Observation of Nonlinear Compton Scattering in Laser-Electron Collisions at CoReLS

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In this work we confirm the experimental demonstration of nonlinear Compton scattering (NCS) through the observation and characterization of gamma-ray beams. We implemented the experiments by colliding a 1-3 GeV electron beam produced from laser wakefield acceleration with an ultra-intense laser pulse (I$> 10^{20}$ W/cm^2). The precise synchronization of the two beams, over a few-μm spatial scale and $\approx$10 fs timescale, allowed us to attain a quantum nonlinearity parameter of $\chi_e \approx 0.5$. The resulting gamma-ray beams exhibited exceptional brightness, having a critical energy $E_c > 150$ MeV and divergence $\theta_\gamma \approx 1$ mrad. All potential sources of noise were characterized, giving us a high confidence in the NCS measurements. The outcome of this work opens the path to more in-depth studies of Strong Field QED in laser-electron collisions.