Abstract Submitted
for the DPP06 Meeting of
The American Physical Society

A general MHD stability formulation for plasmas with flow and resistive walls L. GUAZZOTTO, J.P. FREIDBERG, MIT, R. BETTI, U. of Rochester — Toroidal rotation, either induced by means of neutral beams (e.g. in NSTX and DIII-D) or appearing spontaneously (e.g. in Alcator C-Mod, JET and Tore Supra) is routinely observed in modern tokamak experiments. Poloidal rotation is also commonly observed, in particular in the edge region of the plasma. Plasma rotation has a major effect on plasma stability. Flow and flow shear stabilize external modes such as the resistive wall mode (as observed e.g. in DIII-D), suppress turbulence when the flow shear is large enough, and also have a significant influence on the stability and nonlinear evolution of the internal kink and ballooning modes. Flow shear can in particular have both a stabilizing (by breaking up unstable structures) and destabilizing (through the Kelvin-Helmholtz mechanism) effect. A self-consistent analysis of the effect of rotation requires the use of numerical tools. In this work, we present a general eigenvalue formulation based on a variational stability analysis, including arbitrary (both toroidal and poloidal) plasma rotation and a thin resistive wall of arbitrary shape and resistivity. It is shown the problem can always be reduced to a classic eigenvalue formulation of the kind $i\omega\underline{\underline{A}}\cdot\zeta = \underline{\underline{B}}\cdot\zeta$, where ζ is an unknown eigenvector related to the plasma displacement, and ω the (complex) evolution frequency of the perturbation. The formulation is well suited for a finite element analysis.

J.P. Freidberg

Date submitted: 20 Jul 2006 Electronic form version 1.4