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Terahertz Time Stamping Tool Development for SLAC MeV-UED

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Mega electron volt (MeV) accelerators used for ultrafast electron diffraction (UED) have provided a unique insight into visualizing elusive ultrafast processes from photochemical reactions and lattice motion, to phase transitions occurring in quantum materials. In this work, we demonstrate recent measurements of strong THz streaking of ultrafast electron bunches generated from an rf photoinjector using an efficient THz deflector structure. We show that the structure can achieve upward of 1.5 MV/cm of peak THz fields to 3 MeV, 10 fC bunches subsequently improving the timing resolution of single-shot measurements of bunch length and jitter. Such measurements are used to obtain a significant improvement in the MeV-UED timing resolution. With this setup, we have measured coherent charge wave oscillations in photo-excited TaS₂ thin film within ~50 fs temporal resolution. These results are essential for the development of a THz timing tool toward new regimes of few femtosecond timing resolution.

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Footnotes

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