Dynamic Modeling of Multi-Channel Transport Bifurcations Using Ion Temperature Gradient Based Models for Tokamak Plasmas*

J.E. Kinsey,[1] H.E. St. John, G.M. Staebler, and R.E. Waltz

General Atomics, P.O. Box 85608, San Diego, California 92186-5608
[1]Oak Ridge Associated Universities, Oak Ridge, Tennessee

Rotational shear stabilization is believed to play a major role in the formation of internal transport barriers in tokamak plasmas. However, dynamically following bifurcations in the particle, energy, and momentum confinement that lead to the formation of transport barriers with the most comprehensive theoretical models remains an important yet unresolved numerical problem. In DIII–D VH–mode and NCS discharges, it has been argued that $E \times B$ rotational shear induced by a momentum channel bifurcation is the most likely cause of the observed core transport barrier. In TFTR, diamagnetic rotatonal shear stabilization induced heat flow bifurcations have been proposed as the dominant mechanism for internal transport barriers. This mechanism is of particular interest since a pessimistic power threshold is predicted at smaller values of normalized gyroradius ρ_*. In previous studies by Staebler *et al.* [1], simple heuristic models were used to examine multi-channel bifurcations. In this work, we consider the GLF23 gyro-fluid based transport model [2] which contains both heat flux and momentum bifurcation mechanisms. Using the GLF23 model, we explore various numerical techniques in order to successfully allow time-dependent transport codes to dynamically follow bifurcations to enhanced confinement regimes by self-consistently computing the effect of $E \times B$ shear stabilization. Successful implementation of numerically robust algorithms will allow determination of power threshold scalings for internal transport barriers.

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