respective quanta, called magnons. The possibility of steering the propagation direction of spin waves in magnetic insulators such as yttrium iron garnet (YIG) is of crucial importance for the realization of magnonic logic devices. By changing the orientation of the external bias magnetic field relative to the propagation direction, the propagation of spin waves can be manipulated. In this work, numeric simulations of an X-shaped YIG crossing are presented, which allows the steering of spin waves from one input arm into all three output arms at selected frequencies by rotation of the magnetic bias field.

MA 15.23 Tue 10:00 P1

Coupled dynamic modes of a skyrmion chain in a synthetic antiferromagnet (SAF) — •Kauser Zulfiqar[1,2,3], Samuel Holt[1,3], Martin Lang[1,3], Swapneel Amit Pathak[1,3], and Hans Fangohr[1,3,4] — [1]Max Planck Institute for the Structure and Dynamics of the Matter, Hamburg, Germany. — [2]University of Hamburg, Hamburg, Germany. — [3]Center for Free Electron Laser, Hamburg, Hamburg, Germany. — [4]University of Southampton, Southampton, United Kingdom.

Synthetic antiferromagnets (SAFs) are multilayer structures with ferromagnetic layers coupled via RKKY interaction [1]. Skyrmions in SAFs are smaller than in ferromagnetic systems, and studying their modes provides insights into their dynamics and stability, enhancing their potential for spintronic devices [2].

In this work, we expand on previous studies of skyrmion dynamics in circular geometries [3] by exploring a chain of Néel-type skyrmions in a rectangular strip using finite-difference micromagnetic simulations [4]. We use the ringdown method to excite the system with a sinc pulse. Through Fourier analysis, we identify individual modes and observe hybrid and coupled breathing modes among layers.

This work is funded by Marie Skłodowska-Curie (grant 101152613), MaMMoS (Horizon Europe, grant 101135546), and HEC-DAAD (ID 57630247).

[1]. Physical Review B 94, 064406 (2016) [2]. Applied Physics Letters 118, 082403 (2021) [3]. Physical Review B 102, 104403 (2020) [4]. IEEE Transactions on Magnetics 58, 1-5 (2022)

MA 15.24 Tue 10:00 P1

Spin dynamics in ferrimagnetic heterostructures — •Felix Fuhrmann[1], Akashdeep Akashdeep[1], Sven Becker[1], Mathias Weiler[3], Gerhard Jakob[1,2], and Mathias Kläui[1,2,4] — [1]Institute of Physics, University of Mainz, Germany — [2]Graduate School of Excellence "Materials Science in Mainz" (MAINZ), Germany — [3]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Rheinland-Pfälzische Technische UniversitätKaiserslautern-Landau, 67663 Kaiserslautern, Germany — [4]Center for Quantum Spintronics, Norwegian University of Science and Technology, Trondheim, Norway

Magnons emerge as promising information carriers for energy-efficient technology. To advance magnon-based devices, crucial materials requirements must be addressed. Yttrium Iron Garnet (YIG, $Y_3Fe_5O_{12}$) and related garnets, like Gadolinium Iron Garnet (GdIG, $Gd_3Fe_5O_{12}$), stand out due to low damping and large magnon propagation lengths. Using pulsed laser deposition, we fabricated YIG/GIG heterostructures and simulated their magnetic properties. Our findings reveal ferromagnetic coupling between Fe sublattices, leading to complex magnetic response and nontrivial temperature dependence [1]. Experiments on spin current generation via spin Seebeck effect and spin pumping at ferromagnetic resonance align with our micromagnetic simulations [2]. These results provide insights for magnon-based devices and highlight YIG/GIG heterostructures' potential in spintronics applications. [1] S. Becker et al., Phys. Rev. Appl., 16, 014047 (2021). [2] F. Fuhrmann et al., ArXiv:2303.15085 (2023).

