MA 9: INNOMAG e.V. Diploma/Master Prize (2021)

Die Arbeitsgemeinschaft Magnetismus der DPG hat einen Diplom-/Masterpreis ausgeschrieben, welcher auf der Online-Tagung der DPG 2021 vergeben wird. Ziel des Preises ist die Anerkennung herausragender Forschung im Rahmen einer Diplom-/Masterarbeit und deren exzellente Vermittlung in Wort und Schrift. Im Rahmen dieser Sitzung tragen die besten der für ihre an einer deutschen Hochschule durchgeführten Masterarbeit Nominierten vor. Im direkten Anschluss entscheidet das Preiskommittee über den Gewinner bzw. die Gewinnerin des INNOMAG e.V. Diplom/Master-Preises 2021 in Höhe von 500 EURO. Talks will be given in English!

Time: Wednesday 12:30–14:20 Location: H2

MA 9.1 Wed 12:30 H2

Orbital Magnetic Moment of Magnons — •Robin R. Neumann[1], Alexander Mook[1,2], Jürgen Henk[1], and Ingrid Mertig[1] — [1]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale), Germany — [2]Department of Physics, University of Basel, Basel, Switzerland

It is commonly accepted that magnons—collective excitations in a magnetically ordered system—carry a spin of $1\hbar$ or, phrased differently, a magnetic moment of $g\mu_B$. In this talk, I demonstrate that magnons carry magnetic moment beyond their spin magnetic moment. Our rigorous quantum theory uncovers a magnonic orbital magnetic moment brought about by spin-orbit coupling. We apply our theory to two paradigmatic systems where the notion of orbital moments manifests itself in novel fundamental physics rather than just quantitative differences. In a coplanar antiferromagnet on the two-dimensional kagome lattice the orbital magnetic moment gives rise to an orbital magnetization. While the spin magnetization is oriented in the kagome plane, the orbital magnetization also has a finite out-of-plane component leading to 'orbital weak ferromagnetism.' The insulating collinear pyrochlore ferromagnet $Lu_2V_2O_7$ exhibits a 'magnonic orbital Nernst effects,' i. e. transversal currents of orbital magnetic moment induced by a temperature gradient. The orbital magnetization and the orbital Nernst effect in magnetic insulators are two signatures of the orbital magnetic moment of magnons.

MA 9.2 Wed 12:50 H2

Angle-Dependent Magnetotransport in Semimetals — •Felix Spathelf[1,2,3], Benoît Fauqué[2], and Kamran Behnia[1] — [1]LPEM (CNRS), ESPCI Paris, Université PSL, Paris, France — [2]JEIP, USR 3573 CNRS, Collège de France, Université PSL, Paris, France — [3]Universität Heidelberg

We report on studies of the electrical and thermoelectric transport properties of semimetals with high mobilities at temperatures down to 2 K and in magnetic fields up to 13.8 T to understand their remarkable amplitude. The Seebeck effect, magnetoresistance and the Hall effect of bismuth were measured and compared to the results of a theoretical model, which was developed on the basis of semiclassical theory. The model perfectly describes the zero field Seebeck coefficient from 10 K to 300 K and agrees well with experimental data in a large part of the (T, B, Θ)-space. It is shown that the contribution of the Nernst coefficient to the Seebeck effect has to be taken into account when explaining the latter. In addition, the Seebeck effect of bismuth is at least up to a temperature of 120 K significantly affected by Landau quantisation. Furthermore, the influence of the sample shape on the angle-dependent magnetoresistance is studied in bismuth and antimony. At 40 K, magnetoresistance shows the symmetry inherited from the Fermi surface topology. Upon cooling below 20 K, this symmetry is lost in bismuth, but not in antimony. The loss of symmetry is sample-dependent and can be traced back to a robust surface contribution to conductivity. Besides, the highest magnetoresistance ever observed was measured in bismuth, amounting to $1.56 \cdot 10^8$ under a magnetic field of 12.8 T.

MA 9.3 Wed 13:10 H2

Optimizing the magnetocaloric effect in all-d-metal Ni-Co-Mn-Ti Heusler alloys — •Benedikt Beckmann and Oliver Gutfleisch — TU Darmstadt, 64287 Darmstadt, Germany

Magnetocaloric refrigeration is a promising cooling technology which could be an environmentally friendly and more energy efficient alternative to conventional vapor compression refrigeration. Among magnetocaloric materials, Ni-Mn based Heusler alloys, showing a first-order magnetostructural phase transition, are promising candidates. In this study, a systematic analysis of all-d-metal $Ni_{50-x}Co_xMn_{50-y}Ti_y$ Heusler alloys is carried out [1]. Due to their enhanced mechanical stability, these alloys can also be utilized in cooling cycles that apply magnetic field and pressure as external stimuli to induce the phase transition. A systematic heat treatment optimization is carried out, resulting in a substantial decrease of the transition width down to only 4 K. The microstructural differences between as-cast and differently annealed alloys are analyzed in detail by *in-situ* polarized light microscopy. As a result, large isothermal entropy changes up to 38 $Jkg^{-1}K^{-1}$ are achieved in 2 T. The adiabatic temperature change is measured directly for this material system and values up to -3.8 K for the first field application and -0.8 K under cyclic conditions are obtained in moderate magnetic field changes of 1.93 T.

We acknowledge financial support from DFG (CRC/TRR 270) and ERC (Adv. Grant No. 743116).

[1] A. Taubel & B. Beckmann et al., Acta Materialia 201, 425-434 (2021)

MA 9.4 Wed 13:30 H2

High-Resolution Dilatometry Studies on Transition Metal Oxides — •Marco Hoffmann, Kaustav Dey, Sven Spachmann, and Rüdiger Klingeler — Kirchhoff Institute for Physics, Heidelberg University, INF 227, D-69120 Heidelberg, Germany

The thermodynamic properties of the transition metal oxides $CoTiO_3$ and $R_4Ni_3O_{10}$ (R = La, Pr, Nd) were studied by means of high-resolution capacitance dilatometry. Thermal expansion and magnetostriction measurements were performed in temperatures down to 2 K and fields up to 15 T. For $CoTiO_3$ a strong magnetoelastic coupling is found and its phase diagram is constructed [1]. A phenomenological domain model is applied to explain its magnetostriction and magnetization data. Furthermore, a hydrostatic pressure dependence of the Néel temperature ($T_N = 37$ K) of $dT_N/dp = 0.8$ K/GPa is derived by a Grüneisen analysis. This analysis also shows a single dominant energy scale in $CoTiO_3$ below 50 K. For the $R_4Ni_3O_{10}$ compounds, on the other hand, Grüneisen analyses indicate competing interactions just below the metal-to-metal transition temperatures T_M and pressure dependencies of $dT_M/dp = -8$ K/GPa, -4 K/GPa and -3 K/GPa for R = La, Pr, Nd, respectively [2]. Clear anomalies in the thermal expansion at T_M for all three compounds show strong coupling between the electronic and lattice degrees of freedom. [1] M. Hoffmann, K. Dey, J. Werner, R. Bag, J. Kaiser, H. Wadepohl, Y. Skourski, M. Abdel-Hafiez, S. Singh, and R. Klingeler, Phys. Rev. B (accepted 2021) [2] D. Rout, S. R. Mudi, M. Hoffmann, S. Spachmann, R. Klingeler, and S. Singh, Phys. Rev. B **102**, 195144 (2020).

Short break followed by bestowal of INNOMAG e.V. Diploma/Master Prize (2021)