Nonlinear interactions, heating and turbulence associated with large amplitude Alfvén waves in a laboratory plasma

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Electromagnetic turbulence is thought to play an important role in plasmas in astrophysical settings (e.g. the interstellar medium, accretion disks) and in the laboratory (e.g. transport in magnetic fusion devices). From a weak turbulence point of view, nonlinear interactions between shear Alfvén waves are fundamental to the turbulent energy cascade in magnetic turbulence. Motivated by this, experiments on the interaction between large amplitude Alfvén waves are being carried out on the the Large Plasma Device (LAPD) at UCLA. Large amplitude Alfvén waves ($\delta B/B \sim 1\%$) are generated either using a resonant cavity (the Alfvén wave MASER[1]) or loop antennas. Nonlinear interactions between two copropagating waves have been observed[2]. Two kinetic Alfvén waves are observed to pass through one another due to dispersion and beat together, nonlinearly driving a low frequency perturbation at the beat frequency. The low frequency perturbation then scatters the pump Alfvén waves, generating a series of sidebands. In addition to three-wave interactions, nonlinear processes associated with single waves are observed. Strong, localized electron heating during large amplitude kinetic Alfvén wave launch is observed during these experiments. The heating results in significant gradients in the electron temperature which in turn excite unstable drift-Alfvén waves. The drift waves then interact with the initial Alfvén wave, leading to sidebands and spectral broadening. Details of these experimental observations will be discussed, as well as future plans for studies of nonlinear processes assocaiuted with Alfvén waves in LAPD.

[1] J.E. Maggs and G.J. Morales, Phys. Rev. Lett. **91**, 035004 (2003)
[2] T.A. Carter, B. Brugman, *et. al*, Phys. Rev. Lett. **96**, 15501 (2006)