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End-view Observations of Large-amplitude Longitudinal Oscillations of a Quiescent Prominence

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Prominence seismology on the large-amplitude longitudinal oscillation is applied to diagnose the geometry and strength of the magnetic fields inside the prominence indirectlly. Combining the imaging and spectroscopic data, we present the end-view observations of large-amplitude longitudinal oscillations of a quiescent prominence at northwest limb on 2023 December 04.

Particularly, the prominence oscillation involved Doppler velocities derived from the spectroscopic data and horizontal motions in extreme-ultraviolet (EUV) images. Originally, the prominence oscillation was triggered by the collision and heating of the adjoining hot structure associated with the two coronal jets. The horizontal motions involved two groups of oscillation signals with similar oscillatory parameters, an initial amplitude of ~21.5 Mm and a velocity amplitude of ~27 km s^{-1}, each lasting for ~4 cycles with a period of ~77 minutes.

Combining the Doppler velocities derived from the spectroscopic data provided by the Chinese Hα Solar Explorer/Hα Imaging Spectrograph, the three-dimensional (3D) oscillatory initial amplitude and velocity amplitude are determined to be ~40 Mm and ~48 km s^{-1}, while the angle between the direction of 3D velocities and the prominence axis is estimated to be ranging from 10°-30°.

The curvature radius evolution of magnetic dips supporting the prominence are calculated by integrating the 3D velocities, which increased from ~30 Mm to 210 Mm from the bottom to both sides, and then decreased to ~20 Mm, with transverse magnetic field strength ⩾22 G. From this, the realistic 3D geometry of the prominence magnetic dips are sinusoidal rather than semicircular.

To our best knowledge, we present the first accurate calculation for the 3D curvature radius and geometry of the prominence magnetic dips based on the high-resolution observation.

References

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