Magnetic Summer School 2025
Poster Presentation Program

# June 22, 2025 (Sunday)

# S-01: Nicholas Homrocky

*Oakland University - Rochester Hills (Michigan)*

**Title: Magneto-Elastic Coupling and Excitation of Backward Volume Spin Waves and Surface Acoustic Waves**

Surface acoustic waves (SAW) are excited efficiently, well understood and used in signal processing, and sensory technology. We show SAW can efficiently excite Backward Volume Spin Waves (BVSW). This case is studied theoretically in a 2-layer system of Yttrium Iron Garnet (YIG) on top of a Gadolinium Gallium Garnet (GGG) substrate. An internal in-plane magnetic field is applied along direction of wave propagation. The magnetoelastic (ME) coupling rate for SAW-BVSW is found via overlap of wave profiles from the ME energy density. Results show thinner YIG films (250nm) and larger magnetic fields (3000 Oe) give the better coupling rate at ~100 MHz. This will produce a 200 MHz anti-crossing gap in the wave spectrum. Numerical calculations of the ME gap in the wave spectrum also show us a frequency gap where no waves can pass and be controlled via magnetic field strength. Considering the group velocity for BVSW, the thicker films support faster transport of BVSW in the opposite direction of SAW propagation. The 5µm thick YIG film has BVSW at 1.7 km/s while the 250nm has BVSW at .4 km/s at 100 Oe. This speed is important to note when damping is large for isolators/filters when used properly while controlling the magnetic field. The thicker 5µm thick YIG film would require less energy to achieve the frequency gap considering lower magnetic fields less than 500 Oe is needed compared to thinner films. This method for easy excitations of BVSW to SAW, or vice versa too, allows us to study numerous other phenomena.

# S-02: Bin Luo

*Northeastern University (MA)*

**Title: LOW-LOSS WIDEBAND NONRECIPROCAL MAGNETO-ACOUSTIC RF ISOLATORS ENABLED BY NON-COLLINEAR DIPOLAR-COUPLED FERROMAGNETIC STACK (tentative, may change)**

Nonreciprocal RF isolators and circulators are critical components in modern wireless communication systems, enabling full-duplex radios and protecting power amplifiers from back-reflections in high-power microwave transmitters. These functionalities significantly enhance spectral efficiency and coordination in mesh or relay networks, particularly for 5G, IoT, and emerging 6G technologies. However, conventional RF isolators and circulators are bulky, expensive, and power-hungry due to their reliance on ferrite materials, which require high-temperature, oxidizing growth conditions and permanent magnets for operation via Faraday rotation—factors that are incompatible with CMOS processes.

Magneto-acoustic RF devices have recently emerged as promising alternatives, offering nonreciprocity with excellent power efficiency and CMOS compatibility. These devices incorporate a magnetic stack placed within the surface acoustic wave (SAW) propagation path between two interdigital transducers (IDTs) on a piezoelectric substrate. When RF voltage is applied, the resulting SAW interacts with spin waves in the magnetic layers, forming hybrid magneto-acoustic waves with direction-dependent loss characteristics. Despite significant advancements using magnetic heterostructures such as FeGaB-based and synthetic antiferromagnetic stacks, prior demonstrations have often been hindered by high insertion losses (typically >40 dB) and limited bandwidth.

In this work, we demonstrate a compact, low-loss, wideband nonreciprocal magneto-acoustic RF isolator utilizing a non-collinear dipolar-coupled FeGaB/SiO₂/FeGaB trilayer. The ferromagnetic stack couples to the fundamental SAW mode at 2.87 GHz on a 128° Y-X cut LiNbO₃ substrate. By engineering the magnetic anisotropy angles (10° and 70° relative to the SAW wavevector) through in-situ angled field deposition, we achieve multiple wideband nonreciprocal windows from 2.48 to 3.15 GHz. The device exhibits a peak nonreciprocity of ~40 dB (200 dB/mm), with low insertion loss of ~13 dB off-resonance and ~25 dB on-resonance at 2.87 GHz. This ultra-compact device offers strong potential for compact, low-power full-duplex radios, quantum transducers, and hybrid magnonic-acoustic systems.

# S-03: Olivia Zanoni

*University of Colorado Colorado Springs (Colorado)*

**Title: Growth and Characterization of Epitaxial KMnF3 Antiferromagnetic Thin Films**

Like other bosons, magnons can condensate into their quantum ground state, and the Bose-Einstien condensation (BEC) of magnons in antiferromagnets (AFMs) has attracted much attention in the last few years. Epitaxial thin films promise a straightforward approach to investigate the behavior of antiferromagnons; however, several AFMs which have historically been magnetically well characterized in bulk have not been characterized in thin films.
 We prepared several monocrystaline epitaxial thin films of the AFM KMnF3 on MgO substrate using molecular beam epitaxy (MBE). These films are of varying thickness and crystal quality. Characterization of these films has been undertaken using: reflected high-energy electron diffraction (RHEED); X-ray diffraction (XRD); SQUID magnetometry; and broadband ferromagnetic resonance (BFMR).
 RHEED and XRD confirm our films are indeed monocrystaline with good crystallinity. Additionally, the XRD results show the films have a cubic crystal structure with a lattice constant of 4.189 Angstroms, which matches the crystal structure of the bulk.
 The ongoing SQUID and BFMR investigation of the KMnF3 reveal complex magnetic behavior with a high degree of temperature sensitivity. Our studies open the door to applications of high-quality epitaxial AFM films for BEC and other magnonic and spintronic experiments.

# S-04: Bo Yin

*China Three Gorges University (Yichang City, Hubei Province, China)*

**Title: An efficient topology optimization method for electromagnetic devices considering the hysteresis characteristics of electrotechnical steel materials**

Topology optimization seeks the optimal topological layout form of a structure to achieve some or some performance indexes under certain constraints, and the research on topology optimization theory and application technology of electromagnetic devices has been vigorously developed in recent years. However, the existing topology optimization methods in the calculation process of topology optimization of electromagnetic devices, the hysteresis characteristics of electrotechnical steel materials are often ignored, some electromagnetic devices, such as transformers or motors, there are a large number of rotating magnetic flux in the core, the hysteresis effect of the core under the rotational magnetization will increase the core loss, exacerbate the vibration and deformation of the core, which will lead to the inaccuracy of the iterative calculation of topology optimization results, which will affect the final optimization results. At the same time, most of the existing electromagnetic devices topology optimization methods have the problems of long calculation time, non-convergence of the optimization results, and difficulty in processing and manufacturing of topology optimized shapes and structures, which will limit the further development of the theory of electromagnetic devices topology optimization methods and application technology. Therefore, the hysteresis characteristics of electrotechnical steel materials cannot be neglected in the topology optimization design of electromagnetic devices, and there is an urgent need to study a topology optimization method of electromagnetic devices that can take the hysteresis characteristics into account and has a short computation time, fast convergence of the optimization results, and the shape structure of the topology optimization is easy to be processed and manufactured.

# S-05: Jiri Maier

*Czech Technical University in Prague (Czech Republic)*

**Title: Miniaturized Fluxgate using Flip-chip Technology**

This workpresents a novel approach to designing
 a miniaturized fluxgate magnetic sensor using flip-chip tech
nology. The design consists of two chips bonded together
 using flip-chip technology, with a racetrack-shaped core in
 between. Metal layers of the chips and the bonds between the
 chips form a solenoid coils around the core. To maintain an
 acceptable fabrication cost, the top and bottom chips should
 be identical so that we can use multiple chips of the same
 layout rather than fabricating two different layouts. The lay
out must, therefore, be perfectly symmetrical, which makes
 the design challenging.

# S-06: Jiahao Liu

*Beihang University (China)*

**Title: Interfacial Spin Configuration and Origin of Exchange Bias at the IrMn/CoFeB Interface**

Exchange bias fields at the antiferromagnet/ferromagnet (AFM/FM) interface play a significant role in spintronic devices. Despite extensive research, the physical origin of exchange bias remains unresolved. In this study, we present a detailed investigation of a prototype AFM/FM interface commonly used in spintronic devices, i.e., IrMn/CoFeB interface. Synchrotron-radiation-based high-resolution X-rays reveal the presence of uncompensated Mn spins at the interface. While the majority of these spins are strongly coupled with the upper CoFeB layer, a small fraction of the remaining spins is pinned to the IrMn underlayer. Element-specific X-ray magnetic circular dichroism hysteresis loops demonstrate that pinned spins can be switched with increasing annealing magnetic fields. Micromagnetic simulations find that the quantity imbalance between opposite pinned spins, dictating the variation of exchange bias, can be reconfigured via annealing fields, which are validated through annealing experiments. These results provide essential insight into understanding the microscopic origin and modulation of exchange bias.

# S-07: Jiacheng LIU

*HKUST (Hong Kong) (Hong Kong, SAR)*

**Title: On-chip zero-field spin wave frequency multiplier and its application on qubit quantum control**

Frequency multiplication is a nonlinear process that
generates high harmonics from base frequency, which has
many applications in RF devices and emerging quantum
systems. Spin wave frequency multiplier based on noncrystalline
magnetic materials presents a compelling
alternative to existing ones based on semiconductor diodes and
MEMS resonators. It operates in the GHz range and is easily
integrated with any substrates but usually needs an undesired
bias magnetic field. In this work, we demonstrate a spin wave
frequency multiplier up to the 5th harmonic at 0mT magnetic
field. We detect the nonlinear dynamics of spin waves in the
local magnetic domain of the microsize on-chip, low-damping
CoFeB waveguide by the nitrogen-vacancy quantum sensing
method. The experimental result is consistent with
micromagnetic simulations. Furthermore, for the first time, we
demonstrate that the nonlinear spin-wave interaction-induced
high harmonic wave can achieve coherent quantum control of
a qubit.

# S-08: Dominik Pavelka

*Brno University of Technology (Czechia)*

**Title: Parametrically pumped high momentum nonlinear magnons detected by Mie-enhanced Brillouin light scattering**

Spin waves (SWs) have the potential to play a key role in the future of computing as they can carry information with minimal energy losses. For optimal performance in computational devices, the information-carrying wave must have a nanoscale wavelength. Parametric pumping seems to be a promising method of selective excitation and amplification of such nanoscale wavelength SWs [Brächer, et. al., Phys. Rep. 699 (2017)]. During this process, two magnons (quanta of SWs) at half of the excitation frequency and with opposite wavevectors are pumped. The conservation of momentum is always satisfied this way, therefore there are no requirements on the excitation antenna geometry in order to excite nanoscale SWs. Moreover, as it is a nonlinear process it may cause some unconventional SW interactions which can be used in e.g. neuromorphic computing networks [Papp, et. al., Nature Comm. 12, 6422, (2021)].
However, due to the finite width of the excitation antenna, the parametrically pumped magnons do not occur exactly at half of the excitation frequency, but they are symmetrically offset [Heinz, Dissertation (2021)]. This so-called non-adiabatic case effectively prohibits measurement of such magnons with pump-probed techniques e.g. Scanning Transmission X-ray microscopy. The micro-focused Brillouin light scattering is a more suitable method to detect parametrically pumped SWs, however this technique can only measure SWs down to the wavelengths of 400 nm. To investigate even shorter wavelengths, we utilize a Mie-enhanced Brillouin Light Scattering microscopy which allows us to push the detection limits to higher wavenumbers than the standard approach [Wojewoda, et. al., Comm. Phys. 6, 94, (2023)]. The Mie-enhanced measurements reveal a broader SW spectrum and high wavenumber dynamics resulting from multiple magnon interactions. These exciting observations stimulate new subjects of interest for upcoming research and possible applications of nonlinear SW computing.

# S-09: Swati Sucharita Das

*Akita University- Akita, Japan (Japan)*

**Title: Investigating the Magnetic properties of (Bi,Lu)(Fe,M)O3 (Lu: La, Nd, or Eu & M: Mn, Co, Ni, Cu or Co+Ni) based multiferroic thin films and origination of magnetism**

BiFeO3 (BFO) based materials are well known for their ferromagnetic and ferroelectric behavior. They are promising candidates for energy efficient magnetic memory devices. We have successfully demonstrated magnetization switching and magnetization transfer by the application of electric field in BFO materials, highlighting their potential in magnetic memory device application. Despite its potential, the reported BFO based thin films does not show good magnetic properties like saturation magnetization (Ms) and perpendicular magnetic anisotropy (PMA) which requires refinement, for the magnetic memory devices applications. To improve the magnetic properties, we substituted La in the A-site and Mn,Co,Ni and Cu in the B-site of BFO. We have optimized the concentration of the substituents at 50at% in the A-site and 25at% in the B-site. The thin films were fabricated using pulsed DC reactive sputtering using VHF plasma. Cu and Mn substitution failed to improve the Ms. Co substitution was effective for improving Ms whereas Ni substitution resulted in good PMA. So, we explored on the dual substitution of Co and Ni in the B-site which resulted in improved Ms of around 70 emu/cm3 and squareness S⊥/ S// (PMA) around 1.2. To understand the role of A-site substitution along with Co and/or Ni substitution in the B-site, we substituted Nd and Eu. The substitution of Nd in the A-site showed nearly the same results with La substitution with a small improvement in Ms above 75 emu/cm3 whereas Eu substitution showcases maintenance in Ms and a prominent change in PMA with the addition of Ni in the B-site.
This study emphasizes the crucial role of appropriate A-site and B-site element substitution in BFO based multiferroic thin films to enhance magnetization and PMA.
To understand and analyze the origin of magnetism in these thin films, we will use XMCD measurement using synchrotron radiation at Nanoterasu.

