

Heating by transverse waves in simulated coronal loops

The dynamics of oscillating cylindrical flux tubes have been addressed by many models, with resonant absorption having been established as an important damping mechanism of both standing and propagating waves. Its nonlinear nature has been examined alongside the Kelvin-Helmholtz instability, which is expected to manifest in the case of standing transverse waves. The two mechanisms have also been connected to heating of coronal loops, by dissipating the oscillation energy through resistivity and viscosity. A severe shortcoming, however, is that heating is located only at the resonant layer, which is usually found near the outer regions of loops. In the current work we study the effects of wave heating from transverse waves in a coronal loop. Using the MPI-AMRVAC code, we perform ideal, three dimensional magnetohydrodynamic (MHD) simulations of both (a) footpoint driven and (b) impulsively excited standing kink waves in a straight density enhanced coronal flux tube, in the presence of numerical resistivity. In order to focus on the wave heating mechanisms, models with equal temperature across the domain are considered. We identify Ohmic heating as the reason for the observed temperature increase, as indicated by the higher values of temperature and current densities near the footpoints. By performing forward modeling with the FoMo code, the temporal and spatial evolution of our systems are studied. Transverse Wave Induced Kelvin-Helmholtz (TWIKH) rolls are generated near the velocity antinodes of our models, leading to an expanded turbulent layer and to extensive mixing between the loops and their environment. The footpoint driven oscillations result into fully turbulent loops, where the density profile is completely deformed due to KHI. Finally, the introduction of a temperature gradient between the inner tube and the surrounding plasma, in the case of a hotter environment, leads to a temperature increase greater than the contribution of the aforementioned wave heating mechanism.