§26. Emission of Electromagnetic Pulses from Laser Wakefields through Linear Mode Conversion

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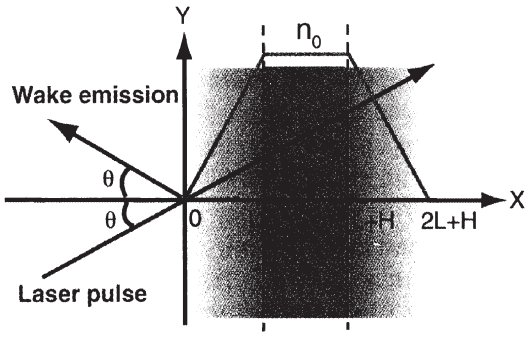

Fig.1 Schematics of electromagnetic emission from a wakefield generated by a laser pulse incident obliquely to the plasma density gradient.

A large wakefield is an electron plasma wave driven by the ponderomative force of a laser pulse. It has been studied intensively for the purpose of particle acceleration or frequency up-conversion of a laser pulse, laser pulse compression, and more recently light intensification. Since the typical plasma oscillation frequency for these applications is in the terahertz (THz) range, the wakefield can potentially serve as a powerful THz emitter. Currently, it is still challenging to obtain intense THz emission for various applications.

In this study, we consider the laser wakefield excitation when a plane laser pulse propagates at an angle to the density gradient of an inhomogeneous plasma slab, as shown in Fig.1. The plasma slab is underdense with a trapezoid density profile along the x-direction.

Powerful coherent emission around the plasma oscillation frequency can be produced from a laser wakefield through linear mode conversion.

The emission spectrum and conversion efficiency are obtained analytically. which are in agreement with particle-in-cell simulations. The emission can be tuned to be a radiation source in the terahertz region and with field strengths as large as a few GV/m. suitable for high-field applications. The emission also provides a simple way to measure the wakefield produced for particle acceleration. In other word, it provides a new diagnostics of laser wakefield amplitudes and even wave breaking in the context of wakefield accelerators.

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