Abstract Submitted
for the GEC10 Meeting of
The American Physical Society

Simulating ECRH with VORPAL, a Particle-in-Cell Code, using Higher-Order Particles CHRISTINE ROARK, Tech-X Corportation, PAUL MULLOWNEY, KEVIN PAUL, DAVID SMITHE, PETER STOLTZ, Tech-X Corporation — We present results of using higher-order particles to suppress artificial heating for modeling electron cyclotron resonant heating in a plasma sustained by microwaves. We compare these results to those using standard first-order particles and to a plasma dielectric model. Specifically, we compare the electron temperature, sheath size, and rate of plasma formation for simulations with an argon gas of 0.05 Torr pressure at 2.45 GHz. We also compare the effect of magnetic profiles on the plasma density and the effects of elastic, inelastic and ionizing collisions. Researchers often would like to apply Particle-in-Cell (PIC) methods to model cold, high pressure plasmas in order to discern any kinetic, nonlinear or space charge effects. However, the PIC method typically does not perform well at low temperatures and high densities due to limitations on time and space scales for numerical and practical reasons. One of these limitations is the requirement to resolve the Debye length. Failure to resolve the Debye length in a PIC simulation typically results in artificial heating of the plasma known as grid heating. For applications such as plasma processing, the rate of plasma production is a sensitive function of the electron temperature, so grid heating can make simulation results entirely unreliable. To eliminate this unphysical heating and allow cold, dense plasmas to be simulated using PIC, we use higher-order particle algorithms that smooth out the particle current and charge.

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Date submitted: 14 Jun 2010 Electronic form version 1.4