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On the presence of linear polarization in the flare on 26 June, 1999

P. Kotrč[1], L. K. Kashapova[2] and J. A. Kupryakov[1,3]

[1]Astronomical Institute Ondřejov, Czech Republic, email: pkotrc@asu.cas.cz
[2]Institute of Solar-Terrestrial Physics RAS, Irkutsk, Russia
email: lkk@iszf.irk.ru
[3]GAISH MGU, Moscow, Russia, email: kupry@sai.msu.ru

Abstract. Solar flare on 26 June 1999 was accompanied by radio bursts giving an indirect evidence of accelerated superthermal particle beams. It is generally believed that this effect can stimulate an impact linear polarization in Balmer series spectral lines. The flare was observed simultaneously by the Ondřejov Multichannel Flare Spectrograph (MFS) and by the Large Solar Vacuum Telescope (LSVT) using the polarization optics in the Hα line. Spectropolarimetric data obtained by the two instruments are analyzed, however no substantial linear polarization was detected. Both spectral and auxiliary data, including radio and X-ray observations are analyzed to discuss possible reasons of the lack of linear polarization.

1. Introduction

One of the most fundamental but still open problems in solar physics is to find and understand why there is an impact polarization measured in some flares while any polarization is detected in the others. Analyzing contemporary observations from ground based (Ondřejov and Irkutsk) and space borne telescopes (TRACE and SOHO) we try to understand why no linear polarization was detected in the solar flare on 26 June 1999.

2. Observations

The flare of importance 1F/C7.0 occurred at NOAA 8598 located N25E00. The flare began at 06:50 UT, reached its maximum at 07:23 and ended at 08:19 UT. Analyzing Hα filtergrams, optical spectrograms from the Multichannel spectrograph, radioflux and radio spectra from the Ondřejov Observatory we could distinguish three phases in the flare. In each individual phase a new Hα emission region appeared (see figure 1). In addition, data from SOHO and TRACE were used to follow magnetic field of the region, structure and dynamics of the flare processes.

The radio flux as measured at 3000 MHz at the Ondřejov radio telescope displays two maxima corresponding to the second and the third flare kernels. Both from the radio flux and X-ray flux, we can see that the most energetic part of the flare was observed at about 7:18 UT. During the period between 07:16 UT to 07:23 UT radiospectrogram 1.0 to 2.0 GHz shows the peculiarities that can be considered as an evidence of a plasmoid moving from the lower layers of the corona to the more high ones. The second part of the flare was the most energetic one as could be seen e.g. from the GOES measurements. During the latest phase of the flare the radio and soft X-rays were observed and a measurement of the linear polarization at the Hα line was obtained by the Large Solar Vacuum telescope. The position of the slit is marked at the Figure 1.

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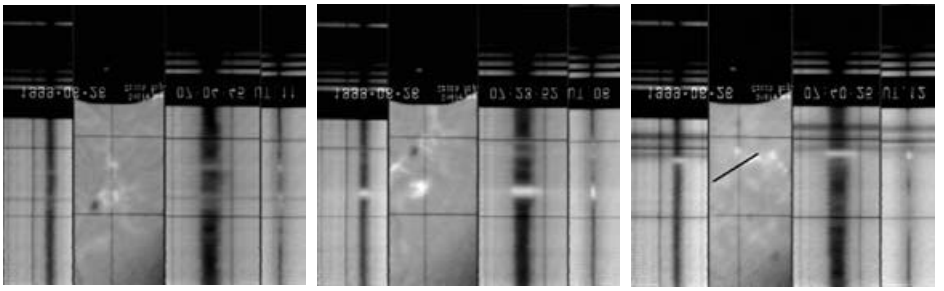

Figure 1. Composed spectrograms of Hβ, Hα, CaII 8542 Å lines and Hα slit-jaw filtergrams taken by MFS at 07:04:45, 07:23:25 and 07:40:25 UT are showing three phases of the flare (left to right). Position of the slit during the LSVT measurement of linear polarization as projected on the MFS slit-jaw picture of the flare (the inclined line crossing the emission kernel) is shown in the right hand-side image.

3. Discussion and conclusions

The observed flare occurred in the active region with a complicated magnetic field structure. The flare had three centers of emission that appeared successively in different parts of the active region. However, it is not excluded that the three flare phases had no common causality relation, or at least it was not so evident to reveal it in the analysis performed up to now. According to the available observation data the first phase of the flare was accompanied by rather weak energetic effects. From the radio spectrum 0.8-2.0 GHz we can conclude that energy transfer via particle beams probably occurred during the second phase of the flare. However, the microwave flux profiles measured during the second and the third phases of the flare can be treated as profiles belonging to thermal processes. No linear polarization has been detected during the measurements performed in the third phase of the flare. This can be in favor of the occurrence of a simple thermal mechanism of the energy transport during the flare. By the way, absence of the linear polarization coupled with the microwave flux profile form is evidence that measurements of linear polarization may quite really indicate possible mechanisms of the energy transport. We are also able to suppose that in spite of the drifts on radio spectrum 0.8-2.0 GHz the energy transport during the second phase of the flare was most likely a thermal one. In order to test this suggestion we plan to analyze the processed optical spectra of Hα and Hβ lines according to the results of Kašparová & Heinzel (2002) and to compare the obtained results of the analysis with the hard X-ray flux from GOES.

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