A27308 Petty Webbing

Abstract

The potential of the hybrid scenario (first developed as an advanced inductive scenario for high fluence) as a regime for high-beta, steady-state plasmas is demonstrated on the DIII-D tokamak. These experiments show that the beneficial characteristics of hybrids, namely safety factor ≥1 with low central magnetic shear, high stability limits and excellent confinement, are maintained when strong central current drive (electron cyclotron and neutral beam) is applied to increase the calculated non-inductive fraction to ≈100% (≈50% bootstrap current). The best discharges achieve normalized beta of 3.4, IPB98(y,2) confinement factor of 1.4, surface loop voltage of 0.01 V, and nearly equal electron and ion temperatures at low collisionality. A zero-dimensional physics model shows that steady-state hybrid operation with *Q*fus ~ 5 is feasible in FDF and ITER. The advantage of the hybrid scenario as an Advanced Tokamak regime is that the external current drive can be deposited near the plasma axis where the efficiency is high; additionally, good alignment between the current drive and plasma current profiles is not necessary as the poloidal magnetic flux pumping self-organizes the current density profile in hybrids with an *m*/*n*=3/2 tearing mode.