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Compact Single-Side-Pumped Terahertz-Driven Booster Accelerator

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Recent demonstrations of terahertz (THz) powered accelerators and beam manipulators have opened a pathway towards miniaturized accelerators that promise to enable new science due to unique features such as reduced timing-jitter and reduced space-charge broadening of the electron bunches. Here, we present on the development of a matchbox sized multi-layered accelerator structure powered by a single few-cycle terahertz pulse and designed to boost the output of a 55 keV DC electron gun to energies up to ˜ 400 keV. An integrated actuated mirror is used to interfere the transversely injected THz pulse with itself, creating a transient standing wave optimized for efficient acceleration of the electrons. In contrast to a double-side-pumped approach this reduces the complexity of the optical setup by using the available THz energy more efficiently. We demonstrate first acceleration and map out the booster performance by varying the injection timing of the electrons and fine-tuning of the transient THz standing wave. Such a table-top source is promising for ultrafast electron diffraction experiments as well as precursor for subsequent acceleration to MeV energy by THz-driven LINACs.

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