GEC16-2016-000316

Abstract for an Invited Paper
for the GEC16 Meeting of
the American Physical Society

**Fluid and hybrid models for streamers**[1]

ZDENĚK BONAVENTURA, Department of Physical Electronics, Fac. Sci., Masaryk University, Brno, Czech Republic

Streamers are contracted ionizing waves with self-generated field enhancement that propagate into a low-ionized medium exposed to high electric field leaving filamentary trails of plasma behind. The widely used model to study streamer dynamics is based on drift-diffusion equations for electrons and ions, assuming local field approximation, coupled with Poisson's equation. For problems where presence of energetic electrons become important a fluid approach needs to be extended by a particle model, accompanied also with Monte Carlo Collision technique, that takes care of motion of these electrons. A combined fluid-particle approach is used to study an influence of surface emission processes on a fast-pulsed dielectric barrier discharge in air at atmospheric pressure. It is found that fluid-only model predicts substantially faster reignition dynamics compared to coupled fluid–particle model. Furthermore, a hybrid model can be created in which the population of electrons is divided in the energy space into two distinct groups: (1) low energy 'bulk' electrons that are treated with fluid model, and (2) high energy 'beam' electrons, followed as particles. The hybrid model is then capable not only to deal with streamer discharges in laboratory conditions, but also allows us to study electron acceleration in streamer zone of lighting leaders. There, the production of fast electrons from streamers is investigated, since these (runaway) electrons act as seeds for the relativistic runaway electron avalanche (RREA) mechanism, important for high-energy atmospheric physics phenomena. Results suggest that high energy electrons effect the streamer propagation, namely the velocity, the peak electric field, and thus also the production rate of runaway electrons.

[1]This work has been supported by the Czech Science Foundation research project 15-04023S.