Improvement of detector response matrices of the high-energy electron experiments (HEP) onboard the Arase satellite

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The high-energy electron experiments (HEP) onboard the Arase satellite detects 70 keV-2 MeV electrons and generates three-dimensional velocity distribution data for these electrons in every period of the satellite's rotation. Electrons are detected by two instruments, HEP-L and HEP-H, which differ in their geometric factor (G-factor) and energy range they cover. HEP-L detects 70 keV–1 MeV electrons with the G-factor of 9.3 $\times 10^{-4}$ cm^2 sr at maximum, while HEP-H observes 0.7 MeV–2 MeV electrons with the G-factor of 9.3 $\times 10^{-3}$ cm^2 sr at maximum. The instruments utilize silicon strip detectors and application-specific integrated circuits to read out incident charge signals from each strip.

In order to deduce the distribution of incident electrons from the direction and energy detections in orbit, we have developed a detector simulator using the Geant4 toolkit. Using the simulator, we calculate response matrices of the detectors and derive incident fluxes from the detected counts. The derived fluxes of electrons at around 100 keV are consistent with those observed by the medium-energy particle experiments - electron analyzer (MEP-e), which utilizes an electrostatic analyzer.

Recently, we have evaluated effects on detection efficiency caused by on-board signal processing. We found that the detection efficiency for higher energy electrons affected by parameters such as an energy threshold and readout noise, which are used to determine whether to read out the signal from the detector. We have updated the response matrices taking those parameters into account. In this presentation, we will present our calibration methods and their evaluation status. Especially, we will show a comparison before and after updating the matrices.

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