Abstract Submitted
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Detecting stray microwaves and nonequilibrium quasiparticles in thin films by single-electron tunneling OLLI-PENTTI SAIRA, Aalto University, Olli V. Lounasmaa Laboratory, VILLE MAISI, ANTTI KEMPPINEN, Centre for Metrology and Accreditation (MIKES), MIKKO MÖTTÖNEN, Aalto University, Department of Applied Physics/COMP, JUKKA PEKOLA, Aalto University, Olli V. Lounasmaa Laboratory — Superconducting thin films and tunnel junctions are the building blocks of many state-of-the-art technologies related to quantum information processing, microwave detection, and electronic amplification. These devices operate at millikelvin temperatures, and – in a naive picture – their fidelity metrics are expected to improve as the temperature is lowered. However, very often one finds in the experiment that the device performance levels off around 100–150 mK. In my presentation, I will address three common physical mechanisms that can cause such saturation: stray microwaves, nonequilibrium quasiparticles, and subgap quasiparticle states. The new experimental data I will present is based on a series of studies on quasiparticle transport in Coulomb-blockaded normal-insulator-superconductor tunnel junction devices. We have used a capacitively coupled SET electrometer to detect individual quasiparticle tunneling events in real time. We demonstrate the following record-low values for thin film aluminum: quasiparticle density $n_{\mathrm{qp}} < 0.033/\mu\mathrm{m}^3$, normalized density of sub-gap quasiparticle states (Dynes parameter) $\gamma < 1.6 \times 10^{-7}$. I will also discuss some sample stage and chip designs that improve microwave shielding.

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