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THOR Ion Mass Spectrometer instrument – IMS

Alessandro Retinò (1), Harald Kucharek (2), Yoshifumi Saito (3), Markus Fraenz (4), Christophe Verdeil (1), Frederic Leblanc (1), Jean-Denis Techer (1), Alexis Jeandet (1), John Macri (2), John Gaidos (2), Mark Granoff (2), Shoichiro Yokota (3), Dominique Fontaine (1), Matthieu Berthomier (1), Dominique Delcourt (1), Lynn Kistler (2), Antoniette Galvin (2), Satoshi Kasahara (3), and Elena Kronberg (4)

(1) Laboratoire de Physique des Plasmas, Ecole Polytechnique, Palaiseau, France (alessandro.retino@lpp.polytechnique.fr), (2) Space Science Center, University of New Hampshire, USA, (3) ISAS-JAXA, Sagamihara, Japan, (4) Max Planck Institute for Solar System Research, Gottingen, Germany

Turbulence Heating ObserveR (THOR) is the first mission ever flown in space dedicated to plasma turbulence. Specifically, THOR will study how turbulent fluctuations at kinetic scales heat and accelerate particles in different turbulent environments within the near-Earth space. To achieve this goal, THOR payload is being designed to measure electromagnetic fields and particle distribution functions with unprecedented resolution and accuracy. Here we present the Ion Mass Spectrometer (IMS) instrument that will measure the full three-dimensional distribution functions of near-Earth main ion species (H+, He+, He++ and O+) at high time resolution ($\sim$ 150 ms for H+ , $\sim$ 300 ms for He++) with energy resolution down to $\sim$ 10% in the range 10 eV/q to 30 keV/q and angular resolution $\sim 10^{\circ}$. Such high time resolution is achieved by mounting multiple sensors around the spacecraft body, in similar fashion to the MMS/FPI instrument. Each sensor combines a top-hat electrostatic analyzer with deflectors at the entrance together with a time-of-flight section to perform mass selection. IMS electronics includes a fast sweeping high voltage board that is required to make measurements at high cadence. Ion detection includes Micro Channel Plates (MCP) combined with Application-Specific Integrated Circuits (ASICs) for charge amplification, discrimination and time-to-digital conversion (TDC). IMS is being designed to address many of THOR science requirements, in particular ion heating and acceleration by turbulent fluctuations in foreshock, shock and magnetosheath regions. The IMS instrument is being designed and will be built by an international consortium of scientific institutes with main hardware contributions from France, USA, Japan and Germany.