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Lower Hybrid wave edge power loss quantification on the Alcator C-Mod tokamak[1]

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For the first time, the power deposition of Lower Hybrid RF waves into the edge plasma of a diverted tokamak has been systematically quantified. Edge deposition represents a parasitic loss of power that can greatly impact the use and efficiency of Lower Hybrid Current Drive (LHCD) at reactor-relevant densities. Through the use of a unique set of fast time resolution edge diagnostics, including innovative fast-thermocouples, an extensive set of Langmuir probes, and a Ly_α ionization camera, the toroidal, poloidal and radial structure of the power deposition has been simultaneously determined. Power modulation was used to directly isolate the RF effects due to the prompt ($t < \tau_E$) response of the scrape-off-layer (SOL) plasma to LHRF power. LHRF power was found to absorb more strongly in the edge at higher densities. It is found that a majority of this edge-deposited power is promptly conducted to the divertor. This correlates with the loss of current drive efficiency at high density previously observed on Alcator C-Mod, and displaying characteristics that contrast with the local RF edge absorption seen on other tokamaks. Measurements of ionization in the active divertor show dramatic changes due to LHRF power, implying that divertor region can be key for the LHRF edge power deposition physics. These observations support the existence a loss mechanism near the edge for LHRF at high density ($n_e > 1.0 \cdot 10^{20}$ [m^{-3}]). Results will be shown addressing the distribution of power within the SOL, including the toroidal symmetry and radial distribution. These characteristics are important for deducing the cause of the reduced LHCD efficiency at high density and motivates the tailoring of wave propagation to minimize SOL interaction, for example, through the use of high-field-side launch.

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