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Guest Lecture

"Neutron Scattering Studies on Chiral Multiferroics“

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Address: Department of Physics, University of Cologne, Germany

Date: Friday, 15th of January 2016
Time: 2:30 pm
Place: Seminar Room CBEG02 (387, Photonics); Gußhausstraße 27

Abstract: Chiral magnetism plays a central role in several recently discovered phenomena such as skyrmions or type-II multiferroics. Chiral magnetic order is, however, difficult to experimentally analyze, in particular if one needs to distinguish it from other incommensurate magnetic models with complex domain contributions. Neutron scattering with three-dimensional polarization analysis is the ideal tool to analyze chiral magnetism, because the neutron can be considered as a chiral object itself, and, therefore, such experiments can unambiguously identify chiral magnetism.

In multiferroics one may follow the chiral components as function of temperature and electric field and thereby directly study the multiferroic hysteresis cycles of chiral domains versus electric field. In our neutron experiments the rise times of multiferroic domain inversion can be studied over eight decades in time. While $MnWO_4$ exhibits rather slow rise times of the order of 10ms, a very simple activation law is found for the temperature dependence of multiferroic rise times in $TbMnO_3$ that is fulfilled over five decades in time. This simple activation law contrasts to the behavior of normal ferroelectrics.

Combining unpolarized and polarized neutron scattering studies, the frequencies and polarization patterns of magnetic excitations can be precisely determined. The phason-type magnetic excitations in a cycloid are also chiral. With neutron polarization analysis we may follow this chiral character of magnons, which can be quantitatively described by spin-wave calculations. Evidence for an electromagnon, a hybridized phonon-magnon excitation, is obtained for several *RE*MnO_3 in infra-red experiments. Comparison with the neutron results allows for a complete characterization of these modes. Also for $MnWO_4$ the comparison of neutron scattering and infrared data indicate an electromagnon excitation, which can be considered as a general feature in multiferroics. $TbMnO_3$ and $MnWO_4$ also exhibit diffuse chiral scattering around the ferroelectric transition, which can be poled by an electric field. Slightly above the ferroelectric transition we find quasielastic chiral ordering without long-range order.

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