UNIVERSITÉ DU LUXEMBOURG

Physics seminar

Tuesday, 21st September 2010 at 16h15

(coffee at 16h00)

Campus Limpertsberg

Room BS 1.04

Andreas MICHELS

ATTRACT Fellow, University of Luxembourg

"Magnetic interactions in nanomagnets: A neutron-scattering study"

We report on the recently developed technique of magnetic-field-dependent small-angle neutron scattering (SANS), with attention to bulk ferromagnets exhibiting random magnetic anisotropy. In these materials, the various magnetic anisotropy fields (magnetocrystalline, magnetoelastic, and/or magnetostatic in origin) perturb the perfectly parallel spin alignment of the idealized ferromagnetic state. By varying the applied magnetic field, one can control one of the ordering terms which competes with the above mentioned perturbing fields. Experiments which explore the ensuing reaction of the magnetization will therefore provide information not only on the field-dependent spin structure but, importantly, on the underlying magnetic interaction terms. This strategy, which underlies conventional studies of hysteresis loops in magnetometry, is here combined with magnetic SANS. While magnetometry generally records only a single scalar quantity, the integral magnetization, SANS provides access to a vastly richer data set, the Fourier spectrum of the response of the spin system as a function of the magnitude and orientation of the wave vector. The required data-analysis procedures have recently been established, and experiments on a number of magnetic materials, mostly nanocrystalline or nanocomposite metals, have been reported. Here, we summarize the theory of magnetic-field-dependent SANS by micromagnetic theory, and we discuss experiments which have explored the magnetic interaction parameters, the value of the exchange-stiffness constant as well as the Fourier components of the magnetic anisotropy field and of the magnetostatic stray field. A model-independent approach, based on the experimental autocorrelation function of the spin misalignment, provides access to the characteristic length of the spin misalignment. The field dependence of this quantity is in quantitative agreement with the predictions of micromagnetic theory. Experiments on nanocomposite ferromagnets reveal that the jump of the magnetization at internal phase boundaries leads to a significant magnetostatic perturbing field, with an unusual "clover-leaf-shaped" SANS pattern as the experimental signature.

Next Physics Seminars

- **Tuesday, 5th October :** **Katja HÖNES, PhD student at the Laboratory of Photovoltaïcs**
  in Belval , 16:15 **"Photoluminescence of a new solar cell material: kesterites"**

- **Tuesday, 19th October :** **speaker and topic will be announced shortly**
  at Limpertsberg, 16:15

- **Tuesday, 2d November :** **Ulrich MÜLLER, Post-doc at the Laboratory of Physics and Material Research**
  in Belval , 16:15 **"Temperature modulated refractometry: a novel access to structural evolution in isotropic media"**

- **Tuesday, 16th November :** **speaker and topic will be announced shortly**
  at Limpertsberg, 16:15

- **Tuesday, 30th November :** **speaker and topic will be announced shortly**
  in Belval, 16:15

- **Tuesday, 14th December :** **speaker and topic will be announced shortly**
  at Limpertsberg, 16:15