DPP10-2010-001688

Abstract for an Invited Paper
for the DPP10 Meeting of
the American Physical Society

Kinetic simulations of a deuterium-tritium z pinch with >10^{16} neutron yield[1]

DALE WELCH, Voss Scientific, LLC

Fully kinetic, collisional, and electromagnetic simulations of the time evolution of an imploding z-pinch plasma have been performed as first reported in D. R. Welch, *et al.* [*Phys. Rev. Lett.* **103**, 255002 (2009)]. Using the implicit particle-in-cell (PIC) code Lsp, multi-dimensional (1-3D) simulations of deuterium and deuterium-tritium z-pinches provide insight into the mechanisms of neutron production. The PIC code allows non-Maxwellian particle distributions, simulates finite mean-free-path effects, performs self-consistent calculations of anomalous resistivity, and permits charge separation. At pinch current $I < 7$ MA, neutron production is dominated by high energy ions driven by instabilities. The instabilities produce a power-law ion-energy distribution function in the distribution tail. At higher currents, roughly half of the neutrons are thermonuclear in origin and follow a I^4 neutron yield scaling. High-current, multi-dimension simulations ($>$ 40 MA with $> 10^{16}$ neutron yield) suggest that the fraction of thermonuclear neutrons is not sensitive to I, and the strong dependence of neutron yield on current will continue at still higher currents. Scenarios for fusion breakeven and possible ignition will be discussed.

[1]Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed-Martin company, for the United States Department of Energy's National Nuclear Security Administration, under contract DE-AC04-94AL85000.