Simulations of internal transport barrier formation in tokamak discharges using the GLF23 transport model

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Abstract

Results are presented for simulations of tokamak discharges exhibiting internal transport barriers (ITBs) with significant reductions in the core thermal transport using a comprehensive theory–based model for drift-wave transport. The predicted temperature and toroidal velocity profiles from the GLF23 model are compared against the experimental data for twenty two L- and high-confinement mode (H-mode) ITB discharges from three large tokamaks including DIII-D [J. L. Luxon and L. G. Davis, Fusion Tech. **8**, 441 (1985)], Tokamak Fusion Test Reactor (TFTR) [D. J. Grove and D. M. Meade, Nucl. Fusion **25**, 1167 (1985)], and Joint European Torus (JET) [P. H. Rebut and B. E. Keen, Fusion Tech. **11**, 13 (1987)]. The combined effects of $E \times B$ shear and Shafranov shift stabilization of the turbulent transport are essential in reproducing the barriers in the plasma core. Shafranov shift or α-stabilization is found to be an essential ingredient in suppressing the thermal transport due to ion and electron temperature gradient (ITG, ETG) and trapped electron modes (TEM) that can result in simultaneous electron and ion barriers. Another consequence of α-stabilization is that the power threshold for ITB formation is predicted to decrease for strongly reversed magnetic shear cases in comparison with weakly reversed shear cases.

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