

Charged Particle Response of a Prototype Detector Array for the PoGOLite Astronomical Hard X-ray Polarimeter

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Despite potential importance of polarization measurement of celestial X-ray and gamma-ray sources, there has been only one significant polarization detection in the X-ray band (2.6 and 5.2 keV) from the Crab nebular with an instrument aboard the OSO-8 satellite [1, 2]. This was simply due to the large amount of background produced by cosmic-ray particles which poses a big challenge for detector design in this energy band. Polarized Gamma-ray Observer – Light Version (PoGOLite) [3, 4] is a balloon-borne astronomical soft gamma-ray polarimeter and measures polarization in the energy range of 25–100 keV by using the azimuthal angle anisotropy of Compton scattered photons. Its design is based on the well-type phoswich technology proven to be very effective in reducing cosmic-ray background through the WELCOME balloon experiment [5] and Suzaku Hard X-ray Detector [6]. A maiden flight of PoGOLite is now scheduled in 2009.

In order to mimic a “realistic” condition in the balloon environment and to demonstrate how effectively our background rejection scheme works, we investigated the performance of one-unit PoGOLite sensor irradiated by weak gamma-ray signals (59.5 keV from ²⁴¹Am) under constant illumination of 392 MeV protons (0.1k to 100k cts/s). Fig 1 (*left*) shows three irradiation configuration in this proton beam test. The incoming beam rate was monitored by the coincidence of the PoGOLite sensor itself and a plastic scintillator placed in front of the beam ejection window. Fig 1 (*right*) shows an example spectrum of 59.5 keV gamma-rays under the proton injection of 451 Hz, which is about a factor of 5 larger than that expected in orbit. We confirmed our system works pretty well under various injection of high energy protons without significant degrade of energy resolution and noise increase.

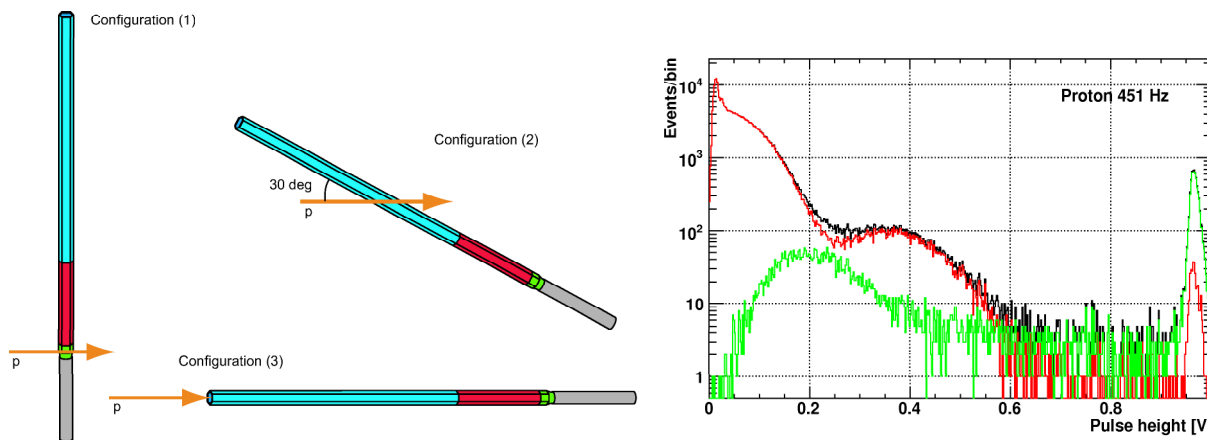


Figure 1: *left*: Three configurations in the proton beam test. See Kataoka et al. 2005 for detailed description of PoGOLite sensor. Approximate energy deposits for each configurations are 40, 1, and 100 MeV, respectively for (1)–(3). *right*: Spectra of ²⁴¹Am obtained in the configuration (3), where an injection rate of proton is 451 Hz. The upper includes total events (src + bgd), middle is selected for ²⁴¹Am only, and lower is proton induced background only.

References

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