ISSN 1845–8319

MULTI-WAVELENGTH OBSERVATIONS OF MICROFLARES NEAR AN ACTIVE REGION

B. BEIN[1], A. VERONIG[1], J. RYBÁK[2], P. GÖMÖRY[1,2], S. BERKEBILE-STOISER[1] and P. SÜTTERLIN[3]

[1] *IGAM/Institute of Physics, University of Graz, A–8010 Graz, Austria*
[2] *Astronomical Institute, Slovak Academy of Sciences, SK–059 60 Tatranská Lomnica, Slovakia*
[3] *The Royal Swedish Academy of Sciences, SE–104 05 Stockholm, Sweden*

Abstract. We study the multi-wavelength characteristics of a microflaring active region (AR 10898) near disc centre. The analysed data were from the 4^{th} of July 2006, and were recorded by DOT (Hα, Ca II H), RHESSI (X-rays), TRACE (EUV) and SOHO/MDI (magnetograms). The identified microflare events were studied with respect to their magnetic field configuration and their multi-wavelength time evolution.

Key words: microflare - multi-wavelength observations - magnetic field

1. Introduction

Solar microflares release energies of 10^{27} to 10^{30} ergs (Aschwanden, 2004) and show properties similar to large flares, like Hα footpoints and coronal X-ray sources located above the magnetic neutral line connecting regions of opposite magnetic polarities (e.g. Kundu *et al.*, 2005; Liu *et al.*, 2004; Stoiser *et al.*, 2007). According to theoretical models, they could be one of the main mechanisms responsible for the coronal heating.

2. Data

The used data sets of the 4^{th} of July 2006 focused on AR 10898. The data were provided by DOT (Dutch Open Telescope), by RHESSI (Reuven Ramaty High Energy Solar Spectroscopic Imager), by TRACE (Transition Region and Coronal Explorer) and by SOHO (Solar and Heliospheric Observatory)/ MDI (Michelson Doppler Imager). The obtained DOT Hα and Ca II H data have a field of view (FOV) of about $80'' \times 70''$ and a cadence

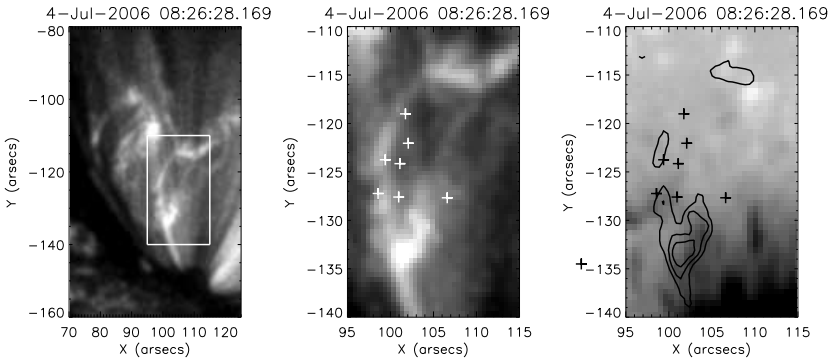

Figure 1: Left: TRACE 171 Å image showing microflare brightenings and a fine loop which brightened up in the impulsive phase of an X-ray event (peak: $\sim$ 08:26:30 UT). Middle: Zoom of the marked region in the first image. The crosses mark the centroid positions of RHESSI X-ray sources, which were observed between 06:30 UT and 09:00 UT. Right: High resolution MDI magnetogram taken at 07:45 UT with RHESSI centroids and TRACE loop contours (70, 80, 90 % of the image peak) overlaid.

between 23 s and 25 s. We used RHESSI X-ray data in the 3–9 keV energy range and SOHO/MDI high-resolution images with a FOV of about $600'' \times 300''$. The EUV 171 Å data from TRACE have a FOV of about $500'' \times 500''$ and a cadence of about 80 s.

3. Data Analysis and Results

For the whole day a RHESSI light curve was created in the energy range 3–9 keV. For all microflare events, identified by a peak in the light curve, RHESSI images were reconstructed, in the same energy range. The centroid position of these events were compared with TRACE and MDI data. In most cases these centroids, which mark the loop top source, are located in between regions of opposite magnetic polarities. Events occurring between 06:30 UT and 06:50 UT and between 08:25 UT and 08:45 UT accumulated in a small region around the sunspot. A number of 8 out of 19 identified RHESSI microflares occurred within a loop system, which was observed by TRACE (Figure 1). When comparing TRACE 171 Å data and the MDI magnetogram (Figure 1), we can see that a loop system is connecting two regions of opposite polarities. Figure 2 shows an image sequence (top row: Hα, bottom row: Ca II H) for the evolution of one microflare event observed

