NEAR SPACE PLASMA DIAGNOSTIC AT EXTREMELY LOW FREQUENCIES

J.-L. Bougeret[1], **N. N. Kalinichenko**[2], **A. A. Konovalenko**[2],
I. S. Falkovich[2], **M. R. Olyak**[2]

[1] *Paris-Meudon Observatory, France*

[2] *Institute of Radio Astronomy, NAS of Ukraine*
4 Chervonopraporna St., 61002 Kharkiv-2, Ukraine
e-mail: kalinich@ira.kharkov.ua

Solar wind shock waves associated with high-speed streams and coronal mass ejections (CMEs) are constantly present in the interplanetary medium. Though they decay with distance from the Sun, the most powerful CMEs are observed close to the border of the heliosphere [1]. Shocks in the inner heliosphere have been extensively studied by measuring the interplanetary scintillation (IPS) of distant, compact radio sources at centimetre, decimetre and metre wavelengths at which the scintillation index has maximum at solar elongations less 90° [2]. Since at large elongations the scintillation index at decametre wavelengths is higher than that above-stated, it is interesting to investigate whether IPS technique at decametre wavelengths can be applied with greater success to study large-scale solar wind disturbances in the outer heliosphere. It is necessary to note that such research have been only episodically undertaken with the help of spacecrafts.

To study this question, IPS observations have been made with the UTR-2 radio telescope of the Institute of Radio Astronomy of the NASU [3]. The UTR-2 radio telescope is the world's largest decametric array that operates at the frequency range from 8 MHz to 32 MHz. The full effective area of the UTR-2 is near 150,000 square meters for the zenith orientation and the beam width range is from 20 minutes to 1.5 degrees of arc. The radio source 3C273 was observed at solar elongation $\cong 140°$. To discriminate a radio source signal and a terrestrial interference, the standard procedure of simultaneous observations of a radio source and a background one was applied by using 5 spatially separated beams of the UTR-2 antenna array. Two frequencies were used: 20 and 25 MHz, with band width 10 kHz. The data processing consists in definition of scintillation indices with the purpose of detection of their sharp (hours), long (few days), and strong (tens of percents) increases which can be associated with shocks.

Since December 1999 to March 2000 we completed a total of 56 hours of IPS observations and did not find out such disturbances except for the case on January 26, 2000. During these observations the scintillation index was typically as 0.09 ± 0.02 (20 MHz) and 0.1 ± 0.02 (25 MHz). On January 26, 2000 down to 23:40 UT the scintillation index behaved in a similar manner. From 23:40 UT at the interval of about 1.5 hours the appreciable increase of the scintillation index from 0.09 to 0.18 to be occurred. In our opinion, however, the shocks are not the cause of this phenomenon. The detailed analysis of the visible movement of the radio source on this day shows that it crossed the "shadow" of the Moon in the solar wind and the beginning and end of the effect rather well coincided with the radio source going in and out the lunar "shadow".

It is known that the Moon as well as another bodies of the solar system are the obstacle on the way of the solar wind. Its movement results in the perturbation of the interplanetary magnetic field and plasma. Calculations have shown that on the night side of the Moon the cavity (or "shadow") of the conic form which lasts behind it in the direction of the solar wind will be formed [4]–[6]. The magnetic field strength increases and the interplanetary plasma density decreases inside the cavity. The phenomenon which we name by the lunar cavity or "shadow" was first discovered by Explorer 18 [7].

The assumption of the connection of the index increase with the lunar "shadow" is not contradicted by the scintillation spectra. Inside the "shadow" the spectra are wider than outside of it. Physically, it can mean an increase of irregularities of a speed or/and a share of small-scale irregularities over the line of sight. During the other days of observations the lack of the effect may well be attributable to large distance between the Moon and the examined region at which the "shadow" is weak (for the moment, this distance was equal to $14\,R_L$, during the other days of observations $\geq 30\,R_L$).

Our results can be summarized as follows:

1. No shock was found in the data of our observations. We believe that it may be connected with the short duration of observations and with only one direction of observations.
2. The increase of the scintillation index, which we observed on 26.01.2000, is probably associated with

the lunar "shadow" in the solar wind. If this statement is correct, then the size of irregularities is less inside the lunar "shadow" and speed of irregularities is higher than outside of it.

3. IPS technique at decametre wavelengths, which is efficient for large elongations, especially with using of a huge radio telescope, can be useful as a ground support of space missions (WIND, STEREO, *etc.*) to study parameters and evolution of large-scale solar wind structures moving from the Sun up to the Earth and further behind its orbit combining with low frequency observations of various kind solar radioemissions.

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