High-power Lasers Drive Terahertz Pulse Energy to a Record High in Laboratory

Electromagnetic waves between infrared and microwaves are called as Terahertz (THz) radiation. It is a big challenge to generate intense THz radiation, which is significantly important for THz sciences and applications in many interdisciplinary fields. Although THz sources have been generated with electronic and optical techniques for the last decades, the THz pulse energy reported is lower than a millijoule. Results recently published in *PNAS* show that strong THz bursts with tens millijoules of energy, a world record for laboratory sources, can be obtained using high-power lasers.

Prof. LI Yutong's group from the Institute of Physics (IOP), Chinese Academy of Sciences, and Prof. ZHANG Jie's group from the Shanghai Jiao Tong University, in collaboration with Prof. David Neely from the Central Laser Facility, STFC Rutherford Appleton Laboratory, Prof. Paul McKenna from the University of Strathclyde, and UK scientists from the University of York have studied THz radiation from intense laser-metal foil interactions. Using the Vulcan laser at the Central Laser Facility, the record for the highest energy in a single THz pulse has been achieved in the laboratory.

The generation of such a strong THz source is mainly attributed to the coherent transition radiation when an energetic electron bunch crosses the rear surface of the thin foil. The electron bunch with high charge is accelerated by the high-intensity laser pulses from the mm-sized metal foil.

THz radiation has already been used in tech in many fields, for example, the full body scanners for airport security check. THz waves are fantastic for this type of application due to the fact that they are effective probes whilst being non-ionizing. The powerful THz source driven by high power lasers provides opportunities to use this type of "scanning" ability to look at nonlinear dynamics in matter.

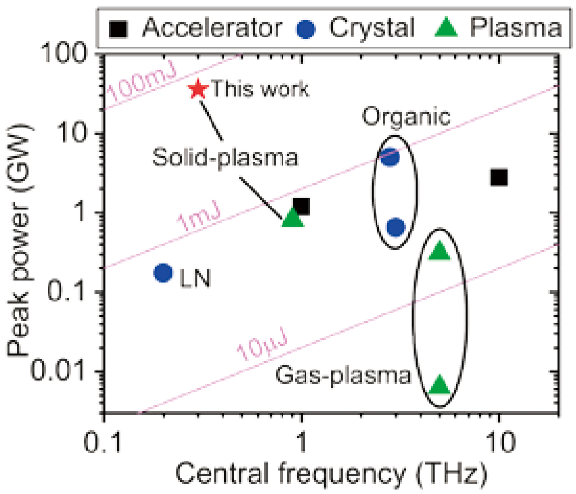

Figure1. Comparison of currently available high-peak-power THz sources. The data are referenced from previously reported typical results of THz sources based on conventional accelerators (black squares), optical rectification from crystals (blue circles) like lithium niobate (LN) and organic crystals, and gas/solid-density plasmas (green triangles). The red star represents the data presented in this paper. Magenta curves represent different energy ranges for half-cycle THz pulses. (Image by Institute of Physics)

This study entitled "Multi-millijoule coherent terahertz bursts from picosecond laser-irradiated metal foils" was published in *PNAS*.

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