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THOR Ion Mass Spectrometer (IMS)

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Turbulence Heating ObserveR (THOR) is the first mission ever flown in space dedicated to plasma turbulence. The Ion Mass Spectrometer (IMS) onboard THOR will provide the first high-time resolution measurements of mass-resolved ions in near-Earth space, focusing on hot ions in the foreshock, shock and magnetosheath turbulent regions. These measurements are required to study how kinetic-scale turbulent fluctuations heat and accelerate different ion species. IMS will measure the full three-dimensional distribution functions of main ion species (H^+, He^{++}, O^+) in the energy range 10 eV/q to 30 keV/q with energy resolution DE/E down to 10% and angular resolution down to 11.25°. The time resolution will be 150 ms for O^+, 300 ms for He^{++} and $\sim$ 1s for O^+, which correspond to ion scales in the the foreshock, shock and magnetosheath regions. Such high time resolution is achieved by mounting four identical IMS units phased by 90° in the spacecraft spin plane. Each IMS unit combines a top-hat electrostatic analyzer with deflectors at the entrance together with a time-of-flight section to perform mass selection. Adequate mass-per-charge resolution (M/q)/(ΔM/q) ($\geq$ 8 for He^{++} and $\geq$ 3 for O^+) is obtained through a 6 cm long Time-of-Flight (TOF) section. IMS electronics includes a fast sweeping high voltage board that is required to make measurements at high cadence. Ion detection includes Micro Channel Plates (MCPs) combined with Application-Specific Integrated Circuits (ASICs) for charge amplification and discrimination and a discrete Time-to-Amplitude Converter (TAC) to determine the ion time of flight. A processor board will be used to for ion events formatting and will interface with the Particle Processing Unit (PPU), which will perform data processing for THOR particle detectors. The IMS instrument is being designed and will be built and calibrated by an international consortium of scientific institutes from France, USA, Germany and Japan and Switzerland.