# S-10: Sourav Sarkar

*SNBNCBS, Kolkata (INDIA)*

**Title: Correlation between Negative Dielectric Permittivity and Magnetism in spinel ferrite nano-structures**

Metamaterials with negative dielectric permittivity have become a research hotspot due to their potential effectiveness in a variety of electromagnetic applications, including filter and antenna design, innovative capacitance and inductor design, electromagnetic absorber, etc. This study opens up a world of possibilities for manipulating the morphology of magnesium ferrite, a naturally occurring compound, to induce metamaterial features like negative dielectric permittivity. In this study, we present the relationship between the structural, dielectric, and magnetic characteristics of the system in the same chemical composition but distinct morphologies, namely, nano solid spheres (NSSs) and nano hollow spheres (NHS). Remarkably, the Lorentz dielectric resonance at a metamagnetic transition causes only NHSs to exhibit negative dielectric permittivity. Subsequent studies reveal that the uncompensated charges store inside NHSs and discharge at specific frequencies and temperatures, resulting in the backscattering of dipoles, which in turn creates the resonance. NHSs have hollow cores and more interfaces than NSSs. Negative dielectric permittivity is not observed in NSSs with concrete morphology and higher anti-ferromagnetic interaction. These metamaterials, with their unique physical properties such as negative refractive index, reversed Doppler Effect, etc, can be classified into ordered and random metamaterials. In comparison to the artificially designed ordered metamaterials, random metamaterials have found wide interest due to low cost, ease of fabrication, high availability, and higher control over modification of the negative behaviour. Among the random metamaterials, composites show very high dielectric loss due to high concentration of free electrons, and high temperature instability due to the oxidation of the conductive fillers. In comparison to composites, single phase metamaterials have better temperature stability, favourable homogeneous composition, and feasible methods exist to control their electron concentration. In this backdrop, we propose MgFe2O4, synthesized in a particular morphology, as one of the very few single-phase random metamaterials. This work attempts to find a credible correlation between the unusual dielectric property and magnetism in the system.

# S-11: Agnieszka Klimeczek

*CNRS Institut Néel (France)*

**Title: TBD**

TBD

# S-12: Ayomipo Ojo

*University of South Florida (Florida)*

**Title: Temperature dependent magnetization dynamics in magnetic Weyl semimetal Co2MnGa thin films**

Co$\_2$MnGa (CMG), a magnetic Weyl semimetal, exhibits ultralow damping, strong spin-dependent transport, and topological features favorable for spintronic applications. While its room-temperature magnetization dynamics have been studied, the temperature ($T$) dependence of key dynamic parameters such as the damping and exchange stiffness remains underexplored.
Here, we investigate the temperature-dependent magnetic dynamics in CMG thin films (20, 60, and 80 nm) grown on MgO (001) substrates using broadband ferromagnetic resonance (FMR) spectroscopy with the field applied perpendicular to the sample plane. X-ray diffraction reveals a strain-induced tetragonal distortion, most pronounced in the 20 nm film. As temperature decreases, the saturation magnetization ($M\_s$) deviates from Bloch’s law below 170 K, due to a temperature-dependent tetragonal distortion. The effective magnetization $M\_{{eff}} > M\_s$ indicates a net in-plane anisotropy that strengthens with decreasing temperature, while the perpendicular uniaxial anisotropy ($K\_{u\_{[001]}}$) also increases, with the 20 nm film exhibiting the highest values across all temperatures. Perpendicular standing spin waves (PSSWs) observed in the 60 and 80 nm films enable extraction of the exchange stiffness ($A\_{{ex}}$) and exchange length ($l\_{ex}$), both of which increase with decreasing temperature, with $A\_{{ex}}$ following a $T^2$ dependence. Additionally, the $g$-factor is relatively constant in the 80 nm film but varies with temperature in thinner films. All films exhibit ultralow damping, with the 80 nm film showing temperature-independent behavior.

# S-13: Rattaphon Phoomatna

*Mahasarakham University (Thailand)*

**Title: Near-Field Transducer (NFT) and Waveguide Designs for Heat Assisted Magnetic Recording**

The thermal performance limitation is primarily due to optical challenges in heat-assisted magnetic recording technology (HAMR). To address this, the near-field transducer (NFTs) and waveguide (WGs) have been proposed to enhance thermal spot efficiency to below 50 nm, which increases the areal density of hard disk drives up to 10 Tb/in2. Plasmon materials are designed using dielectric material and metallic components based on localized surface plasmon resonance phenomenon (LSPR). In this work, we investigate the effects of the structural designs of the dielectric waveguides and lollipop-NFTs on the temperature performance. The COMSOL Multiphysics software is used to construct and design the differenct structure of WGs and NFTs and simulate the electromagnetic wave based on Maxwell's equations and the Heat transfer in solid (Fourier’s law) to study the peak temperature, thermal gradient, thermal spot on NFTs and magnetic recording medium. In addition, we demonstrated the power input on the heating process of HAMR. Our results show that the rectangular dielectric waveguide efficiently supports the TE01 electromagnetic wave mode. Furthermore, the geometry of lollipop-NFTs, especially peg width and peg length strongly affects the electric field intensity which leads to the characterization of temperature such as thermal profile, thermal gradient and thermal spot. These thermal characteristics play a crucial role in determining the signal-to-noise ratio (SNR), particularly the transition SNR. Therefore, optimizing the heating process is essential for improving the areal density and reliability of HAMR technology.

Keywords: Heat-assisted magnetic recording technology, Near-field transducer (NFTs), signal-to-noise (SNR),

# S-14: Bilal Jamshed

*NTU-Singapore (Singapore)*

**Title: Field-free spin-orbit torque switching via spin-reorientation in synthetic antiferromagnets**

Spin-orbit torque (SOT) driven magnetization switching offers an energy-efficient method for
electrical control of magnetization, making it a promising candidate for next-generation nonvolatile memory and spin logic applications. However, conventional SOT devices with a
perpendicular magnetic anisotropy require an in-plane magnetic field to break inversion
symmetry, which hinders device scalability and increases power consumption, limiting their
practicality for mass fabrication. In this study, we have demonstrated field-free magnetization
switching of a ferromagnet by utilising spin re-orientation, obtained via SAF coupling. By
tuning the thickness of the bottom Co layer, we effectively modified the exchange coupling
and magnetic anisotropy in SAF, facilitating spin re-orientation. We observed spin
reorientation until Co thickness of 2.8 nm, which appears to be a large value for spinreorientation. We observed a maximum switching efficiency of 82% in our optimized samples
for a Co thickness of 2.4 nm. We performed angular-dependent anomalous Hall measurements
to further explore the origin of field-free switching in our sample. This study highlights an
interesting strategy for achieving field-free switching in SAF samples through spin
reorientation

# S-15: Anna Dickinson-Lomas

*University of Birmingham, UK (United Kingdom)*

**Title: The Removal of Epoxy Resin Coatings from Sintered NdFeB Magnets for Improved Recycling**

Neodymium-iron-boron (NdFeB) permanent magnets contain critical elements that present supply chain challenges to Western users, particularly those in the electric motor and power generation industries.
The International Energy Agency has forecast the annual production of electric vehicles to reach 30
million by 2035 [1]. This is accompanied by a predicted increase in rare earth element market value
from 5 billion USD in 2023 to 36.2 billion USD in 2050 [2], since many kilograms of NdFeB magnets are
used in these vehicles. This is a key motivator for refining the recycling process for these rare earth permanent magnets. To facilitate corrosion resistance, sintered NdFeB magnets are often coated with
thermosetting epoxy resins which pose challenges when the magnets come to be recycled.

To aid the recycling of sintered NdFeB magnets coated with epoxy resin, a solvent-based batch process
has been developed. Individual commercial magnet samples of grade N42SH were exposed to a
solution of 30 ml isopropanol in a 100 ml pressure vessel and heated to between 150 and 300 °C for a
time range of 0 to 40 min. This study indicated that resin removal from the surface of the sintered N42SH
magnets was successful to varying degrees across these conditions, with the degradation reaction appearing to take place in the temperature window 150 °C – 200 °C, as depicted in Figure 1. At
temperatures greater than or equal to 200 °C, the resin degradation seems to plateau, although the
plateau is uneven due to variations in coating thickness across the samples.

This process was found to have very little effect on the magnetic properties of the magnet samples.
Losses in remanence and maximum energy product of ~1.6 % and ~3.5 % respectively were deemed
to be insignificant, since the samples retained more than 95 % of the original average properties. In
contrast, the coercivity was found to increase by ~2.7 % when compared to the originally measured
average coercivity. Carbon analysis experiments pre- and post-solvolysis also demonstrated a
reduction in carbon content from ~2700 ppm to ~825 ppm, which is close to the levels of carbon found
in virgin NdFeB magnets [3]. These early-stage experiments therefore suggest there is no significant
detriment to the recovered material.

References
[1] J. Ormerod, “Permanent magnet markets and applications,” Modern Permanent Magnets,
pp. 403–434, Jan. 2022, doi: 10.1016/B978-0-323-88658-1.00012-1.
[2] Green Car Congress, “Adamas Intelligence expects 10-fold increase in value of rare
earths to $36.2B by 2035; growth led by passenger EV traction motors.” Accessed: Jan.
08, 2024 [Online]. Available: https://www.greencarcongress.com/2023/02/20230204-
admas.html
[3] C. Jönsson et al., “The extraction of NdFeB magnets from automotive scrap rotors using
hydrogen,” J Clean Prod, vol. 277, p. 124058, Dec. 2020, doi:
10.1016/J.JCLEPRO.2020.124058

# S-16: Jose Luis Marqués Fernández

*Universidad de Oviedo (Spain)*

**Title: Broadband oscillator as a high-precision nanoparticle quantification system**

Nanoparticles, due to their magnetic permeability and electric permittivity, have a wide range of applications, including medical diagnosis and therapy, electronic components, and nano sensing. These applications often require highly sensitive measurements of changes in magnetic and electric susceptibilities, as nanoparticles are typically present in small quantities. However, current equipment for these measurements is bulky and expensive. Therefore, developing alternative solutions that are more compact and cost-effective could enhance the accessibility and range of these applications.

We have develop a solution that resolves these issues by two main features. Our system work in the frequency domain, this reduce cost while maintaining high sensitivity, and to increase further the sensitivity of our sensor, it is sensitive at the same time to both the magnetic permeability and electric permittivity. We have achieved this by means of a custom oscillator design called astable tuned oscillator (ATO), which only uses as resonant tank a L-C parallel network. In this way we use the self-inductance and stray capacitance of an inductive sensor in combination with a set of varactor to have the high sensitivity and susceptibility measurement capabilities. We have measured the magnetic permeability and electric permittivity of different types of nanoparticles in low concentrations. The cost to sensitivity ratio of our system is better than previous solutions.

# S-17: Shreya Shrestha

*University of Delaware (Delaware)*

**Title: Correlating ultrafast demagnetization with terahertz radiation using spintronic bilayer heterostructures**

The Terahertz gap has experienced significant technological advancements over the past decade, driven by its applications in medicine, industrial processes, and its potential for quantum transduction. Combined with its ultrafast time scale, interest also arises in its application in spectroscopy. Spintronic THz emitters (STE), magnetic heterostructures consisting of a ferromagnetic and heavy metal bilayer, have emerged as broadband and polarization tunable THz sources. The phenomenological explanation of the emission of THz radiation from STE is the ultrafast demagnetization triggered by a highly non-equilibrium state initiated by ultrafast laser pulse excitation. This process leads to the generation of an ultrafast spin current that diffuses from the ferromagnet into the heavy metal layer where it is converted into a charge current by means of the inverse spin Hall effect, resulting in THz emission. However, this conceptually simple explanation has recently been scrutinized as the microscopic origin of such interlayer spin current remains vague [arXiv:2410.07360]. One way to experimentally untangle the different processes leading to THz emission is to temporally correlate the ultrafast demagnetization process with the resulting THz emission upon femtosecond laser excitation of the magnetic heterostructure.
Here, we present time-resolved magneto-optic Kerr effect (TR-MOKE) measurements correlated with time-domain terahertz spectroscopy (TDTS), allowing us to probe the ultrafast spin dynamics and THz emission simultaneously. TR-MOKE is used to investigate the magnetization dynamics due to laser excitation, while TDTS measures the emitted THz radiation. The synchronization of these probing techniques will give us information about the demagnetization dynamics and correlate their temporal fingerprint with the resulting THz signal. Our preliminary results suggest that the THz emission occurs at a much earlier time than one expects from the universally accepted model. We believe that our experiments will help to validate and refine theoretical models of spin dynamics and THz generation mechanisms.

