Geophysical Research Abstracts
Vol. 17, EGU2015-8704, 2015
EGU General Assembly 2015

Modeling of the increase of the electric field in head-on collisions between a negative and a positive streamer

Kevin Mohand A Ihaddadene and Sebastien Celestin
LPC2E, University of Orleans, CNRS, Orleans, France (mohand.ihaddadene@cnrs-orleans.fr)

Head-on collisions between negative and positive streamers have recently been suggested to be a plausible mechanism for the production of X-rays by discharges in air [Cooray et al., JASTP, 71,1890, 2009; Kochkin et al., J. Phys. D: Appl. Phys., 45, 425202, 2012]. Moreover, head-on collisions between streamers of different polarities are very common. Indeed, during the formation of a new leader step, the negative streamer zone around the tip of a negative leader interact with the positive streamers initiated from the positive part of a bidirectional space leader. In laboratory experiments, when streamers are approaching a sharp electrode, streamers with the opposite polarity are initiated from the electrode and collide with the approaching streamers. Given that positive and negative streamers respectively carry positive and negative charges at their fronts, it is reasonable to consider that the electric field between a negative and a positive streamer heads would increase as the two streamers are approaching each other. However, this is a non-linear problem that depends on the dynamics of both streamers. Indeed, an increase of the electric field above the conventional breakdown threshold field will increase the electron density, and therefore the conductivity at this location. This in turn, will tend to collapse the peak electric field.

In this work, we will simulate numerically head-on collisions between a negative and a positive streamer in order to investigate the behavior of the maximum electric field produced. We will quantify whether and how such collisions can increase the electric field up to magnitudes sufficient to produce thermal runaway electrons and the associated X-rays.