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Improving detection efficiency of Ti-based superconducting transition edge sensors with optical cavity

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Superconducting transition edge sensors (TESs) have demonstrated high detection efficiency and photon-number resolving capability, making TESs attractive in quantum information. The detection efficiency is determined by several factors: fiber-to-detector coupling, absorption of photons in superconducting films, and internal quantum efficiency. The optical absorption of titanium film at the wavelength of 1550 nm, is approximately 30%, determined by its refractive index. Embedding the Ti-based TES in an optical structure to enhance its absorption is an effective approach for improving detection efficiency. We integrated the TES with an optical cavity, consisting of 16-layer dielectric reflection mirror and 4-layer anti-reflection layer, and studied the effect of fabricated optical cavity on the detection efficiency of Ti TES single photon detectors. The critical temperature (T_c) is decreased to 260 mK after deposition of antireflection layer from its original T_c of 350 mK. The detection efficiency (i.e., the ratio of the detected power to input power) was increased up to 30%, thanks to the enhancement of photon absorption by adding the optical cavity.

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

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Student (Ph.D., M.Sc. or B.Sc.)

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