# S-18: Muhammad Sabbir Alam

*Virginia Commonwealth University (Virginia)*

**Title: Quantized nanomagnetic domain wall synapse based autoencoder for efficient unsupervised network anomaly detection**

Autoencoders learn to effectively extract meaningful patterns and representations from unlabeled data through an encoder-decoder architecture in an unsupervised learning manner. However, implementing them in edge devices that are capable of learning in real-time is extremely challenging due to limited hardware, computational resources, and energy. In this context, we propose a low resolution quantized magnetic domain wall (DW) synapse based autoencoder, designed to address these limitations. The proposed autoencoder model is evaluated based on anomaly detection tasks on NSL-KDD data. Due to the small on/off ratio of magnetic tunnel junctions (MTJs), which can be at most 7:1 at room temperature, current/voltage controlled DW devices that encode information in the resistance of MTJs have drawbacks including low resolution as well as stochastic nature. Here, we simulate a notched DW device for the proposed autoencoder synapses, where limited state (5-state) synaptic weights are controlled by spin orbit torque (SOT) current pulses on a magnetic racetrack in room temperature. Extensive micromagnetic simulations are performed to determine stochastic variations in each memory state of the DW device. Next, hardware-aware training of the autoencoder is performed, where the training algorithm is inspired by neural network training with low precision weights. While limited number of quantized states and the inherent stochastic nature of DW synaptic weights in nanoscale device is usually detrimental to training and testing accuracy, the hardware-aware training can leverage this imperfect device characteristics to generate a significant improvement in accuracy (90.98%) compared to accuracy (90.85%) obtained by floating point trained weights. Therefore, with this approach, resource limited low energy autoencoders simulated with DW devices show improved performance.

# S-19: Margo Hauwaert

*UCLouvain (Belgium)*

**Title: If possible I would really prefer visiting Quantum Design. If that is not possible, I can present a poster.**

# S-20: Chandan Kumar

*S.N. Bose National Centre for Basic Sciences, Kolkata, India (India)*

**Title: Investigation of Additive Interfacial Dzyaloshinskii–Moriya Interaction in Monolayer-MoS2/Co/Pt Asymmetric Trilayer System**

Investigation of Additive Interfacial Dzyaloshinskii–Moriya Interaction in Monolayer-MoS2/Co/Pt Asymmetric Trilayer System
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The additive interfacial Dzyaloshinskii-Moriya interaction (iDMI) characteristic observed in multilayer samples is anticipated to emerge as a pivotal element in the progression of three-dimensional (3D) spintronics. It holds substantial potential to facilitate the stabilization of a variety of 3D chiral spin configurations, including skyrmionic cocoons [1], merons, torons, among others [2]. Two-dimensional transition-metal dichalcogenides (2D-TMDs), characterized by intrinsic spin-orbit coupling, broken inversion symmetry in odd-numbered layers, and spin-valley coupling, are increasingly emerging as significant contributors in the domain of iDMI [3], a domain traditionally dominated by heavy metals (HMs) [4]. These advancements have rendered the exploration of additive iDMI within the complex 2D-TMD/Ferromagnet/HM trilayer structure to be an exceptionally compelling challenge. In this study, employing the Brillouin light scattering technique, it was demonstrated that the monolayer-MoS2/Co interface markedly augments the iDMI of the Co/Pt interface by contributing additional iDMI in the MoS2/Co/Pt trilayer configuration. Additionally, the FM layer thickness-dependent study has achieved two primary objectives: evaluating the iDMI strength between Co(t)/Pt(4) and MoS2/Co(t)/Pt(4) systems (where t = 2, 4, 8 nm), and substantiating that the DMI in these systems originates exclusively from the interface. The present study elucidates the promising potential of employing hybrid multilayers to achieve stabilization of chiral spin textures, thereby suggesting prospective applications in the realm of future spintronics devices.

[1] M. Grelier, F. Godel, A. Vecchiola, S. Collin, K. Bouzehouane, A. Fert, V. Cros, and N. Reyren, Three-dimensional skyrmionic cocoons in magnetic multilayers, Nat. Commun. 13, 6843 (2022).
[2] I. Lima Fernandes, S. Blügel, and S. Lounis, Spin-orbit enabled all-electrical readout of chiral spin-textures, Nat. Commun. 13, 1576 (2022).
[3] A. Kumar, A. K. Chaurasiya, N. Chowdhury, A. K. Mondal, R. Bansal, A. Barvat, S. P. Khanna, P. Pal, S. Chaudhary, A. Barman et al., Direct measurement of interfacial Dzyaloshinskii–Moriya interaction at the MoS2/Ni80Fe20 interface, Appl. Phys. Lett. 116, 232405 (2020).
[4] M. Kuepferling, A. Casiraghi, G. Soares, G. Durin, F. Garcia-Sanchez, L. Chen, C. H. Back, C. H. Marrows, S. Tacchi, and G. Carlotti, Measuring interfacial Dzyaloshinskii-Moriya interaction in ultrathin magnetic films, Rev. Mod. Phys. 95, 015003 (2023).

# S-21: Jhantu Pradhan

*Research Scholar, Department of Physics, IIT Hyderabad (India)*

**Title: Ultra-low Gilbert Damping and Self-Induced Inverse Spin Hall Effect in GdFeCo Thin Films**

Ferrimagnetic materials have garnered significant attention due to their broad range of tunabilities and functionalities in spintronics applications. Among these materials, rare earth-transition metal GdFeCo alloy films have been the subject of intensive investigation due to their spin-dependent transport properties and strong spin-orbit coupling. In this report, we present self-induced spin-to-charge conversion in single-layer GdFeCo films of different thicknesses via inverse spin Hall effect. A detailed investigation of spin dynamics was carried out using broadband ferromagnetic resonance measurements. The anisotropy constant and the effective g-factor are found to decrease with thickness, and they become nearly constant for thicknesses beyond 25 nm. A remarkably low damping constant of 0.0029±0.0003 is obtained in the 43-nm-thick film, which is the lowest among all previous reports on GdFeCo thin films. Furthermore, we have demonstrated self-induced inverse spin Hall effect, which has not reported so far in a single-layer of GdFeCo thin film. Our analysis shows that the inverse spin Hall effect becomes increasingly dominant over the spin rectification effect with increasing film thickness. The in-plane angular-dependent voltage measurement of the 43-nm-thick film reveals a spin pumping voltage of 1.64 µV. The observation of spin-to-charge current conversion could be due to the high spin-orbit coupling element Gd in the film, as well as the interface between GeFeCo/Ti and Substrate/GdFeCo of the films. Our findings underscore the potential of GdFeCo as a prime ferrimagnetic material for emerging spintronic technologies.

# S-22: Olivia Zanoni

*University of Colorado Colorado Springs (Colorado)*

**Title: Growth and Characterization of Epitaxial KMnF3 Antiferromagnetic Thin Films**

Like other bosons, magnons can condensate into their quantum ground state, and the Bose-Einstien condensation (BEC) of magnons in antiferromagnets (AFMs) has attracted much attention in the last few years. Epitaxial thin films promise a straightforward approach to investigate the behavior of antiferromagnons; however, several AFMs which have historically been magnetically well characterized in bulk have not been characterized in thin films.
 We prepared several monocrystaline epitaxial thin films of the AFM KMnF3 on MgO substrate using molecular beam epitaxy (MBE). These films are of varying thickness and crystal quality. Characterization of these films has been undertaken using: reflected high-energy electron diffraction (RHEED); X-ray diffraction (XRD); SQUID magnetometry; and broadband ferromagnetic resonance (BFMR).
 RHEED and XRD confirm our films are indeed monocrystaline with good crystallinity. Additionally, the XRD results show the films have a cubic crystal structure with a lattice constant of 4.189 Angstroms, which matches the crystal structure of the bulk.
 The ongoing SQUID and BFMR investigation of the KMnF3 reveal complex magnetic behavior with a high degree of temperature sensitivity. Our studies open the door to applications of high-quality epitaxial AFM films for BEC and other magnonic and spintronic experiments.

# S-23: Wiranya Chomphurach

*Mahasarakham University (Thailand)*

**Title: Machine Learning for Predicting Magnetic Properties of FePt in HAMR Technology**

 To increase the data density of hard drives beyond 2 TB/in² for HAMR technology, it can be achieved by reducing the magnetic grain size to less than 5 nm and using ferromagnetic materials with high anisotropy to enhance thermal stability. Iron-Platinum (FePt) is one of the most promising materials for this application. However, the HAMR writing process requires heating the recording disk to a temperature close to the Curie temperature, which varies with the magnetic grain size. Previous research has studied the calculation of the Curie- temperature of materials via atomic-scale simulations, but it was found that this simulation is computationally time-consuming. Therefore, in this research, we use machine learning using the Random Forest Regression model to model the relationship between magnetization and temperature to calculate the Curie temperature for different magnetic grain sizes. And compare the results with the atomistic model simulation. From the study, it was found that this model gives a mean square error (MSE) less than 0.001 and an R-squared value of 0.99, indicating high accuracy. In addition, the calculation of the Curie temperature with this model takes only 0.1 seconds compared to the atomic-level simulation. Therefore, the use of the Random Forest Regression model not only reduces the calculation time, but also has an accuracy close to that of the atomic-level simulation. As a result, this model has high potential to predict complex magnetic behaviors and can be effectively used in the development of HAMR technology and magnetic material research.

# S-24: Jinseo Lee

*Korea University (Republic of South Korea)*

**Title: Enhanced spin-orbit torque of Pt/Co heterostructures by Zr alloying into Pt layers**

Platinum (Pt) exhibits a significantly large spin hall conductivity among 5d heavy metals. Unlike the competitive heavy metals like Tungsten (W) and Tantalum (Ta), Pt can operate with low energy consumption due to relatively low resistivities, exhibiting a significant potential for spin-orbit torque (SOT) based devices such as magnetic random access memory (MRAM), spin-torque oscillators (STO), physical unclonable function (PUF), and neuromorphic computing system. Despite its remarkable spin hall conductivity, the damping-like torque (DLT) efficiency from Pt is still lower than beta-phase W.
Recently, Pt alloy engineering with other materials has been studied to enhance DLT efficiency. We investigated the SOT properties of Pt with the addition of Zirconium (Zr). Thermodynamically, Pt100-xZrx can exhibit solid-solution phases up to about Zr 20 at%. The thin films of Pt100-xZrx also exhibited face-centered cubic (111) structures up to 23 at%, as predicted in the phase diagram. In the range of the solid solution in Pt100-xZrx, the enhancement of the DLT efficiency reached more than two-fold compared to the pure Pt. The SOT from Pt100-xZrx mainly depended on the thickness, suggesting the spin Hall effect was dominant in this system. Moreover, the decreasing spin Hall conductivity of Pt100-xZrx was consistent with the dirty metal behaviors, excluding the extrinsic spin Hall effect by measuring the residual resistivities and calculating both skew scattering and side-jump contributions. The enhancement of DLT efficiency continued to be more efficient in current-induced magnetization switching than the pure Pt heterostructures.

# S-25: Doowon KIM

*Korea University (South Korea)*

**Title: Spin-orbit torque engineering by Ti alloying in beta W-based heterostructure**

Spin-orbit torque (SOT) switching has emerged as a promising technology for non-volatile embedded memory in advanced automotive applications. We investigated the critical yet understudied area of temperature-dependent SOT switching, essential for developing automotive Grade-0 electronics that can operate from -40°C to 150°C. We focused on enhancing SOT efficiency to achieve low operating currents using materials compatible with semiconductor fabrication processes. We employ first-principles calculations to estimate changes in spin Hall conductivity (σSH) of Ti-alloyed β-phase tungsten (W) structures. These calculations predict a peak σSH value of -1461 (ℏ/e) S/cm at 12.5 atomic percent Ti composition. To verify these theoretical predictions, we fabricated β-W-Ti(x at%)/Co40Fe40B20/MgO heterojunctions with varying Ti compositions. Experimental results show that the heterojunction with 11.5 at% Ti exhibits an enhanced damping-like SOT efficiency of 0.54, compared to 0.30 for pure β-W, with a longitudinal resistivity of 149.7 μΩ·cm. The critical current density (Jc) reaches a low value of 15.5 MA/cm2. Importantly, we demonstrate successful SOT switching across a wide temperature range from -55°C to +150°C, meeting the demanding requirements for automotive applications. This result represents a significant advancement in developing high-efficiency, temperature-resistant SOT devices compatible with semiconductor fabrication processes. The findings pave the way for the potential integration of these devices into advanced automotive electronics, addressing the need for reliable, high-performance, non-volatile memory in extreme temperature environments.

# June 23, 2025 (Monday)

# M-01: Adrián Fernández Calzado

*IMDEA Nanoscience (Spain)*

**Title: "Nanostructuring as Path to High Coercive Sr-Ferrite without Critical Elements"**

The application of hard ferrite-based magnets has potential for expansion in the electromobility sector due to improved magnetic properties combined with a redesign of the final application system to fully exploit these advances and thereby improve overall performance. This could reduce Europe's dependence on critical raw materials in the permanent magnet industry.

This study demonstrates the feasibility of producing high coercivity Sr-ferrite powders with excellent performance at low temperatures without relying on critical raw elements such as La and Co. This achievement was realized by starting with commercial ferrite and nanostructuring it using the self-developed "flash milling" technique. The resulting Sr-ferrite/hematite (SrFe12O19 / Fe2O3) nanocomposite exhibited a room temperature coercivity exceeding 475 kA/m with increasing milling time. In addition, the introduction of Fe2O3 powder prior to milling reduced the processing time required, resulting in a nanocomposite with a high coercivity at low temperatures: 430 kA/m measured at -100ºC, opening the door to future applications.

