Charged Particle Acceleration Using Intense Laser and Particle beams

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I will describe our work on acceleration of electrons using both laser and particle beams in the so-called blow-out regime of the Plasma Wakefield Accelerator (PWFA).

In the case of a laser driver both power and density thresholds for self-guiding and self-trapping have been experimentally determined using a 100 TW class laser. It is found that to exceed energy gains of 1 GeV using these lasers a new mechanism for electron injection into the wake has to be employed. Using this so-called ionization induced trapping we have injected K-shell electrons from both nitrogen and oxygen into predominantly He wakes and accelerated them to about 1.5 GeV.

In the case of a beam driver our recent work has focused on the determination of the one of the most important figures of merit: the transformer ratio. We have shown that the transformer ratio in an Rb plasma can be significantly reduced by ionization and subsequent injection of the second electron of the Rb atoms. The acceleration gradient can dramatically fall from an unloaded value of 30 GeV/m to less than 15 GeV/m as a result of this beam loading by the Rb II electrons.

I will also describe our ongoing work on PWFA using the nominally 250 TW Callisto laser at LLNL and the FACET facility at SLAC.

Work in collaboration with my colleagues from SLAC, LLNL, USC, Duke and UCSD.
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