TT 69: Correlated Electrons: Spin Systems and Itinerant Magnets - Chiral Magnets

Time: Wednesday 15:00–16:15 Location: HSZ 204

TT 69.1 Wed 15:00 HSZ 204

Effective mass of skyrmions in chiral magnets — •Christoph Schütte, Markus Garst, and Achim Rosch — Universität zu Köln, Zülpicher Straße 77, D-50937 Köln

A single skyrmion in a ferromagnetic background is due to its topological protection a long-lived, large-amplitude excitation. It can be described by a collective coordinate and interpreted as a quasi-particle. To understand its dynamics, it is not sufficient to consider only a rigid skyrmion but also the effects of fluctuations have to be included. We calculate the numerically exact fluctuation spectrum and scattering wavefunctions taking both thermal and quantum fluctuations into account. We show that this gives rise to additional terms in the effective action for the collective coordinate and determine the angle-resolved scattering amplitude and the mass of the skyrmion.

TT 69.2 Wed 15:15 HSZ 204

Small Angle Neutron Scattering of the Skyrmion Lattice Decay in Chiral Magnets — •Jonas Kindervater[1], Alfonso Chacon[1], Andreas Bauer[1], Sebastian Mühlbauer[2], and Christian Pfleiderer[1] — [1]Physik-Department E21, Technische Universität München, Garching, Germany — [2]Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität München, Garching, Germany

Skyrmion lattices in chiral magnets differ from conventional magnetic order in terms of their non-trivial topology. In turn the phase transition between conventional magnetic order and the skyrmion lattice phase is always first order. An open question concerns thereby the specific microscopic mechanisms by which this first order phase transition takes place, i.e., by which the non-trivial topology unwinds. Using small angle neutron scattering we report detailed measurements of the time-dependence of the skyrmion lattice decay in $Fe_{1-x}Co_xSi$ after quenching the skyrmion lattice phase into a metastable state. As our main result we find pronounced differences for the decay into the helical and the conical phase as a function of temperature and magnetic field. We discuss our results in the context of recent magnetic force magnetometry of the skyrmion lattice to helical transition in the same material under similar conditions [1].

TT 69.3 Wed 15:30 HSZ 204

Spin chirality flips in transition-metal monogermanides — •Sven-Arne Siegfried[1], Evgeny.V. Altenbayev[2,3], Nadezhda M. Chubova[2], Vadim Dyadkin[4,2], Evgeny V. Moskvin[2,3], Vladimir Dimitriev[4], Dirk Menzel[5], Charles D. Dewhurst[6], Andre Heinemann[1], Dimitry Chernyshov[4], Ravil A. Sadykov[7,8], Sergey N. Axenov[7], Ludmila N. Formicheva[8], Anatoly V. Tsvyshchenko[8,9], Dieter Lott[1], Andreas Schreyer[1], and Sergey V. Grigoriev[2,3] — [1]Helmholtz-Zentrum Geesthacht, Germany — [2]Petersburg Nuclear Physics Institute, Russia — [3]Saint-Petersburg State University, Russia — [4]Swiss Norwegian Beamlines at ESRF, France — [5]TU Braunschweig, Germany — [6]Institute Laue-Langevin, France — [7]Institute for Nuclear Research, Russia — [8]Institute for High Pressure Physics, Russia — [9]Moscow State University, Russia

The $Mn_{1-x}Fe_xGe$ compounds are helimagnetically ordered within the full concentration range. Small-angle neutron diffraction measurements show a change of the helical wavevector from $|\mathbf{k}| = 2.23$ nm^{-1} for pure MnGe passing through a minimum at $x \approx 0.75$ (with $|\mathbf{k}| \to 0$) to a value of $|\mathbf{k}| = 0.09$ nm^{-1} for pure FeGe. The helical structure transforms to a ferromagnetic-like one for $x \to x_c$, along with a change of the magnetic chirality for $x < x_c$ and $x > x_c$. Further studies reveal similar behaviour for $Fe_{1-x}Co_xGe$ compounds [2]. We argue that this behaviour is caused not by the different signs of the Dzyaloshinskii-Moriya interaction but rather by the complex multi-shell exchange interaction.

[1] S.V. Grigoriev et al.,Phys. Rev. Lett. 110, 207201 (2013)
[2] S.V. Grigoriev et al., to be published.

TT 69.4 Wed 15:45 HSZ 204

Anisotropies in the phase transition between helical and conical state in MnSi — •Alfonso Chacon Roldan[1,3], Felix Rucker[1], Michael Wagner[1], Andreas Bauer[1], Tim Adams[1], Markus Garst[2], and Christian Pfleiderer[1] — [1]Physik Department E21, Technische Universität München, München, Deutschland — [2]Institut für Theoretische Physik, Universität zu Köln, Köln, Deutschland — [3]Heinz Maier-Leibnitz Zentrum, Garching b. München, Deutschland

We report a comprehensive study of the crystalline anisotropies of the cubic chiral helimagnet MnSi, in which we focus on the transition between the multi-domain helical state at low fields and the single-domain conical state at higher fields. Careful measurements of the magnetization and the transverse susceptibility as well as small-angle neutron scattering were carried out on a spherical sample in order to account for the effects of demagnetization fields. In combiniation with high-precision specific heat data, we establish a consistant picture and determine the cubic anisotropy terms of the free energy quantitatively.

TT 69.5 Wed 16:00 HSZ 204

Excitations in magnetoelectric Cu_2OSeO_3 — •Steffen Harms[1], Maria Belesi[2], Helmuth Berger[3], Jean-Philippe Ansermet[3], Daniel Niermann[1], Christoph Grams[1], and Joachim Hemberger[1] — [1]2. Physikalisches Institut, University of Cologne, Germany — [2]Leibniz Institute for Solid State and Material Research, Dresden, Germany — [3]Institut de Physique de la Matière Condensée, Ecole Polytechnique Fédérale de Lausanne, Switzerland

The magnetoelectric helimagnetic insulator Cu_2OSeO_3 shows a multiplicity of magnetic phases due to the interplay of ferrimagnetic and Dzyaloshinkii-Moriya interaction. It was recently shown, that the excitations of these phases can be seen in the microwave absorption spectra where an AC magnetic field was coupled to the sample[1].
Additionally, topologically protected spin textures called skyrmions have been identified in these spectra. Since their discovery in MnSi, skyrmions have been of specialy interest because of their high potential for applications in spintronics[2].
We present the results of our broadband dielectric spectroscopy measurements up to 5 GHz, in which we measured the excitations created by coupling electric and magnetic AC-fields to the sample for different magnetic DC-fields at fixed temperatures of 57.5 K and 40 K.

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[1] Y. Onose et al., Phys. Rev. Lett. 109, 037603 (2012)
[2] C. Pfleiderer and A. Rosch., Nature 465, 880 (2010)