Further experiments on sintered magnets confirmed the hypothesis that Fe2O3 plays an active role in increasing the coercivity. This behaviour was successfully maintained during powder consolidation, validating the approach. The results showed significant improvements in magnetic properties compared to those of the original commercial materials (coercivity of 400 kA/m versus 300 kA/m). These results highlight the importance of optimised nanostructuring in the development of new, effective and sustainable solutions for this sector.

# M-02: Robert Kraft

*University of Vienna (Austria)*

**Title: Fast and Accurate Continuous FMM Stray Field Evaluation for FEM Micromagnetics**

Micromagnetic simulation is an indispensable tool for developing novel magnetic materials and devices at the micron scale. As applications increase in complexity, simulation meshes increase in size leading to extremely long runtimes. The main bottleneck is the long-ranged stray field interaction, especially for the irregular grids used in finite-element analysis. Here, the Fast Multipole Method (FMM) promises unparalleled performance with linear scaling and efficient parallel implementations. In this work, we implement a fast and accurate FMM stray field evaluation method which makes macroscopic sample sizes possible by reducing runtimes and memory usage significantly. We use our own FMM library written in JAX, jaxFMM, which features very concise and easily maintainable code whilst still offering good performance on both CPU and GPU. Additionally, this gives access to automatic differentiation which can be used to compute inverse-design problems.

# M-03: Nabil Menai

*University of Bristol (United Kingdom)*

**Title: Large spin Hall angle in MnPt-based antiferromagnetic alloys**

Antiferromagnets (AFMs) have emerged as crucial materials for spintronic technologies for their ability to host spin-dependent transport phenomena, despite their zero net magnetization. Their robustness against external magnetic fields and ultrafast spin dynamics make them ideal for efficient spin-charge interconversion, offering significant potential for advanced spintronic applications.

In this theoretical study, we use density functional theory and Green’s function methods to investigate the transport properties of Mn-based binary alloyed AFMs. Our focus is on the total spin Hall conductivity (SHC), accounting for both the intrinsic contributions from Berry curvature and the extrinsic effects from skew scattering and side-jump mechanisms. The objective is to identify AFM materials that exhibits a high spin Hall angle (SHA); with an efficient charge-to-spin Hall current conversion ratio.

Our results reveal that doping MnPt with Ir significantly enhances the SHA, achieving a value of 8% at room temperature; an improvement that should be experimentally observable. In contrast, doping with Pd produces lower SHA values but demonstrates stability with respect to temperature variations. These findings underscore the potential of antiferromagnetic alloys for efficient spin current generation.

# M-04: William Bouckaert

*Université Paris-Saclay (France)*

**Title: Tailoring Skyrmion Nucleation and Motion: Effects of Substrate Topography, Thermal Diffusion, and In-Plane Magnetic Fields**

Magnetic skyrmions offer great potential for spintronic devices due to their stability and efficient current-driven motion. In this work, we explore the control of skyrmion nucleation and dynamics through substrate engineering, thermal dissipation, and in-plane magnetic fields.

We demonstrate that thermal effects dominate the nucleation process: longer current pulses or substrates with lower thermal dissipation enhance nucleation by locally raising the temperature. In contrast, improved thermal management, via shorter pulses or more dissipative substrates, suppresses unwanted nucleation, a key requirement for reaching high-speed, flow-like motion regimes.

In-plane magnetic fields, when applied perpendicular to the current, alter skyrmion velocity but do not suppress motion. This contrasts with domain wall dynamics, where such fields can significantly slow or even stop motion, highlighting the robustness of skyrmion topology against field-like torque effects.

Substrate topography further enables spatial control of skyrmion nucleation. Focused electron beam induced deposition (FEBID) of C-Pt structures before multilayer growth creates reproducible nucleation sites. The threshold current density for nucleation is found to depend on the deposit height, providing an effective knob for localized control.

Our results underscore the importance of coordinated control over thermal, magnetic, and structural parameters to reliably tailor skyrmion behavior for device applications, including racetrack memories and neuromorphic computing platforms.

# M-05: Melissa Sonia Yactayo Yaranga

*Institute Jean Lamour - UL (France)*

**Title: TBD**

TBD

# M-06: Leonor Andrade

*University of Porto - IFIMUP (Portugal)*

**Title: An innovative approach to simultaneously study the structural and magnetic phase transitions in R5(Si, Ge)4 materials family**

Magnetic refrigeration prototypes have been explored since last decades due to the efficiency problem the current technologies present. Magnetocaloric materials rose as refrigerants for a clean and efficient alternative for refrigeration technology – magnetic refrigeration. The R5(Si, Ge)4 materials family is one of the most interesting due to its field-induced first-order phase transitions. However, to increase the efficiency of magnetocaloric devices, we should aim for very rapid transitions occurring in these materials. In contrast, recent studies show that we may have transitions occurring in several minutes and very shallow understanding exists on the (de)coupling of structural and magnetic phase transformations. [1]
In this work, we were able to design and implement a setup for simultaneous measurements of temperature, magnetization and strain of a sample at high magnetic fields, in collaboration with High Field Magnetic Lab (HFML), in Nijmegen, Netherlands. This setup is useful not only to study magnetocaloric materials phase transitions but can be extremely helpful to understand a broad range of other materials as well. A bulk sample of Gd5Si2Ge2 was studied in this setup using a specific protocol employed earlier to study La(Fe,Si)13 compounds [2] to compare the kinetics of the structural and magnetic transitions. Preliminary results showed that the transition rate of the of structural/magnetic properties is not fully synchronized. With that in mind, different magnetic field values, magnetic field sweep rate values and different measurement temperatures will be applied to study the evolution of such phase transitions in a systematic and thorough approach.
In the future, we expect to add resistivity measurements by developing a new probe that can acquire temperature, magnetization, strain and resistivity simultaneously, aiming to further understand the (de)coupling between order parameters while simultaneously providing a pathway for efficiency optimization in magnetic refrigeration prototype.
[1] https://doi.org/10.1002/aenm.201401639
[2] https://doi.org/10.1016/j.mtphys.2024.101388

# M-07: João Silva

*University of Porto- IFIMUP (Portugal)*

**Title: Refrigeration impact of form anisotropy and composition on MnFePSi epoxy-bonded composites for rotating magnetocaloric effect**

Each year, more than one million lives could be saved through vaccination. Yet, half the vaccines produced worldwide are wasted primarily due to faulty temperature control, highlighting the need for novel systems with higher efficiency and without GWP refriger-ants. The magnetocaloric effect (MCE) and, more recently, the rotating magnetocaloric effect (RMCE), based on the demagnetizing effect, allows commercially viable devices with low-intensity fields (~0.4 T), reducing the high cost of intense magnetic field sources while yielding high RMCE. Even so, usual magnetocaloric materials (MCMs) used for RMCE (i) have heavy rare earth metals like Gd or Rh; (ii) are either single crystals or highly textured polycrystals that are complex to produce; and (iii) are second-order magnetic transition alloys to avoid the first order magnetic hysteresis and brittleness. Efforts towards sustainable MCMs, coupled with shape anisotropy RMCE, a cheaper method to observe RMCE, and polymer-bonded MCM composites, which allow mechanically stable first-order alloys, feed the expectation of overcoming the commercialization fron-tier. Thus, this work, within the EU project Magccine, focuses on the study of high-loading MnFePSi epoxy-bonded composites for rotating magnetocaloric refrigeration. Here, epoxy dried in a high aspect ratio mold with up to 98wt% of MCM to study the shape anisotropy RMCE, through VSM and near adiabatic ΔT measurements, was compared with analogous composites that possessed a magnetic field applied during the drying stage to combine a simple magnetocrystalline with shape anisotropy. The presented results provide signifi-cant knowledge on the impact of both anisotropies in MCMs for RMCE and the magnetic field-assisted epoxy curing process for composites.

# M-08: Mukesh Murali

*Chalmers University of Technology (Sweden)*

**Title: Additive Manufacturing of High Silicon Steel Soft Magnetic Materials**

Soft magnetic materials (SMM) play a crucial role in enhancing the efficiency of electric motors, which are becoming increasingly important in the era of electric transportation. While traditional Si steel (Fe-3.2 wt.% Si) performs well in low frequencies, it shows limitations at higher frequencies, promoting the search for alternative materials. High silicon steel alloys, with 6.5% silicon content, present a promising alternative due to their high electrical resistivity, low iron loss, and minimal magnetostriction, rendering them well-suited for mitigating energy losses, failures, and noise commonly encountered in high-frequency environments. However, the brittleness inherent to high-silicon steel alloys presents manufacturing challenges during conventional processing techniques. Additive manufacturing (AM) offers a solution, providing precise control over texture and a high cooling rate to enhance ductility. We investigated the potential of Powder Bed Fusion-Laser Beam (PBF-LB) to produce Fe-6.5wt%Si magnetic materials with improved multi-properties required for high-frequency electric machines. A high-throughput approach was employed to optimize process parameters for printing highly dense and defect-free Fe-6.5wt%Si alloys by systematically varying the different parameters within a single build. Furthermore, the microstructure was tailored by systematically varying scan strategies (rotation angles) to optimize magnetic and electrical properties. Distinct melt pool morphologies resulting from different scan strategies influenced the grain structure and texture, consequently affecting the multi-properties. Results indicate that increasing rotation angles from 0° to 90° led to reductions in resistivity, Vickers hardness, and coercivity. This work demonstrates the feasibility of using PBF-LB and controlled scan strategies to produce Fe-6.5wt%Si SMM with tunable properties for advanced high-frequency applications.

# M-09: Esther Chen

*New York University (New York)*

**Title: Solving combinatorial optimization problems through stochastic Landau-Lifshitz-Gilbert dynamical systems**

Magnetic Tunnel Junctions (MTJs) hold significant potential for innovative computing applications due to their rich dynamics and stochastic nature. One prominent application in computing is finding solutions to NP-Hard combinatorial optimization problems. Most optimization paradigms using MTJs are based on the energy and annealing models, where the true solution to an optimization problem is mapped to the ground state of the system’s Hamiltonian. The optimization task then becomes a physical process of finding the system’s ground state. While experiments have been conducted with arrays of (<100) MTJs to factor semiprimes and solve small optimization problems, comprehensive theoretical and numerical studies on the advantages of these systems compared to established classical optimization methods are needed to fully understand their potential and limitations.

We present numerical studies modeling a system of macrospins governed by Landau-Lifshitz-Gilbert (LLG) dynamics, capturing the essential physical characteristics of MTJ’s free magnetic layer. We apply this system to solve the Sherrington-Kirkpatrick (SK) model, which serves as an ideal benchmark due to having an exact solution in the thermodynamics limit as system size n goes to infinity. To compare our results with classical optimization protocols, we benchmark against the Glauber dynamics of Ising spins. We compute the disorder-average energy per spin <E>/n of the SK model at the end for system sizes ranging from n=40 to 2000. We observe the LLG dynamics consistently finds a lower energy state than the Glauber dynamics, and the LLG results extrapolate to <E>/n=-0.762(1) as n goes to infinity, which is very close to the exact optimal value <E>/n=-0.763. Our results demonstrate the potential of using magnetization dynamics of coupled macrospins to solve NP-hard optimization problems.

# M-10: Hauwa Adedo

*Miami University (Ohio)*

**Title: Controlling Magnetostructural Phase Transition Gaps and Magnetic Properties in Cu and Fe Doped Ni2Mn0.65-xCu0.35FexGa Heusler Alloys**

The Ni2MnGa derivative Heusler alloys are extensively studied for their numerous multifunctional properties including ferromagnetic shape memory effect and large entropy changes. The strong hybridization between the Ni {d orbital} electrons and the Ga{p orbital} electrons drives the martensitic phase transition in Ni-Mn-Ga based materials, and can be precisely controlled through stoichiometry manipulation and atomic doping. In Ni2Mn1-xCuxGa, a Cu-doped derivative of the Heusler alloy Ni2MnGa, increasing ‘x’ results in increasing martensitic temperature and decreasing ferromagnetic transition temperature. Upon heating, a first order coupled magnetostructural phase transformation is observed near ~345 K in Ni2Mn0.70Cu0.30Ga. A partial decoupling of the phase transitions occurs during cooling resulting in a large variation in the magnetocaloric properties of the material when the measurements are done while heating and cooling. In this poster, I will present my research on the phase transitions and associated magnetic properties of Ni2Mn0.65-xCu0.35FexGa, a Fe doped derivative of Ni2Mn0.70Cu0.30Ga, for 0.05 ≤ x ≤ 0.25.

# M-11: Juuso Attenberg

*Aalto University (Finland)*

**Title: Mechanical Modulation of Confined Spin Waves in Yttrium Iron Garnet (YIG) Bridges**

Magnomechanics has gotten more attention in recent years due to its appealing properties, such as high tunability and compact implementation. Consequently, this poster presents a magnomechanical system featuring a micrometer-sized bridge composed of yttrium iron garnet (YIG). The main objective is to identify a physically realistic configuration for the YIG bridge, in which mechanical vibrations interact with spin waves, resulting in their modulation. Specifically, the focus is on synchronizing the mechanical frequency with the frequency difference between two suitable confined spin wave modes. The synchronization allows energy transfer between the two modes through mechanical modulation, leading to the amplification of magnetic response. The main focus is on micromagnetic simulations and the underlying theory.

