Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **460** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

(G*) Stimulated Excitation of Thermal Waves in Magnetized Plasmas and Use in Thermal Conductivity Measurement

Tuesday 8 June 2021 13:00 (15 minutes)

There exists an unconventional class of waves known as thermal diffusion waves, or simply thermal waves, that are produced using sinusoidally, time-varying heat sources and they can be used to determine the thermal conductivity in the medium. Recent advancements have resulted in the construction of thermal wave resonator cavities (TWRCs) capable of sustaining quasi-standing thermal waves which have been used to measure the thermal properties of solids, liquids, and gases. The success of TWRC diagnostic techniques with different forms of matter motivates the application of similar methods to magnetized plasmas, where heat transport processes are of particular importance to magnetic confinement fusion devices. Results are presented from experiments in a large linear magnetized plasma device using an electron temperature filament that is formed from a cerium hexaboride crystal cathode that injects low energy electrons along a magnetic field into the center of a pre-existing plasma, forming a hot electron filament embedded in a colder plasma that behaves as a thermal resonator. By oscillating the cathode voltage we produce an oscillating heat source in the filament and demonstrate the stimulated excitation of thermal waves and the presence of a thermal resonance in the finite-length temperature filament. We have successfully used this technique to determine the thermal conductivity in the plasma. A theoretical model of the thermal wave dispersion relation and resonator is compared to the Langmuir probe data from the experiment.

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Session Classification: TS-3 Plasma Physics Symposium (DPP) / Symposium de physique des plasmas (DPP)

Track Classification: Symposia Day (DPP) - Low temperature plasmas/Fusion plasmas (magnetic and inertial confinement)/ Laser plasmas/Basic plasmas