Large-amplitude longitudinal oscillations in solar prominences

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Abstract

Large amplitude longitudinal (LAL) prominence oscillations consist of periodic mass motions along a filament axis. The oscillations appear to be triggered by an energetic event, such as a microflare, subflare, or small C-class flare, close to one end of a filament. Observations reveal speeds of several tens to 100 km/s, periods of order 1 hr, damping times of a few periods, and displacements equal to a significant fraction of the prominence length. We have developed a theoretical model to explain the restoring force and the damping mechanism. Our analytic model for the LAL oscillations demonstrates that the main restoring force is the projected gravity in the flux tube dips where the threads oscillate. Although the period is independent of the tube length and the constantly growing mass, the motions are strongly damped by the steady accretion of mass onto the threads. We conclude that the LAL movements represent a collective oscillation of a large number of cool, dense threads moving along dipped flux tubes, triggered by a small, nearby energetic event. Our model yields a powerful seismological method for constraining the coronal magnetic field strength and radius of curvature at the thread locations.

Keywords: Prominences, Large Amplitude Oscillations, F¡lament Magnetic Structure

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