Low Frequency Wave Emission and Transport in the Presence of Single and Multiple Interacting Magnetized Temperature Striations

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Temperature gradients in magnetized plasmas can naturally occur in various plasma environments such as the Earth's ionosphere and the Solar corona or can be artificially induced through intense radio waves in ionospheric heating experiments. Steep thermal gradients can induce a variety of spontaneous low frequency excitations such as thermal waves (D. Pace et al., Phys. Rev. Lett., **101**, 035003 (2008)), drift-Alfven waves (A. Burke et al., Phys. Plasmas **7**, 1397 (2000)) and convective cells. These wave modes have previously been investigated under controlled conditions using a single, isolated heat source in a large linear plasma device. We extend these laboratory studies to include multiple heat sources that lead to magnetized temperature striations or filaments in close proximity and enhanced cross-field transport from nonlinear filament-filament interaction.

Experiments are performed in the Large Plasma Device (LAPD) at UCLA. The setup consists of three biased CeB_6 crystal cathodes that inject low energy electrons (below ionization energy) along a strong magnetic field into a pre-existing large and cold plasma forming 3 electron temperature filaments embedded in a colder plasma, and far from the machine walls. The cathodes are mounted on separate probe drives for variable positioning and each have a separate power supply that allows for individual DC voltage biasing capabilities. A triangular spatial pattern is chosen for the thermal sources and multiple axial and transverse probe measurements allow for determination of the cross-field mode patterns and axial filament length.

We have characterized the thermal and drift-Alfven waves driven by the steep thermal gradient on an individual filament when a single cathode source is activated. When the 3 sources are activated, and in close proximity (within a few collisionless electron skin depths), a complex wave pattern emerges due to interference of the various wave modes on each filament, thus leading to enhanced cross-field transport from chaotic mixing (ExB). Detailed eigenmode analysis of the tri-filament configuration and comparison with nonlinear 2-fluid and gyrokinetic simulations will be reported.