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Superconducting Qubit Advantange for Dark Matter (SQuAD)

We describe two complementary strategies that utilize superconducting transmon qubits to enable future dark matter searches. First, we discuss a novel photon counting technique harnessing the quantum non demolition (QND) nature of the qubit-photon interaction, which allows us to subvert the quantum limit. We have demonstrated an unprecedented counting error rate equivalent to noise 15.7 dB below the standard quantum limit. This results in a factor of 1300 speed up of future dark matter searches. Second, we enhance the dark matter induced signal by initializing a microwave cavity in a large n-photon Fock state using the non-linearity of the qubit. With preliminary results in preparing the n=10 Fock state, we expect an enhancement of a factor of 10 in the dark matter induced signal. This transfer of technology from the quantum information community opens up new frontiers for dark matter searches in the 3-30 GHz range.

Primary frontier topic

Instrumentation Frontier

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