Dependence of Kinetic Entropy on Plasma Temperature and Density in Particle-in-Cell Simulations of Antiparallel Reconnection

MAHMUD HASAN BARBHUIYA, West Virginia University, HAOMING LIANG, The University of Alabama in Huntsville, PAUL CASSAK, West Virginia University, MARC SWISDAK, University of Maryland, VADIM ROYTERSHTEYN, Space Science Institute — Kinetic-scale energy conversion and dissipation plays a crucial role during magnetic reconnection. Many theoretical approaches have been used to identify energy conversion and dissipation in reconnection. We focus our investigation on kinetic entropy, related to the phase space integral of "f ln f", where f is the distribution function. The motivation behind using kinetic entropy as a diagnostic is that it is the most natural quantity to identify and quantify dissipation in a closed physical system [e.g., Liang et al., Phys. Plasmas, 26, 082903, 2019]. We use particle-in-cell simulations using the P3D code that are two-dimensional in physical space and three-dimensional in velocity space to study the generation, spatial structure and time evolution of kinetic entropy in anti-parallel magnetic reconnection. We perform a parametric study varying the temperature and density of the electrons and ions to investigate their impact on kinetic entropy and the usage of kinetic entropy to identify regions of adiabatic and irreversible processes.

Mahmud Hasan Barbhuiya
West Virginia University