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(G*) Time-resolved optical emission spectroscopy of a nanosecond, pulsed microwave plasma ignited by time reversal

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Microwave plasmas are hugely-studied plasmas, they have characteristics that make them unique, they can be generated for low and high-pressures, they have relatively high densities of charged particles, and can be generated in different cavity geometries. A new way to ignite microwave plasmas was recently developed using time reversal and a nanosecond pulsed generator. This method allows the dynamic control of the plasma position and the study of plasmas on timescales rarely studied. The ignition method of such plasmas was investigated [1], but the time- and space-resolved plasma characteristics remain unexplored. Some imaging measurements were performed for different pressures. It was found that in nominally pure argon plasmas, the space-integrated light emission intensity sharply increases over a few tens of nanoseconds and then decreases with timescales in the hundred of nanoseconds. In this work, optical emission spectroscopy of argon 4p-4s transitions coupled with collisional-radiative modeling [2] is used to examine the behavior of the electron temperature and excited states populations during ignition and extinction stages. For pressures between 1.5 and 4 Torr, even with maximum plasma dimensions in the centimeter range, it is found that radiation trapping play a significant role on the analysis of argon line emission intensities. In addition, the populations of argon 4s states and charged species also influence discharge ignition through a so-called memory effect between subsequent discharges.

1. V.Mazières and al. "Spatio-temporal dynamics of a nanosecond pulsed microwave plasma ignited by time reversal"2020 Plasma Sources Sci. Technol. 29
2. A. Durocher-Jean, E. Desjardins and L. Stafford. "Characterization of a microwave argon plasma column at atmospheric pressure by optical emission and absorption spectroscopy coupled with collisional-radiative modelling ». In: Physics of Plasmas vol. 26, n°6, pp. 063516, juin 2019

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