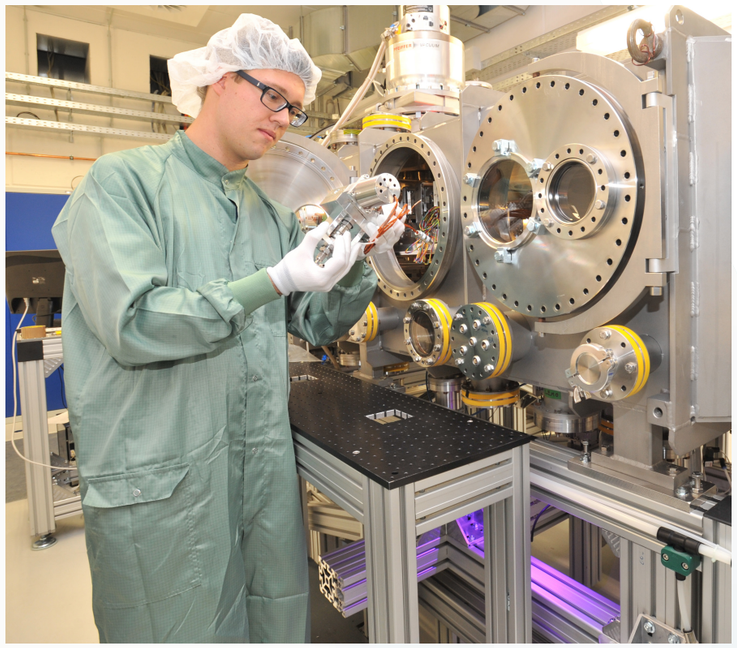
ACCELERATOR TECHNOLOGY

Technology

The realization of a wakefield accelerator with the industrial beam quality of EuPRAXIA requires the external injection of high-brightness electron beams.

High-brightness electron beams must be transported from the source (the external RF injector or the plasma injector) to the plasma cell in which the electron beam is accelerated.

High accuracy and precision diagnostic tools are also required for both transverse and longitudinal characterization of the electron beam along the whole accelerator in order to check the matching conditions and the acceleration process.



(Right) Laser wakefield acceleration chamber at HZDR (Germany).
Credit: Frank Bierstedt, Helmholtz-Zentrum Dresden-Rossendorf

Challenges & Innovation potential of EuPRAXIA

Staging

The energy gain in a single plasma cell is limited by several factors such as dephasing and laser diffraction. In order to overcome the depletion of laser energy, it is necessary to sequence the accelerator into stages, each powered by a separate laser pulse.

Beam transport

The manipulation of the beam is particularly challenging because the beam must be only a few femtoseconds long and a few micrometers large at the entrance of the plasma accelerating structure. After the accelerating plasma structure, the electron beam must be optimized to fit the needs of the user.

Electron beam matching

The need for matching the electron beams in and out of plasma channels requires magnetic focusing to a small beam size of the order of one micrometer.

Plasma cell technology

EuPRAXIA foresees the design of an "industrial" plasma cell design that provides a path to high beam energies by cascading.

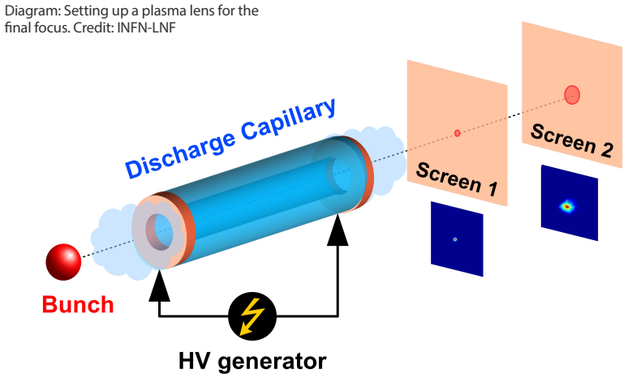
Magnet technology

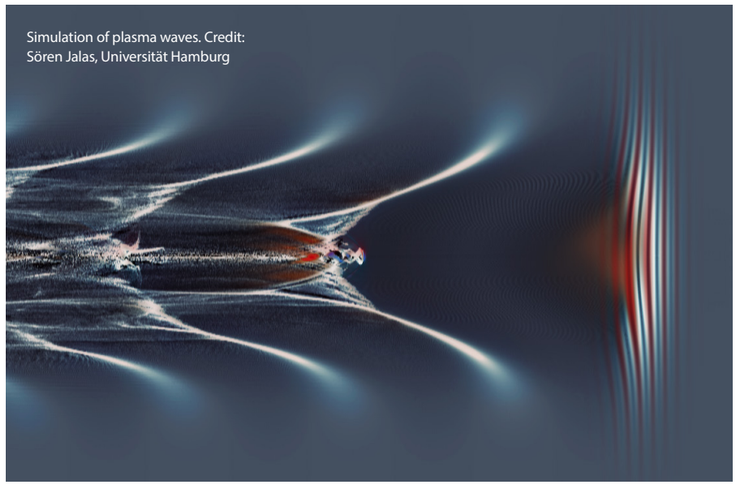
EuPRAXIA fosters the development of compact accelerator magnets with high field quality, chromatic correction, and a certain tuning range.

Ultrafast beam diagnostics

EuPRAXIA will define high-precision diagnostic tools for the characterization of electron beams, developing novel techniques for sub-fs and sub-μm beam diagnostics.

Diagram: Setting up a plasma lens for the final focus. Credit: INFN-LNF





Simulation of plasma waves. Credit: Sören Jalas, Universität Hamburg

(Left) The ALICE accelerator at STFC's Daresbury Laboratory (UK)

EuPRAXIA

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