MA 15.25 Tue 10:00 P1

Magnetization fluctuations probed via the anomalous Hall effect — •Nadine Nabben[1], Giacomo Sala[2], Ulrich Nowak[1], Matthias Krüger[3], and Sebastian T. B. Goennenwein[1] — [1]Universität Konstanz — [2]ETH Zürich — [3]Universität Göttingen

Fluctuation phenomena inherently limit the precision of physical measurements, making it essential to understand the underlying mechanisms for improving measurement accuracy. In particular, analyzing magnetic fluctuations provides valuable insights into magnetization behavior and domain wall dynamics. We employ the anomalous Hall effect to electrically investigate low-frequency magnetization fluctuations in thin ferromagnetic layer stacks with perpendicular magnetic anisotropy. By examining the anomalous Hall effect noise at different points in the hysteresis loop, we probe the distinct types of magnetic noise associated with different magnetization states. Our results show that Barkhausen noise, exhibiting a characteristic $1/f^2$ frequency dependence, dominates as long as magnetic relaxation processes occur. In contrast, quasi-stationary magnetization fluctuations generate noise that obeys a $1/f$ frequency dependence. We discuss how these findings offer new perspectives on magnetic fluctuation mechanisms and their implications for both fundamental understanding and technical applications.

MA 15.26 Tue 10:00 P1

Micromagnetic Mumax3 simulations of spin-waves under the influence of stray field landscapes — •Fabian Samad[1,2], Attila Kákay[2], and Olav Hellwig[1,2] — [1]University of Technology Chemnitz, Chemnitz, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

In most spin-wave application concepts the capability of manipulating and confining the spin-waves is pivotal. One promising way is the usage of hybrid systems [1,2], where the spin-wave transport layer is not directly manipulated, e.g. by patterning, but instead is influenced by a "programming" layer. In our study, we choose for the programming layer a synthetic antiferromagnet (SAF) with perpendicular magnetic anisotropy (PMA) [3], which acts on a spin-wave transport layer via its stray field. The SAF can exhibit a variety of magnetic states depending on the energy parameters and the applied magnetic field, making it – and thus the hybrid system – field-reconfigurable. By performing Mumax3 simulations, we investigate the influence of the stray field of various magnetic patterns in the SAF on the spin-wave dispersion in a layer with YIG-type properties. Particularly, we focus on regular and periodic magnetic domains in the SAF, which can be stabilised e.g. by means of focussed ion beam irradiation and manipulated with external magnetic fields [4].

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MA 15.27 Tue 10:00 P1

Quantum spin liquid mimicry in correlated proton disorder double hydroxide perovskite $CuSn(OD)_6$ — •Anton Kulbakov[1], Ellen Haeussler[2], Aswathi Mannathanath Chakkingal[1], Nikolai Pavlovskii[1], Kaushick Parui[1], Sergey Granovsky[1], Sebastian Gass[3], Laura Teresa Corredor Bohorquez[3], Anja Wolter[3,4], Vladimir Pomjakushin[5], Darren Peets[1], Thomas Doert[2], and Dmytro Inosov[1,4] — [1]IFMP, TUD, Dresden, Germany — [2]Faekultaet fuer Chemie und Lebensmittelchemie, TUD, Dresden,Germany — [3]IFW, Dresden, Germany — [4]Wuerzburg-Dresden ct.qmat, TUD, Dresden, Germany — [5]PSI, Villigen, Switzerland

In a magnetic double perovskite hydroxide $CuSn(OD)_6$, the frustration of the proton network coexists with magnetic frustration on the distorted fcc sublattice. Structural distortions, which are most pronounced in the Cu^{2+} compounds due to the Jahn-Teller effect, partially alleviate both frustrations. On the other hand, the quantum spin $S = \frac{1}{2}$ promotes quantum fluctuations that lower the ordering temperature. Proton disorder is also expected to suppress long-range order tendencies from most general considerations, as it should lead to variations in the exchange constants, which can effectively be described as bond disorder in the spin model. In certain scenarios, these can destroy long-range order in favor of spin-liquid-mimicry.

MA 15.28 Tue 10:00 P1

Observation of the spiral spin liquid in a triangular-lattice material — •Nikita Andriushin[1], Stanislav Nikitin[2], Oystein Fjellvag[2,3], John White[2], Andrey Podlesnyak[4], Dmytro Inosov[1], Marein Rahn[6,1], Marcus Schmidt[5], Michael Baenitz[5], and Aleksandr Sukhanov[6,1] — [1]TU Dresden, Germany — [2]PSI, Switzerland — [3]IFE, Norway — [4]ORNL, USA — [5]MPI CPfS, Dresden, Germany — [6]Augsburg University, Germany

The spiral spin liquid (SSL) is a highly degenerate state characterized by a continuous contour or surface in reciprocal space spanned by a spiral propagation vector. Although the SSL state has been predicted in a number of various theoretical models, very few materials are so far experimentally identified to host such a state. Via combined single-crystal wide-angle and small-angle neutron scattering, we report observation of the SSL in the quasi-two-dimensional delafossite-like $AgCrSe_2$ [1]. We show that it is a very close realization of the ideal Heisenberg J_1–J_2–J_3 frustrated model on the triangular lattice. By supplementing our experimental results with microscopic spin-dynamics simulations, we demonstrate how such exotic magnetic states are driven by thermal fluctuations and exchange frustration.

