Walther-Meißner-Institut

Bayerische Akademie der Wissenschaften

Walther-Meißner-Seminar

Walther-Meißner-Institut, Seminar Room 143

Date: **Friday, July 6th, 2018, 13:30 h**

Speaker: **Dr. Hans Nembach**

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Title: **Magnetization Dynamics in Nanostructures and Thin Films**

Abstract:
In the first part of my talk I will discuss the outstanding question in the broad field of spin dynamics with ferromagnets whether the damping of gyromagnetic precession is in actuality subject to finite size effects at the nanometer length scale. We demonstrate that the effective damping in nanomagnets depends strongly on the excited spin-wave mode and on the size of the nanomagnet. We developed a novel heterodyne magneto-optical microwave microscope to measure ferromagnetic resonance in individual, well-separated nanomagnets by use of heterodyne detection of magneto-optical signals at microwave frequencies. The experimental results are in good agreement with calculations based on the theory of dissipative transverse spin-currents internal to a conductive magnetic film, where the spin-currents are proportional to the spatial curvature of the excited mode [1], [2].
In the second part, I will focus on the Dzyaloshinskii-Moriya Interaction (DMI), which has received great interest, because it can give rise to many chiral phenomena, including chiral domain-walls and skyrmions. We measure the DMI induced frequency-shift with Brillouin-Light-Scattering spectroscopy (BLS). Here, I will present recent results to provide insight into the underlying physics of the DMI. It has been predicted earlier by Fert [3] and Moriya [4] that for metallic oxides and magnetic spin-glasses the DMI and the Heisenberg exchange are proportional to each other. We prepared a series of $Ni_{80}Fe_{20}$/Pt samples for a range of $Ni_{80}Fe_{20}$ thicknesses and found that the proportionality holds also for the interfacial DMI [5]. In a second study we introduced an ultrathin Cu layer between Pt and CoFeB. The proximity induced magnetic moment in the Pt and DMI both decrease exponentially with the Cu thickness as they are both the result of the direct exchange coupling at the interface. Finally, we studied the influence of an oxide layer on the DMI in Cu/CoFe and Pt/CoFe samples. We found that an oxide layer gives rise to DMI. We used ferromagnetic resonance spectroscopy (FMR) in the perpendicular geometry to determine the spectroscopic splitting factor g. The change of g with increasing oxidation indicates hybridization and charge transfer at the interface. This was predicted by recent density functional theory work [6].

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[3] A. Fert, Mater. Sci. Forum 59&60, 439 (1990)
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