MA 10 Micromagnetism / Computational Magnetism

Time: Monday 17:00–17:45 Room: HSZ 401

MA 10.1 Mon 17:00 HSZ 401

Simulation of vortex structures in Permalloy, Fe and Co nanoparticles — •Sebastian Macke, Dagmar Goll, and Gisela Schütz — MPI für Metallforschung, Stuttgart

Recently, magnetic vortex structures have attracted much attention because of their influences on magnetization processes in nanostructures as used in data storage and spintronics.

By the methods of computational micromagnetism based on the finite element method the distribution of magnetization within a vortex in small square particles of permalloy, iron and cobalt has been studied systematically.

The magnetization distribution within the vortex and the vortex energy sensitively depend on the dimensions and the material parameters of the particles. It is shown that there exists a periodic fluctuation of the out-of-plane magnetization due to the dipolar interactions and the vortex contracts at the surfaces in the case of thicker films. The results are compared with analytical approaches.

Finally the interactions between vortices in rectangular nanodots and patterns of nanodots are investigated.

MA 10.2 Mon 17:15 HSZ 401

Ferromagnetic Hollow Cylindrical Nanoparticles — •D. Goll, G. Schütz, and H. Kronmüller — Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart, Germany

Magnetic ground states of hollow cylindrical nanoparticles with a nonmagnetic core have been analytically calculated on the basis of the theory of micromagnetism. As a function of the three material parameters, spontaneous polarization, magnetocrystalline anisotropy constant and the exchange constant, the phase diagrams of three types of magnetic configurations have been determined. For uniaxial perpendicular anisotropy a single-domain homogeneous state, a curling configuration and a homogeneous multidomain state may exist as a function of the above material constants. The critical radii where the transitions between these configurations take place are determined as a function of the material parameters. The special cases of soft and hard magnetic materials are discussed in relation to the exchange lengths. The analytical results are compared with numerical micromagnetic simulations on the basis of the finite element method.

MA 10.3 Mon 17:30 HSZ 401

The Jacobs-Bean model of chains of magnetic spheres, revisited — •Riccardo Hertel — Institut für Festkörperforschung,Forschungszentrum Jülich, D-52425 Jülich

The field-driven magnetization reversal in a chain of perfectly aligned magnetic nano-spheres is studied by means of micromagnetic simulations. The diameter of the Fe spheres is 10 nm, the spacing is 1 nm. Chains of different length (up to 20 spheres) have been simulated. The only coupling between the spheres is given by the magnetostatic dipole interaction. According to the analytical Jacobs-Bean (JB) model for chains of magnetic spheres [1], the reversal is expected to occur by means of an inhomogeneous, so-called fanning mode. While the principal predictions of the JB model are confirmed by the simulations, a number of interesting additional features are observed. According to the simulations, the reversal of each individual sphere is given by a precessional reorientation towards the external field. The phase of the precession of each sphere is non-trivially coupled to the phase of the other spheres. The inhomogeneous reversal mode is symmetric with respect to the central plane perpendicular to the chain axis, leading to qualitative differences depending on whether the number of spheres in the chain is even or odd. The reversal begins in the central part of the chain. This is in striking contrast to the case of magnetic nanowires of similar size, where magnetization reversal has been shown to start at the wire ends.

[1] I.S. Jacobs and C.P. Bean, Phys. Rev 100 (4) 1060 (1955)