INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: **Laboratoire de Physique des Solides**
CNRS identification code: **UMR 8502**
Internship director'surname: **Julien Gabelli (CR CNRS)**
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Internship location: **LPS (Orsay)**

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ANR RISOTO

Correlations in electronic shot noise at optical frequencies

The NS2 group developed an activity linking quantum transport and plasmonics. We have investigated the emission mechanism of photons from a tunnel junction and established a quantitative relationship between the emitted light power and current fluctuations at optical frequencies. Although this allowed us to measure tunneling time directly[1], it turns out that inelastic processes excite surface plasmons before emitting photons. Understanding the correlations between the current and the photons emitted by inelastic electron tunneling is crucial for the electrical control of photon emission. In order to measure such correlations, we have to measure plasmons directly.

To that purpose, we are developing an on-chip surface plasmon detector based on kinetic inductance technology. With this detector, we aim to explore correlations between current and radiative decaying plasmons, analogous to the third moment of current fluctuations at optical frequencies. From a more fundamental point of view, this also raises a basic question related to the quantum detection theory: is a radiofrequency electronic measurement equivalent to a photo-detection measurement[2]? The objectives are to address several questions of fundamental interest including a possible back action in the presence of high-Q optical modes onto the junctions or even cross-correlations between several junctions coupled to the same optical bath. The experimental work will be supported by theoretical input from the University of Marseille developing a new theoretical framework based on the Non-Equilibrium Green's Function for investigating IET.

The candidate must have a strong theoretical background in condensed matter physics and light-matter interaction, with a strong interest in nano-devices, nano-optics, and weak-signal detection.

1. P. Février *et al*. Tunneling time probed by quantum shot noise. Nat. Comm. 9, 4940 (2018).
2. J. Gabelli *et al*. Electron–photon correlations and the third moment of quantum noise, New J. Phys. 15 113045 (2013)

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	NO
Quantum Physics:	YES	Theoretical Physics:	YES