

**FOR IMMEDIATE RELEASE**

November 2, 2009

## **Researchers Use Trident Laser to Accelerate Protons to Record Energies**

*Laser-particle acceleration is expected to contribute to future advances  
in modern cancer radiotherapy*

ATLANTA—An international team of physicists at Los Alamos National Laboratory, led by principal investigator Kirk Flippo, has succeeded in using intense laser light to accelerate protons to energies never before achieved by a laser. Using this technique, scientists can now accelerate particles to extremely high energies that would otherwise only be possible using large accelerator facilities. Physicists around the world are examining laser particle acceleration and laser produced radiation for potential future uses in cancer treatment.

An experiment directed by Sandrine Gaillard, as part of her doctoral thesis which is supervised by Prof. Cowan, director of the Institute of Radiation Physics at the Forschungszentrum Dresden-Rossendorf (FZD), achieved world-record energies for laser accelerated particles. These record results were obtained in partnership with scientists at FZD, Sandia National Laboratories, the University of Nevada, Reno, and the University of Missouri, Columbia, all working at the Trident Laser Facility at the Los Alamos National Laboratory in New Mexico. Protons were accelerated to velocities of 254 million miles per hour (or 37% of the speed of light).

The new record was achieved using specially shaped targets (see Fig. 1) at Trident, the world's highest contrast high-intensity, high-energy laser. The scientists shot high-contrast ultrashort laser pulses of approximately 600 femtoseconds (600 quadrillionths of a second) and around 80 Joules directly into the cone-shaped structures, whose flat-top tips are covered with a thin disk. The surfaces were created using nanotechnology, and produced by the company Nanolabz.

When the intense laser light collides with the inside of these anvil-like microstructures, electrons are liberated from the material. In contrast to flat-foils, the microstructures act as an electron guide to the tip. The electric field generated can then be used to accelerate the protons to energies that were previously unachievable. Cu K-alpha X-ray imaging (see Fig. 2) was used as a diagnostic tool to help illustrate and clarify the laser-cone interaction. The precise interactions, however, must still be resolved by the scientists via simulations (see Fig. 3, animation link). Next, they will study the cones' ability to efficiently convert laser light into high energy protons.

The record measurements will be presented at the annual APS Division of Plasma Physics meeting in November 2009 in Atlanta, GA.

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Abstract: **GO6.00003**

**65+ MeV Protons from Short-Pulse-Laser Micro-Cone-Target Interactions**

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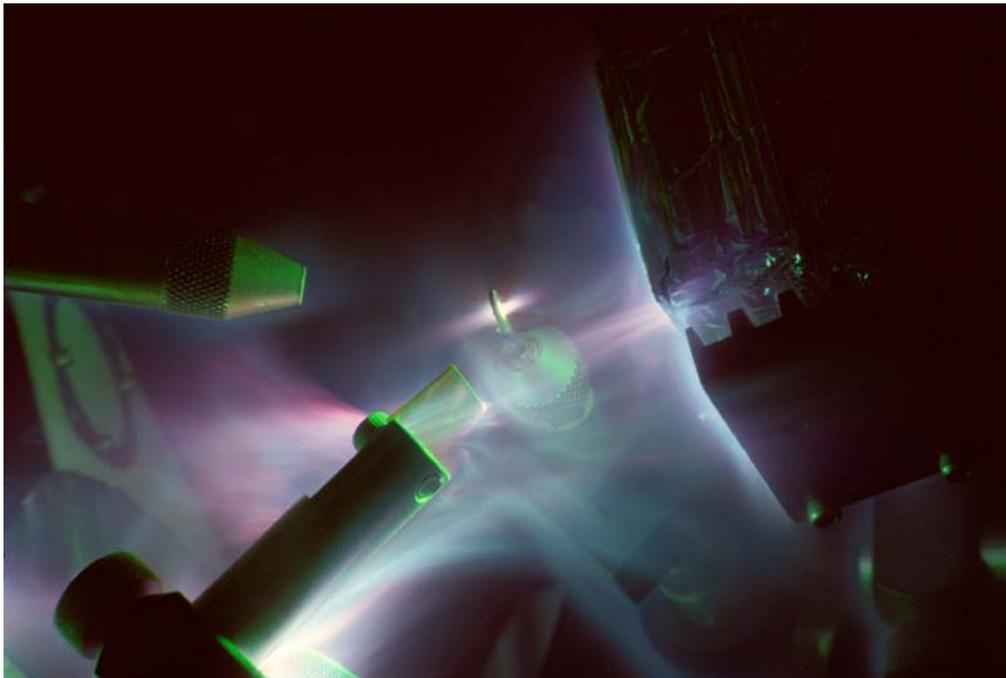


Figure 1: Image of the infrared laser (not seen, entering from left-hand side) interacting with a flat target (center), and the associated plasma production from the interaction on the various diagnostic instruments in the chamber. This is a time integrated image over five seconds. (Photo Credit: Joe Cowan and Kirk Flippo, LANL)

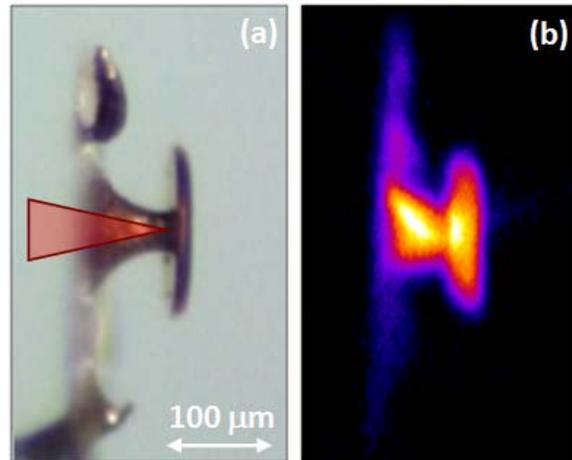


Figure 2: (a) Micro-scale Cu Flat-Top Cone target, with the incident laser (represented in red) coming from the left, (b) Cu K-alpha X-ray image showing the deep penetration of the laser light inside the cone neck.

Figure 3: Animated Particle in Cell simulation of a reduced model of the proton acceleration from laser interaction with Flat-Top Cone target <http://www.dresden-enlite.de/cone/anim.html> . (by T. Kluge, using PICLS code by Y. Sentoku).