TT 34: Correlated Electrons: Frustrated Magnets - Chiral Magnets & $RuCl_3$

Time: Tuesday 14:00–16:00 Location: H20

TT 34.1 Tue 14:00 H20

Experimental determination of the Fermi surface in the itinerant helimagnet MnSi — Matthias Dodenhöft[1], •Schorsch Michael Sauther[1], Stephan Gerhard Albert[1], Felix Rucker[2], Andreas Bauer[2], Marc Andreas Wilde[1], Christian Pfleiderer[1,2], and Dirk Grundler[1,3] — [1]Phys.-Dep. E10, TU München — [2]Phys.-Dep. E51, TU München — [3]LMGN, IMX, STI, EPF Lausanne

Manganese silicide (MnSi) is an itinerant helimagnet that has been studied for over five decades. Its cubic crystal structure lacks inversion symmetry. The strong electronic correlations in MnSi result in a rich phase diagram with a helimagnetic ground state. Further, MnSi is the material in which the topologically exotic skyrmion lattice phase has been discovered [1]. This triggered a large interest. However, a thorough experimental determination of the Fermi surface (FS) of bulk MnSi is still lacking. In our experiment, we employ torque magnetometry at low temperatures T and in high magnetic fields B to measure the magnetization M of high-quality, single-crystalline bulk samples of MnSi. We observe quantum oscillations in $M(B)$, i.e. the de Haas-van Alphen effect, with multiple frequencies which correspond to extremal cross sections of the FS. We study the angular dependence of these oscillations and extract the effective electron masses from the temperature dependence of the oscillation amplitudes. The experimental findings are compared to the FS calculated via density functional theory.

[1] S. Mühlbauer *et al.*, Science **323**, 915 (2009)

TT 34.2 Tue 14:15 H20

Uniaxial pressure dependence of magnetic order in MnSi — •Alfonso Chacon[1], Andreas Bauer[1], Tim Adams[1], Felix Rucker[1], Georg Brandl[1,2], Robert Georgii[1,2], Markus Garst[3], and Christian Pfleiderer[1] — [1]Physik Department, Technische Universität München, James-Franck-Strasse 1, 85748 Garching, Germany — [2]Heinz Maier Leibnitz (MLZ), Technische Universität München, Lichtenbergstr., D-85748 Garching, Germany — [3]Institute for Theoretical Physics, Universität zu Köln, Zülpicher Str. 77, D-50937 Köln, Germany

We report the ac susceptibility and small angle neutron scattering (SANS) of the helical order, conical phase and skyrmion lattice phase (SLP) in MnSi under uniaxial pressures. For all crystallographic orientations uniaxial pressure imposes a strong easy-axis anisotropy along the pressure axis on the modulation direction . In turn, under applied magnetic fields uniaxial pressure favours the magnetic order for which a magnetic modulation is closest to the pressure axis. In particular, uniaxial pressures perpendicular to the magnetic field axis enhance the SLP strongly on the expense of the conical phase, whereas the SLP is suppressed for pressure parallel to the field. Yet, for both orientations key characteristics of the SANS pattern of the SLP remain essentially unaffected. Our results establish how strain allows to control skyrmions in chiral magnets.

TT 34.3 Tue 14:30 H20

The microscopic NMR probe in chiral magnets: zero field-, field-modulated- and Skyrmion- states in FeGe and MnSi — •Michael Baenitz[1], Hiroshi Yasuoka[1], Mayukh Majumder[1], Panchanan Khuntia[1], Sebastian Witt[2], Cornelius Krellner[2], and Markus Schmidt[1] — [1]MPI for the Chemical Physics of Solids, 01187 Dresden, Germany — [2]Goethe University Frankfurt, 60438 Frankfurt am Main, Germany

