Seeing the dark: exploring the limits of dark count rate in superconducting single-photon detectors

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Detectors based on superconducting technologies have emerged as the highest-performing single-photon detectors available. These include the Transition Edge Sensor (TES), the Superconducting Nanowire Single-Photon Detector (SNSPD) and the Microwave Kinetic Inductance Detector (MKID). Because these detectors are operated in cryogenic environments (<1 K) and can be well isolated from ambient light and noise, they exhibit very low background rates. Dark count rates of a few counts per day have been observed, even in high efficiency devices. In this talk, I will review the state of the art of superconducting detectors, with a special focus on dark count rate. I will also discuss what we know (and don’t yet know) about the fundamental physics underlying photodetection in these devices.

Upper left: Transition Edge Sensor (TES) wafer, showing a few dozen individual keyhole devices. Lower left: SEM image of a Superconducting Nanowire Single-Photon Detector (SNSPD). Right: Photo of self-aligned detector mounting scheme used for TESs and SNSPDs.