Heliospheric studies by the next generation solar wind observation system

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Solar wind is a plasma flow from the Sun with its velocity from around 300 km/s to around 800 km/s, that forms the heliosphere. The acceleration mechanism of the solar wind is not well understood and is being actively studied as a major problem in solar physics and space physics. In addition, the solar wind often significantly disturbs the Earth's surrounding environment. This disturbance can seriously damage social infrastructure including communication failure and troubles in artificial satellites. The scopes of this research are (1) to elucidate the acceleration mechanisms of the solar wind and (2) improve the forecasting accuracy of the solar wind arrival to the Earth.
Interplanetary scintillation (IPS) is a radio scattering phenomenon caused by the disturbances in the solar wind. The IPS observation using ground-based radio telescopes has been an important technique to investigate the global structure of the solar wind in the heliosphere. In this project, we will develop new ground-based radio observation systems at 327 MHz by constructing a 2D flat phased-array antenna system consisting of multiple dipole antennas, and installing digital beam forming devices. The multidirectional simultaneous radio scintillation observation using this system enables the solar wind observation 10 times as much as the conventional radio instruments have been done. This observation data will enable us to clarify the source region of the solar wind with an enough spatial resolution to distinguish the solar wind acceleration processes. In addition, the real-time data provided by the new instruments will be assimilated to the global MHD simulation of the heliosphere to improve the accuracy of the arrival-time of the solar wind disturbances to the Earth. This project is led by Institute for Space–Earth Environmental Research (ISEE), Nagoya University, aiming to be realized in 2020s. The total cost of this project is expected to be 1~2 billion yen.

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