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Gas cell density characterization for laser wakefield acceleration

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Laser plasma acceleration (LPA) is a promising scheme for compact high energy accelerators and the multi-staged scheme is actively investigated in relation with several large scale projects such as CILEX / Apollon and EuPRAXIA. However, several issues have to be addressed to optimize electron properties.
In particular, the target density average and its fluctuations are crucial parameters and need to be controlled. Indeed, the electron density influences the laser beam propagation and plays a crucial role in the injection of electrons in the plasma wave. Moreover, density fluctuations are suspected to have a major influence on electron beam pointing fluctuations which need to be reduced to allow reliable external injection in a second stage.
In the frame of CILEX / Apollon, several gas cells are being tested as prototypes of the future electron injector in the 50 –200 MeV range. As optical density characterization is not possible over the entire geometry due to the presence of opaque walls, interferometry is used to estimate the electron density in experiments; these results are combined to fluid simulations to determine the absolute density profile in a wide range of experimental parameters; experimental and simulation results will be discussed.

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