The theoretical framework studies the mechanics of a beam bridge, particularly its dynamics through the nonlinear Euler-Bernoulli beam equation, describing the strain within an oscillating bridge. Furthermore, the magnetic dynamics is based on the linearized Landau-Lifshitz-Gilbert equation. And with the Walker equation, the dispersion relations for Damon-Eshbach spin waves (DESP) and perpendicular standing spin waves (PSSW) are obtained. The findings indicate good tunability of the frequency difference between the first confined DESP and odd PSSW modes. Mechanical simulations were carried out in COMSOL Multiphysics, while micromagnetic simulations were performed using MuMax3.

The results show that the strain distribution within the oscillating bridge corresponds particularly well with the mode shape of the first odd PSSW mode. This makes mechanical oscillation a natural device to modulate spin waves between these two modes. Therefore, the magnetic response to mechanical oscillations can be significantly enhanced by matching the mechanical frequency with the frequency difference between the spin wave modes. The results are promising, depicting a practical setup in which spin waves are coupled with mechanical oscillations, and they provide strong motivation for physical experimentation.

# M-12: FNU Anu

*UGC-DAE Consortium for Scientific Research, Mumbai (India )*

**Title: Topological Hall effect in Mn5Sn3**

Topological materials have become hot topic for research of late owing to its various applications in devices as well fundamental physics point of view. Compounds such as Mn2 PtSn, Fe3 Sn2 and Fe5 Sn3 show topological behaviour. It would be interesting to explore the isostructural hexagonal (SG: P63/mmc) compound Mn5 Sn3 for topological character. Mn5 Sn3 orders ferromagnetically at Tc ~ 227K and undergoes spin reorientation transition at ~110K. Magnetoresistance (MR) for T below 75K is negative but small at low fields, wheres it is becomes significant between 100K to 235K. MR becomes positive above 0.35T. To explore topological behaviour, Hall effect was also measured at several temperatures. Symmetrized Hall data was used to calculate topological hall effect using equation ρxy = ρxy N+ ρxy A + ρT, where superscripts N, A and T refer to ordinary, anomalous and topological Hall resistivities, respectively. ρxy A arises in ferro or ferrimagnets. Below 0.7T, ρT data show peaks and dips that are characteristics of topological behaviour. Similar, topological features were seen in single crystal Fe5 Sn3 and Mn2 PtSn. However, in the present case two additional features are seen compared Fe5 Sn3 . This could be due to differences in magnetic behaviour of the two compounds.

# M-13: Bijaya Kharel

*University of Delaware (Delaware)*

**Title: TBD**

TBD

# M-14: Kate Matthews

*UC San Diego (California)*

**Title: Investigating Interfacial Magnetic Coupling in La0.7Sr0.3MnO3-La0.3Sr0.7FeO3 Heterostructures**

Spintronics are an energy efficient alternative to conventional electronics because of their use of spin current as information carriers instead of charge current. Metallic ferromagnets like permalloy have traditionally been studied for these applications. However, there is growing interest in studying alternative materials like oxides to further improve the efficiency of spin-based devices. In this work, we investigate the magnetic properties and interfacial coupling in LSMO-LSFO (ferromagnet-antiferromagnet) thin film bilayers using a combination of magnetometry, X-ray spectroscopy, and X-ray scattering measurements.

# M-15: Matteo Casadei

*University of Bologna (Italy)*

**Title: Fe2P based materials for permanent magnets applications**

# M-16: Ana Isabel Jiménez Ramírez

*University of Oviedo (Spain)*

**Title: Co₂FeIn Heusler Nanowires: Magnetic and Structural Properties**

The development of advanced information storage technologies has spurred interest in three-dimensional magnetic nanostructures as alternatives to traditional microelectronics. Among these, nanowire (NW) arrays show promise due to their unique magnetic properties, making them suitable for high-density magnetic storage and spintronic devices. In this study, we investigated Co₂FeIn full-Heusler alloy NWs, known for their high spin polarization, ideal for spintronics.
The NWs were synthesized via pulsed electrochemical deposition (PED) using nanoporous alumina membranes (NAMs) as templates. Structural and compositional analysis using SEM, TEM, and XRD revealed uniform NWs with diameters of (165±11) nm, lengths around 12 µm, a Co₄₉Fe₂₈In₂₃ composition, and an A2 crystal structure.
Magnetic properties were evaluated using vibrating sample magnetometry (VSM), showing a coercive field of (HC = 72±10) Oe. First-order reversal curve (FORC) measurements, performed in parallel configuration at various temperatures, indicated magnetostatic interactions and a narrow switching field distribution. Additionally, magneto-optic Kerr effect (MOKE) microscopy on isolated NWs showed a Lorentzian switching field distribution with a mean of (HSW = 70±5) Oe, consistent with VSM results.
Thermomagnetic measurements confirmed a Curie temperature above 1000 K, aligning with reported values for similar Heusler alloys. These findings highlight the potential of Co₂FeIn NWs in next-generation spintronic applications.

# M-17: Guillermo Gestoso

*Universidad del País Vasco UPV/EHU (Spain)*

**Title: TBD**

TBD

# M-18: Tamer Taşkıran

*Bilkent University (Turkey)*

**Title: Computational design of materials with altermagnetic properties: RuO2 example**

This study explores the computational design of materials with
altermagnetic properties, a newly identified class of magnetic materials that
exhibit characteristics distinct from conventional ferromagnetic (FM) and
antiferromagnetic (AFM) materials. Unlike FM and AFM materials, altermagnets
display collinear magnetic ordering while exhibiting phenomena such as the
Anomalous Hall effect, large Spin Hall conductivity, and spin torque transfer,
all without net magnetization. Altermagnetic materials can also offer
significant advantages for spintronics. Their ability to exhibit strong spin
splitting, large Spin Hall conductivity, and stable collinear magnetic ordering
without the drawbacks of stray fields or sensitivity to external magnetic
fields makes them ideal candidates for next-generation spintronic devices.
Combining the desirable features of FM and AFM materials, altermagnets could
enable faster, more efficient, and more stable spintronic components, such as
spin filters, memory devices, and logic circuits.

Building on the recently proposed spin-group formalism, this research aims to identify,
analyze, and predict candidate altermagnetic materials using a systematic
computational workflow. The study begins with RuO₂ as a primary
subject due to its recently recognized—and still debated—altermagnetic
behavior. Results have been obtained through ab initio calculations
of magnetic ordering, mechanical stability, spin-polarized band structures, and
Hall effect properties. Advanced density functional theory (DFT) simulations
were used to generate data for Wannier function-based analysis of Berry
curvature and Hall conductivities. In the future, high-throughput screening of
materials databases will complement manual analysis of specific binary and
ternary compounds. Candidate materials will be screened based on spin-symmetry
criteria to identify those with high Spin Hall conductivity for spintronic
applications. Additionally, the effects of doping, strain, and stacking on the
electronic properties of altermagnetic materials will be investigated.

Tamer Taşkıran (1), and Cüneyt Şahin (1)
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# M-19: Tej Raj Karki

*The University of Texas at Arlington (Texas)*

**Title: Superspin glass in FeCo nanoparticles**

In this study, we synthesized FeCo nanoparticles using the chemical thermal decomposition approach. XRD confirmed the FeCo cubic phase, whereas the morphology of nanoparticles was observed to be spherical with the particle size of 27 nm. The nanoparticles exhibit a high saturation magnetization (MS) of 190 emu/g with the coercivity (HC) of 330 Oe at room temperature. To observe the interparticle magnetic dipolar interactions between these nanoparticles, two samples were prepared, i.e. (1) dilute: nanoparticles dispersed in non-magnetic epoxy, (2) concentrated: an agglomerated chunk of nanoparticles. The decrease in magnetization upon field cooling (FC) of the concentrated FeCo nanoparticles indicates the dominance of strong dipolar interactions, however, it was not observed in the dilute NPs where the separation between the NPs resulted into weak interparticle magnetic dipolar interactions [Figure 1(a, b)]. The sharp increase of magnetization in zero field cooled (ZFC) curve up to 50 K shows a superspin glass state in the dilute NPs sample. To further confirm the existence of a superspin glass state; aging, and memory experiments were performed [Figure 1(c, d)], which are considered as the experimental signature for the spin glass systems [1, 2]. The sample with dilute nanoparticles showed magnetic relaxation below 50 K and a strong memory effect, which confirmed the existence of a superspin glass state in these nanoparticles.

# M-20: David Anthofer

*JGU Mainz (Germany)*

**Title: Tuning spin-injection into metallacrown/thin-metal film systems**

Single-molecule magnets (SMMs) have recently gained significant interest due to their ability to retain magnetic information at the molecular level, surpassing the superparamagnetic limit of conventional magnetic storage technologies and offering potential applications in ultra-compact and high-density data storage devices. A crucial challenge hindering their application in technology is the functionalization of molecules adsorbed on thin film underlayers.
To address this key challenge of probing and understanding the hybridization effects between SMMs and metal thin films, we employ two complementary experimental techniques. First, spin pumping at ferromagnetic resonance is used to inject a pure spin current into hybrid molecule/non-magnetic metal thin-film heterostructures. For this, we utilize molecules based on the metallacrown system, chosen for their unique combination of synthetic versatility and structural stability. By measuring changes in magnetic damping before and after molecule adsorption, we quantify the spin-injection efficiency at the hybrid interface. We observe a notable increase in damping after adsorption of Dysprosium-based metallacrown SMMs. In contrast, no change in damping was observed after deposition of Copper-based metallacrowns indicating the significance of molecular composition on the spin-injection efficiency at the hybrid interface. Further optimization of ferromagnetic and non-magnetic metal layer thicknesses reveals a tunable framework for probing spin-injection dynamics at molecule/metal interfaces. The second technique, x-ray magnetic circular dichroism, allows us to cool the molecule/metal sample down to cryogenic temperatures, below the blocking temperature of the SMM. With that, we can directly probe the impact of hybridization on the magnetic properties of the molecules.
This complementary approach enhances our understanding of spin transfer at hybrid interfaces, enabling the tuning of spin-injection efficiency by molecular design. Simultaneously, it provides deeper insights into the magnetic behavior of SMMs when hybridized with metal thin films, paving the way towards integrations of SMMs in spintronic devices.

# M-21: Benjamin Mimica

*Universidad Tecnica Federico Santa Maria (Chile)*

**Title: TBD**

We explore spin-wave dynamics in magnetic nanotubes, focusing on the influence of the
 Dzyaloshinskii-Moriya interaction and curvature. The study uses analytical methods to examine how these factors influence the emergence of nonreciprocity and azimuthal standing waves in nanotubes with longitudinal magnetization along the axis or with a vortex-like magnetization. The interplay between exchange, Dzyaloshinskii-Moriya, and dipolar couplings in determining the chirality of spin waves is discussed. When the magnetization is saturated along an axis, the spin waves propagating along it are symmetric under the inversion of the wave vector. However, magnetochirality, mainly driven by exchange and Dzyaloshinskii-Moriya couplings, is observed in the azimuthal standing modes. In the vortex state, frequency nonreciprocity occurs for waves propagating along the tube, while the azimuthal modes remain reciprocal. The sign of the DMI strength, determined by the direction of the interface either reinforces the asymmetry induced by the dipolar interaction is reinforced, or opposes this asymmetry. The influence of radial anisotropy is also examined. It is found that radial anisotropy reduces the frequency of the modes and shifts the dispersion minimum to a finite wave vector in the vortex state.

# M-22: Jorge Alejandro Lopez Solaiman

*Materials Science Institute of Madrid (ICMM-CSIC)) (Spain)*

**Title: Magnetomechanical Stimulation through Magnetic Nanostructured Surfaces**

Research on magnetic nanostructures has become one of the most interesting areas in recent years for the development of nanotechnology, particularly in exploring what is known as magnetic cellular transduction through the magnetostrictive effect. This work investigates nanofabrication routes for active surfaces designed for cellular stimulation. These surfaces are fabricated via a combination of the Langmuir-Blodgett technique—to create a highly compact monolayer of nanoparticles (NPs) of different sizes—and Physical Vapor Deposition (PVD) to add a highly magnetostrictive material, Terfenol-D. Additionally, some samples were coated with polyethylene glycol (PEG) to enhance their hydrophilicity .

The characterization of the samples was carried out with three main objectives: assessing the quality of the monolayer, analyzing the surface properties of Terfenol-D, and evaluating the magnetic response of the nanostructured surfaces. To achieve these objectives, various techniques were employed, including Scanning Electron Microscopy (SEM), X-ray Photoelectron Spectroscopy (XPS), Magnetic Force Microscopy (MFM), and Vibrating Sample Magnetometry (VSM). Cell experiments focused on analyzing the cytotoxicity of the material and the stimulation capacity of central nervous system cells via magnetostriction.