[1] N. D. Andriushin, *et al.*, arXiv:2410.04954 (2024).

MA 15.29 Tue 10:00 P1

Magnetism in i-Tb-Cd quasicrystals — •Andreas Kreyssig — Institute for Experimental Physics 4, Ruhr-Universität Bochum, 44801 Bochum, Germany

i-Tb-Cd orders as icoshedral quasicrystal with the magnetic Tb3+ ions arranged in Tsai-type clusters. We studied the magnetic correlations and excitations by elastic and inelastic neutron scattering on single-grain isotopically enriched samples. The measurements of the crystalline electric field excitations demonstrated that the Tb3+ moments are directed along the local fivefold axes of the Tsai-type clusters. By using a simple Ising-type model for the moment configurations on a single Tb3+ icosahedron, we calculated the magnetic diffuse scattering for the low-energy configurations and identified the most likely moment configuration in a single cluster by comparison with our diffuse neutron scattering signals. We further studied the role of intercluster interactions for magnetic frustration and the magnetic scattering.

This work was supported by the U. S. DOE, BES, DMSE, under Contract DE-AC02-07CH11358. This research used resources at HFIR and SNS, U. S. DOE Office of Science User Facilities operated by the Oak Ridge National Laboratory.

MA 15.30 Tue 10:00 P1

Magnetism in i-Tb-Cd quasicrystals — •Andreas Kreyssig[1,2], P. Das[2], G. S. Tucker[2], A. Podlesnyak[3], Feng Ye[3], Masaaki Matsuda[3], T. Kong[2], S. L. Bud'ko[2], P. C. Canfield[2], R Flint[2], P. P. Orth[2,4], T. Yamada[5], and A. I. Goldman[2] — [1]Experimental Physics IV, Ruhr University Bochum, Bochum, Germany — [2]Ames Laboratory, U.S. DOE, and Department of Physics and Astronomy, Iowa State University, Ames, USA — [3]Neutron Scattering Division, Oak Ridge National Laboratory, USA — [4]Department of Physics, Harvard University, Cambridge, USA — [5]Department of Applied Physics, Tokyo University of Science, Tokyo, Japan

i-Tb-Cd orders as icoshedral quasicrystal with the magnetic Tb^{3+} ions arranged in Tsai-type clusters. We studied the magnetic correlations and excitations by elastic and inelastic neutron scattering on single-grain isotopically enriched samples. The measurements of the crystalline electric field excitations demonstrated that the Tb^{3+} moments are directed along the local fivefold axes of the Tsai-type clusters. We calculated the magnetic diffuse scattering for the low-energy configurations using an Ising-type model for the moment arrangements on a single Tb^{3+} icosahedron. By comparison with our diffuse neutron scattering signals, we identified the most likely moment configuration in a single cluster. We further studied the role of intercluster interactions for magnetic frustration and the magnetic scattering.

This work was supported by the U. S. DOE, BES, DMSE, Contract DE-AC02-07CH11358, and resources at HFIR and SNS, U. S. DOE.

P. Das, A. Kreyssig, et. al., Phys. Rev. **B** 108, 134421 (2023).

MA 15.31 Tue 10:00 P1

Frustrated magnetism in hydrogenated hexagonal Boron Nitride — •Maksim Ulybyshev, Manish Verma, and Giorgio Sangiovanni — Institut für Theoretische Physik und Astrophysik, Universität Würzburg, 97074 Würzburg, Germany

We study monolayer hexagonal boron nitride (h-BN) with hydrogen adatoms arranged in a regular triangular lattice. Extensive density functional theory (DFT) calculations reveal a flat band formed by electronic states localized near the adatoms, situated within the band gap of h-BN. Based on these results, we construct a tight-binding model that captures the essential features of this band structure and derive an effective Hamiltonian for electrons in the flat band. This effective Hamiltonian incorporates the effects of long-range Coulomb interactions projected onto the flat band using a technique previously validated by Quantum Monte Carlo simulations of similar systems. We demonstrate that the lack of particle-hole symmetry in this system causes the projected long-range Coulomb interactions to induce frustrated spin couplings between electrons localized near neighboring adatoms. Depending on the spatial configuration of the adatoms, this frustration can give rise to various nontrivial magnetic states.

