Advanced tokamak profile evolution in DIII-D

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Abstract. Using off-axis electron cyclotron current drive (ECCD), self-consistent integrated advanced tokamak operation has been demonstrated on DIII-D combining high β (>3%) at high q ($q_{min} > 2.0$)

with good energy confinement ($H_{89} \sim 2.5$) and high noninductive current fraction ($f_{BS} \sim 55\%$, $f_{NI} \sim 90\%$). Modification of the current profile by ECCD led to internal transport barrier formation even in the presence of type I edge localized modes. Improvements were observed in all transport channels, and increased peaking of profiles led to higher bootstrap current in the core. Separate experiments have shown the ability to maintain a nearly steady-state current profile for up to 1 s with $q_{min} > 1.5$. Modeling indicates that this favorable current profile can be maintained indefinitely at a higher β_N using tools available to the near-term DIII-D program. Modeling and simulation have become essential tools for the experimental program in interpreting the data and developing detail plans for new experiments.

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