The results demonstrated the effectiveness of the Langmuir-Blodgett technique in fabricating compact monolayers. Moreover, nanostructuring influenced the magnetic response, and several interesting properties of the material have been identified for potential application in biological systems.

# M-23: Ayomipo Ojo

*University of South Florida (Florida)*

**Title: Temperature-dependent magnetization dynamics in magnetic Weyl semimetal Co2MnGa thin films**

Co$\_2$MnGa (CMG), a magnetic Weyl semimetal, exhibits ultralow damping, strong spin-dependent transport, and topological features favorable for spintronic applications. While its room-temperature magnetization dynamics have been studied, the temperature ($T$) dependence of key dynamic parameters such as the damping and exchange stiffness remains underexplored. Here, we investigate the temperature-dependent magnetic dynamics in CMG thin films (20, 60, and 80 nm) grown on MgO (001) using broadband ferromagnetic resonance (FMR) spectroscopy with the field applied perpendicular to the sample plane. X-ray diffraction reveals a strain-induced tetragonal distortion, most pronounced in the 20 nm film. As temperature decreases, the saturation magnetization ($M\_s$) deviates from Bloch’s law below 170 K, due to a temperature-dependent tetragonal distortion. The effective magnetization $M\_{{eff}} > M\_s$ indicates a net in-plane anisotropy that strengthens with decreasing temperature, while the perpendicular uniaxial anisotropy ($K\_{u\_{[001]}}$) also increases, with the 20 nm film exhibiting the highest values across all temperatures. Perpendicular standing spin waves (PSSWs) observed in the 60 and 80 nm films enable extraction of the exchange stiffness ($A\_{{ex}}$) and exchange length ($l\_{ex}$), both of which increase with decreasing temperature, with $A\_{{ex}}$ following a $T^2$ dependence. Additionally, the $g$-factor is relatively constant in the 80 nm film but varies with temperature in thinner films. All films exhibit ultralow damping, with the 80 nm film showing temperature-independent behavior.

# M-24: Miguel Mancias

*Boise State University (Idaho)*

**Title: Engineering High Thermal Stability in Zr-doped CoFeB for High Power Conditioning in Extreme Environments**

Modern soft magnets have vast applications in high-power-high-frequency power conversion and conditioning that are critical for future propulsion and energy distribution systems. However, soft magnets in extreme environments, such as space, must possess high-temperature stability, handle high power and frequency, and have robust manufacturing processes. These requirements correspond to a large saturation magnetization (Ms), low permeability, and a high temperature for a first-order phase transition in thin films and ribbons used for miniaturized inductor cores. To achieve these, this work proposes alloying cobalt iron boron (CoFeB, 60/20/20), a high MS soft magnet, with zirconium (Zr) to expand its operating temperature. Preliminary results from differential scanning calorimetry (DSC) and in-situ transmission electron microscope (TEM) indicate that increasing the atomic concentration of Zr increases the temperature required to induce a first-order phase transition in CoFeB, while maintaining a large MS of 800 emu/cc. At Zr concentrations <10%, the phase transitions were observed only beyond 600 K, which is higher than those temperatures for undoped CoFeB. Magnetic measurements also revealed that Zr-CoFeB has a “wasp-waisted” hysteresis, indicating a two-phase magnetic switching, possibly from localized order induced by Zr in a CoFeB matrix. These results demonstrate promise in exploring alloys of CoFeB with Zr for improving temperature stability and potentially other rare-earth elements for high-frequency operation.

# M-25: Shubham Atmaram Patil

*UGC-DAE Consortium for Scientific Research, Mumbai (India)*

**Title: Magnetic and Structural Properties of distorted honeycomb Na2Cu2TeO6**

Honeycomb layered oxides have garnered significant interest due to their structural versatility and high-voltage electrochemistry, making them promising candidates for quantum spin liquids, sustainable energy materials, and next-generation rechargeable batteries. In this study, we report the structural and magnetic properties of Na₂Cu₂TeO₆, a spin-dimer compound synthesized via the ceramic route. X-ray diffraction analysis confirms that Na₂Cu₂TeO₆ crystallizes in a monoclinic structure (space group C2/m), featuring Cu₂TeO₆ layers with Na atoms occupying octahedral voids. SEM-EDS analysis verifies the elemental composition, while dielectric measurements at ambient conditions reveal the absence of distinct grain boundaries. Magnetic susceptibility and specific heat studies indicate the absence of long-range magnetic ordering down to 2.5 K. However, a broad maximum in magnetization at 160 K suggests short-range one-dimensional antiferromagnetic correlations. Furthermore, magnetic susceptibility data reveal a spin-gap opening, indicative of spin dimerization. Temperature-dependent neutron diffraction measurements show a gradual decrease in unit cell volume with cooling, attributed to reduced thermal agitation. Notably, no magnetic reflections are observed down to 3 K, suggesting a quantum disordered ground state in this spin-gapped system. To gain deeper insight into its magnetic excitation spectrum, we plan to perform inelastic neutron scattering, which will help establish a microscopic understanding of the relationship between bulk physical properties and crystal structure.

# June 25, 2025 (Wednesday)

# W-01: Thomas Neuner

*Northwestern University (United States - Illinois)*

**Title: Field-Free Concealable PUF with Voltage-Controlled-MTJs**

Physically Unclonable Functions (PUFs) leveraging Voltage-Controlled Magnetic Anisotropy (VCMA) in Magnetic Tunnel Junctions (MTJs) present a promising approach for secure hardware authentication. Voltage-controlled MTJs (V-MTJS) exploit voltage-induced modulation of magnetic anisotropy to enable low power consumption, fast switching, and high endurance, where process-induced variations generate a unique device fingerprint. By applying a global switching voltage to all MTJs, the PUF key is generated. To enhance security against physical attacks, a concealment scheme is applied, which mitigates risks from optical probing, side-channel attacks, and fault injections by minimizing the temporal window of data exposure and preventing passive state leakage. The proposed V-MTJ PUF shows high entropy, high reliability, and a reliable concealment scheme demonstrating its circuitry and is a viable candidate for secure device identification in resource-constrained environments.

# W-02: Heng Niu

*Nanjing University (China)*

**Title: Out-of-plane and engineered Dzyaloshinskii-Moriya interaction in the magnetic ultrathin films**

 The Dzyaloshinskii-Moriya antisymmetric exchange interaction (DMI) stabilizes topological spin textures with promising future spintronics applications. According to crystal symmetry, the DMI can be categorized as different types that favour different chiral textures. Such as bulk-DMI, interfacial-DMI, anisotropic-DMI and interlayer-DMI. Out-of-plane DMI, as the missing type that favours in-plane chirality, remained unexplored so far. Utilizing molecular-beam-epitaxy (MBE) we fabricate the ultrathin magnetic films with Cs symmetry and observe the out-of-plane DMI stabilized in-plane chirality using spin-polarized electron microscopy. Our results show that extremely low out-of-plane DMI strengths at μeV/atom are sufficient to stabilize topological spin textures, including merons and bimerons. We also demonstrate field-induced reversible control of the in-plane chirality and merons. Our findings open up untapped paths on topological magnetic textures and their potential applications.
 DMI is conventionally considered to be unable to induce individual topological magnetic structures with topological charge greater than one. we experimentally realize the control of Q of magnetic skyrmionic structures at room temperature in a DMI platform with spatially alternating signs. Depending on how many times it crosses the interfaces between DMI regions with opposite signs, the magnetic skyrmionic structures possess different Q. Modifying the DMI energy landscape through chemisorbed oxygen, a magnetic topological transition is realized. Our findings open up an unexplored avenue on various topological magnetic skyrmionic structures and their potential applications.

# W-03: Davide Benettin

*SPINTEC, (Univ. Grenoble Alpes/CEA) IRIG / CEA Grenoble (France)*

**Title: Molecular beam epitaxy of dielectric layers on 2D magnets for spintronics devices**

The newly discovered class of 2D magnetic materials paves the way for the realization of ultracompact spintronic devices with enhanced functionalities for memory and logic applications. Among the different 2D magnets discovered so far, FenGeTe2 (n=3,4,5) compounds have caught special attention due to their itinerant ferromagnetism and high Curie temperatures approaching room temperature. Many efforts have been made to study the properties of these 2D magnets alone or combined with other 2D materials in complex heterostructures. However, most of these works rely on mechanical exfoliation, a method that yields nanoflakes with uncontrolled thickness and shape. Here, we use molecular beam epitaxy (MBE) emerging as a powerful method to grow cm-scale 2D materials with fine-tuning of the composition, control of the thickness down to the 2D limit and ability to fabricate heterostructures with sharp and clean interfaces. Namely, we will present our progress in fabricating Fe3GeTe2 and its integration with dielectric tunnel barriers into fully-epitaxial van der Waals heterostructures, aiming to realize scalable magnetic tunneling junctions with the 2D magnets as electrodes. In parallel, we perform ab-initio calculations in order to explore the potential of these novel van der Waals interfaces for spin filtering and interlayer exchange coupling.

# W-04: Kamal Khanal

*OSU - Stillwater (Oklahoma )*

**Title: TBD**

TBD

# W-05: AHMAD KAMAL OTHMAN

*Universiti Malaysia Perlis ( Malaysia )*

**Title: Design of Torus Axial Flux Surface-Inset Permanent Magnet Synchronous Motor**

The growing scarcity of high energy density rare-earth materials has driven significant advancements in the development of single stator double rotor (SSDR) axial flux permanent magnet (PM) synchronous machines. However, achieving an optimal design for PM motors remains a formidable challenge, as it requires balancing multiple, often conflicting, factors, such as, high torque-per-volume density, cost efficiency, operational performance, minimal weight, and manufacturability. Meanwhile, the analytical models are utilized to predict motor performance, which are unable to accurately capture the performance complexities under varying operating conditions. Additionally, conventional optimization techniques often lack the necessary capability of exploration and exploitation, further complicating the pursuit of an ideal motor design.

Therefore, a novel multi-objective optimization framework has been developed, integrating commercial finite element analysis (FEA) with advanced genetic algorithm and whale optimization algorithm, to precisely predict motor performance and accurately determine optimal designs for PM motors. Firstly, the motor dimensions of SSDR PM motors have been calculated using basic sizing principles, considering various motor types, winding configurations, and slot/pole combinations, with simulations conducted under open-circuit and on-load conditions using FEA. Then, the key performance metrics for the PM motors, such as back-EMF, cogging torque, flux distributions, electromagnetic torque with its ripples, power losses, efficiency, rare-earth material usage, cost, and motor weight, are rigorously evaluated under diverse operational conditions. Next, the improved and advanced optimizers have been designed to balance the exploration and exploitation in enhancing the search for optimal solutions. By integrating advanced optimization techniques directly with FEA, this framework addresses the challenges of multi-objective optimization, by achieving the Pareto-front optimality, in determining the optimum motor design. Hence, the approach significantly advances SSDR motors, ensuring more efficient, reliable performance, and cost effective, in industrial applications. Finally, comprehensive verification and validation confirm the robustness and practical applicability of the proposed framework in real-world scenarios.

# W-06: Rohiteswar Mondal

*Ph.D.-IIT Hyderabad (India)*

**Title: Interface engineering of topological BiSb/CoFeB heterostructures for efficient spin-charge conversion**

Topological insulators (TIs), exemplified by BiSb, exhibit exceptional spin-charge conversion efficiency arising from their topological surface states, positioning them as promising candidates for energy-efficient spin-orbit-torque (SOT) devices and as viable alternatives to heavy metals in conventional spintronics. However, the realization of these advantages is impeded by challenges such as the growth of high-quality TI thin films and the adverse interfacial interactions with ferromagnetic (FM) layers, which suppress the topological surface states and degrade spin transport properties. Addressing these limitations necessitates the implementation of optimized interlayers (ILs) at the TI/FM interface to mitigate intermixing, preserve structural integrity, and sustain the topological characteristics critical for efficient spin-charge conversion.
Our study systematically investigates the role of various IL materials, including elemental metals and metal-semiconductor compounds, in BiSb/CoFeB heterostructures. Thin films were deposited on sapphire c-plane substrates via DC magnetron sputtering, with their structural and morphological quality characterized using atomic force microscopy (AFM) and X-ray diffraction (XRD), confirming the high-quality textured growth of BiSb along the [0001] crystallographic direction. Magnetic properties were evaluated using a vibrating-sample magnetometer (VSM) to analyze the magnetic dead layer behavior in FM films. The spin-orbit torque efficiencies were quantified through spin-torque ferromagnetic resonance (ST-FMR) measurements conducted on bar-structured devices integrated with coplanar waveguides. Remarkably, the introduction of ILs led to a substantial enhancement in SOT efficiency, increasing from ~0.2 in the BiSb/CoFeB system to ~0.5 in BiSb/IL/CoFeB heterostructures. This improvement is attributed to the ILs' ability to preserve the topological surface states and inhibit elemental diffusion at the interface. These findings underscore the pivotal role of interface engineering in TI/FM systems and its critical importance in enabling the practical deployment of TI-based spintronic devices for next-generation energy-efficient technologies.

