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Secondary sources from laser wakefield acceleration in pump-depletion dominated regime

Efficient neutron production from laser-accelerated electrons is crucial for advancing applications in science and technology. This work explores optimal configurations for maximizing neutron yields using Monte Carlo simulations informed by Particle-in-Cell (PIC) outputs. A high-resolution PIC simulation, inspired by the work of V. Horný et al. [Phys. Rev. E 110, 035202], was performed using Smilei to model a 6-fs interaction of a 1.5-J laser pulse. The simulation captured the acceleration of several nanocoulombs of electron bunches, achieving energies of up to 300 MeV in the primary Laser Wakefield Acceleration (LWFA) regime and up to 600 MeV in the secondary Plasma Wakefield Acceleration (PWFA) regime. Electron energy spectra from different time steps of the PIC simulation were extracted and used as inputs for FLUKA simulations, where lead converter thickness was varied to optimize neutron production.

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