MA 51: Magnetic textures II

Time: Thursday 15:00–17:30 Location: EB 407

MA 51.1 Thu 15:00 EB 407

Chiral Magnetic Phase Diagrams and Cubic Anisotropy — •Lukas Heinen[1], Alfonso Chacón Roldán[2], Marco Halder[2], Andreas Bauer[2], Wolfgang Simeth[2], Sebastian Mühlbauer[2], Halmuth Berger[3], Markus Garst[4], Christian Pfleiderer[2], and Achim Rosch[1] — [1]Universität zu Köln, Germany — [2]Technische Universität München, Germany — [3]École Polytechnique Federale de Lausanne, Switzerland — [4]Universität Dresden, Germany

Chiral magnets exhibit rich magnetic phase diagrams, including several types of chiral magnetic order. The most prominent of these phases is the skyrmion lattice phase, consisting of a regular arrangement of whirl-like magnetic structures called skyrmions. Since skyrmions benefit from topologically-induced protection, and are easily manipulated, they are promising candidates for future applications in spintronics. Consequently, their range of thermodynamic stability is the topic of intensive research. However, the phase diagrams for unstrained bulk systems reported so far are remarkably similar across a multitude of different materials.

Motivated by recent experiments we study the influence of certain types of *cubic* anisotropy. The resulting phase diagram matches the experiment, is highly anisotropic and contains two new phases, one of which is a *second* skyrmion lattice phase.

MA 51.2 Thu 15:15 EB 407

Creating 3D-magnetic textures in synthetic antiferromagnets by focused ion beam irradiation — •Fabian Samad[1], Leopold Koch[1,2], Phani Arekapudi[1], Miriam Lenz[2], and Olav Hellwig[1,2] — [1]Institute of Physics, Chemnitz University of Technology, Germany — [2]Institute for Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Germany

The DMI assisted emergence of 3D-magnetic textures in general and magnetic skyrmions in particular were hitherto typically observed in B20-materials at low temperatures or in ferromagnetic multilayers at room temperature [1]. In contrast, we used a synthetic antiferromagnet (AF) [2] as a ground system which provides the striking benefits of an absence of stray fields as well as high domain wall velocities [3], making it interesting for possible future data storage applications. Using focused ion beam irradiation with different fluences, we modified the local energy interplay between AF interlayer exchange and dipolar energy. Thus, we were able to create a variety of laterally coexisting magnetic phases and 3D-magnetic textures in different confinements. Detailed investigation of their interactions as well as their field reversal behavior were performed with in-field high resolution magnetic force microscopy.

[1] Soumyanarayanan et al., Nat. Mater. 16, 898-904 (2017)
[2] Hellwig et al., J. Magn. Magn. Mater. 319, 13-55 (2007).
[3] Yang et al., Nat. Nanotechnol. 10, 221-226 (2015).

MA 51.3 Thu 15:30 EB 407

Reciprocal-space structure of the magnetic modulations in lacunar spinel $GaMo_4S_8$ studied by SANS — •Ádám Butykai[1,2], Sándor Bordács[1,2], László Ferenc Kiss[3], László Balogh[1], Lisa DeBeer-Schmitt[4], and István Kézsmárki[1,2,5] — [1]Department of Physics, Budapest University of Technology and Economics, Budafoki út 8. — [2]MTA-BME Lendület Magneto-optical Spectroscopy Research Group — [3]Wigner Research Centre for Physics, Budapest, Hungary — [4]Chemical and Engineering Materials Division, Oak Ridge National Laboratory, Oak Ridge, TN, 37831, USA — [5]Experimental Physics V, Center for Electronic Correlations and Magnetism, University of Augsburg, 86135 Augsburg, Germany

$GaMo_4S_8$ is a member of the lacunar spinel family and similarly to its sister compounds, GaV_4S_8 [1] and GaV_4Se_8 [2,3], it presumably hosts a Néel-type skyrmion phase. Magnetization measurements suggest the existence of modulated magnetic phases below T_C=19 K extending down to the lowest temperatures and persisting in magnetic fields up to 1.5-2T. Small-angle neutron scattering (SANS) revealed modulations with a wavelength of approx. 10 nm. Preliminary results on the 3D reciprocal-space structure of the modulation vectors will be presented in comparison with the other lacunar spinels.