# W-07: Zhaochun Liu

*Beihang University (China)*

**Title: Voltage-gated spin-orbit torque for selective data writing in IrMn-based perpendicular magnetic tunnel junction arrays**

Magnetic random-access memory (MRAM) holds immense potential as a key memory technology of the next generation owing to its fast speed, non-volatility, and high density. Spin-orbit torque (SOT)-induced switching of perpendicular magnetization usually necessitates an in-plane external field, which limits its practical application. One approach involves changing the SOT channel material from heavy metals to antiferromagnets (AFMs), where field-free SOT switching can be achieved with the assistance of an in-plane exchange bias (EB) from AFM/ferromagnet interface. Nevertheless, challenges such as high power consumption and the three-terminal requirement still limit the energy efficiency and integration density of SOT-MRAM.
In this paper [1-2], we first experimentally demonstrate field-free SOT switching in 80 nm IrMn-based perpendicular magnetic tunnel junctions (pMTJs) with the assistance of the in-plane EB. Moreover, after 1×1010 bipolar SOT switchings, field-free SOT switching can still be achieved, showing a robust EB and reliable SOT switching performance. Then we fabricate a memory array that integrates multiple pMTJs on a shared IrMn strip. The voltage-controlled magnetic anisotropy (VCMA) effect is introduced to reduce the energy barrier during SOT switching, leading to decreased power consumption and selective data writing. When a gate voltage of 0.8 V is applied to a pMTJ in the array, the SOT critical current density decreases by 70%, resulting in a substantial 91% reduction in total power consumption. In addition, we show a clear operation window for selective writing. Through this voltage-gated SOT switching, selective data writing in the MTJ array is accomplished. Moreover, the write error rate below 8×10-5 and the endurance of more than 1×1012 are achieved. These findings demonstrate the high performance of voltage-gated SOT devices and contribute to its practical application in MRAM.
[1] W. Li et al., IEEE EDL, vol.45, no.5, p.921–924(2024)
[2] Z. Liu et al., IEEE EDL. vol.46, no.5, p.745–748.(2025)

# W-08: Viorica-Monica Moisiuc

*UAIC - Iași (România)*

**Title: Specific absorption rate in Magnetic Hyperthermia**

Magnetic hyperthermia is promising for potential aplications in oncology. This medical method uses the nanoparticles systems with specific magnetic and thermal properties. These special magnetic materials convert the absorbed energy of the magnetic field into heat, in the presence of alternating magnetic field [1, 2]. Specific Absorption Rate (SAR) is the amount of energy dissipated as heat by nanoparticles per unit mass. This parameter is one of the important parameters in the thermal analysis for Magnetic Hyperthermia [3]. Control of SAR values allows a better thermal response of tissues during hyperthermia. This paper describes the evolution of SAR for magnetite and maghemite with: i) magnetic field parameters (frequency and magnetic field amplitude); ii) the magnetic nanoparticles (MNP) size; iii) ferrofluid viscosity and iv) materials magnetic anisotropy. In the superparamagnetic regime (nanometer size), the SAR values for these materials were analyzed by the Neel and Brown relaxation mechanisms. The evolution of SAR with MNP size is significantly influenced by these two relaxation processes. For a specific nanoparticle size, SAR reaches a maximum. This maximum varies with the applied field parameters and corresponds to the maximum energy absorption. SAR reaches a maximum for the following specific sizes: 19 nm (magnetite) and 24 nm (maghemite) when the field parameters are H = 60 Oe and f = 200 kHz.
From experimental point of view, SAR was determined by measuring the temperature increase of the ferrofluid over time under the action of a controlled alternating magnetic field. For the accuracy of the experimental results, it is essential to thermally isolate the samples and use a precise temperature monitoring system (thermocouple). The (theoretical/experimental) study of this parameter provides insight into the mechanisms of energy conversion into heat and allows optimization of magnetic material properties.
References:
[1] M. Peiravi, H. Eslami, M. Ansari, Journal of the Indian Chemical Society 2022, 99, 100269.
[2] I. Astefanoaei, A. Stancu, Journal of Magnetism and Magnetic Materials 2021, 537, 168221.
[3] R. Hergt, S. Dutz, R. Muller, M. Zeisberger, Journal of Physics: Condensed Matter. 2006, 18, S2919.

# W-09: Luca Felipe Haag

*University of Kaiserslautern-Landau (Germany)*

**Title: Optical signatures of bulk g-wave altermagnetism in MnTe**

Altermagnets continue to attract interest due to their novel magnetic properties that, among other things, combine those of known ferromagnets and antiferromagnets [1,2]. Their momentum dependent spin polarization in reciprocal space without net magnetization make altermagnets attractive candidates for the study of optical properties on ultrashort timescales. It has recently been demonstrated by magneto-optical Kerr effect (MOKE) measurements that the spin system in planar d-wave altermagnets can be controlled by linearly polarized optical excitation [3]. Depending on the polarization vector of the linearly polarization light pulse one can selectively address spin-up or spin-down electrons. Paired with the intrinsically weak spin-orbit coupling in altermagnets, this results in a long-lasting excited spin polarization (~1ps) in a material that is magnetically compensated in its ground state [4].
The objective of this study is to investigate whether similar optical effects can be observed in bulk g-wave altermagnets. To this end, we focus on MnTe, which has been demonstrated to be altermagnetic by ARPES measurements [5]. Using ab-initio techniques together with a time-dependent calculation of the absorption process [6,7], we study theoretically the optically induced spin polarization for all polarization angles. Our results show an intriguing interplay between the complex nodal-plane structure in bulk g-wave altermagnets and the anisotropic excitation due to the polarized pulses, causing planar d-wave or g-wave signatures depending on the laser’s incident direction.

References

[1] L. Šmejkal et al., Phys. Rev. X 12, 040501 (2022)
[2] L. Šmejkal et al., Phys. Rev. X 12, 011028 (2022)
[3] M. Weber, S. Wust, L. Haag et al., arXiv:2408.05187 (2024)
[4] M. Weber, K. Leckron, L. Haag et al., arXiv:2411.08160 (2024)
[5] Krempaský, Nature 626, 517–522 (2024)
[6] S. Essert and H. C. Schneider, Phys. Rev. B. 84, 224405 (2011)
[7] M. Stiehl et al., Appl. Phys. Lett. 120, 062410 (2022)

# W-10: Zhaohui Li

*National University of Singapore (non-US baswd attendees)*

**Title: TBD**

TBD

# W-11: Rachel Maizel

*Virginia Tech (Virginia)*

**Title: Room-Temperature Perpendicular Magnetization and Anomalous Hall Effect in Polycrystalline Antiferromagnetic γ-FeMn Films**

Noncollinear antiferromagnets can exhibit intriguing topological phenomena, such as orbital magnetism and anomalous Hall (AH) effects [1-2]. However, topological antiferromagnets films require growth or annealing at high temperatures [1-2], posing difficulty for device manufacturing. Here, we show net out-of-plane magnetism and AH response at room temperature in sputter-grown polycrystalline FCC FeMn without any high-temperature growth or annealing. Since FeMn is a widely used antiferromagnets for exchange-biasing, its potential as a topological material is attractive for practical applications.

Theoretical works [3-4] predict topological magnetism and transport in FCC antiferromagnets with scalar spin chirality from the (111) orientation and uniaxial strain. The key to our (111) oriented FCC FeMn is an ultrathin Cu seed layer. We observe perpendicular magnetization superficially reminiscent of topological antiferromagnets with a uniaxial strain present in the FCC FeMn ~1.4% [5]. Our findings indicate that commonplace 𝞬-FeMn alloys, long used for exchange biasing since the 1970s, can be transformed into practical alternatives to topological antiferromagnets in spintronic devices.

[1] Taylor, J. M., et al., Phys Rev B, Vol. 101, pgs. 094404, (2020)

[2] Nakatsuji, S., et al., Nat, Vol. 527, pgs. 212-215, (2015).

[3] Hanke, J. P., et al., Sci. Rep, Vol. 7, pg. 41078, (2017)

[4] Kubler, J., et al., Jour. of Phys F: Met. Phys, Vol. 18, (1988)

[5] Cankurtaran, M., et al, Phys Rev B, Vol. 47, pgs. 3161-3170, (1993).

# W-12: Tianxing Wang

*UC San Diego (US)*

**Title: Exchange bias induced by spin-flip transition**

Exchange bias (EB) is a widely employed interfacial effect in magnetics to pin the reference layer in antiferromagnet/ferromagnet stacks. Setting EB is often limited to one method which is by field cooling through the antiferromagnet’s Néel temperature. We demonstrate that a temperature-triggered spin reorientation (Morin transition) can be leveraged to induce EB in an epitaxial α-Fe\_2 O\_3 (001)/NiFe heterostructure. In this system, EB can be set and reverse its sign far below the Néel temperature. Moreover, the anisotropy change brought by the Morin transition leads to a unique thermal behavior of the EB in that it occurs only in a temperature window. This Morin transition induced EB may provide new functionalities for spintronics and have implications on Néel vector switching assisted by magnetic phase transition.

# W-13: Krishbold Bhandari

*Virginia Commonwealth University (Virginia)*

**Title: TBD**

TBD

# W-14: Bin Luo

*Northeastern University (MA)*

**Title: Low-Loss Wideband Nonreciprocal Magnetoacoustic RF Isolator Enabled by Non-Collinear Dipolar-Coupled Ferromagnetic Stack**

Nonreciprocal RF isolators and circulators are critical components in modern wireless communication systems, enabling full-duplex radios and protecting power amplifiers from back-reflections in high-power microwave transmitters. These functionalities significantly enhance spectral efficiency and coordination in mesh or relay networks, particularly for 5G, IoT, and emerging 6G technologies. However, conventional RF isolators and circulators are bulky, expensive, and power-hungry due to their reliance on ferrite materials, which require high-temperature, oxidizing growth conditions and permanent magnets for operation via Faraday rotation—factors that are incompatible with CMOS processes.

Magneto-acoustic RF devices have recently emerged as promising alternatives, offering nonreciprocity with excellent power efficiency and CMOS compatibility. These devices incorporate a magnetic stack placed within the surface acoustic wave (SAW) propagation path between two interdigital transducers (IDTs) on a piezoelectric substrate. When RF voltage is applied, the resulting SAW interacts with spin waves in the magnetic layers, forming hybrid magneto-acoustic waves with direction-dependent loss characteristics. Despite significant advancements using magnetic heterostructures such as FeGaB-based and synthetic antiferromagnetic stacks, prior demonstrations have often been hindered by high insertion losses (typically >40 dB) and limited bandwidth.

In this work, we demonstrate a compact, low-loss, wideband nonreciprocal magneto-acoustic RF isolator utilizing a non-collinear dipolar-coupled FeGaB/SiO₂/FeGaB trilayer. The ferromagnetic stack couples to the fundamental SAW mode at 2.87 GHz on a 128° Y-X cut LiNbO₃ substrate. By engineering the magnetic anisotropy angles (10° and 70° relative to the SAW wavevector) through in-situ angled field deposition, we achieve multiple wideband nonreciprocal windows from 2.48 to 3.15 GHz. The device exhibits a peak nonreciprocity of ~40 dB (200 dB/mm), with low insertion loss of ~13 dB off-resonance and ~25 dB on-resonance at 2.87 GHz. This ultra-compact device offers strong potential for compact, low-power full-duplex radios, quantum transducers, and hybrid magnonic-acoustic systems.

# W-15: Heng Niu

*Nanjing University (China)*

**Title: Out-of-plane and engineered Dzyaloshinskii-Moriya interaction in the magnetic ultrathin films**

The Dzyaloshinskii-Moriya antisymmetric exchange interaction (DMI) stabilizes topological spin textures with promising future spintronics applications. According to crystal symmetry, the DMI can be categorized as different types that favour different chiral textures. Such as bulk-DMI, interfacial-DMI, anisotropic-DMI and interlayer-DMI. Out-of-plane DMI, as the missing type that favours in-plane chirality, remained unexplored so far. Utilizing molecular-beam-epitaxy (MBE) we fabricate the ultrathin magnetic films with Cs symmetry and observe the out-of-plane DMI stabilized in-plane chirality using spin-polarized electron microscopy. Our results show that extremely low out-of-plane DMI strengths at μeV/atom are sufficient to stabilize topological spin textures, including merons and bimerons. We also demonstrate field-induced reversible control of the in-plane chirality and merons. Our findings open up untapped paths on topological magnetic textures and their potential applications.
DMI is conventionally considered to be unable to induce individual topological magnetic structures with topological charge greater than one. we experimentally realize the control of Q of magnetic skyrmionic structures at room temperature in a DMI platform with spatially alternating signs. Depending on how many times it crosses the interfaces between DMI regions with opposite signs, the magnetic skyrmionic structures possess different Q. Modifying the DMI energy landscape through chemisorbed oxygen, a magnetic topological transition is realized. Our findings open up an unexplored avenue on various topological magnetic skyrmionic structures and their potential applications.

