Diploma Thesis: Electron-induced Magnetization Dynamics in Layered Systems

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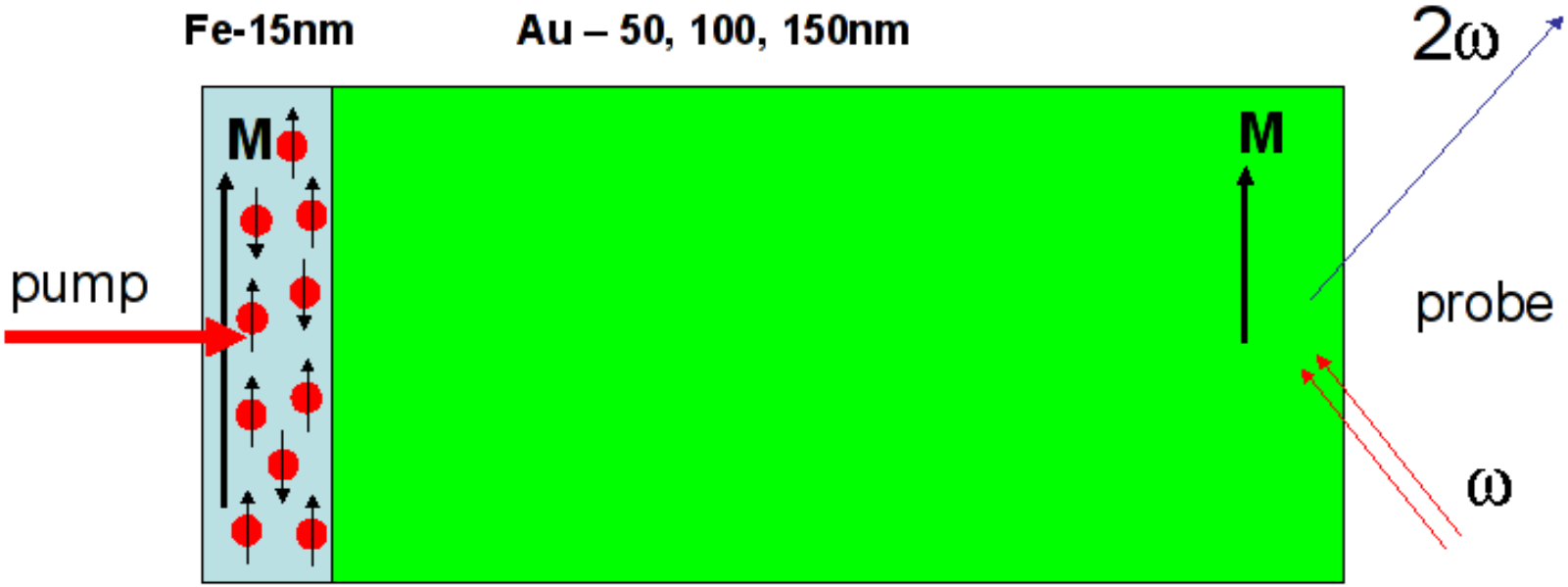
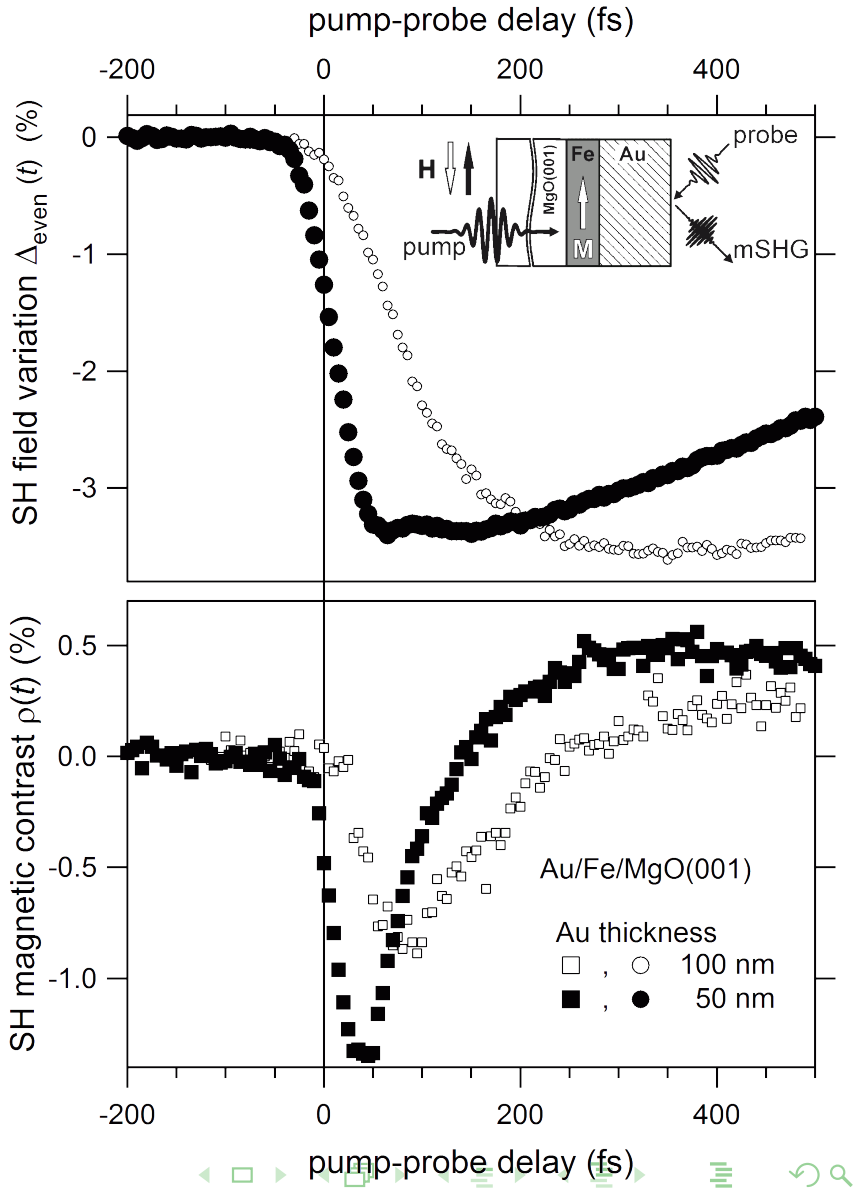
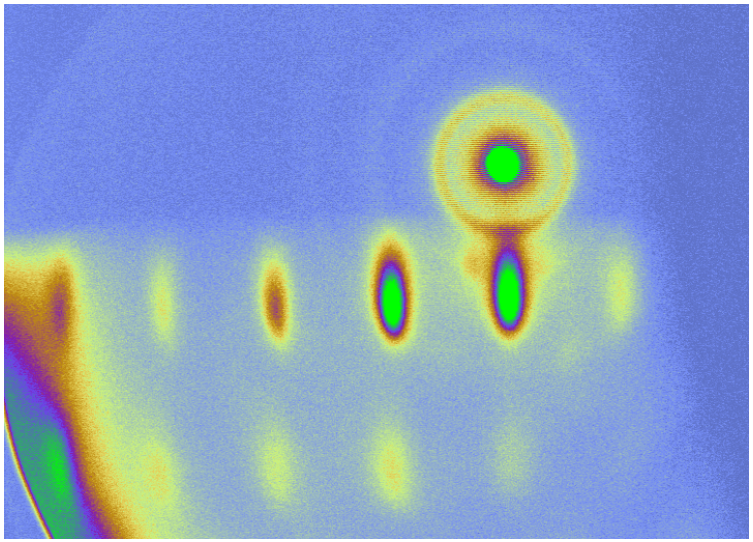
- Excite hot-electrons with femtosecond-laser from iron-layer
- Both Electrons and spin will travel balistically through gold-layer and can be detected with probe-signal



