Exploration of the Jovian electromagnetic environment by using decametrer and decimeter radio waves

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Jupiter is a planet abounding in various kinds of natural radio emissions. With auroral emissions, natural radio emissions are one of the most sensitive indicators of the electromagnetic environment of planet, and will give important clues for understanding physical and chemical processes, and global energy flows and balance in the solar-magnetosphere coupling system. In this presentation, we will discuss how we act on the exploration of planetary electro-magnetic environment in the CAWSES program from the observational approaches of the Jovian radio waves.

The Jovian non-thermal radio waves are generally categorized into two types; i.e., one is generated from plasma processes in the magnetosphere, and the other is originated from the synchrotron radiation process in the radiation belt. The most intense radio wave in the former type is called decameter radio wave (DAM), while the later type is called decimeter radio wave (DIM). In the CAWSES program, we plan to make following new projects in both the DAM and DIM observations.

Ground-based observations of DAM have been extensively carried out in the decameter radio wave observatory of Tohoku University since 1975 and the core observation facilities have been developed during the past 27 years (Oya and Morioka, 1979; Oya, et al., 1984; Oya et al., 1997). Being on the bases of this background, recent study fields concerning the DAM can be devided into two categories; 1) energy source and energy transport processes to the Jovian polar region, and 2) generation mechanism of this strong radio emission. As for the energy source, three types of energy sources have been considered although the strong Io effect is essentially the tapping process of rotational energy of Jupiter; i.e., 1) energy injection from the solar wind, 2) rotational energy of Jupiter, and 3) Io's control. Discussions will be made especially focused on the solar wind control effect as well as the energy production processes at the satellite Io. To seek the physical processes on the generation mechanism of DAM, in parallel to the theoretical studies, direct mode identification of DAM from observations is essential. Basic properties and theories on the newly developed interferometer system in Tohoku University will be discussed.

On the DIM observation, a new 1000m^2 radio telescope has been just developed by Tohoku University in 2001 in Fukushima (Misawa et al., 2001). Major observation targets are the investigation of characteristics of time variations in DIM, particularly short-term variation with the time scale of days to weeks. It is confirmed that the short-term variation cannot be generated by a classical radial diffusion process and other physical processes are required which make rapid changes in electron phase space density and/or diffusion coefficient in the radiation belt. In the domain of the phase space density, information of variations of electron physical conditions, such as energy, pitch angle, and location in the planetary magnetic field, is obtained with a radio wave measurement; i.e., spectrum, polarization and imaging, respectively. In the period of CAWSES, we just plan to make observations of spectrum, polarization, and imaging using the new radio telescope and by coordinated experiments with several radio-telescope facilities (STE lab., CRL, EISCAT).

References:

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