Electron acceleration and betatron radiation control by using two color laser-ionization injection in laser wakefield acceleration

Guo-Bo Zhang,[1] Xiao-Hu Yang[1], Yan-Yun Ma,[1]

[1]*National University of Defense Technology, Changsha 410073, China*

Tunable X-ray sources of the laser-driven wakefield have great application potential. Here, by using three-dimensional particle-in-cell, we have proposed and demonstrated a useful scheme to make tunable electron dynamics and X-ray radiation. A long wavelength driver laser excites a strong plasma wake, and a short wavelength injected laser can ionize the K-shell electrons of the high-Z gas, which carries residual transverse momentum result from the paralleled electric field of injection laser. These electrons can experience collective spatial oscillations in the wake, which leads to the tunability on the radiation intensity and polarization distributions. When the suitable injection laser parameters were used, an annular intensity distribution and circularly polarization betatron radiation can be realized. Simulations results show that the peak brilliance of annular radiation can achieve $1.3 \times 10^{19}\mathrm{photon/s/mm^2/mrad^2/0.1\%}$ bandwidth. The results provide a feasible method of the tunable X-ray source for wide applications.