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Development and characterization of Plasma Targets for LWFA experiments at SPARC_LAB

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One of the most important features of laser-plasma based accelerators is their compactness while still providing very high accelerating fields up to hundreds of GV/m. The main challenge lies in characterizing and controlling the plasma itself, which determines its proper synchronization with the particle beam to be accelerated, an issue that strongly influences the quality of the accelerated bunches.

The characterization and optimization of plasma targets used at the SPARC_LAB laboratories for LWFA will be presented. In particular, the study and the realization of the plasma guiding process of a laser pulse inside a plasma-filled capillary discharge will be shown. This laser pulse confinement technique becomes particularly relevant for extending the acceleration channel, for example, in a plasma elongated to several centimeters or more. It will be discussed how this optical process was achieved for an ultra-short 10 mJ laser pulse in a 500 μm diameter capillary discharge, using time-resolved online spectroscopic measurements of the transverse and longitudinal density distribution of the generated plasma.

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