Electron waiting times in mesoscopic conductors

Mathias Albert[1,2]
[1]*INLN, Université de Nice-Sophia Antipolis, CNRS; 1361 route des Lucioles, 06560 Valbonne, France*
[2]*Laboratoire de Physique des Solides, Université Paris Sud, 91405 Orsay, France*
e-mail: mathias.albert2027@gmail.com

Controllable single electron sources are at the forefront of current research on nanoscale electronics. Systems that generate quantized electrical currents, for example quantum capacitors and quantum pumps, are of great interest due to their potential applications in metrology and quantum information processing as well as in basic research on single- and few-electron physics in mesoscopic structures.

Electronic transport through mesoscopic devices is known to be stochastic due to the quantum nature of the charge carriers. The noise power spectrum as well as the Full Counting Statistics (FCS) provide many important informations about the system under study as it has been shown during the past 20 years. However the distribution of waiting times (WTD) between the detection of several charge carriers has been recently investigated and shown to be very powerful to understand the short time physics and correlations between different elementary events [1-3] in the same spirit than the level spacing distribution in the spectral statistics of complex systems.

In this talk we will use this quantity to discuss the short time correlations in two different systems. The first one is the so called single electron source built up from a quantum capacitor[4]. We show how the waiting time distribution can be used as a powerfull tool to quantify the accuracy of such an electron source. In that case, the system is described by a semi-classical formalism and all the non trivial correlations come from the external driving. The second one is a perfect one dimensional quantum channel with a quantum point contact. Although the system is extremely simple, the WTD reveals quite striking transport properties that can be explained using random matrix theory in a totally unexpected context. Some other quantum states, such as a train of Lorentzian pulses [5] will be also considered and the relation between the WTD and the FCS also discussed.

[1] T. Brandes, Ann. Phys. (Berlin) **17**, 477 (2008).
[2] M. Albert, C. Flindt, and M. Büttiker, Phys. Rev. Lett. **107**, 086805 (2011).
[3] M. Albert, G. Haack, C. Flindt and M. Büttiker, Phys. Rev. Lett. **108**, 186806 (2012).
[4] G. Fève *et al.*, Science **316**, 1169 (2007).
[5] J. Keeling, I. Klich, L. S. Levitov, Phys. Rev. Lett. **97**, 116403 (2006).