P- 219

ERG搭載 中間エネルギー帯 イオン分析器・電子分析器の開発状況

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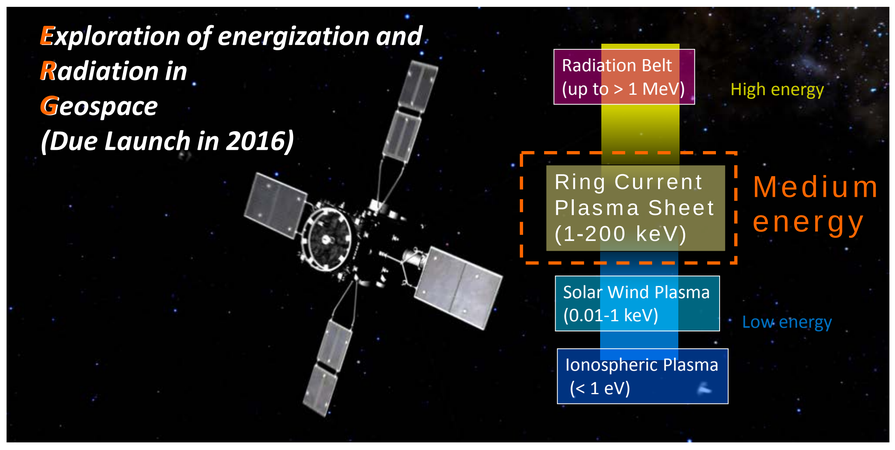
Abstract

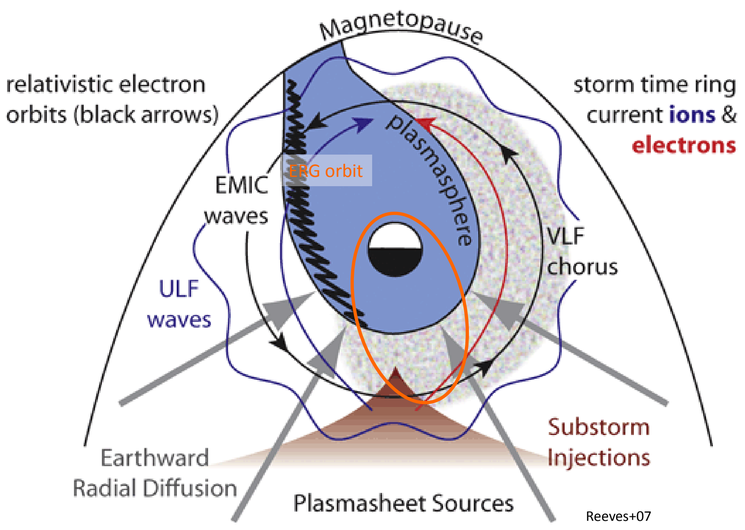
We have been developing instruments for the observations of the medium-energy electrons (10-80 keV) and ions (10-180 keV/q) in our coming radiation belt mission ERG (Exploration of energization and Radiation in Geospace). The mission goal is to understand the radiation belt dynamics during space storms. The medium-energy electron measurement is one of the most important issues in this mission since these electrons generate whistler chorus wave, which is believed to play significant roles in the relativistic electron acceleration and loss during storms. On the other hand, such a measurement has been a challenging issue due to the harsh radiation environment, where penetrating particles and secondary particles result in significant background. Our strategy for enhancing signal-to-noise ratio is to combine an electrostatic analyzer and silicon detectors, which provide energy coincidence for true signals. In parallel with the electron instrument, we also have designed and tested a medium-energy ion mass spectrometer. This instrument is comprised of an electrostatic analyser, time-of-flight (TOF) mass spectrometer, and solid state detectors, hence it can measure energy, mass and charge state of medium-energy ions. It provides significant information of particle flux and pitch angle distribution of ring current core components, which contributes to the radiation belt dynamics via electromagnetic waves and global magnetic field deformation.



- Medium energy: 10-200 keV
  - Dominant component for the energy density
- We develop MEP-i and MEP-e for ERG

Scientific goals: MEP-i

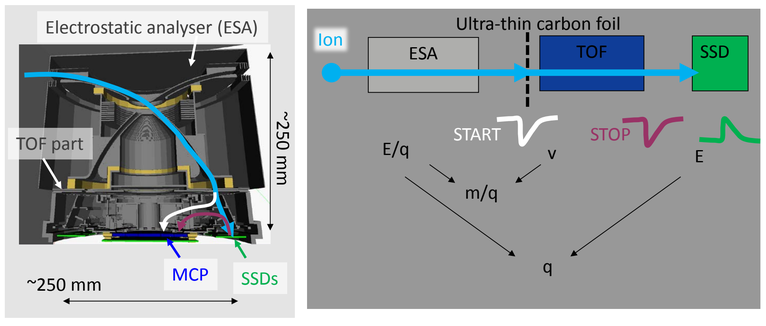
- Magnetic field deformation by RC ions (1-200 keV) governs the radiation-belt electron trajectories
- Magnetosonic wave excited by RC ions can accelerate keV-MeV electrons via the wave-particle interaction (WPI)
- Electromagnetic ion cyclotron wave generated by RC ions contribute to the MeV electron precipitation via the WPI



