# MAGNETISATION DYNAMICS IN FERROMAGNETIC DISKS AND SQUARES:

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In recent years the investigation of dynamic eigenmodes in confined magnetic structures has triggered intensive research. The response of micron and sub-micron sized to ultra short magnetic field pulses and the accurate modelling of the spin excitations following a magnetic field pulse is of central interest in advanced magnetic recording technology as switching times are further reduced and pushed well into the gyromagnetic regime. In order to understand the complex trajectories the magnetization vector may take in ultra fast switching experiments we set out with the aim of understanding the excitation spectra of micron sized magnetic elements in the linear excitation regime.

We will report on recent experiments performed using time resolved Kerr microscopy [1]. We investigate micron sized Permalloy disks, which in equilibrium are in the flux closed vortex state. Upon excitation with perpendicular or in-plane magnetic tipping field pulses a complicated dynamic response of the magnetisation evolves. Phase sensitive Fourier transformation allows the identification of several radial and azimuthal eigenmodes, which can be accounted for in a dipolar model. The azimuthal modes in this system show negative dispersion: modes with higher node number are lower in frequency, a behaviour that is reminiscent of magneto-static backward volume modes known to appear in thin magnetic films.

In addition, we analyse not only the mode spectrum of the excited modes, but also their damping behaviour. We have evidence for mode-mode coupling in the studied elements. Mode-mode coupling leads to an apparent increase of the damping parameter.

Recently, some effort has been undertaken to increase the spatial resolution available in time resolved experiments. We will summarize experiments preformed at the Swiss Light Source using a time resolved soft x-ray photoemission microscope. First results demonstrate the ability to determine the modal structure of Permalloy squares in the Landau equilibrium magnetization state with high spatial and temporal resolution [2].

[1] "Vortex dynamics", C.H. Back, D. Pescia, and M. Buess in Burkard Hillebrands und Andre Thiaville eds., "Spin Dynamics in Confined Magnetic Structures III", Springer, Berlin (2005).

[2] "Quantitative Analysis of Magnetic Excitations in Landau Flux-Closure Structures Using Synchrotron-Radiation Microscopy",
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