On-chip Photon-assisted detection of the noise of a Quantum Point Contact

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We describe the first experimental realization of on-chip detection of the noise of a Quantum Point Contact (QPC) (emitter) using an additional capacitive-coupled QPC (detector). Here, the QPC emitter is dc biased and emits a wide band quantum shot noise which, due to the capacitive coupling, will generate electron-hole pairs in the detector line. The detection is based on the following mechanism: when a QPC is submitted to a time dependent drain-source voltage, electron-hole pairs are generated. Their partitioning at the QPC generates a current noise called photon-assisted shot noise (PASN). Alternatively to shot noise, electron-hole pairs also generate a photon-current. We report photo-current and PASN measurements in excellent agreement with theoretical predictions. In particular, this approach enables us to detect fluctuations up to several tens of GHz and could be extended to THz by improving the geometry or replacing QPCs by Carbone nanotubes.

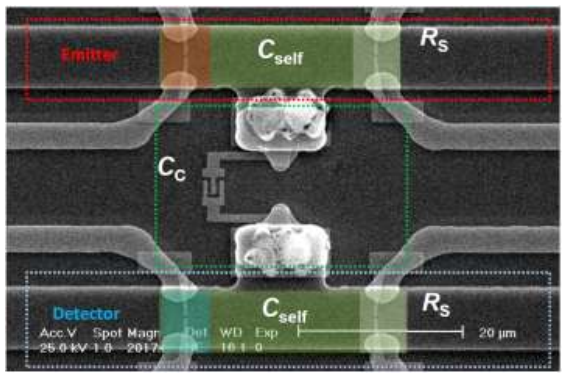

Figure: Scanning electron microscope view of the sample. Two lines defined by wet etching of the mesa are coupled via a coupling capacitance C_C. On the upper line are patterned two QPCs in serie: in red the QPC emitter, and in white a serie resistor tuned on a plateau (therefore noiseless). On the lower line, the QPC detector is colored in blue.

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