2C12

Stability analysis for a finite aspect ratio screw pinch

D.D. Ryutov, R.H. Cohen, L.D. Pearlstein

Lawrence Livermore National Laboratory, Livermore, CA 94551

Abstract

We consider the ideal MHD stability of a cylindrical screw pinch of a finite length, limited by two parallel perfectly conducting plates in the axial direction, without making any assumptions regarding the ratio of the length L to the pinch radius a and the radius of the cylindrical outer shell b. Despite the simple geometry, the problem is much more complex than that for a long pinch, where one can easily separate the axial and the radial variables. Our interest in this problem is driven by its potential relevance to the performance of the Livermore spheromak SSPX [1], where instabilities of the central plasma column are thought to affect plasma confinement in some regimes. Based on the standard energy principle, we derive several alternative expressions for the energy perturbation and reduce them to the form suitable for the iterative analysis. In the particular case of a skin current, we obtain a one-dimensional eigen-equation for the radial displacement of the plasma boundary and recover Kruskal-Shafranov criterion in the appropriate limit. In the general case, the pinch becomes more stable. Bearing in mind possible modifications of the shape of the SSPX vacuum vessel, we consider also a more complex geometry, with a plasma column sitting on the top of a cylindrical pedestal (so that the length of the pinch is less than L), and the geometry of a hard-core pinch.

1. Hooper E.B. Pearlstein L.D. Bulmer R.H. Nucl. Fusion. **39**, 863, 1999