Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Simulations of Electron Density Perturbations in a Gas Discharge
JAMES CAPLINGER, VLADIMIR SOTNIKOV, DANIEL MAIN, Air Force Research Laboratory, Wright-Patterson AFB — Beginning with the idealized case of the Pierce diode, a series of particle-in-cell (PIC) simulations are conducted in order to characterize density perturbations in a laboratory gas discharge. This work is conducted to support future experimental investigations into electromagnetic scattering off of electron density perturbations excited by plasma flows. As a first step, 2D PIC simulations were conducted for the Pierce diode case, which is a simple model that exploits instabilities of a monochromatic electron beam between two grounded electrodes. These results were compared to the standard analytical solution. Departing from this idealized case we will include in the simulations electron-neutral collisions, particle creation from ionization, as well as an electric field generated by biased electrodes. A parameter study of electric field strength and collision frequency will be performed for values approaching the Pierce diode as well as extending to cases of expected laboratory parameters. If we can extract physical density spectra from simulations with parameters approaching experimental values, it may be possible to analyze electromagnetic scattering characteristics.

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Date submitted: 23 Jul 2015 Electronic form version 1.4