aac24 ADVANCED ACCELERATOR CONCEPTS
A Chicagoland meeting of the global Advanced Accelerator Concepts community

Contribution ID: **277** Type: **Poster**

Development of 100mJ coherently combined CPSA fiber laser laboratory demonstrator for driving particle acceleration and secondary radiation experiments (Student Poster)

Monday, 22 July 2024 18:00 (1h 30m)

Next generation laser drivers for laser plasma acceleration and secondary radiation sources will require 3 to 4 orders of magnitude increase in pulse repetition rates, to produce TW-PW class peak power ultrashort pulses at multi-kilowatt average powers [1]. Coherently combined ultrashort pulse fiber laser systems are recognized as a pathway to such high power technology [1]. However, although the current state-of-the-art high-power coherently combined fiber laser systems have demonstrated a relatively large number of combined channels ranging from 16 and up to 61 so far, but they all achieved only moderate femtosecond pulse energies in the 10-30mJ range, far below what is needed for driving particle-acceleration experiments.

We had developed a novel time-domain coherent combining technique (coherent pulse stacking amplification - CPSA) that enables 100 times higher energies per channel than conventional fiber CPA, achieving record high femtosecond pulse energies of up to ~10mJ per channel, far exceeding any other fiber laser results. This opens an effective pathway to reaching higher pulse energies, which we recently validated in a 4-channel coherently-spatially combined array, producing ~27mJ per spatially and temporally combined beam [2]. We will report the development of a 12-channel table-top laboratory system upgrade to produce 100mJ/1kW spatially and temporally combined beams, which after compression are sufficient for acceleration and secondary-radiation experiments. This work includes development of a new energy-scalable pre-pulse cleaning technique necessary for driving majority of high-intensity laser plasma interactions. This development constitutes an important milestone towards future multi-kW average and TW-kW peak power laser drivers.

Working group

WG1 : Laser-driven plasma wakefield acceleration

Primary author: PASQUALE, Christopher (Graduate Student)

Co-authors: JING, Yanwen (University of Michigan); RAINVILLE, Alexander (University of Michigan); WHITTLESEY, Mathew (University of Michigan); YANG, Bowei (University of Michigan); CHEN, Mingshu (University of Michigan); COLEMAN, Tayari (University of Michigan); GARNER, Michael (University of Michigan); DU, Qiang (Lawrence Berkeley Laboratory); GALVANAUSKAS, Almantas (University of Michigan)

Presenter: PASQUALE, Christopher (Graduate Student)

Session Classification: Poster [Atrium]