Cubic FeGe is a prototype B20 chiral magnet (T_c = 280 K) which allows to study chiral correlations directly "on-site" via the ^{57}Fe nucleus because of its S=1/2 nuclear spin interacting only with the electron spin moment. NMR provides the static and dynamic staggered local magnetization M_Q through the hyperfine field (H_{hf}) and the spin lattice relaxation rate (SLRR = $1/T_1$). Measurements were performed on randomly oriented ^{57}Fe enriched FeGe single crystals between 2-300 K. Helical- , conical- and field-polarized-states could be clearly identified and spin dynamics of each phase was investigated. MnSi single crystals and ^{29}Si enriched MnSi polycrystals were studied by ^{29}Si-NMR (S=1/2) in the ordered state (T_c = 29 K) and above. The T- and H- dependence of H_{hf} and SLRR was investigated in great detail for both FeGe and MnSi.The ^{29}Si-NMR lines in MnSi are narrow and H_{hf}-values obtained are smaller than in FeGe. Our results are in general accordance with the extended SCR theory for itinerant helical magnets [1], although the theory does not include the symmetry breaking in the B20 structure and the multi-band nature. For FeGe correlations are complex due to its more localized magnetism.

[1] T. Moriya, J. Phys. Soc. Jpn. **40**, 933 (1976)

TT 34.4 Tue 14:45 H20

Magnon spectrum of the helimagnetic insulator Cu_2OSeO_3 — P. Y. Portnichenko[1], J. Romhányi[2], Y. A. Onykiienko[1], A. Henschel[3], M. Schmidt[3], A. S. Cameron[1], M. A. Surmach[1], J. A. Lim[1], J. T. Park[4], A. Schneidewind[5], D. L. Abernathy[6], H. Rosner[3], J. van den Brink[7], and •D. S. Inosov[1] — [1]TU Dresden — [2]MPI-FKF, Stuttgart — [3]MPI-CPfS, Dresden — [4]MLZ, Garching — [5]JCNS, Jülich — [6]ORNL, Oak Ridge — [7]IFW Dresden

Complex low-temperature ordered states in chiral magnets are typically governed by a competition between multiple magnetic interactions. The chiral-lattice multiferroic Cu_2OSeO_3 became the first insulating helimagnetic material in which a long-range order of topologically stable spin vortices known as skyrmions was established. We employed state-of-the-art inelastic neutron scattering (INS) to comprehend the full three-dimensional spin excitation spectrum of Cu_2OSeO_3 over a broad range of energies. Distinct types of high- and low-energy dispersive magnon modes separated by an extensive energy gap are observed in excellent agreement with the previously suggested microscopic theory based on a model of entangled Cu_4 tetrahedra. The comparison of our INS data with model spin-dynamical calculations based on these theoretical proposals enables an accurate quantitative verification of the fundamental magnetic interactions in Cu_2OSeO_3 that are essential for understanding its abundant low-temperature magnetically ordered phases.

TT 34.5 Tue 15:00 H20

Critical dynamics in $LiCuVO_4$ — •Christoph Grams[1], Petra Becker[2], and Joachim Hemberger[1] — [1]II. Physikalisches Institut, Universität zu Köln, Germany — [2]Institut für Kristallographie, Universität zu Köln, Germany

Without an external magnetic field the 1D spin chain compound $LiCuVO_4$ has a phase transition into a cycloidal spin ordered phase below $T_N = 2.3$ K where it simultaneously is antiferromagnetic and ferroelectric. The transition temperature of this phase transition can be lowered with increasing magnetic field. Ferroelectric phase transitions are of continuous type and are accompanied by a symmetry lowering that yields soft modes. Near the critical point the dynamics show a "critical slowing down" scenario.

We studied the magnetic field and temperature dependence of $\varepsilon(\nu)$ in $LiCuVO_4$ in the vicinity of the multiferroic phase transition by means of broadband dielectric spectroscopy. While we find the expected relaxational behavior close to T_N, below 0.4 K a nearly gapless excitation is observed as was theoretically predicted in terms of chiral solitons [1].

Funded through the Institutional Strategy of the University of Cologne within the German Excellence Initiative.

