# Very Intense, Terahertz Light Created for the First Time

Scientists report in the November 14, 2002 issue of *Nature* that they have created a beam of radiation that has never been produced before. The beam, which contains a broad spectrum of frequencies up to about one terahertz - or a trillion of cycles per second - and a brightness 20,000 times higher than that of previous terahertz beams, was produced at the U.S. Department of Energy's Thomas Jefferson National Accelerator Facility in Newport News, Virginia.

"One of the anticipated applications for this terahertz radiation is imaging," says Larry Carr, a physicist at the NSLS, and lead author of the study. "Terahertz radiation can penetrate many centimeters inside materials, allowing one to 'see' what's inside."

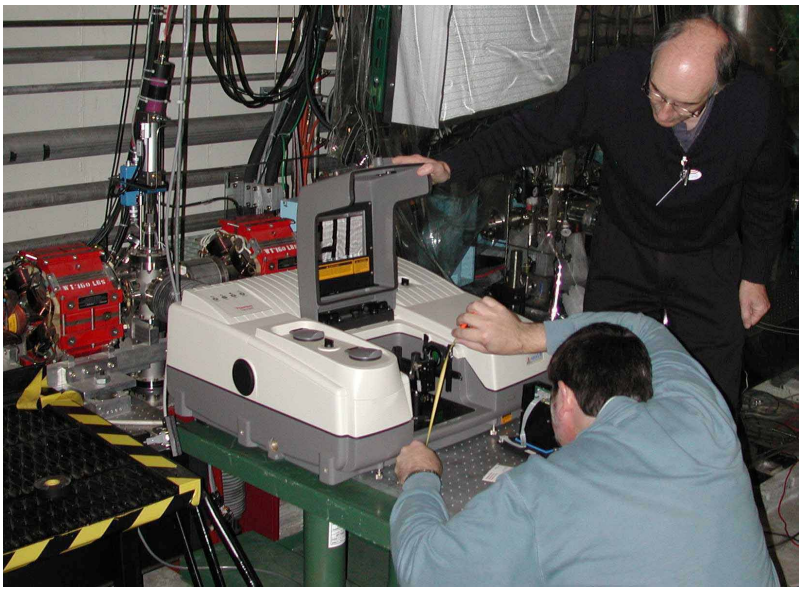
Other potential applications of the newly created terahertz radiation include better detection of concealed weapons, hidden explosives and land mines; "fingerprinting" of chemical and biological terror materials in envelopes, packages or air; and widening the frequency bands available for wireless communication.

The powerful terahertz radiation was produced in an experiment conceived and led by Gwyn Williams, physicist at Jefferson Lab. He and his collaborators, from Brookhaven and Lawrence Berkeley National Laboratories, sent a beam of electrons at nearly the speed of light inside an accelerator, in which they were deflected by a magnetic field, causing them to emit radiation. Inside the accelerator, the electrons were squeezed into small bunches (less than 1 millimeter long), inside which they emitted radiation in unison.

"Producing intense light pulses by this method dates back to more than 10 years ago," Carr says, "but the pulse rate was limited to just a few times each second. Now, we can accelerate 75 million electron bunches each second, which creates a stream of terahertz pulses delivering the unprecedented average power of 20 watts."

As with any new technology, the most important applications of terahertz radiation are not known so far, but the authors of the study are confident that it can potentially extend and add to the wave-based technologies that have defined the last century and a half. "The growing awareness of the usefulness of terahertz radiation is like what happened a century ago with X-rays - only terahertz radiation will have a much wider range of applications," Williams says.

-Patrice Pages



*NSLS Physicist Larry Carr (left) and Jefferson Lab Physicist Gwyn Williams working on the experiment that recently produced very powerful terahertz radiation.*