

Intro on heavy ion instruments in JAXA and requirements for the space plasma applications

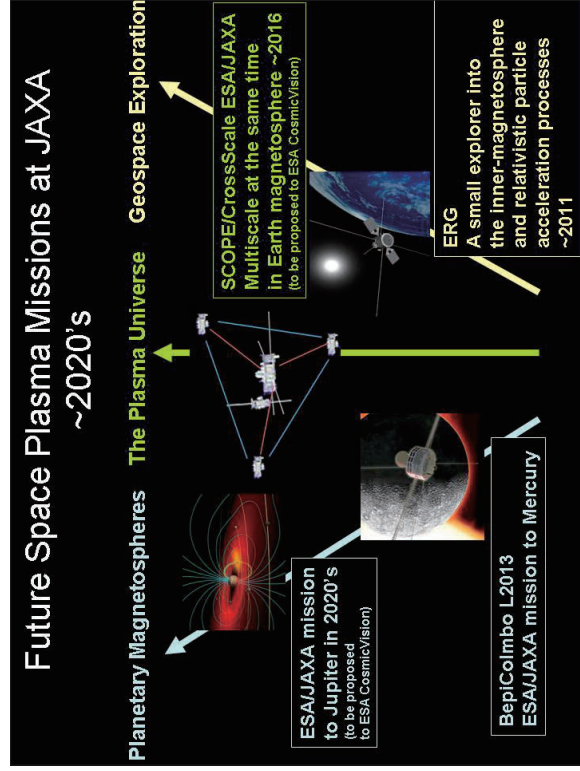
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Activity of Development for Particle Detectors

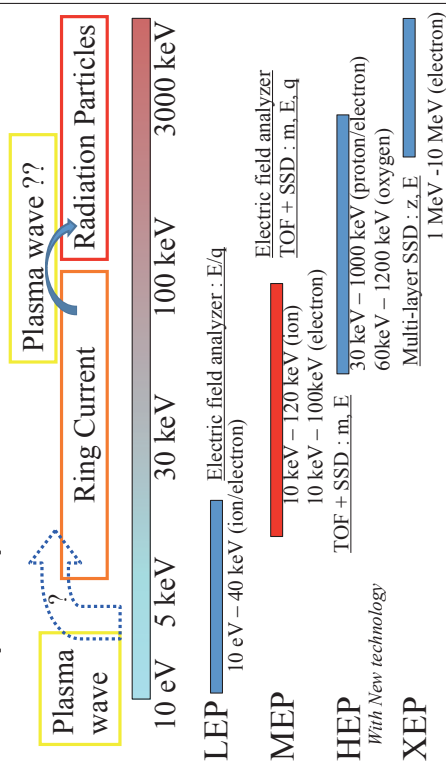
- Two main groups in JAXA
 - **ISAS for scientific missions**
 - Development for scientific missions
 - Exploration of planet missions
 - New detectors optimized for scientific targets in each mission
 - **IAT for measurement of radiation environment**
 - Measurement of radiation environment for satellite in order to investigate the effect of radiation damage in new test instruments and new electric parts

Scientific targets

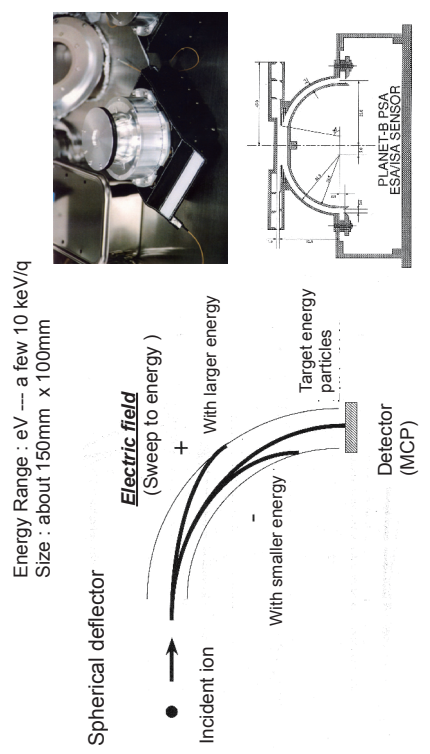
- We can not see what is happening in interplanetary space unless we go there.
Ex. Magnetic Field, particles, solar wind (plasma).
- In-situ measurements by space plasma mission are important to study,
- Physical process in plasma universe (micro scale)
 - Particle acceleration in space plasma
 - Energy transfer in magnetosphere around planets
 - Release of magnetic energy and energy transfer to space plasma
 - Measurement of radiation environment (macro scale)
 - Distribution of energetic particles in solar system
 - Dynamics of Heliosphere with fluxes of particles (spectrum and time variation)



