Observations and simulations of longitudinal oscillations of an active region prominence

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Abstract

Context. Filament longitudinal oscillations have been observed in Hα observations of the solar disk.
Aims: We intend to find an example of the longitudinal oscillations of a prominence, where the magnetic dip can be seen directly, and examine the restoring force of this type of oscillations.
Methods: We carry out a multiwavelength data analysis of the active region prominence oscillations above the western limb on 2007 February 8. In addition, we perform a one-dimensional hydrodynamic simulation of the longitudinal oscillations.
Results: Our analysis of high-resolution observations performed by Hinode/SOT indicate that the prominence, seen as a concave-inward shape in lower-resolution extreme ultraviolet (EUV) images, consists of many concave-outward threads, which is indicative of magnetic dips. After being injected into the dip region, a bulk of prominence material started to oscillate for more than 3.5 h, with the period of 52 min. The oscillation decayed with time, on the decay timescale 133 min. Our hydrodynamic simulation can reproduce the oscillation period, but the damping timescale in the simulation is 1.5 times as long as the observations.
Conclusions: The results clearly show the prominence longitudinal oscillations around the dip of the prominence and our study suggests that the restoring force of the longitudinal oscillations might be the gravity. Radiation and heat conduction are insufficient to explain the decay of the oscillations. Other mechanisms, such as wave leakage and mass accretion, have to be considered. The possible relation between the longitudinal oscillations and the later eruption of a prominence thread, as well as a coronal mass ejection (CME), is also discussed.

Keywords: Sun: filaments, prominences – Sun: oscillations – methods: observational – methods: numerical

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