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Development of superconducting tunnel junction detector with cryogenic amplifier for COBAND experiment.

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The purpose of COBAND (COsmic BAckground Neutrino Decay) experiment is to determine neutrino mass by measuring neutrino decay photon. Expected neutrino decay photon energy is too small (25 meV) to detect using a semiconductor detector,so we adopted the STJ (Superconducting tunnel Junction) detector using superconductor which has much smaller energy gap than a semiconductor. Our Nb/Al-STJ prototype already satisfied our demands to detect a far-Infrared single photon, but the large noise of readout line inside of refrigerator prevent the detection. For that reason we consider amplifying the STJ's signal by cryogenic amplifier near STJs. We require that the cryogenic amplifier can be operated at lower than 3 K, can amplify fast signal from STJ (<10μs), has low noise (NEP ~$1\times10^{-19}\mathrm{W}/\sqrt{\mathrm{Hz}}$), and has lower power consumption than the refrigerator cooling capability. Cryogenic amplifier consists of FD-SOI-MOSFET known to operate at cryogenic temperature. The present prototype of a cryogenic amplifier is a charge integrating amplifier with negative feedback. It is composed of an amplification stage and a buffer amplifier. We confirmed that this amplifier worked at cryogenic temperature 350 mK and measured its gain and equivalent input noise charge. I will report the result of amplification with this cryogenic amplifier of Nb/Al-STJ signals by illuminating visible laser pulse.

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

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