Scientific goals: MEP-e

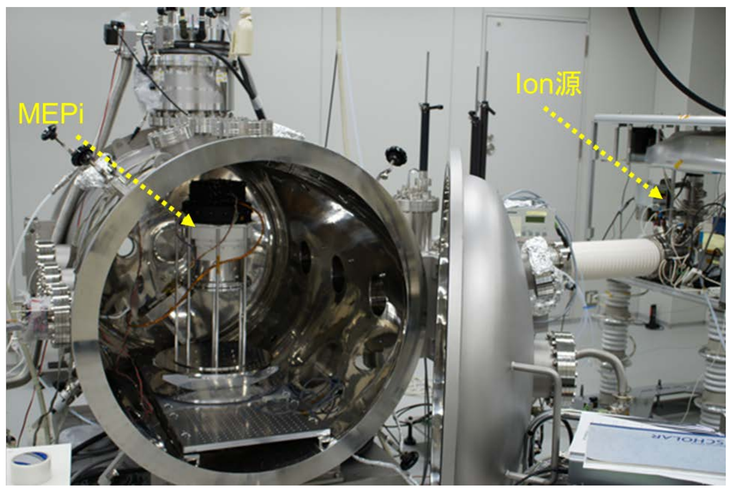
- Magnetic field deformation by RC electrons (1-100 keV) governs the radiation-belt electron trajectories
- Whistler chorus excited by RC electrons can accelerate keV-MeV electrons via the wave-particle interaction (WPI)
- Whistler chorus/hiss generated by RC electrons contribute to the MeV electron precipitation via the WPI

Specification: MEP-i



Energy range: 10-180 keV/q (dE/E= 15 %)
FOV: 10° x 360° (resolution: 22.5° x 22.5°)
Species: H+, He++, He+, O+
Sensitivity: 5×10^{-3} cm² sr keV/keV

Beam facility for tests



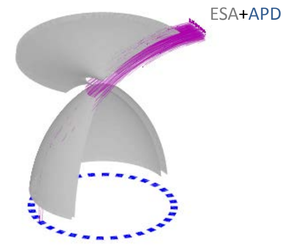
Specification: MEP-e

ESA covers
- energy range of **10-80 keV**
- FOV: **4π sr** (within a half spin)
- G-factor: 5×10^{-5} [cm²-sr-keV/keV/5°-sector]

➔Expected count rate: **10^{1-4} cps/sector**

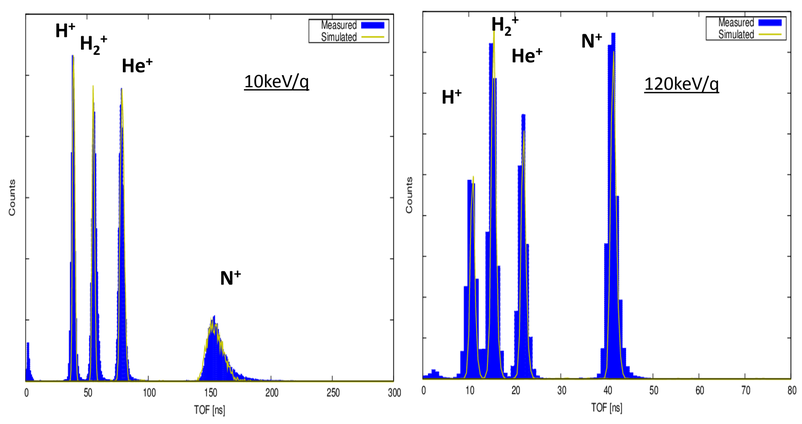
APD provides high and predictable detection efficiency

ESA+APD enables cross-check of electron energy➔ background rejection



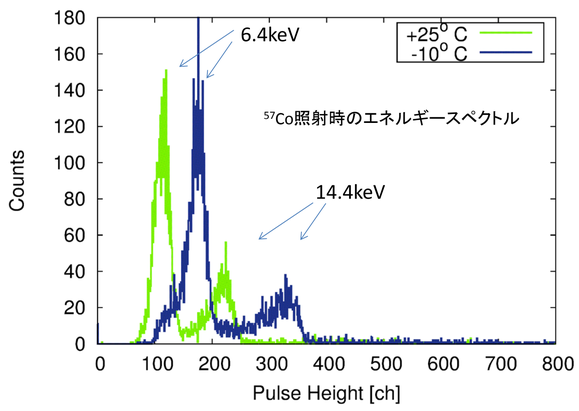
Kasahara et al., 2009

Test results of EM: TOF profile

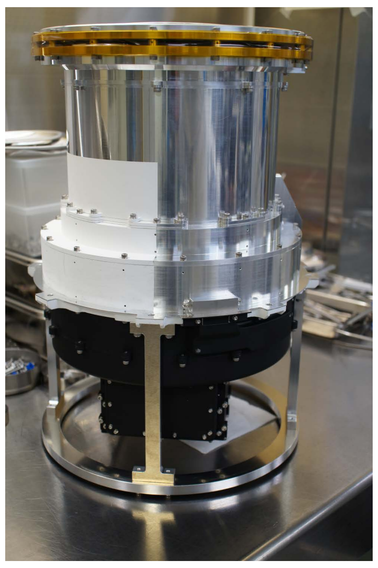


Ion/electron beam line in
STEL/Nagoya University: 5 - >120 keV
Ion species: H+, He++, He+, N+

Test results of EM: energy spectrum after ASSY



MEPi EM



MEPe EM