The damping of transverse oscillations of prominence threads: a comparative study

Roberto Soler*†[1], Ramon Oliver[1], and José Luis Ballester[1]

[1]Universitat Illes Balears (UIB) – Departament de Física. Edifici Mateu Orfila. C. Valldemossa, km 7,5. E-07122 Palma de Mallorca, Spain

Abstract

Transverse oscillations of thin threads in solar prominences are frequently reported in high-resolution observations. The typical periods of the oscillations are in the range of 3 - 5 minutes. A peculiar feature of the oscillations is that they are damped in time, with short damping times on the order of few periods of the oscillation. Theoretically, the oscillations are interpreted as kink magnetohydrodynamic waves. However, the mechanism responsible for the damping is not well known and several causes have been suggested. Here we perform a comparative study between different physical mechanisms that may damp kink waves in prominence threads. The considered processes are thermal conduction, cooling by radiation, resonant absorption, and ion-neutral collisions. Our results indicate that thermal conduction and cooling are very inefficient for the damping of kink waves and, therefore, these mechanisms can be discarded. Ion-neutral collisions are important for short-period waves but their effect is minor for waves with periods usually observed. Resonant absorption is the only process that produces an efficient damping. The damping times theoretically predicted by resonant absorption are compatible with those reported in the observations. Based on this conclusion and in the context of prominence seismology, we show that it is possible to apply the existing seismological schemes for resonantly damped kink waves to the case of prominence thread transverse oscillations.

Keywords: waves, oscillations, magnetohydrodynamics, prominences, seismology

*Speaker

†Corresponding author: roberto.soler@uib.es