Current Drive and Pressure Profile Modification With Electron Cyclotron Power in DIII-D Quiescent Double Barrier Experiments*

T.A. Casper,[1] K.H. Burrell,[2] E.J. Doyle,[3] P. Gohil,[2] C.M. Greenfield,[2] R.J. Groebner,[2] R.J. Jayakumar,[1] M.A. Makowski,[1] T.L.Rhodes,[3] and W.P. West[2]

[1]*Lawrence Livermore Natinoal Laboratory, Livermore, California, USA*
[2]*General Atomics, San Diego, California, USA*
[3]*University of California, Los Angeles, California, USA*

Recent experiments in quiescent double barrier (QDB) plasmas on DIII-D have explored the possibility for current profile modification using electron-cyclotron heating (ECH) and current drive (ECCD). These experiments, motivated by transport modeling to explore the effects of ECH and ECCD, were consistent with the modeling predictions and provided an initial demonstration of the effects of current profile control with ECCD on the DIII-D tokamak. As a result of the direct ECCD, we observed significant changes in the q-profile both near the ECCD location and the magnetic axis due to inductive effects. In addition to the current profile modification predicted, we also observed a reduction in the pressure profile peaking and an associated beneficial reduction in the total impurity concentration. This modification of the pressure profile resulted in secondary changes in the current profile both through changes in the neutral-beam-driven current and self-consistent changes in the bootstrap current. In these counter-neutral beam injection discharges, we observed a narrowing of the neutral-beam current profile resulting from a change in neutral-beam deposition due to changes in both the density and temperature profiles resulting from heating and changes in transport and possibly due to a reduction in fluctuations. We observed offsetting changes in the bootstrap current that increases with heating but is ultimately reduced by large changes in the local density gradient as the pressure peaking is reduced. These pressure-profile-induced changes in current density complicate the evolution of the q profile and its subsequent control but afford the opportunity for simultaneous control of q, pressure and impurities. Additional DIII-D experiments are scheduled to explore these changes in particle transport with EC injection and to improve performance with neutral-beam injection in QDB discharges. We will discuss details of the experimental results and the modeling predictions.

*Work supported by the U.S. Department of Energy under Contract Nos. W-7405-ENG-48, DE-C03-99ER54463, and DE-FG03-01ER54615.