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Microwave plasma source in multimode cavity: the wave plasma brush

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The aim of this communication is first to present the concept of the innovative plasma source we introduced recently, namely the “wave plasma brush”. It has been introduced to address the challenge of controlling plasmas in large cavities (multimode) that has been identified in the literature [1,2]. Contrary to conventional microwave plasma technologies, the idea of this innovative source is not to ignite a plasma occupying the entire volume of a plasma vessel, but rather to ignite a localized plasma whose location in the plasma vessel can be dynamically controlled. This dynamic control of the plasma location is made possible by changing the temporal waveform of the transmitted signal to a multimode cavity. It is then the behavior of the waves inside the cavity that control the plasma location, hence the name of wave plasma brush. The concept of this source is illustrated on Figure 1. We first experimentally demonstrated this microwave plasma source using time reversal [3] and later using a more elaborated technique [4]. In those papers, we successfully managed to control in a pulsed regime the plasma location on several igniters in a multimode cavity. In the present communication, we will focus on the unusual characteristics that this microwave source possesses: the plasma dimensions and location are entirely uncorrelated from the cavity design, the low rise time (in the order of the nanosecond) and the very low duty cycle (in the order of 0.05%). This work is a continuation of our paper [5], in which we proposed a first spatio-temporal description of these original plasmas.

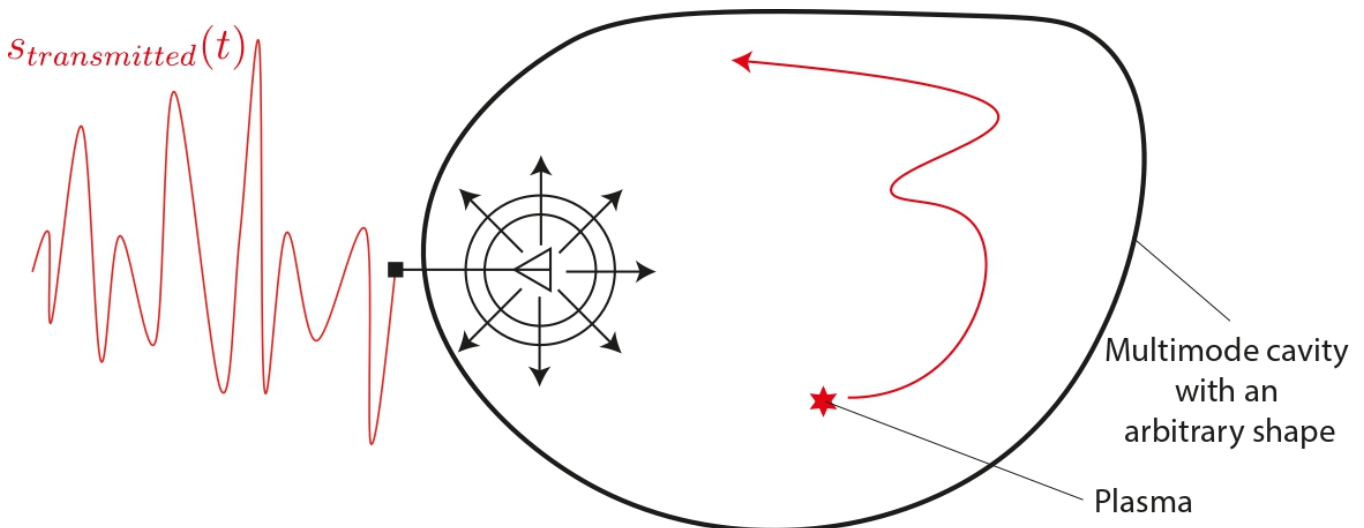


Figure 1: Principle of the “wave plasma brush”.

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