Control of Gradient-Driven Instabilities using Shear Alfvén Beat-Waves

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We report on studies of control of gradient-driven instabilities in the Large Plasma Device (LAPD) through nonlinear interaction with shear Alfvén waves[1]. Coherent gradient-driven fluctuations are driven unstable through the creation of a field-aligned cylindrical density depletion. Two independent, co-propagating shear Alfvén waves are launched along the depletion, generating a nonlinear response at the beat-frequency. When the beat-frequency is set near the frequency of the instability, a strong interaction between the beating Alfvén waves and the unstable mode and related stable modes is observed. Resonant drive of the instability is observed when the beat wave is driven at the instability frequency. When the beat wave is set close to and above the instability frequency, a separate resonance is observed. This second resonance is associated with a mode similar in properties to the instability but with a distinct angular mode number m. During the resonant drive of the higher m-number mode mode, the original unstable mode is suppressed, leaving only the resonantly-driven higher frequency mode. When the resonant drive is removed, the higher frequency mode decays with a measurable damping rate, at which point the initial instability returns. Results of analytic estimates of eigenmodes present on the depletion structure will be presented along with comparisons to experimental measurements. Initial work on modeling the coupling between the beat-wave and the gradient-localized modes will also be presented.

[1]Auerbach, Carter, Vincena, Popovich, *PRL*, Vol. 105, pp. 135005, 2010