δf Simulation of Collisionless Tearing Modes

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The evolution of the collisionless tearing mode is studied using a three-dimensional particle-in-cell simulation model that uses the δf-method with the split-weight scheme to enhance the time step, and a novel algorithm to accurately solve the Ampere's equation for experimentally relevant β values, $\beta \frac{m_i}{m_e} \gg 1$.[1] We compare the cases of gyrokinetic electrons with drift-kinetic electrons. The gyrokinetic electron simulation is interesting because kinetic theory shows that during reconnection, the half width of the induced current could be well below the ion Larmor radius and the effect of finite electron Larmor radius could be significant. Linear simulation results will be benchmarked with eigenmode analysis for the case of fixed ions and drift kinetic electrons. The nonlinear dynamics of small-scale magnetic islands will be studied using the δf scheme and the results will be compared with previous studies using the full-f PIC simulation method[2].

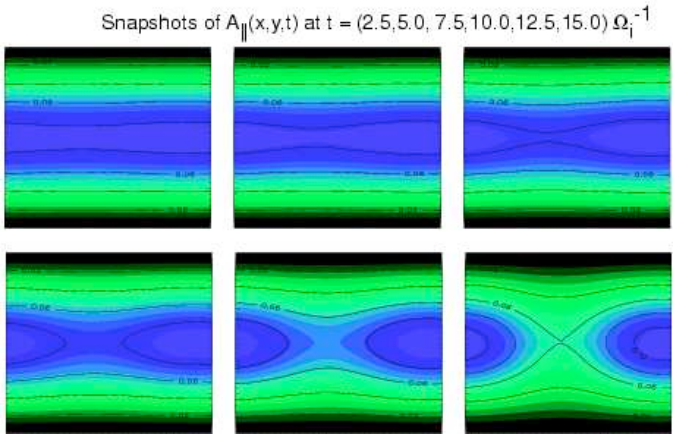

Figure 1: Island growth due to a tearing mode with $k_y \rho_i = 1$, $k_{\|} = 0$, $\beta = 6\%$, obtained from the split-weight δf code.

[1] Y. Chen and S. E. Parker, submitted to J. Comp. Phys.
[2] R. D. Sydora, Phys. Plasmas **8, 1929 (2001)**