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Quantum Sensors for Axion Searches in DarkQuantum and RADES

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The search for axions and axion-like particles requires detection techniques capable of measuring extremely weak electromagnetic signals. Quantum sensors provide a promising way to improve the sensitivity of microwave cavity experiments beyond conventional limits. In this work, we discuss the integration of superconducting quantum devices into axion haloscopes, focusing on their role as ultra-sensitive photon detectors. Within the DarkQuantum project and RADES collaboration, we are developing a detection scheme based on a microwave cavity coupled to a superconducting transmon, enabling operation in the single-photon regime. We present the experimental concept, the main technical challenges, and the current status of the setup, and discuss its prospects for future axion dark matter searches.

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