[1] S. Furukawa *et al.*, JPSJ **77**, 123712 (2008)

TT 34.6 Tue 15:15 H20

High-frequency ESR studies and the magnetic phase diagram of chiral-structured $MnSb_2O_6$ — •Johannes Werner[1], Changhyun Koo[1], Elena Zvereva[2], and Rüdiger Klingeler[1] — [1]Kirchhoff Institute for Physics, Heidelberg University, Heidelberg, Germany — [2]Faculty of Physics, Moscow State University, Moscow, Russia

Magnetic properties of the chiral-structured magnet $MnSb_2O_6$ ($P321$ phase) were investigated by means of static magnetization and high-frequency electron-spin-resonance (HF-ESR) studies. The ground state has been reported to exhibit incommensurate order based on corotating cycloids [1]. Our studies confirm T_N = 11.5 K but imply at least three different AFM phases appearing in the magnetic phase diagram. HF-ESR spectra of the $MnSb_2O_6$ powder sample at frequencies of f $\sim$ 260 GHz and f $\sim$ 38 GHz show a single resonance feature at high temperatures, respectively, which significantly broadens upon cooling. In addition, the resonance shifts to lower fields when temperature is approaching T_N, signaling the evolution of local fields. At

low-temperatures, the magnetic field vs. frequency diagram exhibits two resonance branches which are associated with the antiferromagnetic resonance (AFMR) modes. The AFMR branches are linear in the range of 70 GHz to 320 GHz but the low field resonance branch shows an upturn indicating a zero-field splitting of ZFS = 22 GHz. The data are analyzed in terms of an AFMR mean field model with six sublattices.

[1] R. D. Johnson, K. Cao, L. C. Chapon, F. Fabrizi, N. Perks, P. Manuel, J. J. Yang, Y. S. Oh, S.-W. Cheong, P. G. Radaelli, PRL **111**, 017202 (2013).

TT 34.7 Tue 15:30 H20

Thermal conductivity of a 2D honeycomb material — •Richard Hentrich[1], Keerthi Dorai Swamy Reddy[1], Bernd Büchner[1], Maximilian Geyer[1], Anja Wolter-Giraud[1], Jennifer Sears[2], Young-June Kim[2], Domenic Nowak[3], Anna Isaeva[3], Thomas Doert[3], and Christian Hess[1] — [1]IFW Dresden, Germany — [2]Department of Physics, University of Toronto, Canada — [3]Inorganic Chemistry Department II, Dresden University of Technology, Germany

α-$RuCl_3$ is a material composed of hexagonal layers of edge sharing $RuCl_6$ octahedra in a $J_{\text{eff}} = 1/2$ state due to a combination of Coulomb repulsion and strong spin orbit coupling. This kind of spin structure is a possible realisation of the Heisenberg-Kitaev model for which theory predicts a multitude of non-trivial excitations. Thermal transport measurements are known as a valuable tool to probe elementary excitations of systems with low dimensional spin structure. We have investigated transport properties of α-$RuCl_3$ single crystals and found an anomalous behaviour of the heat conductivity parallel to the honeycomb planes. The clear deviation from a purely phononic signal suggests that additional excitations are contributing to heat transport.

TT 34.8 Tue 15:45 H20

Magnetic and Thermodynamic Characterisation of α-$RuCl_3$ — •Maximilian Geyer[1], Laura Theresa Corredor Bohorquez[1], Sebastian Gass[1], Wolf Schottenhamel[1], Anja Wolter-Giraud[1], Anna Isaeva[2], Domenic Nowak[2], Thomas Doert[2], and Bernd Büchner[1,2] — [1]Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden, Helmholtzstraße 20, 01069 Dresden, Germany — [2]Technische Universität Dresden, Helmholtzstraße 10, 01069 Dresden, Germany

The interplay between electronic correlations and spin-orbit coupling in heavy transition metal compounds has been intensively studied in the last years due to their interesting properties and unusual ground states like quantum spin liquids. Particulary α-$RuCl_3$ seems to be a suitable candidate for the experimental realisation of the Kitaev-Model due to its $J_{eff} = 1/2$ state and its layered honeycomb lattice of Ru^{3+} ions in the $4d^5$ configuration. This leads to highly anisotropic magnetic properties in this compound . We report on specific heat and magnetisation measurements for α-$RuCl_3$ single crystals grown by means of chemical transport reactions. Furthermore magnetisation experiments under high pressure were conducted on this compound.