SEMINAIRE

de **16 h à 17 h**, salle Belledonne, IMEP-LaHC, Bât. BCAi, Minatec,

ouvert à tous : enseignants, étudiants, chercheurs, administratifs, techniciens

Jeudi 06 avril 2017

"Origin of chaos and shot noise in mesoscopic cavities"

by Massimo MACUCCI

(Engineering Dept., University of Pisa - Italy)

Abstract: Shot noise suppression in mesoscopic devices, and in mesoscopic cavities in particular, has attracted significant interest in the last two decades. Many authors have focused on the suppression, in a symmetric cavity, of the shot noise power spectral density to one quarter of the value expected from Schottky's theorem and on the further suppression observed as the width of the constrictions defining the cavity or the energy of the injected electrons are raised, or in the presence of a magnetic field. Most of the literature provides an interpretation based on a so called "quantum to classical" transition resulting from the interplay between the dwell time of particles in the cavity and the Ehrenfest time, i.e. the time over which particle trajectories significantly diverge as a result of the chaotic nature of the cavity. Supported also by detailed numerical simulations, we reach the conclusion that no classically chaotic shape is actually needed to achieve the observed behavior, which is simply the result of quantum diffraction at the apertures, leading to multiple trajectories and therefore to quantum chaos. We show that in the presence of a magnetic field the relevant quantities are the classical cyclotron diameter of the electrons and the width of the constrictions: shot noise is suppressed as the ratio of the cyclotron diameter to the width of the constrictions approaches unity, and completely disappears when such ratio becomes very small, since in this limit scattering, and therefore diffraction, at the apertures become negligible. Finally, we show that, contrary to what can be found in some of the existing literature, the presence of a disordered potential is certainly not needed for the observation of the regime with the "one quarter" suppression and does not extend the range of values of the constriction widths (or particle energy) over which such a suppression factor is observed.

Massimo Macucci *graduated in Electrical Engineering in 1987 at the University of Pisa, he then obtained the "Perfezionamento" (Doctorate) degree from the Scuola S.Anna-Pisa (1990), and his Master (1991) and Ph.D. (1993) degrees from the University of Illinois at Urbana-Champaign. Since 1992 he has been on the faculty of the Engineering Department of the University of Pisa, currently as Professor of Electronics. His research interests include novel nanoelectronic semiconductor devices and noise phenomena in electronic components and circuits, as well as some aspects of electromagnetic compatibility and of molecular electronics. He is also working on electronics for transportation applications, in particular safety systems for railways and solar-powered aircrafts. He is a member of the Advisory Committees of the International Conference on Noise and Fluctuations (ICNF) and of the International Workshop on Computational Nanotechnology (IWCN). He has been the coordinator of the European research project QUADRANT, and has been involved in several European projects in the FET domain.*

Institut de Microélectronique, Electromagnétisme et Photonique
MINATEC, Grenoble-INP, 3 Parvis Louis Néel, CS 50257, 38016 GRENOBLE CEDEX 1, France
Tél. +33 (0) 456.529.503 - Fax. +33 (0) 456.529.501
UMR 5130 CNRS Grenoble-INP UJF
Institut Polytechnique de GRENOBLE