Proceedings of the Research Institute of Atmospherics,
Nagoya University, vol. 32(1985) –Activity Report–

Section 6. Solar Emission and Related Terrestrial Phenomena

IPS observations of 16 radio sources at a UHF frequency (327 MHz) have been continued at three stations (Toyokawa, Fuji, and Sugadaira). The data book, "Solar Wind Speed from IPS Measurements, January-December 1983", has been published. The number of observable radio sources will be increased as a result of continuous effort to improve the instruments. A system which enables us to make the calibration as well as the correction of errors both in the gain and the phase of the receiving system (Kojima et al., Proc. Res. Inst. Atmospherics, Nagoya Univ., **29**, 61-83, 1982) has been completed. The accuracy of the correction is 0.2 db rms in the gain, and 2 degrees rms in the phase. We can finish the whole calibration-and-correction procedures within 5 minutes. A remote control system is being installed to change the observation schedule of each remote station in a short time scale to prepare for transient interplanetary phenomena, e.g., solar-flare generated interplanetary shock waves.

A joint U.S.-Japan seminar, "Recent Advances in the Understanding of Structure and Dynamics of the Heliomagnetosphere During the Current Maximum and Declining Phase of Solar Activity", was organized by T. Kakinuma and S. T. Wu, and held in Kyoto (Hotel Keihan) during November 5-9, 1984. The number of participants in total was 57; 36 from Japan, 19 from U. S., and 2 from other countries. More than 40 scientific papers and 6 papers on future projects of solar-terrestrial observations were presented. This seminar was sponsored by The Japan Society for the Promotion of Science and also by National Science Foundation, U. S. A.

Kakinuma and Kojima (1984) discussed the evolution of three-dimensional structure of the solar wind with solar cycle on the basis of the IPS observations at the VHF (69 MHz) and the UHF (327 MHz) frequencies. The general latitude dependence of the solar wind speed changes with the size of the polar coronal hole which produces the high-speed solar wind stream (high-speed region). The axially aligned, polar high-speed region has the greatest size near the sunspot minimum and shrinks in the ascending phase. The localized high-speed streams with a limited longitude extent are observed in all phases of the sunspot cycle and, in most cases, extend from high latitudes to the solar equator; thus they are observed as the equatorward extensions of the polar high-speed regions, except near the sunspot maximum.

Kojima has returned from University of California, San Diego last October. During his stay in UCSD for two years, he joined a project to construct a large VHF antenna for IPS observations (Kojima et al., 1984). Completion of this array has brought us an opportunity to make a cooperation between our IPS group (UHF observation) and the IPS group of UCSD (VHF observation). This cooperation will make it possible to observe the solar wind in wide range of interplanetary space ranging from 0.1 to 1 AU, measured from the Sun (Kojima et al., 1984).

Kojima also joined the first IPS observations with the VLA telescope (operated by the U. S. National Radio Astronomy Observatory in New Mexico) at three wavelengths (21, 6, 2 cm). These observations covered an elongation range of 3 to 30 solar radii. Preliminary results of the observations were reported by Coles et al. (1984). Active solar wind was observed inside 10 solar radii. Plasma irregularity has an anisotropic spatial structure elongated in the radial direction, and the direction of the mean flow is also radial. The mean flow measured between 3.5 and 4 solar radii showed a very rapid speed change from tens of km/s to a few hundreds of km/s. All data showed a large random motion of the solar wind plasma. Further analysis is in progress.

Watanabe and Kakinuma (1985a) reviewed recent developments in the study of interplanetary disturbances by IPS techniques, and discussed three-dimensional propagation properties of interplanetary disturbances observed in years (1978-1981) around the maximum of the 21st solar cycle. It is shown that the net excess mass and energy in an interplanetary disturbance associated with a disappearing solar filament can be comparable to those of an interplanetary disturbance associated with a large solar flare. Several disturbances showed oblate configurations; the latitudinal extent is smaller than the longitudinal extent. A statistical analysis (Watanabe and Kakinuma, 1984, 1985b) showed that the three-dimensional shape of an interplanetary disturbance can be approximated by an ellipsoid having an axial ratio of about 1.8. The average latitudinal angular extent at 1 AU heliocentric distance ($\pm$ 30° centered at the normal of the eruption) is comparable to those of high-speed (> 500 km s^{-1}) coronal mass ejections.

Watanabe (1985) found that the interplanetary manifestation of the halo coronal mass ejection of Nov. 27, 1979 was a quasi-spherical interplanetary disturbance. The total angular spread was larger than 70° at 1 AU heliocentric distance in the longitudinal direction. The disturbance propagated with approximately constant speed out to 0.1-0.3 AU from the Sun, then decelerated as a blast wave in the solar wind.

A computer analysis of the solar wind have been also done. The properties of the transonic solution and the related interplanetary shock wave associated with the sudden increase of temperature due to a solar flare effect have been investigated by Washimi by the use of the Lax-Wendroff scheme in a spherically symmetric hydrodynamic system. Corresponding to the new high temperature at the base of the solar wind, the solar wind velocity increases abruptly near the base at the beginning, and this high velocity region expands outwardly to form the new transonic solution. It has been found that the expanding high velocity gas forms a shock wave. Because the solar wind plasma near the sun is highly inhomogeneous, this shock wave does not satisfy the Rankine-Hugoniot relations. The shock speed is approximately equal to the local wind speed of the new transonic solution. An analysis in an axis-symmetric MHD system have been also done. In this case an oblique shock wave has been found and the shock speed differs from the local wind speed by the magnetic effect.

A time-dependent dynamical model of solar prominence with a current sheet has been investigated by Sakai (Toyama Univ.) and Washimi. Coupled basic equations with self-similar solutions have been derived to give a theoretical base of the prominence which is suspended above a magnetic neutral line between two opposite magnetic polarities. The global structure of the current sheet including solar wind plasma has been also simulated by means of full MHD equations.

February 28, 1985
-Takakiyo Kakinuma-

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