Waves in Wave-Produced Plasmas: Ducted Kinetic Alfvén Waves in Helicon Sources

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Dissipation of Alfvén waves (AW's) is the most probable mechanism for ion heating in the solar corona. AW's are also thought to play a role in aurora formations. Due to their long wavelength in typical laboratory plasmas, experimental investigations of the AW's require very long plasmas. However a plasma with high density reduces the need for long parallel dimensions for such experimental investigations. Although helicon plasma sources are theoretically ideal candidates for AW studies because of their high plasma density ($n \sim 10^{13}$ cm^{-3}) and moderate length ($L \sim 2$ m), they potentially introduce some challenges: a) the ubiquitous high power rf makes it difficult to resolve the excited AW's, b) the plasma has a steep radial density gradient that essentially dictates the kinetic and inertial regimes for AW's propagation, and c) the plasma has a significant neutral density which alters the AW's dispersion through ion-neutral collisions. Here we present measurements of propagating kinetic Alfvén waves in helium helicon plasma. The measured wave dispersion is well fit with a kinetic model that includes the effects of ion-neutral damping and that assumes the high density plasma core defines the radial extent of the wave propagation region. Further investigation shows that the measured wave amplitude versus plasma radius is consistent with the pile up of wave magnetic energy at the boundary between the kinetic and inertial regime regions.