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Rotational stability of a long, high-beta, field-reversed column D.C. BARNES, L.C. STEINHAUER, Tri Alpha Energy, J.P. FREIDBERG, MIT-Plasma Fusion Science Center — Rotationally driven modes are observed to be important in determining FRC stability and confinement. As a first model, we consider a long, rotating column. The B is in the axial direction and the pressure gradient and centripetal acceleration are balanced by a strong radial gradient of B, which may pass through zero and reverse on axis, as in an FRC. The non-reversed version of this problem was considered earlier[1] using an approximate solution of the ion kinetic equation. We simplify the present analysis by assuming incompressible motion of the plasma and including the gyro-viscous (GV) stress to construct an eigenvalue problem. This leads to a formally symmetric o.d.e. which contains the eigenfrequency in a complicated manner. Finite axial wavenlength is included to leading order. Regular solutions, which satisfy the outer boundary condition at a conducting wall, give normal modes, and are found by the shooting method. We show that this procedure reproduces the results of Ref. 1 and generalizes to more complicated equilibria having rotational shear and field reversal. In the case of field reversal, it is necessary to employ a GV form that is appropriate for small B. For this we use either the collisional form[2] or a new low-collisionality form which accounts for the de-magnetization of the ion orbits at small B. Results for FRC's with and without strong shear are presented.

[1]J. P. Freidberg and L. D. Pearlstein, *Phys. Fluids* **21**, 1207 (1978).
[2]N. Iwasawa, A. Ishida, L. C. Steinhauer, *Phys. Fluids* **B8**, 1240 (2001).

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