[1] Kézsmárki, I. et al. Nature Materials 14, (2015)
[2] Bordács, S. et al. Scientific Reports 7, (2017)
[3] Fujima, Y. et al., Physical Review B 95, (2017)
[4] White, J.S. et al., arXiv:1704.03621 (2017)

MA 51.4 Thu 15:45 EB 407

Thermal expansion and Hall effect of Mn_3ZnN-based non-collinear antiferromagnets — •Sihao Deng[1,2], Cong Wang[3], Gerda Fischer[1], Qingzhen Huang[4], Sasmita Srichandan[1], and Christoph Sürgers[1] — [1]Physikalisches Institut, Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Fundamental Science on Nuclear Wastes and Environmental Safety Laboratory, SWUST, Mianyang, China — [3]Dept. of Physics, Beihang University, Beijing, China — [4]NIST Center for Neutron Research, NIST, Gaithersburg, USA

Antiferromagnetic Mn_3ZnN-based antiperovskites show a number of interesting magnetic properties due to a non-collinear arrangement of magnetic moments. We investigate the thermal expansion and the magneto-electronic behavior of polycrystalline $Mn_3Zn_{0.77}Mn_{0.19}N_{0.94}$, $Mn_3Zn_{0.83}Mn_{0.15}N_{0.99}$, and $Mn_3Zn_{0.5}Ge_{0.5}N$. Neutron diffraction performed between 5 and 300 K reveals the existence of a triangular non-collinear antiferromagnetic phase below the Neel temperature T_N in these compounds [1, 2]. This magnetic phase with strong spin-lattice coupling gives rise to a zero thermal expansion behavior observed for these compounds. Furthermore, we investigate the Hall effect for temperatures down to 2 K. For $Mn_3Zn_{0.5}Ge_{0.5}N$, we observe a change of the Hall effect at low temperatures, presumably caused by a structural distortion and the accompanied modification of the magnetic texture with a non-coplanar component.

[1] S. Deng, et al., Script. Mater. 146, 18 (2018)
[2] S. Deng, et al., J. Phys. Chem. C 119, 24983 (2015)

MA 51.5 Thu 16:00 EB 407

Magnetic fluctuations in $Mn_{1.4}PtSn$ studied by small-angle neutron scattering — •Aleksandr Sukhanov[1], Praveen Vir[1], Alistair Cameron[2], Andre Heinemann[3], Dmytro Inosov[2], and Claudia Felser[1] — [1]Max Planck Institute for Chemical Physics of Solids, 01187 Dresden, Germany — [2]Institut fuer Festkoerperphysik, TU Dresden, D-01069 Dresden, Germany — [3]German Engineering Materials Science Centre (GEMS) at Heinz Maier-Leibnitz Zentrum (MLZ), Helmholtz-Zentrum Geesthacht GmbH, 85747 Garching bei Muenchen, Germany

$Mn_{1.4}PtSn$ belongs to the family of tetragonally-distorted Heulser compounds where non-collinear magnetic order is expected to appear as a result of competition between Heisenberg exchange interaction, the Dzyaloshinskii-Moriya interaction and uniaxial magnetocrystalline anisotropy. Recent examples include the canted antiferromagnetic order in the compound Mn_2RhSn and the lattice of antiskyrmions in $Mn_{1.4}Pt_{0.9}Pd_{0.1}Sn$, which is a structural analogue of the discussed compound [1,2]. Small-angle neutron scattering experiments on an oriented single crystal of $Mn_{1.4}PtSn$ revealed highly-anisotropic nature of the spatial spin-spin correlation function in the range of 100 nm. The latter might be associated with a long-range fluctuation of the ferromagnetic order along one of the principal in-plane crystallographic directions. The scattering patterns show clear dependence on the temperature and the applied magnetic field.

[1] O. Meshcheriakova *et al.*, Phys. Rev. Lett. **113**, 087203 (2014)
[2] A. K. Nayak *et al.*, Nature **548**, 561 (2017)

15 minutes break

MA 51.6 Thu 16:30 EB 407

Multi-axial spin textures in HoCu — Wolfgang Simeth[1], •Marein Rahn[2], Andreas Bauer[1], Robert Georgii[3], Martin Meven[3], Kirill Nemkovski[4], Sebastian Mühlbauer[3], Tobias Schrader[3], Anatoliy Senyshyn[3], Bachir Ouladdiaf[5], and Christian Pfleiderer[1] — [1]Technische Universität München — [2]Los Alamos National Laboratory — [3]Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II) — [4]Forschungszentrum Jülich — [5]Institut Laue-Langevin

The rare-earth intermetallic compound HoCu condenses in the centrosymmetric CsCl-structure (space group $Pm\bar{3}m$). As a consequence of several competing interactions (itinerant, indirect, and quadrupolar exchange interactions as well as crystal electric fields), a rich magnetic

phase diagram with a multitude of phase pockets unfolds. In these phases, the localized 4f magnetic moments of the rare earth atoms order in complex arrangements [1]. For a proper magnetic structure determination, several neutron techniques were used. Data for Rietveld refinement (using Jana2006 [2]) were collected at a four-circle diffractometer. Combined with a XYZ polarization analysis the possible solutions were narrowed down. Ambiguities due to multi-domain effects were suppressed by applying symmetry-breaking magnetic fields. We find that the compound orders in multi-axial AFM structures as well as large-unit-cell modulated AFM structures ($\sim$ 15 nm) akin to the helifan-texture in elemental Ho. [1] P. Morin and D. Schmitt, J. Magn. Magn. Mater. 21, 243 (1980). [2] V. Petricek, M. Dusek and L. Palatinus, Z. Kristallogr. 229(5), 345 (2014).

