

PEM024-P11

Room: Convention Hall

Time: May 25 17:15-18:45

Performance of SSSDs in the High Energy Particle detector (HEP-ion) for BepiColombo/MMO mission

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BepiColombo/MMO is the Mercury orbiter planned to launch in 2014 as a collaborate project between ESA and JAXA to elucidate structure and dynamics of Mercury's magnetosphere. In order to understand Mercury's magnetosphere it is important to observe directly plasma particles over wide energy range, MMO carries five different plasma particle detectors. HEP-ion, one of MMO's detectors, investigates distribution of high energy ion like a particle accelerated in mercury's magnetosphere or a particle of solar origin. HEP-ion consists of two parts; one is the energy analysis part (30~1500keV) based on silicon semiconductor detectors with the thin dead layer in order to observe to low energy ion. The other is the velocity analysis part using the TOF (Time-Of-Flight) technique with the thin carbon foil and MCP (Micro Channel Plate).

The major challenge of MMO is countermeasures against solar intense light, heat and radiation 5~11 times of the Earth around Mercury. In the case of plasma particle detector like HEP-ion, Si semiconductor detector is susceptible to heat and radiation input because entrance of detector must be exposed to outside of orbiter. Thus, we use the Single sided Si Striped Detector (SSSD) and readout detail of striped electrodes by analog ASIC, in order to improve the signal to noise ratio depending on the leakage current in Si semiconductor along with temperature increase. At present, it is confirmed that internal temperature of HEP-ion is up to 90 degrees, but we verified that SSSDs work at 90 degrees without breakdown (FWHM=19keV).

In above-mentioned experiment we used radiation sources. Next, in order to investigate performance of SSSDs under intense radiation environment, we irradiated SSSDs two kinds of baryon beams in NIRS (National Institute of Radiation Science); One is Si⁺ beam to suppose over-signal in space, the other is H⁺ beam to suppose energy response of a few hundred keV as main measurement. In this presentation, we report the result of there experiments.

Keywords: BepiColombo/MMO, HEP, SSSD, ASIC, Radiation, Magnetosphere