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Beam-driven plasma acceleration of electrons and positrons at FACET

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Beam-driven plasma accelerators, with their high electric fields and energy efficiencies, are being considered as a mean to make future electron-positron colliders more compact and affordable. The field of beam-driven plasma acceleration has recently seen a rapid experimental progress, in particular with the last few years of running of the FACET facility at SLAC.

I will present some of the key results recently obtained at FACET. First, the acceleration of a distinct trailing bunch of electrons, at high fields and with high energy efficiency, was demonstrated. We have also shown that a short electron bunch is capable of generating very high fields in a beam-ionized high-ionization-potential gas, leading to energy gains of nearly 30 GeV in a ~25 cm acceleration distance. The problematic of the acceleration of the electron antimatter counterpart, the positron, was studied. A new regime where energy is efficiently transferred from the front to the rear within a single positron bunch was discovered. The self-loading of the wake leads to the formation of a narrow energy spread bunch of positrons. Finally, experimental results on hollow plasma channels, which are also considered for positron acceleration, will be presented.

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