# MAGNETIC PROPERTIES OF ULTRAVIOLET TRANSIENT PHENOMENA
## ARE BLINKERS AND EXPLOSIVE EVENTS THE SAME PHENOMENON?

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ABSTRACT

Simultaneous 'quiet' Sun observations were performed on 2001 October 23 with the SUMER and CDS spectrometers on-board SoHO together with the Big Bear Solar Observatory magnetograph. The aim was to study the magnetic properties and distinct nature of the transition region phenomena such as explosive events and blinkers. The different appearance of the two phenomena in both spectrometer observations was analysed. Blinker phenomena were clearly associated with bipolar magnetic regions with always one polarity stronger than the other one. Higher resolution observations are needed in order to associate explosive events with any particular magnetic field changes.

Key words: SoHO; SUMER; CDS; BBSO; blinkers; explosive events.

## 1. INTRODUCTION

A new phenomenon named as blinker was first introduced and analysed by Harrison (1997) using the Coronal Diagnostic Spectrometer (CDS) on-board SoHO. Blinkers represent an enhancement in the flux of transition region lines such as O III, O IV and O V. They were also studied in detail by Bewsher et al. (2002) who found that these events have a typical size of $\sim 8'' \times 8''$, a lifetime of $\sim$ 16 min, mean intensity enhancement of 1.8 and are preferentially located in the network lanes.

Another ultraviolet phenomenon of interest in the present study are explosive events, analysed in detail already for 2 decades using Naval Research Laboratory High Resolution Telescope and Spectrometer (HRTS) and Solar Ultraviolet Measurements of Emitted Radiation (SUMER) spectrometer observations. They are characterized by non-Gaussian profiles, have a lifetime of $\sim$ 200 s and size $\sim 4''$–$5''$, showing velocities up to $\sim$ 200 km s$^{-1}$.

Blinker phenomena were first identified in CDS observations, while the explosive events were only found in SUMER observations. Chae et al. (2000) have already identified blinker phenomena in SUMER observations, showing that the events consist of short-lived, small-scale brightenings which last about 2-3 minutes and have size of about $3''$–$5''$. Bewsher et al. (2002) showed that blinkers occur mostly above one dominant magnetic polarity. Explosive events, however, were found at the edges of unipolar magnetic field regions or in the magnetic network lanes characterized by weak mixed polarity magnetic field (Dere et al. 1991, Porter & Dere 1991).

## 2. OBSERVATIONAL MATERIAL

- SUMER – 2001 October 23, from 15:26 to 19:37 UT, N V 1238.82 Å, 20 s exposure time.
- CDS – 2001 October 23, from 15:22 to 19:32 UT Å, O V 629 Å, 15 s exposure time.
- BBSO longitudinal magnetograms – 2001 October 23, from 15:16 UT to 19:32 UT, 30 s exposure time.

## 3. RESULTS

Several blinkers and explosive events were registered and examples of two of each of them are shown in this paper. The two phenomena were identified in both spectrometers (SUMER (Fig. 2) and CDS (Fig. 1)). Despite the difficulties in deriving the absolute magnetic flux because of the pointing shift during the magnetic field BBSO measurements, the absolute magnetic flux during blinker phenomena was obtained. We were not able to associate the explosive events with any magnetic field changes, which is due to the insufficient resolution. Here are some of the main results:

- The SUMER data showed that blinkers consist of short-living (2-3 min), small-scale ($3''$–$5''$) brightenings as was already found by Chae et al. (2000). The intensity in these features increase by a factor 1.6–2.
- The derived absolute velocity (from -10 to 20 km s$^{-1}$) in the blinker phenomena using a few C I lines as a wavelength reference show a predominant redshift (Fig. 3). In one case in a short time interval a

