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A personal future perspective of international collaborations in space physics

SEKI, Kanako[1*]

[1]Solar-Terrestrial Environment Laboratory, Nagoya University

Space physics is a research field that has developed rapidly along with the dawn of the space age. The international collaborations have been one of key elements of researches in the space physics. Interdisciplinary researches are also fundamental nature of the research field, since it has close relations with astronomy, meteorology, planetary science, plasma physics, and other fields. In recent years, it has further developed roughly in three directions. One direction is contribution to understanding of universal plasma processes in the universe such as the magnetic reconnection, plasma turbulence, and shock waves, utilizing the 'in-situ' plasma observations that enable direct measurements of space plasma phenomena in the solar system. In this direction, the launch of NASA's formation flight mission called MMS (Magnetospheric Multi-Scale) is schedules in March 2015 with instrument-level collaboration between US and Japan. The main goal of the mission is to reveal the nature of the microphysics of three fundamental plasma processes, i.e., the magnetic reconnection, energetic particle acceleration, and turbulence. Interdisciplinary researches between space physics, astronomy, and laboratory plasma physics have been enhanced.

The second direction is the understanding of dynamic variations of Geospace environment. A wide scope of researches from basic studies of physical mechanisms to applications to space weather forecast has been deployed worldwide. In this direction, international geospace exploration is underway: NASA's Van Allen Probes has provided new data since their launch in 2012, and in Japan, preparation of the ERG (Energization and Radiation in Geospace) mission is ongoing for scheduled launch in summer 2016. Regional couplings are key elements in this direction of researches, and the solar wind-magnetosphere-ionosphere-thermosphere interactions have been investigated. The international programs such as ISTP, CAWSES, and VarSITI have played important role in promotion of international collaborations.

The third direction is expansion to the comparative planetary researches. Each planet in our solar system has different properties in terms of size, weight, distance from the sun, atmosphere, and intrinsic magnetic field. Particularly, characteristics of atmosphere and structure as well as strength of intrinsic magnetic field are important parameters to determine space environment around a planet. The knowledge of other planets with different conditions enables us to understand more deeply the solar-terrestrial system. International mission to Mercury, BepiColombo is now under preparation and will be launched in 2016. The mission consists of two orbiters and one of the orbiters, MMO, has been developed in Japan, while ESA is responsible for MPO development. The mission has also enhanced international collaborations in science before launch. There are many other missions that have excited international collaborations such as MAVEN and JUICE. In order to understand the diversity and universality of the stellar-planetary system, cooperation with astronomy and planetary science is getting more essential. This presentation provides a brief review of these international collaborations in space physics. Keeping these three directions of researches, a personal future perspective will be also presented.

Keywords: magnetosphere, ionosphere, planetary exploration, space physics, space plasma, solar-planetary system