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Zoom meeting B ：11/4 AM2 (10:45-12:30)
11:15〜11:30

Development by numerical design of double-shell electrostatic energy analyzer with hemispherical field of view

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The terrestrial magnetosphere has regions with various structures due to the influence of the solar wind, the terrestrial intrinsic magnetic field and the upper atmosphere of the Earth. In-situ observations with space plasma analyzers are important for understanding the physical phenomena in these areas. While three-dimensional (3-D) velocity distribution functions have been acquired by analyzers with a fully planar field-of-view(FOV) on spin-stabilized satellites, this type of the analyzer is unsuitable for three-axis stabilized satellites to obtain the wide and precise 3-D velocity distributions. As opportunities for applications to three-axis stabilized satellites increase, we are developing a plasma particle analyzer that can sweep over the hemispherical field of view using an electrostatic deflector.

The miniaturization of satellites has been promoted in these decades, and it is necessary to reduce the size and weight of plasma particle analyzers for these small/micro satellites. In the case of observing ions and electrons in the conventional technology, two separate analyzers must be installed, one for ions and another for electrons. However, it could be difficult to mount two analyzers due to the restriction for small/micro satellites. If these two sensor heads of the ion and electron analyzers can be combined into one, it is possible to reduce the total instrument size, weight, and power for the ion and electron observations on small/micro satellites. We have been developing double-shell electrostatic energy analyzer which enables to observe ions and electrons by one sensor head over a hemispherical FOV on a three-axis stabilized satellite.

Similar to the charged-particle analyzers on SELENE(KAGUYA) [Yokota et al., 2005], the hemispherical FOV double-shell electrostatic energy analyzer is cylindrically symmetric and consists of an FOV deflection system, an ion/electron separator, a double-shell electrostatic energy analyzer, and detectors. The design to achieve better performance of the analyzer utilizes the charged particle orbit calculation software SIMION. Particles with energies of 10 keV for ions and 8.3 keV for electrons can be energy-analyzed from 0 to 90 degrees in the deflected angle, and the analyzer constant is about 4.88 for ions and about 4.05 for electrons. Based on the results, a bread board model(BBM) of a hemispherical FOV double-shell electrostatic energy analyzer is under precise design, and we are preparing for calibration experiments of the BBM using the ion and electron beamline in our laboratory. The electron detector is would be a micro channel plate(MCP) assembly or floating-type avalanche photodiode(APD) array, and the ion mass discrimination is based on the Time-Of-Flight (TOF) mass spectroscopy. The design of the TOF mass spectrometer is one of future works.

We report the current status of the hemispherical FOV double-shell analyzer development including the performance evaluation by numerical calculations and the BBM fabrication in a machine shop in Nagoya university.