Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

Snakes and sawteeth in nonlinear MHD[1] LINDA SUGIYAMA, MIT, LUIS DELGADO-APARICIO, PPPL — The "snake," a helical $m/n = 1/1$ concentration of ion density near the $q = 1$ magnetic surface in a toroidal confined plasma, is shown to arise naturally in nonlinear resistive MHD when the plasma density evolves. The results help to resolve the theoretical problems posed by long snake lifetimes and their coexistence with periodic sawtooth crashes. Numerical simulations with the M3D code show that a helical density perturbation imposed around $q = 1$ can form a quasi-steady helical state over $q \geq 1$. Within $q < 1$, two principal outcomes depend on the magnitude of $\tilde{n}/n$ and the 1/1 internal kink stability and correspond to the two main types of snake formation observed in experiments. For a small $q < 1$ region, the applied density drives a new type of slowly growing mode with some features of the nonlinear internal kink. It resembles the early broad kink seen in heavy-impurity-ion snakes in ohmic discharges, including recent observations on Alcator C-Mod. For a larger, more unstable $q < 1$ region, the helical density perturbation drives a conventional kink, leading to a rapid sawtooth crash. The crash redistributes the density to a localized helical concentration over $q \leq 1$, consistent with the formation of sawtooth-induced snakes.

[1]Work supported by the U.S. Department of Energy.

Linda Sugiyama
MIT

Date submitted: 17 Jul 2012 Electronic form version 1.4