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Nonlinear Plasma Response to Resonant Magnetic Perturbation in Rutherford Regime[1] PING ZHU, University of Science and Technology of China, University of Wisconsin-Madison, XINGTING YAN, WENLONG HUANG, University of Science and Technology of China — Recently a common analytic relation for both the locked mode and the nonlinear plasma response in the Rutherford regime has been developed based on the steady-state solution to the coupled dynamic system of magnetic island evolution and torque balance equations. The analytic relation predicts the threshold and the island size for the full penetration of resonant magnetic perturbation (RMP). It also rigorously proves a screening effect of the equilibrium toroidal flow. In this work, we test the theory by solving for the nonlinear plasma response to a single-helicity RMP of a circular-shaped limiter tokamak equilibrium with a constant toroidal flow, using the initial-value, full MHD simulation code NIMROD. Time evolution of the parallel flow or "slip frequency" profile and its asymptotic approach to steady state obtained from the NIMROD simulations qualitatively agree with the theory predictions. Further comparisons are carried out for the saturated island size, the threshold for full mode penetration, as well as the screening effects of equilibrium toroidal flow in order to understand the physics of nonlinear plasma response in the Rutherford regime.

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