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RADIOASTRONOMICAL OBSERVATIONS OF THE SOLAR ECLIPSE OF 20 MAY 1966 IN THE 0.8, 1.6, 3.3 AND 10 CM WAVELENGTHS

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SUMMARY

The one-dimensional brightness distribution is given of the local source over a sunspot group during the solar eclipse of 20 May 1966. The densities are shown of radioemission flux.

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Data on the fine structure of the radioemission source above a sunspot group have been obtained during radioastronomical observations of the solar eclipse by means of a radiotelescope with high resolution.

The observations were conducted at the Oksk Radioastronomical Station of the USSR Institute of Physics using the PT-22 radiotelescope. The aim of the observations was the study of local sources of radioemission and radio-brightness distribution on the limb of the Sun in the I and IV contact regions and in the broad wavelength range.

The use for the solution of such problems of antennas with narrow radiation pattern was found to be more advantageous than with wide radiation pattern as the observed source contrast increaaes relative to the quiet Sun level and, consequently, the possibility increases of separating the weaker and thinner details. It is indeed easy to show that the observed contrast (ratio of Sun's to source's temperatures) is

$$\frac{T_{ai}}{T_{a\odot}} = \frac{S_i}{S_\odot} \quad \text{for} \quad \Omega_a > (\Omega_\odot, \Omega_i)$$

$$\frac{T_{ai}}{T_{a\odot}} = \frac{S_i}{S_\odot} \cdot \frac{\Omega_\odot}{\Omega_a} \quad \text{for} \quad \Omega_i < \Omega_a < \Omega_\odot.$$

Here S is the radioemission flux; $\Omega_\odot, \Omega_i$ are the solid angles subtended respectively by the Sun and the source; Q_a is the effective solid angle of antenna radiation pattern.

Moreover, with the narrowing of the diagram the absolute values of antenna temperatures increase, which also improves the observation conditions of feeble details.

However, it should be noted that the advantages resulting from the use of narrow radiation patterns are accompanied by more rigid requirements with regard t antenna tracking during observations and by the necessity of taking into account the influence of antenna pattern during the processing of eclipse registrations.

The characteristics of PT-22 radiotelescope utilized by us are well known [1]. The half-power values of antenna radiation pattern for the waves utilized are compiled in Table 1.

TABLE 1

λ, cм	$\Delta\varphi_{0,5}$, min,arc
0,8	2,3
1,6	3,5
3,3	6
10	20

TABLE 2

λ, cм	S_i, %
0,8	0,1
1,6	0,25
3,3	1
10	10

TABLE 3

λ, cм	$S_{\odot}\times10^{22}$ $w/m^2\cdot hz$	$S_i\times10^{22}$ $w/m^2\cdot hz$
0,8	2300	2,3
1,6	800	2
3,3	230	2,3
10	70	7,0

The radiation patterns in the 0.8, 3.3 and 10 cm were superimposed, and the pattern in the 1.6 cm wavelength was 4' distant by azimuth, so that the material obtained in this wavelength was poorer. Superheterodyne receivers were utilized in all wavelengths, with a sensitivity sufficient to render the noise track unnoticeable at obtained high antenna temperatures (the fluctuations on the registration were determined by tracking fluctuations).

At the point of observation the eclipse maximum was 0.7. Three sunspots groups were noted on the day of eclipse. One of them, the No.57, had coordinates 20°S and 7°E and consisted of 13 spots with total area of 102 ppm of the hemisphere (all data on coordinates and areas of sunspot groups are given for 0630 hours UT on 20 May). This group was most practical for observations. Group No.59 with coordinates 18°N and 51°W had an area of 594 ppm, but was only partially concealed. The third group No.60 with area of 601 ppm was located at the eastern limb (14°N and 74°E) near the point of IVth (the curves source's and solar limb's concealing were found to be superimposed).(Fig.1). Shown in this figure are the setup on the Sun, the Moon disk's center motion relative to that of the Sun and the positions of lunar limb at time of concealing or opening of sunspot groups.

Presented in this preliminary communication are the results obtained from rgistrations of source's covering and opening connected with the southern group No.57. An example of eclipse registration is shown in Fig.2. One-dimensional brightness distributions are obtained alongside with detail dimensions in the direction of motion of the lunar limb directly from the recordings. These data are shown in Fig.3.

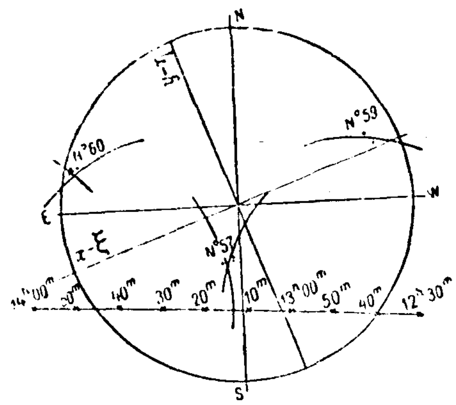

Fig.1. Setup on the Sun and motion of the Moon

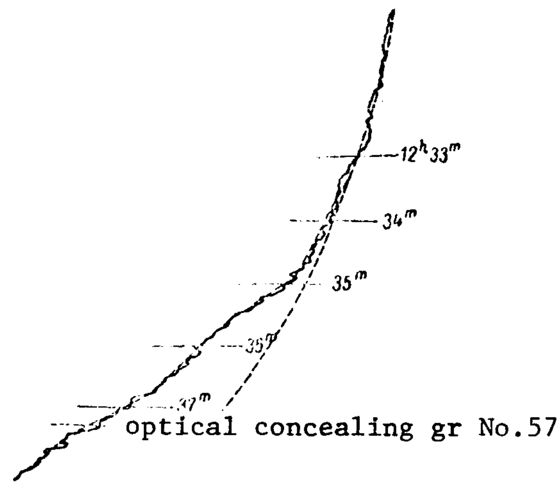

Fig.2. Curve of radiosource eclipse above the sunspot group (at 3.3 cm)

Examination of brightness distributions shows that the source clearly split into two basic parts corresponding to group No.57 configuration. The total source's dimension is however found to be somewhat greater than the sunspot group. The values of source's fluxes relative to the "quiet" Sun are compiled in Table 2 (preceding page).

