Mitigation of RF Sheaths Through Rotated ICRF Antenna Design *

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One of the primary challenges of ICRF heating is the reduction of impurities associated with ICRF operation. ICRF-specific impurity production is thought to result from sputtering of PFCs by ions accelerated by rectified radio frequency (RF) sheaths [1]. A new rotated antenna was optimized for magnetic flux coupling, power handling, and minimized integrated $E_{||}$. Using finite element method and a cold plasma model, four antenna phases were analyzed for the rotated antenna: [0,π,0,π], [0,0,π,π], [0,π,π,0], [0,0,0,0]. In each case, the rotated antenna had reduced integrated $E_{||}$ relative to the existing antenna geometry. The average reduction in the integrated $E_{||}$ was a factor of 2-3. However, the most significant result occurs for monopole [0,0,0,0] phasing. Monopole phasing, which results in such overwhelming impurities on C-Mod that it precludes its operation, actually had the greatest $E_{||}$ mitigation of all possible phase configurations for a rotated antenna. This is an especially significant result because monopole phasing provides the optimum magnetic flux coupling to the plasma among all antenna phases. Thus, an ICRF antenna aligned with the equilibrium magnetic field, should create the lowest RF sheath potentials and impurity generation while coupling the most power to the plasma, particularly when operated in monopole.

[1] D. A. D'Ippolito, et al., Plasma Phys. Control. Fusion, Vol. 33, No. 6 (1991) 607.

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