Plasma Physics Seminar

Physics & Astronomy Building (PAB) Room 4-330
Via Zoom: https://ucla.zoom.us/my/pab4330
Friday May 2nd at 12:30 PM
Lunch will be served at 12:00 PM

Helicon Wave Experiments on the LArge Plasma Device (LAPD) Space Debris

Josh Larson (UCLA)

Low-power (~100 W) 'helicon' (fast waves in the lower hybrid range of frequencies) experiments were conducted on the LArge Plasma Device (LAPD) at UCLA to study wave propagation and coupling properties with a 10-element comb-line traveling wave antenna (TWA). Helicon waves are launched unidirectionally along the long axis of the machine from the inductively coupled antenna modules. Varying the launch frequency within the passband of the antenna selects the principal normalized parallel wavenumber . The accessible diagnostic suite and simplified geometry of the LAPD make it well equipped to conduct this systematic study of the comb-line antenna coupling and wave propagation in the plasma. With well resolved spatial and temporal measurements of density and fields, wave power in the plasma was measured across a range of tunable parameters. These parameters included the background magnetic field, plasma density, wave launch direction, and launch frequency. Across the range of densities there are times during the discharge where both the fast (helicon) and slow ('lower hybrid wave') branches may simultaneously propagate in the plasma. Therefore, distinguishing between the two branches is imperative in assessing the effectiveness of this launcher. These experiments demonstrate the antenna acts as designed: coupling to fast waves, control over the imposed through drive frequency, and directionality are all shown. A comparison to 2D full-wave cold plasma modeling shows agreement with the wave fields measurements. Follow-up experiments were conducted to investigate the role of filamentary density structures on the propagation of these waves. Launchers must couple waves through the turbulent scrap-off-layer (SOL) of fusion devices. In the SOL there are intense spatially coherent density structures called filaments. The presence of these intense density enhancements in the plasma can cause mode-conversion from one cold plasma branch to the other in a process known as 'stimulated mode-conversion'. By use of a carbon iris mask mechanism and an additional plasma source an experimental proxy for the filaments is created. Waves are launched at the filament and the resulting wave electric fields are measured. Evidence of the mode conversion process has been observed as the measured fields exhibit properties that are indicative of a propagating slow wave. A comparison to 2D full-wave cold plasma modeling shows consistency with this interpretation.

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