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Diagnostic of forward fast electrons and shied fields using terahertz radiation

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Fast electron generation and transport are important for fast ignition of the inertial confinement fusion, laser-driven x-ray and proton acceleration. Fast electrons in a solid target can be diagnosed with x-ray emission, proton acceleration and optical transition radiation. However, it is quite challenge to measure their temporal evolution in targets.

We have systematically studied THz radiation from solid targets driven by relativistic laser pulses. For a foil target, fast electrons transport forward through the target and will induce transition radiation when crossing the rear surface-vacuum boundary. Usually the bunch length of the fast electrons driven by a laser pulse in tens of femtosecond duration is of the order of ~10 μm, which is smaller than the wavelength of THz radiation. This will lead to the coherent transition radiation (CTR) at terahertz regime. We have developed theoretical models to explain the THz generation. Based on the models, we have used the THz CTR to characterize the temporal history, charge, and divergence angle of the fast forward fast electrons in a solid target and sheath field at the rear surface of the target.

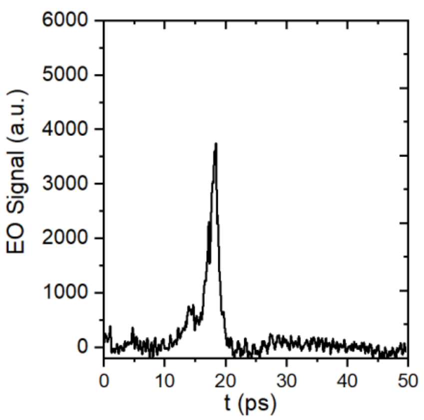

Fig. 1. THz waveform obtained by single-shot measurement. The waveform represents the history of forward fast electron beam.

Our results show that THz emission from intense-laser-produced plasmas can not only be a potential tabletop brilliant THz source, but also a noninvasive diagnostic for fast electrons.

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