Publications of the Department of Astronomy — Beograd. № 2, 1970.

LOW ENERGY PARTICLE EFFECTS OVER BELGRADE AFTER THE PROTON FLARE OF THE 7th OF JULY, 1966

Dr M. Vukićević — Karabin

Introduction

Having in mind the importance of the Proton Flare as an extraordinarily complex form of the Solar activity being of interest both for astrophysics and geophysics, an international scientific attempt has been organized named "Proton Flare Project (PFP)" foreseen as as atudy of various phenomena of an isolated Solar event. The Proton Flare Project is a part of the programme of the International Years of the Quiet Sun, and has been performed under the leadership of Dr. Z. Švestka, Astronomical Institute, Ondrejov, and Dr. P. Simon, Observatoire de Paris, Meudon. In the project 54 institutions from 18 countries have participated.

This contribution exposes the results of our measurements during the PFP on the 7th of July, 1966. Exchanging the data with the observatories abroad involved in the PFP, we have got information on H_α and Radio emission during Flare as well as some data about Interplanetary magnetic field, and Ionospheric data, as as well.

Analysis of Results

Solar Flare of the 7th July, 1966 represents one of 20 Flares in total which, as it has been found, produced the Ground Level Effect (GLE) at the sea level by the protons with energy above 500 MeV [1]. On July 7, 1966 at 0025 U.T. there broke out the Solar Flare of class 2B at 34° N; 50° W, reached its maximum at 0038 — 0040 U. T. and lasted for about 70 minutes.

The configuration of local magnetic field, and particularly of type IV Radio Burst (Fig. 1) indicated that the acceleration processes took place in the Flare region and that a flux of charged particles with different energies, that would cause secondary geophysical effects, could be expected. The measurements of ionospheric characteristics over Belgrade up to a height of 800 km showed that there were not any disturbances on July 7, 1966. That was an exceptionally quiet day ($k_t = 0$; $k_p = 0$). On July 8, 1966 a two-phase storm began in ionosphere first with an increase, and then an abrupt decrease of critical frequencies of the

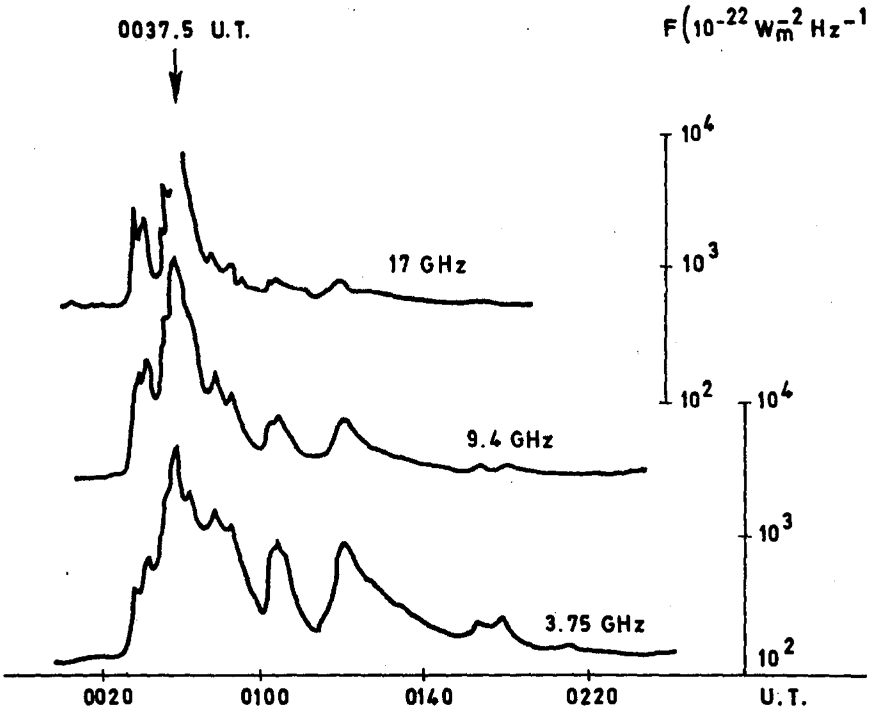

Fig. 1

F_2 layer ($\Delta f_0F_2 > 20\%$) and all the characteristics that follow the irruption of low energy particles. Changes in the F_2 layer measured at the station Belgrade (mag. dip 61°) have been compared with the data of four stations more at higher geomegnetic latitudes. These results are shown in Fig. 2. Analysing these results one can conclude as follows:

1) The beginning of the positive phase and its maximum, as well, appeare earlier at the stations of higher geomagnetic latitudes;
2) Positive phase is more intensive at the stations of lower geomagnetic latitudes;
3) From the analysis of N(h) profile over Belgrade we have concluded that the maximum of positive phase was at a height of $280 < h < 300$ km and that the increase of electron density amounted to about 40%;
4) Negative phase began earlier and was of greater intensity at the stations closer to the pole. At the station Lyksele (mag dip 75°. 4) there was a complete black-out lasting for more hours on the July 9 and 10.

