

THz Accelerators and their Application to Ultrafast Electron Diffraction

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Accelerators ranging from midscale RF photoinjectors for femtosecond electron-diffraction experiments, to kilometer long free electron lasers that produce femtosecond x-ray pulses are utilized to resolve materials with atomic precision on femtosecond timescales. While the performance and recent results of these facilities are extraordinary, ensuring their continued vitality requires us to explore new accelerator physics and innovate the next generation of technology. One approach to achieving performance and accelerating gradients orders of magnitude above present capabilities is to dramatically increase the operational frequency into the Terahertz (THz) range. We are exploring accelerating structures designed to withstand high gradients and able to manipulate high-charge beams on femtosecond timescales; developing novel electronic and photonic THz sources; and laying the foundation for THz accelerator technology. Results from recent experiments on high gradient THz accelerators and their application to time stamping and electron bunch compression for ultrafast electron diffraction will be presented, along with a future outlook for the field.

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