ON THE FINE STRUCTURE OF POLARIZED ELEMENTS IN SOLAR FLARES AND MOUSTACHES

(Research Note)

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Abstract. Hα spectral observations of flares and moustaches using linear polarization analyser have been carried out. It is found that some flare knots and moustaches show strong polarization.

1. Introduction

In 1982–1983 we followed our earlier (Babin and Koval, 1983, 1985) study of linear polarization of the emission in active features on the Sun. The observational data were obtained at the Crimean Astrophysical observatory using the Large Coronagraph ($D/F = 51 \text{ cm}/20 \text{ m}$) and the Solar Tower telescope ($D/F = 45 \text{ cm}/21 \text{ m}$). The Hα-line spectra were taken in the third order of diffraction spectrographs (dispersion 1.7 mm Å⁻¹) using Kodak IIF plates (the exposure time for Coronagraph and Tower telescope is 0.06 s and 0.2 s, respectively) and isopanchrom film ‘type 17’ (exposure 1/60 s). As an analyser of linear polarization a birefringent prism was used being located on the exit of the spectrograph, or a set of two polarization prisms placed behind the entrance slit. Due to continuous patrol observations we succeeded to registrate the explosive phase of flare development. Observations of flares and moustaches were carried out in good seeing conditions, moreover, short exposures permitted to obtain high quality spectrograms with about 0′′6 spatial resolution.

2. Results

Visual analysis of spectrograms showed that the apperance of some emission knots taken in orthogonal polarizations remarkably differs: in some cases significant differences are evident mostly in their structure, and sometimes predominantly in brightness, thus suggesting substantial polarization of the knots. The examples of these spectrograms are reproduced in Figure 1. In order to study the differences in more detail and estimate the degree of polarization, the spectrograms were subjected to photometrical reduction.

The photometry across the direction of dispersion was made at the red and blue wings and the center of the Hα line for five spectrograms of flares and five spectrograms of moustaches observed near solar limb. To take into account the instrumental polarization the intensities have been normalized relative to undisturbed photosphere. Then the
degree of polarization of an emission detail is expressed as

\[ P = \frac{I_\parallel - I_\perp}{I_\parallel + I_\perp}, \]

where \( I_\parallel \) and \( I_\perp \) are the excess emissions in two orthogonal polarizations.

For the flare studied we obtained the following results:

1. Some flare knots appear as a single emission detail in the light of one polarization, but as a double feature in the opposite polarization. In the latter case the plane of electric vector vibration is approximately orthogonal to the disk center direction.

2. In some flare knots the degree of polarization \( P \) and azimuth of polarization plane change strongly when we pass from one point to another (for a distance of several arc seconds) of the same knot.

3. The degree of polarization of the emission details ranges from 3\% to 25\%.

Fig. 1. The different appearance of \( \text{H} \alpha \) emission in the orthogonally polarized light (upper and lower spectra in each pair). (a) The importance SB flare on 19 July, 1982, 11:36:06 UT; the flare emission is single in the lower spectrum and double in the upper. (b) A moustache located near the solar limb, 6 October, 1983, 07:17 UT; the moustache is single in the lower spectrum and an additional emission strip is distinctly seen in the red wing of the \( \text{H} \alpha \) line in the upper one.