L→H transitions and transport barrier propagation in a simple model of coupled heat and particle fluxes

M.A. Malkov and P.H. Diamond

University of California at San Diego, 9500 Gilman Dr, La Jolla, CA 92093-0319, USA

Abstract

The origin and structure of edge [1] and internal [2] transport barriers is one of the central problems in magnetic fusion research. A simplified model proposed in [3] includes coupling between the nonlinear fluxes of particles and heat in a form of two diffusion equations. Earlier, we solved this model analytically in a steady state assuming that regularization (taken in a form of hyperdiffusion) is applied to only one field (density or pressure). In this simple case the transition is shown to obey the Maxwell equal area rule. However, different regularization schemes result in different transition rules. We have shown that inclusion of the curvature of radial pressure profile, for example, leads to a criterion that the transition occurs at lower heat and particle fluxes. This dependence of transition criteria on the regularization clearly demonstrates the necessity of dynamical modelling. In this paper, we therefore also explore a time dependent approach. In particular we discuss the front propagation solutions describing the penetration of the H-mode state into L-mode state and vice versa.

[1] Wagner F, et al., **49**, PRL, 1408 (1982)
[2] Koide, Y. et al. PRL, **72**, 3662 (1994)
[3] Hinton, F. L. and Staebler, G.M. Phys. Fluids, 1281 (1993)