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## High Efficiency and High-Gradient Acceleration of Electrons and Positrons in a Plasma Wakefield Accelerator

*Monday, 14 September 2015 11:30 (30 minutes)*

Recent progress on high-gradient and high-efficiency electron and positron acceleration in a plasma wakefield accelerator at the FACET facility will be described. In the case of electrons, a high current drive bunch is used to produce an extremely nonlinear, high gradient wake in a meter-scale plasma. An appropriately placed trailing bunch containing a significant charge loads the wake and flattens the accelerating field. The particles in the trailing bunch gain energy nearly at the same rate thus maintaining the narrow energy spread of the bunch. The beam loading leads to a high energy extraction efficiency.

For high efficiency, high gradient acceleration of positrons, we use a single, compressed positron bunch. The plasma electrons are now pulled inwards and cross the bunch axis even before the peak current of the bunch is reached. While most of the electrons overshoot the axis and form a bubble-like sheath, some of the plasma electrons are confined near the bunch axis by the back of the positron bunch. This alters (loads) the longitudinal wakefield such that the accelerating field is flattened and a significant fraction of the positrons gain energy at a near constant rate forming a spectrally narrow bunch.

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