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High-energy single-cycle terahertz sources for compact particle accelerators and manipulators

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Novel accelerator concepts such as all-optical terahertz (THz) based compact accelerators demand high-power THz sources that are robust in order to enable reliable testing. THz sources based on the tilted-pulse front scheme have become the method of choice for table-top, high-energy, single-cycle (SC) THz generation due to both their versatility and scalability. However, due to the noncollinear interaction geometry, fine-tuning of the performance and tailoring of the THz beam properties requires a detailed understanding of the dependences on the setup parameters. Here, we present on the use of multi-dimensional parameter scans to systematically map out sensitivities of such THz sources on the primary interaction parameters and show experimental characterization of a robust, high-energy, single-cycle THz source designed and constructed based on these findings. This setup delivers pulses centered at 300 GHz with pulse energies exceeding 400 µJ at 52 Hz repetition rate and a shot-to-shot rms stability < 3.8%. Such robust, high-energy THz sources are crucial for the development of next generation THz-driven particle accelerators and manipulators.

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