BULL. AUSTRAL. MATH. SOC. 76E25, 82A45
VOL. 10 (1974), 143-144.

Abstracts of Australasian PhD theses

Magneto-viscous effects on resistive plasma instabilities

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The influence of ion "parallel" viscosity, finite Larmor radius and "perpendicular" viscosity in resistive, normal mode analysis for the "interchange" and "tearing" instabilities is investigated.

For a plasma slab (cartesian) model, it is shown that ion "parallel" viscosity is unimportant for the resistive-g instability, but that ion "perpendicular" viscosity has a stabilizing effect consistent with results in previous literature.

A preliminary, cartesian model calculation for the incompressible resistive "tearing" mode in the hard-core pinch, with "parallel" viscosity included in the outer (non-resistive) region, suggests that "parallel" viscosity might be destabilizing. This result is not confirmed in cylindrical geometry calculations involving viscosity in the outer region, however; the dominant "parallel" viscosity is found to have no significant effect, except for slight stabilization in the extreme shear case.

A more complete treatment of the resistive "tearing" mode with viscosity, including both cylindrical geometry and compressibility, suggests the possibility of:

(i) a new (double) viscous instability;

(ii) a "parallel" viscosity modified resistive "tearing" instability, more unstable at lower temperatures but more stable at high temperature;

Received 21 May 1973. Thesis submitted to the Flinders University of South Australia, May 1973. Degree approved, November 1973. Supervisor: Professor R.J. Hosking, University of Waikato.

(iii) negative values of $\Delta(Q)$, the discontinuity in the logarithmic derivative of the radial perturbed magnetic field across the inner resistive region, and resultant viscous instability;

(iv) possible complete stabilization of the resistive tearing mode by "parallel" viscosity.

https://doi.org/10.1017/S0004972700040739 Published online by Cambridge University Press