Network Loop Oscillations with EIS/Hinode

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Abstract We analyze a time sequence of He II 256.32 Å images obtained with EIS/Hinode, sampling a small magnetic loop in magnetic network. Wavelet analysis indicates 11-min periodicity close to the loop apex. We interpret this oscillation as forcing through upward leakage by the fundamental acoustic eigenmode of the underlying field-free cavity. The observed loop length corresponds to the value predicted from this mechanism.

1 Introduction

Field-free cavities under bipolar magnetic canopies (Centeno et al. 2007) in the vicinity of magnetic network are likely to serve as resonators for fast magnetoacoustic waves (Kuridze et al. 2007). Srivastava et al. (2008) have studied the properties of the fundamental fast magnetoacoustic mode in brightened magnetic network. It leaks through the magnetic network into the upper solar atmosphere. Recently, Martinéz González et al. (2007) found evidence for low-lying loops in magnetic internetwork. In EIS/Hinode observations of bright magnetic network, we found a small loop located near the south pole. We search for magnetoacoustic oscillations in this loop through wavelet analysis.

2 Observations

The observations were acquired on 11 March 2007 during 19:04–19:54 UT in the study HPW005_QS_Slot_60m. The slot-center position was ($X = 118''$, $Y = -973''$), with a $40'' \times 512''$ field of view (Fig. 1). The data were binned

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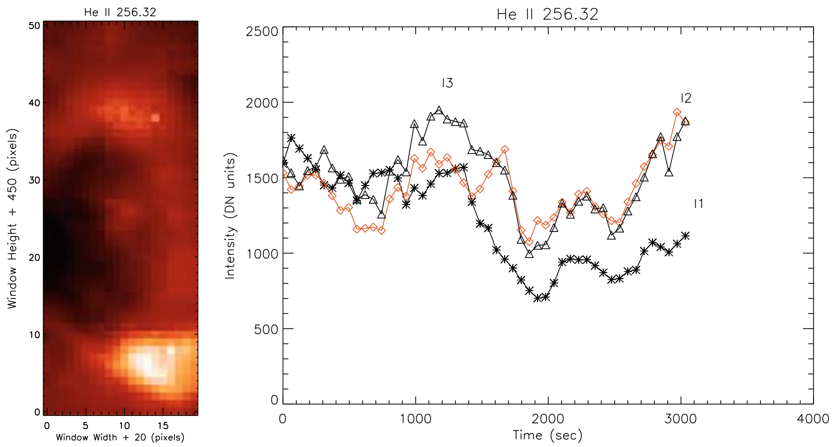

Fig. 1 *Left*: partial image in He II 256.32 Å showing bright magnetic network. *Right*: intensity vs. time for the loop apex (I2) and footpoints (I1 and I3). The similarity of the temporal intensity profiles indicates the presence of a closed system such as a small-scale loop in this bright magnetic network

over $1'' \times 1''$. The exposure time was about 60 s per spectral line, and the integration time per step of the time series was 60 s. The data reduction is described in Srivastava et al. (2008).

3 Magnetoacoustic Oscillations

Using standard wavelet analysis, we found intensity oscillations at the loop apex with periodicity about 11 min (Fig. 2). We propose that this oscillation results from eigen-mode oscillation leakage from a field-free cavity under the magnetic loop.

To test this suggestion we solve the ideal MHD equations in cylindrical geometry for such a cavity and an overlying magnetic loop, and merge the solutions at the interface to obtain an analytical dispersion relation (Kuridze et al. 2007, Srivastava et al. 2008). Figure 3 plots this dispersion relation for the fundamental harmonic ($m = 1$ in cylindrical coordinates). The observed periodicity is reproduced when the length of the cavity–loop interface is about 3,500 km. This estimate agrees well with the observed loop length.

We conclude that indeed the fundamental harmonic of the field-free cavity may force the observed oscillation in the small overlying loop.

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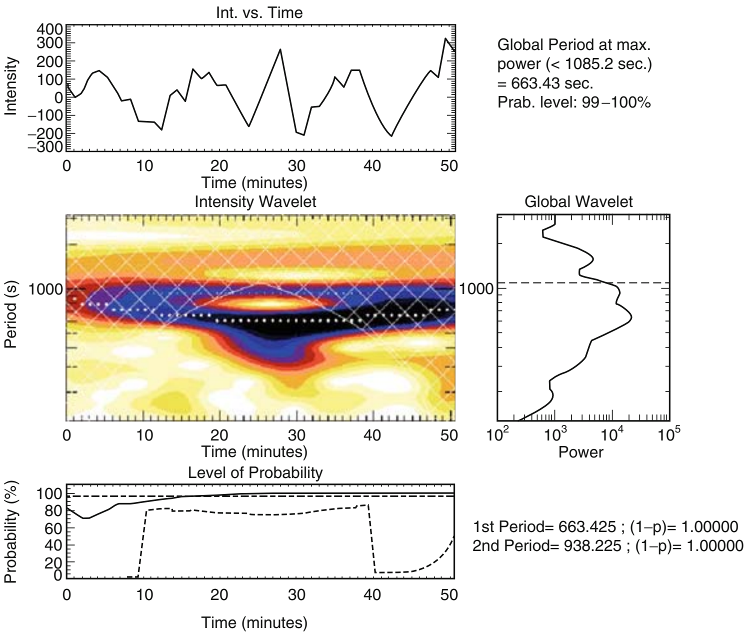
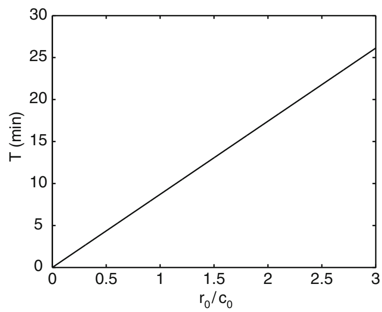


Fig. 2 Wavelet analysis for He II 256.32 Å, following Mathioudakis et al. (2006). The *top panel* shows the intensity variation, the *middle panel* the wavelet power spectrum, the *bottom panel* the probability

Fig. 3 The period of the $m = 1$ harmonic against the ratio of the cavity size r_0 and the sound speed c_0



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