Terahertz Light Source and User Facility at FACET

Being a long-time underutilized portion of the electromagnetic spectrum, terahertz (100 GHz ~10 THz) spectral range is experiencing a renaissance in recent years, with broad interests from chemical and biological imaging, material science, telecommunication, semiconductor and superconductor research, etc. Nevertheless, the paucity of THz sources especially strong THz radiation hinders both its commercial applications and nonlinear processes research. FACET —Facilities for Accelerator science and Experimental Test beams at SLAC— provides high energy density electron beam with peak currents of ~ 20 kA focused down to a 10 μm x 10 μm transverse spot size at an energy of ~ 23 GeV, by beam-driven plasma wakefield accelerators. Such an intense electron beam, when microbunched to sub-picosecond longitudinal bunch length, will coherently radiate high intensity EM fields well within THz frequency range that are orders of magnitude stronger than those available from laboratory tabletop THz sources, and enable a wide variety of THz related research opportunities. Together with a description of the FACET facility and electron beam parameters, this paper will report the FACET THz beam line design, where the beam is sent through a foil to generate THz photons. A final table is being set up along the THz beam line as well, with various signal diagnostics including THz power detector, beam profiler, sample stages, as well as Michaelson interferometer and time-domain spectrometer for spectroscopy purposes. The setup will also be presented. A couple of potential THz researches including studies of magnetism, ferroelectric switching dynamics, semiconductor devices, and chemical reaction controls have already been proposed, and their introductions will be given. FACET THz beam line may provide unique facilitations for future THz user groups.

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