Abstract for an Invited Paper
for the DPP08 Meeting of
The American Physical Society

Penetration of Resonant Magnetic Perturbations in Rotating Plasma[1]

FRANÇOIS WAELBROECK, Inst. for Fusion Studies, Univ. Texas

Mode penetration occurs when a magnetic perturbation changes the plasma rotation so as to eliminate the screening effect. This enables the induced island to grow to a size comparable to its vacuum size. In the core, mode penetration gives rise to disruptive locked modes and must be avoided. In the edge, by contrast, resonant magnetic perturbations (RMP) have been shown to mitigate the edge localized modes (ELM), which present a serious threat to the ITER divertor. It is unclear, however, if mode penetration (and thus magnetic stochasticity) is in fact achieved in ELM mitigation experiments or if the favorable effect of the applied perturbations is due to the influence of the screened modes on edge turbulent transport. This is a critical question for ITER, since design constraints make it very difficult to place coils sufficiently close to the plasma so as to produce mode penetration at the edge while avoiding locked modes in the core. We have used a two-fluid model to investigate the effects of pedestal drifts and turbulence on mode penetration. We find that penetration occurs when the electric (ExB) drift compensates the electron diamagnetic drift, so that the electron fluid is at rest with respect to the perturbation. If the electrons are flowing, however, there is a marked asymmetry in the plasma response according to the direction of their flow. When their total velocity is opposite to that of the ion fluid, the magnetic perturbation excites drift-acoustic waves that cause anomalous transport. These waves propagate beyond the screened islands, so that the drift- acoustic wakes for nearby islands will overlap before the islands do. This suggests that the beneficial effects of RMP could accrue for much lower amplitudes than those required for mode penetration.

[1]Supported by US DOE contracts DE-FG03-96ER-54346 and DE-FC02-04ER54785.