Contribution ID: **219** Type: **Poster Presentation**

PIC/DSMC Simulation of Radiation Transport Dynamics in Helium Gas Discharges

Friday 8 July 2016 14:40 (20 minutes)

Largely absent from kinetic, low-temperature plasma simulations is the capability for simulating radiation transport. It is largely acknowledged that self-produced radiation from gas discharges may have an impact on plasma formation and there is a need to include this physics into modern simulation codes. As such, there has been some effort in including photon dynamics into plasma simulations although they are generally only applicable to a single gas mixture such as air or focus on a small subset of transitions. In this work, a thorough kinetic description of Helium is included into a massively parallel Particle-in-Cell (PIC) utilizing Direction Simulation Monte Carlo (DSMC) for electron-neutral interactions. Additionally, a method for radiation transport is included that includes both natural and Doppler line broadening as well as self-absorption mechanisms. This method demonstrates the capability of modern PIC simulations to simulate temporally and spatially-resolved emission spectra and include energy-dependent photon dynamics such as photo-emission from the electrode surfaces. One-dimensional simulations of a Townsend discharge at various pressures in pure helium depict the evolution of the excited state densities and subsequent spontaneous emission. It is shown that high-energy photons emitted from the ground state transitions of helium (41P -> 11S, 31P -> 11S, 21P -> 11S), while heavily self-absorbed by background neutral particles, are capable of reaching the cathode causing additional electron current due to photo-emission.

---

* Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Author: FIERRO, Andrew (Sandia National Laboratories)

Co-authors: Mr SCHEINER, Brett (University of Iowa); Dr MOORE, Chris (Sandia National Laboratories); Dr HOPKINS, Matt (Sandia National Laboratories)

Presenter: FIERRO, Andrew (Sandia National Laboratories)

Session Classification: Poster 3-A

Track Classification: Plasmas, Discharges, and Electromagnetic Phenomena