Analytical equilibrium and interchange stability of single- and double-axis field-reversed configurations inside a cylindrical cavity

P. B. Parks and M. J. Schaffer
General Atomics, P.O. Box 85608, San Diego, California 92186-5608

Abstract. This paper reports on the interchange stability of a realistic analytical equilibrium solution of a field-reversed configuration (FRC) contained within a tight fitting cylindrical flux conserver with end walls, no external flux, and arbitrary elongation $E$. For $E >> 1$, interchange stability is possible with $p_s / p_0 > 7/12$, where $p_0$ is the peak pressure at the magnetic axis, and $p_s$ is the pressure at the separatrix/wall, a condition that appears to be compatible with high-pressure wall-confined, pulsed FRC implosions. Oblate configurations require somewhat less $p_s / p_0$ for stability. Analytical equilibria have been found for FRCs with two magnetic axes (doublets) with an internal figure-of-eight separatrix. A striking improvement in stability with respect to interchange modes was found in doublets: the private flux region (core) can be completely stabilized with zero separatrix pressure. This new finding suggests that doublet FRCs may be more relevant for steady-state fusion applications, which for good performance nominally require the absence of interchange turbulence as well as low edge-to-core pressure ratios.

PACS Nos. 52.55.Lf