DPP19-2019-002132
C

Abstract for an Invited Paper
for the DPP19 Meeting of
the American Physical Society

Particle Acceleration by Current-driven Instabilities

JONATHAN ZRAKE, Columbia University

Many objects in the universe produce light by dissipating magnetic energy. Examples include solar flares, the nebulae surrounding pulsars, AGN jets, and gamma-ray bursts. Traditionally, magnetic energy dissipation and particle acceleration in these systems has been investigated from the microscopic point of view, focusing on magnetic reconnection around small-scale magnetic null points. I will present results from a research program that focuses instead on the macroscopic scales, paying particular attention to particle acceleration by unstable magnetic flux tubes. These structures are observed directly in the solar corona, and exist in magnetically accelerated outflows, including AGN jets and pulsar wind nebulae. We have found, using fully kinetic particle-in-cell simulations, a particular class of current-driven instability that is an exceptionally efficient accelerator of non-thermal particles. The mechanism is a first-order Fermi-like process, whereby plasma particles execute curvature-drifts in the direction of a coherent, inductive (MHD-like) electric field, while diffusing in a turbulent magnetic field. This mechanism is distinct from injection process observed near reconnecting current layers, where the dominant acceleration comes from the unscreened (parallel) electric field.