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Investigation of wave characteristics by red coronal line observations

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Abstract. This paper presents the results of the active region observations in red coronal line ($\lambda = 6374$ Å). The analysis was made of the dependence of the profile parameters of the red coronal line on the exposition value.

Existence and properties of solar corona and solar wind are determined by sources of plasma heating and acceleration as well as by magnetic field structure Parker (1992). The heating source is usually considered to be the dissipation of coronal currents or the attenuation of magnetohydrodynamic waves of various types. Nowadays the corona and solar wind heating is suggested most likely to be a result of wave dissipation. However, wave types, their spectral distribution and mechanisms of absorption are still uncertain. Thus the determination of spectral characteristics of waves in solar corona on the basis of observed data is of considerable interest. The corona is optically thin for the most of observed lines. Therefore those elements of plasma volume in which the waves have different phases and directions of polarization contribute to formation of line profile. This fact significantly complicates the relation between the wave characteristics and profile parameters of observed line.

In this study the relation between parameters of optically thin coronal line and velocity oscillations of transverse MHD waves is analyzed. The dependence of the line parameters on the exposure is shown as well as the testing of this dependence is carried out on the basis of several sets of observations of red coronal line in the solar corona obtained at different exposures.

Emission intensity of element of plasma volume moving at the velocity v_l along line of sight is:

$$I(\lambda) = (n^2 F/\sqrt{2\pi}\sigma) \exp\{-[\lambda - \lambda_0(1 + v_l/c)]^2/(2\sigma^2)\}, \tag{0.1}$$

where λ is the wavelength, F is the amount of energy emitted by one atom per unit time, n is the concentration of atoms, c is the speed of light, and σ is the dispersion (half-width) of the line profile dependent on temperature ($\sigma^2 = \lambda^2 kT/c^2 m$).

The analysis made early in Molodykh (1995) of the relation of the parameters of profile of optically thin coronal lines with the characteristics of wave motions shows that firstly, the parameters of coronal line depend not only on the observation time but also on the exposure value, and secondly, there is possibility to investigate the oscillations within the large-scale regions of the solar corona using the observations made at different exposures. This method was proposed in Molodykh (1987), and the problem of relation between the parameters of coronal lines and the exposure was considered in Molodykh (1995) in a somewhat different definition. To test this method we obtained 10 sets, each of 30 observations at the exposures of 15 through 80 sec. The observations were made in

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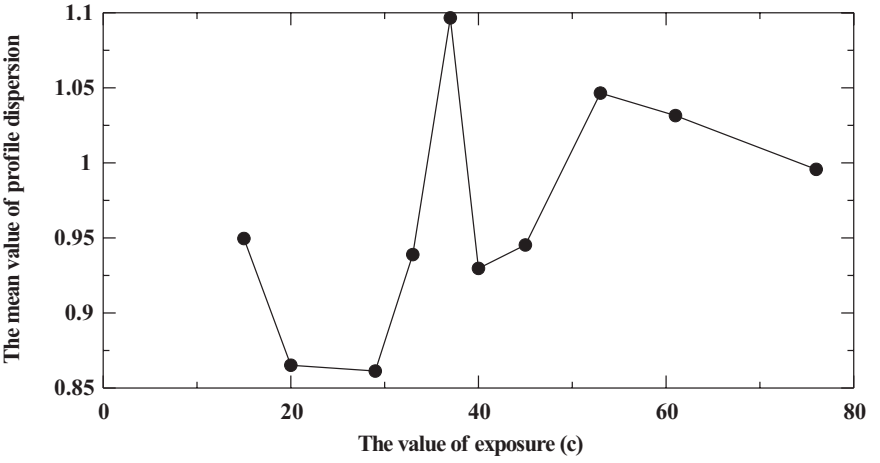

Figure 1. The dependence of the mean value of the profile dispersion of red coronal line $\lambda = 6374$ Å on the exposure value.

red coronal line $\lambda = 6374$ Å. The Figure 1 shows the dependence of the mean value of the red coronal line profile dispersion on the exposure value.

As is seen from the Figure 1 the mean value of the red coronal line profile dispersion, actually depends on the exposure value. This dependence is caused by the presence of waves in the observed region of solar corona. Besides, the mean value of the red coronal line profile dispersion is maximum at the exposure about 40 sec that suggests the existence of wave motions with this period.

There was also made the correloperiodogramanalysis of the obtained time dependences of the mean wavelength and the profile dispersion of the red coronal line. This method is confirmed to be efficient for studying the plasma wave motions in solar corona using the measurements with different expositions value.

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