Influence of Dzyaloshinskii-Moriya interaction on the magnetization dynamics

Contact: Liliana PREJBEANU DSM/INAC/SPINTEC liliana.buda@cea.fr 0438784419

PhD may follow: Yes

Summary :

In ultrathin ferromagnetic systems with inversion of symmetry (conductor /ferromagnet/ insulator) the exchange interaction is not anymore isotope and a new term is involved called

Dzyaloshinskii-Moriya interaction [1]. One shows recently that this kind of effect stabilizes skyrmions and chiral magnetic domains that can be manipulated extremely fast by an injected current [2]. By using a full 3D micromagnetic model the magnetization reversal mechanism will be explore in nanosized ferromagnetic dots. The magnetization will be controlled by applying an external magnetic field and/or injecting a spin polarized current. Phenomena related to spin-orbit coupling (Rashba effect and spin Hall effect) will be also considered in order to follow tightly the experiments carried out in our laboratory.

[1] E. Dzyaloshinskii, Sov. Phys. JETP 5, 1259 (1957)

[2]A Fert t al., Nature Nanotechnology (2013)

Full description :

Since the giant magnetoresistance was discovered, the spintronic evolves extremely fast and many applications have been developed: find sensors, reading heads, magnetic memories, …). The control of the magnetization of nanostructures by the injection a spin polarized current requests to reduce the size of the system bellow 100nm and associate different kind of materials in thin films (conductors/insulators, magnetic/non-magnetic). At nanometer length scale, phenomena considered as negligible at macroscopic scale emerge such as: dipolar coupling between ferromagnetic elements, mutual spin transfer, Rashba effect and spin Hall effect. The symmetry inversion is adding a new ingredient via the Dzyaloshinskii-Moriya interaction. All these new terms are included in the full 3D micromagnetic solver Micro3D and thus it will be used to predict the magnetization reversal mechanism in nanosized ferromagnetic dots. Two kinds of excitation will be considered: externally applied field and injected spin polarized current. The numerical results will be directly correlated with the experimental data.

Requested skills :

master in condensed matter and magnetism

affinity for theory and modeling