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Optical-Fiber-Illuminated Response of a Superconducting Microwave Resonator Below 1 K KRISTEN VOIGT, J. B. HERTZBERG, S. K. DUTTA, J. E. HOFFMAN, J. A. GROVER, J. LEE, P. SOLANO, R. P. BUDOYO, C. BALLARD, J. R. ANDERSON, C. J. LOBB, S. L. ROLSTON, F. C. WELLSTOOD, JQI and CNAM, Dept. of Physics, University of Maryland —

As a step towards building a hybrid quantum system that couples superconducting elements to neutral atoms trapped on a tapered optical nanofiber, we have studied how the presence of the fiber dielectric and light scattered from a fiber affect the response of a translatable thin-film lumped-element superconducting Al microwave resonator that is cooled to 15 mK. The resonator has a resonance frequency of about 6 GHz, a quality factor Q 2 x 10^5, and is mounted inside a 3D Al superconducting cavity. An optical fiber is tapered to a 60 um diameter and passes through two small holes in the 3D cavity such that it sits near the resonator. The 3D cavity is mounted on an x-z piezo-translation stage that allows us to change the relative position of the thin-film resonator and fiber. When the resonator is brought closer to the fiber, the resonance frequency decreases slightly due to the presence of the fiber dielectric. When 200 uW of 780 nm light is sent through the fiber, about 100 pW/mm is Rayleigh-scattered from the fiber. This causes a position-dependent illumination of the resonator, affecting its resonance frequency and Q. We compare our results to a model of the resonator response that includes the generation, diffusion, and recombination of quasiparticles in the resonator and find that the frequency response allows us to track the position of the fiber to within 10 um.

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