# Kinetic Inductance Detector for surface plasmon polaritons

Surface plasmon polaritons (SPPs) are used to manipulate optical energies in nanoscale conductors. They result from the resonant interaction between electromagnetic radiation and conduction electrons at metal/dielectric interface. Recently, several sources of SPPs based on inelastic electron tunneling (IET) have been developed. These tunnel junctions have been embedded in optical antennas allowing the realization of electrically-controlled SPPs. Our recent work[1] allows us to understand the interplay between quantum electronic transport and photon emission processes. For the time being, this source is not an efficient light emitter. A carefully designed plasmonic nano-antenna may allowed to increase the conversion efficiency by two orders of magnitude[2] by focusing on surface plasmons polariton (SPP) in a nano-antenna and reach a conversion rate of about $10^{-3}$ SPP/e. But a fundamental question remains: what are the links between the local current-current fluctuations and the optical electromagnetic field within the tunnel junction? One way to answer this question would be to perform a correlation measurement between current fluctuations and plasmons emission. The answer to this question requires an effective detection of SPP. However, SPP are usually detected through their photons leakage which implies an additional plasmon-to-photon conversion rate. It would therefore be better to directly detect SPP emitted by the junction with a sensitive detector.

The internship will be devoted to the development of a **kinetic inductance detector** od SPP (KISPPD). It involves nano-fabrication (optical and electronic lithography) to realize microwave resonators (Fig. 1a), microwave measurement (Fig. 1b) at low temperature and optical excitation of SPP.

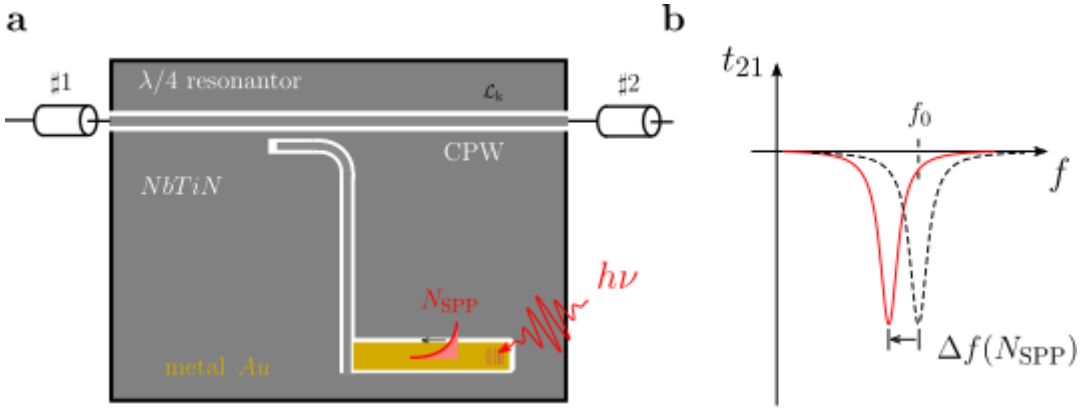


Figure 1 a- The presence of SPP sustained by a metallic gold plate in the vicinity of a quarter-wave superconducting resonator made of NbTiN induces pair-breaking in the resonator. The resonator is made of a superconductor with high kinetic inductance whose resonance frequency depends on the number of broken pairs. b- Frequency dependence of the microwave transmission $t_{21}$ in the presence (red solid line) or in the absence (dashed lines) of SPPs.


1. Février, P. & Gabelli, J. Tunneling time probed by quantum shot noise. *Nat. Comm.* **9**, 4940 (2018).

2. Zhang, C et *al*. Antenna surface plasmon emission by inelastic tunneling. *Nat. Comm.* **10**, 4949 (2019).