A tunable fiber-coupled optical cavity for agile enhancement of detector absorption

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Maximizing photon absorption into thin active structures can be the limiting factor for photodetector efficiency. In this work, a fiber-coupled tunable cavity is demonstrated, designed to achieve close to unity absorption of photons into a thin film superconducting nanowire single photon detector (SNSPD). A technique for defining a stable cavity between the end of a telecommunications optical fiber and a reflective substrate is described and realized. Cavity resonances are demonstrated both through the tuning of input wavelength and cavity length. The resulting optical cavity can tune the resonant absorption in situ over a wavelength range of 100. This technique is used to maximize the single photon absorption into both a back-side-coupled Au mirror SNSPD and a front-side-coupled distributed Bragg reflector cavity SNSPD. The system detection efficiency (SDE) is limited by imperfections in the thin films, but in both cases we demonstrate an improvement of the SDE by 40% over bare fiber illumination.
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