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Transition region blinkers versus explosive events

A. Brković and H. Peter

Kiepenheuer-Institut für Sonnenphysik, D-79104 Freiburg, Germany, email: alen@kis.uni-freiburg.de

Abstract. Explosive events and blinkers are two observational classes of transients seen on the quiet Sun and an investigation of the significance of and relationship between such events may be critical for understanding basic processes at work in the solar atmosphere. Our analysis showed that blinkers and explosive events are independent phenomena which have to be explained separately.

1. Introduction

Explosive events are short, $1-2$ minutes, living transition region phenomena (Brueckner & Bartoe 1983 and Dere *et al.* 1984). Their line profiles are highly broadened and their blue and red components are shifted on average by some 100 km/s. Explosive events are *not necessarily* related to a strong brightening. Observational studies performed using the Solar Ultraviolet Measurements of Emitted Radiation (SUMER; Wilhelm *et al.* 1995) specrometer on SOHO clarified that explosive events are bi-directional jets following a reconnection event (Innes *et al.* 1997 and Innes & Tóth 1999).

EUV brightenings, so-called blinkers (Harrison 1997), are most pronounced in the transition region O III, O IV, O V and O VI lines. The main characteristic of these events is an intensity increase of typically $60-100\%$, and duration of 5 to 30 minutes. While explosive events are widely thought to be due to reconnection events, the cause for blinkers is yet to be determined. The relationship between explosive events and blinkers needs further investigation and this work contributes significantly to our understanding of these events.

2. Observations

We analysed five SUMER time-series spectra of the quiet Sun near the disc centre of transition region O V 629 Å, O VI 1032 Å and O VI 1038 Å lines. Instrumental corrections that we applied account for: flat-field, pin-cushion distortion of the image introduced by the detector, the inclination of the spectral lines with respect to the detector columns, dead time and gain depression of the detector. Once we performed these established SUMER procedures, in order to increase the signal-to-noise ratio of the spectra we applied running means in time with a box width corresponding to 150 s. The width of the box is chosen as a compromise between the goodness of the fit χ^2_r and the time resolution. Spectral line data were further fitted with either single or double Gauss fits. Least-squares fits were applied and a linear background was subtracted in the fits.

3. Results

To identify blinkers in O V and O VI we used the same automated routine as applied by (Brković *et al.* 2001). The identification of explosive events was performed by eye inspection of velocity-time plots of line profiles for each pixel. The cases with "strong" satellite components (velocity larger than 50 km s^{-1} towards the blue or red) we registered as explosive events. The identification methods detected 1086 blinkers and 778 explosive events in five data-sets. We investigated how often explosive events occurred during the course of a blinker at the same location. "Co-temporality" refers to the common time steps of co-spatial (recorded in the same pixel) blinkers and explosive events. The term "blinker with an explosive event" stands for co-spatial and "co-temporal" blinker.

We found that slightly more than a half of all explosive events occurred during about one third of all blinkers. This co-spatiality and co-temporality of blinkers and explosive events could easily lead us to think of a close relationship between blinkers and explosive events. However, analyses of blinker maximum intensity increases showed very different results for events with and without explosive events. The largest average maximum intensity increase was for blinkers with explosive events (210%), followed by the blinkers without explosive events (140%), with the least being for the explosive events which did not happen during the course of a blinker (60%).

4. Discussion

Since maximum intensity increases are significantly different for blinkers with and without explosive events we believe that they point to an independent nature of blinkers and explosive events. We speculate that although we detect a blinker and an explosive event at the same location and almost at the same time the two events are actually different processes, blinkers leaving a strong signal in the intensity and explosive events strong signal(s) in the line width and/or line of sight velocity. If both of these events by chance happen in a close time interval along the SUMER's line of sight their emissivities will be added. This "coincidence" can lead to the stronger observed intensity than in the case when only one of these events takes place. We can not rule out the possibility that both events are ultimately two different realizations of some single event-type which can lead to heating and flows. The observations showed that for some events we see flows and no heating and for others we see heating and no flows and finally there are some events in between, but for the single event-type scenario we still miss the evidence.

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