DPP19-2019-001501

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

Thomas H. Stix Award for Outstanding Early Career Contributions to Plasma Physics Research Talk: Magnetic reconnection, collisionless shocks, and cosmic particle acceleration in the laboratory[1]

WILLIAM FOX, Princeton Plasma Physics Laboratory

Magnetic reconnection and collisionless shocks are of great interest as fundamental physics processes which allow rapid conversion of energy in plasmas. Magnetic reconnection mediates a change of magnetic topology and the explosive release of stored magnetic energy, while shocks mediate a fast thermalization of colliding supersonic plasma flows. In collisionless plasmas, shocks must be mediated by electromagnetic interactions, rather than particle collisions. The recent generation of laboratory experiments, especially high-energy-density physics facilities, has opened significant avenues to experimentally study these fundamental processes. I will review recent experimental progress and future opportunities on several challenge problems, including observation of fast magnetic reconnection mediated by two-fluid effects and by current sheet or plasmoid instabilities, laboratory generation and observations of magnetized collisionless shocks, spontaneous magnetic field generation by Biermann battery and Weibel instability, and acceleration of energized particle populations. First-principles kinetic simulations provide invaluable insights to guide experiments and predictions for observables under experimental conditions.

[1]Research supported by DOE Office of Science, NNSA National Laser User Facility, and NIF Discovery Science. Simulations conducted on Titan at Oak Ridge National Laboratory under Contract No. DE-AC05-00OR22725