MA 15.32 Tue 10:00 P1

Geometrical frustration mediated unconventional magnetism in a Kondo lattice Ce3ZrBi5 — •Saswata Halder, Arumugam Thamizhavel, and Kalobaran Maiti — Tata Institute of Fundamental Physics, Mumbai, India

Kondo lattice materials with geometric frustration offer fertile ground for exploring exotic new physics with a field-induced fractional magnetization platform. In this work, we investigate hexagonal Ce3ZrBi5 with 1D Bi chains and a frustrated Ce-kagome network to understand its magnetic properties. Density functional theory (DFT) calculations reveal the presence of a non-trivial electronic structure, that changes significantly in the presence of SOC. The temperature dependent magnetization for Ce3ZrBi5 show the presence of two antiferromagnetic (AFM) transitions below TN = 4.9 K; highlighting a complex and highly anisotropic magnetic landscape. The magnetization shows a peculiar nature where the moments align along the CEF hard axis; contrary to conventional antiferromagnets. The unconventional magnetization can be attributed to multiple observables: geometric frustration, presence of competing Kondo and RKKY nergy scales and strong

spin- orbit coupling (SOC). Field-induced metamagnetic transitions are observed in the isothermal magnetization data which follows the one-third magnetization rule observed in frustrated Kagome lattices. Specific heat and transport measurements highlight inherent Kondo-lattice characteristics in Ce3ZrBi5. Our work establishes Ce3ZrBi5 and related materials as a unique platform for exploring low-dimensional quantum fluctuations in frustrated antiferromagnets.

MA 15.33 Tue 10:00 P1

Flat bands and megnetoelectric effect in XX sawtooth chain with three-spin interactions — •Karen Baghdasaryan[1], Vadim Ohanyan[2,3], Ostap Baran[4], and Oleg Derzhko[4] — [1]Ludwig-Maximilians-Universität, München, Germany — [2]Yerevan State University, Yerevan, Armenia — [3]CANDLE Synchrotron Research Institute, Yerevan, Armenia — [4]Institute for Condensed Matter Physics, Lviv, Ukraine

We present an exact analysis of the XX sawtooth chain with three-spin interactions and the Katsura-Nagaosa-Balatsky (KNB) mechanism. Using Jordan-Wigner fermionization, we identify all zero-temperature phases of the model and observe the emergence of a flat band in the free-fermion spectrum. These flat bands result in jumps in observables such as magnetization and dielectric polarization as functions of both magnetic and electric fields.

MA 15.34 Tue 10:00 P1

Two-dimensional coherent spectroscopy as a probe for spin-1 single ion bound states — •Sagar Ramchandani[1], Yoshito Watanabe[1], Simon Trebst[1], and Ciarán Hickey[2,3] — [1]Institute for Theoretical Physics, University of Cologne, 50937 Cologne, Germany — [2]School of Physics, University College Dublin, Belfield, Dublin 4, Ireland — [3]Centre for Quantum Engineering, Science, and Technology, University College Dublin, Dublin 4, Ireland

Nonlinear spectroscopy has emerged as a powerful prospect to probe quantum magnets by extracting information from higher-order responses. In this work, we report on the implementation of 2-dimensional coherent spectroscopy (2DCS) in the context of the Su(n)ny Julia package for modelling atomic-scale magnetism. We employ this code (and its semi-classical approach) to study the properties of spin-1 single ion bound states (SIBS), motivated in part by recent experiments on FeI_2.

MA 15.35 Tue 10:00 P1

Theoretical study on in-plane, out-of-plane, and transverse anisotropic magnetoresistance effects for ferromagnetic films — •Satoshi Kokado[1] and Masakiyo Tsunoda[2] — [1]Shizuoka University, Hamamatsu, Japan — [2]Tohoku University, Sendai, Japan

We theoretically study the in-plane [1], out-of-plane [2], and transverse anisotropic magnetoresistance (AMR) effects [3] for a strong ferromagnet, Fe_4N. We here use the electron scattering theory with an extrinsic mechanism, in which the conduction electron is scattered into the conduction state and the localized d states by impurities and so on [4]. The in-plane and out-of-plane AMR effects exhibit the negative AMR ratio with the twofold symmetry, while the transverse AMR effect shows the positive AMR ratio with the fourfold symmetry. The calculation results agree qualitatively well with the respective experimental results [1,2,3] for Fe_4N. In addition, the peak structures of the AMR ratios reflect the probability densities of the current direction of the single atomic d states.

