Characterization of a prototype TES-based anti-coincidence detector for use with TES X-ray calorimeter arrays

Main author:

YOON Wonsik

Co-authors:

Adams J.S, NASA Goddard Space Flight Center
Audley H., NASA Goddard Space Flight Center
Bailey C.N., NASA Goddard Space Flight Center
Bandler S.R., NASA Goddard Space Flight Center
Betancourt-Martinez G.L., NASA Goddard Space Flight Center
Busch S.E., NASA Goddard Space Flight Center
Chervenak J.A., NASA Goddard Space Flight Center
Eckart M.E., NASA Goddard Space Flight Center
Ewin A.J., NASA Goddard Space Flight Center
Finkbeiner F.M., NASA Goddard Space Flight Center
Kelley R.L., NASA Goddard Space Flight Center
Kilbourne C.A., NASA Goddard Space Flight Center
Lee S.-J., NASA Goddard Space Flight Center
Porst J.-P., NASA Goddard Space Flight Center
Porter F.S., NASA Goddard Space Flight Center
Sadleir J.E., NASA Goddard Space Flight Center
Smith S.J., NASA Goddard Space Flight Center
Sultana M., NASA Goddard Space Flight Center
Yoon W.S., NASA Goddard Space Flight Center
Yoon Wonsik, NASA Goddard Space Flight Center

We are developing anti-coincidence (anti-co) detectors that employ transition-edge sensors (TES) to discriminate x-ray signals from background events, such as ionizing particles. The anti-co detector will be installed with the TES focal-plane arrays planned for future x-ray observatories. The anti-co consists of a silicon wafer covered with superconducting phonon collecting fins and TES microcalorimeters. Relativistic particles are minimum ionizing, depositing a characteristic amount of energy per distance

traveled in the detector. The athermal phonons created by these events are absorbed in the superconducting fins, and break the Cooper pairs. The resulting quasi-particles diffuse along the fin, and some fraction of them makes a signal when they reach the TES. We can identify the background events by determining a correlation between signals of the anti-co and the x-ray detector. We have fabricated and tested a single-channel prototype anti-co device on a 1.5 x 1.9 cm2 chip. We have measured the signals in this device from photons of several energies between 1.5 and 60 keV, as well as laboratory background events and have demonstrated a threshold almost 100 times lower than needed to screen events from minimum ionzing particles. New designs are now being developed that isolate the region of anti-coincidence energy deposition from the region of thermal contact to the heat bath and the regions of the bond pads, thereby minimizing the energy that can be lost to these pads. We are also investigating different absorber fin compositions, to increase the thermal diffusivity of the quasi-particles. These developments will be discussed.