MOTIONS AND OSCILLATIONS IN FILAMENTS

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Abstract

Radial velocities observed in quiescent filaments show that :

1 - long living motions seem to be mainly upward and vertical

2 - chromospheric oscillations are strongly reduced in filament material.

1. Data

Results presented here have been obtained with two kinds of data :

a) H_α pictures from the 9-channel MSDP operating at the Meudon solar tower. This instrument will be described in more details during the last session of this meeting. It is equivalent to 9 monochromatic filters used simultaneously and centered at $H_\alpha \pm n \times 0.30$ Å ($n = 0, 1, 2, 3, 4$)

b) H_α patrols with the Meudon 3λ-heliograph ($H_\alpha \pm 0.75$ Å).

2. Long living motions in quiescent filaments

H_α patrol observations covering 170 hours and corresponding to 34 cases of various latitudes, longitudes and distances to active regions, have been analysed. Comparison between visibility of filaments in the blue and red H_α-wings ($\pm$ 0.75 Å) provides the sign of radial velocity. We assume that dark filaments correspond to source-functions decreasing upwards, so that velocity and Dopplershift have the same sign. Data have been divided into 3 parts, according to the center-limb location (Θ-value). Fig. 1 shows the relative times corresponding to the following situations : blue shifts only are observed (B), red shifts only (R), blue and red shifts observed simultaneously in different regions (B+R), no shift (0). We can see that :

a) blue shifts are always dominating near the center, which indicates that motion are mainly upward. This result seems to be conflicting with proper motions observed at the limb, unless the regions of line formation correspond to quite different locations inside prominences. More detailed observations are needed. So far, velocity maps provided by MSDP in a few cases seem to confirm

our result.

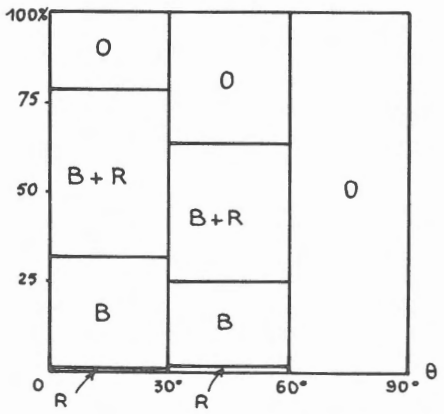

Fig. 1 - Normalized observing times corresponding to occurrence of blue (B) and red (R) shifts, versus center-limb location of filaments

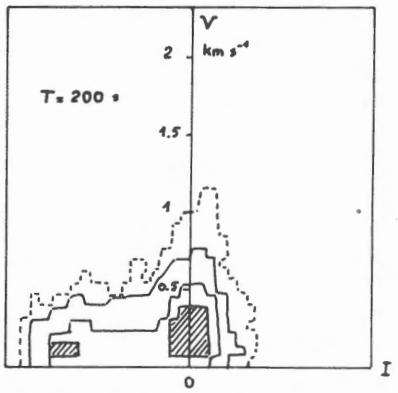

Fig. 2 - Histogram of oscillation amplitude (period 200 s) versus average intensity ($H_\alpha \pm 0.30$ A), in filament and neighbouring chromosphere.

3. Oscillations in quiescent filaments

A time sequence of MSDP pictures has been obtained on July 17, 1979, on a filament located at N36 W20. The duration was 720 s. Dopplergram and intensity maps have been computed with a 60 s time-step. A shorter sequence (420 s) was analysed every 30 s. "Steady" flows and "oscillatory" motions have been investigated by Fourier transforms on the total observed field (1' x 6') with a spatial resolution of 1 arc second. Of course, long periods cannot be discriminated from real steady flows, but 3 min or 5 min oscillations can easily be separated. The results can be summarized in the following way :

a) "Steady" flows are fast only in some localized regions, near the edges of dark material. Average values over the whole filament confirm the general trend observed previously (upward velocities).

b) Oscillations appear to be weak inside the filament. Fig. 2 shows an histogram of oscillation amplitude versus average intensity (whole field of view, 600 s sequence) for periods around 200 s. Dark regions of the filament

are located at the left of the diagram, and correspond to smallest amplitudes. This behaviour can be checked on amplitude maps : oscillations seen to avoid the regions where the filament lies. Analyses have been performed for two different distances from H_α center ($\pm$ 0.30 and $\pm$ 0.60 Å). The oscillation amplitude decreases towards the line center. It could be possible that the material velocity amplitude is nearly zero inside the filament, and that residual Dopplershifts are due to superimposed chromospheric motions, if the dark material is not optically thick. This result is very consistent with efficient reflection of acoustic waves at the top of the chromosphere, and with a very small leakage of acoustic flux into the corona.

4. Active region filaments

Time sequence of MSDP observations have also been obtained for active region filament. Preliminary analysis in one case shows that higher velocities are present. Weak oscillations can also be detected. As expected, they correspond to lower frequencies. Fourier analysis is more difficult to interpret because of sporadic motions connected with magnetic field evolution. In other respects, the shape of some function should be known in order to deduce velocities from Dopplershifts, especially in neighbouring bright regions.

REFERENCES

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- Malherbe, J.M., 1980, DEA d'astrophysique, Rapport de stage.