DPP11-2011-000697

Abstract for an Invited Paper
for the DPP11 Meeting of
the American Physical Society

Sensitivity of Transport and Stability to the Current Profile in Steady-state Scenario Plasmas in DIII-D[1]

F. TURCO, Columbia University

Recent experiments on DIII-D have provided the first systematic data on the impact of the current profile on the transport and stability properties of high-performance, steady-state scenario discharges. To achieve 100% noninductive conditions, the current profile J must be sustained by a large fraction of bootstrap current J_{bs}, which is nonlinearly coupled with the kinetic profiles. Systematic scans of q_{min} and q_{95} were performed to determine empirically the best alignment of the noninductive currents with J and the variation of the transport properties with q. Transport analysis indicates that χ_e and χ_i are very sensitive to the details of J, in a way that makes the pressure profile peaking and J_{bs} scale nonlinearly with both q and β in the experiment. Drift wave stability analysis using TGLF indicates the trends in the calculated linear growth rates do not reproduce experimental trends in χ with q_{min} and q_{95}. At high β, necessary to maximize f_{bs}, the discharge duration is often limited by $n = 1$ tearing modes, whose stability also depends on the J profile. Broadly deposited EC current at mid-radius was found to supply part of the required noninductive current and to positively affect the tearing stability. The modes appear when J_{ec} is turned off for stable cases, and always appear when the EC deposition is shifted outwards. The variation in the EC scan results is consistent with PEST3 calculations, showing that the tearing stability becomes extremely sensitive to small perturbations of the equilibrium in wall-stabilized discharges run close to the ideal MHD limit. These modeling results are being used to design new experiments with higher ideal and tearing limits. The new off-axis neutral beam injection system will be used to explore higher q_{min} scenarios and different current alignments.

[1]Supported by the US DOE under DE-FC02-04ER54698.