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Nanowire Detection of Photons from the Dark Side

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In recent years, the development of fast and low-dark-count single-photon detectors for photonic quantum information applications promise a radical improvement in our capacity to search for dark matter. The advent of superconducting nanowire detectors, which have fewer than 10 dark counts per day and have demonstrated sensitivity from the mid-infrared to the ultraviolet wavelength band, provides an opportunity to search for bosonic dark matter in the neighborhood of 1 eV. These detectors are simple to fabricate and operate, and can be combined with gas cells, dielectric stacks, or combinations of these structures in cryogenic targets, optimized for dark matter absorption. Furthermore, superconducting nanowires can be used as both target and sensor for direct detection of sub-GeV dark matter [1].

In this work, we will combine resonator systems and quantum large-area single-photon detector, to establish a novel paradigm to look for dark matter with rest mass energies in the range of meV to 10 eV. Inherently resonant systems at these energies—narrow molecular absorption transitions [2] and periodically layered dielectric stacks [3] —bring with them a range of advantages: selectivity, control, and natural background reduction. We demonstrate high-performance 400 by 400 μm large-area tungsten-silicide nanowire prototype with 0.8-eV energy threshold with more than 90 thousand seconds of exposure, which showed no dark counts. The future experiment should enable probing new territory in the detection landscape, establishing the complementarity of this approach to other existing proposals.

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

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