Contribution ID: **456** Type: **Oral contribution**

Single-mode laser guiding in non-parabolic plasma channels for high-energy electron acceleration

Thursday, 25 September 2025 18:00 (20 minutes)

The discovery of laser wakefield acceleration in gaseous plasma was a major milestone that could lead to a significant reduction of size and cost of large electron accelerators. For higher-energy laser-driven electron acceleration guiding plasma channels were proposed, which are
matched to the laser pulse parameters. A parabolic density profile is
needed for guiding a Gaussian beam, which is difficult to realize experimentally. The realistic channel profiles can be described
by higher order polynomial functions which are not optimal for guiding due to the development of undesired distortions in the laser intensity envelope. However, here we show that for non-parabolic
plasma channels well-defined matching conditions exist, which we call mode matching. This leads to the guiding of the fundamental mode only in the acceleration regime, where the plasma electron density is modulated by the high-intensity laser pulse. In this way we eliminate two deteriorating
factors of laser wakefield acceleration, namely the mode dispersion and energy leakage. We apply this new matching condition for single-mode guiding in quasi-3D simulations to show that 10 GeV energies can be reached in a distance of less than 15 cm.

Primary author: LÉCZ, Zsolt

Co-authors: HAFZ, Nasr (ELI-ALPS); MAJOROSI, Szilárd (Research Fellow)

Presenter: LÉCZ, Zsolt

Session Classification: PS8: Plasma sources and related diagnostics

Track Classification: PS8: Plasma sources and related diagnostics