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Real-Time Position Control of Long-Lived FRC Plasmas N. RATH, D. BARNES, S. PUTVINSKI, Tri Alpha Energy, TAE TEAM — Recent experiments on the C-2 device [1] at Tri Alpha Energy have produced FRC plasmas with lifetimes of up to 5 ms. On this time scale, the vessel wall acts as a perfect conductor and passively stabilizes the plasma. In future experiments, increased heating power is expected to increase the FRC lifetime beyond the resistive decay time of the wall so that the plasma position has to be actively feedback controlled. We present a theoretical model and simulation results for an appropriate control system. We consider rigid displacements of the bulk plasma linearized around a variety of axisymmetric two-fluid equilibria. The resulting perturbed 3-D equilibria are coupled to a finite-element model of the confinement vessel to obtain a linear system of ODEs that describes the time evolution of rigid perturbations of the plasma position. The linearized model is used to control both plasma stability and plasma position using a set of axisymmetric trim coils. Reflection symmetric currents are applied to obtain plasma equilibria that are stable to transverse displacements and resistively unstable in the axial direction, and additional antisymmetric components are used to balance the plasma axially. The time evolution of the closed-loop system is simulated using a time-dependent 2-D fluid code.

[1] M. Tuszewski et al., Phys. Rev. Lett. 108, 255008 (2012)

Nikolaus Rath
Tri Alpha Energy

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