# Acceleration and Application of Relativistic Electron Bunches


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Acceleration of electrons in vacuum by intense laser fields holds great promise for generating high-charge, ultrashort, relativistic electron bunches. Here, we present the results of investigations into the properties of the accelerated electrons under various experimental conditions. To this end, nanotips were exposed to relativistic-intensity, few-cycle laser pulses. Vacuum laser acceleration yielded electron beams with charges of several hundred pC and energies up to 15 MeV.

Two different focusing geometries, differing in peak intensity by nearly an order of magnitude, produced comparable overall charge and electron spectra. Three-dimensional particle-in-cell simulations show good agreement with our experimental results. They highlight the importance not only of the accelerating field but also of the effective acceleration length, which is limited by laser diffraction, and electron dephasing in determining the final energy gain. The simulations also predict the generation of attosecond electron pulses at the end of the acceleration process.

Furthermore, we explore a potential application of these pulses: the generation of attosecond x-ray pulses via Thomson backscattering.