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Oscillations Observed in Intensity and Velocity for a Quiescent Prominence

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Abstract. We present the results obtained from analyzing SUMER/ SOHO observation data of a quiescent solar prominence. From the 1 hour data set, we derive via a wavelet transform, characteristic frequencies in terms of intensity and velocity oscillations, as measured in 4 transition region lines.

1. Introduction

A way of improving our understanding of filaments and prominences, and their link with the corona is to study the oscillations of their structure, or in other words to study the prominence seismology. In 1998, Vial reviewed the typical periods observed in velocities which can be separated in three categories: short periods (less than 5 minutes), intermediate periods (between 6 and 20 minutes) and long periods (between 40 and 90 minutes) as seen recently e.g by Régnier et al. (1999).
Blanco et al. (1999) studied a quiescent prominence observed on June 6, 1997 and its correlation with the classification of oscillations cited above. Four lines were observed with SUMER on board SoHO, Si IV (1393.76 $\AA$ and 1402.77 $\AA$), and O IV (1401.16 $\AA$ and 1404.81 $\AA$), for which they found that the largest energy content is localized in waves with periods between one and six minutes, which can be classified as intermediate and/or very short periods. These periods correspond to the characteristic periods of the chromosphere and photosphere (3 and 5 minutes respectively) which could be the source of the perturbations.
We present intensity and velocity oscillations derived in the same prominence for a longer time series and we discuss the results of the wavelet transform we applied on these two quantities.

2. Time/frequency analysis

The data presented here were obtained with SUMER (Wilhelm *et al.*, 1995, Wilhelm *et al.*, 1997, Lemaire *et al.*,1997) on board SoHO, in the frame of Joint Observing Program JOP09, during the June 1997 MEDOC campaign. Four wavelengths of the transition region were observed on June 6, between 7:21 and 8:24 UT, with the 0.3" x 120" slit: Si IV (1393.76 *Å* and 1402.77 *Å*) and O IV (1401.16 *Å* and 1404.81 *Å*). The observations lasted 3696 s, with a 12 s exposure time. More details on data analysis can be found in Bocchialini et al. (2000).

We derived the spatial and spectral average of intensity in the prominence; in order to determine the Doppler velocity in the prominence, we used the time averaged profiles obtained on the disk, as a reference, by using a gaussian curve with a linear background, using the routine available from the CDS software. The positions of the centroids obtained are used as references to compute the Doppler velocities for the prominence.

The presence of oscillations in intensity and in Doppler velocity are revealed for the total duration of the observations. In order to find the characteristic frequencies, we performed a wavelet analysis. Different oscillation periods are detected in the prominence: in terms of intensity, the photospheric 5 minutes oscillations are evidenced for the 4 lines by the time/frequency presentation. A 3 minute oscillation pulse (chromospheric oscillations) is seen in O IV (1402.81 Å). We also notice longer period oscillations (8 minutes and 15 minutes). In terms of Doppler velocity, 7 minute periods are detected in the 4 lines. Such intermediate periods are seen in filaments (Régnier et al., 2000) and interpreted as fast sausage modes. Duration of the pulses (in intensity and velocity) are limited to 20 minutes time-interval, which is coherent with the results derived by Molowny-Horas et al. (1998). We confirm the fine structure in a prominence and its connection with the chromosphere via the magnetic fields.

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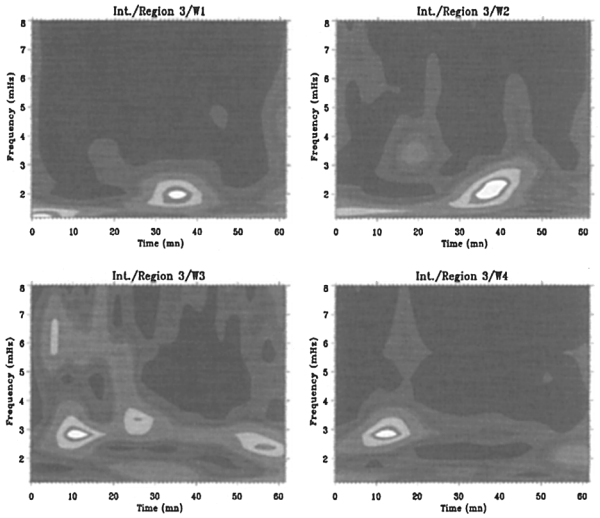

Figure 1. Time/Frequency analysis of the intensity variations for the 4 lines; Si IV (lines 1 and 2) and O IV (lines 3 and 4). Color table in arbitrary units.

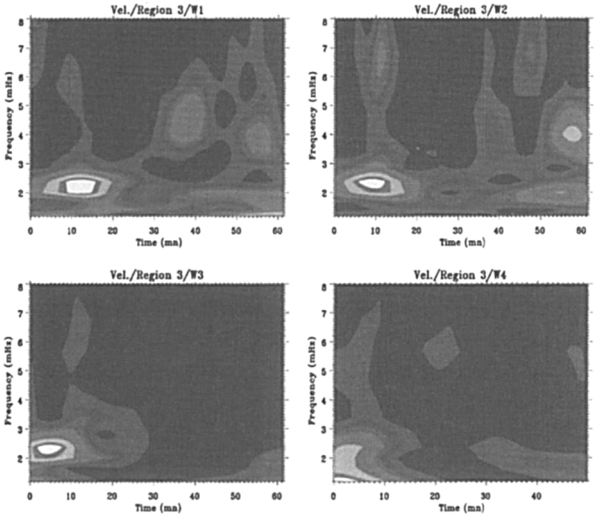

Figure 2. Time/Frequency analysis of the Doppler velocity variations for the 4 lines; Si IV (lines 1 and 2) and O IV (lines 3 and 4). Color table in arbitrary units.

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