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Itinerant Single Microwave Photon Detection

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Bringing the operating frequency of available single photon detectors down to the microwave regime is an important capability for microwave quantum optics and superconducting quantum information processing. However, this task remains challenging due to the small energy of photons at this frequency compared to room temperature noise. Our circuit quantum electrodynamics (cQED) based detector [1] exploits the superradiant 'bright'and subradiant 'dark'states that are formed when superconducting transmons are coupled an appropriate distance from each other on a common waveguide [2]. Detuning each transmon inhomogeneously from the operating frequency leads to coupling of the bright and dark subspaces which allows for absorbed photons to be trapped for longer than the inverse of the absorption bandwidth. We utilize this long interaction time to achieve high-fidelity measurements of the photon number in the ensemble leveraging the nearly quantum noise limited amplification of a JPA and Josephson Travelling Wave Parametric Amplifier (JTWPA) in series. Operating the detector at 8 mK and using a single photon source, we benchmark the performance of this protocol. Plans to extend this scheme to GHz bandwidth will also be presented.
[1] B. Royer et al., Phys. Rev. Lett. 120, 203602 (2018)
[2] A. F. van Loo et al., Science 342 1494 (2013)

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

Y

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

Y

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