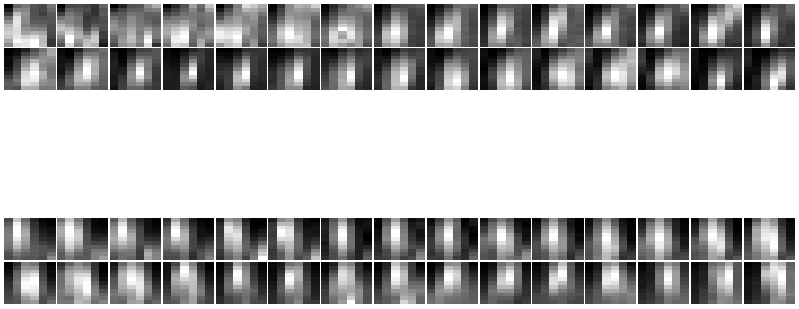

*Figure 1. Upper and bottom panels: Intensity images in O v 629 Å with field-of-view 24″ × 19″ showing from left to right the temporal evolution of the intensity changes in two blinkers.*

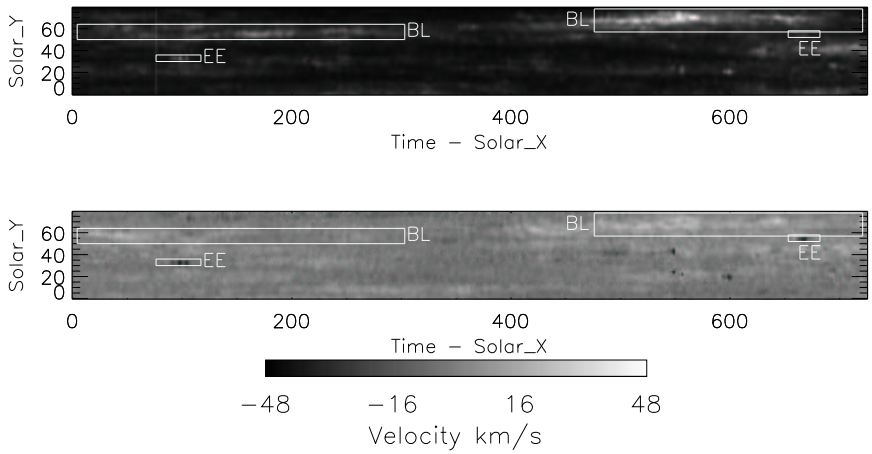


*Figure 2. Upper panel: Intensity image in N V 1238.82 Å. Bottom panel: Velocity image obtained by automatic single Gaussian fitting. The areas indicated with 'BL' represent the analysed blinker, and 'EE', the explosive event regions of appearance.*

switch from blueshift to redshift and back were also observed. One of the blinkers only shows a blueshift and its second appearance is accompanied by a redshift.

- Several explosive events were also registered and their counterpart in CDS data was found (Fig. 4). They appear as an intensity enhancement showing also a blueshift of the center of the line and in some cases a line width increase.

- The two transient phenomena appear to have an independent existence. They appear sometimes close to each other but it seems that no one can be accepted as a triggering feature for the appearance of the other one.

- The derived magnetic flux shows an impulsive increase during blinker phenomena with roughly the same duration as the intensity enhancements in SUMER observations (Fig. 3).

## 4. DISCUSSION

The observations presented in the present paper reveal details on the small-scale structure of blinker phenomena and their relation to the explosive event features. On the first place we clearly see the differences in the appearance of both phenomena, their Doppler velocities and location. Blinkers have velocities in the range from -10 to 25 km $s^{-1}$ with a predominant redshift. The physical characteristics of the small-scale brightenings forming a blinker raise the question whether these phenomena could be the disk counterpart of already well known feature - **solar solar spicules**. Wilhelm (2000) presented unique SUMER observations of solar spicules and macrospicules, one of them in the N v line. Some of these data, presented here in Fig. 5, clearly show the presence of spicules everywhere in the network, and the most important fact is that the spicules and macrospicules appear as a bright feature on the limb as well as on the disk. This observational fact was recently confirmed by Zachariadis et al. (2001) who, using Sacramento Peak H$\alpha$ observations, found that bright limb spicules have their origin in bright mottles

