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THz Smith-Purcell Radiation from Laser Wakefield Accelerated Electron Bunches

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Smith-Purcell Radiation (SPR) is a special case of diffraction radiation produced when a charged particle passes just over the top of a grating surface. The wavelength of emitted radiation is dispersed as a function of angle and order. Laser Wakefield Accelerators (LWFAs) produce highly-energetic, temporally-short electron bunches that could provide an unusually strong, coherent, superradiant source of SPR in the THz regime for nonlinear optical applications. I will present calculations showing that 300 MeV, 0.5 nC, 10 fs electron bunches (common LWFA beam parameters at Helmholtz-Zentrum Dresden-Rossendorf) paired with a chosen metallic grating can produce a pulse of light with a central frequency of 30 THz and a peak electric field strength close to 100 MV/cm (assuming full coherence of electron bunch, a 2° collection angle, and pulse duration of 100 fs). With such a field strength, nonlinear processes such as high-harmonic generation from Graphene or topological insulators and THz sum-frequency processes for infrared vibrational spectroscopy are expected to become available. I will describe planned experiments at HZDR aimed at characterizing LWFA-generated SPR and realizing its potential applications.

Acknowledgments

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