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Positron Driven High-Field Terahertz Waves via Dielectric Wakefield Interaction

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Advanced acceleration methods based on wakefields generated by high energy electron bunches passing through dielectric-based structures have demonstrated >GV/m fields, paving the first steps on a path to applications such as future compact linear colliders. For a collider scenario, it is desirable that, in contrast to plasmas, wakefields in dielectrics do not behave differently for positron and electron bunches. In this article, we present measurements of large amplitude fields excited by positron bunches with collider-relevant parameters (energy 20 GeV, and 0.7x10^10 particles per bunch) in a 0.4 THz, cylindrically symmetric dielectric structure. Interferometric measurements of emitted coherent Cerenkov radiation permit spectral characterization of the positron-generated wakefields, which are compared to those excited by electron bunches. Statistical equivalence tests are incorporated to show the charge-sign invariance of the induced wakefield spectra. Transverse effects on positron beams resulting from off-axis excitation are examined and found to be consistent with the known linear response of the DWA system. The results are supported by numerical simulations and demonstrate high-gradient wakefield excitation in dielectrics for positron beams.

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