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Monte Carlo simulation on background noise for ERG/MEP-e

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The main purpose of the ERG mission is to reveal mechanisms that cause drastic variability of the radiation belt electron flux. Among various measurements by ERG, acquisition of the velocity distribution function of medium-energy electrons (10-80 keV) is especially important since they are likely to transport significant energy from the tail region into the inner magnetosphere. The energy of medium-energy electrons can be transported to relativistic electrons through wave-particle interaction: the whistler chorus wave, which can be generated by medium-energy electrons, is one of the most likely candidate for the relativistic electron generation. In order to study the detail of medium-energy electron behaviour, we have developed MEP-e (Medium Energy Particle instrument for electrons); the instrument observes 10-80 keV electrons in the radiation belt. It consists of an electrostatic anlyser(ESA), which works as an energy bandpass filter, and avalanche photodiodes (APD), which detect electrons. During the medium-energy electron observation, high-energy electrons (100 keV and higher) and protons (10 MeV and higher) can penetrate inside of the instrument and hit detectors, resulting in the background noise. Since the background count rate is substantial for an unshielded sensor, careful study is required on the efficient shielding structure with minimizing the total mass. In order to quantify the background noise, we have conducted a monte-carlo simulation (Geant 4). With realistic particle flux (AE-8/AP-8 model and CRRES observation), the expected count rates can be calculated. Through this simulation, we have confirmed that the count rate of the high-energy electron noise is less than 300 counts per second during intense-flux periods; the count rate can be further decreased by a factor to an order, by checking two energy determinations from the ESA and APDs (note that the typical count rate for medium-energy electrons is approximately 1000 counts per second). On the other hand, the background noise caused by the inner radiation belt protons and the intense solar energetic protons are hard to inhibit.

Keywords: radiation belt, background noise, medium energy electrons