Proposal for a post-doctoral position

Localization properties of disordered interacting cold atomic gases

Laboratoire Kastler-Brossel
(Ecole Normale Supérieure and Université Pierre et Marie Curie, Paris)

directed by: Dominique Delande (Complex Quantum Systems group)

Description:

The aim of the project is to study the localization properties in complex quantum systems, and, more precisely, how interactions between particles affects the transport properties of waves in a disordered system, in the specific situation of Anderson localization and of the metal/insulator Anderson transition.

The atomic kicked rotor – in the absence of atom-atom interaction - is a paradigmatic system of classical and quantum chaos. For periodic kicking, it displays one-dimensional Anderson localization (called dynamical localization in this context). By using a quasi-periodic kicking sequence, one can reach a unique situation where the system displays dynamical properties of multi-dimensional systems, such as the existence of the metal/insulator Anderson transition while keeping a one-dimensional configuration space. When atom-atom interaction come into play, the situation is much more complicated, and there is currently no consensus on how the Anderson metal/insulator scenario is affected. It is however possible to take advantage of the reduced dimensionality in configuration space to perform extensive numerical and theoretical studies, using well established tools like the Gross-Pitaevskii equation, t-DMRG, bosonisation, etc. The understanding of the fundamental processes at work in this system is expected to bring new views on the general problem of transport and localization of interacting particles;

The candidate will contribute to analytical and numerical studies on the atomic kicked rotor in the presence of atom-atom interaction, in connection with the new experimental setup being built in Lille. The effect of quantum statistics (bosons/fermions) and of finite temperature will be studied.

The requested skills are in atomic, solid state, statistical or theoretical physics and in numerical computations. A good knowledge of the theory of cold atomic gases or in mesoscopic physics would be appreciated. A PhD. in physics obtained not earlier than 2010 is required.

The position provides a one year appointment (which can be renewed once) that **may start on May, 1st, 2012**. Applicants should send their CV and two recommendation letters to Dominique Delande (Dominique.Delande@spectro.jussieu.fr) before March, 31st, 2012.

This project is part of ANR LAKRIDI, that gathers two French teams, the Complex Quantum Systems group (directed by Dominique Delande) at Laboratoire Kastler-Brossel in Paris and the Quantum Chaos group (directed by Jean-Claude Garreau and Pascal Szrifgtgiser) at Laboratoire de Physique des Lasers, des Atomes et des Molécules (PHLAM) in Lille.

[1] J. Chabé, G. Lemarié, B. Grémaud, D. Delande, P. Szriftgiser and J.C. Garreau, Phys. Rev. Lett. **101**, 255702 (2008): ”Experimental observation of the Anderson metal-insulator transition with atomic matter waves”

[2] G. Lemarié, J. Chabé, P. Szriftgiser, J.C. Garreau, B. Grémaud and D. Delande, Phys. Rev. A **80**, 043626 (2009), arXiv:0907.3411: “Observation of the Anderson Metal-Insulator Transition with Atomic Matter Waves: Theory and Experiment”

[3] G. Lemarié, B. Grémaud and D. Delande, Europhys. Lett. **87**, 37007 (2009), arXiv:0904.2324: “Universality of the Anderson transition with the quasiperiodic kicked rotor”

[4] M. Lopez, J.F. Clément, P. Szriftgiser, J.C. Garreau and D. Delande, Phys. Rev. Lett. **108**, 095701 (2012), arXiv:1108.0630: “Experimental Test of Universality of the Anderson Transition”