# W-16: Thuan Pham Van

*Institute of Science tokyo (non-US based attendees)*

**Title: Vertical Spin Valve Device Utilizing Low-Temperature Grown 400-nm-thick-InAs Sandwiched by MnAs Layers on GaAs(111)B**

Spintronic devices, particularly spin field-effect transistors (spin-FETs), have significant potential for reducing power consumption compared to traditional MOSFETs. Additionally, vertical structures are gaining attention due to their potential to extend Moore's law. Therefore, our goal is to fabricate vertical spin-FETs (VSFETs) to explore the full potential of spin-FETs by adopting a vertical structure. To achieve this, we selected a MnAs/InAs/MnAs/GaAs(111)B structure due to the unique properties of these materials. MnAs is a ferromagnetic material that can serve as both a spin polarizer and a detector, while InAs, with its narrow bandgap and strong spin-orbit coupling (SOC), is ideal for transporting spin-polarized electrons. Initially, we fabricated and measured vertical spin valve (VSV) devices to investigate their transport properties. Subsequently, we plan to fabricate gate-all-around (GAA) structures to study the operation of vertical spin-FET devices. This presentation focuses on the first phase of our research. We successfully fabricated and measured a VSV device with a 400 nm thick InAs channel at 120 K. The results clearly demonstrate spin valve behavior consistent with the magnetization properties of the material. Specifically, we observed distinct resistance peaks, indicating antiparallel spin states when an external magnetic field was applied. The magnetization curve and the spin valve signal showed two-step magnetization switching due to differences in coercive forces between the top and bottom MnAs layers, attributed to their non-uniform thickness. This switching behavior indicates that spin-polarized electrons in the 400 nm thick InAs channel are controlled by the Rashba effect. Our findings are promising for the development of vertical spin-FETs capable of exhibiting multiple spin precessions through the Rashba effect. This study highlights the potential of using MnAs/InAs/MnAs/GaAs(111)B structures for advanced spintronic devices, combining the benefits of both ferromagnetic and semiconductor materials.

# W-17: André Soares

*University of Porto (Portugal)*

**Title: Noval Multimodal Characterization of Magneto-Mechanical Properties in NiMnIn Alloy**

This work focuses on the kinetics of the Half-Heusler NiMnIn alloy, one
of the most promising magnetocaloric materials. It undergoes a
transition from an antiferromagnetic to ferromagnetic state, coupled
with a martensite-austenite transformation. By simultaneously
measuring magnetization, strain, and temperature this study aims to
elucidate the correlation between magnetic and structural changes,
enhancing our understanding of these critical phase transitions and
paving the way for more efficient magnetic refrigeration technologies.

# W-18: Vimukthi Deshan Ganepola Arachchige

*University of South Florida (Florida)*

**Title: Dynamic Spin-Wave Characterization in Ferrimagnetic Insulators: TIme-resolved Imaging and Frequency Domain Analysis**

We employ time-resolved scanning transmission X-ray microscopy (TR-STXM)
using the MAXYMUS at the BESSY II synchrotron, combined with X-ray Magnetic
Circular Dichroism (XMCD), to investigate the spin-wave dynamics and magnetic
properties of the ultra-low damping spinel ferrite MgAl0.5Fe1.5O4 (MAFO), which
can be grown on single-crystal spinel substrates, a capability that arises from the
availability of MgAl2O4 as the only commercially available spinel substrate [1]. Using
TR-STXM, we visualize the spin-wave amplitude and phase dynamics across a range
of frequencies: 6.57 GHz, 8.57 GHz, 9.28 GHz, 10.07 GHz, and 13.5 GHz.
Our on going analysis focuses on identifying Damon-Eshbach modes and exploring
field-driven transitions to backward volume spin waves. Spin waves were measured at
gigahertz frequencies along the Damon-Eshbach geometry, and transitions to backward volume modes were observed as the external magnetic field was increased.
These spin-wave dispersions and transitions demonstrate the strong sensitivity of
spin dynamics to the external magnetic field.
These findings enhance our understanding of superexchange interactions in ferrimagnetic oxides and their role in determining spin-wave propagation and damping
properties. This approach extends methods used in earlier studies to a new class of
materials, with considerable potential implications for spintronic applications.

# W-19: Yung-Cheng Li

*Max Planck Institute of Microstructure Physics (Germany)*

**Title: Magnetic oscillator on the racetrack**

Spin-torque nano-oscillators (STNOs) are promising nanoscale microwave sources with diverse dynamic modes—propagating spin waves, magnetic vortices, and droplets—making them attractive for communication, sensing, and neuromorphic applications. However, enhancing their microwave output and achieving synchronization remains a key challenge.

Meanwhile, domain wall (DW)-based racetrack devices, driven by spin-orbit torque (SOT), offer scalable solutions for memory and logic. Beyond storage, DWs can modulate spin wave phase and amplitude—an underexplored avenue for hybrid spintronic systems.

In this study, we propose a novel platform combining STNOs with SOT-driven racetracks. This hybrid system allows controlled DW positioning and tunable microwave emission, enabling us to explore mutual interactions:
How DWs affect STNO dynamics (mode, frequency, amplitude)
How STNO-generated waves influence DW motion
Our ongoing work focuses on device fabrication and experimental setup to enable real-time probing of these coupled dynamics.

# W-20: Jiguang Yao

*University of Manitoba (Canada)*

**Title: Nonreciprocal Control of the Speed of Light Using Cavity Magnonics**

We demonstrate nonreciprocal control of the speed of light by sending a microwave pulse through a cavity magnonics device. In contrast to reciprocal group velocity controlled by conventional electromagnetically induced transparency (EIT) effects, incorporating a dissipative magnon-photon coupling establishes a nonreciprocal EIT effect, allowing slow and fast light propagation in opposite directions at the same frequency with comparable amplitude. Remarkably, reversing the magnetic field enables a directional switch between nonreciprocal fast and slow light. This discovery may offer new possibilities for pulse time regulation in microwave signal communications, neuromorphic computing, and quantum signal processing.

# W-21: Noora Naushad

*Nano Engineering & Spintronic Technologies Group (NEST), Department of Computer Science, The University of Manchester (United Kingdom)*

**Title: Developing novel magnetic L10 alloys for spintronics**

Magnetic materials with a significant magnetic moment, high anisotropy and low damping are important in many spintronic applications and for applications more widely. Typically, these materials require either scarce or expensive elements such as rare earth metals. Here, we work towards creating high anisotropy, high moment magnetic thin films made from abundant and inexpensive Mn and Al [1]. Specifically, the τ phase of MnAl with its L10 structure demonstrates these properties. However, the L10 phase only forms in a narrow range of fabrication conditions, where temperature plays a vital role [2]. This becomes a multidimensional optimization problem where we control parameters such as substrate, seed layers, deposition conditions and annealing temperature in order to achieve L10 ordered thin ﬁlms of MnAl for applications such as Spin-torque nano-oscillators.
Fabrication of L10 MnAl thin ﬁlms was investigated using two approaches. Firstly, by alternately depositing few nanometres thick Mn and Al films, followed by annealing it at various temperatures to promote intermixing and alloy formation. The second approach uses a composite mosaic target of Al foil placed on the Mn target in different surface area proportions in order to vary the composition. The narrow compositional range of the magnetic τ-phase leads to a need for the advanced technique to study the composition, including X-ray Fluorescence (XRF), Hard X-ray Photoelectron Spectroscopy (HAXPES), and XPS etching. The results from these techniques showed notable differences possibly due to the different sensitivity to the surface layers. This work highlights the difficulties in obtaining accurate compositional information in ultrathin films particularly when the target composition is only weakly connected to the composition of the final film.

[1] Oogane et al., JJAP, (2017) DOI: 10.7567/JJAP.56.0802A2
[2] Hafarov et al., Modern Magnetic and Spintronic Materials, Springer (2020). DOI: 10.1007/978-94-024-2034-0\_4

# W-22: Ashley Argueta

*New York University (New York )*

**Title: Temperature and Composition Dependence of Coercive Fields in GdxCo1-x**

Ferrimagnetic GdCo alloys are of significant interest in spintronics due to their tunable magnetic compensation properties and potential for energy-efficient switching. In this work, we investigate the magnetic behavior of Ta 4nm/Pt 2nm/GdₓCo₁₋ₓ 5nm/ Pt 2nm thin films through temperature-dependent Hall effect measurements across multiple compositions. Thin films were deposited via sputtering and patterned into Hall bar geometries to extract coercive fields and analyze the anomalous Hall resistance from 150 K to 350 K. Our results reveal clear polarity reversals and peaks in the coercive field near the magnetization compensation temperatures. Square-shaped Hall hysteresis loops confirm perpendicular magnetic anisotropy across all samples. These features shift systematically with Gd concentration. Notably, for the Gd₂₃Co₇₇ composition, the compensation temperature is identified at approximately 330K. These findings provide insight into tuning magnetic properties in GdCo-based systems for spintronic applications.

# W-23: Erin Marlowe

*Georgetown University (Washington DC)*

**Title: Electrodeposited FeCoNiCuZn High Entropy Alloy Thin films and Nanowires**

High-entropy alloys (HEAs) have emerged as an exciting platform for explorations of new materials phases and novel functionalities. These alloys are typically formed using bulk synthesis or physical vapor deposition techniques. We have investigated the synthesis of FeCoNiCuZn high-entropy alloys by electrochemical deposition under ambient conditions. A key challenge is that it is nontrivial to find a common set of electrodeposition conditions to allow simultaneous deposition of the HEAs with designed compositions. We have succeeded in realizing FeCoNiCuZn thin films with compositions well within the 5-35 at% range desirable for HEAs. Electrodeposition conditions, including electrolyte species and composition, pH, potential, etc., have been optimized to yield continuous films with a metallic finish. X-ray diffraction has confirmed a single-phase face-centered-cubic structure in the as-grown films. Magnetic properties of such films are comparable to those made by magnetron sputtering in the as-grown state. Additionally, the synthesis approach has allowed the fabrication of HEA nanowires, which have been used as building blocks to construct nanoporous metallic foams as efficient filtration media. These electrodeposited HEA nanostructures not only offer a new arena to explore the vast parameter space of HEAs, but also present opportunities to explore their functionalities.

# W-24: Greis Cipi

*CNRS - Université Paris-Saclay (France)*

**Title: Enhancement of the current-induced torque by a Cu/CuOx interface**

Magnetic skyrmions are topologically protected chiral spin textures that emerge in systems with broken inversion symmetry and can be controlled via electric currents. At heavy metal (HM)/ferromagnetic (FM) interfaces, spin-orbit coupling (SOC) generates spin currents (SC) when charge currents flow, enabling manipulation of magnetic textures through spin-orbit torque (SOT) [1]. Significant current-induced torques have also been observed in multilayer stacks with light metal/oxide interfaces, attributed to orbital current (OC) generated at these interfaces due to the low SOC in light metals [2,3].

This study aims to optimize the use of OC for efficient skyrmion manipulation. OC injection into FM occurs in two stages: generation at the light metal/oxide interface and conversion into SC to exert torque on FM. To achieve this, intermediate HM layers can be employed for conversion. Stacks of Pt(2)/Co(1)/Ta(t)/Cu\*(3) (nm), where Cu\* represents naturally oxidized Cu, were engineered. The Pt/Co interface contributes Dzyaloshinskii–Moriya interaction (DMI), while the Co/Ta interface provides SOC, DMI, and converts OC from the Cu\* layer into SC.

The dependence of the damping-like torque on Ta thickness (t) was analyzed using second harmonic generation linked to the anomalous Hall effect. Hall voltage measurements reveal static properties (ω component) and current-induced torques (2ω component) [4]. By analyzing the 2ω signal as a function of Ta thickness, the role of the metal/oxide layer was determined. Analysis of the damping-like torque showed an enhancement at t = 5.5 nm.

We acknowledge funding by France 2030 (plan project Chirex PEPR SPIN ANR-22-EXSP-0002).

References
[1] A. Thiaville et al. EPL 100, 57002 (2012).
[2] D. Go et al. Phys. Rev. Lett. 121, 086602 (8 2018).
[3] S. Krishnia et al. 2024. APL Mater 2024 12 (5).
[4] S. Krishnia et al. Phys. Rev. Appl. 16, 024040 (2 2021).

# W-25: Praveen Palabindela

*Spintronics and Nanomagnetism Laboratory, Department of Physics and Nanotechnology, SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu, India. (INDIA)*

**Title: Topological Transitions in Square Ferromagnetic Dot: Vortex to Bimeron**

Developing spintronics applications require a thorough and fundamental understanding of the transition process between the magnetic spin textures [1], and their dynamic behavior under various external stimuli [2]. This study highlights the transformation from magnetic vortices to bimerons, holds particular significance in the realm of topological spin textures, offering significant potential for future technologies in data storage, and quantum computing. We use micromagnetic simulations to investigate a thin ferromagnetic Permalloy square-dot, with an initial vortex magnetization [3]. By applying an appropriate in-plane current density and DMI value, we can induce and stabilize the bimerons/anti-bimerons in the square dot. The spin-transfer torque (SST) created by the applied current, which destabilize the spins from the initial magnetic vortex core, leading to change their orientation to the chiral spin textures, i.e., bimerons. Besides, we explore the impact of varying the strength of the in-plane bias magnetic field, demonstrating that bimerons are exclusively nucleated within the square dot, and intriguingly, reversing the field direction from positive to negative results solely in the formation of antibimerons. Finally, we analyze the variations in energy and topological charge as a function of bias field strength, providing critical insights into the underlying mechanisms driving these transitions. These new findings offer a deeper understanding of bimeron physics, thereby contributing valuable knowledge for designing and optimizing future spintronic devices.

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