Contribution ID: **130** Type: **Invited Talk**

Coherent combination of high-power fiber lasers for laser-plasma-based collider applications

Friday, 18 April 2025 09:33 (33 minutes)

Laser-plasma accelerators have great potential to be compact and economic to enable future colliders up to 10 TeV. Such colliders couple many plasma accelerator stages, each requiring a ultrafast laser driver with multi-Joule pulse energy and tens-of-kHz rep-rate, i.e., hundred-kW-class average power. Tens-of-percent wall-plug efficiency is also required. Current ultrashort laser technologies, e.g., Ti:Sapphire systems with pulse energies up to 100-Joule class and rep-rates up to a few Hertz, are limited by thermal handling and wall-plug efficiency and do not scale to the collider driver parameters.

Fiber lasers are the most efficient high-average power laser technology demonstrated to date, and novel coherently-combined (in space, time, and spectrum) fiber lasers are considered one of the most promising solutions that are energy/power scalable to the collider laser driver parameters. Tremendous progress has been made on demonstrating the principles and sub-scale systems of the scalable, coherently-combined, ultrafast fiber laser technology. In the near- to mid-term, tens of kW systems will be available to drive laser-plasma accelerators, and an R&D path has been identified to achieve hundreds of kW laser driver systems for colliders.

This work is a collaboration between LBNL, Univ. of Michigan, and LLNL, supported by DOE, DARPA, and Moore Foundation.

Primary author: ZHOU, Tong (Lawrence Berkeley National Laboratory)

Presenter: ZHOU, Tong (Lawrence Berkeley National Laboratory)

Session Classification: Plenary Session