Geophysical Research Abstracts
Vol. 18, EGU2016-11967, 2016
EGU General Assembly 2016

THOR Electric Field Instrument – EFI

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Turbulence Heating ObserveR (THOR) is the first mission ever flown in space dedicated to plasma turbulence. The Electric Field Instrument (EFI) will measure the vector electric field from 0 to 200 kHz. EFI consists of two sets of sensors: Spin-plane Double Probes (EFI-SDP) providing high sensitivity DC electric field in the spacecraft spin plane (2D), and the High-Frequency Antenna (EFI-HFA) providing 3D electric field at frequencies above $\sim$1 kHz. EFI-SDP consists of 4 biased spherical probes extended on 50 m long wire booms, 90 degrees apart in the spin plane, giving a 100 m baseline for each of the two spin-plane electric field components. EFI-HFA consists of 6 x 1.25 m long monopoles, forming 3 dipolar antennas crossed at 90 degrees to each other. In addition to the sensors, EFI contains HFA and SDP pre-amplifiers, as well as bias electronics boards (BEBs) hosted in the man electronics box of the Field and Wave processor (FWP). As THOR spacecraft has a sun-pointing spin axis, EFI-SDP measures the electric field in the plane approximately orthogonal to the sun using long wire booms. The sun-pointing attitude greatly reduces errors due to wake effects and asymmetric photoelectron clouds, enabling the highly accurate in comparison to earlier missions $\pm$0.1 mV/m near-DC electric field measurements. Interferometry using the electric field probes can be used to infer wavelengths and scale sizes at the smallest scales in the plasma. EFI also measures the floating potential of the satellite, which can be used to estimate the plasma density at very high time resolution (up to a few hundred Hz). The sun-pointing attitude greatly reduces changes in the illuminated area, and hence the associated spin-dependent errors. In combination with densities derived from the observed plasma frequency emission line, EFI monitors the plasma density from DC to a few hundred Hz. EFI measurements characterize electric field and density variations associated with kinetic scale plasma processes, and therefore are crucial for addressing the THOR science question of turbulent energy dissipation and particle energization.

The EFI instrument shall be designed and built by an international consortium of scientific institutes with main hardware contributions from Poland, Sweden and USA.