中間エネルギー電子分析器の設計と大面積APDの開発：ERGミッションに向けて

笠原 慧 [1]; 浅村 和史 [1]; 高島 健 [1]; 平原 聖文 [2]
[1] 宇宙研; [2] 東大・理・地惑

Designing of a medium-energy electron analyser and development of a large-area APD toward the ERG mission

Satoshi Kasahara[1]; Kazushi Asamura[1]; Takeshi Takashima[1]; Masafumi Hirahara[2]
[1] ISAS/JAXA; [2] Dept. Earth & Planet. Sci, Univ. Tokyo

The energy transport from keV-range electrons to MeV-range electrons via wave-particle interaction is considered to be one of the key processes in the buildup of the Earth's radiation belt. The past observations, however, have not addressed the microscopic aspect of such wave-particle interactions in the radiation belt study. Identification of wave-particle interaction in the storm-time radiation belt is one of the most important and unique items in our forthcoming mission, Energization and Radiation in Geospace (ERG). Therefore, reliable measurements of keV-range electrons are significant for this mission. Since the early era of space explorations, they have long been detected with microchannel plates (MCPs) or channel electron multipliers (CEMs). However, the quantum efficiencies of these multipliers decrease with increasing electron energy above ~1 keV, and generally the accurate determination of the efficiencies is quite difficult; this results in the observational gap of reliable flux data in the medium-energy range (5-80 keV). In recent years, instead of MCPs and CEMs, avalanche photodiodes (APDs) have been applied to the electron measurements. A combination of an electrostatic analyser (ESA) and APDs is a promising way for the measurements of medium-energy electrons in the light of the elimination of incoming ions and photons and the attenuation of the background noise caused by high-energy electrons. We are planning to use this combination for the electron measurements and expect to capture wave-particle interaction through the ERG mission. However, sizes of conventional APDs are so small (the diameter of 3 mm) that an unreasonably large number of APDs are required for the combination with ESA. In addition, the spaces between individual APDs mean the large dead areas. In order to solve this issue, we have developed and tested a large-area APD (10mm x 10mm). Although large-area APDs have been applied to scintillator detection systems, our APDs are distinguished by a thin dead-layer for the detection of kiloelectronvolt electrons. In a laboratory a peak of 5 keV electrons is clearly detected, although electric noise levels are rather high. The dominant contribution to the electric noise is from a large dark current (100 nA).