MA 51.7 Thu 16:45 EB 407

Lattice relaxation effects of the spin-ice $Dy_2Ti_2O_7$ — •T. Stoeter[1,2], T. Nomura[2], S. Granovsky[1], M. Doerr[1], O. A. Petrenko[3], G. Balakrishnan[3], S. Zherlitsyn[2], and J. Wosnitza[1,2] — [1]Institut für Festkörper- und Materialphysik, TU Dresden — [2]Hochfeld-Magnetlabor Dresden (HLD-EMFL), Helmholtz-Zentrum Dresden-Rossendorf — [3]Department of Physics, University of Warwick

$Dy_2Ti_2O_7$ and $Ho_2Ti_2O_7$ have attracted enormous scientific interest because of the unusual spin-ice ground state and exotic excitations – magnetic monopoles. In this work, we investigated how the lattice reacted to the change of the monopole density from the spin-ice through the Kagome ice to the saturated monopole phase and whether the very slow monopole dynamics predicted in theory were also detectable in lattice effects. We have performed magnetostriction and thermal-expansion measurements with a capacitive dilatometer on $Dy_2Ti_2O_7$ at temperatures down to 0.28 K to explore the lattice effects in the different regimes: Indeed, we have observed a field-dependent lattice anomaly and have found lattice relaxation effects which could be related to previously proposed monopole dynamics. This research has been supported by the DFG within project C01 of SFB 1143.

MA 51.8 Thu 17:00 EB 407

Antiferromagnetic dynamics in time and space — •Nele Thielemann-Kühn[1,2,3], Daniel Schick[1], Niko Pontius[1], Alessandro Romualdi[1,3], Rolf Mitzner[1], Karsten Holldack[1], Alexander Föhlisch[1,2], and Christian Schüssler-Langeheine[1] — [1]Institut für Methoden und Instrumentierung der Forschung mit Synchrotronstrahlung, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Albert-Einstein-Straße 15, 12489 Berlin, Germany — [2]Institut für Physik und Astronomie, Universität Potsdam, Karl-Liebknecht-Straße 24/25, 14476 Potsdam, Germany — [3]Fachbreich Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany

With combined time [1]- and depth-resolved [2] x-ray magnetic resonant diffraction we studied optically induced antiferromagnetic dynamics in the 4f metal dysprosium. This allows us to draw not only conclusion about the temporal development but also on the spatial evolution of the magnetic order after exposure to a pump-laser pulse. We find a complex depth dependent quenching behavior of the magnetic order indicative for the interplay of different delocalized as well as local excitation channels. Further, on longer time scales, we observe two clearly distinguishable regions with different magnetic properties within the sample hinting to a long-living non-equilibrium state of the 4f magnetic system.

[1] H. Ott et al., Phys. Rev. B 82, 214408 (2010).
[2] N. Thielemann-Kühn et al., Phys. Rev. Lett. 119, 197202 (2017).

MA 51.9 Thu 17:15 EB 407

Electronic and magnetic properties of the 2H-NbS_2 and TaS_2 compounds intercalated by 3*d* transition metals — •Svitlana Polesya[1], Sergiy Mankovsky[1], Sebastian Mangelsen[2], Wolfgang Bensch[2], and Hubert Ebert[1] — [1]Dept. Chemistry, LMU Munich, D-81377 Munich, Germany — [2]Institute of Inorganic Chemistry, 24118 Kiel, Germany

The electronic structure and magnetic properties of the 2H-NbS_2 and 2H-TaS_2 compounds intercalated by 3d-elements for various 3d-concentrations have been investigated by means of the Korringa-Kohn-Rostoker (KKR) method. Investigations have been performed for the systems with and without atomic ordering of the 3d-element on its sublattice. Magnetic torque calculations have been performed to study the magneto-crystalline anisotropy (MCA) of the compounds for the ground state ($T = 0$ K). The calculated isotropic exchange coupling parameters have been used in MC simulations to investigate the magnetic structure and finite temperature magnetic properties of the systems. The calculations give rather strong interatomic Dzyaloshinskii-Moriya interactions (DMI) that can give rise to a helimagnetic structure as it occurs in $Cr_{1/3}NbS_2$ exhibiting FM order if the DMI is neglected. The negative exchange interactions in $Fe_{1/3}NbS_2$ results in a frustrated magnetic structure in line with experiment. The composition and temperature dependent transport properties have been investigated and compared with available experimental results.