Progress in Modeling Internal Transport Barrier Formation Using the GLF23 Transport Model

J.E. KINSEY, Lehigh U., G.M. STAEBLER, R.E. WALTZ, GA — Significant progress has been made in predicting internal transport barrier (ITB) in tokamaks. Results are presented for simulations of the thermal and toroidal momentum transport in L- and H-mode ITB discharges using the GLF23 driftwave model. The turbulence suppression mechanisms of $E \times B$ shear and Shafranov shift stabilization are essential in reproducing the observed core barriers in the ion and/or electron transport. While $E \times B$ shear can suppress the transport due to low to intermediate wavenumber ($k$) ITG/TEM modes, Shafranov shift can reduce the low-$k$ (ITG) and high-$k$ (ETG) modes for reversed magnetic shear resulting in simultaneous electron and ion barriers. The model predicts the temperature and toroidal velocity profiles for more than 20 ITB discharges from DIII-D, TFTR, and JET with an RMS error in the incremental stored energy of 13%. The same model reproduces the temperature profiles from over 100 L- and H-mode discharges without ITBs. For reversed-shear cases in FIRE and ITER-FEAT, an ITB is predicted as a result of $\alpha$-stabilization and diamagnetic $E \times B$ shear stabilization with modest density peaking.

$^1$Supported by the US DOE under DE-FG03-95ER54309 and DE-FG03-92ER54141.