Researchers build bench size laser-pulsed neutron source

February 1 2013, by Bob Yirka

(Phys.org)—Researchers from Institut für Kernphysik in Germany, working with colleagues from Sandia National Laboratories and Los Alamos National Laboratory, have succeeded in building a compact neutron source small enough to be used in a conventional lab. It's based, the researchers report in their paper published in *Physical Review Letters*, on laser pulses directed onto a plastic target doped with deuterium atoms.

Physics researchers around the world have been hoping someone would develop a neutron source small enough to fit in a conventional lab for several years, as neutrons have become an important means for studying the properties of many materials. Currently, most find it necessary to compete with other researchers for time at a nuclear reactor or dedicated accelerator facility to conduct such research. This new source method offers a possible alternative.

To create their source, the researchers doped a thin sheet of plastic with deuterium atoms. It was placed just 5 nm in front of second target made of beryllium. A laser was then fired at the plastic sheet, penetrating and ionizing it – the liberated electrons were subsequently pushed to the back of the target causing the ions to accelerate further. When they struck the secondary target a nuclear reaction occurred, producing neutrons.

The researchers found that their source was able to produce just 25 percent of the energy of other experimental sources, but the neutrons produced were 10 times as energetic and 10 times more plentiful. They

also found that a number of the neutrons were emitted from the source in a forward facing direction, which the researchers note, is likely due to the type of nuclear reaction that took place. To demonstrate the usefulness of their source, the researchers took a series of radiographs by placing objects in front of the neutron beam and recording the shadows produced in a neutron detector.

The researchers suggest that with fine tuning for commercialization, their device should be able to fit on a work bench, and that only the target would need shielding to protect researchers in the area. This they note would allow for lab based neutron experiments at the course level, giving students access to science previously reserved for a select few physicists who have access to large nuclear facilities.

More information: Bright Laser-Driven Neutron Source Based on the Relativistic Transparency of Solids, *Phys. Rev. Lett.* 110, 044802 (2013) DOI: 10.1103/PhysRevLett.110.044802

Abstract
Neutrons are unique particles to probe samples in many fields of research ranging from biology to material sciences to engineering and security applications. Access to bright, pulsed sources is currently limited to large accelerator facilities and there has been a growing need for compact sources over the recent years. Short pulse laser driven neutron sources could be a compact and relatively cheap way to produce neutrons with energies in excess of 10 MeV. For more than a decade experiments have tried to obtain neutron numbers sufficient for applications. Our recent experiments demonstrated an ion acceleration mechanism based on the concept of relativistic transparency. Using this new mechanism, we produced an intense beam of high energy (up to 170 MeV) deuterons directed into a Be converter to produce a forward peaked neutron flux with a record yield, on the order of 1010 n/sr. We present results comparing the two acceleration mechanisms and the first

short pulse laser generated neutron radiograph.

© 2013 Phys.org

Citation: Researchers build bench size laser-pulsed neutron source (2013, February 1) retrieved 2 May 2024 from https://phys.org/news/2013-02-bench-size-laser-pulsed-neutron-source.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.