Density and Temperature Profile Modifications with Electron Cyclotron Power Injection in Quiescent Double Barrier Discharges on DIII-D*

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Quiescent double barrier (QDB) conditions often form when an internal transport barrier is created with high-power neutral-beam injection into a quiescent H-mode (QH) plasma. These QH-modes offer an attractive, high-performance operating scenario for burning plasma experiments due to their quasi-stationarity and lack of ELMs. In DIII-D experiments, we have been exploring a variety of techniques to expand the QH-mode operating space. We have employed strong shaping, particle control using cryopumping in the divertor region, current ramps to explore stability, neutral-beam-injection (NBI) power ramps to increase stored energy and electron cyclotron heating (ECH) and current drive (ECCD) to control both the q and electron density (n_e) profiles. Our initial experiments and modeling using ECH/ECCD in QDB shots were designed to control the current profile and, indeed, we have observed a strong dependence on the q-profile when EC-power is used inside the core transport barrier region. While strong electron heating is observed with EC power injection, we also observe a drop in the other core parameters; ion temperature and rotation, electron density and impurity concentration. These dynamically changing conditions provide a rapid scan in the range of T_e/T_i profiles accessible with $0.3 < (T_e/T_i)_{axis} < 0.8$ observed in QDB discharges. We are exploring the correlation and effects of observed density profile changes with respect to these time-dependent variations in the temperature ratio. Thermal and particle diffusivity calculations over this temperature ratio range indicate a consistency between the rise in temperature ratio and an increase in transport corresponding to the observed change in density. Details of these experiments and measurements on DIII-D and their relation to models for core turbulence will be discussed. We plan to expand these comparisons to include data from and comparisons with other tokamaks under the auspices of the ITPA.

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