The control achieved with ultracold atomic systems allows nowadays for the realization of ideal quantum simulators to tackle fundamental problems in condensed matter physics. In this context, the study of ultracold atoms in tailored disordered potentials is of utmost interest. The disorder, which is unavoidable in real material, lies indeed at the heart of many fundamental transport properties, such as Anderson localization in disordered electronic conductors, superfluidity in porous media, and possibly high-Tc superconductivity.

With the observation of Anderson localization of ultracold atoms in 1D\(^1\) and 3D\(^2\), together with the recent observation of the Coherent Backscattering\(^3\) (a.k.a. weak localization), the Atom Optics group of the Institut d’Optique Graduate School occupies a leading position in this new line of research. Building upon the first results obtained in 3D configuration, the group is now pursuing an important challenge, i.e. the precise investigation of the emblematic Anderson transition (between diffusive and localized states) where many open questions remain.

In order to observe precisely the critical regime, an important improvement of the experimental scheme will be necessary in order to control, at will, the energy of the atoms around the transition. The scheme will be to create a disordered potential, whose amplitude depends on the specific magnetic substate of the atoms. Starting with a well-defined energy state in a state insensitive to the disorder, a resonant transfer (via radio frequency coupling) will be performed towards a well-defined energy state, which is now sensitive to the disorder potential. This spectroscopic method should allow us to populate selectively the energy levels around the mobility edge (i.e. the energy of the transition).

Such state dependent potential is currently being installed on the experiment. The aim of the project of the internship will be to characterize it in detail and to participate to the first tests on the experiment. Depending on the progresses, and on the interest of the student, a theoretical study on the spectroscopic scheme will be also envisioned.

**Eligibility**

There is no restriction of citizenship. The candidate should be following Master classes in Physics, special emphasis in the fields of Quantum Physics, Atomic Physics or Optics will be appreciated.

**PhD thesis**

The internship should lead to a PhD thesis on the same experimental apparatus aiming at measuring 3D correlation functions across quantum phase transitions of lattice bosons. The PhD thesis will start in September 2014.

**Application procedure**

Candidates should contact by e-mail Dr. Vincent Josse (vincent.josse@institutoptique.fr / 01 64 53 33 34), possibly providing him with a Curriculum Vitae (date of birth, full address, e-mail address and Master courses).