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Next-Generation High-Repetition-Rate Lasers for Laser–Plasma Accelerators and Secondary Sources

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Laser–plasma accelerators (LPAs) are emerging as compact drivers for science and industry, yet their exploitation critically depends on the availability of high-repetition-rate, high-energy laser systems.

Amplitude has pioneered this field with a 10TW 100 Hz Ti:Sapphire system installed already in 2013 at LP3 laboratory. This unique laser drives a table-top high brightness X-ray plasma source, and demonstrated phase-contrast imaging or X-ray diffraction. Building on this foundation, a new concept for a 1 J, 100 Hz Ti:Sapphire driver is being currently developed. It combines a CPA architecture seeded by an industrial-grade Yb-laser–pumped OPCPA front-end, with amplification stages pumped by a newly designed diode-pumped Titan-C laser. Amplifier thermal management is addressed through cryogenic cooling, while solutions to circumvent thermal effects in the compressor are studied in collaboration with the HZDR and LP3 groups. Additionally, the development of multi-J pump lasers designed for 100Hz and more prepares the advent of PW class lasers for future accelerator facilities, such as EUPRAXIA project.

In parallel, Amplitude explores the use of Yb-based lasers as compact, high-average-power drivers for industrial applications. We will present our latest results, achieving 0,6TW at 1kHz by compressing 20mJ 350fs pulses down to 23 fs using a multipass cell.

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