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**Field-Aligned ICRF Antenna Characterization and Performance in Alcator C-Mod**[1]

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Impurity contamination associated with ion cyclotron range of frequency (ICRF) heating remains a major challenge to ICRF utilization in magnetic confinement devices, particularly with metallic plasma facing components. Here, we report results on an experimental investigation of a high power, magnetic field-aligned (FA) antenna, designed to reduce parallel electric (E||) field through symmetry and thereby reduce RF related impurity contamination. Using the standard non-field aligned antennas (ST) as a reference, the impurity contamination and sources on the antenna are significantly lower for the FA-antenna than the ST antennas. In addition, the radiated power is reduced for given injected power for the FA-antenna compared to the ST-antennas in L and H-mode discharges. The improved performance is consistent with simulations indicating that the FA-antenna has reduced integrated E|| relative to the non-aligned antennas. However, the simulation also predicts that so-called monopole phasing, where antenna strap current has [0,0,0,0] phase, should have the lowest integrated E||. The initial results suggest that monopole phasing has a stronger impact on the plasma potential and higher core impurity contamination and sources at the antenna. Utilizing gas puff imaging, the radial electric field profile in the scrape-off-layer (SOL) is readily measured. For the ST and FA-antennas, fine structure (variations of order $\sim$0.5 cm) in the radial electric field is observed and radial penetration of the rectified potential structures is $\sim$10 times greater than the skin depth. This anomalous penetration appears to be consistent with including cross-field RF polarization currents in the sheath model. Further comparisons of the FA- and ST-antennas are being carried out with an extensive array of boundary plasma diagnostics to characterize the impurity behavior and impact on the SOL transport and SOL density profiles; the latest results will be presented.

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