Transverse, propagating velocity perturbations in solar coronal loops

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As waves and oscillations carry both energy and information, they have enormous potential as a plasma heating mechanism and, through seismology, to provide estimates of local plasma properties which are hard to obtain from direct measurements. Being sufficiently near to allow high-resolution observations, the atmosphere of the Sun forms a natural plasma laboratory. Recent observations have revealed that an abundance of waves and oscillations is present in the solar atmosphere, leading to a renewed interest in wave heating mechanisms.

In this talk, I will give an overview of recently observed transverse, propagating velocity perturbations observed in coronal loops. These ubiquitous perturbations are observed to undergo strong damping as they propagate. Using both numerical and analytical modelling, we demonstrate that these can be understood in terms of coupling of different wave modes in the inhomogeneous boundaries of the loops: we perform 3D numerical simulations of footpoint-driven transverse waves propagating in a coronal plasma with a cylindrical density structure. Mode coupling in the inhomogeneous boundary layers of the loops leads to the coupling of the transversal (kink) mode to the azimuthal (Alfvén) mode, observed as the decay of the transverse kink oscillations. Both the numerical and analytical results show that the initial damping is Gaussian in nature, before tending to linear exponential damping at large heights. In addition, recent analysis of CoMP (Coronal Multi-channel Polarimeter) Doppler shift observations of a large, off-limb, trans-equatorial loops system show that Fourier power at the apex appears to be higher in the high-frequency part of the spectrum than expected from theoretical models. We suggest that this excess high-frequency FFT power could be tentative evidence for the onset of a cascade of the low-to-mid frequency waves into (Alfvénic) turbulence.