CURRENT PROFILE MODIFICATION AND HEATING USING FAST WAVE CURRENT DRIVE IN NEGATIVE CENTRAL SHEAR PLASMAS IN DIII–D*

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Fast wave current drive (FWCD) has been used to change the current profile evolution in plasmas with negative central shear, resulting in clear improvements in confinement and stability. These plasmas are created by injecting neutral beams during the current ramp of DIII–D discharges. After current flattop, up to 2.7 MW of rf power has been coupled to the plasma core, providing central electron heating and either co- or counter-directed non-inductive current drive in the central region of the plasma. The profile of FWCD, which has been measured and found to be in good agreement with theory, is centrally peaked, inside ρ = 0.2. Up to 250 kA of current of has been driven, with the fast wave driven current density exceeding the local current density by a factor of 3 on some discharges. Comparing co- and counter-FWCD discharges, we find that counter FWCD enhances the shear reversal, and that these counter FWCD discharges have better confinement and stability properties than the corresponding co cases. Power balance transport analysis of these co/counter comparison shots shows the local thermal diffusivities correlate with the degree of shear reversal, and that the confinement improves as the central current density increases. With counter FWCD, a mode of improved confinement was observed in which both the ion and electron thermal diffusivities decreased in the region of negative central shear. Analysis of the rotation measurements indicates the confinement improvement is consistent with microturbulence suppression by changes in the rotational shear, $\partial/\partial\rho\ (E_r/\rho\ B_p)$. The change in rotational shear has comparable contributions from the change in radial derivative of E_r and of B_p. This illustrates a new positive feedback mechanism by which increasing off-axis bootstrap current and counter FWCD increase the magnetic shear, modifying the transport.

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*Work supported by the U.S. Department of Energy under Contract Nos. DE-AC03-89ER51114 and W-7405-ENG-48.

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