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

## Internship proposal 2009-2010


**Laboratory : Laboratoire de Physique des Lasers**

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*Title for the scientific project*

**Atoms in the vicinity of a wall : from temperature controlled long-range atom-surface interaction to nanometric confinement inside an opal** .

**Scientific project :**

The team "Resonant Coherent Optics" (OCR) at LPL-Paris13 has a unique experience in the measurement of long-range atom-surface interaction.

This has led the team to develop various methods of optical spectroscopy at an interface: the team has notably developed an original technique of spectroscopy in a nanocell, of submicron thickness. Now, the technical developments are oriented towards an approach of 3D-confinement, with an atomic vapour located inside the interstitial volume of an opal (made of silica nanoballs). The present step of the research requires a fine optical characterization of the opal, with the need to avoid the preparation of clusters on opal nanoballs. The next step will concentrate on the detailed spectroscopy of the confined vapour. It is expected from these studies that one should be able to generate very compact atomic frequency reference, which could be insensitive to the Doppler broadening.

The long range interactions that were studied are mostly dipole-dipole van der Waals interaction, in which the quantum fluctuations of an atomic dipole interact with the fluctuating image induced in the wall. Such an interaction typically spans from the nm range (as soon as the atomic details of the surface structure become insignificant) to the µm range (when the propagation effects have to be taken into account, *i.e.* in the Casimir limit). It can be understood as a change in the quantum electrodynamics correction, owing to a modified structure of the vacuum fluctuations in the vicinity of the surface. An experimental set-up aims at the observation of a temperature dependence of this atom-surface interaction. This should yield one of the few ways to investigate evidences of quantum fluctuations at non zero temperature: until now, experiments in this domain of temperature effects remain scarce, in spite of their fundamental importance.

The training will be on one of the corresponding experimental set-ups, depending on the status of the experimental developments, and on the interest and scientific background of the trainee.

**Techniques in use :** High resolution Laser spectroscopy ( extended cavity diode lasers), linear and non linear spectroscopy in absorption and reflection, temperature controlled density of an atomic vapour, sensitive optical detection, opal fabrication, ...

**Applicant skills :** atomic physics, spectroscopy techniques, electronics, software for data analysis, numerical calculations and/or nonlinear fittings with curves from a library

**Granted internship : yes (minimum legal ~380 €/month, or more if negotiated - according to CV-**
**C'nano IdF laboratory (France only) : yes**
**Possibility for a thesis : yes (type of grant : University and or ANR support)**