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MA 15.36 Tue 10:00 P1

Preparation and characterization of $Co_{20}Fe_{80}Si_x$ thin films — •Florian Knossalla, Maik Gaerner, Luca Kempe, Karsten Rott, Jan Schmalhorst, and Günter Reiss — Bielefeld University, Germany

In spintronics, materials with favorable magnetic properties, such as large magnetic polarization and a high Curie temperature are essential. By means of machine learning, different Fe-Co-Si compounds were identified as promising [1]. This study focuses on the investigation of alloys with the composition $Co_{20}Fe_{80}Si_x$.

The samples were fabricated using DC and RF magnetron co-sputtering. Subsequently, temperature-dependent resistance measurements, investigations of the ordinary and the anomalous Hall effect were performed alongside with measurements of the anisotropic magneto-resistance.

The magnetic polarization decreased with increasing silicon content, from approximately 2 T for $Co_{20}Fe_{80}$ to about 0.5 T for $Co_{20}Fe_{80}Si_{100}$. In the latter, a phase transition at 60K was observed, which coincides with the appearance of a linear nonsaturating magnetoresistance. Interestingly, $Co_{20}Fe_{80}Si_{50}$ exhibited a higher magnetic polarization than $Co_{20}Fe_{80}Si_{25}$, as well as twice the charge carrier density compared to $Co_{20}Fe_{80}$.

[1]Timothy Liao u. a. Phys. Rev. Materials 7, 034410(2023)

MA 15.37 Tue 10:00 P1

Real-time in-situ giant magnetoresistance measurements in Co/Cu multilayers during sputter deposition — Michael Mattern, •Luca Kempe, Jan Schmalhorst, and Günter Reiss — Bielefeld University, Faculty of Physics, Germany

Magnetoresistive sensors generate important input information that is further processed in complex microelectronic systems in a wide range of applications. For optimization purposes or the investigation of new material combinations, a permanent analysis of the influence of deposition conditions on the magnetoresistive performance is necessary. Today, research and development in the field of magnetic sensor technology is slowed down due to slow feedback from results of ex-situ characterization of samples into modelling and production. This study presents an experimental technique for real-time in-situ measurements of magnetoresistive effects, such as giant magnetoresistance (GMR), during the sputtering process. As an example, an oscillating in-plane magnetic field with an amplitude of 420 Oe and a frequency of 10 Hz was applied to samples of cobalt/copper multilayers during film growth. By employing advanced instrumentation with a sampling rate of 20 kS/s and the implementation of real-time GMR amplitude calculation, we were able to obtain and analyze complete R versus H curves within 100 milliseconds. Correlations between the magnetic response of these samples and structural changes at different stages of film deposition are shown.

MA 15.38 Tue 10:00 P1

Quantitative study of the spin Hall magnetoresistance in a yttrium iron garnet/Pt heterostructure — •Denise Reustlen, Sebastian Sailler, Davina Schmidt, Richard Schlitz, Michaela Lammel, and Sebastian T. B. Goennenwein — Department of Physics, University of Konstanz, 78457 Konstanz

The spin Hall magnetoresistance (SMR) is a well-known and extensively studied phenomenon in the field of spintronics. The SMR is most commonly observed in heterostructures consisting of a ferromagnetic insulator and a normal metal with a large spin orbit interaction. In this study, we use yttrium iron garnet as the ferrimagnetic insulator and platinum as the normal metal due to its relatively large spin Hall angle. While the SMR is usually measured locally, on a single Hallbar structure, the data obtained often are used to gauge the magnetic quality of the underlying magnetic insulator or of the magnet/metal interface. Interestingly, however, up to now little is known about the SMR statistics in one Hallbar and the scatter of the SMR magnitude across several Hallbars on a single sample. Given that the SMR is a local effect, it is relevant to ascertain the significance of a single measurement as a representative measure for the entire sample. We thus have patterned more than 200 nominally identical SMR microstructures into a single YIG/Pt bilayer and studied the statistical distribution of the SMR as a function of position across the entire sample. Our results demonstrate that the SMR amplitude is robust and provide the basis for a consistent comparison of the SMR.

