1997 International Sherwood Fusion Theory Conference
April 23–26, 1997, Madison, Wisconsin

Rotation Damping and ITG Modes

F.L. Hinton, M.N. Rosenbluth,† and R.E. Waltz

General Atomics
San Diego, California

Recent advances in gyro-fluid simulation of Ion Temperature Gradient (ITG) modes in tokamaks have shown that the predominant saturation mechanism for the instability is the production of $m = n = 0$ primarily poloidal flows which vary with radius and serve to shear-stabilize the instability. Thus the damping of such poloidal flows is critically important in determining the turbulence level to be expected, and the adequacy of gyro-fluid models for calculating the damping is an issue. We solve kinetically a relevant model problem, and suggest it as a benchmark for gyro-fluid simulations. We calculate the linear collisionless damping of poloidal rotation with particular interest in the level of buildup of such rotation as fed by ITG modes. We find that, after a transient of a few ion transit times, the kernel relating the rotation to the nonlinear source asymptotes to a plateau value which would then slowly damp according to neoclassical collisional damping. This plateau value is compared with gyro-fluid predictions. A higher value would imply a stronger shear-stabilizing effect, and hence a lower level of ITG turbulence.

This is a report of research partially sponsored by the U.S. Department of Energy under Grant No. DE-FG03-95ER54309.

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†ITER-JCT, San Diego, California.