The development of an electrostatic analyzer for medium energy particles using a pair of cylindrical electrodes

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Observations of plasma particles are highly important to know the environment around the earth. From the viewpoint of protection and safety of spacecraft, we have to know the time variations in intensities and the spatial distribution of electrons with the energy of about 40keV which are thought to be the major factor of ADEOS II breakdown. However, detailed observations of ions and electrons with medium energies (10keV-100keV) have not been conducted yet in the past. This is because the observation of plasma particles with such energies by electrostatic analyzer is technically difficult. For example we need quite large electrodes or very high voltage for applying to the electrodes. Furthermore the efficiency of particle detector such as a channeltron or MCP becomes quite low in the medium energy range.

In this study, we develop an electrostatic analyzer for medium energy particles using a pair of cylindrical electrodes, focusing on achieving a small size and low electrodes voltage.

The structure of the analyzer is as follows: (1) Using a collimator, we select particles whose incident angles (alpha) fit into a given range, they are guided to the cylindrical electrodes. (2) We separate the velocity vector of measured particle (V) into the component parallel to the axis of symmetry of cylindrical electrodes (Vpara), and the orthogonal component which is in the direction of rotational angle (Vperp). We measure only the energy of a particle associated with Vperp. (3) We can get the value of V from alpha and Vperp, therefore, E/q.
Using this method, we can measure the particles in the medium energy range with relatively low electrode voltage.

In this paper, we compare the experimental results with those obtained from simulations. Moreover, we calculate the counting rate and energy resolution, and assess the performance of the analyzer. Finally, we also comment on the improvement of the analyzer.