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Coherent diffraction radiation of relativistic terahertz pulses from a laser-driven micro-plasma-waveguide

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We propose a method to generate isolated relativistic terahertz (THz) pulses using a high-power laser irradiating a mirco-plasma-waveguide (MPW). When the laser pulse enters the MPW, high charge electron bunches are produced and accelerated to 100 MeV by the transverse magnetic modes. A substantial part of the electron energy is transferred to THz emission through coherent diffraction radiation as the electron bunches exit the MPW. We demonstrate this process with three-dimensional particle-in-cell simulations. The frequency of the radiation is determined by the incident laser duration, and the radiated energy is found to be strongly correlated to the charge of the electron bunches, which can be controlled by the laser intensity and micro-engineering of the MPW target. Our simulations indicate that 100-mJ level relativistic-intense THz pulses with tunable frequency can be generated at existing laser facilities, and the overall efficiency reaches 1%.

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