Ultrafast magnetization dynamics in ferromagnetic nanostructures probed with High order Harmonics

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Two decades ago, it has been shown that femtosecond laser pulses can be used to induce an ultrafast demagnetization in ferromagnets [1]. Despite some controversies that still exist on the physical origin of this phenomenon, the ability to control magnetization on very fast time scales represents a very appealing research field for data processing technologies improvement. The resulting transient magnetization dynamics that involves spin polarized electrons and phonons has been studied in a wide variety of magnetic materials by using pump probe magneto optical techniques based on Kerr or Faraday effect. More recently, high harmonics table-top spectroscopy have opened new routes of explorations. Such tool adresses the XUV range which corresponds to core levels of transitions metals with unprecedented temporal resolution [2,3]. It takes adavantage of chemical selectivity to disentangle sublattices dynamics in alloys and multilayers

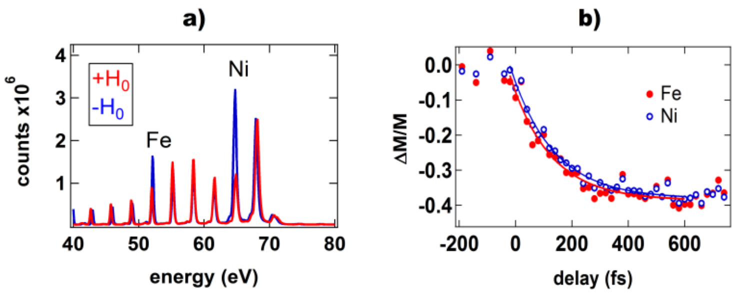

Figure 1: *a) reflected XUV spectra for antiparallel magnetic field ±H_0 in the plane of a 10 nm thick NiFe ferromagnetic thin film. The maximal asymmetry appears at the M-edges of Ni (at 66 eV) and Fe (at 54 eV) . b) Strongly exchange coupled Ni and Fe momenta ultrafast dynamics induced by a 30fs IR laser pulse. The curves show the maximum demagnetization of each sublattice at a specitific laser excitation density.*

Our research group is internationnally recognized for its expertise in time resolved magnetization dynamics from infrared to XUV range. We investigate new approaches such as magneto acoustics or coherent magnetism to propose new schemes of ultrafast magnetization control. Our group has recently shown that the balance between spin flip mechanisms involved in ultrafast demagnetization such as hot electron transport and spin orbit coupling is element dependent [4]. The PhD project will benefit of our forefront setup to probe magnetization dynamics in ferromagnetic alloys and multilayers with chemical selectivity with ultimate time resolution. This project will provide new insights on the role of the exchange interaction and element dependent spin flip processes during the ultrafast demagnetization. We are looking for highly motivated candidates with an excellent background in physics of condensed matter and light matter interaction processes as well as in experimental physics.

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