Properties of a Frequency Multiplexed Superconducting Nanowire Kinetic Inductance Detector Array

J. Glasby¹, A. Sinclair¹,², P. Mauskopf¹,², H. Mani², D. Zhu³, M. Colangelo³, K. Berggren³

1) Arizona State University, Department of Physics
2) Arizona State University, School of Earth and Space Exploration
3) Massachusetts Institute of Technology, Research Laboratory of Electronics

Design

Superconducting nanowire single photon detectors (SNSPDs) show many promising characteristics including high detection efficiency, low dark count rate, short reset time, and short timing jitter. The major drawback in implementation is reading out a large array of cryogenically cooled detectors. To overcome this, we take advantage of the well developed kinetic inductance detector (KID) frequency multiplexed readout scheme by inserting an NbN nanowire meander to the inductive element of each KID in an array. With this setup we hope to realize some of the applications SNSPDs has to offer (e.g. intensity interferometry, deep space communication, quantum information systems).

Single Photon Detector

The input port on the transmission line is terminated and a DC bias is applied to the nanowires. When a photon breaks a Cooper pair a portion of the nanowire turns normal. The normal region expands to the width of the nanowire, and a voltage pulse is generated. The signal oscillates at the resonant frequency of the detector that was hit and is sent through the amplifier to be read out.

Discussion: Embedding a superconducting nanowire as the inductive element of a kinetic inductance detector has shown to work as both a sensitive KID as well as a DC biased single photon detector for low energy photons. The nonuniformity in the count rate is likely due to a combination of LED positioning, and variations in intrinsic properties (e.g. quantum efficiency and critical current).

Future projects: Improve optical coupling using a fiber optic setup. Measure both timing jitter and system detection efficiency with an ultrafast light source. Develop a large area fast readout system. Fabricate single on-chip array.