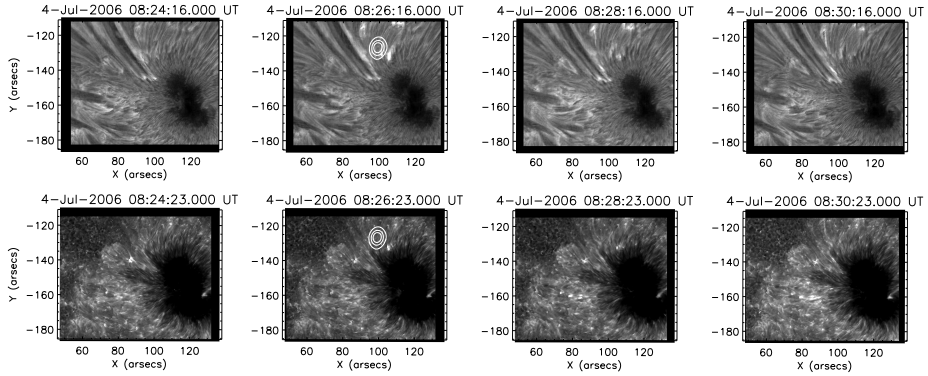

Figure 2: Image sequence of the evolution of the microflare event at about 08:26 UT observed in DOT Hα (upper row) and Ca II H (lower row). In each case the contours (30, 50, 70 % of the image maximum) of the corresponding RHESSI 3–9 keV image is plotted over the second image, taken at the flare maximum.

by DOT. In the second image, which shows the microflare maximum at about 08:26 UT, we plotted the contours of the corresponding RHESSI X-ray image. The RHESSI 3–9 keV source is located between two footpoints, observable in Hα as well as in Ca II H. Figure 3 shows the corresponding light curves of the microflare event observed in Hα, Ca II H and RHESSI 3–9 keV. Whereas for the RHESSI X-ray light curve the emission is integrated over the whole solar disc, we integrated the Hα and Ca II H light curves only over small regions around the southern microflare footpoint. In all three light curves a strong peak at about 08:26 UT can be noticed.

4. Conclusions

In accordance with former studies we found conjugate footpoint brightenings in Hα and Ca II H for 3 RHESSI microflares. One of the microflare footpoints is situated in the penumbra of a sunspot. We also observed an X-ray (> 10 MK) and EUV (≈ 1 MK) loop source situated in between the two footpoints connecting two regions of opposite magnetic polarities. Most of the studied microflares during our observation day accumulate in a small

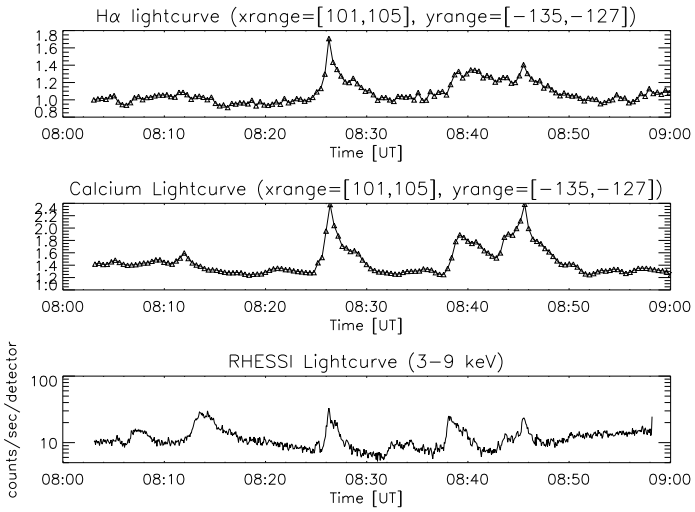

Figure 3: DOT Hα, Ca II H and RHESSI X-ray light curve. For creating the Hα and Ca light curves, we concentrated on the event at about 08:26 UT and integrated the light curve for a $4'' \times 7''$ large field around the southern footpoint lying in the penumbra.

region and are thus probably homologous.

5. Acknowledgements

The DOT is operated by the Utrecht University at the Observatory del Roque de los Muchachos of the Instituto de Astrofísica de Canarias. The authors thank the Slovak/Austrian Science and Technology Cooperation grant SK-AT-00706 and SK-AT-0004-08. The work of JR and PG was also supported by the Slovak grant agency grant APVV-0066-06.

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