Efficient Laser Wake Field electron acceleration with chirped intense laser pulses

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The temporal rearrangement of the spectral components of the wide spectrum of an ultrafast and intense laser pulse (chirp) offers significant possibilities for controlling its interaction with matter and plasma. In the relativistic laser intensity regime, the propagation of laser pulses within the plasma, induced by their leading edge, the chirp plays an important role in the generation of the wakefield. Depending on the geometry of the gas medium, the laser pulse chirp seems to accurately control the electron injection inside the bubble of the wakefield. Proof of principle experiments indicate that positively chirped laser pulses ("red" photons of the laser spectrum arrive first followed by the "blue" photons) accelerate electrons in the order of ~100 MeV via LWFA[1] more efficiently in respect to electron beam reproducibility, maximum electron energy and current in comparison to Fourier transform limited or negatively chirped pulses. Corresponding PIC[2] simulations are in good agreement with the experimental findings. The computational results enlighten the physical processes and the mechanisms occurring behind the efficient LWFA of electrons with positively chirped laser pulses. Results on GeV electron acceleration with positively chirped pulses of PW lasers have been reported although based on different physical processes[3]. The reliability of the proposed method for the production of laser-plasma relativistic electron beams is of significant importance for applications in the fields of biomedicine and material science.

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