QPhysics AT QUEENS COLLEGE

Colloquium Notice

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Cavity quantum electrodynamics with quantum transport

The field of cavity quantum electrodynamics (cQED) with quantum conductors has become an extremely active field of research. The milestone year was 2004, when superconducting qubits have been integrated within a microwave cavity in order to reach, for the very first time in the condensed matter context, the strong coupling regime between photons and matter [1,2]. Since then, many other systems have been successfully coupled to microwave cavities, such as quantum wires [3], carbon nanotubes [4], quantum dots [5], etc. Such hybrid systems offer platforms for new kinds of physics, as one can engineer and manipulate the electromagnetic environment at will. The versatility of the cQED method relies on the fact that it allows to 1) monitor in a noninvasive fashion the electronic states in quantum conductors, both in equilibrium and non-equilibrium situations, 2) to affect and manipulate the electronic transport, 3) to establish long-range correlations between remote quantum conductors and, finally, 4) it opens the pathway to create non-classical states of light by means of electronic transport.

In this talk, I will discuss some of these aspects for various types of quantum conductors out of equilibrium. I will focus on tunnel junctions [5], magnetic tunnel junctions [6], quantum dots [5] and Josephson junctions [7,8], respectively. I will show that one can reveal properties that are invisible in electronic transport (via the conductance), in particular in out-of-equilibrium situations pertaining to a large voltage bias applied over the quantum conductor [8]. For the case of voltage biased Josephson junction, I will show that the emitted radiation is non-classical in the sense that the photonic correlators violate some Cauchy-Schwarz inequalities [9]. I will confront the theory with some recent experimental studies where such violations have been measured [10].

References:
[1] A. Wallraf, D. I. Schuster, A. Blais et al., Nature 431, 162 (2004).
[2] A. Blais et al., Phys. Rev. A 69, 062320 (2004).
[3] K. D. Petersson et al., Nature 490, 380 (2012). [4] J. Viennot et al., Science 349, 6246 (2015).
[4] T. Frey et al., Phys. Rev. Lett. 108, 046807 (2010).
[5] Olesia Dmytruk, Mircea Trif, Christophe Mora, and Pascal Simon, Phys. Rev. B 93, 075425 (2016).
[6] Mircea Trif and Pascal Simon, Phys. Rev. B 90, 174431 (2014).
[7] Mircea Trif and Pascal Simon, Phys. Rev. B 92, 014503 (2015).
[8] O. Parlavecchio et al, Phys. Rev. Lett. 119, 137001 (2017).

Monday

January 29, 2018

Starts at 12:15 PM

Coffee at 12:00 PM

Physics Conference Room, SB B326