MA 9: INNOMAG e.V. Prizes 2022 (Diplom-/Master and Ph.D. Thesis)

Die Arbeitsgemeinschaft Magnetismus der DPG hat einen Dissertationspreis und einen einen Diplom-/Masterpreis ausgeschrieben, welche auf der Tagung der DPG 2022 in Regensburg vergeben werden. Ziel der Preise ist die Anerkennung herausragender Forschung im Rahmen einer Diplom-/Masterarbeit beziehungsweise einer Promotion und deren exzellente Vermittlung in Wort und Schrift. Im Rahmen dieser Sitzung tragen die besten der für ihre an einer deutschen Hochschule durchgeführten Diplom-/Masterarbeit beziehungsweise Dissertation Nominierten vor. Im direkten Anschluss entscheidet das Preiskommittee über den Gewinner des INNOMAG e.V. Diplom/Master-Preises und des Dissertationspreises 2022. Talks will be given in English!

Time: Monday 15:00–17:00 Location: H43

MA 9.1 Mon 15:00 H43

Magnetoelastic coupling and uniaxial pressure dependencies in the honeycomb quantum magnets CrI_3 and $Na_2Co_2TeO_6$ — •Jan Arneth[1], Martin Jonak[1], Mahmoud Abdel-Hafiez[2], Kwang-Yong Choi[3], and Rüdiger Klingeler[1] — [1]Kirchhoff-Institute for Physics, Heidelberg University, Germany — [2]Dep. of Physics and Astronomy, Uppsala University, Sweden — [3]Dep. of Physics, Sungkyunkwan University, Republic of Korea

Due to their layered structure, competing magnetic interactions, and magnetic anisotropy, quasi-2D honeycomb systems are promising quantum materials featuring fundamentally and technologically relevant phenomena. Often, relevant materials are at the verge of the desired properties, and strain has been proven to be a tuning parameter. Strain engineering of the critical temperature in 2D ferromagnetic semiconductors such as CrI_3 [1] towards room temperature or driving the quantum magnet $Na_2Co_2TeO_6$ into the Kitaev spin-liquid phase are illustrative examples. The precise determination of uniaxial strain effects is hence a mandatory step towards new applications and phenomena. We report dilatometric studies on the honeycomb quantum magnets CrI_3 and $Na_2Co_2TeO_6$ at low temperatures and high magnetic fields. Our data enable us to quantify magnetoelastic coupling and the uniaxial pressure dependencies of the respective ordering temperatures. Additionally, the magnetic phase diagrams are constructed, including structural response of the surface phase in CrI_3 and signatures of competing degrees of freedom in $Na_2Co_2TeO_6$.

[1] J. Arneth et al., Phys. Rev. B 105, L060404 (2022)

MA 9.2 Mon 15:20 H43

Magnetisation dynamics in epitaxial Co_2Mn-based Heusler thin films with ultralow damping for thicknesses below 50 nm — •Anna M. Friedel[1,2], Claudia de Melo[2], Victor Palin[2,3], Sébastien Petit-Watelot[2], Stéphane Andrieu[2], and Philipp Pirro[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Technische Universität Kaiserslautern, Kaiserslautern, Germany — [2]Institut Jean Lamour, UMR CNRS 7198, Université de Lorraine, Nancy, France — [3]Synchrotron SOLEIL-CNRS, L'Orme des Merisiers, Gif-sur-Yvette, France

For future applications of magnetisation dynamics, materials with low Gilbert damping are indispensable. Co_2Mn-based Heusler compounds are considered excellent candidates as they combine high saturation magnetisation, high Curie temperature, half-metallicity and ultralow Gilbert damping, especially when grown epitaxially with decent control over stoichiometry to ensure the desired chemical ordering [1]. However, downscaling towards microstructures is a challenge in which the fabrication of high-quality ultrathin films with consistent excellent properties is a crucial step. We succeeded in the epitaxial growth of high-quality Co_2MnSi Heusler films in the thickness range of 4-44 nm for all of which the half-metallicity was confirmed [2]. Consequently, an ultralow Gilbert damping was obtained for the whole series reaching down to 7.8×10^{-4} for the 8 nm film. Coupling effects and magnetisation dynamics in heterostructures are currently under investigation.

[1] C. Guillemard, *et al.*, J. Appl. Phys. **128**, 241102 (2020)
[2] C. de Melo, *et al.*, Appl. Mater. Today **25**, 101174 (2021)

MA 9.3 Mon 15:40 H43

ΔE-Effect Magnetic Field Sensors — •Benjamin Spetzler, Elizaveta Golubeva, Patrick Wiegand, Robert Rieger, Jeffrey McCord, and Franz Faupel — Kiel University, Kiel, Germany

Many conceivable biomedical and diagnostic applications require the detection of small-amplitude and low-frequency magnetic fields. Against this background, we investigate a magnetometer concept based on the magnetoelastic ΔE effect. The ΔE effect causes the resonance frequency of a magnetoelastic resonator to detune in the presence of a magnetic field, which can be read out electrically with an additional piezoelectric phase. Various microelectromechanical resonators are experimentally analyzed in terms of the ΔE effect and signal-and-noise response, and models are developed and extended where necessary to identify current limitations. Although a large ΔE effect is confirmed in the shear modulus, the sensitivity of classical cantilever resonators does not benefit from this effect. An approach utilizing surface acoustic shear waves provides a solution and can detect small signals over a large bandwidth. Comprehensive analyses of the quality factor and piezoelectric material parameters indicate methods to increase sensitivity and signal-to-noise ratio significantly. The latter is currently limited by the loss of the magnetic material. First exchange-biased ΔE-effect sensors pave the way for compact setups and arrays with a large number of sensor elements. The insights gained lead to a new resonator and processing concept that can circumvent several previous limitations with prospects for sensor improvements in the future.

MA 9.4 Mon 16:05 H43

High-contrast mapping of atomic-scale spin-textures — •Lucas Schneider, Philip Beck, Jens Wiebe, and Roland Wiesendanger — Department of Physics, University of Hamburg, D-20355 Hamburg, Germany

A scanning tunneling microscope (STM) with a magnetic tip that has a sufficiently strong spin polarization can be used to map the sample's spin structure down to the atomic scale [1] but usually lacks the possibility to absolutely determine the value of the sample's spin polarization. Magnetic impurities in superconducting materials give rise to pairs of perfectly, i.e., 100%, spin-polarized subgap resonances. In this talk, I will present a method exploiting this effect by functionalizing the apex of a superconducting Nb STM tip with such impurity states [2]. These tips can be used to probe the spin polarization of atom-manipulated Mn nanomagnets on a Nb(110) surface. By comparison with spin-polarized STM measurements of the same nanomagnets using conventional Cr bulk tips, we demonstrate an extraordinary spin sensitivity and the possibility to measure the sample's spin-polarization values close to the Fermi level quantitatively with the new functionalized probes.

[1] R. Wiesendanger, Rev. Mod. Phys. **81**, 1495 (2009)
[2] L. Schneider *et al.*, Sci. Adv. **7**, eabd7302 (2021)

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