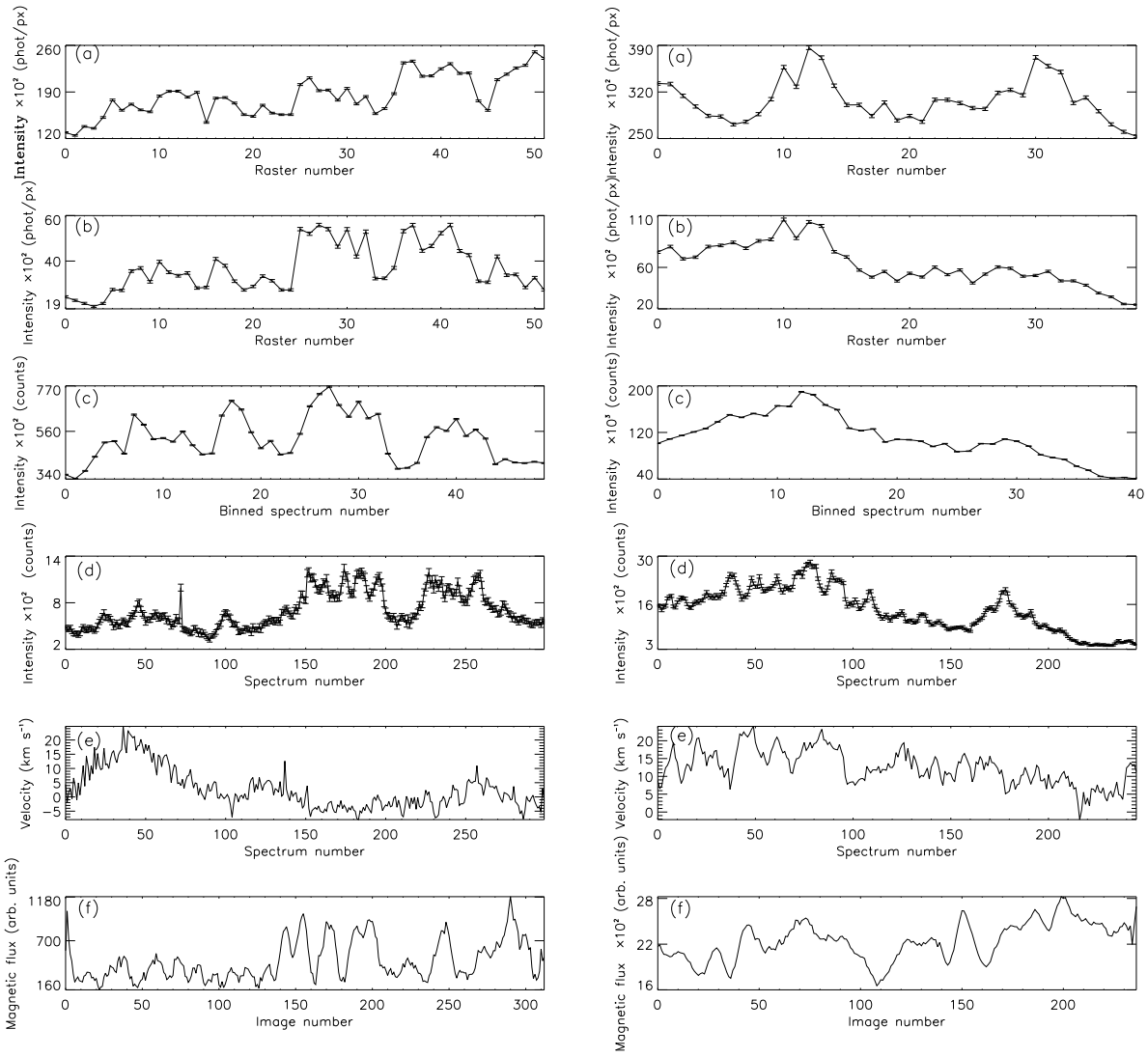


*Figure 3. Left and right panels: a) CDS O* V *intensity profile obtained integrating over the blinker area; b) CDS O* V *intensity profile in a single X pixel (in the SUMER position); c) SUMER N* V *intensity profile after binning over 6 spectra in order to obtain the CDS resolution. d) SUMER intensity profile in the same slit position; e) Velocity profile in the same slit position ; f) Integrated absolute magnetic flux in the blinker area. All profiles start and finish at the same time despite the different scales.*

