Equilibrium and stability of rotating plasmas in a mirror geometry *

James B. Aydemir[1] and Ahmet Y. Aydemir[2]

[1] *Westwood High School*
12400 Mellow Meadow Drive
Austin, TX 78750

[2] *Institute for Fusion Studies*
The University of Texas at Austin
Austin, TX 78712

Plasma flows of significant magnitude seem to be a ubiquitous feature of confined plasmas. The flow by itself, or in combination with the shear in the flow profile, is now recognized to have a stabilizing influence on large scale instabilities such as the resistive wall and internal kink modes in tokamaks, and microturbulence. Long before the beneficial effects of these incidental flows were discovered, flows driven externally as in integral part of a confinement scheme were also examined[1]. Recently some of these ideas have been revived, as in the centrifugal confinement experiment MCT[2] of Maryland and the magneto-Bernoulli experiment of FRC[3]. Both use a mirror field in conjunction with a radial electric field to drive large cross-field flows. We have done a systematic study of the MHD equilibrium and stability of these configurations. Although we have easily found centrifugally confined detached states, our stability calculations have consistently yielded negative results. The expected shear stabilization of the interchange modes is observed for rotation frequencies comparable to the growth rate of the flute modes. However, centrifugal confinement becomes effective at much higher frequencies, where a plethora of ideal MHD modes are observed, both with $k_{\|} = 0$, and with finite $k_{\|}$. These rotationally-driven modes are observed even in a pure $\theta-$pinch configuration without the unfavorable curvature of the mirror fields. Therefore, accessibility of these detached states look highly questionable, although we are continuing with our efforts.

[1] B. Lehnert, Nucl. Fusion **11**, 485 (1971).

[2] R. F. Ellis, A. B. Hassam, S. Messer, and R. B. Osborn, Phys. Plasmas **8**, 2057 (2001).

[3] H. Quevedo, P. M. Valanju, and Roger D. Bengtson, Bull. Am. Phys. Soc. **47**, 67 (2002).

*Work supported by U.S. Department of Energy Contract No. DE-FG03-96ER-54346.