Phys. Plasmas

A two-dimensional magnetohydrodynamic stability model for helicity- injected devices with open flux

D.P. Brennan

General Atomics, P.O. Box 85608, San Diego, California 892186-5608

P.K. Browning

University of Manchester Institute of Science and Technology,

Manchester, England

R.A.M. Van der Linden

Royal Observatory of Belgium, Brussels, Belgium

(April 9, 2002)

Abstract

We present models of the ideal MHD stability of spheromaks and spherical tokamaks, including the effects of current on the open flux which play a key role in helicity injected current drive. A previous one dimensional model is extended to more realistic two dimensional equilibria which properly incorporate a region of closed magnetic flux as well as open flux penetrating the boundaries at electrodes. A new stability code SCOTS has been developed which can determine the growth rates of ideal MHD modes in this geometry. The coordinate system for this code has been developed such that it extends smoothly across the separatrix between closed and open flux. The code is benchmarked against previous models of MHD stability of spheromaks, which include only the closed flux, and against one dimensional equilibria consisting

entirely of open flux. The stability of spheromak equilibria with both open and closed flux and realistic current profiles representative of helicity injected state is then investigated, where a kink instability in the open flux is shown to dominate a tilt mode in the closed flux as the open flux current density is increased.

PACS Nos. 52.55.Wq, 52.35.Py, 52.55.Ip, 52.65.Vv