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Lower Hybrid Current Drive Experiments in Alcator C-Mod[1]

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Lower Hybrid Current Drive (LHCD) experiments have been implemented in Alcator C-Mod. The long-term objective is to use LHCD to control j(r) and to supplement the bootstrap current in high beta-poloidal and enhanced confinement regimes. Thus far up to 800 kW of RF power at 4.6 GHz have been coupled to C-Mod plasmas through a waveguide grill arranged in 4 rows, each with 24 waveguides. Electronic control of the amplitude and phase in each waveguide allows dynamic variation of the n-parallel spectrum with 1 ms response time over the range 1.5 <4. This feature enables measurement of the reflection coefficient as a function of n-par in one discharge. By varying the gap between the separatrix and the grill, its dependence on density at the grill is also obtained. Good agreement between the measurements and modeling based on the Brambilla coupling code (M. Brambilla 1976 Nuclear Fusion **16,** 47-54) is obtained by assuming a small ($\sim$1 mm) vacuum gap between the grill and the plasma in the code. Hard X-Ray imaging of the accelerated fast-electron bremsstrahlung reveals a relatively broad emission profile with energies in excess of 100 keV. Non-thermal synchrotron emission is also observed. Modeling of the hard X-ray and ECE emission using both the CQL3D and DKE codes in synthetic diagnostic mode is in progress and comparison with the experimental spectra and spatial profiles will be presented. LHCD experiments have thus far operated in the ITER relevant line-average density range from 5e19m-3 to 8e19 m-3 and toroidal field 5.4 < B < 6.5 T. At the 800 kW power level the maximum decrease in loop voltage due to LHCD is about 75% of the ohmic value at a plasma current of 700 kA. Analysis is underway to quantify the LH driven current fraction. A decrease in internal inductance of about 0.1 has been measured, suggesting a broadening of the current profile. Sawtooth stabilization and other core MHD activity have also been observed as well as substantial electron heating.

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