11-1-2000

Tabletop Accelerators are Brighter and Faster

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Physics News Update
The AIP Bulletin of Physics News

Number 510 #1, November 1, 2000 by Phil Schewe and Ben Stein

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At last week's APS plasma physics meeting, Donald Umstadter of the University of Michigan's Center for Ultrafast Optical Science (734-764-2284, dpu@umich.edu) reported on advances at his lab and elsewhere in tabletop laser accelerators, devices that use light to accelerate beams of electrons and protons to energies of a million volts in distances of only microns.

This acceleration rate or "gradient" is up to a thousand times larger than in conventional accelerators because the tabletop laser light can now exert pressures of gigabars, the highest ever achieved, and approaching the pressure of light near the Sun. Not only that, but Umstadter's lab has just shown that the brightness of a tabletop particle beam is roughly ten times higher than that produced by conventional accelerator technology. This is because laser accelerators can generate very narrow particle beams by focusing light on an extremely tiny spot in a gas target.

Additionally, the researchers have demonstrated a thousand-fold improvement in repetition rate, which is how often bursts of electrons can be accelerated with these devices. Tabletop accelerators now have a repetition rate of 10 Hz (corresponding to 10 electron bursts per second), compared to previous tabletop acceleration rates of one burst per ten minutes.

A couple of caveats: laser accelerators produce particles over a spectrum of energies, and only a few particles are at the highest energies. But even the lower-energy particles are useful for applications, Umstadter says, and there are enough of them within a narrow energy range to extract a monochromatic beam. In fact, researchers are now considering using the tabletop accelerator as an injector for coherent x-ray sources, such as the LCLS (Linac Coherent Light Source) facility proposed at the SLAC.

Published in *Physics News Update* **510**, American Institute of Physics Bulletin of Physics News, November 1, 2000, http://www.aip.org/pnu/2000/split/510-1.html