SELF-INJECTION IN A MODERATELY RELATIVISTIC LWFA REGIME

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Today, more than 30000 particle accelerators are operative worldwide but only 1% are research machines with energies above 1GeV. It appears clear that miniaturized particle accelerators look attractive in many fields, especially in <GeV applications. In the Laser Wake Field Accelerator (LWFA), an ultra-intense laser pulse is used to produce a plasma wave (wakefield). The high longitudinal electric field supported by the plasma wave is used to accelerate trapped electrons with a velocity close to wave phase velocity. With respect to the standard RF-linacs, the accelerating gradient of LWFA is much higher and the acceleration length can be 1000 time shorter. In this work we present a study of a weakly relativistic LWFA regime performed at ILIL laboratory. The purpose is to understand the self-injection mechanism in order to improve the quality of accelerated bunches and gain control of the acceleration process. The role of self-focusing and gas target ionization potential is discussed in detail via experimental and numerical investigation. Comparing results obtained with different gases target (helium or nitrogen), we can observe a different properties in trapping efficiency, transverse beam geometry and energy spectrum. The weakly relativistic LWFA regime, self-focusing, and ionization play a key role in the different phenomenology observed. At the end, it is possible to control the properties of injected electrons by exploiting the different gases properties.

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