MASTER DE PHYSIQUE ET APPLICATIONS - 2ème année
Spécialité Sciences des Matériaux et Nano-objets
International Nanomat Master Program

Internship proposal 2009-2010

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Study of the profiles of magnetic domain walls by neutron imaging.

There exist a wide range of magnetic imaging techniques (Kerr effect, Magnetic Force Microscopy, X-ray PEEM imaging, electronic microscopy…). These different techniques are very powerful but are only surface techniques. Moreover, these techniques only allow to distinguish magnetic domains from one another but are not sensitive enough to probe domain walls (transition regions between magnetic domains). Presently, the knowledge of the profile of magnetic domain walls is mainly theoretical even though these defects can play a key role in the magneto-transport properties.

Neutrons are particles which are very sensitive to the magnetic fields (contrary to the visible light or x-rays). Moreover they penetrate easily into the matter (contrary to electrons). The combination of these two advantages allows to consider the use of neutrons for the characterisation of magnetic structures in-depth and the fine characterization of magnetic domain walls.

Two approaches are possible: (i) Measurements in the direct space and (ii) measurements in the reciprocal space. In the case of the measurements in the direct space, we propose to use neutron precession techniques through the magnetic matter in order to determine the profile of magnetic walls in the thickness of thin films (Bloch type domain walls). If this technique is fruitful, it could be extended in the future to the imaging in volume of magnetic structures at the micro-magnetic scale (for example for the study of micro-systems based on permanent magnetic thin films).
In the case of measurements in the reciprocal space, by neutron reflection on thin films or by the scattering of neutrons at small angles in crystals, we will study the case of magnetic walls formed at grain boundaries in a magnetic crystal or at the interface between two magnetic materials.

This work will cover both an experimental aspect (set-up development, measurements) and a modelling aspect (modelling of the magnetic structures, interpretation and modelling of the measurements)

Techniques in use :
Neutron scattering – Neutrons precession – Reflectivity
Numerical modelling – Micromagnetic calculations

Applicant skills :

Granted internship :	**yes**
C'nano IdF laboratory (France only) :	**yes**
Possibility for a thesis :	**yes (type of grant : CEA/CFR, if accepted)**