Laser Plasma Acceleration and Radiation

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We report on the demonstration of a stable high-quality laser wakefield accelerator (LWFA) via manipulating electron injection as well as controlling energy chirp for the compression of energy spread. Stable high-brightness electron beams with peak energies in the range of 200-800 MeV, 0.3-1% rms energy spread, 1-80 pC charge, and ~0.2 mrad rms divergence are experimentally obtained.

Based on the high-quality electron beams generated in the LWFA, we have experimentally realized a new scheme to enhance the betatron radiation by introducing a tilted shockfront to manipulate the beam transverse oscillation in the wakefield. By employing a self-synchronized all-optical Compton scattering scheme, we produced tunable quasi-monochromatic MeV γ-rays with a peak brilliance of ~3.1×10^{22} photons s^{-1} mm^{-2} $mrad^{-2}$ 0.1% BW at 1 MeV.

Besides, an experimental setup for developing intense coherent x-ray radiation sources using the high-quality LWFA electron beams, a linear transport system consisting of seven quadrupoles to focus the electron beam and a 6-meter-long undulator with a period of 2 cm has been tested. The synchrotron radiation at ~30 nm via the scheme of free electron lasering based on the LWFA electron beams has been demonstrated.

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