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High efficiency fiber laser systems for wake-field particle accelerators

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An important driver of scientific progress has always been the envisioning of applications far beyond existing technological capabilities. In the case of laser physics, one of these applications is laser wake-field particle acceleration and possible future uses thereof, such as in collider experiments, or for medical applications such as cancer treatment. To accelerate electrons and positrons to multi-GeV energies, a laser architecture is required that allows for the combination of high efficiency, Petawatt peak powers, and Megawatt average powers. Developing such a laser system would be a challenging task that might take decades of aggressive research, development, and, most important, revolutionary approaches and innovative ideas.
In the presentation we will present rare-earth-doped fiber laser based systems for a compact, efficient, scalable, and cost-effective high-average and high-peak power ultra-short pulse laser concept. The proposed approach relies on the spatially and temporally separated amplification of ultrashort laser pulses in waveguide structures, followed by coherent combination into a single train of pulses (or into a programmable multi-pulse structure) and into a single beam with increased average power and pulse energy.

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