

# Non Local Magnetization Dynamics Due to Spin Pumping

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Spin pumping in magnetic nanostructures may prove to be an important effect for the investigation of pure spin currents in metallic magnetic heterostructures. Here, time resolved scanning Kerr microscopy (TRSKEM) was used to study the non-local magnetization dynamics in magnetic double layers [1].

In our experiment a microwave field was synchronized to the probe laser pulses and used to excite the magnetic moments in epitaxial Fe/Au/Fe/GaAs(001) magnetic double layers that were patterned into coplanar waveguide structures. A variable time delay between the microwave driving field and the laser pulses allows one to measure the time dependent rf-magnetization with ps time resolution. The resonance frequencies of the two magnetic films were split by several GHz due to their different interface anisotropies and film thicknesses [2]. For a thick Au spacer layer only the top Fe film can be observed by TRSKEM. This leads to a unique situation where one can resonantly excite the bottom layer while observing the response on the top layer which is tuned far from the resonance. In doing so TRSKEM allows one to observe rf-excitations originating from the coupling between the bottom and top Fe layers. This coupling can be understood in terms of the spin-pump and spin-sink model [3,4, 5]. The TRSKEM experiment allowed us to measure the amplitude and phase of the magnetization precession with respect to the rf-driving field. The amplitude and phase of the precession of the top layer were also calculated using the Landau-Lifshitz equations of motion which includes the spin pumping coupling.

Furthermore we investigate ferromagnet/normal metal bilayer systems using FMR techniques and electrical detection. Here, the ferromagnetic layer is driven into resonance and emits a pure spin current into the normal metal layer. By using the inverse spin Hall effect the pure spin current in the normal metal can be transformed into a signal that can be detected electrically.

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