MAGNETIC FIELDS IN THE SOLAR CORONA AS FOUND FROM HIGH SPECTRAL POLARIZATION AND SPATIAL RESOLUTION RADIO OBSERVATIONS WITH RATAN-600 RADIOTELESCOPE

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Abstract. The results of radio measurements of coronal magnetic field over a large leading sunspot are presented during its passage over the solar disk (August 1992). The ratio of coronal to photosphere field strength was found to be about 0.62, the small decrease in this value being registered during the highest flare activity in the following part of the sunspot group.

Key words: Coronal Magnetic Fields – Radio Observations

The spectral - polarization observations of sunspot associated sources at microwaves present a unique opportunity to measure magnetic field in the solar corona above sunspots (Akhmedov *et al.*, 1982; Gelfreikh, 1993). The accuracy of this method was significantly increased using new Panoramic Analyser of the Spectra (PAS). In this paper we present the results of the analyses of coronal magnetic field of a large sunspot (the leader of sunspot group No. 255 according to the bulletin "Solnechnye Dannye", August 1992).

The value of the magnetic field was found using the equation

$$B_{rad} = \frac{3570}{\lambda_k} \tag{1}$$

where λ_k is the shortest wavelength where the radio emission (generated by thermal electrons at the third harmonic of gyrofrequency) is detected. The results of the analyses are presented in Table 1 where photospheric values according to B_{opt} are also given. The last column contains the ratio $\eta = B_{rad}/B_{opt}$. The active region was observed on the solar disk from August 11 to August 24, 1992. It was the developed sunspot group with dominating large leading spot with approximately circular umbra (about 50″ in diameter) and penumbra (about 100″ in diameter). The following part

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Table 1. The magnetic field strengths above the leader sunspot of the group No. 255 obtained from radio observations on RATAN-600 in August 1992

data	B_{rad}, Gs	B_{opt}, Gs	B_{rad}/B_{opt},[%]
14	2295 ± 35	3600	64
15	2390 ± 55	3600	68
16	2200 ± 30	3600	61
18	2120 ± 30	3600	59
19	2230 ± 60	3600	62
20	2220 ± 30	3600	62
21	2290 ± 60	3600	64

of the group was developing with numerous flares. At the same time the leader spot was very stable. Over the period of 10 days its area varied only in the limits of 868 – 1046 m.p.h. . The strength of magnetic field at photosphere level with peak values of 3500 – 3600 G has been registered in the leader spot daily in the period of August 14 – 20 according to Crimea Observatory data ("Soln. Dannye", No 8, 1992). At the same time the structure and area of the following part of the sunspot group changed very rapidly over the whole period of observations. In some days the number of spots in the following part exceeded 90. The leader spot had N-polarity, the following part consisted of the opposite polarity spots.

The component associated with the leader sunspot dominated in the radio source above active region over the whole period of observations.

Table 1 shows that this ratio is very stable and in average is 62% for the sunspot under consideration. It is less, than it was determined by the same method for other sunspots observed earlier with the RATAN-600 radiotelescope (Gelfreikh, 1994).

So one can conclude that in this particular sunspot the corona begins a bit higher than in other cases but yet the coronal magnetic field (the mean value $\overline{B}_{rad} = 2250$ G) is still very large. It is interesting to note that the lowest value of the coronal magnetic strength above the leader sunspot of the group No. 255 turned out to be on the day (August 18, 1992) when the peak value of the area and number of spots in the following part of the sunspot group have been registered.

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