N89-15866

ARCHES SHOWING UV FLARING ACTIVITY

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Abstract

The UVSP data obtained in the previous maximum activity cycle show the frequent appearance of flaring events in the UV. In many cases these flaring events are characterized by at least two footpoints which show compact impulsive non-simultaneous brightenings and a fainter but clearly observed arch develops between the footpoints. These arches and footpoints are observed in lines corresponding to different temperatures, as Lyman alpha, N V and C IV, and when observed above the limb display large Doppler shifts at some stages. The size of the arches can be larger than 20 arc sec.

Summary

The flaring arches are a rather important constituant of the evolution of active regions in the times between the large flares; also according to Svestka (1988) they constitute a component of the large flares. Their role in the overall energy balance of the active regions is not easy to assess since there is not yet statistics on these events and their distribution and there is no accurate estimate of the released energy in such events.

Since in many aspects the network elements are similar to small active regions, one can expect that these phenomena can also contribute to the energy release in the quiet sun network.

The flaring arches cover a large dynamic range, from rather small events which can be called microflares which are well observed in the transition region lines but at present with no detected counterparts in X-rays and H alpha, up to more energetic events sometimes called compact subflares which display clear X-ray and H alpha signatures.

We belive the less energetic of these events are basically identical to the microflares observed by Porter et al. (1984), and the most energetic are those related with compact flares and can be easily identified in the HXIS X-ray data, like for instance the flaring arches studied by Martin and Svestka (1988).

Some of these UV brightenings are studied by Fontenla et al. (1988) who propose a model of the time development of the brightenings and small UV surges associated with them. The model consists in the sudden release of thermal energy at chromospheric layers where the thermal conduction is not efficiently transmiting the heat to the regions above, nor is able to emit it efficiently in optically thick lines. The resulting overpressure will then accelerate the cold material above along the magnetic field lines and gradually heat it up. This model fits well with the general behavior of the flaring arches we are reporting here, although at that time the X-ray data was unknown to the authors.

The flaring arches are characterized by impulsive brightening of a small area (or primary footpoint) in all transition region lines and (in the cases where we found observations) also in X-rays. Then with extremely short delay, one or more secondary footpoints also display impulsive brightenings. Later, a bridge of fainter emission develops between the footpoints and frequently remains slowly fading after the brightenings of the footpoints dissapear. It is also common to observe more than one simple spike in the primary footpoint (probably in a slightly different unresolved location) and several spikes at different places along the arch. The phenomenon clearly often shows that the arch consists in several magnetic loops with very close primary footpoints but scattered secondary footpoints, and that there is more than one energy release.

There seem to be a continuous range between the small and the large events. However, in the more energetic events, the footpoints in the UV lines are rather intense; in the brighter events the footpoints were so bright that the UVSP instrument shut off at the times the raster reached the primary footpoint. The bridging material does not show such a large increase of intensity in the transition region lines and may even display a decrease in intensity for the more energetic events. In any case, we observe that the contrast in the transition region temperature material between the footpoints and the bridging material increases dramatically with the intensity of the event.

We have observed flaring arches in lines from Lyman alpha up to Fe XXI, which shows the extreme range in temperature of events of this nature, a span from about 10^4 to at least 10^7 K. It is not clear whether the more energetic events reach higher temperatures or just the emitting volume is not large enough so their high temperature emission can be easily observed. Preliminary comparaison with X-ray shows that at least in the more energetic events, there is a clear correspondance between the transition region lines brightenings and HXIS localized flaring (courtesy of Z. Svestka).

It is of particular importance to observe in several transition region lines with good spatial and temporal resolution, with coordinatedly imaging X-rays to asses the time evolution of the material there. Such observations promise important findings in the process of magnetical energy release which seem to occur in the flaring arches. Particularly the transition region temperature material is able to produce substantial emission that can be detected easier than H alpha emission. The timing between the colder and hotter emissions would indicate wether the material which is being injected into the arch from the primary footpoint is initially hot and cools down (chromospheric evaporation) or is initially cold and heats up as proposed by Fontenla et al. (1988). The Doppler velocities of the material should also be observed; their relation to the heating or cooling of the material will clarify if the apparent motion constitutes a real mass motion or the progress of a condensation front.

We consider it of great importance to study in Max91 not only the large flares, but also the smaller ones which are more simple in their structure and are more suitable for theoretical modeling and diagnostics.