THE HORIZONTAL COMPONENT OF SPICULE MOTION

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Abstract. In movies of Hα spectra taken with the slit tangential to the solar limb we can observe motion of spicules both parallel to the slit and along the line of sight. We find strong evidence that, although most motion is along the axis of the spicule, some features move at right angles to their axes. Several cases were observed of features separating into two widely-split components. A power spectrum of the changes of Doppler shifts with time shows the 1/frequency characteristics of random motion.

1. Introduction

Movies of the sun taken through Hα filters show that the chief motion of spicules is along their long axis, but movements perpendicular to this axis seem to exist in some cases. Seeing difficulties make it impossible to draw firm conclusions. But the horizontal component (parallel to the solar surface) of these motions can be measured in spectra taken with the spectrograph slit tangential to the solar limb. Beckers (1968) reviews reports of variations and changes in sign of Doppler shifts in such spectra.

D. Lambert and H. Zirin used the Mount Wilson 150-foot solar tower telescope and spectrograph to take movies of the Hα line. These were taken on 35 mm film with time lapse rates of 5 to 15 seconds during the period 10 September-13 October 1967. The slit (width 150μ or ½ arc-sec) was tangential to the solar limb near the equator and far from active regions. An automatic guider was used, but was sensitive to the blue-light solar image, which is displaced by a varying amount from the red-light image by atmospheric refraction; hence corrections had to be added by hand. The visual appearance of the Hα line profile was used as a guide, since this is a sensitive indicator of height in the chromosphere. We have selected for study movies in which the line is slightly flat-topped, which is typical of the region 5000–6000 km above the limb (Pasachoff, 1968). Figure 1 shows an example of our photographs.

In many cases we can see motion of emission features parallel to the slit, that is, 'horizontal' movements at right angles to the line-of-sight movements which cause motion. Motion parallel to the slit has previously been noted by Pasachoff et al. (1968) and Nikolskii (1970).

2. Horizontal Motion in Two Dimensions

The most typical motion is a simple change in Doppler shift without change of sign, indicating acceleration along the line-of-sight. But a minority of features (at least 5%) show unmistakable undirectional motion parallel to the slit.

The Doppler changes in most cases must represent motions of gas along the spicule
Fig. 1. Hydrogen-α emission observed with a slit tangential to the solar limb (negative print; wavelength increases from bottom to top). The upper picture was taken at 15h 48m 07s UT, October 13, 1967; the separation of A and B is 3.5 arc-sec. In the lower picture, taken 2m 02s later, we see that the spicular feature A has moved leftward with respect to the feature B at 5–6 km sec⁻¹. Also, on the original negative it is clear that A, which appears here as a slanted line, consists of two quite distinct components.

axis, but it is difficult to explain the movements along the slit in these terms. We might be seeing exceptionally bright blobs of gas, with sizes no larger than the spicule width, moving up or down spicules which are inclined at great angles to our slit; however, this is unlikely, since Hα photographs of spicules shows no indication of such blobs. Another possible explanation is that we are seeing a geometrical effect caused by fluctuation of the slit position relative to inclined spicules. But in this case we would