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Determination of depairing current of superconducting thin films by means of superconducting nanowire resonators

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We estimate the depairing current of superconducting nanowire single-photon detectors[1] (SNSPDs) by studying the dependence of the kinetic inductance on the bias current. The kinetic inductance is determined by measuring the microwave resonance frequency of resonator-style nanowires[2]. Bias current dependent shifts in the measured resonant frequency correspond to a change in the kinetic inductance, which can be compared to theoretical predictions. We demonstrate that the fast relaxation model[3] described in the literature accurately matches the experimental data, as expected based on the short relaxation time of the superconductor compared to the resonant frequencies of the test devices. This method provides a valuable tool for directly determining the depairing current, since it minimizes reliance on externally measured values. Accurate measurement of the depairing current is extremely useful both for theoretically understanding the detection mechanism in SNSPDs and for estimating the quality of the fabricated nanowires and, ultimately, the yield of potentially large arrays. Finally, experiments show that the accessible fraction of the depairing current, namely the so-called constriction factor[4] C which is the ratio between the *switching* and *depairing* currents, decreases with increasing temperature.

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Less than 5 years of experience since completion of Ph.D

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