Laboratory Measurements of Transient Behavior of Stressed Ge:Ga Detector

H. Kaneda[1], M. Akazaki[1], Y. Okamura[2], T. Nakagawa[1], I. Yamamura[1]

[1] *Institute of Space and Astronautical Science (ISAS)*
[2] *National Space Development Agency of Japan (NASDA)*

Two types of gallium-doped germanium detector arrays, stressed and unstressed ones, are onboard ASTRO-F, the next Japanese infrared astronomical satellite. Prior to pre-launch calibration of such detector arrays, we have investigated transient behaviors of one-element stressed Ge:Ga detector. Measurement system on the cold stage consists of two blackbody sources and a shutter. We measured the response of the Ge:Ga detector against the step irradiation by driving the shutter in front of the aperture of one blackbody. The other blackbody works for a background source. By changing the temperatures of the two blackbodies ($15 \sim 50$ K) and numbers of attenuation filters in front of the aperture of the detector housing, we changed influxes of signal and background photons independently. In order to obtain calibration data for ASTRO-F, our measurements cover wide ranges of signal influx of 2×10^5 to 1×10^9 (photons/sec) and background influx of 3×10^4 to 1×10^9 (photons/sec).

For the upward steps (shutter open), two-component exponential model with an instantaneous jump reproduces observed behaviors very well. An amplitude fraction of each component is $10 \sim 25$ % to the total step, and is almost constant for various levels of incoming photons, while each time constant strongly depends on the photon influx after shutter open. For the downward steps (shutter closed), only one component with an instantaneous drop is required for the model fitting. A contribution of the transient component is only $1 \sim 10$ % of the total step, which does not have a clear dependence on photon influx. The observed time constant depends on the photon influx after shutter closed ($\phi_{\rm B}$). Hence, responses for upward and downward steps are significantly different.

Considering the effects of cosmic-ray hitting, we have also measured gradual changes of the detector response by irradiation of gamma-rays from ^{137}Cs, and investigated differences of the transient response before and after the irradiation. We report the current status of our experiment.