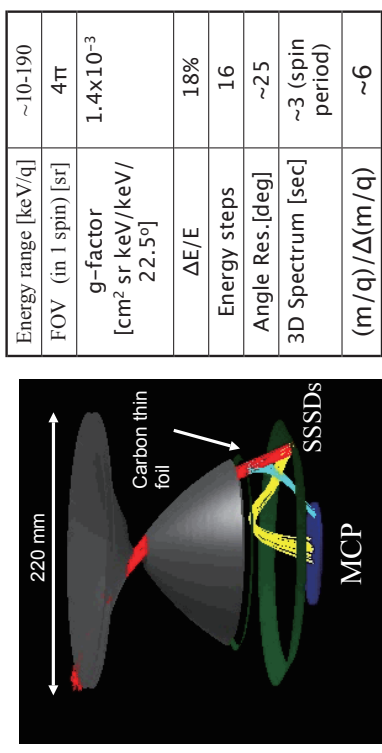
Observation of energy range for space plasma missions EX. ERG



Plasma instrument Low Energy Particle (LEP)



Medium Energy Particle analyzer (MEP)



Configuration

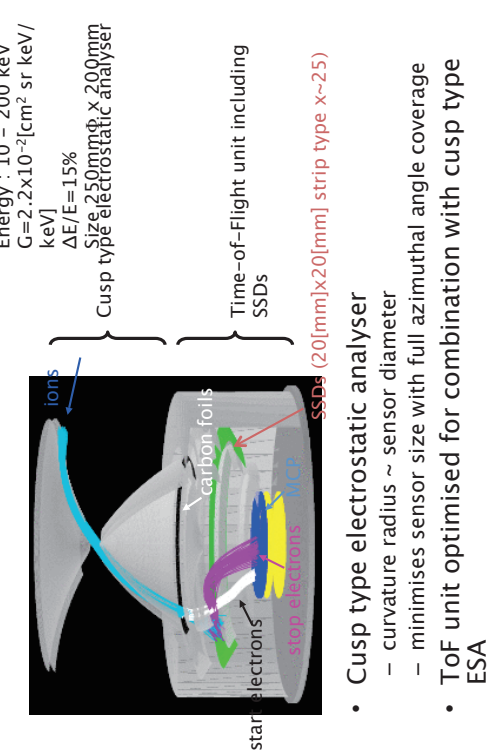
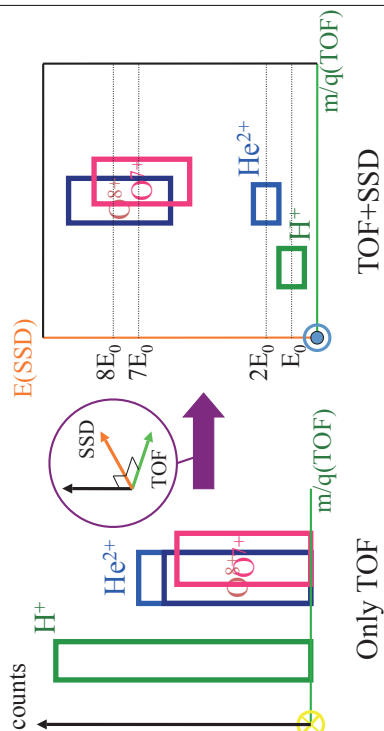


Diagram illustrating the TOF-MS setup for ion and electron detection. The setup includes a Collimator, a 16° angle, a Stepper, a Spring, a Biphennyli, a Reflector, a Gl. C-Foil, a Stop MCP, and a Start MCP. The flight path is 45mm. The detector region has a 20° angle and a 20° angle. The detector is labeled "Ion sensor" and "Electron sensor". The energy range is 100 - 2300 keV for ion and 100 - 1700 keV for electron. The G-factor is 0.015 cm² str for TOF and 0.027 cm² str for ΔE-E. The Si detector is 3 mmφ 9μm and the E Si is 14 mmφ 460μm.

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To measure the incident angle of particle by two PSDs is important

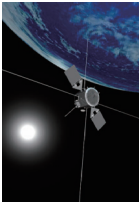
What we need and requirements to Geant4 in our space missions ?

- Data analysis : already observed data
 - Background rejection from observation data
- Contamination of high energy particles background that pass through the instrument body
- Trace of particle tracks in sensor with energy range between eV to GeV (deposited energy calculation) and fragmentation of incident particle
- Secondary electron emitted from materials by high energy particles

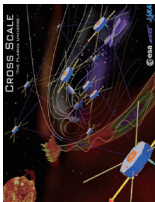
What we need and requirements to Geant4 in our space missions ?

- Design tools for a development of new detector
 - Reduce contamination of high energy particles
 - Especially for exploration missions, mass resource is very severe and then the instrument need to be designed with balance between mass resource and performance
- Not for scientist but for engineer to design instruments
 - It is too difficult to use Geant4 in order to design new instruments for engineer. Ex if can use CAD data, it is comfortable
 - typical environment template
 - Low earth orbit, Radiation belt
 - Interplanetary, planetary orbiter (Moon, Mars, Jupiter etc)

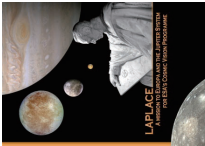
Target missions



ERG mission : scientific small satellite program
Science : relativistic electron acceleration in the radiation belt
Launch : after 2012
Strong radiation environment



SCOPE/CrossScale mission : formation flight
Science : cross scale coupling and plasma universe
Launch : after 2017



Jupiter exploration mission :
Science : particle acceleration and binary star
Launch : after 2025
Strongest radiation environment