NEGATIVE FLARES ON THE SUN

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Introduction

In two former articles (Hénoux *et al.* 1990; Aboudarham *et al.* 1990) we published calculations to predict that an analog event of stellar negative preflares can also exist on the Sun. We showed that under certain conditions at the beginning of a solar white-light flare (WLF) event an electron beam can cause a transient darkening before the WLF emission starts. We named this event as "black light flare" (BLF) as a counterpoint of the subsequent WLF.

We pointed out that at the very beginning of the bombardment if the beam is intense and impulsive enough, it has two effects: (i) it enhances the hydrogen recombination emission in the upper atmosphere (ii) it increases the H^- population in the lower atmosphere. The increase of H^- causes an enhanced absorption which results in a transient decrease of the white-light emission (negative flare or BLF). The event lasts ($\approx$20 sec) until the heating of the atmosphere turns the absorption into emission and the WLF starts.

Here we propose optimal conditions for possible observation of solar negative flares and present an observation, which may be the first identified observation of such events.

Conditions for BLF observations

The most common location of WLFs is in the penumbrae of big δ-spots, frequently near umbral/penumbral boundaries. To find BLFs we have to look for dark spots in the penumbrae, or transient enhancements of umbral areas in the vicinity of the flare centre. We expect that BLFs will appear as diffuse dark patches for about 20 seconds preceding WLFs with intense and impulsive hard X-ray bursts, at the same place as the forthcoming bright patches. Their contrast depends on the position of the flare on the solar disc and on the wavelength band of the observation (Hénoux *et al*, 1990; Aboudarham *et al*, 1990). The ideal diagnostic would be to observe at several different wavelengths in the same time between 365-570 nm and above 820 nm with a sampling time not longer than 10 seconds.

Observation of a BLF

The WLF event of 26 July 1981 (2B, X3.5) occurred in Hale region 17760 in a big δ-spot, where opposite polarity umbrae of different ages, embedded in a common penumbra, compressed and sheared the magnetic fields (Gesztelyi *et al.* 1986).

At Debrecen Heliophysical Observatory two full-disc white-light photoheliograms were taken before the WLF maximum, (Fig. 1) at the beginning of and during the impulsive phase of the hard X-ray burst (Gesztelyi *et al.* 1986) The second photoheliogram (taken at 13:51:03 UT, see Fig. 1) shows already a weak WL emission at the border of the umbral-penumbral border of the big (S polarity) umbra *a*, and an even weaker emission at the edge of opposite (N) polarity umbra *b*: this was the beginning stage of the WLF. The first photoheliogram, which was taken unfortunately under worse seeing conditions at 13:49:31 UT (Fig. 1), shows no sign of WLF yet, but on the contrary: umbrae *a* and *b* seem to be elongated towards the places of the forthcoming

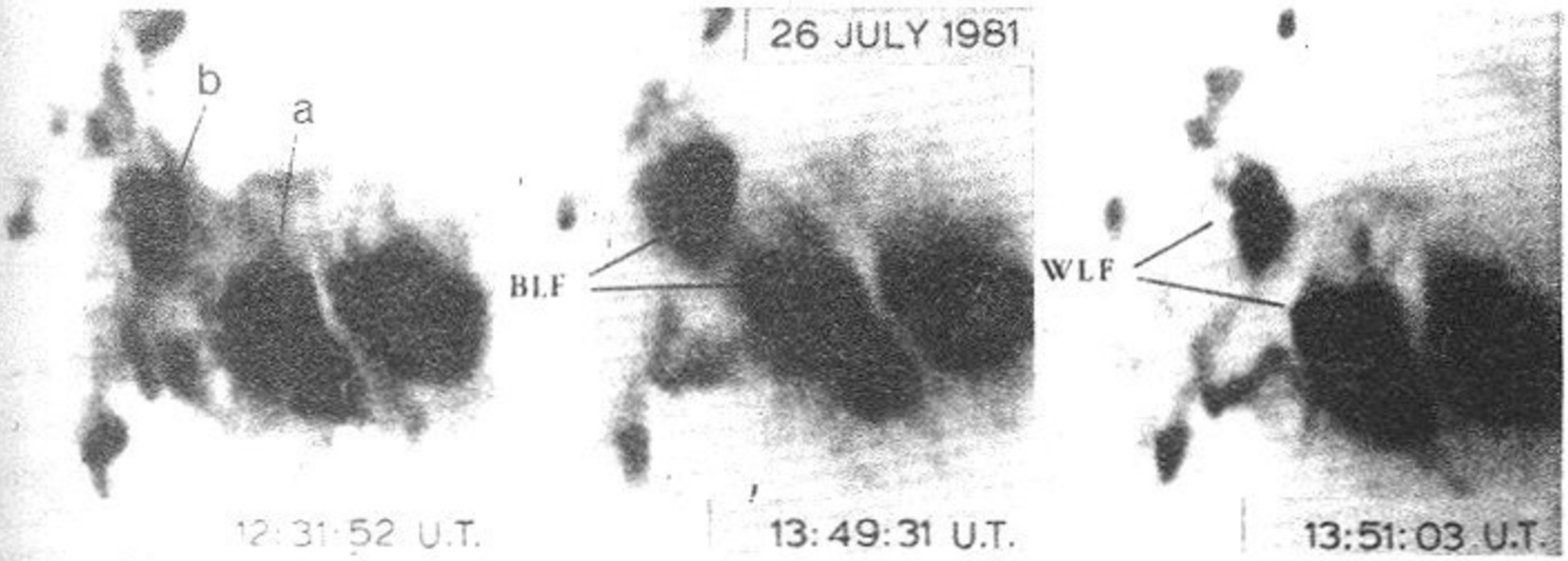

Figure 1: Photographs of the δ spot in Hale region 17760 taken respectively 80 and 1.5 minutes before, and at the start of, the WLF on 26 July 1981. Umbrae *a* and *b* had opposite polarities and at these two umbrae the WLF patches appeared. At 13:49:31 UT, at the beginning of the hard X-ray burst (Gesztelyi *et al.* 1986), 1.5 minutes before the WLF observation dark patches can be seen where the WLF patches appeared later - these may be an example of a BLF.

WLF patches. If we compare their form and area with an observation taken 80 minutes earlier at 12:31:52 UT (Fig. 1), we find that spots *a* and *b* were definitely bigger at 13:49:31 UT than they were 80 minutes before or 1.5 minutes later. Umbrae can not change their area so much so quickly, therefore this can be only an arbitrary area growth, an effect of earth atmospheric seeing or an effect of the solar atmosphere. Our argument in favour of the solar effect is that although the bad seeing changed the shape of umbrae the probability is low that it created elongations (darkenings) by chance precisely at the places of both future WLF patches. We suspect therefore that these darkenings are patches of a genuine BLF, but even if it is not so, it certainly illustrates the kind of manifestation which can be expected.

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References

Aboudarham, J. and Hénoux, J.C., Brown, J.C., van den Oord, G.H.J., van Driel-Gesztelyi, L., and Gerlei, O.: 1990, *Solar Phys.* in press

Gesztelyi, L., Karlicky, M., Fárník, F., Gerlei, O., and Valniček, B.: 1986, in D.F. Neidig (ed.) *The Lower Atmosphere of Solar Flares*, NSO/Sacremento Peak (Sunspot, NM), p. 163.

Hénoux, J.C., Aboudarham, J., Brown, J.C., van den Oord, G.H.J., van Driel-Gesztelyi, L., and Gerlei, O.: 1990, *Astron. Astrophys.*, in press