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Plasma density profile measurements for ultra-short high power laser beam guiding experiments at SPARC_LAB

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External injection is a promising method to achieve high accelerating gradients and to control the beam properties. The energy gain of an electron via the wakefield is proportional to the product of the accelerating field multiplied by the effective propagation distance of the laser. Therefore, in order to bring the electron energy to the order of the GeV , a longer propagation length is required, which can be obtained by guiding the laser pulse in a wave-guide. In the case of SPARC_LAB, a $500\ \mu m$ diameter hydrogen-filled capillary discharge is used; to guide the laser beam it is necessary to act on the refractive index of the plasma, depending on its density.

In this work measurements of the trend over time of longitudinal and transverse profiles of plasma density within the capillary are presented, compared with the results of MHD simulations based on initial gas profiles obtained in openFOAM and on the real discharge profile. The gas emission line enlargement produced by the Stark effect was detected by a spectrometer. Preliminary test of laser guiding are also shown, detecting the behavior of the laser beam at the exit of the capillary with respect to the discharge current value.

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