[H13.06] Vacuum Laser Acceleration of Electrons and Acceleration in Structures

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An accelerator of charged particles is based on the conversion of electromagnetic field energy to mechanical energy of the particles. A conventional accelerator based on a waveguide structure emphasizes interference between the drive fields and the the spontaneous radiation fields (those fields radiated when charged particles pass through an otherwise empty cavity). In this case the interference term, and hence the particles' energy gain, is linear with the drive field. Particles can also extract positive mechanical energy from a drive wave in free space, where the corresponding decrease in field energy occurs due to interference between the drive fields and the radiated fields of the charged particles as a result of their motion in the drive field. This viewpoint leads to the conclusion that a focused laser pulse in vacuum (far from any mechanical structures) can transfer a fraction r_e/\gamma \lambda of its energy to a free, relativistic electron. The energy gain during vacuum laser acceleration is quadratic in the strength of the laser field.