DS 11: Multiferroics: Matter at low temperature (jointly with MA, DF, TT, KR)

Time: Monday 16:45–18:00 Location: H 3005

Invited Talk DS 11.1 Mon 16:45 H 3005

Multiferroicity in an organic charge-transfer salt: Electric-dipole-driven magnetism — •Peter Lunkenheimer[1], Jens Müller[2], Stephan Krohns[1], Florian Schrettle[1], Alois Loidl[1], and Michael Lang[2] — [1]Experimental Physics V, Center for Electronic Correlations and Magnetism, University of Augsburg, Germany — [2]Institute of Physics, Goethe-University Frankfurt, Germany

Multiferroics, showing simultaneous electrical and magnetic ordering, are remarkable materials from both an academic and technological point of view. A prominent mechanism is the spin-driven ferroelectricity, often found in materials with helical spin order. However, recently a different mechanism, namely purely electronic ferroelectricity, where charge order breaks inversion symmetry, has attracted considerable interest. In the present talk, I will treat examples for both types of multiferroics like perovskite manganites and magnetite, concentrating on their dielectric properties, which often are only poorly characterized. An especially interesting case is a two-dimensional organic charge-transfer salt, which shows ferroelectricity, accompanied by antiferromagnetic spin order and belongs to a new class of multiferroics [1]. In this material, the ferroelectric ordering leads to a breaking of spin frustration, which triggers simultaneous dipolar and spin order. Hence, here the spin order is driven by the ferroelectricity, in marked contrast to the spin-driven ferroelectricity in helical magnets.

[1] P. Lunkenheimer, J. Müller, S. Krohns, F. Schrettle, A. Loidl, B. Hartmann, R. Rommel, M. de Souza, C. Hotta, J.A. Schlueter, M. Lang, preprint (arXiv:1111.2752).

DS 11.2 Mon 17:15 H 3005

Critical dynamics in $LiCuVO_4$ — •Christoph Grams[1], Maximilian Schalenbach[1], Daniel Niermann[1], Sandra Niesen[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 $LiCuVO_4$ has a phase transition into a cycloidal spin ordered phase below 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 fashion and are accompanied with a symmetry lowering that yields soft modes. Near the critical point the dynamics of the ionic polarization mechanisms are slowed down and therefore denoted as critical (“critical slowing down”).

We observe the critical dynamics of the low temperature multiferroic phase transition of $LiCuVO_4$ with broadband dielectric spectroscopy. Therefore the compound's dielectric response to an external electric AC field of frequencies from 10 mHz to several GHz in the temperature range 20 mK to 300 K was measured in dependence of magnetic fields up to 14 T.

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DS 11.3 Mon 17:30 H 3005

Vortex domain walls in helical magnets — •Thomas Nattermann[1], Fuxian Li[2], and Valery L. Pokrovsky[2,3] — [1]Institut für Theoretische Physik, Universität zu Köln, D-50937 Köln, Germany — [2]Department of Physics, Texas A&M University, College Station, Texas 77843-4242 — [3]Landau Institute for Theoretical Physics, Chernogolovka, Moscow District, 142432, Russia

The theory of domain walls in both centrosymmetric and noncentrosymmetric helical magnets is presented. With the exception of discrete orientations domain walls consist of an array of parallel vortex lines, their width is only weakly depending anisotropy, in contrast to ferromagnets and antiferromagnets. In conical phases vortex walls carry Berry phase flux which gives rise to an anomalous Hall effect. In multi-ferroics vortices are electrically charged.

DS 11.4 Mon 17:45 H 3005

Infrared and THz spectroscopy in multiferroic $Eu_{1-x}Ho_xMnO_3$ — •Zhenyu Chen[1], Michael Schmidt[1], Franz Mayr[1], Zhe Wang[1], A.A. Mukhin[2], Joachim Deisenhofer[1], and Alois Loidl[1] — [1]Experimentalphysik V, EKM, University of Augsburg, 86135 Augsburg, Germany — [2]General Physics Institute of the Russian Academy of Sciences, 119991 Moscow, Russia

We investigated $Eu_{1-x}Ho_xMnO_3$ with the concentration varying from 0.1 to 0.5. On cooling, $Eu_{0.9}Ho_{0.1}MnO_3$ enters an incommensurate antiferromagnetic phase, which turns into an commensurate antiferromagnetic one at lower temperatures. Doping leads to ferroelectricity with polarization parallel to the a-axis, which flips to P//c by further doping. In order to detect the coupling between low energy phonons and electromagnons [1-4], we performed systematic polarization dependent IR and THz studies. The data will be compared to $TbMnO_3$ and the related system $Eu_{1-x}Y_xMnO_3$.

[1] A.Pimenov et al., Nature Phys., 2, 97(2006).
[2] A.Pimenov et al., Phys. Rev. B, 77, 014438(2008).
[3] N.Kida et al., Phys. Rev. B, 78, 104414(2008).
[4] R.Valdés Aguilar et al., Phys. Rev. Lett., 102, 047203(2009).