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Two-fluid simulations of sawteeth in a periodic boundary driven screw-pinch.[1] V.S. LUKIN, S.C. JARDIN, Princeton Plasma Physics Laboratory
— We numerically study non-linear evolution of m=1 internal kink mode in 2D helical geometry. Initial value simulations have been conducted with the macroscopic modeling code SEL. A number of plasma fluid models, from reduced MHD to full two-fluid extended MHD, have been applied to the problem. Both resistive and two-fluid evolution of an ideally unstable initial condition through full Kadomtsev reconnection is studied. In the semi-collisional regime, onset of fast reconnection is shown to be correlated with the width of resistive current sheets falling below characteristic inertial scales available to the system. In simulations with assumed peaked radial profile of conductivity and Ohmic current drive, formation of a helical paramagnetic quasi- equilibrium with enhanced stability properties is observed following the initial reconnection event. Plasma is then shown to produce periodic sawtoothing behavior which is independent of the initial conditions. Observed sawteeth are characterized by relatively slow semi-resistive kinking followed by apparent onset of the quasi-interchange mode on an ideal MHD time-scale. Incomplete reconnection of the plasma core, maintaining the safety factor q in the central plasma region below unity throughout a sawtooth cycle, is demonstrated.

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