Nonlinear Evolution of Axisymmetric Toroidal Plasma Mode

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Abstract

The motion of an ideal tokamak plasma embedded in a nonhomogeneous external magnetic field leads to the induction of eddy currents in conductors as well as surface current at the plasma boundary. We describe a self-consistent model to study the nonlinear evolution of a toroidal plasma equilibrium configuration surrounded by external conductors. The model includes free boundary plasma equilibrium with plasma surface current and a prescribed safety factor distribution as well as circuit equations for eddy currents in the conductors. We present a new version of the PET code [2]-[3], which solves the problem. The code provides flux conserving equilibrium evolution of the tokamak plasma simultaneously with calculation of the plasma boundary surface current and conductor eddy currents. The code uses grid adaptive to magnetic surfaces inside plasma domain. Plasma axisymmetric stability and feedback control analysis can be performed. Good agreement with linear MHD model growth rate values for up-down symmetric as well as for single-null plasma configurations [3] is demonstrated. It is shown that existence of the surface plasma current can essentially change the axisymmetric growth rate values especially for single-null plasma configurations.

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