Keep-in-Touch meeting
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Diagnostics and modeling of an atmospheric pressure argon micro-plasma jet

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Atmospheric-pressure plasma jets provide an open and easily accessible way of producing excited and charged species. These unobtrusive sources are used in different applications, especially medical and biological [1]. Furthermore, the innate plasma-flow interaction provides a rich opportunity for different modeling and experimental studies [2].

Plasma jets can be created by streamers propagating along the jet flow of a gas. These guided ionization waves propagate in a spatially varying gas composition, partially due to the mixing of the surrounding gas into the plasma jet. The discharge itself perturbs the flow [3], affecting, at least, the gas composition and velocity field for future discharges. This effect shows a coupling between the flow and the plasma, a coupling which models should consider.

We are particularly interested in the study of dielectric barrier discharge micro-plasma jets [4]. Using Schlieren and fast imaging, we characterize the jet flow and the discharge propagating within. We obtain the spatial and temporal profiles of the Ar(1s5)'s density using laser absorption spectroscopy. Also in this experiment, the shielding mixture varies between different N2-O2 fractions, which helps to understand how the surrounding gas affects the plasma jet.

For the modeling study, we recovered methods from computational fluid dynamics to obtain a high-fidelity description of the jet flow. We adapted SPARK [5], the Software Platform for Aerothermodynamics, Radiation, and Kinetics, to subsonic flows with free electrons. Using operator splitting methods, we simulate the sudden excitation of different species by the ionization waves that periodically propagate along the jet.

This presentation starts with different experimental and modeling results that characterize some aspects of our jet, the plasma, and their interaction. We follow these results with current efforts to model pulsed discharges in 0D and 2D. Finally, we suggest further adaptations and applications of the methods developed.

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