The ∇B Drift Effect, Sawteeth, and the H-mode Power Threshold Scaling

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General Atomics — Because the H-mode transition takes place at the plasma edge, it is believed that the power flow across the separatrix, \( P_{\text{SEP}} \), is important in determining the threshold power. Cross field fluxes due to the ∇B drift effect and the heat pulse associated with a sawtooth crash are two mechanisms that can influence this power. We have modeled the equivalent power due to these effects and find that they contribute significantly to the total \( P_{\text{SEP}} \). It is proposed that the observed scaling of the power threshold, \( P_{\text{TH}} \), is strongly influenced by these effects. In experiments performed with the ion ∇B drift away from the x-point (reverse B), \( P_{\text{TH}} \) is 2–3 times larger than for the ion ∇B drift toward the X-point (forward B). This is attributed to the cross field fluxes changing sign with the ∇B drift direction. Transitions triggered by sawteeth show an almost linear dependence of \( P_{\text{TH}} \) on the toroidal field, B. However, \( P_{\text{TH}} \) in discharges where the sawteeth were suppressed showed almost no dependence on B. Including the ∇B and sawteeth effects, a simple scaling of the power threshold is derived. This model predicts a much lower threshold power for ITER than a simple power law regression of the database.

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