MA 15.39 Tue 10:00 P1

Spin Textures Stability in Exfoliated Fe3GaTe2 Two-Dimensional Magnets — •Kai Litzius[1], Yara Mahboub[2], Krishnanjana Puzhekadavil Joy[2], Steffen Wittrock[1], Lilian Prodan[1], István Kézsmárki[1], and Felix Büttner[1,2] — [1]University of Augsburg, Augsburg, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany

Two-dimensional (2D) van der Waals magnets have emerged as an exciting area of research, providing unique opportunities to study magnetism in reduced dimensions. Among these materials, Fe3GaTe2 is particularly notable for its exceptionally high Curie temperature [1], which enables investigations and device applications at room temperature. Moreover, its structural and compositional similarity to Fe3GeTe2, one of the most extensively studied 2D magnets, suggests significant potential for tuning its magnetic properties [2,3], making it a promising candidate for both fundamental research and spintronic device applications. In this study, we explore the spin texture stability of Fe3GaTe2 thin flakes, prepared through mechanical exfoliation, using magnetic force microscopy (MFM). We also assess their resistance to oxidation [4] and degradation under ambient conditions, confirming their robust performance. These results highlight Fe3GaTe2 as a high-TC, stable 2D magnet, well-suited to advancing research in 2D magnetism and enabling next-generation spintronic technologies. References: [1] H. Shi et al., Nano Lett. 24, 11246 (2024). [2] Y. Wu et al. Nat. Commun. 11, 3860 (2020). [3] M. T. Birch et al. 2D Mater. 11, 025008 (2024). [4] D. S. Kim et al. Curr. Appl. Phys. 30, 40 (2021).

MA 15.40 Tue 10:00 P1

Electrical detection of spin currents in magnetic insulators — •Ankita Nayak[1], Matthias Kronseder[2], Nynke Vlietstra[3], Hans Huebl[3,4,5], Jeroen A. Heuver[6], Beatriz Noheda[6], Maxim Mostovoy[6], Christian Back[3,4], and Aisha Aqeel[1,3,4] — [1]University of Augsburg, 86135, Augsburg, Germany — [2]Department of Physics, Regensburg University, 93053, Regensburg, Germany — [3]Department of Physics, Technical University Munich, 85748 Garching b. München, Germany. — [4]Munich Center for Quantum Science and Technology (MCQST), Schellingstr. 4, D-80799, München, Germany. — [5]Walther -Meißner-Institut, Bayerische Akademie der Wissenschaften, 85748, Garching, Germany, — [6]Zernika Institute for Advanced Materials, University of Groningen, Nijenborgh 4, 9747 AG, Groningen, The Netherlands.

We investigate the spin current-induced phenomena, such as spin Hall magnetoresistance and the spin Seebeck effect within Pt films deposited on a noncollinear magnet [1], CoCr2O4 (CCO). CCO is a spinel with a collinear ferrimagnetic state below Tc = 94 K and noncollinear magnetic phases at lower temperatures [2]. We investigated the SMR and the SSE at different temperatures (5K-300K) [2]. The temperature-dependent behavior of both SMR and SSE signals exhibits a noticeable variation correlated with different magnetic phases of CCO. This study offers insights into spin-current-driven phenomena, paving the way for potential spintronic applications. [1]. A. Aqeel, et al., Phys. Rev. B 103 (10), L100410 (2021). [2]. A. Aqeel, Phys. Rev. B 92 (22), 224410 (2015).

MA 15.41 Tue 10:00 P1

First principle study of Spin and charge transport properties in CrO2/CrI3/Td-WTe2/CrO2 based device heterostructures — •Nivedita Pandey and Oscar Granas — Department of Physics and Astronomy, Uppsala University, SE-751 20 Uppsala, Sweden

Van der Waals heterostructures are attractive for spintronic applications due to tunability of electronic, and magnetic properties. Herein, we show that precise control over spin injection and filtering can be achieved by interfacing magnetic and non-magnetic 2D layers, and these properties are robust to electrode attachment. We study a bilayer of CrI3/WTe2, using electrode CrO2 to design a promising spintronic device. We use density functional theory, capturing charge transport and thermal properties through the use of the non-equilibrium Green function. Integration of ferromagnetic CrI3 with either metallic or semiconducting phase of WTe2 results in substantially different properties of the interface. Further, the coupling between magnetism, and charge/spin transport has been studied in detail for both parallel magnetization and anti-parallel magnetization case. The spin polarized current with variation in the electrode temperature has been calculated for the designed CrO2/CrI3/WTe2/CrO2 device, further the spin filtration efficiency is extracted to understand the effect of temperature on spin filtration. The proposed device shows a spin filtration efficiency of around 100% at the studied temperatures. In addition, a high thermal magnetoresistance has been obtained for the designed device.

