Abstract Submitted
for the APR06 Meeting of
The American Physical Society

Ideal $m = 1$ internal kink mode in line-tied screw pinch YI-MIN HUANG, CMSO, University of Wisconsin, Madison, ELLEN G. ZWEIBEL, CARL R. SOVINEC, University of Wisconsin, Madison — It is well known that the radial displacement of the $m = 1$ internal kink mode in a periodic screw pinch has a steep jump at the resonant surface where $\mathbf{k} \cdot \mathbf{B} = \mathbf{0}$. In a line-tied system, relevant to solar and astrophysical plasmas, the resonant surface is no longer a valid concept. It is then of interest to see how line-tying alters the result for a periodic system. If the line-tied kink also produces a steep gradient, it may lead to strong heating even with weak dissipation. Numerical solution of the eigenmode equations finds that the fastest growing kink mode in a line-tied system still possesses a jump in the radial displacement at the location coincident with the resonant surface of the fastest growing mode in the periodic counterpart. However, line-tying thickens the inner layer and reduces the growth rate. As the system length L approaches infinity, both the inner layer thickness and the growth rate approach the periodic values. In the limit of small $\epsilon \sim B_\phi/B_z$, the critical length for instability $L_c \sim 1/\epsilon^3$. The relative increase in the inner layer thickness due to line-tying scales as $(1/\epsilon)(L_c/L)^{2.5}$. The nonlinear equilibrium after the onset of the kink instability is of greater interest. Work is in progress to solve the new equilibrium by a magnetofrictional relaxation method. To avoid reconnection due to numerical resistivity, we take a Lagrangian approach formulated in Clebsch coordinates.

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Date submitted: 12 Jan 2006 Electronic form version 1.4