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

Internship proposal 2009-2010

Laboratory : Institut des NanoSciences de Paris
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Title for the scientific project

Highly charged Ions and magnetic surfaces:
a new method to investigate polarization effects on nanometric scale

Scientific project :

Context:

Several methods are commonly used to characterize magnetic properties of surfaces, like the Kerr effect or the spin polarized tunneling effect. In our group, we are developing an entirely new alternative method based on measurements that combine both X-ray- and ion- spectroscopy, which should provide insights on magnetic properties of surfaces, or on their modifications due to ion irradiation on a nanometric scale.
The Physics of multicharged ions (like Ar^{16+}, $Ne^{9+,10+}$) cover a wide field of research topics: from atomic physics, for which highly charged ions open new opportunities to test fundamental aspects of quantum theory, to materials sciences, including plasmas physics issues of interest for astrophysics or related to magnetic plasmas within the ITER project. This fundamental research leads to a broad range of applications; it is worth mentioning for instance, the production of nanobeams which is one of the current challenges that should pave the way for new nanolithography technique. Both fundamental research and technological developments are based on the strong knowledge of fundamental mechanisms involved in the dynamics of ion-matter interaction.

Objective:

We propose to determine the degree of polarization of a magnetic surface by investigating the selectivity of the X-ray emission during ion- surface interaction. Based on the Pauli principle and selection rules of radiative deexcitations, it should be possible to measure the correlation in spin orientation of the electrons captured at the time of the interaction.
During the internship, several experimental campaigns will be pursued on the ECR* ion source (SIMPA) located at the Jussieu Campus.

During this internship, the student will have the opportunity to become more familiar with the different topics of research driven by our team and could participate to an experiment planed in Saclay, using the LUCA**, to study intense laser-cluster interaction.

*ECR ion source: Electron Cyclotron Resonance Ion Source
**LUCA: Accordable and ultra-short laser setup

Techniques in use : The student would have the opportunity to use *i)* high-tech X-ray and ion spectroscopy *ii)* production and transport of highly charged ions from an ECRIS and using a beam line equipped with a solenoid, a dipole, a set of steerers and focus lenses *iii)* UHV techniques and temperature control & surface manipulation.

Applicant skills : Basic knowledge on atomic physics and/or material sciences.

Granted internship : yes (398 €/month)
C'nano IdF laboratory (France only) : yes
Possibility for a thesis : yes (type of grant : to be defined)