APR07-2006-000089

Abstract for an Invited Paper
for the APR07 Meeting of
the American Physical Society

Spontaneous Rotation in Tokamak Plasmas

JOHN RICE, MIT

Spontaneous toroidal rotation has been observed in Alcator C-Mod tokamak plasmas with no external momentum input. The magnitude of the rotation ranges from –60 km/s in discharges with low energy confinement (L-mode) to +140 km/s in plasmas with good energy confinement (H-mode). The rotation in L-mode plasmas is found to depend strongly and in a complicated fashion on the electron density, the plasma current and the magnetic topology, and is typically in the counter-current direction. In contrast, the rotation velocity in H-mode discharges is observed to scale linearly with the plasma stored energy (or plasma pressure) normalized to the plasma current, a relatively simple dependence, and is directed co-current. Immediately following the abrupt transition from L-mode to H-mode, the co-current rotation appears near the plasma edge and propagates to the center on a time scale similar to the energy confinement time, but anomalously fast compared to the classical (collisional) momentum diffusion time. Very similar scalings in H-mode plasmas have been made on many tokamaks worldwide in a variety of operating conditions, indicating the fundamental nature of spontaneous rotation. A universal scaling is beginning to emerge with an eye toward prediction of the level of rotation expected in future devices such as ITER. At present there is no comprehensive theory which explains this phenomenon.