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ON THE EXISTENCE OF OSCILLATIONS IN SOLAR FILAMENTS OBSERVED IN H_α AND C IV LINES

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ABSTRACT

Time sequence observations of filaments in both the H_α line and the 1548 A C IV line were analyzed with the Fourier transform technique in the frequency range (1 - 10 mHz). No oscillation is detected in filaments except at the footpoints where a steady velocity gradient is large. The energy is probably due to convective motions rather than pressure oscillations.

INTRODUCTION

Studies on the heating mechanisms of the solar corona have pointed out the importance of the inhomogeneities in the atmosphere. The observations of filaments which are structures located inside the corona and connected with the photosphere can make understandable the transport of energy through magnetic structures.

Time sequences of filament observations were made simultaneously in the H_α line and in the C IV line in 1980 using respectively the Multichannel Subtractive Double Pass spectrograph (MSDP) operating on the Meudon Solar Tower and the Ultra - Violet Spectrometer and Polarimeter (UVSP) on board the SMM satellite. Table 1 gives the characteristics of the observations.

Table 1 Filament observations

instrument	MSDP (Meudon)	UVSP (SMM)
line	H_α	C IV
wavelength	6563 A	1548 A
number of sequences	3	5
time duration	15 - 25 min	25 - 35 min
time step	60 sec	30 sec
spatial resolution	1"	3"
field of view	1' x 3'	1' x 1'

