**Quantum systems in one-dimension and quantum transport**

November 8-10, 2016

**IPCMS – Institut de Physique et Chimie des Matériaux de Strasbourg**

Quantum systems confined to low dimensions, such as spin chains, carbon nanotubes or cold atoms in optical lattices, often behave in a universal way that is efficiently described in terms of simple effective theories. These introductory lectures will review the bosonization approach for one-dimensional interacting systems and will discuss various properties of the universal Luttinger liquid physics through examples of theoretical and experimental interest.

The focus will be on models of interacting fermions and bosons trapped on lattice potentials, on their phase diagrams and how the latter are determined by correlation functions. The effects of disorder will be discussed in the context of bosonization, which leads to dramatic effects such as the Anderson localization for fermions and to the Bose glass phase for bosons. We will then turn to the quantum transport in one dimension deriving the conductance of a mesoscopic conductor within the Landauer-Buettiker formalism. We will then consider non-equilibrium noise and discuss the conductance through a quantum-point-contact. Finally, we will try to link the scattering approach to the bosonization one introduced in the first part of the lectures, as an extension to the interacting systems.

**Program:**

**Tuesday, November 8th 2016**

9:50 – 10:00 Welcome addresses

10:00 – 11:45 **Prof. Roberta Citro**, Univ. of Salerno (IT) and Univ. of Strasbourg

*Introduction to bosonization and Luttinger physics (theory)*

12:00 – 13:00 Lunch

13:00 – 14:45 **Prof. Roberta Citro**

*Interacting fermions and bosons on a lattice (theory)*

**Wednesday, November 9th 2016**

9:00 – 10:45 **Prof. Roberta Citro**, Univ. of Salerno and Univ. of Strasbourg

*Disordered systems: Anderson localization and Bose glass (theory)*

11:15 – 13:00 **Prof. Christian Ruegg**, Paul Scherrer Institute (CH)

*Spin chains in solid state (experiment)*

**Thursday, November 10th 2016**

9:00 – 10:45 **Prof. Roberta Citro**, Univ. of Salerno and Univ. of Strasbourg

*Quantum transport in 1D: introduction to scattering matrix approach, Landauer-Buettiker formalism, non-equilibrium and shot noise; the quantum point contact (theory)*

11:15 – 13:00 **Prof. Jean-Philippe Brantut**, EPFL (CH)

*Quantum transport in cold atom experiments (experiment)*

*Bibliography*

T. Giamarchi, Quantum Physics in one dimension, Oxford press

M. Cazalilla, R. Citro et al., Review of Modern Physics **83**, 1405 (2011)

Y. Imry, Introduction to mesoscopic physics, Oxford University Press; 2nd edition 2008

*Place :* November 8 - 9 **th** at the Auditorium of “Institut de Physique et Chimie des Matériaux de Strasbourg and November 10that salle 74 of “Institut de Physique et Chimie des Matériaux de Strasbourg”, 23 rue du Loess, 67034 Strasbourg

*Contacts: Dr. Guido Pupillo, IPCMS – ISIS, University of Strasbourg (* *pupillo@unistra.fr* *)*

 *Dr. Dietmar Weinmann, IPCMS (* *dietmar.weinmann@ipcms.unistra.fr* *)*