



Contribution ID: 26

Type: **Contributed Talk**

Beam transport system with active plasma lens for LPA-driven EUV FEL

Monday, 14 July 2025 15:15 (15 minutes)

Laser-Plasma Accelerators (LPAs) produce high-quality electron beams with high peak currents and low emittance, making them ideal for compact novel Free Electron Lasers (FELs). However, the large angular divergence and energy spread of these beams pose challenges for efficient beam transport overall FEL performance. This study explores the use of an Active Plasma Lens (APL) as a capture block to improve the transport of LPA-generated beams into an undulator. Initial beam parameters were based on published results from LWFA studies. In this report, we present the design of a LPA-based electron beamline operating in the EUV FEL regime. Our goal is to achieve saturation of the photon beam power within the undulator section. The results show that the APL enables efficient beam transport and facilitates the generation of high-brightness coherent X-rays.

This work underscores the potential of APLs in developing compact FELs and advancing LPA beams. This technology is essential for creating a new generation of FELs at ELI-ERIC in the Czech Republic and within the EuPRAXIA project.

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Session Classification: Session 2: FEL driven by LWFA