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Experimental techniques for the space plasma/particle measurements in the near-Earth/planetary space environment

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The space physics, particularly for the exploration in the near-Earth/planet space like the magnetospheres/ionospheres, essentially requires in situ plasma/particle measurements covering a wide energy range from a few eV up to several tens of MeV as well as the magnetic/electric and plasma wave measurements. The extremely energetic (several hundreds of keV to tens of MeV) particles widely distributing in the Earth's magnetosphere are accelerated in the radiation belt (Van Allen belt) and drastically change their characteristic energy, flux, and location according to solar-terrestrial interaction effects. Some recent theoretical/simulation works indicate that plasma wave-particle interaction would play a crucial role in the generation of radiation belt electrons also called killer electrons. The radiation belt is surrounded by or coexists with both ring current region consisting of high-energy (about 10 to several hundreds of keV) ions and electrons and plasma sheet characterized by its hot (a few hundreds of eV to tens of keV) plasma population. This multi-sphere space system has conspicuous energy-layered structures/distributions, which fundamentally drives typical plasma processes in the Geospace, like the auroral emissions in the polar ionosphere, the particle accelerations, the plasma wave excitation, and so on. Also in the planetary space environment, plasma/particle measurements would bring us crucial information on the elementary processes of the space plasma processes and the evolution of planetary atmospheres, for instance, in the magnetospheres of Mercur and Jupiter, and the topside ionosphere of Mars. At present, our Japanese team is now making aggressive efforts toward realizing both comprehensive measurements of space plasma over the wide energy range of ten to the sixth order using a plasma/particle instruments package consisting of several types of sensor for the geospace exploration and future observations for the investigations of planetary atmospheric environment. In this presentation, we introduce the current/future plans for the space plasma/particle measurements based on the in-situ observations using exploration spacecraft.

Keywords: Space Plasma, In-situ Observation, Measurement Technique, Exploration Spacecraft, Integrated Observation, Wave-particle Interaction