Geophysical Research Abstracts, Vol. 8, 04248, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04248

Miniaturized Electron Magnetic Spectrometer

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The characterization of energetic electrons in space plasmas is fundamental to the scientific understanding of those plasmas, their magnetic topology, and the electric fields and waves which may be modifying the plasma. High time resolution is often very important as is high-energy resolution, clean separation of ions and electrons, and comprehensive angular coverage. Traditionally magnetic electron spectrometers provide the most reliable electron measurements at energies above $\sim$10 keV. However, the inclusion of powerful magnets presents problems for spacecraft with magnetic cleanliness requirements, and the magnetic yoke required to close the magnetic flux close to the instrument is bulky and heavy. To mediate the aforementioned shortcomings, we developed a new miniature magnetic electron spectrometer that measures energetic electrons from 20 keV to 1 MeV. The proposed detector covers close to 360 degrees in the azimuthal direction and +/- 3 degrees off the plane, and if mounted on a spinning spacecraft, we can measure the full spherical angular distribution twice per spin. This represents a very large advance over previous designs, which typically measure a very limited angular cone at any one time. As a result of the placement of the magnets in our novel design, the magnetic flux closes intrinsically, hence no bulky flux-containing magnetic yoke is required as is typical in previous designs. In this paper, we will present simulation and preliminary beam test results of our prototype sensor.