ASTRONOMY

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Fig. 1

Figure 1: Fig. 1

Abstract

Full Text

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INVESTIGATION OF THE PROFILES OF THE CORONAL LINES 10747 AND 10798 Å

(Presented by Academician V. G. Fesenkov, 5 January 1957)

The present work represents a further development of the investigation of the intense coronal lines Fe XIII 10747 and 10798 Å, ionization potential 325 V, excitation potentials 1.15 and 2.30 V.

In February 1957 we assembled an attachment with an electron-optical converter (EOC) for the diffraction spectrograph of the coronal station of the Astrophysical Institute of the Academy of Sciences of the Kazakh SSR, designed by M. G. Karimov (Fig. 1). The spectrograph can be used in two variants: with a camera mirror of $f = 500$ mm and $f = 1000$ mm. Photography was carried out in the first order of a grating with 600 lines per 1 mm. The dispersion was then 40 Å/mm in the first case and 20 Å/mm in the second. Precise setting of the spectral region was made by the green part of the second order, so that both coronal lines were located symmetrically with respect to the center of the photocathode. A circular slit was used, placed concentrically to the edge of the solar disk at a distance of $60''$.

Fig. 1. 1 –slit; 2 –prism of total internal reflection; 4 –diffraction grating; 3, 5, 6 –mirrors; 7 –cassette

The film used was RF-3, which was calibrated with a step attenuator through the spectrograph and converter. The EOC was powered from a line-voltage source (1) and could be regulated within the range 15–30 kV. Photography of the spectrum from the EOC screen was carried out with two objectives, $1:1.2$ with $f = 50$ mm, while the second objective could be replaced by a $1:2$ objective with $f = 100$ mm; then the dispersion reached 10 Å/mm. With the indicated setup the exposure was 30 sec for a dispersion of 30 Å/mm and reached 10 min for a dispersion of 10 Å/mm. A gelatin filter, transmitting only [[unclear: continuation cut off on page]], was placed in front of the EOC photocathode.

Fig. 2

Fig. 2

Figure 2: Fig. 2

radiation with $\lambda > 7500$ Å; it cut off the superposed radiation with $\lambda \sim 5500$ Å of the second order.

The spectrograph with the attachment for the electro-optical converter proved convenient in operation, sufficiently compact and light.

The instrumental profile was obtained from the reduction of absorption lines for the center of the Sun, which was photographed with the same exposure, but with an attenuation by a factor of 10^4. In addition, neon lines near 9500 Å were photographed with the same apparatus and with the same slit width.

The subsequent reduction of the spectrograms was carried out in the usual manner, and the contour constructed for one day of observation, 11 II 1957, is presented in Fig. 2.

It should be noted that the results obtained by V. F. Esipov and I. A. Prokof'eva at Pulkovo ([2]) were not confirmed. Although the relative intensity of the lines 10747 and 10798 varies within wide limits ([3,4]), it nevertheless always remains greater than unity. For example, for the same day of observation, 11 II 1957, the ratio of the equivalent widths is $\omega_{10747}/\omega_{10798} = 1.55$. The half-widths of both lines obtained by Esipov and Prokof' eva, moreover, are "underestimated," which is apparently explained by the large amount of scattered light in the coronagraph and by insufficiently careful allowance for it.

The temperature calculated from the measured half-widths of the line is equal to $T = 1.9 \cdot 10^{6\,\circ}$. However, too much significance should not be attached to it, since our knowledge of turbulence in the corona is insufficient. To separate turbulent velocities from thermal ones, it is desirable to observe the profile of some line of another element, for example Ni XII λ4231 Å, Ni XIII λ5116 Å, or Ni XV 6702 Å, since all the bright emission lines in the corona, i.e., 5300, 6374, 10747, and 10798 Å, belong to one and the same element.

Determining the temperature from the relative intensities of the lines Fe XIV 5303 Å and Fe X 6374 Å, whose ionization potentials are very different, is unwarranted, and the temperature obtained may differ substantially from the real one, since the regions of luminescence of the 5303 and 6374 Å lines are, spatially, most likely different and lie only on the same line of sight.

Liu' s observations ([5]) indicate that macroturbulence in the corona is apparently small; however, during the maximum of solar activity the situation may change substantially. Contours of coronal lines with strongly broadened wings are observed ([6]).

In photographs obtained with the 5303 Å interference-polarization filter at the coronal station (Fig. 3), structural formations are clearly visible in the corona,

Fig. 3.

Figure 3: Fig. 3.

very similar to rapidly changing vortices and jets. It is desirable to obtain accurate data on velocities in the corona, which can be done, for example, with a Fabry–Perot etalon ([7]).

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Fig. 3.

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