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

# Internship proposal 2011-2012


**Laboratory : Institut des NanoSciences de Paris**

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## *Cluster formation dynamics probed by strong collisional perturbation.*

**Scientific project :**

Large Van der Waals clusters are fascinating objects filling the gap between gas and solids. Their formation dynamics remains poorly known and explained. Clusters are generally produced during an adiabatic expansion of a pulsed supersonic jet. In the case of rare gas clusters, their size can easily be varied between a few atoms up to several million atoms. Our group has now a few years of experience in studying their properties and condensation dynamics associating X-ray spectroscopy techniques and time tagging, and combining collision experiments with various projectiles:

- Interaction of intense IR or UV laser pulses produces very efficiently keV X-rays when interacting with clusters. Measuring time dependence of X-ray emission at a sub-microsecond scale from the **nanoplasma produced** enables to determine the time-dependant **cluster density** in the jet.
- Bombardment of clusters by keV electrons allows measuring time dependence of the total **atomic density** in the jet.
- Finally, a drastic decrease in the X-ray signal is expected (and observed) when slow highly charged ions interact with a clustered jet compared to isolated atoms and lead to the measurement of the (isolated) **unclustered atomic density**.

By exploiting the specific properties of cluster dynamics under those three types of projectiles, we have access to the temporal structure of the cluster bunch which gives rise to a direct experimental measurement of the condensation yields in cluster jets.

Complementary measurements with slow heavy ions at the Institut für Kernphysik, Frankfurt and synchrotron radiation at SOLEIL and/or XFEL radiation at Hamburg are planned to be performed in the near future: the ratio of surface to bulk atoms can be inferred which should lead, for the first time, to determination of the mean size of such large clusters.

The internship work may correspond either to experiments at SOLEIL and/or with electrons in our laboratory. Analysis of previous results with laser pulses obtained at LUCA (Laser Ultra Court Accordable) at CEA Saclay is also needed. In case of continuation with an M2 internship and a PhD, new experiments with laser pulses, XFEL radiation and highly charged ions will have to be performed.

**Techniques in use :** nanocluster production, X-ray and electron spectroscopy, spectra analysis ;, optics and laser pulse shape

**Applicant skills :** Good basic skills in atomic physics and/or in materail sciences, laser and optics

**Granted internship : yes ( _the official amount for an intership_€/month)**
**C'nano IdF laboratory (France only) : yes**
**Possibility for a thesis : yes (type of grant : _ED UPMC_____)**