Under the assumption that on July 7 and 8, 1966, the quasi-regular interplanetary magnetic field [2] with a configuration of Archimedean spiral was dominant in the Sun — Earth space, then based on the time delay of geophysical effects it can be concluded that the ionospheric disturbances were caused by particles whose critical concentration was:

$$n_{kr} = 1.0 \times 10^{-6} \text{ cm}^{-3}$$

intensity:

$$I = 1.3 \text{ cm}^{-2} \text{ sec}^{-1} \text{ sterad}^{-1}$$

and energy:

$$10 < E_k < 20 \text{ keV}.$$

However, due to possible scattering on nonhomogenities of interplanetary magnetic field, and different ways of particles propagation within the Sun — Earth space [3], as well, the above mentioned results can have an-error up to 50% Inaccuracy of these results is still such that the question whether the ionospheric data can be used as indicators of Sun particles flux and energy, must not be answered univocally.

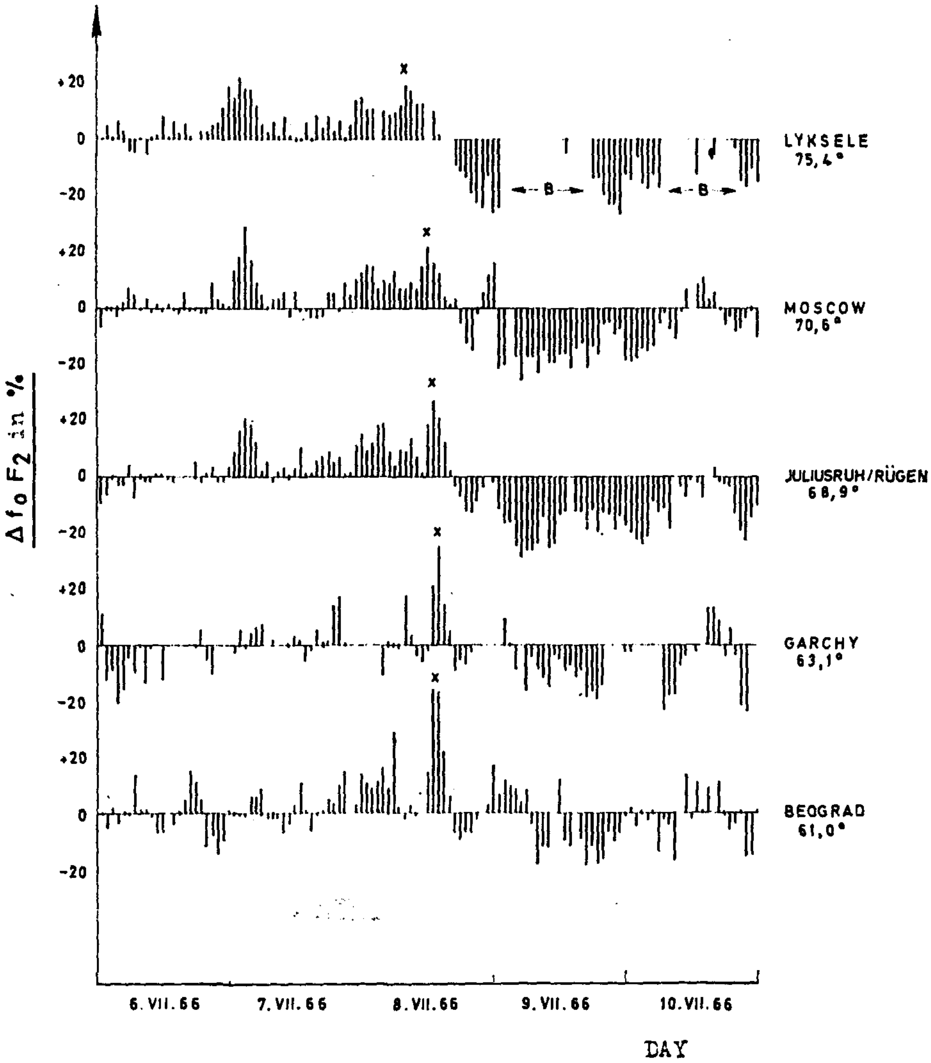

Fig. 2

There remains the fact that due to absorption in the Earth atmosphere and the sensitivity threshold of the equipment in satellites, the direct recording of the low energy particles still remains a pendent problem [4, 5]. Therefore the ionospheric results are very useful in this phase of investigations.

Conclusion

This paper analyses the effect of low energy Solar particles after the Solar Flare of 7th July, 1966. The geophysical effects were particularly outstanding in F layer being not the case with every Solar Flare. The ionospheric measurements over Belgrade were compared with the measurements of foreing ionospehric stations. The results obtained show the expected dependency of the effect upon the geomagnetic latitude. The importance of these measurements was pointed-out with respect to the problems of recording the low energy Solar particles by means of both balloons and rockets and satellites, as well.

References

[1] Švestka Z., "Solar Discrete Particle Events", STP Symposium, Leningrad, 1970.

[2] Ness N. F., Taylor H. E., "Observations of the Interplanetary Magnetic Field", 4—12 July 1966", Annales of the IQSY **3**, 366 (1969).

[3] Dorman L. I., Miroshnichenko L. I., „Solnečnie kosmičeskie luči", Moscow, (1968).

[4] Bryant D. A., et al. „Continuous Accelerations of Solar Protons in the MeV Regions", Phys. Rev. Letters **15**, No. 13, 484, (1965).

[5] Blake J. B. et al. "Solar Protons 1—25 MeV Following the August 28, 1966 Flare", Trans. Amer. Geophys. Union **48**, No. 1, 177. (1967).