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Sub-nanosecond dynamics of atmospheric air discharge under highly inhomogeneous and transient electric field[1] PIERRE TARDIVEAU, LIONEL MAGNE, STEPHANE PASQUIERS, PASCAL JEANNEY, BLANDINE BOURNONVILLE, Laboratoire de Physique des Gaz et des Plasmas, CNRS (UMR 8578), Université Paris-Sud, 91405 Orsay Cedex France — The effects of the application of extreme overvoltages (>500 %) in air gaps over less than a few nanoseconds bring us to reconsider the classical physics of streamer used to describe air discharges at atmospheric pressure. Non equilibrium discharges created by extremely transient and intense electric fields in standard conditions of pressure and temperature exhibit unusual diffuse and large structure. In point-to-plane electrode configurations, a plasma cloud is observed which properties depend on voltage pulses features (amplitude, rise time, length, and frequency) and electrodes properties (material, shape, and gap length). Our parametric experimental study is based on fast electrical characterization and sub-nanosecond imaging and shows the different stages of propagation of the cloud. This work details the conditions to maximize the cloud size without moving towards a multi-channel streamer regime. Based on the analysis and the Abel transform processing of the emission of excited states of nitrogen from the discharge, a focus is made on the structuration of the plasma cloud while it is propagating. It shows how much, according to the experimental conditions, the external electric field can be screened by the plasma and, inversely, how deep and how long a high electric field can be sustained in the gap, that is challenging for pulsed atmospheric plasmas applications.

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