RECENT ECCD EXPERIMENTAL STUDIES ON DIII-D*

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Ongoing electron cyclotron current drive (ECCD) experiments on DIII-D are solidifying the physics basis for localized, off-axis current drive in both standard and advanced operating modes, the goal being to validate a predictive model of ECCD. The ECCD radial profile can be found from the internal magnetic field measurements by motional Stark effect (MSE) spectroscopy either by comparing the total and Ohmic current profiles determined by equilibrium reconstruction, or by comparing the measured MSE signals to simulations of the expected MSE response to localized current drive.

Experiments in low-density L-mode plasmas have concentrated on validating the expected strong dependencies of the ECCD efficiency on the toroidal injection angle, electron trapping, and the quasi-linear effect. A scan of the toroidal injection angle clearly shows that the ECCD switches from the co to the counter current direction, with radial injection driving no current. The normalized current drive efficiency decreases with increasing minor radius and with decreasing poloidal angle (moving from the inboard to outboard side of the plasma at fixed radius) for both the co and counter current drive directions; these dependencies are consistent with the effect of electron trapping. The experimental ECCD is found to be in better agreement with Fokker-Planck models than with linear models that neglect the quasi-linear effect. In H-mode plasmas, experiments using modulated electron cyclotron wave power verify that the wave absorption remains localized despite edge localized modes (ELMs) and the steep edge density gradient. Clear evidence of localized current drive using electron cyclotron waves in H-mode plasmas is seen by MSE spectroscopy.

Fully non-inductive advanced operating modes on DIII-D require localized current drive near the half radius. Results of off-axis ECCD in H-mode discharges with high electron beta will be presented.

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