DPP06-2006-000618

Abstract for an Invited Paper
for the DPP06 Meeting of
the American Physical Society

Fast Collisionless Reconnection in Electron-Positron Plasmas[1]

NAOKI BESSHO, Space Science Center and Center for Magnetic Self-Organization, University of New Hampshire, Durham, New Hampshire 03824

There has been growing interest in pair plasmas for their applications to astrophysical as well as laboratory plasma physics. Important astrophysical applications include extragalactic jets, and winds and jets from pulsars. In addition to these applications, studies of magnetic reconnection in electron-positron plasmas present a new opportunity to examine critically the question of the ingredients that are essential in realizing regimes of fast magnetic reconnection. In a pair plasma, the electron and ion skin depth parameters are identical, the Hall current cancels out exactly, and whistler waves do not exist. We demonstrate, by means of two-dimensional particle-in-cell simulations, that fast reconnection occurs in a pair plasma without a separation of spatial scales between electron and positron flows, and without the intervention of the Hall current. Despite the absence of the Hall current and whistler waves, our numerical results provide clear evidence of fast collisionless reconnection due to the localization caused by the off-diagonal components of the pressure tensors [N. Bessho and A. Bhattacharjee, Phys. Rev. Lett., 95, 245001 (2005)]. We have carried out simulations in non-relativistic as well as relativistic regimes, the latter with drifting Jüttner-Synge distribution functions. When the Alfvén speed is close to the speed of light, the outflow speed due to reconnection also becomes close to the speed of light. Ultrarelativistic particles are generated by reconnection. We will discuss the energy spectrum of accelerated particles and the mechanisms of their acceleration.

[1]Collaborator: A. Bhattacharjee. This research is supported by the DOE, NSF, and the Paul Chair Endowment.