Comparison study of different simulation codes for positive streamers propagating into a region below breakdown

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For streamer simulations a range of computational models have been developed by various groups for various purposes. These models differ in dimensionality (2D, 3D), model type (particle, fluid or hybrid approach and further differentiation), possible inclusion of electrodes or dielectrics, transport and reaction coefficients, initial conditions and numerical implementation. The aim of the present study is to benchmark the results of different computational models for axisymmetric single positive streamers in air at 1 bar and 300 K. We have invited potential participants to join on March 1, and we will present the current state of the study in July in a poster.

1. Introduction

Streamers are ionized channels with electric field enhancement at their tips that grow rapidly in different gases and liquids. Study of emergence and propagation of streamer discharges have gained a lot of interest from different research groups due to their vast industrial and medical applications. Furthermore, study of streamer discharges is essential since they are responsible for the initial stages of sparks, lightning, and they appear directly as sprite discharges.

Computational models of streamers depend on different factors and parameters, such as:

- the type of the model, e.g. fluid, particle or hybrid models, and the further approximations taken like local field approximation etc.,
- dimensionality (2D, axisymmetric or full 3D),
- mobility and reaction coefficients,
- initial conditions,
- the implementation of photo-ionization,
- electrode shapes and boundary conditions, and
- numerical resolution and accuracy.

We aim to study how simulation results depend on these choices and parameters and approximations involved, and on March 1 (2 days before the deadline of this abstract), we have invited other groups internationally to join the study, after an earlier initiative of Sergey Pancheshnyi in October 2016. We now suggest to compare results for a single axisymmetric positive streamer in air. The results of the comparison study will be presented in a poster.

2. Methodology and Results

Single positive streamer with cylindrical symmetry with size R=1.25 cm, and L=1.25 cm in air at 300K temperature and 1 bar pressure is studied. A homogenous electric field of -1.5 MV/m is imposed by applying a potential difference of 18.75 kV between the two planar electrodes. A needle electrode protruding from the planar anode is mimicked by inserting a package of positive ions on the axis at z=1 cm.

We hope that a number of groups internationally will participate. In Amsterdam, we will use afivo-streamer [1,2] based on the afivo framework [3].

We present the results of the comparison study in a poster.

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4. References

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