Plasma-based acceleration of non-relativistic particles

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The past years have seen a growing interest in plasma-based accelerator technology since it provides a route to more compact, ecological, yet powerful accelerators. However, even well-established acceleration techniques like [1, 2] are only effective with particles travelling at speeds close to the speed of light (relativistic particles), leading to the exclusion of heavier particles, e.g. muons [3] from the acceleration process.

Recently, cutting-edge methods for shaping the spatio-temporal spectrum of electromagnetic wave packets that produce pulses with variable group velocities have been devised [4]. These pulses can drive superluminal ionization fronts and are attractive plasma acceleration drivers since they can, for instance, avoid dephasing. At the same time, they can propagate with subluminal group velocities, making them suitable candidates to drive acceleration wakes for slower particles. Furthermore, if carefully crafted, these pulses can also increase or decrease their group velocity while propagating [5]. This work presents our ongoing research toward a plasma-based acceleration method for non-relativistic particles using pulses with increasing group velocities as drivers. The suggested method has been studied analytically and then tested using 2D particle-in-cell simulations with the code OSIRIS [6].

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