

Generation of guided streamers in a magnetic-coil plasma gun device (MCPG): influence of electromagnetic induction on propagation and counter-propagation kinetics

H. Decauchy¹, T. Dufour¹

¹Laboratoire de physique des plasmas, Sorbonne Université, Centre National de la Recherche Scientifique, École Polytechnique, 4 place Jussieu 75252 PARIS
email: henri.decauchy@sorbonne-universite.fr

First, forward/backward propagation of guided streamers generated by a HV pulse generator is studied using a plasma gun device interacting with a grounded metallic target [1]. Electrical measurements combined with high-resolution (1ns) ICCD imaging are achieved to decipher the kinetics of propagation, as illustrated in Figure 1. In agreement with previous numerical [2] and experimental approaches [3], the counter-propagation of the positive guided streamers is clearly observed from 434 to 3000 ns. These observations are also partly supported by electrical measurements carried out in the target. Interestingly, a second guided streamer counter-propagates from 1100 ns to 3000 ns without entering into the capillary. Several hypotheses will be discussed to explain such phenomena.

Second, the plasma gun device is implemented with a magnetic coil coaxially placed at a distance d from the inner HV electrode, while the grounded target remains 15 mm away from the capillary's outlet. Such configuration permits to study the influence of electromagnetic induction on guided streamers propagation. ICCD imaging clearly shows that before/after passing through the magnetic coil, the streamer experiences deceleration due to a partial conversion of its kinetic energy to magnetic energy. Depending on the location of the magnetic coil, we explain how this conversion rate can be increased and to which extent. We also demonstrate a strong correlation between these ICCD measurements and measurements of current profiles carried out inside the magnetic coil and in the grounded target.

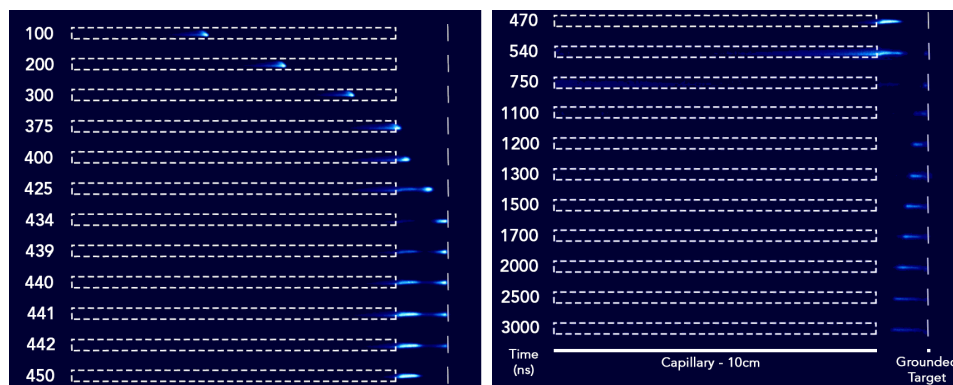


Figure 1 : Timeline of a positive guided streamer propagating in the capillary (10 cm in length) before and after interacting with a grounded target.

Références

- [1] Judée, F., & Dufour, T. *Journal of Physics D: Applied Physics*, 52 16 (2019)
- [2] Norberg, S. A., Johnsen, E., & Kushner, M. J. *Journal of Applied Physics*, 118 1 (2015)
- [3] Darny, T., Pouvesle, J. M., Puech, V., Douat, C., Dozias, S., & Robert, E. *PSST*, 26 4 (2017)