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Measuring the local sensitivity of a superconducting nanowire using a scanning current injector

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Superconducting nanowires have become a very efficient means of detecting infrared single photons. Recent experiments and development in theory have elucidated large parts of the detection mechanism, and have shown that a combination of a photon-induced quasiparticle distribution and the passing of vortices through the wire are responsible for the detection event. Detailed optical experiments on the position dependence of the detection efficiency are however difficult, due to the diffraction limit of the illumination that exceeds the relevant device dimensions by an order of magnitude.

To probe the microscopic details of the detection mechanism, we have used a scanning tunneling microscope as a local injector of non-equilibrium quasiparticles in a 200 nm wide, 4 nm thick titanium nitride nanowire. We locally inject the quasiparticles with STM, and measure the critical current of the nanowire. The injection of quasiparticles significantly reduces the current carrying capacity of the nanowire. This reduction is strongly dependent on both quasiparticle energy and rate. As a function of position, we find both geometric and microscopic variations in the reduction of the critical current: quasiparticles injected at the edges of the nanowire are more efficient.

I will relate these results to our current knowledge of the microscopic working mechanism of superconducting single-photon detectors, and discuss how our scanning current injector can be used as a diagnostic tool for nanodevices.