PLASMA X-RAY SPECTROSCOPY DURING LOWER HYBRID CURRENT DRIVE ON ALCATOR

by

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ABSTRACT

Lower hybrid current drive experiments have been performed on the Alcator C tokamak at plasma densities up to $n_e \approx 1 \times 10^{14} \text{ cm}^{-3}$. An equilibrium plasma current of several hundred kiloamperes has been maintained by the injected radiofrequency power alone. Current drive requires the generation of a high energy electron tail, anisotropic in velocity space, which must be investigated in order to understand the physics issues related to lower hybrid current drive. Bremsstrahlung emission produced by this tail has been measured using NaI spectroscopy. Both the emission profiles and the emission as a function of the angle between the magnetic axis and the emission direction have been measured. The profile measurements show that the emission is peaked on axis and that the spectra extend out to several hundred keV. The measurements of the emission as a function of angle are compared to the emission calculated from a reasonable model distribution function. The physical basis and the sensitivity of this modeling technique are discussed. The data indicate that the electron tail is nearly flat and is highly anisotropic extending in a preferred toroidal direction out to approximately 500 keV. The plasma properties that can be derived from this model are discussed. It is found that the stored energy in the tail is comparable to the stored energy in the bulk plasma. A detailed study also shows that the energy confinement for the tail is better than for the bulk plasma, and that the energy confinement time increases with tail electron energy.

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