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All-laser driven MeV photon source for photonuclear applications[1]

SUDEEP BANERJEE, University of Nebraska - Lincoln

I will discuss the development of a tunable, MeV photon source based on all-optical inverse Compton scattering. In this device, high-energy electron beams are generated by the process of laser-wakefield acceleration in which a high-intensity laser pulse interacts with a supersonic gas jet and drives relativistic plasma waves. The laser generated electron beam then interacts with a second laser pulse in a nearly counterpropagating geometry to produce high-energy photons by the process of inverse Compton scattering. By tuning the energy of the laser-driven electron accelerator and using both the fundamental and second harmonic of a Titanium:Sapphire laser (800 nm) we have demonstrated the generation of high-brightness x-ray beams spanning the spectral range of 50 keV – 20 MeV. These x-rays are characterized by a variety of methods. The spatial profile of the collimated x-rays is determined using pixelated CsI detectors while the spectral content is determined using techniques such as single photon spectroscopy, attenuation measurements and the ability to trigger photonuclear reactions. The ability to use this source in the energy range $<$1 MeV makes it uniquely suited for isomeric studies. We have applied the source to excite isomeric transitions in Indium and Holmium including measurement of decay lifetimes. This novel table-top source has been used for high-energy radiography and the identification of actinides in shielded configuration.

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