Modeling of high pressure glow discharges using a finite element method

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The spatiotemporal behavior of gas discharges in argon is described by means of a coupled set of partial differential equations for the densities of electrons, ions and neutral particles as well as the electric potential. In order to take into account the nonlocal transport of electrons in the plasma, in addition, the electron energy balance equation is solved. That is, transport coefficients for electrons as well as rate coefficients of electron collisions are determined in dependence on the mean electron energy.

For the spatial discretization of the transport equations of charged particles a stabilized Petrov-Galerkin finite element method is adapted where the test functions are weighted in dependence on the local Péclet number [1,2]. The diffusion equations for neutral particles and Poisson's equation for the electric potential are discretized by means of the Galerkin finite element method. For the temporal evolution a semi-implicit procedure is used.

In the present talk, details of the discretization approach are discussed and numerical results for an argon glow discharge at atmospheric pressure between plane parallel electrodes are represented.

[1] I. CHRISTIE, D. GRIFFITH, A. MITCHELL, AND O. ZIENKIEWICZ: Finite element methods for second order differential equations with significant first derivatives. *Int. J. Numer. Meth. Eng.* **10** (1976), 1389–1396 .

[2] M.M. BECKER, D. LOFFHAGEN, AND W. SCHMIDT: A stabilized finite element method for modeling of gas discharges. *Comp. Phys. Commun.* In press.