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Efficient Spatiotemporal Characterization of THz Near-Fields for Particle Acceleration

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The THz-frequency range could provide the accelerating gradients needed for next generation accelerators with compact, GV/m-scale devices. One of the most promising THz generation techniques for accelerator applications is optical rectification in lithium niobate using the tilted pulse front method. Current THz accelerators are limited by significant losses during transport of THz radiation from the THz source to the acceleration structure. In addition, the broadband spectral properties of high-field laser-driven THz sources make it difficult to couple THz radiation into accelerating structures. We demonstrate a fast and efficient technique for spatial and temporal characterization of single cycle strong field THz pulses in the near-field of a lithium niobate source using electro-optic sampling. Using this technique, we have reconstructed the full temporal 3D THz near-field close to the lithium niobate emission face and shown that the near-field can be controlled by manipulating the generation setup. Analysis of these results will allow for evaluation of the applicability of the THz near field to electron beam acceleration and manipulation and the development of improved THz coupling schemes.

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