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Development of Low Energy Ion Analyzer for Observation in the Inner Magnetosphere

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It has been known that the inner magnetosphere is the region where energetic particles of a wide range of energies from a few eV to about 10 MeV coexist and it changes dynamically with geomagnetic storm, the massive energy release phenomena. However, processes of energetic particle acceleration, transports, and losses are not fully understood. For example, the main components of ring current ions are H+ and O+ with energies from a few eV to 200 keV, while their initial energies in the source region (H+;both ionosphere and solar wind. O+;only ionosphere) are from 1 eV to less than 1 keV. How this kind of ions are accelerated and injected into ring current during storm main phase remains an open question. And it is also a problem that how these ion quantities contribute to ring current dynamics. Thus, in order to understand energetic particle dynamics in the inner magnetosphere, it is highly desired to observe particles with energies from a few eV up to 200 keV without any unobserved energy gaps and to separate dominant ions-H+, He+, O+, and so on. In spite of such importance, most observations of the low-energy ions get significant amount of background noise due to large fluxes of high-energy particles in the inner magnetosphere. One of the main purposes of our study is to develop a low-energy ion instrument which can reduce the effects of high-energy particles to obtain accurate data. A combination of an electrostatic analyzer and a time-of-flight mass spectrometer provides energy-per-charge (E/q), velocity (V), and then, mass-per-charge (M/q). We designed an electrostatic analyzer which measures energy range of ions from 10 eV/q to 20 keV/q with energy resolution 15%, angular resolution of 11 degrees, and has g-factor(=10ˆ(-2) cmˆ2 sr keV/keV). In addition, we are developing a time-of-flight mass analyzer which is capable of noise reduction. Our idea is to reduce the background noises with minimization of detector anode area, a coincidence technique provided by the time-of-flight method, and thickening the electrode/chassis. We will report our progress in the development of the low energy ion analyzer.