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Plasma Wakefield Acceleration, FACET-II and a Wakefield Collider

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Plasma wakefield acceleration (PWFA) shows promise in reducing the size and cost of accelerators, with a particular focus on colliders and light sources. The advantage of PWFA lies in a plasma's ability to support fields up to 100s of gigavolt-per-meter, orders of magnitude beyond the traditional radiofrequency and superconducting radiofrequency accelerators. Such high fields have application in acceleration [1] and focusing [2] and as sources of cosmic rays [3]. In this talk I will describe plasma wakefield acceleration and the recent progress and status, as well as the prospects of FACET-II and a design study for a 10 TeV wakefield collider.

The guiding mission of the FACET-II facility at SLAC National Accelerator Laboratory [4] is the generation of high-intensity electron beams for the study of physics in the extreme, including PWFA. The FACET-II science program includes the demonstration of efficient, beam quality preserving acceleration [5], generation of beam with phase space densities beyond state of the art [6], generation of beams with peak currents of more than 100 kA [7], and strong-field QED effects in beam-laser collisions [8].

This research at FACET-II is designed to study extreme beam effects and demonstrate key milestones that together enable more compact, higher efficiency light sources and colliders. With the conclusion of the Particle Physics Project Prioritization Panel [9], a decadal process that defines the direction of high-energy physics in the United States, a community-driven design study for a 10 TeV parton-center-of-mass wakefield accelerator collider has been formed. This talk will cover the status of the goal to deliver a unified wakefield collider concept.

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