MA 15.42 Tue 10:00 P1

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 and quality. We will discuss these workflows from a system administrator's perspective, emphasizing the infrastructure and tools needed to support scientific computing. Using a recent scientific project as a case study, we present an example workflow that makes the projects numerical methods for calculating the three-dimensional topological Hopf index accessible [1]. Not only do we offer Python scripts, but we also develop extensions for the standard micromagnetic software tool, Mumax3 [2]. Code management is handled through GitLab, ensuring access to the most current versions of code [3], while Zenodo is used to provide persistent identifiers for released versions [4].

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MA 15.43 Tue 10:00 P1

Angle-resolved calculation of magnetocrystalline anisotropy using symmetry-adapted Wannier functions — •Hiroto Saito and Takashi Koretsune — Tohoku University, Sendai, Japan

Magnetocrystalline anisotropy is one of the most fundamental physical quantities that determine the properties of magnetic materials. However, since its value is often very small, dense k-mesh is needed to accurately calculate it using first-principles calculations. We have previously developed a method to calculate magnetocrystalline anisotropy with high precision and low computational cost by constructing a Wannier tight-binding model that incorporates both crystal and spin symmetries, and by using the time-reversal-symmetry operation to separate the magnetization and spin-orbit interaction [1, 2].

Recently, a systematic approach for generating a complete set of symmetry-adapted multipole bases has been developed to describe the electronic degrees of freedom in crystals [3]. In this study, we apply this method to demonstrate that symmetry-adapted Wannier Hamiltonians for magnetic materials can be expanded using multipole bases. This finding highlights the feasibility of constructing symmetry-based effective models directly from first-principles calculations. As a practical application, we report the calculation results of the magnetic anisotropy of anomalous Hall conductivity.

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MA 15.44 Tue 10:00 P1

Discretization Anisotropy In Micromagnetics — Samuel Holt[1,2], •Andrea Petrocchi[1,2], Martin Lang[1,2], Swapneel Pathak[1,2], and Hans Fangohr[1,2,3] — [1]Max Planck Institute for the Structure and Dynamics of Matter, Luruper Chaussee 149, 22761 Hamburg, Germany — [2]Center for Free-Electron Laser Science, Luruper Chaussee 149, 22761 Hamburg, Germany — [3]Faculty of Engineering and Physical Sciences, University of Southampton, Southampton SO17 1BJ, United Kingdom

Micromagnetics models the physics of magnetic systems using partial differential equations to express quantities such as the magnetization, energy density, and effective field. The discretization of these equation onto a regular lattice produces anisotropy. Its impact is extensive and includes phenomena such as the energy-minimizing rotation of magnetic structures, preferred directions, and creating artificial magnetization structures.

Despite this, the consequences of discretization anisotropy and how to mitigate against it are rarely discussed in the context of micromagnetics. A thorough understanding of these effects is important for the accurate interpretation of simulation results and for enhancing the overall fidelity of micromagnetic modeling. In this work we focus on these errors introduced by using finite difference approximations in micromagnetic simulations.

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MA 15.45 Tue 10:00 P1

Magnetization Reconstruction from Magnetic Field Measurements Using Physics-Informed Inverse Problems — •Alexander Setescak, Florian Bruckner, and Claas Abert — University of Vienna, Austria

Understanding the magnetization of topological spin textures is crucial for advancing spintronic applications. This work covers a physics-informed framework for reconstructing magnetization from high-resolution magnetic field measurements, such as those obtained via nitrogen-vacancy (NV) magnetometry. The approach leverages the micromagnetic equilibrium condition as a critical constraint in the inverse problem, ensuring the reconstructed magnetization satisfies the fundamental energy minimization principles.

The reconstruction process is formulated as an optimization problem, where a loss functional is designed to minimize discrepancies between measured and computed magnetic fields while imposing physical and regularization constraints. Efficient gradient computation is achieved through a combination of backpropagation algorithms and the adjoint method, enabling accurate and robust parameter optimization.

