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Free-electron lasing with compact beam-driven plasma wakefield accelerator

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We report in this talks the results of the experimental evidence of FEL lasing by a compact (3 cm) particle beam-driven plasma accelerator recently obtained at SPARC_LAB in Frascati.

The accelerated beams have been completely characterized in the six-dimensional phase-space and have high-quality, comparable with state-of-the-art accelerators. This allowed the observation of narrow-band amplified SASE radiation in the infrared range with typical exponential growth of its intensity reaching tens of nJ over six consecutive undulators.

Starting from the SASE results, we upgraded the experimental setup by seeding the FEL with an external laser. FEL radiation is still emitted in the infrared range, showing the typical exponential growth of its energy. Compared to SASE, the seeded FEL pulses have two orders of magnitude larger energies (around 1 uJ) and a three times higher stability (around 90%).

These results are a fundamental steppingstone towards the realization of the EuPRAXIA project, the ESFRI project for a compact European infrastructure with 1-5 GeV electron beams based on plasma accelerators. The EuPRAXIA concept will be also presented and target parameters introduced.