

## Superradiant terahertz facilities for high field Terahertz Science – the first 2 decades

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Ultrashort flashes of THz light with low photon energies of a few meV, but strong electric or magnetic field transients have in the past two decades been increasingly employed to prepare various fascinating nonequilibrium states in matter. Superradiant Terahertz radiation from linear accelerators, first demonstrated in 2001 at Jefferson lab [1], is the working principle of a new class of sources for high-field THz pulses which turned out to be ideally suited to perform experiments of this type. Over the past 20 years several superradiant THz facilities have been commissioned (see e.g. [2]) from facilities operating parasitically at the linac of soft X-ray free electron lasers [3,4] to dedicated compact facilities operating at high repetition rates based on superconducting linac technology [5]. This talk will give an overview of these developments and will discuss some of the scientific highlight experiments. An outlook into proposed next generation facilities is given which will include facilities at hard X-ray free electron lasers [6,7] and dedicated multi-user facilities. In addition, emerging new experimental opportunities are presented.

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[2] M. Gensch et al, SUPER-RADIANT LINAC-BASED THz SOURCES IN 2013, proceed. Of FEL 2013, New York, WEIBNO01 (2013).

[3] A. Perucchi et al, The TeraFERMI terahertz source at the seeded FERMI free-electron-laser facility, *Rev. Sci. Instr.* 84, 022702 (2013).

[4] M. Gensch et al, New infrared undulator beamline at FLASH, *Infrared Phys. Technol.* 51, 423 (2008).

[5] B. Green et al, High-field high-repetition-rate sources for the coherent THz control of matter, *Sci. Rep.* 6, 22256 (2016).

[6] T. Tanikawa et al, Volt-per-Ångstrom terahertz fields from X-ray free-electron lasers, *J. Synch. Rad.* 27, 796 (2020).

[7] Z. Zhang et al, A high-power, high-repetition-rate THz source for pump-probe experiments at Linac Coherent Light Source II, *J. Synch. Rad.* 27, 890 (2020).

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