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Experimental Investigation and Modeling of Electron Pulse Generation using Surface Plasmons SCOTT IRVINE, ABDULHAKEM ELEZZABI, University of Alberta — Ultrashort bursts of high-energy electrons can be used to study the intricate details of atomic/molecular events. Contemporary methods for generating ultrashort energetic electron pulses for time-resolved electron diffraction are based on electrostatic acceleration, which limits the electron pulse duration to several hundred femtoseconds. This results from the large experimental arrangements that are dominated by space-charge effects. We investigate an innovative technique that employs surface plasmon waves launched with ultrashort laser pulses. This allows for synchronous generation and acceleration of electrons, eliminating the necessity of electrostatic grids and reducing the accelerating region to a space smaller than the excitation laser wavelength. Experimental results indicate that this all-optical method can produce 2 keV electrons using 30 fs, 0.5 mJ pulses from a Ti:Sapphire laser amplifier. The findings are compared with test-particle code, which indicates that the electrons are accelerated within 300 nm, yielding acceleration gradients in the multi GeV/m range. These findings open the doorway for a variety of experiments involving ultrashort time-resolved electron diffraction and pulsed x-ray generation.

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