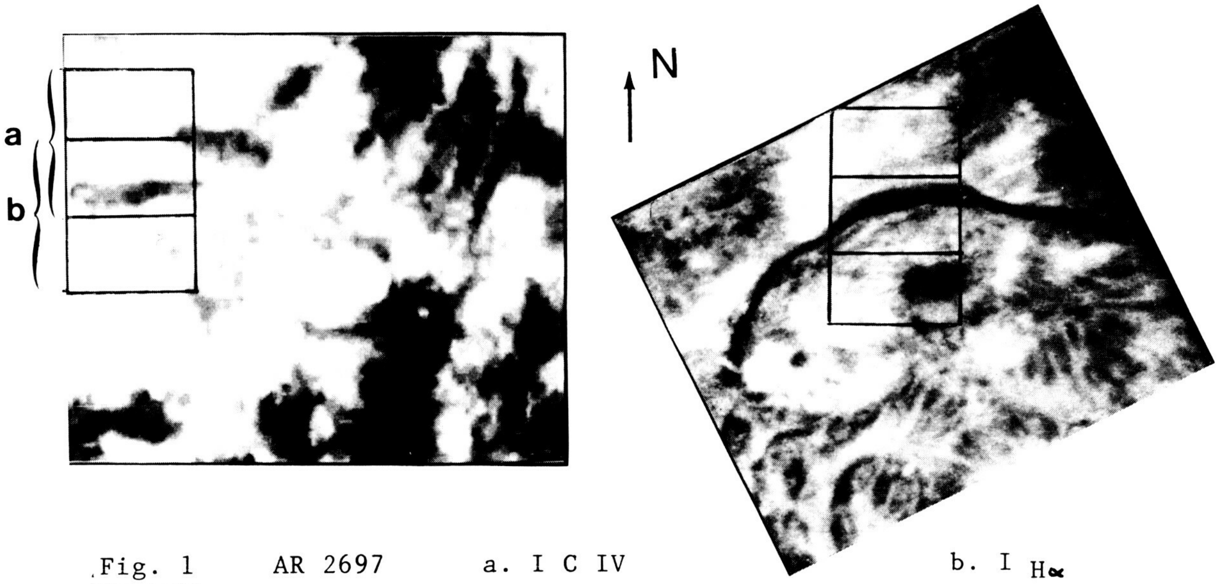

Fig. 1 AR 2697 a. I C IV b. I $H\alpha$

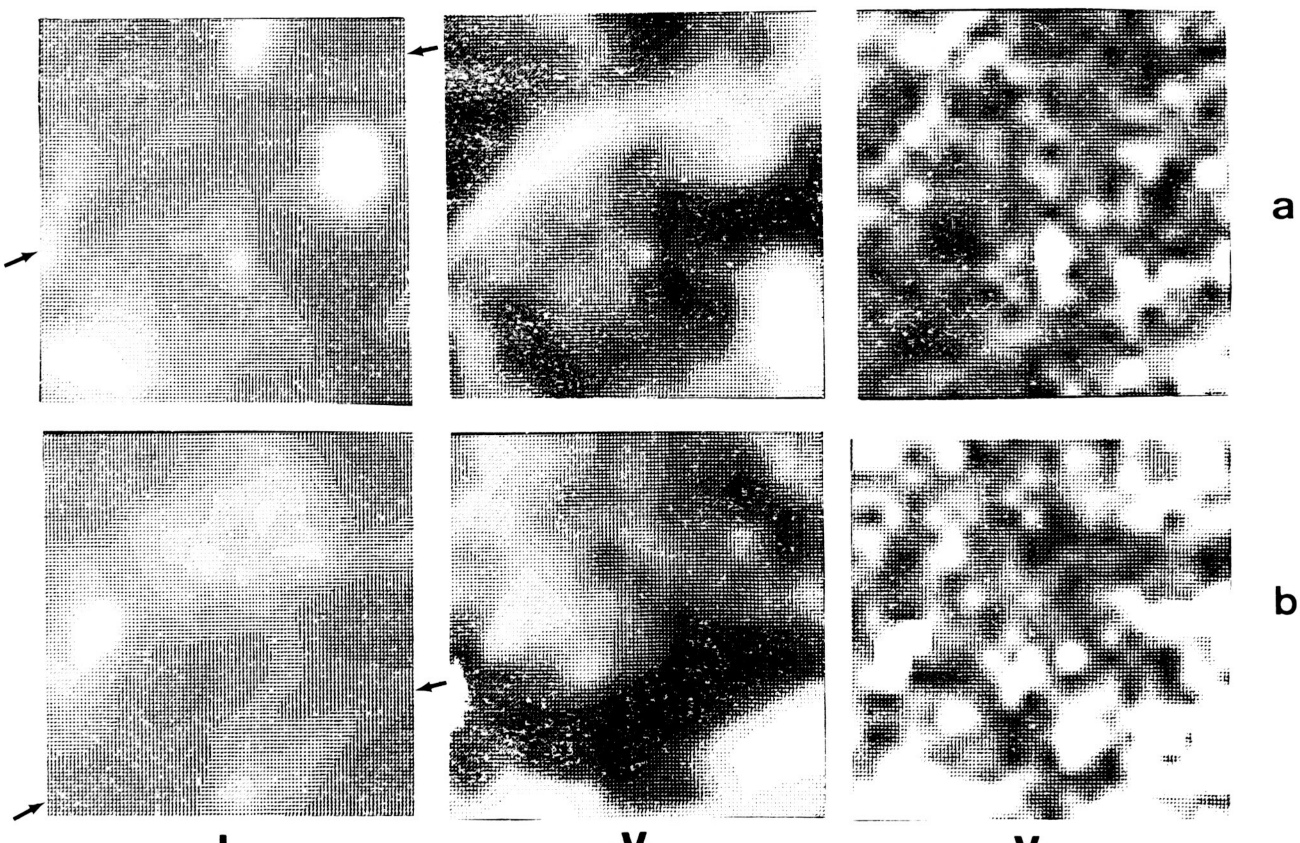

Fig. 2 CIV observations a: case 1- Sept 30 1980, b: case 2-Sept 28 1980

These observations concern two different active regions named by NOAA : AR 2701 and AR 2697 (Fig. 1). Boxes a and b in figure 1 indicate the C IV field of view (1' x 1') represented on the figure 2, respectively 2a and 2b. The arrows show the filament region (Fig. 2 I).

Stationary velocity fields

For almost all the time sequences, the stationnary velocity field is upward in the filament (Fig. 2a V : white zone) but in case 2 we observe a strong horizontal gradient of velocity at the location of the filament (Fig. 2b V) suggesting a loop (Engvold et al. 1985). The mean values over the time reach + 10km s^{-1} and - 14 km s^{-1} in C IV, and 2.5 and -3.5 kms^{-1} in H_{α}. Such regions have been interpreted as foot points of filaments (Schmieder et al.1985).

