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Hot loop oscillations seen by SUMER

T.J. WANG, S.K. SOLANKI, W. CURDT, D.E. INNES and I.E. DAMMASCH

Max-Planck-Institut für Aeronomie, D-37191 Katlenburg-Lindau, Germany

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1. Introduction

Recently a new kind of damped oscillations of hot coronal loops was revealed by the Solar Ultraviolet Measurements of Emitted Radiation (SUMER) spectrometer on SOHO (Kliem et al. 2002; Wang et al. 2002a, b, c). Observations of 17 flare-like events show that the oscillations have periods of 11−31 min, with a decay time of 5.5−29 min, and show an initial large Doppler shift pulse (up to 200 km s^{-1}). The oscillations were interpreted in terms of standing slow or kink magnetosonic modes. An 1D MHD simulation by Ofman & Wang (2002) shows that slow waves can be damped quickly on a time scale comparable to observations due to the large thermal conduction in a hot coronal loop.

2. Observations

For all events, spectra were recorded by the SUMER spectrometer (Wilhelm et al. 1995), with a slit placed at a fixed position above an active region at the limb. The observations were made with a 50 s or 162 s exposure time in 1999−2002. The spectral windows contain lines formed in the temperature range of 0.01−10 MK (e.g. Si III, Ca X, and Fe XIX).

For a Doppler shift time series averaged along the slit, the function

$$V(t) = V_0 + V_m sin(\omega t + \phi)e^{-\lambda t}, \quad (1)$$

is fit to the oscillation (an example is shown in Fig.1). The parameters of the time series for 35 oscillations in 17 events were derived by Wang et al. (2002c).

3. Results and discussions

From a statistical study on 17 flare-like events, Wang et al. (2002c) summarized the main properties of the hot loop oscillations: (a) Doppler shift oscillations were detected only in flare lines of T=6−10 MK. Some available observations show that they were associated with the Yohkoh/SXT loops. (b) Most cases belong to recurring events, and were not associated with GOES flares, unlike loop transverse oscillations seen by TRACE that were mostly triggered by strong flares (Aschwanden et al. 2002). (c) There is a large shift pulse with peak velocities up to 200 km s^{-1} during the rising phase of the flux which is followed by two or three periods of strongly damped alternating red and blue shift oscillations. (d) The periods are about 11−31 minutes, longer than those (2−11 min) observed by TRACE (Aschwanden et al. 2002). (e) The exponential decay time is in the range 5.5−29 minutes, comparable to the TRACE loops' damping time. The best fit power law scaling of the damping time with the period gives an exponent of 1.07±0.16, i.e. a linear relation. (f) Variations of line-integrated intensity have impulsive profiles. For more than 1/3 of oscillations, the intensity profiles have several peaks, but show no periodic behavior. The Doppler shift generally peaks earlier than the flux, but almost simultaneously with the line width.

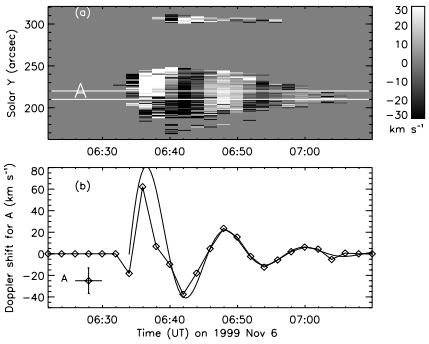

Fig. 1. (a) Doppler shift oscillation event in Fe XXI 1354.06 Å on 6 Nov 1999. (b) Average time profile of Doppler shifts along the cut A. The thick solid curve is the best fit damped sine function (1).

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Correspondence to: wangtj@linmpi.mpg.de

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