Measurements of ICRF Power Deposition and Thermal Transport with an ECE Grating Polychromator on the Alcator C-Mod Tokamak

by

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Abstract

ICRF provides Alcator C-Mod with up to 3.5 MW of power at 80 MHz using two double-strap antennas. By varying the magnetic field and the mix of ion species, a variety of heating regimes have been studied. To investigate electron heating regimes, mixtures of He$^3$ and H were used in plasmas at 6.5T. Efficient ($< 80\%$) direct electron heating has been observed in this scenario and is attributed to mode conversion to the ion Bernstein wave (IBW). Measurements of the mode conversion power deposition using a nine channel grating polychromator (GPC) indicate that the IBW damping can be very strong, with central power densities $> 25 MW/m^3$ and FWHM widths of $\approx 0.2a$. The presence of $> 8\%$ deuterium "impurity" in these plasmas is shown to significantly broaden the power deposition profiles. The GPC has also been used to study the heating mechanisms in the two standard C-Mod heating scenarios: $D(H)$ and $D(He^3)$ minority heating at 5.3T and 7.9T respectively. Mode conversion can provide a significant fraction of the heating in $D(He^3)$ plasmas, with 60% efficiency and profiles which are peaked well off axis ($r/a \approx 0.6$) at the highest $He^3$ concentrations ($n_{He^3}/n_e \approx 0.2$). Data from $D(H)$ experiments illustrate techniques to measure minority ion tails using electron temperature dynamics. In addition, evidence is presented for $D(H)$ mode conversion heating at high hydrogen concentration.

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