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Driver-Witness Configuration in CNT Array-Based Acceleration

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Solid-state plasma wakefield acceleration might be an alternative to accelerate particles with ultra-high accelerating gradients, in the order of TV/m.

In addition, due to their thermodynamic properties, 2D carbon-based materials, such as graphene layers and/or carbon nanotubes (CNT) are good candidates to be used as the media to sustain such ultra-high gradients. In particular, due to their cylindrical symmetry, multi-nm-aperture targets, made of CNT bundles or arrays may facilitate particle channelling through the crystalline structure.

In this work, a two-bunch, driver-and-witness configuration is proposed to demonstrate the potential to achieve particle acceleration as the bunches propagate along a CNT-array structure.

Particle-in-cell simulations have been performed using the VSIM code in a 2D Cartesian geometry to study the acceleration of the second (witness) bunch caused by the wakefield driven by the first (driver) bunch.

The effective plasma-density approach was adopted to estimate the wakefield wavelength, which was used to identify the ideal separation between the two bunches, aiming to optimize the witness-bunch acceleration and focusing.

Simulation results show the high acceleration gradient obtained, and the energy transfer from the driver to the witness bunch.

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Footnotes

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