Master 2: ***International Centre for Fundamental Physics***

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Centre de Nanosciences et de Nanostructures
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Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: LABEX

Non-linear spin wave interaction towards reservoir computing

Spin waves describe the eigen excitations of a ferromagnetic system. In the linear regime, their interaction can be described as simple superposition of waves. Nevertheless, when they are excited resonantly at large driving magnetic field amplitudes, very rich non-linear behaviors can be excited such as magnetic soliton, auto-oscillations, chaos, etc... In the internship we will focus on the understanding of energy redistribution between non-linearly excited modes. Being able to reach these non-linearities implies to have ferromagnetic systems with intrinsic very low magnetic damping. In this context, the internship will focus on the non-linear propagation of spin waves in microstructures elements made of Heusler or YIG thin films.

The spin waves will be experimentally studied by using Brillouin Light Scattering microscopy which allows to measure spin waves with a spatial resolution, a phase resolution and a temporal resolution. High power uniform excitations provided by broadband microwave transmission lines will be used to study highly nonlinear spin waves dynamics. The parametric thresholds of the different quantised SW modes in the saturated and vortex ground states will be determined, as well as the dependence of these thresholds upon spin orbit torque produced by a dc current injected in an adjacent Platinum layer. The beyond threshold state and transient regimes induces by high power microwave pulses or spin orbit torque pulse will be studied experimentally.

These experimental results would be the basis for a PhD project related to this topic aiming at using non-linear spin waves as a non-linear dynamical state of a reservoir computing to perform time series analysis. This PhD project falls in the topic of two recently funded European and ANR project, with a secured PhD funding.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Soft Matter and Biological Physics: NO
Quantum Physics: YES Theoretical Physics: NO