

New Method of Gamma-ray Observation using Plasma Particle Detector

Yasuyuki T. Tanaka[1]; Toshio Terasawa[2]; Ichiro Yoshikawa[3]; Kazuo Yoshioka[4]; Yoshifumi Saito[5]; Toshifumi Mukai[6]

[1] Earth and Planetary Sci., Univ of Tokyo; [2] Dept. Earth Planetary Sci., Univ. of Tokyo; [3] Univ. of Tokyo; [4] Earth Planet Phys. Univ of Tokyo; [5] ISAS; [6] ISAS/JAXA

Synchronized with the occurrence of the large solar flares, background noise counts of plasma particle detector (LEP) onboard GEOTAIL increase drastically. Takei et al. (2005) found that these counts are due to high energy photons from solar flares, but the energy range of photons detected with LEP and its detection efficiency for photons were unknown.

Compared with other detectors specialized in observing gamma-rays from such as GRBs (Gamma Ray Bursts), the detection area of plasma particle detector is very small and its efficiency for gamma-rays is as low as about several percents. However this extreme smallness is suitable for observing the high energy transient phenomena such as SGR (Soft Gamma-ray Repeater) giant flares, which saturated all the gamma-ray detectors and did not obtain the light curve in the first several hundred milliseconds.

From the comparison of LEP background noise counts with YOHKOH/HXT, we determined the energy range of photons detected with plasma particle detector (MCP) and its quantum detection efficiency.

Because the interactions of gamma-rays with spacecraft body are stochastic processes, we perform a Monte Carlo simulation using Geant4. In this simulation, we construct a mass model of GEOTAIL, irradiate gamma rays from various angles, and count the number of photons which come into the detector.

Finally, in order to determine the detection efficiency of plasma particle detector for gamma-rays, we perform the laboratory experiments using the same MCP equipped with GEOTAIL/LEP. Now this experiment is under way, but the preliminary results show that the quantum detection efficiency is about several percents, which is consistent with the analysis results obtained from the comparison with YOHKOH/HXT.

This calibration of LEP onboard GEOTAIL as a gamma-ray detector is very useful in analyzing the data of SGR giant flares on 1998 and 2004. This method can be applied to other particle detectors onboard magnetospheric, interplanetary, and planetary explorers and open up a new field of gamma-ray observation.