Excitations and Switching in Magnetic Microparticles

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We study the static and dynamic magnetic properties of permalloy microparticles using synchrotron based PEEM. The PEEM provides magnetic contrast through x-ray magnetic circular dichroism (XMCD). By combining the naturally pulsed structure of the synchrotron light with magnetic field pulses to the sample we are able to study magnetization dynamics with a time resolution of t_{fwhm}<100ps. By rotating the sample with respect to the light polarization $\underline{P}$ we measure both components of the in-plane magnetization vector $\underline{M} = (M_x, M_y)$.

Micron sized soft magnetic particles can be prepared with a simple domain pattern, a Landau flux-closure pattern for squares and a vortex pattern for circles. Using time resolved PEEM we determine the principle excitation modes of these structures and give quantitative values for the excitation amplitudes, damping and frequencies.

The squares consist of three subunits, the homogenously magnetized domains, the domain walls, and the vortex at the intersection of the domain walls. We show how the excitations of these subunits evolve in time and determine their coupling. In particular we show that the domain walls are not transparent to magnetic excitations originating in the domains. Micromagnetic simulations show that they block incoming spin waves, but act as a source of plane wave like excitations themselves.

Extending our work on magnetic excitations we are presently investigating precessional switching in such micron sized magnetic particles. A bistable potential for the magnetic vortex is introduced by introducing two defects in the vicinity of the disk center during the lithography process. Application of a field pulse H_{Puls} can toggle the vortex between the two defects. First results of this switching work will be presented.