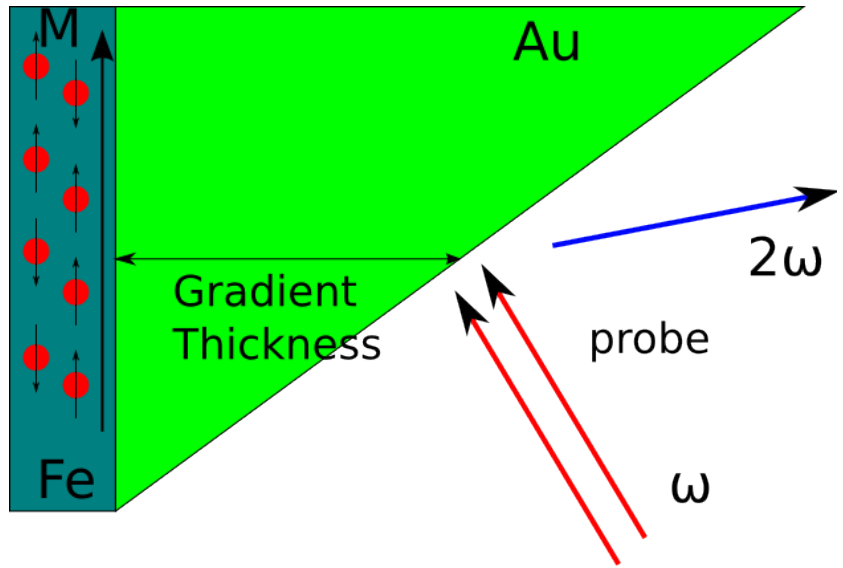
- First measurements were made on 50 and 100 nm thicknesses by A. Melnikov
- Upper figure shows detection of absolute of electric field showing the "arrival" of the ballistic electrons at the golds outer interface
- Lower figure shows the difference between electric fields of different spin-orientation and thus magnetic contrast and is thus a direct meaurement for magnetization
- Detected fields are obviously thickness-dependent; intensity drops for thicker films



- Samples are MgO-(001)-subtrates, both-sides polished
- Use an electron-beam evaporator to grow thin films of iron and gold onto the MgO, control epitaxial growth with RHEED (*in-situ*) and STM/AFM-analysis; RHEED allows determination of crystal quality and thickness of evaporated film
- First samples are iron (100, about $5 - 10$ nm) and gold (about 50 nm) on top of MgO



- To determine mean free path of electrons and spins we will need to conduct the experiments with different thicknesses
- A wedge-shaped gold-layer allows to make measurements for different thicknesses
- We expect different mean free pathes for electron and spin-transport due to different scattering mechanisms of each of them



What do I want to do ?

- Examine magnetization dynamics in thin metallic-films which I produce
- Use a femto-second-laser to produce hot-electrons in an iron-film
- Measure and determine the optimum parameters for ballistical transports in a gold-film (e.g. film-thickness)

$\Longrightarrow$ GOALS:

- Design and build electro-magnet with sample-holder
- Comprehend results from earlier experiments by other groups
- Evaporate thin films with gradient thickness to be able to sweep film-thickness
- Finally: Better understanding of spin-transfer processes

- On top of the gold-film, another iron-film with different easy-axis of magnetization (compared to first layer) will be grown
- Change magnetization in second ferromagnetic layer by spin-injection from first ferro-magnetic layer
- Preferred magnetization in layer is determined on how the layer is grown onto its underlying layer (easy axis of magnetization aligns along certain crystal axis)