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Quantum Sensors for Quantum Coherent Dark Matter Detectors

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Cryogenic lumped-element resonators are near-optimal detectors of the electromagnetic interactions of ultralight (sub-μeV), wavelike dark matter candidates, including axions and hidden photons. Operated as classical detectors, they have sensitivity to well motivated regions of dark matter parameter space, including the QCD axion band at masses from 10neV to 1 μeV. Quantum coherent measurement techniques can dramatically improve their sensitivity and allow them to probe the QCD axions at lower masses, motivating the development of quantum sensors that operate in the appropriate frequency range (below ~300MHz). The Radio Frequency Quantum Upconverter (RQU) is a quantum sensor capable of implementing a variety of quantum coherent measurement techniques in this frequency range, including two-mode squeezing, sideband cooling, and back-action evasion. I will describe the implementation of an RQU with Josephson junctions and superconducting microwave circuit elements and quantum coherent measurement protocols appropriate for reading out a resonant dark matter detector with an RQU.

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

Y

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

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