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**Lower Hybrid Current Drive Experiments on Alcator C-Mod: Comparison with Theory and Simulation**[1]

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Recently, lower hybrid current drive (LHCD) experiments have been carried out on Alcator C-Mod using an RF system consisting of 12 klystrons at 4.6 GHz, feeding a $4 \times 22$ waveguide array. Up to 900 kW of LH power has been coupled in the range$1.6 \leq n_{//} \leq 4$), where $n_{//}$is the parallel refractive index. Driven LH currents have been inferred from magnetic measurements by extrapolating to zero loop voltage, yielding an efficiency of $n_{20}I_{LH}R/P_{LH} \approx 0.3$ [1]. We have simulated the LH current drive in these discharges using the combined ray tracing / 3D ($r$, $v_{\perp}$, $v_{//}$) Fokker Planck code GENRAY – CQL3D [2] and found similar current drive efficiencies. Measurements of nonthermal x-ray emission and electron cyclotron emission (ECE) confirm the presence of a significant fast electron population that varies with waveguide phasing and plasma density. Studies are currently underway to investigate the role of fast electron diffusion and full-wave effects such as diffractional broadening in determining the spatial and velocity space structure of the nonthermal electrons. The 3D ($r$, $v_{\perp}$, $v_{//}$) electron distribution function from CQL3D has been used in synthetic diagnostic codes to simulate the measured hard x-ray and ECE emissions. Fast electron diffusion times have been inferred from x-ray data by employing a radial diffusion operator in CQL3D and determining the fast electron diffusivities that are required to reproduce the experimentally observed profiles of hard x-ray emission. Finally, we have been performing full-wave LH field simulations using the massively parallel TORIC –LH solver [3] in order to assess spatial and spectral broadening of the incident wave front that can result from diffraction and wave focusing effects.

[1] R. Parker, Bull. Am. Phys. Soc. **51**, 20 (2006).
[2] R.W. Harvey and M. McCoy, "The CQL3D Fokker Planck Code," *Proc. IAEA Tech. Comm. Meeting on Simulation and Modeling of Thermonuclear Plasmas*, Montreal, Canada, 1992.
[3] J. C. Wright *et al.*, Nucl. Fusion **45**, 1411 (2005).

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