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Abstract

Full Text

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Astronomy

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ESTIMATION OF THE STRUCTURE OF THE SOLAR CORONA FROM THE ROCKET EXPERIMENT OF 15 II 1961

(Presented by Academician V. V. Shuleikin, 22 IV 1969)

The development of satellite and rocket methods of observation poses new problems in the interpretation of the information obtained. One such problem is the representation of the brightness distribution in the outer solar corona, measured from rockets equipped with scanning instruments.

On 15 II 1961 a rocket experiment was carried out to investigate the brightness distribution in the outer solar corona in the visible region of the spectrum during a solar eclipse ([1]). The measurements were made with an electrophotometer with a rectangular slit installed on a geophysical rocket. In order to eliminate the influence of atmospheric scattering, the measurements were carried out at an altitude of 100 km above the Earth' s surface. The brightness was recorded on a telemetry tape in the form of successive points with a constant angular step of $8'$. During the time the photometer was in the region of totality, it was possible to obtain several thousand records of individual brightness values. Some of these observations are shown in Fig. 2 (curve 1).

Fig. 1. Angular distribution of the sensitivity of the DOIS-2 electrophotometer

In order to judge, from the experimentally found brightness $\tilde{I}(\theta)$, the real picture $I(\vartheta)$, it is necessary to "completely" eliminate the influence of the aperture or to take account of systematic instrumental distortions. In the present case the main distorting factor is the angular distribution of the photometer sensitivity $K(\theta - \vartheta)$, caused by the finite dimensions of the instrument aperture. For this electrophotometer it has the form shown in Fig. 1.

The relation between the experimentally found and the true brightness is established by the integral equation:

Fig. 2. Form of the smoothed and restored curves. 1 —result of observations; 2 —restored curve for experimental error $\delta = 9.5\%$

Figure 2: Fig. 2. Form of the smoothed and restored curves. 1 —result of observations; 2 —restored curve for experimental error $\delta = 9.5\%$

$$\tilde{I}(\theta) = \frac{1}{2\omega} \int_{\theta-\omega}^{\theta+\omega} K(\theta - \vartheta) I(\vartheta)\, d\vartheta, \tag{1}$$

where 2ω is the angle from which the receiver can receive light energy.

To obtain stable solutions of problem (1), the calculation was carried out according to the scheme ([2]). However, with the assumed measurement error ($\delta = 5\%$), at some points of the restored function we obtained negative ordinates, which is physically impossible. Calculations kindly carried out by staff members of the [[unclear: truncated institution name]] led to a similar result.

···by the Computing Center of Moscow University by P. N. Zaikin and V. Ya. Gaukin, who used A. N. Tikhonov' s regularizing algorithm [3] with an error of 5%.

In order to obtain admissible solutions by the method described in [2], problem (1) was solved for an increasing value of the experimental error (with step $h = 0.5\%$). It turned out that, beginning with the value $\delta = 9.5\%$, the restored function has not a single negative root. Hence it may be confidently assumed that the error of the initial data is not less than 9.5%.

Fig. 2. Form of the smoothed and restored curves. 1 —result of observations; 2 —restored curve for experimental error $\delta = 9.5\%$

The result of the restoration, showing the character of the change in brightness in the outer solar corona, is shown in Fig. 2 (curve 2).

The obtained picture makes it possible to draw certain conclusions about the structure of the outer corona, namely, that it does indeed consist of separate inhomogeneities. Judging by the distance between neighboring maxima or minima of the curve, for the restored section considered the inhomogeneities have angular dimensions from $24'$ to $70'$.

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Note: Figure translations are in progress. See original paper for figures.