

GEC09-2009-000319

Abstract for an Invited Paper  
for the GEC09 Meeting of  
the American Physical Society

### Nonlocal collisionless and collisional electron transport in low temperature plasmas<sup>1</sup>

IGOR KAGANOVICH

The purpose of the talk is to describe recent advances in nonlocal electron kinetics in low-pressure plasmas. A distinctive property of partially ionized plasmas is that such plasmas are always in a non-equilibrium state: the electrons are not in thermal equilibrium with the neutral species and ions, and the electrons are also not in thermodynamic equilibrium within their own ensemble, which results in a significant departure of the electron velocity distribution function from a Maxwellian. These non-equilibrium conditions provide considerable freedom to choose optimal plasma parameters for applications, which make gas discharge plasmas remarkable tools for a variety of plasma applications, including plasma processing, discharge lighting, plasma propulsion, particle beam sources, and nanotechnology. Typical phenomena in such discharges include nonlocal electron kinetics, nonlocal electrodynamics with collisionless electron heating, and nonlinear processes in the sheaths and in the bounded plasmas. Significant progress in understanding the interaction of electromagnetic fields with real bounded plasma created by this field and the resulting changes in the structure of the applied electromagnetic field has been one of the major achievements of the last decade in this area of research [1-3]. We show on specific examples that this progress was made possible by synergy between full scale particle-in-cell simulations, analytical models, and experiments. In collaboration with Y. Raitses, A.V. Khrabrov, Princeton Plasma Physics Laboratory, Princeton, NJ, USA; V.I. Demidov, UES, Inc., 4401 Dayton-Xenia Rd., Beavercreek, OH 45322, USA and AFRL, Wright-Patterson AFB, OH 45433, USA; and D. Sydorenko, University of Alberta, Edmonton, Canada.

[1] D. Sydorenko, A. Smolyakov, I. Kaganovich, and Y. Raitses, *IEEE Trans. Plasma Science* **34**, 895 (2006); *Phys. Plasmas* **13**, 014501 (2006); **14** 013508 (2007); **15**, 053506 (2008).

[2] I. D. Kaganovich, Y. Raitses, D. Sydorenko, and A. Smolyakov, *Phys. Plasmas* **14**, 057104 (2007).

[3] V.I. Demidov, C.A. DeJoseph, and A.A. Kudryavtsev, *Phys. Rev. Lett.* **95**, 215002 (2005); V.I. Demidov, C.A. DeJoseph, J. Blessington, and M.E. Koepke, *Europhysics News*, **38**, 21 (2007).

<sup>1</sup>This work was supported by AFOSR through STTR contract.