Absolute source's fluxes (Table 3) can be obtained with reference to [2], by assuming the absolute fluxes of the Sun in the given wavelengths. Spectrum S_1 of Table 3 corresponds to the existing representations [3].

Estimates of the brightness temperature of details may be made by constructing a "two-dimensional" radioimage of the source corresponding to the obtained one-dimensional distribution in two directions. For such a constuction one must know more accurately the position of the lunar limb at the given moments of time and be better assured in the absence of variations in the source at time of observation.

In conclusion the authors express their deep gratitude to coworkers of the Oksk Radioastronomical Station of the Physicsl Institute and of the Institute of Radioengineering and Electronics of the USSR for their cooperation and help in the work,

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Follow Fig.3 and references ../..

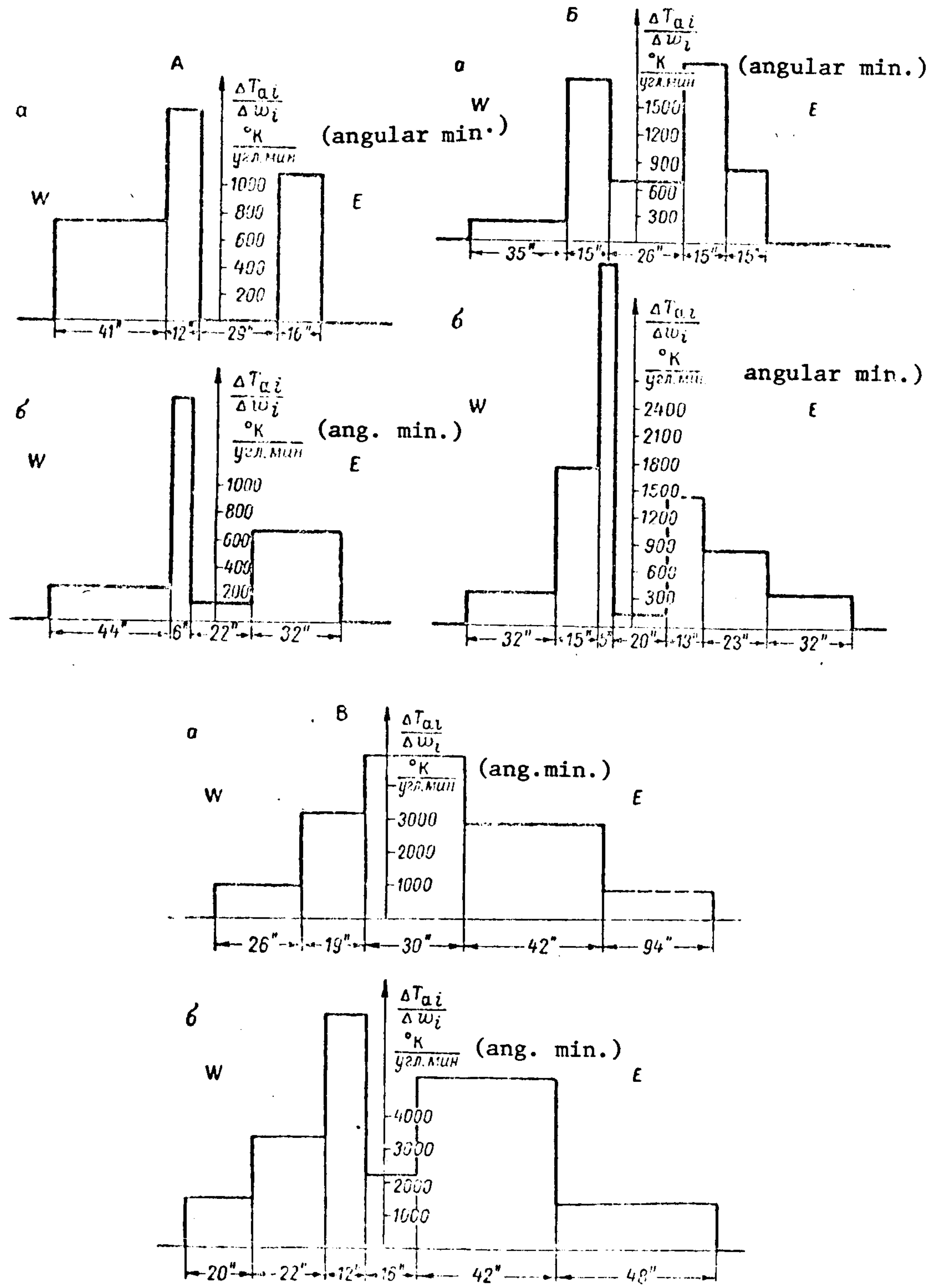

Fig.3. Simultaneous distributions of brightness during concealing (a) and opening (b) of the radiosource in wavelengths:

R E F E R E N C E S

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[2]. L. MOLWO, S. FÜRTENBERG, A. KRÜGER, A. MICHEL WALLIS. Int.Rep.IQSI Ass. Madrid, 1965.

[3]. V. V. ZHELEZNYAKOV. Radioizlucheniye Solntsa i planet (Sun's and Planets' Radioemission). M. GITTL, 1964.

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