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Terahertz Radiation As A Bunch Diagnostic For Laser-Wakefield-Accelerated Electron Bunches[1] J. VAN TILBORG, G. PLATEAU, C.B. SCHROEDER, CS. TOTH, C.G.R. GEDDES, E. ESAREY, W.P. LEEMANS, LBNL — Experimental results are reported on the single shot temporal and spectral characterization of coherent terahertz (THz) radiation. The radiation is emitted by relativistic electron bunches, which in turn are produced by a laser-driven plasma-based accelerator. As the femtosecond electron bunches exit the plasma-vacuum interface, coherent transition radiation (at THz frequencies) is emitted. Measuring the properties of this radiation allows characterization of the electron bunches. Theoretical work on the emission mechanism is also presented, including a model that calculates the THz waveform from a given bunch profile. It is found that the spectrum of the THz pulse is coherent up to the 200 μm thick ZnTe detection limit of 4 THz, which corresponds to the production of sub-50 fs (root-mean-square) electron bunch structure. The measurements demonstrate both the shot-to-shot stability of bunch parameters that are critical to THz emission (such as total charge and bunch length), as well as femtosecond synchronization between bunch, THz pulse, and laser beam.

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