Velocity power spectrum

These sequences of observations were analyzed by the Fourier transform technique. We obtain velocity maps at different frequencies. In figure 2 Vp, we present results for periods around 200 s. The oscillations in filaments are not detected in H_{α} line in the frequency range (1-10mHz) ; they have no significant amplitudes in C IV lines (case 1 -Fig. 3ab). This result is consistent with the efficient reflection of acoustic waves at the top of the chromosphere confirming a previous result (Malherbe et al. 1981). Outside the filament, the well known chromospheric oscillations around 200s are present (Fig. 3a). In the transition region no oscillation is detected outside sunspots and bright points. As that concerns only a few points, the power spectrum is weak (Fig. 3b). For the case 2 we observe energy located principally in the loop region corresponding to upflows (Fig. 2b Vp - white zones correspond to energetic regions). The power spectrum (Fig. 3c) presents a low decay towards high frequencies. The observed peaks do not seem significant, because the variations of intensity and velocity versus time at oscillating points show no particular enhanced frequencies.
No present filament model is valid to interpret the existence and the stability of the footpoints of the filaments: siphon mechanism (Ribes and Unno 1980), magnetic flux rope (Schmieder et al. 1985). The existence of energy power in the footpoints during activation of the region can be due to photospheric convective motions rather than oscillations (Malherbe et al. 1986).

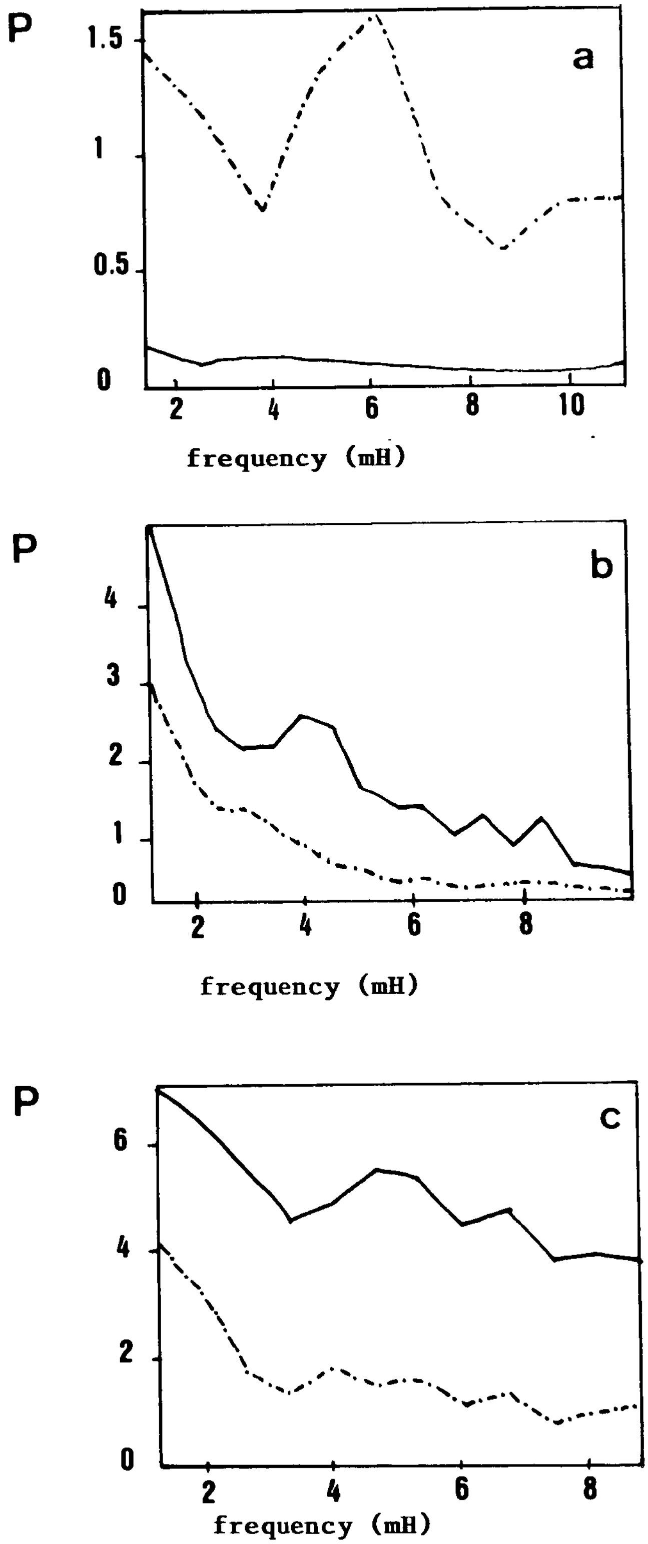

Fig. 3 Velocity Power Spectrum

a. H$_\alpha$ (Sept 30. 80)
b. C IV. case 1 (Sept 30. 80)
c. C IV. case 2 (Oct 2. 80)

(dashed line — bright regions
solid line — dark regions)

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