背景雑音除去性能向上のための中間エネルギーイオン質量分析器の改良

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Modification of a medium-energy ion mass spectrometer for an improvement in the background rejection

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We have been developing a medium-energy ion instrument (MEP-i) for the radiation belt investigation satellite SPRINT-B/ERG. MEP-i is comprised of an electrostatic analyser, time-of-flight (TOF) mass spectrometer, and solid state detectors; therefore it can measure energy, mass and charge state of the 10-180 keV/q ions. This instrument will provide the significant information of flux and pitch angle distribution of ring current core components, which is essential for the understanding of the radiation belt dynamics. For particle measurements in the inner magnetosphere, the key technology is the mitigation of the background noise caused by the radiation belt particles. When the penetrating high-energy electrons (greater than MeV) and protons (greater than 10 MeV) hit detectors in the TOF unit, they produce spurious signals. Secondary particles (electrons and gamma rays) also cause a significant background. The background count rate is greater for larger detector areas; it means that the background rate can be lowered if the detector areas are reduced. On the other hand, sizes of the detectors are dependent on the focusing property of true signal electrons, from which ion TOF are deduced. In order to reduce the detector areas without decreasing the collection efficiency of true signals, these electron trajectories need to focus sufficiently at the detector. In this study, we depart from our previous model of the TOF unit that is axisymmetric and two-dimensional, and propose a new design that can focus electron trajectories by the introduction of three-dimensional structures.