Experiment 320 at SLAC

Tatiana Smorodnikova (on behalf of the E-320 collaboration)*,[1]

[1]*Stanford PULSE Institute, SLAC National Accelerator Laboratory, Menlo Park, CA, USA*
*tasmr24@stanford.edu

The experiment 320 is probing Strong-Field QED (SFQED) by colliding a $\sim$10 GeV electron beam, generated at SLAC's FACET-II facility, with $\sim$10 TW NIR laser pulses [1,2]. For the multiphoton regime of SFQED, characterized by small values of the classical intensity parameter $a_0 = eE/(mc\omega)$ ($a_0^2 \ll 1$), the probability of n-th order Compton scattering scales as $(a_0^2)^n$, allowing us to treat the laser-electron beam interaction perturbatively [3]. In this regime, nonlinear Compton scattering and electron-positron pair production via the decay of emitted gamma photons were first observed in the seminal SLAC experiment 144 ($a_0^2 \sim 0.16$) [4].

An early objective of E-320 is to measure the a_0-dependent electron and gamma-photon emission spectra during the transition from the multiphoton ($a_0^2 \ll 1$) to the non-perturbative regime ($a_0^2 \gg 1$) and compare with theory. We expect to see an intensity dependent redshift of the Compton edges that leads to a quasi-continuous quantum-corrected synchrotron spectrum. In particular, we will be able to measure the ponderomotive shift of the electron mass.

Currently the main observables of E-320 are the spectra of the scattered electrons and the angular profile of the emitted gamma photons [5]. In the future we also plan to measure the spectra of the emitted gamma photons, which will allow us to study the range of validity of the Local Constant Field Approximation (LCFA) [6]. Once the quantum parameter reaches unity ($\chi \gtrsim 1$) and a low positron background is achieved, which requires a clean transmission of the electron beam through the accelerator, we will be able to measure electron-positron pair production in the tunneling regime [7].

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