Preliminary results reveal detailed magnetization structures consistent with theoretical predictions and experimental observations. This demonstrates the potential of the proposed framework to investigate tailored magnetic configurations on the nanoscale, thereby laying the groundwork for future advancements in spintronic device engineering.

MA 15.46 Tue 10:00 P1

Synthetic Data Training Strategies for Magnetic Phase Classification — •Marcelo Arlego[1,2], Agustín Medina[1], and Carlos Lamas[1] — [1]Instituto de Física La Plata, La Plata, Argentina. — [2]Institute for Theoretical Physics TU-BS

In this work, we explore the potential of artificial neural networks trained with a synthetic catalogue of spin patterns, examining their ability to generalize and classify phases in complex models beyond the simplified training context.

Specifically, we investigate the transition from order to disorder in a diluted Ising model, a problem for which no exact solution exists, and where most current analytical and numerical techniques face significant difficulties.

Despite these obstacles, we used direct methods to achieve consistency in determining percolation densities and transition temperatures.

Our results suggest that a simple yet strategic training approach for neural networks can help in understanding complex physical phenomena, with potential applications beyond condensed matter physics.

MA 15.47 Tue 10:00 P1

Simulation of magnetoelastic mode filters for surface acoustic waves — •Bernhard Emhofer[1], Michael Karl Steinbauer[1], Peter Flauger[1], Matthias Volz[3], Matthias Küss[2], Stephan Glamsch[2], Manfred Albrecht[2], Hubert Krenner[3], and Claas Abert[1] — [1]University of Vienna — [2]University of Augsburg — [3]University of Münster

Surface acoustic wave (SAW) propagation critically depends on the waveguide geometry, with a key challenge being the independent excitation of specific mode types such as Rayleigh and shear modes.

In this study, we employ micromagnetic simulations, specifically the python library magnum.np [1], to explore a novel approach for selectively absorbing specific acoustic modes via magnetoelastic coupling. This coupling occurs through the excitation of spin waves in a thin magnetic film, layered on top of the waveguide. To achieve controlled mode filtering, the equilibrium magnetization is manipulated by varying the angle and strength of an external magnetic field. The distinct resonance configurations for Rayleigh and shear modes observed experimentally [2], enable their selective attenuation.

Simulations performed for a $LiNbO_3$ substrate with a 108 nm thick Ni film show that SAWs experience significant attenuation, with the maximum displacement at the surface reduced by around 70% after 13 wavelengths. These results demonstrate the potential of magnetoelastic interactions for precise mode filtering.

[1] F. Bruckner et al., Sci. Rep. 13, 12054 (2023).
[2] M. Küß et al., Phys. Rev. Appl. 15, 034046 (2021).

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Revealing rich magnetic phases and novel spin-wave spectra in Orthorhombic perovskite TbCrO3: a frsfprinciples study — •Fengyi Zhou — Faculty of Applied Sciences, Macao Polytechnic University, Macao SAR, 999078, China

The experimental measurements have revealed the orthohombic perovskite $TbCrO_3$ crystal exhibits rich magnetic structures with temperature variation. Specifically, a long-range canted AFM state of Cr^{3+} ions is formed below $T_N^{Cr} = 157.9$ K. At a lower temperature (below $T_N^{Tb} \sim 7.7$ K), the Tb^{3+} ions exists a long-range antiferromagnetic (AFM) order. Furthermore, a weak competition between the FM and AFM interactions within the Cr^{3+} ions is observed at 15 K. Importantly, a strong coupling between the spin orders of the Cr^{3+} and Tb^{3+} ions is observed at 1.8 K. As the temperature decreases, the magnetic moment of Tb disappears first. Currently, in-depth theoretic research is appealing and urgently needed to explore these complex magnetic interactions, magnetic phase transition and spin wave spectra of $TbCrO_3$.

Based on the first-principles study, this study presents the entire magnetic landscape of $TbCrO_3$ including the magnetic ground state, equilibrium state, and excited state. Meanwhile, we clarified the detailed magnetic exchange mechanisms including the isotropic Heisenberg exchange and the antisymmetric Dzyaloshinskii-Moriya interaction, as well as single ion anisotropy. Finally, the spin wave spectrum considered adiabatic and temperature-dependent relationships is also evaluated.