

12th International "Hiroshima" Symposium on the Development and Application of Semiconductor Tracking Detectors (HSTD12) at Hiroshima, Japan

Contribution ID: 336

Type: ORAL

## Annealing of proton radiation damages in Si-PM at room temperature

Tuesday 17 December 2019 17:00 (20 minutes)

CAMELOT (CubeSats Applied for MEasuring and Localizing Transients) project plans to launch a group of nano-satellites for detection and position determination of short gamma-ray bursts and other transients. Detector is designed to consist of CsI (TI) scintillator and Silicon Photomultipliers (Si-PMs). Si-PMs can be driven with low voltage (~50 V), high gain ( $10^6$ ) and small size (~mm), which are suitable for the nano-satellite platform. However, they have been little used in space, and their damages of orbital radiations have not been investigated in detail. As a purpose of this study, we investigated how Si-PM performance recovers after proton-beam irradiation.

In this experiment, we irradiated Si-PMs (Hamamatsu Photonics K.K: S13360-6050CS) with dose of 300, 1000 and 5000 rad of 200 MeV protons in The Wakasa-wan Energy Research Center in November 2018. The dose of 100 rad is yielded by  $6.2 \times 10^8$  200 MeV protons and equivalent to the same number of irradiation with 1 MeV neutron. Then, we measured the performance at two epochs, just after irradiation and after 7 month. Si-PMs were stored at room temperature during these 7 months.

We measured the energy spectrum of X-ray of  $^{241}\text{Am}$  by using  $1 \text{ cm}^3$  CsI (TI) and Si-PM irradiated with 300 rad of proton. It shows recovery of the energy threshold by a factor of  $\sim 2$ . Si-PM irradiated by 5000 rad protons had a higher noise and  $^{241}\text{Am}$  signals were not able to be detected just after irradiation. As a result of room-temperature annealing during 7 month, a lower energy threshold is achieved and 59.5 keV peak of  $^{241}\text{Am}$  is visible. In this paper, we report the recovery of various properties of Si-PM.

### Submission declaration

Original and unpublished

**Primary author:** Mr NAOYOSHI, Hirade (Dept. of Physical Science, Hiroshima Univ.)

**Co-authors:** Dr HIROMITSU, Takahashi (Dept. of Physical Science, Hiroshima Univ.); Mr NAGOMI, Uchida (Dept. of Physical Science, Hiroshima Univ.); Dr YASUSHI, Fukazawa (Dept. of Physical Science, Hiroshima Univ.); Mr KENTO, Torigoe (Dept. of Physical Science, Hiroshima Univ.); Dr TSUNEFUMI, Mizuno (Hiroshima Astrophysical Science Center); Mr KENGO, Hirose (Dept. of Physical Science, Hiroshima Univ.); Dr MASANORI, Ohno (Eotvos Univ. ); Dr KAZUTAKA, Yamaoka (ISEE, Nagoya Univ.); Mr SYOHEI, Hisadomi (Dept. of Physics, Nagoya Univ.); Dr KAZUHIRO, Nakazawa (Dept. of Physics, Nagoya Univ.); Dr SATOSHI, Hatori (The Wakasawan Energy Research Center); Dr KYO, Kume (The Wakasawan Energy Research Center); Dr SATOSHI, Mizushima (The Wakasawan Energy Research Center)

**Presenter:** Mr NAOYOSHI, Hirade (Dept. of Physical Science, Hiroshima Univ.)

**Session Classification:** Session10

**Track Classification:** Radiation damage and radiation tolerant materials