Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

Laboratory name: Matériaux et Phénomènes Quantiques (MPQ), Université de Paris/Paris Diderot
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Thesis possibility after internship: YES
Funding: NO

Anderson localization of disordered quantum systems

When a quantum particle (atom, electron, photon) moves in a random medium with mountains and valleys (see figure below), it generates a plethora of scattered waves, whose interference can completely suppress the diffusion of the wave-packet. This phenomenon, called Anderson localization in honor of P.W. Anderson, who first discovered it, is currently studied in different experimental platforms [1], going from cold atoms to photonic lattices as well as solid-state systems.

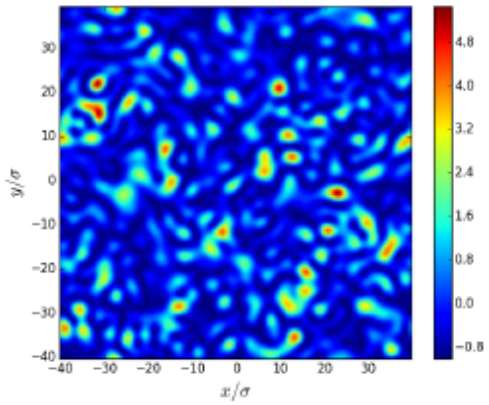
In this Thesis we will explore different aspects of Anderson localization in disordered lattices, using a combination of state-of-the-art numerical methods, including Green's functions, exact diagonalization and transfer matrix algorithms [3,4]. The study will be complemented by analytical calculations in specific regimes.

We look for a student with a taste for numerical simulations and willing to perform research in this highly interdisciplinary and exciting field.

[1] For a review, see G. Modugno, **Rep. Prog. Phys.** 73 (2010) 102401.
https://arxiv.org/abs/1009.0555

[2] G. Orso, Anderson transition of cold atoms with synthetic spin-orbit coupling in two-dimensional speckle potentials, **Phys. Rev. Lett.** 118, 105301 (2017).
https://arxiv.org/abs/1607.08164

[3] F. Stellin and G. Orso, Two-body mobility edge in the Anderson-Hubbard model in three dimensions: Molecular versus scattering states, **Phys. Rev. Research** 2, 033501 (2020).
https://journals.aps.org/prresearch/abstract/10.1103/PhysRevResearch.2.033501



Numerically generated disorder potential for atoms as created by laser speckles.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES
Quantum Physics: YES
Soft Matter and Biological Physics: NO
Theoretical Physics: YES