J. Astrophys. Astr. (2000) **21**, 263–264

Emergence of Twisted Magnetic Flux Related Sigmoidal Brightening

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Key words. Sun: Sigmoid—filament—sunspots.

Extended abstract

We have examined the morphological properties of a sigmoid associated with an SXR (soft X-ray) flare. The sigmoid is cospatial with the EUV (extreme ultra violet) images and in the optical part lies along an S-shaped H_α filament. The photoheliogram shows flux emergence within an existing δ type sunspot which has caused the rotation of the umbrae giving rise to the sigmoidal brightening.

It is now widely accepted that flares derive their energy from the magnetic fields of the active regions and coronal levels are considered to be the flare sites. But still a satisfactory understanding of the flare processes has not been achieved because of the difficulties encountered to predict and estimate the probability of flare eruptions. The convection flows and vortices below the photosphere transport and concentrate magnetic field, which subsequently appear as active regions in the photosphere (Rust & Kumar 1994 and the references therein). Successive emergence of magnetic flux, twist the field, creating flare productive magnetic shear and has been studied by many authors (Sundara Raman *et al.* 1998 and the references therein). Hence, it is considered that the flare is powered by the energy stored in the twisted magnetic flux tubes (Kurokawa 1996 and the references therein). Rust & Kumar (1996) named the S-shaped bright coronal loops that appear in soft X-rays as 'Sigmoids' and concluded that this S-shaped distortion is due to the twist developed in the magnetic field lines. These transient sigmoidal features tell a great deal about unstable coronal magnetic fields, as these regions are more likely to be eruptive (Canfield *et al.* 1999). As the magnetic fields of the active regions are deep rooted in the Sun, the twist developed in the subphotospheric flux tube penetrates the photosphere and extends in to the corona. Thus, it is essentially favourable for the subphotospheric twist to unwind the twist and transmit it through the photosphere to the corona. Therefore, it becomes essential to make complete observational descriptions of a flare from the magnetic field changes that are taking place in different atmospheric levels of the Sun, to pin down the energy storage and conversion process that trigger the flare phenomena.

In this work, we have attempted to correlate the soft X-ray and EUV brightening appeared in the active region NOAA 8688 of YOHKOH and SOHO pictures on 17th August 1999, with the corresponding features in $H\alpha$ and white light photoheliograms observed at Kodaikanal. A bipolar δ type sunspot group appeared in the eastern limb on its second rotation on 14th August 1999. On 17th and 18th August, the spot had grown to its large size with a common penumbra. As a result of the successive emerging flux, the change in the orientation of the umbrae is well observed in the photoheliogram from 16th to 18th August 1999. The rotation of the umbrae within the δ type spot is calculated with respect to the rotation axis of the Sun (see Sundara Raman *et al.* 1998). The umbral structures are visible from 16th August 1999 and an umbral rotation of 16° is observed between 16th and 17th August, whereas, on the next day the rotation is only 4°. An overlying filament observed in the H_α spectroheliogram had grown in size from 16th to 17th August and appears as twisted S-shaped filament on 18th August. A coronal loop brightening is observed in a sigmoidal structure at 12.57.55 hrs UT on 17th August 1999. The observations show the occurrence of the brightening closely associated with the rotation of the umbrae, along with a corresponding development in the filament size and shape.

It can be concluded that the photospheric twist is transmitted to the filament as it is connected to the photosphere by its foot points. As a result, the geometry and structure of the filament becomes highly sheared and the overlying coronal magnetic field is observed as a sudden brightening in the sheared loop that appears in arcades spanning the S-shaped filament.

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