ON THE EVALUATION OF MAGNETIC SHEAR FROM H-ALPHA PICTURES

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ABSTRACT. The recently reported pre-flare activity in H-alpha filaments (Sivaraman, K. R., Rausaria, R. R., and Aleem, S. M.: 1992, *Solar Phys.* **138**, 353) is shown to be unrelated to changes in magnetic shear. An alternative interpretation for these observations is suggested.

1. INTRODUCTION

Recently, Sivaraman, Rausaria, and Aleem (1992) have reported very interesting pre-flare changes occurring in the H-alpha filaments. They interpret these changes in terms of changes in the magnetic shear of the associated magnetic field. In what follows, I suggest a more plausible interpretation of their results.

2. DEFINITIONS

The 'shear angle' is defined by the above authors to be the angle γ between the normal to the line joining the main sunspots and the neutral line (i.e. the H-alpha filament). Presumably the authors were trying to follow the methodology of Tanaka and Nakagawa (1973), who defined γ as the angle between the normal to the line joining the sunspots and the direction of the penumbral filaments. Now, the line joining the sunspots will approximate the direction of the transverse component of the potential field calculated from the distribution of the line-of-sight component of the magnetic field. Similarly, the direction of the penumbral filaments will represent the direction of the transverse component of the observed field. In this sense, the definition of Tanaka and Nakagawa (1973) is physically related to the magnetic shear angle, defined by Hagyard et al. (1984) to be the angle between the observed azimuth of the vector field and the potential field azimuth. The only difference would be that Tanaka and Nakagawa would measure large values of γ corresponding to small values for the magnetic shear angle of Hagyard et al. (1984). Tanaka and Nakagawa, in fact, comment that $\pi/2-\gamma$ represents the degree of shearing in the transverse magnetic field.

3. INTERPRETATIONS

The potential field azimuth is a local indicator of the distribution of magnetic flux. It is generally believed that the normal to the potential field must be tangent to the polarity inversion line. This need not be always true and cannot be expected from theory as well, but

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was indeed verified to be true within 18 degrees in 4 magnetograms of AR 4474 (Venkatakrishnan, Narayanan, and Prasad, 1992). However, the point is that one generally expects the angle γ as measured by Sivaraman, Rausaria, and Aleem (1992), to be small. This is so whenever the line joining the main sunspots is a good approximation to the potential field azimuth. Changes in this angle γ then represent the changes in the deployment of the magnetic flux relative to the main sunspots. These cannot be interpreted to explicitly represent the changes in dynamical quantities like magnetic stresses. One must include some estimate of the transverse magnetic field to be able to measure magnetic shear. The use of penumbral filaments as an appromixation to the transverse field, in the definition of Tanaka and Nakagawa (1973), is a good example.

4. DISCUSSION AND CONCLUSIONS

The results of Sivaraman, Rausaria, and Aleem (1992) indicate that significant changes in the value of γ herald the onset of flares with a lead time of a day or so. Going by the arguments presented in the previous section, changes in γ imply redeployment of the sources of magnetic flux relative to the main sunspots or the emergence of new flux. As mentioned earlier, it would be very difficult to link these changes with possible changes in magnetic shear without involving any measure of the transverse magnetic field. For example, had the authors used the direction of the H-alpha fibrils constituting the filament (rather than the mean direction of the filament itself), one could have had a better handle on the magnetic stresses. The only information available on the stresses is the fact that the filament persisted even after the flare events. This could mean either that the filament under investigation was not fully disrupted by the flare, or that the conditions for filament formation persisted after the flare. This would in itself imply the persistence of large photospheric magnetic shear if we accept Martin's (1990) conditions for filament formation. Thus there seems to be no doubt that non potential magnetic fields are necessary for flares.

The Skylab era favoured the scenario of a flare trigger in the form of emerging flux, while the SMM era showed very little evidence for the same. On the other hand, vector magnetograms of pre-flare active region fields indicated that magnetic shear could be one parameter that had to cross a threshold value to produce flares. As pointed out in Venkatakrishnan (1990), all instability induced flare scenarios require flare triggers, while the non-equilibrium induced flare scenarios require thrsehold parameter. Since the issue is not yet settled between the two kinds of scenarios, it is essential to interpret flare related data with great care. This letter is thus an attempt to put the reported observations of Sivaraman, Rausaria, and Aleem (1992) - which undoubtedly add to the information on pre-flare filament activity - in proper perspective.

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