Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

Constructing current singularity in a 3D line-tied plasma YAO ZHOU, YI-MIN HUANG, HONG QIN, AMITAVA BHATTACHARJEE, Princeton University — We revisit Parker's conjecture of current singularity formation in 3D line-tied plasmas, using a recently developed numerical method, variational integration for ideal magnetohydrodynamics in Lagrangian labeling. With the frozen-in equation built-in, the method is free of artificial reconnection, hence arguably an optimal tool for studying current singularity formation. Using this method, the formation of current singularity has previously been confirmed in the Hahm-Kulsrud-Taylor problem in 2D. In this paper, we extend this problem to 3D line-tied geometry. The linear solution, which is singular in 2D, is found to be smooth for all system lengths. However, with finite amplitude, the linear solution can become pathological when the system is sufficiently long. The nonlinear solutions turn out to be smooth for short systems. Nonetheless, the scaling of peak current density vs. system length suggests that the nonlinear solution may become singular at a finite length. With the results in hand, we can neither confirm nor rule out this possibility conclusively, since we cannot obtain solutions with system length near the extrapolated critical value.

Yao Zhou
Princeton University

Date submitted: 14 Jul 2017 Electronic form version 1.4