Nuclear photonics: Gamma rays search for concealed nuclear threats

May 2 2011

Gamma rays are the most energetic type of light wave and can penetrate through lead and other thick containers. A powerful new source of gamma rays will allow officials to search for hidden reactor fuel/nuclear bomb material.

These gamma rays, called MEGa-rays (for mono-energetic gamma rays), are made by using a beam of fast-moving electrons to convert laser photons (light at a lesser energy) into the gamma ray part of the spectrum. The incoherent gamma rays can be tuned to a specific energy so that they predominantly interact with only one kind of material.

A beam of MEGa-rays, for example, might be absorbed by the nuclear fuel uranium-235 while passing through other substances including the more common (but less dangerous) isotope uranium-238. That sort of precision opens the door to "nuclear photonics," the study of nuclei with light. "It is kind of like tunable laser absorption spectroscopy but with gamma-rays," says Chris Barty of Lawrence Livermore National Laboratory, who will present on MEGa-rays at this year's Conference on Lasers and Electro Optics (CLEO: 2011, May 1- 6 in Baltimore).

In the last couple of years, MEGa-ray prototypes have identified elements like lithium and lead hidden behind metal barriers. The next-generation of MEGa-ray machines, which should come on-line in a couple of years, will be a million times brighter, allowing them to see through thick materials to locate specific targets in less than a second.

Barty will present several MEGa-ray applications in use today and will describe the attributes of next-generation devices. Work is under way on a MEGa-ray technology that could be placed on a truck trailer and carried out into the field to check containers suspected of having bomb material in them. At nuclear reactors, MEGa-rays could be used to quickly identify how enriched a spent fuel rod is in uranium-235. They could also examine nuclear waste containers to assess their contents without ever opening them up. MEGa-ray technology might also be employed in medicine to track drugs that carry specific isotope markers.

More information: Presentation ATuF2, "Mono-Energetic Gamma-rays (MEGa-rays) and the Dawn of Nuclear Photonics," by Chris Barty is at 4:30 p.m. Tuesday, May 3.

Provided by American Institute of Physics