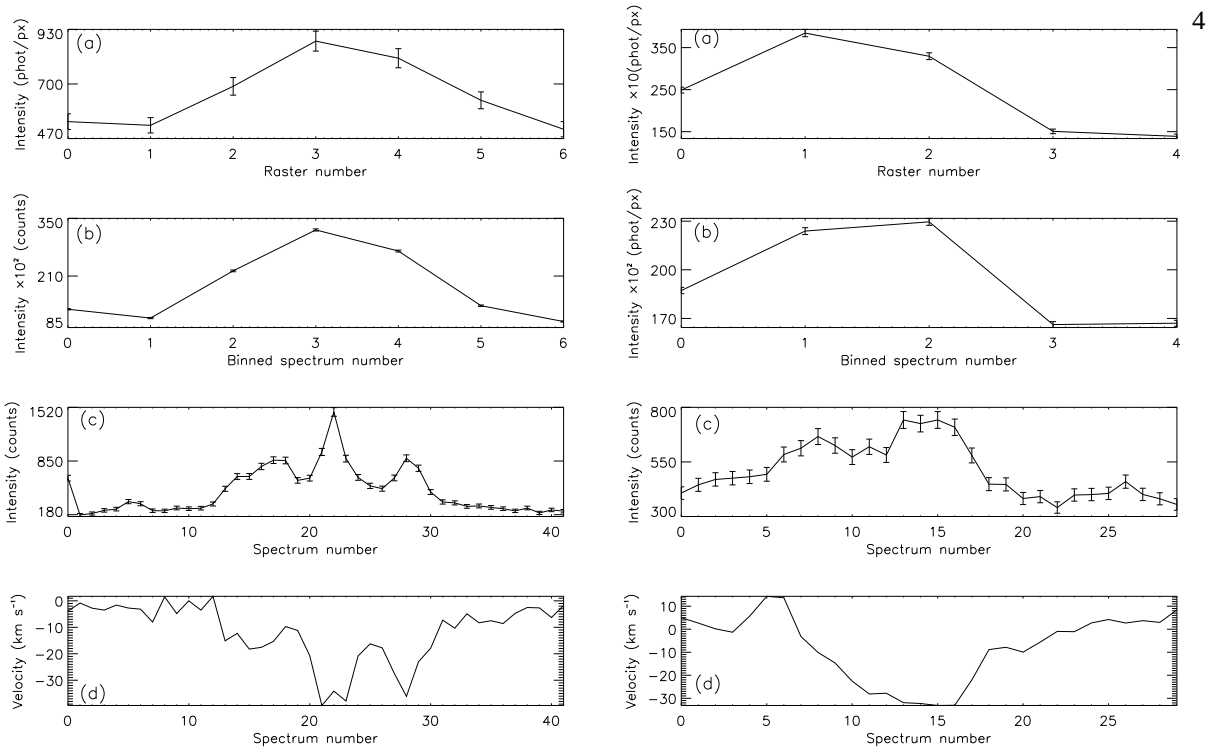


*Figure 4. Left and right panels: a) CDS O* V *intensity profile obtained by integrating over the explosive event area; b) SUMER N* V *intensity profile after binning over 6 spectra in order to obtain the CDS resolution. c) SUMER intensity profile in the explosive event without binning; d) Velocity profile in the same slit position.*

on the disk. The brightenings forming a blinker have the same size, duration and velocity as a spicule phenomenon according to the numerous works done on this feature. Therefore, we have to expect that these features should be seen in any SUMER disk observations in spectral lines covering the temperature range in which solar spicules could be registered.

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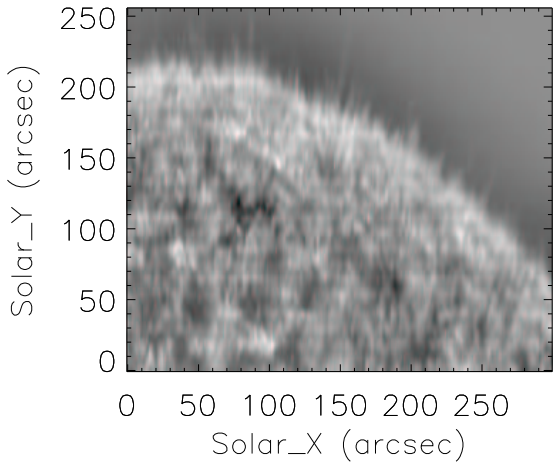


*Figure 5. Intensity image in N* V *1383.82 obtained on 31 August 1996. The scan covers a polar region showing the network and numerous spicules.*

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