

# **Lasers, the Bragg Peak and Cancer Therapy**

November 6 2008, By Miranda Marquit

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(PhysOrg.com) -- “When a laser goes through a plasma,” John Cary tells *PhysOrg.com*, “it pushes electrons away. Then when it snaps back, it generates an electric wake behind the laser pulse, picking the electrons up and carrying them along.” Cary is a physics professor at the University of Colorado in Boulder, as well as the founder of Tech-X Corporation, a company that specializes in computational physics and simulation software. He is a member of a collaboration that wanted to see if it was possible to accelerate heavy ions with a laser.

“Accelerating electrons is easier, because they are light,” he says. “Instead, we wanted to see if there could be the possibility of doing this with protons and heavier nuclei.” The collaboration, a team from the Shanghai Institute of Optics and Fine Mechanics in China and Cary, produced a simulation outlining possibilities. The results of the simulation are reported in *Physical Review Letters*: “Generating Monoenergetic Heavy-Ion Bunches with Laser-Induced Electrostatic Shocks.”

Cary says that the information found in the simulation may have a variety of applications. “But the most exciting application, and the one that many people are looking to use,” he points out, “is for use in cancer therapy.”

The simulation shows that for heavier ions, it is possible to accelerate them, as well as control what is known as the Bragg Peak. “When you have a small charge to mass ratio,” Cary explains, “as an ion beam travels through matter, it deposits energy. At the end, just before it comes to

rest, there is a very sharp peak of energy deposition.”

This Bragg Peak is used in proton therapy to concentrate the energy on cancerous tumors to destroy them.

But there can be a problem: “If the beam is not monoenergetic, the peak smears out, potentially overlapping healthy tissue, which can then be damaged,” Cary says. “Researchers are trying to narrow this peak so that it is more precise, destroying the tumor but not the surrounding healthy cells.” This new simulation implies that this could be possible: “We found that carbon may have what is needed. The configuration seems to have nice properties, with a small energy spread and a fair amount of beam.”

Cary also points out that this work could lead to producing isotopes for other kinds of therapy, as well as provide the groundwork for particle beams for homeland security. “Particle beams could be used to scan ship containers coming into harbor for fissile material. The simulation indicates a direction for compact and mobile production of needed monoenergetic nuclei.”

Of course, the next step is to try and replicate what was found in the simulation with an experiment using an actual laser. The technology exists to try the configuration out, Cary says: “This is within the regime of what lasers are being built to do now.” But it is nice to have an idea of what needs to be done before trying the experiment. “That’s the nice thing about simulations, especially with today’s powerful supercomputers, which permit very detailed simulations. You can mock up all sorts of scenarios and explore a lot more ‘what if’ scenarios if you don’t have to build it each time.”

This is one “what if” researchers may be excited to start building.

[More information:](#) Generating Monoenergetic Heavy-Ion Bunches with

Laser-Induced Electrostatic Shocks, Phys. Rev. Lett. 101, 164802 (2008)

[link.aps.org/abstract/PRL/v101/e164802](https://link.aps.org/abstract/PRL/v101/e164802)

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