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Scaling Studies of the H–Mode Pedestal[1]

R.J. GROEBNER, for the DIII–D Physics Group, General Atomics

Possible mechanisms controlling the gradient and width of the H–mode transport barrier, formed at the edge of H–mode discharges, are being studied in the DIII–D tokamak. Measurements of the edge electron temperature, density and pressure profiles (T_e, n_e and p_e) and of the edge C VI temperature, density and pressure profiles (T_i, n_i and p_i) are obtained with sufficient spatial resolution to resolve the H–mode barrier. An analysis procedure has been developed in which the height, gradient and width of the pedestal for any of these profiles are obtained by fitting a hyperbolic tangent function plus appropriate linear terms to the edge data.[2] Studies of a series of discharges made in the ITER shape[3]and of a random sample of discharges covering a large part of the DIII–D operational space[4] show that the edge pressure gradients in H–mode are typically close to but often exceed the critical gradients for infinite-n ballooning modes by factors of 2–3. Furthermore, it is anticipated that the use of current density profiles which are consistent with the measured steep edge pressure gradients (work in progress) would push the plasma edge further into second stability. Accordingly, improvement of the infinite-n theory or inclusion of other physics (*e.g.* medium-n modes) may be required. Studies of the width of the transport barrier have been performed by examining the dependence of the width of the pressure profile on specific measured parameters. Regression analyses of the two studies noted above, in which T_e was used as a proxy for T_i, suggest that the width of the pressure barrier is proportional to $\beta_p^{1/2}$ where β_p is the poloidal beta at the pedestal or as $\rho_{i\theta}^{2/3}$ where $\rho_{i\theta}$ is the ion poloidal gyroradius. However, a specific scaling study of the measured p_i profile has been done in a series of discharges in which the triangularity δ and ion poloidal gyroradius $\rho_{i\theta}$ were varied. The observed width of the p_i profile was constant in these discharges with a value of about 1.5–2.0 cm at the outside midplane despite variations of $\rho_{i\theta}$ and δ of more than a factor of two. Thus, it is not yet clear what controls the width of the p_i profile.

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[2]R.J. Groebner *et al.*, to be published in Proc. of 1996 IAEA meeting.
[3]T. Osborne *et al.*, to be published in proceedings of 1997 EPS meeting.
[4]P. Yushmanov *et al.*, Bull Amer. Phys. Soc. **41**, (1996) 1575.