Fast wave experiments at LAPD in support of fusion

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Recent work on ICRF physics at the Large Plasma Device (LAPD) at UCLA has focused on deleterious near-field antenna effects, such as RF rectification, sputtering, convective cells and power lost to the plasma edge. Plasma parameters in LAPD are similar to the scrape-off layer of current fusion devices. The machine has a 17 m long, 60 cm diameter magnetized plasma column with typical plasma parameters $n_e \sim 10^{12} - 10^{13}$ cm^{-3}, $T_e \sim 1 - 10$ eV and $B_0 \sim$ 1000 G. A new high-power (~150 kW) RF system and fast wave antenna have been developed for LAPD, enabling the generation of large amplitude fast waves. Evidence of rectified RF sheaths is seen in large increases (~ 10 T_e) in the plasma potential on field lines connected to the antenna, and in copper deposition on plasma facing components due to sputtering at the antenna. The rectified potential scales linearly with antenna current. The rectified RF sheaths set up convective cells of local **E x B** flows, measured indirectly by potential measurements, and measured directly with Mach probes. At high antenna powers substantial modifications of the density profile were observed after the RF antenna is powered up. The density rearrangement is asymmetric with a decrease in plasma density near the top of the antenna and an increase near the bottom. The plasma density profile initially exhibits transient low frequency oscillations (~10 kHz) and settles into a quasi-steady state profile for the remainder of the RF pulse. RF antenna current is constant during the pulse. In preliminary experiments at low antenna powers, the parasitic coupling to slow waves in the low density region in front of the antenna is being studied. Detailed wave field measurements show coupling to both the short wavelength slow wave and the long wavelength fast wave if the density at the antenna is low enough. Coupling to lower hybrid waves was demonstrated for a range of normalized frequencies, from $1 < f/f_{ci} < 30$.

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