Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM34-01 Room:503 Time:May 1 11:30-11:55

Frontier of space plasma observations expanding from interplanetary space to interstellar medium

TOKUMARU, Munetoshi[1*]

[1]Solar-Terrestrial Environment Laboratory, Nagoya University

The Sun emits the super-sonic plasma flow, called the solar wind, to form the heliosphere in the ambient interstellar medium. The spatial scale of the heliosphere is about 100 AU. Since interesting physical phenomena such as the solar wind formation, excitation and propagation of shocks, acceleration of energetic particles arises through interaction between plasma and fields in the heliosphere, it is used as an experiment site to make various observational studies of the space plasma. Remote sensing measurements of the solar wind with the interplanetary scintillation (IPS) method are one of those studies. The obtained IPS data revealed the global distribution of the solar wind drastically changes its global distribution over short- and long-timescales being closely associated with the solar activities (Tokumaru, 2013).

At present, marked progress occurs in the heliospheric sciences, being driven by new observational facts. One of progress has been brought about by exploration of heliospheric boundary region by Voyager-1, 2 (V1,V2) and IBEX spacecraft (Gurnett et al., 2013, McComas et al., 2009). The V1 encountered the termination shock (TS) at 94 AU in 2004, and reached the heliopause at 120 AU in 2012, then entered the interstellar medium. The V2 encountered the TS at 87 AU in 2007, being expected to reach the heliopause in a few years. The IBEX revealed the large-scale ribbon structure surrounding the heliosphere from imaging observations of energetic neutral atoms (ENAs). In order to interpret those observations, information on 3-diminensional (3D) structure of the heliospheric boundary region is needed. Since IPS observations mentioned above give global distribution of the solar wind in the inner heliosphere, 3D structure of the heliospheric boundary region can be determined precisely by MHD simulation based on the IPS data. The IPS-based MHD simulation data are provided to both Voyager and IBEX teams to make collaborative studies of the heliospheric boundary region.

Another driver for progress in the heliospheric science is arrival of the peculiar solar activity. The level of the current solar cycle is 100 years low, and IPS observations revealed that significant changes including marked drop of the solar wind density and different distribution of fast and slow solar winds occurs in this cycle (Tokumaru et al., 2009, 2010, 2012). These facts are important not only for studies of the heliospheric boundary region and influence on the planetary magnetospheres (i.e. the space weather), but also for elucidating enigma of the solar wind acceleration mechanism. Besides, observations during the current peculiar activity provide a clue to understand a hidden process for cooling of the Earth's climate during the Maunder minimum in the 17th century.

The V2 encounter for the interstellar medium which is expected to occur within a few years will enable detailed investigation of plasma environment in the local interstellar cloud surrounding the heliosphere. Furthermore, the heliopshere is immersed in the low-density (but high-beta) region called the local bubble, whose plasma properties have been investigated from radio observations using pulsars (Spangler, 2009). In the future, space plasma study for the integrated region ranging from the heliosphere to the local bubble will significantly advance by using in situ and remote sensing observations.

Keywords: solar wind plasma, interplanetary scintillation, heliosphere, interstellar medium, solar cycle