SLAC E-320: Probing Strong-Field QED at FACET-II

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When exceeding the QED critical field $E_{crit} \sim 10^{16}$ V/cm, the vacuum becomes unstable to pair production and novel strong-field phenomena are expected to occur. This regime is referred to as the non-perturbative regime of strong-field QED (SFQED). The equivalent laser intensities required to reach this regime exceed $10^{29}\,\mathrm{W/cm^2}$ cannot be achieved with existing, or future envisioned laser systems.

Figure 1: The National User Facility for Advanced Accelerator Experimental Tests II (FACET-II) at the SLAC National Laboratory provides unique capabilities for advanced accelerator R&D and research on coherent radiation techniques with high-energy electron and positron beams. The co-location of a high-energy electron beam with a high-power laser system also provides the tools to probe strong-field QED phenomena

By combining high-intensity laser pulses with ultra-relativistic electron beams, such extreme electric fields become accessible due to the Lorentz boost.

The E-320 collaboration at SLAC plans to use the 13 GeV electron beam provided by FACET-II and an intense laser pulse ($a_0 \sim 10$) to access the non-perturbative regime of SFQED for the first time and to perform precision measurements of the fundamental processes of pair production and photon emission from the perturbative to the non-perturbative regime.

This talk will outline the major objectives of this experimental program, describe the planned experimental setup and provide an update on its ongoing commissioning.